TH180
TH250A
TH350A／TS3000

Industrial Robot

INSTRUCTION MANUAL

INDUSTRIAL ROBOT

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.

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NUMAZU, JAPAN

Preface

This manual describes how to unpack and install the industrial robot TH series and controller. 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 Startup Manual and Safety Manual so that you can learn the names and functions of various components and the safety measures.

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

Section 1 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 2 Installation
This section discusses the equipment installation environment, space requirements, and how to install the equipment.

Section 3 System Connections
This section describes how to connect the robot, controller and peripheral equipment.

Section 4 Tool Interlace
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.

Section 5 Specifications
This section describes the specifications of the robot and the robot controller.

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.

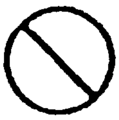
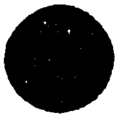
[Explanation of indications]

Indication	Meaning of indication
 **DANGER**	This means that "incorrect handling will lead to fatalities or major injuries".
 **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. The details of the actual danger are indicated with pictures or words in or near the symbol.
	This means 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 arm 2 cover 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, securely fix it on the base. The robot will be unstable if just set down, and it could tilt over.

Table of Contents

Section 1 Transportation

1.1 Unpacking

The robot and controller are shipped separately in corrugated cardboards. The teach pendant and other accessories such as the instruction manual are packaged separately.

Open the packages in a location easily accessible to where the equipment is to be installed. Take careful precautions not to damage the robot or controller. After opening the packages, make sure that all the accessories are present and that nothing has been damaged in transit.

⚠ 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 corrugated cardboards, polyethylene shipping bags and cushion material according to your standards.

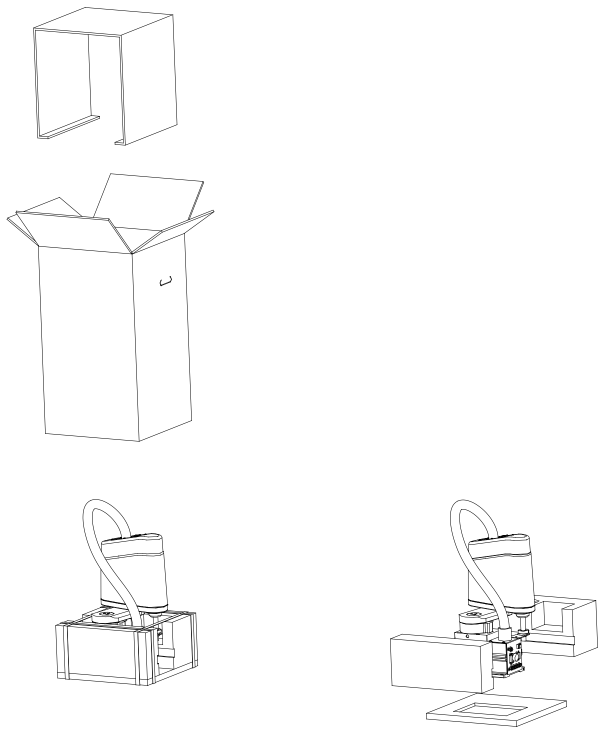


Fig. 1.1 Packaging state (TH250A)

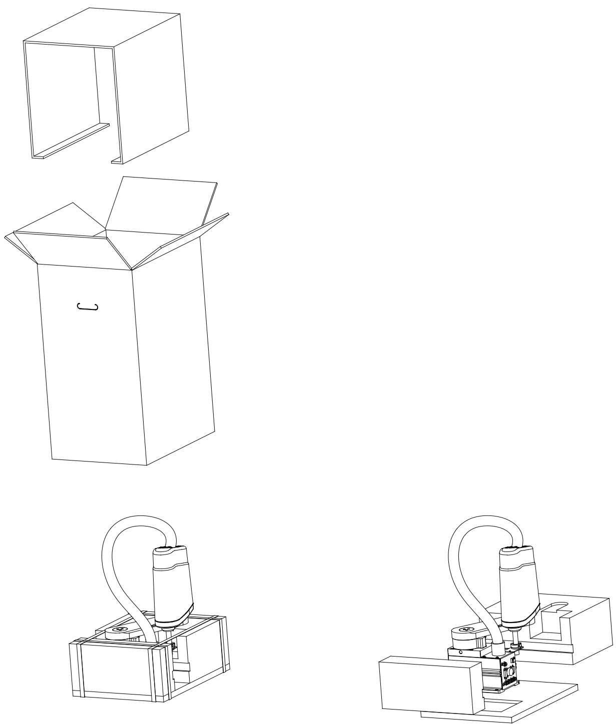


Fig. 1.2 Packaging state (TH350A)

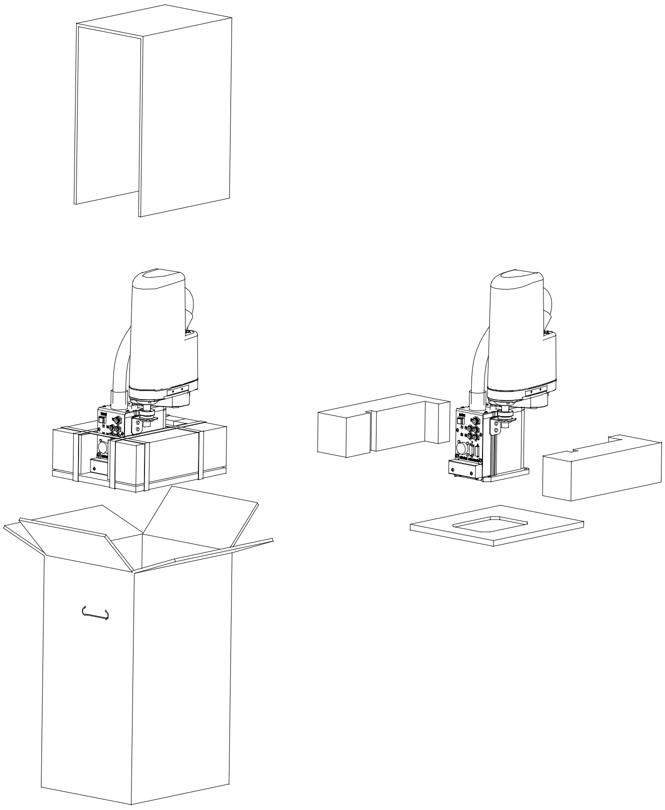


Fig. 1.3 Packaging state (TH180)

1.2 Transportation

Move the robot and controller very carefully. Make sure that no excessive impact (9.8 m/s^2 or more) 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 nuts and screws 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.

1.2.1 Mass and Dimensions

The mass and dimensions of the robot and controller are shown in Table 1.1.

Table 1.1

Type	Mass
Robot TH180	9 kg
Robot TH250A	14 kg
Robot TH350A	14 kg
Robot TH350A- T	14 kg
Controller TS3000	13 kg

1.2.2 Transporting the Robot

To transport the robot, fold back and secure the arm with the attached clamp. (The robot is shipped in this posture. After you have unpacked the shipment, you can move it as it is.)

⚠ **DANGER**

- Be sure to secure the arm with the attached clamp before transporting the robot. Failure to do so could cause a hazardous situation as the arm will move when the robot is lifted.

⚠ CAUTION

- When transporting or unpacking the robot and robot controller, take careful precautions not to get injured by the drop of them or not to damage the equipment.
- When lifting the robot by workers, hold the locations (shaded areas) by hands as shown in Figs. 1.4 to 1.6. If the arm 2 or cover is held by hands, an unusually large force is exerted, resulting in a malfunction.
- If the robot has been carried manually by workers, take utmost care to prevent their hand or leg from being caught in the robot when placing it on the floor.

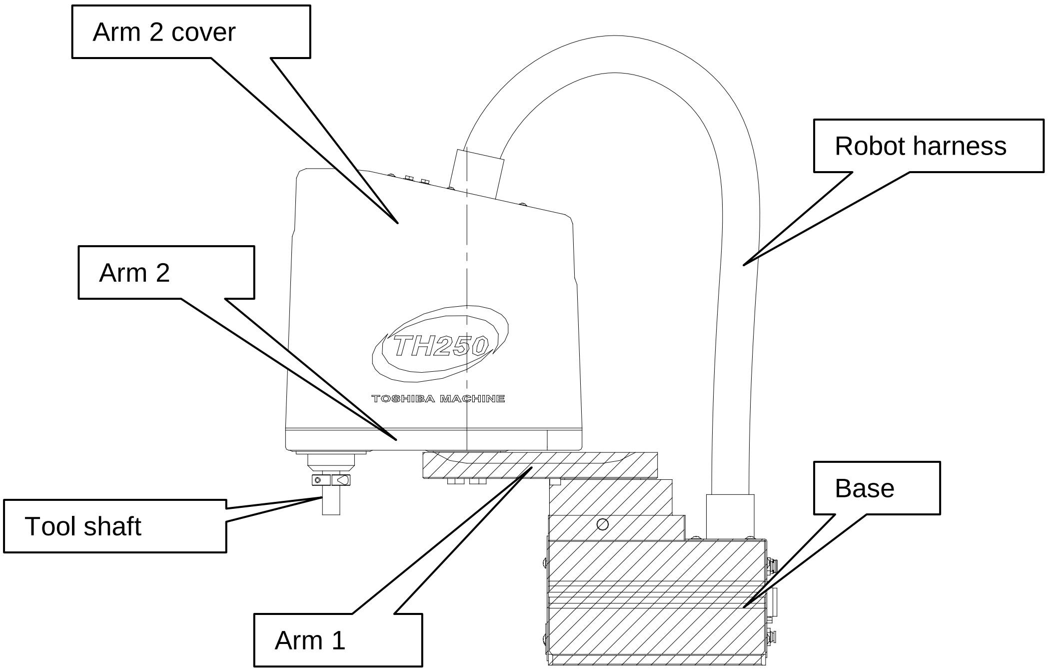


Fig. 1.4 Robot handling area (shaded area) (TH250A, TH350A)

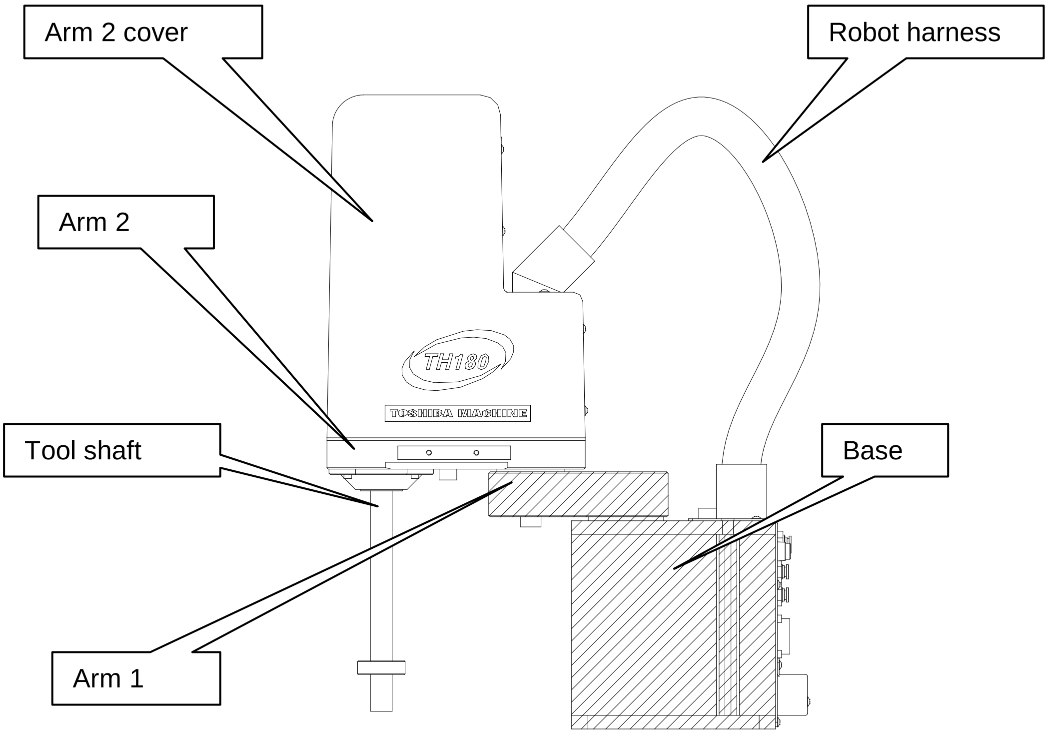


Fig. 1.5 Robot handling area (shaded area) (TH180)

After the installation, remove the clamp used for transport.

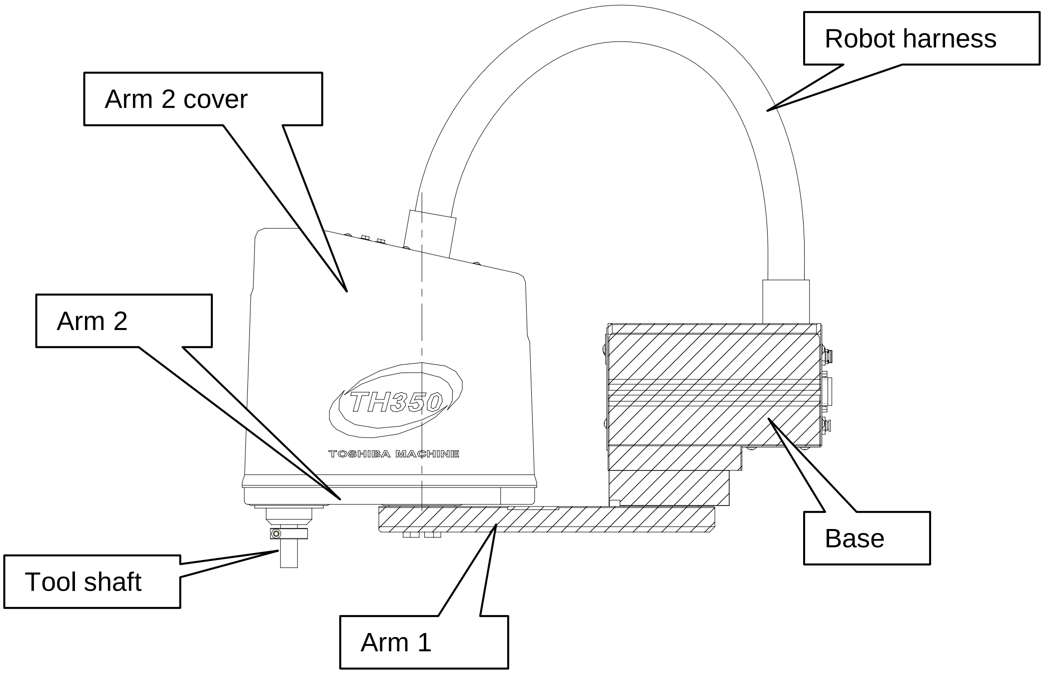


Fig. 1.6 Robot handling area (shaded area) (TH350A- T)

1.2.3 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 catch your hands or feet.

1.3 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.

1.3.1 Storage Precautions for the Robot

It is recommended to secure the robot in the shipment posture, using the attached clamp for transport.

> ⚠ **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. As the tool shaft is susceptible to rust development, coat it with rust-preventive agent or grease.

1.3.2 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.
> - Store the controller in a plastic bag to prevent rust and dust, and place a desiccant inside the bag.

Section 2 Installation

2.1 Installation Environment

Table 2.1 shows the environmental conditions for the location in which the TH series Robot and TS3000 controller are to be installed.

Table 2.1 Environmental conditions for robot and controller

Item	Specifications
Temperature	In operation : 0 to 40°C In storage : –10 to 50°C
Humidity	20 to 90 % (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 : 0.98 m/s^2 or less In transport : 9.8 m/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.
Protection class	IEC60529 IP10 (robot side) IP20 (controller side)
Overvoltage category	IEC60664-1 Class III (controller side)
Electric shock protection	IEC61140 Class I (controller side)
Contamination level	IEC60664-1 Contamination Level 3 (controller side)
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 conditions	Avoid any iron powder, oil or salt content, and organic solvent. Do not wet the robot with water or the like

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

- In the case where batteries for detecting the motor position are of alkaline type, the batteries can overheat, leak battery fluid, or rupture when used under high temperatures. Also, high temperatures can reduce the performance and lifespan of the battery. If using the robot under high temperatures, please consult with the Toshiba Machine sales office.
- If high-speed operation is performed when starting in a low temperature environment, the torque may increase and an error may occur.
  To operate the robot in a low temperature environment, be sure to operate the robot continuously at low speed for several minutes first when starting in order to soften the grease, and then change to high speed operation.

2.2 Robot Installation

Before installing the robot, you should plan a layout, fully considering the working envelope, coordinate system and space for maintenance.
It is recommended to replace the batteries at the time of installation so that they can be replaced at regular inspection and maintenance. For the battery replacement, see Para. 2.3.8 of the Maintenance Manual.

2.2.1 External Dimensions

External view drawings of the robot are shown in Figs. 2.1 to 2.4.

2.2.2 Working Envelope

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. Additionally, soft limits which can be set by the user are provided.

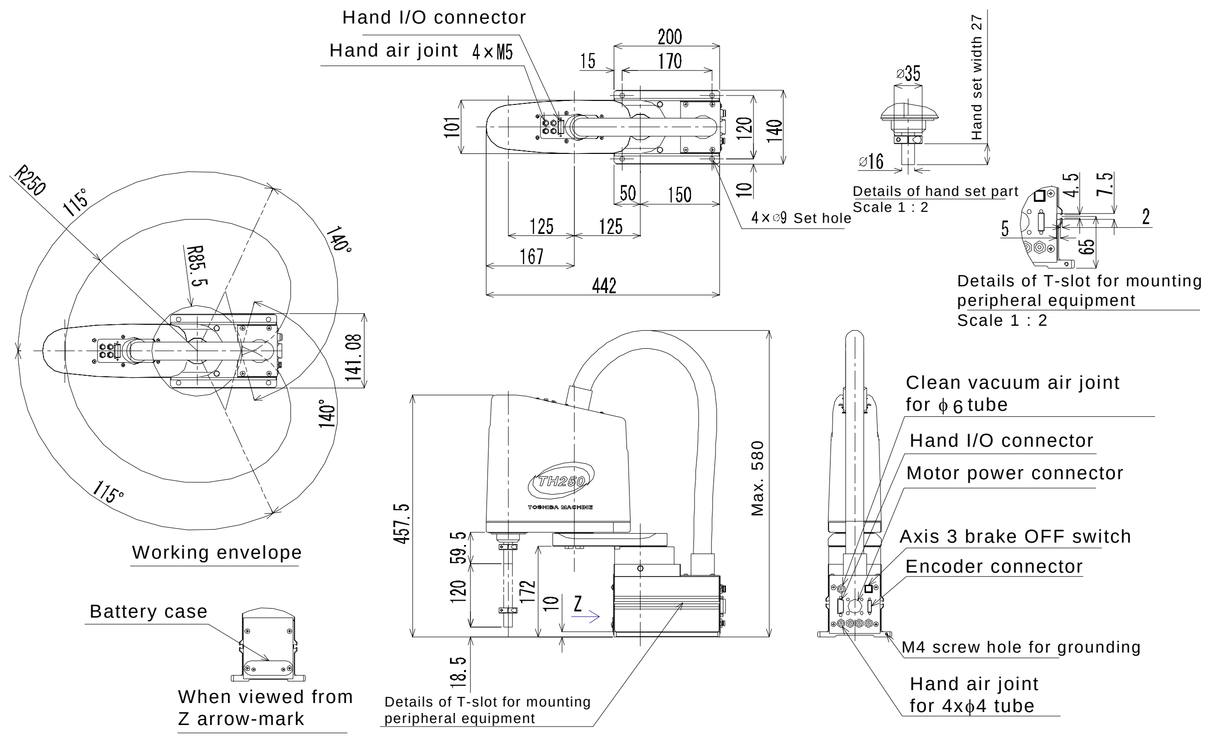


Fig. 2.1 External view of TH250A robot

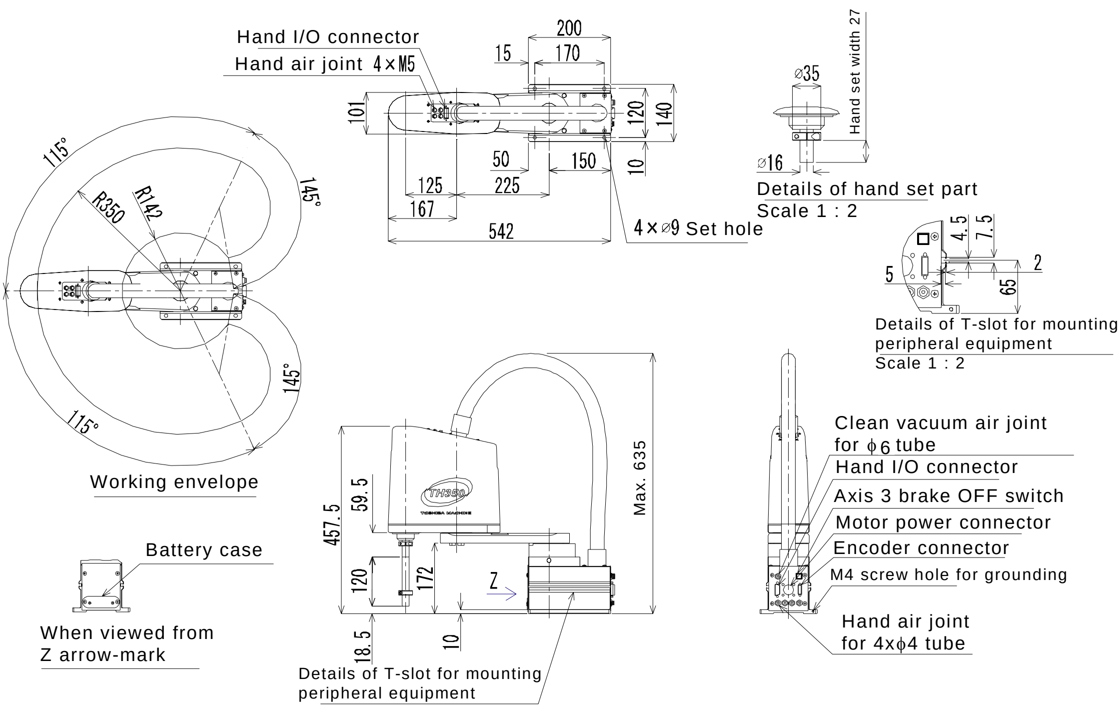


Fig. 2.2 External view of TH350A robot

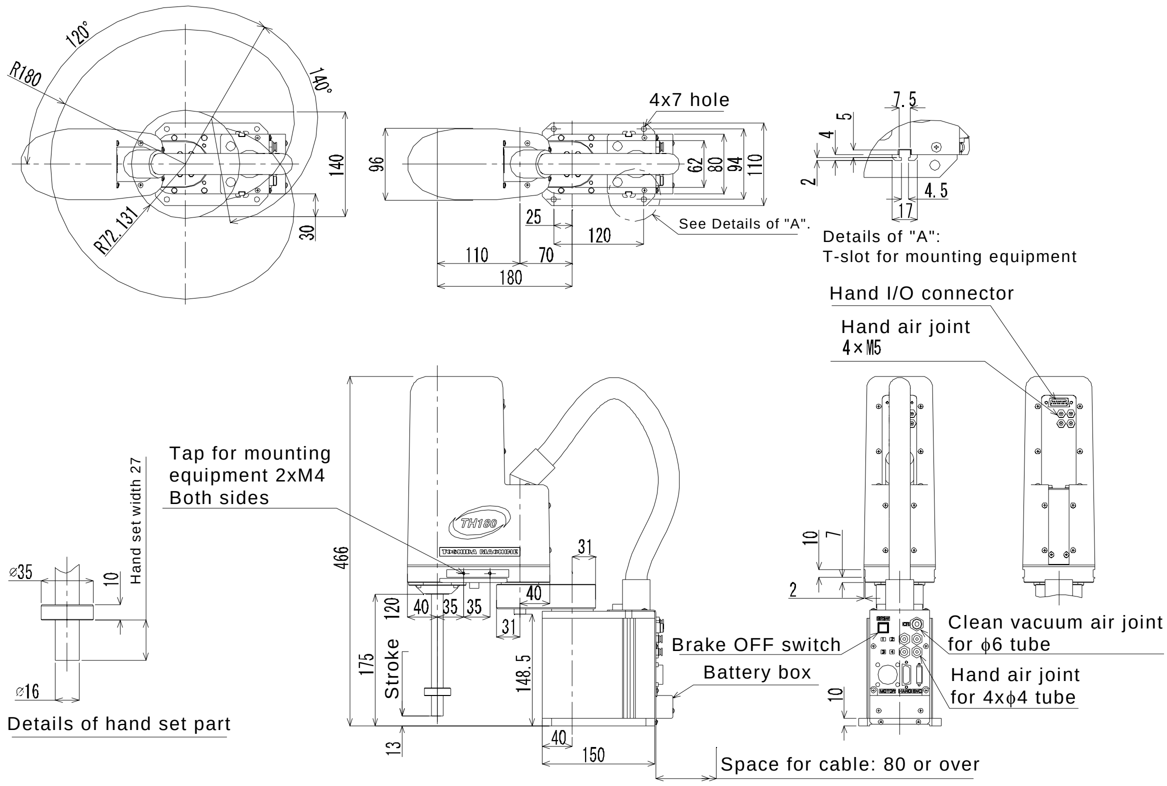


Fig. 2.3 External view of TH180 robot

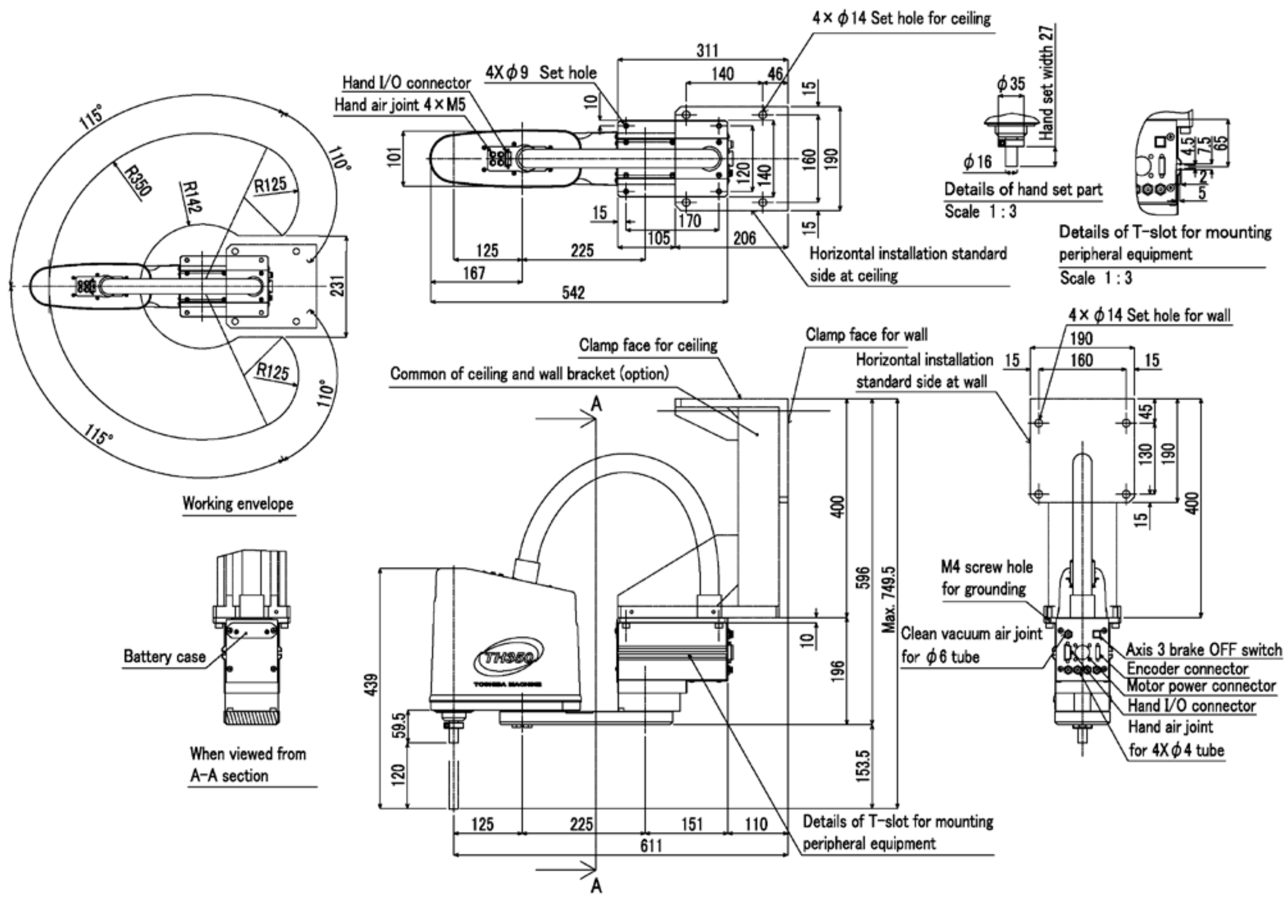


Fig. 2.4 External view of TH350A- T robot

2.2.3 Coordinate System

The robot's joint angle origin (0° or 0 mm position) is factory-calibrated according to the base reference planes. The base coordinate system is determined according to this calibration. Figs. 2.5 to 2.8 show the base coordinate system and zero position of each axis joint angle. Figs. 2.5 to 2.8 show the base coordinate system by $X_B Y_B Z_B$.

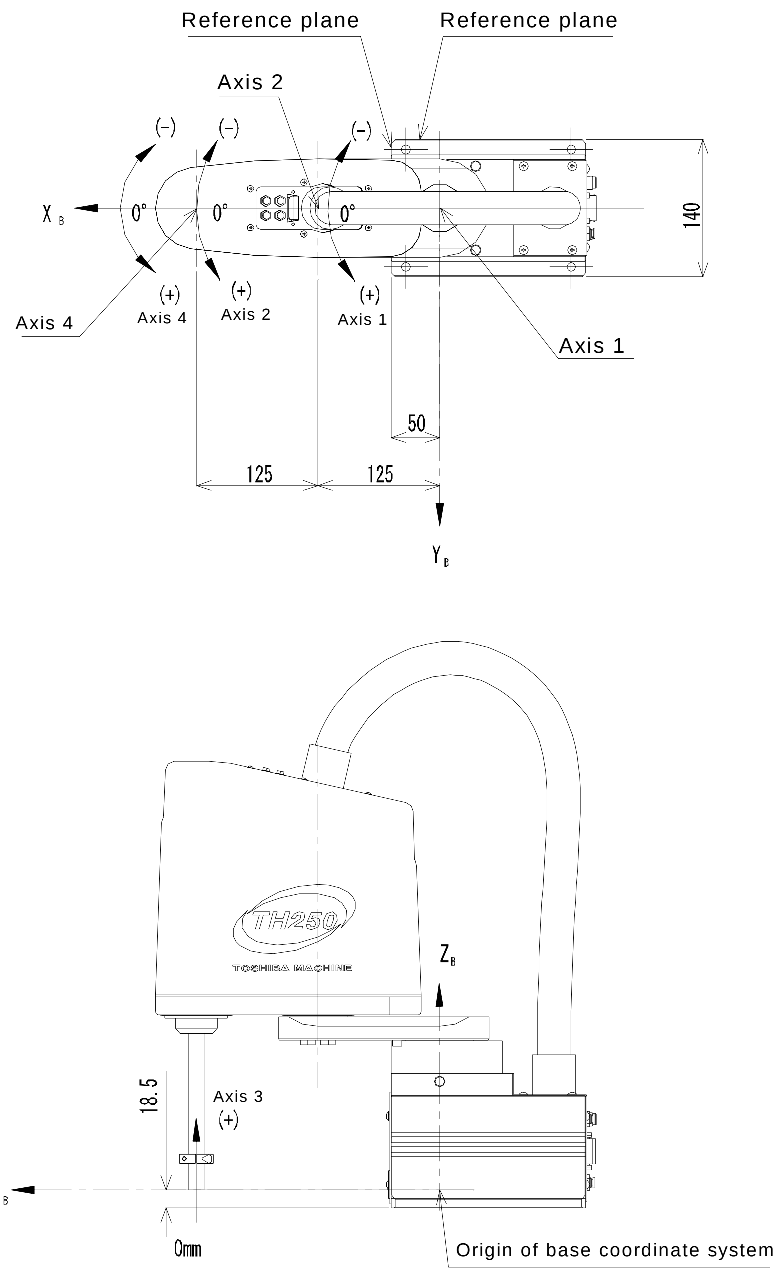
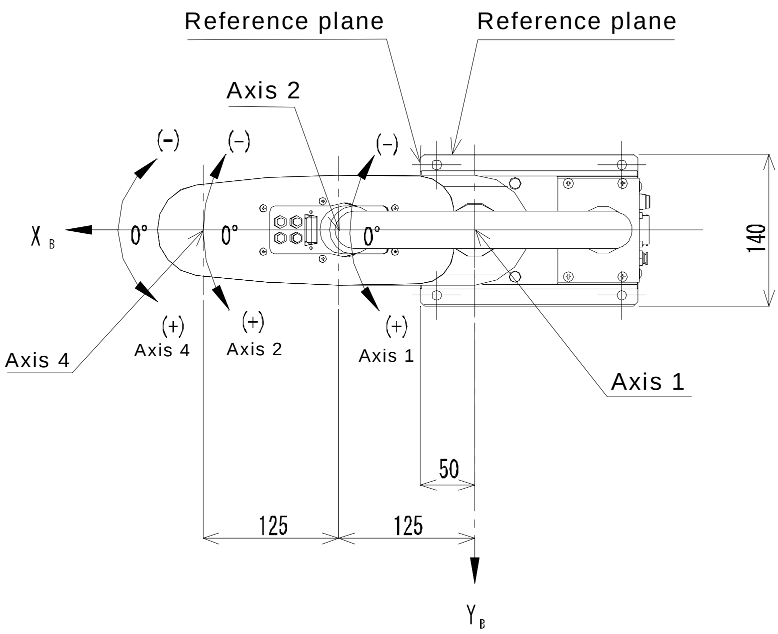


Fig. 2.5 TH250A base coordinate system and joint angle origin



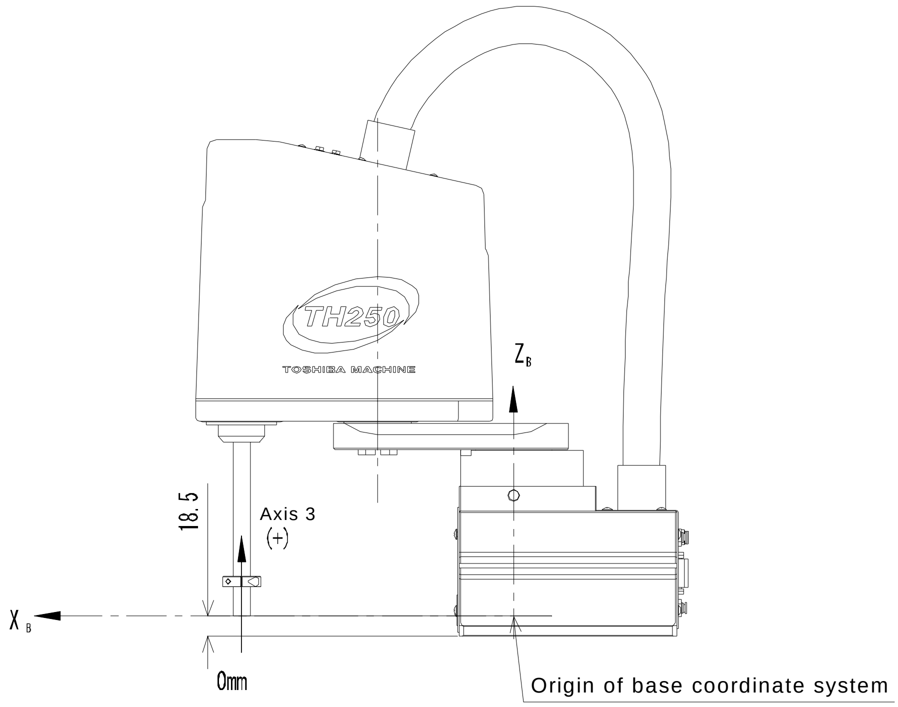


Fig. 2.6 TH350A base coordinate system and joint angle origin

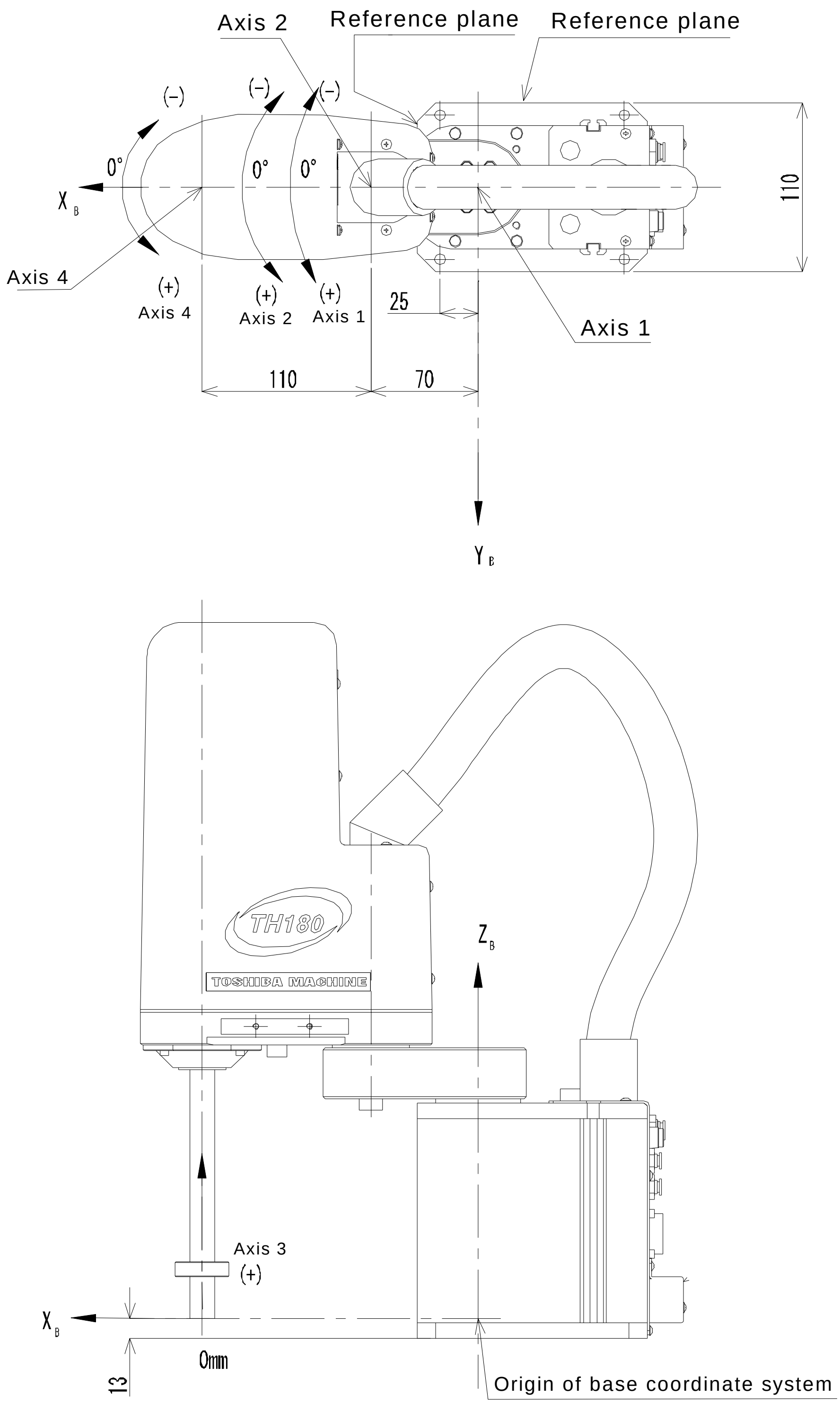


Fig. 2.7 TH180 base coordinate system and joint angle origin

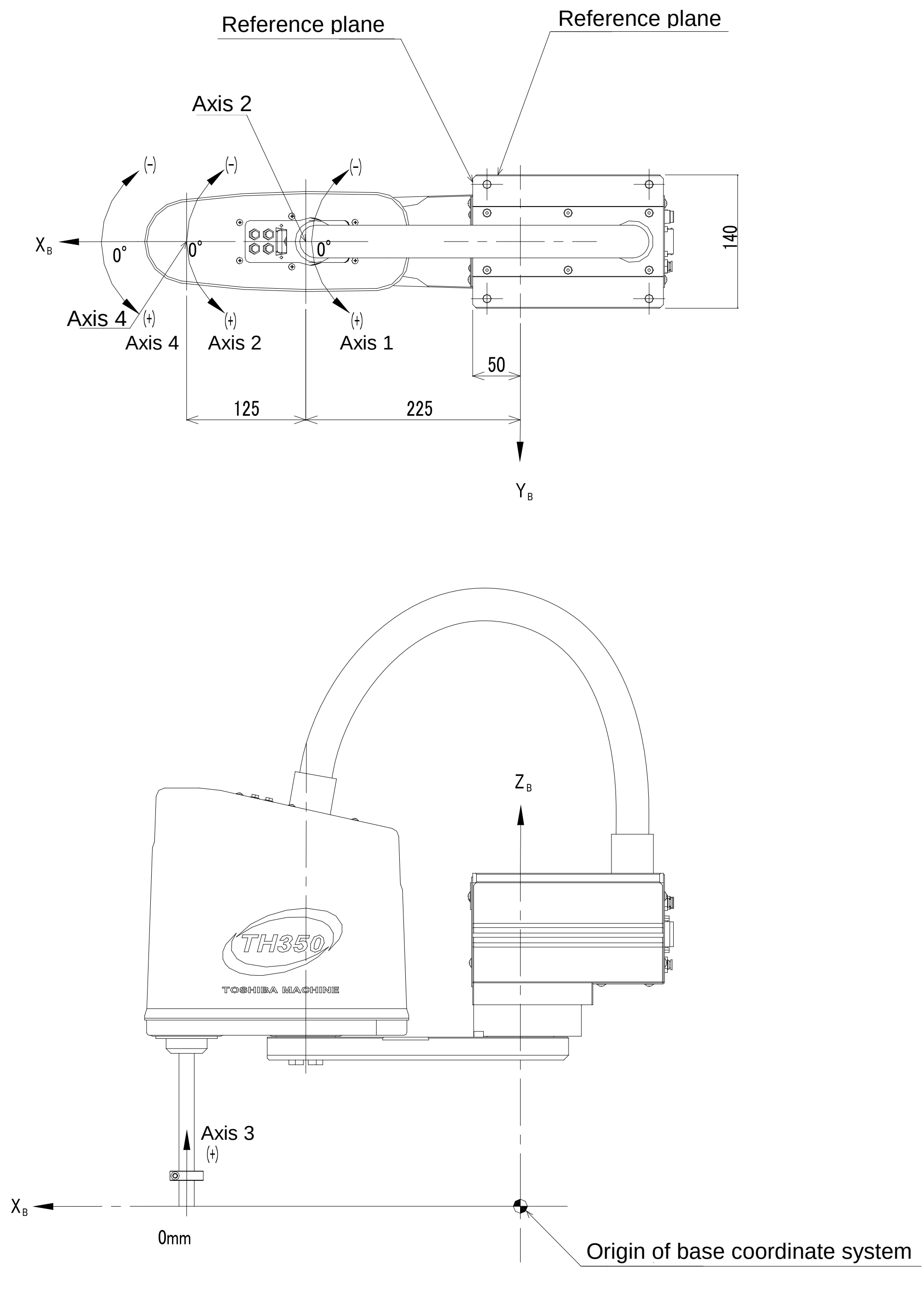


Fig. 2.8 TH350A- T base coordinate system and joint angle origin

2.2.4 Installing the Robot

The robot is secured, using the set holes on the base. Use M8 hexagon socket head cap screws.

The robot installation method is shown in Figs. 2.9 to 2. 11. Reference planes are provided on the base section and marked with “xxx”.1

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.

⚠ CAUTION

- The robot will suddenly accelerate and decelerate during operation. When installing it on a frame, make sure that the frame has sufficient strength and 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.

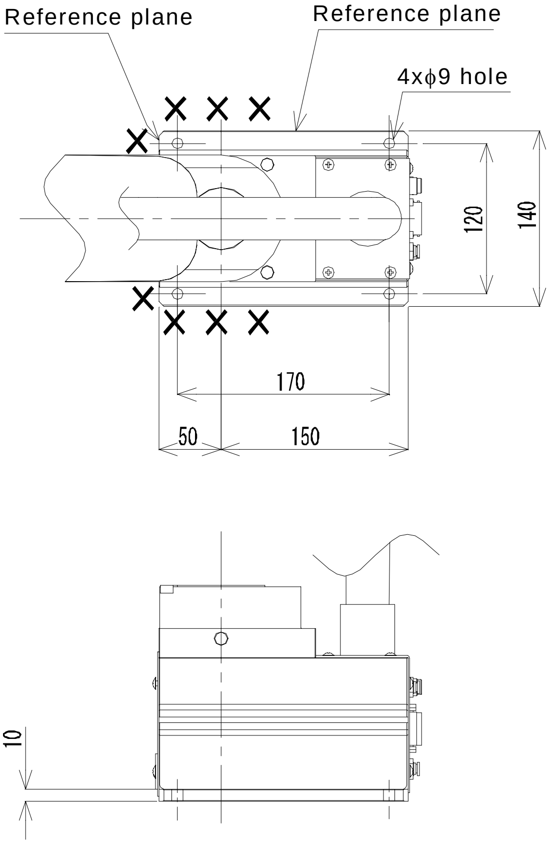


Fig. 2.9 Installing the TH250A and TH350A robots

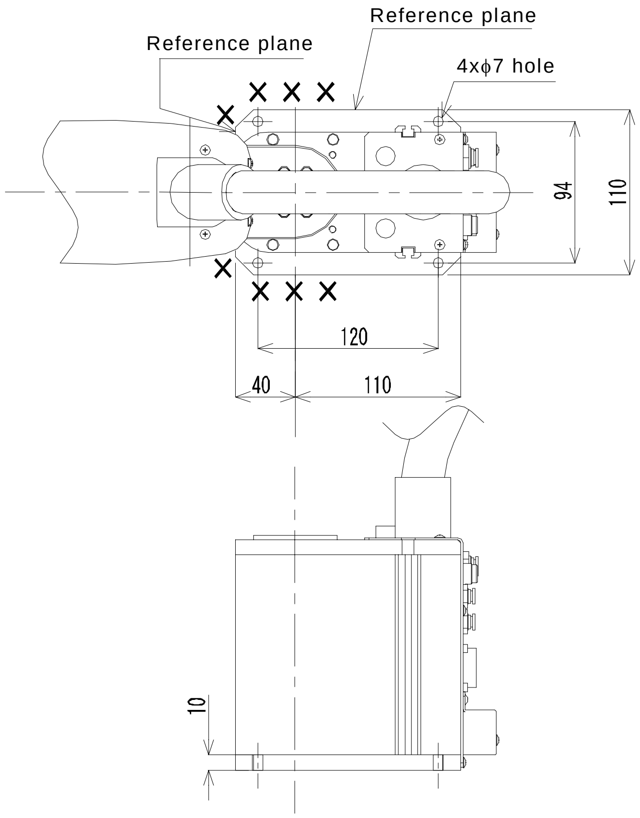


Fig. 2.10 Installing the TH180 robot

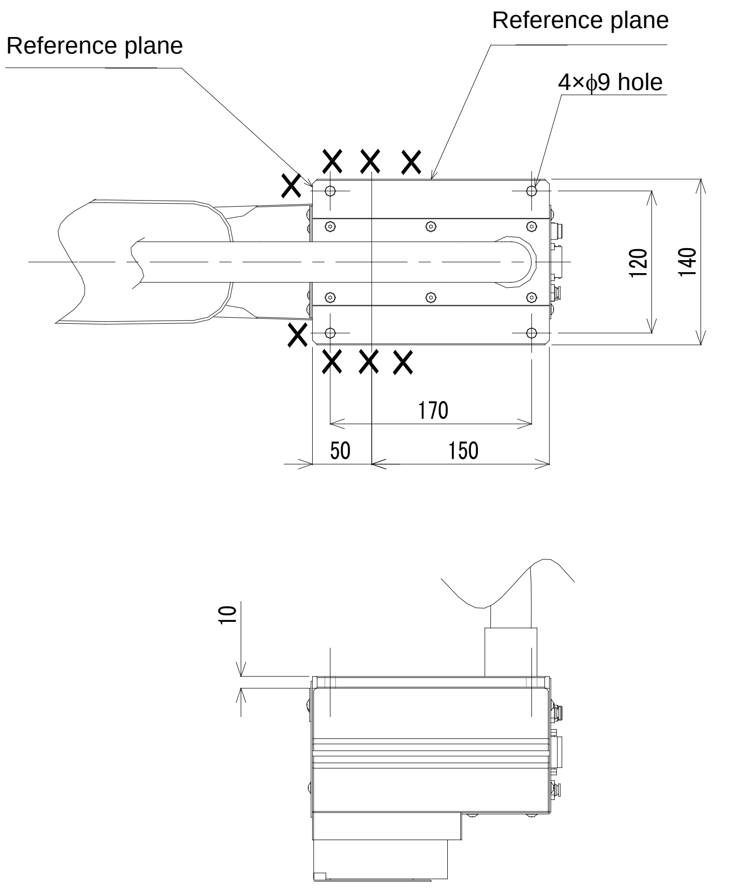


Fig. 2.11 Installing the TH350A- T robot

2.3 Changing the Mechanical Ends

Mechanical stoppers are installed to the robot to mechanically control the operating range of each axis. Changing the mechanical operating range of the robot by modifying or adding these mechanical stoppers is referred to as "changing the mechanical ends." Here, how to change the mechanical ends of Axes 1 to 3 of the robot is explained.

Note that Axis 4 is different from other operating axes; it restricts the operating range with software limits only, not with mechanical stoppers. Therefore, regarding how to change the mechanical ends of Axis 4, see "2.3.3, Changing Software Limits."

⚠ CAUTION

- To change mechanical ends, design and produce mechanical stoppers by referring to this document according to your usage.
- When mechanical stoppers have been changed and then mechanical ends have been changed, be sure to also change software limits to prevent contact with the mechanical stoppers while operating the robot.
- Mechanical stoppers do not securely limit the movable range of the robot. When the power of the robot is turned on, never enter the operating range of the robot.
- If the robot collides with mechanical stoppers, the robot detects the collision and stops, but the mechanical stoppers may be damaged, Avoid reusing such mechanical stoppers.
- The mechanical stopper reference drawings shown in this document do not completely satisfy the customer's usage.
  Design, produce and install mechanical stoppers according to your usage, such as the operating range.
- The failures of the robot caused by mechanical stoppers will be excluded from the warranty coverage.

2.3.1 Changing the Mechanical Ends of Axes 1 and 2 (TH180)

When the robot is shipped from the factory, software limits and mechanical stoppers are preset so that the stroke of Axis 1 satisfies ±120° and the stroke of Axis 2 satisfies ± 140°.

Fig. 2.12 and Fig. 2.13 show the settings of the mechanical ends when the robot is shipped from the factory. Fig. 2.14 shows the mounting positions of the mechanical stoppers.

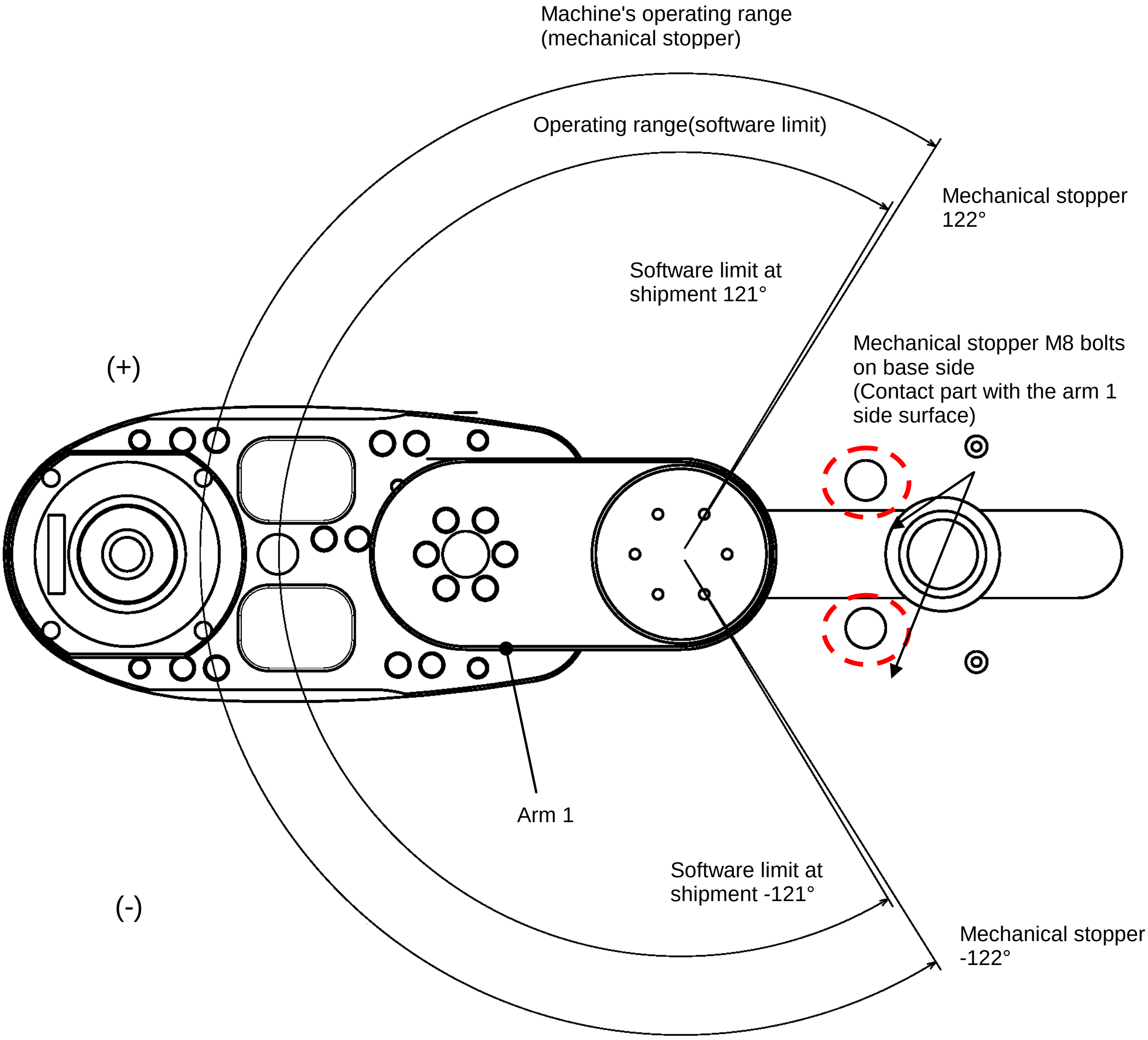


Fig. 2.12 Axis 1 mechanical end settings (TH180)

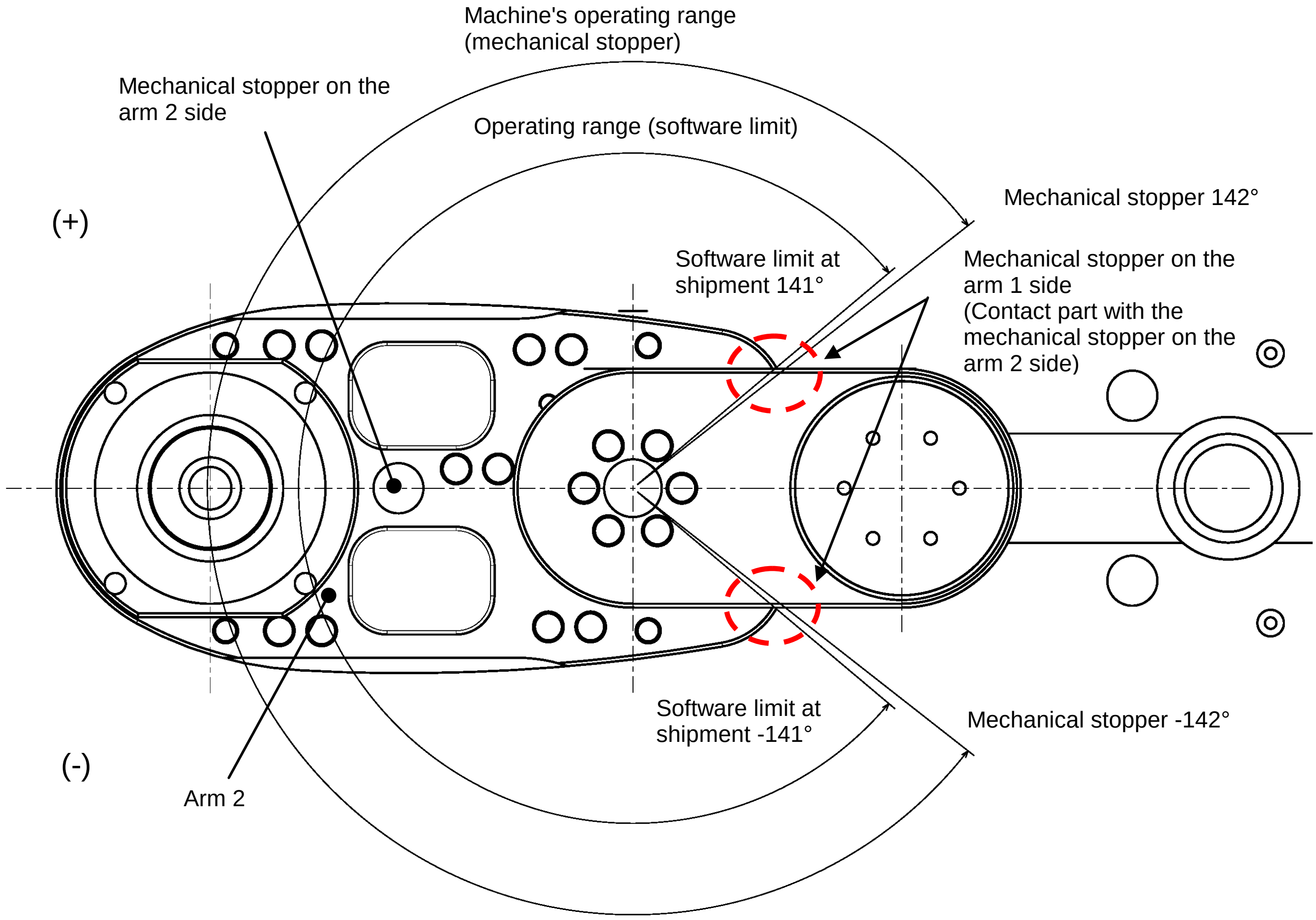


Fig. 2.13 Axis 2 mechanical end settings (TH180)

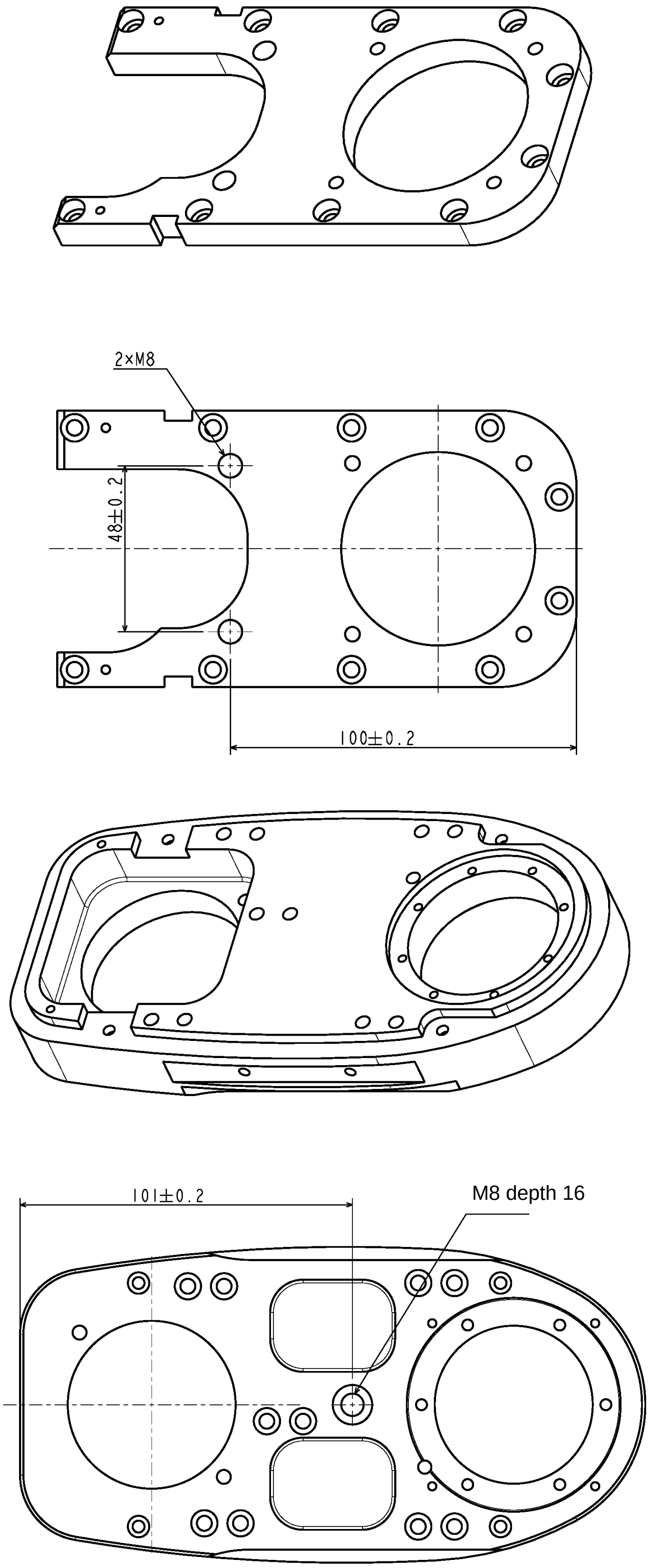


Fig. 2.14 Mechanical stopper installation positions

The mechanical ends can be set into a desired operating range by changing the shapes of the mechanical stoppers. An example of changing the mechanical stopper for Axis 1 is shown in Fig. 2.15 and examples of changing the mechanical stopper for Axis 2 are shown in Fig. 2.17 and Fig. 2.18, so design and produce mechanical stoppers as necessary.

Example of changing the
mechanical stopper for Axis 1
Setup operating range: 100°, -100°
Material: S45C

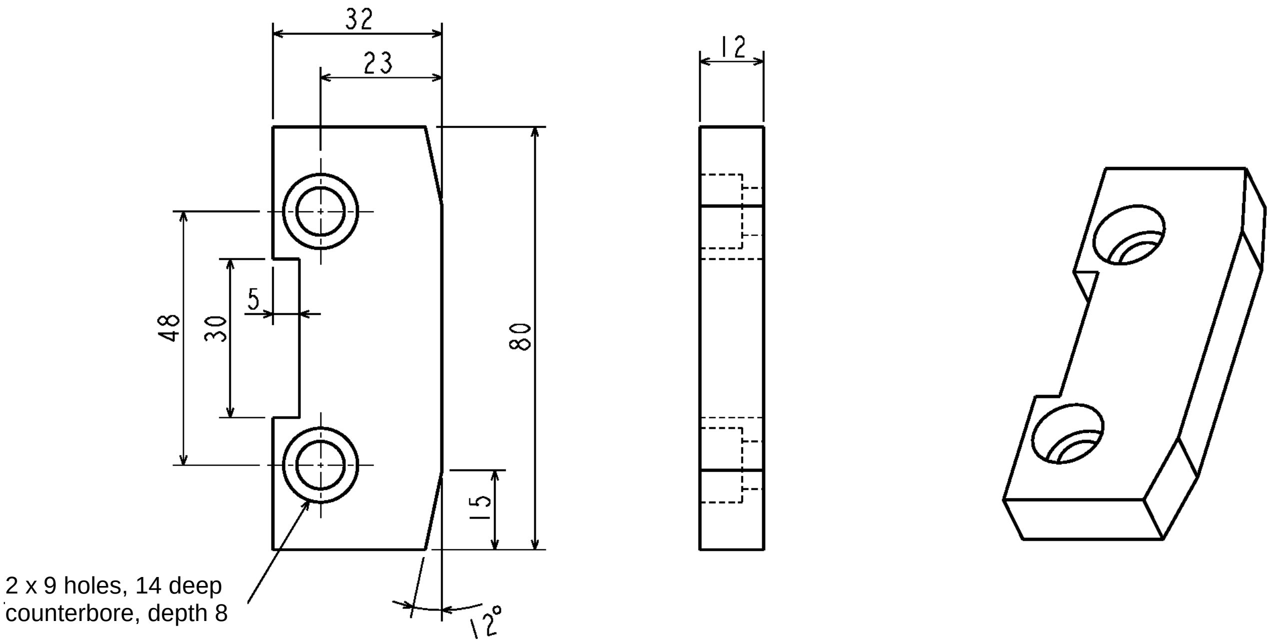


Fig. 2.15 Example of changing the mechanical stopper for Axis 1

Example) When the stroke of Axis 1 has been changed to 100°, -100°

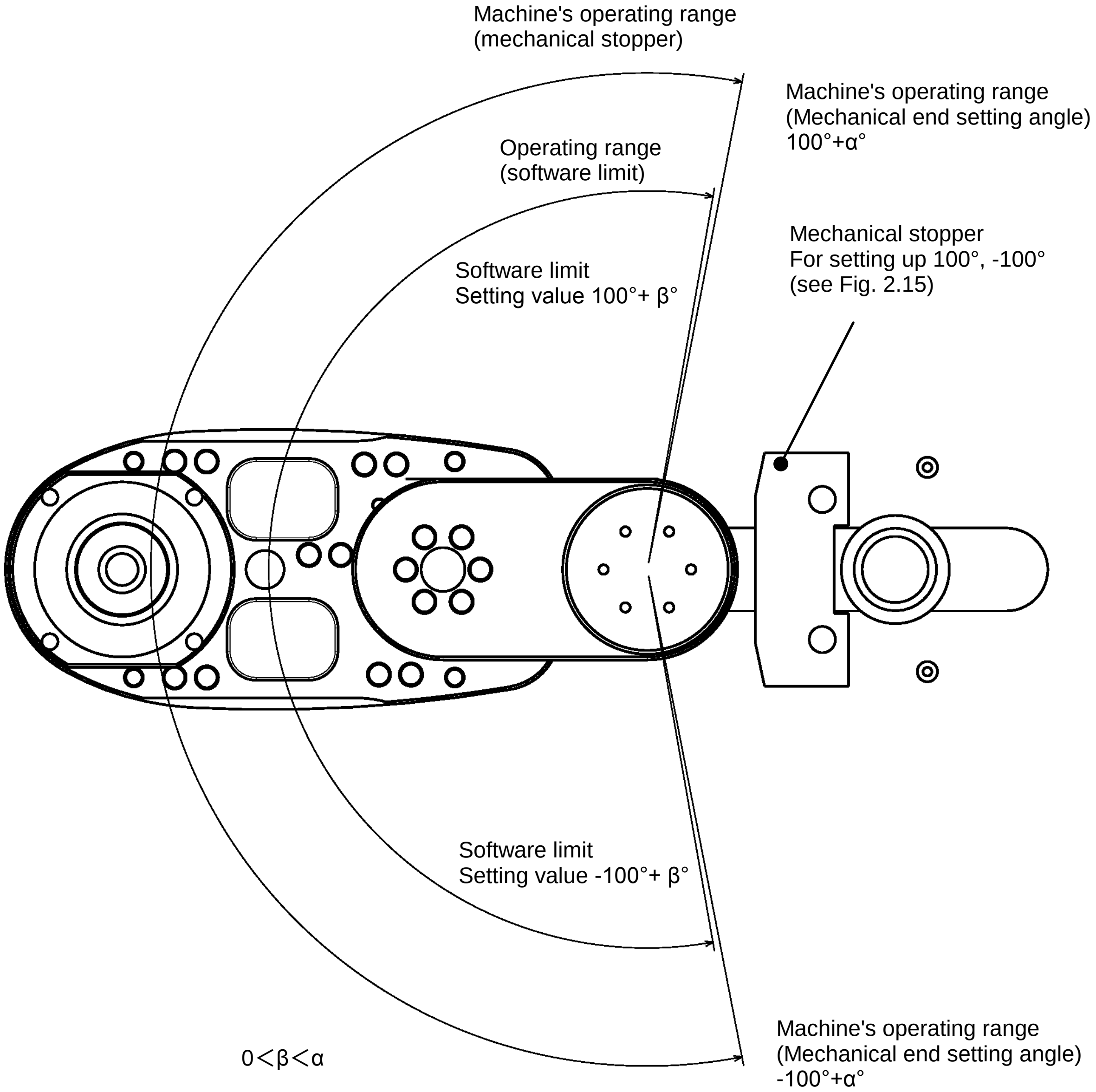


Fig. 2.16 Example of changing the mechanical ends of Axis 1

Example of changing the mechanical stopper for Axis 2
Setup operating range: 120°, -120°
Material: S45C

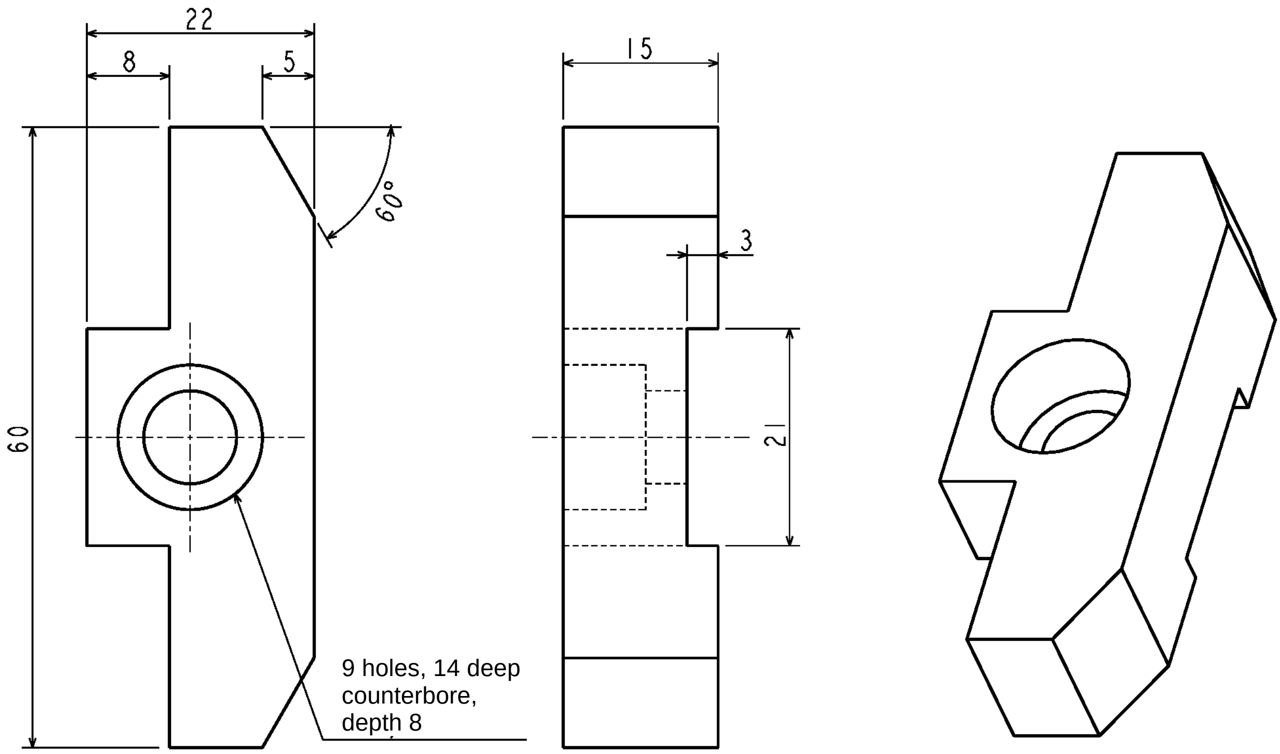


Fig. 2.17 Example of changing the mechanical stopper for Axis 2

Example) When the stroke of Axis 2 has been changed to 120°, -120°

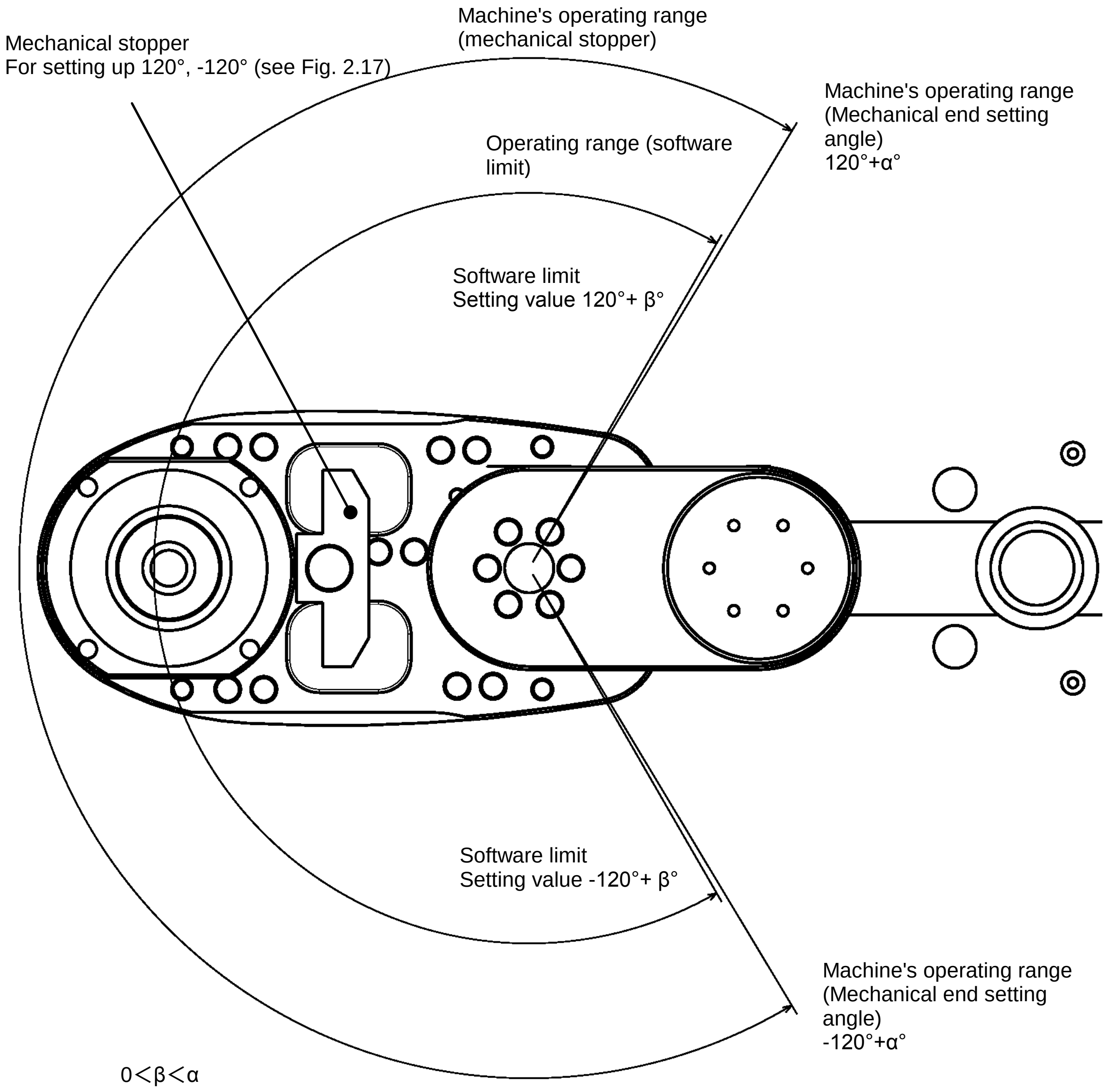


Fig. 2.18 Example of changing the mechanical ends of Axis 2

2.3.2 Changing the Mechanical Ends of Axis 3

When the robot is shipped from the factory, software limits and mechanical stoppers are preset so that the Z stroke of Axis 3 satisfies the range from 0 to 120 mm.
Fig. 2.19 shows the settings of mechanical ends when the robot is shipped from the factory.

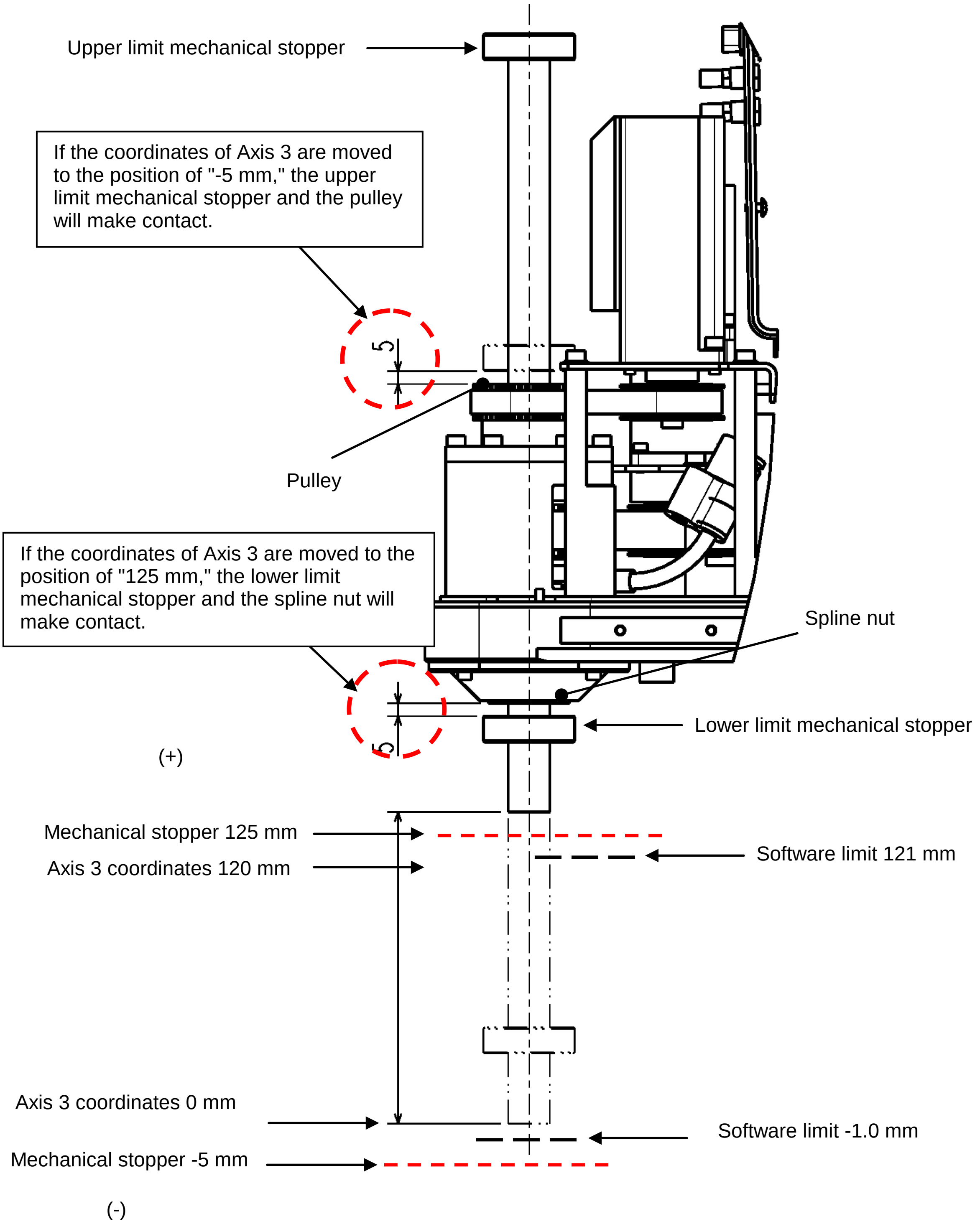


Fig. 2.19 Axis 3 mechanical end settings

To change the mechanical ends of Axis 3, change the stationary position of the mechanical stopper according to the procedure below.

1) Remove the arm 2 cover. The arm 2 cover is secured to the cover fastening bracket and the arm 2 with 10 truss head screw (M3 x 6) and 4 socket head cap screws (M3 x 10).

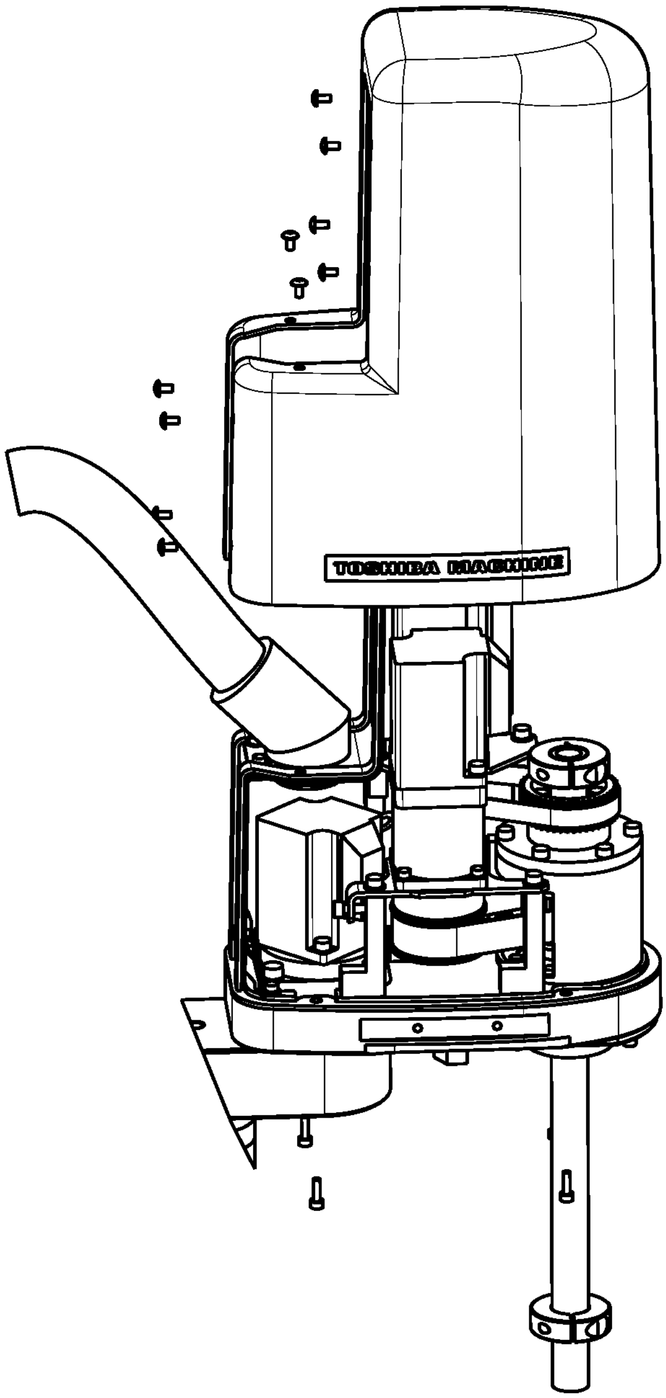
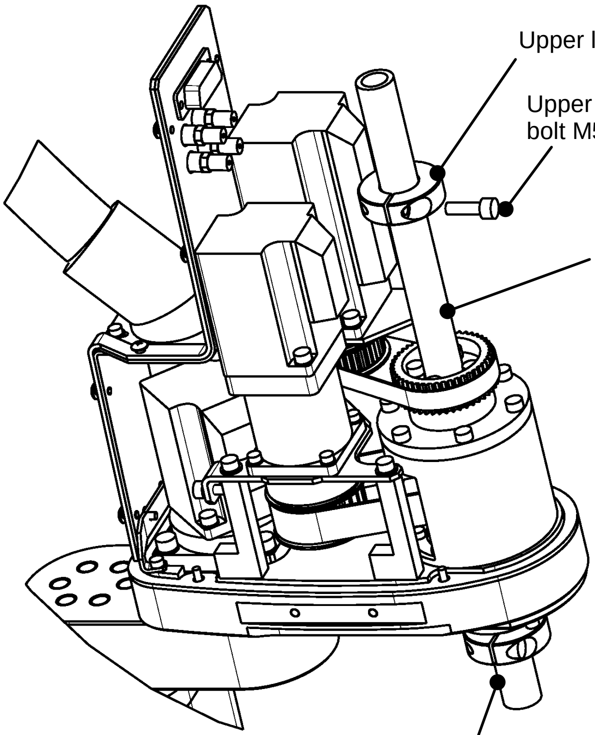


Fig. 2.20 Removing the Arm 2 cover

2) Loosen the fixing bolts of the mechanical stoppers, move the mechanical stoppers to a desired position, and fix them again. When fixing the mechanical stoppers, be sure to apply Loctite to the fixing bolts.



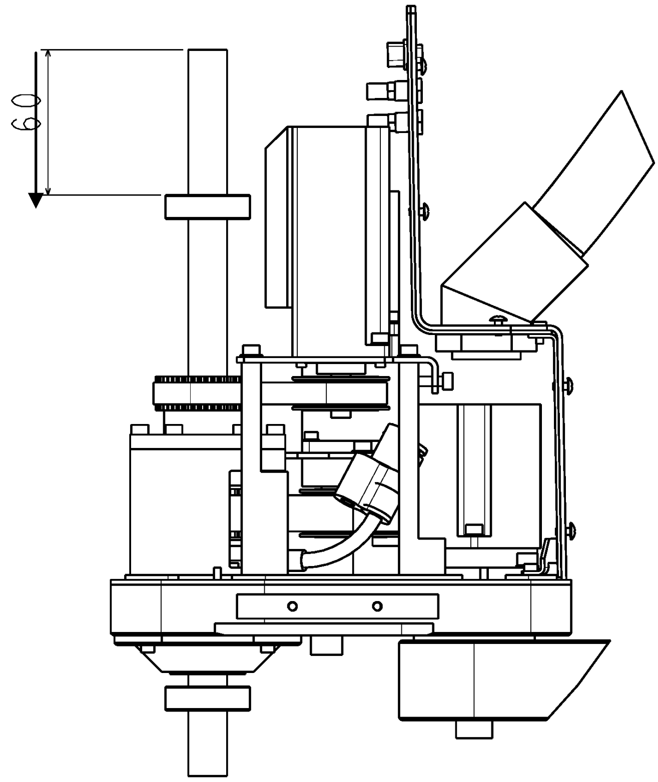


Fig. 2.21 Moving the mechanical stopper

3) While pressing down the Brake Release switch, manually move Axis 3 up and down, and verify that the operating range has been changed.

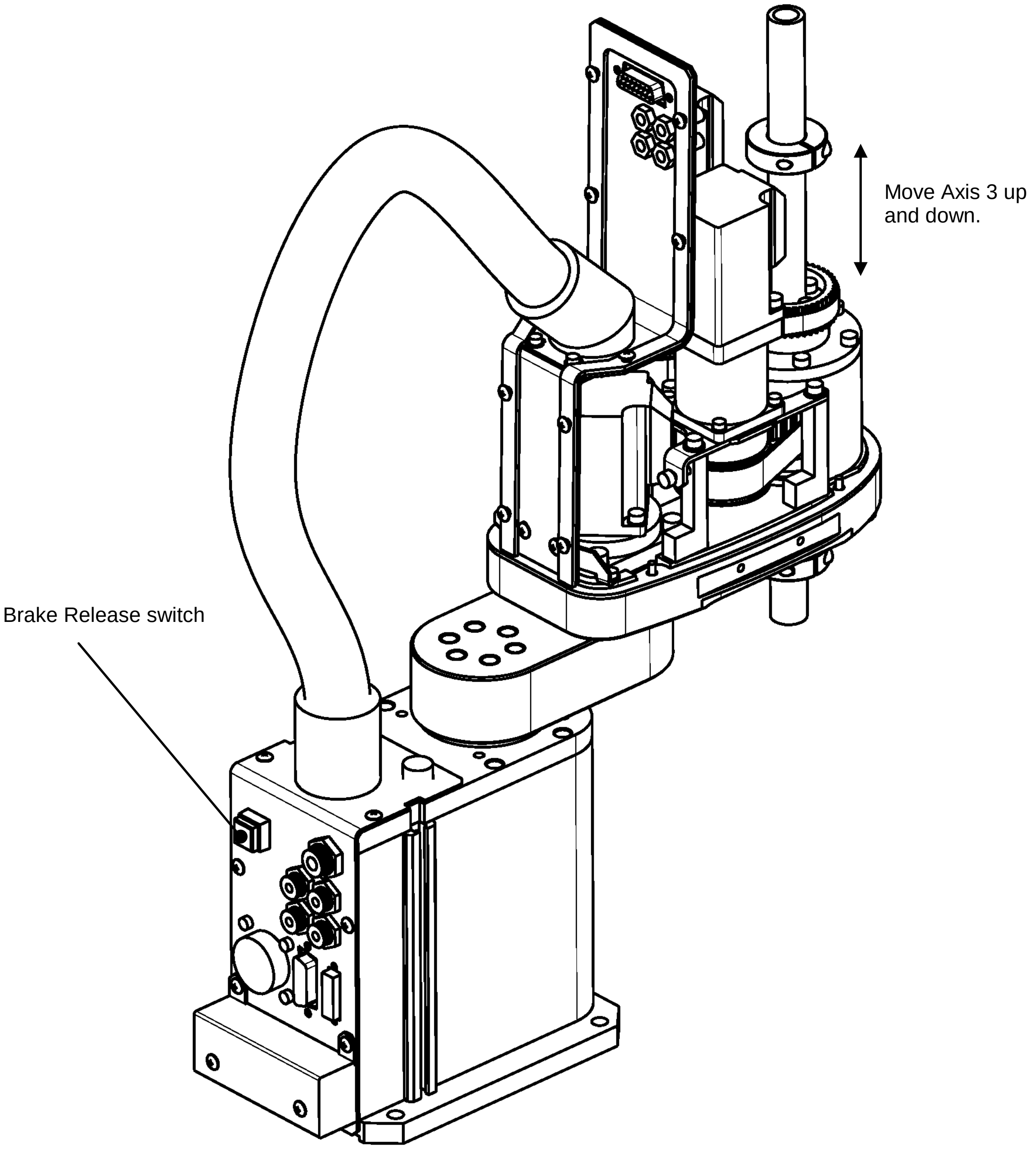


Fig. 2.22 Verifying the operating range after change

Example) When the Z stroke has been changed to 60 to 120 mm

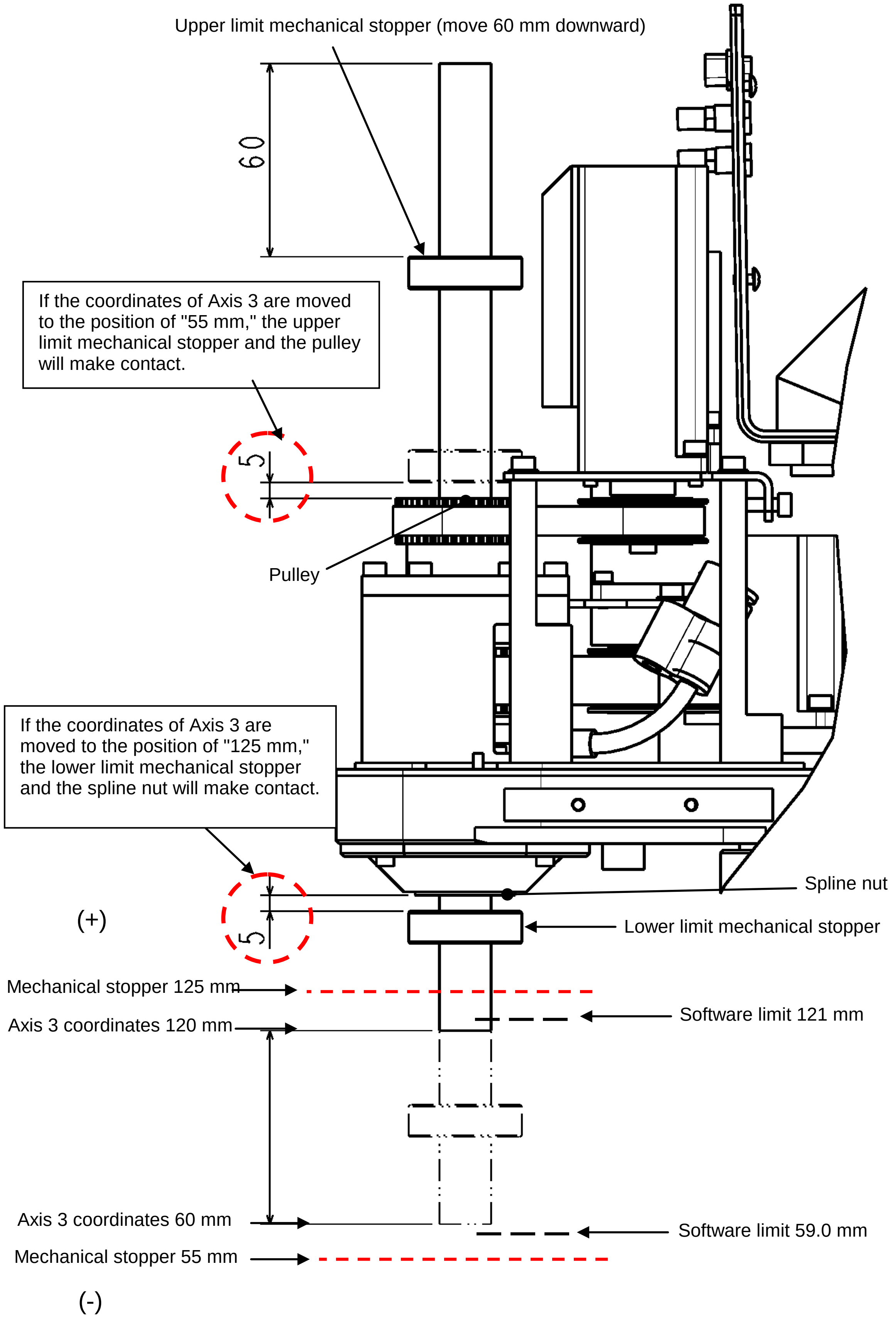


Fig. 2.23 Example of changing the mechanical ends of Axis 3

To move the Z stroke range into the range from 0 to 75 mm, move the fixing position of the lower limit mechanical stopper 75 mm upward according to the procedure in 2).

4) Reinstall the arm 2 cover. Install the arm 2 cover with 10 truss head screw (M3 x 6) and 4 socket head cap screws (M3 x 10) using the recommended tightening torque.

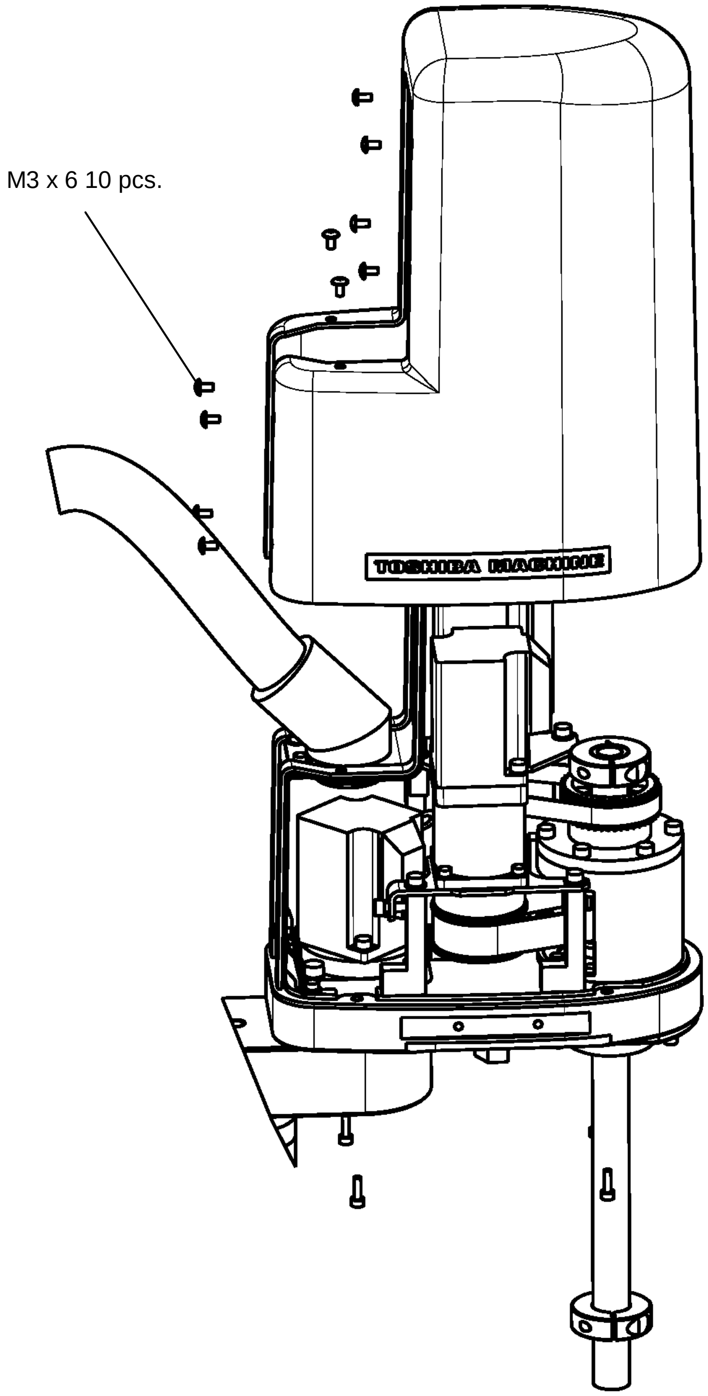


Fig. 2.24 Reinstalling the Arm 2 cover

2.3.3 Changing Software Limits

When the mechanical ends were changed, be sure to also change the software limits. There are the following two types of methods to change the software limits.

[1] Change the setting values of the "User Parameter File (file name: USER.PAR)." There are software limits that can be set by the customer. For more details, refer to Item [U14] SOFTWARE LIMIT in the "User Parameters" available in a separate user manual volume.

[2] By manipulating the teaching pendant, change the software limits in the utility mode "J-LIM."
For more details, refer to "10.8, Joint Limit Setting [J-LIM]" of "Section 10, "Utilities" in the "Operations" available in a separate user manual volume.

Note that if the software limits are changed using the above two types of methods, the factory preset values of the software limits set up in the "User Parameter File (file name: USER.PAR)" will be saved by overwriting.
Thus, **be sure to create a backup of the "User Parameter File" before changing the software limits** in order to save the factory preset values of the software limits set up in the "User Parameter File."

2.4 Installing the Controller

2.4.1 External Dimensions

Fig. 2.25 shows the outline drawing of the controller.

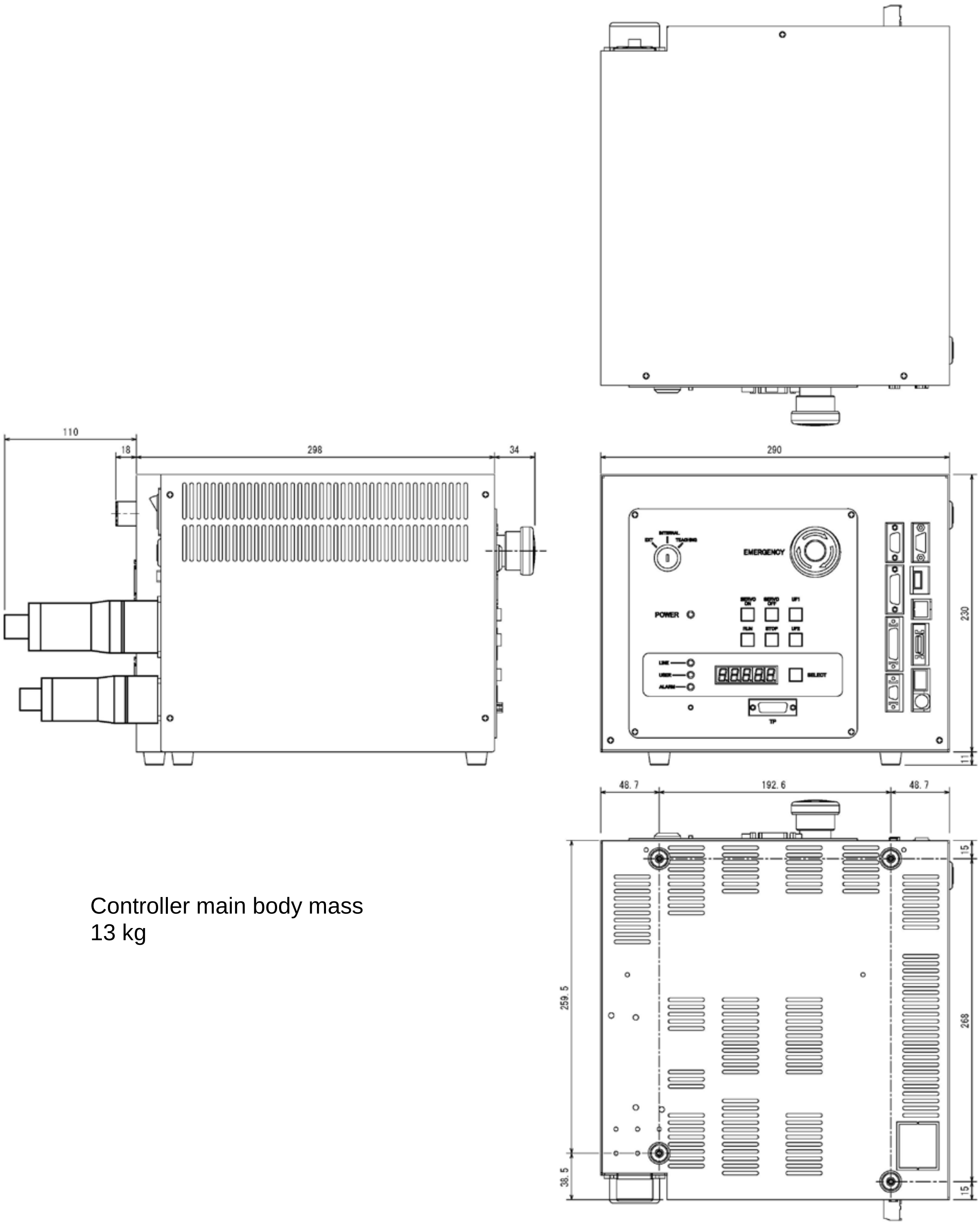


Fig. 2.25 TS3000 controller outline drawing

2.4.2 Precautions for Direct Installation

Allocate a space of at least 50 mm at both left and right in the side directions of the controller and at least 100 mm above 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.
- Do not stack controllers.
- Do not place any object on top of controllers.

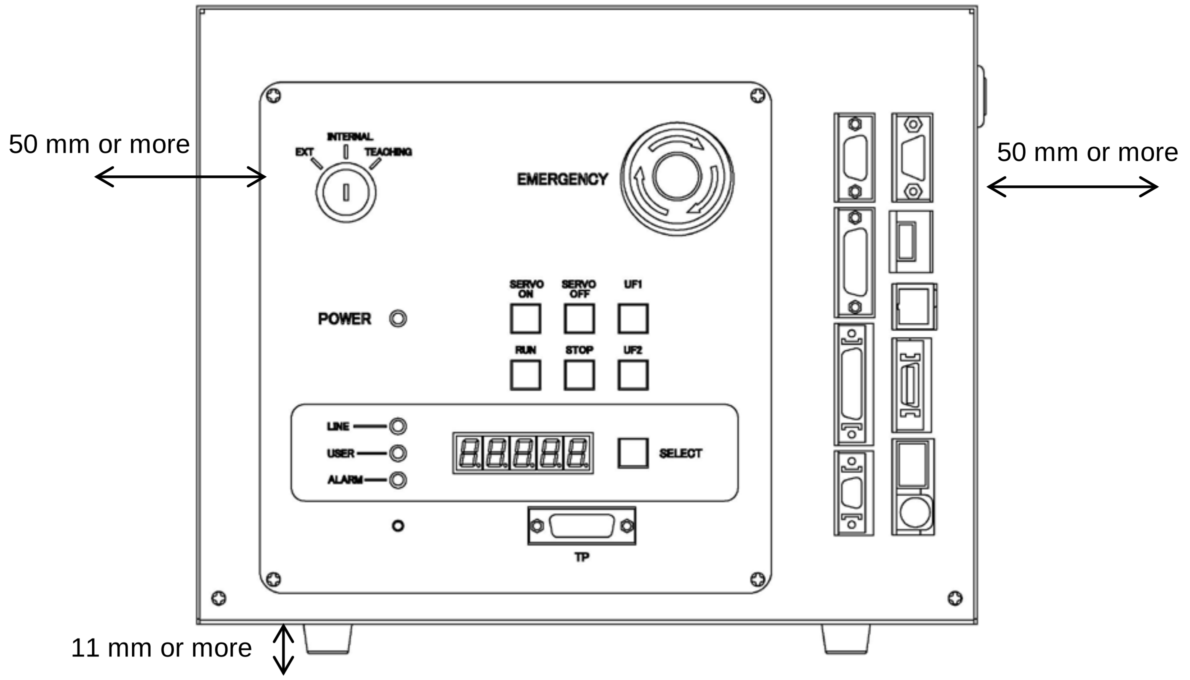


Fig. 2.26 Spaces for ventilating the controller

2.4.3 Rack Mounting Dimensions

When mounting the robot controller in a rack, mount the side brackets using the screw holes provided on both ends of the front panel, and secure the controller to the rack. The side brackets [1] in Fig. 2.7 are optional.

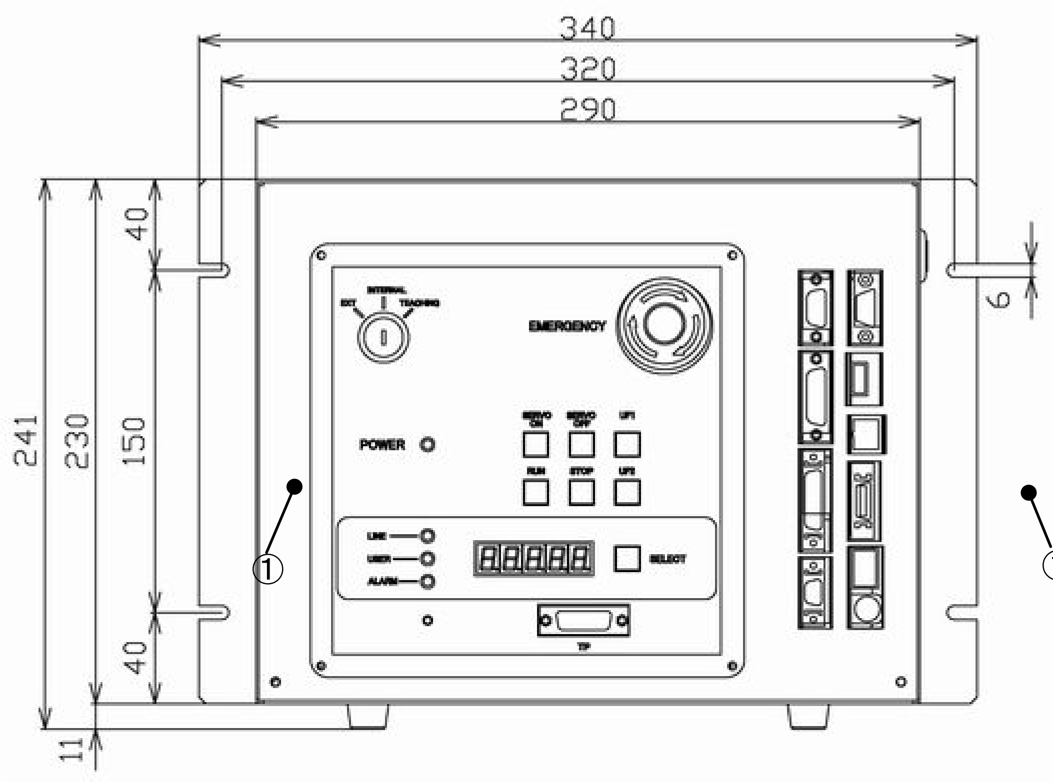


Fig. 2.27 Screw hole dimensions for securing controller

2.4.4 Precautions for Rack Mounting

Pay attention to the following matters when rack-mounting the TS3000 robot controller.

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

b) Because a cable connector will be connected to the rear of the controller, a space of at least 110 mm is necessary in the rear direction.
To do maintenance of the controller, remove the upper cover. (See Figure 2.28.)

CAUTION

- If the rack is completely sealed, provide holes to allow the air to be let out, force-ventilate the rack with a fan, or cool it indirectly so that the heat will not be trapped in the rack.

  If the heat is trapped in the rack or controller, faults could occur.

Keep this in mind when installing the controller. Especially when the controller is stored in the rack, it will be necessary to take out the controller from the rack for maintenance.

Specifically, be careful of the following points.

1) Arrange the cables around the rear side of the controller (so that the controller can be removed).

2) Arrange the cables between the controller and control panel when the control panel is separated.

3) Connect all cables in such a manner that the robot can be operated even if the controller is removed from the rack.

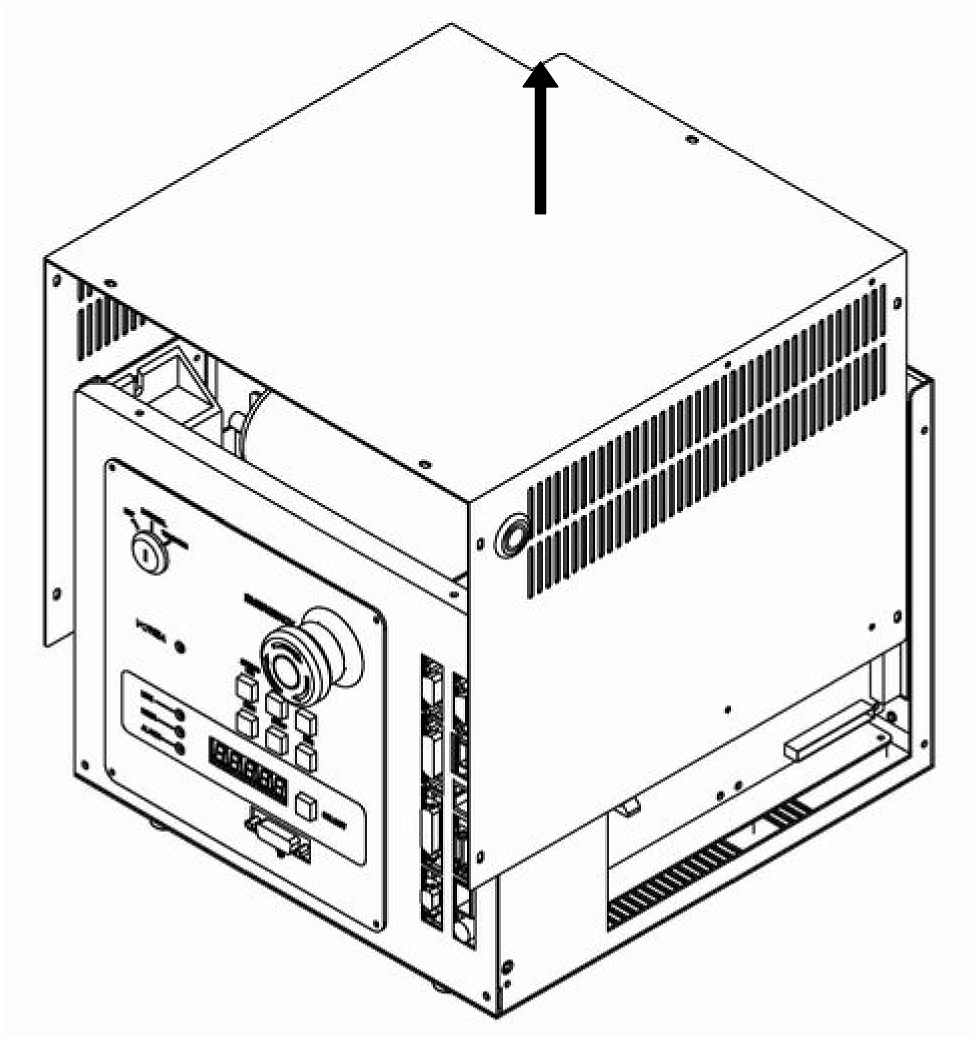


Fig. 2.28 Removing upper cover

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

d) On the front of the controller, a clearance of approx. 90 mm should be provided for connecting the connector of the teach pendant. Even if the teach pendant is not used, a clearance of approx. 60 mm is required for connecting a dummy plug.

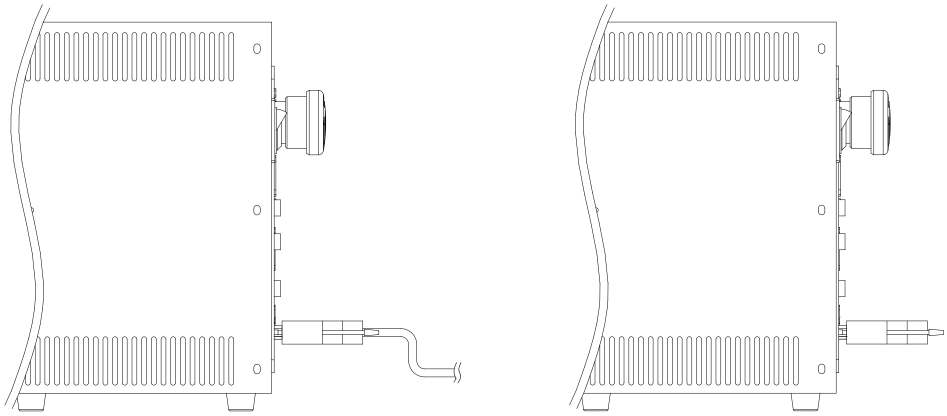


Fig. 2.15 Clearance of controller front side

2.5 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.

2.6 Safety Measures

a) When installing the robot, provide sufficient space to carry out the work safely.

b) Clarify the hazard zone, and provide a safety fence so that other persons cannot enter the zone easily. The hazard zone is the zone near the robot's working space where a hazardous state could occur if a person enters.

c) Provide a limit switch, photo switch or foot switch, etc., at the entrance of the safety fence to provide an emergency stop function that will stop the robot if a person enters the hazard zone. The emergency stop function should be an electrically independent close contact (closed in normal operation) with compulsive opening function and must not be automatically recovered.

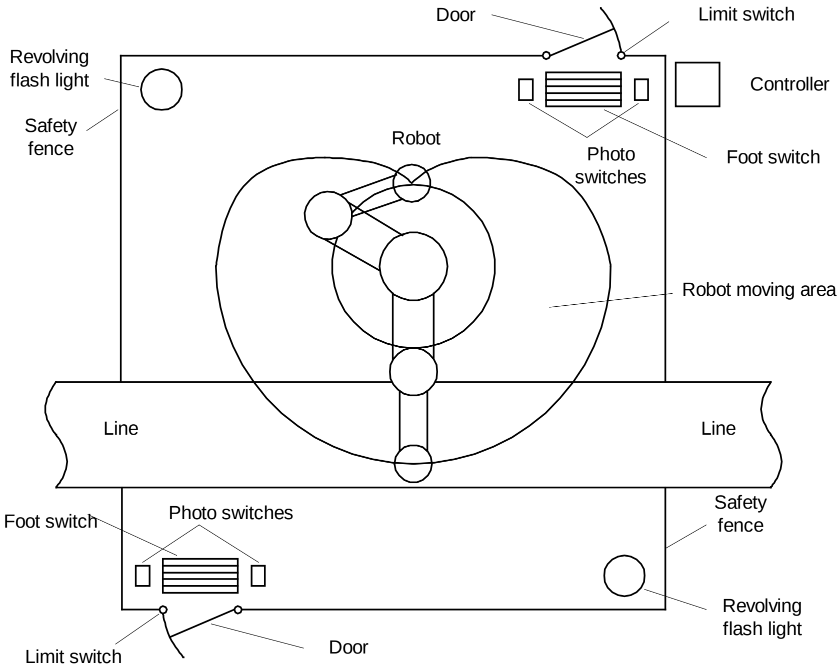


Fig. 2.17 Example of safety measures

d) The controller should be installed at a place outside the hazard zone where the operator can view the robot movement.

2.7 Position Detector Backup Batteries

The robot has batteries to back up positional information on position detectors in its base. Unless the robot is used for a long period of time, the battery voltage will drop and the positional data of origin will be lost.
Replace the batteries every year. It is recommended to replace the batteries at the time of installation so that they can be replaced at regular inspection and maintenance.
Also, if the battery voltage for backup of the X8LC printed board SRAM of controller has dropped, absolute position data set by the user will be lost. To avoid this, replace the batteries on a regular basis.
If the master power voltage of the batteries has dropped, an alarm of level 1 as shown below occurs first. When this happens, replace the batteries immediately. For the battery replacement, see Para. 2.3.8 and 3.3.3 of the Maintenance Manual.

Table 2.2 List of level 1 alarms

Error code	Descriptions
1–049	Axis1 Battery alarm
1–065	Axis2 Battery alarm
1–081	Axis3 Battery alarm
1–097	Axis4 Battery alarm
1–113	Axis5 Battery alarm
1–129	Axis6 Battery alarm
1–145	MAIN Battery alarm

If the master power voltage has dropped further, an alarm of level 8 as shown below occurs. When this happens, replace the batteries with new ones and perform encoder error reset operation because there is a fear that the position encoder backup data has been lost. For the encoder error reset operation, see Appendix B of the Maintenance Manual.

Table 2.3 List of level 8 alarms

Error code	Descriptions
8–065	Axis1 Encoder abnormal
8–097	Axis2 Encoder abnormal
8–129	Axis3 Encoder abnormal
8–161	Axis4 Encoder abnormal
8–193	Axis5 Encoder abnormal
8–225	Axis6 Encoder abnormal

2.8 Using the Robot in Clean Room

The main robot is designed pursuant to the Clean Class 10.
To be more specific, when this robot is operated in the clean bench (Clean Class 1 or less) installed in the downflow clean room, the number of 0.3 µm or more fine particles in 1 ft^3 as measured on the surface of the axis 3 stroke lower limit position is 10 or less.
The downflow air speed should be 0.3 to 0.5 m/s.
As the TS3000 controller is not designed to satisfy the specified clean class, take careful precautions to select the place of installation.
In the clean robot, an air tube is incorporated for ventilation. To operate it as the clean robot, scavenge by connecting a scavenging vacuum pump (or equivalent, which is to be provided by the customer) with the air joint. The target scavenging volume is 50 L/min.
When the robot is operated without scavenging, the specified clean class cannot be maintained.

Section 3 System Connections

3.1 Cable Wiring

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

3.1.1 Connector Arrangement on the Controller

The cables connected to the TS3000 robot controller are shown in Fig. 3.1.

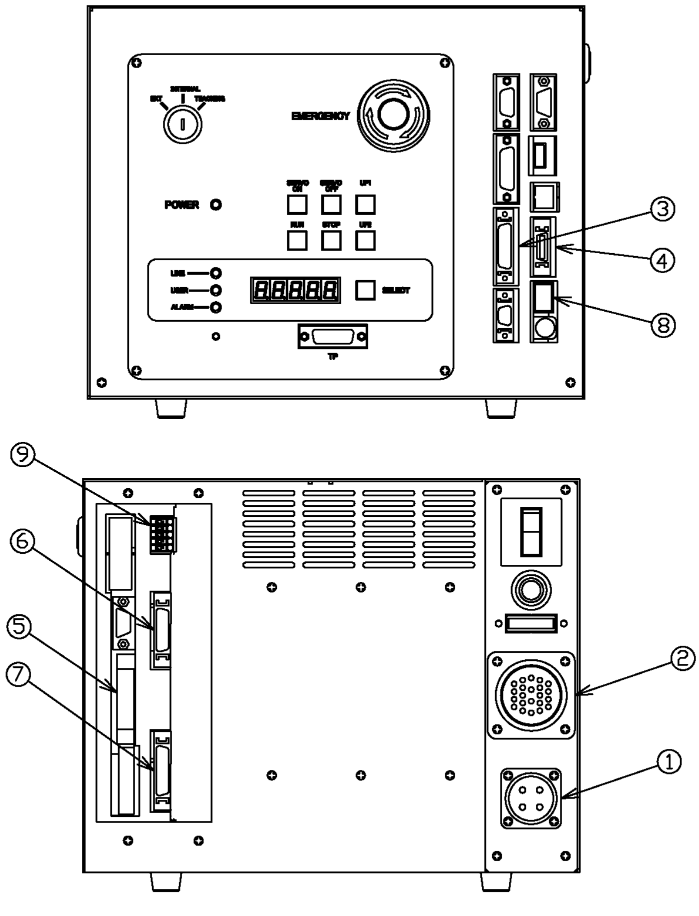


Fig. 3.1 TS3000 robot controller connector layout

[1] Power cable (ACIN)
[2] Motor cable (MOTOR)
[3] Encoder cable (ENC)
[4] Robot control signal cable (HAND)
[5] External operation input signal cables (SYSTEM)
[6] External operation input signal cables (INPUT)

[7] External operation input signal cables (OUTPUT)
[8] Brake signal cable (BRK)
[9] Distribution I/O cable (EXT-I/O)

In the subsequent paragraphs, we explain how to connect cables ① to ④ inclusive.
For information on how to connect cables ⑤ to ⑨, refer to the Interface Manual.

3.1.2 Connecting the Power Cable “ACIN” [1] of Fig. 3.1 (Plug Connector Attached)

The power cable is used to supply the main AC power to the controller.

Table 3.1 Power supply specifications

Item	Specifications
Power supply	Single phase, AC 200 ~ 240 V, 50/60 Hz±1 Hz
Power supply capacity	TH250A/TH350A (0.9 kVA) TH180 (0.5 kVA) TH350A-T (0.9 kVA)
Instantaneous power failure	For 50 Hz, within 40 msec For 60 Hz, within 32 msec
Grounding	Dedicated Type D grounding

The connector is ACIN (Fig. 3.1-[1]).

Because the cable is not included in the accessories, the customer needs to create it using the attached plug connector to be connected to ACIN on the controller side.

ACIN plug connector	Type: JL04V–6A18–10SE–EB	Maker: Japan Aviation Electronics Industry
ACIN cable clamp	Type: JL04–18CK	Maker: Japan Aviation Electronics Industry
Wire	3.5 mm^2 ~ 5.5 mm^2 (AWG22 ~ 20)	

As the cable is not an accessory, use the attached plug connector connected to ACIN on the controller side to manufacture a cable.
Wires are to be soldered to the connector.

⚠ DANGER

- Always 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.

For the terminal arrangement, see Para. 4.1.7.

⚠ 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 of the 8–027 error, see Para. 13.7 of the Operator’s Manual.

3.1.3 Connecting the Motor Cable “MOTOR” Fig. 3.1-[1] (Cable Attached)

The motor cable connects the controller and the robot, supplies the power required to rotate the motor from the controller's servo driver to each axis motor of the robot and turns ON/OFF the brake for securing the motor axis.

The connector for connecting the motor cable is MOTOR (Fig. 3.1-[1]). The locations of the MOTOR connectors on the robot side are shown in Fig. 3.2-[1], Fig. 3.3-[1] and Fig. 3.4-[1].

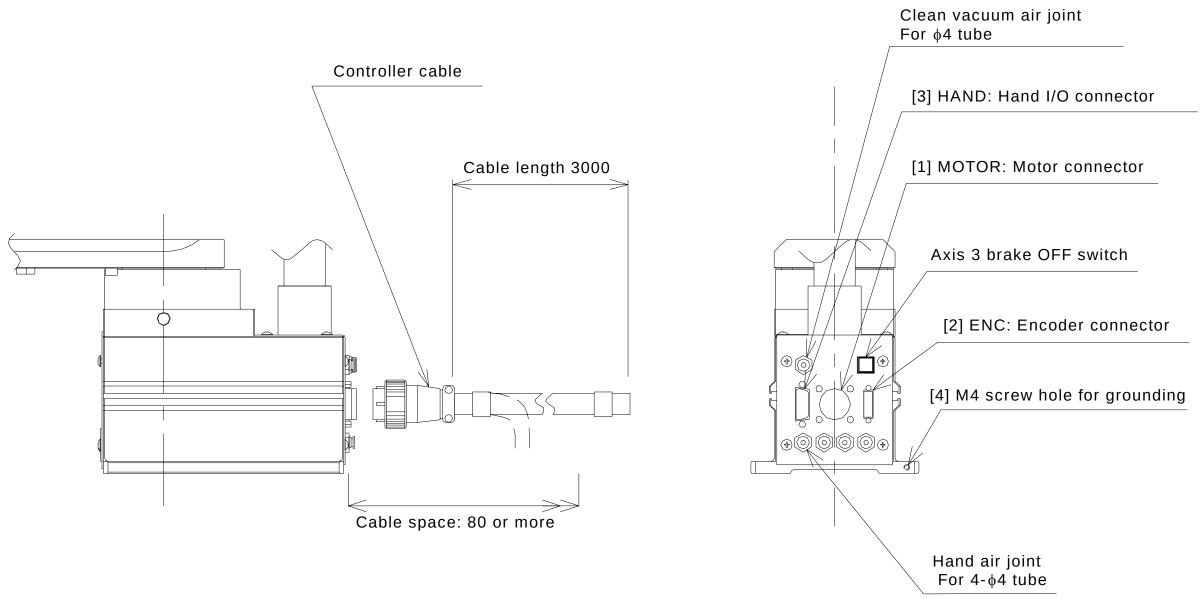


Fig. 3.2 Robot side connector layout drawing (TH250A, TH350A)

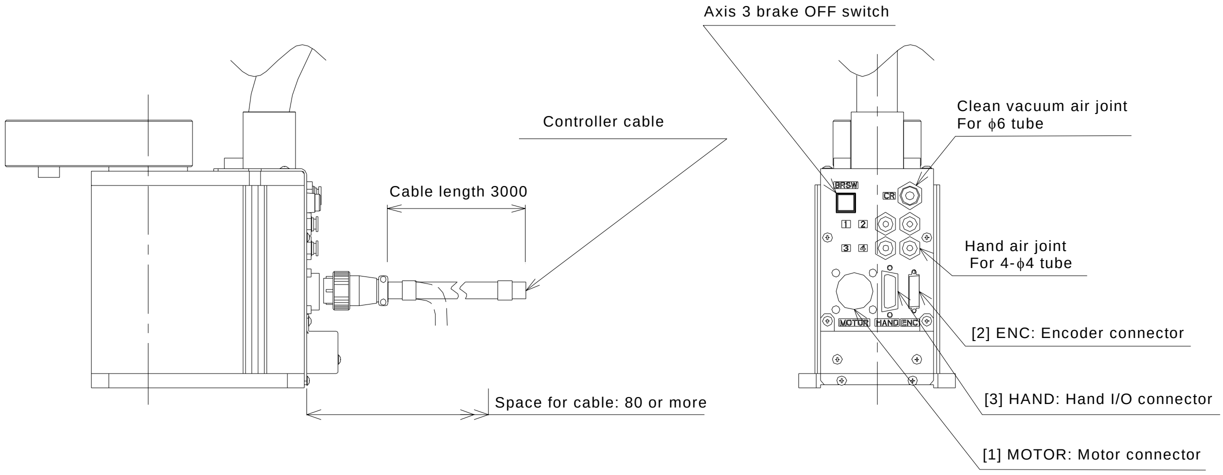


Fig. 3.3 Robot side connector layout drawing (TH180)

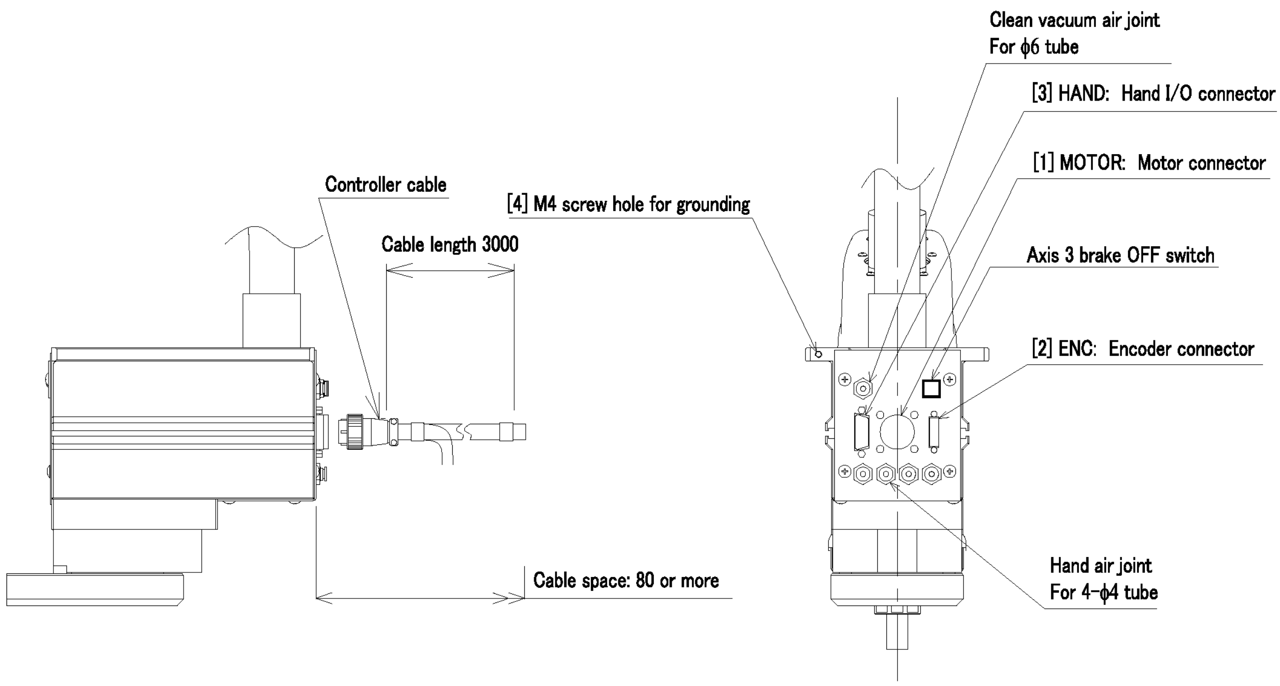


Fig. 3.4 Robot side connector layout drawing (TH350A-T)

3.1.4 Connecting the Encoder Cable “ENC” Fig. 3.1 [3] (Cable attached)

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 connector for connecting the encoder cable is ENC ([3] of Fig. 3.1).

The locations of the ENC connectors on the robot side are shown in Fig. 3.2-[2], Fig. 3.3-[2] and Fig. 3.4-[2].

3.1.5 Connecting the Hand Control Signal Cable “HAND” Fig. 3.1-[4] (Cable Optional)

The hand control signal cable is used for input and output of robot control signals such as the hand operation signal. The connector for connecting the hand control signal cable is HAND (Fig. 3.1-[4]).

The locations of the HAND connectors on the robot side are shown in Fig. 3.2-[3], Fig. 3.3-[3] and Fig. 3.4-[3].

3.1.6 Connecting the Brake Signal Cable "BRK" Fig. 3.1-[8] (Cable Attached)

The brake signal cable is used to turn ON/OFF the brake for fixing the motor axis.
The connector for connecting the brake signal cable is BRK (Fig. 3.1-[8]).
The locations of the BRK connectors on the robot side are shown in Fig. 3.2-[1], Fig. 3.3-[1] and Fig. 3.4-[1].

3.1.7 Grounding the Robot

An M4 screw hole for grounding is provided in the base section of the robot's main body. (Fig. 3.2-[4] and Fig. 3.4-[4]). Be sure to securely connect the protective conductor of the entire facility with this M4 screw hole.

3.1.8 Inserting and Removing Cables

⚠ CAUTION

- Before inserting or removing any controller cable, be sure to turn off the “POWER” switch.
- When removing a cable, be sure to pull the plug and not the cord. Otherwise, you may damage the cable.

a) Circular connectors: ACIN, MOTOR
First, completely insert the connector on the cable side into the controller connector. Then, turn the cable side lock screw to the right to clamp the cable. A loose plug can cause a contact failure or other accident, so be careful and do the job right.
To remove the connector, turn the lock screw to the left and pull out the cable side connector.

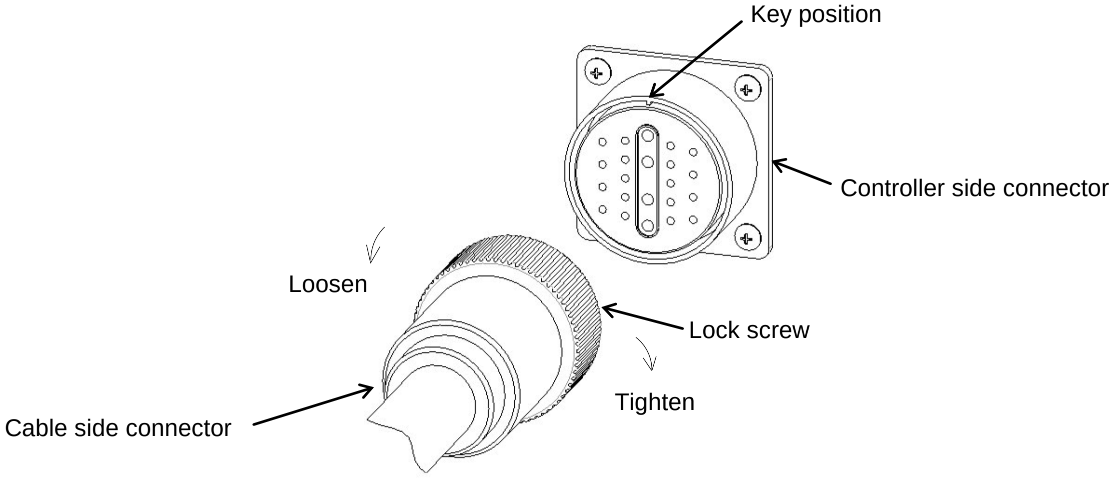


Fig. 3.5 Inserting and removing a circular connector

b) Square connectors: ENC, HAND, TP, INPUT, OUTPUT, COM1, HOST1, TCPRG
First, 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 plug can cause a contact failure or other accident, so be careful and do the job right.
To remove the connectors, first loosen the lock screws, then pull out the cable side connector.

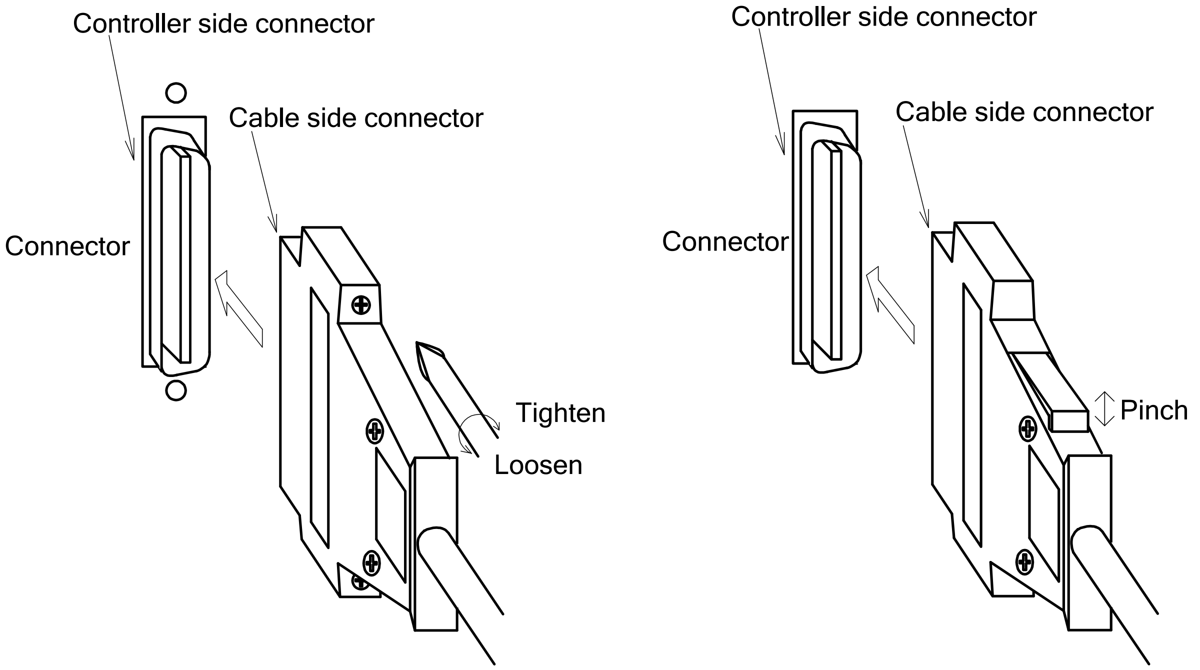
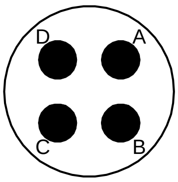


Fig. 3.6 Inserting and removing a square connector

3.1.9 Examples of Connector Terminal Arrangement

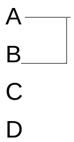
a) Power cable connector ACIN



Connects to controller.

Type: JL04V–2E18–10PE–B

Manufacturer:
Japan Aviation Electronics Industry



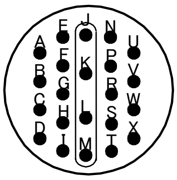
Single phase, AC 170~250 V, 50/60 Hz

Grounding with grounding resistance of 100 Ω or less.

DANGER

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

b) Motor cable connector MOTOR

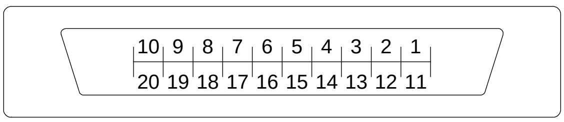


Connects to controller.

Type: JL04V-2A28-11SE

Manufacturer: Japan Aviation Electronics Industry

c) Encoder cable connector ENC

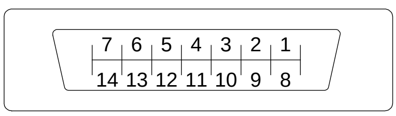


Connects to controller.

Type: 52986-3659

Manufacturer: MOLEX

d) Robot hand control signal cable connector HAND

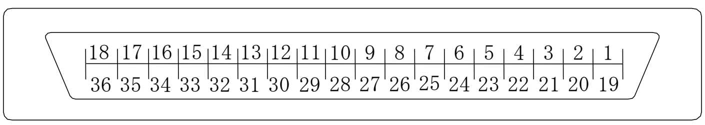


Connects to controller.

Type: 52986-20798

Manufacturer: MOLEX

e) External input signal cable connector INPUT

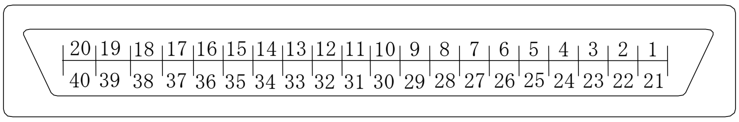


Connects to controller.

Type: DHA-RC36-R132N-FA

Manufacturer: DDK

f) External output signal cable connector OUTPUT

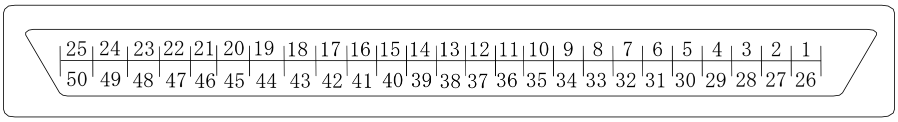


Connects to controller.

Type: DHA-RC40-R132N-FA

Manufacturer: DDK

g) System input/output signal cable connector SYSTEM

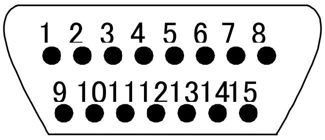


Connects to controller.

Type: 52986-5079

Manufacturer: MOLEX

h) Trigger input connector TRIG

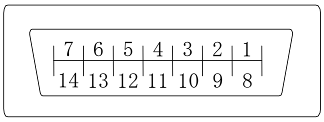


Connects to controller.

Type: XM2C–1542–112L

Manufacturer: OMRON

i) Encoder cable connector CONV

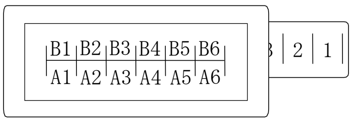


Connects to controller.

Type: 52986-1479

Manufacturer: MOLEX

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

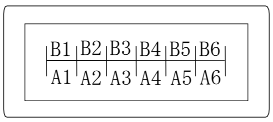


Connects to controller.

Type: XL-4000CWJH–10PGY

Manufacturer: SATO PARTS

k) Brake connector BRK



Connects to controller.

Type: I-1827876-6

Manufacturer: Tyco Electronics AMP

3.2 Controller Connector Signals

3.2.1 Connector Signal Connection Diagrams

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

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

These signals are already jumpered for the connectors provided for the TS3000 controller. If you wish to use them, therefore, you should remove the jumpers and rewire as appropriate. If you plan to use the robot without using system signals, be sure to connect the attached connector to the controller side INPUT connector.
It is recommended to jumper the following signals under some circumstances.

SYSTEM–15	(LOW_SPD)
SYSTEM–13	(CYCLE)

Connector jumpers

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.
- For all connectors not used, attach connector covers. Otherwise, the controller will malfunction due to static electricity.

3.3 Separating Control Panel from Controller

3.3.1 Removing Control Panel

Remove the control panel in the following manner.

a) Loosen the four (4) screws at the four (4) corners, which secure the control panel.

b) Remove these screws, then carefully draw out the control panel toward your side.
Caution: Be careful of the cable connected on the rear side.

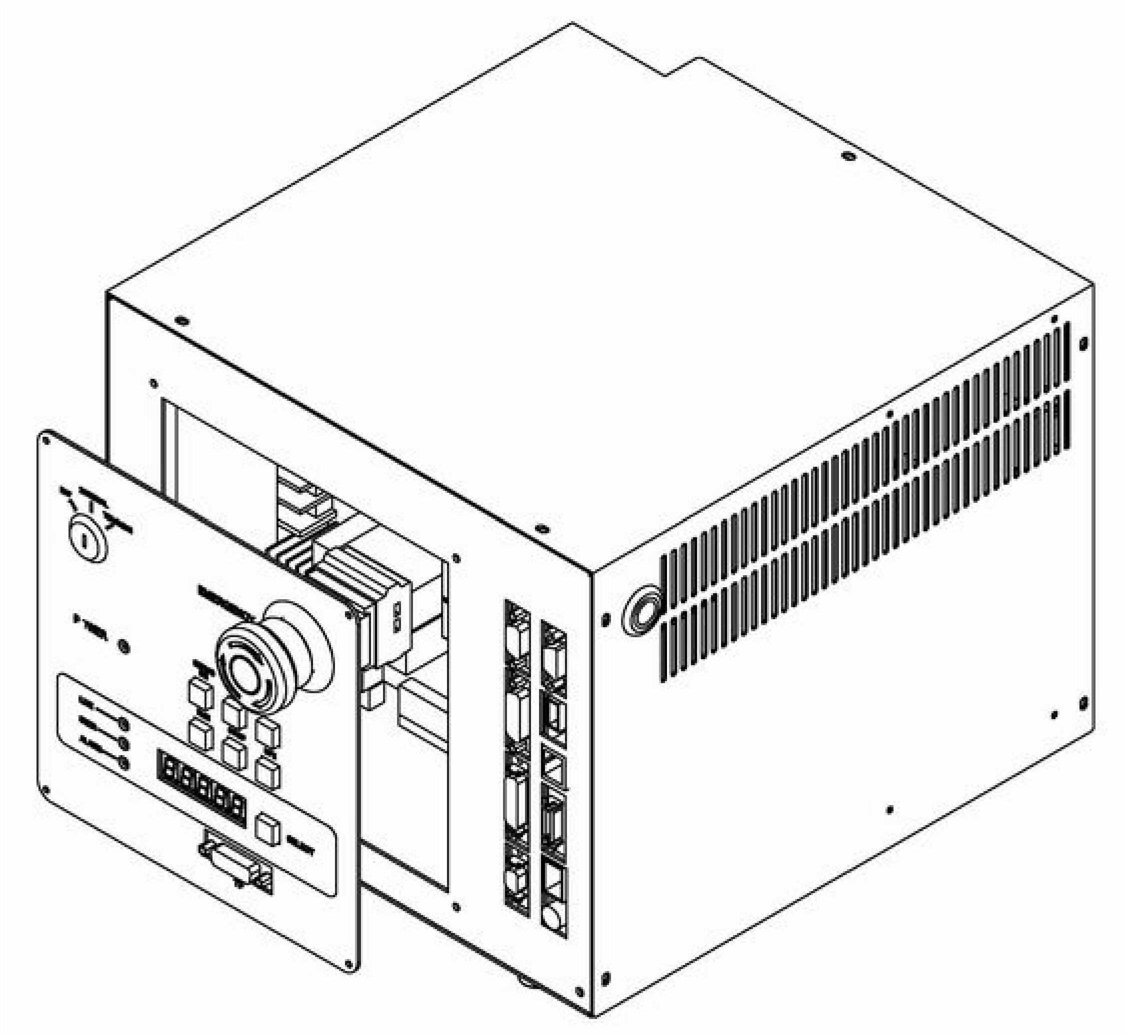


Fig. 3.7 Removing control panel

3.3.2 Cable between Controller and Control Panel

The cable required to connect the control panel and controller when they are installed separately can be provided optionally.

3.3.3 Control Panel Mounting Dimensions

The dimensions of mounting the control panel are shown in Fig. 4.6.
Cross truss head screws (ø3 × 6, ZN3–B) are used.

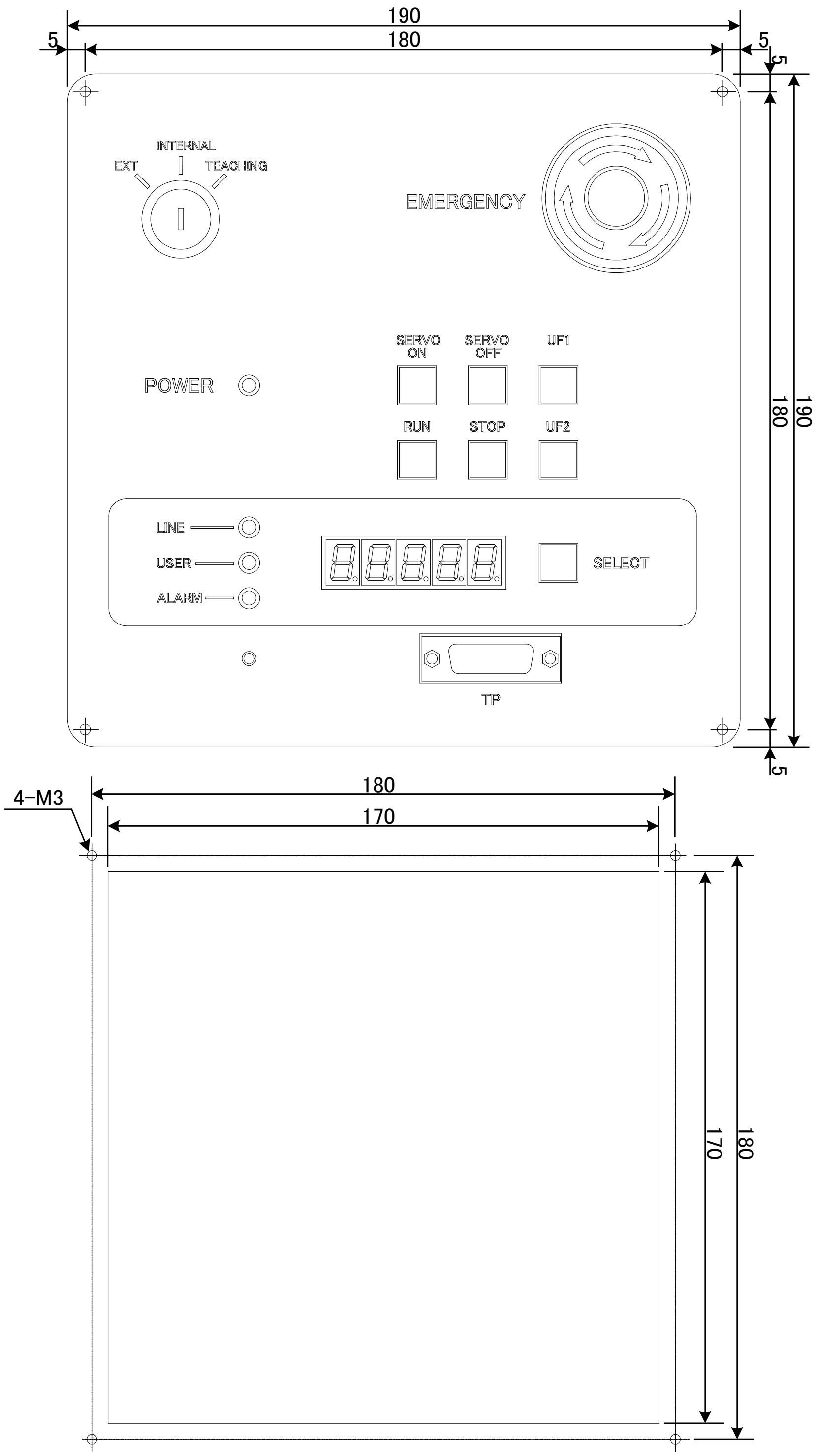


Fig. 3.8 Control panel mounting dimensions

3.3.4 Mounting Dummy Panel on Controller

When the control panel has been disengaged from the controller, mount a dummy panel on the place where the control panel was set before, as shown in Fig. 4.7. The dummy panel, mounting parts, etc. are provided optionally.

a) Connect the cable connector which was disconnected when separating the controller from the control panel, to the rear side of the dummy panel, then screw both ends of the connector. When mounting the connector, use the cross truss screws (ø3 × 6, ZN3–B).

b) Screw the dummy panel into the controller.

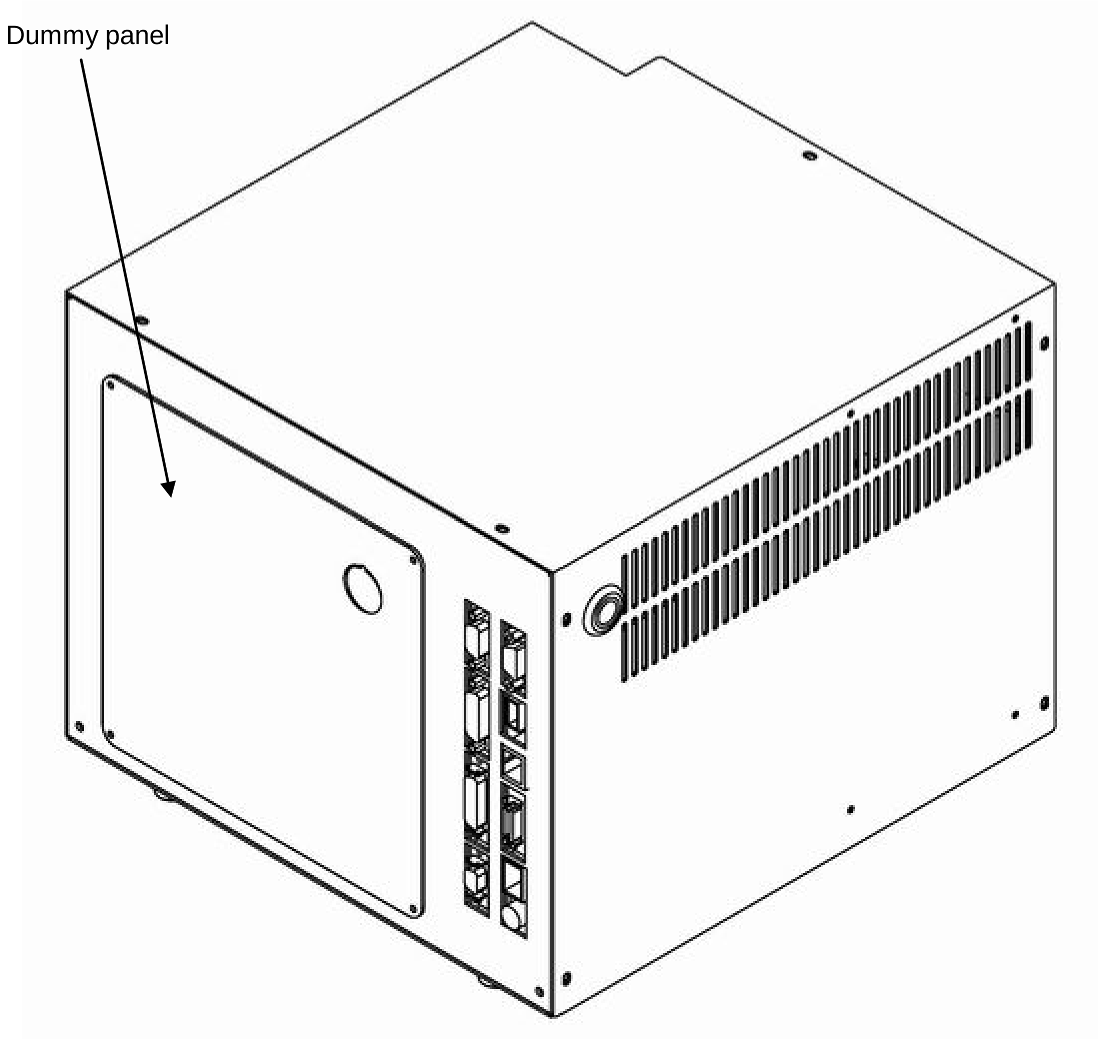


Fig. 3.9 Mounting dummy panel

3.3.5 Dimensions when Separating Control Panel

Fig. 4.8 shows the connections of the control panel and dummy panel. Provide a clearance of 50 mm or more (with cover, 60 mm or more) on the rear side of the separated control panel.
When the cable is connected to the dummy panel of the controller, provide a clearance of 80 mm or so in front of the controller as the cable connector sticks out of the panel surface.

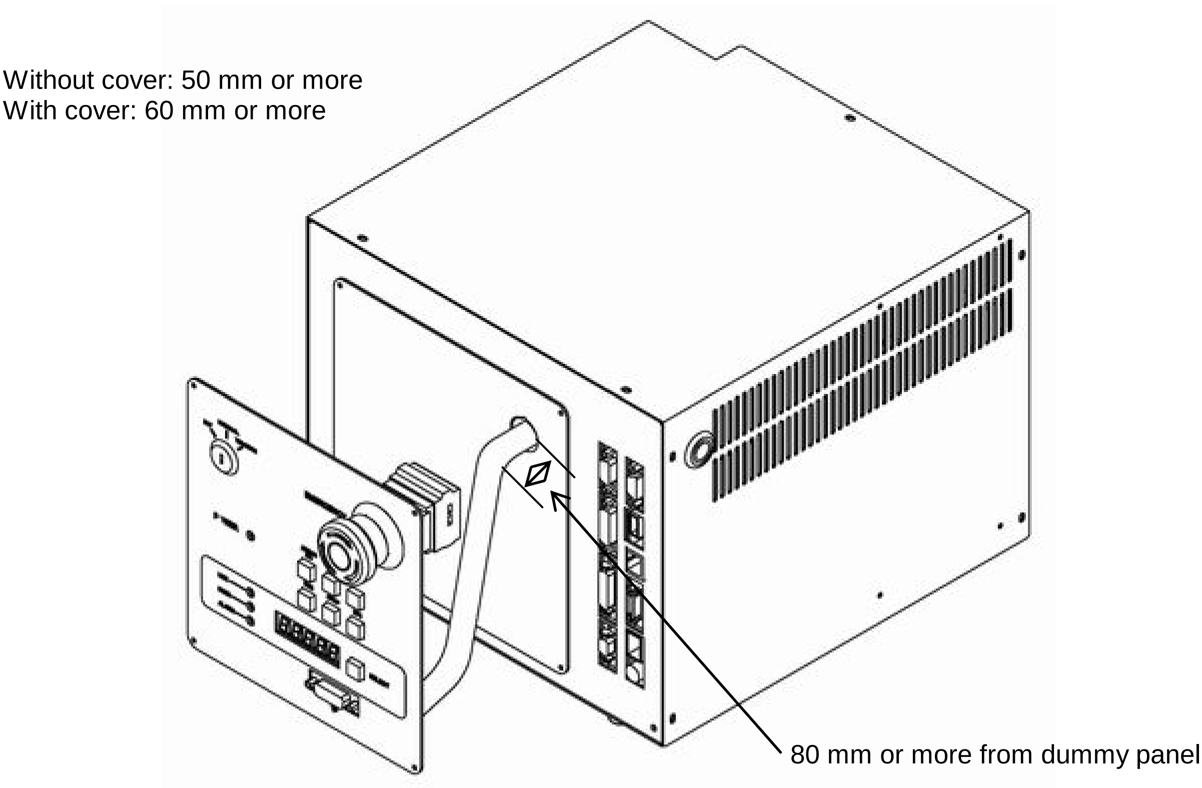


Fig. 3.10 Cable connections of dummy panel and control panel

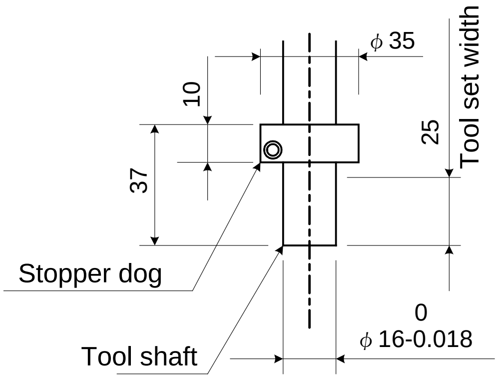
Section 4 Tool Interface

4.1 Mounting Tool

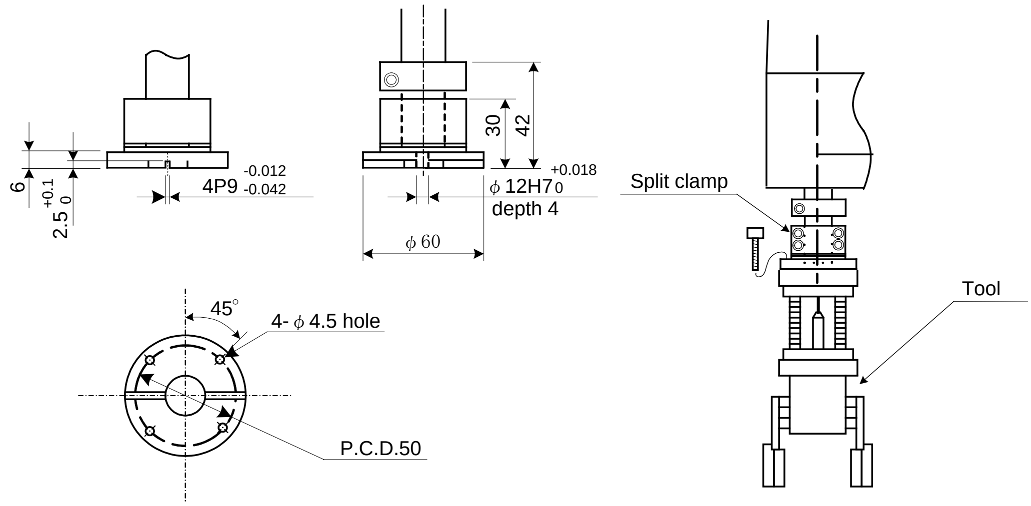
a) TH250A, TH350A, TH180 and TH350A- T

The tool is mounted on the end of the tool shaft (ø16). The tool shaft has a dog for the stopper, and the section in front of the dog is used for mounting the tool. At this time, the dog should not be removed. Dimensions of the tool shaft section are shown in Fig. 4.1 (a).

As shown in Fig. 4.1, the tool is secured to the tool shaft with split clamp. As there is not a reference such as keyway on the tool shaft, however, take care of the tool direction when mounting.



(a) Dimensions of tool shaft section



(b) Dimensions of tool set flange (option)

Fig. 4.1 Mounting TH250A, TH350A , TH180 and TH350A- T tools

4.2 Tool (Hand) Wiring and Piping

The robot is provided with wiring and air piping for the tool. These wiring and piping extend to the arm 2 from the base.

a) Wiring for tool

Arm side
DSUB 25-pin connector
(XM2D–1501 made by OMRON)

<table>
<tr><th rowspan="2">Pin No.</th><th colspan="2">Signal name</th></tr>
<tr><th>Type-N</th><th>Type-P</th></tr>
<tr><td>1</td><td colspan="2">D-IN0</td></tr>
<tr><td>2</td><td colspan="2">D-IN1</td></tr>
<tr><td>3</td><td colspan="2">D-IN2</td></tr>
<tr><td>4</td><td colspan="2">D-IN3</td></tr>
<tr><td>5</td><td colspan="2">D-IN4</td></tr>
<tr><td>6</td><td colspan="2"></td></tr>
<tr><td>7</td><td colspan="2">D-OUT0</td></tr>
<tr><td>8</td><td colspan="2">D-OUT1</td></tr>
<tr><td>9</td><td colspan="2">D-OUT2</td></tr>
<tr><td>10</td><td colspan="2">D-OUT3</td></tr>
<tr><td>11</td><td colspan="2"></td></tr>
<tr><td>12</td><td>P24V</td><td>P24G</td></tr>
<tr><td>13</td><td>P24V</td><td>P24G</td></tr>
<tr><td>14</td><td>P24G</td><td>P24V</td></tr>
<tr><td>15</td><td colspan="2">Shield</td></tr>
</table>

Base side
DSUB 25-pin connector
(XM2A–1501 made by OMRON)

<table>
<tr><th rowspan="2">Pin No.</th><th colspan="2">Signal name</th></tr>
<tr><th>Type-N</th><th>Type-P</th></tr>
<tr><td>1</td><td colspan="2">D-IN0</td></tr>
<tr><td>2</td><td colspan="2">D-IN1</td></tr>
<tr><td>3</td><td colspan="2">D-IN2</td></tr>
<tr><td>4</td><td colspan="2">D-IN3</td></tr>
<tr><td>5</td><td colspan="2">D-IN4</td></tr>
<tr><td>6</td><td colspan="2">D-IN5</td></tr>
<tr><td>7</td><td colspan="2">D-OUT0</td></tr>
<tr><td>8</td><td colspan="2">D-OUT1</td></tr>
<tr><td>9</td><td colspan="2">D-OUT2</td></tr>
<tr><td>10</td><td colspan="2">D-OUT3</td></tr>
<tr><td>11</td><td colspan="2">D-OUT4</td></tr>
<tr><td>12</td><td>P24V</td><td>P24G</td></tr>
<tr><td>13</td><td>P24V</td><td>P24G</td></tr>
<tr><td>14</td><td>P24G</td><td>P24V</td></tr>
<tr><td>15</td><td colspan="2">Shield</td></tr>
</table>

Fig. 4.2 Machine I/O harness wiring

b) Air piping for tool
A total of four (4) lines ($\phi 4 \times 2.5$) are provided for the tool air piping, which are shown in Fig. 4.3 to Fig. 4.5.
Pneumatic devices such as solenoid valve should be provided by the customer.

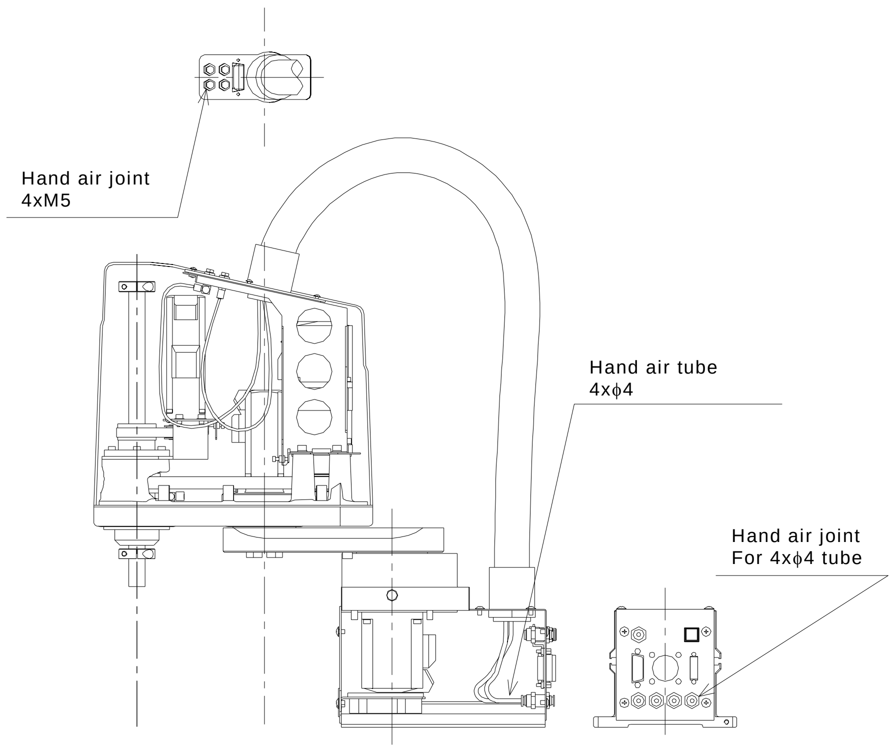


Fig. 4.3 Air piping for tool (TH250A, TH350A)

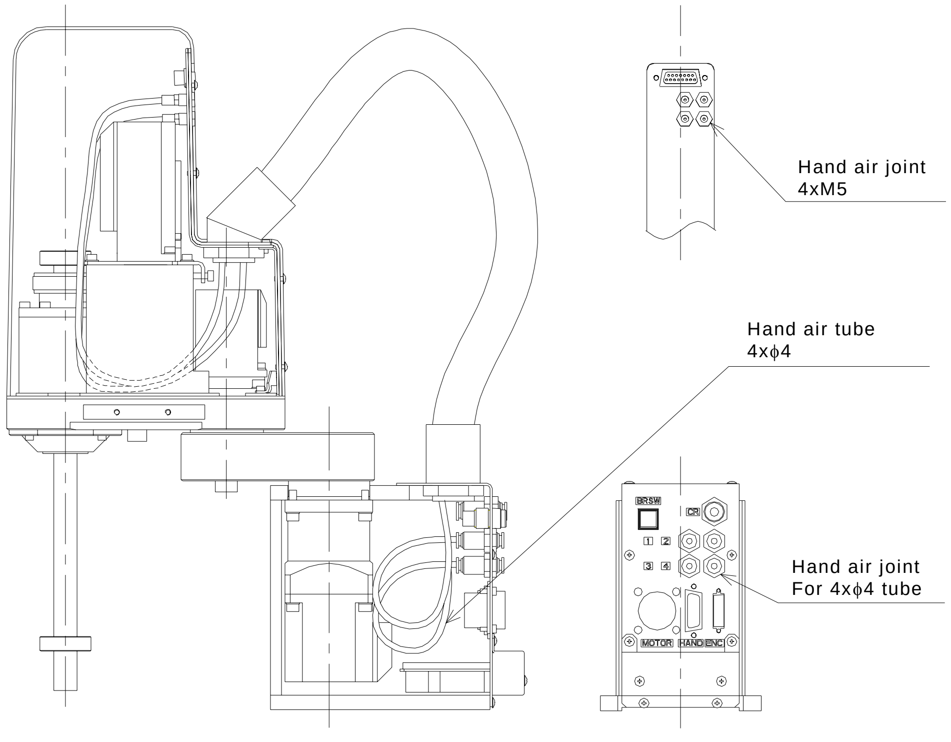


Fig. 4.4 Air piping for tool (TH180)

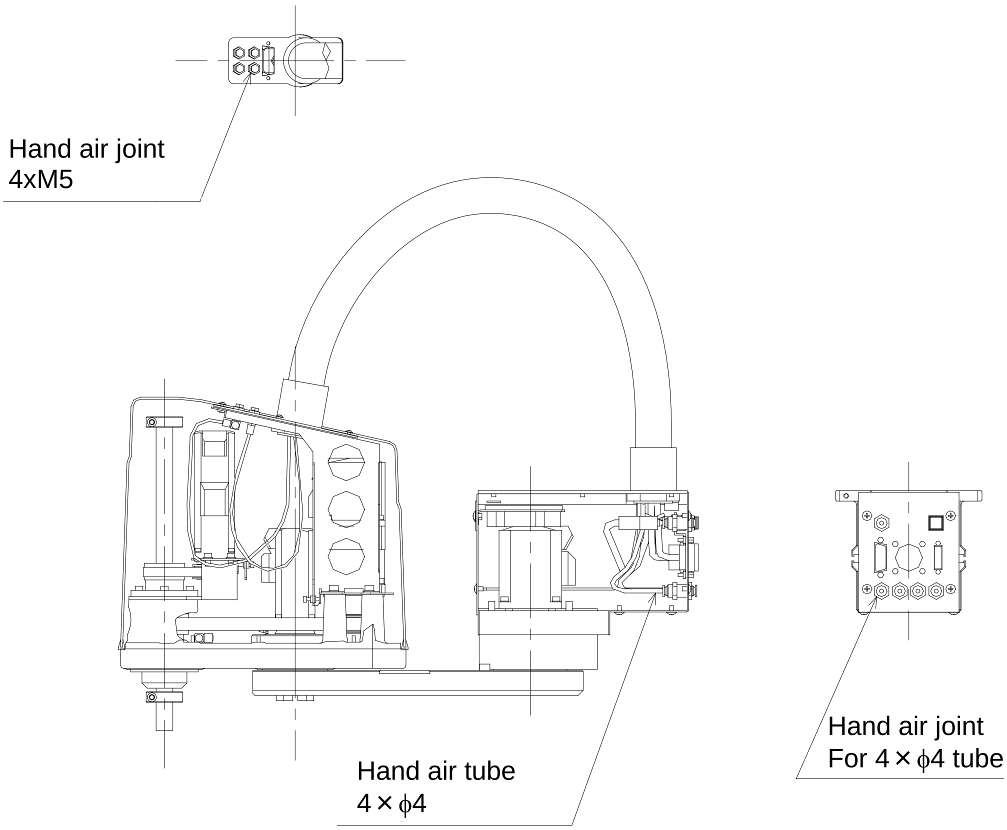


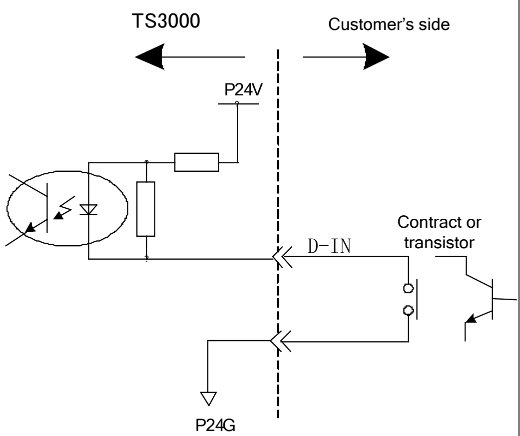
Fig. 4.5 Air piping for tool (TH350A−T)

4.2.1 Controller's Tool Signals

The controller is provided with tool signals (i.e., five (5) input signals for sensor, etc., four (4) control signals for solenoid valve, etc., DC 24V and DC 24 VGND signals), which can be connected also from the controller side. (A cable between the controller and cable is an option.) The relevant signals are described below.

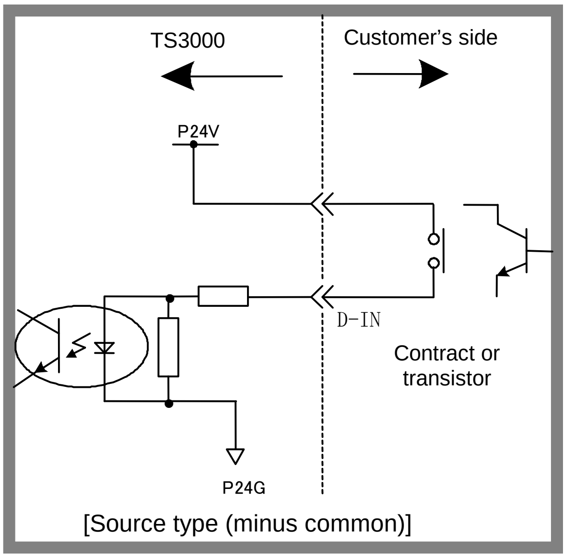
a) Input signal connector HAND (Type-N)

Table 4.1 Input signals

<table>
<tr><th>Pin</th><th colspan="2">Signal name</th><th>Signal No.</th><th>Input circuit and example of connections</th></tr>
<tr><td>1</td><td>D-IN0</td><td>Input signal 0</td><td>201</td><td rowspan="8">

[Source type (plus common)]</td></tr>
<tr><td>2</td><td>D-IN1</td><td>Input signal 1</td><td>202</td></tr>
<tr><td>3</td><td>D-IN2</td><td>Input signal 2</td><td>203</td></tr>
<tr><td>4</td><td>D-IN3</td><td>Input signal 3</td><td>204</td></tr>
<tr><td>5</td><td>D-IN4</td><td>Input signal 4</td><td>205</td></tr>
<tr><td>6</td><td>D-IN5</td><td>Input signal 5</td><td>206</td></tr>
<tr><td>7</td><td>D-IN6</td><td>Input signal 6</td><td>207</td></tr>
<tr><td>8</td><td>D-IN7</td><td>Input signal 7</td><td>208</td></tr>
<tr><td>19</td><td rowspan="2">P24G</td><td rowspan="2">0V</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>20</td></tr>
</table>

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

Pin	Signal name		Signal No.	Input circuit and example of connections
1	D-IN0	Input signal 0	201	 [Source type (minus common)]
2	D-IN1	Input signal 1	202	
3	D-IN2	Input signal 2	203	
4	D-IN3	Input signal 3	204	
5	D-IN4	Input signal 4	205	
6	D-IN5	Input signal 5	206	
7	D-IN6	Input signal 6	207	
8	D-IN7	Input signal 6	208	
19	P24V		DC24V power supply	
20				

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

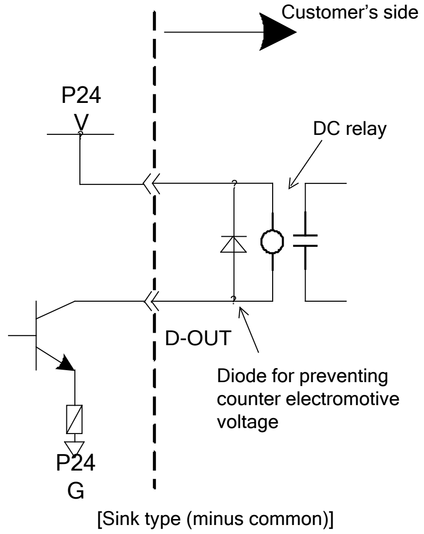
No-voltage contact specifications:

Contact rating: DC24 V, 10 mA or over (circuit current: approx. 7 mA)
Minimum contact current: DC24 V, 1 mA
Contact impedance: 100 Ω or less

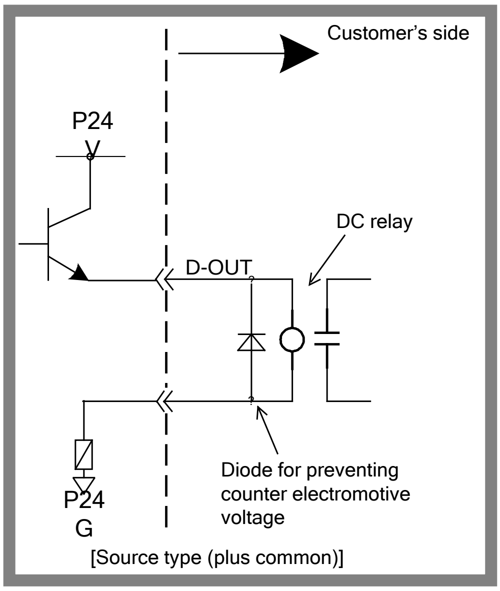
Transistor specifications:

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 (Type-N)

Pin	Signal name		Signal No.	Output circuit and example of connections
9	D-OUT0	Output signal 0	201	
10	D-OUT1	Output signal 1	202	
11	D-OUT2	Output signal 2	203	
12	D-OUT3	Output signal 3	204	
13	D-OUT4	Output signal 4	205	
14	D-OUT5	Output signal 5	206	
15	D-OUT6	Output signal 6	207	
16	D-OUT7	Output signal 7	208	
17	P24V		DC24V power	
18				

b-1) Output signal connector HAND (Type-P)

Pin	Signal name		Signal No.	Output circuit and example of connections
9	D-OUT0	Output signal 0	201	
10	D-OUT1	Output signal 1	202	
11	D-OUT2	Output signal 2	203	
12	D-OUT3	Output signal 3	204	
13	D-OUT4	Output signal 4	205	
14	D-OUT5	Output signal 5	206	
15	D-OUT6	Output signal 6	207	
16	D-OUT7	Output signal 7	208	
17	P24G	0V		
18				

By using the DC24 V 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 TS3000 robot controller. NEVER connect +24 V with P24 V. Otherwise, the power supply may be damaged.

Output specifications:

Rated voltage : DC24 V (P24V)
Rated current : 100mA

- When a relay or solenoid valve, etc., is connected, it is necessary to use a surge killer or diode to absorb the surge voltage.
- When a double solenoid is used, HO_1 and HO_2, and HO_3 and HO_4 are used as pairs.

4.3 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.

4.3.1 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. 4.6 and Fig. 4.7.
The load conditions permitted for the TH250A, TH350A, TH180 and TH350A- T robots are shown in Table 4.3.

Table 4.3 Permissible load conditions

Model	Conditions	Permissible values
TH250A TH350A TH350A- T	Load mass	Max. 3 kg
	Moment of inertia	Max. 0.0170 kg·m^2
	Gravity center offset of load	Max. 70 mm
TH180	Load mass	Max. 2 kg
	Moment of inertia	Max. 0.01 kg·m^2
	Gravity center offset of load	Max. 50 mm

CAUTION

- The robot life and safety cannot be guaranteed if the robot is operated under the load conditions exceeding the permissible values.

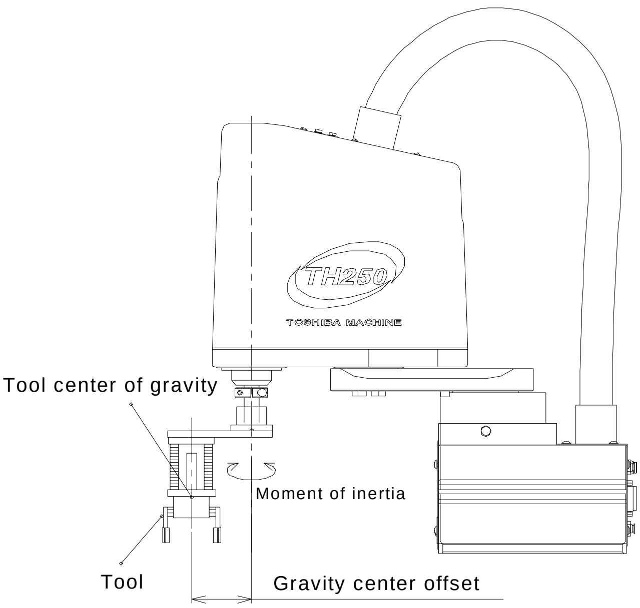


Fig. 4.6 Tool and robot body (Normal type)

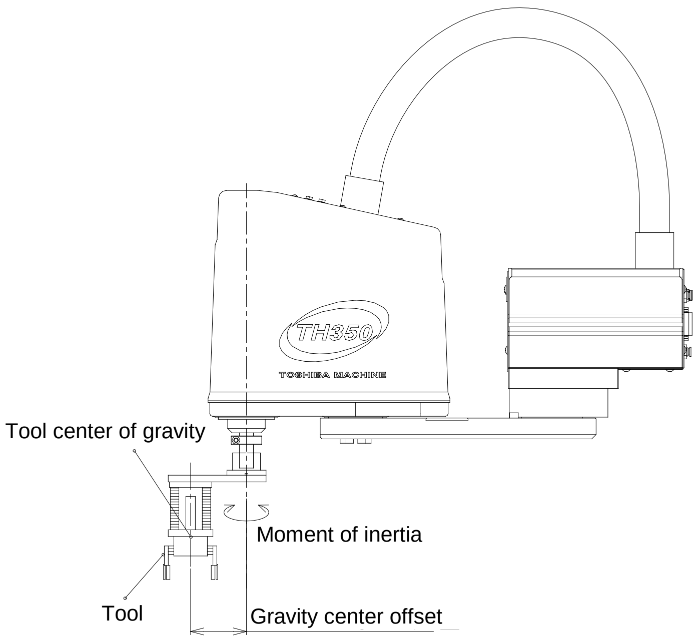


Fig. 4.7 Tool and robot body (Ceiling type)

4.3.2 Load Conditions and Program Setting

Even if the tool load conditions are within the permissible values listed in Table 4.3, acceleration and servo gain that are adequate for the load conditions should be set. If this setting is inadequate, the robot may vibrate or overshoot, resulting in reduction of the robot life.
The TH series can automatically change the acceleration and servo gain according to the load conditions by using the PAYLOAD command in the program. The specific method for using this function is explained below.

a) PAYLOAD command

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

PAYLOAD = {M, L}

M : Load mass (unit: kg)
L : Gravity center offset (unit: mm)

The PAYLOAD command has the following functions.

- The acceleration of each robot axis is 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) Example programs

The basic programs using the PAYLOAD command are exemplified below. For further information, see the Robot Language Manual.

(Example program 1)

The robot is moved under the load conditions of 2 kg mass and 30 mm gravity center offset.

```
PROGRAM SAMPLE
   SPEED= 100
   PAYLOAD={2,30}
   MOVE A
   MOVE B
   STOP
END
```

(Program example 2)

Let’s assume that the hand mass is 1 kg and gravity center offset is 30 mm, and that the mass is 3 kg and gravity center offset is 50 mm when the workpiece is grasped.

Pick-and-place operation is executed under these conditions.

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

c) Setting of PAYLOAD command

In the default state, or when the PAYLOAD command is not used, the acceleration is set to 100% and the servo gain is set to the value under the minimum load. (See Para. 4.3.3.)

⚠ CAUTION

Be sure to use the PAYLOAD command in the following occasions.

- When the load mass exceeds 1 kg.
- When there is a gravity center offset of load.

Unless the PAYLOAD command is used, the robot will vibrate or overshoot, resulting in shortening of the life of the mechanisms.

⚠ CAUTION

The moment of inertia of load should be within the tolerances given in Table 4.3. Even if there is no gravity center offset of load, the robot may vibrate if the moment of inertia is large. When this happens, figure out virtual gravity center offset L [mm] from the following equation, using the moment of inertia J [kg·m^2] and mass M [kg].

$$L = \sqrt{(J \times 10^6 / M)}$$

Then, designate the following.

PAYLOAD = {M, L}

⚠ CAUTION

When guiding manually, the robot may vibrate if the load mass or gravity center offset is large. This is because the servo gain is not appropriate. When this happens, perform the following operation while setting the load conditions in the TEACHING mode.

```
DO PAYLOAD = {5, 100}
[EXE]
```

Then, the servo gain is changed to the value which meets the load conditions.

If the robot still vibrates or overshoots after setting the above conditions, contact Toshiba Machine. Advise us of the then load conditions and program also.

4.3.3 Setting Robot Acceleration and Maximum Speed for Load Conditions

a) TH250A

Acceleration of the robot is automatically changed according to the load conditions when the PAYLOAD command is used.

The acceleration changes with the load mass, as shown in Fig. 4.8. The vertical line shows the acceleration. If the load mass is 3 kg, for instance, the acceleration of axes 1, 2, and 4 is 66 % of the maximum value.

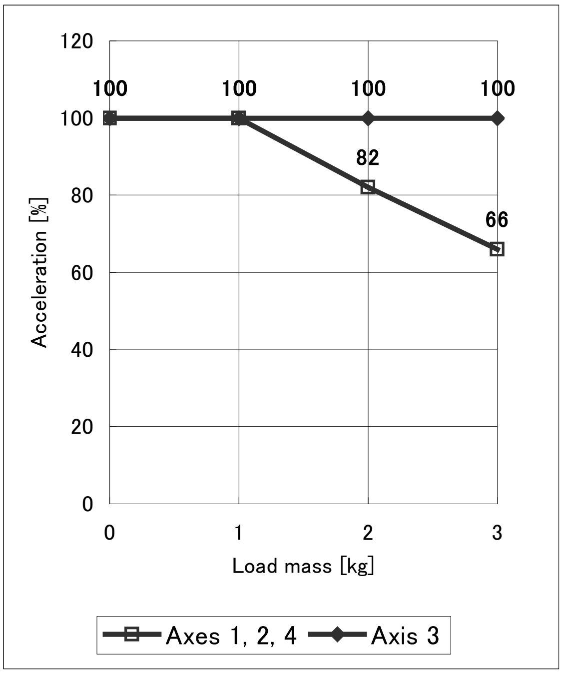


Fig. 4.8 Setting of acceleration for load mass (TH250A)

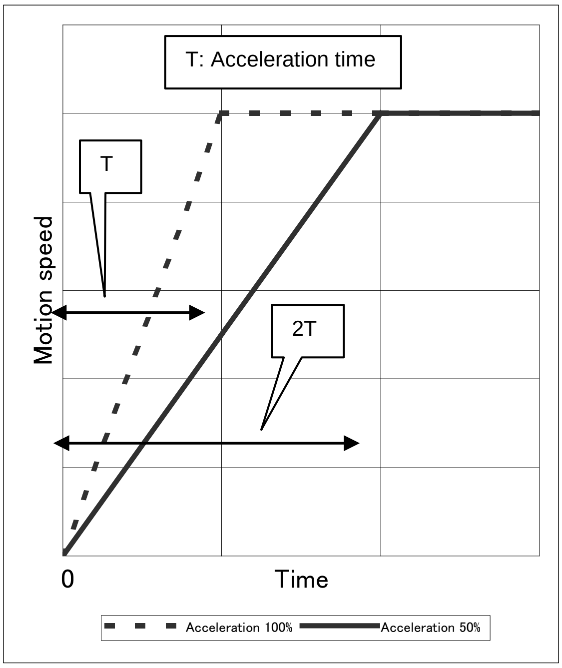
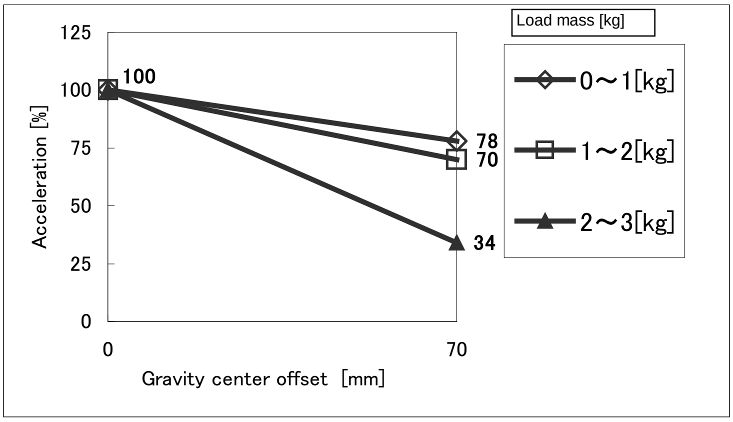
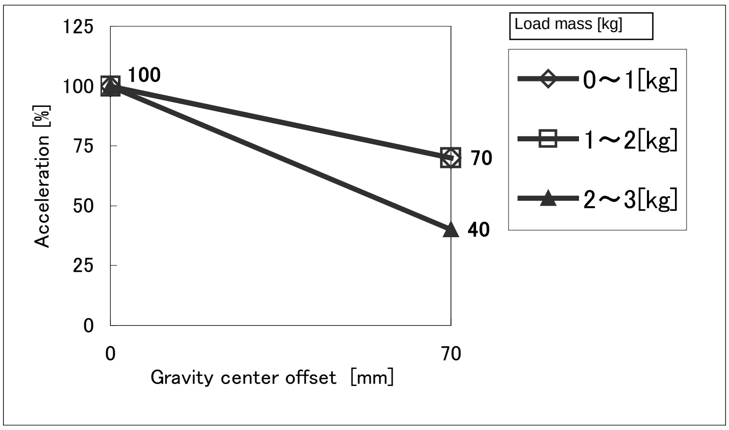


Fig. 4.9 Acceleration changes

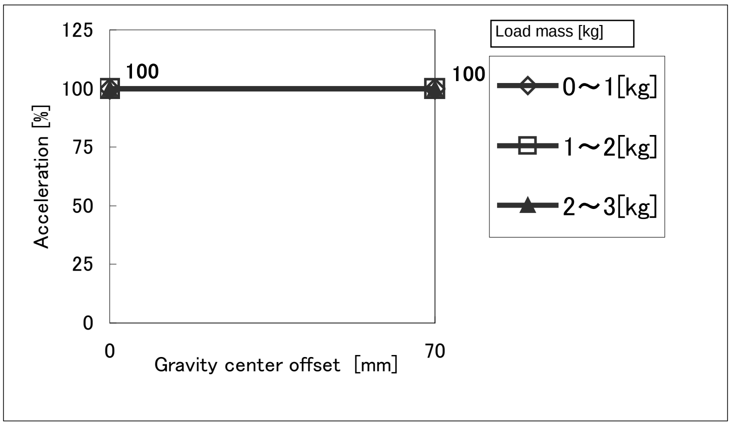
Additionally, if there is a gravity center offset of load, the acceleration and maximum speed change as shown in Fig. 4.10 and Fig. 4.11, respectively. If the load mass is 3 kg and gravity center offset is 70 mm, for instance, the acceleration of axes 1 and 2 is 22 % (= 66 % × 34 %) and the maximum speed of axes 1, 2 and 4 is 100 %.



(a) Axes 1 and 2

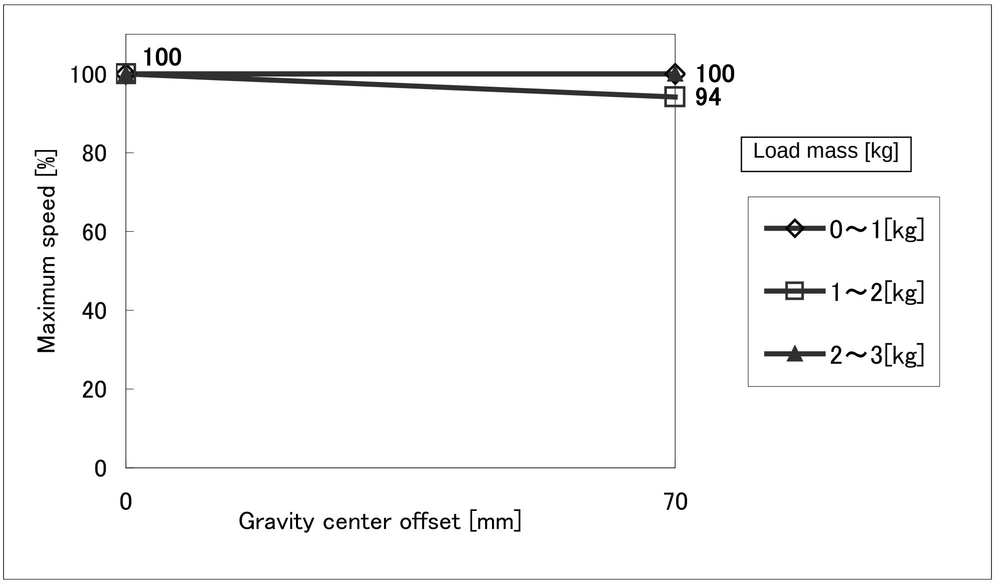


(b) Axis 4

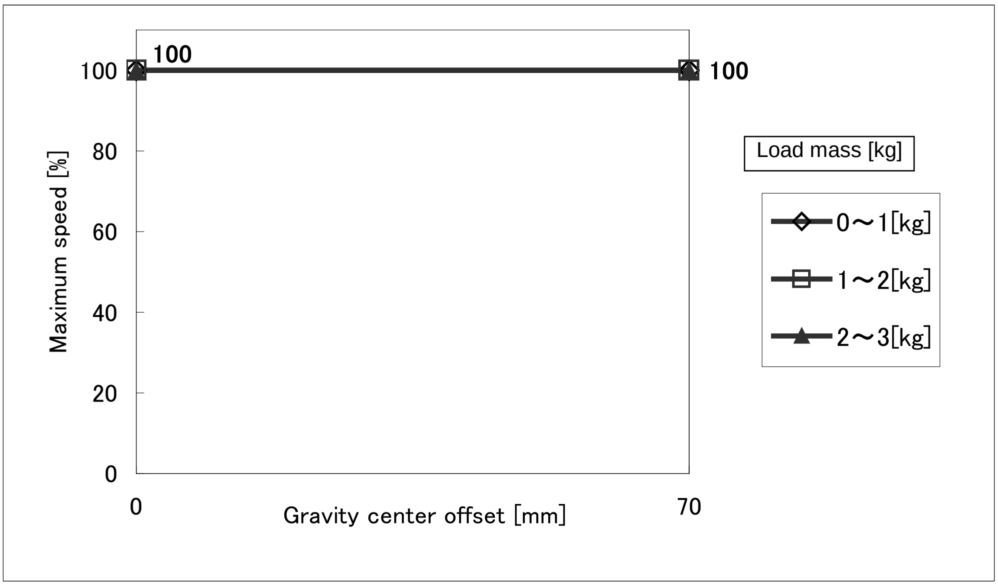


(c) Axis 3

Fig. 4.10 Setting of acceleration for gravity center offset (TH250A)



(a) Axes 1, 2, 4



(b) Axis 3

Fig. 4.11 Setting of maximum speed for gravity center offset (TH250A)

b) TH350A

Acceleration of the robot is automatically changed according to the load conditions when the PAYLOAD command is used.

The acceleration changes with the load mass, as shown in Fig. 4.12. The vertical line shows the acceleration. If the load mass is 3 kg, for instance, the acceleration of axes 1, 2 and 4 is 70 %.

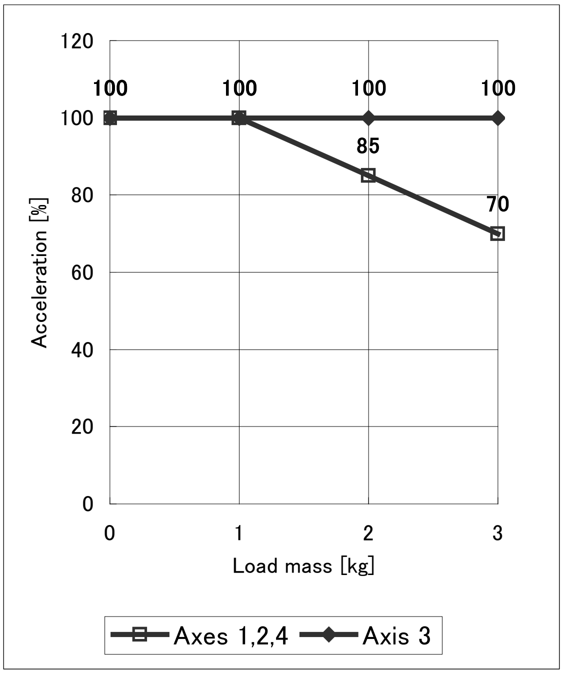
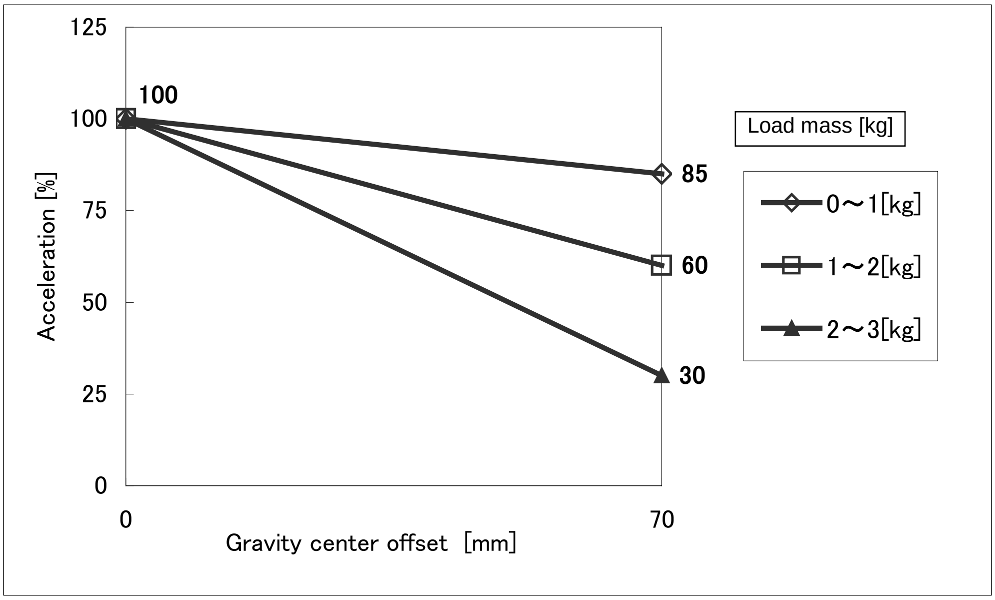


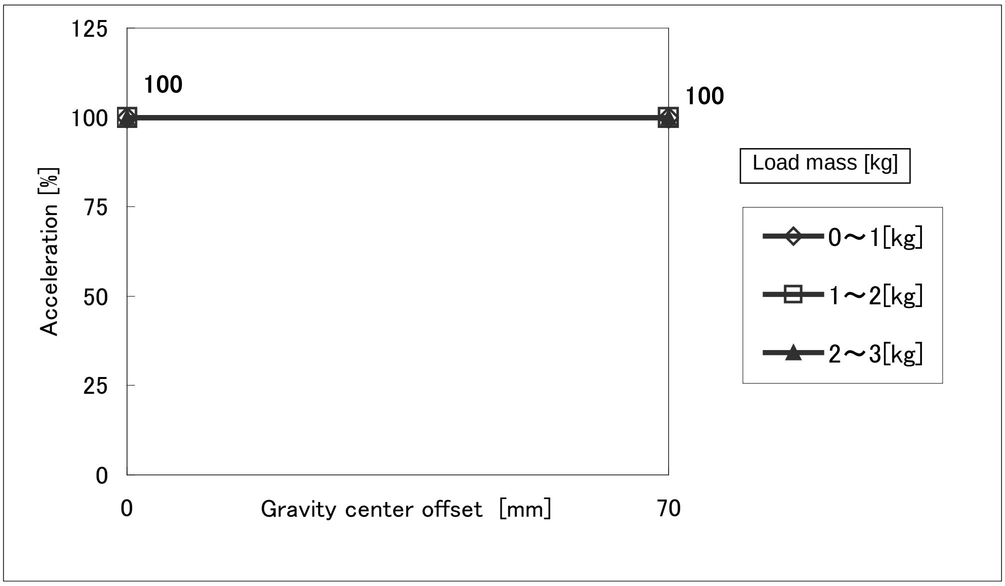
Fig. 4.12 Setting of acceleration for load mass (TH350A)

Additionally, if there is a gravity center offset of load, the acceleration changes as shown in Fig. 4.13.

If the load mass is 3 kg and gravity center offset is 70 mm, for instance, the acceleration of axes 1, 2 and 4 is 21 % (= 70 % × 30 %).



(a) Axes 1, 2, and 4



(b) Axis 3

Fig. 4.13 Setting of acceleration for gravity center offset (TH350A)

c) TH180

Acceleration of the robot is automatically changed according to the load conditions when the PAYLOAD command is used.

The acceleration changes with the load mass, as shown in Fig. 4.14. The vertical line shows the acceleration. If the load mass is 2 kg, for instance, the acceleration of axes 1 and 2 is 79 %.

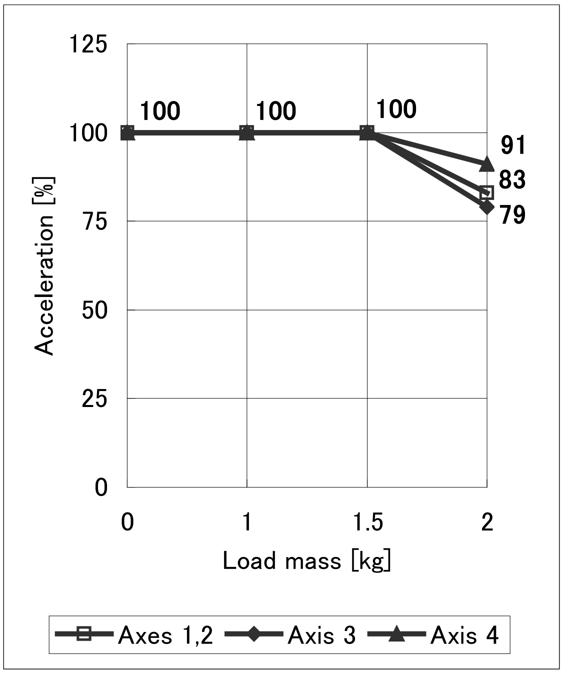
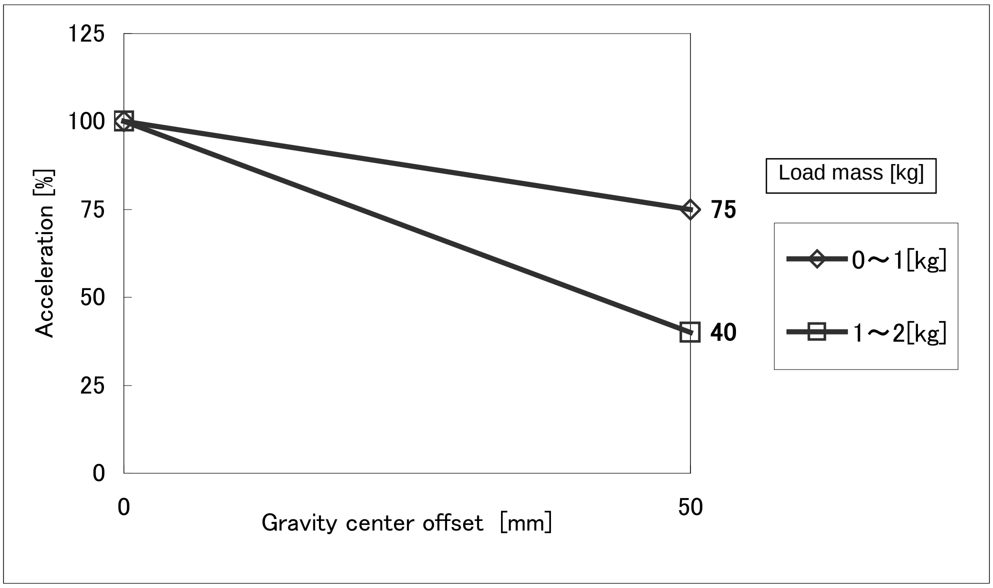


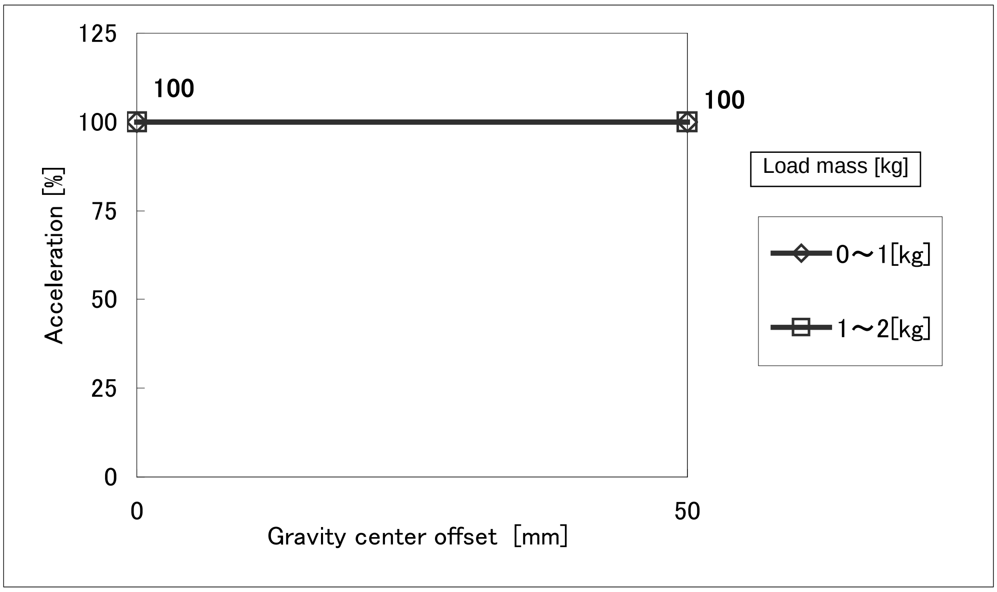
Fig. 4.14 Setting of acceleration for load mass (TH180)

Additionally, if there is a gravity center offset of load, the acceleration changes as shown in Fig. 4.15.

If the load mass is 2 kg and gravity center offset is 50 mm, for instance, the acceleration is 31 % (= 79 % × 40 %).



(a) Axes 1, 2, and 4



(b) Axis 3

Fig. 4.15 Setting of acceleration for gravity center offset (TH180)

d) TH350A- T

Acceleration of the robot is automatically changed according to the load conditions when the PAYLOAD command is used.

The acceleration changes with the load mass, as shown in Fig. 4.16. The vertical line shows the acceleration. If the load mass is 3 kg, for instance, the acceleration of axes 1, 2 and 4 is 70 %.

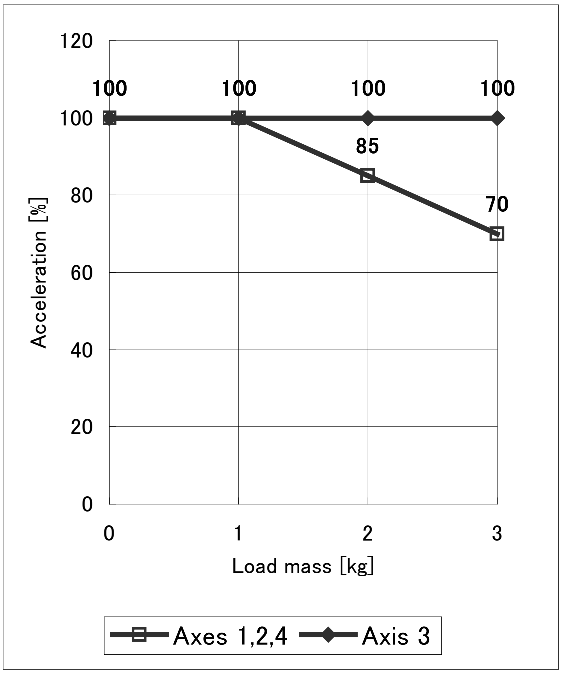
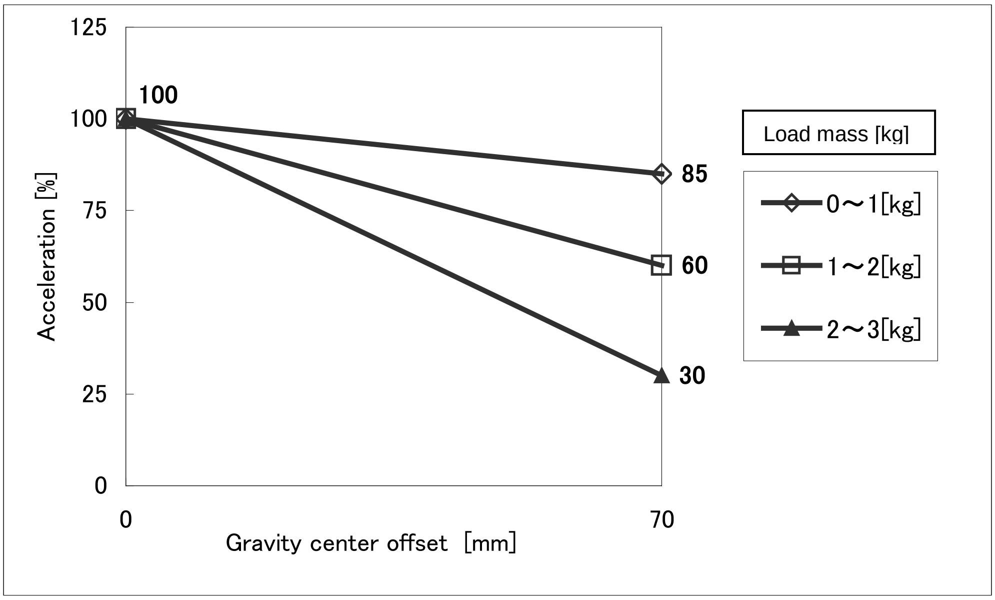


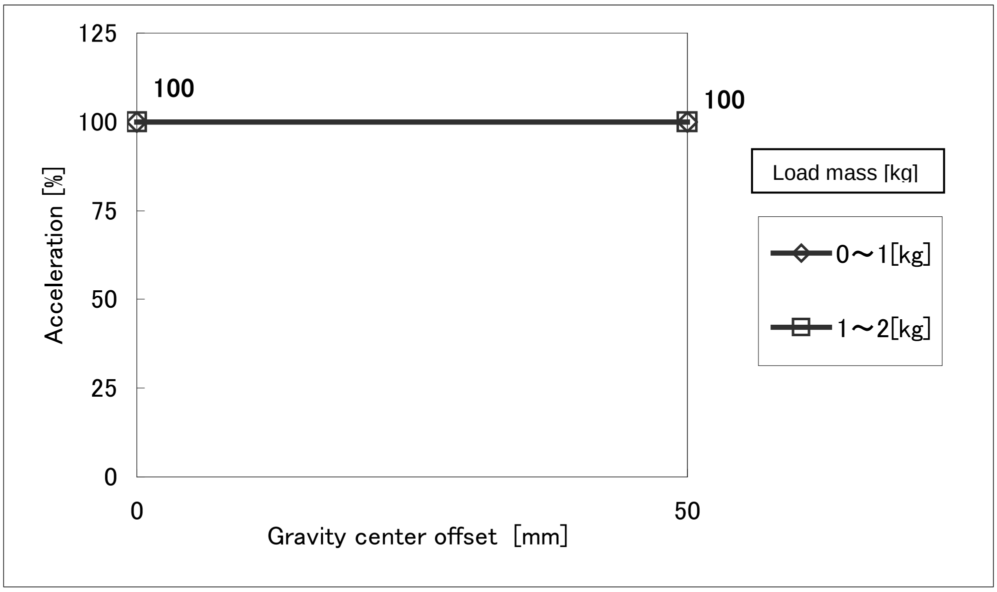
Fig. 4.16 Setting of acceleration for load mass (TH350A)

Additionally, if there is a gravity center offset of load, the acceleration changes as shown in Fig. 4.17.

If the load mass is 3 kg and gravity center offset is 70 mm, for instance, the acceleration of axes 1, 2 and 4 is 21 % (= 70 % $\times$ 30 %).



(a) Axes 1, 2, and 4



(b) Axis 3

Fig. 4.17 Setting of acceleration for gravity center offset (TH350A- T)

Section 5 Specifications

5.1 Specifications Table

Item		Specifications
Structure		Horizontal multi-joint type SCARA robot
Model		TH180
Applicable controller		TS3000
Mass of actuator		9 kg
No. of controlled axes		Four (4)
Arm length		180 mm (70 mm + 110 mm)
Motor capacity	Axis 1	100 (W)
	Axis 2	50 (W)
	Axis 3	50 (W)
	Axis 4	50 (W)
Operating range	Axis 1	±120 (deg)
	Axis 2	±140 (deg)
	Axis 3	120 (mm)
	Axis 4	±360 (deg)
Maximum speed (*1)	Axis 1	533 (deg/s)
	Axis 2	480 (deg/s)
	Axis 3	1013 (mm/s)
	Axis 4	1186 (deg/s)
	Composite speed of axes 1 and 2	2.6 (m/s)
Rated payload mass		1 (kg)
Maximum payload mass		2 (kg)
Permissible load inertia (*1)		0.01 ($kg{\cdot}m^2$)
Repeatability	X, Y	±0.01 (mm)
	Z	±0.01 (mm)
	C	±0.005 (deg)
Cycle time (*2) (When payload mass is 1 kg)		0.35 (sec)
Drive system		By means of AC servo motors
Position detection method		Absolute

*1: There are restrictions on speed and acceleration speed depending on the operation pattern, load mass and offset amount.

*2: This is unidirectional position repeatability when the ambient temperature is constant at 20°C. It is not absolute positioning accuracy.

*3: The standard cycle operation pattern cannot achieve continuous operation exceeding the effective load rate.
With horizontal direction 300mm, vertical direction 25mm round-trip, and rough positioning.

*4: The tone of the paint color may be different among production lots. It does not affect the product quality, however.

⚠ CAUTION

Put the Z-axis (axis 3) in the raised position as much as possible, when moving Axes 1, 2, and 4.

Moving Axis 1, 2, or 4 when the Z-axis is in low positions can lead to premature damage to the ball screw spline (Z-axis shaft).

If Axis 1, 2, or 4 must be moved while the Z-axis is in low positions due to unavoidable circumstances, prevent the ball screw spline vibrations by using the SPEED, ACCEL/DECEL, and PAYLOAD commands to adjust the operation speed and acceleration.

If Axis 1, 2, or 4 is moved while the Z-axis is in low positions, be extremely careful not to collide with any objects. Even if Axis 1, 2, or 4 is moved at low speed, a collision or other impact with an object can damage the ball screw spline (Z-axis shaft) before alarm occurs.

Item		Specifications	
Structure		Horizontal multi-joint type SCARA robot	
Model		TH250A	TH350A
Applicable controller		TS3000	
Mass of actuator		14 kg	
No. of controlled axes		Four (4)	
Arm length		250 mm (125 mm + 125 mm)	350 mm (225 mm + 125 mm)
Motor capacity	Axis 1	200 (W)	
	Axis 2	100 (W)	
	Axis 3	100 (W)	
	Axis 4	100 (W)	
Operating range	Axis 1	±115 (deg)	
	Axis 2	±140 (deg)	
	Axis 3	120 (mm)	
	Axis 4	±360 (deg)	
Maximum speed (*1)	Axis 1	540 (deg/s)	337.5 (deg/s)
	Axis 2	500 (deg/s)	
	Axis 3	1120 (mm/s)	
	Axis 4	1143 (deg/s)	
	Composite speed of axes 1 and 2	3.53 (m/s)	3.24 (m/s)
Rated payload mass		1 (kg)	
Maximum payload mass		3 (kg)	
Permissible load inertia (*1)		0.017 (kg·m^2)	
Repeatability	X, Y	±0.01 (mm)	
	Z	±0.01 (mm)	
	C	±0.03 (deg)	
Cycle time (*2) (When payload mass is 2 kg)		0.41 (sec)	
Drive system		By means of AC servo motors	
Position detection method		Absolute	

*1: There are restrictions on speed and acceleration speed depending on the operation pattern, load mass and offset amount.
*2: This is unidirectional position repeatability when the ambient temperature is constant at 20°C. It is not absolute positioning accuracy.
*3: The standard cycle operation pattern cannot achieve continuous operation exceeding the effective load rate.
With horizontal direction 300mm, vertical direction 25mm round-trip, and rough positioning.

*4: The tone of the paint color may be different among production lots. It does not affect the product quality, however.

⚠ CAUTION

Put the Z-axis (axis 3) in the raised position as much as possible, when moving Axes 1, 2, and 4.

Moving Axis 1, 2, or 4 when the Z-axis is in low positions can lead to premature damage to the ball screw spline (Z-axis shaft).

If Axis 1, 2, or 4 must be moved while the Z-axis is in low positions due to unavoidable circumstances, prevent the ball screw spline vibrations by using the SPEED, ACCEL/DECEL, and PAYLOAD commands to adjust the operation speed and acceleration.

If Axis 1, 2, or 4 is moved while the Z-axis is in low positions, be extremely careful not to collide with any objects. Even if Axis 1, 2, or 4 is moved at low speed, a collision or other impact with an object can damage the ball screw spline (Z-axis shaft) before alarm occurs.