

**Kawasaki Robot Controller  
E5x Series**

**Installation and  
Connection Manual**

**Robot**

Kawasaki Heavy Industries, Ltd.

## Preface

This manual describes the installation and connection of the E51/E52/E54/E58 controllers.

This manual covers the installation, wiring 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 controller. 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.

E51/E52/E54/E58

- 
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.

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## 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.**
- 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 separate "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 Safety

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

### 1.1 Precautions during Transportation and Storage

To transport the Kawasaki Robot Controller 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 or a forklift, never support the controller manually.
2. During the transportation, stay out from under the lifted controller.



#### CAUTION

1. Since the controller 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 controller. Clear a passage for the transportation of controller before using a crane or forklift.
3. When transporting or storing a controller:
  - (1) keep the ambient temperature within the range of minus 10 to 60°C
  - (2) keep the relative humidity within the range of 35 to 85% RH  
(Non condensing)
  - (3) keep free from excessively large shock and vibration.

## 1.2 Installation Environments of Robot Controller

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

1. Ambient temperature during operation: within 0 to 45 °C.
2. Relative humidity: 35 to 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 controller.) The resistance to oil may not be sufficient, so do not use the controller under the condition where the controller gets oil on it or oil mist floats. If the controller is used under the condition where there are water and oil around the controller, take measures so that the controller does not get water and oil.  
E51/E52/E54/E58: Pollution degree: 3 or below, IP54 (Protective against entry of dust into the controller which causes the loss of controller function and water droplets.)



### CAUTION

**When installing the controller in the environment where metal dust, etc. is generated in robot application to works shown below, mount fan filter prepared as option (E51/E52/E54/E58 controllers).**

5. Free from electrical noise interference. (Controller external power noise: 1 kV/1 μs or less)

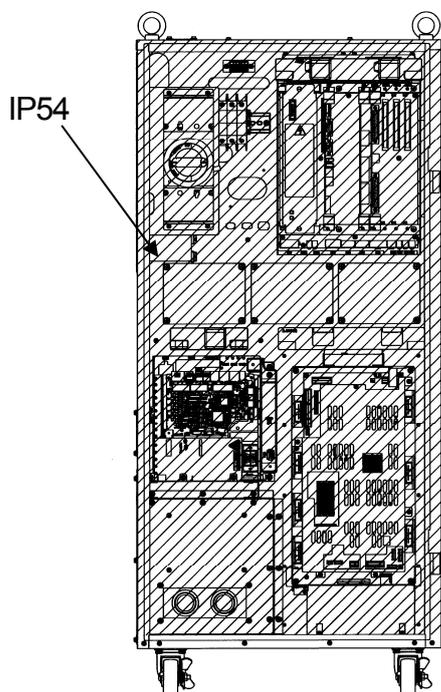


### CAUTION

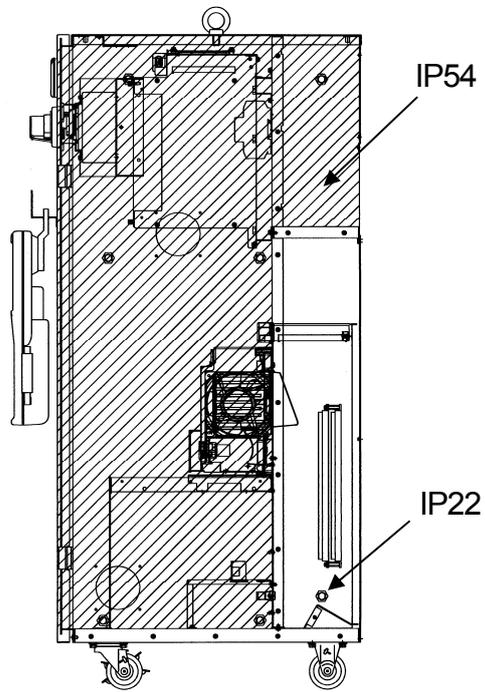
**If the controller is installed near equipment that generates a lot of electrical noise, be sure to provide appropriate surge killers around that equipment. Noise producing equipment includes: induction motors, electromagnetic brakes, solenoids, or contact equipment, etc.**

Degrees of protection in each controller

E51/E52/E54

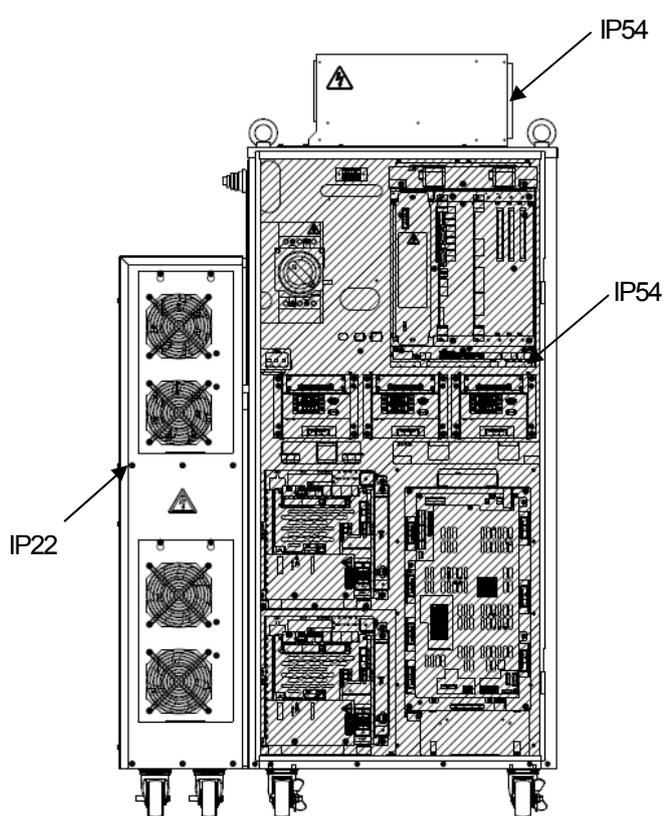


Front (Door omitted)

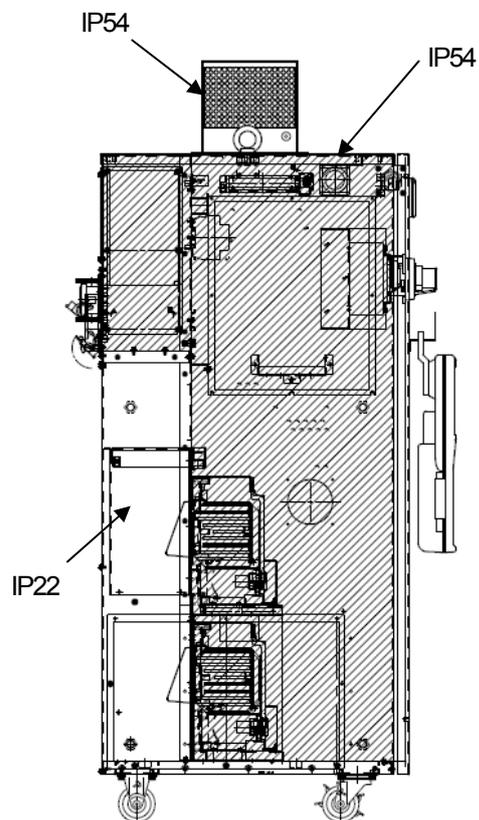


Right

E58



Front (Door omitted)



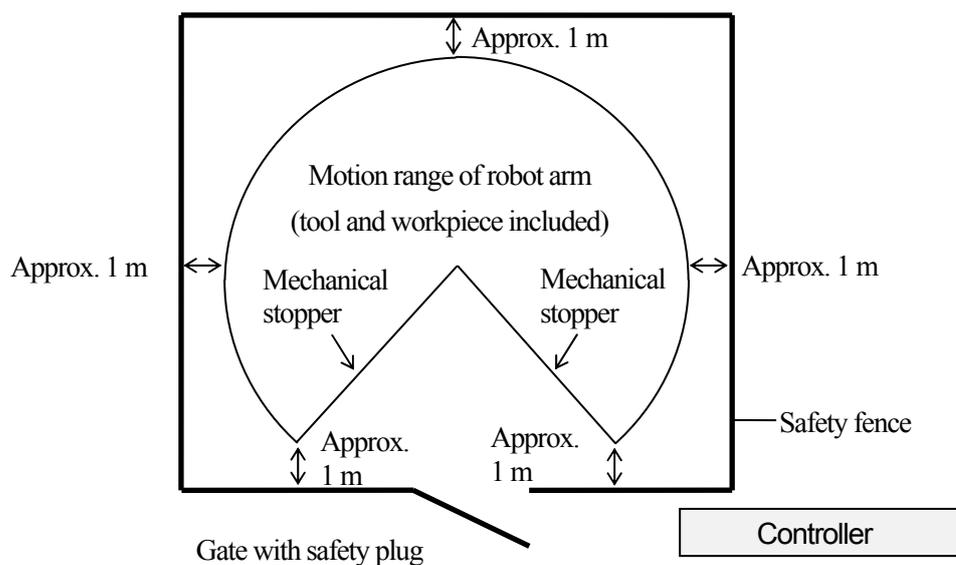
Left

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



In addition, ensure the followings:

- Enough space for easy access to the controller 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. ISO 13854-13855, ISO 13857, ISO 14119-14120 etc.)



### 1.3 Precautions When Connecting 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 controller 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 signal and motor harnesses. 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 controller 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 meets specifications shown on the rating plate and the label attached on the side of the breaker. Supplying out-of-specification power will damage electric components in the controller.
2. Ground the controller to prevent against electrical noise and shock.
3. Use dedicated ground wire (100  $\Omega$  or less), which is equal to or larger than the recommended power cable size (3.5 to 13 mm<sup>2</sup>).
4. Never share an ground 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 ground line.
6. Without fail, before turning ON the external power to controller, make sure the power supply wiring is complete and all the covers reattached properly. Otherwise, failure to do so may cause electric shock.



### CAUTION

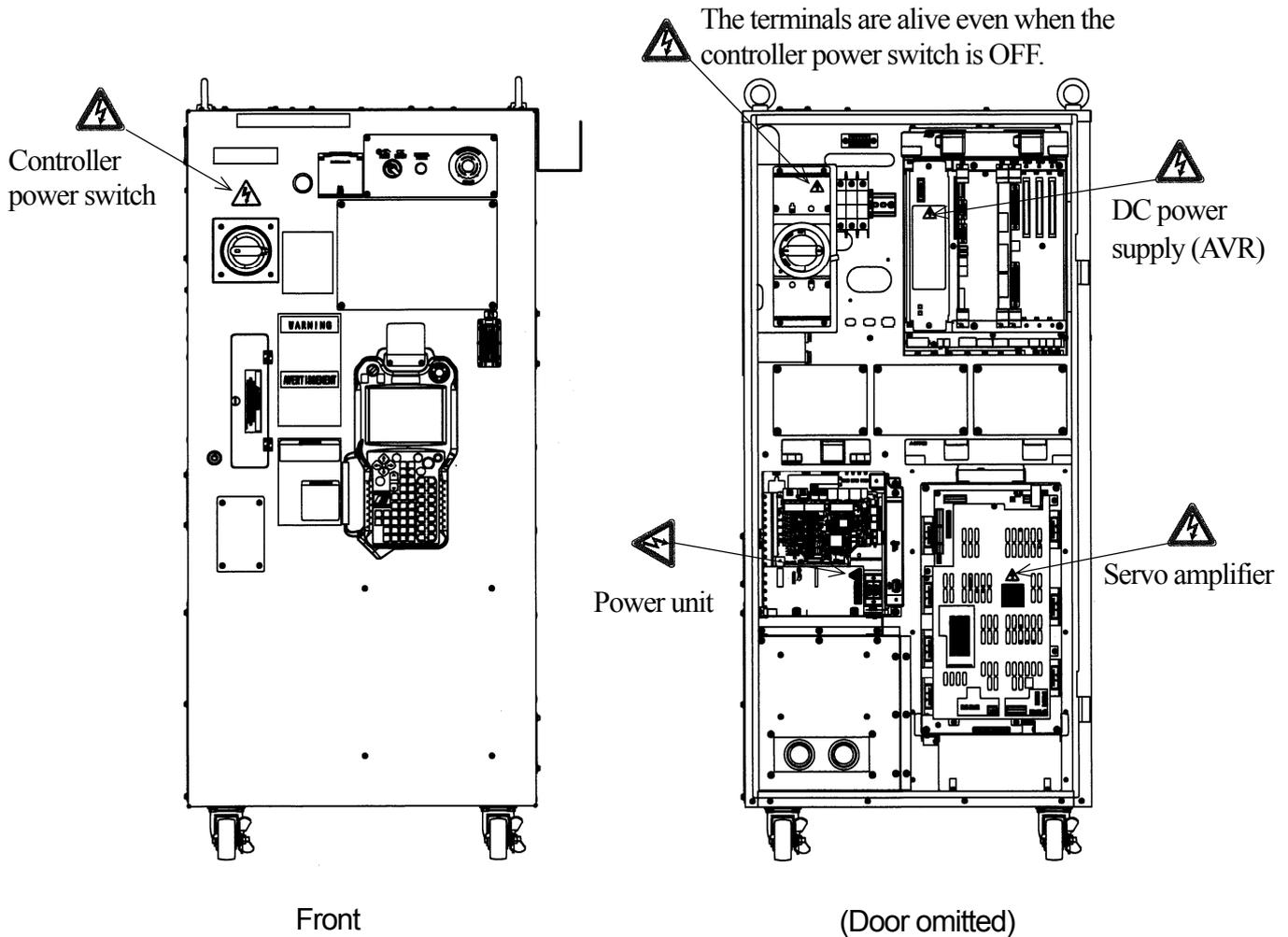
1. Prepare external power that meets the specifications of the controller in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the controller's specified range (above/below ratings), then the power monitoring circuit 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 a ground leakage breaker. (Use a time delay type with sensitivity of 100 mA or more.)
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.

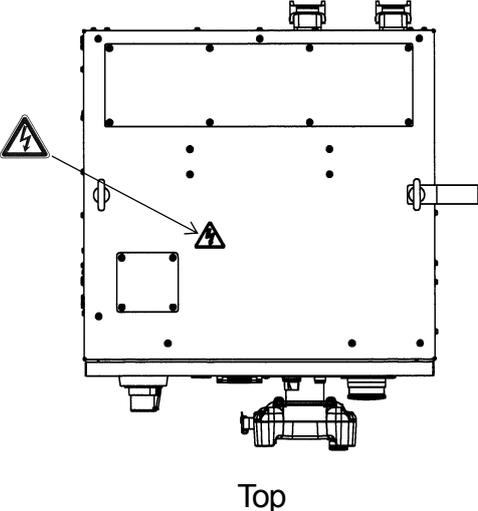
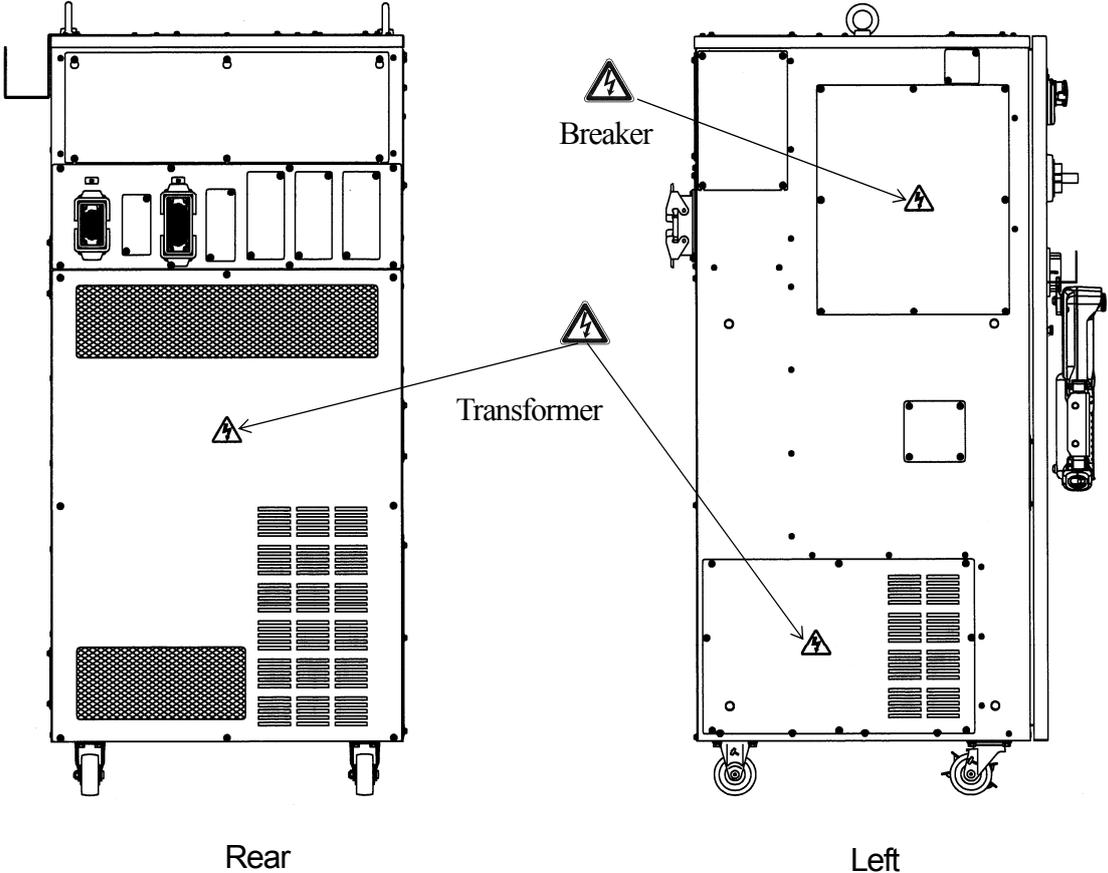
**NOTE\*** Proximity switch directly connected with power line etc. may suffer from the influence.

### 1.5 Warning Label for Electric Shock

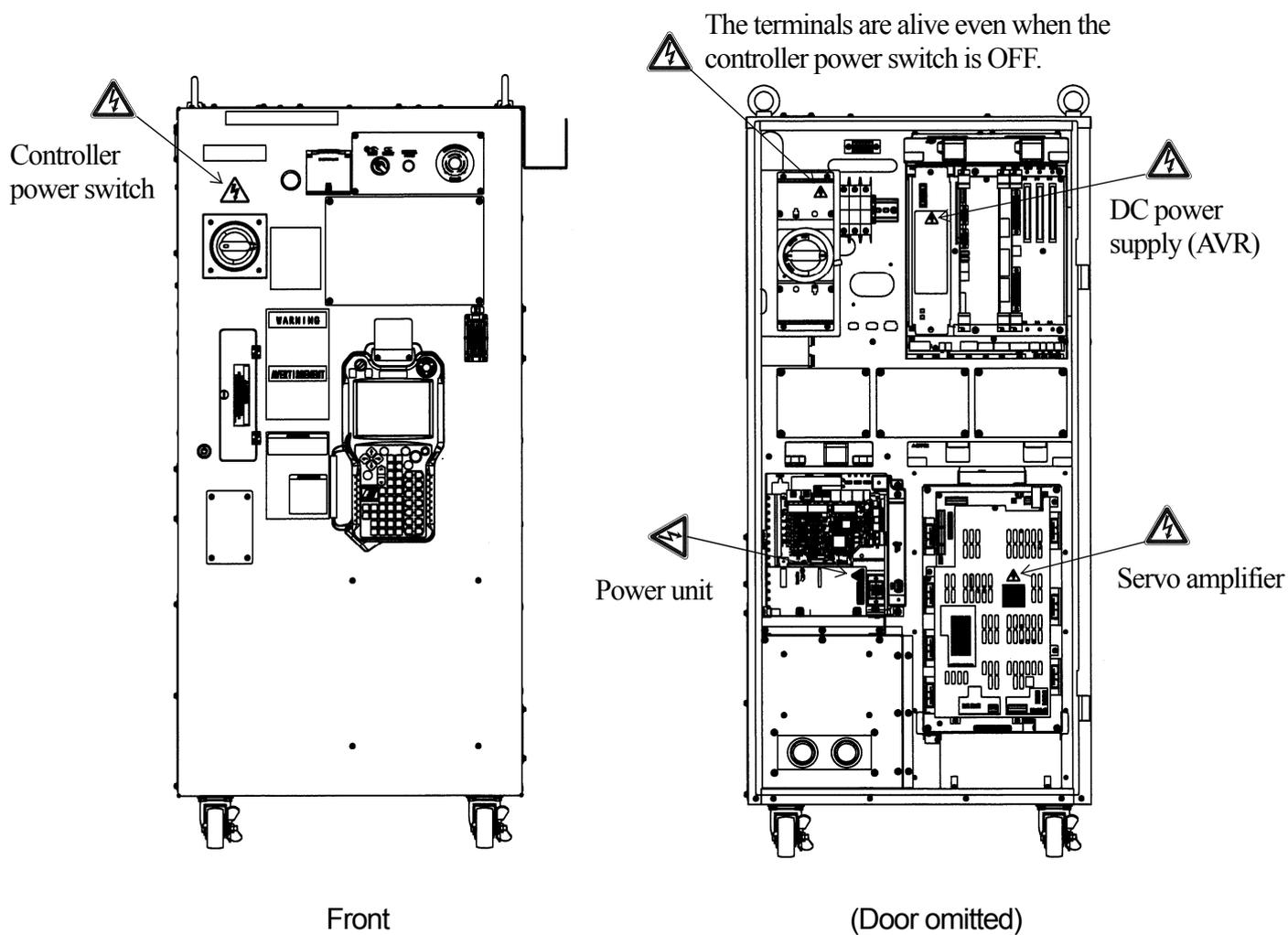
Warning labels for electric shock are located on the controllers shown below.

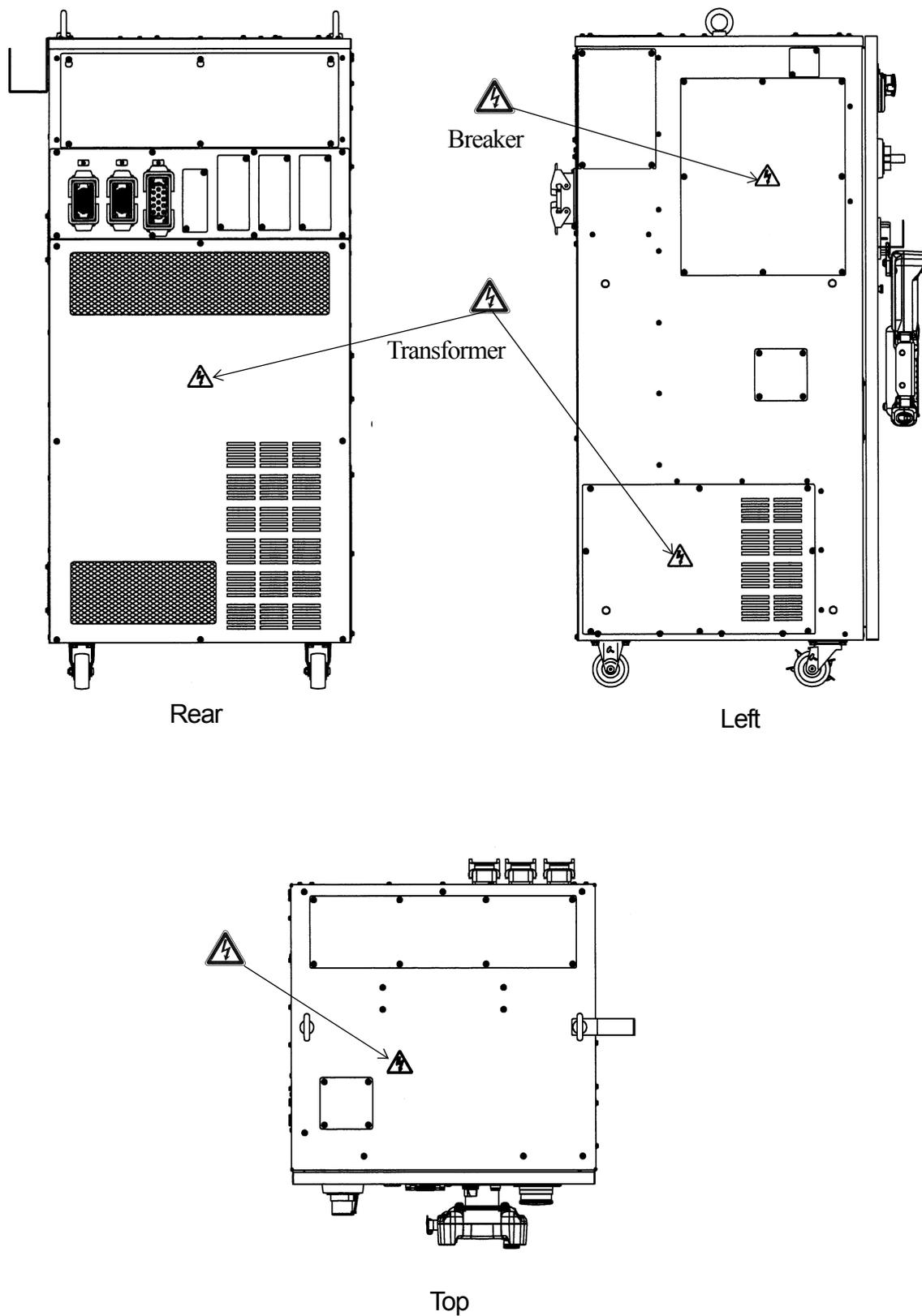
E51 controller



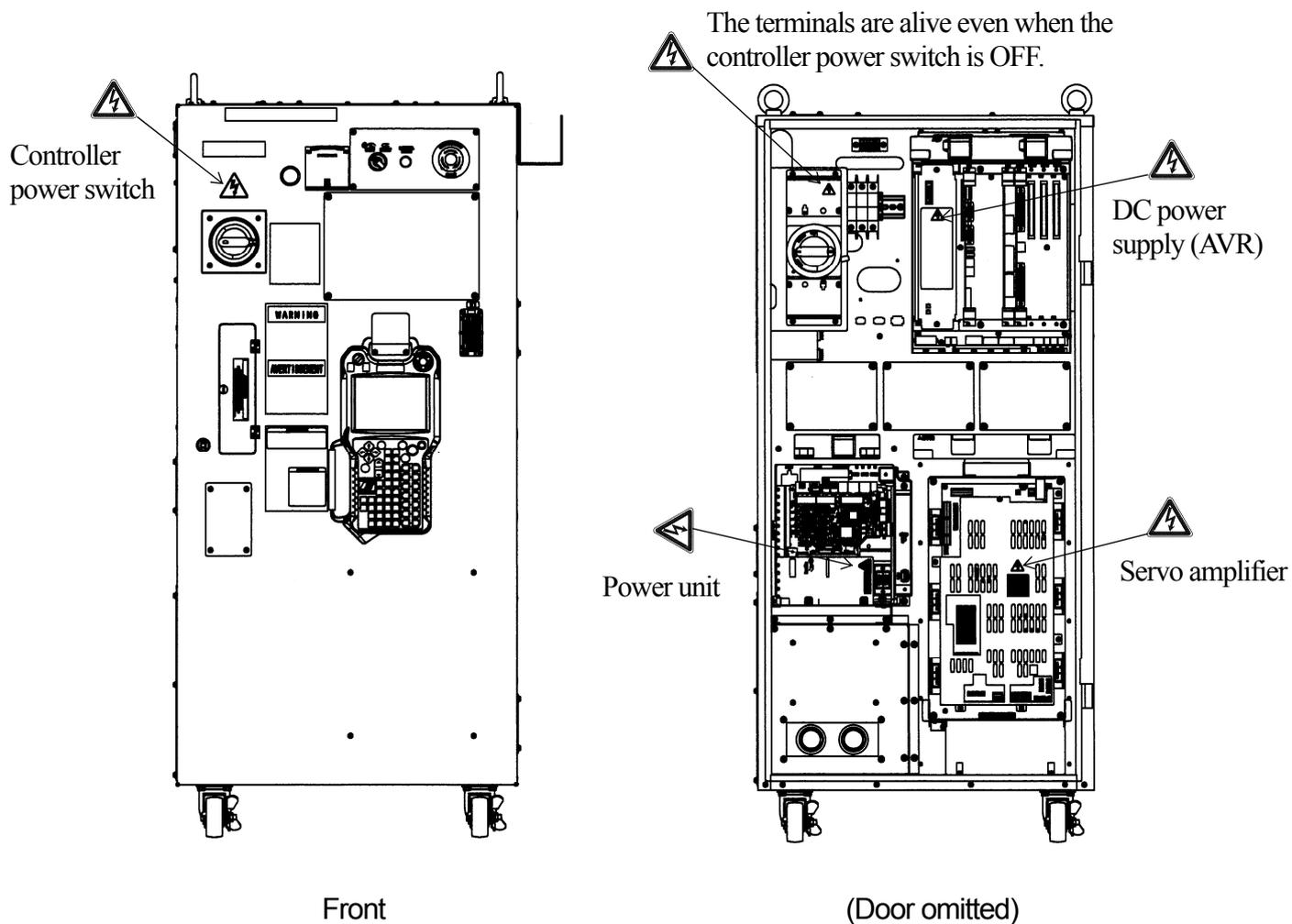


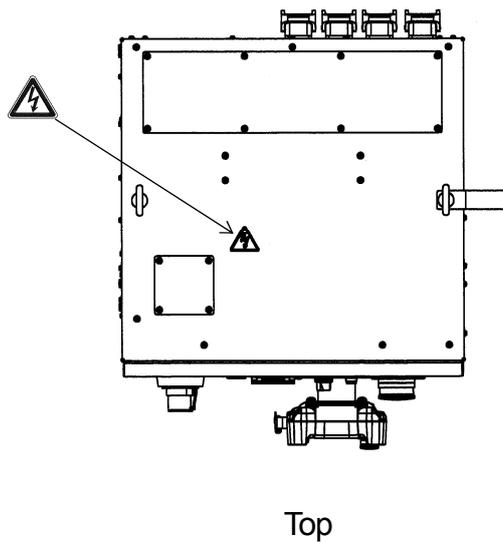
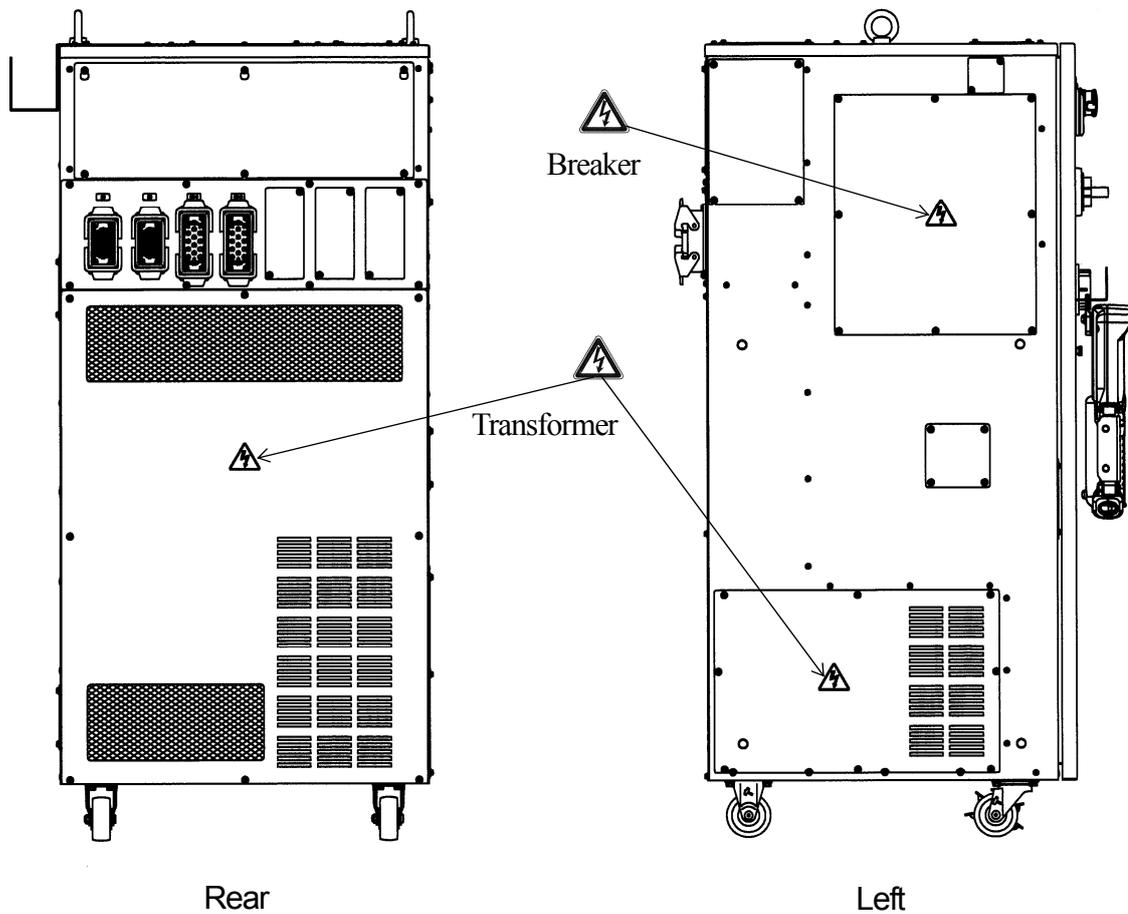
E52 controller



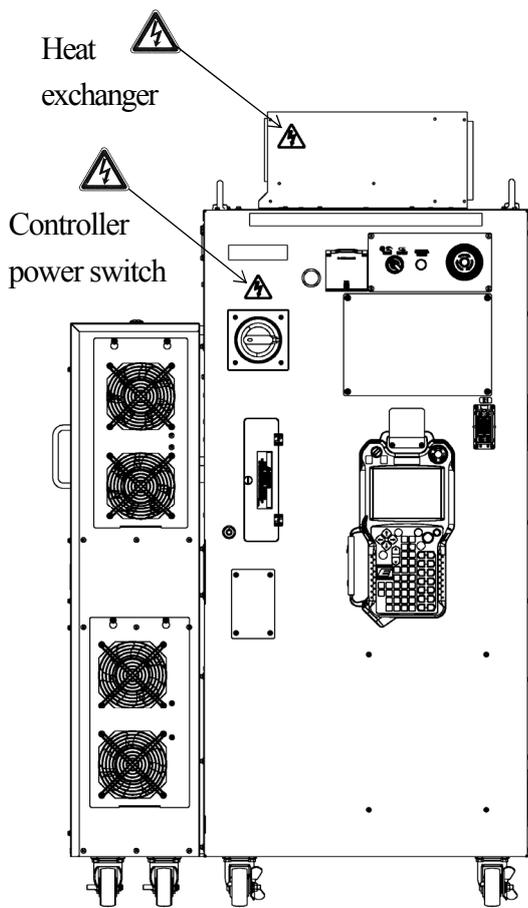


E54 controller

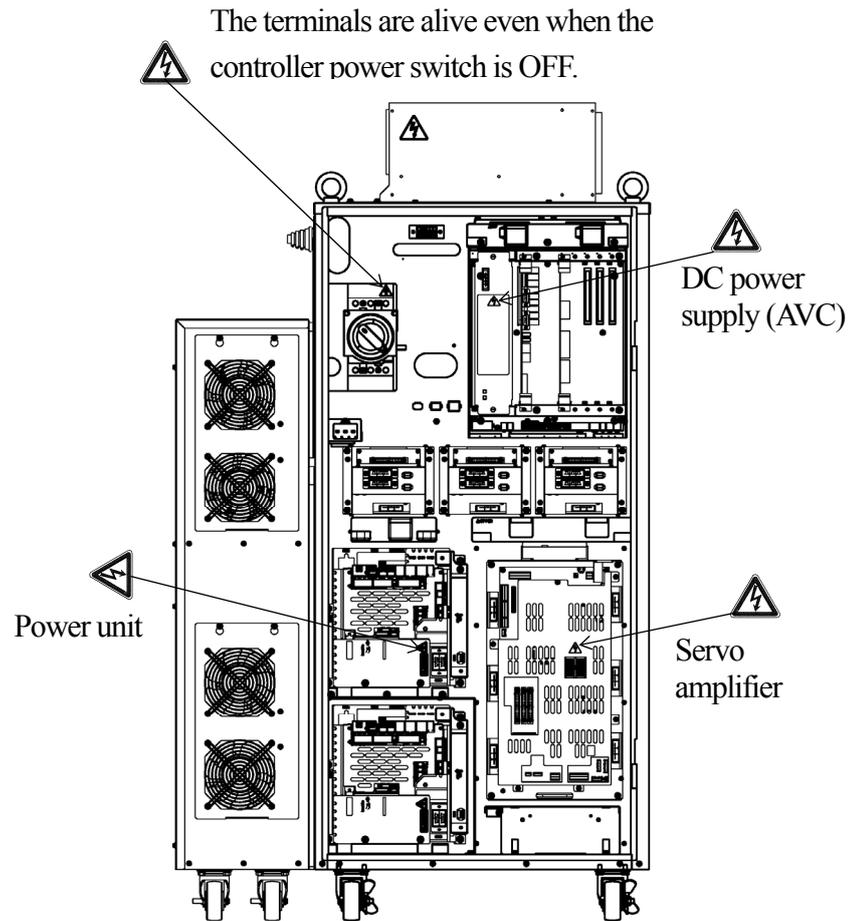




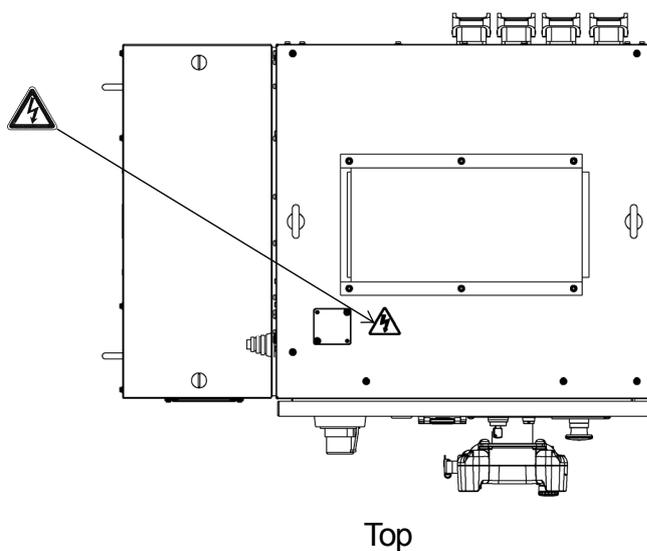
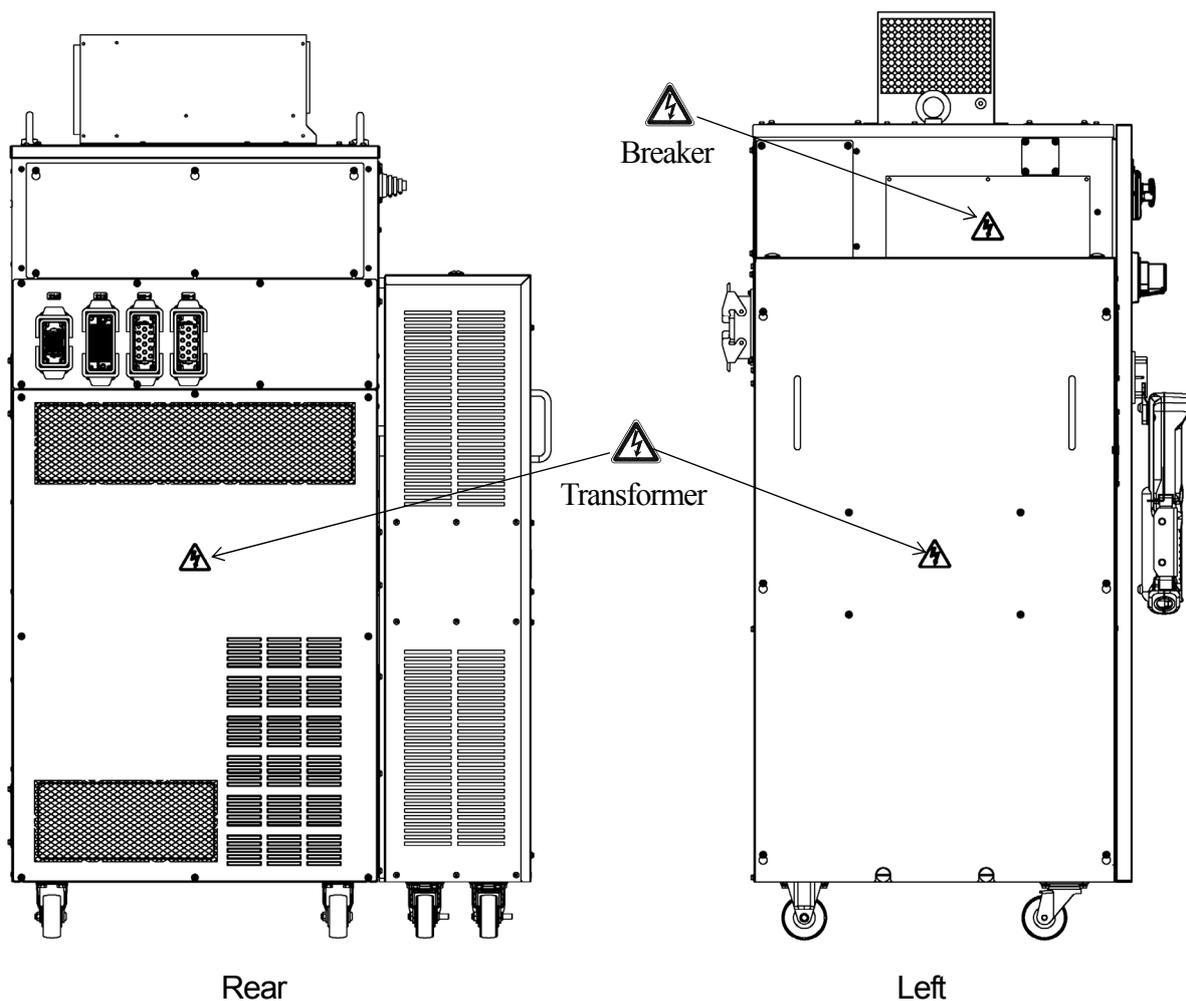
E58 Controller



Front

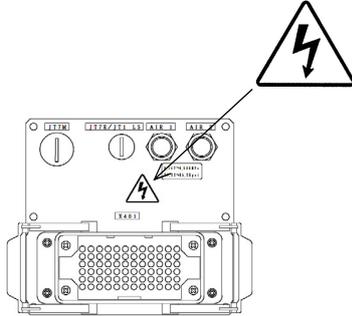


(Door omitted)

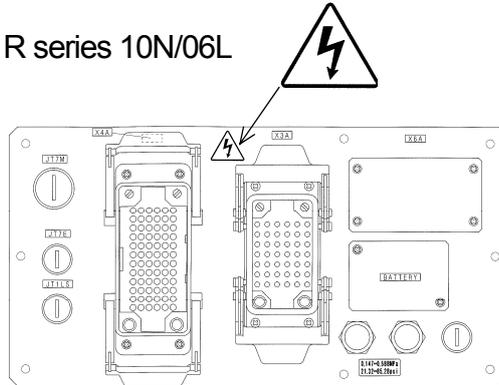


Connector plates on arm base section

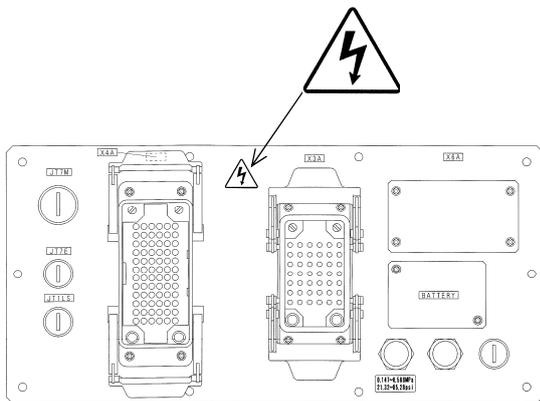
R series 03N/05N/05L



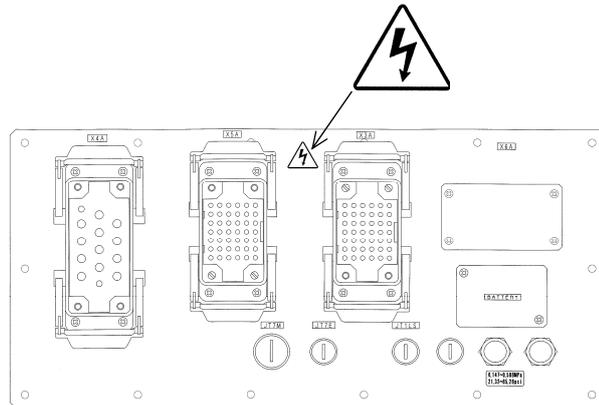
R series 10N/06L



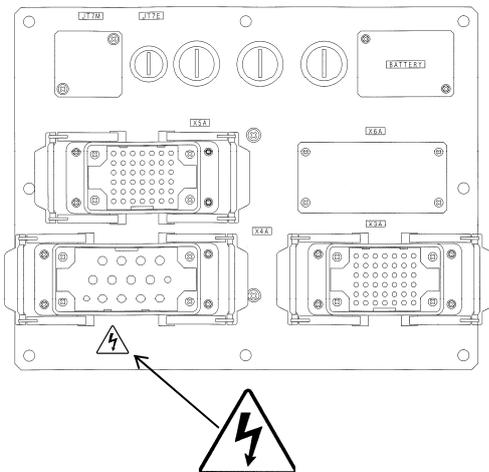
R series 20N/10L



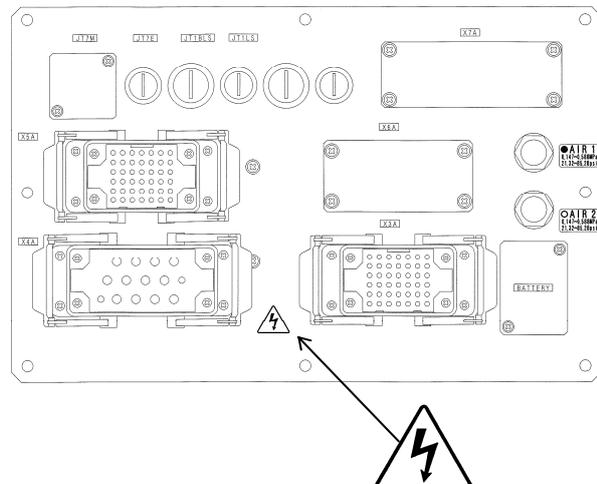
R series 30N/50N/80N/15X



ZH



ZX/ZT





## 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.

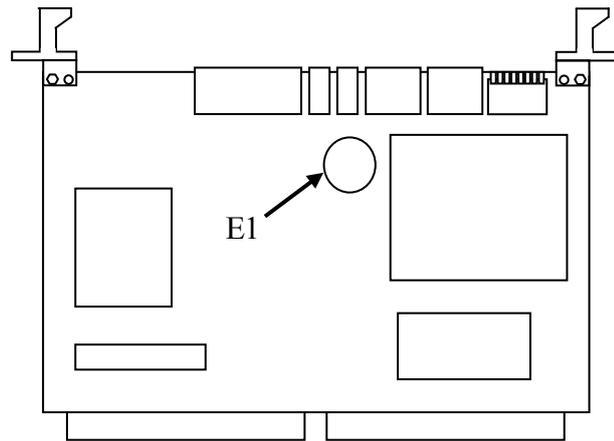


### CAUTION

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.

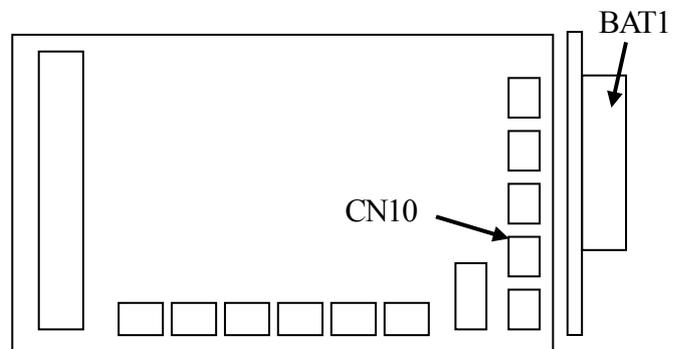
**Locations of Batteries**

1VA board (in Card Rack)  
 Location Number: E1  
 Model: BR2032  
 Manufacturer: Panasonic



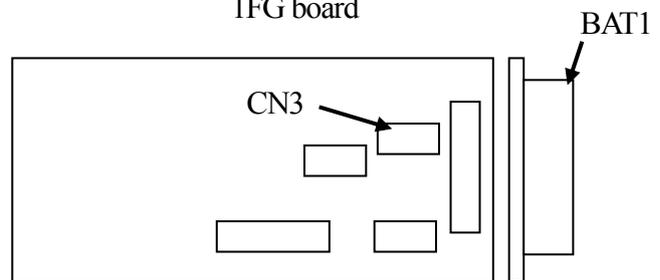
1VA board

1FG board (in Robot Base)  
 Location Number: BAT1  
 Part Number: 50750-1007 or 50750-1018  
 Manufacturer: KHI  
 Connector: CN10

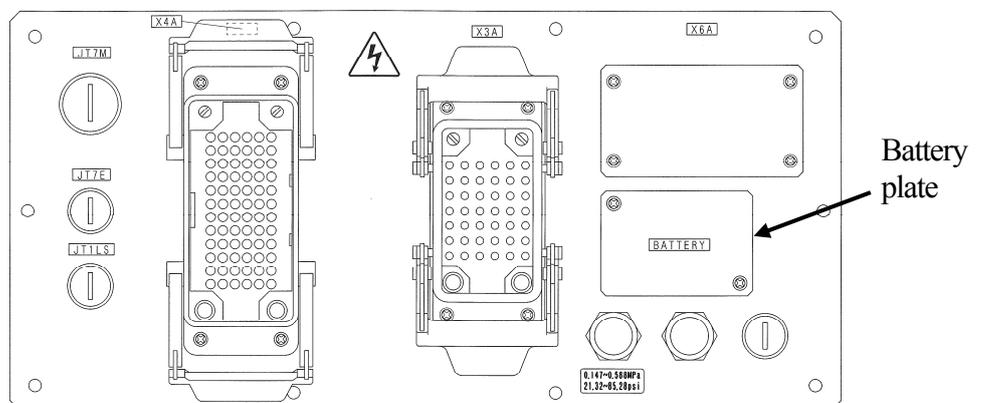


1FG board

1HG board (in Robot Base)  
 Location Number: BAT1  
 Part Number: 50750-1007 or 50750-1018  
 Manufacturer: KHI  
 Connector: CN3



1HG board



Connector plate on robot base

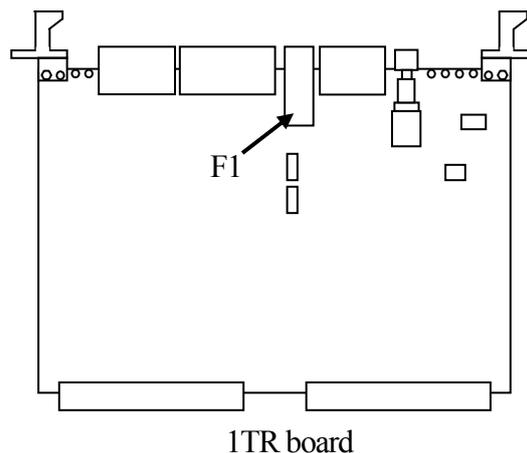
## Location of Fuse

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 emergency 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 teach and repeat modes.
3. Safety circuits of the controllers satisfy requirements of PLe in category 4 defined by ISO 13849-1:2015. Category and Performance level (PL) are determined by the whole system and conditions.
4. (For the robot arms with a servo lamp) When the servo ON lamp (located on the mechanical unit) is illuminated, servo motor power is available to the robot and motion is possible.
5. Teach pendant and operation panel are equipped with red mushroom-type E-stop switches. And all robot controllers have external E-stop inputs.
6. Teach pendant is equipped with three-position, enabling devices. Enabling devices must be pressed to enable motor power in teach and check modes.
7. Teach and check mode velocities are limited to a maximum of 250 mm/s (10.0 in/s).
8. Velocities are not limited to 250 mm/s (10.0 in/s) in the Fast Check Mode that satisfy requirements for ISO 10218-1:2011.
9. Optional overtravel limit switches are available on JT1, JT2 and JT3 of the arm. See the specifications of the product for details.
10. Mechanical units have overtravel mechanical stoppers on the JT1, JT2 and JT3 (optional for JT2 and JT3) axes. Mechanical stoppers are capable of stopping the robot at full speed and with maximum payload. See the specifications of the product for details of the mechanical stoppers.
11. All robot axes are equipped with 24 VDC electromechanical brakes that engage when power is removed. If the robot loses power unexpectedly, the mechanical unit arm is held in position by the brakes.

## 1.8 Operating External Axis without a Motor Driven Power Supply (During Emergencies or in Abnormal Situations)

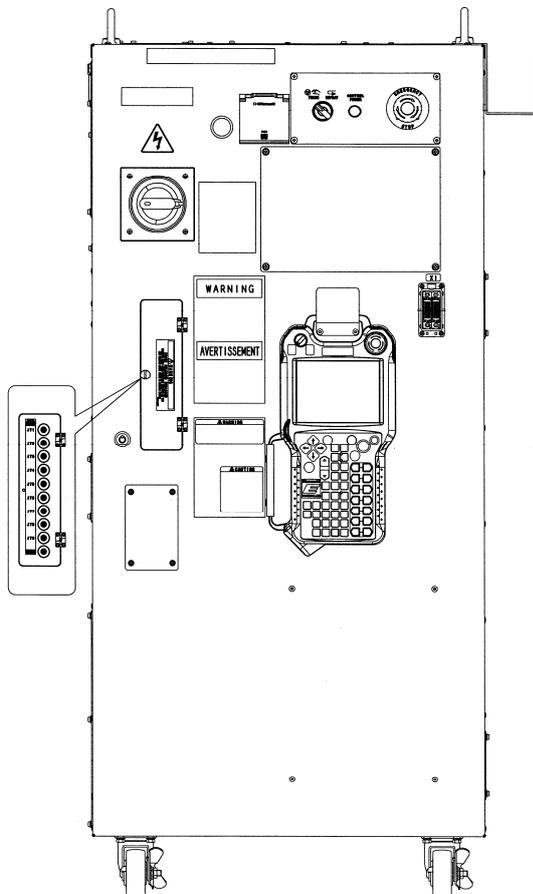
A brake release switch is installed in order to enable the operation of external axes during emergencies or abnormal situations without the use of a motor driven power supply.

The brake release switch is located on the inner side of the access door on the controller.

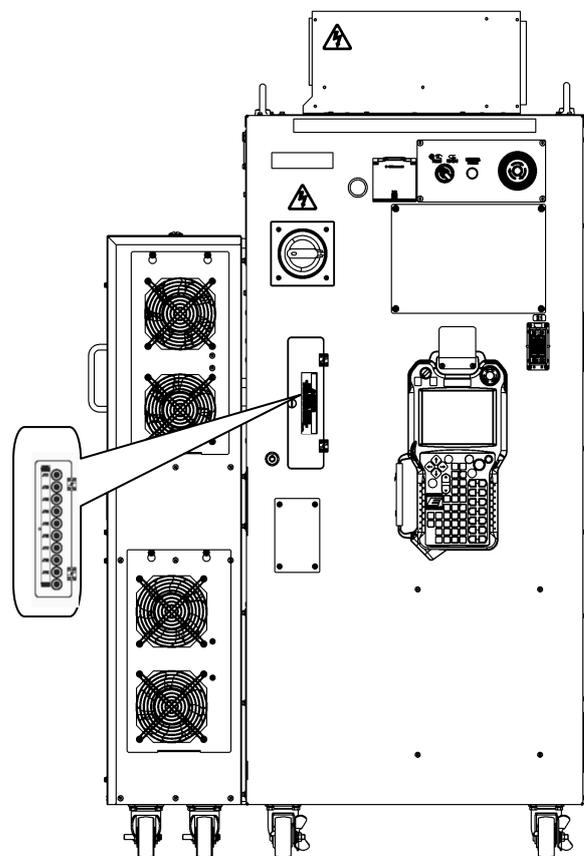
**!** **WARNING**

**If no motor driven power is supplied, the electromagnetic brakes lock in order to maintain the robot arm posture. There is a possibility that 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. When operating switches, stand in a position where you are able to see the entire device and keep your attention focused on the arm at all times.**

E51/E52/E54 controllers



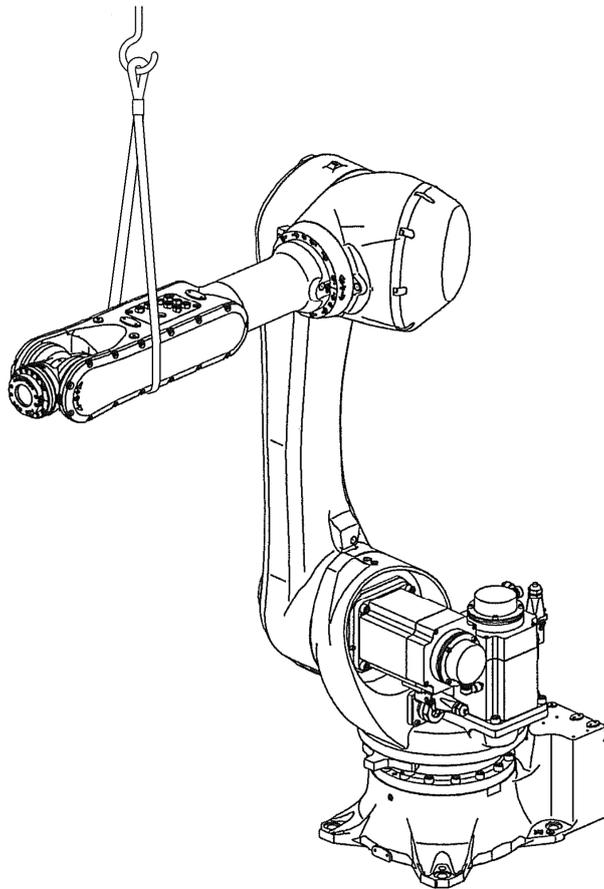
E58 controller





## 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

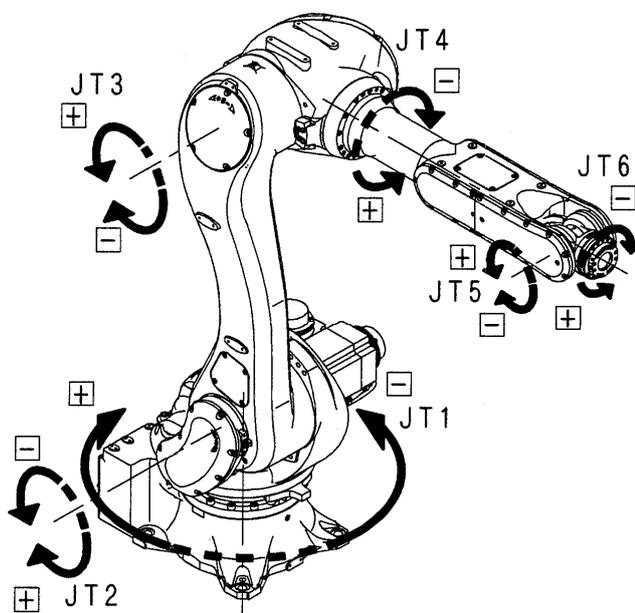
To manually release axes brakes follow the procedure below.

1. Turn 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 access door to the manual brake release switches.
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.

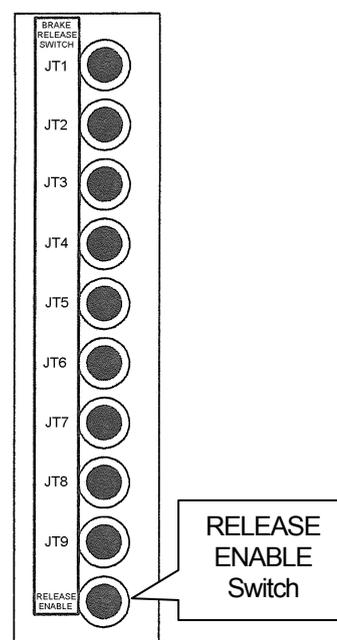
7. Press and hold the “RELEASE ENABLE” switch (see lower right figure). If the brake is released at this time, do not use the switch (see CAUTION).
8. Press the manual brake release switch for the axis to release the brake (see lower right figure).
9. The brake remains released until the brake release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

**! 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.**



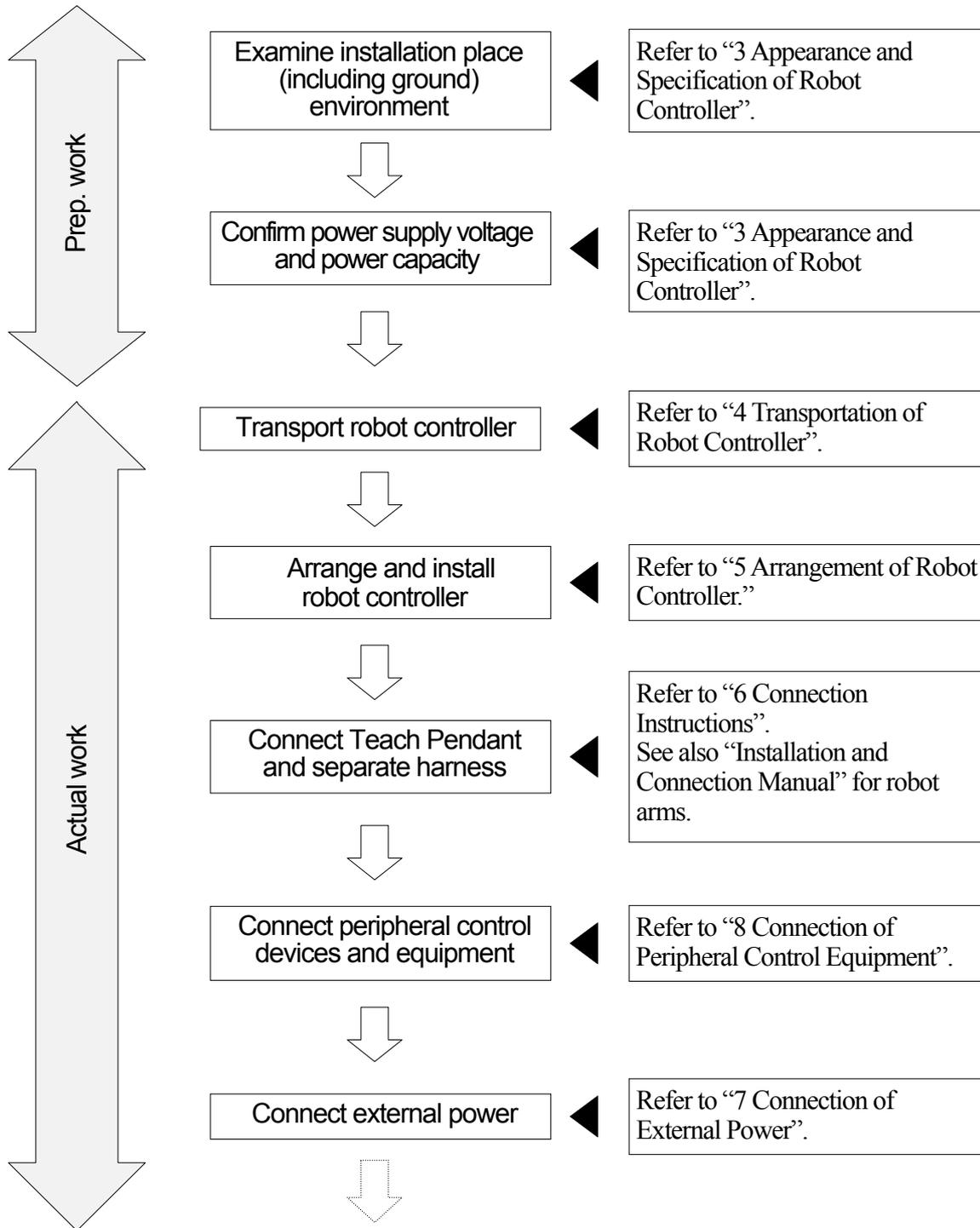
Robot brake release axes

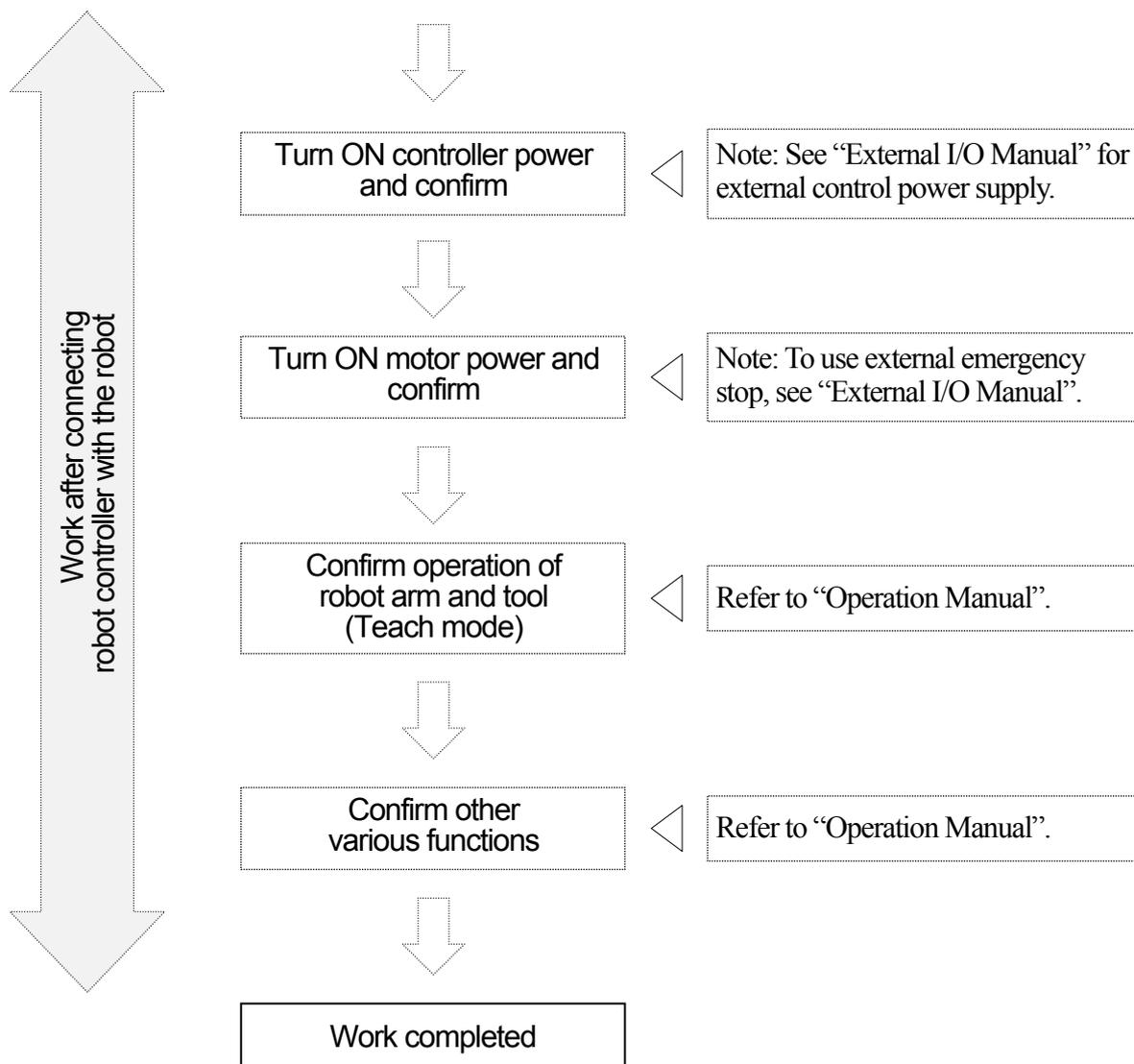


Manual brake release switch

## 2 Workflow - Robot Controller Installation and Connection

This workflow describes only the robot controller. For the robot arms, refer to the separate “Installation and Connection Manual” for them.



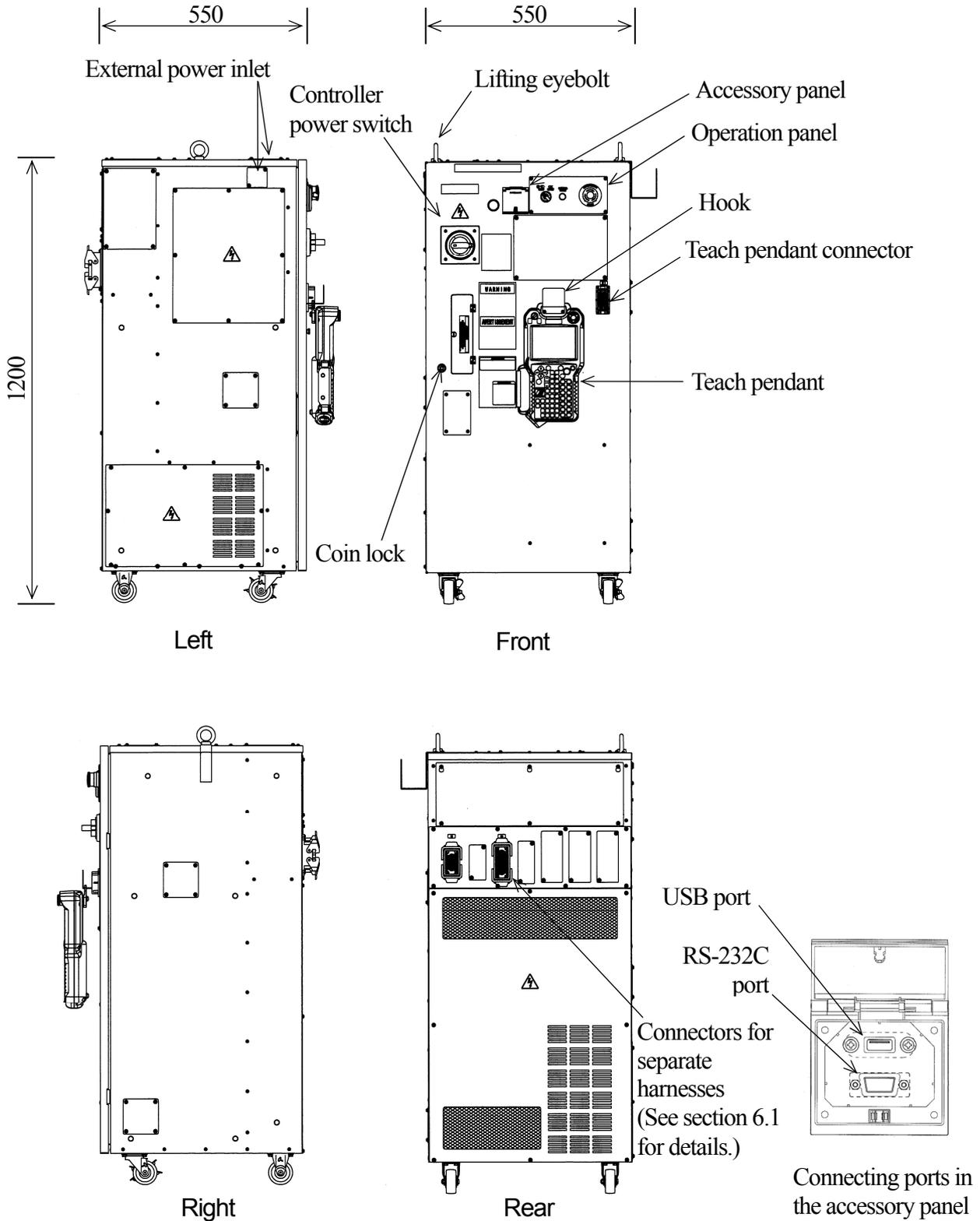


**[NOTE]**

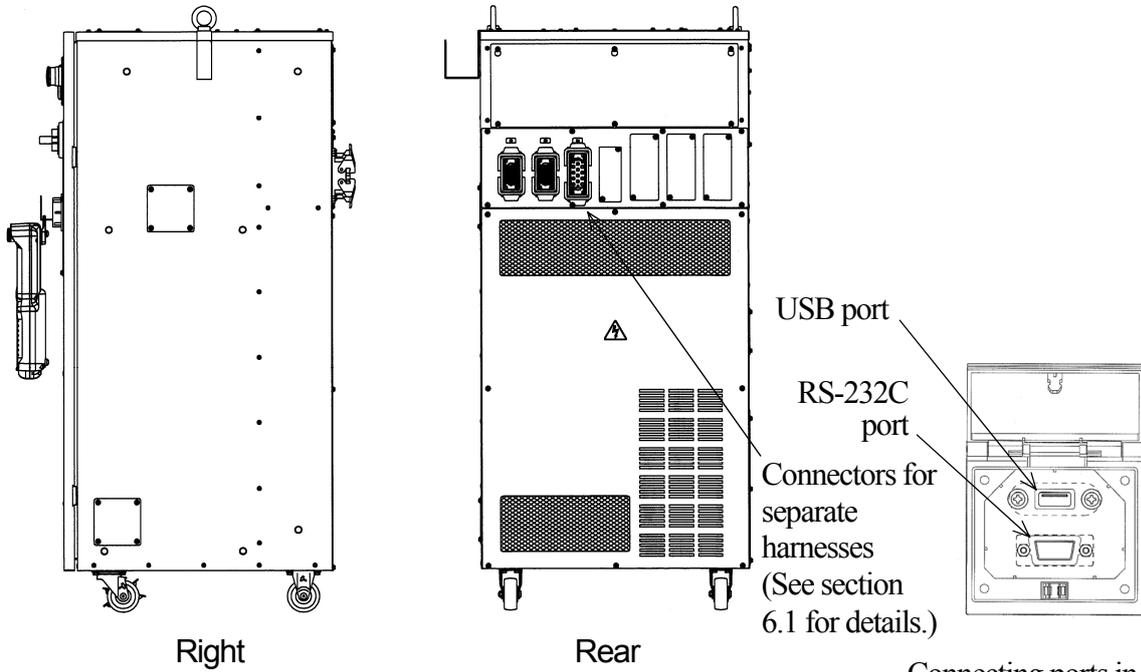
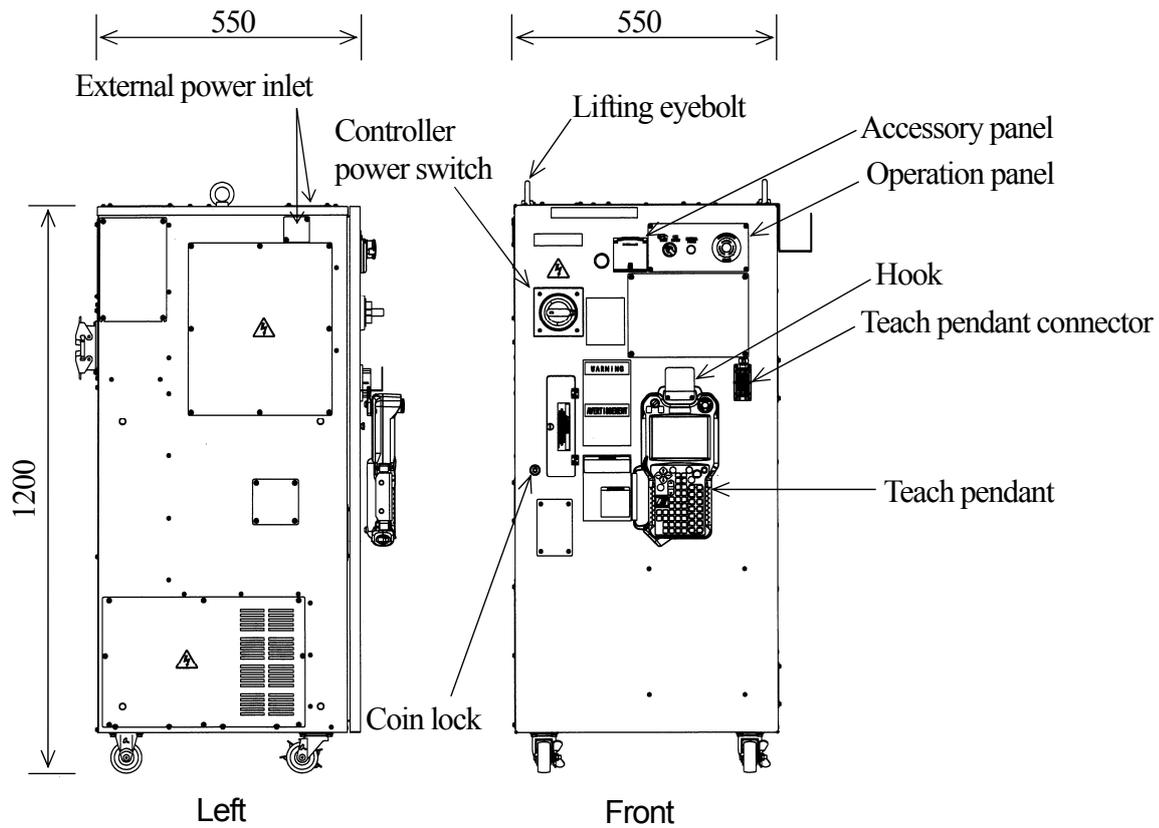
This manual only describes procedures from installation place examination to connection with external power.

### 3 Appearance and Specification of Robot Controller

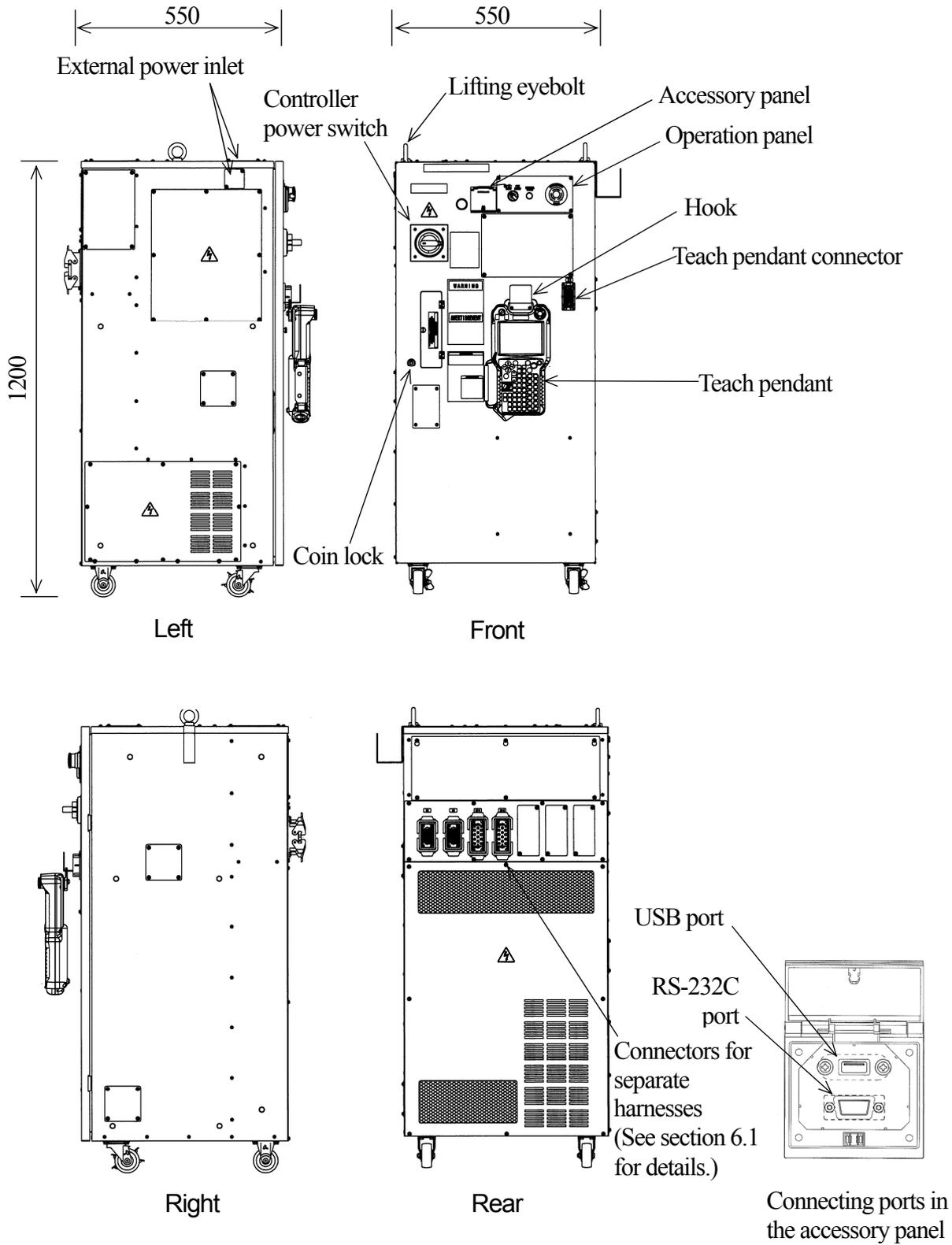
#### 3.1 Controller Appearance



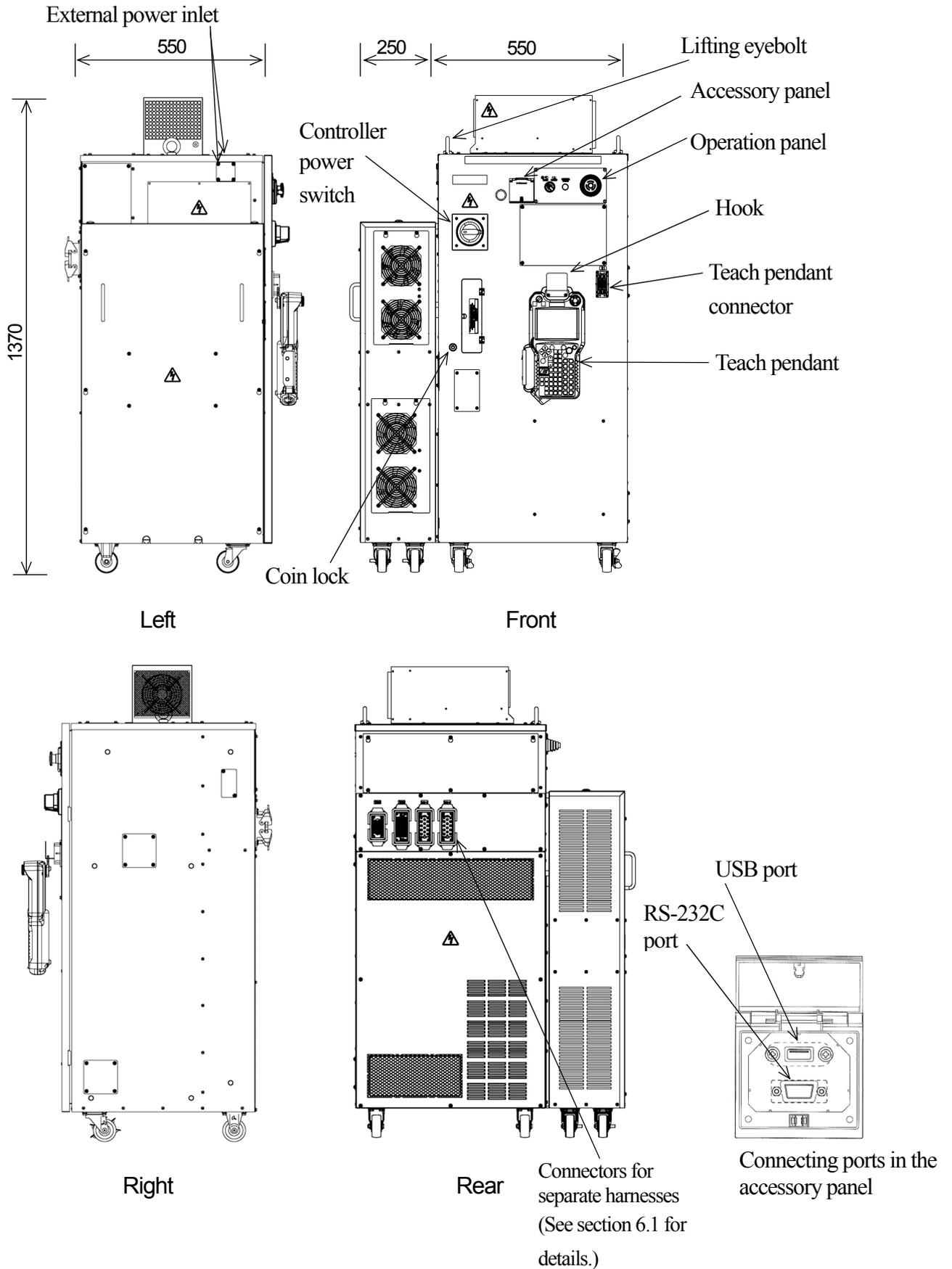
E51 controller



E52 controller

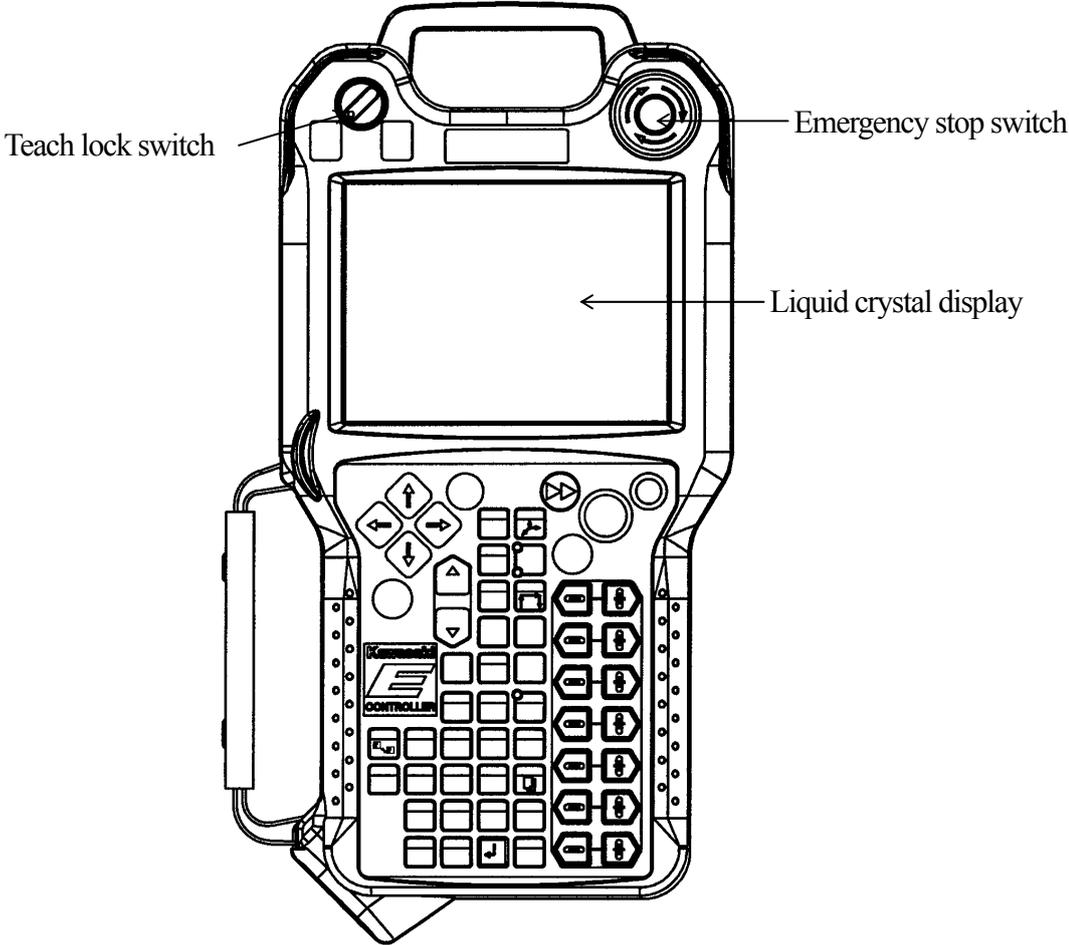


E54 controller



E58 controller

**3.2 Teach Pendant Appearance**



Teach Pendant

### 3.3 Controller Specification

#### E51/E52/E54/E58 controllers

Construction		Self-sustaining fully closed, indirect cooling system
Mass		E51, E52: 140 kg E54: 145 kg E58: 215 kg
Ambient environment	Temperature	0 to 45°C
	Humidity	35 to 85%RH (Non condensing)
	Altitude	Up to 1000 meters above mean sea level
	Pollution degree	3 or below
Power source		AC 380-415 V $\pm$ 10 %, 50/60 Hz, 3 Phase or AC 440-480 V $\pm$ 10%, 50/60 Hz, 3 Phase (Voltage switching tap is switched by a connector.)
Optional		AC 200-220 V $\pm$ 10%, 50/60 Hz, 3 Phase AC 515, 575 V $\pm$ 10 %, 60 Hz, 3 Phase**
Power capacity		Refer to the table below.
Grounding		Dedicated grounding (100 $\Omega$ or less)
Length of teach pendant cable		5 m/10 m/15 m (5 m, 15 m are options.)
Length of separate harnesses*		5 m/7 m/10 m/15 m (5 m, 7 m, 15 m are options.)

**NOTE\*** Harness length between robot arm and controller.

**NOTE\*\*** Only for E51/E52/E54 controllers

Controller model	Arm model	Power capacity	Recommended power cable size (Including ground wire)	Length requirement
E51	R series 05-20	5.6 KVA max.	3.5 mm <sup>2</sup> or more (AWG #12 or more)	200 m or less
E52	R series 30-80 Z, MT series B series	7.5 KVA max.	5.5 mm <sup>2</sup> or more (AWG #10 or more)	200 m or less
E54	MX series	12 KVA max.	5.5 mm <sup>2</sup> or more (AWG #10 or more)	200 m or less
E58	MG series	15 kVA max.	8.0 mm <sup>2</sup> or more (AWG #8 or more) to 13 mm <sup>2</sup> or more (AWG #6 or more)	200 m or less

## Circuit breaker spec. for external power connection

Controller model	External power voltage	Rated current	Rated voltage	Rated interrupting capacity
E51	AC380-480 V	15 A	AC480 Y/277 V	30 kA (UL 489)
	AC515/575 V	20 A	AC600 Y/347 V	18 kA (UL 489)
	AC200-220 V	40 A	AC240 Y	50 kA (UL 489)
E52/54	AC380-480 V	20 A	AC480 Y/277 V	30 kA (UL 489)
	AC515/575 V	20 A	AC600 Y/347 V	18 kA (UL 489)
	AC200-220 V	40 A	AC240 Y	50 kA (UL 489)
E58	AC200-220 V	60 A	AC230 V	50 kA (Icu)
	AC380-415 V	50 A	AC400 V	30 kA (Icu)
			AC415V	30 kA (Icu)
	AC440-480 V	50 A	AC480 V	30 kA (UL 489)

## 4 Transportation of Robot Controller

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

### 4.1 By Crane Lifting



#### WARNING

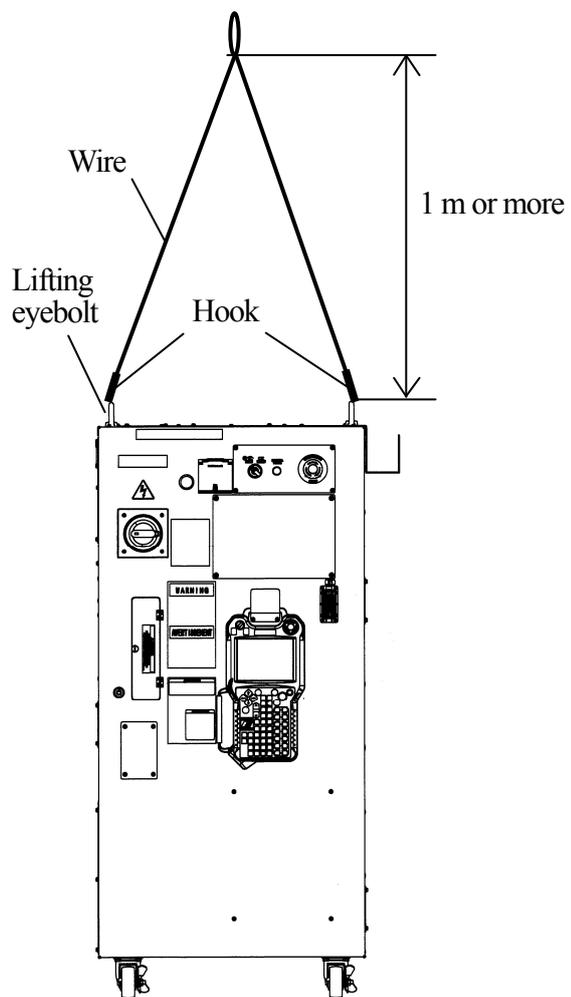
1. Never support the controller by hand when it is lifted up. And, never go under or stay too close to the controller during transport.
2. Hook the wire at the lifting eyebolts as shown below.
3. Ensure that the lifting eyebolts are not loose. Check each one and retighten if it is loose. Otherwise, the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



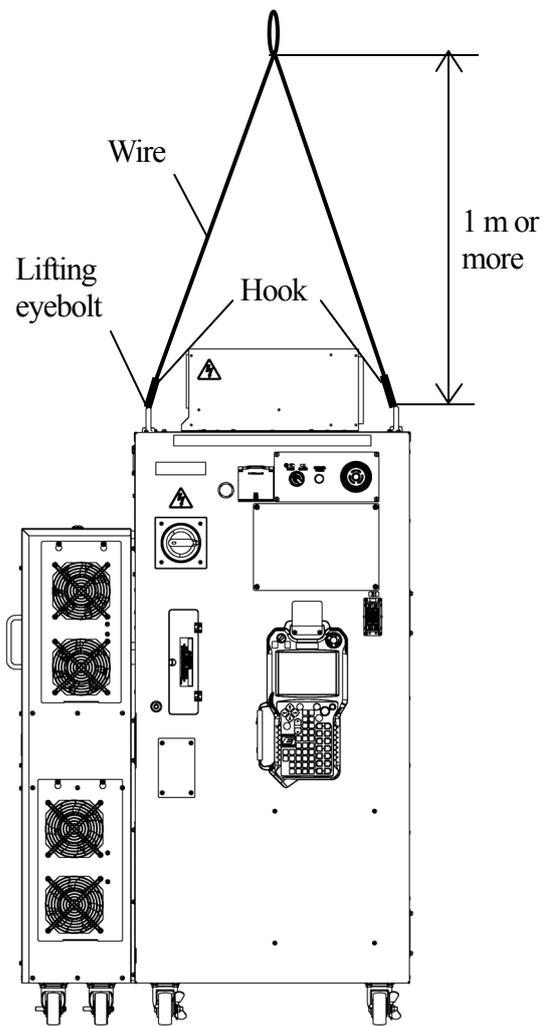
#### CAUTION

1. Prepare wire and crane capable of hoisting 300 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 figures on the next page.
4. Be careful as the controller may lean when lifted up.
5. Be careful not to let the wire snag on other equipment.

E51/E52/E54 Controller



E58 Controller



## 4.2 By Caster



### WARNING

1. If the transport path is flat enough then the controller can be moved on its casters. Otherwise, it may happen that moving on an incline or an uneven surface will topple the controller, and cause serious damage.
2. E51/E52/E54 controllers fall if it is inclined as follows.  
Back or forth: Approx. 15° or more  
Right or left: Approx. 15° or more
3. E58 controller fall if it is inclined as follows.  
Back or forth: Approx. 15° or more  
Right or left: Approx. 15° or more



### CAUTION

1. Release the stoppers on the two casters in front of the controller when moving the controller. (Push the “OFF” side pedal.)
2. Relock the casters after the transport is complete. (Push the “ON” side pedal for locking.)

### 4.3 By Forklift Truck

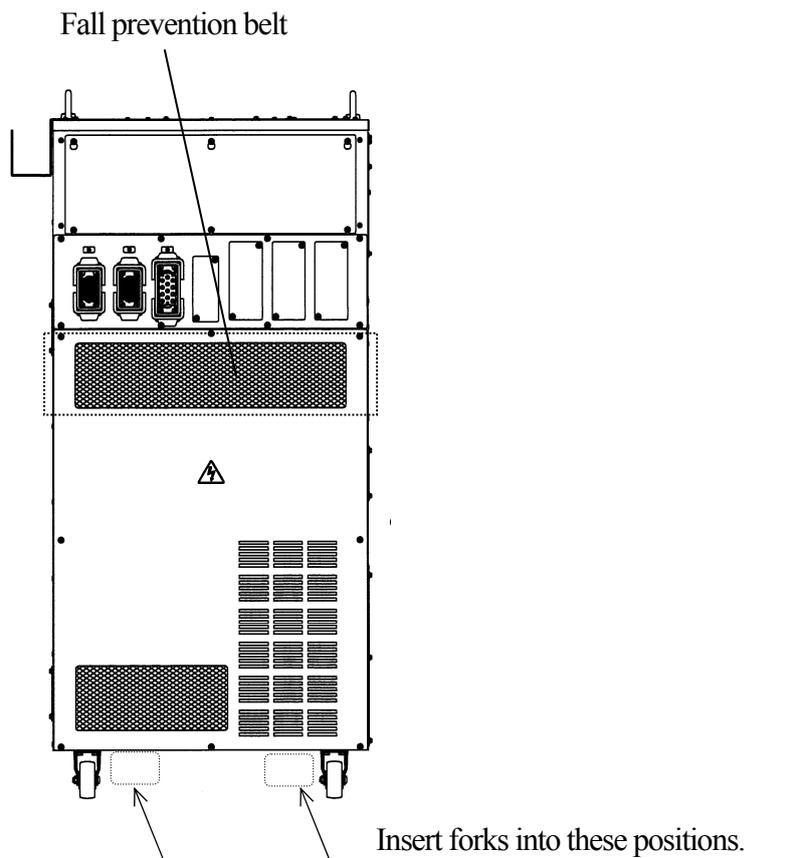
**! WARNING**

To prevent the controller from toppling over, fasten it to the forklift with a belt as shown below.

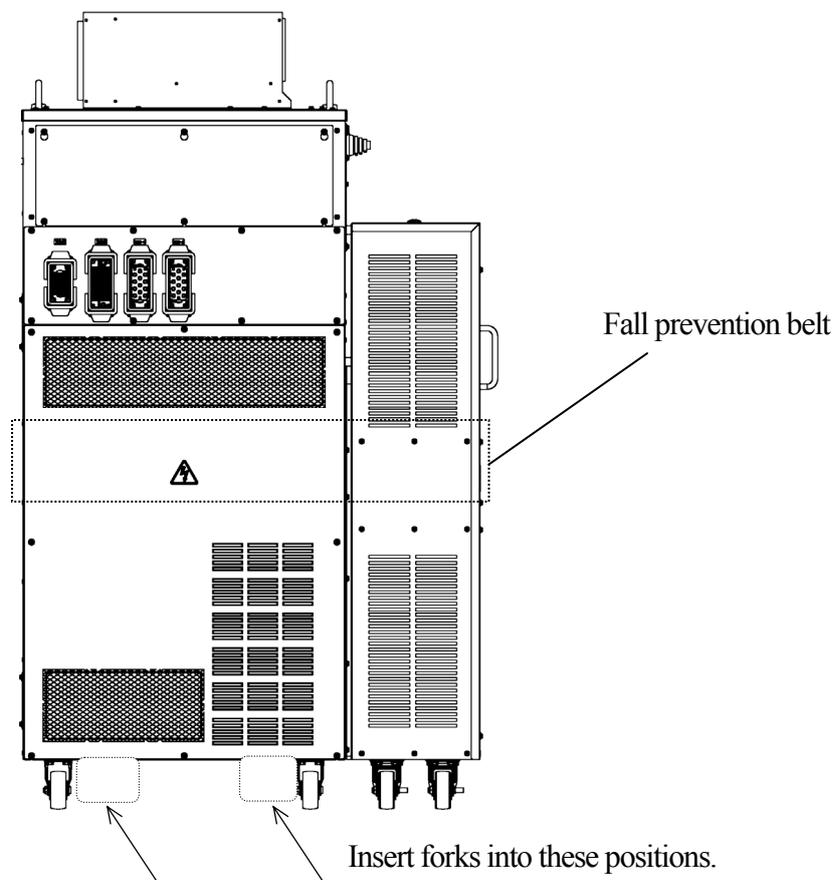
**! CAUTION**

1. Remove the teach pendant and teach pendant holder. The fork cannot be inserted from the side. Insert the fork under the controller body as shown on below.
2. Be careful not to shock the controller during transport.
3. Be careful not to get caught on other equipment, cables, etc.

#### E51/E52/E54 Controller



E58 Controller

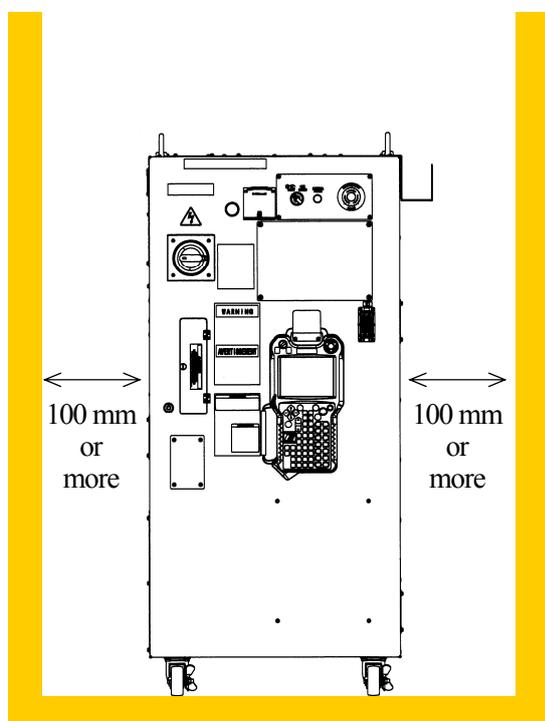


## 5 Arrangement of Robot Controller

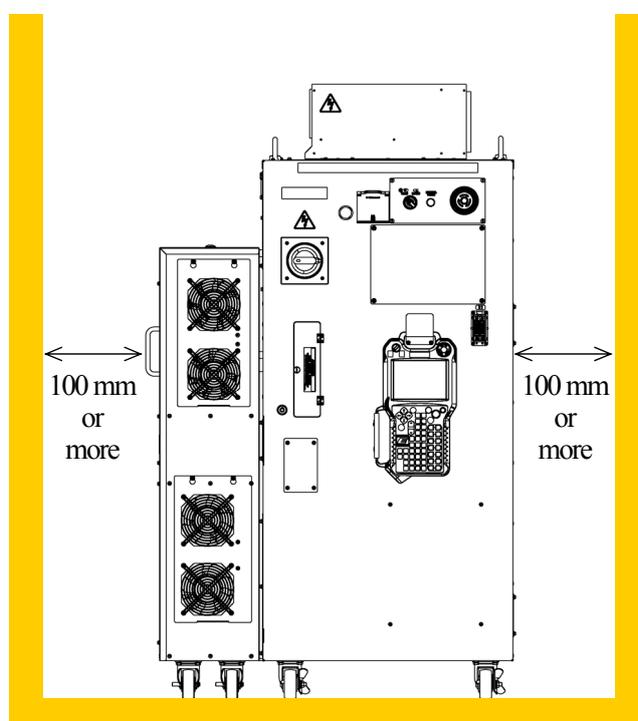
In order for the controller to maintain the proper internal temperature, the installation site must conform to the four points below.

1. Arrange the controller on a flat, horizontal floor. When an object is placed on the top surface of the controller, the mass should be 40 kg or less.
2. Separate the controller right/left side from the wall by 100 mm or more.

E51/E52/E54 Controller



E58 Controller



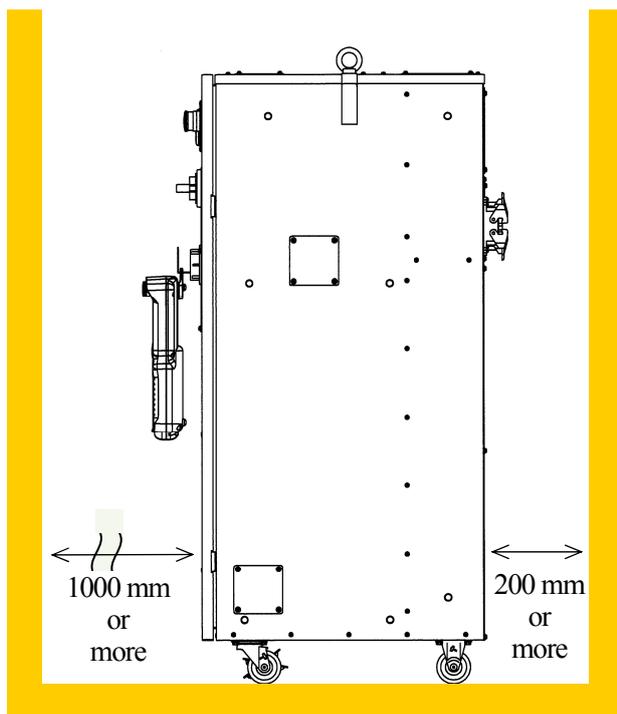
- The inlet port for air-cooling is on the rear upside of the controller, and the air exhaust port is on the rear downside.

**CAUTION**

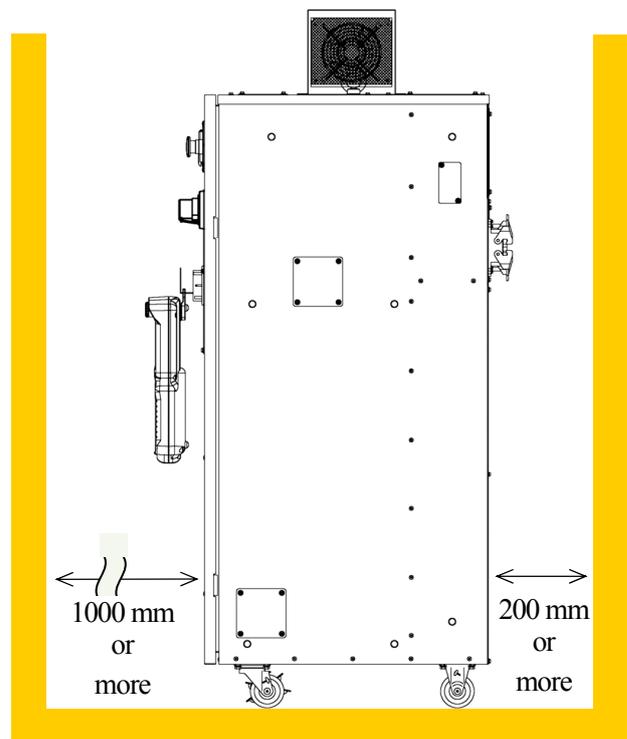
**Do not block the air inlet and exhaust ports when arranging the controller. Separate the controller backside from the wall by 200 mm or more.**

- Make fixing bracket(s), and fix the controller with M12 bolts. See the figures on the next page for reference.

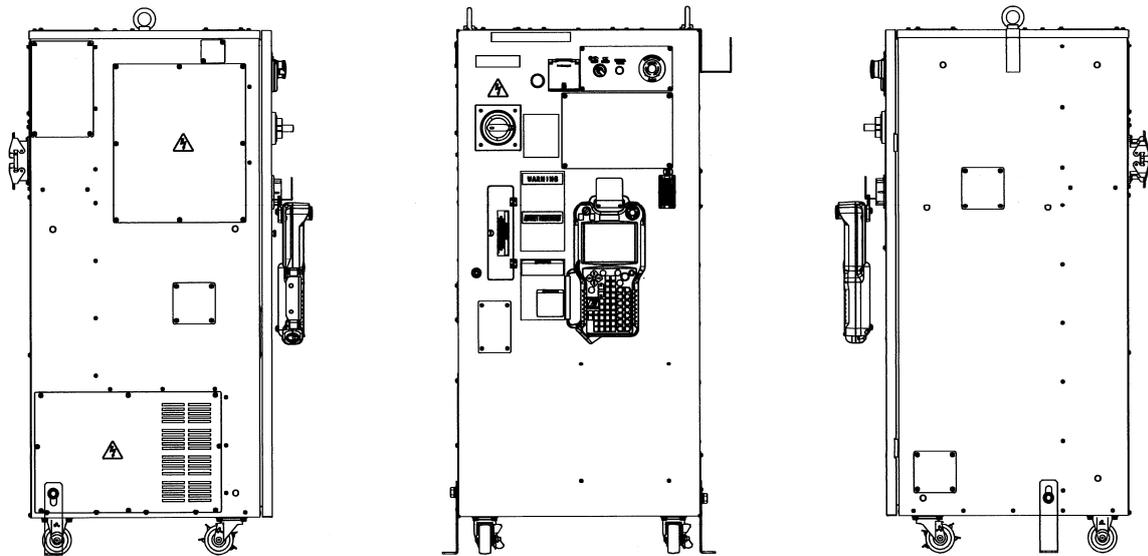
E51/E52/E54 Controllers



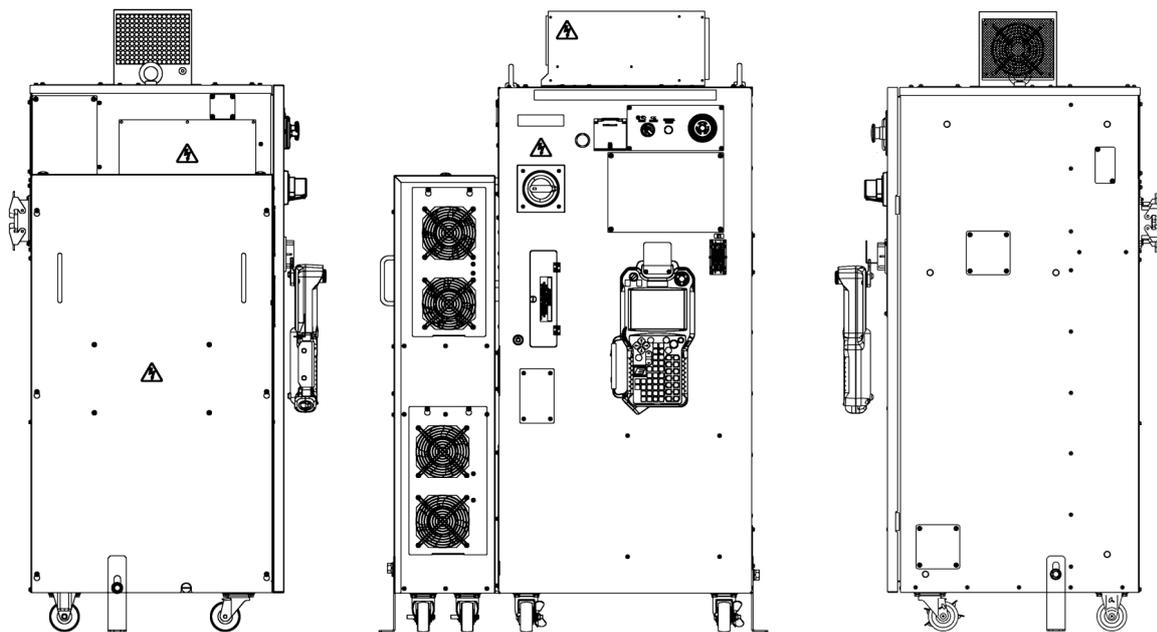
E58 Controller



E51/E52/E54 Controllers



E58 Controller



 **CAUTION**

1. Release the stoppers on the two casters in front of the controller when moving the controller. (Push the “OFF” side pedal.)
2. Relock the casters after the transport is complete. (Push the “ON” side pedal for locking.)

## 6 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

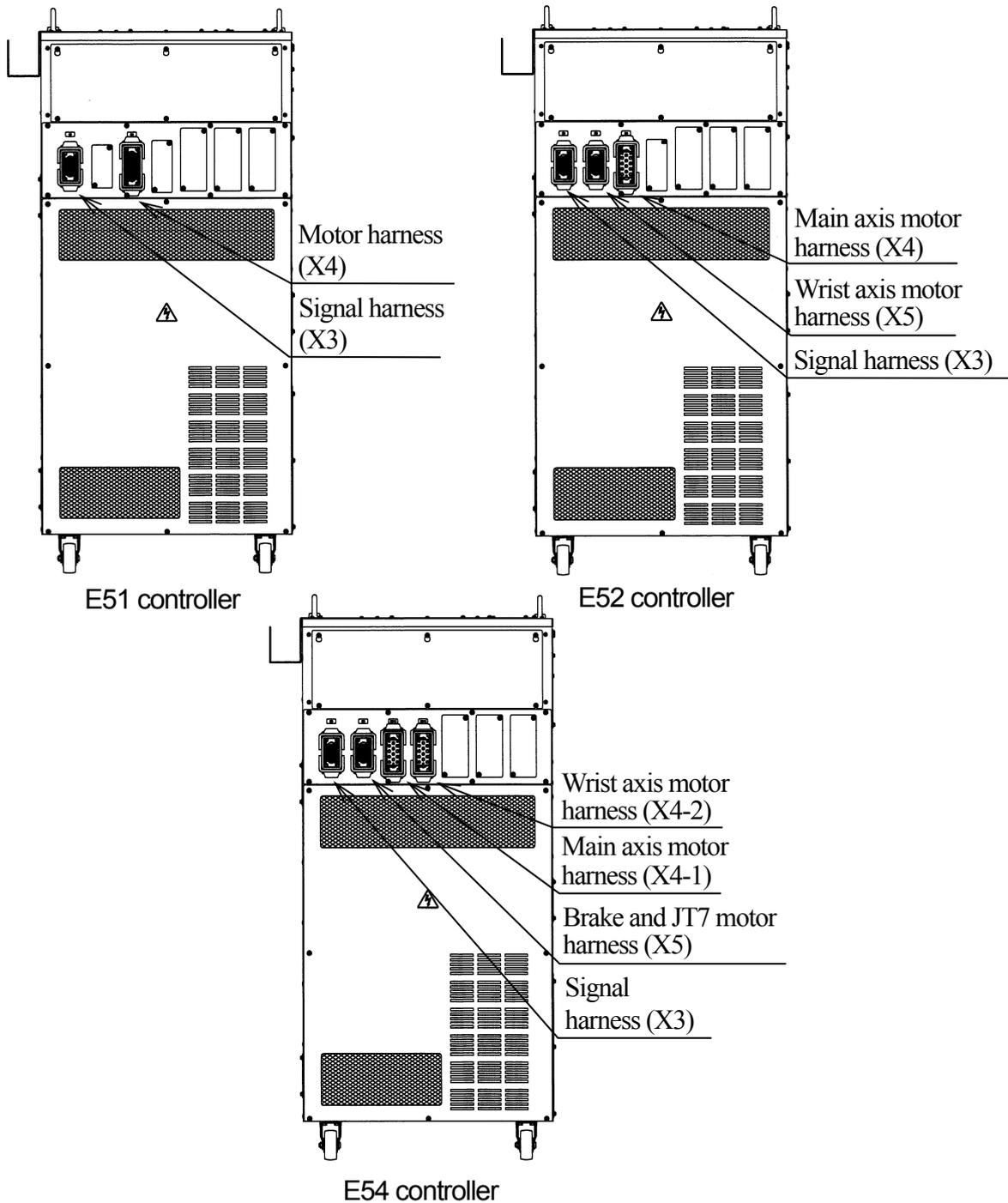
1. When connecting the harnesses, be sure to use the correct harnesses. Using an incorrect harness, or forcing or misconnecting the harness may damage connectors or cause a break in the electrical system.
2. Prevent people or equipment (forklift etc.) from stepping on or riding over the signal and motor harness lines. Otherwise, the harness may become damaged or the electrical system may break.
3. 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.
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 ground line connection for the controller.

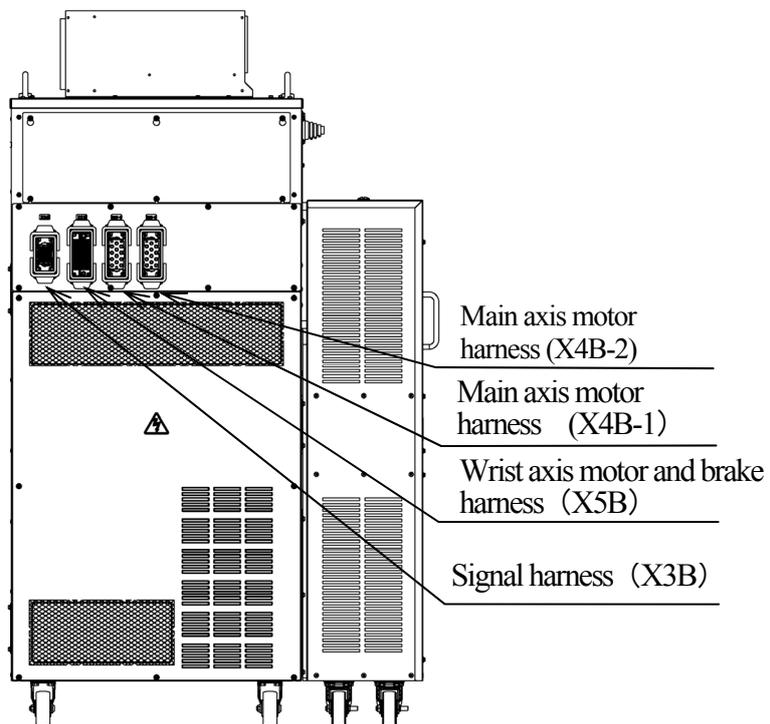
Connect the separate harnesses to their designated ports as shown below.

1. Controller side

**⚠ CAUTION**

1. Fix each connector securely. The robot may malfunction if connectors are loosen or detached.
2. The harness should drop straight down from the connector. Because connectors are located at the upper part of controller, the controller might topple over if the connected harnesses are pulled to the controller side or to the rear direction.

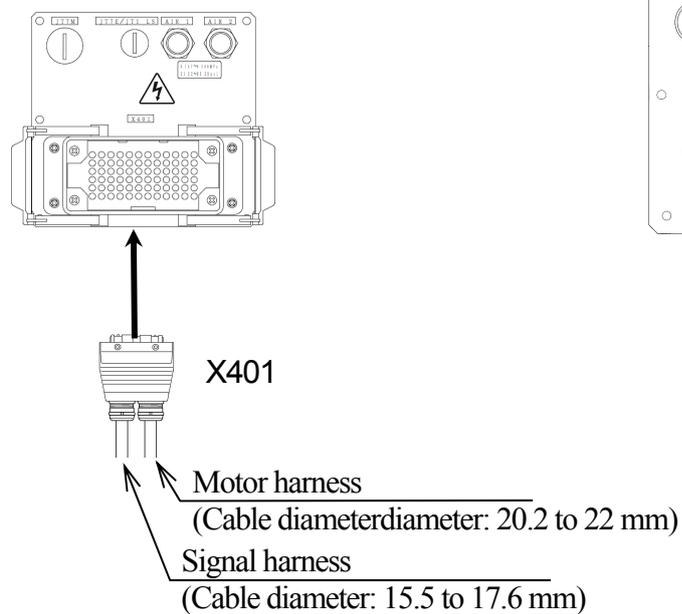




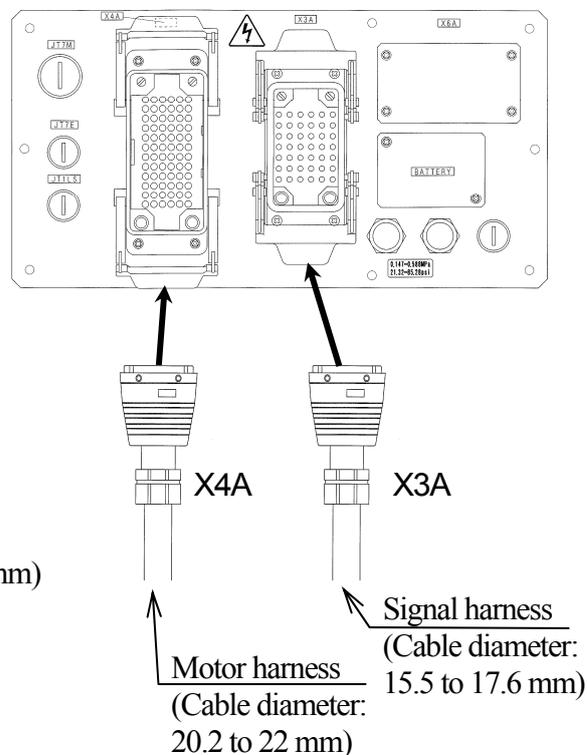
E58 Controller

2. Arm side

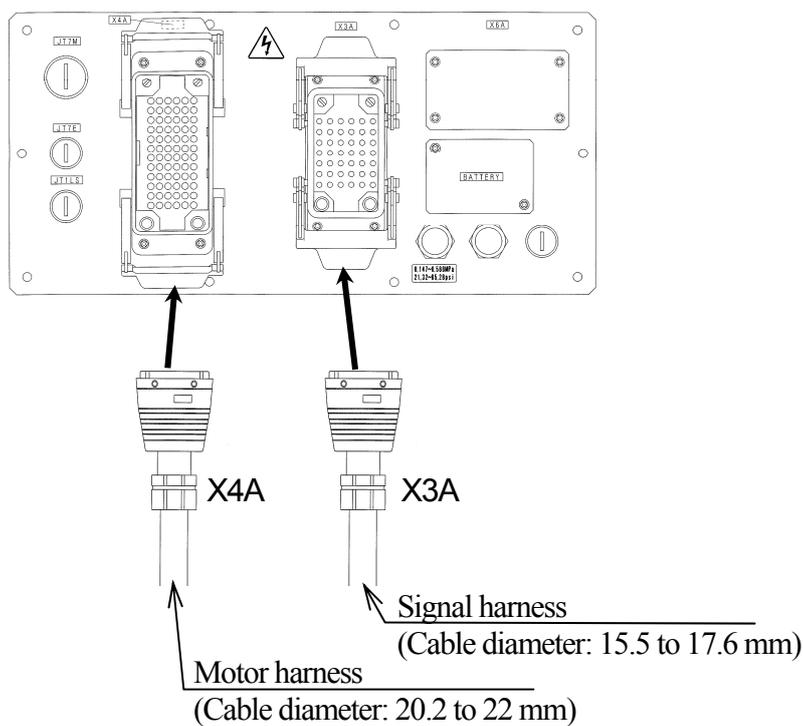
R series 03N/05N/05L



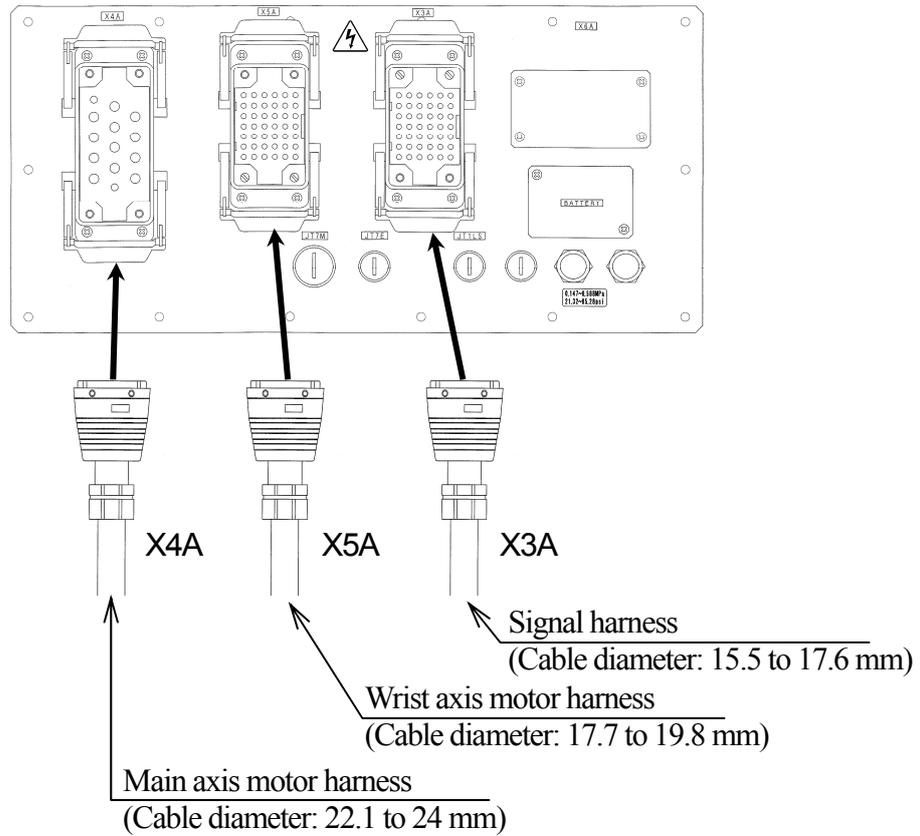
R series 10N/06L



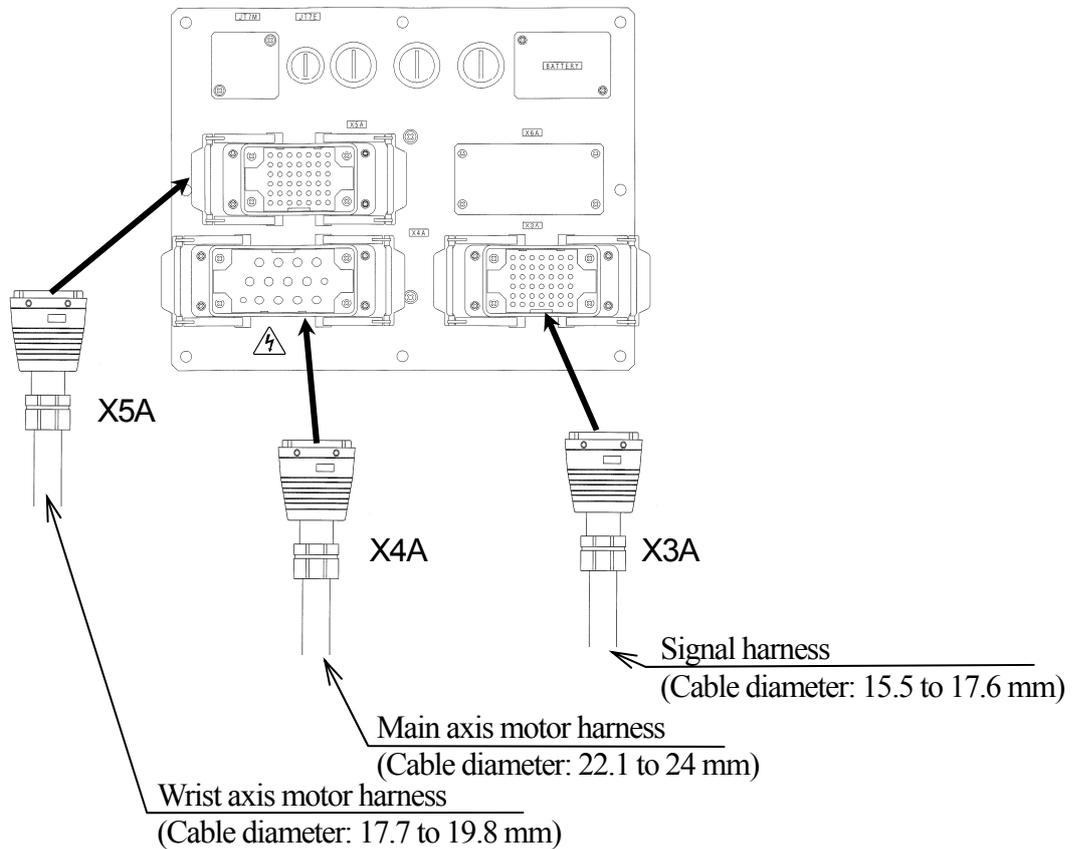
R series 20N/10L



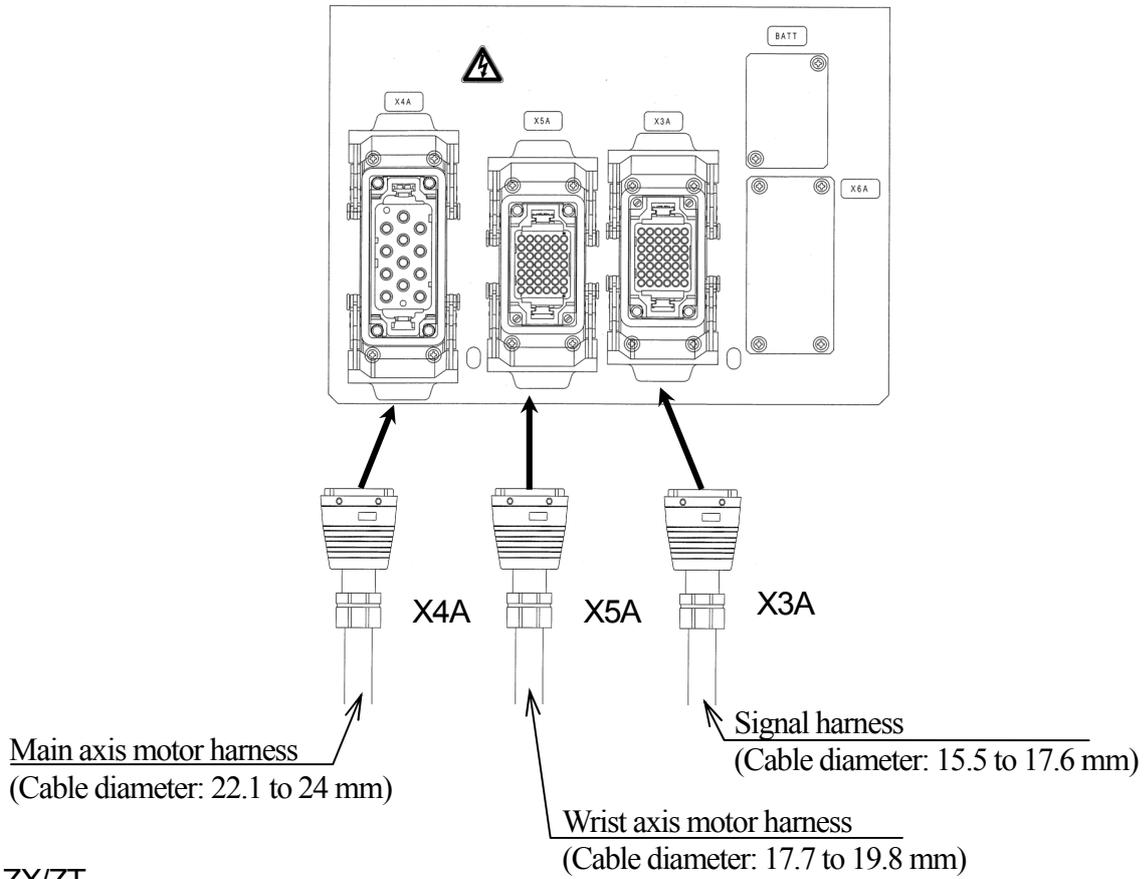
R series 30N/50N/80N/15X



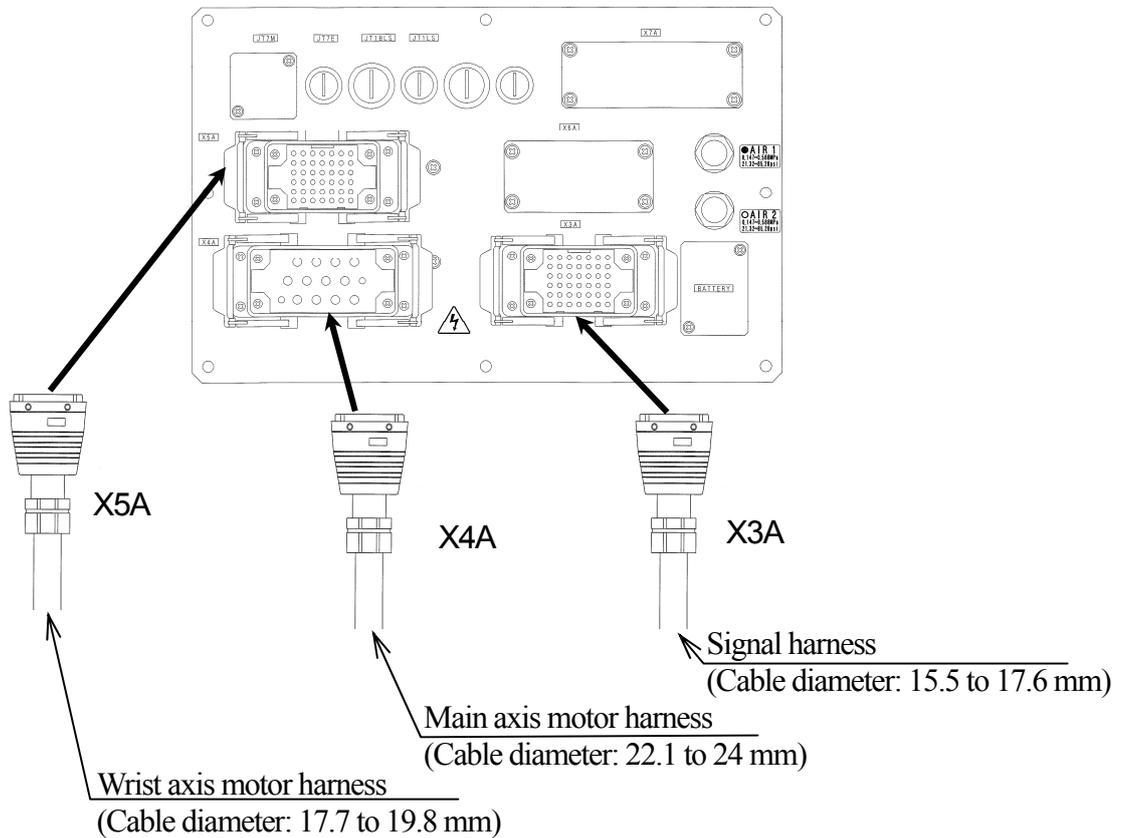
ZH



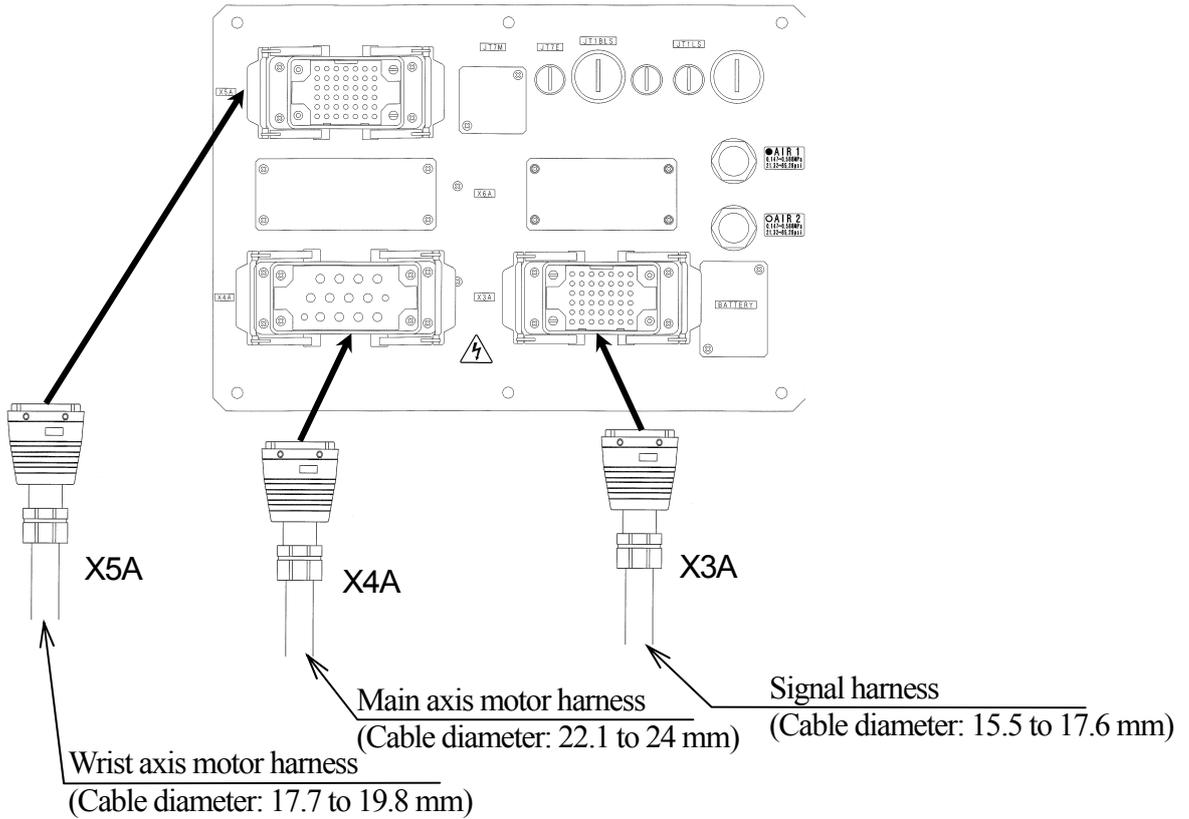
B series



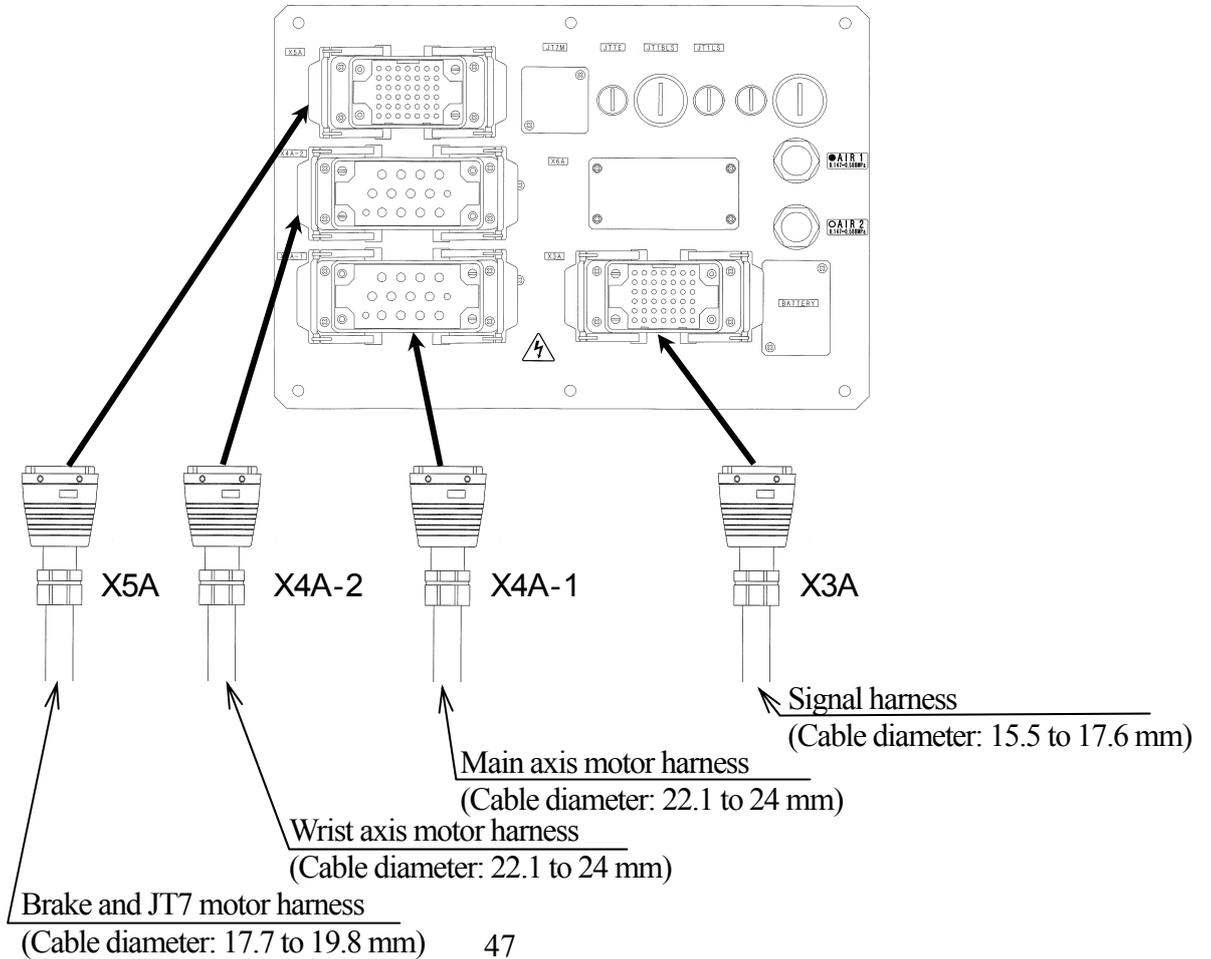
ZX/ZT



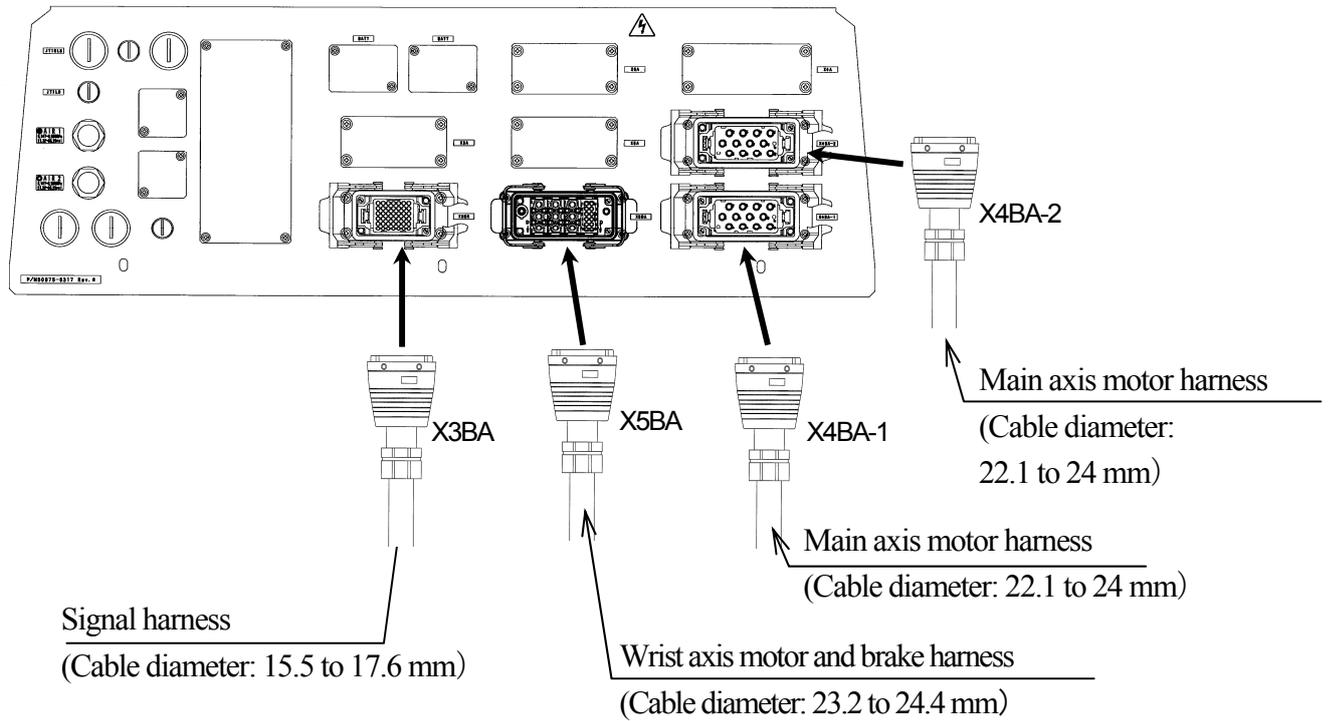
MT



MX

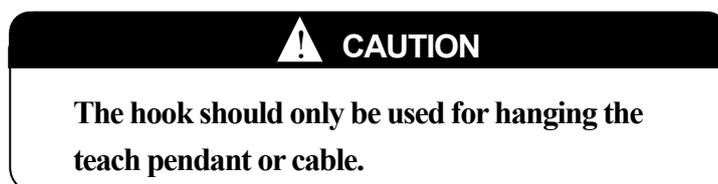


MG

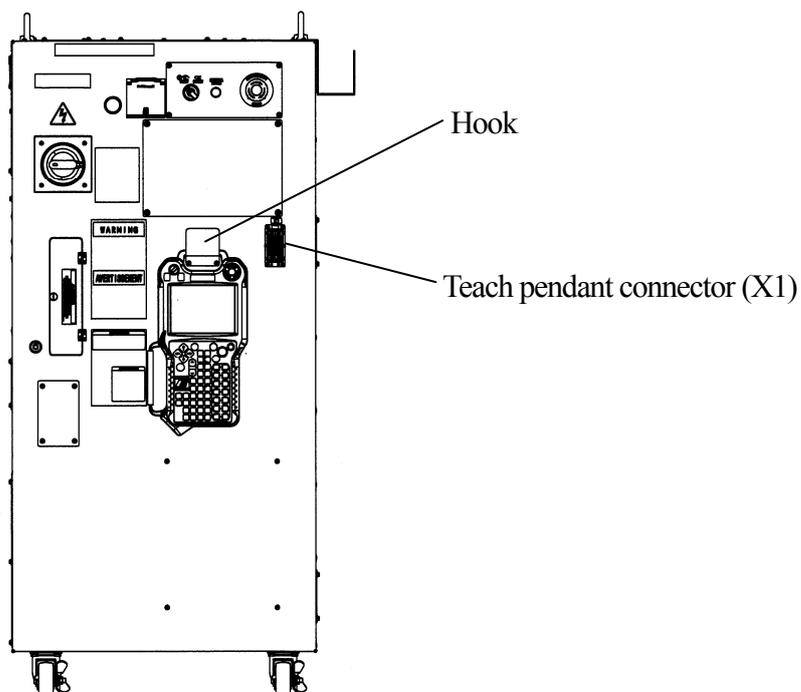


## 6.2 Connection between Controller and Teach Pendant

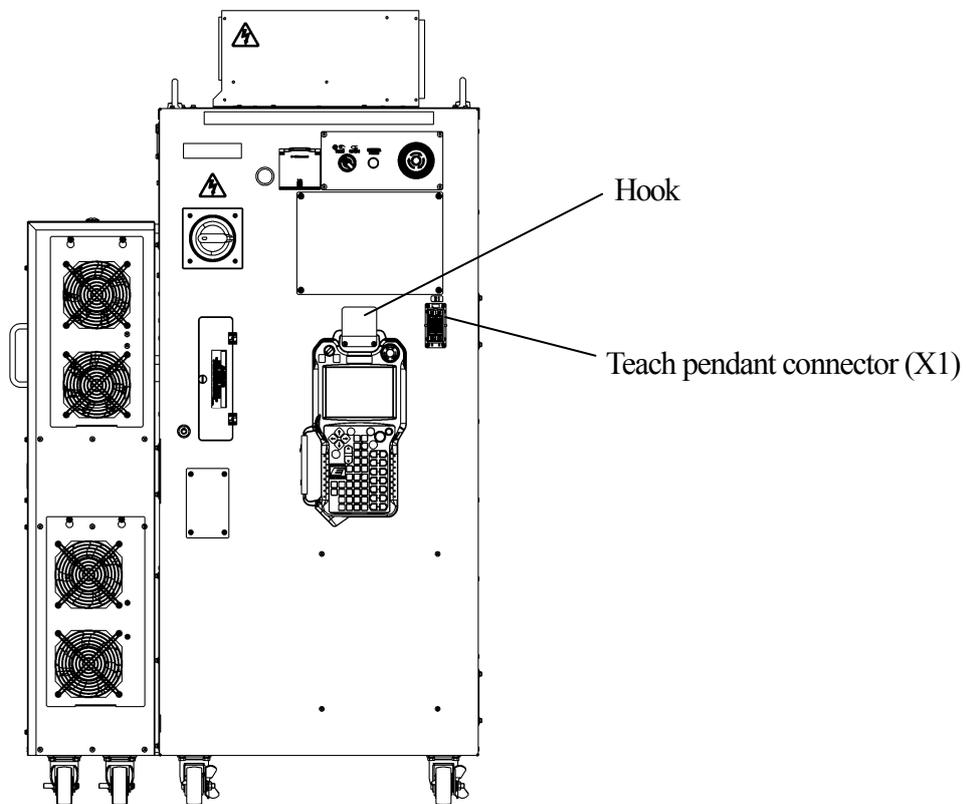
1. Connect the teach pendant cable with the connector, lower of operation panel. Pull up the lever and insert the cable side connector, and then pull down the lever to lock the connectors.
2. Hang the teach pendant and the teach pendant cable on the hook.



### E51/E52/E54 Controllers



E58 Controller



## 7 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 controller 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 meets specifications shown on the rating plate and the label attached on the side of the breaker. Supplying out-of-specification power will damage electric components in the controller.**
- 2. Ground the controller to prevent against electrical noise and shock.**
- 3. Use dedicated ground wire (100  $\Omega$  or less), which is equal to or larger than the recommended power cable size (3.5 to 13 mm<sup>2</sup>).**
- 4. Never connect ground wires to welding machines, etc. or sharing grounding with negative electrodes.**
- 5. For use in work such as arc welding, connect the negative electrode (base material) on the power supply used for welding directly to the base material or to the fixture. Never have the main robot unit, the controller and the multi-axis controller share grounding, and ensure they are grounded in isolation of each other.**
- 6. Without fail, before turning ON the external power to controller, make sure the power supply wiring is complete and all the covers reattached properly. Otherwise, failure to do so may cause electric shock.**

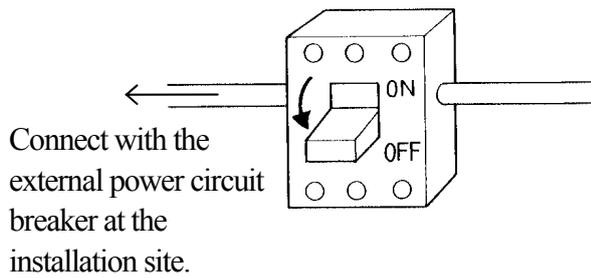


### CAUTION

1. Prepare external power that meets the specifications of the controller in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the controller'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 a ground leakage breaker. (Use a time delay type with sensitivity of 100 mA or more.)
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.

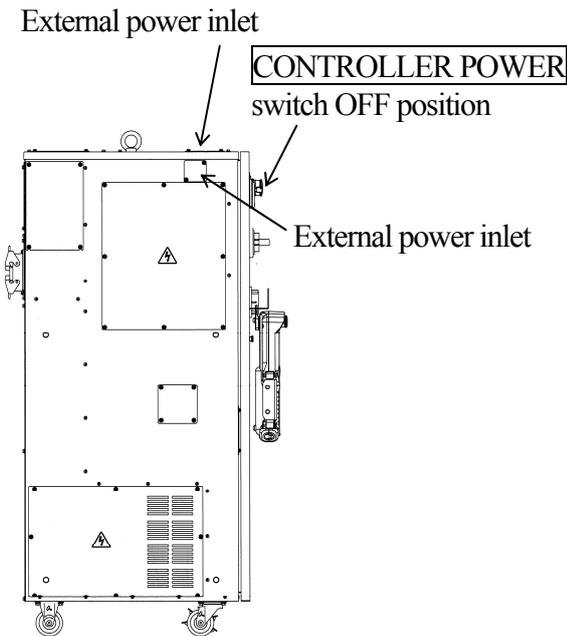
**NOTE\*** Proximity switch directly connected with power line etc. may suffer from the influence.

E5x controller



Connect the external power according to the following procedure.

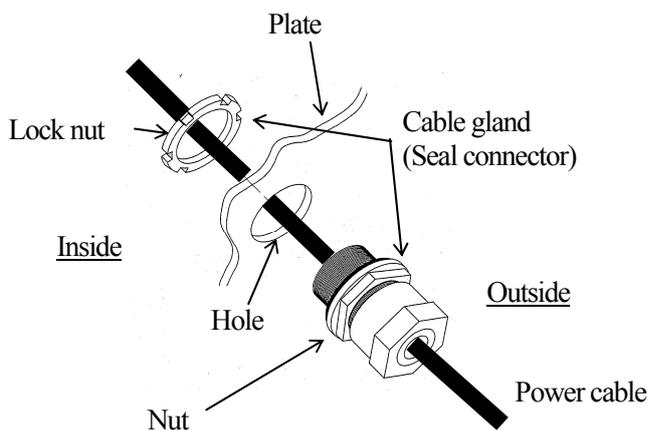
1. Turn OFF the external power for the controller.



2. Set **CONTROLLER POWER** switch on the left front of the controller to the OFF position.

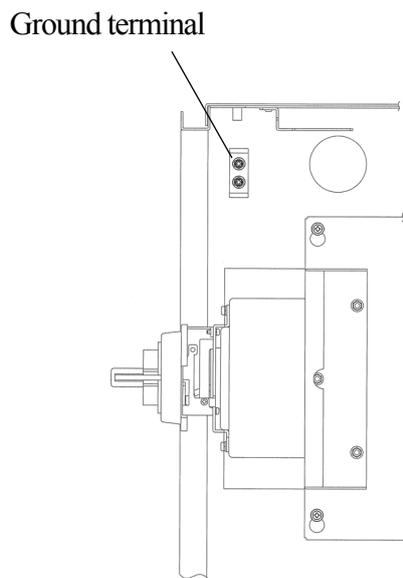
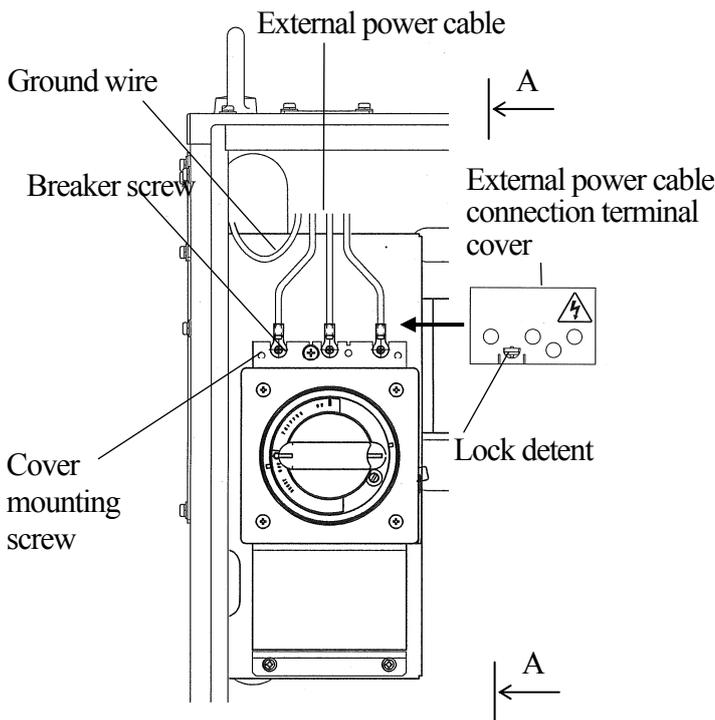
3. Feed the external power cable into the inlet on the top or left side of the controller with following procedures.

- Prepare the cable gland that is suitable for the power cable diameter.
- Remove the plate on external power inlet, and make a hole for the cable gland.
- Pass the cable through the cable gland.
- Tighten the nut after adjusting length of the cable.
- Insert the cable into the inlet and tighten the lock nut.



**CAUTION**

1. Confirm current requirements and select a power cable with adequate capacity. (See “3 Appearance and Specification of Robot Controller”.)
2. Do not install wire that is too small in diameter, the voltage may drop or the cable may overheat.



View A-A

4. Attach round crimp-type terminals on the ends of the individual wires of the power cable.

- Use crimp-type terminal, UL listed type shown in the table below.
- The crimp-type terminal should be crimped with appropriate tools in accordance with manufacturer's instruction manual.

5. Attach the plate on external power inlet.

6. Unscrew the cover mounting screws, remove the breaker terminal cover (upper side), and connect the external power cable to the breaker terminal (3 screws), and the dedicated ground terminal. Connect the ground wire with the ground terminal as shown left figure. After wiring, return the cover as it was.

**! WARNING**

**Tighten the terminal screws securely. Operating the robot with loose terminals is very dangerous and may lead to electric shock, robot malfunction, or breakdown of the electrical system.**

**! DANGER**

**Mount the external power cable connection terminal cover when the wiring is complete. Failing to mount the cover may lead to electric shock due to accidental contact with power line.**

External power voltage: AC200-220 V, AC380-415 V, AC440-480 V, AC515 V, AC575 V

North America specification

Electric cable size to be used	Crimp-type terminal size (Use the UL listed terminal)	
	For breaker	For ground terminal
3.5 mm <sup>2</sup> (AWG12) 5.5 mm <sup>2</sup> (AWG10)	R5.5-8	R5.5-5
8 mm <sup>2</sup> (AWG8)	R8-8	R8-5
13 mm <sup>2</sup> (AWG6)	R14-8	R14-5

Japan and Europe specification

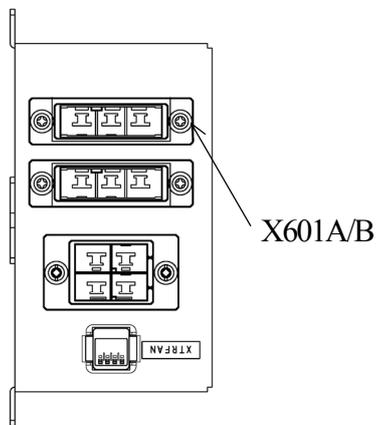
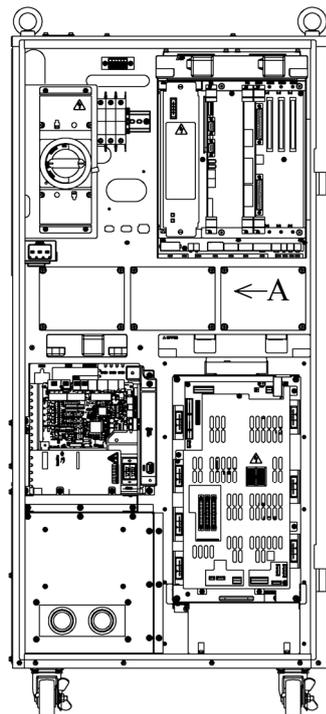
Electric cable size to be used	Crimp-type terminal size	
	For breaker	For ground terminal
3.5 mm <sup>2</sup> (AWG12) 5.5 mm <sup>2</sup> (AWG10)	R5.5-5	R5.5-5
8 mm <sup>2</sup> (AWG8)	R8-5	R8-5
13 mm <sup>2</sup> (AWG6)	R14-5	R14-5

## 7.1 Change of External Power Input Voltage

Change the connection of the transformer connector before changing the external power input voltage.

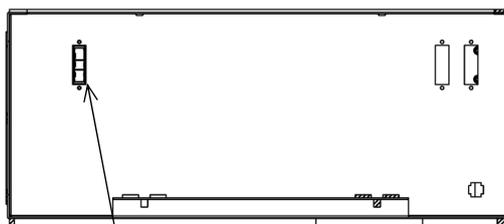
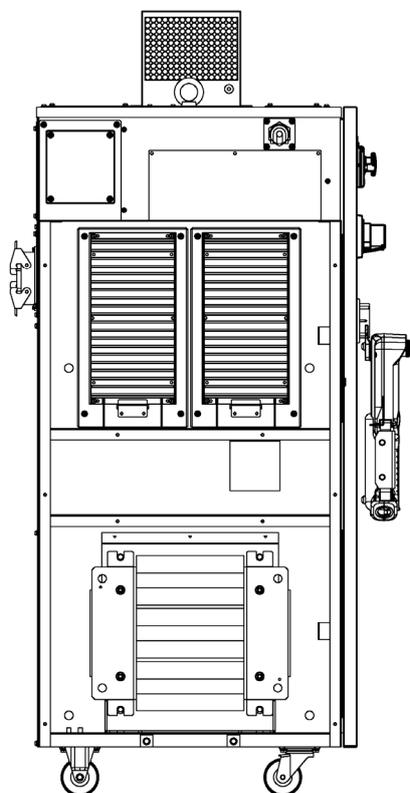
Specification	External power input voltage	Connector
E51/E52/E54	440 V/460 V/480 V	X601A
	380 V/400 V/415 V	X601B
E58	380 V/400 V/415 V	X601A
	440 V/460 V/480 V	X601B

E51/E52/E54 Controller



Cross section A

E58 Controller



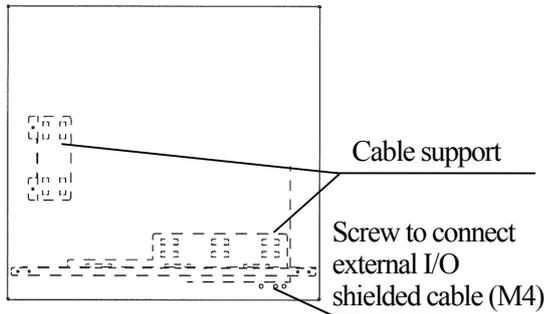
X601A/B

Cross section A

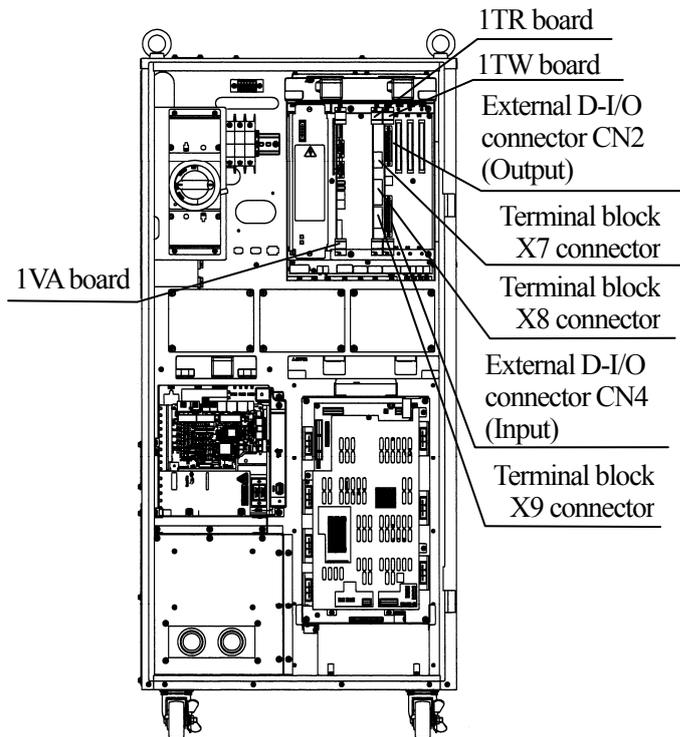
## **8 Connection of Peripheral Control Equipment**

According to application specifications, connect the peripheral controller or devices to the respective connectors in the controller as shown below.

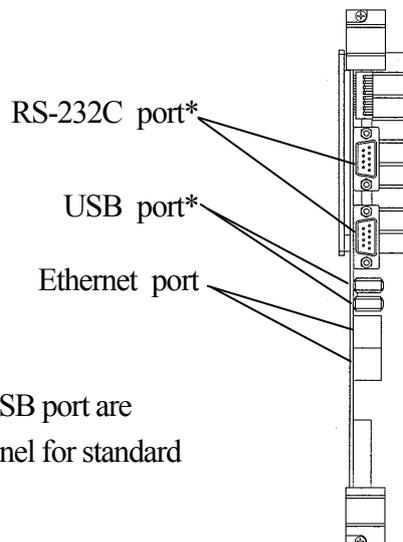
E5x controller



Use cable support for wiring of 24 Vdc or less such as I/O, Ethernet and fieldbus cable etc. Make sure not to put any stress on connectors on each board.



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



**NOTE\*** The upper RS-232C port and the upper USB 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.**

Controller model	Procedure to prevent turning ON the power during operations
E51/E52/E54/E58	Padlock the main breaker handle.



### 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.**
- 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.

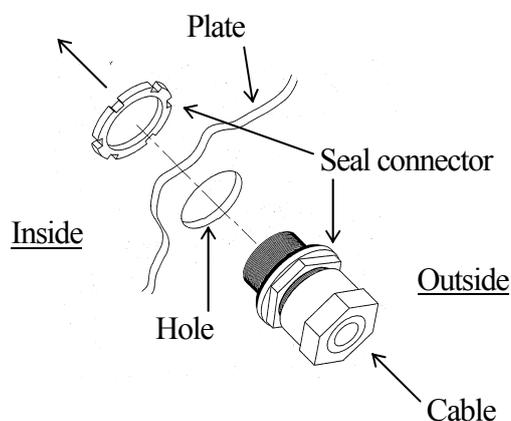
I/O signal inlet: Left side of the controller,

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

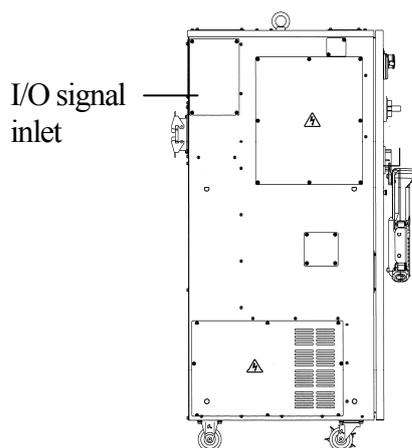
(1) Make a hole in the plate suitable for the seal connector.

(2) Pass the cable through the seal connector

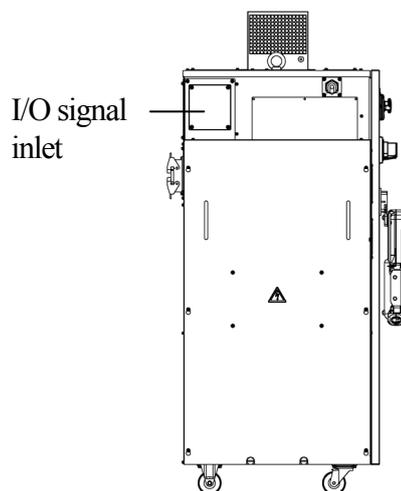
(3) After passing the cable to the hole, tighten the nut(s) of the seal connector.



E51/E52/E54 Controller



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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 to 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]**

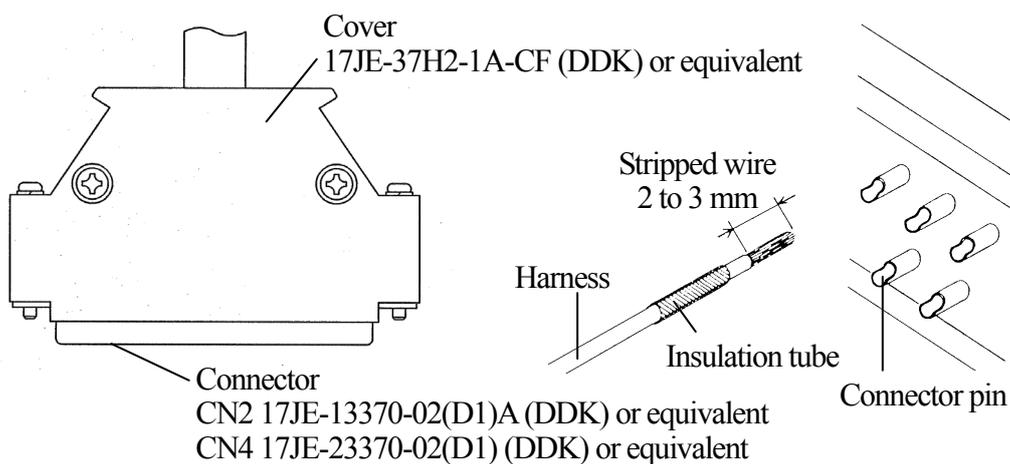
1. Use an insulation tube of heat shrinkage type, or bind the tube ends on each line so they do not come off.
2. It is recommended to use AWG22-24 or equivalent for cables.

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.

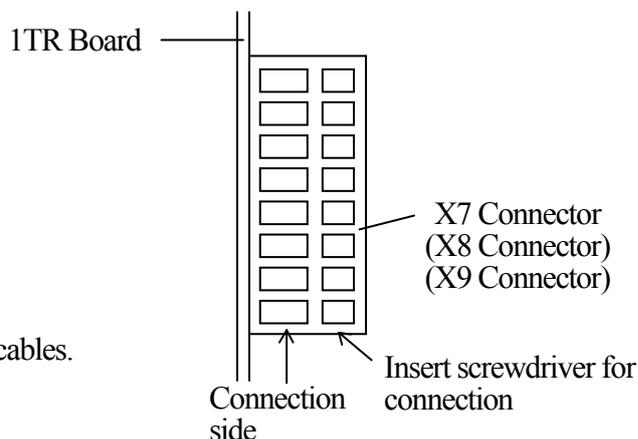
It is recommend to use AWG22-24 or equivalent for cables.  
(Stripped wire length: 7 mm)

To assure the wiring, it is recommended use 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 1VA board 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 (90210-1177) 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 (90210-1248) 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 (90210-1184) 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 and 1TY boards. Refer to the option manuals (90210-1246 and 90210-1247) for details.



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