

**Kawasaki Robot Controller
E Series**

**Installation and
Connection Manual**

Robot

Kawasaki Heavy Industries, Ltd.

PREFACE

This manual describes the installation and connection of the E series 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.

E10, E12, E13, E14, E20, E22, E23, E24, E73, E74, E94 (Japan spec.)
E30, E32, E33, E34, E76, E77, E97 (North America spec.)
E40, E42, E43, E44, E70, E71, E91 (Europe spec.)
E28 (Japan/North America/Europe spec.)

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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.**
- 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 controller. 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 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 - 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 CONTROLLER

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

1. Ambient temperature during operation: within 0 - 45 °C or within 0 - 40 °C when placing E7x controller vertically and E91 controller
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 controller.)
The resistance to oil may not 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.
E1x/E2x/E3x/E4x/E7x/E91: Pollution degree: 3 or below, IP53/54 (Protective against entry of dust into the controller which causes the loss of controller function and water droplets.)
E94/E97: Pollution degree: 2 or below, IP20, without dew condensation (Not protective against objects which are thinner than fingers though it is impossible to insert fingers, entry of electricity-conducting foreign substances such as metal powder, foreign substances which conducts electricity by moisture, and water.)



CAUTION

When E94/E97 controller is used under the environmental condition with the pollution degree of 3 or above, the use of optional enclosed structure (IP54) is required.



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 (E1x/E2x/E3x/E4x controllers). For E91 controller (without optional filter) and E94/E97 controllers (takes the air into the controller), they cannot be installed with the following environment because air is taken into the controllers.

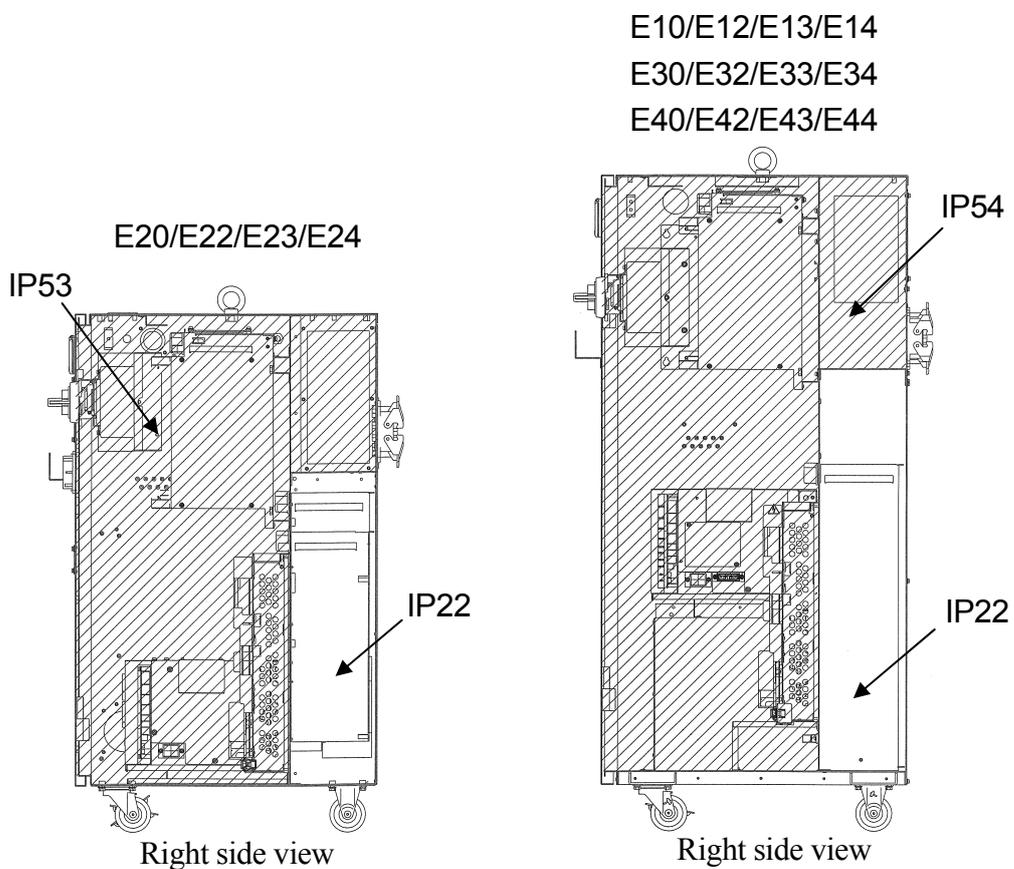
1. Metal workpiece polishing
2. Polished metal workpiece handling
3. Metal workpiece deburring
4. Deburred metal workpiece handling
5. Metal workpiece shotblasting
6. Aluminum package cutting (Cutting powder is generated.)
7. Other processing works where metal dust, etc. is generated.

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

! **CAUTION**

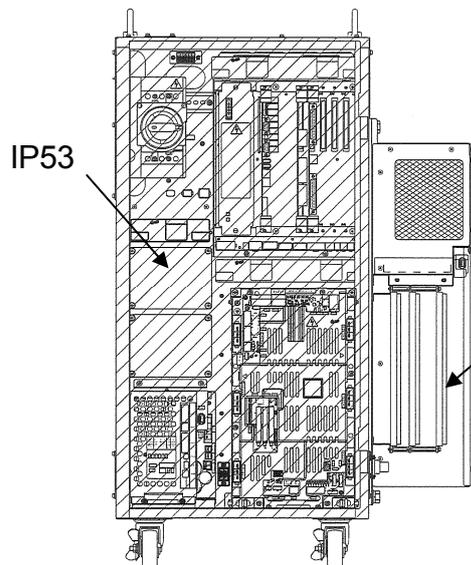
If the controller is installed near equipment that generates a lot of electrical noise, be sure to provide appropriate surge killers around that equipment. Noise producing equipment includes: induction motors, electromagnetic brakes, solenoids, or contact equipment, etc.

Degrees of protection in each controller

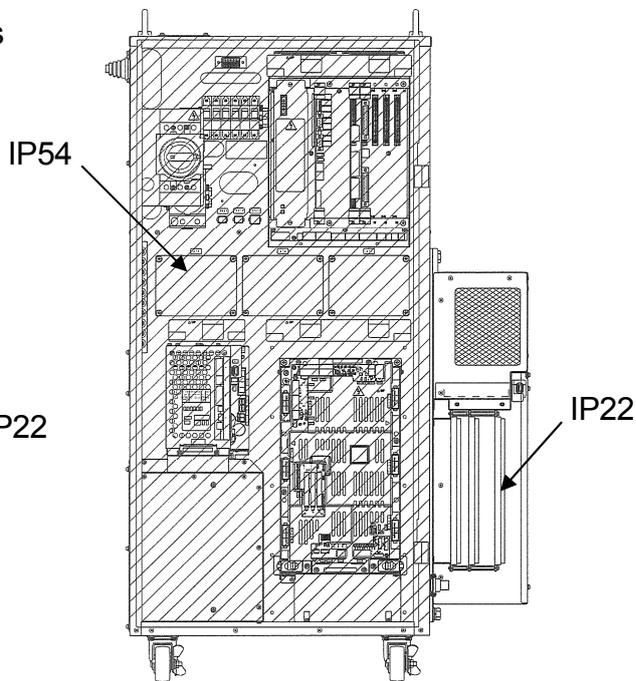


Controller with added regeneration resistors
E13/E14(MD)/E33/E34(MD)/E43/E44(MD)

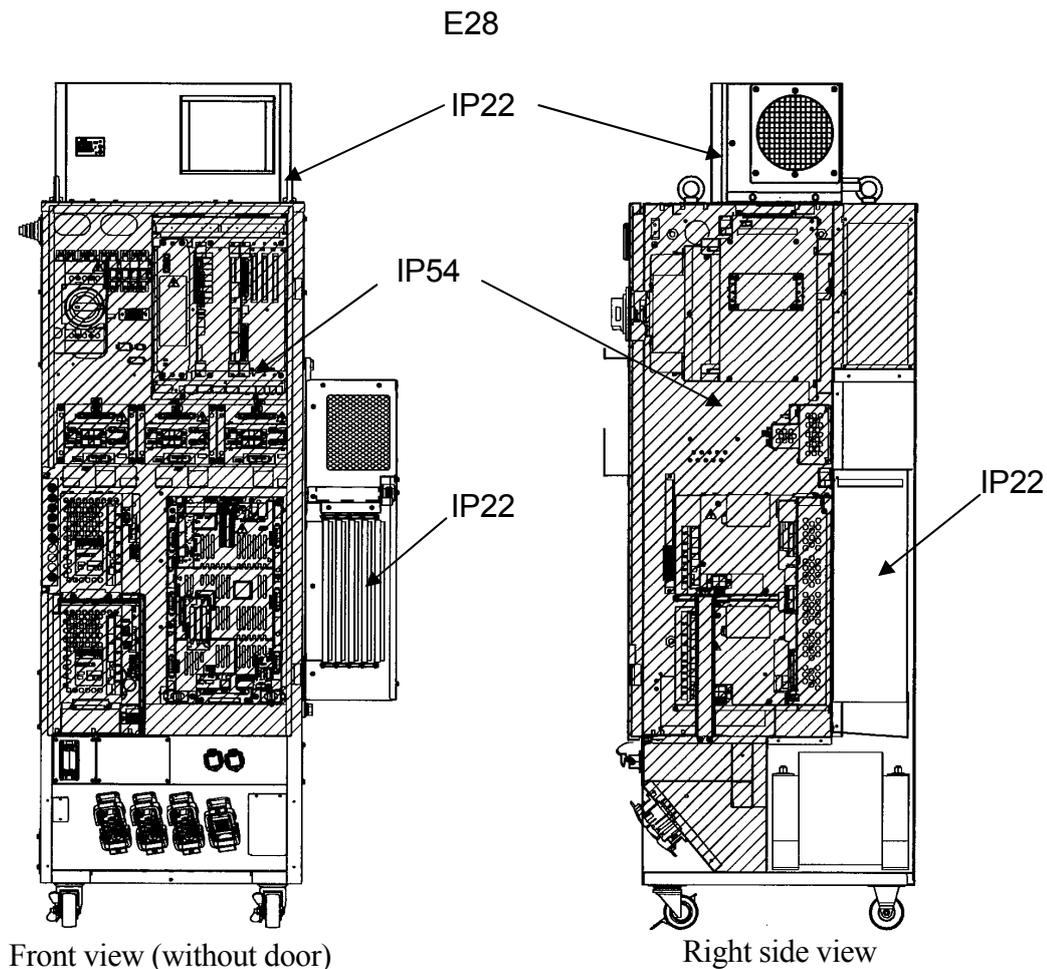
Controller with added regeneration resistors
E23/E24(MD)



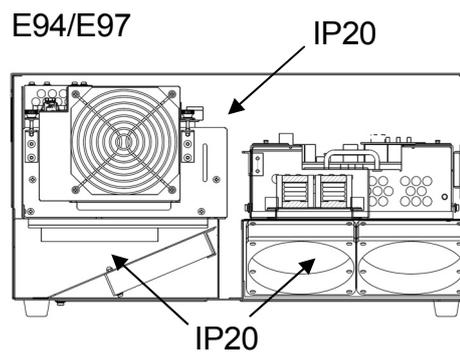
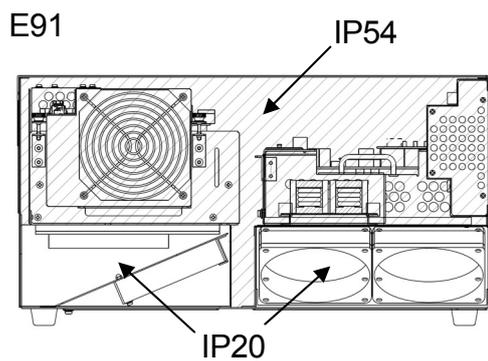
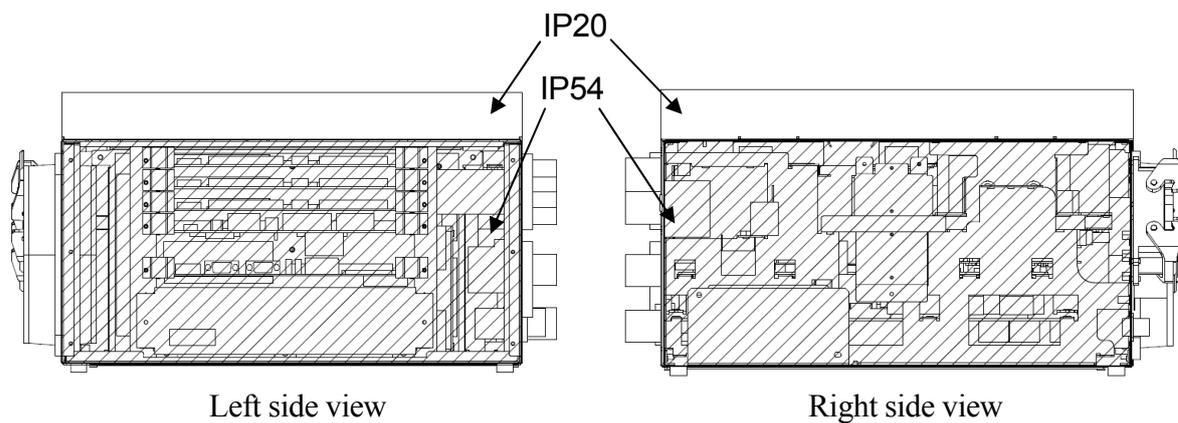
Front view (without door)



Front view (without door)



E70/E71/E73/E74/E76/E77

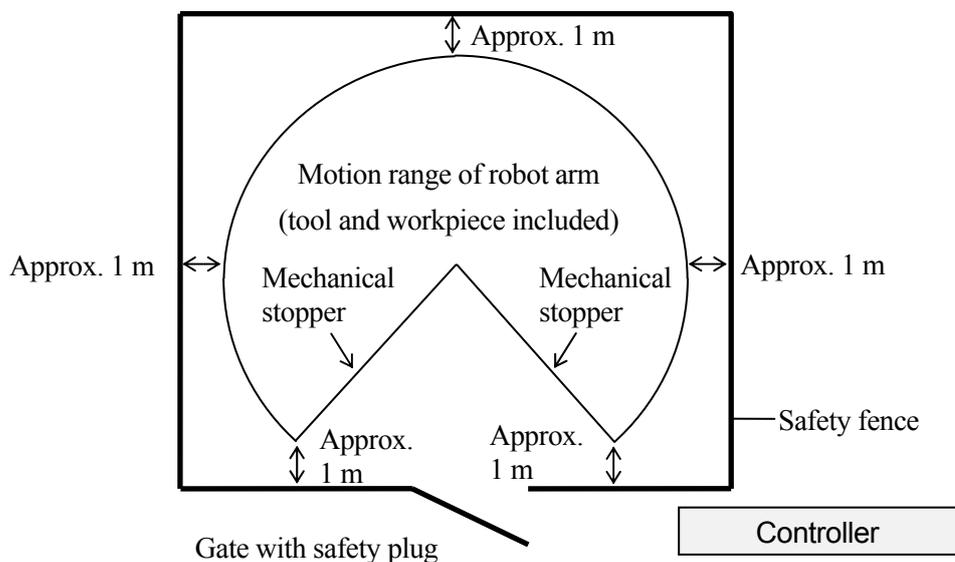


6. Free from flammable and/or corrosive liquid and gas.
7. Free from excessively strong vibration.
8. Place where power is supplied within specifications.
9. Place where dedicated earthing is provided. (100 Ω or less)
10. Outside the safety fence with margin (min. 1 m) from the motion range of robot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



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. 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 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. 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 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

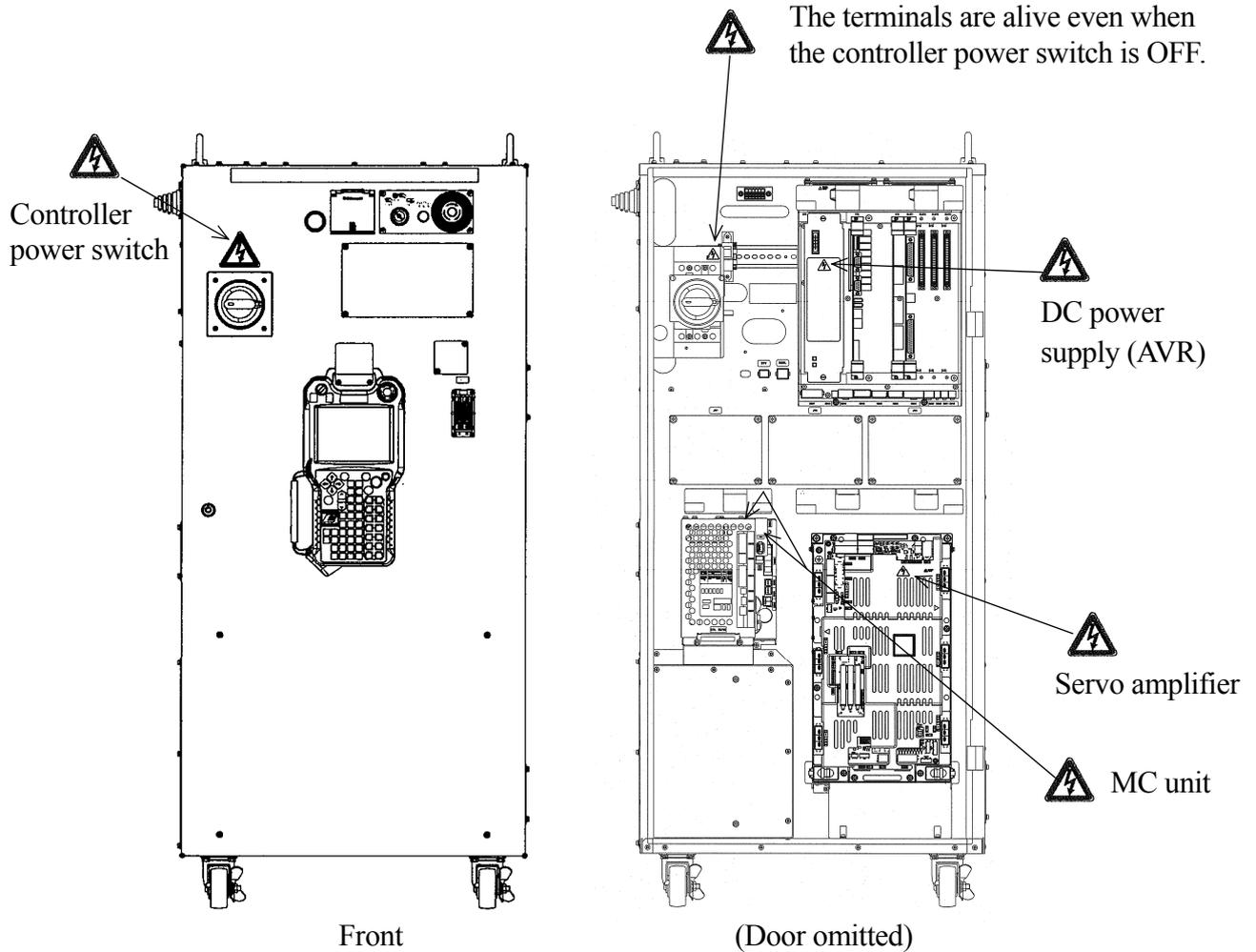
1. Prepare external power that meets the specifications of the controller in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the controller's specified range (above/below ratings), then the power monitoring circuit 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 an earth 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.

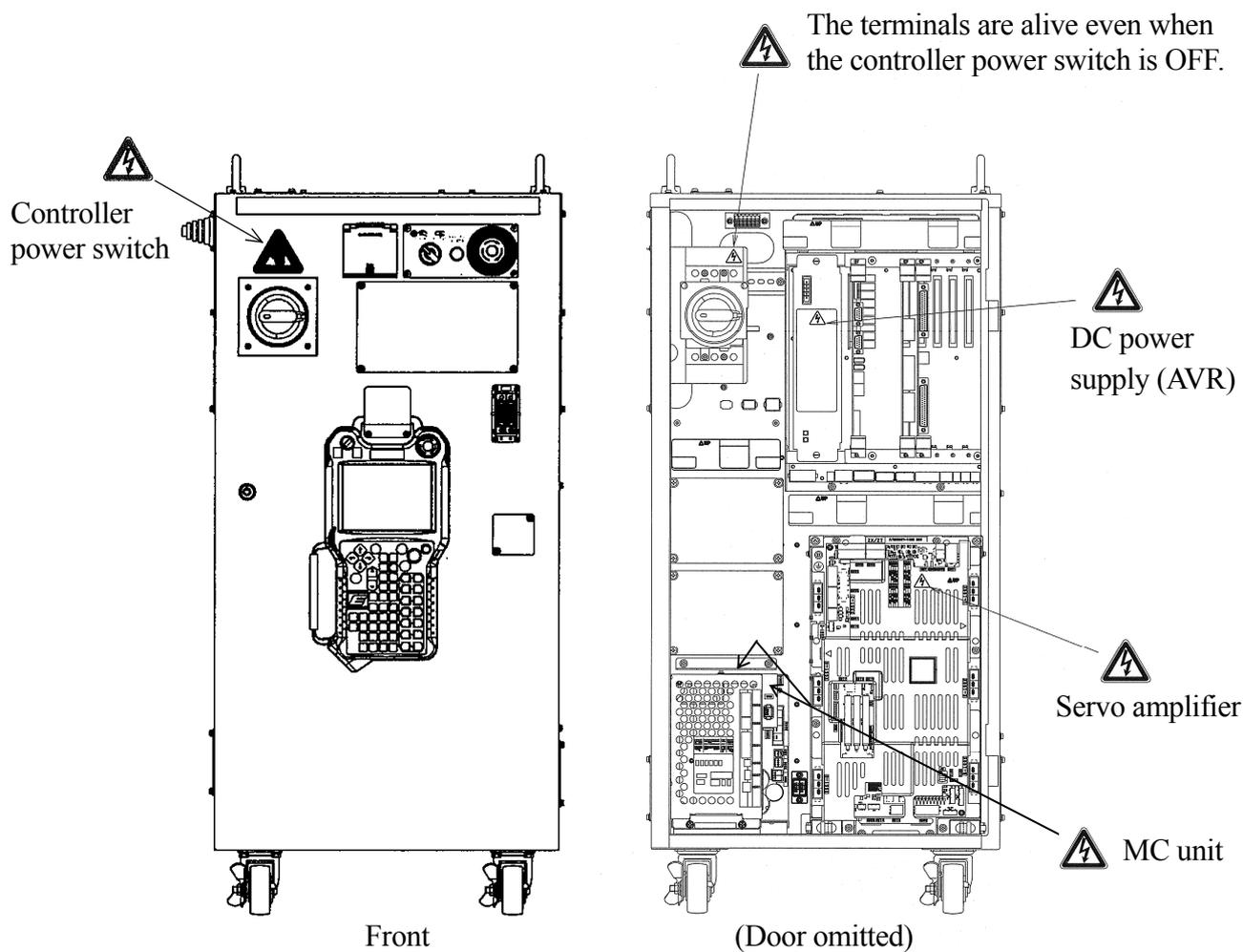
1.5 WARNING LABEL FOR ELECTRIC SHOCK

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

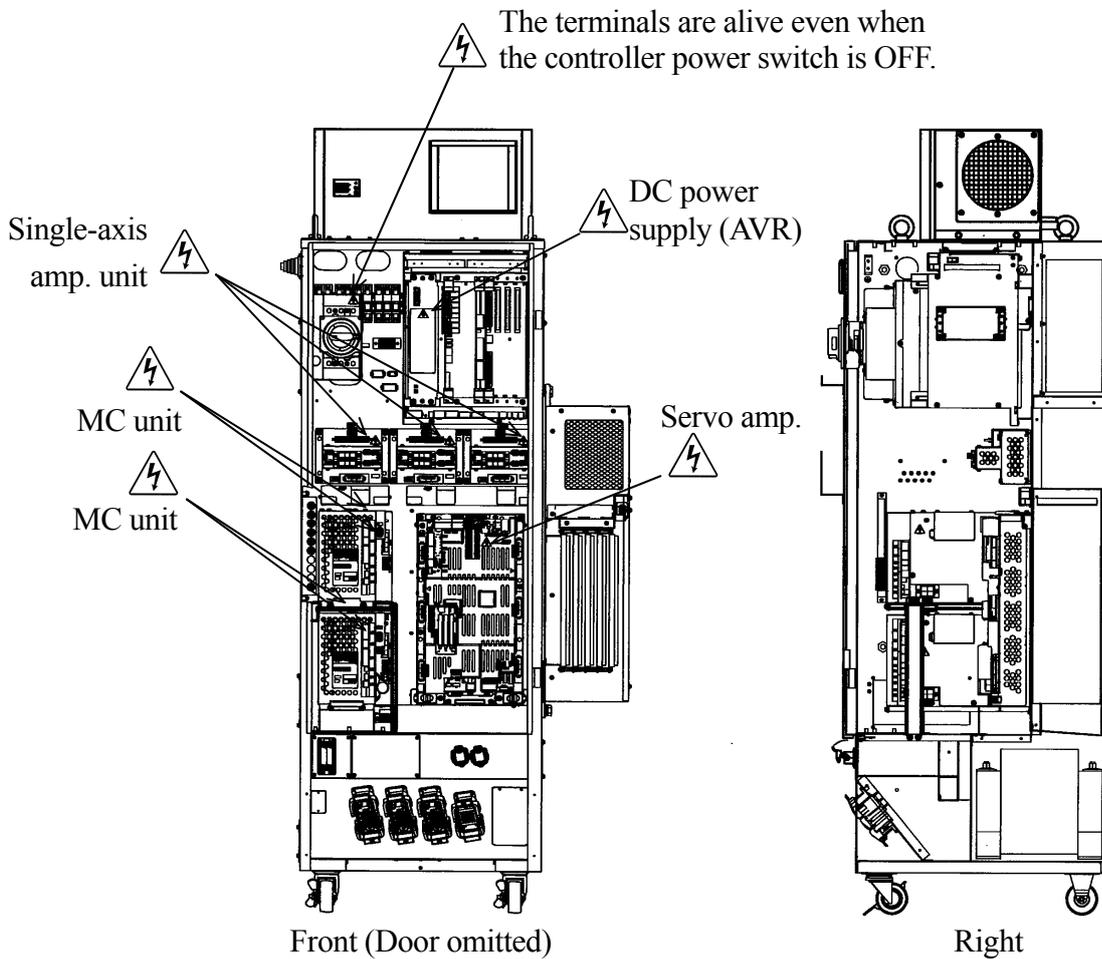
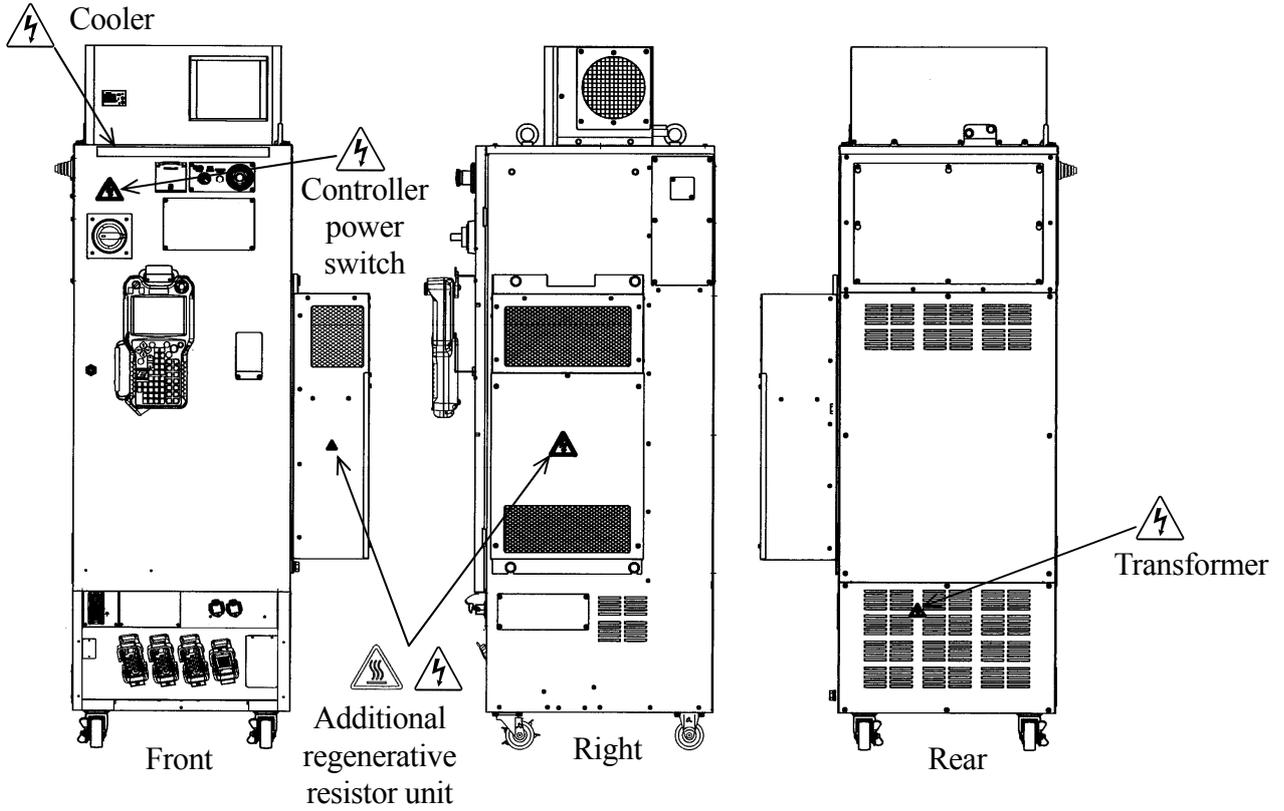
E1x controller



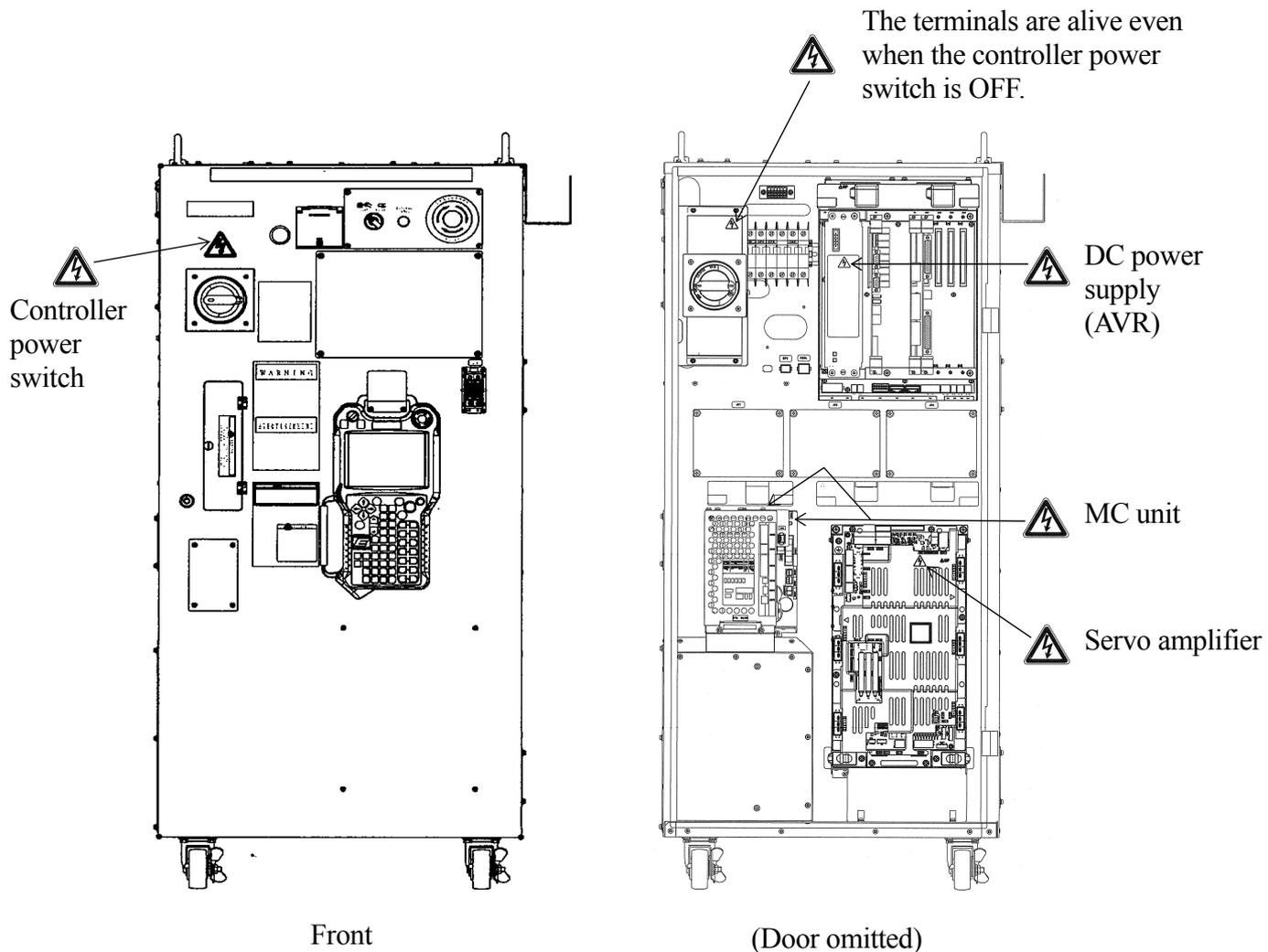
E2x (exc E28) controller

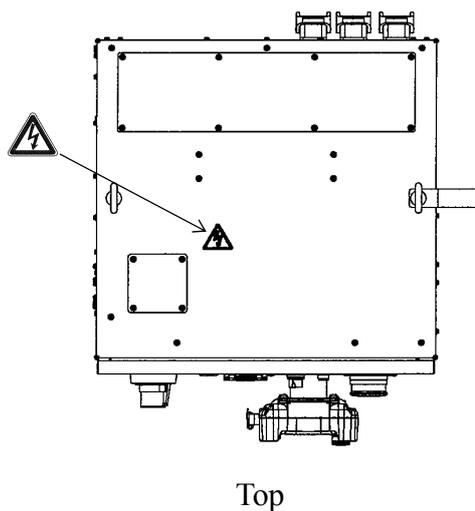
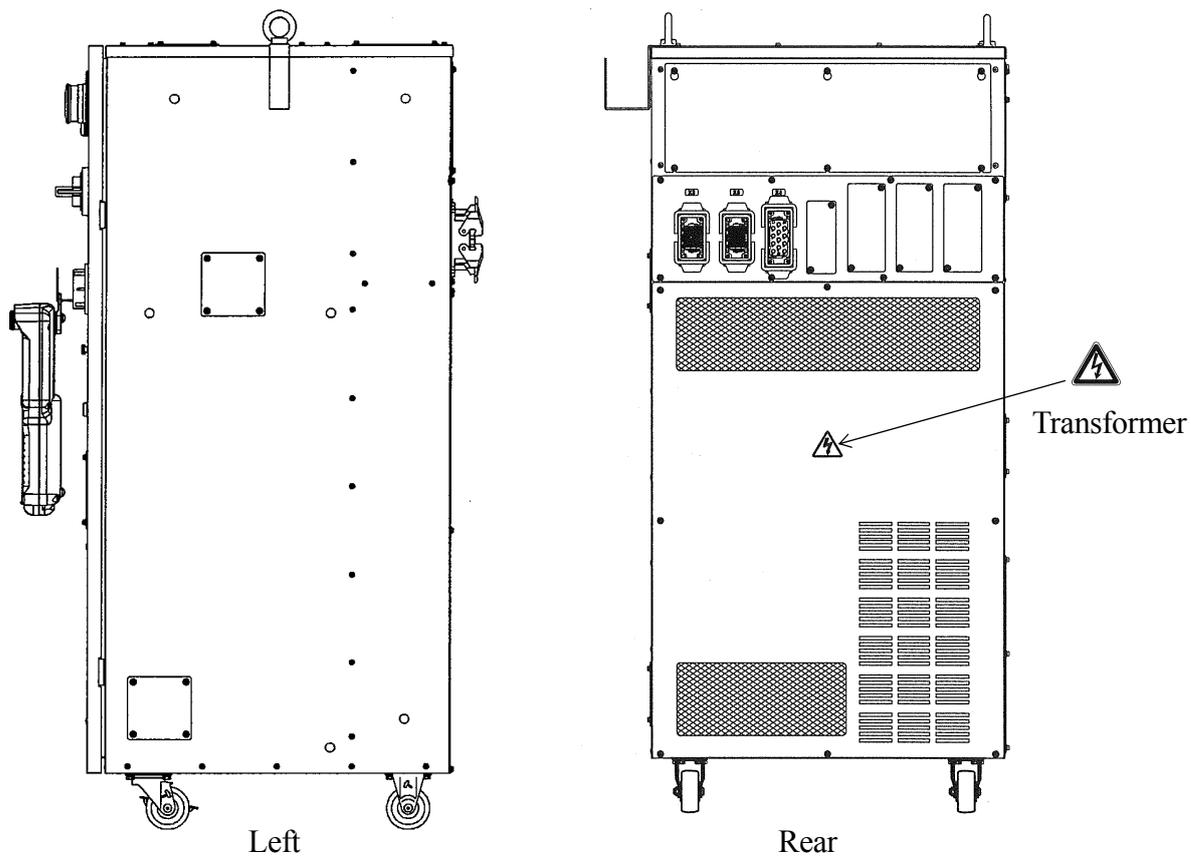


E28 controller

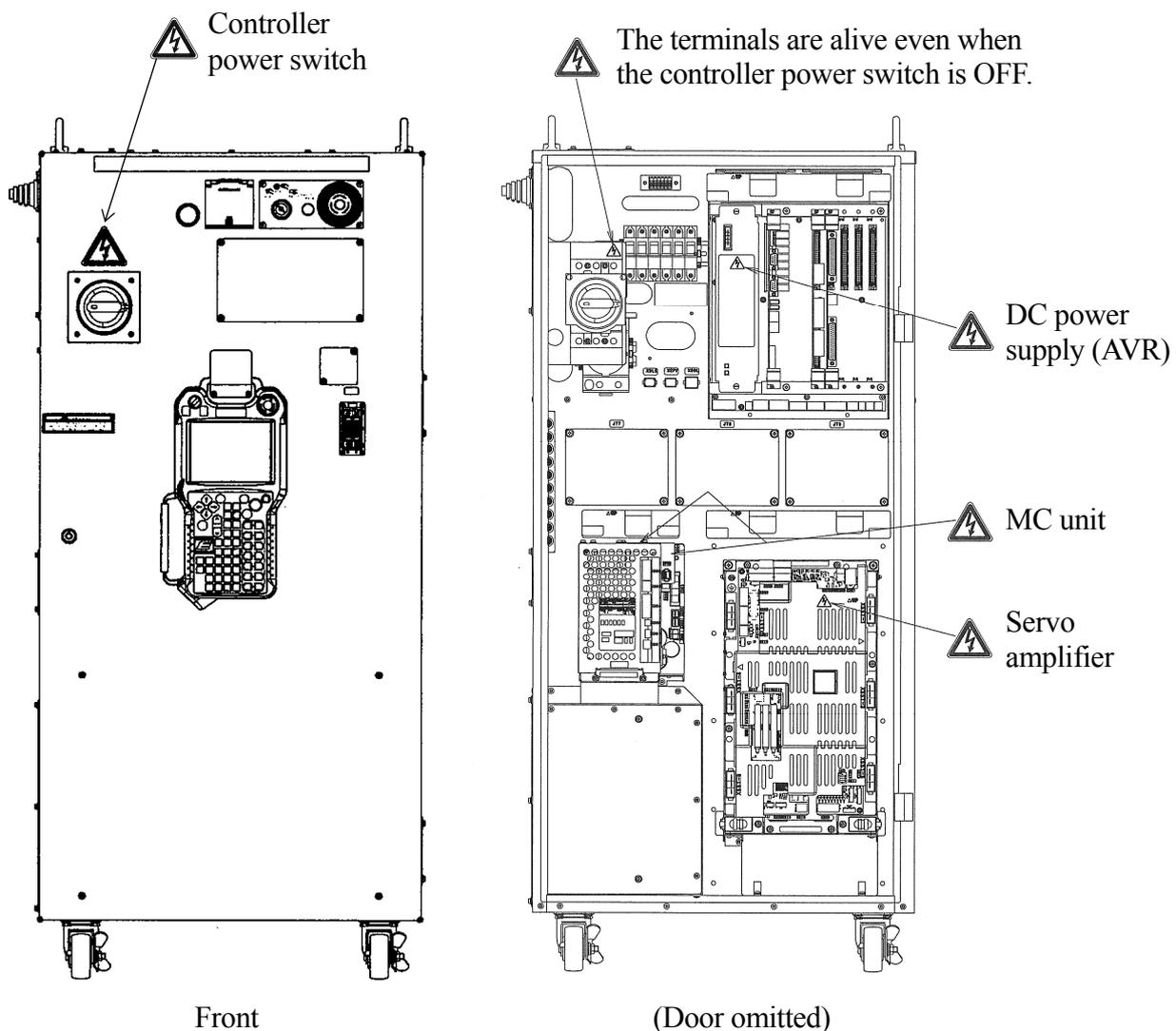


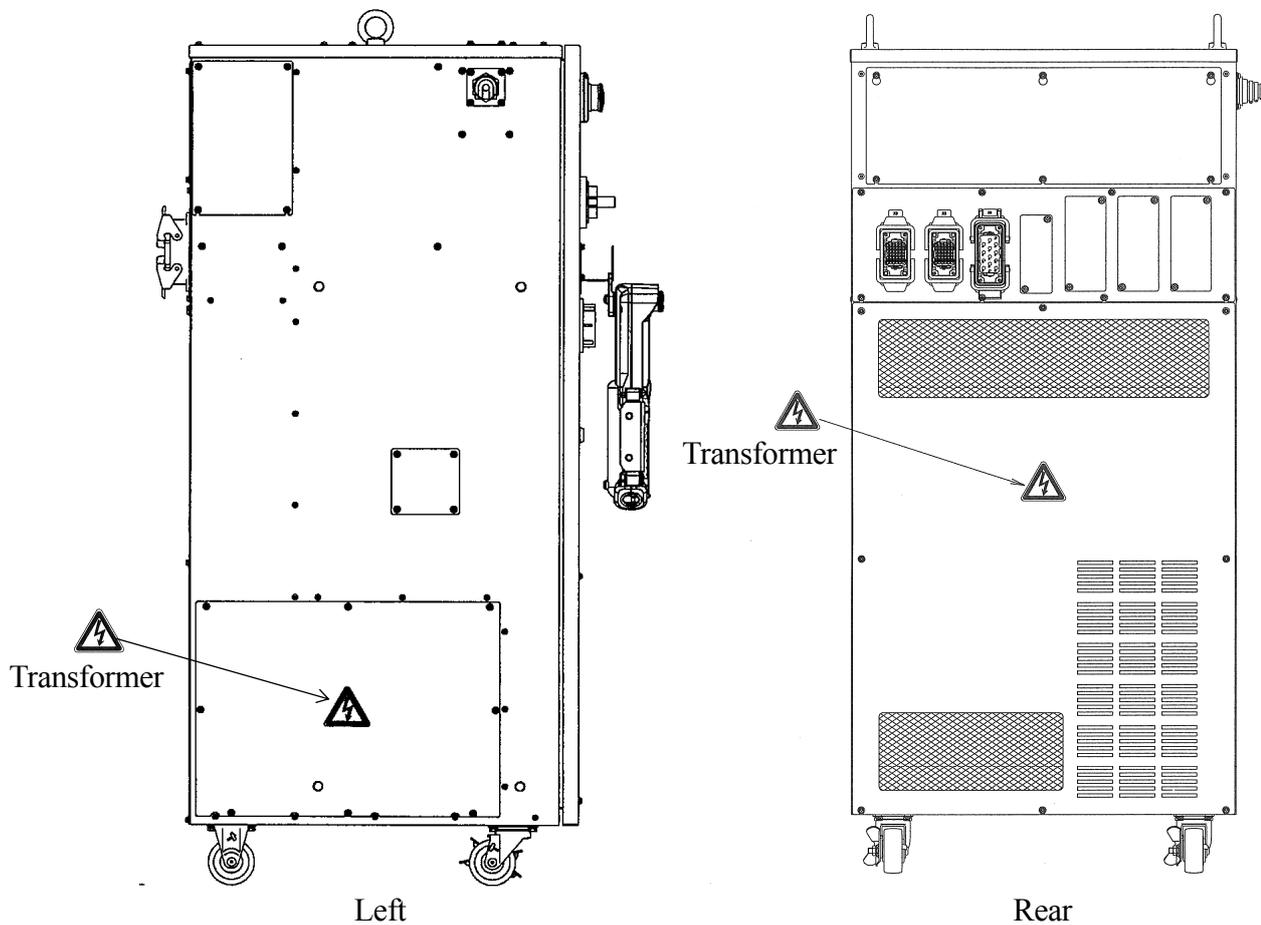
E3x controller



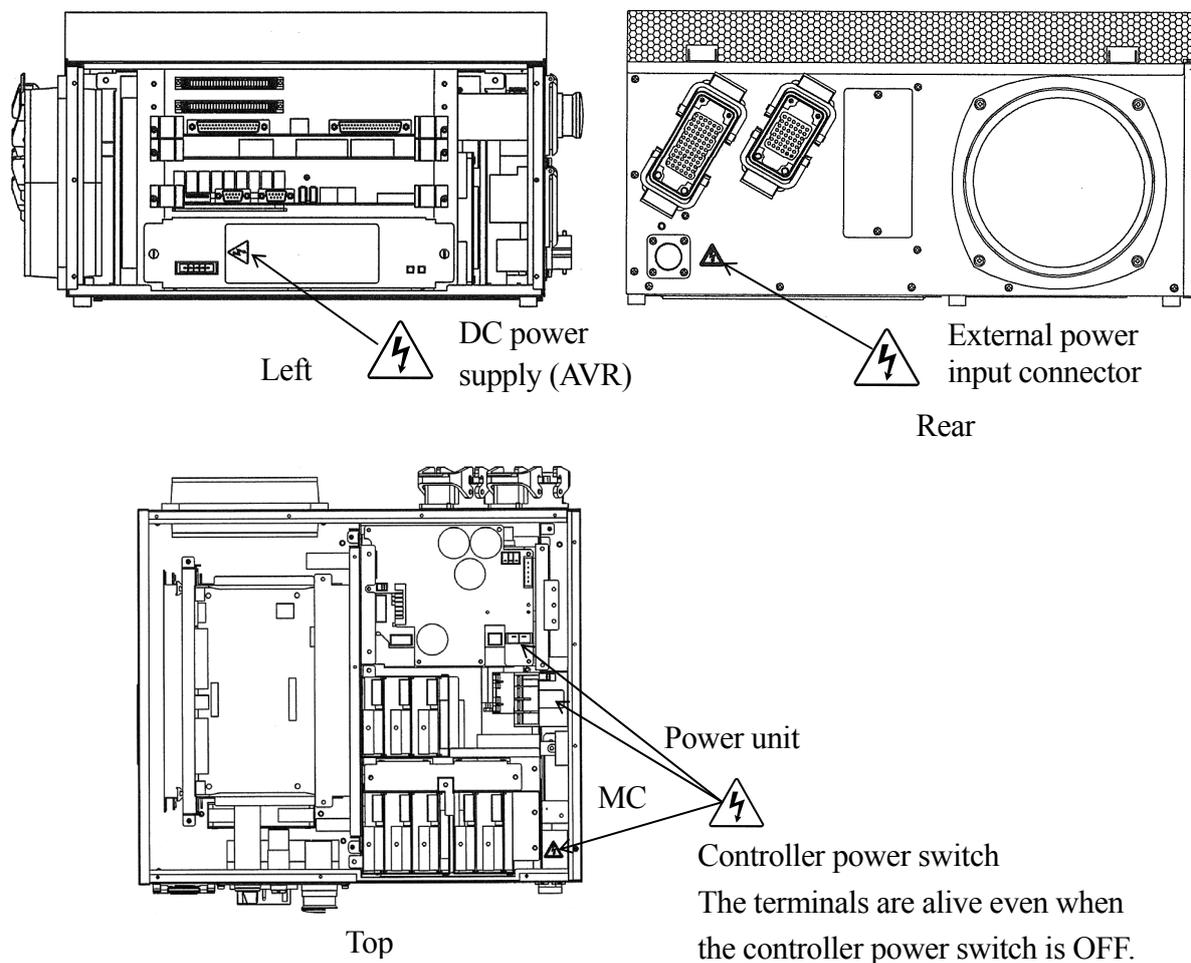


E4x controller

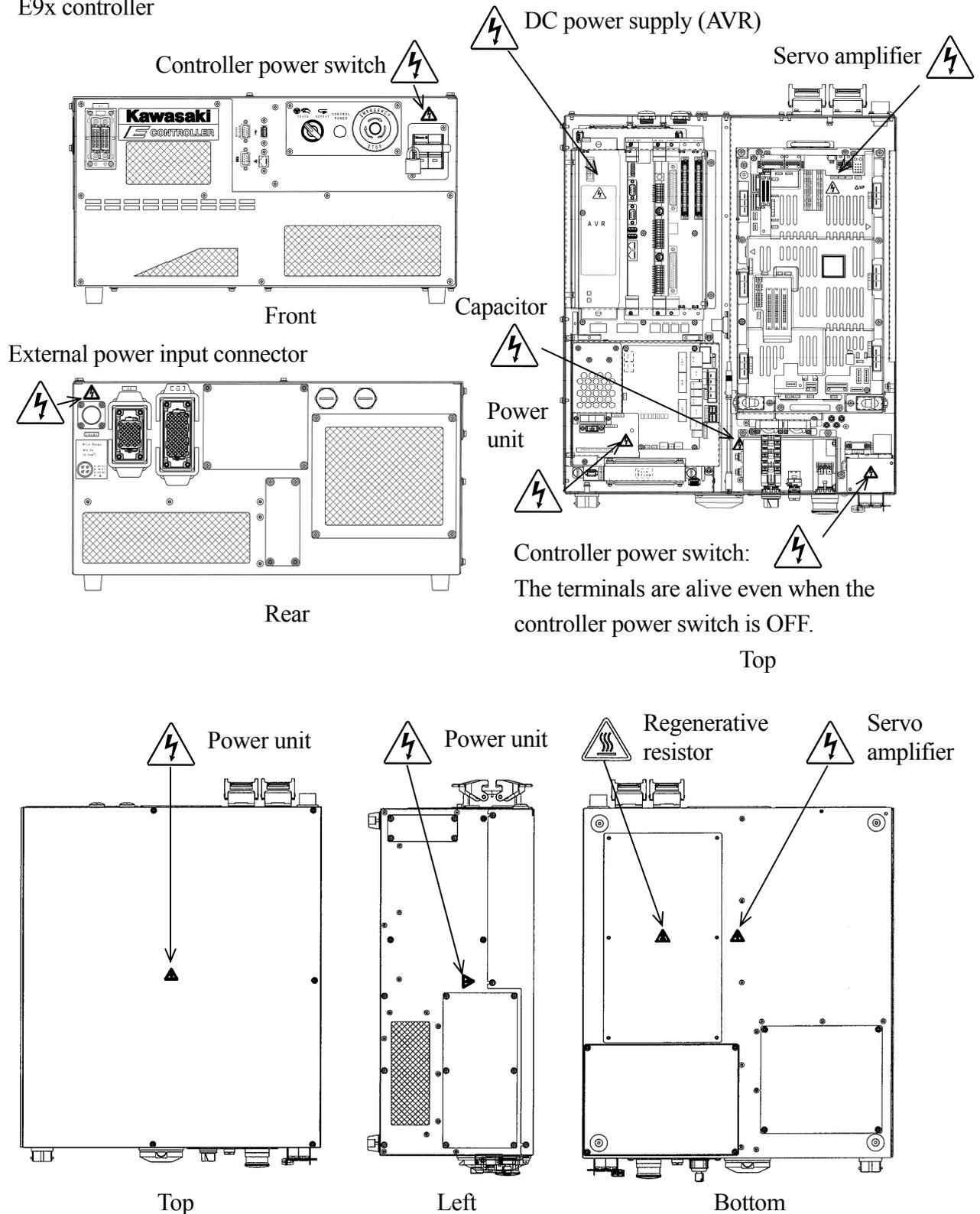




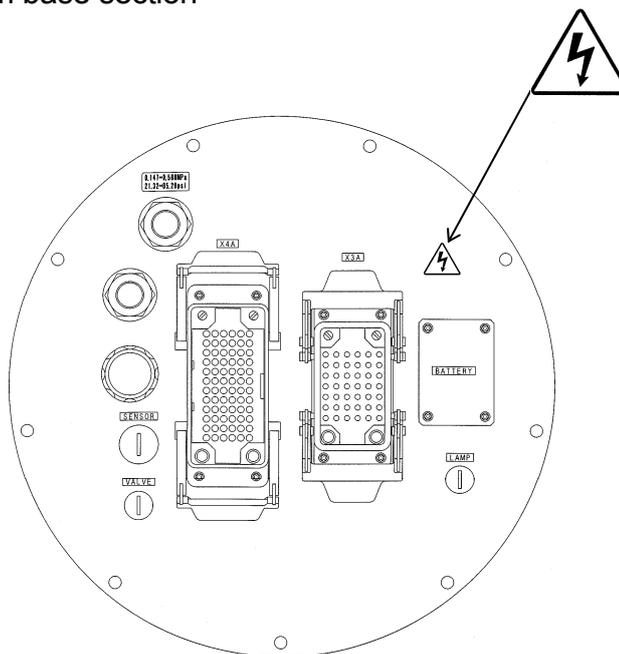
E7x controller



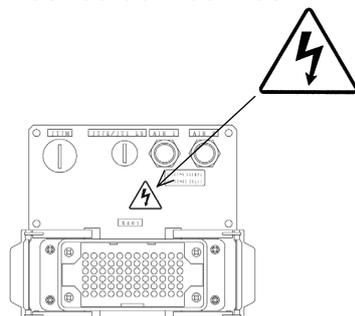
E9x controller



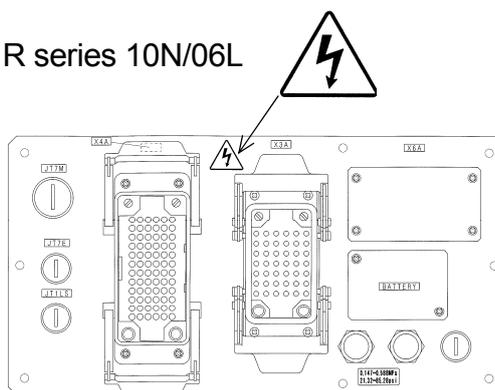
Connector plates on arm base section
YF003N



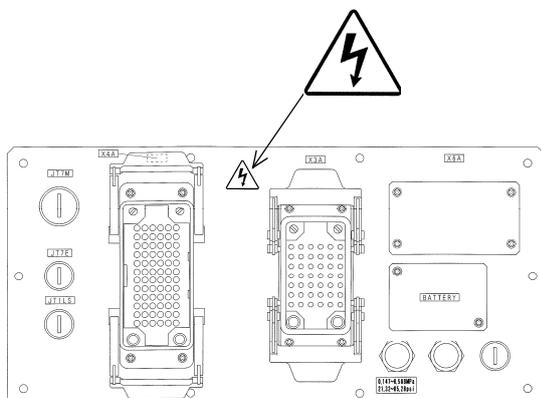
R series 03N/05N/05L



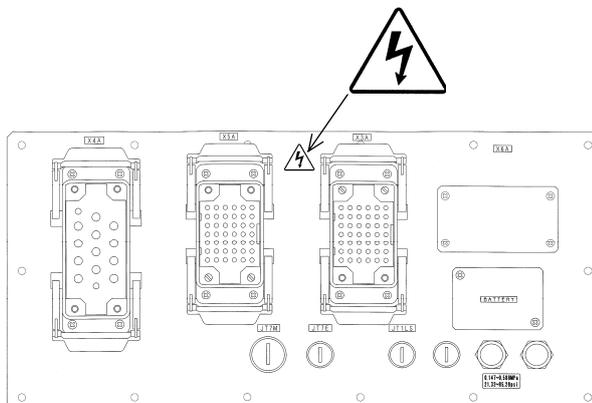
R series 10N/06L



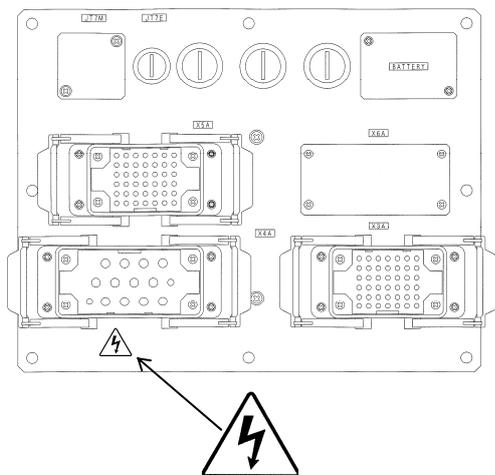
R series 20N/10L



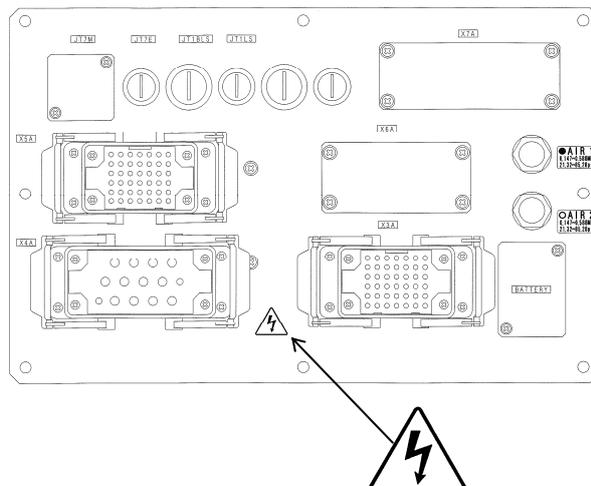
R series 30N/50N/80N/15X



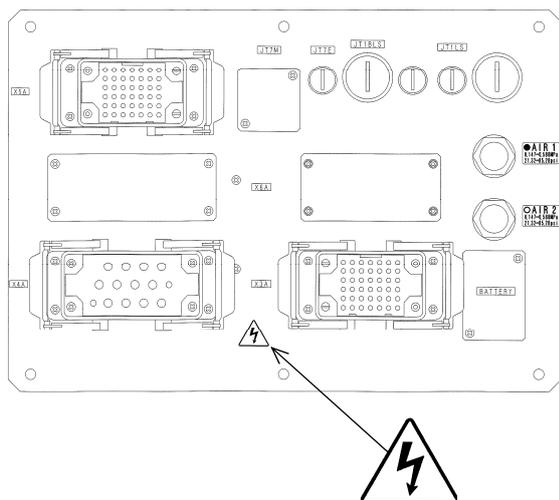
ZH



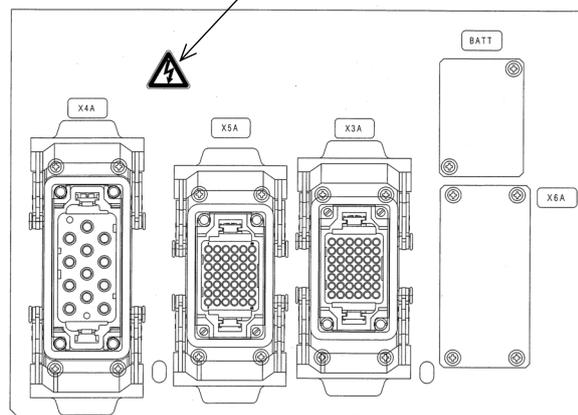
ZX/ZT/ZD



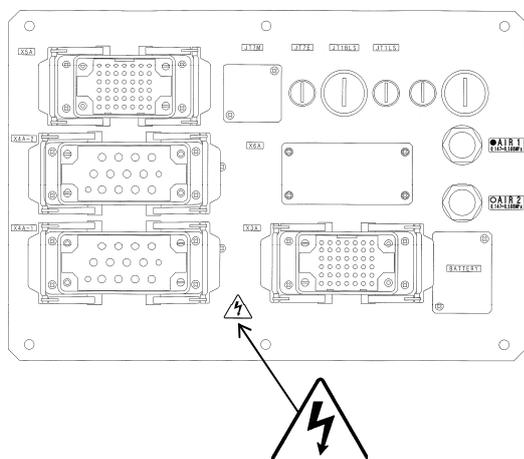
MT



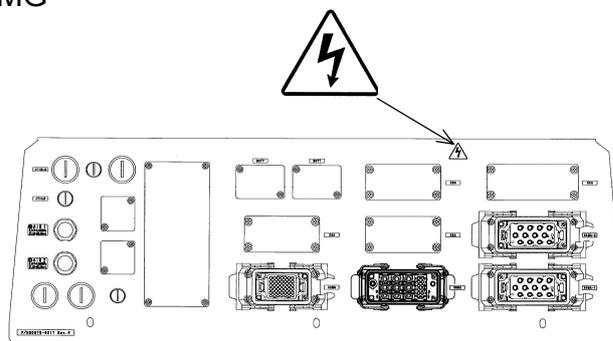
B Series



MX/MD



MG



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 1TA/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.



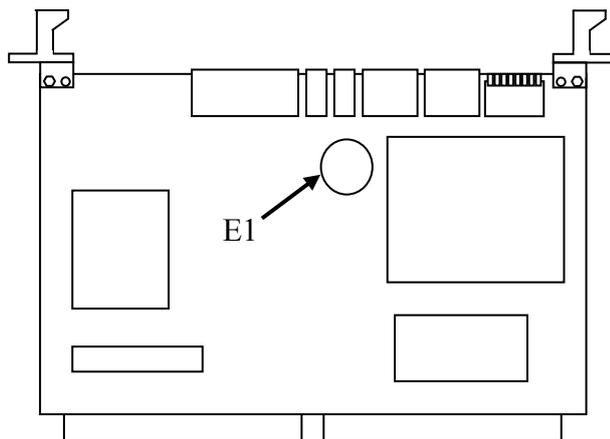
CAUTION

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

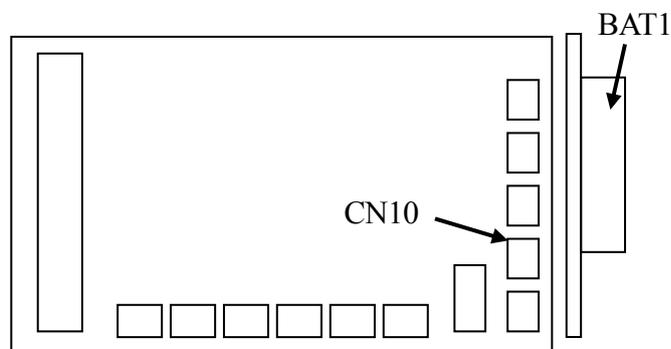
1TA/1VA board (in Card Rack)

Location Number: E1
 Model: BR2032
 Manufacturer: Panasonic



1FG board (in Robot Base)

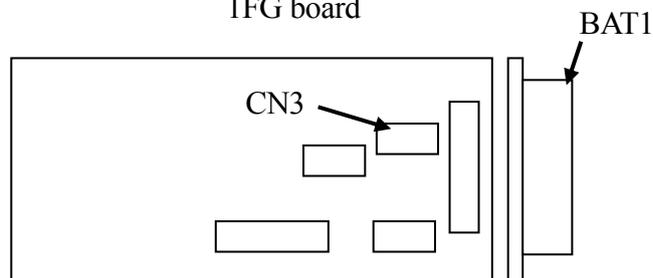
Location Number: BAT1
 Model: 50750-1007 or 50750-1018
 Manufacturer: KHI
 Connector: CN10



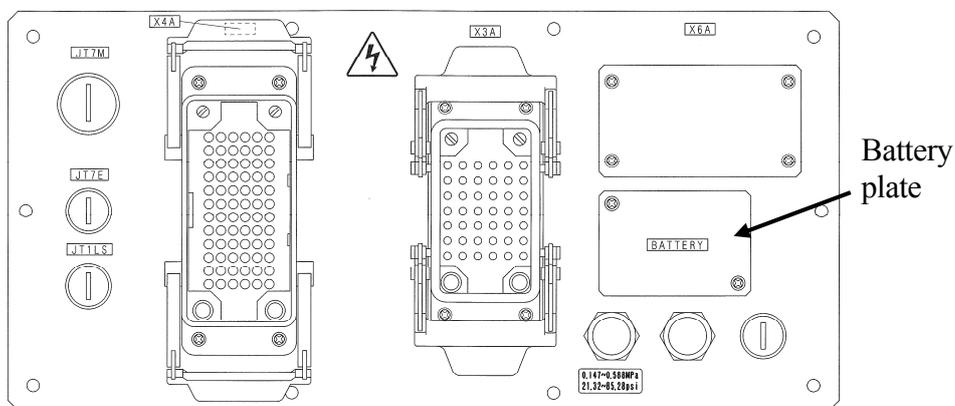
1FG board

1HG board (in Robot Base)

Location Number: BAT1
 Model: 50750-1007 or 50750-1018
 Manufacturer: KHI
 Connector: CN3



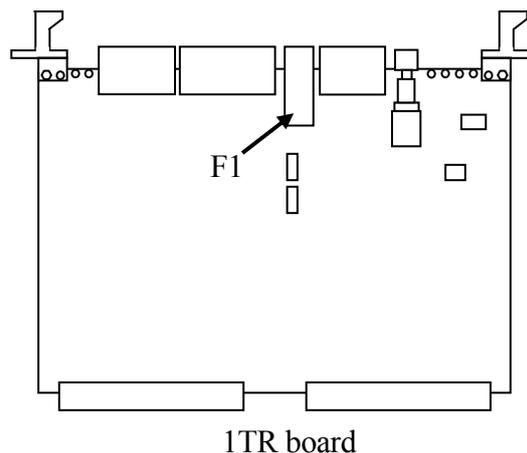
1HG board



Connector plate on robot base

Location of Fuse

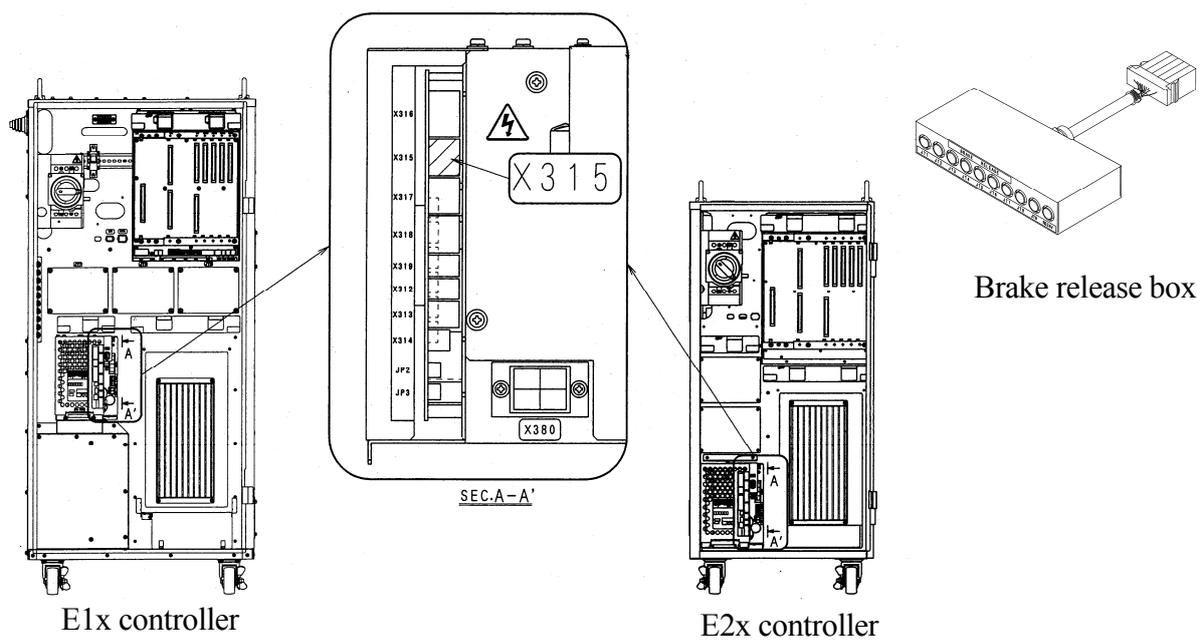
1TR board (in Card Rack)
Location Number: F1
Rating: 1.0A 125/250V
UL Listed type



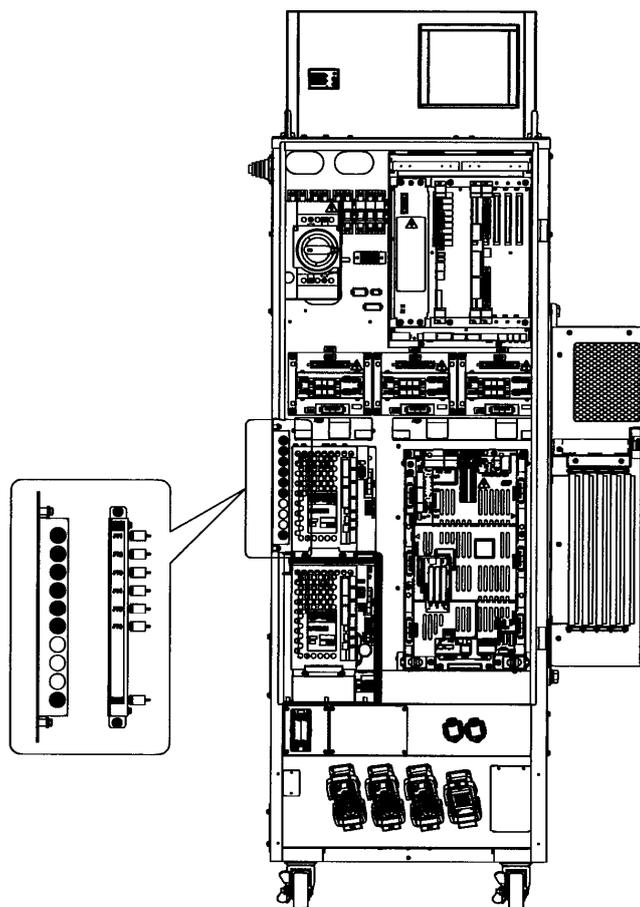
1.7 SAFETY FEATURES

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

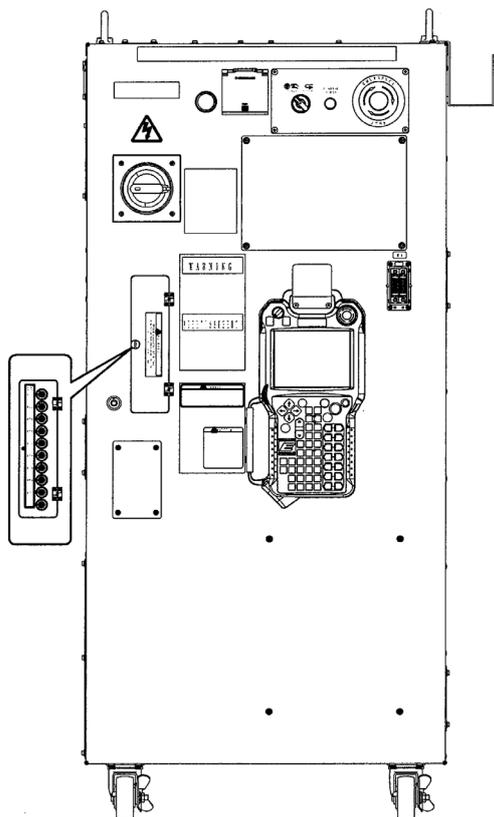
1. All E-stops are hard-wired.
2. All robot controllers are equipped with a redundant dual channel safety circuit. Both channels of the safety circuit must be closed to allow for robot operation in the teach and repeat modes.
3. Safety circuits of E28/E3x/E76/E77/E97 and E4x/E70/E71/E91/E94 controllers satisfy requirements of PLd in category 3 defined by ISO 13849-1. Category and Performance level (PL) are determined by the whole system and conditions.
4. (For E3x/E76/E77/E97 controllers) 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. 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. Teach and check mode velocities 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. (E28/E4x/E70/E71/E91 controllers: Standard, E1x/E2x (exc E28)/E73/E74/E94 controllers: Option)
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 hardstops on the JT1, JT2 and JT3 (optional for JT2 and JT3) axes. Mechanical hardstops are capable of stopping the robot at full speed and with maximum payload. See the specifications of the product for details of the mechanical hard stops.
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.



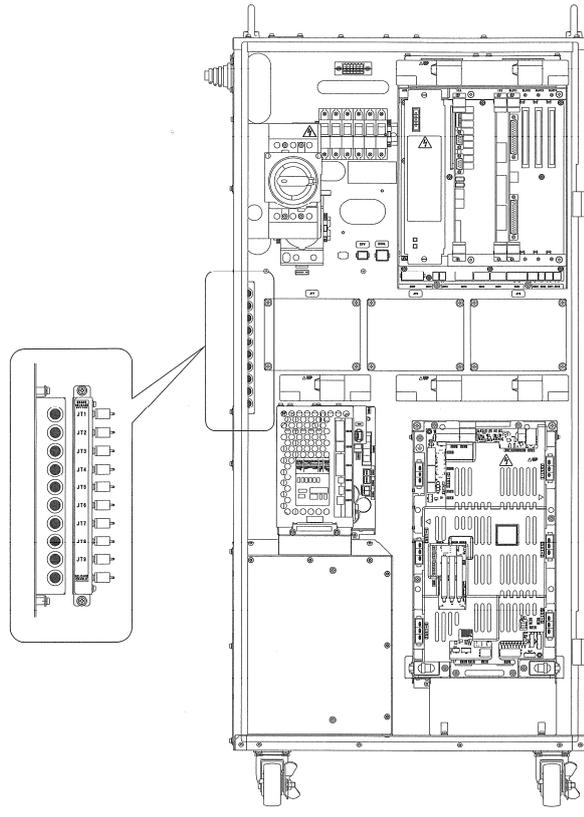
Brake release switch connecting port (X315)



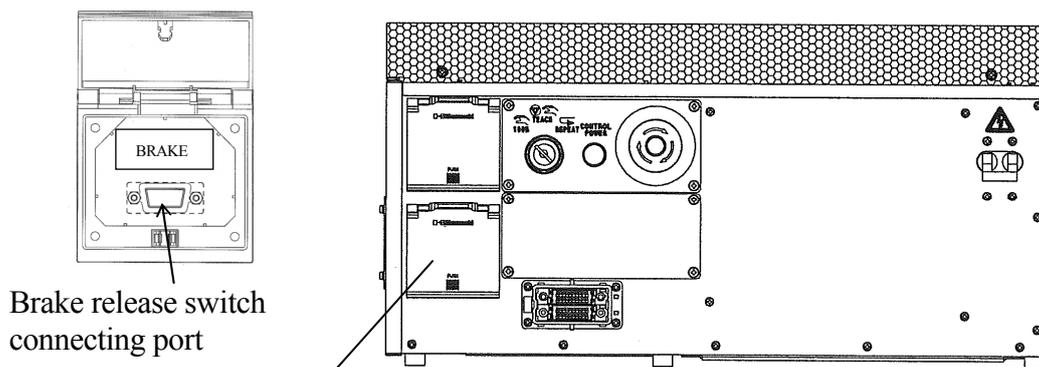
Brake release switches of
E28 controller



Brake release switches of
 E3x controller



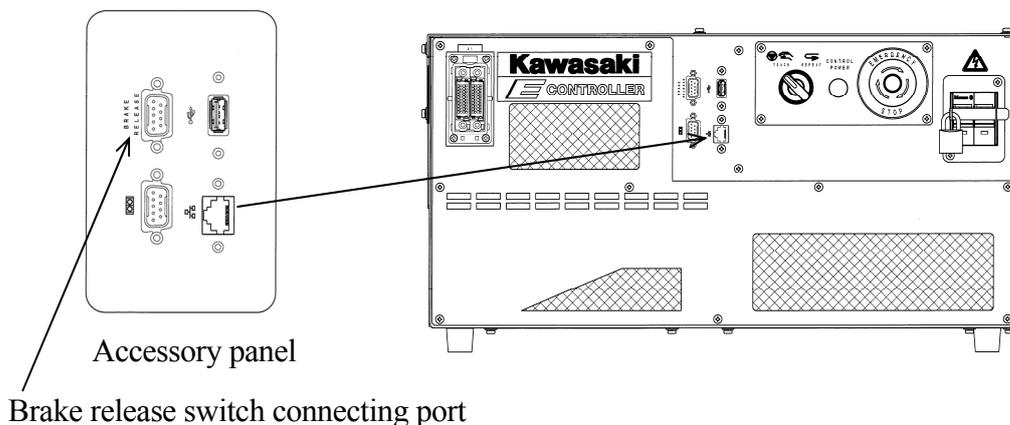
Brake release switches of
 E4x controller



Brake release switch
 connecting port

Brake release panel

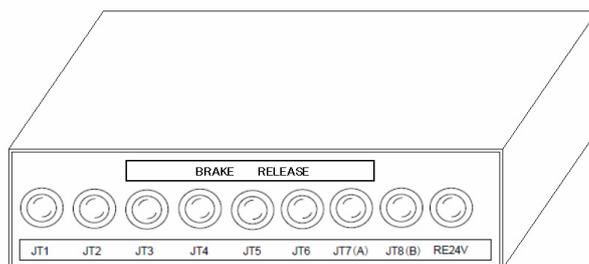
Brake release switch connecting port of E7x controller



Brake release switch connecting port of E9x controller

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

• Brake release switch box is the option.

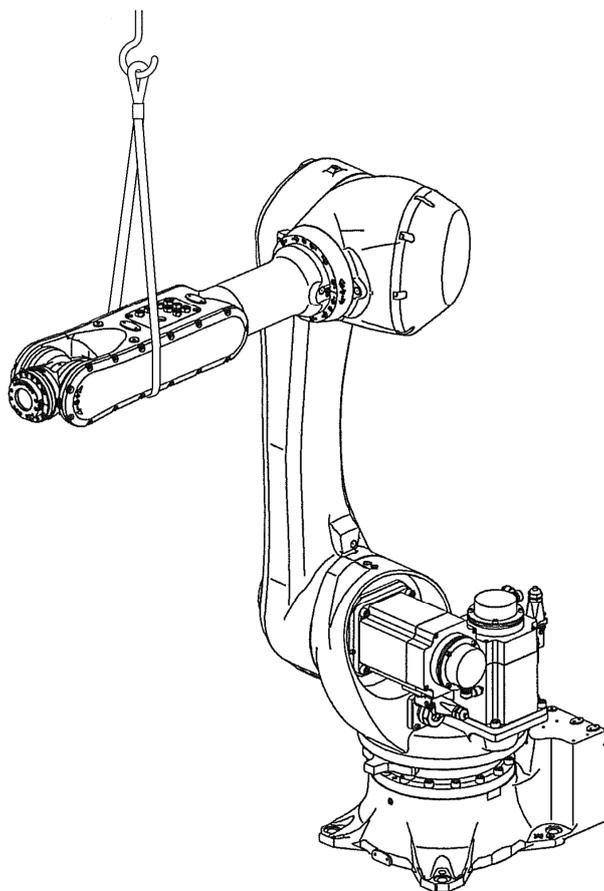


Brake release box



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

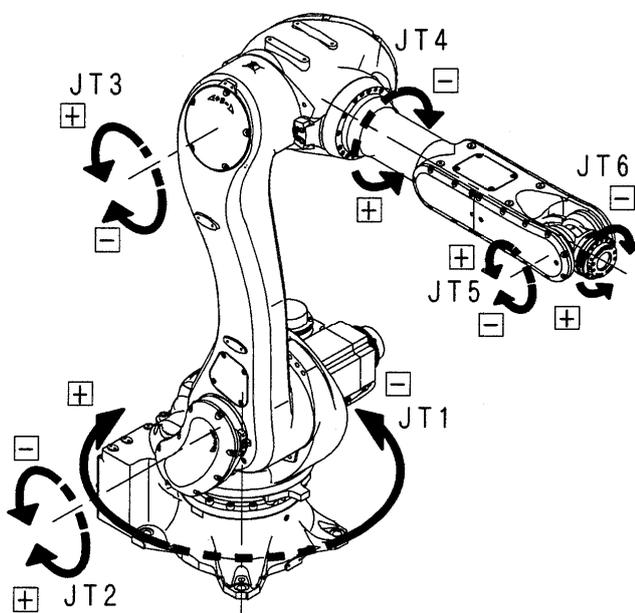
To manually release axes brakes follow the procedure below.

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 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.

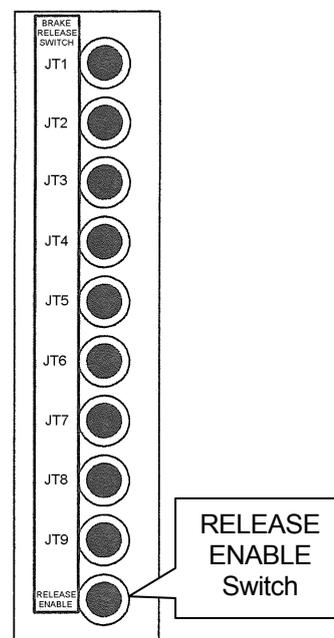
7. Press and hold the “RELEASE ENABLE” switch (see lower right figure). If the brake is released at this time, do not use the switch (see CAUTION).
8. Press the manual brake release switch for the axis to release the brake (see lower right figure).
9. The brake remains released until the brake release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



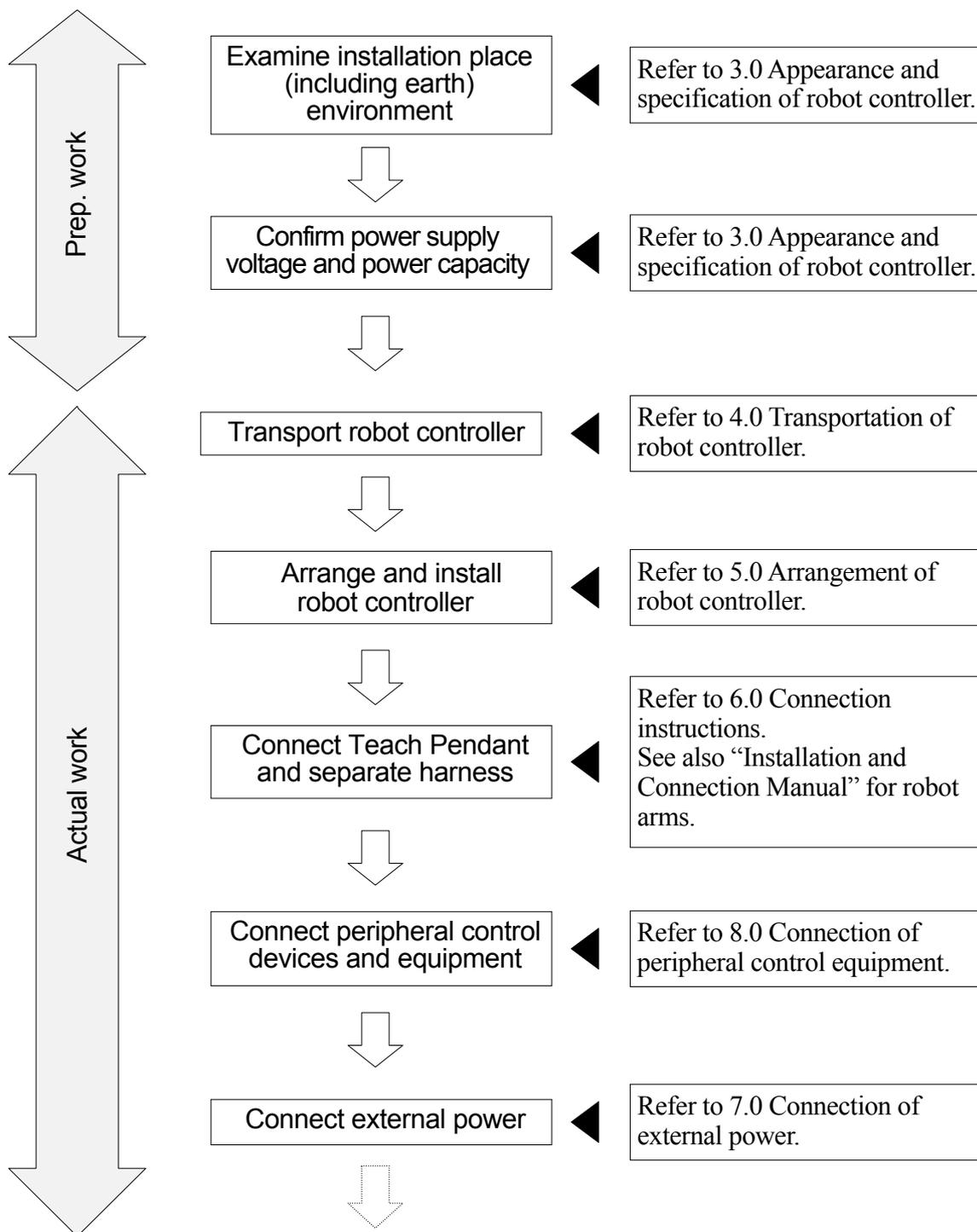
Robot brake release axes

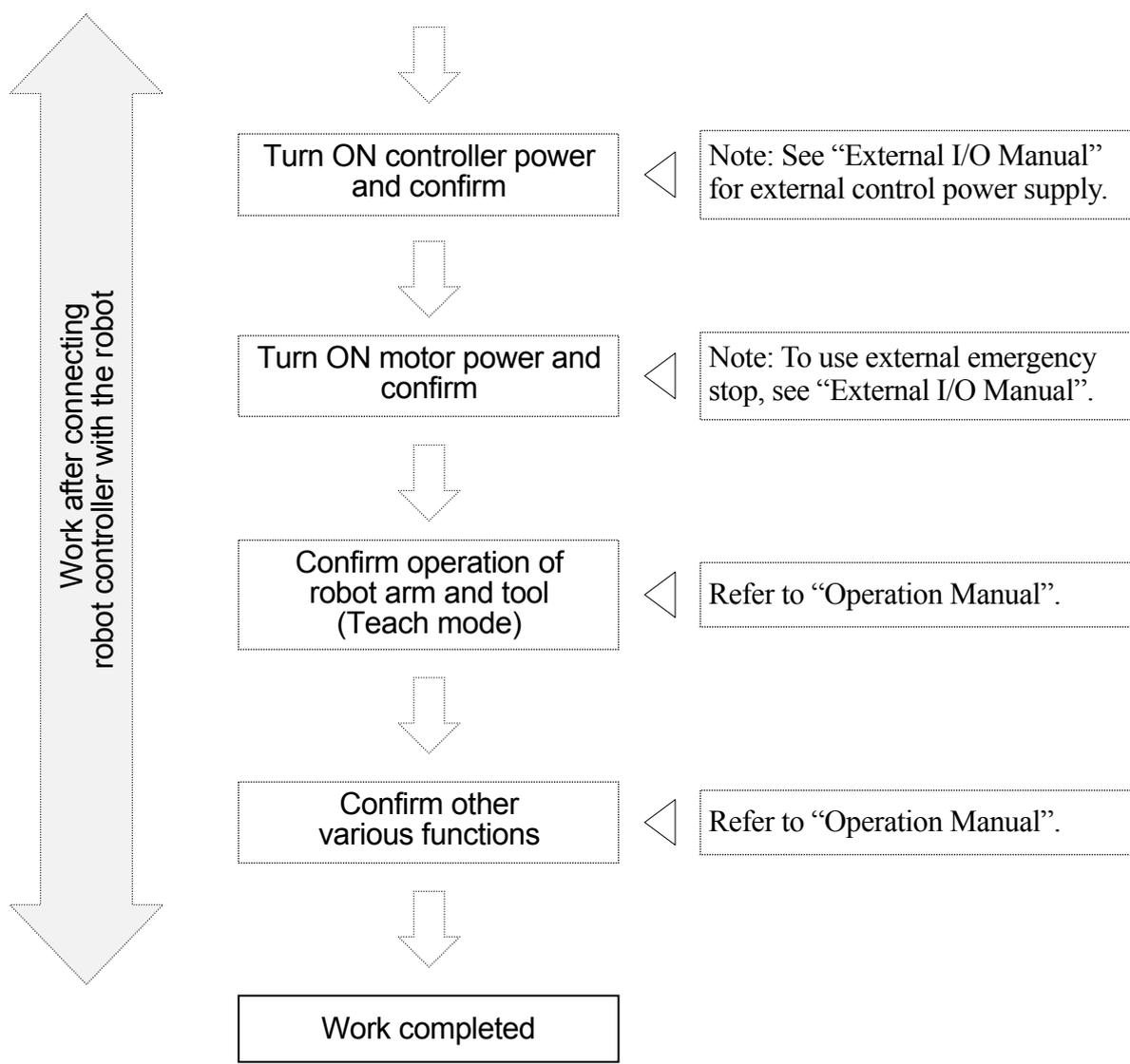


Manual brake release SW

2.0 WORKFLOW - ROBOT CONTROLLER INSTALLATION AND CONNECTION

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

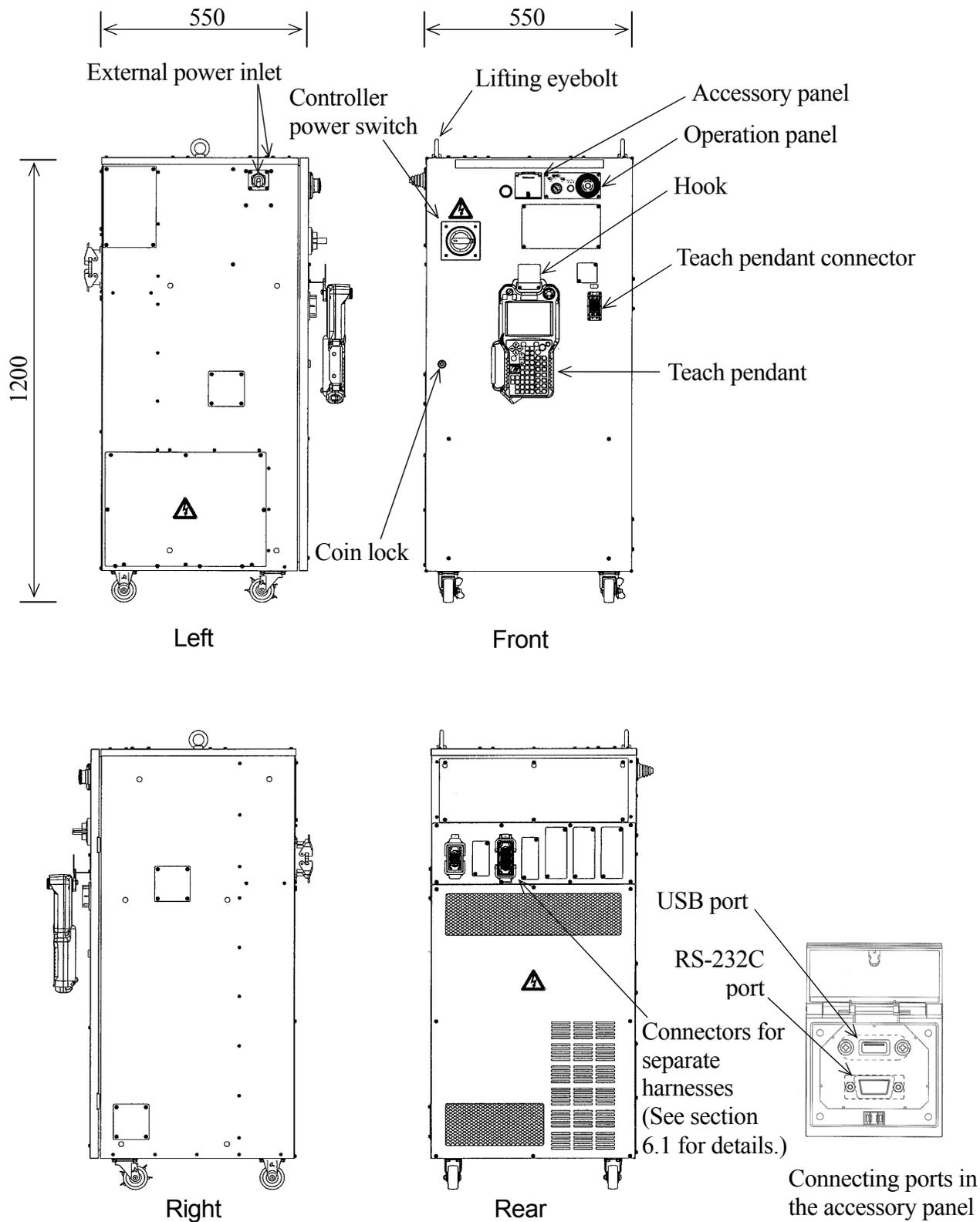




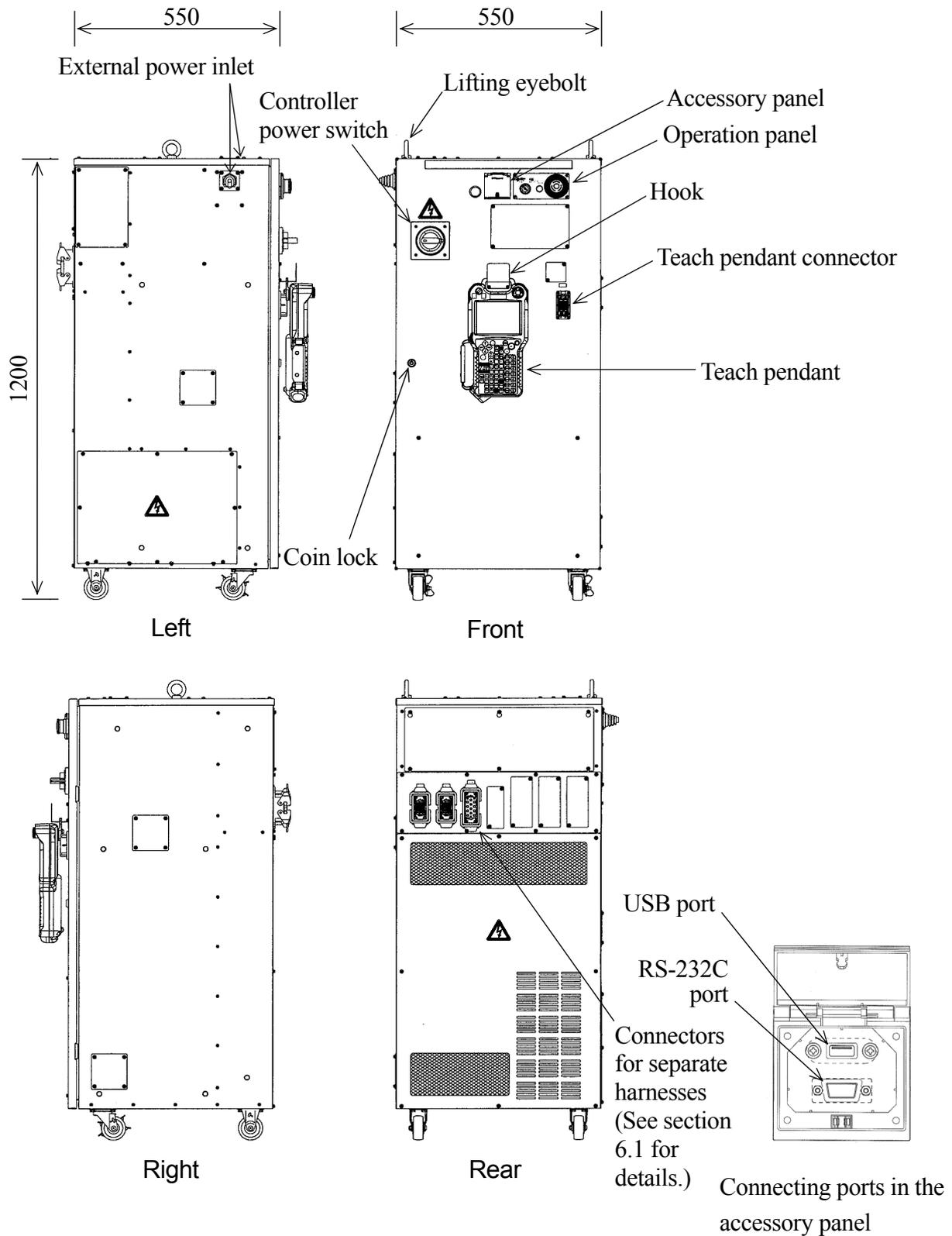
[NOTE]
This manual only describes procedures from installation place examination to connection with external power.

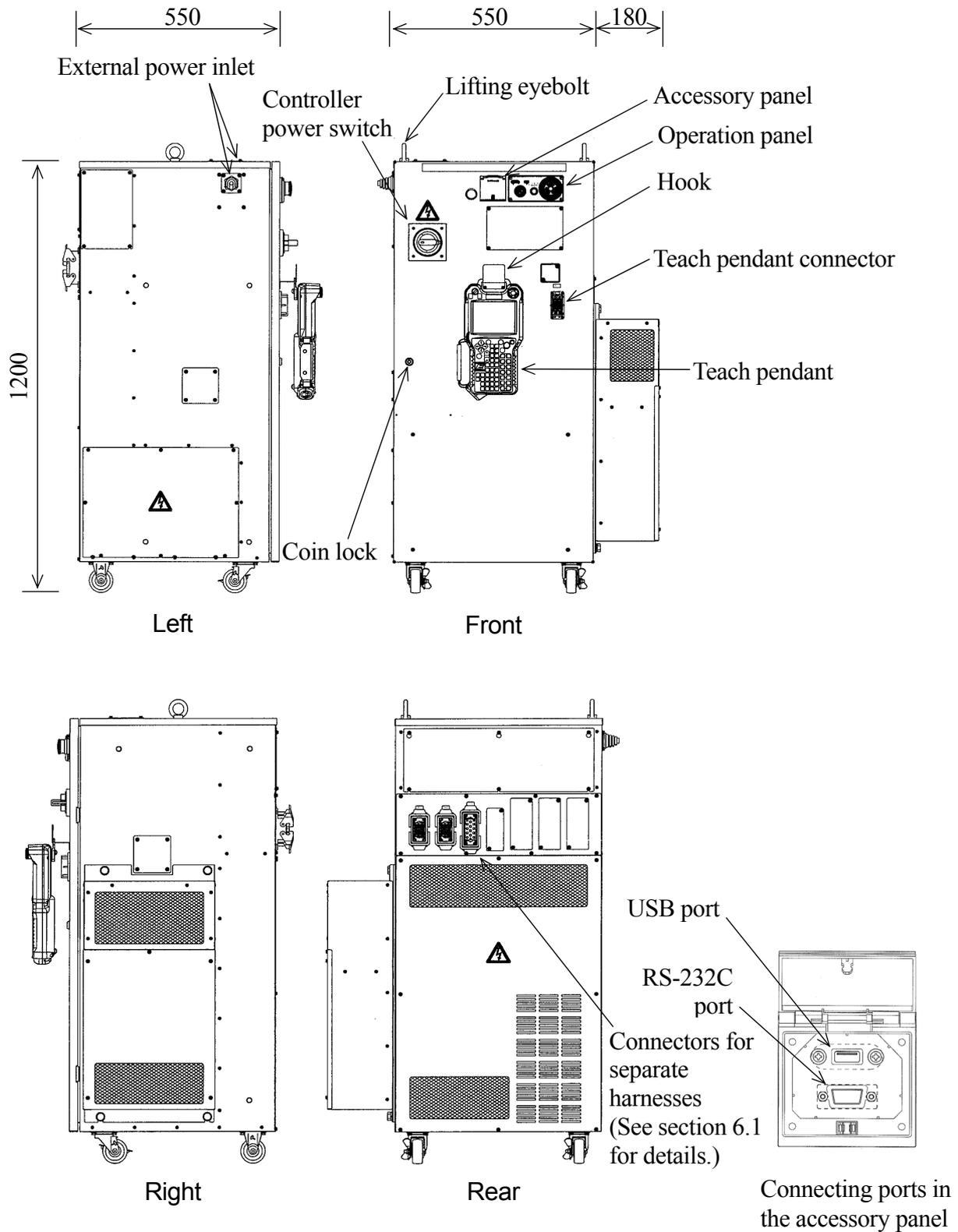
3.0 APPEARANCE AND SPECIFICATION OF ROBOT CONTROLLER

3.1 CONTROLLER APPEARANCE

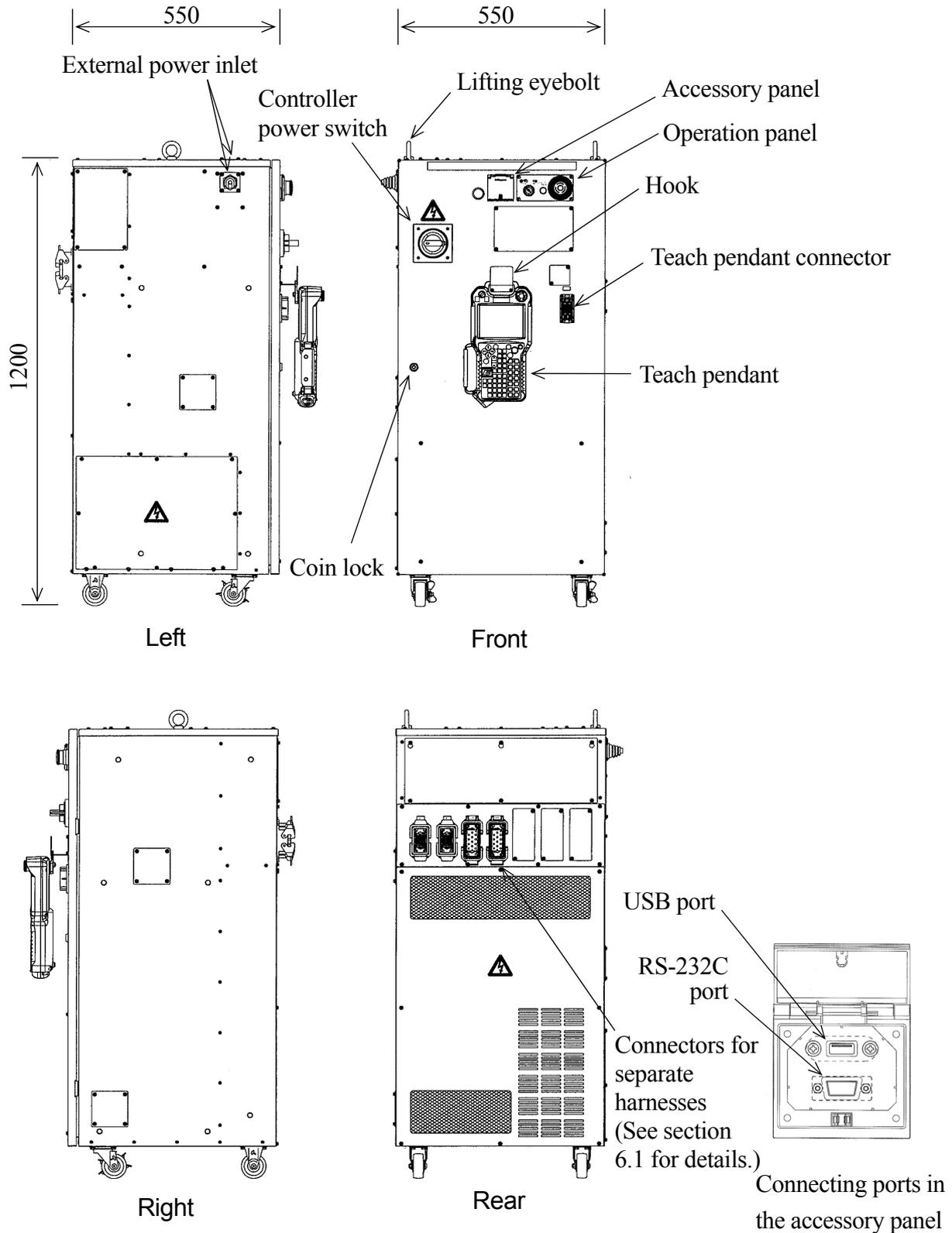


E10 controller

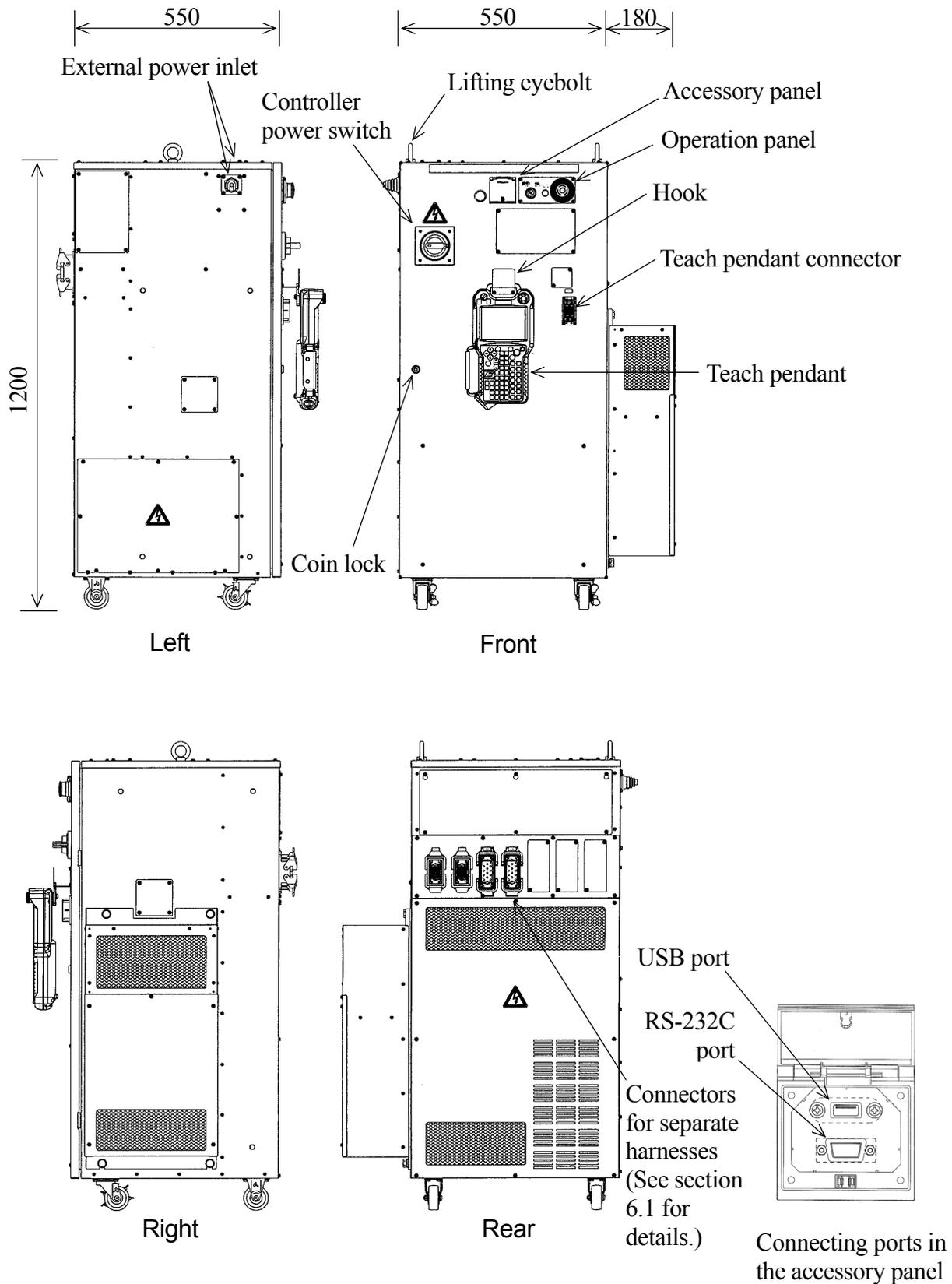




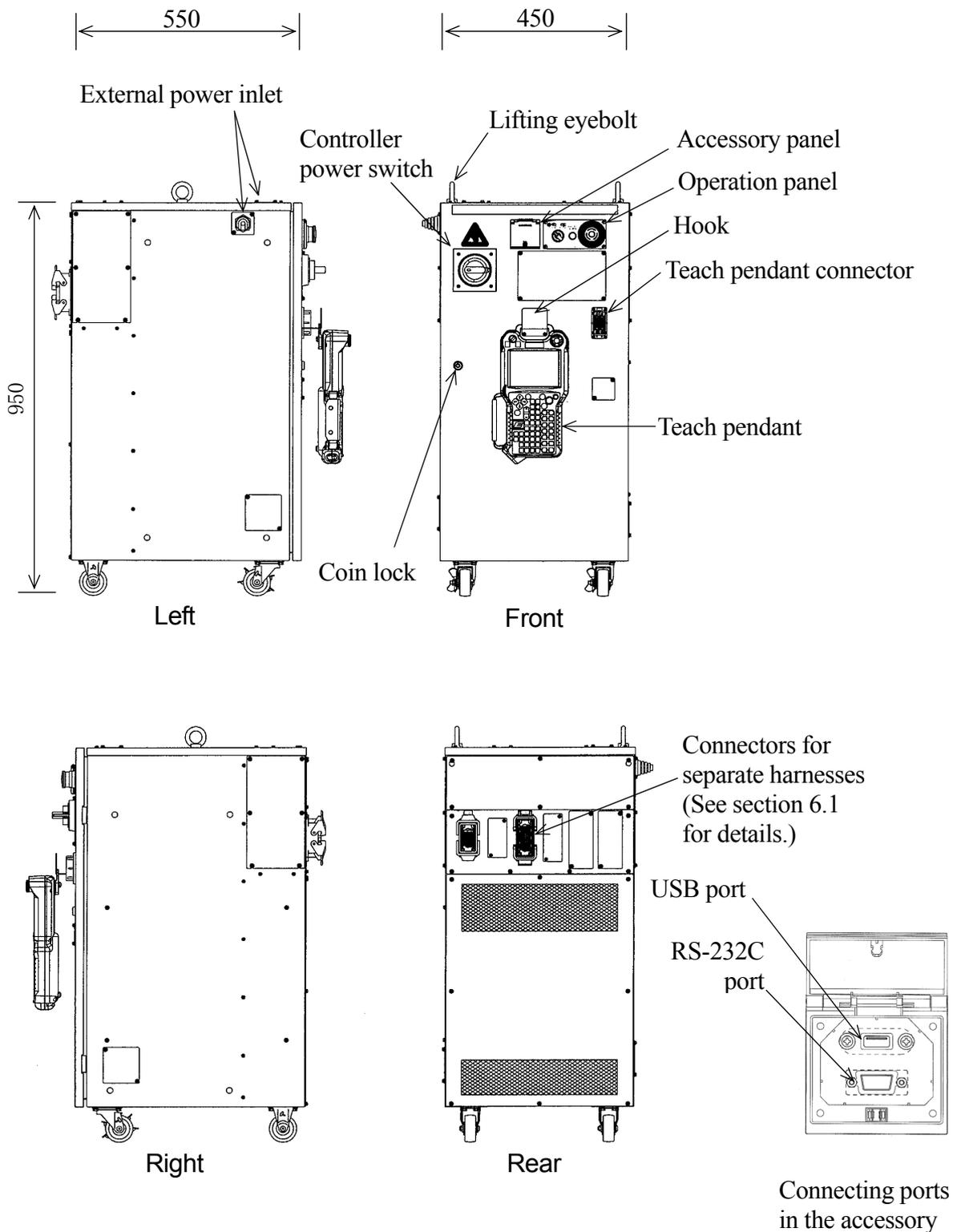
E13 controller



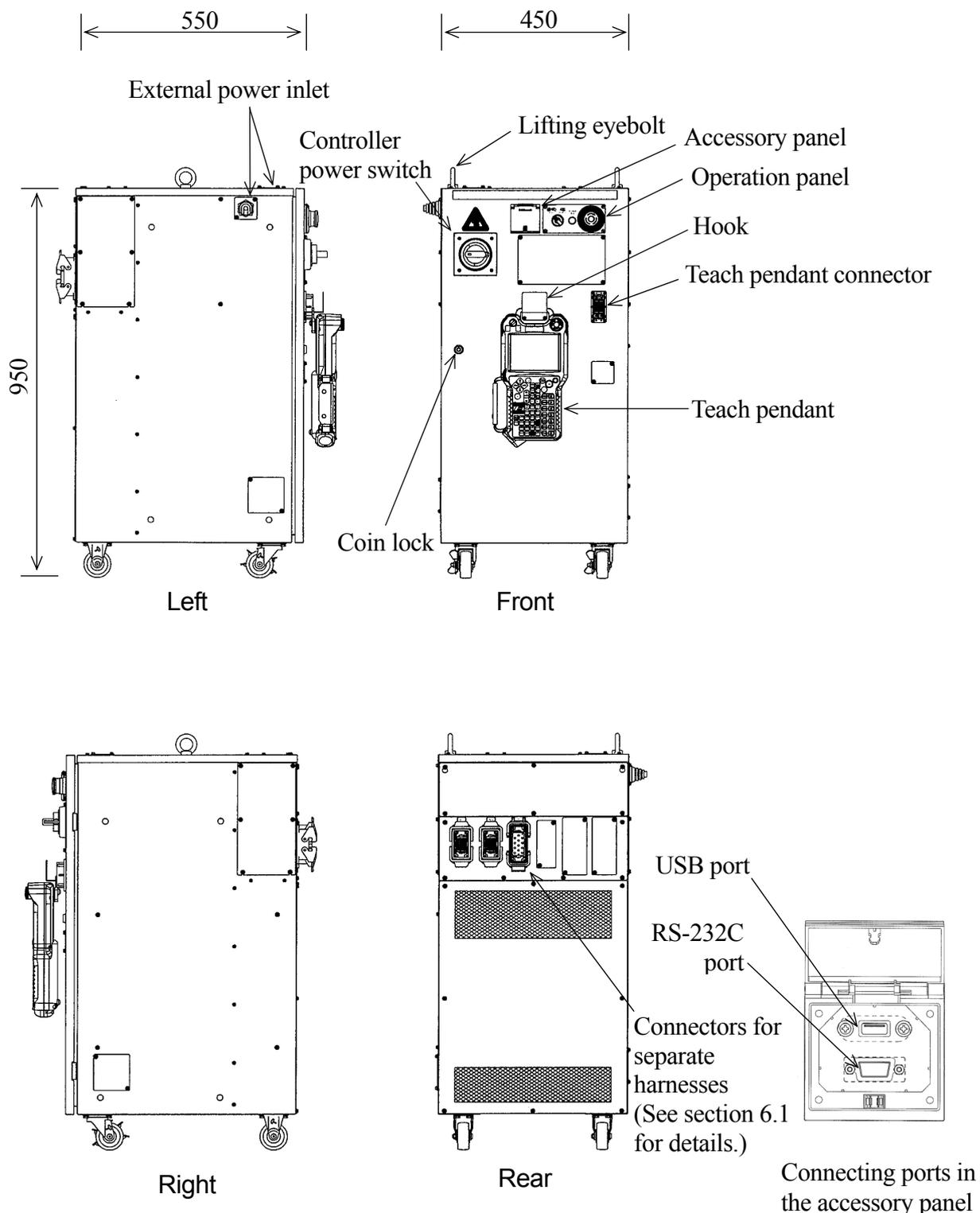
E14 controller (MX)



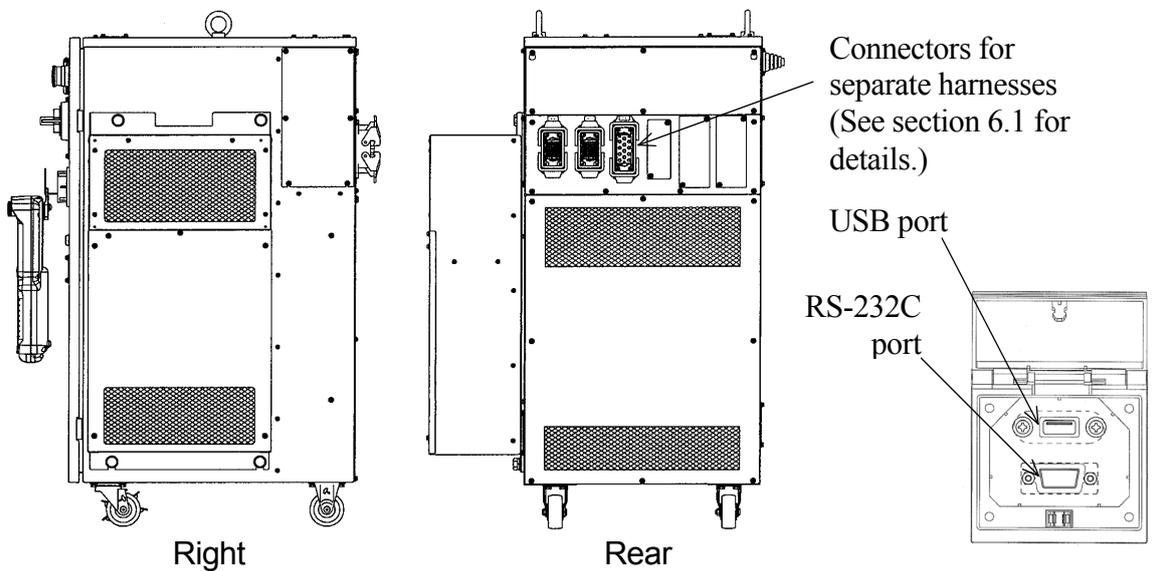
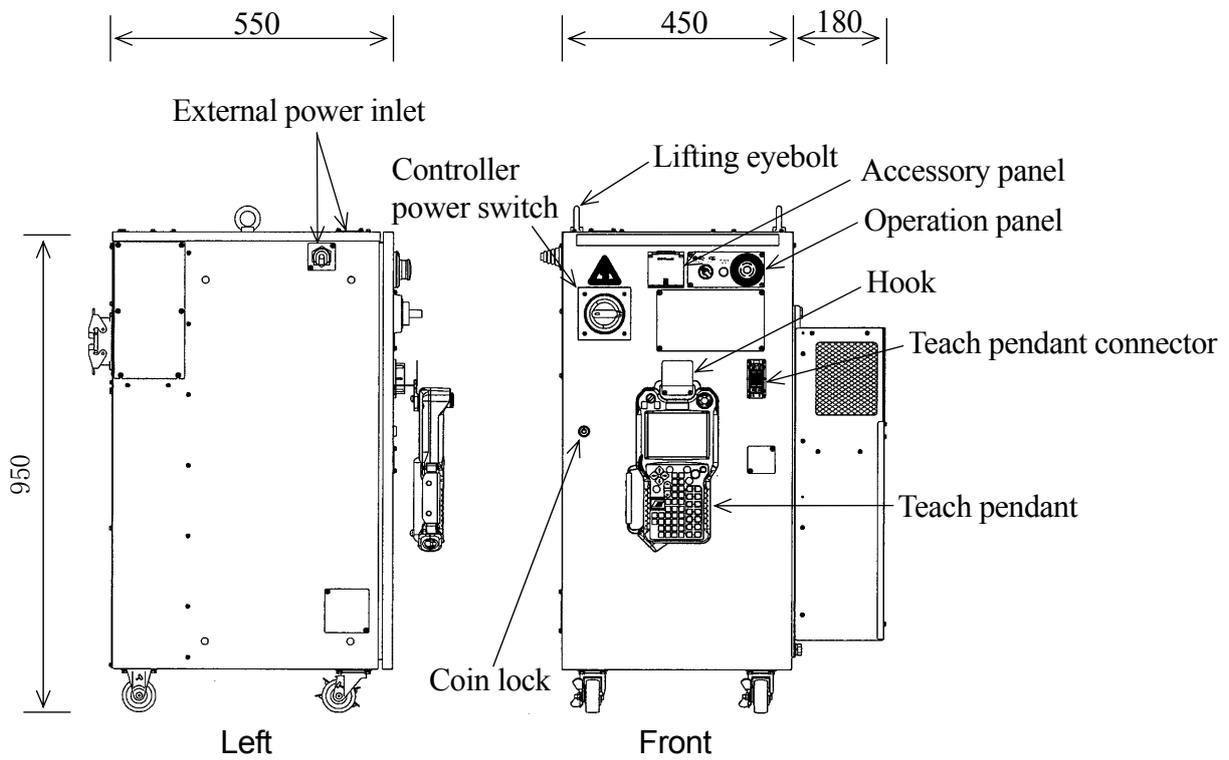
E14 controller (MD)



E20 controller

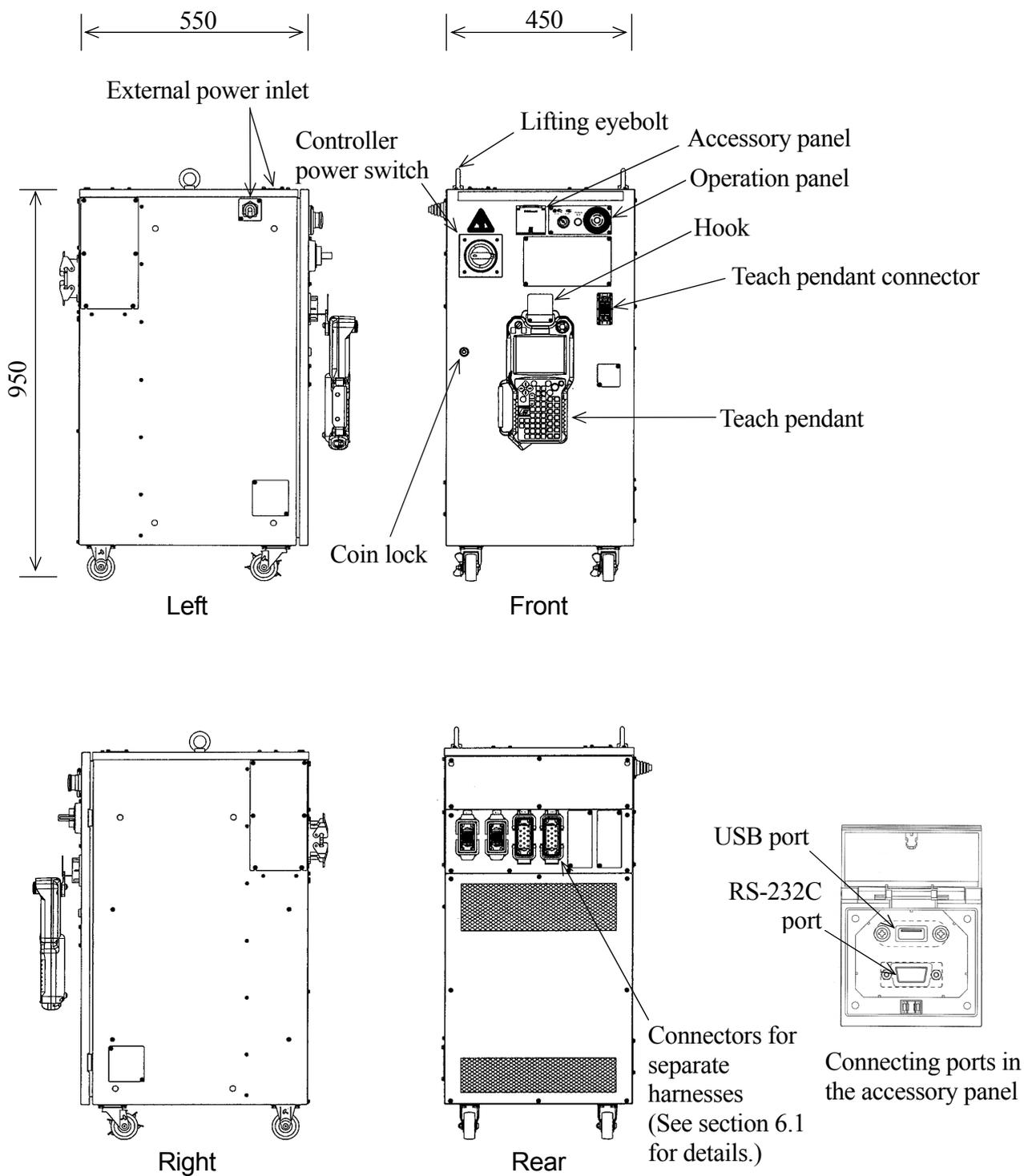


E22 controller

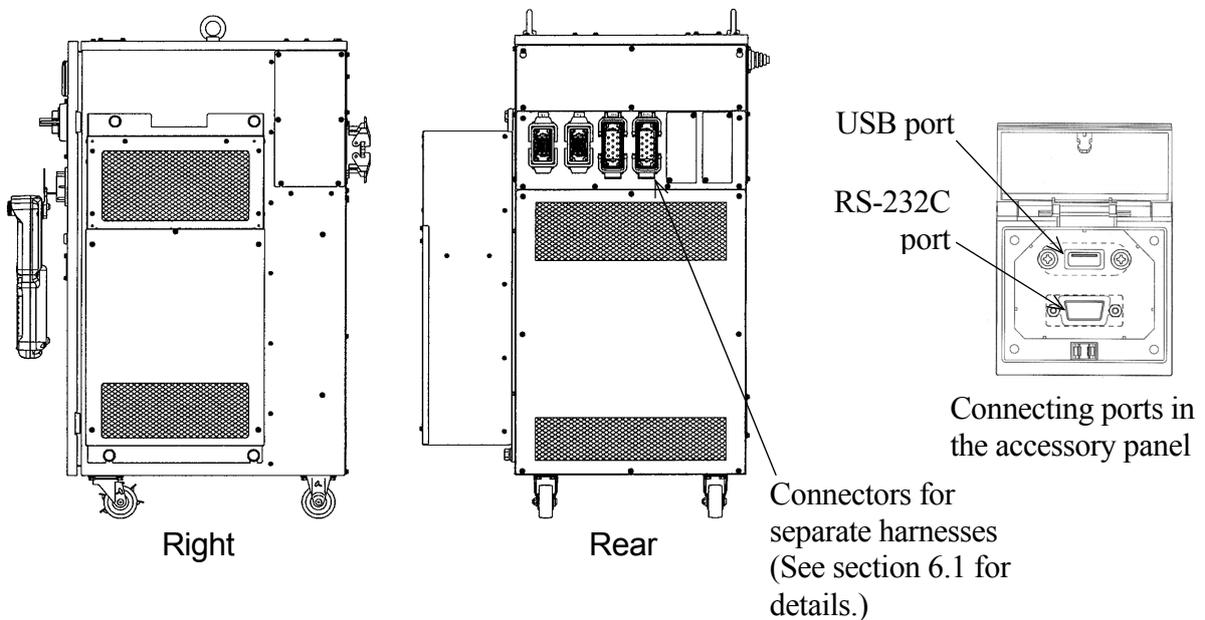
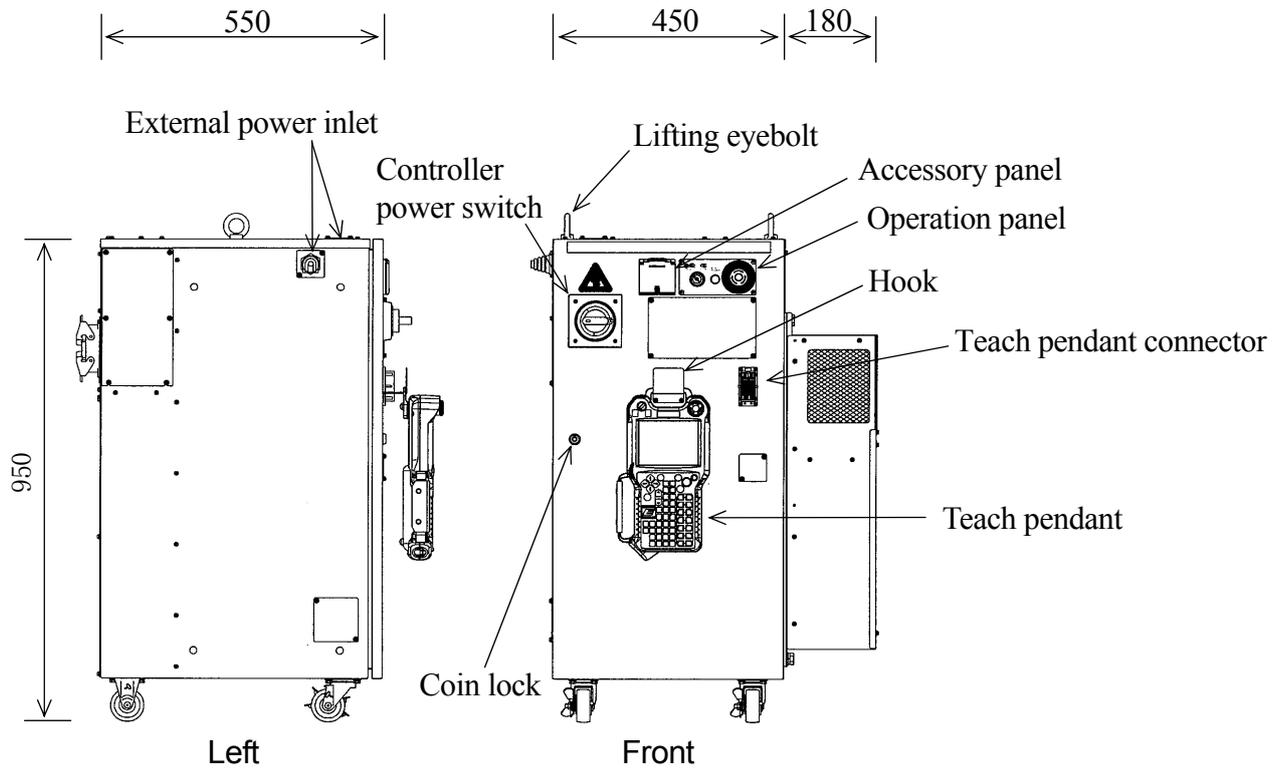


Connecting ports in the accessory panel

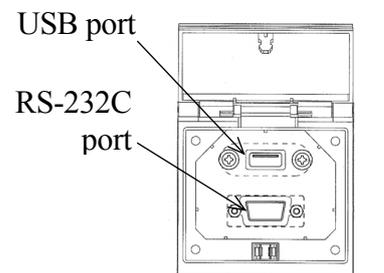
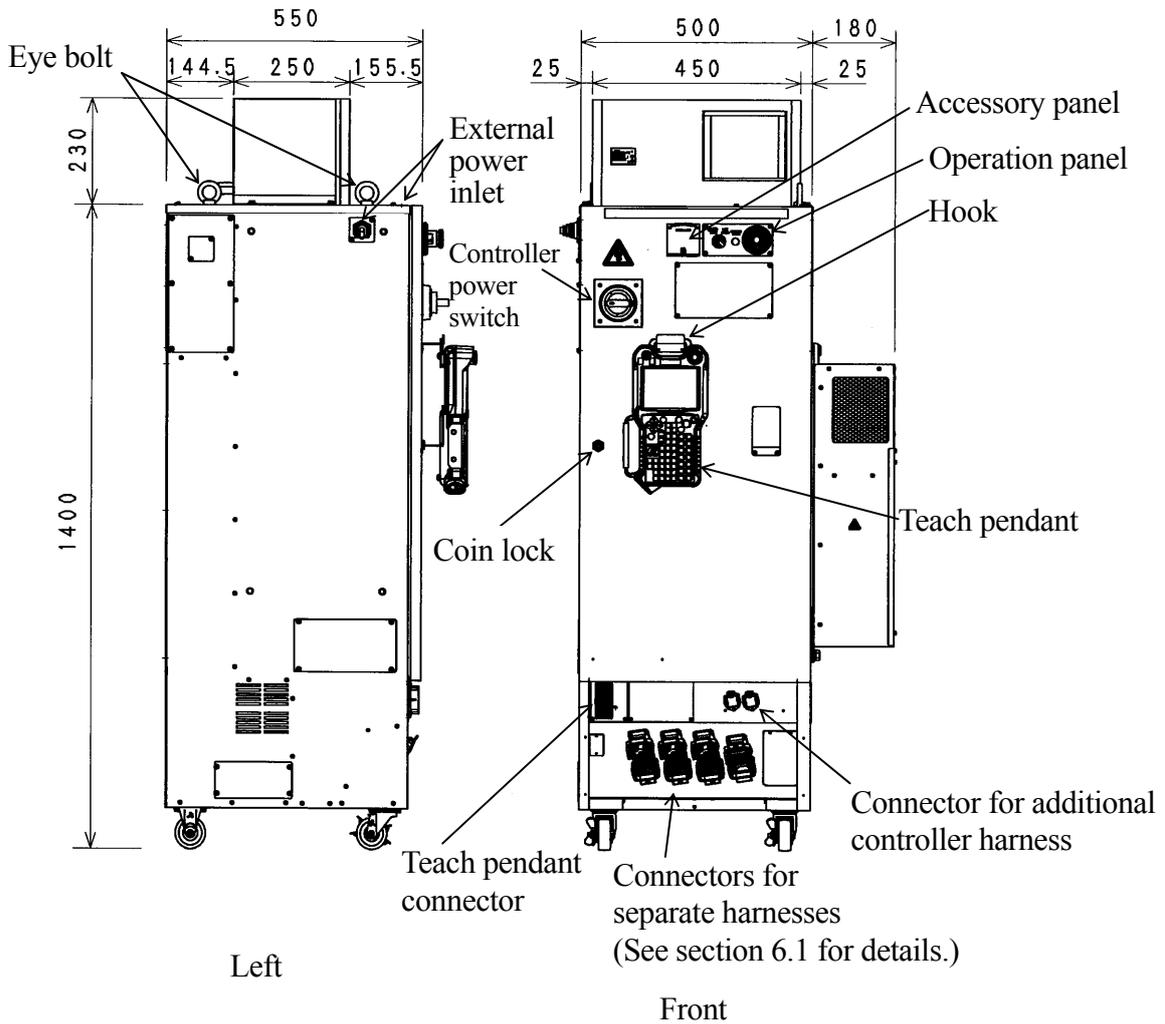
E23 controller



E24 controller (MX)

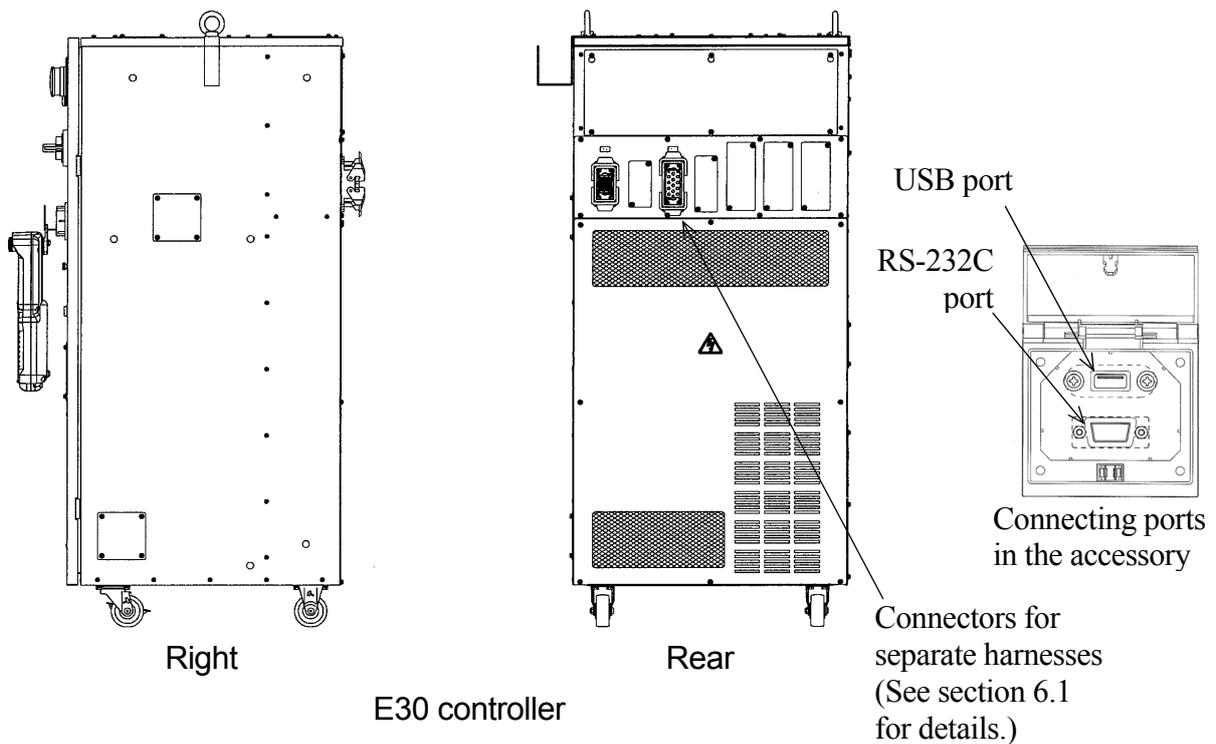
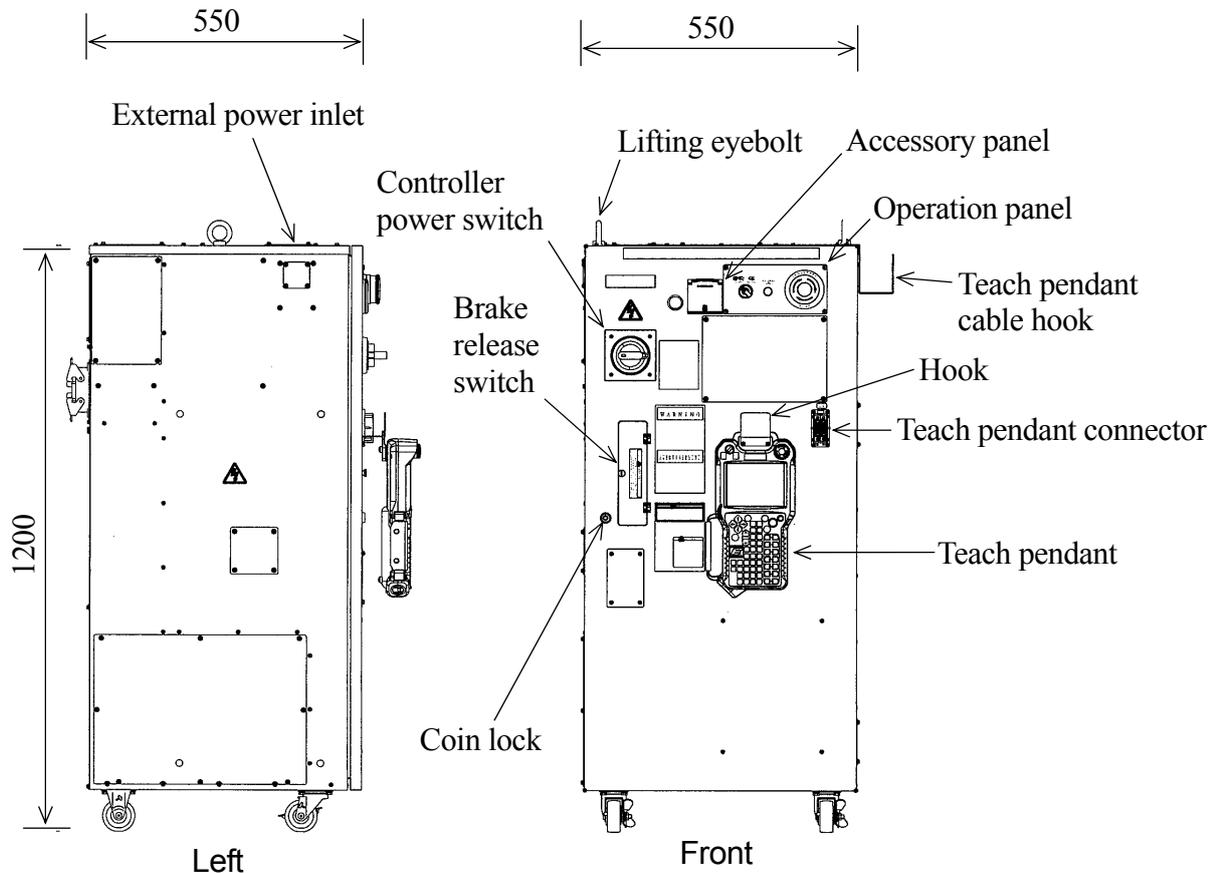


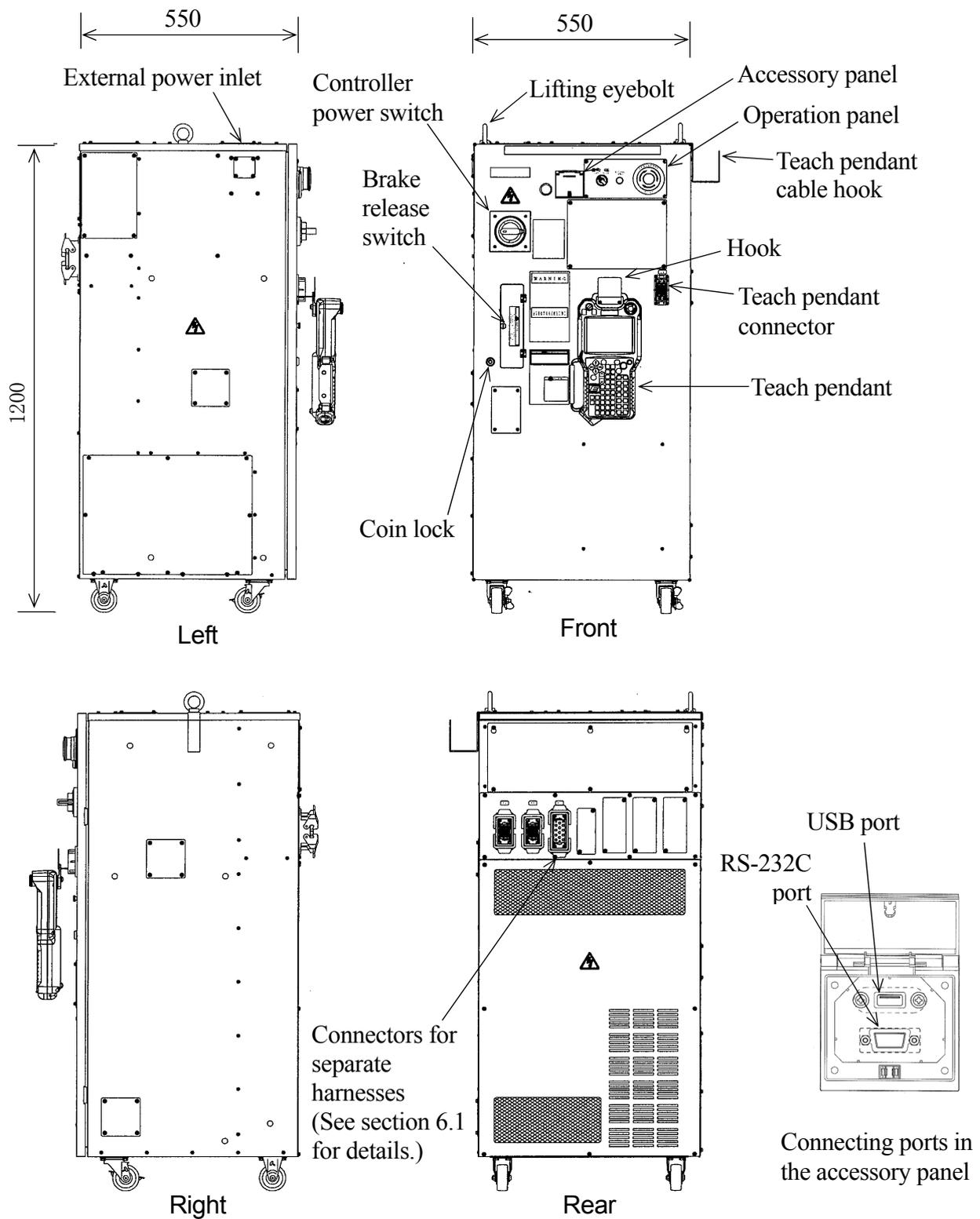
E24 controller (MD)



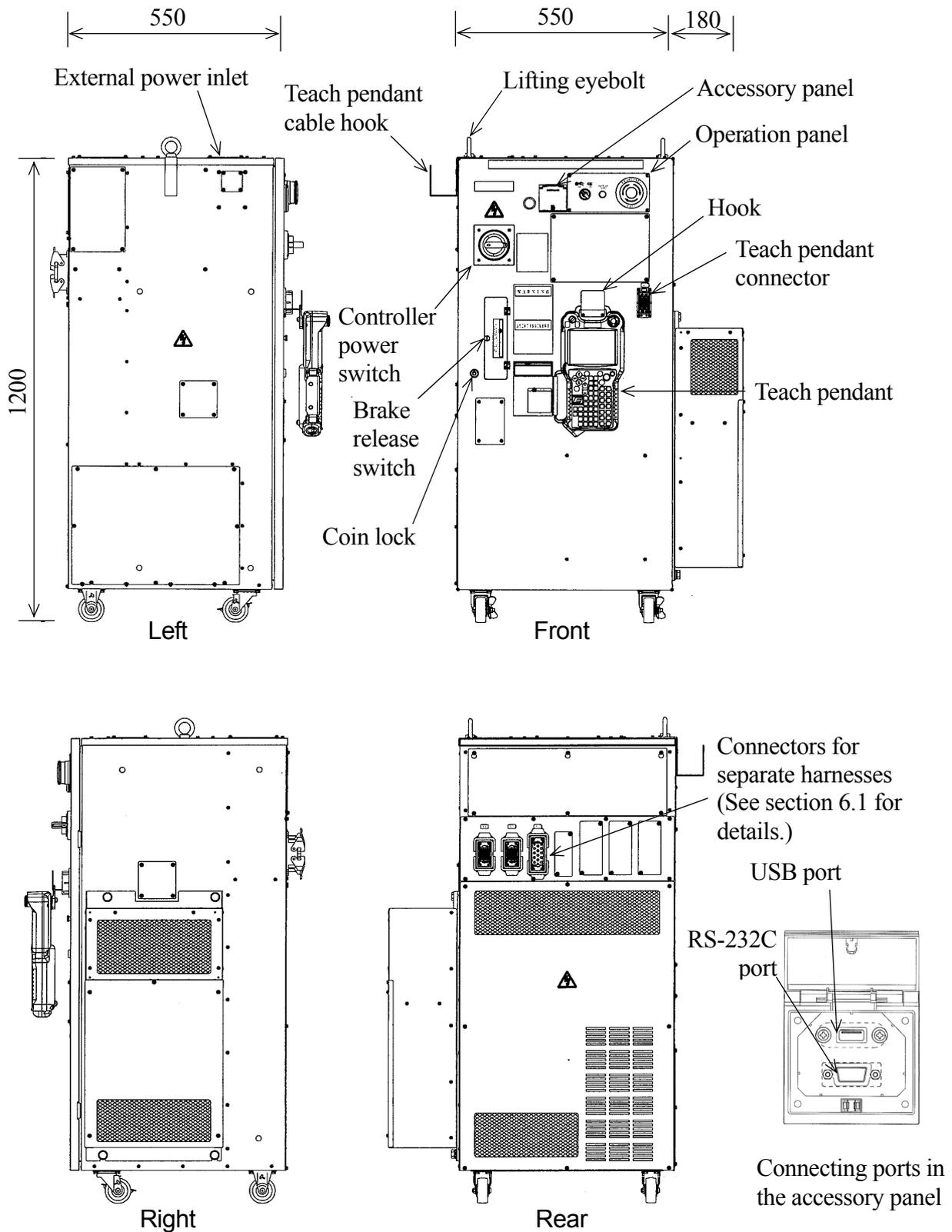
Connecting ports in the accessory panel

E28 controller

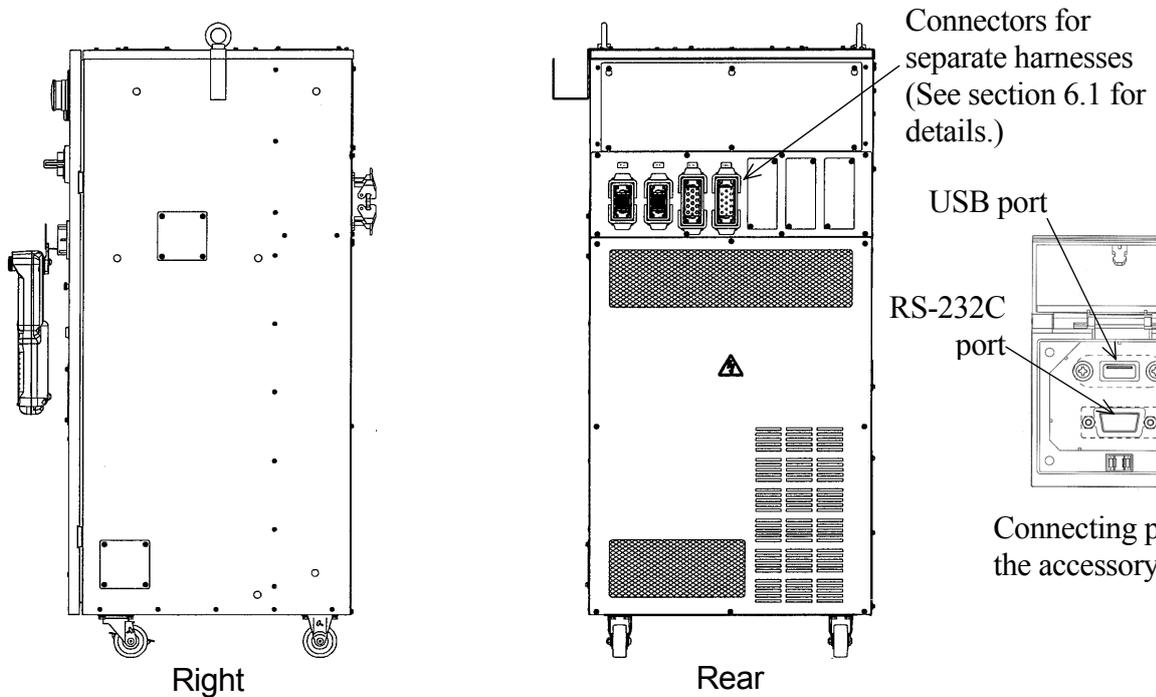
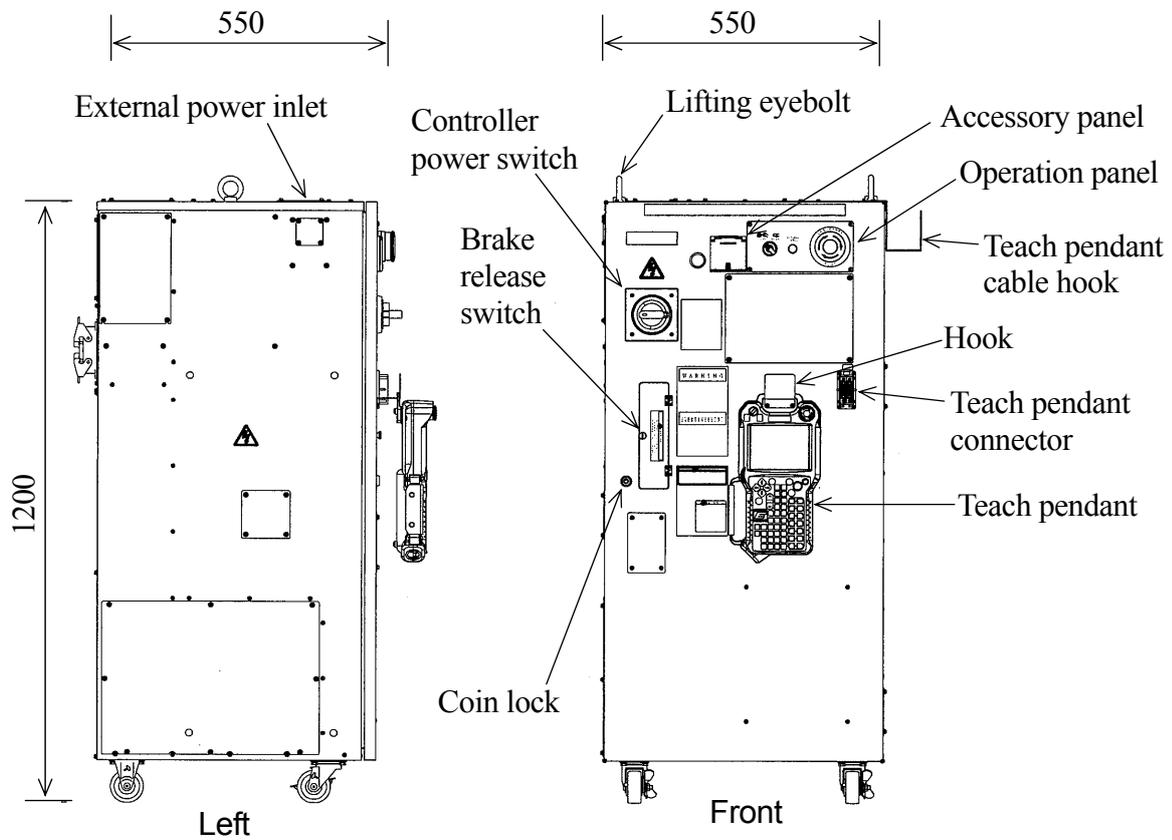




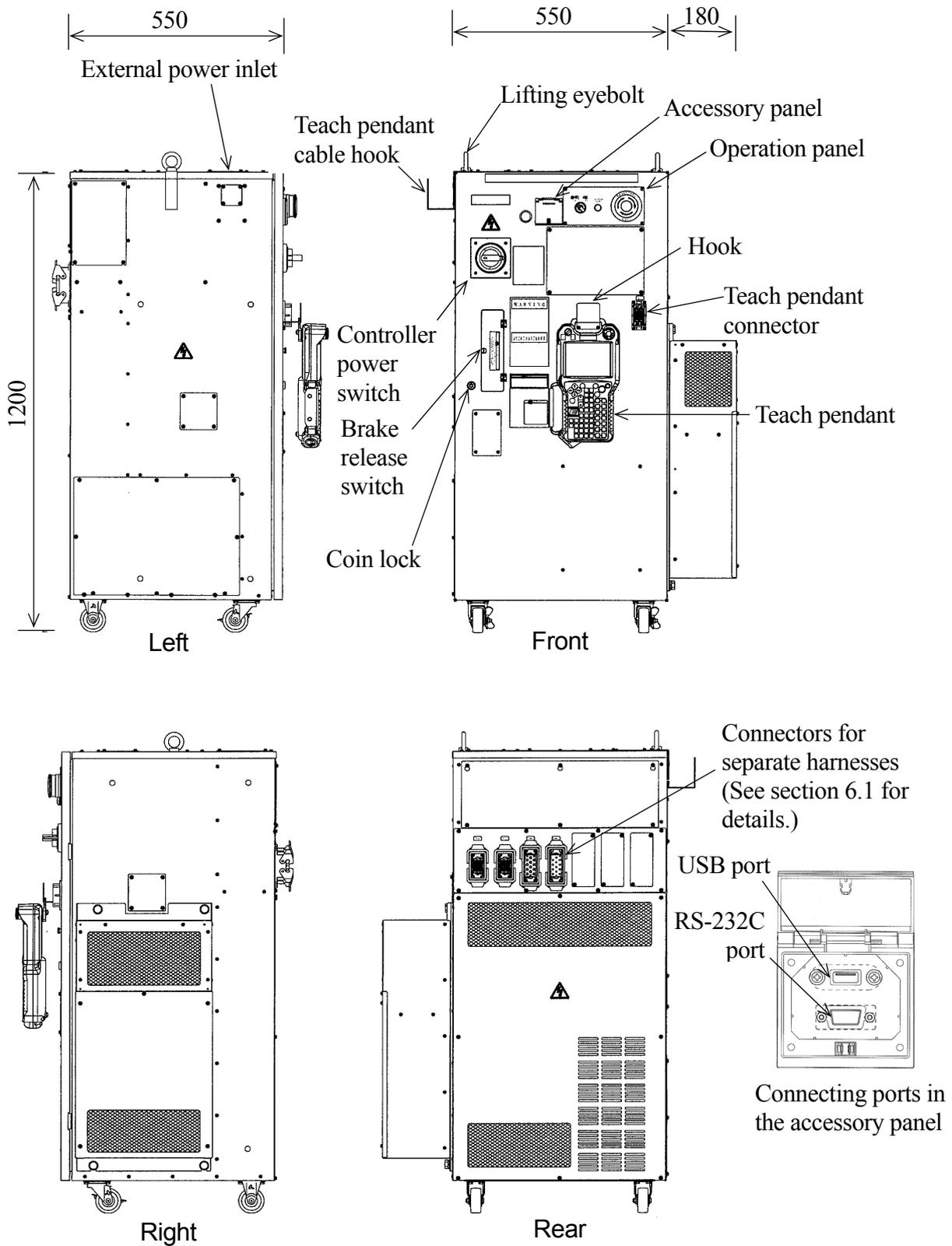
E32 controller



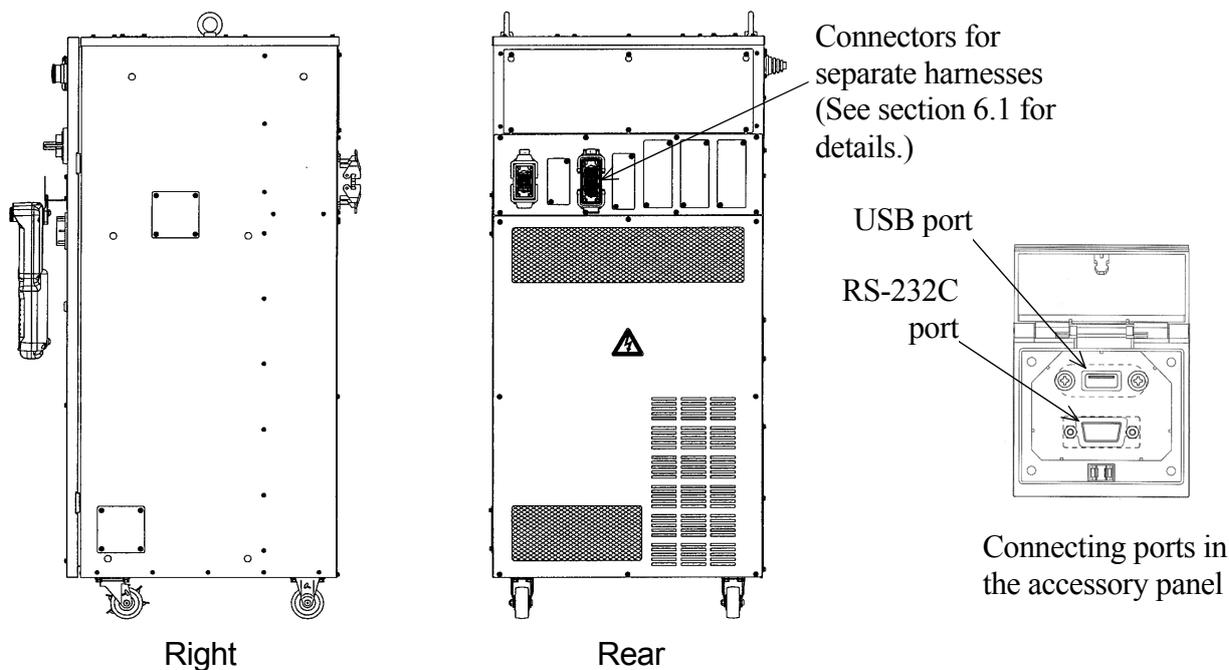
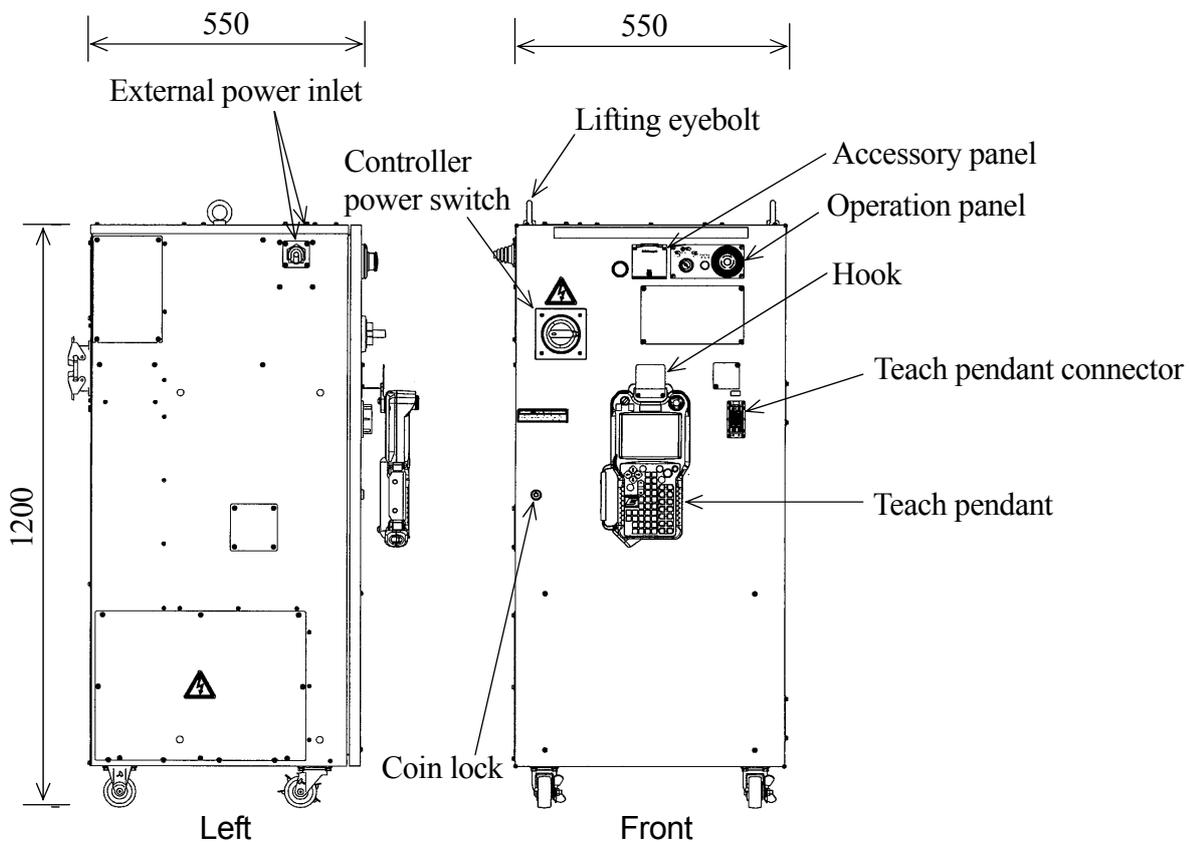
E33 controller



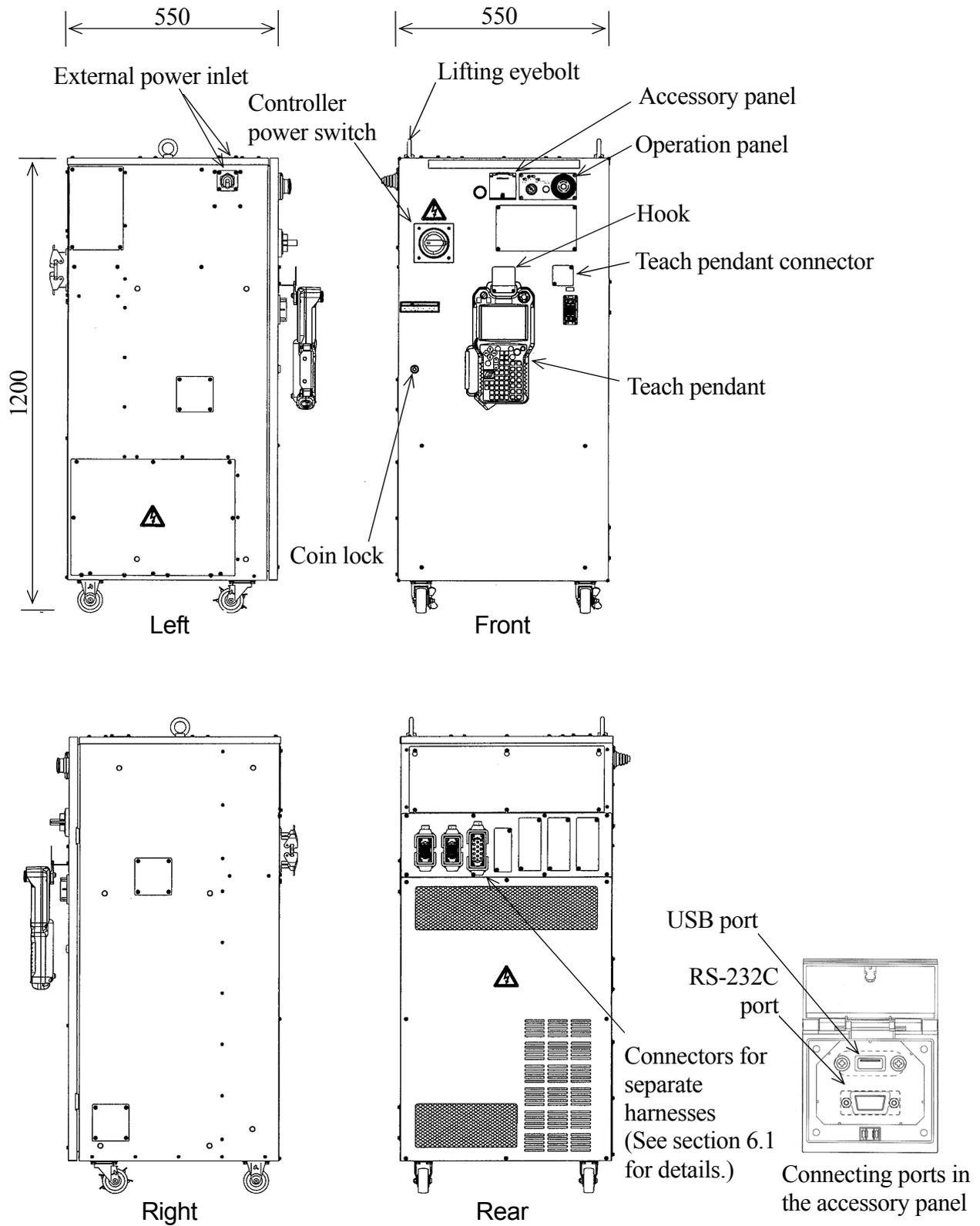
E34 controller (MX)



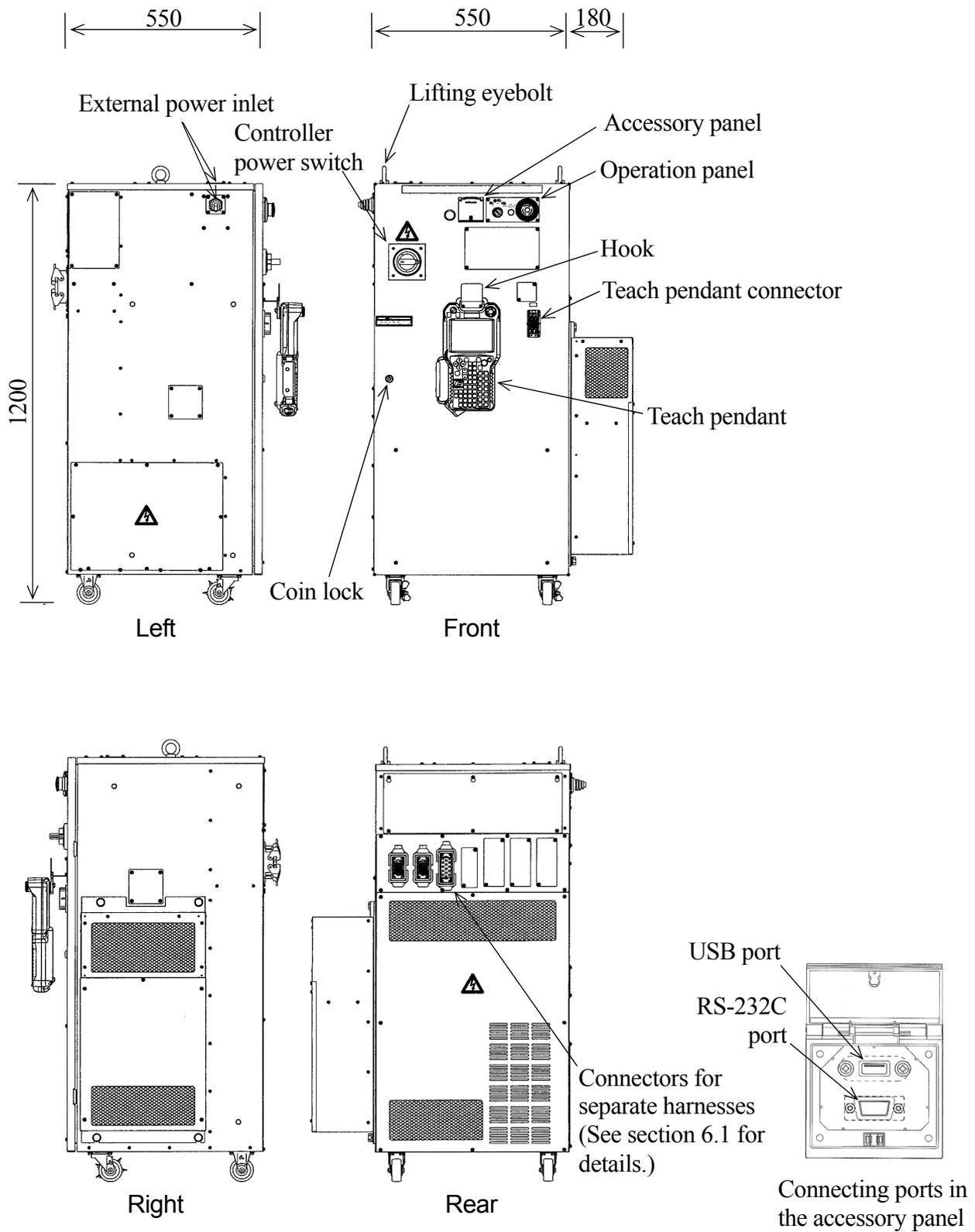
E34 controller (MD)



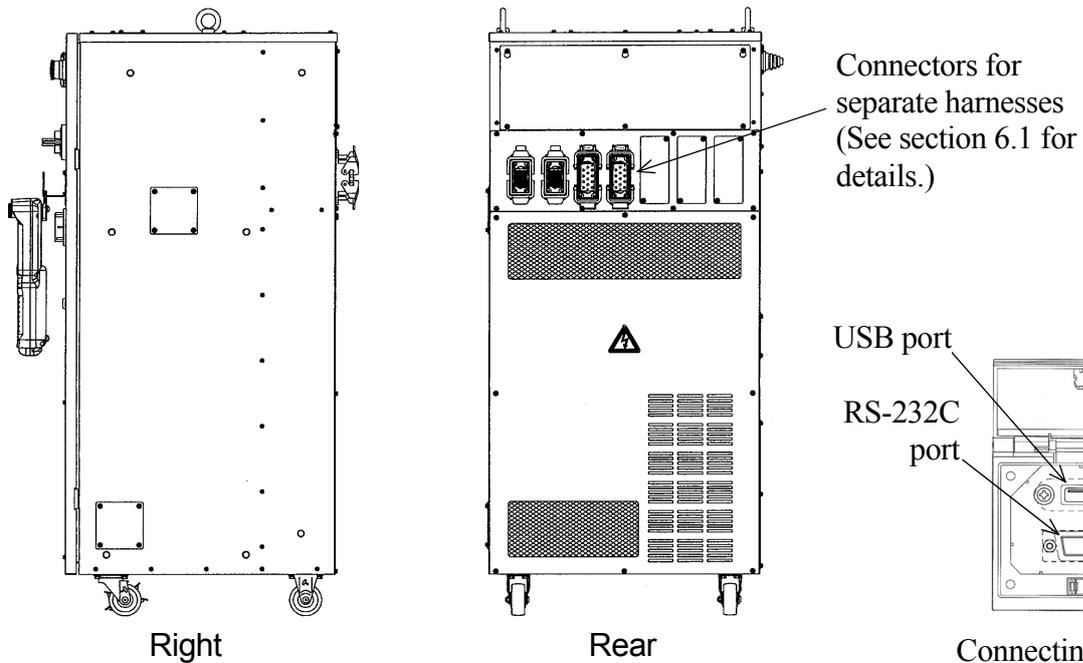
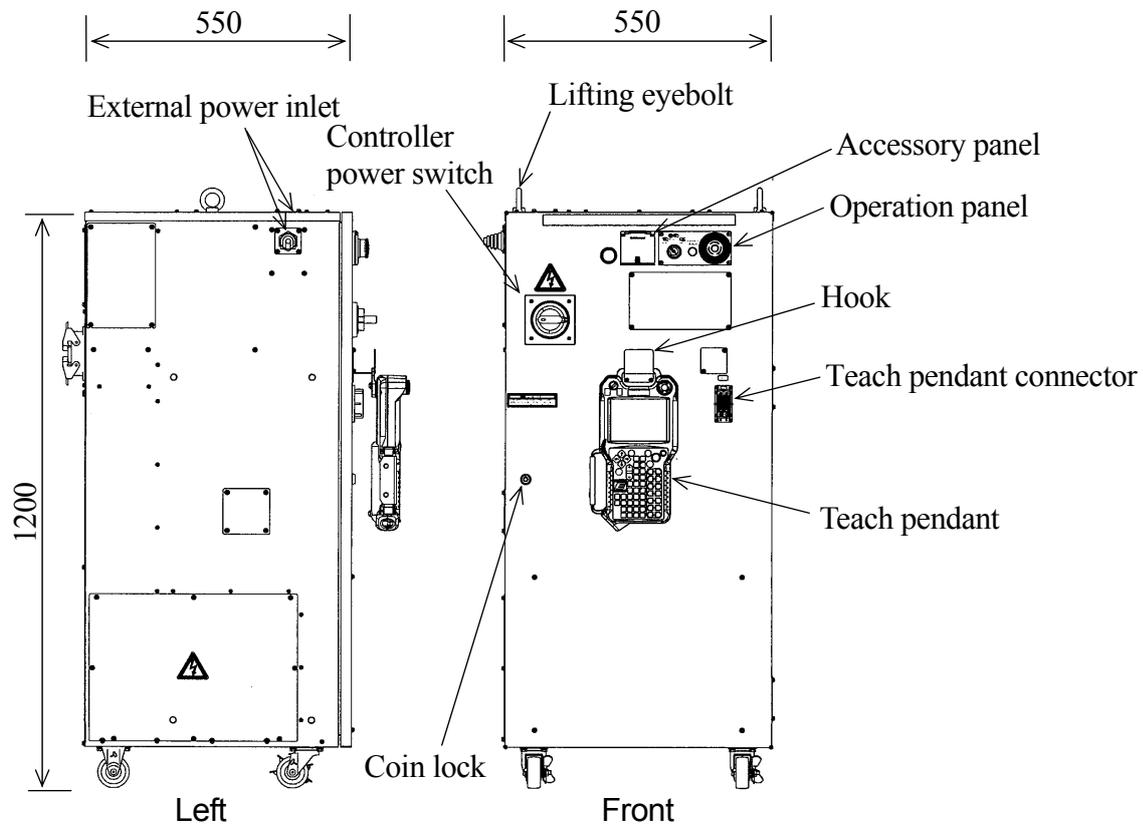
E40 controller



E42 controller

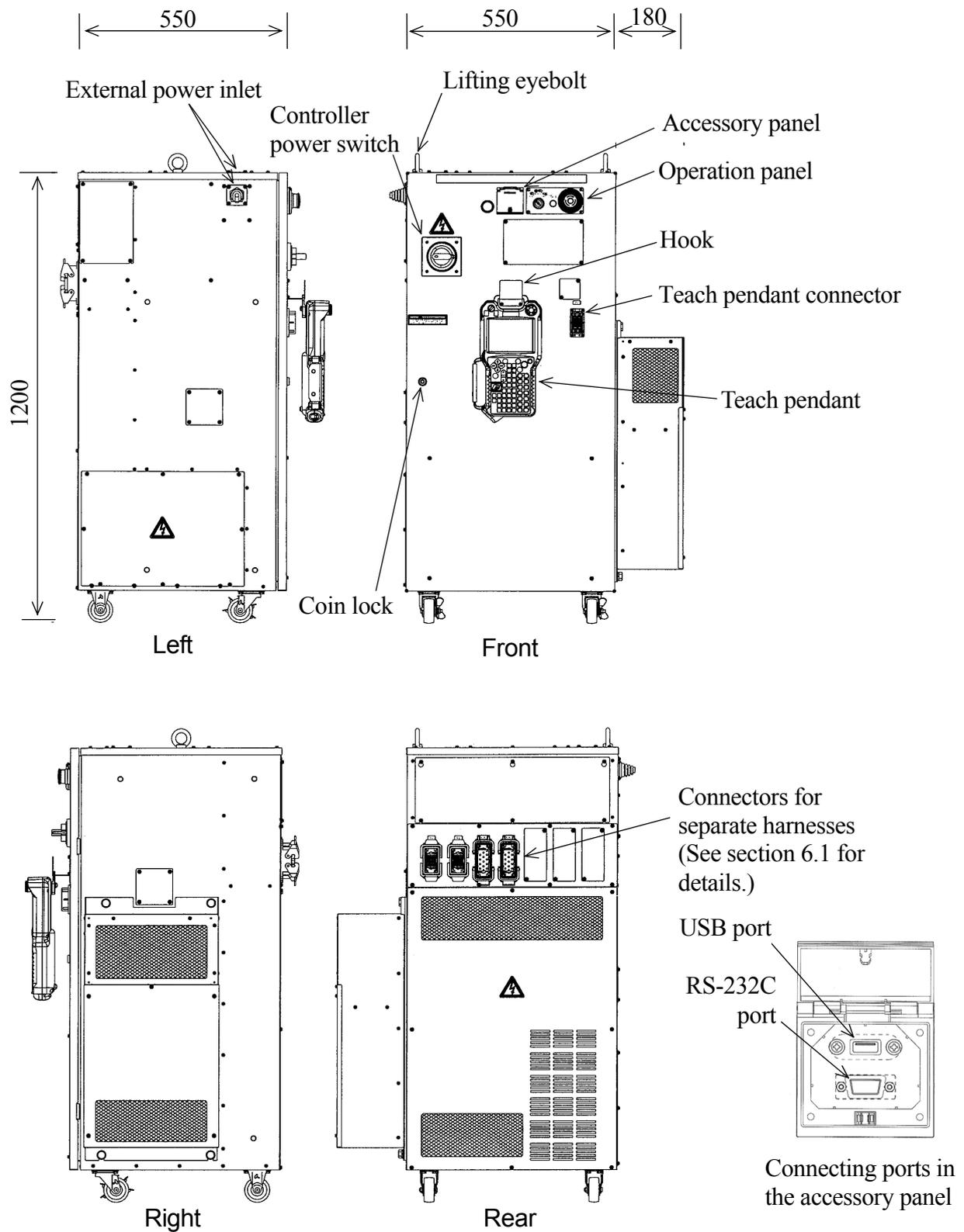


E43 controller

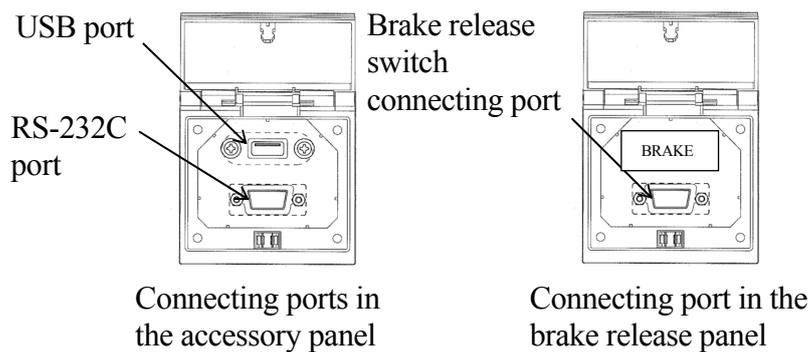
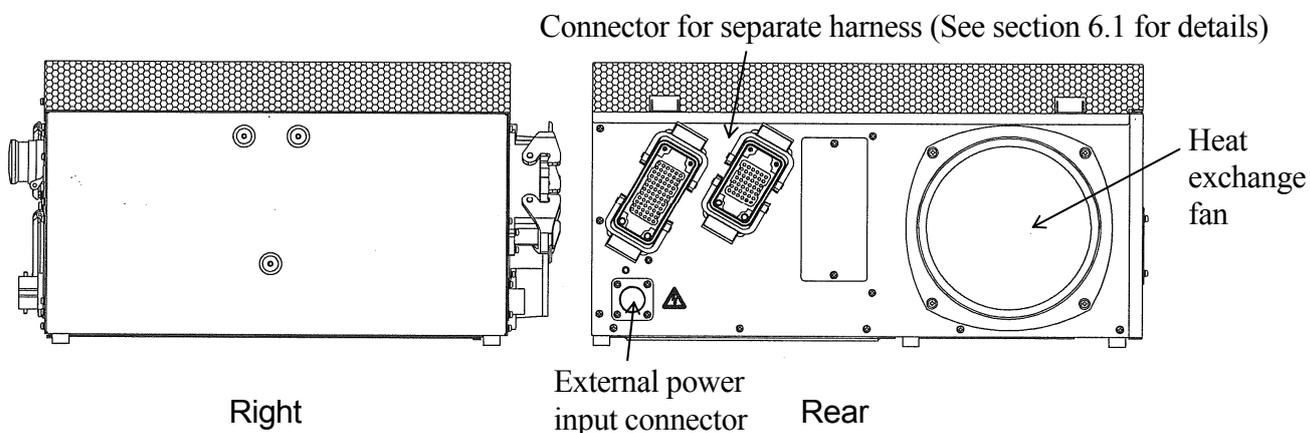
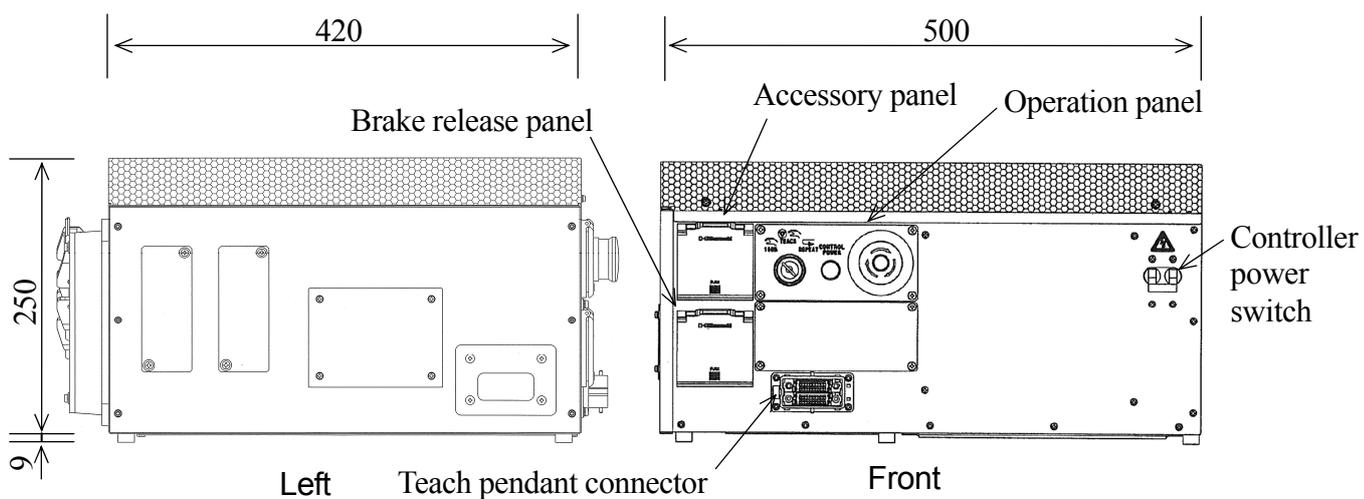


Connecting ports in the accessory panel

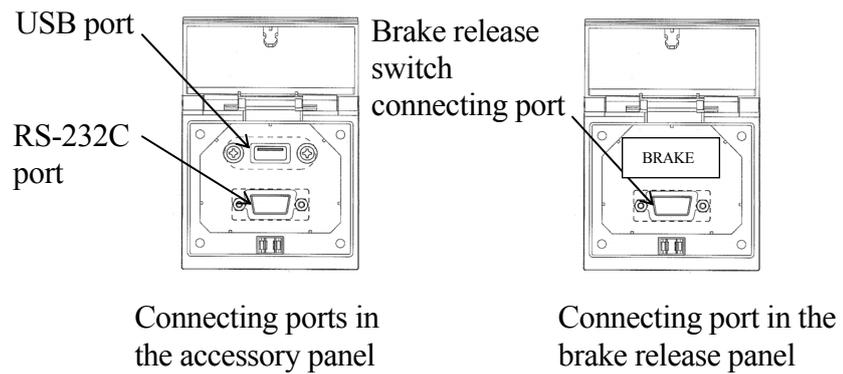
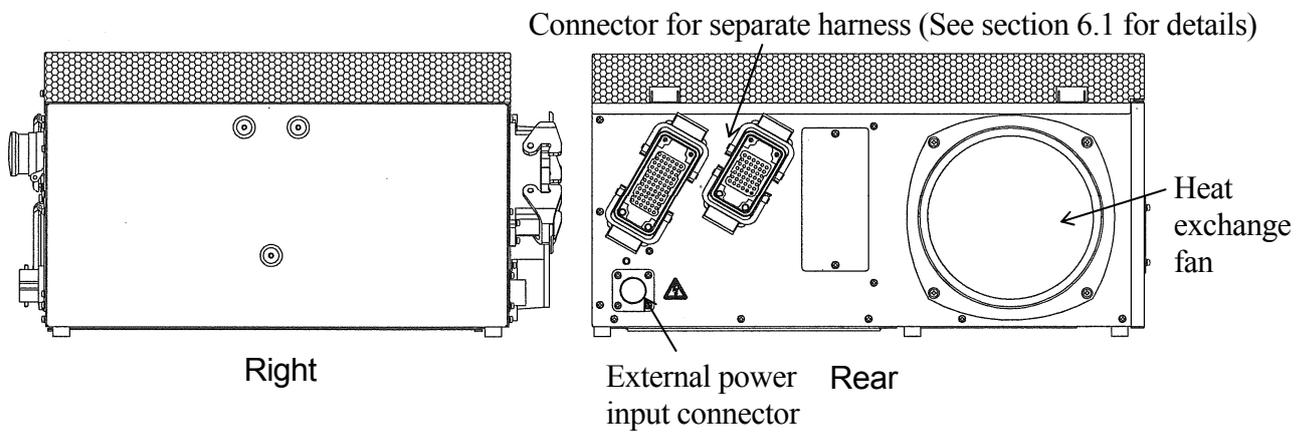
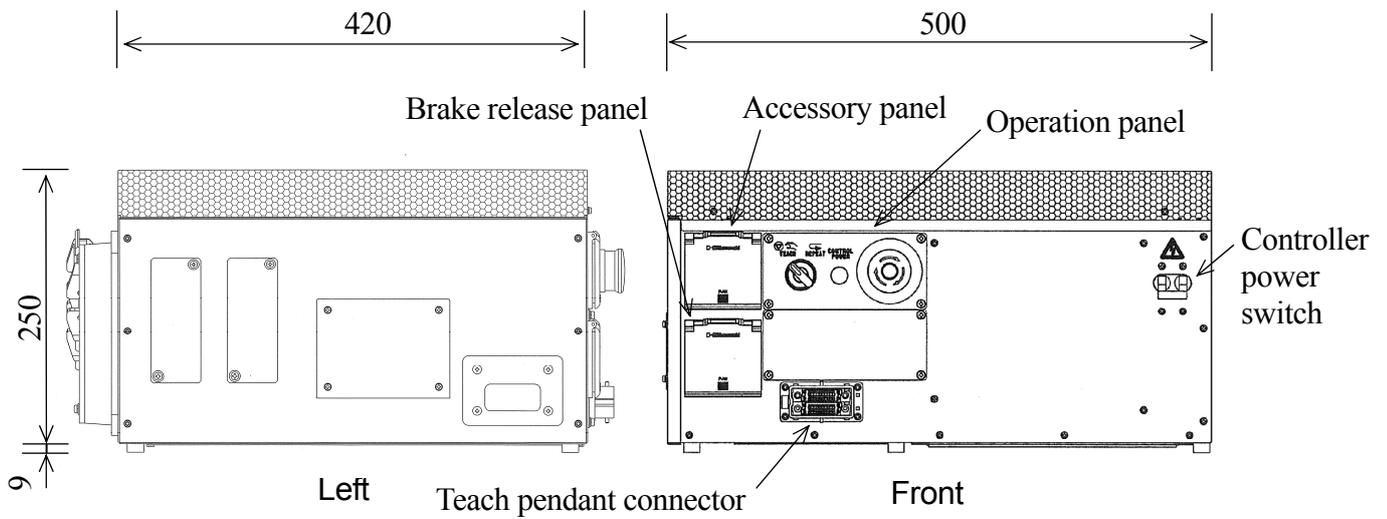
E44 controller (MX)



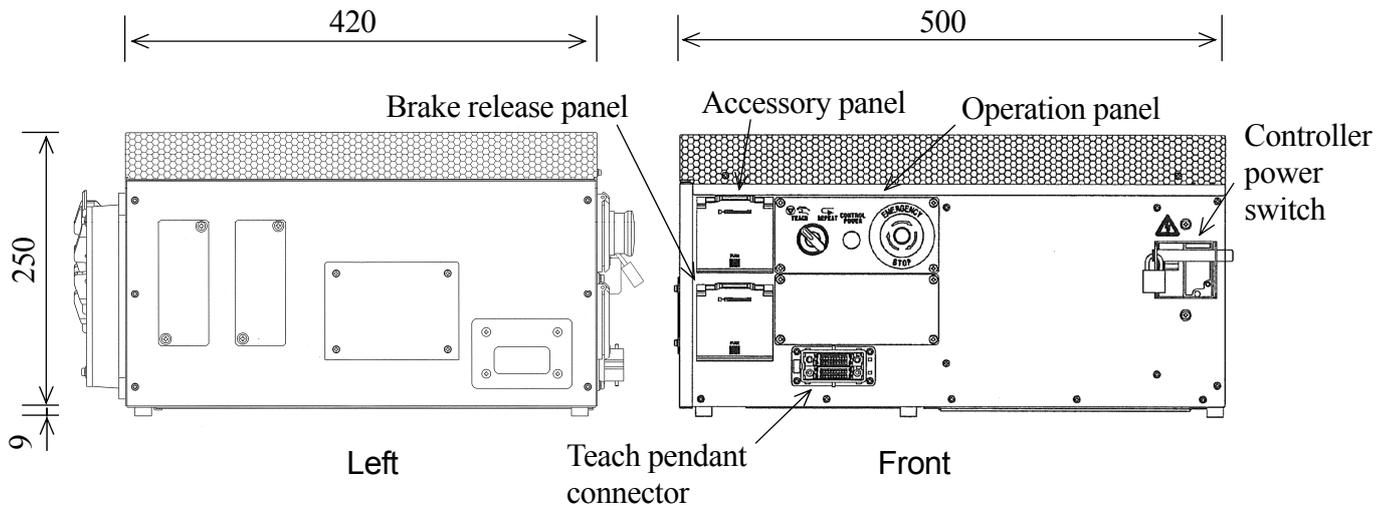
E44 controller (MD)



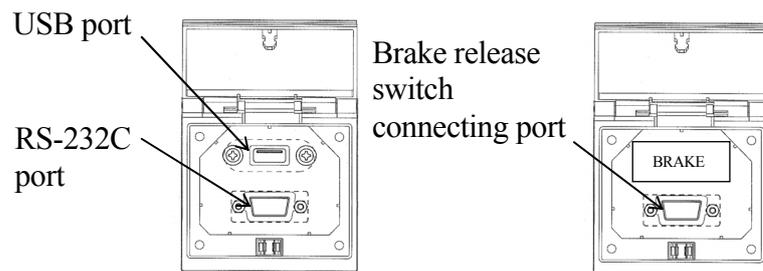
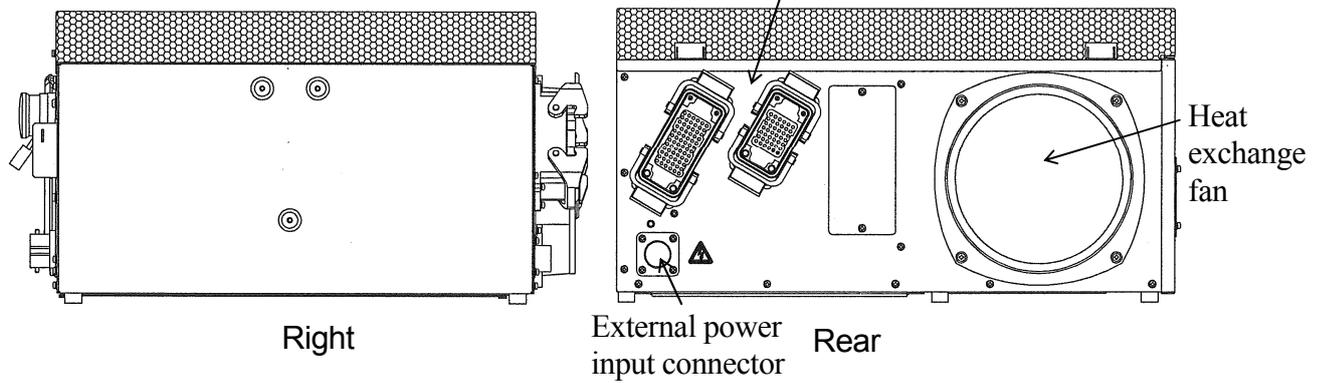
E70/E71 controllers



E73/E74 controllers



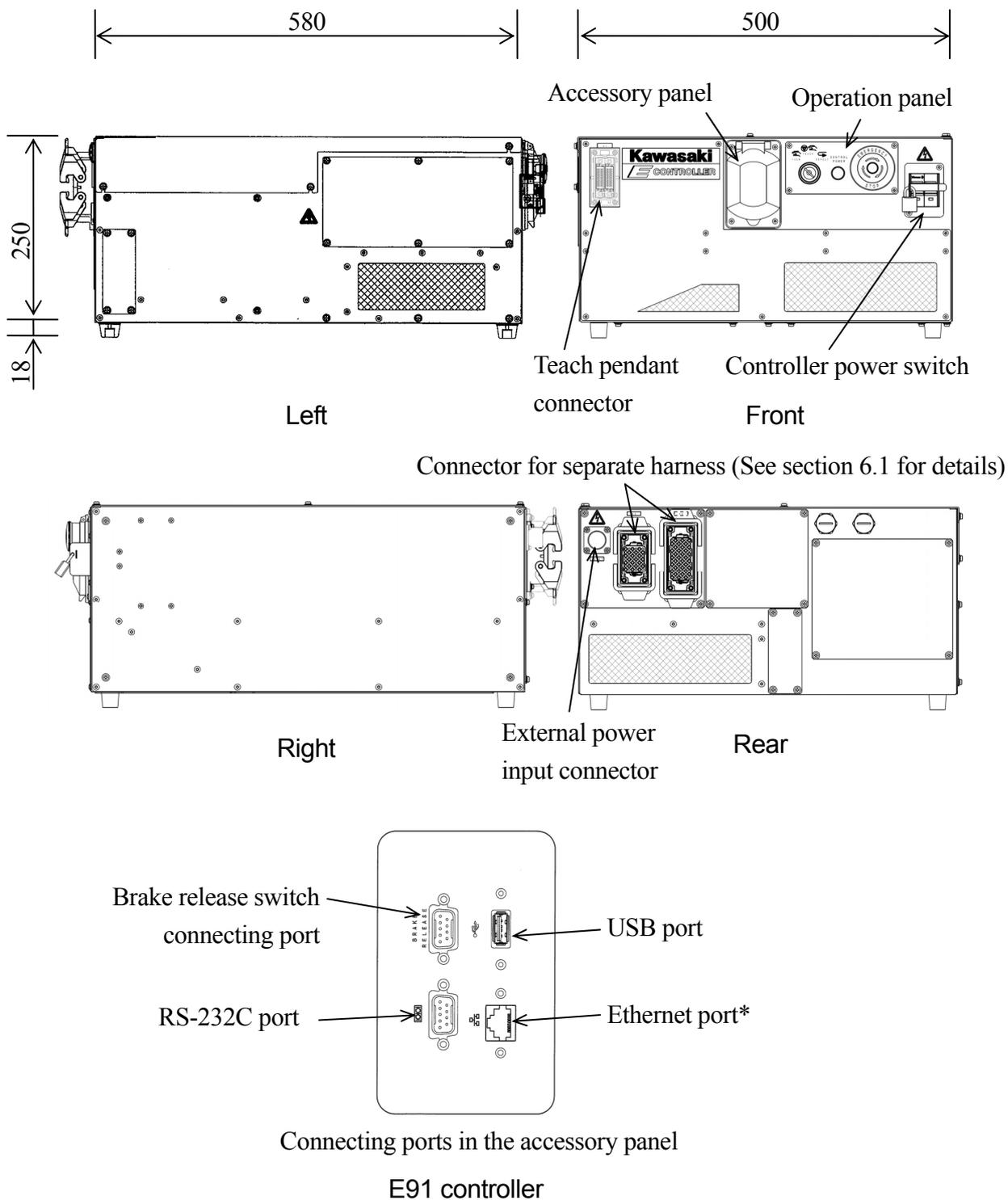
Connector for separate harness (See section 6.1 for details)



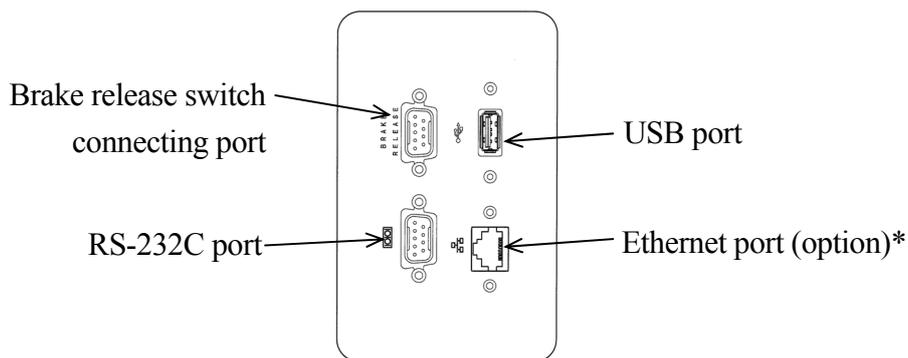
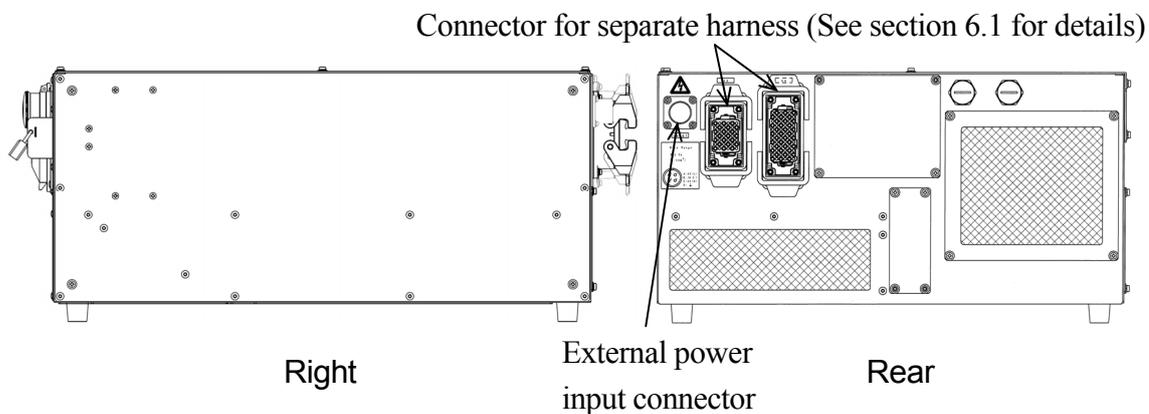
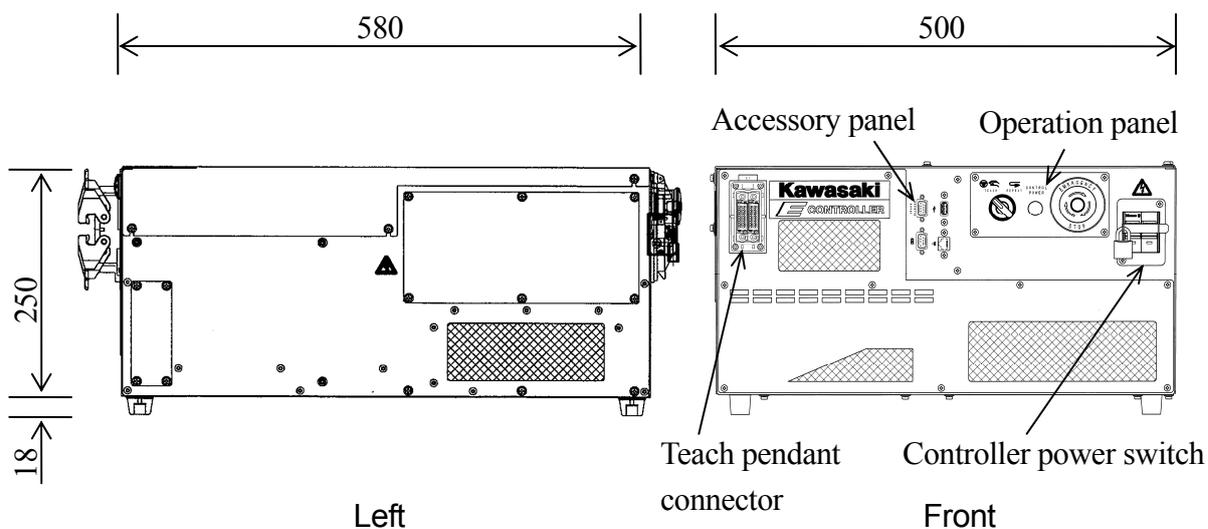
Connecting ports in the accessory panel

Connecting port in the brake release panel

E76/E77 controllers



NOTE* The maximum length of the cable which can be connected to the Ethernet port is 30 m.

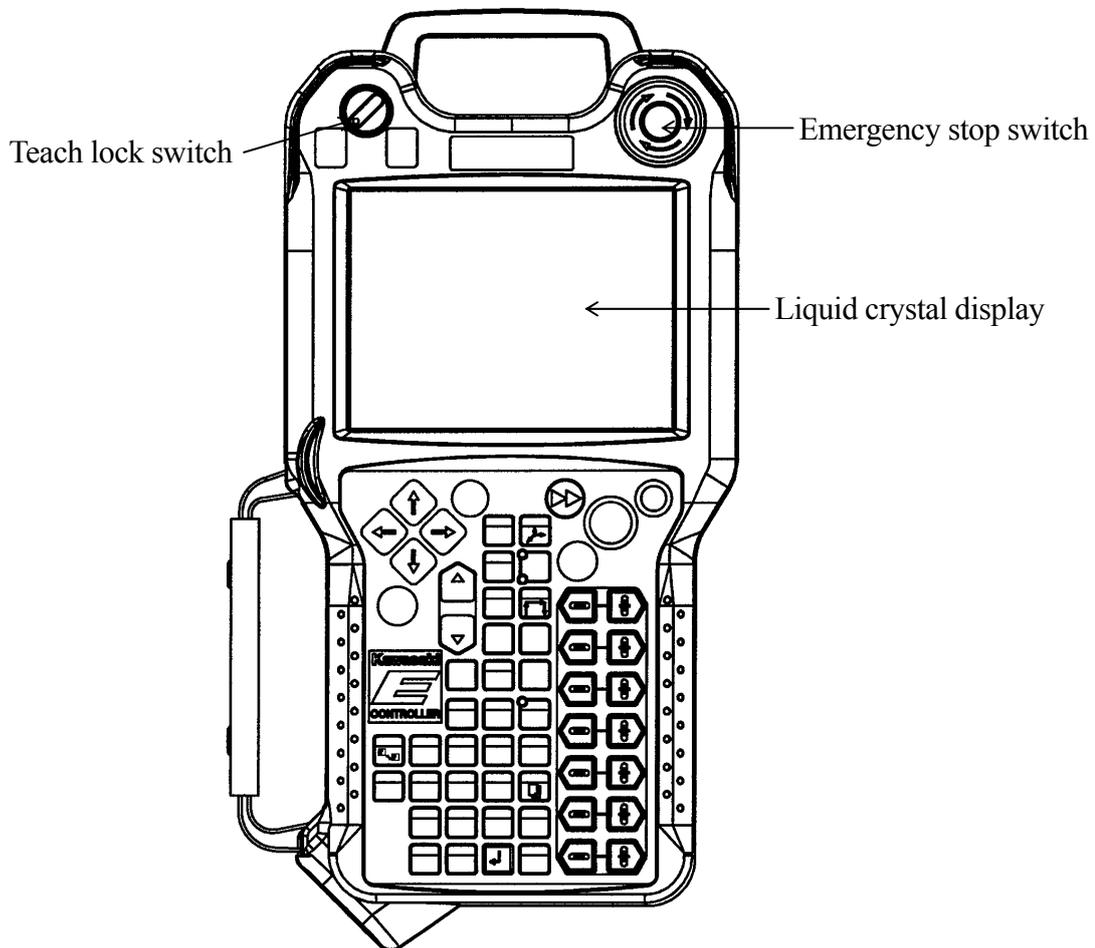


Connecting ports in the accessory panel

E94/E97 controllers

NOTE* The maximum length of the cable which can be connected to the Ethernet port is 30 m.

3.2 TEACH PENDANT APPEARANCE



Teach Pendant

3.3 CONTROLLER SPECIFICATION

E1x/E2x (exc E28) controller

Construction		Self-sustaining fully closed, indirect cooling system	
Mass		E10, E12, E14 (MX): Approx. 120 kg (without transformer), Approx. 180 kg (with transformer) E20, E22, E24 (MX): Approx. 95 kg, E13, E14 (MD): Approx. 135 kg (without transformer), Approx. 195 kg (with transformer) E23, E24 (MD): Approx. 110 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	
		Option (E1x controller)	AC 200-220 V ±10 %, 50/60 Hz, 3 Phase (with transformer, 200 V) AC 380-400/440 V ±10 %, 50/60 Hz, 3 Phase (with transformer, 400 V)
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 (10 m, 15 m are options.)	
Length of separate harnesses*		5 m/10 m/15 m (10 m, 15 m are options.)	

NOTE* Harness length between robot arm and controller

Controller model	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E10/E20	R series 05-20 Y series	5.6 KVA max.	3.5 mm ² or more (AWG #12 or more)	200 m or less
E12/E13/ E22/E23	R series 30-80 Z series MT series B series	10 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less
E14/E24	MX/MD series	10 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less

Circuit breaker spec. for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
E1x (without transformer)/E2x	40 A	AC230 V	7.5 kA (Icu)
E1x (with transformer, 200 V)	40 A	AC230 V	7.5 kA (Icu)
E1x (with transformer, 400 V)	20 A	AC400 V	5 kA (Icu)
		AC440 V	2.5 kA (Icu)

E28 controller

Construction		Self-sustaining fully closed, indirect cooling system
Mass		E28: 280 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 (Japan spec) AC 380-415 V±10 %, 50/60 Hz, 3 Phase (Europe spec) AC 440-480 V±10 %, 60 Hz, 3 Phase (North America spec)
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 (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.

Controller model	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E28	MG series	14.6 KVA max.	8.0 mm ² (AWG #8) - 13 mm ² (AWG #6)	200 m or less

Circuit breaker spec. for external power connection

Controller model	External power voltage	Rated current	Rated voltage	Rated interrupting capacity
E28	AC 200-220 V	50 A	AC 230 V	50 kA (Icu)
	AC380-415 V	50 A	AC 400 V	30 kA (Icu)
			AC 415 V	30 kA (Icu)
	AC440-480 V	40 A	AC 480 V	30 kA (UL489)

E3x controller

Construction		Self-sustaining fully closed, indirect cooling system
Mass		E30: 145 kg, E32, E34 (MX): 180 kg, E33, E34 (MD): 195 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 440-480 V±10 %, 60 Hz, 3 Phase
Optional		AC 380-415 V, 440-480 V, 515 V, 575 V±10 %, 50/60 Hz, 3 Phase 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 (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.

Controller model	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E30	R series 05-20 Y series	4.9 KVA max.	3.5 mm ² (AWG #12) (*: 5.5 mm ² (AWG#10))- 13 mm ² (AWG #6)	200 m or less
E32/E33	R series 30-80 Z, MT series B series	9.9 KVA max.	8.0 mm ² (AWG #8) - 13 mm ² (AWG #6)	200 m or less
E34	MX/MD series	9.9 KVA max.	8.0 mm ² (AWG #8 or more) - 13 mm ² (AWG #6)	200 m or less

Circuit breaker spec. for external power connection

Controller model	External power voltage	Rated current	Rated voltage	Rated interrupting capacity
E30	AC 380-480 V	15 A	AC 480 Y/277 V	30 kA (UL 489)
	AC 515/575 V	20 A	AC 600 Y/347 V	18 kA (UL 489)
	AC 200-220 V	40 A	AC 240 Y	50 kA (UL 489)
E32/33/34	AC 380-480 V	20 A	AC 480 Y/277 V	30 kA (UL 489)
	AC 515/575 V	20 A	AC 600 Y/347 V	18 kA (UL 489)
	AC 200-220 V	40 A	AC 240 Y	50 kA (UL 489)

E4x controller

Construction		Self-sustaining fully closed, indirect cooling system
Mass		E40: 145 kg, E42, E44 (MX): 180 kg E43, E44 (MD): 195 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
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 (5 m, 15 m are options.)
Length of separate harnesses*		5 m/10 m/15 m (5 m, 15 m are options.)

NOTE* Harness length between robot arm and controller.

Controller model	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E40	R series 05-20 Y series	4.9 KVA max.	3.5 mm ² or more (AWG #12 or more)	200 m or less
E42/E43	R series 30-80 Z series MT series B series	9.9 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less
E44	MX/MD series	9.9 KVA max.	5.5 mm ² or more (AWG #10 or more)	200 m or less

Circuit breaker spec. for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
E40	10 A	AC400 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)
E42/43/44	20 A	AC400 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)

E7x controller

Construction		E70, E71, E73, E74, E76, E77: horizontal enclosed structure, indirect cooling system
Mass		E70, E71, E73, E74, E76, E77: 30 kg
Ambient environment	Temperature	0 - 45 °C (0 - 40°C in vertical placing)
	Humidity	35 - 85 %RH (Non condensing)
	Altitude	Up to 1000 meters above mean sea level
	Pollution degree	3 or below
Power source		AC 200-240 V±10 %, 50/60 Hz, Single 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 (5 m, 15 m are options.)
Length of separate harnesses*		5 m/10 m/15 m (5 m, 15 m are options.)

NOTE* Harness length between robot arm and controller.

Controller model	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E70/E73/E76	R series 03N	1.5 KVA max.	2-2.5 mm ² or more (AWG #14)	200 m or less
E71/E74/E77	R series 05N/05L/06L/10N	3.0 KVA max.	2-2.5 mm ² or more (AWG #14)	200 m or less

Circuit breaker spec. for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
E70/71/73/74	10 A	AC250 V	1.5 kA (Icu)
E76/77	10 A	AC277 V	10 kA (UL 489)

E9x controller

Construction		E91: horizontal enclosed structure, indirect cooling system E94, E97: horizontal open structure (Enclosed structure is an option.)
Mass		E91, E94, E97: 40 kg
Ambient environment	Temperature	E91: 0 - 40 °C E94, E97: 0 - 45 °C (0 - 40 °C for enclosed type)
	Humidity	35 - 85 %RH (Non condensing)
	Altitude	Up to 1000 meters above mean sea level
	Pollution degree	E91: 3 or below E94, E97: 2 or below (3 or below for optional enclosed structure)
Power source		AC 200-230 V±10 %, 50/60 Hz, Single phase
Power capacity		Refer to the table below.
Earthing		Dedicated earthing (100 Ω or less)
Length of Teach pendant cable		E91, E97: 5 m/10 m/15 m (5 m, 15 m are options.) E94: 5 m/10 m/15 m (10 m, 15 m are options.)
Length of separate harnesses*		E91, E97: 5 m/10 m/15 m (5 m, 15 m are options.) E94: 5 m/10 m/15 m (10 m, 15 m are options.)

NOTE* Harness length between robot arm and controller.

Controller model	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E91/E94/E97	Y series R series 10L/20N	5 KVA max.	3.5 mm ² or more (AWG #12)	200 m or less

Circuit breaker spec. for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
E91	32 A	AC250 V	10 kA (Icu)
E94/E97	30 A	AC277 V	10 kA (UL 489)

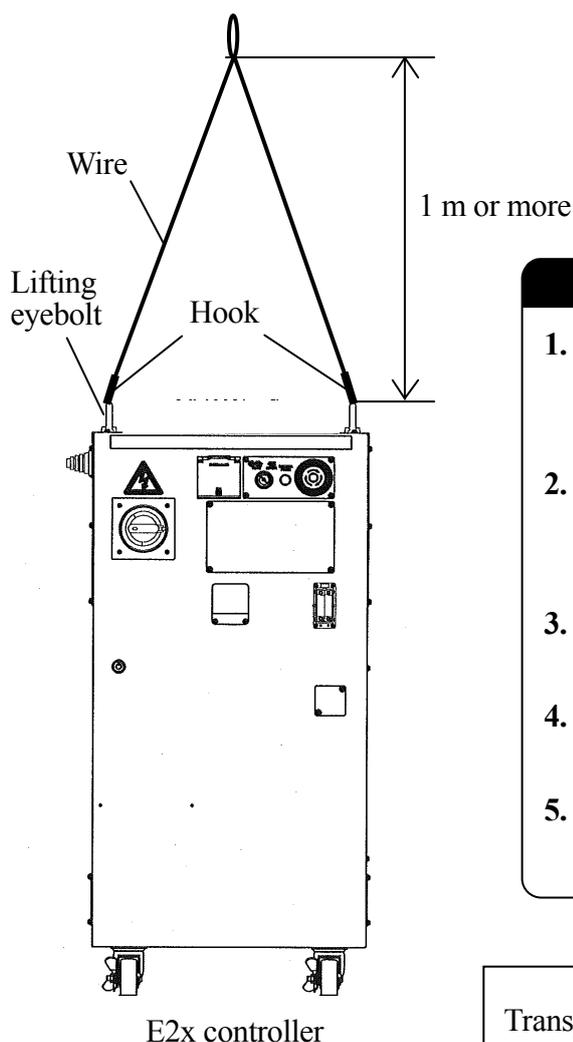
4.0 TRANSPORTATION OF ROBOT CONTROLLER

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

4.1 BY CRANE LIFTING (E1X, E2X, E3X, E4X)

⚠ WARNING

1. Never support the controller manually 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 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 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.

[NOTE]

Transportation of E7x and E9x controllers by crane lifting is not possible.

4.2 BY CASTER (E1X, E2X, E3X, E4X)



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. The E2x controller falls if it is inclined as follows.
Back or forth: Approx. 20° (10°) or more (10° is for E28 controller)
Right or left: Approx. 15° or more
The E1x/E3x/E4x controllers falls 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.)

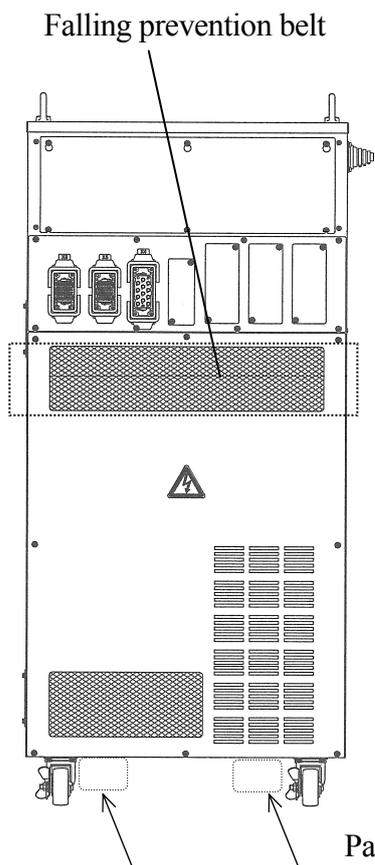
[NOTE]

Transportation of E7x and E9x controllers by caster is not possible.

4.3 BY FORKLIFT TRUCK (E1X, E3X, E4X)

WARNING

To stop 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 passed from the side. Pass the fork under the controller body as shown on the left.
2. Be careful not to shock the controller during transport.
3. Be careful not to get caught on other equipment, cables, etc.

[NOTE]

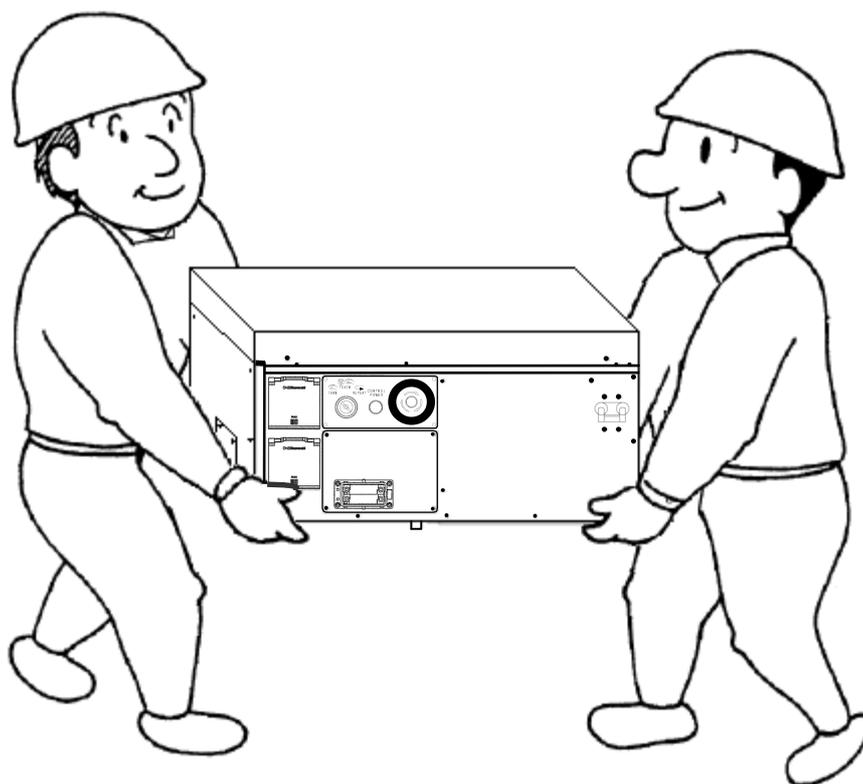
Transportation of E2x, E7x and E9x controllers by forklift is not possible.

4.4 BY TWO PERSONS (E7X, E9X)



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 controller and the floor is small (E7x: 9 mm, E9x: 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 (E7x: 30 kg, E9x: 40 kg), it is impossible to carry the controller with fingertips. On the left side of E7x controller, handle is provided to hold up the controller.**



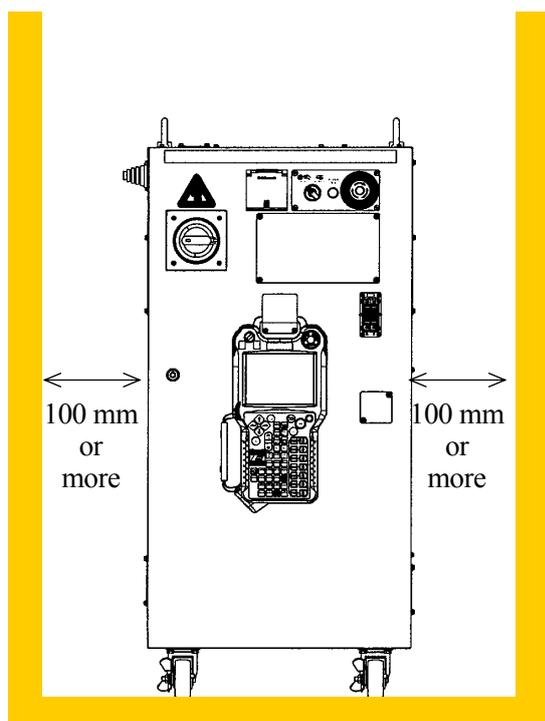
[NOTE]

Transportation of E1x, E2x, E3x and E4x controllers by two persons is not possible.

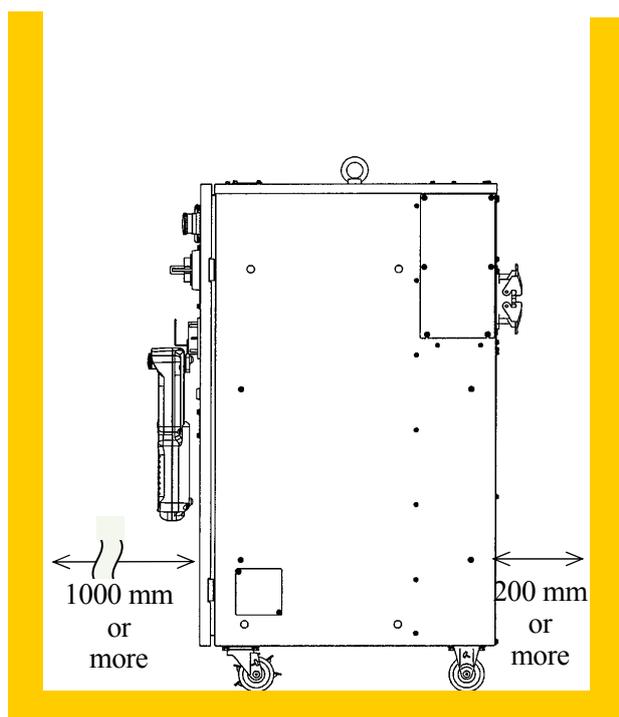
5.0 ARRANGEMENT OF ROBOT CONTROLLER

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

5.1 ARRANGEMENT OF E1X/E2X/E3X/E4X CONTROLLERS



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.



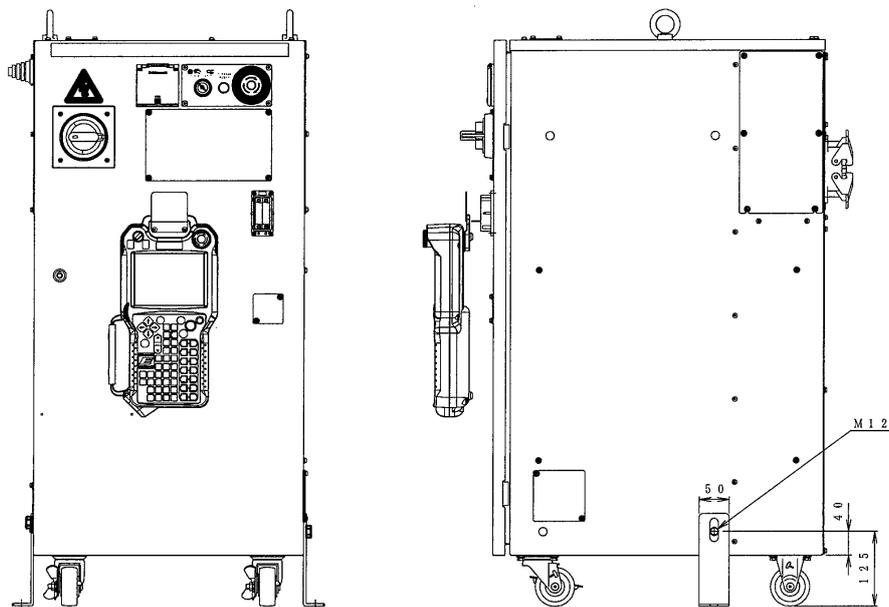
3. The inlet port for air-cooling is on the rear upside of the controller, and the air exhaust port is on the rear downside.

CAUTION

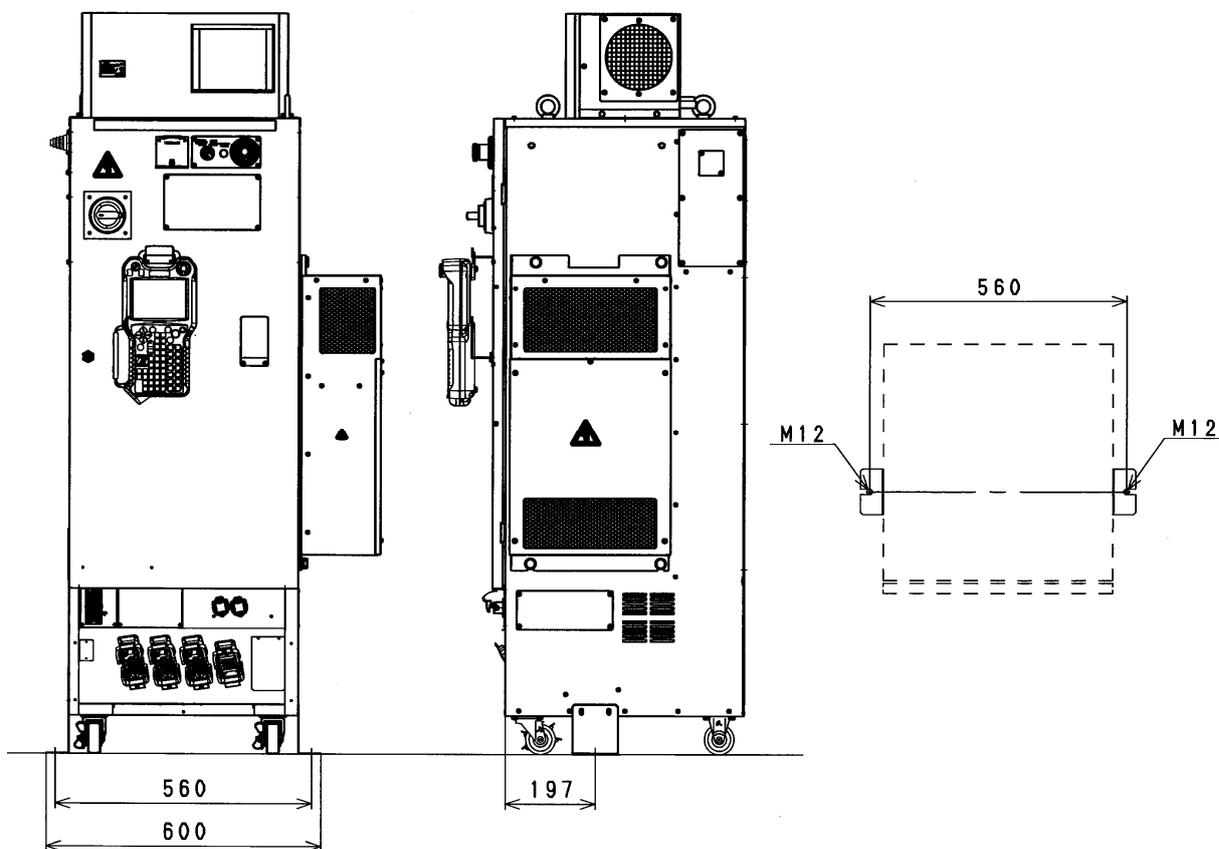
Do not block the air inlet and exhaust ports when arranging the controller. Separate the controller backside from the wall by 200 mm or more.

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

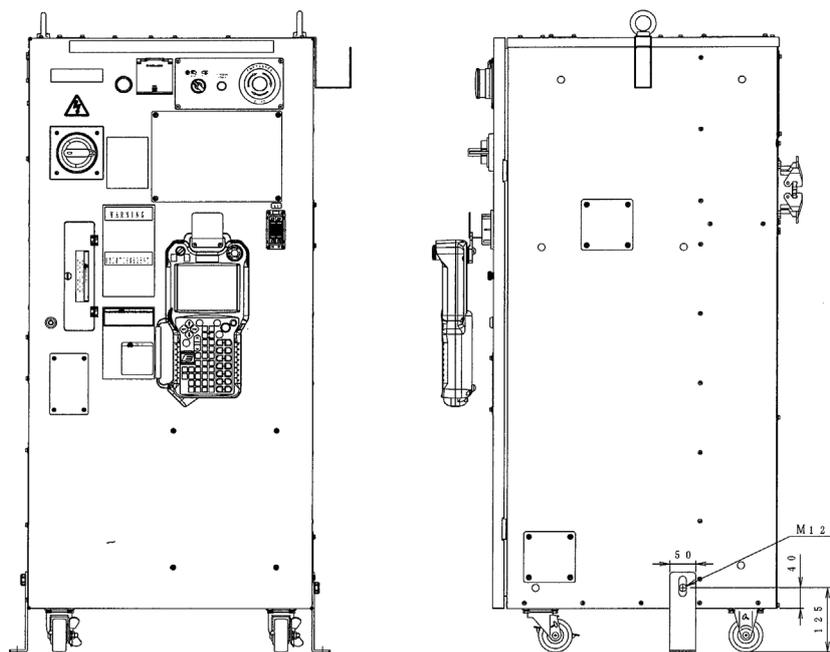
E2x (exc E28) controller



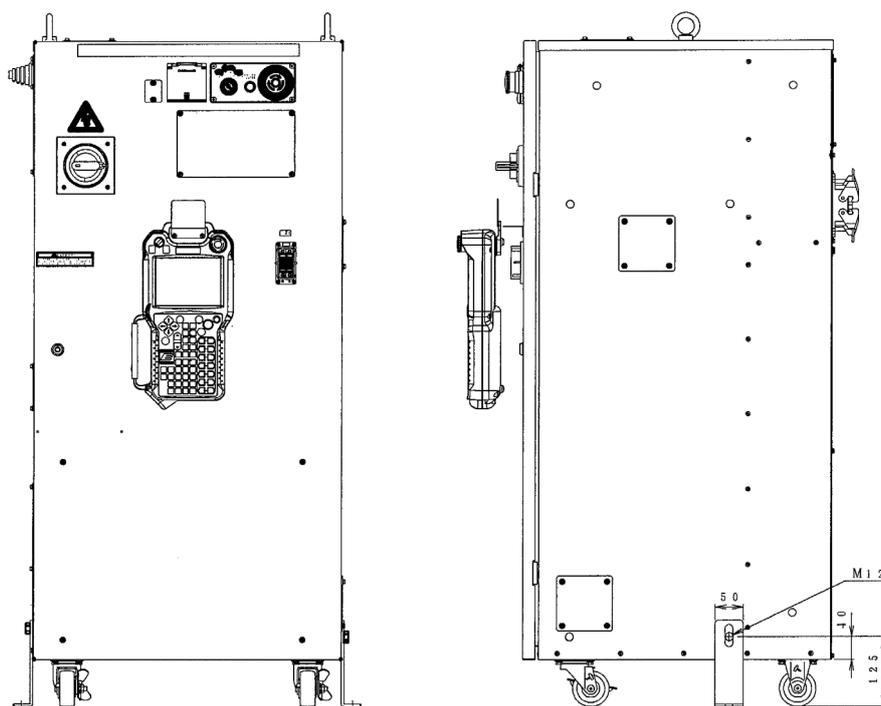
E28 controller



E3x controller



E1x/E4x controllers



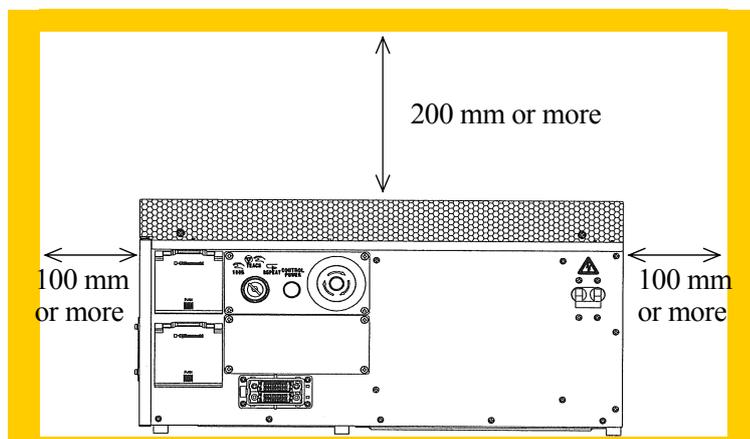
CAUTION

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.)

5.2 ARRANGEMENT OF E7X/E9X CONTROLLERS

Horizontal arrangement is the standard for E7x and E9x controllers. Follow the procedure below to arrange the controllers. For the E9x controller with the enclosed structure, the ambient temperature should be between 0-40 °C.

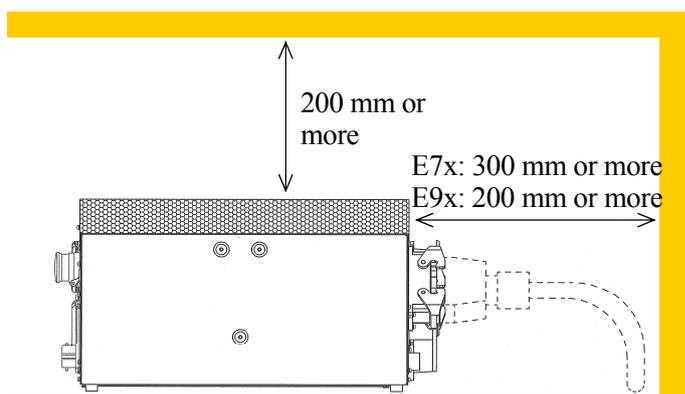
1. Arrange the controller on a flat, horizontal floor. An object cannot be placed on the top surface of E7x controller. When an object is placed on the top surface of E9x controller, the mass should be 40 kg or less. It is possible to place an E9x controller on another E9x controller as far as the mass goes. However, when an object is placed on the top surface of E9x controller, it is necessary to remove the object once in maintenance.
2. Separate the controller right/left side from the wall by 100 mm or more.
3. Separate the controller top surface from the wall by 200 mm or more.



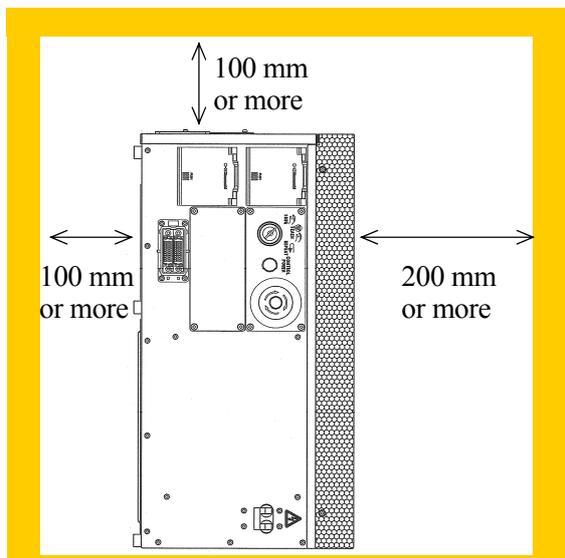
4. Heat exchange fan is provided on the rear of the E7x controller.

CAUTION

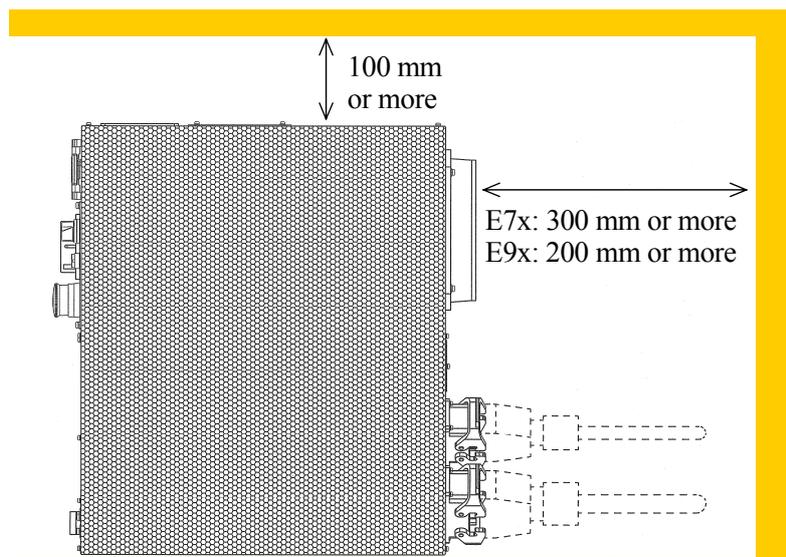
Do not block the air inlet and exhaust ports when arranging the E7x controller. For the E7x controller, separate the controller backside from the wall by 300 mm or more, leaving enough space for the separate harness to be bent.



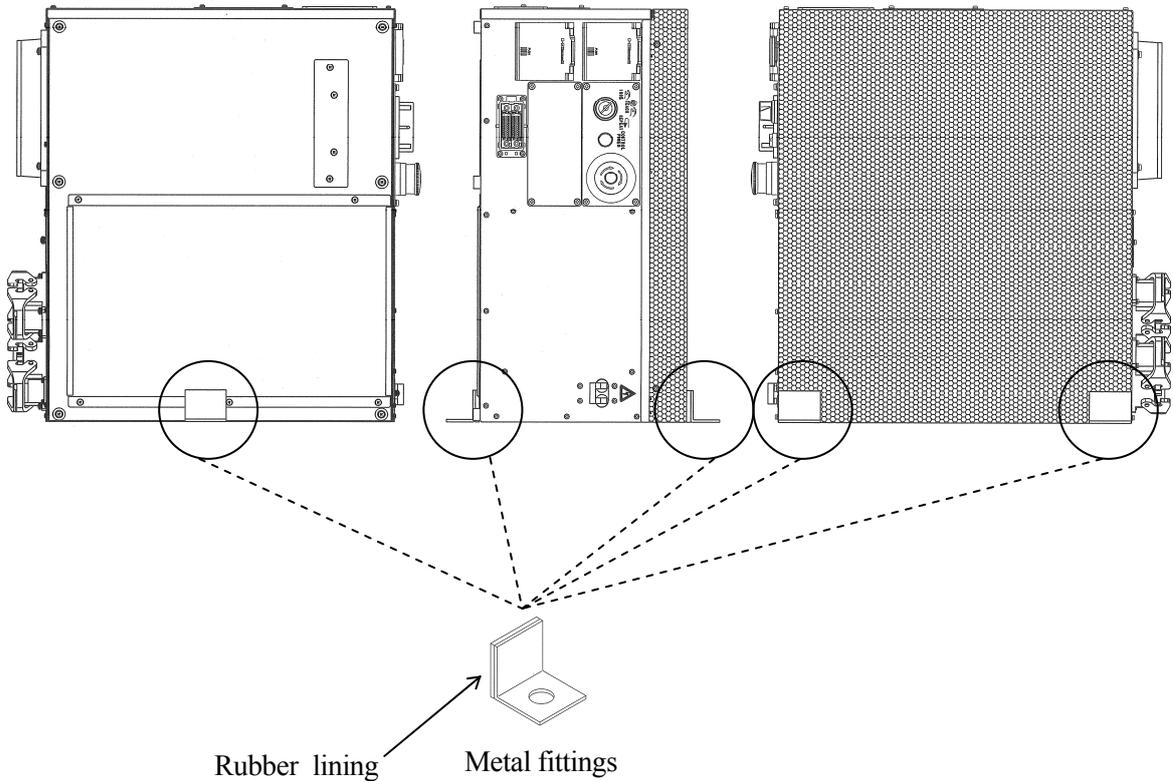
Follow the procedure below when arranging E7x/E9x controllers vertically. The ambient temperature should be within 0-40 C° when arranging the E7x controller vertically. For the E9x controller, feet attached on the bottom of the controller can be reattached on the right side. An object cannot be placed on the top surface of the controller when the controllers are placed vertically.



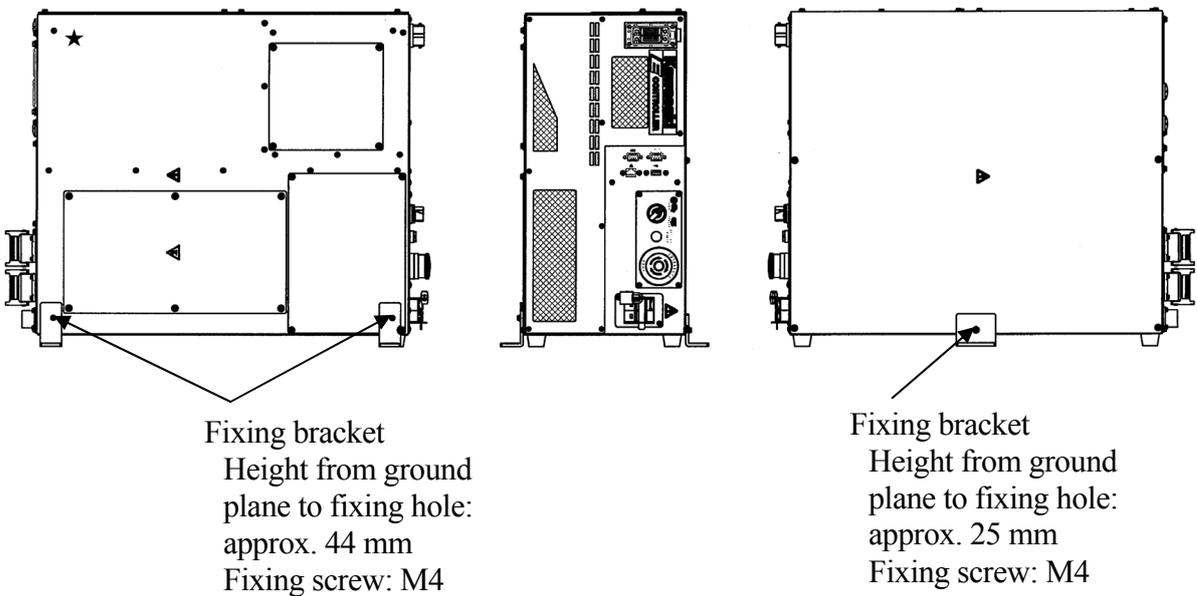
1. Arrange the controller on a horizontal floor. Arrange the controller with its controller power switch facing downward.
2. Separate the controller right side (top surface when placing the controller vertically) from the wall by 200 mm or more.
3. Separate the controller top/left side from the wall by 100 mm or more.
4. Separate the controller rear side from the wall by 300 mm or more for E7x controller and 200 mm for E9x controller.
5. If needed, make metal fittings as shown in the figure on the next page to fix the controller.



E7x controller



E9x controller



NOTE: Replace foot rubbers together with fixing screws when the foot rubbers on the bottom are attached on the right side. If the screw with ★ mark is too long, change it to the screw whole length is 6 mm or less when changing the screw. Otherwise, internal parts may be damaged.

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.

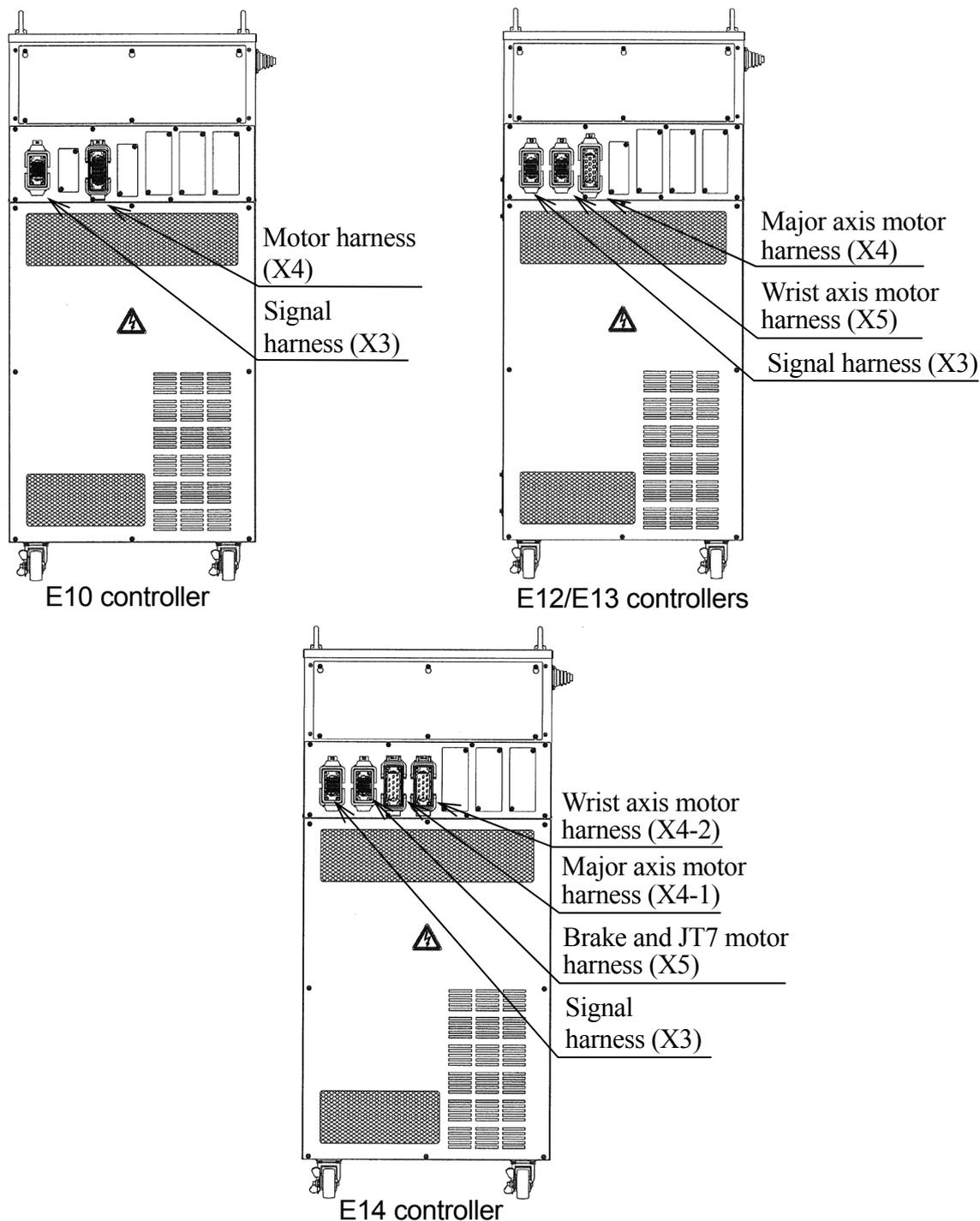


CAUTION

- 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.**

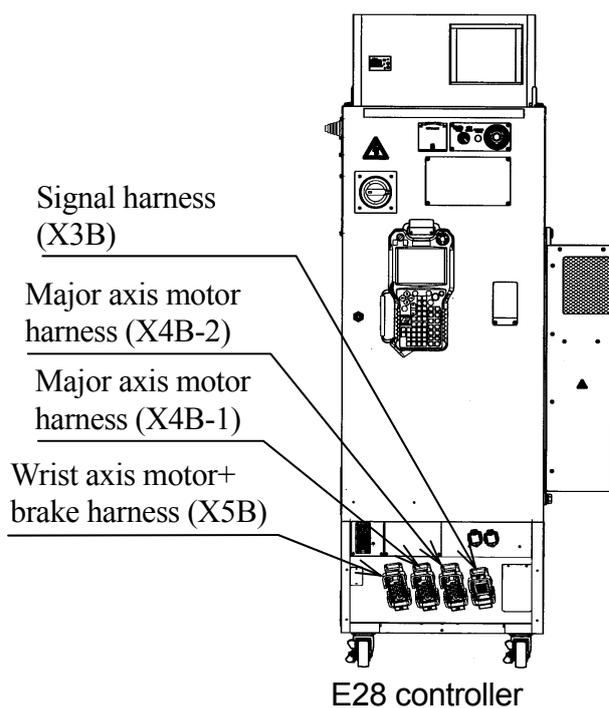
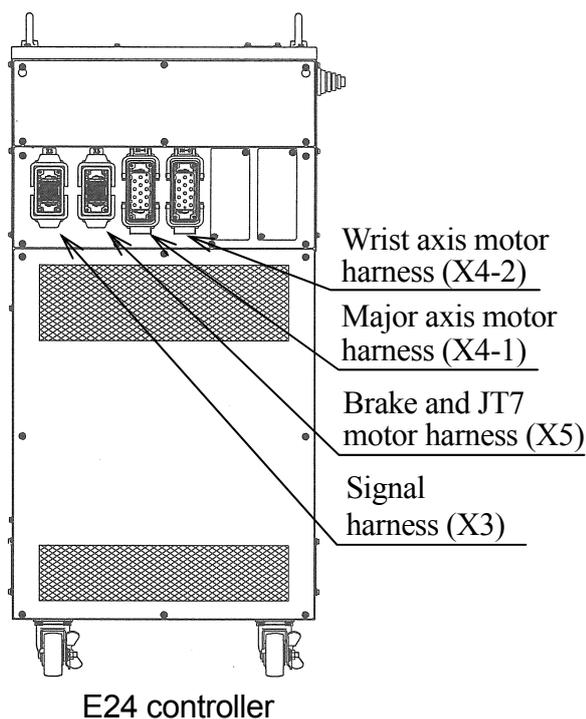
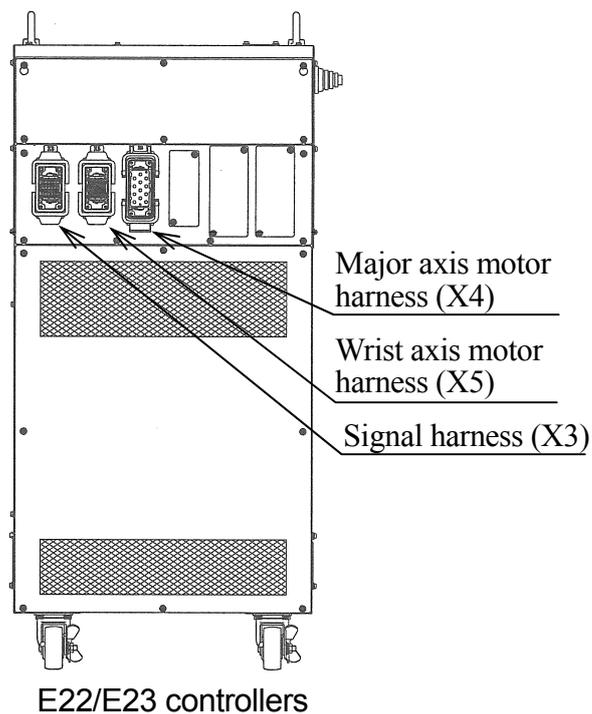
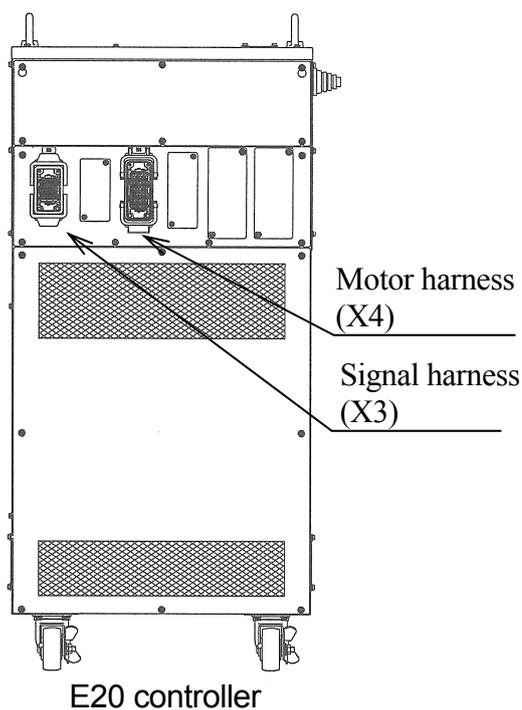
Connect the separate harnesses to their designated ports as shown below.

1. Controller side



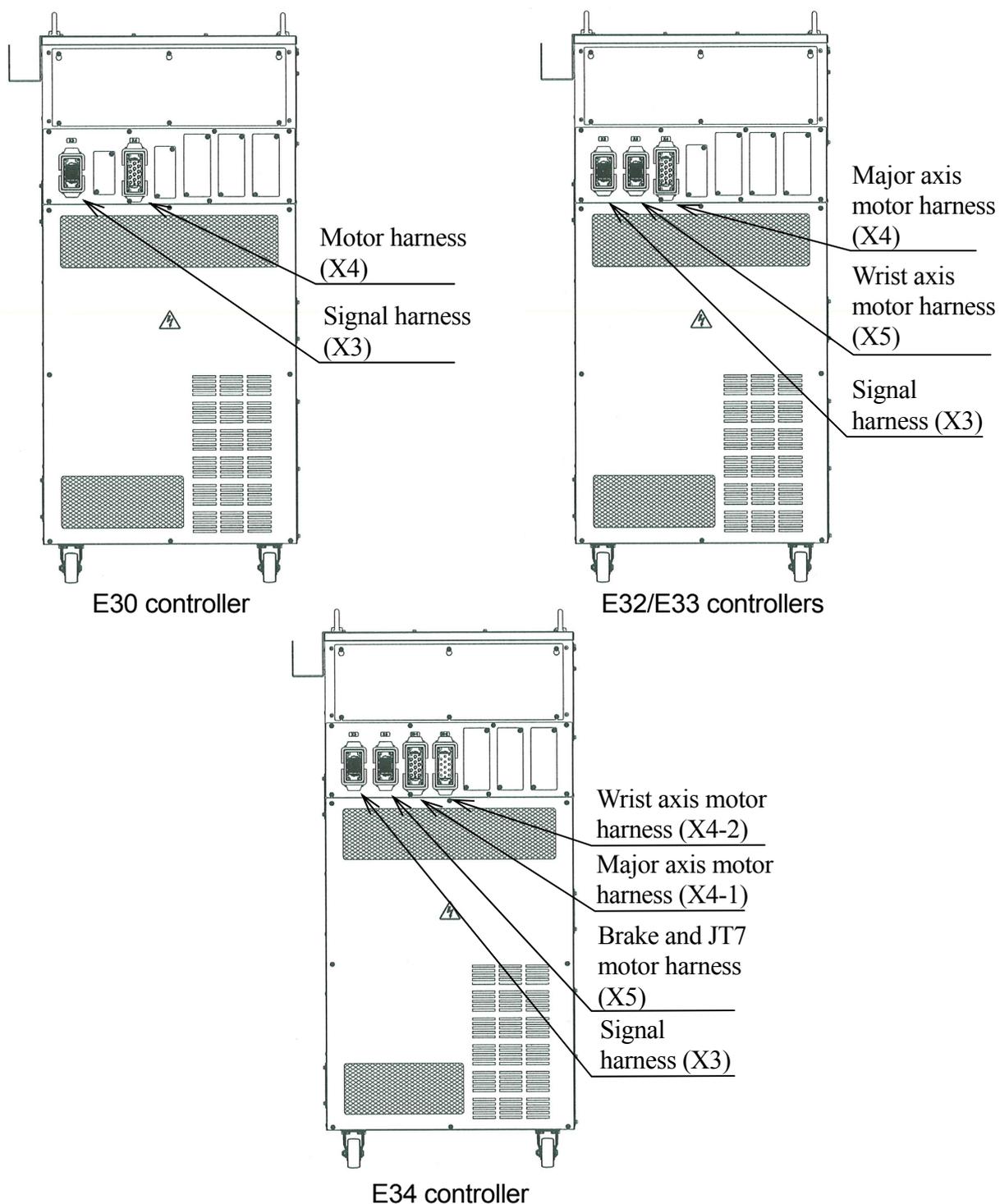
CAUTION

1. Fix each connector securely. The robot may malfunction if connectors loosen or detach.
2. 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.

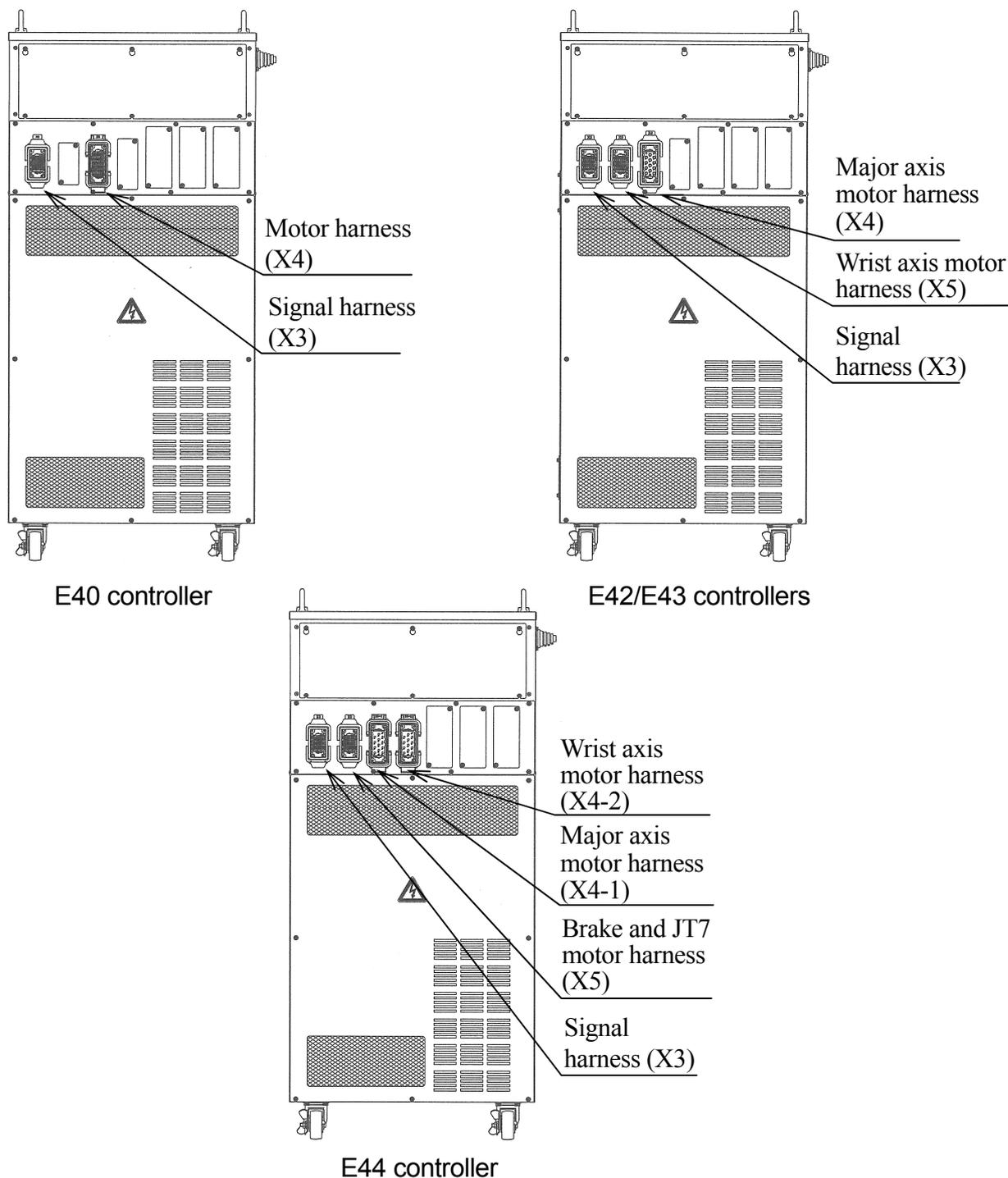


CAUTION

1. Fix each connector securely. The robot may malfunction if connectors loosen or detach.
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.

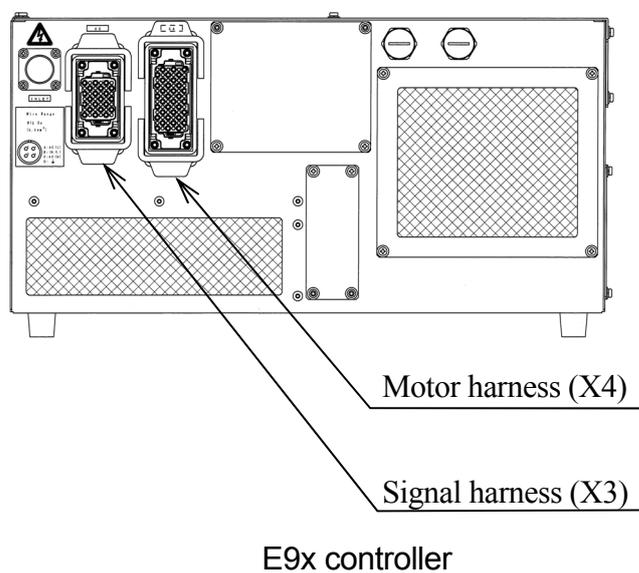
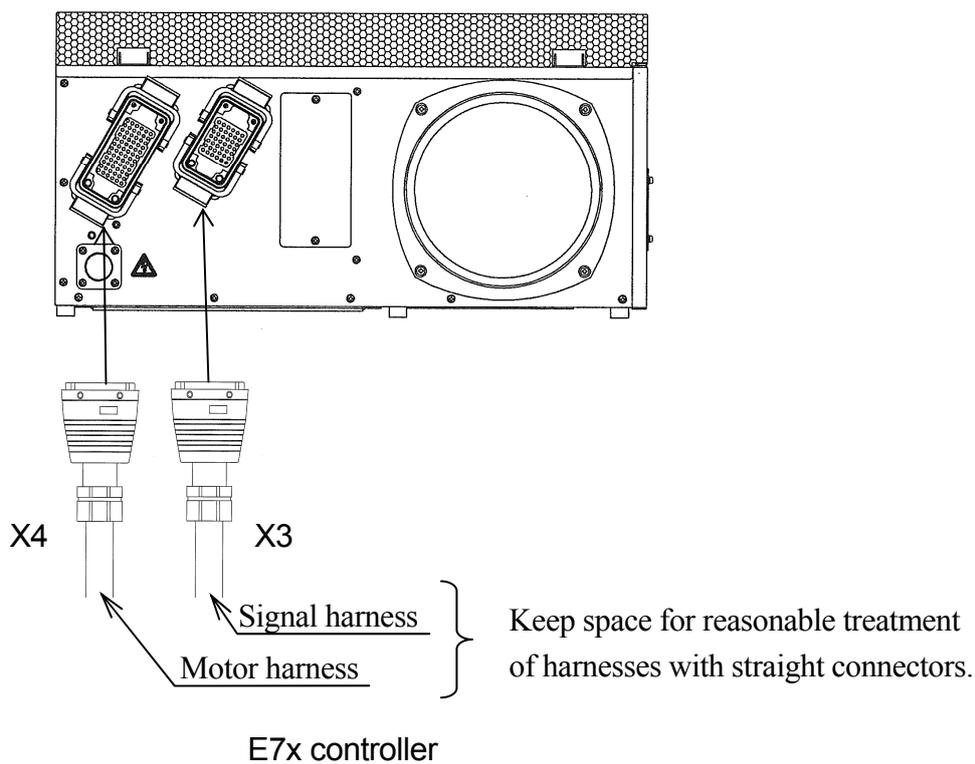


- ! CAUTION**
1. Fix each connector securely. The robot may malfunction if connectors loosen or detach.
 2. The harness should drop straight down from the connector. Because connectors are located at the upper part of controller, the controller might topple over if the connected harnesses are pulled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



⚠ CAUTION

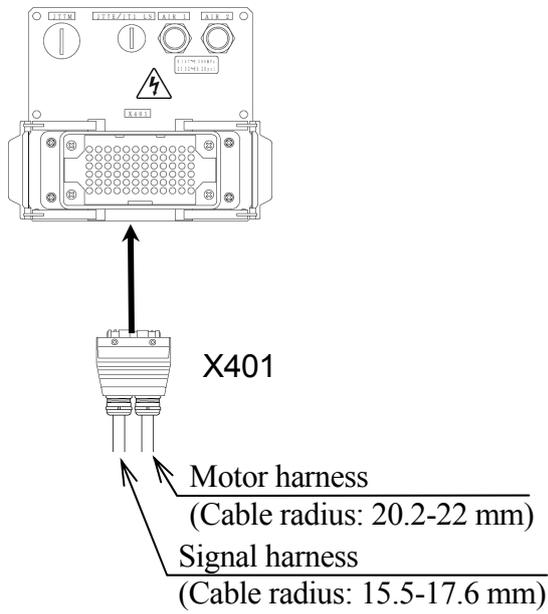
1. Fix each connector securely. The robot may malfunction if connectors loosen or detach.
2. The harness should drop straight down from the connector. Because connectors are located at the upper part of controller, the controller might topple over if the connected harnesses are pulled to the controller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



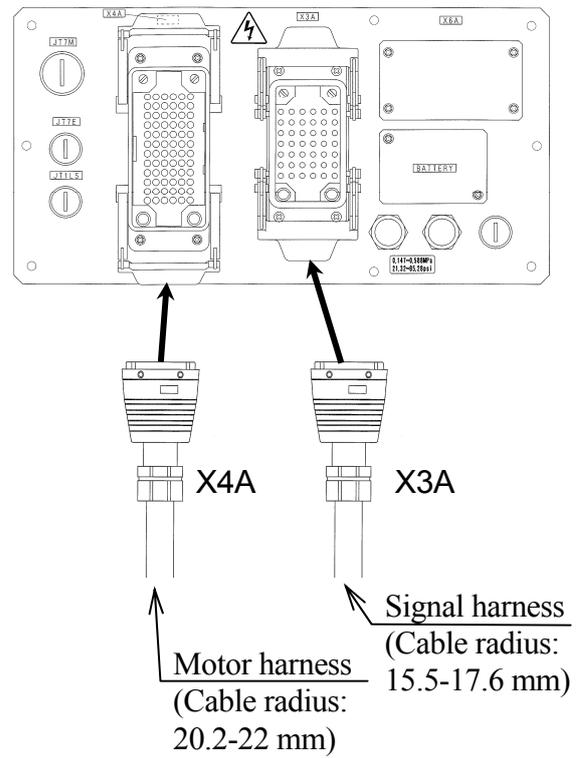
CAUTION

Fix each connector securely. The robot may malfunction if connectors loosen or detach.

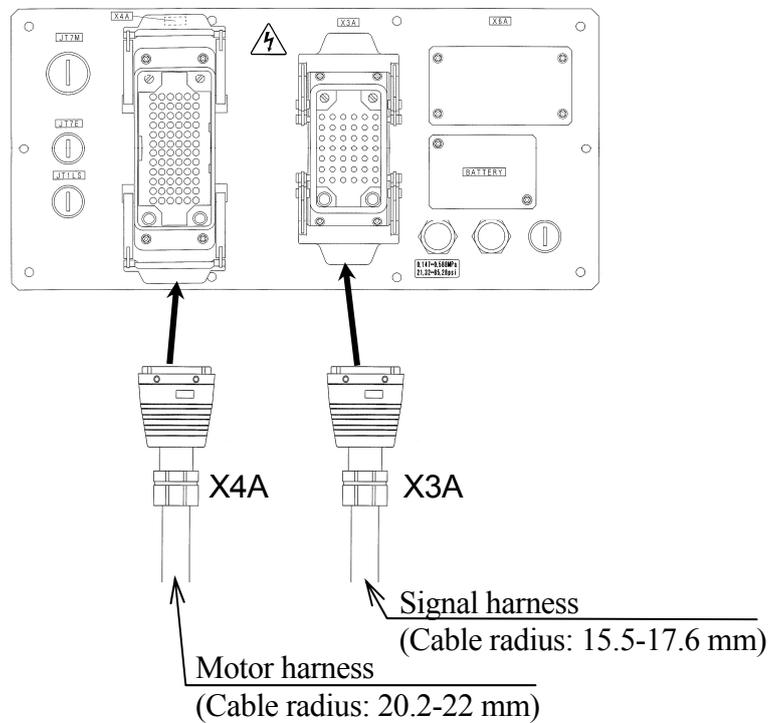
R series 03N/05N/05L



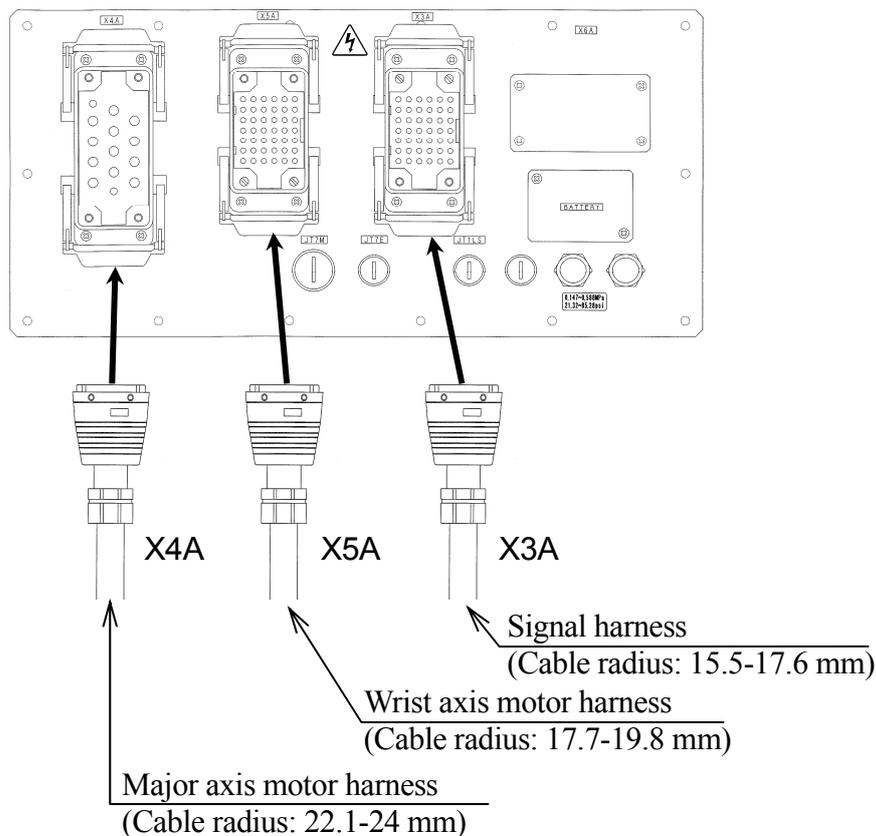
R series 10N/06L



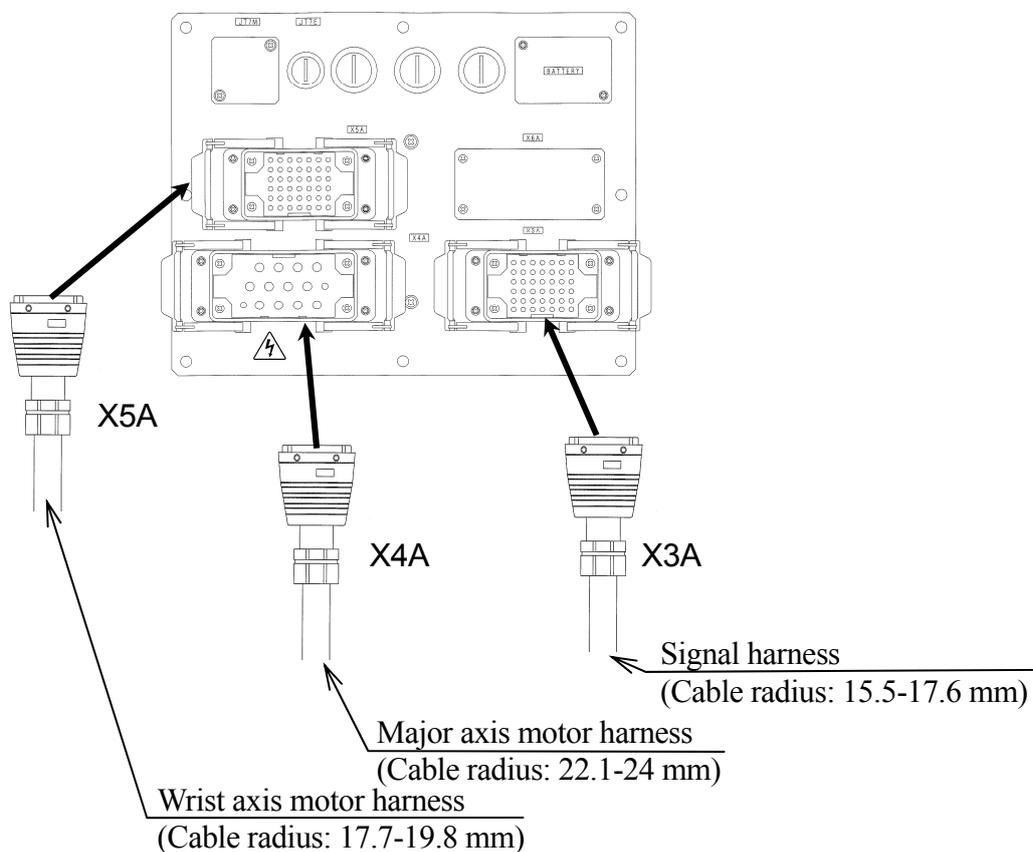
R series 20N/10L



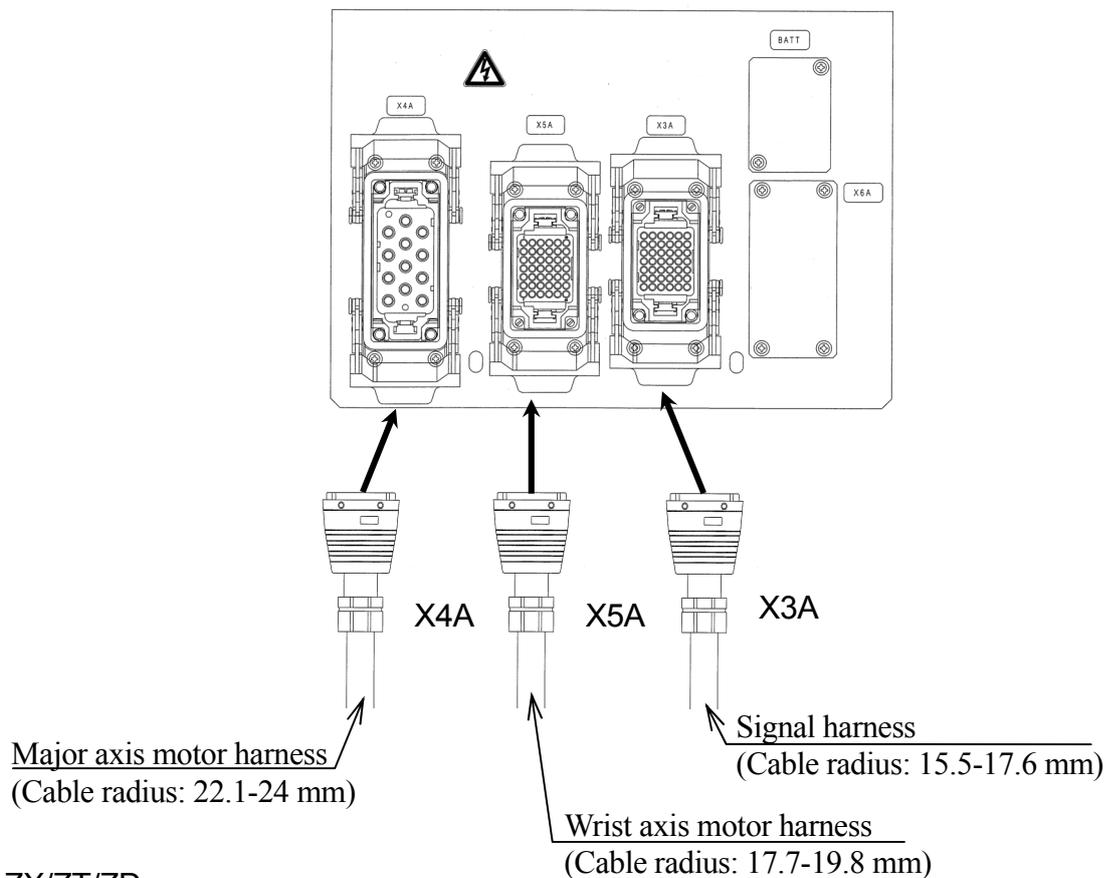
R series 30N/50N/80N/15X



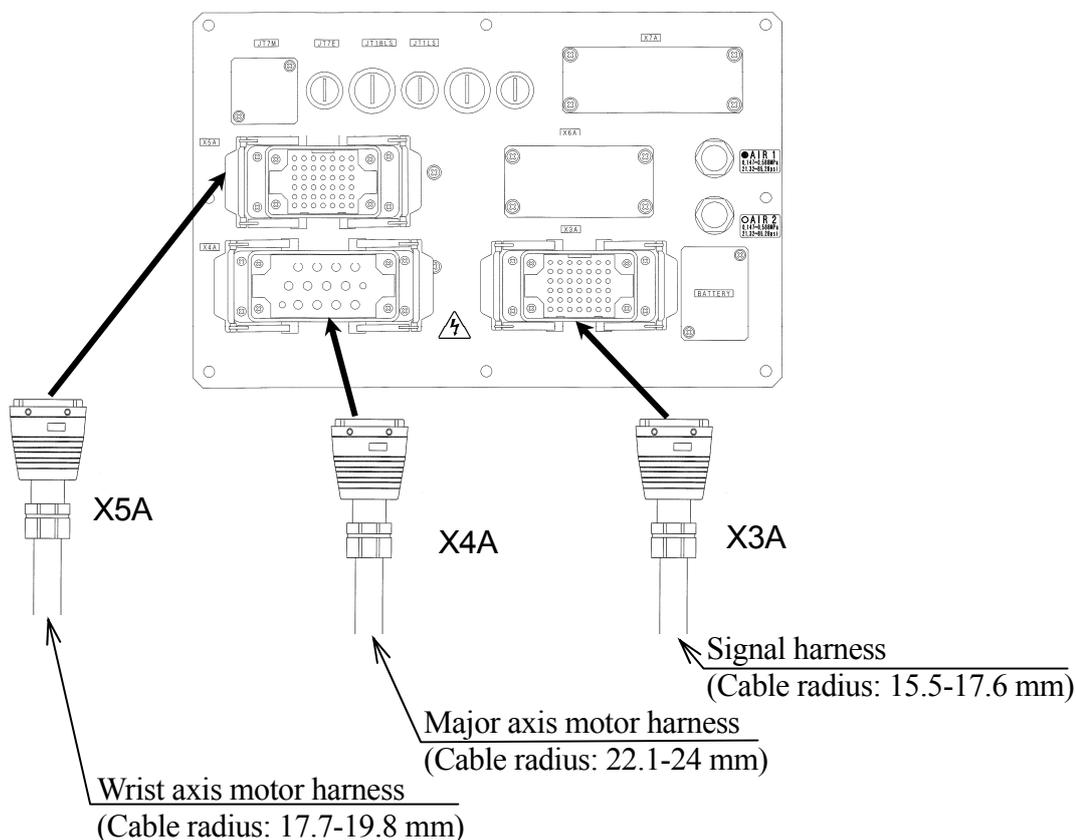
ZH



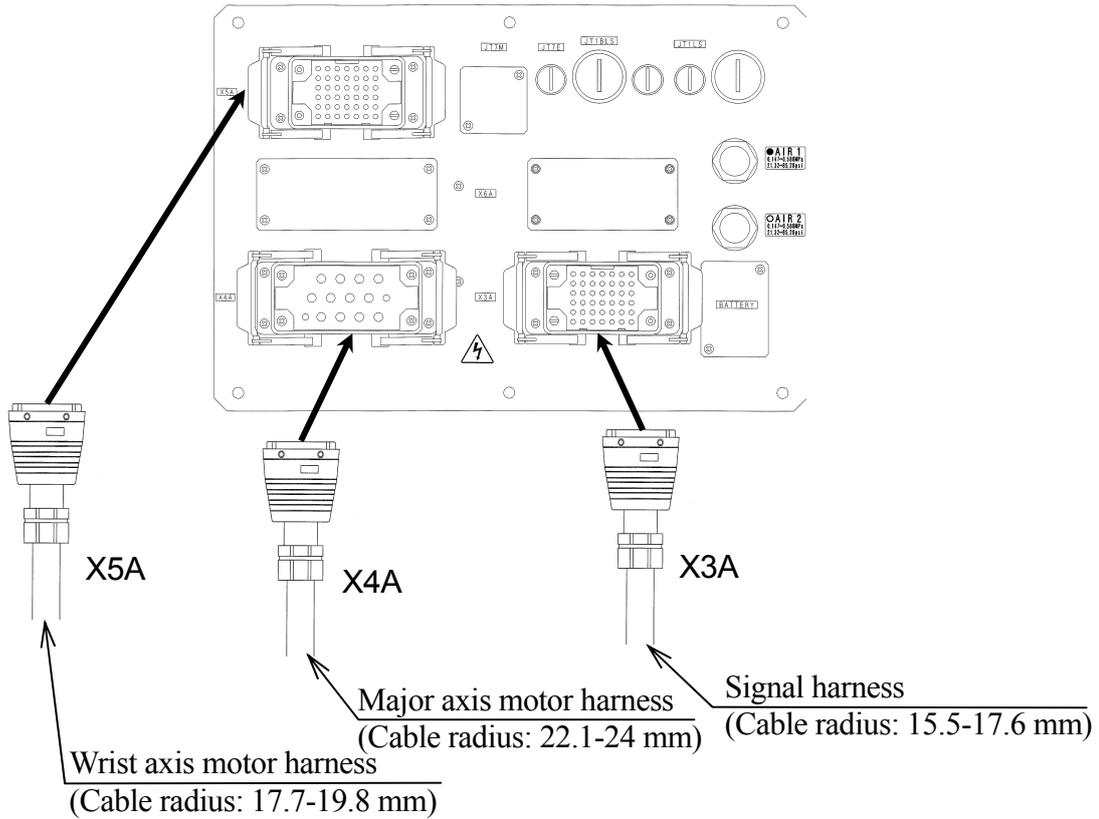
B series



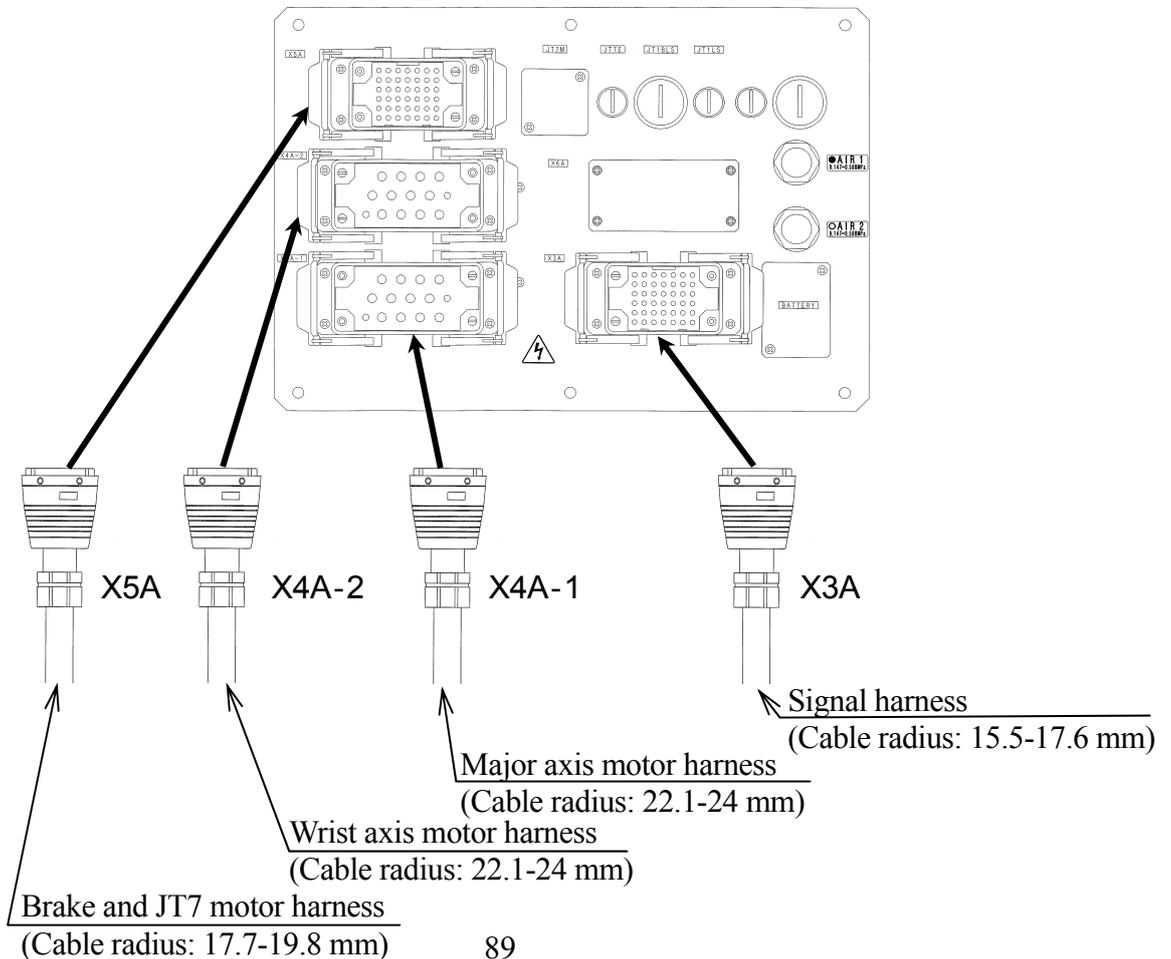
ZX/ZT/ZD



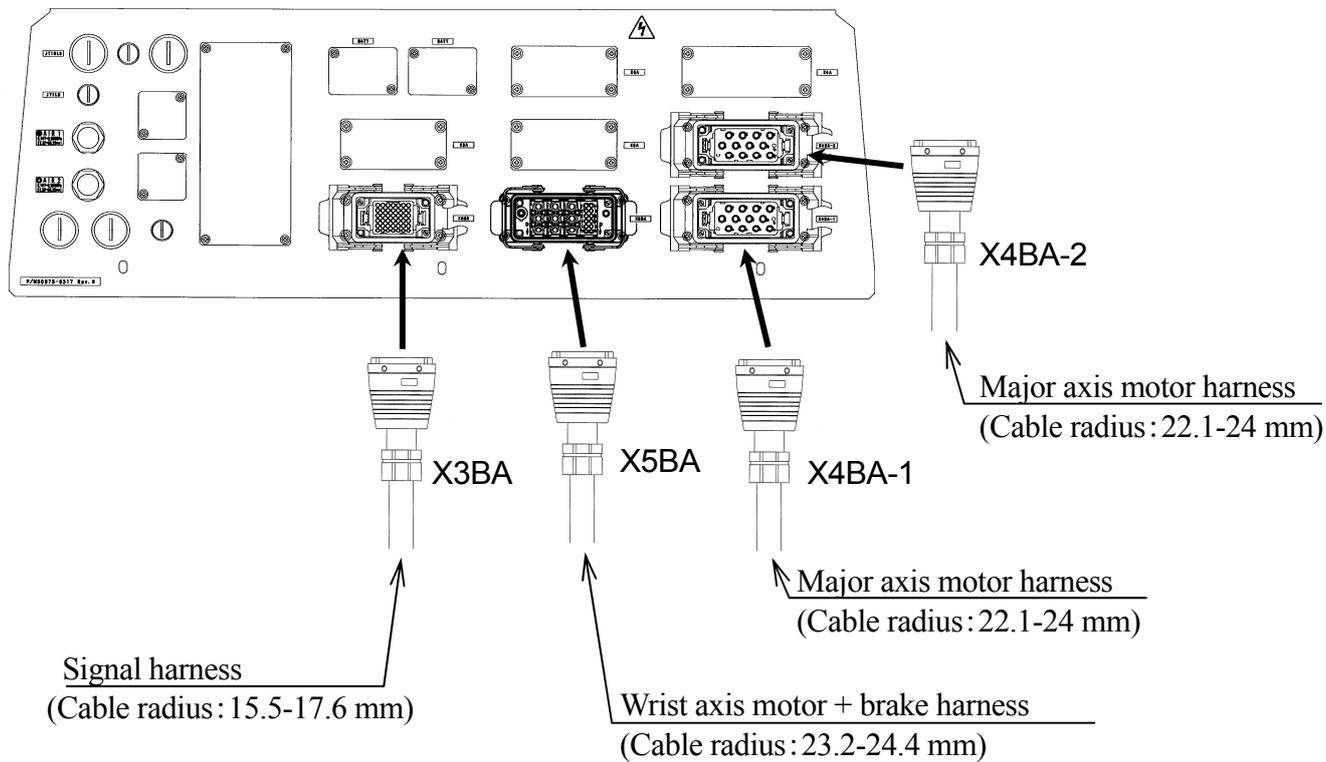
MT



MX/MD

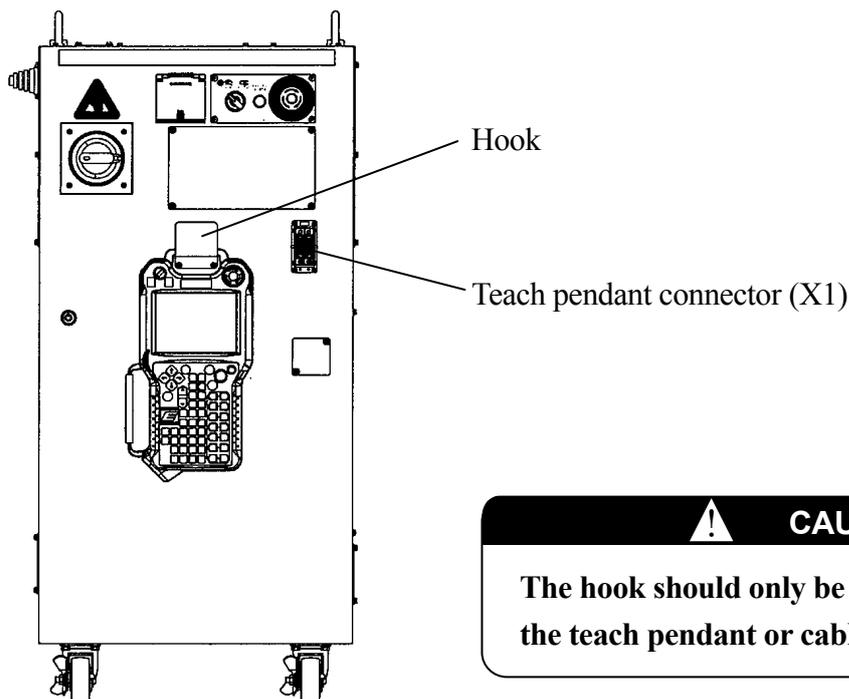


MG



6.2 CONNECTION BETWEEN CONTROLLER AND TEACH PENDANT

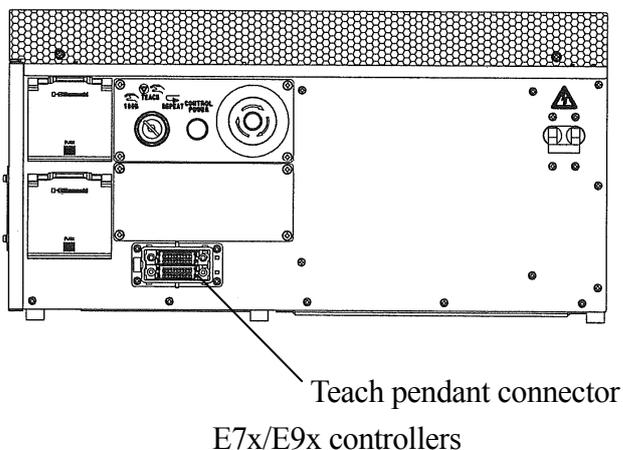
1. Connect the teach pendant cable with the connector, lower of operation panel. Pull up the lever and insert the cable side connector, then pull down the lever to lock the connectors.
2. Hang the teach pendant and the teach pendant cable on the hook. (No hook is provided for E7x/E9x controllers.)



CAUTION

The hook should only be used for hanging the teach pendant or cable.

This figure shows E2x controller.



(This figure shows E7x controller.)

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 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. 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 controller, make sure the power supply wiring is complete and all the covers reattached properly. Otherwise, failure to do so may cause electric shock.**

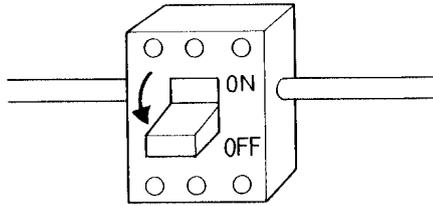


CAUTION

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 an earth 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.

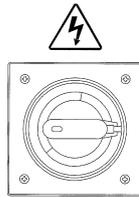
NOTE* Proximity switch directly connected with power line etc. may suffer from the influence.

E1x/E2x/E4x controllers

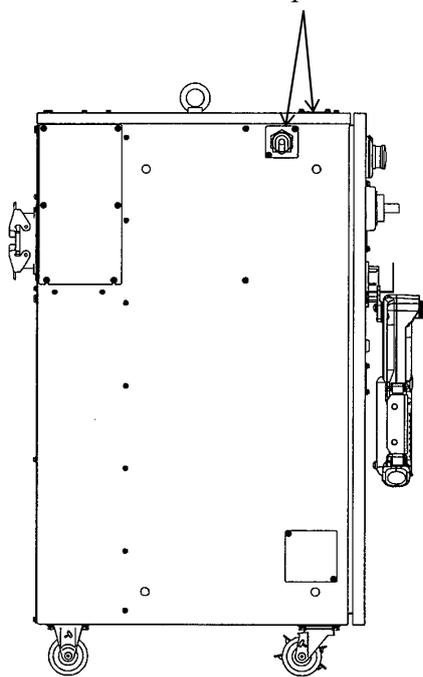


Connect with the external power circuit breaker at the installation site.

CONTROLLER POWER switch



External power inlet

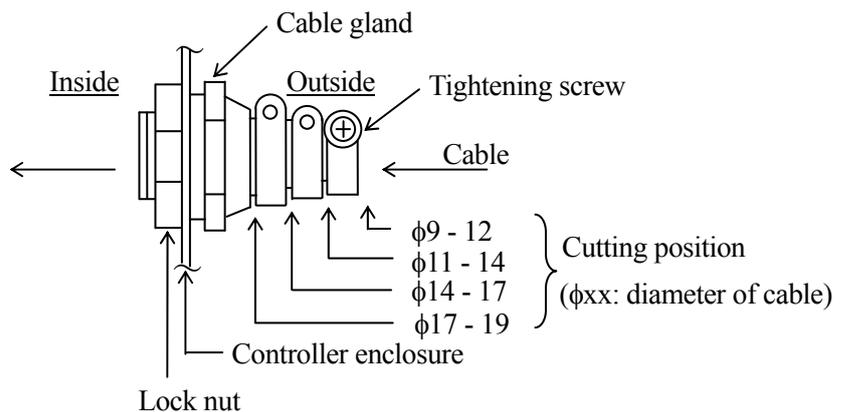


Connect the external power according to the following procedure.

1. Turn OFF the external power for the controller.
2. Set **CONTROLLER POWER** switch on the controller door to the OFF side.
3. Feed the external power cable into the inlet on the left side of controller.

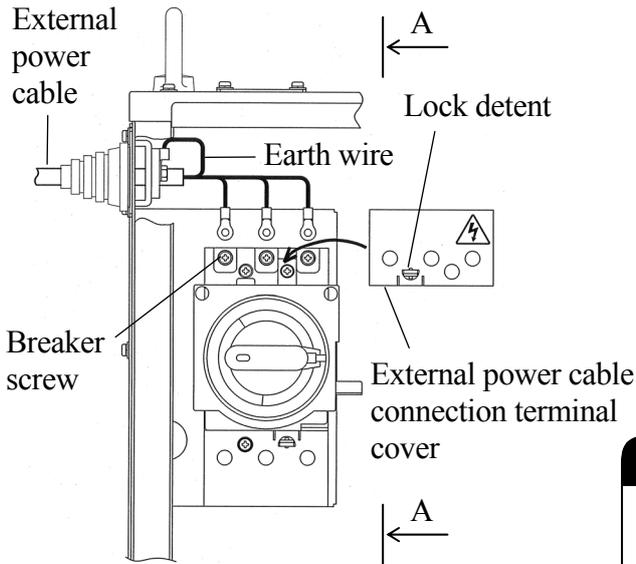
Detailed procedure of fixing a cable is shown below.

- Cut a cable gland (supplied with the controller) in accordance with the diameter of the cable.
- NOTE*:** If the cable diameter is more than $\phi 19$, prepare a seal connector which is appropriate for the cable diameter. The hole diameter of the plate is $\phi 34$.
- Pass the cable through the cable gland.
- Tighten the screw after adjusting length of the cable.
- Pass the cable through the inlet and tighten the lock nut.



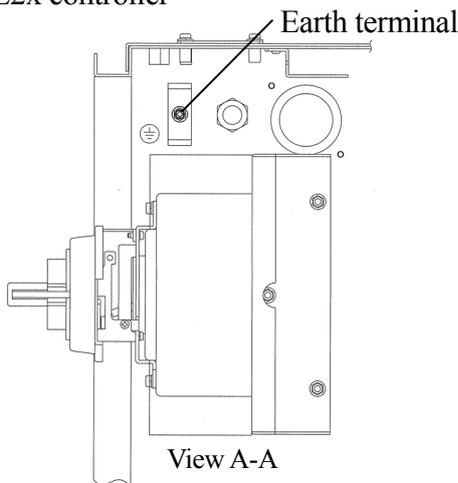
CAUTION

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.

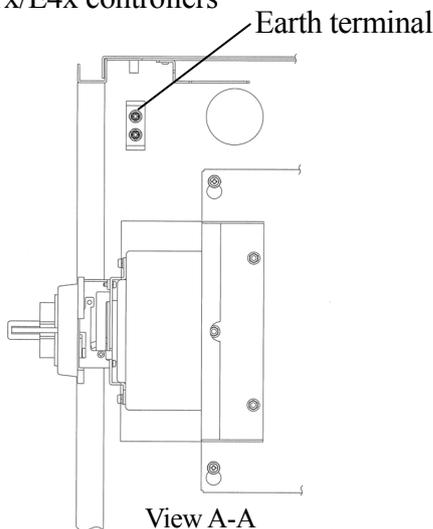


Connect the earth wire to the earth terminal as shown below.

E2x controller



E1x/E4x controllers



4. Attach round, crimp-type terminals on the ends of the individual wires of the power cable. Use round insulators on each of these wires to prevent contact between the crimped part and metal. (See left figure.)
5. Connect the external power cable to the breaker terminal (3 screws), and the dedicated earth terminal.

⚠ 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.

[NOTE]

As to E1x/E2x controllers without insulation transformer, make sure to connect earth phase S to the center terminal in the case of connecting external power to the breaker. If not, the earth leakage breaker might trip.

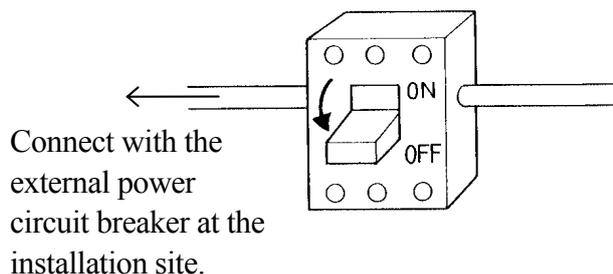
6. Mount the external power cable connection terminal cover.

⚠ 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.

Electric cable size to be used	Crimp-type terminal size	
	Breaker	Earth terminal
3.5 mm ² (AWG12)	R5.5-5	R5.5-5
5.5 mm ² (AWG10)		
8 mm ² (AWG8)	R8-5	R8-5
13 mm ² (AWG6)	R14-5	R14-5

E3x controller

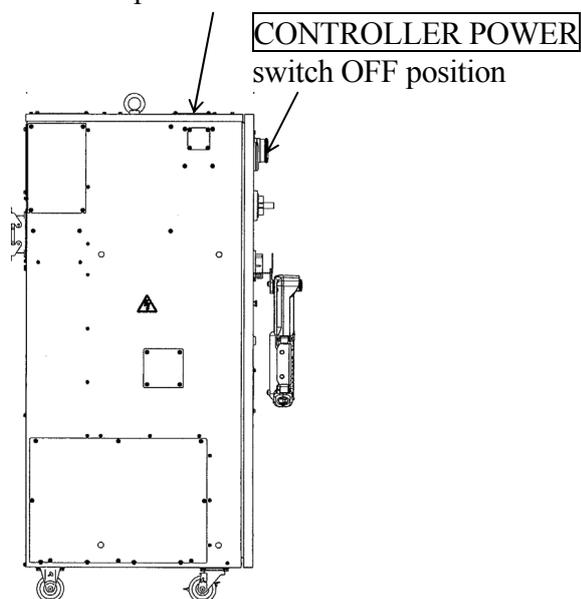


Connect with the external power circuit breaker at the installation site.

Connect the external power according to the following procedure.

1. Turn OFF the external power for the controller.

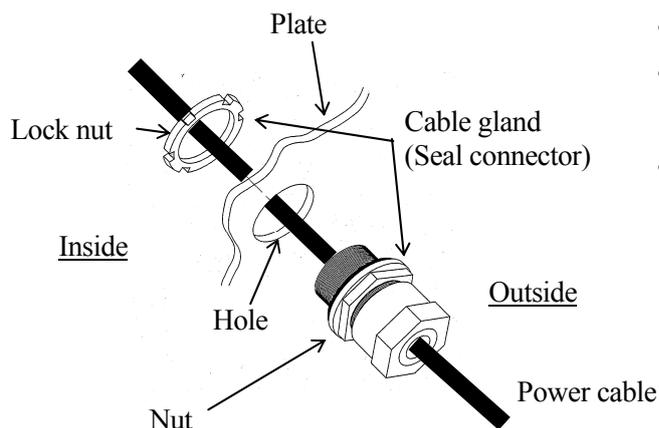
External power inlet



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

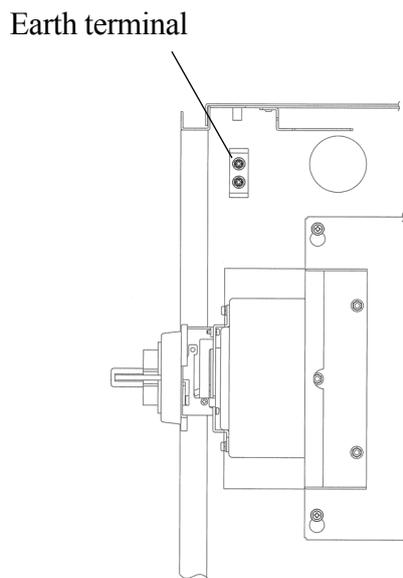
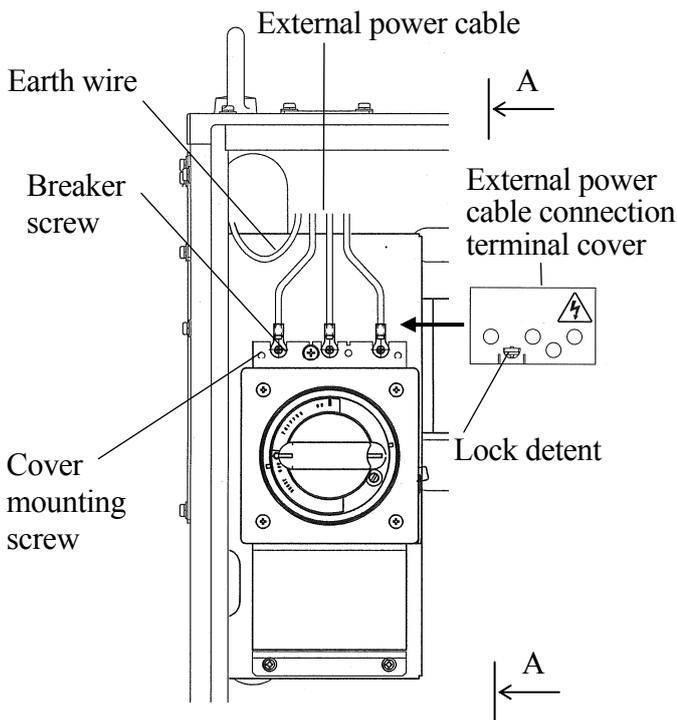
3. Feed the external power cable into the inlet on the top of the controller with following procedures.

- 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.
- Pass the cable through the inlet and tighten the lock nut.



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.



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 earth 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.

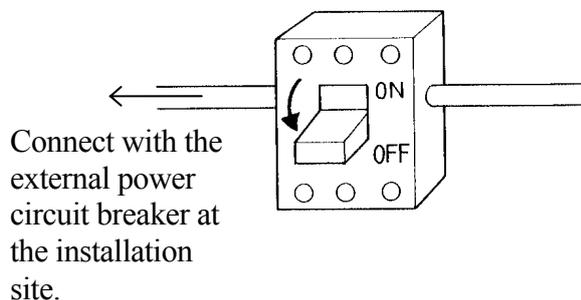
! DANGER

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: AC200-220V, AC380-415, AC440-480, AC515, AC575V

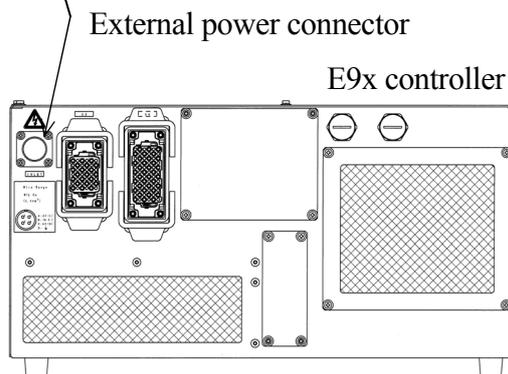
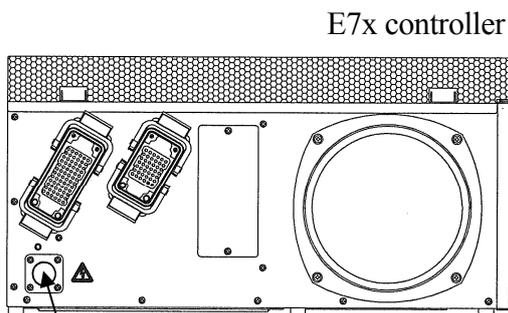
Electric cable size to be used	Crimp-type terminal size (Use the UL listed terminal)	
	Breaker	Earth terminal
3.5 mm ² (AWG12) 5.5 mm ² (AWG10)	R5.5-8	R5.5-5
8 mm ² (AWG8)	R8-8	R8-5
13 mm ² (AWG6)	R14-8	R14-5

E7x/E9x controllers

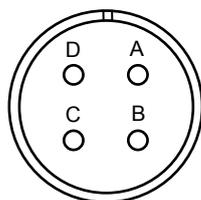


Connect the external power according to the following procedure.

1. Turn OFF the external power for the controller.
2. Set **CONTROLLER POWER** switch on the front of the controller to the OFF position without fail.
3. Connect the external power cable to the external power connector on the rear of the controller.
 - Solder the attached connector on the external power cable. The figure below shows pin configuration of connector.



External power connector



A	AC(L)
B	(N.C.)
C	AC(N)
D	FG

Wiring diagram of attached connector



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.

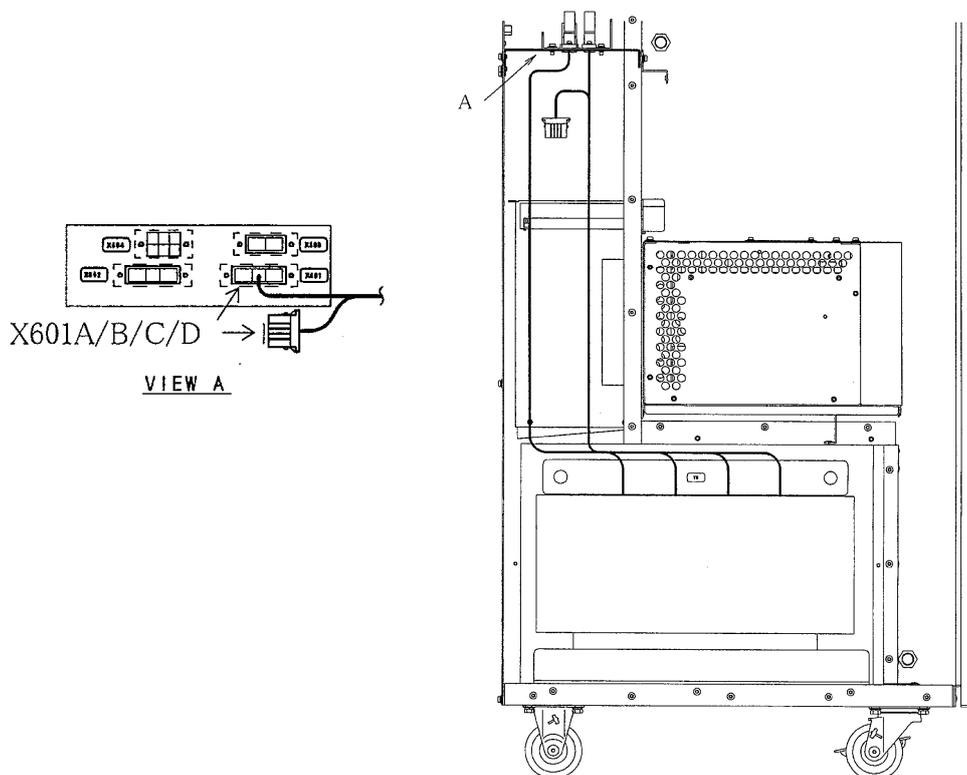
7.1 CHANGE OF EXTERNAL POWER INPUT VOLTAGE (ONLY FOR E1X/E3X CONTROLLERS WITH OPTIONAL TRANSFORMER)

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

Specification	External power input voltage	Connector
E1x series (optional) 380-400/440 V	380/400 V	X601A
	440 V	X601B
Specification	External power input voltage	Connector
E3x series (optional) 380-415/440-480/515/575 V	380/400/415 V	X601A
	440/460/480 V	X601B
	515 V	X601C
	575 V	X601D

Specification	External power input voltage	Connector
E28 controller	200/220 V	X601A
	380/400/415 V	X601B
	440/460/480 V	X601C

To change the connection, remove the bottom panel on the back side of the cabinet.

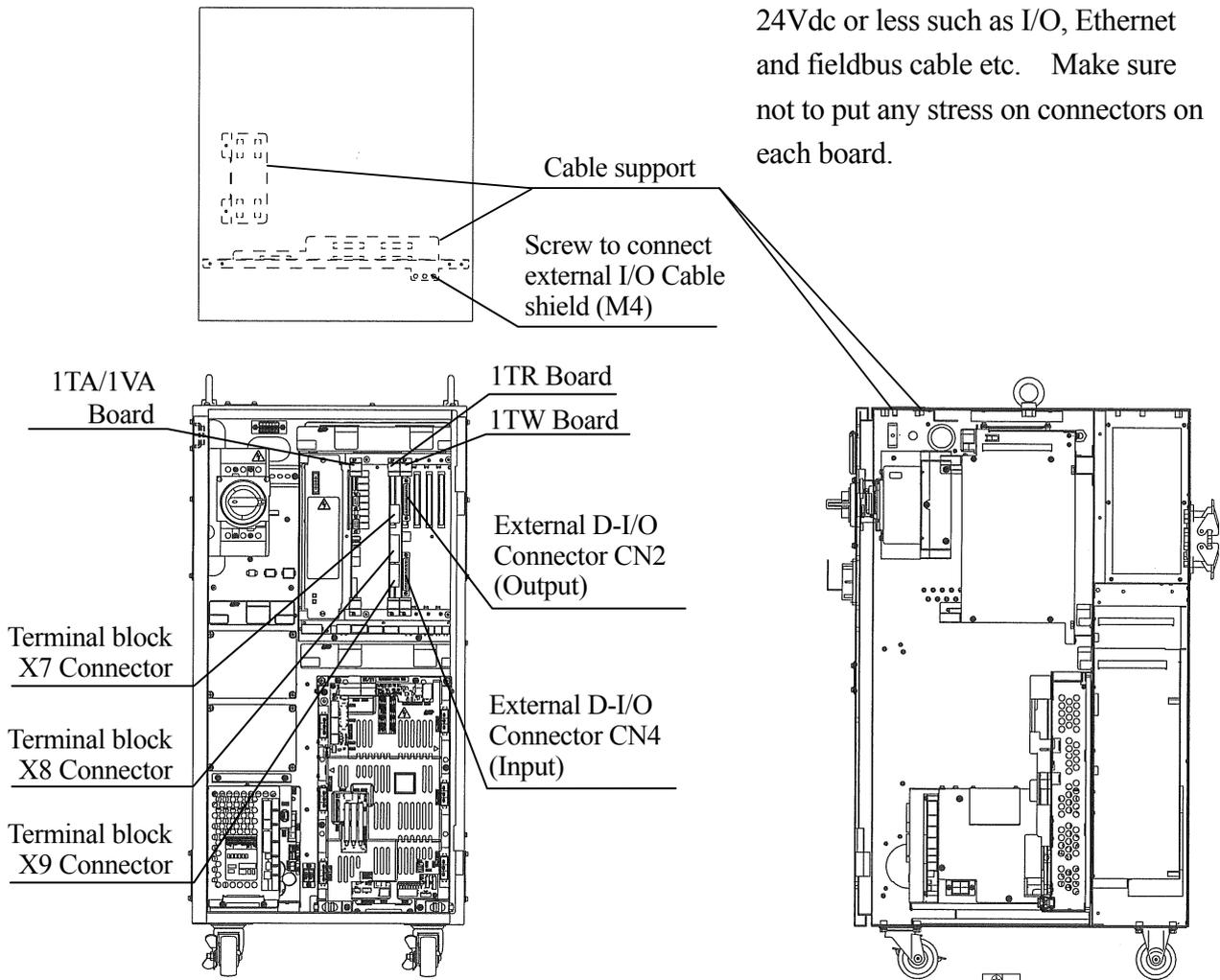


8.0 CONNECTION OF PERIPHERAL CONTROL EQUIPMENT

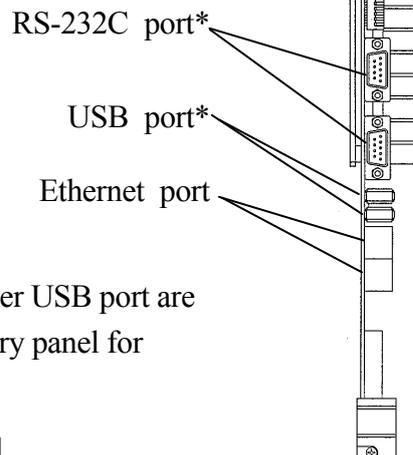
According to application specifications, connect the peripheral controller or devices to the respective connectors in the controller as shown below.

E2x controller

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

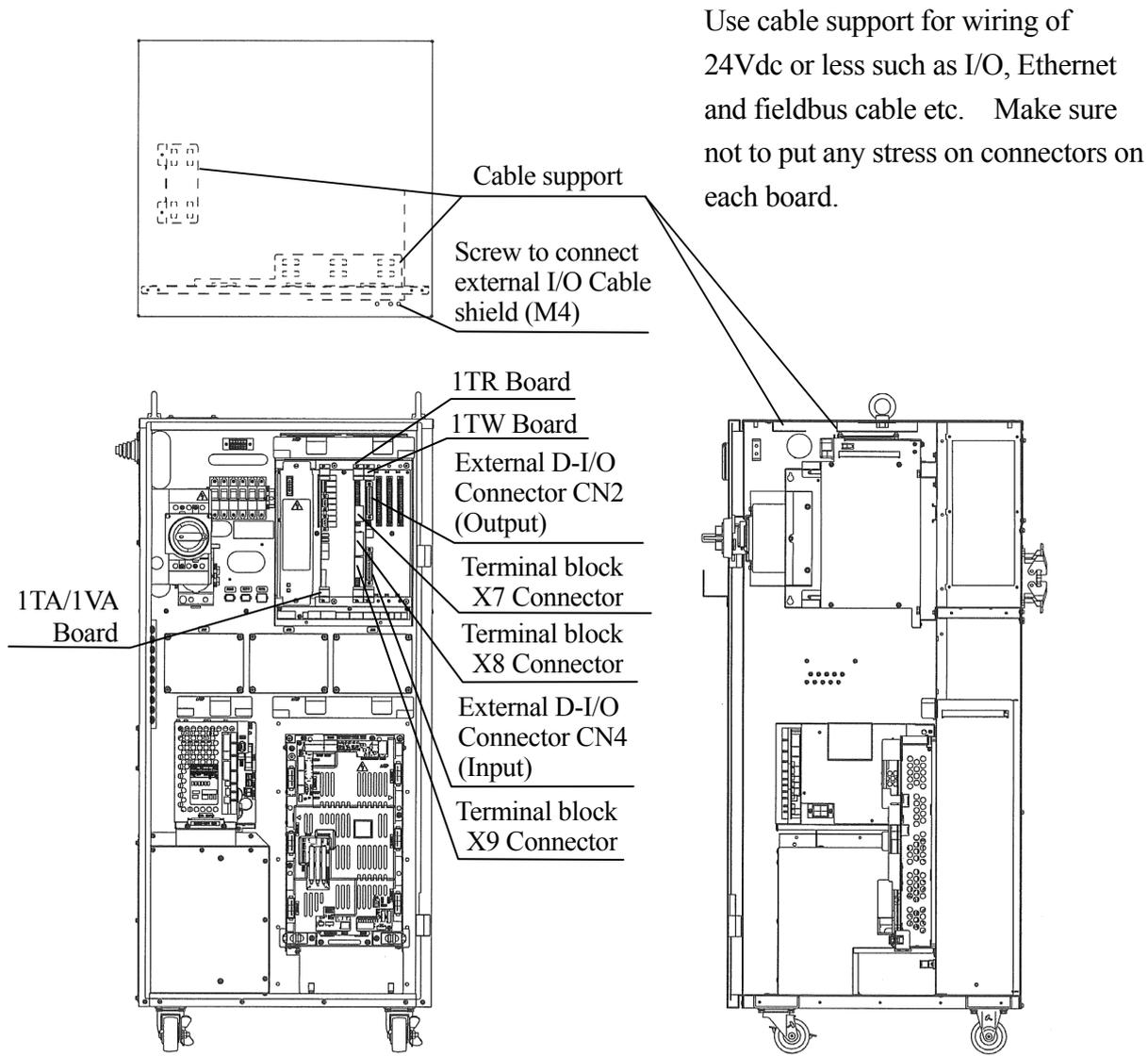


See the right figure for details on connecting ports of 1TA/1VA board.

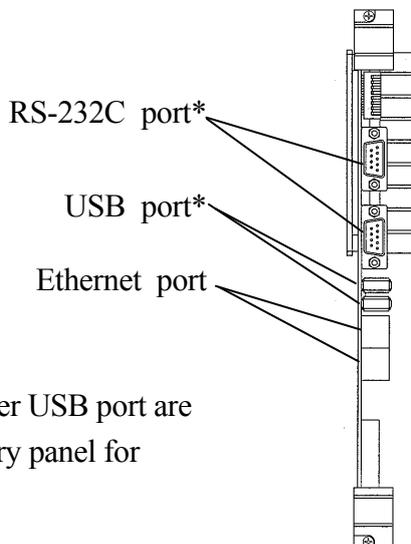


NOTE*: The upper RS-232C port and the upper USB port are connected to each port in the accessory panel for standard specification.

E1x/E3x/E4x controllers

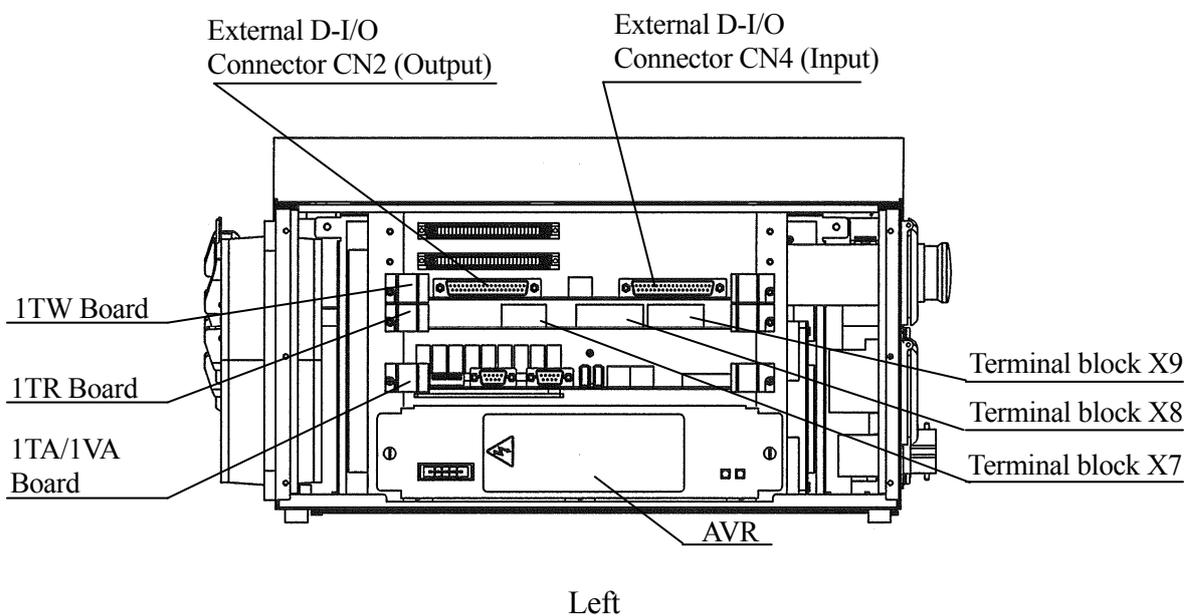
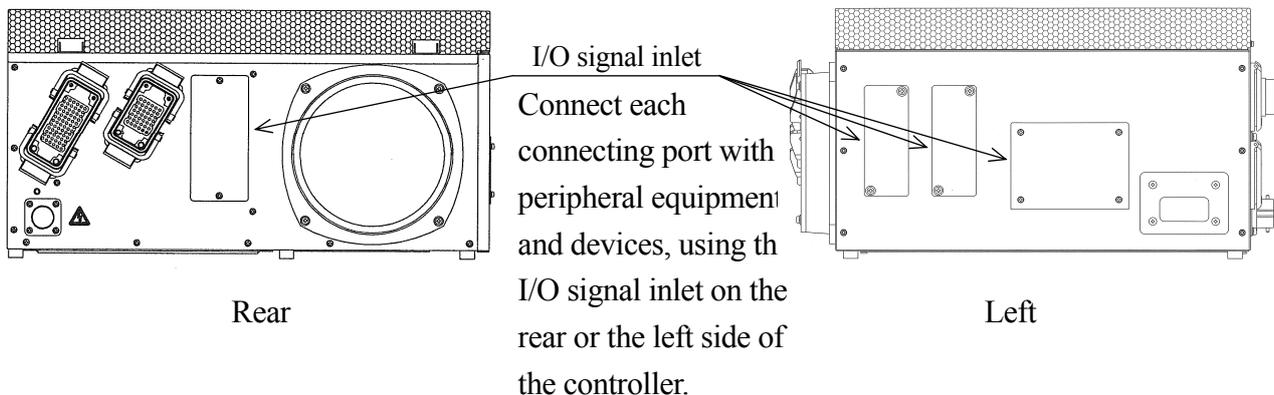


See the right figure for details on connecting ports of 1TA/1VA board.

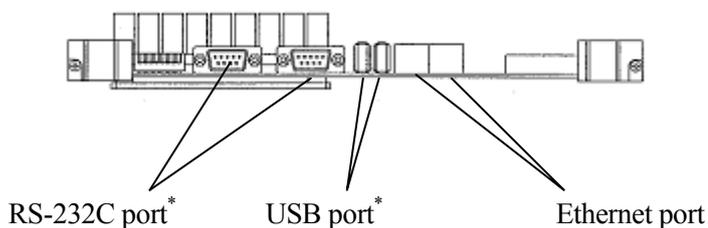


NOTE*: The upper RS-232C port and the upper USB port are connected to each port in the accessory panel for standard specification.

E7x controller

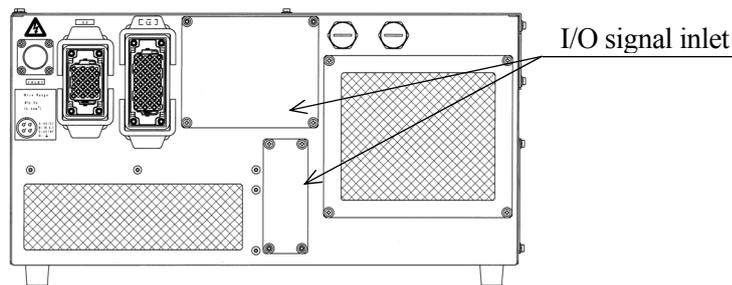


See the right figure for details on connecting ports of 1TA/1VA board.

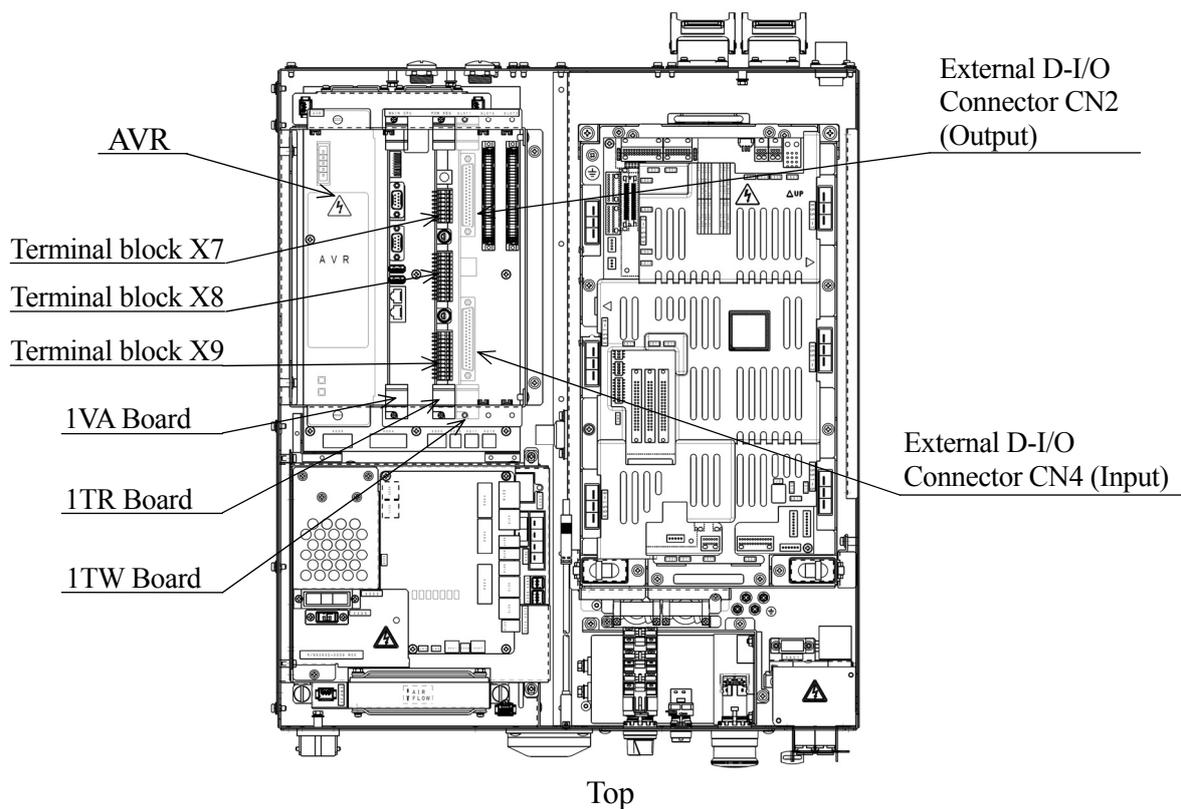


NOTE*: The left RS-232C port and the left USB port are connected to each port in the accessory panel for standard specification.

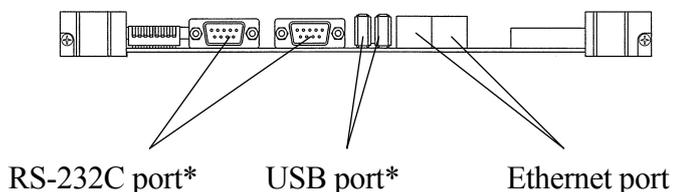
E9x controller



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 and the left 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
E1x/E2x/E3x/E4x	Padlock the main breaker handle.
E70/E71/E73/E74	Mount the attached lock part or disconnect the external power connector.
E76/E77/E91/E94/E97	Lock by attached lock fitting or padlock, or disconnect the external power connector.

⚠ 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

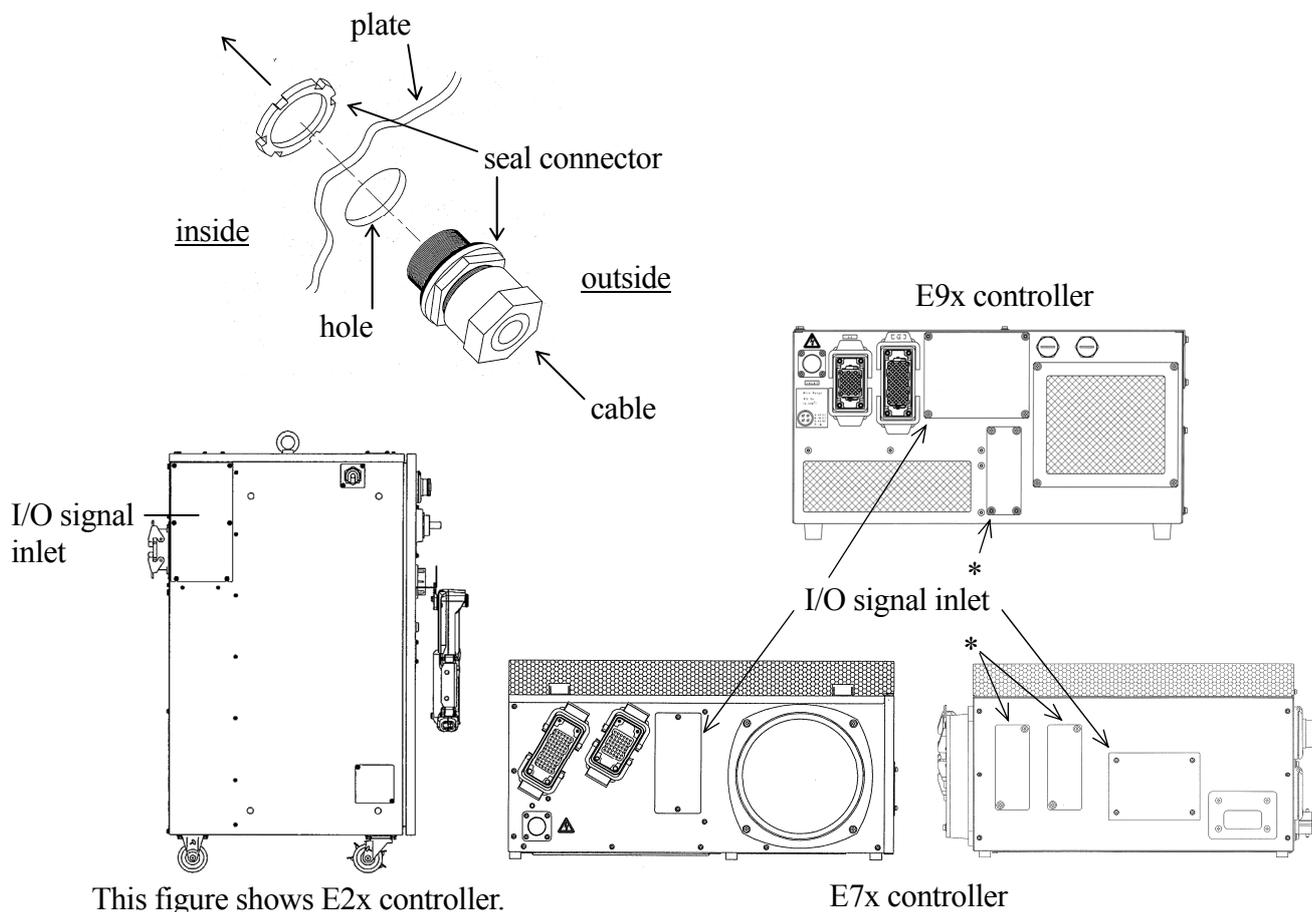
The robot can operate synchronously with the peripheral equipment or other robots when connecting I/O signals to the peripheral controller with connectors CN2 and CN4 on the 1TW board. (Connectors on the cable side of CN2 and CN4 are optional.)

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

I/O signal inlet: Left side of the controller for E1x/E2x/E3x/E4x, rear or left side of the controller for E7x, rear of the controller for E9x

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.



This figure shows E2x controller.

E7x controller

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.

[NOTE]

On the plate part shown with *, cables can be put through by mounting commercial cable entry (manufactured by PHOENIX CONTACT, KEL cable entry system).

6. Cover the connector pin with the insulation tube.

[NOTE]

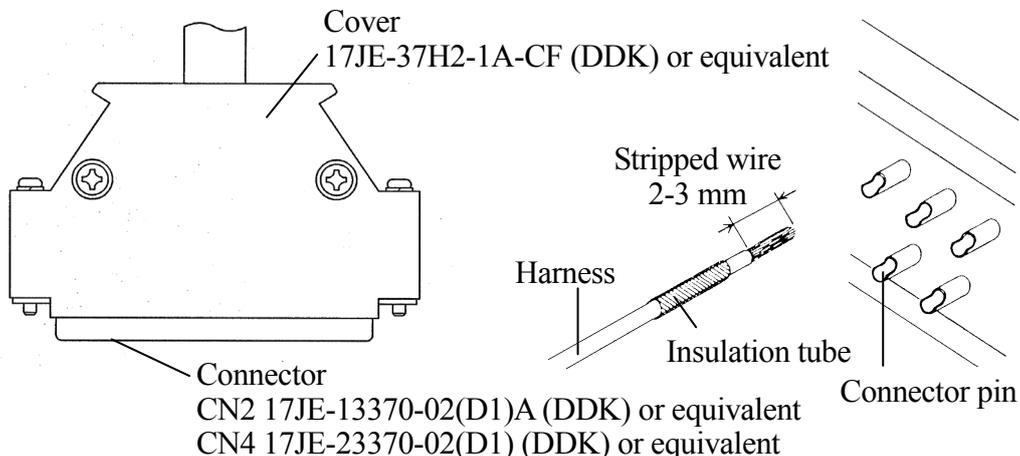
1. Use an insulation tube of heat shrinkage type, or bind the tube ends on each line so they do not come off.
2. We recommend using AWG22-24 or equivalent for cables.

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

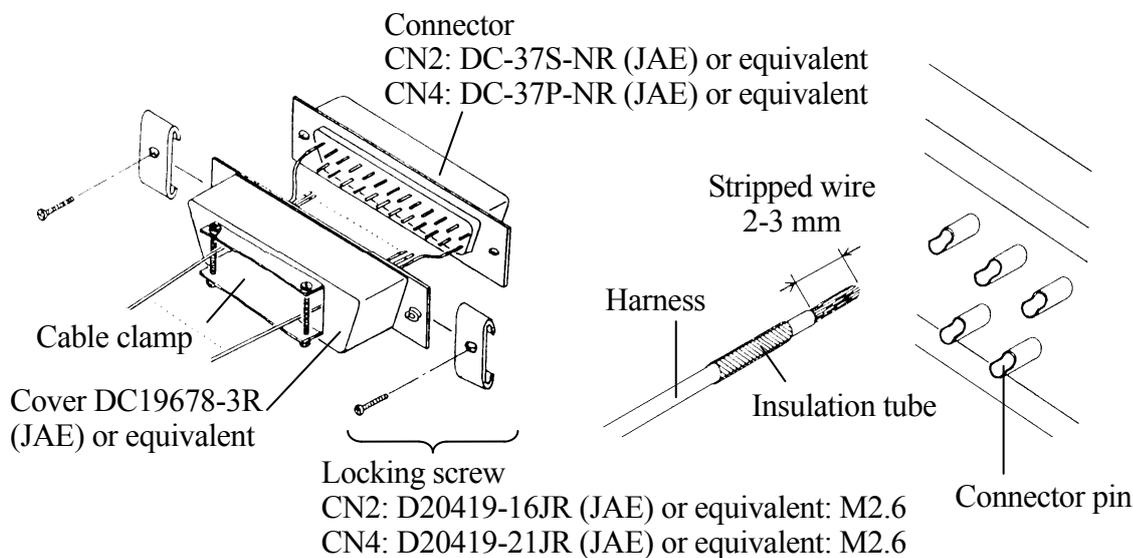
8. Insert the connector into 1TW board and fix with locking screws at both ends.

[NOTE]

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



E1x/E2x/E3x/E4x controllers

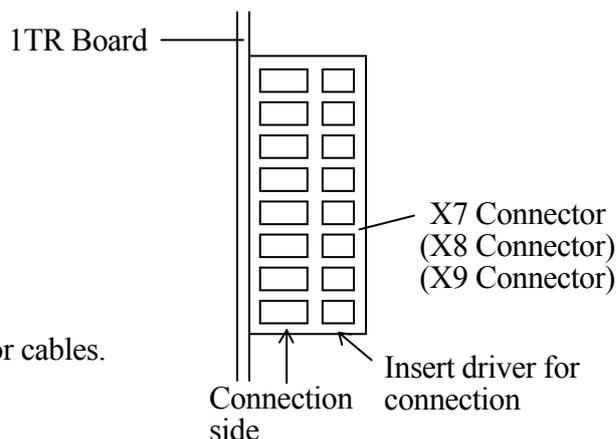


E7x/E9x controllers

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 1TA/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 1TA/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 1TA/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)

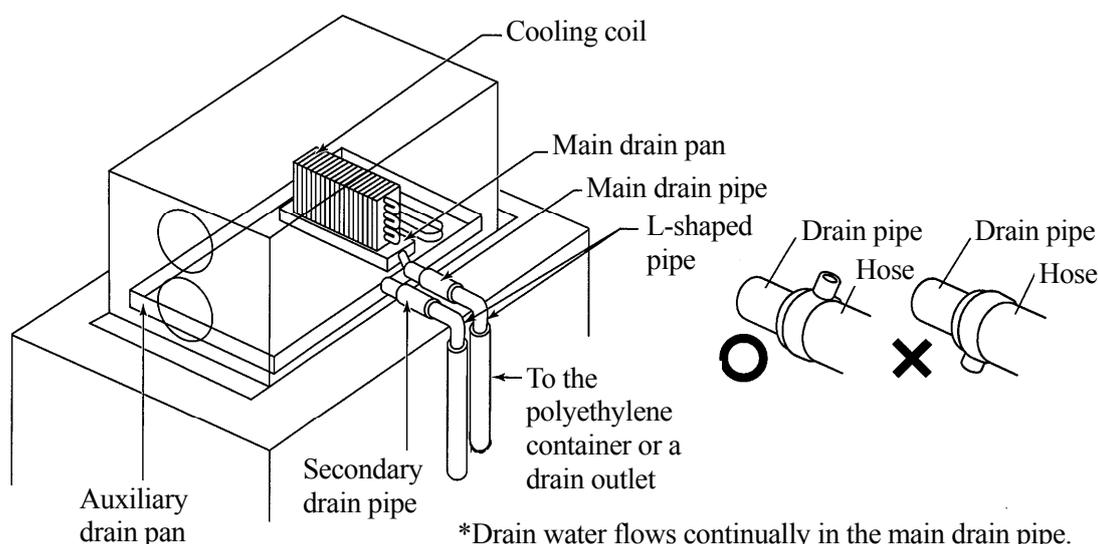
Input from sensors mounted on arm and control of output of driving energy to the valves become available by adding arm ID and machine I/O boards, such as 1PV, 1JD, 1JE, 1TK and 1TY boards. Refer to the option manuals 90210-1246DE* and 90210-1247DE* for details.

8.9 COOLER DRAIN PIPING OF E28 CONTROLLER

The E28 controller is equipped with a cooler and the drain water is discharged during the operation. Carry out the drain piping following the procedure shown below.

1. Connect a drain hose to the drain pipe located on the back side of the cooler.
2. Make sure to connect hoses to both the main and secondary drain pipes.
3. Fix the drain hose, the drain pipe, and the L-shaped pipe using a tying band as shown in the figure below.

*Make sure that the clamp for the tying band faces upward.

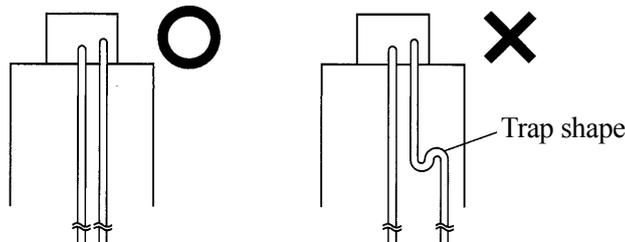


- *Drain water flows continually in the main drain pipe. Make sure to connect it to a polyethylene container or a drain outlet.
- *The secondary drain pipe is a drain pipe for emergency use when the main drain pipe is blocked with something.

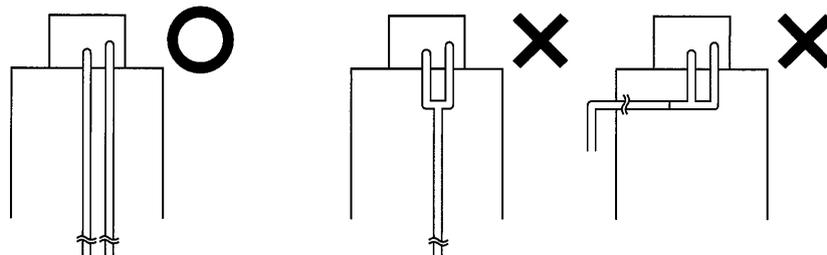
8.9.1 PRECAUTIONS TO BE TAKEN DURING DRAIN PIPING

<Appropriate piping method of drain water>

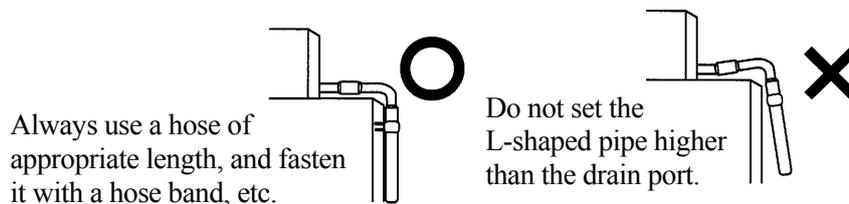
1. The cooler has the double drain pan structure as a measure against water leakage, however, the water may leak if the piping is not carried out following the procedure below. In addition, the drain water is unable to be drained in the pipe with drain trap.



2. If discharging the drain water by linking two drain pipes into one, the drain water may flow backward or leak. Make sure to arrange the main drain pipe and secondary drain pipe separately.

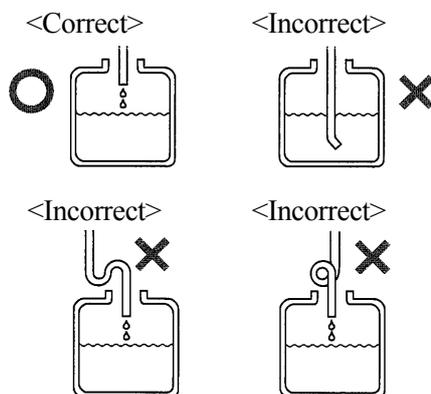


3. Make sure that the corner section to which an L-shaped pipe is connected is not raised.



4. The drain hose must be arranged as shown below.

*When storing the drain water in a container, do not immerse the hose in the water.



*If the hose is immersed in the water, the drain water does not flow smoothly.

*The drain water is dropped naturally, so be sure to set the hose in such a way that the water can drain smoothly. If the hose sags or is blocked somewhere, the drain water will not be discharged smoothly.



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