

Simple  friendly



Kawasaki Robot Controller E0x Series

Installation and Connection Manual

Robot

Kawasaki Heavy Industries, Ltd.

PREFACE

This manual describes the installation and connection of the E01/E02/E03/E04 controller and transformer unit for the controller (option).

This manual covers the installation and wiring of the controllers and transformer units (hereafter called control equipment) and connection with external controller, devices and power. Please refer to “Operation Manual” and “External I/O Manual” for the operation of the controller.

Read and understand the contents of this and safety manuals thoroughly and strictly observe all rules for safety before proceeding with any operation.

This manual describes only the installation and connection of the control equipment. For the robot arms, please refer to the separate manuals for them.

This manual also describes devices equipped as an option; however, all the controllers might not include the devices explained here.

This manual is applicable to the following controller models.


E01, E02, E03, E04

-
1. This manual does not constitute a guarantee of the systems in which the robot is utilized. Accordingly, Kawasaki is not responsible for any accidents, damages, and/or problems relating to industrial property rights as a result of using the system.
 2. It is recommended that all personnel assigned for activation of operation, teaching, maintenance or inspection of the robot attend the necessary education/training course(s) prepared by Kawasaki, before assuming their responsibilities.
 3. Kawasaki reserves the right to change, revise, or update this manual without prior notice.
 4. This manual may not, in whole or in part, be reprinted or copied without the prior written consent of Kawasaki.
 5. Store this manual with care and keep it available for use at any time. If the robot is reinstalled or moved to a different site or sold off to a different user, attach this manual to the robot without fail. In the event the manual is lost or damaged severely, contact Kawasaki.


SYMBOLS

The items that require special attention in this manual are designated with the following symbols.


Ensure proper and safe operation of the robot and prevent physical injury or property damage by complying with the safety matters given in the boxes with these symbols.

 **DANGER**

Failure to comply with indicated matters can result in imminent injury or death.

 **WARNING**


Failure to comply with indicated matters may possibly lead to injury or death.

 **CAUTION**

Failure to comply with indicated matters may lead to physical injury and/or mechanical damage.

[NOTE]

Denotes precautions regarding robot specification, handling, teaching, operation, and maintenance.

 **WARNING**

- 1. The accuracy and effectiveness of the diagrams, procedures, and detail explanations given in this manual cannot be confirmed with absolute certainty. Accordingly, it is necessary to give one's fullest attention when using this manual to perform any work. Should any unexplained questions or problems arise, please contact Kawasaki.**
- 2. Safety related contents described in this manual apply to each individual work and not to all robot work. In order to perform every work in safety, read and fully understand the safety manual, all pertinent laws, regulations and related materials as well as all the safety explanations described in each chapter, and prepare safety measures suitable for actual work.**

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1.0 SAFETY

This chapter only describes safety precautions during installation and connection of the control equipment. For all other safety matters, refer to the “Safety Manual”, a separate-volume.

1.1 PRECAUTIONS DURING TRANSPORTATION AND STORAGE

To transport the Kawasaki Robot control equipment to its installation place, strictly observe the following cautions while carrying out the transportation and installation work.

[NOTE]

The installation shall be made by qualified installation personnel and should conform to all national and local codes.



WARNING

1. When transporting a controller with a crane, never support the control equipment manually.
2. During the transportation, stay out from under the lifted control equipment.



CAUTION

1. Since the control equipment is composed of precision parts, be careful not to apply excessive shocks or vibrations to the controller during transportation.
2. To carry out smooth and safe installation, remove all obstacles before installing a control equipment. Clear a passage for the transportation of control equipment before using a crane or forklift.
3. When transporting or storing a controller:
 - (1) keep the ambient temperature within the range of minus 10 - 60°C
 - (2) keep the relative humidity within the range of 35 - 85% RH
(Non condensing)
 - (3) keep free from excessively large shock and vibration.

1.2 INSTALLATION ENVIRONMENTS OF ROBOT CONTROL EQUIPMENT

Install the control equipment in a site that satisfies all the following environmental conditions:

1. Ambient temperature during operation: within 0 - 45 °C
2. Relative humidity: 35 - 85 %RH (Non condensing)
3. Altitude: up to 1000 meters above mean sea level
4. The following environmental conditions should be satisfied for dust, smoke, water, etc.
(Pollution degree and degrees of protection (IPxx) are specified by IEC60664-1 and IEC60529, respectively. See figures on the next pages for the degrees of protection in each control equipment.) The resistance to oil may not sufficient, so do not use the control equipment under the condition where the control equipment gets oil on it or oil mist floats. If the control equipment is used under the condition where there are water and oil around the control equipment, take measures so that the control equipment does not get water and oil.
E01/E02/E03/E04: Pollution degree: 3 or below, IP54 (Protective against entry of dust into the control equipment which causes the loss of control equipment function and water droplets.)



CAUTION

The control equipment cannot be installed under the environment where metal dust, etc. is generated in the following work.

1. Metal workpiece polishing
2. Polished metal workpiece handling
3. Metal workpiece deburring
4. Deburred metal workpiece handling
5. Metal workpiece shotblasting
6. Aluminum package cutting (Cutting powder is generated.)
7. Other processing works where metal dust, etc. is generated.

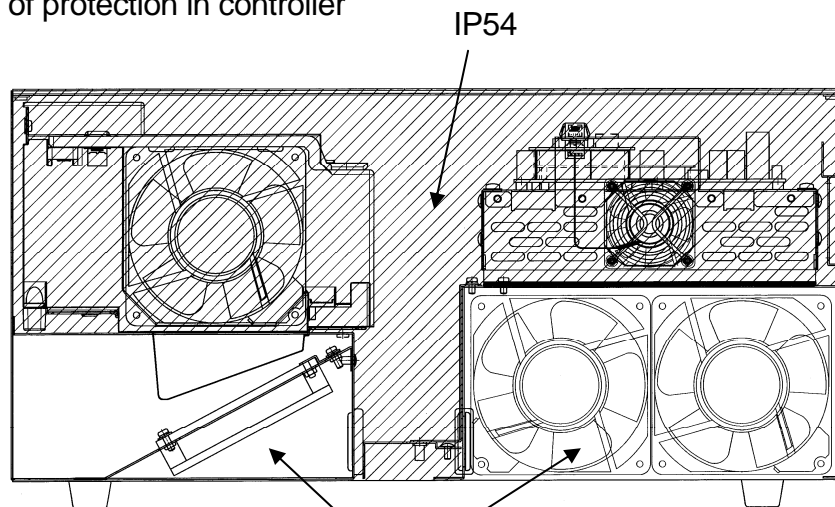
5. Free from electrical noise interference. (Control equipment external power noise: 1 kV/1 μ s or less)



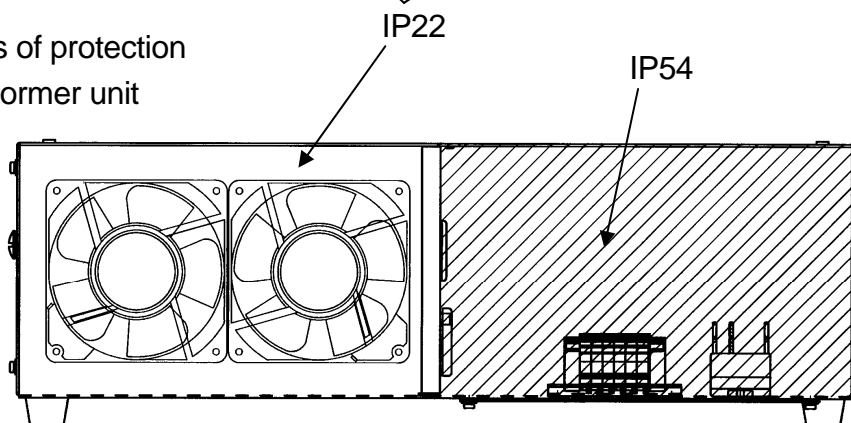
CAUTION

If the control equipment is installed near equipment that generates a lot of electrical noise, be sure to provide appropriate surge killers around that equipment. Noise producing equipment includes: induction motors, electromagnetic brakes, solenoids, or contact equipment, etc.

Degrees of protection in controller



Degrees of protection in transformer unit



6. Free from flammable and/or corrosive liquid and gas.
7. Free from excessively strong vibration.
8. Place where power is supplied within specifications.
9. Place where dedicated earthing is provided. (100 Ω or less)
10. Outside the safety fence with margin (min. 1 m) from the motion range of robot arm (with tools and workpieces).

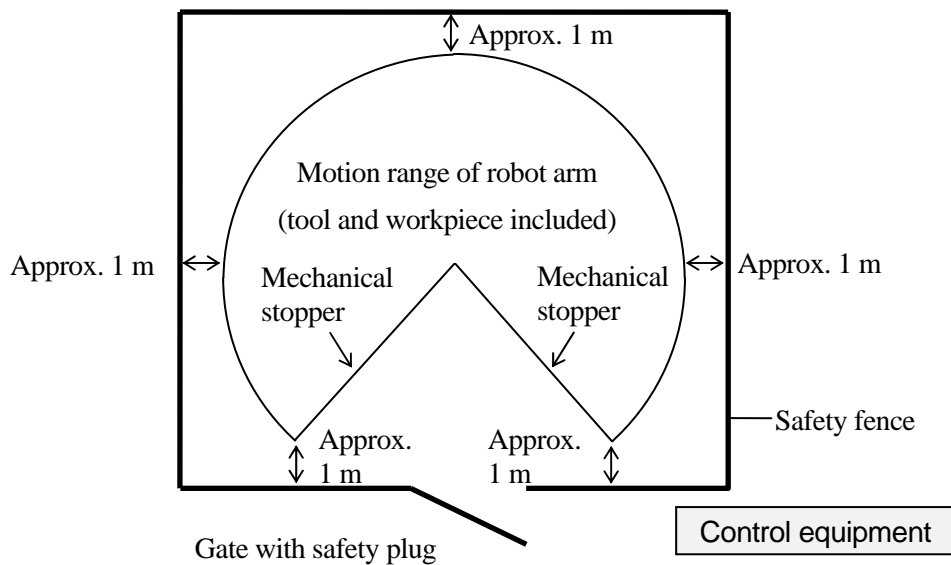


CAUTION

The control equipment shall not be located inside of the robot's motion range/workcell/safety fence.

In addition, ensure the followings:

- Enough space for easy access to the control equipment during maintenance
- Installing an entrance gate with a safety plug to the safety fence
- Referring the requirements established in each region for details of the safety fence (e.g. ISO13852-13855, ISO14119-14120, JISB9707-9708, JISB9710-9711, JISB9715-9716)



1.3 PRECAUTIONS WHEN CONNECTING THE HARNESS

Strictly observe the following precautions when connecting the robot arm with the robot controller.



WARNING

In order to prevent accidents caused by electric shock, do not connect the external power until connections between the robot arm and robot control equipment are complete.



CAUTION

- 1. Be careful when connecting the harnesses. Be sure to use the correct harnesses. Using an incorrect harness, or forcing or misconnecting the harness may damage connectors or cause a break in the electrical system.**
- 2. Prevent people or equipment (forklift etc.) from stepping on or riding over the harnesses and connection cables between transformer unit and controller. Otherwise, the harness may become damaged or the electrical system may break.**
- 3. Separate the harnesses from any nearby high voltage lines (min. 1 m apart). Do not bundle or run the harnesses in parallel with other power lines. Otherwise, the noise generated from power lines will cause malfunctions.**
- 4. Even when the harnesses are long, do not bundle them winded or bended. Bundling the harness causes the heat to build up in the harness, resulting in over-heat and furthermore may cause fire.**

1.4 PRECAUTIONS WHEN CONNECTING THE EXTERNAL POWER

Strictly observe the following precautions when connecting the external power.



DANGER

Before beginning the connection work, confirm that the external power supply for the control equipment is cut off at the source. To prevent external power from being turned ON accidentally, tag the breaker and indicate clearly that work is in progress. Or, assign a supervisor in front of the breaker until all the connections are complete. Connecting components while power is supplied is extremely dangerous and may cause electric shock.



WARNING

1. Confirm that the connected supplying power to the controller meets specifications shown on the rating plate. In addition, when using the transformer unit, confirm the connected supply power meets specifications shown on the label attached on the side of the transformer unit and connect the voltage switching connector (X601) in accordance with the voltage specifications. Supplying out-of-specification power will damage electric components in the controller.
2. Earth the controller to prevent against electrical noise and shock.
3. Use dedicated earth wire (100 Ω or less), which is equal to or larger than the recommended power cable size (3.5 - 8.0 mm²).
4. Never share an earth line with workpiece to be welded or another machine (weld machine, etc.).
5. In arc welding applications, connect the minus pole of the weld power supply to a jig or directly to workpiece to be welded. Insulate the robot body and controller so that they do not share a common earth line.
6. Without fail, before turning ON the external power to control equipment, make sure the power supply wiring is complete and all the covers reattached properly. Otherwise, failure to do so may cause electric shock.

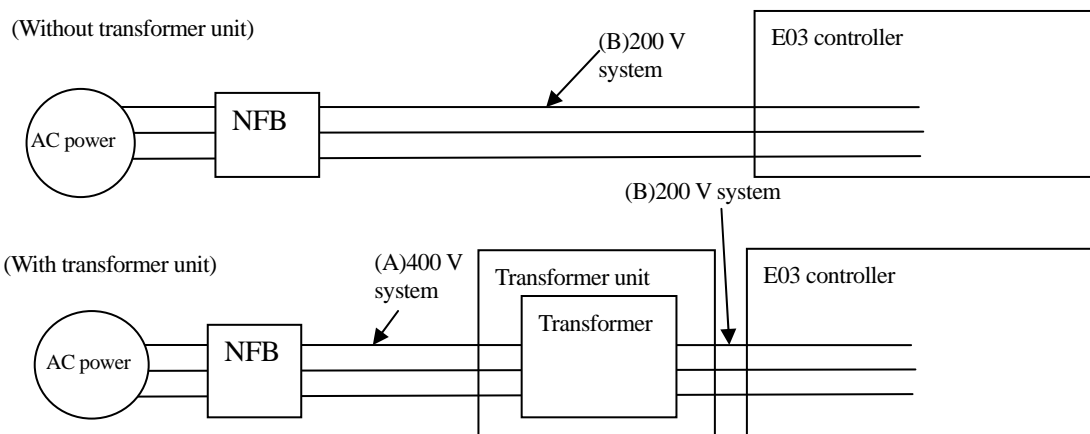


CAUTION

1. Prepare external power that meets the specifications of the control equipment in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the control equipment's specified range (above/below ratings), then the power monitoring circuit activates cutting off the power, and an error is returned.
2. If the external power emits a lot of electrical noise, set up a noise filter to reduce the interference.
3. PWM noise from robot motor lines may cause malfunction of low noise-resistant devices* via external power line. Confirm that there are no such devices in the vicinity.
4. Install a separate external power switch (breaker) for the robot, independent and unconnected to the weld machine.
5. To prevent shorting or accidental leakage on the external power switch, install an earth leakage breaker. (Use a time delay type with sensitivity of 100 mA or more.) Also, use a time-delay-type earth leakage breaker with sensitivity of 100 mA or more when using a transformer unit.
6. If there is a possibility that surge voltage such as lightning surge might be applied from external power line, decrease the surge voltage level by mounting a surge absorber.
7. For the controller with electric power regeneration function (E03), the AC line voltage of breaker on the secondary side may increase up to the peak value in the table below if the power breaker supplying the AC power to the controller (NFB in the figure below) is cut. Mind this when other equipment shares the common power from the same breaker with the controller.

NOTE* Proximity switch directly connected with power line etc. may suffer from the influence.

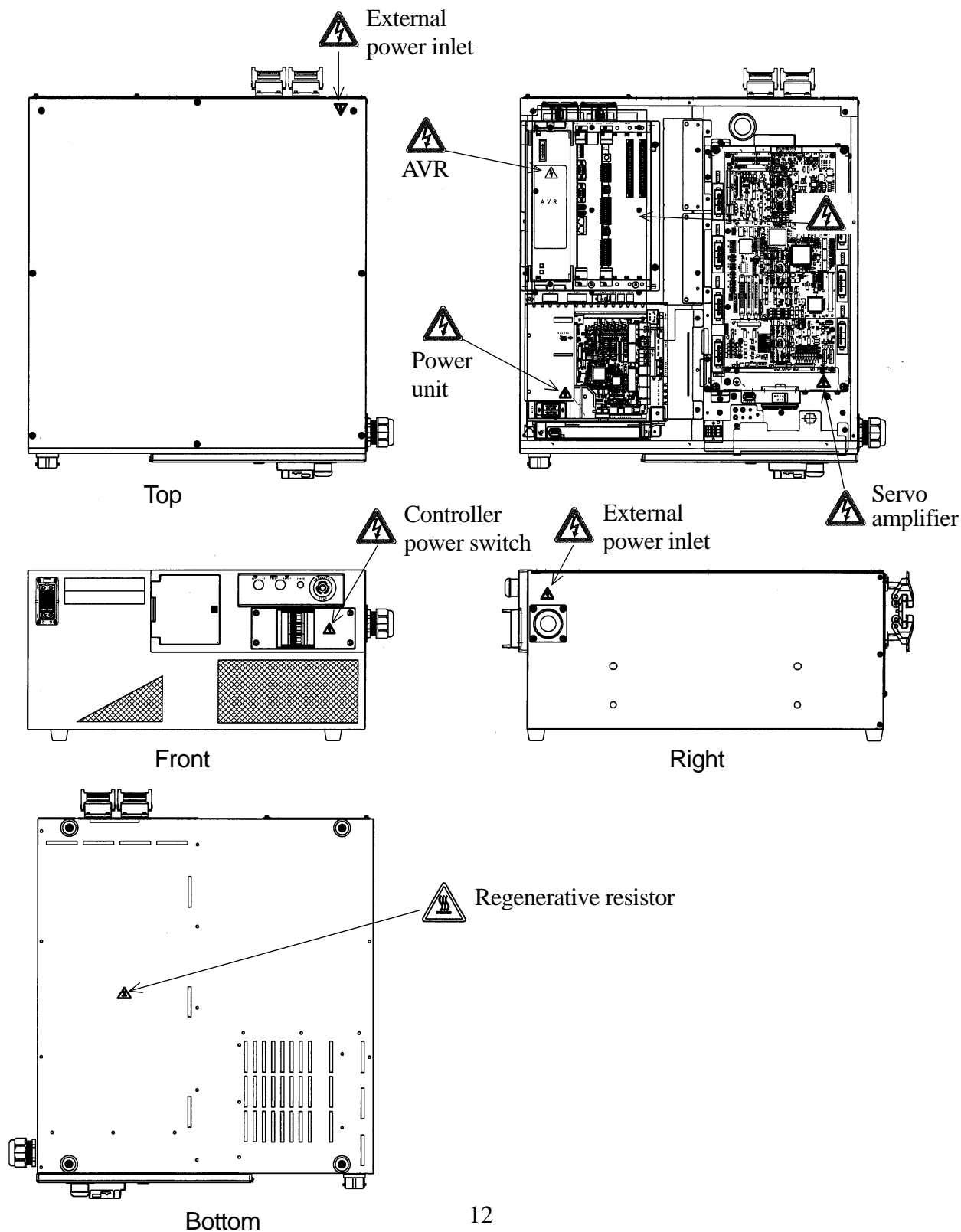
Power supplied to the controller		Peak value of line voltage at point A (400 V system) (V)	Peak value of line voltage at point B (200 V system) (V)
① Without transformer unit *For AC200-220V		380 V 10 ms or less	380 V 10 ms or less
② With transformer unit	When the power source setting inside the transformer unit (X601 connector) is on 380V - 415 V side	700 V 10 ms or less	
	When the power source setting inside the transformer unit (X601 connector) is on 440V - 480 V side	800 V 10 ms or less	



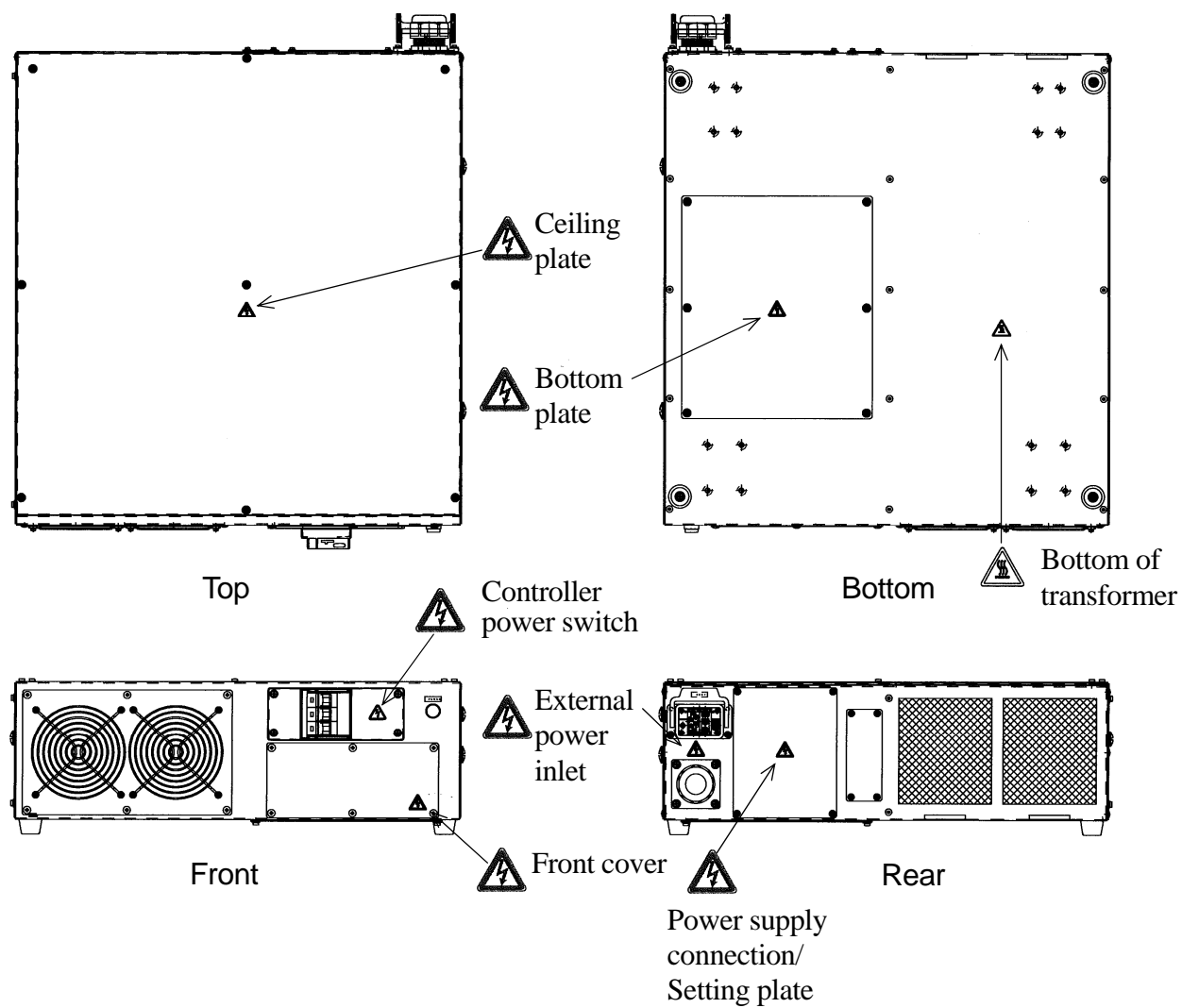
1.5 WARNING LABELS

Warning labels for electric shock and high temperature are located on the controller s shown below.

E01 controller (Warning labels of E02-E04 controllers are attached on the same places.)

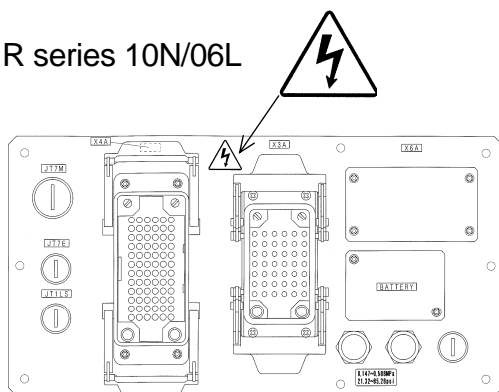


Transformer unit

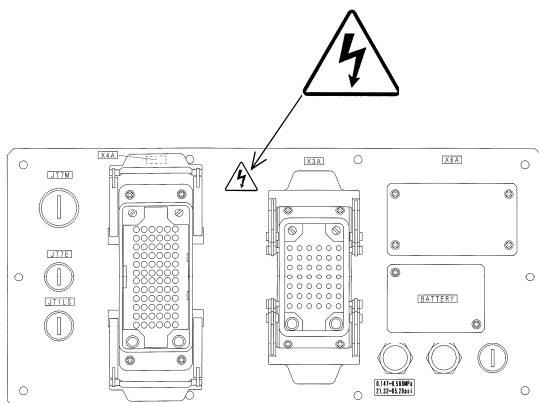


Connector plates on arm base section

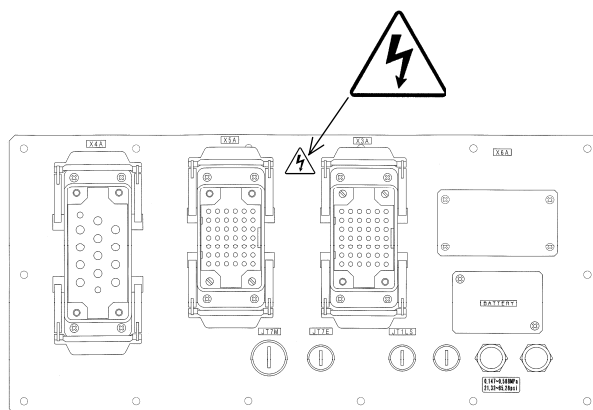
R series 10N/06L



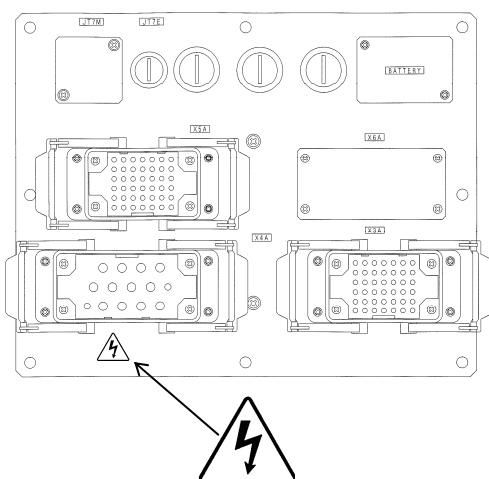
R series 20N/10L



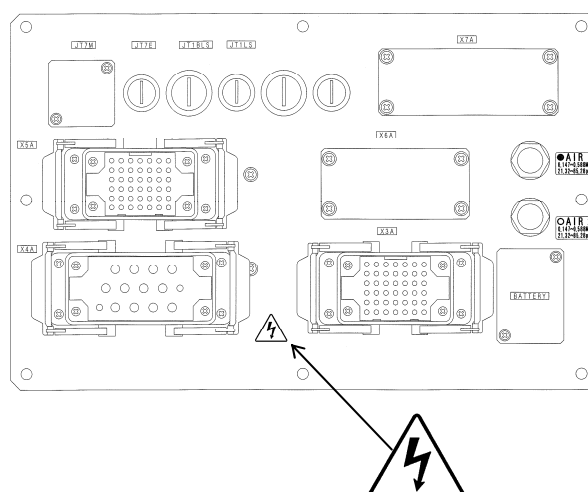
R series 30N/50N/80N/15X



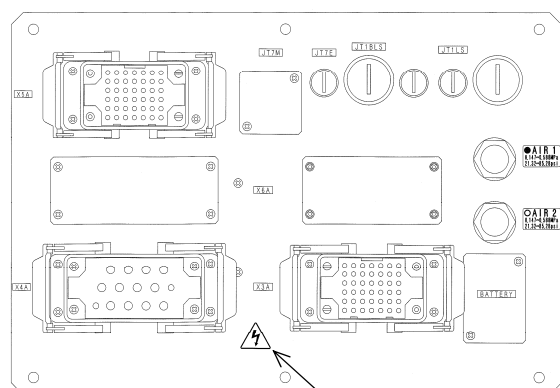
ZH



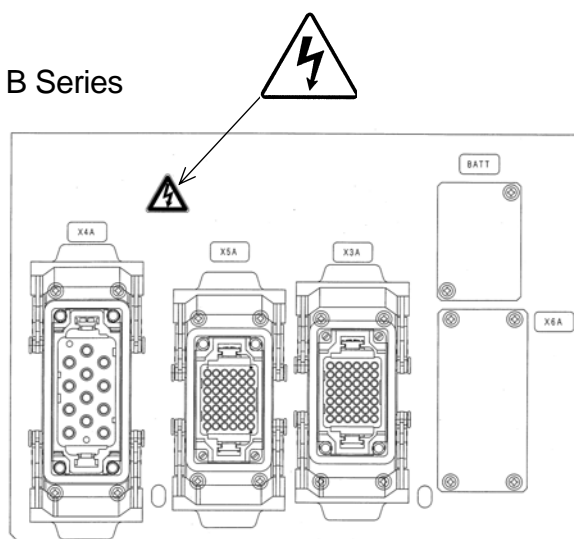
ZX/ZT/ZD



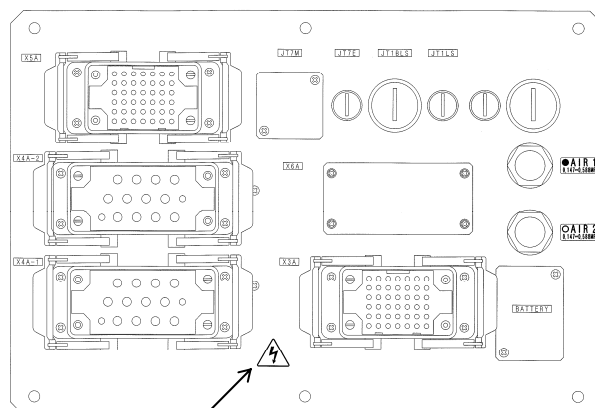
MT



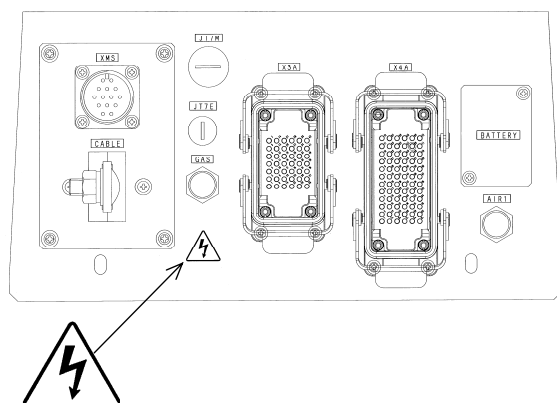
B Series



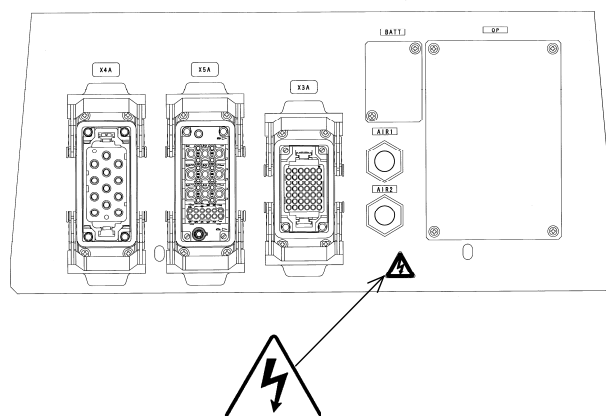
MX



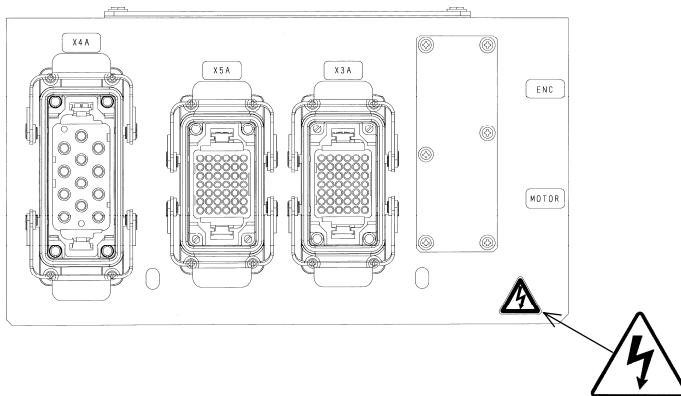
BA



CP



CX



1.6 BATTERY AND FUSE USE AND DISPOSAL

Batteries are used for data backup in the robot mechanical unit and controller. Figures on the next page show the location of the batteries on the 1VA board and the 1FG/1HG boards. Batteries for 1FG/1HG board can be handled without removing connector plate on robot base, only with removing the plate indicating “BATTERY” shown in figure on the next page (bottom).

If not used and disposed of properly, these batteries may malfunction, ignite, overheat, explode, corrode, leak, etc. Always use and dispose of all batteries in compliance with the following warnings and cautions.

Figure on the page after next shows the location of fuse F1 (1.0 A, 125 V/250 V) on the 1TR board.



WARNING

1. Only use batteries specified by Kawasaki.
2. Never re-charge, dismantle, convert and/or overheat batteries.
3. Never dispose of batteries into water or fire.
4. Batteries with damaged cases may short internally and must not be used.
5. Never short the positive and negative poles of a battery with material such as wire.



CAUTION

Never dispose of depleted batteries with garbage that is disposed of in an incinerator, land-fill, dumping-ground, etc. When disposing of batteries, insulate with tape so as not to contact other metal. Comply with local regulations and rules for battery disposal.

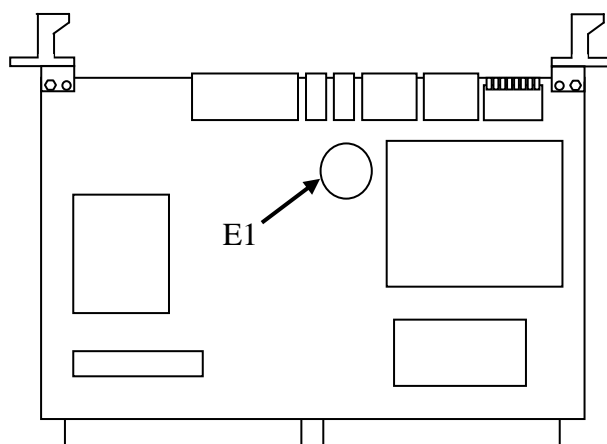
Locations of Batteries

1VA board (in Card Rack)

Location Number: E1

Model: BR2032

Manufacturer: Panasonic



1VA board

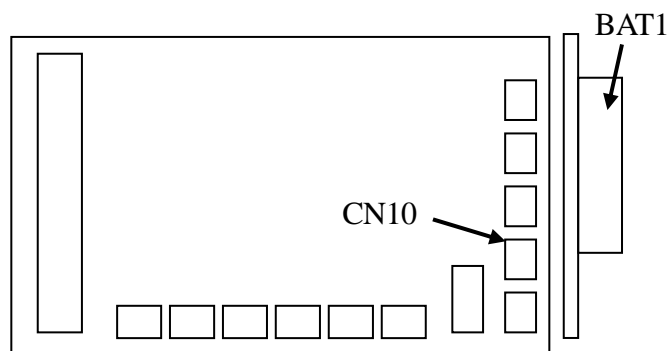
1FG board (in Robot Base)

Location Number: BAT1

Model: 50750-1007 or 50750-1018

Manufacturer: KHI

Connector: CN10



1FG board

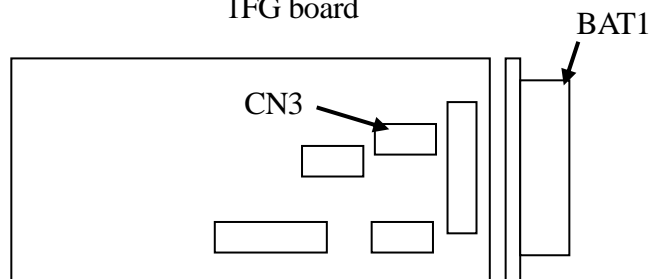
1HG board (in Robot Base)

Location Number: BAT1

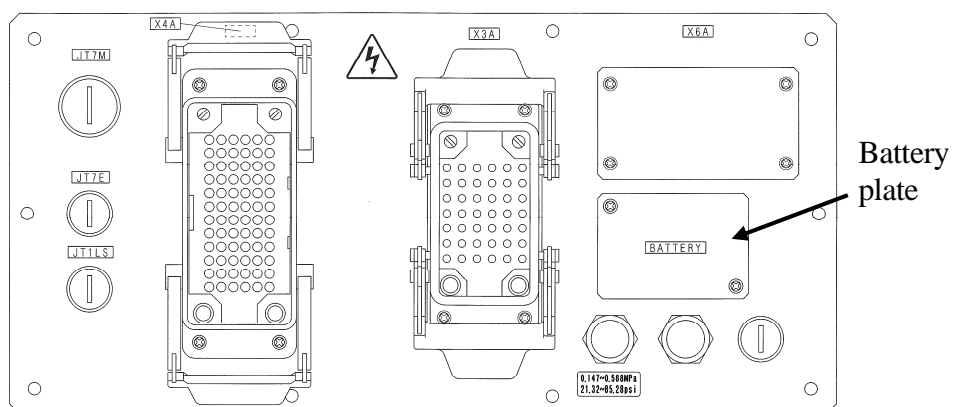
Model: 50750-1007 or 50750-1018

Manufacturer: KHI

Connector: CN3



1HG board



Connector plate on robot base

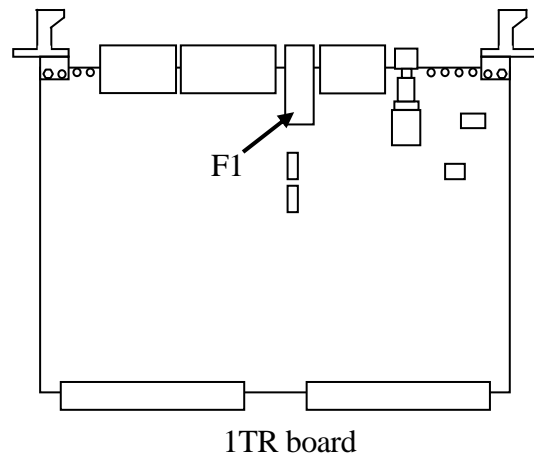
Location of Fuse

1TR board (in Card Rack)

Location Number: F1

Rating: 1.0 A 125/250 V

UL Listed type



1.7 SAFETY FEATURES

To safeguard the user, Kawasaki robot systems are equipped with many safety features, including the following:

1. All E-stops are hard-wired.
2. All robot controllers are equipped with a redundant dual channel safety circuit. Both channels of the safety circuit must be closed to allow for robot operation in the teach and repeat modes.
3. Safety circuits of controllers satisfy requirements of PLe in category 4 defined by ISO 13849-1:2006. Category and Performance level (PL) are determined by the whole system and conditions.
4. (For the arms which are equipped with servo lamp ON) When the servo ON lamp is illuminated, servo motor power is available to the robot and motion is possible.
5. The teach pendant and operation panel are equipped with red mushroom-type E-stop switches. And all robot controllers have external E-stop inputs.
6. The teach pendant is equipped with three-position, enabling devices. The enabling devices must be pressed to enable motor power in teach and check modes.
7. TCP speeds in teach and check modes are limited to a maximum of 250 mm/s (10.0 in/s).
8. The velocities are not limited to 250 mm/s (10.0 in/s) in the Fast Check Mode that satisfy requirements for ISO 10218-1.

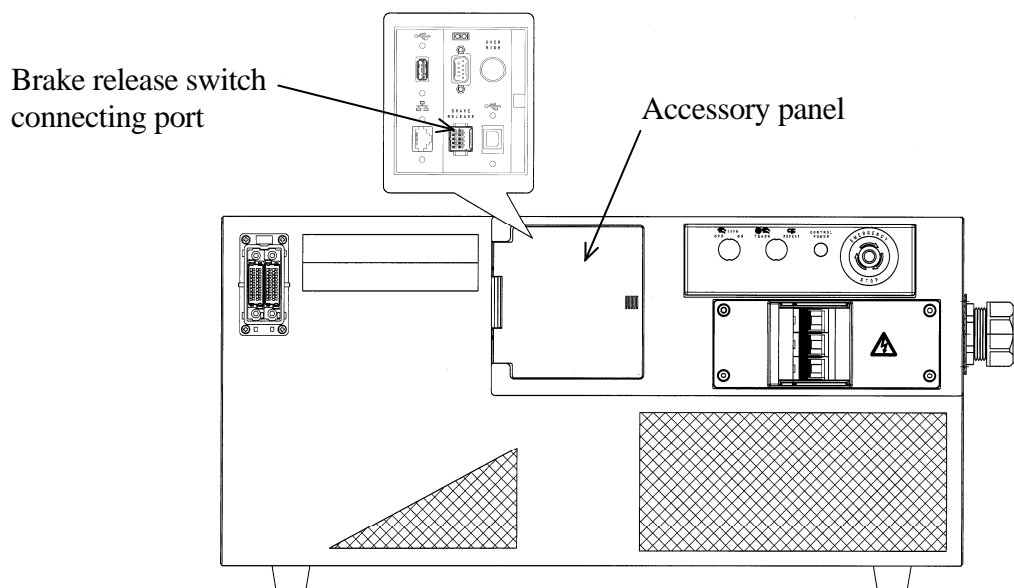
1.8 EMERGENCY MOVEMENT WITHOUT DRIVE POWER

The manual brake release switches allow the operator to move individual robot axes without using motor power for maintenance and emergency situations (Option).

The connector for the manual brake release switches is located at the places shown below.

WARNING

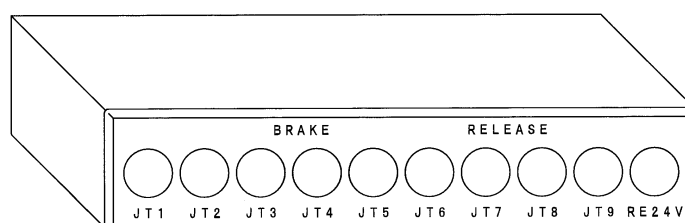
When no servo power is applied, electromagnetic brakes lock to maintain the robot arm posture. Unsupported axes may fall when the brake release switch is pressed. Axes which are overhung, particularly JT2 and JT3, will fall down the fastest, depending on robot position, weight of the end-of-arm tooling, and wrist axis position. Position yourself to observe the entire robot arm and keep your eyes on the arm when operating this switch.



Brake release switch connecting port of E0x controller

Connecting port of brake release switch is provided at the position shown in the figure.

- Brake release switch box is the option. (Parts No. - other than CP series: 50818-0015, CP series: 50818-0038)

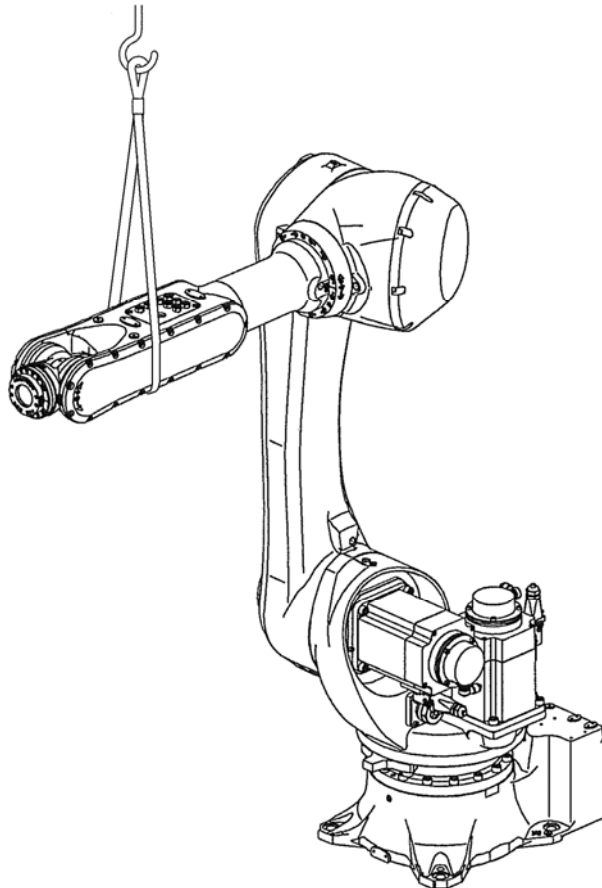


Brake release switch box



WARNING

To prevent injury to persons or damage to robotic equipment provide suitable support for the robot arm, end-of arm tooling and payload, before using a brake release switch. The robot arm can be supported overhead using a sling and an overhead crane (see figure below).



Robot arm support

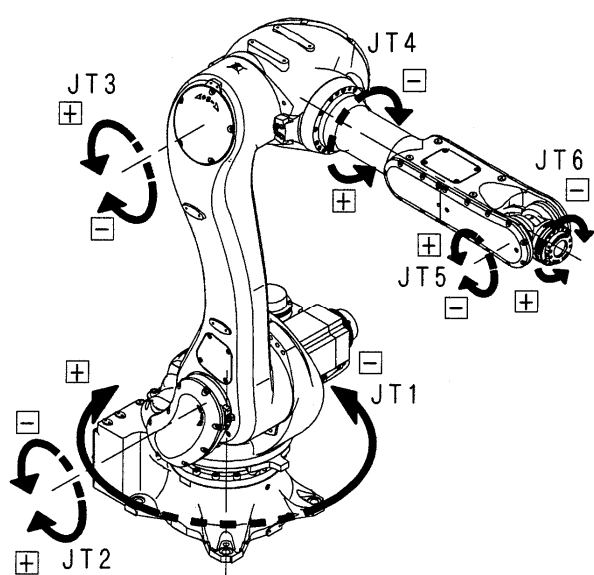
To manually release axes brakes follow the procedure below.

1. Set motor power OFF.
2. Ensure all personnel are clear of site and all safety precautions are followed.
3. Provide suitable support of the robot arm, end-of-arm tooling, and payload if there is a risk of personal injury (see above figure).
4. Open the accessory panel and connect the harness from the brake release switch box to the brake release switch connecting port.
5. Ensure the switches are in the OFF position and in operating condition.
6. Press the brake release switch of the axis to release for a moment, and confirm that the brake will not be released.

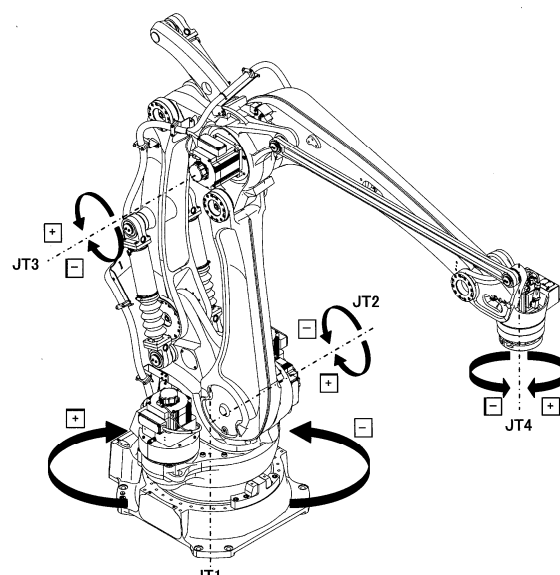
7. Press and hold the “RE24V” switch (see figure below). If the brake is released at this time, do not use the switch (see CAUTION).
8. Press the manual brake release switch for the axis to release the brake (see figure below).
9. The brake remains released until the brake release switch is released.
10. After using the brake release switches, close the accessory panel.

! **CAUTION**

Stop using the manual brake release switch immediately if the electromagnetic brake is released by pressing only one switch. The switch may be defective.

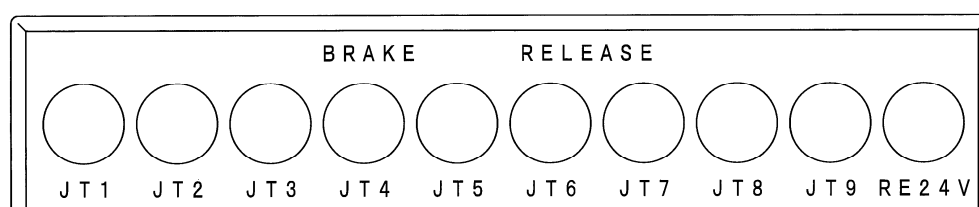


6-axis robot



CP series

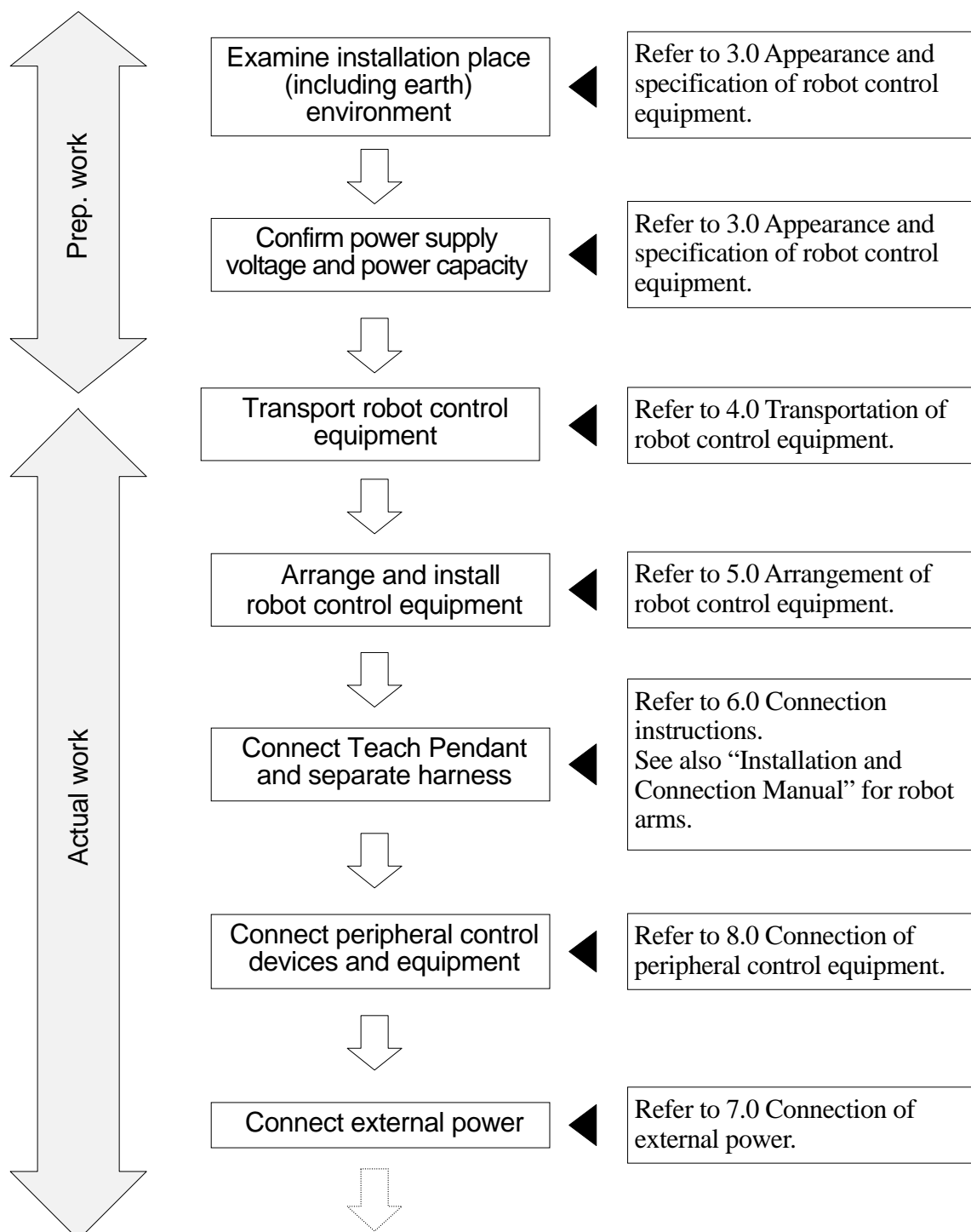
Robot brake release axes

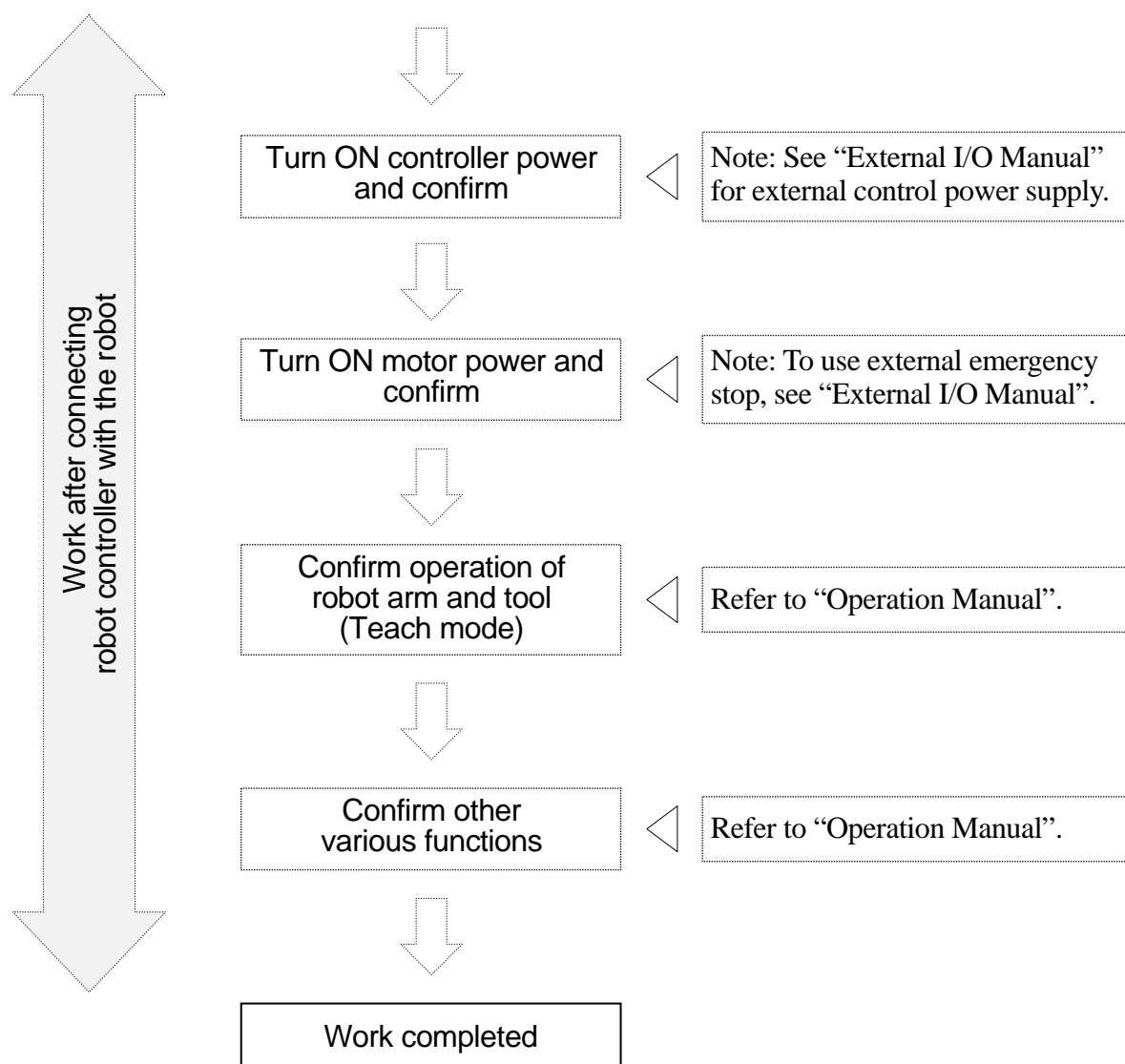


Manual brake release SW

2.0 WORKFLOW - ROBOT CONTROL EQUIPMENT INSTALLATION AND CONNECTION

This workflow describes only the robot controller. For the robot arms, refer to the separate manuals for them.



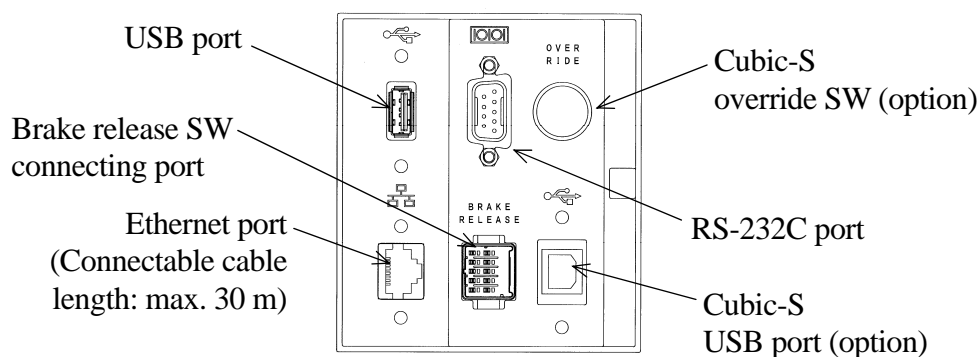
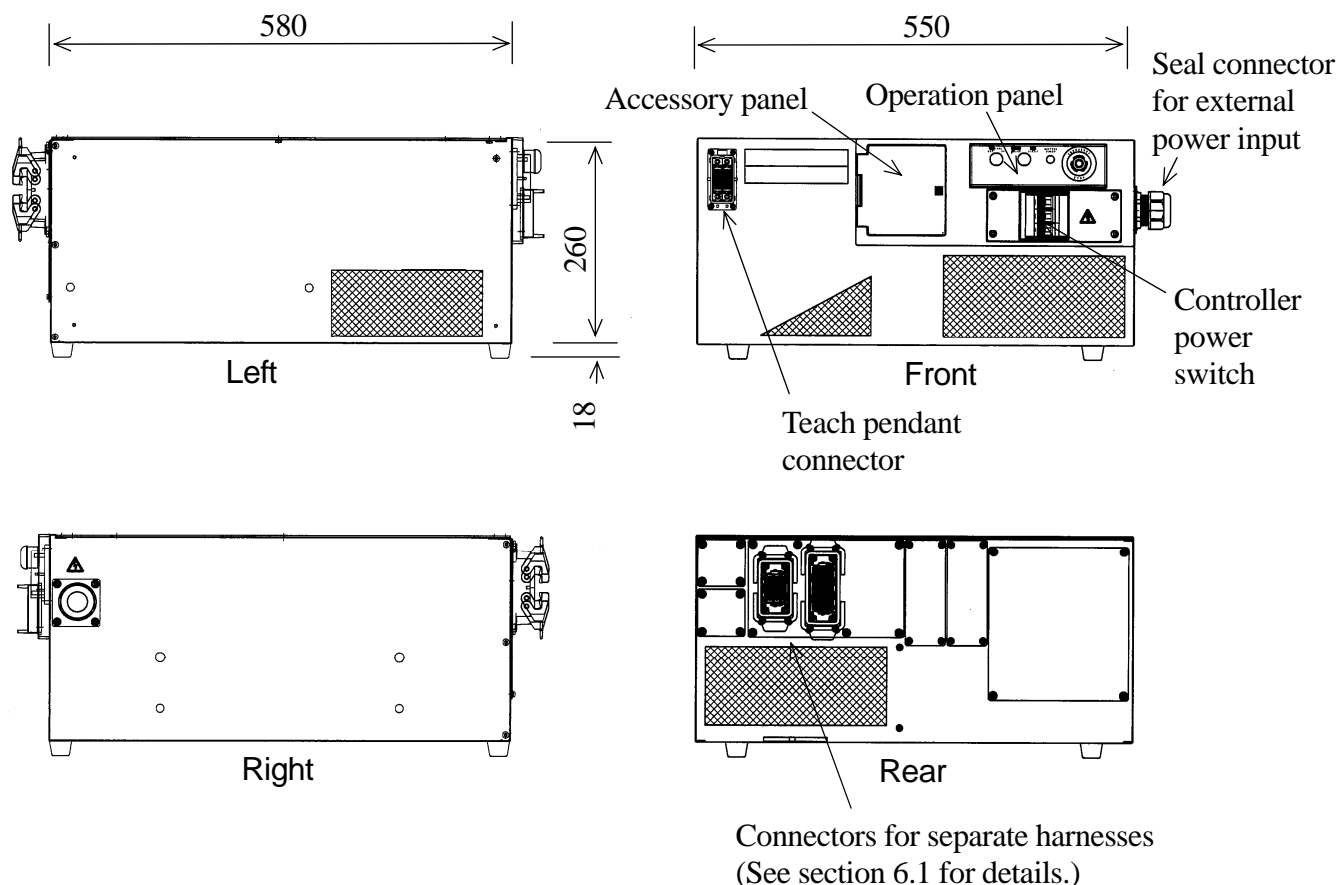
**[NOTE]**

This manual only describes procedures from installation place examination to connection with external power.

3.0 APPEARANCE AND SPECIFICATION OF ROBOT CONTROL EQUIPMENT

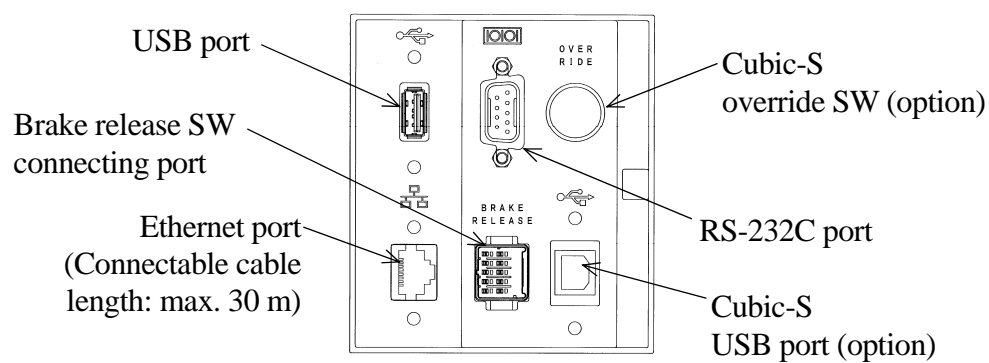
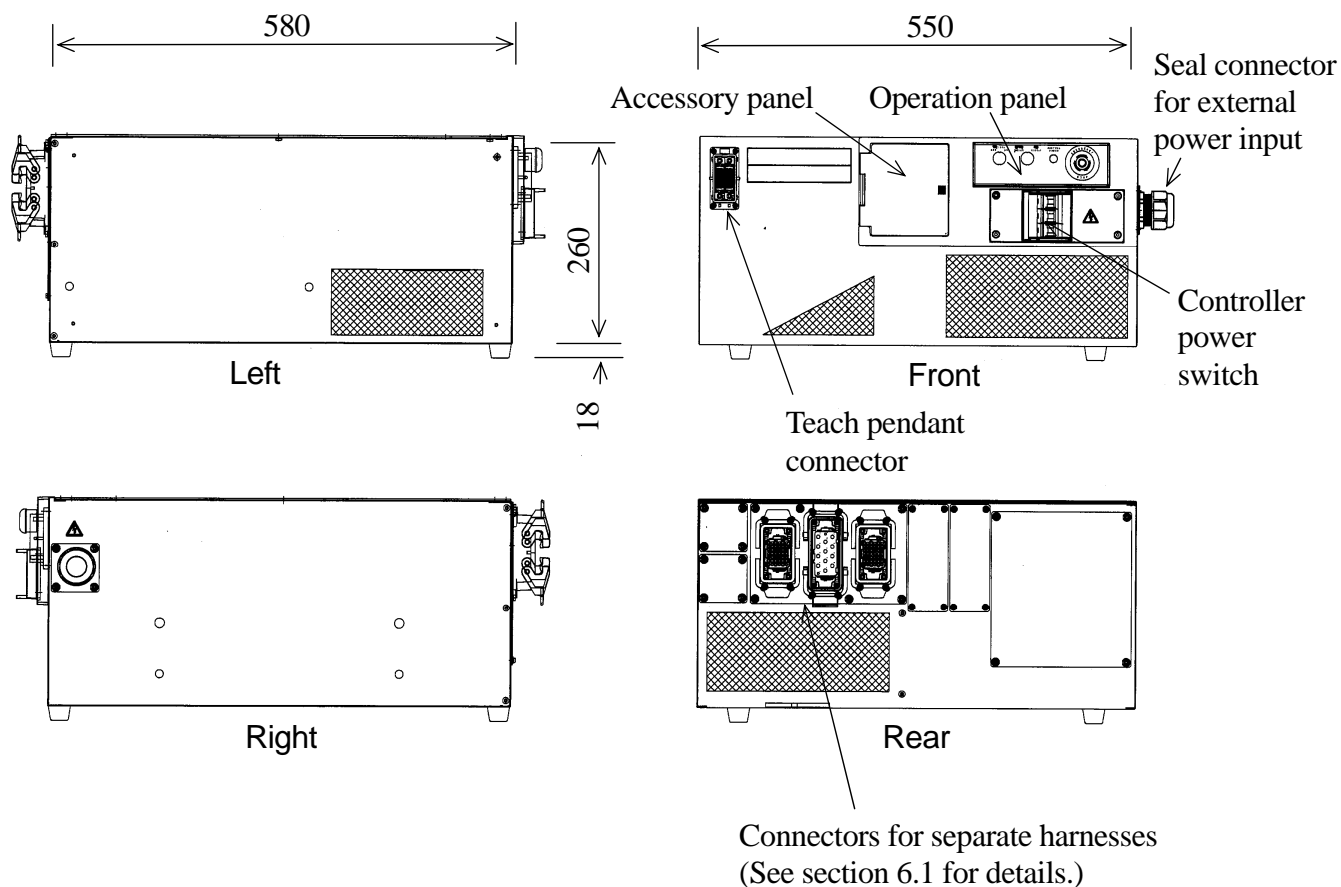
3.1 CONTROLLER APPEARANCE

E01 controller



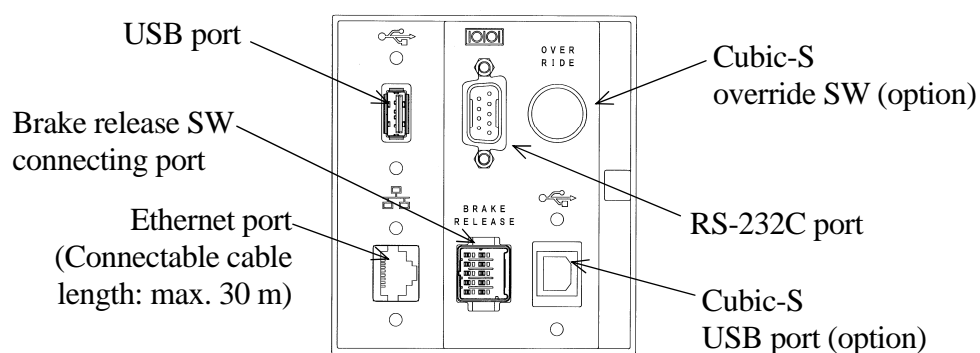
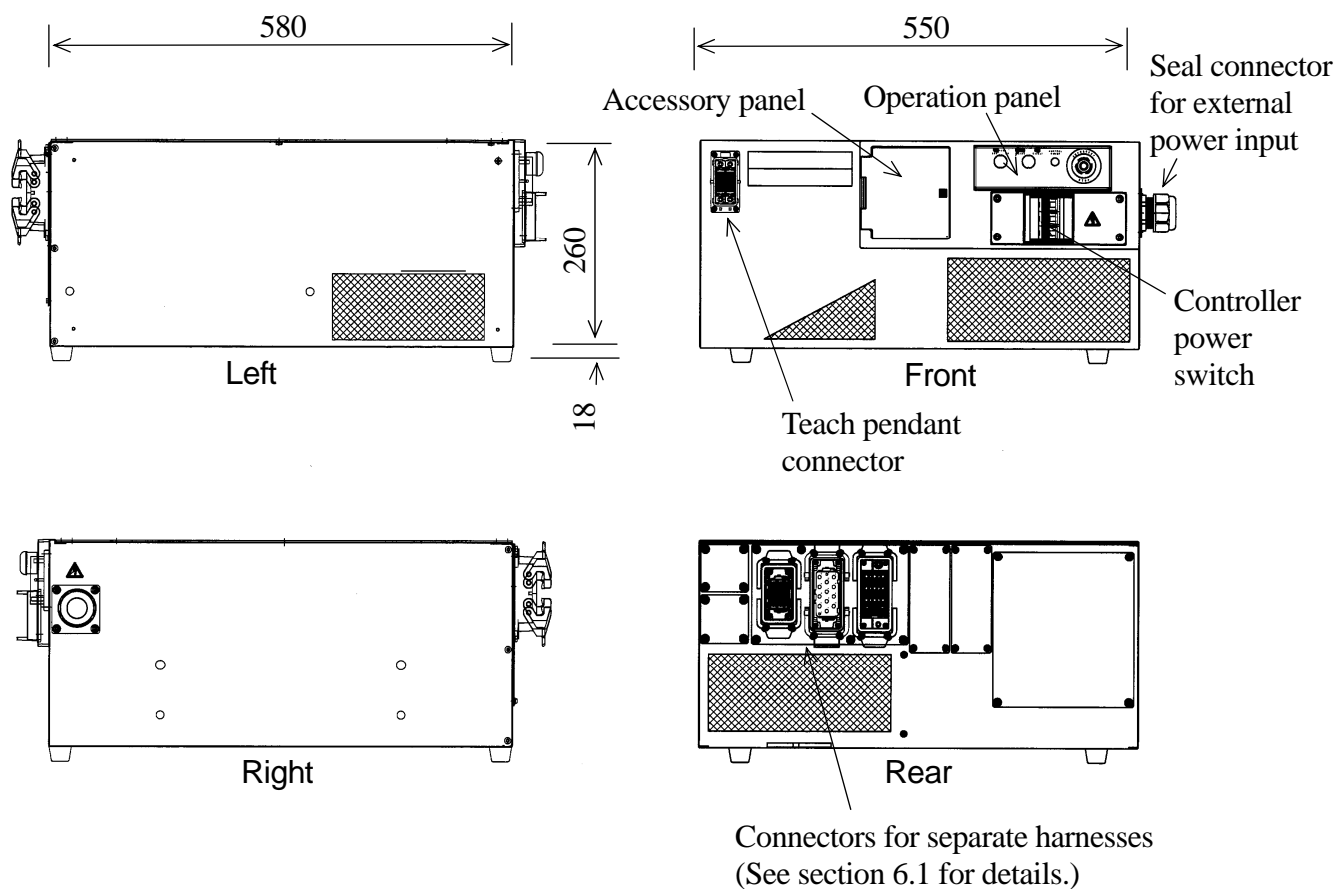
Connecting ports in the
accessory panel

E02 controller



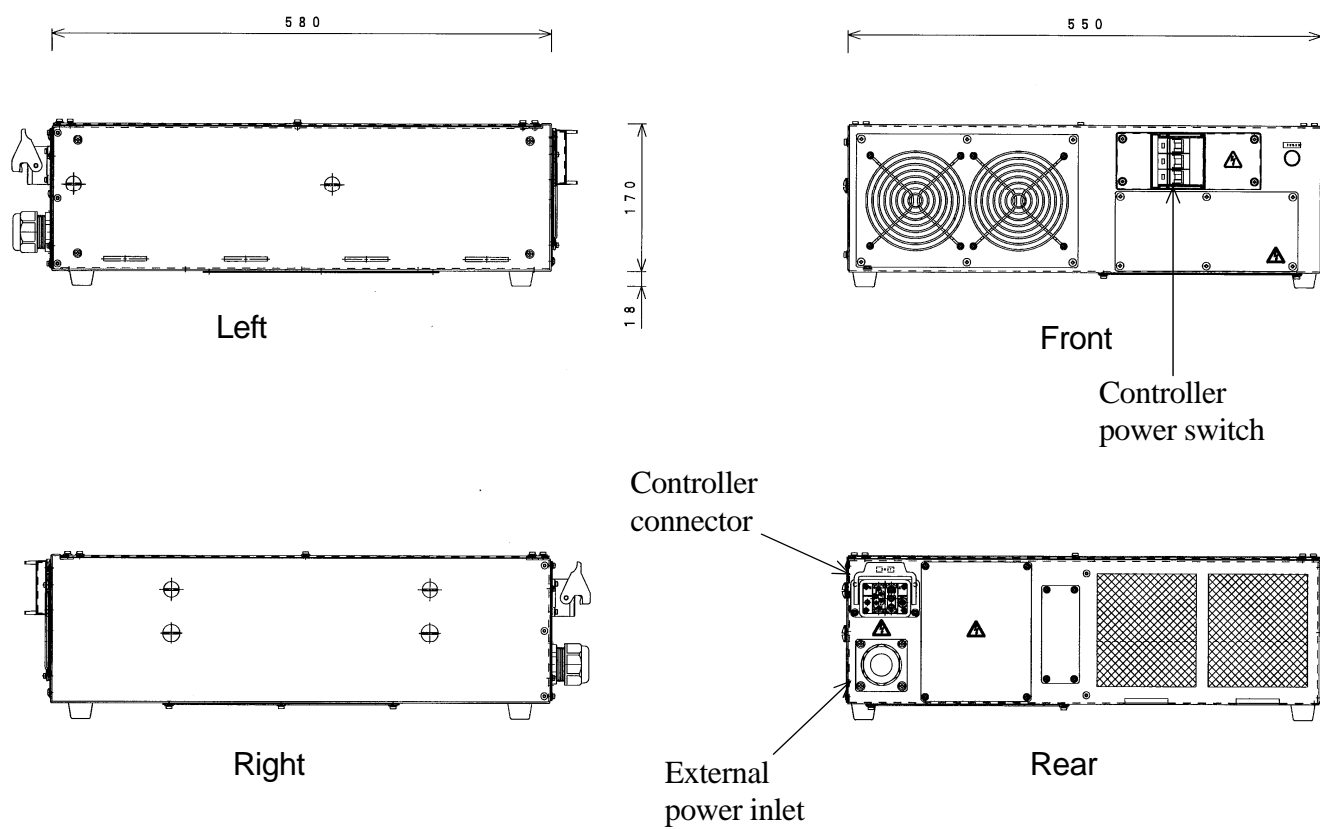
Connecting ports in the
accessory panel

E03/E04 controller

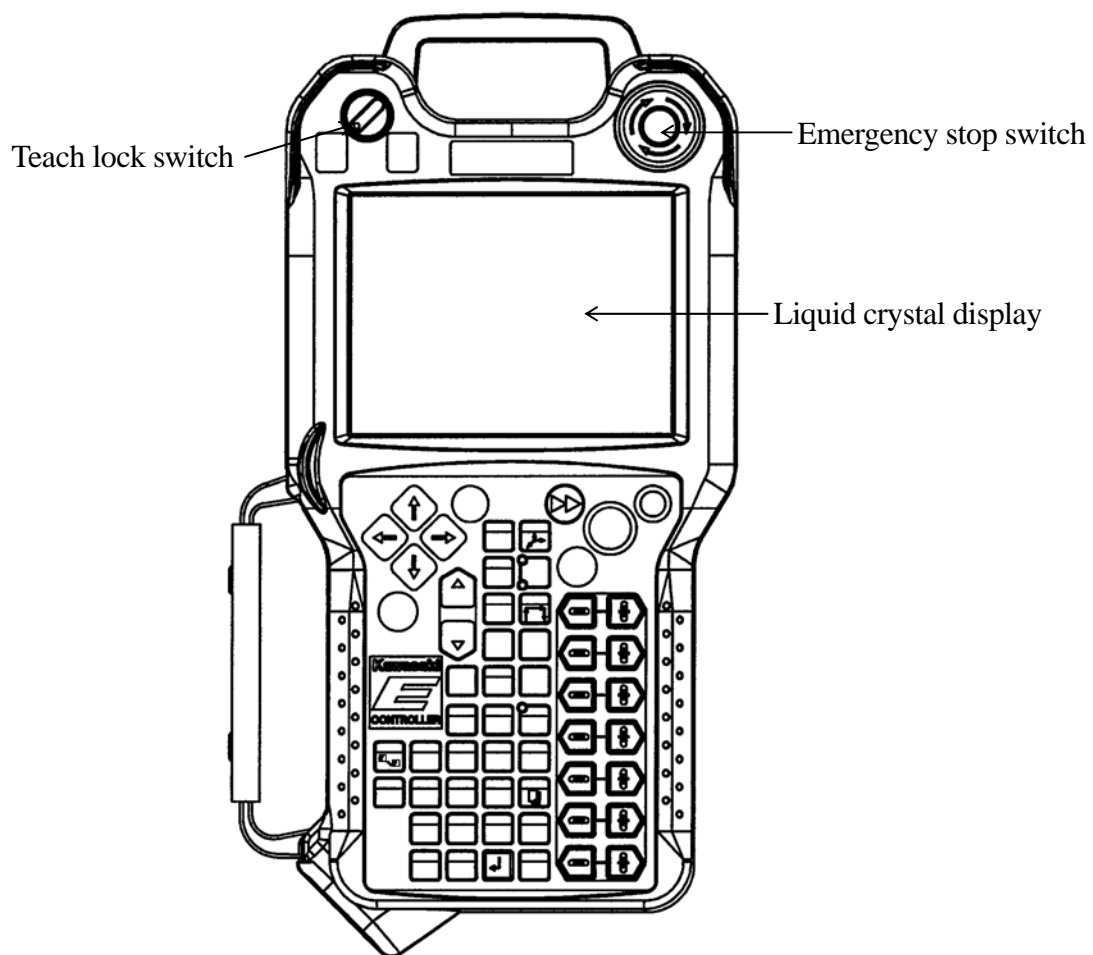


Connecting ports in the
accessory panel

Transformer unit



3.2 TEACH PENDANT APPEARANCE



Teach Pendant

3.3 E0X CONTROL EQUIPMENT SPECIFICATION

Controller

Construction		Enclosed structure, indirect cooling system
Mass		E01, E02, E04: 40 kg E03: 45 kg
Ambient environment	Temperature	0 - 45 °C
	Humidity	35 - 85 %RH (Non condensing)
	Altitude	Up to 1000 meters above mean sea level
	Pollution degree	3 or below
Power source		AC 200-220 V ± 10 %, 50/60 Hz, 3 Phase
Power capacity		Refer to the table below.
Earthing		Dedicated earthing (100 Ω or less)
Length of Teach pendant cable		5 m/10 m/15 m

Transformer unit

Construction		Enclosed structure, indirect cooling system
Mass		45 kg
Ambient environment	Temperature	0 - 45 °C
	Humidity	35 - 85 %RH (Non condensing)
	Altitude	Up to 1000 meters above mean sea level
	Pollution degree	3 or below
Power source		AC 380-415 V ± 10 %, 50/60 Hz, 3 Phase or AC 440-480 V ± 10 %, 50/60 Hz, 3 Phase (Switched by voltage switching connector.)
Power capacity		Refer to the table below.
Earthing		Dedicated earthing (100 Ω or less)
Length of connection cable with controller		1 m (max. 5 m for option)

Voltage source capacity for external power connection and cable specifications

Destination	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E01 controller	R series 05-20 BA series	5.6 KVA max.	3.5 mm ² or more (AWG #12 or more)	200 m or less
E02 controller	R series 30-80 Z series MT series B series CX series	7.5 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less
E03 controller	RD series CP series	12 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less
E04 controller	MX series	12 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less
Transformer unit		12 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less

Circuit breaker spec. for external power connection

Destination	Rated current	Rated voltage	Rated interrupting capacity
E01/E02 controller	30 A	AC277 V	10 kA (UL489)
E03/E04 controller	40 A	AC277 V	10 kA (UL489)
Transformer unit	25 A	AC480Y/277V	10 kA (UL489)

4.0 TRANSPORTATION OF ROBOT CONTROL EQUIPMENT

When transporting the control equipment, strictly observe the precautions given in the sections below for whichever transport method is chosen.

4.1 BY CRANE LIFTING

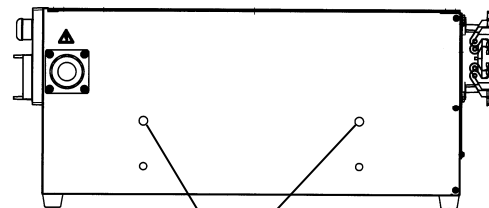
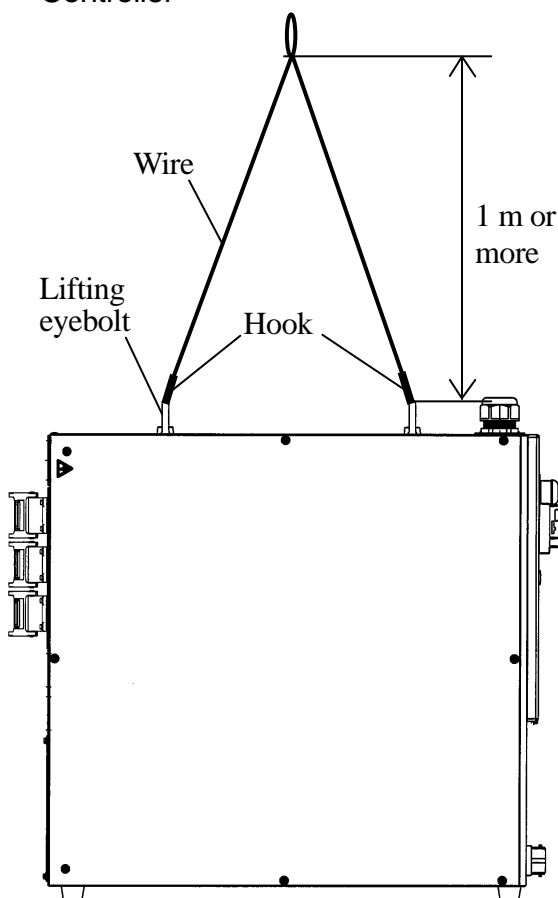
Attach the following eyebolts to the M10 tapped holes in the figure below when transporting the controller by crane lifting. (Manufacturer: TAKIGEN MGF CO., LTD. Model: B-130-10 or equivalent. The screw length should be 25 mm or less.)



WARNING

1. **Never support the control equipment manually when it is lifted up. And, never go under or stay too close to the control equipment during transport.**
2. **Hook the wire at the lifting eyebolts as shown below.**
3. **Ensure that the lifting eyebolts are not loose. Check each one and retighten if loose. Otherwise, the control equipment may fall**

Controller



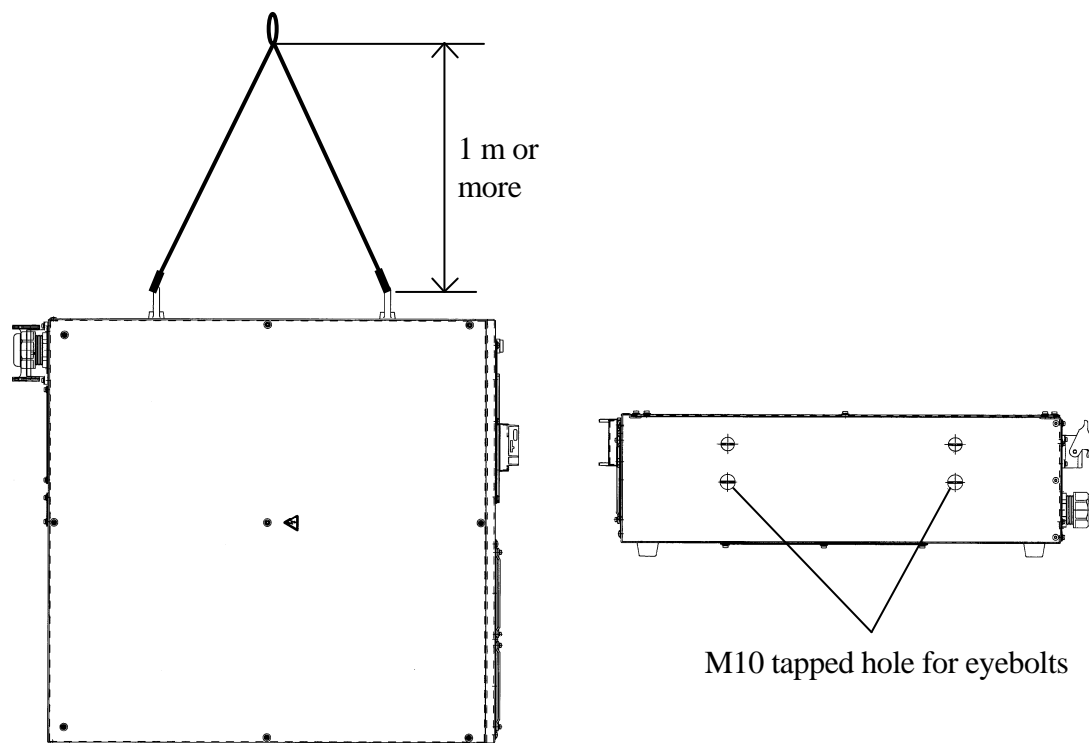
M10 tapped hole for eyebolts



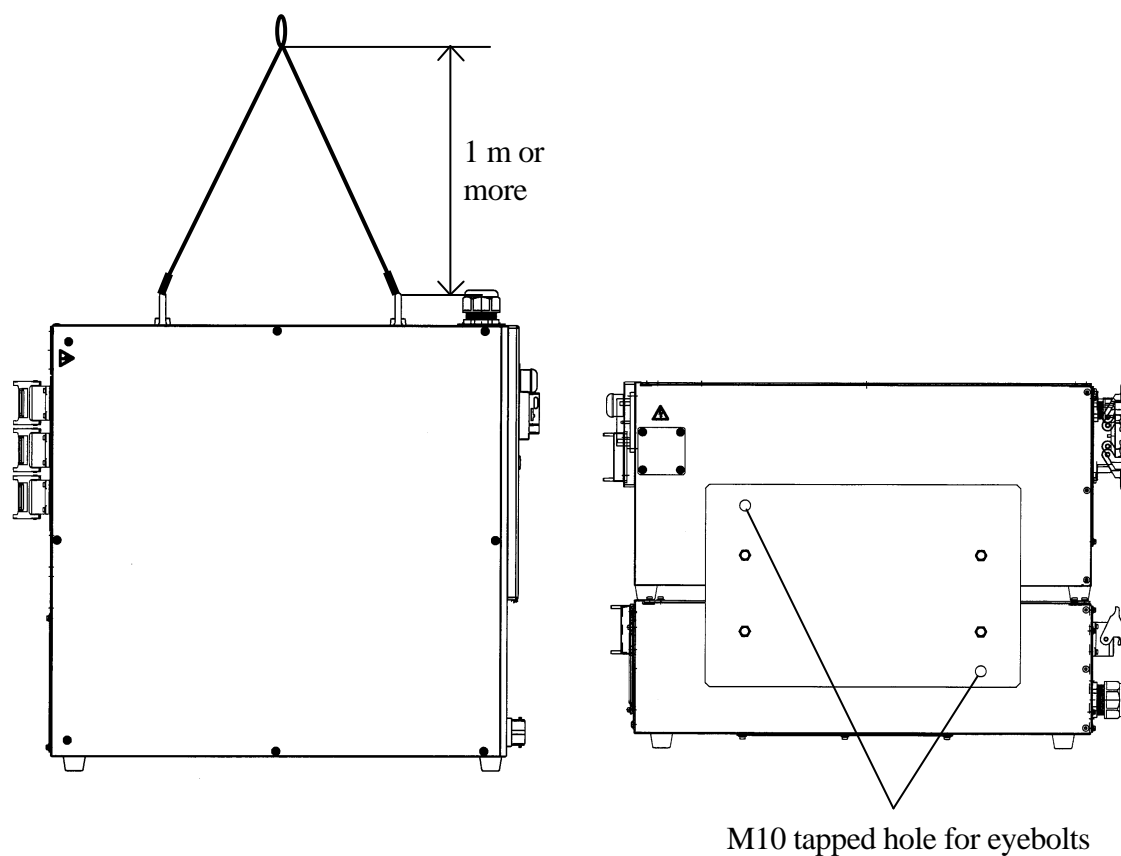
CAUTION

1. **Prepare wire and crane capable of hoisting 200 kg or more, sufficient for a controller loaded with full options.**
2. **Remove the teach pendant and teach pendant holder (if equipped) before lifting with the wire sling.**
3. **Wire length: 1 m or more as shown in left figure.**
4. **Be careful as the controller may lean when lifted up.**
5. **Be careful not to let the wire snag on other equipment.**

Transformer unit



Controller combined with transformer unit

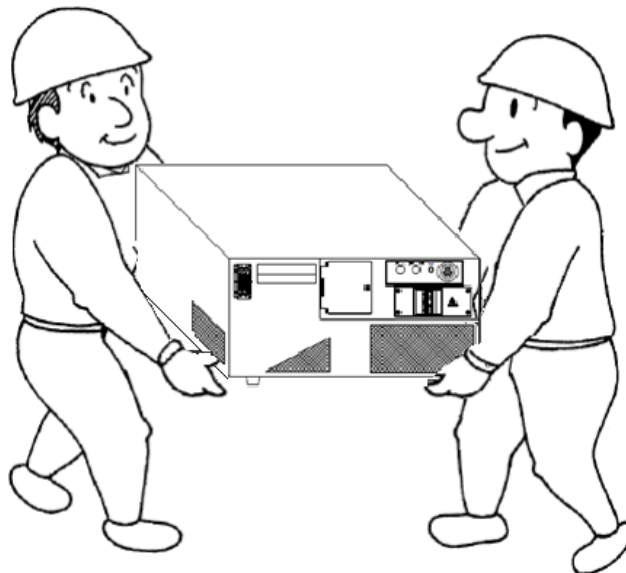


4.2 BY TWO PERSONS



CAUTION

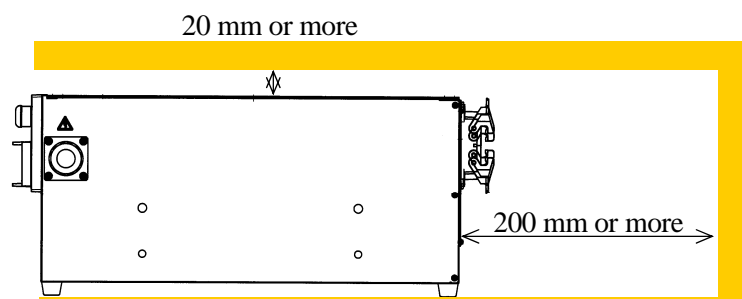
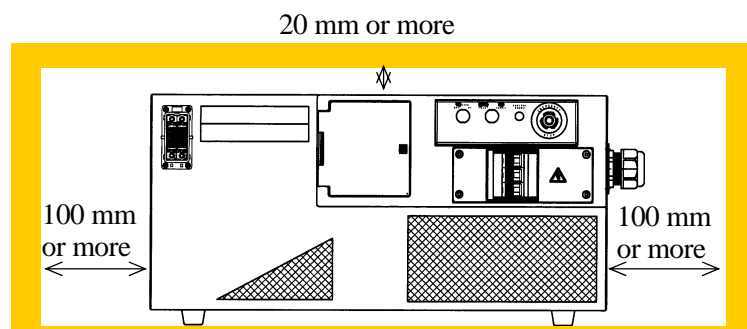
1. Disconnect the Teach Pendant.
2. Be careful not to put an impact on the controller during transportation.
3. The clearance between the bottom of the control equipment and the floor is small (18 mm). Accordingly, hold up one side of the controller then the other side, and get your fingers placed on the bottom of controller body sufficiently before holding up the controller. Because the controller has mass (E01, E02, E04: 40 kg, E03: 45 kg, Transformer unit: 45 kg), it is impossible to carry the controller with fingertips.
4. It is impossible to carry the control equipment by two persons when the controller is combined with the transformer unit, because the total mass is 90 kg. Carry the control equipment by crane lifting or carry the controller and the transformer unit separately after disconnecting them.



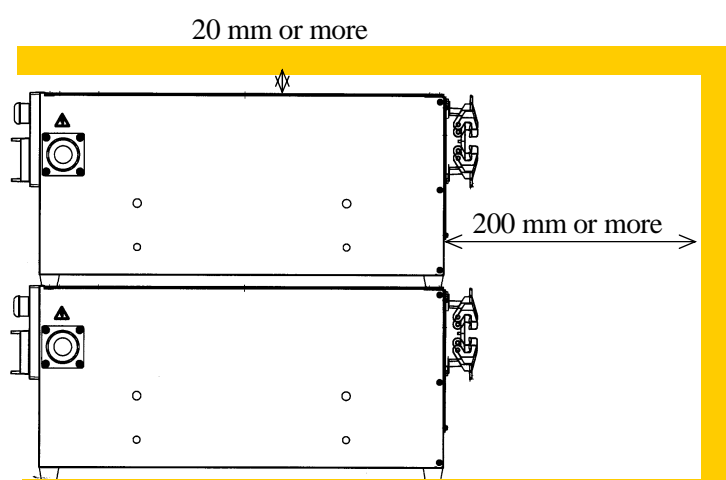
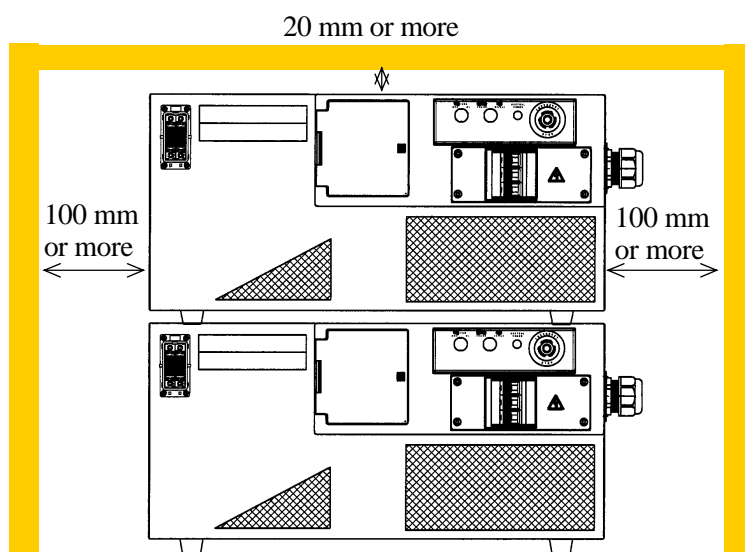
5.0 ARRANGEMENT OF ROBOT CONTROL EQUIPMENT

In order for the controller to maintain the proper internal temperature, the installation site must conform to the four points below. Horizontal arrangement is the standard for E0x controllers. When an object is placed on the top surface of the controller, the mass should be 45 kg or less. It is possible to place a controller on another controller as far as the mass goes. However, when an object is placed on the top surface of the controller, it is necessary to remove the object once in maintenance.

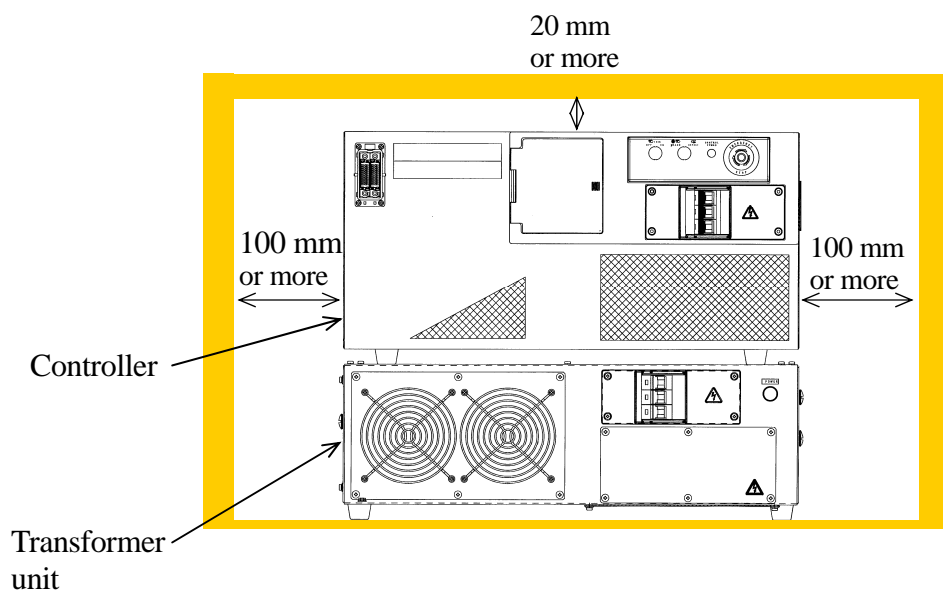
1. Arrange the controller on a flat, horizontal stand and adjust its height so that the heights of controller power switch and operation switches from the floor are between 0.6 to 1.9 m. (Provide a clearance of rubber feet height in the vertical direction because there is an air inlet on the bottom.)
2. Provide a clearance of 100 mm or more between the controller right/left side and the wall.
3. Provide a clearance of 20 mm or more between the controller top surface and the wall.



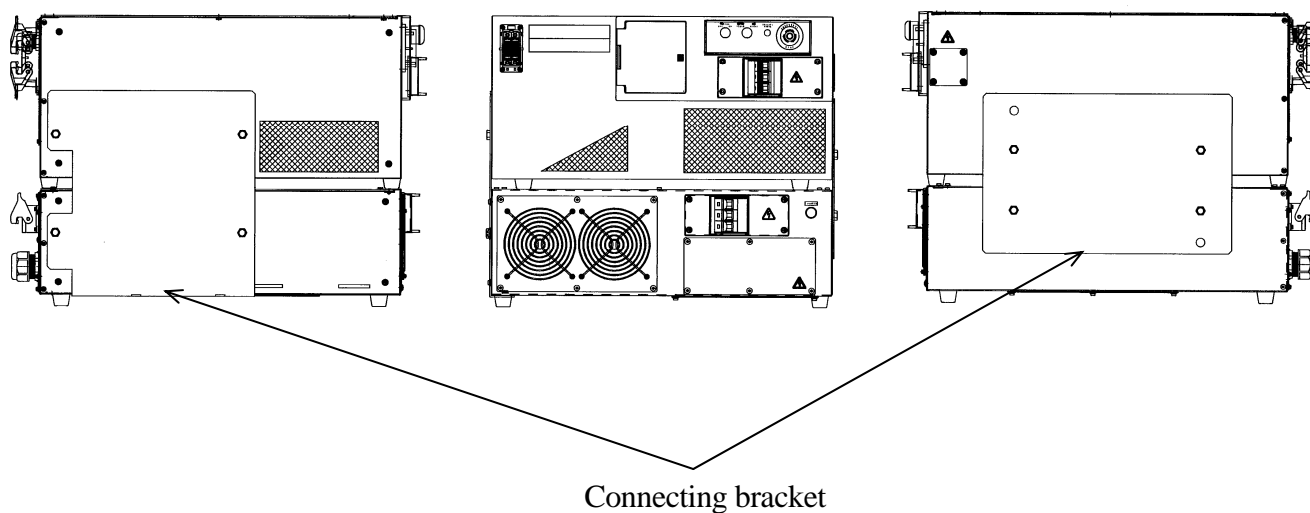
For horizontal arrangement, a controller can be placed on another controller. See the figure below for the required clearance between the controller and the wall in that case.



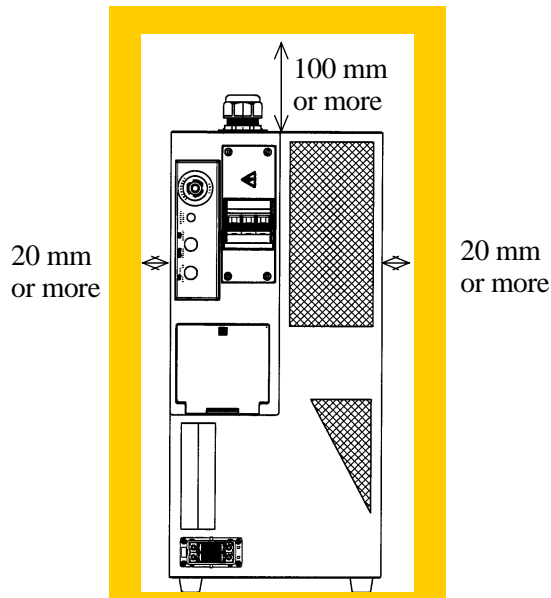
It is also possible to place a controller on a transformer unit for horizontal arrangement. See the figure below for the required clearance between the control equipment and the wall in that case.



The controllers and the transformer unit can be combined by connecting brackets (option) as shown in the figure below.



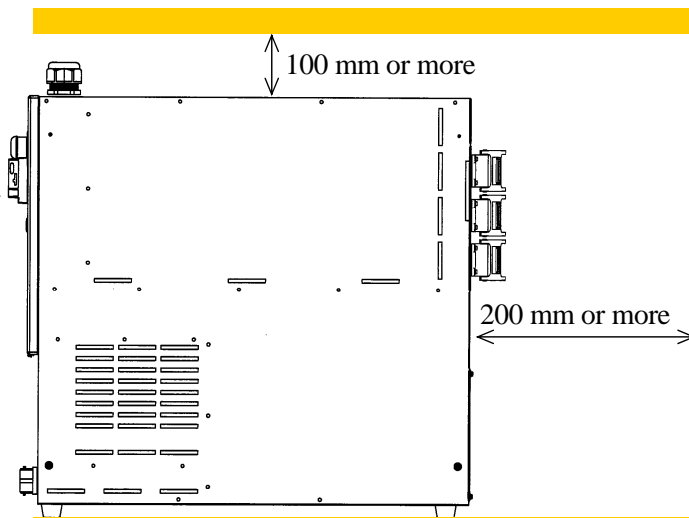
Follow the procedure below when arranging the controllers vertically. Feet attached on the bottom of the controller can be reattached on the left side. An object cannot be placed on the top surface of the controller when the controllers are placed vertically.



1. Arrange the controller on a horizontal stand and adjust its height so that the heights of controller power switch and operation switches from the floor are between 0.6 to 1.9 m. Arrange the controller with its controller power switch facing upward.

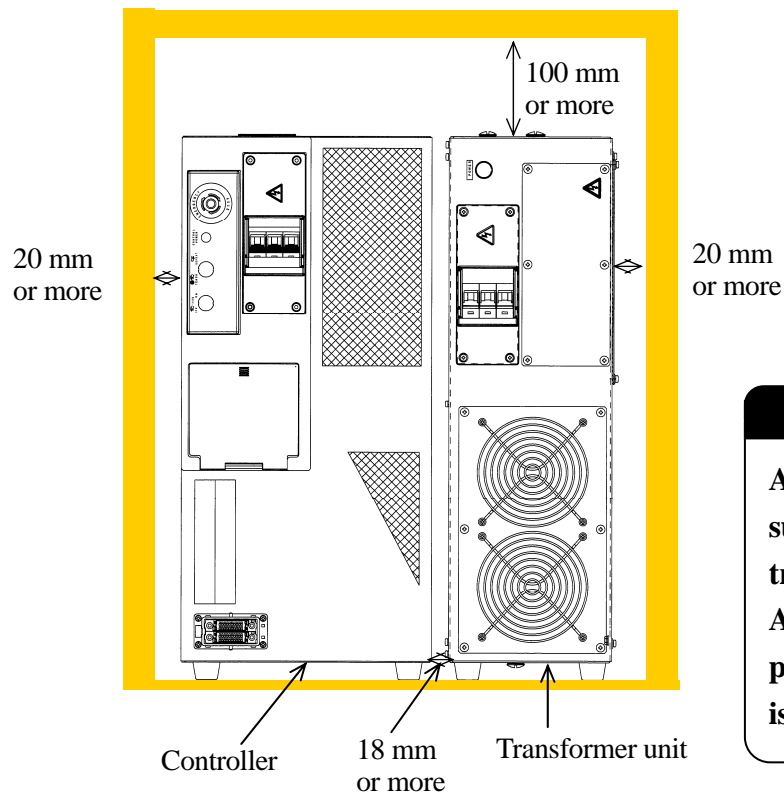
**CAUTION**

When arranging the controller vertically, the exhaust port comes bottom. Accordingly, reattach the rubber feet without fail, and provide a clearance between the floor and the bottom.



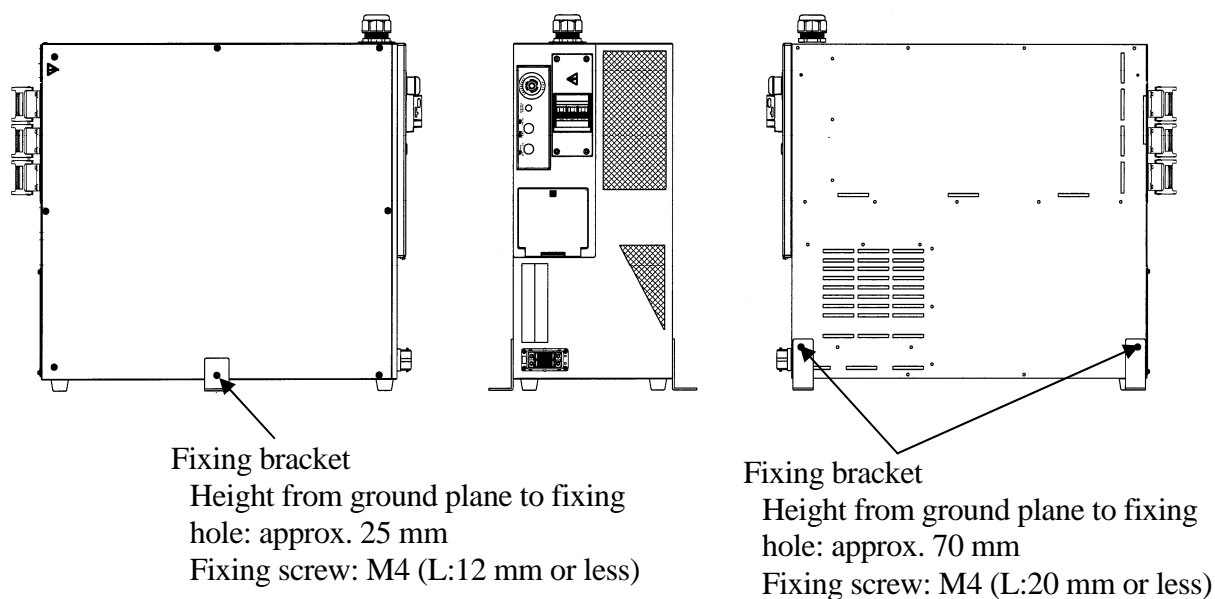
2. Provide a clearance of 20 mm or more between the controller right/left sides and the wall.
3. Provide a clearance of 100 mm or more between the controller top and the ceiling.
4. Provide a clearance of 200 mm or more between the controller rear side from the wall.
5. If needed, make metal brackets as shown in the figure on the pages 39 and 40 to fix the control equipment.

See the figure below when arranging the transformer unit vertically.

**CAUTION**

Attach rubber feet on the bottom surface when arranging the transformer unit vertically. Also, fix the transformer unit to prevent it from falling because it is small in width.

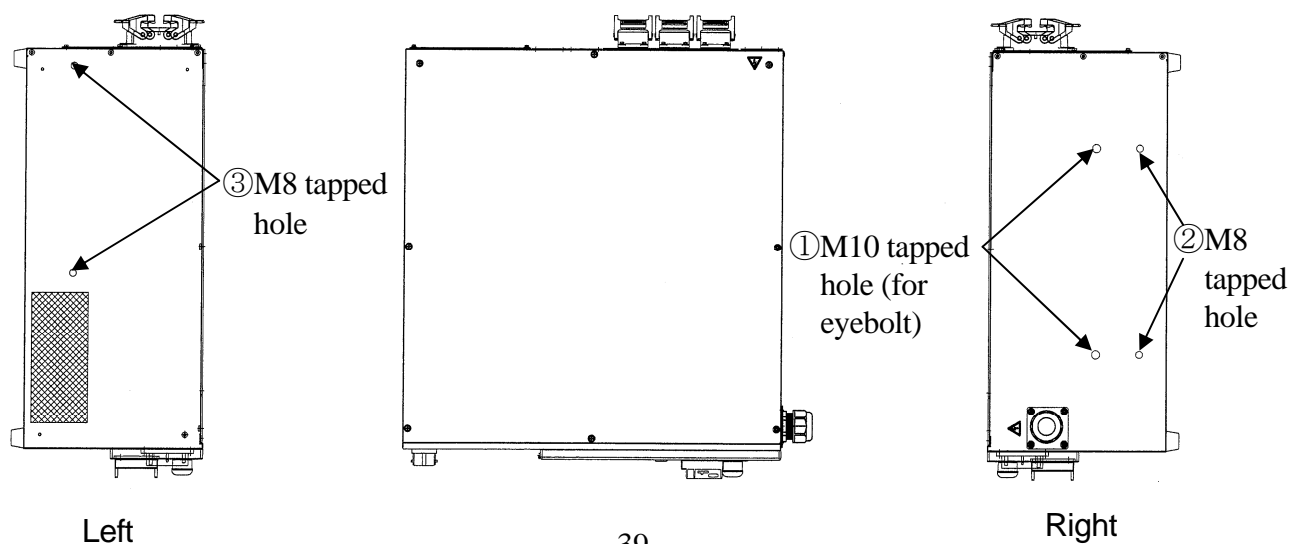
Fixing the controller



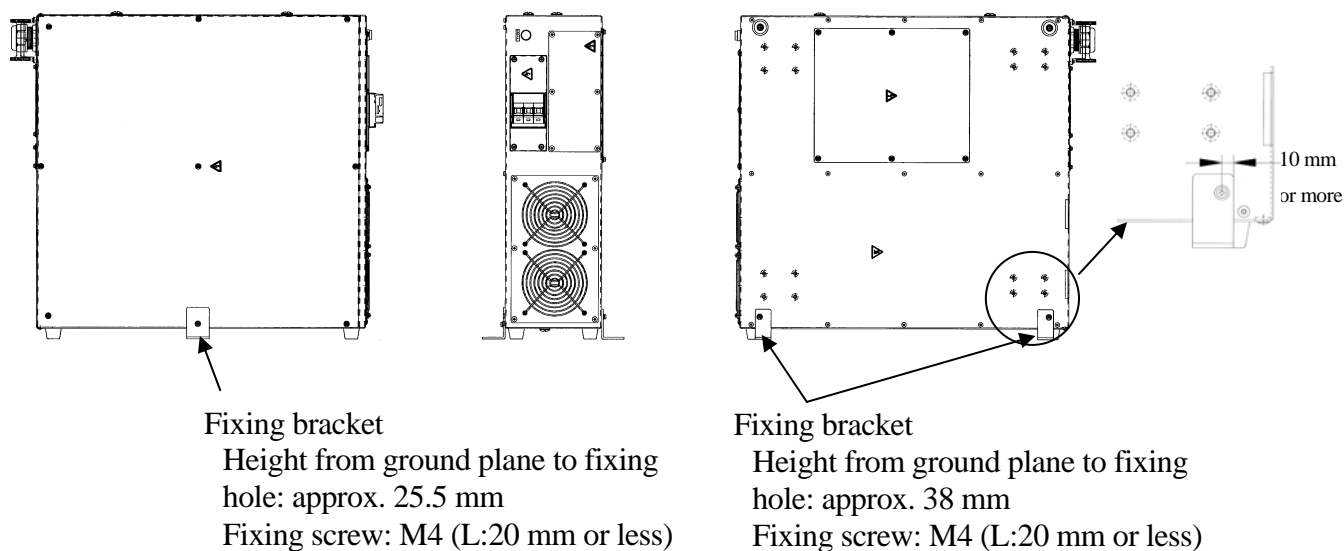
NOTE: Replace rubber feet together with fixing screws when the rubber feet on the bottom are attached on the left side.

When using the tapped holes below, engagement length should be as follows so that the screwed bolt does not bottom out.

Tapped hole No.	Screw size	Engagement length of bolt
①	M10	25 mm or less
②	M8	20 mm or less
③	M8	12 mm or less



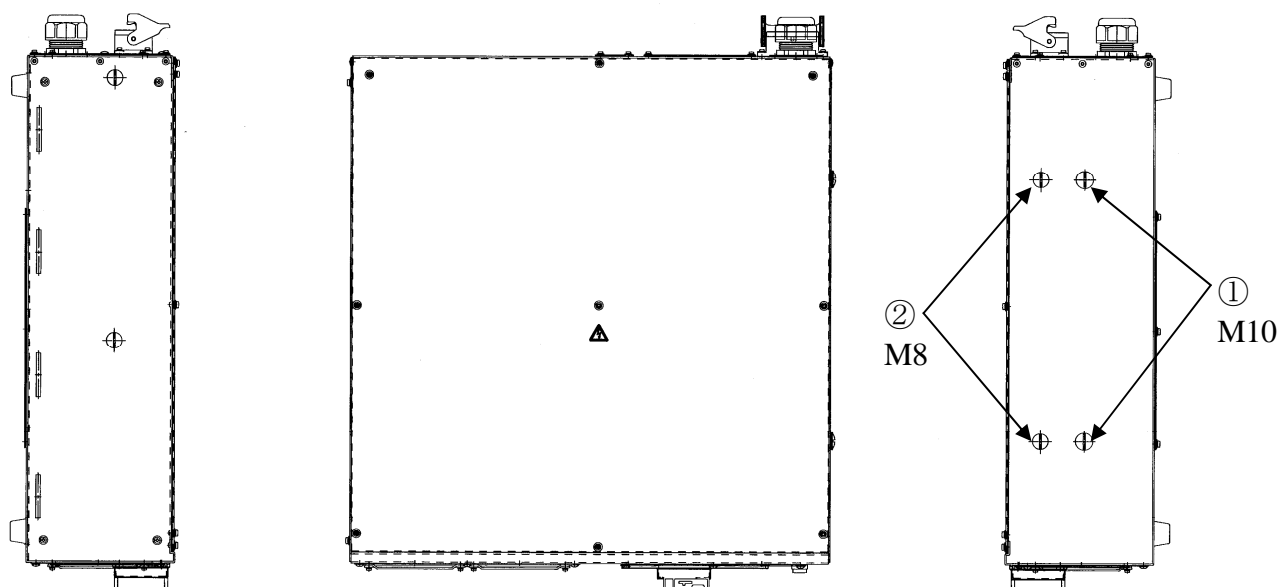
Fixing the transformer unit



NOTE: Replace rubber feet together with fixing screws when the rubber feet on the bottom are attached on the left side.

When using the tapped holes below, engagement length should be as follows so that the screwed bolt does not bottom out.

Tapped hole No.	Screw size	Engagement length of bolt
① (for eyebolt)	M10	30 mm or less
②	M8	30 mm or less



6.0 CONNECTION INSTRUCTIONS

6.1 CONNECTION BETWEEN CONTROLLER AND ROBOT



WARNING

Do not connect the external power until connections between controller and robot are complete. Accidents, such as electric shock may occur.

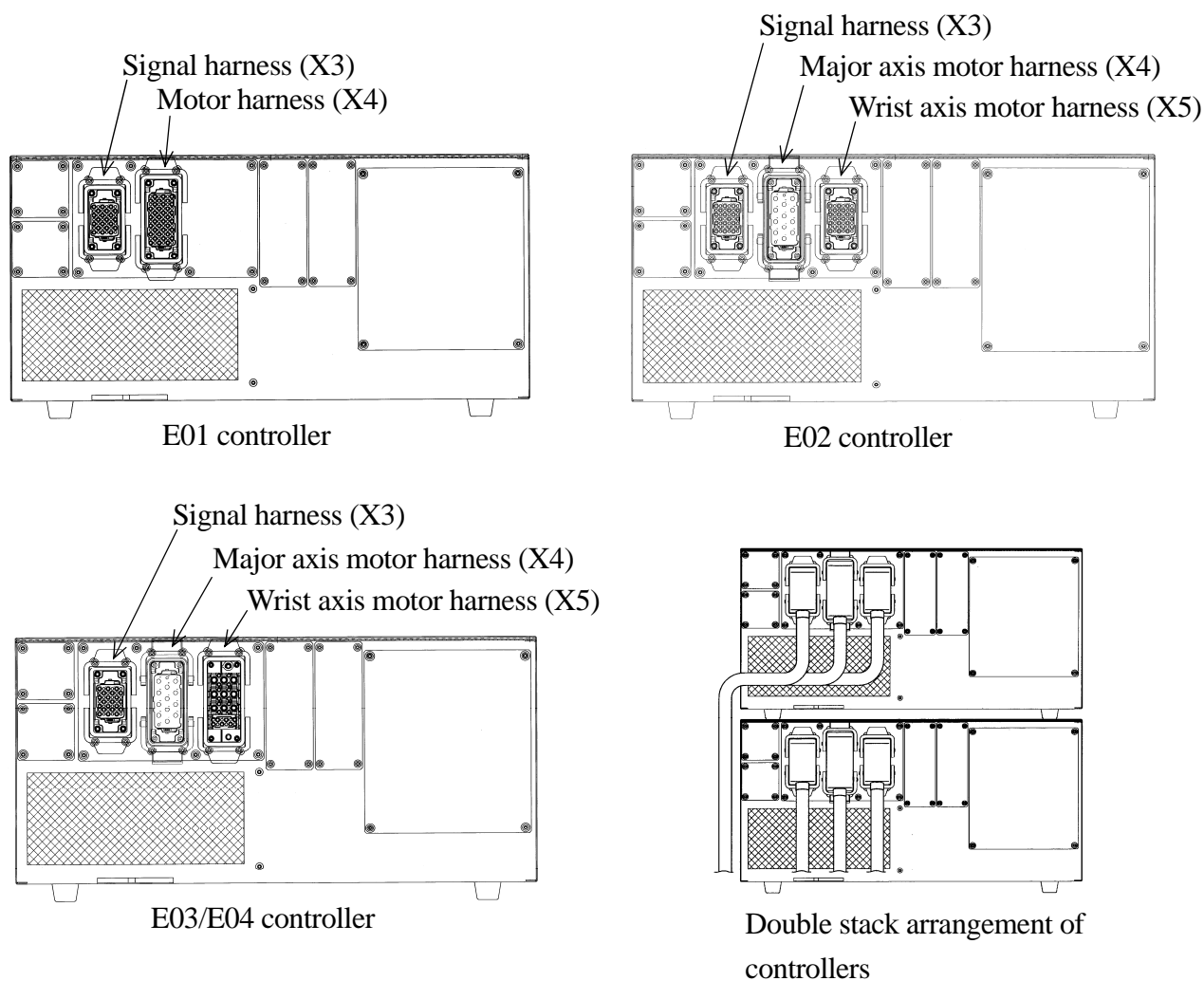


CAUTION

- 1. When connecting the harnesses, be sure to use the correct harnesses. Using an incorrect harness, or forcing or misconnecting the harness may damage connectors or cause a break in the electrical system.**
- 2. Prevent people or equipment (forklift etc.) from stepping on or riding over the signal and motor harness lines. Otherwise, the harness may become damaged or the electrical system may break.**
- 3. Even when the harnesses are long, do not bundle them winded or bended. Bundling the harness causes the heat to build up in the harness, resulting in over-heat and furthermore may cause fire.**
- 4. Separate the harnesses from any nearby high voltage lines (min. 1 m apart). Do not bundle or run the harnesses in parallel with other power lines. Otherwise, the noise generated from power lines will cause malfunctions.**
- 5. Separate the motor harness from the communication and sensor cables, and distribute the lines so they are neither bundled nor running in parallel. Moreover, connect the communication and sensor cables using shield mesh wire that includes twisted pair lines and connect the mesh wire to an adequate FG terminal. Otherwise, PWM noise radiated from the robot's motor drive lines may penetrate into various cables, such as communication cable and cause communication errors.**
- 6. Separate the welder secondary cable from the robot's signal harness. Do not wire them in the same duct.**
- 7. The motor harness (power line) between the robot and controller will generate PWM noise due to the PWM control driving the motors. This noise may cause interference with signal lines. Prevent interference using these countermeasures:**
 - (1) Separate the power and signal lines as much as possible.**
 - (2) Use the shortest possible length for the power line.**
 - (3) Avoid bundling, wiring in parallel the power and signal lines as much as possible.**
 - (4) Do not wire the power and signal line within the same duct/conduit.**
 - (5) Set and secure a firm earth line connection for the controller.**

Connect the separate harnesses to their designated ports as shown below.

1. Controller side

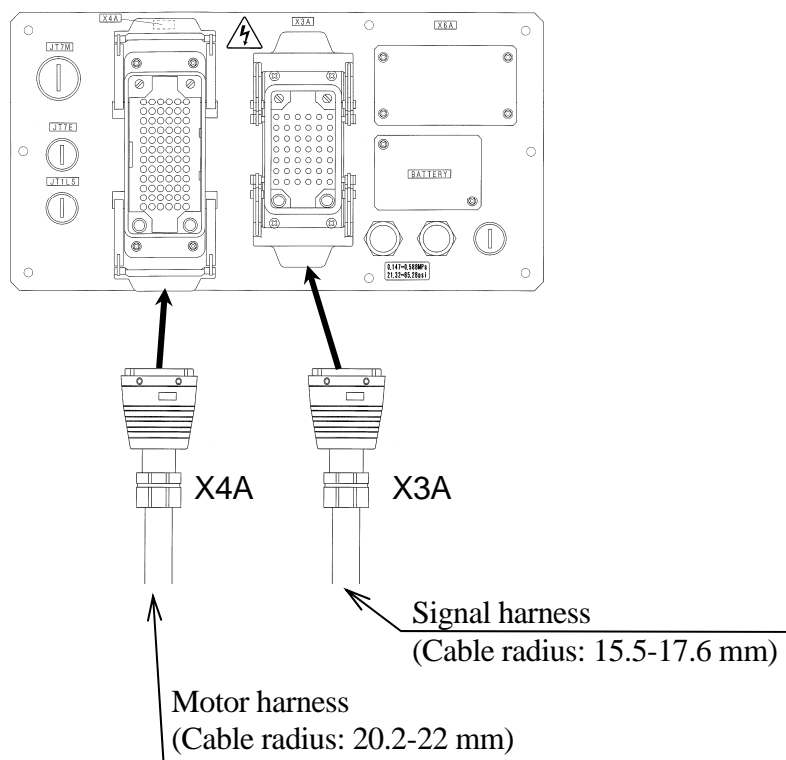


CAUTION

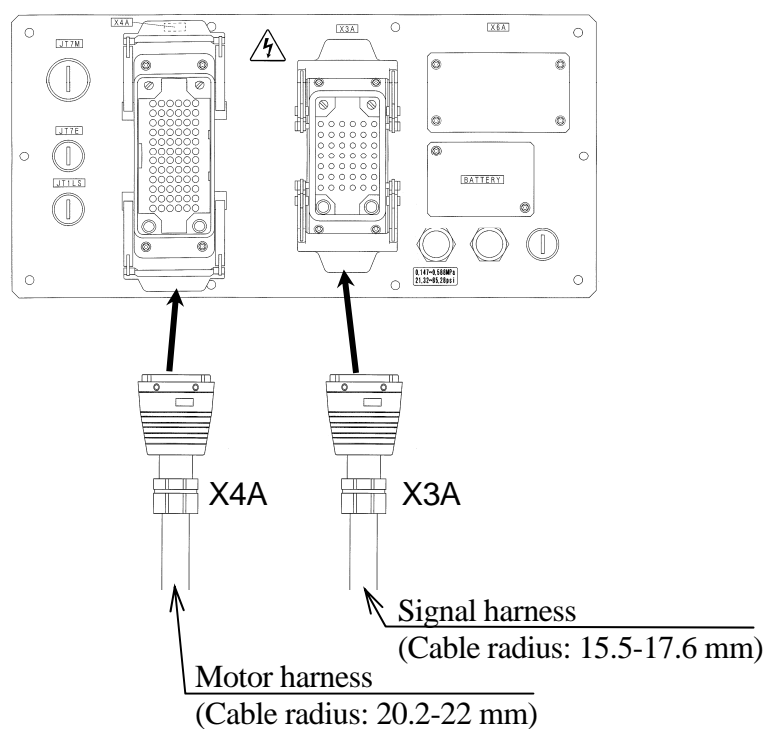
1. **Fix each connector securely.** The robot may malfunction if connectors loosen or detach.
2. **When placing a controller on another controller, connect the separate harnesses so that they do not block the exhaust port of the bottom controller.**

2. Arm side

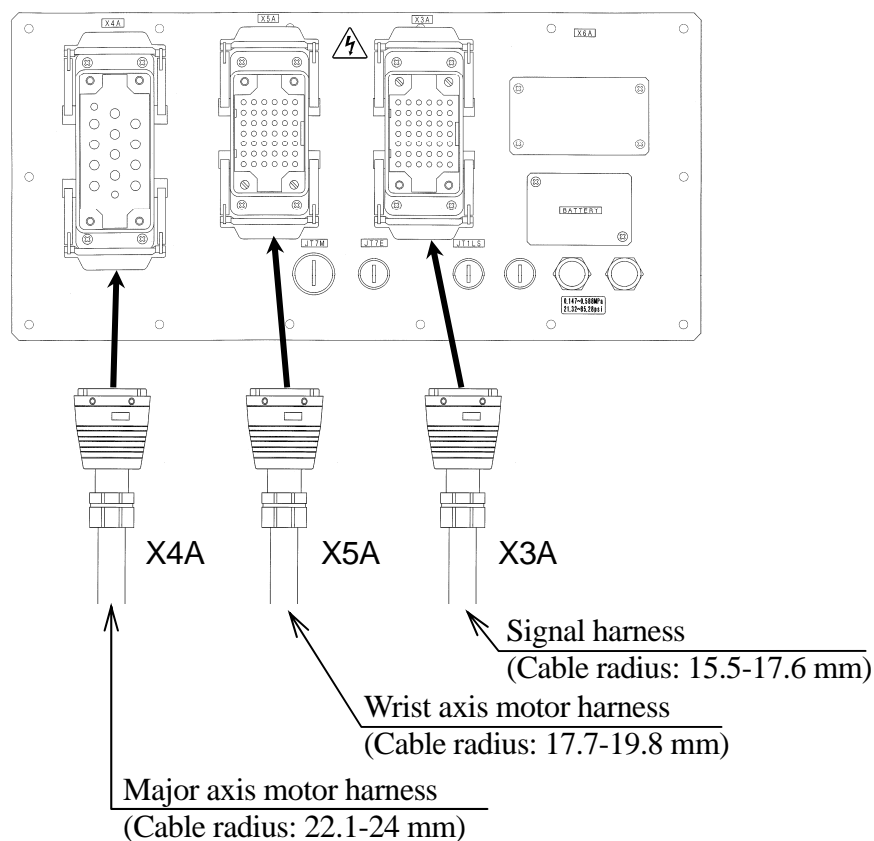
R series 10N/06L



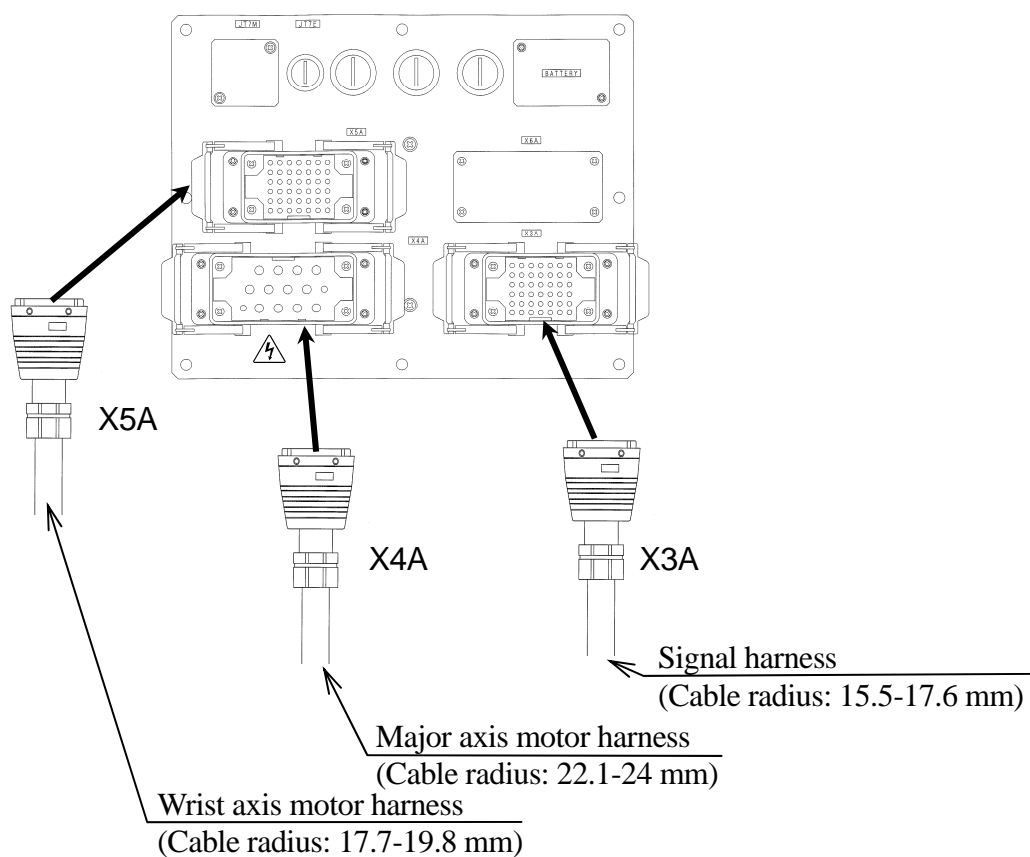
R series 20N/10L



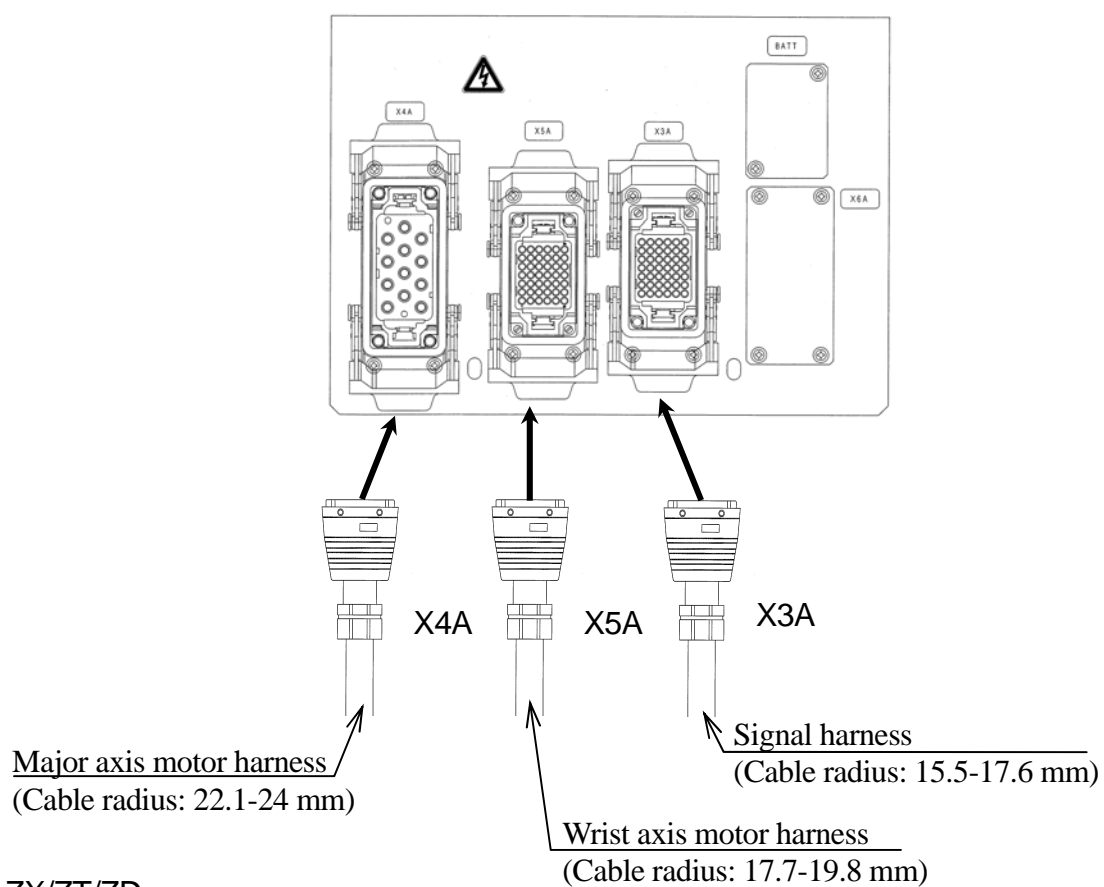
R series 30N/50N/80N/15X



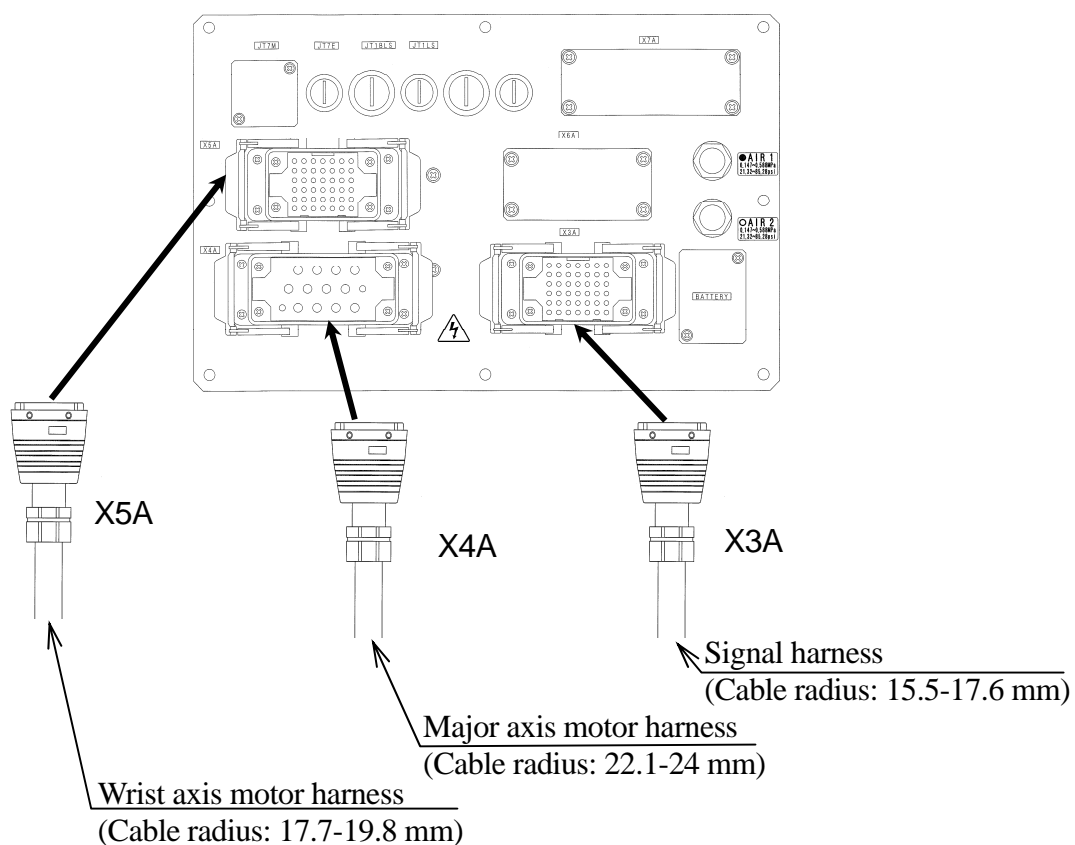
ZH



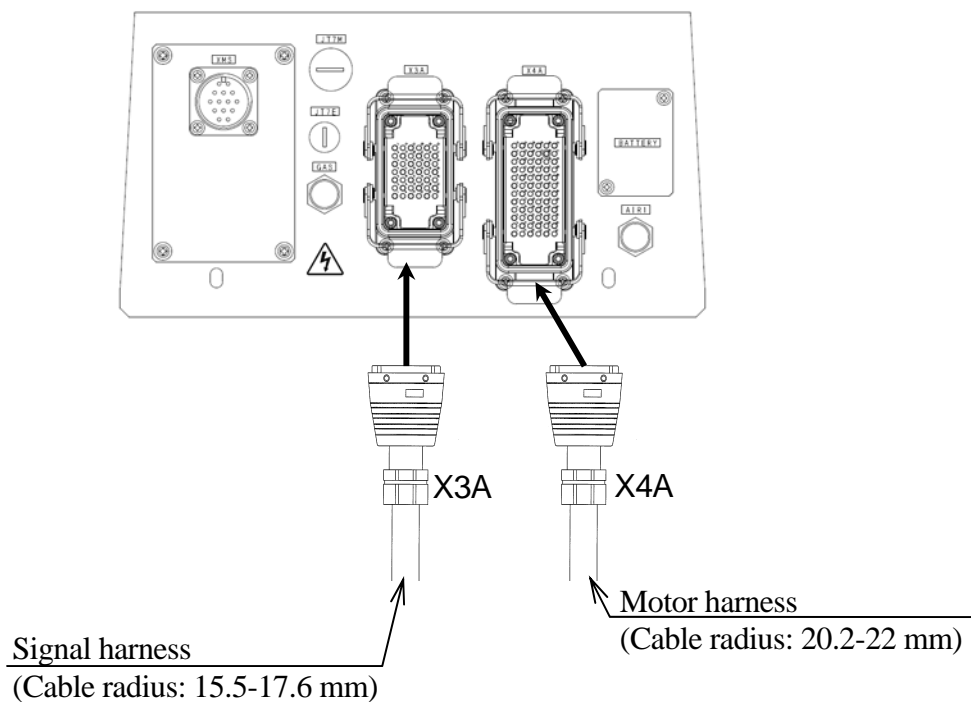
B series



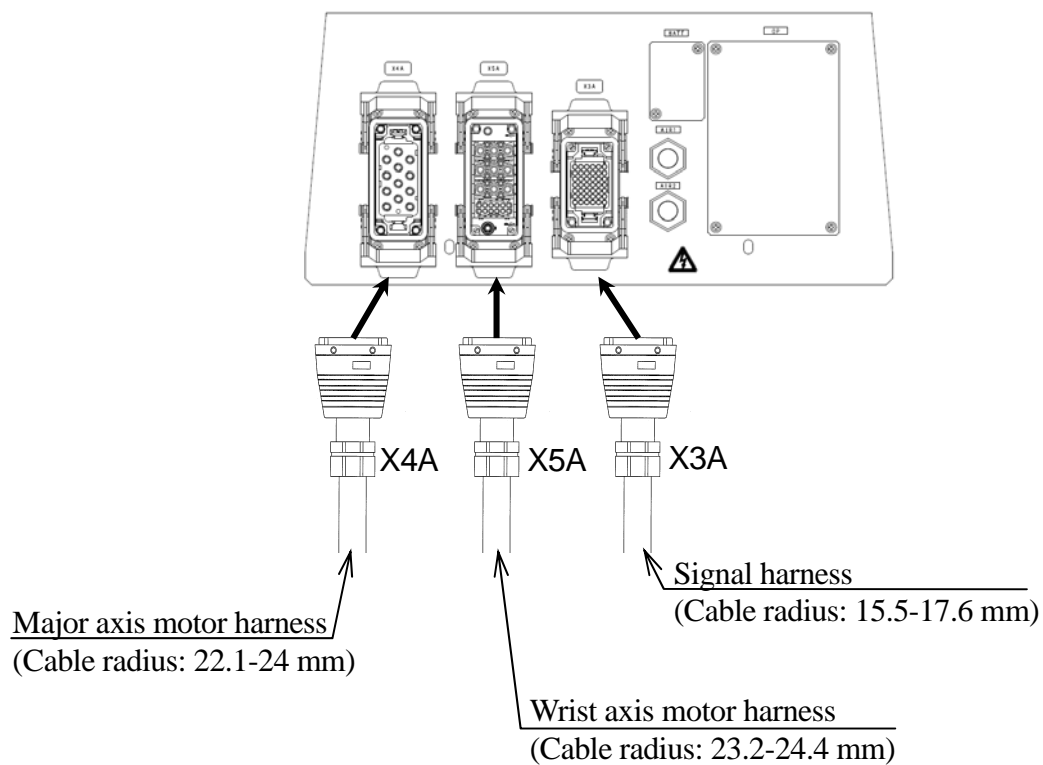
ZX/ZT/ZD



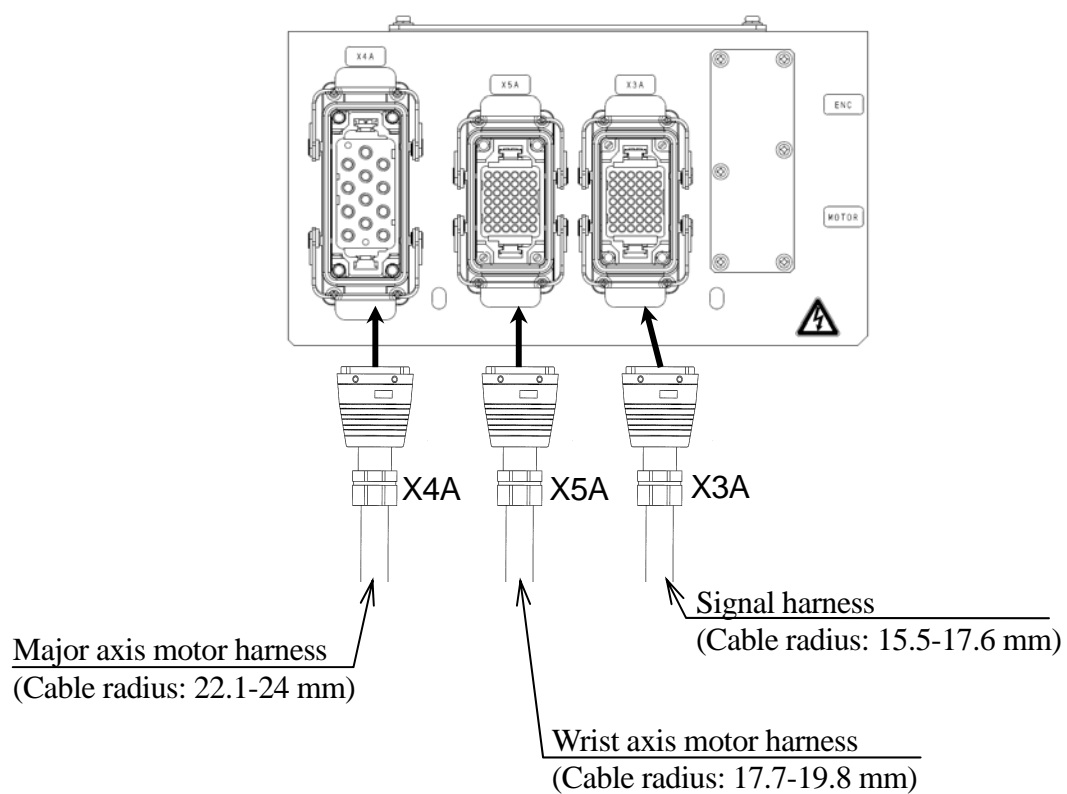
BA



CP

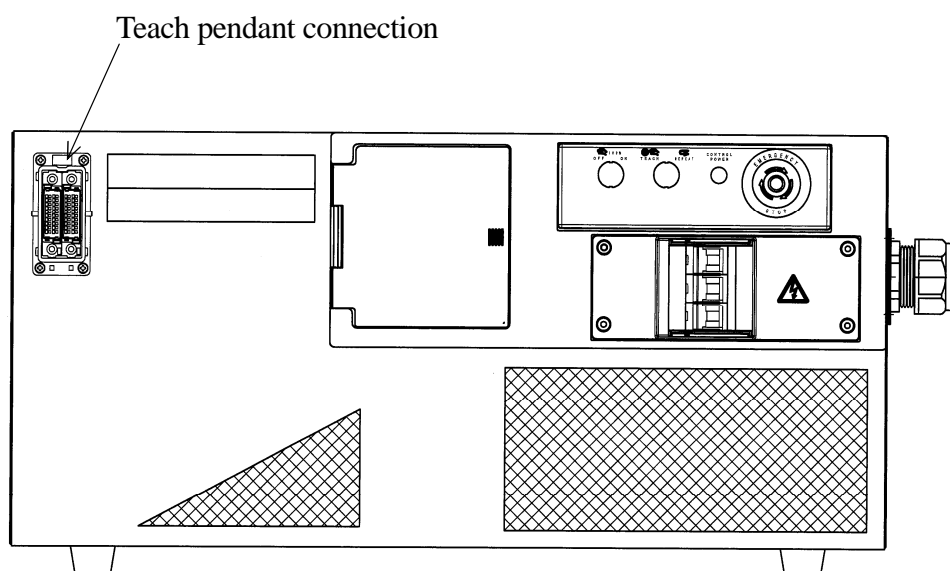


CX



6.2 CONNECTION BETWEEN CONTROLLER AND TEACH PENDANT

Connect the teach pendant cable with the connector, lower of operation panel. Pull up the lever and insert the cable side connector, then pull down the lever to lock the connectors.



7.0 CONNECTION OF EXTERNAL POWER

Strictly observe the following precautions when connecting the external power.



DANGER

Before beginning the connection work, confirm that the external power supply for the control equipment is cut off at the source. To prevent external power from being turned ON accidentally, tag the breaker and indicate clearly that work is in progress. Or, assign a supervisor in front of the breaker until all the connections are complete. Connecting components while power is supplied is extremely dangerous and may cause electric shock.



WARNING

1. Confirm that the connected supplying power to the controller meets specifications shown on the rating plate. In addition, when using the transformer unit, confirm the connected supply power meets specifications shown on the label attached on the side of the transformer unit and connect the voltage switching connector (X601) in accordance with the voltage specifications. Supplying out-of-specification power will damage electric components in the controller.
2. Earth the controller to prevent against electrical noise and shock.
3. Use dedicated earth wire (100 Ω or less), which is equal to or larger than the recommended power cable size (3.5 - 8.0 mm²).
4. Never share an earth line with workpiece to be welded or another machine (weld machine, etc.).
5. In arc welding applications, connect the minus pole of the weld power supply to a jig or directly to workpiece to be welded. Insulate the robot body and controller so that they do not share a common earth line.
6. Without fail, before turning ON the external power to control equipment, make sure the power supply wiring is complete and all the covers reattached properly. Otherwise, failure to do so may cause electric shock.

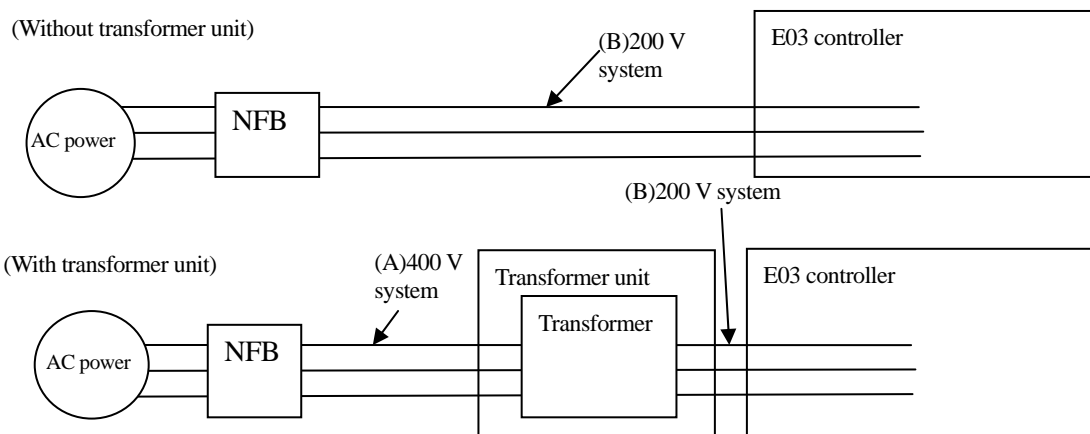


CAUTION

1. Prepare external power that meets the specifications of the control equipment in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the control equipment's specified range (above/below ratings), then the power monitoring circuit activates cutting off the power, and an error is returned.
2. If the external power emits a lot of electrical noise, set up a noise filter to reduce the interference.
3. PWM noise from robot motor lines may cause malfunction of low noise-resistant devices* via external power line. Confirm that there are no such devices in the vicinity.
4. Install a separate external power switch (breaker) for the robot, independent and unconnected to the weld machine.
5. To prevent shorting or accidental leakage on the external power switch, install an earth leakage breaker. (Use a time delay type with sensitivity of 100 mA or more.) Also, use a time-delay-type earth leakage breaker with sensitivity of 100 mA or more when using a transformer unit.
6. If there is a possibility that surge voltage such as lightning surge might be applied from external power line, decrease the surge voltage level by mounting a surge absorber.
7. For the controller with electric power regeneration function (E03), the AC line voltage of breaker on the secondary side may increase up to the peak value in the table below if the power breaker supplying the AC power to the controller (NFB in the figure below) is cut. Mind this when other equipment shares the common power from the same breaker with the controller.

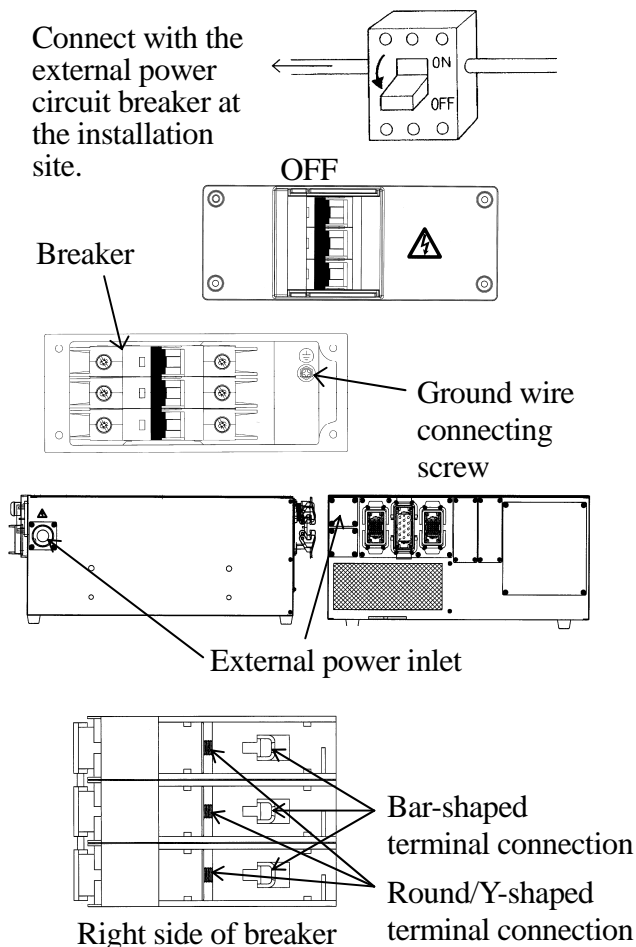
NOTE* Proximity switch directly connected with power line etc. may suffer from the influence.

Power supplied to the controller		Peak value of line voltage at point A (400 V system) (V)	Peak value of line voltage at point B (200 V system) (V)
① Without transformer unit	*For AC200-220V	380 V 10 ms or less	380 V 10 ms or less
② With transformer unit	When the power source setting inside the transformer unit (X601 connector) is on 380V - 415 V side	700 V 10 ms or less	
	When the power source setting inside the transformer unit (X601 connector) is on 440V - 480 V side	800 V 10 ms or less	



When not using transformer unit

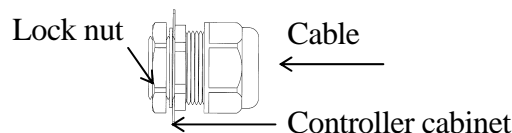
Connect with the external power circuit breaker at the installation site.



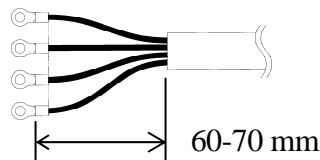
Connect the external power according to the following procedure.

1. Turn OFF the external power for the controller.
2. Set **CONTROLLER POWER** switch on the controller to the OFF side without fail.
3. Open the front cover of **CONTROLLER POWER** switch.
4. Feed the external power cable into the inlet on the right or rear side of controller.
5. Connect the power cable to the part shown in the right figure and the ground wire to the part shown in the above figure.

- Seal connector for external power inlet is provided on the right side of controller. Use the power cable whose diameter is $\phi 16$ - $\phi 22$.



- When inserting the power cable from the right side of controller, the stripped length of cable sheath should be between 60 and 70 mm.



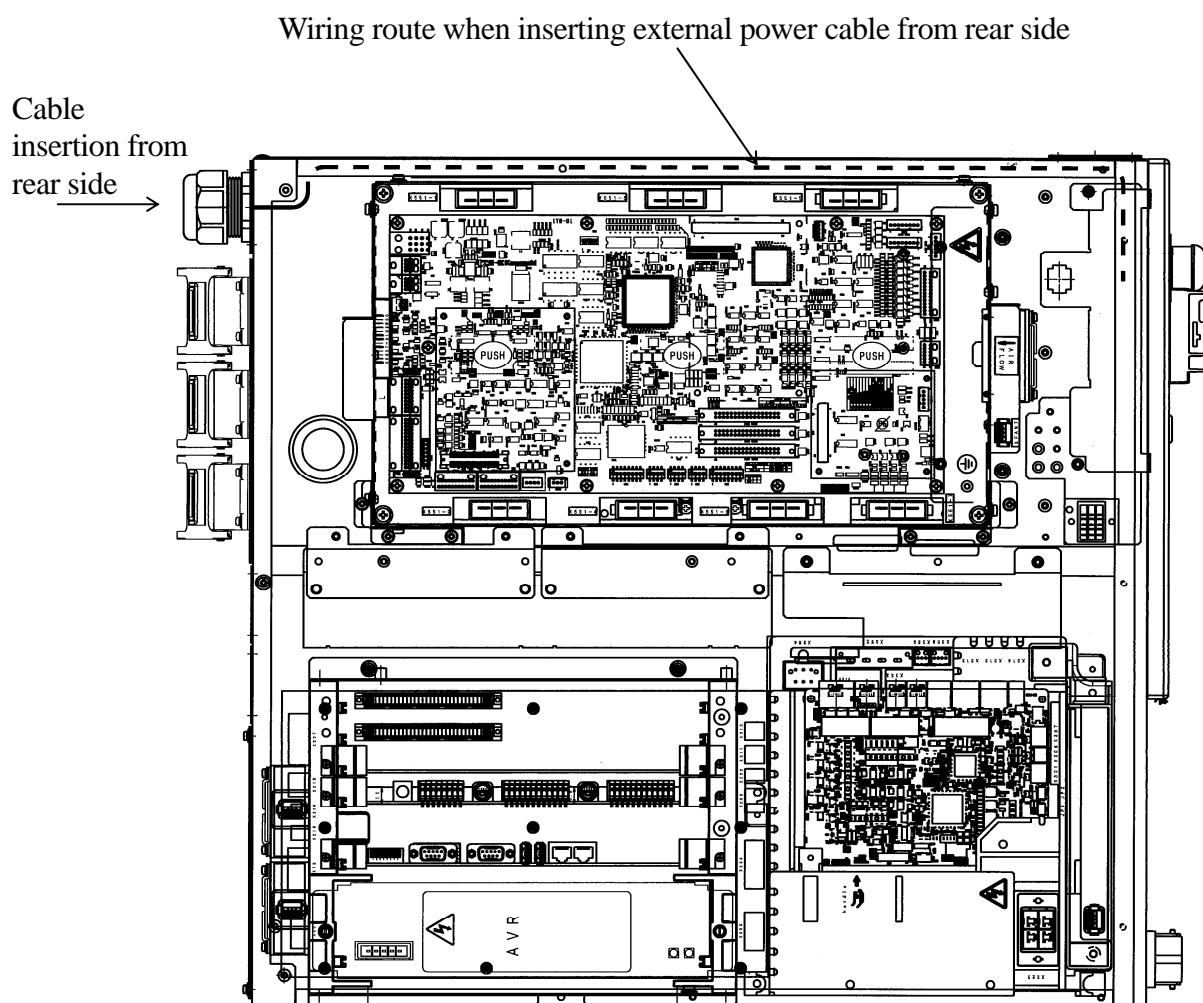
- Use crimp-type terminals to connect to the breaker. When using round/Y-shaped terminal, use the terminal for M5 screw.

NOTE*: If the cable diameter is more than $\phi 22$, prepare a seal connector which is appropriate for the cable diameter. The hole diameter of the plate for external power inlet is $\phi 34$.

- When inserting the external power cable from rear side, wire the cable along the route shown in the figure below.

⚠ CAUTION

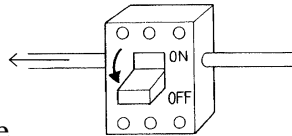
1. **Confirm current requirements and select a power cable with adequate capacity. (See section 3.0.)**
2. **Do not install wire that is too small in diameter, the voltage may drop or the cable may overheat.**



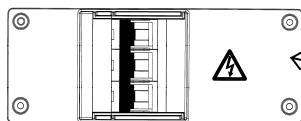
When using transformer unit

1. Connection between the controller and the transformer unit

Connect with the external power circuit breaker at the installation site.



OFF



Front cover

Connect the controller and the transformer unit with dedicated power cable according to the following procedure.

1. Turn OFF the external power for the controller.
2. Set **CONTROLLER POWER** switch on the controller to the OFF side without fail.
3. Open the ceiling plate and front cover of the controller, and remove incoming plate on the rear side (upper, without hole) and incoming plate on the side (with seal connector). On this occasion, mount the above incoming plate on the rear side to the inlet on the side.
*The incoming plate on the side with seal connector is not used.
4. Insert the power cable from the inlet on the rear side, and wire it to the breaker through the wiring route shown in the figure below. (At this time, tighten the seal connector on the rear side securely.)

Wiring route inside controller

*Insert wire medial to the harness guide.

Use seal connector + incoming plate mounted on power cable.

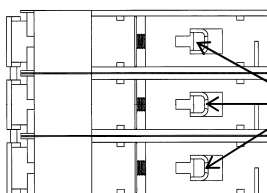
Incoming plate on rear side (upper)

Mount incoming plate on rear side (without hole) to the inlet on the side.

Breaker

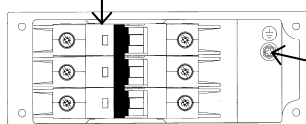
XTRFAN connector

Right side of breaker



Connect here.

Breaker

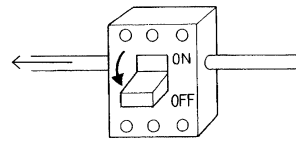


Ground wire connecting screw

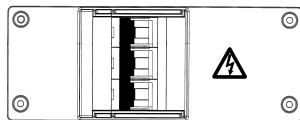
5. "XTRFAN" connector is provided at the place shown above. Remove the jumper connector which is being connected, and connect the connector of the power cable. (The removed jumper connector is not used.)
6. Connect the power cable to the place shown in the figure of the right side of breaker and the ground wire to the place shown in the left figure.
7. Close the ceiling plate and the front cover.

2. Connection between external power and transformer unit

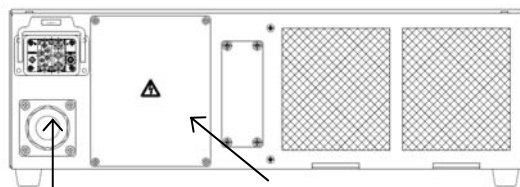
Connect with the external power circuit breaker at the installation site.



OFF



Rear

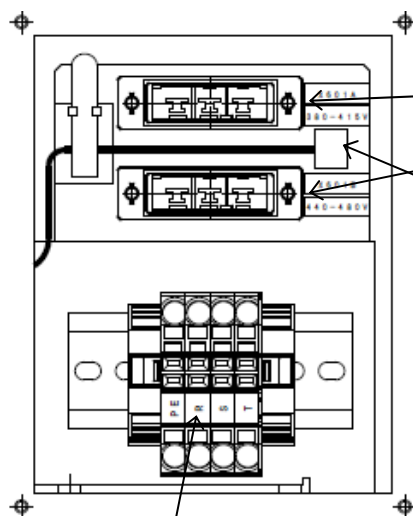


External power inlet

Power connection/
Setting plate
Opened in the figure below.

Connect the external power with the transformer unit according to the following procedure.

1. Turn OFF the external power for the control equipment.
2. Set **CONTROLLER POWER** switch on the transformer unit to the OFF side without fail.
3. Feed the external power cable into the inlet on the rear side of transformer unit.
4. Open the power connection/setting plate, and connect X601 power source connector in accordance with the voltage to be used.
5. Connect external power cable to each terminal of PE, R, S and T of TB1 terminal block.



(A)380V-415V connector

(B)440V-480V connector

Connect X601 power source connector bound at the place to the above (A) or (B) in accordance with the voltage to be used.

TB1 terminal block: PE, R, S and T from the left [Terminal block type: 2006-1201/WAGO]

(1) When using naked wire

Recommended wire diameter: AWG10-AWG8

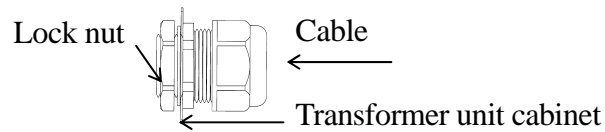
(2) When using Ferrule with insulation collar

Recommended wire diameter: AWG10

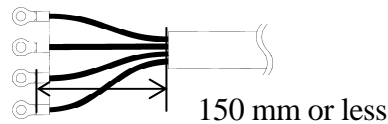
Connecting terminal length: 12 mm

*Refer to the specifications of terminal block manufacturer for details.

- Seal connector for external power inlet is provided on the rear side of transformer unit. Use the power cable whose diameter is $\phi 16$ - $\phi 22$.



- The stripped length of cable sheath of inserted power cable should be 150 mm or less.



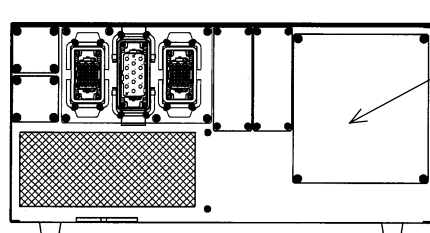
NOTE*: If the cable diameter is more than $\phi 22$, prepare a seal connector which is appropriate for the cable diameter. The hole diameter of the plate for transformer unit inlet is $\phi 34$.



CAUTION

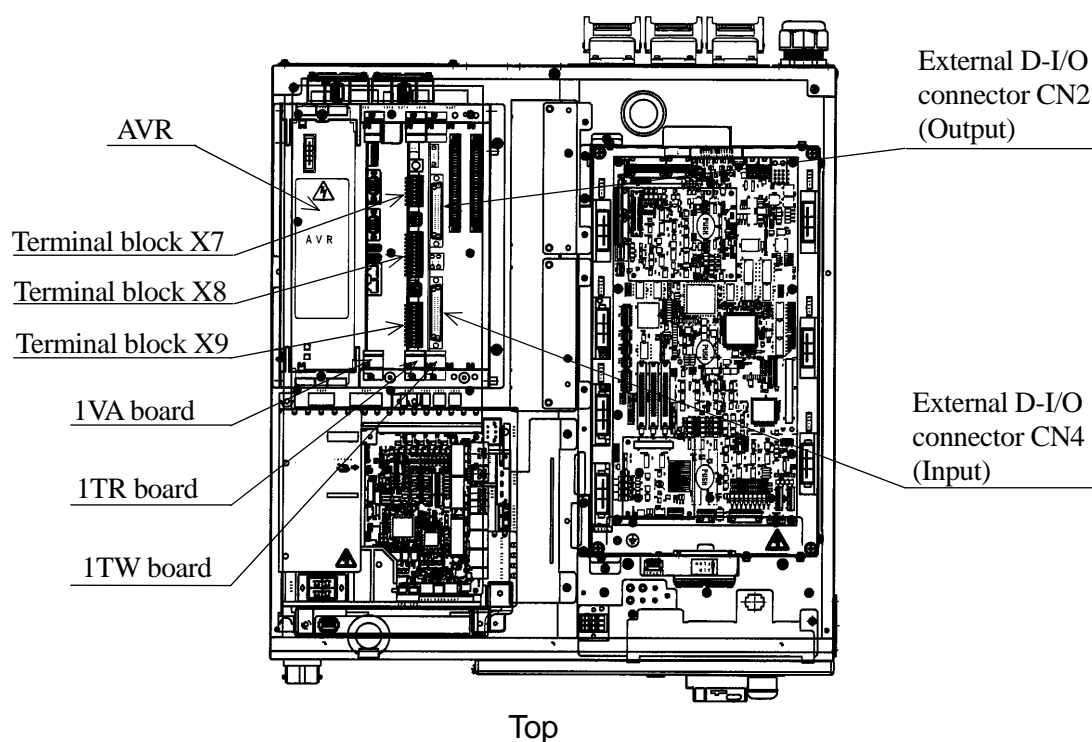
- 1. Confirm current requirements and select a power cable with adequate capacity. (See section 3.0.)**
- 2. Do not install wire that is too small in diameter, the voltage may drop or the cable may overheat.**
- 3. Confirm that two fans of the transformer unit rotate properly after connecting the transformer unit and the controller with their power switch ON.**

8.0 CONNECTION OF PERIPHERAL CONTROL EQUIPMENT

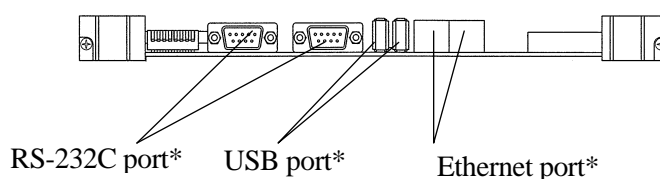


I/O signal inlet

Connect each connecting port with peripheral equipment and devices, using the I/O signal inlet on the rear side of the controller.



See the right figure for details on connecting ports of 1VA board.



NOTE*: The left RS-232C port, the left USB port and the left Ethernet port are connected to each port in the accessory panel for standard specification.

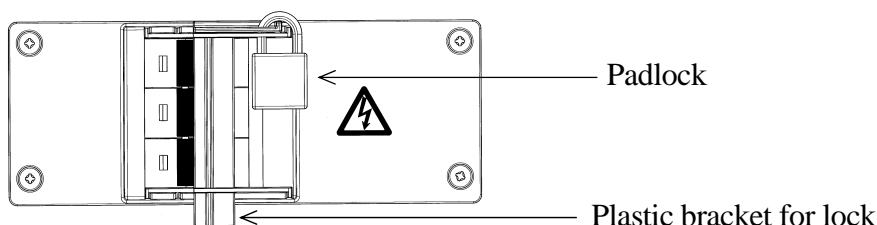
8.1 CONNECTION INSTRUCTIONS



WARNING

Turn OFF the power supply to the controller and peripheral equipment when connecting external I/O. Prevent accidental turn ON of the power until all connections are complete by take procedures shown below or by tagging the breaker to indicate that work is in progress or by assigning a supervisor to stand in front of the breaker. Failure to do so is extremely dangerous and may result in electric shock or damage to the electrical system.

Target	Procedure to prevent turning ON the power during operations
E01/E02/E03/E04 controller, Transformer unit	Lock by attached plastic bracket and padlock (not attached). (See the figure below.)



CAUTION

1. Take the necessary noise countermeasures on equipment with external I/O connections to the controller. Electrical noise that interferes with the I/O signals may cause malfunction or damage to the electrical system.
2. Do not mistake pin Nos. on the connectors when connecting external I/O. Misconnecting pins may cause breakdown of the electrical system.
3. Prevent people or equipment (forklift, objects, etc.) from stepping on or riding over the external I/O cables. An unprotected cable may become damaged causing breaks in the electrical system.
4. Avoid wiring the external I/O cables and the power lines close together or in parallel as much as possible. Separate the cables and lines by at least 20 cm. (either in or outside the controller) Electromagnetic induction noise from the robot motor cable, the power lines for peripheral equipment, welding cable, etc. may penetrate into the I/O cables and lead to malfunction.
5. Use a shield cable for the external I/O cable and connect the shield wire to the controller cabinet.
6. When connecting I/O cables to connectors or terminals, fix them with tying bands in the harness support set on the top of the controller, preventing them from excessive force. (pulling, snagging of cable, etc.)
7. Install the seal connector so that external I/O cables never cause insulation failure or disconnection at the inlet.

8.2 CONNECTION OF GENERAL PURPOSE SIGNAL

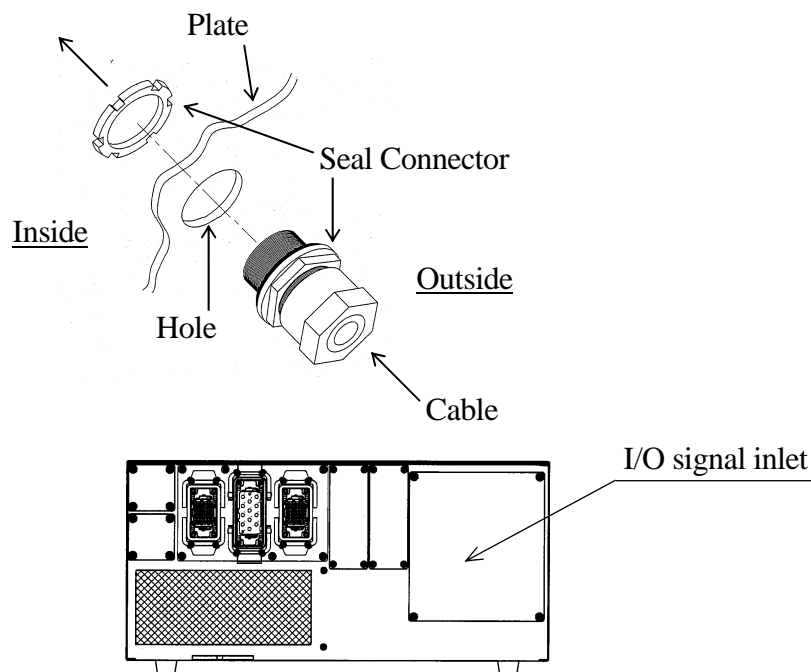
The robot can operate synchronously with the peripheral equipment or other robots when connecting I/O signals to the peripheral controller with connectors CN2 and CN4 on the 1TW board. (Connectors on the cable side of CN2 and CN4 are optional.)

1. Insert the cables into I/O signal inlet.

I/O signal inlet: Rear of the controller

An example of installing the cable(s) is shown below.

- (1) Make a hole in the plate suitable for the seal connector.
- (2) Pass the cable through the seal connector
- (3) After passing the cable to the hole, tighten the nut(s) of the seal connector.



2. Remove the connector cover for CN2 and CN4, and wire for general purpose signal.
3. Solder the connector pin after putting the insulation tube through the electric cable.
4. Strip off the cable coating by 2-3 mm and apply solder to the wire end.
5. Solder the cable to the connector pin.
6. Cover the connector pin with the insulation tube.

[NOTE]

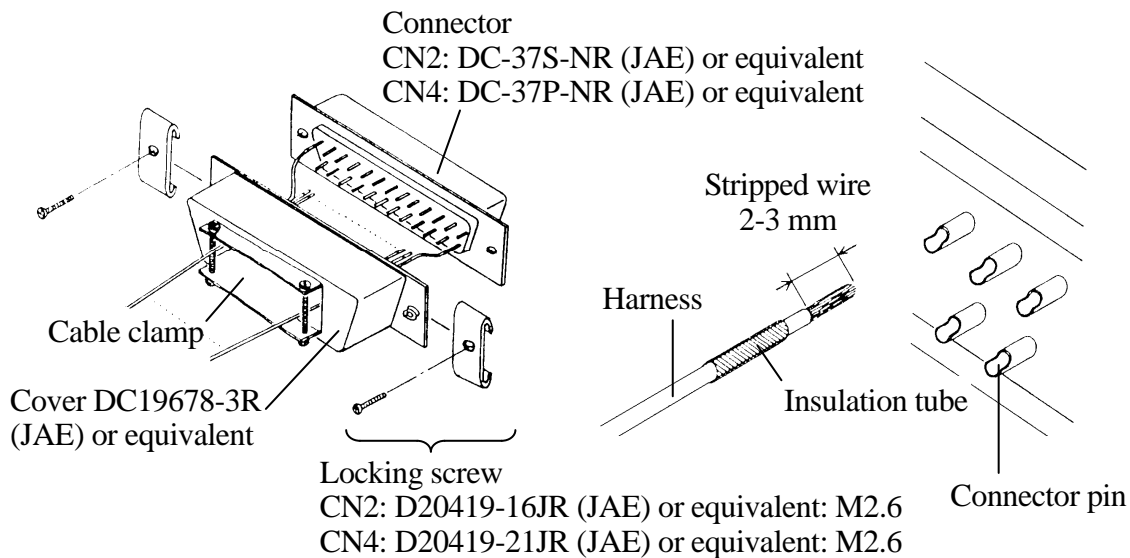
1. Use an insulation tube of heat shrinkage type, or bind the tube ends on each line so they do not come off.
2. We recommend using AWG22-24 or equivalent for cables.

7. After wiring is complete, attach connector cover and fix the cable securely.

8. Insert the connector into 1TW board and fix with locking screws at both ends.

[NOTE]

Tighten the screw thoroughly. The connection may fail if the screw is loose and the connector pins are exposed to excessive stress/force.

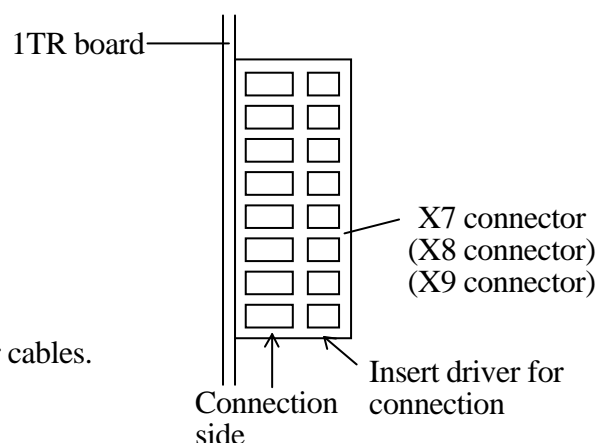


8.3 CONNECTION OF HARDWARE DEDICATED SIGNAL

It is possible to construct a safety circuit using the hardware circuit by connecting the external emergency stop signal or hold signal line to the terminal connector on the 1TR board. Refer to “External I/O Manual” for more details about signals and their connection to each terminal block.

Terminal block connections are held in place by springs. Push a thin flat-head screwdriver (width: 2.5 mm or less) into the hole on the right to open the spring in the left hole. Then insert the wire there to connect.

We recommend using AWG22-24 or equivalent for cables.
(Stripped wire length: 7 mm)



To assure the wiring, we recommend using ferrules;

Recommended model: 216-201 (WAGO)

Recommended crimping tool: 206-204 (WAGO)

(Stripped wire length: 9.5 mm)

8.4 CONNECTION OF PERSONAL COMPUTER

A PC can be used as a terminal for the robot controller, when loaded with terminal softwares KRterm/KCwin32 and connected to the RS-232C port in the accessory panel. Also a PC loaded with KRterm /KCwin TCP/IP can be used as terminal by connecting it to the ethernet port on accessory panel with Ethernet cable. Refer to the “AS Language Reference Manual” for more details.

8.5 CONNECTION OF RS-232C SERIAL SIGNAL (OPTION)

Data communication is possible with the host computer when the host computer is connected to the RS-232C port on the 1VA board with an RS-232C cable. Refer to the option manual 90210-1177DE* for details.

8.6 CONNECTION OF ETHERNET COMMUNICATION SIGNAL (OPTION)

It is possible to build an Ethernet LAN of 10BaseT/100BaseTX using the ethernet port on 1VA board. Refer to the option manual 90210-1248DE* for details.

8.7 CONNECTION OF FIELDBUS (OPTION)

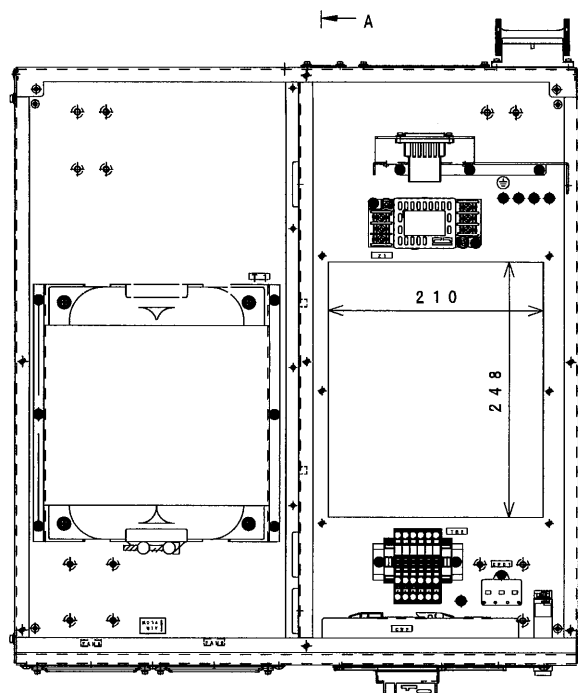
Adding the 1TJ/1UK board for fieldbus (option) enables communication with peripheral devices such as DeviceNet on the fieldbus. Refer to the option manual 90210-1184DE* for details.

8.8 CONNECTION OF SENSORS/VALVES ON ARM (OPTION)

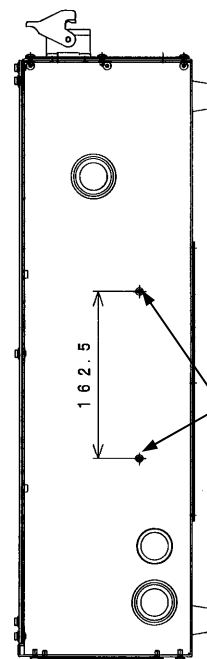
Input from sensors mounted on arm and control of output of driving energy to the valves become available by adding arm ID and machine I/O boards, such as 1PV/1JD/1JE, 1TK/1TY/1XY boards. Refer to the option manuals 90210-1246DE* and 90210-1247DE* for details.

APPENDIX. FREE SPACE INSIDE TRANSFORMER UNIT

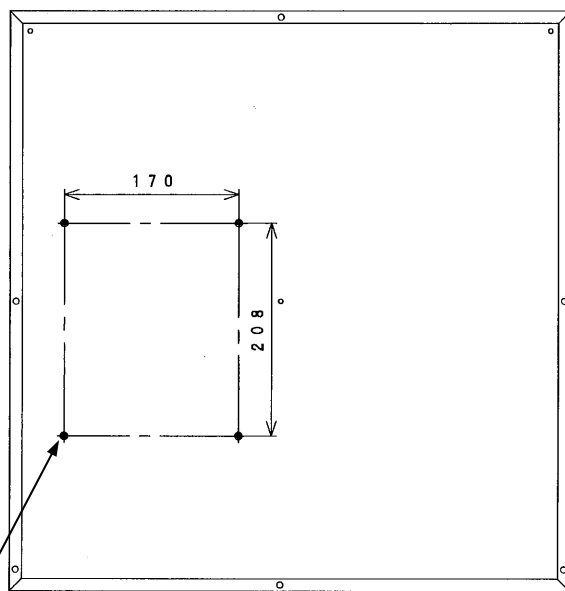
Free space is provided in the transformer unit at the position shown in the figure below.



Ceiling plate is opened.



Cross-section A-A

Spacer with 4-M4
tapped hole (L=8)

Rear side of ceiling plate

Tap size: M4



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