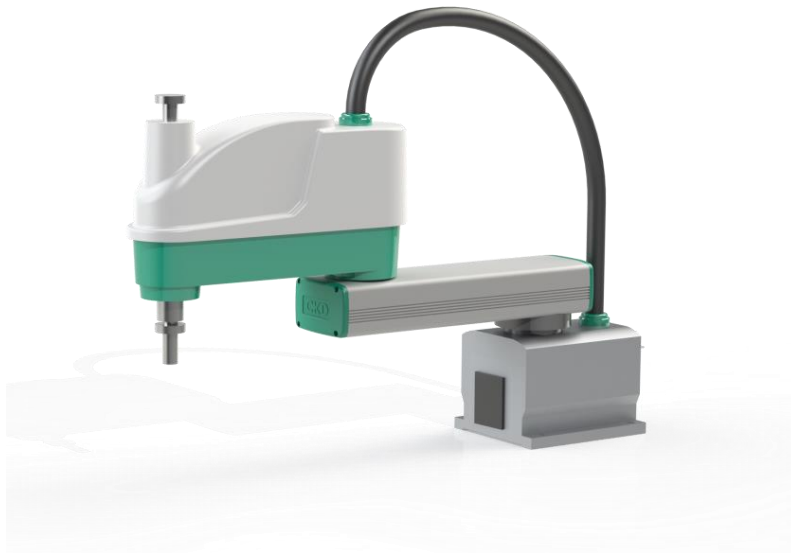


SCARA Robot

KHL Ceiling Type(Overhead Traveling Type)
Industrial Robot Specifications

INSTRUCTION MANUAL

SM-A20063-A



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

CKD Corporation

Preface

This manual describes SHIBA specifications of the KHL series ceiling type (or overhead traveling type) industrial robot.

This manual is essential to keep the robot performance for a long time, to prevent failures and to assure safety. Be sure to look through this manual and set up a maintenance program before actually starting the robot.

This manual is comprised of the following five (5) sections:

Section 1 Specifications

This section describes the basic specifications and names of respective parts for the ceiling type (or overhead traveling type) industrial robot.

Section 2 Transportation

This section describes how to remove the ceiling type robot from its box and how to transport it to the installation site. This section also deals with the precautions to be taken when the robot is to be stored temporarily after unpacked.

Section 3 Installation

This section discusses the ceiling type robot installation environment, space requirements, and how to install the robot.

Section 4: System connection

This section describes the procedures for connecting cables of the call controller between the robot and controller, and the peripheral equipment. For details, see the Part of Installation/Transportation or Interface.

Section 5: Tool interface

This section describes how to install the tool on the robot arm and how to connect the cables and pipes to the tool. For details, see the Part of Installation/Transportation or Interface.

Section 6 Maintenance

This section describes the structure of the ceiling type robot and all items required for the maintenance and inspection of the same robot.

Section 7 Replacement Parts for Maintenance

This section explains the replacement parts for the maintenance.

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 imminently lead to fatalities or major 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 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). 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 and caution. The details of the actual danger and caution are indicated with pictures or words in or near the symbol.

[Maintenance and inspection]

Be sure to observe the following items to use this product safely.

 DANGER	
 Prohibited	• DO NOT incinerate, disassemble or charge the batteries. Otherwise, they may rupture.
 Mandatory	• Be sure to disconnect the power plug or 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 CKD'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

	Page
Preface	3
Precautions on Safety	4
Table of Contents	7
1 Specifications	9
1.1 Name of Each Part	9
1.2 Outer Dimensions	11
1.3 Specifications Table	19
1.4 Position of Cautionary Statement	24
1.4.1 Position of Cautionary Statement for Robot (KHL400-T)	24
1.4.2 Position of Cautionary Statement for Robot (KHL-500-T, KHL-600-T, KHL-700-T)	25
1.4.3 Position of Cautionary Statement for Controller	25
2 Transportation	26
2.1 Unpacking	26
2.2 Transportation	27
2.2.1 Mass and Outer Dimensions	27
2.2.2 Transporting the Robot	29
2.3 Storage	33
2.3.1 Storage Precautions for the Robot	33
2.3.2 Storage Precautions for the Controller	33
3 Installation Environment	34
3.2 External View and Operating Range	36
3.3 Change of Operating Range	40
3.3.1 Change of Operating Range for Axes 1 and 2	40
3.3.2 Change of Operating Range for Axis 3	41
3.4 Installation Posture of the Robot	41
3.4.1 Coordinate System	42
3.4.2 Installing the Robot	46
3.4.3 Frame Rigidity	49
3.5 Controller Installation	50
4 System Connection	50
5 Tool Interface	50

6 Maintenance 51

6.1 Layout of Robot Components 51

7 Replacement Parts for Maintenance 53

7.1 Replacement Parts List for Maintenance 53

1 Specifications

1.1 Name of Each Part

Fig. 1.1 illustrates the names of various parts of the KHL-400-T robot. It should be noted that the KHL-500-T, KHL-600-T and KHL-700-T are the same with each other, except for the arm 1 and base. Fig. 1.2 shows the KHL-600-T as an example.

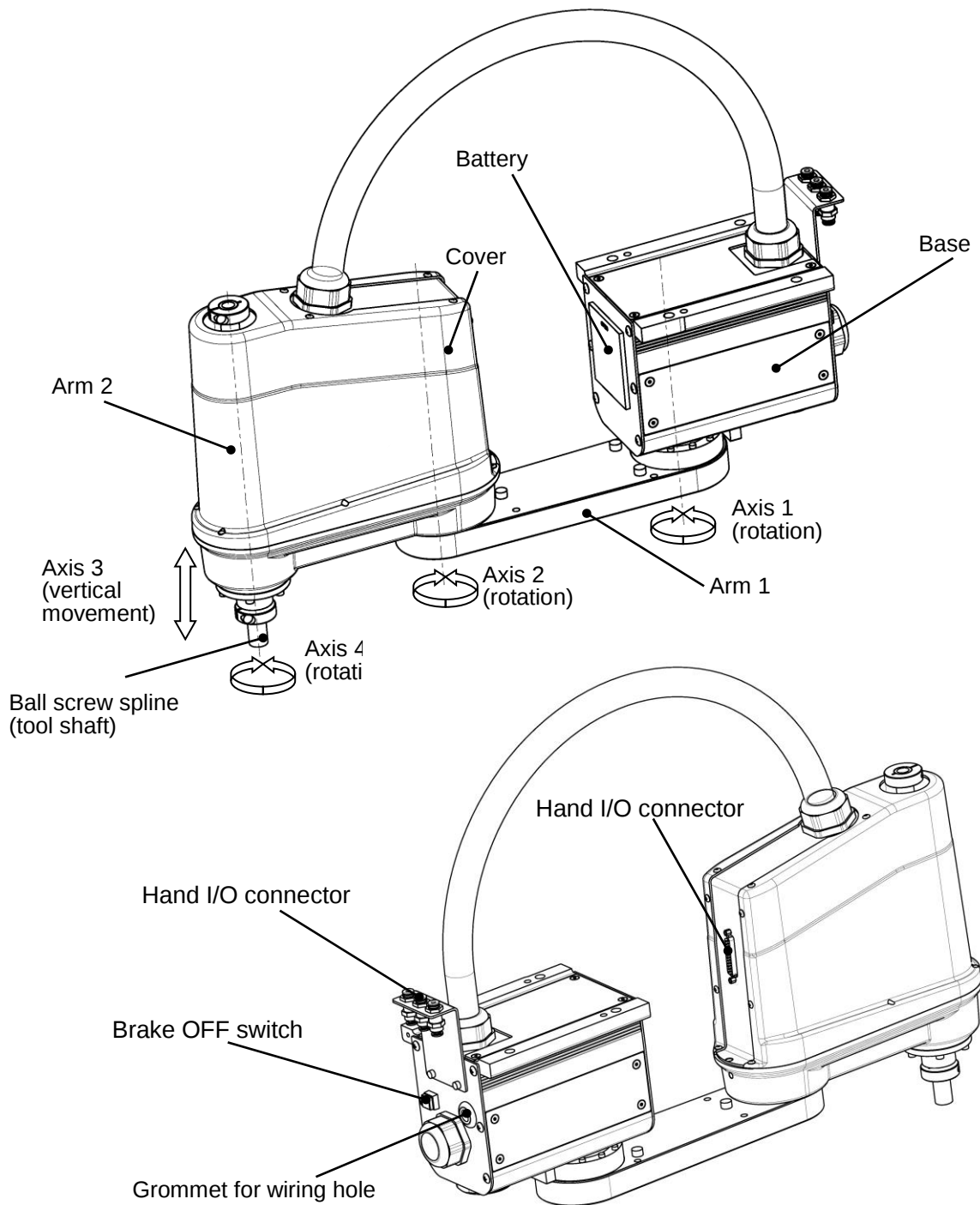


Fig. 1.1 Name of each part (KHL-400-T)

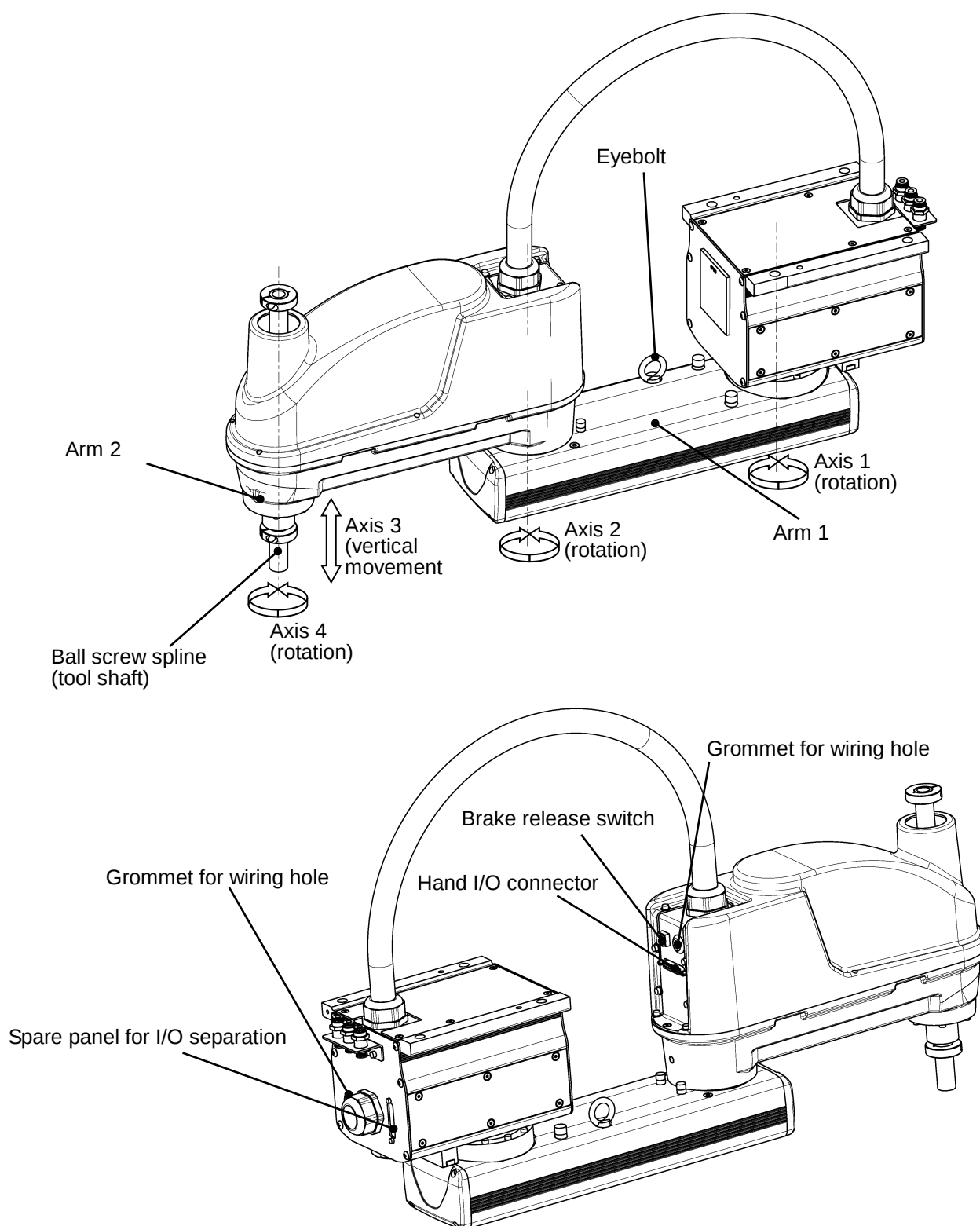


Fig. 1.2 Name of each part (KHL-600-T)

1.2 Outer Dimensions

Fig. 1.3 to Fig. 1.10 show the outer dimensions and operating range of the ceiling type robot.

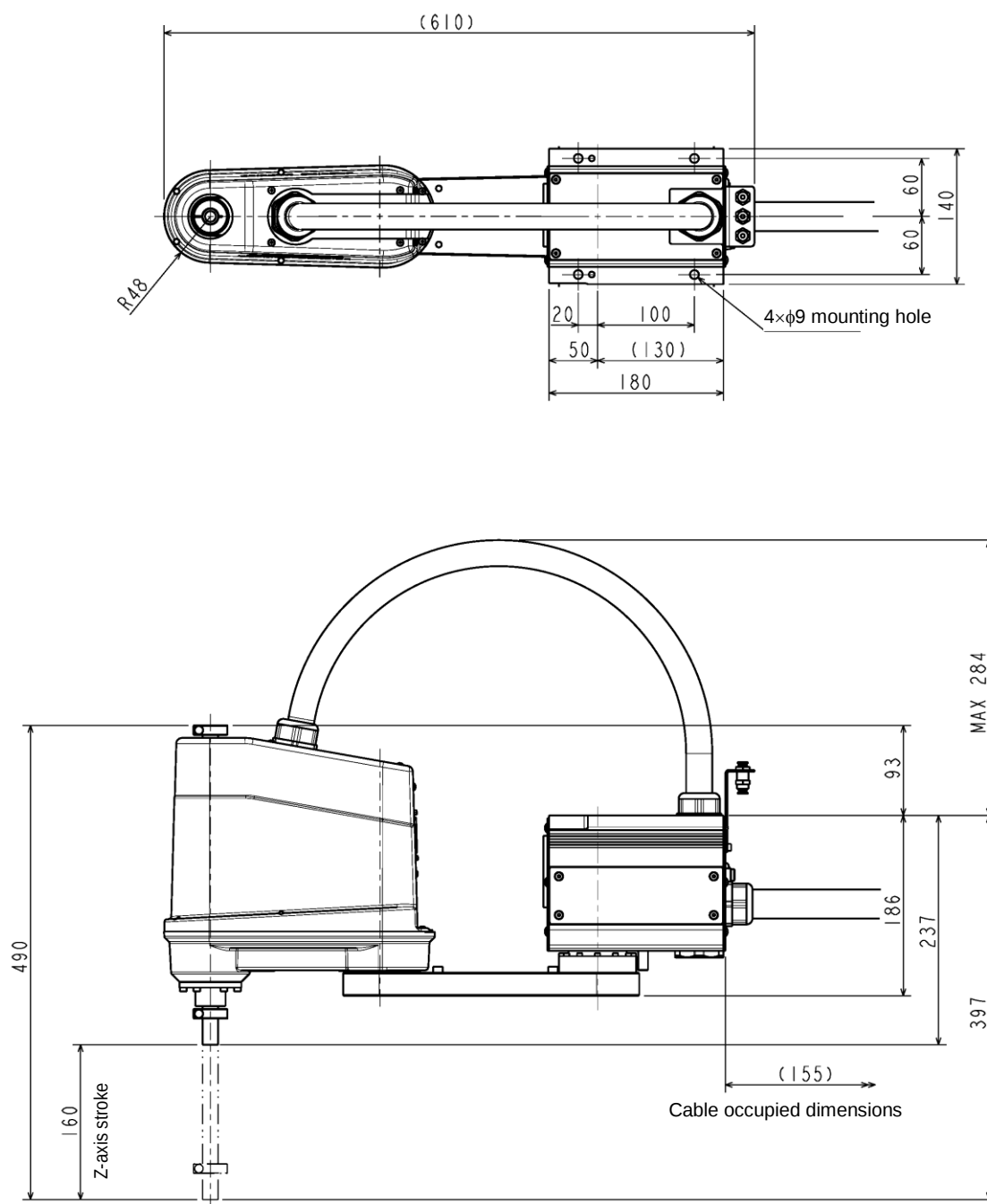


Fig. 1.3 Outer dimensions of the robot (KHL-400-T)

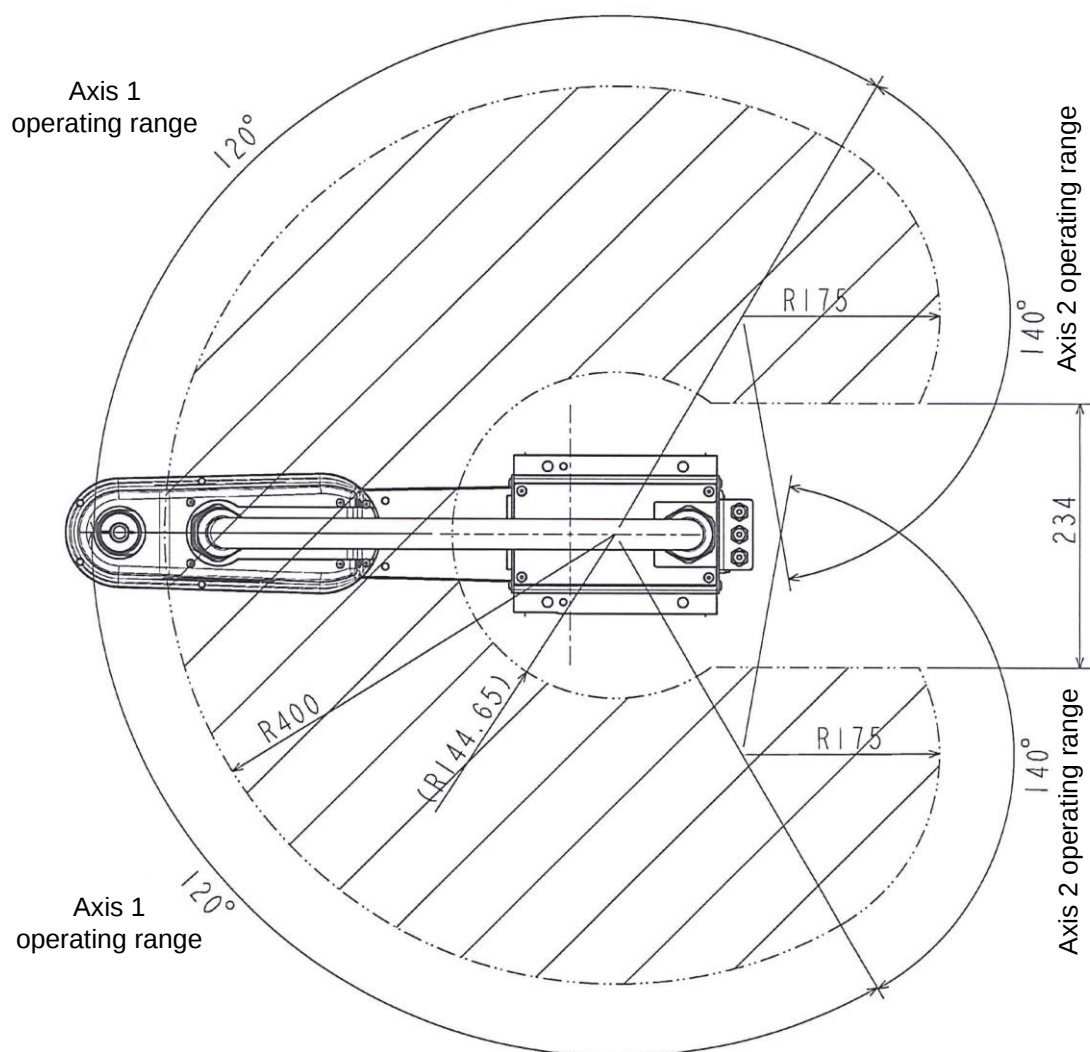


Fig. 1.4 Operating range of the robot (KHL-400-T)

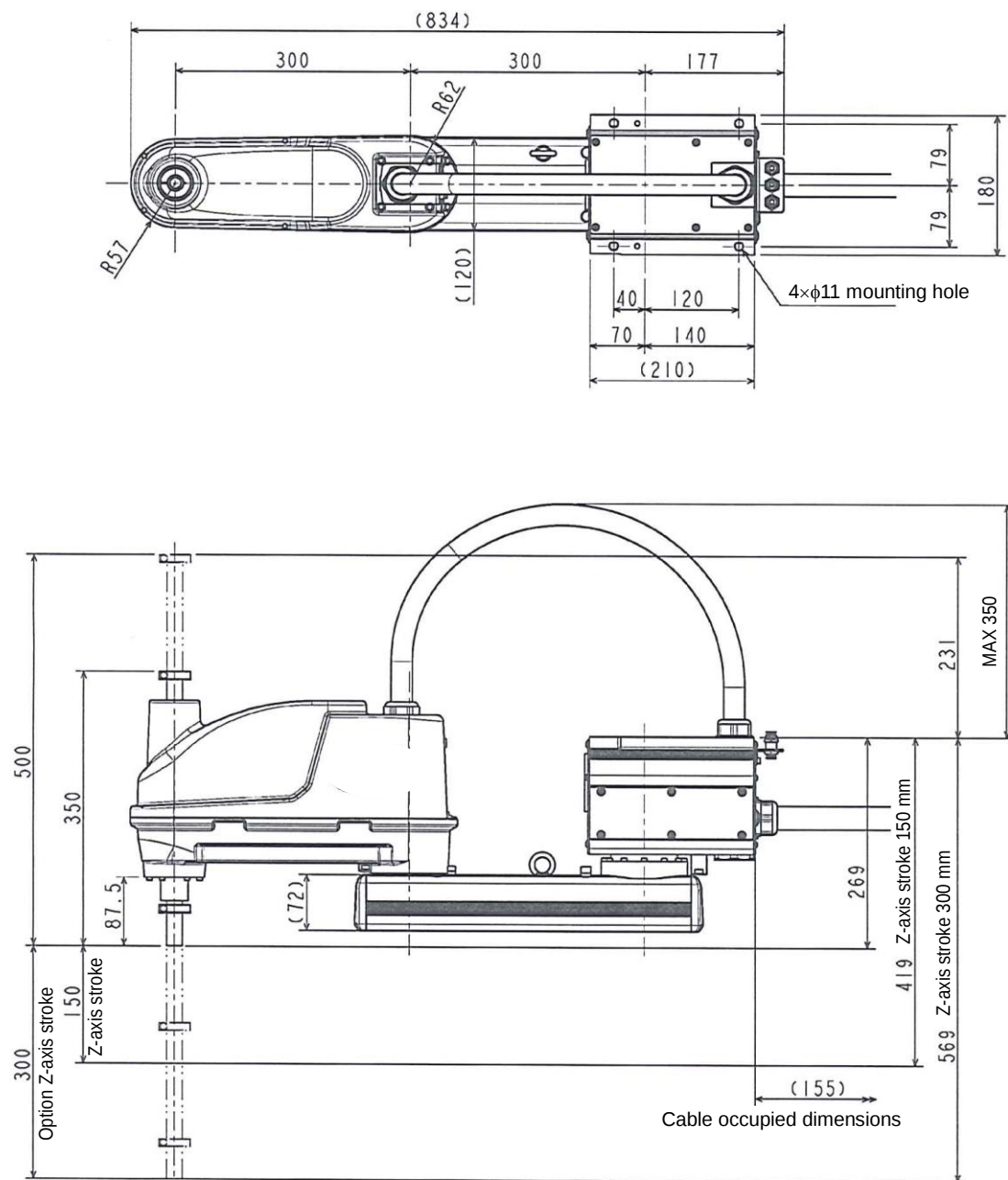


Fig. 1.5 Outer dimensions of the robot (KHL-500-T)

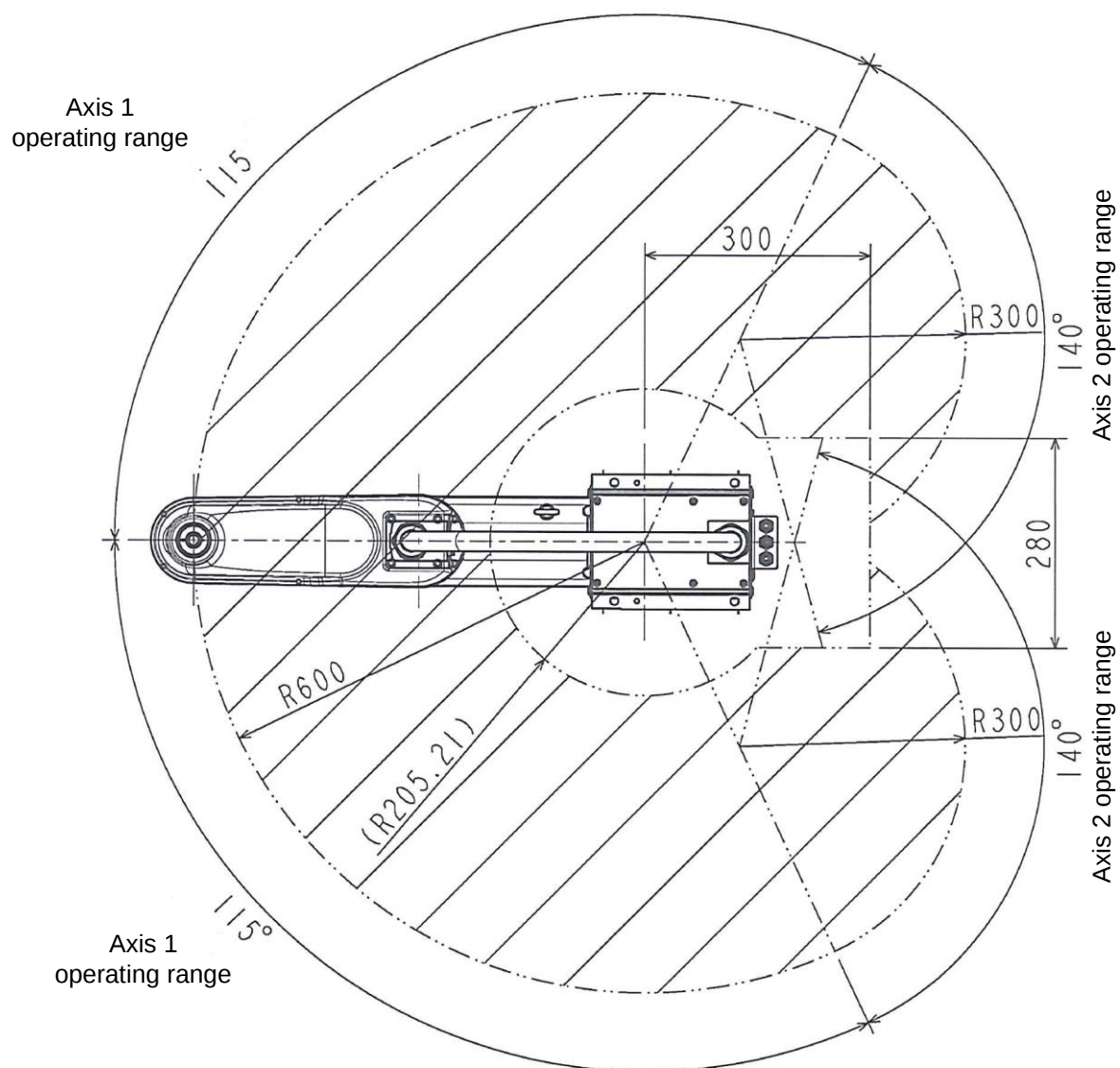


Fig. 1.6 Operating range of the robot (KHL-500-T)

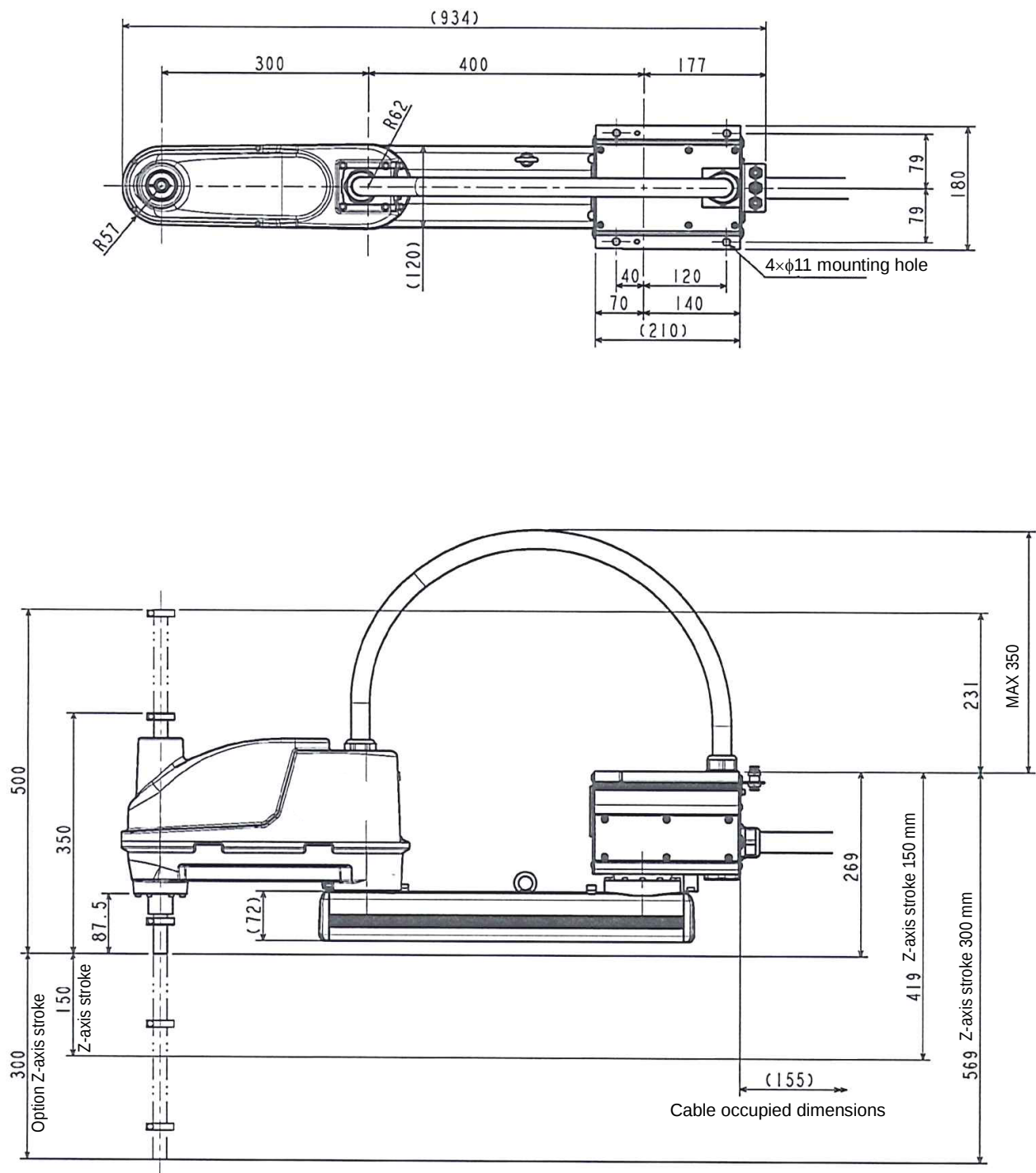


Fig. 1.7 Outer dimensions of the robot (KHL-600-T)

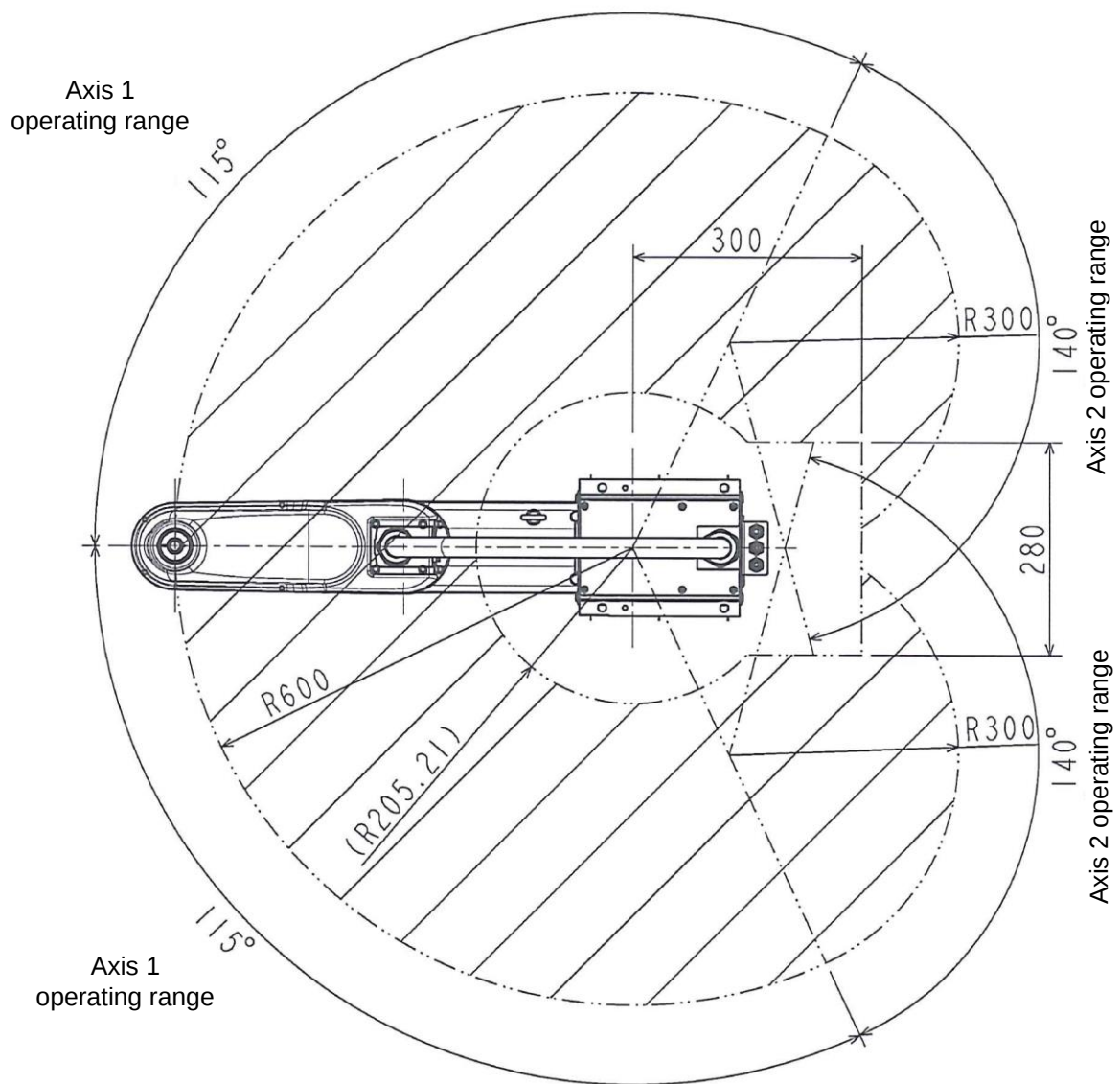


Fig. 1.8 Operating range of the robot (KHL-600-T)

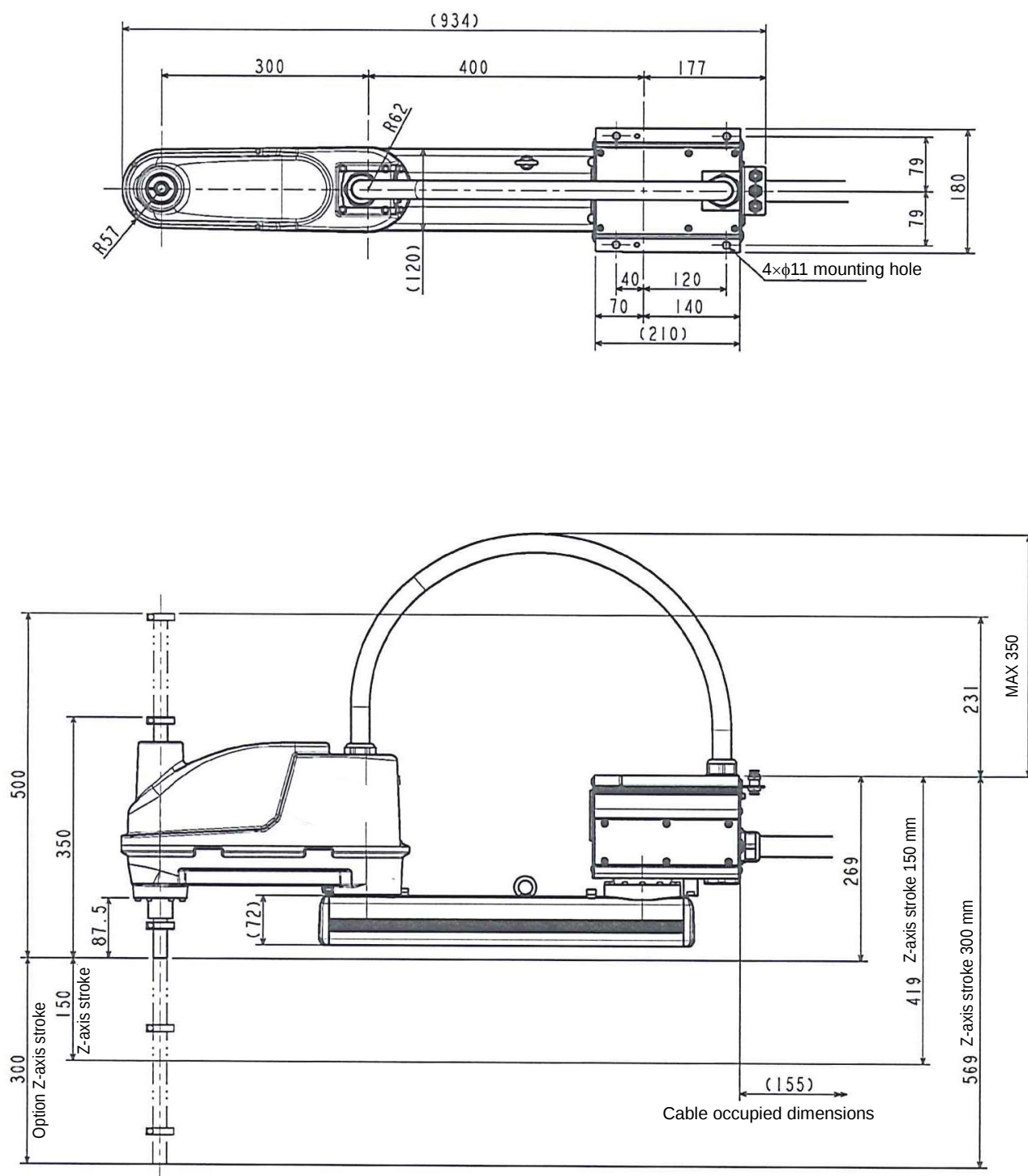


Fig. 1.9 Outer dimensions of the robot (KHL-700-T)

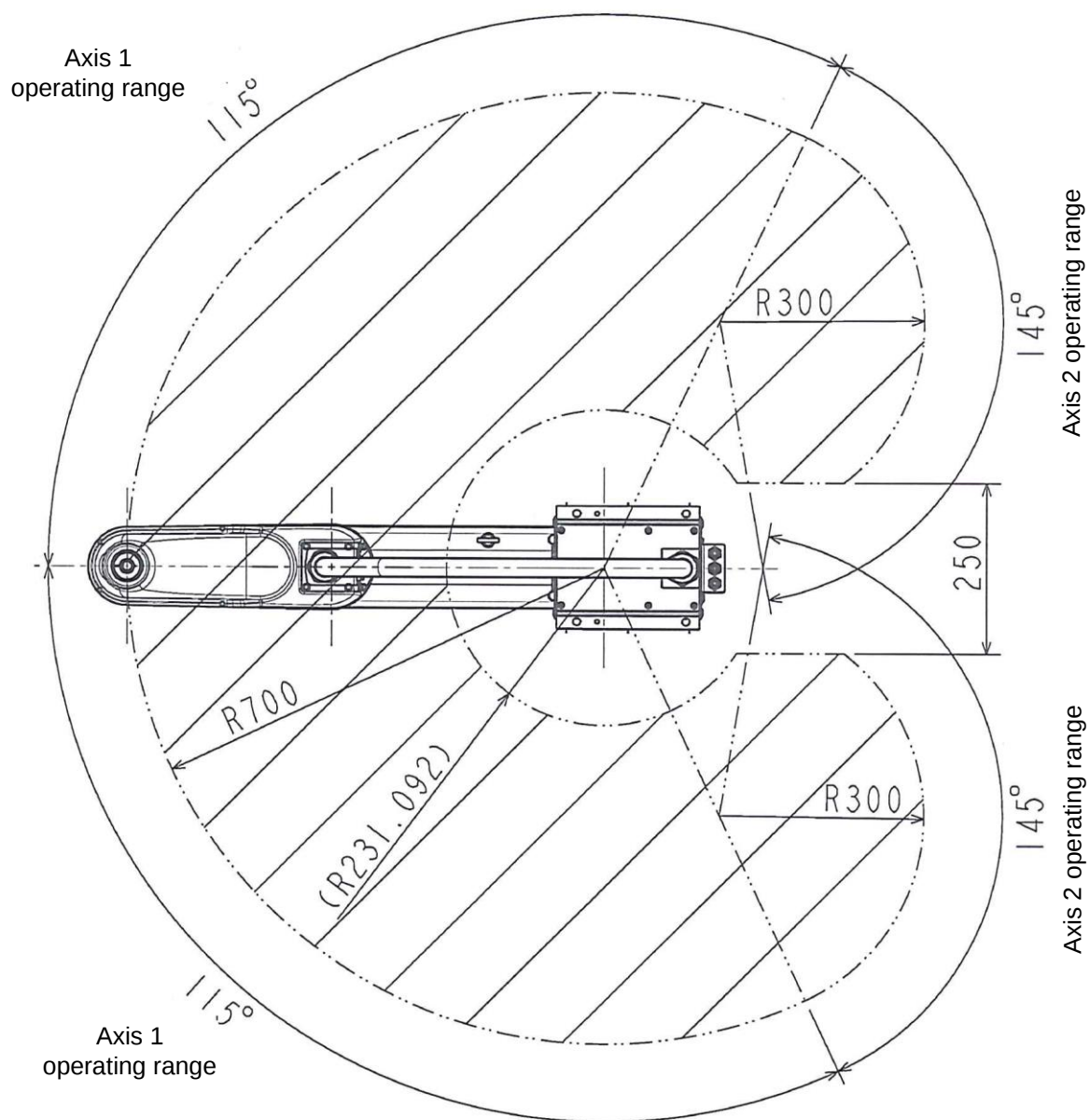


Fig. 1.10 Operating range of the robot (KHL-700-T)

1.3 Specifications Table

[KHL-400-T]

Item		Specifications
Structure		Horizontal multi-joint type SCARA robot
Model		KHL-400-T
Applicable controller		KSL3000
Mass of robot body		13 kg
No. of controlled axes		4
Arm length		400 mm (225 mm + 175 mm)
Motor capacity	Axis 1	200 (W)
	Axis 2	100 (W)
	Axis 3	100 (W)
	Axis 4	100 (W)
Operating range	Axis 1	±120 (deg)
	Axis 2	±140 (deg)
	Axis 3	0 to 160 (mm)
	Axis 4	±360 (deg)
Maximum speed (*1)	Axis 1	660 (deg/s)
	Axis 2	660 (deg/s)
	Axis 3	1120 (mm/s)
	Axis 4	1500 (deg/s)
	Composite speed of axes 1 and 2	6.3 (m/s)
Rated payload mass		2 (kg)
Maximum payload mass		5 (kg)
Permissible load inertia (*1)		0.05 (kg·m ²)
Repeatability (*2)	X, Y	±0.01 (mm)
	Z	±0.015 (mm)
	C	±0.007 (deg)
Cycle time (*3) (When payload mass is 2 kg)		0.47 (sec)
Drive system		By means of AC servo motors
Position detection method		Absolute
Power capacity		0.7kVA

*1: When the mass of load exceeds 2 kg, or when the gravity center position of load is away from the axis 4 center position, both the speed and acceleration should be reduced, using the PAYLOAD command.

*2: This is the value for the single-direction repeatability at a fixed ambient temperature. This is not the absolute positioning accuracy.

*3: The continuous operation in excess of the effective load factor of the standard cyclic operation pattern is disabled. Shuttle time for rough positioning in horizontal direction of 300 mm and vertical direction of 25 mm.

[KHL-500-T]

Item		Specifications
Structure		Horizontal multi-joint type SCARA robot
Model		KHL-500-T
Applicable controller		KSL3000
Mass of robot body		22 kg
No. of controlled axes		4
Arm length		500 mm (200 mm + 300 mm)
Motor capacity	Axis 1	400 (W)
	Axis 2	200 (W)
	Axis 3	200 (W)
	Axis 4	200 (W)
Operating range	Axis 1	±115 (deg)
	Axis 2	±115 (deg)
	Axis 3	0 to 150 (mm) [Option: 0 to 300 (mm)]
	Axis 4	±360 (deg)
Maximum speed (*1)	Axis 1	450 (deg/s)
	Axis 2	450 (deg/s)
	Axis 3	2000 (mm/s)
	Axis 4	1700 (deg/s)
	Composite speed of axes 1 and 2	6.3 (m/s)
Rated payload mass		2 (kg)
Maximum payload mass		10 (kg)
Permissible load inertia (*1)		0.2 (kg·m ²)
Repeatability (*2)	X, Y	±0.01 (mm)
	Z	±0.015 (mm)
	C	±0.007 (deg)
Cycle time (*3) (When payload mass is 2 kg)		0.45 (sec)
Drive system		By means of AC servo motors
Position detection method		Absolute
Power capacity		1.4kVA

*1: When the mass of load exceeds 2 kg, or when the gravity center position of load is away from the axis 4 center position, both the speed and acceleration should be reduced, using the PAYLOAD command.

*2: This is the value for the single-direction repeatability at a fixed ambient temperature. This is not the absolute positioning accuracy.

*3: The continuous operation in excess of the effective load factor of the standard cyclic operation pattern is disabled. Shuttle time for rough positioning in horizontal direction of 300 mm and vertical direction of 25 mm.

[KHL-600-T]

Item		Specifications
Structure		Horizontal multi-joint type SCARA robot
Model		KHL-600-T
Applicable controller		KSL3000
Mass of robot body		23 kg
No. of controlled axes		4
Arm length		600 mm (300 mm + 300 mm)
Motor capacity	Axis 1	400 (W)
	Axis 2	200 (W)
	Axis 3	200 (W)
	Axis 4	200 (W)
Operating range	Axis 1	±115 (deg)
	Axis 2	±140 (deg)
	Axis 3	0 to 150 (mm) [Option: 0 to 300 (mm)]
	Axis 4	±360 (deg)
Maximum speed (*1)	Axis 1	450 (deg/s)
	Axis 2	450 (deg/s)
	Axis 3	2000 (mm/s)
	Axis 4	1700 (deg/s)
	Composite speed of axes 1 and 2	7.1 (m/s)
Rated payload mass		2 (kg)
Maximum payload mass		10 (kg)
Permissible load inertia (*1)		0.2 (kg·m ²)
Repeatability (*2)	X, Y	±0.01 (mm)
	Z	±0.015 (mm)
	C	±0.007 (deg)
Cycle time (*3) (When payload mass is 2 kg)		0.45 (sec)
Drive system		By means of AC servo motors
Position detection method		Absolute
Power capacity		1.4kVA

*1: When the mass of load exceeds 2 kg, or when the gravity center position of load is away from the axis 4 center position, both the speed and acceleration should be reduced, using the PAYLOAD command.

*2: This is the value for the single-direction repeatability at a fixed ambient temperature. This is not the absolute positioning accuracy.

*3: The continuous operation in excess of the effective load factor of the standard cyclic operation pattern is disabled. Shuttle time for rough positioning in horizontal direction of 300 mm and vertical direction of 25 mm.

[KHL-700-T]

Item		Specifications
Structure		Horizontal multi-joint type SCARA robot
Model		KHL-700-T
Applicable controller		KSL3000
Mass of robot body		24 kg
No. of controlled axes		4
Arm length		700 mm (400 mm + 300 mm)
Motor capacity	Axis 1	400 (W)
	Axis 2	200 (W)
	Axis 3	200 (W)
	Axis 4	200 (W)
Operating range	Axis 1	±115 (deg)
	Axis 2	±145 (deg)
	Axis 3	0 to 150 (mm) [Option: 0 to 300 (mm)]
	Axis 4	±360 (deg)
Maximum speed (*1)	Axis 1	450 (deg/s)
	Axis 2	450 (deg/s)
	Axis 3	2000 (mm/s)
	Axis 4	1700 (deg/s)
	Composite speed of axes 1 and 2	7.9 (m/s)
Rated payload mass		2 (kg)
Maximum payload mass		10 (kg)
Permissible load inertia (*1)		0.2 (kg·m ²)
Repeatability (*2)	X, Y	±0.01 (mm)
	Z	±0.015 (mm)
	C	±0.007 (deg)
Cycle time (*3) (When payload mass is 2 kg)		0.5 (sec)
Drive system		By means of AC servo motors
Position detection method		Absolute
Power capacity		1.4kVA

*1: When the mass of load exceeds 2 kg, or when the gravity center position of load is away from the axis 4 center position, both the speed and acceleration should be reduced, using the PAYLOAD command.

*2: This is the value for the single-direction repeatability at a fixed ambient temperature. This is not the absolute positioning accuracy.

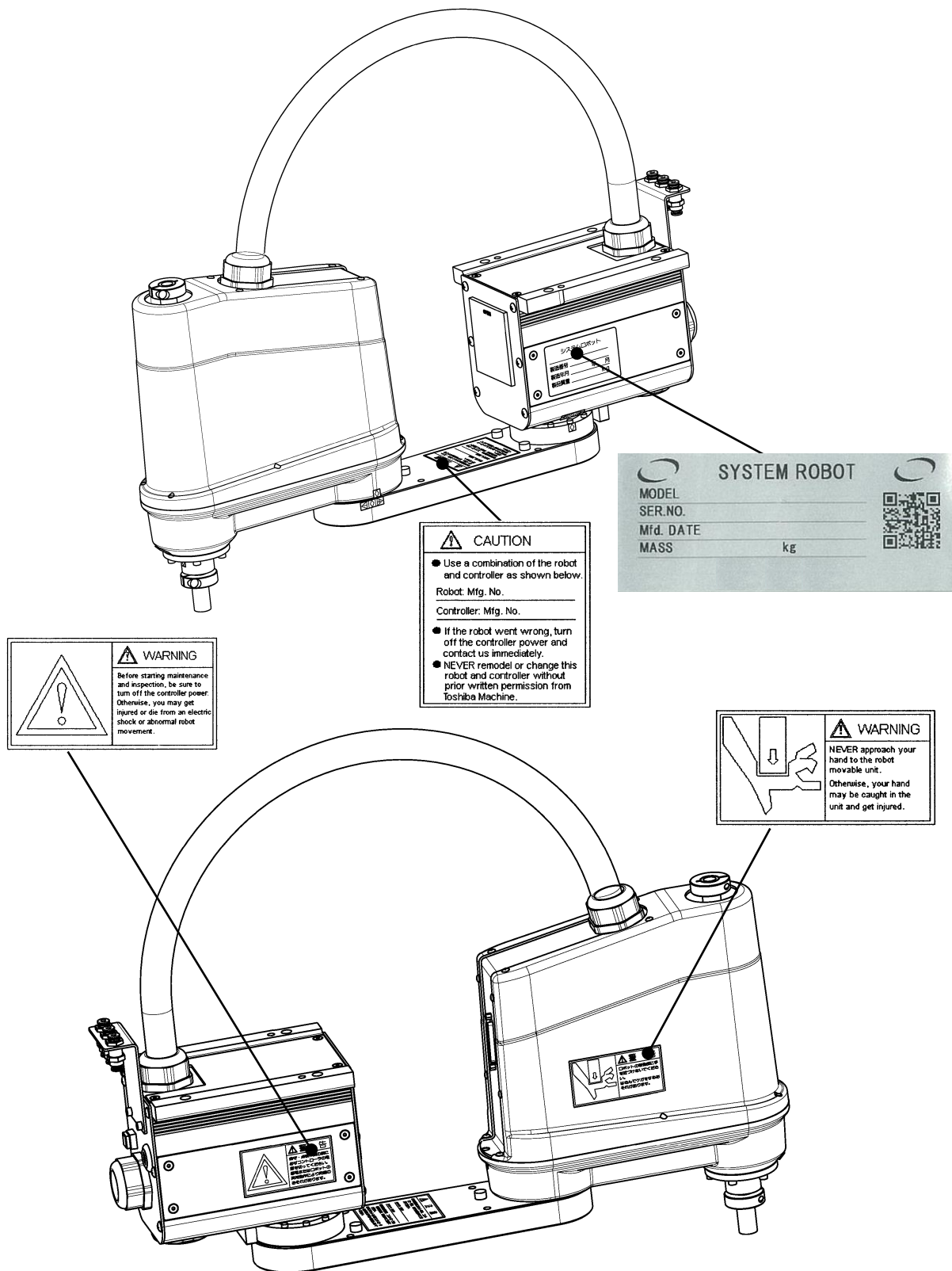
*3: The continuous operation in excess of the effective load factor of the standard cyclic operation pattern is disabled. Shuttle time for rough positioning in horizontal direction of 300 mm and vertical direction of 25 mm.

**Caution**

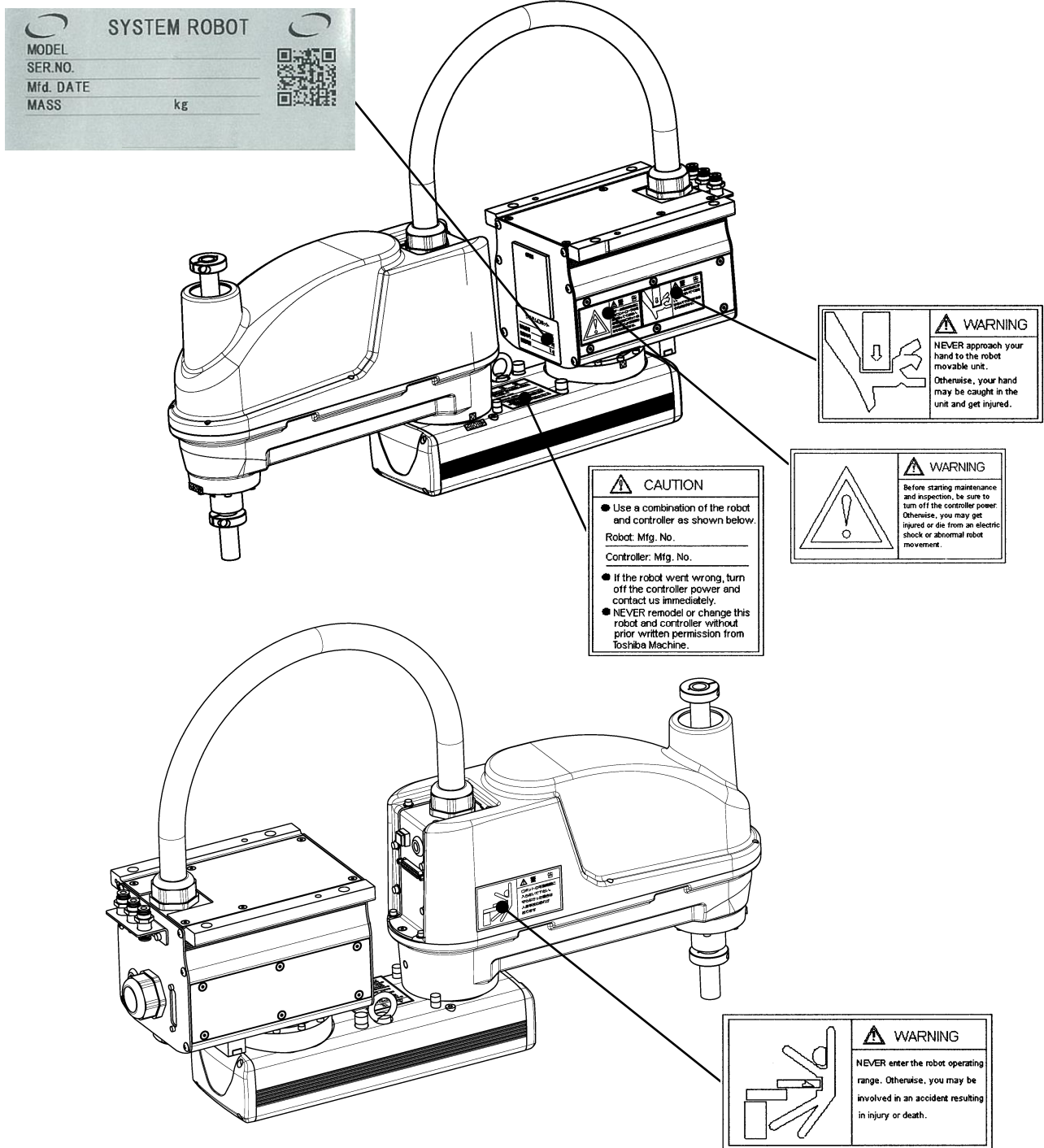
- Vibration may occur depending on the posture of the robot. If vibration occurs, decrease the acceleration.
- When you want to travel the axes 1, 2 and 4, set the Z-axis at the highest possible position. If the axes 1, 2 and 4 are moved with the Z-axis at the lower position, the ball screw spline shaft (Z-axis shaft) may be damaged at an earlier stage. If the axes 1, 2 and 4 must be moved with the Z-axis at the lower position for unavoidable circumstances, use the speed instruction and ACCE/DECEL/PAYLOAD instructions to adjust the operation speed and acceleration so that the ball screw spline shaft will not be vibrated. When the axes 1, 2 and 4 are moved with the Z-axis at the lower position take sufficient care not to collide with an obstacle. Even if the axes 1, 2 and 4 are moved at a lower speed, the ball screw spline shaft (Z-axis shaft) may be damaged before an alarm occurs.
- If an alkaline dry battery is used at a high temperature, there will be a higher risk of heat generation, liquid leakage or rupture of the battery. There is also a risk of reducing the performances or service life of the battery. If the robot is to be used at a high temperature, contact our sales department of our company.

1.4 Position of Cautionary Statement

1.4.1 Position of Cautionary Statement for Robot (KHL400-T)



1.4.2 Position of Cautionary Statement for Robot (KHL-500-T, KHL-600-T, KHL-700-T)



1.4.3 Position of Cautionary Statement for Controller

The position of cautionary statement for controller is the same as that of the standard machine. For details, see the Part of Safety.

2 Transportation

2.1 Unpacking

The robot and controller are shipped separately in wooden crates or corrugated cardboards. Open the packages in a location easily accessible, where the equipment is to be installed. Take careful precautions not to damage the robot and controller. After opening the packages, make sure that all the accessories are present and that no part has been damaged during transport.

For the accessories of the controller, see the accessory list packed with the controller.

For the details of the procedures for unpacking the controller, see the Part of Installation/Transportation.

For the robot accessories, see the following Table:

Table 2.1 Robot accessories (for KHL-400-T)

Parts name	Model	Quantity
Clamp	ABMM-A-D	2 pcs.
Pipe joint	GWL4-0	3 pcs.
Tyrap	T18RW	5 pcs.
Tyrap	T30RW	10 pcs.

Table 2.2 Robot accessories (for KHL-500-T, KHL-600-T, KHL-700-T)

Parts name	Model	Quantity
Clamp	ABMM-A-D	2 pcs.
Pipe joint	GWL04-00	3 pcs.
Tyrap	T18RW	5 pcs.
Tyrap	T30RW	10 pcs.

2.2 Transportation

Move the robot and controller very carefully. Make sure that no excessive impact or vibration is exerted on the equipment. If the equipment is to be subject to vibration over a long period, be sure to tighten all of the clamp and base set bolts completely and put the equipment back into the packaging box.

2.2.1 Mass and Outer Dimensions

The mass and outer dimensions of the robot are shown in Fig. 2.1 to 2.4.

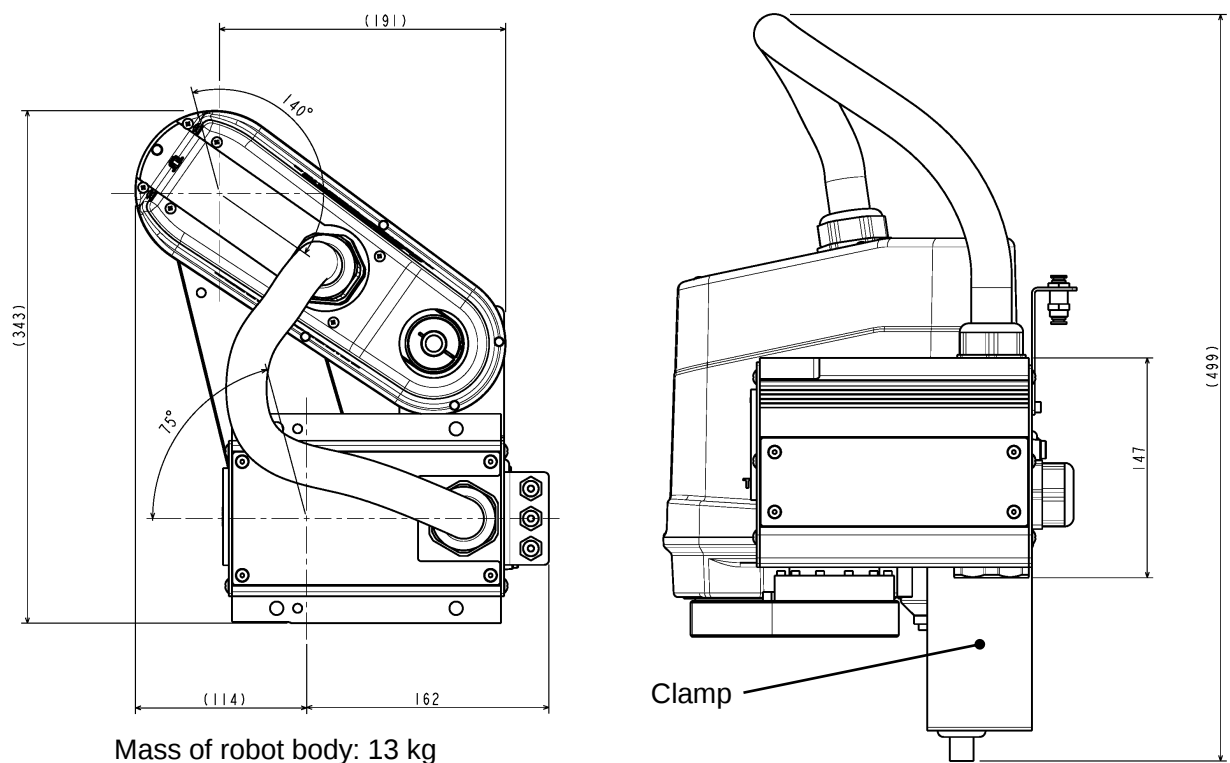


Fig. 2.1 Outer dimensions at transport (KHL-400-T)

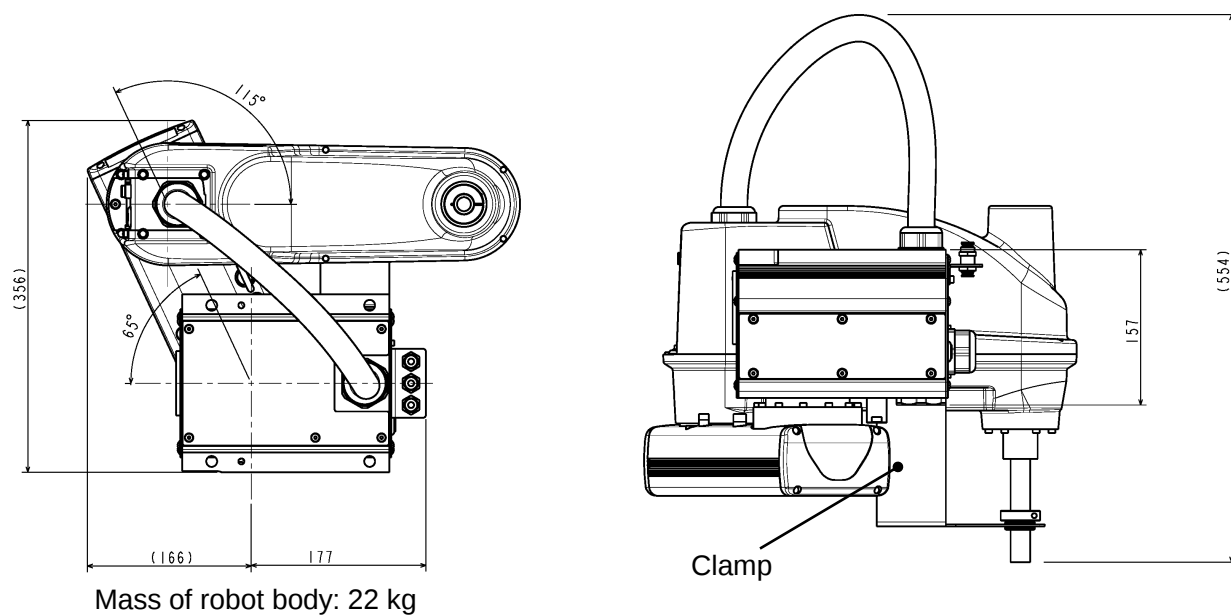


Fig. 2.2 Outer dimensions at transport (KHL-500-T)

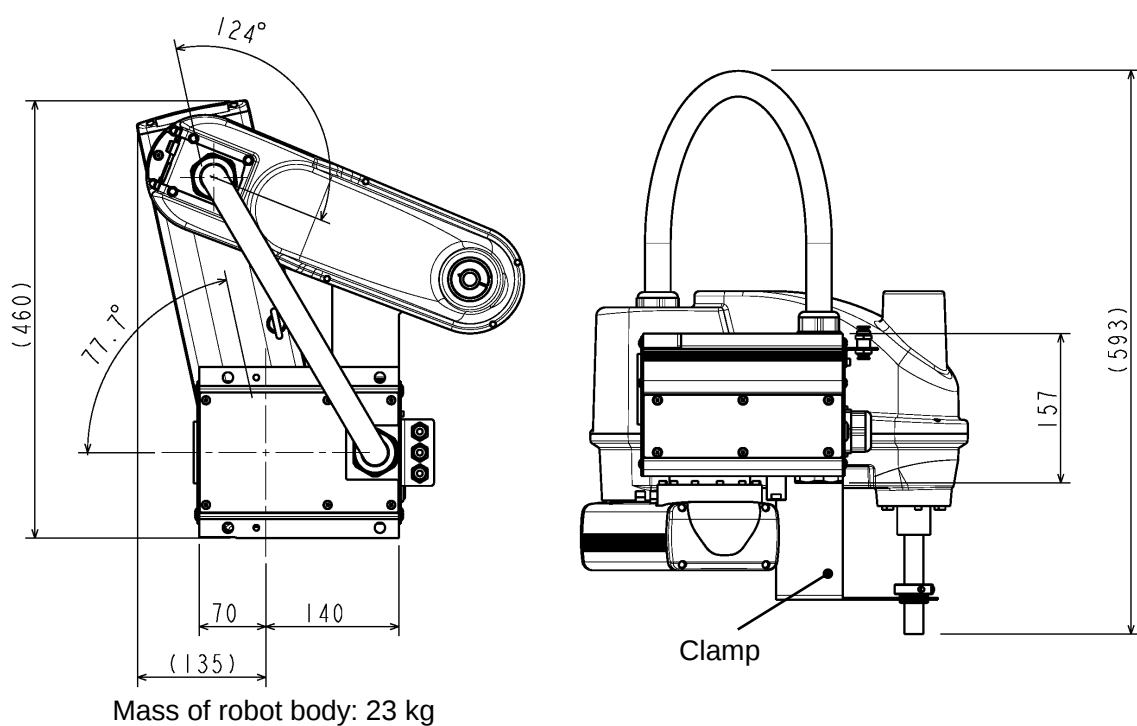


Fig. 2.3 Outer dimensions at transport (KHL-600-T)

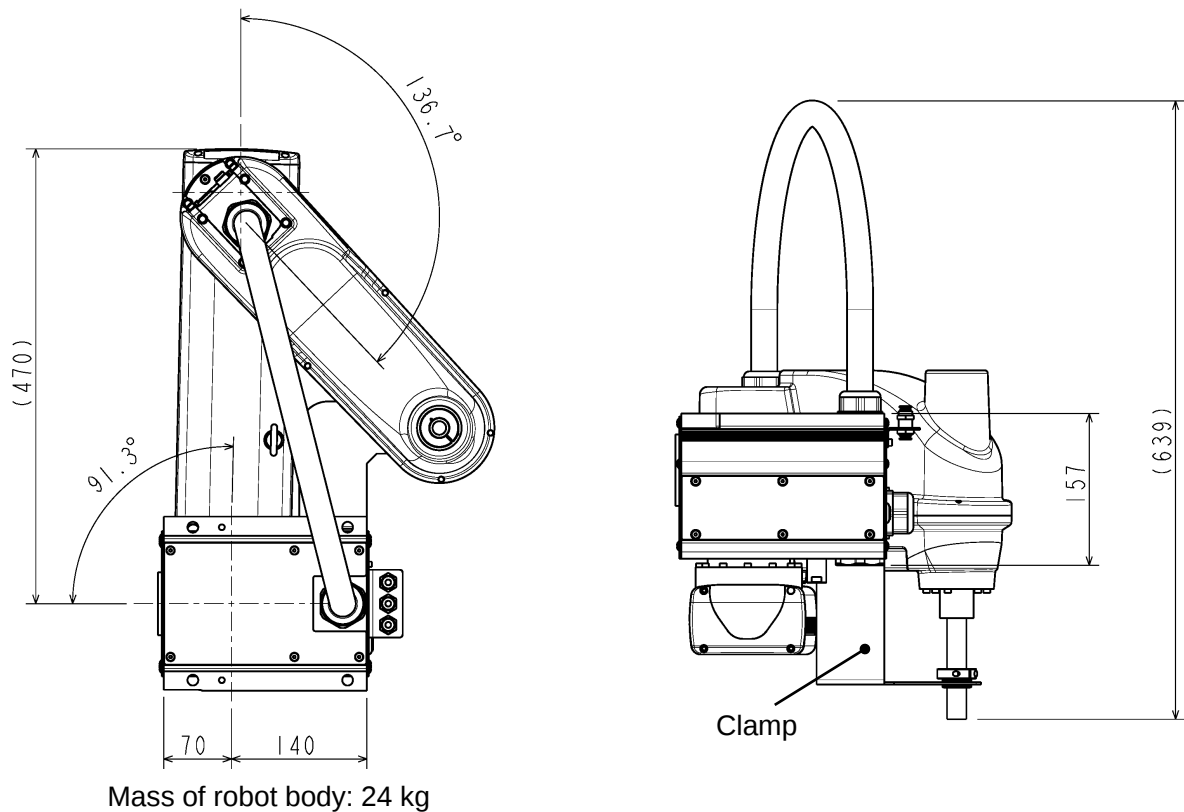


Fig. 2.4 Outer dimensions at transport (KHL-700-T)

2.2.2 Transporting the Robot

In principle, the robot should be transported in the state shown in Figs. 2.1 to 2.4 above. Fold back and secure the arm with the attached clamp. (The robot is shipped in this posture. After you have unpacked the shipment, you should move it as it is.) At this time, take careful precautions not to impose a large force on the tool shaft.



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.

It is possible to lift up and transport KHL-500-T/KHL-600-T/KHL-700-T except for KHL-400-T. Pass the wire through the attached eyebolt, then lift up the robot carefully, as shown in Fig. 2.5.

Use a chain block on the base side or arm 1 side.

- * If a chain block cannot be provided and wires are used on both sides, the wire on one side should be longer than the step between the base and arm (see the table below).

KHL-500-T/KHL-600-T/KHL-700-T	Use a wire with a length of 177 mm on one side.
-------------------------------	---

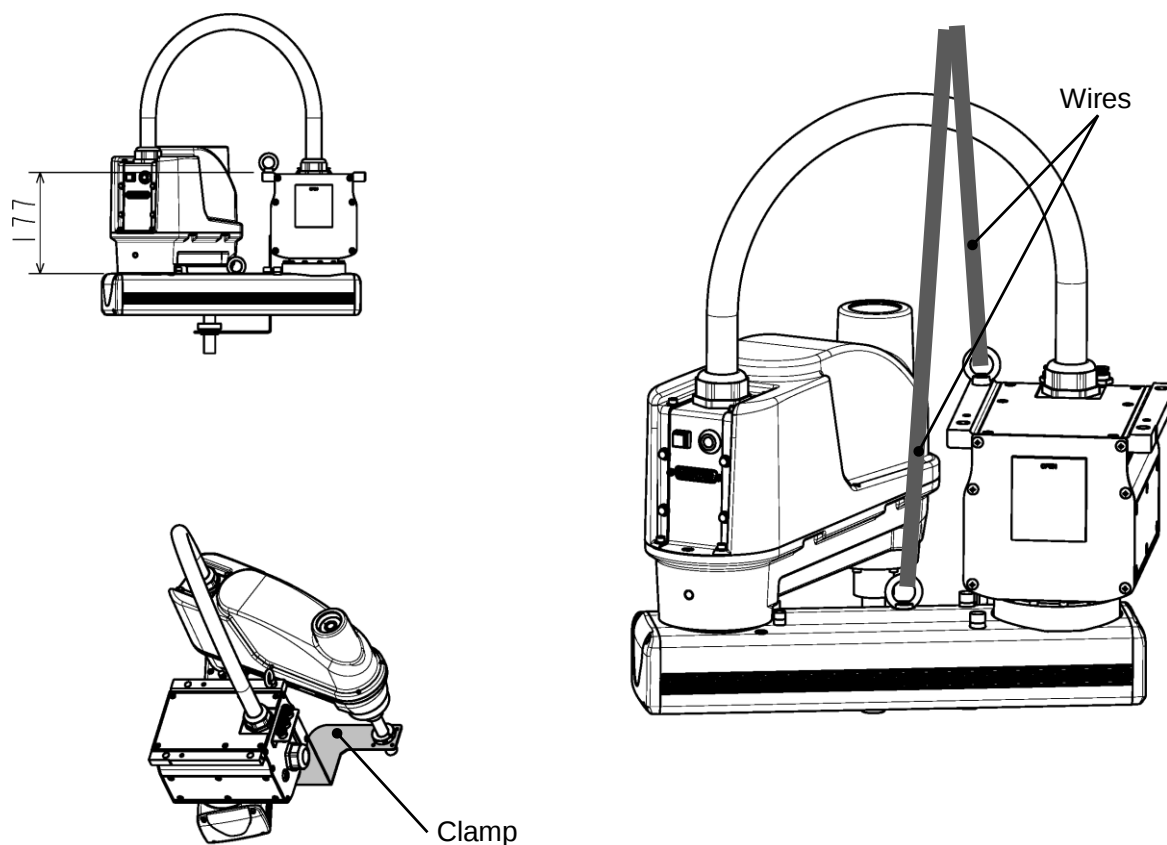
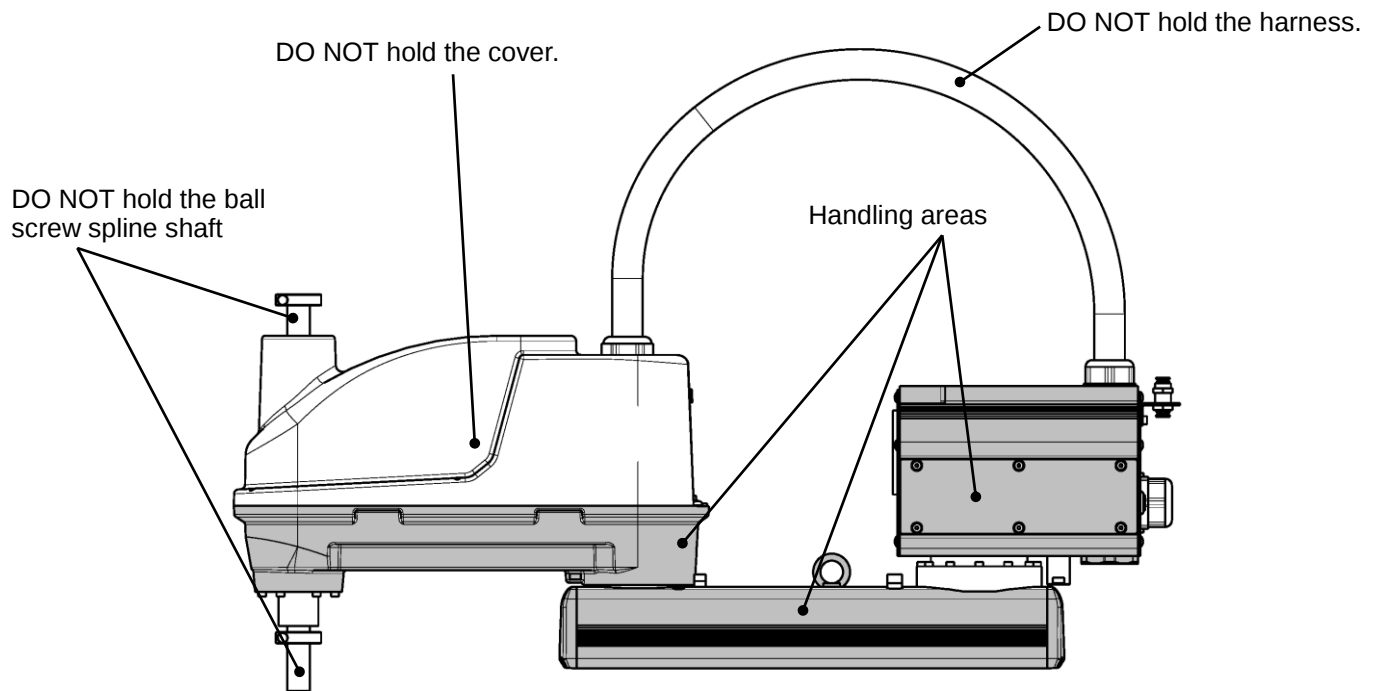


Fig. 2.5 Lifting up the robot

**CAUTION**

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



The above figure shows the KHL-600-T

Fig. 2.6 Robot handling areas

After the installation, remove the clamp and eyebolt used for transport.

**CAUTION**

- When lifting up the robot by workers, hold the specified locations by hand, as shown in Fig. 2.6. If the cover, harness or ball screw spline shaft are held by hand, an unusually large force is exerted, resulting in malfunction.
- When carrying the robot by workers, take careful precautions to prevent their hand or leg from being caught in the robot.
- Never touch the ball screw spline shaft with a bare hand. If it is touched with a bare hand, rust may grow at an earlier stage. Be sure to use gloves.
- The work should be performed by two (2) or more workers.

2.3 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.

2.3.1 Storage Precautions for the Robot



CAUTION

- Secure the base or arm 1 bottom surface 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, high temperature and high humidity. The timing belts and resin covers may deteriorate.
- Seal the robot in a vinyl bag to prevent rust development and contamination. Put a desiccant in the bag to absorb moisture. As the ball screw spline shaft is susceptible to rust development, coat it with rust-preventive agent or grease the entire spline shaft beforehand.
For the painting procedure, see the Part of Maintenance.
- Before the use, apply the grease to the ball screw spline shaft.
- Before starting an operation, perform running completely.
- During storage, the life of the backup batteries will shorten. It is recommended to replace the batteries at the time of operation.

2.3.2 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.
- Seal the controller in a vinyl bag to prevent rust development and contamination. Put a desiccant in the bag to absorb moisture.

3 Installation Environment

3.1 Installation Environment

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

Table 3.1 Environmental conditions for robot and controller

Item	Specifications
Temperature	In operation: 0 to 40°C In storage: –10 to 50°C
Humidity	20 to 80% (Non-condensing) DO NOT install the robot where it may be subject to fluids such as water.
Altitude	1000 m or less
Vibration	In operation: 0.98 m/s ² or less
Dust	No inductive dust should exist. Consult with CKD first if you wish to use the robot and controller in a dusty environment.
Gas	No corrosive or combustible gas should exist.
Degrees of protection	IEC60529 IP10 (robot only) IP20 (controller only)
Overvoltage category	IEC60664-1 Class III (controller only)
Protection against electric shock	IEC61140 Class I (controller only)
Pollution Degree	IEC60664-1 Pollution Degree 3 (controller only)
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 environment	Must be free from iron powder, oil, salt, and organic solvents. Must not be exposed to water.



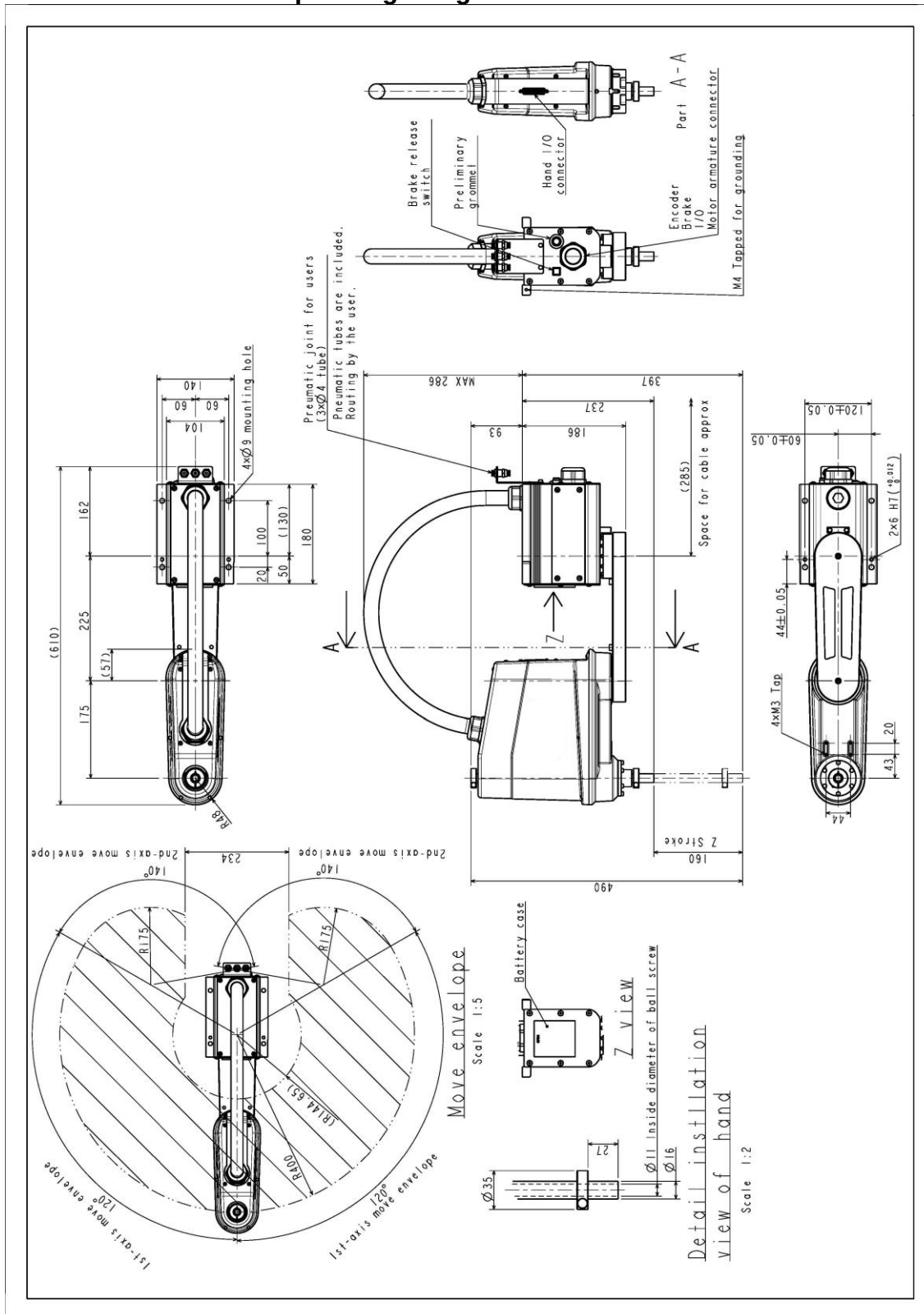
DANGER

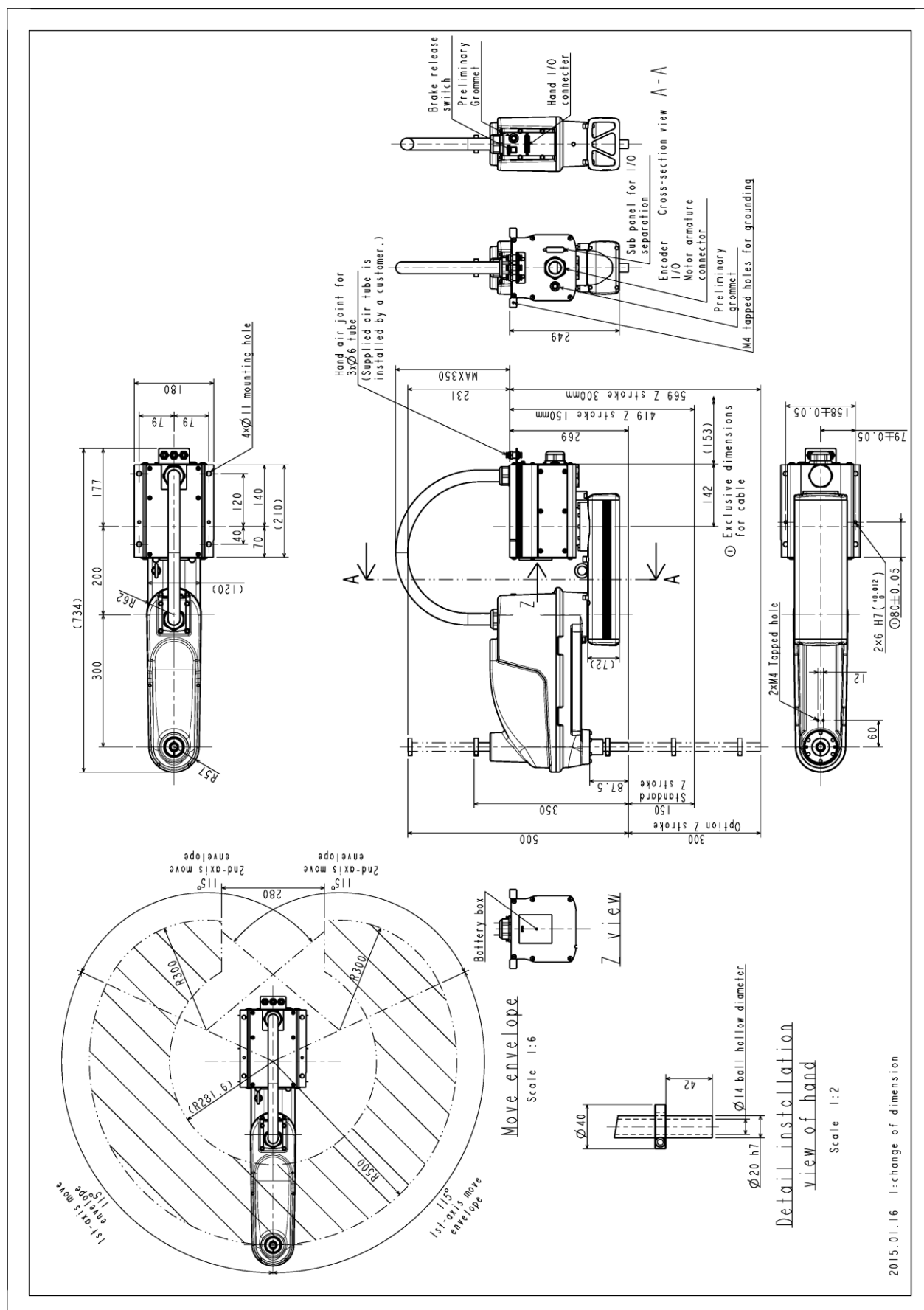
- Do not place the robot or controller near combustible.
Doing so could lead to fires if it ignites due to a fault, etc.

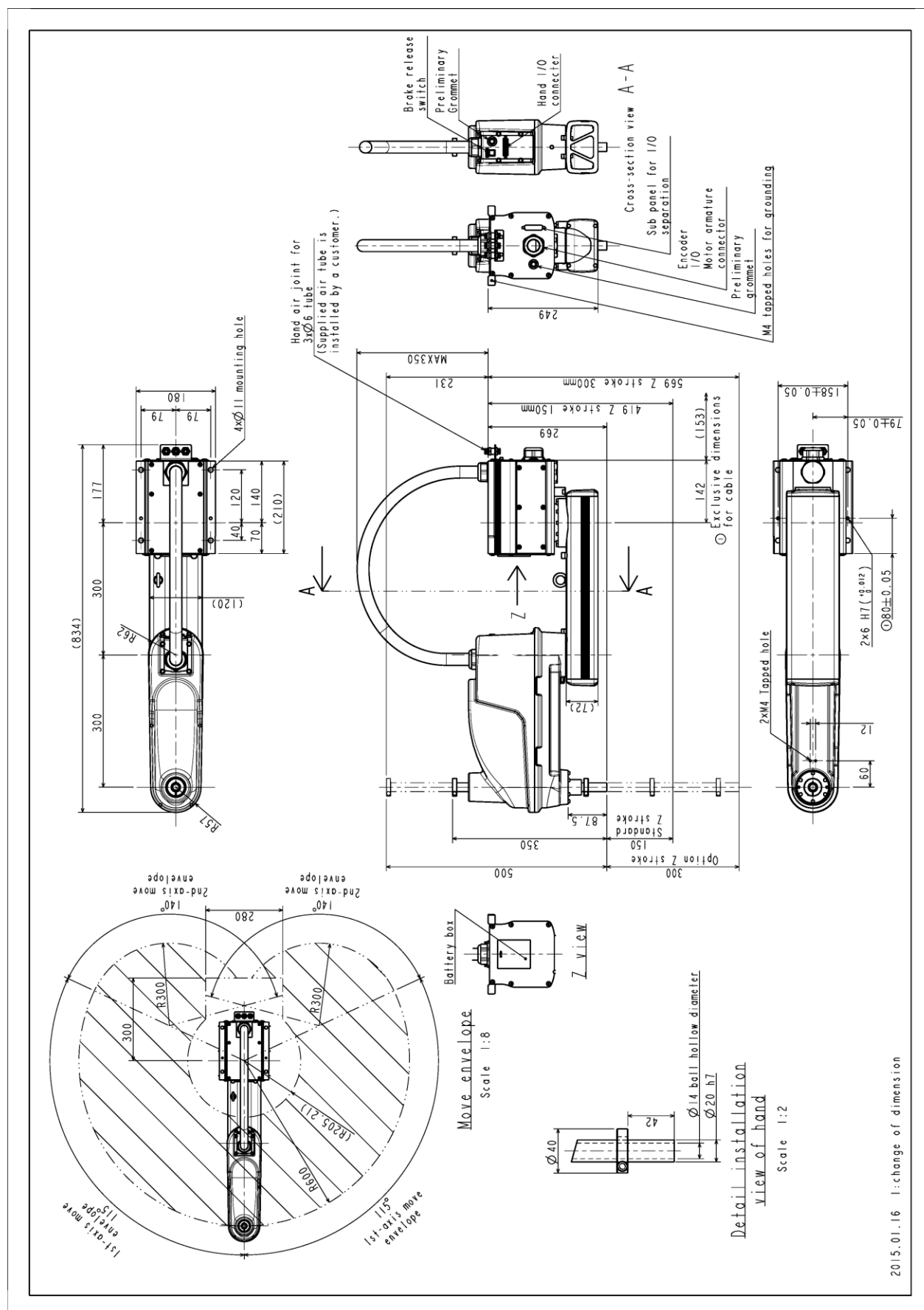
**CAUTION**

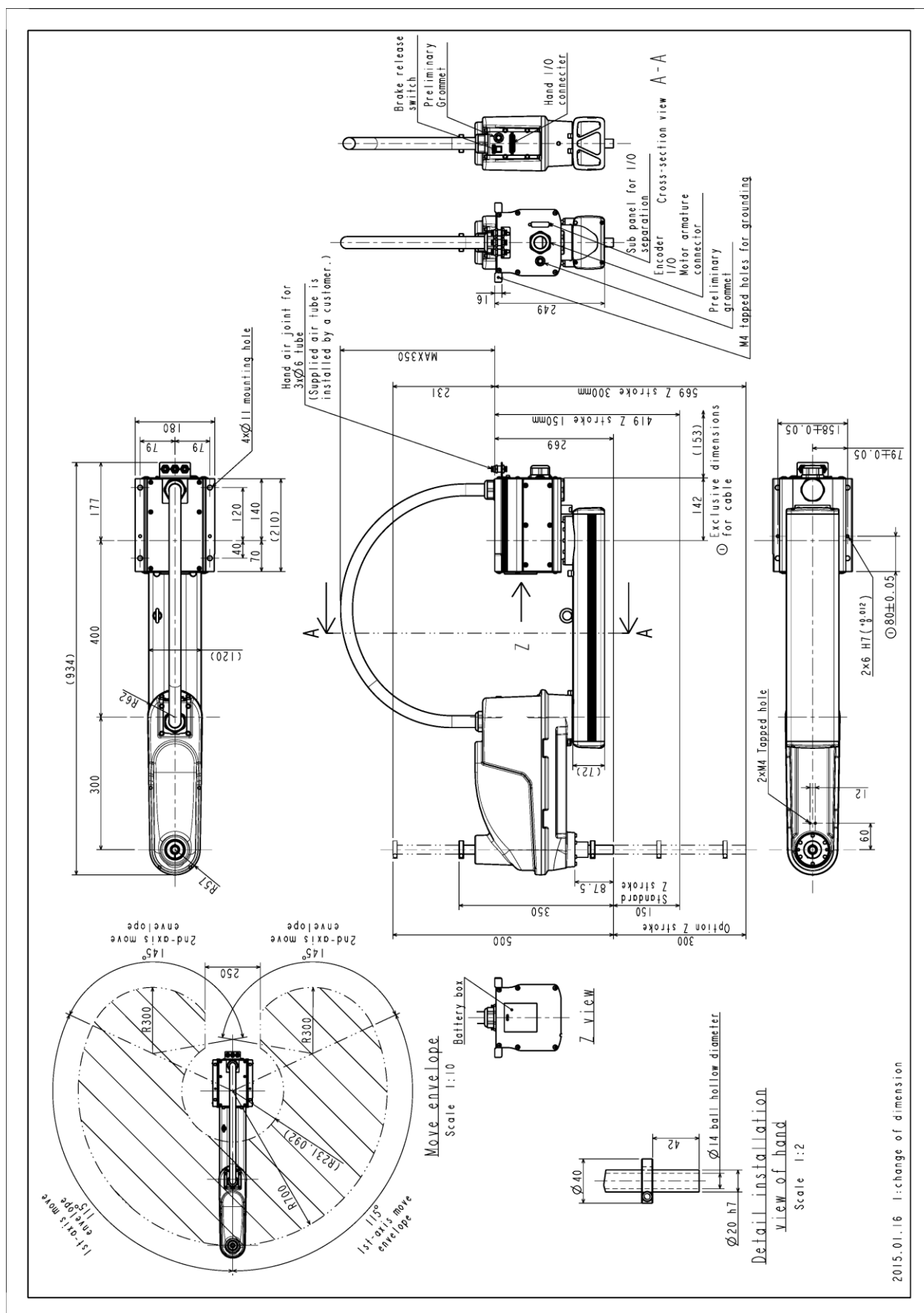
- In the case where batteries for detecting the motor position are of alkaline type (standard type), the batteries can overheat, leak battery fluid, or rupture when used under high temperatures. Also, high temperatures can reduce the performance and lifespan of the battery. If using the robot under high temperatures, please consult with the CKD sales office.
- When starting fast-movement operation in low-temperature environment, errors may occur because of the increased torque. In operating the robot in low-temperature environment, start by making low-speed continuous operation for a several minutes to soften the grease before starting high-speed operations.

3.2 External View and Operating Range









3.3 Change of Operating Range

The robot is provided with a mechanical stopper to restrict the operating range of axes mechanically. "Change of the operating range" can be defined as the change of the mechanical operating range of a robot by changing this mechanical stopper.

3.3.1 Change of Operating Range for Axes 1 and 2

The operating range for axes 1 and 2 is different from that of the axes 1 and 2. For the operating range of the ceiling type robot, see the following Table. The procedure for change is the same as that of the standard machine. See the Part of Installation/Transportation, and change the operating range.

Table 3.2 Operating ranges before and after change (for KHL-400-T)

		Before change	After change
Axis 1 operating range	+ direction	120°	105°
	- direction	120°	105°
Axis 2 operating range	+ direction	140°	120°
	- direction	140°	120°

Table 3.3 Operating ranges before and after change (for KHL-500-T)

		Before change	After change
Axis 1 operating range	+ direction	115°	105°
	- direction	115°	105°
Axis 2 operating range	+ direction	115°	110°
	- direction	115°	110°

Table 3.4 Operating ranges before and after change (for KHL-600-T)

		Before change	After change
Axis 1 operating range	+ direction	115°	105°
	- direction	115°	105°
Axis 2 operating range	+ direction	140°	110°
	- direction	140°	110°

Table 3.5 Operating ranges before and after change (for KHL-700-T)

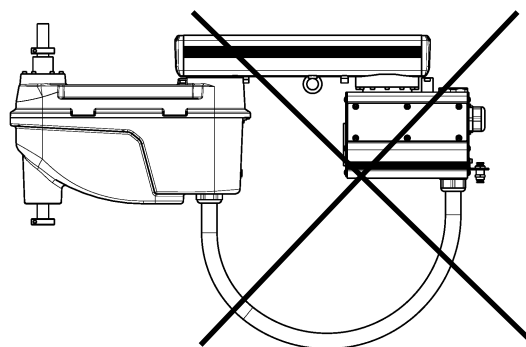
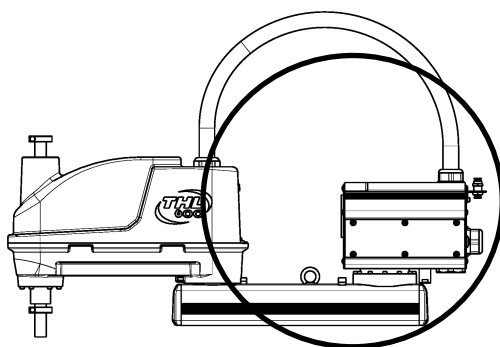
		Before change	After change
Axis 1 operating range	+ direction	115°	105°
	- direction	115°	105°
Axis 2 operating range	+ direction	145°	110°
	- direction	145°	110°

3.3.2 Change of Operating Range for Axis 3

The procedure for changing the operating range for axis 3 is the same as that for the standard machine. For details, see the Part of Installation/Transportation.

3.4 Installation Posture of the Robot

Before installing the robot, you should plan a layout, fully considering the working envelope (or operating range), coordinate system and space for maintenance. Use of this robot is allowed only in the ceiling-hung posture.



Top

Bottom

3.4.1 Coordinate System

The robot's joint angle origin (0° or 0 mm position) is factory-calibrated according to the base reference planes. Figs. 3.1 to 3.4 show the base coordinate system (XB, YB, ZB) and the origin of each axis joint angle.

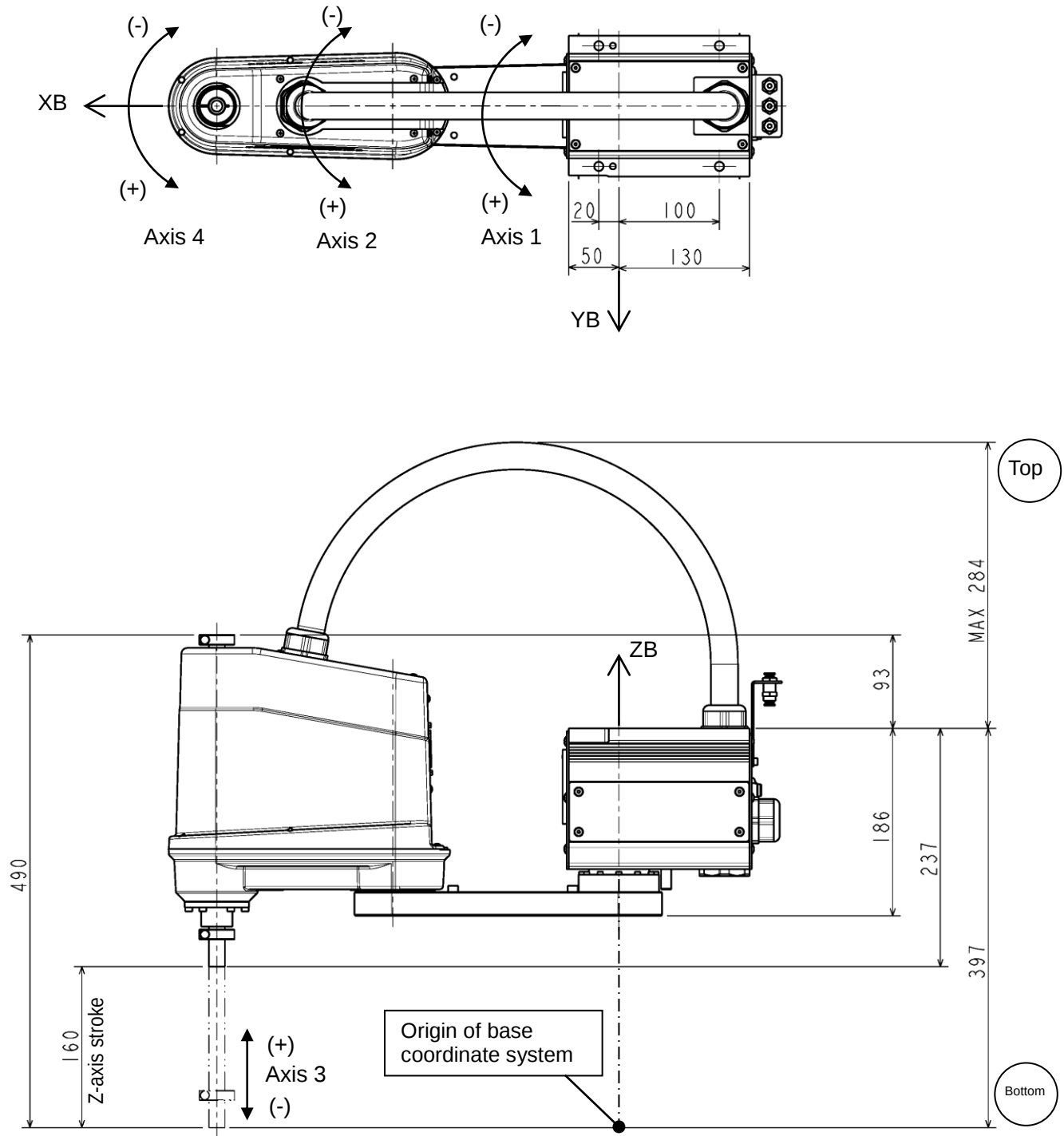


Fig. 3.1 Base coordinate system and joint angle origin (KHL-400-T)

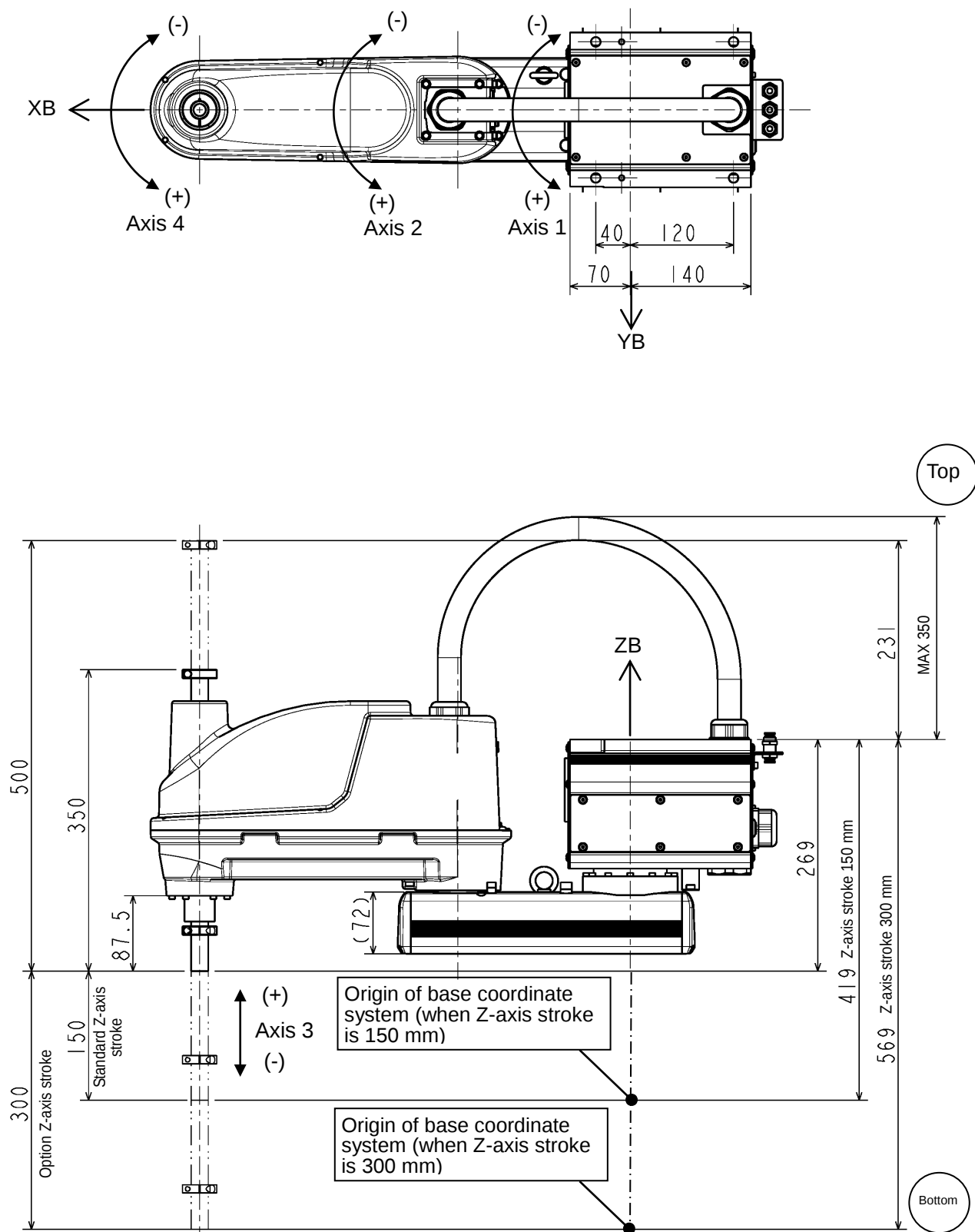


Fig. 3.2 Base coordinate system and joint angle origin (KHL-500-T)

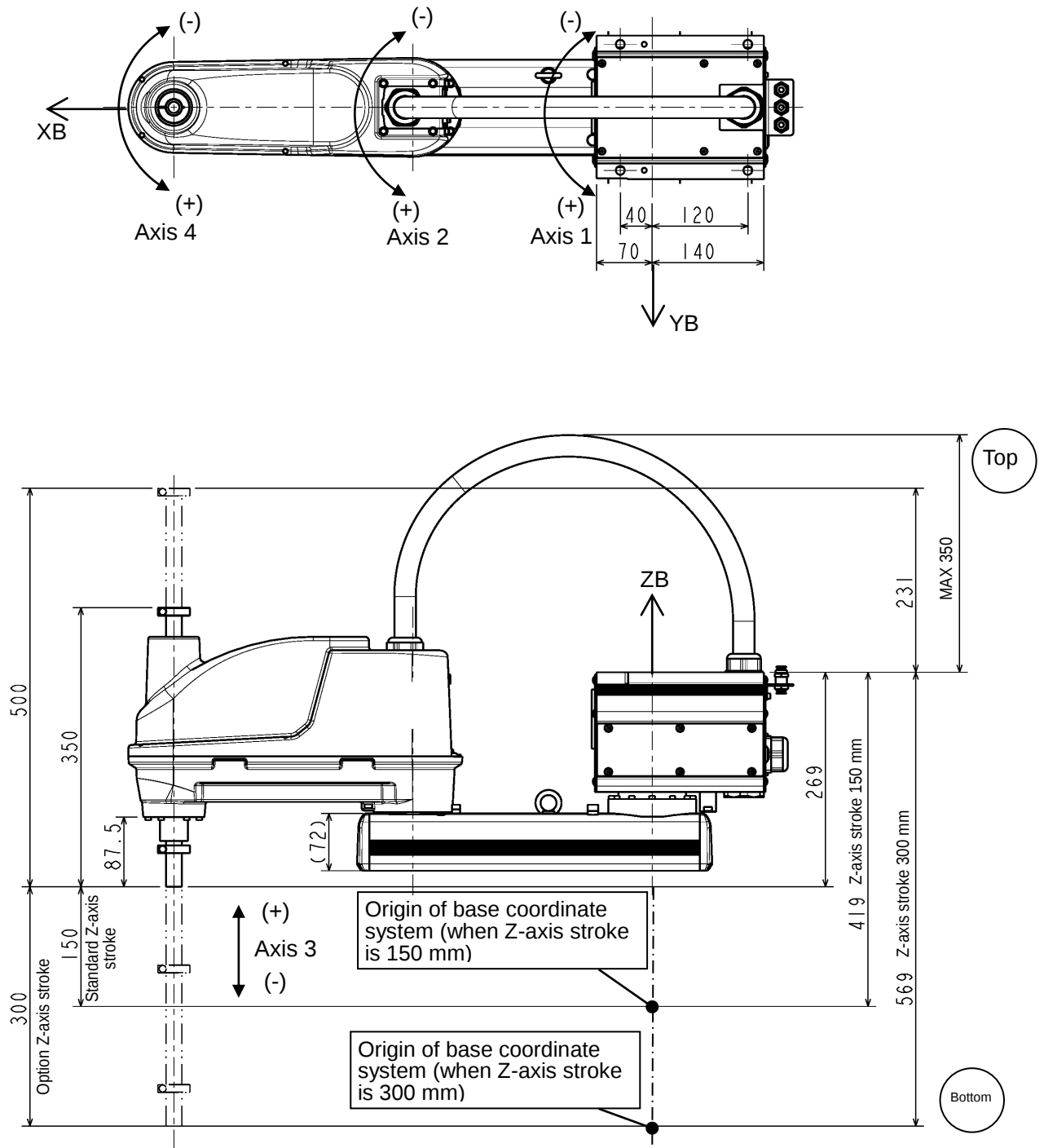
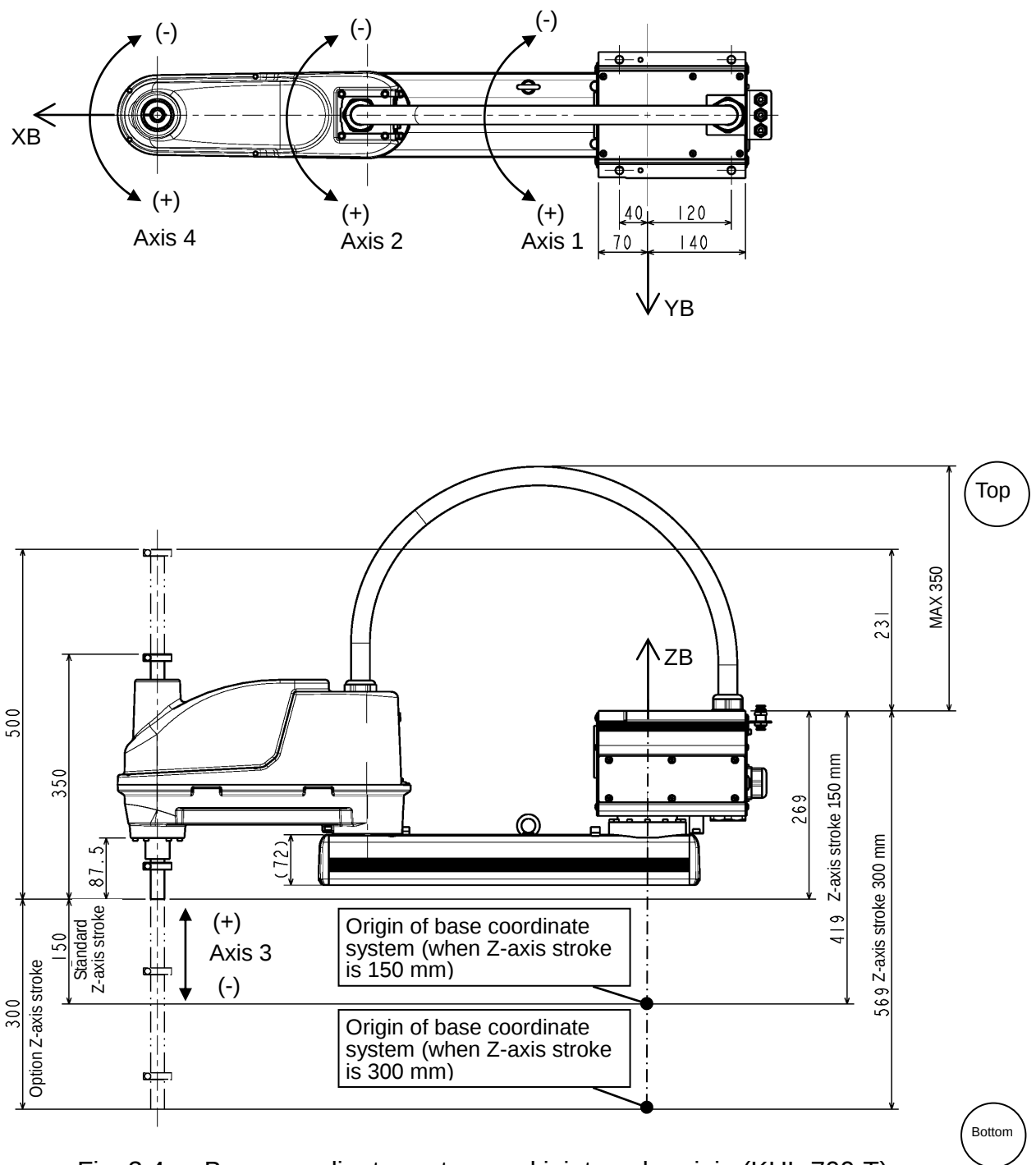


Fig. 3.3 Base coordinate system and joint angle origin (KHL-600-T)



3.4.2 Installing the Robot

The robot is secured, using the set holes on the base (four (4) places).

For fixing KHL-400-T, use M8 hexagon socket head cap screws.

For fixing KHL-500-T/KHL-600-T/KHL-700-T, use M10 hexagonal socket head cap screws.

The robot installation method is shown in Figs. 3.5 and 3.6. Place the robot on a pallet, etc., then carry it to a frame where the robot is to be installed, using a forklift truck, etc.

The base is provided with a reference surface. To adjust the position of the base coordinate system of the robot or to replace the robot, prepare an appropriate reference surface. Apply the reference surface of the base and fix it in position. A pin hole is also provided so that positioning can be performed by the pin hole.

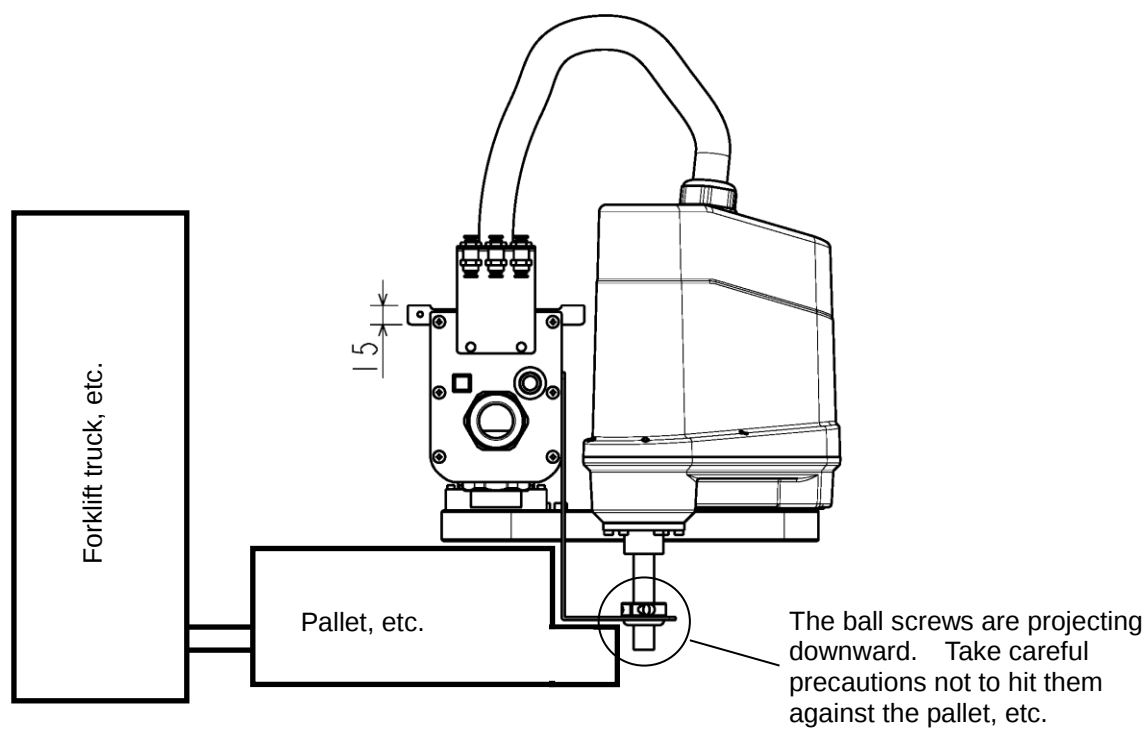
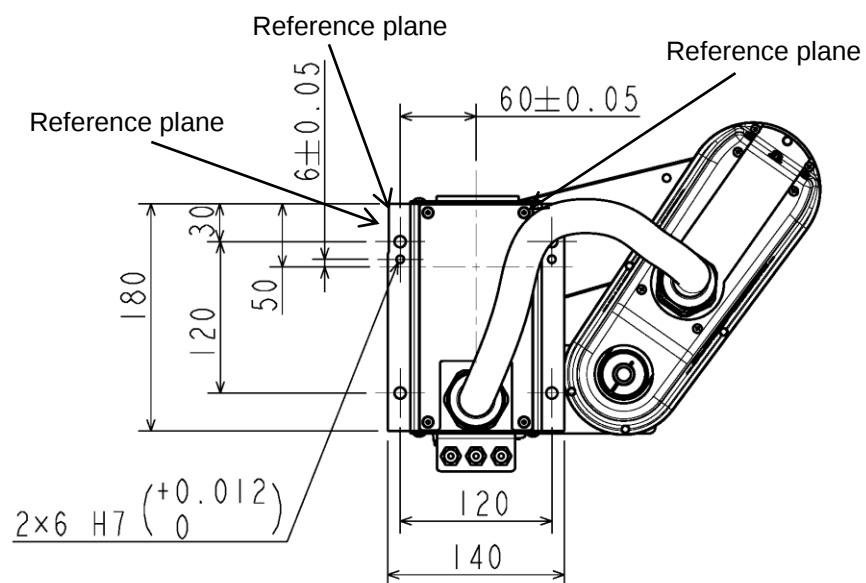


Fig. 3.5 Installation method (KHL-400-T)

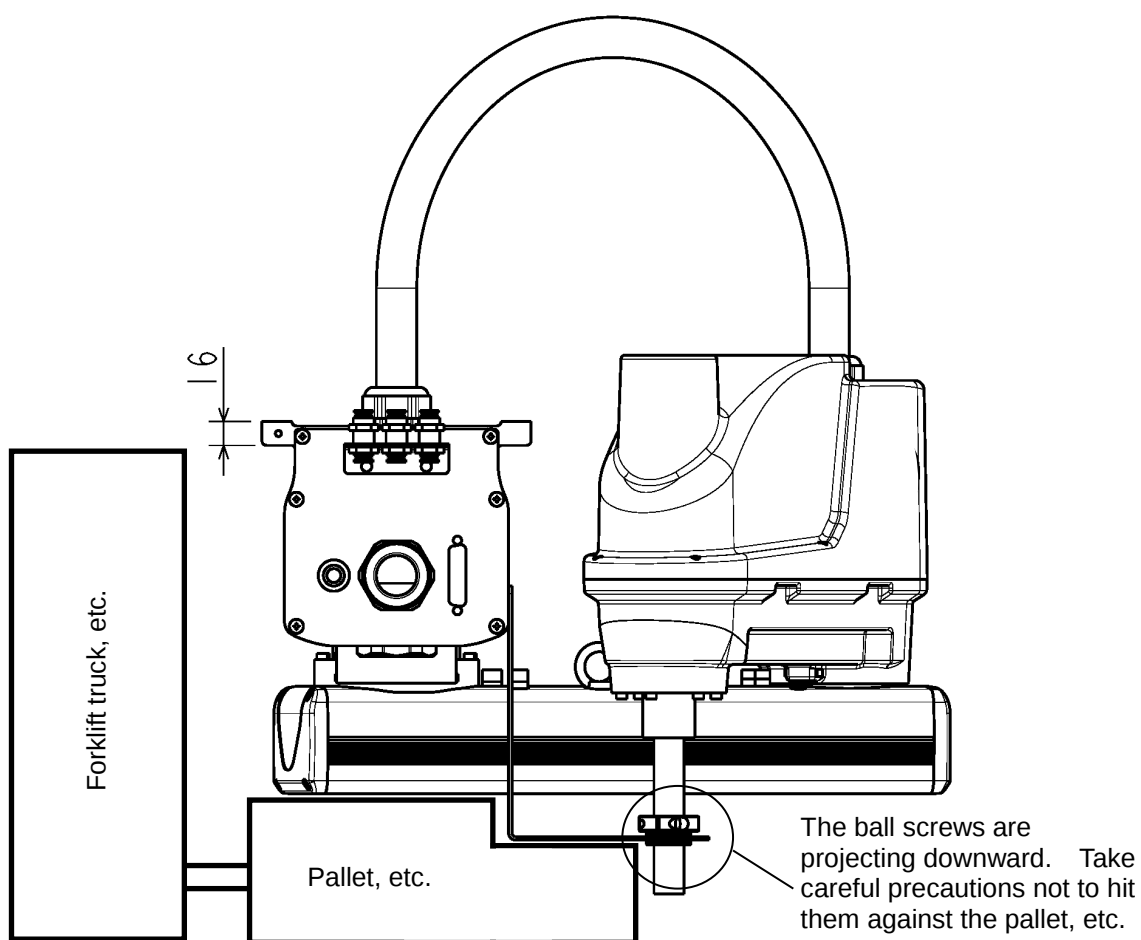
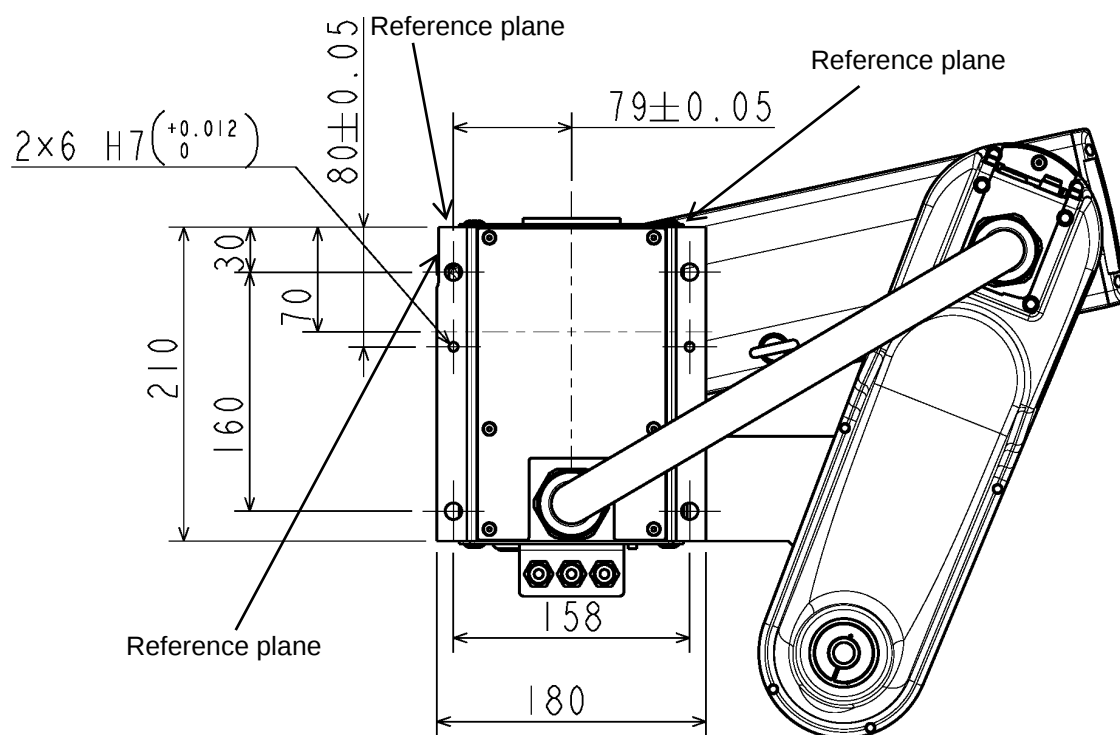


Fig. 3.6 Installation method (KHL-500-T/KHL-600-T/KHL-700-T)

3.4.3 Frame Rigidity

The loads that occur during KHL-400-T/KHL-500-T/KHL-600-T/KHL-700-T operation are shown in Table 3.2.

A reaction force due to the loads shown in Table 3.2 occur on the frame, and so be sure to design the frame by incorporating a large number of beams and using other methods to provide a sufficient factor of safety.

Table 3.2 Frame rigidity

Model	Load by horizontal axis (axes 1, 2, and 4) operation	Load by vertical axis (axis 3) operation
KHL-400-T	110 [Nm]	340 [N]
KHL-500-T	350 [Nm]	410 [N]
KHL-600-T	350 [Nm]	410 [N]
KHL-700-T	350 [Nm]	410 [N]



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.

- Install the robot on a level place. Failure to do so could lead to a drop in performance or faults.
- When carrying the robot to a frame by means of a forklift truck, etc., move down the robot and perform the work with utmost care.
- When carrying the robot to a frame by means of a forklift truck, etc., put your hand on the robot. Failure to do so could cause the robot to tilt and fall. Be careful not to get your hand caught in when carrying the robot.
- When moving up the robot to the set surface by means of a forklift truck, etc., perform the work with utmost care.

3.5 Controller Installation

Controller installation procedure is the same as that of the standard machine. For details, see the Part of Installation/Transportation.

4 System Connection

System connection procedure is the same as that of the standard machine. For details, see the Part of Installation/Transportation or Interface.

5 Tool Interface

System connection procedure is the same as that of the standard machine. For details, see the Part of Installation/Transportation or Interface.

6 Maintenance

The basic structure of the lifting type (or overhead traveling type) robot is the same as that of the standard robot though the arm set direction differs.

This section describes only the items different from those of the standard robot.

6.1 Layout of Robot Components

The layout of the robot mechanical components is shown in Figs. 6.1 and 6.2.

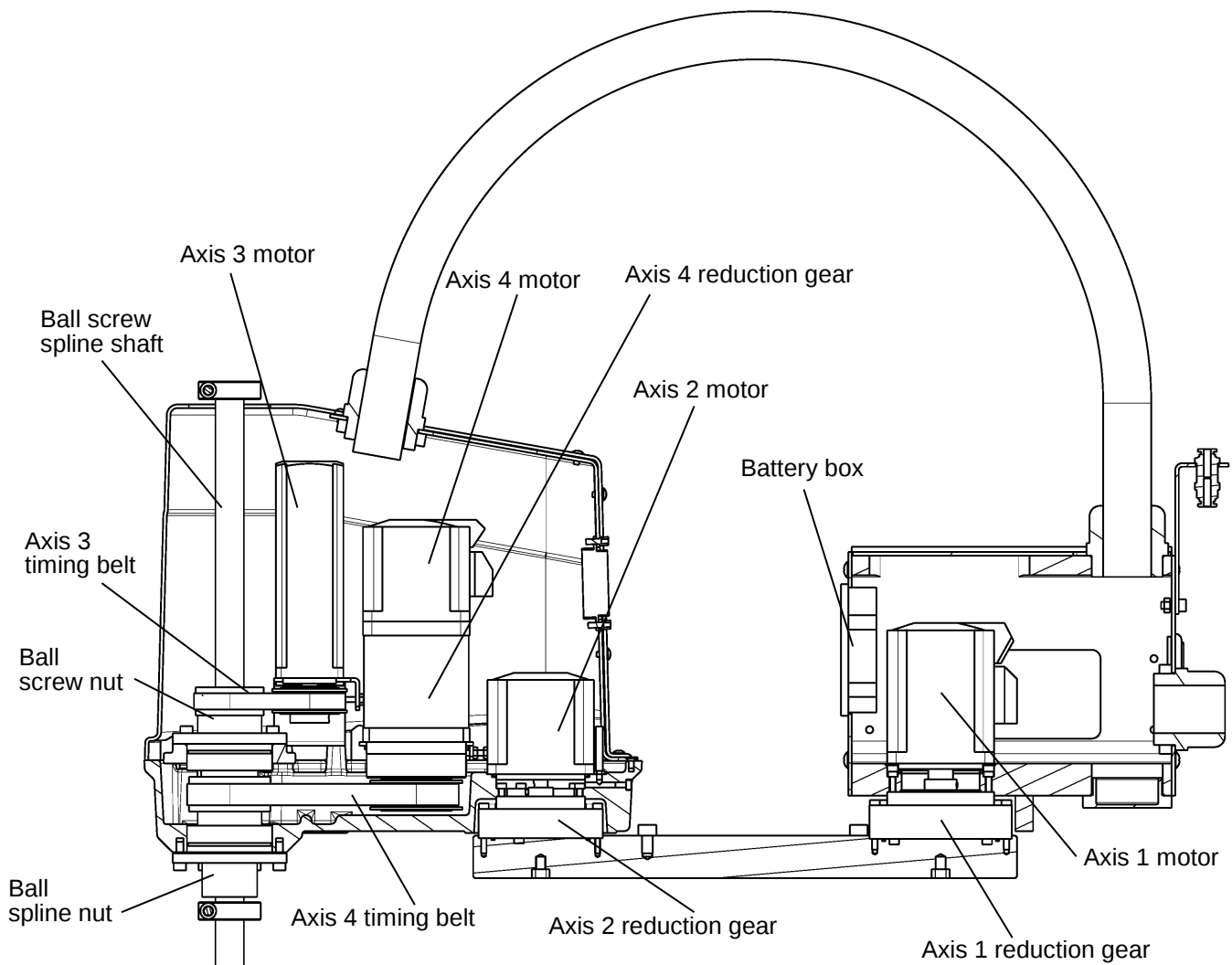


Fig. 6.1 Layout of robot mechanical components (KHL-400-T)

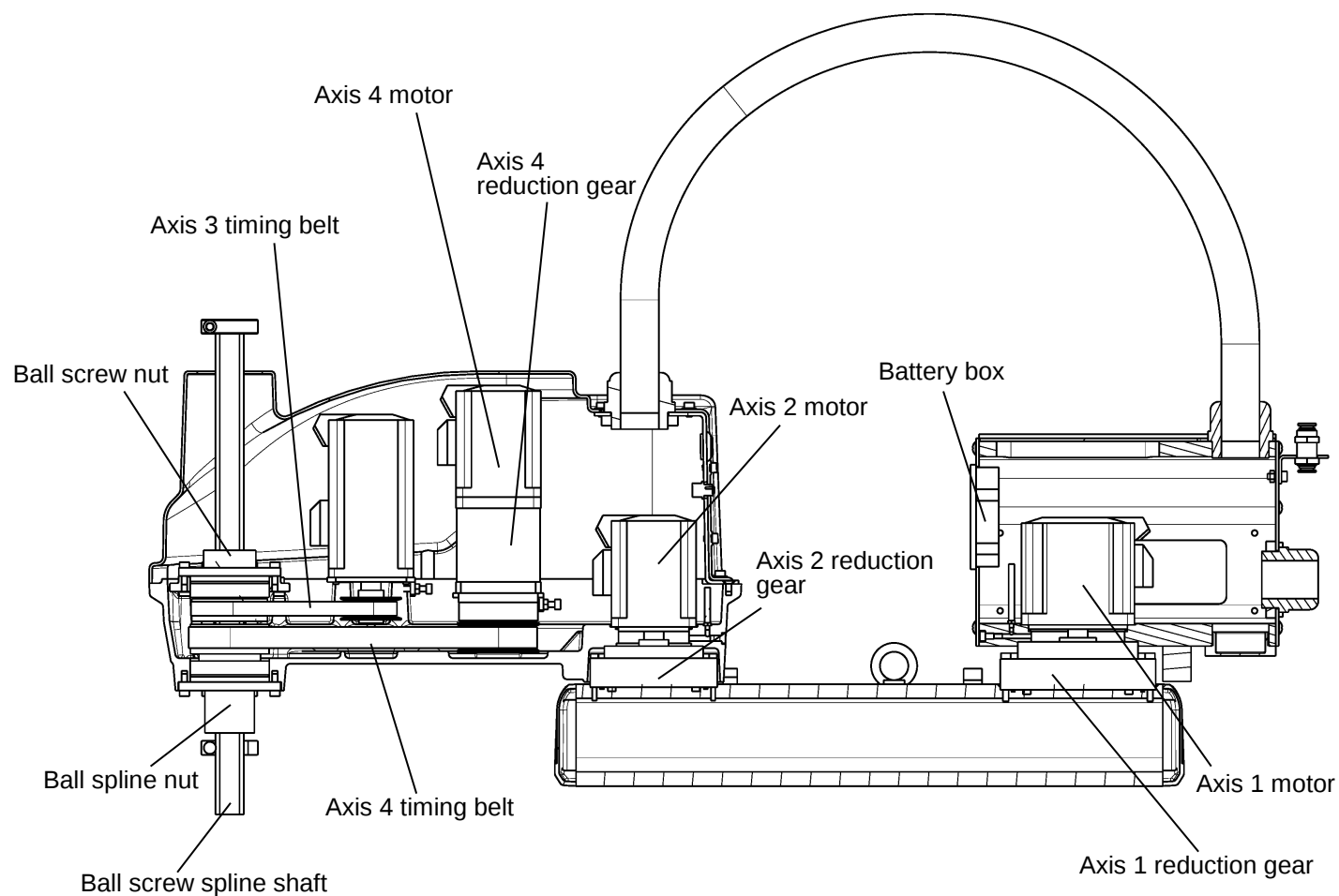


Fig. 6.2 Layout of robot mechanical components (KHL-500-T/KHL-600-T/KHL-700-T)

7 Replacement Parts for Maintenance

7.1 Replacement Parts List for Maintenance

Most of the replacement parts for maintenance are the same as the standard robots.
For details, see Maintenance Manual provided separately.

No.	Parts name	Drawing No.	Unit code	Manufacturer	Quantity	Remarks
1	Harness of main unit For KHL-400-T	F113059	Y610A3RE0	SHIBAURA MACHINE CO.,LTD.	1	
2	Harness of main unit For KHL-500-T	F112965	Y610A3PL0		1	
3	Harness of main unit For KHL-600-T	F113061	Y610A3RG0		1	
4	Harness of main unit For KHL-700-T	F113062	Y610A3RH0		1	

- When you wish to purchase the replacement parts for maintenance, **make sure of the serial number of the main robot** and contact us.