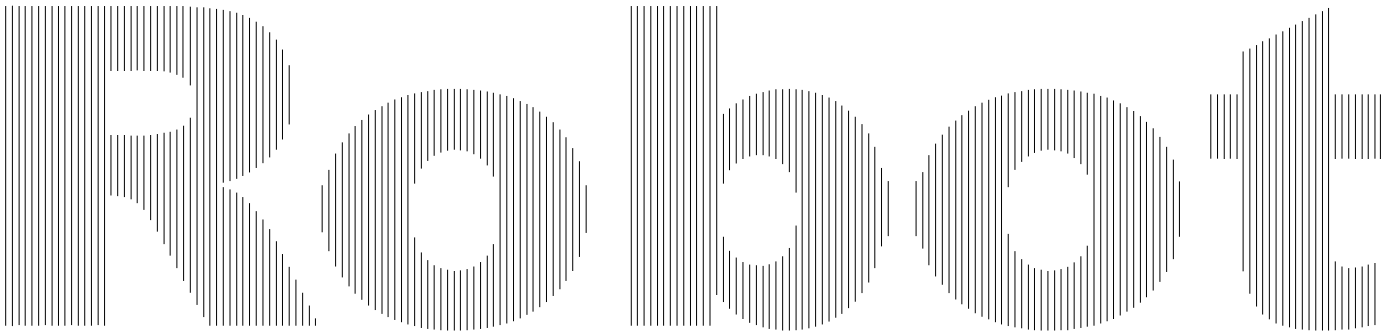
Simple and friendly

Kawasaki

Kawasaki Robot Controller
T Series

Installation and Connection Manual



Kawasaki Heavy Industries, Ltd.

90202-1126DEB

PREFACE

This manual describes the installation and connection of the T controllers.

This manual covers the installation, wiring and connection of controllers, devices and external power. Please refer to "Operation 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.

T51, T52, T81

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

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SYMBOLS

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

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

[NOTE]

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

⚠ WARNING

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

CONTENTS

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, INSTALLATION AND STORAGE

To transport the Kawasaki Robot Controller to its installation place, strictly observe the following cautions while carrying out the transportation, installation and storage 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

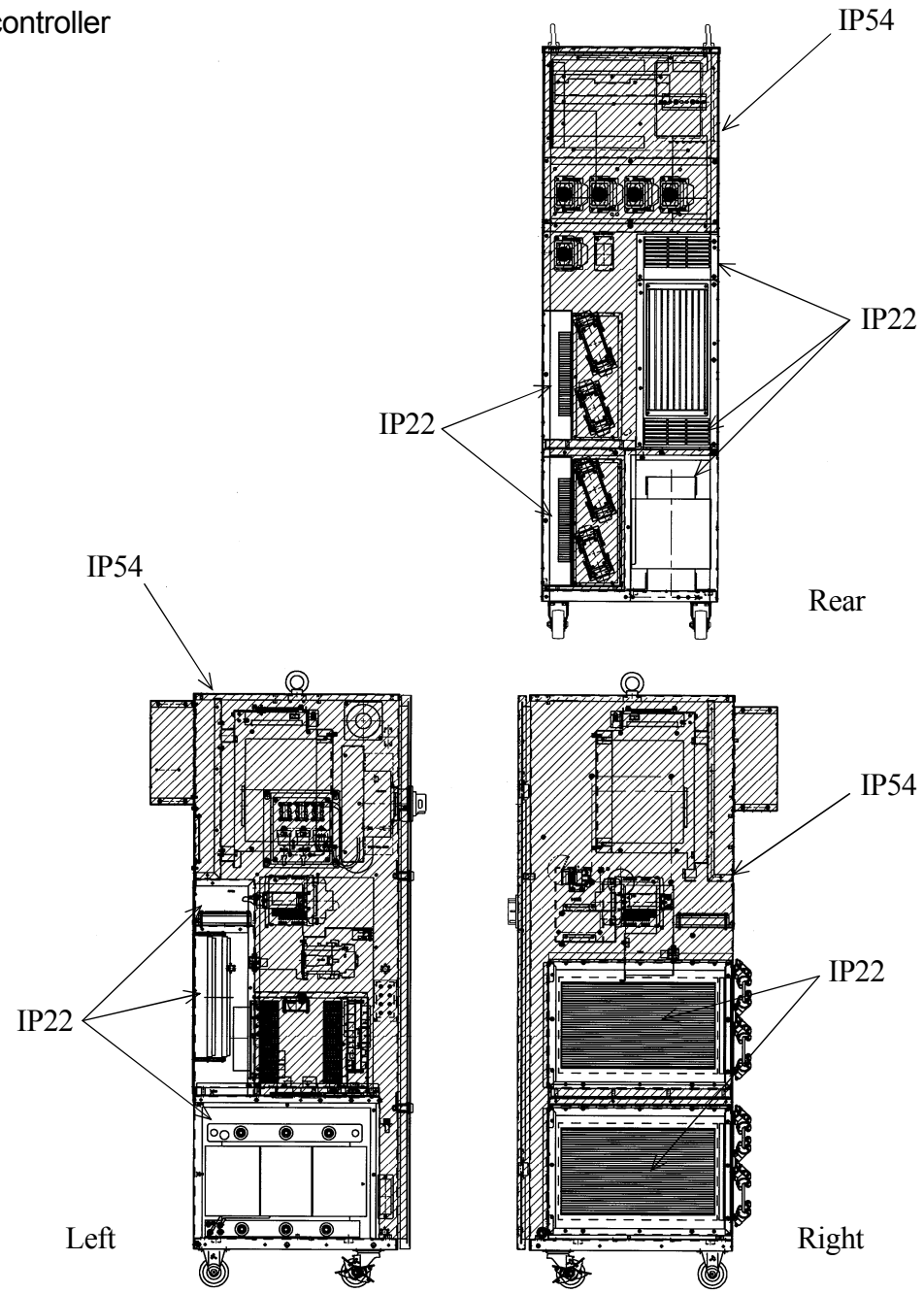
1. **Since the controller is composed of precision parts, be careful not to apply excessive shocks or vibrations to the controller during transportation.**
2. **To carry out smooth and safe installation, remove all obstacles before installing a controller. Clear a passage for the transportation of controller before using a crane or forklift.**
3. **When transporting, installing 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

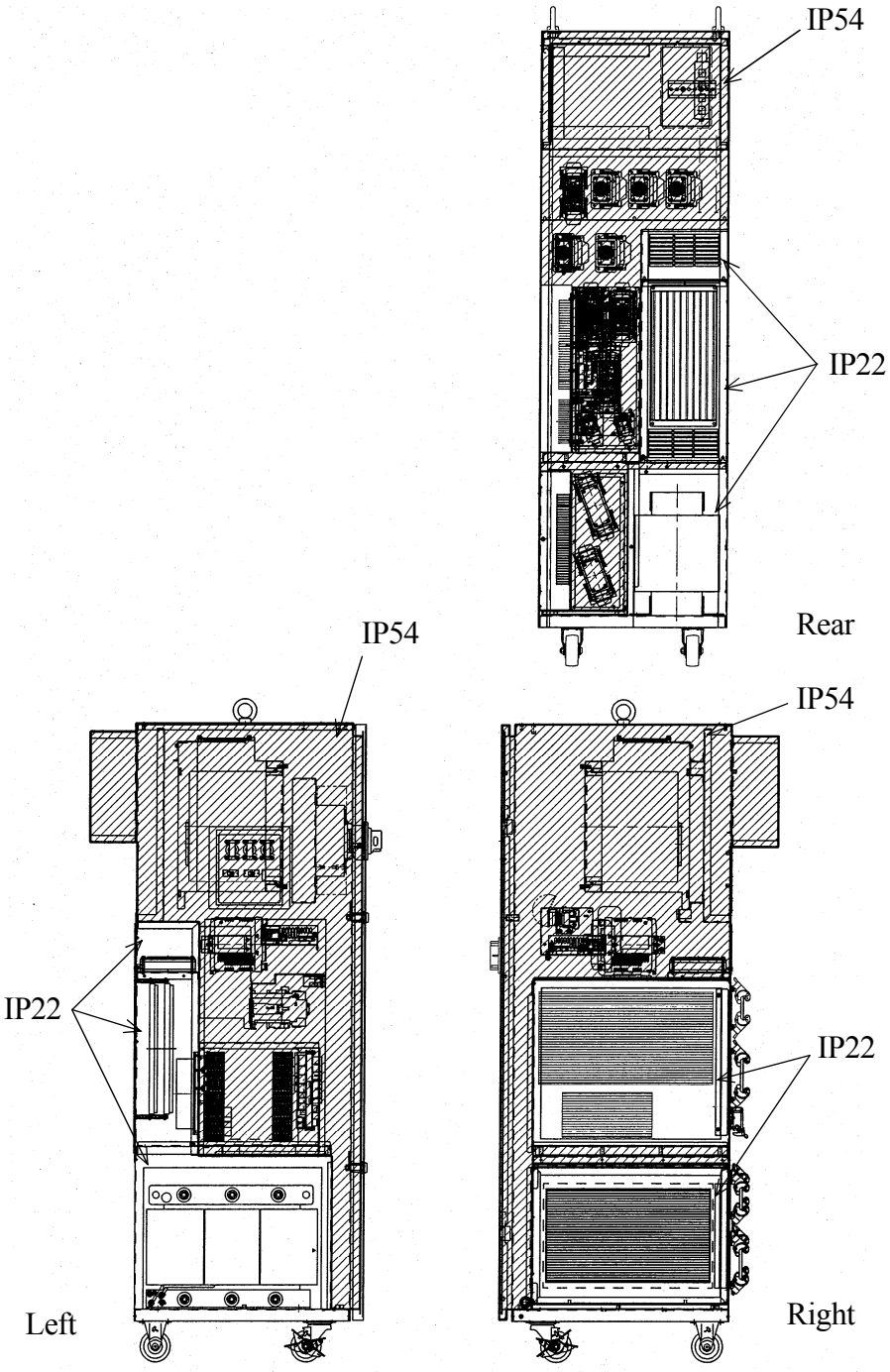
Install the controller in a site that satisfies all the following environmental conditions:

1. Ambient temperature during operation: within 0 - 45 °C
2. Relative humidity: 35 - 85 %RH (Non condensing)
3. Altitude: up to 1000 meters above mean sea level
4. Free from dust, dirt, smoke, water, oil, etc. IEC60664-1 Pollution degree: 3 or below.
   Controller protection grade: IP54 (not including transformer and heat sink sections). (See the figure below.)

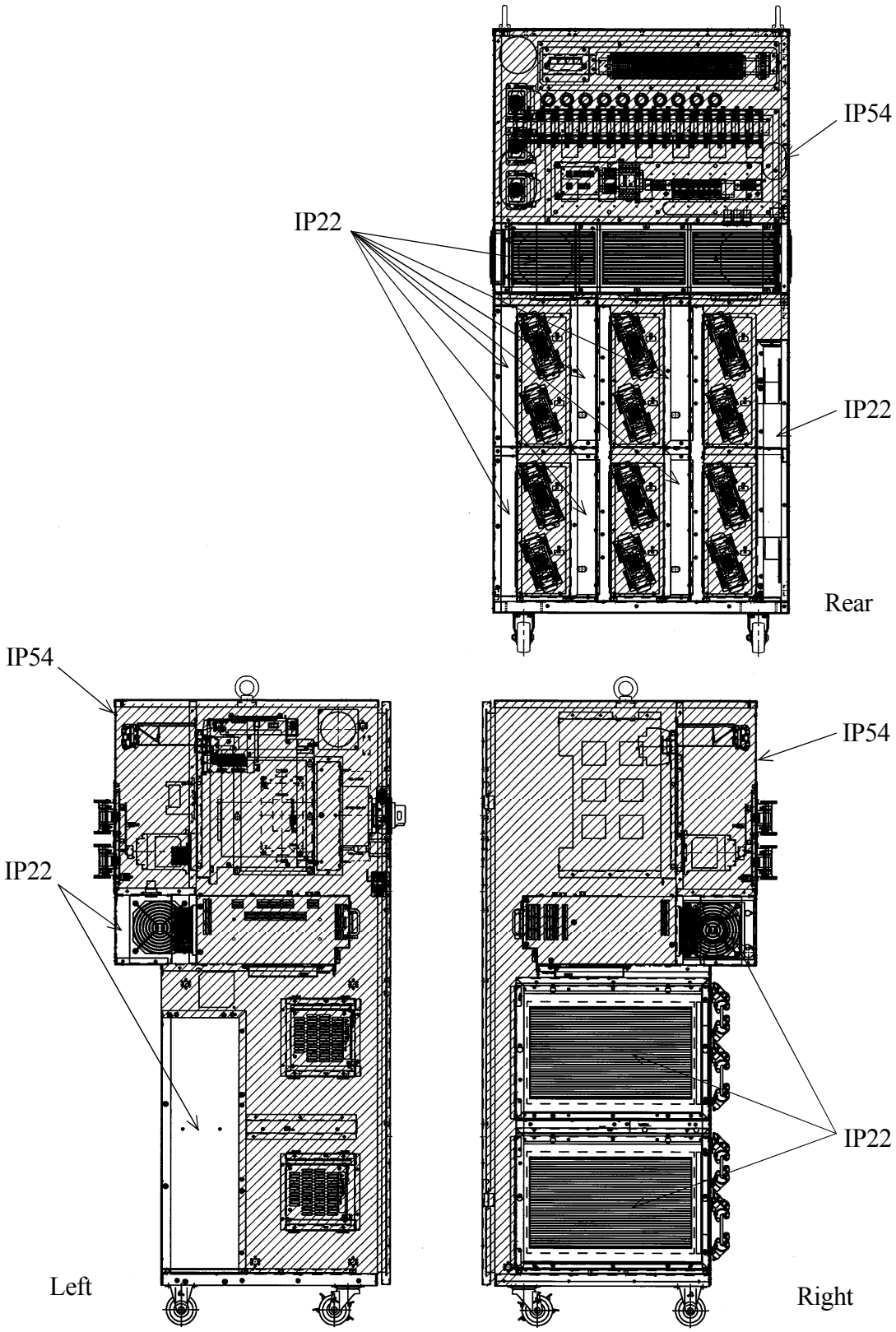
T51 controller



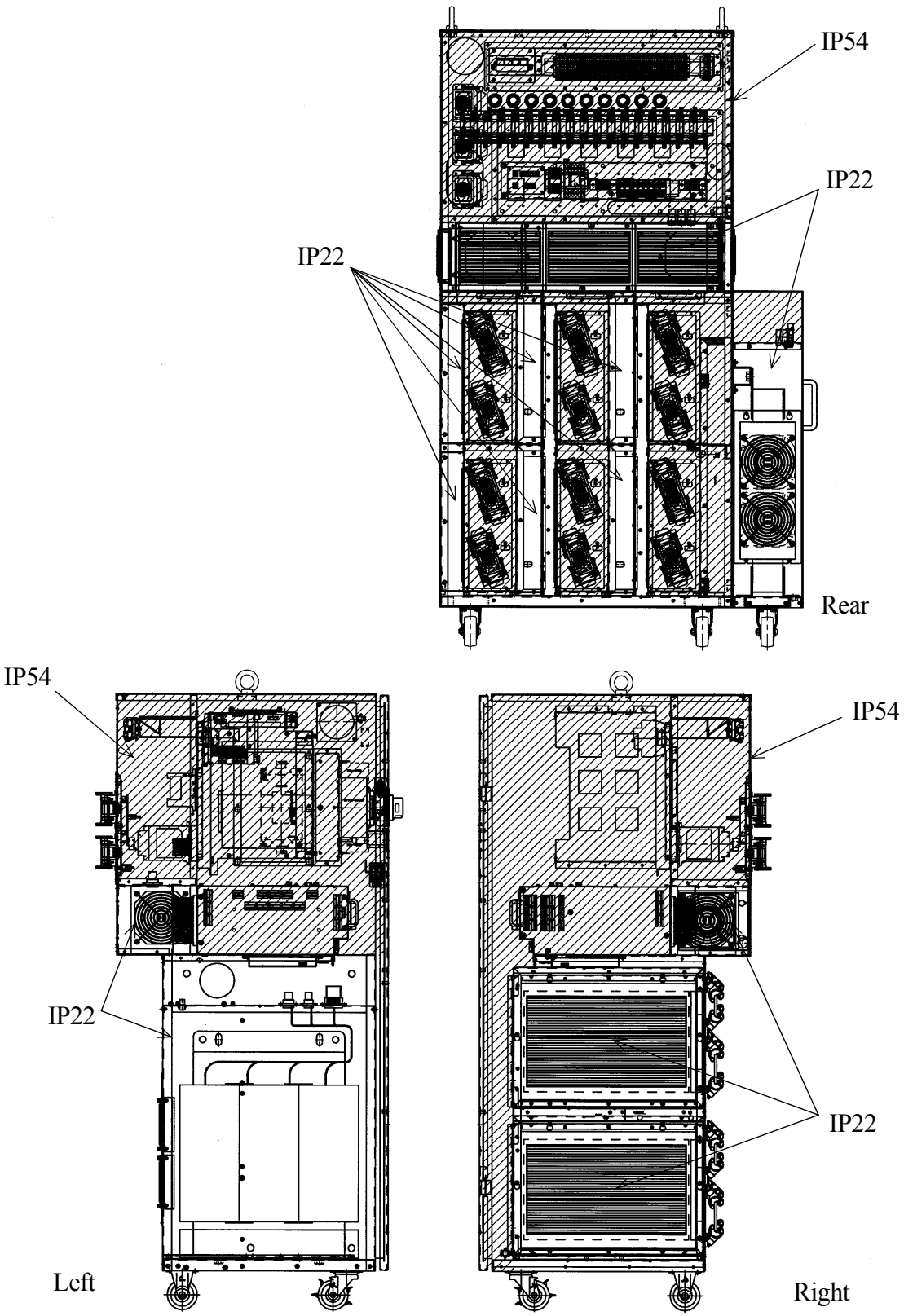
T52 controller



T81 Japan spec. controller



T81 overseas spec. controllers



5. Free from flammable and/or corrosive liquid and gas.
6. Free from excessively strong vibration and shock.
7. Free from electrical noise interference. (Controller external power noise: 1 kV/1 μs or less)

⚠ CAUTION

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

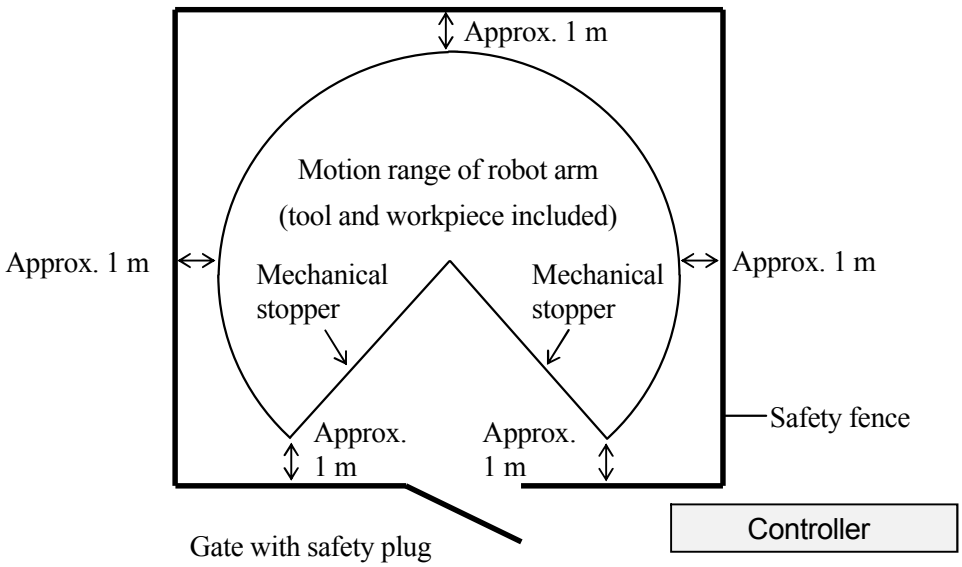
8. Place where power is supplied within specifications. (Fluctuation ratio: ±10 % or less)
9. Place where dedicated earthing is provided.
10. Outside the safety fence with margin (min. 1 m) from the motion range of robot arm (with tools and workpieces).

⚠ CAUTION

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

In addition, ensure the followings:

- Enough space for easy access to the 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 mm^2).**
4. **Never share an earth line with weld machine, minus pole (base material), etc.**
5. **In arc welding applications, connect the minus pole (base material) of the weld power supply to a jig or directly to the base material. 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

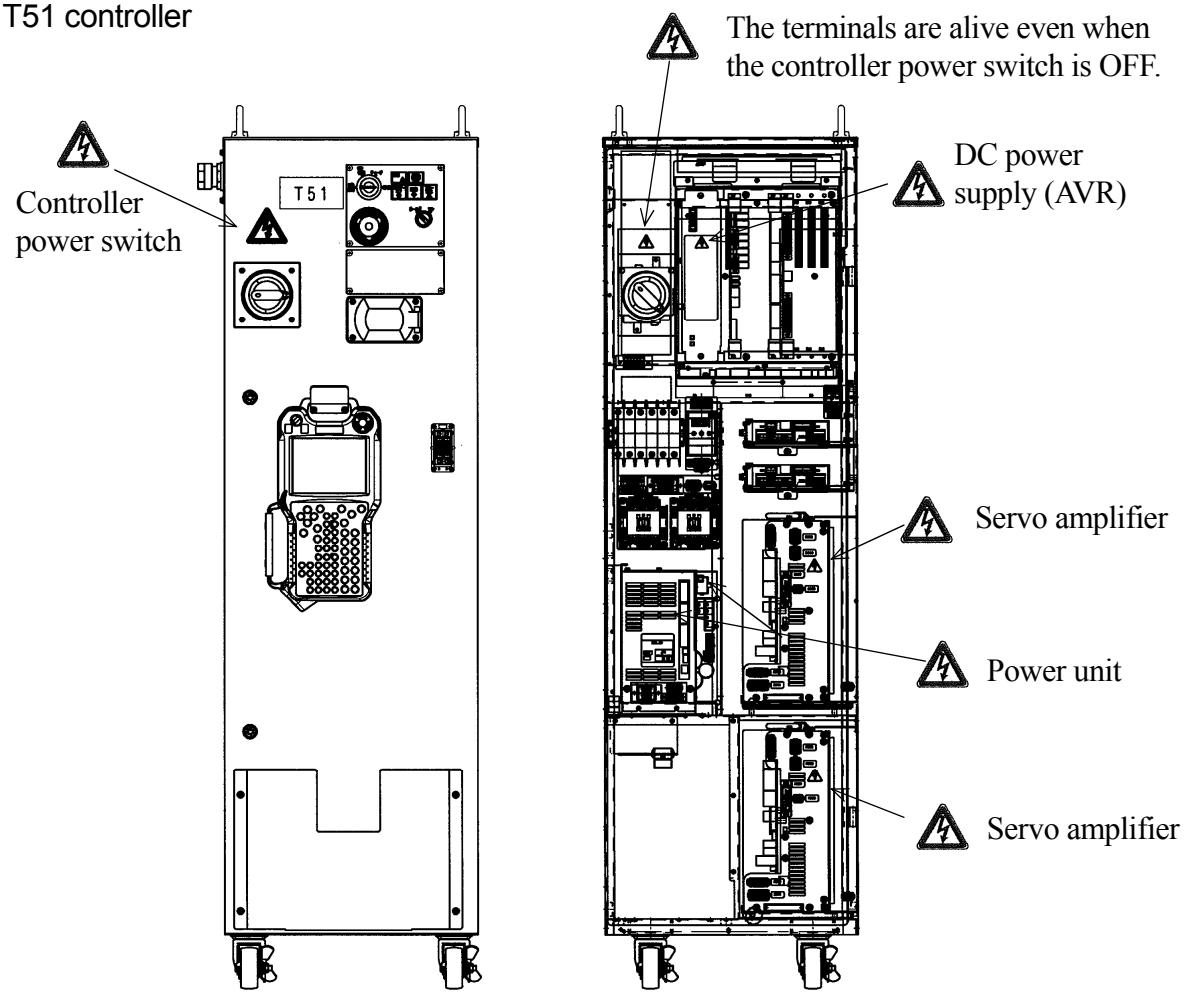
1. **Prepare external power that meets the specifications of the controller in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the controller's specified range (above/below ratings), then the power monitoring circuit 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, etc. to reduce the noise level.**
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, etc.**
5. **To prevent shorting or accidental leakage on the external power switch, use 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.

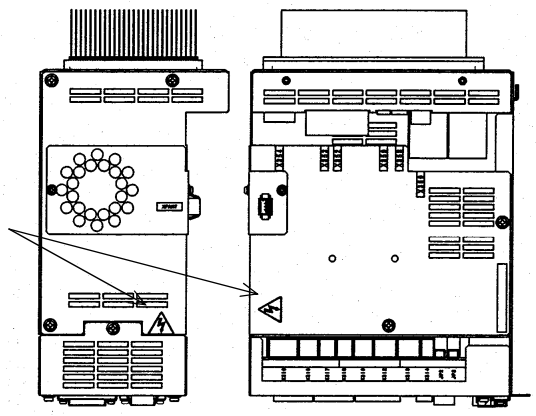
1.5 WARNING LABEL FOR ELECTRIC SHOCK

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

T51 controller



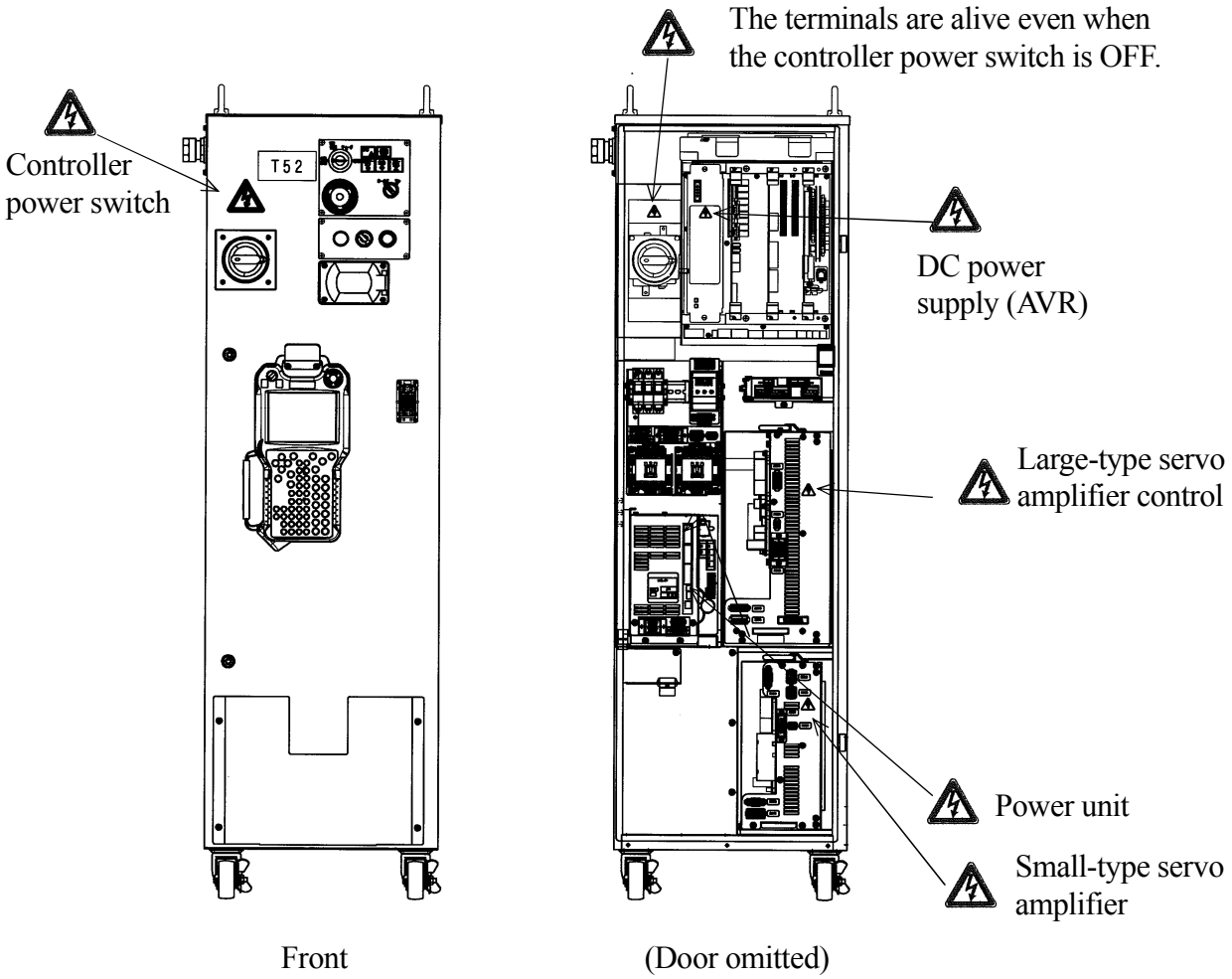
*Warning labels are attached on the top and side faces of the power unit.



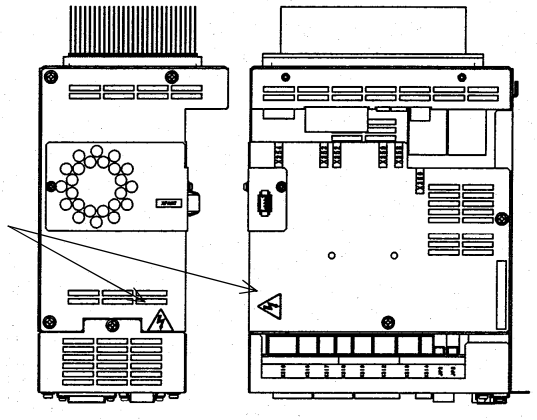
Top view of power unit

Side view of power unit

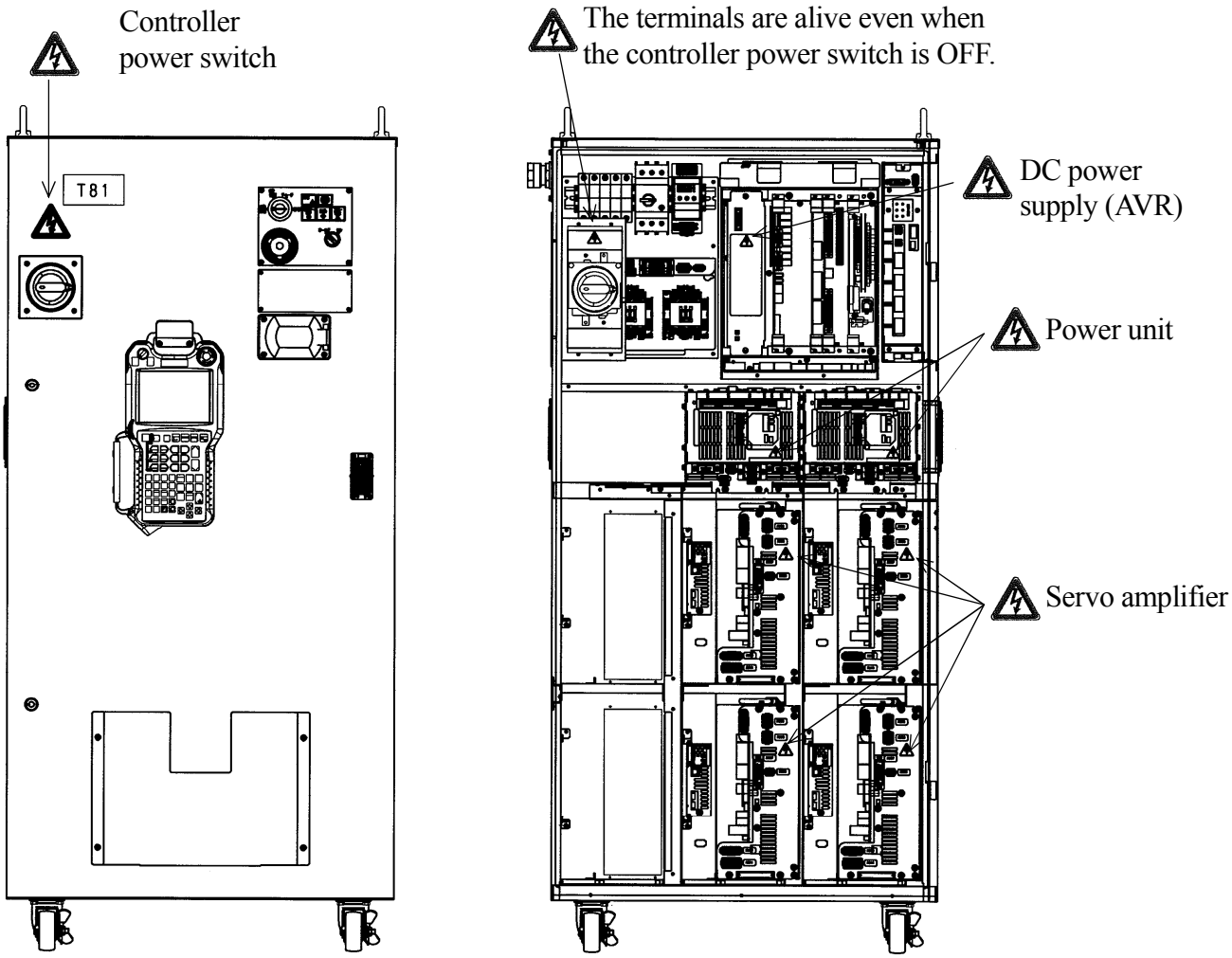
T52 controller



*Warning labels are attached on the top and side faces of the power unit.

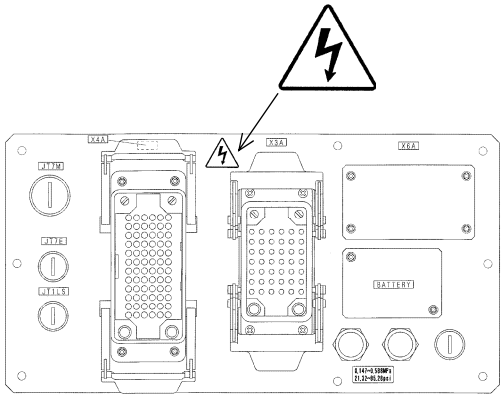


T81 controller

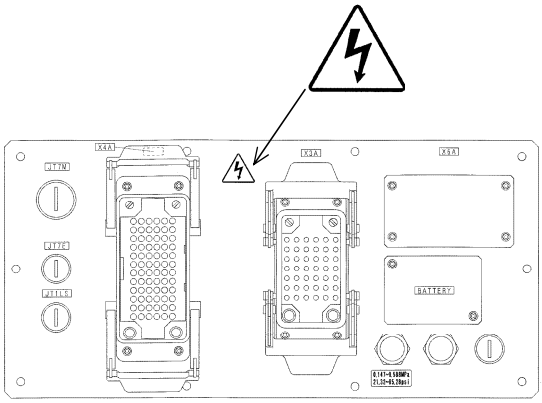


Connector plates on arm base section

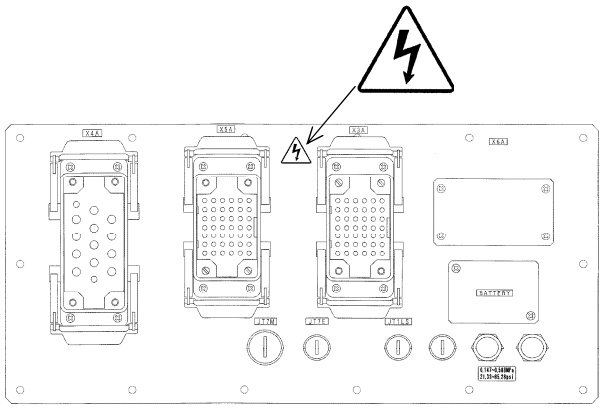
RS10N/RS06L



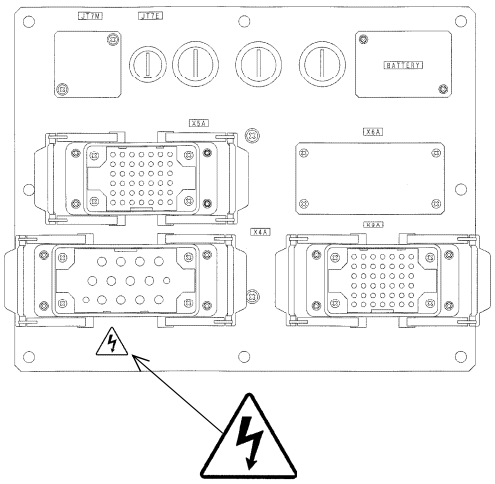
RS20N/RS10L



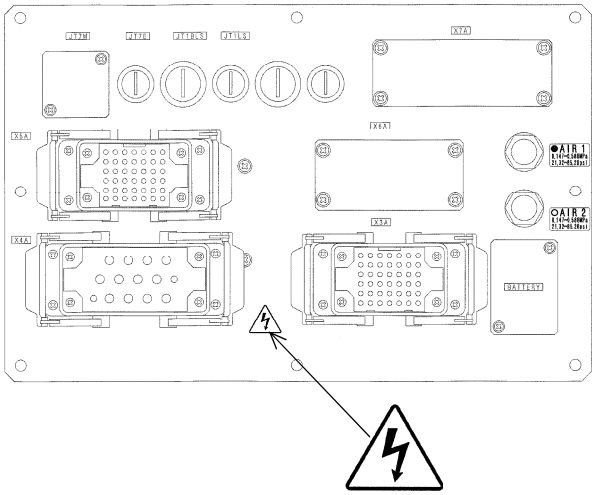
RS30N/RS50N/RS80N/RS15X/RD80N



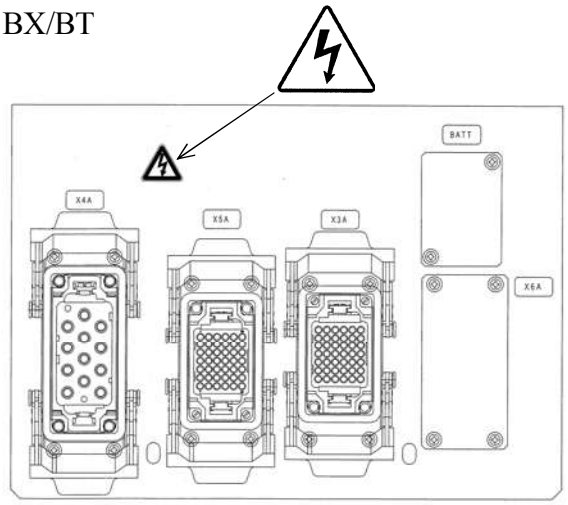
ZS



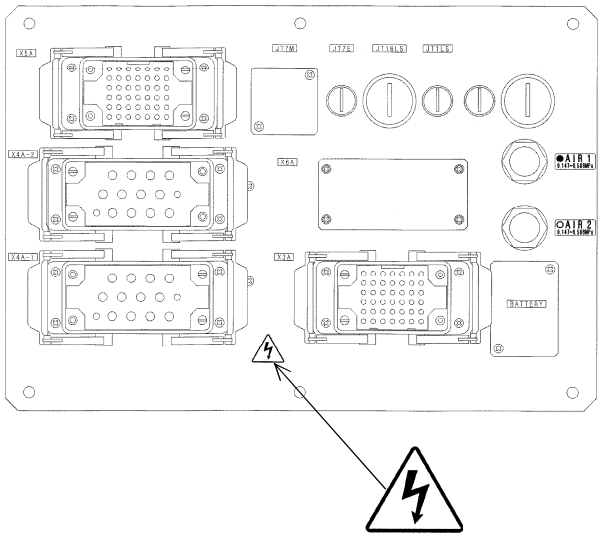
ZX/ZT



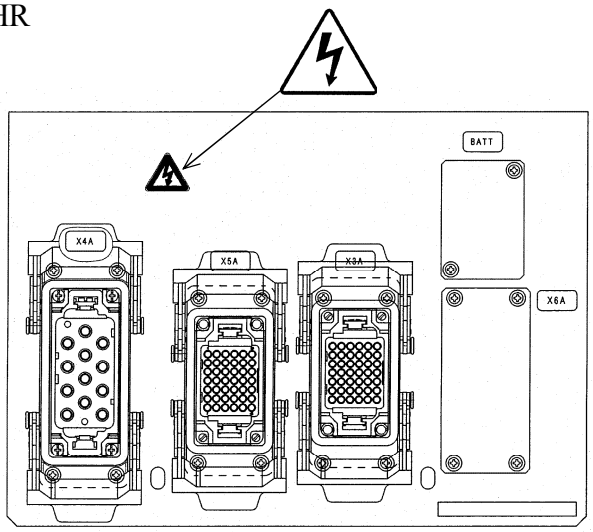
BX/BT


BATT
X4A
X5A
X3A
X6A

MX


X4A-2
X6A
X4A-1
X3A
BATTERY

HR


BATT
X4A
X5A
X3A
X6A

1.6 BATTERY USE AND DISPOSAL

Batteries are used for data backup in the robot arm and controller. Figures on the next page show the location of the batteries on the 1VA board and the 1FG/1HG boards. Batteries for 1FG/1HG boards can be handled without removing connector plate on robot arm 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.

⚠ WARNING

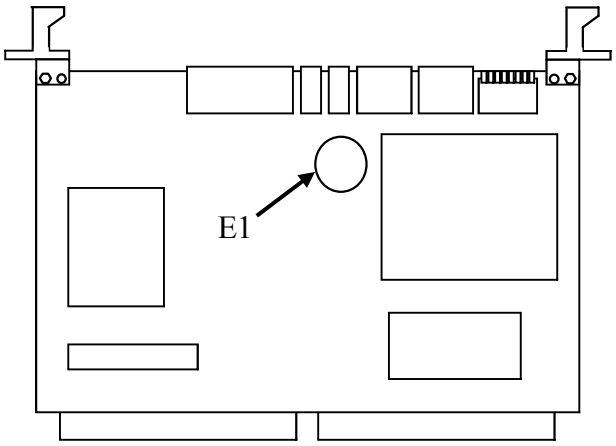
1. **Only use batteries specified by Kawasaki.**
2. **Never re-charge, dismantle, convert and/or overheat batteries.**
3. **Never dispose of batteries into water or fire.**
4. **Batteries with damaged cases may short internally and must not be used.**
5. **Never short the positive and negative poles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

⚠ CAUTION

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

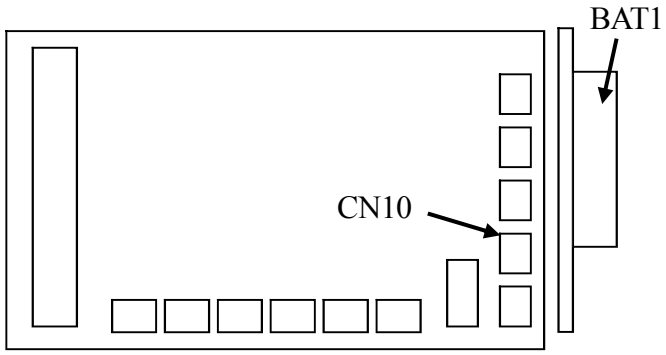
Locations of Batteries

1VA board (in card rack)
Location Number: E1
Model: BR2032
Manufacturer: Panasonic



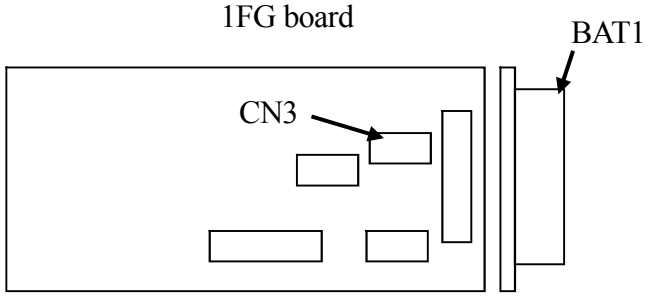
1VA board

1FG board (in robot base)
Location Number: BAT1
Model: 50750-1007 or 50750-1018
Manufacturer: KHI
Connector: CN10

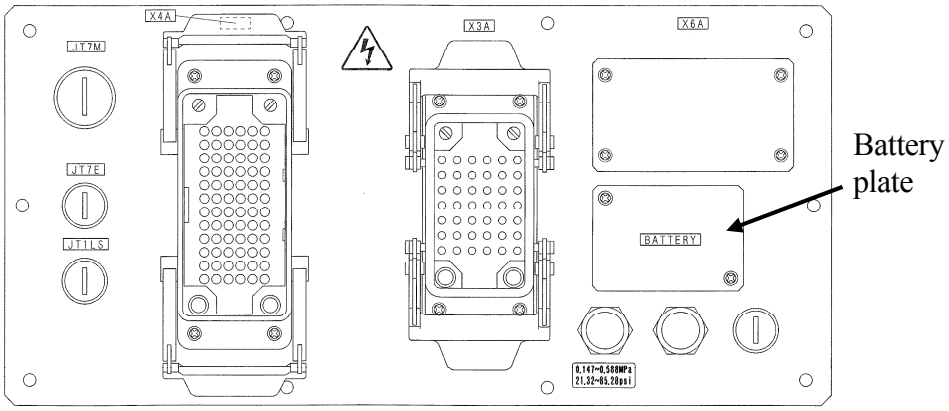


1FG board

1HG board (in robot base)
Location Number: BAT1
Model: 50750-1007 or 50750-1018
Manufacturer: KHI
Connector: CN3



1HG board



Connector plate on robot base

1.7 SAFETY FEATURES

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

1. 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.
2. (For T52 controller) When the servo ON lamp (located on the robot arm) is illuminated, motor power to move the robot is supplied. (For T51/T81 controllers, which are multi-arm controllers) When the servo ON lamp is illuminated, motor power is supplied to the robot and motion is possible.
3. The teach pendant and operation panel are equipped with E-stop switches.
4. The teach pendant is equipped with two, three-position, enabling devices. One of the two enabling devices must be pressed to enable motor power in teach and check modes.
5. Teach and check mode velocities are limited to a maximum of 250 mm/s (10.0 in/s).
6. All R-series, M-series, Z-series and B-series arms have mechanical 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 load mass.
7. All robot axes are equipped with 24 VDC electromechanical brakes that engage when power is removed. If the robot loses power unexpectedly, the mechanical unit arm is held in position by the brakes.

1.8 TRANSPORTATION OF ROBOT ARM WITHOUT MOTOR DRIVE POWER IN EMERGENCY/ABNORMAL STATE)

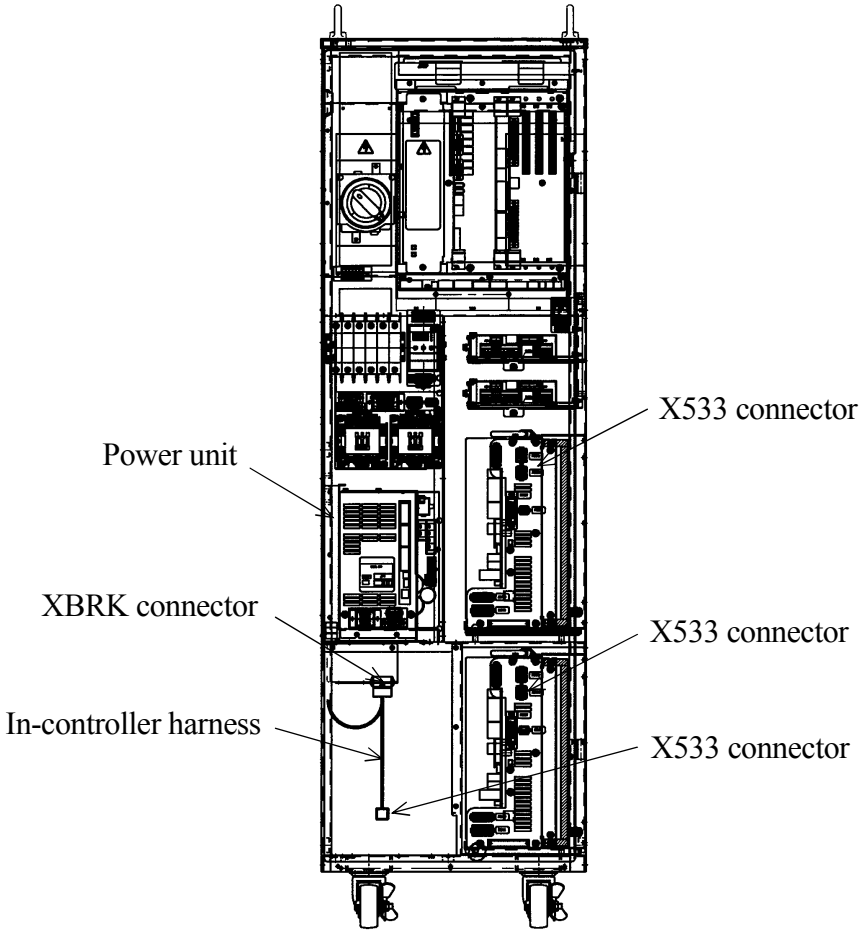
The brake release switch box allows the operator to move robot arm without using motor drive power for abnormal and emergency situations (Option). When using the brake release switch box, connect it to the X315 connector, lower of the power unit shown below. (For T52 controllers which were shpped before March in 2013, connect it to the X315 connector of power unit. The brake release box is also different.)

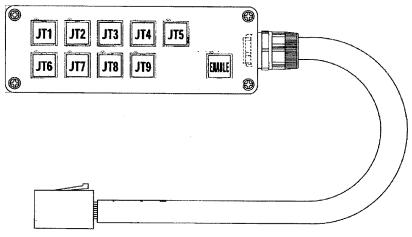
⚠ WARNING

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

T51 controller

First, connect the in-controller harness to the X533 connector of servo amplifier for arm whose axis needs brake release. Then, connect the brake release switch box to the XBRK connector, lower of the power unit, and release the brake of the relevant axis.

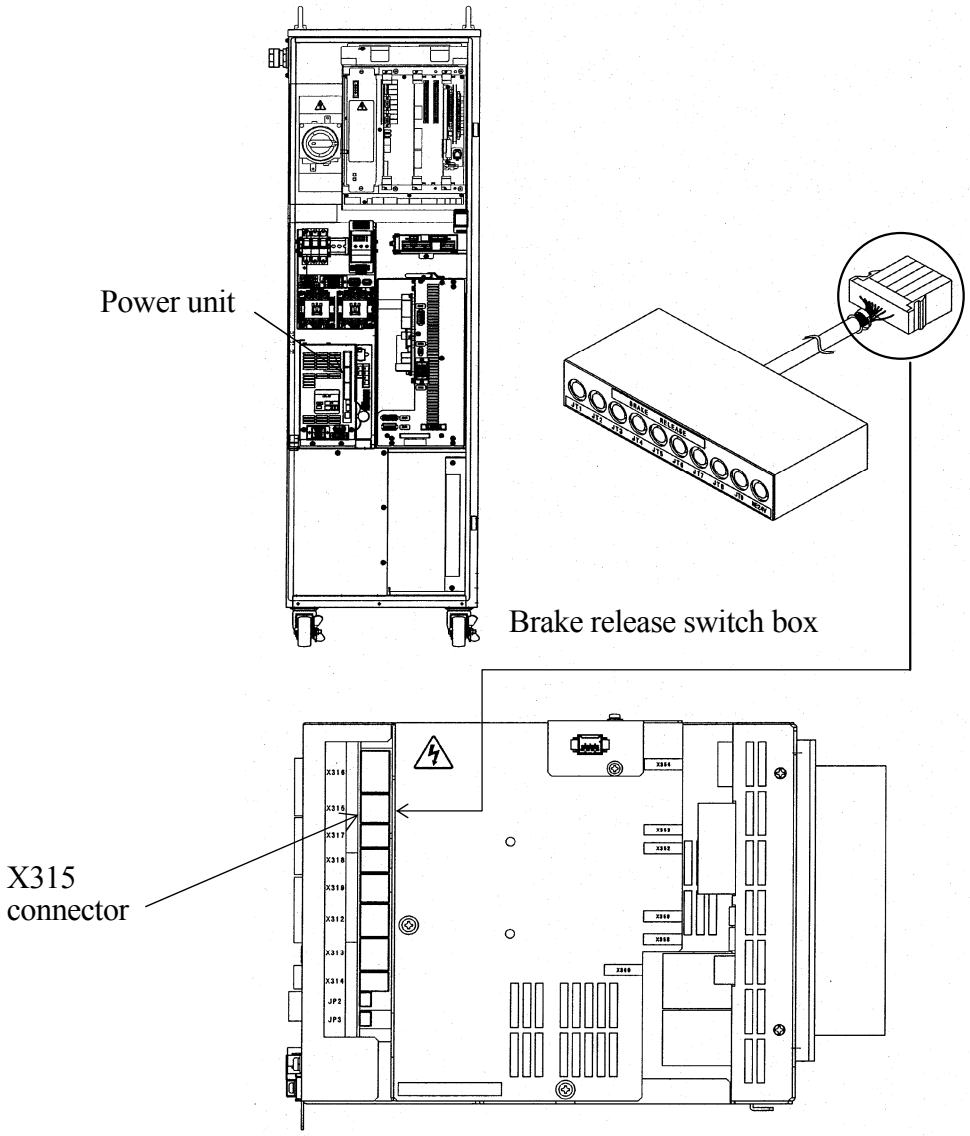




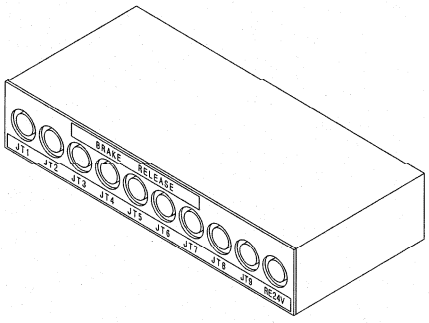
Brake release switch box
(KHI part number: 50818-0018)

T52 controller (shipped before March 2013)

Connect the brake release switch box to the X315 connector of power unit, and release the brake of the relevant axis.



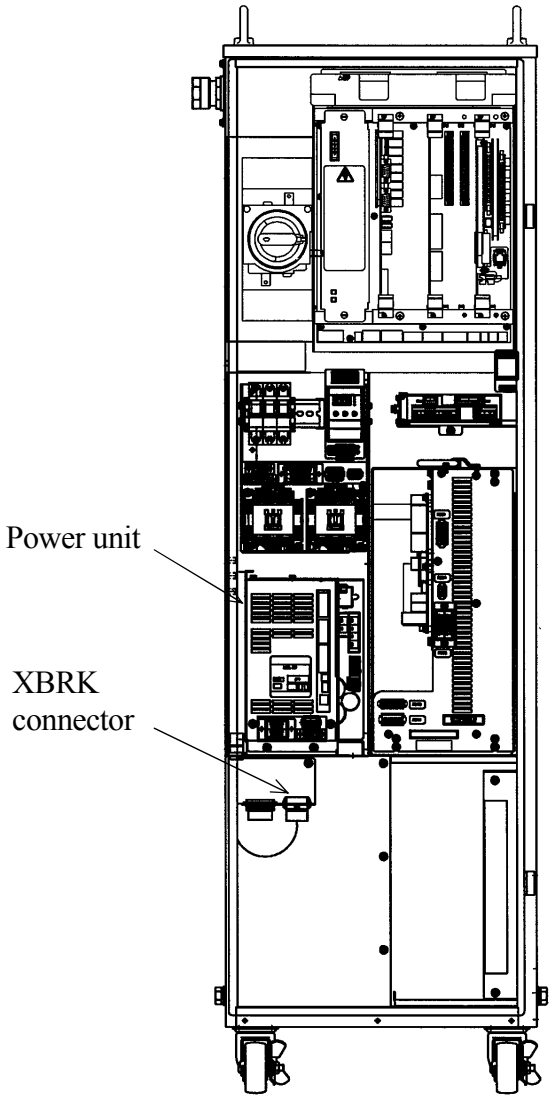
Side view of power unit

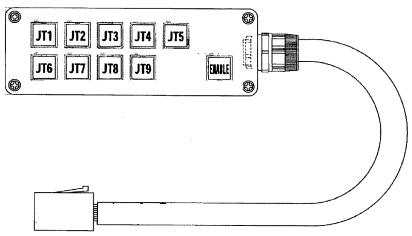


Brake release switch box (option)
(used for the robots shipped before March 2013)

T52 controller (shipped after April 2013)

Connect the brake release switch box to the XBRK connector, lower of the power unit, and release the brake of the relevant axis.

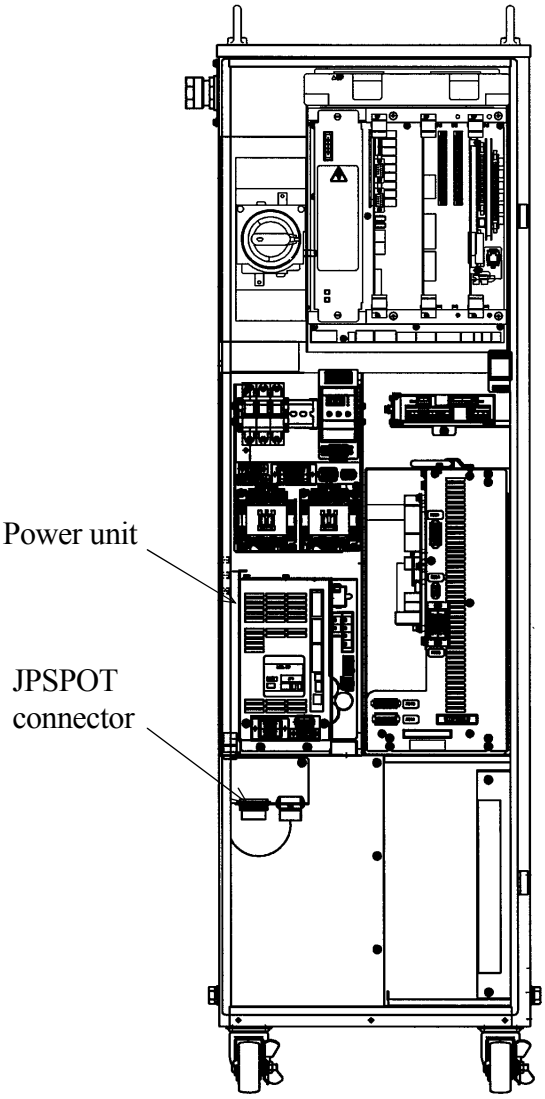


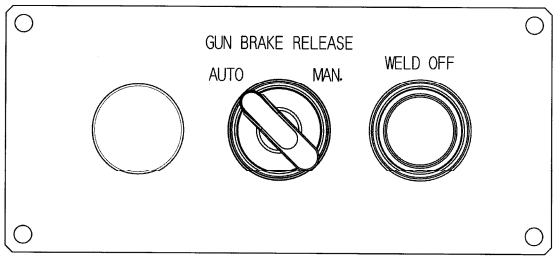


Brake release switch box
(KHI part number: 50818-0018)

T52 controller – Gun axis release by gun brake release switch on controller

Change the JPSPOT connector connection, lower of the power unit as shown in the table below when releasing the brake of gun axis using the gun axis brake switch on the controller below. Wrong connection may release the axis other than the gun axis.



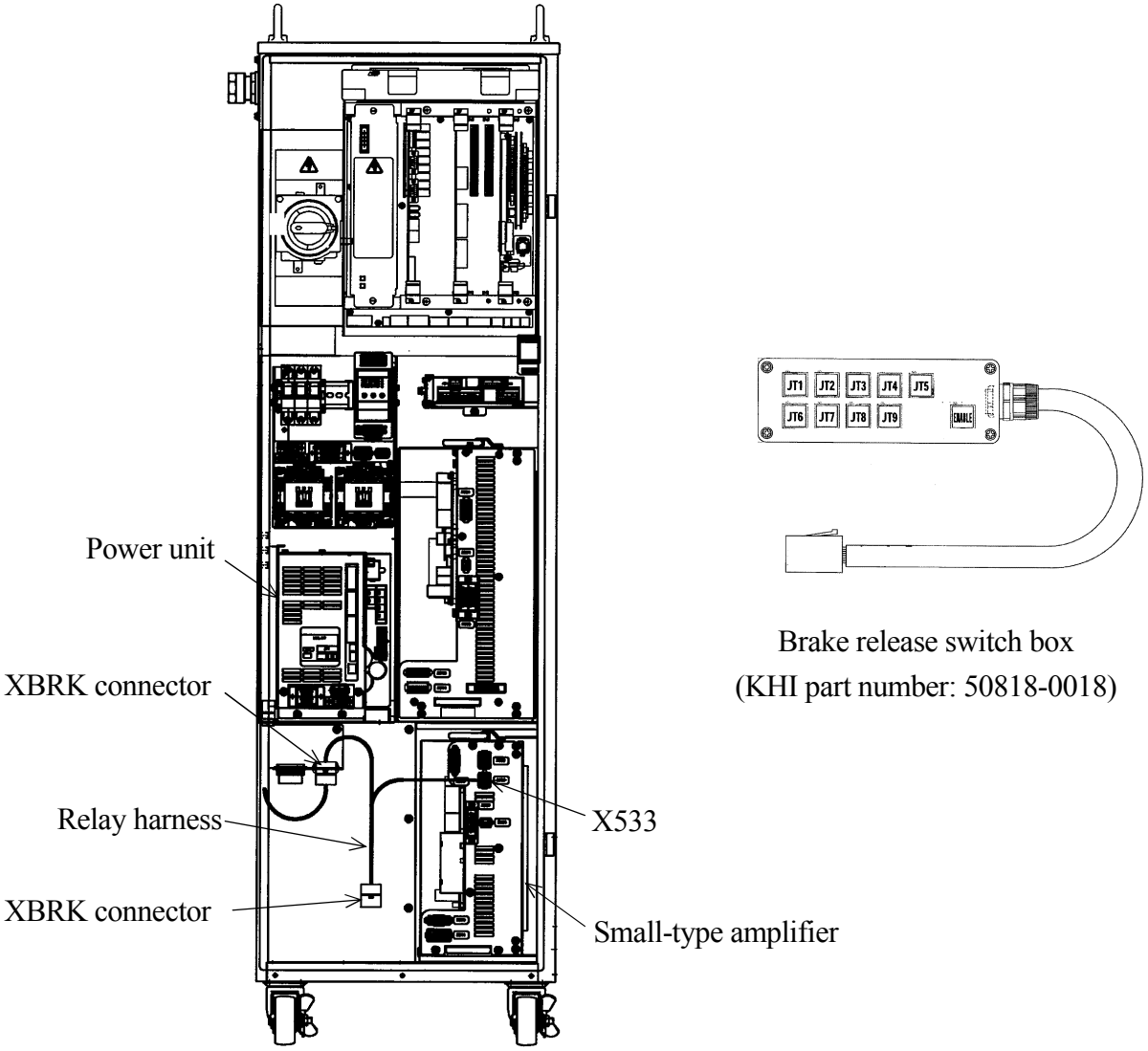


Gun brake release switch on controller

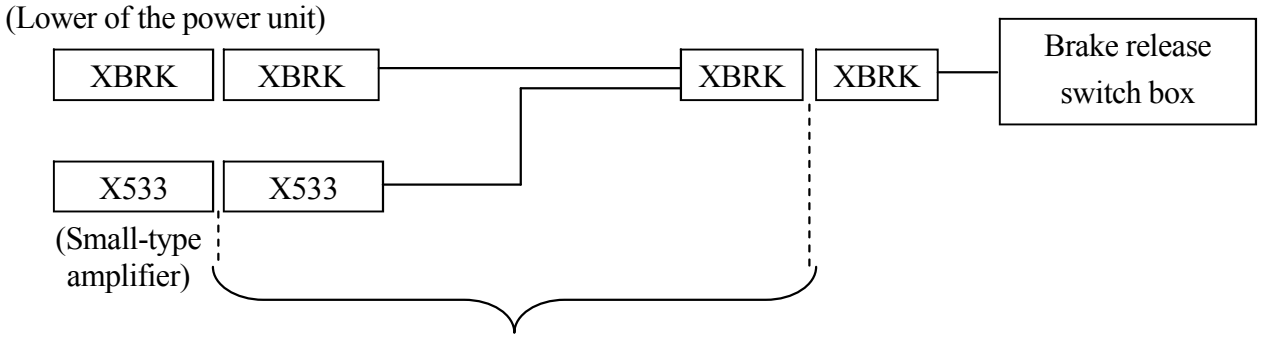
JPSPOT connector connection	Motion when gun axis brake release switch is released	
	JT7	JT8
JPSPOT-OFF	-	-
JPSPOT-G7	Brake release	-
JPSPOT-G8	-	Brake release

T52 servo MATEHAN spec. controller –Release of servo MATEHAN axis

First, connect the X533 connector of relay harness to the small-type amplifier and the XBRK connector to the XBRK connector, lower of the power unit, respectively. Then, connect the brake release switch box to the XBRK connector of relay harness and release the brake of the relevant servo MATEHAN axis.



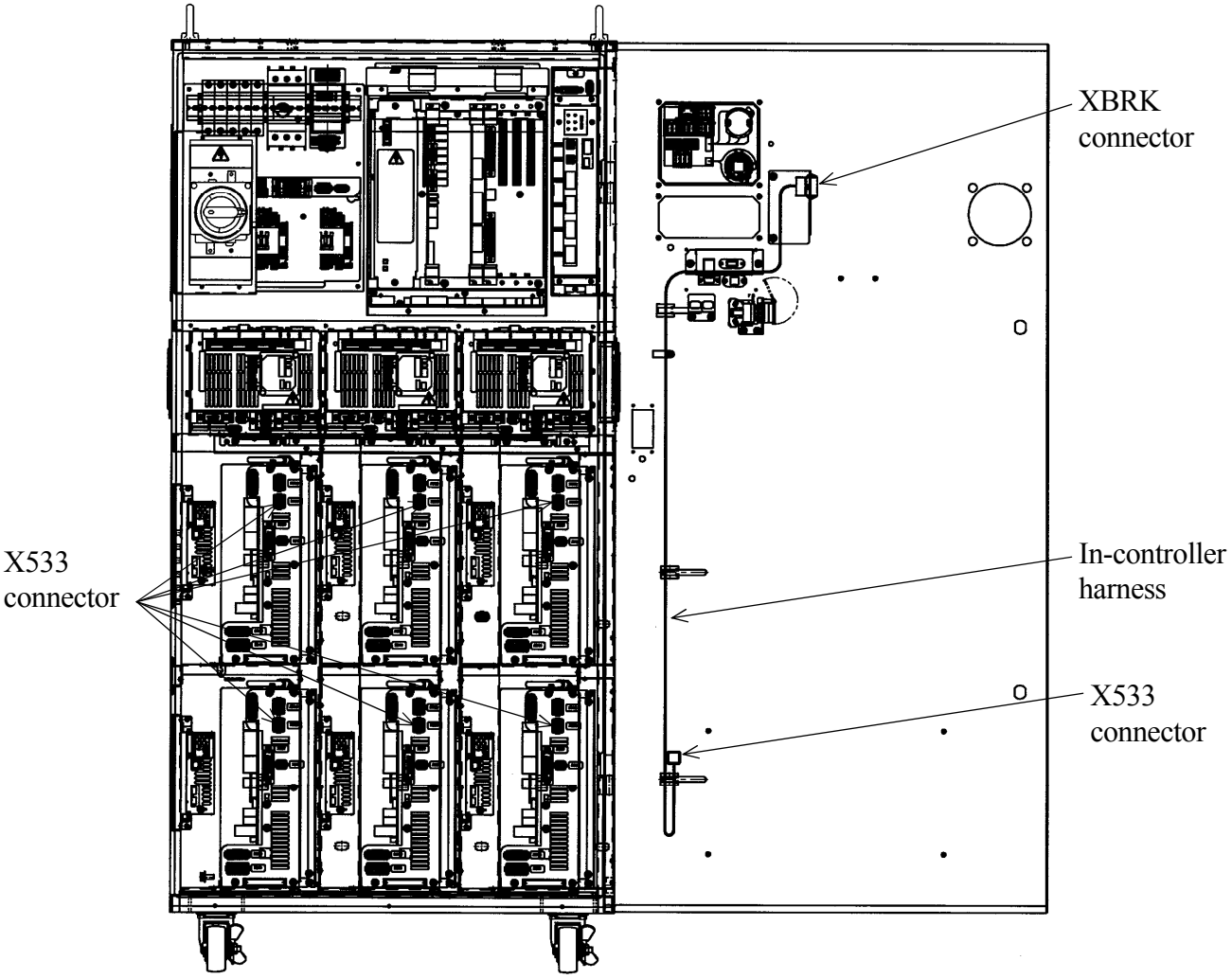
Brake release switch box
(KHI part number: 50818-0018)

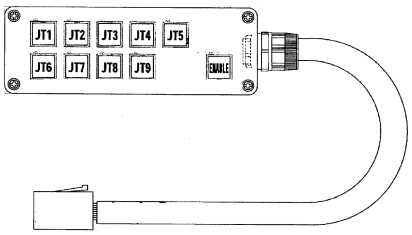


Relay harness for T52 servo MATEHAN
(KHI part number: 50977-0828)

T81 controller

First, connect the in-controller harness to the X533 connector of servo amplifier for arm whose axis needs brake release. Then, connect the brake release switch box to the XBRK connector on the back of controller door and release the brake of the relevant axis.

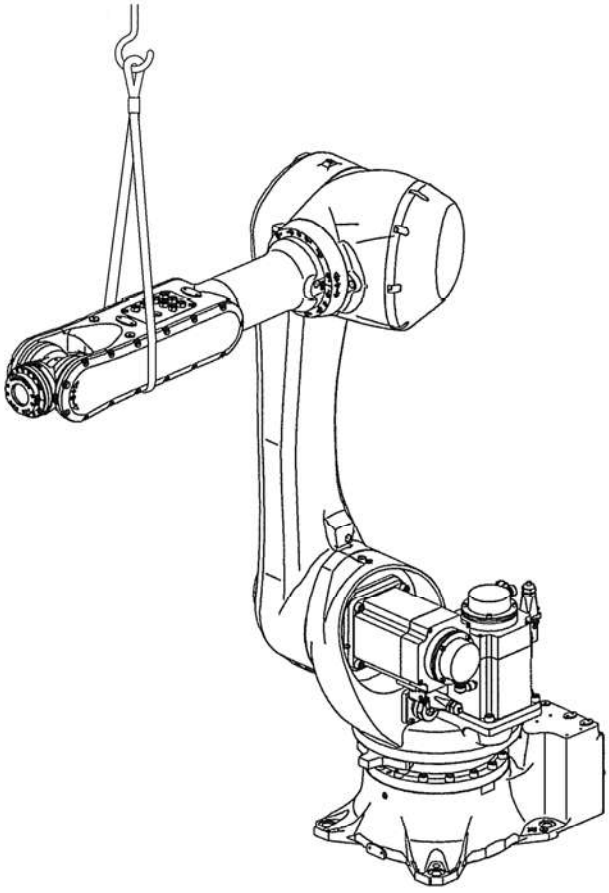




Brake release switch box
(KHI part number: 50818-0018)

⚠ 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 using a wire and a crane (see figure below).



Robot arm support

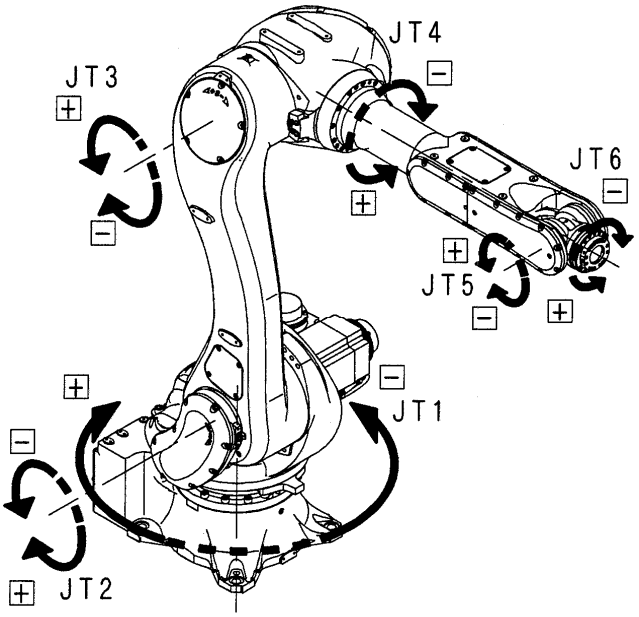
To manually release axes brakes follow the procedure below.

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-or-arm tooling, and payload if there is a risk of personal injury or damage to peripheral equipment before using the brake release switches (see above figure).
4. Open the access door to the brake release switches.
5. Ensure the switches are in the OFF position and in operating condition.

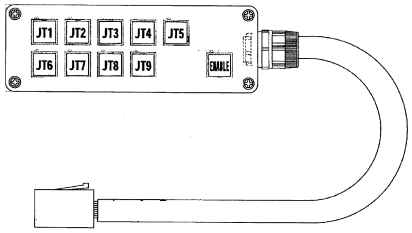
6. Press only the brake release switch of the axis to release for a moment, and confirm that the brake will not be released.
7. Press and hold the "RELEASE ENABLE" switch (see lower right figure). If the brake is released at this time, do not use the switch (see CAUTION).
8. Press the brake release switch of 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 switches immediately if the electromagnetic brake is released by pressing only one switch. The switch may be in failure.



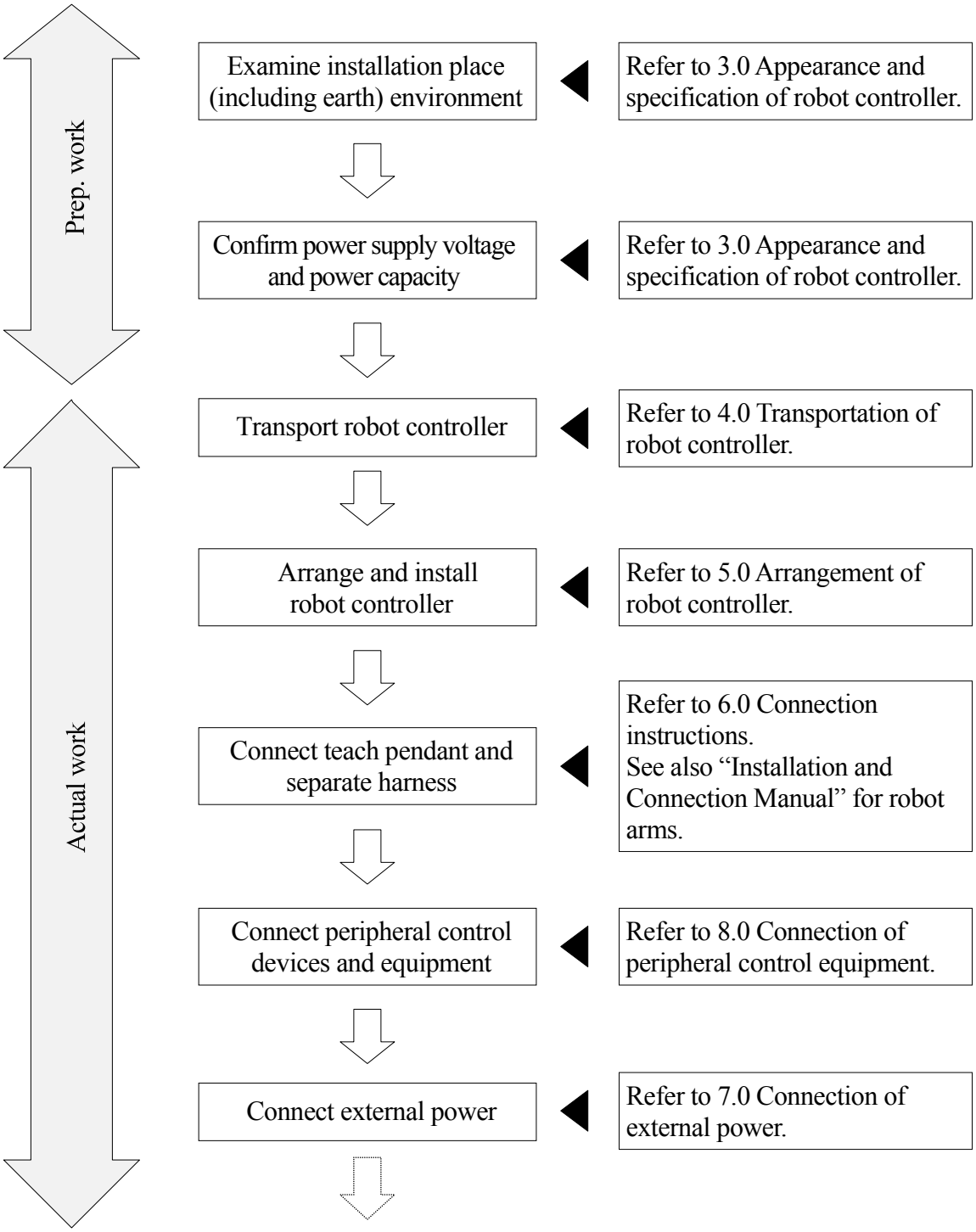
Robot brake release axes

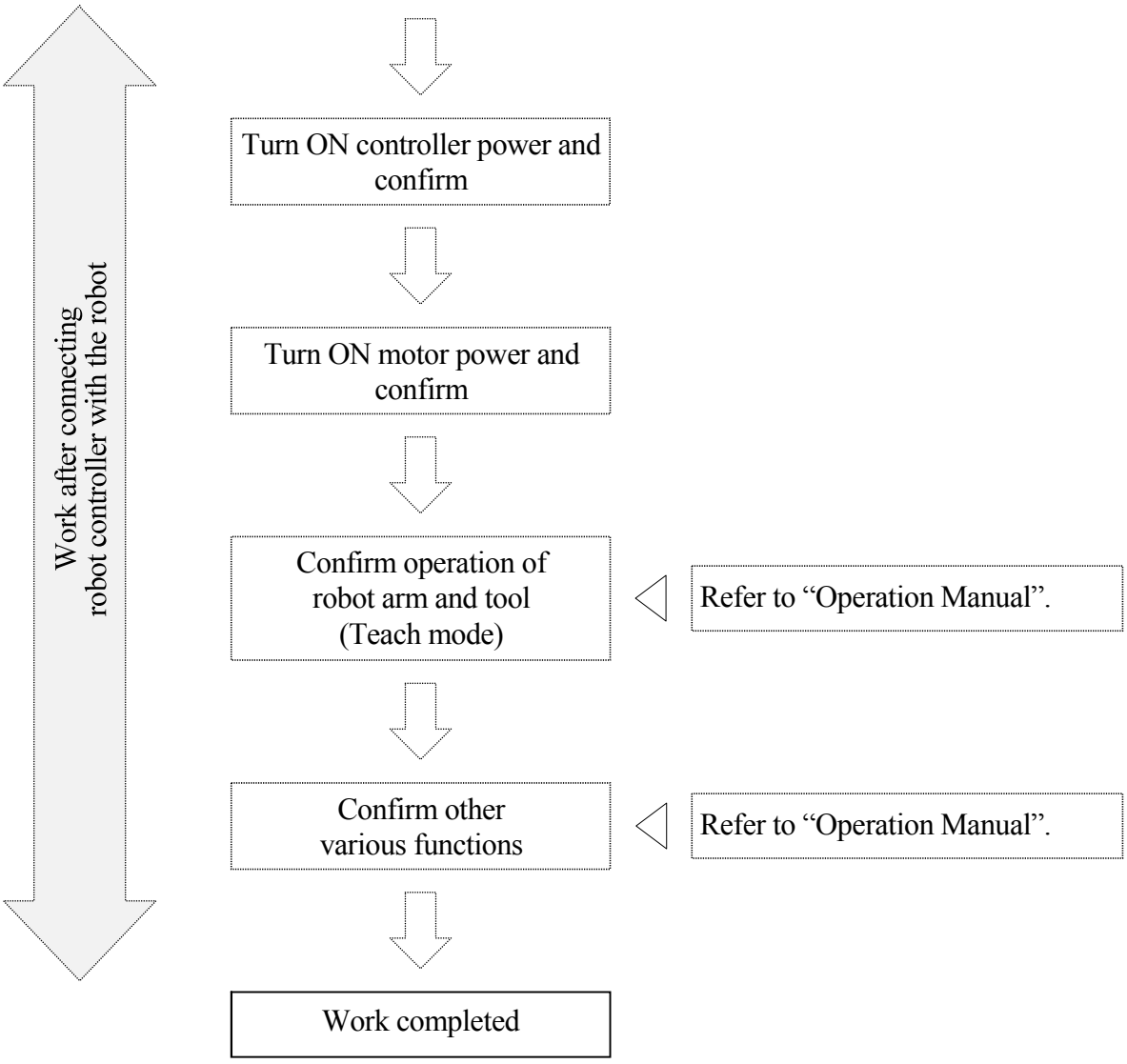


Brake release switch box

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.





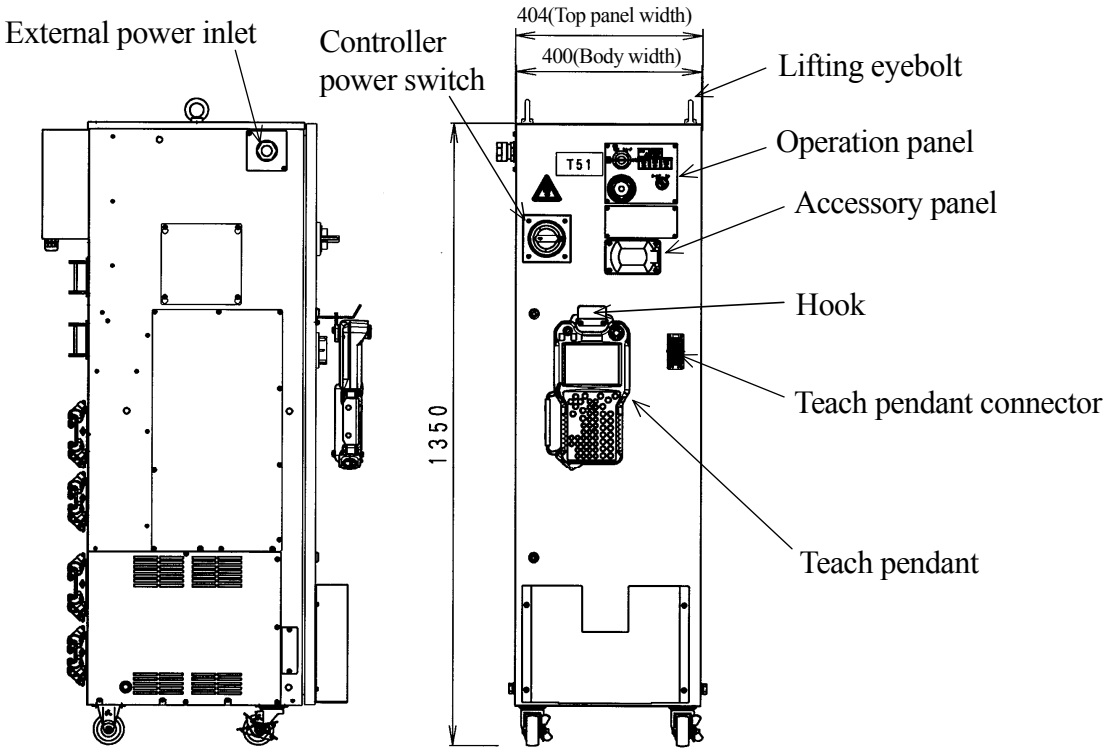
[NOTE]

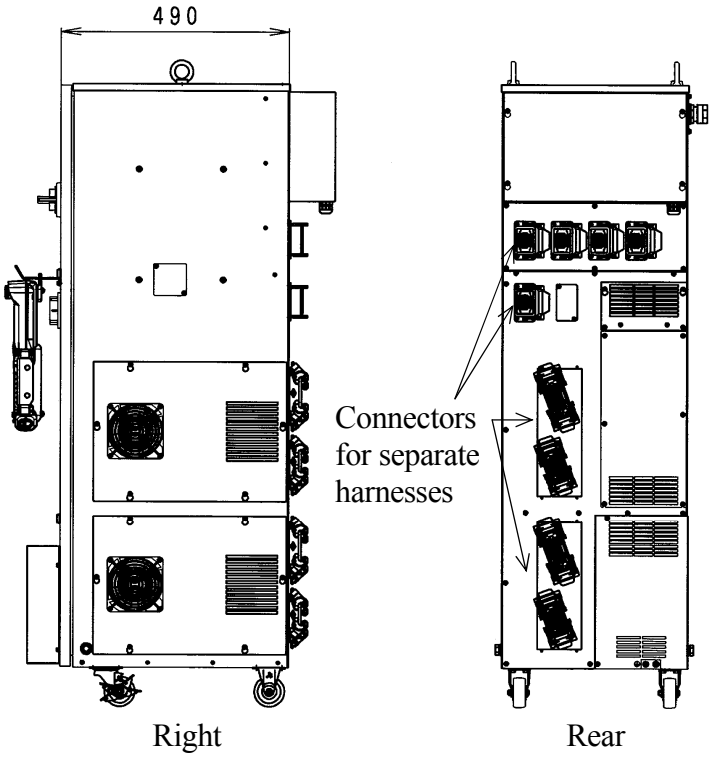
This manual only describes procedures from installation place examination to connection with external power.

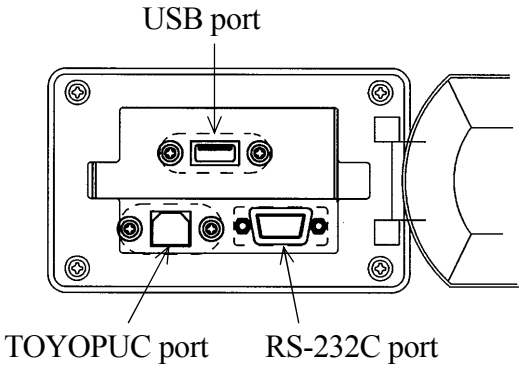
3.0 APPEARANCE AND SPECIFICATION OF ROBOT CONTROLLER

3.1 CONTROLLER APPEARANCE

T51 controller

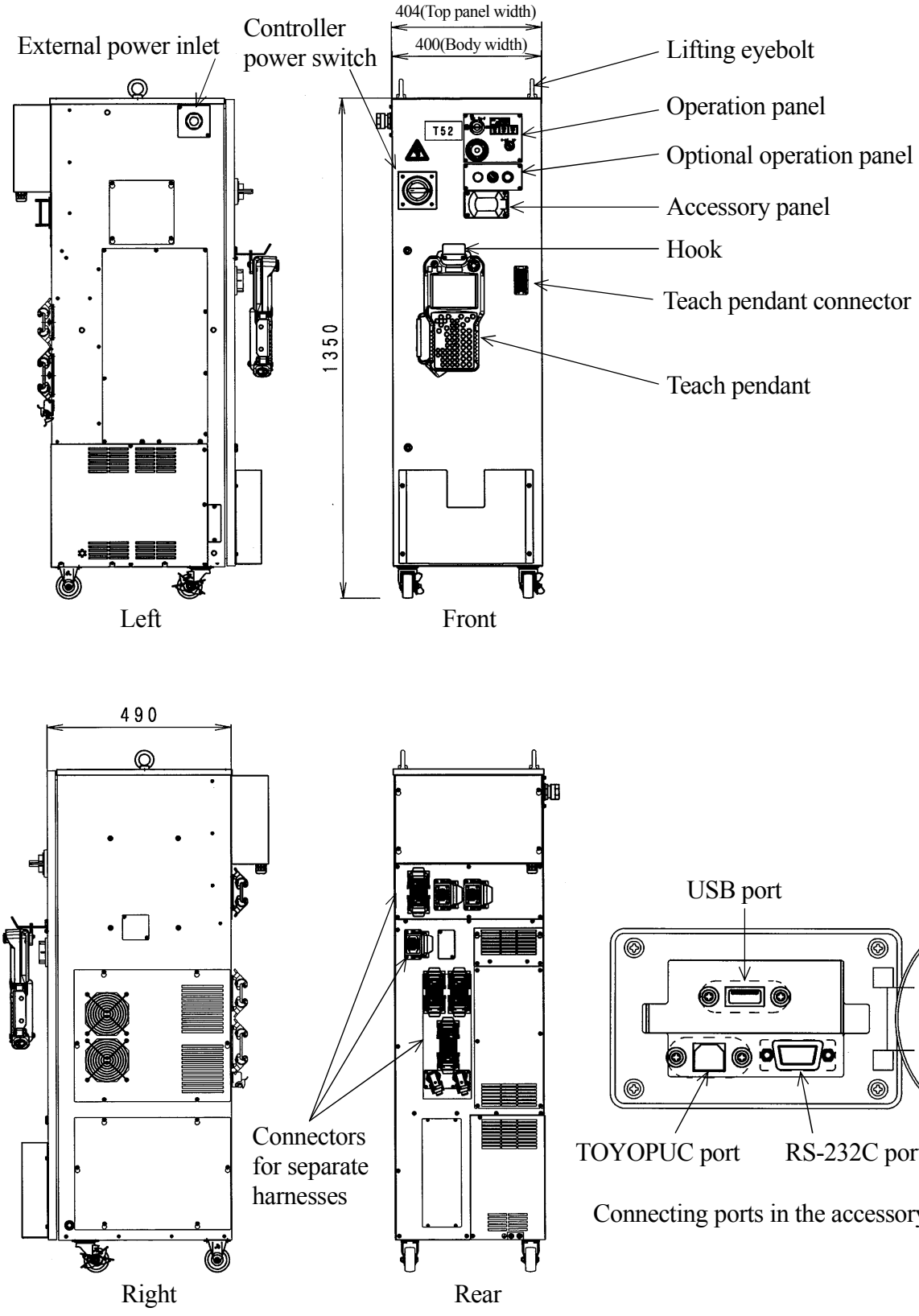




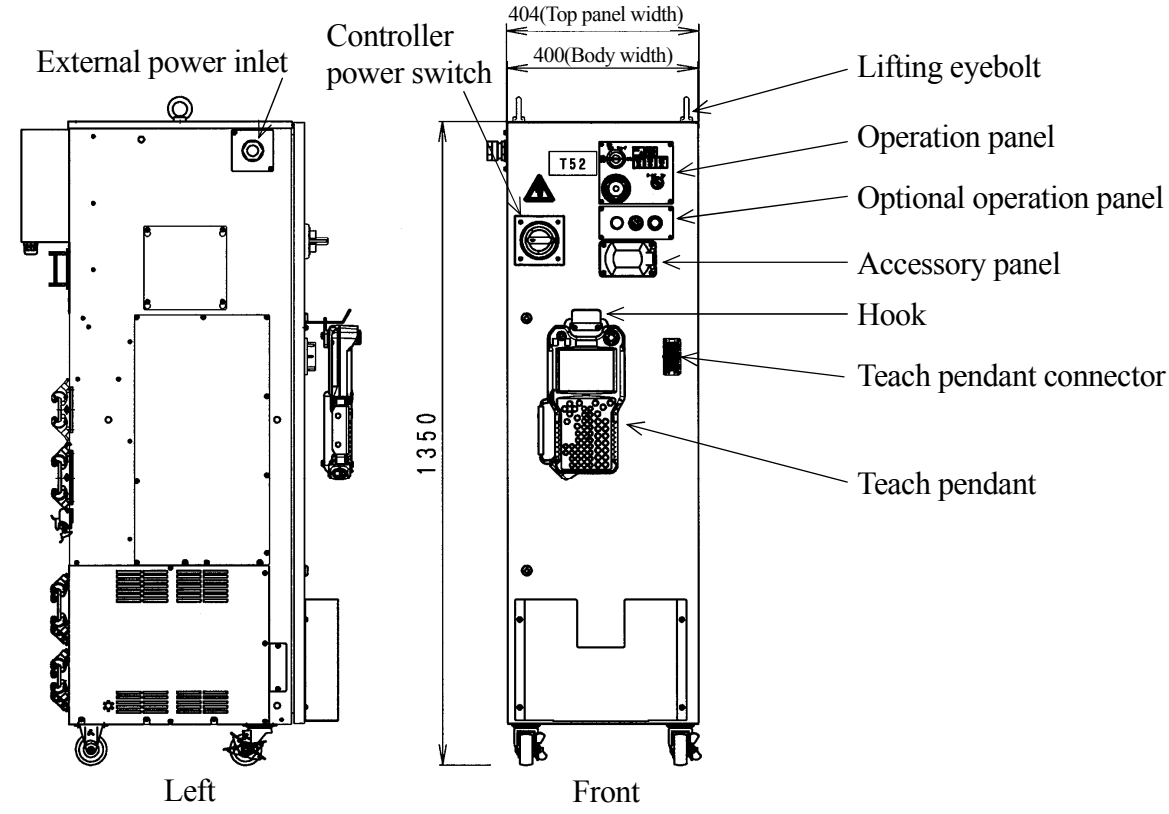


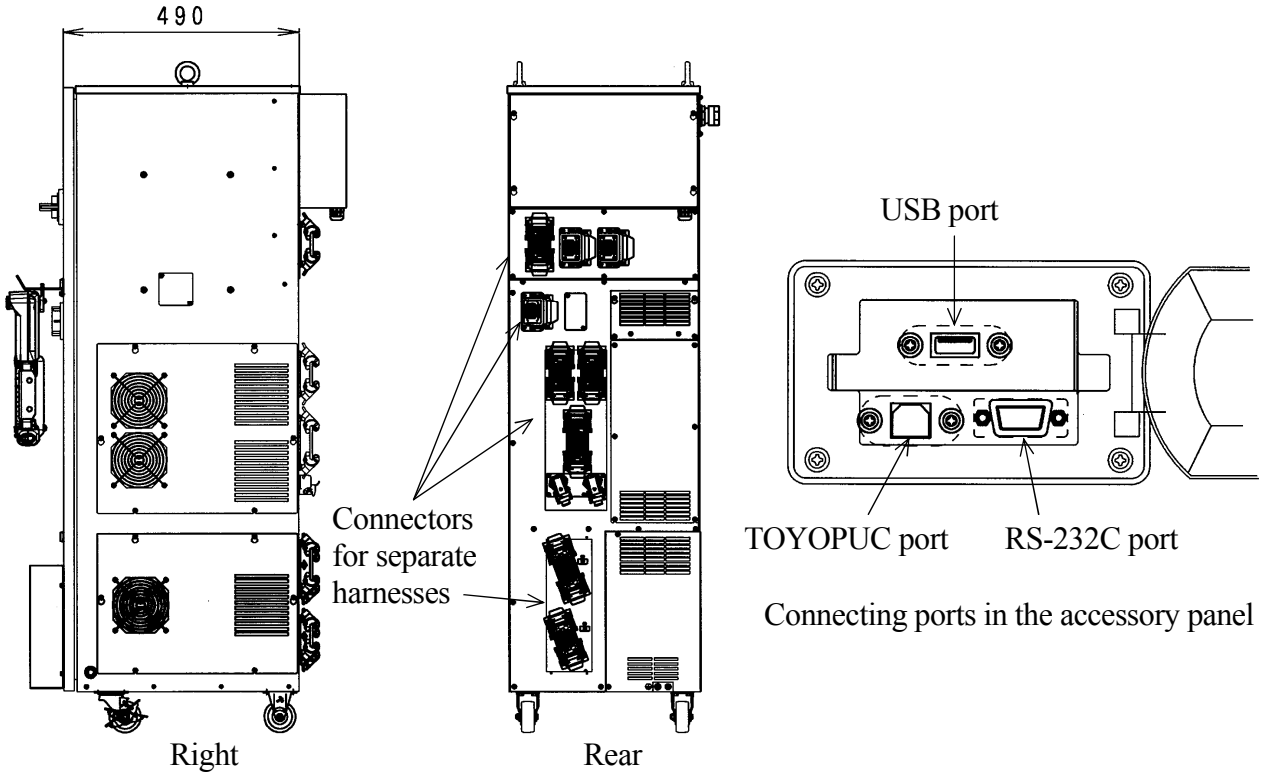
Connecting ports in the accessory panel

T52 controller

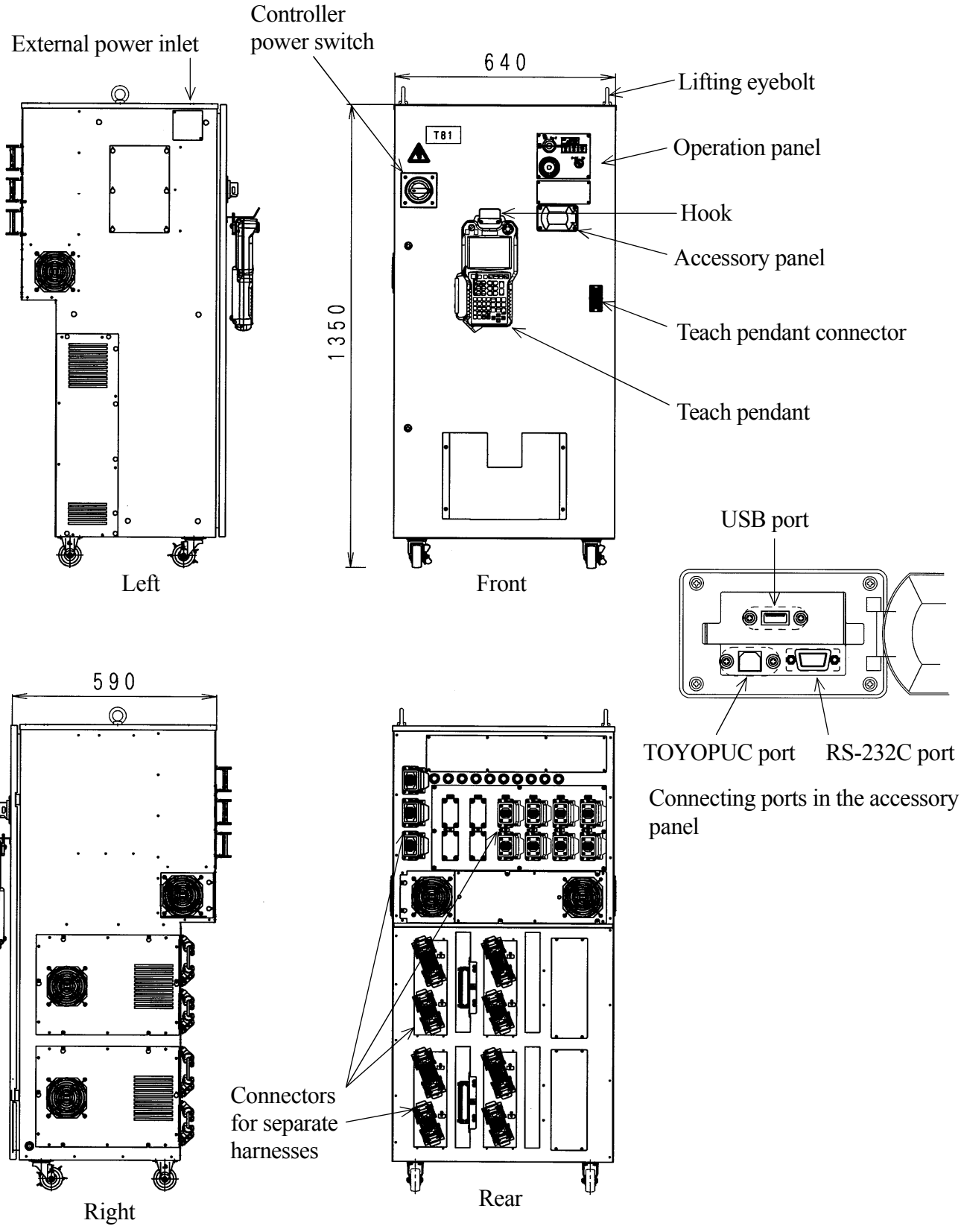


T52 servo MATEHAN spec. controller

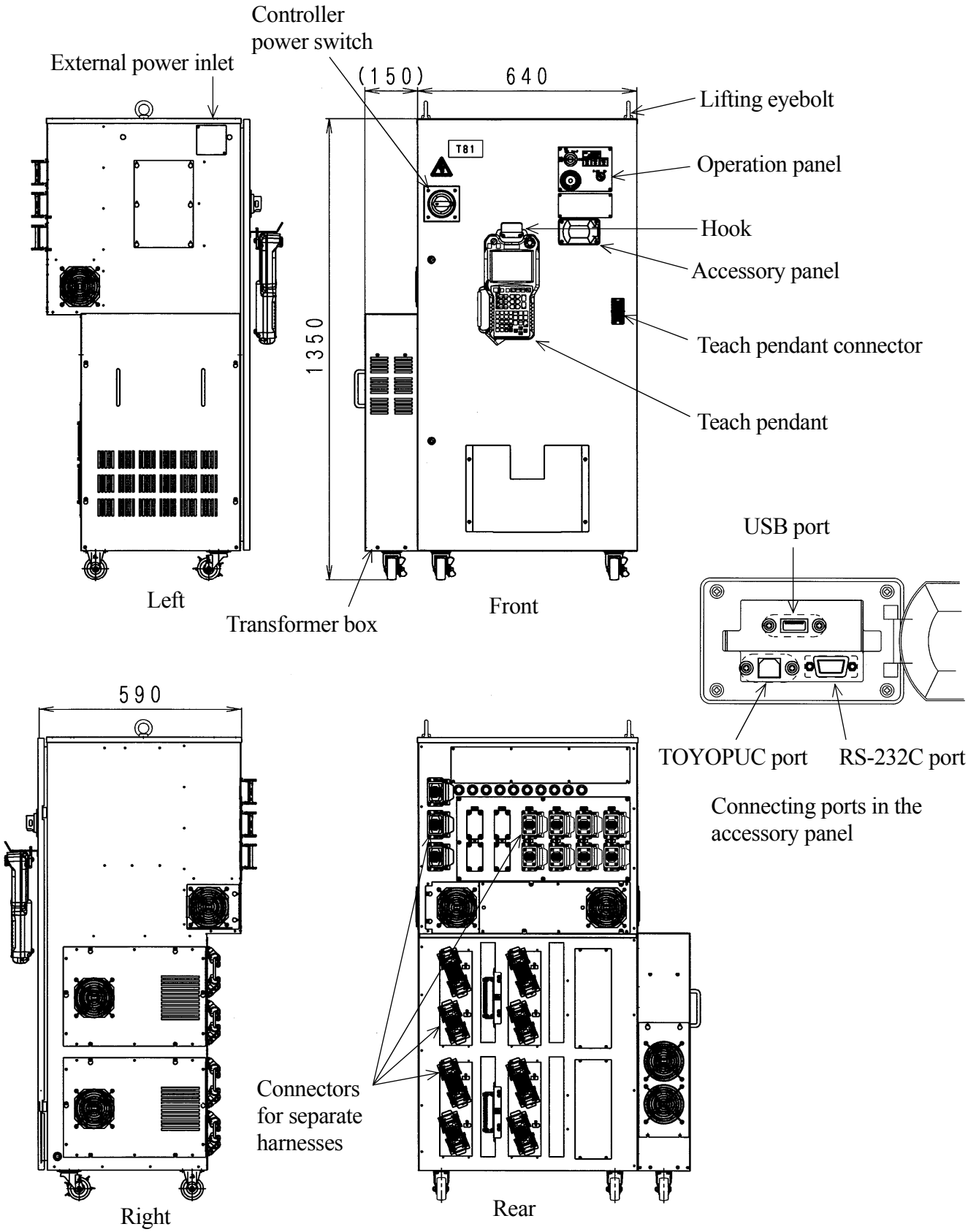




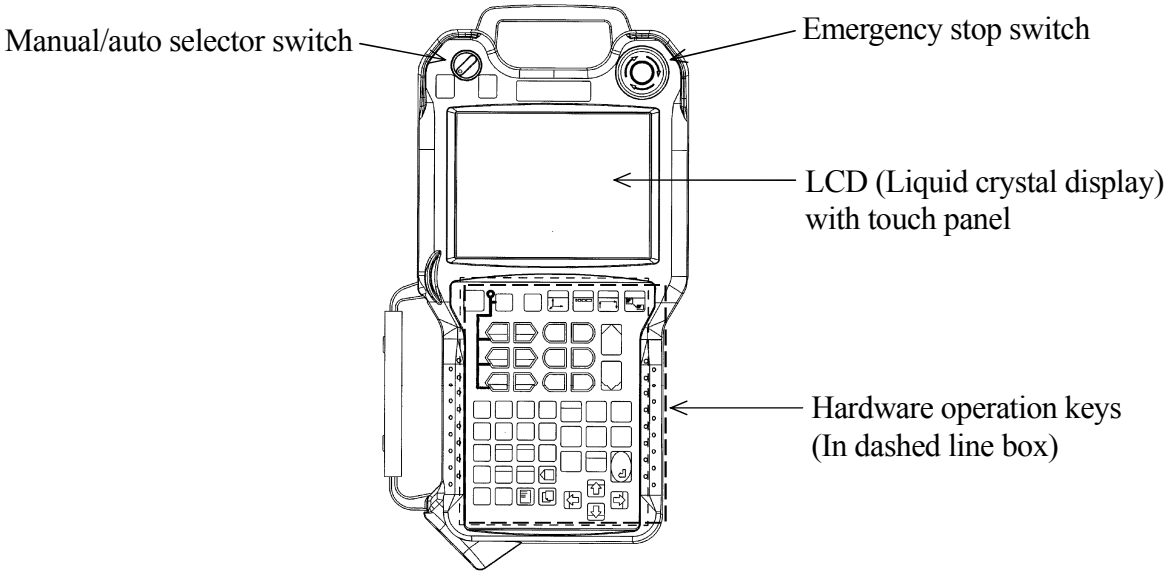
T81 Japan spec. controller



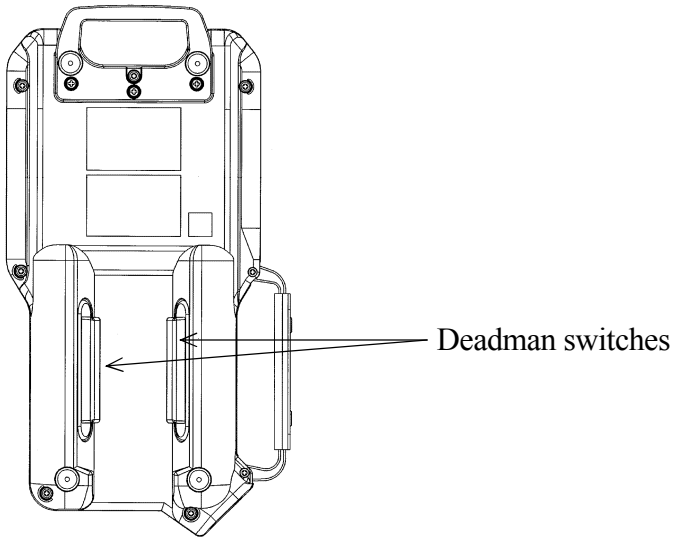
T81 overseas spec. controllers



3.2 TEACH PENDANT APPEARANCE



Front view



Rear view

3.3 T CONTROLLER SPECIFICATIONS

Japan spec.

		T51	T52	T81
Construction		Self-sustaining fully closed, indirect cooling system		
Mass		150 kg	150 kg	250 kg (with 6 ampliifers)
Ambient environment	Temperature	0 - 45 °C		
	Humidity	35 - 85 %RH (Non condensing)		
	Altitude	Up to 1000 meters above mean sea level		
Power source		AC 200-220 V ±10 %, 50/60 Hz, 3 Phase		
Power capacity		Refer to the table below.		
Earthing		Dedicated earthing (100 Ω or less)		
Length of teach pendant cable		10 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
T51	NC SR series R series (1 arm)	1 arm spec.: 5 KVA (8 KVA max.)	8.0 mm^2 or more (AWG #8 or more)	200 m or less
T52	RS30-80 series HR series Z series B series	10 KVA max.	8.0 mm^2 or more (AWG #8 or more)	200 m or less
T81	NC SR series	1 arm spec.: 5 KVA (11 KVA max.)	8.0 mm^2 or more (AWG #8 or more)	200 m or less

Circuit breaker spec. for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
T51	40 A	AC230 V	7.5 kA (Icu)
T52	40 A	AC230 V	7.5 kA (Icu)
T81	60 A	AC230 V	15 kA (Icu)

Asia spec.

		T51	T52	T81
Construction		Self-sustaining fully closed, indirect cooling system		
Mass		200 kg	200 kg	360 kg (with 6 ampliifers)
Ambient environment	Temperature	0 - 45 °C		
	Humidity	35 - 85 %RH (Non condensing)		
	Altitude	Up to 1000 meters above mean sea level		
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		10 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
T51	NC SR series R series (1 arm)	1 arm spec.: 5 KVA (8 KVA max.)	8.0 mm^2 or more (AWG #8 or more)	200 m or less
T52	RS30-80 series HR series Z series B series	9.9 KVA max.	8.0 mm^2 or more (AWG #8 or more)	200 m or less
T81	NC SR series	1 arm spec.: 5 KVA (11 KVA max.)	8.0 mm^2 or more (AWG #8 or more)	200 m or less

Circuit breaker spec. for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
T51	20 A	AC380 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)
T52	20 A	AC380 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)
T81	30 A	AC380 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)

North America spec.

		T51	T52	T81
Construction		Self-sustaining fully closed, indirect cooling system		
Mass		200 kg	200 kg	360 kg (with 6 ampliifers)
Ambient environment	Temperature	0 - 45 °C		
	Humidity	35 - 85 %RH (Non condensing)		
	Altitude	Up to 1000 meters above mean sea level		
Power source		AC 460 V±10 %, 60 Hz, 3 Phase		
Power capacity		Refer to the table below.		
Earthing		Dedicated earthing (100 Ω or less)		
Length of teach pendant cable		10 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
T51	NC SR series R series (1 arm)	1 arm spec.: 5 KVA (8 KVA max.)	8.0 mm^2 (AWG #8) - 13 mm^2 (AWG #6)	200 m or less
T52	RS30-80 series HR series Z series B series	9.9 KVA max.	8.0 mm^2 (AWG #8) - 13 mm^2 (AWG #6)	200 m or less
T81	NC SR series	1 arm spec.: 5 KVA (11 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	Rated current	Rated voltage	Rated interrupting capacity
T51	15 A	AC460 V	30 kA (UL489)
T52	15 A	AC460 V	30 kA (UL489)
T81	30 A	AC460 V	30 kA (UL489)

Europe spec.

		T51	T52	T81
Construction		Self-sustaining fully closed, indirect cooling system		
Mass		200 kg	200 kg	360 kg (with 6 ampliifers)
Ambient environment	Temperature	0 - 45 °C		
	Humidity	35 - 85 %RH (Non condensing)		
	Altitude	Up to 1000 meters above mean sea level		
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		10 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
T51	NC, SR series R series (1 arm)	1 arm spec.: 5 KVA (8 KVA max.)	8.0 mm^2 or more (AWG #8 or more)	200 m or less
T52	RS30-80 series Z, B, HR series	9.9 KVA max.	8.0 mm^2 or more (AWG #8 or more)	200 m or less
T81	NC, SR series	1 arm spec.: 5 KVA (11 KVA max.)	8.0 mm^2 or more (AWG #8 or more)	200 m or less

Circuit breaker spec. for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
T51	20 A	AC380 V	5 kA (Icu)
		AC400 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)
T52	20 A	AC380 V	5 kA (Icu)
		AC400 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)
T81	30 A	AC380 V	5 kA (Icu)
		AC400 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)

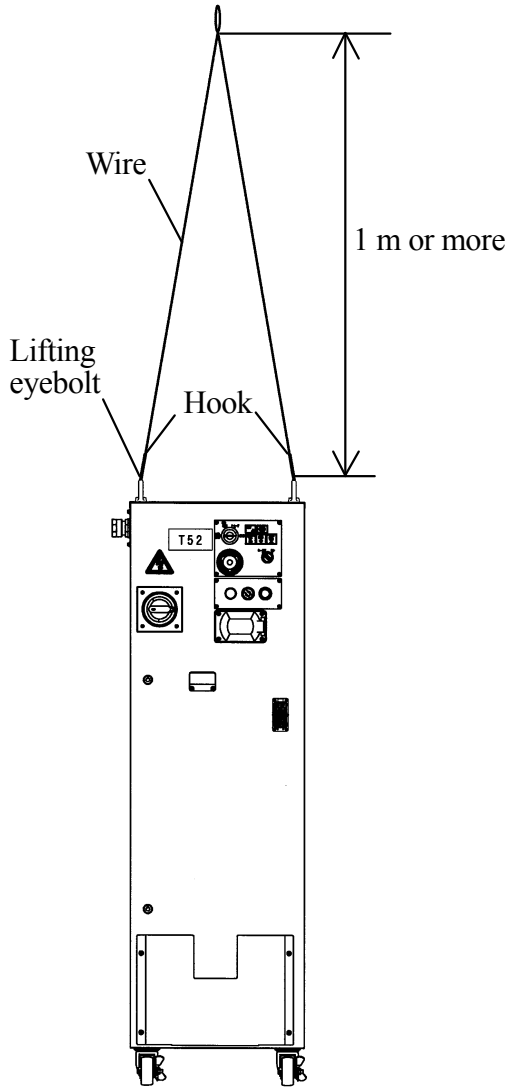
4.0 TRANSPORTATION OF ROBOT CONTROLLER

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

4.1 BY CRANE LIFTING

⚠ 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, etc. capable of hoisting 300 kg or more, sufficient for a controller loaded with full options.**
2. **Remove the teach pendant 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.**

The figure shows T52 controller.

4.2 BY CASTER

⚠ WARNING

1. **If the transport path is flat enough then the controller can be moved on its casters. Otherwise, it may happen that moving on an incline or an uneven surface will topple the controller, and cause serious damage.**
2. **The T52 controller falls if it is inclined as follows.**
   Back or forth: Approx. 12° or more
   Right or left: Approx. 13° or more

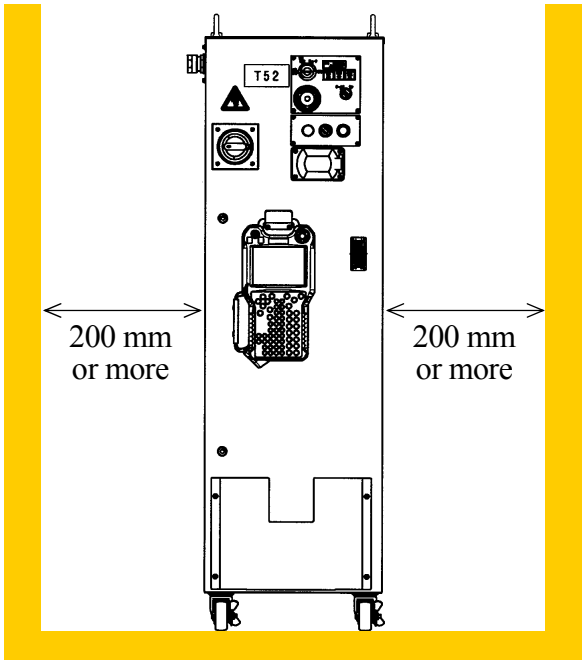
⚠ CAUTION

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.)

5.0 ARRANGEMENT OF ROBOT CONTROLLER

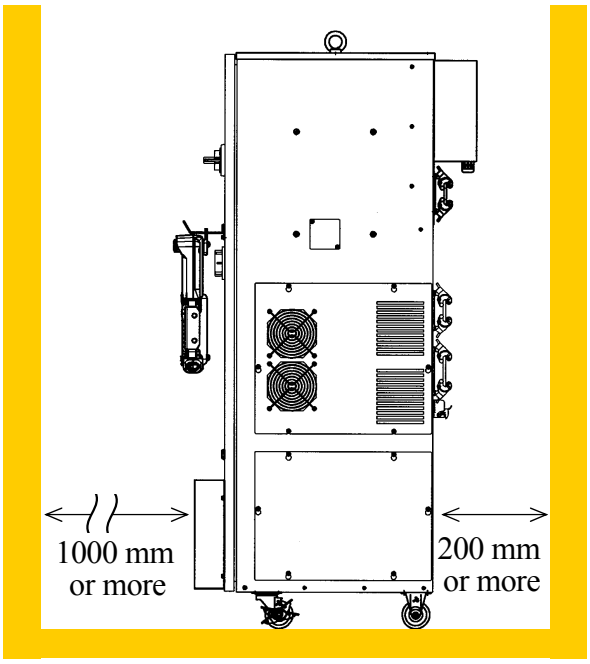
In order for the controller to maintain the proper internal temperature, the installation site must conform to the four points below.

5.1 ARRANGEMENT OF T CONTROLLERS



1. Arrange the controller on a flat, horizontal floor.

2. Separate the controller right/left side from the wall by 200 mm or more.



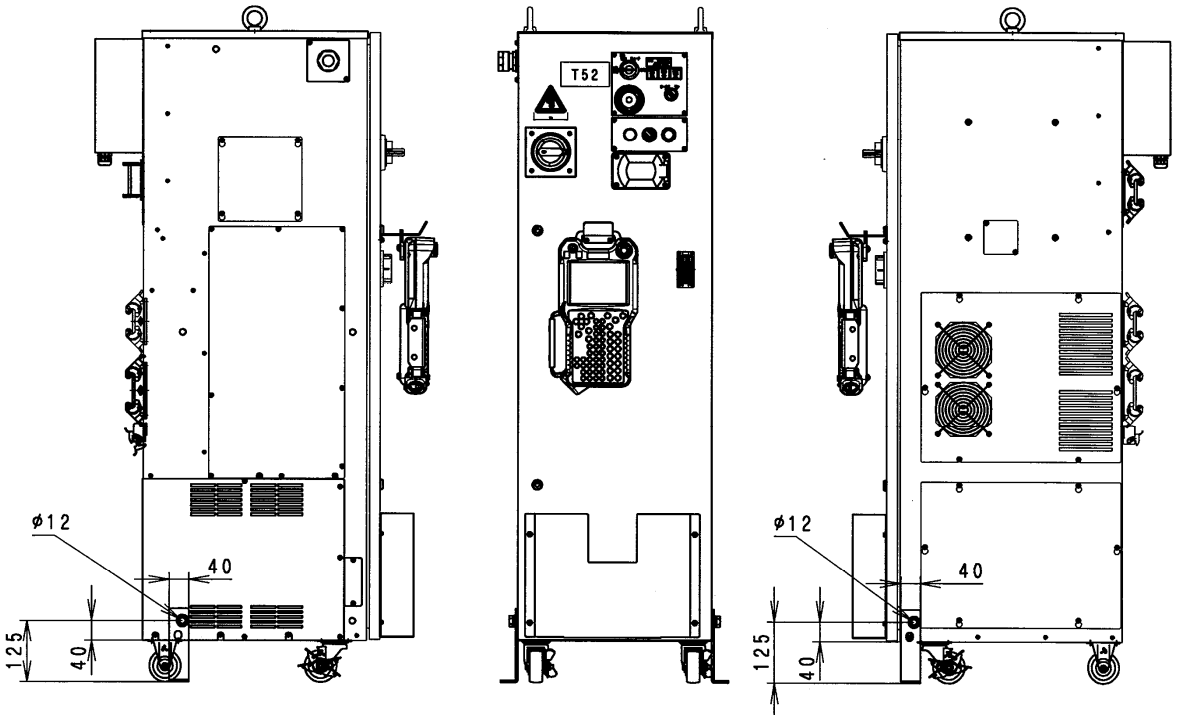
3. The inlet port for air-cooling is on the rear upside/right side of the controller, and the air exhaust port is on the rear downside/right side.

CAUTION

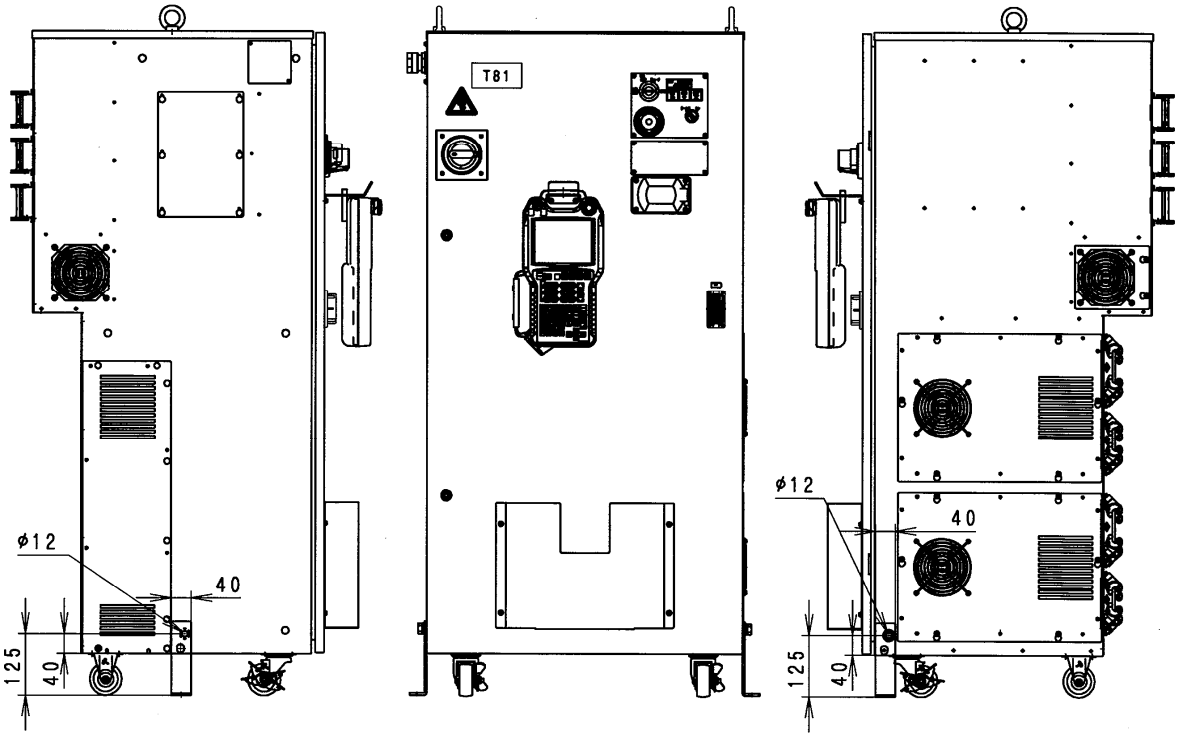
Do not block the air inlet and exhaust ports when arranging the controller. Separate the controller backside from the wall by 200 mm or more.

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

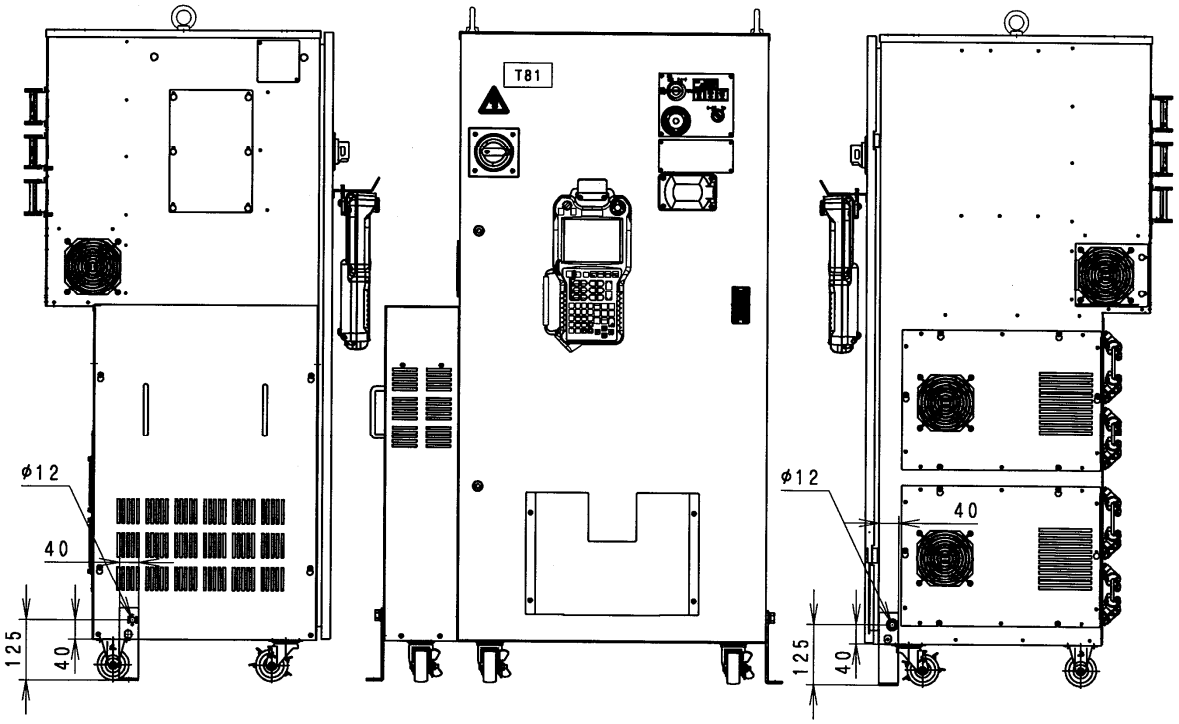
T51/T52 controllers



T81 Japan spec. controller



T81 overseas spec. 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 stoppers of the casters after the transport is complete. (Push the "ON" side pedal for locking.)**

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.

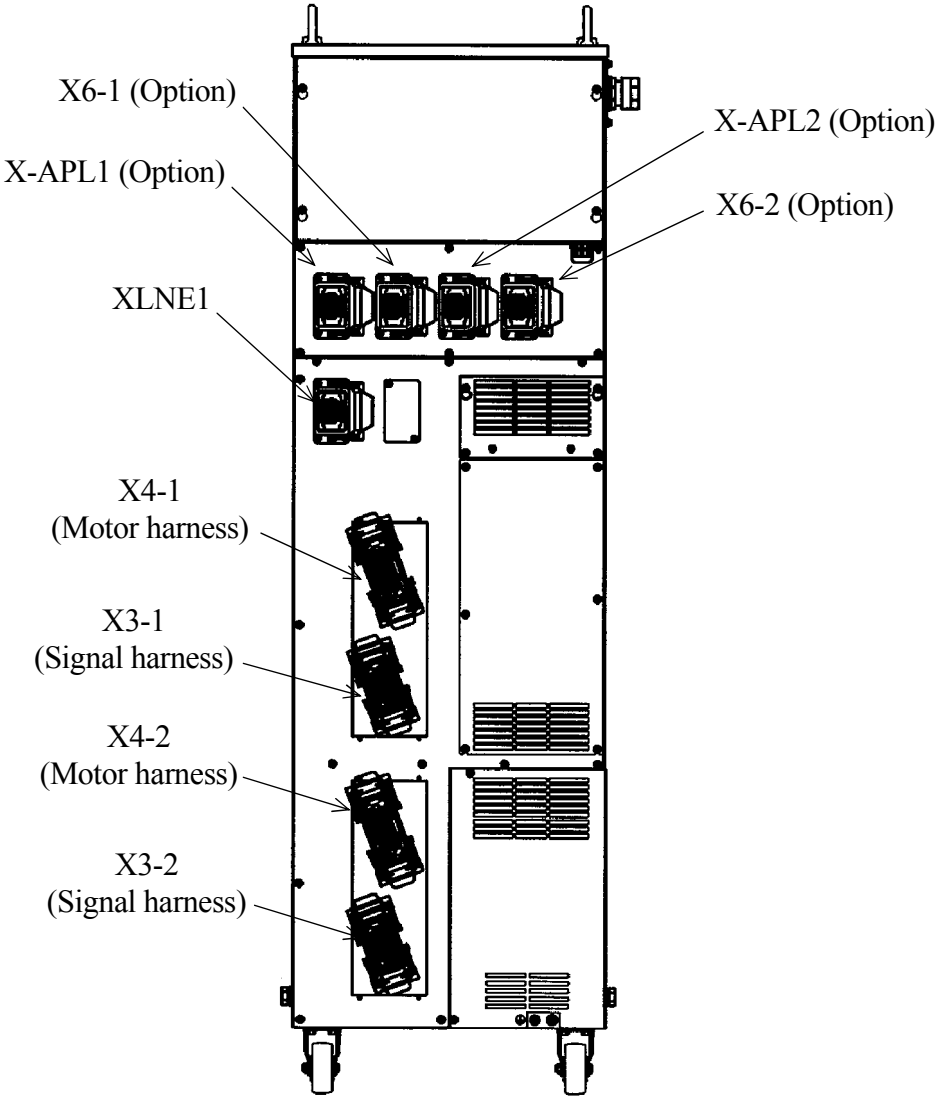
⚠ CAUTION

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. **Separate the harnesses from any nearby high voltage lines (min. 1 m apart). Do not bundle or run the harnesses in parallel with other power lines. Otherwise, the noise generated from power lines will cause malfunctions.**
4. **Even when the harnesses are long, do not bundle them winded or bended. Bundling the harness causes the heat to build up in the harness, resulting in over-heat and furthermore may cause fire.**
5. **Separate the motor harness for robot 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 twisted pair shield lines and connect the mesh wire of the shield line to an adequate FG terminal. Otherwise, noise generated by PWM motor drive may have a negative influence as a radiating noise on various cables such as communication cable and cause communication errors.**
6. **Separate the welder secondary cable from the robot's signal harness without fail. 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 control 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

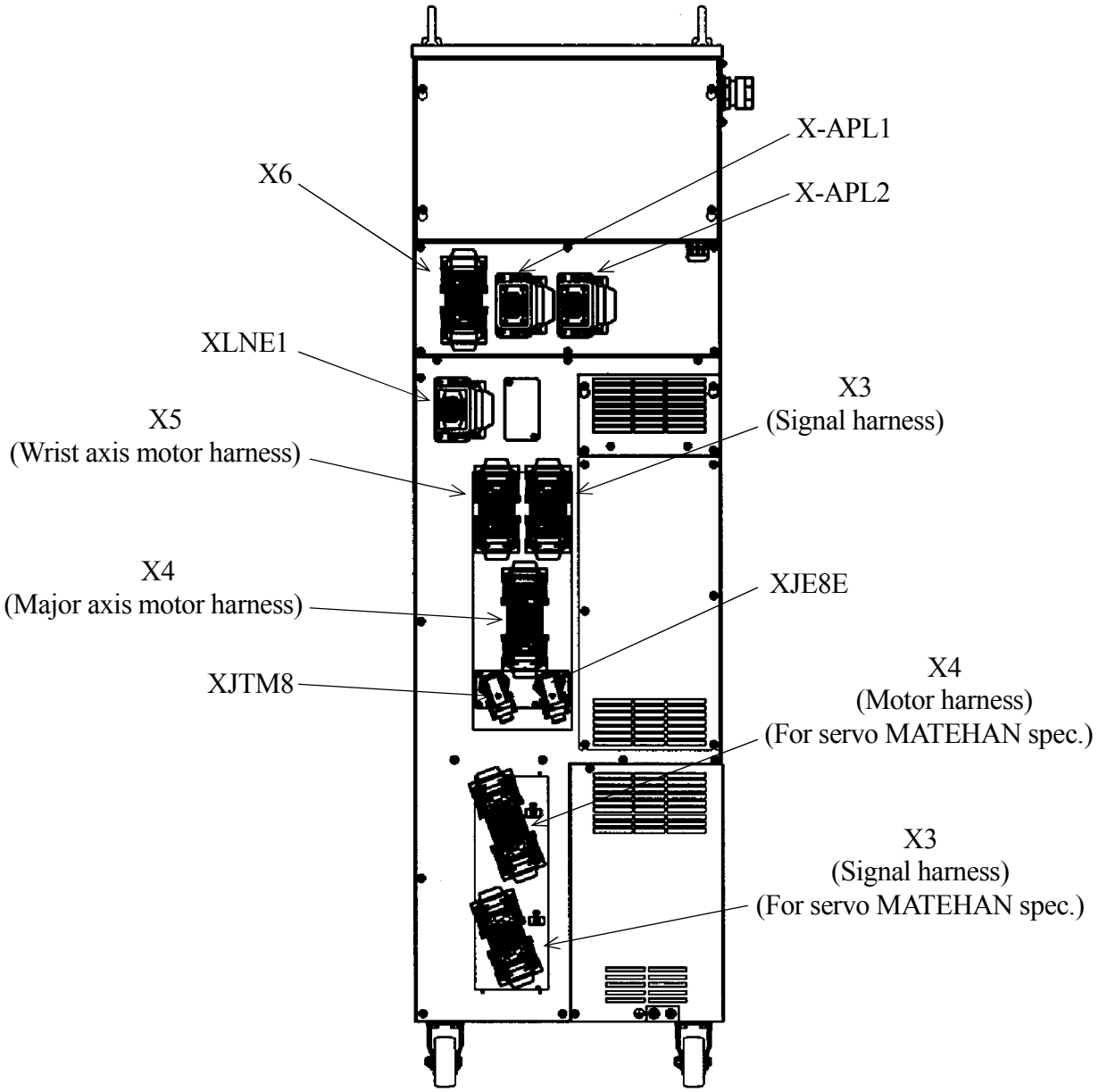
T51 controller



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.**

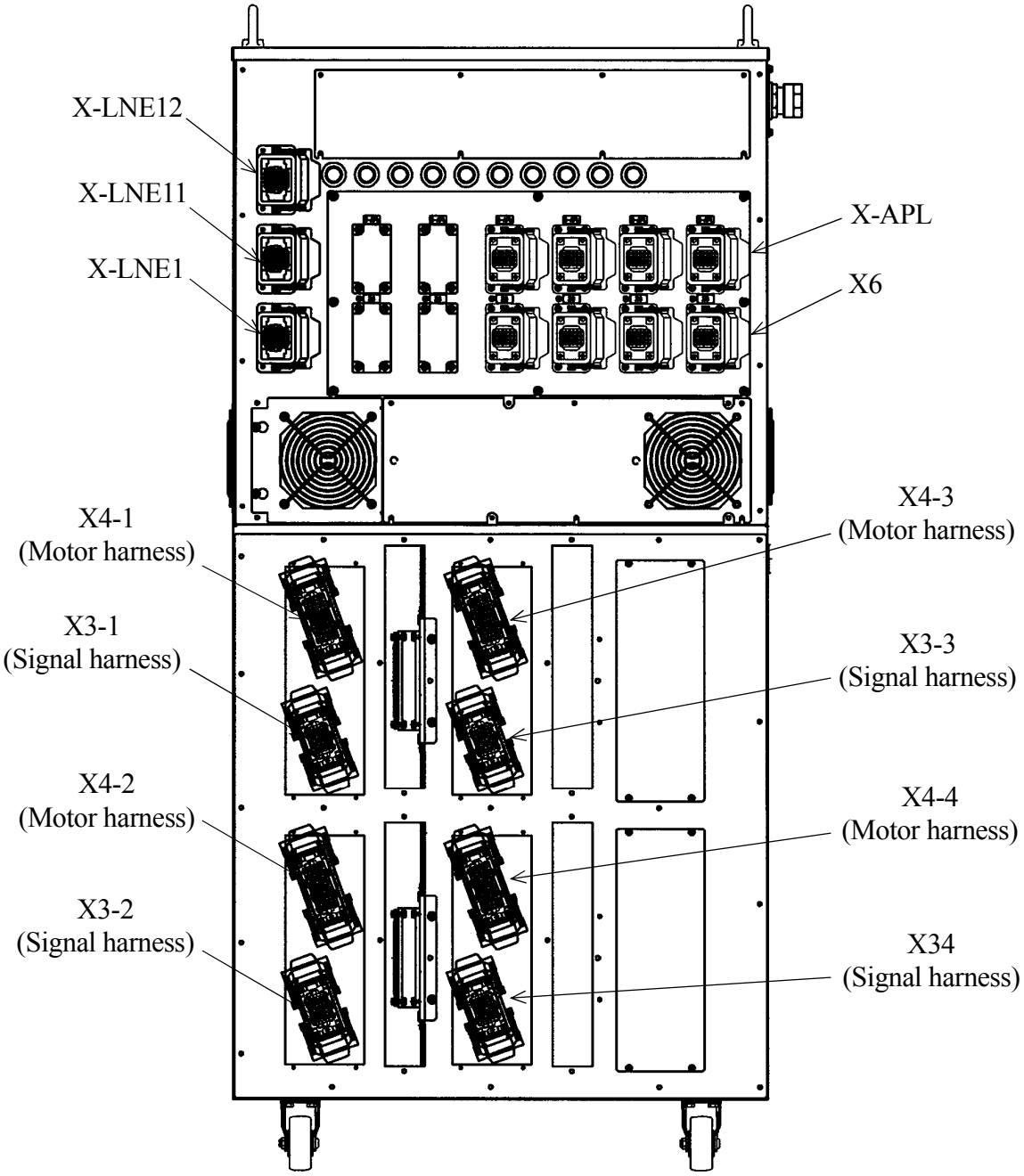
T52 controller



⚠ 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.**

T81 controller

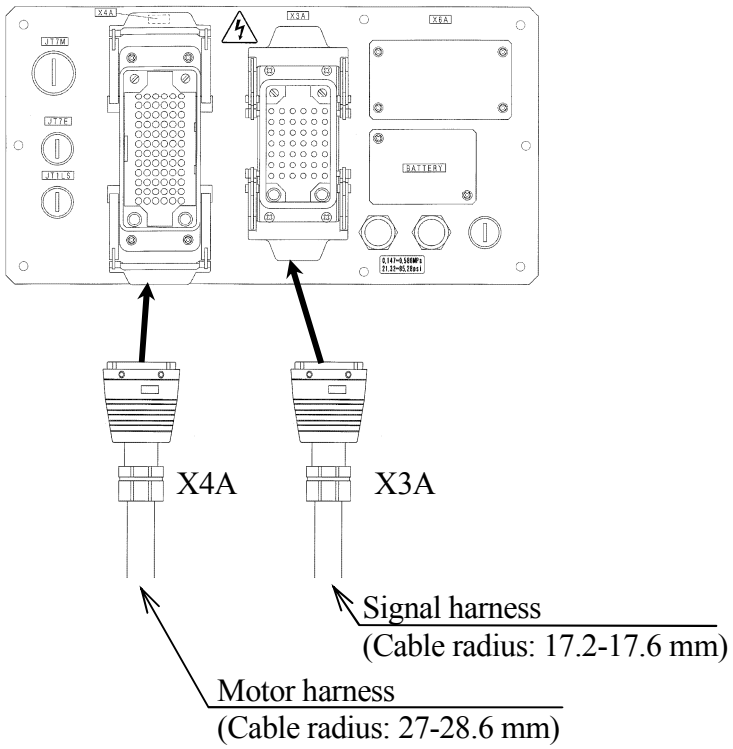


CAUTION

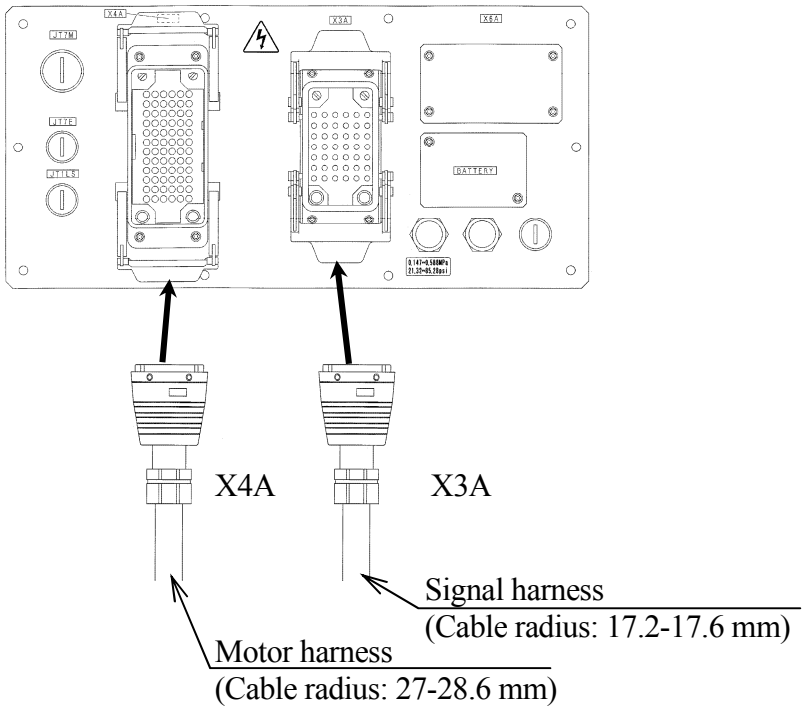
1. **Fix each connector securely. The robot may malfunction if connectors loosen or detach.**
2. **The harness should drop straight down from the connector. Because connectors are located at the upper part of controller, the controller might topple over if the connected harnesses are pulled to the controller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

2. Arm side

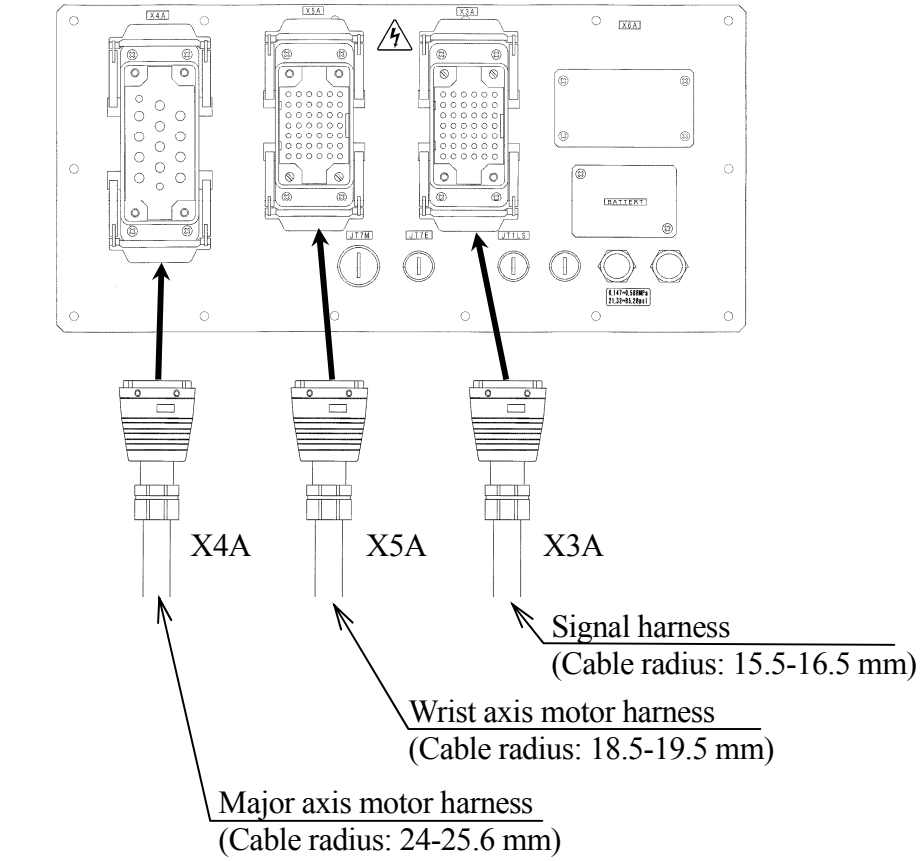
RS10N/RS06L



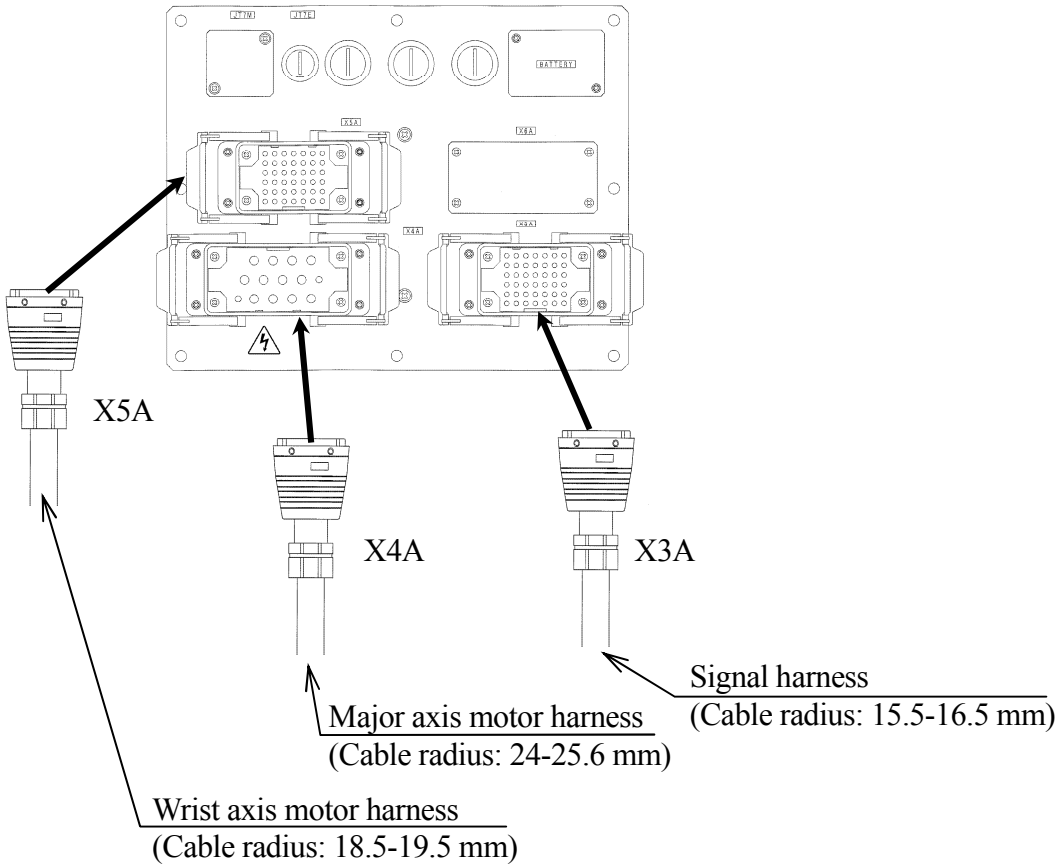
RS20N/RS10L



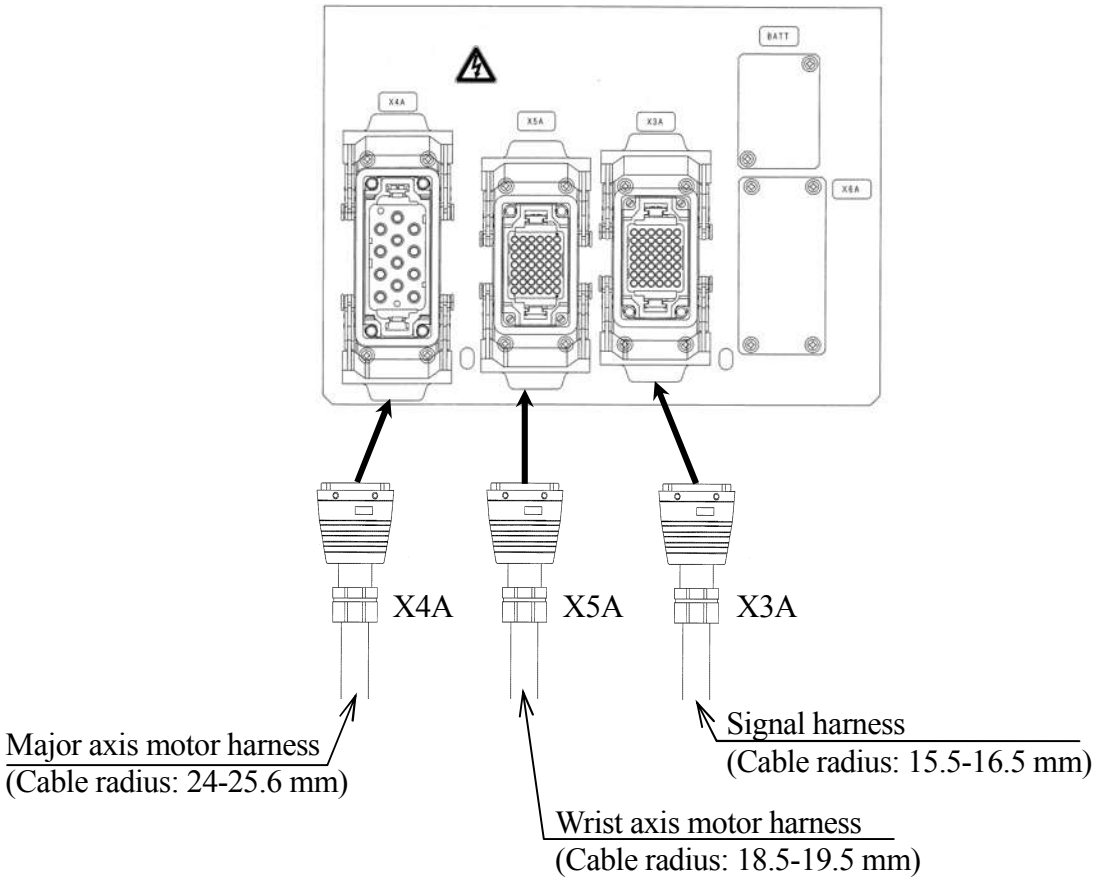
RS30N/RS50N/RS80N/RS15X/RD80N



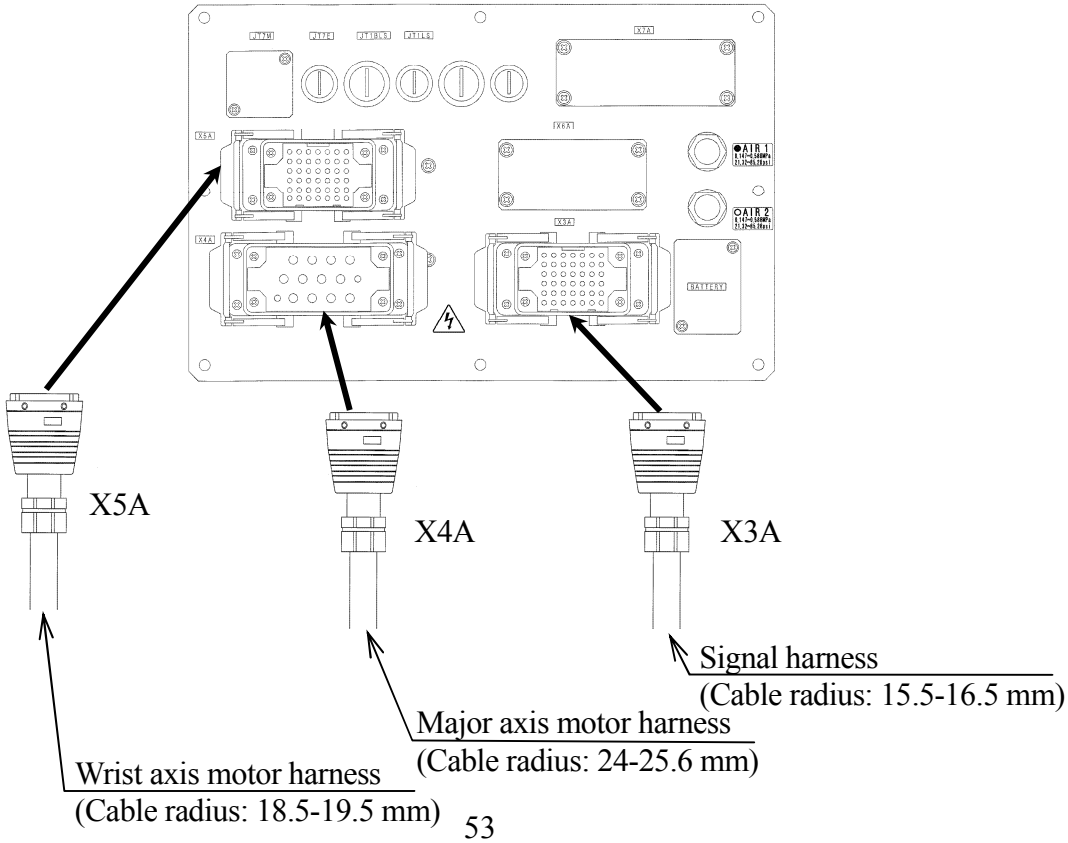
ZS



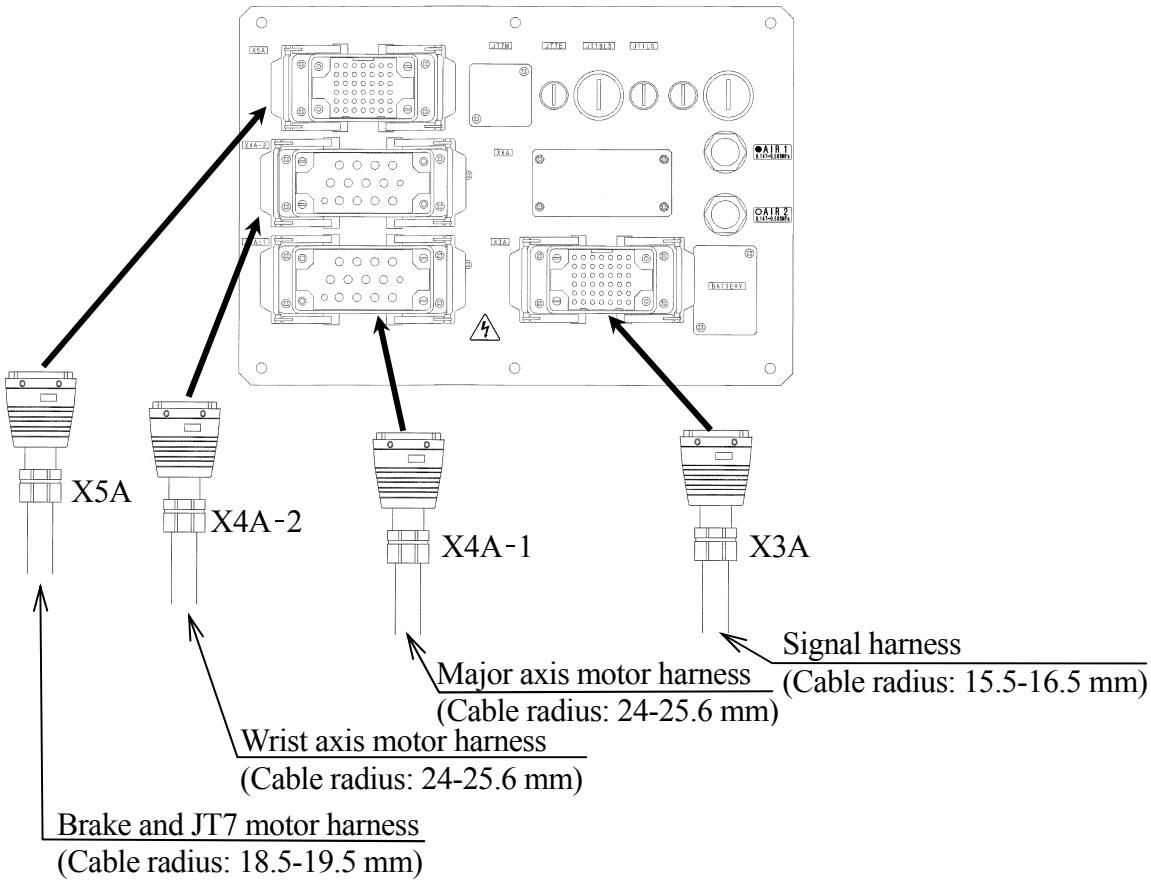
BX/BT


X4A
X5A
X3A
Major axis motor harness
(Cable radius: 24-25.6 mm)
Signal harness
(Cable radius: 15.5-16.5 mm)
Wrist axis motor harness
(Cable radius: 18.5-19.5 mm)

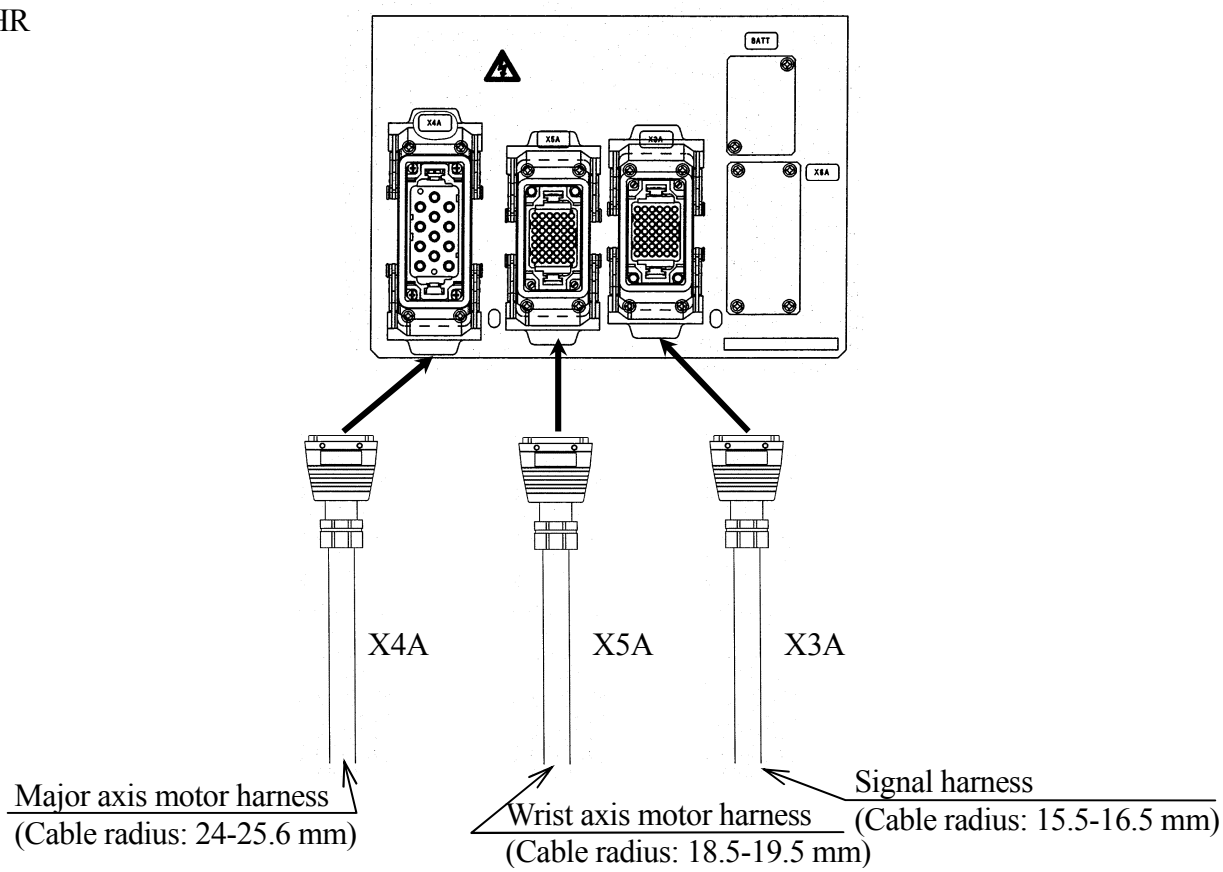
ZX/ZT


X5A
X4A
X3A
Signal harness
(Cable radius: 15.5-16.5 mm)
Major axis motor harness
(Cable radius: 24-25.6 mm)
Wrist axis motor harness
(Cable radius: 18.5-19.5 mm)

MX


X5A
X4A-2
X4A-1
X3A
Signal harness
(Cable radius: 15.5-16.5 mm)
Major axis motor harness
(Cable radius: 24-25.6 mm)
Wrist axis motor harness
(Cable radius: 24-25.6 mm)
Brake and JT7 motor harness
(Cable radius: 18.5-19.5 mm)

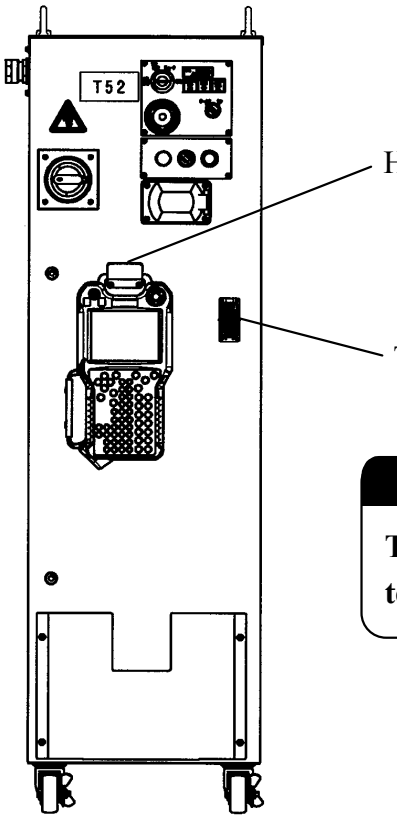
HR


X4A
X5A
X3A
Major axis motor harness
(Cable radius: 24-25.6 mm)
Wrist axis motor harness
(Cable radius: 18.5-19.5 mm)
Signal harness
(Cable radius: 15.5-16.5 mm)

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 connector, then pull down the lever to lock the connectors.

2. Hang the teach pendant and the teach pendant cable on the hook.



CAUTION

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

This figure shows T52 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.

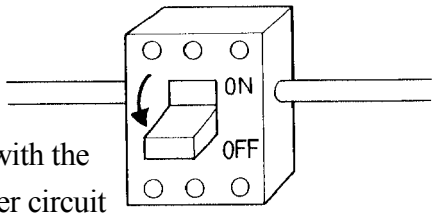
⚠ WARNING

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 mm^2).**
4. **Never share an earth line with weld machine, minus pole (base material), etc.**
5. **In arc welding applications, connect the minus pole (base material) of the weld power supply to a jig or directly to the base material. 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, etc. to reduce the noise level.**
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, etc.**
5. **To prevent shorting or accidental leakage on the external power switch, use 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.

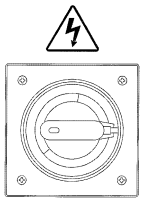


Connect with the your power circuit breaker.

Connect the external power according to the following procedure.

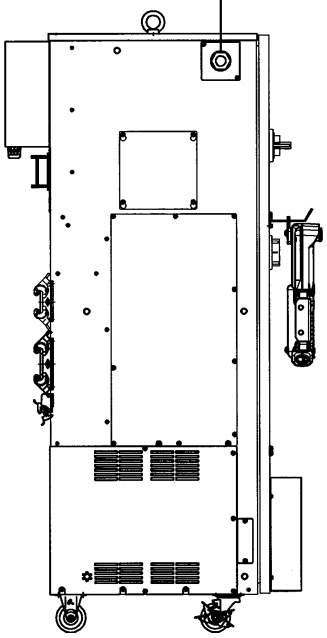
1. Turn OFF your power for the controller.

CONTROLLER POWER switch

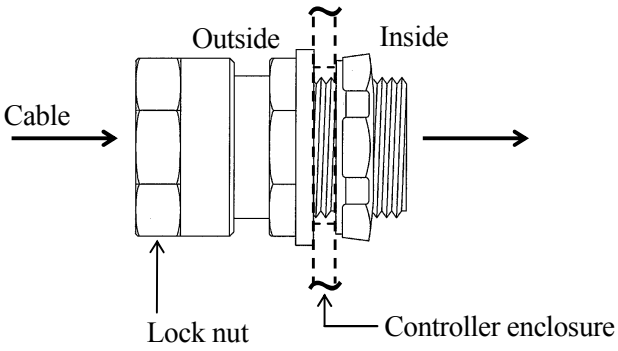


2. Set CONTROLLER POWER switch on the controller door to the OFF side without fail.

External power inlet



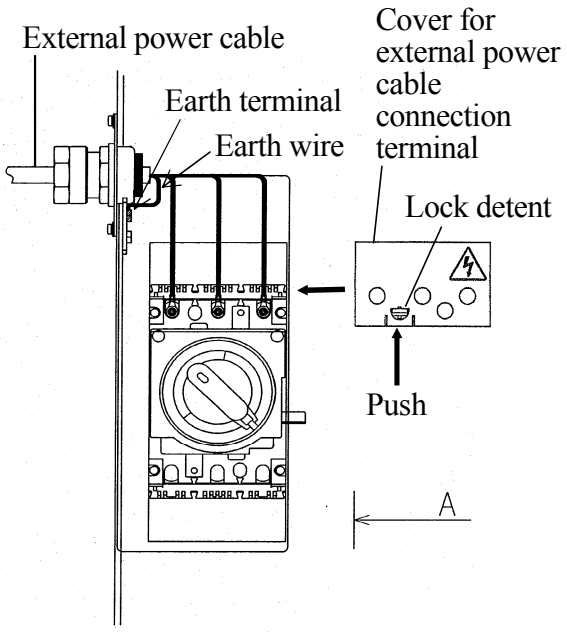
3. Feed the external power cable into the external power inlet of controller.



This figure shows T52 controller.

⚠ CAUTION

Confirm current requirements and select a power cable with adequate capacity. (See section 3.3 for details.) Do not install wire that is too small in diameter, the voltage may drop or the cable may overheat.



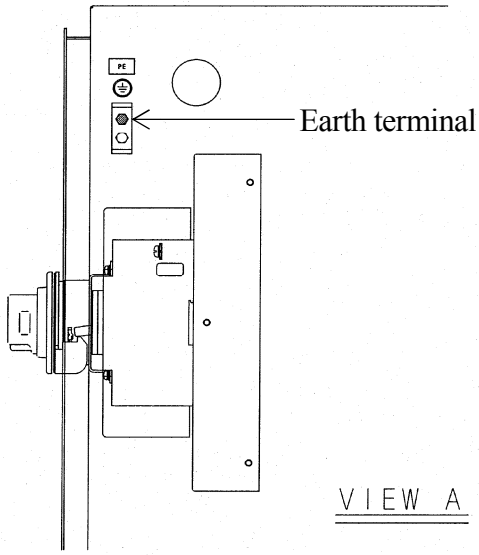
4. Attach round, crimp-type terminals on the ends of the external power cable. Use the terminals with insulators to prevent the metal section from being exposed.

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.

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



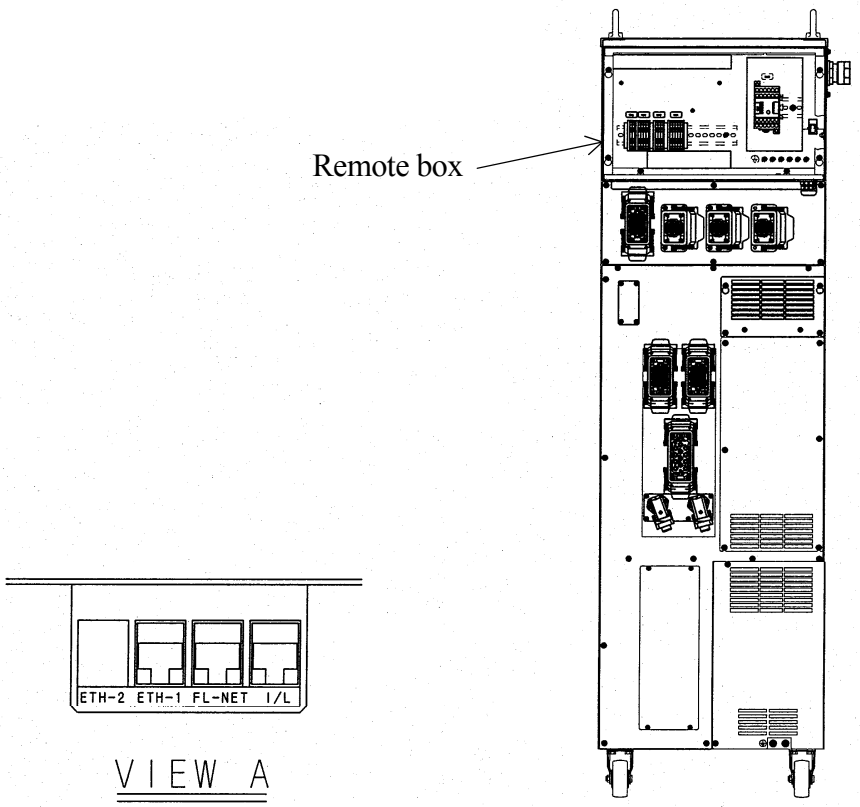
6. Mount the external power cable connection terminal cover.

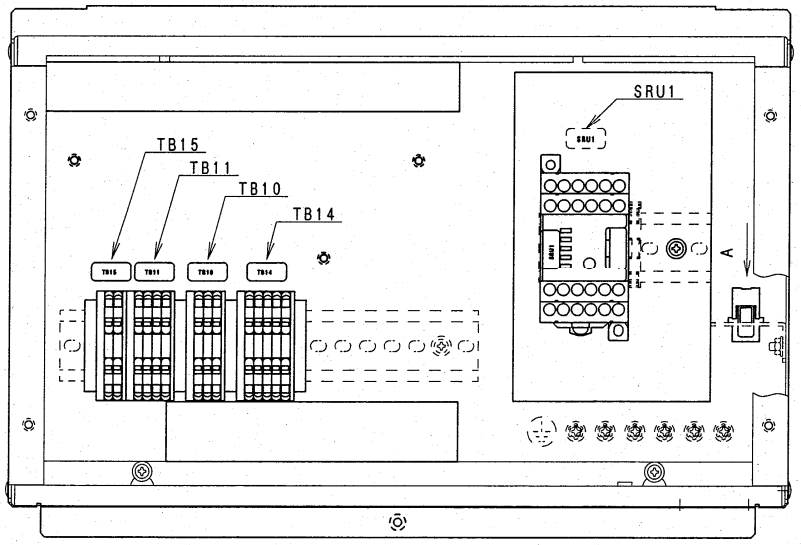
⚠ DANGER

Mount the external power cable connection terminal cover when the wiring is complete without fail. Failing to do so may lead to electric shock due to accidental contact with power line.

8.0 CONNECTION OF PERIPHERAL CONTROL EQUIPMENT

Use the exclusive connectors on controller rear side when connecting the specified peripheral equipment with the T controllers. For optional connection, use the remote box to connect peripheral equipment to the controller. For details, see the specifications attached with the peripheral equipment.





Details of remote box

8.1 CONNECTION INSTRUCTIONS

⚠ WARNING

Turn OFF the power supply to the controller and external equipment when connecting external I/O. Prevent accidental turn ON of the power until all connections are complete by padlocking the main breaker handle 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.

⚠ 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 external I/O cables to connectors or terminals, fix them with tying bands in the cable support set on the top of the controller, preventing them from excessive force.**
7. **Use the seal connector, etc. so that external I/O cables never cause insulation failure or disconnection at the inlet.**

8.2 CONNECTION OF PERSONAL COMPUTER

A PC (personal computer) can be used as a terminal for the robot controller, when loaded with tetminal softwares KRterm/KCwin32 and connected to the RS-232C port in the accessory panel. Also a PC loaded with KRterm /KCwin TCPIP can be used as terminal by connecting it to the ethernet port on 1VA board with Ethernet cable. Refer to the "AS Language Reference Manual" for more details.

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

Data communication is possible with the host computer, etc. when the host computer, etc. is connected to the RS-232C port on the 1VA board with an RS-232C cable.

8.4 CONNECTION OF ETHERNET COMMUNICATION SIGNAL (OPTION)

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

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INSTALLATION AND CONNECTION MANUAL

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