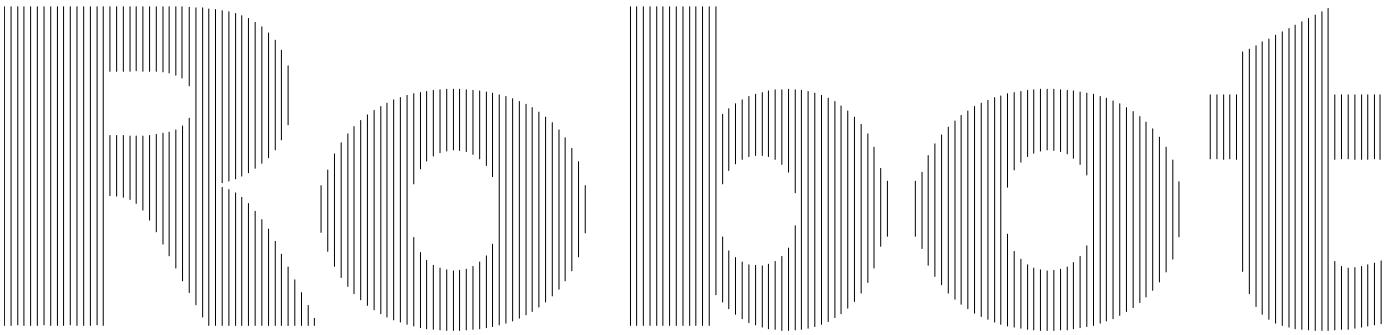
Simple and friendly

Kawasaki

Kawasaki Robot Controller
E Series
(Explosion-proof Specification)

Installation and Connection Manual



Kawasaki Heavy Industries, Ltd.

90202-1111DEI

Preface

This manual describes the installation and connection of the E series controllers. (Explosion-proof specification)

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 “Installation and Connection Manual.”

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.

E25, E27 (Japan/China/Korea specification)
E35, E37 (North America specification)
E45, E47 (Europe specification)

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. Should any unexplained questions or problems arise, 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 separate "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.**

Explosion-proof Specification

This robot is compound explosion-proof type that is constructed with pressurized mechanism and intrinsically safe construction mechanism.

The robot arm and painting device are explosion proofed by a built-in pressurizing mechanism that keeps air within the machine at a higher pressure than the paint booth. This stops gases from entering construction parts and prevents any ignition danger at robot arm's motors/encoders (at normal operation), electrical connections, etc.

The explosion-proof robot protects the motor and machine harness in the arm from explosive gases using pressurized air. However, this protection does not extend to the separate harness connecting the arm with the controller. Make sure the separate harness is not directly exposed to a large quantity of solvent, since the solvent may damage cable coatings causing ground faults or short circuits that may lead to fire. Also, inspect the surface of cable and protecting tube regularly for damage, and replace the separate harness every three to five years.

Purge all explosive gases first before supplying power to equipment in the booth. Install a pressure detection device in the booth that activates automatically if air pressure drops due to error, etc. so that power supply can be cut off immediately (Interlock). Also, power supply must be disabled until the purging is confirmed to be complete, even if the error is cancelled.

For intrinsically safe devices, energy supply to them is limited so that they may not cause explosion within the paint booth under any possible operation or condition. This construction applies to the teach pendant, device to detect the pressure in enclosures and the encoders (only in backup mode).

This robot has been approved for Explosion-proof by various countries' authorizing agencies. However, it is prohibited to modify or add or replace any explosion-proof devices or related parts that may affect the explosion-proof system performance. Also, for maintenance, only approved parts may be used. Contact Kawasaki in case these parts fail and replacement is necessary.

⚠ DANGER

Explosion-proof type robot is certified explosion-proof to ensure safe operation in gaseous or explosive atmospheres (Explosion-proof specification realized by combination of pressurized and intrinsically safe construction). Use extreme care not to mishandle this system; a failure could result in serious accident such as explosion, etc.

Table of Contents

1 Safety

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

1.1 Precautions during Transportation, 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. **Never go under or stay too close to the controller during transport.**

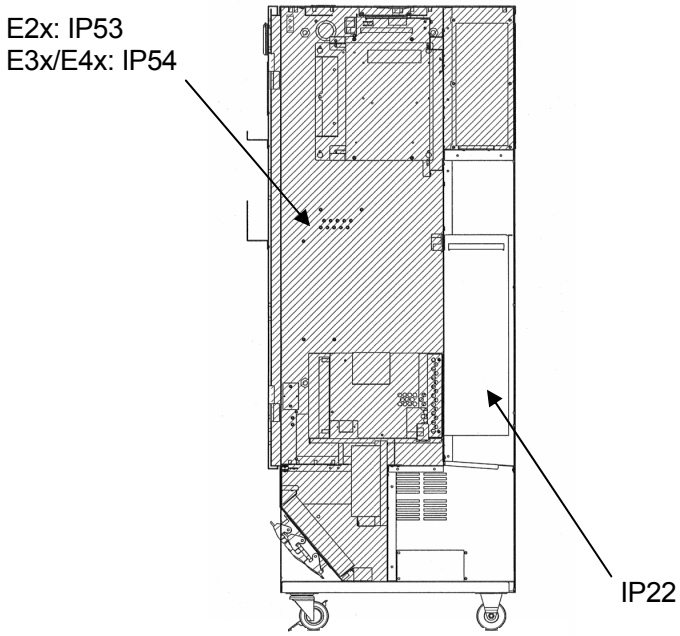
⚠ CAUTION

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. **During transportation, installation, and storage, be sure to observe the following points.**
   (1) Ambient temperature: -10 to 60°C
   (2) Relative humidity: 35 to 85% RH (non-condensing)
   (3) Do not subject the equipment to excess impact, shock or vibration.

1.2 Installation Environments of Robot Controller

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

1. Ambient temperature during operation: within 0 to 45°C.
2. Relative humidity: 35 to 85%RH (Non condensing)
3. Altitude: Up to 1000 meters above mean sea level
4. Free from dust, smoke, water, oil, etc. (IEC60664-1: pollution degree 3 or lower, Controller protection grade: E2x: IP53 and E3x/E4x: IP54 except for transformer section and heat sink section. See the figure below.)



Right side view

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

⚠ CAUTION

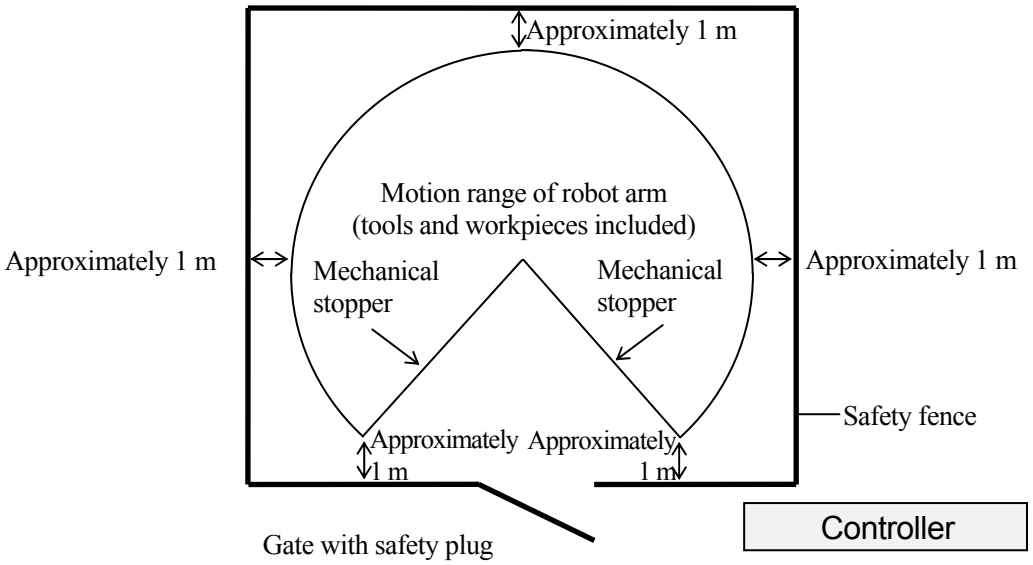
If the controller is installed near equipment that generates a lot of electrical noise, be sure to provide appropriate surge killers around that equipment. Noise producing equipment includes: induction motors, electromagnetic brakes, solenoids, or contact equipment, etc.

8. Place where power is supplied within specifications.
9. Place where dedicated class A and class D groundings for robots, and protective earth (PE) can be provided. (For E2x: class D grounding with resistance of 100 Ω or less for general circuit and class A grounding 10 Ω or less for intrinsically safe circuit. For E3x/E4x: protective earth (PE).)

10. Outside the safety fence with margin (min. 1 m) from the motion range of robot arm (including 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 (ISO 13854 to 13855, ISO 13857, ISO 14119 to 14120, etc.)



1.3 When Connecting the Harnesses

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

⚠ WARNING

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

⚠ 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 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 When Connecting the External Power

Strictly observe the following precautions when connecting the external power.

⚠ DANGER

Confirm that external power supply for the controller is cut off at the source before starting connection process. Failing to do so is extremely dangerous, resulting in accidents, electric shock, etc. To prevent external power from being turned ON, tag the breaker to indicate clearly that work is in progress. Or, assign a supervisor in front of the breaker until all the connections are complete.

⚠ WARNING

1. **Make sure the power supply to be connected to the controller meets the specifications listed on the rating plate and label on the side of the breaker. Connecting to a power source outside specifications may damage internal components.**
2. **Ground the controller to prevent against electrical noise and shock.**
   (For E2x) Two types of grounding are required: Class A (10 Ω or less) and Class D (100 Ω or less). Class A grounding is particularly important to maintain intrinsically safe explosion-proof performance. Be sure to connect each ground line to each specified place. Use ground wire of correct size as shown in "3.3 E2x Controller Specification."
   (For E3x/E4x) Protective earth (PE) is required. This is also important to maintain intrinsically safe explosion-proof performance. Be sure to connect the ground line to the specified place. Use ground wire of correct size as shown in "3.4 E3x Controller Specification" and "3.5 E4x Controller Specification."
3. **Do not use a common ground wire for the controller and the other devices. Also, do not connect ground wires of several controllers to one ground port.**
4. **Before turning on the power supply, ensure that the power supply for the controller is connected securely and that all covers, etc. are mounted correctly. Failure to do so may cause electric shock.**
5. **Orange electric cables in the controller are possibly alive even when external power is turned OFF, so be careful.**

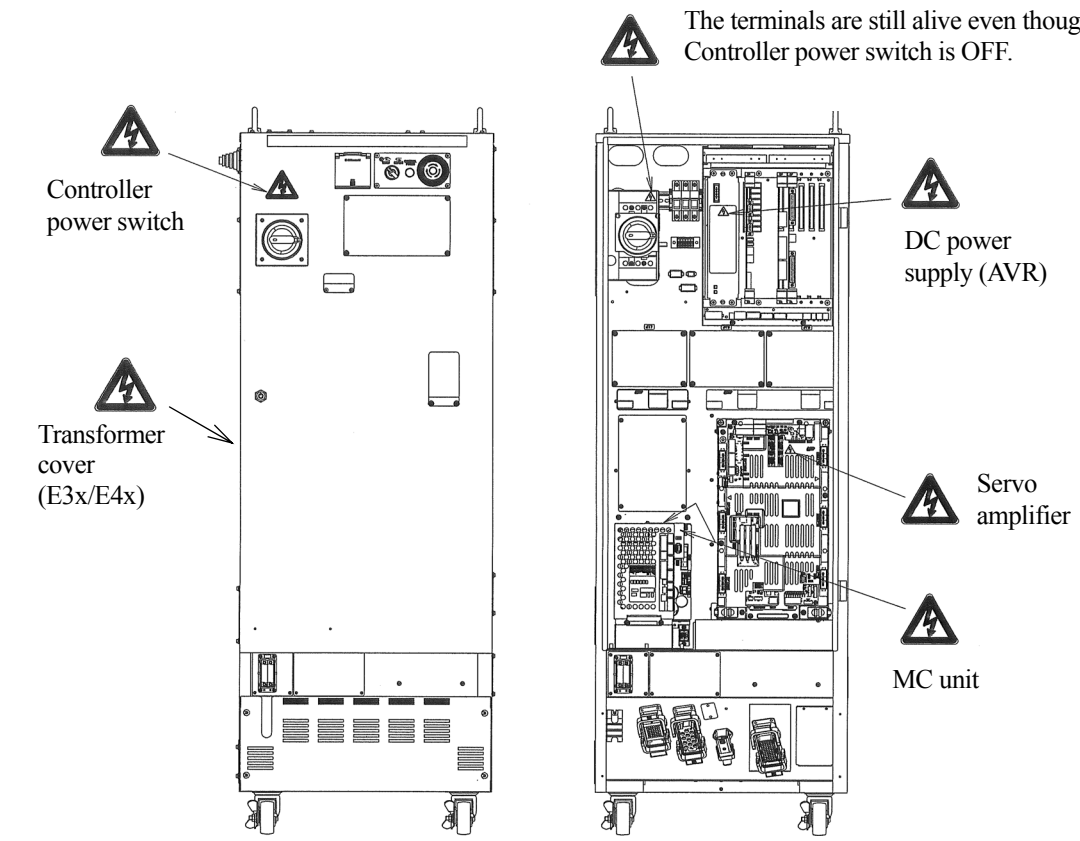
⚠ CAUTION

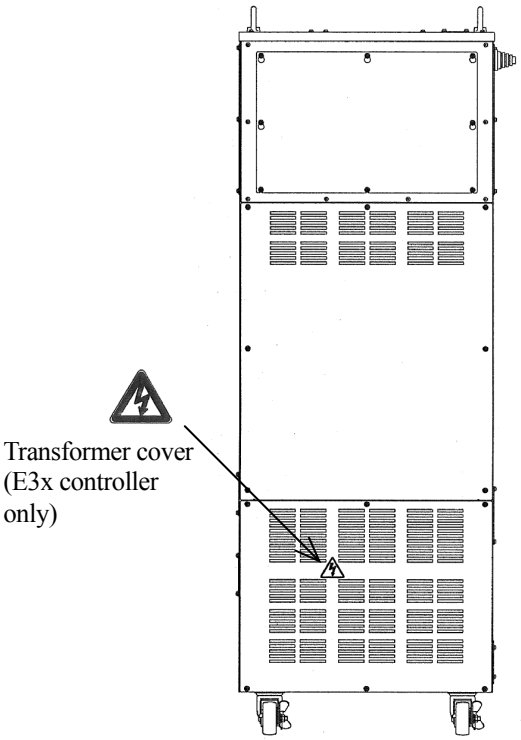
1. **Prepare external power that meets the specifications of the controller in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the controller's specified range (above/below ratings), then the power monitoring circuit activates cutting off the power, and an error is returned.**
2. **If there is a risk of noise from other peripheral devices via the external power supply becoming mixed in, reduce the noise level by adding a noise filter or similar.**
3. **Devices* with poor tolerance to noise from supplied power can be expected to malfunction due to the effects of PWM noise from the robot motor. Therefore ensure in advance that no such devices are present nearby.**
4. **Use dedicated external power supply breakers for robots and never use together with welding machines, etc.**
5. **In order to prevent electrical leakage incidents, use a ground leakage circuit breaker as the source breaker in the external power supply. (Use a time delay type with a current 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**

* Be aware that some devices are highly susceptible to voltage surges such as from proximity switches directly connected to power supplies.

1.5 Warning Label for Electric Shock

Warning labels for electric shock are on the location below.





1.6 Use and Disposal of Battery and Fuse

Batteries are used for data backup in the controller. Figures below and on the next page show the location of the batteries on the 1TA/1VA board and for encoder backup.

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

⚠ WARNING

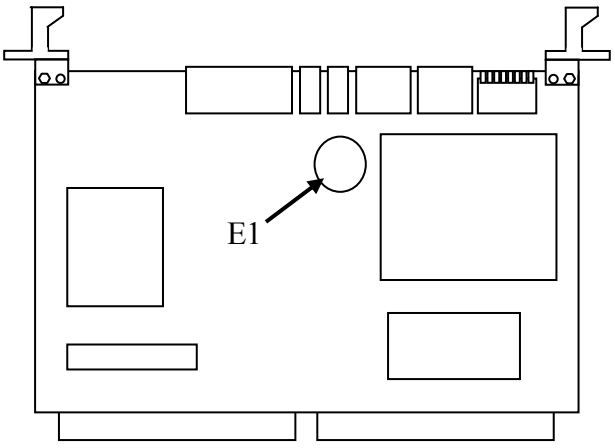
1. **Only use batteries specified by Kawasaki.**
2. **Never re-charge, dismantle, convert and/or overheat batteries.**
3. **Never dispose of batteries into water or fire.**
4. **Batteries with damaged cases may short internally and must not be used.**
5. **Never short the positive and negative poles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

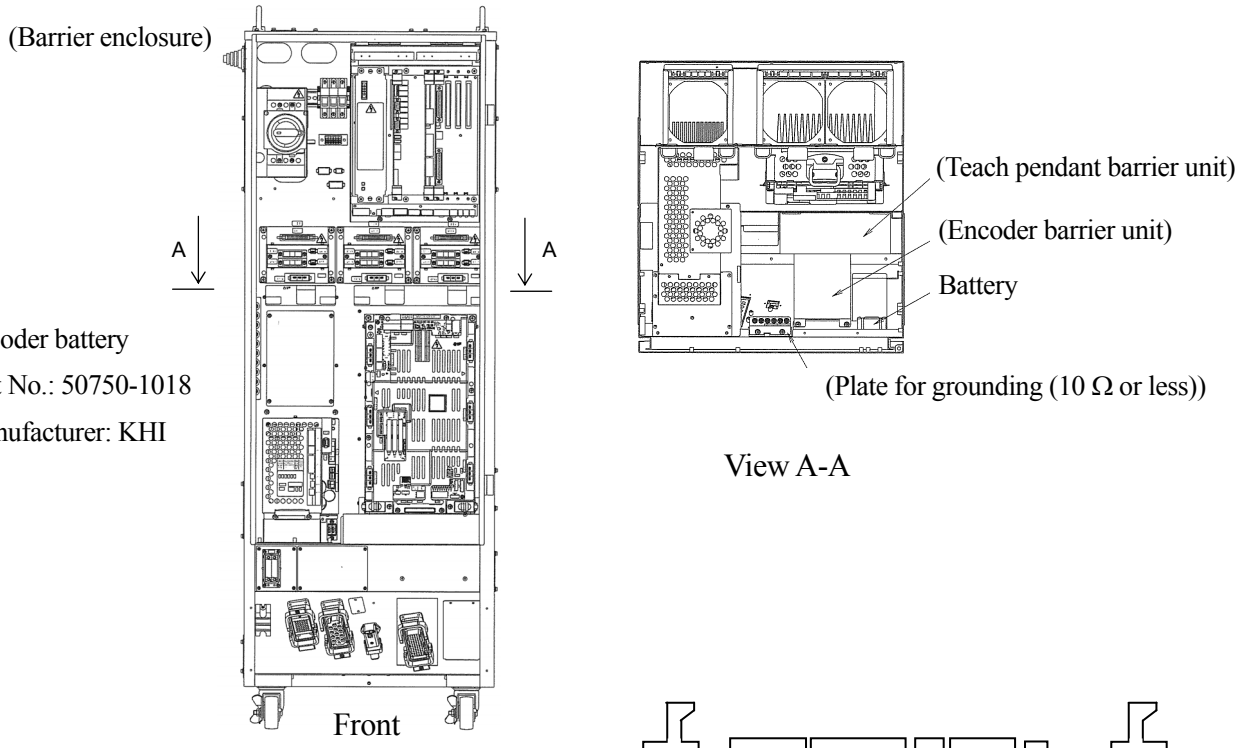
⚠ CAUTION

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

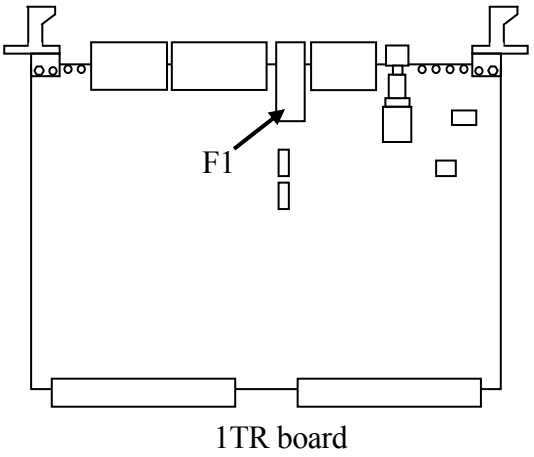




Encoder battery
Part No.: 50750-1018
Manufacturer: KHI

Location of Fuse

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



1TR board

1.7 Safety Features

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

1. All emergency stops are hard-wired.
2. All robot controllers are equipped with a redundant dual channel safety circuit. Both channels of the safety circuit must be closed to allow for robot operation in teach and repeat modes.
3. Safety circuits of E3x/E4x controller satisfy requirements of PLd in category 3 defined by ISO 13849-1:2006. Category and Performance level (PL) are determined by the whole system and conditions. The safety circuit of these controllers is available in the system of category: up to 3, PL: up to d.
4. The teach pendant and operation panel are equipped with emergency stop switches. Also, all robot controllers have external emergency stop inputs.
5. The teach pendant is equipped with two, three-position enable switches. One of the two enable switches must be pressed to enable motor power in teach and check modes.

6. Teach and check mode velocities are limited to a maximum of 250 mm/s (10.0 in/s).
7. All robot axes are equipped with DC24 V electromagnetic brakes that engage when power is removed. If the robot loses power unexpectedly, the axes are held in position by the brakes.
8. In Fast Check mode that satisfies requirements of ISO 10218-1, the velocities are not limited to 250 mm/s (10.0 in/s). (E4x controller: Standard, E2x controller: Option.)

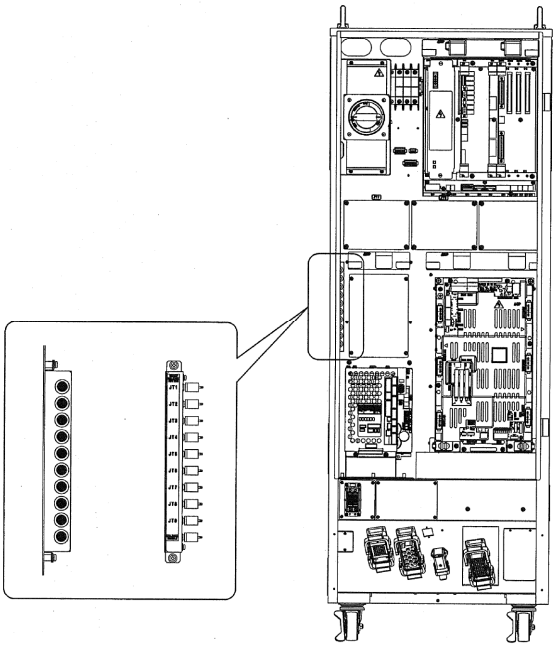
1.8 Emergency Movement without Drive Power

The manual brake release switches allow the operator to move individual robot axes without using motor power for abnormal or emergency situations. (E2x controller: Option, E3x/E4x controller: Standard)

The manual brake release switches are located as shown below.

WARNING

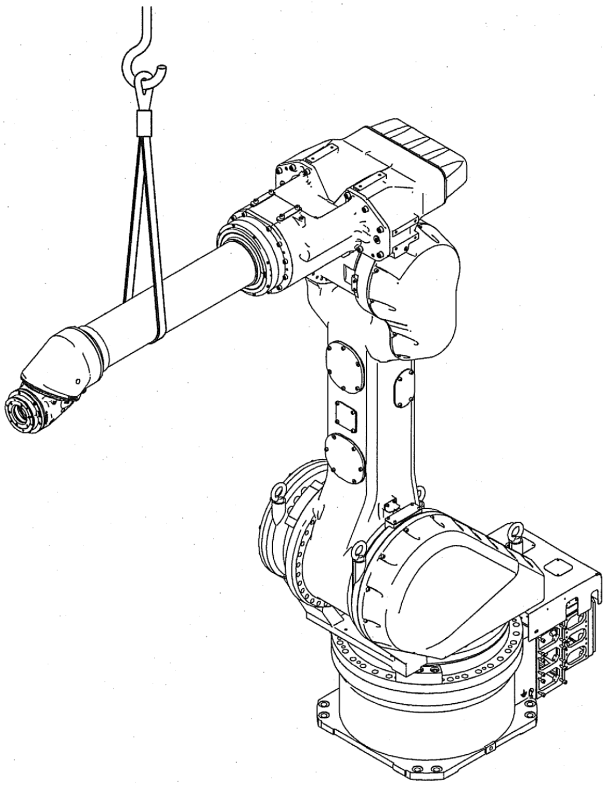
When no servo power is applied, electromagnetic brakes lock to maintain the robot arm posture. Unsupported axes may fall when the brake release switch is pressed. Axes which are overhung, particularly JT2 and JT3, will fall the fastest, depending on robot posture, weight of the end-of-arm tooling, and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



Brake release switch position

⚠ 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).



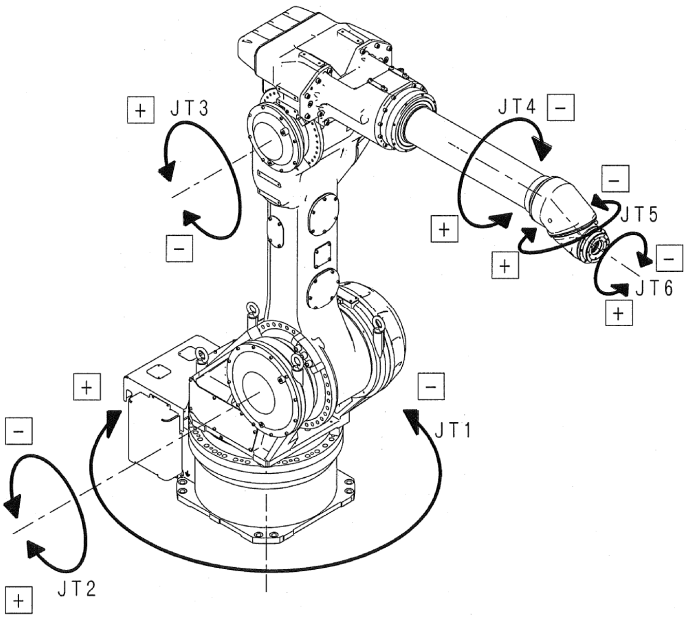
Robot arm support

To manually release axes brakes follow the procedure below.

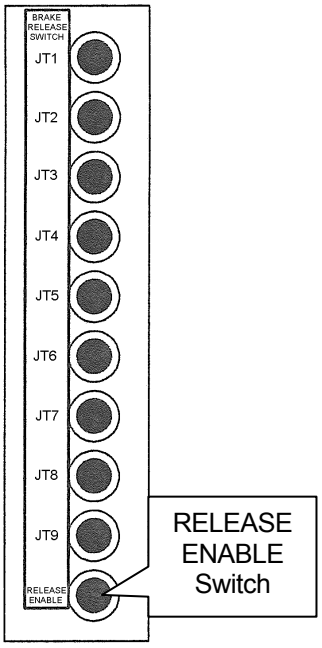
1. Set motor power OFF.
2. Ensure all personnel are clear of site and all safety precautions are followed.
3. Provide suitable support of the robot arm, end-of-arm tooling, and payload if there is a risk of personal injury and damage to the robotic equipment (see above figure).
4. Ensure the switches are in the OFF position and in operating condition.
5. Press the brake release switch for the axis to release the brake for a moment, and confirm that the brake will not be released.
6. Press and hold the “RELEASE ENABLE” switch (see right figure on the next page). If the brake is released at this time, do not use the switch (see “CAUTION”).
7. Press the manual brake release switch for the axis to release the brake (see right figure on the next page).
8. The brake remains released until the brake release switch is released.

⚠ CAUTION

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



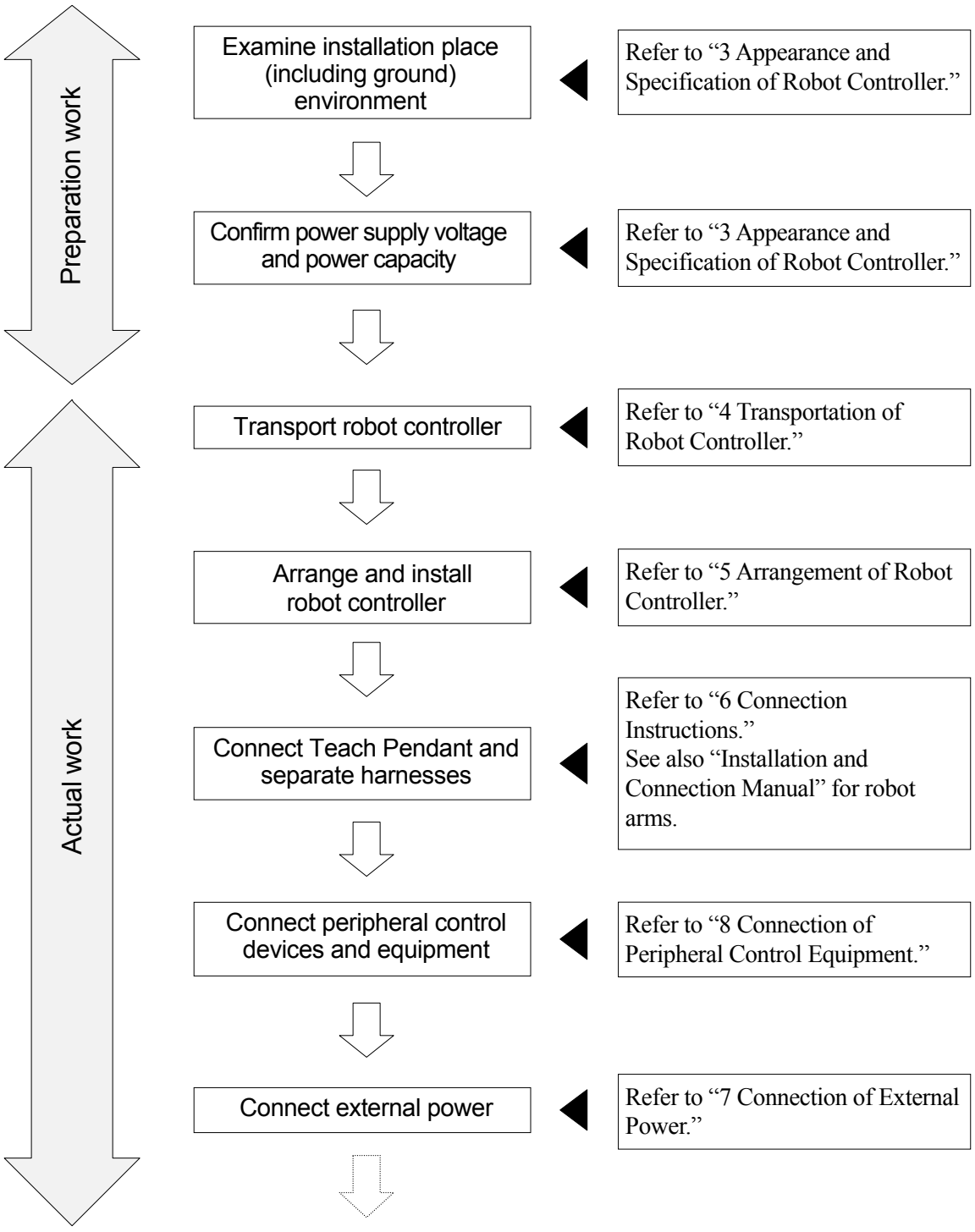
Robot brake release axes

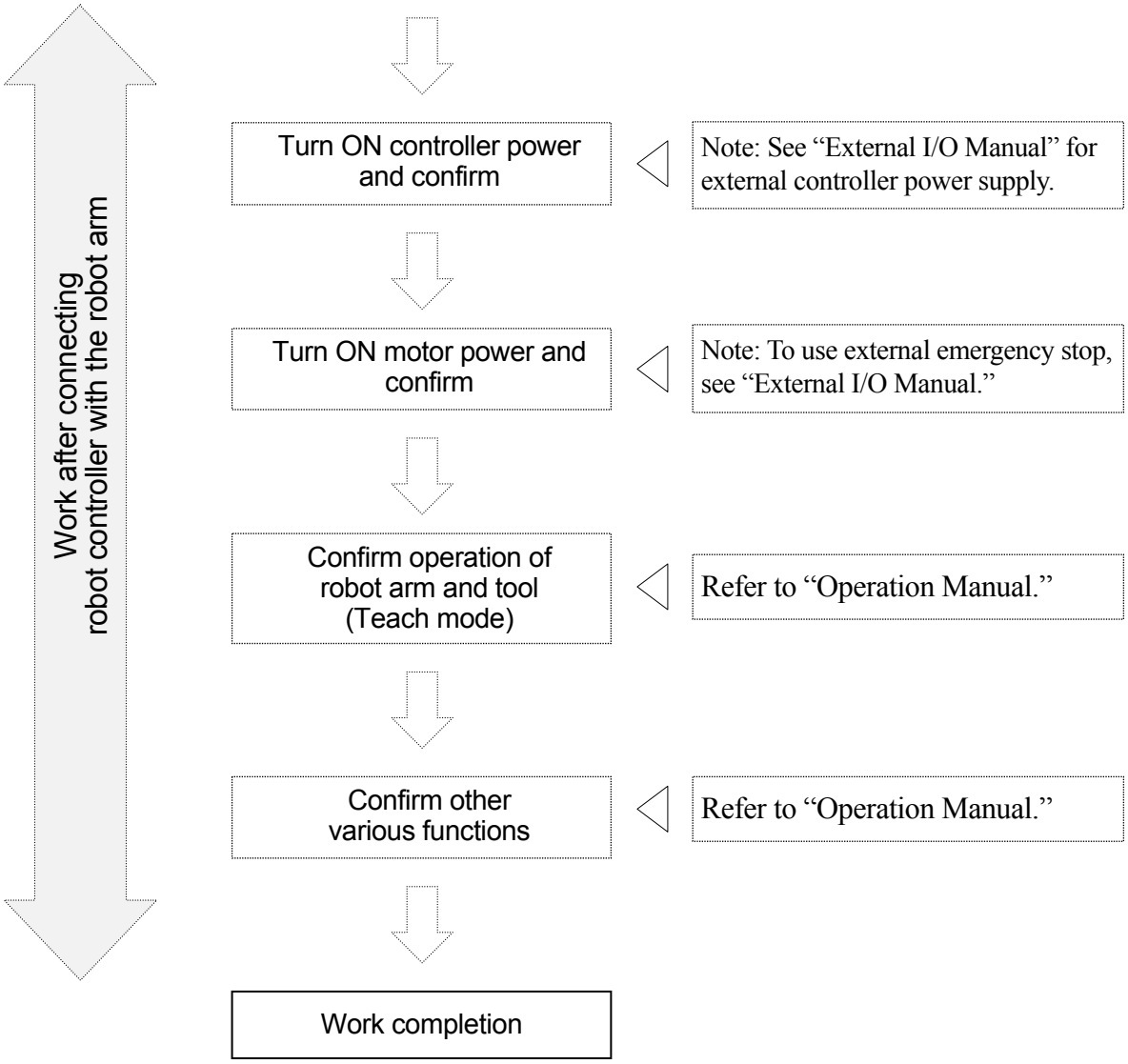


Manual brake release switch

2 Workflow - Robot Controller Installation and Connection

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





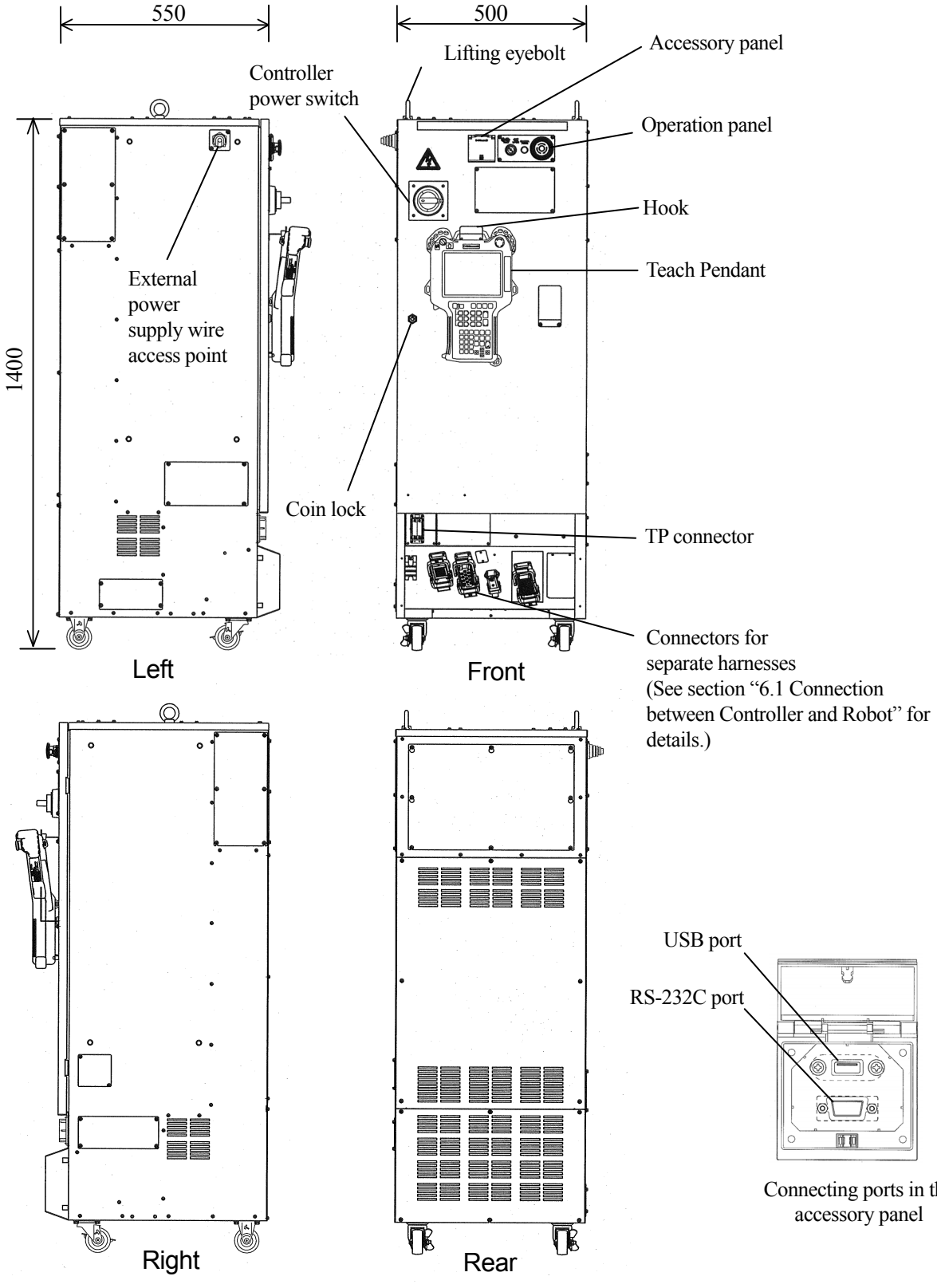
[NOTE]

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

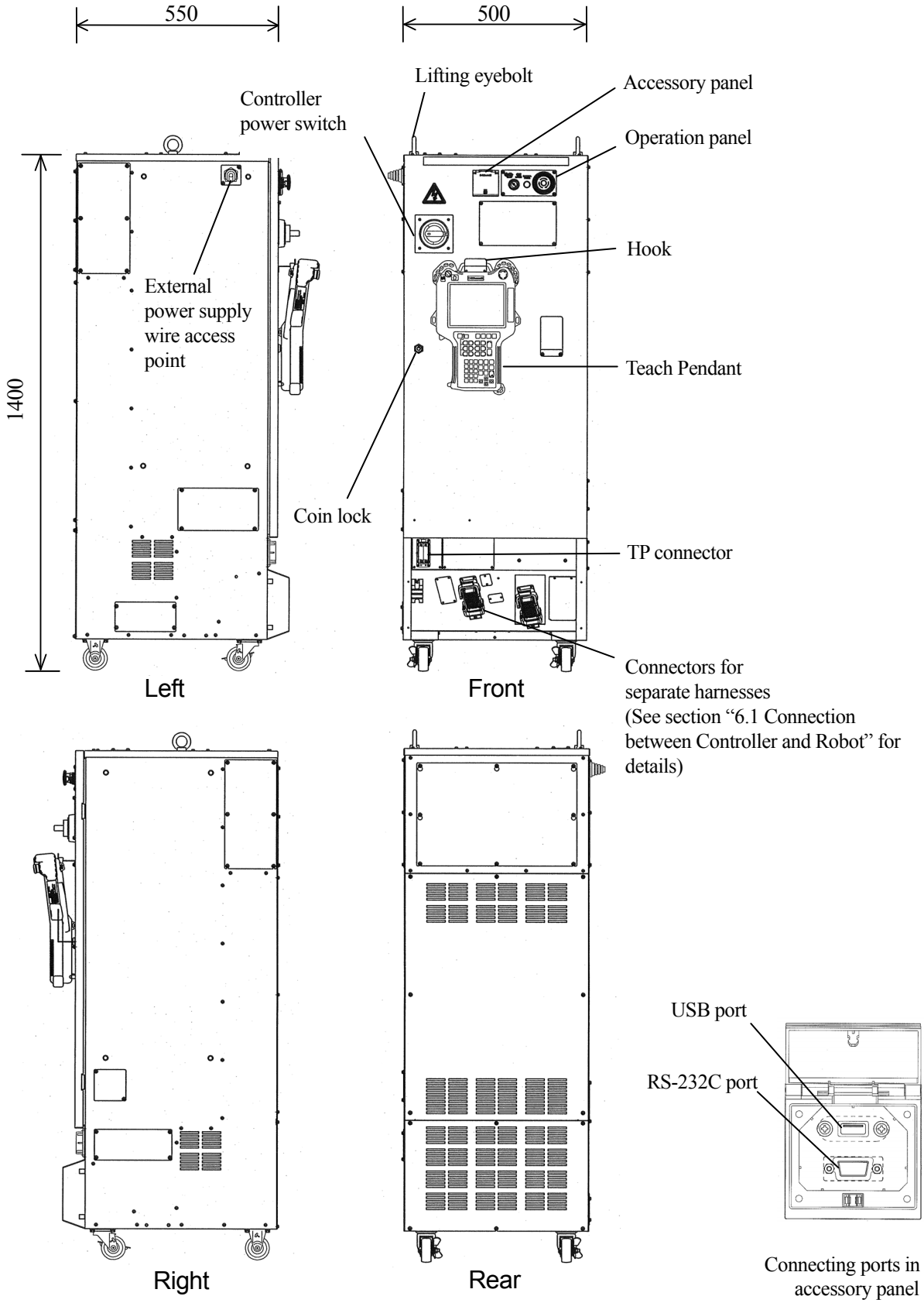
3 Appearance and Specification of Robot Controller

3.1 Controller Appearance

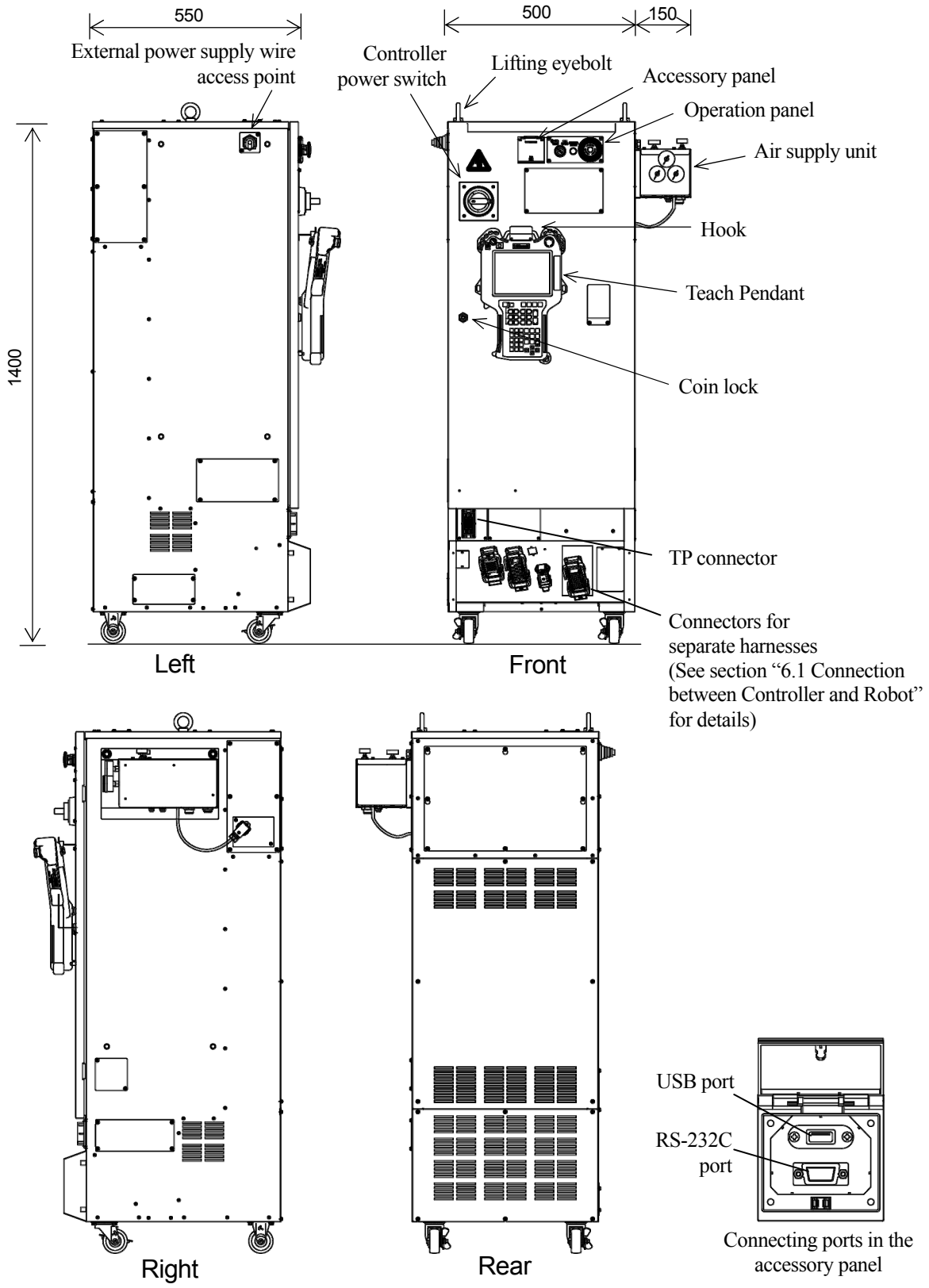
(Front view: without connector cover)



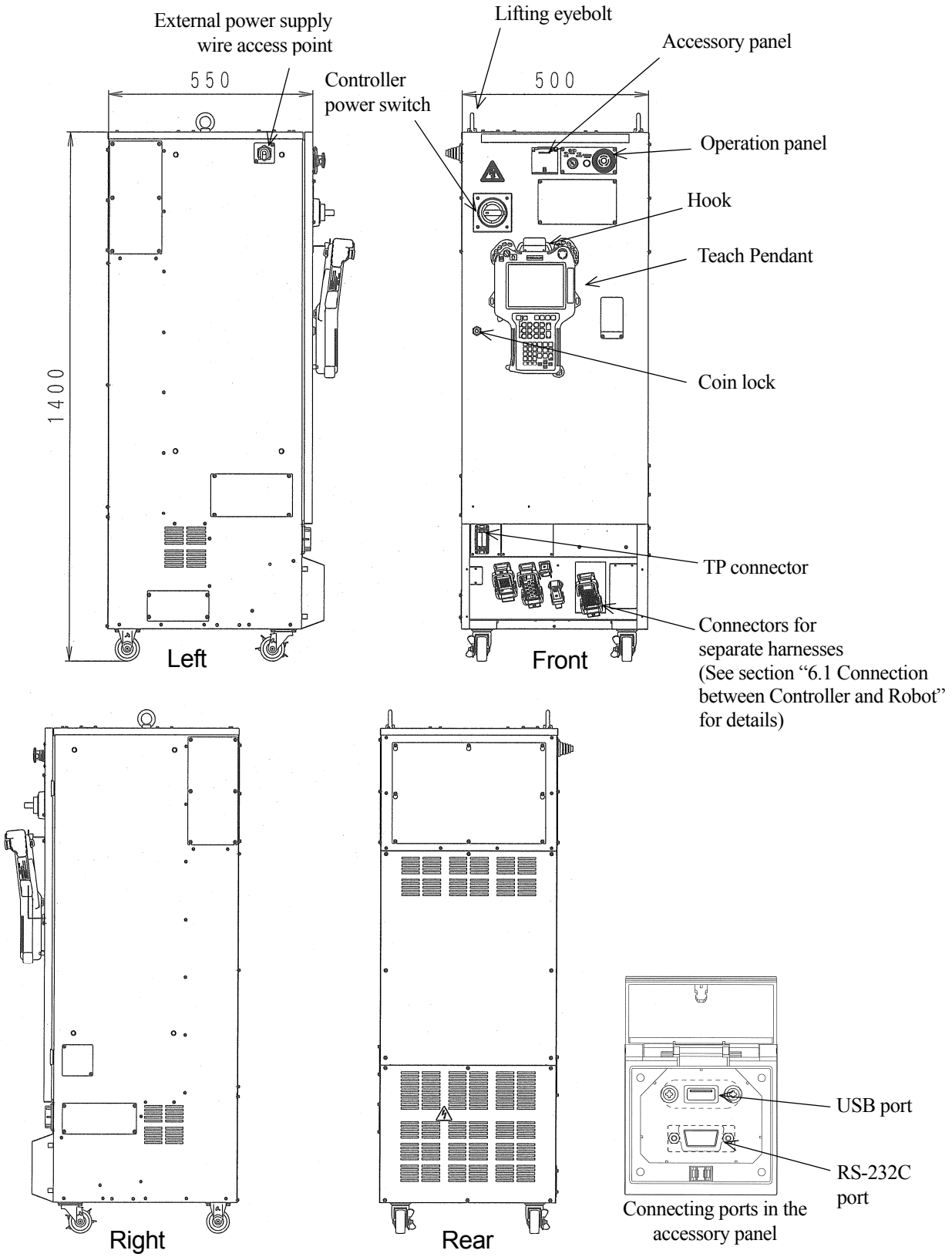
E25/E35 controller



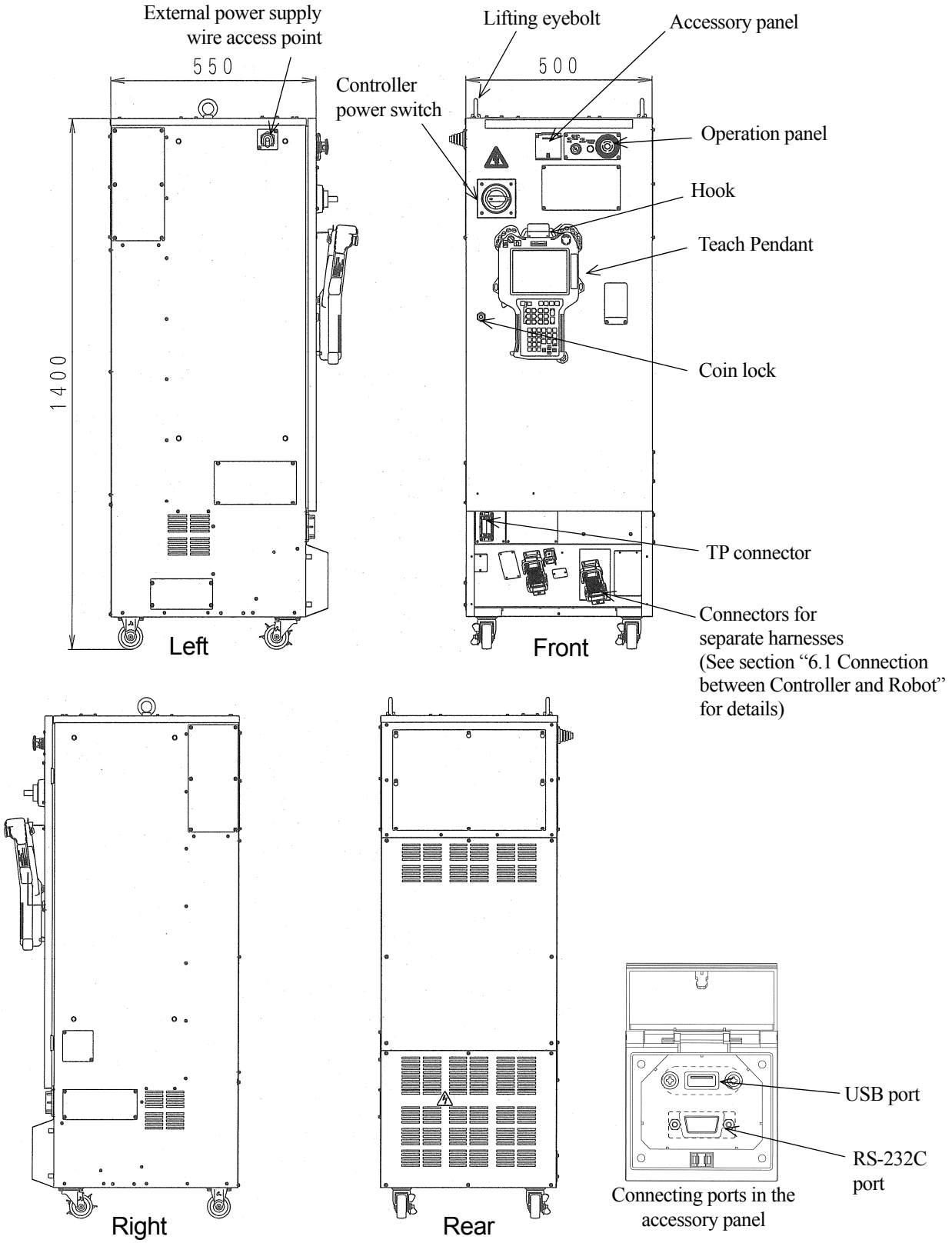
E27/E37 controller



E25/35 controller (KJ12/15 specification)

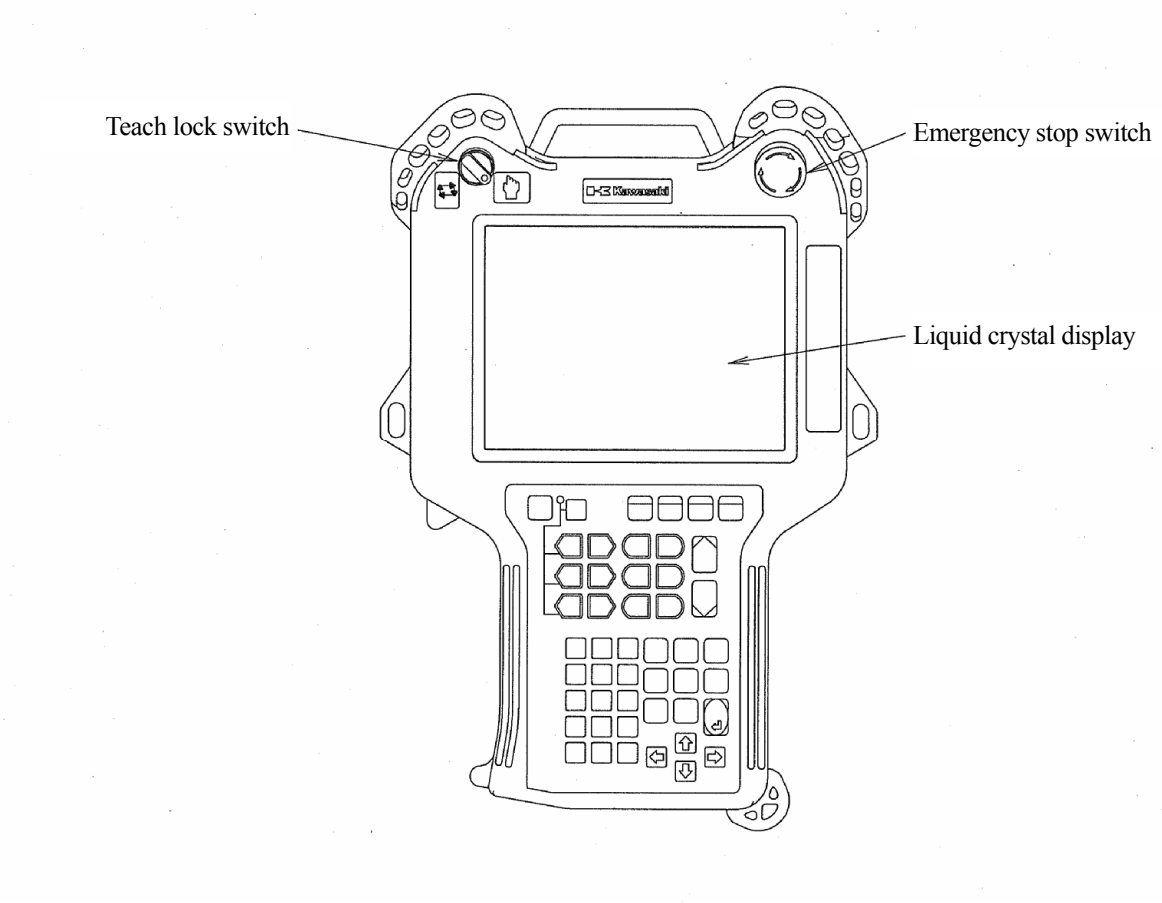


E45 controller



E47 controller

3.2 Teach Pendant Appearance



3.3 E2x Controller Specification

Construction		Self-sustaining fully closed, indirect cooling system
Mass		Approximately 120 kg
Ambient environment	Temperature	0 to 45°C
	Humidity	35 to 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.
Grounding		Class A grounding (with resistance of 10 Ω or less: for intrinsically safe circuit) Class D grounding (with resistance of 100 Ω or less: for general circuit)
Length of Teach Pendant cable		10 m (standard)
Length of separate harnesses		Inside the booth*1: 3 m (standard) Outside the booth*2: 3 m (standard) Inside + outside the booth: 40 m or less

*1 Harness length between the robot and explosion-proof booth wall

*2 Harness length between the explosion-proof booth wall and controller

Controller model	Arm model	Power capacity	Recommended power cable size (Including ground wire)	Length requirement
E25	KG, KF19/26, KJ12/15/19/24/26/31	10 kVA max.	8.0 mm^2 or more (AWG #8 or more)	200 m or less
E27	KF121, KD010	5.6 kVA max.	3.5 mm^2 or more (AWG #12 or more)	200 m or less

Specification of circuit breaker for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
E25/E27	40 A	AC230 V	7.5 kA (Icu)

3.4 E3x Controller Specification

Construction		Self-sustaining fully closed, indirect cooling system
Mass		Approximately 170 kg
Ambient environment	Temperature	0 to 45°C
	Humidity	35 to 85%RH (Non condensing)
	Altitude	Up to 1000 meters above mean sea level
Power source		AC 440-480 V ±10%, 60 Hz, 3 Phase
	Option	AC 380-415, 440-480, 515, 575 V ±10%, 50/60 Hz 3 Phase
Power capacity		Refer to the table below.
Grounding		Protective earth (PE)
Length of Teach Pendant cable		10 m (standard)
Length of separate harnesses		Inside the booth*1: 3 m (standard) Outside the booth*2: 3 m (standard) Inside + outside the booth: 40 m or less

*1 Harness length between the robot and explosion proof booth wall

*2 Harness length between the explosion proof booth wall and controller

Controller model	Arm model	Power capacity	Recommended power cable size (Including ground wire)	Length requirement
E35	KG, KF19/26, KJ12/15/19/24/26/31	7.3 kVA max.	8.0 mm^2 or more (AWG #8 or more)	200 m or less
E37	KF121, KD010	5.1 kVA max.	3.5 mm^2 or more (AWG #12 or more)	200 m or less

Specification of circuit breaker for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
E35	20 A	AC480 Y/277 V	22 kA (UL489)
E37	15 A	AC480 Y/277 V	22 kA (UL489)

3.5 E4x Controller Specification

Construction		Self-sustaining fully closed, indirect cooling system
Mass		Approximately 170 kg
Ambient environment	Temperature	0 to 45°C
	Humidity	35 to 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.
Grounding		Protective earth (PE)
Length of Teach Pendant cable		10 m (standard)
Length of separate harnesses		Inside the booth*1: 3 m (standard) Outside the booth*2: 3 m (standard) Inside + outside the booth: 40 m or less

*1 Harness length between the robot and explosion proof booth wall

*2 Harness length between the explosion proof booth wall and controller

Controller model	Arm model	Power capacity	Recommended power cable size (Including ground wire)	Length requirement
E45	KG, KF19/26, KJ12/15/19/24/26/31	7.3 kVA max.	8.0 mm^2 or more (AWG #8 or more)	200 m or less
E47	KF121, KD010	5.1 kVA max.	3.5 mm^2 or more (AWG #12 or more)	200 m or less

Specification of circuit breaker for external power connection

Controller model	Rated current	Rated voltage	Rated interrupting capacity
E45/E47	20 A	AC400 V	5 kA (Icu)
		AC415 V	2.5 kA (Icu)

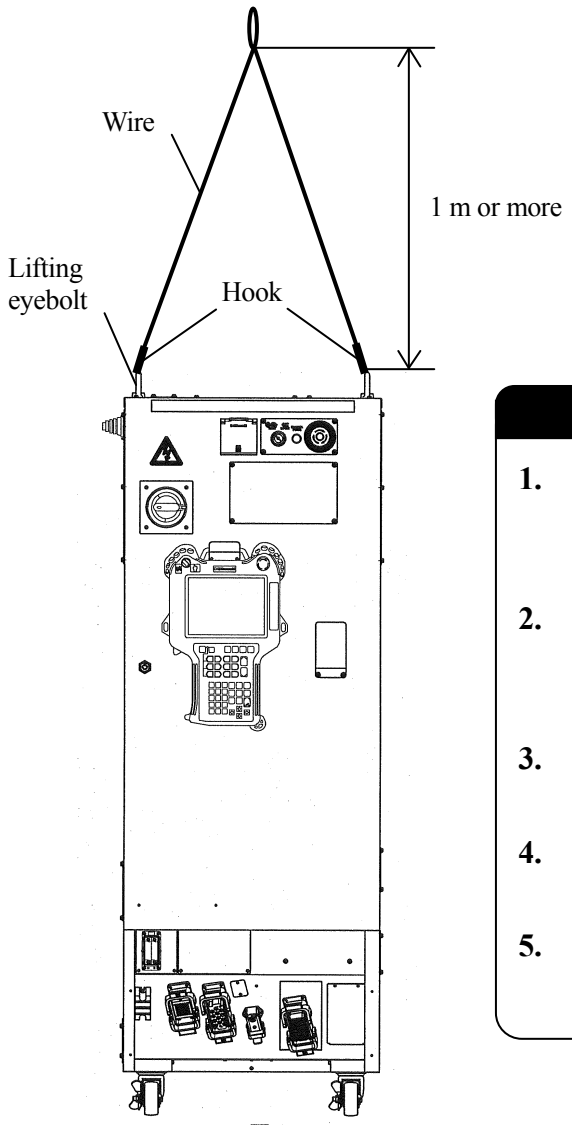
4 Transportation of Robot Controller

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

4.1 By Crane Lifting

⚠ WARNING

1. **Never allow a person to support the controller 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 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.**

4.2 By Caster

⚠ WARNING

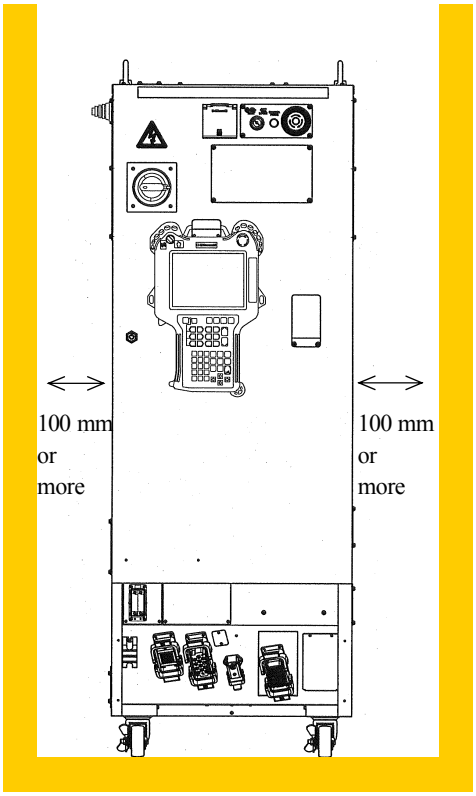
1. **If the transport path is flat enough then the controller can be moved on its casters. Otherwise, it may happen that moving on an incline or an uneven surface will topple the controller, and cause serious damage.**
2. **The controller falls if it is inclined as follows.**
   Back or forth: Approximately 10° or more
   Right or left: Approximately 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.)

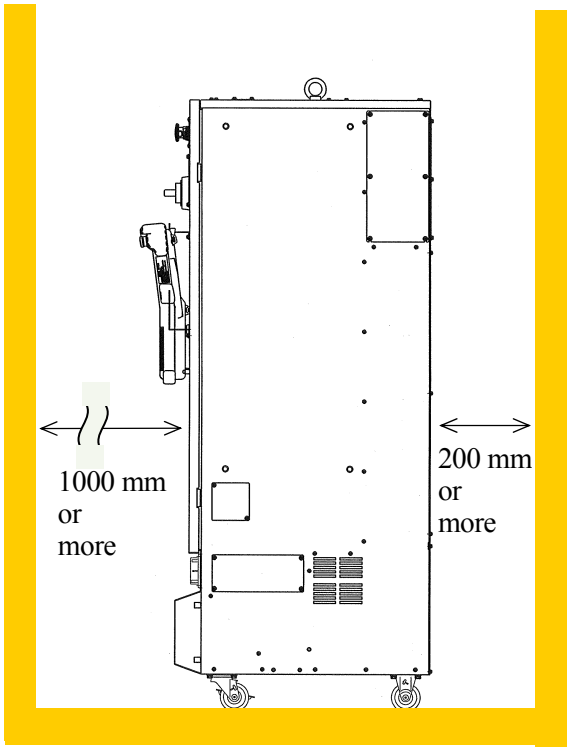
5 Arrangement of Robot Controller

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



1. Arrange the controller on a horizontal floor.

2. Separate the controller right/left side from the wall by 100 mm or more.

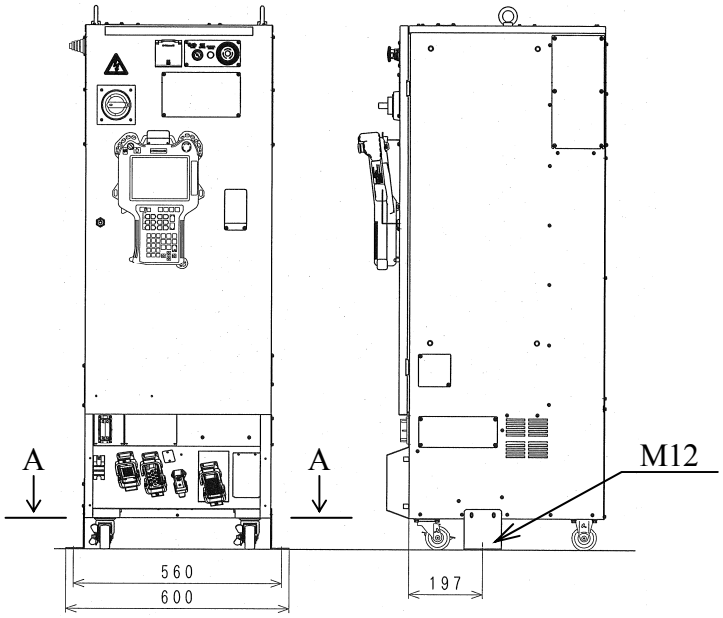


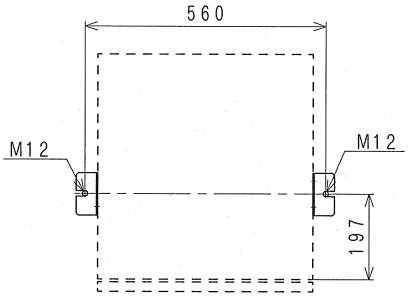
3. The inlet port for air-cooling is on the rear upside of the controller, and the air exhaust port is on the rear downside.

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. Fix the controller with M12 bolts. See the figure on the next page for reference. Fixing brackets are already attached to the controller.





Position of anchor to fix brackets

View A-A

⚠ 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.)

⚠ WARNING

Make sure to fix controller with fixing brackets and bolts on the ground.

6 Connection Instructions

6.1 Connection between Controller and Robot

⚠ WARNING

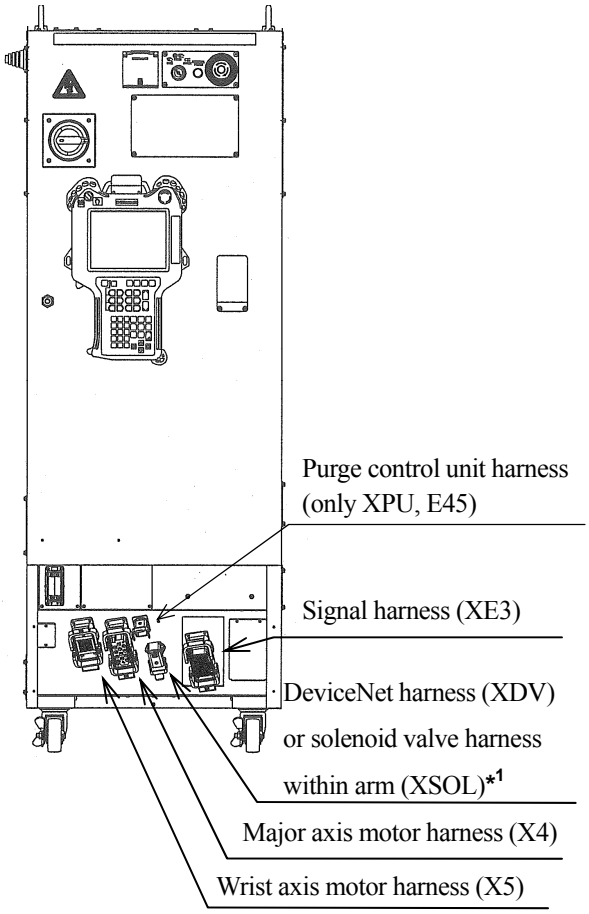
Do not connect the external power until connections between controller and robot are complete. Accidents, such as electric shock may occur.

⚠ CAUTION

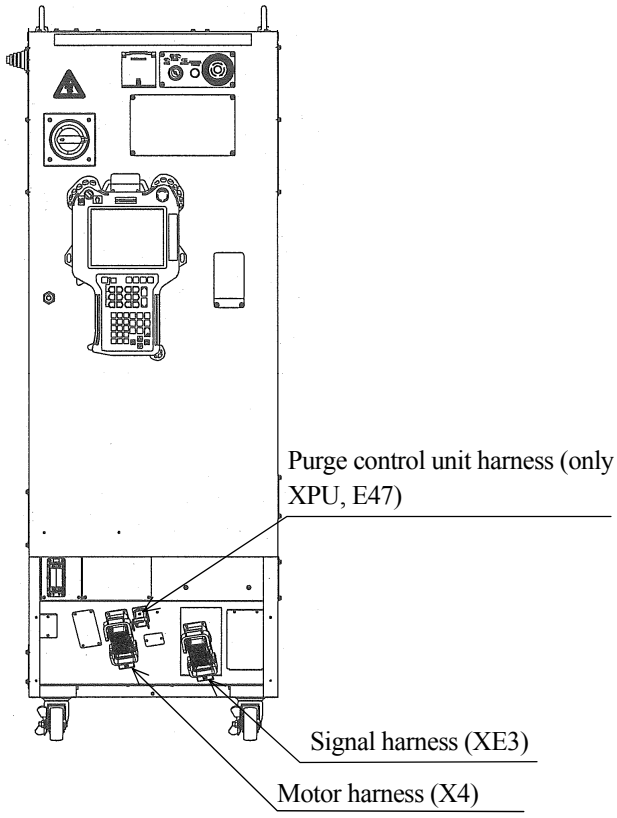
1. **When connecting the harnesses, be sure to use the correct harnesses. Using an incorrect harness, or forcing or misconnecting the harness may damage connectors or cause a break in the electrical system.**
2. **Prevent people or equipment (forklift, etc.) from stepping on or riding over the signal and motor 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.**
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 wires 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. **The motor harness (power line) between the robot and controller will generate PWM noise due to the PWM control driving the motors. This noise may cause interference with signal lines. Prevent interference using these countermeasures:**
   - **(1) Separate the power and signal lines as much as possible.**
   - **(2) Use the shortest possible length for the power line.**
   - **(3) Avoid bundling, wiring in parallel the power and signal lines as much as possible.**
   - **(4) Do not wire the power and signal line within the same duct/conduit.**
   - **(5) Set and secure a firm ground line connection for the controller.**

Connect the separate harnesses to their designated ports as shown below. Mount the connector cover after connecting the separate harnesses.

1. Controller side



E25, E35, E45 controller

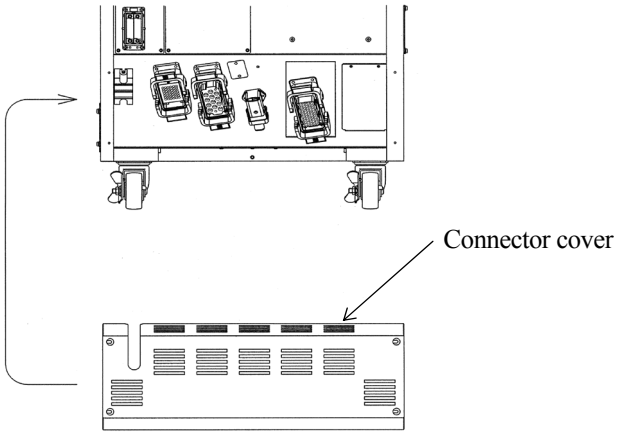


E27, E37, E47 controller

*1 KJ12/15-specification controllers only.

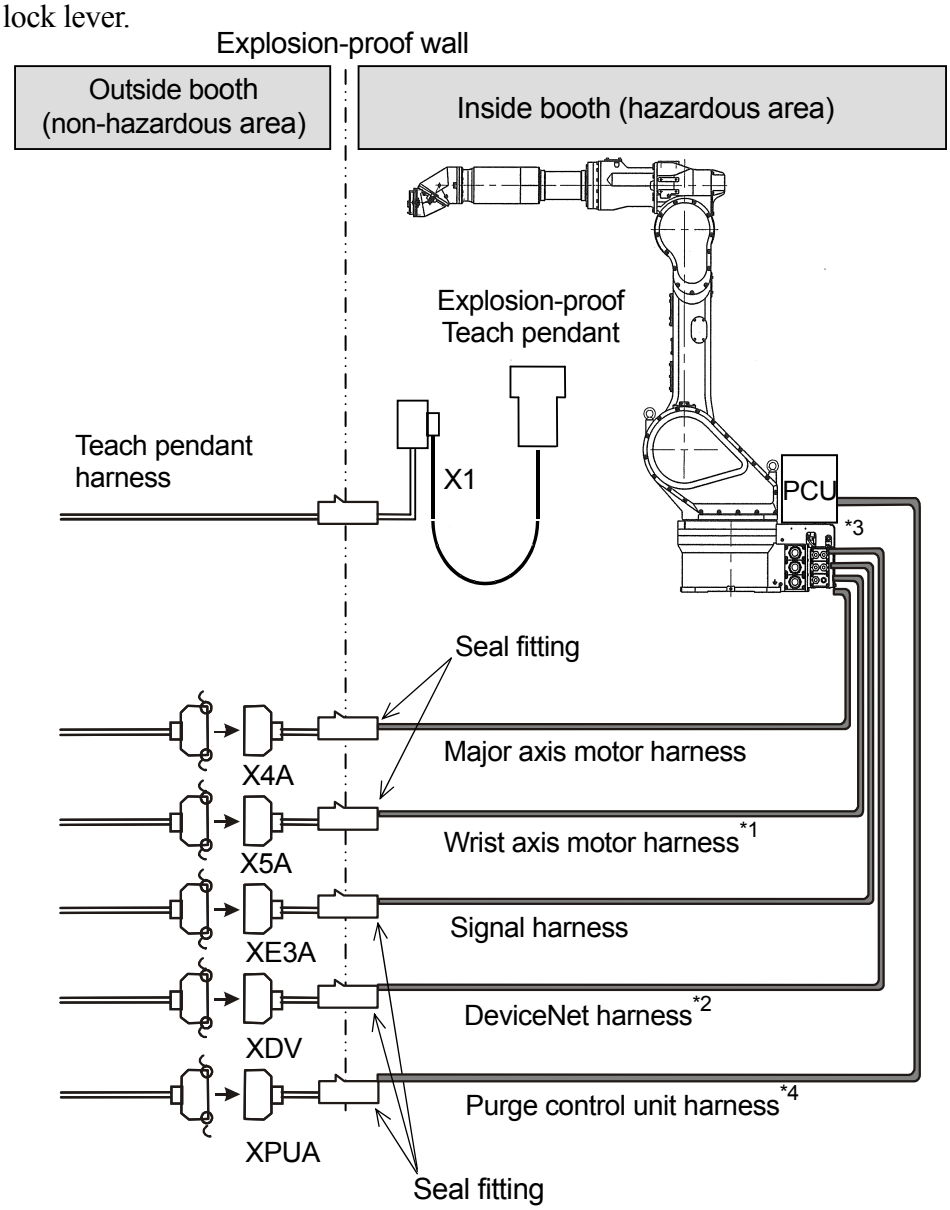
CAUTION

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



2. Arm side (except for KJ12/15)

Check labels for harness connectors. Connect the connectors surely as follows and lock it with a lock lever.



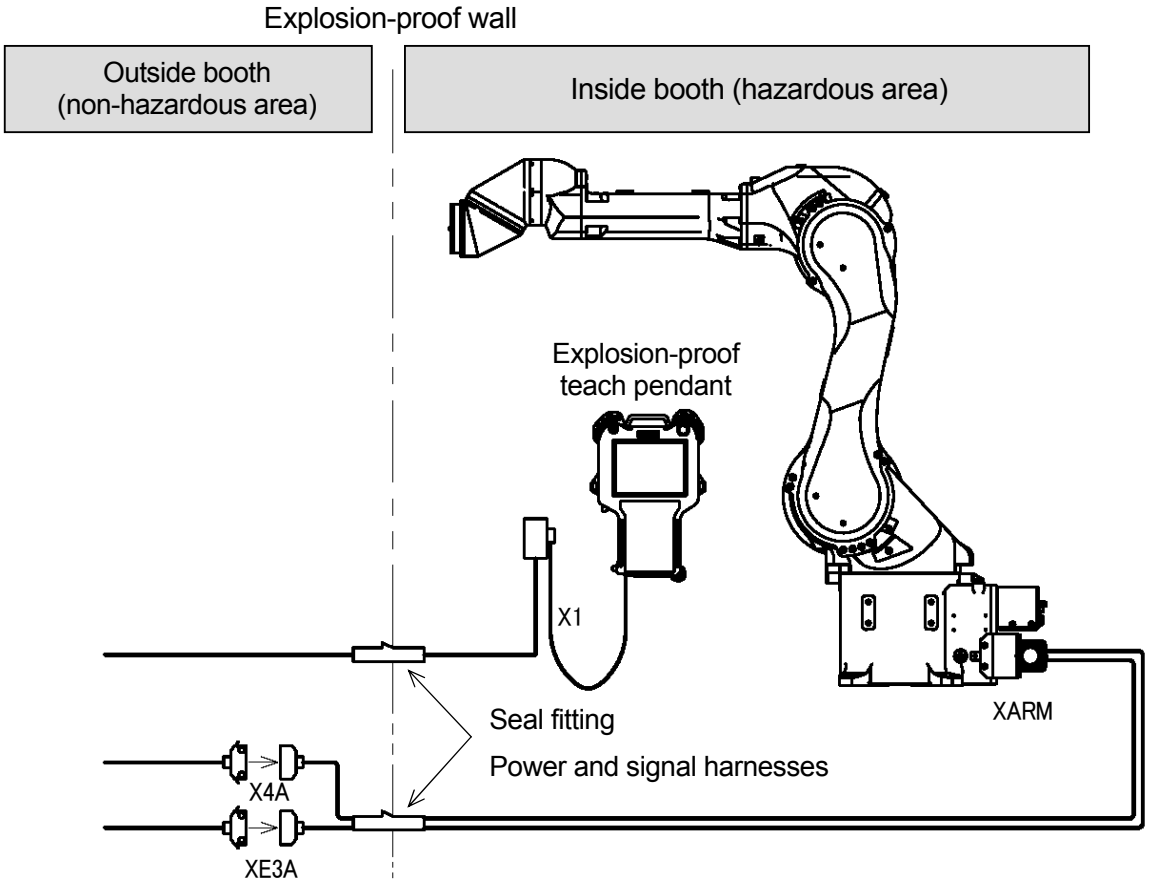
*1 Only E25, E35 and E45 have this harness.

*2 Only KG series and KJ19/24/26/31 have this harness.

*3 For North America specification, cables in hazardous area need protection by metal conduits to comply with National Electric Code (NEC). Refer to the separate "Installation and Connection Manual" for the concrete wiring procedure. If the robot is installed on a traverse unit and cables in the hazardous area move, the protection by metal conduits is not possible and flexible braided cables are allowed to use as moving cables in this case.

*4 Only E45 and E47 have this harness and PCU.

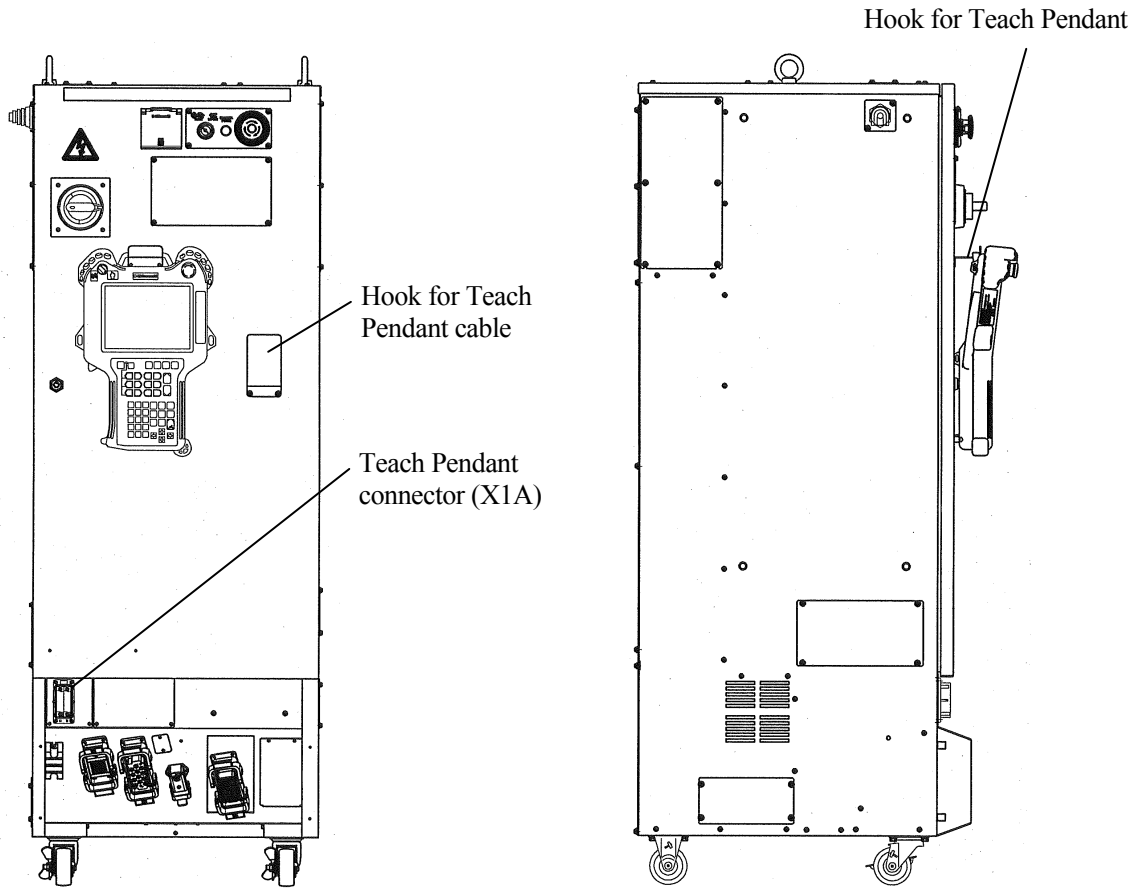
3. Arm side (KJ12/15)



6.2 CONNECTION BETWEEN CONTROLLER AND TEACH PENDANT

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

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



⚠ CAUTION

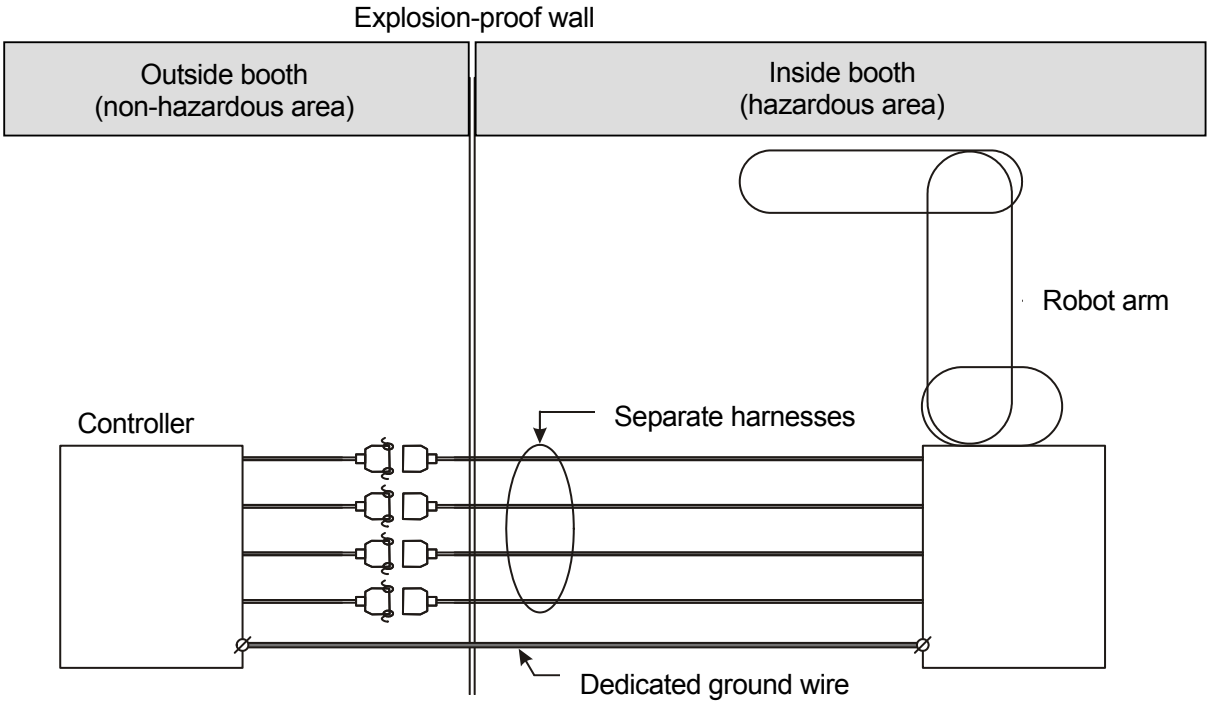
The hook should only be used for hanging the teach pendant or cable.

6.3 Connection of Dedicated Ground Wire between Controller and Arm

For E3x/E4x controller:
Connect controller and arm with a dedicated ground wire.

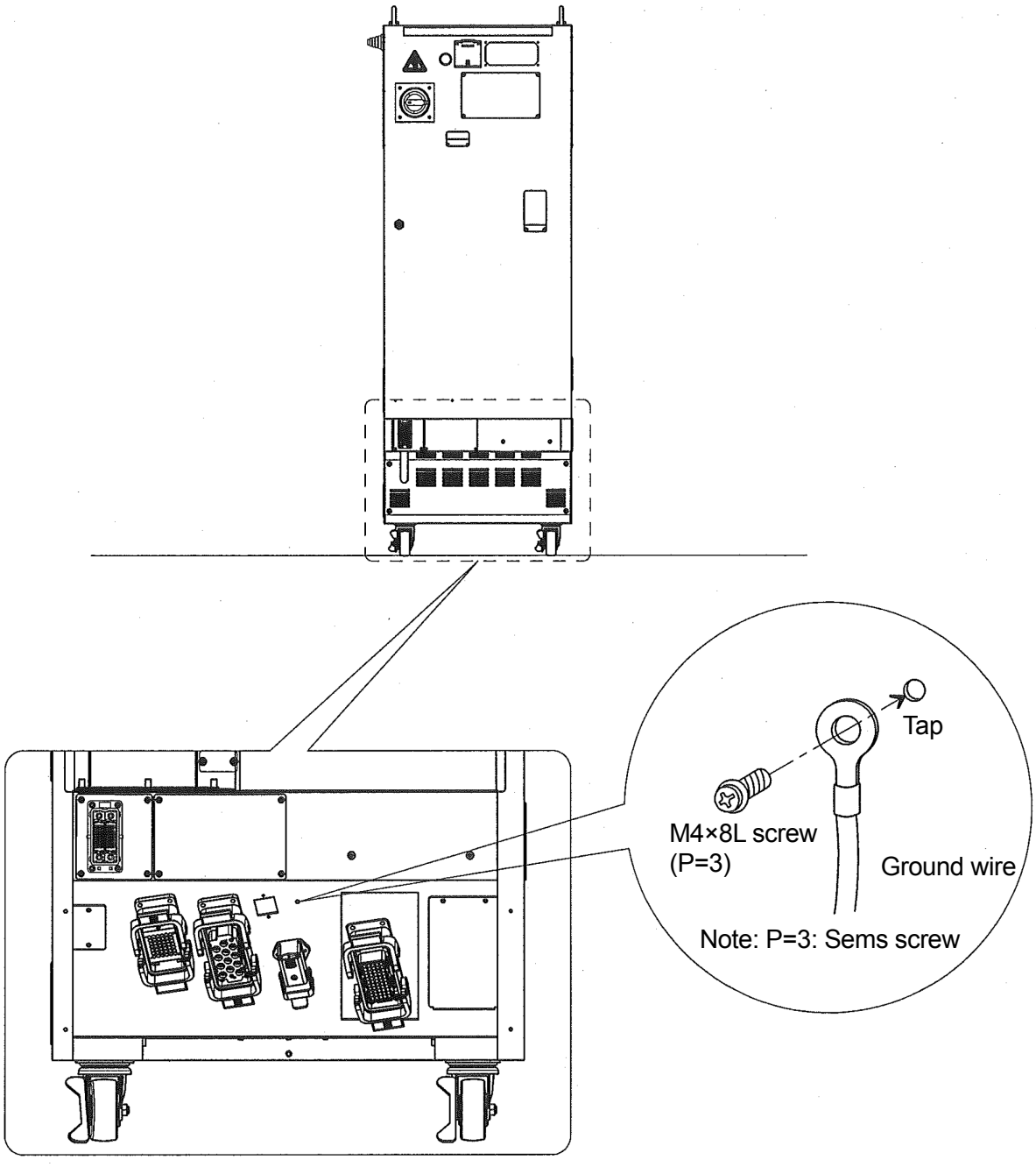
⚠ WARNING

To conform to the explosion-proof code, a dedicated ground wire is needed for North America specification and Europe specification Not connecting it or connecting it incompletely may cause an explosion or a fire, so connect it securely without fail.



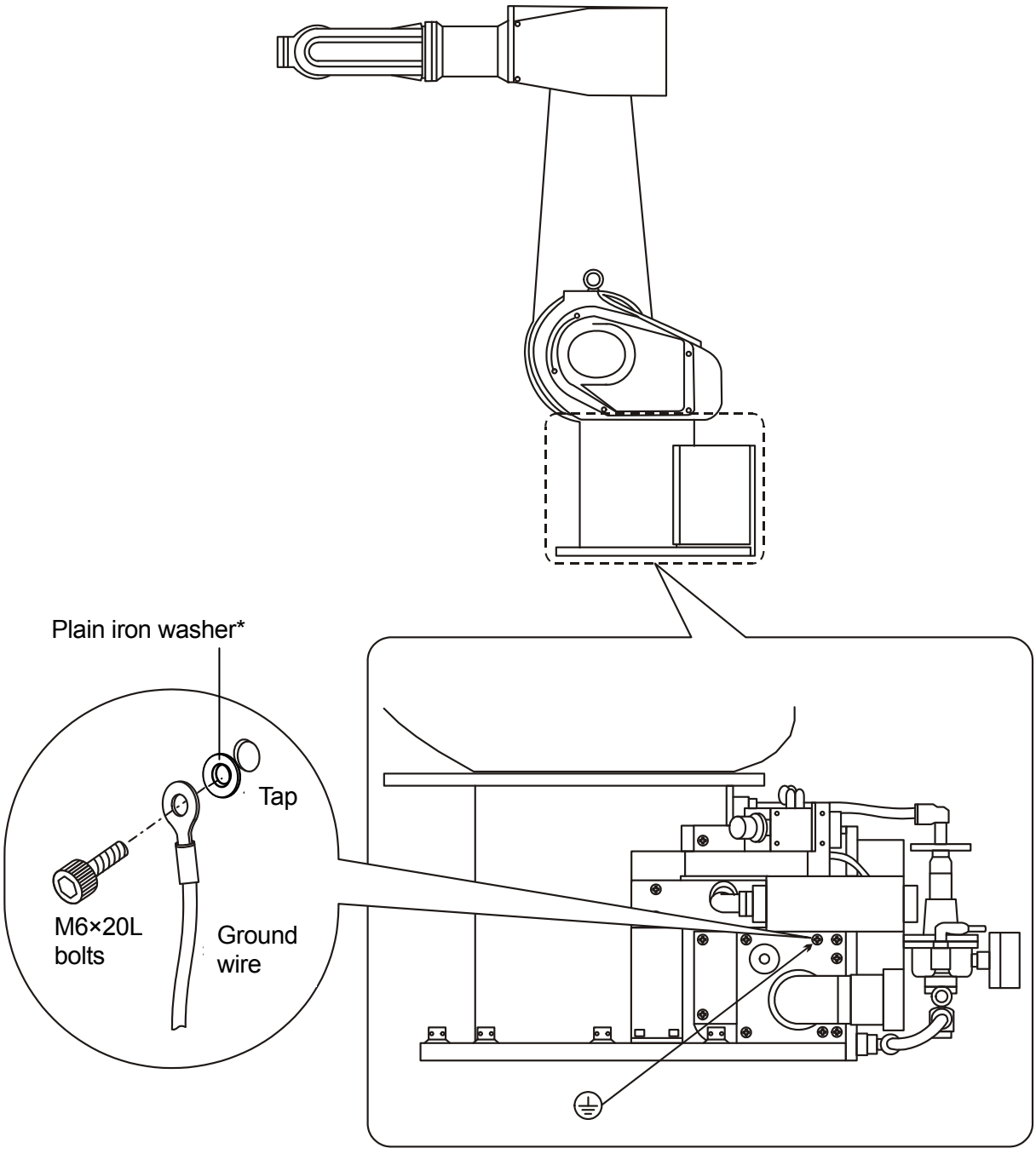
1. Material specification of dedicated ground wire
   UL1015AWG10 (5.5 sq) green/yellow (green/yellow color ratio: ratio of one color to the other color must be within 30% to 70%).
   In North America, green wire can be used.

2. Connection with controller (common for E3x/E4x controller)



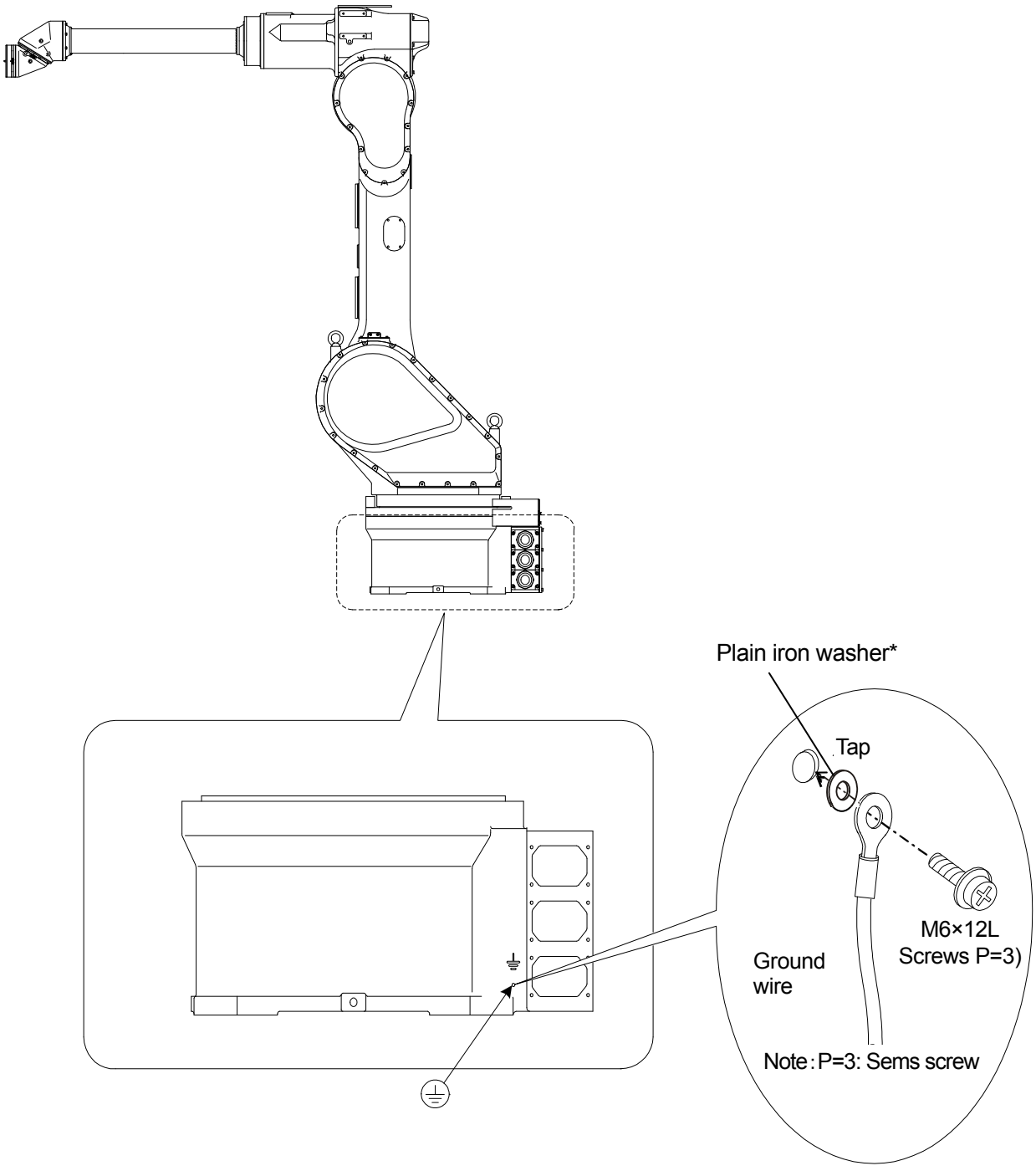
3. Connection with arm

(1) KF121



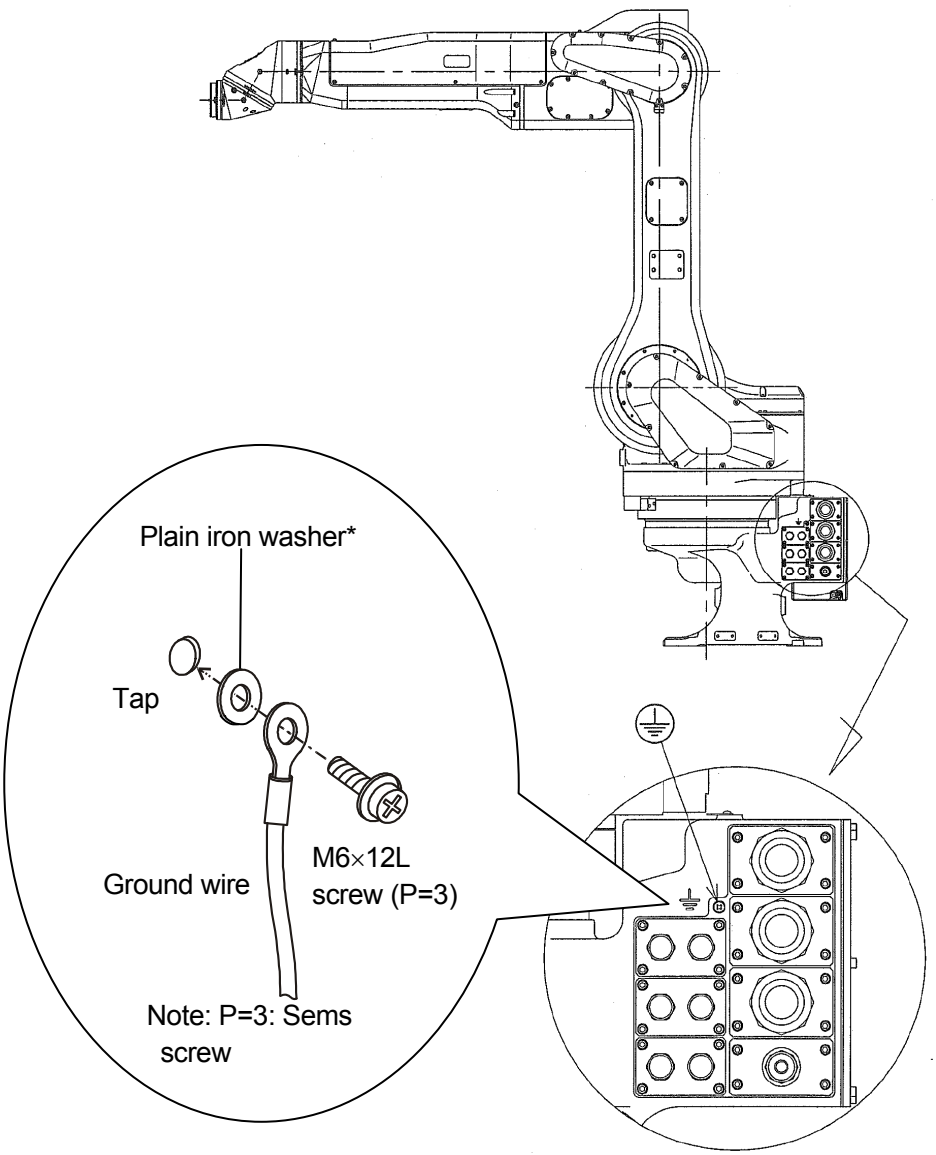
* Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion.

(2) KF19x/26x (x=2, 3, 4)



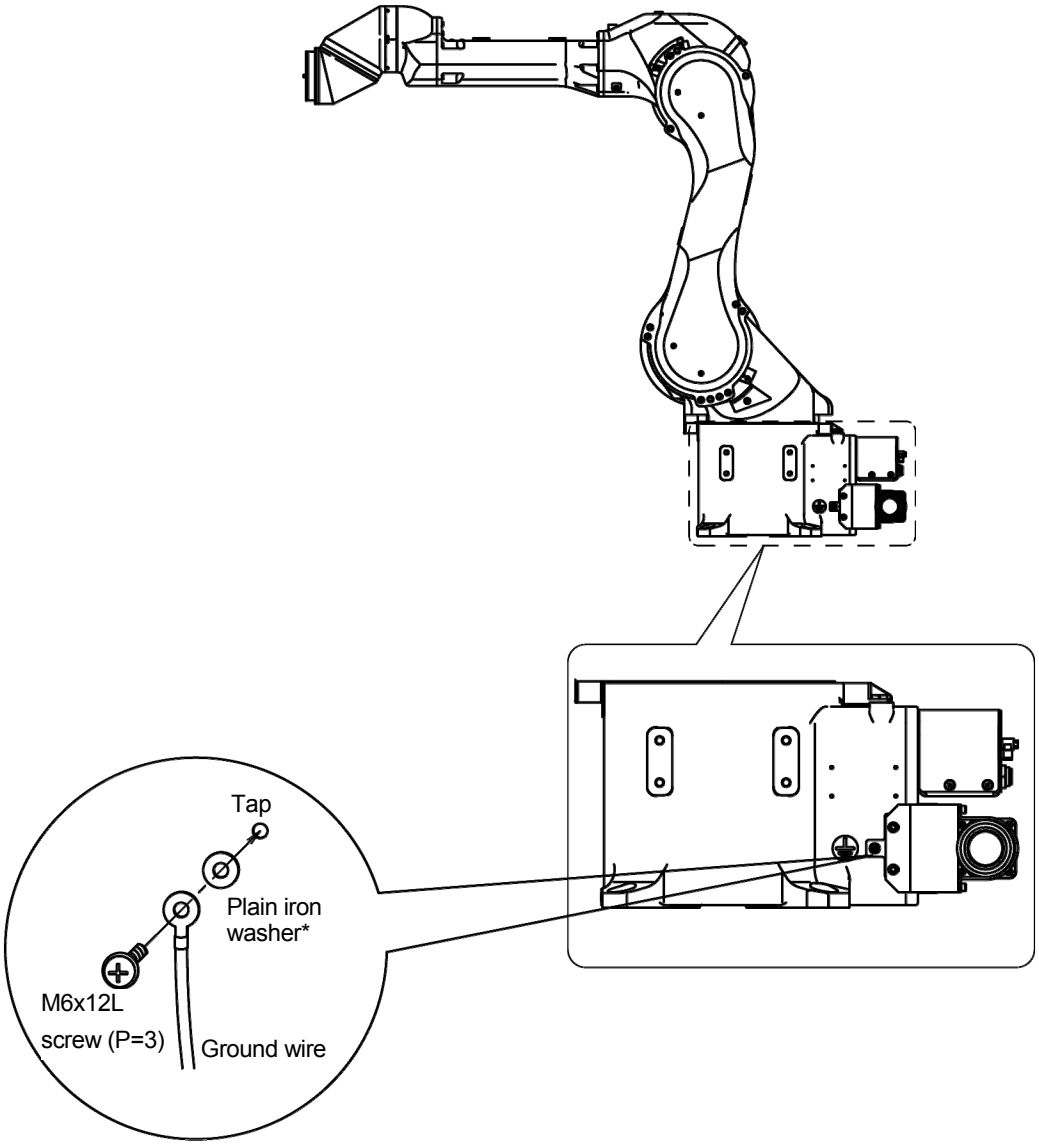
* Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion.

(3) KG264



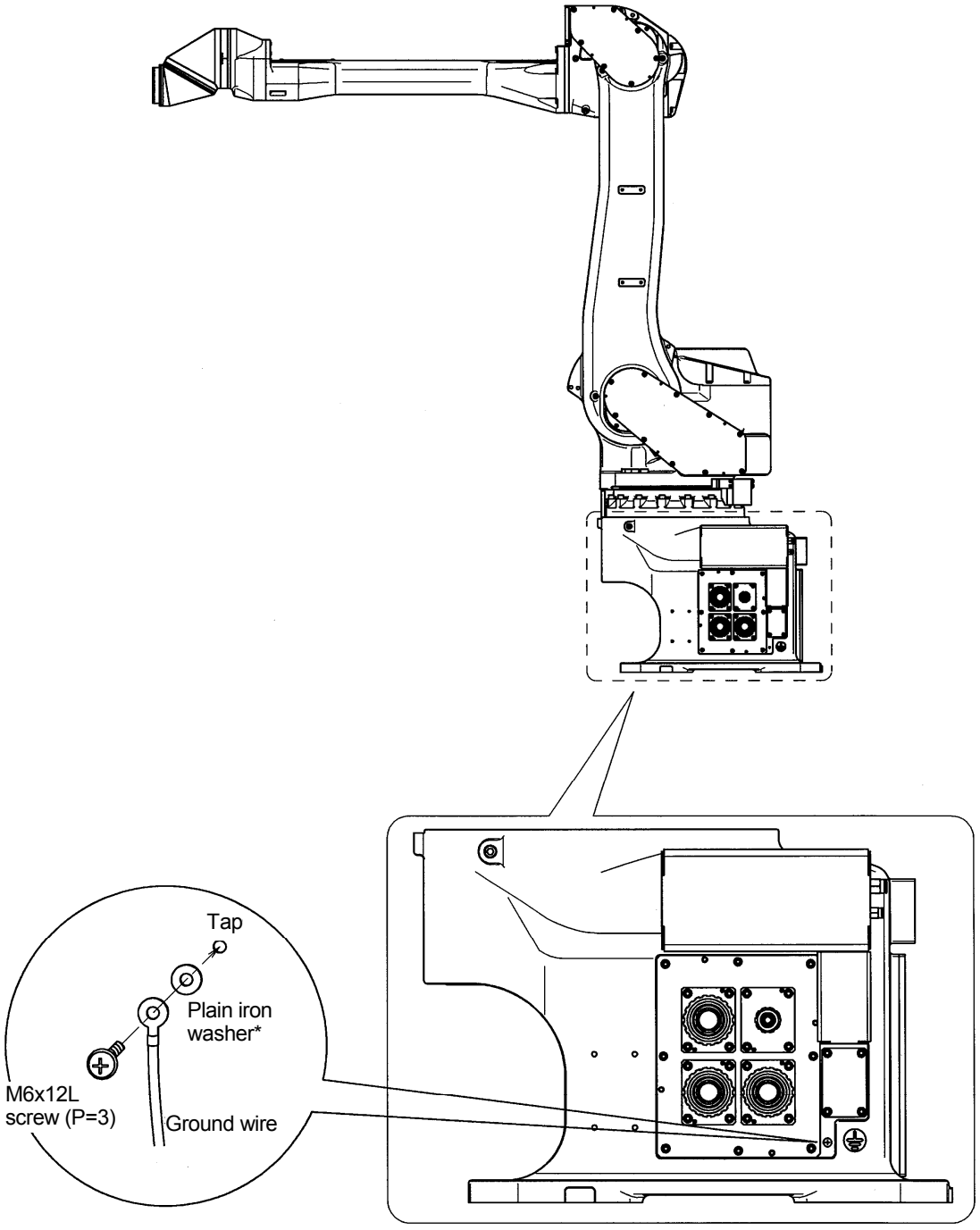
* Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion.

(4) KJ125/155



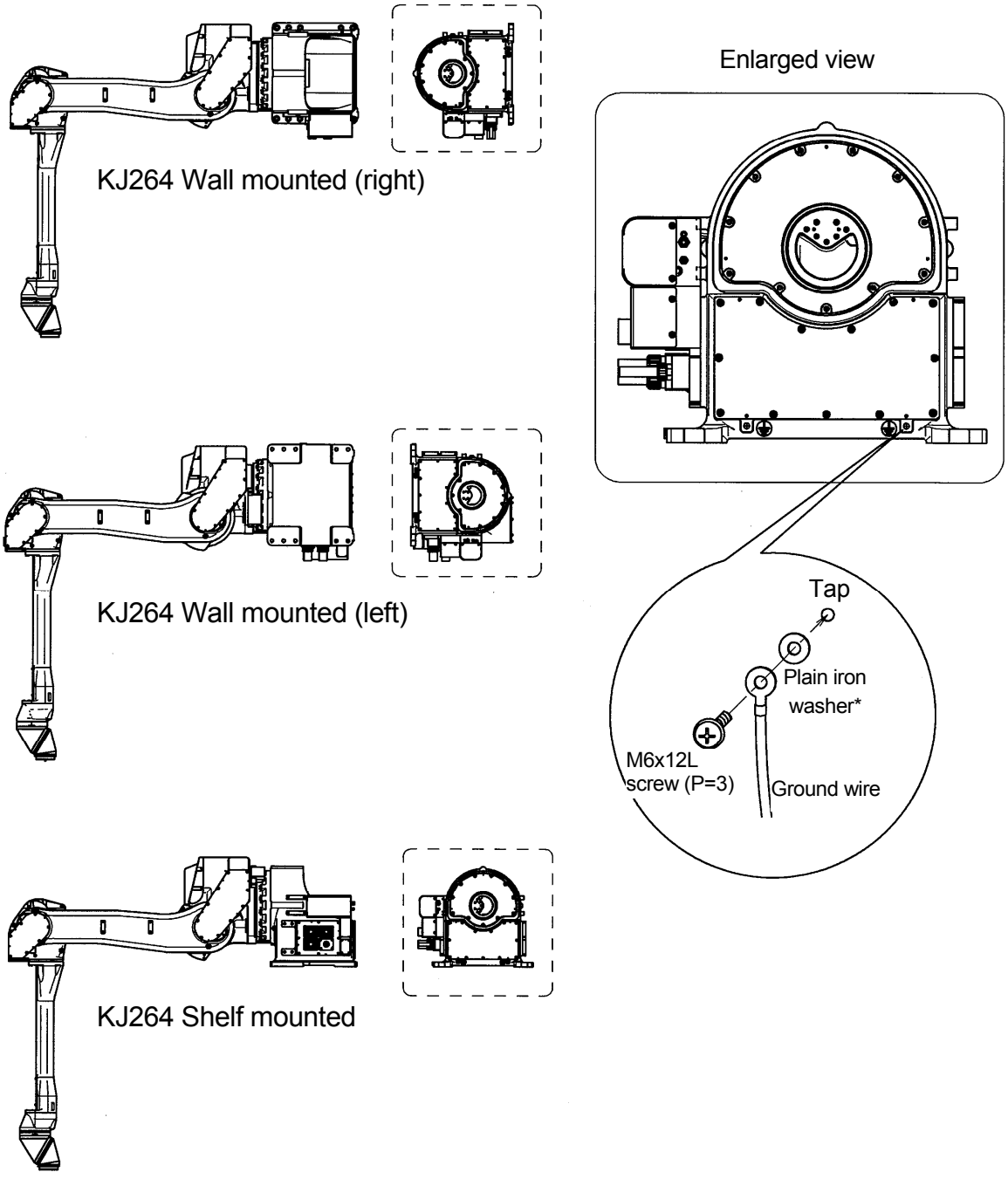
* Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion. The above figure shows KJ155 as an example. The connection point of ground wire shown above is the same as that of KJ125.

(5) KJ194/244/264 (Floor mounted specification)



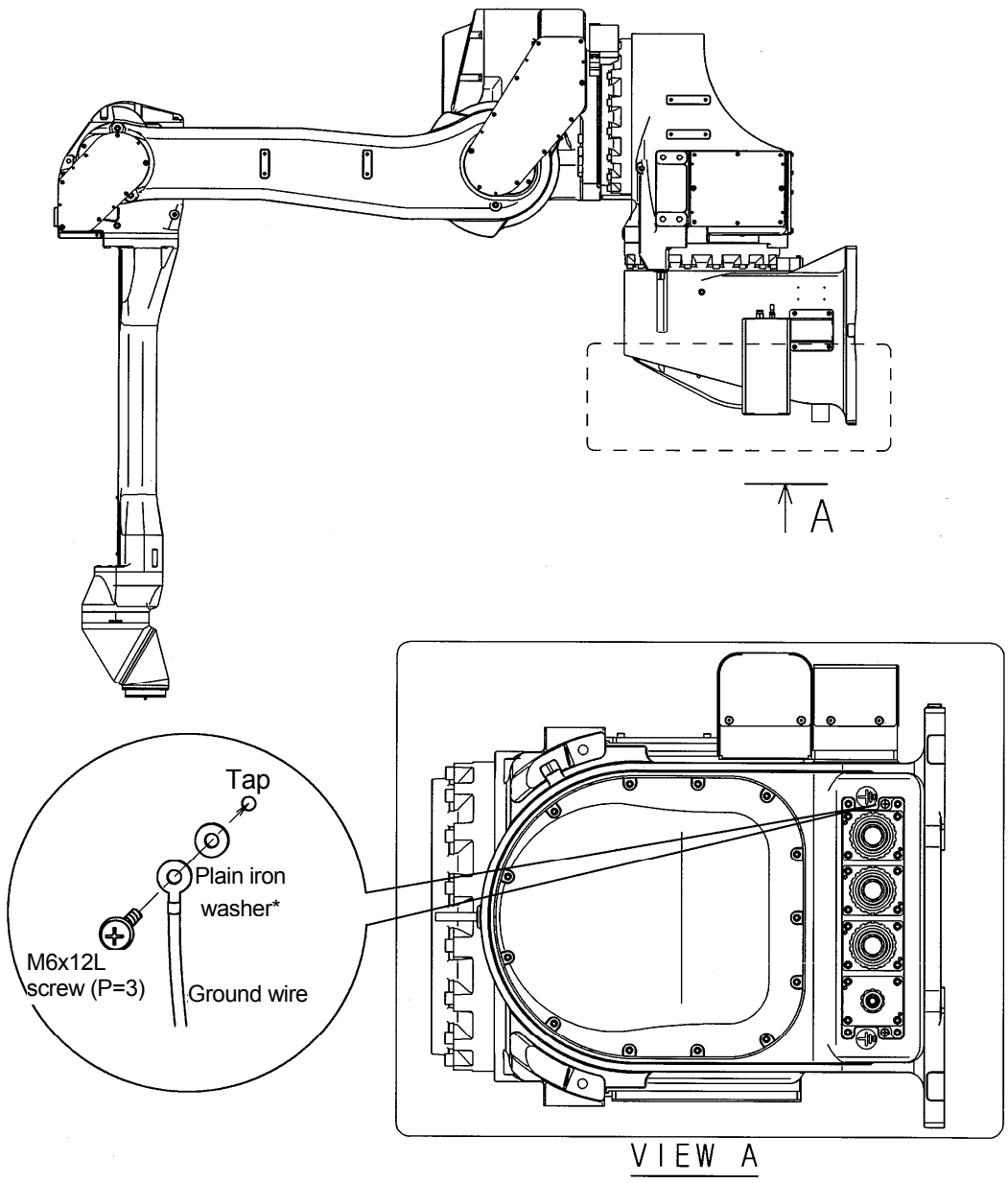
*Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion. The above figure shows KJ264 as an example. The connection point of ground wire shown above is the same as that of KJ194 and KJ244.

(6) KJ194/244/264 (Wall mounted specification, shelf mounted specification)



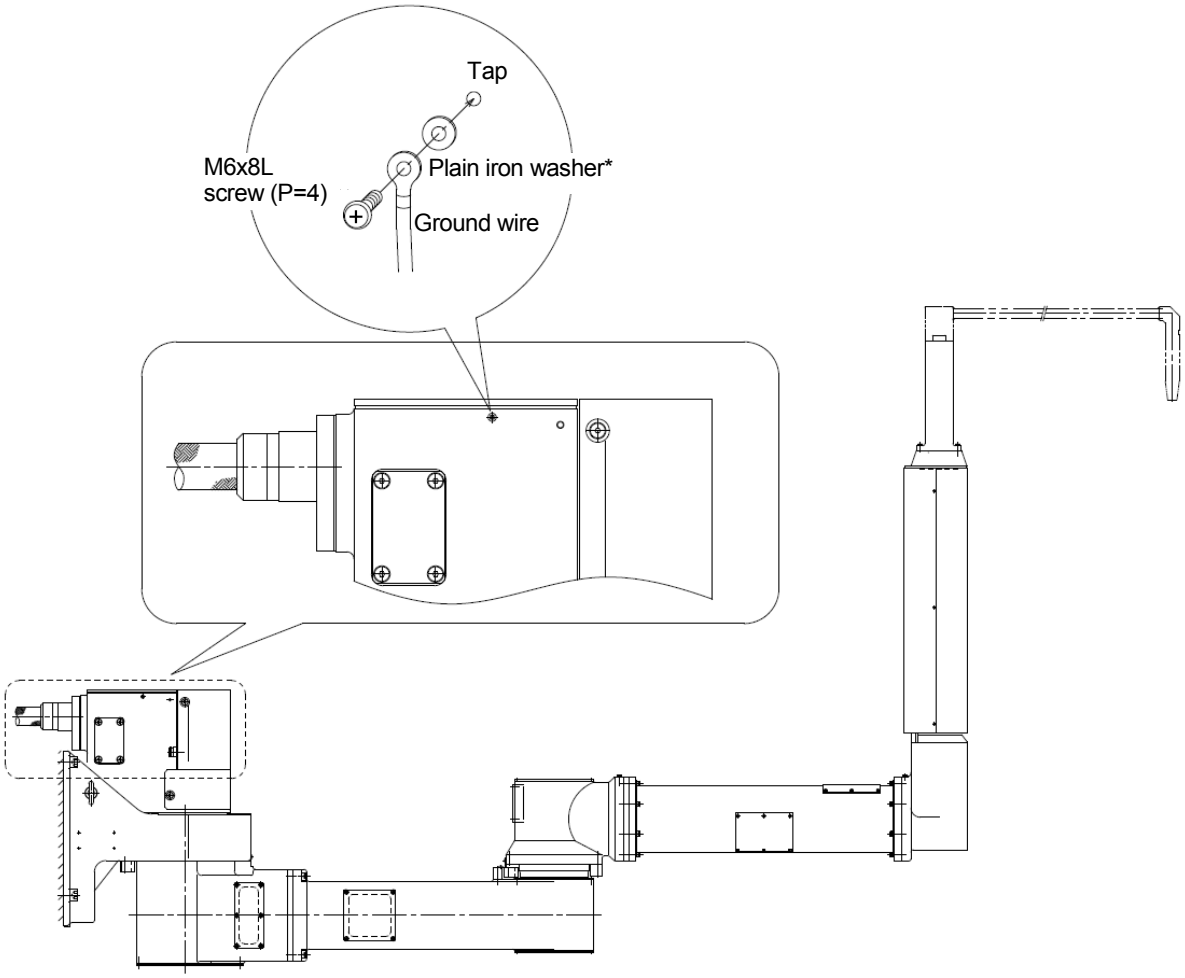
* Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion. The above figure shows KJ264 as an example. The connecting point of ground wire shown above is the same as that of KJ194 and KJ244.

(7) KJ314



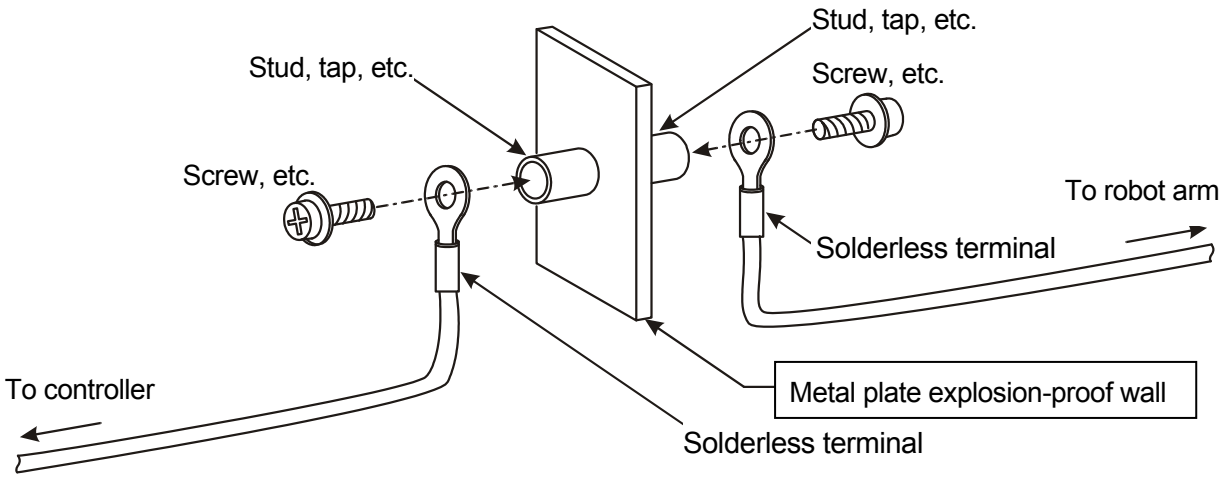
*Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion.

(8) KD010



*Insert a plain iron washer between the arm and the ground wire to secure ground and to avoid corrosion.

4. When using metal plate for explosion proof wall



7 Connection of External Power

Strictly observe the following precautions when connecting the external power. The following precautions are the same as those in section 1.4.

⚠ DANGER

Confirm that external power supply for the controller is cut off before starting connection process. Failing to do so is extremely dangerous, resulting in accidents, electric shock, etc. To prevent external power from being turned ON, tag the breaker to indicate clearly that work is in progress. Or, assign a supervisor in front of the breaker until all connections are complete.

⚠ WARNING

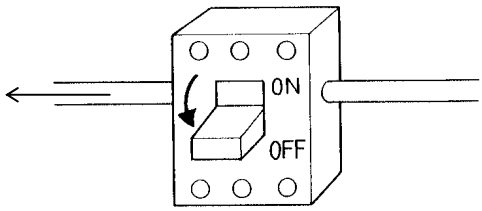
1. **Make sure the power supply to be connected to the controller meets the specifications listed on the rating plate and label on the side of the breaker. Connecting to a power source outside specifications may damage internal components.**
2. **Ground the controller to prevent against electrical noise and shock.**
   (For E2x) Two types of grounding are required: Class A (10 Ω or less) and Class D (100 Ω or less). Class A grounding is particularly important to maintain intrinsically safe explosion-proof performance. Be sure to connect each ground line to each specified place. Use ground wire of correct size as shown in "3.3 E2x Controller Specification."
   (For E3x/E4x) Protective earth (PE) is required. This is also important to maintain intrinsically safe explosion-proof performance. Be sure to connect the ground line to the specified place. Use ground wire of correct size as shown in "3.4 E3x Controller Specification" and "3.5 E4x Controller Specification."
3. **Do not use a common ground wire for the controller and the other devices. Also, do not connect ground wires of several controllers to one ground port.**
4. **Without fail, before turning ON the external power to controller, make sure the power supply wiring is complete and all the covers reattached properly. Failure to do so may cause electric shock.**
5. **Orange electric cables in the controller are possibly alive even when external power is turned OFF, so be careful.**

⚠ 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 there is a risk of noise from other peripheral devices via the external power supply becoming mixed in, reduce the noise level by adding a noise filter or similar.**
3. **Devices* with poor tolerance to noise from supplied power can be expected to malfunction due to the effects of PWM noise from the robot motor. Therefore ensure in advance that no such devices are present nearby.**
4. **Use dedicated external power supply breakers for robots and never use together with welding machines, etc.**
5. **In order to prevent electrical leakage incidents, use a ground leakage circuit breaker as the source breaker in the external power supply. (Use a time delay type with a current sensitivity of 100 mA or more.)**
6. **If there is a risk of voltage surges from external power supply such as those caused by lightning surges, decrease the surge voltage level by**

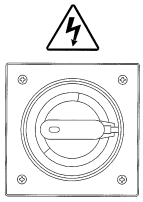
***** Be aware that some devices are highly susceptible to voltage surges such as from proximity switches directly connected to power supplies.

1. Connection with external power

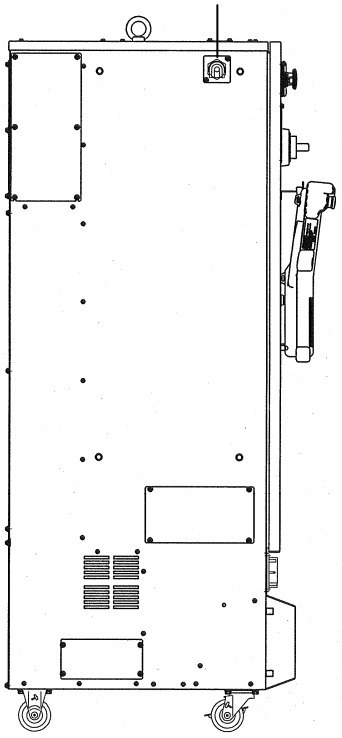


Connect with the external power circuit breaker at the installation site.

Controller Power switch



External power supply wire access point



Connect the external power according to the following procedure.

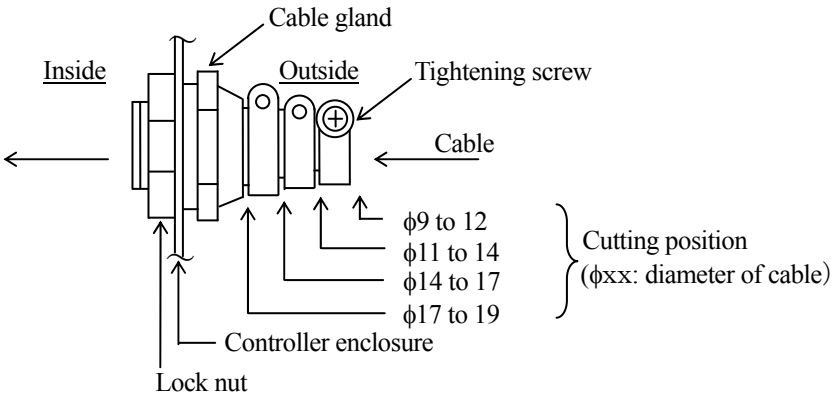
1. Turn OFF the external power for the controller.

2. Set Controller Power switch on the controller door to the OFF side.

3. Run the external power cable through the external power supply wire access point on the left side of controller.

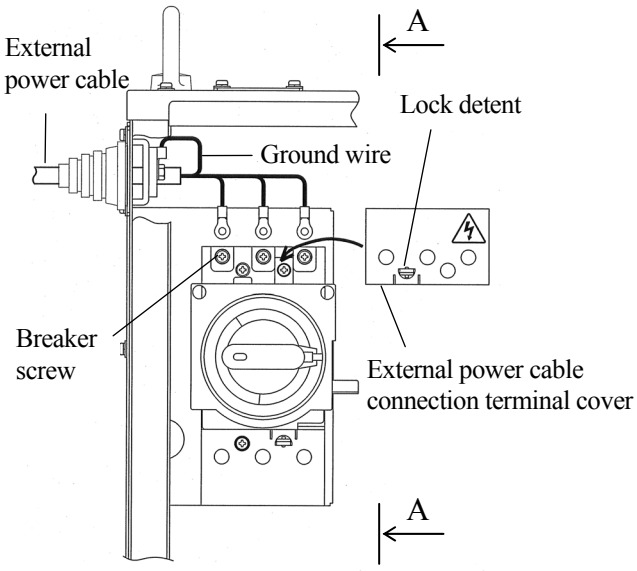
Detailed procedure of fixing a cable is shown below.

- Cut a cable gland (supplied with the controller) in accordance with the diameter of the cable.
- Pass the cable through the cable gland.
- Tighten the screw after adjusting length of the cable.
- Pass the cable through the external power supply wire access point and tighten the lock nut.



⚠ CAUTION

1. **Check the power supply capacity used before selecting a cable. (See "3 Appearance and Specification of Robot Controller.")**
2. **Note that there is the possibility of voltage drops or the cable heating up if the wire diameter is small.**



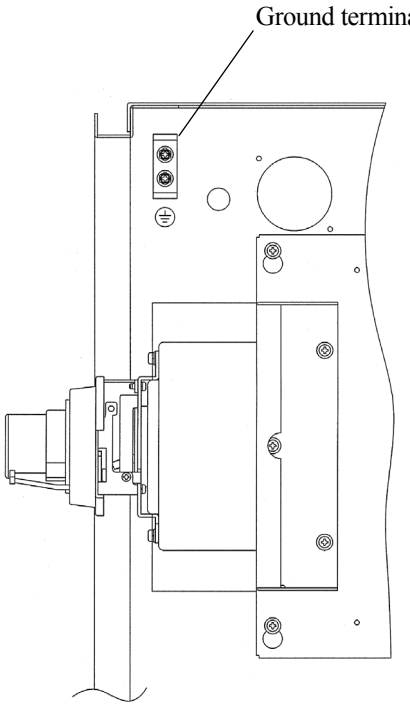
4. Attach round crimp terminals on the ends of the individual wires of the power cable. Use round insulators on each of these wires to prevent contact between the crimped part and metal. (See left figure.)

5. Connect the external power cable to the breaker terminal (3 places), and the dedicated ground 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 ground wire to the ground terminal as shown below.



View A-A

[NOTE]

In case of connecting external power to the breaker for E2x controller (without isolation transformer), make sure to connect ground phase S to the center terminal. If not, the ground leakage breaker might trip.

6. Mount the external power cable connection terminal cover.

⚠ DANGER

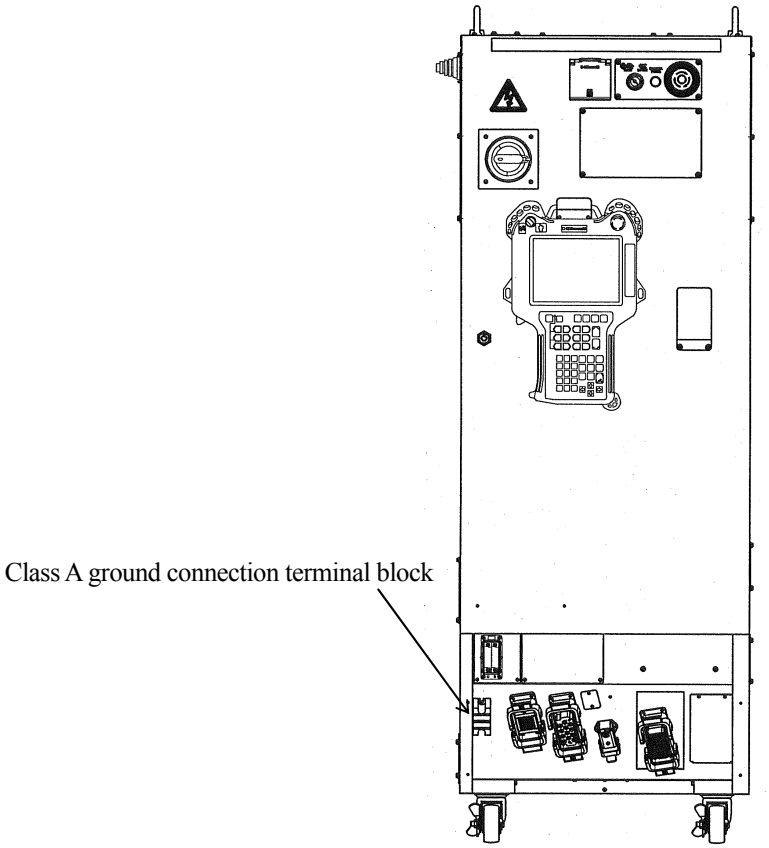
Be sure to mount the external power cable connection terminal cover when the wiring is complete. Failing to mount the cover may lead to electric shock due to accidental contact with power line.

2. Connection of class A grounding for intrinsically safe circuit (E2x controller only)

For E2x controller, connect the class A ground wire to the class A ground connection terminal block for intrinsically safe circuit with resistance under 10 Ω as shown in the figure below.

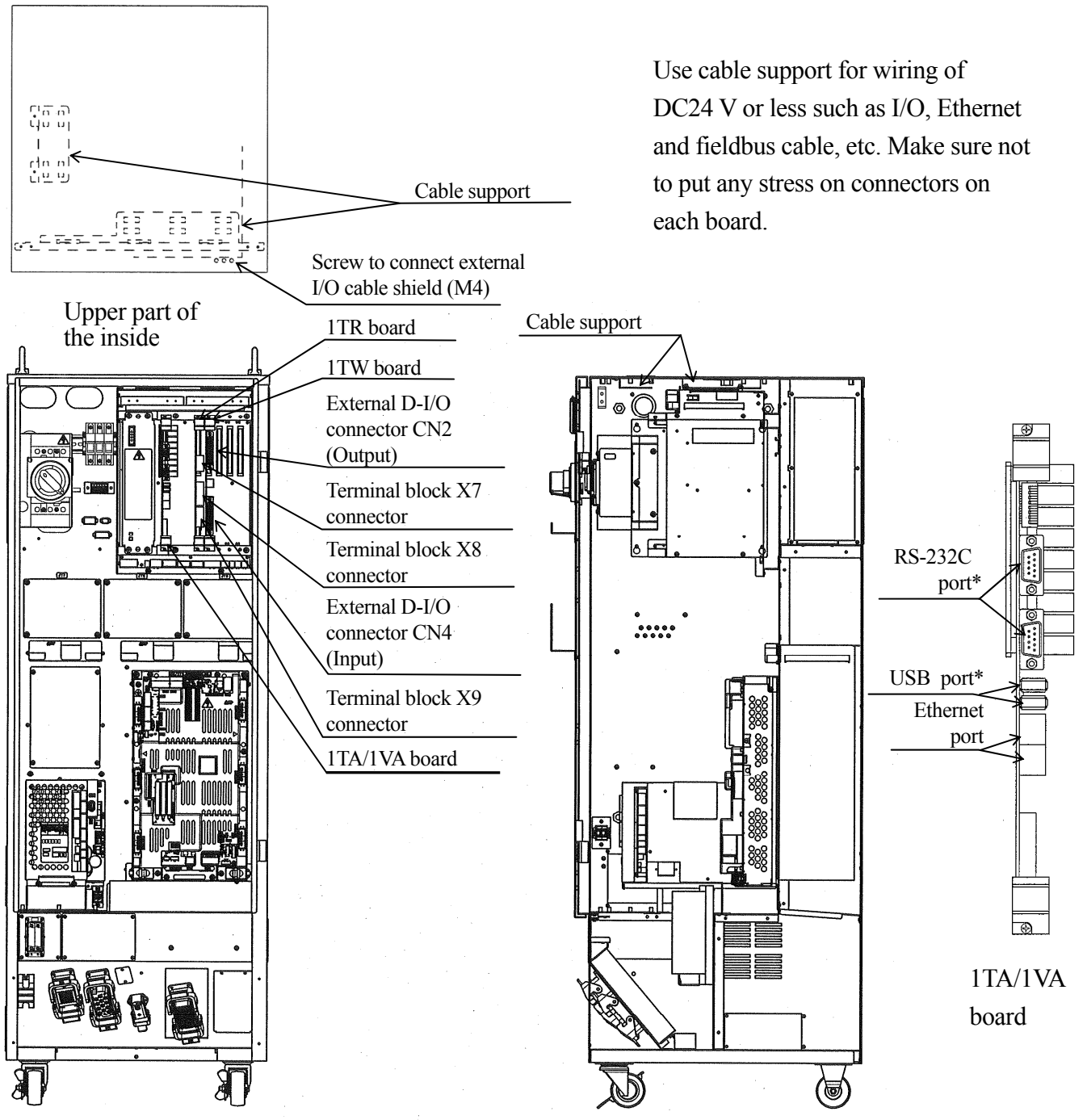
⚠ WARNING

Class A grounding is important to maintain intrinsically safe explosion-proof performance. Be sure to carry out connection to ground.



8 Connection of Peripheral Control Equipment

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



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

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

8.1 Instructions at the Connection

⚠ 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 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.

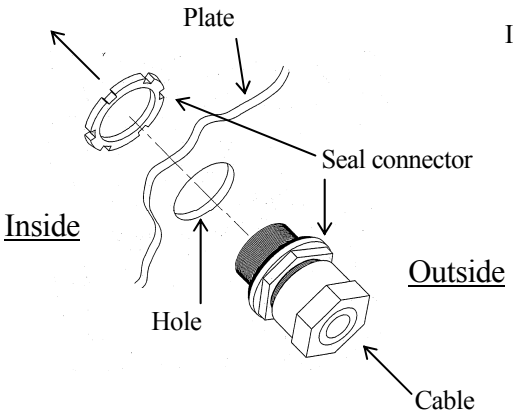
⚠ CAUTION

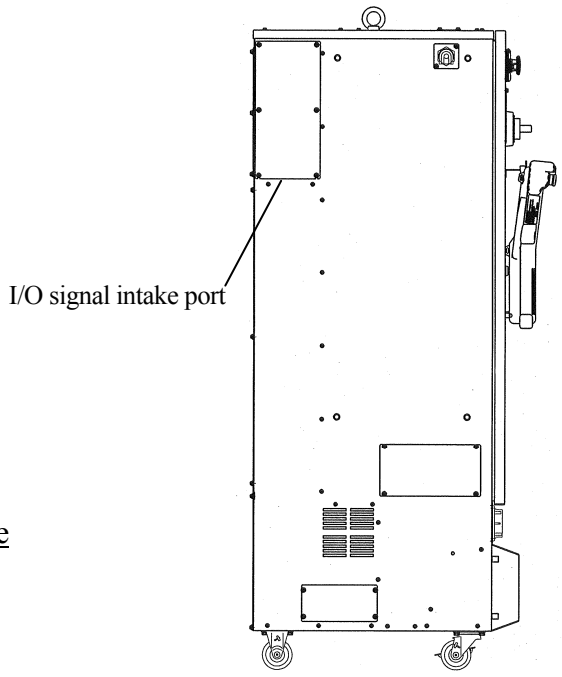
1. **Take the necessary noise countermeasures on equipment with external I/O connections to the controller. Electrical noise that interferes with the I/O signals may cause malfunction or damage to the electrical system.**
2. **Do not mistake pin No. on the connectors when connecting external I/O. Misconnecting 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 terminal blocks, fix them with tying bands in the cable support set on the top of the controller, preventing them from excessive force. (pulling, snagging of cable, etc.)**
7. **Mount the seal connector so that external I/O cables never cause insulation failure or disconnection at the intake port.**

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 intake port on the left side of the controller.
   The 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 through the hole, tighten the nut(s) of the seal connector.





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

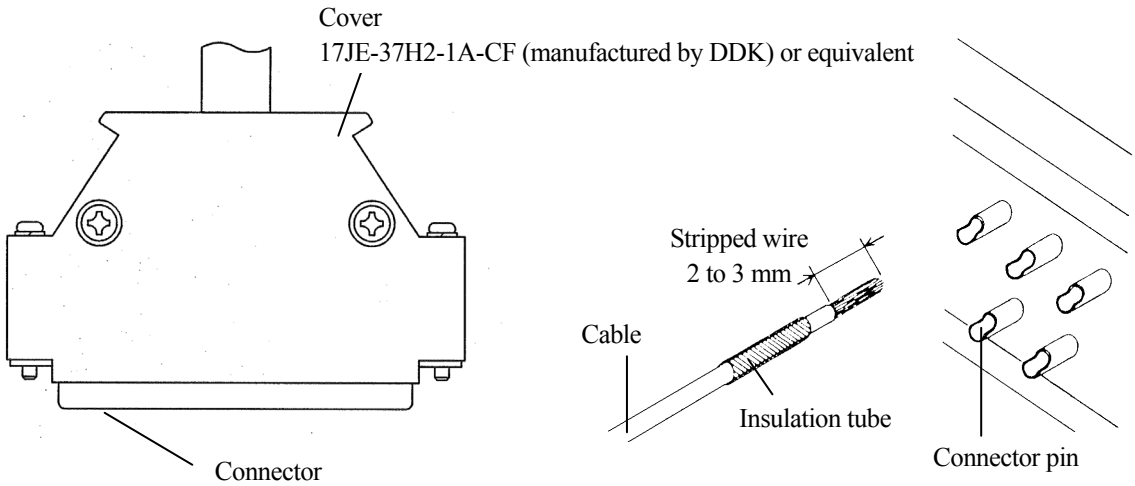
[NOTE]

1. Use an insulation tube of heat shrinkage type, or bind the tube ends on each line so as not to come off.
2. We recommend using AWG22 to 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]

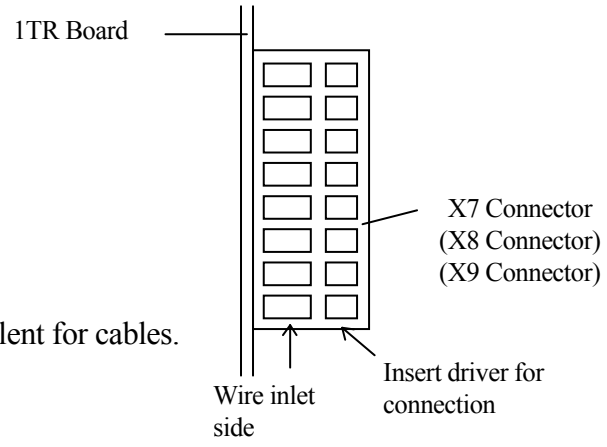
Tighten the screw thoroughly. If the screw is loose, the connector pins may be exposed to force beyond standard and that may lead connection failure.



8.3 Connection of Hardware Dedicated Signal

It is possible to construct a safety circuit using the hard 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 spring in the left hole. Then insert the wire there for connection.



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

To assure the wiring, we recommend using ferrules;

Recommended model: 216-201 (manufactured by WAGO)

Recommended crimping tool: 206-204 (manufactured by WAGO)

(Stripped wire length: 9.5 mm)

8.4 Connection of Personal Computer

It is possible to use a PC as terminal for the robot controller, when connecting a PC loaded with KRterm/KCwin32 software to the RS-232C port in the accessory panel. It is also possible to do so, when connecting a PC loaded with KCwin/KRterm software to the Ethernet port on 1TA/1VA board using Ethernet cable. Refer to "AS Language Reference Manual" for more details.

8.5 Connection of RS-232C Serial Signal (Option)

Data communication is possible between the host computer and 1TA/1VA board, when connecting to the RS-232C port on the 1TA/1VA board with an RS-232C cable. Refer to option manual 90210-1177 for details.

8.6 Connection of Ethernet Communication Signal (Option)

It is possible to build an Ethernet LAN of 10BaseT/100BaseTX using the Ethernet port on the 1TA/1VA board. Because cables differ according to each application specification, refer to option manual 90210-1248 for details.

8.7 Connection of Fieldbus (Option)

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

Kawasaki Robot Controller E Series

(Explosion-proof Specification)

Installation and Connection Manual

2009-02 : 1st Edition

2019-07 : 9th Edition

Publication : Kawasaki Heavy Industries, Ltd.

90202-1111DEI