MITSUBISHI ELECTRIC

Mitsubishi Industrial Robot

CR750-D/CR751-D/CR760-D Controller INSTRUCTION MANUAL

Controller setup, basic operation, and maintenance

MELFA
BFP-A8867-AA

⚠ Safety Precautions

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ DANGER

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

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

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

⚠ DANGER	When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.
⚠ CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠ CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠ CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠ CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠ CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠ CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
⚠ WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠ WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠ CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠ WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠ CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠ CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
⚠ CAUTION	Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
⚠ CAUTION	Never carry out modifications based on personal judgments, or use non-designated maintenance parts. Failure to observe this could lead to faults or failures.

⚠ WARNING

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ DANGER

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

⚠ DANGER

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

⚠ DANGER

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

⚠ CAUTION

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

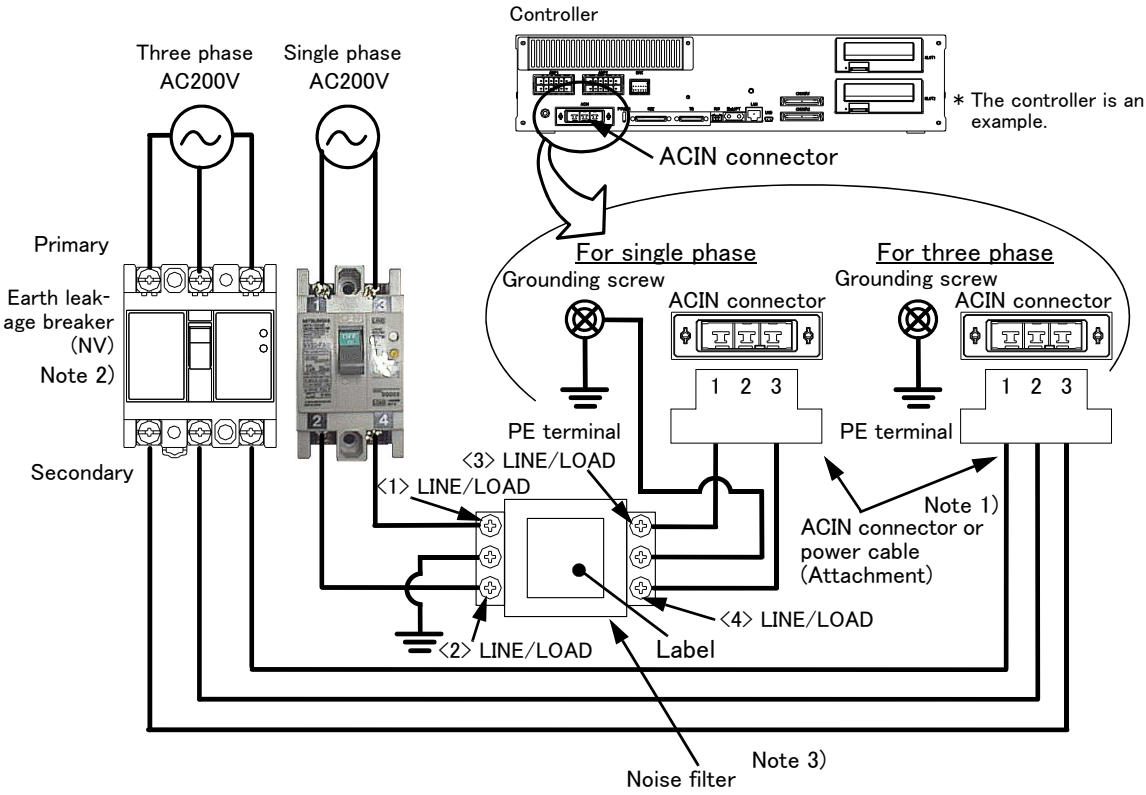
⚠ CAUTION

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

*CR751-D or CR751-Q controller

Notes of the basic component are shown.

⚠ CAUTION Please install the earth leakage breaker in the primary side supply power supply of the controller of CR751-D or CR751-Q because of leakage protection.



Note 1) Crimping swage is recommended for connecting the attachment ACIN connector (soldering is also possible)
Recommendation compression tools: 234171-1(Tyco Electronics)

Note 2) The earth leakage breaker is the customer preparation. Always use the cover below.
Recommendation: For single primary power supply ..... NV30FAU-2P-10A-AC100-240V-30mA, (Cover: TCS-05FA2)
For three primary power supply ..... NV30FAU-3P-10A-AC100-240V-30mA, (Cover: TCS-05FA3)

Note 3) If necessary, as shown in the figure, connects the noise filter between ACIN terminal blocks and primary power supply.
(Recommended noise filter: SUP-EL20-ER6 *OKAYA ELECTRIC INDUSTRIES)

1) Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary power supply (AWG #14 (2mm^2 or above), cables to ground the primary power supply (AWG #12 (3.5mm^2 or above).
The secondary power cable (with the ACIN connector) for single phase or three phase power is supplied with the product to match the specifications. When you build a cable suitable for your environment using the ACIN connector and the ACIN terminal supplied, prepare a secondary power cable (AWG #14 (2mm^2) or above).
2) Confirm that the primary power matches the specifications.
3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.
4) Connect the secondary power cable.
a) When using the supplied power cable with the ACIN connector
Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.
b) When building a power cable using the ACIN connector and the ACIN terminals supplied
Connect the ACIN terminals with the secondary power cable (prepared by customers), and insert the ACIN terminals to the ACIN connector pins with the following numbers. Crimping caulking is recommended to connect the ACIN terminals.
For single phase: 1 and 3
For three phase: 1, 2, and 3
Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.
5) Connect this ACIN connector to the ACIN connector on the front of the controller.
6) Connect the grounding cable to the PE terminal. (M4 screw)
7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

Revision history

Date of print	Specifications No.	Details of revisions
2012-02-01	BFP-A8867	・First print
2012-03-21	BFP-A8867-A	・Notes were added to the example of safety measures. (The measure against the noise, The electric specification of the output terminal)
2012-06-05	BFP-A8867-B	・The connection method of the Fig.2-25 : AXMC terminal connector (CR750) corrected to "soldering". ・Limitation of the electric current value of the relays (coil) connected to the external emergency stop input was added.
2012-10-02	BFP-A8867-C	・The notes about installation of the controller and the robot arm were added. (neither direct rays nor the heat of lighting)
2012-10-15	BFP-A8867-D	・The noise filter (for CE) was added to "Table 2-1: Standard configuration". ・The connecting method of the noise filter for CE specification was added to "Fig 2-6: Connecting the power cable and grounding cable" and "Fig. 2-7 : Connecting the power cable and grounding cable".
2012-11-20	BFP-A8867-E	・The statement about trademark registration was added. ・The wiring example 5 of the "Examples of safety measures" was corrected. (Error in writing) ・The notes about the input-output connected to the controller were added. (do not ground the + side of 24V power supply prepared by customer) ・The fuse was added to the "Table 2-1 : Standard configuration". ・The note were added to the "4.3.1 Turning the control power ON".
2012-12-03	BFP-A8867-F	・The connection method of the three phase power supply specification was added. (use by single phase power supply)
2012-12-05	BFP-A8867-G	・Distinction of the ACIN terminal was corrected.
2013-01-09	BFP-A8867-H	・Note of the external emergency stop were added (opens the connector terminal at factory shipping).
2013-03-21	BFP-A8867-J	・The mass of the controller was shown which was divided by each robot type. ・The explanation about the controller of RV-7FLL, RV-13F and RV-20F series were added.
2013-09-14	BFP-A8867-K	・"Fig.2-25: Limitations when connecting the relay etc. (CR750)" and "Fig.2-26: Limitations when connecting the relay etc. (CR751)" were corrected. (Error output → Emergency stop output, Contactor controleoutput for additional axes → Error output) ・"Table 2-1: Standard configuration" was corrected. 4A fuse was added and the numbers of cable clamp were corrected. ・The number of a controller in "Fig.2-23: Example of safety measures (Wiring example 4)" was corrected. (formerly: #1) ・The noise filter (attachments) of CR751 controller was deleted. ・The RH-3FHR series robot is supported.
2014-01-06	BFP-A8867-M	・"2.2.4 Installing procedures of attachments" was added. ・Power cable was added as attachment to the CR751 controller.
2014-03-31	BFP-A8867-N	・Ex-T control function was added. ・Lists of pin assignment of connectors for exclusive input/output signals were added. ・LM40 fuse and HM32 fuse were added to the Controller spare parts list. ・The types of the ACIN terminal on CR750 controller were added.
2014-08-06	BFP-A8867-P	・The cover and corporate logo mark of this manual was changed.
2014-08-20	BFP-A8867-R	・The note of using the Mode key switch input was added. ・A safety relay in "example of safety measures (wiring example 5) " both CR750 and CR751 controller were changed.
2014-12-24	BFP-A8867-S	・The description about attachments (ACIN connector, ACIN Terminal, power cable) was modified.
2015-02-05	BFP-A8867-T	・The chapters of "2.3.4 Emergency stop input and output etc." and "2.3.6 Mode changeover switch input" were added. ・The 3.2 Amp fuse (LM32) is added to "Table 2-1: Standard configuration" and "Table 5-5: Controller spare parts list".
2015-10-29	BFP-A8867-U	・Note1) in "Table2-9: Function of the key switch interface" was corrected. ・The explanation of CR760 controller was added.

Date of print	Specifications No.	Details of revisions
2015-12-14	BFP-A8867-V	・Circuit diagrams in “2.2.7 Connecting the external emergency stop” and “2.2.9 Examples of safety measures” were modified.
2016-03-24	BFP-A8867-W	・Pin assignment lists of the CNUSR2 and EMG2 connectors were modified. ・Notice for using a USB was added.
2016-09-08	BFP-A8867-X	・CE marking specification of CR760 controller was added.
2016-09-22	BFP-A8867-Y	・”Fig.2-50 ： Noise suppression for CR760 CE marking specification” was modified.
2017-05-10	BFP-A8867-AA	・Description of installing and wiring method of the controller protection box was added. ・Information of authorised representative was updated.

■ 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.
Always read through this manual before starting use to ensure correct usage of the robot.
The optional equipments and power supply voltage are different according to connecting robot type.
Refer to separate "Standard Specifications Manual" for detail.
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."

In this manual, CR750, CR751, and CR760 series controller are written together.
In CR751 controller, there are two kinds of the outside dimension different in its height.

- 98 mm height: "CR751 (Thin type)"
- 174 mm height: "CR751 (Heavy type)"

* Refer to Page 2, "1.1.2 Symbols used in instruction manual".

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 23, "2.2.7 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 controller 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 61, "2.2.10 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.

For users operating robots that have not been mounted with an operation panel:

Operation of robot programs such as start-up and shutdown are carried out using external signals (exclusive input/output signals). This instruction manual is based on robots that are mounted with an operation panel at the front of the controller, and these operations are explained using key operations on that panel. Using the parameter settings, please assign exclusive input/output signals that correspond with each key operation to general purpose input/output signals, and operate the robot using signal operations.
The following table details exclusive input/output signals that correspond with the key operations of the operation panel explained in this manual. Please use this as a reference to assign signals and operate the robot.
For further details regarding parameters please see the separate instruction manual "Detailed explanations of functions and operations".

Table: Conversion table of the buttons and dedicated I/O signals

Operation panel button, lamp	Parameter name	Class	Function	Default setting
START button START button lamp	START	Input	Starts a program.	3,0
		Output	Indicates that a program is being executed.	
STOP button STOP button lamp	STOP	Input	Stops a program.	0,-1
		Output	Indicates that the program is paused.	
RESET button RESET button lamp	ERRRESET	Input	Releases the error state.	2,2
		Output	Indicates that an error has occurred.	
	SLOTINIT	Input	Cancels the paused status of the program and brings the executing line to the top. Executing a program reset makes it possible to select a program.	-1,-1
		Output	Outputs that in the program selection enabled state.	
CHNG DISP button UP/DOWN button	PRGSEL	Input	Selects the value inputted into the signal assigned to the numerical input as a program number.	-1,
		Output	-	
	PRGOUT	Input	Outputs the program number selected to the signal assigned to the numerical output.	-1,-1
		Output	Indicates outputting the program number to the numerical output.	
	OVRDSEL	Input	Sets the value inputted into the signal assigned to the numerical input as a override.	-1,
		Output	-	
	OVRDOUT	Input	Outputs the override value to the signal assigned to the numerical output.	-1,-1
		Output	Indicates outputting the override value to the numerical output.	
	LINEOUT	Input	Outputs the current line number to the signal assigned to the numerical output.	-1,-1
		Output	Indicates outputting the current line number to the numerical output.	
	ERROUT	Input	Outputs the error number to the signal assigned to the numerical output.	-1,-1
		Output	Indicates outputting the error number to the numerical output.	
	IODATA	Input	Reads the program number and the override value as a binary value.	-1,-1, -1,-1
		Output	Outputs the program number, line number and override value as a binary value.	
END button END button lamp	CYCLE	Input	Starts the cycle stop.	-1,-1
		Output	Outputs that the cycle stop is operating.	
SVO.ON button SVO.ON button lamp	SRVON	Input	Turns ON the servo power supply.	4,1
		Output	Indicates the servo power supply is ON.	
SVO.OFF button SVO.OFF button lamp	SRVOFF	Input	Turns OFF the servo power supply.	1,-1
		Output	This output indicates a status where the servo power supply cannot be turned ON. (Echo back)	

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. Moreover, handling and operation of a teaching pendant (T/B) are described based on R32TB (R33TB) in instruction manuals. If using other T/B, such as R56TB (R57TB), refer to a supplied instruction manual of the T/B.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

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

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.
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
Extended Function Instruction Manual	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures, about the PLC(CR750-Q/CR751-Q controller) and the GOT(CR750-D/CR751-D controller).

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	Stand-alone type	
	Controller	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	Indicates the operating panel on the front of controller or drive unit for the controller which installed the operating panel
	CR751 (Thin type) CR751 (Heavy type)	There are two kinds of CR751 controller; one is "Thin type" (the height is 98mm) and the other is "Heavy type" (the height is 174mm), each of which are different in height. Thin type: CR751-03HD/Q, CR751-06HD/Q, CR751-12HD/Q, CR751-20HD/Q, CR751-03HRD/Q, CR751-02VD/Q, CR751-04VD/Q, CR751-04VJD/Q, CR751-07VD/Q. Heavy type: CR751-13VD/Q, CR751-20VD/Q, CR751-07VLD/Q. * Refer to separate Standard Specifications Manual for the outside dimension of CR751 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	When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.
⚠CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
⚠WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
⚠CAUTION	Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
⚠CAUTION	Never carry out modifications based on personal judgments, or use non-designated maintenance parts. Failure to observe this could lead to faults or failures.
⚠ WARNING	When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

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

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

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

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

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

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

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
CR750-D controller				
1	Controller	CR750-D	1 unit	Stand alone type
2	Safety manual	BFP-A8006	1 copy	
3	CD-ROM (Instruction manual)	5F-FA01-C00	1 pc.	Stand alone type
4	Dummy plug for T/B	2D-DP1	1 pc.	Connect, when not using T/B.
5	CNUSR connector (Connector cover)	10350-52Y0-008	1 pc.	
6	CNUSR connector (Plug)	10150-3000 PE	1 pc.	
7	CNUSR connector	BU770D007G51	3 pcs.	For the CNUSR11/12/13 connector.
8	Ferrite core	E04SR301334	1 pc.	For emergency stop wiring
9	Noise filter	SUP-EL20-ER6	1 pc.	CE specification only.
10	Lock cover set	HL-05FA	1 pc.	For locking the power switch.
11	1.6A fuse (reserves)	LM16	2 pcs.	
12	3.2A fuse (reserves)	HM32	2 pcs.	
13	4A fuse (reserves)	LM40	1 pc.	
14	3.2A fuse (reserves)	LM32	1 pc.	Only with a controller for the following models. RV-13F/13FL/20F series, RH-1FHR
15	Guarantee Card		1 copy	
CR751-D controller				
1	Controller	CR751-D	1 unit	Stand alone type
2	Safety manual	BFP-A8006	1 copy	
3	CD-ROM (Instruction manual)	5F-FA01-C00	1 pc.	Stand alone type
4	ACIN connector Note1)	1-179958-3	1 pc.	
5	ACIN terminal Note1)	316041-2	2 pcs.	Only with single-phase controller
			3 pcs.	Only with three-phase controller
6	Power cable (with the ACIN connector) Note1)	BU774D126G03	1 pc.	Only with single-phase controller. Length: 3m
		BU774D126G23	1 pc.	Only with three-phase controller. Length: 3m
7	Dummy plug for T/B	2F-DP1	1 pc.	Connect, when not using T/B.
8	CNUSR connector (Connector cover)	10350-52Y0-008	2 pcs.	
9	CNUSR connector (Plug)	10150-3000 PE	2 pcs.	
10	Ferrite core	E04SR301334	1 pc.	For emergency stop wiring
11	1.6A fuse (reserves)	LM16	2 pcs.	
12	3.2A fuse (reserves)	HM32	2 pcs.	
13	4A fuse (reserves)	LM40	1 pc.	
14	3.2A fuse (reserves)	LM32	1 pc.	Only with a controller for the following models. RV-13F/13FL/20F series, RH-1FHR
15	Cover plate	BU773C012G61	1 pc.	For connector protection of the controller.
16	Cable fixing plate	BU773C011H02	1 pc.	For fixing the cable of the controller.
17	Cable clamp	AB-10N	1 pc.	For fixing the machine cable (CN1) One fixing screw (M4) is attached.
		AB-6N	4 pcs.	For fixing TB cable, power supply and FG cable, communication cable and machine cable (CN2) Four fixing screws (M4) are attached.
18	Guarantee Card		1 copy	

No.	Part name	Type	Qty.	Remarks
CR760-D controller				
1	Controller	CR760-D	1 unit	Stand alone type
2	Safety manual	BFP-A8006	1 copy	
3	CD-ROM (Instruction manual)	5F-FA01-C00	1 pc.	Stand alone type
4	Dummy plug for T/B	2D-DP1	1 pc.	Connect, when not using T/B.
5	Connector for EMG1	DFMC 1,5/12-ST-3,5-LR	1 pc.	
6	Connector for EMG2	DFMC 1,5/12-ST-3,5-LR	1 pc.	
7	Ferrite core	E04SR301334	4 pc.	For emergency stop wiring
8	1.6A fuse (reserves)	LM16	1 pcs.	
9	7.5A fuse (reserves)	GP75	2 pcs.	
10	Guarantee Card		1 copy	

Note1) When the power cable (with the ACIN connector) is used, the ACIN connector and the ACIN terminal are not used.
When you build a power cable suitable for your environment, the ACIN connector and the ACIN terminal are used.

2.2 Installation

2.2.1 Unpacking procedures

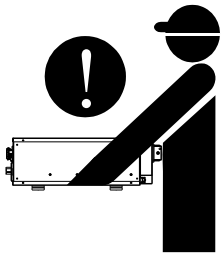
The controller is shipped from the factory packaged in cardboard.

2.2.2 Transportation procedures

The following shows how to transport the controller.

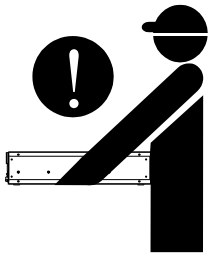
(1) Transporting CR750/CR751 controller

CR750 controller



Mass:
Approx. 16 – 18kg

CR751 controller

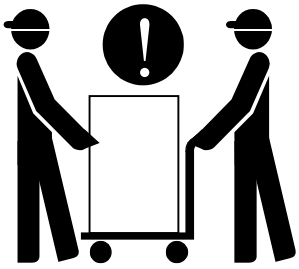


Mass:
Thin type: Approx. 12kg
Heavy type: Approx. 15kg

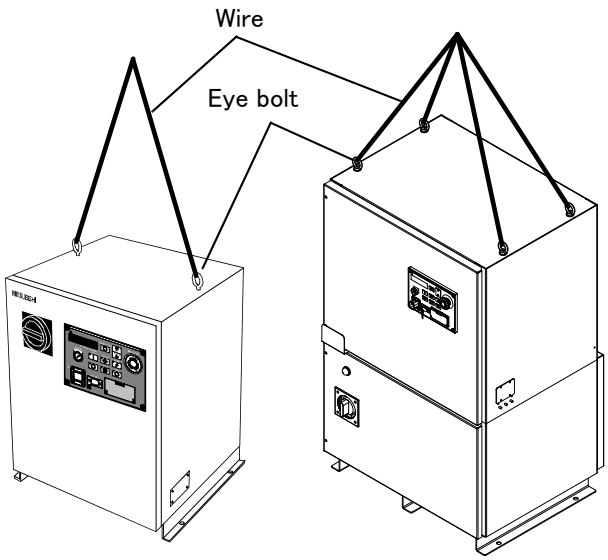
Fig. 2-1 : Transporting CR750/CR751 controller

1) Slightly tilt the controller and put your hands underneath. Providing steady support with both hands, lift it up and transport.
Be careful not to trap fingers when transporting the controller.

(2) Transporting CR760 controller



Mass:
Non-CE marking: Approx. 95kg
CE marking specification: Approx. 296kg



<Non-CE marking> <CE marking>

Fig. 2-2 : Transporting CR760 controller

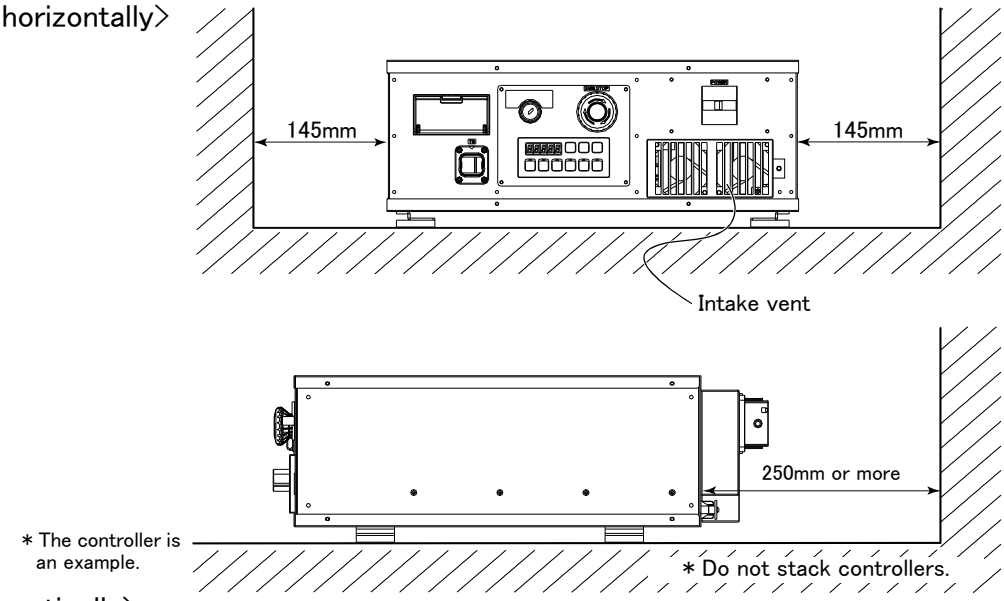
1) Two workers must transport the controller using a crane or lifter.

2.2.3 Installation procedures

The installed size is shown as follows.

(1) CR750 controller

<Placed horizontally>



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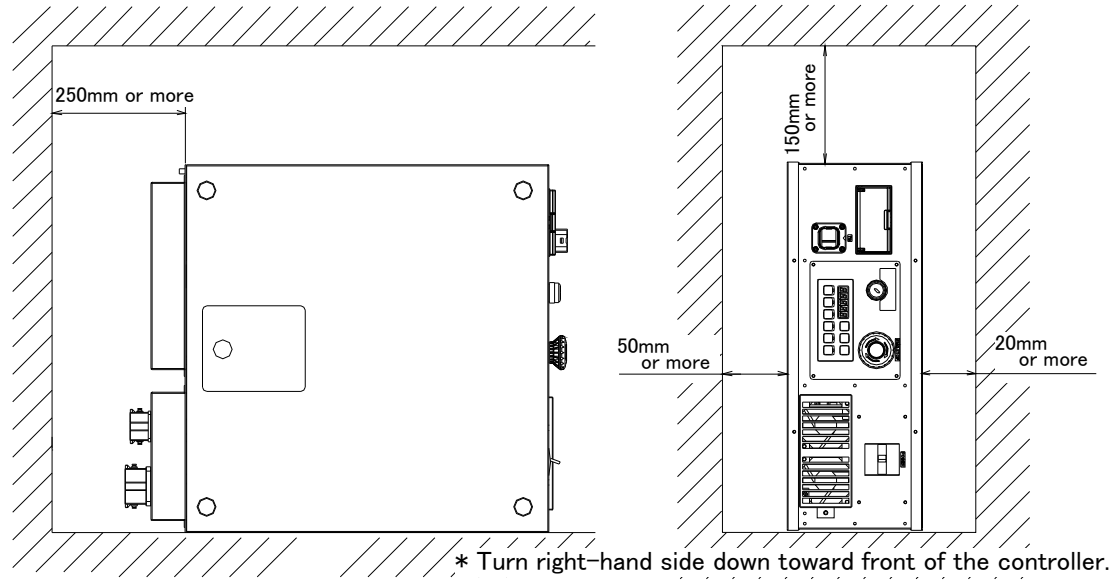

* The controller is an example.

Fig. 2-3 : Installation dimensions (CR750 controller)

⚠CAUTION When using the controller in its upright position, please be sure to take measures to prevent toppling, such as fixing the installation section. Fig. 2-4 shows a fixing plate for upright use. Please refer to this when using the controller in its upright position. Please use M4 x 8 screws (or shorter) to fix the controller to the fixing plate. (Make sure that screws into the controller board's internal section (lateral board thickness of 1.2mm) stick out 6.8mm or less).

⚠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. And, don't install the controller in the position where direct rays or the heat of lighting hits. The skin temperature of the controller may rise, and the error may occur.

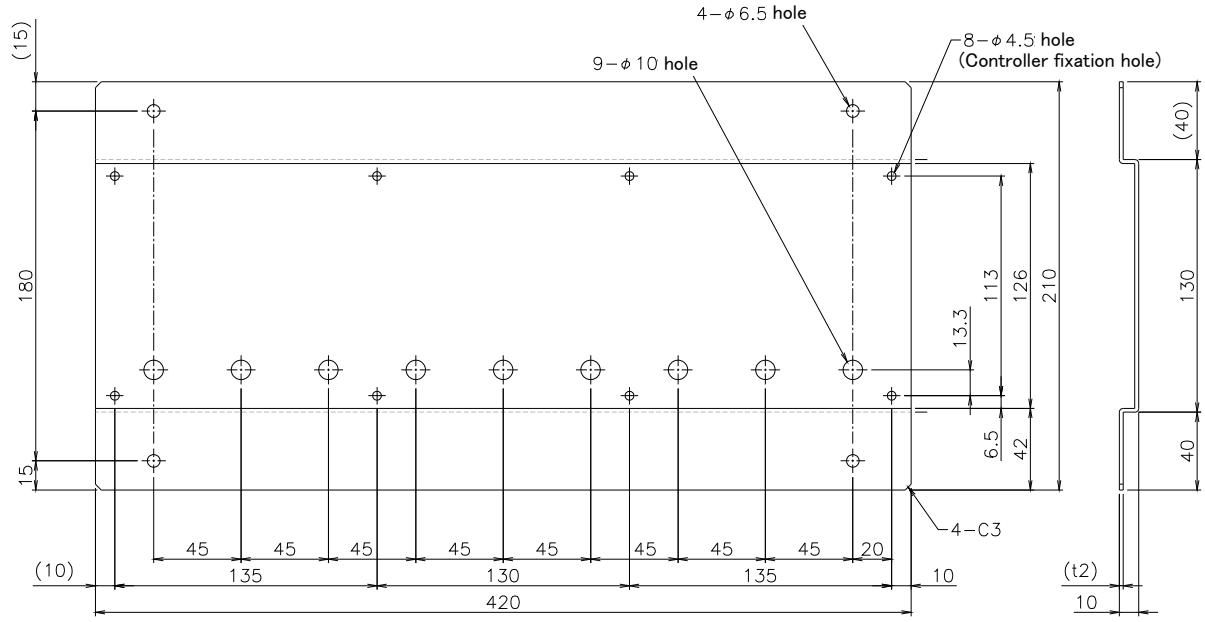

Fig. 2−4 : Metal plate for fixation to placing vertically (reference) (CR750 controller)

(2) CR751 controller: Thin type

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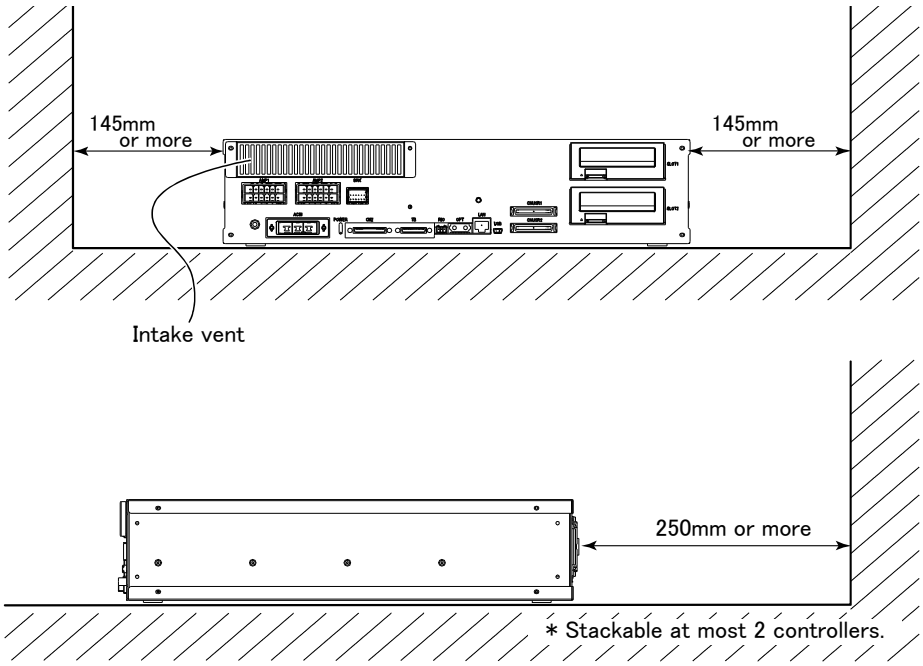


<Placed vertically>

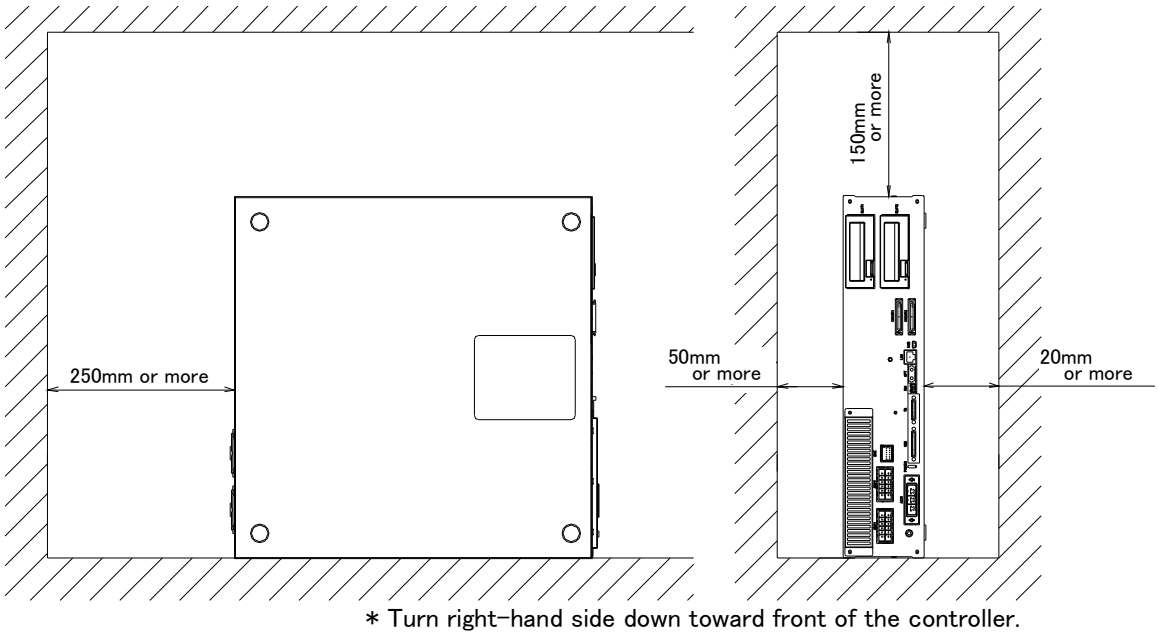


Fig. 2-5 : Installation dimensions (CR751 controller: Thin type)

⚠CAUTION When using the controller in its upright position, please be sure to take measures to prevent toppling, such as fixing the installation section. Fig. 2-6 shows a fixing plate for upright use. Please refer to this when using the controller in its upright position. Please use M4 x 8 screws (or shorter) to fix the controller to the fixing plate. (Make sure that screws into the controller board's internal section (lateral board thickness of 1.2mm) stick out 6.8mm or less).

⚠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. And, don't install the controller in the position where direct rays or the heat of lighting hits. The skin temperature of the controller may rise, and the error may occur.

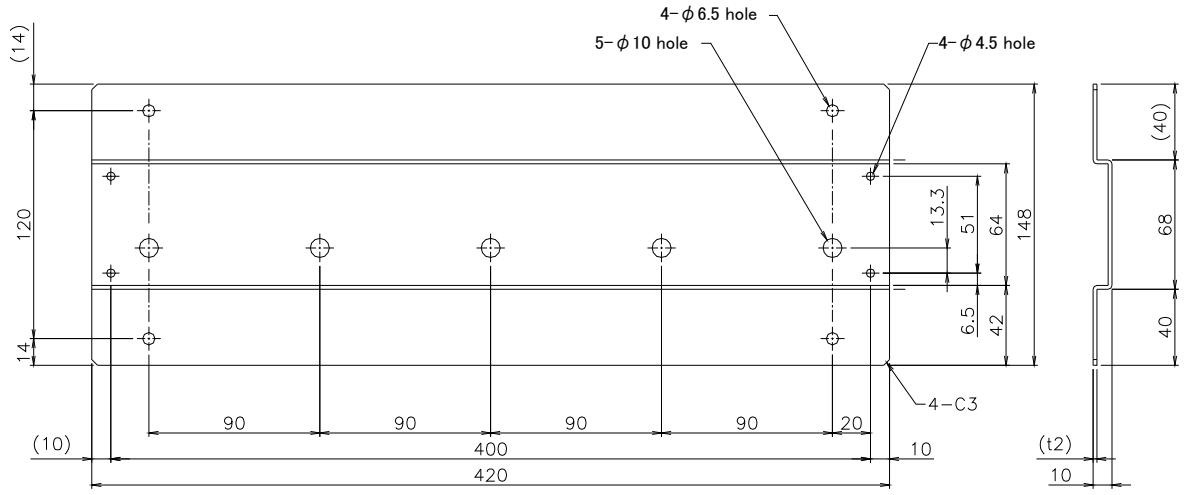
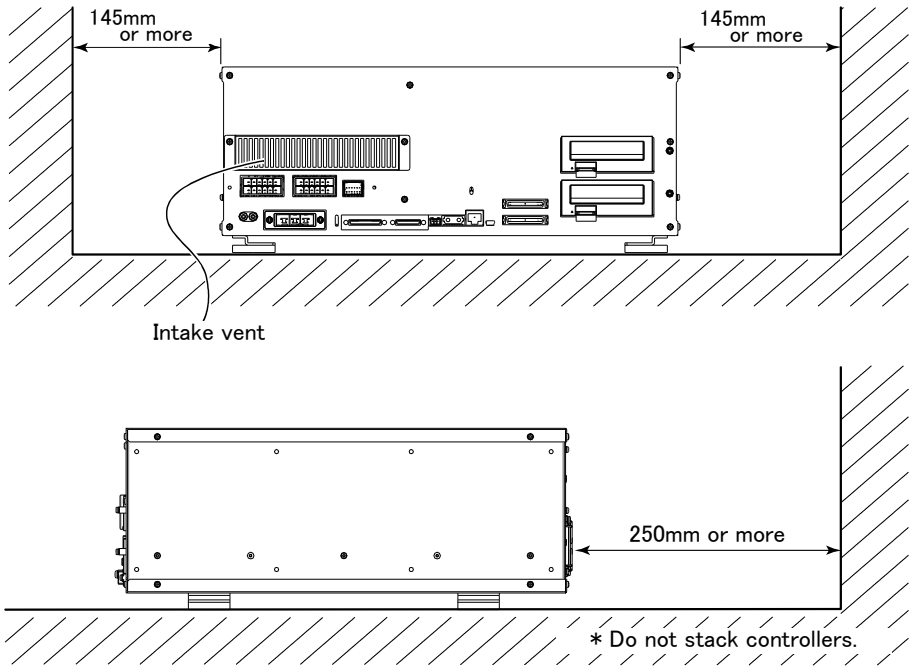


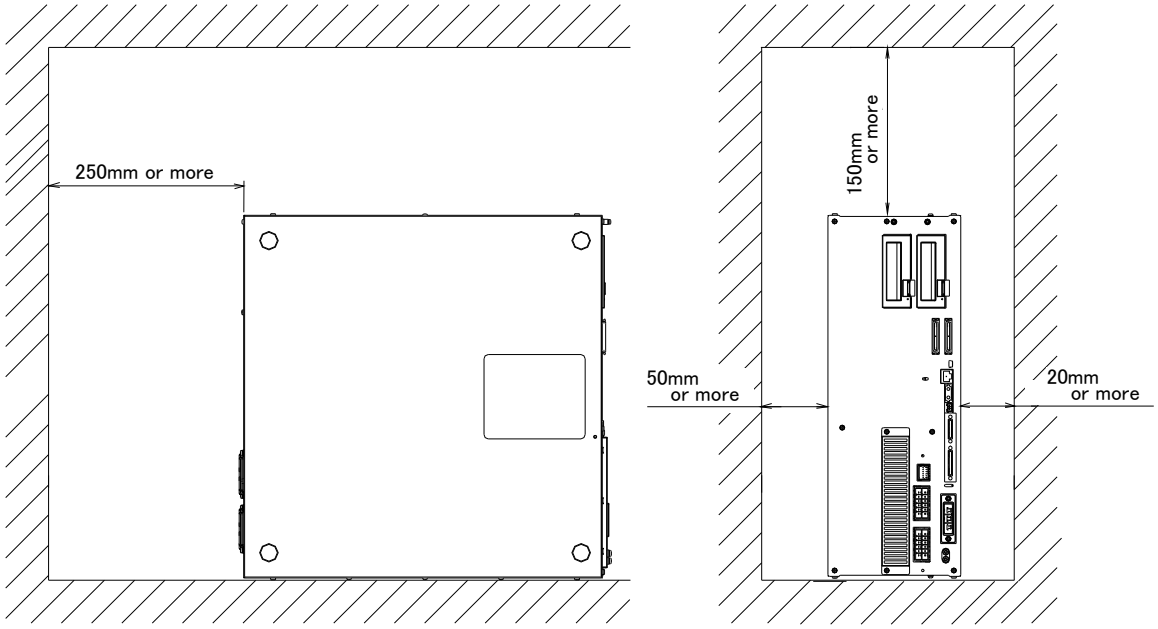
Fig. 2−6 : Metal plate for fixation to placing vertically (reference)

(3) CR751 controller: Heavy type

<Placed horizontally>



<Placed vertically>



* Turn right-hand side down toward front of the controller.

Fig. 2-7 : Installation dimensions (CR751 controller: Heavy type)

⚠CAUTION

When using the controller in its upright position, please be sure to take measures to prevent toppling, such as fixing the installation section. Fig. 2-8 shows a fixing plate for upright use. Please refer to this when using the controller in its upright position. Please use M4 x 8 screws (or shorter) to fix the controller to the fixing plate. (Make sure that screws into the controller board's internal section (lateral board thickness of 1.2mm) stick out 6.8mm or less).

⚠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. And, don't install the controller in the position where direct rays or the heat of lighting hits. The skin temperature of the controller may rise, and the error may occur.

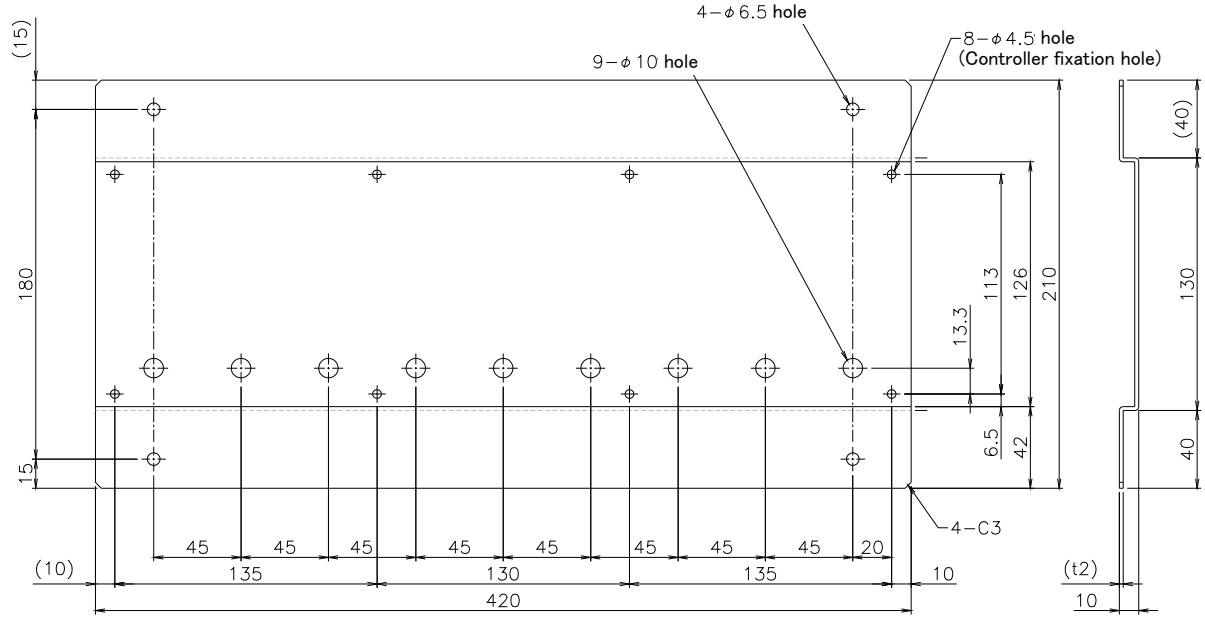
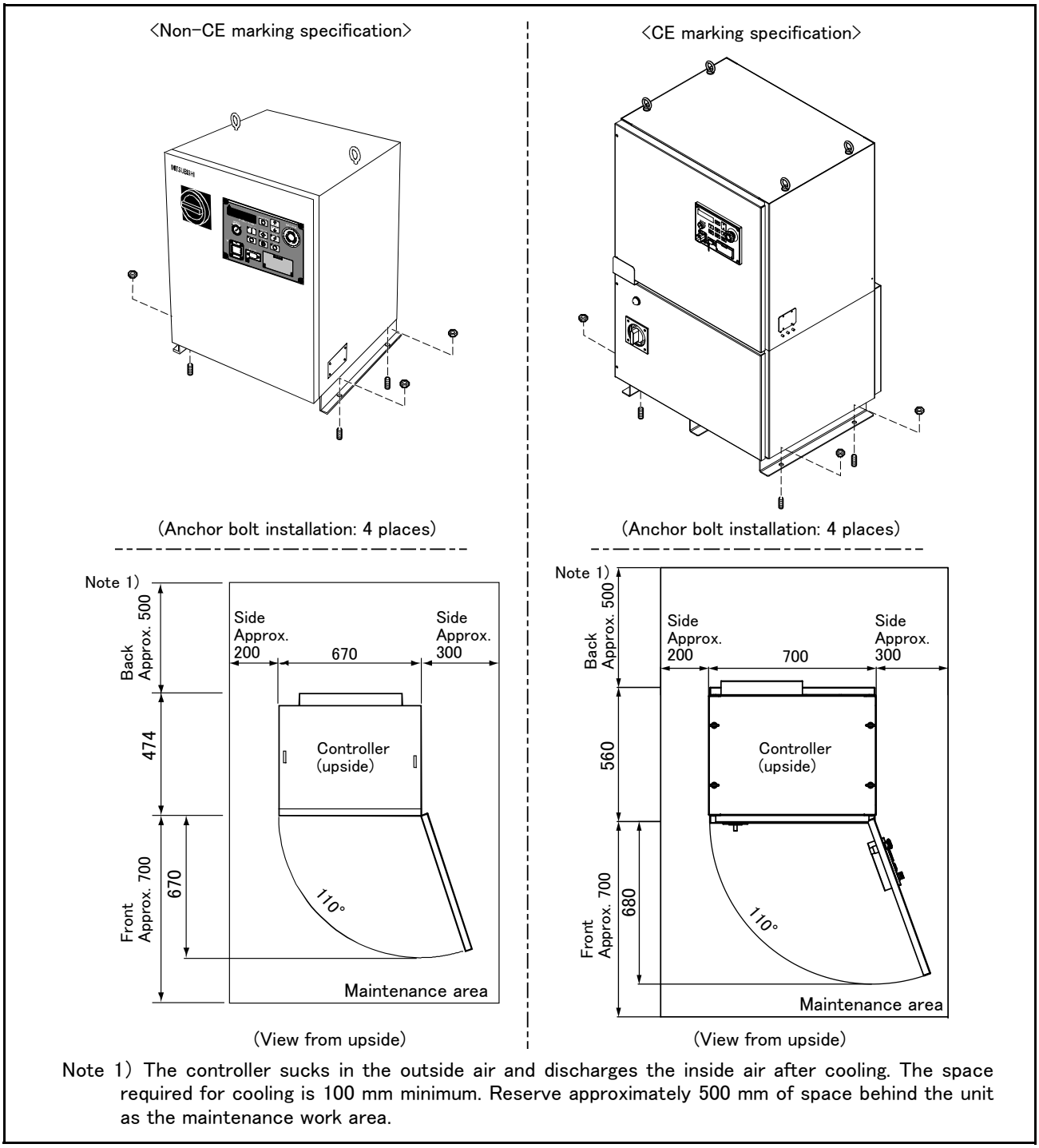


Fig. 2−8 : Metal plate for fixation to placing vertically (reference)

(4) CR760 controller



Note 1) The controller sucks in the outside air and discharges the inside air after cooling. The space required for cooling is 100 mm minimum. Reserve approximately 500 mm of space behind the unit as the maintenance work area.

Fig. 2-9 : Installation dimensions (CR760 controller)

⚠CAUTION Install the controller so that it is level.

⚠CAUTION Do not block the ventilation holes on the side and rear surfaces of the controller.

⚠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. And, don't install the controller in the position where direct rays or the heat of lighting hits. The skin temperature of the controller may rise, and the error may occur.

2.2.4 Attachments installation procedures

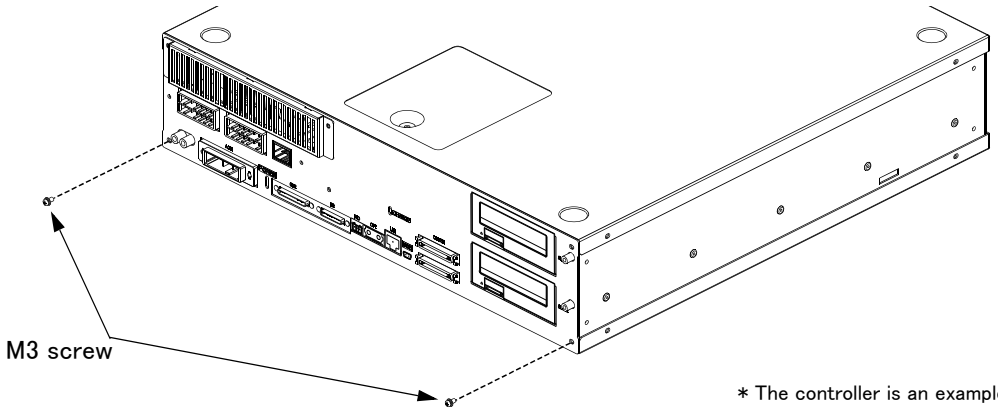
The CR751 controller has the cable fixation plate and cover plate to protect the cable connector connected to the controller.

Always use the controller after installing the cable fixation plate and cover plate.

Procedures to install the cable fixation plate and cover plate are shown below.

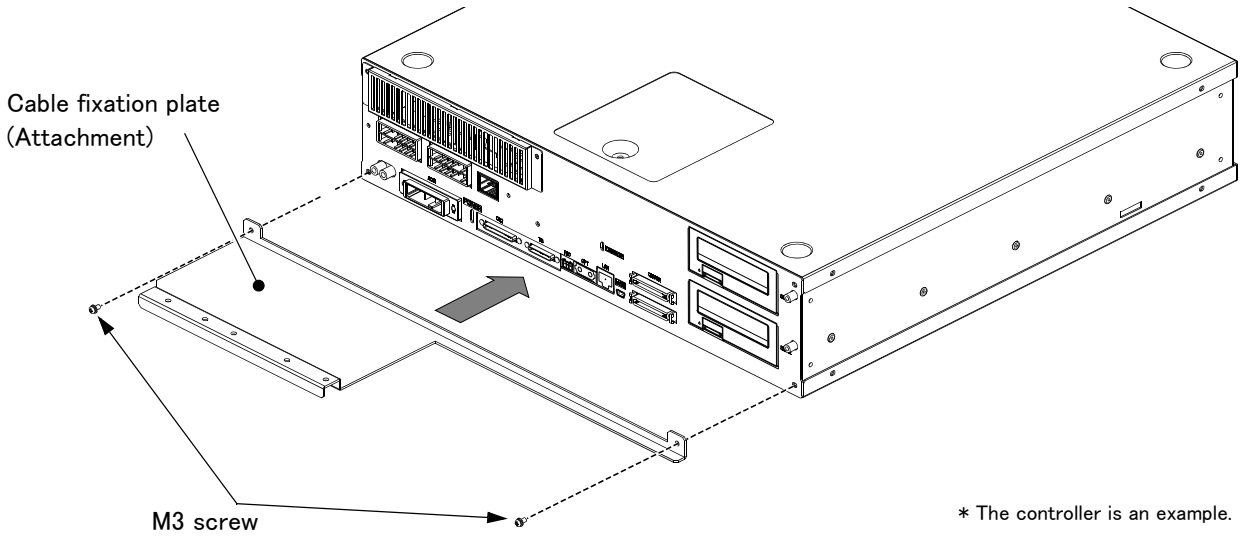
(1) Installing the cable fixation plate

1) Remove two screws (M3).



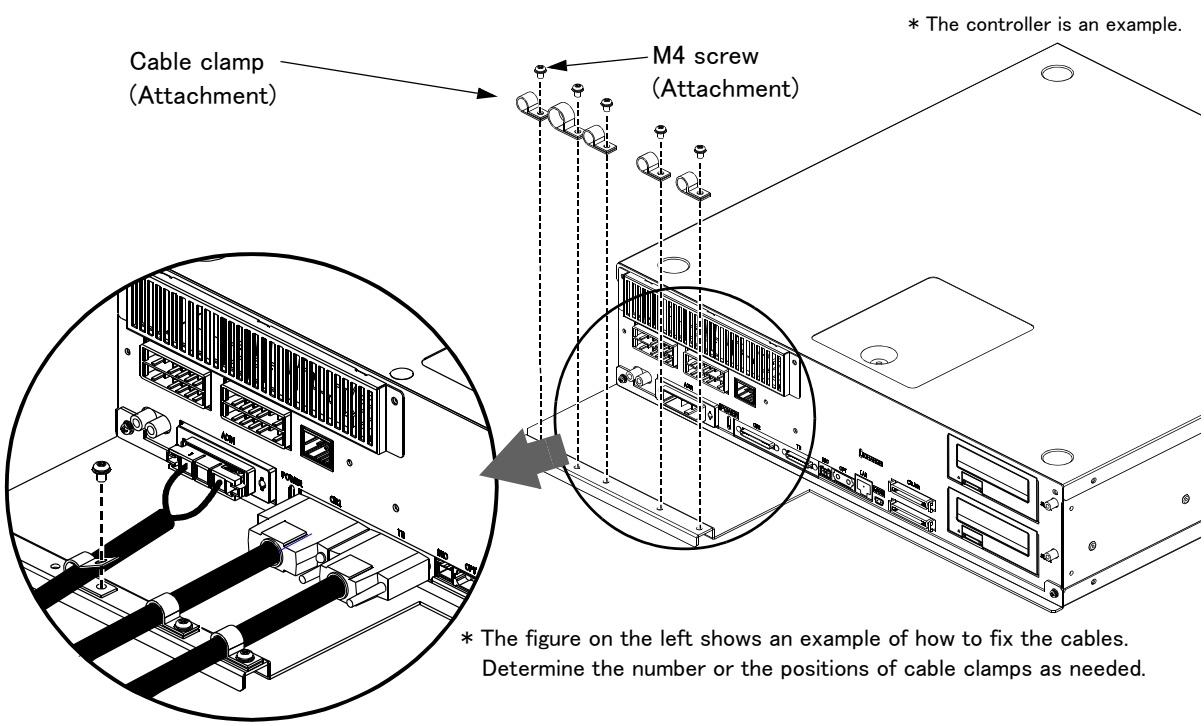
* The controller is an example.

2) Install the cable fixation plate to the controller with removed screws in step "1)".



* The controller is an example.

3) Connect cables (machine cables, TB cable, power cable and communication cables) and hold the cables with cable clamps (attachments).



* The figure on the left shows an example of how to fix the cables.
Determine the number or the positions of cable clamps as needed.

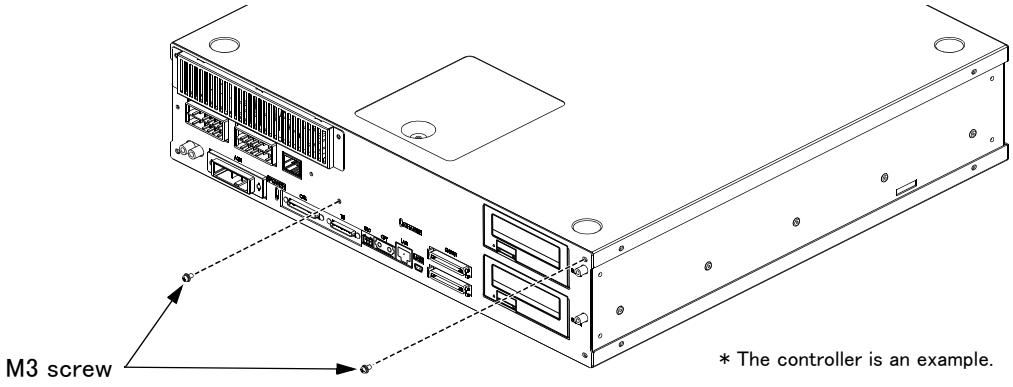
⚠CAUTION When installing the cable fixation plate, use the screws removed in the step "1)". Using screws other than those may cause damage of the components inside the controller.

⚠CAUTION When the cable clamp cannot tighten a cable enough and the cable slips under the clamp, wrap tape around the cable to increase the diameter to be firmly fixed.

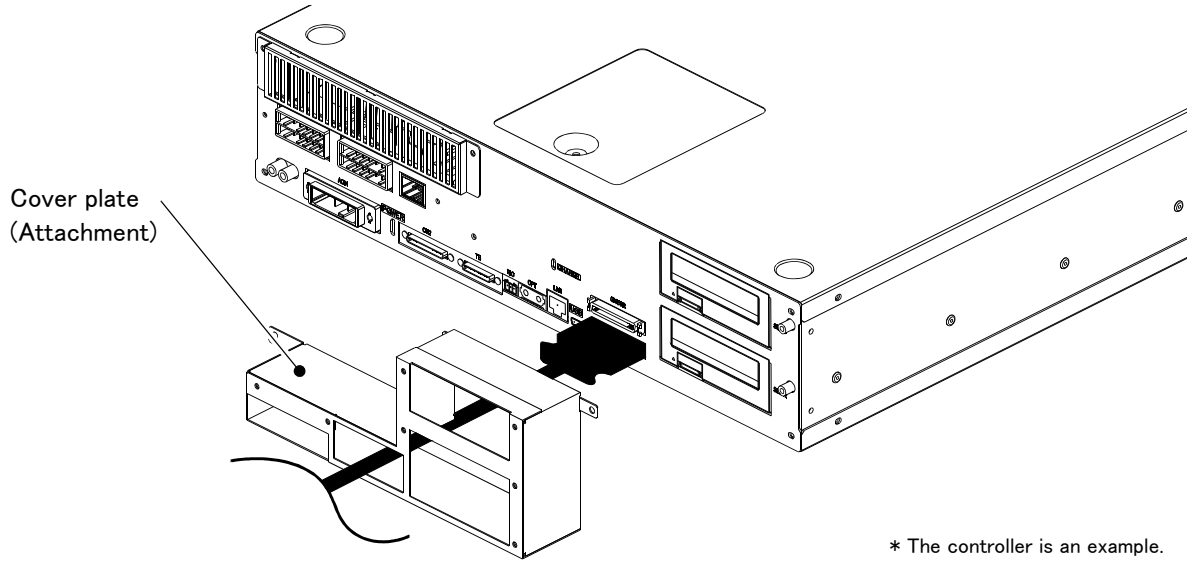
⚠CAUTION Applying force to the cable fixation plate may cause deformation of the plate or damage on the fixing screws.

(2) Installing the cover plate

1) Remove two screws (M3).

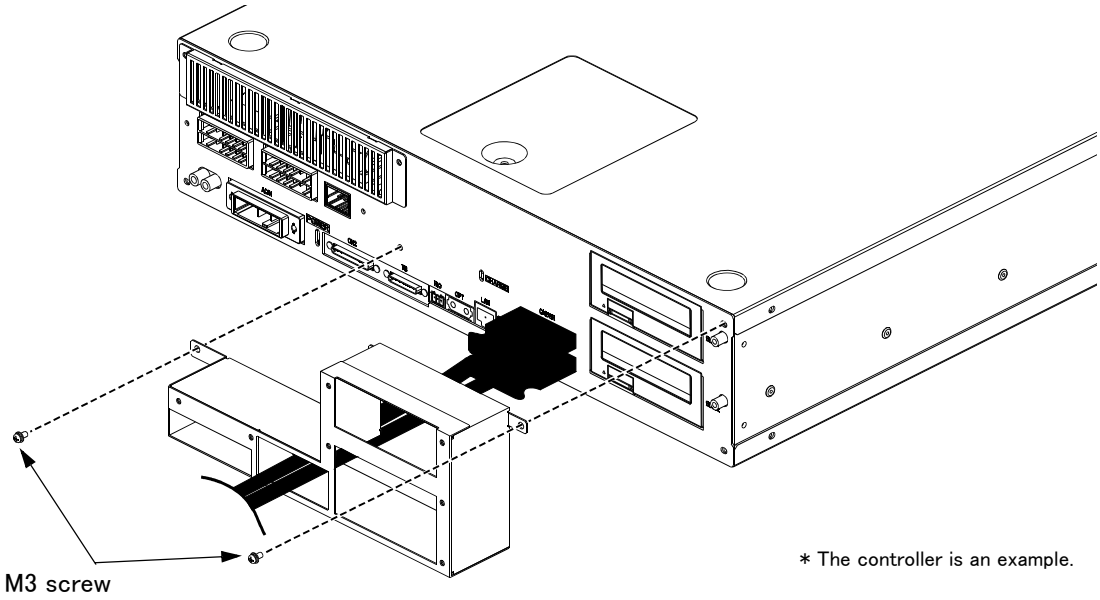


2) Pass a communication cable or the like through the square hole of the cover plate, and connect it to the controller.



* The controller is an example.

3) Install the cover plate to the controller with removed screws in step "1)".



* The controller is an example.

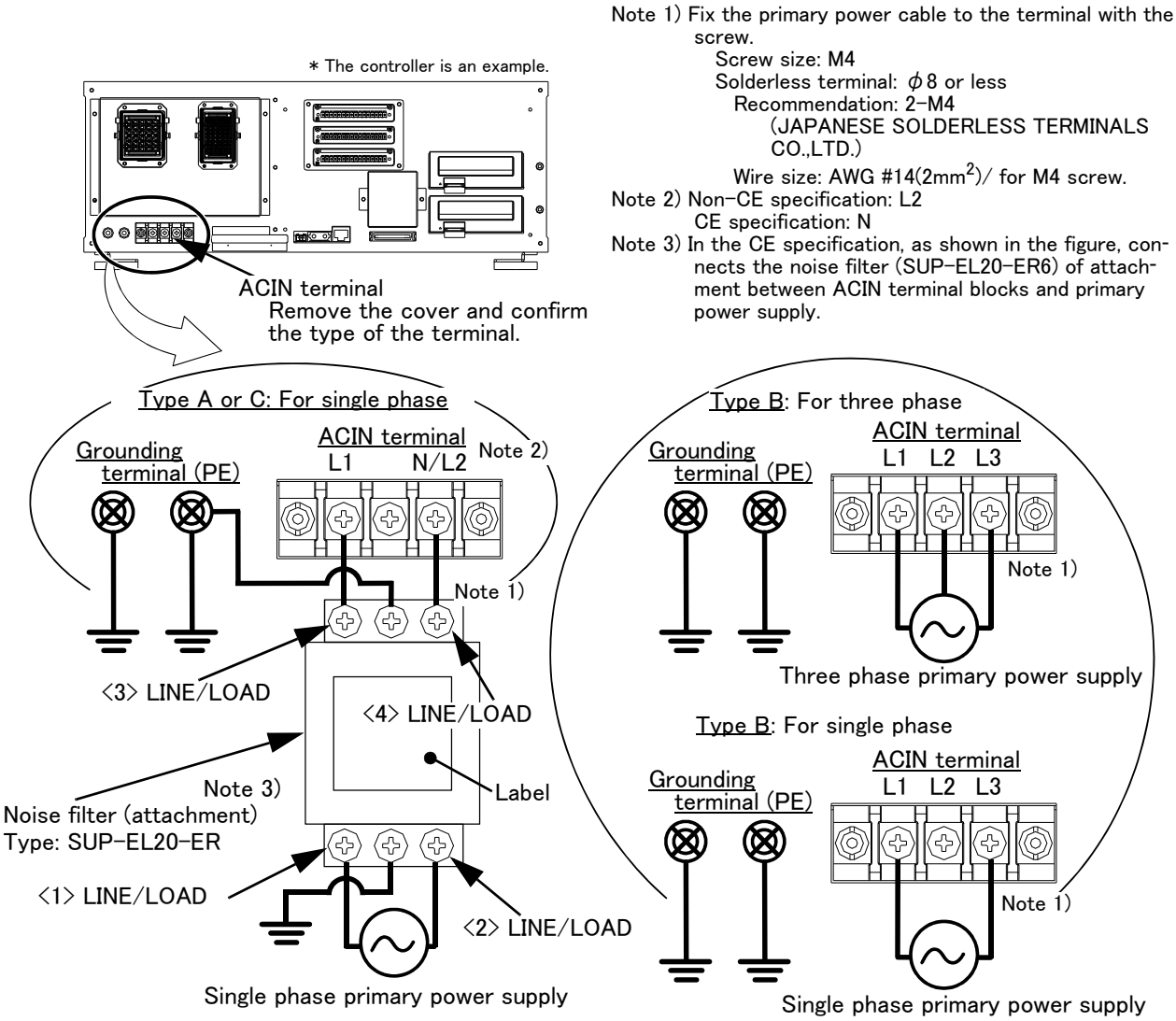
⚠CAUTION When installing the cover plate, use the screws removed in the step "1)". Using screws other than those may cause damage of the components inside the controller.

⚠CAUTION Applying force to the cover plate may cause deformation of the plate or damage on the fixing screws.

2.2.5 Connecting the power cable and grounding cable

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

(1) CR750 controller



Note 1) Fix the primary power cable to the terminal with the screw.
Screw size: M4
Solderless terminal: ϕ8 or less
Recommendation: 2-M4
(JAPANESE SOLDERLESS TERMINALS CO.,LTD.)
Wire size: AWG #14(2mm^2)/ for M4 screw.

Note 2) Non-CE specification: L2
CE specification: N

Note 3) In the CE specification, as shown in the figure, connects the noise filter (SUP-EL20-ER6) of attachment between ACIN terminal blocks and primary power supply.

Note) When fixing the power cable to the ACIN terminal block with screws, be sure to hold the crimp terminal with your hand to ensure that it does not rotate while fastening screws.
The dividers between terminals of the ACIN terminal block are fragile and may break if pressed.

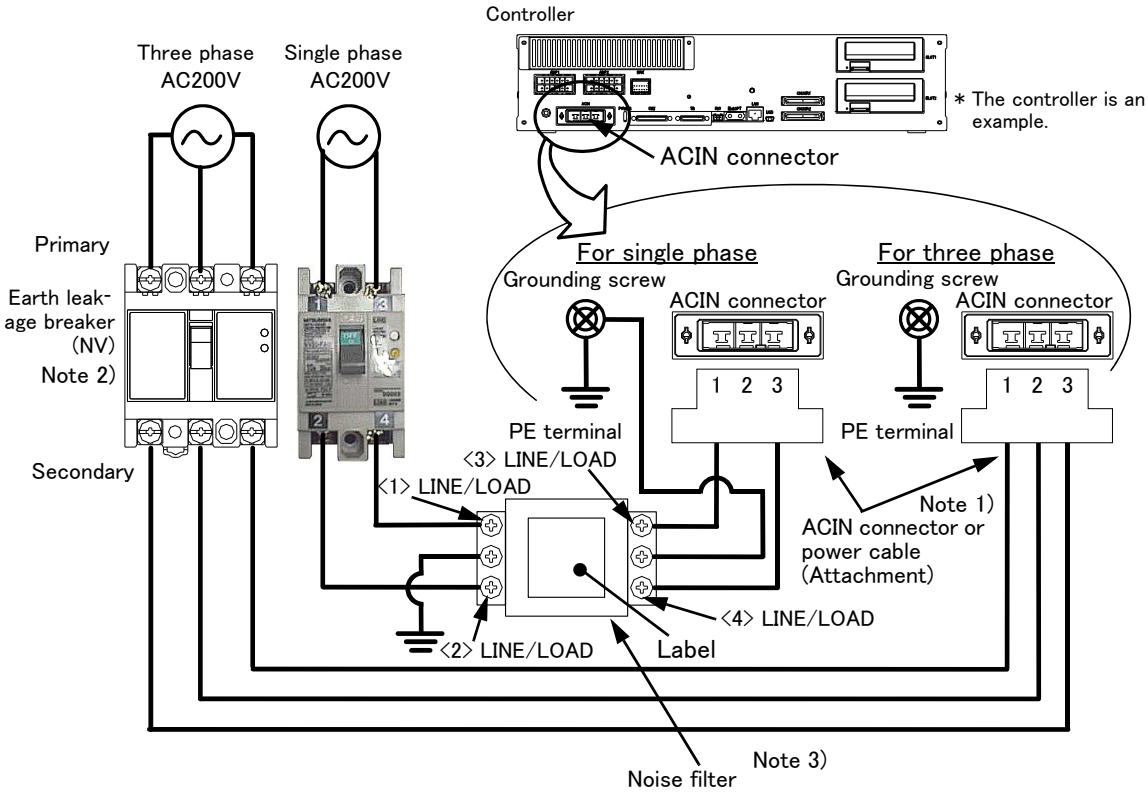
Fig. 2-10 : Connecting the power cable and grounding cable (CR750)

1) Prepare the power cable (AWG#14 (2mm^2) or more).
2) Loosen the two screws fixing the terminal cover, and remove the cover. Then refer to Page 73, "(1) CR750 controller" and confirm the type of the terminal.
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) Connects the cable for the primary power supply connection to the ACIN terminal block of the controller. When the Type A or C terminal, connect the primary power supply to L1 and L2/N terminal. When Type B is attached, connect the primary power supply to L1, L2, and L3 terminal when using the three phase primary power supply, and connect the primary power supply to L1 and L3 terminal when using the single phase primary power supply.
6) Connect a cable of a primary power supply grounding to the ground terminal of the controller.
7) Install the power terminal cover as before.

This completes the connection of the power and grounding cables.

(2) CR751 controller

CAUTION Use an earth leakage breaker (customer preparation) in the primary power supply circuit of the controller to prevent short circuit.



Note 1) Crimping swage is recommended for connecting the attachment ACIN connector (soldering is also possible)
Recommendation compression tools: 234171-1(Tyco Electronics)
Note 2) The earth leakage breaker is the customer preparation. Always use the cover below.
Recommendation: For single primary power supply .....NV30FAU-2P-10A-AC100-240V-30mA, (Cover: TCS-05FA2)
For three primary power supply .....NV30FAU-3P-10A-AC100-240V-30mA, (Cover: TCS-05FA3)
Note 3) If necessary, as shown in the figure, connects the noise filter between ACIN terminal blocks and primary power supply.
(Recommended noise filter: SUP-EL20-ER6 *OKAYA ELECTRIC INDUSTRIES)

Fig. 2-11 : Connecting the power cable and grounding cable (CR751)

1) Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary power supply (AWG #14 ($2mm^2$ or above), cables to ground the primary power supply (AWG #12 ($3.5mm^2$ or above).
The secondary power cable (with the ACIN connector) for single phase or three phase power is supplied with the product to match the specifications. When you build a cable suitable for your environment using the ACIN connector and the ACIN terminal supplied, prepare a secondary power cable (AWG #14 ($2mm^2$) or above).
2) Confirm that the primary power matches the specifications.
3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.
4) Connect the secondary power cable.
a) When using the supplied power cable with the ACIN connector
Refer to Fig. 2-11 and connect the cable from the secondary side of the earth leakage breaker.
b) When building a power cable using the ACIN connector and the ACIN terminals supplied
Connect the ACIN terminals with the secondary power cable (prepared by customers), and insert the ACIN terminals to the ACIN connector pins with the following numbers. Crimping caulking is recommended to connect the ACIN terminals.
For single phase: 1 and 3
For three phase: 1, 2, and 3
Connect the cable from the secondary side of the earth leakage breaker.
5) Connect this ACIN connector to the ACIN connector on the front of the controller.
6) Connect the grounding cable to the PE terminal. (M4 screw)
7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

This completes the connection of the power and grounding cables.

(3) CR760 controller

<Non-CE marking specification>

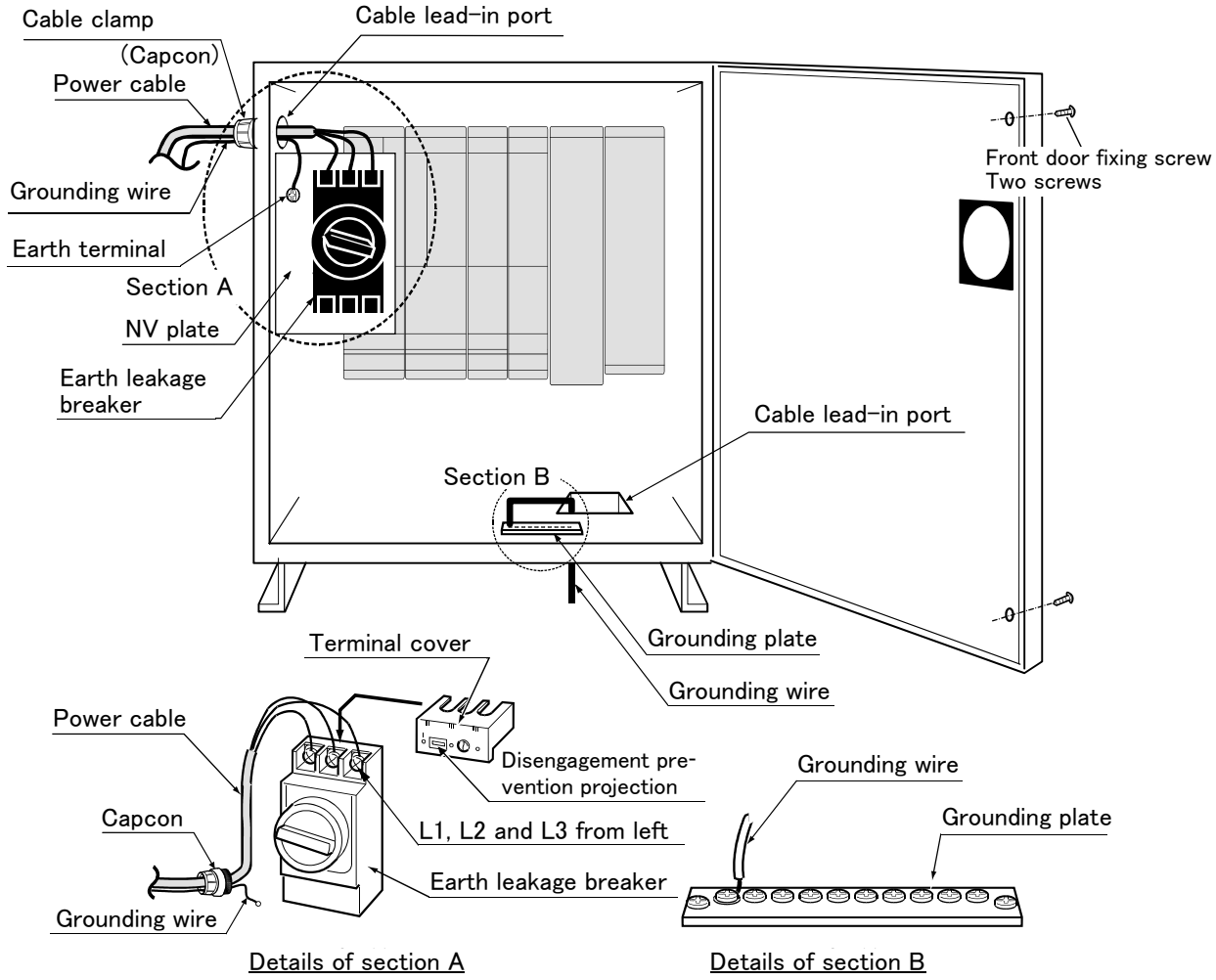


Fig. 2-12 : Connecting the power cable and grounding cable (CR760 non-CE marking)

1) Prepare the power cable (AWG#8 (8mm^2) or more) and grounding cable (AWG#6 (14mm^2) or more).
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 (M8 screw). (L1, L2 and L3 from left)
8) Connect the grounding cable to the NV plate terminal (M6 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.

<CE marking specification>

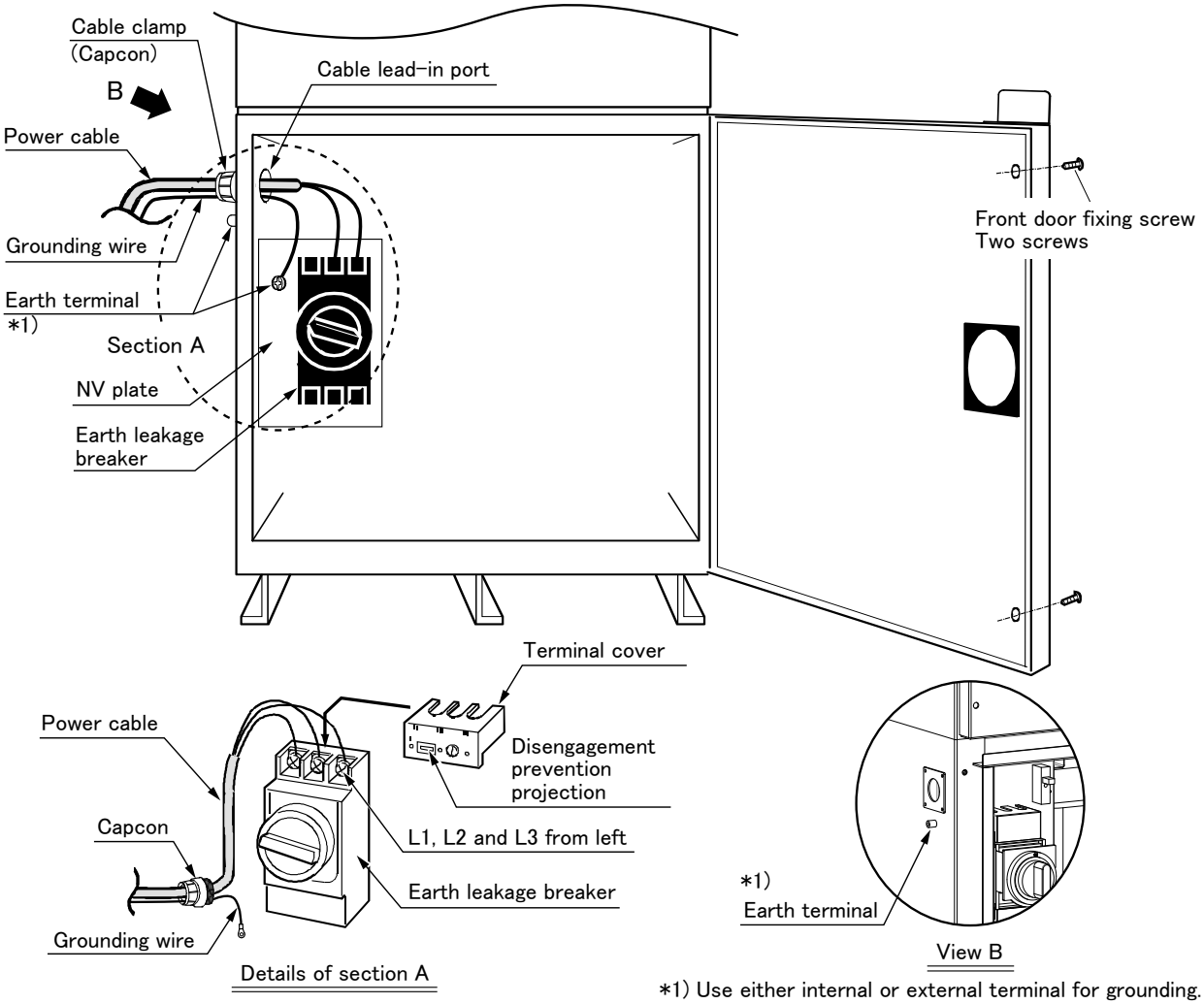


Fig. 2-13 : Connecting the power cable and grounding cable (CR760 CE marking)

1) Prepare the power cable (AWG#8 (8mm^2) or more) and grounding cable (AWG#6 (14mm^2) or more).
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 (M6 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.

2.2.6 Emergency stop input and output etc.

Do wiring of the external emergency stop, the special stop input, the door switch, and the enabling device from the "special input/output" terminal connector.

Connection of the external emergency stop is explained in "2.2.7Connecting the external emergency stop". And about wiring of the others, refer to separate "Standard Specifications Manual".

Table 2-2 : Special input/output terminal

Item	Name	Function
Input	Emergency stop	Applies the emergency stop. Dual emergency line.
Input	Special stop input	Applies the stop. (Refer to "Special stop input (SKIP)" in separate "Standard Specifications Manual".)
Input	Door switch	Servo-off. Dual line, normal close. (Refer to "Door switch function" in separate "Standard Specifications Manual".)
Input	Enabling device	Servo-off. Dual line, normal close. (Refer to "Enabling device function" in separate "Standard Specifications Manual".)
Output	Robot error output	Contactor is opening during error occurrence.
Output	Emergency stop output	The point of contact opens under occurrence of emergency stop of external input signal, emergency stop of OP, emergency stop of T/B.
Output	Mode output	MANUAL mode: contactor is opening, AUTOMATIC mode: contactor is closing.
Output	Magnet contactor control connector output for addition axes	When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the robot arm. (Refer to Page 61, "2.2.10 Magnet contactor control connector output (AXMC) for addition axes".)

*At the time of the power supply OFF, the output point of contact is always open.

[Note] The contact capacity of each input/output terminal is DC24V/10mA – 100mA. Don't connect the equipment except for this range. The use exceeding contact capacity causes failure.
In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

2.2.7 Connecting the external emergency stop

The following shows how to connect the external emergency stop. The example is shown in "2.2.9Examples of safety measures".

For external emergency stop, connect to the connector at the front of the controller (reference Fig. 2-14). When shipped from the factory, external emergency stop input, door switch input, and the enabling device terminal, are opened (contacts not shorted) as shown on Fig. 2-15 (CR750 controller), Fig. 2-19 (CR751 controller), and Fig. 2-22 (CR760 controller). Customers should be sure to prepare the external emergency stop, door switch and enabling device, etc. and use the robot while these are connected. Connection procedures are shown below.

[Caution] The emergency stop circuit is duplicated inside the controller. For the emergency stop switch, use a double contact-type switch, and be sure to connect both of the contacts to the connector pins as shown below in order to ensure the wiring is duplicated. An error cannot be reset if only one of the pins is connected.

1) Please prepare the emergency stop switch, door switch and enabling device.
2) Connect the contacts of each switch to the contacts as shown below:
   a) External emergency switch
      - CR750 controller .....CNUSR11 connector "between 3 and 4" and CNUSR12 connector "between 3 and 4"
      - CR751 controller .....CNUSR1 connector "between 2 and 27" and "between 7 and 32"
      - CR760 controller .....EMG1 connector "between 3 and 15" and "between 4 and 16"
   b) Door switch
      - CR750 controller .....CNUSR11 connector "between 7 and 8" and CNUSR12 connector "between 7 and 8"
      - CR751 controller .....CNUSR1 connector "between 4 and 29" and "between 9 and 34"
      - CR760 controller .....EMG1 connector "between 9 and 21" and "between 10 and 22"
   c) Enabling device
      - CR750 controller .....CNUSR11 connector "between 9 and 10" and CNUSR12 connector "between 9 and 12"
      - CR751 controller .....CNUSR1 connector "between 5 and 30" and "between 10 and 35"
      - CR760 controller .....EMG1 connector "between 7 and 19" and "between 8 and 20"

[Caution] Be sure to use a shield cable for the emergency stop wiring cable. And when operating in an environment that is easily affected by noise, be sure to install the included ferrite core (model number: E04SR301334, manufacturer: Seiwa Electric Mfg. Co., Ltd.). Be sure to place the ferrite core in 300mm or less from the connecting terminal section.

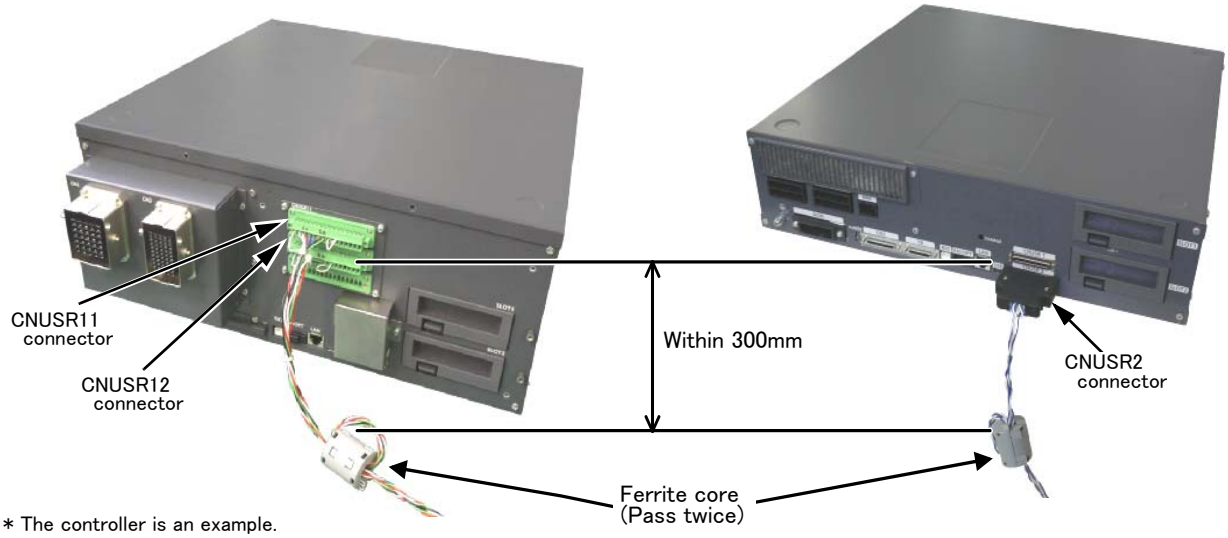
⚠CAUTION Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in failures, such as the emergency stop not being released. In order to prevent from occurring, please be sure to check that all functions (such as the teaching box emergency stop,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

⚠CAUTION You should always connect doubly connection of the emergency stop, the door switch, and the enabling switch. In connection of only one side, if the relay of customer use should break down, it may not function correctly.
And, the output contacts from the robot controller (robot error output, emergency stop output, mode output, addition axis contactor control output) are dual contacts (synchronizes). You should connect surely by dual line with the customer's equipment as well as connection of the emergency stop and the door switch.

⚠CAUTION When using several emergency stop switches, perform wiring carefully to make sure that each emergency stop switch functions independently. Check and make sure that the emergency stop does not function under an AND condition (when multiple emergency stop switches are ON at the same time).

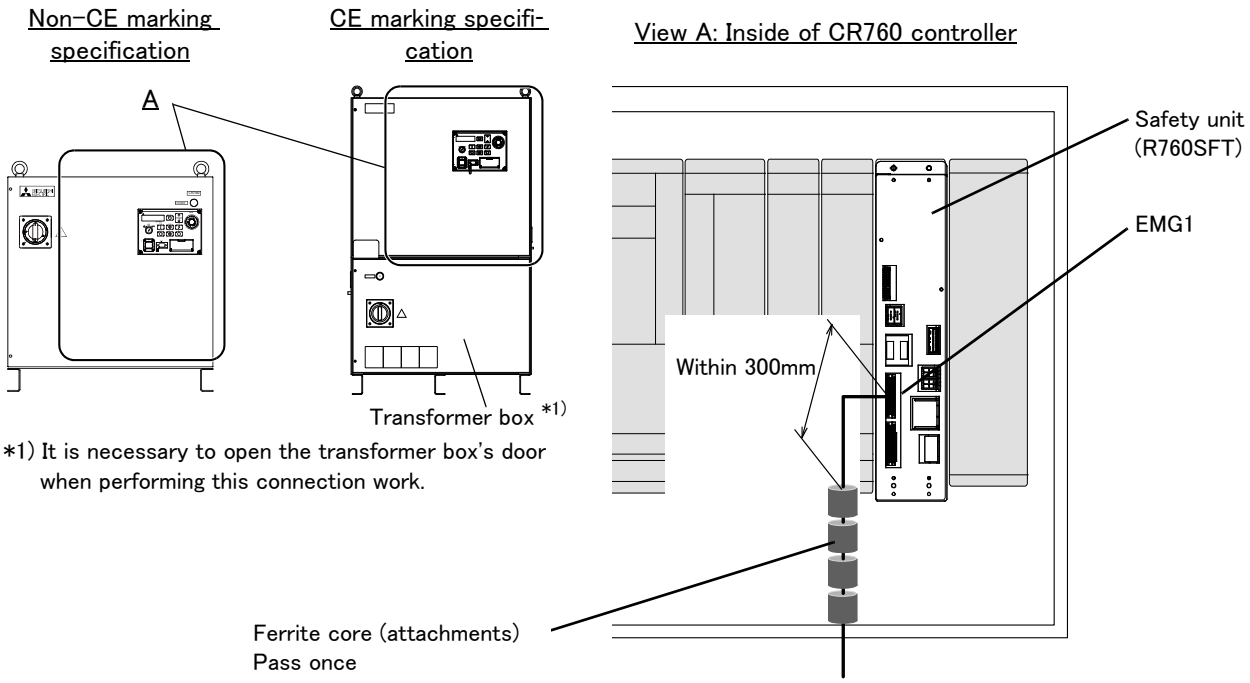
<CR750 controller (Rear side)>

<CR751 controller (Front side)>



* The controller is an example.

<CR760 controller>

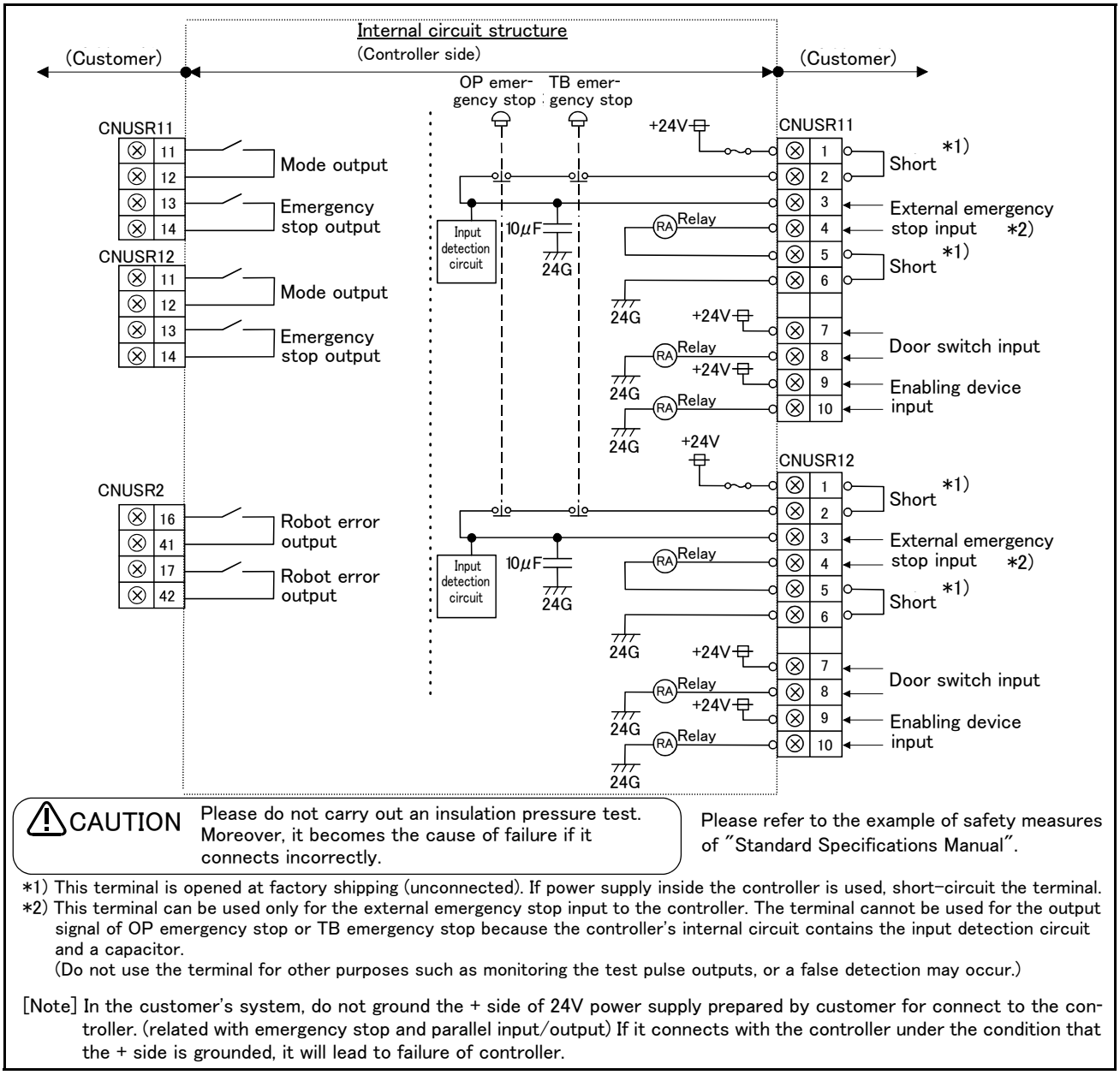


*1) It is necessary to open the transformer box's door when performing this connection work.

Fig. 2-14 : Emergency stop cable connection

(1) CR750 controller

An example of external emergency stop connection is shown below. Details of arrangement of connectors for exclusive input/output signals and the pin assignments are shown in the following pages.



CAUTION Please do not carry out an insulation pressure test. Moreover, it becomes the cause of failure if it connects incorrectly.

Please refer to the example of safety measures of "Standard Specifications Manual".

*1) This terminal is opened at factory shipping (unconnected). If power supply inside the controller is used, short-circuit the terminal.
*2) This terminal can be used only for the external emergency stop input to the controller. The terminal cannot be used for the output signal of OP emergency stop or TB emergency stop because the controller's internal circuit contains the input detection circuit and a capacitor.
(Do not use the terminal for other purposes such as monitoring the test pulse outputs, or a false detection may occur.)

[Note] In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig. 2-15 : External emergency stop connection (CR750 controller)

CAUTION Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by refer to Page 42, "2.2.9 Examples of safety measures".
This is a necessary measure in order to ensure safe operation so that the robot can be stopped immediately by pressing the emergency stop switch in the event that the robot malfunctions.

Arrangement of connectors for exclusive input/output signals are shown in Fig. 2-16. The pin assignments of the connectors for exclusive input/output signals are shown in Table 2-3 to Table 2-6.

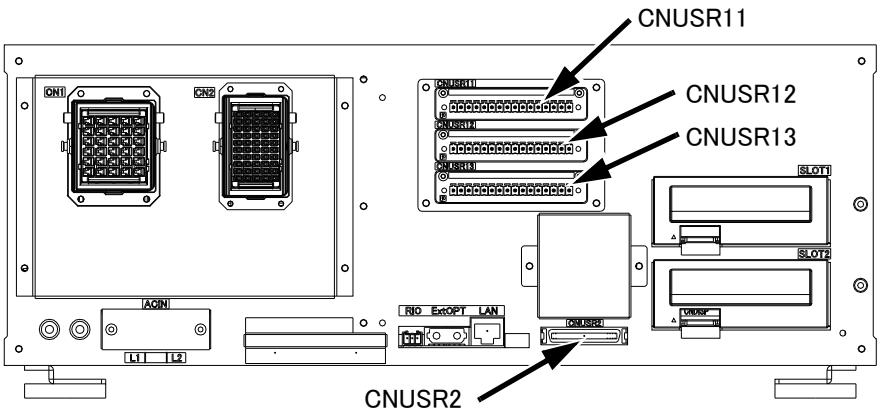


Fig. 2-16 : Arrangement of connectors for exclusive input/output signals

Table 2-3 : Pin assignment (CNUSR11)

Pin No.	Name	Function	Remarks	Pin No.	Name	Function	Remarks
1	EMGIN24V1	Construction of external emergency stop input circuit	Constructing an external emergency stop function. Common pin (SG)	9	24V1 for GRIP	Enabling device connection	Safety measures at teaching. (Servo OFF)
2	EXTEMG11			10	GRIP1		
3	EXTEMG12			11	MODEOUT11	Mode output	Confirming the controller operation mode.
4	EXTEMG13			12	MODEOUT12		
5	EXT-GND1			13	EMGOUT11	Emergency stop output	Confirming the presence/absence of an emergency stop.
6	SG			14	EMGOUT12		
7	24V1 for DOOR	Connection of door switch	Detecting the opening and closing of a door.	15	OPKEY1COM(24V)	Mode key switch input Note1)	Switching an operation mode of a controller.
8	DOOR1			16	OPKEY1		

Note1) The mode key switch input can be used to change the mode of a controller with external command, but never connect the mode key switch input when a key switch on the operation panel is used. When using 15 and 16 pins, the key switch on the operation panel must be set to the MANUAL mode. If the key switch is set to the AUTOMATIC mode, the mode is fixed to AUTOMATIC, which disables the mode selector switch.

Table 2-4 : Pin assignment (CNUSR12)

Pin No.	Name	Function	Remarks	Pin No.	Name	Function	Remarks
1	EMGIN24V2	Construction of external emergency stop input circuit	Constructing an external emergency stop function. Common pin (SG)	9	24V2 for GRIP	Enabling device connection	Safety measures at teaching. (Servo OFF)
2	EXTEMG21			10	GRIP2		
3	EXTEMG22			11	MODEOUT21	Mode output	Confirming the controller operation mode.
4	EXTEMG23			12	MODEOUT22		
5	EXT-GND2			13	EMGOUT21	Emergency stop output	Confirming the presence/absence of an emergency stop.
6	SG			14	EMGOUT22		
7	24V2 for DOOR	Connection of door switch	Detecting the opening and closing of a door.	15	OPKEY2COM(24V)	Mode key switch input Note1)	Switching an operation mode of a controller.
8	DOOR2			16	OPKEY2		

Note1) The mode key switch input can be used to change the mode of a controller with external command, but never connect the mode key switch input when a key switch on the operation panel is used. When using 15 and 16 pins, the key switch on the operation panel must be set to the MANUAL mode. If the key switch is set to the AUTOMATIC mode, the mode is fixed to AUTOMATIC, which disables the mode selector switch.

Table 2-5 : Pin assignment (CNUSR13)

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
1		Reserved		9		Reserved	
2		Reserved		10	LZL1	Z-phase signal – (minus) side of differential encoder CH1	Encoder input of a trucking function CH1 Note2)
3	LAH1	A-phase signal + (plus) side of differential encoder CH1	Encoder input of a trucking function CH1 Note2)	11		Reserved	
4	LAL1	A-phase signal – (minus) side of differential encoder CH1		12		Reserved	
5	LBH1	B-phase signal + (plus) side of differential encoder CH1		13		Reserved	
6	LBL1	B-phase signal – (minus) side of differential encoder CH1		14		Reserved	
7		Reserved		15		Reserved	
8	LZH1	Z-phase signal + (plus) side of differential encoder CH1	Encoder input of a trucking function CH1 Note2)	16		Reserved	

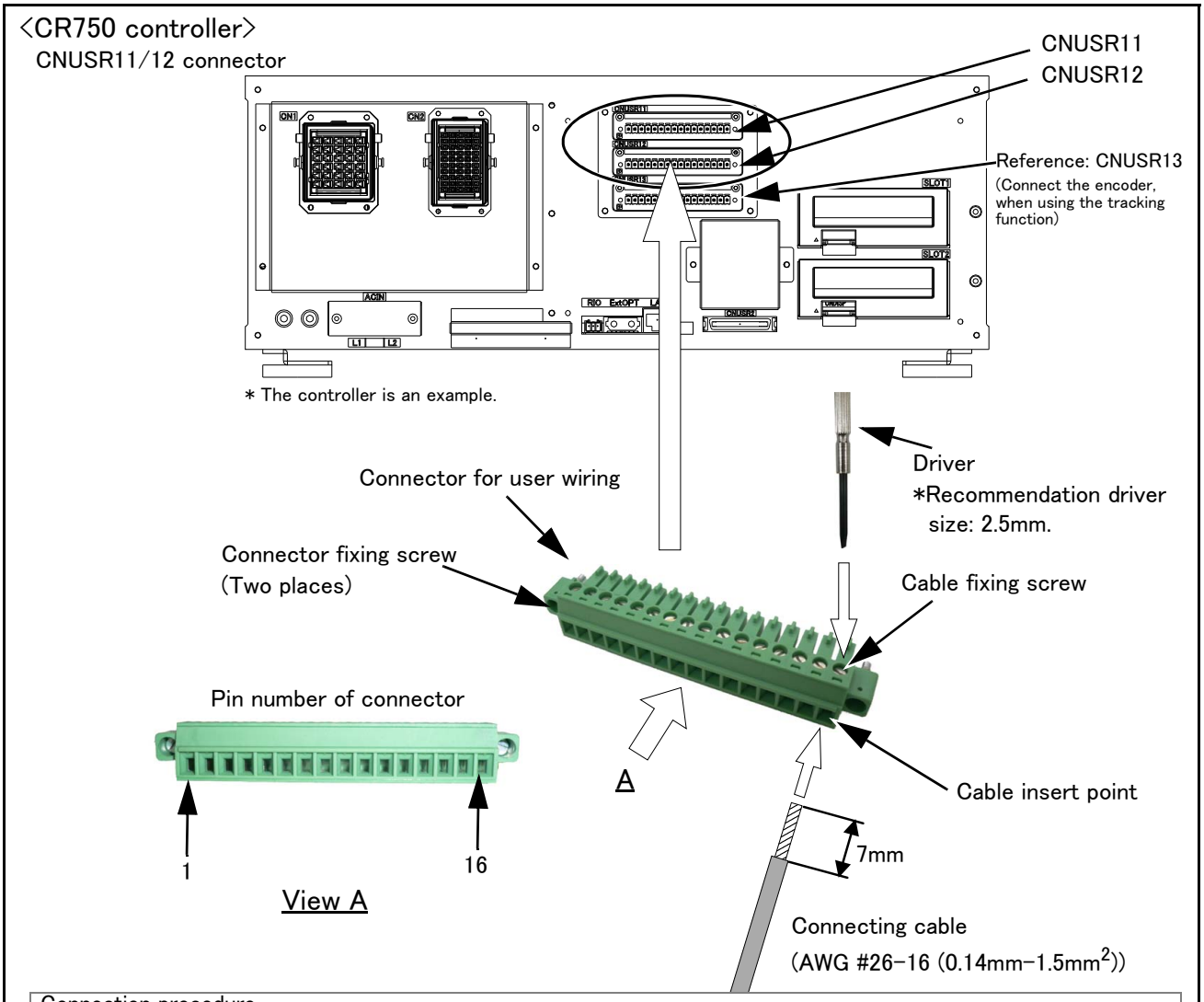
Note1) The reserved pins cannot be used. Do not wire the pins.
Note2) The pin 6 of CNUSR11/12 are used for common line (SG line).

Table 2-6 : Pin assignment (CNUSR2)

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
1	MPI11 (850)	Servo digital input 1		26	MPI14 (851)	Servo digital input 2	
2	MPICOM1	MPI input common (COM)		27	MPI16 (852)	Servo digital input 3	
3		Reserved		28		Reserved	
4		Reserved		29		Reserved	
5		Reserved		30		Reserved	
6		Reserved		31		Reserved	
7		Reserved		32		Reserved	
8		Reserved		33		Reserved	
9	SKIP11	Dedicated stop input common (COM)	This pin and pin 34 is a pair.	34	SKIP12	Dedicated stop input	This pin and pin 9 is a pair.
10	SKIP21	SKIP21 common (COM)	This pin and pin 35 is a pair.	35	SKIP22 (801)	SKIP2 input	This pin and pin 10 is a pair.
11	SKIP31	SKIP31 common (COM)	This pin and pin 36 is a pair.	36	SKIP32 (802)	SKIP3 input	This pin and pin 11 is a pair.
12	SKIP41	SKIP41 common (COM)	This pin and pin 37 is a pair.	37	SKIP42 (803)	SKIP4 input	This pin and pin 12 is a pair.
13		Reserved		38		Reserved	
14		Reserved		39		Reserved	
15	SG	Common pin	Common pin (SG)	40	SG	Common pin	Common pin (SG)
16	ROBOTERR11	Robot error output	This pin and pin 41 is a pair.	41	ROBOTERR12	Robot error output	This pin and pin 16 is a pair.
17	ROBOTERR21	Robot error output	This pin and pin 42 is a pair.	42	ROBOTERR22	Robot error output	This pin and pin 17 is a pair.

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
18		Reserved		43		Reserved	
19	AXMC21	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 44 is a pair.	44	AXMC22	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 19 is a pair.
20	AXMC11	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 45 is a pair.	45	AXMC12	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 20 is a pair.
21	LAH2	A-phase signal + (plus) side of differential encoder CH2	Encoder input of a trucking function CH2	46	LAL2	A-phase signal - (minus) side of differential encoder CH2	Encoder input of a trucking function CH2
22	LBH2	B-phase signal + (plus) side of differential encoder CH2		47	LBL2	B-phase signal - (minus) side of differential encoder CH2	
23	LZH2	Z-phase signal + (plus) side of differential encoder CH2		48	LZL2	Z-phase signal - (minus) side of differential encoder CH2	
24		Reserved		49		Reserved	
25		Reserved		50		Reserved	

Note1) The reserved pins cannot be used. Do not wire the pins.



Connection procedure

Insert the connection cable into the appropriate pin of the user wiring connector that accompanies the product. Fix it securely with a screw and connect the connector to the CNUSR11/CNUSR12 connector at the back of the controller.

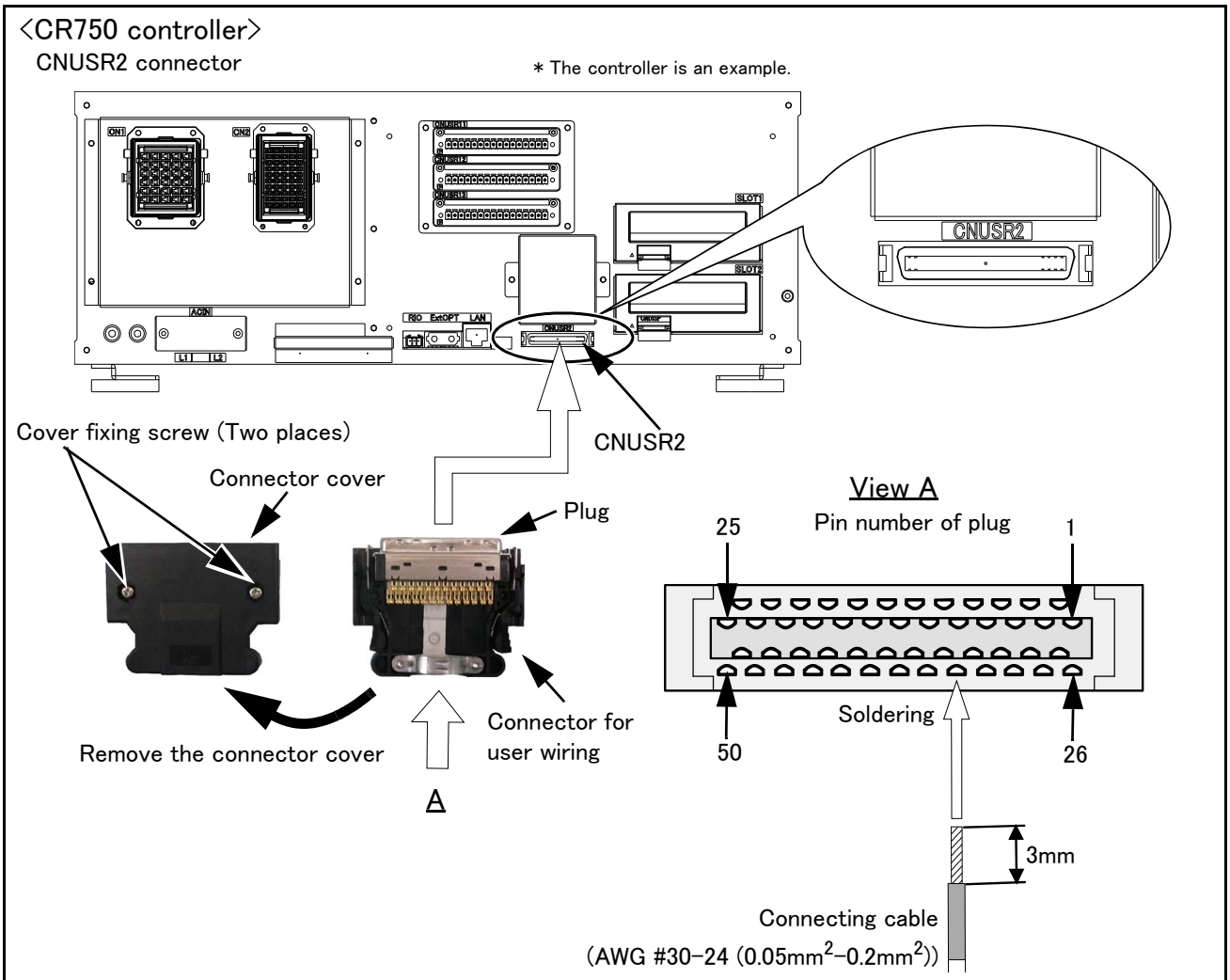
Please use an AWG #26 to 16 (0.14 to 1.5mm^2) connector cable.

1) Prepare the user wiring connector that accompanies the product.
2) Loosen the cable fixing screw at the point where the cable is to be inserted. Please use a screwdriver head with a width of 2.5mm to loosen the screw.
3) Peel the insulation of the connecting cable to 7mm, and insert it into the cable slot of the corresponding connector.
4) Be sure to fix the inserted cable securely by fastening a cable fixing screw. (tightening torque of 0.22 to 0.25Nm)
5) After the necessary cables save been fixed, connect the connector to the connector (CNUSR11/12) that corresponds with the controller. Connect so that the cable fixing screw is comes on top, and make sure to fix securely by fastening connector fixing screws in two places. A screwdriver head with a width of 2.5mm should be used to fix screws (tightening torque of 0.22 to 0.25Nm).

This concludes the connection procedure.

Fig. 2-17 : Method of wiring for external emergency stop connection (CR750 controller (CNUSR11/12))

⚠CAUTION The connector on the controller side that connects to the user wiring connector is CNUSR11 or CNUSR12. Be careful not to connect to CNUSR13 as the robot will not operate properly.



Connection procedure

Solder the pins of the user wiring connector that accompanies the product, and connect the connector to the CNUSR2 connector at the back of the controller. For the connection cables, please use AWG #30 to 24 (0.05 to 0.2mm^2).

1) Loosen the two fixing screws on the user wiring connector that accompanies the product, and remove the connector cover.
2) Peel the insulation of the connecting cable to 3mm, and solder it the appropriate connector pin number.
3) After the necessary cables have been soldered, re-fix the connector cover using the same fixing screws and make sure it is fastened securely.
4) Connect the connector to the corresponding connector (CNUSR2) on the controller. With pin number 1 facing to the upper right, insert firmly until you hear the connector's latch click in to place.

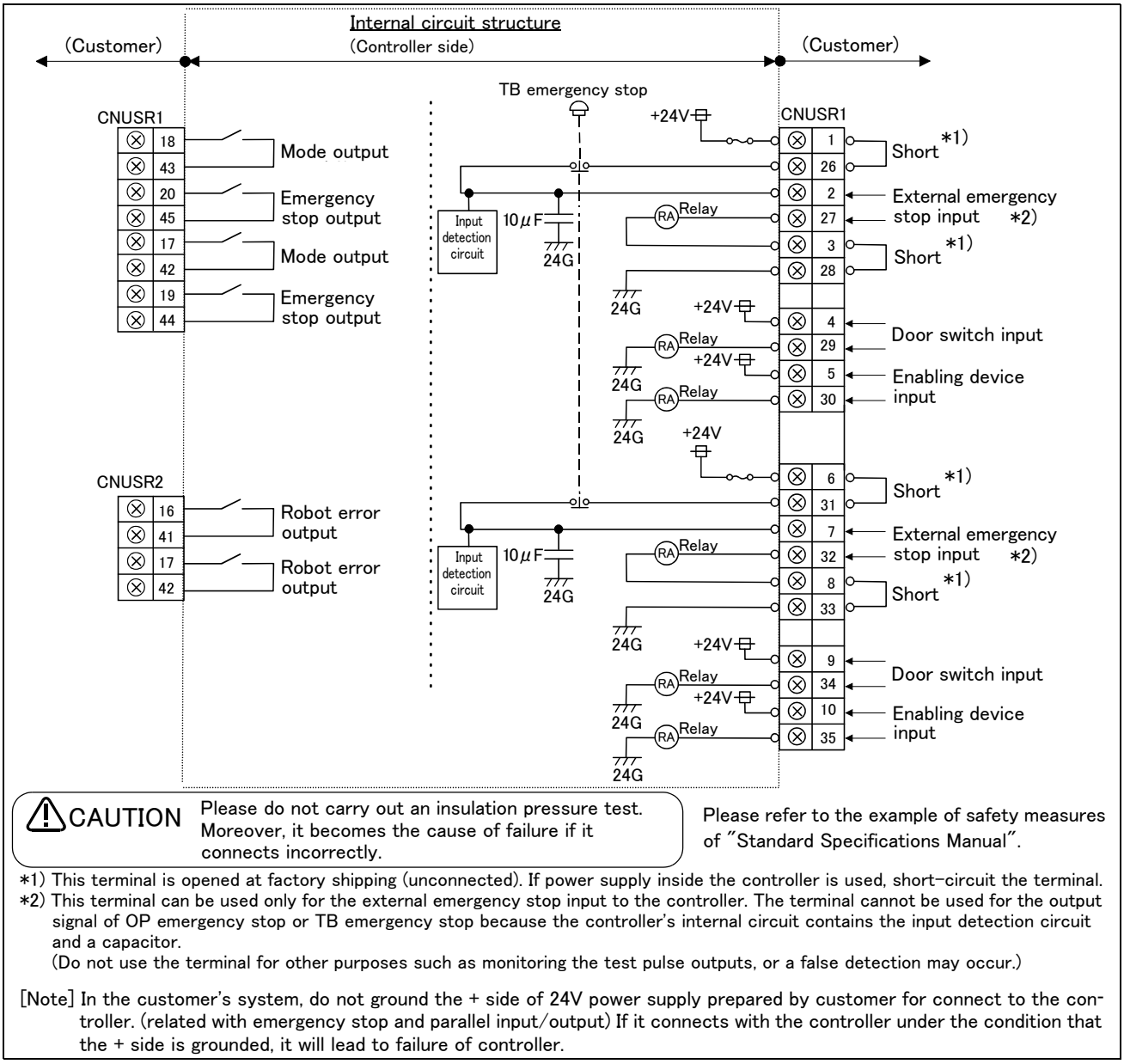
This concludes the connection procedure.

Fig. 2-18 : Method of wiring for external emergency stop connection (CR750 controller (CNUSR2))

⚠CAUTION When soldering please take care to only connect to the specified pin number. Connecting to a different pin number or short-circuiting with another pin will result in the robot breaking down or malfunctioning.

(2) CR751 controller

An example of external emergency stop connection is shown below. Details of arrangement of connectors for exclusive input/output signals and the pin assignments are shown in the following pages.



CAUTION Please do not carry out an insulation pressure test. Moreover, it becomes the cause of failure if it connects incorrectly.

Please refer to the example of safety measures of "Standard Specifications Manual".

*1) This terminal is opened at factory shipping (unconnected). If power supply inside the controller is used, short-circuit the terminal.

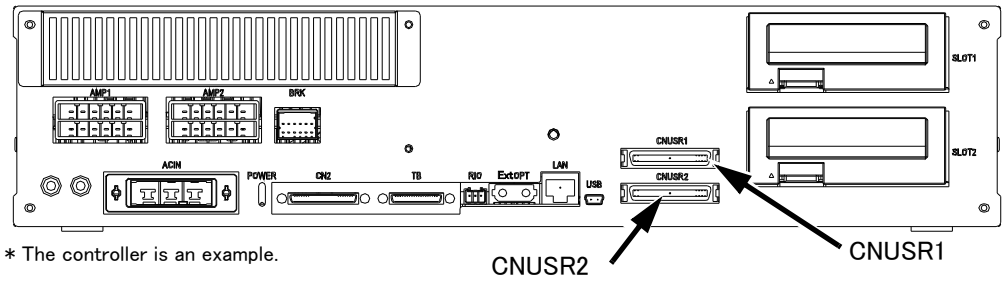
*2) This terminal can be used only for the external emergency stop input to the controller. The terminal cannot be used for the output signal of OP emergency stop or TB emergency stop because the controller's internal circuit contains the input detection circuit and a capacitor.
(Do not use the terminal for other purposes such as monitoring the test pulse outputs, or a false detection may occur.)

[Note] In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig. 2-19 : External emergency stop connection (CR751 controller)

CAUTION Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by referencing Page 42, "2.2.9 Examples of safety measures".
This is a necessary measure in order to ensure safe operation so that the robot can be stopped immediately by pressing the emergency stop switch in the event that the robot malfunctions.

Arrangement of connectors for exclusive input/output signals are shown in Fig. 2-20. The pin assignments of the connectors for exclusive input/output signals are shown in Table 2-7 to Table 2-8.



* The controller is an example.

Fig. 2-20 : Arrangement of connectors for exclusive input/output signals

Table 2-7 : Pin assignment (CNUSR1)

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
1	EMGIN24V1	Construction of external emergency stop input circuit	Constructing an external emergency stop function.	26	EXTEMG11	Construction of external emergency stop input circuit	Constructing an external emergency stop function.
2	EXTEMG12			27	EXTEMG13		
3	EXT-GND1			28	SG		
4	24V1 for DOOR	Connection of door switch	Detecting the opening and closing of a door. This pin and pin 29 is a pair.	29	DOOR1	Connection of door switch	Detecting the opening and closing of a door. This pin and pin 4 is a pair.
5	24V1 for GRIP	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 30 is a pair.	30	GRIP1	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 5 is a pair.
6	EMGIN24V2	Construction of external emergency stop input circuit	Constructing an external emergency stop function.	31	EXTEMG21	Construction of external emergency stop input circuit	Constructing an external emergency stop function.
7	EXTEMG22			32	EXTEMG23		
8	EXT-GND2			33	SG		
9	24V2 for DOOR	Connection of door switch	Detecting the opening and closing of a door. This pin and pin 34 is a pair.	34	DOOR2	Connection of door switch	Detecting the opening and closing of a door. This pin and pin 9 is a pair.
10	24V2 for GRIP	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 35 is a pair.	35	GRIP2	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 10 is a pair.
11		Reserved		36		Reserved	
12		Reserved		37		Reserved	
13		Reserved		38		Reserved	
14		Reserved		39		Reserved	
15		Reserved		40		Reserved	
16		Reserved		41		Reserved	
17	MODEOUT21	Mode output	Confirming the controller operation mode. This pin and pin 42 is a pair.	42	MODEOUT22	Mode output	Confirming the controller operation mode. This pin and pin 17 is a pair.
18	MODEOUT11	Mode output	Confirming the controller operation mode. This pin and pin 43 is a pair.	43	MODEOUT12	Mode output	Confirming the controller operation mode. This pin and pin 18 is a pair.

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
19	EMGOUT21	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 44 is a pair.	44	EMGOUT22	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 19 is a pair.
20	EMGOUT11	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 45 is a pair.	45	EMGOUT12	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 20 is a pair.
21	LAH1	A-phase signal + (plus) side of differential encoder CH1	Encoder input of a trucking function CH1	46	LAL1	A-phase signal – (minus) side of differential encoder CH1	Encoder input of a trucking function CH1
22	LBH1	B-phase signal + (plus) side of differential encoder CH1		47	LBL1	B-phase signal – (minus) side of differential encoder CH1	
23	LZH1	C-phase signal + (plus) side of differential encoder CH1		48	LZL1	C-phase signal – (minus) side of differential encoder CH1	
24	OPKEY1COM(24V) Note2)	Mode key switch input	Switching an operation mode of a controller. This pin and pin 49 is a pair.	49	OPKEY1 Note2)	Mode key switch input	Switching an operation mode of a controller. This pin and pin 24 is a pair.
25	OPKEY2COM(24V) Note2)	Mode key switch input	Switching an operation mode of a controller. This pin and pin 50 is a pair.	50	OPKEY2 Note2)	Mode key switch input	Switching an operation mode of a controller. This pin and pin 25 is a pair.

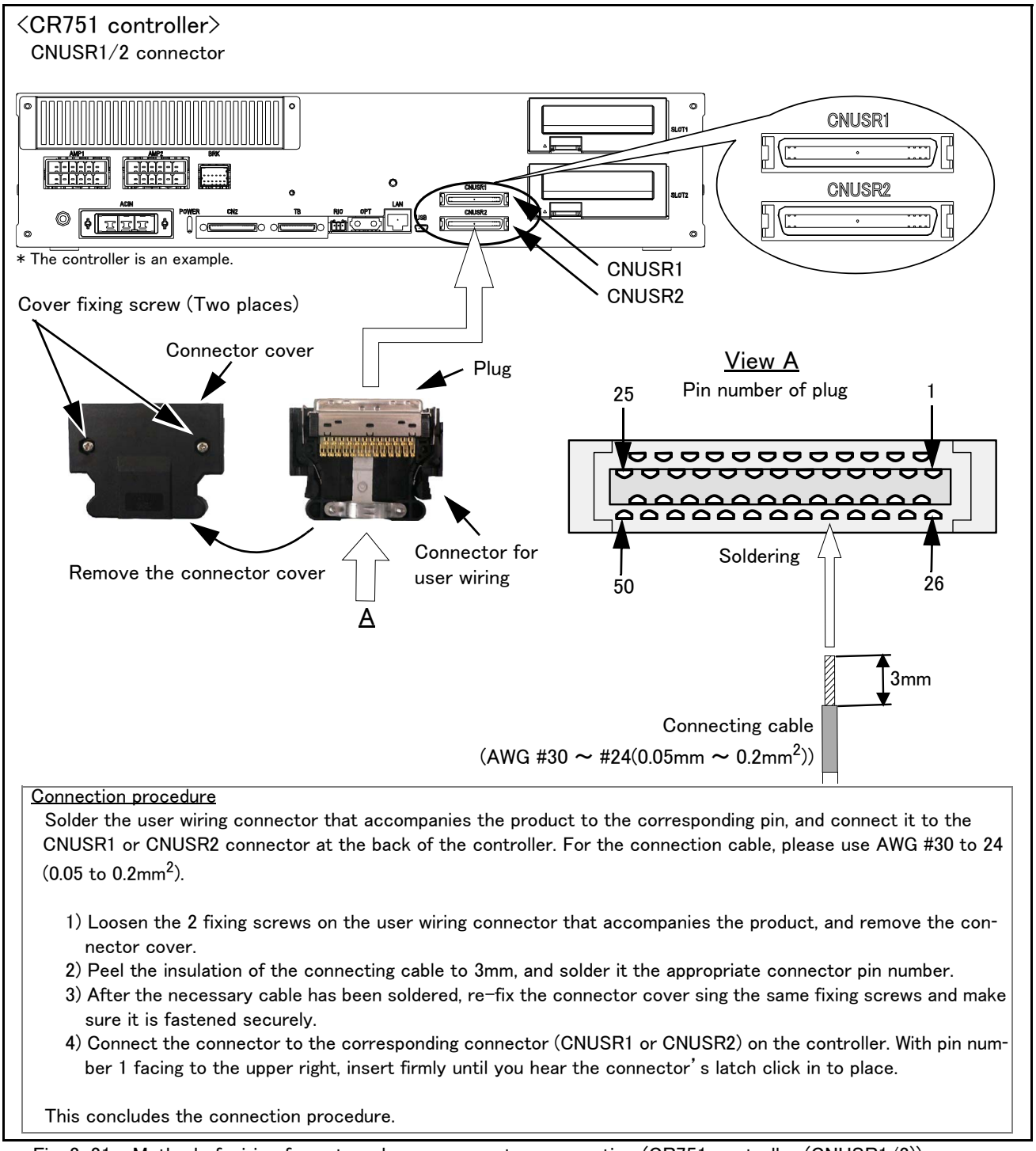
Note1) The reserved pins cannot be used. Do not wire the pins.

Note2) Refer to Page 40, "2.2.8 Mode changeover switch input" about the specifications of mode change over switch input.

Table 2-8 : Pin assignment (CNUSR2)

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
1	MPI11 (850)	Servo digital input 1		26	MPI14 (851)	Servo digital input 2	
2	MPICOM1	MPI input common (COM)		27	MPI16 (852)	Servo digital input 3	
3		Reserved		28		Reserved	
4		Reserved		29		Reserved	
5		Reserved		30		Reserved	
6		Reserved		31		Reserved	
7		Reserved		32		Reserved	
8		Reserved		33		Reserved	
9	SKIP11	Dedicated stop input common (COM)	This pin and pin 34 is a pair.	34	SKIP12	Dedicated stop input common	This pin and pin 9 is a pair.
10	SKIP21	SKIP21 common (COM)	This pin and pin 35 is a pair.	35	SKIP22 (801)	SKIP2 input	This pin and pin 10 is a pair.
11	SKIP31	SKIP31 common (COM)	This pin and pin 36 is a pair.	36	SKIP32 (802)	SKIP3 input	This pin and pin 11 is a pair.
12	SKIP41	SKIP41 common (COM)	This pin and pin 37 is a pair.	37	SKIP42 (803)	SKIP4 input	This pin and pin 12 is a pair.
13		Reserved		38		Reserved	
14		Reserved		39		Reserved	
15	SG	Common pin	Common pin (SG)	40	SG	Common pin	Common pin (SG)
16	ROBOTERR11	Robot error output	This pin and pin 41 is a pair.	41	ROBOTERR12	Robot error output	This pin and pin 16 is a pair.
17	ROBOTERR21	Robot error output	This pin and pin 42 is a pair.	42	ROBOTERR22	Robot error output	This pin and pin 17 is a pair.
18		Reserved		43		Reserved	
19	AXMC21	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 44 is a pair.	44	AXMC22	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 19 is a pair.
20	AXMC11	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 45 is a pair.	45	AXMC12	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 20 is a pair.
21	LAH2	A-phase signal + (plus) side of differential encoder CH2	Encoder input of a trucking function CH2	46	LAL2	A-phase signal - (minus) side of differential encoder CH2	Encoder input of a trucking function CH2
22	LBH2	B-phase signal + (plus) side of differential encoder CH2		47	LBL2	B-phase signal - (minus) side of differential encoder CH2	
23	LZH2	Z-phase signal + (plus) side of differential encoder CH2		48	LZL2	Z-phase signal - (minus) side of differential encoder CH2	
24		Reserved		49		Reserved	
25		Reserved		50		Reserved	

Note1) The reserved pins cannot be used. Do not wire the pins.



Connection procedure

Solder the user wiring connector that accompanies the product to the corresponding pin, and connect it to the CNUSR1 or CNUSR2 connector at the back of the controller. For the connection cable, please use AWG #30 to 24 (0.05 to 0.2mm^2).

1) Loosen the 2 fixing screws on the user wiring connector that accompanies the product, and remove the connector cover.
2) Peel the insulation of the connecting cable to 3mm, and solder it the appropriate connector pin number.
3) After the necessary cable has been soldered, re-fix the connector cover sing the same fixing screws and make sure it is fastened securely.
4) Connect the connector to the corresponding connector (CNUSR1 or CNUSR2) on the controller. With pin number 1 facing to the upper right, insert firmly until you hear the connector's latch click in to place.

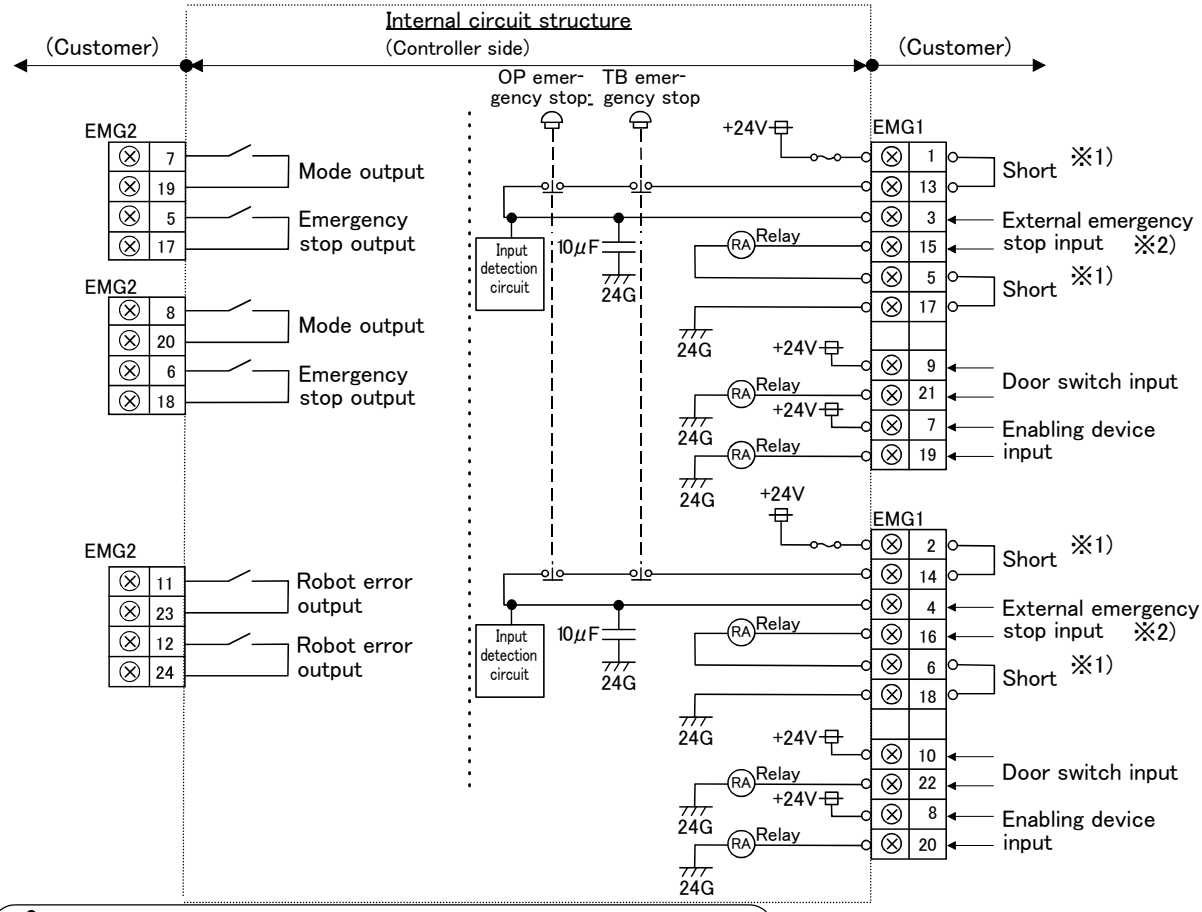
This concludes the connection procedure.

Fig. 2-21 : Method of wiring for external emergency stop connection (CR751 controller (CNUSR1/2))

⚠CAUTION When soldering please take care to only connect to the specified pin number. Connecting to a different pin number or short-circuiting with another pin will result in the robot breaking down or malfunctioning.
The connectors on the controller side are CNUSR1 (upper side) and CNUSR2 (lower side). Makes sure that there is no mistake when connecting to the target connectors. Connecting incorrectly will result in the robot breaking down or malfunctioning.

(3) CR760 controller

An example of external emergency stop connection is shown below. Details of arrangement of connectors for exclusive input/output signals and the pin assignments are shown in the following pages.



CAUTION Please do not carry out an insulation pressure test. Moreover, it becomes the cause of failure if it connects incorrectly.

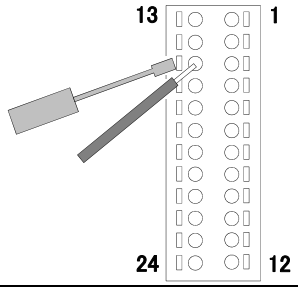
Please refer to the example of safety measures of "Standard Specifications Manual".

*1) This terminal is opened at factory shipping (unconnected). If power supply inside the controller is used, short-circuit the terminal.

*2) This terminal can be used only for the external emergency stop input to the controller. The terminal cannot be used for the output signal of OP emergency stop or TB emergency stop because the controller's internal circuit contains the input detection circuit and a capacitor.
(Do not use the terminal for other purposes such as monitoring the test pulse outputs, or a false detection may occur.)

[Note] In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Wiring method



Peel the sheath of the cable and insert it to the connector directly. Core wires of the cable should be kinked before the cable is used. While pushing the hook inside the tool insertion opening of the connector using a small screwdriver, insert the cable to the back of the cable insertion opening of the connector.

Cable size: AWG#28 ～ AWG#16(0.08mm^2 ～ 1.5mm^2)

[Note] The contact capacity of each input/output terminal is shown below.
DC24V: input 10mA/output 100mA

Fig. 2-22 : External emergency stop connection (CR760)

⚠CAUTION Place the emergency stop switch in an easily operable position, and be sure to wire it to the emergency stop correctly by referencing Page 42, "2.2.9 Examples of safety measures".
This is a necessary measure in order to ensure safe operation so that the robot can be stopped immediately by pressing the emergency stop switch in the event that the robot malfunctions.

⚠CAUTION When connecting the power line to the EMG1 connector, be careful not to cause a short circuit with wires sticking out from adjacent poles. And please do not apply a solder coating to core wires to be inserted in the power line. In some cases solder coating can result in contact failure.

Arrangement of connectors for exclusive input/output signals are shown in Fig. 2-23. The pin assignments of the connectors for exclusive input/output signals are shown in Table 2-9 to Table 2-10.

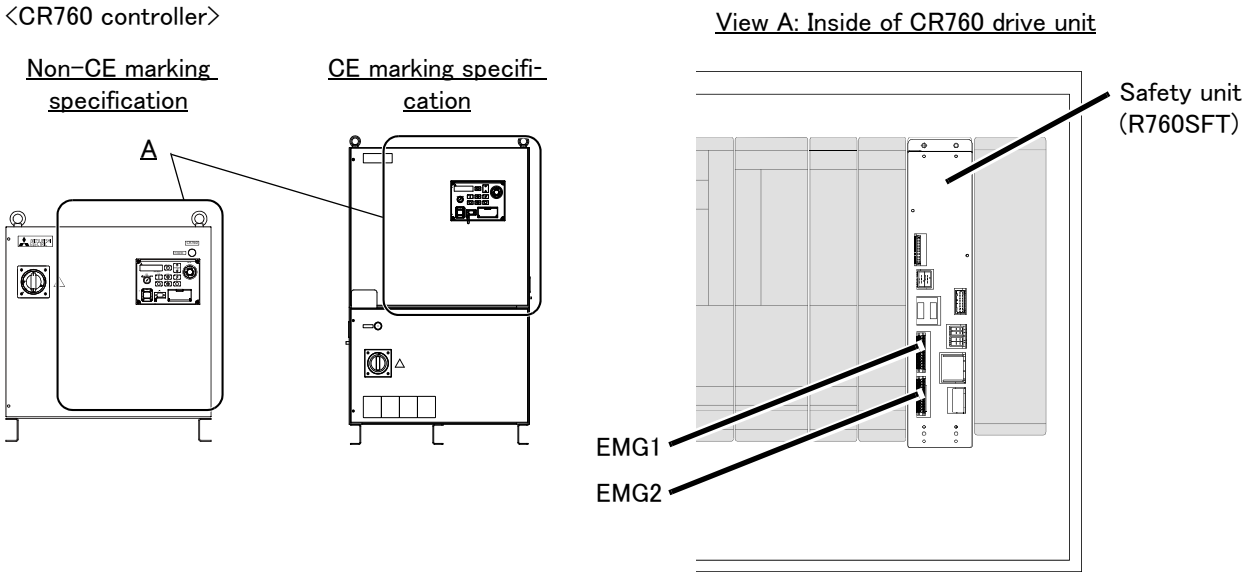


Fig. 2-23 : Arrangement of connectors for exclusive input/output signals

Table 2-9 : Pin assignment (EMG1)

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
1	EMGIN24V1	Construction of external emergency stop input circuit	Constructing an external emergency stop function.	13	EMGIN24V12	Construction of external emergency stop input circuit	Constructing an external emergency stop function.
2	EMGIN24V21			14	EMGIN24V22		
3	EMG11			15	EMG12		
4	EMG21			16	EMG22		
5	EXT-GND1			17	SG		
6	EXT-GND2			18	SG		
7	ENA11	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 19 is a pair.	19	ENA12	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 7 is a pair.
8	ENA21	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 20 is a pair.	20	ENA22	Enabling device connection	Safety measures at teaching (Servo OFF) This pin and pin 8 is a pair.
9	DOOR11	Connection of door switch	Detecting the opening and closing of a door. This pin and pin 21 is a pair.	21	DOOR12	Door switch input	Detecting the opening and closing of a door. This pin and pin 9 is a pair.

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
10	DOOR21	Connection of door switch	Detecting the opening and closing of a door. This pin and pin 22 is a pair.	22	DOOR22	Door switch input	Detecting the opening and closing of a door. This pin and pin 10 is a pair.
11	AXMC11	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 23 is a pair.	23	AXMC12	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 11 is a pair.
12	AXMC21	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 24 is a pair.	24	AXMC22	Magnet contactor control connector output for additional axes	To synchronize an additional axis to a robot's servo ON/OFF. This pin and pin 12 is a pair.

Note1) The reserved pins cannot be used. Do not wire the pins.

Table 2-10 : Pin assignment (EMG2)

Pin No.	Name	Function Note1)	Remarks	Pin No.	Name	Function Note1)	Remarks
1	SKIP11	Dedicated stop input common (COM)	This pin and pin 13 is a pair.	13	SKIP12	Dedicated stop input common	This pin and pin 1 is a pair.
2	SKIP21	SKIP21 common (COM)	This pin and pin 14 is a pair.	14	SKIP22 (801)	SKIP2 input	This pin and pin 2 is a pair.
3	SKIP31	SKIP31 common (COM)	This pin and pin 15 is a pair.	15	SKIP32 (802)	SKIP3 input	This pin and pin 3 is a pair.
4	SKIP41	SKIP41 common (COM)	This pin and pin 16 is a pair.	16	SKIP42 (803)	SKIP4 input	This pin and pin 4 is a pair.
5	EMGOUT11	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 17 is a pair.	17	EMGOUT12	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 5 is a pair.
6	EMGOUT21	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 18 is a pair.	18	EMGOUT22	Emergency stop output	Confirming the presence/absence of an emergency stop. This pin and pin 6 is a pair.
7	MODEOUT11	Mode output	Confirming the controller operation mode. This pin and pin 19 is a pair.	19	MODEOUT11	Mode output	Confirming the controller operation mode. This pin and pin 7 is a pair.
8	MODEOUT21	Mode output	Confirming the controller operation mode. This pin and pin 20 is a pair.	20	MODEOUT21	Mode output	Confirming the controller operation mode. This pin and pin 8 is a pair.
9		Reserved		21		Reserved	
10		Reserved		22		Reserved	
11	ERR11	Robot error output	This pin and pin 23 is a pair.	23	ERR12	Robot error output	This pin and pin 11 is a pair.
12	ERR21	Robot error output	This pin and pin 24 is a pair.	24	ERR22	Robot error output	This pin and pin 12 is a pair.

Note1) The reserved pins cannot be used. Do not wire the pins.

Examples of Safety Measures are shown in Page 42, "2.2.9 Examples of safety measures".

2.2.8 Mode changeover switch input

Connect the key switch of customer prepared and change the right of robot's operation by switch operation.
The key switch can be installed in the operation panel of customer preparation.

<Right of operation (mode)>

AUTOMATIC.....The operation from external equipment becomes available. Operation which needs the right of operation from T/B cannot be performed. It is necessary to set the parameter for the rights of operation to connection with external equipment. Refer to the separate volume, "Instruction Manual/Detailed Explanation of Functions and Operations" for detail.

MANUAL .....When T/B is available, only the operation from T/B becomes available. Operation which needs the right of operation from external equipment cannot be performed.

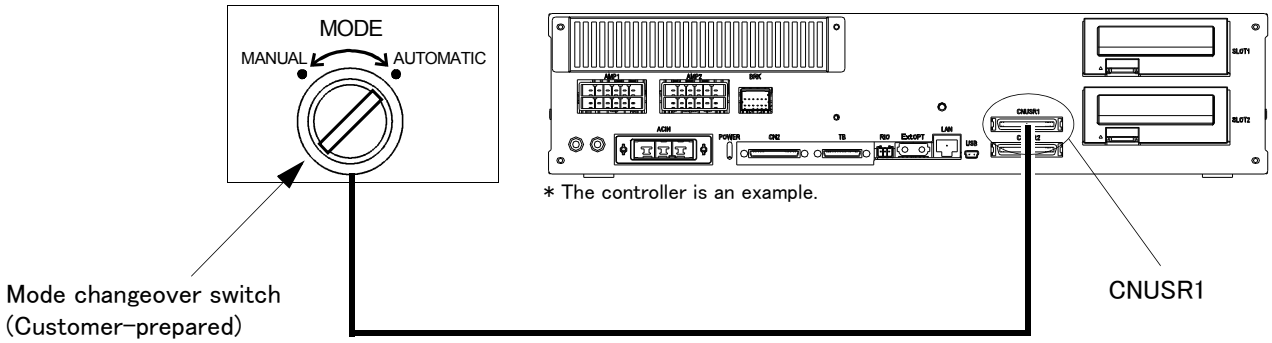


Fig.2-24 : Mode changeover switch image figure (CR751)

(1) Specification of the key switch interface

The function and specification of the key switch interface are shown below.

Table 2-11 : Function of the key switch interface

Pin number and Function (Connector: CNUSR1)		Change mode Note1)	
Pin number	Function	MANUAL	AUTOMATIC
49	1st line KEY input	Open	Close
24	Power supply +24V of pin number 49		
50	2nd line KEY input	Open	Close
25	Power supply +24V of pin number 50		

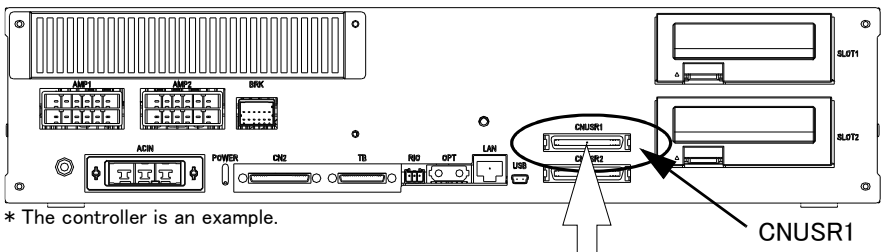
Note1) The mode changes by both opening or both closing between 49-24 pin and between 50-25 pin.
When input states differ between two lines, error H0044 (OP Mode key line is faulty) will occur.

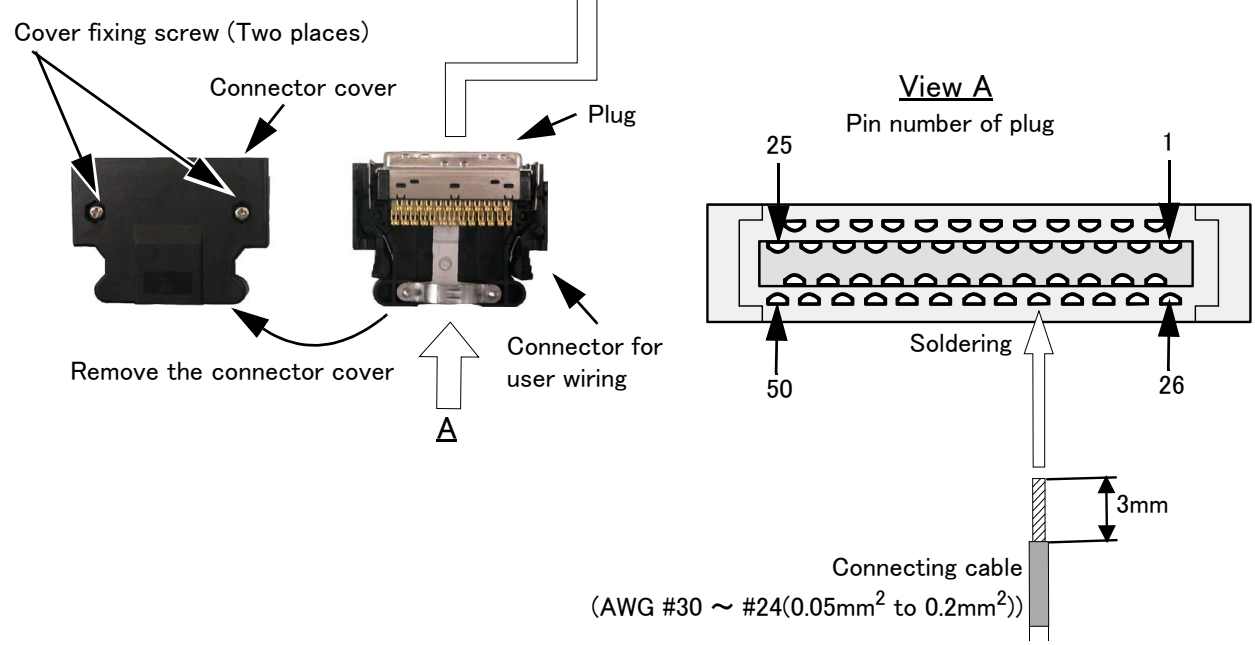
[Note] In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Table 2-12 : Specification of the mode changeover switch input

Item	Specification	Remarks
Rated voltage	DC24V	Supply from the controller.
Current rating	Approx. 10mA	Select the switch or button which operates normally in 24V/10mA.
Input resistance	Approx. 2.2kΩ	
Response time (OFF->ON)	Approx. 15ms	Example: The response time the program starts, after pushing the run button.
Common method	1 point per common	
Connection method	Connector	
Conformity electric wire size	AWG#24 to #18	0.2 to 0.75mm^2
Maker/Type	-	Maker: PHOENIX CONTACT/ Type: FKC2.5/4-STF-5.0B

(2) Connection of the mode changeover switch input





Connection procedure

Solder the user wiring connector that accompanies the product to the corresponding pin, and connect it to the CNUSR1 connector at the back of the controller. For the connection cable, please use AWG #30 to 24 (0.05 to 0.2mm^2).

1) Loosen the 2 fixing screws on the user wiring connector that accompanies the product, and remove the connector cover.
2) Peel the insulation of the connecting cable to 3mm, and solder it the appropriate connector pin number.
3) After the necessary cable has been soldered, re-fix the connector cover sing the same fixing screws and make sure it is fastened securely.
4) Connect the connector to the corresponding connector (CNUSR1) on the controller. With pin number 1 facing to the upper right, insert firmly until you hear the connector's latch click in to place.

This concludes the connection procedure.

Fig.2-25 : Connection of the mode changeover switch input (CR751)

2.2.9 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 57, "(4) External emergency stop connection [supplementary explanation]" and Page 23, "2.2.7 Connecting the external emergency stop".

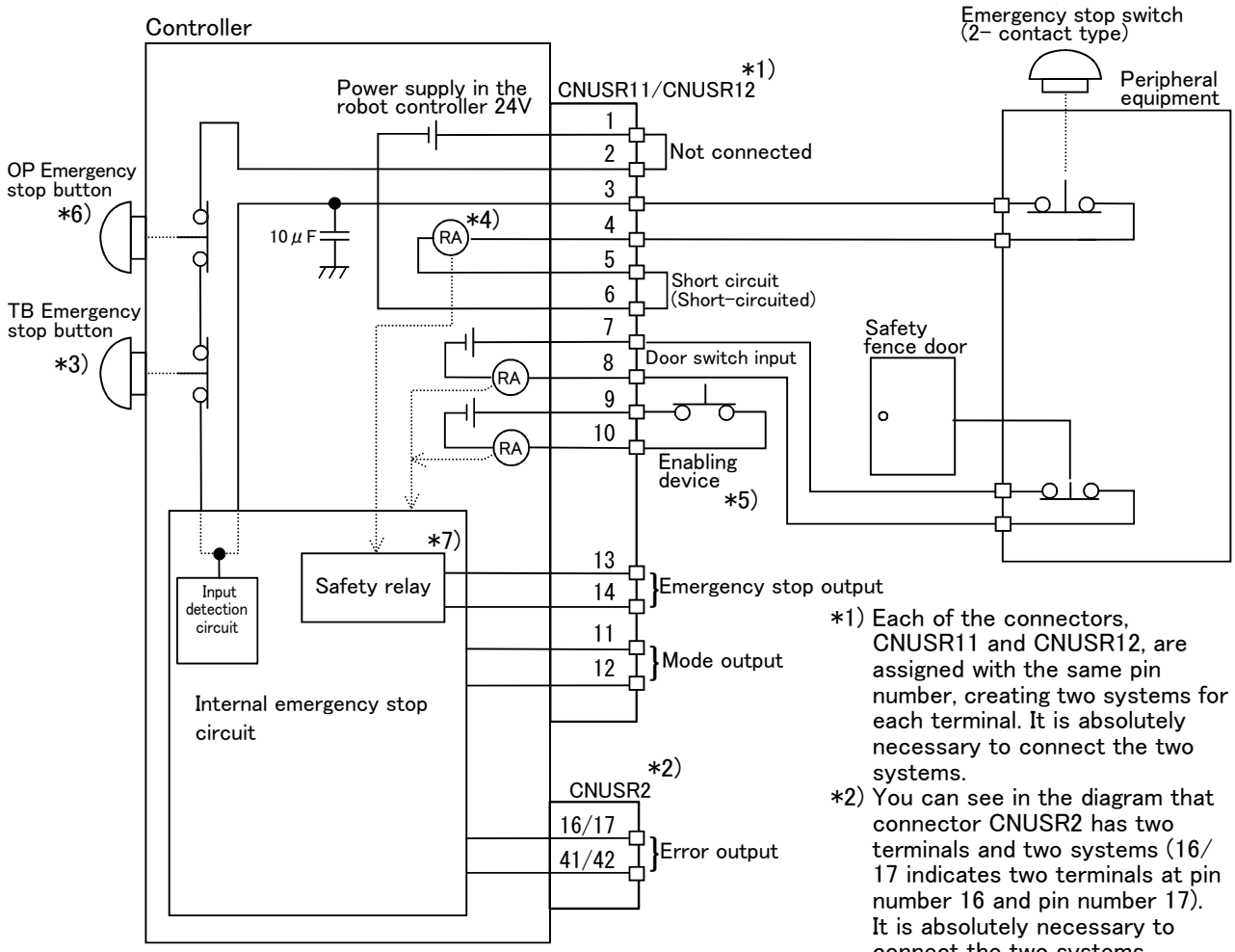
[Note] ・In the emergency-stop related wiring by the customer, if the coil (is not the contact points) of the relay prepared by the customer is connected to the controller, please be sure to implement the measure against the noise by the customer in the coil section. And, please also take the lifetime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

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

・In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

(1) CR750 controller

<Wiring example 1>: Connect the emergency stop switch of peripheral equipment to the controller.
The power supply for emergency stop input uses the power supply in the 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.



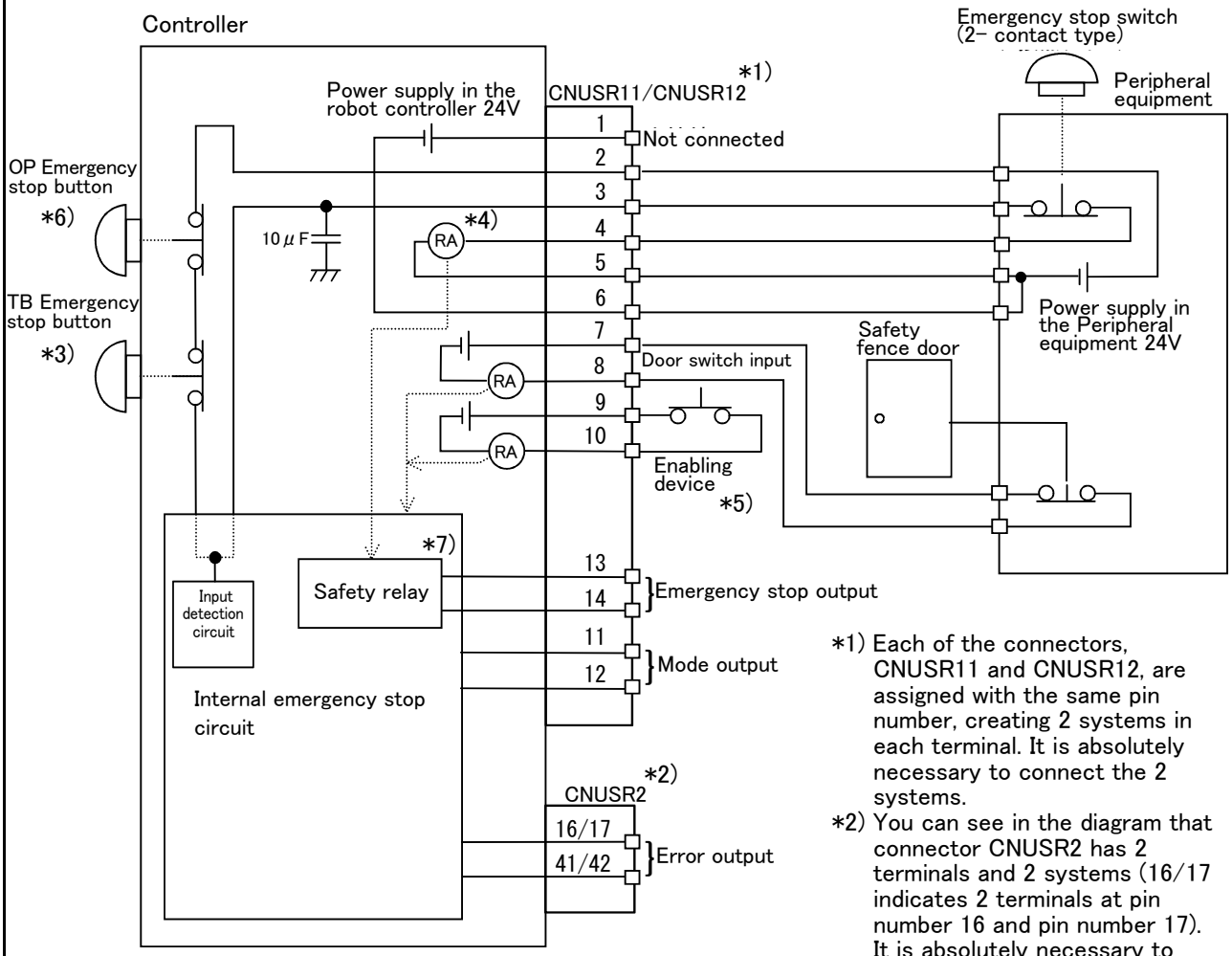
*1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.

*2) You can see in the diagram that connector CNUSR2 has two terminals and two systems (16/17 indicates two terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the two systems.

*3) The T/B emergency stop button connected with the controller.
*4) Emergency stop input relay.
*5) Refer to the Standard specification manual or Special specification manualfor the enabling device.
*6) The emergency stop button of the robot controller. (Only specification with the operation panel.)
*7) The emergency stop input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.2-26 : Example of safety measures (Wiring example 1)

<Wiring example 2>: Connect the emergency stop switch of peripheral equipment to the 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) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.

*2) You can see in the diagram that connector CNUSR2 has 2 terminals and 2 systems (16/17 indicates 2 terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the 2 systems.

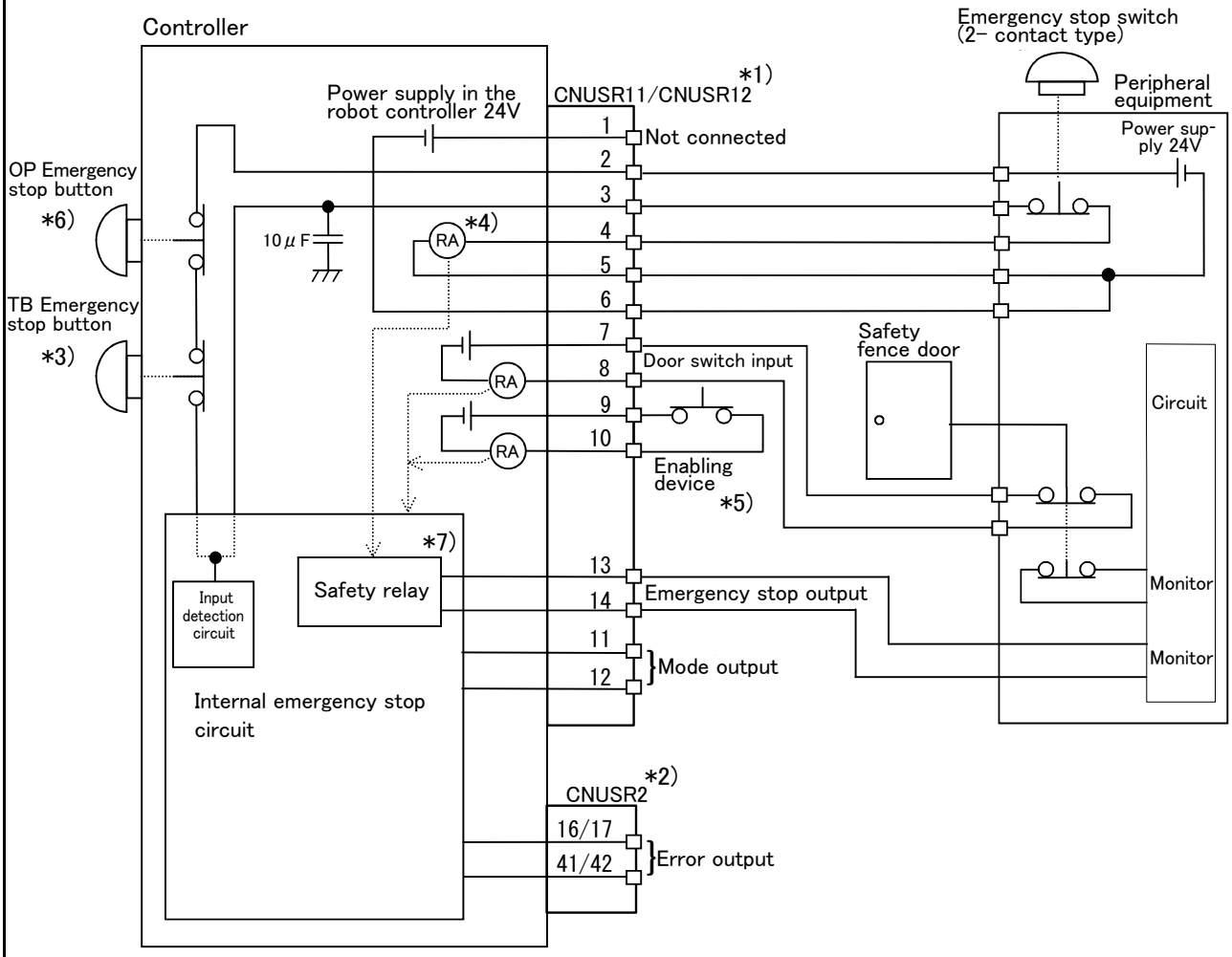
*3) The T/B emergency stop button connected with the controller.
*4) Emergency stop input relay.
*5) Refer to the Standard specification manual or the Special specification manual for the enabling device.
*6) The emergency stop button of the robot controller.
(Only specification with the operation panel.)
*7) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.2-27 : 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 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 controller OFF, peripheral equipment state can be the emergency stop also.



*1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.

*2) You can see in the diagram that connector CNUSR2 has 2 terminals and 2 systems (16/17 indicates 2 terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the 2 systems.

*3)The T/B emergency stop button connected with the controller.

*4) Emergency stop input relay.

*5) Refer to the Standard specification manual or the Special specification manual for the enabling device.

*6) The emergency stop button of the robot controller.
(Only specification with the operation panel.)

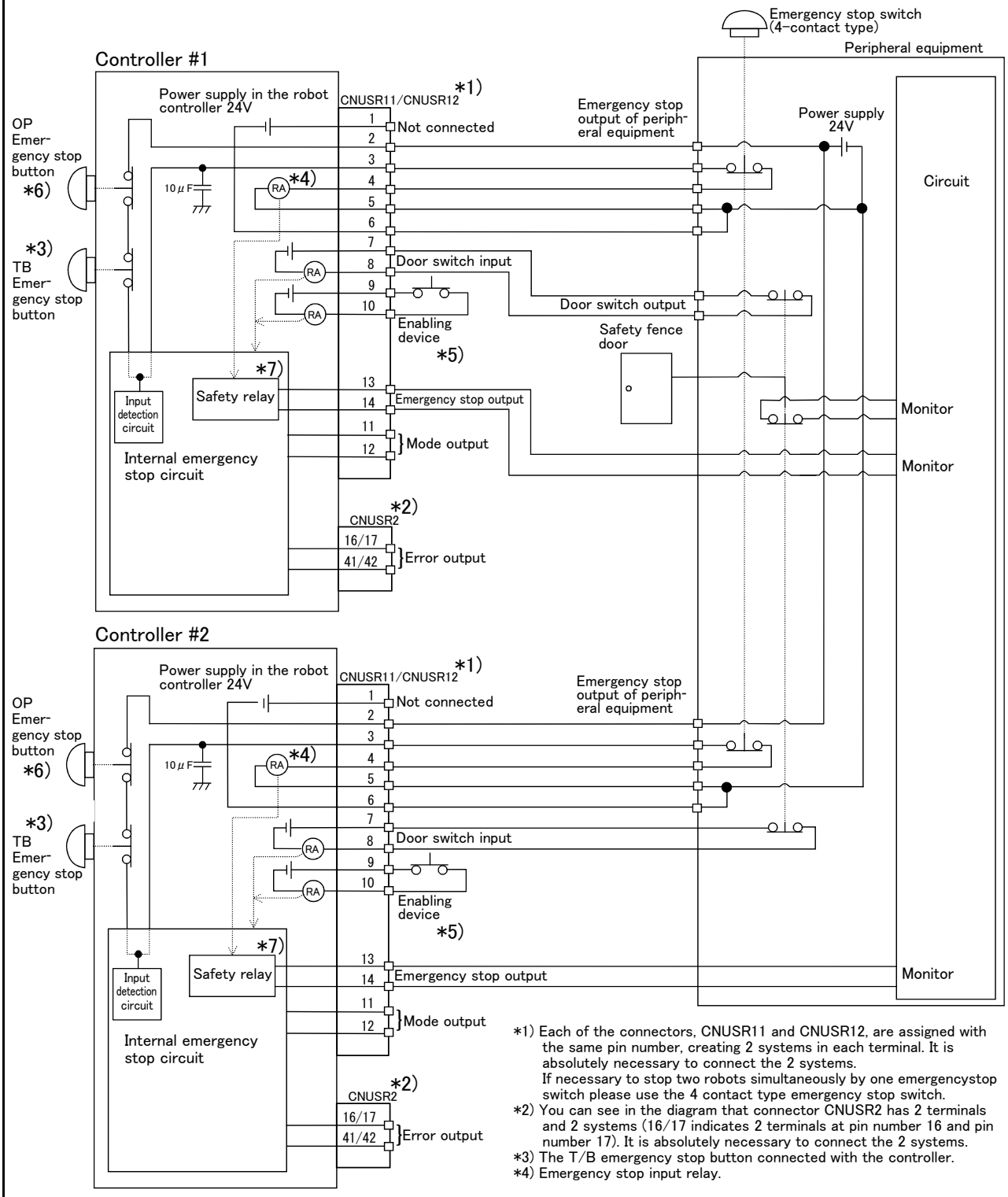
*7) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.2-28 : Example of safety measures (Wiring example 3)

<Wiring example 4>: Connect the emergency stop switch of peripheral equipment, and the door switch to two 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 controller OFF, peripheral equipment state can be the emergency stop also.



*1) Each of the connectors, CNUSR11 and CNUSR12, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
If necessary to stop two robots simultaneously by one emergencystop switch please use the 4 contact type emergency stop switch.

*2) You can see in the diagram that connector CNUSR2 has 2 terminals and 2 systems (16/17 indicates 2 terminals at pin number 16 and pin number 17). It is absolutely necessary to connect the 2 systems.

*3) The T/B emergency stop button connected with the controller.

*4) Emergency stop input relay.

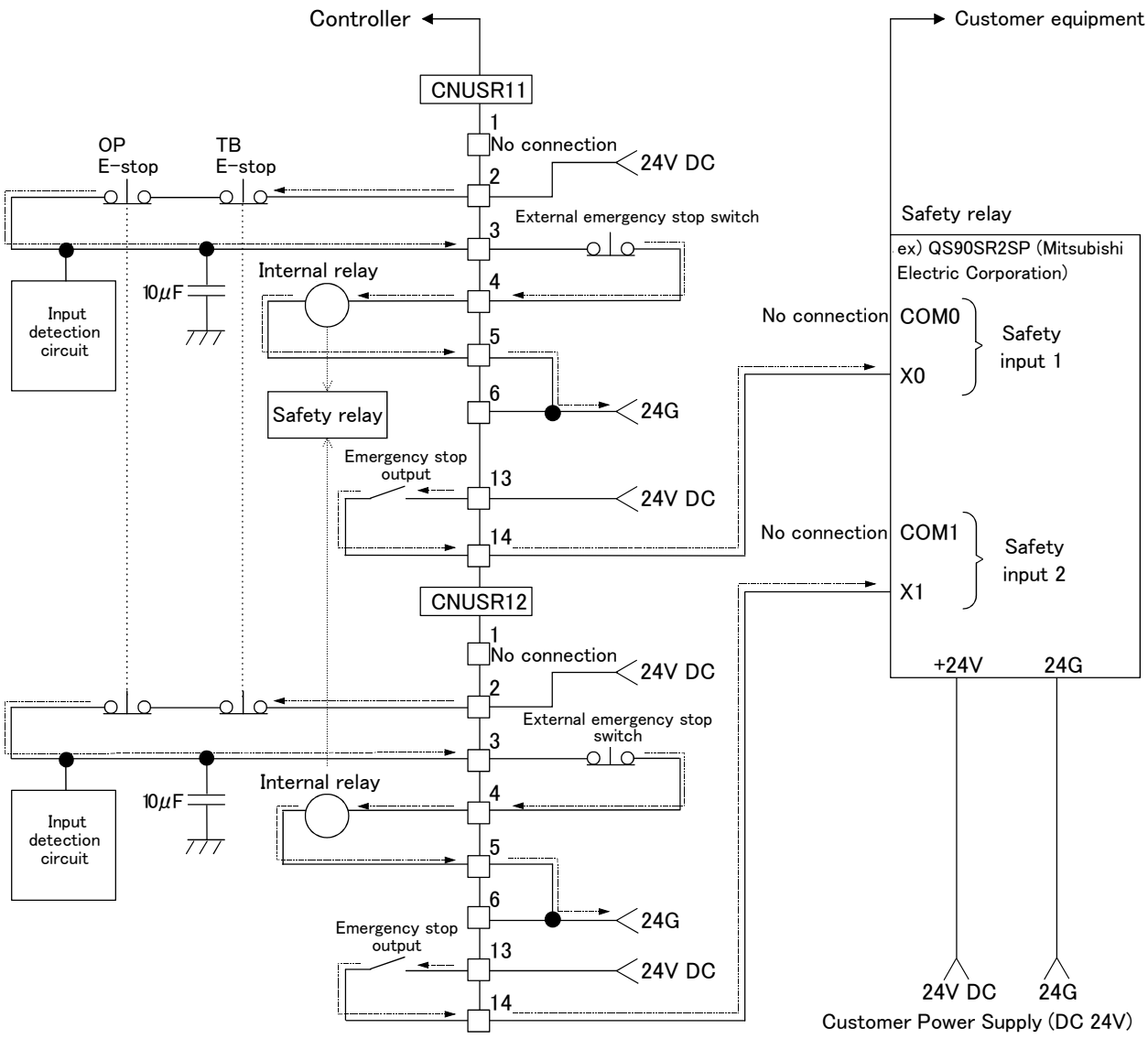
*5) Refer to the Standard specification manual or the Special specification manual for the enabling device.

*6) The emergency stop button of the robot controller. (Only specification with the operation panel.)

*7) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.2-29 : Example of safety measures (Wiring example 4)

<Wiring example 5>: Connect the controller to the safety relay
Use the controller's emergency stop button command as an input to the safety relay.



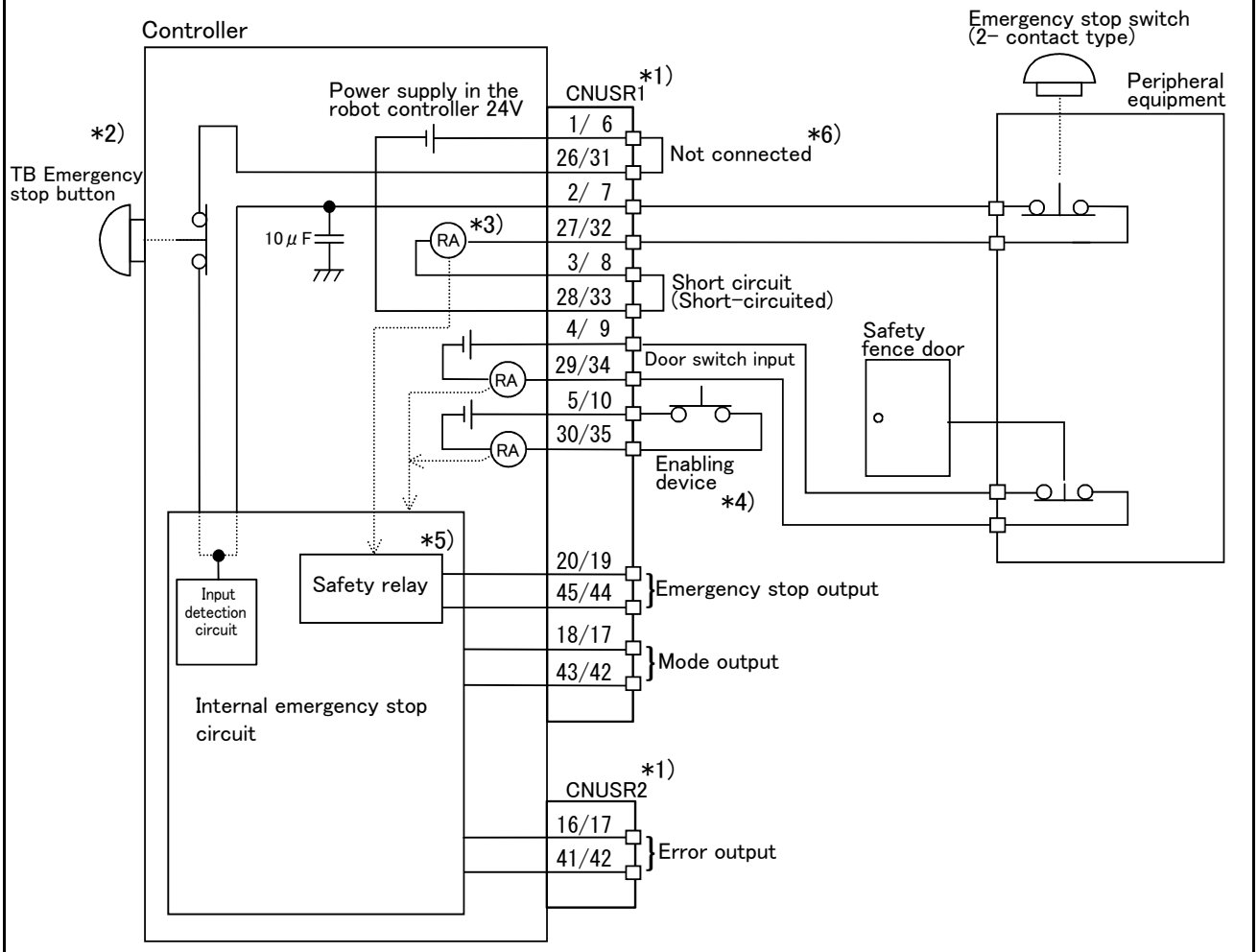
[Caution]

1) This product has category 3 functionality and therefore the robot's whole unit cannot be set to category 4.
2) The controller's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for emergency stop button output when using user equipment. Connect the positive side of the user equipment (24V DC) to the terminal 2 of CNUSR11/12, then connect the emergency stop button (or contact points) in the user equipment to across the terminals 3 and 4 of CNUSR11/12, and ultimately connect the negative side (24G).
3) When installing a safety relay to use it as an input point of the controller's emergency stop button command, use a safety relay that is activated by an input from one of the two systems (i.e. QS90SR2SP (Manufacture: Mitsubishi Electric Corporation)).
4) The emergency stop input detection relay (internal relay) uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
5) When connecting emergency stop button output to an external safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly, this function will not operate correctly. Please connect the terminal 13 of CNUSR11/12 to 24V.

Fig.2-30 : Example of safety measures (Wiring example 5)

(2) CR751 controller

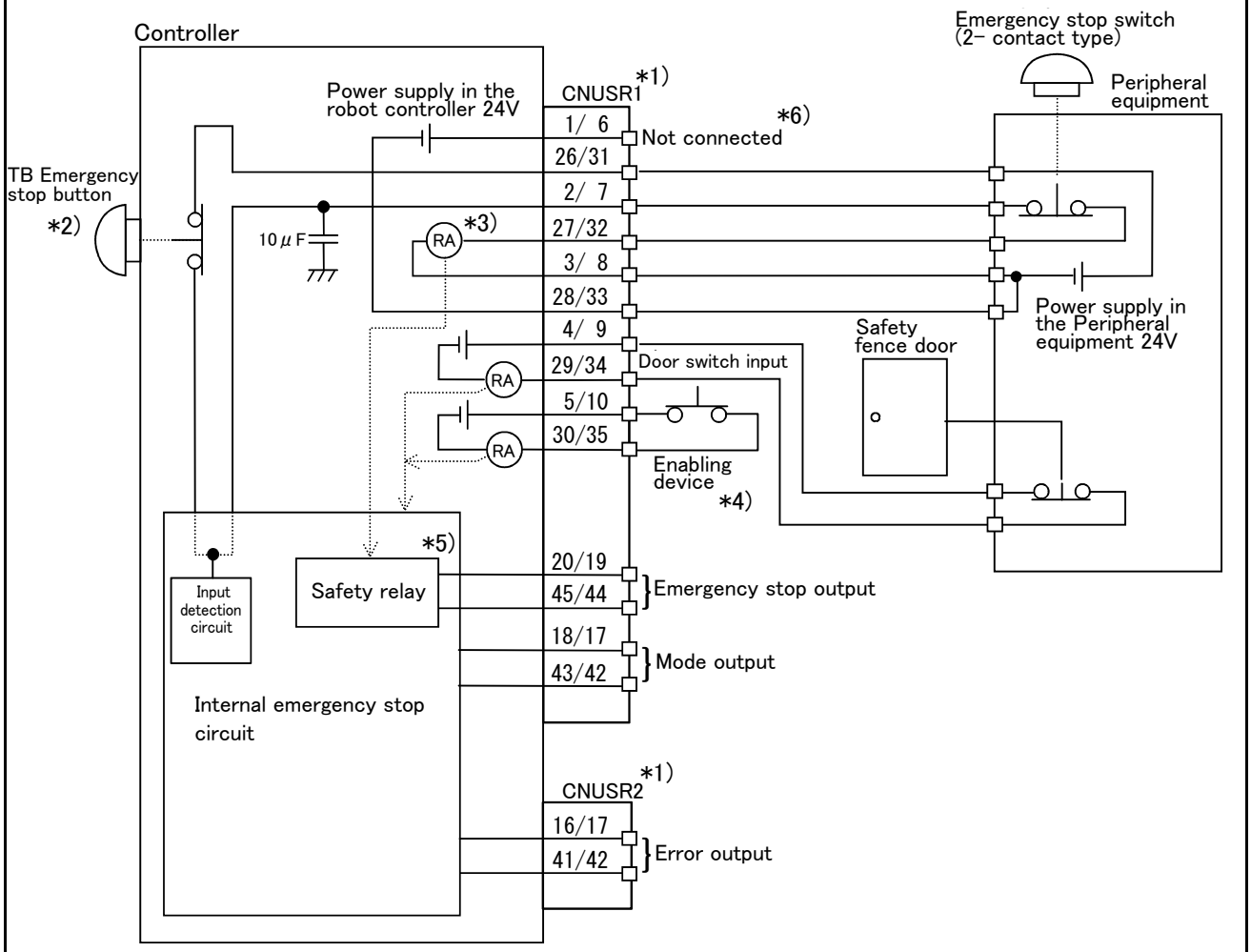
<Wiring example 1>: Connect the emergency stop switch of peripheral equipment to the controller.
The power supply for emergency stop input uses the power supply in the controller.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be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



*1) Each of the connectors, CNUSR1 and CNUSR2, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
*2) The T/B emergency stop button connected with the controller.
*3) Emergency stop input relay.
*4) Refer to the Standard specification manual or the Special specification manual for the enabling device.
*5) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.2-31 : Example of safety measures (Wiring example 1)

<Wiring example 2>: Connect the emergency stop switch of peripheral equipment to the 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.



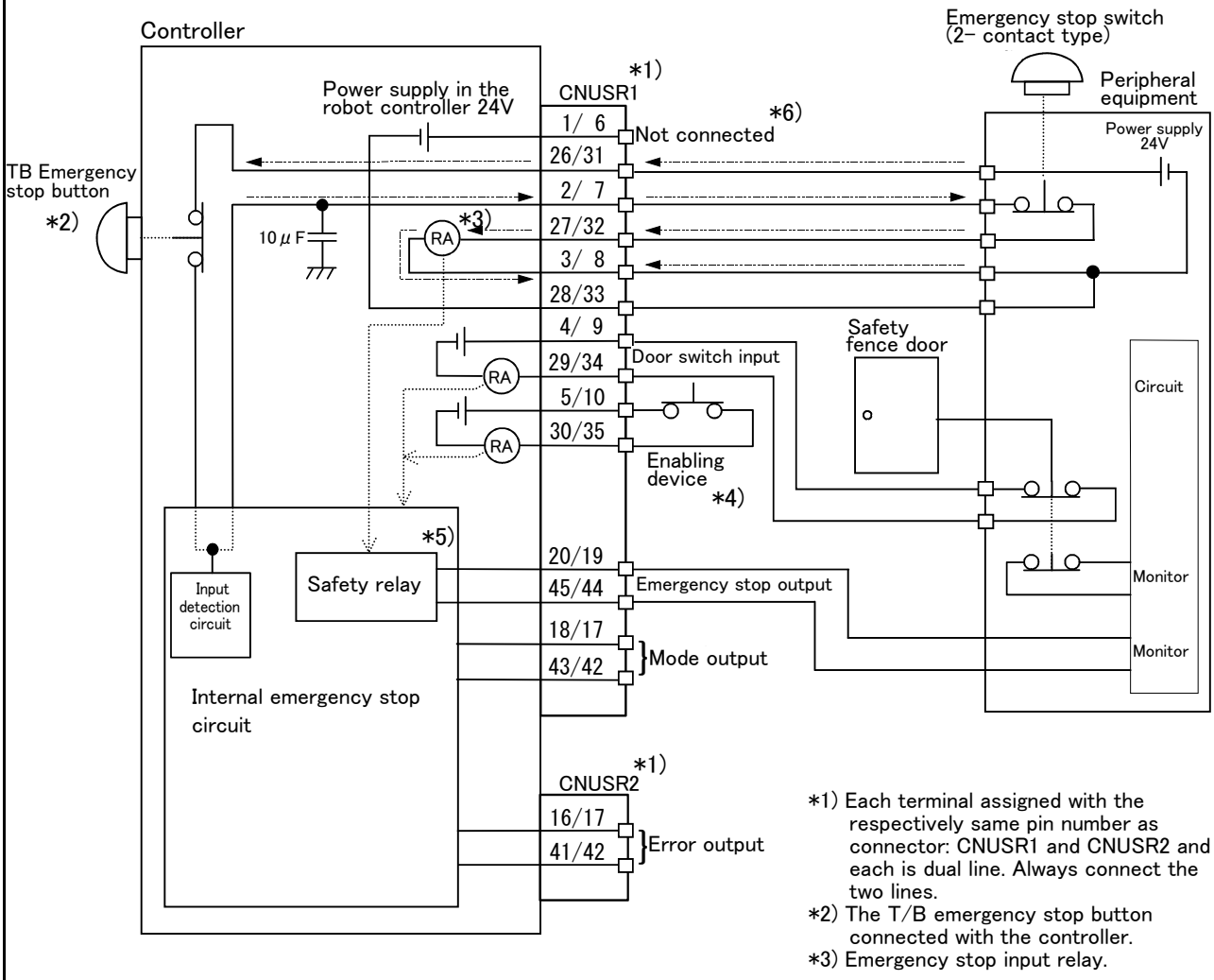
*1) Each of the connectors, CNUSR1 and CNUSR2, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
*2) The T/B emergency stop button connected with the controller.
*3) Emergency stop input relay.
*4) Refer to the Standard specification manual or the Special specification manual for the enabling device.
*5) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
*6) Connect the 24V power supply to 26/31 terminals.

Fig.2-32 : 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 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 controller OFF, peripheral equipment state can be the emergency stop also.



*1) Each terminal assigned with the respectively same pin number as connector: CNUSR1 and CNUSR2 and each is dual line. Always connect the two lines.

*2) The T/B emergency stop button connected with the controller.

*3) Emergency stop input relay.

*4) Refer to the Standard specification manual or the Special specification manual for the enabling device.

*5) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

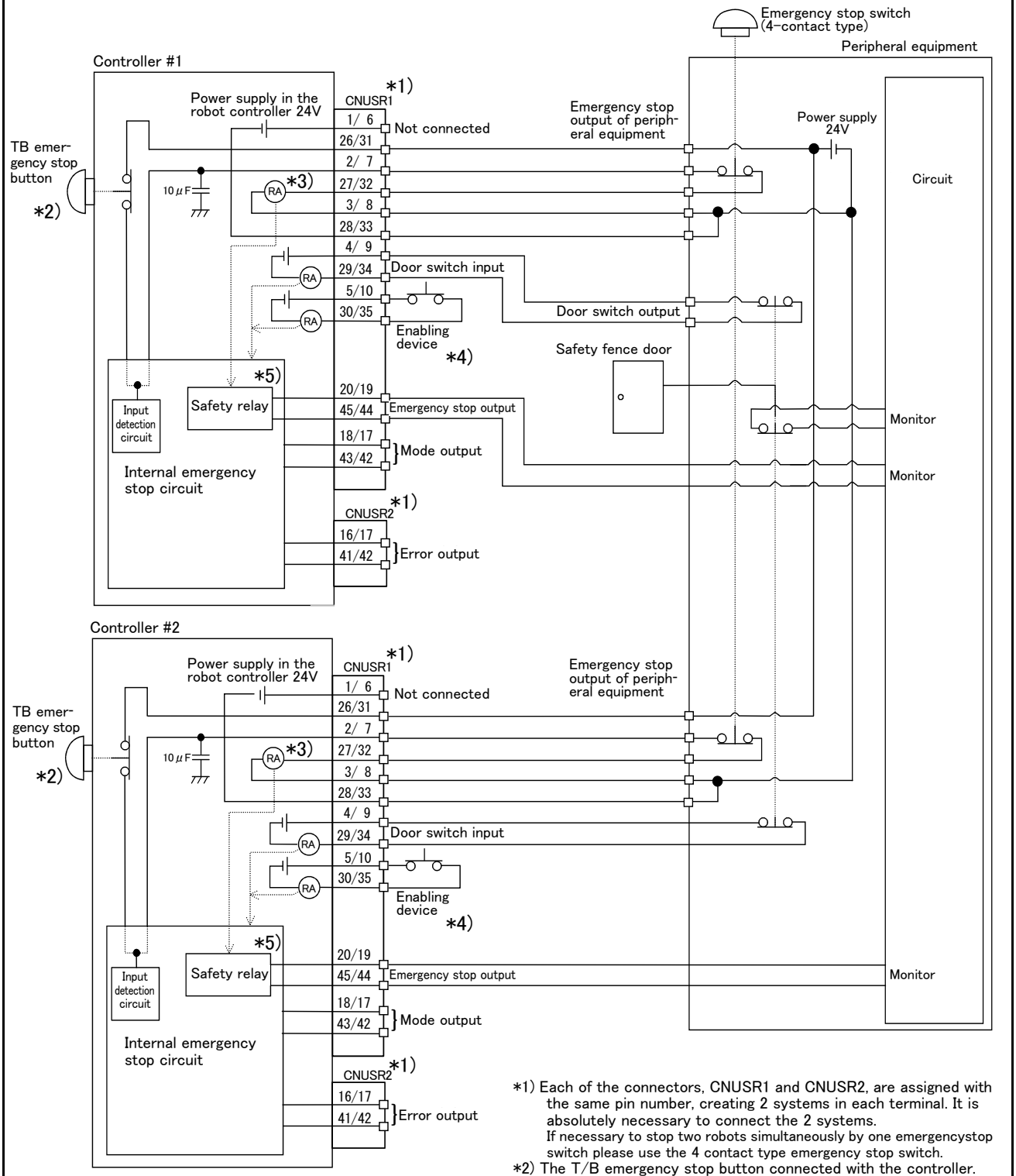
*6) When using emergency stop button output function, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity of the circuit is wrong, the emergency stop button output may not work properly. Please connect the 24V power supply to 26/31 terminals.

Fig.2-33 : Example of safety measures (Wiring example 3)

<Wiring example 4>: Connect the emergency stop switch of peripheral equipment, and the door switch to two 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 controller OFF, peripheral equipment state can be the emergency stop also.



*1) Each of the connectors, CNUSR1 and CNUSR2, are assigned with the same pin number, creating 2 systems in each terminal. It is absolutely necessary to connect the 2 systems.
If necessary to stop two robots simultaneously by one emergencystop switch please use the 4 contact type emergency stop switch.

*2) The T/B emergency stop button connected with the controller.

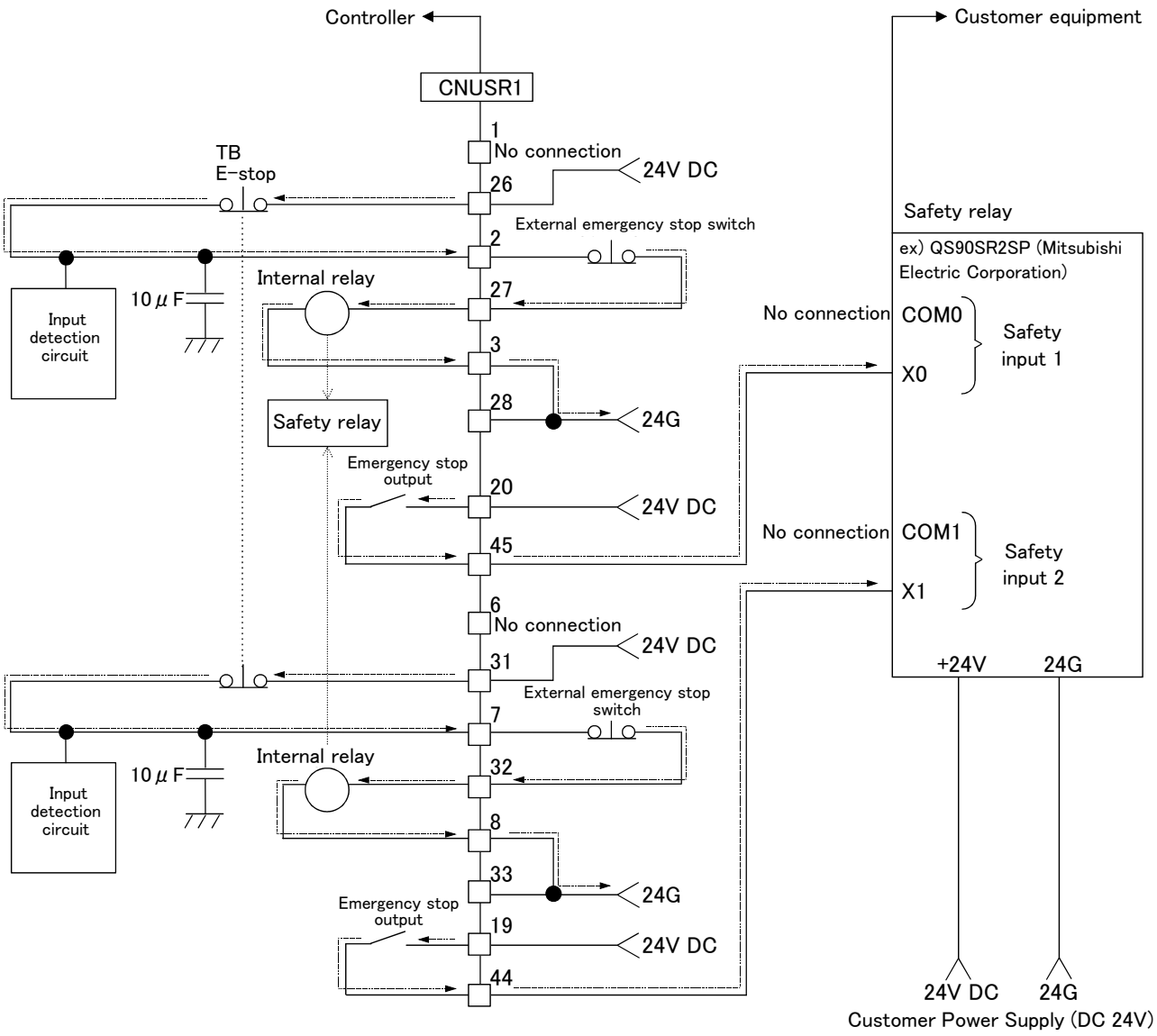
*3) Emergency stop input relay.

*4) Refer to the Standard specification manual or the Special specification manual for the enabling device.

*5) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.2-34 : Example of safety measures (Wiring example 4)

<Wiring example 5>: Connect the controller to the safety relay
Use the controller's emergency stop button to input safety relay.



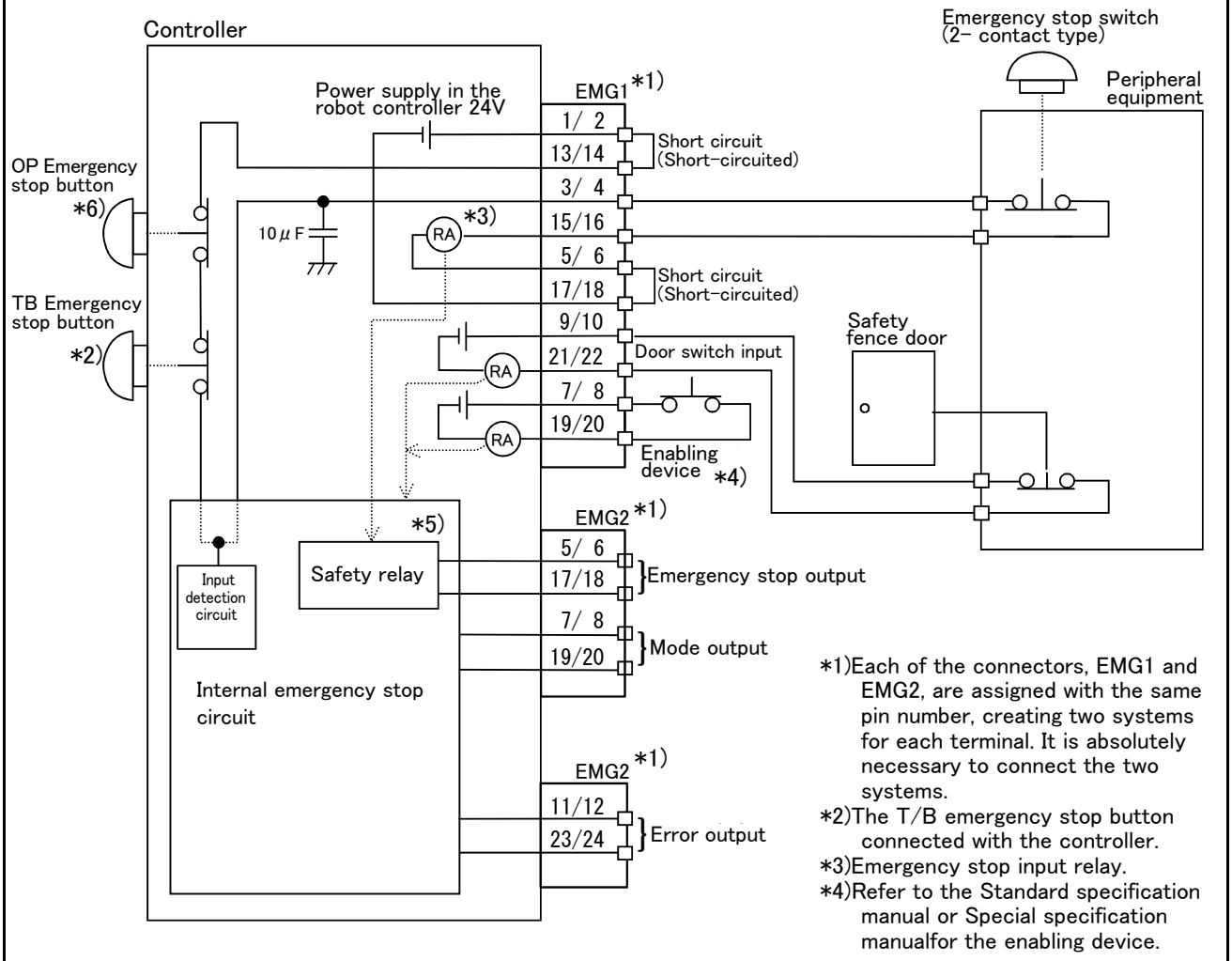
[Caution]

1) This product has category 3 functionality and therefore the robot's whole unit cannot be set to category 4.
2) The controller's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for emergency stop button output when using user equipment. Connect the positive side of the user equipment (24V DC) to the two terminals 26/31, then connect the emergency stop button (or contact points) in the user equipment to the 2-27 and 7-32 terminals, and ultimately connect to the negative side (24G).
3) Setup a safety relay on the user equipment, and when using to input the emergency stop button on the controller, please only use a safety relay that functions when connecting the input to the one end of the 2 systems (i.e. QS90SR2SP (Manufacture: Mitsubishi Electric Corporation)).
4) The emergency stop input detection relay (internal relay) uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
5) When connecting emergency stop button output to an exterior safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly this function will not operate correctly. Please connect 20/19 terminal to 24V.

Fig.2-35 : Example of safety measures (Wiring example 5)

(3) CR760 controller

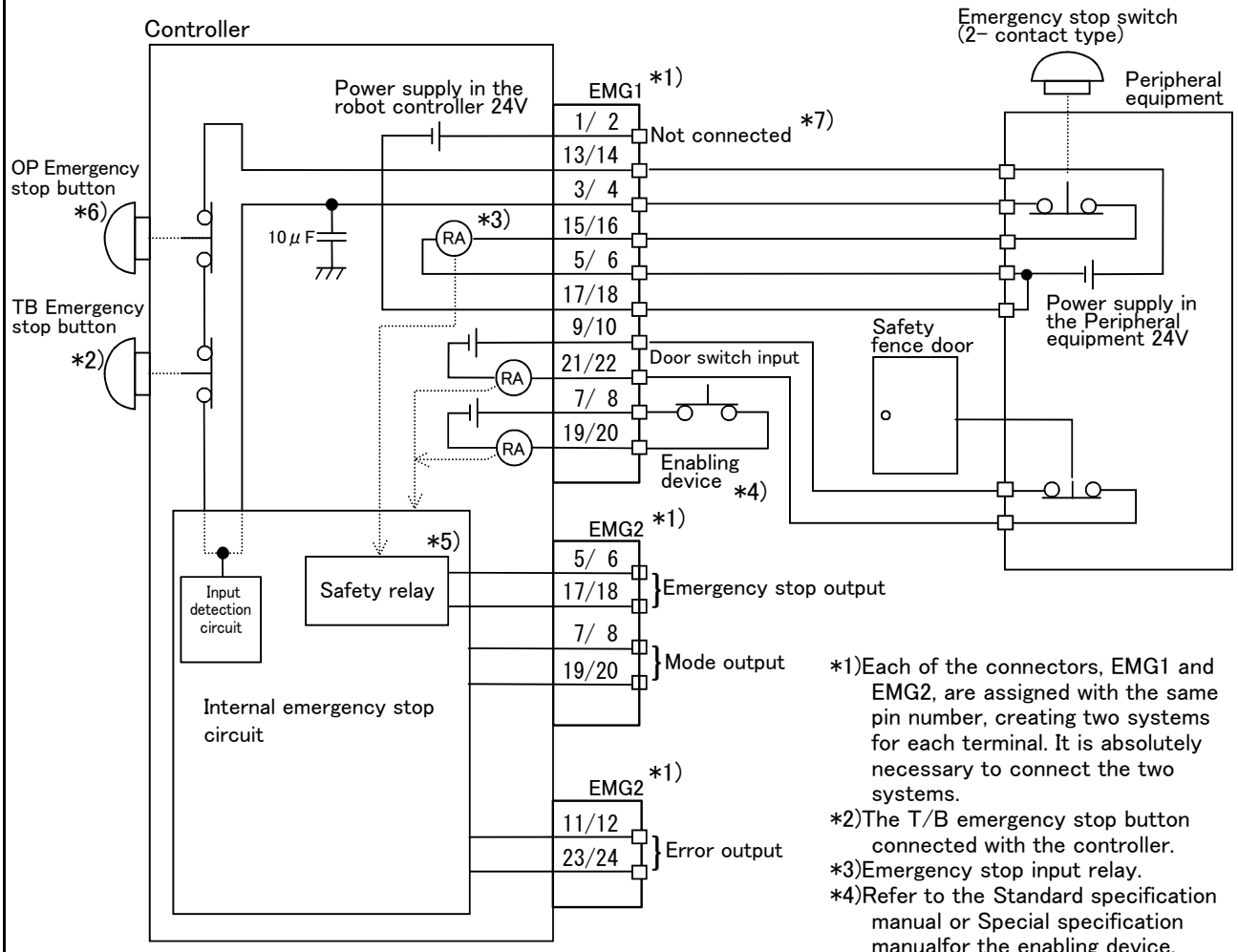
<Wiring example 1>: Connect the emergency stop switch of peripheral equipment to the controller.
The power supply for emergency stop input uses the power supply in the controller.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be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



*5)The emergency stop input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
*6)The emergency stop button of the robot controller. (Only specification with the operation panel.)

Fig.2-36 : Example of safety measures (Wiring example 1)

<Wiring example 2>: Connect the emergency stop switch of peripheral equipment to the 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)Each of the connectors, EMG1 and EMG2, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.
*2)The T/B emergency stop button connected with the controller.
*3)Emergency stop input relay.
*4)Refer to the Standard specification manual or Special specification manualfor the enabling device.

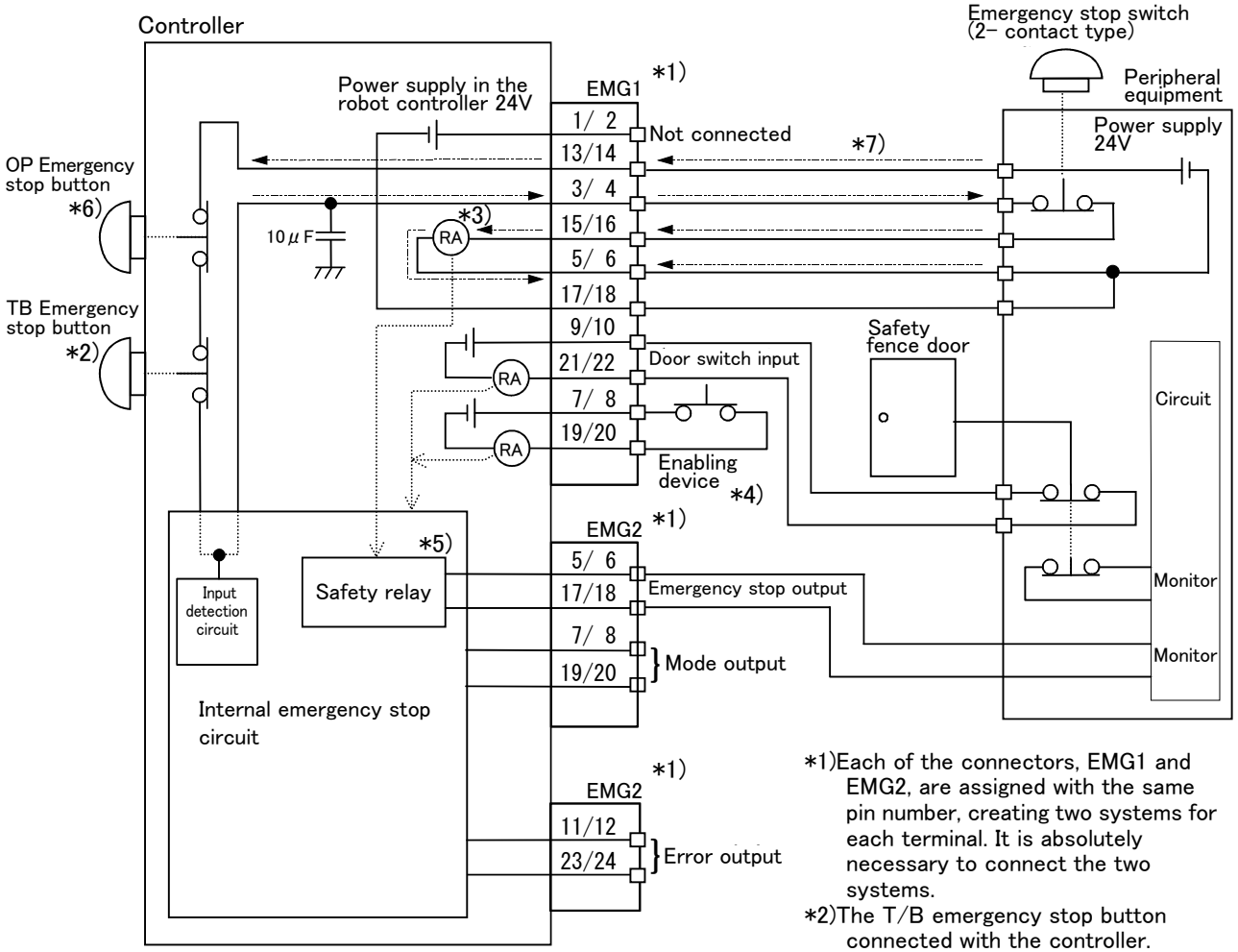
*5)The emergency stop input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.
*6)The emergency stop button of the robot controller. (Only specification with the operation panel.)
*7)Connect the 24V power supply to 13/14 terminals.

Fig.2-37 : 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 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 controller OFF, peripheral equipment state can be the emergency stop also.



*1)Each of the connectors, EMG1 and EMG2, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.

*2)The T/B emergency stop button connected with the controller.

*3)Emergency stop input relay.

*4)Refer to the Standard specification manual or Special specification manualfor the enabling device.

*5)The emergency stop input detection relay is used the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

*6)The emergency stop button of the robot controller. (Only specification with the operation panel.)

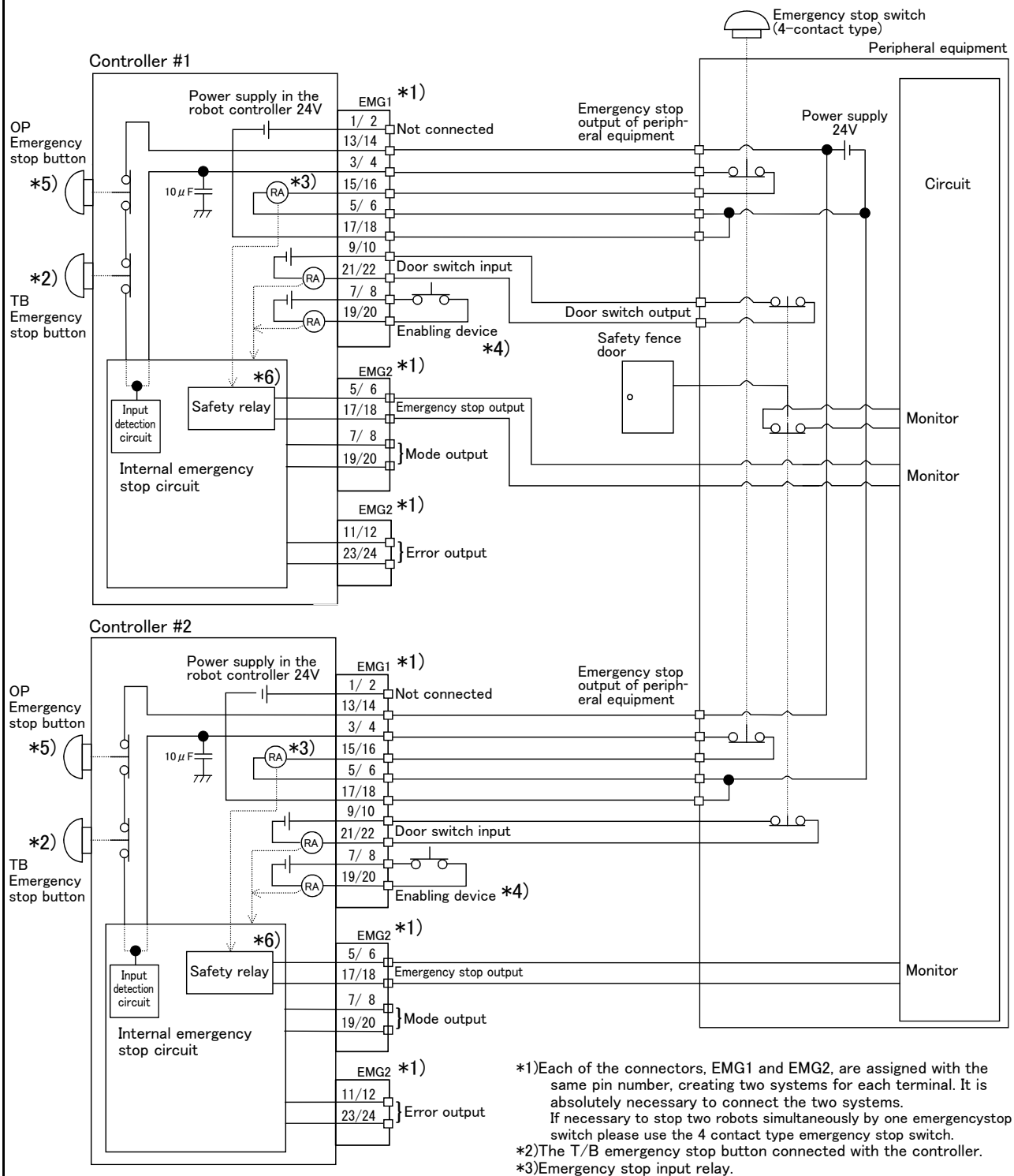
*7)When using emergency stop button output function, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity of the circuit is wrong, the emergency stop button output may not work properly. Please connect the 24V power supply to 13/14 terminals.

Fig.2-38 : Example of safety measures (Wiring example 3)

<Wiring example 4>: Connect the emergency stop switch of peripheral equipment, and the door switch to two 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 controller OFF, peripheral equipment state can be the emergency stop also.



*1)Each of the connectors, EMG1 and EMG2, are assigned with the same pin number, creating two systems for each terminal. It is absolutely necessary to connect the two systems.
If necessary to stop two robots simultaneously by one emergencystop switch please use the 4 contact type emergency stop switch.

*2)The T/B emergency stop button connected with the controller.

*3)Emergency stop input relay.

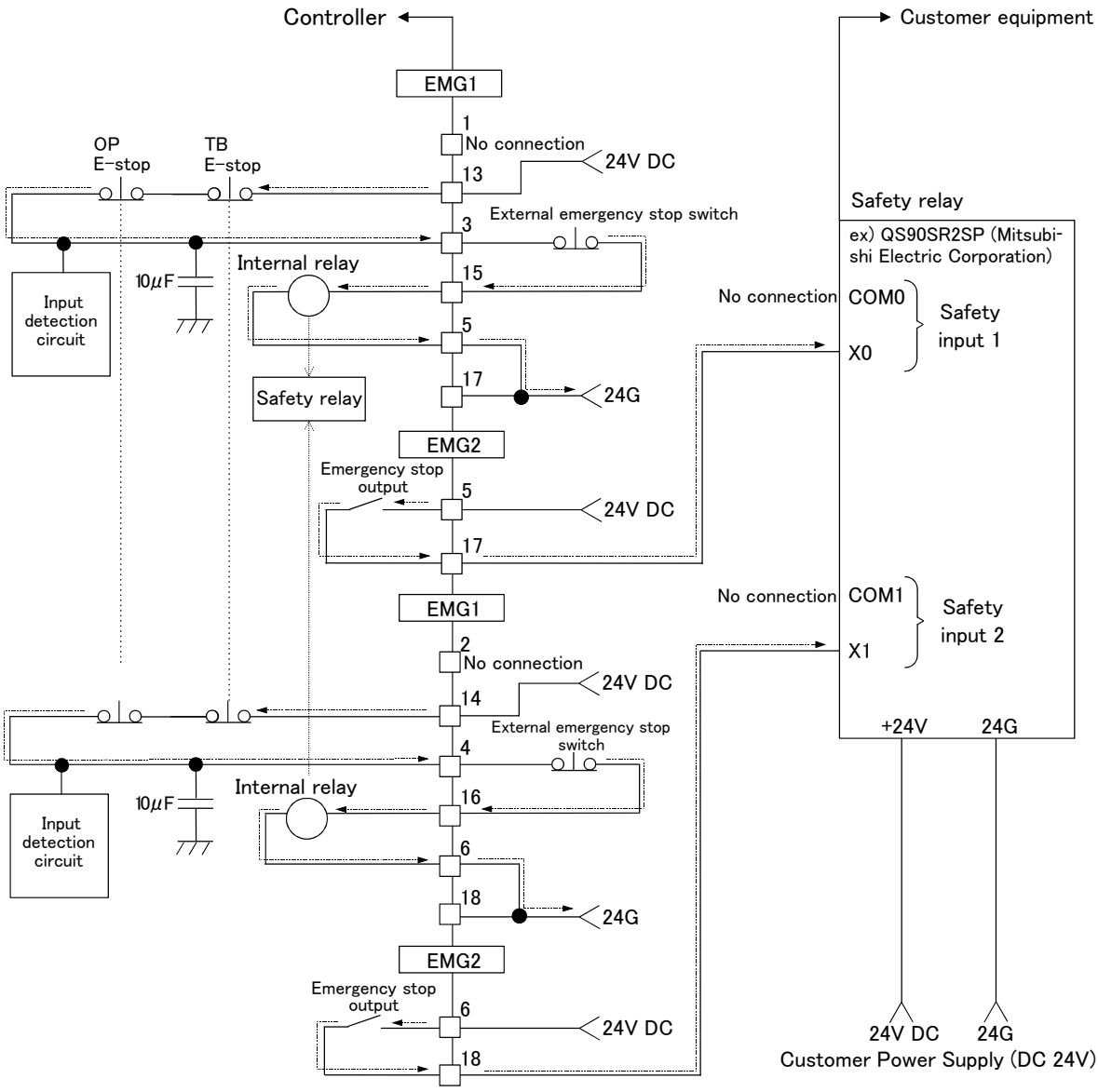
*4) Refer to the Standard specification manual or the Special specification manual for the enabling device.

*5) The emergency stop button of the robot controller. (Only specification with the operation panel.)

*6) The emergency stop input detection relay uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

Fig.2-39 : Example of safety measures (Wiring example 4)

<Wiring example 5>: Connect the controller to the safety relay
Use the controller's emergency stop button command as an input to the safety relay.



[Caution]

1)This product has category 3 functionality and therefore the robot's whole unit cannot be set to category 4.

2)The controller's internal circuit has polarity. Please adhere to the polarity as detailed in the wiring examples, particularly for emergency stop button output when using user equipment. Connect the positive side of the user equipment (24V DC) to the two terminals 13/14 of EMG1, then connect the emergency stop button (or contact points) in the user equipment to the 3-15 and 4-16 terminals of EMG1, and ultimately connect the negative side (24G).

3)When installing a safety relay to use it as an input point of the controller's emergency stop button command, use a safety relay that is activated by an input from one of the two systems (i.e. QS90SR2SP (Manufacture: Mitsubishi Electric Corporation)).

4)The emergency stop input detection relay (internal relay) uses the controller's internal safety relay control. If the emergency stop input detection relay is switched OFF, emergency stop is detected and the safety relay is also switched OFF.

5)When connecting emergency stop button output to an external safety relay, please take note of the polarity and make sure that the electrical current flows in the same direction as indicated by the dotted arrows in the two places in the diagram. If the polarity is setup incorrectly, this function will not operate correctly. Please connect the two terminals 5/6 of EMG2 to 24V.

Fig.2-40 : Example of safety measures (Wiring example 5)

(4) 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 (normal open), 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 of normal close which have two lines 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 figure above. 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 normal open 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. 2-42, Fig. 2-41, Fig. 2-43)
- 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.
  The size of the wire that fits to use is shown below.
  - CR750 controller..... CNUSR11/12/13 connector:
    AWG #26 to #16 (0.14mm^2 to 1.5mm^2)
  - CR750 controller..... CNUSR2 connector:
    AWG #30 to #24 (0.05mm^2 to 0.2mm^2)
  - CR751 controller..... CNUSR1/2 connector:
    AWG #30 to #24 (0.05mm^2 to 0.2mm^2)
  - CR760 controller..... EMG1/2 connector:
    AWG #28 to #16 (0.08mm^2 to 1.5mm^2)

Electric specification of the emergency stop related output circuit is 100mA/24V or less. Don't connect the equipment except for this range.

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

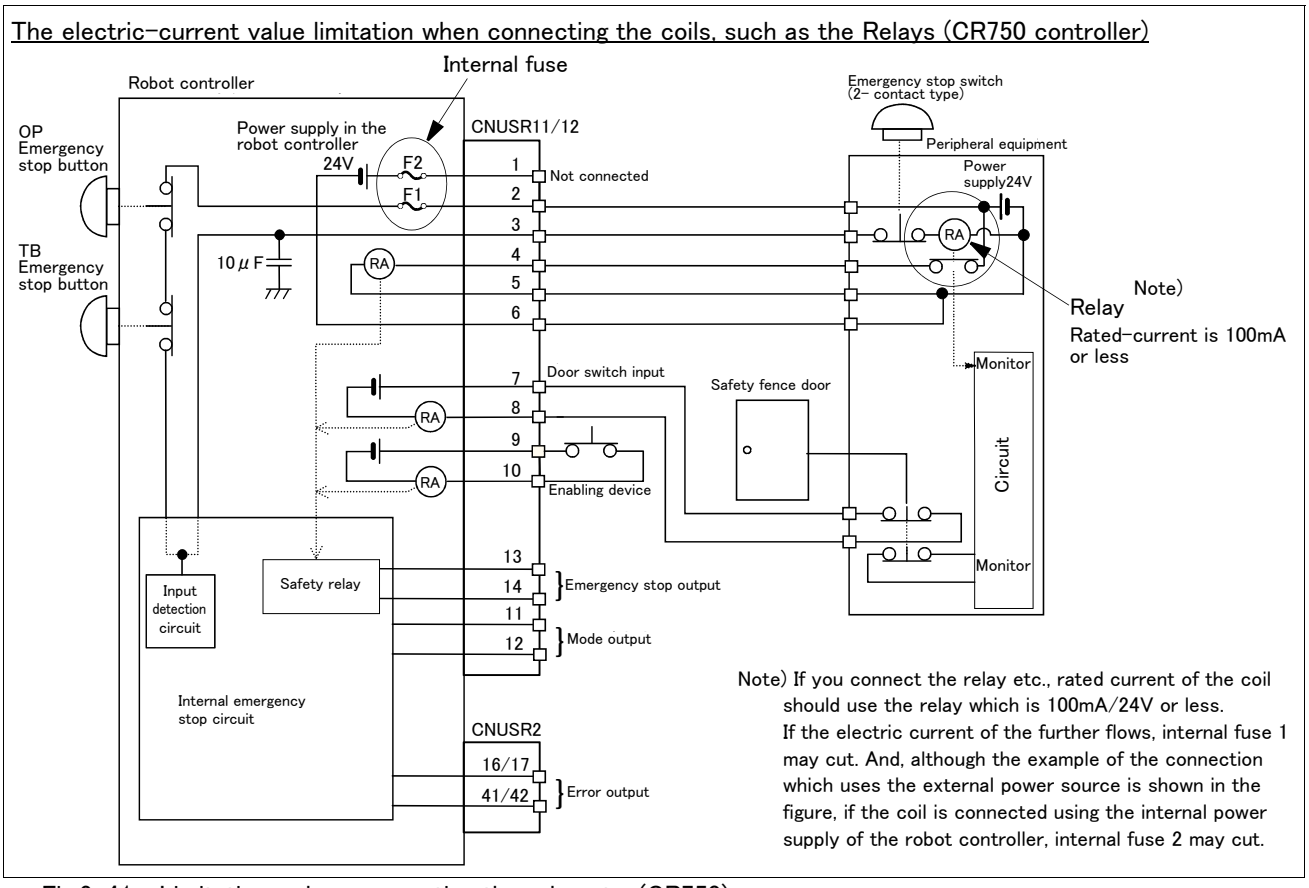


Fig.2-41 : Limitations when connecting the relay etc. (CR750)

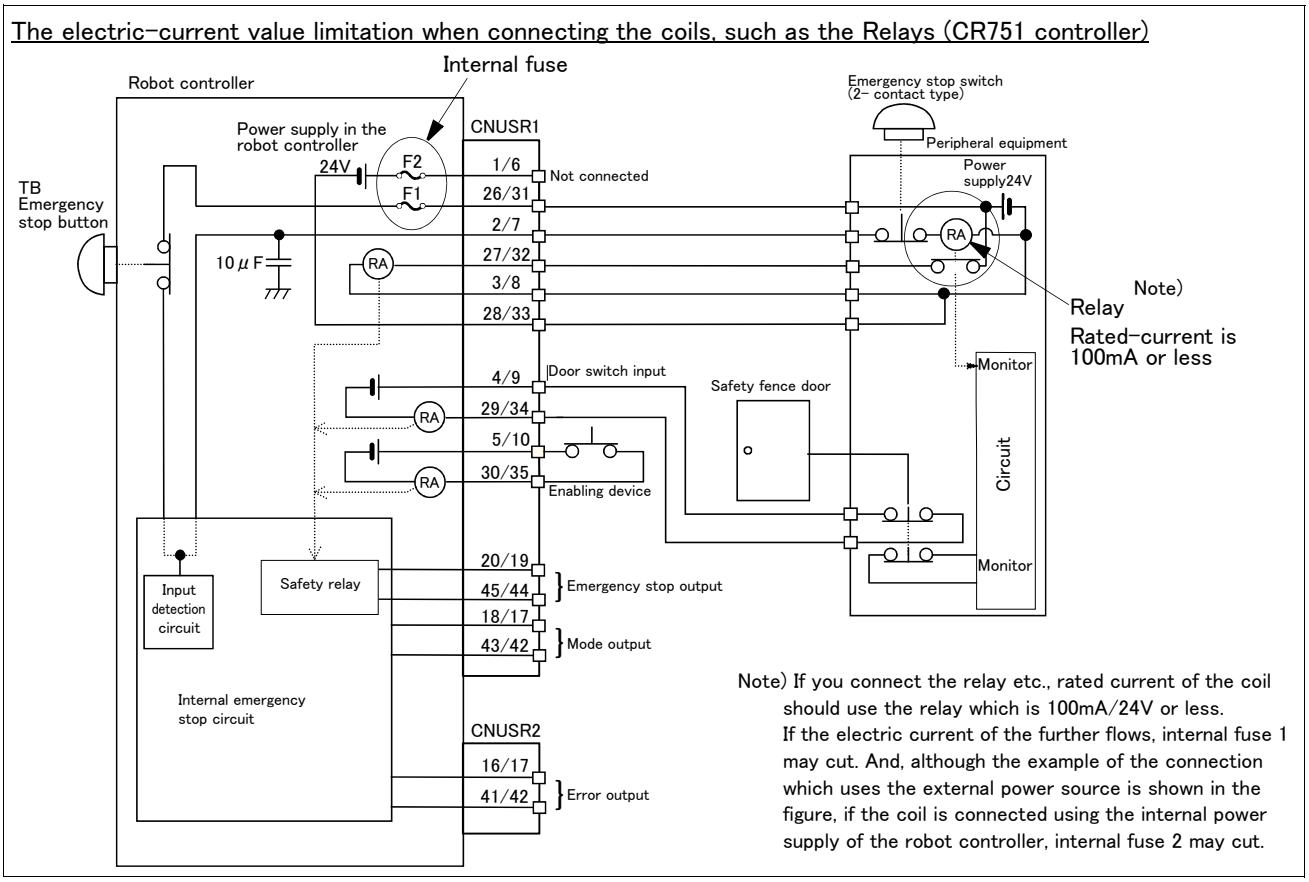


Fig.2-42 : Limitations when connecting the relay etc. (CR751)

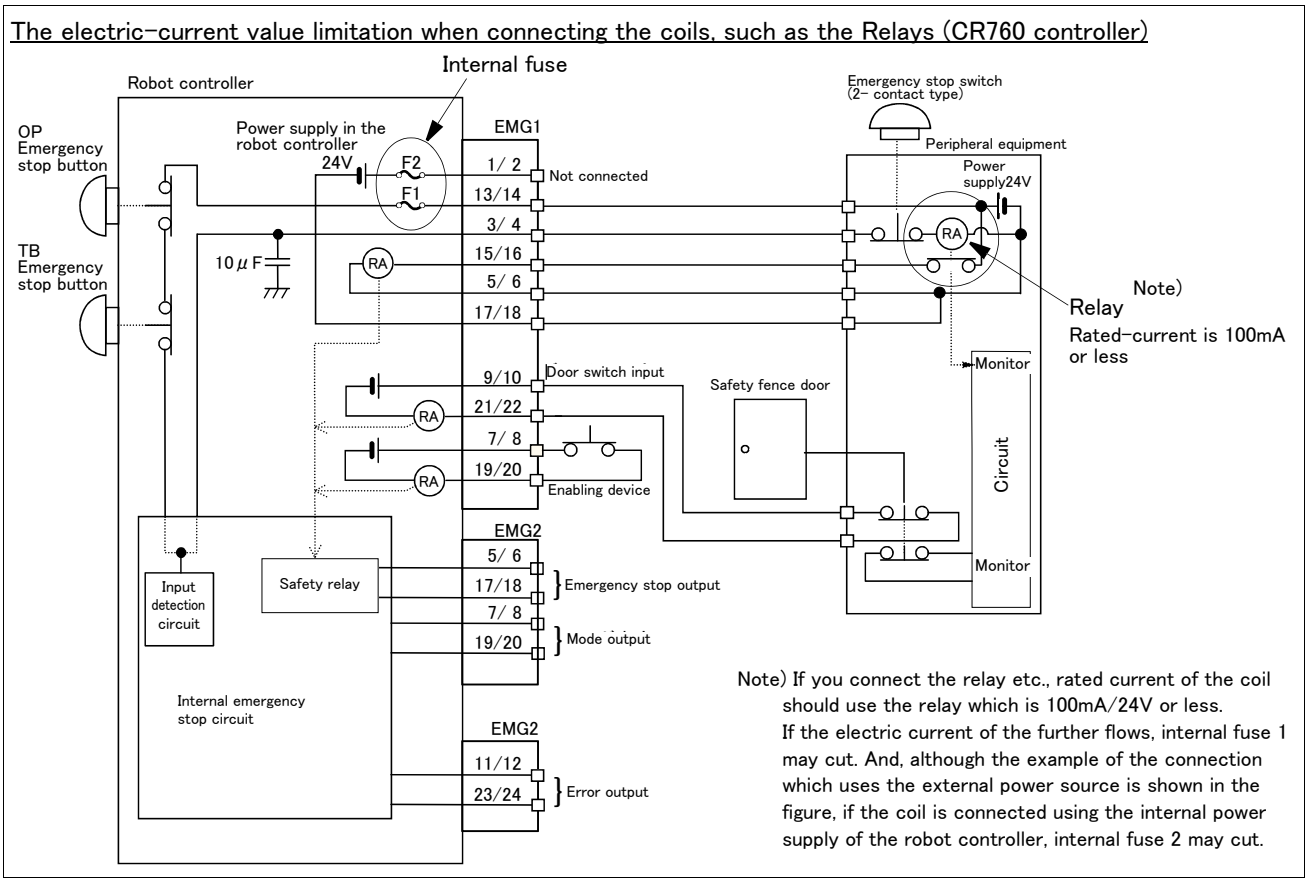


Fig.2-43 : Limitations when connecting the relay etc. (CR760)

[Supplementary explanation regarding emergency stop circuit]

The controller's internal circuit is as shown in the below diagram. Be sure to build a circuit that properly shuts off the emergency stop detection relay when the emergency stop button is pressed.

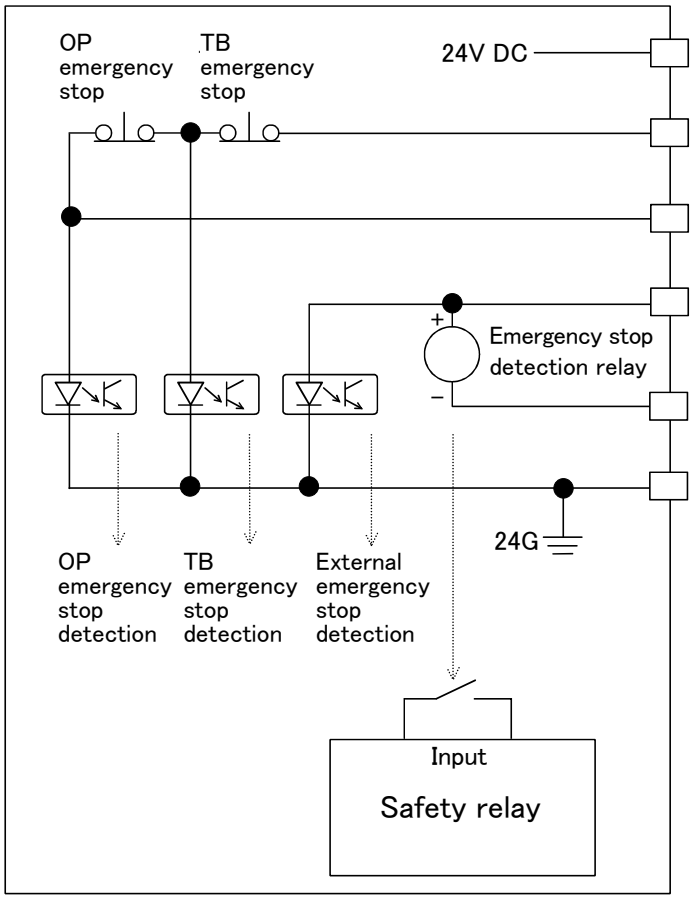


Fig.2-44 : Internal circuit of controller

⚠CAUTION Be sure to perform wiring correctly. If there are mistakes in the wiring, the robot may not stop when the emergency stop button is pressed and there will be a risk of damage or personal injury occurring.
After wiring, be sure to press each of the installed emergency stop switches and check whether the emergency stop circuit works properly.

⚠CAUTION Be sure to duplicate connection of the emergency stop, door switch and enabling switch. If not duplicated, these functions may fail due to a broken relay used by customer, etc.

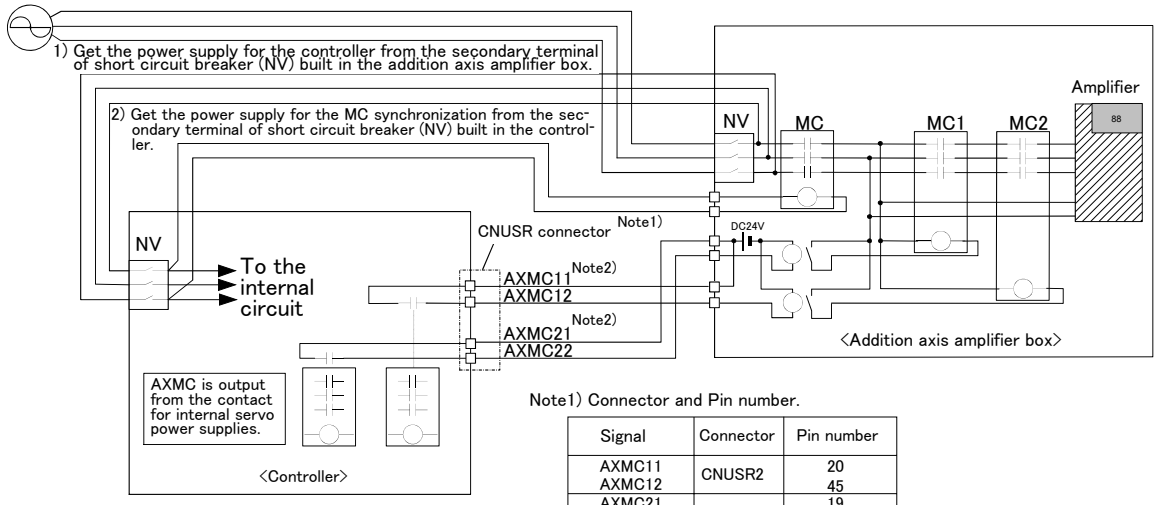
2.2.10 Magnet contactor control connector output (AXMC) for addition axes

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. An example circuit and an image of how to connect the controller connector are shown below. 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.

(1) Example circuit

■ CR750/CR751 controller



Note1) Connector and Pin number.

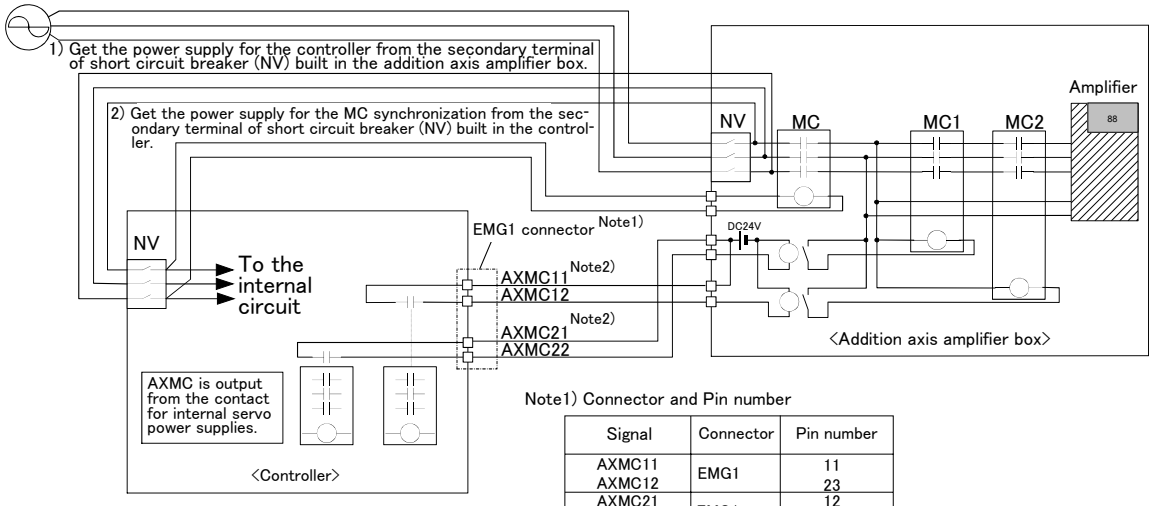
Signal	Connector	Pin number
AXMC11	CNUSR2	20
AXMC12		45
AXMC21	CNUSR2	19
AXMC22		44

Note2) This output is opened, if the robot turns off the servo by occurrence of alarm etc.
<Electric specification>
DC24V/10mA to 100mA

[Note] In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig. 2-45 : Example of circuit for addition axes of Magnet contactor control output (CR750/CR751 controller)

■ CR760 controller



Note1) Connector and Pin number

Signal	Connector	Pin number
AXMC11 AXMC12	EMG1	11 23
AXMC21 AXMC22	EMG1	12 24

Note2) This output is opened, if the robot turns off the servo by occurrence of alarm etc.
<Electric specification>
DC24V/10mA to 100mA

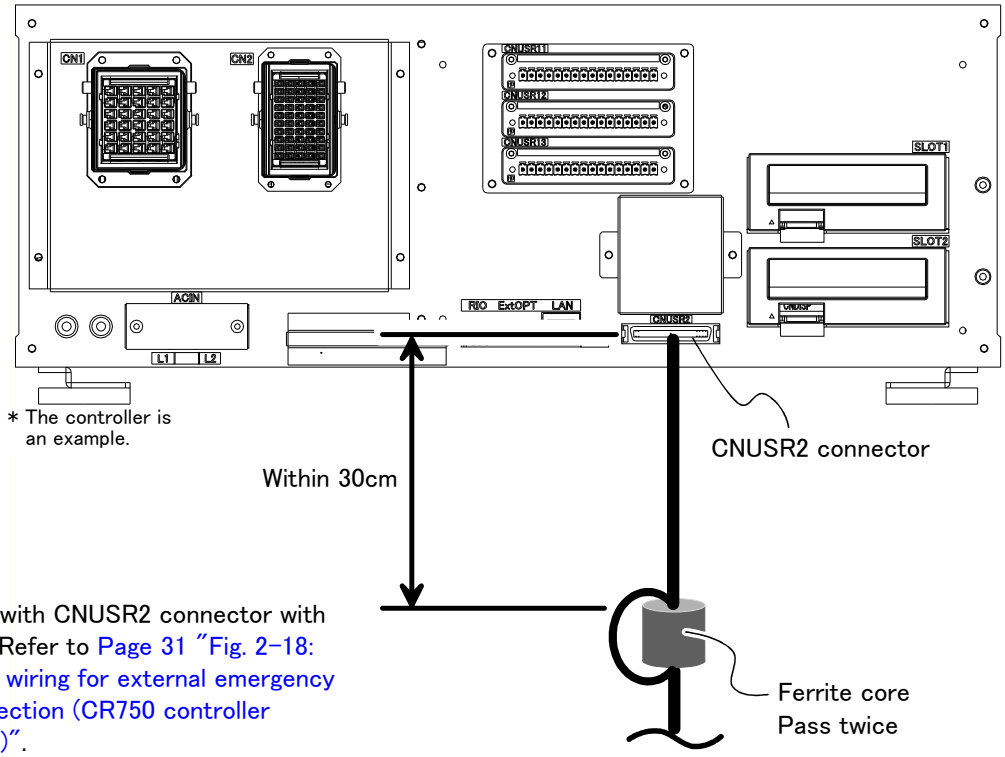
[Note] In the customer's system, do not ground the + side of 24V power supply prepared by customer for connect to the controller. (related with emergency stop and parallel input/output) If it connects with the controller under the condition that the + side is grounded, it will lead to failure of controller.

Fig. 2-46 : Example of circuit for addition axes of Magnet contactor control output (CR760 controller)

(2) Image of how to connect the controller connector

■ CR750 controller

<CR750 controller>

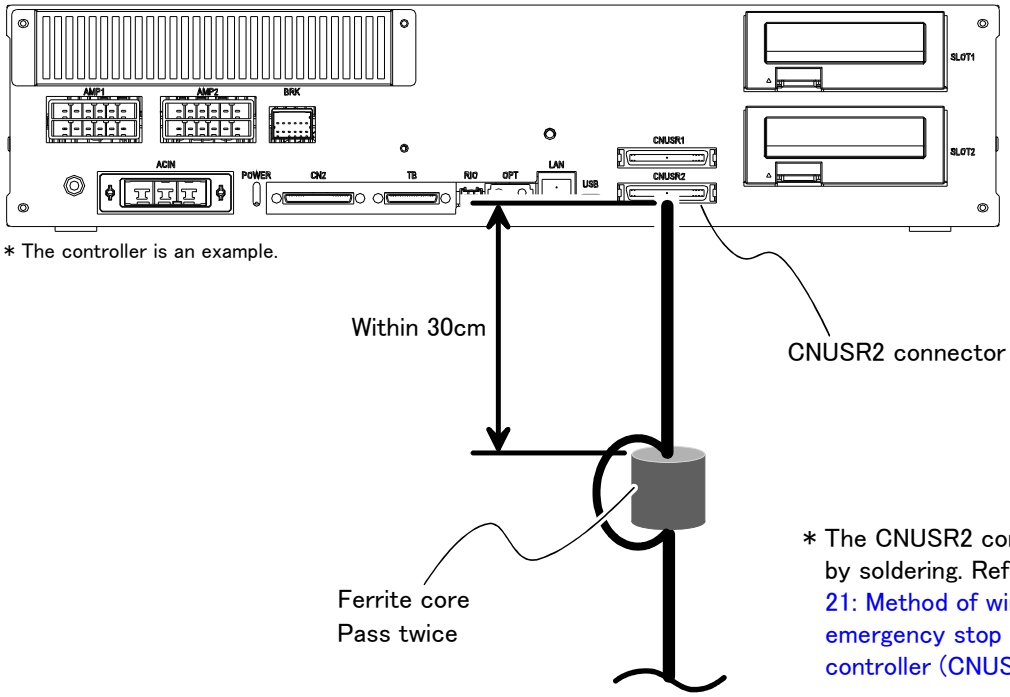


* Connects with CNUSR2 connector with soldering. Refer to Page 31 "Fig. 2-18: Method of wiring for external emergency stop connection (CR750 controller (CNUSR2))".

Fig. 2-47 : AXMC terminal connector (CR750)

■ CR751 controller

<CR751 controller>

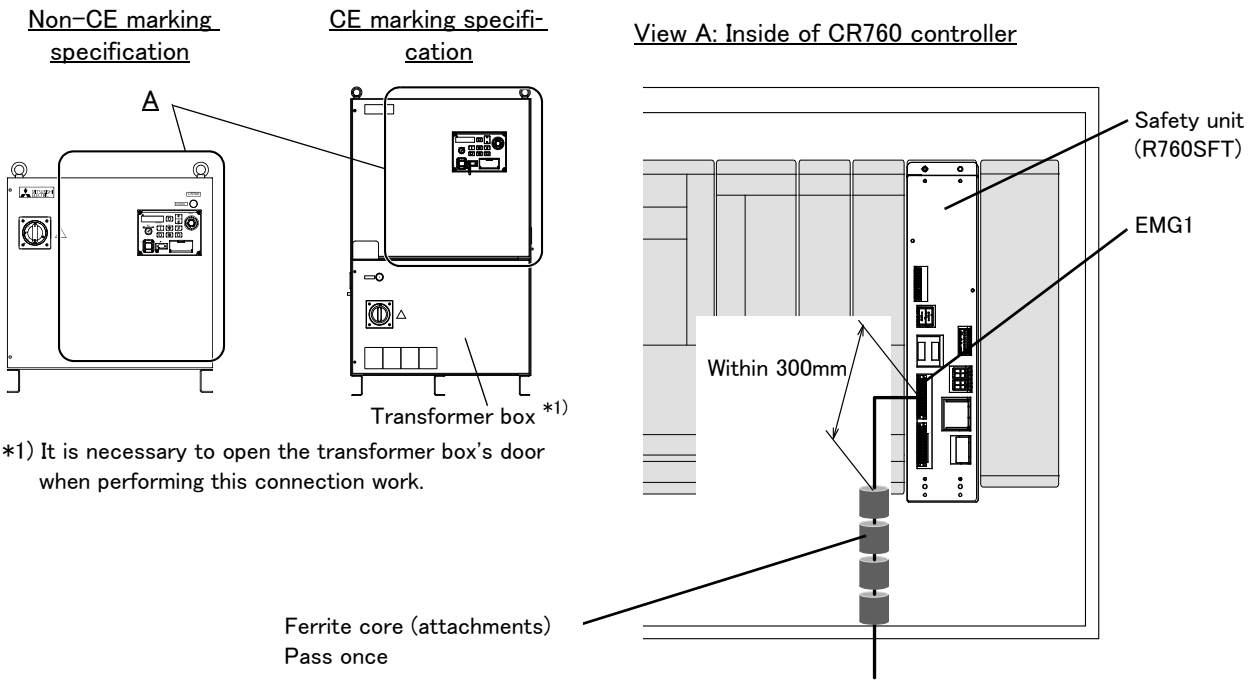


* The CNUSR2 connector is connected by soldering. Refer to Page 36 "Fig. 2-21: Method of wiring for external emergency stop connection (CR751 controller (CNUSR1/2))".

Fig. 2-48 : AXMC terminal connector (CR751)

■ CR760 controller

<CR760 controller>



*1) It is necessary to open the transformer box's door when performing this connection work.

* Connection method is the same as the connection of emergency stop. Refer to Page 37 "Fig. 2-22: External emergency stop connection (CR760)".

Fig.2-49 : AXMC terminal connector (CR760)

2.2.11 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.

2.2.12 Noise suppression for the CR760 CE marking specification

An example of noise suppression for the CR760 CE marking specification is shown below.
Perform noise suppression around the robot controller (if necessary).

1) Insert the six ferrite cores in both end of the CN1 and CN3 cable.
   Recommended ferrite core: GTFC-41-27-16 (Manufacturer: KITAGAWA INDUSTRIES Co., Ltd.)
2) Insert the the three ferrite cores in both end of the CN2 cable.
   Recommended ferrite core: E04SR401938 (Manufacturer: Seiwa Electric Mfg. Co., Ltd.)
3) Add FG cable to the robot controller.
   Recommended cable: ZSK-12HF (Manufacturer Zippertubing (Japan),Ltd.)

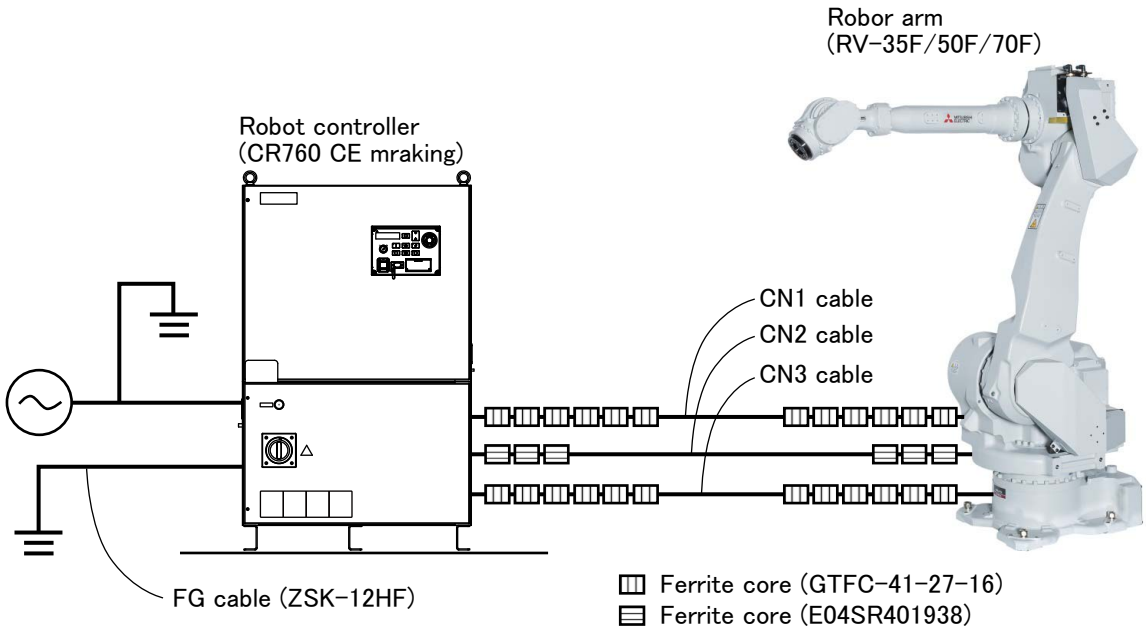


Fig.2-50 : Noise suppression for CR760 CE marking specification

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 82, "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.

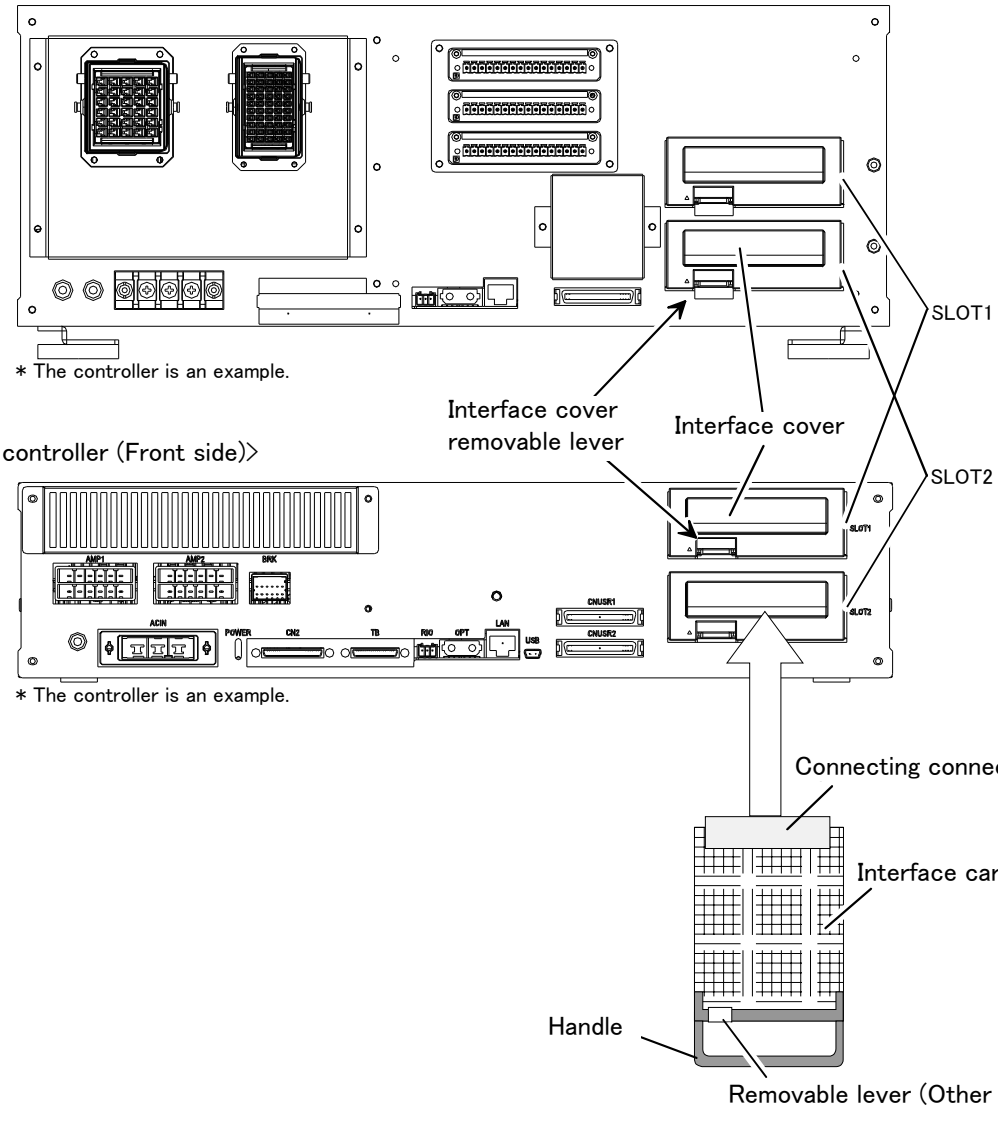
3.1 Installing the Option Card

The installation procedure of the interface card.

(1) CR750/CR751 controller

<CR750 controller (Rear side)>

* The controller is an example.



<CR751 controller (Front side)>

* The controller is an example.

Fig. 3-1 : Installation of the interface card (CR750/CR751 controller)

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 or SLOT2.
   Insert the card as both ends of the card may fit into the guide of slot(SLOT1 or SLOT2 showed in Fig. 3-1).
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.

(2) CR760 controller

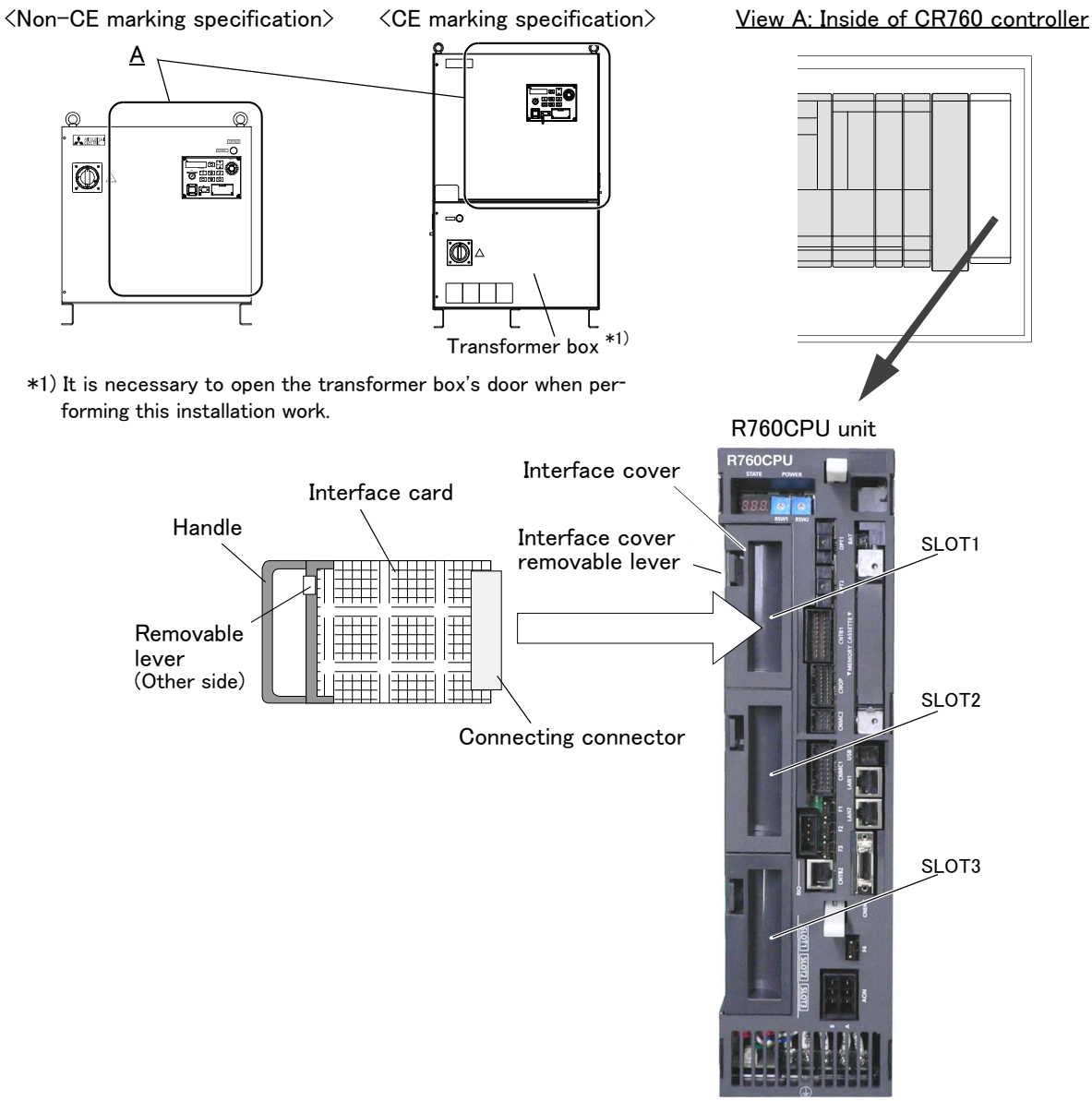
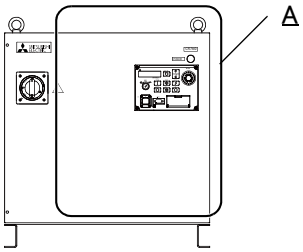


Fig. 3-2 : Installation of the interface card (CR760 controller)

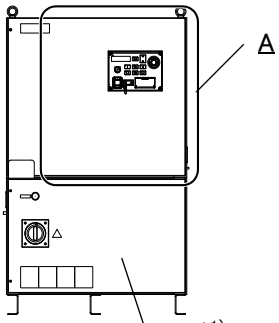
1) Turn off the power.
2) Pick the interface cover removal lever and pull up the interface cover.
3) Insert the interface card in SLOT1, SLOT2, or SLOT3.
Insert the card as both ends of the card may fit into the guide of slot (SLOT1, SLOT2, or SLOT3 showed in Fig. 3-2).
4) Insert the connection connector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

3.2 Installing the extension memory cassette

<Non-CE marking specification>



<CE marking specification>



*1) It is necessary to open the transformer box's door when performing this installation work.

View A: Inside of CR760 controller

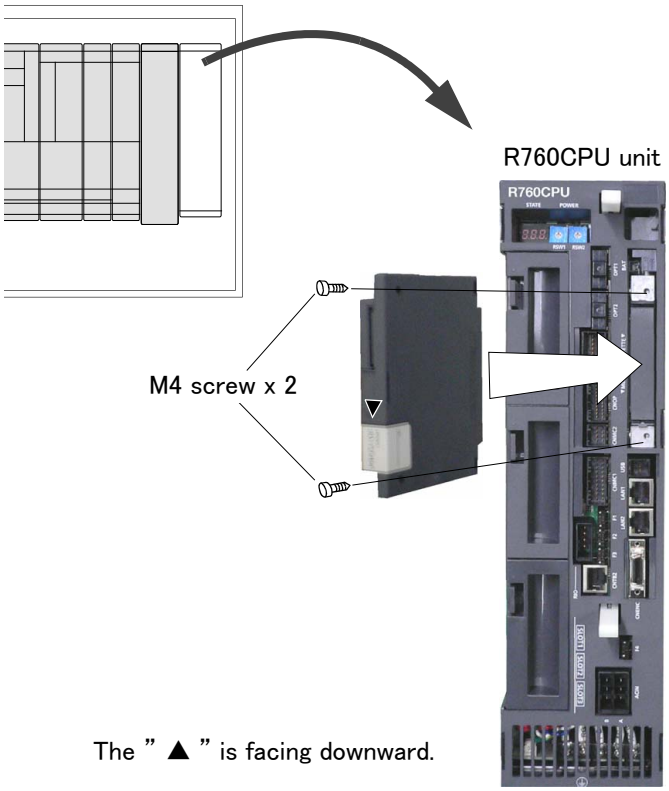


Fig. 3-3 : Installing the extension memory cassette

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) Open the front door of the controller, and remove the cover at the memory cassette slot on the R760CPU unit.
4) Insert the memory cassette all the way to the back with the "arrow mark"(the surface which inserts screw has the mark) facing downward, and fix surely two screws attached as shown in Fig. 3-3.
   Note) Please keep in mind that the cassette will change if it fastens too much.
5) Install the removed cover in "3)".
6) 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.

3.3 Installing and wiring of the controller protection box

Method of installing and wiring with the controller protection box is as follows.

(1) CR750 controller (Controller protection box: CR750-MB)

1) Release the stopper (6 pcs.) of controller protection box (CR750-MB) and remove the top plate.
2) Copy the serial number of the controller to the attached label, and put it to the front of CR750-MB. After that, put the transparent label on to the serial number's label.
3) Remove the fixing plate (screw x 3 pcs.) in the CR750-MB (right side), fix it to the right side of the controller by 4 screws (attached).
4) Remove the rear cover of the controller. (screw x 4 pcs.)
   * When the controller is installed, the rear cover is removed, so please keep it. (Refer to Fig. 3-5.)
5) Connect the internal power cable (attached) to the terminal of controller. And connect the attached earth cable to the earth terminal of controller.
6) Put the controller into the CR750-MB and fix it by 3 screws which are removed in process "3)".
7) Connect the internal power cable to the relay terminal in the CR750-MB. And connect the earth cable to the earth terminal in the CR750-MB.

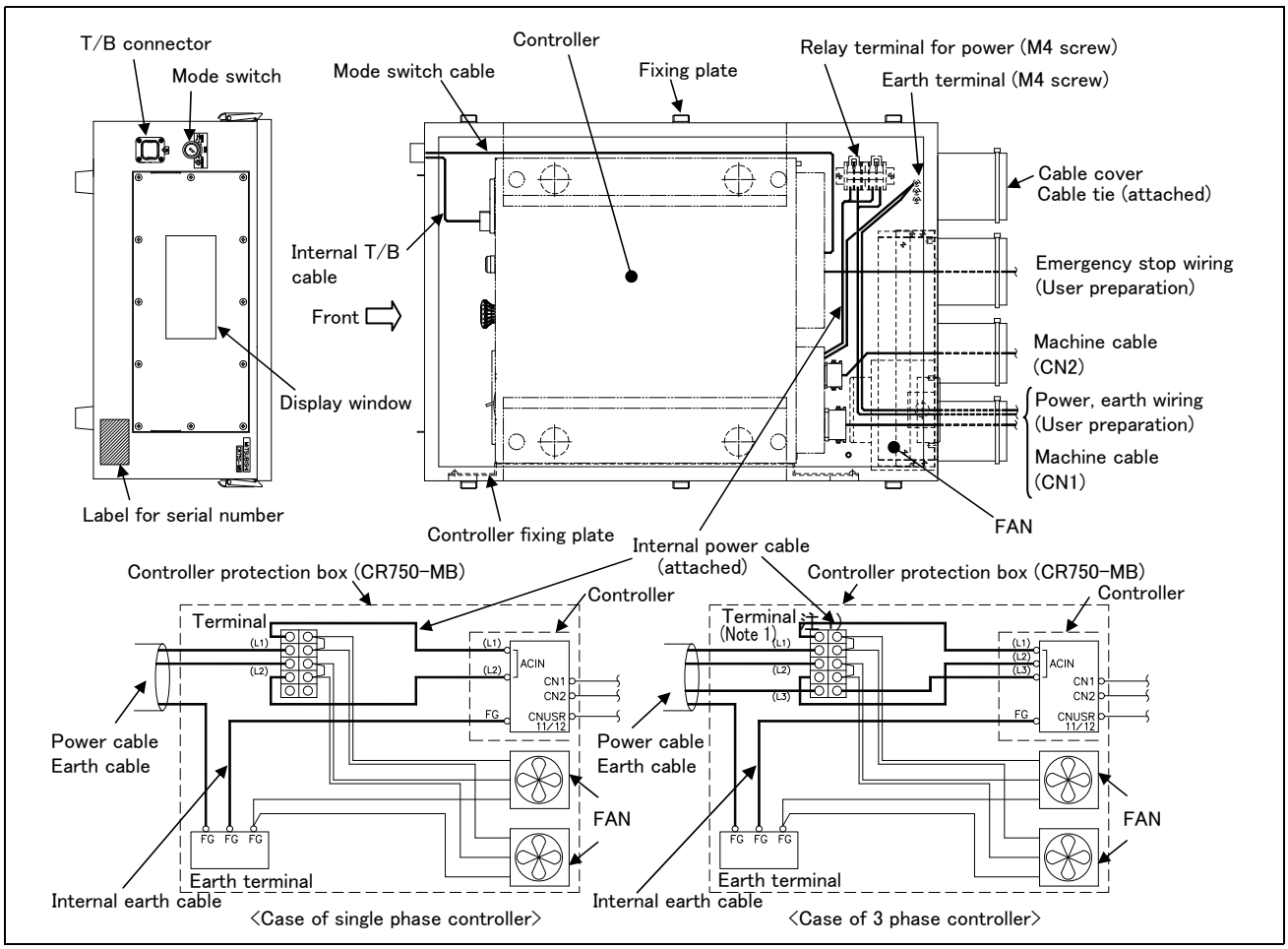


Fig. 3-4 : Internal structure and wiring

8) Connect the internal T/B cable to the T/B connector of controller. And connect the T/B dummy plug or T/B to the T/B connector of CR750-MB.
9) Prepare the power and earth cable, and connect them to the relay terminal and earth terminal in the CR750-MB.
10) For safety, absolutely prepare the external emergency stop equipment.
11) Connect the machine cable to the controller and all package the cable cover by the cable tie.
12) Fix the top plate by fixing plate with 6 screws.

⚠CAUTION Use T/B or T/B dummy plug. IP level is not performed without no T/B.

⚠CAUTION Use the attached mode switch.

⚠CAUTION Install the controller option before combining the controller and CR750-MB.

⚠CAUTION Exchange the rubber parts of right side to bottom's when CR750-MB is used vertically.

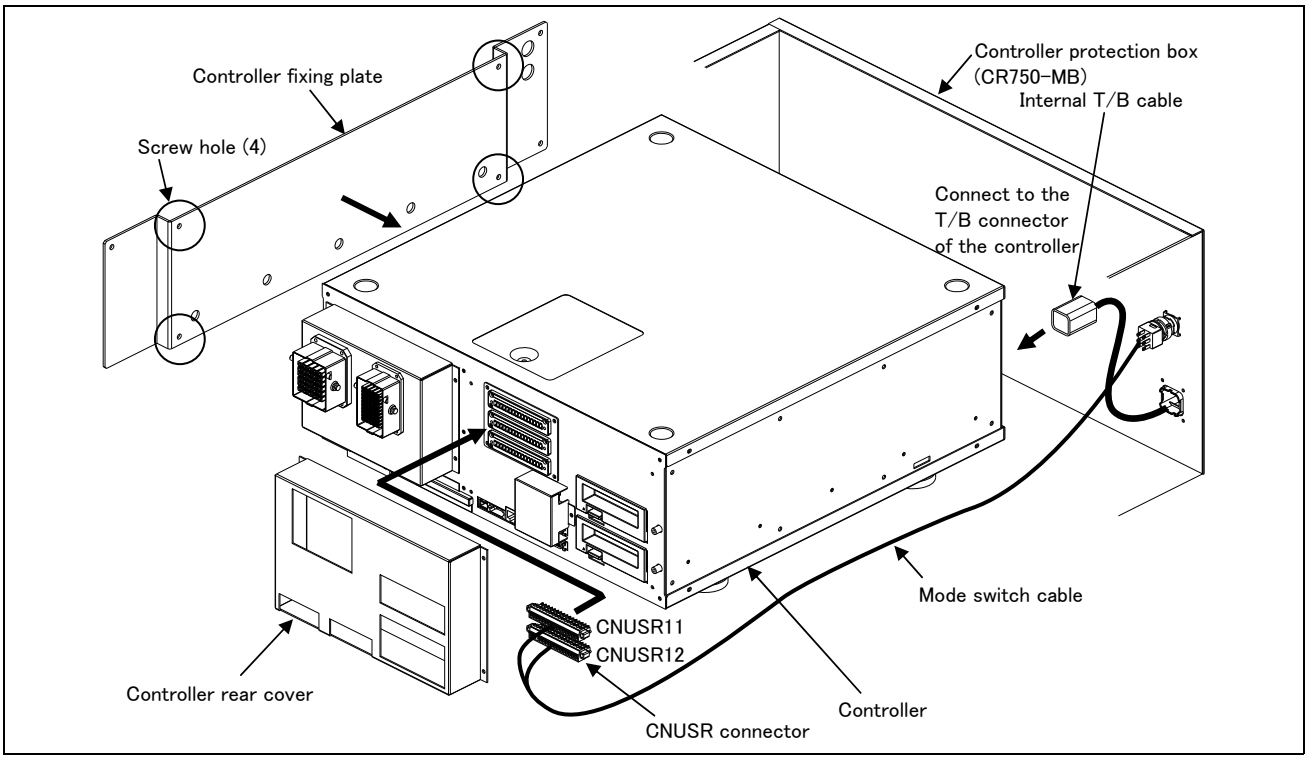


Fig. 3-5 : Mode switch cable, Internal T/B cable wiring

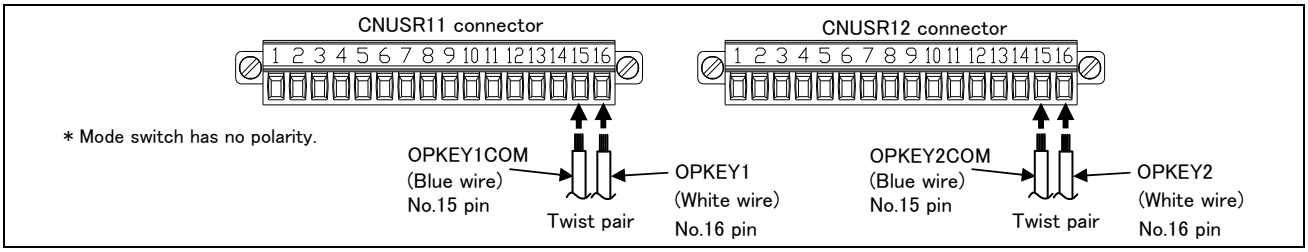


Fig. 3-6 : CNUSR connector wiring

Installing and wiring of the controller protection box (CR750-MB) is completed.

(2) CR751 controller (Controller protection box: CR751-MB)

1) Release the stopper (6 pcs.) of controller protection box (CR751-MB) and remove the top plate.
2) Copy the serial number of the controller to the attached label, and put it to the front of CR751-MB. After that, put the transparent label on to the serial number's label.
3) Remove the fixing plate (screw x 4 pcs.) in the CR751-MB (left side), fix it to the left side of the controller by 4 screws (attached).
4) Remove the cable fix plate and the cover plate of the controller. (screw x4 pcs.) Install the removed 4 screws on former position.
   *When the controller is installed, the cable fix plate and the cover plate is removed, so please keep it. (Refer to Fig. 3-8.)
5) Connect the internal power cable (attached) to the terminal of controller. And connect the attached earth cable to the earth terminal of controller.
6) Put the controller into the CR751-MB and fix it by 4 screws which are removed in process "3)".
7) Connect the internal power cable to the relay terminal in the CR751-MB. And connect the earth cable to the earth terminal in the CR751-MB.

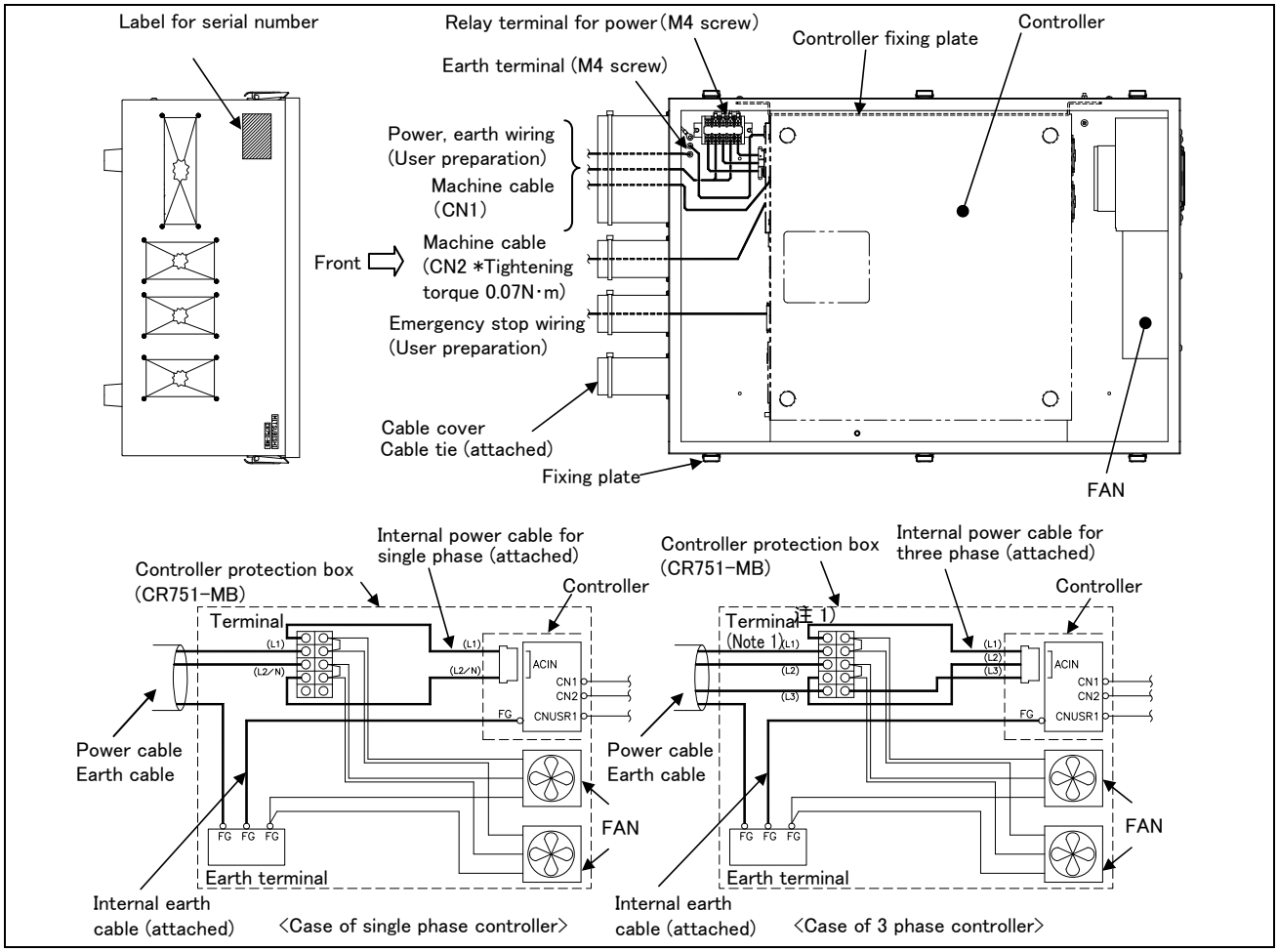


Fig. 3-7 : Internal structure and wiring

8) Prepare the power and earth cable, and connect them to the relay terminal and earth terminal in the CR751-MB.
9) For safety, absolutely prepare the external emergency stop equipment.
10) Connect the machine cable to the controller and all package the cable cover by the cable tie. (The screw tightening torque of the CN2 cable connector is 0.06-0.07N・m. Recommended torque driver: AMLD8CN Manufacture: TOHNICHI)
11) Connect the T/B dummy plug with T/B connector of the controller.
12) Fix the top plate by the stopper (6 pcs.) of CR751-MB.
13) Fix the cable drawn out from the cable cover by the cable clamp (controller attachment parts) to the fixing bracket on the protection box side. (The M4 screw for the cable clamp must use the screw of the controller attachment.)

⚠CAUTION Install the controller option before combining the controller and CR751-MB.

⚠CAUTION When the cable is pulled, the cable connector might be damaged. Fix by using the cable clamp (controller attachment parts).

⚠CAUTION Exchange the rubber parts of left side to bottom's when CR751-MB is used vertically.

⚠CAUTION Transport the protection box (Mass of CR751-MB: 20kg) by two people or more.

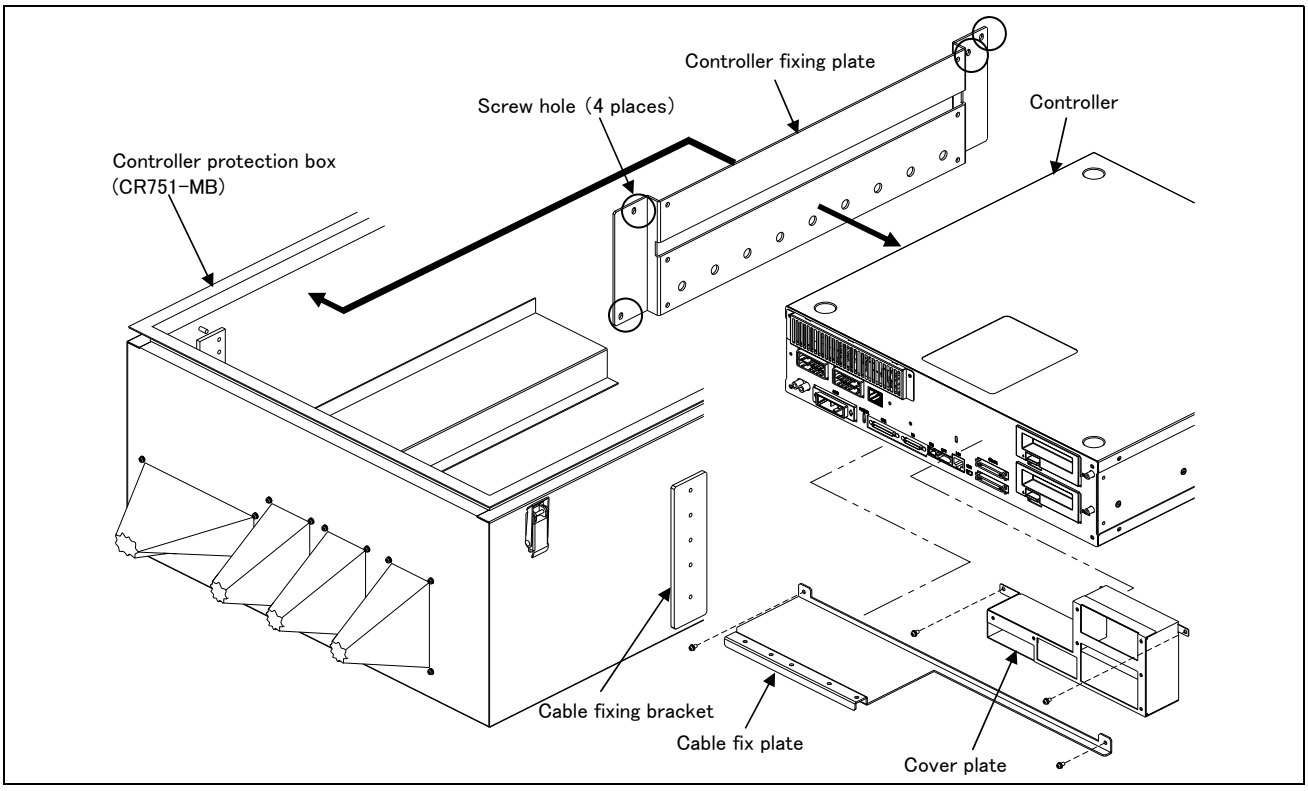


Fig. 3-8 : Controller installation drawing

Installing and wiring of the controller protection box (CR751-MB) is completed.

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.

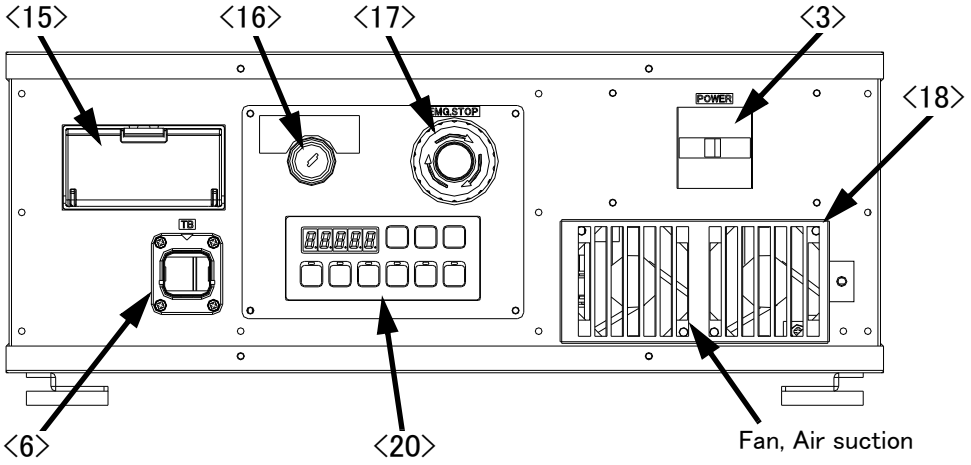
4.1 Handling the controller

4.1.1 Names of each parts

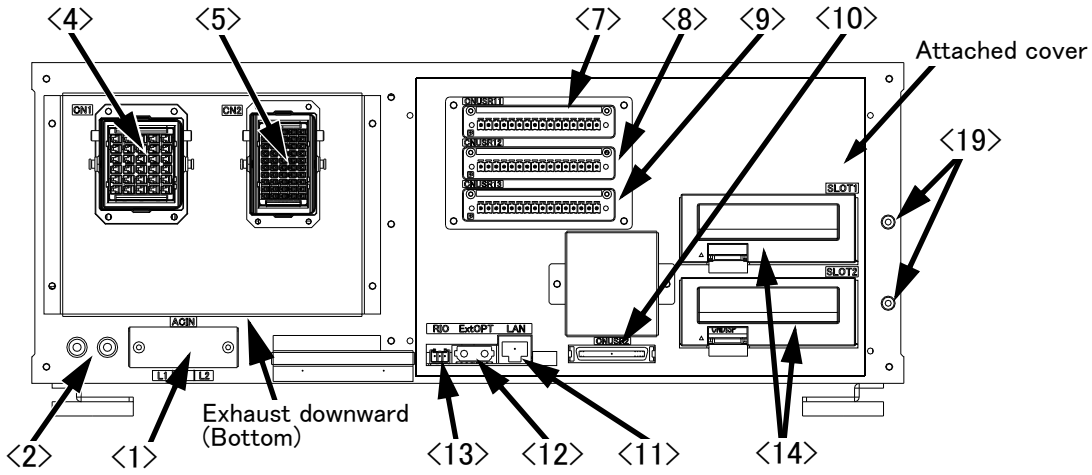
(1) CR750 controller

Controller (Front side)

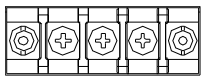
＊ The controller is an example.



Controller (Rear side)



<1>: ACIN terminal



There are three types (Type A, B, and C) of the terminals.
Refer to next page for details.

<20>: The operation panel

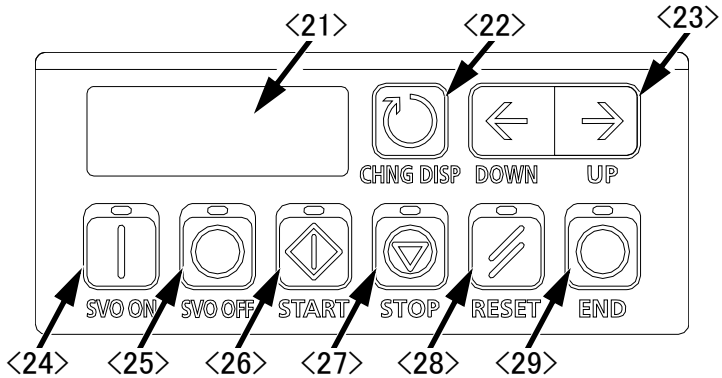
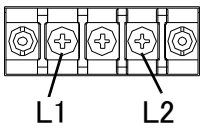
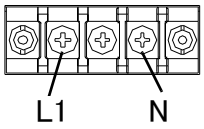
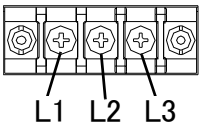


Fig.4-1 : Names of controller parts (CR750)

<1> ACIN terminal .....The terminal box for AC power source (single phase or single phase/ three phase, AC200V) input. (Inner side of a cover)
There are three types of the terminals and the terminal differs depending on the model and specification (CE or non-CE).

Model	Non-CE specification	CE specification
RV-2F series RV-4F/4FL series RV-4FJL series RH-3FH series RH-6FH series RH-3FHR series	Type A: For single phase  Connect the primary power supply to L1 and L2 terminal.	Type C: For single phase  Connect the primary power supply to L1 and N terminal.
RV-7F/7FL series RV-7FLL series RV-13F/13FL series RV-20F series RH-12FH series RH-20FH series	Type B: For single phase/three phase  When using the three phase primary power supply, connect to L1, L2, and L3 terminal. When using the single phase primary power supply, connect to L1 and L3 terminal.	

Refer to Page 19, "(1) CR750 controller" for how to connect a power cable.

<2> PE terminal .....The screw for grounding of the cable. (M4 screw x 2 place)
<3> Power switch.....This turns the control power ON/OFF
<4> Machine cable connector (motor signal) (CN1)
Connect with the CN1 connector of the robot arm.
<5> Machine cable connector (motor power) (CN2)
Connect with the CN2 connector of the robot arm.
<6> T/B connection connector (TB).....This is a dedicated connector for connecting the T/B. When not using T/B, connect the attached dummy connector.
<7><8><9><10> CNUSR connector.....The connector for input/ output connection dedicated for robot. (a plug connector attached)
<7>: CNUSR11, <8>: CNUSR12, <9>: CNUSR13, <10>: CNUSR2
Refer to Page 26, "(1) CR750 controller" for the connection method and the further description of pin assign.
<11> LAN connector (LAN).....For LAN connection
<12> ExtOPT connector (ExtOPT).....Connect the cable for addition axis control.
<13> RIO connector (RIO).....Connect the extension parallel input/output unit.
<14> Option slot (SLOT1, SLOT2)..... Install the interface optional. (Install the cover, when not using.)
<15> Interface cover.....USB interface and battery are mounted.
<16> Mode key switch.....This key switch 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. (Exclude the start of automatic operation.)
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.
<17> Emergency stop switch.....This switch stops the robot in an emergency state. The servo turns OFF.
<18> Filter cover.....There is an air filter inside the cover.
<19> Grounding terminal.....The grounding terminal for connecting cables of option card. (M3 screw x 2 places)
<20> Operation panel.....The operation panel for servo ON/OFF, START/STOP the program etc.
<21> Display panel (STATUS.NUMBER).....The alarm No., program No., override value (%), etc., are displayed.
<22> CHNGDISP button.....This button changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".
<23> UP/DOWN button.....This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.

<24> SVO.ON button ..... This turns ON the servo power. (The servo turns ON.)
<25> SVO.OFF button..... This turns OFF the servo power. (The servo turns OFF.)
<26> START button..... This executes the program and operates the robot. The program is run continuously.
<27> STOP button ..... This stops the robot immediately. The servo does not turn OFF.
<28> RESET button ..... This resets the error. This also resets the program's halted state and resets the program.
<29> END button ..... This stops the program being executed at the last line or END statement.

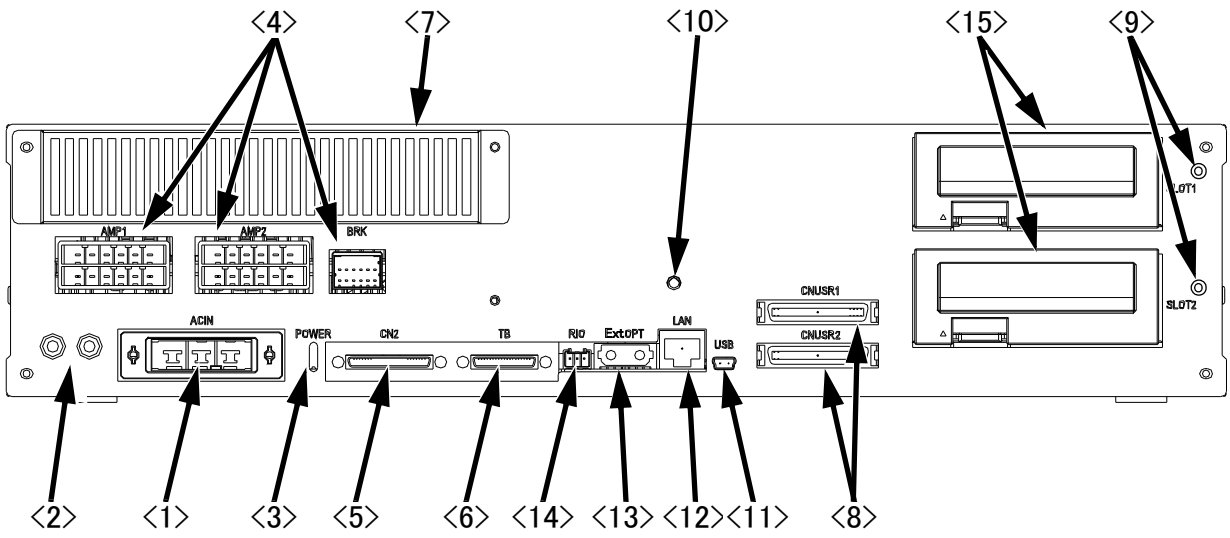
⚠CAUTION Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such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

⚠CAUTION For USB connection between the RT ToolBox2 and the robot controller, noise may cause the instability in data communication.
As a solution, switching communication method to LAN connection is recommended.

(2) CR751 controller

Controller (Front side)

* The controller is an example.



Controller (Rear side)

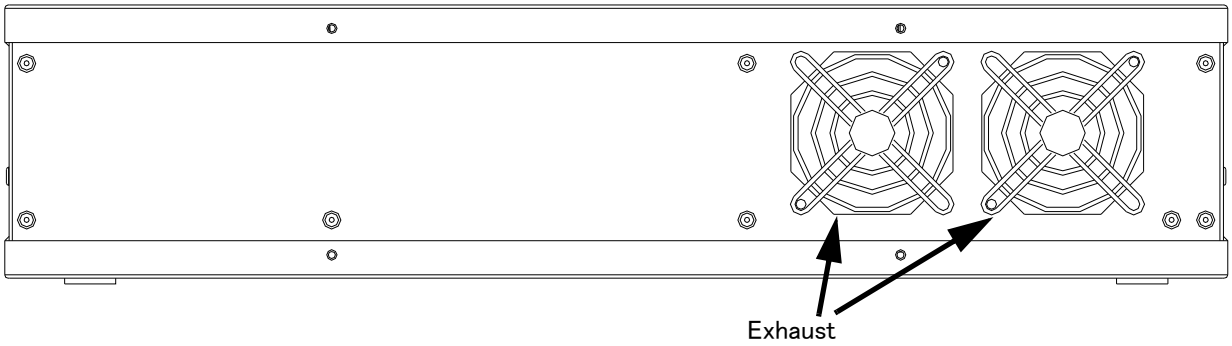


Fig.4-2 : Names of controller parts (CR751)

<1> ACIN connector.....The connector for AC power source (single phase, AC200V) input (a socket housing and a terminal are attached)
Refer to Page 20, "(2) CR751 controller" for how to connect a power cable.
<2> PE terminal.....The screw for grounding of the cable. (M4 screw x 2 place)
<3> POWER lamp.....Lamp of control power source
<4> Machine cable connector (motor power)
AMP1, AMP2: Motor power, BRK: Motor brake
<5> Machine cable connector (motor signal)
CN2: Motor signal
<6>T/B connection connector (TB).....This is a dedicated connector for connecting the R33TB. When not using T/B, connect the attached dummy plug.
<7>Filter cover.....There is an air filter and buttery inside this cover.
<8>CNUSR connector.....The connector for input/ output connection dedicated for robot. (CNUSR1、CNUSR2) (a plug connector attached)
Refer to Page 32, "(2) CR751 controller" for the connection method and the further description of pin assign.
<9>Grounding terminal.....The grounding terminal for connecting cables of option card. (M3 screw x 2 places)
<10>Power supply charge lamp (CRARGE)
The lamp is to ensure safe timing (prevent electric shocks) when removing the cover (users are not normally required to remove the cover).
This lamp is illuminated (red) when electrical energy accumulates on the

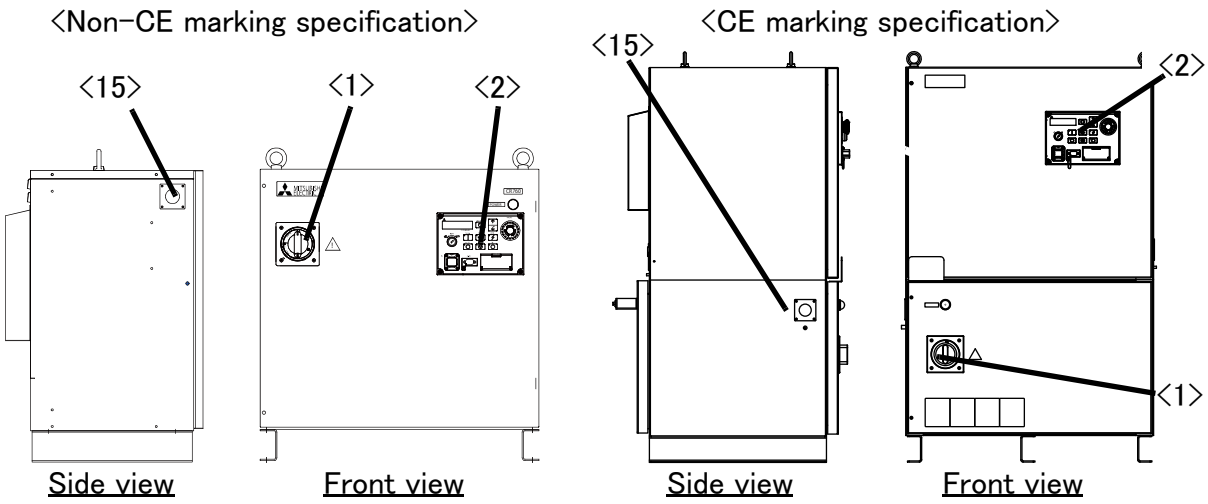
controller's power supply circuit board due to the robot's servo being ON. After turning the control power OFF and allowing a few minutes to pass, the lamp will go out.

<11>USB connecting connector (USB)..For USB connection
<12>LAN connector (LAN).....For LAN connection
<13>ExtOPT connector (ExtOPT).....Connect the cable for addition axis control.
<14>RIO connector (RIO).....Connect the extension parallel input/output unit.
<15>Option slot.....Install the interface optional. (Install the cover, when not using.)
(SLOT1、SLOT2)

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

⚠CAUTION For USB connection between the RT ToolBox2 and the robot controller, noise may cause the instability in data communication.
As a solution, switching communication method to LAN connection is recommended.

(3) CR760 controller



<2>: Operation panel

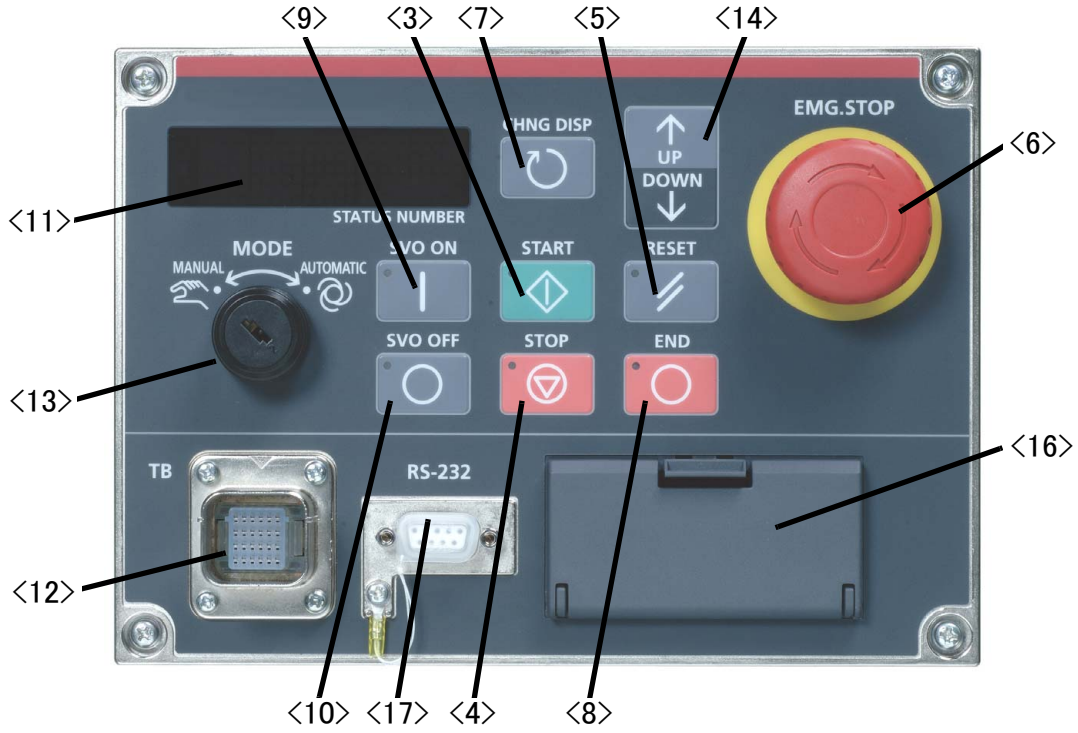
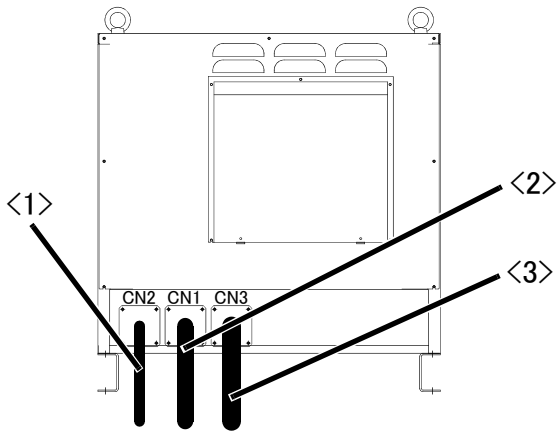


Fig.4-3 : Names of controller parts (CR760)

<1> Power switch.....This turns the control power ON/OFF. (With earth leakage breaker function)
<2> Operation panel.....The operation panel for servo ON/OFF, START/STOP the program etc.
<3> START button.....This executes the program and operates the robot. The program is run continuously.
<4> STOP button.....This stops the robot immediately. The servo does not turn OFF.
<5> RESET button.....This resets the error. This also resets the program's halted state and resets the program.
<6> Emergency stop switch.....This switch stops the robot in an emergency state. The servo turns OFF.
<7> CHNGDISP button.....This button changes the details displayed on the display panel in the order of "Override" → "Line No." → "Program No." → "User information." → "Maker information.".
<8> END button.....This stops the program being executed at the last line or End statement.

<9> SVO.ON button.....This turns ON the servo power. (The servo turns ON.)
<10> SVO.OFF button.....This turns OFF the servo power. (The servo turns OFF.)
<11> Display panel (STATUS.NUMBER).....The alarm No., program No., override value (%), etc., are displayed.
<12> T/B connection connector (TB).....This is a dedicated connector for connecting the T/B. When not using T/B, connect the attached dummy connector.
<13> Mode key switch.....This key switch 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. (Exclude the start of automatic operation.)
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.
<14> UP/DOWN button.....This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.
<15> Cable lead-in port.....Draw in the primary power cable.
<16> Interface cover.....USB interface and battery are mounted.
<17> RS-232 connector.....This is an RS-232 specification connector for connecting the personal computer.

<Non-CE marking specification>



<CE marking specification>

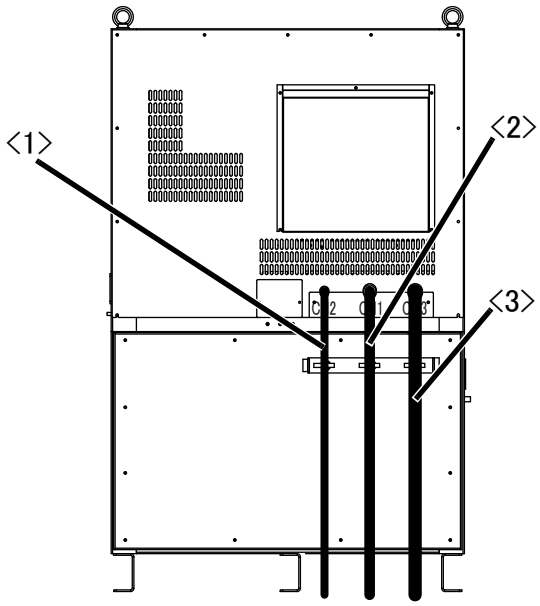
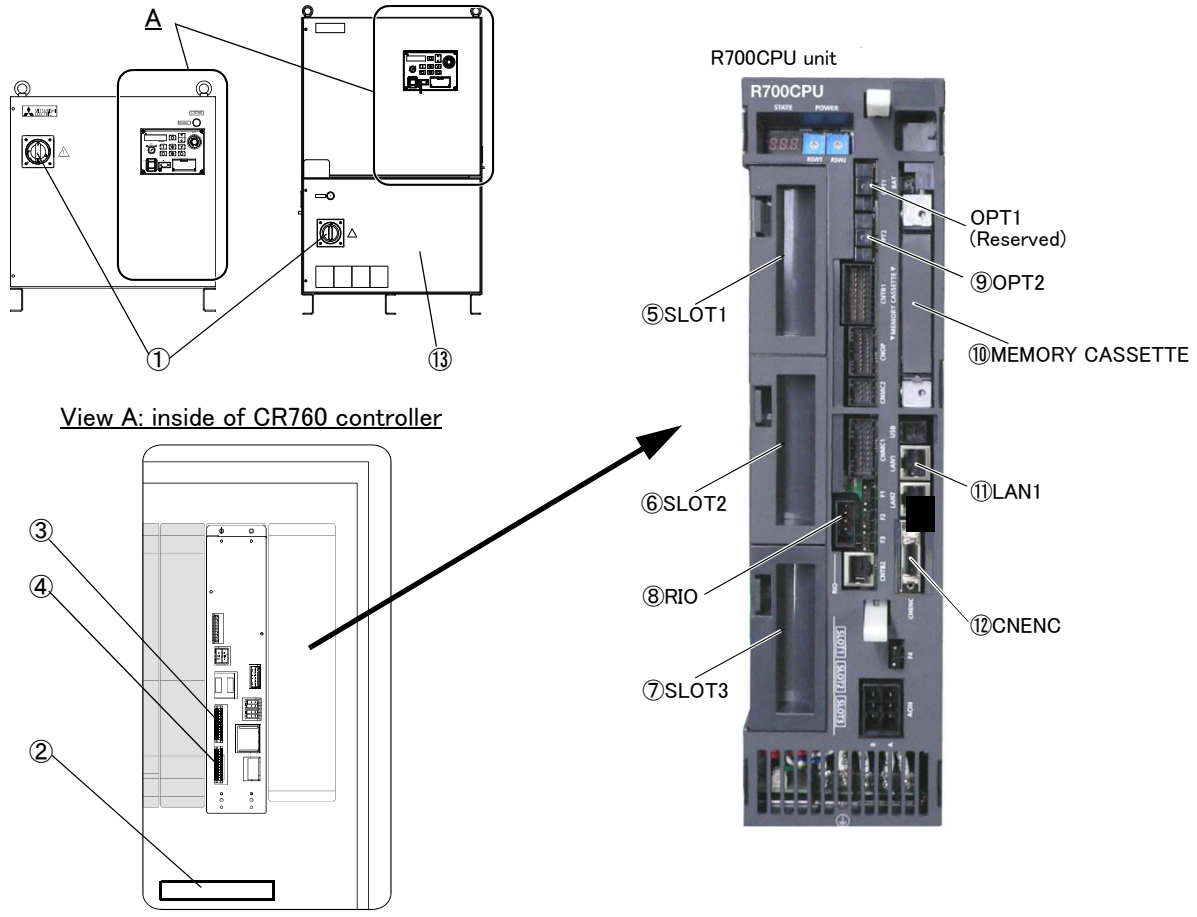


Fig.4-4 : Names of controller parts (Rear of CR760)

<1> Machine cable (For motor signal: CN2).....Connects to the robot arm base. (CN2 connector)
<2> Machine cable (For motor power: CN1).....Connects to the robot arm base. (CN1 connector)
<3> Machine cable (For motor power: CN3).....Connects to the robot arm base. (CN3 connector)



① Earth leakage breaker ..... Connect the primary power source.
② Grounding plate ..... The grounding terminal for grounding the cable. (Strip off the sheath of the cable and ground the controller case using this plate.)
③ EMG1 connector ..... External emergency stop input, door switch input, enabling device switch, and magnet contactor control connector output for addition axes
④ EMG2 connector ..... Emergency stop output, mode output, robot error output, and special stop input (SKIP).
⑤⑥⑦ Option slot (SLOT1, SLOT2, SLOT3) ..... Install the interface optional.
⑧ Extension parallel input/output unit connection connector (RIO)
Connect the extension parallel input/output unit.
⑨ Addition axis connection connector (OPT2) ..... Connect the cable for addition axis control.
⑩ Expansion memory cassette (MEMORY CASSETTE) ..... Install the memory cassette optional.
⑪ Ethernet interface (LAN1) ..... Connect the Ethernet cable.
⑫ Tracking interface (CNENC) ..... Connect the encoder cable, if it uses the tracking function.
⑬ Transformer box (CE marking specification only) ..... Connect a power cable and a grounding cable.

Fig.4-5 : Names of controller parts (inside of CR760)

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

⚠CAUTION For USB connection between the RT ToolBox2 and the robot controller, noise may cause the instability in data communication.
As a solution, switching communication method to LAN connection is recommended.

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

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

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

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

4.2 Handling the T/B

4.2.1 Installing and removing the T/B

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

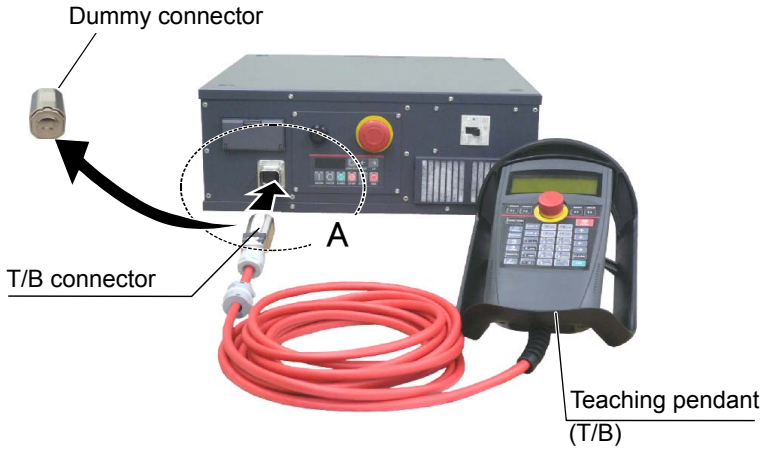
Please do not pull the cable of T/B strongly or do not bend it too much.
It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself.

(1) Installing the T/B (CR750/CR760 controller)

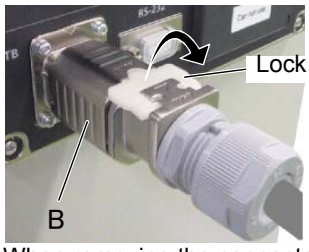
Explain the installation method of T/B below.

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. 4-6, and push in until there is sound.

<CR750 controller>

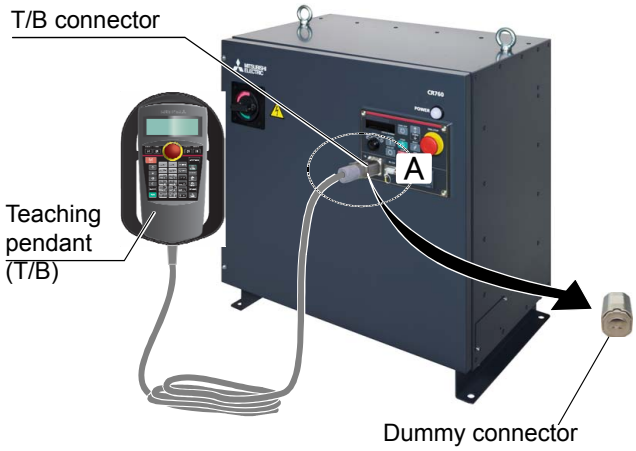


Details of the A section



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.

<CR760 controller> Note)



Note) As for CE marking specification of CR760, the transformer box is installed in the controller bottom. Refer to Fig. 4-5.

Fig. 4-6 : Installing and removing the T/B (CR750/CR760 controller)

The installation of T/B is finished.

(2) Installing the T/B (CR751 controller)

Explain the installation method of T/B below.

1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Connect the T/B connector to the controller's T/B connector. Make sure to fix it securely by fastening the hand locks (in 2 places), as shown in Fig. 4-7.

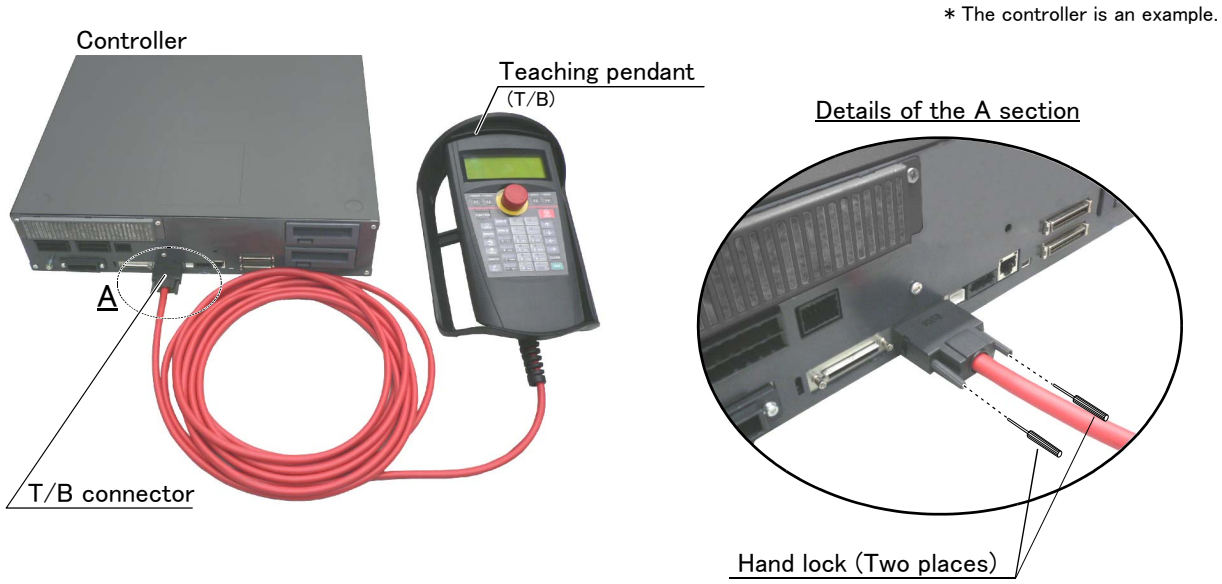


Fig. 4-7 : Installing and removing the T/B (CR751 controller)

The installation of T/B is finished.

(3) Removing the T/B (CR750/CR760 controller)

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.
   Please install the dummy connector, if you use the robot, without connecting T/B.

The removing of T/B is finished.

(4) Removing the T/B (CR751 controller)

Explain the removing method of T/B below.

1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Loosen the handle locks (two places) of a connector, and pull up the connector.
   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

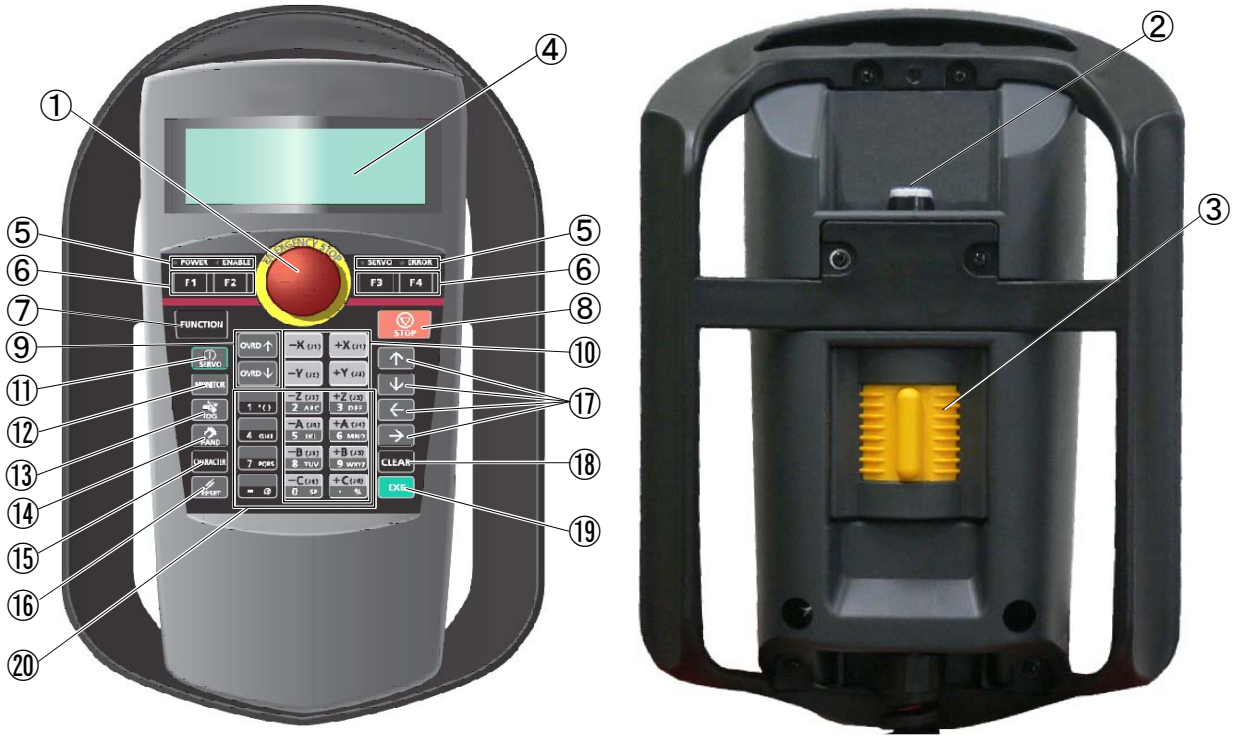


Fig. 4-8 : Teaching pendant

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.

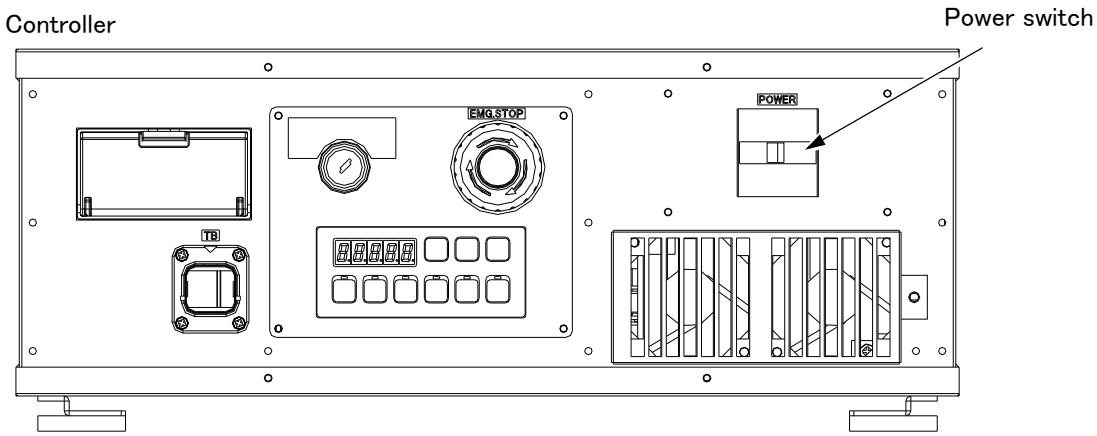
4.3 Turning the power ON and OFF

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.

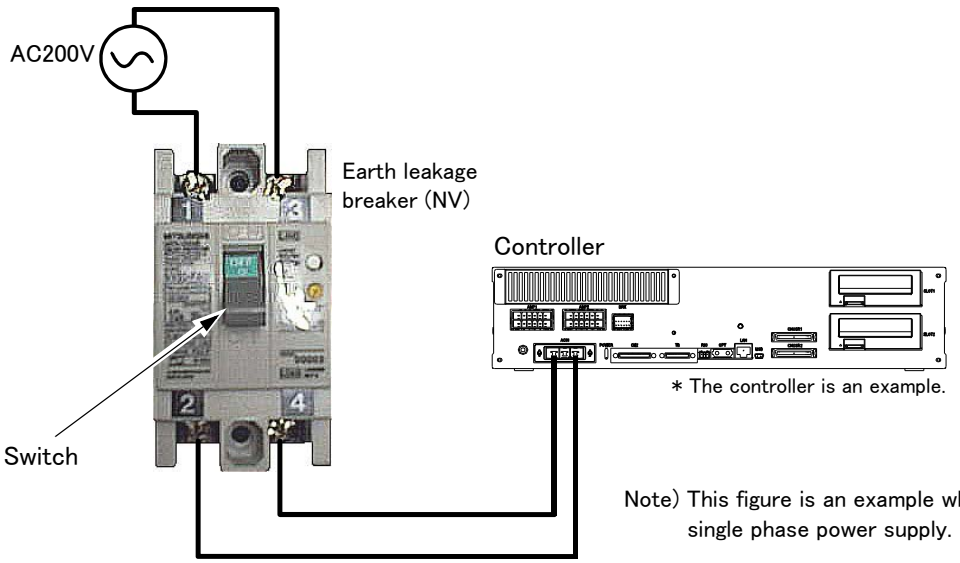
(1) CR750 controller



Turn the controller [POWER] switch ON. The controller power turn on, and the STATUS NUMBER display lights up.

(2) CR751 controller

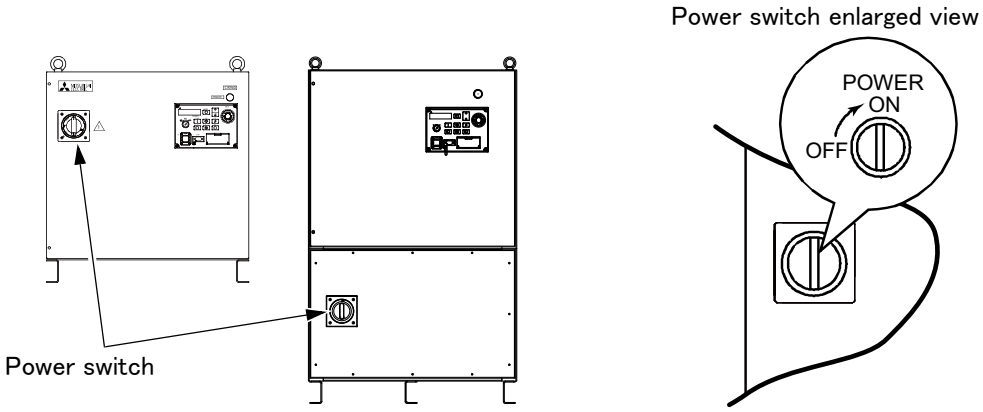
Note) Although the figure shows the CR751 (Thin type), it is the same also in a CR751 (Heavy type).



Note) This figure is an example which connected the single phase power supply.

Operate the earth leakage breaker of installation outside to do the controller's power supply ON/OFF. Turns ON the switch of the earth leakage breaker of installation outside. The controller power turn on, and the power lamp lights up.

(3) CR760 controller



Turn the controller [POWER] switch ON. The controller power turn on, and the STATUS NUMBER display lights up.

[Note] If the following issue occur with the power supply ON of the controller, please contact to the dealer.
- Although the FAN of the controller is operating, the operation panel does not light up and the operation of the robot cannot be done.
- Although the T/B has got the electricity, the operation of T/B cannot be done.

◇◆◇ 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.

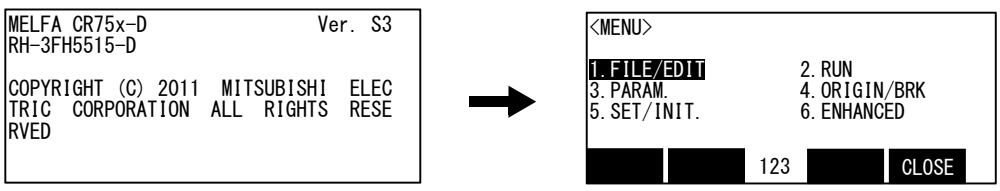
◇◆◇ Error: It is if C0150 occurs. ◇◆◇

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. (Refer to Page 86, "4.3.2 Input the serial number".)

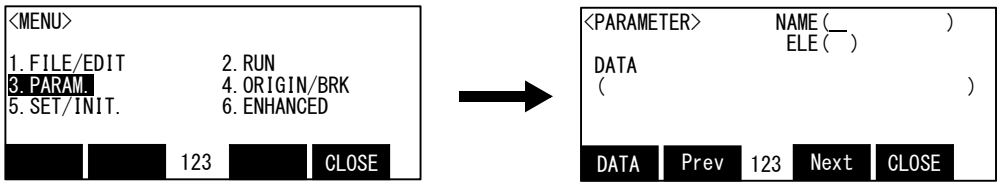
4.3.2 Input the serial number

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.

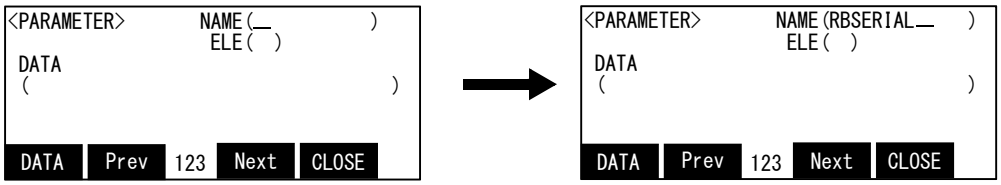
1) Press the [RESET] key of T/B and cancel the error of T/B.
2) Press the [EXE] key of T/B and display the menu panel.



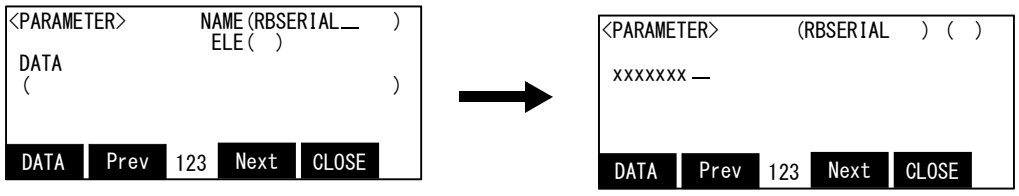
3) Press the [3] key of T/B and display the parameter.



4) Input "RBSERIAL" into the name.



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

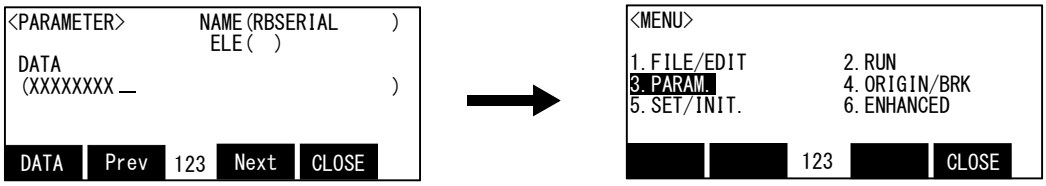


Press the [EXE] key, and fix the value with sound, and return to the parameter screen.

◇◆◇ The input of the number/character ◇◆◇

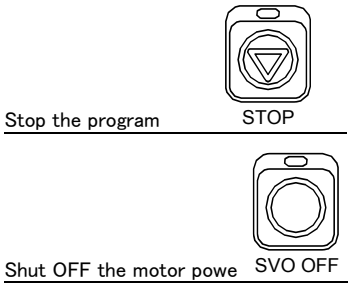
Each time the [CHARACTER] key is pressed, the number input mode and the character input mode change. The current input mode is displayed in the center under the screen, and the display of "123" shows that the number input mode and "ABC" is the character input mode.
For details, please refer to "INSTRUCTION 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.



4.3.3 Shutting OFF the control power

＊Following figures are CR750 controller's switch.



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

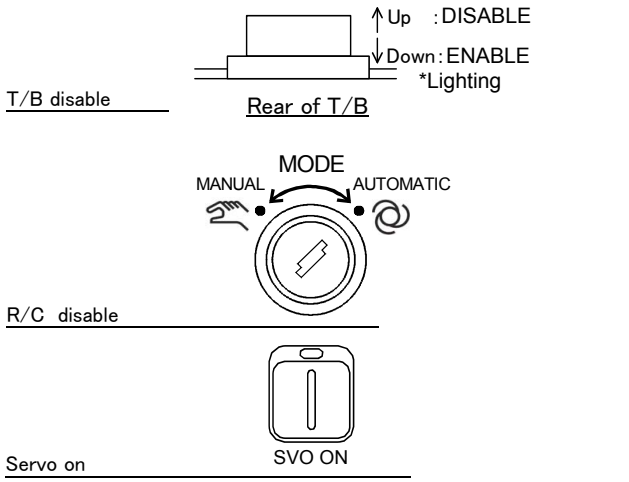
2) After the robot has stopped, press the controller [SVO OFF] switch, and turn the servo OFF.

3) Turning off operation of the controller power according to the controller type is shown below.
   ＊CR750/CR760 controller: turn OFF a front power switch.
   ＊CR751 controller: turn OFF the switch of the earth leakage breaker installed outside.

   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)



* Figures above are CR750 controller's switch.

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

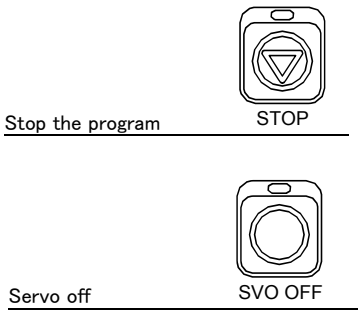
2) Confirm that the mode of the controller is set to "AUTOMATIC".

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)

* Following figures are CR750 controller's switch.



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

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

◇◆◇ Operation rights not required ◇◆◇

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

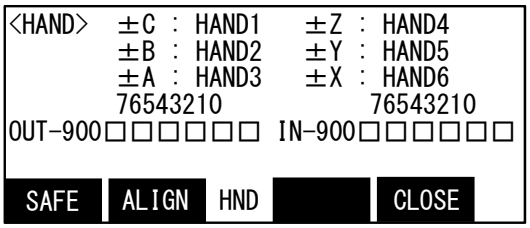
4.5 Jog operation

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

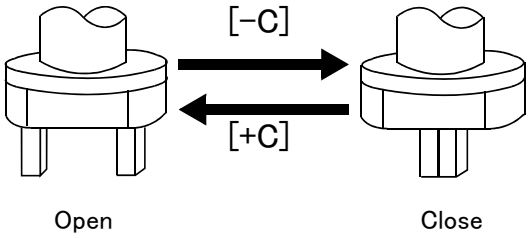
Jog mode	Main application	Explanation
JOINT JOG	・Moves each joint. ・Moves the robot arm largely. ・Changes the robot posture.	Separate manual "Robot arm setup and maintenance" Separate manual "Detailed explanations of functions and operations"
XYZ JOG	・Accurately sets the teaching position. ・Moves the 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.	
WORK JOG (Work jog mode)	・Accurately sets the teaching position. ・Moves the axis straight along the coordinates system (work coordinates system) defined in accordance with a workpiece, pallet, etc. ・Changes the posture along the work coordinates system.	
WORK JOG (Ex-T jog mode)	・Accurately sets the teaching position. ・Moves the axis straight along the work coordinates system (Ex-T coordinates system) defined in accordance with an installed grinder, dispenser, etc. ・Changes the posture along the work coordinates system (Ex-T coordinates system).	

4.6 Opening and closing the hand

Hands 1 to 6 can be opened and closed with the T/B.



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

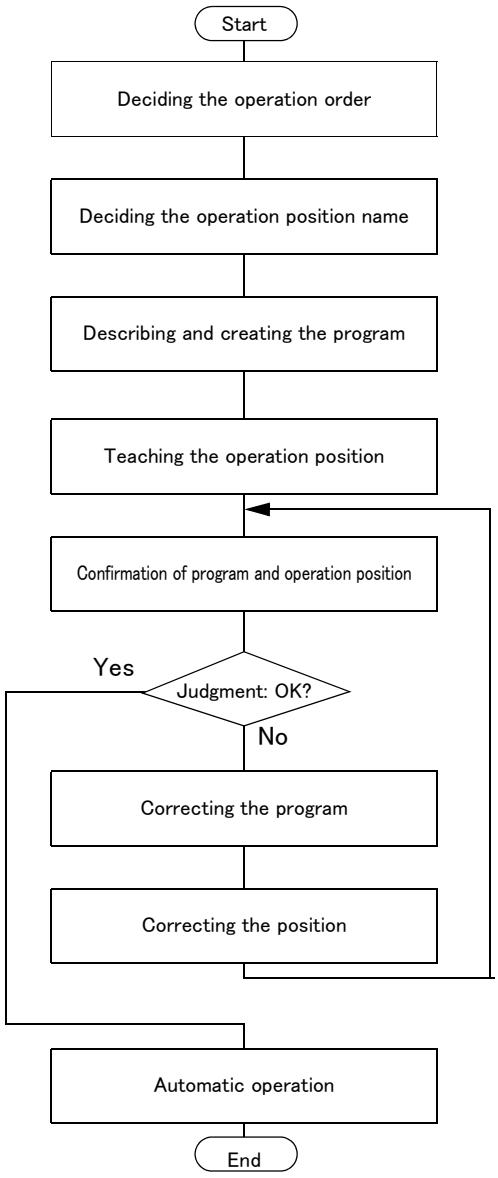


Opening and closing hand 1
Open: Press [+C] key
Close: Press [-C] key
Opening and closing hand 2
Open: Press [+B] key
Close: Press [-B] key
Opening and closing hand 3
Open: Press [+A] key
Close: Press [-A] key
Opening and closing hand 4
Open: Press [+Z] key
Close: Press [-Z] key
Opening and closing hand 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



Decide the robot operation order, operation path (necessity of linear movement), and the work at each operation position (hand open/close, etc).

Teach the robot operation position in the position variables.
Decide the position variable name.

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.

Move the robot to each operation position with jog operation, and teach each position in the position variables.

Execute the program saved in the controller line by line, and confirm that the program and operation positions are correctly saved.

If any mistakes were found in the robot operation or work during the program confirmation, correct the program.

If any mistakes were found in the robot operation position during the program confirmation, correct the taught position.

Automatically execute the completed program.

Fig.4-9 : Program creation procedures

(2) Robot work

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

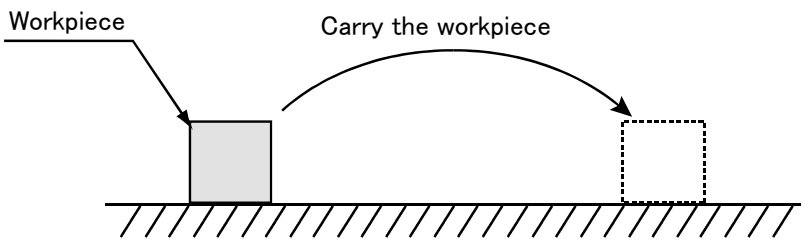
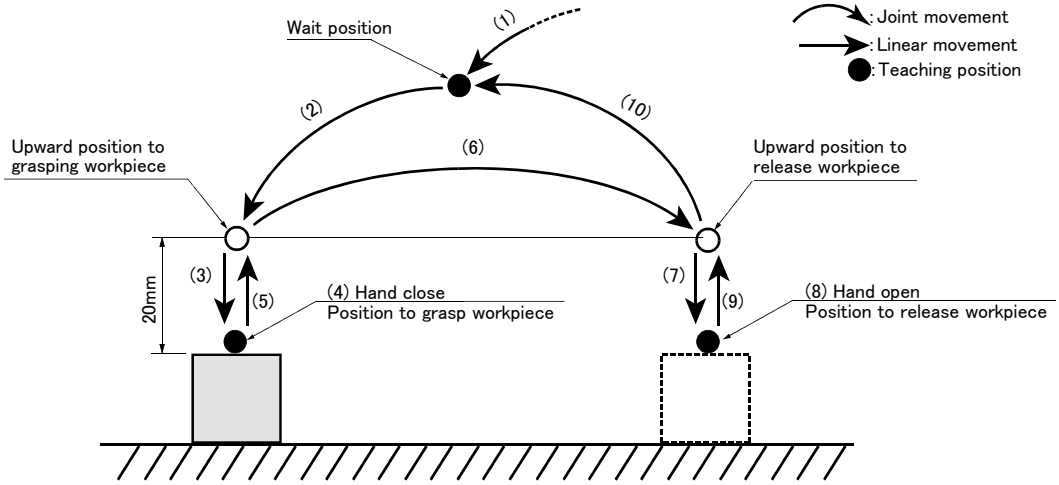


Fig.4-10 : Example of work

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

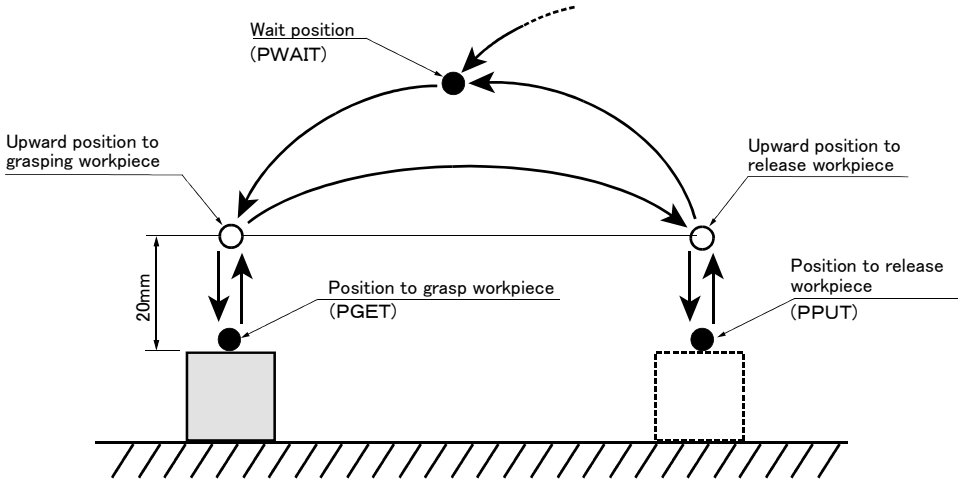
Fig.4-11 : Deciding the operation order

◇◆◇ 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.4-12 : 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. 4-12 can be designated with commands as "position 20mm away from target position". Refer to Page 95, "(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.

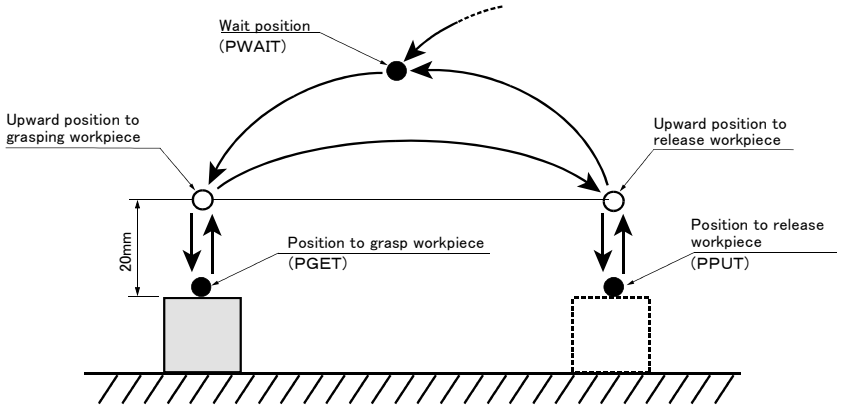
Refer to the separate manual "Instruction Manual: Detailed explanations of functions and operations" for details on the commands.

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

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. Confirm the Z axis direction of the TOOL coordinate system. Then, designate the correct sign (direction) that matches the robot being used. The example of designation above is an example using a horizontal multiple-joint type robot.

■ 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. 4-13 : 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. 4-13.

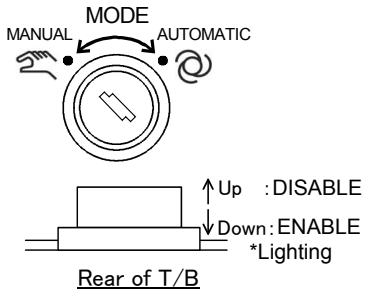
Example) 1　　Ｍｏｖ　　ＰＷＡＩＴ

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

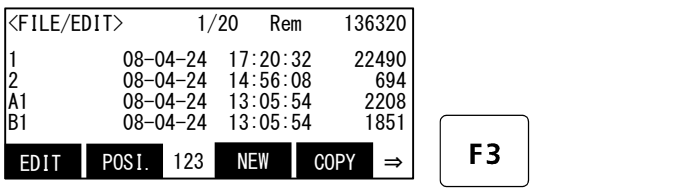


Rear of T/B

1) Set the controller mode to "MANUAL".

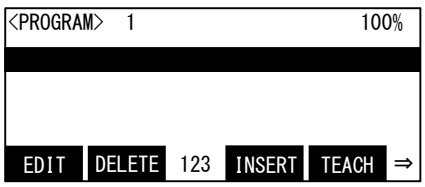
2) Set the T/B [ENABLE] switch to "ENABLE".

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.



CLEAR

◇◆◇ Using the T/B ◇◆◇

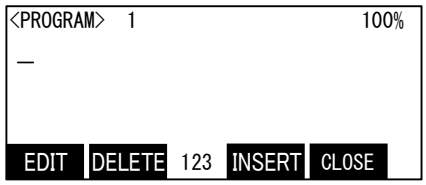
Set the controller mode to "MANUAL" and the T/B [ENABLE] switch to "ENABLE". Operations from the T/B are not possible unless the controller mode is set to "MANUAL".

◇◆◇ 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.

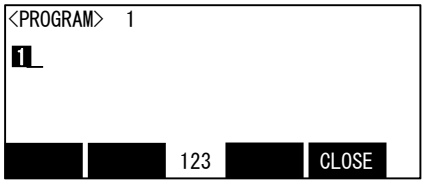
◇◆◇ Correcting incorrect numbers ◇◆◇

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.



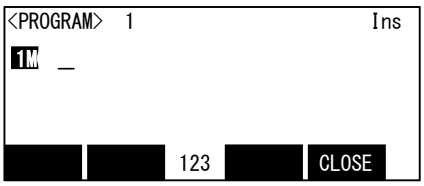
F3

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



1 '( )

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

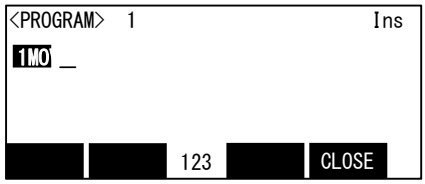


CHARACTER

−C (J6) 0 SPACE

+A (J4) 6 MNO

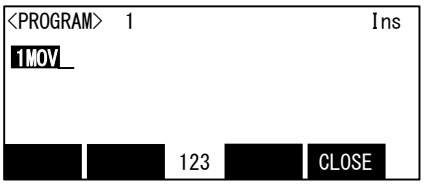
8) Press the [CHARACTER] key, and set to the character input mode, then press [SP] , [MNO] key. Display the space and "M."



→

+A (J4) 6 MNO

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



−B (J5) 8 TUV

10) Press the [TUV] key 3 times, and input "v".

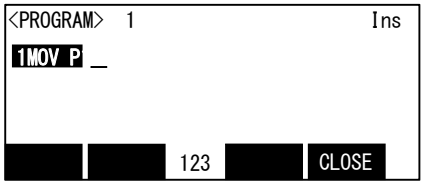
◇◆◇ Inputting characters and space ◇◆◇

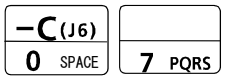
Each time the [CHARACTER] key is pressed, the number input mode and the character input mode change. The current input mode is displayed in the center under the screen, and the display of "ABC" shows that the character input mode. The character currently written to the lower right of each key in this 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 ◇◆◇

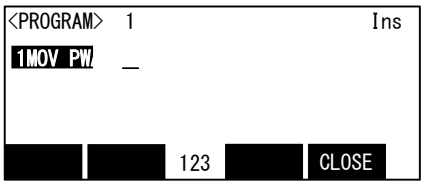
It comes out to input the character which is not displayed on the key. The character currently assigned to the key is shown below.

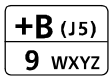
a) [' ( )] key..... ' → (→) → " → ^ → : → ; → ¥ → ?
b) [@ =] key..... @ → = → + → − → * → / → < → >
c) [, %] key..... , → % → # → $ → ! → & → _ → .



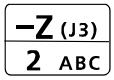


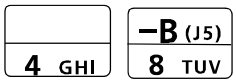
11) Press the [SP], [PQRS] key, and input the space and "P".





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





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

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

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 ◇◆◇

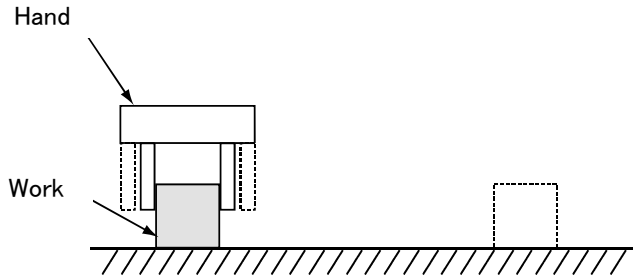
Display the four lines on the screen of T/B. For moving the cursor to the front line, the [↑] key is pressed, for moving the cursor to the next line, press the [↓] key, and select.

◇◆◇ 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)

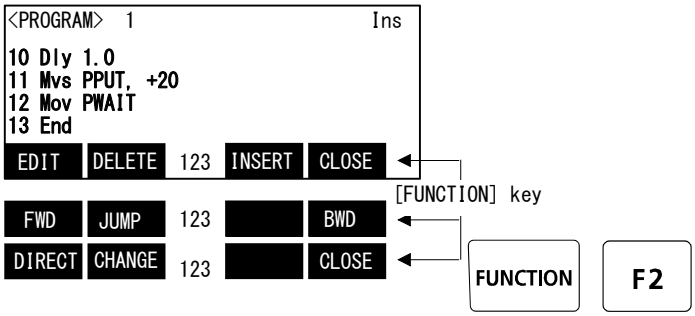


1) Move the robot with jog operation, and set the end of the hand to the position for grasping the workpiece. When the position has been set, open and close the hand to confirm that the workpiece can be grasped.

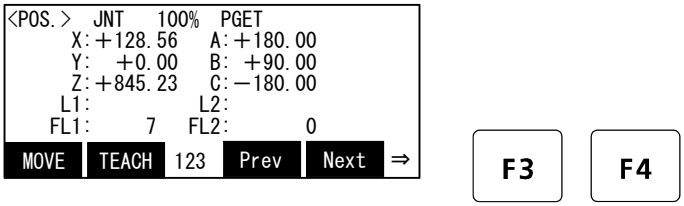
Refer to Page 90, "4.5Jog operation" for details on the jog operation, and section Page 91, "4.6Opening and closing the hand" for detains on opening and closing the hand.

◇◆◇ Effective use of jog mode ◇◆◇

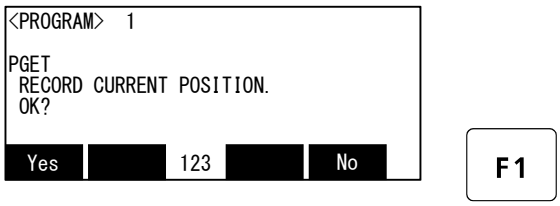
When the robot's current position is greatly separate from the target position, move the robot in axis units with the "JOINT JOG mode", to approach the position.
If the target position is nearby, move linearly with the "XYZ JOG mode", and finely adjust the position. The position can be set accurately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



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.

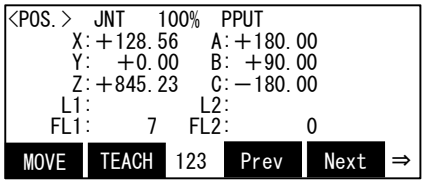


3) Press the [F3](Next) or the [F4](Prev) key, and display "PGET" on the screen upper right.
The current registration coordinate value of the position variable name PGET is displayed.



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.

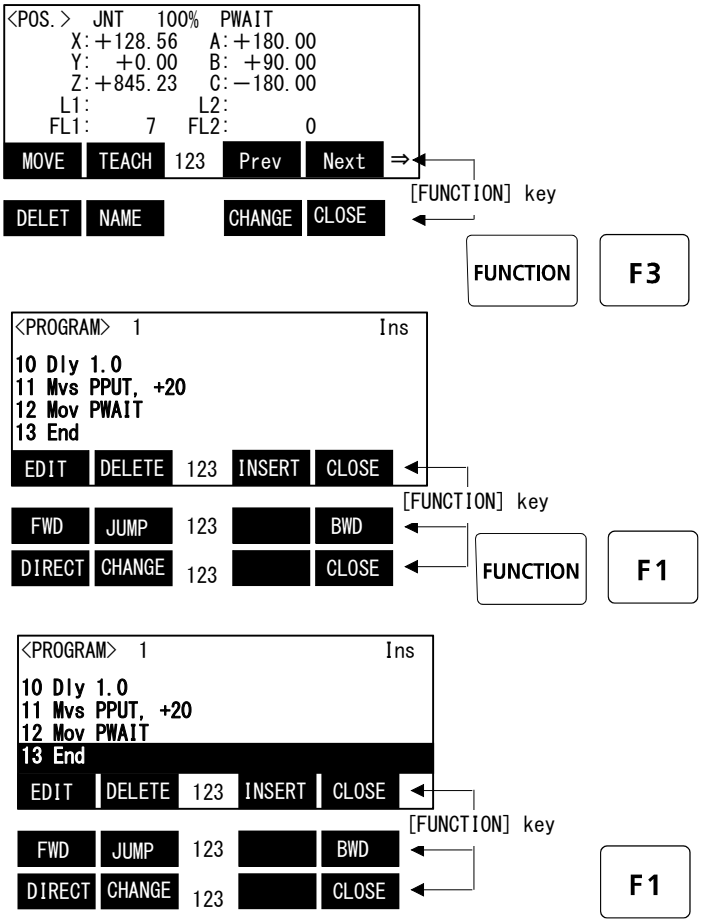
This completes teaching of the robot operation positions.

◇◆◇ 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.



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

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.

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) 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 ◇◆◇

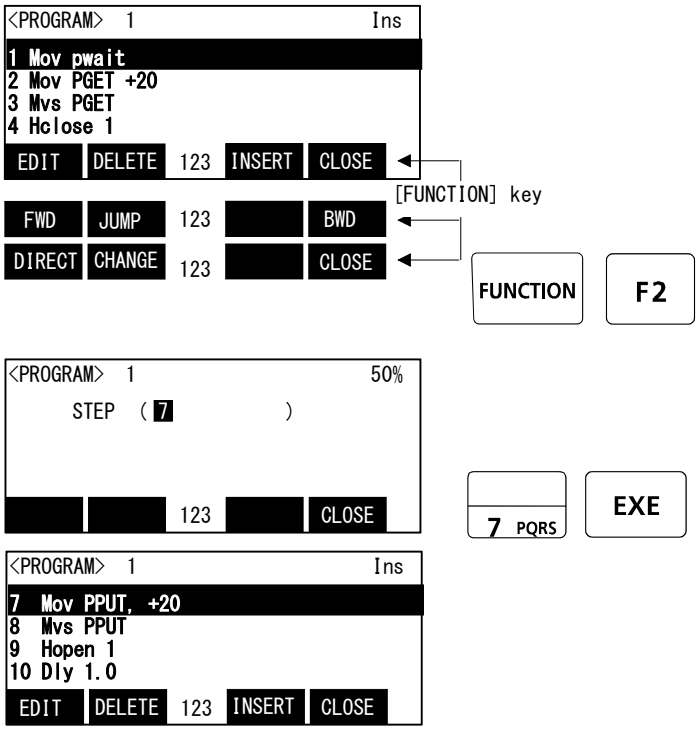
- Press the [EMG.STOP] (emergency stop) switch.
  The servo will turn OFF, and the moving robot will immediately stop.
  To resume operation, reset the alarm, turn the servo ON, and start step operation.
- Release or forcibly press the "enable" switch.
  The servo will turn OFF, and the moving robot 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)



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

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

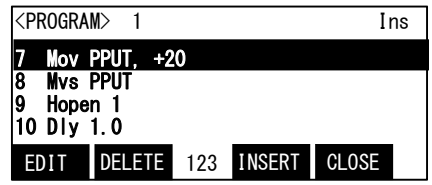
⚠ CAUTION Note) Upward movement is designated at a position along the Z axis of the TOOL coordinate system, and the direction is designated with the + and − signs.
Refer to the section on the TOOL JOG operation in the separate "Installation Manual/ Robot arm setup and maintenance", and confirm the Z 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.

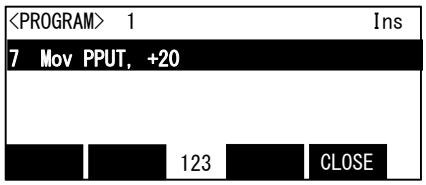
◇◆◇ Displaying the previous and next command step ◇◆◇

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.



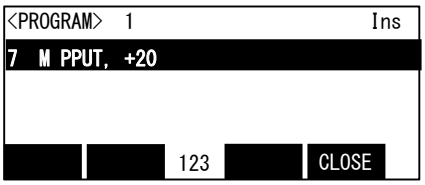
F1

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



→

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



CLEAR

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

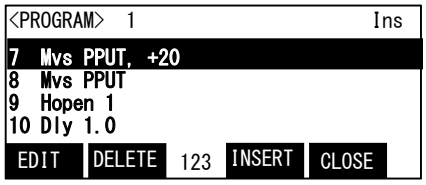
CHARACTER

−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.



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 ◇◆◇

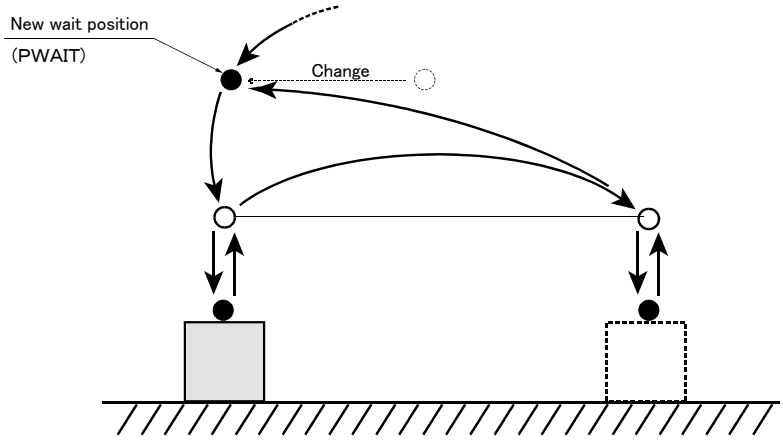
After correcting the program, carry out step operation, and confirm that the program has been corrected.

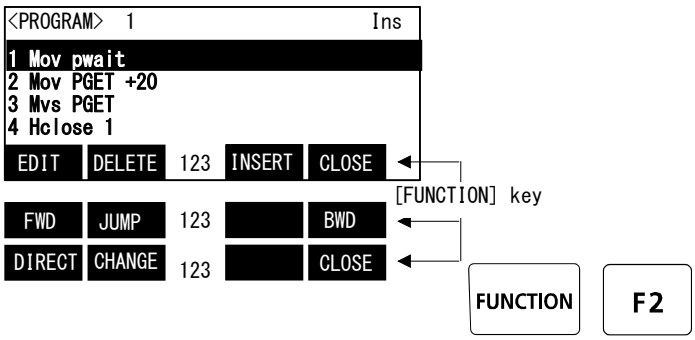
◇◆◇ Inputting characters and space ◇◆◇

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.

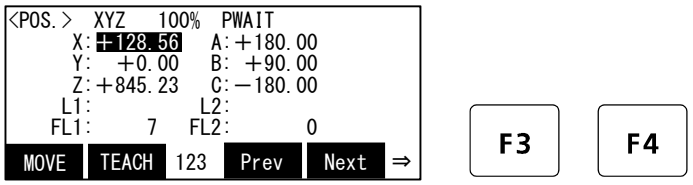
■ Correcting the taught position

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



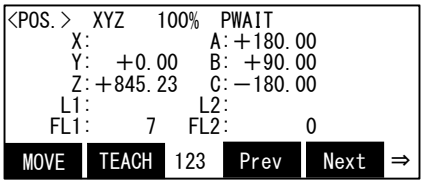


1) In the program edit screen, press the [FUNCTION] key twice and change the function display. [F2](change) Press the key and display the position edit screen.



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.

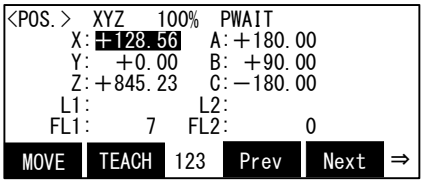


Move the robot to the new standby position by jog operation.

Refer to Page 90, "4.5Jog operation" for details on the jog operation, and section Page 91, "4.6Opening and closing the hand" for detains on opening and closing the hand.

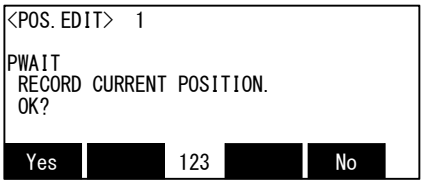
◇◆◇ Calling out a position variable ◇◆◇

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



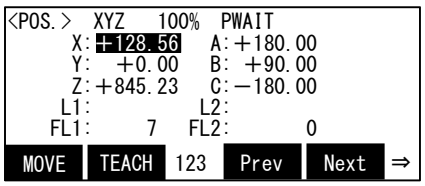
F2

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



F1

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



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.

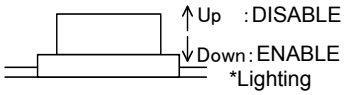
(7) Start automatic operation.

⚠ 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.

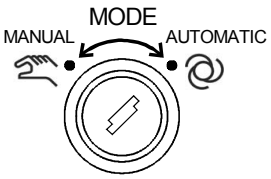
In the following explanation, automatic operation will be carried out with the controller.
Starting the automatic operation by T/B is available in the version of T/B 1.7 or later. Refer to separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details.

Prepare the controller



Dsiable the T/B — Rear of T/B

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



Enable the R/C

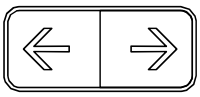
2) Set the controller mode to "AUTOMATIC".

Set override

* Following figures are CR750 controller's switch and display panel.

Dsiplay override — CHNG DISP

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%.



Set override

⚠ CAUTION The servo will turn OFF when the controller mode is changed.
Note that axes not provided with brakes could drop with their own weight.

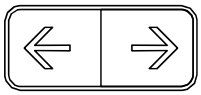
Select the program number

＊Following figures are CR750 controller's switch and display panel.

Display the program number CHNG DISP

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.



DOWN UP

Select the program number

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

Start automatic operation

Servo on SVO ON

Start START

End with one cycle END

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.
The robot operation will start and will stop after one cycle.

⚠ CAUTION

When executing the work example given in Page 92, "Fig.4-10 : 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 to "AUTOMATIC". Operations from the controller are not possible unless the controller mode 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), th override display will increment or decrement each time the [UP] or [DOWN] key is pressed. The max. speed is 100%.
Initially set a low speed, and gradually increase it.

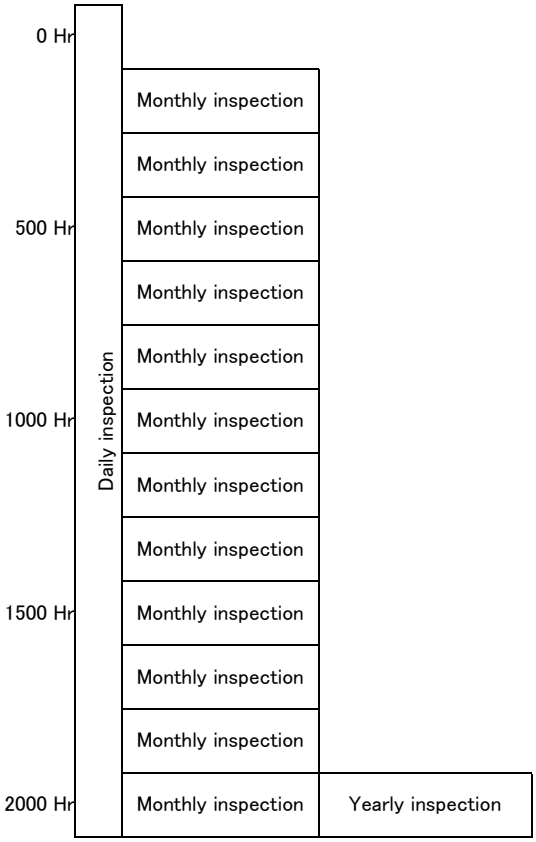
5 Maintenance and Inspection

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

5.1 Maintenance and inspection interval

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

(1) Inspection schedule



Operating time

<Guideline for inspection period>

For one shift

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

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

For two shifts

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

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

Fig. 5-1 : Inspection schedule

5.2 Inspection items

The controller inspection items are shown below.

Refer to section "Maintenance and Inspection" in the separate manual "Robot arm setup and maintenance", and inspect the robot arm at the same time.

5.2.1 Daily inspection items

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

Table 5-1 : Daily inspection items (details)

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

5.2.2 Periodic inspections

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

Table 5-2 : Periodic inspection items (details)

Procedure	Inspection items (details)	Remedies
Monthly inspection items		
1	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
2	Is the controller filter dirty? (Visual)	Clean or replace with a new part. Inspect, clean and replace the filter by refer to Page 113, "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 110, "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 Page 115, "5.4 Maintenance parts". Contact your dealer for these parts when required.

5.3.1 Replacing the battery

While power of controller is turned off, the programs must be saved by the backup battery. The robot arm also uses backup batteries to save the position data of an encoder. 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 lithium 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 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.

The method of replacing the battery of the controller is shown below. Refer to the separate "ROBOT ARM SETUP & MAINTENANCE" about robot arm's battery.
About the purchase of the battery, refers to Page 115, "5.4 Maintenance parts".

⚠ 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 CR750/CR760 controller

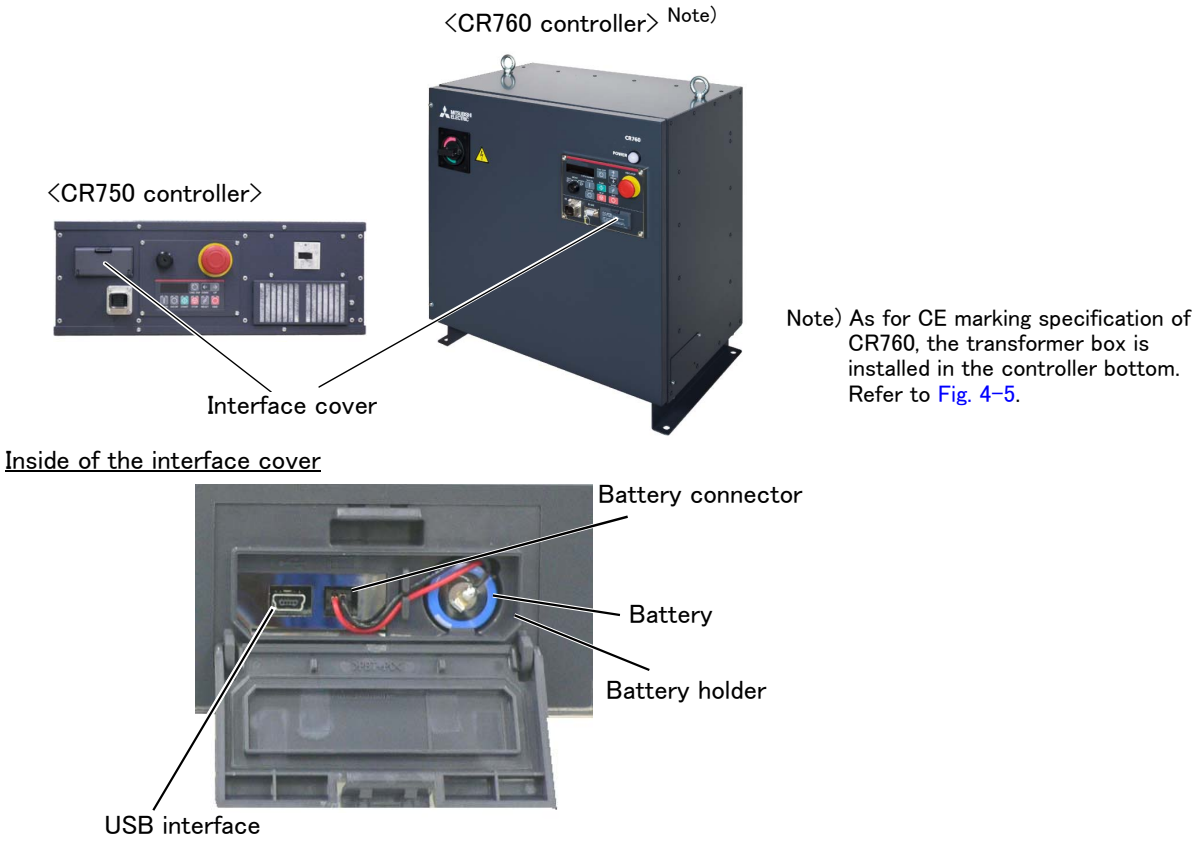


Fig. 5-2 : Exchange of the battery (CR750/CR760 controller)

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 on the front of the controller. 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.

(2) The battery exchange method of the CR751 controller

Note) Although the figure shows the CR751 (Thin type), it is the same also in a CR751 (Heavy type).

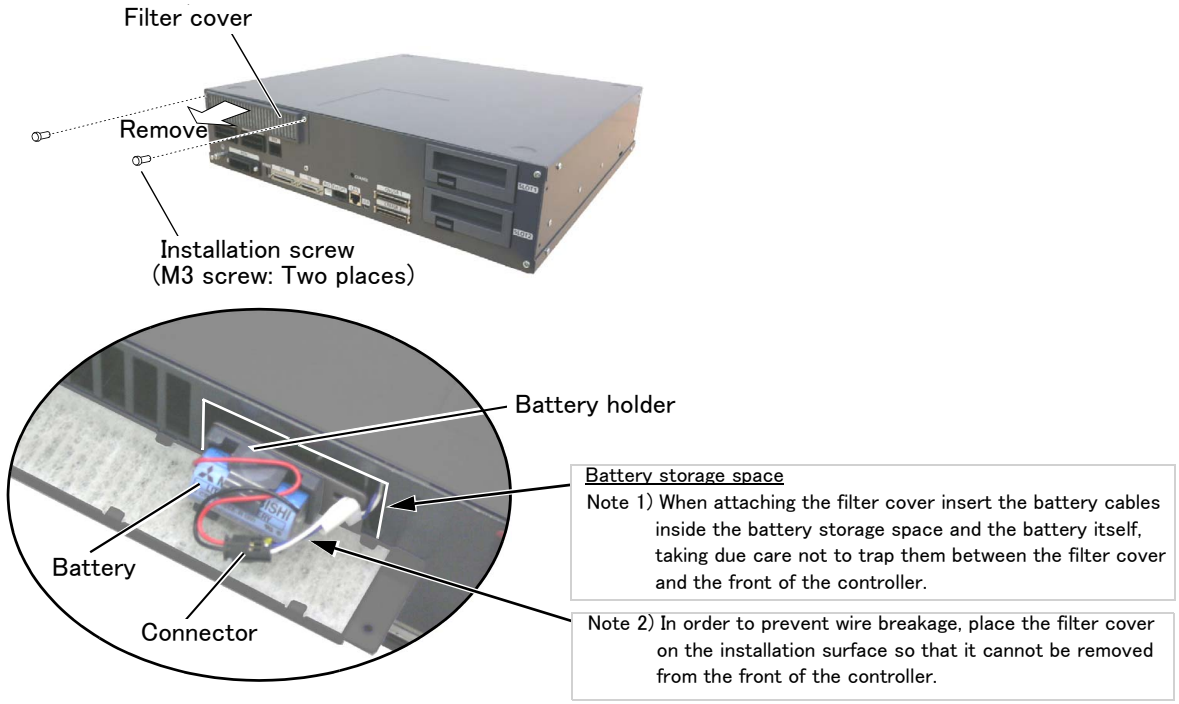


Fig. 5-3 : Exchange of the battery (CR751 controller)

1) Turn the controller power ON once. (For approx. one minute.)
2) Turn OFF the power supply of the controller and remove the filter cover of the controller front. The battery is in the filter cover. Place the filter cover on the installation surface so that it cannot be removed from the front of the controller.
3) Pick and pull up the connector of the old battery and remove from battery holder.
4) Fix new batteries into the battery holder. As shown in Fig. 5-3, fix the cables that come out of the battery so that they are not trapped by the side of the filter.
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) Make sure that the filter is not separated from the cover, and re-fix the filter cover on to the front of the controller, fixing securely. When doing this take care not to trap the battery cable.
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 CR750/CR751 controller.
The following shows the procedure for inspecting, cleaning and replacing the filter:

(1) CR750 controller

1) Loosen the M4 x 6 screws and remove the filter cover from the front of the controller. Remove the claw on the left side of the filter cover as it is inserted in the front face of the controller.
2) Remove the filter from the filter cover and remove dust and other dirt that has built up on it.
   * If the filter is particularly dirty then wash it in water and detergent and then dry fully before re-fixing. In the event that the surface of the washed filter has become fluffy, please replace it with a new filter.
3) Attach the cleaned or new filter to the controller, and install the filter cover to controller with the M4 x 6 screw (1 pcs.).

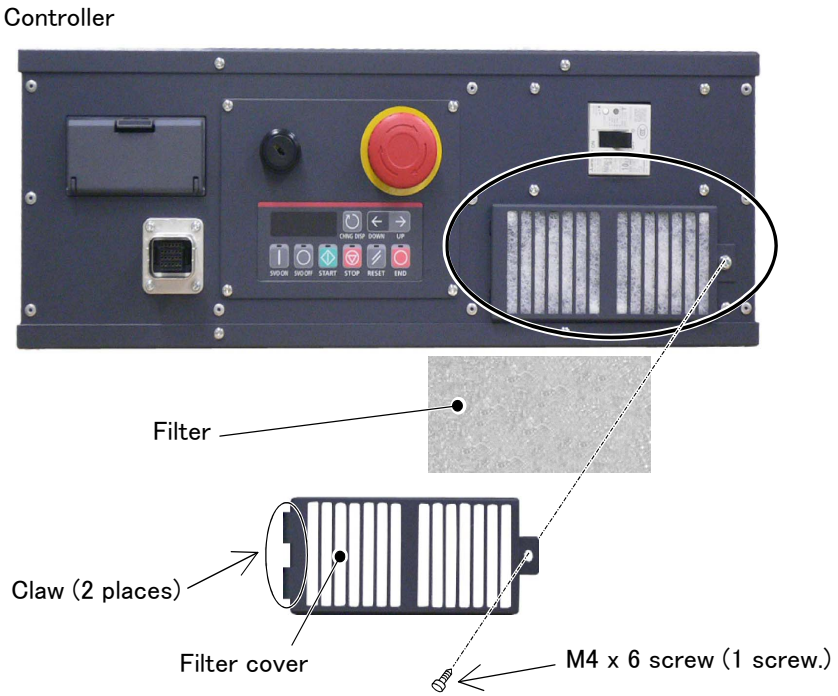


Fig. 5-4 : Cleaning, exchanging the filter (CR750 controller)

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

(2) CR751 controller

1) Loosen the M3 screws and remove the filter cover from the front of the controller. Remove the claw on the left side of the filter cover as it is inserted in the front face of the controller.
2) Remove the filter from the filter cover and remove dust and other dirt that has built up on it.
   * If the filter is particularly dirty then wash it in water and detergent and then dry fully before re-fixing. In the event that the surface of the washed filter has become fluffy, please replace it with a new filter.
3) Attach the cleaned or new filter to the filter plate
4) Make sure that the filter is not separated from the cover, and re-fix the filter cover on to the front of the controller, fixing securely. When doing this take care not to trap the battery cable.

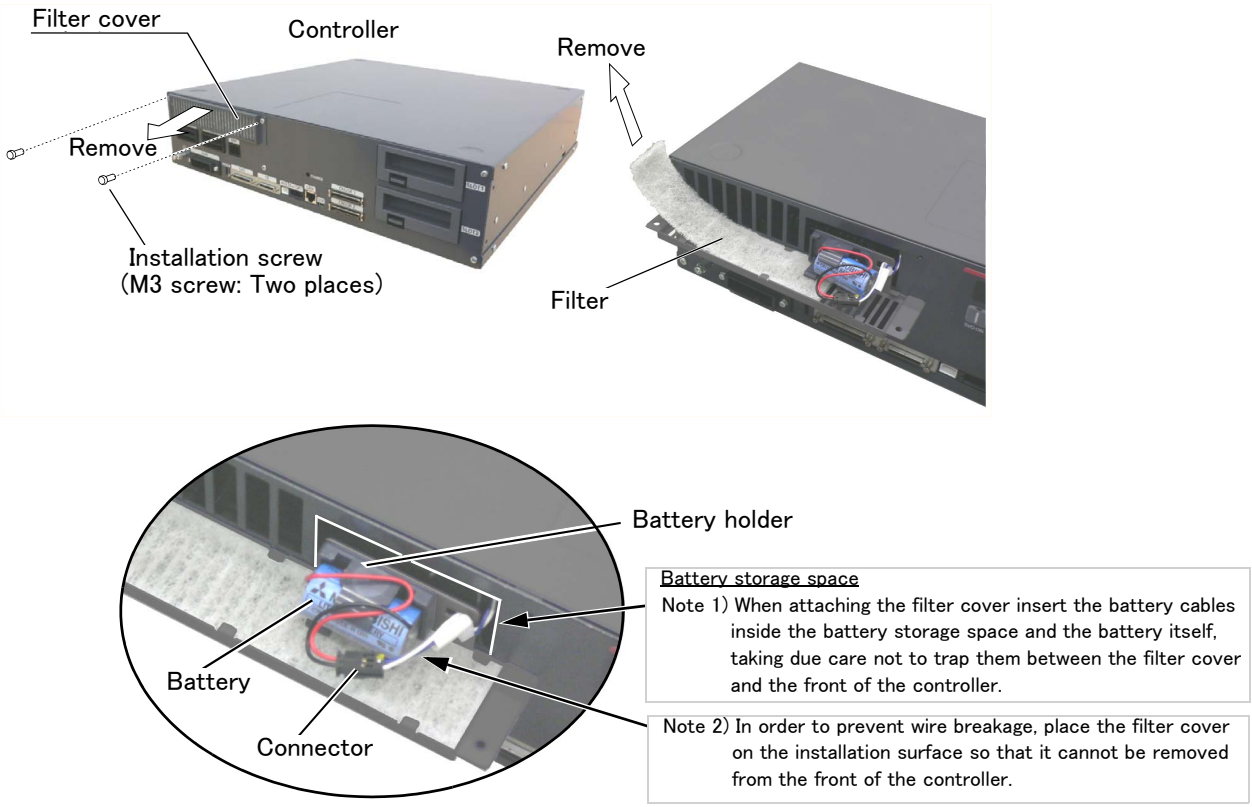


Fig. 5-5 : Cleaning, exchanging the filter (CR751 controller)

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 parts list

No.	Part name	Type Note1)	Qty.	Usage section	Maker
1	Lithium battery	Q6BAT	1	CR750/CR760 controller: Inside the interface cover on the front of the controller.	Mitsubishi Electric System & Service;Co.,Ltd.
				CR751 controller: Inside the filter cover	
2	Filter	BKOFA0773H42	1	CR750 controller: Inside the filter cover.	
		BKOFA0773H41	1	CR751 controller: Inside the filter cover.	

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 parts list

No.	Part name	Type Note1)	Qty.	Usage section	Maker
1	1.6A fuse	LM16	1		Mitsubishi Electric System & Service;Co.,Ltd.
2	3.2A fuse	HM32	1		
3	4A fuse	LM40	1		
4	3.2A fuse	LM32	1		
5	7.5A fuse	GP75	1		

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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