

**YASKAWA** ROBOTICS

**MH12**

YR-MA12-A00

# Operating and Maintenance Manual



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Rev. 09: Revised version of the original HW1482347.6 ("Shipping bracket", "Inspection intervals" (2015-08))  
Rev. 10: Revised version of chapter "Inspection intervals", "Shipping bracket and bolts" and "Recommended spare parts"

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We have checked the content of this publication for compliance with the hardware described. Nevertheless, discrepancies cannot be ruled out. Therefore, we cannot guarantee full compliance. However, the information given in this publication is checked regularly and any necessary corrections will be made in subsequent editions.

Subject to technical modifications.

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# 1 General

## 1.1 Notes for safe operation

### **DANGER!**

Indicating immediate danger at high risk, hazard that can cause death or serious bodily injuries if no precautions are taken.

### **WARNING!**

Indicating possible medium risk hazard situation which can cause death or serious bodily injuries if it is not avoided.

### **CAUTION!**

Indicating potentially dangerous situation with low risk of minor or moderate bodily injuries result if it is not avoided. This signal word can also be used for property damage warnings.

### **NOTICE**

Indicates important background information and application advice.

## 1.2 Frequently used terms

The YASKAWA robot is a product of YASKAWA Electric Corporation, and is provided by default with the robot control, the programming pendant and robot cable.

**The terms are designated as follows in this manual:**

Term	Description
Control	Robot control
Industrial robot	Robot
Programming pendant / teach box	Programming pendant
Supplying cable between robot and robot control	Cable
Robot, robot control and cable	Robot system
Yaskawa Electric Corporation	YEC
YASKAWA Robotics Division	YEU-R
Moving, calibrating and setting up of the robot	Teachen
Movement sequences of the robot	JOBS
Technical customer service	TCS

### 1.3 Target group

This manual is directed at users with the following knowledge:

- Advanced knowledge of mechanical engineering
- Advanced knowledge of electrical engineering
- System knowledge of the robot control
- Specially trained staff

#### **NOTICE**

According to the international DIN EN ISO 10218-1 standard, operators of a robot system must receive training before they operate the robot.

For optimal use of our products, we recommend our customers to take part in a training session at the YASKAWA Academy. For more detailed information on the training programme, please visit [www.yaskawa.eu.com](http://www.yaskawa.eu.com) or directly get in touch with your YASKAWA branch office.

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### 1.4 Intended use

Typical applications:

- Flange-mounting tools
- Installation of spot welding guns
- Installation of arc welding equipment
- Installation of grippers
- Machining and transporting workpieces or products

### 1.5 Improper use

Any use that deviates from the intended use shall be regarded as impermissible misuse. This includes:

- Transport of people and animals
- Use as ascending aid.
- Use outside the permissible operating limits.
- Use in environments with risk of explosion (except for ATEX-approved robots).
- Overload
- Use without protective equipment.

#### **NOTICE**

Modifications to the robot, e.g. drilling holes or similar modifications, can damage parts. This will be regarded as improper use (i.e. use that deviates from the intended use) and will lead to loss of warranty and liability claims as well as loss of the declaration of incorporation.

---

 **CAUTION!****The robot system is an incomplete machine.**

The robot system may be put into operation only after it has been determined that the incomplete or complete machine in which the robot system is being installed:

- ▶ Corresponds to the provisions of the machinery directive.
- ▶ Complies with all relevant (harmonized) standards.
- ▶ Corresponds to the state of the art.

## 1.6 About this manual



- This instruction manual is intended to explain mainly on the mechanical part of the robot for the application to the actual operation and for proper maintenance and inspection. It contains information on safety and handling, technical data, the tools and materials required for maintenance and inspection and instructions for operation and maintenance. Read this manual carefully and make sure you are familiar with its contents before installing and operating the robot.
- To ensure correct and safe operation, read the robot controller operating instructions (Basic Information, Installation and Wiring and System Setup).
- In order to illustrate details clearly, some drawings are shown with the protective covers or shields removed. All protective covers and shields must be mounted before the robot is operated.
- The drawings and figures in this manual are representative illustrations. They may differ from the product delivered.
- YEU-R reserves the right to make technical changes. These changes may include product improvements, modifications or changes in specifications
- If your copy of the operating and maintenance instructions is damaged or lost, please contact the local YASKAWA branch office to order a new copy. The official branch offices are listed on the last page. Please mention the manual number in your order.
- YASKAWA Europe GmbH is not responsible for damage caused due to unauthorized modification of the system. If any impermissible modifications are made to the system and to the robot, all warranty and liability claims as well as the declaration of incorporation will expire.

## 1.7 Safety

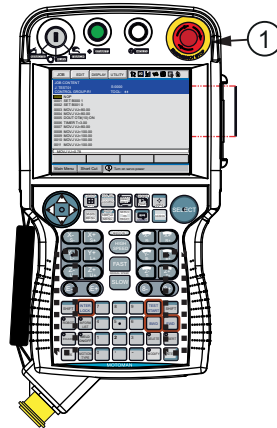


Fig. 1-1: Programming pendant

- ① Emergency Stop button

 **WARNING!**

**Death or injury because of danger of crushing**

If the emergency stop button does not function properly, the robot cannot be stopped in the event of an emergency.

- ▶ The robot should not be used if the emergency stop button does not function.
- ▶ Before operating the robot check the function of the emergency stop button. The SERVO power has to immediately go off once the emergency stop button on the programming pendant has been pressed (see Fig. 1-3: "Emergency Stop button").
- ▶ When the SERVO power is turned OFF, the SERVO ON LED on the programming pendant goes off (see Fig. 1-2: "LED SERVO ON").



Fig. 1-2: LED SERVO ON



Fig. 1-3: Emergency Stop button



**⚠ WARNING!****Death or injury because of danger of crushing**

Before you release the emergency stop button (see Fig. 1-4: "Release of emergency stop button by turning") note the following:

- ▶ Make sure that there is no one within the maximum working range of the robot.
- ▶ Clear the cell of all items which could collide with the robot.
- ▶ Now you can switch ON the SERVO power by pressing the enable switch on the programming pendant.



*Fig. 1-4: Release of emergency stop button by turning*

**⚠ WARNING!****Death or injury because of danger of crushing**

if anyone enters the working area of the robot during operation or any problems occur, always press the emergency stop button immediately. The emergency stop button is located on the programming pendant (see Fig. 1-1: "Programming pendant").

Observe the following precautions when performing teaching operations within the robot's working range:

- ▶ View the Robot from the front whenever possible.
- ▶ Always follow the prescribed operating procedure (see the instructions on robot control as well as the operating instructions on "Handling" or "Universal Application").
- ▶ An area must be left clear so that the operator can retreat to it in case of emergency.

The following inspection procedures must be performed prior to teaching the robot. If problems are found, correct them immediately, and be sure that all other necessary measures have been performed.

- Check for problems in robot movement.
- Check the connectors for tight fit and all cables for damage.
- Hang the programming pendant back on the robot control after use.
- Make sure that the key for the key switch (Teach/Automatic) of the programming pendant is kept by a skilled person who has been specially trained.
- The key may be inserted in the key switch of the programming pendant only during teach operation; after the teach operation it must be immediately removed and kept in a safe place.

## **1.8 Manufacturer**

Address:

**YASKAWA ELECTRIC CORPORATION**

2-1 KUROSAKISHIROISHI

YAHATANISHI-KU

KITAKYUSHU

JAPAN

## **1.9 Authorized representative**

Address:

**YASKAWA Europe GmbH**

Robotics Division

Yaskawastr. 1

85391 Allershausen

Germany

## 2 Supply

### 2.1 Checking the scope of delivery

The standard delivery includes the following items:

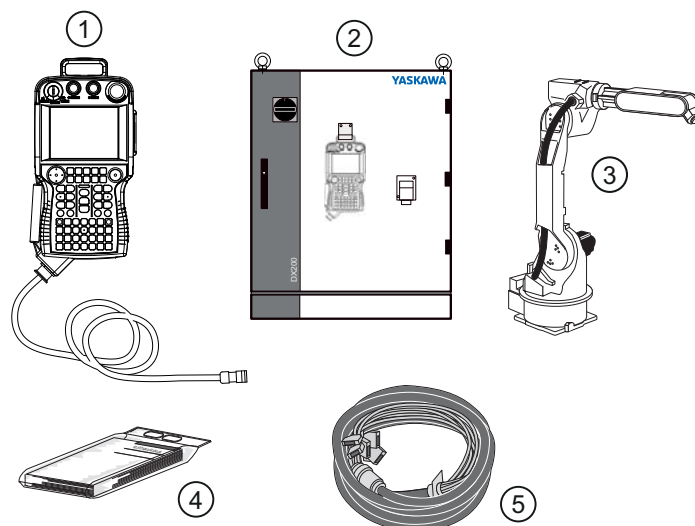


Fig. 2-1: Scope of delivery

- |                       |                        |
|-----------------------|------------------------|
| ① Programming pendant | ④ Assembly instruction |
| ② Robot controller    | ⑤ Cable                |
| ③ Robot               |                        |

## 2.2 Position type plate

Verify whether the serial number of the robot, the robot controller and the programming pendant with the delivery. The serial number can be found on the type plate as shown below.

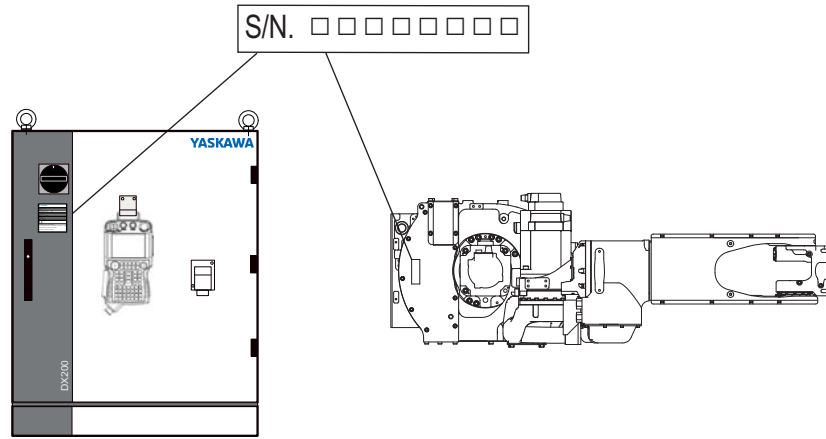


Fig. 2-2: Position type plate

### **NOTICE**

Please contact the local YASKAWA branch office if the serial numbers do not match the information on the delivery note.

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## 3 Transportation

### 3.1 Transporting method

**⚠ CAUTION!**

**Damage to persons and damage to property due to external force influences**

- External forces must not be exerted on the robot or the motors.

- Check that the eyebolts are securely fastened.
- The robot weights approximately 130 kg. Use load carrying devices strong enough to withstand the weight.
- The transport safety devices support the robot; therefore, use them exclusively for the transport of the robot.
- Before transport, be sure to mount the shipping bolts and brackets to the robot.

#### 3.1.1 Using a crane

Adequate load handling devices must be used to transport the robot. Make sure that the robot is lifted as shown in the diagram "Transport by crane".

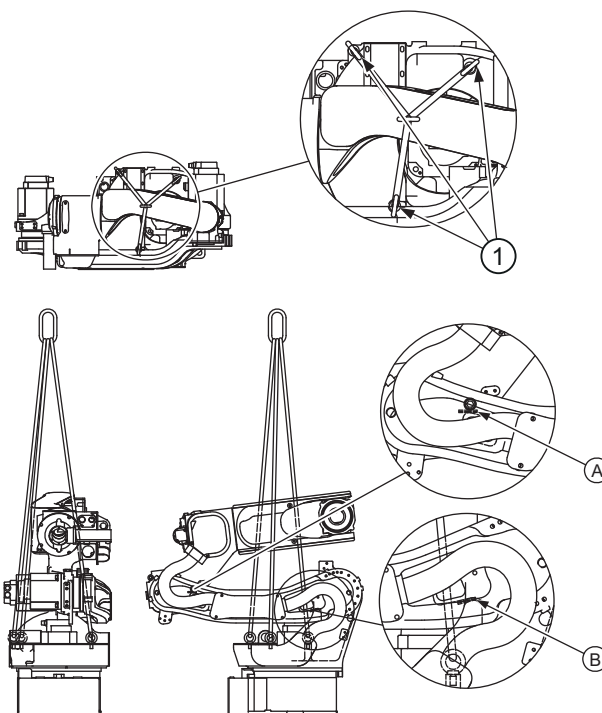


Fig. 3-1: Transport with crane

- ① 3 eyebolts M12

### 3.1.2 Using a forklift

If the robot is transported using a forklift, it should be fixed on a pallet with transport securing devices and shipping bolts as shown in the figure below "Transport using a forklift". Make sure that the forklift and the transportation route have sufficient bearing capacity. Always take due care when transporting the robot.

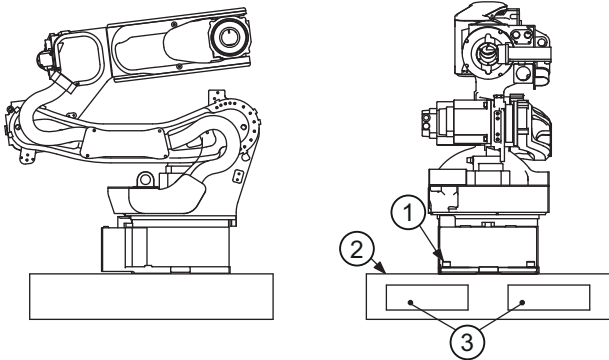


Fig. 3-2: Using a forklift

- ① 4 screws M16
- ② Palette
- ③ Forklift claw entries

## 3.2 Shipping brackets and bolts

### NOTICE

Before turning ON the power, check to be sure that the shipping bolts and brackets are removed.

After removing the transport securing devices and the shipping bolts, keep them at a safe place. The transport securing devices and shipping bolts will be required again if the system is transported again.

For transportation purposes the robot is fitted in the range (A) and (B) with a rubber buffer (see Fig. 3-3: "Damping material for transport").

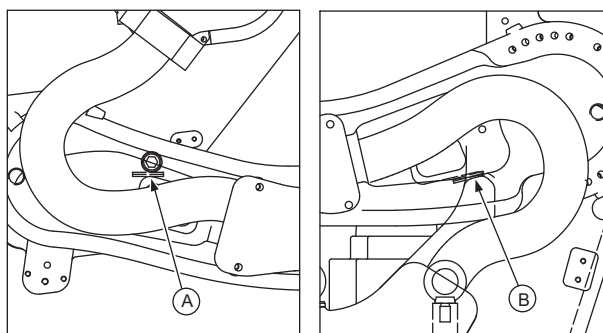


Fig. 3-3: Damping material for transport

### NOTICE

Before turning ON the power, check to be sure that the rubber buffer are removed.

After removing the rubber pads, keep them at a safe place. The rubber pads will be required again if the system is transported again.

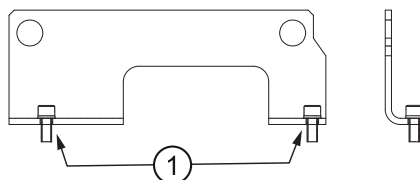


Fig. 3-4: Shipping brackets and bolts until August 2016

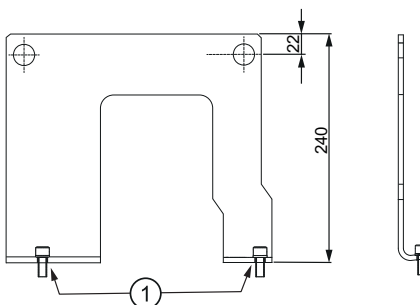


Fig. 3-5: Shipping brackets and bolts from August 2016

- ① 2 screws M10 x 25

## 4 Installation

### CAUTION!

#### **Personal injury and damage to property**

The following precautions must be taken.

- ▶ Check that the robot controller is complete and not damaged.
  - ▶ Do not put into operation a robot controller that is damaged or incomplete.
  - ▶ Check that all transport safety devices and transport screws have been removed.
- 

### 4.1 Protection measures

### DANGER!

#### **Personal injury and material damage**

The robot system must not be operated without protective devices. Starting up without appropriate protective measures can lead to death of people, serious bodily harm or material damage.

Implement the following protection measures

- ▶ Separating protection devices
  - ▶ Non-contact protection devices
  - ▶ Enclosures
  - ▶ Marked areas
  - ▶ Signs
  - ▶ Emergency Stop button
  - ▶ Display elements
- 

### **NOTICE**

#### **Operator's responsibility**

The operator of a robot or a robot system must ensure that all specifications and requirements of the standards DIN EN ISO 10218-1 and DIN EN ISO 10218-2 are met.

In the first instance, the following must be observed:

- ▶ Preparing a risk assessment
  - ▶ The installation of protective devices
  - ▶ Regular training of the employees
  - ▶ Regular inspection of all protective devices
  - ▶ Checking for compliance with intended use
-



## 4.2 Ambient conditions and installation location

When installing a robot, it is necessary to satisfy the undermentioned environmental conditions:

- Ambient temperature: From 0°C to +45°C.
- Air humidity: 20% to 80% relative humidity (non-condensing).
- Free of corrosive gases, liquids, or explosive gases. No water, oil or dust and free from excessive electrical noise (plasma).
- Free from excessive vibration (Vibration acceleration: 4.9 m/s<sup>2</sup> [0.5 G] or less).
- Maximum unevenness of the support surface of the robot base: 0.5 mm.

### 4.3 Installation example

1. At the first set out, anchor the base plate firmly onto the floor.
2. The robot base is tapped for 4 mounting holes. Fix the robot base with the screws M16 (Strength category 12.9) Minimum length: 50 mm.
3. Next, fix the robot base to the base plate. Tighten the hexagon head bolts and anchor bolts securely so that they will not work loose during operation (see figure „Mounting of the robot on the base plate“).

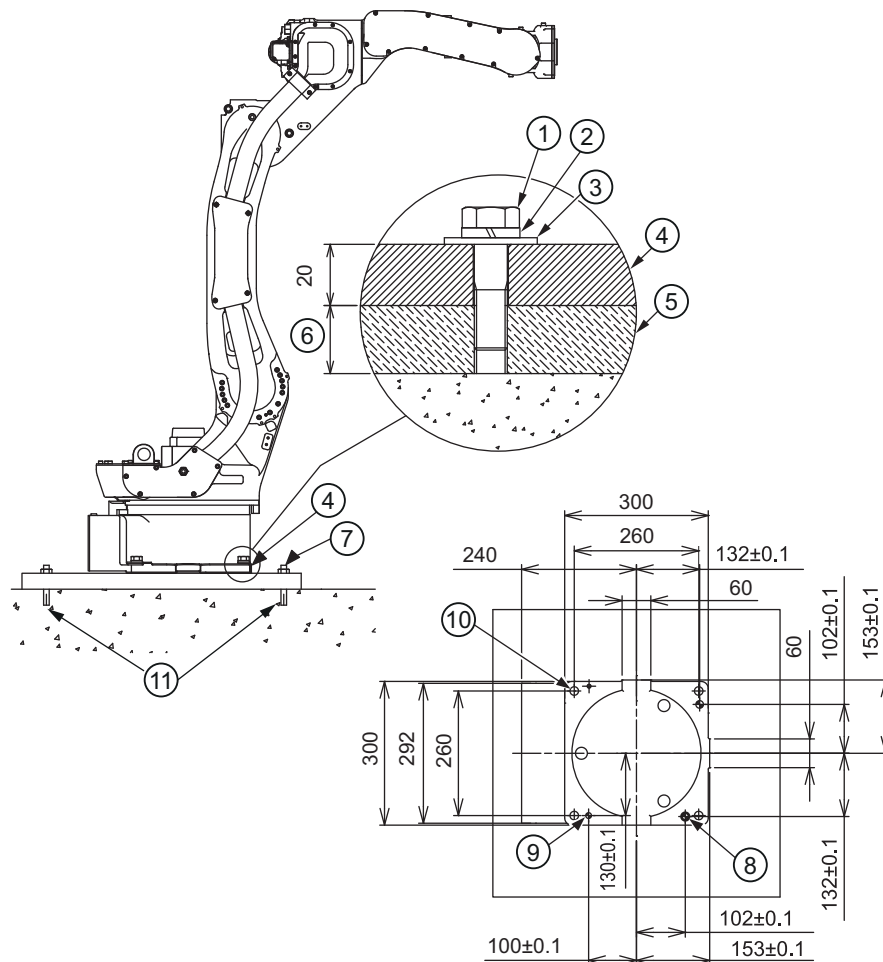


Fig. 4-1: Mounting the robot on the base plate

- |                  |                                 |
|------------------|---------------------------------|
| ① Screws         | ⑦ Anchor bolt (M16 or greater)  |
| ② Spring washer  | ⑧ 2 holes $\varnothing 16^{H7}$ |
| ③ Washer         | ⑨ 2 holes $\varnothing 12^{H7}$ |
| ④ Robot base     | ⑩ 4 Holes $\varnothing 18$      |
| ⑤ Base plate     | ⑪ adhesive                      |
| ⑥ at least 25 mm |                                 |

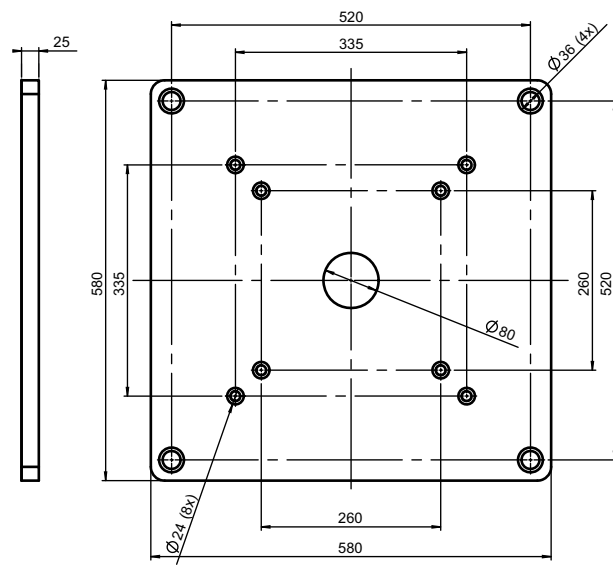


Fig. 4-2: Base plate

Direction of movement	Horizontal		Vertical	
	Force $F_H$	Moment $M_H$	Force $F_V$	Torque $M_V$
Emergency stop (Stop category 0)	9025 N	4120 Nm	5885 N	4120 Nm
Acceleration/Deceleration (Stop category 1)	3140 N	1275 Nm	2355 N	1670 Nm

Tab. 4-1: Forces and torques

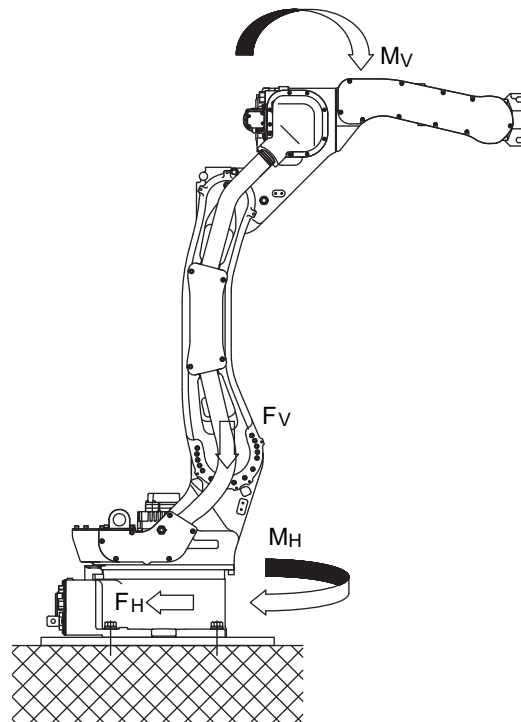


Fig. 4-3: Robot Force and Torque

### Types of Mounting

The robot can be mounted in the following positions:

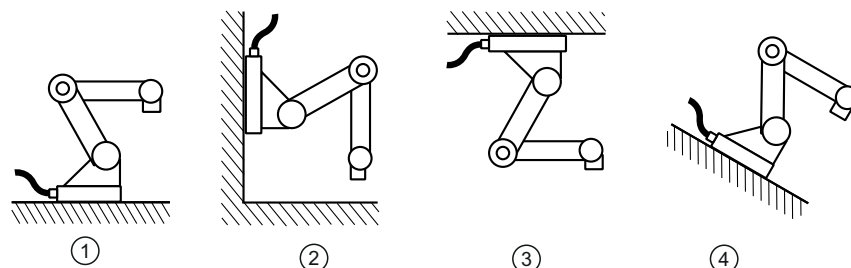


Fig. 4-4: Types of Mounting

- ① 0° = standing (standard)
- ② 90° = hanging on the wall
- ③ 180° = hanging from the ceiling
- ④ 10° - 90° = mounted on an angle

***Suspended mounting***

Suspended mounting differs from assembly in a standing position in the following points.

- S-axis working range
- Fixing the robot base

**NOTICE**

For suspended mounting in any position, please contact the local YASKAWA branch office.

---

***S-axis working range***

For the wall-mounted type, the S-axis movable range is  $\pm 30^\circ$  (the range is adjusted prior to the shipment).

***B-Axis operating range***

For ceiling-mounted type, the B-axis operating range is  $-90^\circ$  to  $+135^\circ$  (The range is adjusted prior to the shipment).

***Fastening the robot base***

With suspended mounting, the robot must be fastened with 4 screws M16 (Strength category 12.9) . Use a torque of 206 Nm in tightening the screws.

***Precaution against falling***

In case of suspended mounting, take measures to prevent the robot from falling down.

**NOTICE**

If the setup is changed, please contact the local YASKAWA branch office.

---

## 5 Wiring

### DANGER!

**Danger to life due to electric shock, risk of fire due to short circuit.**

Wiring must be performed by authorized or certified personnel.

Follow the instructions given below before wiring.

- ▶ Make sure that the earthing resistance does not exceed 0.1  $\Omega$ .
- ▶ Turn OFF the main power supply.
- ▶ Put up the warning sign prescribed, e.g. "**Do not turn the power on!**".
- ▶ Install a switch-on guard as prescribed.

### 5.1 Grounding

Follow the applicable electrical installation standards and wiring regulations for earthing. The cable cross-section must be 6 mm<sup>2</sup> or more.

For information on connecting the earthing cable directly, see Fig. 5-1: "Earthing connection".

#### NOTICE

##### Note on the earthing connection

Never use the earthing cable together with an earthing cable of, for example:

- ▶ A different electrical consumer
- ▶ A different motor-driven consumer
- ▶ Welding devices, etc.

If the earthing cable is laid in a metal duct, metal conduit or some other metal system, this must be earthed in accordance with the applicable electrical installation standards.

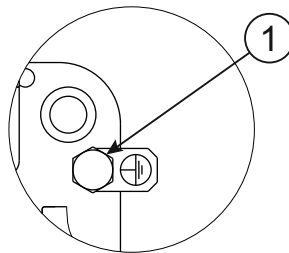


Fig. 5-1: Earthing connection

- ① M8 screw for earthing is supplied with the robot (at least 6 mm<sup>2</sup> protective earth conductor).

## 5.2 Cable connections

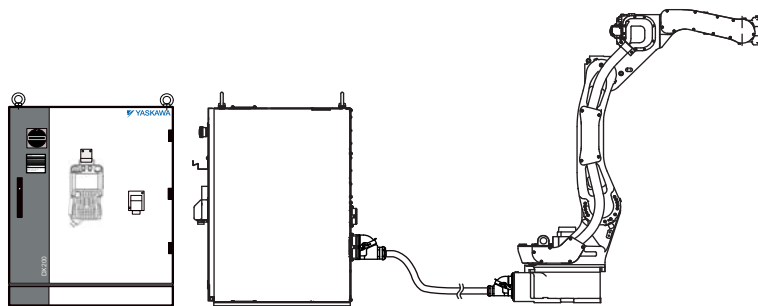


Fig. 5-2: Connecting the robot system

Two cables are delivered with the robot (refer to Fig. 5-3: "Robot cable").

- Encoder cable (1BC)
- Power cable (2BC)

Before connecting the robot cable, check the marking on the robot cable and the connections on the connector plate of the robot (see the following diagram "Robot cable").

Connect the cables to the connections on the robot base and on the robot controller (see the following chapter on "robot connection" and "robot controller connection").

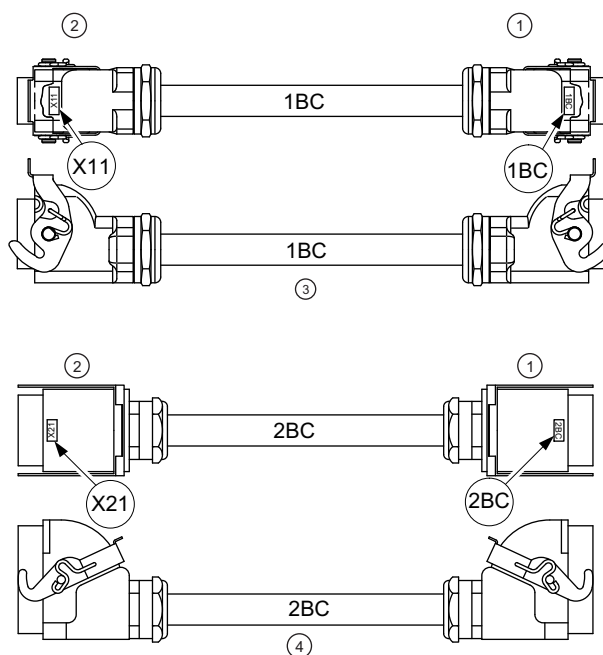
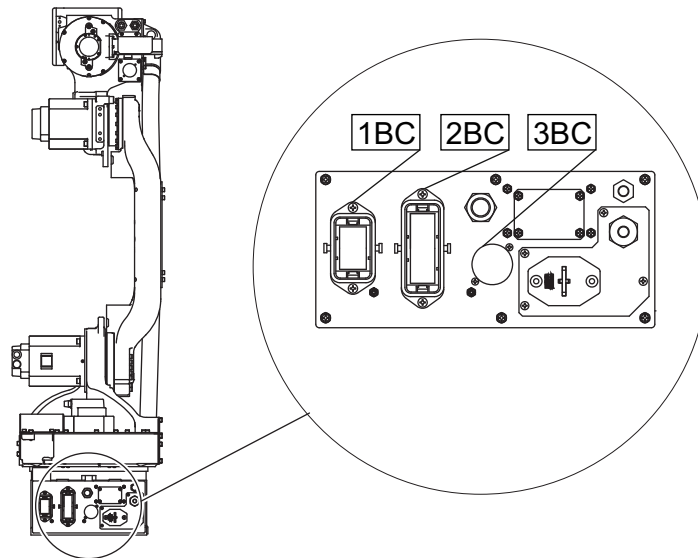


Fig. 5-3: Robot cable

- |                      |                       |
|----------------------|-----------------------|
| ① Robot control side | ③ Encoder cable (1BC) |
| ② Robot side         | ④ Power cable (2BC)   |

### 5.2.1 Connecting the robot

1. Check the encoder cable (1BC) and the power cable (2BC).
  2. Connect the encoder cable (1BC) to the connector plate of the robot.
  3. Connect the power cable (2BC) to the connector plate of the robot.
- Make sure that you hear each locking clip snap into place (clicking sound).



*Fig. 5-4: Connector plate of the robot*



### 5.2.2 Connection of the robot controller

Attach the robot cables in the following order.

1. Connect the encoder cable (1BC) X11 at connection X-1 to the robot controller.
2. Connect the power cable (2BC) X21 at connection X-2 to the robot controller.

Make sure that you hear the locking clips snap into place (clicking sound).

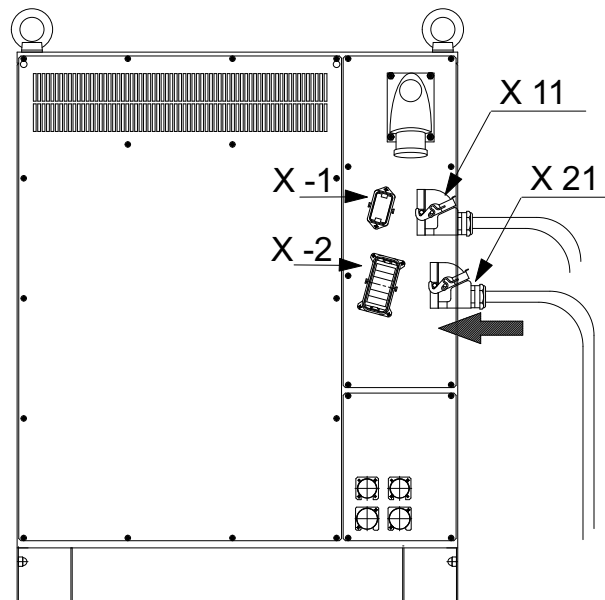


Fig. 5-5: Connection of the robot controller

### 5.2.3 Connecting the programming pendant

Connect the programming pendant cable to the connection (X81) (see diagram "Connecting the programming pendant")

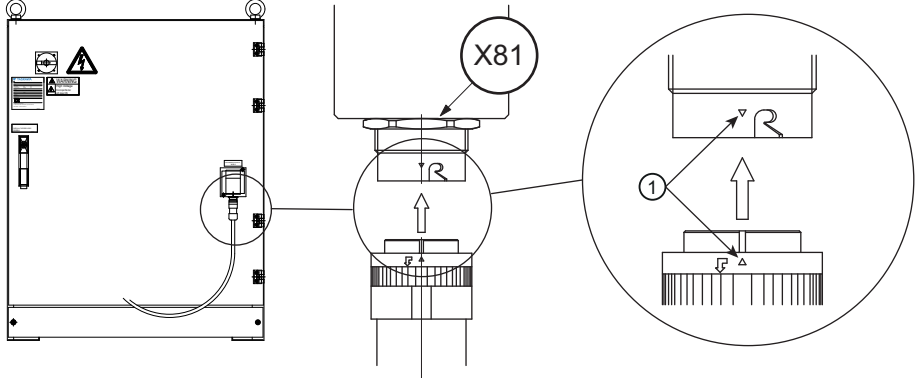


Fig. 5-6: Connection programming pendant

- ① Alignment marks

## 6 Technical data

<b>Type:</b>	A00
<b>Types of Mounting:</b>	Floor, wall and angle mounting
<b>Degree of freedom:</b>	6
<b>Carrying capacity:</b>	12 kg
<b>Repeatability:<sup>1</sup></b>	± 0.08 mm
Power consumption:	1.5 kVA
<b>Weight:</b>	130 kg
<b>Working area main axis:</b>	
S-axis (turning)	-170° ~ +170°
L-axis (lower arm) <sup>2</sup>	-90° ~ +155°
U-axis (upper arm) <sup>2</sup>	-175° ~ +240°
<b>Working area wrist axis:</b>	
R-axis (wrist roll) <sup>2</sup>	-180° ~ +180°
B-axis (wrist yaw/pitch)	-135° ~ +135°
T-axis (wrist twist)	-360° ~ +360°
<b>Protection class (IP):</b>	
Main axes	IP54
Wrist axis	IP67
<b>Maximum speed:</b>	
S-axis	3.84 rad/s, 220°/s
L-axis	3.49 rad/s, 200°/s
U-axis	3.84 rad/s, 220°/s
R-axis	7.16 rad/s, 410°/s
B-axis	7.16 rad/s, 410°/s
T-axis	10.60 rad/s, 610°/s
<b>Admissible moment (Nm):<sup>3</sup></b>	
R-axis	22 Nm
B-axis	22 Nm
T-axis	9.8 Nm
<b>Permissible moment of inertia (kgm<sup>2</sup>):</b>	
R-axis	0,65 kgm <sup>2</sup>
B-axis	0,65 kgm <sup>2</sup>
T-axis	0,17 kgm <sup>2</sup>
<b>Sound pressure level (dB):<sup>4</sup></b>	78.8 dB

1. Tested according to ISO 9283

2. The range of motion of L, U and R axes is limited depending on their position.

3. See the following diagram "Moment of arm rating in section 7" for further information on the permissible moment of inertia.

4. It is measured at maximum load and speed of the robot. The measurement is performed at height of 1.2 m and 1.5 m above the floor and at distance of 400 mm to the working area.

### 6.1 Parts and work axis label

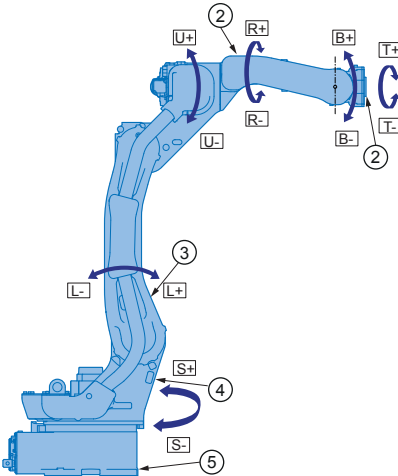


Fig. 6-1: Part names and working axes

- ① Upper arm (U-arm)
- ② Wrist flange
- ③ Lower arm (L-arm)
- ④ Rotating head of S-axis
- ⑤ Robot base

## 6.2 Robot base dimension

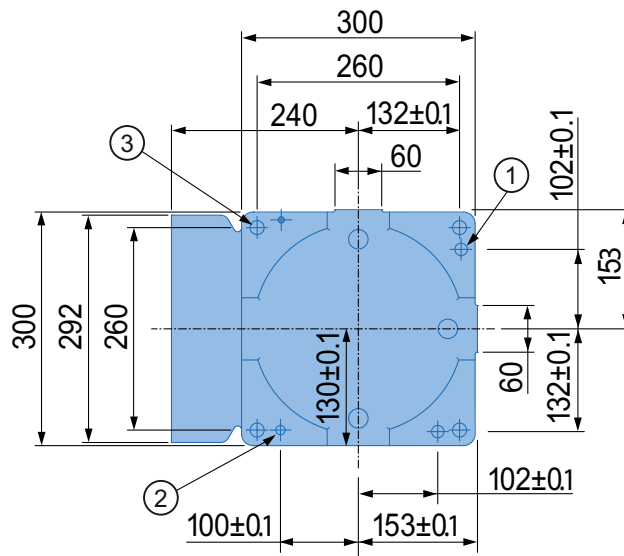


Fig. 6-2: Robot base dimensions

① 2 holes  $\varnothing 16^{H7}$

② Hole  $\varnothing 12^{H7}$

③ 4 mounting holes  $\varnothing 18$

All dimensions in mm

### 6.3 Dimensions and defined working area

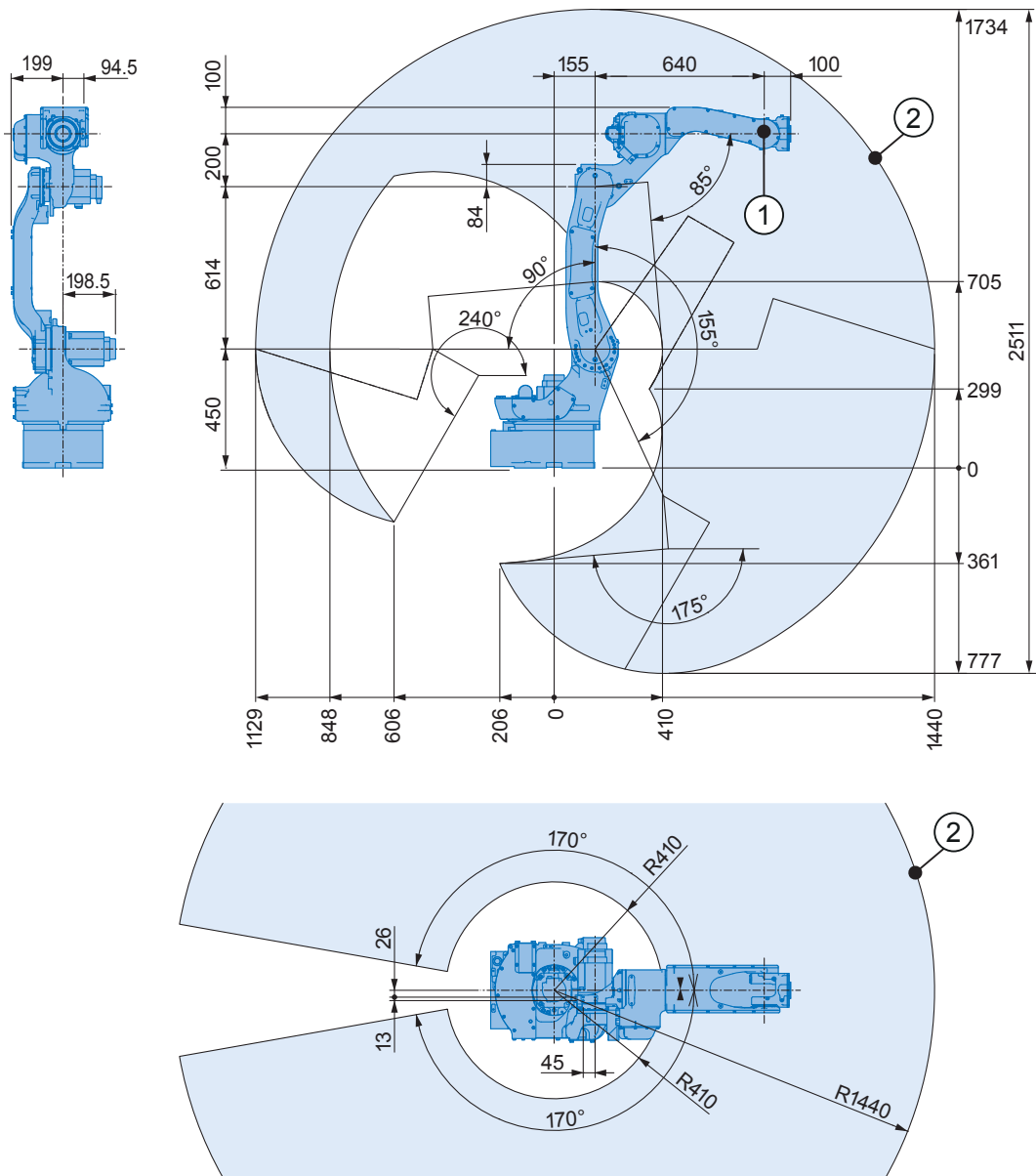


Fig. 6-3: Part names and working axes

- ① P point
  - ② Working area, defined with point P
- All dimensions in mm

## 6.4 Adjustable working area

The work area of the s-axis may be changed depending on the type of application. If any modification is necessary, please contact the local YASKAWA branch office.

Item	Specifications
S-axis working range	$\pm 170^\circ$ (standard) $\pm 150^\circ$ $\pm 135^\circ$ $\pm 120^\circ$ $\pm 105^\circ$ $\pm 90^\circ$ $\pm 75^\circ$ $\pm 60^\circ$ $\pm 45^\circ$ $\pm 30^\circ$

### 6.4.1 Instructions for Installing the Mechanical Limit

- Mount the mechanical limit of S axis so that as shown in the figure "Components of the S axis limit".
- When inserting the pin in the limit, apply Loctite 242 on the screw-on surface of the pin.
- Fasten the dog on the S-head using 2 x M12 screws (Strength category 12.9). Tighten the screws with a tightening torque of 150 Nm.
- With a working area of  $\pm 170^\circ$ , the stop must be mounted (as shown in the figure "Components of the S axis limit").
- The stop can be mounted at 15-degree intervals. To avoid a mechanical interference from stop duplication (eg  $\pm 30^\circ$ ,  $\pm 150^\circ$ ), install the mechanical stop as shown in the following table Fig. 6-4: "Components of the S-axis limitation".

#### **NOTICE**

- ▶ Always use the specified components when installing the S-axis limit
- ▶ Switch OFF the supply voltage before you start mounting.

### 6.4.2 Components for Changing the Working Area

If you change the working area of S-axis, the following components are required (see the following figure).

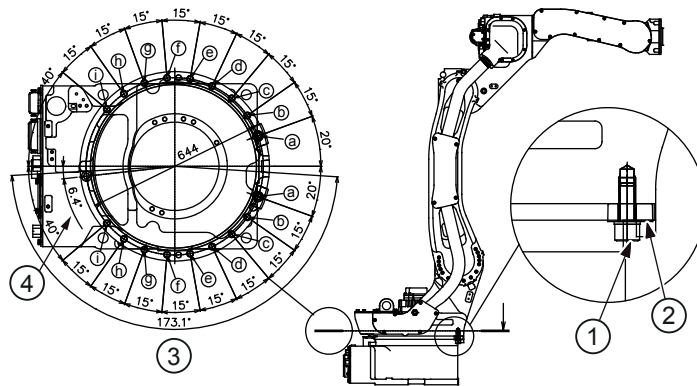


Fig. 6-4: Components of the S-axis limitation

- ① Sleeve
- ② 2 screws M12 x 30
- ③ 18 x M12 Assembling position
- ④ Mechanical limit

S-axis working range	Stop position
± 170°	-
± 150°	a
± 135°	b
± 120°	c
± 105°	d
± 90°	e
± 75°	f
± 60°	g
± 45°	h
± 30°	i



### 6.4.3 Adjusting the S-Axis Pulse Limit

If you want to change the movement range of S-axis, follow the instructions in the System Setup Manual, section: "Changing the Parameter Setting".

- Pulse limit [positive direction (+) of S-axis]: SICxG400.
- Pulse limit [negative direction (-) of S-axis]: SICxG408.

Degree	± 30°	± 45°	± 60°	± 75°	± 90°
Number of pulses	±43061	±64591	±86121	±107651	±129182

Degree	± 105°	± 120°	± 135°	± 150°	± 170°
Number of pulses	±150712	±172242	±193772	±215303	±244010

#### NOTICE

To change the movement range of the machine, set both the pulse limit and the angle of the mechanical S-axis limit.

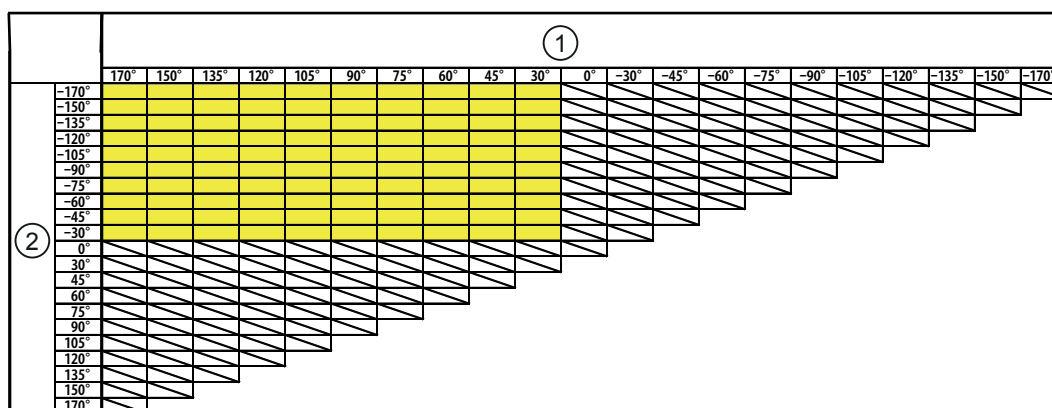


Fig. 6-5: Adjustable angle for the S-axis limit

- ① The angle in plus direction                       = adjustable angle
- ② The angle in minus direction                       = non-adjustable angle

### 6.5 Stopping Angle and Time at the Emergency Stop

The definition of the coastdown times is important for determining the safety distance for protective devices. The overrun time is the time that elapses from the point of time when the stop signal is triggered until the robot comes to a complete stop. The overrun distance is the angle that the robot travels from the point of time when the stop signal is triggered until the robot comes to a complete stop.

The following diagrams show only the values for the S, L, and U axes since these axes have the largest deflection. For a safety stop with stop category 0, the mean values determined through testing and simulation are specified.

The actual overrun distances and overrun times may differ due to internal and external influence on the braking torque. According to the mode, robot application, and number of triggered safety stops with stop category 0, a different brake wear may occur. We recommend that the coastdown path be checked once a year.

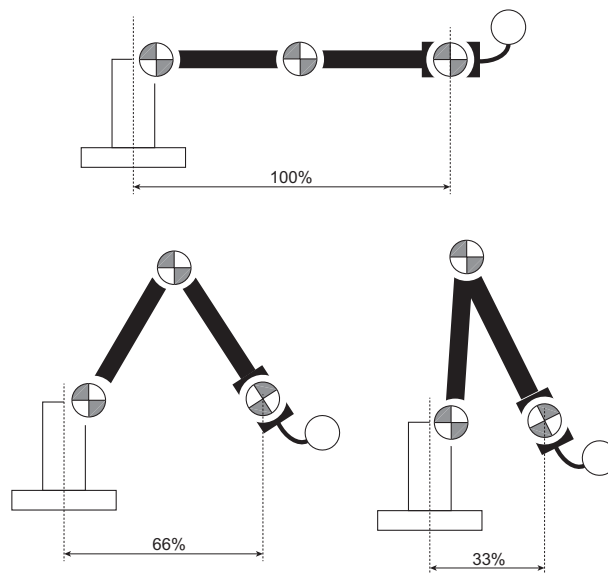


Fig. 6-6: Main axes at 100%, 66%, and 33% deflection

In Fig. 6-6: "Main axes at 100%, 66%, and 33% deflection" the S, L, and U axes are shown at 33%, 66%, and 100% deflection according to DIN EN ISO 10218-1.

In these three positions, the coastdown paths and coastdown times were determined during a safety stop with stop category 0 and stop category 1. In the following diagrams, they are specified at payloads of 33%, 66%, and 100%.

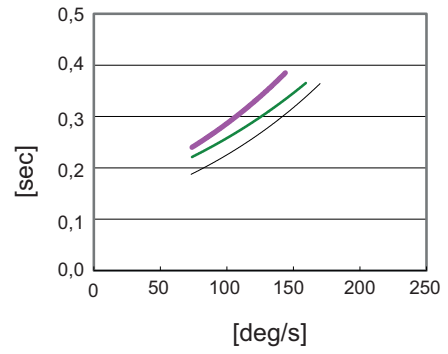
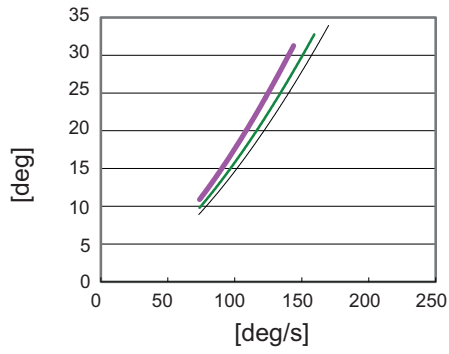
The pertinent legend can be found in the following table:

Definitions	Description
Category 0 Load 100%	pink <span style="color: pink;">—</span>
Category 0 Load 66%	green <span style="color: green;">—</span>
Category 0 Load 33%	gray <span style="color: gray;">—</span>
Category 1	blue <span style="color: blue;">—</span>
Overrun distance degrees°	[deg]
Overrun time second	[sec]
Robot speed degrees°/second	[deg/s]

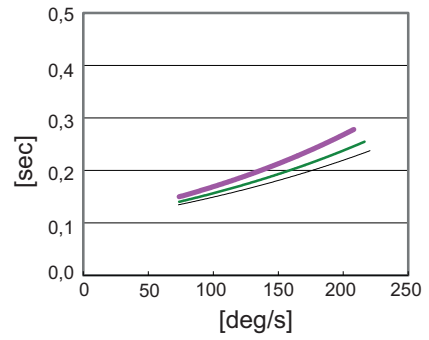
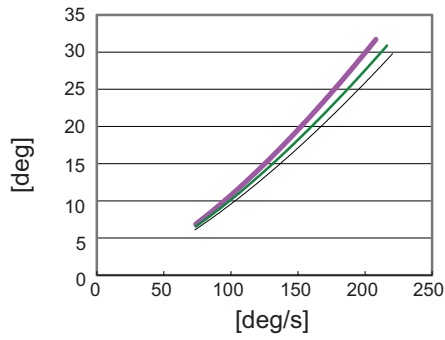
**6.5.1 Stop category 0**

**6.5.1.1 Stop position S-axis**

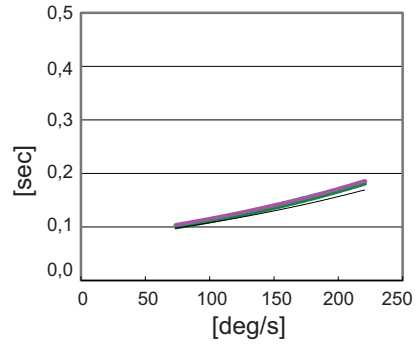
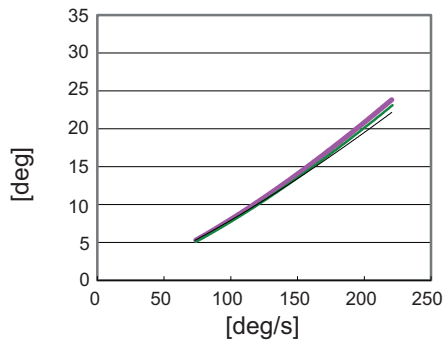
100%



66%

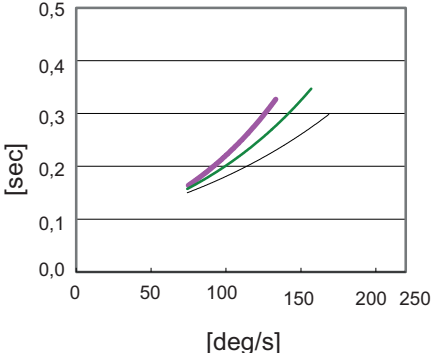
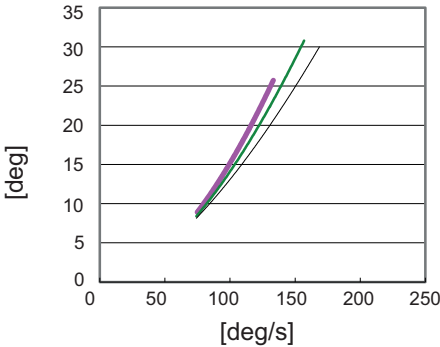


33%

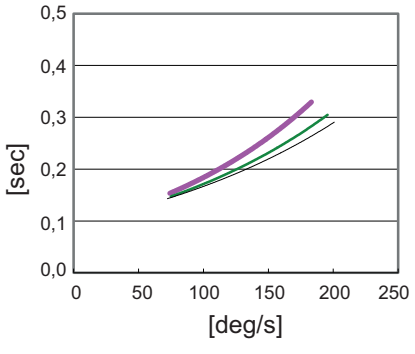
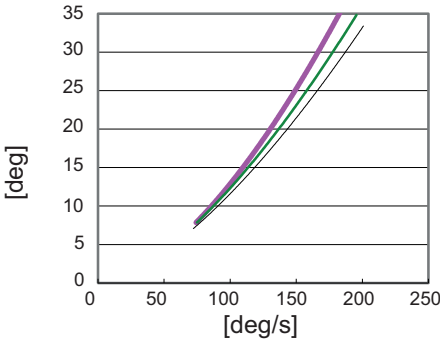


6.5.1.2 Stop position L-axis

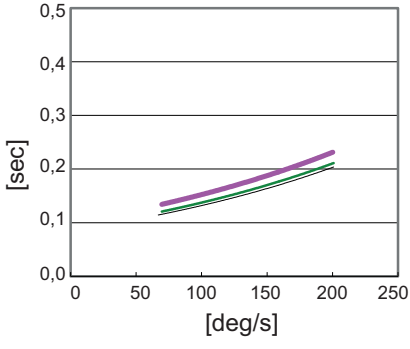
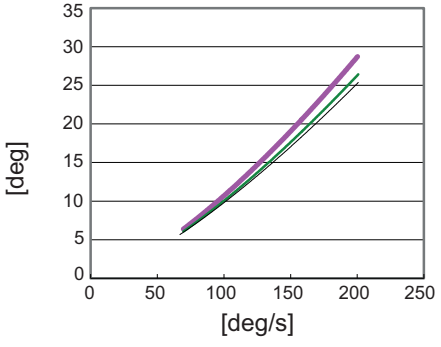
100%



66%

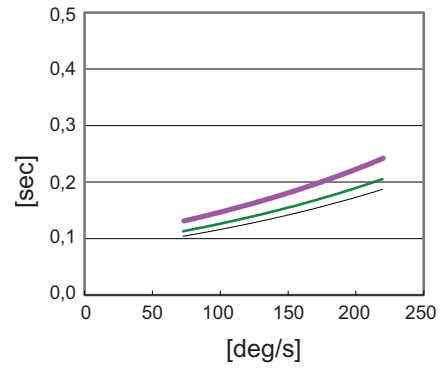
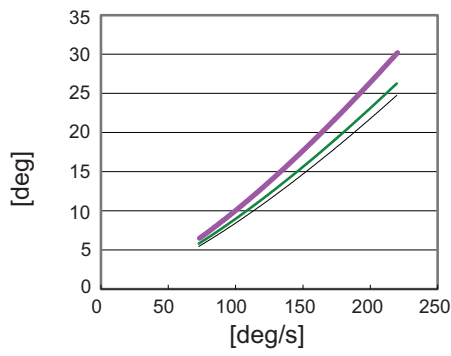


33%

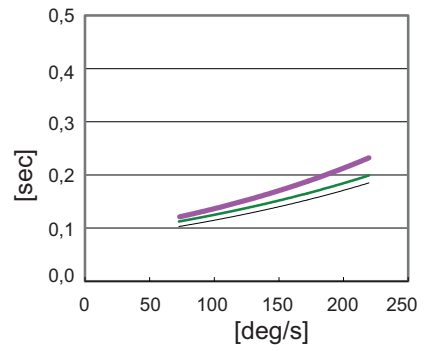
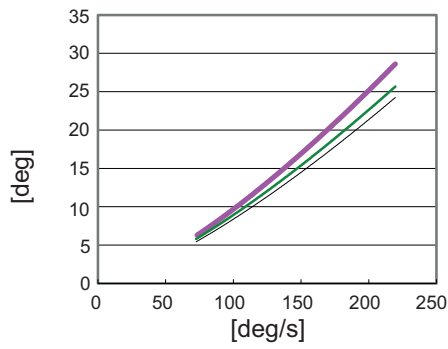


6.5.1.3 Stop position U-axis

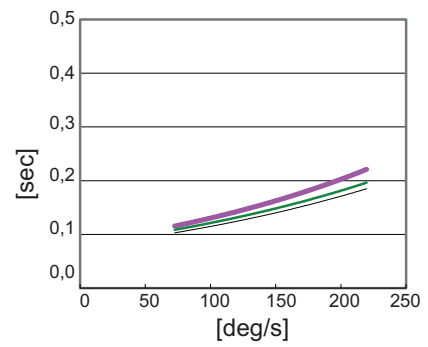
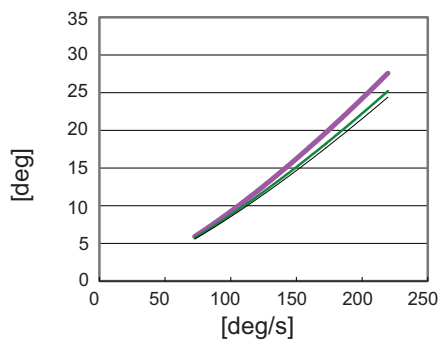
100%



66%



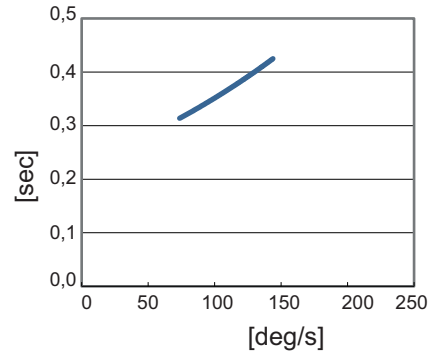
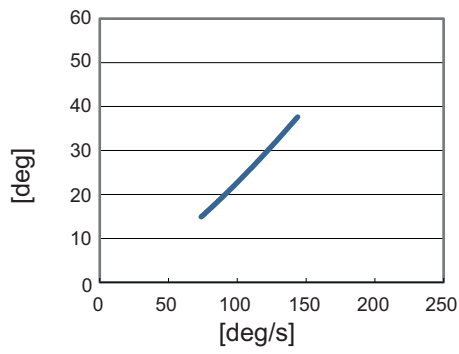
33%



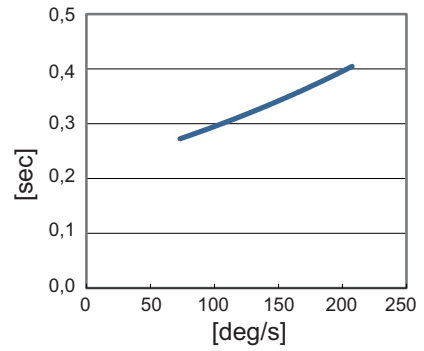
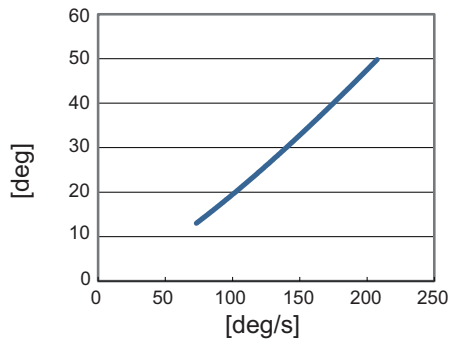
## 6.5.2 Stop category 1

### 6.5.2.1 Stop position S-axis

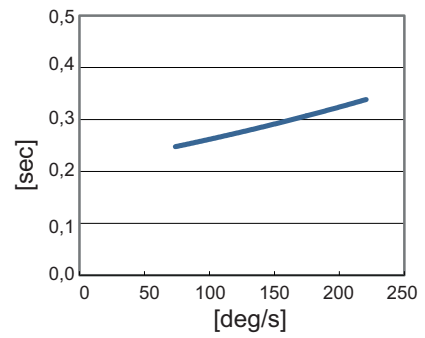
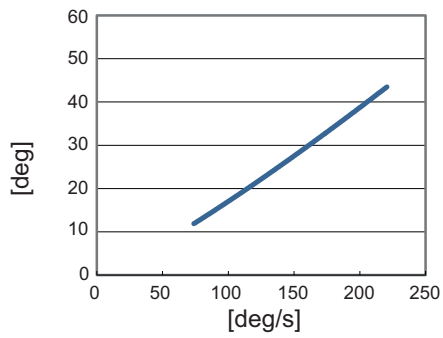
100%



66%

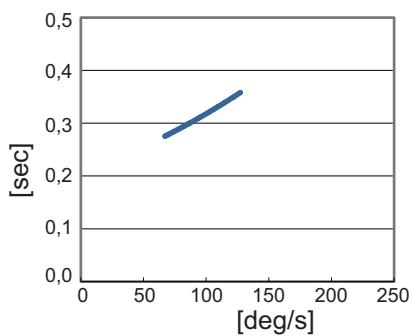
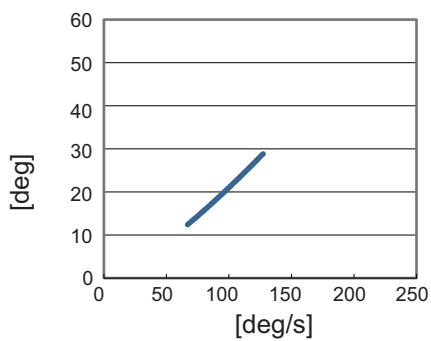


33%

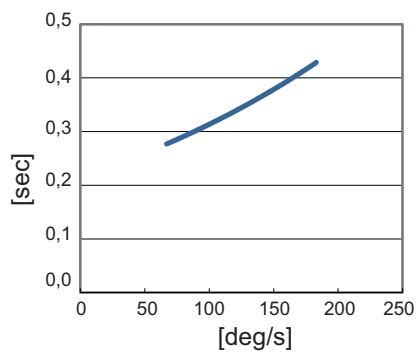
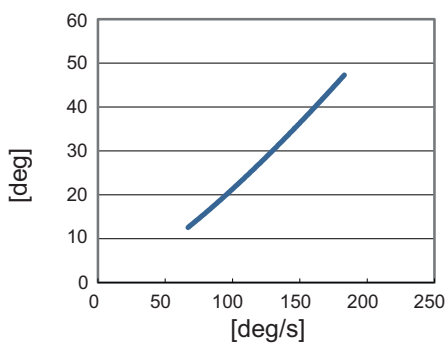


6.5.2.2 Stop position L-axis

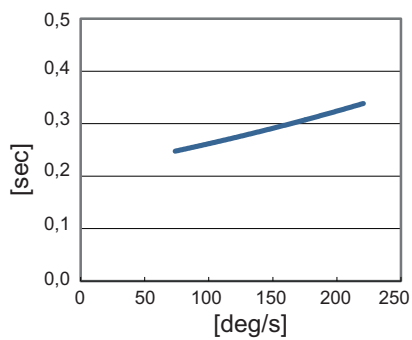
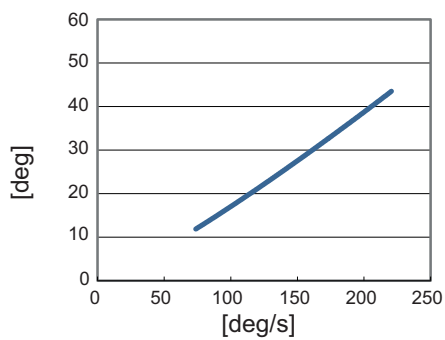
100%



66%

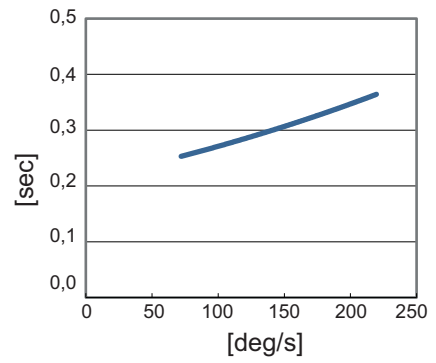
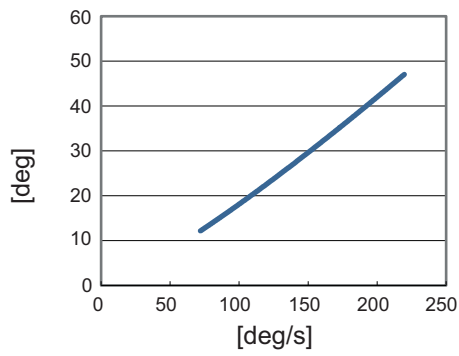


33%

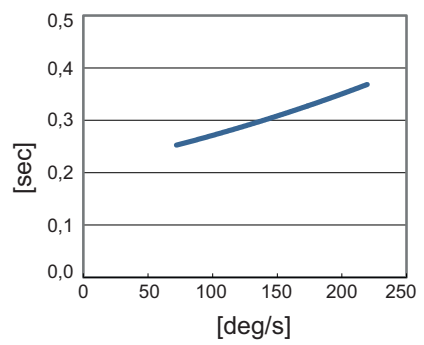
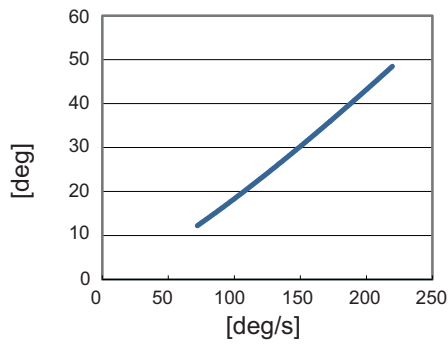


### 6.5.2.3 Stop position U-axis

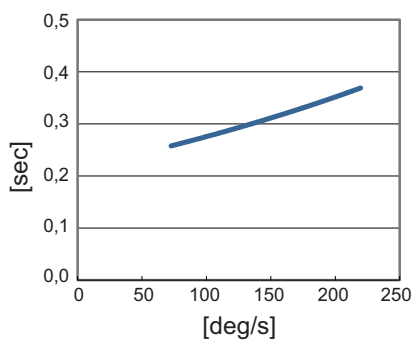
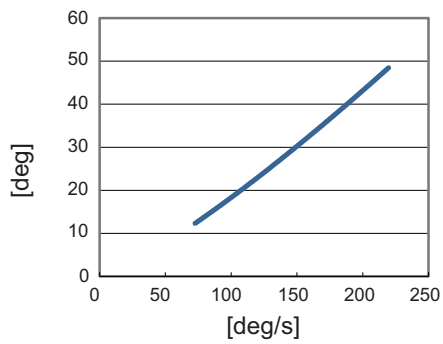
100%



66%



33%





## 7 Allowable load for wrist axis and wrist flange

### 7.1 Wrist flange

The dimensions of the wrist flange are shown in the following figure "Wrist flange". To ensure that the home position marks can be seen at all times, the tool may only be flange-mounted with the inner diameter. Fitting depth of inside fittings must be 5 mm.

#### NOTICE

Before mounting a tool, remove anticorrosive coating on the flange. Thinner or light fuel oil are the most suitable for this purpose.

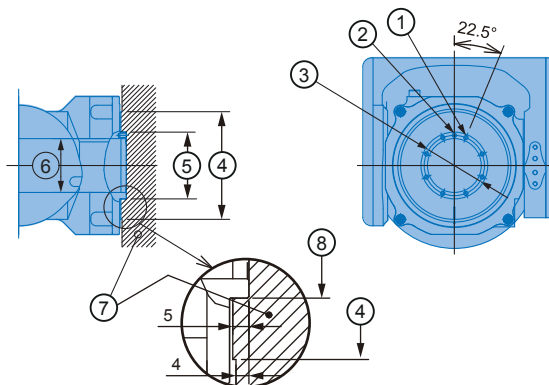


Fig. 7-1: Wrist flange

- |   |                              |
|---|------------------------------|
| ① 8 tapped holes M4 x 8                   | ⑤ $\text{Ø } 62 \text{ h}^7$ |
| ② Hole $\text{Ø } 4 \text{ H}^7 \times 6$ | ⑥ $\text{Ø } 50$             |
| ③ P.C.D 56                                | ⑦ Mount tools in this range. |
| ④ $\text{Ø } 100$                         | ⑧ Depth: 5                   |

All dimensions in mm

### 7.2 Maximum load of the S-axis

For peripheral devices of specific applications, additional mounting options are provided on the robot.

### 7.3 Optimal robot performance

To achieve optimal robot performance, the maximum load of the S-axis must never exceed the permissible bearing capacity of the robot.

### 7.4 Allowable Wrist Load

The permissible wrist loads amounts to a maximum of 12 kg. Should however force instead of load be exercised on the wrist axis, the power has to be at the axes within the moments (see the following figure and table).

For further information or help, please contact your YASKAWA branch office.

Axis	Permissible torque (Nm)	Permissible moment of inertia (kgm <sup>2</sup> )
R-axis	22 Nm	0,65 kgm <sup>2</sup>
B-axis	22 Nm	0,65 kgm <sup>2</sup>
T-axis	9.8 Nm	0,17 kgm <sup>2</sup>

Tab. 7-1: Permissible torque and permissible moment of inertia

Keep the centroidal distance of the load/mass within the specifications; refer to the following figure, "Hand loads."

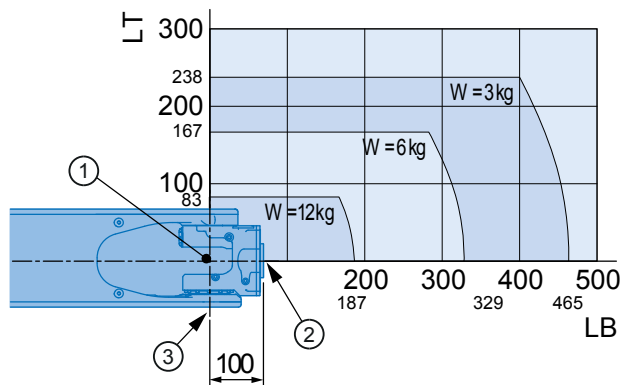


Fig. 7-2: Moment of arm rating

- ① P-point
  - ② R-, T-axes rotation center line
  - ③ B-axes rotation center line
- All dimensions in mm

## 7.5 Maximum capacity load

The maximum permissible load for U-axis, including wrist, is 22 kg.

For example, if the load mounted on the joint is 12 kg, the load on the upper arm must not exceed 10 kg.

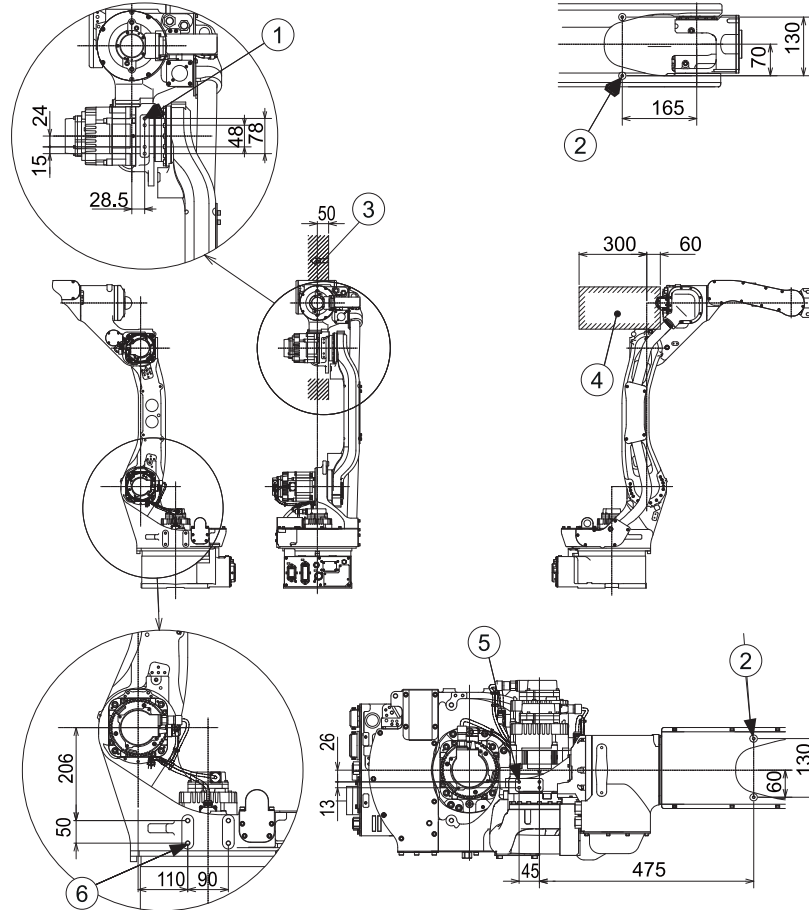


Fig. 7-3: Installing peripheral equipment mounts

- ① 4 threaded holes M8 x 18
- ② 2 threaded holes M6 x 12
- ③ Mount the peripherals in this range
- ④ Center of gravity of accessories mount on U arm in this range
- ⑤ 4 threaded holes M6 x 12
- ⑥ 4 threaded holes M10 x 18

## 8 Internal cables and compressed air lines

Internal cables (3BC: 14 wires, 8 x 0.20 mm<sup>2</sup>, 2 x 0.75mm<sup>2</sup>, and 4 x 1.25 mm<sup>2</sup>) and air hoses are used in order to use peripheral devices (e.g. gripper). They are mounted on the upper arm as shown in the following diagram "Connector for internal cables and compressed air lines".

The pins 1 to 16 are assigned as shown in the following figure. Wiring must be performed by the user.

The following requirements must be met:

- The total current value for the internal wiring harness must be 40 A .
- The current-carrying capacity per single conductor (cross-section 0.20 mm<sup>2</sup>, 0.75 mm<sup>2</sup>, and 1.25 mm<sup>2</sup>) must not exceed 3 A or less .
- The air pressure for the air hose must not exceed 600 kPA (the inner diameter of the air hose is Ø 6.5 and Ø 8 mm).
- For the power cable when arc welding the nominal current may not exceed 350A. In permanent operation the current may not exceed 60% of the nominal current (permissible current at permanent operation = 60% x (350A/operating current)<sup>2</sup>).

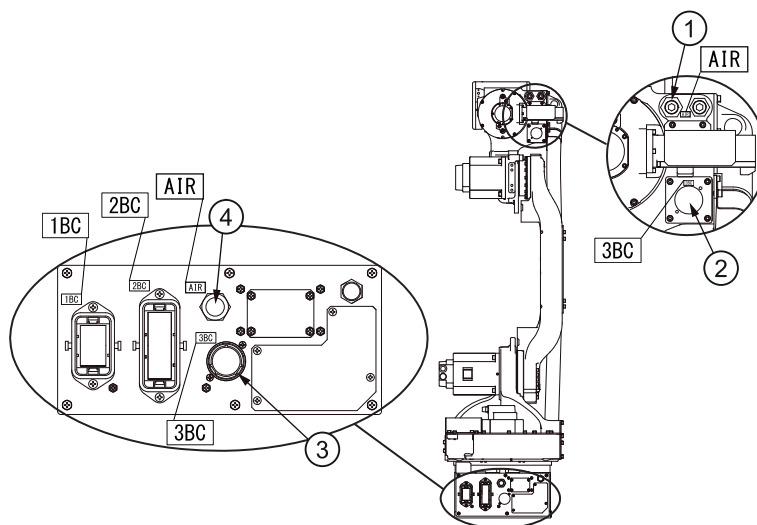


Fig. 8-1: Connectors for internal user I/O wiring harness and air line

- ① Air outlet
- ② There is a connecting plug for internal cable ducting in the case.
- ③ Connector plug for the internal cable feedthrough on the base
- ④ Air inlet

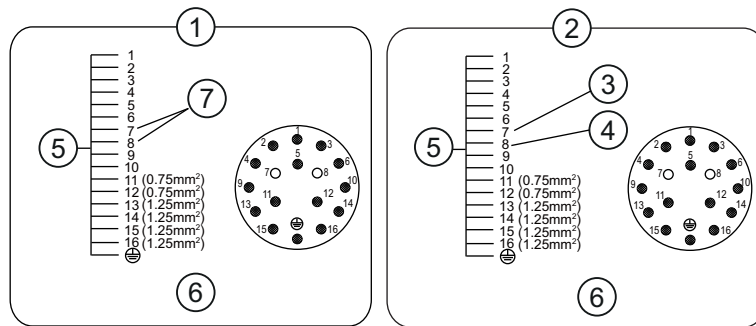


Fig. 8-2: Details of the plug

● = assigned

○ = unassigned

- |   |   |
|---|---|
| ① Connector plug for the internal cable feedthrough on the base | ⑤ Pins used   |
| ② Connector plug for the internal cable feedthrough on U-arm    | ⑥ Internal user I/O wiring harness: 8 wires 0.2 mm <sup>2</sup> , 2 wires 0.75 mm <sup>2</sup> , 4 wires 1.25 mm <sup>2</sup> |
| ③ +24 V (1A) for shock sensor                                   | ⑦ 7 and 8 are open  |
| ④ Shock sensor signal input                                     |   |

The pins used on the connectors (3BC: 14 wires, 8 x 0.20 mm<sup>2</sup>, 2 x 0.75mm<sup>2</sup>, and 4 x 1.25 mm<sup>2</sup>) are connected to the stand and arm with individual wires.

In the standard specification, pins 7 and 8 are connected as follows:

- To the 3BC connection for the collision sensor on the U arm.
- To the 3BC connection for the collision sensor on the robot controller.

Pins 7 and 8 of the respective 3BC connections on the connector plate and U arm are connected to each other.

For the wiring, see the following figure, "Connecting diagram for internal connections."

The internal connections of the robot are shown in the following diagrams "Connection diagram A" and "Connection diagram B".

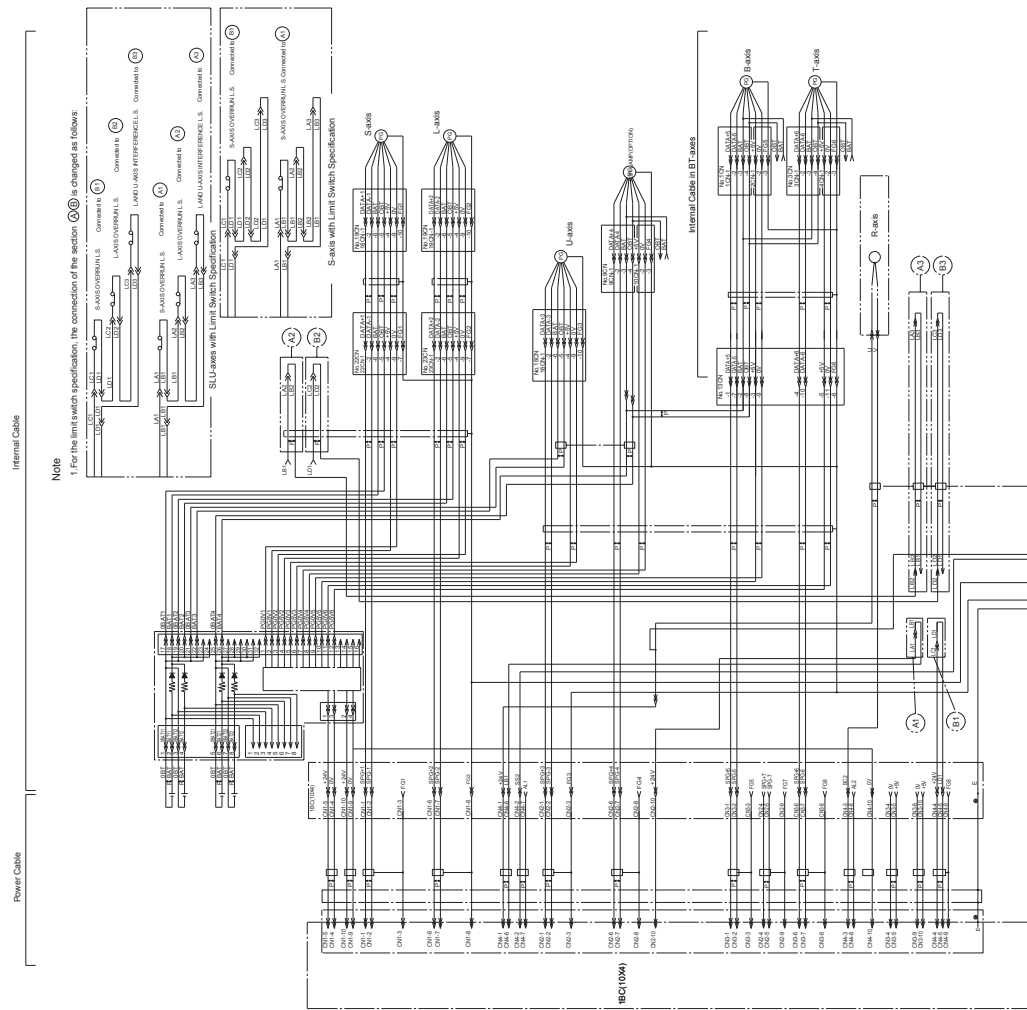


Fig. 8-3: Internal connection diagram (a)

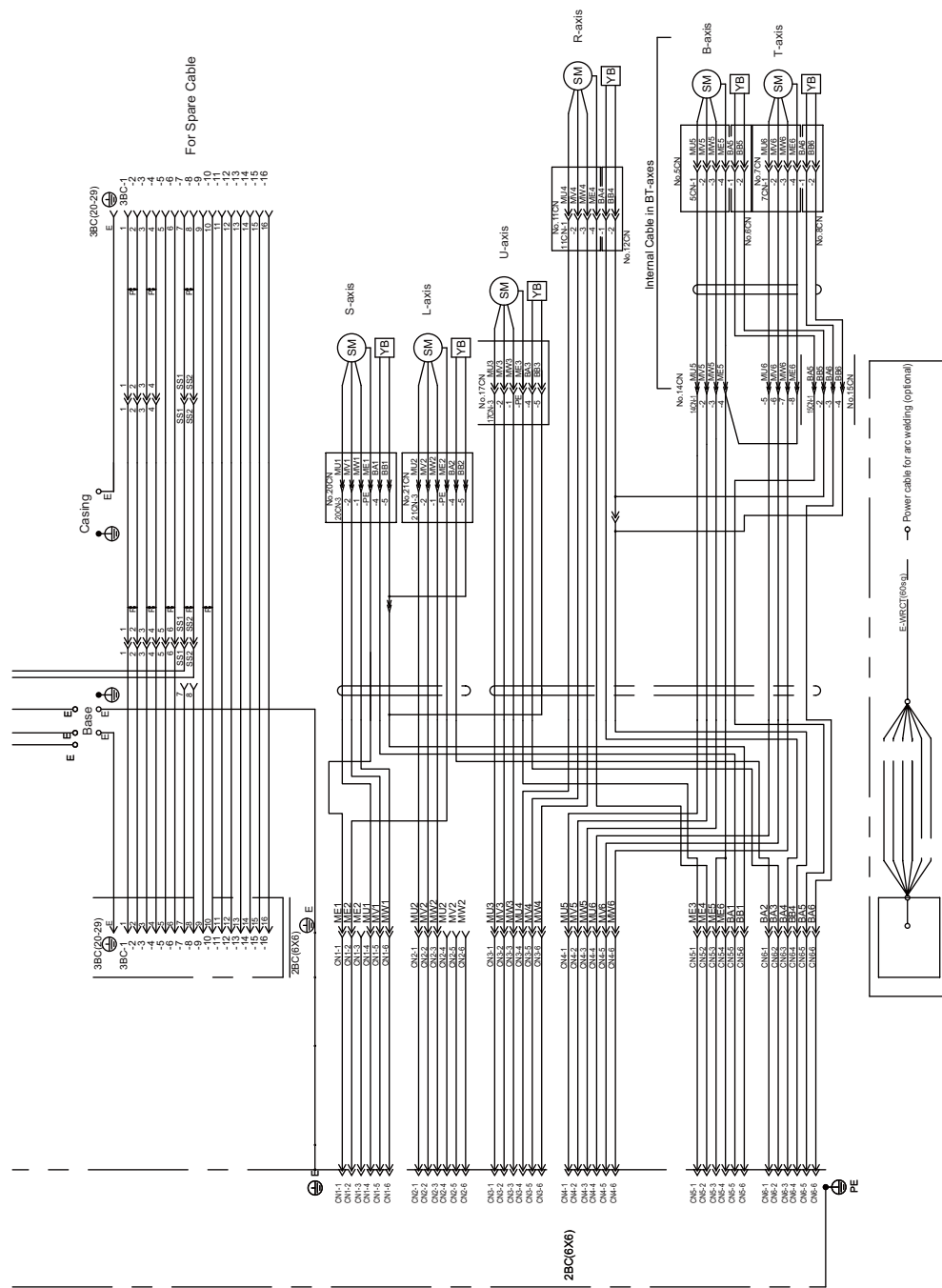


Fig. 8-4: Internal connection diagram (b)



## 9 Maintenance and inspection

### **DANGER!**

#### **Danger to life due to electric shock**

Maintenance and inspections must be performed by specified personnel.

The instructions given below must be followed before taking maintenance and inspection measures:

- ▶ Turn OFF the main power supply.
- ▶ Put up the required warning sign, e.g. "**Do not turn the power on!**".
- ▶ Install a switch-on guard as prescribed.

---

If you have any questions regarding disassembly or repair, please contact the local YASKAWA branch office.

### **NOTICE**

#### **Home position data is lost**

Before removing the connector of the encoder cable to perform maintenance or inspection,

- ▶ Connect the spare battery unit.
- 

### 9.1 Inspection schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period. But also to prevent malfunctions and assure safe operation. Inspection are classified into several time levels as shown by the following table "Inspection intervals".

In the table of "Inspection intervals", the inspections are divided according to three levels of requirement:

- Works, carried out by trained staff.
- Work carried out by staff trained by YASKAWA.
- Works, carried out by YASKAWA staff.

Inspections are only carried out by trained staff.

### **NOTICE**

- ▶ The inspection intervals depend on the SERVO power time (see point 1 in Fig. 9-1: "SERVO power time").
  - ▶ The table "Inspection intervals" applies to normal cases.
  - ▶ Deviations are to be determined by the TCS service department of YEU-R.
-

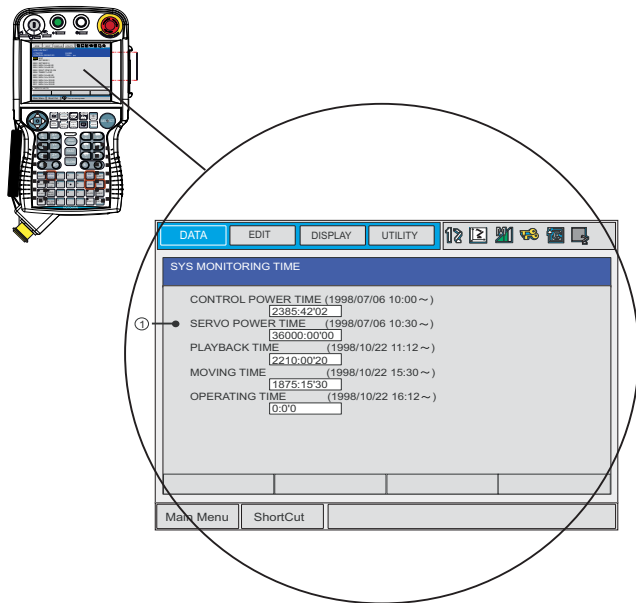


Fig. 9-1: SERVO power time

- 1 Trained staff
- 2 YASKAWA trained staff
- 3 YASKAWA personnel

### Inspection intervals

Item number <sup>1</sup>		Schedule (h)						Method	Operation	To be performed by:		
		Daily	1000	6000	12000	24000	36000			1	2	3
1	Alignment marks	●						Visual inspection	Check alignment mark correspondence and damage at the zero position.	●	●	●
2	External cables	●						Visual inspection	Check cables for damage.	●	●	●
3	Working area and robot	●						Visual inspection	If the working area is dirty, it must be cleaned. Check the robot for damage and external cracks.	●	●	●
4	Motor for S-, L-, U-axes	●						Visual inspection	Check for grease leakage.	●	●	●
5	Fixing screws of the base plate		●					Using a corresponding tool,	tighten loose screws (replace if necessary).	●	●	●
6	Fixing screws of the cover		●					Using a corresponding tool,	tighten loose screws (replace if necessary).	●	●	●
7	Power input module		●					Manually	Check for loose connections.	●	●	●
8	Toothed belt for B- and T-axes				●			Manually	Check for tension and wear		●	●
9	Wiring harness in the robot (wires of the S-, L-, U-, R-, B- and T-axis)				●			Visual inspection with multimeter	Check the bushing between the connector on the stand and the intermediate connectors by manually moving the wires. Check the protective coil. <sup>2</sup>		●	●
						●			Exchange <sup>3</sup>			●

## Inspection intervals

Item number <sup>1</sup>	Schedule (h)	Method	Operation	To be performed by:		
				1	2	3
	Daily 1000 6000 12000 24000 36000					
10	Wiring harness in the robot (wires of the B- and T-axis)	Visual inspection with multimeter	Check the wires between the terminals for wear.		●	●
			Exchange			●
11	Protective tube	Visual inspection	Inspect the protective tube for holes, cracks and adhesion of welding spatters (replace if necessary).	●	●	●
			Refer to manual "OPTIONS FOR PROTECTIVE TUBING (VELCRO TYPE) REPLACING PROCEURES".	●	●	●
12	Battery unit in robot		If a battery alarm appears or after the robot has been operated for 36000 hours, the battery must be exchanged.		●	●
13	S, L, U, R, B and T-axes gear	Grease gun	Check for malfunctions (replace if necessary). The grease <sup>4</sup> must be refilled every 6000 hours and exchanged every 12000 hours (see Chapter 9.4.1 "Grease filling the main axes" and 9.4.2 "Grease filling the wrist axes").		●	●

### Inspection intervals

Item number <sup>1</sup>	Schedule (h)						Method	Operation	To be performed by:		
	Daily	1000	6000	12000	24000	36000			1	2	3
14	Overhaul					●					●

1. The item numbers correspond with the following figure, "Inspection intervals."

2. When checking for conduction with multimeter, connect the battery to "BAT" and "OBT" of the plug connections of the respective motor. Now remove the connectors of the encoders of the respective motor. Failure to observe this sequence can lead to loss of home positions (see section 9.3.1 "Wrist unit" on page. 58

3. The internal wiring harness in the robot (for the S, L, U, R, B and T axes) must be replaced at the 24,000 hours inspection.

4. The grease or lubricants used can be found in the following table, "Inspection points and greases used."

*Tab. 9-1: Inspection intervals*

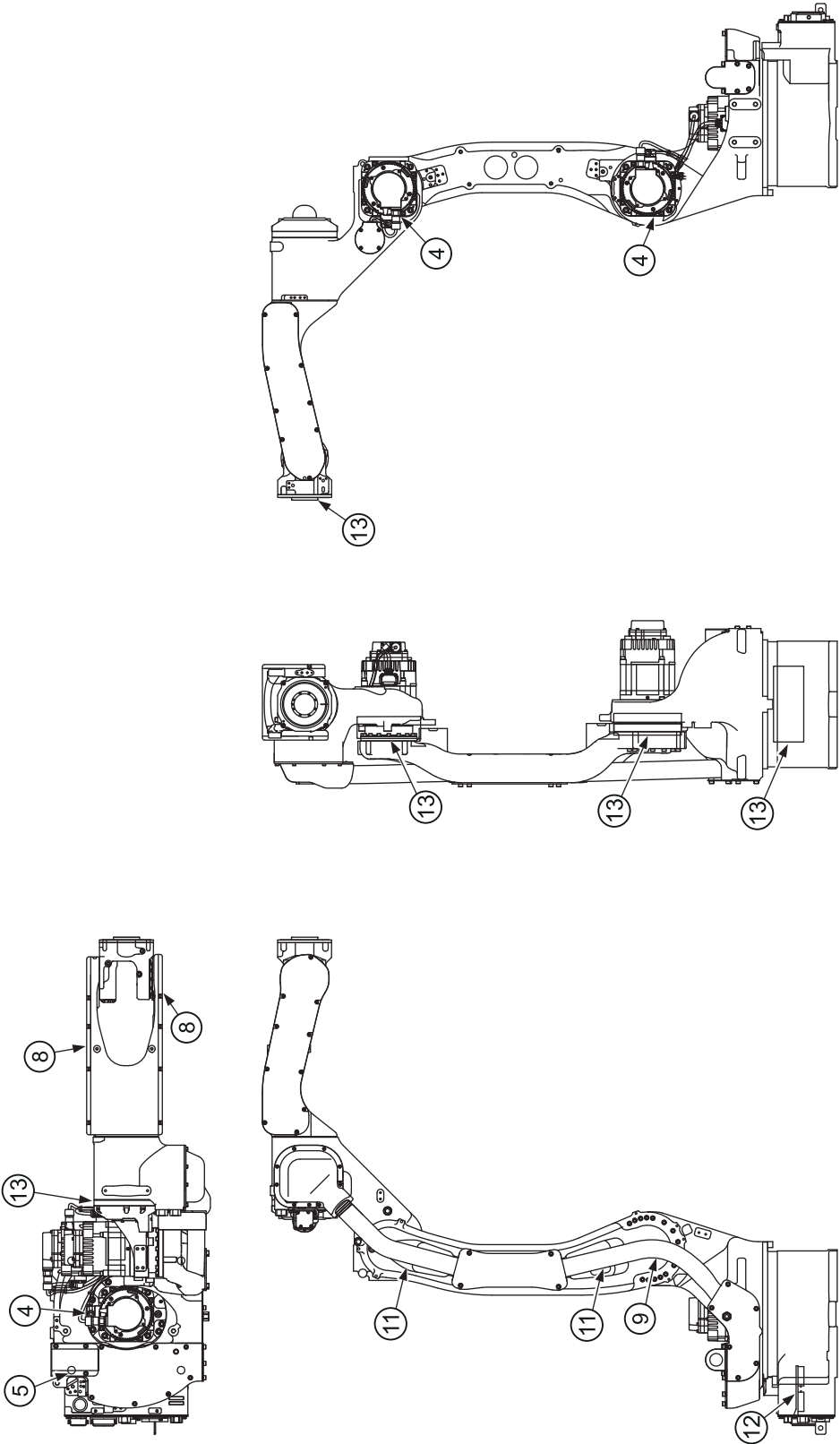


Fig. 9-2: Inspection intervals

## 9.2 Note on battery unit

### 9.2.1 Changing battery unit

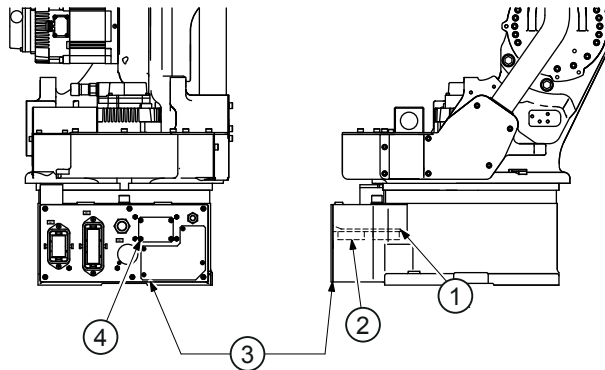


Fig. 9-3: Battery unit location

- |                  |                                  |
|------------------|----------------------------------|
| ① Battery holder | ③ Connector plate                |
| ② Battery pack   | ④ Mounting screws of cover plate |

The battery units are installed as shown in picture "The location of the battery unit".

If battery alarm occurring in the robot controller, battery pack has to be changed in the following form.

1. Turn the robot controller to the main power supply (see Fig. 9-4: "Main power switch in "switch-off" position").

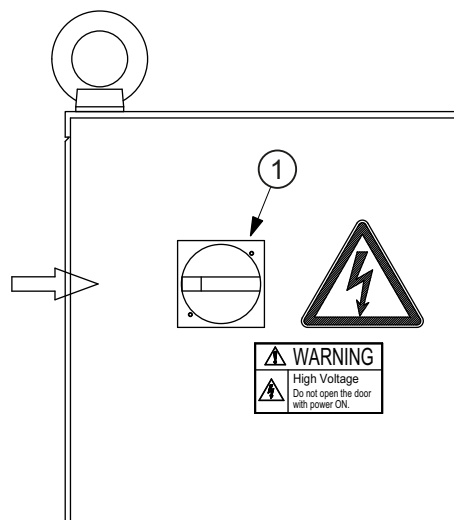


Fig. 9-4: Main power switch in "switch-off" position

- ① Main power switch in "switch-off" position
2. Remove the fixing screws from the cover plate.

- Carefully pull out the battery pack from the base.

**NOTICE**

**The absolute encoder data will be lost**

Removing the battery pack, make sure you not to remove the plug from circuit board.

---

- Connect the new battery pack to the unoccupied connector on the board.

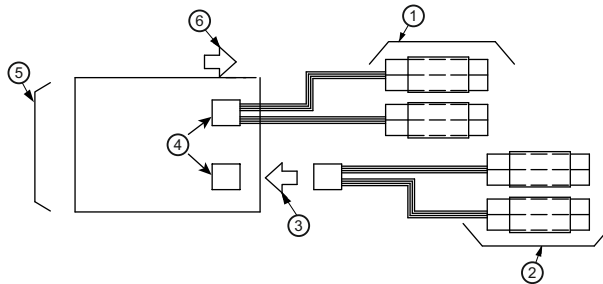


Fig. 9-5: Battery pack connections

- |                                       |                        |
|---------------------------------------|------------------------|
| ① Old battery pack before replacement | ④ Plug                 |
| ② New battery pack                    | ⑤ Circuit board        |
| ③ See exchange, step 6                | ⑥ See exchange, step 7 |

- Remove the old battery pack from the battery holder.
- Mount the new battery pack to the battery holder.

**NOTICE**

**The absolute encoder data will be lost**

Never remove old battery pack before having installed new battery pack.

---

- Please remove old battery pack plug from circuit board.

**NOTICE**

Make sure that no wires are pinched when you install the battery pack and the cover plate again.

---

- Please apply Teroson Plast sealing compound (material no. 143813) to thread part of screws.

*Exchanging the battery unit is completed after reinstalling the cover plate on the plug plate.*



### 9.2.2 Battery pack connector (including warning note)

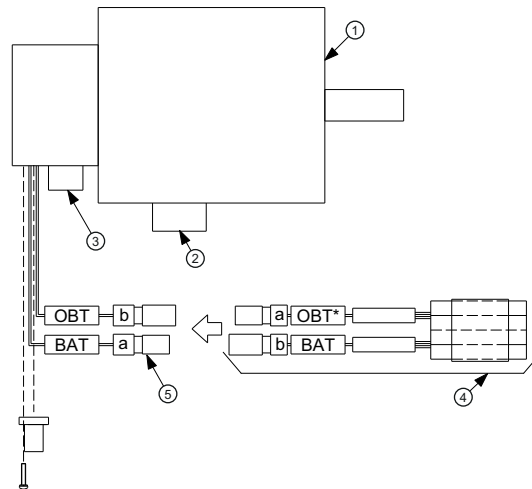


Fig. 9-6: Battery unit connector diagram for S-, L- and U-axes

- |                         |                   |
|-------------------------|-------------------|
| ① Motor                 | ④ Battery unit    |
| ② Motor power connector | ⑤ Plug for backup |
| ③ Encoder connector     |                   |

Before removing the encoder connector (with CAUTION label), connect the battery to the motor as shown in the following figure.

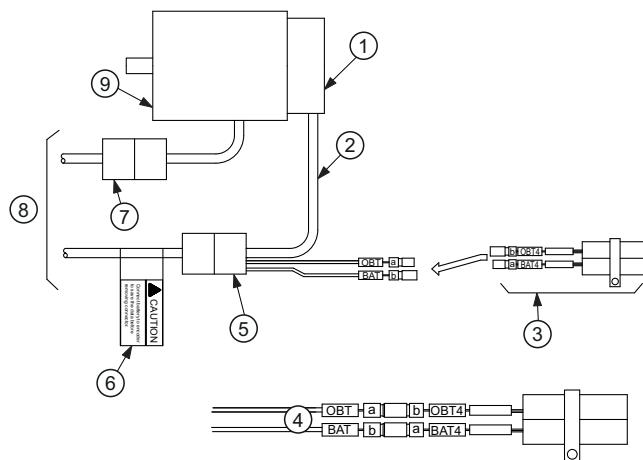


Fig. 9-7: Battery unit connector diagram for R-, B- and T-axes

- |                                     |                               |
|-------------------------------------|-------------------------------|
| ① Encoder                           | ⑥ Warning label               |
| ② Motor cable                       | ⑦ Power connector             |
| ③ Battery unit                      | ⑧ Wiring harness of the robot |
| ④ a: Plug - socket<br>b: Plug - pin | ⑨ Motor                       |
| ⑤ Encoder connector                 |                               |



## 9.4 Refill/Replace grease.

Make sure to follow the instructions. If the following instructions are not followed, it might cause damage to motor or gear.

### CAUTION!

#### Burns from heated grease

The grease may be under pressure and may spray out of the threaded hole when opening the threaded hole.

- ▶ Wear safety goggles

### NOTICE

- ▶ Make sure that the plug has been removed from the grease outlet. If the plug is not removed, grease will enter the motor or the oil seal of the gear will be damaged. This might cause damage to the motor or gear.
- ▶ Lubrication or grease replacement is only allowed at operating temperature.
- ▶ Lack the labels "IN and" OUT "is generally lubricated from the bottom up.
- ▶ Do not install a joint, hose, etc. to the grease outlet. If this instruction is not followed, the motor will be damaged.
- ▶ Avoid air getting into the gear.
- ▶ Insert grease with a grease gun.
- ▶ If an automatic lubricating pump is used, the grease supply pressure must be 0.3 kPa.
- ▶ Set the grease injection rate to a value not higher than 7 g/s.
- ▶ The limit values may not be exceeded also if a conventional grease gun is used.
- ▶ In ceiling-mounted robots the grease outlet and the grease inlet are located the other way around (related to the figures in the operating and maintenance instructions).
- ▶ Install a receptacle at the grease outlet.
- ▶ Exchanged grease must be disposed of in an environmentally sound manner.

#### Inspection parts and grease used

Grease used	Material no.	Inspected Parts
Vigo grease RE no. 0	176827	S-, L-, U axes gear
Harmonic grease 4B No. 2	127612	R- and B-axes gear
Grease Shell Gadus S2 V220 2	146745	T-axis gear

Tab. 9-2: Grease used

Safety data sheets on grease types can be requested from YEU-R.

### Tightening torque the set screw

Designation	Tightening torque (Nm)
PT 3/8	23
PT 1/4	12
PT 1/8	5
PT 1/16	4

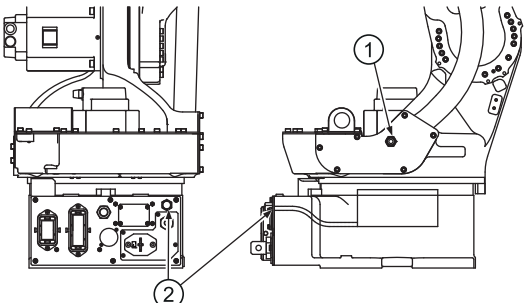
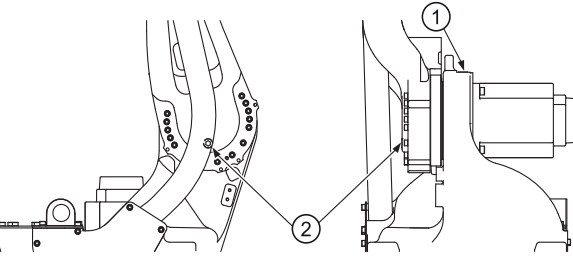
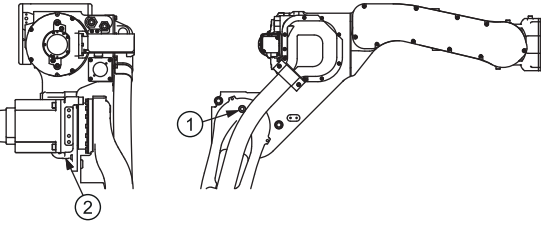
1. Remove plug from grease exhaust port (OUT) and grease inlet (IN) port.

#### Example:



2. Mount the lubricating nipple to the grease inlet opening.
3. Press the grease into the grease inlet opening using a grease gun.
4. To squeeze out the excess fat, all taxes must be brought to operating temperature.
  - In a operating JOB or a special moving JOBs (about 20 minutes at 100% speed).
5. Wipe away excess grease with a cloth.
6. Remove the lubricating nipple from the grease inlet opening and mount the plug again. Before mounting the plug, apply to thread part.

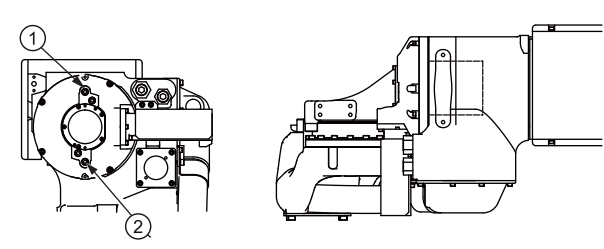
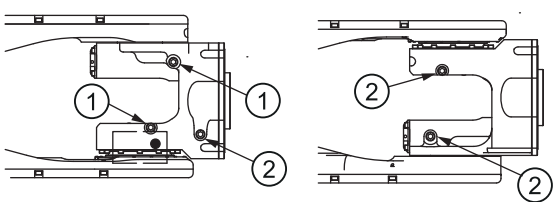
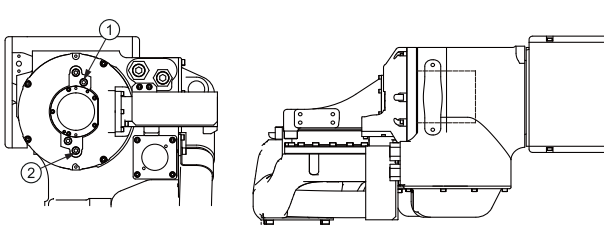
### 9.4.1 Grease filling the main axes

Figure the axes		Amount of grease:
<b>S-axis gear</b> 		<b>Replenishment:</b> 70 cm <sup>3</sup> / approx. 63 g
		<b>Exchange:</b> 450 cm <sup>3</sup> / approx. 405 g <sup>1</sup>
<b>L-axis gear</b> 		<b>Replenishment:</b> 65 cm <sup>3</sup> / approx. 58 g
		<b>Exchange:</b> 420 cm <sup>3</sup> / approx. 378 g <sup>1</sup>
<b>U-axis gear</b> 		<b>Replenishment:</b> 40 cm <sup>3</sup> / approx. 35 g
		<b>Exchange:</b> 250 cm <sup>3</sup> / approx. 220 g <sup>1</sup>
① Grease outlet	② Grease inlet port	

1. The grease exchange is complete when new grease appears from the exhaust port. (The new grease can be distinguished from the old grease by color.)

### 9.4.2 Grease filling the wrist axes

#### Grease filling the wrist axes

Figure the axes		Amount of grease:
R-axis gear 		<b>Replenishment:</b> 6 cm <sup>3</sup> / approx. 5 g <b>Exchange:</b> _1
B- and T-axes gear 		<b>Replenishment:</b> B-axis 6 cm <sup>3</sup> / approx. 5 g and T-axis 5 cm <sup>3</sup> / approx. 4.5 g <b>Exchange:</b> _1
R-axis cross roller bearing 		<b>Replenishment:</b> 10 cm <sup>3</sup> / approx. 9 g
①	Grease outlet	② Grease inlet port

1. The grease exchange is complete when new grease appears from the exhaust port. (The new grease can be distinguished from the old grease by color.)

## 9.5 Home position calibration

Follow the safety instructions described in section 1.7 "Safety" on page 8 .

### NOTICE

- ▶ Teaching or playback are not possible before the completion of the home position calibration.
- ▶ Teach and save a second testing position immediately after installing the robot system. This second testing position can be determined, e.g., by using tips (screw-in tip on the torch, fixed counterpart on the cell wall) and stored in the robot controller.
- ▶ After a collision or in the event of track deviations it is recommended not to re-teach individual jobs, but to approach and reset the basic position and/or the second home position.
- ▶ After each collision or emergency stop situation the robot must be moved to its basic position in setup mode and its home position must be checked.
- ▶ In a system with two or more Robots, the home position of all the Robots must be calibrated before starting teaching or playback.
- ▶ For more information, see also system setup in the manual or contact your YASKAWA branch.

When setting the home position, the position of the absolute encoder must match it. Although this operation is performed prior to shipment at the factory, the following cases require this operation to be performed again.

- Change in the combination of the robot and robot controller.
- Replacement of the motor or absolute encoder.
- Clearing stored memory (by replacement of the main CPU board, weak battery pack, etc.).
- Home position deviation caused by hitting the robot.

### Home position calibration

To calibrate the home position mark on each axis, use the axis keys, so that the robot can take their position as home position.

There are two operations for home position calibration:

- All the axes can be moved at the same time.
  - If the combination of robot and main board (CPU) has been changed, reset the home position. The home position set by moving all axes simultaneously.
- Axes can be moved individually.
  - If you have replaced the motor or the absolute encoder, reset the home position for the individual axes.

If the absolute data of its posture for the home position is already known, set them again after completing home position registration.

### NOTICE

The window for calibrating the home position is only displayed if safety mode is selected as the management mode.

### 9.5.1 Register all axes

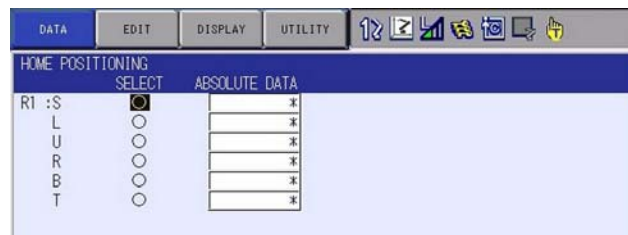
1. Select {ROBOT} from the main menu.

The sub-menu choices appear.



2. Select {HOME POSITION}.

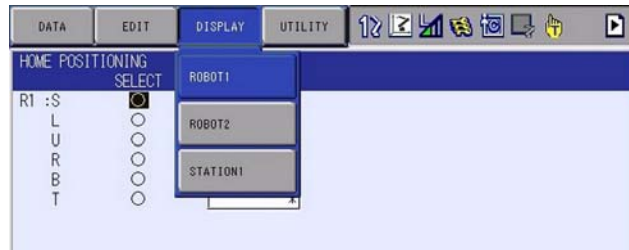
The <HOME POSITIONING> window appears.



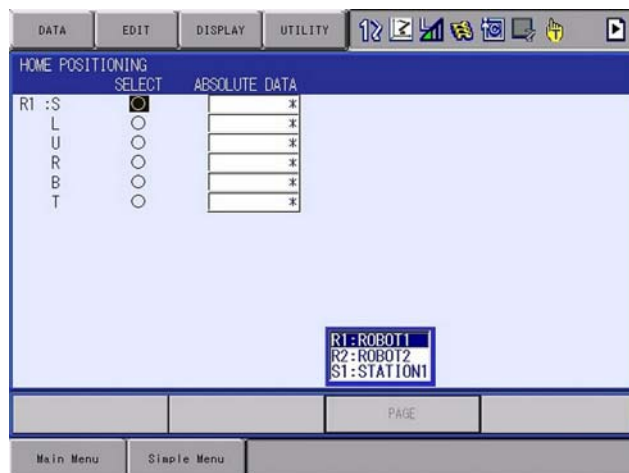


## 3. Select {DISPLAY}

The pull-down menu appears.




The same operation as in step 3 can also be performed by selecting the {PAGE} button. In this case a selection box appears.



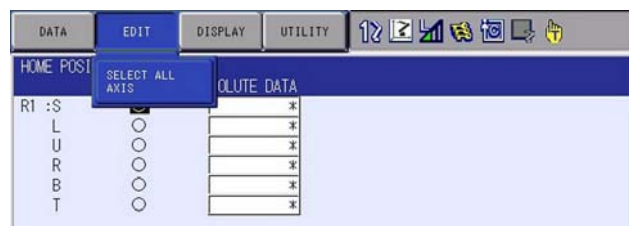
## 4. Select the sub-assembly to calibrate (e.g. R1:ROBOT).

Select the control group for {HOME POSITIONING}.

The control group can also be selected by pressing page key .

## 5. Select {EDIT} in the main menu.

The pull-down menu appears.



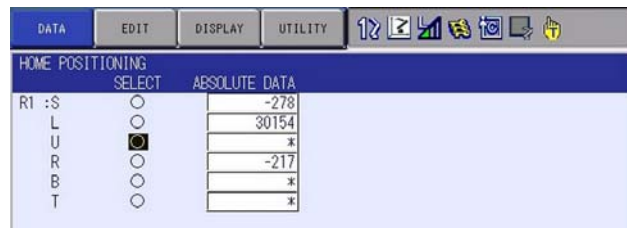
6. Select {SELECT ALL AXES}.  
A confirmation dialog box is displayed.



7. Select {YES}.  
Displayed position data of all axes are registered as home position.  
When {NO} is selected, the registration will be canceled.

### 9.5.2 Register individual axes

1. Select {ROBOT} on the main menu.  
The sub-menu choices appear.
2. Select {HOME POSITION}.
3. Select the module to be calibrated (e.g. R1:ROBOT).  
Perform steps 3 and 4, as described in section 9.5.1 "Register all axes" to select the desired control group.
4. Move the cursor to the axis you want to register, and select it.



A confirmation dialog box appears.

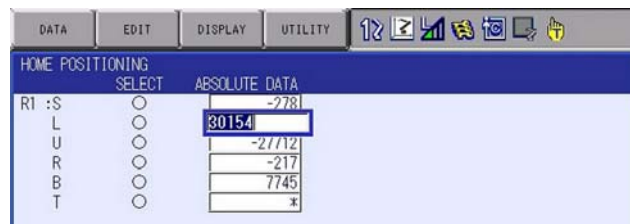


5. Select {YES}.  
The displayed position data of the selected axis is registered as the zero position.  
If you select {NO}, registration is aborted.

### 9.5.3 Changing absolute data

After you have set the home position, change the absolute data of the axis as follows:

1. Select {ROBOT} from the main menu.  
The sub-menu choices appear.
2. Select {HOME POSITION}.
3. select the sub-assembly/components to be calibrated.  
Carry out steps 3 and 4 as described in section 9.5.1 "Register all axes" on page 64 to select the desired control group.
4. Select the absolute data to be registered.

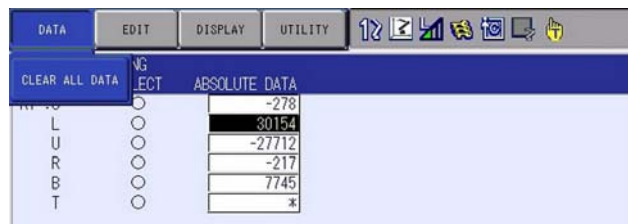


5. Enter the absolute data using the numeric keys.
6. Select {ENTER}.  
The absolute encoder data is changed.

### 9.5.4 Clearing absolute data

Once you have set the home position, delete the absolute data of the axis as follows:

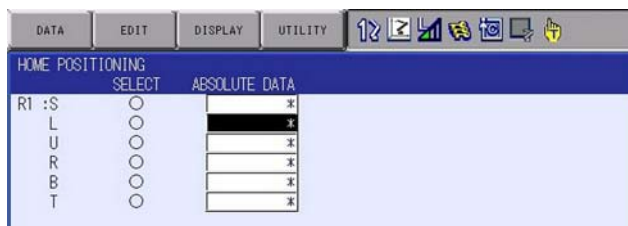
1. Select {ROBOT} from the main menu.  
The sub-menu choices appear.
2. Select {HOME POSITION}.  
Carry out steps 3 and 4 as described in section 9.5.1 "Register all axes" on page 64 to select the desired control group.
3. Select {DATA} from the main menu.  
The pull-down menu appears.



4. Select {CLEAR ALL DATA}.  
A confirmation dialog box appears.



5. Select {YES}.  
All absolute data will be deleted.



When {NO} is selected, the registration will be canceled.

## 9.6 Setting the second home position (check point)

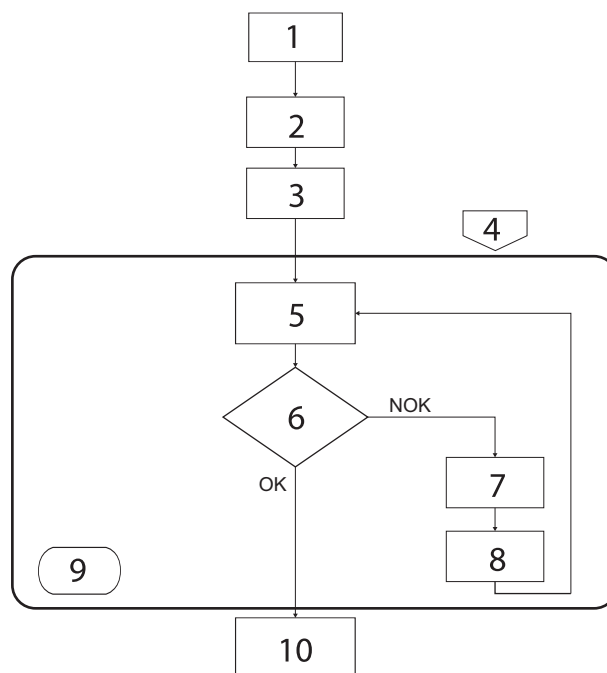
### 9.6.1 Purpose of position check operation

If the absolute number of rotations detected when the power is switched on does not match the data stored by the absolute encoder the last time the power was switched off, an error message is output.

There are two possible causes of this error message:

- Error in the pulse generating system
- The robot was moved after the power supply was turned OFF

If the alarm "OUTSIDE THE RANGE (ABSOLUTE DATA)" appears, automatic mode is not possible. The home position must be checked.



- |   |   |
|---|---|
| ① If the "OUT OF RANGE (ABSOLUTE DATA)" alarm occurs: | ⑥ Compare second home position (check point)* with current position pulses.           |
| ② Alarm reset   | ⑦ The alarm occurs again  |
| ③ Switch the servo power on                           | ⑧ Correct the faulty axis, replace the pulse generating system, set the home position |
| ④ Procedure after an alarm                            | ⑨ * Position checking point   |
| ⑤ Position confirmation                               | ⑩ Automatic mode possible   |

**Position check**

If the "OUT OF RANGE (ABSOLUTE DATA)" alarm occurs, move to the second zero position using the axis buttons, and check the position. Automatic mode, test runs and FWD movement are not possible unless the position is checked with "CONFIRM POSITION".

**Pulse difference check**

The number of pulses at the second zero position is compared with that at the current position. If the deviation is within the permissible range, automatic mode is possible.

If not, the error message appears again.

**NOTICE**

- ▶ The pulse for the permissible range is the number of pulses per rotation of the motor (PPR data).
  - ▶ The initial value of the second zero position is the zero position in which all axes have the pulse 0. The second home position can be changed. You will find more information 9.6.2 "Procedure for the second home position setting" on page .71.
- 

**Alarm message**

If the alarm occurs again, the error may be in the PG system. Check the pulse generating system. Once you have set the faulty axis, set the zero position of the axis and then check the position again.

**NOTICE**

If you set the zero position simultaneously for all axes, automatic mode is possible without a position check.

However, you should always carry out a position check with "CONFIRM POSITION". Under the special conditions described above, the robot moves as follows:

- ▶ To start with, the robot moves slowly (at 1/10 of the maximum speed) to the step indicated by the cursor. If the robot is stopped and restarted during this movement, the slow-motion speed is maintained until the step marked by the cursor is reached.
  - ▶ Regardless of the cycle setting, the robot stops when it reaches the step marked by the cursor. When the robot is restarted, it moves at the programmed speed and in accordance with the programmed cycle for the job.
- 

**9.6.2 Procedure for the second home position setting**

Apart from the "home position" of the robot, the second home position can be set up as a check point for absolute data. Use the following steps to set the specified point.

**NOTICE**

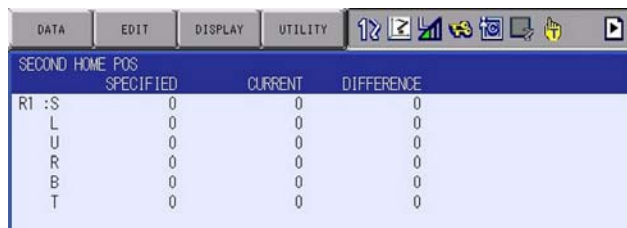
If 2 or more Robots or stations are controlled by one controller, the second home position must be set for each robot or station.


---

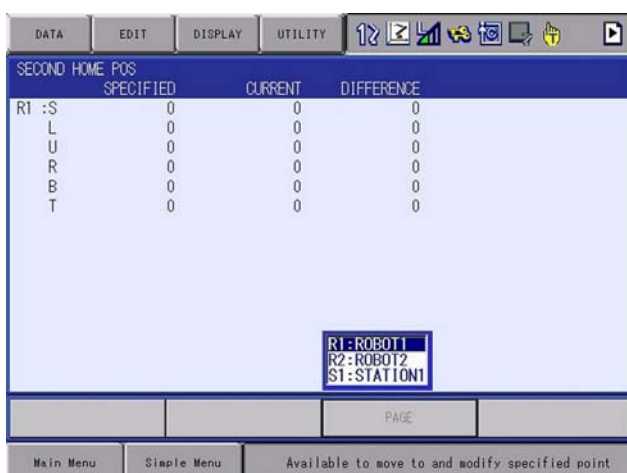
1. Select {ROBOT} from the main menu.
  - The sub-menu choices appear.



2. Select {SECOND HOME POS}.
  - The {SECOND HOME POS} window appears. Message is spoken „Available to move to and modify specified point“.



3. Press the „page key“  or select {PAGE} to display the selection window for the control group.
  - Occuring 2 or more group axes, select those one to you intend to specify second home position.



4. Press the axis keys.
  - Move the Robot to the new second home position.
5. Press {MODIFY} then {ENTER}.
  - The second home position is changed.



### 9.6.3 Procedure after alarm

Follow the safety instructions described in section 1.7 "Safety" on page 8 .

#### **WARNING!**

#### **Death or injury because of danger of crushing**

Irregularities in the PG system may lead to an alarm and the robot may perform unexpected movements.

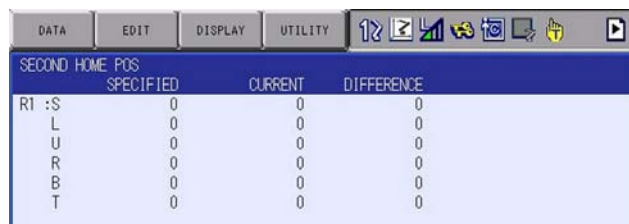
If the "OUT OF RANGE (ABSOLUTE DATA)" alarm occurs,

- Reset the alarm.
- the SERVO power ON.

Then confirm the second home position. After the confirmation, if the PG system is found to be the cause of the alarm, perform the necessary operation, such as replacing the PG system, etc.

The robot current position data when turning main power supply ON and OFF can be confirmed in {POWER ON/OFF POS} window.

1. Select {ROBOT} from the main menu.  
The sub-menu choices appear.
2. Select {SECOND HOME POS} from the main menu.  
The SECOND HOME POS window appears.



	SPECIFIED	CURRENT	DIFFERENCE
R1 :S	0	0	0
L	0	0	0
U	0	0	0
R	0	0	0
B	0	0	0
T	0	0	0

3. Press the „page key“  or select {PAGE} to display the selection window for the control group.

Occuring two or more group axes, select those one to you intend to specify second home position.



	SPECIFIED	CURRENT	DIFFERENCE
R1 :S	0	0	0
L	0	0	0
U	0	0	0
R	0	0	0
B	0	0	0
T	0	0	0

R1:ROBOT1  
R2:ROBOT2  
S1:STATION1

PAGE

Main Menu    Staple Menu    Available to move to and modify specified point

4. Press {FWD}.

TCP moves to the second home position. The robot moving speed is set as selected manual speed.

5. Select {DATA} in the menu.

6. Select {CONFIRM POSITION}.

A message "Home position checked" appears.

Pulse data of the second home position and current pulse data should be compared. Automatic mode can be done if compared error is in allowed range.

If the error is beyond the allowed range, the alarm occurs again.

## 10 Recommended spare parts list

It is recommended to keep in stock parts and components in the following table as spare parts. Product performance cannot be guaranteed when using spare parts from any company other than YASKAWA.

### NOTICE

Please contact your YASKAWA branch office if you need spare or replacement parts.

#### Part List robot

Designation	Part-No.	Material no.
Grease	Vigo grease RE no. 0	176827
Grease	Harmonic grease SK1A	127610
Grease	Grease Shell Gadus S2 V220 2	146745
Sealing compound	Teroson Plast	143813
Battery pack	Robot	128708
Battery pack	Controller	155543
Protective tube	MTK-50FR	173362
<b>S-axis:</b>		
Gear	HW0386621-B	135942
Pinion	HW0312734-2	164745
Motor	SGMRV-05ANA-YR2*	144191
<b>L-axis:</b>		
Gear	HW0387809-A	144084
Pinion	HW0312735-2	164746
Motor	SGMRV-09ANA-YR1*	144076
<b>U-axis:</b>		
Gear	HW1380153-A	158432
Pinion	HW1303245-1	164747
Motor	SGMRV-05ANA-YR2*	144191
<b>R-axis:</b>		
Gear	HW1382521-A	164748
Gear (Input side)	HW1303246-1	164750
Gear unit	HW1303247-1	164751
Motor	SGMAV-01ANA-YR1*	144070
<b>B-axis:</b>		
Gear	HW1382522-A	164749
Motor	SGMAV-01ANA-YR1*	144070
Toothed belt	60S3M642	164742
<b>T-axis:</b>		
Gear (Output side)	HW1371294-A	164752
Gear (Input side)	HW1303249-1	164753
Motor	SGMAV-01ANA-YR1*	144070

**Part List robot**

<b>Designation</b>	<b>Part-No.</b>	<b>Material no.</b>
Toothed belt	80S3M819	164744
Wire harness	HW1171418-A	164755
Wire harness (Optional)	HW1171418-B	164761
Wire harness (Optional)	HW1171418-C	164763
Wire harness B- and T-axis	HW1270926-A	164765
Battery board	SGDR-EFBA02A	154241

**Part List robot controller**

<b>Designation</b>	<b>Part-No.</b>	<b>Material no.</b>
Power supply	JZNC-YPS21-E	164754
Additional power supply	JZNC-YPS02-E	147571
CPU Rack	JZNC-YRK21-1E	164756
CPU Circuit Board	JANCD-YCP21-E	168996
Robot I/F board	JANCD-YIF01-2E	145855
Machine safety CPU board	JANCD-YSF21-E	164757
Machine safety I/O logic board	JANCD-YSF22B-E	169501
General I/O board (PNP Type)	JANCD-YIO22-E	164762
Power ON unit (Cat.4)	JZRRCR-YPU52-1	164764
Axis board	SRDA-EAXA21A	170650
Converter module	SRDA-COA30A21B-E	164767
Capacitor module (12A Type)	SRDA-CUA662AA	164781
SERVO Amplifier S	SRDA-SDA14A01A-E	144168
SERVO Amplifier L	SRDA-SDA21A01A-E	149438
SERVO Amplifier U	SRDA-SDA14A01A-E	144168
SERVO Amplifier R	SRDA-SDA06A01AE	144167
SERVO Amplifier B	SRDA-SDA06A01AE	144167
SERVO Amplifier T	SRDA-SDA06A01AE	144167
Resistor	SMVK500W6R0J	164775
Memory device (Compact Flash)	SFCF0256H1BK1MT-1-MS-553-SMA	172731

# 11 Parts lists

## 11.1 S-axis drive

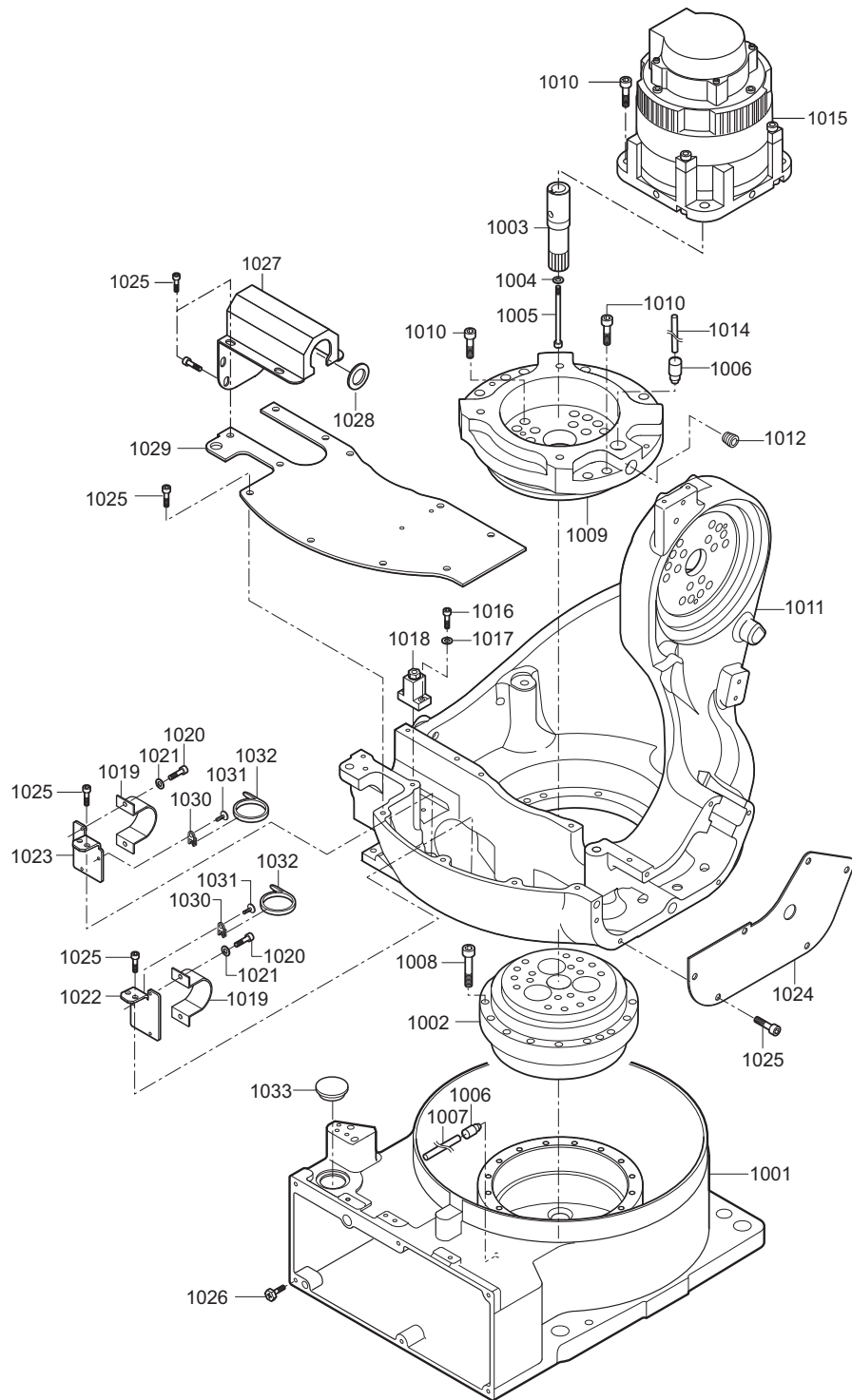


Fig. 11-1: S-axis drive

No.	DWG no.	Designation	Piece
1001	HW1100498-1.	Stand	1
1002	HW0386621-B.	Gear	1
1003	HW0312734-2.	Gear	1
1004	2L-5.	Washer	1
1005	M5 x 85	Screw	1
1006	ATSH8-03.	Connection	2
1007	NB-0860-0.3	Hose	1
1008	M6 x 35	Screw	16
1009	HW1303263-1.	Housing	1
1010	M8 x 25	Screw	28
1011	HW1100499-1.	Housing	1
1012	PT3/8	Grub screw	1
1014	NB-0860-0.2	Hose	1
1015	SGMRV-05ANA-YR2*	Motor	1
1016	M5 x 16	Screw	2
1017	2L-5.	Washer	2
1018	TS200CHM.	Block	1
1019	CD31.	Clamp	2
1020	M5 x 8	Screw	4
1021	2L-5.	Washer	4
1022	HW0414670-2.	Support	1
1023	HW0414670-1.	Support	1
1024	HW1303253-1.	Cover	1
1025	M6 x 15	Screw	22
1026	M5 x 10	Screw	6
1027	HW1303254-1.	Cover	1
1028	C-30-SG-30A.	Washer	1
1029	HW1303255-1.	Cover	1
1030	TA1-S10	Clamp	2
1031	M5 x 8	Screw	2
1032	T50R.	Cable tie	2
1033	EZ5036A0.	Sealing plug	1

Tab. 11-1: S-axis drive

## 11.2 L-axis unit

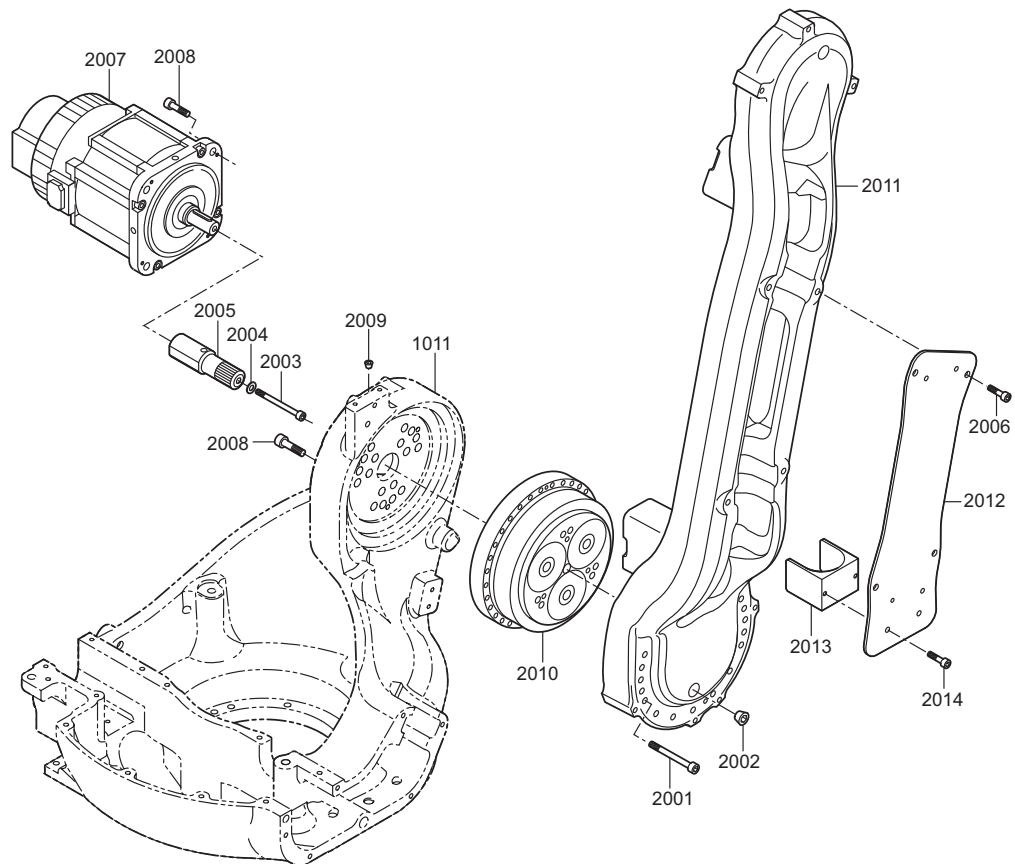


Fig. 11-2: L-axis drive

No.	DWG no.	Designation	Piece
2001	M6 x 60	Screw	16
2002	NPTF3/8 (STAINLESS)	Screw	1
2003	M6 x 75	Screw	1
2004	2L-6.	Washer	1
2005	HW0312735-2.	L-axis gear	1
2006	M6 x 15	Screw	4
2007	SGMRV-09ANA-YR1*	Motor	1
2008	M8 x 25	Screw	22
2009	PT3/8	Grub screw	1
2010	HW0387809-A.	Gear	1
2011	HW1100500-1.	L-arm	1
2012	HW1404040-1.	Cover	1
2013	HW1405226-1.	Support	1
2014	M5 x 10	Screw	2
1011	HW1100499-1.	Housing	1

Tab. 11-2: Parts list L-axis drive





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<b>No.</b>	<b>DWG no.</b>	<b>Designation</b>	<b>Piece</b>
3005	2L-5.	Washer	1
3006	HW1303245-1.	Gear	1
3007	PT3/8	Grub screw	1
3008	HW1380153-A.	Gear	1
3009	M5 x 25	Screw	16
3010	M10 x 30	Screw	6
3011	SGMRV-05ANA-YR2*	Motor	1
3012	M8 x 30	Screw	4
3013	M6 x 25	Screw	3
3014	HW1404044-1.	Support	1
3015	PT3/8	Grub screw	1
3016	HW1404041-1.	Support	1
3017	HW0404554-2.	Housing	1
3018	M3 x 16	Screw	2
3019	M3	Nut	1
3020	M4 x 12	Screw	4
3021	KQE10-03.	Connection	1
3022	KQE12-03.	Connection	1
3023	PT3/8	Grub screw	2
3024	HW1404786-1.	Gasket	1
3025	KR8G5.	Terminal	1
3026	M5 x 8	Screw	1
3027	T120R.	Cable tie	1
3028	HW1404517-1.	Gasket	1
3029	HW1404057-1.	Cover	1
3030	M5	Washer	1
2011	HW1100500-1.	L-arm	1

*Tab. 11-3: Parts list U-axis drive*

## 11.4 R-axis unit

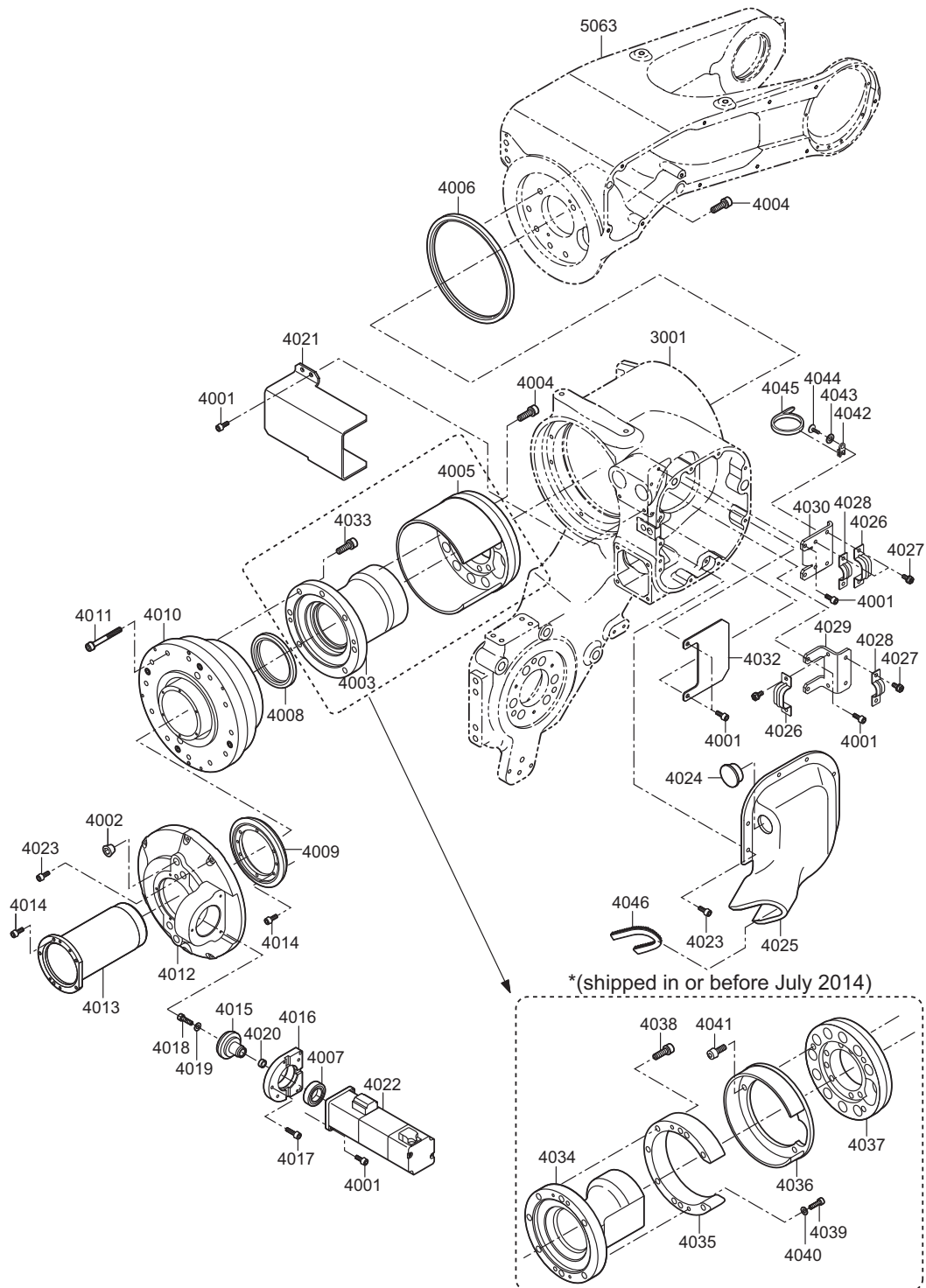


Fig. 11-4: R-axis drive

\* Delivered before July 2014

No.	DWG no.	Designation	Piece
4001	M4 x 12	Screw	10
4002	PT1/8	Grub screw	4
4003	HW1304069-1. <sup>1</sup>	Axis	1
4004	M6 x 20	Screw	20
4005	HW1304196-1. <sup>1</sup>	Flange	1
4006	TC1151306.	Oil seal	1
4007	AE0478G.	Oil seal	1
4008	TC52647.	Oil seal	1
4009	HW1303247-1.	Gear	1
4010	HW1382521-A.	Gear	1
4011	M5 x 45	Screw	6
4012	HW1303242-1.	Housing	1
4013	HW1303257-1.	Pipe	1
4014	M3 x 12	Screw	11
4015	HW1303246-1.	Gear	1
4016	HW1404045-1.	Housing	1
4017	M3 x 16	Screw	3
4018	M4 x 16	Screw	1
4019	2L-4.	Washer	1
4020	HW0404304-2.	Gasket	1
4021	HW1406288-1.	Cover	1
4022	SGMAV-01ANA-YR13.	Motor	1
4023	M4 x 12	Screw	11
4024	HW1405970-1.	Sealing plug	1
4025	HW1303241-1.	Cover	1
4026	PZ1212.	Clamp	2
4027	M4 x 6	Screw	8
4028	PZ1208.	Clamp	2
4029	HW1404042-1.	Support	1
4030	HW1405181-1.	Support	1
4032	HW1404499-1.	Cover	1
4033	M6 x 40 <sup>1</sup>	Screw	7
4034	HW1304053-1. <sup>2</sup>	Axis	1
4035	HW1404986-1. <sup>2</sup>	Flange	1
4036	HW1405180-1. <sup>2</sup>	Sleeve	1
4037	HW1404958-1. <sup>2</sup>	Flange	1
4038	M6 x 35 <sup>2</sup>	Screw	7
4039	M4 x 35 <sup>2</sup>	Screw	2
4040	2L-4. <sup>2</sup>	Washer	2
4041	M6 x 15 <sup>2</sup>	Screw	3
4042	TA1-58.	Terminal	1

<b>No.</b>	<b>DWG no.</b>	<b>Designation</b>	<b>Piece</b>
4043	M4	Washer	1
4044	M4 x 6	Screw	1
4045	T30R.	Cable tie	1
4046	TG107.	Gasket	1
3001	HW1100501.	Housing	1
5063	HW1100502-1.	U-arm	1

1. Delivered after August 2014  
2. Delivered before July 2014

*Tab. 11-4: Parts list R-axis drive*

## 11.5 Wrist unit

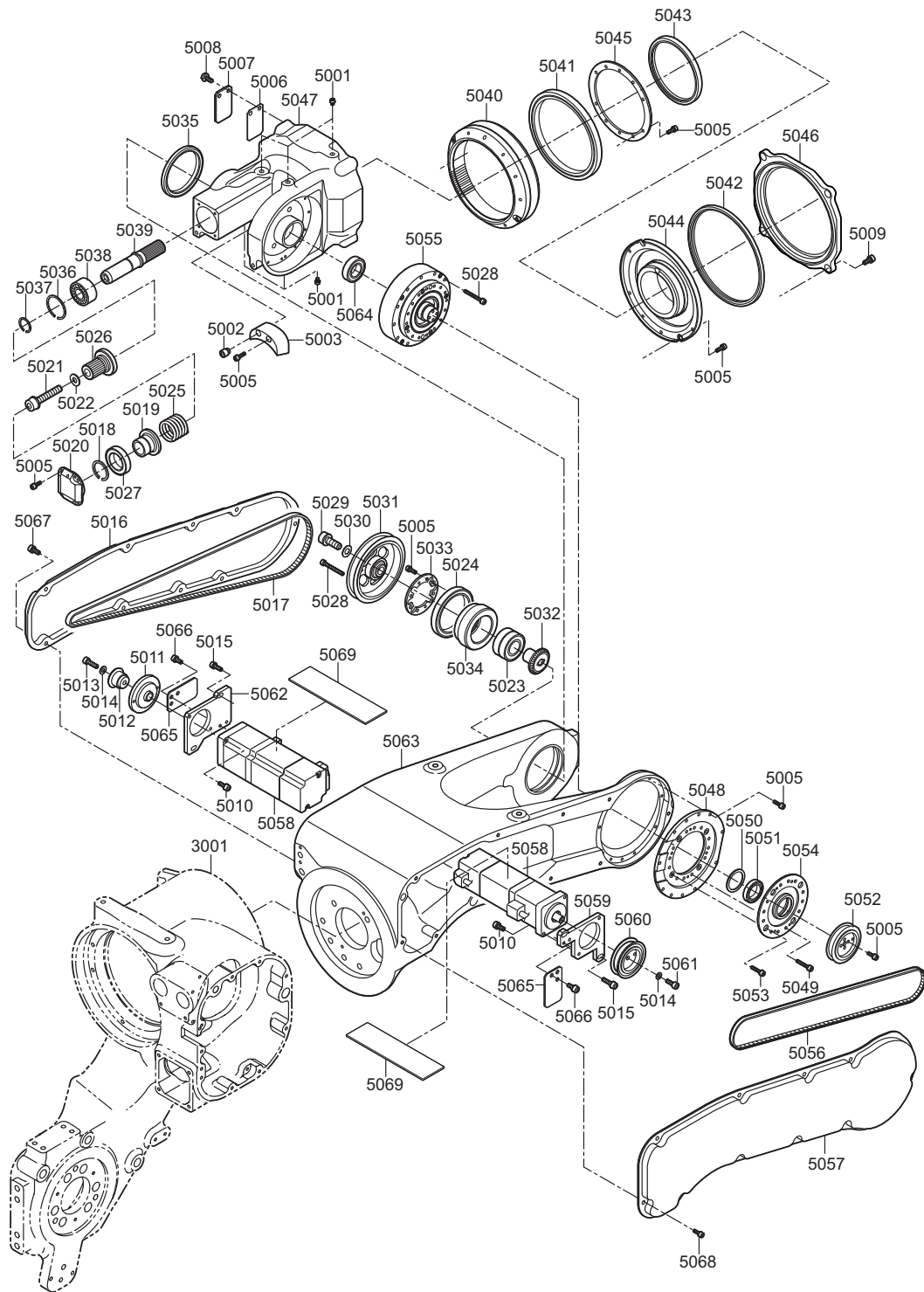


Fig. 11-5: Wrist unit

No.	DWG no.	Designation	Piece
5001	M6 x 6	Screw	5
5002	HW0404371-1.	Screw	1
5003	HW1405971-1.	Cover	1

<b>No.</b>	<b>DWG no.</b>	<b>Designation</b>	<b>Piece</b>
5005	M3 x 10	Screw	39
5006	HW1404060-1.	Gasket	1
5007	HW1404069-1.	Cover	1
5008	M4 x 10	Screw	2
5009	M4 x 12	Screw	4
5010	M4 x 10	Screw	4
5011	HW1404053-1.	Flywheel	1
5012	HW1404038-A.	Pulley	1
	HW1404038-B (after 2015-06-21)		
5013	M4 x 16	Screw	1
	M4 x 20 (after 2015-06-21)		
5014	2L-4.	Washer	2
5015	M4 x 16	Screw	4
5016	HW1303244-1. <sup>1</sup>	Cover	1
	HW1304180-1. <sup>2</sup>	Cover	1
5017	80S3M819.	Toothed belt	1
5018	WR20.	Terminal	1
5019	HW1303260-1.	Shaft	1
5020	HW1404049.	Cover	1
5021	M8 x 40	Screw	1
5022	2L-8.	Washer	1
5023	HW1481728-A.	Bearing	1
5024	6809DDU.	Bearing	1
5025	HW1404059-6.	Spring	1
5026	HW1303248-1.	Pinion	1
5027	6804	Bearing	1
5028	M3 x 28	Screw	18
5029	M8 x 20	Screw	1
5030	2L-8.	Washer	1
5031	HW1404039-1.	Pulley	1
5032	HW1303249-1.	Pinion	1
5033	HW1404048-1.	Cover	1
5034	HW1404054-1.	Shaft	1
5035	TC50606.	Oil seal	1
5036	AR28.	Terminal	1
5037	WR15.	Terminal	1
5038	NA4902.	Bearing	1
5039	HW1303250-1.	Pinion	1
5040	HW1371294-A.	Flange	1
5041	RA9008CO.	Bearing	1

No.	DWG no.	Designation	Piece
5042	TC1001105.	Oil seal	1
5043	TC64746.	Oil seal	1
5044	HW1303261-1.	Flange	1
5045	HW1404055-1.	Flange	1
5046	HW1303262-1.	Flange	1
5047	HW1100503-1.	Wrist	1
5048	HW1303259-1.	Shaft	1
5049	M3 x 20	Screw	12
5050	IRTW26.	Circlip	1
5051	6803LLU.	Bearing	1
5052	HW1404037-1.	Pulley	1
5053	M3 x 16	Screw	4
5054	HW1404047-1.	Housing	1
5055	HW1382522-A.	Gear	1
5056	60S3M642.	Toothed belt	1
5057	HW1303243-1. <sup>1</sup>	Cover	1
	HW1304179-1. <sup>2</sup>	Cover	1
5058	SGMAV-01ANA-YR1*	Motor	2
5059	HW1404046-1. <sup>3</sup>	Fastening	1
	HW1406071-1. <sup>4</sup>	Fastening	1
5060	HW1404036-A.	Pulley	1
5061	M4×12	Screw	1
5062	HW1404052-1. <sup>3</sup>	Fastening	1
	HW1406072-1. <sup>4</sup>	Fastening	1
5063	HW1100618-1.	U-arm	1
5064	6902	Bearing	1
5065	HW1404516-1.	Cover	2
5066	M4 x 8	Screw	4
5067	M4 x 12 <sup>1</sup>	Screw	9
	M4 x 10 <sup>2</sup>	Screw	9
5068	M4 x 12 <sup>1</sup>	Screw	10
	M4 x 10 <sup>2</sup>	Screw	10
5069	HW1482873-G. <sup>4</sup>	Metal sheet	2
3001	HW1100617-1.	Housing	1

1. Delivered before October 2014

2. Delivered after November 2014

3. Delivered before April 2015

4. Delivered after May 2015

Tab. 11-5: Parts list wrist unit

## 11.6 Gear unit

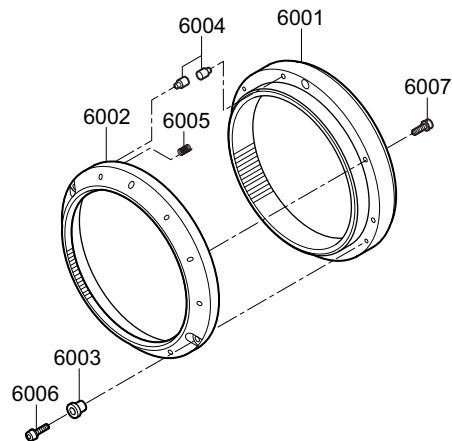


Fig. 11-6: Gear unit

No.	DWG no.	Description	Pcs
6001	HW1303251-1	Pinion outer part	1
6002	HW1303252-1	Pinion outer part	1
6003	HW1404051-1	Sleeve	2
6004	HW1404050-1	Pin	6
6005	HW1405463-2	Clamping sleeve	3
6006	M3 x 12	Screw	2

Tab. 11-6: Parts list gear unit





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