CKD

SCARA Robot

KSL3000 Controller Manual

INSTRUCTION MANUAL

SM-A20046-A

- Read this Instruction Manual before using the product.
- Read the safety notes carefully.
- Keep this Instruction Manual in a safe and convenient place for future reference.

CKD Corporation

This instruction manual applies to the controller KSL3000.
The compatible robots of the KSL3000 are the KHL/KHE series robots.

Introduction

Thank you very much for your purchase of CKD's robot system.
This manual describes the standard specifications, installation, wiring, and maintenance of the controller. Read this manual before unpacking the product.
Read also "ST85358 KSL3000 for Safety" to understand the safety measures for using the controller.

This manual has the following chapters.

Chapter 1: Specifications
This chapter describes the standard specifications of the controller.

Chapters 2 to 4: Installation
These chapters describe transport and installation of the controller, and precautions for temporary storing the unpacked controller.
These chapters also describe the installation environment, required space, and installation procedure for the controller, and wiring between the controller and other controllers or peripheral devices.

Chapters 5 to 7: Maintenance
These chapters describe maintenance of the controller.

Contents

Use Range

This product is the horizontally articulated type industrial robot in which the manipulator has two horizontally rotating joints and the mechanical interface on its tip moves vertically and rotates horizontally.
The product has been developed with intention of adapting it to automation of wide range of work including conveying work such as movement and alignment of workpieces and assembly work such as insertion of parts and screw tightening.
The customer should also use this product with the aim to adapt it to automation of these work and incorporate it to the automation equipment.

This product is not intended to apply it to work that contacts a human (such as work related to medical care and nursing care), incorporate it to the equipment that supports human life (such as life support device and incubator), incorporate it to the equipment on which a human rides (including transport equipment such as car, aerospace equipment such as airplane, and game equipment such as roller coaster), and incorporate it to the equipment that protects human life and human body (such as safety device).
This product is not intended to incorporate it to the equipment aimed to control large quantity of heat (such as nuclear power controller and incinerator controller).
This product is prohibited from being used to apply it to work or incorporate it to the equipment that is likely to threaten human life and harm a human body directly due to a failure or malfunction. If this product is used, it will be guaranteed under customer's responsibility.

Use Method

The use conditions for the KHE series robot are described. If the product is used in the state that differs from the conditions, unexpected risk may occur. Abide by the conditions for use.

1. Main Specifications of Product: See Specifications "1.3 Controller Specifications", Installation "3.1 Installation Environment", and "KHL/KHE Series Robot Manual Specification Part" in the Instruction manual.

2. Restrictions on Use: Tables 1 and 2 give "Restricted Specification Sheet" indicating restrictions on use.

Table 1　Restricted Specification Sheet (1)

1. Purpose and application of using product (restrictions on use)	
1) Intended use	Allow the robot to achieve operation along with the purposes (article conveyance, assembly, inspection, machining, etc.). (1) During teaching and adjustment operation −Operation is likely to be performed by turning on the servo power within the movable range of the robot. −A person who observes teaching and operation checking worker as a co-worker is arranged outside the movable range. (1) Teach the position where the robot operates. (2) Create the operation sequence (program, etc.). (3) Transfer and check signal and data with the external equipment. (4) Check operation at low speed (250 mm/sec or less). (2) During operation −Danger prevention measures that prevent contact with the robot (installation of the fence or enclosure) are taken to keep a person away from the operating robot. −When the operating robot is approached, measures shall be taken to turn off the servo power. (1) Start the robot. (2) Perform operation along with the purpose at the specified speed. (3) Stop the robot. (3) During maintenance and inspection −Contents performed within the movable range of the robot when the primary power is off (1) Check the bolts for looseness and backlash and re-tighten them. (2) Check the cable clamp for looseness. (3) Inspect damage. (4) Clean dust. (5) Inspect and apply antirust agent. (6) Check the timing belt for looseness and crack. (7) Check the cable and air tube for wear. (8) Check the operation when each axis is pushed and moved by hand. (9) Replace the consumable parts for the robot and controller. (10) Replace the battery for memory in the controller. −Contents performed within the movable range of the robot when the primary power is on (1) Check the grease state and apply grease (when the servo power is off). (2) Push each axis by hand and check it for backlash (when the servo power is on). (3) Check abnormal vibration and sound during operation (when the servo power is on). (4) Check the teaching point for misalignment (when the servo power is on). (5) Replace the battery for robot position detector (when the servo power is off).

Table 2　Restricted Specification Sheet (2)

2) Predictable misuse	−Use for work which applies excessive impact to the robot or to which excessive impact is applied by the robot −Modification of robot body, controller, and optional parts and energization with these covers removed −Operation in other than the specified installation state (floor, suspension, and wall-mounted) −Operation on the frame that does not satisfy the specified strength −Operation in other than the specified environment	
3) Unexpected start	−Malfunction caused by excessive noise −Robot start caused by start signal unexpectedly sent from the peripheral equipment to the robot −Unintended start caused by abnormal communication data −Malfunction caused by voltage fluctuation	
2. Replacement of product components (restrictions on time)		
1) Mechanical restriction 2) Electrical restriction	Replace consumable parts as required or periodically through daily inspection, regular inspection (every 3 and 6 months and every year) and overhaul (every 5 years).	
3 Movable range of product (restriction on space)		
1) Operating range	Axis 1	Conforms to "THL/THE Series Robot Manual Specification Part" in the Instraction manual.
	Axis 2	Conforms to "THL/THE Series Robot Manual Specification Part" in the Instraction manual.
	Axis 3	Conforms to "THL/THE Series Robot Manual Specification Part" in the Instraction manual.
	Axis 4	Conforms to "THL/THE Series Robot Manual Specification Part" in the Instraction manual.
	Additional axis	Conforms to individual specifications.
	—	—
	—	—
2) Interface	−The product shall be installed at a location suitable for outer shape and operating range. −Space required for maintenance and inspection shall be secured.	
3) Work environment	−Danger prevention measures that prevent contact with the robot (installation of the fence or enclosure) shall be taken. −Space shall be secured to prevent a person from being caught between the robot and the fence or AY15enclosure.	
4. Life cycle of product		
During the life cycle of assembly, shipment test, transportation, installation, teaching, operation, maintenance and disposal, risk assessment is carried out for "installation" stage (transportation and installation), "use" stage (teaching, operation, and maintenance) and disposal.		
5. Person who approaches the machine		
Target	Knowledge, experience, and condition	
1) Transportation and install	Knowledge: Person who has understood the instruction manual Experience: — Condition: Qualified person on forklift or crane (as required)	
2) Teaching/adjustment operation worker (including co-worker)	Knowledge: Person who has understood the instruction manual Experience: Person who has acquired the operation of the robot to be used Condition: Person who has received special training pertaining to the operation such as teaching of the industrial robot and to whom work has been permitted by the employer	
3) Operation worker (operator)	Knowledge: Person who has understood the instruction manual Experience: Person who has understood the work regulation Condition: —	
4) Maintenance and inspection worker	Knowledge: Person who has understood the instruction manual Experience: Person who has acquired the operation of the robot to be used and person who has acquired maintenance work of the target robot Condition: Person who has received special training pertaining to the operation such as inspection of the industrial robot and to whom work has been permitted by the employer	
5) Disposal worker	Knowledge: Person who has understood the instruction manual and the disposal method for each local government Experience: — Condition: —	
6. Other		

Warranty

We conduct a strict tests and inspections before delivery to ensure that the product satisfies our performance standards.
We provide warranty to cover defects of the product based on the following prerequisites.

1. Warranty period The warranty period of the product is either of the following, whichever is earlier.
   1) 18 months after delivery from our factory
   2) 12 months after installation at your site
   3) Operating time of 2400 hours.

2. Warranty scope
   1) We provide warranty for the product. Note that only the specifications and functions defined in the product specifications, catalog, and instruction manual are covered by the warranty. Any secondary or incidental damages caused by failure of the product are not covered by the warranty in any circumstances.
   2) We provide repair of a faulty product for free only if the product has been handled and used according to the instruction manual that comes with the product.
      Any repairing after the warranty period passes will be charged.

3. DisclaimerThe warranty shall not apply to the following cases.
   1) Any failure or damage arising from your careless use or misuse that is not defined in the instruction manual.
   2) Any failure caused by aging or normal wear and tear (discoloration, deterioration of consumables[*1]).
   3) Any failure regarding sensuous phenomena such as noise not affecting the functions
   4) When any modification or disassembly without our consent is confirmed
   5) Any failure or damage arising from insufficient maintenance and inspection or inappropriate repair
   6) Any failure or damage due to act of God, fires, and other force majeure
   7) Internal data such as programs and points created or modified by users
   8) When a product purchased in Japan is taken abroad

4. Precautions
   1) CKD shall not guarantee the standard performance of the product if you use the product beyond the specifications.
   2) If the customer did not observe the "WARNING" and "CAUTION" described in this instruction manual, CKD will not assume the responsibility for any consequential accident resulting in injury or death, damage or trouble.
   3) Note that "WARNING" and "CAUTION", and other information are those assumed by CKD.

   (*1) Consumable parts refer to the replacement parts for maintenance as listed in Chapter 7 in this instruction manual.

Standards, laws and regulations regarding safety of industrial robots

The international industrial standard ISO/DIS 12100 "Safety of machinery" defines measures for reducing risks regarding machinery.

Step 1: Fundamental safe design measures - Restrictions on force, speed, and energy
Step 2: Safety protection - Installation of protective fences, etc.
Additional protection measures - Installation of emergency stop devices
Step 3: Information for use - Warning labels, alerts, instruction manuals

Based on the above, the ISO/IEC defines the "Guide 51" that groups various standards in a hierarchal structure. Safety standards for industrial robots are standardized as separate safety standards for machinery in layer C.

●ISO 10218, ISO 10218-1

Comply with the standards, laws and regulations in the countries where you use industrial robots.

The following describes the major Japanese standards for industrial robots.

Safety standards for industrial robots are defined by the Japanese Industrial Standards (JIS) by applying ISO 10218 and ISO 10218-1 without changing any of their technical contents and configuration.

●JIS B 8433, JIS B 8433-1

Japanese laws and regulations for safety of industrial robots are defined as follows.

● Industrial Safety and Health Act, Article 59 (Safety and Health Education)

"The employer shall, when a worker is to be placed in the dangerous or harmful operations, give the worker the special education for safety and/or health concerning the said operations."

Operations requiring special education for handling industrial robots are defined as follows.

● Labor Safety and Health Regulation, Article 36 (Operations Requiring Special Education)

• Item 31, Teaching and other operations of the industrial robots
• Item 32, Inspection and other operations of industrial robots

Measures that should be taken to prevent danger in operations handling industrial robots are defined as follows.

● Labor Safety and Health Regulation, Section 9 (Industrial Robot)

• Article 150 (3), Teaching, etc.
• Article 150 (4), Preventing danger during operation
• Article 150 (5), Inspection, etc.
• Article 151, Inspection

Industrial robot
(some are out of regulation scope)

In automatic operation

Action	Regulation
Giving a signal to start operation	Article 104
Installation of fences, etc.	Article 150 (4)

(Work in the movement range)

Teaching and other operations

When the driving source is not disconnected

Action	Regulation
Defining working rules	Article 150 (3)
Fast stop of operation	Article 150 (3)
Indication of work-in-process	Article 150 (3)
Providing special education	Article 36, Item 31
Inspection before work	Article 151

When the driving source is disconnected (including shutdown)

Action	Regulation
Indication of work-in-process	Article 150 (3)

Inspection and other operations

Action	Regulation
Inspection while operation stopped	Article 150 (5)
Indication of work-in-process	Article 150 (5)

Inspection during operation by necessity

Action	Regulation
Defining working rules	Article 150 (5)
Fast stop of operation	Article 150 (5)
Indication of work-in-process	Article 150 (5)
Providing special education (excluding cleaning and lubrication)	Article 36, Item 32

System diagram of the Labor Safety and Health Regulation

Safety Precautions

This manual contains important information for the safe use of the equipment and the prevention of injury to the operator and others and the prevention of damage to property.
Read and understand the meanings of the following indications and symbols first, and observe these precautions.

[Meanings of Indications]

Indication	Meaning
⚠ DANGER	Indicates the imminent danger that incorrect operation could cause death or serious injury.
⚠ WARNING	Indicates the danger that incorrect operation could cause death or serious injury.
⚠ CAUTION	Indicates the possibility that incorrect operation could cause injury*1 to the operator or damage to the property*2.

*1: Injury indicates injuries such as wounds, burns, and electric shock that do not require hospitalization or long-term outpatient treatment.

*2: Damage to property indicates extensive damage related to the destruction of assets or materials.

[Meanings of symbols]

Symbol	Meaning
	Indicates a prohibited action. The specific content of the prohibition is shown pictorially or in text form inside the symbol or nearby it.
	Indicates a required action. The specific content of the required action is shown pictorially or in text form inside the symbol or nearby it.
	Indicates a danger and precaution. The specific content of the precaution is shown pictorially or in text form inside the symbol or nearby it.

⚠ CAUTION
• To install and operate the controller safely, read and understand the separate Instruction Manual "ST85358 KSL3000 Safety Manual" in advance.

[Installation]

Strictly observe the following to use the controller safely.

⚠ DANGER	
 Prohibited	• Do not run the equipment if it is damaged or parts are missing. Otherwise, electric shock, fire, or malfunction may result. • Do not install the equipment in a place where liquid such as water is applied. Otherwise, electric shock, fire, or malfunction may result. • Do not place a flammable material near the equipment. Fire may result if the equipment ignites due to failure.
 Required	• Install the equipment before wiring. Wiring before installation may cause electric shock and injury. • Use the power supply voltage and capacity specified by CKD. Otherwise, equipment failure or fire may result. • Use the power cable specified by CKD. Using cables not specified by CKD may cause fire or malfunction. • The controller must be installed outside of the danger zone where the operator can overlook the operation of the robot. Otherwise, robot movement may cause significant danger when operating the controller. • Ensure that the equipment is grounded by a grounding wire. Otherwise, electric shock or fire may result due to malfunction or electric leakage. Malfunction due to noise may also result.

⚠ CAUTION	
 Prohibited	• Ensure that there is a ventilation space required for the controller. Otherwise, malfunction may result due to heating of the controller.

[Maintenance and inspection]

Strictly observe the following in order to use the controller safely.

⚠ DANGER	
 Prohibited	• Do not burn, disassemble, or recharge the battery. Otherwise it may blow out.
 Required	• Before conducting maintenance and inspection, be sure to disconnect the power plug of the controller from the power outlet. • When disposing of the battery, observe the customer-defined rules. • Ensure that the equipment is grounded by a grounding wire. Otherwise, electric shock or fire may result due to malfunction or electric leakage. Malfunction due to noise may also result.

⚠ CAUTION	
 Prohibited	• Do not replace or modify parts that are not stated in the instruction manual. Performance degradation, failure or accident may result.
 Required	• Use replacement parts specified by CKD. • Regularly conduct maintenance and inspection. Otherwise, equipment failure or accident may result.

Specifications

This part describes the basic specifications and the names of components of the KSL3000.

1 Specifications

1.1 Equipment Configuration

Figure 1.1 shows the robot equipment configuration.
This controller supports the KHL Series (KHL-300 to 700) and KHE Series (KHE-400) SCARA robots.

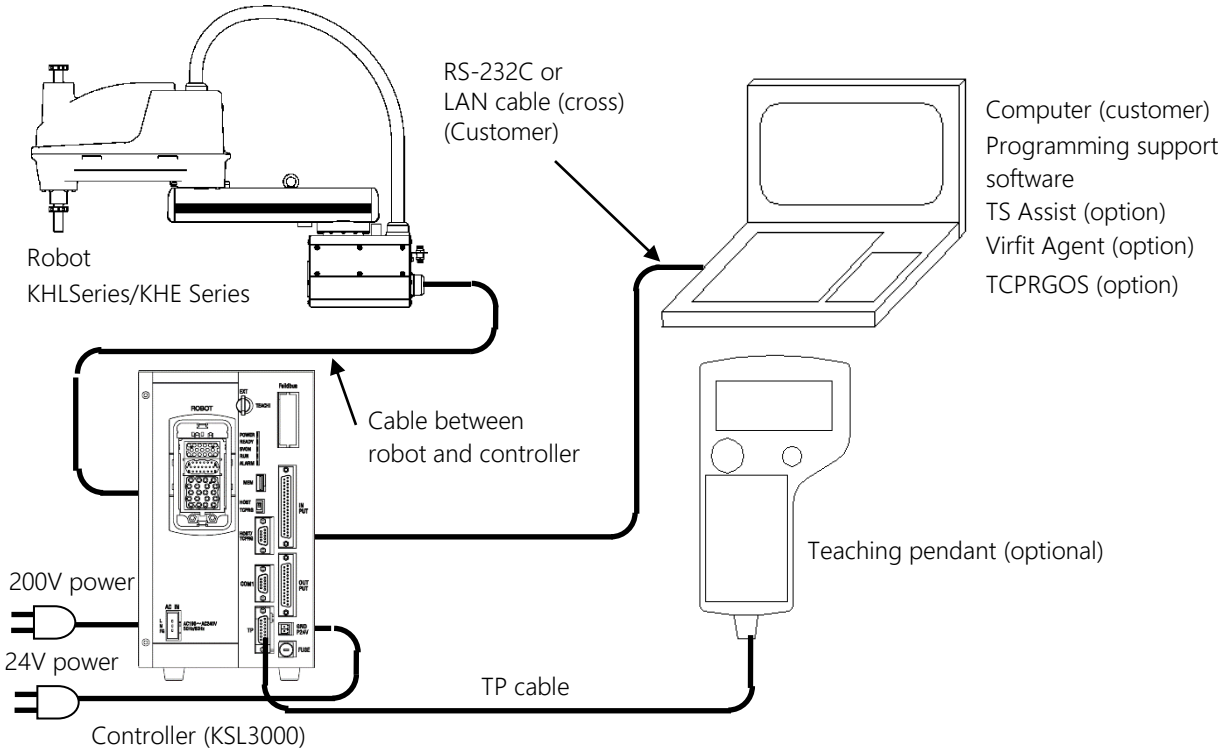


Figure 1.1 Robot equipment configuration

For connecting the 200V power supply, refer to 4.1.2 "ACIN" connector for connecting the power cable (Figure 4.1-①). For connecting the 24V power supply, refer to 4.1.7 "GNDP24V" connector for connecting the I/O signal power cable (Figure 4.1-③).

1.2 Names of Components

Figure 1.2 shows the names of components.
For connecting the ACIN, ROBOT and GNDP24V connectors, refer to Chapter 4.

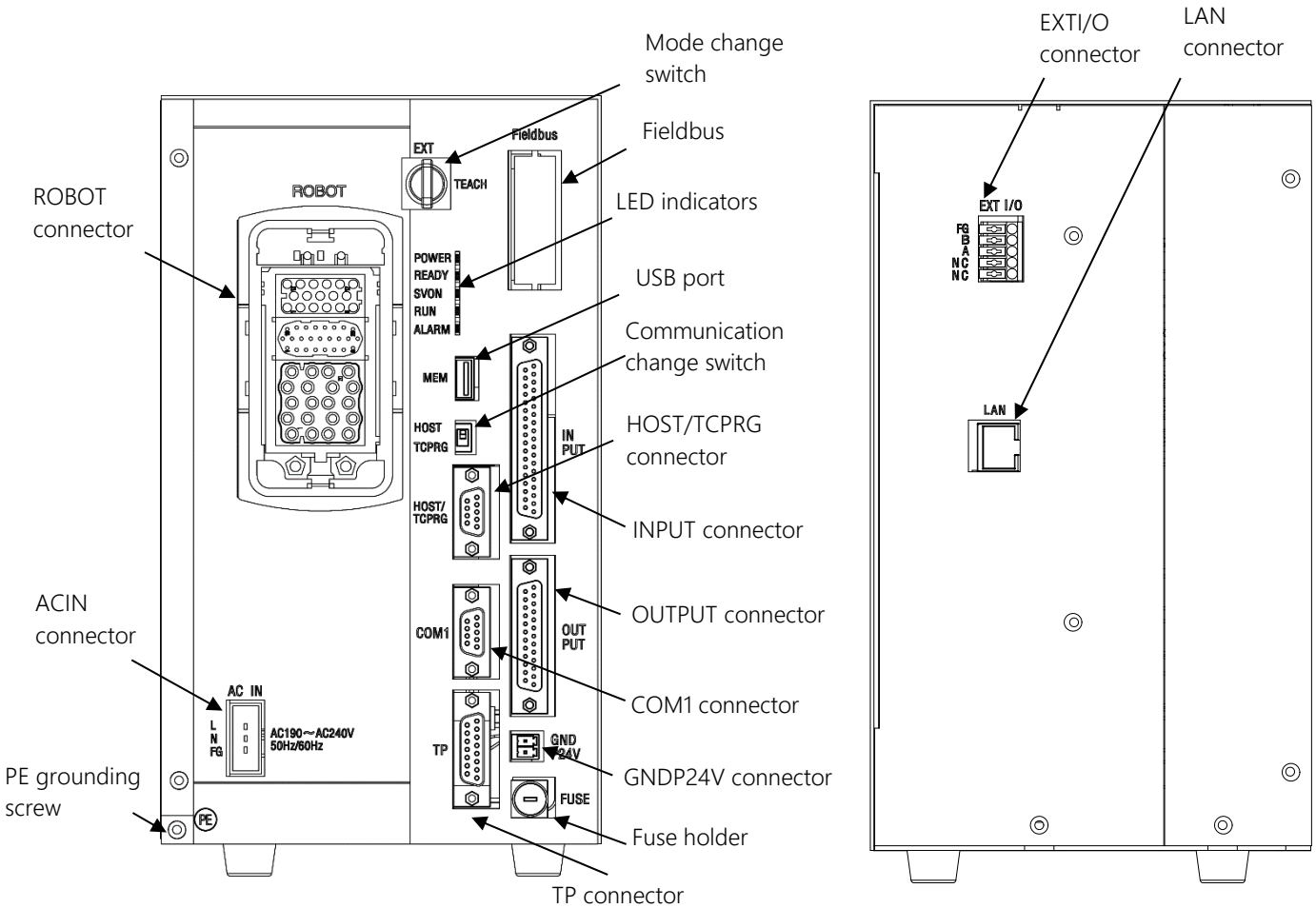


Figure 1.2 Names of components

1.3 Controller Specifications

No.	Item		Specifications	Remarks
1	Number of controlled axes		Simultaneous 4 axes maximum	
2	Operating mode		PTP, CP (line, arc), Short cut, arch operation	
3	Servo type		Digital servo	
4	Storage capacity		Total: Approx. 6400 points + 12800 steps 1 program: Approx. 2000 points + 3000 steps	0.5 Mbytes
5	Number of programs that can be registered		Up to 256 (247 user files and 9 system files)	
6	Auxiliary memory		USB memory	
7	Storage type		Battery backup RAM	
8	Position detection method		Absolute encoder	
9	Teaching method	Point teaching	Remote: Control via the teaching pendant	
			Coordinates: Input the X, Y, Z, C, and T values via the teaching pendant. Servo free: Arm movement via input	
		Program input	Input via the teaching pendant	
10	External I/O signals		8 inputs, 8 outputs	
11	Band control signals		Determined by the robot specifications	
12	External control signals	Input	Program select, start-up, stop, program reset, etc.	
		Output	Servo ON, operation ready, failure, cycle stop, etc.	
13	Serial communication port		RS-232C: 1 port (HOST/TCPRG), dedicated type RS-232C: 1 port (COM1) general-purpose RS-422: 1 port, TP1000, dedicated type	HOST/TCPRG is supported by the change switch.
14	Speed setting		Override/Speed limit/Program instructions, 1 to 100% for each instruction	
15	Acceleration setting		Program instruction: 1 to 100%	
16	Torque Control		Program instruction: 1 to 300%	
17	Teaching device		Teaching pendant	
18	Coordinate system		The Base, Workpiece, and Tool coordinates can be set.	
19	Movement limit		Soft limit	
20	Self-diagnostic function		Error detection, etc.	
21	Interrupt function		Starts an interrupt program via an input signal, timer, etc.	

No.	Item		Specifications	Remarks
22	Operating mode		TEACH mode, External Auto mode (SIGNAL), External Auto mode(RS232C)/ External Auto mode(ETHERNET)	
23	Operating method	Internal	Continuous, Cycle, Step, Operation step	
24		External	Cycle, Continuous	
25	Controller main unit	Dimensions	150(W) × 266(H) × 304(D)	The height includes the rubber foot height.
		Weight	7 kg	
		Color	Black	
	Power supply		Single phase 190 to 240 VAC, 50/60 Hz	
26	Computer software TSPC		Program creation, teaching, remote operation, etc.	
27	Programming language		SCOL	

[Specifications of Controller Options]

No.	Name of product	Specification	Remarks
1	Teaching pendant	KSL-TP1000	Standard cable: 5 m
2		(TP3000)	Standard cable: 5 m
3	Teaching pendant cable extension		10m/15m
4	Controller Output polarity	Type-P	+ Common
5	External input signal cable	INPUT	Cable length: 6 m
6	External output signal cable	OUTPUT	Cable length: 6 m
7	Controller mounting bracket		2 pieces/set
8	Extended I/O expansion	TR48DIOCN	Type-N
9		TR48DIOC	Type-P
10	TSPC program support software	TSPC	Instruction Manual supplied
11	TCPRGOS program support software	TCPRGOS	Instruction Manual supplied
12	Field bus extensions	PROFIBUS	*1
13		DeviceNet	
14		CC-Link	
15		EtherNet/IP	
16		EtherCAT	
17		PROFINET	

*1 : Select either PROFIBUS, DeviceNet, CC-Link, EtherNet/IP, EtherCAT, or PROFINET for the slave module for the field bus. Customers need to decide which field bus they use when placing an order. PROFIBUS is a trademark of Profibus User Organization. DeviceNet is a trademark of ODVA. CC-Link is a registered trademark of Mitsubishi Electric. EtherNet/IP is a trademark of ODVA. EtherCAT is a registered trademark of Beckhoff Automation GmbH.
For details of the field bus, refer to the ST80756 KSL3000 Instruction Manual for Field Bus Slave.

Installation

This part describes the items you should know before transporting, installing, or operating the controller.

2 Transport

The transport of the controller can be carried out only by qualified personnel. Also, be sure to follow the laws and regulations as well as ordinances of the applicable country.

Recommended protector:

Type and name	Protection part and use	Recommended example
Helmet	Protection part: Head Use: Protect from a falling object. Protect from collision with the arm.	
Safety glasses	Protection part: Eyes Use: Protect from a flying object. Protect from collision with the arm.	
Protective gloves	Protection part: Hands and fingers Use: Protect hands and fingers when caught in the machine. Prevent a carried object from dropping.	
Protective shoes	Protection part: Feet and toes Use: Protect from a falling object.	

2.1 Unpacking the Controller

The controller is shipped in corrugated cardboards.

Figure 2.1 shows the packing state. Open the packages in a location easily assessable, where the equipment is to be installed. Take careful precautions not to damage the robot and controller.

After opening the packages, make sure that all the accessories are present and that nothing has been damaged during transport. For the controller accessories, see the accessory list packed with the controller.

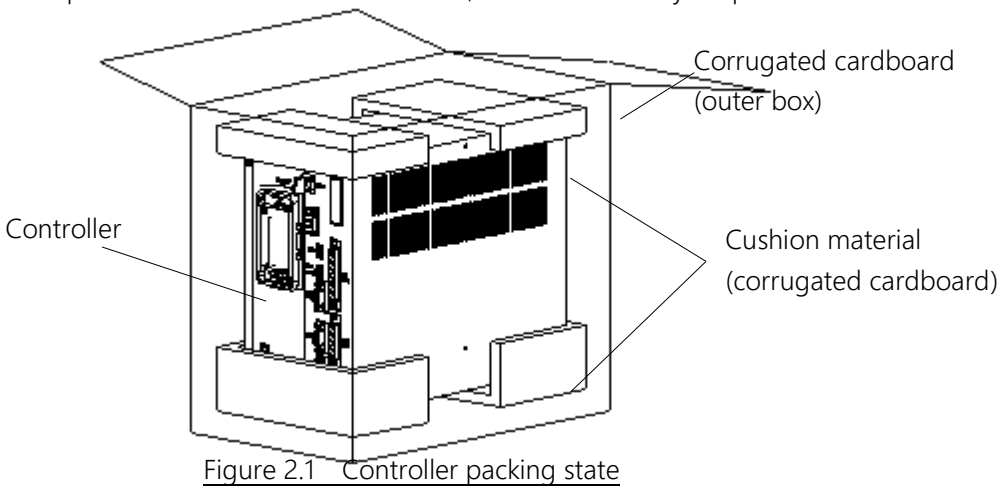


Figure 2.1 Controller packing state

⚠ CAUTION

- If any parts of the equipment are found damaged or any accessories are missing after the shipment containing the equipment and controller have reached your office. DO NOT install and operate them. Otherwise, the equipment will malfunction. Contact CKD immediately.
- Dispose of the wooden pallet, corrugated cardboards, polyethylene shipping bags, and cushion material according to the customer's in-house regulations.

2.2 Transport of the Controller

Disconnect and remove cables and teaching pendant from the controller before transport.
Do not apply an excessive force to the controller. Otherwise the controller may be damaged.

⚠ DANGER

- Be careful not to pinch your foot or hand when placing the controller on the floor.

2.3 Storage

Avoid storing the controller not being used for an extended period after it is unpacked.
If such long-term storage is not avoidable, follow the precautions below.

2.3.1 Precautions for storing the controller

⚠ CAUTION

- Store the controller avoiding direct sunlight.
  It may result in fault due to heating inside the controller.
- Seal the controller in a vinyl bag with desiccant inside to prevent rust and dust.

3 Installation

The installation of the controller can be carried out only by qualified personnel. Also, be sure to follow the laws and regulations as well as ordinances of the applicable country.

Recommended protector:

Type and name	Protection part and use	Recommended example
Helmet	Protection part: Head Use: Protect from a falling object. Protect from collision with the arm.	
Safety glasses	Protection part: Eyes Use: Protect from a flying object. Protect from collision with the arm.	
Protective gloves	Protection part: Hands and fingers Use: Protect hands and fingers when caught in the machine. Prevent a carried object from dropping.	
Protective shoes	Protection part: Feet and toes Use: Protect from a falling object.	

3.1 Installation Environment

Table 3.1 shows the environment specifications for the controller.

Table 3.1 Environment specifications for the controller

Item	Specifications
Temperature	In operation state: 0 to 40°C In storage state: -10°C to 50°C
Humidity	20 to 80% (no condensation) Do not install the controller in a place where liquid such as water is applied.
Altitude	Up to 1000 m
Vibration	Do not apply excessive vibration and shock.
Dust	Ensure that there is no electric conductive dust. Contact us if you use the controller in a dusty environment.
Gas	Ensure that there is no corrosive or flammable gas.

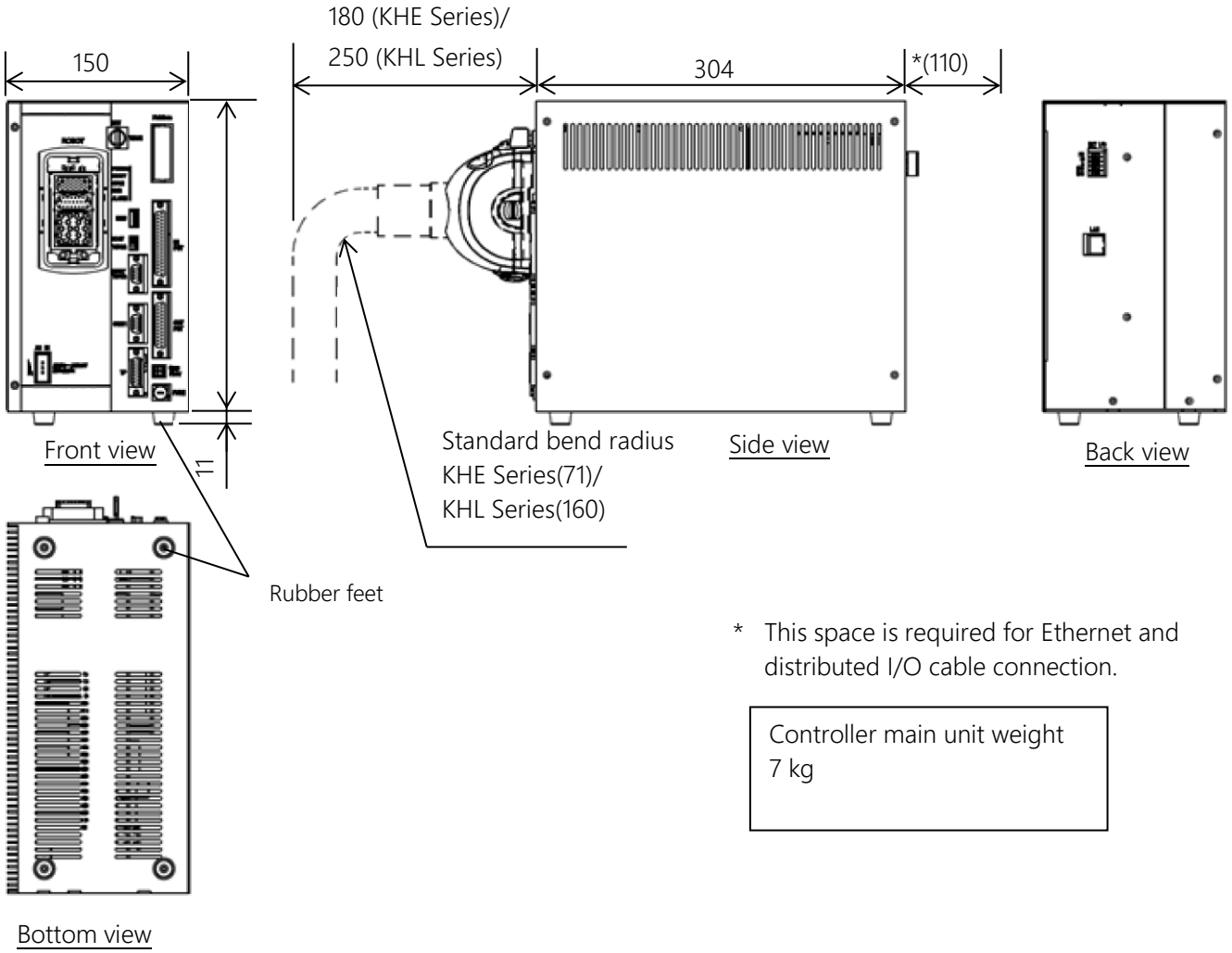
Item	Specifications
Protection degree	IP20
Overvoltage category	IEC60664-1 Class III
Electric shock protection	IEC61140 Class I
Pollution level	IEC60664-1 Pollution Level 3
Solar radiation	Avoid direct sunlight.
Power supply noise	Ensure that there is no surrounding device generating excessive noise.
Magnetic field	Ensure that there is no surrounding device generating a strong magnetic field.
Surrounding environment	Ensure that there is no iron powder, oil, salt, or organic solvent in the environment. Ensure that water is not applied to the controller.

⚠ DANGER

- Do not place any flammable object near the controller.
  Fire may result if the controller ignites due to failure.

3.2 Dimensions

Figure 3.1 shows the outline drawing of the controller.



* This space is required for Ethernet and distributed I/O cable connection.

Controller main unit weight 7 kg

Figure 3.1 Outline drawing of the controller

3.3 Precautions for Installation on Floor

Keep 50 mm or more clearance around the sides of the controller and 100 mm or more clearance above the top surface of the controller.

⚠ CAUTION

- Keep enough clearance around the sides of the controller to prevent the vent holes being blocked. Keep clearance under the controller as the space for rubber feet. Otherwise, the controller may be in failure due to decreased cooling performance.
- Do not stack controllers.
- Do not place any object on the controller.

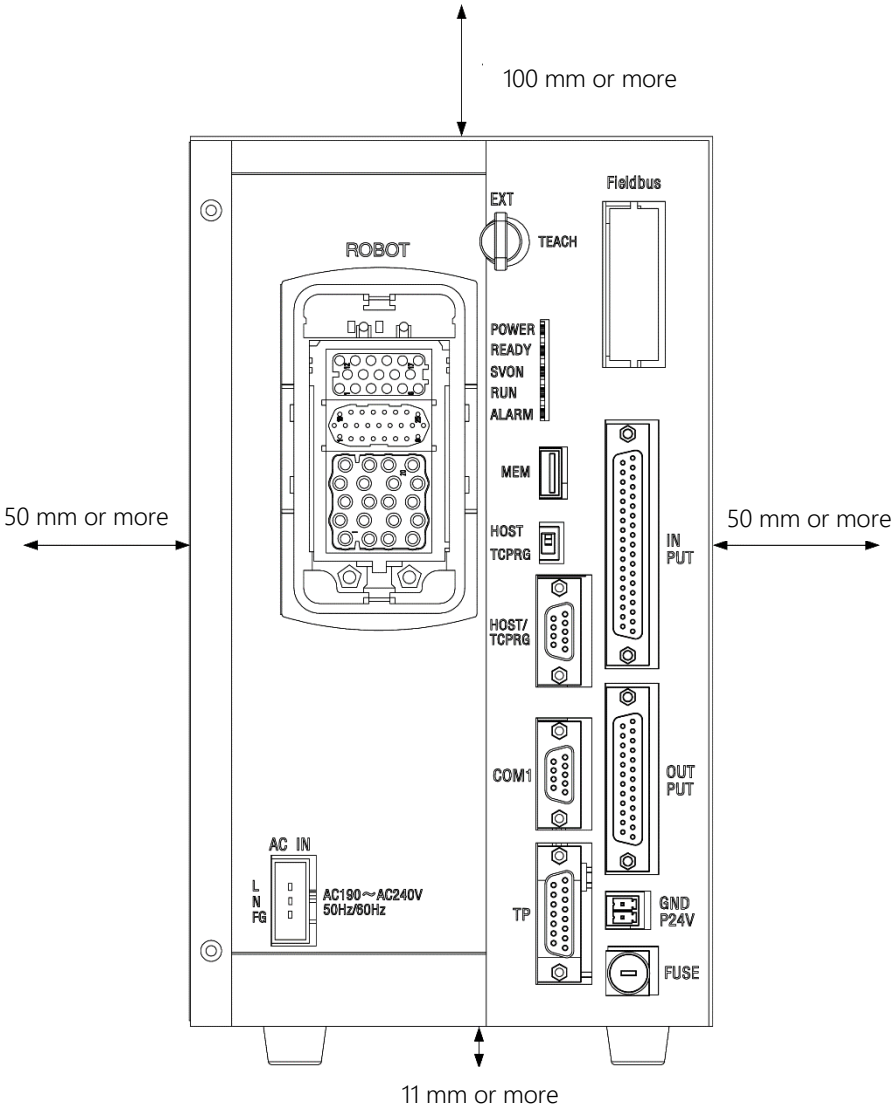


Figure 3.2 Air-passing spaces for the controller

3.4 Mounting Dimensions

When mounting the controller on the control panel, use the screw holes for rubber legs on the bottom to fit the mounting brackets and secure the controller to the control panel.

Note: The mounting bracket (2-piece set) is optional. The customer is requested to assemble it.

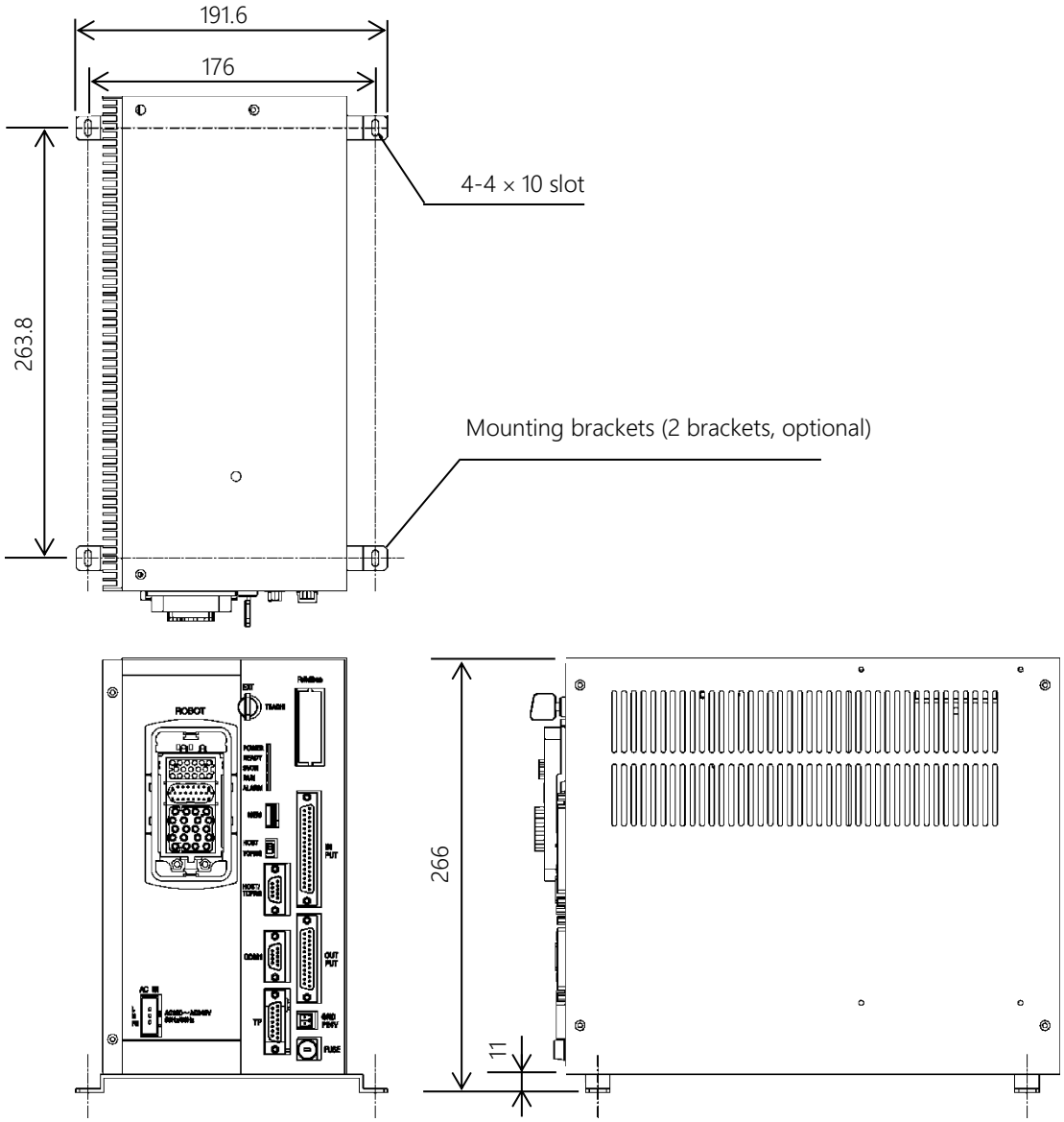


Figure 3.3 Screw hole dimensions for securing controller

3.5 Precautions for Mounting to the Control Panel

Observe the following when mounting the controller to the control panel, etc.

a) Remove the rubber feet from the bottom surface, and use these rubber foot mounting holes to mount the controller to the control panel.

b) Keep 110 mm clearance from the back of the controller for connecting cables for the Ethernet support and distributed I/O (option).

c) Remove the top cover when performing maintenance of the controller.

d) Consider serviceability for maintenance of the controller when installing the controller. When storing the controller to the control panel, ensure that the controller can be detached from the control panel for maintenance.

Specifically, consider the following.

1) Controller cable routing (Ensure that the controller can be pulled out.)

2) Ensure that the robot can be operated with all cables connected when the controller is pulled out of the control panel.

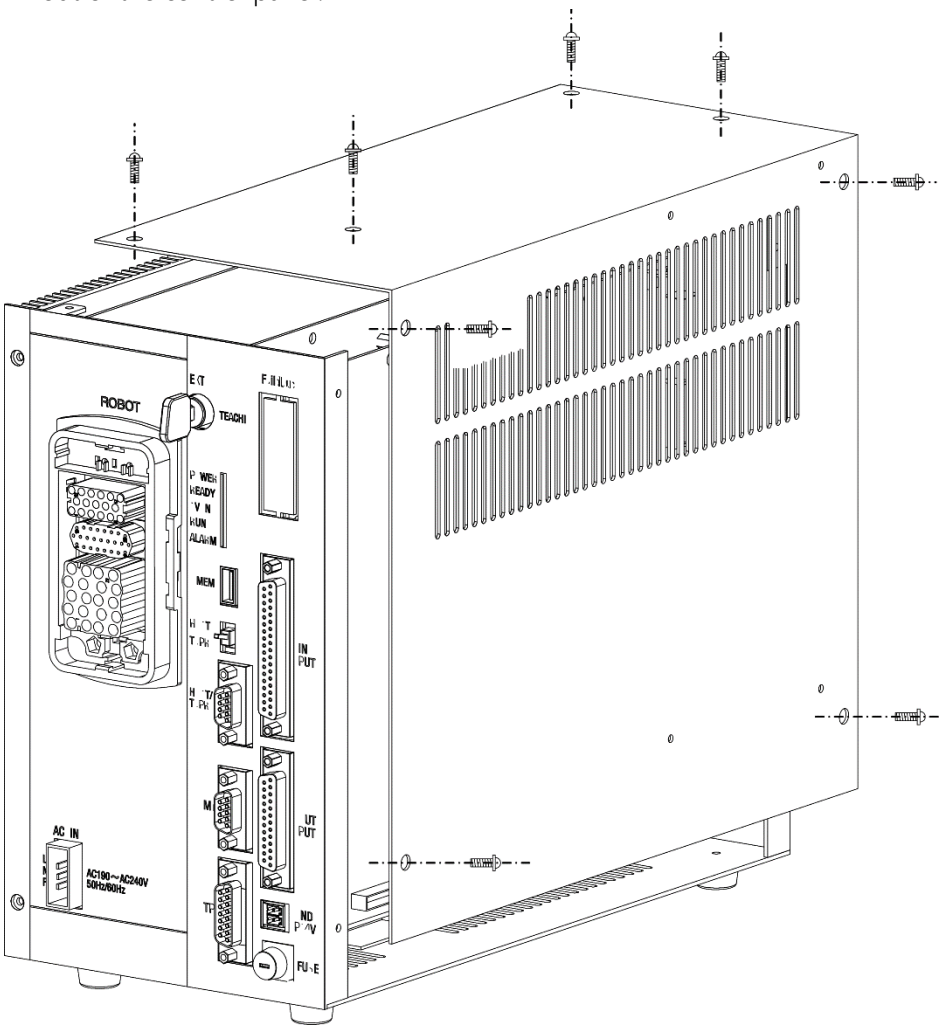


Figure 3.4 Removing the top cover

e) Keep clearance from the front of the controller for connecting robot cable connectors.

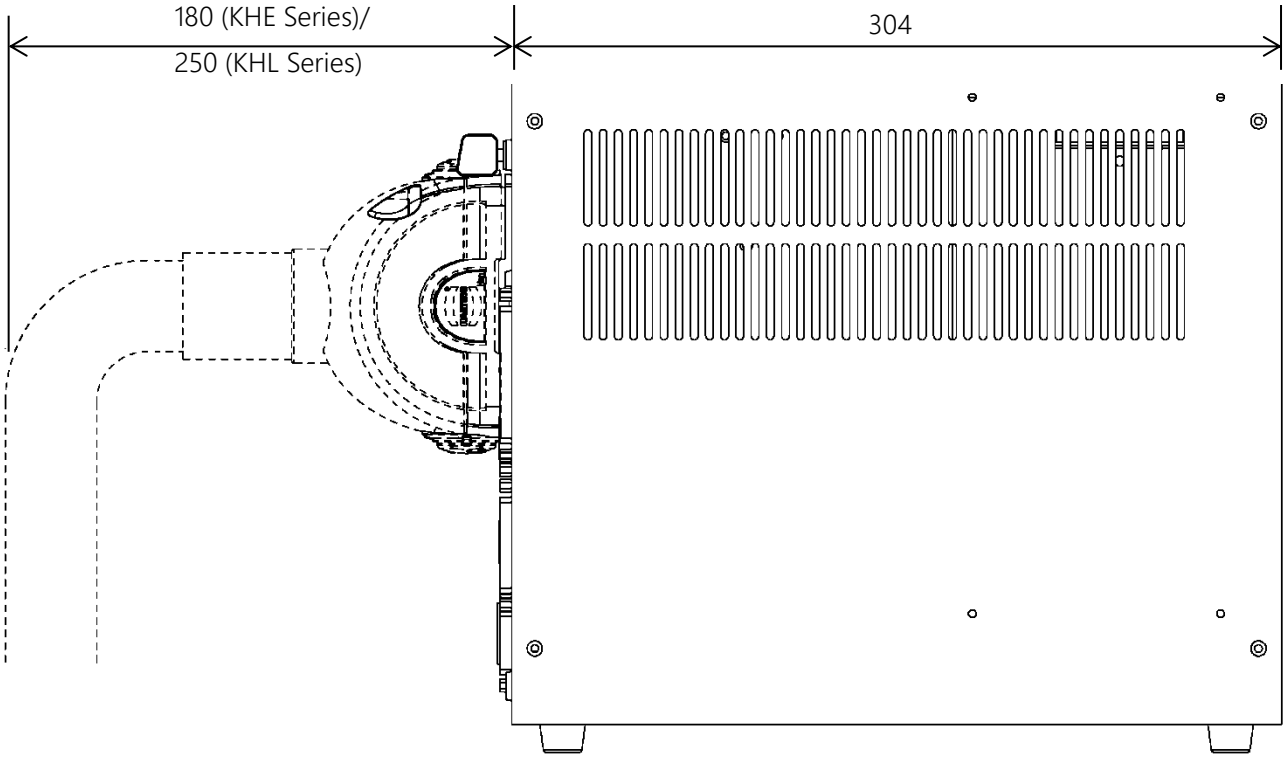


Figure 3.5 Clearance from the front of the controller

⚠ CAUTION

- When the control panel is sealed completely, create vent holes to dissipate heat or install a fan to ventilate the controller, or apply other indirect cooling methods. Heat inside the controller and control panel may cause equipment failure.

4 Cable Connection

Cable connection can only be carried out by qualified personnel. Also, be sure to follow the laws and regulations as well as ordinances of the applicable country.

Recommended protector:

Type and name	Protection part and use	Recommended example
Helmet	Protection part: Head Use: Protect from a falling object. Protect from collision with the arm.	
Safety glasses	Protection part: Eyes Use: Protect from a flying object. Protect from collision with the arm.	
Protective gloves	Protection part: Hands and fingers Use: Protect hands and fingers when caught in the machine. Prevent a carried object from dropping.	
Protective shoes	Protection part: Feet and toes Use: Protect from a falling object.	

4.1 Wiring

This section describes types of cables and connectors and how to connect them.

4.1.1 Connectors on the controller

Figure 4.1 shows the cables connected to the controller.

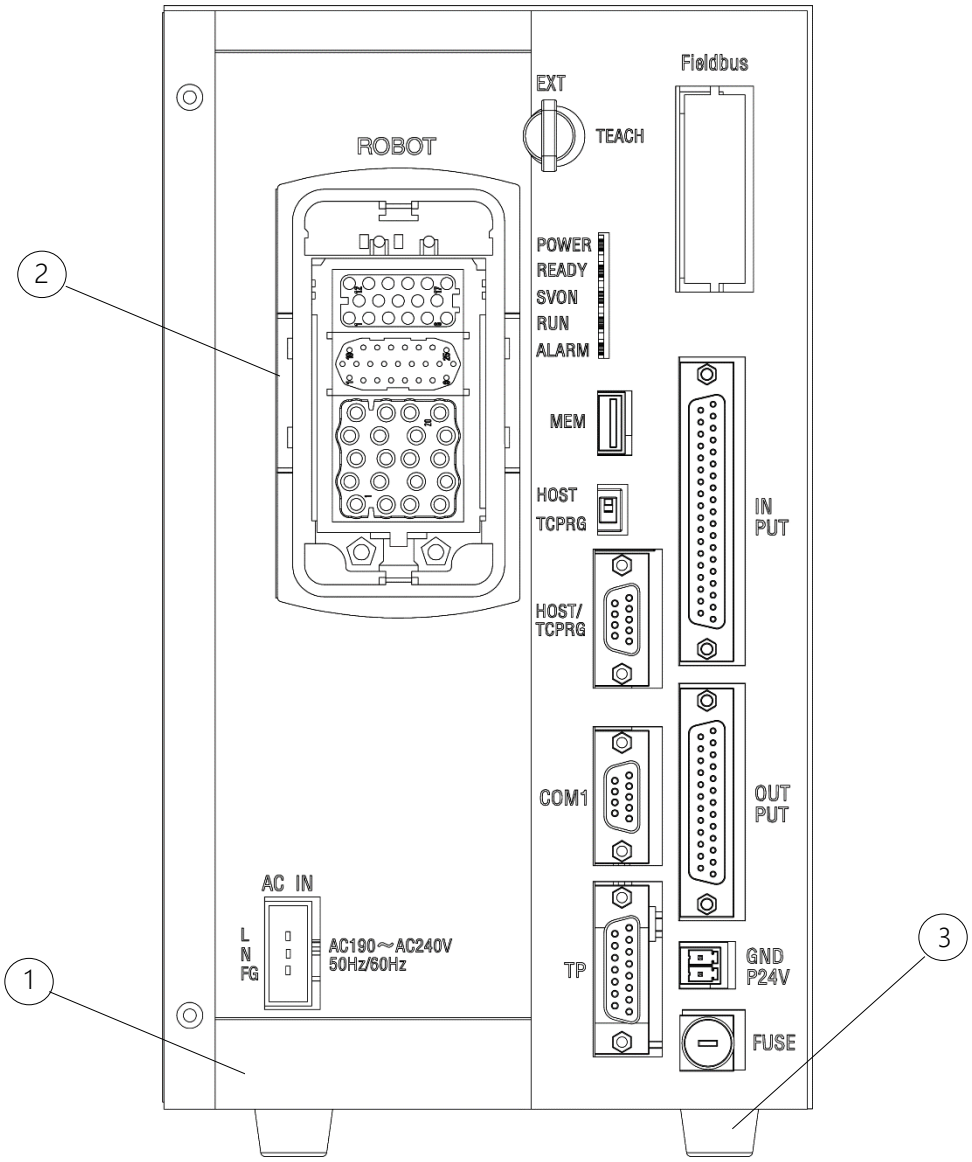


Figure 4.1 Controller connector layout

[1] "ACIN" connector for connecting the power cable

[2] "ROBOT" connector for connecting the motor, encoder, robot control signal, and brake signal cables

[3] "GNDP24V" connector for connecting the I/O signal power cable

The following sections describe connecting the above cables. For connecting other cables, refer to the ST85364 KSL3000 Instruction Manual for Interface.

4.1.2 "ACIN" connector for connecting the power cable (Figure 4.1-①)

The power cable is used to supply power to the controller. The ACIN plug connector (Figure 4.1 - ①) is supplied with the product.

ACIN plug connector model:

03JFAT-SAYGF-I, Manufacturer: Japan Solderless Terminal MFG

Line: 0.8 mm^2 to 2.0 mm^2 (AWG#18 to AWG#14)

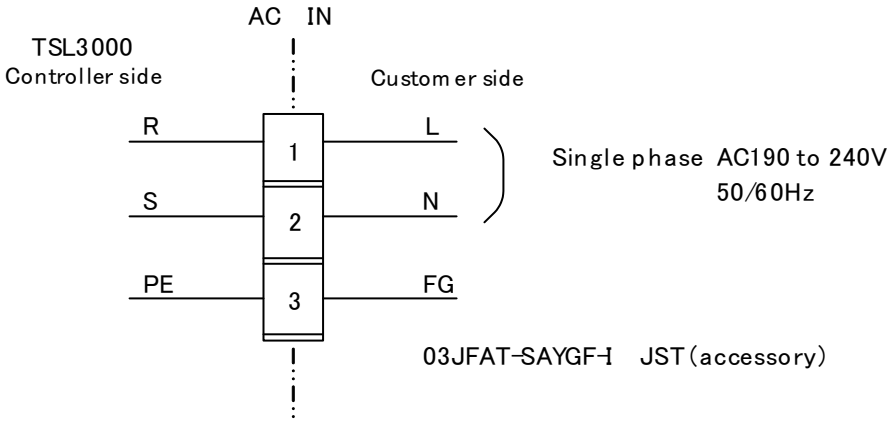


Table 4.1 Power supply specifications

Power supply	Single-phase, 190 to 240 VAC 50/60 Hz ± 1 Hz
Momentary power loss	Within 40 msec
Grounding	Class D only

* Cables are not supplied with the product. Customers need to provide a cable for the supplied connector to be connected to the controller side ACIN.
For the terminal layout, see "4.1.9 Connector terminal layout list."

⚠ DANGER

- Use cables specified by CKD. Otherwise, accidents such as fire may result.
- When connecting cables to the connector, make sure that the terminal arrangement is correct.
- After connecting the cables, check the behavior using a tester.

⚠ CAUTION

- "8-027 Slow charge error" occurs at servo ON if the main power supply fails to supply power to the controller due to an open phase or voltage drop. In this case, confirm that the power supply voltage at the power supply connector is stable and satisfies the controller input power supply specification value.
- For details of "8-027 slow charge error", see the error codes in "ST80723 KSL3000 for Alarms".

4.1.3 "ROBOT" connector for connecting the motor cable (Figure 4.1-②)

The cable is integrated with the encoder cable, robot control signal cable, and brake signal cable and integrated into the robot. The motor cable connected between the controller and the robot supplies power for motors to drive from the controller servo driver to each axis motor.

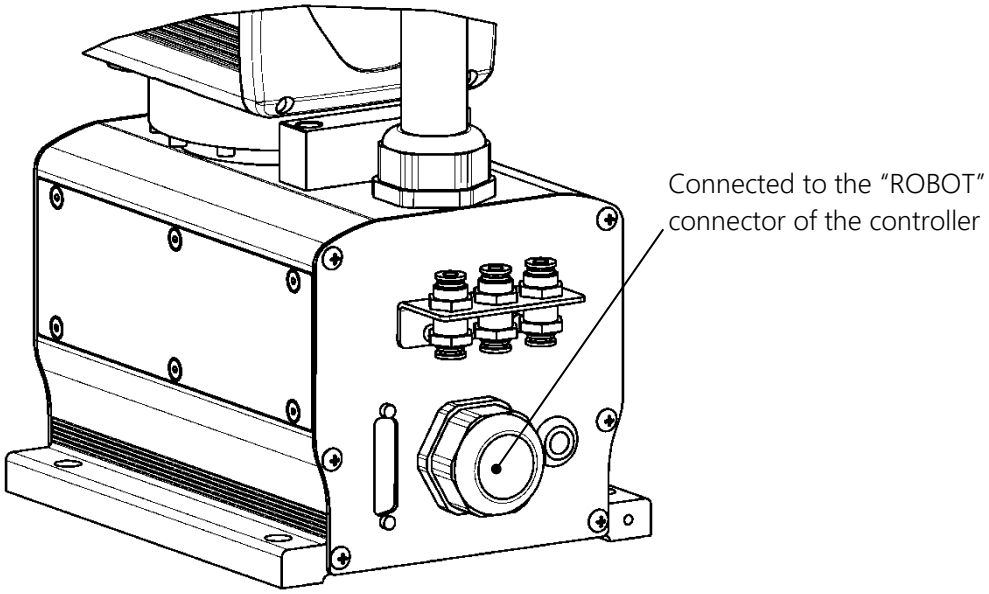


Figure 4.2 Robot-side connector layout (KHL Series)

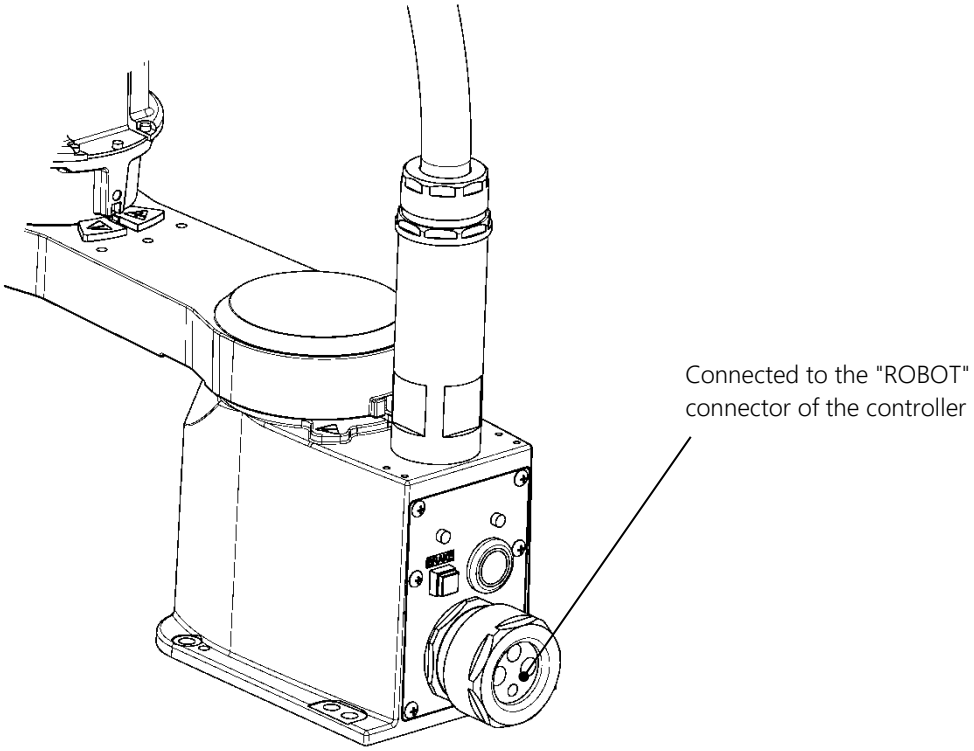


Figure 4.3 Robot-side connector layout (KHE Series)

4.1.4 "ROBOT" connector for connecting the encoder cable (Figure 4.1-②)

The cable is integrated with the motor cable, robot control signal cable, and brake signal cable, and integrated into the robot. The encoder cable is a signal line to input signals from the rotation angle detection encoder of each axis of the robot to the controller.

4.1.5 "ROBOT" connector for connecting the robot control signal cable (Figure 4.1-②)

The cable is integrated with the motor cable, encoder cable, and brake signal cable, and integrated into the robot. The robot signal cable is used to input/output robot control signals such as the motor axis fixing brake ON/OFF signal and hand operation signal.

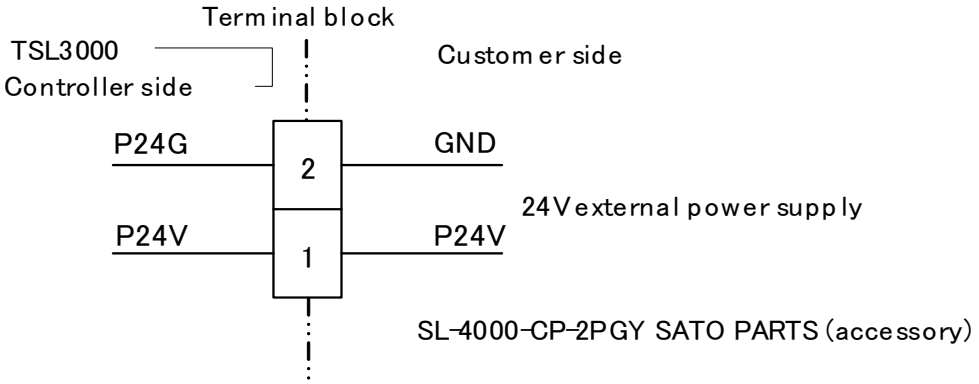
4.1.6 "ROBOT" connector for connecting the brake signal cable (Figure 4.1-②)

The cable is integrated with the motor cable, encoder cable, and robot control signal cable, and integrated into the robot. The brake signal cable is used to turn on/off the motor axis fixing brake.

4.1.7 "GNDP24V" connector for connecting the I/O signal power cable (Figure 4.1-③)

Use the accompanying connector SL-4000-CP-2PGY to connect the I/O signal power cable. The P24V power supply is provided from the front of the controller.
The following inputs/outputs use the external power supply (24 VDC). Ensure that the power is supplied from an external power supply (24 VDC).

- External I/O
- External operation I/O
- Extended I/O
- Hand I/O



Use cables with the size "AWG24 to 16" for connectors.
Select an appropriate external power supply in accordance with your system specifications such as the current capacity.
For connecting/disconnecting the I/O signal power cable, refer to the ST85364 KSL3000 Instruction Manual for Interface.

⚠ CAUTION

Make sure to use the external power supply (24 VDC). Otherwise, the signal for safety measures will not be enabled and the servo power supply of the controller cannot be tuned on.

4.1.8 Connecting/disconnecting the connectors

⚠ CAUTION

- Turn off the power supply before disconnecting cables from the controller.
- When disconnecting a cable, hold the connector and pull it.
  Pulling the cable may damage the cable.
- When disconnecting a cable, hold the controller and pull the plug. Otherwise, the controller may fall down when pulling the connector.

- ROBOT connector "ROBOT"

  To connect the ROBOT connector, securely insert the cable connector into the connector on the controller side while pressing the top and bottom buttons on the cable connector. Loose insertion of the connector causes an accident due to poor contact of the connector; therefore, be sure to check whether the connector is securely connected.

  To disconnect the ROBOT connector, follow the same procedure in reverse order. Pull out the cable connector while pressing the top and bottom buttons.

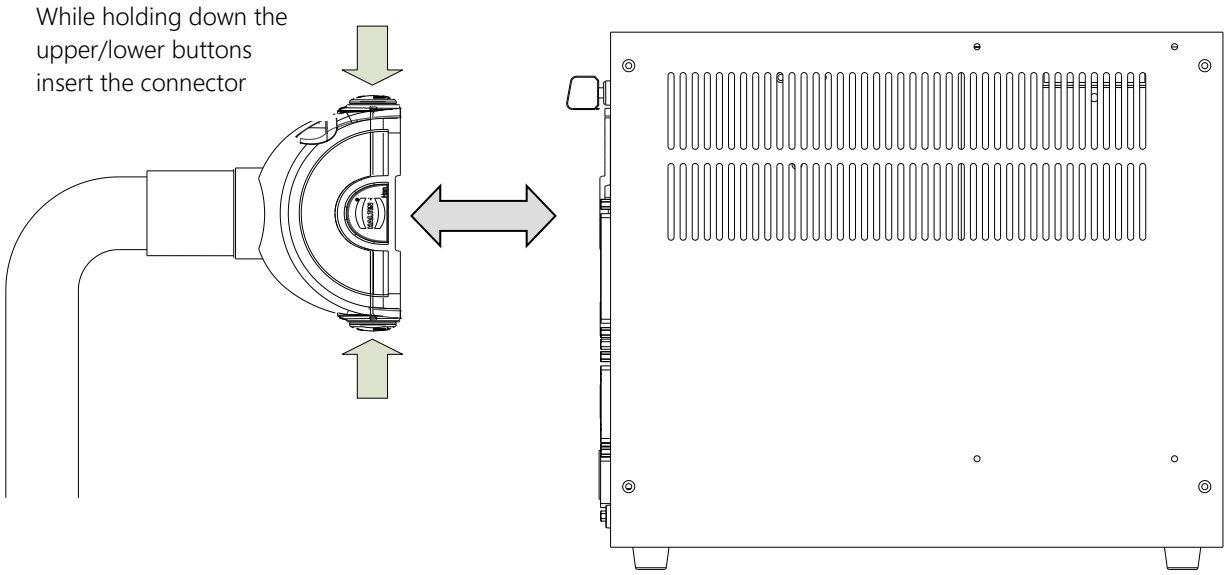


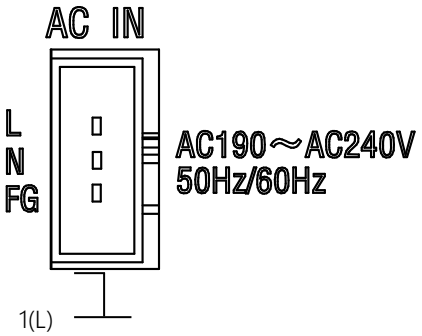
Figure 4.4 Connecting/disconnecting the ROBOT connector

4.1.9 Connector terminal arrangement

⚠ DANGER

- Ensure that the equipment is grounded by a grounding wire. Otherwise, electric shock or fire may result due to malfunction or electric leakage.
  Malfunction due to noise may also result.

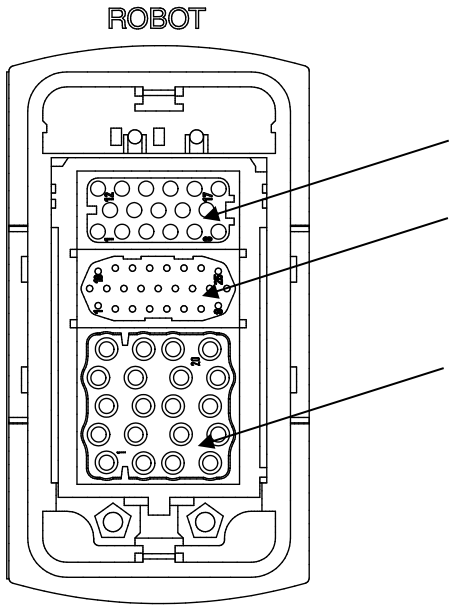
a) "ACIN" connector for power supply (Figure 4.1 - ①).



Controller side
Model: 03JFAT-SAYGF-I
Manufacturer: J.S.T. Mfg. Co., Ltd.
The paired power supply connector is also supplied.

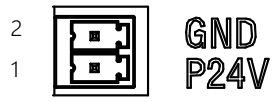
1(L)	Single-phase 190 to 240 VAC, 50/60 Hz
2(N)	
FG	Grounding (Class D or higher)

b) "ROBOT" connector for the motor, encoder, robot control signal, and brake signal cables (Figure 4.1 - ②)



Controller side
Manufacturer: HARTING

c) Connector for the power supply for external I/O signals "GNDP24V" (Figure 4.1-③)



Controller side
Model: SL-4000-CWJH 02PGY
Manufacturer: SATO PARTS
Parts for the device to be connected are supplied with the controller.
For details, refer to ST85364 KSL3000 Instruction Manual for Interface.

4.2 Controller Connector Signals

4.2.1 Connector signal connection diagram

For signals connected to terminals of each connector, refer to the ST85364 KSL3000 Instruction Manual for Interface, Chapter 2 "Connecting the External Cables".

4.2.2 Signal jumpers for safety measures

The following system input signal lines are provided as safety measures.

System input signal lines ... INPUT-12 (STOP)
INPUT-14 (SVOFF)
INPUT-32 (BREAK)
INPUT-18, 19 (EMS1B to EMS1C)
INPUT-36, 37 (EMS2B to EMS2C)
INPUT-17, 35 (INCOM to P24V)
Assume the standard P24V positive common

For connectors supplied with the controller, these signals are bypassed by default. To use or modify these signals, remove relevant jumpers and rewire the connector. When operating the robot without using the system I/O signals, make sure to connect the supplied connector to the controller-side INPUT connector. Also, apply jumpers to the following signals if they are not used as system signals.

INPUT-13 (LOW_SPD)
INPUT-31 (CYCLE)

Connector jumpers

INPUT			
12-16	14-16	32-16	36-37
(13-16)	(31-16)	18-19	17-35

⚠ CAUTION

- If the "SVOFF" signal and emergency stop contacts 1 and 2 are not jumped, the servo power supply of the controller cannot be tuned on.
- If the "CYCLE" is not jumped, the controller will switch to the cycle operation mode.
- If the "LOW_SPD" signal is not jumped, the robot automatic operation speed will be slow.
- If the "STOP" signal is not jumped, the robot automatic operation will not be available.
- If the "BREAK" signal is not jumped, the robot automatic operation will not be available.

Maintenance

This part describes the maintenance and inspection of the controller.

5 Maintenance

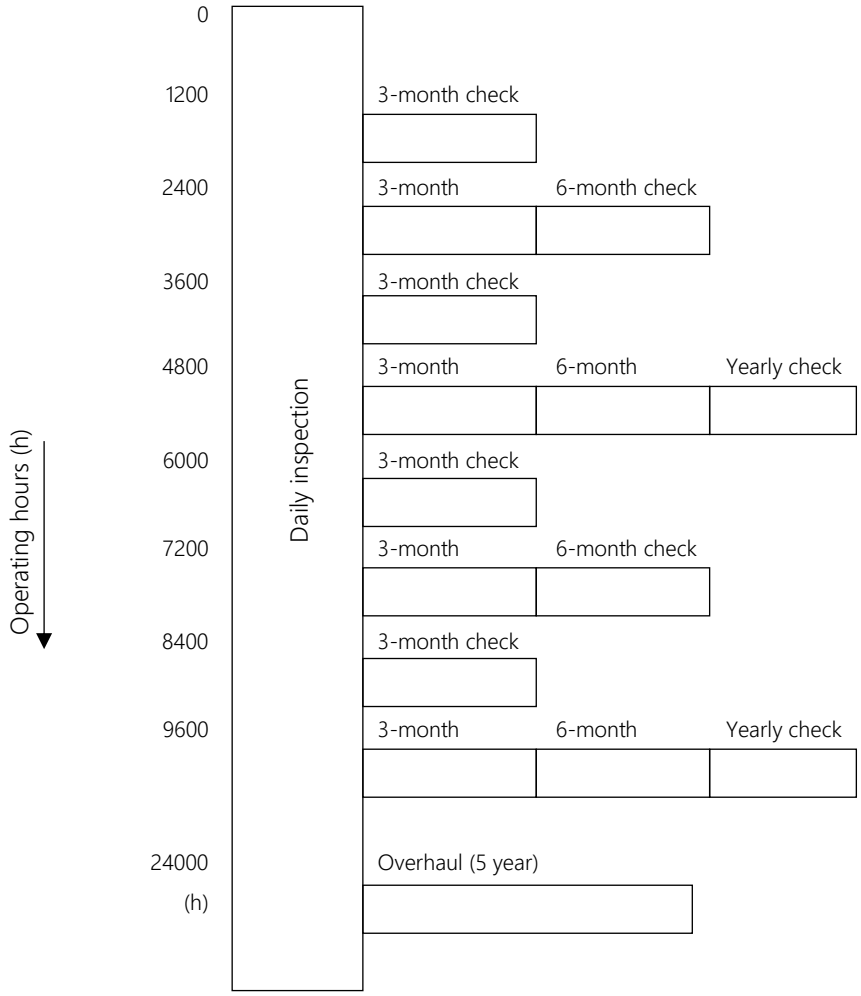
The maintenance and inspection of the controller can be carried out only by qualified personnel.
Also, be sure to follow the laws and regulations as well as ordinances of the applicable country.

Recommended protector:

Type and name	Protection part and use	Recommended example
Helmet	Protection part: Head Use: Protect from a falling object. Protect from collision with the arm.	
Safety glasses	Protection part: Eyes Use: Protect from a flying object. Protect from collision with the arm.	
Protective gloves	Protection part: Hands and fingers Use: Protect hands and fingers when caught in the machine. Prevent a carried object from dropping.	
Protective shoes	Protection part: Feet and toes Use: Protect from a falling object.	

5.1 Maintenance Schedule

Daily and periodic maintenance and inspection are required. Inspection items are added in each periodic maintenance and inspection carried out every 1200 operating hours.



Periodic maintenance and inspection time calculation

16 operating hours per day: 1200 hours / 16 hours / 25 days = 3 months
24 operating hours per day: 1200 hours / 24 hours / 25 days = 2 months

If the operating hours per day are 16, maintenance and inspection are required every three months. If the operating hours per day are longer than 16, earlier maintenance and inspection are required.

Figure 5.1 Maintenance schedule

5.2 Maintenance/Inspection Items

Daily and periodic maintenance and inspection are required.
This section describes items of maintenance and inspection. For details of each maintenance and inspection, refer to the relevant section stated in the reference column.

5.2.1 Inspection in the power-off state

Table 5.1 Inspection in the power-off state

Inspection	Location	Daily check	3-month check	6-month check	Yearly check	Reference
Check screws for tightness. If they are loose, retighten them.	Cover mounting screws	○	○	○	○	6.3.4 6.3.5 6.3.6
Connector tightness	All connector section	○	○	○	○	4.1.8
Damage check Cleaning of accumulated dust	The entire robot controller	○	○	○	○	
Vent hole check	Vent holes	○	○	○	○	6.3.1

5.2.2 Inspection in the power-on state

Table 5.2 Inspection in the power-on state

Inspection	Location	Daily check	3-month check	6-month check	Yearly check	Reference
Emergency stop validation	Emergency Stop button	○	○	○	○	6.3.2 6.3.3
Enable switch validation	Enable switch	○	○	○	○	
Mode switch TEACH/EXT mode validation	TEACH/EXT mode	○	○	○	○	*1
Robot/controller validation	All axis validation in TEACH mode	○	○	○	○	*2

*1: Refer to ST80720 KSL3000 Instruction Manual for Operation, Section 1.2.1.
*2: Refer to ST80720 KSL3000 Instruction Manual for Operation, Section 3.1.

5.2.3 Overhaul

Table 5.3 Overhaul

Maintenance details	Service parts	5 years	Reference
Battery replacement	Battery for controller backup	○	6.3.4
Switching power supply replacement	Inside the controller	○	6.3.5

5.3 Maintenance Contract and Repair Service

5.3.1 Maintenance contract

Inspections after the six-month maintenance are difficult for customers to perform. Please request us to provide such inspections. We recommend that you make a service agreement with us at the time of purchase.

5.3.2 Repair service

If the system malfunctions, turn off the power supply, and contact our service department. Please notify us of the details of the failure and the following information stated on the nameplates of the robot and controller. (For the contact information of our service department, refer to "Service Network".)

- Robot model
- Robot product number
- Controller product number
- Robot production date
- Operating hours

For the product number and production date, check the nameplate on the robot base.

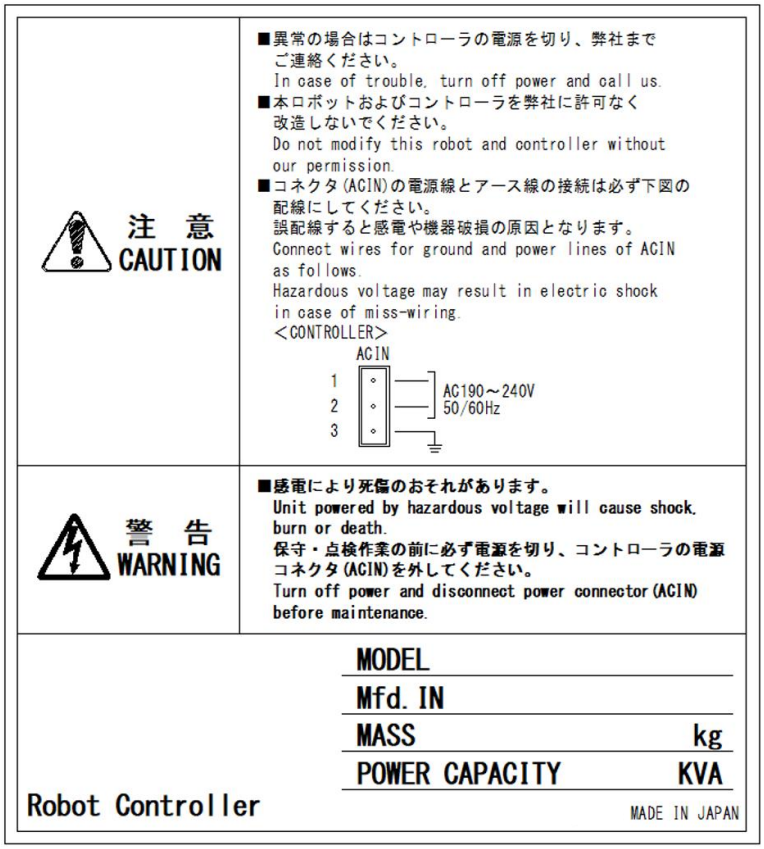


Figure 5.2 Nameplates

5.3.3 Modification

Do not disassemble or modify the controller without consent of CKD.

⚠ CAUTION

- Never replace or modify parts that are not stated in the instruction manual.
  Performance degradation, malfunction, and accidents may result.

5.4 Maintenance Tools

We recommend that you provide the following tools for maintenance.

- Phillips screwdrivers #1, #2, flat head screwdriver #2
- Nippers (to cut cable ties)

Recommended items other than tools

- Alcohol (for cleaning), cloth
- TSAssist program creation/teaching support software (option)

6 Maintenance of the Controller

The maintenance and inspection of the controller can be carried out only by qualified personnel.
Also, be sure to follow the laws and regulations as well as ordinances of the applicable country.

6.1 Precautions for Maintenance and Inspection

For maintenance and inspection of the controller, observe the following to ensure safety.

⚠ DANGER

- The servo power board, servo board, and switching power supplies remain charged when the power supply is turned on.
  Make sure to disconnect the power plug before work. Otherwise, electric shock may result.

⚠ CAUTION

- When removing the cover from the controller for maintenance and inspection, make sure to first disconnect the power plug from the controller.
  When connecting/disconnecting the power cable, turn off the breaker for the power supply as well.
- Do not touch the servo driver until two minutes passes after the power supply is disconnected. The large-size capacitor in the servo driver remains charged and could cause electric shock.
- Do not disconnect the connectors of the battery for any purpose other than replacing the battery. Files saved in the storage device will be deleted.

6.2 Controller Component Layout

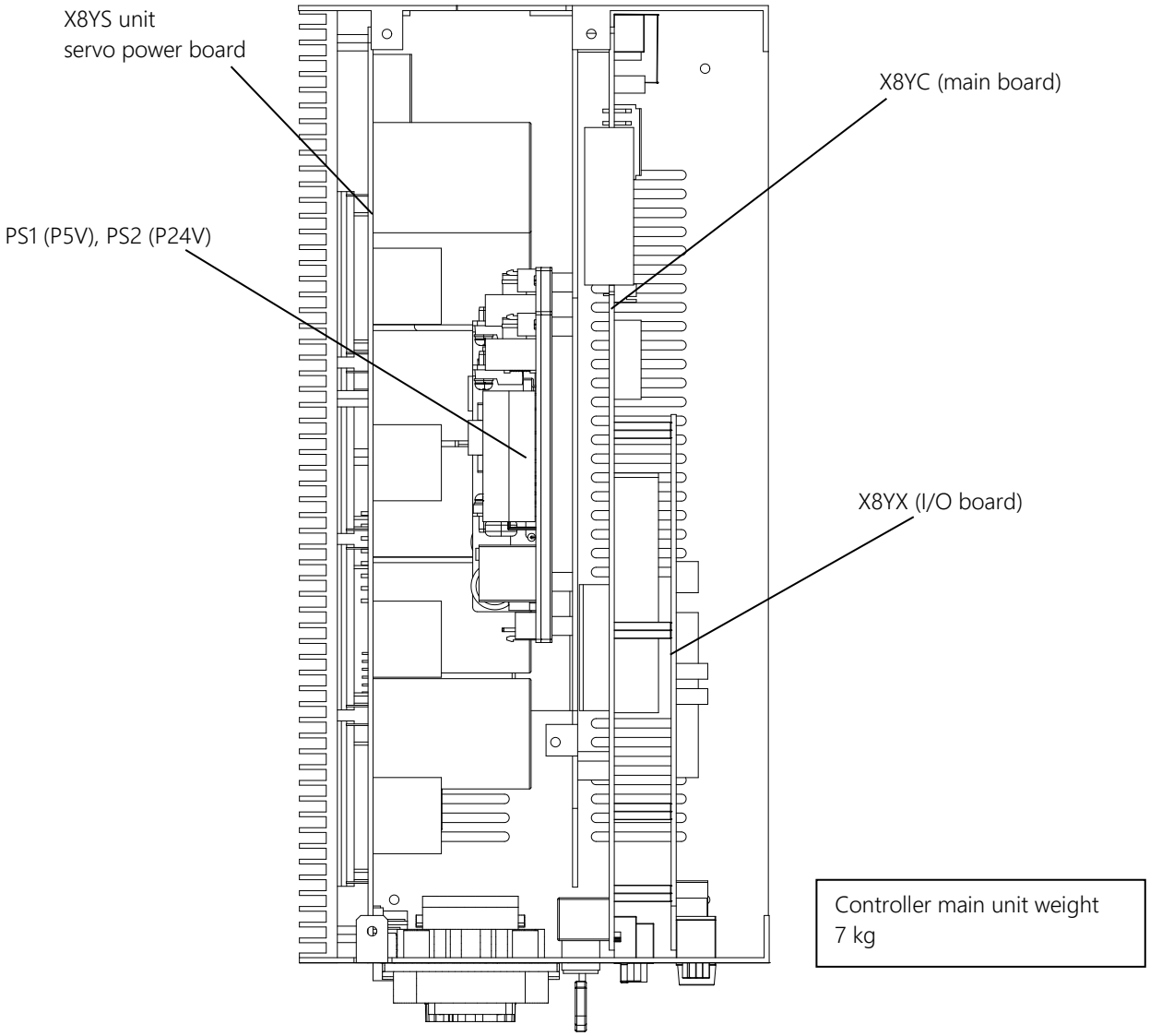


Figure 6.1 Controller component layout

Table 6.1 Controller components

Name	Description
PS1, PS2	PS1(P5V), PS2(P24V) output Switching power supply
X8YC*	Main control board
X8YX*	I/O Output board
X8YS*	Servo power supply module

6.3 Maintenance Procedure

6.3.1 Checking the vent holes of the controller

If the vent holes are blocked, the temperature inside the controller increases, resulting in malfunction. Check the following to ensure that the vent holes are not blocked.

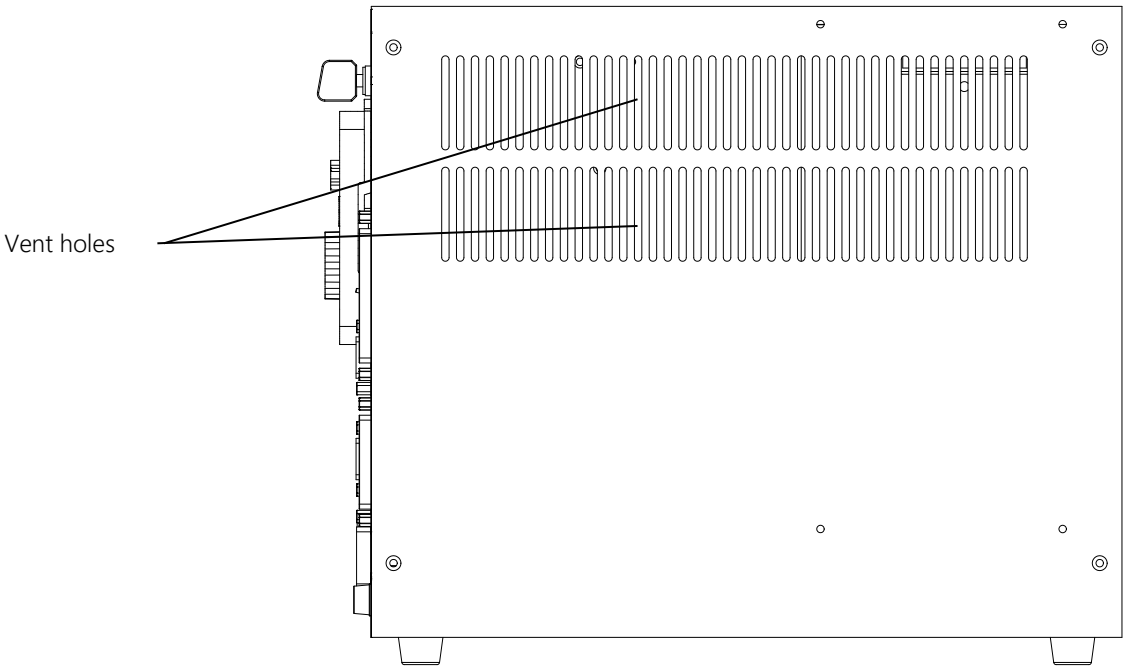


Figure 6.2 Rear view of the controller

1) Remove any object in front of the vent holes to ensure ventilation.
2) Ensure there is no substance stuck in the vent holes.
   Remove any substance stuck in the vent holes.

6.3.2 Safety device validation (TP1000, TP1000-6AX)

Confirm that the emergency stop switch and other switches of the teaching pendant and safety devices connected to the external operation input signals function normally.

1) Confirm that the emergency stop switch of the teaching pendant functions normally.
   a) Turn the key on the front of the controller to the TEACH position.
   b) Turn the emergency stop switch ① clockwise and confirm that it turns off.
   c) While holding the Enable switch ③ of the teaching pendant at its neutral position, press the Servo ON switch ② to turn on the servo. Confirm that the LED of the Servo ON switch ② turns on.
   d) Press the emergency stop switch ① of the teaching pendant and confirm that the servo is turned off. The LED of the Servo ON switch ② turns off.
      * In this case, confirm that the emergency stop switch ① is in the pressed state.
   e) Turn the emergency stop switch ① clockwise and confirm that it turns off.

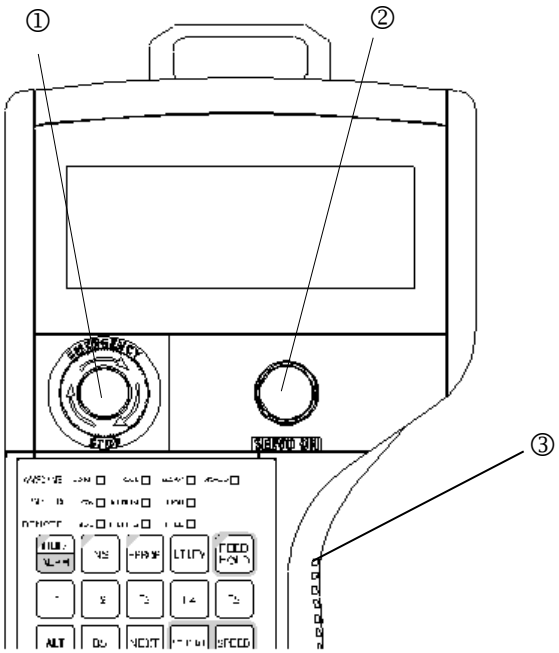


Figure 6.3 Emergency stop switch of the teaching pendant (TP1000)

2) Confirm that safety devices connected to the external operation input signals function normally.
   a) Connect the power plug to the power supply, turn on the servo, turn on the safety devices (external emergency stop switch, beam type safety device, foot switch, etc.) connected to the "emergency stop" external operation input signals, and confirm that the servo can turn off.
   b) Confirm that safety devices connected to the "low speed instruction" external operation input signals turn on and function normally.

6.3.3 Safety device validation (TP3000)

Confirm that the emergency stop switch and other switches of the teaching pendant and safety devices connected to the external operation input signals function normally.

1) Confirm that the emergency stop switch of the teaching pendant functions normally.
   a) Turn the key on the front of the controller to the TEACH position.
   b) Turn the emergency stop switch ① clockwise and confirm that it turns off.
   c) While holding the Enable switch ③ of the teaching pendant at its neutral position, press the Servo ON switch ② to turn on the servo. Confirm that the LED of the Servo ON switch ② turns on.
   d) Press the emergency stop switch ① of the teaching pendant and confirm that the servo is turned off.
      The LED of the Servo ON switch ② turns off.
      * In this case, confirm that the emergency stop switch ① is in the pressed state.
   e) Turn the emergency stop switch ① clockwise and confirm that it turns off.

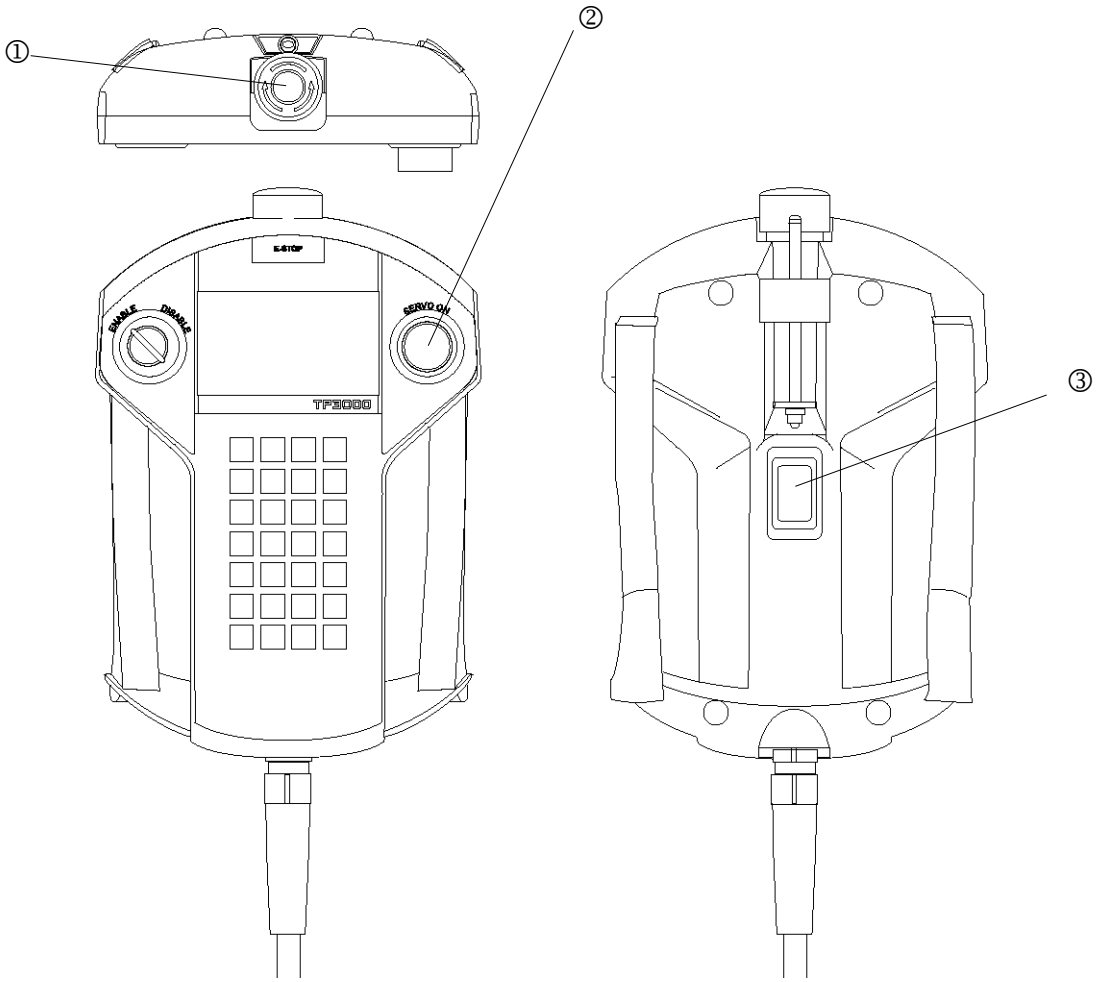


Figure 6.4 Emergency stop switch of the teaching pendant (TP3000)

2) Confirm that safety devices connected to the external operation input signals function normally.
   a) Connect the power plug to the power supply, turn on the servo, turn on the safety devices (external emergency stop switch, beam type safety device, foot switch, etc.) connected to the "emergency stop" external operation input signals, and confirm that the servo can turn off.

b) Confirm that safety devices connected to the "low speed instruction" external operation input signals function normally.

6.3.4 Battery replacement

⚠ DANGER

- When replacing the battery, observe the customer-defined rules.
  Do not fire, short-circuit, charge, disassemble, or heat the battery.
  Otherwise, liquid leakage or blowout may result.

The memory installed on the X8YC board of the controller is backed up by the lithium battery to retain data in the memory.
Replace the battery every five years. The lithium battery has a certain lifespan. Using beyond the lifespan causes battery voltage drop below the level required for retaining data in the memory. In this case, data will be lost and malfunction may result due to liquid leakage.

Replace the battery if any of the following alarms occurs.
"MAIN Battery alarm" (Alarm code 1-145)

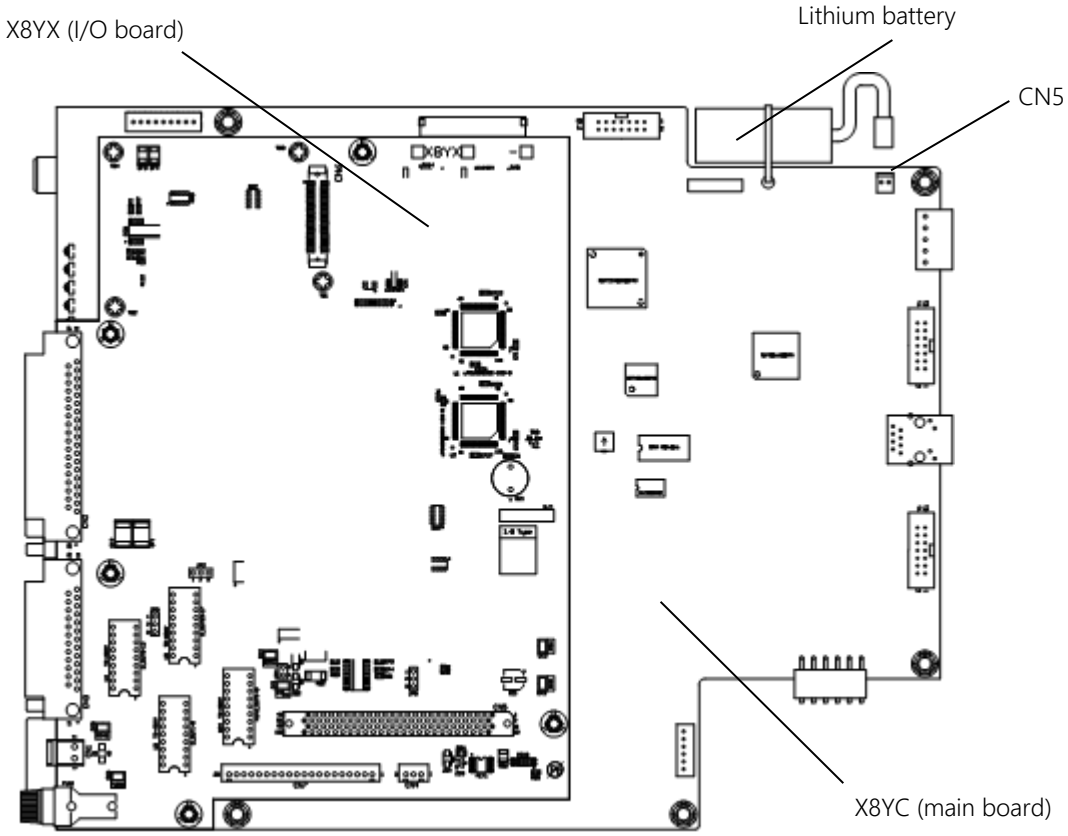


Figure 6.5 Lithium battery location

Table 6.2 Battery replacement

Battery type	Manufacturer	Battery life
ER6C WK27	HITACHI MAXELL	10 years (normal room temperature)

Note: The battery life is 10 years at normal temperature, but it varies depending on the operating temperature, humidity, and other environmental factors. We recommend replacing the battery every five years.
The dedicated battery specified in the above table must be used. Contact us to purchase the battery.

Replacement procedure

1) If the controller is to be left without the battery for one minute or more, save the programs and parameters from the memory to the computer in advance. Data in the memory will be lost.
2) Turn off the breaker for the power supply, and remove the power plug from the power supply.
3) Remove the ACIN connector from the controller.
4) Prepare a new battery, remove the eight flat head screws (M3 × 6) fixing the cover, and remove the cover from the unit.
   (* Mount the cover firmly by tightening the screws after the battery is replaced.)

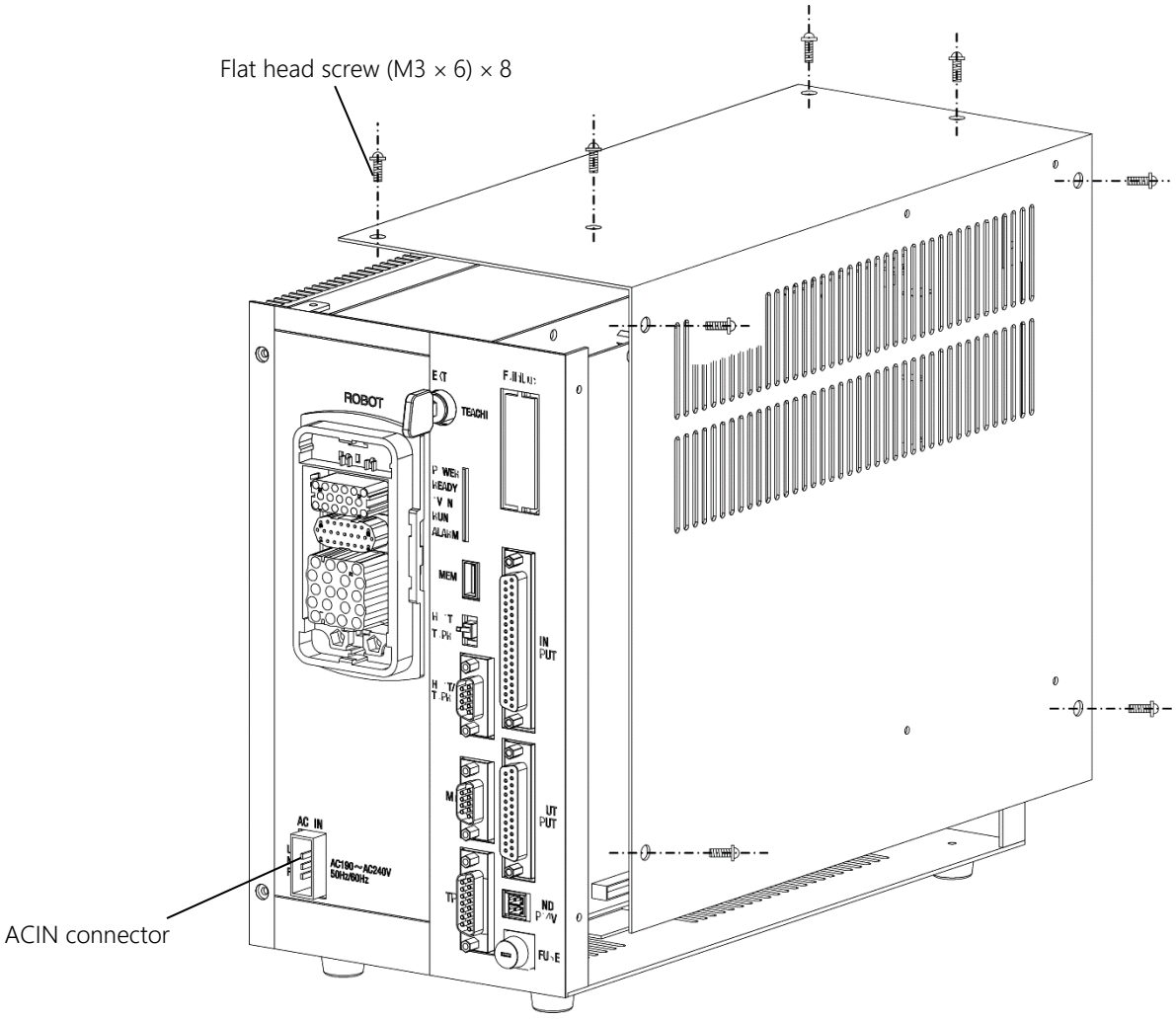


Figure 6.6 Removing the cover

5) Cut the cable ties that hold the battery by nippers, and remove the battery.
   (Refer to Figure 6.5 for the battery position.)
6) Remove the battery connector from CN5 of the X8YC board. Immediately connect a new battery connector to CN5. (If the controller is left with battery disconnected for one minute or more, data in the memory will be lost.)
   The lithium battery discharges even when it is not used.
   Use a lithium battery purchased within three years and has been stored at normal temperature.
7) Fix the battery connected to CN5 with cable ties.
8) Mount the cover with the eight flat head screws (M3 × 6).
9) If the controller is left without battery for one minute or more, connect the controller's power plug to the power supply, and load the programs from the USB flash drive or the computer on which TS Assist (option) is installed.
   If the controller detects a battery voltage drop alarm before the five years of lifespan passes, replace the battery immediately.

6.3.5 Switching power supply replacement

⚠ DANGER

- Make sure to turn off the power supply before work.
- The PS1 and PS2 switching power supplies have the same mounting pitch. Do not set them upside-down or left-right inverted, or do not switch their positions.

The lifespan of the switching power supplies (5 VDC, 24 VDC) used for the controller depends on the use condition. Since the aluminum electrolytic capacitor is used, the lifespan will be shorter with the higher load current, longer operating hours, and higher ambient temperatures.
The lifespan of the power supply may extend from 5 years to 10 years depending on the use condition, but we recommend replacing the power supply every five years as preventive maintenance.

Replacement Procedure

1) Turn off the breaker for the power supply, and remove the power plug from the power supply.
2) Remove the ACIN connector from the controller.
3) Remove the key from the controller.
4) Using the Phillips screwdriver (#2), remove the flat head screws (M3 × 6 × 8 pcs) fixing the cover, and remove the cover from the unit. (*Mount the cover firmly by tightening the screws after the switching power supply is replaced.)

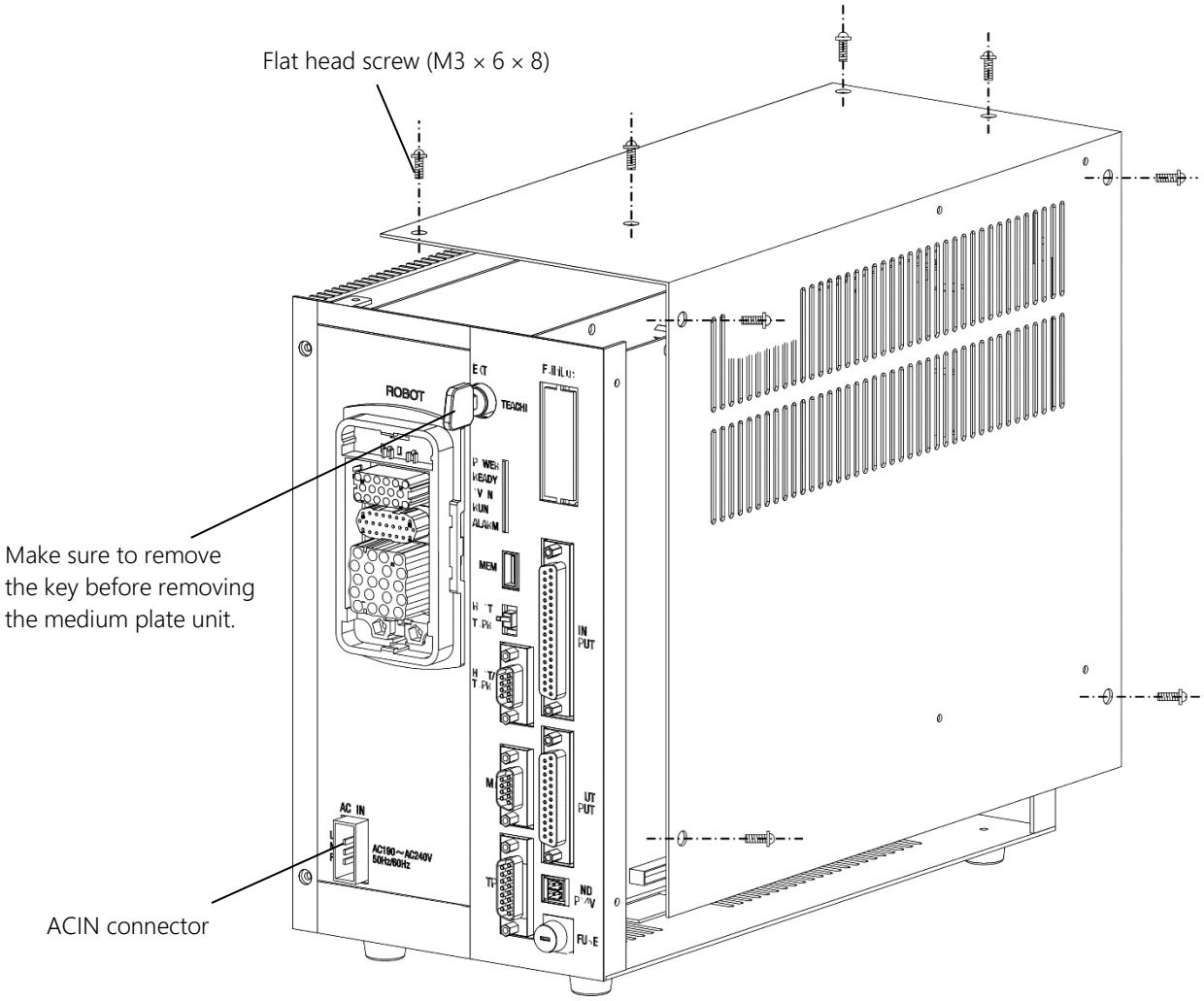


Figure 6.7 Removing the cover

5) Disconnect the DC cable (blue and red), SVIF cable (blue), and encoder cable (blue) from the X8YC (main) board, and the hand I/O cable (blue) and brake cable (blue) from the X8YX (I/O) board.
6) Disconnect the cables (red × 1, blue × 1, black × 2) from PS1 and PS2.

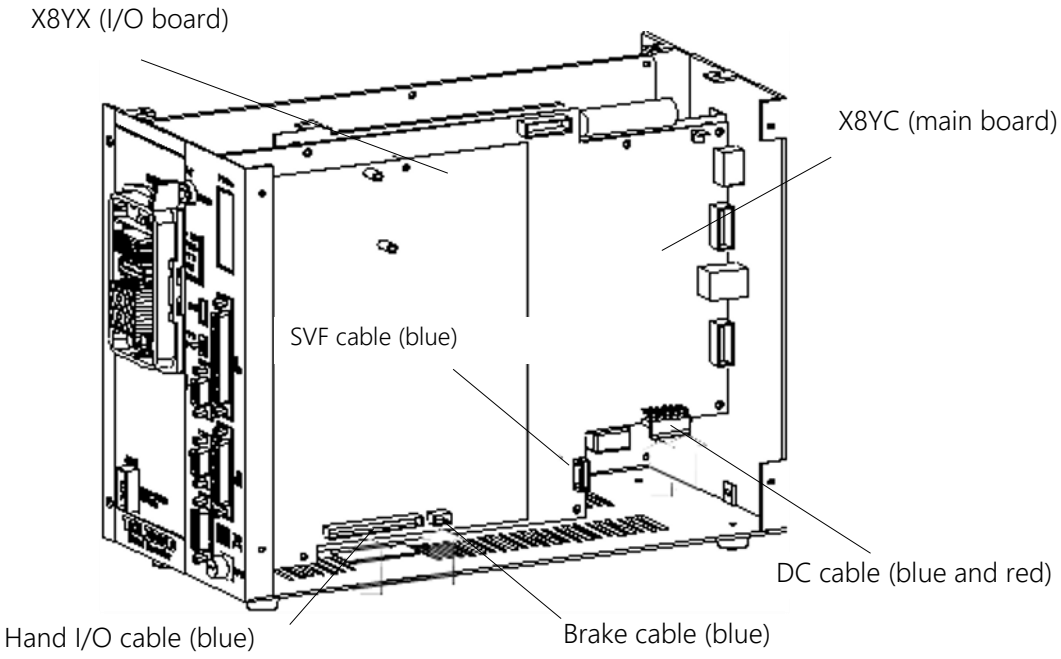


Figure 6.8 Inner side of the controller

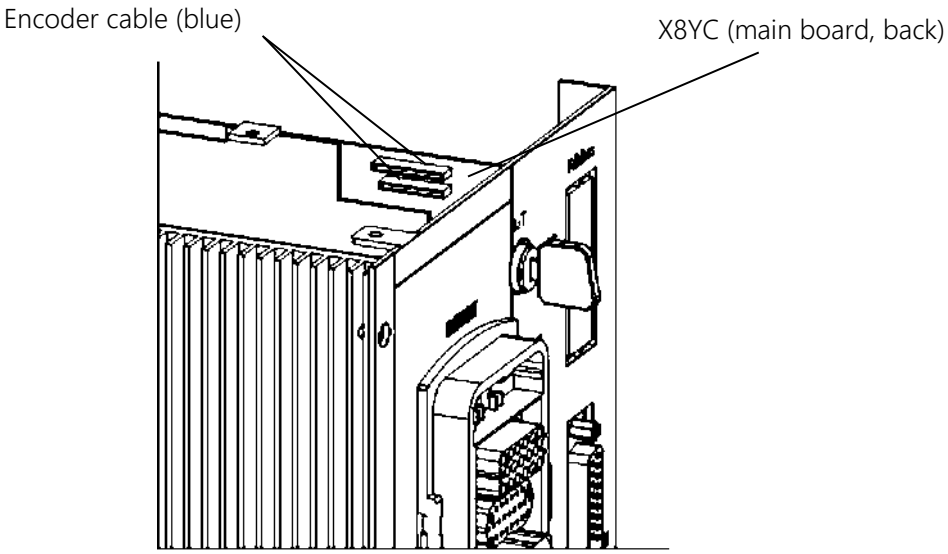


Figure 6.9 Inner front of the controller

7) Remove the flat head screws (M3 × 6 × 1 pcs) that fasten the intermediate plate unit.
Pull out the intermediate plate unit toward the rear side of the controller.
When removing the intermediate plate unit, be sure to remove the key.

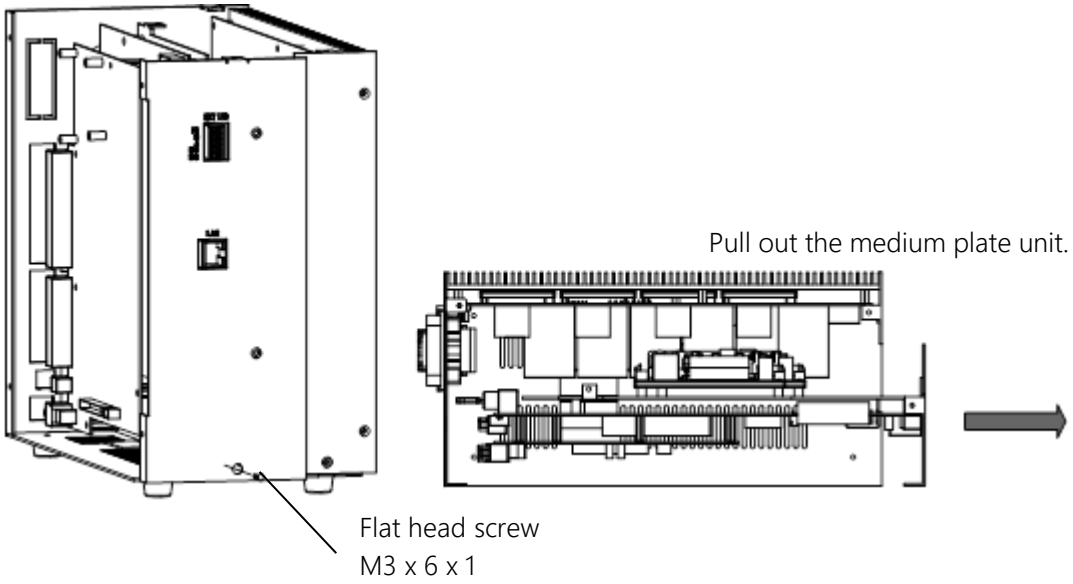


Figure 6.10 Removing the medium plate unit

8) Remove four Sems screws (M3 × 8) from each of the switching power supplies (PS1 and PS2), and remove the switching power supplies from the medium plate unit.

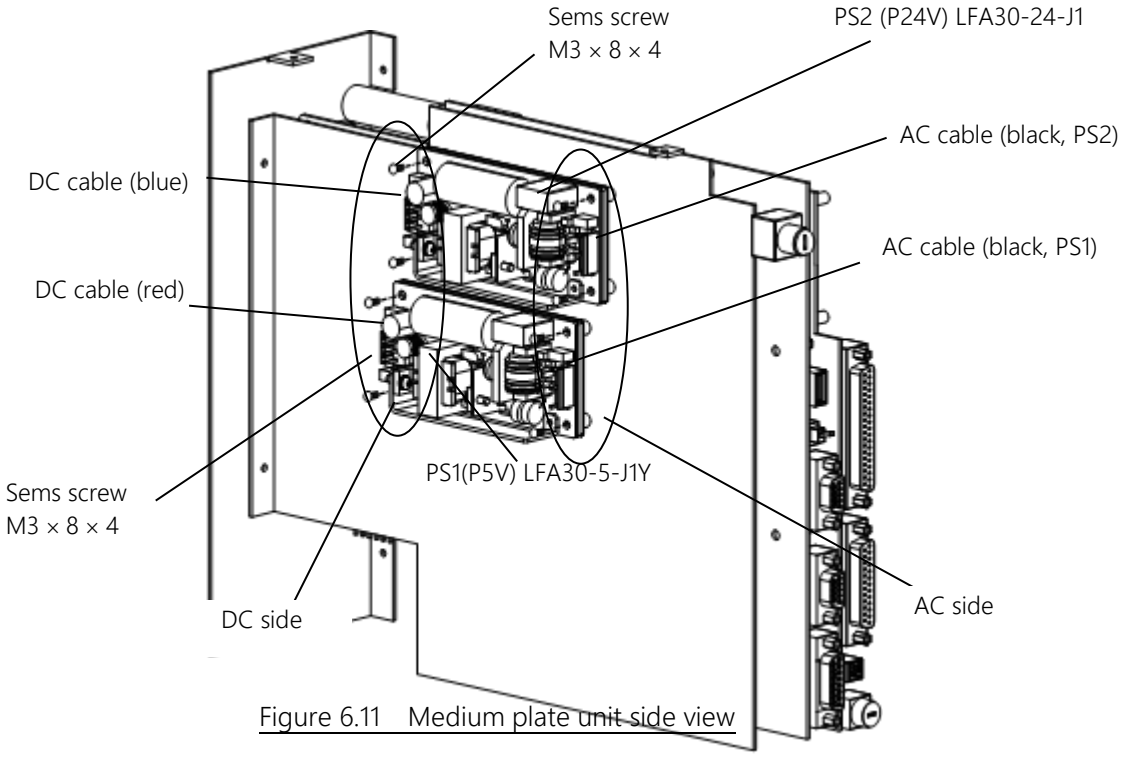


Figure 6.11 Medium plate unit side view

9) Mount each switching power supply with four Sems screws (M3 × 8) to the unit.
   Note: The PS1 and PS2 switching power supplies have the same mounting pitch. Do not set them upside-down or left-right inverted, or do not switch their positions.
10) Connect cables to PS1 and PS2.
   Note: Connect the DC cable (red) to the DC side of the PS1 and the AC cable (black, PS1) to the AC side of PS1, and connect the DC cable (blue) to the DC side of PS2 and the AC cable (black, PS2) to the AC side of PS2.
11) Insert the pulled-out medium plate unit to the controller and mount it with the flat head screw (M3 × 6).
12) Connect the DC cable (blue and red), SVIF cable (blue), and encoder cable (blue) to the X8YC (main) board, and the hand I/O cable (blue) and brake cable (blue) to the X8YX (I/O) board.
13) Mount the cover with the eight flat head screws (M3 × 6).

6.3.6 Fuse replacement (X8YX board)

The fuse installed on the front of the controller blows out when the current higher than the specification value flows in the I/O part. If the "I/O Fuse Broken" (8-273) alarm is displayed, the fuse has been blown out. Replace the fuse.
If the fuse of the output module blows out, thoroughly investigate which circuit was in failure, and remove the cause before replacing the fuse.

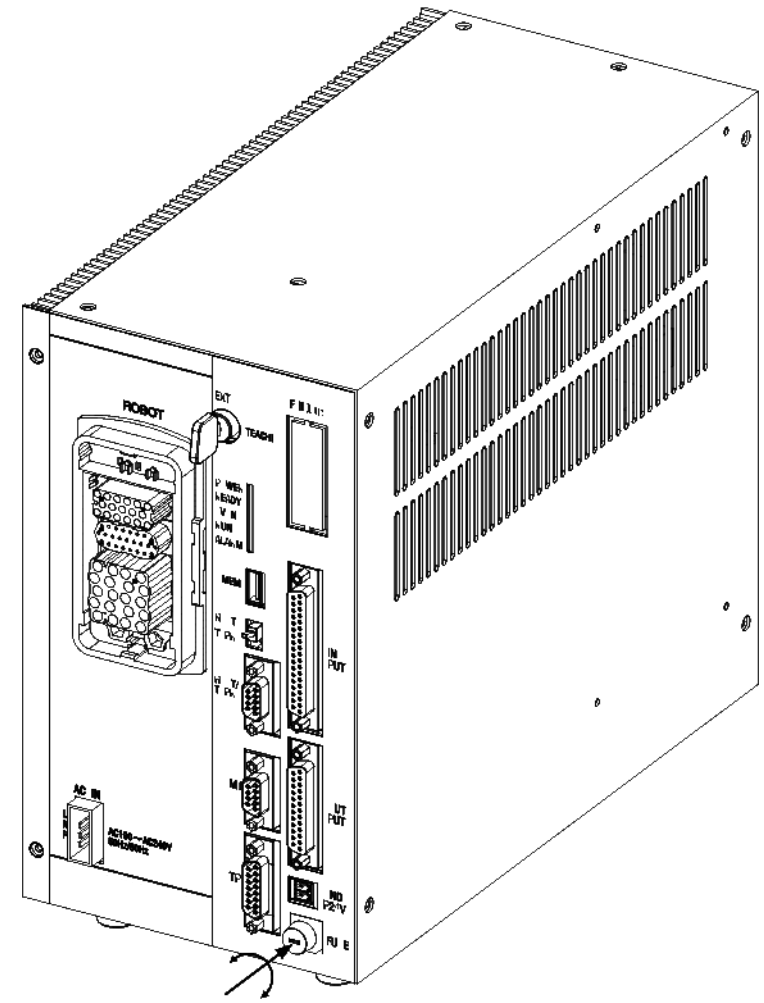


Figure 6.12 Fuse replacement

Table 6.3 Fuse replacement table

Fuse type	Manufacturer
51NM030H	PICO

Replacement procedure

1) Disconnect the power plug from the power supply of the controller main unit.
2) Use the flat head screwdriver (#2) to remove the fuse holder in the above figure. (Hold down and turn the holder 90 degrees counterclockwise to unlock it.)
3) Remove the fuse, and attach a new fuse to the fuse holder.
4) Mount the fuse holder. (Hold down and turn the holder 90 degrees clockwise to lock it.)
5) Connect the power plug of the controller main unit to the power supply, and confirm that no error occurs.

6.3.7 Output part IC replacement (X8YX board)

A transistor output IC of the X8YX board will be damaged if the current higher than the specification value flows in the output part. In this case, replace the IC. Before replacement, thoroughly investigate which circuit was in failure, and remove the cause.
The following figure shows the output ICs and corresponding output signals.

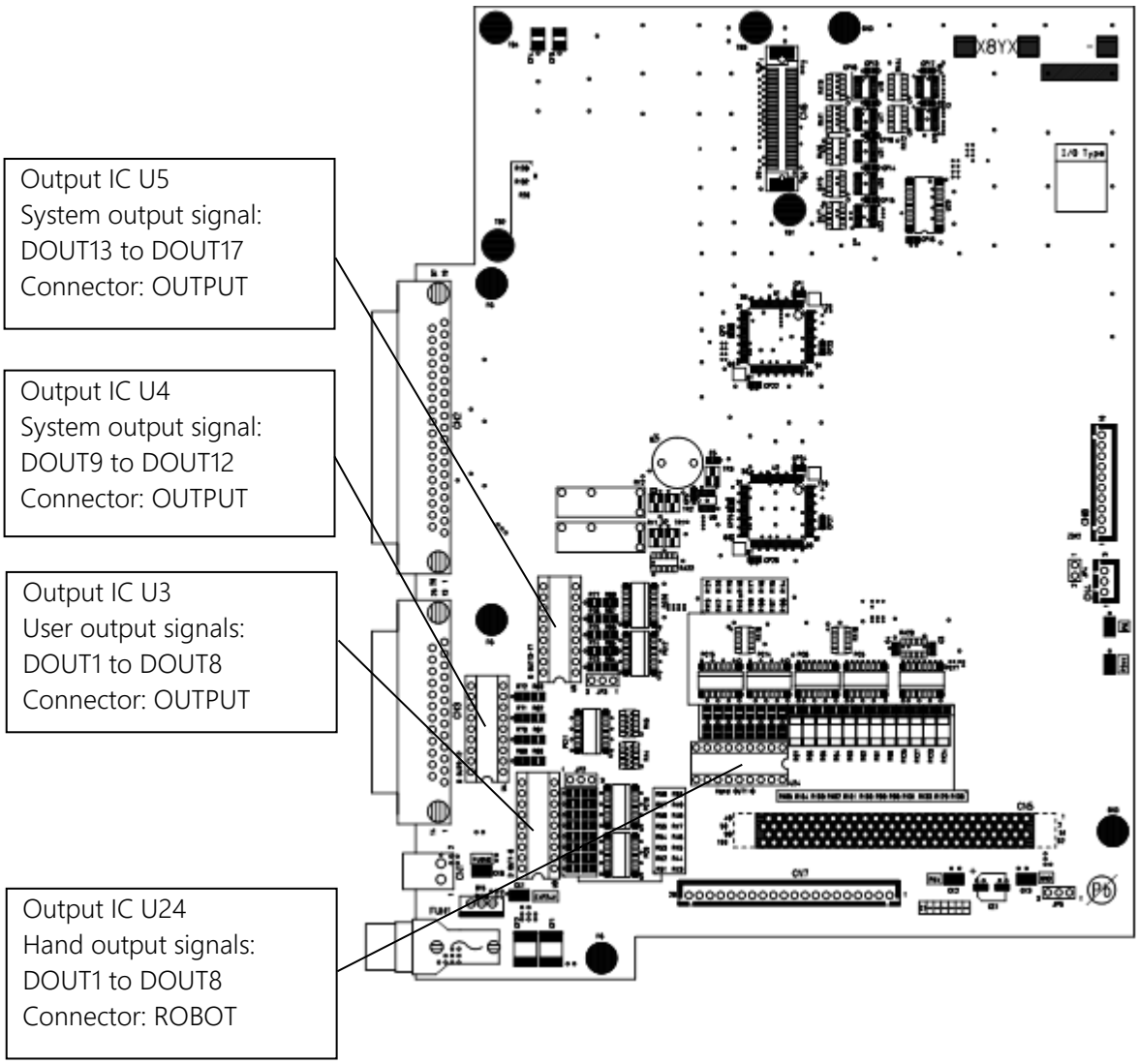


Figure 6.13 I/O board (X8YX)

The transistor output ICs are available in two types. For details, refer to the following table.

Table 6.4 Transistor output IC

	Output type	Transistor output IC type	Manufacturer
①	Type-N	TD62084APG	TOSHIBA
②	Type-P	M54562WP	MITSUBISHI ELECTRIC

Replacement procedure

1) Turn off the breaker for the power supply.
2) Remove the ACIN connector from the controller.
3) Remove the eight flat head screws (M3 × 6) fixing the cover, and remove the cover from the unit.
   (* Mount the cover firmly by tightening the screws after replacement.)

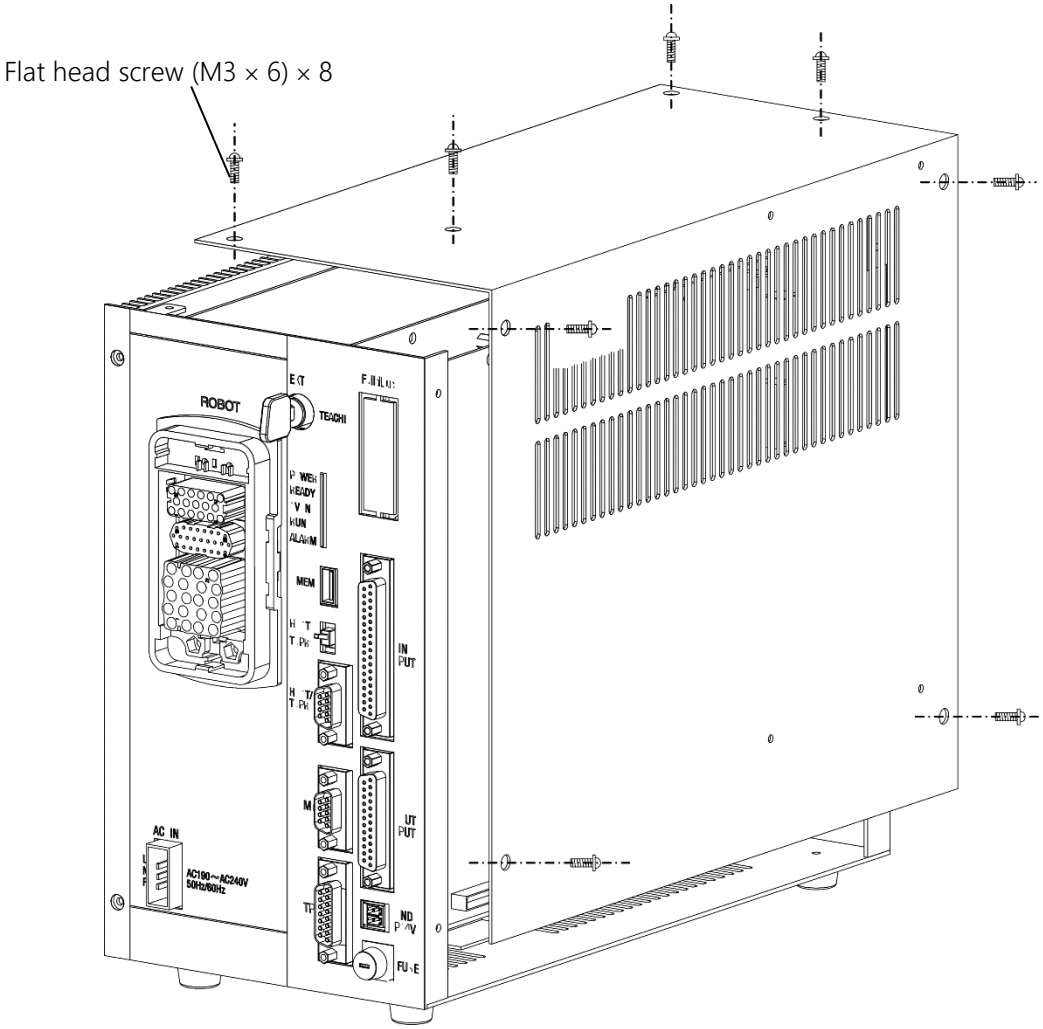


Figure 6.14 Removing the cover

4) Disconnect the hand I/O cable (blue) and brake cable (blue) from the X8YX (I/O) board.
5) Remove the five Sems screws (M3 × 8) fixing the X8YX board, and detach the X8YX board.

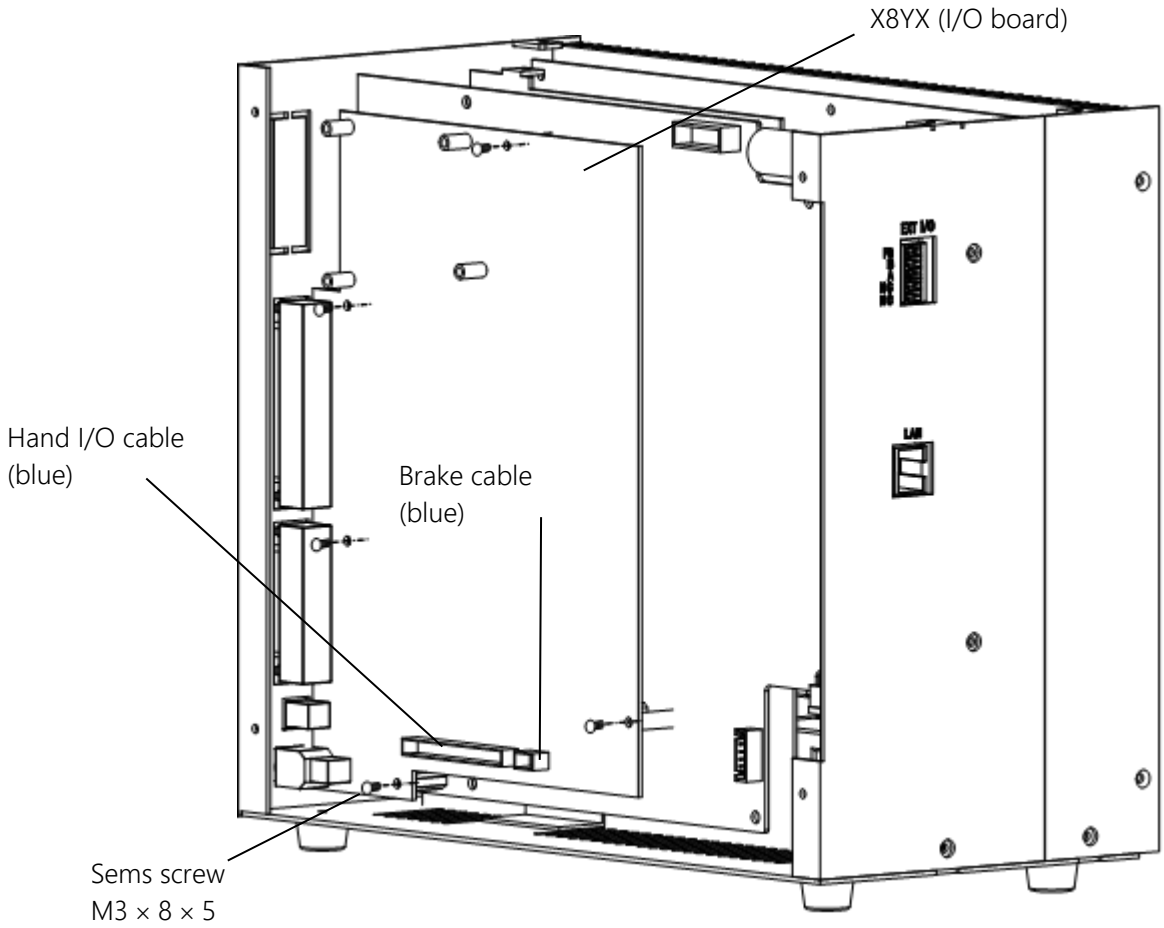


Figure 6.15 Detaching the X8YX board

6) Remove a transistor output IC from the socket as shown in Figure 6.13.
7) Connect a new transistor output IC to the socket.
   Note: Ensure that the model number of the transistor output IC is correct, and connect it in the correct orientation.
8) Mount the X8YX board to the unit with the five Sems screws (M3 × 8).
9) Connect the hand I/O cable (blue) and brake cable (blue) to the X8YX (I/O) board, and mount the cover to the unit with the eight flat head screws (M3 × 6).
10) Connect the power plug of the controller main unit.

7 Replacement Parts for Maintenance

7.1 Precautions Regarding Replacement Parts

⚠ CAUTION

- All replacement parts in the list are specially-manufactured products. Please contact us for ordering/purchasing these parts.
- Replacement of these parts must be carried out by our service engineers.
  If these parts are replaced by customers, CKD is not liable for any resulting failure and accident.

7.2 Replacement Parts List

No.	Name of product	Model	Unit code	Manufacturer	Use	Remarks
1	PS1 (switching power supply)	LFA30F-5-J1Y		COSEL	1	P5V power supply
2	PS2 (switching power supply)	LFA30F-24-J1			1	P24V power supply
3	Lithium battery	ER6C WK27		HITACHI MAXELL	1	X8YC board
4	Fuse	51NM030H		PICO	1	X8YX board
5	Printed board (main control)	X8YCB	Y610A90B0	SHIBAURA MACHINE	1	
6	Printed board (servo power supply)	X8YSB	Y610A9040	SHIBAURA MACHINE	1	*1
		X8YSC	Y610A9050		1	*2
		X8YSE	Y610A9090		1	*3
7	Printed board (I/O board)	X8YXA	Y610A9020	SHIBAURA MACHINE	1	Type-N
		X8YXB	Y610A9030		1	Type-P
8	Transistor output IC	TD62084APG		TOSHIBA	4	Type-N
		M54562WP		MITSUBISHI ELECTRIC	4	Type-P
9	Teaching pendant	TP1000	Y610A2600	SHIBAURA MACHINE	1	5 m cable supplied
		TP3000	Y610A43A0		1	5 m cable supplied High performance TP
10	System disk	TS3000SYS	Y610A3HC0	SHIBAURA MACHINE	1	CD-ROM

*1 : KHL-500 to KHL-700

*2 : KH-L300, KHL-400

*3 : KHE-400

7.3 List of Accessories

The whole set of accessories can be purchased with the unit code Y610A91B0.

No.	Name of product	Model	Manufacturer	Use	Remarks
1	I/C jumper connector	M067817	SHIBAURA MACHINE	1	For INPUT
2	TP jumper connector	M067819		1	For TP
3	Connector	XM2S-2511	OMRON	2	Shell
4		03JFAT-SAYGF-I	Japan Solderless Terminal MFG	1	For ACIN
5		J-FAT-OT		1	ACIN mounting bracket
6		XM3A-2521	OMRON	2	For OUTPUT, HAND
7		SL-4000-CP-5PGY	SATO PARTS	1	For extended I/O
8		SL-4000-CP-2PGY		1	For EXT24V
9	Fuse	51NM030H	PICO	1	EXT24V fuse
10	Switch	140007050010	NIDEC COPAL ELECTRONICS	1	For mode key