TH180
TH250A
TH350A／TS3000
Industrial Robot

MAINTENANCE 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.

September 2012

TOSHIBA MACHINE CO., LTD.

NUMAZU, JAPAN

WARRANTY

This machine is delivered to each customer only after it is inspected very carefully to make sure that it satisfies the Toshiba Machine's standard.   Should it cause an inconvenience, we will guarantee as described below.

1. Warranty period
    Toshiba Machine agrees to repair or replace as necessary all defective material or workmanship up to the period shown below, whichever comes first.

    1) Eighteen (18) months from the date of dispatch from our plant.
    2) Twelve (12) months from the date of machine installation at customer's job site.
    3) 2,400 running hours from the date of initial machine operation.

2. Contents of warranty

    1) Only the product delivered to the customer is subject to Toshiba Machine's Guarantee.   Such Guarantee covers the specifications and functions as defined in the product specifications manual, catalog, instruction manual, etc.   In no event does the Guarantee cover any secondary or associated damage caused by malfunction of the delivered product.

    2) Toshiba Machine repairs the product free of charge only when it malfunctioned after handling or use according to the instruction manual attached to the product within the specified warranty period.

3. Exemption from responsibility
    Toshiba Machine's Guarantee shall not cover the following cases.

    1) Incorrect use not described in the instruction manual, and trouble or damage caused by negligent use.

    2) Inconvenience caused by aged deterioration or long-term usage (natural fading of coating or painting, deterioration of consumable parts [*1], etc.).

    3) Inconvenience caused by sensuous phenomena (noise generation, etc. which will not affect the function).

    4) Remodeling or disassembly which Toshiba Machine will not permit.

    5) Trouble and damage caused by insufficient maintenance/inspection or improper repair.

6) Trouble and damage caused by disaster, fire or other external factor.

7) Internal data such as program and point which were created by the customer.

8) When the robot purchased in Japan was shipped overseas.

4. Precautions

1) Unless the robot was used pursuant to its specifications, Toshiba Machine will not guarantee the basic performance of the robot.

2) If the customer did not observe the warnings and cautions described in this manual, Toshiba Machine will not assume the responsibility for any consequential accident resulting in injury or death, damage or trouble.

3) Please note that the warnings, cautions and other descriptions stipulated in this manual are only those which can be assumed by Toshiba Machine as of now.

(*1) The consumable parts signify the replacement parts for maintenance as listed in Section 4 of this manual.

INTRODUCTION

This manual describes the maintenance of the TH series industrial robots and controller.

The maintenance and inspection are essential to maintain the robot performance for long years to prevent a trouble and improve the safe work.
Before starting an actual operation, it is strongly recommended to read through this manual and draw up a maintenance schedule.

This maintenance manual consists of the following four (4) sections.

Section 1   Maintenance Items

        This section describes a maintenace schedule of the robot and controller and necessary maintenance and inspection items.

Section 2   Maintenance of the Robot

        This section describes the robot mechanism and items required for inspection.

Section 3   Maintenance of Controller

        This section describes the robot mechanism and maintenance and inspection methods.

Section 4   Maintenance Replacement Parts

        This section describes the maintenance replacement parts of the robot and the robot controller.

CAUTIONS ON SAFETY

This manual contains the important information on the robot and controller to prevent injury to the operators and persons nearby, to prevent damage to assets and to assure 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 imminently lead to fatalities or serious injuries."
⚠ **WARNING**	This means that "incorrect handling may 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 medical treatment.

*2)   Physical damage refers to damages 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). 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). Details of the actions that must be done are indicated with pictures or words in or near the symbol.
⚠	This means danger or caution. Details of the actual danger or caution are indicated with pictures or words in or near the symbol.

<table>
<tr><td colspan="2" align="center">⚠ **CAUTION**</td></tr>
<tr><td>•</td><td>Before carrying out the actual operation, read through "Safety Measures" of the separate Instruction Manual in order to safely run the workflow from installation to transportation of the robot.</td></tr>
</table>

[Maintenance and inspection]

Be sure to observe the following items to use the robot safely.

⚠ DANGER	
Prohibited	• DO NOT incinerate, disassemble or charge the batteries. Otherwise, they may rupture.
Mandatory	• Be sure to turn off the main power switch of the controller before starting inspection or maintenance. • Batteries should be disposed of according to the user's in-house regulations.

| ⚠ CAUTION	
Disassembly prohibited	• The user must NEVER replace or modify parts other than those described in the instruction manual. Otherwise, the performance may deteriorate or faults or accidents will be caused.
Mandatory	• Always use the Toshiba Machine's designated spare parts when replacing the parts. • Maintenance and inspection should be performed regularly. Otherwise, the system may malfunction or accidents will be caused.

Table of Contents

Section 1   Maintenance Items

1.1   Maintenance Schedule

Maintenance comes in the two (2) types; daily inspection, and regular inspection and maintenance.   For the regular inspection and maintenance, inspection items are added every 1,200 running hours.
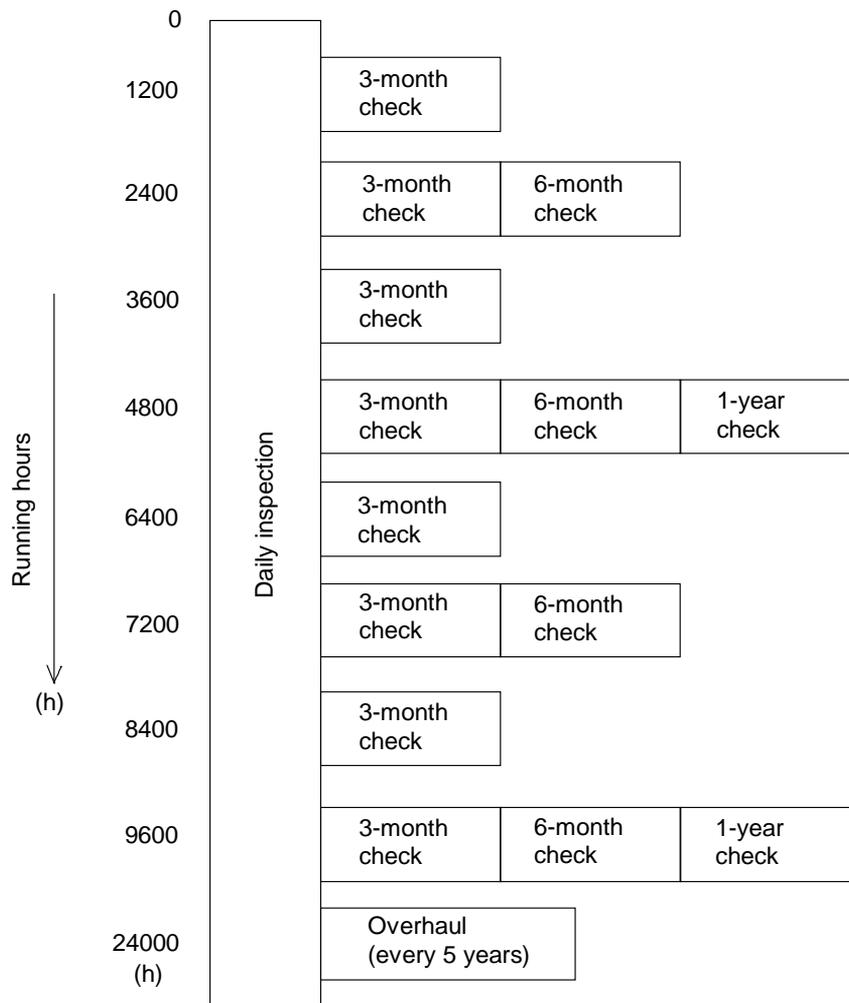
Inspection schedule

- When the system is operated for 16 hours per day:
  16 hours × 25 days × 3 months = 1,200 hours

- When the system is operated for 24 hours per day:
  24 hours × 25 days × 3 months = 1,800 hours

1.2   Items for Maintenance and Inspection

This section describes the items for maintenance and inspection.
For the executing procedures, see the relevant paragraph listed in the table below.

a)   Daily inspection

No.	Item	Inspection procedures	Relevant Para.
1	Cable ducts	(1) Make sure that any cable duct will not twist, bend or crack locally at the time of robot motion. (2) Make sure that all connectors of the cable ducts are tightened completely.	2.3.1
2	Hand set flange	Make sure that the hand set flange bolts are tightened completely.	2.3.2
	Robot installation bolts	Make sure that the robot base installation bolts are tightened completely.	
3	Vibration and noise	Make sure that each axis can move smoothly.	
4	Change in positioning accuracy	Make sure that the robot can stop at a predetermined position accurately.	
5	Air leakage (When air piping is used)	Make sure that the air will not leak from the robot interior or air joints.	2.3.3
6	Controller vent holes	(1) Make sure that no obstacle stands in front of the vent holes. (2) Make sure that no contaminant is left in the vent hole.	3.3.1
7	Function of safety devices	Make sure that each safety device connected to the emergency stop pushbutton switch and external operation input signal can function properly.	3.3.2

b)   Quarterly (every three (3)-month) inspection

No.	Item	Inspection procedures	Relevant Para.
1	Lubricated state of ball screw spline	Make sure that the ball screw spline (or tool shaft) is greased completely and that no rust is developed on it.	2.3.4

c)   Semi-annual (every six (6)-month) inspection

No.	Item	Inspection procedures	Relevant Para.
1	Greasing of ball screw spline	Apply the grease to the ball screw spline.	2.3.4
2	Each axis drive system	Move each axis by hand and make sure that it moves smoothly.	2.3.5
3	Timing belts	(1) Make sure that each timing belt is not worn off or cracked. (2) Check each timing belt for tension.	2.3.6

d)   Annual (every year) inspection

No.	Item	Inspection procedures	Relevant Para.
1	Lubrication of ball screw	Fill grease to the ball screw spline.	2.3.4
2	Lubrication of reduction gears	Fill grease to the reduction gears from the grease nipples.	2.3.7
3	Wiring and piping	Make sure that all cables and air tubes are in the good state.	
4	Replacement of position detector batteries (Be sure to replace the batteries every year.)	Replace the position detector backup batteries (housed in the robot base unit). If the running time is long, battery consumption is small. If the power OFF time is long, the consumption is large. If the battery voltage drops, a battery alarm occurs. Then replace the batteries immediately.	2.3.8

e)   Overhaul (every five (5) years)

No.	Item	Inspection procedures	Relevant Para.
1	Inspection of consumable parts	Inspect the flexible cables, reduction gears, ball screw splines, timing belts and motors, then replace them when necessary.	
2	Battery replacement (Replace the battery every five (5) years.)	Replace the RAM (controller) backup battery. If the running time is long, battery consumption is small. If the power OFF time is long, the consumption is large. If the battery voltage drops, the battery alarm message saying "1–145 MAIN Battery alarm" is displayed. Then replace the battery immediately.	3.3.3
3	Replacement of switching power supply unit (Replace the battery every five (5) years.)	As the switching power supply unit uses an aluminum electrolytic condenser, its life is limited. Replace the switching power supply unit (DC5 V, DC24 V) for preventive maintenance. The life of the switching power supply unit differs with load current, running hours and ambient temperature. If the load current is large, the running time is long or the ambient temperature is high, the life becomes short.	3.3.4

1.3   Maintenance Tools

We recommend to use the following tools for maintaining the robot and controller.

- Phillips screwdrivers
- Hexagonal wrench set: M3 ~ M8
- Assembly wrench set
- Water pump pliers
- Nippers
- Grease guns

1.4   Maintenance Contract and Repair

1.4.1 Maintenance Contract

With the exception of greasing and lubrication, we recommend that the user conclude with us an after-sale service contract on the inspection items for maintenance and inspection to be done semi-annually and after.

1.4.2 Repair

If a fault has occurred or if repair is necessary, turn off the controller power and contact the Toshiba Machine Service Department.   At this time, advise us of the details of the fault and the following information stated on the robot and controller.

- Robot model
- Manufacture number
- Date of manufacture
- Operating time

1.4.3 Modification

This robot and controller MUST NOT be modified without the consent from Toshiba Machine.

⚠ **CAUTION**

- The user must NEVER replace or modify parts other than those described in the instruction manual.   Otherwise, the performance may deteriorate or faults or accidents will be caused.

Section 2   Maintenance of the Robot

2.1   Cautions on Maintenance and Inspection

When performing inspection or maintenance of the robot, strictly observe the following precautions to protect yourself and coworkers.

⚠ **DANGER**

• Be sure to turn off the main power switch of the controller before approaching the robot for maintenance and inspection.

2.2   Layout of Robot Components and Drive Mechanism

The layout of the robot mechanical components is shown in Fig. 2.1 and Fig. 2.2.
The drive mechanism of each axis is described below.

a)   Axis 1
     The output of axis 1 AC servo motor is input to the reduction gear.   The output of the same gears directly controls the arm 1 motion.

b)   Axis 2
     The output of axis 2 AC servo motor is input to the reduction gear.   The output of the same gear directly controls the arm 2 motion.

c)   Axis 3
     The output of axis 3 AC servo motor is input to the ball screw nut through the timing belt to move the ball screw spline up and down.

d)   Axis 4
     The rotation of axis 4 AC servo motor is input to the reduction gear and the output of axis 4 AC servo motor is input to the ball spline nut through the timing belt to revolve the ball screw spline shaft.
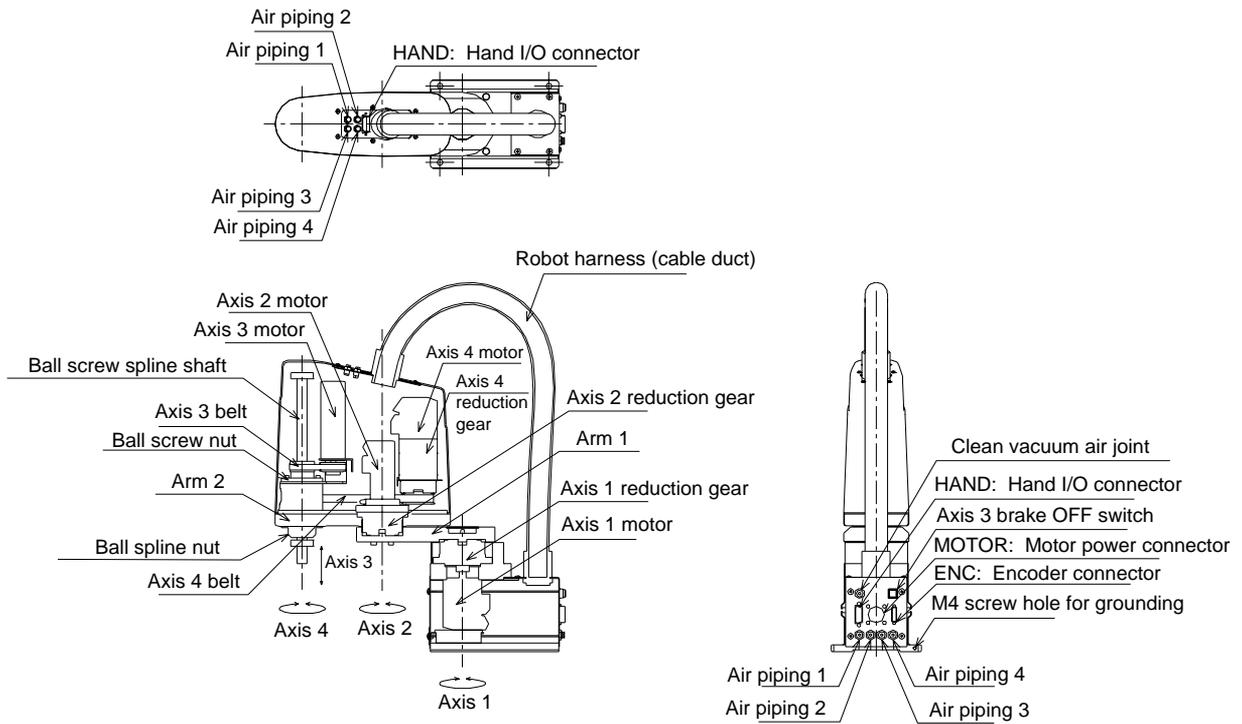
Fig. 2.1   Layout of robot mechanical components (TH250A, TH350A)
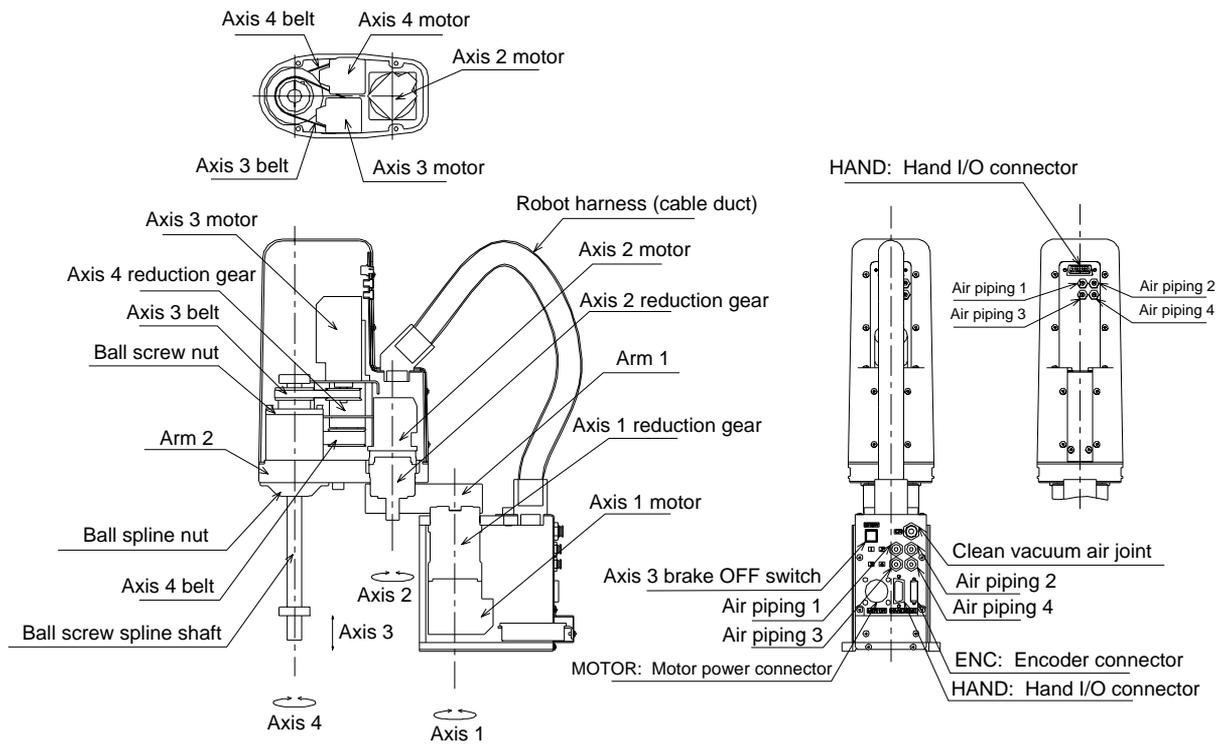
Fig. 2.2   Layout of robot mechanical components (TH180)

Air piping 2
Air piping 1
HAND: Hand I/O connector
Air piping 3
Air piping 4

Robot harness
(cable duct)

Axis 2 motor
Axis 3 motor
Axis 4 motor
Ball screw spline shaft
Axis 3 belt
Ball screw nut
Arm 2
Ball spline nut
Axis 1 motor
Axis 1 reduction gear
Arm 1
Axis 2 reduction gear

Clean vacuum air joint
HAND: Hand I/O connector
Axis 3 brake OFF switch
MOTOR: Motor power connector
ENC: Encoder connector
M4 screw
hole for GND
Air piping 1
Air piping 2
Air piping 4
Air piping 3

Fig. 2.3 Layout of robot mechanical components (TH350A-T)

2.3   Robot Maintenance Procedures

2.3.1   Check of Cable Duct for Abnormality

a)   Visually check to see that the cable duct is not locally twisted, bent or cracked when the robot moves.   If there is any abnormality, replace the cable to prevent breakage of the cable wire, etc.

b)   The connectors securing the cable duct are secured by tightening it to the plate with a hexagon nut.   If the hexagon nut is loosened, tighten it with a pair of water pump pliers, etc.
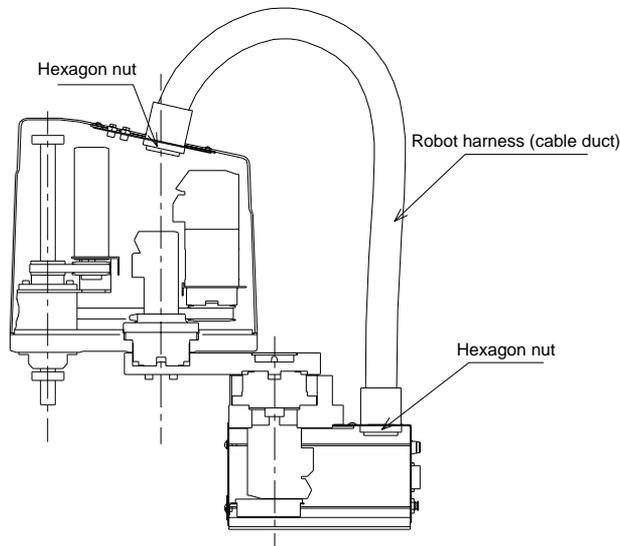
Fig. 2.4   Cable duct layout (TH250A, TH350A)
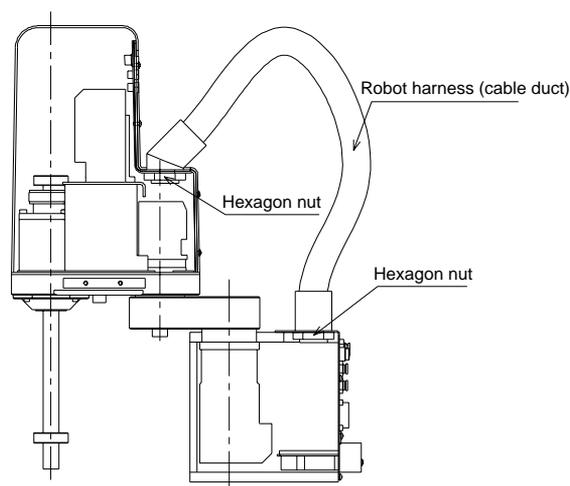
Fig. 2.5   Cable duct layout (TH180)
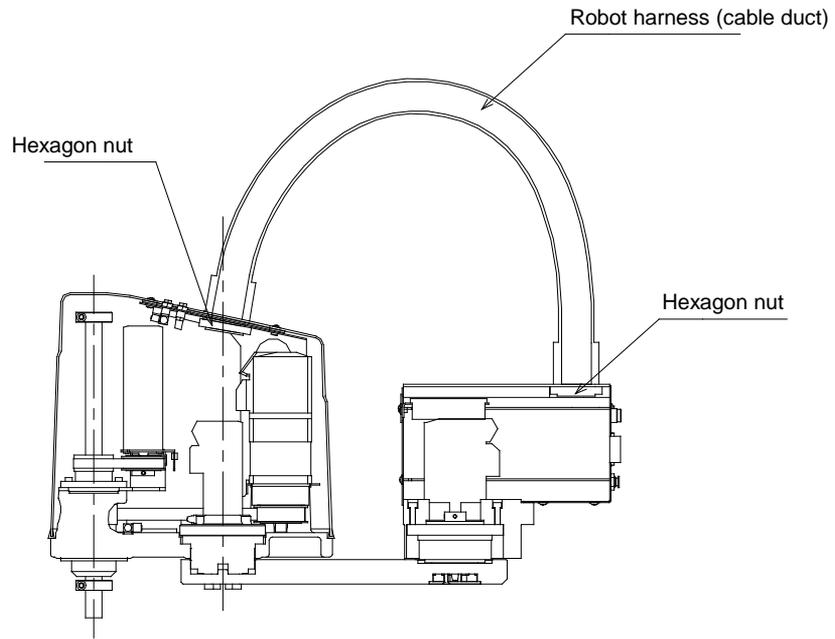
Fig. 2.6   Cable duct layout (TH350A-T)

2.3.2 Check of Hand and Base for Mounting

> ⚠ **DANGER**
>
> • Completely tighten the hand clamp bolt.   Otherwise, the hand may drop or shift from a predetermined position.

a) Check of hand set flange (option) for looseness

Make sure, using a hexagonal wrench key, that the hexagon socket head cap screw of the hand set flange that is tightened to the ball screw spline is not loosened.   Otherwise, tighten it.

Also make sure by means of a hexagonal wrench key that the hexagon socket head cap screw securing the hand set flange and hand is not loosened. Otherwise, tighten it.

Hexagon socket head cap screw
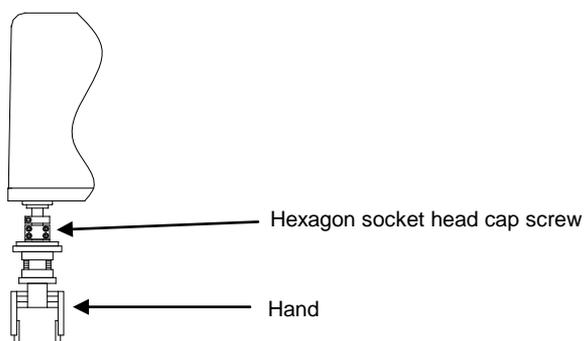
Hand

Fig. 2.7   Hand set area

b) Check of basic robot installation bolts

Make sure, using a hexagonal wrench key, that the installation bolts of the robot base are not loosened.   Otherwise, tighten them.

Installation bolt position

Installation bolt position

Installation bolt position

Installation bolt position
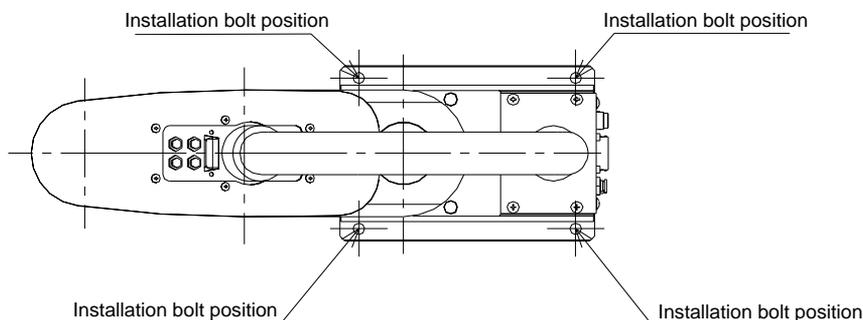
Fig. 2.8   Installation bolt positions

2.3.3 Check of Air Leakage

Piping connections in the robot are shown in Figs. 2.9 to 2.11.   Make sure that no air leaks from the robot interior or air joints.

> ⚠ **DANGER**
>
> • Be sure to turn off the main power switch of the controller before approaching the robot for maintenance and inspection.
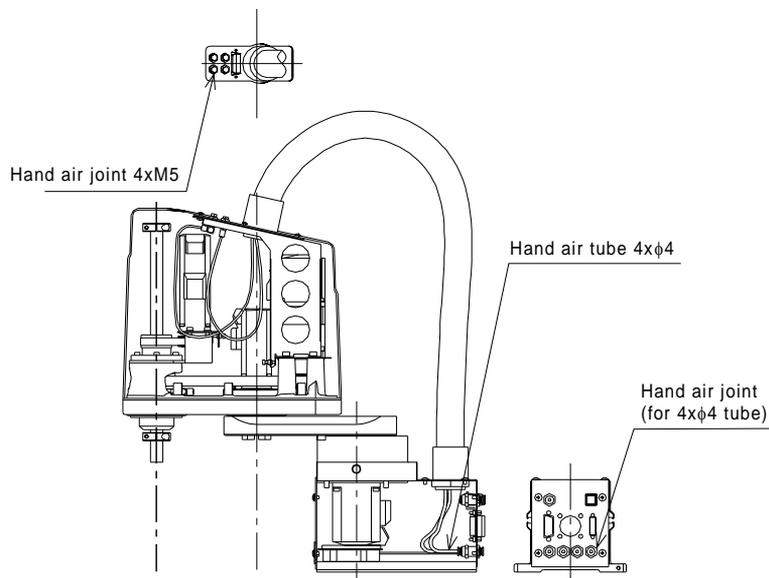
Fig. 2.9   Hand air piping (TH250A, TH350A)
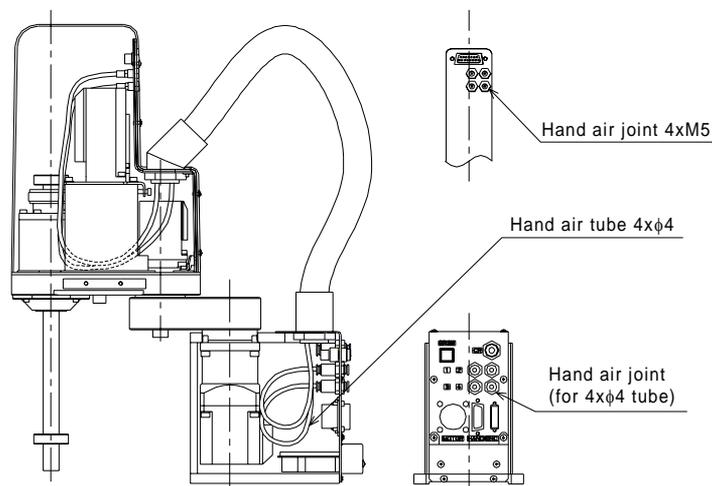
Fig. 2.10   Hand air piping (TH180)

Hand air joint
4 × M5

Hand air tube
4 × φ4

Hand air joint
(for 4xφ4 tube)
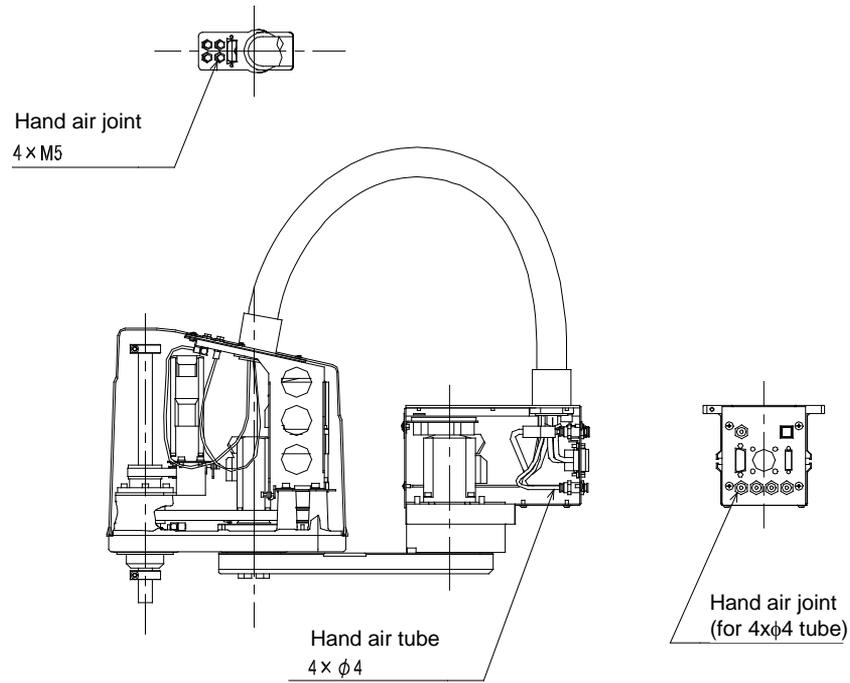
Fig. 2.11   Hand air piping (TH350A-T)

2.3.4   Lubrication of Ball Screw Spline Shaft

To lubricate the ball screw spline shaft, use the following grease.

• FOMBLIN grease (Ex. OT–20 made by Solvay Solexis)

⚠ **CAUTION**

• DO NOT mistake the type of grease.   Otherwise, the robot performance may deteriorate or the robot may malfunction.

• After you have touched the ball screw spline by hand, be sure to apply the grease to it.   Otherwise, rust will develop on the shaft.

---

a)   Check of ball screw spline shaft for lubrication
Open the arm 2 cover and make sure that the ball screw spline shaft has not run out of grease and that no rust has developed on it.   If the ball screw spline shaft has run out of grease, apply the grease according to Para. b).

b)   Greasing of ball screw spline shaft
Apply the grease with a brush or by hand so that all guide slots around the shaft are covered.   Just after the greasing, DO NOT start an operation.   First, move the ball screw spline shaft slowly over the entire motion range.   Then wipe off any grease that oozes from the shaft.
Repeat this operation a few times.

2.3.5 Check of Each Axis Drive Status

Move each axis by hand to make sure that it can move smoothly.
For the axes 3 and 4, make them in the servo-free status and make sure of the above.

$\triangle$ **!** **DANGER**

- When nearing the robot in the servo-free status, be sure to carry out the work by two (2) persons.   One person should carry out the work while the other is monitoring the work outside the hazardous zone.   The latter person should watch the work and be ready to press the EMERGENCY stop switch if any abnormality occurs.

2.3.6 Check of Timing Belt Status

Remove the arm 2 cover, and visually check to see that the belts of axis 3 and axis 4 are not worn off or cracked.
Also check the timing belt for tension and adjust as necessary, referring to Table 2.1 below.

Table 2.1

Robot model	Axis	Tension [N]	Unit mass [g/cm^2]	Belt width [mm]	Span [mm]
TH250A TH350A TH350A-T	3	48 ~ 64	0.22	9	49.5
	4	66 ~ 88	0.22	12	183
TH180	3	44 ~ 50	0.025	9	59
	4	96 ~ 110	0.040	15	63

2.3.7 Greasing of Reduction Gears (TH250A, TH350A, TH350A-T)

To lubricate the reduction gears, use the following grease.

⚫ Harmonic grease 4B No.2 (Maker: Harmonic Drive Systems)

⚠ **CAUTION**

⚫ DO NOT mistake the type of grease.   Otherwise, the robot performance may deteriorate or the robot may malfunction.

Remove the axis 1 cover and arm 2 cover, and fill the specified volume of grease from the grease nipples, using a grease gun.

The greasing volume is 5 cm^3 and the greasing locations are shown in Figs. 2.12 and 2.13.

(For dismantling the arm 2 cover, see Para. 2.3.9.)

The type of grease nipple is A–M6F.

As the axis 4 reduction gear of TH250A, TH350A and TH350A-T and axes 1, 2, 4 reduction gears of TH180 are grease-sealed, they need not be greased at all.

Grease nipple for axis 2 reduction gear

Grease nipple for axis 1 reduction gear
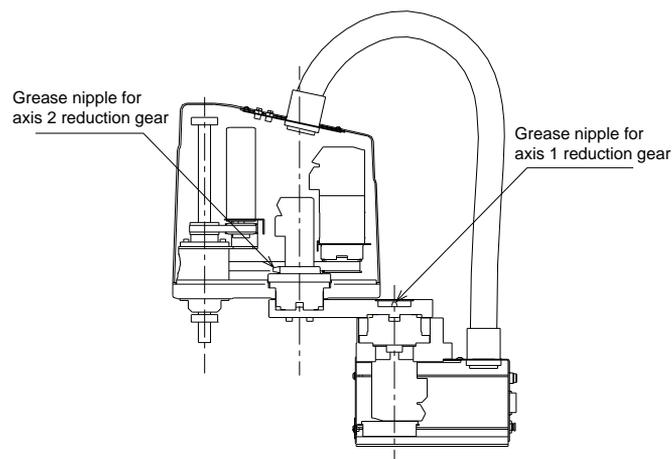
Fig. 2.12   Greasing locations of reduction gears (TH250A, TH350A)

Grease nipple for axis 2 reduction gear

Grease nipple for axis 1 reduction gear
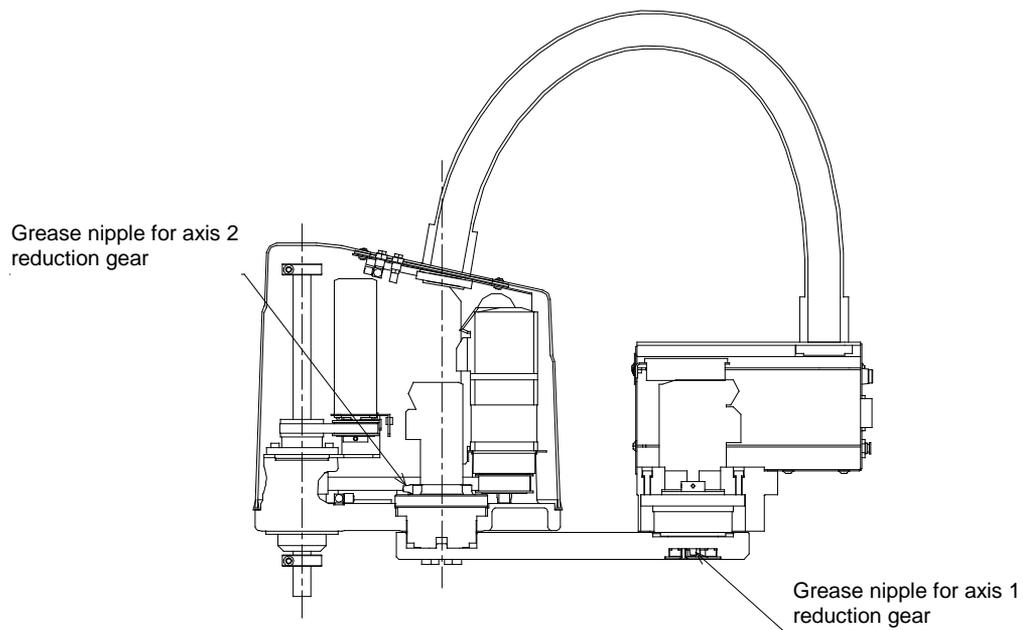
Fig. 2.13   Greasing locations of reduction gears (TH350A-T)

⚠ ! CAUTION

- After all greases in the axis 1 and axis 2 reduction gears have been replaced, be sure to perform running-in for more than half an hour at 5 % speed override.   Otherwise, the performance of the reduction gears may deteriorate or they may malfunction.

2.3.8   Replacement of Position Detector (or Encoder) Batteries

To back up the data of the position detector attached to each motor, batteries are used.

The battery life changes with the controller power OFF time.   When the controller is operated at a rate of eight (8) hours per day, the calculated life is approximately two (2) years which may vary, however, with the operating condition, ambient temperature, etc.   Be sure to replace the batteries, therefore, at the time of yearly inspection.   For the replacing procedures, see the descriptions below.

Note: The battery alarm comes in the two (2) types; battery warning alarm (Battery alarm) and battery error (Encoder abnormal).

Normally, when the battery warning alarm has generated, the battery error can be avoided by replacing the batteries with new ones.   When this happens, however, the battery error (Encoder abnormal) will occur within one (1) month after generation of the battery warning alarm.

If the time of battery replacement is delayed, the battery error will generate and the robot may not be moved at all.

Once the battery error has been detected, the robot enters an emergency stop state, and reset of the encoder error is required.

(For how to reset the encoder error, see the Appendix B of this manual. <u>Be sure to replace the batteries at the time of annual inspection.</u>

The following messages are displayed at the time of battery error.

Error code	Description	Remarks
8-601	Axis1 Enc multi count err	
8-602	Axis2 Enc multi count err	
8-603	Axis3 Enc multi count err	
8-604	Axis4 Enc multi count err	
8-605	Axis5 Enc multi count err	

If any of these errors is displayed, counter skipping may be occurring due to insufficient battery power. Change the battery. If changing the battery does not correct the problem and the error is still displayed, the encoder may be faulty. In such a case, change the motor.

Error code	Description	Remarks
8-611	Axis1 Enc battery alarm	
8-612	Axis2 Enc battery alarm	
8-613	Axis3 Enc battery alarm	
8-614	Axis4 Enc battery alarm	
8-615	Axis5 Enc battery alarm	

If any of these errors is displayed, the battery power may be insufficient. Change the battery.

Error code	Description	Remarks
8-401	Axis1 Encoder abnormal	
8-402	Axis2 Encoder abnormal	
8-403	Axis3 Encoder abnormal	
8-404	Axis4 Encoder abnormal	
8-405	Axis5 Encoder abnormal	

In the case of level 8 battery errors, basically the two types of errors shown previously are displayed; however, these errors above may be displayed in rare cases. If any of these errors is displayed, change the battery.

The battery error can be identified when the following alarm has generated, which is displayed also in the error history at the same time.

Error code	Description	Remarks
1-401	Axis1 Enc battery low(Battery alarm)	
1-402	Axis2 Enc battery low(Battery alarm)	
1-403	Axis3 Enc battery low(Battery alarm)	
1-404	Axis4 Enc battery low(Battery alarm)	
1-405	Axis5 Enc battery low(Battery alarm)	

Other types of "battery error" may lead to a position detector error due to a single position detector error (encoder error).   The restoration operation varies with an error content.   In order to properly recover from the position detector error, make sure to read carefully "2.5 Robot Home Point and Position Detector Error " and understand the position detector error and the restoration operation.

<div>

⚠ **DANGER**

- The batteries should be replaced while the power is turned on and emergency stop is effected only after the safety is assured.

</div>

[Replacing procedures]

1) <u>Assure the safety, then press the EMERGENCY stop switch to emergency-stop the robot while the power is turned on.</u>

2) Remove the truss head screws 4×6 SUS or truss head screws 3×6 SUS from the robot base unit, and disengage the battery case or battery box.　(See Fig. 2.14 (a), Fig. 2.15 (a) and Fig. 2.16 (a).)

3) Remove the batteries which are connected by means of the connector.

4) Set the new batteries.

5) Attach the battery case or battery box.

6) Reset the error through the teach pendant.

<div>

⚠ **CAUTION**

- Batteries should be disposed of according to the user's in-house regulations.

- NEVER drop the batteries into fire.　NEVER short-circuit, charge, disassemble or heat them.　Otherwise, liquid leakage or rupture may be caused.

</div>

Battery case

Truss head
screw 4x6 SUS

Batteries

(a)　　　　　　　　　　(b)
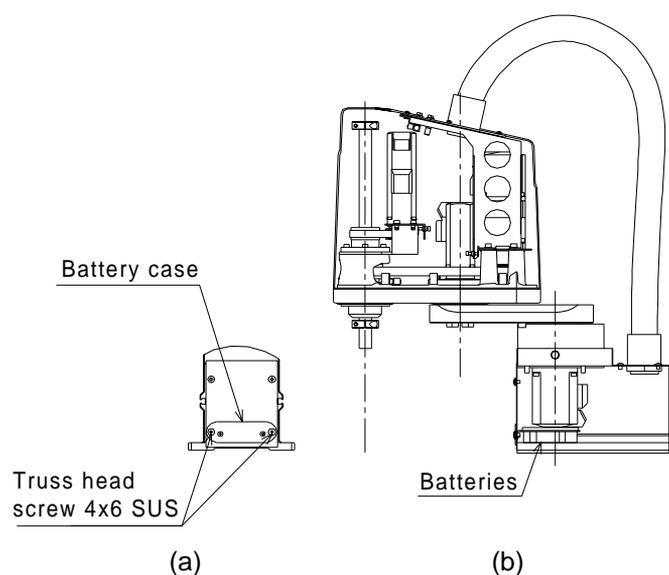
Fig. 2.14　Position detector battery set position (TH250A, TH350A)

Truss head screw
3 × 6SUS

Truss head screw
3 × 6SUS

Battery box

Batteries

(a)

(b)
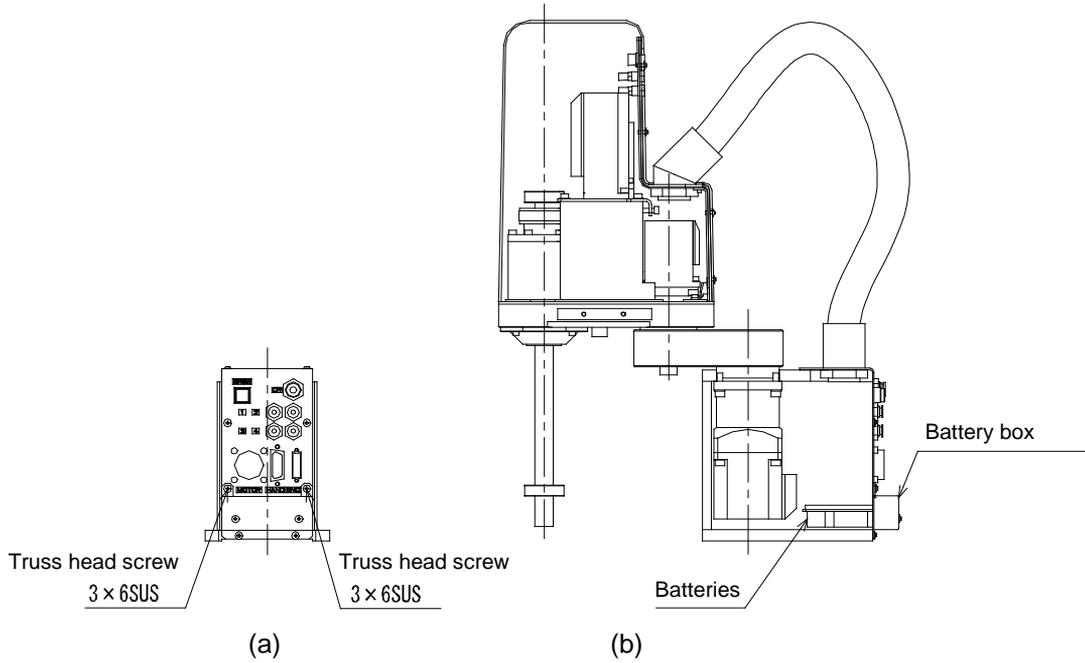
Fig. 2.15   Position detector battery set position (TH180)

Truss head screw
4 × 6SUS

Battery case

Batteries

Section A-A

(a)

(b)
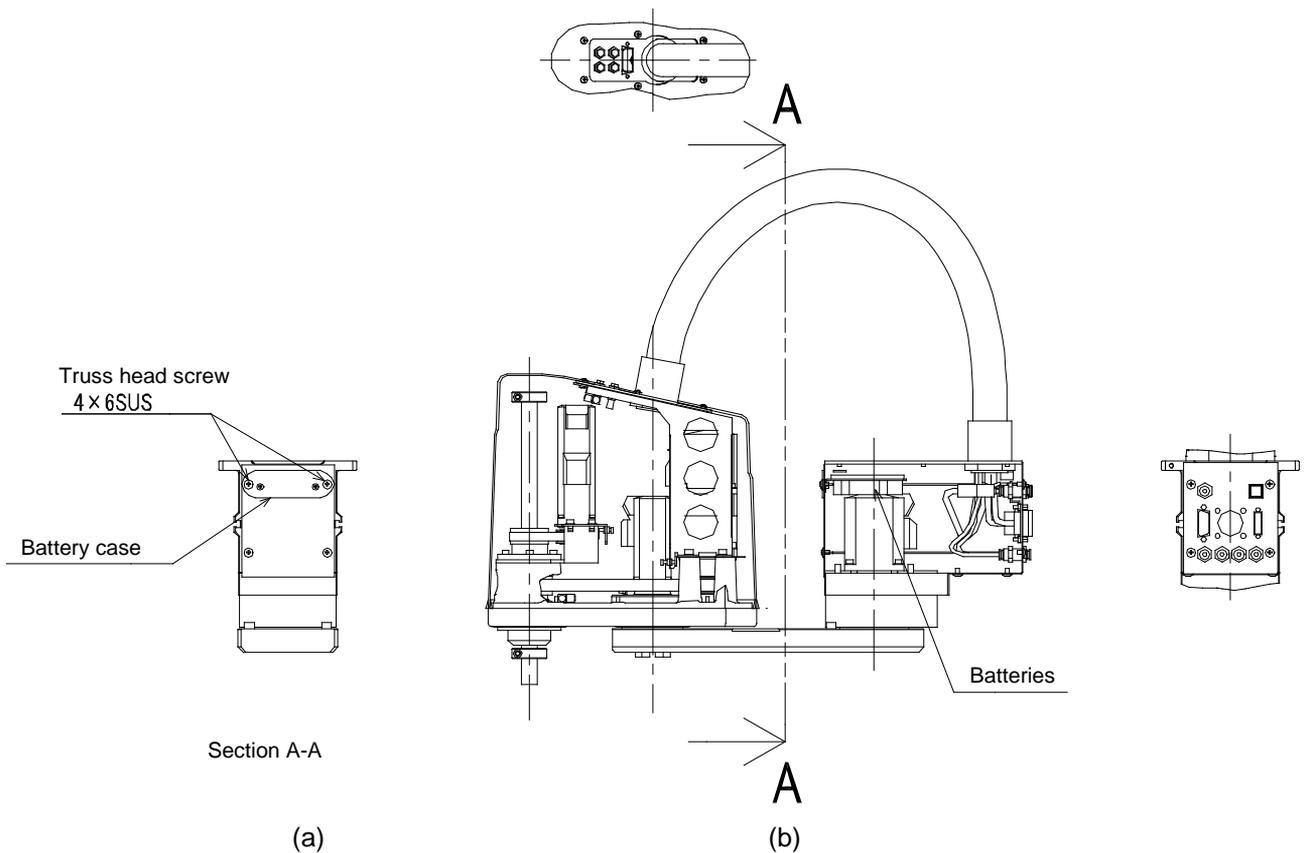
Fig. 2.16   Position detector battery set position (TH350A-T)

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2.3.9 Disconnection of Arm 2 Cover

First of all, provide the following tools.

- Hexagonal wrench key
- Plus driver

Turn off the controller power before the operation.

Remove the truss head screws 3×8 SUS and hexagon socket head cap screws 3×16 SUS as shown in Fig. 2.17 and Fig. 2.19, or the truss head screws 3×6 SUS and hexagon socket head cap screws 3×10 SUS as shown in Fig. 2.18.

Then pull the arm 2 cover upward and disconnect it.
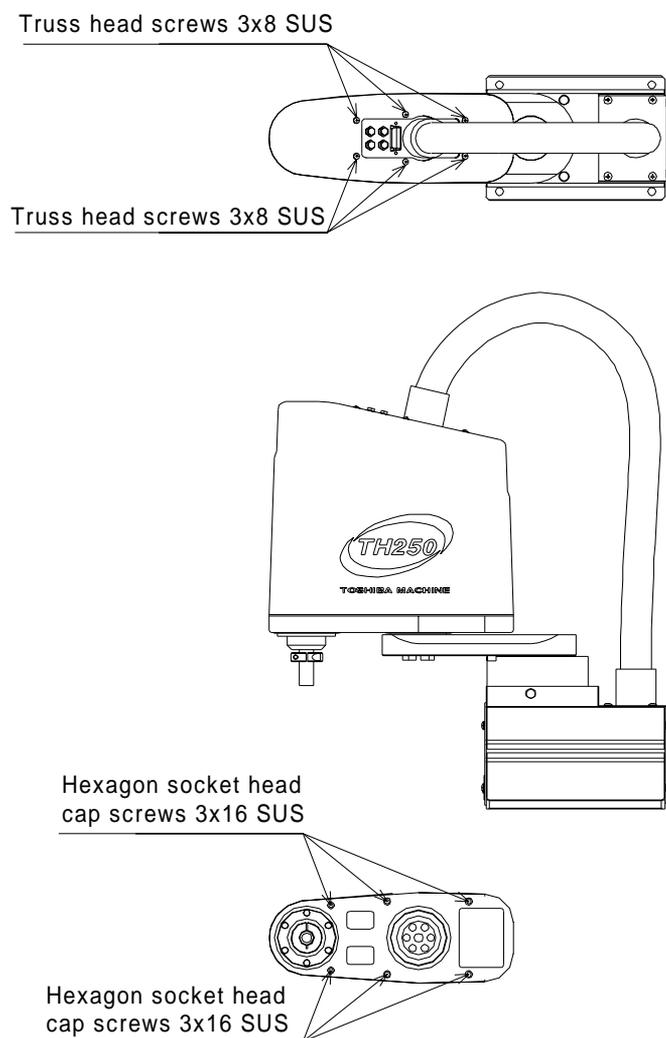
Fig. 2.17   Disengaging Arm cover (TH250A, TH350A)

Truss head
screws 3x6 SUS

Truss head
screws 3x6 SUS

Truss head
screws 3x6 SUS

Hexagon socket head
cap screws 3x10 SUS

Hexagon socket head
cap screws 3x10 SUS
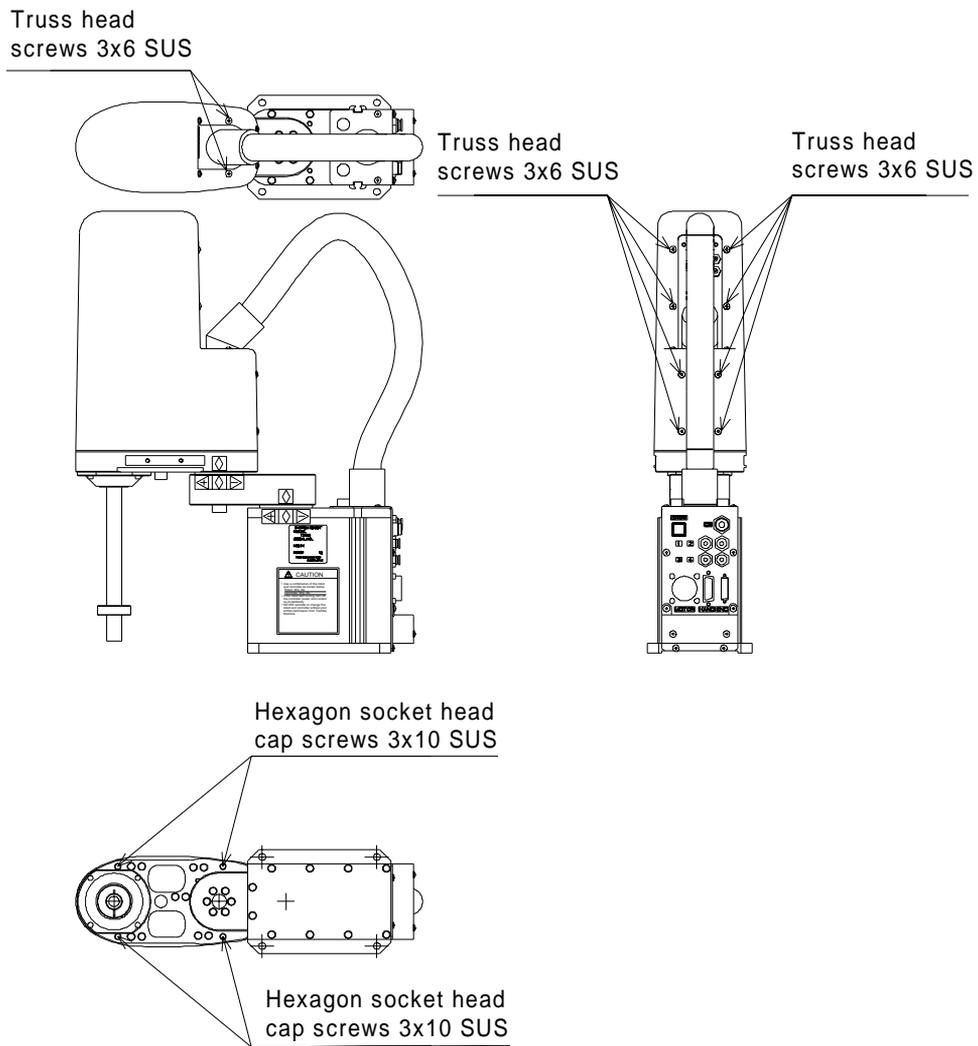
Fig. 2.18   Disengaging Arm cover (TH180)
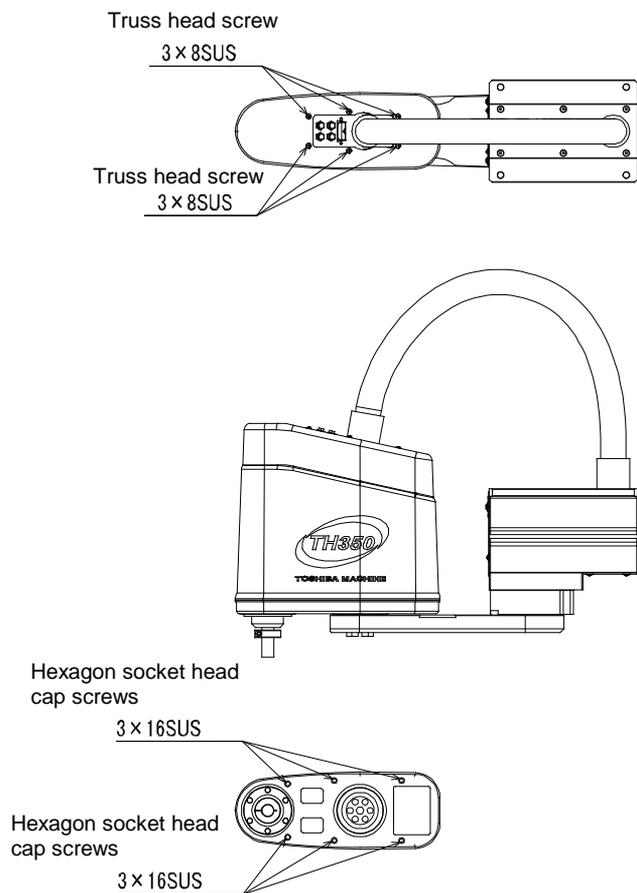
Fig. 2.19　Disengaging Arm cover (TH350A-T)

2.4　Cautions on Robot Transport and Storage

When transporting or storing the robot, it is recommended to secure the robot in the shipment posture, using the attached clamp for transport.

2.5　Robot Home Point and Position Detector Error

2.5.1　Setting Robot Home Point

Before delivery from our plant, home point setting is performed for the robot after its arm is secured with clamp for home point setting.

At the time of home point setting, position data of the motor position detector (i.e., encoder) is backed up by batteries, and coordinates of the robot need not be set each time the power is turned on.

The position data of the motor position detector comes in the two (2) types; home position data within one (1) full turn of motor and motor multi-turn data.

Home position data within one (1) full turn of motor:
At home point setting operation of the robot (i.e., ZEROP operation and REORG operation), the data are written into the parameter file.   As the data is backed up by batteries, the parameters should be loaded again from the attached system disk at replacement of the main control printed board.

Motor multi-turn data:
This data is kept in the encoder by battery backup, which differs from the backup battery of the main control printed board.   When the battery voltage drops, correct multi-turn data cannot be guaranteed and the encoder itself outputs an alarm.   This data is set to zero (0) at home point setting operation of the robot (i.e., ZEROP operation and REORG operation).   Likewise, it is set to zero (0) also by multi-turn data reset operation.

2.5.2   Position Detector Error

If a position detector error (encoder error) occurs, either of the following errors is shown on the error display of the robot controller.

Table 2.2   List of error

Error code	Error content
8-401	Axis1 Encoder abnormal
8-402	Axis2 Encoder abnormal
8-403	Axis3 Encoder abnormal
8-404	Axis4 Encoder abnormal
8-405	Axis5 Encoder abnormal

or

Error code	Error content
8-601	Axis1 Enc multi count err
8-602	Axis2 Enc multi count err
8-603	Axis3 Enc multi count err
8-604	Axis4 Enc multi count err
8-605	Axis5 Enc multi count err

The position detector error is an error detected by the encoder itself.   Even if the data in the parameter file is lost (or changed) to change the home point coordinates of the robot, for instance, a position detector error will not occur.   If the machine coordinates have changed without causing a position detector error, the mechanical connecting position of the servo motor and mechanical unit shifted or the data in the parameter file described above was changed.   (Ex.: Tooth skip of timing belt, etc.)

Errors detected by the encoder itself include the battery voltage drop, error caused by temperature rise in the encoder, counter overflow, internal counter data inconsistency, etc.   Among these errors, the error which occurs most frequently is the battery voltage drop which is caused by the absence of maintenance at specified change intervals (once a year) due to a long-term shutdown or cable breakage.

To prevent the position detector error, therefore, replace the batteries on a regular basis.   For the battery replacement, see Para. 2.3.8.

Also, a heavy vibration should not be exerted on the robot or the robot should not be moved suddenly by hand during power OFF.   Especially, when transporting and storing the robot, secure the robot in a posture for shipment, using the attached clamps.

2.5.3   Restoration from position detector error

The restoring operation from the position detector error comes in the following four (4) manners.

[1]   Encoder error reset operation
[2]   Multi-turn data reset operation
[3]   REORG operation
[4]   ZEROP operation

(1)   When the mechanical connecting position with the motor has changed after motor or belt replacement:

A position detector error may occur after replacement and adjustment of the servo motor or timing belt.   When this happens, execute the following restoring operation.

1)   Execute "[3] REORG operation."

2)   Execute "[4] ZEROP operation."   At this time, the contents in the parameter file (i.e., home position data within one (1) full turn of motor) are updated. Rewriting of the data into the system disk is necessary.

3)   Make sure that the error has been reset, referring to the error display.

4)   In the "[3] REORG operation" and "[4] ZEROP operation", some error may be caused according to the adjusting method.   Re-teaching of the teach points may be required under some circumstances.

(2) <u>When a position detection error has occurred during normal operation with the mechanical connection position unchanged:</u>

For example, if the battery voltage drops, or after changing the battery or cables, the position detector may operate abnormally. In such a case, perform recovery operation according to the procedure described below.

1) Perform [1] Encoder error reset operation.

2) Referring to the error screen, make sure that the error has been cleared.

⚠ **DANGER**

- When moving the robot by hand while the power is turned on, be sure to assure the safe work and effect an emergency stop beforehand.

- In the above situation, if the work is to be done while the axis 3 motor brake OFF switch is pressed, be sure to perform the work by two (2) persons.
  One person should carry out the work while the other is monitoring the work outside the hazardous zone.   The latter person should watch the work and be ready to turn off the controller switch if any abnormality occurs.   Once the controller power is turned off, the motor brake actuates even if the axis 3 motor brake OFF switch is kept pressed.

- If the axis 3 motor brake OFF switch is pressed while the robot is carrying a heavy workpiece, the axis 3 may drop suddenly.   To avoid this, the customer should take all necessary measures by themselves.

2.1)   **<u>When the error has been reset:</u>**
Turn on the controller power only (DO NOT turn on the servo power), and make sure by moving the arm, etc. by hand that the position detector error will not occur again.   Then turn off the controller power and turn on again to make sure that the same error will not recur.

2.1.1)   **<u>When the error occurs again:</u>**
The position detector has possibly malfunctioned.

2.1.2)   **<u>When the error will not occur again:</u>**
Turn on the servo power.   Select the TEACHING mode and gradually move each axis at low speed to make sure of its soft stroke.   If the soft stroke or machine coordinate is abnormal, perform "[2] Multi-turn data reset operation."

2.2)   **When the error is not reset:**
Replace the batteries, then perform "[1] Encoder error reset operation" again.
Make sure again that the error has been reset, referring to the error display.

2.2.1)   **When the error has been reset:**
Execute the same operation as in Para. 2.1) above.

2.2.2)   **When the error cannot be reset:**
The position detector has possibly malfunctioned, or the encoder cable
has broken.

2.6   Restoring Operation from Position Detector Error

Make sure on the error display that a position detector error is generated.   Identify the type of the position detector error and position data on the encoder status display, then perform each restoring operation.

2.6.1 Encoder Status Display

Call the encoder status screen on the teach pendant display, and make sure of the position data and the type of position detector error there.   The type of the position detector error (i.e., error status) is expressed as shown below.   The motor multi-turn data, home position data within one (1) full turn of motor and error status are displayed under the column of [MULTI], [SINGLE] and [Err-df], respectively.
To call the encoder status screen, observe the following procedures.

[1]   Press the "UTILITY" key provided on the teach pendant.   Press the [NEXT] key until [ENC] is displayed on the function menu.

[2]   Press the [ENC] <F5> key, and the encoder status screen appears on the display.

```
          MULTI      SINGLE       Err-df        ID
  E 1          0   00001234       0200          10
  E 2          0   00001234       0200          10
  E 3          0   00001234       0200          10
  E 4          0   00001234       0200          10
  E 5          0   00000000       0000          00

  ERROR                    RESET
```

If the error status shown in Table 4.1 is displayed, you can restore from the position detector error. If an error status other than those shown in Table 4.1 is displayed, contact our service departments on page 8.

Table 4.1   Error status table

Error status	Description
0000	Signifies the normal condition.
0100	This error occurs when a heavy vibration has been exerted on the robot or when the robot has been moved fast by hand while the power drive cable was disconnected during power OFF. The multi-turn data has possibly shifted.
0200	Because axis feed was not executed after power ON, the encoder resolution has deteriorated. During axis feed, the encoder resolution returns to normal. No alarm will generate.
8000	The battery voltage has dropped. Replace the batteries.
4000	The battery voltage has dropped further than the above. An error has possibly occurred in the multi-turn data.
4200	Errors 4000 and 0200 have occurred at the same time.

2.6.2 Encoder Error Reset Operation

When the mechanical connecting position of the servo motor and mechanical unit remains unchanged, that is, after battery replacement due to battery voltage drop or cable replacement due to cable breakage, execute this operation.

[1]   Call the encoder status screen on the teach pendant display, referring to Para. 2.6.1 above.

[2]   Just after the encoder status screen is called, the cursor points out the [Err-df] column on the [E1] line.   Move the cursor to a line for the system you wish to execute the encoder error reset operation by means of the cursor keys (i.e., "↑" and "↓" keys).

```
        MULTI    SINGLE     Err-df      ID
  E1       0    00001234     0200       10
  E2       0    00001234     0200       10
  E3       0    00001234     4200       10
  E4       0    00001234     0200       10
  E5       0    00000000     0000       00

  ERROR          RESET
```

[3]   To reset the axis 3 encoder error, for instance, move the cursor to the [Err-df] column on the [E3] line and press the [RESET] <F3> key.   If everything is OK, press the "EXE" key.   Now the axis 3 encoder error has been reset.

[4]   Call the normal error screen, press the [RESET] <F3> key to reset the error of "8–403 Axis3 Encoder Abnormal."

2.6.3 Multi-Turn Data Reset Operation

This operation should be executed after the home position of an appropriate axis has been established, using the home point match-marks, that is, after the relevant axis has returned to the home position.

As only the multi-turn data of the absolute encoder can be zero-reset and no single-turn data is affected by this operation, the axis can be restored to a status which is quite the same as the status prevailing before position error generation.

Also, as described above, the encoder error can be reset in lieu of the encoder error reset operation.

⚠ **DANGER**

• When moving the robot by hand while the power is turned on, be sure to assure the safe work and effect an emergency stop beforehand.

• In the above situation, if the work is to be done while the axis 3 motor brake OFF switch is pressed, be sure to perform the work by two (2) persons.
One person should carry out the work while the other is monitoring the work outside the hazardous zone.   The latter person should watch the work and be ready to turn off the controller switch if any abnormality occurs.   Once the controller power is turned off, the motor brake actuates even if the axis 3 motor brake OFF switch is kept pressed.

• If the axis 3 motor brake OFF switch is pressed while the robot is carrying a heavy workpiece, the axis 3 may drop suddenly.   To avoid this, the customer should take all necessary measures by themselves.

⚠ **CAUTION**

• A misoperation of the multi-turn data reset can significantly affect the robot current position. Therefore, the multi-turn data reset is always protected against misoperation. Do not attempt to cancel the protection except when operating the mutli-turn data reset.

---

[1]   Referring the section 2.6.1, display the encoder status screen on the teach pendant.

```
        MULTI    SINGLE    Err-df    ID
 E 1    1234    00001234    0200    10
 E 2    2345    00001234    4200    10
 E 3    3456    00001234    0200    10
 E 4    4567    00001234    0200    10
 E 5       0    00000000    0000    00

 ERROR          RESET
```

[2]   Move all axes for which multi-turn data reset operation is to be executed to respective home positions.   Minor error is acceptable.

[3]   The multi-turn data reset function is normally protected because it will seriously influence the robot current position by wrong operation.
To cancel this protect function, press the "ALT" and "0" keys at the same time.

[4]   Only after the protect mode is canceled, the cursor can be moved.   Move the cursor to a line where you wish to perform the multi-turn data reset operation, using the cursor keys ("↑" and "↓").   In the system which does not allow the encoder error reset operation, the "→" cursor key is inoperative.

[5]   To reset the axis 2 multi-turn data, for instance, move the cursor to the "MULTI" column on the "E2" line.

```
        MULTI    SINGLE    Err-df    ID
 E 1    1234    00001234    0200    10
 E 2    2345    00001234    4200    10
 E 3    3456    00001234    0200    10
 E 4    4567    00001234    0200    10
 E 5       0    00000000    0000    00

 ERROR          RESET
```

[6]   Press the [RESET] <F3> key and press the "EXE" key if everything is OK.

```
         M U L T I      S I N G L E      E r r － d f      I D
 E 1       1 2 3 4    0 0 0 0 1 2 3 4      0 2 0 0        1 0
 E 2       0 0 0 0    0 0 0 0 1 2 3 4      4 2 0 0        1 0
 E 3       3 4 5 6    0 0 0 0 1 2 3 4      0 2 0 0        1 0
 E 4       4 5 6 7    0 0 0 0 1 2 3 4      0 2 0 0        1 0
 E 5            0    0 0 0 0 0 0 0 0      0 0 0 0        0 0

   E R R O R                R E S E T
```

[7]   Now, the axis 2 multi-turn data is reset to zero (0) at the same time that the encoder error is reset.

[8]   Call the normal error screen and press the [RESET] <F3> key to reset the error of "8–129 Axis2 Encoder abnormal".

[9]   For validating the current position according to the multi-turn data reset, turn off the power of the controller and turn it on again.

2.6.4 REORG Operation

Perform this operation only when the mechanical robot's zero point position has changed by changing the motor or timing belt.

To perform this operation, move each axis to the HOME position. The HOME position is the position data for reproducing the zero point position data, and its details are explained in "(1) Overview of HOME".

The zero point position of an axis for which REORG operation has been performed can be recovered to almost the state at the time of shipment. Multi-rotation data, however, is different from the time of shipment. In other words, multi-rotation data is set to 0 at the zero point position when shipped and, after REORG operation, multi-rotation data is set to 0 at the HOME position. Thus, please perform ZEROP operation (Appendix E) in order to set multi-rotation data to 0 at the zero point position, similar to the time of shipment.

Note that this operation may cause a slight error depending on the adjustment method, so it is necessary to do teaching of the teaching point again in some cases.

Also, in zero point position data reproducing operation with HOME1 to HOME4 (II, III), move the robot manually. At this time, a software limit error may occur, but it can be ignored until the operation completes.

⚠ **!** **DANGER**

• When moving the robot by hand while the power is turned on, be sure to assure the safe work and effect an emergency stop beforehand.

• In the above situation, if the work is to be done while the axis 3 motor brake OFF switch is pressed, be sure to perform the work by two (2) persons.
One person should carry out the work while the other is monitoring the work outside the hazardous zone.   The latter person should watch the work and be ready to turn off the controller switch if any abnormality occurs.   Once the controller power is turned off, the motor brake actuates even if the axis 3 motor brake OFF switch is kept pressed.

• If the axis 3 motor brake OFF switch is pressed while the robot is carrying a heavy workpiece, the axis 3 may drop suddenly.   To avoid this, the customer should take all necessary measures by themselves.

---

(1)   Outline of HOME Function

This function memorizes a specific coordinate value in each axis and restores the original home position data by using the HOME function when the machine home position data has been destroyed.

The set points are provided for HOME1 to HOME4, and the axis 1 to axis 3 plus (+) side mechanical stopper positions are set in HOME3, and the axis 1 to axis 3 minus (−) mechanical stopper positions in HOME4.   The axis 4 is set at the 0° position according to the home point match-mark.
For HOME1 and HOME2, you can specify any values.   It is recommended that when building up a system, you specify the place for securing the robot end.
On the following REORG screen, the unit of each axis position is "$\times 10^{-4}$ [deg], [mm]".
For example, the value of "(J1) 1183468" below signifies that the axis 1 is positioned at 118.3468 [deg].   Pressing the "NEXT" key allows for switching the page.

(Page 1)

```
USER       HOME 1          HOME 2
  (J 1)            0                0   [d e g]
  (J 2)            0                0   [d e g]
  (J 3)            0                0   [mm  ]
  (J 4)            0                0   [d e g]
  (J 5)            0                0   [mm  ]

  SET                        TEACH
```

(Page 2)

```
SYSTEM  HOME3      HOME4
 (J1)      1183468   −  1180474  [deg]
 (J2)      1450716   −  1450720  [deg]
 (J3)      1239092   −    36711  [mm ]
 (J4)            0              0  [deg]
 (J5)            0              0  [mm ]

 SET                     TEACH
```

⚠ **! CAUTION**

• This function is used to restore the machine home point of each axis.
  NEVER use the function at other than the setting for restoration.

(2)   Operating procedures

   I.   HOME setting:
        In this paragraph, setting of values in HOME1 is explained.   (The same is also
        applicable to HOME2.)

   [1]   Guide the robot to secure the ball screw spline shaft at a desired position.

   [2]   Turn off the servo power.

   [3]   Press the "UTILITY" key equipped on the teach pendant.

   [4]   Press the "NEXT" key until the [REORG] menu appears, then press the
         [REORG] <F1> key.

   Data is set by means of the [TEACH] key.

```
USER     HOME1      HOME2
 (J1)            0              0  [deg]
 (J2)            0              0  [deg]
 (J3)            0              0  [mm ]
 (J4)            0              0  [deg]
 (J5)            0              0  [mm ]

 SET                     TEACH
```

Soft key for updating the current position.
The current position of an axis indicated by the
cursor is replaced by the memorized data.

Soft key for memorizing the current position.
The memorized data at the cursor position is
updated.

[5]   When the above screen appears, memorize the position where the robot was secured for each axis by moving the cursor and using the [TEACH] <F4> key mode.

[6]   To establish the above, press the "EXE" key.

[7]   Press the "ESC" key to exit the REORG screen to finish.

II.   Reproducing method with HOME1 (HOME2)
Here, the reproducing method using HOME1 is described. The method is the same with HOME2. Because this operation is the same as the reproducing method with HOME3 (HOME4), please perform it by referring to "III. Reproducing Method with HOME3 (HOME4)".

[1]   I. By referring to HOME setup methods [2] to [4], go to the REORG screen.

[2]   I. Move the robot to the position fixed with HOME setup method [1], and then fix the robot.

[3]   Move the cursor to the axis on the HOME1 row of the REORG screen you want to reproduce, and then press the [SET] <F1> key).

[4]   If there is any problem, enter the "EXE" key. This makes it possible to reproduce the zero point position.

[5]   Press the "ESC" key to exit the REORG screen to finish.

[6]   To reflect the data updated by this operation on the current position, turn OFF the power to the controller and then turn it ON again.

[7]   Perform ZEROP operation (Appendix E).

III. How to restore the data by HOME3 (or HOME4):
The plus (+) side mechanical stopper positions and minus (–) side mechanical stopper positions of the axes 1 to 3 are factory-set in HOME3 and HOME4, respectively.   The machine home point can be restored, using the above. This paragraph deals with the restoration procedures, using HOME3.

! ⚠ **DANGER**

- When moving the robot by hand while the power is turned on, be sure to assure the safe work and effect an emergency stop beforehand.

- In the above situation, if the work is to be done while the axis 3 motor brake OFF switch is pressed, be sure to perform the work by two (2) persons.
  One person should carry out the work while the other is monitoring the work outside the hazardous zone.   The latter person should watch the work and be ready to turn off the controller switch if any abnormality occurs.   Once the controller power is turned off, the motor brake actuates even if the axis 3 motor brake OFF switch is kept pressed.

- If the axis 3 motor brake OFF switch is pressed while the robot is carrying a heavy workpiece, the axis 3 may drop suddenly.   To avoid this, the customer should take all necessary measures by themselves.

! ⚠ **CAUTION**

- [TEACH] is always protected on the REORG screen of HOME3 (HOME4). To reproduce the zero point position at the time of shipment using HOME3 (HOME4), please do not release the protection of [TEACH].

Cautions:

- Regarding the order of zero point setting, because J3 (Axis 3) and J4 (Axis 4) interfere with each other, **be sure to follow the order of J4→J3**.

- If the moving axis touches the mechanical stopper, the moving axis will exceeds the software limit; thus, causing an error. When the moving axis moves within the software limit range, an error will automatically be cleared.

[1]   I. By referring to HOME setup methods [2] to [4], go to the REORG screen.

[2]   Press the "NEXT" key to call Page 2.

```
S Y S T E M   H O M E 3          H O M E 4
   ( J 1 )      1 1 8 3 4 6 8     –  1 1 8 0 4 7 4   [ d e g ]
   ( J 2 )      1 4 5 0 7 1 6     –  1 4 5 0 7 2 0   [ d e g ]
   ( J 3 )      1 2 3 9 0 9 2     –      3 6 7 1 1   [ m m   ]
   ( J 4 )              0                      0     [ d e g ]
   ( J 5 )              0                      0     [ m m   ]

    S E T                         T E A C H
```

Soft key for updating the current position. The current position of an axis indicated by the cursor is replaced by the memorized data.

Soft key for memorizing the current position. The key is always protected.

[3]   Contact the axis 1 of the robot to the plus (+) side mechanical stopper by hand.

[4]   Move the cursor to (J1) of HOME3, then press the [SET] <F1> key.   To establish, press the "EXE" key.   Now, the machine home point of the axis 1 is restored.

[5]   Likewise, contact the axis 2 of the robot to the plus (+) side mechanical stopper by hand.

[6]   Move the cursor to (J2) of HOME3, then press the [SET] key.   To establish, press the "EXE" key.   Now, the machine home point of the axis 2 is restored.

[7]   Align Axis 4 with the zero point alignment mark. This operation will be performed while holding down the Axis 3 Motor Brake Release switch.

[8]   Apply Axis 3 against the mechanical stopper on the positive side. This operation will be performed while holding down the Axis 3 Motor Brake Release switch.

[9]   Move to the REORG screen again.

[10]   Move the cursor to (J4) of HOME3, press [SET], and then select with the "EXE" key. This reproduces Axis 4.

[11]   Move the cursor to (J3) of HOME3, then press the [SET] key.   To establish, press the "EXE" key.   Now, the machine home point of the axis 3 is restored.

[12]   Go to the regular Error screen, press [RESET] <F3> key, and then reset a position detection error.

[13]   To reflect the data updated by this operation on the current position, turn OFF the power to the controller and then turn it ON again.

[14]   Perform ZEROP operation (2.6.5).

2.6.5 ZEROP Operation

Perform this operation only when the mechanical robot's zero point position has deviated by changing the motor or timing belt.

In regular ZEROP operation, the zero point position is determined using a dedicated jig and then that position is set up as the zero point. In ZEROP operation after REORG operation, the MOVEA instruction is executed directly with servo ON and, after moving the axis for which REORG operation has been performed to the zero point position, that position is then set up as the zero point. For more information about direct execution, refer to Section 8 of the Operation manual.

This operation may cause a slight error depending on the adjustment method. It is necessary to do teaching of the teaching point again in some cases.

⚠ **DANGER**

• When moving the robot by hand while the power is turned on, be sure to assure the safe work and effect an emergency stop beforehand.

• In the above situation, if the work is to be done while the axis 3 motor brake OFF switch is pressed, be sure to perform the work by two (2) persons.
One person should carry out the work while the other is monitoring the work outside the hazardous zone.   The latter person should watch the work and be ready to turn off the controller switch if any abnormality occurs.   Once the controller power is turned off, the motor brake actuates even if the axis 3 motor brake OFF switch is kept pressed.

• If the axis 3 motor brake OFF switch is pressed while the robot is carrying a heavy workpiece, the axis 3 may drop suddenly.   To avoid this, the customer should take all necessary measures by themselves.

---

a)   Turn on the controller power and align the home point match-marks of each axis in the manual mode.
For the axis 4, however, align the center of the ball screw spline groove (left) with the axis 4 home point match-mark, as shown in Fig. 4.2.
If this is not possible, mark the reference position of each axis and jot down its coordinate beforehand.   Or it is recommended that when building up the system, you specify the place and clamp for securing the robot end.
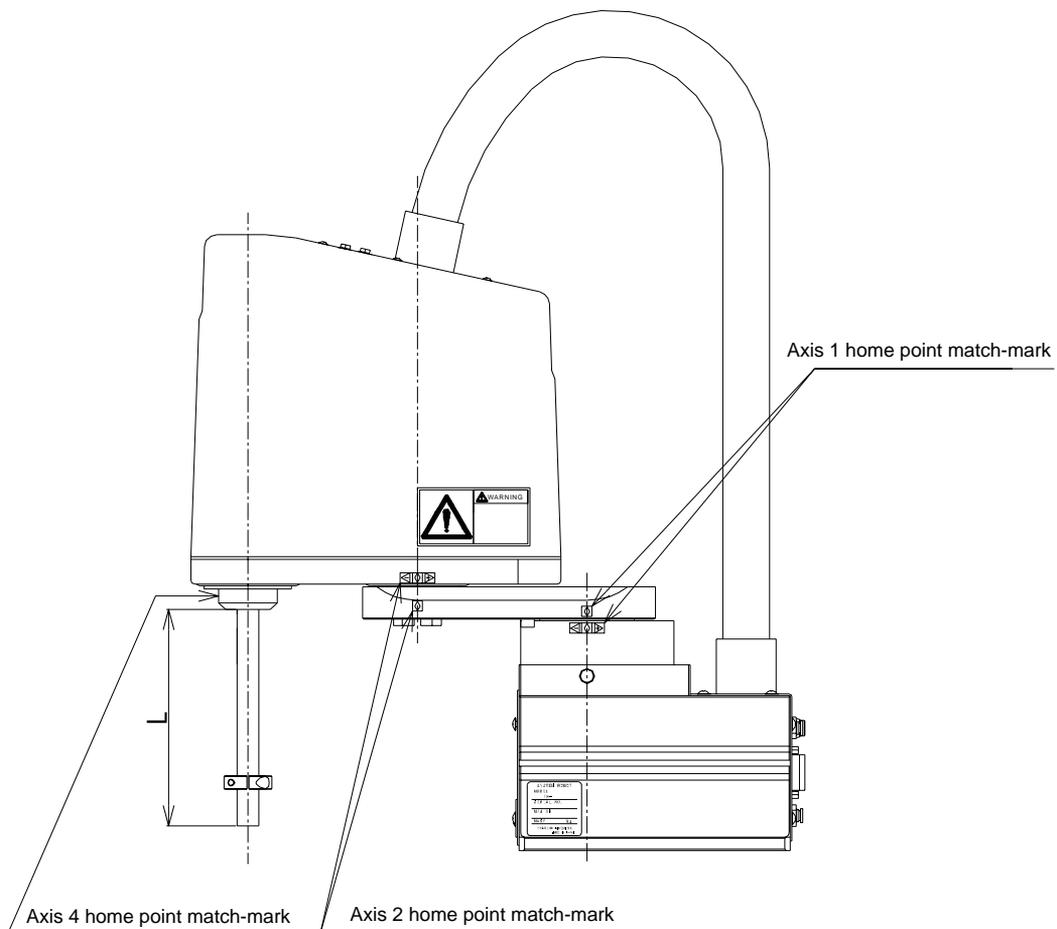
Fig. 2.20   Locations of home point match-marks of respective axes
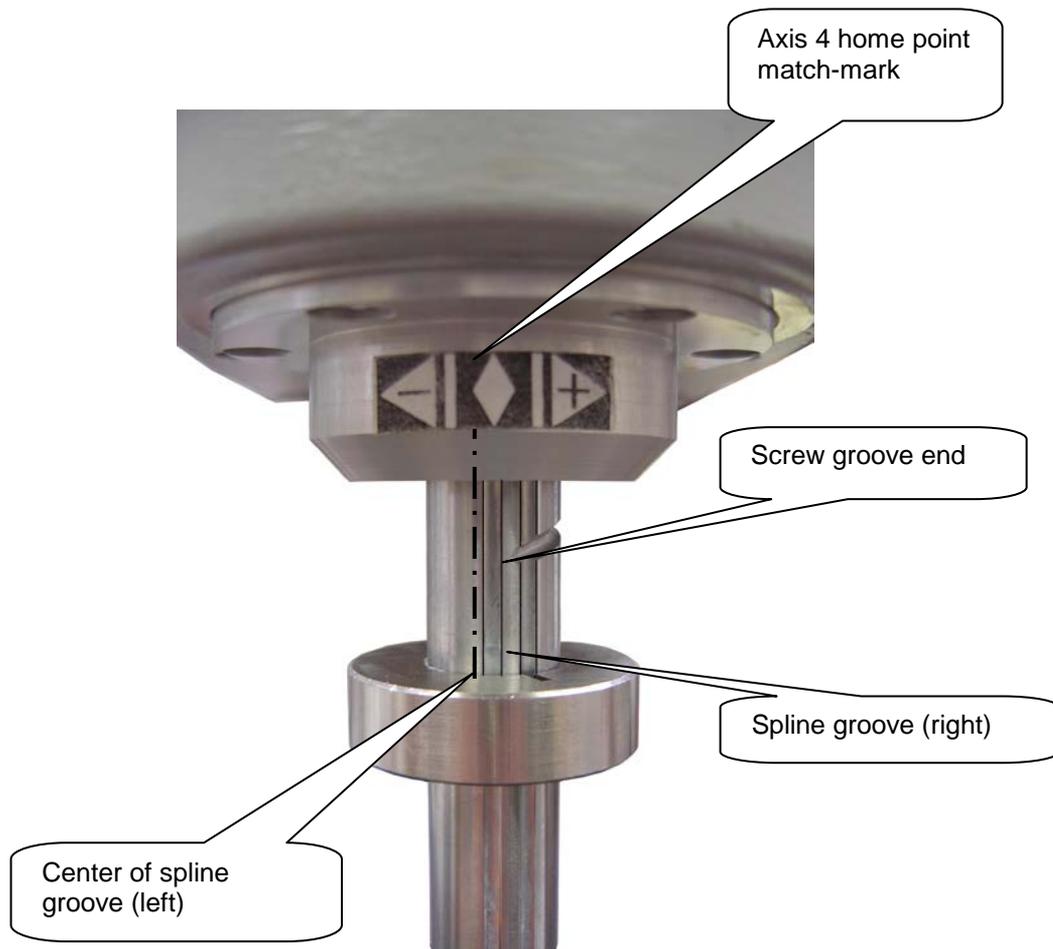
Fig. 2.21 Axis 4 home point match-mark position and spline groove
(when viewed from the front side)

b) Because no home point match marks are provided for the axis 3, establish the axis 3 home point in the following manner.
Move the axis 3 down to near the lower limit and set length "L" in Fig. 4.1 above (i.e., distance between the boss end surface of the ball screw spline and hand flange end surface) to the following value.   This position is the axis 3 home position (Z = 0).

TH250A   : 160.5 mm
TH350A   : 160.5 mm
TH180   : 162 mm
TH350A-T: 160.5 mm

If the zero point adjustment of Axis 3 cannot be done as shown above, mark the reference position and record the coordinates in advance. When configuring a system, it is recommended to allocate a place to fix the robot's tip and provide jigs.

c)   Setting of new home position data (To be set through teach pendant.)

> ⚠ **CAUTION**
>
> • ZEROP operation seriously affects the current position of the robot, it is always protected. Please do not release the protection except when setting up the zero point position.

Caution: Be sure to set the home point in the order of E4 → E3 because E3 (axis 3) and E4 (axis 4) of the SCARA robot are interlocked with each other.

1)   Select the TEACHING mode by means of the master mode switch.

2)   Press the "UTILITY" key equipped on the teach pendant.

3)   Press the "NEXT" key on the teach pendant twice.

4)   Turn off the servo power.

5)   Press the <F3> key on the teach pendant to select the ZEROP mode.

6)   The following home point setting screen is called.
The unit of each axis position is "×10^{-4} [deg], [mm]".   For example, the value of "E1 −75000" below signifies that the axis 1 is positioned at −7.5000 [deg].

```
Z E R O      P O S I T O N
        E 1 :       − 7 5 0 0 0
        E 2 :     1 3 9 9 8 0 0
        E 3 :             5 8 0 9
        E 4 :       2 9 0 0 0 0
        E 5 :                   0
```

7)   Press the "ALT" and "0" keys on the teach pendant.

8)   When the "EXE" key on the teaching pendant is pressed, the numeric value of E1 as shown in the lower left below appears. Setting this value to 0 and pressing the "EXE" key will set the value of E1 to 0.
If it is not possible to align with the zero point alignment mark, enter the coordinate values recorded in advance.

```
ZERO      POSITON
          E 1 :          -75000
          E 2 :        1399800
          E 3 :             5809
          E 4 :          290000
          E 5 :                  0


    ████████   ████████   ████████   ████████   ████████
```

9) When the "↓" key on the teach pendant is pressed, the following E2 value is displayed by reversed image.　Perform setting in the same manner as above.

```
ZERO      POSITON
          E 1 :                  0
          E 2 :        1399800
          E 3 :             5809
          E 4 :          290000
          E 5 :                  0


    ████████   ████████   ████████   ████████   ████████
```

10) To reflect the settings of the zero point position data on the current position, turn OFF the power to the controller and then turn it ON again.

d)   Confirmation of home position

1) Make sure of the robot current position according to the POS data of the UTILITY mode.　Guide the robot to the approximate home position by manual operation and confirm the position.　Unless it could be located at the home point mark, make sure that the approximate position is the reference position marked in advance.

2) Execute the following program and make sure of the robot machine home position.　Unless the robot could be located at the home point mark, DO NOT use the following program.
Create a program in which the robot moves to the position recorded beforehand, referring to the following program.　Then make sure that the robot moves to the reference position mark according to the program thus created.

```
PROGRAM ZERO
 SPEED=30
 MOVEA 3,100
 MOVEA 1,0
 MOVEA 2,0
 MOVEA 3,0
 MOVEA 4,0
 STOP
 END
```

e) Data saving
    Save the "MACHINE. PAR" file stored in the controller to another media.
    Connect the personal computer and controller using TSPC (option), insert the
    system disk into the floppy disk unit and save the "MACHINE.PAR" file from the robot
    controller to the personal computer.
    The home position data is the data characteristic of the robot, which differs with the
    robot you use.   This data is necessary when you effect a cold start and restore the
    home position data again.

f) Now, the operation completes.

Section 3   Maintenance of Controller

3.1   Cautions on Maintenance and Inspection

When performing maintenance and inspection of the controller, follow the items given below so that the work can be carried out safely.

⚠ CAUTION

- Before removing the controller cover for maintenance or inspection, be sure to turn off the main power switch of the controller.
  Also, turn off the power breaker when connecting or disconnecting the power cable.

- DO NOT touch the servo driver for at least two (2) minutes after the main power switch is turned off.   The large-capacity capacitor in the servo driver may be charged with voltage, and touching the servo driver could lead to electric shocks.

- DO NOT disconnect the battery connector at other than battery replacement. Otherwise, files saved in the memory may be lost.

⚠ DANGER

- Be sure to turn off the main power switch.   If the main power switch remains ON, the servo power printed board, servo printed board and switching power supply are charged, and touching them could lead to electric shocks.   To avoid this, be sure to turn off the main power switch before starting the work.

3.2   Layout of Controller Parts
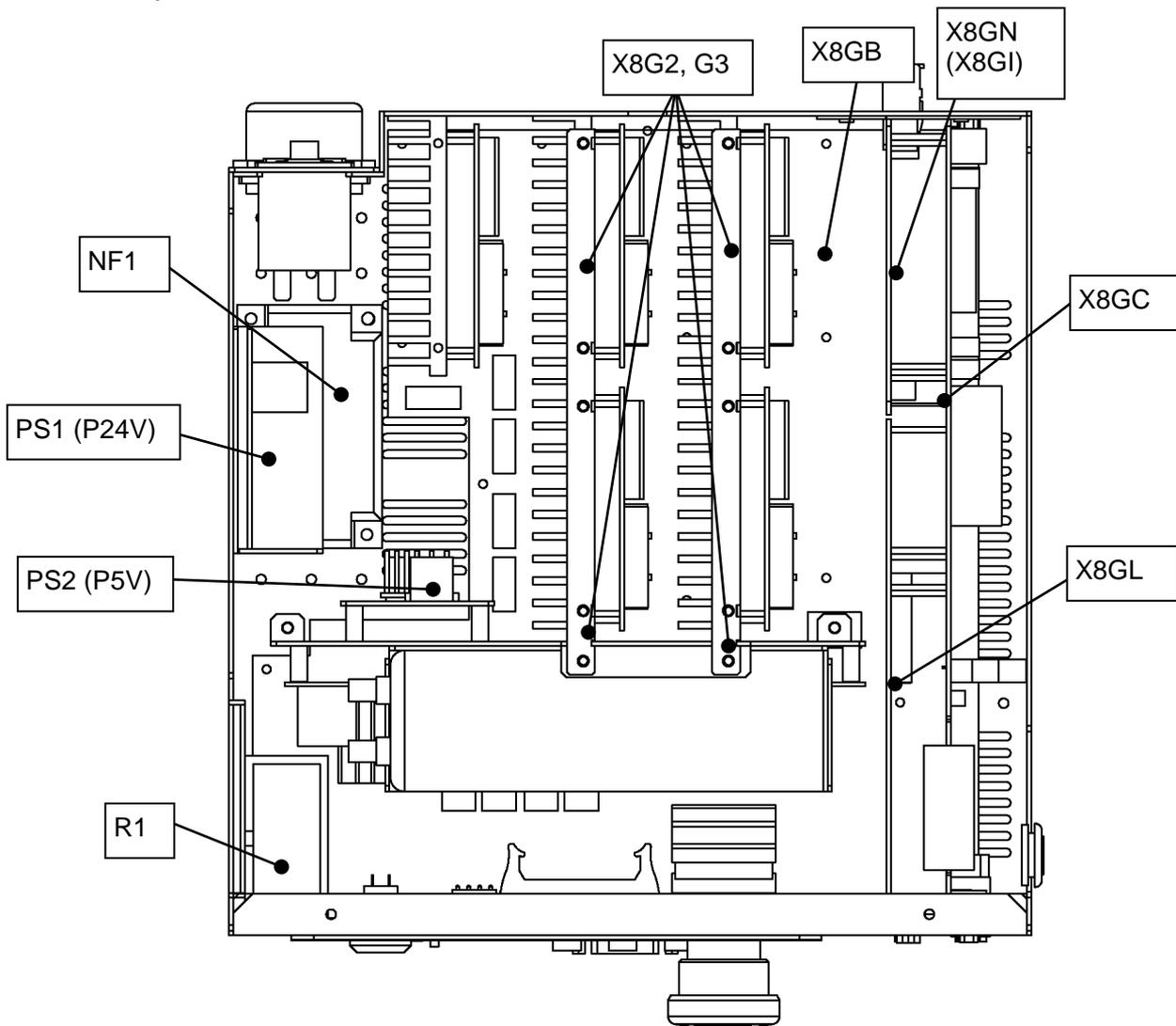
Fig. 3.1   Layout of controller parts

Part name	Descriptions
PS1	P24V output switching power supply
PS2	P5V output switching power supply
X8GC	Main control printed board
X8GN (X8GI)	I/O output printed board
X8GL	Servo logic printed board
X8G1 ~ X8G3	Servo amplifier printed board
X8GB	Mother board
R1	Regenerative resistor
NF1	Noise filter

3.3   Maintenance Procedures

3.3.1 Check of Controller Air Vent Holes

If the air vent holes are blocked, the controller may overheat and malfunction.
To avoid this, perform check on the air vent holes to make sure that air is flowing
freely through them.
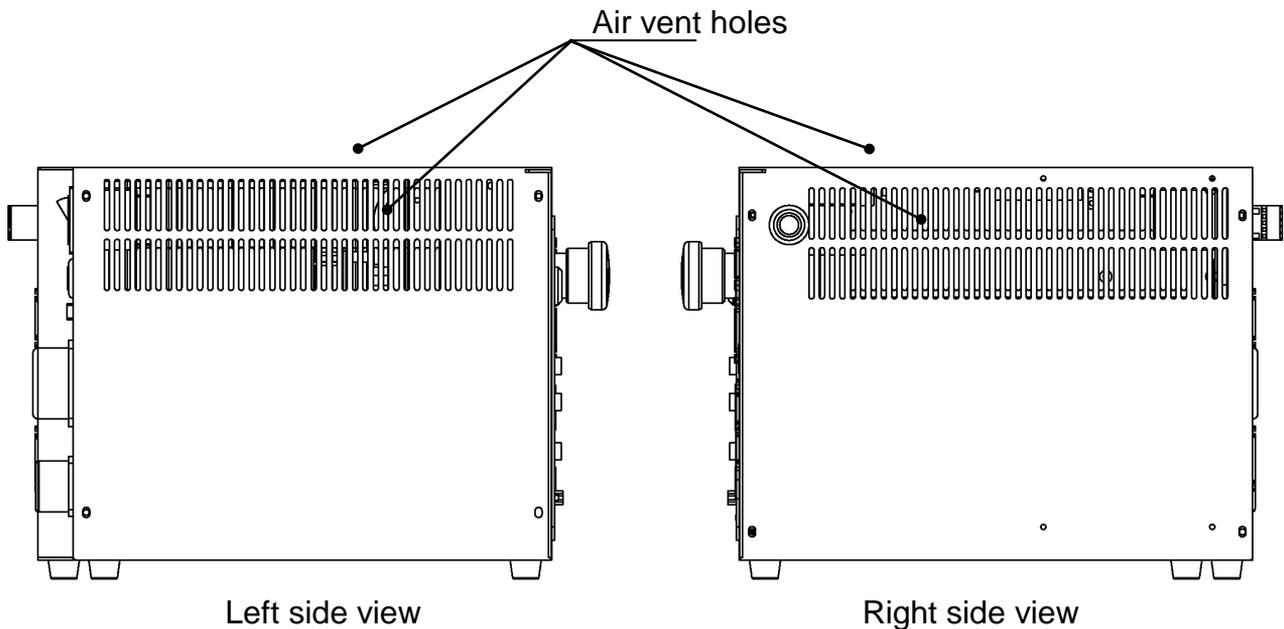
Fig. 3.2   Controller side views

a)   If there is any obstacle, move it away from the air vent hole so that air flow is
      not blocked.

b)   Make sure that no contaminant is left on the air vent holes.   If any contaminant
      is left on the vent hole, remove it.

c)   If the controller is placed sideways, make sure that the air vent holes on the
      bottom surface of the controller are more than 11 mm away from the floor
      surface.   Always keep the space of 11 mm or over.   The length of rubber shoe
      is approximately 11 mm.

3.3.2 Check of Safety Devices for Function

Make sure that the EMERGENCY stop pushbutton switches equipped on the control panel and teach pendant work properly.   Also make sure that the safety devices controlled by the external operation input signals work correctly.
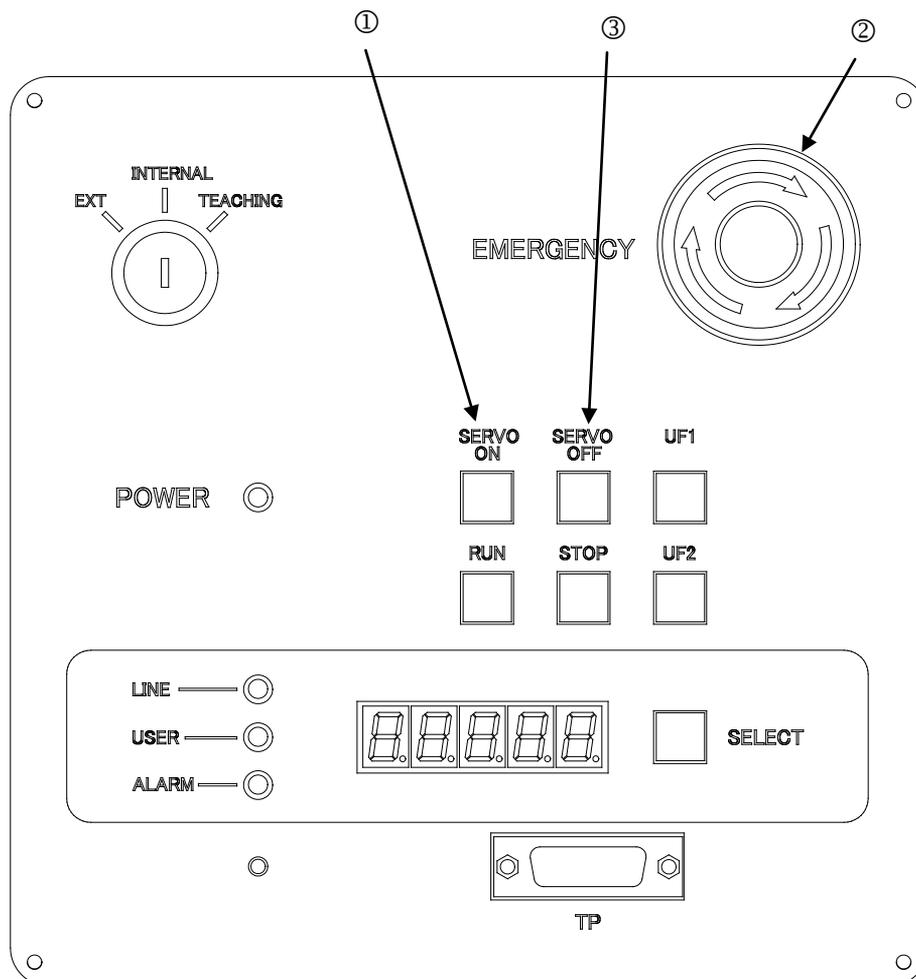
Fig. 3.3   Layout of control panel switches

a)   Make sure that the EMERGENCY (emergency stop) switch [2] provided on the control panel functions properly.

1)   Press the SERVO ON switch [1] provided on the control panel to turn the servos on and make sure that the SERVO ON switch [1] LED is illuminated.

2)   Press the EMERGENCY switch [2] and make sure that the servos are turned off.   The SERVO ON switch [1] LED goes out and the SERVO OFF switch [3] LED is illuminated.   At this time, make sure that the EMERGENCY switch [2] remains depressed.

3) Turn the EMERGENCY switch [2] clockwise and make sure that the same switch turns off.

b) Make sure that the EMERGENCY STOP switch [6] provided on the teach pendant functions properly.

1) To turn on the servo power, press the SERVO ON switch [4] on the teach pendant while keeping the ENABLE switch at the neutral position.   Make sure that the SERVO ON switch LED [5] is illuminated.

Note: The servo power cannot be turned on in the INTERNAL and EXT modes.

2) Press the EMERGENCY STOP switch [6] on the teach pendant and make sure that the servos are turned off.   The SERVO ON switch LED [5] goes out.

Fig. 3.4   EMERGENCY STOP switch provided on teach pendant

At this time, make sure that the EMERGENCY STOP switch [5] remains depressed.

3) Turn the EMERGENCY STOP switch [6] clockwise and make sure that the same switch turns off.

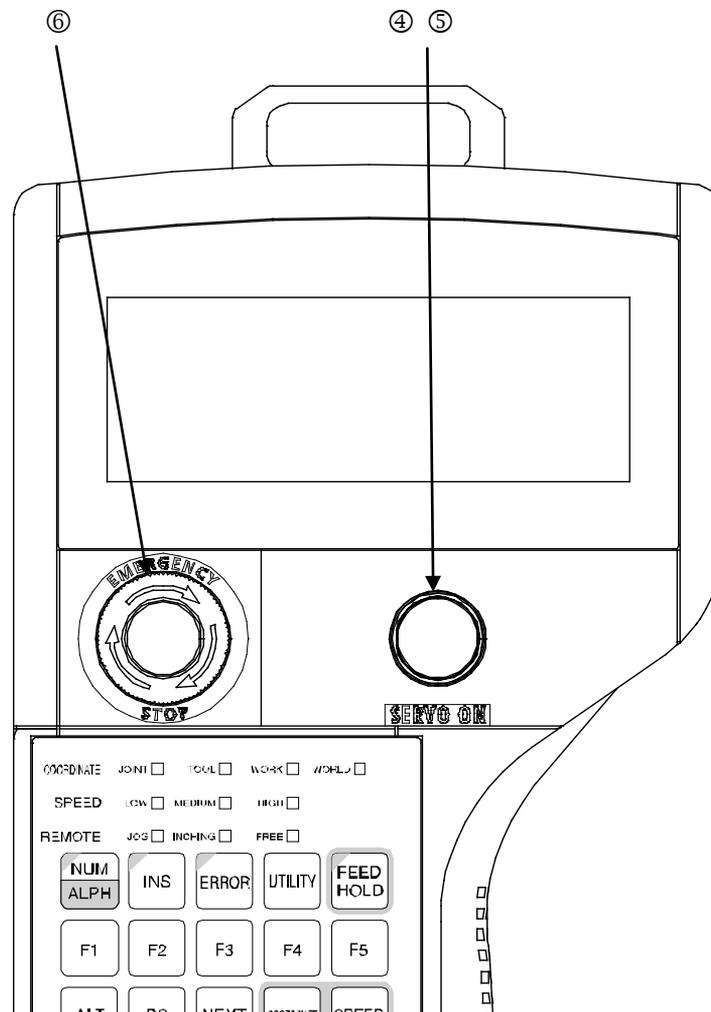c) Make sure that the safety devices controlled by the external operation signals work properly.

1) Press the SERVO ON switch [1] equipped on the control panel to turn on the servo power.   Then turn on (or trip) the safety devices connected with external operation input signal "emergency stop" (such as external emergency stop switch, photoelectric type sensing safety device and foot switch) to make sure that the servo power is turned off.

2) Set ON the safety devices connected with external operation input signal "low speed command", and make sure that each signal functions properly.

3.3.3 Battery Replacement

The memory equipped on the X8GC printed board of the robot controller is backed up by a lithium battery to save the data.   Replace the battery every five (5) years. The lithium battery will turn its life when used for a predetermined time.   If it is used, neglecting the life, the battery voltage will drop to below the voltage required for keeping the memory data, resulting in the data being lost and faults caused by leakage of the battery liquid.

If the following alarm has occurred, replace the battery with a new one.
• 1–145   MAIN Battery alarm (Alarm code 1-45)

Lithium battery   CN3   X8GC
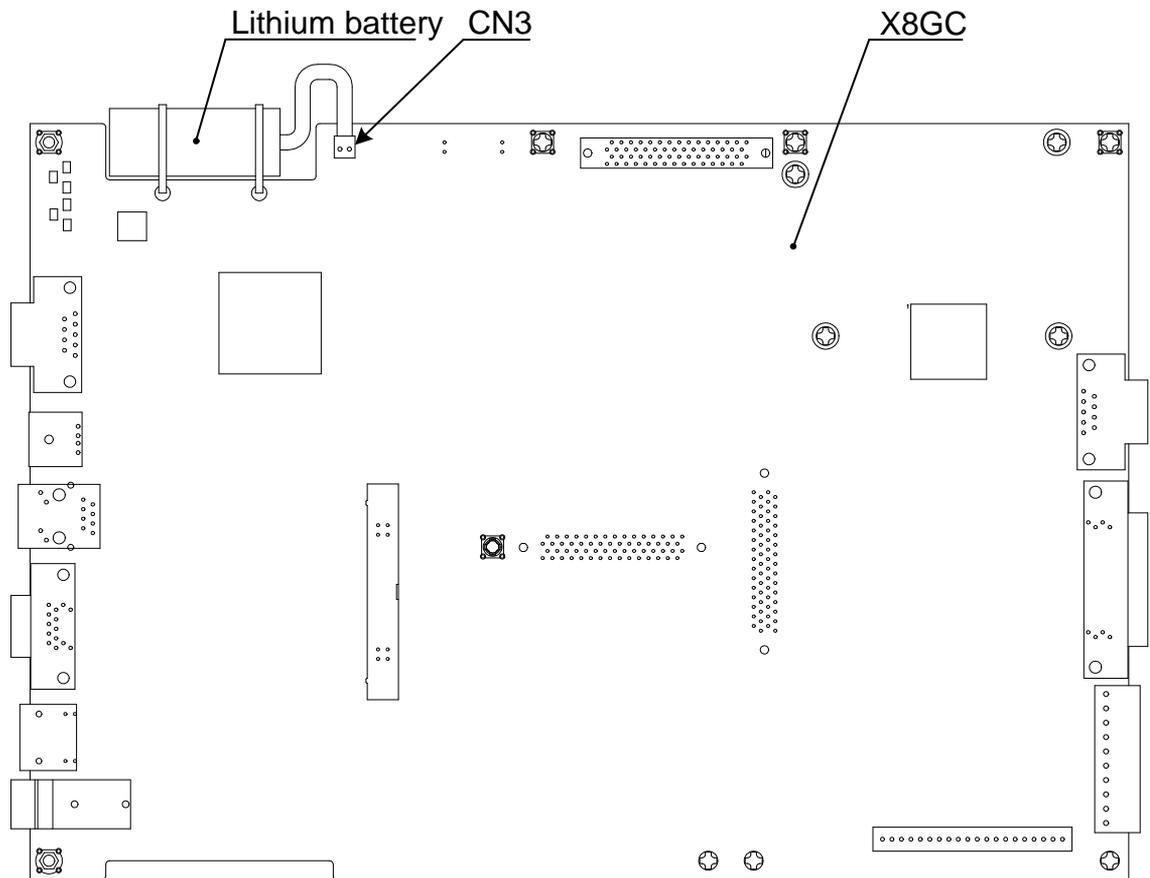
Fig. 3.5   Location of lithium battery

Type of battery	Manufacturer	Battery service life
ER6C WK27	Maxcell	10 years (at room temperature)

Note: The battery life is ten (10) years at the room temperature.   As it differs with the external environment such as operating temperature and humidity, we recommend to replace the battery every five (5) years.
Only the battery shown in Table 3.2 should be used.   As this is an exclusive battery, contact Toshiba Machine at order entry.

[Battery replacement procedures]

1)   If the battery is to be kept removed for more than one (1) minute, copy all programs and various parameters stored in the internal memory to the personal computer.   In the worst case, all memory data are lost.

2)   Set OFF the main power switch.

3) Prepare a new battery, then remove the cover from the controller.

4) Disconnect the battery connector from CN3 of the X8GC printed board, and remove the battery from the TY-RAP securing the battery.
(For the battery position, see Fig. 3.5.)

5) Set the new battery immediately.   (If the battery is kept removed for more than one (1) minute, all memory data are lost.)
Even if not used, the lithium battery capacity decreases by natural discharge. Use a lithium battery which is within three (3) years (kept at the room temperature) from purchasing.

6) Mount the cover on the controller.

7) If the battery is kept removed for more than one (1) minute, turn on the main power switch and load the programs and various parameters from the floppy disk unit or personal computer in which the TSPC (option) is already installed. If the controller has detected the battery voltage drop alarm even before the five (5)-year replacement period, replace the battery immediately.

⚠ **CAUTION**

- Waste battery should be disposed of according to the user's in-house regulations.

  NEVER drop the battery into fire.   NEVER short-circuit, charge, disassemble or heat it.   Otherwise, liquid leakage or rupture may be caused.

3.3.4 Replacement of Switching Power Supply Unit

The life of the switching power supply unit (DC5 V/DC24 V) used in the robot controller differs with the operating conditions.   This unit uses an aluminum electrolytic capacitor, and if the load current is large, the running time is long and the ambient temperature is high, the life will reduce.
As the life varies largely with the user's operating conditions (5 ~ 10 years), replace the power supply unit every five (5) years for preventive maintenance.

[Replacement procedures]

1) Turn off the main power switch.

2) Turn off the power breaker.

3) Remove the cover from the controller.

4) Remove the two (2) screws securing the switching power supply (PS1).

PS
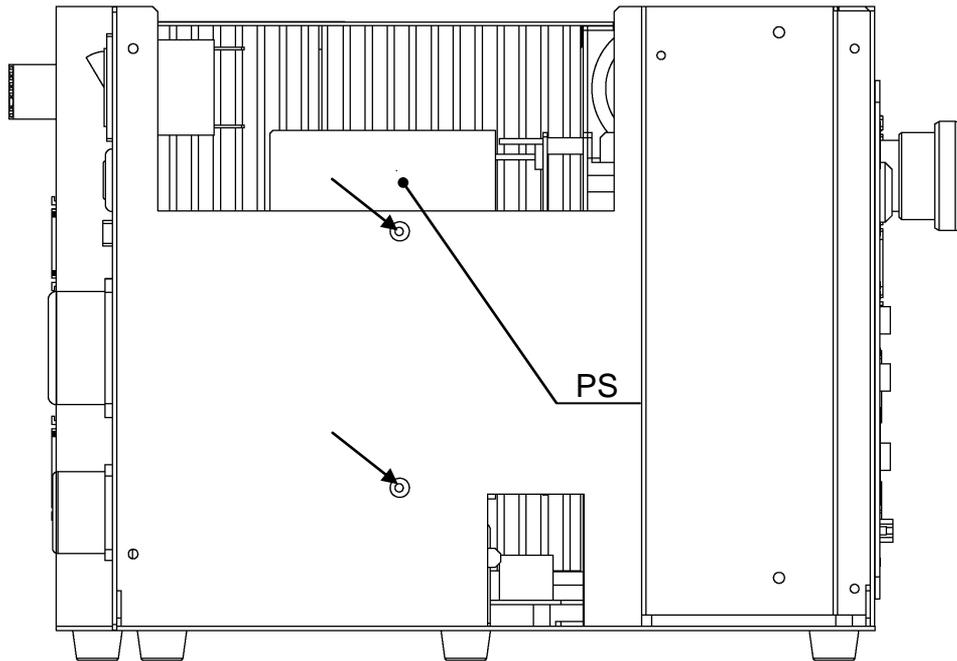
Fig. 3.6   Lower part of the TS3000 left side

5) Mount the new power supply unit on the controller by tightening the screws. (At 2 positions)

6) Attach the cover to the controller.

3.3.5 Replacement of Fuse (X8GN, X8GI Printed Board)

If the current exceeding the specified current has run through the I/O unit, the fuse in the front of TS3000 controller is blown out.   If the alarm saying "I/O Fuse Broken (8–273)" is displayed, replace the fuse with a new one.
If the fuse of the output module has been blown out, examine and identify an fault circuit, remedy the cause, then replace the fuse.

Fuse holder   Fastened
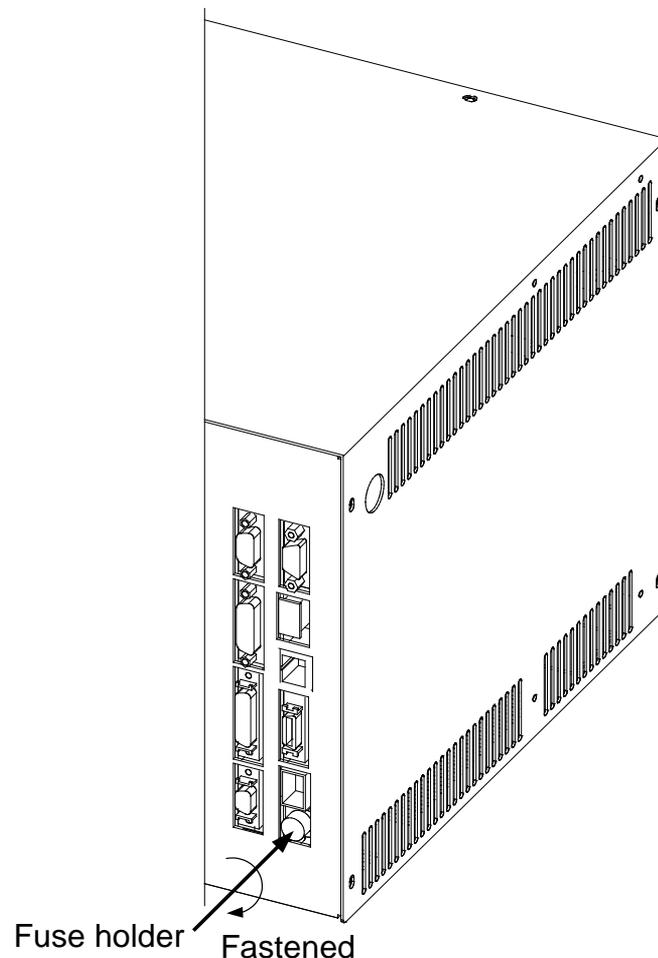
Type of fuse	Manufacturer
51NM030H	PICO

[Replacement procedures]

1)   Turn off the controller main power.
2)   Remove the fuse holder in the above figure. (Push and turn the holder to the left by 90°.   It will be unlocked.)
3)   Remove the fuse and set a new fuse.

4) Mount the fuse holder. (Push and turn the holder to the right by 90°. It will be locked.)

1) Turn on the controller main power and make sure that no error will occur.

3.3.6 Replacement of Output ICs (X8GN, X8GI Printed Board)

If the current exceeding the specified current has run through the output unit, the ICs on the X8GC, X8GN (X8GI) printed board is damaged.

When this happens, replace the ICs.

Before the replacement, examine and identify an fault circuit, remedy the cause, then replace the ICs.

The relationship between the output ICs [2] and output signals is shown below.

[1] Output IC

[2] Output IC U3
User output signal:
DOUT1 ~ DOUT8
Connector: OUTPUT

[2] Output IC U4
User output signal:
DOUT9 ~ DOUT16
Connector: OUTPUT

[2] Output IC U5
User output signal:
DOUT17 ~ DOUT24
Connector: OUTPUT

[2] Output IC U6
User output signal:
DOUT25 ~ DOUT32
Connector: OUTPUT

I/O printed board(X8GN/X8GI)

[2] Output IC U83
System output signal:
ACK. TEACH. EXT-SiG
(SYSTEM-29~ -36 signal)
Connector: SYSTEM

[2] Output IC U79
Hand output signal:
DOUT201 ~ DOUT208
Connector: HAND

[2] Output IC U82
System output signal:
SV_RDY.BT_ALM
(SYSTEM-21~ -28 signal)
Connector: SYSTEM

Main printed board (X8GC)

	Name of board	Type of IC	Manufacturer
[1]	X8GN	TD62082AP	Toshiba Corp.
[2]	X8GI	M54562WP	Mitsubishi Electric

[Replacement procedures]

1) Turn off the controller main power.

2) Remove the cover from the controller.

3) Disconnect all connectors connected to the X8GC, X8GN (X8GI) printed board in the controller.

4) Disconnect the X8GC, X8GN (X8GI) printed boards from the controller.

5) Remove the ICs shown above from respective sockets.

6) Attach the new ICs to the sockets.

7) Mount the X8GC, X8GN (X8GI) printed boards on the controller.

8) Connect all disconnected connectors to the X8GC printed board, then attach the controller cover.

9) Turn on the controller main power.

Section 4 Maintenance Replacement Parts

4.1 Robot Main Body Maintenance Replacement Parts List

List of [1] TH250A/[2] TH350A/[3]TH350A-T replacement parts for maintenance

Part name	Model	Type	Unit code	Maker	Q'ty	Remarks
AC servo motor	[1] [2] [3]	S746329	Y610A34D0		1	Axis 1
	[1] [2] [3]	S753268	Y610A34E0		1	Axis 2
	[1] [2] [3]	S777296	Y610A37A0		1	Axis 3
	[1] [2] [3]	S777297	Y610A37B0		1	Axis 4
Reduction gear	[1]	M074824	Y610A3020		1	Axis 1
	[2] [3]	M086369	Y610A3030		1	Axis 1
	[1] [2] [3]	M074825	Y610A3040		1	Axis 2
Battery	[1] [2] [3]	Size AA alkali battery (LR6AG)			3	
Planetary reduction gear	[1] [2] [3]	M074826	Y610A3050	Toshiba Machine Co., Ltd.	1	Axis 4
Timing belt	[1] [2] [3]	S777403			1	Axis 3
	[1] [2] [3]	S777404			1	Axis 4
Timing pulley	[1] [2] [3]	S777399			1	Axis 3
	[1] [2] [3]	S777400			1	Axis 3
	[1] [2] [3]	S777401			1	Axis 4
	[1] [2] [3]	S777402			1	Axis 4
Ball screw spline	[1] [2] [3]	S711330	Y610A3010		1	Axis 3
Main harness	[1]	H14051G01	Y610A3740		1	
	[2]	H14051G02	Y610A3750		1	
	[3]	F14276G01	Y610A3790		1	
Grease	[1] [2] [3]	4B No.2		Harmonic Drive Systems	500 g 2.5 kg	
	[1] [2] [3]	OT–20 2		Solvay Solexis	2.5 kg	

⚠ CAUTION

- With the exception of the grease, all parts listed above are custom-made to Toshiba Machine specifications.   Contact Toshiba Machine at order entry.
- NEVER replace the parts other than the batteries by the user.

List of TH180 replacement parts for maintenance

Part name	Type	Unit code	Maker	Q'ty	Remarks
AC servo motor	S777273	Y610A3620	Toshiba Machine Co., Ltd.	1	Axis 1
	S777271	Y610A3600		1	Axis 2
	S777272	Y610A3610		1	Axis 3
	S777271	Y610A3600		1	Axis 4
Reduction gear	S777267	Y610A3630		1	Axis 1
	S777268	Y610A3640		1	Axis 2
Battery	Size AA alkali battery (LR6AG)			3	
Planetary reduction gear	S777269	Y610A3650		1	Axis 4
Timing belt	243-3GT-9			1	Axis 3
	250-5GT-15			1	Axis 4
Timing pulley	S777217			1	Axis 3
	S777216			1	Axis 3
	S777219			1	Axis 4
	S777218			1	Axis 4
Ball screw spline	S711330	Y610A3010		1	Axis 3
Main harness	H14039G	Y610A3690		1	
Grease	OT-20		Solvay Solexis	2.5 kg	

⚠️ **! CAUTION**

- With the exception of the grease, all parts listed above are custom-made to Toshiba Machine specifications.   Contact Toshiba Machine at order entry.

- NEVER replace the parts other than the batteries by the user.

4.2   List of Mechanical Replacement Parts for Maintenance

TH250A/TH350A/TH350A-T

NO.	Part name	Type		Q'ty	Remarks
1	PS1 (Switching power supply)	LEB100F-0524		1	
3	Main power switch	IR-11-A8-25-1BF		1	
4	Lithium battery	ER6C WK27		1	
5	Fuse	51NM030H		1	X8GC printed board
6	Printed circuit board	X8GCA (Main control)	Y610A4000	1	Type N
		X8GCA (Main control)	Y610A4020	1	Type P
		X8GNA (I/O printed board)	Y610A40A0	1	Type N
		X8GIA (I/O printed board)	Y610A40B0	1	Type P
		X8G3A(10A) (Servo)	Y610A40H0	1	Axis 1
		X8G3B(5A) (Servo)	Y610A40K0	3	Axes 2, 3, 4
		X8GHA (Servo power supply)	Y610A40S0	1	
		X8GBA (Mother board)	Y610A40R0	1	
7	Operation panel unit	TS3000CP1	Y610A4080	1	
8	Teach pendant	TP1000	Y610A2600	1	With 5 m long cable
9	System disk	TS3000SYS		1	

TH180

NO.	Part name	Type		Q'ty	Remarks
1	PS1 (Switching power supply)	LEB100F-0524		1	
3	Main power switch	IR-11-A8-25-1BF		1	
4	Lithium battery	ER6C WK27		1	
5	Fuse	51NM030H		1	X8GC printed board
6	Printed circuit board	X8GCA (main control)	Y610A4000	1	Type N
		X8GCA (main control)	Y610A4020	1	Type P
		X8GNA (I/O board)	Y610A40A0	1	Type N
		X8GIA (I/O board)	Y610A40B0	1	Type P
		X8G3B(5A) (servo)	Y610A40K0	1	Axis 1
		X8G3C(2.5A) (servo)	Y610A40J0	3	Axes 2, 3, 4
		X8GHA (servo power supply)	Y610A40S0	1	
		X8GBA (mother board)	Y610A40R0	1	
7	Operation panel unit	TS3000CP1	Y610A4080	1	
8	Teach pendant	TP1000	Y610A2600	1	With 5 m long cable
9	System disc	TS3000SYS		1	

⚠ CAUTION

- As the parts shown in the Controller Maintenance Parts List are all special specification items, please contact us for their purchases and orders.

- The replacement work of maintenance parts will be done by our service staff. We will not warrant for any failures and accidents if the parts are replaced by the customer.