TVL Series

Industrial Robot

Robot controller TSL3100
Robot controller TSL3100E
Robot controller TS3100

INSTRUCTION MANUAL

TRANSPORTATION AND INSTALLATION MANUAL

Notice

1. Make sure that this instruction manual is delivered to the final user of Toshiba Machine's industrial robot.
2. Before operating the industrial robot, read through and completely understand this manual.
3. After reading through this manual, keep it nearby for future reference.

April 2014

TOSHIBA MACHINE CO., LTD.

This manual is applicable to the following robots.

TVL Series : TVL500,TVL700

The information contained in this manual is subject to change without notice to effect improvements.

Preface

This manual describes the basic specifications of the industrial robot and controller, and how to unpack and install them. Specifically, it describes how to unpack the shipment containing the equipment, how to install the equipment, how to connect wiring and air piping, and how to attach tools. Be sure to look through this manual before unpacking the shipment.

Before beginning the work according to this manual, read through the Safety Manual so that you can understand the safety measures.

This manual is divided into the following five (5) sections:

Section 1	Specifications This section describes the basic specifications and names of respective units of the robot and controller.
Section 2	Transportation This section describes how to remove the robot and controller from their boxes and how to transport them to the installation site. This section also discusses how to temporarily store the equipment after unpacking the shipment.
Section 3 to 6	Installation This section discusses the equipment installation environment, space requirements, and how to install the equipment.
Section 7 to 9	System Connections This section describes how to connect the robot, controller and peripheral equipment.
Section 10 to 13	Tool Interface This section describes how to connect the tool to the robot arm and how to connect pipes and wires to the tool. This section also discusses maximum permissible loads of the tool.

Precautions on Safety

Important information on the robot and controller is noted in the instruction manual to prevent injury to the user and persons nearby, prevent damage to assets and to ensure correct use.
Make sure that the following details (indications and symbols) are well understood before reading this manual. Always observe the information that is noted.

[Explanation of indications]

Indication	Meaning of indication
 **DANGER**	This means that "incorrect handling will lead to fatalities or major injuries".
 **WARNING**	This means that "incorrect handling will lead to fatalities or serious injuries."
 **CAUTION**	This means that "incorrect handling may lead to personal injuries *1) or physical damage *2)".

*1) Injuries refer to injuries, burns and electric shocks, etc., which do not require hospitalization or long term treatment.

*2) Physical damage refers to major fires due to destruction of assets or resources.

[Explanation of symbols]

Symbol	Meaning of symbol
	This means that the action is prohibited (must not be done). The details of the actions actually prohibited are indicated with pictures or words in or near the symbol.
	This means that the action is mandatory (must be done). The details of the actions that must be done are indicated with pictures or words in or near the symbol.
	This means danger and caution. The details of the actual caution are indicated with pictures or words in or near the symbol.

CAUTION

- Always read through the Safety Manual provided separately before starting actual work to ensure safety work covering from the robot installation to operation.

[Installation and transportation]

Always observe the following items to safely use the robot.

DANGER	
Prohibited	• DO NOT install or operate if any parts are damaged or missing. Doing so could lead to electric shocks, fires or faults. • DO NOT install the robot where it may be subject to fluids such as water. Doing so could lead to electric shocks, fires or faults. • Do not place the robot near combustible matters. Doing so could lead to fires if the matter ignites due to a fault, etc.
Mandatory	• Always secure the robot with the attached clamps before transporting it. Failure to do so could lead to injuries if the arm moves when the robot is suspended. • Wire the robot after installation. Wiring the robot before installation could lead to electric shocks or injuries. • Always use the power voltage and power capacity designated by Toshiba Machine. Failure to do so could lead to device faults or fires. • Always use the designated power cable. Using a cable other than that designated could lead to fires or faults.
Always ground	• Completely connect the grounding cable. Failure to do so could lead to electric shocks or fires if a fault or fault current occurs. Noise could lead to malfunction. Also, it could cause mis-operation by noise.

CAUTION	
 Prohibited	• NEVER lift the robot by the cable duct or arm 2. Doing so will apply an excessive force on the robot's mechanism section and could lead to faults. • For the controller, secure the ample space for air vent. Heating of controller could lead to malfunction.
 Mandatory	• When lifting the robot, lift it up slowly. The robot will tilt slightly, so lifting it up suddenly could be hazardous. • When storing the robot, secure it to the base. The robot will be unstable if just set down, and it could tilt over.

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1. Specifications

1.1. Equipment Configuration Diagrams

The TVL series robots are compatible with the TSL3100 and TS3100 robot controllers. The equipment configuration drawings of these robot controllers are shown in Fig. 1.1 and Fig. 1.2, respectively.

1.1.1. Equipment Configuration Drawing (For the TSL3100)

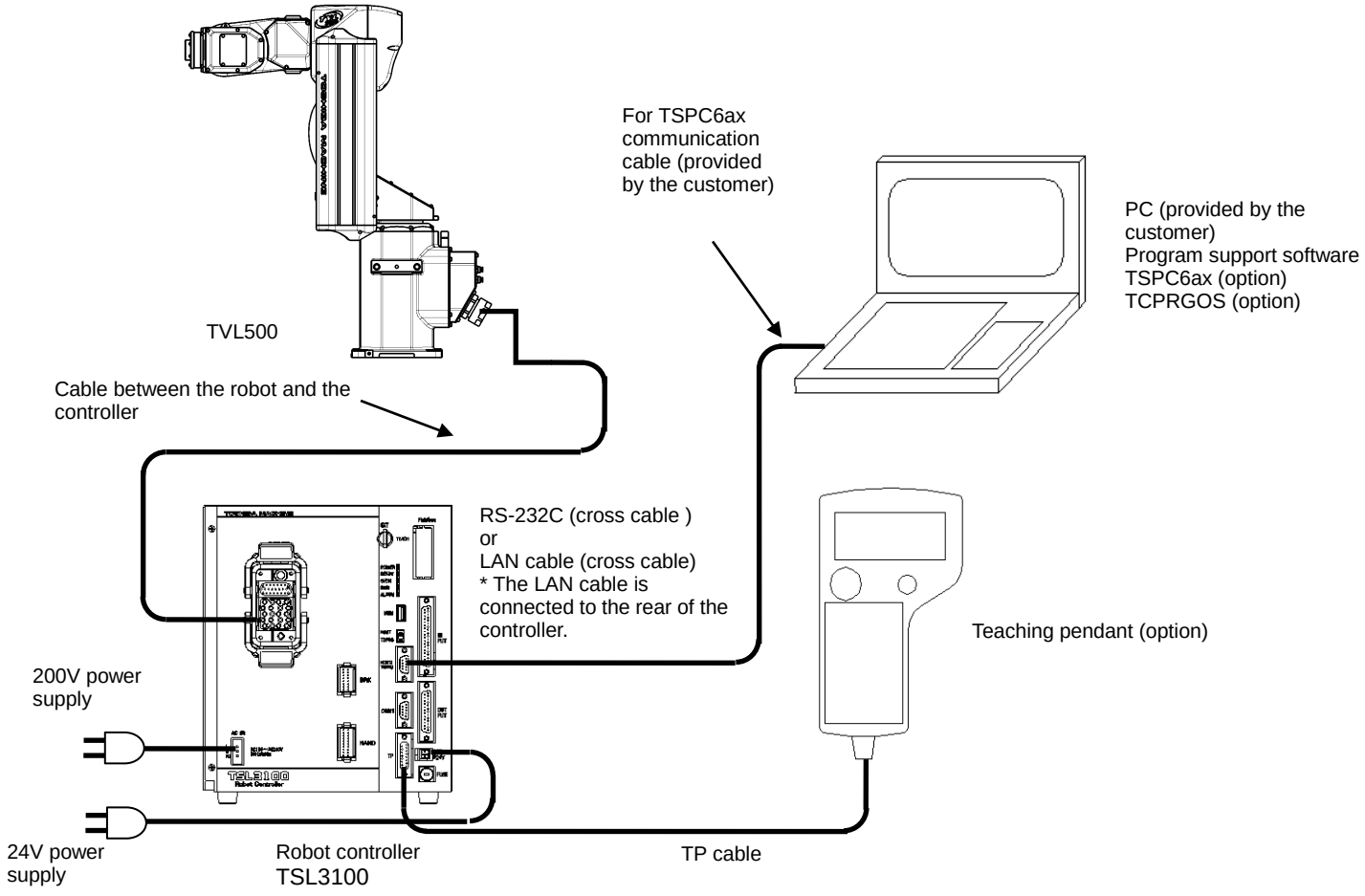


Fig. 1.1 Equipment Configuration (TSL3100)

As for the connection method of power supply 200V, see "7.1.2 Connecting the Power Cable "ACIN"". Again, for the connection method of power supply 24V, see "7.1.5 Connecting Power Supply Cable for External Input/Output".

1.1.2. Equipment Configuration Drawing (For the TSL3100E)

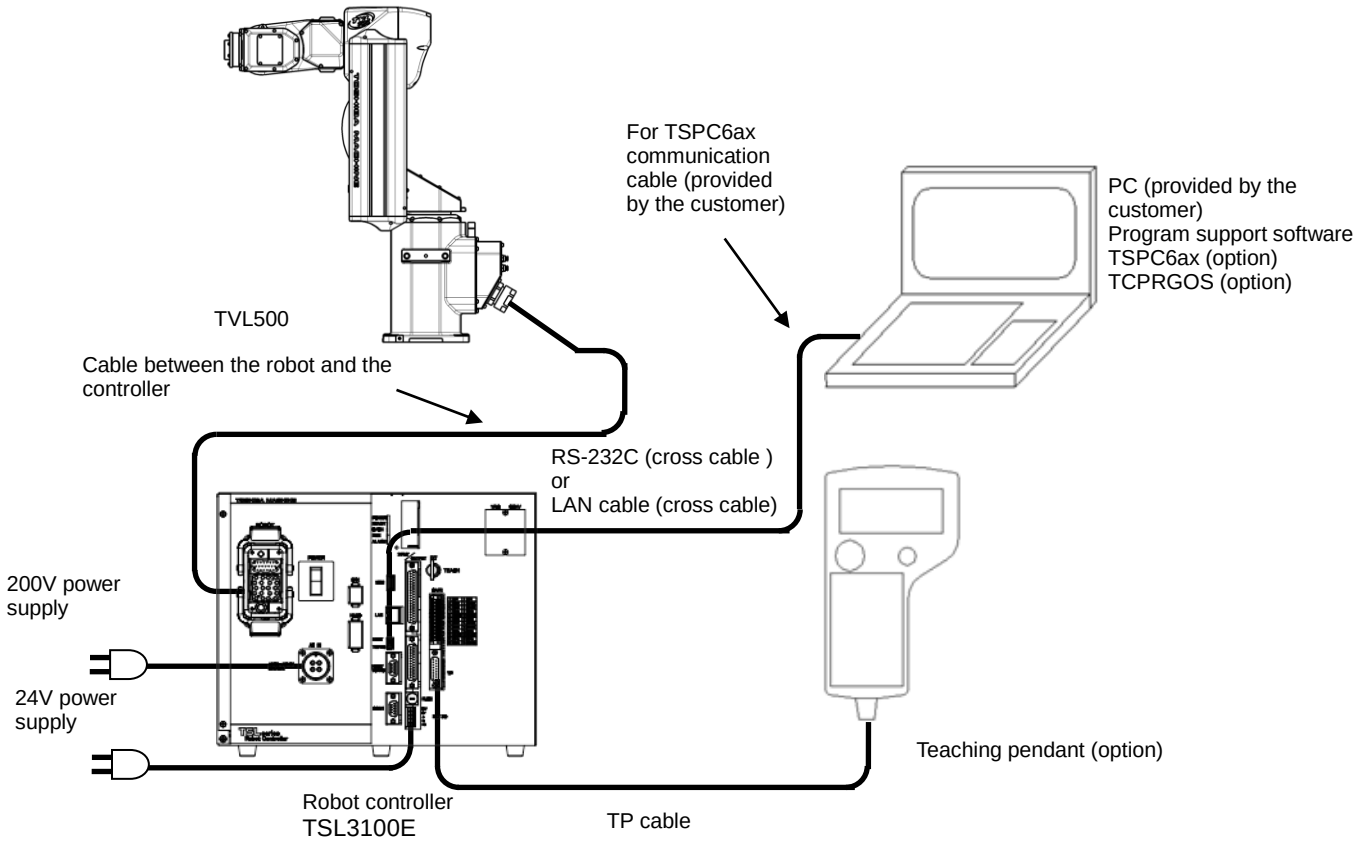


Fig. 1.2 Equipment Configuration (TSL3100E)

As for the connection method of power supply 200V, see "8.1.2 Connecting the Power Cable "ACIN"". Again, for the connection method of power supply 24V, see "8.1.5 Connecting Power Supply Cable for External Input/Output".

1.1.3. Equipment Configuration Drawing (For the TS3100)

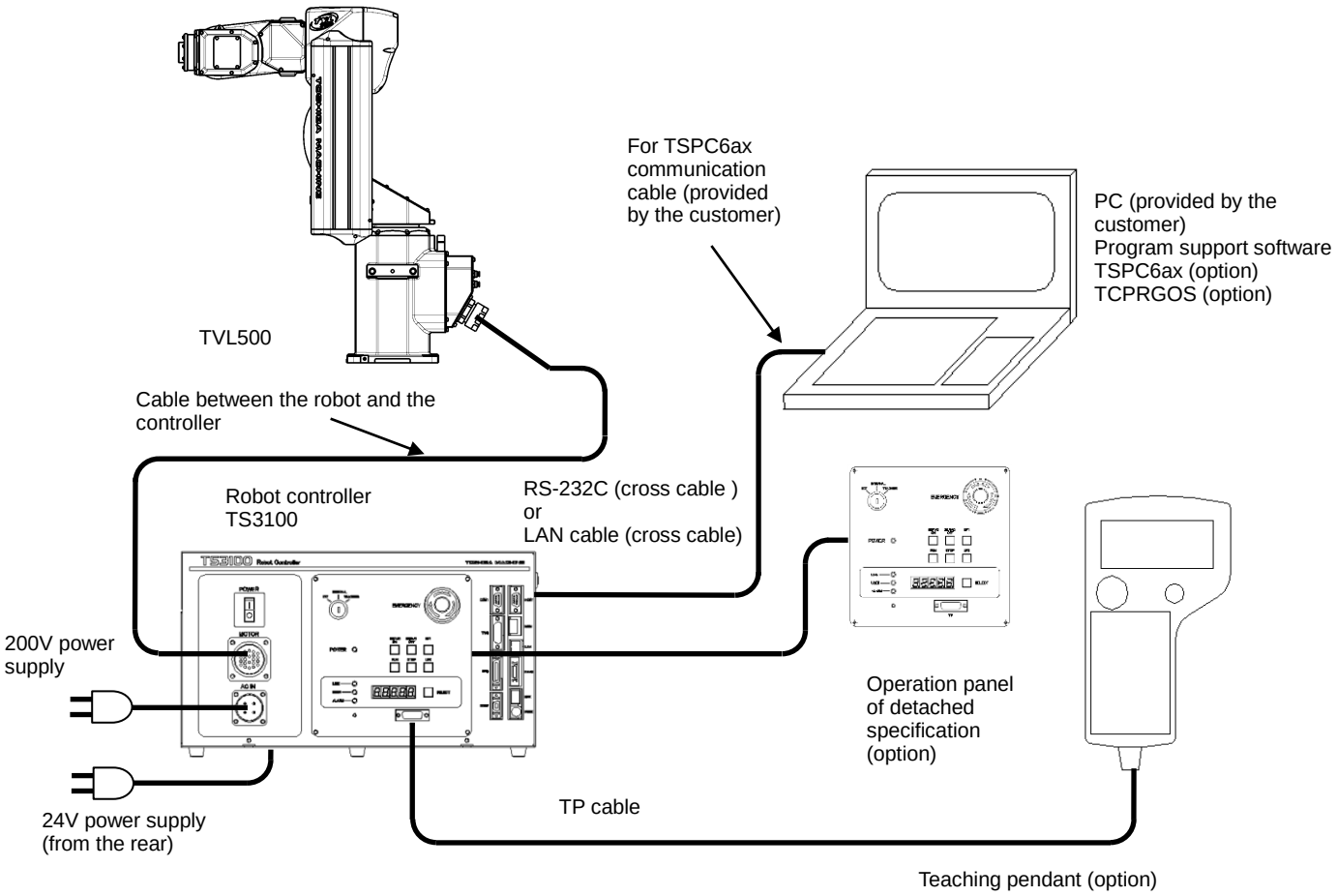


Fig. 1.3 Equipment Configuration (TS3100)

As for the connection method of power supply 200V, see "9.1.2 Connecting the Power Cable "ACIN"". Again, for the connection method of power supply 24V, see "9.1.5 Connecting Power Supply Cable for External Input/Output".

1.2. Name of Each Part

Fig. 1.4 shows the name of each part of the robot of the TVL series.

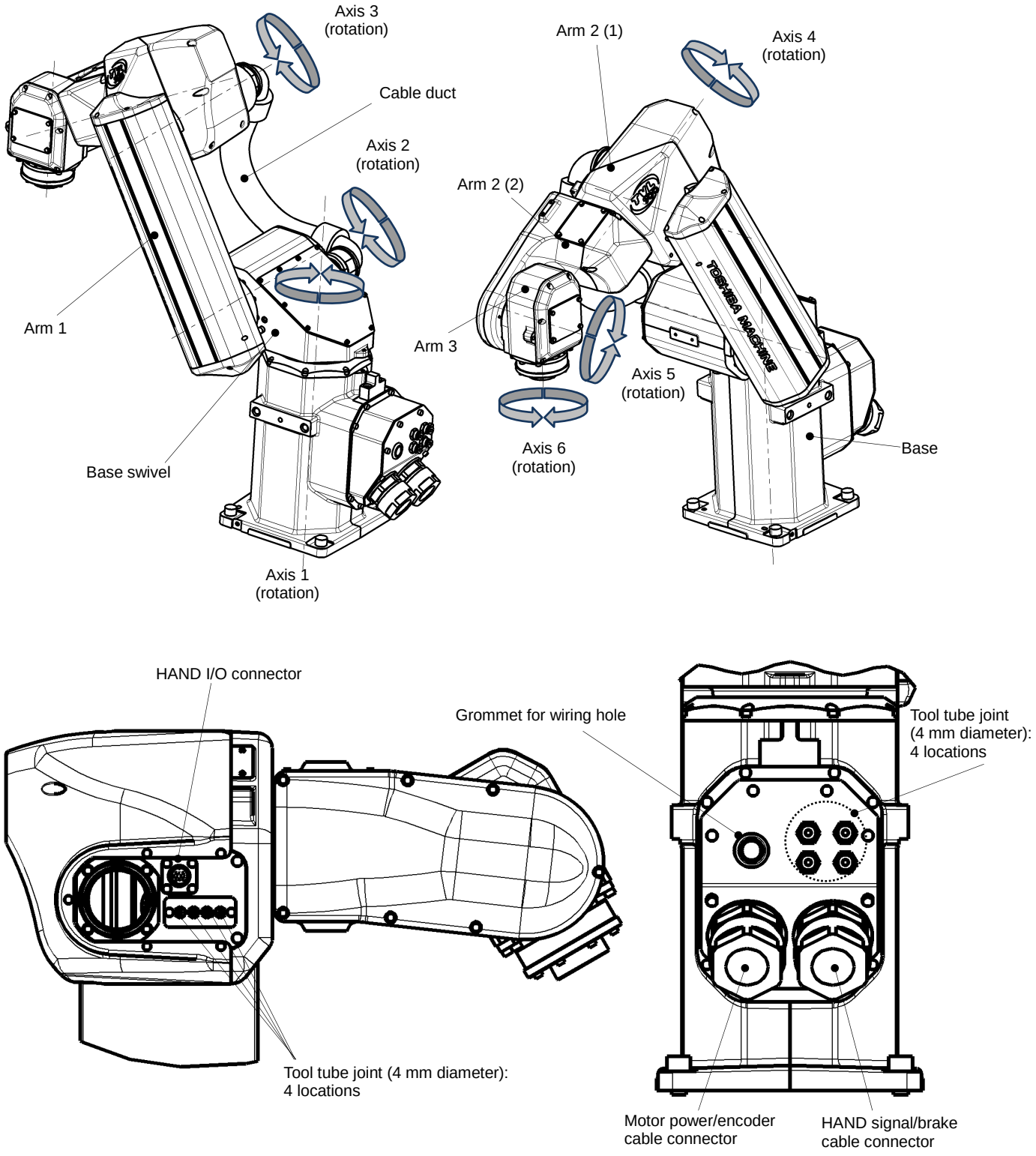


Fig. 1.4 Name of each part (TVL500)

1.3. External Dimensions

Fig. 1.5 to 1.6 refers to the external dimensions of the TVL500/TVL700.

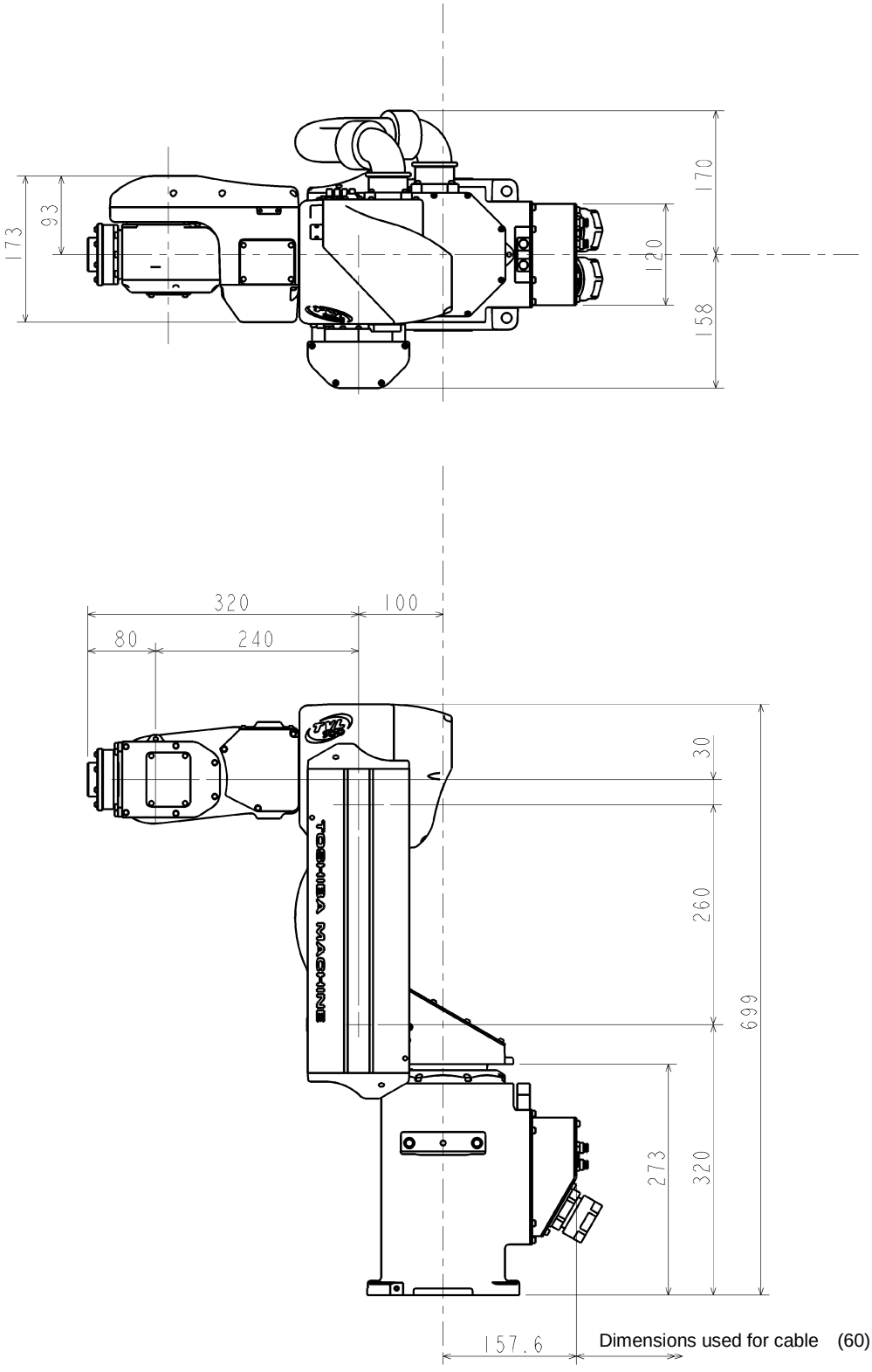


Fig. 1.5 External dimensions of the TVL500

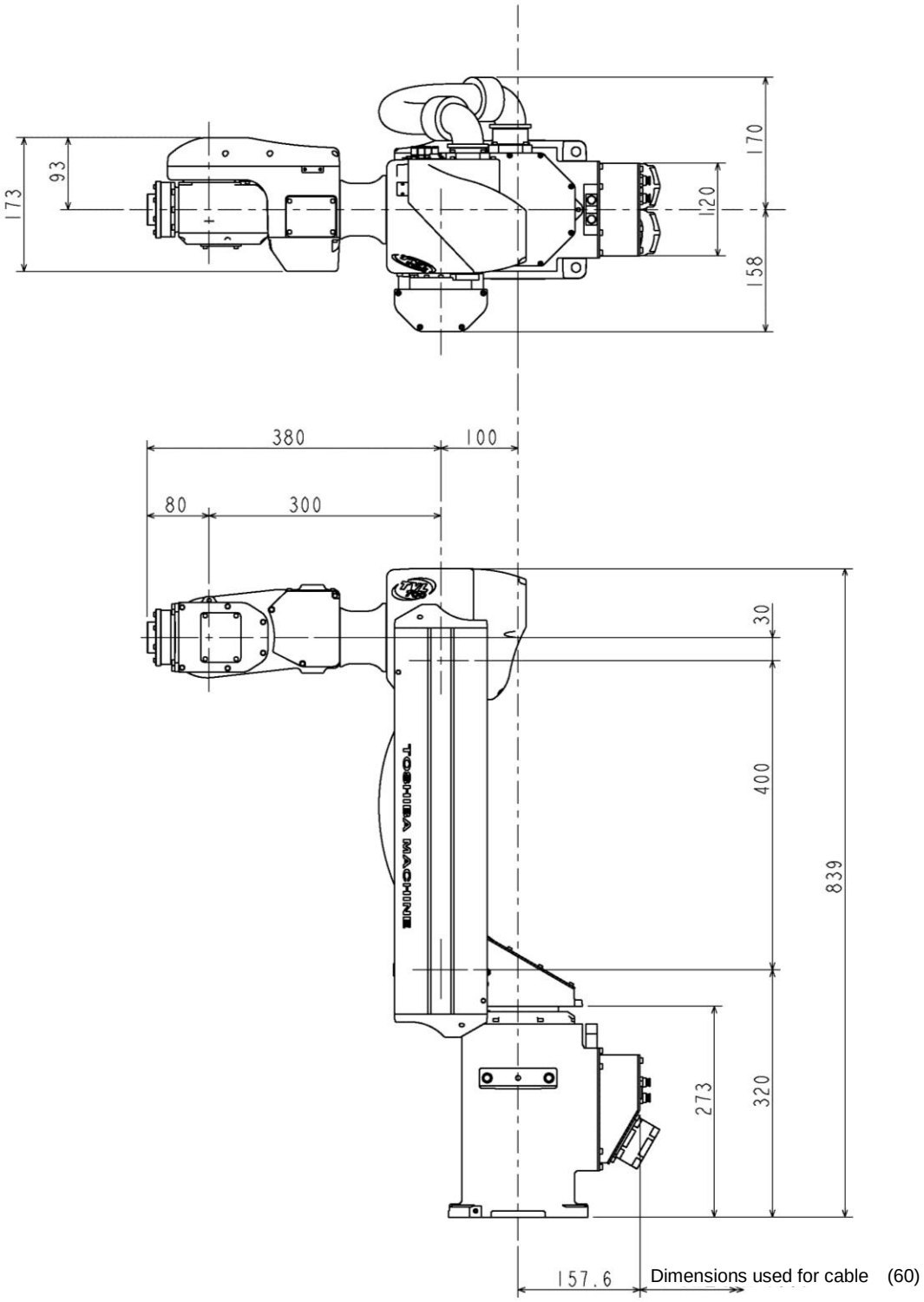


Fig. 1.6 External dimensions of the TVL700

1.4. Specifications Table

No	Item		Specifications		Remarks
1	Structure		Vertical multi-joint		
2	Model		TVL500	TVL700	
3	No. of controlled axes		6		
4	Arm length	Total length	500(mm)	700(mm)	
		Arm 1	260(mm)	400(mm)	
		Arm 2	240(mm)	300(mm)	
	Reach		602(mm)	801(mm)	
5	Motor capacity / Current limit	Axis 1	400(W) / 18.1(A_{0-P})		
		Axis 2	400(W) / 18.1(A_{0-P})		
		Axis 3	100(W) / 4.666(Ao-p)		
		Axis 4	50(W) / 5.091(Ao-p)		
		Axis 5	50(W) / 5.091(Ao-p)		
		Axis 6	50(W) / 5.091(Ao-p)		
6	Operating range	Axis 1	±170(deg)		
		Axis 2	-64~+165(deg)	-90~+165(deg)	
		Axis 3	-0~+150(deg)	-0~+165(deg)	
		Axis 4	±190(deg)		
		Axis 5	±120(deg)		
		Axis 6	±360(deg)		
7	Maximum speed	Axis 1	435(deg/sec)	295(deg/sec)	Note 1)
		Axis 2	348(deg/sec)	270(deg/sec)	
		Axis 3	348(deg/sec)	295(deg/sec)	
		Axis 4	422(deg/sec)		
		Axis 5	422(deg/sec)		
		Axis 6	696(deg/sec)		
		Maximum composite speed	7.98(m/sec)	7.71(m/sec)	
8	Payload mass	Rating	1(kg)		Note 1)
		Max.	3(kg)(Downward 5 kg)	4(kg)(Downward 5 kg)	
9	Standard cycle time (for 1 kg transportation)		0.3 (sec) unit	0.4 (sec) unit	Note 2)
10	Permissible load inertia	Axes 4 and 5	0.15(kgm^2)	0.09(kgm^2)	Note 1)
		Axis 6	0.20(kgm^2)	0.10(kgm^2)	
11	Repeatability	X-Y-Z	±0.02(mm) Each component	±0.03(mm) Each component	Note 3)
12	Drive system		TSL3100/TSL3100E/TS3100		
13	Power supply capacity		1.5(kVA)		
14	Robot body	Mass	28(kg)	31(kg)	
		Color	White/blue		Note 4)

Note 1: The speed and acceleration are limited in accordance with the operation pattern, the load mass, and the offset value.

Note 2: Continuous operation cannot be performed if the effective load factor of the standard cycle operation pattern is exceeded.
When carrying 1kg, with horizontal direction 300 mm, vertical direction 25 mm round-trip, and rough positioning

Note 3: Repeatability in one direction at a constant ambient temperature of 20°C
Note 4: The color and surface treatment of the robot body may differ according to each production lot. Please note that there is no problem in the very nature of the product quality.

2. Transportation

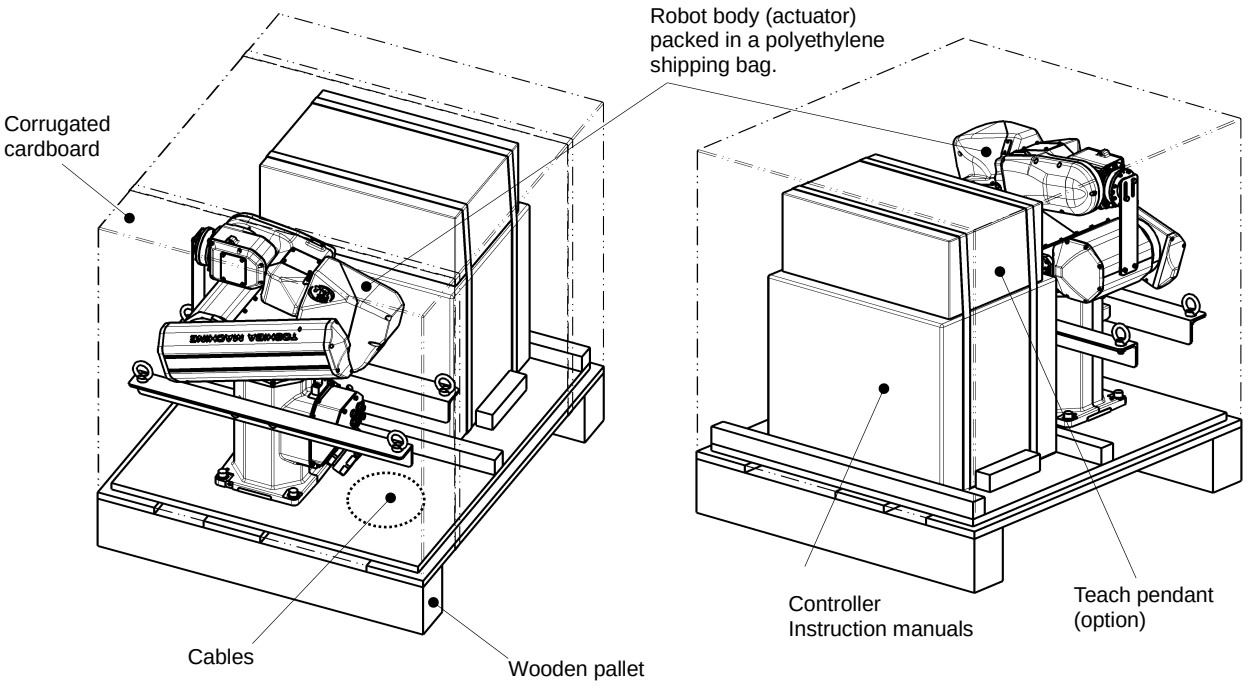
2.1. Unpacking (for the TSL3100,TSL3100E)

For the TS3100, please see 2.2, "Unpacking (for the TS3100)."
The robot and controller are shipped separately in corrugated cardboards. Fig. 2.1 shows each packaging state.

Open the packages in a location easily accessible, 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 accessories, see the accessory list that comes with the controller.



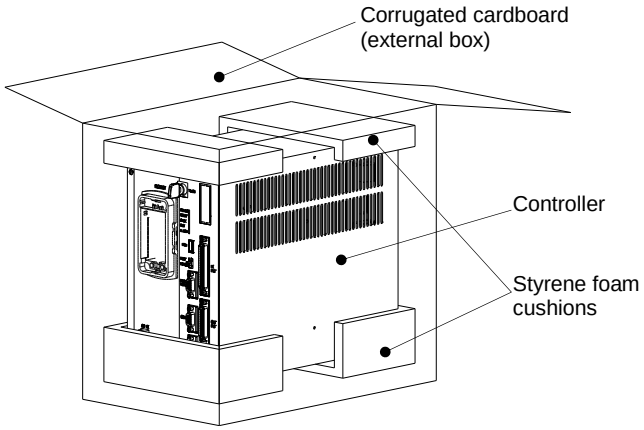


Fig. 2.1 Packaging state (TSL3100)

DANGER

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

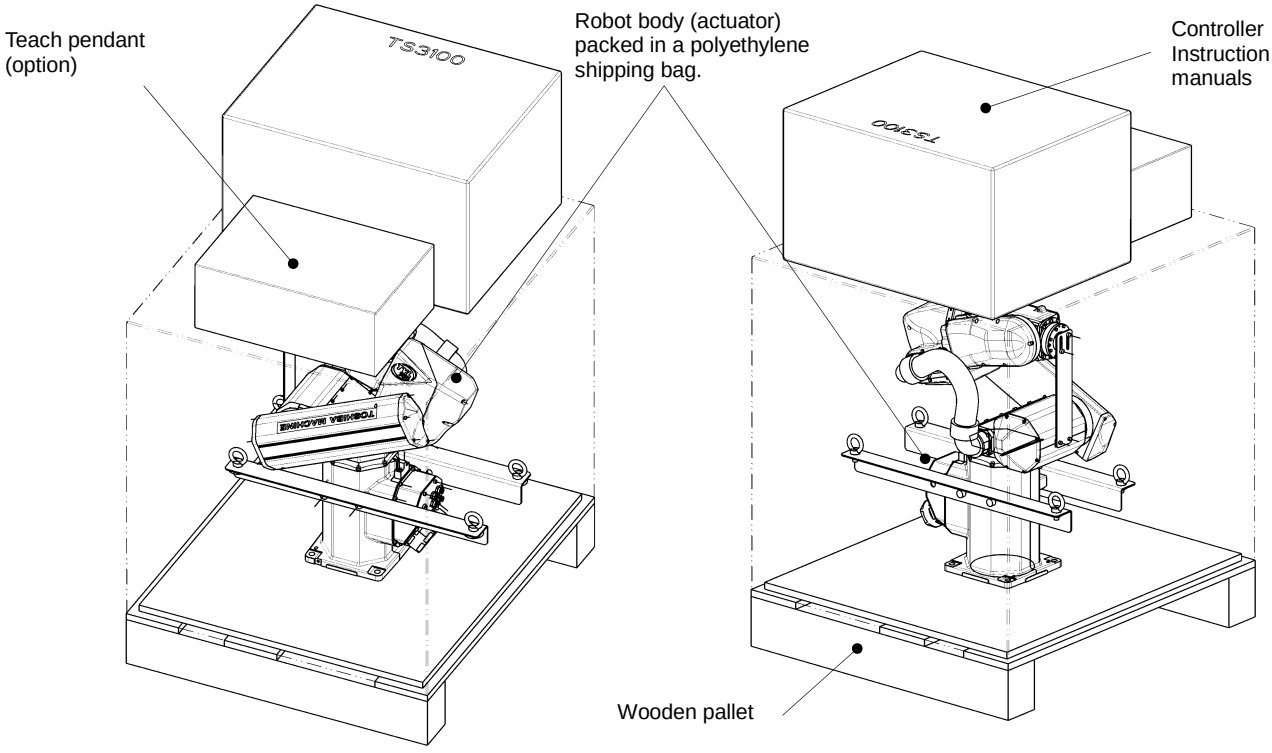
2.2. Unpacking (for the TS3100)

For the TSL3100,TSL3100E, please see 2.1, "Unpacking (for the TSL3100,TSL3100E)" The robot and controller are shipped separately in corrugated cardboards. Fig. 2.2 shows each packaging state.

Open the packages in a location easily accessible, 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 accessories, see the accessory list that comes with the controller.



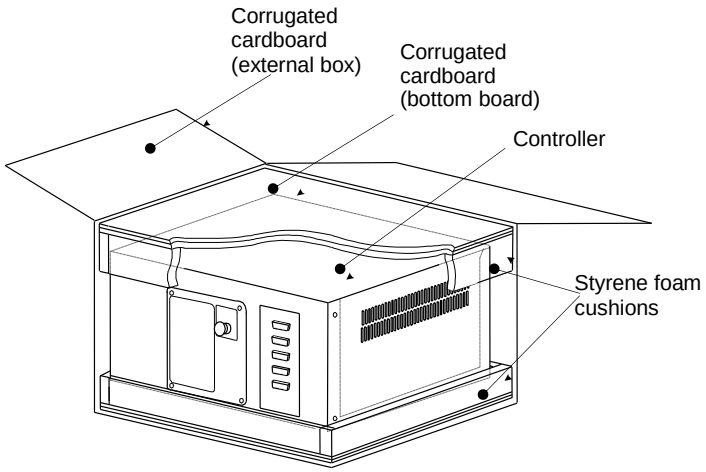


Fig. 2.2 Packaging state (TS3100)

DANGER

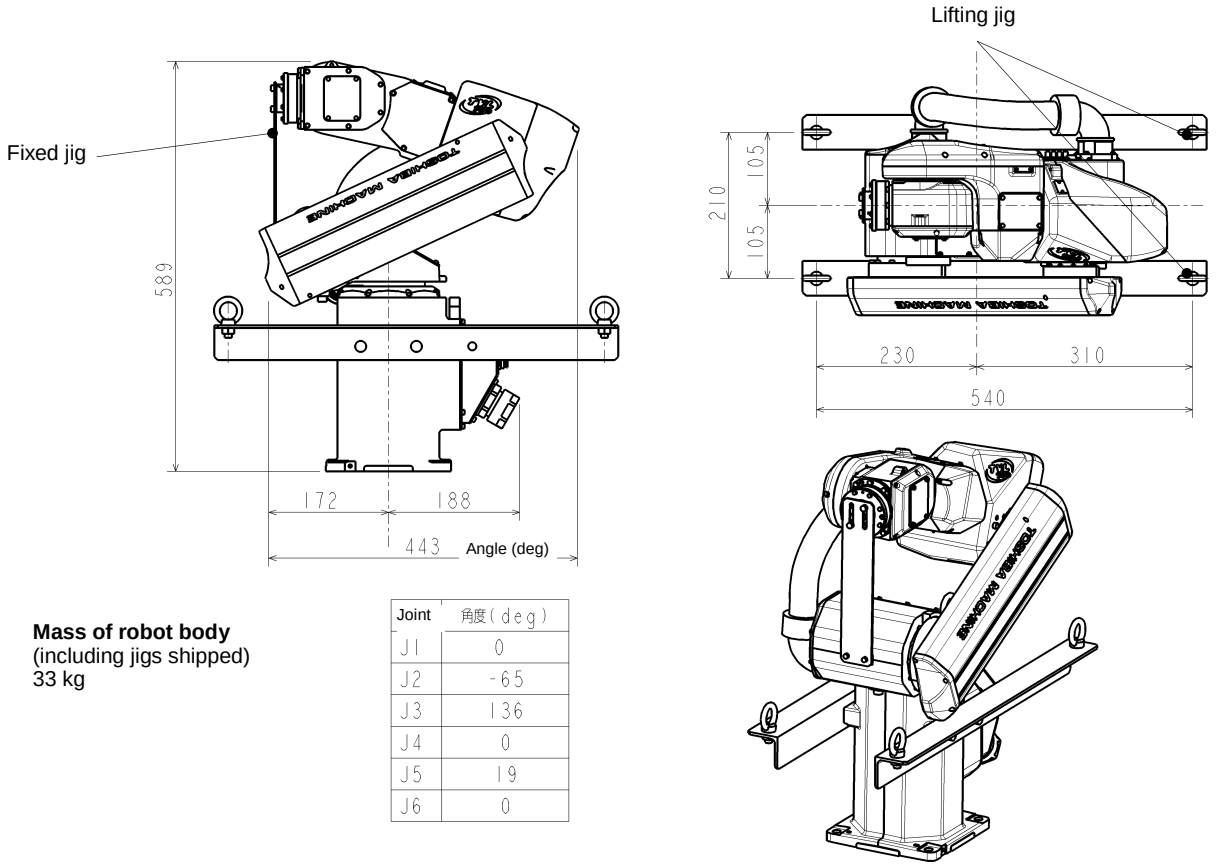
- If any parts of the equipment are found damaged or any accessories are missing after the shipment containing the robot and controller have reached your office, DO NOT install and operate them. Otherwise, the equipment will malfunction. Contact Toshiba Machine immediately.
- Dispose of the wooden pallet,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

2.3. Transportation

Move the robot and controller very carefully. Make sure that no excessive impact or vibration is exerted on the equipment. If the equipment is to be subject to vibration over a long period, be sure to tighten all the clamp and base set bolts completely.
If the equipment is to be moved to a location some distance from where it was unpacked, reposition the cushions as they were and put the equipment back into the corrugated cardboards.

2.3.1. Mass and Dimensions

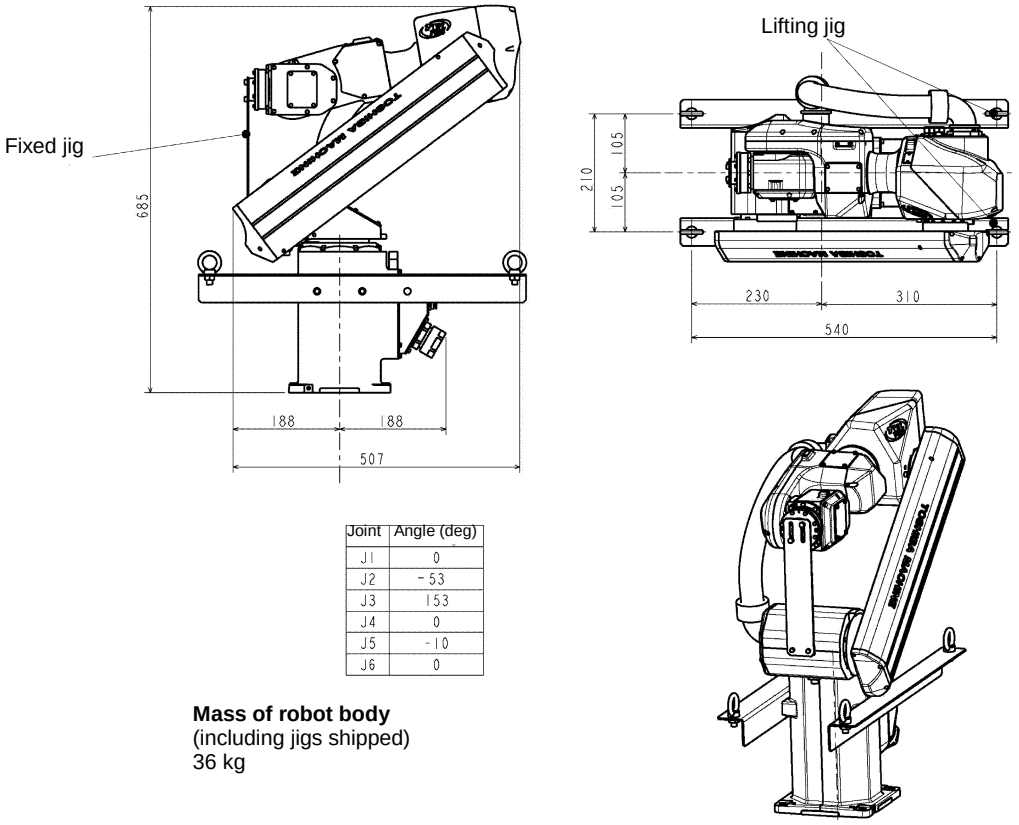
The mass and outer dimensions of the robot are shown in Fig. 2.3 and 2.4.
For details about the mass and external dimensions of the robot controller, see Fig. 4.1 (for the TSL3100), Fig. 5.1 (for the TSL3100E) or Fig. 6.1(for the TS3100).



Mass of robot body
(including jigs shipped)
33 kg

Joint	角度(deg)
J1	0
J2	-65
J3	136
J4	0
J5	19
J6	0

Fig. 2.3 Outer dimensions at transport



Joint	Angle (deg)
J1	0
J2	-53
J3	153
J4	0
J5	-10
J6	0

Mass of robot body
(including jigs shipped)
36 kg

Fig. 2.4 Outer dimensions at transport

2.3.2. Transporting the Robot

In principle, the robot should be transported in the state shown in Fig. 2.5 and 2.6 above. Fold back and secure the arm with the attached clamp. (The robot is shipped in this posture. After you have unpacked the shipment, you should move it as it is.)

DANGER

- Be sure to secure the arm with the attached clamp before transporting the robot. If a strong vibration or load is applied to the arm when power is off, a motor position detection error may occur.

It is possible to lift up and transport the robot.

Pass the wire through the attached eyebolt, then lift up the robot carefully, as shown in Fig. 2.5.

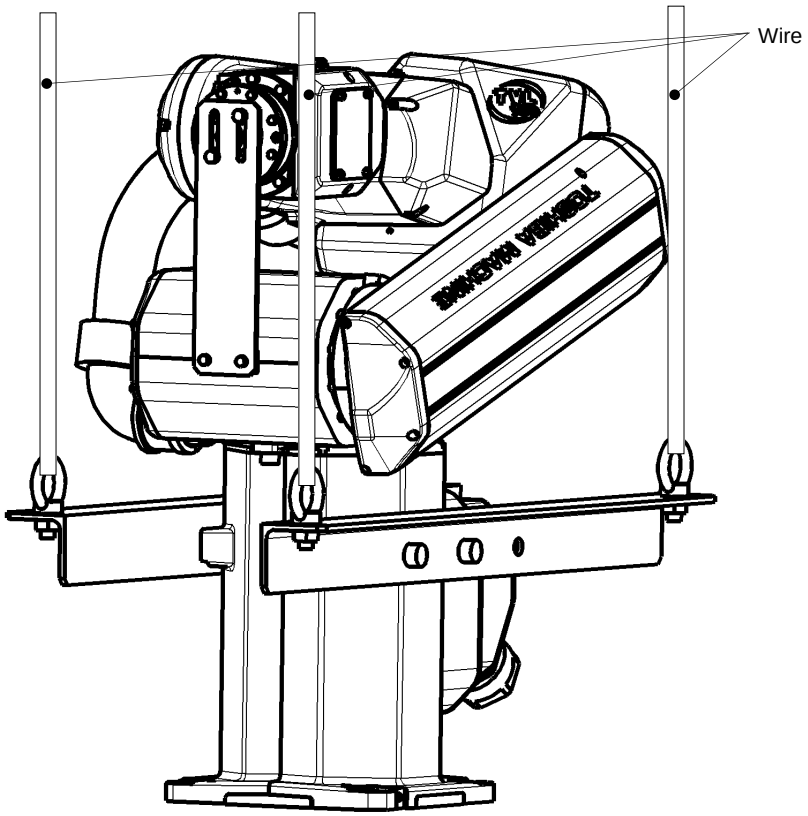


Fig. 2.5 Lifting up the robot (TVL500)

! CAUTION

- The wire to be used should be such that can well withstand the mass of the robot.
- When lifting up the robot, it may tilt a little. Lift it up slowly.
- Lifting up and down should be performed carefully so that any impact cannot be exerted on the robot.
- When carrying the robot by workers, take careful precautions to prevent their hand or leg from being caught in the robot.

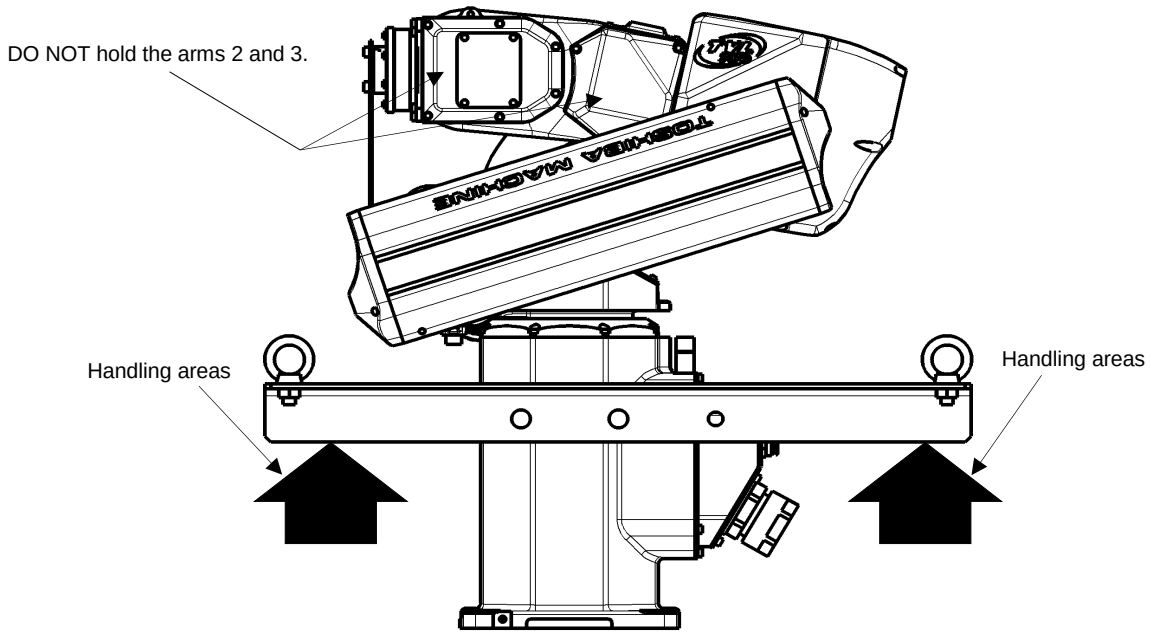


Fig. 2.6 Robot handling areas

After the installation, remove the clamp and lifting jig used for transport.

! CAUTION

- When lifting up the robot by workers, hold the locations (arrowed parts) by hands as shown in Fig. 2.6. If the arm 2 and arm 3 are held by hands, an unusually large force is exerted, resulting in a malfunction.
- Do not hold the cable duct by hand. If you hold it, the harness cable may be broken or the connections may be faulty.
- When carrying the robot by workers, take careful precautions to prevent their hand or leg from being caught in the robot.
- The handling position may contain irregularities such as a notch in some very rare cases. Take care not to be injured by them.
- The work should be performed by two or more workers.

2.3.3. Transporting the Controller

Disconnect all cables and teach pendant before transporting the controller.

DANGER

- When placing the controller on the floor, etc., make sure not to have your hands or feet caught.

2.4. Storage

Avoid storing the robot and controller for long periods of time after unpacking them. If this is unavoidable, however, strictly observe the following precautions for storage.

2.4.1. Storage Precautions for the Robot

CAUTION

- Secure the base completely to prevent the robot from falling over. When placed directly on the floor, the robot is unstable and will fall over.
- Keep the robot out of direct sunlight. The timing belts and resin covers may deteriorate.
- Seal the robot in a vinyl bag to prevent rust development and contaminant. Put a desiccant in the bag to absorb moisture.
- Before starting an operation, perform running completely.
- During storage, the life of the backup batteries will shorten. It is recommended to replace the batteries at the time of operation.

2.4.2. Storage Precautions for the Controller

CAUTION

- Keep the controller out of direct sunlight. Otherwise, the controller interior will be excessively heated up, causing a trouble.
- Seal the controller in a vinyl bag to prevent rust development and contaminant. Put a desiccant in the bag to absorb moisture.

3. Installation of the Robot Body

3.1. Installation Environment

Table 3.1 shows the environmental conditions for the location in which the robot and controller are to be installed.

Table 3.1 Environmental conditions for robot and controller

Item	Specifications
Temperature	In operation : 0 to 35°C *1 In storage : –20 to 55°C
Humidity	20 to 80 % (Non-condensing) DO NOT install the robot where it may be subject to fluids such as water.
Altitude	1000 m or less
Vibration	In operation : 0.98m/s^2 or less
Dust	No inductive dust should exist. Consult with Toshiba Machine first if you wish to use the robot and controller in a dusty environment.
Gas	No corrosive or combustible gas should exist.
IP (Ingress Protection) rating	IEC60529 IP40 (for the robot), and IP20 (for the controller)
Overvoltage category	IEC60664-1 Class III (for the controller)
Protection against electric shock	IEC61140 Class I (for the controller)
Pollution degree	IEC60664-1 Pollution Degree 3 (for the controller)
Sunlight	The robot and controller should not be exposed to direct sunlight.
Power noise	A heavy noise source should not exist nearby.
Magnetic field	A heavy magnetic field source should not exist nearby.
Other ambient environmental requirements	No iron powder, no oil, no salt content, and no organic solvent. No water splash on the robot/controller.

*1: If the robot is used in a place where the temperature rises to 35°C or more, pay special attention to the ambient temperature when the robot is operating. Consider the cooling of the robot body as needed. Please ask us for the cooling of the robot.

DANGER

- Do not place the robot or controller near combustible. Doing so could lead to fires if it ignites due to a fault, etc.

CAUTION

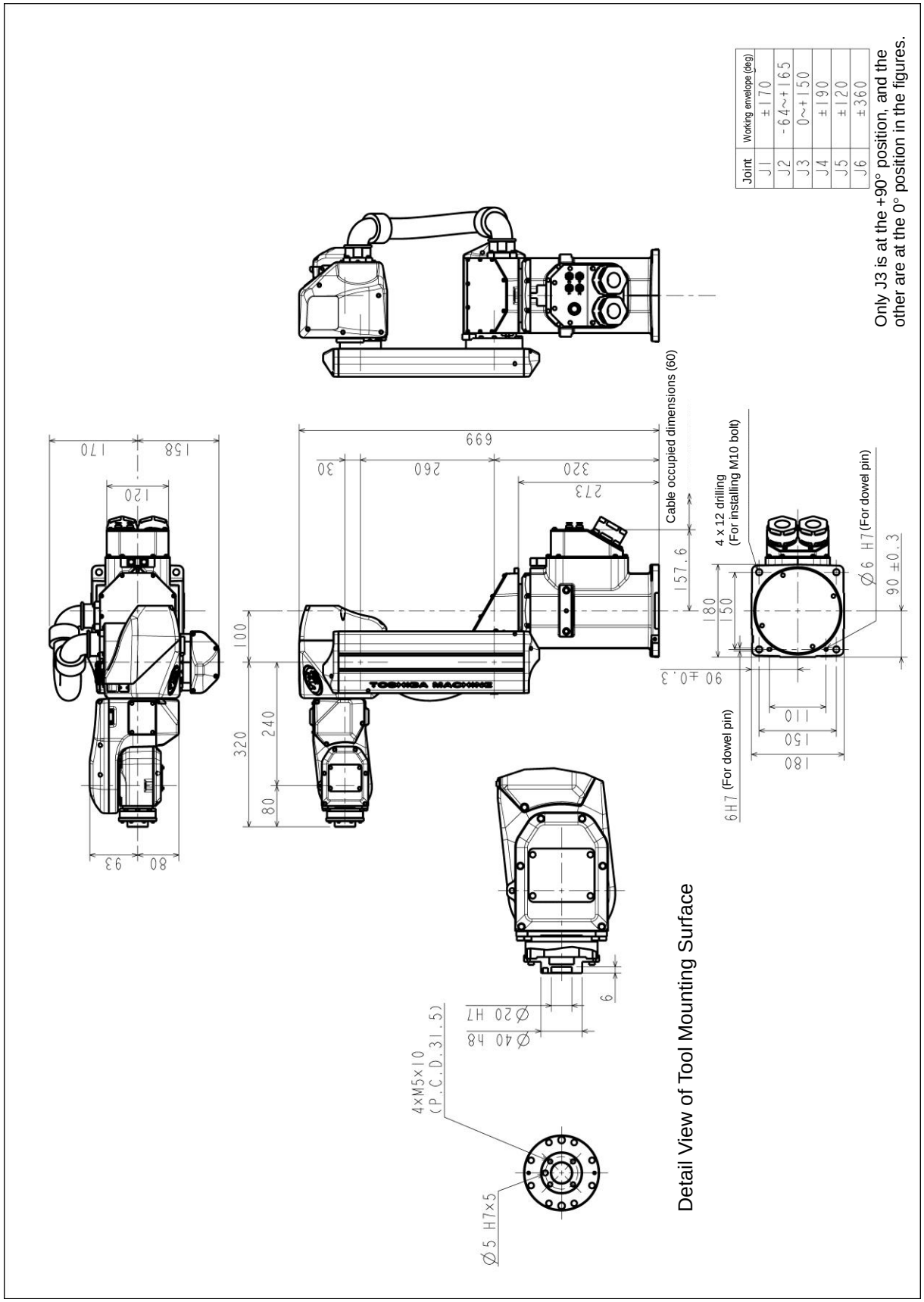
- If the robot is operated at high speed when started in a low-temperature environment, the torque increases, and an error can occur.
  In a low-temperature environment, be sure to operate the robot at low speed in continuous operation mode for several minutes after starting it, which softens the grease. Then, change to high-speed operation.

3.2. Robot Installation

Before the robot can be installed, the installation layout must be studied in consideration of the working envelope, the coordinate system, and the maintenance clearance.

3.2.1. External Dimensions

Fig. 3.1 and 3.2 shows an external view of TVL500 and TVL700.


Joint | Working envelope (deg)
J1 | ±170
J2 | -64~+165
J3 | 0~+150
J4 | ±190
J5 | ±120
J6 | ±360
Only J3 is at the +90° position, and the other are at the 0° position in the figures.
Cable occupied dimensions (60)
4 x 12 drilling (For installing M10 bolt)
Ø6 H7 (For dowel pin)
6H7 (For dowel pin)
4×M5×10 (P.C.D.31.5)
Ø5 H7×5
Detail View of Tool Mounting Surface

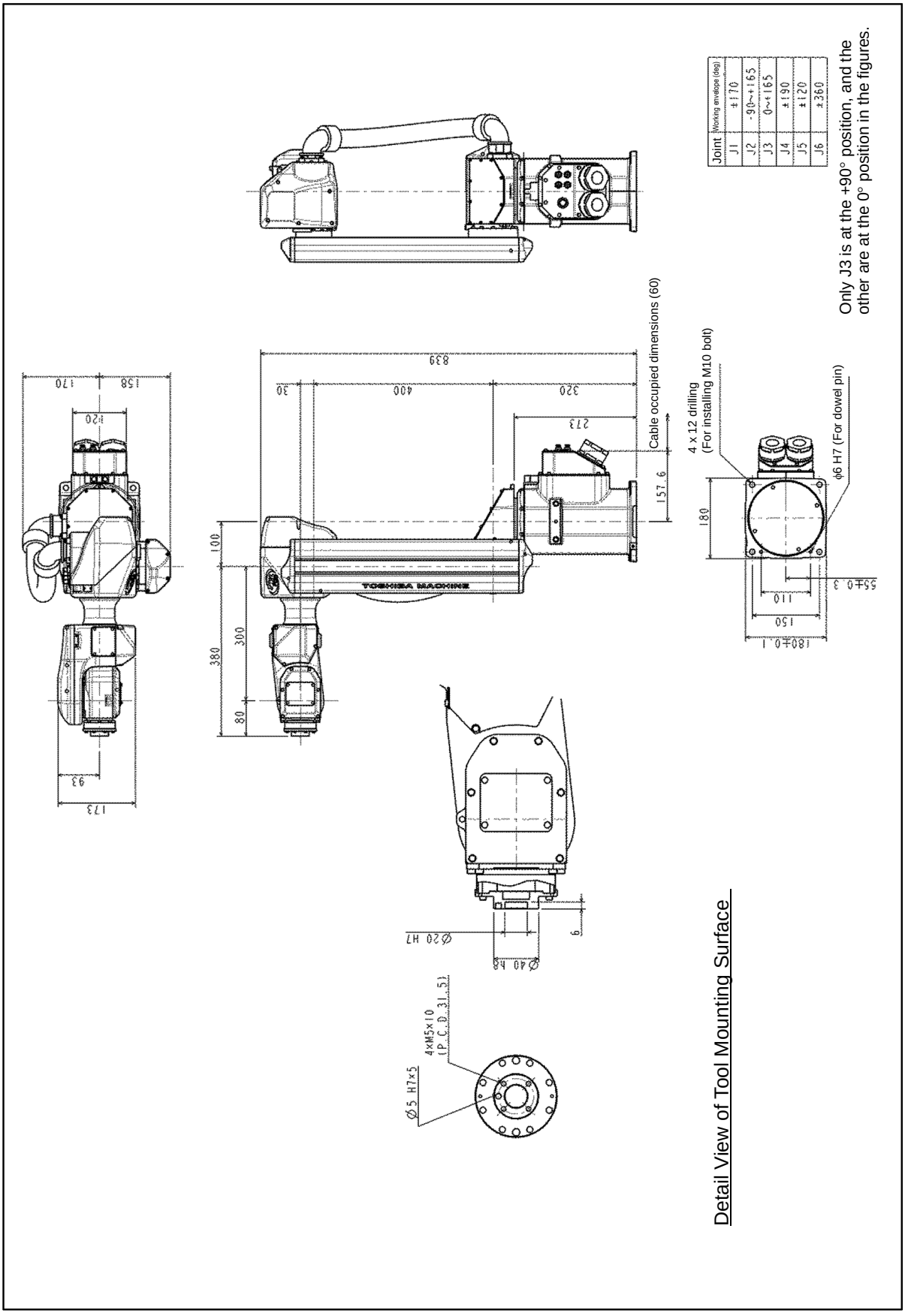


Fig. 3.2 External view TVL700

3.2.2. Working Envelope

Fig. 3.3 and 3.4 shows the working envelope of the robot.
Each axis can operate within the working envelope. To prevent the robot from moving out of the working envelope by mis-operation, the robot is equipped with mechanical stoppers outside the working envelope.
In addition, there are travel limits (hereinafter called soft limits) which are set by software. The settings of soft limits can be changed by the user. For details, see the "Instruction Manual: User Parameters" provided as a separate volume.

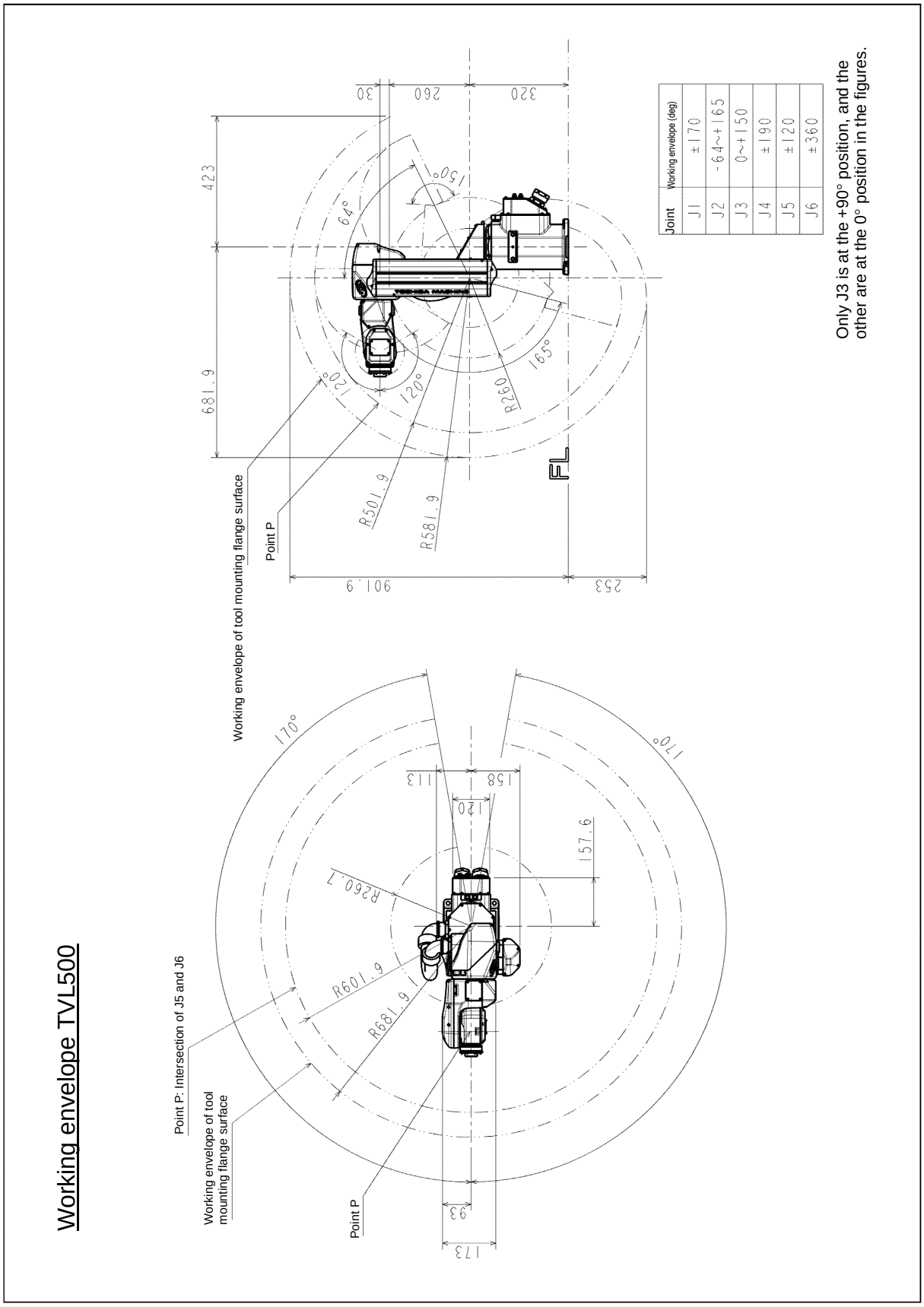


Fig. 3.3 Working envelope TVL500

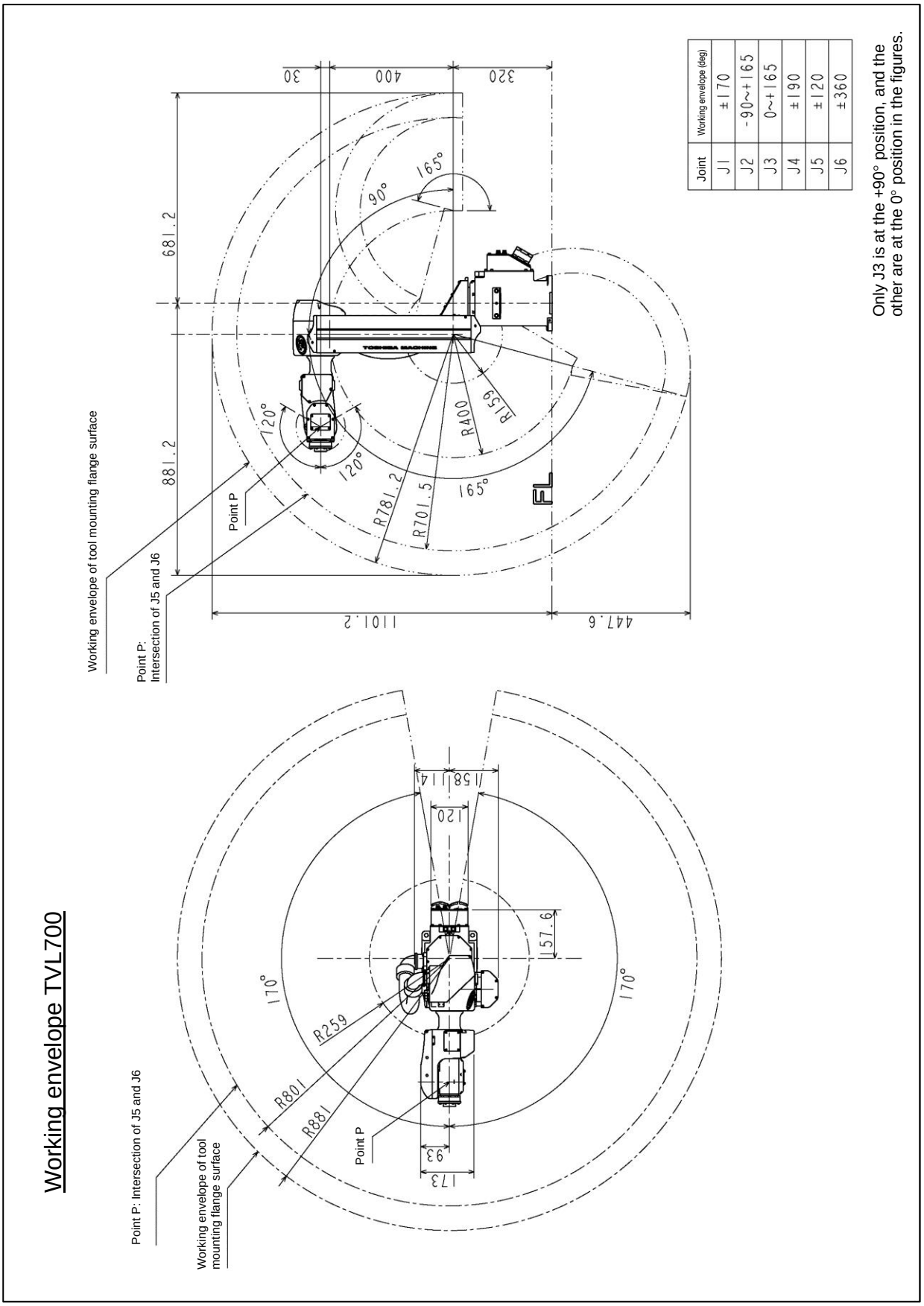
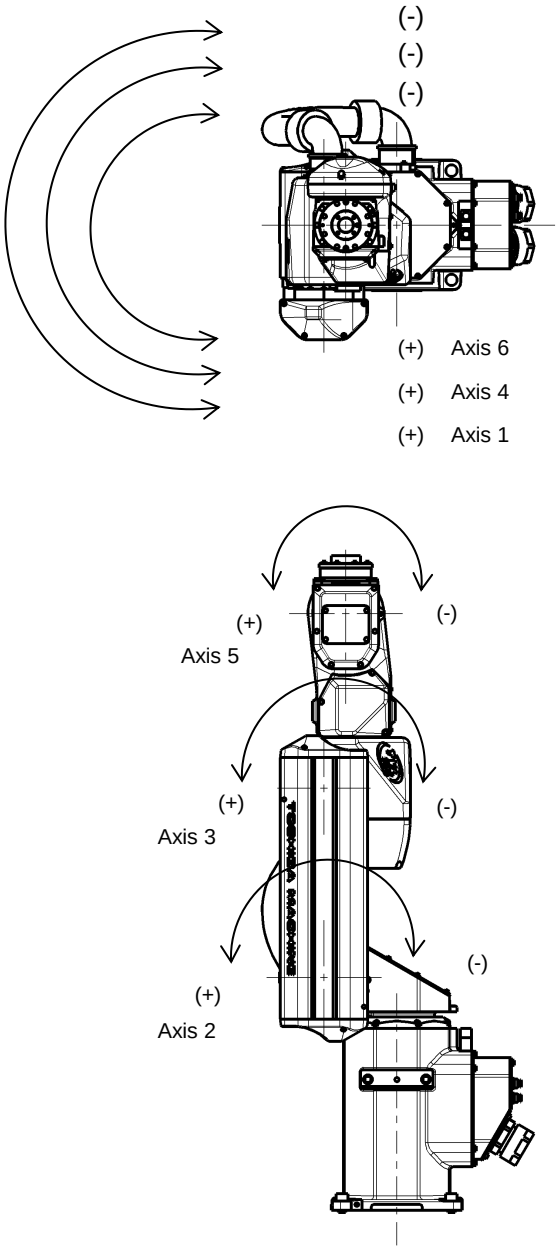


Fig. 3.4 Working envelope TVL700

3.2.3. Coordinate System

The robot's joint angle origin (0° position) is factory-calibrated according to the base reference planes. Fig. 3.5 shows the base coordinate system and origin of each axis joint angle.



TVL500/TVL700		TVL500		TVL700	
Angle of axis [°]		Base coordinate system [mm]		Base coordinate system [mm]	
J1	0	X	70	X	70
J2	0	Y	0	Y	0
J3	0	Z	900	Z	1100
J4	0	A	0	A	0
J5	0	B	0	B	0
J6	0	C	0	C	0

Fig. 3.5 Base coordinate system and joint angle origin (TVL500)

3.2.4. Installing the Robot

The robot is secured, using the set holes on the base (four (4) places). Use M10 hexagon socket head cap screws.

The installation can be made in the following two steps. Select one of them according to your frame installation procedure.

A step using the reference surface of base ①

Fig. 3.6 show a robot installation step using the reference surface. Reference planes are provided on the base unit. To align the robot position in the base coordinate system, or to replace the robot, provide adequate reference planes. Then, contact such reference planes to the base reference planes and secure the robot.

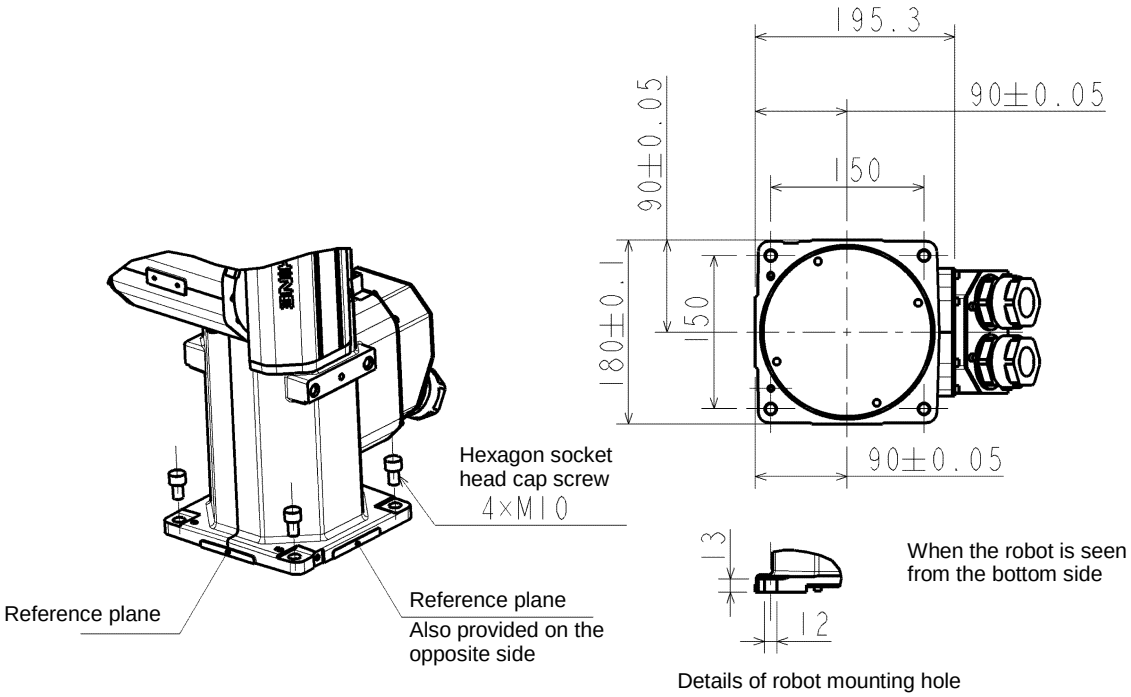


Fig. 3.6 Setting method [1]

[2] Step using the dowel pin

Fig. 3.7 shows a robot installation step using the dowel pin. The bottom surface of the base is provided with a positioning dowel pin (ϕ6 mm).

When you want to adjust the position of the base coordinate system of the base or to replace the robot, prepare a dowel pin hole on the frame on which to mount the robot. Then adjust the position. (* The dowel pin is not supplied by us. You are requested to prepare it.)

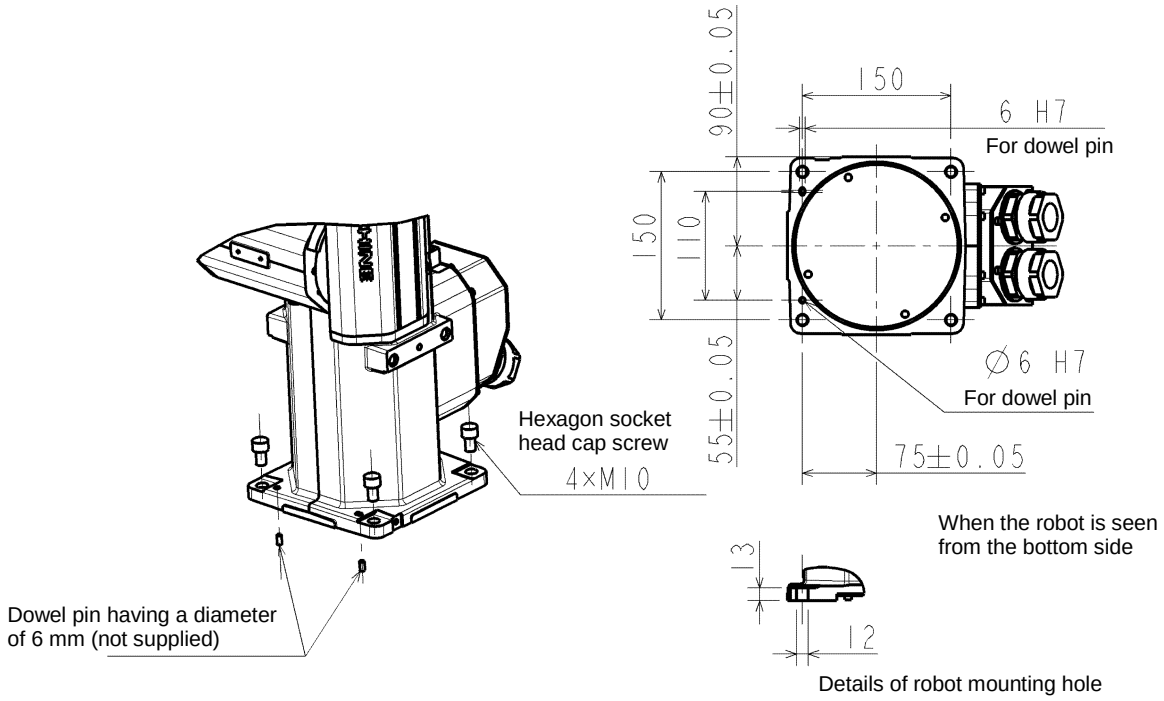


Fig. 3.7 Setting method [2]

CAUTION

- While the robot is working, a great load is applied to the frame. If you want to install on the frame, make sure that the frame has a sufficient rigidity.

  If the robot is installed on a frame that does not have sufficient rigidity, vibration will occur while the robot is operating, and could lead to faults.

  When installing the robot on the floor, secure the robot with anchor bolts, etc.
- Install the robot on a level place. Failure to do so could lead to a drop in performance or faults.

3.3. Working Envelope Change

This section explains the change of working envelope for the axes 1 to 3 of the TVL500/TVL700.

! CAUTION

- If a working envelope is to be changed, design and manufacture mechanical stoppers in accordance with your operating conditions, referring to this manual.
- If a working envelope is changed after the mechanical stoppers, be sure to change the soft limits in order to prevent the robot from coming into contact with the mechanical stoppers during operation.
- The mechanical stoppers are not to strictly limit the movable range of the robot. Do not go into the robot's working envelope when you turn on the robot.
- If the robot collides with a mechanical stopper, the robot will stop recognizing the collision, but the mechanical stopper may be damaged. Do not use the mechanical stopper any more.
- The mechanical stopper reference drawings in this manual do not satisfy your operating conditions. Design, manufacture, and mount mechanical stoppers in accordance with your operating conditions such as the working envelope.
- A robot failure arising from mechanical stoppers is excluded from the warranty.

3.3.1. Change of Axis-1 Working Envelope

<1> Change of axis-1 working envelope

The TVL500/TVL700 is shipped while the soft limits and mechanical stoppers are factory-set for axis 1 to travel between ±171°.

The first axis mechanical stopper is common to both the TVL500 and the TVL700 robots.

Fig. 3.8 shows the factory-set working envelope.

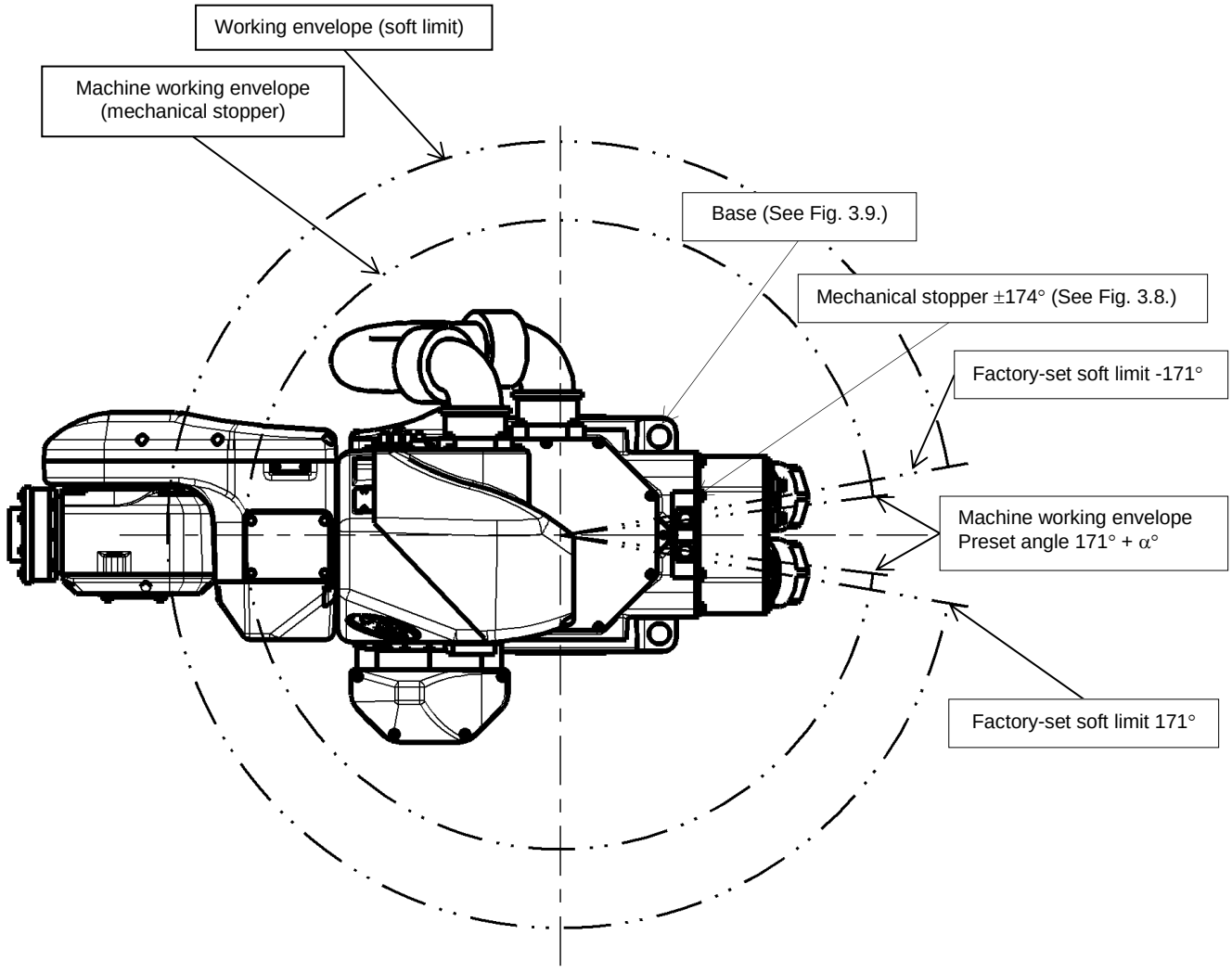


Fig. 3.8 Axis-1 working envelope setting

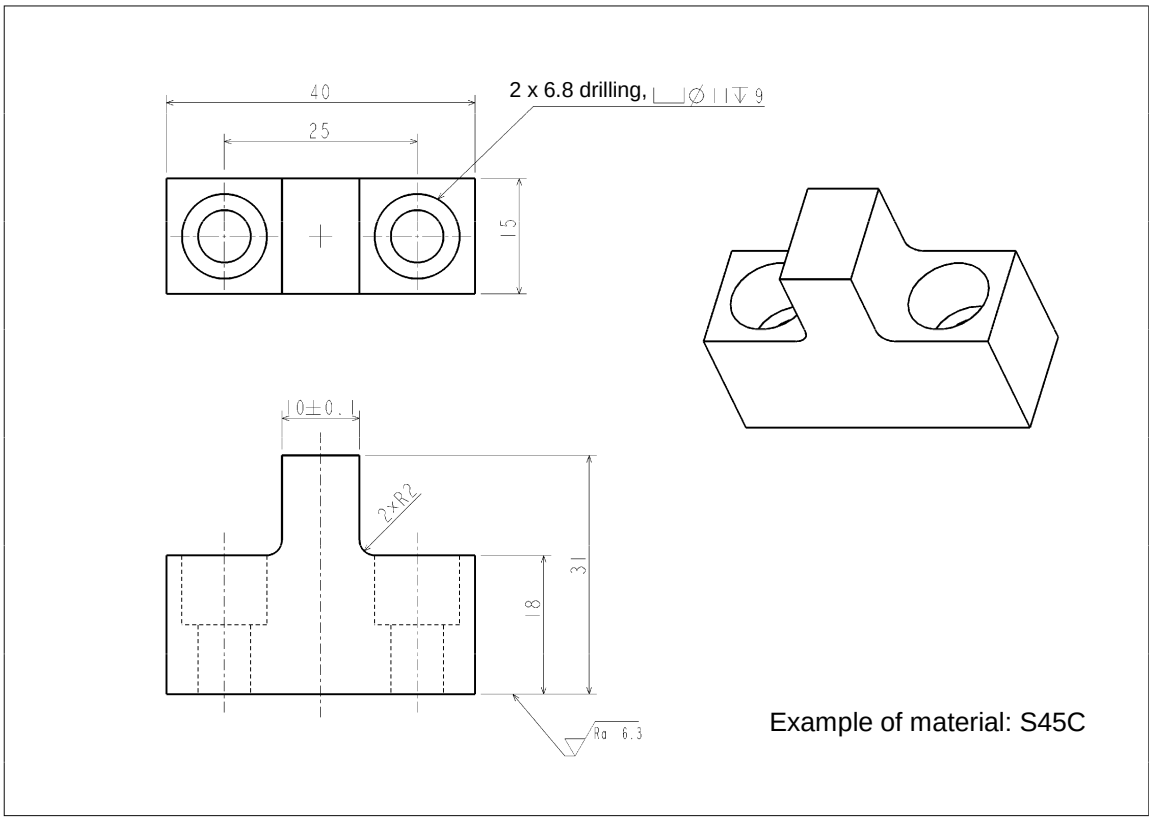


Fig. 3.9 Factory-set mechanical stopper (TVL500/TVL700)

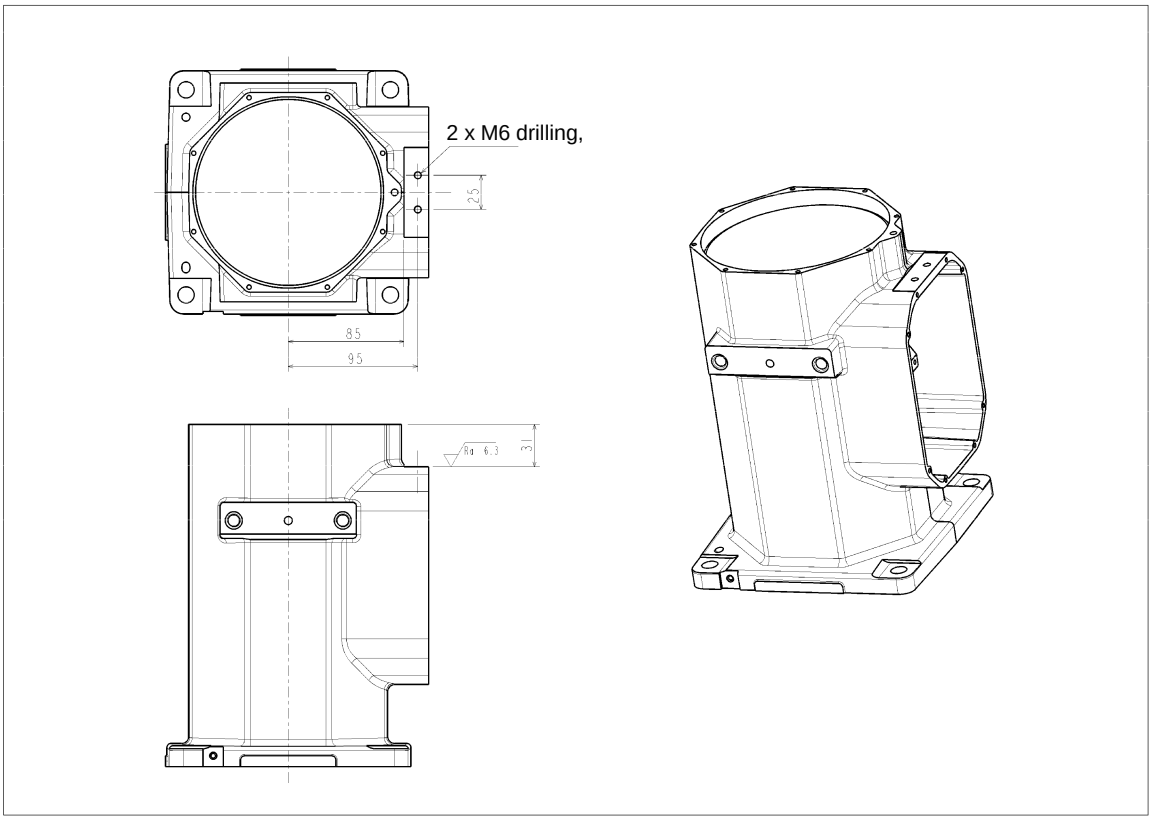


Fig. 3.10 Mechanical stopper location (at the base) (TVL500/TVL700)

<2> Example of changing axis-1 working envelope and the change method

Desired operating ranges of the machine can be set up by changing the shapes of the mechanical stoppers for the TVL500/TVL700 robot. To change the operating range of the first axis, the customer needs to design and produce a mechanical stopper by referring to Fig. 3.11 and Fig. 3.12 as needed.

If a working envelope position is changed, the soft limit must be changed. As for the change of soft limits, see the "Instruction Manual: User Parameters" provided as a separate volume.

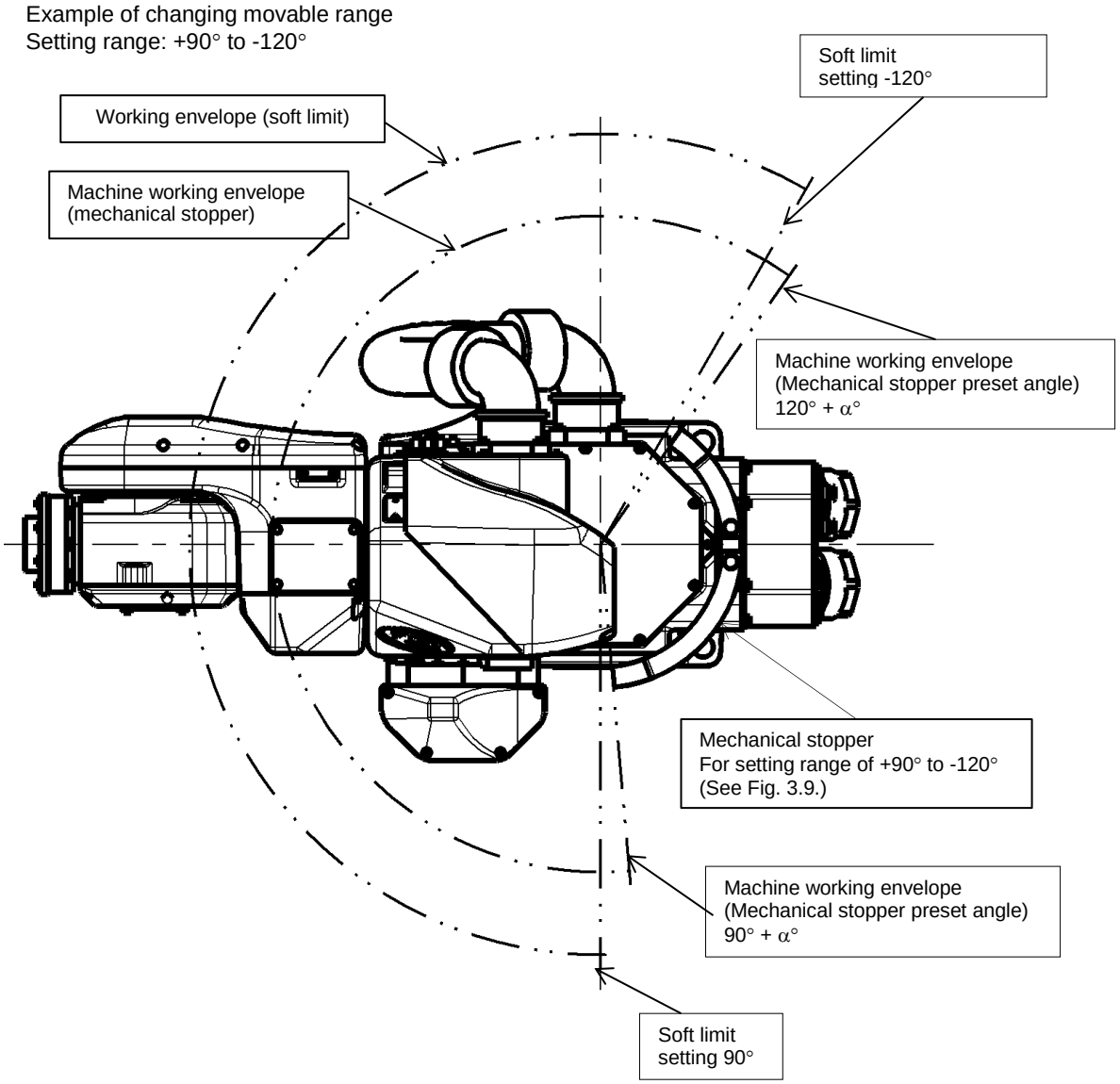


Fig. 3.11 Example of changing axis-1 working envelope (TVL500)

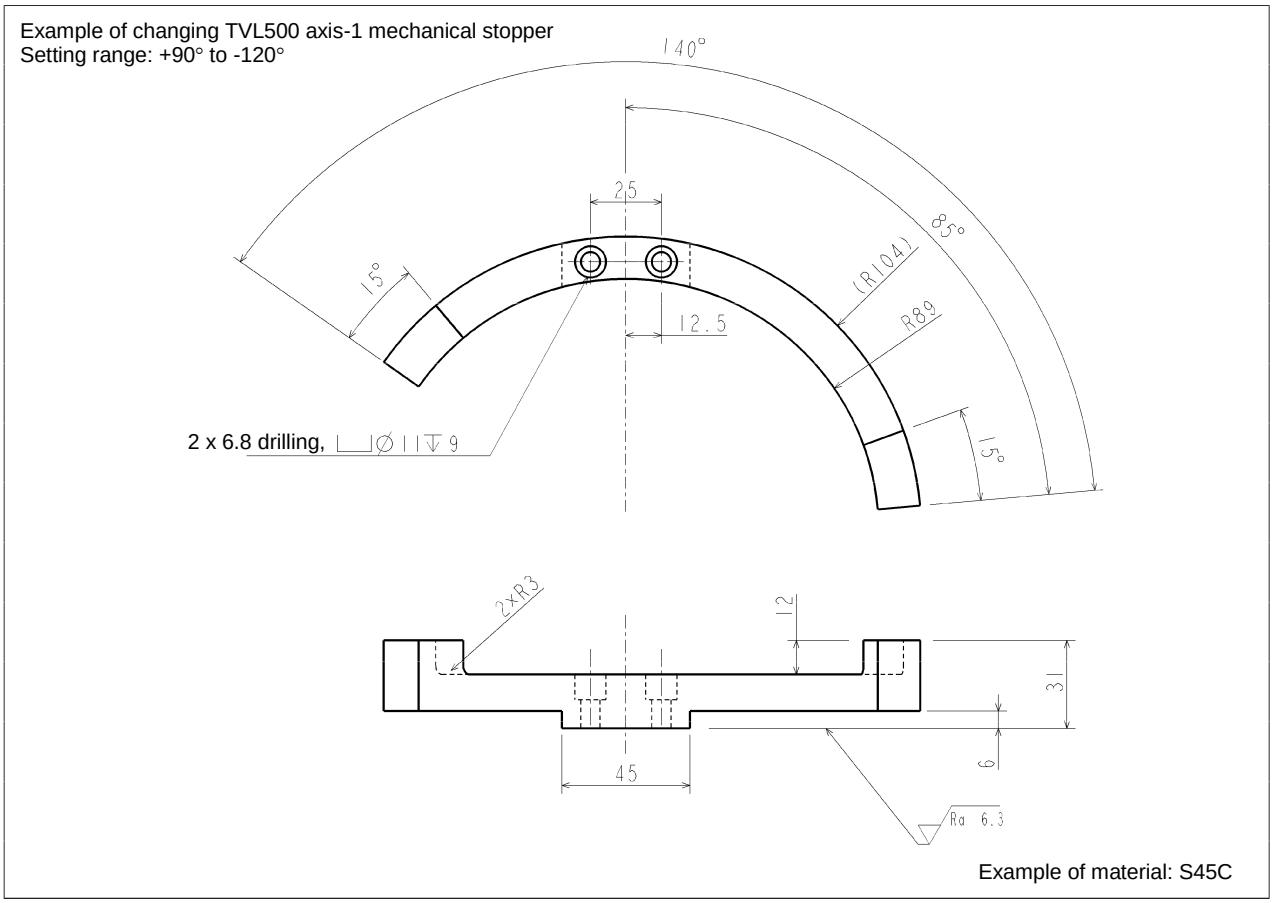


Fig. 3.12 Example of changing axis-1 mechanical stoppers (reference)

3.3.2. Change of Axis-2 Working Envelope

<1> Change of axis-2 working envelope

When the TVL500/TVL700 robot is shipped from the factory, software limits and mechanical stoppers are preset so that the stroke of the second axis can satisfy the angles shown in Table 3.2.

Table 3.2 Strokes of the second axis at factory shipment

Operating direction	TVL500	TVL700
+	+166	+166
-	-65	-91

The settings of the operating range when the TVL500 robot is shipped from the factory are shown in Fig. 3.13 and those of the TVL700 robot in Fig. 3.14.

To change the operating range of the second axis, the customer needs to prepare a new mechanical stopper.

If the operating range is changed, it is also necessary to changer the software limits. For details about changing the software limit, see the "Instruction Manual: User Parameters" provided as a separate volume.

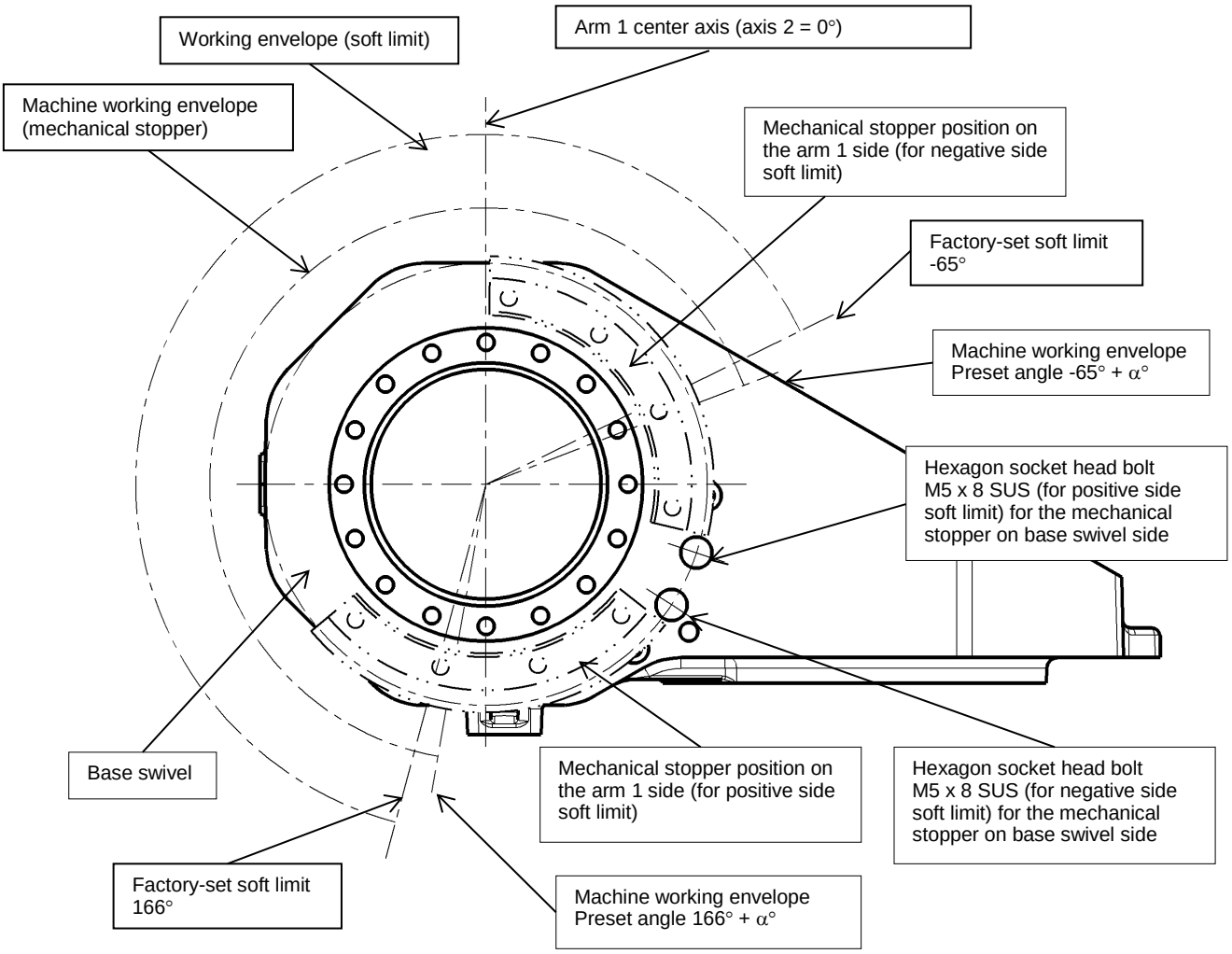


Fig. 3.13 Axis-2 working envelope setting (TVL500)

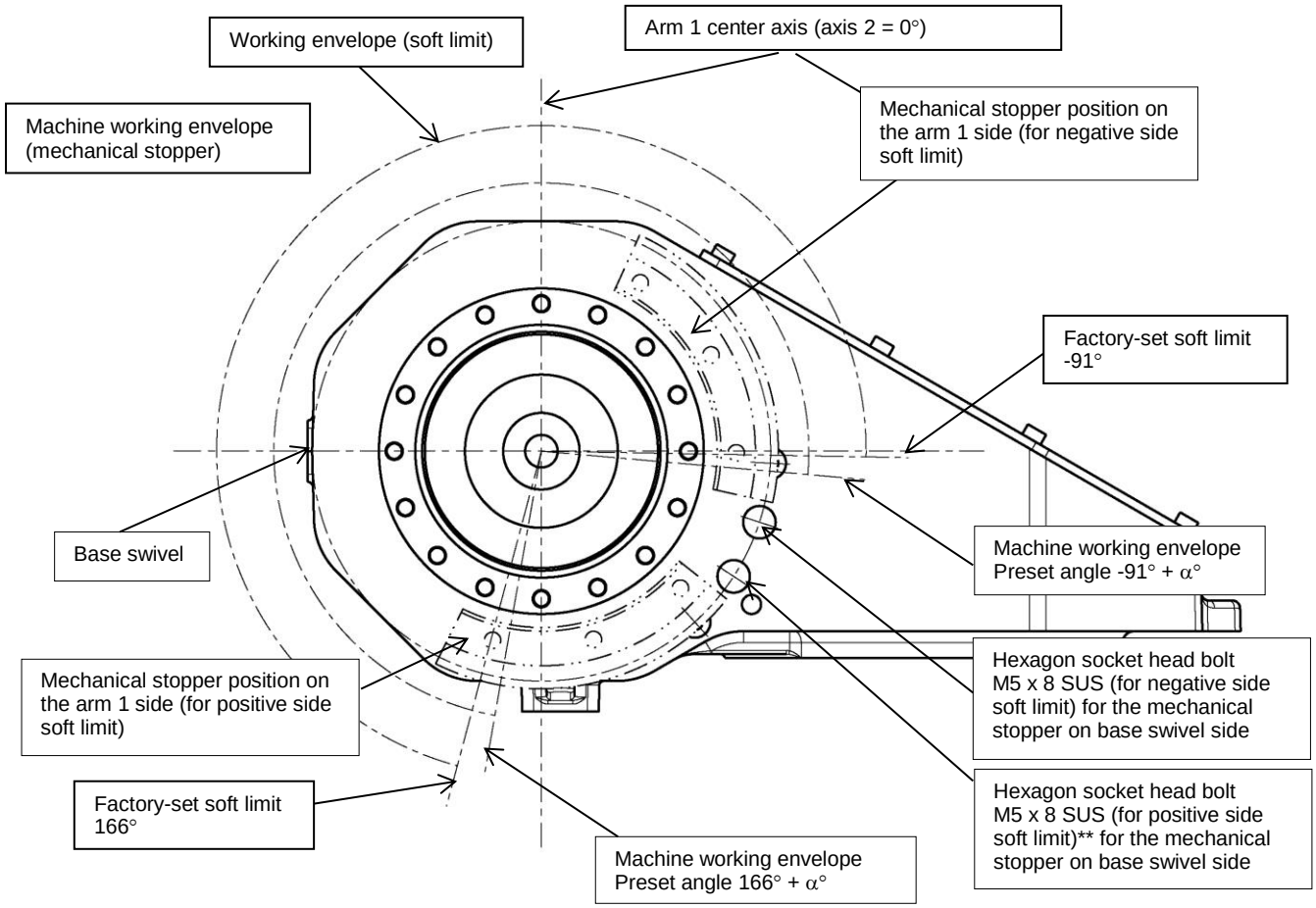


Fig. 3.14 Axis-2 working envelope setting (TVL700)

<2> Examples of changing axis-2 working envelope and the change method

Desired operating ranges of the machine can be set up by changing the shapes of the mechanical stoppers for the TVL500/TVL700 robot. A design example of a mechanical stopper is explained below using the VL500 robot as an example. By referring to Fig. 3.15 to Fig. 3.18 as needed, the customer needs to design and produce a mechanical stopper on the base turning side.

If a working envelope position is changed, the soft limit must be changed. As for the change of soft limits, see the "Instruction Manual: User Parameters" provided as a separate volume.

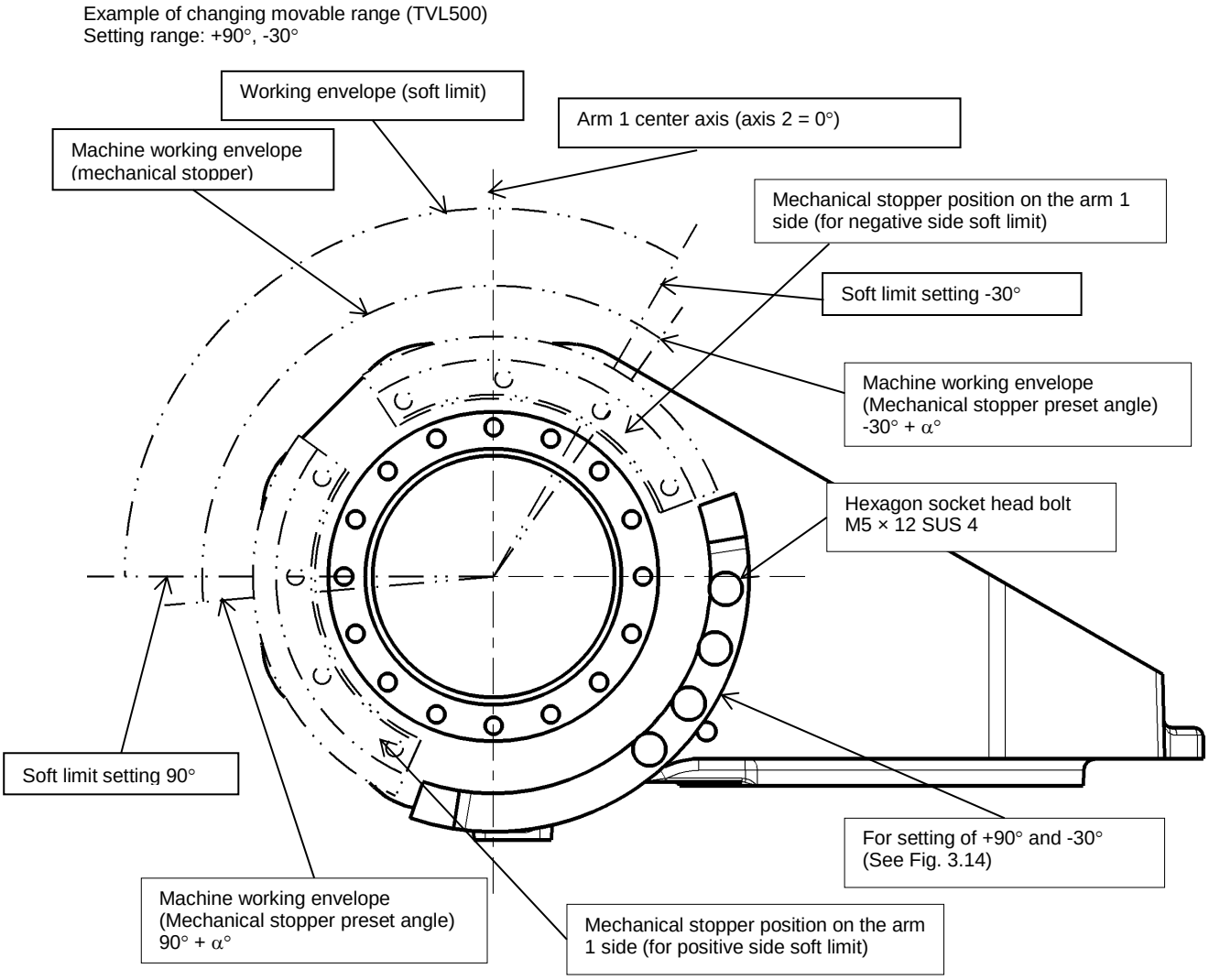


Fig. 3.15 Example of changing axis-2 working envelope (TVL500)

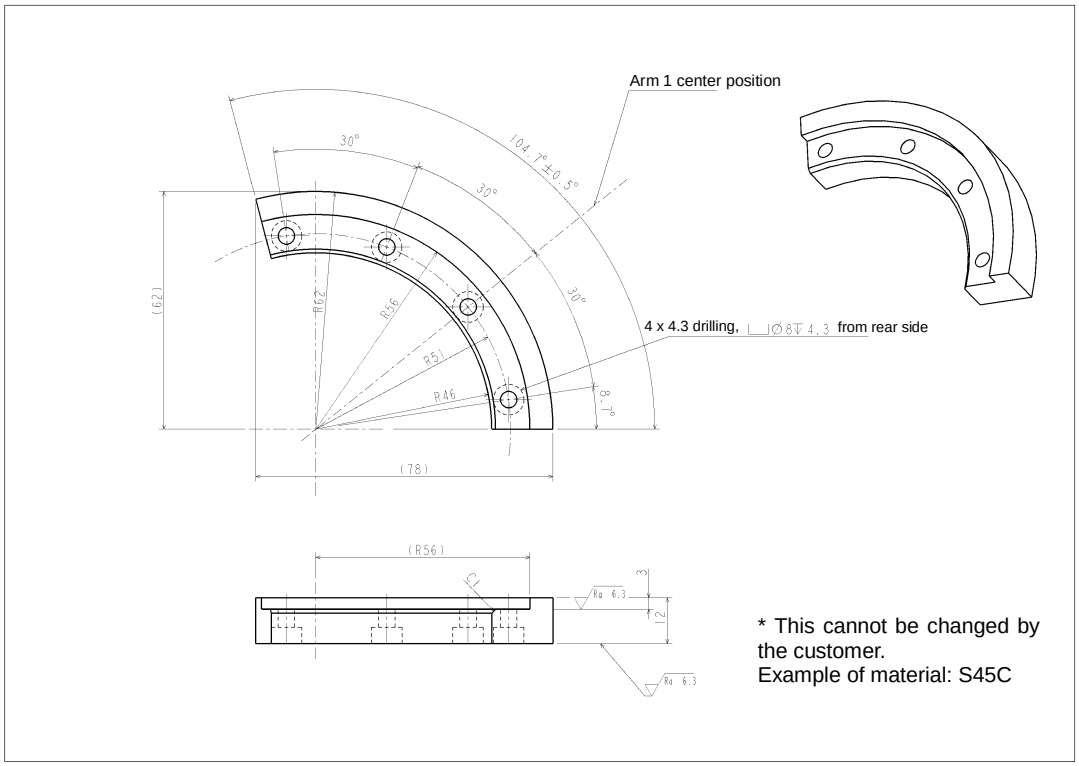


Fig. 3.16 Arm 1 side mechanical stopper (TVL500)

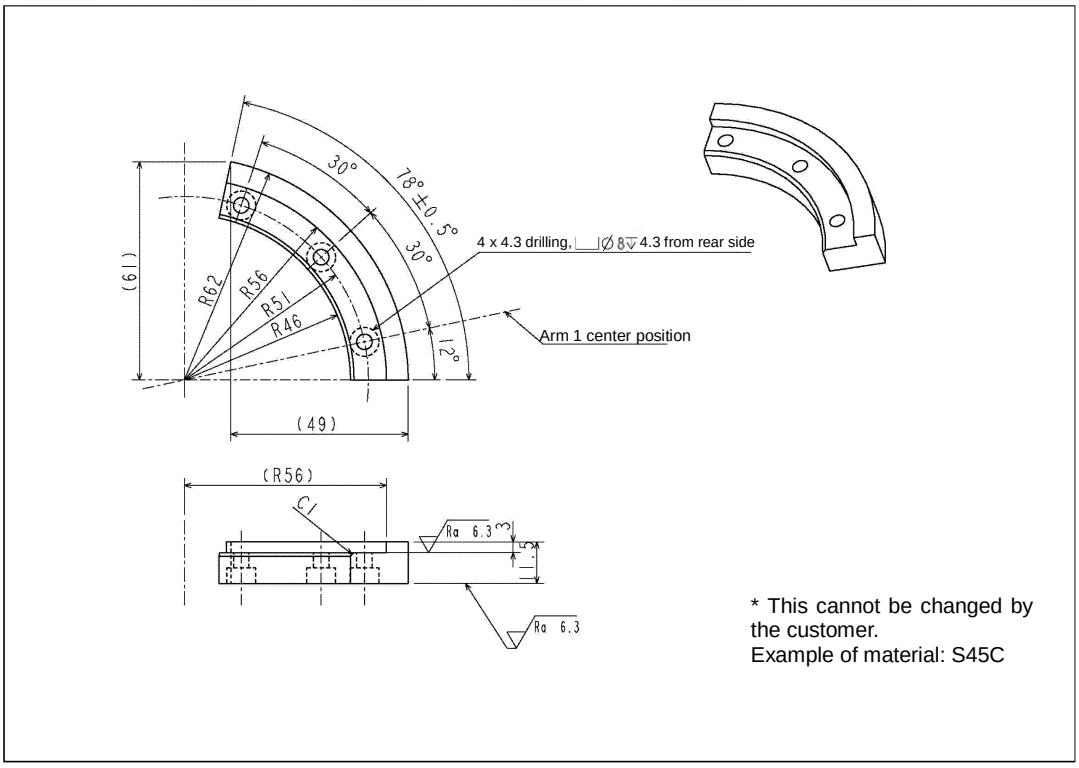
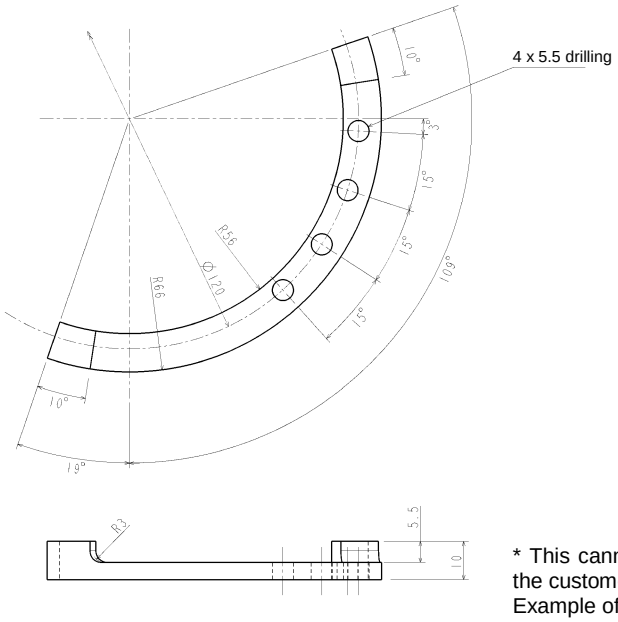


Fig. 3.17 Arm 1 side mechanical stopper (TVL700)

Example of changing movable range
Setting range: -30°, -90°



* This cannot be changed by the customer.
Example of material: S45C

Fig. 3.18 Design example of mechanical stopper on base swivel side (For reference, e.g.: TVL 500)

3.3.3. Change of Axis-3 Working Envelope

<1> Before shipment of the TVL 500/TVL700, the soft limit and mechanical stopper are set in such a way that the stroke of the axis 3 is kept within the range of Table 3.3.

Table 3.3 Strokes of the third axis at factory shipment

Operating direction	TVL500	TVL700
+	+150.5	+166
-	-0.5	-0.5

The settings of the operating range when the TVL500 robot is shipped from the factory are shown in Fig. 3.19 and those of the TVL700 robot in Fig. 3.20.
To change the operating range of the second axis, the customer needs to prepare a new mechanical stopper.
If the operating range is changed, it is also necessary to changer the software limits. For details about changing the software limit, see the "Instruction Manual: User Parameters" provided as a separate volume.

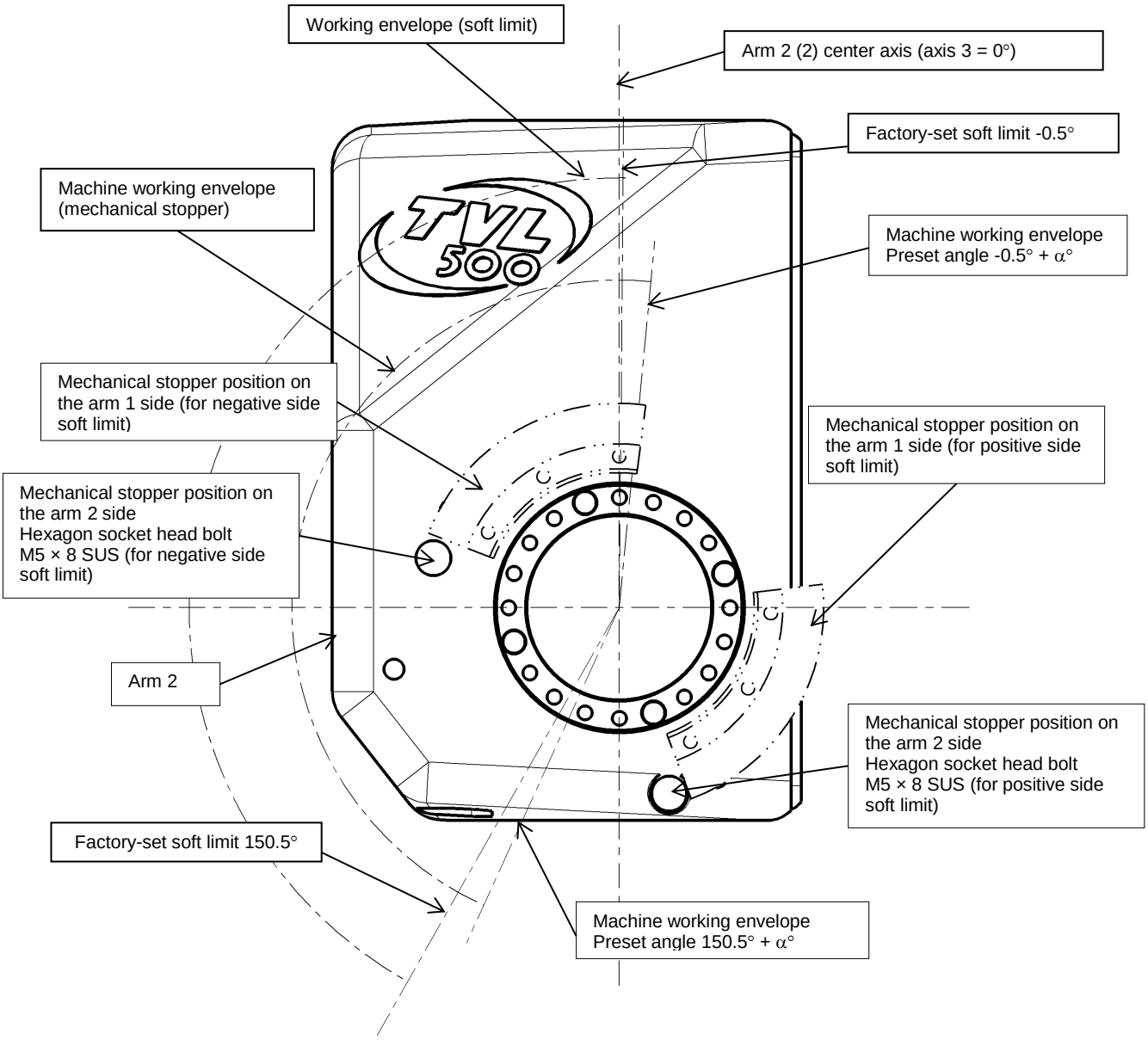


Fig. 3.19 Axis-3 working envelope setting (TVL500)

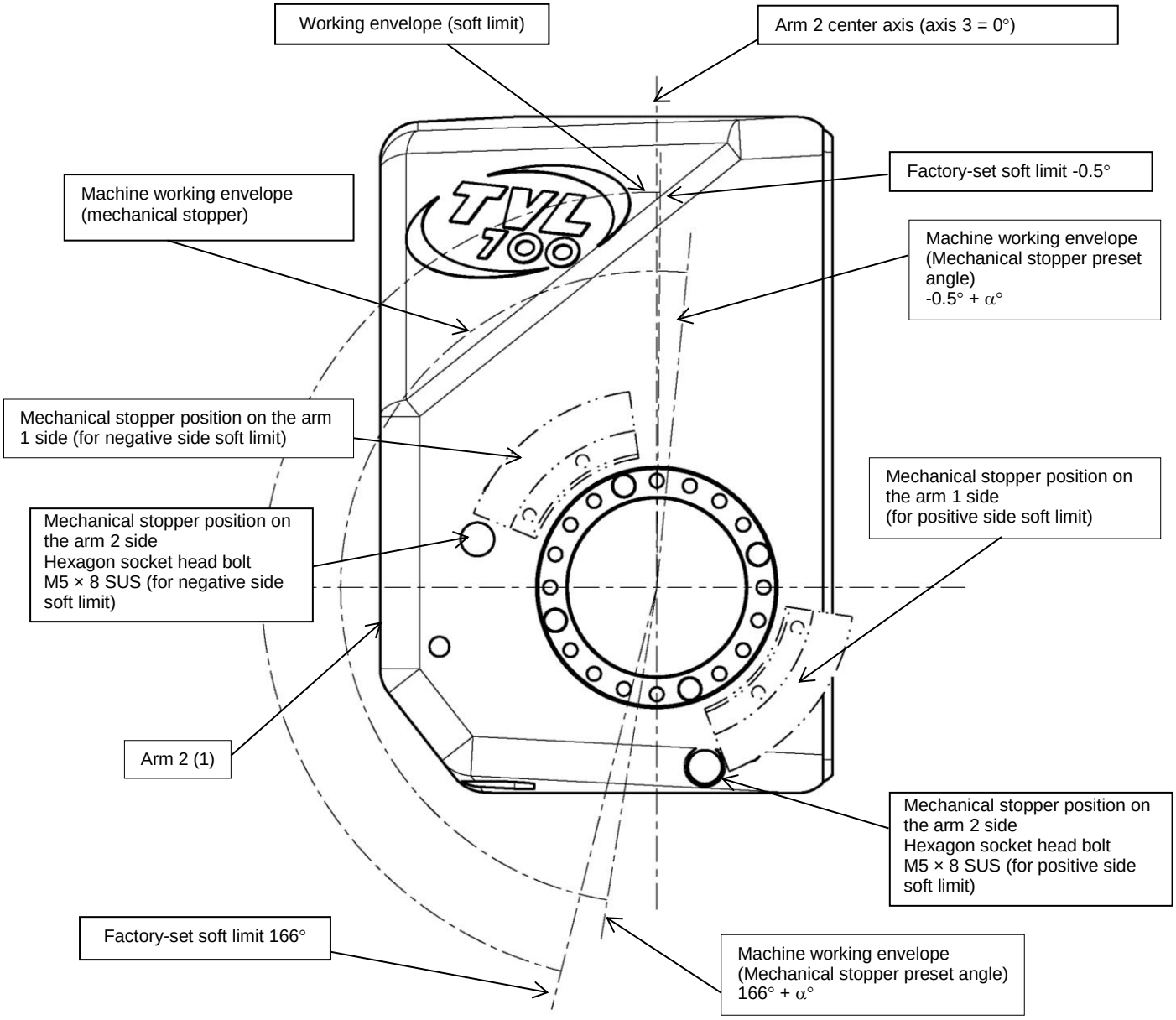


Fig. 3.20 Example of changing axis-3 working envelope (TVL 700)

<2> Examples of changing axis-3 working envelopes and the change method

By changing the shape of the mechanical stopper, you can set the operation range of the machine at a desired level. A design example of a mechanical stopper is explained below using the TVL500 robot as an example. Wherever required, you can design and manufacture a mechanical stopper on the arm 2 (1) side according to Figs. 3.21 to 24.

If a working envelope position is changed, the soft limit must be changed. As for the change of soft limits, see the "Instruction Manual: User Parameters" provided as a separate volume.

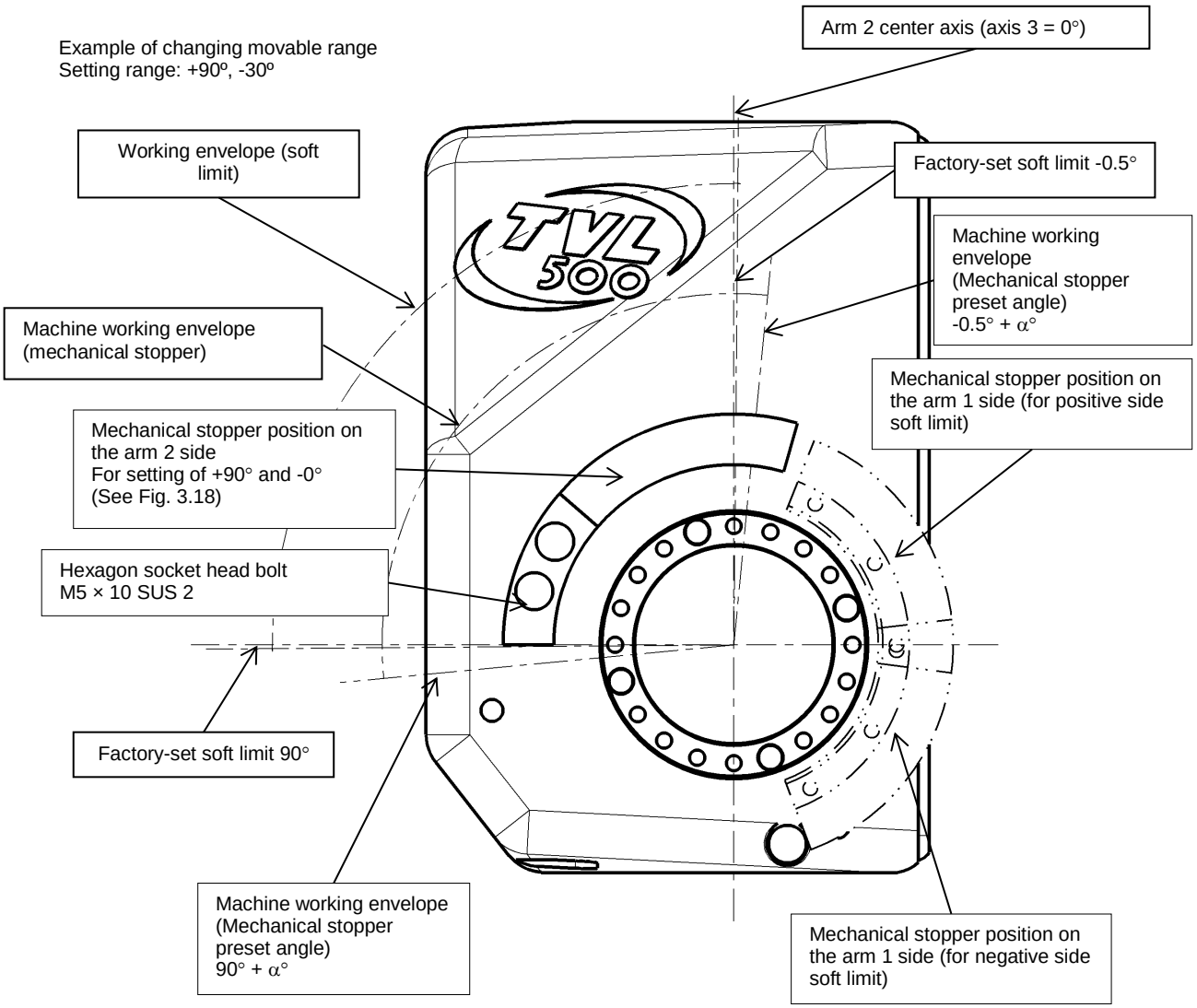


Fig. 3.21 Example of changing axis-3 working envelope (TVL 500)

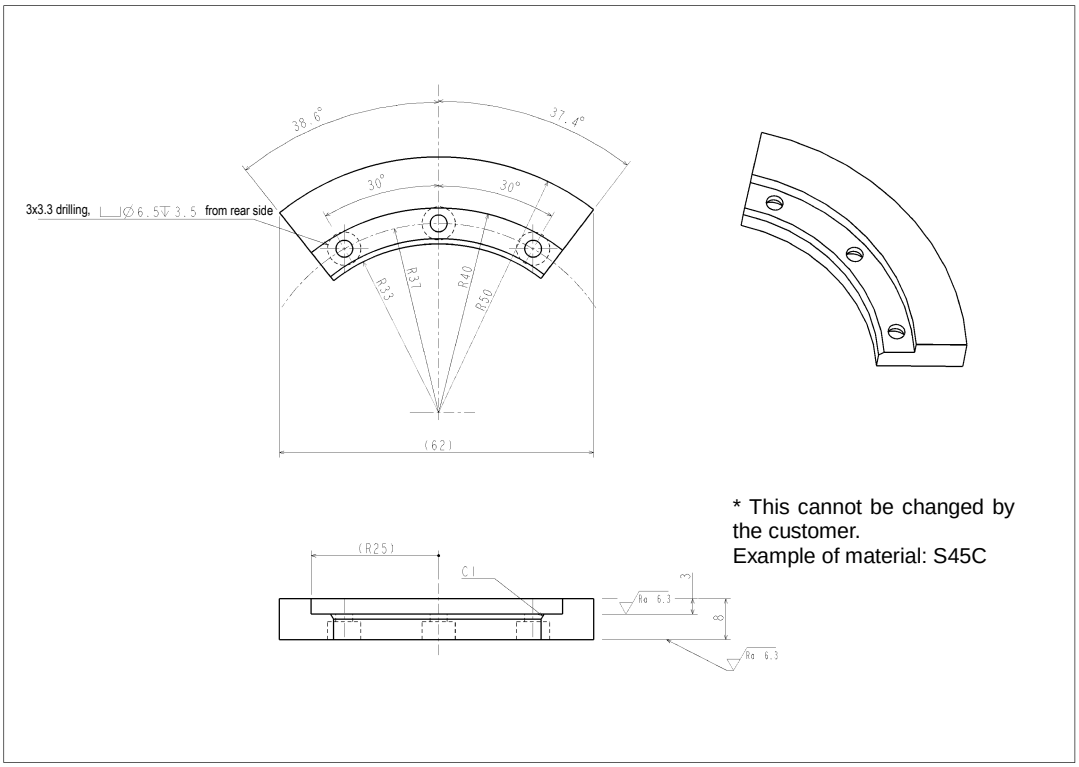


Fig. 3.22 Arm 1 side mechanical stopper (TVL500)

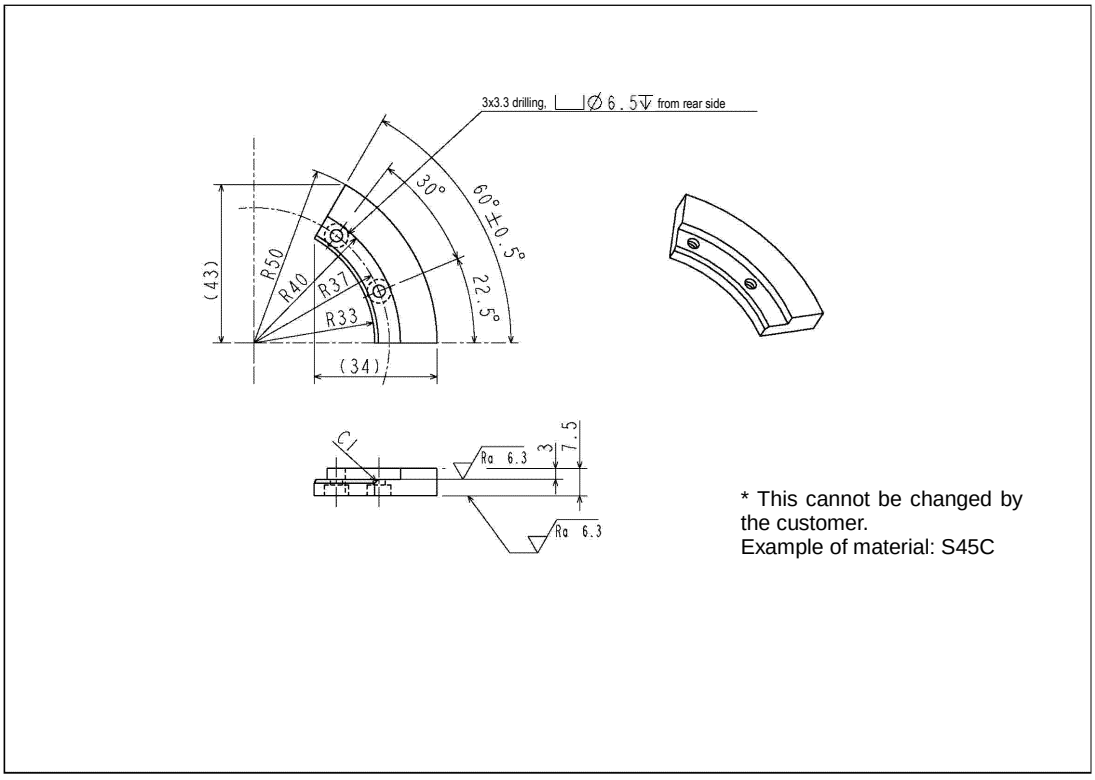


Fig. 3.23 Arm 1 side mechanical stopper (TVL700)

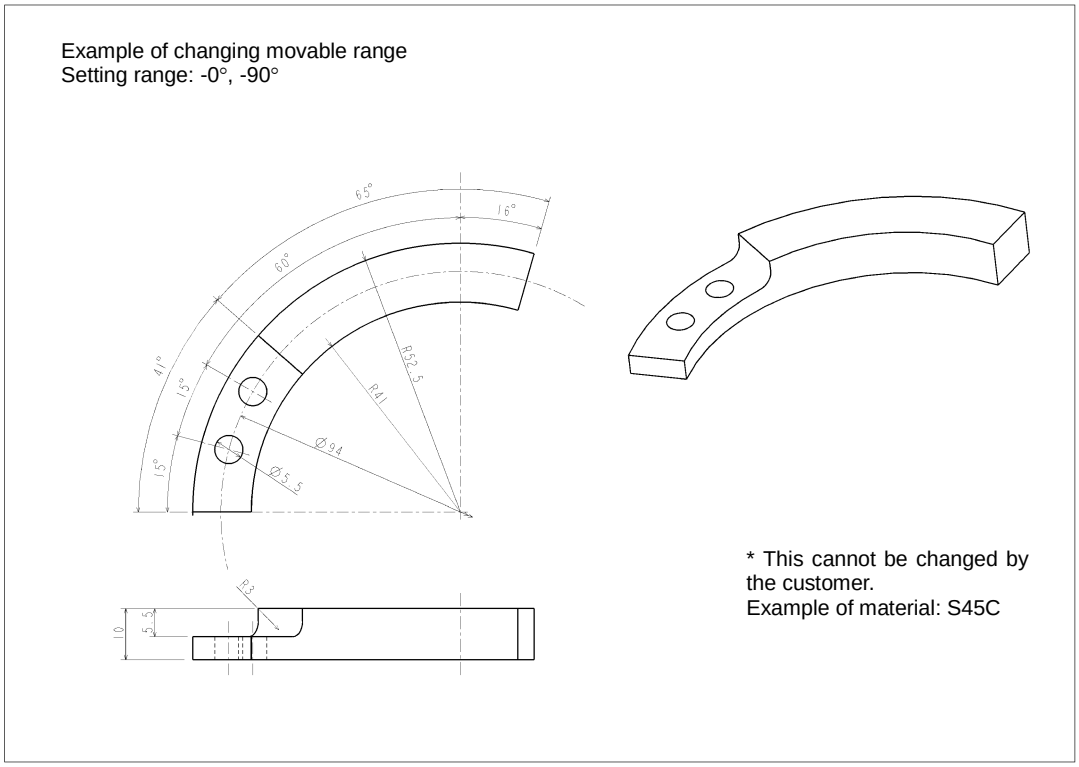


Fig. 3.24 Design example of mechanical stopper on the arm 2 (1) side (For reference, e.x. TVL500)

3.4. Precautions for Handling the Teach Pendant

Be careful of the following matters when handling the teach pendant.

CAUTION

- DO NOT drop the teach pendant or hit it against anything.
- DO NOT pull the cable running from the teach pendant.
- DO NOT press the switches on the teach pendant with anything sharp (like the tip of a knife, pencil, ball-point pen, etc.).
- DO NOT place or use the teach pendant near open flames.
- DO NOT leave the teach pendant in direct sunlight for a long period of time.

3.5. Safety Measures

To correctly handle the robot, carefully read the instruction manual "Safety" as a separate volume and take necessary safety measures.

4. Installing the Controller(In case of TSL3100)

4.1. External Dimensions

For the TSL3100E, please see "5. Installation of the Controller (In case of TSL3100E)". For the TS3100, please see "6. Installation of the Controller (In case of TS3100)". External view of the controller is shown in Fig. 4.1.

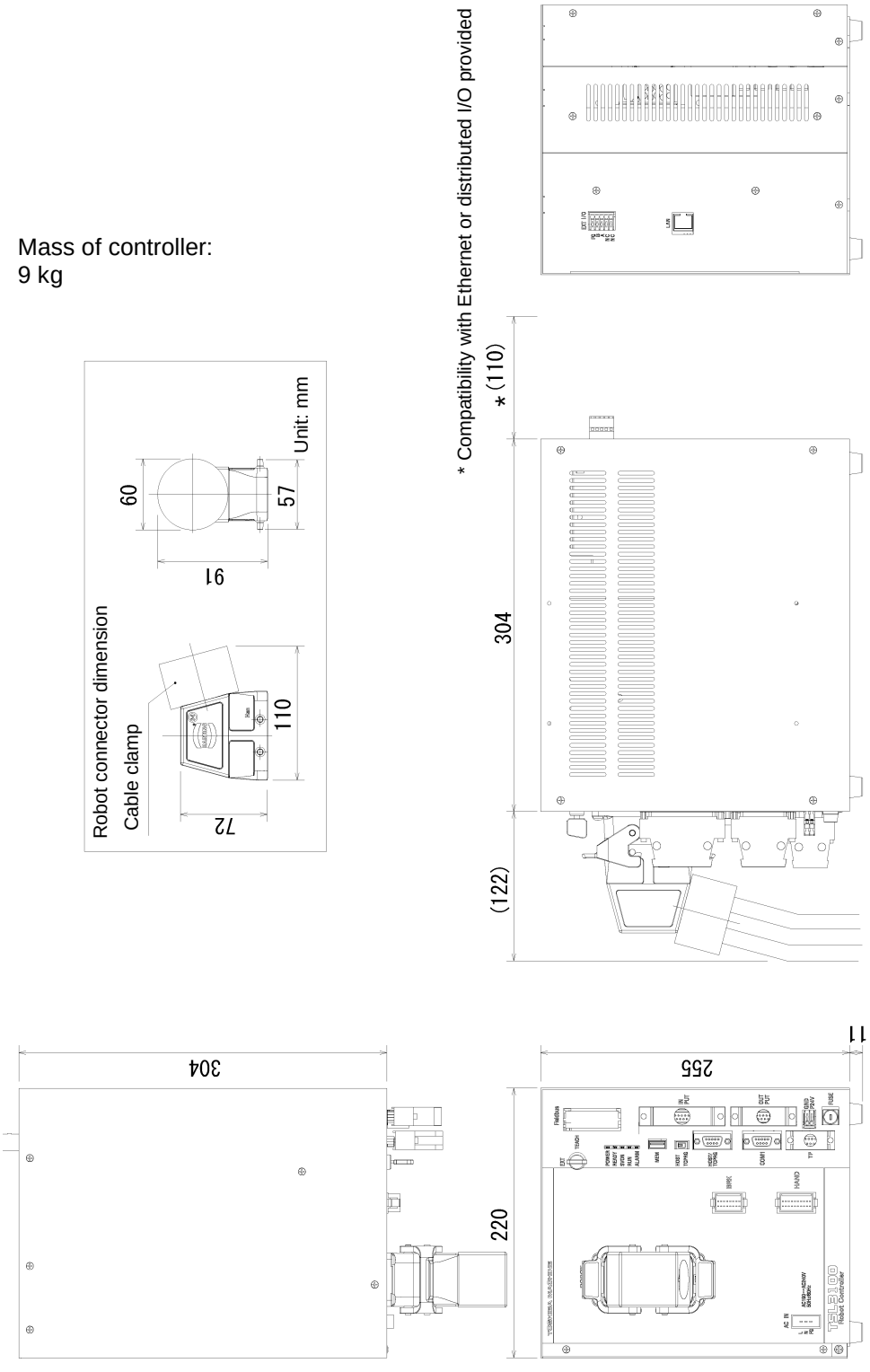


Fig. 4.1 External view of controller (TSL3100)

4.2. Precautions for Direct Installation

It is necessary to provide a clearance of 50 mm or more in the horizontal direction and a clearance of 100 mm or more in the upward direction near the controller.

CAUTION

- Provide a ventilation space at the side of the controller so that the air vent holes are not blocked. The space equal to the length of the legs should be kept below the lower surface.
  Failure to do so could cause the cooling performance to drop or to faults.
- DO NOT stack the controllers.
- DO NOT place any object on top of the controller.

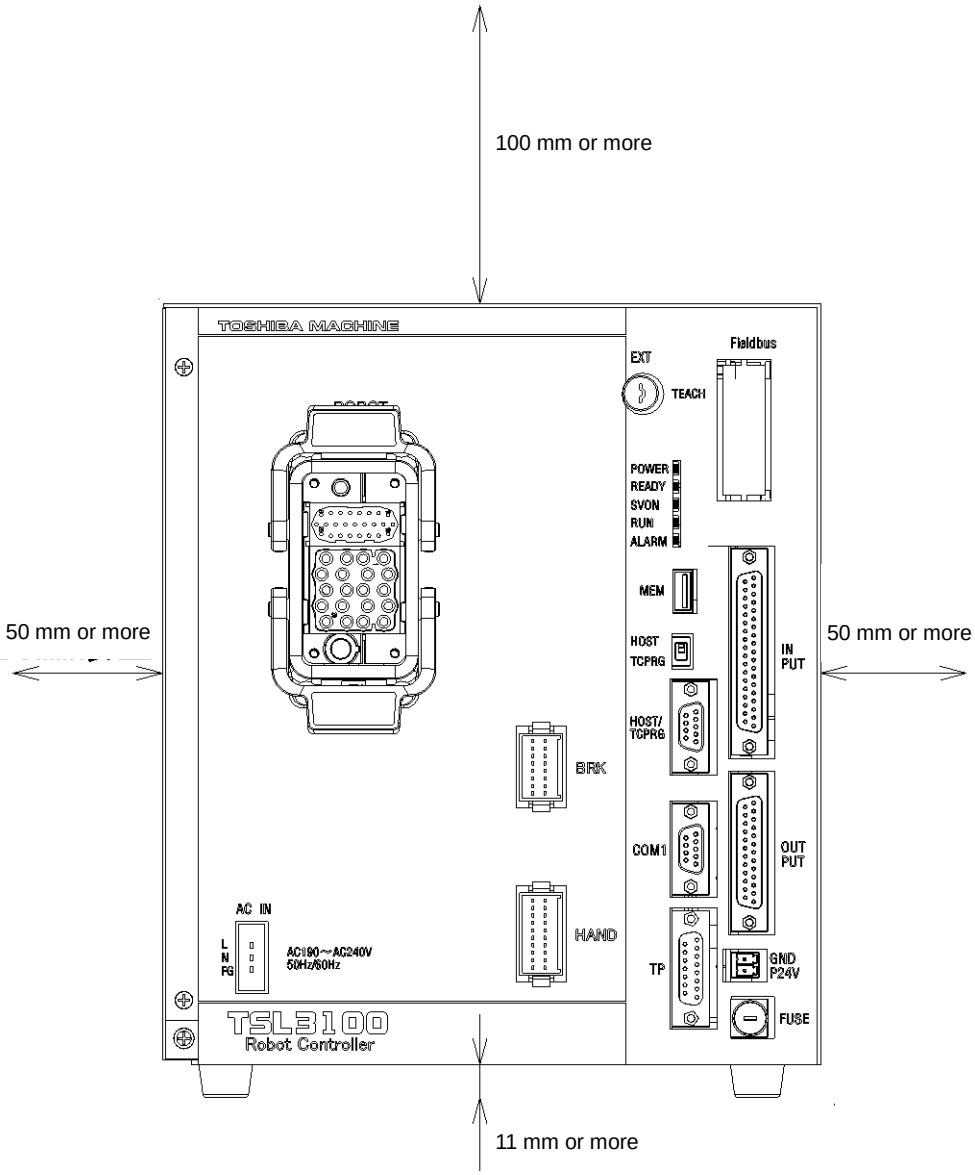


Fig. 4.2 Controller ventilation space (TSL3100)

4.3. Installation surface dimensions

To install the robot controller TSL3100 on the control panel or others, mount the fixture using the rubber leg screw hole on the bottom surface, and fix the controller on the control panel.

Note) The fixture (two-piece set) is optional. You are requested to assemble it.

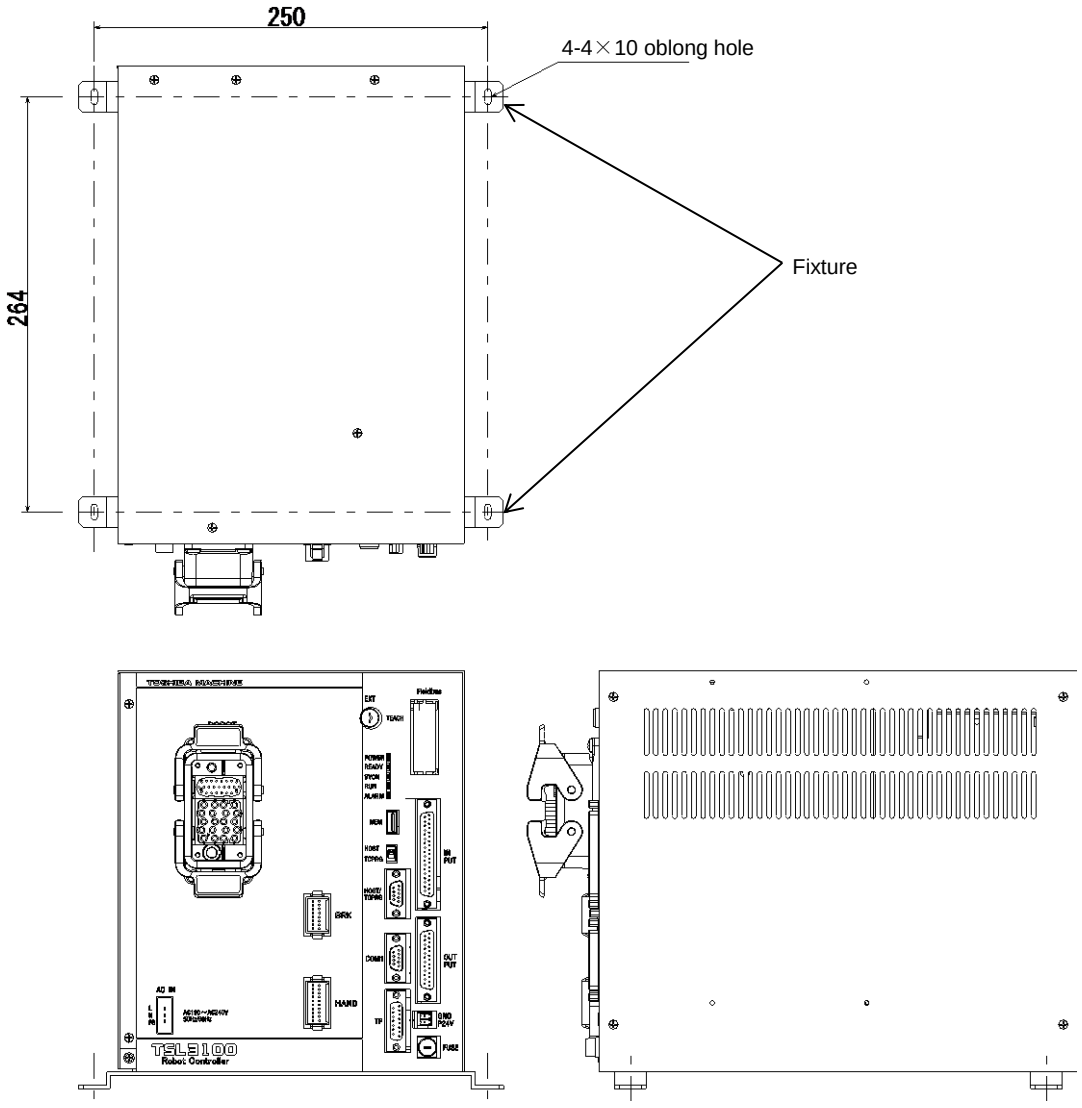


Fig. 4.3 Screw hole dimensions for securing controller (TSL3100)

4.4. Cautions for assembling the control panel

To install the robot controller TSL3100 on the control panel or others, take care of the following:

a) To install the robot controller TSL3100 on the control panel or others, remove the rubber leg from on the bottom surface. Fix the controller in position using the hole for mounting the rubber leg.

b) When there are options such as compatibility with Ethernet or distributed I/O, a cable must be connected to the rear of the controller. In this case, a space of 110 mm is required.

c) For maintenance, the upper cover should be removed. (See Fig. 4.4.)

d) Keep this in mind when installing the controller. In particular when the controller is mounted on the control panel at the time of shipment, the controller must be removed from the control panel at the time of maintenance. Specifically, be careful of the following points.

    1) Arrange the cables around the controller (so that the controller can be removed).
    2) Connect all cables in such a manner that the robot can be operated even if the controller is removed from the rack.

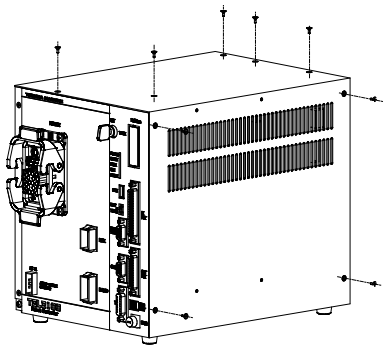


Fig. 4.4 Removing upper cover (TSL3100)

e) For connection with the robot cable connector, a clearance of 122 mm must be provided on the front portion of the controller, and a clearance of 110 mm on the rear of the controller.

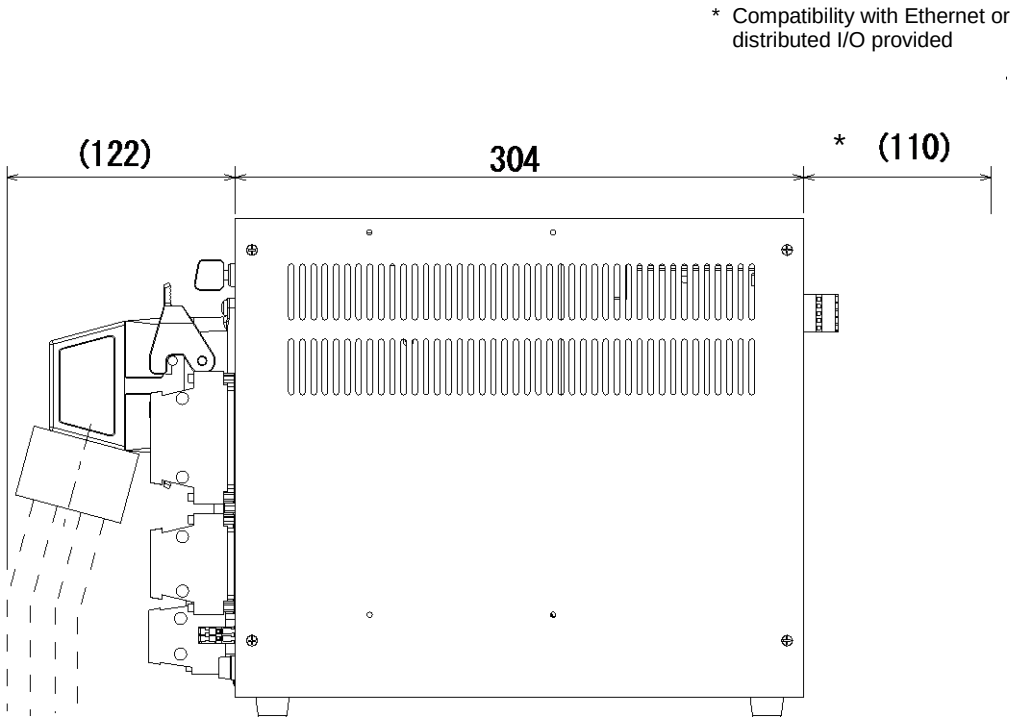


Fig. 4.5 Clearance of controller front side (TSL3100)

CAUTION

- If the control panel is completely sealed, open an air vent hole, use a fan to provide forcible ventilation or provide indirect cooling so that heat will not remain inside the control panel. If not, heat will remain in the control panel and controller and this may cause a trouble.

5. Installing the Controller (In case of TSL3100E)

5.1. External Dimensions

For the TSL3100, please see "4. Installation of the Controller (In case of TSL3100)." For the TS3100, please see "6. Installation of the Controller (In case of TS3100)."

External view of the controller is shown in Fig. 5.1.

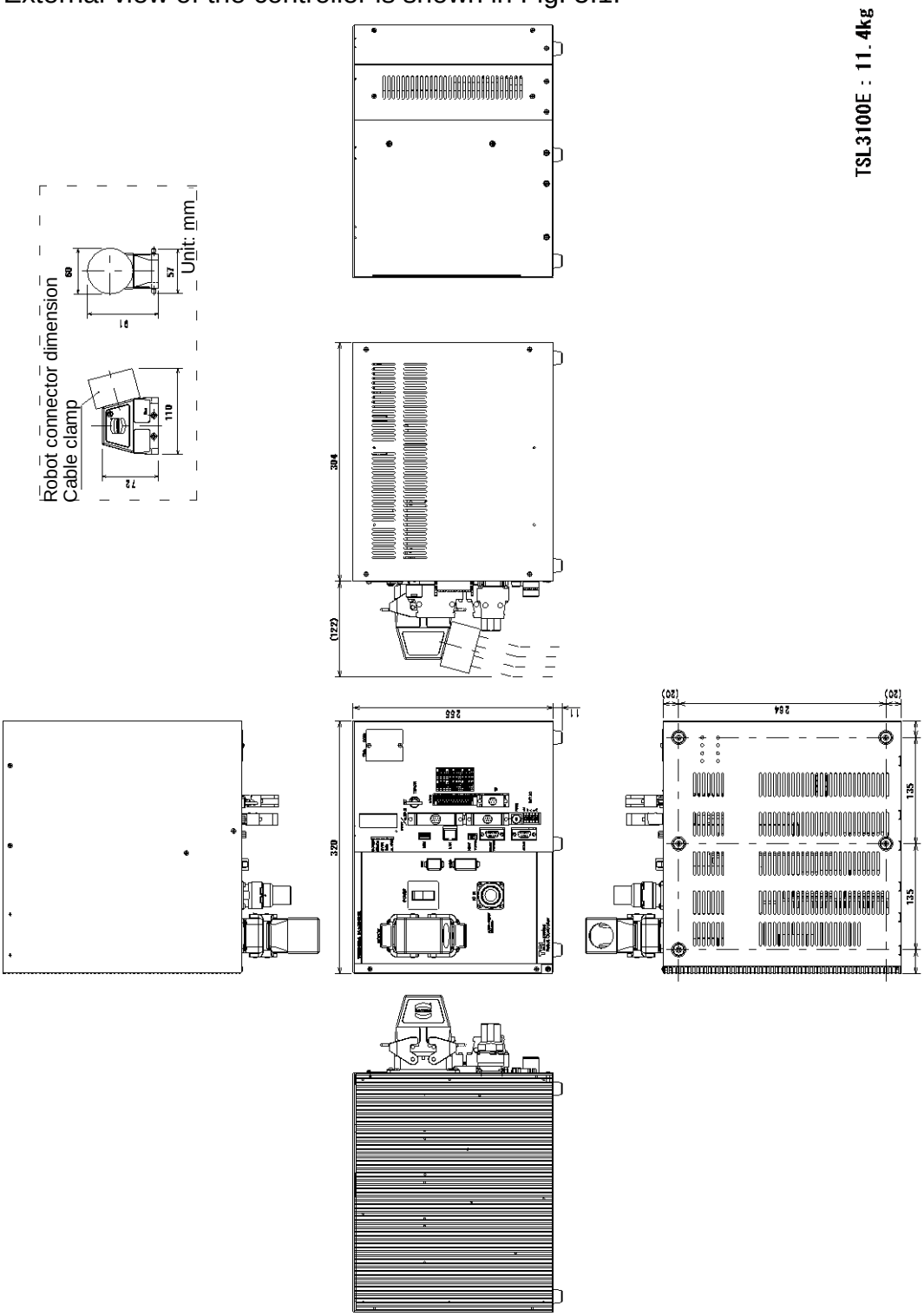


Fig. 5.1 External view of the controller (TSL3100E)

5.2. Precautions for Direct Installation

It is necessary to provide a clearance of 50 mm or more in the horizontal direction and a clearance of 100 mm or more in the upward direction near the controller.

CAUTION

- Provide a ventilation space at the side of the controller so that the air vent holes are not blocked. The space equal to the length of the legs should be kept below the lower surface.
  Failure to do so could cause the cooling performance to drop or to faults.
- DO NOT stack the controllers.
- DO NOT place any object on top of the controller.

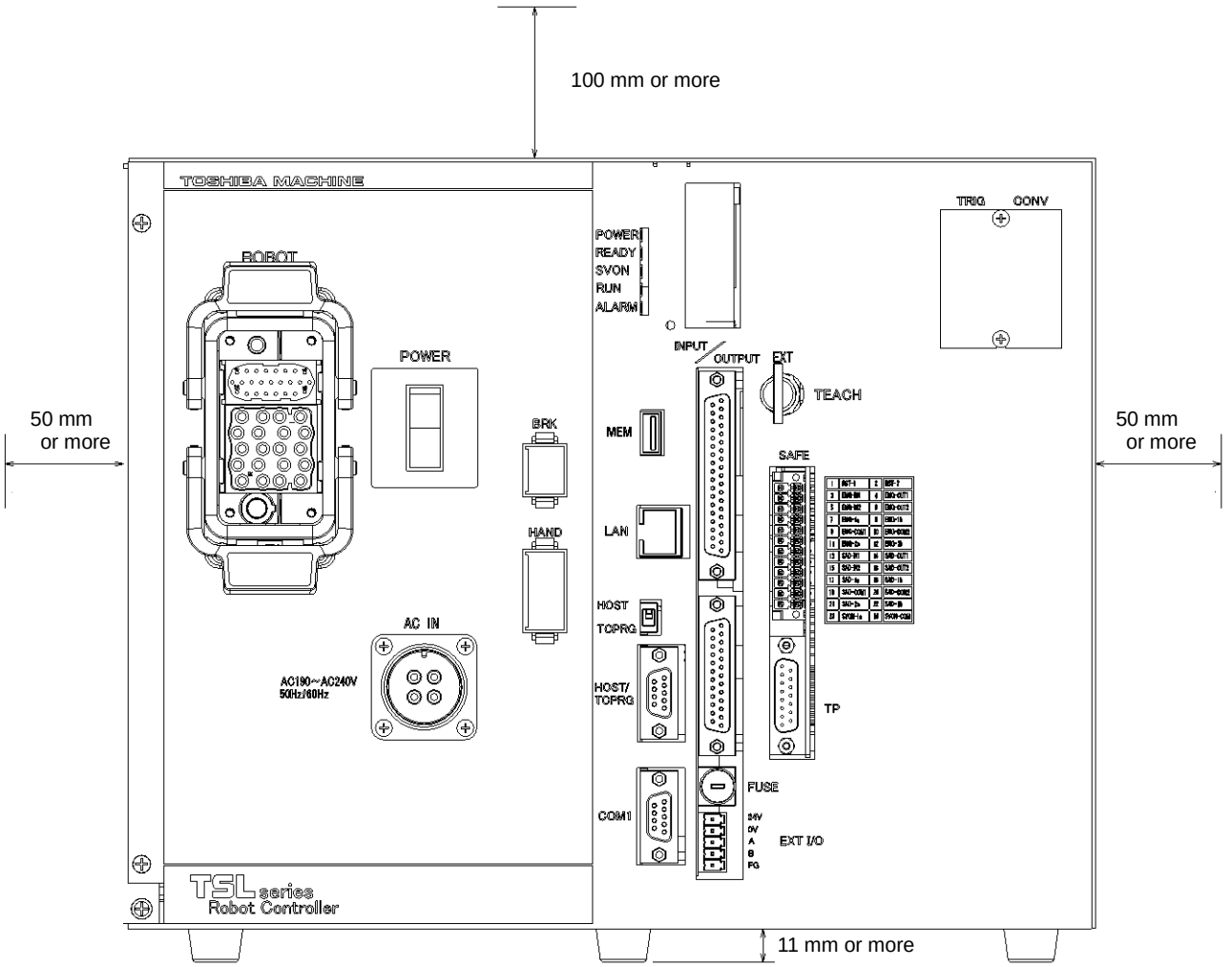


Fig. 5.2 Controller ventilation space (TSL3100E)

5.3. Installation surface dimensions

To install the robot controller TSL3100E on the control panel or others, mount the fixture using the rubber leg screw hole on the bottom surface, and fix the controller on the control panel. The rubber leg located in the middle of controller should not be removed

Note) The fixture (two-piece set) is optional. You are requested to assemble it.

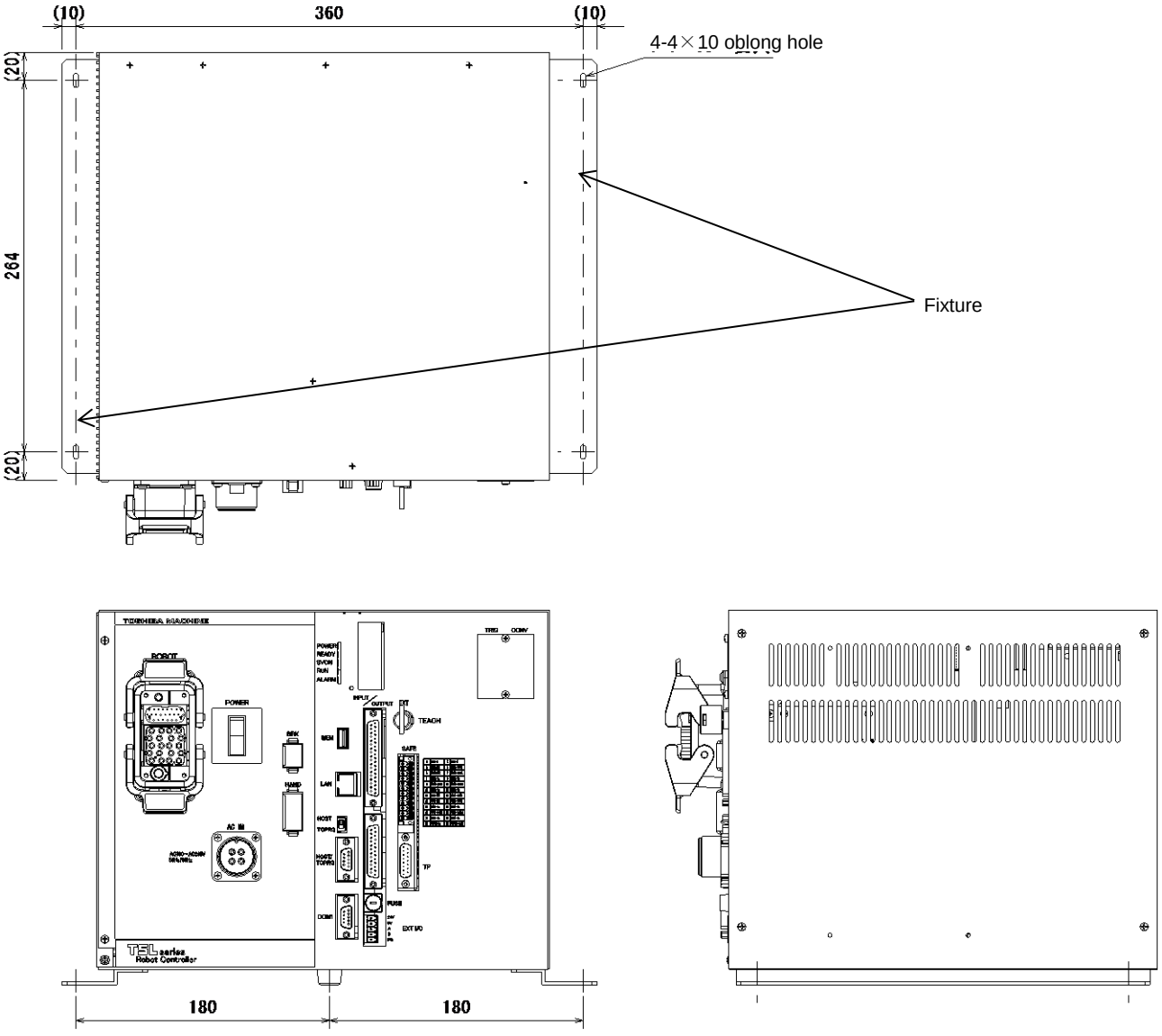


Fig. 5.3 Screw hole dimensions for securing controller (TSL3100E)

5.4. Cautions for assembling the control panel

To install the robot controller TSL3100E on the control panel or others, take care of the following:

a) To install the robot controller TSL3100E on the control panel or others, remove the rubber leg from on the bottom surface. Fix the controller in position using the hole for mounting the rubber leg.

b) For maintenance, the upper cover should be removed. (See Fig. 5.4.)

c) Keep this in mind when installing the controller. In particular when the controller is mounted on the control panel at the time of shipment, the controller must be removed from the control panel at the time of maintenance. Specifically, be careful of the following points.

1) Arrange the cables around the controller (so that the controller can be removed).
2) Connect all cables in such a manner that the robot can be operated even if the controller is removed from the rack.

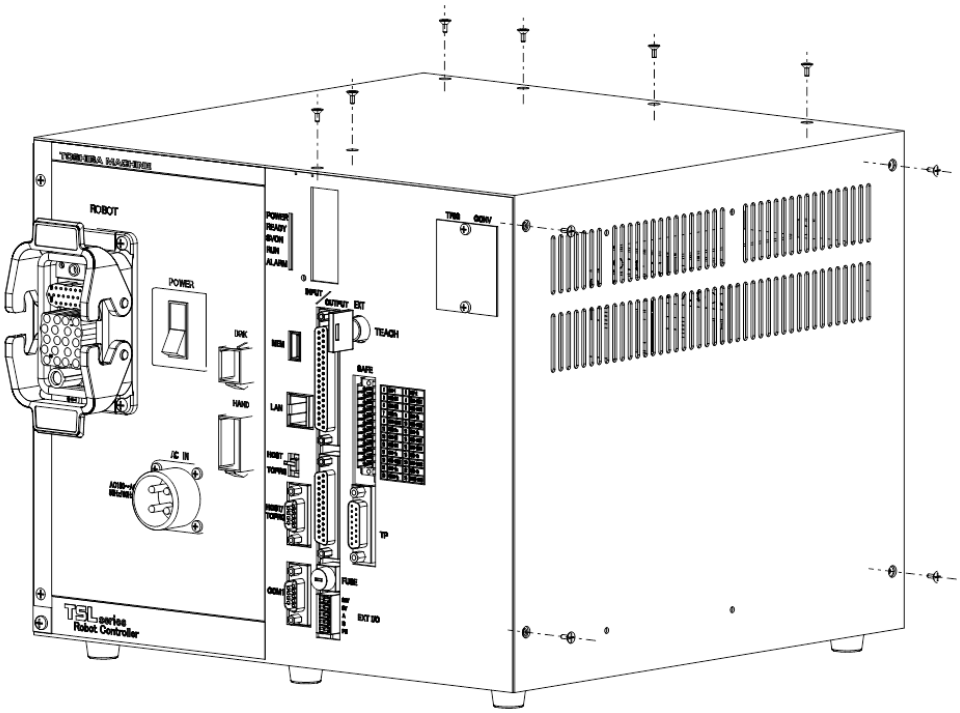


Fig. 5.4 Removing upper cover (TSL3100E)

d) For connection with the robot cable connector, a clearance of 122 mm must be provided on the front portion of the controller, and a clearance of 110 mm on the rear of the controller.

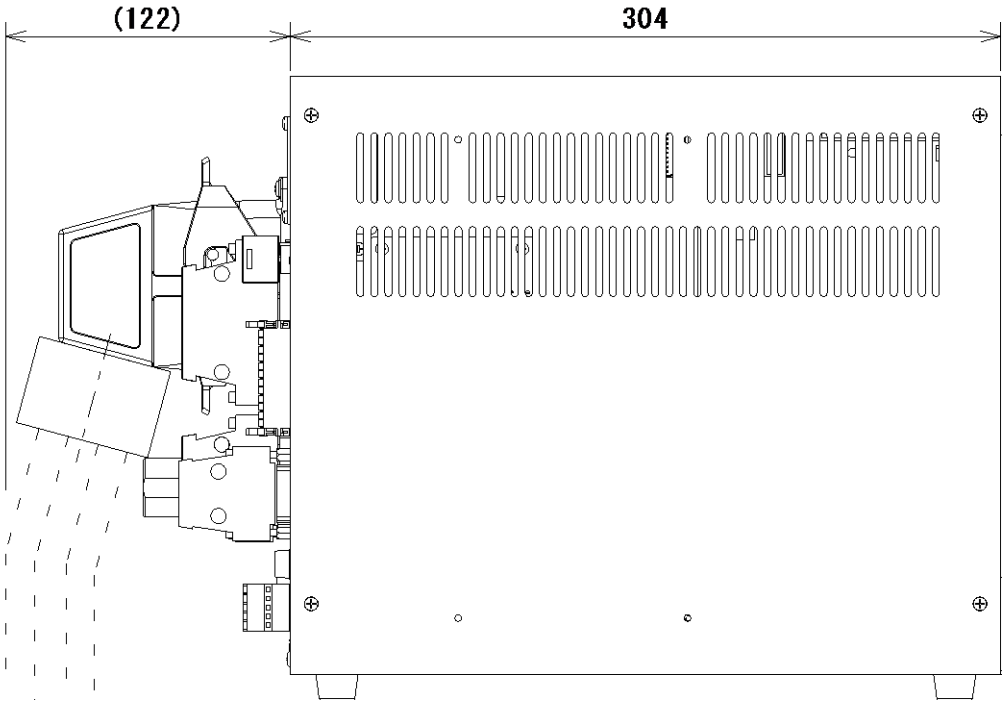


Fig. 5.5 Clearance of controller front side (TSL3100E)

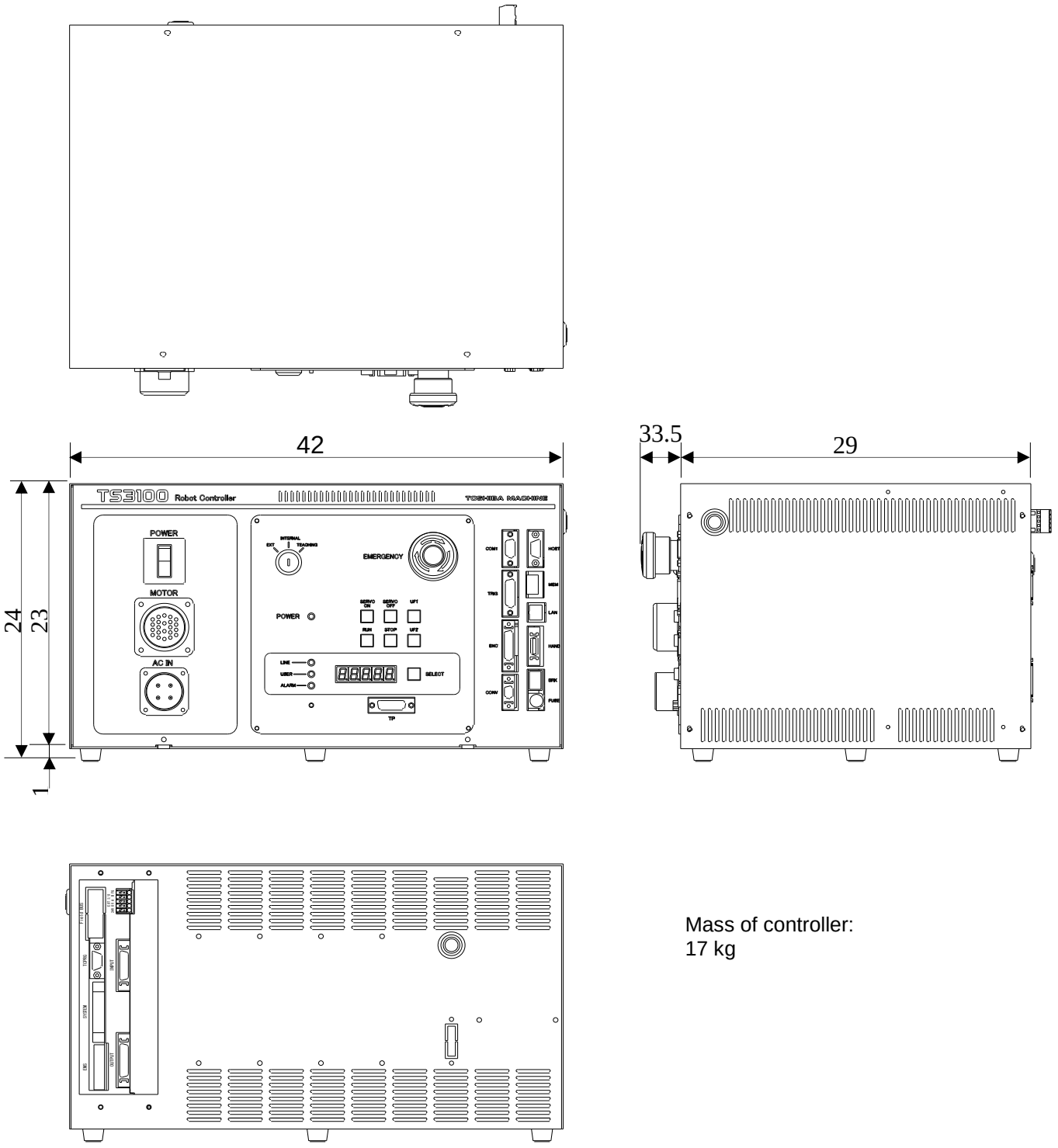
CAUTION

- If the control panel is completely sealed, open an air vent hole, use a fan to provide forcible ventilation or provide indirect cooling so that heat will not remain inside the control panel. If not, heat will remain in the control panel and controller and this may cause a trouble.

6. Installing the Controller (In case of TS3100)

6.1. External Dimensions

For the TSL3100, please see "4. Installation of the Controller (In case of TSL3100)." For the TSL3100E, please see "5. Installation of the Controller (In case of TSL3100E)." External view of the controller is shown in Fig. 6.1.



Mass of controller:
17 kg

Fig. 6.1 External view of the controller(TS3100)

6.2. Precautions for Direct Installation

It is necessary to provide a clearance of 50 mm or more in the horizontal direction and a clearance of 100 mm or more in the upward direction near the controller.

CAUTION

- Provide a ventilation space at the side of the controller so that the air vent holes are not blocked. The space equal to the length of the legs should be kept below the lower surface.
  Failure to do so could cause the cooling performance to drop or to faults.
- DO NOT stack the controllers.
- DO NOT place any object on top of the controller.

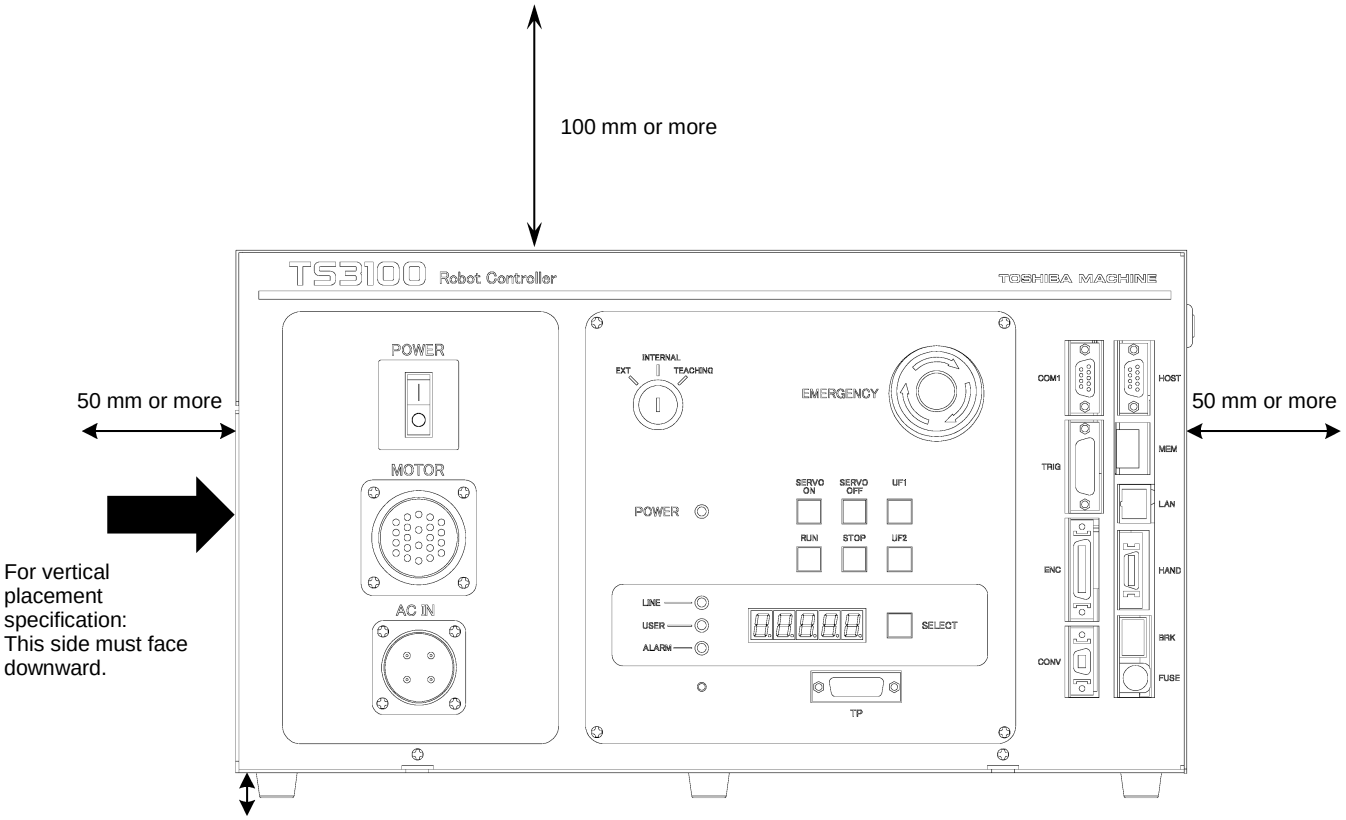


Fig. 6.2 Controller ventilation space

6.3. Installation surface dimensions

When installing the robot controller by mounting in a rack, use the holes located at both ends of the front panel to fix the robot controller to the rack. The side bracket [1] in Fig. 6.3 is an option.

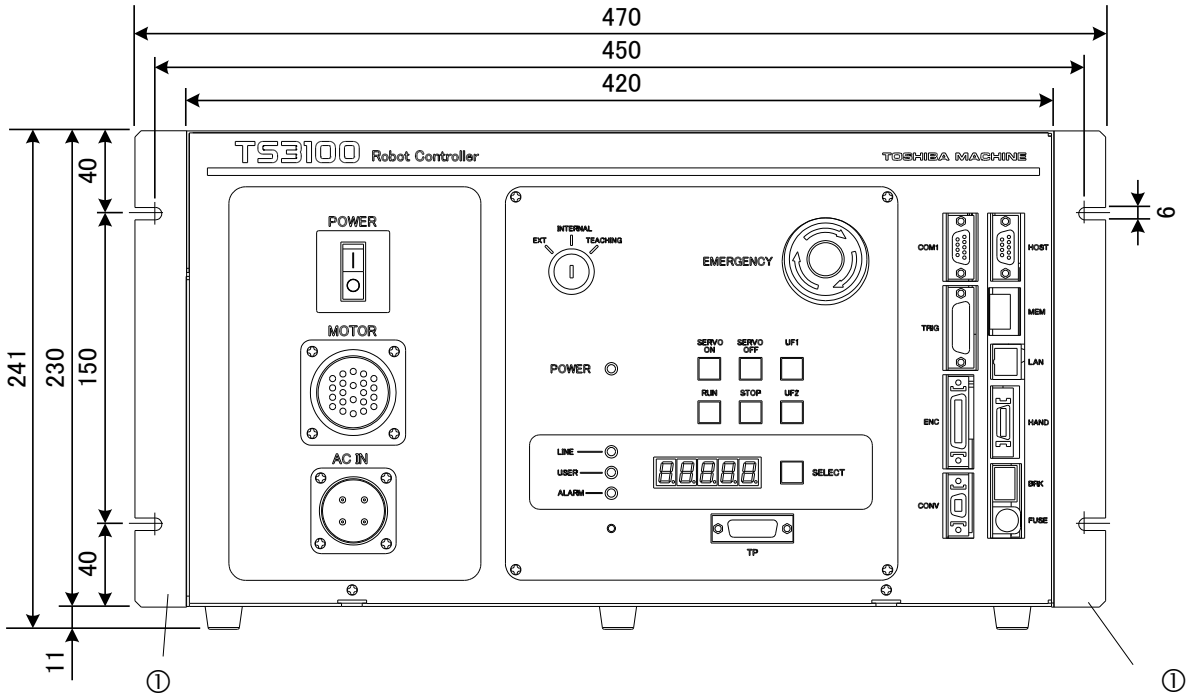


Fig. 6.3 Screw hole dimensions for securing controller

6.4. Precautions for Rack Mounting

When mounting the robot controller TS3100 to the rack, please follow the precautions below,

a) When installing the robot controller by mounting in a rack, use the holes located at both ends of the front panel to fix the robot controller to the rack (Side brackets are required.)

⚠ CAUTION

If the rack is completely airtight, open air release holes, ventilate the air forcibly with a fan, or conduct indirect cooling to release heat from the rack.
Otherwise, heat is confined inside the rack and the robot controller, causing failure.

b) Because a cable connector will be connected to the rear of the robot controller, a space of at least 110 mm is necessary in the rear direction.
To perform maintenance of the robot controller, remove the upper cover. (See Fig. 6.4.)

When installing the robot controller, make sure that the maintenance of the robot controller can be done without any problem. Especially when the robot controller is stored in a rack, it will be necessary to take out the robot controller from the rack for maintenance.
The following items must be taken into account:

1) Cable installation in the rear of the robot controller (Cables must be installed in such a way that the robot controller can be pulled out easily.)
2) Cable installation between the robot controller and the control panel when the control panel is detached
3) Keep the robot operable by connecting all the cables even when the robot controller is taken out of the rack.

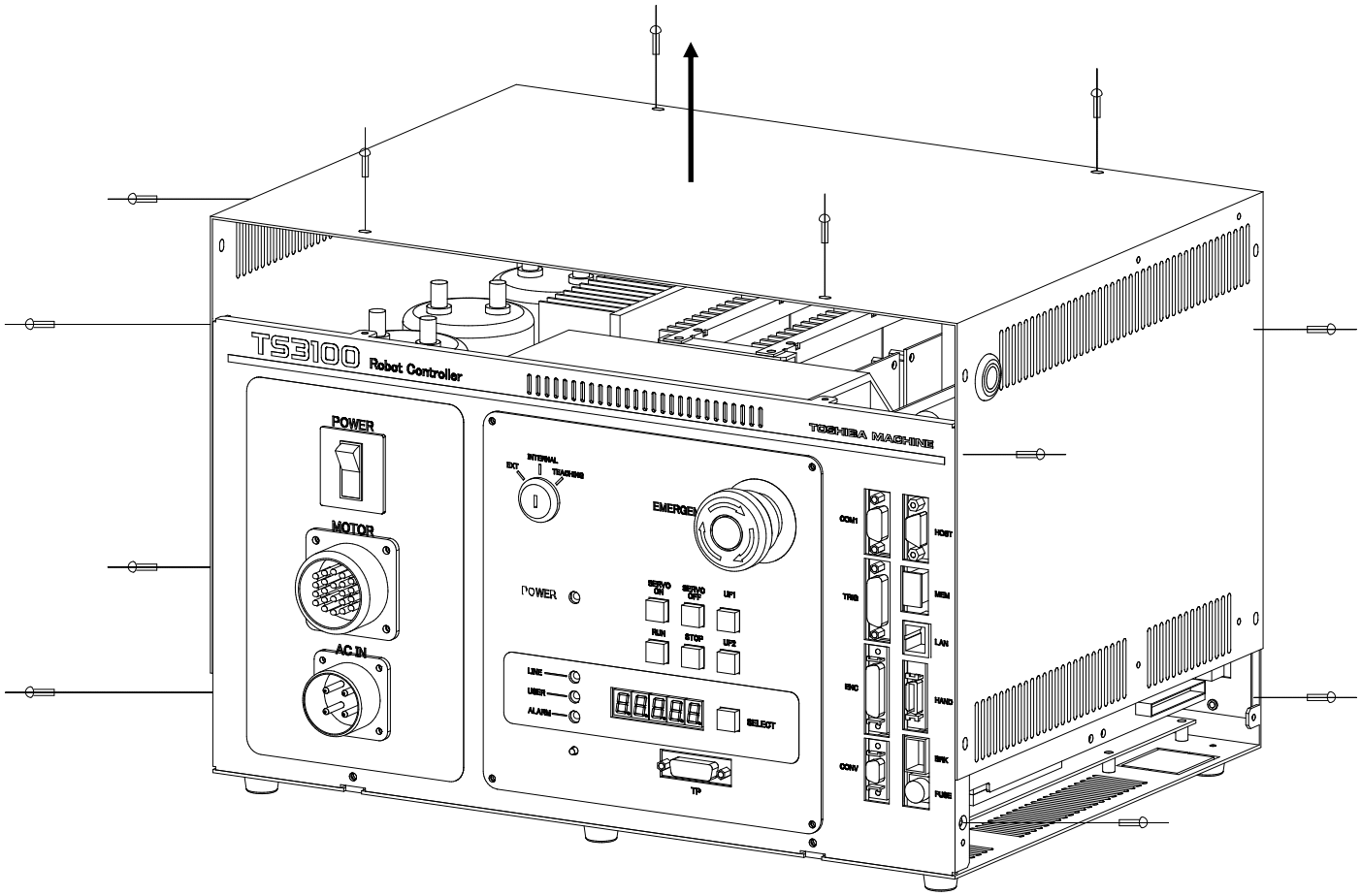


Fig. 6.4 Removing the upper cover

c) When mounting the robot controller in a rack, be sure to construct so that the weight of the robot controller can be supported by the legs of the robot controller themselves. The robot controller's rack mount screw holes are provided to fasten the robot controller panel and thus the weight of the robot controller cannot be supported solely with these.

d) Allocate a clearance of about 90 mm in front of the robot controller for connecting the teaching pendant connector. Even if the teaching pendant is not used, a clearance of about 60 mm is required since a dummy plug must be connected.

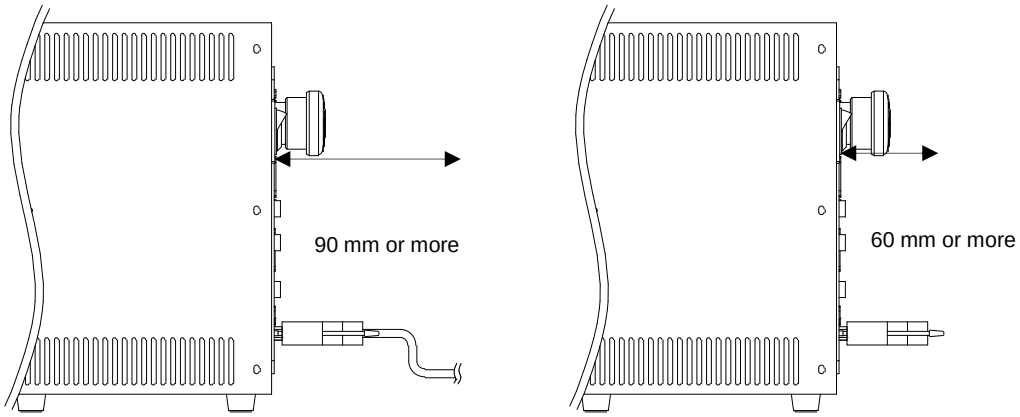


Fig. 6.5 Clearance in front of the Controller

7. System Connections(In case of TSL3100)

7.1. Cable Wiring

This section describes the various types of cables and connectors and explains how these are to be connected.

7.1.1. Connector Arrangement on the Controller

The cables connected to the robot controller are shown in Fig. 6.1.

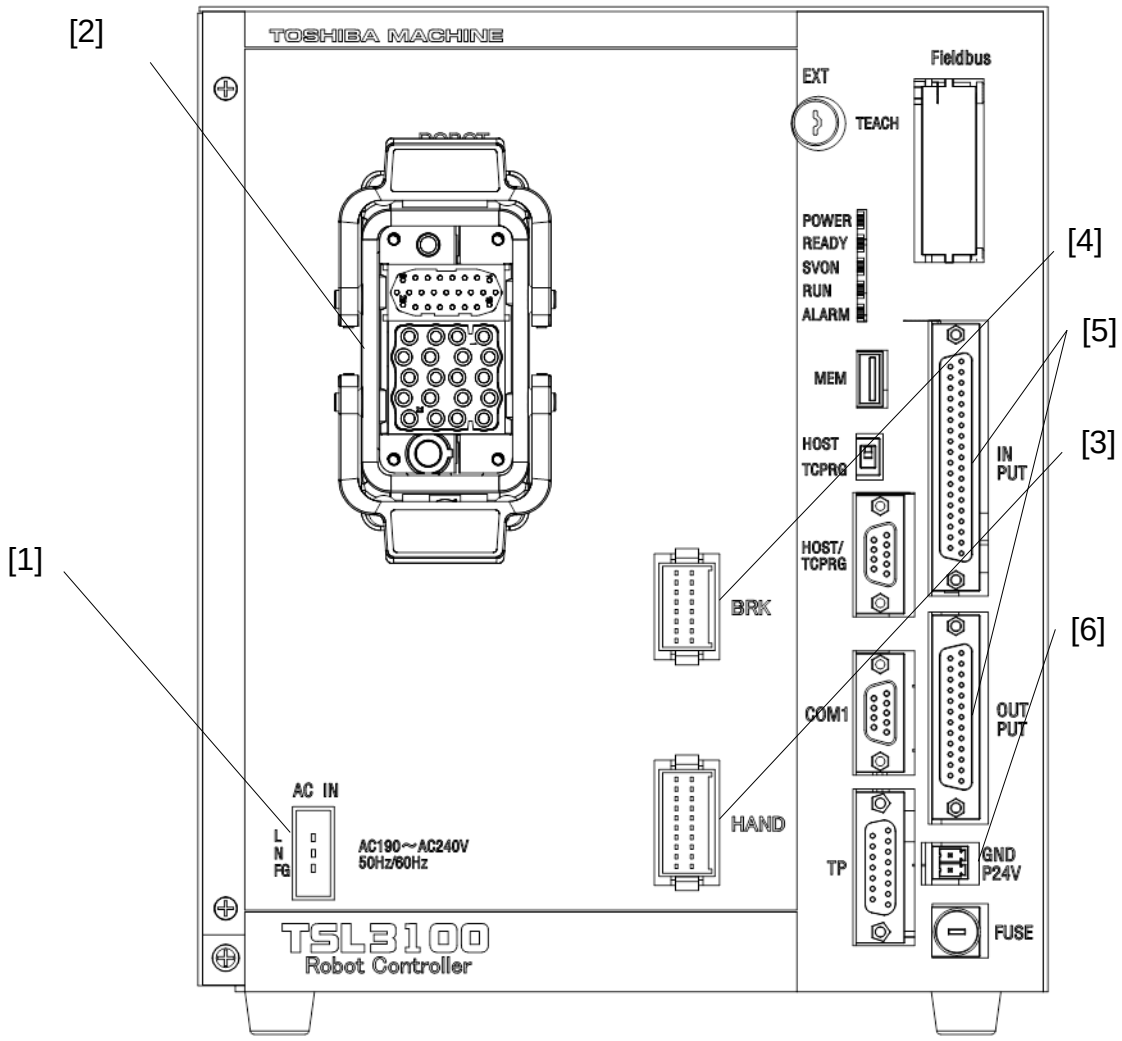


Fig. 7.1 Robot controller connector arrangement (TSL3100)

[1] Power cable (ACIN)
[2] Motor cable, Encoder cable (ROBOT)
[3] Robot control signal cable (HAND)

[4] Brake signal cable (BRK)
[5] External operation input signal cables (INPUT, OUTPUT)
[6] Power supply cable for external input/output (GND, P24V)

In the subsequent paragraphs, we explain how to connect cables [1] to [4] inclusive. For information on how to connect cables [5] and [6] refer to the Interface Manual.

7.1.2. Connecting the Power Cable

The power cable (“ACIN” ([1] of Fig. 7.1)) is used to supply the main AC power to the controller.

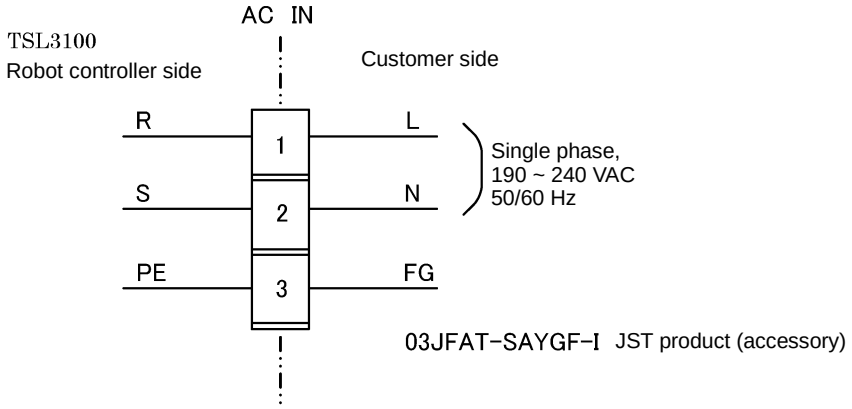


Table 7.1 Power supply specifications (TSL3100)

Power supply	Single-phase, 190 ~ 240 VAC, 50/60 Hz ±1 Hz
Instantaneous power failure	Within 40 msec
Grounding	Class D grounding

The connector is a standard accessory.

ACIN plug connector Type: 03JFAT-SAYGF-I Maker: J.S.T. Mfg.
Wire 0.8 mm^2 ~ 2.0 mm^2 (AWG#18~AWG#14)

As the cable is not an accessory, use the attached plug connector connected to ACIN on the controller side to manufacture a cable.
For connection between the connector and cable, place the conductor in-between.
For the terminal arrangement, see Para. 7.1.7.

DANGER

- Be sure to use the designated wire. Failure to do so could lead to fires or faults.
- When connecting the connector and wires, make sure not to mistake the terminal arrangement.
- After making the connection, use a tester, etc., to confirm the connection.

CAUTION

- Unless the main power is normally supplied to the controller due to phase defect or voltage drop, an error of “8–027 Slow Charge error” occurs. When this happens, make sure that the maser power voltage at the controller power connector satisfies the specified input power of the controller, and that the same voltage is stabilized.
- For details on "8-027 Slow Charge error," see the "Instruction Manual: Alarms" provided as a separate volume.

7.1.3. Connecting the Motor Cable/Encoder Cable

The motor cable connects the controller and robot, and supplies the power required to rotate the motor from the controller servo driver to each axis feed motor of the robot. The encoder cable is a signal line used to transmit a signal from the rotation angle detecting encoder of each robot axis to the controller.

The motor cable connector and encoder connector are for ROBOT ([2] in Fig. 7.1). The motor cable and encoder cable on the robot side are located at [1] of Fig. 7.2.

The cables and connectors for the motor cable and encoder cable are standard accessories.

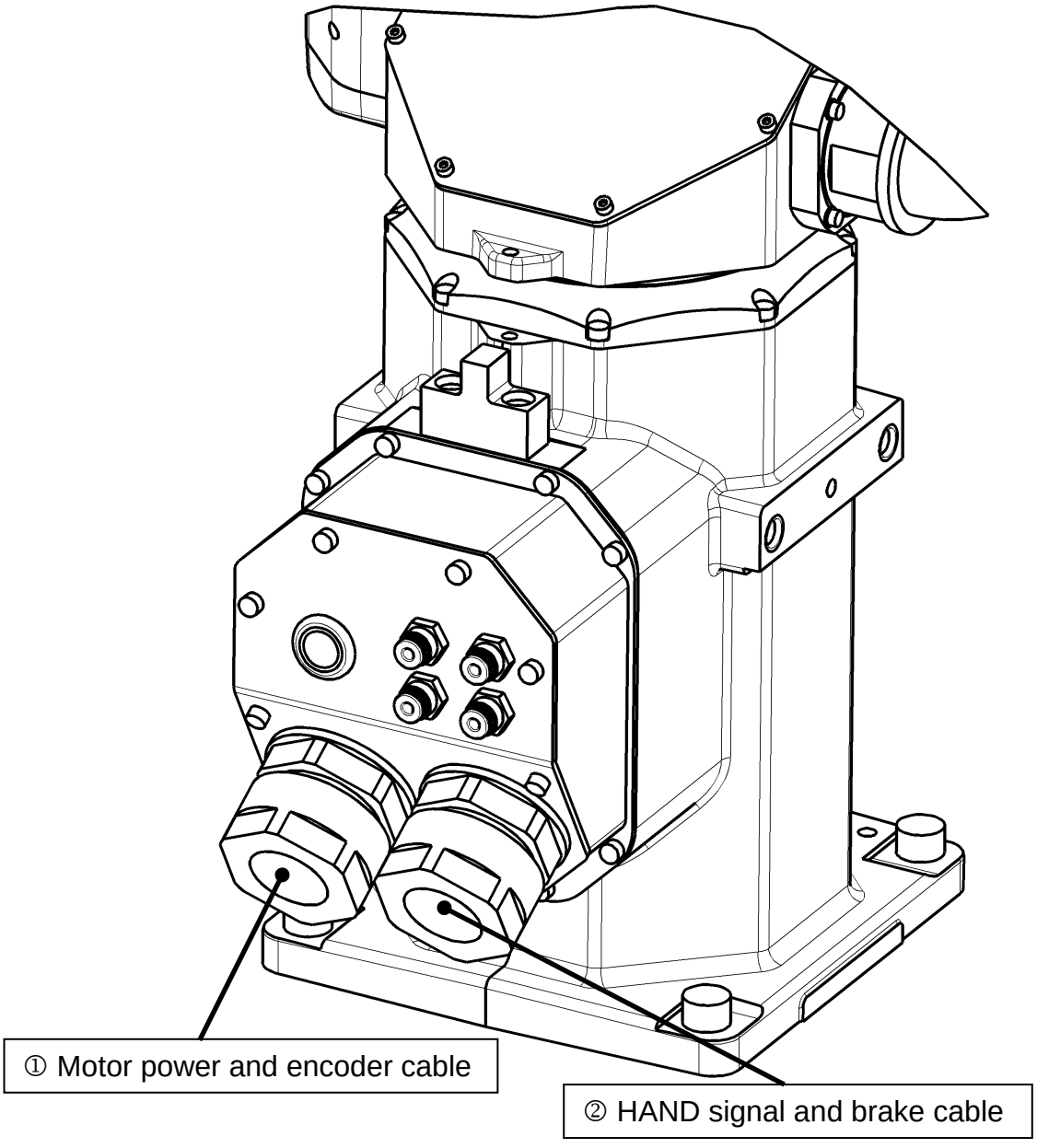


Fig. 7.2 Robot side connector arrangement (TSL3100)

7.1.4. Connecting the Brake Cable/Robot Control Signal Cable

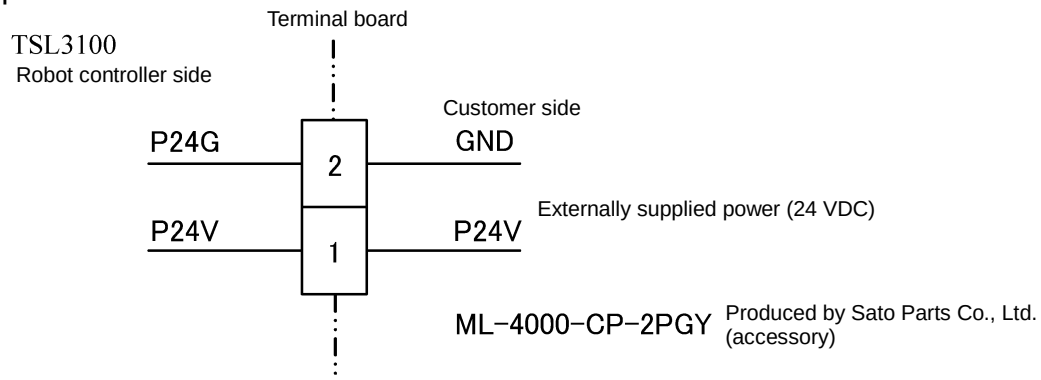
The brake cable is used to input and output an ON/OFF signal for the brake to lock the motor shaft.
The brake signal cable used to lock the motor shaft is connected to the connector BRK ([4] in Fig. 7.1).

The robot control signal cable is used for input and output of robot control signals such as hand operation signal.
The robot control signal cable is connected to the connector "HAND" ([3] of Fig. 7.1).
The brake cable/robot control signal cable on the robot side are connected to [2] of Fig. 7.2.
The cables and connectors for the brake cable and robot control signal cable are standard accessories.

7.1.5. Connecting Power Supply Cable for External Input/Output

Use the attached connector [ML-4000-CP-2PGY] to connect the power supply cable for external input/output ("GND, P24V" ([6] in Fig. 7.1)). The P24V power is supplied from the front of the controller.
Shown below are the input/output signals that use the externally supplied power (24 VDC). Be sure to supply external power (24 VDC).

- External input/output
- External operation input/output
- Extended input/output
- Hand input/output



The wires for the connector are AWG24 to AWG16.
Choose the most suitable external power supply for your system specification (ampacity).
See the "Instruction Manual: Interface" for how to connect/disconnect the power supply cable for external input/output.

CAUTION

Be sure to supply external power (24 DVC). Otherwise, the safety signal will not be enabled and the controller servo power cannot be turned on.

7.1.6. Connecting and Disconnecting Cables

CAUTION

- Before connecting or disconnecting any controller cable, be sure to turn off the main power.
- When disconnecting a cable, be sure to pull the connector and not the cord. Otherwise, you may damage the cable.
- When removing the cable, pull off the plug while holding the controller. If you do not hold the controller, the controller may be overturned when removing the plug.

a) ROBOT connector: ROBOT

To connect the connector, firmly insert the connector on the cable side into the connector on the side of the controller body. Raise the levers located on the upper and lower portions on the side of the controller body, and lock it in position.

To remove it, reverse the above-mentioned procedure.

Tilt the levers located on the upper and lower portions. After that, pull off the connector on the cable side.

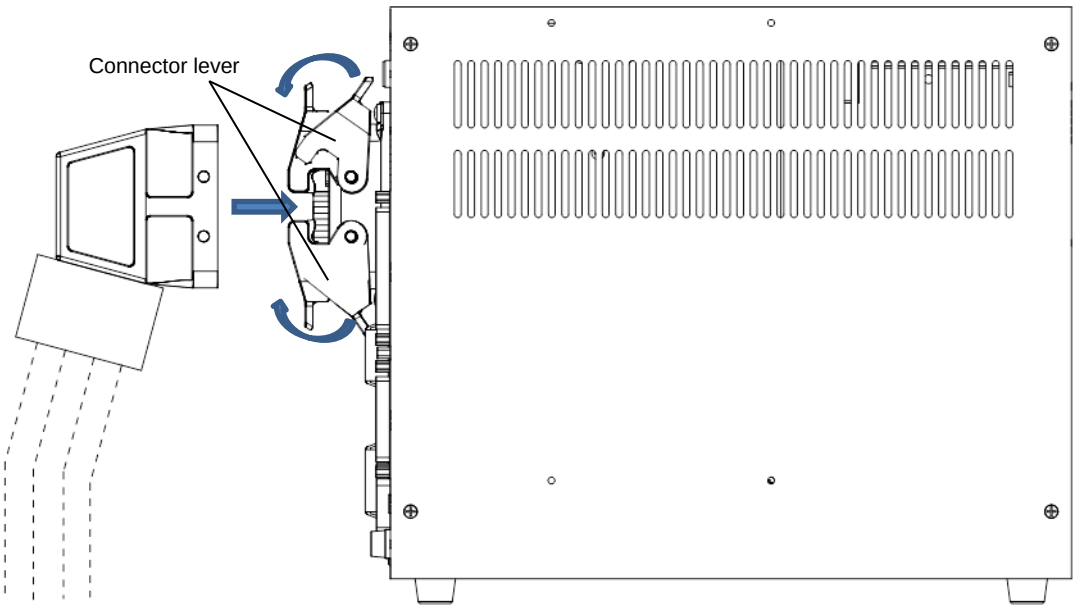


Fig. 7.3 Connecting and disconnecting a ROBOT connector(TSL3100)

b) Square connectors: INPUT, OUTPUT, TP, HOST/TCPRG, COM1, BRK, HAND
Firstly, completely insert the cable side connector into the controller connector. Then tighten the lock screws on both ends of the cable side connector with a screwdriver. A loose screw can cause a contact failure or other accident. To avoid this, make sure that the screws are clamped completely
To disconnect the connectors, first loosen the lock screws, then pull out the cable side connector. BRK and HAND are quick-operated lock type connectors, however.

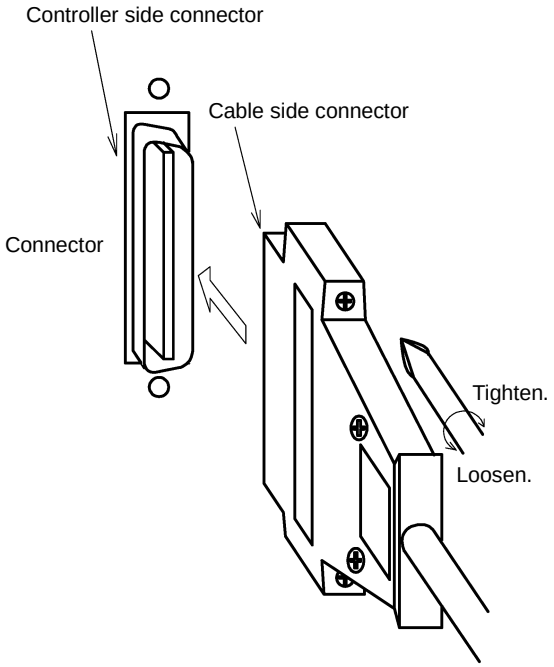
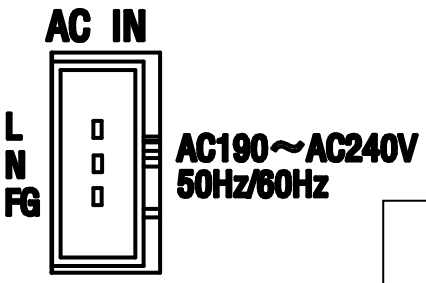


Fig. 7.4 Connecting and disconnecting a square connector (TSL3100)

7.1.7. Examples of Connector Terminal Arrangement (for the TSL3100)

a) Power cable connector ACIN



Connects to controller.

Type: 03JFAT-SAYGF-I

Manufacturer: J.S.T. Msg.

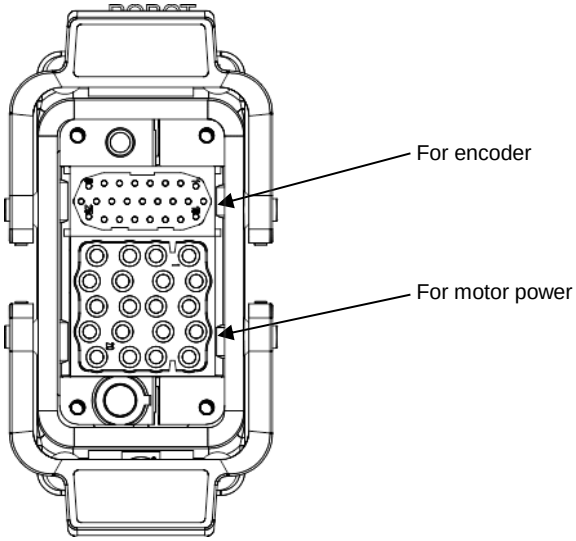
1(L)
2(N) —— Single-phase, 190 to 240 VAC, 50/60 Hz

3(FG) —— Grounding (Class D or higher level)

⚠ DANGER

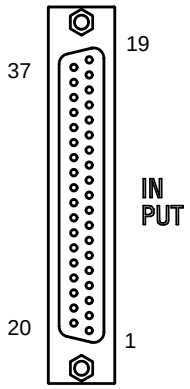
- Completely connect the grounding cable. Otherwise, an electric shock or fire may be caused if a fault or electric leak occurred. Or mis-operation may be caused by noise.

b) Motor/Encoder cable connector ROBOT



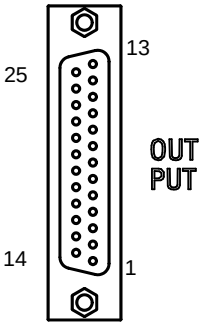
Connects to controller.
Manufacturer: Harting Co., Ltd.

c) General purpose input signal cable connector INPUT



Connects to controller.
Type: XM3B-3722-112
Manufacturer: Omron
The counterpart is attached to the controller.
For details, see Part ST85364 TSL3000 Interface.

d) General purpose output signal cable connector OUTPUT

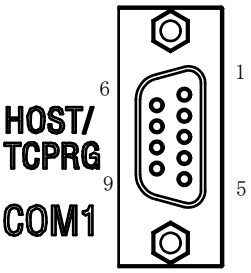


Connects to controller.
Type: XM3B-2522-112
Manufacturer: Omron
The counterpart is attached to the controller.
For details, see Part ST85364 TSL3000 Interface.

e) Input/output signal power supply connector

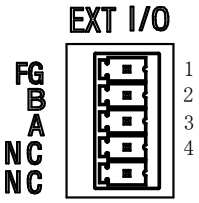
Connects to controller.
Type: ML-4000-CWJH 02PGY
Manufacturer: Sato Parts Co., Ltd.
The counterpart is attached to the controller.
For details, see Part ST85364 TSL3000 Interface.

f) Communication connector HOST/TCPRG, COM1



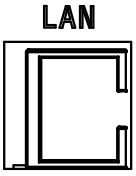
Connects to controller.
Type: XM2C-0942-132L
Manufacturer: Omron

g) Distributed I/O connector EXT I/O (Controller rear)



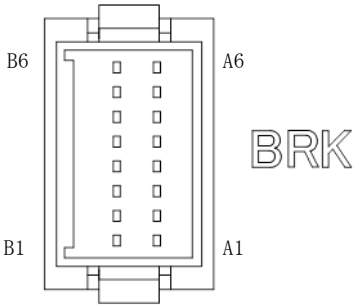
Connects to controller.
Type: ML-4000-CWJH 05PGY
Manufacturer: Sato Parts Co., Ltd.
The counterpart is attached to the controller.
For details, see Part ST85364 TSL3000 Interface.

h) Ethernet connector LAN (Controller rear)



Connects to controller.
Type: J0026D21BNL
Manufacturer: PULSE Electronics

k) Brake signal cable connector BRK

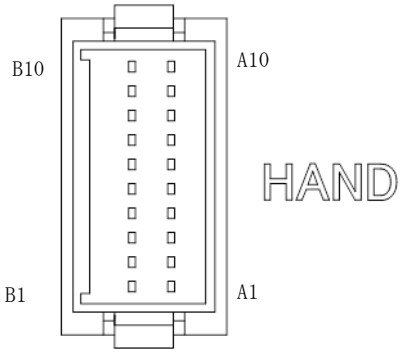


Connects to controller.

Type: J21DPM-12V-KX

Manufacturer: J.S.T. Mfg.

l) Robot control signal cable connector HAND



Connects to controller.

Type: J21DPM-20V-KX

Manufacturer: J.S.T. Mfg.

7.2. Controller Connector Signals

7.2.1. Connector Signal Connection Diagrams

Diagrams showing which signals correspond to which terminals are shown in Section 2 of the Interface Manual.

7.2.2. Jumpers for Safety Related Signals

The following system input signals are provided to serve for the safety purpose.

System input signals…	INPUT-12	(STOP)
	INPUT-14	(SVOFF)
	INPUT-32	(BREAK)
	INPUT-18, 19	(EMS1B~EMS1C)
	INPUT-36, 37	(EMS2B~EMS2C)
	INPUT-17, 35	(INCOM~P24V)
		Standard 24V (+) common is assumed.

These signals are already jumpered for the connectors provided for the TSL3100 robot controller. If you wish to use or change them, therefore, you should remove the jumpers and rewire as appropriate. If you plan to use the robot without using system input signals, be sure to connect the attached connectors to the controller side INPUT connector.

Unless the following signals are used as the system signals, jumper them also.

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

Connector jumpers (TSL3100)

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

CAUTION

- Unless the signals of SVOFF and emergency stop contacts 1, 2 are jumpered, the controller servo power cannot be turned on.
- Unless the CYCLE signal is jumpered, the controller enters the cycle operation mode.
- Unless the LOW_SPD signal is jumpered, the robot is operated at low speed during automatic operation.
- Unless the STOP signal is jumpered, automatic operation of the robot is not possible.
- Unless the BREAK signal is jumpered, automatic operation of the robot is not possible.

8. System Connections (In case of TSL3100E)

8.1. Cable Wiring

This section describes the various types of cables and connectors and explains how these are to be connected.

8.1.1. Connector Arrangement on the Controller

The cables connected to the robot controller are shown in Fig. 8.1.

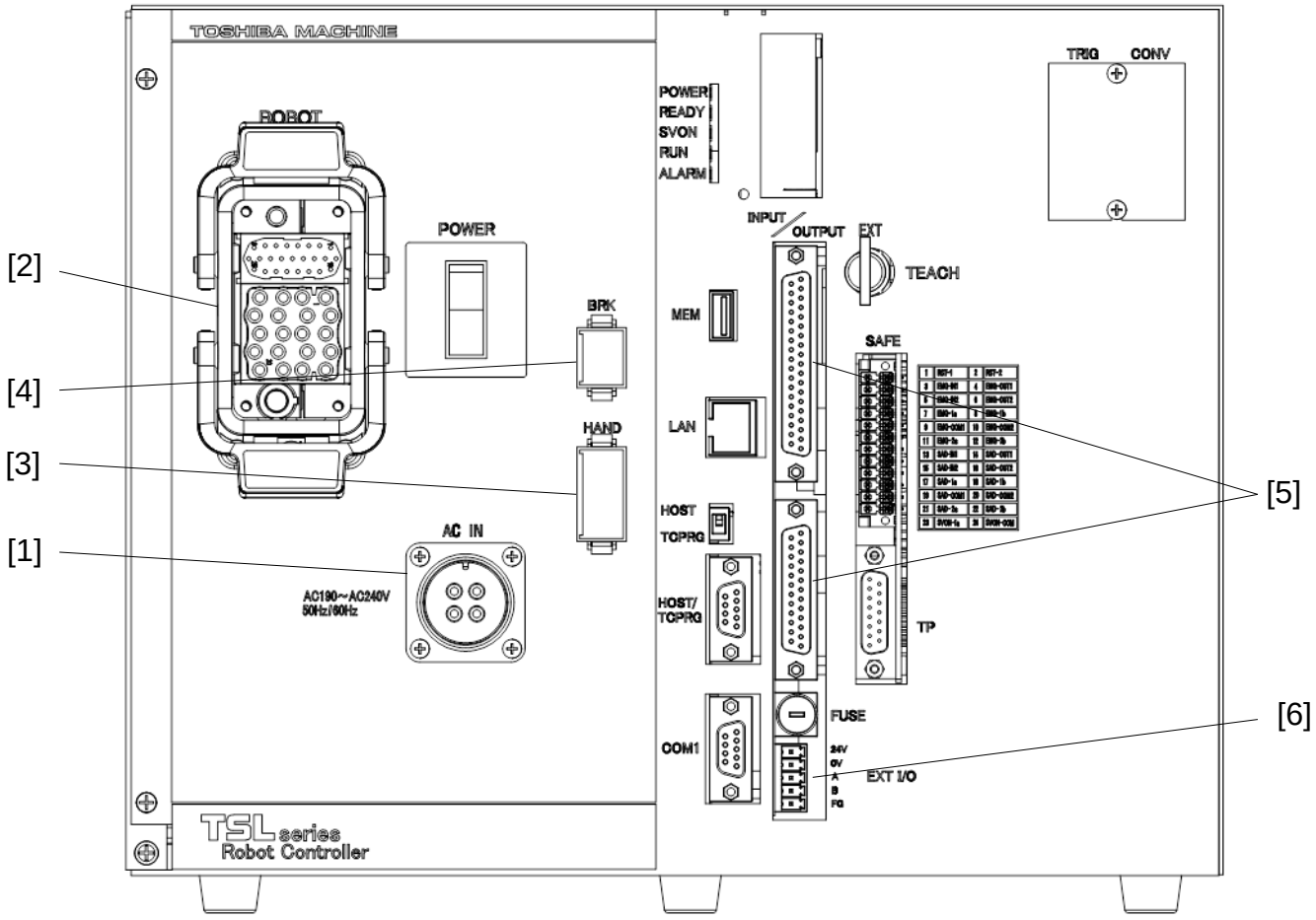


Fig. 8.1 Robot controller connector arrangement (TSL3100E)

[1] Power cable (ACIN)
[2] Motor cable, Encoder cable (ROBOT)
[3] Robot control signal cable (HAND)

[4] Brake signal cable (BRK)
[5] External operation input signal cables (INPUT, OUTPUT)
[6] Power supply cable for external input/output (GND, P24V)

In the subsequent paragraphs, we explain how to connect cables [1] to [4] inclusive. For information on how to connect cables [5] and [6] refer to the Interface Manual.

8.1.2. Connecting the Power Cable

The power cable (“ACIN” ([1] of Fig. 8.1)) is used to supply the main AC power to the controller.

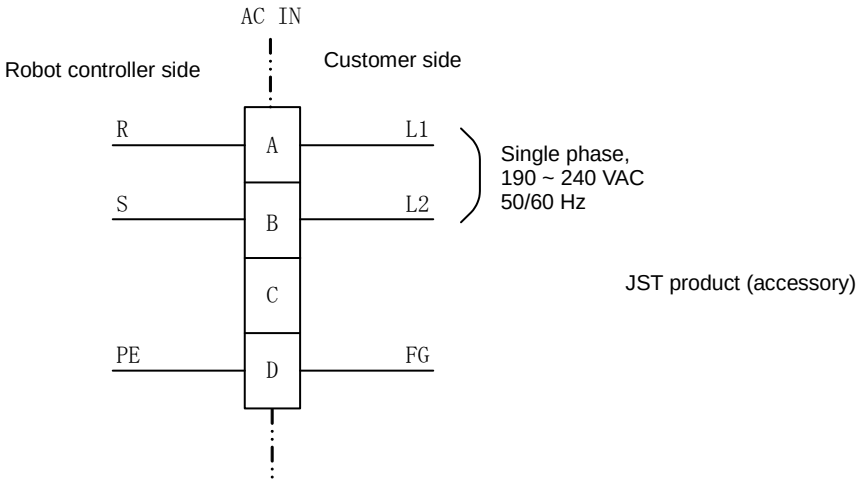


Table 8.1 Power supply specifications (TSL3100E)

Power supply	Single-phase, 190 ~ 240 VAC, 50/60 Hz ±1 Hz
Instantaneous power failure	Within 40 msec
Grounding	Class D grounding

The connector is a standard accessory.

ACIN plug connector	Type: JL04V-6A18-10SE-EB	Maker: J.S.T. Mfg.
Wire	2.0mm2 (AWG#14)	

As the cable is not an accessory, use the attached plug connector connected to ACIN on the controller side to manufacture a cable.
For connection between the connector and cable, place the conductor in-between.
For the terminal arrangement, see Para. 8.1.7.

DANGER

- Be sure to use the designated wire. Failure to do so could lead to fires or faults.
- When connecting the connector and wires, make sure not to mistake the terminal arrangement.
- After making the connection, use a tester, etc., to confirm the connection.

CAUTION

- Unless the main power is normally supplied to the controller due to phase defect or voltage drop, an error of “8–027 Slow Charge error” occurs. When this happens, make sure that the maser power voltage at the controller power connector satisfies the specified input power of the controller, and that the same voltage is stabilized.
- For details on "8-027 Slow Charge error," see the "Instruction Manual: Alarms" provided as a separate volume.

8.1.3. Connecting the Motor Cable/Encoder Cable

The motor cable connects the controller and robot, and supplies the power required to rotate the motor from the controller servo driver to each axis feed motor of the robot. The encoder cable is a signal line used to transmit a signal from the rotation angle detecting encoder of each robot axis to the controller.

The motor cable connector and encoder connector are for ROBOT ([2] in Fig. 8.1). The motor cable and encoder cable on the robot side are located at [1] of Fig. 8.2.

The cables and connectors for the motor cable and encoder cable are standard accessories.

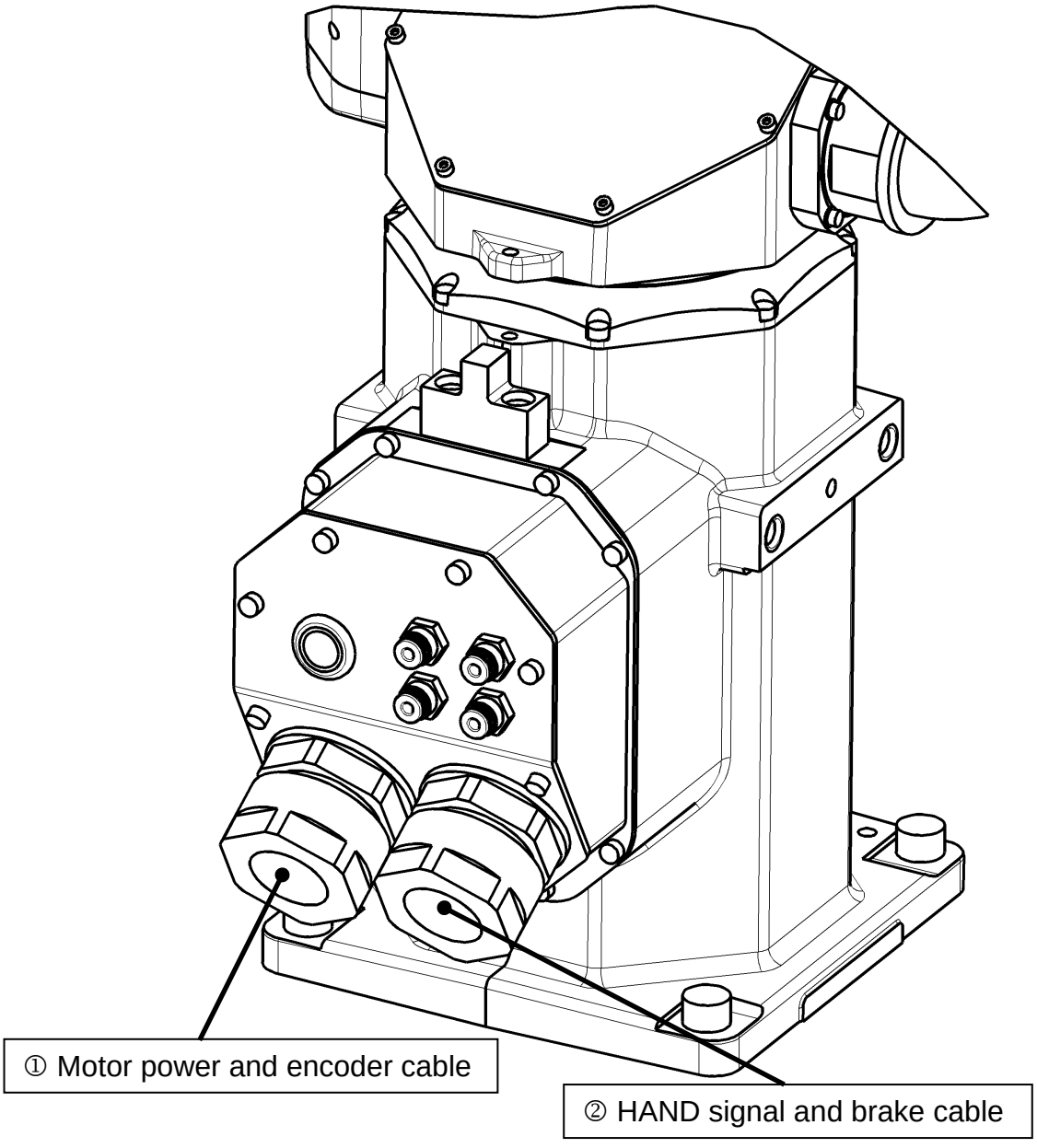


Fig. 8.2 Robot side connector arrangement (TSL3100E)

8.1.4. Connecting the Brake Cable/Robot Control Signal Cable

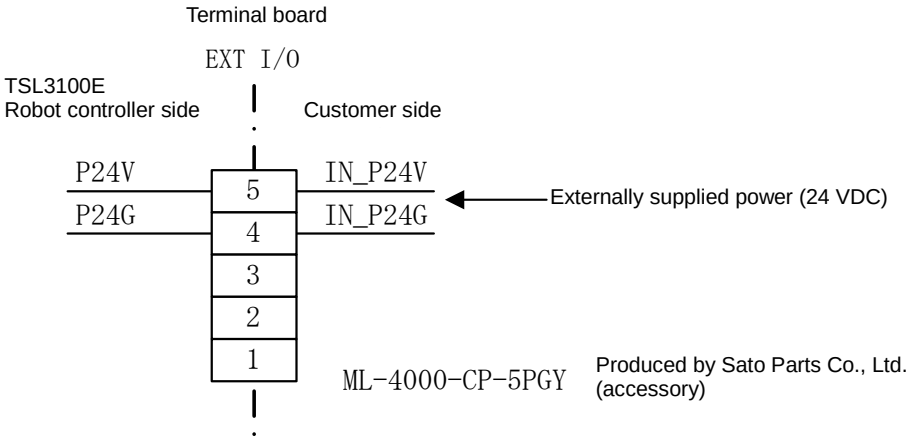
The brake cable is used to input and output an ON/OFF signal for the brake to lock the motor shaft.
The brake signal cable used to lock the motor shaft is connected to the connector BRK ([4] in Fig. 8.1).

The robot control signal cable is used for input and output of robot control signals such as hand operation signal.
The robot control signal cable is connected to the connector "HAND" ([3] of Fig. 8.1).
The brake cable/robot control signal cable on the robot side are connected to [2] of Fig. 8.2.
The cables and connectors for the brake cable and robot control signal cable are standard accessories.

8.1.5. Connecting Power Supply Cable for External Input/Output

Use the attached connector [ML-4000-CP-5PGY] to connect the power supply cable for external input/output ("GND, P24V" ([6] in Fig. 8.1)). The P24V power is supplied from the front of the controller.
Shown below are the input/output signals that use the externally supplied power (24 VDC). Be sure to supply external power (24 VDC).

- External input/output
- External operation input/output
- Extended input/output
- Hand input/output



The wires for the connector are AWG24 to AWG16.
Choose the most suitable external power supply for your system specification (ampacity).

See the "Instruction Manual: Interface" for how to connect/disconnect the power supply cable for external input/output.

CAUTION

Be sure to supply external power (24 DVC). Otherwise, the safety signal will not be enabled and the controller servo power cannot be turned on.

8.1.6. Connecting and Disconnecting Cables

CAUTION

- Before connecting or disconnecting any controller cable, be sure to turn off the main power.
- When disconnecting a cable, be sure to pull the connector and not the cord. Otherwise, you may damage the cable.
- When removing the cable, pull off the plug while holding the controller. If you do not hold the controller, the controller may be overturned when removing the plug.

a) ROBOT connector: ROBOT

To connect the connector, firmly insert the connector on the cable side into the connector on the side of the controller body. Raise the levers located on the upper and lower portions on the side of the controller body, and lock it in position.

To remove it, reverse the above-mentioned procedure.

Tilt the levers located on the upper and lower portions. After that, pull off the connector on the cable side.

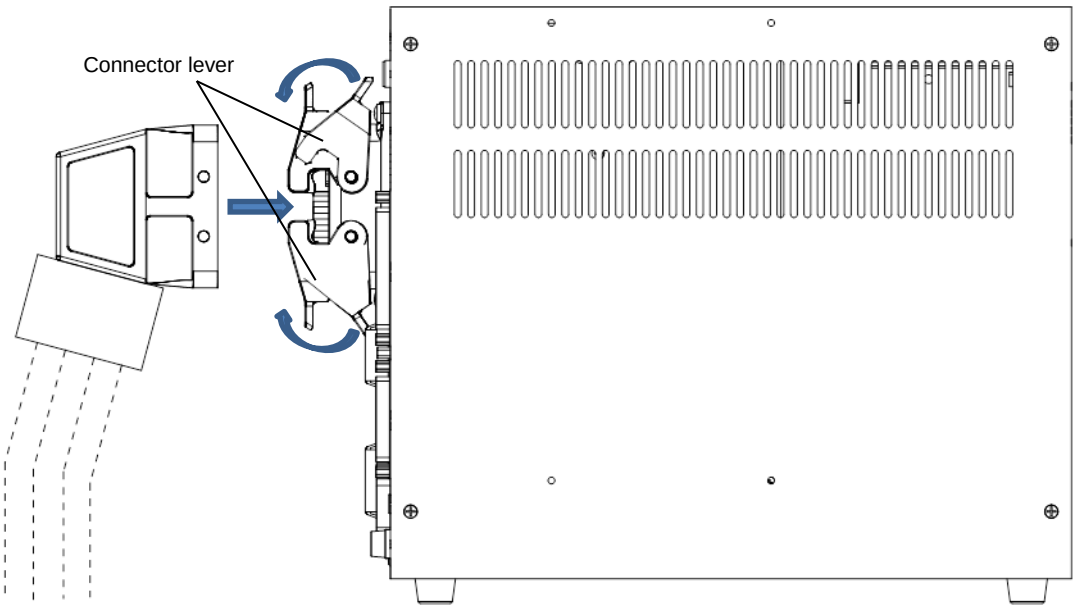


Fig. 8.3 Connecting and disconnecting a ROBOT connector(TSL3100E)

b) Square connectors: INPUT, OUTPUT, TP, HOST/TCPRG, COM1, BRK, HAND
Firstly, completely insert the cable side connector into the controller connector. Then tighten the lock screws on both ends of the cable side connector with a screwdriver. A loose screw can cause a contact failure or other accident. To avoid this, make sure that the screws are clamped completely
To disconnect the connectors, first loosen the lock screws, then pull out the cable side connector. BRK and HAND are quick-operated lock type connectors, however.

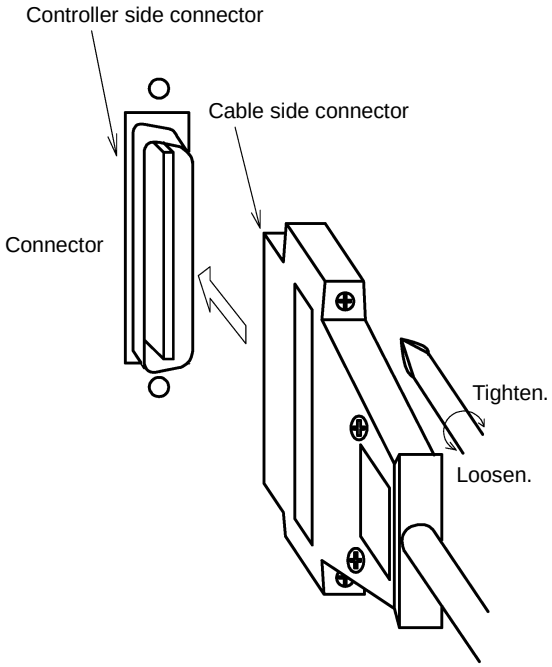


Fig. 8.4 Connecting and disconnecting a square connector (TSL3100E)

c) Circular connector: ACIN

To connect the connector, align the key position, securely insert the connector on the cable side into the connector on the robot controller body side, and then tighten by rotating the lock screw on the cable side clockwise. If the connector is loose, it may cause accidents due to connector contact failure, so be sure to check that the connector is securely inserted.

To disconnect the connector, rotate the lock screw counterclockwise, in the opposite direction from connecting, to loosen the connector, and then pull out the connector on the cable side.

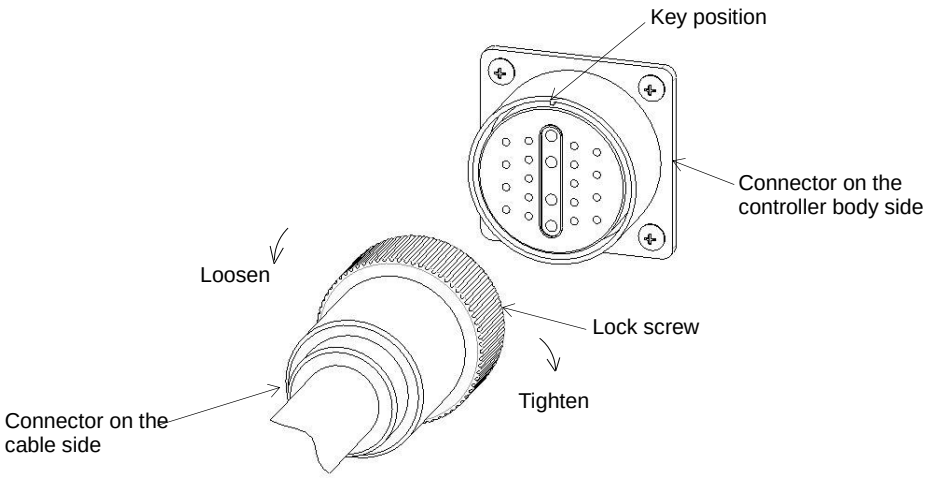
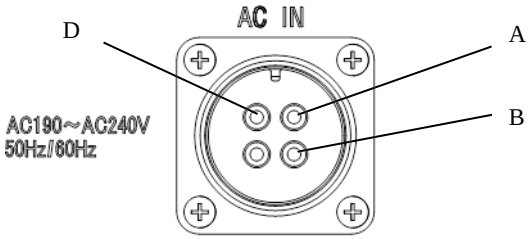


Fig. 8.4 Connecting/disconnecting the circular connector (TS3100E)

8.1.7. Examples of Connector Terminal Arrangement (for the TSL3100)

a) Power cable connector ACIN



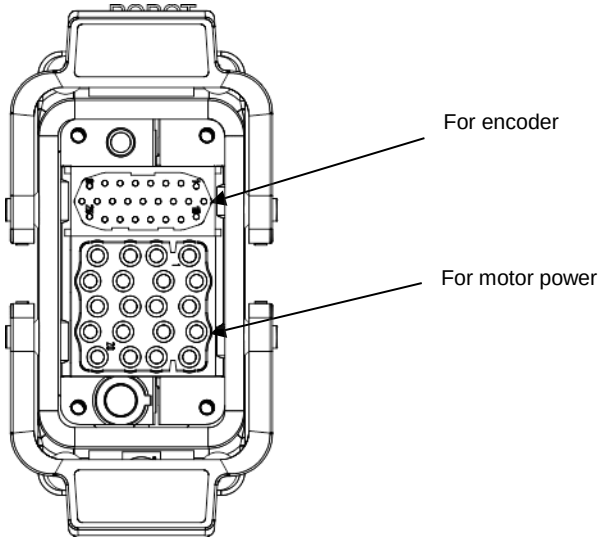
Connects to controller.
Type: JL04V-2E18-10PE-B
Manufacturer: J.S.T. Msg.

A
B — Single-phase, 190 to 240 VAC, 50/60 Hz

D — Grounding (Class D or higher level)

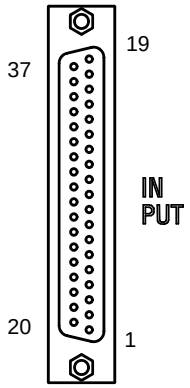
> **⚠ DANGER**
>
> • Completely connect the grounding cable. Otherwise, an electric shock or fire may be caused if a fault or electric leak occurred. Or mis-operation may be caused by noise.

b) Motor/Encoder cable connector ROBOT



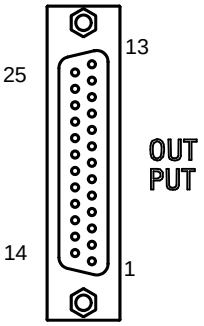
Connects to controller.
Manufacturer: Harting Co., Ltd.

c) General purpose input signal cable connector INPUT



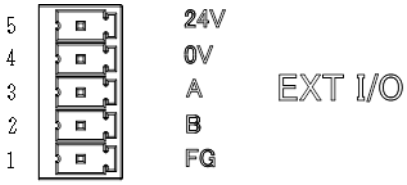
Connects to controller.
Type: XM3B-3722-112
Manufacturer: Omron
The counterpart is attached to the controller.
For details, see Part ST85364 TSL3000 Interface or Part ST85457 TSL3000E Interface.

d) General purpose output signal cable connector OUTPUT



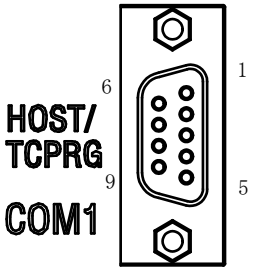
Connects to controller.
Type: XM3B-2522-112
Manufacturer: Omron
The counterpart is attached to the controller.
For details, see Part ST85364 TSL3000 Interface or Part ST85457 TSL3000E Interface.

e) Input/output signal power supply and Distributed I/O connector EXT I/O connector



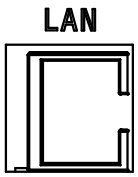
Connects to controller.
Type: ML-4000-CWJH 05PGY
Manufacturer: Sato Parts Co., Ltd.
The counterpart is attached to the controller.

f) Communication connector HOST/TCPRG, COM1



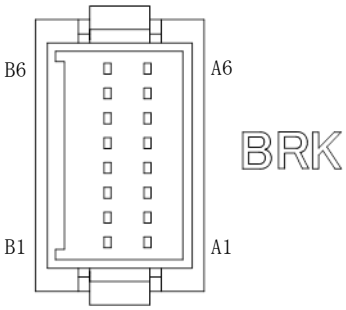
Connects to controller.
Type: XM2C-0942-132L
Manufacturer: Omron

g) Ethernet connector LAN (Controller rear)



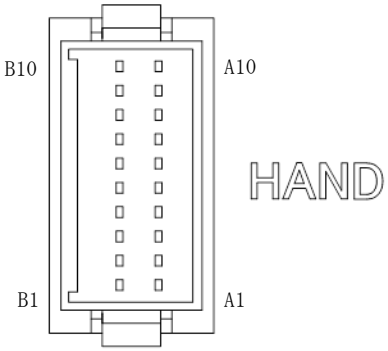
Connects to controller.
Type: J0026D21BNL
Manufacturer: PULSE Electronics

k) Brake signal cable connector BRK



Connects to controller.
Type: J21DPM-12V-KX
Manufacturer: J.S.T. Mfg.

l) Robot control signal cable connector HAND



Connects to controller.
Type: J21DPM-20V-KX
Manufacturer: J.S.T. Mfg.

8.2. Controller Connector Signals

8.2.1. Connector Signal Connection Diagrams

Diagrams showing which signals correspond to which terminals are shown in Section 2 of the Interface Manual.

8.2.2. Jumpers for Safety Related Signals

The following system input signals are provided to serve for the safety purpose.

System input signals…	INPUT-12	(STOP)
	INPUT-14	(SVOFF)
	INPUT-32	(BREAK)
	INPUT-17, 35	(SYSINCOM~P24V)
		Standard 24V (+) common is assumed.

These signals are already jumpered for the connectors provided for the TSL3100E robot controller. If you wish to use or change them, therefore, you should remove the jumpers and rewire as appropriate. If you plan to use the robot without using system input signals, be sure to connect the attached connectors to the controller side INPUT connector.

Unless the following signals are used as the system signals, jumper them also.

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

Connector jumpers (TSL3100E)

INPUT		
12-16	14-16	32-16
17-35	(13-16)	(31-16)

CAUTION

- Unless the signals of SVOFF and emergency stop contacts 1, 2 are jumpered, the controller servo power cannot be turned on.
- Unless the CYCLE signal is jumpered, the controller enters the cycle operation mode.
- Unless the LOW_SPD signal is jumpered, the robot is operated at low speed during automatic operation.
- Unless the STOP signal is jumpered, automatic operation of the robot is not possible.
- Unless the BREAK signal is jumpered, automatic operation of the robot is not possible.

9. System Connections(In case of TS3100)

9.1. Cable Wiring

This section describes the various types of cables and connectors and explains how these are to be connected.

9.1.1. Connector Arrangement on the Controller

The cables connected to the robot controller are shown in Fig. 9.1.

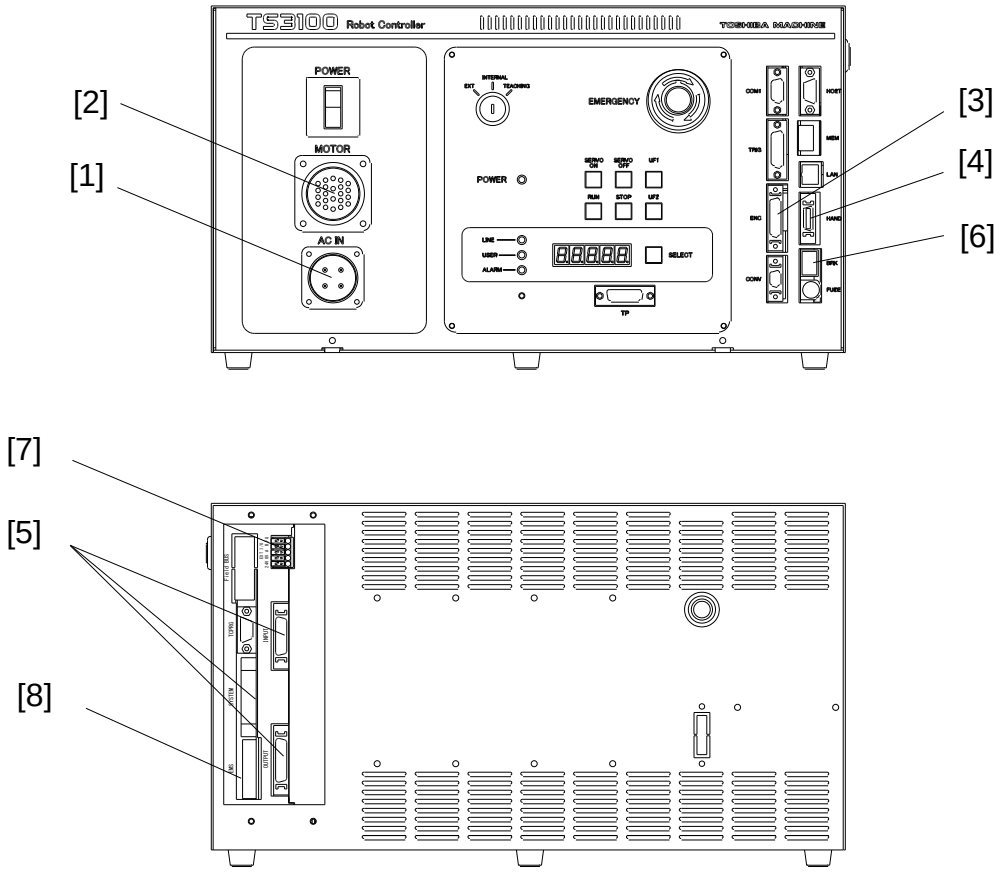


Fig. 9.1 Robot controller connector arrangement (TS3100)

[1] Power cable (ACIN)
[2] Motor cable (MOTOR)
[3] Encoder cable (ENC)
[4] Robot control signal cable (HAND)
[5] External input signals (SYSTEM, INPUT, OUTPUT)
[6] Brake signal cable (BRK)
[7] Distributed I/O (EXT-I/O)
[8] Power supply cable for external input/output (EMS)

In the subsequent paragraphs, we explain how to connect cables [1] to [4] inclusive. For information on how to connect cables [5], [6] and [7] refer to the Interface Manual.

9.1.2. Connecting the Power Cable

The power cable “ACIN” ([1] of Fig. 9.1) is used to supply the main AC power to the controller.

Table 9.1 Power supply specifications (TS3100)

Power supply	Single-phase, 200~240V, $50/60H_Z \pm 1H_Z$
Instantaneous power failure	Within 40 msec
Grounding	Class D grounding

The connector is a standard accessory.

ACIN plug connector	Type: 03JFAT-SAYGF-I	Maker: Japan Aviation Electronics Industry, Limited
ACIN cable clamp	JL04-2022CK(14)-R	Maker: Japan Aviation Electronics Industry, Limited
Wire	$3.5mm^2$~$5.5mm^2$	

As the cable is not an accessory, use the attached plug connector connected to ACIN on the controller side to manufacture cable.
Connect the connector and the power cable by soldering.

For the terminal arrangement, see Para. 9.1.7.

! DANGER

- Be sure to use the designated wire. Failure to do so could lead to fires or faults.
- When connecting the connector and wires, make sure not to mistake the terminal arrangement.
- After making the connection, use a tester, etc., to confirm the connection.

! CAUTION

- Unless the main power is normally supplied to the controller due to phase defect or voltage drop, an error of “8–027 Slow Charge error” occurs. When this happens, make sure that the maser power voltage at the controller power connector satisfies the specified input power of the controller, and that the same voltage is stabilized.
- For details on "8-027 Slow Charge error," see the "Instruction Manual: Alarms" provided as a separate volume.

9.1.3. Connecting the Motor Cable/Encoder Cable

The motor cable connects the controller and robot, and supplies the power required to rotate the motor from the controller servo driver to each axis feed motor of the robot. The encoder cable is a signal line used to transmit a signal from the rotation angle detecting encoder of each robot axis to the controller.

The motor cable connector and encoder connector are for MOTOR ([2] in Fig. 9.1). The motor cable and encoder cable on the robot side are located at [1] of Fig. 9.2.

The cables and connectors for the motor cable and encoder cable are standard accessories.

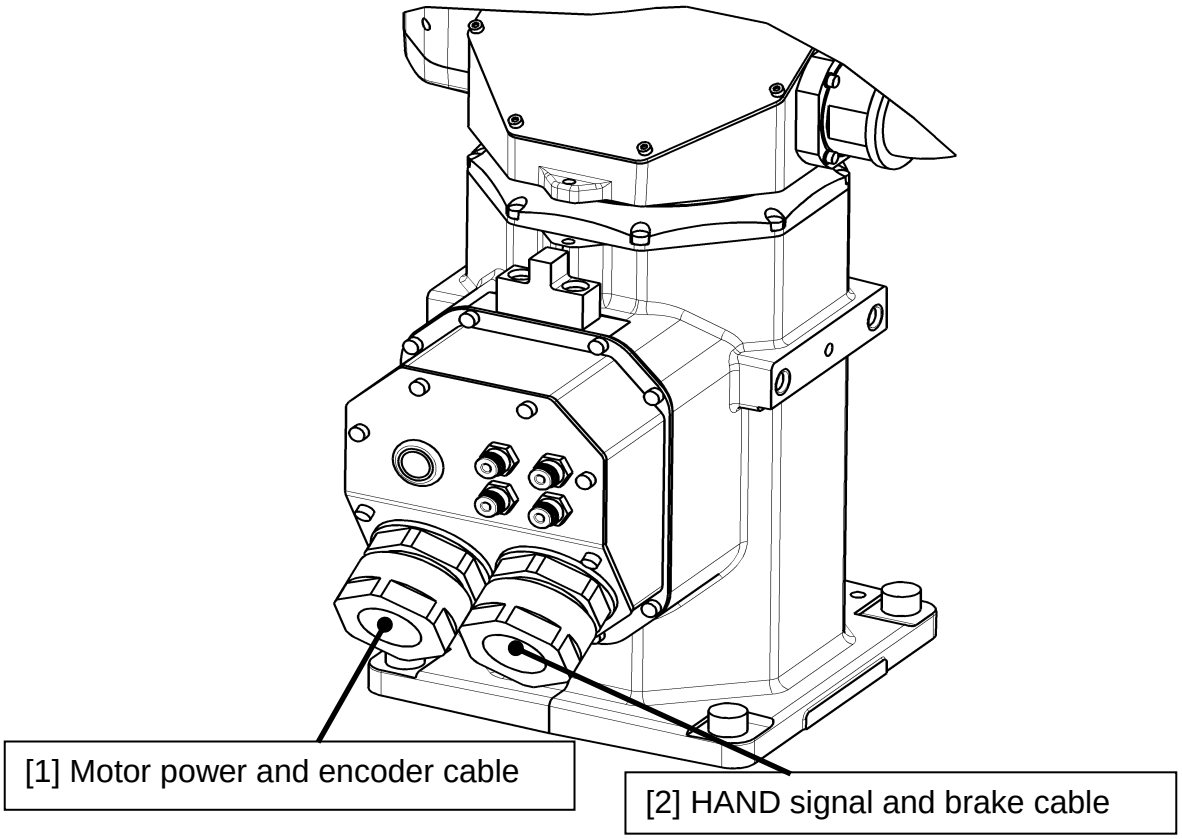


Fig.9.2 Robot side connector arrangement (TS3100)

9.1.4. Connecting the Brake Cable/Robot Control Signal Cable

The brake cable is used to input and output an ON/OFF signal for the brake to lock the motor shaft.
The brake signal cable used to lock the motor shaft is connected to the connector BRK ([6] in Fig. 9.1).

The robot control signal cable is used for input and output of robot control signals such as hand operation signal.
The robot control signal cable is connected to the connector "HAND" ([4] of Fig. 9.1).
The brake cable/robot control signal cable on the robot side are connected to [2] of Fig. 9.2.
The cables and connectors for the brake cable and robot control signal cable are standard accessories.

9.1.5. Connecting Power Supply Cable for External Input/Output "GND, P24V" ([8] in Fig. 9.1

For the connection of the power supply cable for external input/output, use the [ML-4000-CP-10PGY] connector that comes with the product, which is the same as the one used for the safety input signal cable. Supply P24V power from the "EMS connector located on the rear of the robot controller.
Shown below are the input/output signals that use the externally supplied power (24 VDC). Be sure to supply external power (24 VDC).

- External input/output
- External operation input/output
- Extended input/output
- Hand input/output

Note that both trigger input and brake output use the power supply (24 VDC) inside the robot controller.

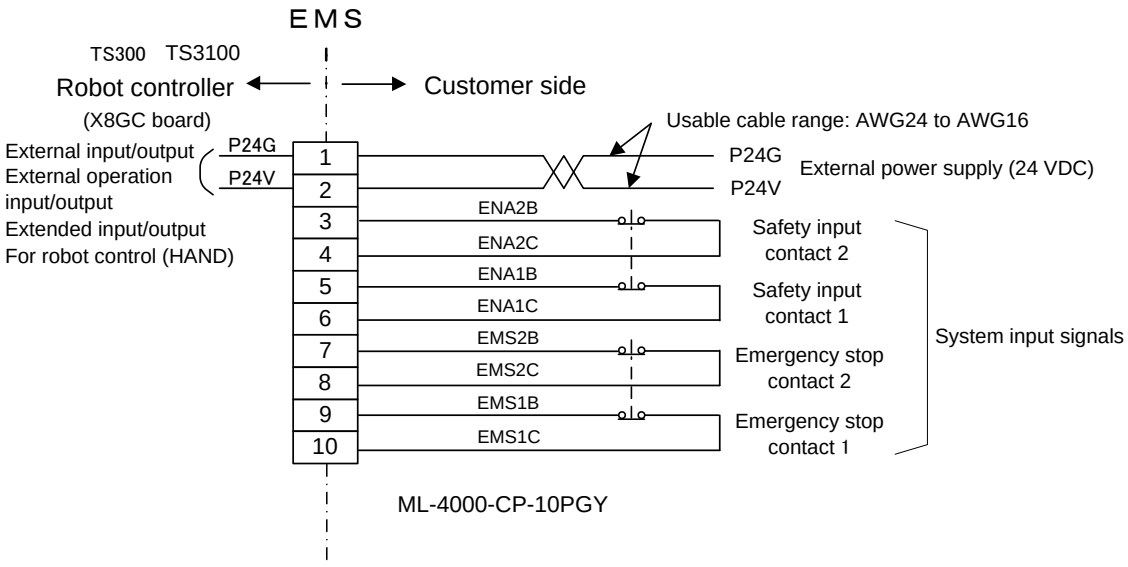


Fig. 9.3 Connection of External Power Supply (TS3100)

The wires for the “EMS” connector are AWG24 to AWG16.
Choose the most suitable external power supply for your system specification (ampacity)
For details about the plugging and unplugging the "EMS" connector, see the "Instruction Manual: Interface."

CAUTION

Be sure to supply external power (24 DVC). Otherwise, the safety signal will not be enabled and the controller servo power cannot be turned on.

9.1.6. Connecting and Disconnecting Cables

CAUTION

- Before connecting or disconnecting the cables to or from the robot controller, be sure to turn off the main power (POWER switch) in advance.
- When disconnecting a cable, be sure to pull the connector and not the cord. Otherwise, you may damage the cable.

a) Circular connector: ACIN, MOTOR

To connect the connector, align the key position, securely insert the connector on the cable side into the connector on the robot controller body side, and then tighten by rotating the lock screw on the cable side clockwise. If the connector is loose, it may cause accidents due to connector contact failure, so be sure to check that the connector is securely inserted.

To disconnect the connector, rotate the lock screw counterclockwise, in the opposite direction from connecting, to loosen the connector, and then pull out the connector on the cable side.

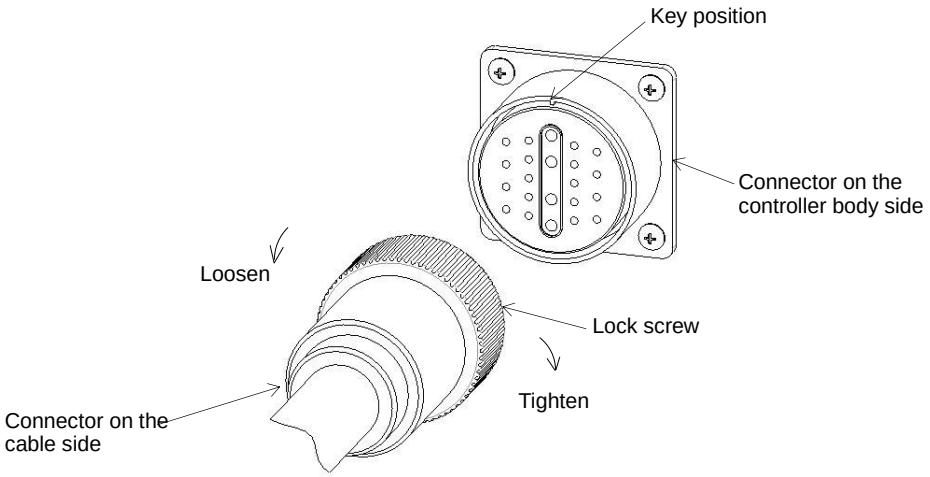


Fig. 9.4 Connecting/disconnecting the circular connector (TS3100)

b) Square connectors: ENC, HAND, SYSTEM, INPUT, OUTPUT, TRIG, CONF. Firstly, completely insert the cable side connector into the controller connector. Then tighten the lock screws on both ends of the cable side connector with a screwdriver. A loose screw can cause a contact failure or other accident. To avoid this, make sure that the screws are clamped completely

To disconnect the connectors, first loosen the lock screws, then pull out the cable side connector. INPUT and OUTPUT are quick-operated lock type connectors, however.

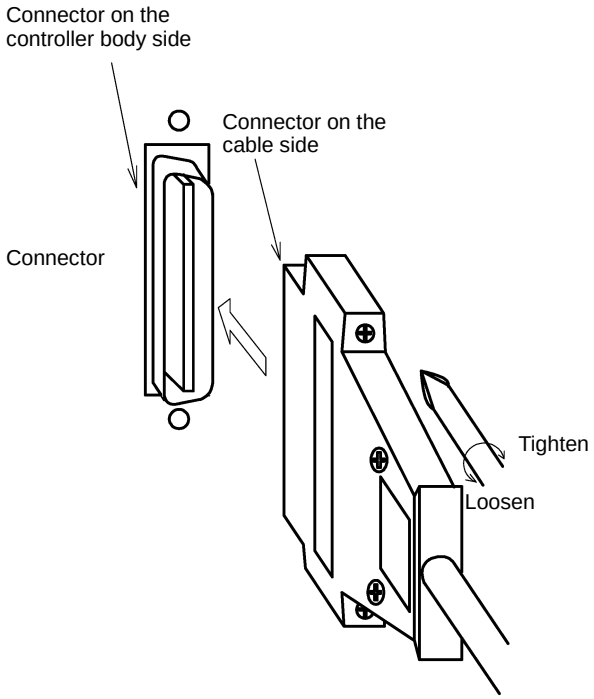
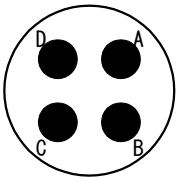


Fig. 9.5 Connecting and disconnecting a square connector (TS3100)

9.1.7. Examples of Connector Terminal Arrangement (for the TS3100)

a) Power cable connector ACIN



Connects to controller.

Model:JL04HV-2E22-22PE-B

Manufacturer: Japan Aviation Electronics Industry, Limited

A
B — Single-phase, 200 to 240V AC,50/60Hz

C

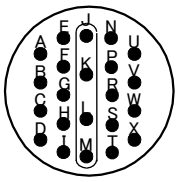
D — Grounding (Class D or higher level)

⚠ Danger

- Completely connect the grounding cable. Otherwise, an electric shock or fire may be caused if a fault or electric leak occurred. Or mis-operation may be caused by noise.

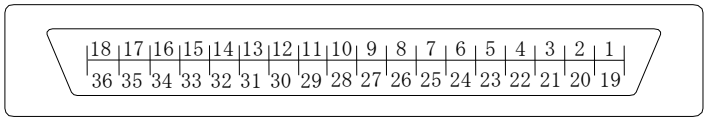
Single-phase, 190 to 240 VAC, 50/60 Hz

b) Motor cable connector MOTOR



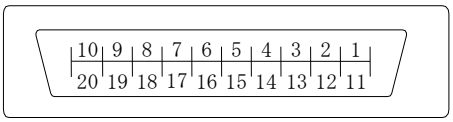
Connects to controller.
Type: JL04V-2A28-11SE
Manufacturer: Japan Aviation Electronics Industry, Ltd

c) Encoder cable connector ENC



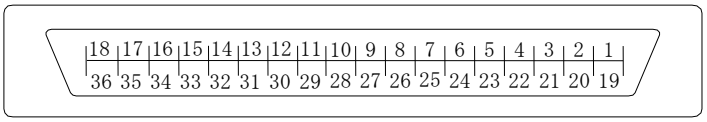
Connects to controller.
Type: 52986-3659
Manufacturer: Molex Co., Ltd.

d) Robot control signal cable connector HAND



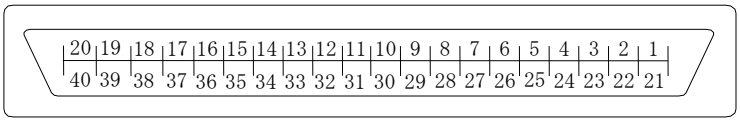
Connects to controller.
Type: 52986-2079
Manufacturer: Molex Co., Ltd.

e) General purpose input signal cable connector INPUT



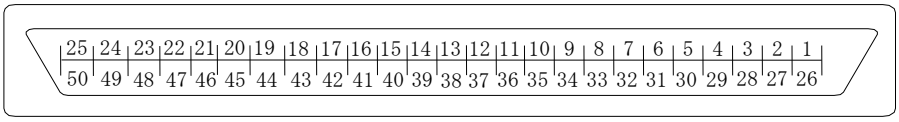
Connects to controller.
Type: DHA-RC36-R132N-FA
Manufacturer: DDK Ltd.

f) General purpose output signal cable connector OUTPUT



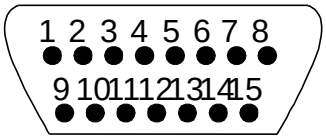
Connects to controller.
Type: DHA-RC40-R132N-FA
Manufacturer: DDK Ltd

g) System input/output signal cable connector SYSTEM



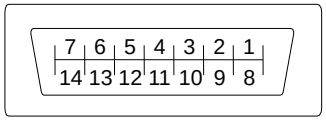
Connects to controller.
Type: 52986-5079
Manufacturer: Molex Co., Ltd.

h) Trigger input connector TRIG



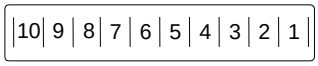
Connects to controller.
Type: XM2C-1542-112L
Manufacturer: Omron

i) Encoder cable connector CONV



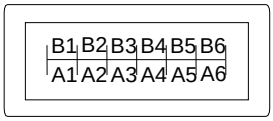
Connects to controller.
Type: 52986-1479
Manufacturer: Molex Co., Ltd.

j) Emergency stop, safety input and external P24V supply connector EMS



Connects to controller.
Type: ML-4000CWJH-10PGY
Manufacturer:Sato Parts Co., Ltd.

k) Brake connector BRK



Connects to controller.
Type: 1-1827876-6
Manufacturer: Tyco Electronics Japan G.K.

9.2. Controller Connector Signals (for the TS3100)

9.2.1. Connector Signal Connection Diagrams

Diagrams showing which signals correspond to which terminals are shown in Section 2 of the Interface Manual.

9.2.2. Jumpers for Safety Related Signals

The following system input signals are provided to serve for the safety purpose.

System input signals…
SYSTEM-12 (STOP)
SYSTEM-16 (SVOFF)
SYSTEM-14 (BREAK)
EMS-7,8 (EMS2B to EMS2C)
EMS-9,10 (EMS1B to EMS1C)
EMS-3,4 (ENA2B to ENA2C)
EMS-5,6 (ENA1B to ENA1C)

These signals are already jumpered for the connectors provided for the TS3100 robot controller. If you wish to use or change them, therefore, you should remove the jumpers and rewire as appropriate. If you plan to use the robot without using system input signals, be sure to connect the attached connectors to the controller side SYSTEM, EM connector.
Unless the following signals are used as the system signals, jumper them also.

SYSTEM-15 (LOW_SPD)
SYSTEM-13 (CYCLE)

Connector jumpers (TS3000)

SYSTEM		EMS	
12-17(18)	14-17(18)	3-4	5-6
16-17(18)	(13-17(18))	7-8	9-10
(15-17(18))	-		

CAUTION

- Unless the signals of SVOFF and emergency stop contacts 1, 2 are jumpered, the controller servo power cannot be turned on.
- Unless the CYCLE signal is jumpered, the controller enters the cycle operation mode.
- Unless the LOW_SPD signal is jumpered, the robot is operated at low speed during automatic operation.
- Unless the STOP signal is jumpered, automatic operation of the robot is not possible.
- Unless the BREAK signal is jumpered, automatic operation of the robot is not possible.

9.3. When Detaching the Control Panel from the Controller (for the TS3100)

9.3.1. Dismounting the Control Panel

To dismount the control panel, perform the following procedure.

a) Loosen the four corner screws that fix the control panel.

b) Remove the four screws and slowly pull out the panel section forward.

Note: Exercise caution as cables are connected to the rear side of the panel section.

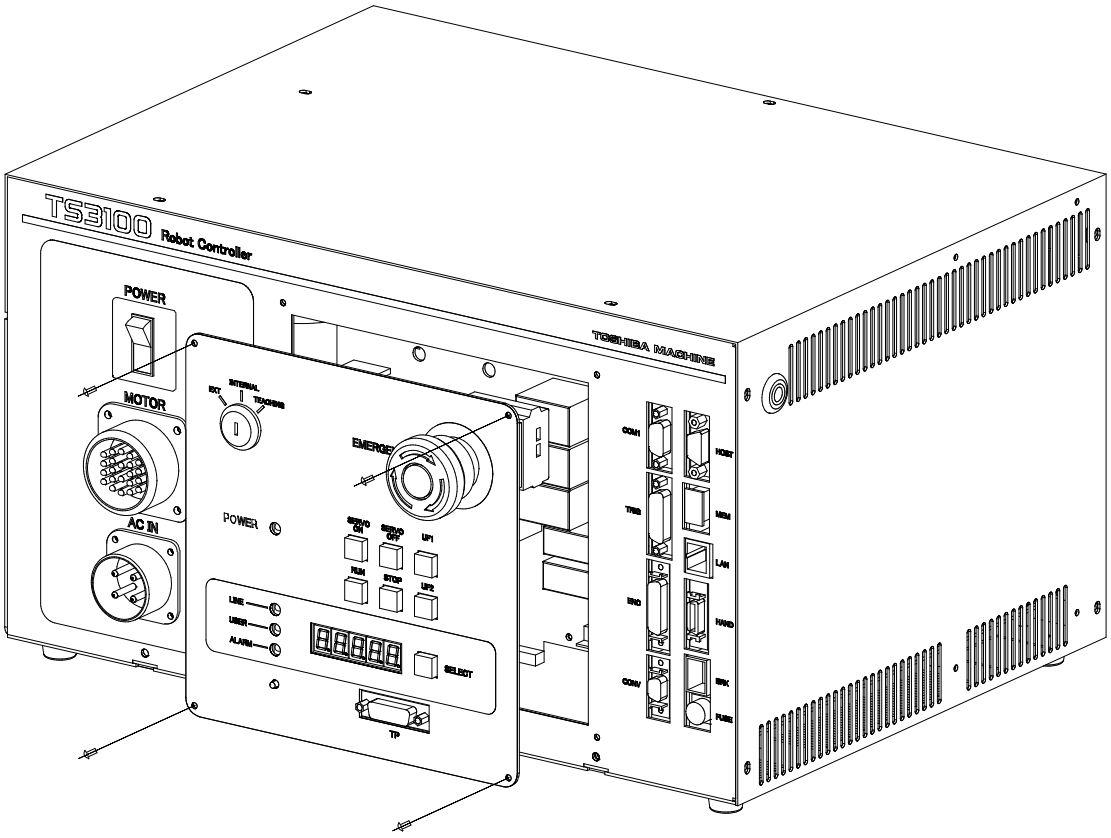


Fig. 9.6 Dismounting the control panel (TS3100)

9.3.2. Cables between the Controller and the Control Panel

When the control panel is detached from the robot controller, the cable that connects the controller panel to the robot controller is provided as an option.

9.3.3. Installation Dimensions of the Control Panel

The installation dimensions of the control panel are as shown in Fig. 9.6.
Cross truss screws (φ3×6, ZN3-B) are used.

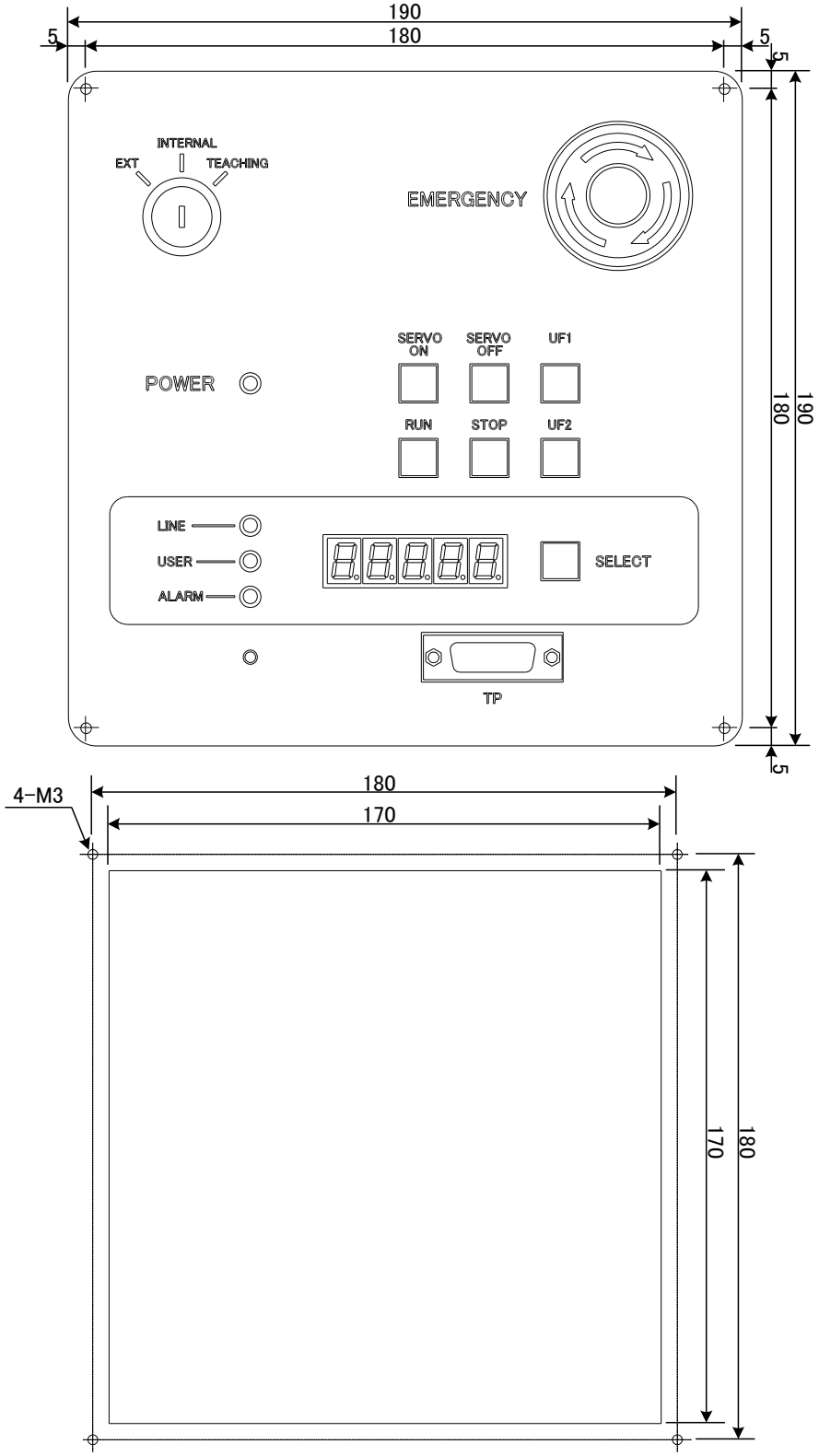


Fig. 9.7 Installation dimensions of the control panel (TS3100)

9.3.4. Mounting the Dummy Panel to the Controller

After the control panel is dismounted from the controller, mount the dummy panel to the location where there was the control panel as shown in Fig. 9.8. The dummy panel and mounting parts are provided as options.

a) Insert the connector of the cable, which was removed when detaching the control panel from the controller, from the rear side of the dummy panel and fix both ends of the connector with screws. To mount the connector, use cross truss screws (φ3×6, ZN3-B).

b) Fix the dummy panel to the controller with the screws.

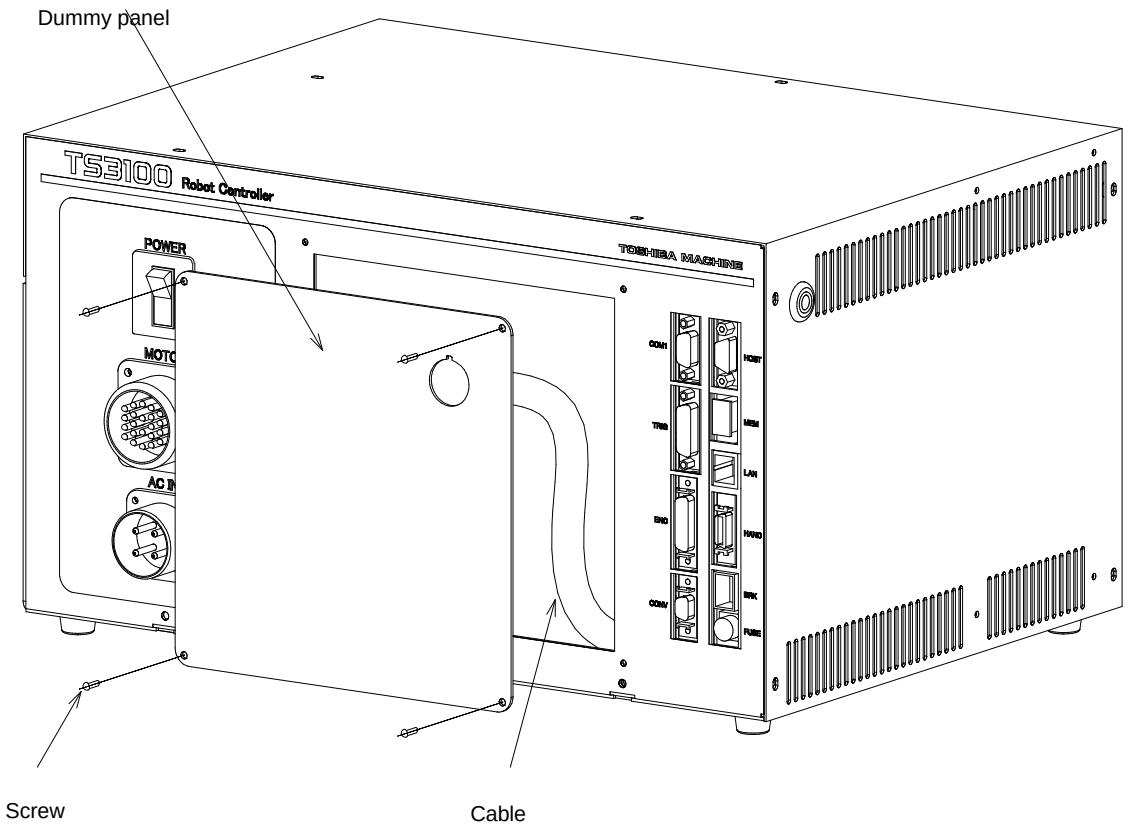


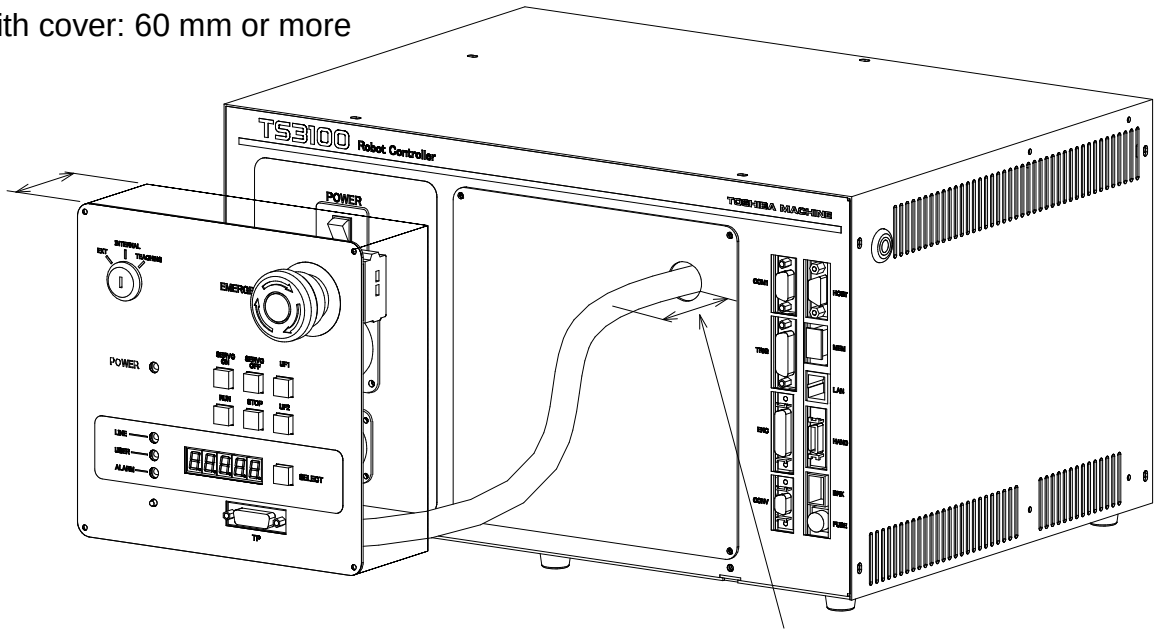
Fig. 9.8 Mounting the dummy panel (TS3100)

9.3.5. Dimensions When the Control Panel Is Detached

The connection diagram of the control panel and the dummy panel is shown in Fig. 9.9. Allocate a clearance of 50 mm or more (60 mm or more when the cover is used) in the back of the detached control panel. When the connection cable is attached to the dummy panel of the controller, a clearance of about 80 mm is required as the cable connector is protruded to the front of the controller.

.

Without cover: 50 mm or more
With cover: 60 mm or more



80 mm or more from the dummy panel

Fig. 9.9 Connection diagram of the dummy panel and the control panel (TS3100)

10. Tool Interface (Robot Body Side)

10.1. Mounting Tool

The tool is to be mounted on the tool mounting flange at the end of arm 3. Fig. 10.1 shows the dimensions of the tool mounting flange.

As shown in Fig. 10.1, the tool is centered with the ø20H7 mating section. The tool direction is adjusted by means of the ø5 knock pin and secured with four (4) M5 bolts.

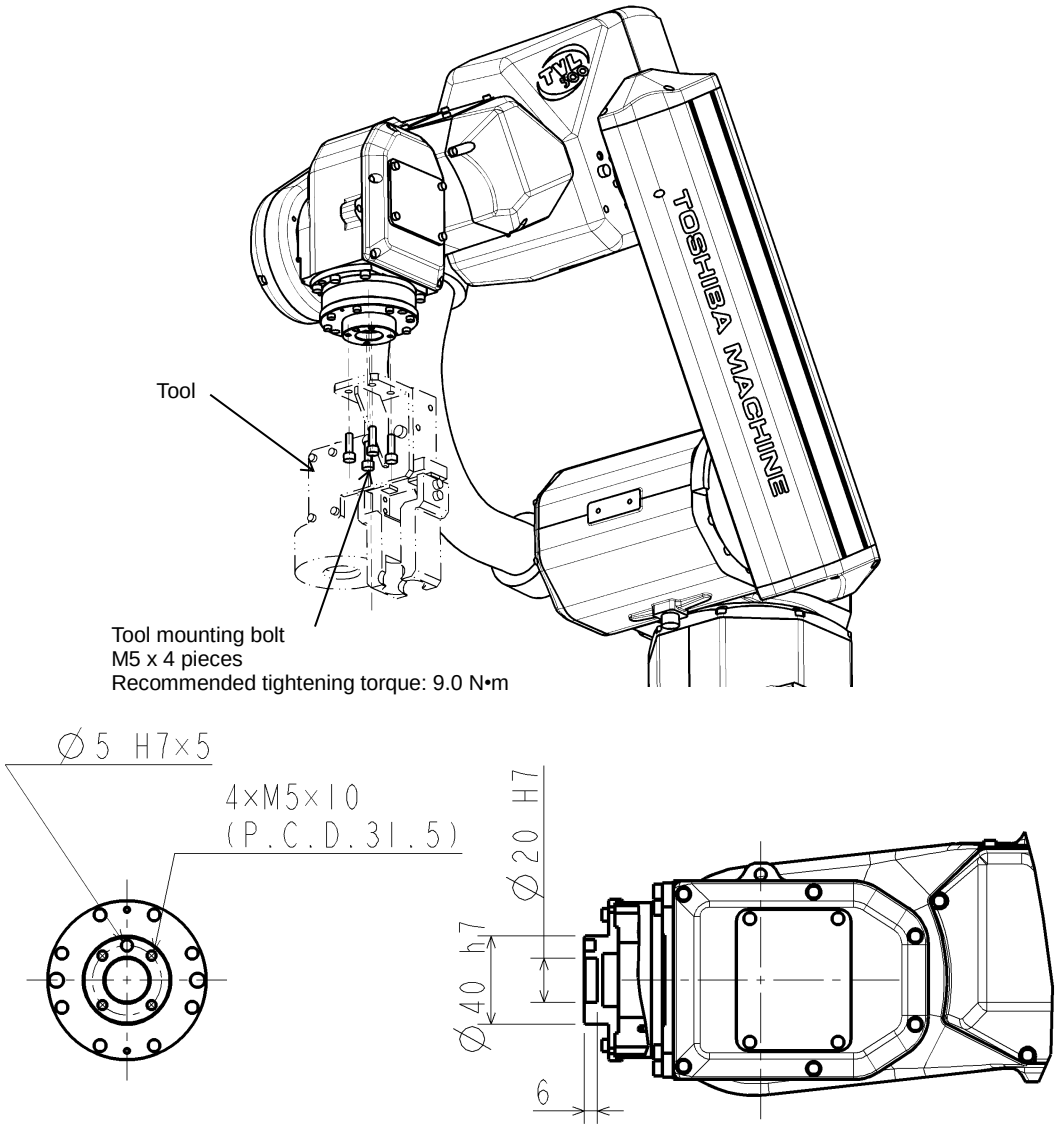


Fig. 10.1 Tool mounting dimensions

10.2. Tool Air Piping

The robot is provided with four (4) air lines for the tool.
The outer diameter of the air pipelines is 4 mm. Fig. 10.2 shows the tool air piping.

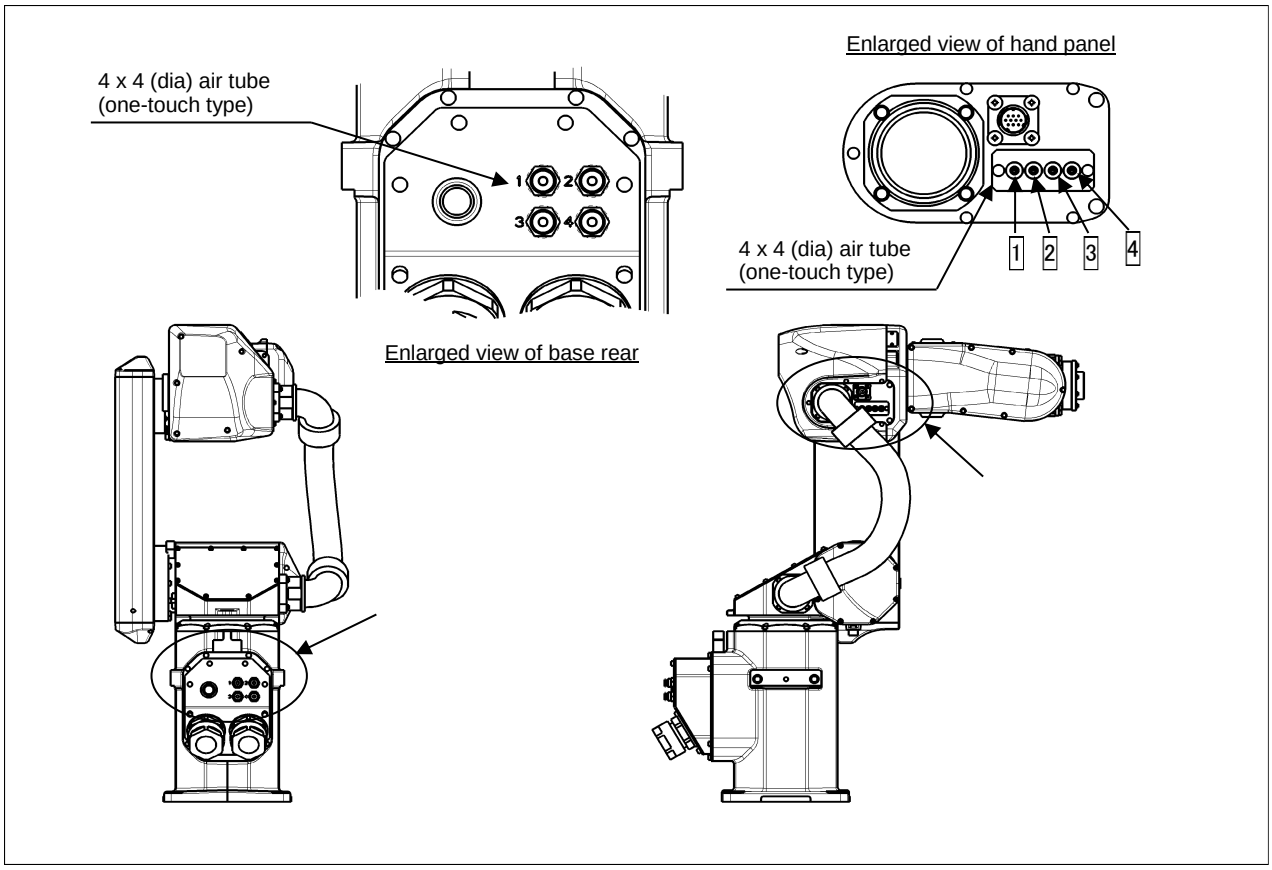


Fig. 10.2 Tool air piping

The air tube is identified by the number and color. At piping, make sure that each tube is connected properly, referring to the below-mentioned.

1 : Red 2 : White 3 : Blue 4 : Yellow

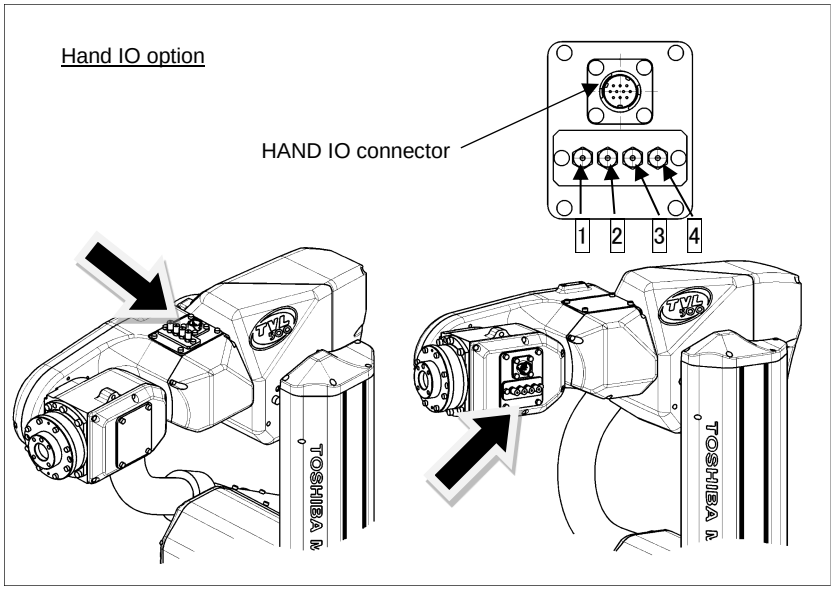


Fig. 10.3 Tool air piping (option)

10.3. Permissible Load Conditions and Program Setting

This paragraph describes the permissible load conditions of the robot and how to set up the program according to the load.

10.3.1. Permissible Load Conditions

The robot load conditions are defined by the tool mass, moment of inertia and offset value of tool gravity center from the center of the tool shaft, as shown in Fig. 10.4 and Fig. 10.5

The permissible load conditions for TVL500/TVL700 are shown in Table 10.1.

Table 10.1 Permissible load conditions

Conditions	Permissible values	
Type	TVL500	TVL700
Mass	Rating 1 kg (Max. 3 kg)	Rating 1 kg (Max. 4kg)
Load inertia	Axes4 and 5: 0.15 kg•m^2 axis 6: 0.2 kg•m^2	Axes4 and 5: 0.09 kg•m^2 axis 6: 0.1 kg• m^2
Offset value of load gravity center	Max. 100 mm (load ≤ 3 kg)	Max. 100 mm (load ≤ 4 kg)

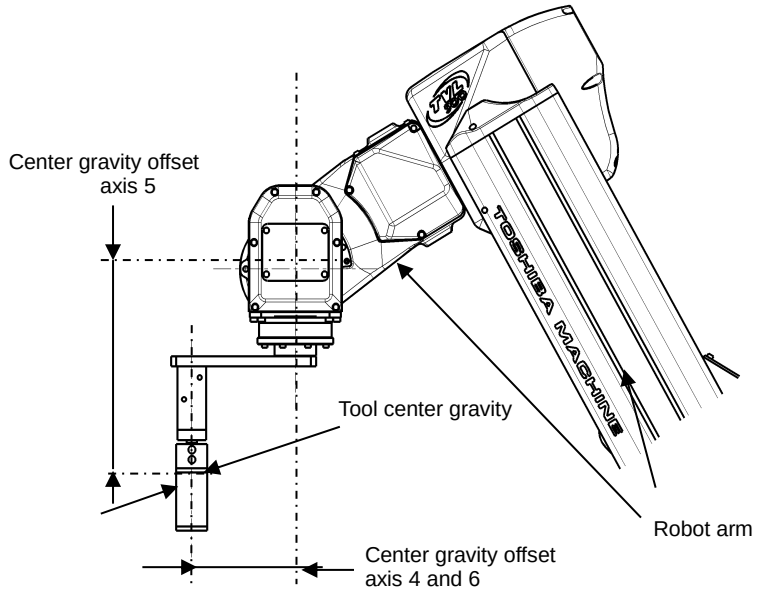


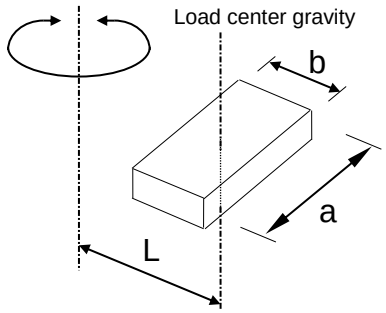
Fig. 10.4 Explanation of inertia moment

! CAUTION

- NEVER operate the robot under the load conditions exceeding the permissible values. Otherwise, the robot life and safety cannot be guaranteed.

○ Inertia moment

The following drawing shows an example of a model with simplified robot and load, and a formula for calculating the load inertia moment.



L : Distance from the center of axis 6 to load center gravity (m)
a: Load width (m)
b: Load length (m)
M: Load mass (kg)

$$\text{Inertia moment } (kg \cdot m^2) = \frac{M}{12}(a^2+b^2) + ML^2$$

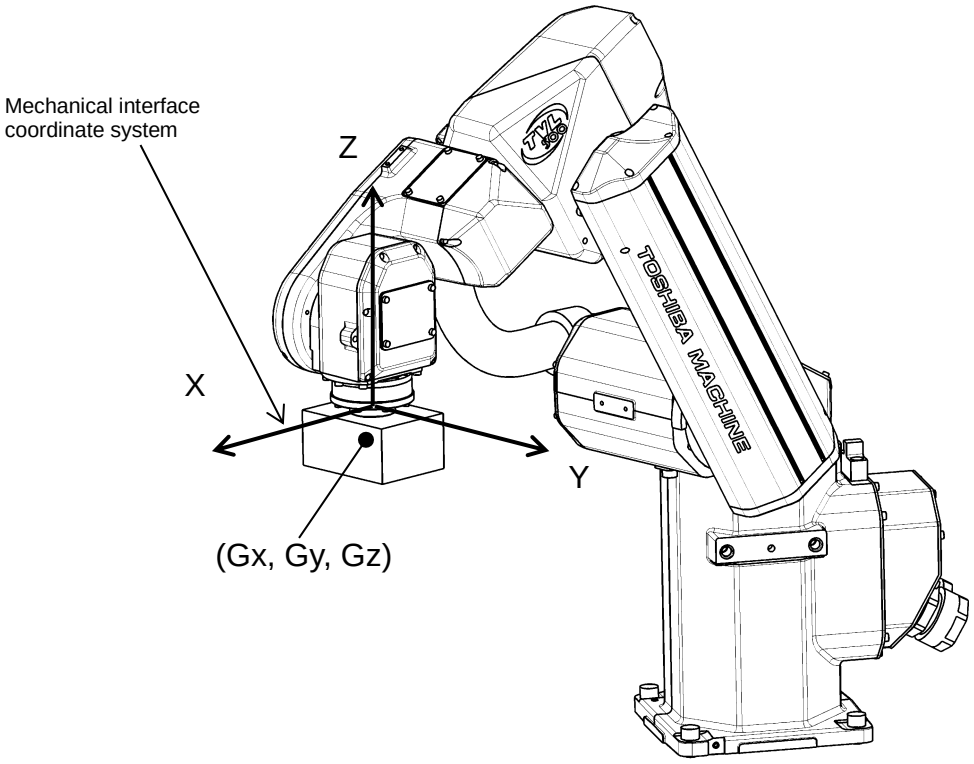


Fig. 10.5 Robot tool coordinate system

10.3.2. Load Conditions and Program Setting

This robot can automatically change the maximum speed, acceleration/deceleration and servo gain by using the PAYLOAD command in the program according to the load conditions.

Be sure to use the PAYLOAD command.

The specific method for using this function is explained below.

a) PAYLOAD command format

The PAYLOAD command format is written as shown below if the tool mass is M kg and the gravity center offset is G mm.

PAYLOAD = {M, Gx, Gy, Gz}

M: Load mass (unit: kg)

Gx: Center-of-gravity offset in the X direction (Units in mm: Absolute value)

Gy: Center-of-gravity offset in the Y direction (Units in mm: Absolute value)

Gz: Center-of-gravity offset in the Z direction (Units in mm: Absolute value)

The PAYLOAD command has the following functions.

- The maximum speed and acceleration/deceleration of each robot axis are automatically changed according to the set load conditions.
- The servo gain of each robot axis is automatically changed according to the set load conditions.

b) Program examples

Basic program examples using the PAYLOAD command are shown below. For further information, see the Robot Language Manual.

(Program example 1)

The robot is moved under the load conditions of 3 kg mass and (50 mm, 50 mm, 50 mm) gravity center offset.

```
PROGRAM SAMPLE
   SPEED=100
   PAYLOAD={5,50,50,50}
   MOVE P1
   MOVE P2
   STOP
END
```

(Program example 2)

When the hand mass is 3 kg and the gravity center offset is (0 mm, 0 mm, 20 mm) and the mass is 1 kg and gravity center offset is (30 mm, 0 mm, 50 mm) when the workpiece is grasped.

Pick-and-place operation is executed under the above conditions.

```
PROGRAM SAMPLE
   PAYLOAD={3,0,0,20}
   ACCUR=COARSE
   ENABLE NOWAIT
   RESET DOUT
   MOVE P0
   DOUT(1)
   WAIT DIN(1)
LOOP:
   MOVE P1+POINT(0,0,100)
   IF DIN(-1)THEN GOTO FIN
   MOVE P1
   WAIT MOTION>=100
   DOUT(213)
   DELAY 1
   PAYLOAD={1,30,0,50}
   MOVE P1+POINT(0,0,100)
   MOVE P2+POINT(0,0,100)
   MOVE P2
   WAIT MOTION>=100
   DOUT(-213)
   DELAY 1
   PAYLOAD={3,0,0,20}
   MOVE P2+POINT(0,0,100)
   GOTO LOOP
FIN:
   MOVE P0
   DOUT(1)
   STOP
END
```

c) Setting of PAYLOAD command

In the default state, or when the PAYLOAD command is not used, the maximum speed and acceleration/deceleration are set to 100 % and the servo gain is set to the value under the minimum load. (See Para. 8.3.3.)

! CAUTION

- Be sure to use the PAYLOAD command.
- Unless the PAYLOAD command is used, the robot will vibrate or overshoot, resulting in malfunction or shortening of the life of the mechanisms. In the worst case, the mechanism will be damaged.
- Even when the PAYLOAD command is used, regulate the speed by using the SPEED or DECEL command while confirming the workpiece behavior subject to handling.

! CAUTION

- The load moment of inertia should be within the tolerances given in Table 10.1.
- A large inertia moment may cause the robot to vibrate even through the load's center of gravity is not offset. In this case, arbitrarily specify the following:

  PAYLOAD= {M, Gx, Gy, Gz}

! CAUTION

- A large load mass or center-of-gravity offset may cause the robot to rotate when it is manually guided. This is because the servo gain is not appropriate.
  In this case, set M, Gx, Gy, Gz with [UTILITY] PAYLOAD in accordance with the load requirements.
  The current servo gain is changed to the value matched to the load requirements.

11. Tool Interface (for the TSL 3100)

11.1. Tool wiring

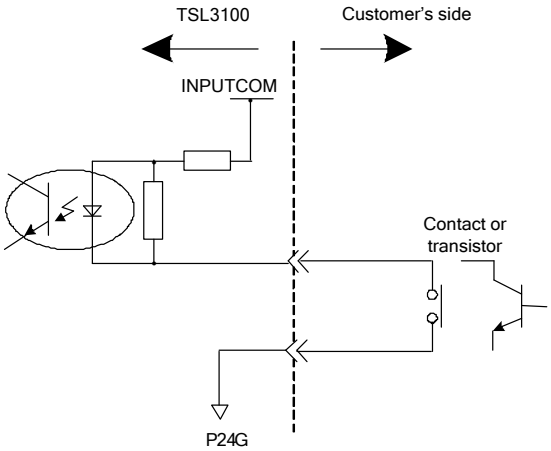
The robot is provided with the tool cable air pipe and arm 1 (1) (arm 2 (2) and arm 3 as options).

Connection to external equipment from the robot controller can also be made without using the tool wiring in the robot arm.

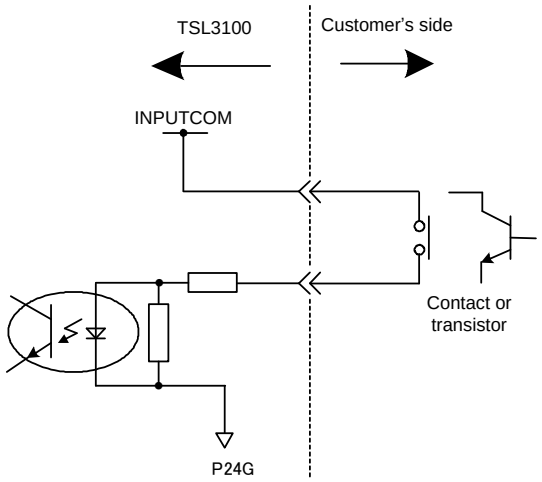
11.1.1. Tool Signals (Controller Side)

Eight input signals for components such as sensors, eight control signals for components such as solenoid valves, 24 VDC, and 24 VDC GND are provided as tool signals for the controller, thus enabling the wiring from the controller to external equipment. (Cables between the controller and external equipment are optional.) The signals are explained below.

a-1) Input signal connector HAND (TSL3100 Type-N)

Pin	Signal name		Signal No.	Input circuit and example of connections
A1	D_IN1	Input signal 1	201	 [Source type (+Common)]
B1	D_IN2	Input signal 2	202	
A2	D_IN3	Input signal 3	203	
B2	D_IN4	Input signal 4	204	
A3	D_IN5	Input signal 5	205	
B3	D_IN6	Input signal 6	206	
A4	D_IN7	Input signal 7	207	
B4	D_IN8	Input signal 8	208	The INPUTCOM signal is the same as that of the pins 6, 17 and 30 connected to the INPUT connector on the controller front face.
A5	DC 24V GND(P24G)			

a-2) Input signal connector HAND (TSL3100 Type-P)

Pin	Signal name		Signal No.	Input circuit and example of connections
A1	D_IN1	Input signal 1	201	 [Sink type (-Common)] The INPUTCOM signal is the same as that of the pins 6, 17 and 30 connected to the INPUT connector on the controller front face.
B1	D_IN2	Input signal 2	202	
A2	D_IN3	Input signal 3	203	
B2	D_IN4	Input signal 4	204	
A3	D_IN5	Input signal 5	205	
B3	D_IN6	Input signal 6	206	
A4	D_IN7	Input signal 7	207	
B4	D_IN8	Input signal 8	208	
A5	DC 24V(P24V)			

As input signals, no-voltage contacts or transistor open collector inputs are used.

No-voltage contact specifications:

Contact rating: 24 VDC, 10 mA or over (circuit current: approx. 7 mA)

Minimum contact current: 24 VDC, 1 mA

Contact impedance: 100 Ω or less

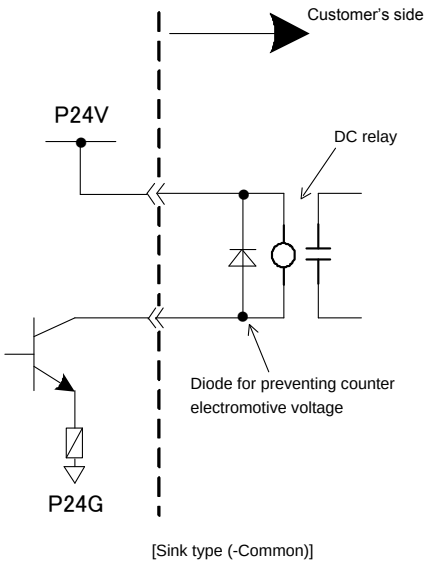
Transistor specifications:

Withhold voltage between collector and emitter: 30 V or over

Current between collector and emitter: 10 mA or over (circuit current: approx. 7 mA)

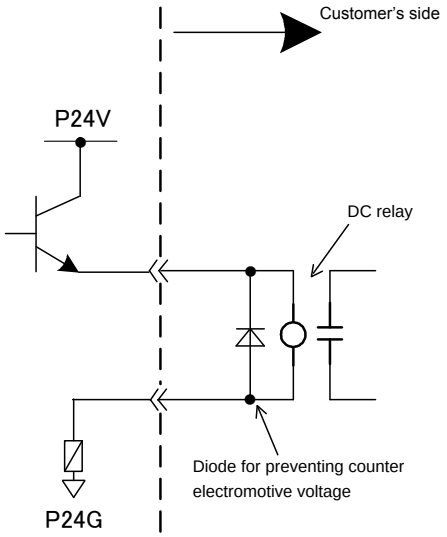
Leak current between collector and emitter: 100 μA or less

b-1) Output signal connector HAND (TSL3100 Type-N)

<table>
<tr><th>Pin</th><th colspan="2">Signal name</th><th>Signal No.</th><th>Output circuit and example of connections</th></tr>
<tr><td>B5</td><td>D_OUT1</td><td>Output signal 1</td><td>201</td><td rowspan="9"> 

[Sink type (-Common)]</td></tr>
<tr><td>A6</td><td>D_OUT2</td><td>Output signal 2</td><td>202</td></tr>
<tr><td>B6</td><td>D_OUT3</td><td>Output signal 3</td><td>203</td></tr>
<tr><td>A7</td><td>D_OUT4</td><td>Output signal 4</td><td>204</td></tr>
<tr><td>B7</td><td>D_OUT5</td><td>Output signal 5</td><td>205</td></tr>
<tr><td>A8</td><td>D_OUT6</td><td>Output signal 6</td><td>206</td></tr>
<tr><td>B8</td><td>D_OUT7</td><td>Output signal 7</td><td>207</td></tr>
<tr><td>A9</td><td>D_OUT8</td><td>Output signal 8</td><td>208</td></tr>
<tr><td>A10</td><td colspan="2">DC 24V(P24V)</td><td rowspan="2">24 VDC power</td><td rowspan="2"></td></tr>
<tr><td>B10</td><td colspan="2">DC 24V(P24V)</td></tr>
</table>

b-2) Output signal connector HAND (TSL3100 Type-P)

Pin	Signal name		Signal No.	Output circuit and example of connections
B5	D_OUT1	Output signal 1	201	
A6	D_OUT2	Output signal 2	202	
B6	D_OUT3	Output signal 3	203	
A7	D_OUT4	Output signal 4	204	
B7	D_OUT5	Output signal 5	205	
A8	D_OUT6	Output signal 6	206	
B8	D_OUT7	Output signal 7	207	
A9	D_OUT8	Output signal 8	208	
A10	DC 24V GND (P24G)			
B10	DC 24V GND (P24G)			

[Source type (-Common)]

By using the 24 VDC power of the controller, a relay, solenoid valve, etc., can be driven. To use external power supply, connect GND of the external power supply with the 24 VDC GND (P24G) of the robot controller (GND common connection). However, do NOT connect the external power supply +24V with the 24 VDC (P24V) of the robot controller. Otherwise, the power supply may be damaged.

Output specifications: Rated voltage: 24 VDC
Rated current: 100 mA

- When a relay or solenoid valve, etc., is connected, it is necessary to use a surge killer or diode to absorb the surge voltage.
- The right figure shows the DC relay circuit when the external power is used.

11.1.2. Tool Wiring (Robot Arm Side)

Four input signals are provided for sensors, etc. and four control signals for solenoid valves, etc. A supply power signal of 24 VDC is also provided. They are connected to the controller. The wiring arrangement for these cables is shown in Fig. 11.1. The wires are connected to the connectors on the arm 2 (1). The customer should provide the following connectors to connect the cables.

Cannon connector (standard) Type: Angle plug JN2FS10SL2-R
(Maker: Japan Aviation Electronics Industry)

Type of contact:	JN1-22-26S-PKG100	Adaptive cable:	AWG26~AWG28
	JN1-22-22S-PKG100		AWG21~AWG25
	JN1-22-20S-PKG100		AWG20

If the above-mentioned parts cannot be procured, we will prepare the cables. Table 5.1 shows the HAND cable (option) list.

! DANGER

- Be sure to use the designated wire. Otherwise, fires or faults may be caused.
- When connecting the connector and wires, make sure not to mistake the terminal arrangement.
- After making the connection, use a tester, etc., to confirm the connection.

If the separately installed sequencer or the like is used for control, remove the connector panel of the base portion and separate the connectors HIN and HOUT on the rear. Then connect the cable of the sequencer or the like through the cable inlet of the connector panel. (See Fig. 11.1.) For ahead of the HIN and HOUT connectors, the user should prepare the following plug connectors and connect the cables. The current is 1 A or less per cable.

Type of connector:	HIN	SMR-06V-B (Maker: J.S.T. Mfg.)
	HOUT	SMR-10V-B (Maker: J.S.T. Mfg.)
Type of contact:	SYM-001T-P0.6	Adaptive cable: AWG22~AWG28

ROBOT connector type

Type of connector:	HIN	SMP-06V-BC (Maker: J.S.T. Mfg.)
	HOUT	SMP-10V-BC (Maker: J.S.T. Mfg.)

Type of contact: SHF-001T-0.8BS Adaptive cable: AWG22~AWG28

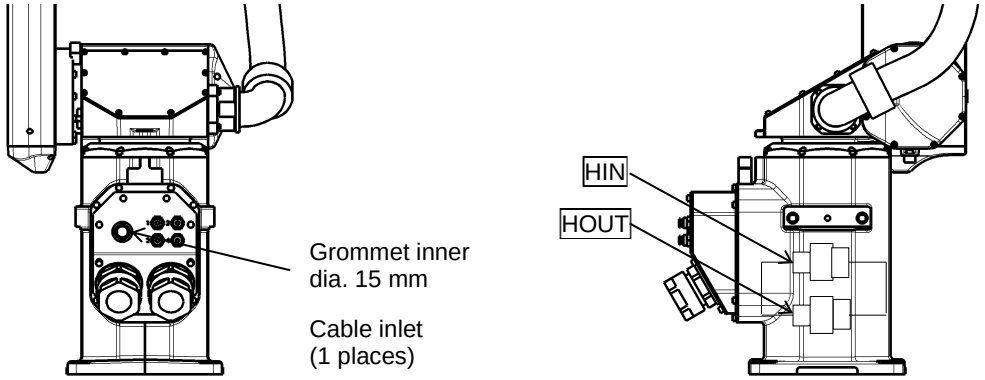
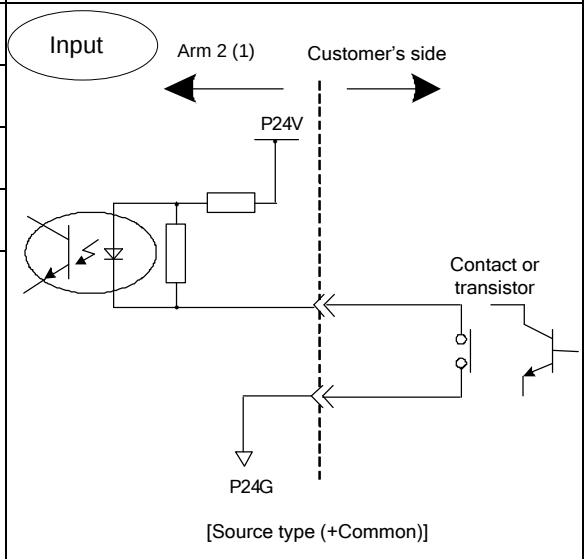
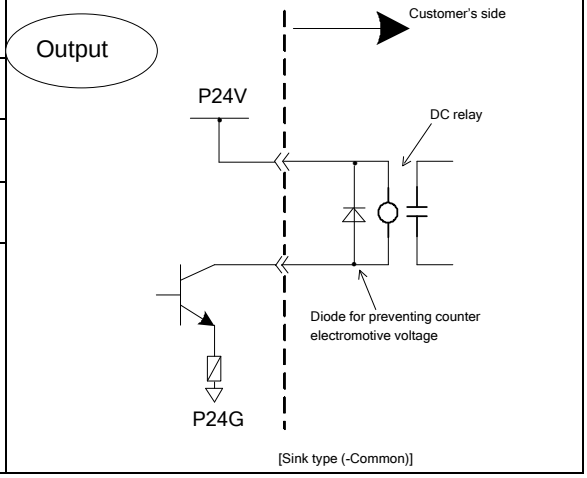


Fig. 11.1. Wiring to PLC, etc.

Mechanical side

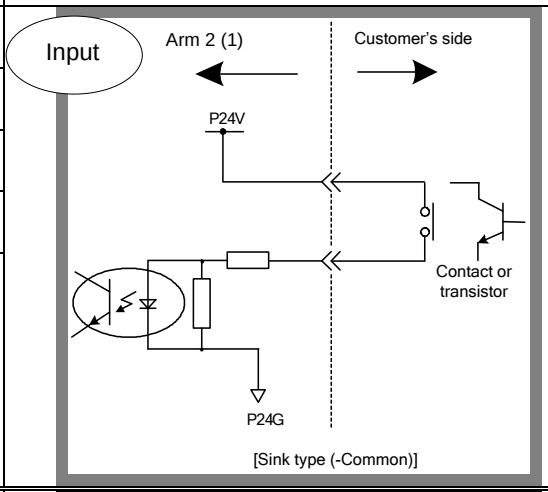
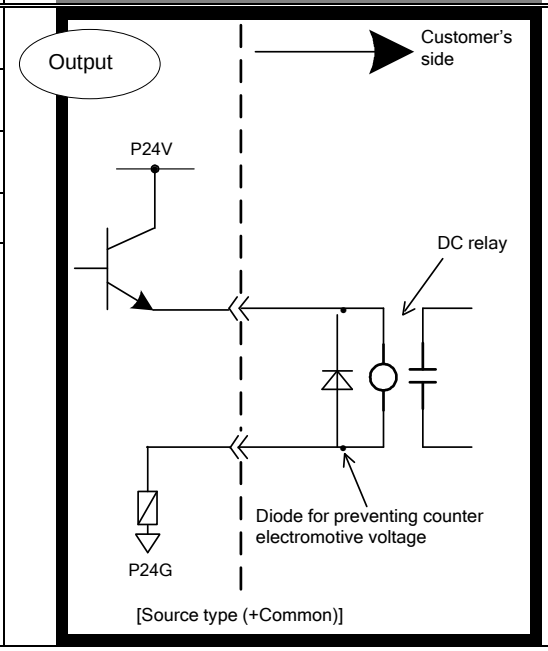
Input/output signal connector HAND (TSL 3100 Type-N)

Pin	Signal name		Signal No.	Input/output circuit and example of connections
1	D_IN1	Input signal 1	201	
2	D_IN2	Input signal 2	202	
3	D_IN3	Input signal 3	203	
4	D_IN4	Input signal 4	204	
5	DC 24V GND(P24G)			
6	D_OUT1	Output signal 1	201	
7	D_OUT2	Output signal 2	202	
8	D_OUT3	Output signal 3	203	
9	D_OUT4	Output signal 4	204	
10	DC 24V (P24V)			

Input/output signal connector HOUT3, HOUT4 (TSL3100 Type-N)
(This connector is located in arm 2 (1), and connected to the solenoid valve when the manifold is optional.)

Pin (Connector): HOUT3)	Signal name		Signal No.
1	D_OUT5	Output signal 5	205
2	D_OUT6	Output signal 6	206
3	DC 24V (P24V)		
Pin (Connector): HOUT4)	Signal name		Signal No.
1	D_OUT7	Output signal 7	207
2	D_OUT8	Output signal 8	208
3	DC 24V (P24V)		

Input/output signal connector HAND (TSL3100 Type-P)

Pin	Signal name		Signal No.	Input/output circuit and example of connections
1	D_IN1	Input signal 1	201	
2	D_IN2	Input signal 2	202	
3	D_IN3	Input signal 3	203	
4	D_IN4	Input signal 4	204	
5	DC 24V (P24V)			
6	D_OUT1	Output signal 1	201	
7	D_OUT2	Output signal 2	202	
8	D_OUT3	Output signal 3	203	
9	D_OUT4	Output signal 4	204	
10	DC 24V GND (P24G)			

Input/output signal connector HOUT3, HOUT4 (Type-P)

(This connector is located in arm 2 (1), and connected to the solenoid valve when the manifold is optional.)

Pin (Connector): HOUT3)	Signal name		Signal No.
1	D_OUT5	Output signal 5	205
2	D_OUT6	Output signal 6	206
3	DC 24V GND (P24G)		
Pin (Connector): HOUT4)	Signal name		Signal No.
1	D_OUT7	Output signal 7	207
2	D_OUT8	Output signal 8	208
3	DC 24V GND (P24G)		

As input signals, no-voltage contacts or transistor open collector inputs are used.

No-voltage contact specifications:

Contact rating: 24 VDC, 10 mA or over (circuit current: approx. 7 mA)
Minimum contact current: 24 VDC, 1 mA
Contact impedance: 100 Ω or less

Transistor specifications:

Withhold voltage between collector and emitter: 30 V or over
Current between collector and emitter: 10 mA or over (circuit current: approx. 7 mA)
Leak current between collector and emitter: 100 μA or less

By using the 24 VDC power of the controller, a relay, solenoid valve, etc., can be driven. When the external power is used, GND of the external power should be common to GND (PG) of the robot controller.

Output specifications:

Rated voltage: 24 VDC
Rated current: 100 mA

- If the 24 VDC power supplied from the robot controller is used, the total current should be 2 A or less.
- When the external power is used, the total current should also be 2 A or less.
- When a relay or solenoid valve, etc., is connected, it is necessary to use a surge killer or diode to absorb the surge voltage.

Table 11.1 HAND cable (option) list

	Part name	Toshiba Dwg. No.	Unit code	Maker	Plug type	Length
1	I/O cable	392N1201	Y610A3VP0	Toshiba Machine	Angle plug	1M
2		392N1202	Y610A3VQ0			2M

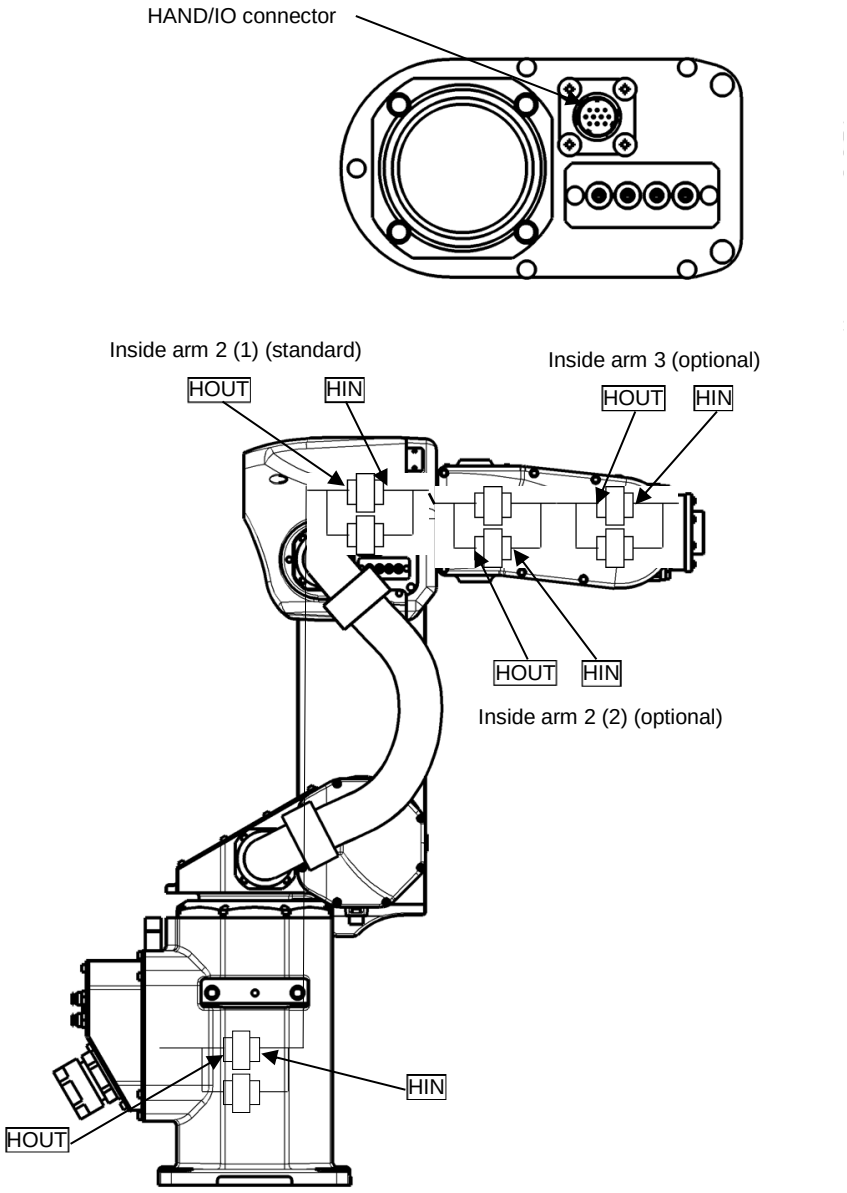


Fig. 11.2 Tool I/O wiring

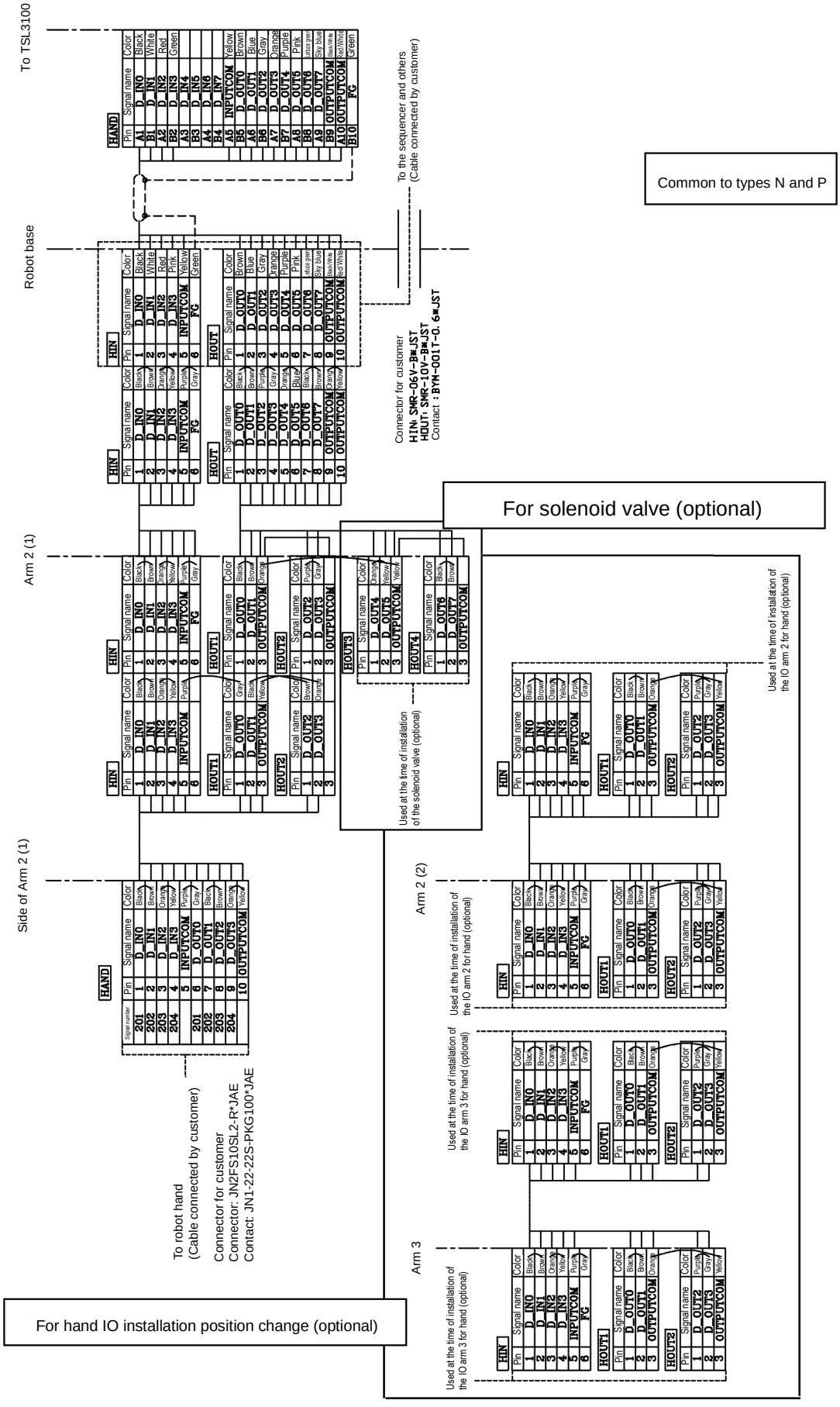


Fig. 11.3 Internal connection diagram (TSL3100)

12. Tool Interface (for the TSL3100E)

12.1. Tool wiring

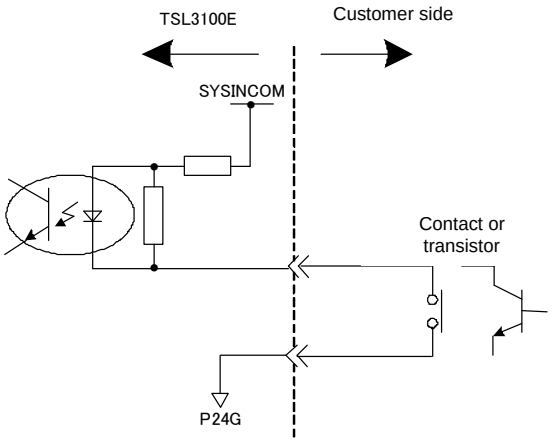
The robot is provided with the tool cable air pipe and arm 1 (1) (arm 2 (2) and arm 3 as options).

Connection to external equipment from the robot controller can also be made without using the tool wiring in the robot arm.

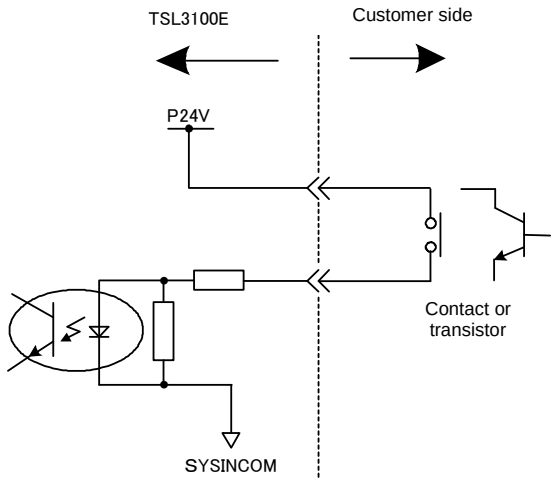
12.1.1. Tool Signals (Controller Side)

Eight input signals for components such as sensors, eight control signals for components such as solenoid valves, 24 VDC, and 24 VDC GND are provided as tool signals for the controller, thus enabling the wiring from the controller to external equipment. (Cables between the controller and external equipment are optional.) The signals are explained below.

a-1) Input signal connector HAND (TSL3100E Type-N)

Pin	Signal name		Signal No.	Input circuit and example of connections
A1	D_IN1	Input signal 1	201	 [Source type (+Common)]
B1	D_IN2	Input signal 2	202	
A2	D_IN3	Input signal 3	203	
B2	D_IN4	Input signal 4	204	
A3	D_IN5	Input signal 5	205	
B3	D_IN6	Input signal 6	206	
A4	D_IN7	Input signal 7	207	The SYSINCOM signal is the same as that of the pins 17 and 30 connected to the INPUT connector on the controller front face.
B4	D_IN8	Input signal 8	208	
B9	DC 24V GND(P24G)			

a-2) Input signal connector HAND (TSL3100E Type-P)

Pin	Signal name		Signal No.	Input circuit and example of connections
A1	D_IN1	Input signal 1	201	 [Source type (+Common)] The SYSINCOM signal is the same as that of the pins 17 and 30 connected to the INPUT connector on the controller front face.
B1	D_IN2	Input signal 2	202	
A2	D_IN3	Input signal 3	203	
B2	D_IN4	Input signal 4	204	
A3	D_IN5	Input signal 5	205	
B3	D_IN6	Input signal 6	206	
A4	D_IN7	Input signal 7	207	
B4	D_IN8	Input signal 8	208	
A5	DC 24V(P24V)			

As input signals, no-voltage contacts or transistor open collector inputs are used.

No-voltage contact specifications:

Contact rating: 24 VDC, 10 mA or over (circuit current: approx. 7 mA)

Minimum contact current: 24 VDC, 1 mA

Contact impedance: 100 Ω or less

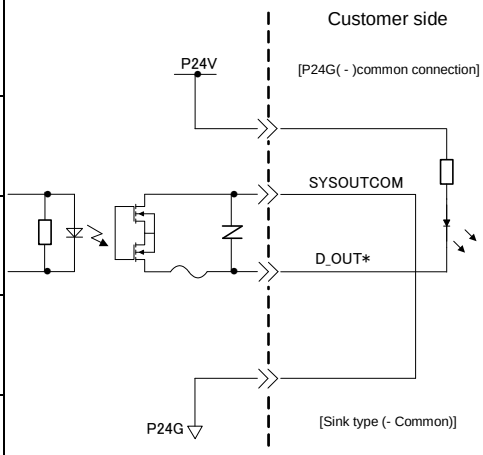
Transistor specifications:

Withhold voltage between collector and emitter: 30 V or over

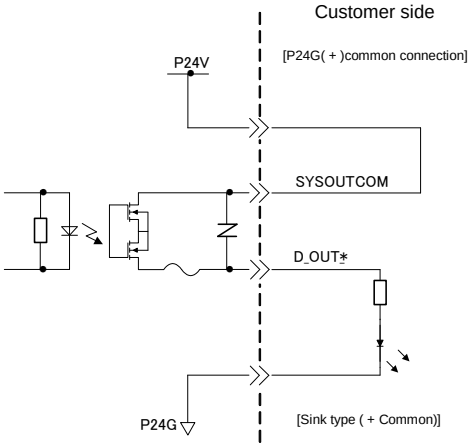
Current between collector and emitter: 10 mA or over (circuit current: approx. 7 mA)

Leak current between collector and emitter: 100 μA or less

b-1) Output signal connector HAND (TSL3100E Type-N)

Pin	Signal name		Signal No.	Output circuit and example of connections
B5	D_OUT1	Output signal 1	201	 The SYSPUTCOM signal is the same as that of the pins 10 and 23 connected to the OUTPUT connector on the controller front face.
A6	D_OUT2	Output signal 2	202	
B6	D_OUT3	Output signal 3	203	
A7	D_OUT4	Output signal 4	204	
B7	D_OUT5	Output signal 5	205	
A8	D_OUT6	Output signal 6	206	
B8	D_OUT7	Output signal 7	207	
A9	D_OUT8	Output signal 8	208	
A5	DC 24V(P24V)			

b-2) Output signal connector HAND (TSL3100E Type-P)

Pin	Signal name		Signal No.	Output circuit and example of connections
B5	D_OUT1	Output signal 1	201	 The SYSPUTCOM signal is the same as that of the pins 10 and 23 connected to the OUTPUT connector on the controller front face.
A6	D_OUT2	Output signal 2	202	
B6	D_OUT3	Output signal 3	203	
A7	D_OUT4	Output signal 4	204	
B7	D_OUT5	Output signal 5	205	
A8	D_OUT6	Output signal 6	206	
B8	D_OUT7	Output signal 7	207	
A9	D_OUT8	Output signal 8	208	
B9	DC 24V GND(P24G)			

By using the 24 VDC power of the controller, a relay, solenoid valve, etc., can be driven. To use external power supply, connect GND of the external power supply with the 24 VDC GND (P24G) of the robot controller (GND common connection). However, do NOT connect the external power supply +24V with the 24 VDC (P24V) of the robot controller. Otherwise, the power supply may be damaged.

Output specifications: Rated voltage: 24 VDC
Rated current: 100 mA

- When a relay or solenoid valve, etc., is connected, it is necessary to use a surge killer or diode to absorb the surge voltage.
- The right figure shows the DC relay circuit when the external power is used.

12.1.2. Tool Wiring (Robot Arm Side)

Four input signals are provided for sensors, etc. and four control signals for solenoid valves, etc. A supply power signal of 24 VDC is also provided. They are connected to the controller. The wiring arrangement for these cables is shown in Fig. 12.1. The wires are connected to the connectors on the arm 2 (1). The customer should provide the following connectors to connect the cables.

Cannon connector (standard) Type: Angle plug JN2FS10SL2-R
(Maker: Japan Aviation Electronics Industry)

Type of contact:	JN1-22-26S-PKG100	Adaptive cable:	AWG26~AWG28
	JN1-22-22S-PKG100		AWG21~AWG25
	JN1-22-20S-PKG100		AWG20

If the above-mentioned parts cannot be procured, we will prepare the cables. Table 12.1 shows the HAND cable (option) list.

! DANGER

- Be sure to use the designated wire. Otherwise, fires or faults may be caused.
- When connecting the connector and wires, make sure not to mistake the terminal arrangement.
- After making the connection, use a tester, etc., to confirm the connection.

If the separately installed sequencer or the like is used for control, remove the connector panel of the base portion and separate the connectors HIN and HOUT on the rear. Then connect the cable of the sequencer or the like through the cable inlet of the connector panel. (See Fig. 12.1.) For ahead of the HIN and HOUT connectors, the user should prepare the following plug connectors and connect the cables. The current is 1 A or less per cable.

Type of connector:	HIN	SMR-06V-B (Maker: J.S.T. Mfg.)
	HOUT	SMR-10V-B (Maker: J.S.T. Mfg.)
Type of contact:	SYM-001T-P0.6	Adaptive cable: AWG22~AWG28

ROBOT connector type

Type of connector:	HIN	SMP-06V-BC (Maker: J.S.T. Mfg.)
	HOUT	SMP-10V-BC (Maker: J.S.T. Mfg.)

Type of contact: SHF-001T-0.8BS Adaptive cable: AWG22~AWG28

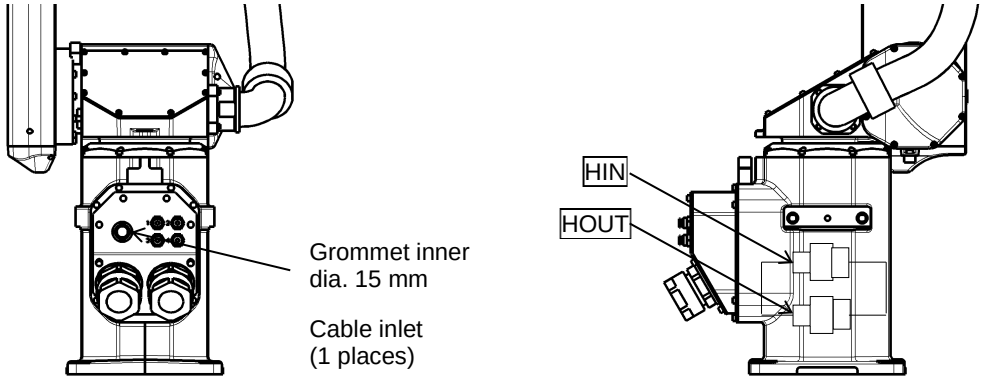
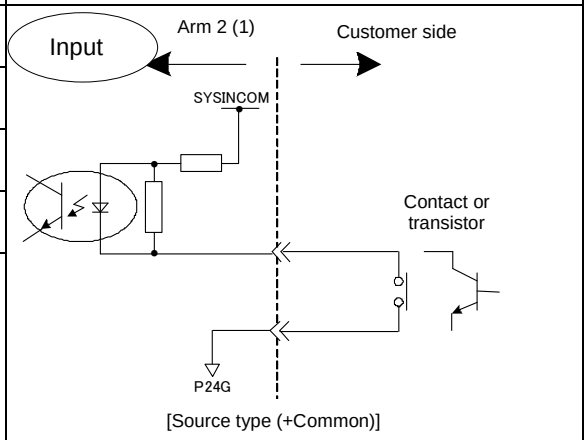
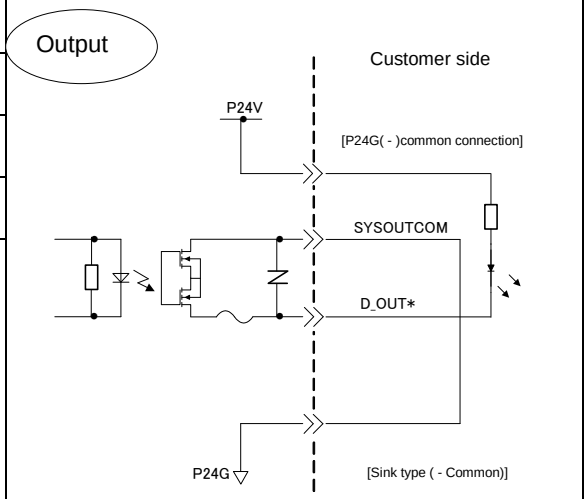


Fig. 12.1. Wiring to PLC, etc.

Mechanical side

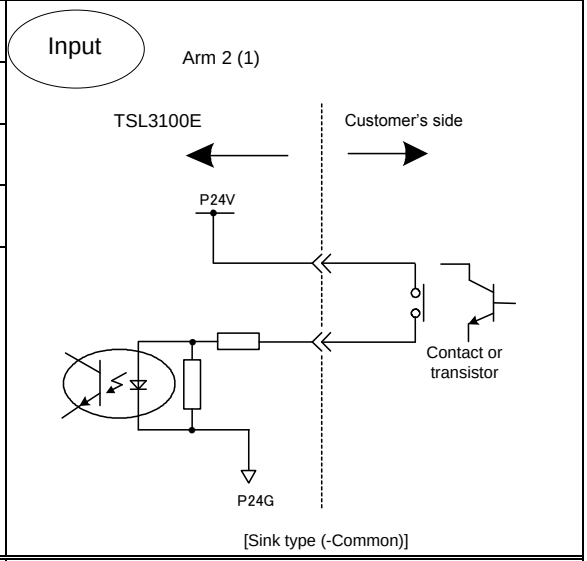
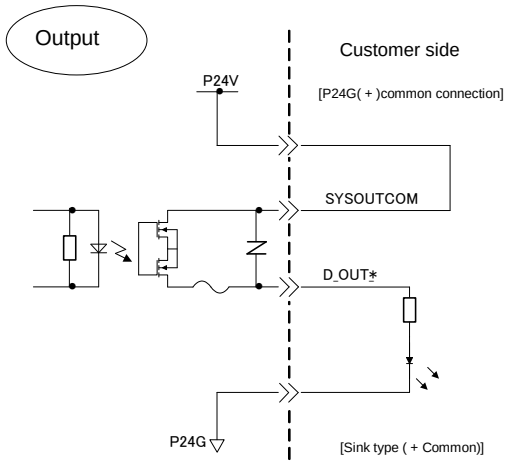
Input/output signal connector HAND (TSL3100E Type-N)

Pin	Signal name		Signal No.	Input/output circuit and example of connections
1	D_IN1	Input signal 1	201	
2	D_IN2	Input signal 2	202	
3	D_IN3	Input signal 3	203	
4	D_IN4	Input signal 4	204	
5	DC 24V GND(P24G)			
6	D_OUT1	Output signal 1	201	
7	D_OUT2	Output signal 2	202	
8	D_OUT3	Output signal 3	203	
9	D_OUT4	Output signal 4	204	
10	DC 24V(P24V)			

Input/output signal connector HOUT3, HOUT4 (TSL3100E Type-N)
(This connector is located in arm 2 (1), and connected to the solenoid valve when the manifold is optional.)

Pin (Connector): HOUT3)	Signal name		Signal No.
1	D_OUT5	Output signal 5	205
2	D_OUT6	Output signal 6	206
3	DC 24V(P24V)		
Pin (Connector): HOUT4)	Signal name		Signal No.
1	D_OUT7	Output signal 7	207
2	D_OUT8	Output signal 8	208
3	DC 24V(P24V)		

Input/output signal connector HAND (TSL3100E Type-P)

Pin	Signal name		Signal No.	Input/output circuit and example of connections
1	D_IN1	Input signal 1	201	
2	D_IN2	Input signal 2	202	
3	D_IN3	Input signal 3	203	
4	D_IN4	Input signal 4	204	
5	DC 24V(P24V)			
6	D_OUT1	Output signal 1	201	
7	D_OUT2	Output signal 2	202	
8	D_OUT3	Output signal 3	203	
9	D_OUT4	Output signal 4	204	
10	DC 24V GND(P24G)			

Input/output signal connector HOUT3, HOUT4 (Type-P)

(This connector is located in arm 2 (1), and connected to the solenoid valve when the manifold is optional.)

Pin (Connector): HOUT3)	Signal name		Signal No.
1	D_OUT5	Output signal 5	205
2	D_OUT6	Output signal 6	206
3	DC 24V GND(P24G)		
Pin (Connector): HOUT4)	Signal name		Signal No.
1	D_OUT7	Output signal 7	207
2	D_OUT8	Output signal 8	208
3	DC 24V GND(P24G)		

As input signals, no-voltage contacts or transistor open collector inputs are used.

No-voltage contact specifications:

Contact rating: 24 VDC, 10 mA or over (circuit current: approx. 7 mA)
Minimum contact current: 24 VDC, 1 mA
Contact impedance: 100 Ω or less

Transistor specifications:

Withhold voltage between collector and emitter: 30 V or over
Current between collector and emitter: 10 mA or over (circuit current: approx. 7 mA)
Leak current between collector and emitter: 100 μA or less

By using the 24 VDC power of the controller, a relay, solenoid valve, etc., can be driven. When the external power is used, GND of the external power should be common to GND (PG) of the robot controller.

Output specifications:

Rated voltage: 24 VDC
Rated current: 100 mA

- If the 24 VDC power supplied from the robot controller is used, the total current should be 2 A or less.
- When the external power is used, the total current should also be 2 A or less.
- When a relay or solenoid valve, etc., is connected, it is necessary to use a surge killer or diode to absorb the surge voltage.

Table 12.1 HAND cable (option) list

	Part name	Toshiba Dwg. No.	Unit code	Maker	Plug type	Length
1	I/O cable	392N1201	Y610A3VP0	Toshiba Machine	Angle plug	1M
2		392N1202	Y610A3VQ0			2M

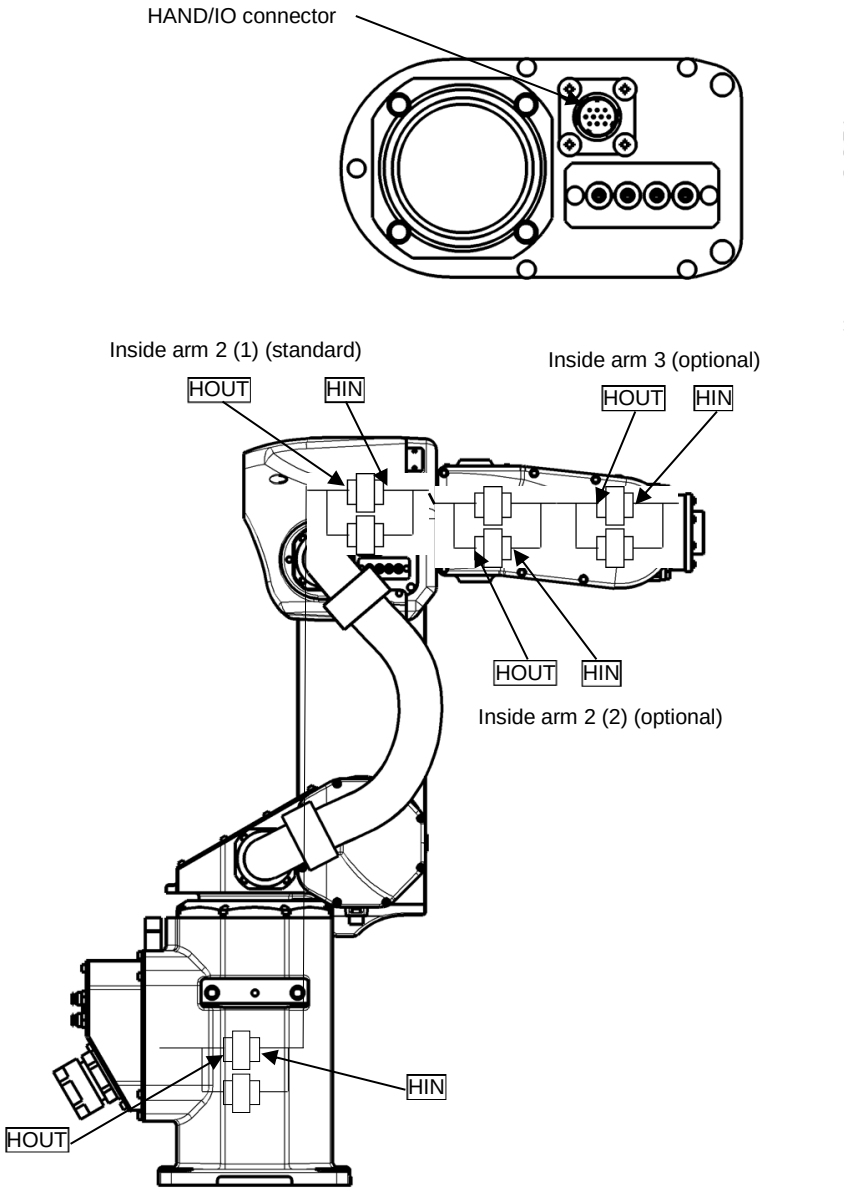


Fig. 12.2 Tool I/O wiring

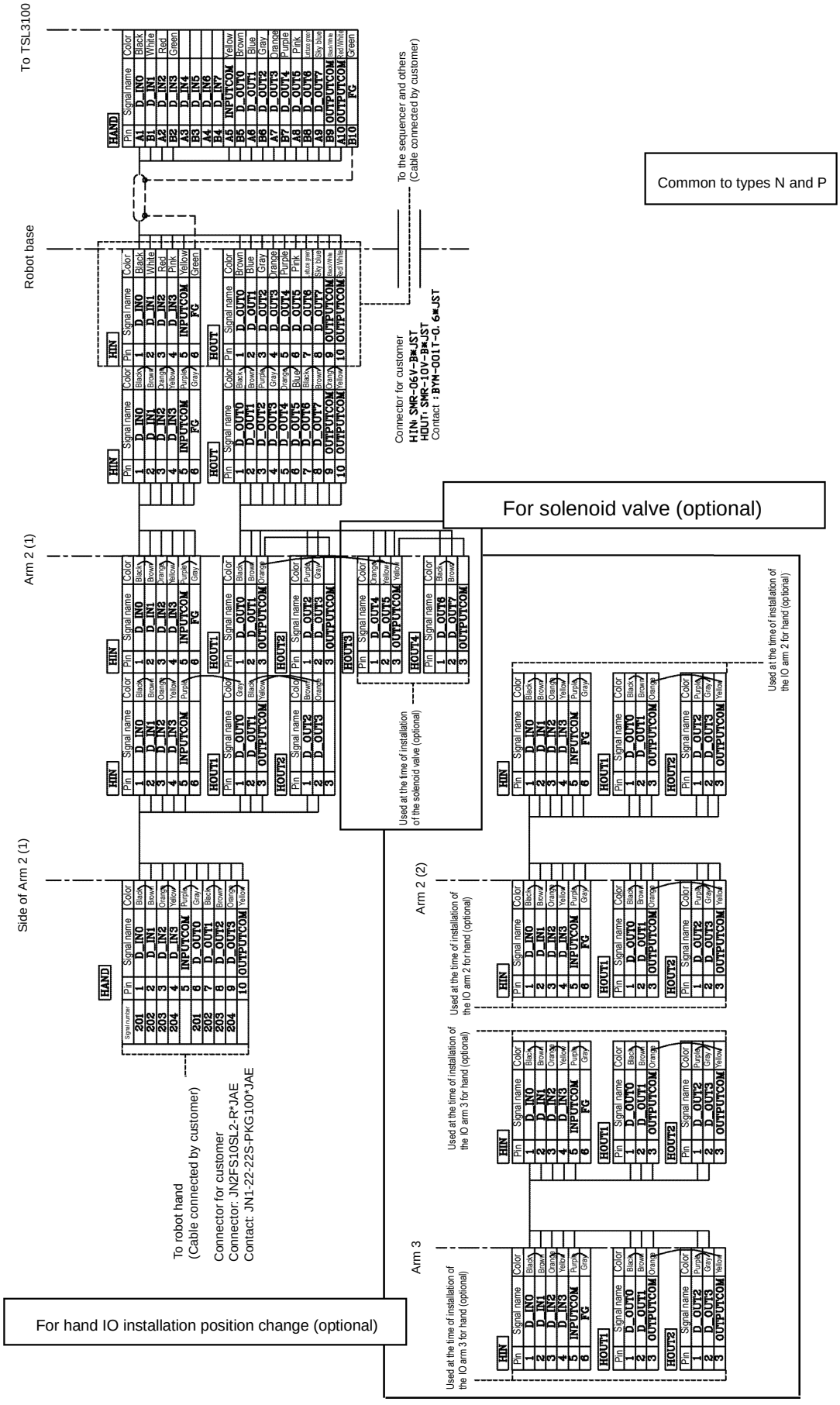


Fig. 12.3 Internal connection diagram (TSL3100)

13. Tool Interface (for the TS3100)

13.1. Tool wiring

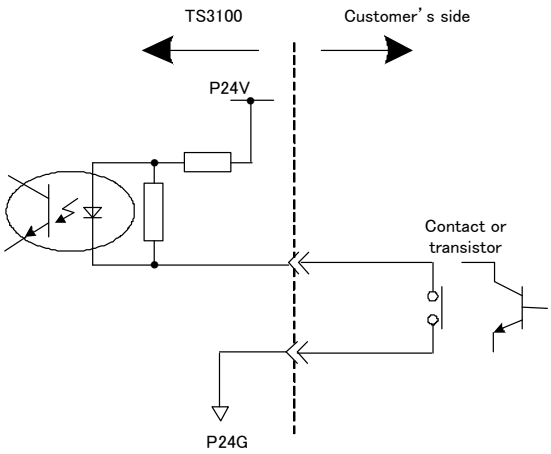
The robot is provided with the tool cable air pipe and arm 1 (1) (arm 2 (2) and arm 3 as options).

Connection to external equipment from the robot controller can also be made without using the tool wiring in the robot arm.

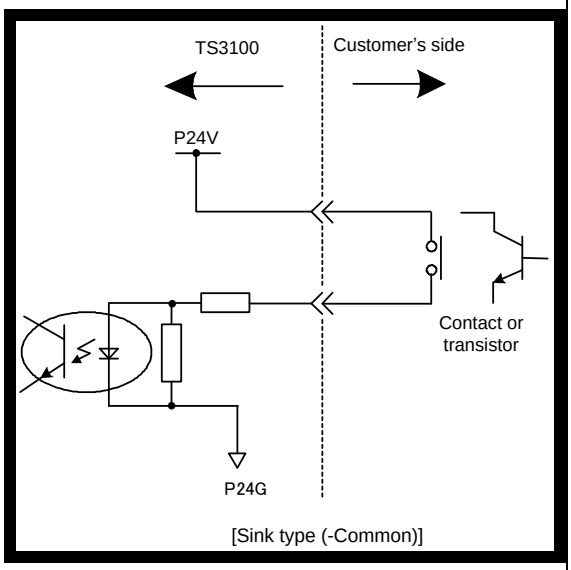
13.1.1. Tool Signals (Controller Side)

Eight input signals for components such as sensors, eight control signals for components such as solenoid valves, 24 VDC, and 24 VDC GND are provided as tool signals for the controller, thus enabling the wiring from the controller to external equipment. (Cables between the controller and external equipment are optional.) The signals are explained below.

a-1) Input signal connector HAND (TS3100 Type-N)

Pin	Signal name		Signal No.	Input circuit and example of connections
1	D_IN1	Input signal 1	201	 [Source type (+Common)]
2	D_IN2	Input signal 2	202	
3	D_IN3	Input signal 3	203	
4	D_IN4	Input signal 4	204	
5	D_IN5	Input signal 5	205	
6	D_IN6	Input signal 6	206	
7	D_IN7	Input signal 7	207	
8	D_IN8	Input signal 8	208	
19	DC 24VGND(P24G)			
20	DC 24VGND(P24G)			

a-2) Input signal connector HAND (TS3100 Type-P)

Pin	Signal name		Signal No.	Input circuit and example of connections
1	D_IN1	Input signal 1	201	
2	D_IN2	Input signal 2	202	
3	D_IN3	Input signal 3	203	
4	D_IN4	Input signal 4	204	
5	D_IN5	Input signal 5	205	
6	D_IN6	Input signal 6	206	
7	D_IN7	Input signal 7	207	
8	D_IN8	Input signal 8	208	
19	DC 24V(P24V)			
20	DC 24V(P24V)			

As input signals, no-voltage contacts or transistor open collector inputs are used.

No-voltage contact specifications:

Contact rating: 24 VDC, 10 mA or over (circuit current: approx. 7 mA)

Minimum contact current: 24 VDC, 1 mA

Contact impedance: 100 Ω or less

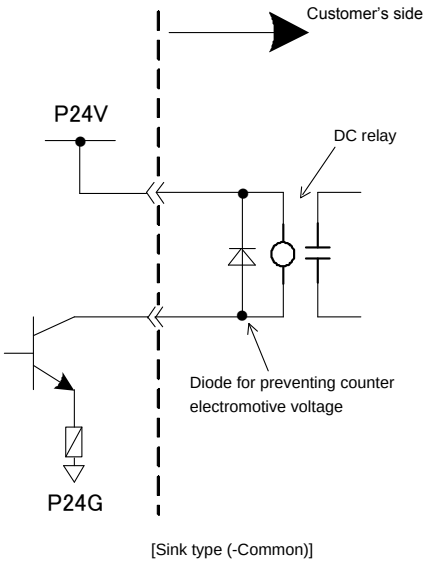
Transistor specifications:

Withhold voltage between collector and emitter: 30 V or over

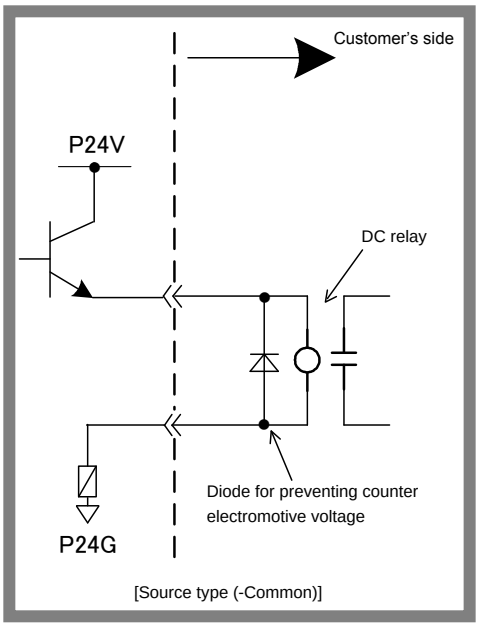
Current between collector and emitter: 10 mA or over (circuit current: approx. 7 mA)

Leak current between collector and emitter: 100 μA or less

b-1) Output signal connector HAND (TS3100 Type-N)

Pin	Signal name		Signal No.	Pin
9	D_OUT1	Output signal 1	201	 [Sink type (-Common)]
10	D_OUT2	Output signal 2	202	
11	D_OUT3	Output signal 3	203	
12	D_OUT4	Output signal 4	204	
13	D_OUT5	Output signal 5	205	
14	D_OUT6	Output signal 6	206	
15	D_OUT7	Output signal 7	207	
16	D_OUT8	Output signal 8	208	
17	DC 24V(P24V)			
18	DC 24V(P24V)			

b-2) Output signal connector HAND (TS3100 Type-P)

Pin	Signal name		Signal No.	Output circuit and example of connections
9	D_OUT1	Output signal 1	201	
10	D_OUT2	Output signal 2	202	
11	D_OUT3	Output signal 3	203	
12	D_OUT4	Output signal 4	204	
13	D_OUT5	Output signal 5	205	
14	D_OUT6	Output signal 6	206	
15	D_OUT7	Output signal 7	207	
16	D_OUT8	Output signal 8	208	
17	DC 24VGND(P24G)			
18	DC 24VGND(P24G)			

By using the 24 VDC power of the controller, a relay, solenoid valve, etc., can be driven. To use external power supply, connect GND of the external power supply with the 24 VDC GND (P24G) of the robot controller (GND common connection). However, do NOT connect the external power supply +24V with the 24 VDC (P24V) of the robot controller. Otherwise, the power supply may be damaged.

Output specifications: Rated voltage: 24 VDC
Rated current: 100 mA

- When a relay or solenoid valve, etc., is connected, it is necessary to use a surge killer or diode to absorb the surge voltage.
- The right figure shows the DC relay circuit when the external power is used.

13.1.2. Tool Wiring (Robot Arm Side)

Four input signals are provided for sensors, etc. and four control signals for solenoid valves, etc. A supply power signal of 24 VDC is also provided. They are connected to the controller. The wiring arrangement for these cables is shown in Fig. 13.1. The wires are connected to the connectors on the arm 2 (1). The customer should provide the following connectors to connect the cables.

Cannon connector (standard) Type: Angle plug JN2FS10SL2-R
(Maker: Japan Aviation Electronics Industry)

Type of contact:	JN1-22-26S-PKG100	Adaptive cable:	AWG26~AWG28
	JN1-22-22S-PKG100		AWG21~AWG25
	JN1-22-20S-PKG100		AWG20

If the above-mentioned parts cannot be procured, we will prepare the cables. Table 13.1 shows the HAND cable (option) list.

! DANGER

- Be sure to use the designated wire. Otherwise, fires or faults may be caused.
- When connecting the connector and wires, make sure not to mistake the terminal arrangement.
- After making the connection, use a tester, etc., to confirm the connection.

If the separately installed sequencer or the like is used for control, remove the connector panel of the base portion and separate the connectors HIN and HOUT on the rear. Then connect the cable of the sequencer or the like through the cable inlet of the connector panel. (See Fig13.1.1.) For ahead of the HIN and HOUT connectors, the user should prepare the following plug connectors and connect the cables. The current is 1 A or less per cable.

Type of connector:	HIN	SMR-06V-B (Maker: J.S.T. Mfg.)
	HOUT	SMR-10V-B (Maker: J.S.T. Mfg.)
Type of contact:	SYM-001T-P0.6	Adaptive cable: AWG22~AWG28

ROBOT connector type

Type of connector:	HIN	SMP-06V-BC (Maker: J.S.T. Mfg.)
	HOUT	SMP-10V-BC (Maker: J.S.T. Mfg.)

Type of contact: SHF-001T-0.8BS Adaptive cable: AWG22~AWG28

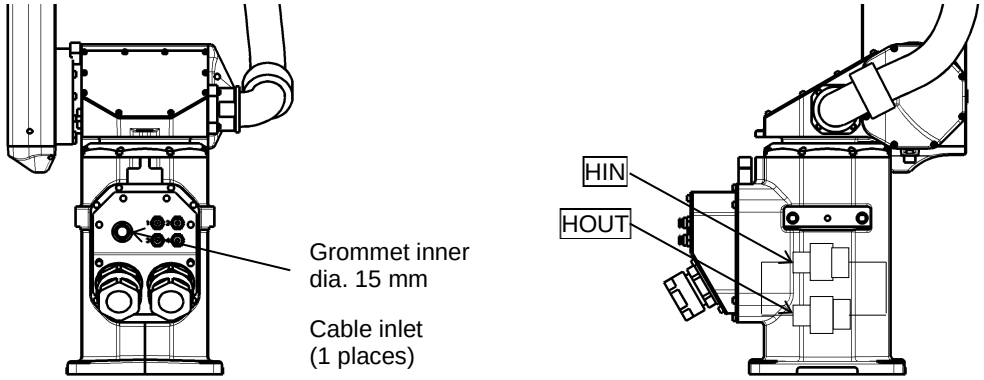
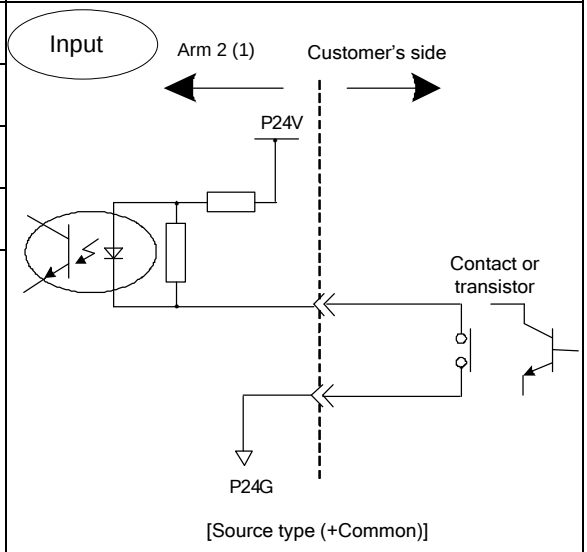
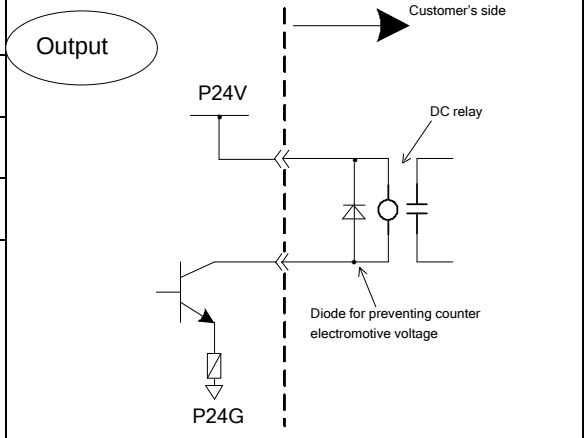


Fig. 13.1. Wiring to PLC, etc.

Mechanical side

Input/output signal connector HAND (Type-N)

<table>
<tr><th>Pin</th><th colspan="2">Signal name</th><th>Signal No.</th><th>Input/output circuit and example of connections</th></tr>
<tr><td>1</td><td>D_IN1</td><td>Input signal 1</td><td>201</td><td rowspan="5"> 

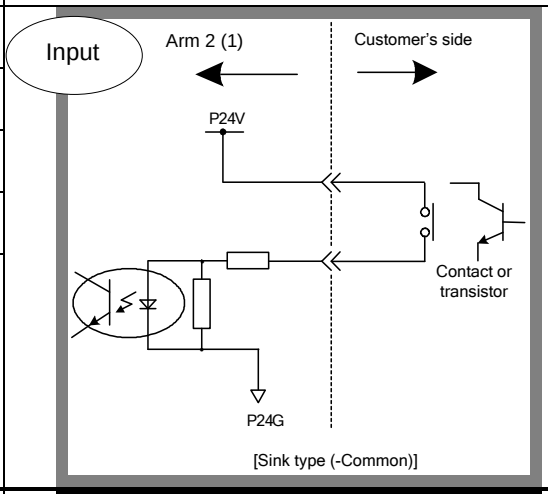
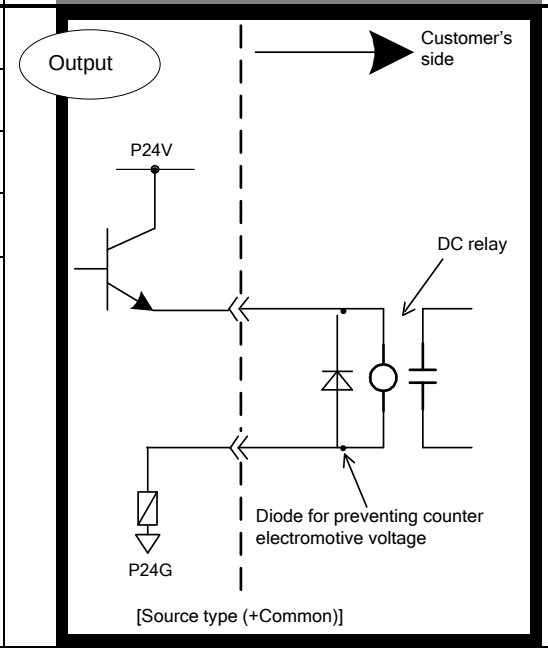
[Source type (+Common)]</td></tr>
<tr><td>2</td><td>D_IN2</td><td>Input signal 2</td><td>202</td></tr>
<tr><td>3</td><td>D_IN3</td><td>Input signal 3</td><td>203</td></tr>
<tr><td>4</td><td>D_IN4</td><td>Input signal 4</td><td>204</td></tr>
<tr><td>5</td><td colspan="2">DC 24VGND(P24G)</td><td></td></tr>
<tr><td>6</td><td>D_OUT1</td><td>Output signal 1</td><td>201</td><td rowspan="5"> 

[Sink type (-Common)]</td></tr>
<tr><td>7</td><td>D_OUT2</td><td>Output signal 2</td><td>202</td></tr>
<tr><td>8</td><td>D_OUT3</td><td>Output signal 3</td><td>203</td></tr>
<tr><td>9</td><td>D_OUT4</td><td>Output signal 4</td><td>204</td></tr>
<tr><td>10</td><td colspan="2">DC 24V (P24V)</td><td></td></tr>
</table>

Input/output signal connector HOUT3, HOUT4 (Type-N)
(This connector is located in arm 2 (1), and connected to the solenoid valve when the manifold is optional.)

Pin (Connector): HOUT3)	Signal name		Signal No.
1	D_OUT5	Output signal 5	205
2	D_OUT6	Output signal 6	206
3	DC 24V (P24V)		
Pin (Connector): HOUT4)	Signal name		Signal No.
1	D_OUT7	Output signal 7	207
2	D_OUT8	Output signal 8	208
3	DC 24V (P24V)		

Input/output signal connector HAND (Type-P)

Pin	Signal name		Signal No.	Input/output circuit and example of connections
1	D_IN1	Input signal 1	201	
2	D_IN2	Input signal 2	202	
3	D_IN3	Input signal 3	203	
4	D_IN4	Input signal 4	204	
5	DC 24V (P24V)			
6	D_OUT1	Output signal 1	201	
7	D_OUT2	Output signal 2	202	
8	D_OUT3	Output signal 3	203	
9	D_OUT4	Output signal 4	204	
10	DC 24V GND (P24G)			

Input/output signal connector HOUT3, HOUT4 (Type-P)
(This connector is located in arm 2 (1), and connected to the solenoid valve when the manifold is optional.)

Pin (Connector): HOUT3)	Signal name		Signal No.
1	D_OUT5	Output signal 5	205
2	D_OUT6	Output signal 6	206
3	DC 24V GND (P24G)		
Pin (Connector): HOUT4)	Signal name		Signal No.
1	D_OUT7	Output signal 7	207
2	D_OUT8	Output signal 8	208
3	DC 24V GND (P24G)		

As input signals, no-voltage contacts or transistor open collector inputs are used.
No-voltage contact specifications:

Contact rating: 24 VDC, 10 mA or over (circuit current: approx. 7 mA)
Minimum contact current: 24 VDC, 1 mA
Contact impedance: 100 Ω or less

Transistor specifications:

Withhold voltage between collector and emitter: 30 V or over
Current between collector and emitter: 10 mA or over (circuit current: approx. 7 mA)
Leak current between collector and emitter: 100 μA or less

By using the 24 VDC power of the controller, a relay, solenoid valve, etc., can be driven.
When the external power is used, GND of the external power should be common to GND (PG) of the robot controller.
Output specifications:

Rated voltage: 24 VDC
Rated current: 100 mA

- If the 24 VDC power supplied from the robot controller is used, the total current should be 2 A or less.
- When the external power is used, the total current should also be 2 A or less.
- When a relay or solenoid valve, etc., is connected, it is necessary to use a surge killer or diode to absorb the surge voltage.

Table 13.1 HAND cable (option) list

	Part name	Toshiba Dwg. No.	Unit code	Maker	Plug type	Length
1	I/O cable	392N1201	Y610A3VP0	Toshiba Machine	Angle plug	1M
2		392N1202	Y610A3VQ0			2M

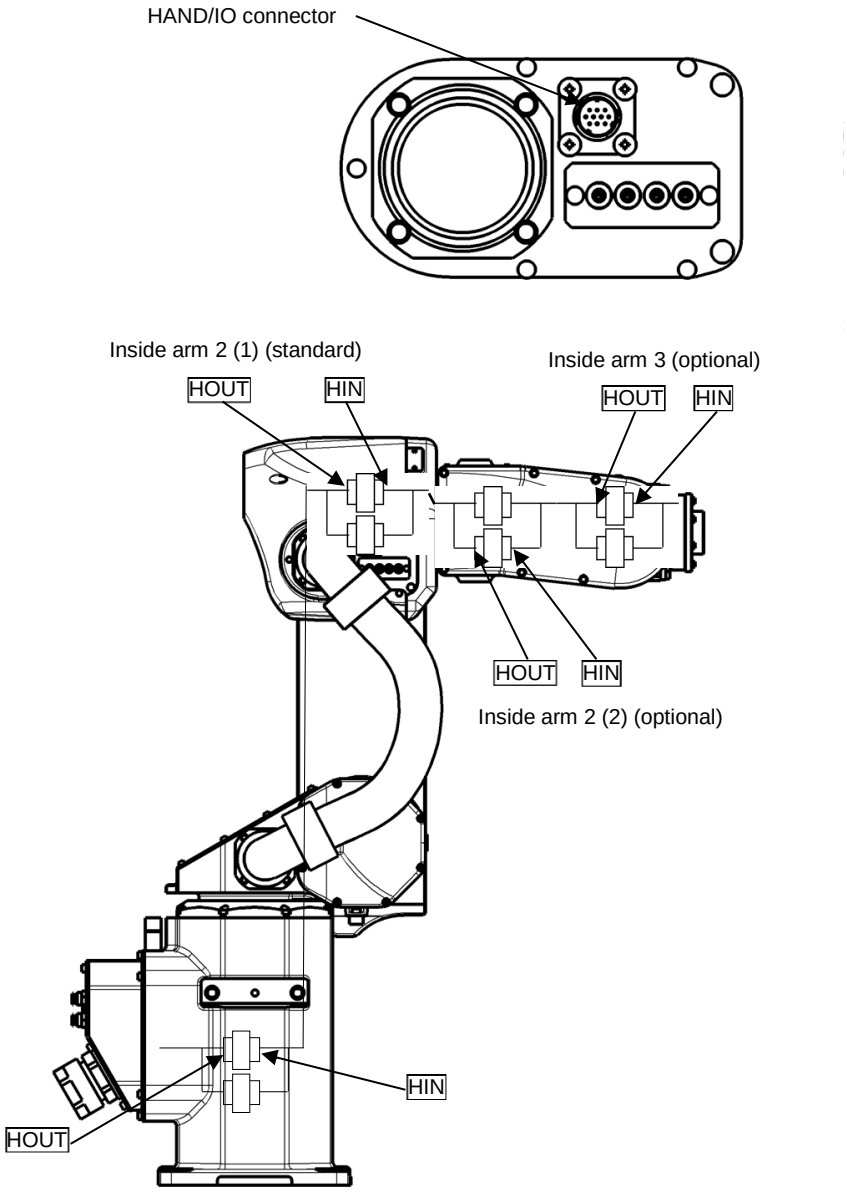


Fig. 13.2 Tool I/O wiring

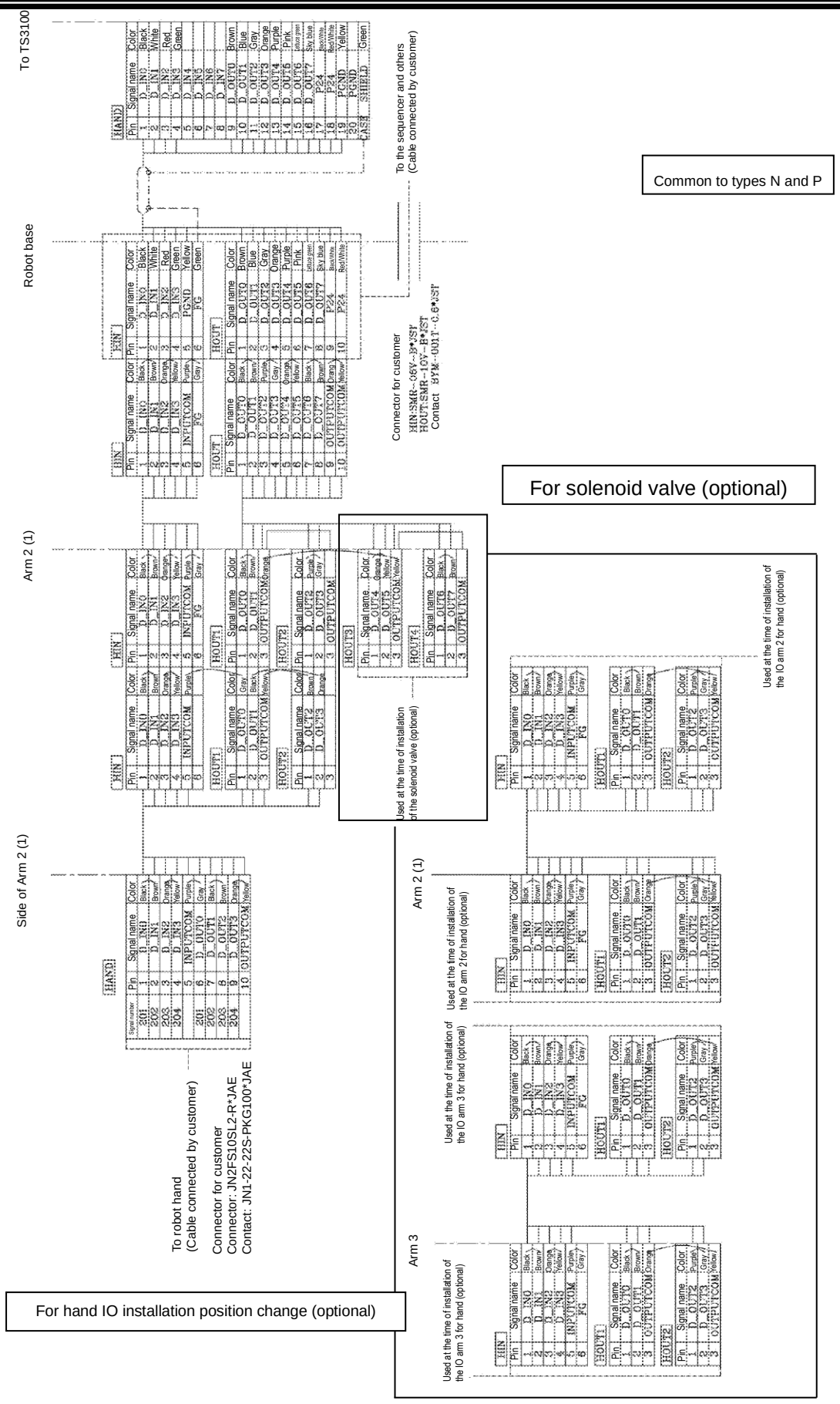


Fig. 13.3 Internal connection diagram (TS3100)