XYt SERIES

Owner's Manual
Introduction

The YAMAHA XY series robots are cartesian coordinate system assembly robots using AC servomotors, developed based on years of YAMAHA experience and achievements in the automation field as well as efforts to streamline our in-house manufacturing systems. The XY series consists of a manipulator comprising X and Y axis arms, and a robot controller (MRCH, QRCH or DRCH series). A vertical movement (Z-axis) and rotary movement (R-axis) at the tip of the manipulator are available as additional functions. The robot can be used for a wide range of assembly applications such as installation and insertion of products, light press-fitting of pins and bearings, application of sealant, and packing operations.

This owner’s manual describes the safety measures, handling, adjustment and maintenance of XY series robots for correct, safe and effective use. Be sure to read this manual carefully before installing the robot. Even after you have read this manual, keep it in a safe and convenient place for future reference.

This owner’s manual should be used with the robot and considered an integral part of it. When the robot is moved, transferred or sold, ensure that this manual accompanies the robot, and explain to the new user the need to read through this manual.

For details on specific operation and programming of the controller, refer to the YAMAHA MRCH, QRCH, TRCH or DRCH Robot Controller Owner’s Manual.

NOTE

◆ We reserve the right to make future product changes that might not be incorporated into this manual.
◆ We request the customer contact concerning any possible errors, omissions or misprints, etc.

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Request for service
CHAPTER 1

Using the Robot Safely

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1 Safety Information

Industrial robots are highly programmable, mechanical devices that provide a large degree of freedom when performing various manipulative tasks. To ensure correct and safe use of YAMAHA industrial robots, carefully read this manual and make yourself well acquainted with the contents. FOLLOW THE WARNINGS, CAUTIONS AND INSTRUCTIONS INCLUDED IN THIS MANUAL. Failure to take necessary safety measures or mishandling due to not following the instructions in this manual may result in trouble or damage to the robot and injury to personnel (robot operator or service personnel) including fatal accidents.

Warning information in this manual is shown classified into the following items.

⚠️ DANGER

Failure to follow DANGER instructions will result in severe injury or death to the robot operator, a bystander or a person inspecting or repairing the robot.

⚠️ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the robot operator, a bystander or a person inspecting or repairing the robot.

⚠️ CAUTION

Failure to follow CAUTION instructions may result in injury to the robot operator, a bystander or a person inspecting or repairing the robot, or damage to the robot and/or robot controller.

It is not possible to detail all safety items within the limited space of this manual. So it is essential that the user have a full knowledge of basic safety rules and also that the operator makes correct judgments on safety procedures during operation.

This manual and warning labels supplied with or affixed to the robot are written in English. If the robot operator or service personnel does not understand English, do not permit him (or her) to handle the robot.
2 Essential Caution Items

Particularly important cautions for handling or operating the robot are described below. In addition, safety information about installation, operation, inspection and maintenance is provided in each chapter. Be sure to comply with these instructions to ensure safe use of the robot.

(1) Observe the following cautions during automatic operation.

Warning labels 1 (Fig. 1-1) are affixed to the robot.
- Install a safeguard (protective enclosure) to keep any person from entering within the movement range of the robot and suffering injury due to being struck by moving parts.
- Install a safety interlock that triggers emergency stop when the door or panel is opened.
- Install safeguards so that no one can enter inside except from doors or panels equipped with safety interlocks.
- Warning label 1 shown in Fig. 1-1 is supplied with the robot and should be affixed to a conspicuous spot on doors or panels equipped with safety interlocks.

⚠️ DANGER

Serious injury or death will result from impact with moving robot.
- Keep outside of guard during operation.
- Lock out power before approaching robot.

(2) Use caution to prevent hands or fingers from being pinched or crushed.

Warning label 2 (Fig. 1-2) is affixed to the X-axis upper cover of the robot.

⚠️ WARNING

Moving parts can pinch or crush.
Keep hands away from robot arms.

Fig. 1-1 Warning label 1
Fig. 1-2 Warning label 2
(3) Follow the instructions on warning labels and in this manual.
Warning label 3 (Fig. 1-3) is affixed to the Y-axis upper cover of the robot.
- Be sure to read the warning label and this manual carefully and make your thoroughly understand the contents before attempting installation and operation of the robot.
- Before starting the robot operation, even after you have read through this manual, read again the corresponding procedures and cautions in this manual as well as descriptions in the this chapter (Chapter 1, “Using the Robot Safely”).
- Never install, adjust, inspect or service the robot in any manner that does not comply with the instructions in this manual.

⚠️ WARNING

Improper installation or operation can result in serious injury or death.
Read owner’s manual and all warning labels before operation.

⚠️ WARNING

Improper installation or operation can result in serious injury or death.
Read owner’s manual and all warning labels before operation.

Fig. 1-3 Warning label 3
(4) Do not use the robot in environments containing inflammable gas, etc.

**WARNING**

- This robot was not designed for operation in environments where inflammable or explosive substances are present.
- Do not use the robot in environments containing inflammable gas, dust or liquids. Explosions or fire could otherwise result.

(5) Do not use the robot in locations possibly subject to electromagnetic interference, etc.

**WARNING**

Avoid using the robot in locations subject to electromagnetic interference, electrostatic discharge or radio frequency interference. Malfunction may otherwise occur.

(6) Use caution when releasing the Z-axis (vertical axis) brake.

**WARNING**

The Z-axis will slide down when the Z-axis brake is released, causing a hazardous situation.
- Press the emergency stop button and prop up the Z-axis with a support stand before releasing the brake.
- Use caution not to let your body get caught between the Z-axis and installation base when releasing the brake to perform direct teach.

(7) Provide safety measures for end effector (gripper, etc.).

**WARNING**

- End effectors must be designed and manufactured so that they cause no hazards (for example, loosening of workpiece) even if power (electricity, air pressure, etc.) is shut off or power fluctuations occur.
- If there is a possible danger that the object gripped by the end effector may fly off or drop, then provide appropriate safety protection taking into account the object size, weight, temperature and chemical properties.
(8) Be cautious of possible Z-axis movement when the controller is turned off or emergency stop is triggered. (ZAF, ZAS)

**WARNING**

The Z-axis moves up when the power to the controller or PLC is turned off, the program is reset, emergency stop is triggered, or air is supplied to the solenoid valve for the Z-axis air cylinder.

- Do not let hands or fingers get caught and squeezed by moving parts of the Z-axis.
- Keep the usual robot position in mind so that the Z-axis will not interfere with obstacles during raising of the Z-axis, except in case of emergency stop.

(9) Use the following caution items when the Z-axis is interfering with peripheral equipment. (ZAF, ZAS)

**WARNING**

When the Z-axis comes to a stop due to obstructions from peripheral equipment, the Z-axis may move suddenly when the obstruction is removed, causing injury such as pinched or crushed hands.

- Turn off the controller and reduce the air pressure before attempting to remove the obstruction.
- Before reducing the air pressure, place a support stand under the Z-axis because it will drop under its own weight.

(10) Use caution on Z-axis movement when air supply is stopped. (ZAF, ZAS)

**WARNING**

The Z-axis may suddenly drop when the air pressure to the Z-axis air cylinder solenoid valve is reduced, creating a hazardous situation.

Turn off the controller and place a prop or support under the Z-axis before cutting off the air supply.

(11) Use the following caution items when disassembling or replacing the pneumatic equipment. (ZAF, ZAS)

**WARNING**

Air or parts may fly outwards if pneumatic equipment is disassembled or parts replaced while air is still supplied.

- Do service work after first turning off the controller and reducing the air pressure.
- Before reducing the air pressure, place a support stand under the Z-axis since it will drop under its own weight.
(12) Use the following caution items when removing the Z-axis motor.

**WARNING**

- The Z-axis will drop when the Z-axis motor is removed, possibly resulting in injury.
- Turn off the controller and set a support stand under the Z-axis before removing the motor.
- Use caution not to allow hands or body to be squeezed or crushed by moving parts on the Z-axis or between the Z-axis and the installation base.

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(13) Use the following caution during inspection of controller.

**WARNING**

- When you need to touch the terminals or connectors on the outside of the controller during inspection, always first turn off the controller power switch and also the power source in order to prevent possible electrical shock.
- Never touch any internal parts of the controller.

---

(14) Consult us for corrective action when the robot is damaged or malfunction occurs.

**WARNING**

If any part of the robot is damaged or any malfunction occurs, continuous operation may be very dangerous. Please consult YAMAHA dealer for corrective action.

<table>
<thead>
<tr>
<th>Damage or Trouble</th>
<th>Possible Danger</th>
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</thead>
<tbody>
<tr>
<td>Damage to machine harness or robot cable</td>
<td>Electrical shock, malfunction of robot</td>
</tr>
<tr>
<td>Damage to exterior of robot</td>
<td>Flying outwards of damaged parts during robot operation</td>
</tr>
<tr>
<td>Abnormal operation of robot (positioning error, excessive vibration, etc.)</td>
<td>Malfunction of robot</td>
</tr>
<tr>
<td>Z-axis brake trouble</td>
<td>Dropping of load</td>
</tr>
</tbody>
</table>

(15) Use caution not to touch controller rear panel cooling fan.

**WARNING**

- Bodily injury may occur from coming into contact with the cooling fan while it is rotating.
- When removing the fan cover for inspection, first turn off the controller and make sure the fan has stopped.
(16) Use caution not to touch the high temperature motor or speed reduction gear casing.

⚠️ WARNING

The motor and speed reduction gear casing are extremely hot after automatic operation, so burns may occur if these are touched. Before touching these parts during inspections or servicing, turn off the controller, wait for a while and check that the temperature has cooled.

(17) Do not remove, alter or stain the warning labels.

⚠️ WARNING

If warning labels are removed or difficult to see, necessary cautions may not be taken, resulting in an accident.
- Do not remove, alter or stain the warning labels on the robot.
- Do not allow the warning labels to be hidden by the device installed to the robot by the user.
- Provide proper lighting so that the symbols and instructions on the warning labels can be clearly seen even from the outside of safeguards.

(18) Be sure to make correct parameter settings.

⚠️ CAUTION

The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If this is not observed, premature end to the life of the drive units, damage to the robot parts or residual vibration during positioning may result.

(19) Do not use the robot for tasks requiring motor thrust.

⚠️ CAUTION

Avoid using the belt-driven type robots for tasks (FxYt, SxYLt) which make use of motor thrust (press-fitting, burr removal, etc.). These tasks may cause malfunctions of the robot.
3 Special Training for Industrial Robot Operation

Companies or factories using industrial robots must make sure that every person, who handles the robot such as for teaching, programming, movement check, inspection, adjustment and repair, has received appropriate training and also has the skills needed to perform the job correctly and safely.

Since the YAMAHA XY series Cartesian robots fall under the industrial robot category, the user must observe local regulations and safety standards for industrial robots, and provide special training for every person involved in robot-related tasks (teaching, programming, movement check, inspection, adjustment, repair, etc.).
4 Robot Safety Functions

(1) Overload detection
This function detects an overload applied to the motor and shuts off the servo power.

(2) Overheat detection
This detects an abnormal temperature rise in the controller’s driver and shuts off the servo power.
If an overload or overheat error occurs, take the following measures.
① Insert a timer in the program.
② Reduce the acceleration coefficient.

(3) Soft limits
Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation.
The working envelope is the area limited by soft limits.

(4) Mechanical stoppers
If the servo power is suddenly shut off during high-speed operation by emergency stop or safety functions, these mechanical stoppers prevent the axis from exceeding the movement range.
No mechanical stopper is provided on the R-axis.
The movement range is the area limited by mechanical stoppers.

(5) Z-axis (vertical axis) brake
An electromagnetic brake is installed to the Z-axis to prevent the Z-axis from sliding down when the servo power is turned off. This brake is working when the controller is off or the Z-axis servo power is off even when the controller is on.
The Z-axis brake can be released by means of the programming unit or by a command in the program when the controller is on.

⚠️ WARNING ⚠️
The Z-axis will slide down when the Z-axis brake is released, causing a hazardous situation.

- Press emergency stop button and prop the Z-axis with a support stand before releasing the brake.
- Use caution not to let your body get caught between the Z-axis and installation base when releasing the brake to perform direct teach.
5 Safety Measures for the System

Since the robot is commonly used in conjunction with an automated system, a dangerous situation is more likely to occur from the automated system than from the robot itself. Accordingly, appropriate safety measures must be taken on the part of the system manufacturer according to the individual system. The system manufacturer should provide a proper instruction manual for safe, correct operation and servicing of the system.
Trial Operation

After installation, adjustment, inspection, maintenance or repair of the robot has been done, perform a trial operation using the following procedures.

(1) If a safeguard has not yet been provided right after installation of the robot, rope off or chain off around the movement area of the manipulator in place of the safeguard, and observe the following points.
   ① Use stable posts which do not totter easily.
   ② The rope or chain should be easily visible by everyone around the robot.
   ③ Place a conspicuous sign prohibiting the operator or other personnel from entering the movement range of the manipulator.

(2) Check the following points before turning on the controller.
   ① Is the robot securely and correctly installed?
   ② Are the electrical connections to the robot correct?
   ③ Are items such as air pressure correctly supplied?
   ④ Is the robot correctly connected to peripheral equipment?
   ⑤ Have safety measures (safeguard enclosure, etc.) been taken?
   ⑥ Does the installation environment meet the specified standards.

(3) After the controller is turned on, check the following points from outside the safeguard.
   ① Does the robot start and stop as intended? Can the operation mode be selected correctly?
   ② Does each axis move as intended within the soft limits?
   ③ Does the end effector move as intended?
   ④ Are the signal transmissions to the end effector and peripheral equipment correct?
   ⑤ Does emergency stop work?
   ⑥ Are the teaching and playback functions normal?
   ⑦ Are the safeguard and interlock working as intended?
   ⑧ Does the robot move correctly during automatic operation?
7 Work Within The Safeguards

(1) When work is required inside the safeguard enclosure, always turn off the controller and place a sign indicating that the robot is being adjusted or serviced in order to keep any other person from inadvertently touching the controller switch or operation panel, except for the following cases.

1) Soft limit settings
2) Teaching

For items 1), follow the precautions and procedure for each section.
To perform item 2), refer to the description in (2) below.

(2) Teaching

When performing teaching within the safeguard enclosure, comply with the instructions listed below.

1) Check or perform the following points from outside the safeguard enclosure.
   ① Make sure that no hazards are present within the safeguard enclosure by visual check.
   ② Check that the programming unit MPB or DPB operates correctly.
   ③ Check that no failures are found in the robot.
   ④ Check that emergency stop works correctly.
   ⑤ Select teaching mode and prohibit automatic operation.
2) Never enter the movement range of the manipulator while within the safeguard enclosure.
8 Automatic Operation

(1) Check the following before starting automatic operation.
   ① No one is within the safeguard enclosure.
   ② The programming unit and tools are in their specified locations.
   ③ The alarm or error lamps on the robot and peripheral equipment do not flash.
   ④ The safeguard is securely installed with safety interlocks actuated.

(2) Observe the following during automatic operation or in cases where an error occurs.
   1) After automatic operation has started, check the operation status and warning lamp to
      ensure that the robot is in automatic operation.
   2) Never enter the safeguard during automatic operation.
   3) If an error occurs in the robot or peripheral equipment, observe the following procedure
      before entering the safeguard enclosure.
      ① Press the emergency stop button to set the robot to emergency stop.
      ② Place a sign on the start switch, indicating that the robot is being inspected in order to
         keep any other person from inadvertently touching the switch and restarting the robot.

9 Adjustment and Inspection

Do not attempt any installation, adjustment, inspection and maintenance that is not described in
this manual.

10 Repair and Modification

Do not attempt any repair, parts replacement and modification not described in this manual.
These works require technical knowledge and skill, and may also involve work hazards.
11 Warranty

The YAMAHA robots are designed and manufactured to be free from defects in materials and workmanship. However, should any failure occur in the robot you purchased, the YAMAHA warranty coverage is as follows.

Warranty Scope: If any failure should arise in the genuine parts constituting the YAMAHA robot due to defects in materials or workmanship, YAMAHA will repair or replace those parts free of charge (hereafter called warranty repair).

Warranty Period: This warranty is effective for a period of:
(1) 18 months (one and a half years) after shipment from Japan, or
(2) One year after installation or
(3) 2,400 hours of actual operation whichever comes first.

Exceptions to the Warranty: This warranty will not apply in the following cases:
- Fatigue arising due to the passage of time, natural wear and tear occurring during operation (natural fading of painted or plated surfaces, deterioration of parts subject to wear)
- Minor natural phenomena which do not effect the capabilities of the robot (noise from computers, motors, etc.).

Failure resulting from the following cases will not apply to warranty repair.

1) Damage due to earthquakes, storms, floods, thunderbolt, fire or any other natural or man-made calamities.
2) Troubles caused by procedures prohibited in this manual.
3) Modification to the robot not approved by YAMAHA or YAMAHA sales representatives.
4) Use of any other than genuine parts and specified lubricant and grease.
5) Insufficiency or errors in maintenance and inspection.
6) Repairs by other than authorized dealers.
12 CE Markings

For information about CE markings relating to cases in which the YAMAHA robot is exported to or used in European countries, refer to the separate "YAMAHA QRCH-E or DRCH-E Robot Controller Owner's Manual".
CHAPTER 2

The XY Series Robot System

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1 Manipulator

The XY series manipulator is composed of the standard X and Y axes (horizontal cartesian slide), and also an optional Z axis (vertical slide) and R axis (rotary).

These four axes can operate as shown below. By attaching a work tool at the tip of the Z or R axis, a wide range of tasks can be performed with high precision at high-speed.

Manipulator movement (with the ZRL unit)
2 Robot Controller

The XY Robot comes with the MRCH, QRCH or DRCH robot controller according to the order from the user. Refer to the separate "YAMAHA Robot Controller Owner's Manual" for more details.
CHAPTER 2 The XYA Series Robot System

3 Z and R Axis

The standard XY series is configured with two axes (X and Y), but a maximum of four axes can be used by adding the Z axis and R axis according to the application. The work range can be expanded by attaching various tools to the Z axis or R axis.

The types and features of the Z axis and R axis are shown below.

Refer to the XY series catalog for more details.

Combination of Z axis and R axis

HXYt, HXYLt

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MXYt

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SXYt, SXYLt

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<td></td>
<td>1/50 reduction gear</td>
</tr>
<tr>
<td>Features</td>
<td>High speed, light load</td>
<td>Max. 10kg can be transported</td>
<td>Medium speed, medium load</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FXYt

<table>
<thead>
<tr>
<th></th>
<th>ZP</th>
<th>ZAF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z Axis</td>
<td>60W Lead 20</td>
<td>Air cylinder</td>
</tr>
<tr>
<td>Features</td>
<td>Light load</td>
<td>Max. 4kg can be transported</td>
</tr>
</tbody>
</table>
CHAPTER 3

Installation

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   1-1 Installation environments ........................................ 3-1

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   2-1 Unpacking ................................................................. 3-2
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1 Robot Installation Conditions

1-1 Installation environments

Be sure to install the robot in the following environments.

<table>
<thead>
<tr>
<th>Items</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable ambient temperature</td>
<td>0 to 40°C</td>
</tr>
<tr>
<td>Allowable ambient humidity</td>
<td>35 to 85% RH (non condensation)</td>
</tr>
<tr>
<td>Height</td>
<td>0 to 1000 meters above sea level</td>
</tr>
<tr>
<td>Ambient environments</td>
<td>Avoid installing near water, cutting water, oil, dust, metallic chips and organic solvent.</td>
</tr>
<tr>
<td></td>
<td>Avoid installation near corrosive gas and corrosive materials.</td>
</tr>
<tr>
<td></td>
<td>Avoid installation in atmosphere containing inflammable gas, dust and liquid.</td>
</tr>
<tr>
<td></td>
<td>Avoid installation near objects causing electromagnetic interference, electrostatic discharge and radio frequency interference.</td>
</tr>
<tr>
<td>Vibration</td>
<td>Do not subject to impacts or vibrations.</td>
</tr>
<tr>
<td>Air supply pressure, etc.</td>
<td>Below 0.58MPa (6.0kgf/cm²); clean dry air not containing deteriorated compressor oil; filtration 40μm or less</td>
</tr>
<tr>
<td>Working space</td>
<td>Allow sufficient space margin to perform jobs (teaching, inspection, repair, etc.)</td>
</tr>
</tbody>
</table>

For detailed information on how to install the robot controller, refer to the separate “YAMAHA Robot Controller Owner’s Manual”.

⚠️ WARNING ⚠️
Avoid installing the robot in locations where the ambient conditions may exceed the allowable temperature or humidity, or in environments where water, corrosive gases, metallic powder or dust are generated. Malfunction, failure or short circuits may otherwise result.

⚠️ WARNING ⚠️
- This robot was not designed for operation in environments where inflammable or explosive substances are present.
- Do not use the robot in environments containing inflammable gas, dust or liquids. Explosions or fire could otherwise result.

⚠️ WARNING ⚠️
Avoid using the robot in locations subject to electromagnetic interference, electrostatic discharge or radio frequency interference. Malfunction may otherwise occur.

⚠️ WARNING ⚠️
Do not use the robot in locations subject to excessive vibration. Robot installation bolts may otherwise become loose causing the manipulator to fall over.
2 Crate

2-1 Unpacking

The XY series manipulator is packed with the robot controller (MRCH, QRCH or DRCH series) and accessories, according to the order specifications. Take sufficient care not to apply shocks to the equipment when unpacking.

WARNING

The robot manipulator and controller are rather heavy. Take sufficient care not to drop them during unpacking as this may damage to the equipment or result in personal injury.
2-2 Checking the product

After unpacking, check the product configuration and conditions. The following configurations are typical examples, so please check that the product is as specified in your order.

⚠️ CAUTION ⚠️

If there is any damage due to transportation or insufficient parts, please notify your YAMAHA sales representative immediately.

Example in combination with the MRCH controller
Example in combination with the QRCH controller
Example in combination with the DRCH controller

- Owner's manual
- Robot manipulator (XY series)
- Robot cable
- Power connector for robot controller
- Connector for I/O
- DRCH controller
- DRII programming unit (option)
3-1 Moving the robot and controller

Use of a hoist, carrying cart (dolly) or fork-lift is recommended for moving the robot or controller. Use sufficient caution when moving the robot, especially models with a long stroke or for large payload, because they are heavy. (To check the robot weight, see Chapter 6, “Specifications”.)

WARNING

Serious injury may occur if the robot falls and pins someone under it.
- Use a hoist and rope with carrying capacity strong enough to support the robot weight.
- Make sure the rope stays securely on the hoist hook.
- Remove all loads attached to the robot manipulator end. If any load is still attached, the robot may lose balance while being carried, and topple over causing accidents.
- Always wear a safety helmet, shoes and gloves during work.
- When moving the robot by equipment such as a fork-lift that requires a license, only properly qualified personnel may operate such equipment. The equipment and tools used for moving the robot should be serviced daily.
3-2 Installation base

1) Prepare a sufficiently rigid and stable installation base, taking the robot weight (including tool) and workpiece into account, because a large reaction force will be applied to the base while the robot is operating.

⚠️ CAUTION

If the installation base is not sufficiently rigid and stable, vibration may occur (resonance) during operation, causing a detrimental effect on the manipulator work.

2) The parallelism of the installation base surface must be machined within a precision of ±0.05mm/500mm.

3) If there is a gap between the manipulator and the base surface, place a shim of a proper thickness between them, so that no stress is applied to the manipulator frame.

⚠️ CAUTION

The manipulator positioning may decrease if the installation surface precision is insufficient.

4) Avoid installing the manipulator on the base with less bolts than specified or bolts at one end of the manipulator. Otherwise vibration or degradation of positioning accuracy in the manipulator may occur.
3-3 Installing the manipulator

To install the manipulator correctly and safely, follow the procedure and safety items below.

1. Tap holes into the surface of the base on which the manipulator is installed.
   Refer to the XY series catalog for the tap dimension and position.

2. Anchor the base in place.
   Securely bolt the base so that vibration will not occur during operation of the manipulator.
   (This step may be performed after the manipulator has been installed on the base, depending
   on the installation site or base configuration.)

3. Quietly place the manipulator in position on the base, by using a hoist.

4. Remove the host belt from the X axis.
   At this point, the support belt should be still placed on the Y axis to keep the Y axis level.

5. Loosen the screws on the top cover of the X axis, and remove the top cover. (MXYt, HXYt, HXYLt)
   Since the FXYt or SXYLt series should be bolted from bottom, it is not necessary to remove
   the cover.
   SXYt can be installed with either method.

6. Secure the manipulator on the base, using the hex socket head bolts.
   Bolt diameter and tightening torque
   MXYt, HXYt, HXYLt .... M8, 230 to 370kgf-cm  (Bolt strength 8.8T)
   FXYt............................ M5, 60 to 90kgf-cm  (Bolt strength 8.8T)
   SXYt, SXYLt ................. M6, 100 to 130kgf-cm  (Bolt strength 8.8T)

7. Remove the remaining hoist belt from the Y axis, and put away the hoist.

**WARNING**

- Take sufficient care not to pinch your fingers when
  removing the hoist belt from the X axis.
- Securely tighten the hex socket head bolt to the correct
  torque. If the bolt is not tightened correctly, the
  manipulator may cause positioning errors or even fall over
  during operation, causing a serious accident.

**CAUTION**

- Use hex socket head bolts which are at least 10mm longer than the thickness of
  the bottom plate of the manipulator. If too short, the manipulator cannot be bolted
  securely on the base.
  (For the FXYt, SXYLt and SXYt series, the bolts should not protrude inside the
  frame.) The manipulator should be bolted using all the holes provided on the
  bottom of the manipulator.
- The manipulator frame is made of aluminum, so be careful not to deform the
  threads when tightening the bolt.
  Installing the manipulator on the base
Installing the manipulator on the base

\( \text{MXY}/\text{HXY}/\text{HXYLt} \)

**WARNING**

Do not use a washer when tightening the M8 bolt from top. If a washer is used, the bolt head may interfere with the linear guide causing damage.

---

**Model** | SXYL | SXYLt | FXYL
---|---|---|---
Robot bottom frame thickness | 10mm | 11mm | 10mm

---

M6(M5) hex socket head bolt

The bolt should not protrude.
Gantry Type Installation

The MXYt, HXYt and HXYLt gantry types have a support guide rail installed at the tip of the Y axis to allow handling of heavy loads. During installation pay particular attention to the parallelism of the X axis and guide rail or to the height difference between their installation surfaces. The distance between the X axis and guide rail can be changed or adjusted if it is within ±5mm. The procedure for this adjustment is described below.

Fasten the robot to the specified locations on the base with bolts.

Make sure the guide rail bolts have been removed at this time. Securely fasten the X axis to the base.

1. Fasten the robot to the specified locations on the base with bolts.
   Make sure the guide rail bolts have been removed at this time. Securely fasten the X axis to the base.

2. When installing a ZR axis or when a tool is already installed, bring as closely as possible to the X axis so that a load is not applied to the guide rail.

3. Loosen the bolts for the Y axis and support bracket. (see figure below.)

4. Temporarily fasten the guide rail to the base with the bolts.
   The guide rail and X axis must be made parallel with each other, so use a dial gage or a pick gage to make sure these two parts are in parallel.

5. As a simple method for setting parallel, first tighten the bolts that were loosened in step 3.
   Then bring the X axis to one side and while in that state, tighten the bolt at one end of the guide rail. Next, bring the X axis to the opposite end and while in that state, tighten the bolt at the opposite side of the guide rail. Repeat this process until the bolts are all tightened. Try to move the X axis as large a distance as possible and tighten the bolt at a position that feels the tightest.

**CAUTION**

Set the guide rail parallel to the X axis during the installation. Make sure no difference in height occurs at the X axis and guide rail installation surface.

Adjustment of the gantry type support rail
Robot Cable Connection

The robot cable is already connected to the XY series robot. Correctly install the other end of the robot cable to the robot controller. For details on connections to the robot controller, refer the separate “YAMAHA MRCH, QRCH or DRCH Series Robot Controller Owner’s Manual”. After making connections, check the operation while referring to “6 Trial operation” in Chapter1.

**WARNING**

- Before connecting the cables, check that there are no bends or breaks in the connector pins of the robot cable and that the cables are not damaged. Bent or broken pins or cable damage may cause malfunction of the robot.
- Ensure that the controller is off before connecting the robot cable to the controller.

**WARNING**

In the QRCH and MRCH controllers, the MOTOR connectors XM and ZM, and YM and RM each have identical shapes. In addition, the PI connectors XY and ZR have identical shapes. Do not confuse these connectors when making connections. Wrong connections may result in malfunction and hazardous situations.

**WARNING**

- If the connector installation is inadequate or if there are contact failures in the pins, the robot may malfunction causing a hazardous situation. Reconfirm that each connector is securely installed before turning on the controller.
- To attach the PI connector securely, tighten the screws supplied with the robot.
- Take caution not to apply an excessive load to the connectors due to stress or tension on the cables.

**WARNING**

Lay out the cables so that they do not obstruct the movement of the manipulator. Determine the robot work area in which the robot cables will not interfere with the load or workpiece picked up by the manipulator. If the robot cables interfere with the movable parts of the robot, the cables may be damaged causing malfunction and hazardous situations.

**WARNING**

Lay out the robot cables so as to keep the operator or any other person from tripping on them. Bodily injury may result if someone trips on the cables.
4-1 Connecting the MRCH controller

Make correct connections to the MRCH controller according to the table below.

<table>
<thead>
<tr>
<th>Robot Cable</th>
<th>MRCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>XY MO CN</td>
<td>MOTOR (Driver Unit 1)</td>
</tr>
<tr>
<td>XY PI CN</td>
<td>PI (Driver Unit 1)</td>
</tr>
<tr>
<td>ZR MO CN</td>
<td>MOTOR (Driver Unit 2)</td>
</tr>
<tr>
<td>ZR PI CN</td>
<td>PI (Driver Unit 2)</td>
</tr>
</tbody>
</table>

Note: These connections apply to the main robot. Refer to the controller owner’s manual for more details.

Connecting the MRCH controller
4-2 Connecting the QRCH controller

Make correct connections to the QRCH controller according to the table below.

<table>
<thead>
<tr>
<th>Robot Cable</th>
<th>QRCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>XY MO CN</td>
<td>MOTOR (Driver unit 1)</td>
</tr>
<tr>
<td>XY PI CN</td>
<td>PI (Driver unit 1)</td>
</tr>
<tr>
<td>ZR MO CN</td>
<td>MOTOR (Driver unit 2)</td>
</tr>
<tr>
<td>ZR PI CN</td>
<td>PI (Driver unit 2)</td>
</tr>
</tbody>
</table>

Note: These connections apply to the main robot. Refer to the controller owner's manual for more details.

Connecting the QRCH controller

⚠️ CAUTION ⚠️

For the QRCH and MRCH controllers, the MOTOR connectors and PI connectors used for the XY axes and ZR axes have an identical shape. Do not confuse the XY and ZR robot cable connectors when making connections.
4-3 Connecting the DRCH controller

Make correct connections to the DRCH controller according to the table below.

<table>
<thead>
<tr>
<th>ROBOT CABLE</th>
<th>DRCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTOR</td>
<td>MOTOR</td>
</tr>
<tr>
<td>ROBOT I/O</td>
<td>ROBOT I/O</td>
</tr>
</tbody>
</table>

Note: Refer to the controller owner's manual for more details.

**WARNING**

1. The robot cable is the most important cable for controlling the robot. If the connector installation is inadequate or if there are contact failures in the pins, the robot may malfunction. Recheck that each connector is securely installed before turning on the power to the controller.

2. Lay out the cables so that they do not obstruct the movement of the manipulator and operator. No excessive load should be applied to the connectors due to stress or tension on the cables.
5  Protective Bonding

⚠️ WARNING ⚠️

Turn off the controller before grounding the robot.

1) Provide a terminal marked “PE” for the protective conductor of the entire system and connect it to an external protective conductor. In addition, securely connect the ground terminal on the robot pedestal to the same protective conductor.

( Symbol 417-IEC-5019 )

2) The ground terminal of each axis (Y-axis for the 2-axis (XY) models, Z-axis for the 3-axis (XYZ) models and R-axis for the 4-axis (XYZR) models) can also be used when the end effector uses an electrical device which, if it malfunctions, might make contact with the power supply. To check the ground terminal locations of the XY robots, refer to Chapter 6, “Specifications”.

⚠️ CAUTION ⚠️

Use a wire thicker than the AWG14 (2mm²) for the grounding wire.
CHAPTER 4

Adjustments

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Outline

The YAMAHA robots are completely adjusted at the factory before shipment. It is not necessary to make any adjustment including the origin adjustment as long as you use the robot under normal conditions. However, when the operating conditions are changed and adjustment of the robot becomes necessary, follow the procedure described in this chapter.

⚠️ DANGER

Serious injury or death will result from impact with moving robot.
- Keep outside of guard during operation.
- Lock out power before approaching robot.

⚠️ WARNING

- Read and understand the contents of this chapter before attempting to adjust the robot. Be sure to observe the safety items explained in Chapter 1.
- Place a conspicuous sign indicating that the robot is being adjusted, in order to keep any person not involved with the adjustment from inadvertently touching the control keys or switches. Provide locks on the switch keys or ask someone to keep a watch as needed.
- Always turn off the power to the control unit before making any adjustments within the manipulator working area.
2 Origin and Machine Reference Adjustments

2-1 Return-to-origin movement

Return-to-origin can be performed by either of the following procedures.

For MRCH and QRCH controllers:
Press the F3 key (ORG) of the MPB or input an origin return signal (DI14) in manual mode.
(Refer to the owner’s manual for the MRCH or QRCH controller for details.)

For DRCH controller:
Press the F1 (origin) key on the programming unit DPB or input the ORG-S signal (refer to DRCH Controller Owner’s Manual) during the manual mode.
Each axis of the robot will normally move in the minus direction at a low speed. The origin return is completed when the origin sensor reacts to the origin dog or when the stroke end is contacted with.

⚠️ CAUTION

- The order in which each axis returns to the origin differs depending on the controller parameter setting. The initial state when equipped with the ZR axis is as follows:
  
  Z axis → X axis → Y axis → R axis

Note that the return-to-origin order of each axis can be changed with the parameter.
(Refer to the owner’s manual for the MRCH or QRCH controller for details.)

Return-to-origin direction for each axis (standard specifications)
Machine reference

The origin position is set at the encoder “0” pulse immediately after the origin sensor has detected the dog (or immediately before the stroke end is detected as the origin signal).

When return-to-origin is performed, there will be a difference in distance between the position where the origin sensor detects the dog and the point at which the next encoder “0” pulse is received. This is called the machine reference (see the figure below) and is usually expressed as a percent, with 100% being equal to one full turn of the motor. The optional MPB or DPB is required to confirm the machine reference. It is displayed on the LCD screen of the programming unit (MPB or DPB) when return-to-origin is complete.

Machine reference display

- **DPB**
  - IOPRT = ORGI
  - Origin complete
  - Machine ref. X=50%
  - Y=50%

- **MPB**
  - MANUAL
  - Machine Reference (%)
    - M1: 51
    - M2: 57
    - M3: 51
    - M4: 52

  - X axis
  - Y axis

  - POINT
  - ORIGIN
  - VEL+
  - VEL-

⚠️ CAUTION

In order to preserve the repeatability of a robot movement, the machine reference for each axis must be adjusted within tolerance. (This is adjusted prior to shipment.)

When the origin position is changed, always readjust the machine reference. Refer to this chapter for adjustment procedures.

Tolerance for machine reference: 40% to 60%
2-3 Adjusting the XY axis origin and machine reference

2-3-1 HXYLt (X axis)

The standard origin of this axis is at the position shown below. However, it can be changed to a random position. When the origin position needs to be changed after the robot has been delivered, follow the procedure below, including the machine reference adjustment. When you are adjusting only the machine reference, proceed from Step 11.

**CAUTION**

Always readjust the parameter setting for the soft limit and the machine reference when the origin position has been changed. In some cases, the return-to-origin direction parameter may need to be reset.

1. Stand outside the movement area of the manipulator, and then turn on the controller. Ensure safety for surrounding area before turning on the controller.

2. Perform return-to-origin and check the current origin position. Refer to 2-1 in this chapter for performing return-to-origin.

3. Turn off the controller.

4. Loosen the screws of the top covers of the X axis, and remove the covers. A “T” slot is seen along the inner frame of the X axis, and the origin dog is attached to it. The origin dog is hidden below the slide plate at the return-to-origin position. Move the slide plate by hand so that the origin sensor is easily accessible.

**Interior of X axis and origin dog (standard origin position)**

![Diagram of X axis and origin dog]
5. Loosen the screw securing the origin dog.
   Loosen the screw slightly (do not remove) to allow the dog to slide along the slot.

6. Move the dog to the desired position and retighten the screw to secure the dog.

7. Stand outside the movement area of the manipulator, and then turn on the controller.

8. Change the parameter setting for the return-to-origin direction as necessary.
   When you have set the origin on the position side, you must change this parameter setting.
   Refer to the robot controller manual for details.

9. Perform return-to-origin, then check the X axis origin position and also the machine reference displayed on the programming unit.
   When the machine reference is within the tolerance range (40 to 60%), the X axis origin adjustment is complete. If it is outside the tolerance range, adjust with the procedure below.

10. Turn off the controller.

---

**Adjusting the machine reference**

11. Turn off the controller.

12. Remove the motor cover.

13. Using a 4mm hex wrench, loosen the screws securing the motor installation plate to the main unit, and loosen the belt.

14. Based on the following guidelines, rotate the small diameter pulley (by a maximum of 1/2 turn).
   - When the machine reference < 40%: slide in direction A
   - When the machine reference > 60%: slide in direction B
   - A 36 degree rotation of the small diameter pulley equals 10% of the machine reference.

---

4-5
15 Adjust the belt tension and tighten the motor installation plate.

16 Stand outside the movement area of the manipulator, and then turn on the controller.

17 Perform return-to-origin and check the machine reference.
   When the machine reference is within the tolerance range (40 to 60%), the adjustment is complete.
   If it is still outside the tolerance range, turn off the controller and then readjust from Step 11.

18 Reattach the motor cover.

**NOTE**

When the origin is opposite to the standard position (that is, the opposite side to the motor), A and B should be reversed for making adjustment.
The standard origin position is on the motor side, but if requested at the order, the robot will be shipped with the origin set on the side opposite the motor side. When changing the origin position to the side opposite the motor side after the robot is delivered, a dedicated origin sensor will be required. When the machine reference amount needs to be adjusted, use the following procedures.

Adjusting the machine reference

1. Stand outside the movement area of the manipulator, and then turn on the controller.

2. Perform return-to-origin and check the machine reference displayed on the programming unit. When the machine reference is within the tolerance range (±40 to 60%), there is no need for adjustment. If outside the tolerance range, adjust with the procedure below.

3. Turn off the controller.

4. Remove the top cover.

5. Using a 2.5mm hex wrench, loosen the screw on the ball screw side of the coupling that links the ball screw to the motor shaft.

6. Based on the following guidelines, rotate the ball screw by hand (by a maximum of 1/2 turn).
   Make sure the motor shaft does not rotate when you do this.
   When the machine reference < 40%: slide in direction A
   When the machine reference > 60%: slide in direction B
   A 36 degree rotation of the ball screw equals 10% of the machine reference.
CHAPTER 4 ADJUSTMENTS

7. Retighten the screw to secure the coupling.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   When the machine reference is within the tolerance range (40 to 60%), the adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 3.

10. Reattach the top cover.

NOTE

When the origin is opposite to the standard position (that is, the opposite side to the motor), A and B should be reversed for making adjustment.
2-3-3 MXYt (Y axis), SXYt (X axis)

The standard origin position is on the motor side, but if requested at the order, the robot will be shipped with the origin set on the side opposite the motor side. When changing the origin position to the side opposite the motor side after the robot is delivered, a dedicated origin sensor will be required. When the machine reference amount needs to be adjusted, use the following procedures.

**Adjusting the machine reference**

1. Stand outside the movement area of the manipulator, and then turn on the controller.
2. Perform return-to-origin and check the machine reference displayed on the programming unit.
   When the machine reference is within the tolerance range (40 to 60%), there is no need for adjustment. If outside the tolerance range, adjust with the procedure below.
3. Turn off the controller.
4. Remove the top cover.
5. Using a 2.5mm hex wrench, loosen the screw on the ball screw side of the coupling that links the ball screw to the motor shaft.
6. Based on the following guidelines, rotate the ball screw by hand (by a maximum of 1/2 turn).
   Make sure the motor shaft does not rotate when you do this.
   When the machine reference < 40%: slide in direction A
   When the machine reference > 60%: slide in direction B
   A 36 degree rotation of the ball screw equals 10% of the machine reference.
7. Retighten the screw to secure the coupling.

8. Stand outside the movement area of the manipulator, and then turn on the controller.


   When the machine reference is within the tolerance range (40 to 60%), the adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 3.

10. Reattach the top cover.

---

**NOTE**

When the origin is opposite to the standard position (that is, the opposite side to the motor). $A$ and $B$ should be reversed for making adjustment.
2-3-4 SXYt (Y axis)

The origin of this axis is detected when the axis travels against the stroke end. The standard origin position is on the motor side, but the robot has been shipped with the origin position opposite the motor side due to customer order. After the robot is delivered, the origin position can be changed to the motor side or side opposite the motor side by changing the controller parameters. Refer to Controller Owner's Manual. In this case, the machine reference must be readjusted. Use the following procedure for adjustment

**Adjusting the machine reference**

1. Stand outside the movement area of the manipulator, and then turn on the controller.

2. Perform return-to-origin and check the machine reference displayed on the programming unit. When the machine reference is within the tolerance range (40 to 60%), there is no need for adjustment. If outside the tolerance range, adjust with the procedure below.

3. Turn off the controller.

4. Remove the top cover.

5. Using a 2.5mm hex wrench, loosen the screw on the ball screw side of the coupling that links the ball screw to the motor shaft.

6. Based on the following guidelines, rotate the ball screw by hand (by a maximum of 1/2 turn).

   Make sure the motor shaft does not rotate when you do this.

   When the machine reference < 40%: slide in direction A
   When the machine reference > 60%: slide in direction B

   A 36 degree rotation of the ball screw equals 10% of the machine reference.
7. Retighten the screw to secure the coupling.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   When the machine reference is within the tolerance range (40 to 60%), the adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 3.

10. Reattach the top cover.

---

**NOTE**

When the origin is opposite to the standard position (that is, the opposite side to the motor), A and B should be reversed for making adjustment.
SXYt (Folding type Y axis)

The origin of this axis is detected when the axis travels against the stroke end. The standard origin position is on the motor side, but the robot has been shipped with the origin position opposite the motor side due to customer order. After the robot is delivered, the origin position can be changed to the motor side or side opposite the motor side by changing the controller parameters. Refer to Controller Owner's Manual. In this case, the machine reference must be readjusted. Use the following procedure for adjustment.

1. Stand outside the movement area of the manipulator, and then turn on the controller.
   Ensure safety for surrounding area before turning on the controller.

2. Perform return-to-origin and check the Y axis machine reference displayed on the programming unit.
   When the machine reference value is within the tolerance range (40 to 60%), there is no need for adjustment. If it is outside the tolerance range, adjust with the procedure below.

3. Turn off the controller.

4. Remove pulley covers.

5. Loosen the three bolts fixing the ball screw side pulley.
   This can be loosened easily by using the M4 screw hole for locking

Adjusting the machine reference
6. Move the Y axis slide plate by hand (10mm maximum) to adjust the machine reference as follows:
   - When the machine reference < 40%: move in direction A
   - When the machine reference > 60%: move in direction B

**NOTE**
- For robots with the origin position setting opposite the motor side, move the slide plate in the reverse of the A and B directions.
- A 2mm movement of the slide plate equals 10% of the machine reference. Be careful not to allow the pulley to turn at this point.

7. Tighten the bolt fixing the pulley on the ball screw side.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   - When the machine reference value is within the tolerance range (40 to 60%), adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 5.

10. After the adjustment is complete, reattach the pulley covers.
2-3-6 FXYt (XY axis), SXYLt (XY axis)

These robots' origin is detected with the stroke end detection method. The standard origin position is on the motor side. However, if requested at the order, the FXYt will be shipped with the origin set on the side opposite the motor. (Note that this is up to an X axis stroke of 550.) After the robot is delivered, the origin position can be changed to the motor side or side opposite the motor side by changing the controller parameters. (FXYt only) In this case, if the machine reference amount needs to be adjusted for any reason, use the following procedures:

1. Stand outside the movement area of the manipulator, and then turn on the controller.

2. Perform return-to-origin and check the machine reference displayed on the programming unit.
   When the machine reference value is within the tolerance range (40 to 60%), there is no need for adjustment. If it is outside the tolerance range, adjust with the procedure below.

3. Turn off the controller.

4. Remove the top cover for each axis. When removing the top cover of the SXYLt,

   ![Top cover](image)

   shift the cover sideways once and then lift it up.

5. Loosen the nut fixing the stroke end stopper. Make sure not to rotate the stopper at this time.

   ![Nut and Stopper](image)

6. The stopper can be rotated by hand with the following procedure.
   - When machine reference < 40%: Counterclockwise direction facing motor
   - When machine reference > 60%: Clockwise direction facing motor

**NOTE**

- When the origin is opposite the standard position (opposite the motor side), slide the origin dog in the reverse of the A-B directions.
7. Tighten and fix the stopper nut.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   When the machine reference is within the tolerance range (40 to 60%), adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 5.

10. After the adjustment is complete, reattach the top cover.

* A 2.4mm movement of the origin dog equals 10% of the machine reference.
2-4 Adjusting the Z axis machine reference

2-4-1 ZL, ZH

The origin position is set at the upper end of the Z axis stroke and cannot be changed. The machine reference is adjusted to an optimum value before shipment and does not deviate from the tolerance range during normal operation. However, if for some reason the machine reference is outside the tolerance range, use the procedure below for adjustment.

Adjusting the machine reference

1. Stand outside the movement area of the manipulator, and then turn on the controller.

2. Perform return-to-origin and check the machine reference displayed on the programming unit.
   When the machine reference is within the tolerance range (40 to 60%), there is no need for adjustment. If outside the tolerance range, adjust with the procedure below.

3. Turn off the controller.

4. Remove the top cover.

5. Using a 2.5mm hex wrench, loosen the screw on the ball screw side of the coupling that links the ball screw to the motor shaft.

6. Based on the following guidelines, rotate the ball screw by hand (by a maximum of 1/2 turn).
   Make sure the motor shaft does not rotate when you do this.
   When the machine reference < 40%: slide in direction A
   When the machine reference > 60%: slide in direction B
   A 36 degree rotation of the ball screw equals 10% of the machine reference.
7. Retighten the screw to secure the coupling.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   When the machine reference is within the tolerance range (40 to 60%), the adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 3.

10. Reattach the top cover.
The origin position of this axis is set at the upper end of the stroke and cannot be changed. The machine reference is adjusted to an optimum value before shipment and does not deviate from the tolerance range during normal operation. However, if for some reason the machine reference is outside the tolerance range, adjust with the procedure below.

**Adjusting the machine reference**

1. Stand outside the movement area of the manipulator, and then turn on the controller.
2. Perform return-to-origin and check the machine reference displayed on the programming unit.
   When the machine reference is within the tolerance range (40 to 60%), there is no need for adjustment. If outside the tolerance range, adjust with the procedure below.
3. Turn off the controller.
4. Remove the top cover.
5. Using a 2mm hex wrench, loosen the screw on the ball screw side of the coupling that links the ball screw to the motor shaft.
6. Based on the following guidelines, rotate the ball screw by hand (by a maximum of 1/2 turn).
   - Make sure the motor shaft does not rotate when you do this.
   - When the machine reference < 40%: slide in direction A
   - When the machine reference > 60%: slide in direction B
   - A 36 degree rotation of the ball screw equals 10% of the machine reference.
CHAPTER 4 ADJUSTMENTS

7. Retighten the screw to secure the coupling.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   When the machine reference is within the tolerance range (40 to 60%), the adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 3.

10. Reattach the top cover.

---

NOTE

When the origin is opposite to the standard position (that is, the opposite side to the motor), A and B should be reversed for making adjustment.
2-4-3 ZF (Folding type)

The origin position of this axis is set at the upper end of the stroke and cannot be changed. The machine reference is adjusted to an optimum value before shipment and does not deviate from the tolerance range during normal operation. However, if for some reason the machine reference is outside the tolerance range, adjust with the procedure below.

1 Stand outside the movement area of the manipulator, and then turn on the controller.
   Ensure safety for surrounding area before turning on the controller.

2 Perform return-to-origin and check the machine reference displayed on the programming unit.
   When the machine reference value is within the tolerance range (40 to 60%), there is no need for adjustment. If it is outside the tolerance range, adjust with the procedure below.

3 Turn off the controller.

4 Remove the pulley cover.

5 Loosen the three bolts fixing the ball screw side pulley. This can be loosened easily by using the M4 screw hole for locking.

Adjusting the Z axis machine reference
6. More the Y axis slide plate by hand (5mm maximum) to adjust the machine reference as follows:
   When the machine reference <40%: move in direction A
   When the machine reference >60%: move in direction B

   NOTES:  
   - A 1mm movement of the slide plate equals 10% of the machine reference. Be careful not to allow the pulley to turn at this point.

7. Tighten the bolt fixing the pulley on the ball screw side.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   When the machine reference is within the tolerance range (40 to 60%), adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 5.

10. After the adjustment is complete, reattach the pulley cover.
The origin position of this axis is set at the upper end of the stroke and cannot be changed. The machine reference is adjusted to an optimum value before shipment and does not deviate from the tolerance range during normal operation. However, if for some reason the machine reference is outside the tolerance range, adjust with the procedure below.

1. Stand outside the movement area of the manipulator, and then turn on the controller.
   Ensure safety for surrounding area before turning on the controller.

2. Perform return-to-origin.
   Refer to 2-1 in this chapter for performing return-to-origin.

3. After return-to-origin is complete, check the Z axis machine reference displayed on the programming unit.
   When the machine reference is within the tolerance range (40 to 60%), there is no need for adjustment. If it is outside the tolerance range, adjust with the procedure below.

4. Turn off the controller.

5. Loosen the screws of the Z axis cover and remove the Z axis cover.
   The origin sensor is attached to the upper end of the Z axis, and the origin dog to the slide plate.

**Adjusting the Z axis machine reference**
CHAPTER 4 ADJUSTMENTS

6. Loosen the screws securing the Z axis origin dog, and move it (5mm maximum) to adjust the machine reference as follows:
   - When the machine reference < 40%: move upward
   - When the machine reference > 60%: move downward

NOTE
A 1mm movement of the origin dog corresponds to 10% of the machine reference.

7. Tighten the screws of the origin dog.

8. Stand outside the movement area of the manipulator, and then turn on the controller.

   - When the machine reference is within the tolerance range (40 to 60%), the adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 5.

10. After the adjustment is complete, reattach the Z axis cover.
2-5 Adjusting the R axis machine reference

The R axis origin position cannot be changed. The machine reference is adjusted to an optimum value before shipment and does not deviate from the tolerance range during normal operation. However, when the return-to-origin direction is changed, it will be necessary to adjust the machine reference. Use the procedures below for adjustment.

2-5-1 ZRL, ZRH, ZRF

1. Stand outside the movement area of the manipulator, and then turn on the controller.
   Ensure safety for surrounding area before turning on the controller.

2. Perform return-to-origin.
   Refer to 2-1 in this chapter four performing return-to-origin.

3. After return-to-origin is complete, check the R axis machine reference.
   When the machine reference is within the tolerance range (40 to 60%), there is no need for adjustment. If it is outside the tolerance range, adjust with the procedure below.

4. Turn off the controller.

5. Loosen the screws of the motor cover and remove the motor cover.

6. Remove the bolts (6 pieces) of the motor installation plate.

7. Pull up the motor along with the plate.
   At this point, be careful to keep the speed reducer (harmonic drive) installed with the motor from rotating. Also be careful not to allow dirt and foreign matter to adhere to it.

Removing the motor cover and motor installation plate
CHAPTER 4 ADJUSTMENTS

8 Rotate the harmonic driver (motor shaft) by hand (180 degrees maximum) to adjust the R axis machine reference as follows:
   When the R axis machine reference < 40%: rotate in direction A
   When the R axis machine reference > 60%: rotate in direction B

Adjusting the R axis machine reference

NOTE: A 36 degree rotation of the motor shaft equals to 10% of the machine reference.

9 Reinstall the motor in the original position while keeping the speed reducer (harmonic drive) from rotating.
   Take care not to apply shock to the harmonic drive when inserting the motor.

10 Tighten the bolts (6 pieces) of the motor installation plate using an even torque.

11 Stand outside the movement area of the manipulator, and then turn on the controller.

12 Perform return-to-origin and check the R axis machine reference.
   When the R axis machine reference is within the tolerance range (40 to 60%), the machine reference adjustment is complete. If it is still outside the tolerance range, turn off the controller and then readjust from Step 8.

13 After the adjustment is complete, attach the motor cover.
1. Stand outside the movement area of the manipulator, and then turn on the controller.
   Ensure safety for surrounding area before turning on the controller.

2. Perform return-to-origin.
   Refer to 2-1 in this chapter four performing return to origin.

3. After return-to-origin is complete, check the R axis machine reference.
   When the machine reference is within the tolerance range (40 to 60%), there is no need for adjustment. If it is outside the tolerance range, adjust with the procedure below.

4. Turn off the controller.

5. Loosen the screws of the Z axis cover and remove the Z axis cover.
   The R axis origin sensor and dog can be seen from the bottom as shown below.

R axis origin sensor and dog
6. Loosen the bolt securing the origin sensor to the frame.

7. Slide the origin sensor slightly to the right or left to adjust the machine reference. At this point, be careful not to allow the origin sensor to touch the origin dog.

8. Retighten the bolt to secure the origin sensor.

9. Stand outside the movement area of the manipulator, and then turn on the controller.

10. Perform return-to-origin and check the R axis machine reference. When this value is within the tolerance range (40 to 60%), the machine reference adjustment is complete. If the R axis machine reference is still outside the tolerance range, turn off the controller and then readjust from Step 6.

11. After the adjustment is complete, reattach the Z axis cover.
2-6 Origin sensor and dog clearance

1) The clearance (gap) between each axis' origin sensor (proximity sensor) and dog is as follows.
   X axis: Approx. 0.5mm
   Y axis: Approx. 0.5mm
   Z axis: Approx. 0.5mm
   R axis: Approx. 0.5mm

2) All origin sensors are normal closed 24V types.
   The origin sensor has a detection display LED (red) which goes out when the dog is reacted to. After adjusting the clearance, use this LED display to confirm that the origin sensor accurately detects the dog.

**WARNING**

To confirm the LED display, always press the emergency stop button and then turn ON the robot controller power.
3 Air Cylinder (Z axis) Adjustment

The method for adjusting the Z axis air cylinder ZAF and ZAS for the SXYt, SXYLt and FXYt is described below. (Air supply pressure: 4kgf/cm²)

⚠️ WARNING

Always confirm that the robot controller power is OFF and that the emergency stop button is ON before adjusting the air cylinder.

3-1 Input/output signals

The ZAF and ZAS rise and lower with the following input/output signals.

<table>
<thead>
<tr>
<th>Controller</th>
<th>Rise operation</th>
<th>Lower operation</th>
<th>Rise end confirmation sensor</th>
<th>Lower end confirmation sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>QRCH, MRCH</td>
<td>DO20 OFF</td>
<td>DO20 ON</td>
<td>DI20 ON</td>
<td>DI20 OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DI21 OFF</td>
<td>DI21 ON</td>
</tr>
<tr>
<td>DRCH</td>
<td>DO10 OFF</td>
<td>DO10 ON</td>
<td>DI10 ON</td>
<td>DI10 OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DI11 OFF</td>
<td>DI11 ON</td>
</tr>
</tbody>
</table>

3-2 Adjusting the air cylinder speed

The air cylinder's rising speed is adjusted with the speed controller knob on the unit's PULL side, and the lowering speed is adjusted with the speed controller knob on the PUSH side. Adjust so that there is no impact at the rise end or lower end.

3-3 Adjusting the cylinder sensor position

Press the valve's manual button to turn it ON and OFF, and raise and lower the air cylinder. Confirm that the sensor's LED lamp lights at the rise end or lower end. If the LED does not light, shift the sensor to the position where it lights.
4 Adjusting the Belt Tension

The FXYt and SXYLt use a timing belt in the drive section. Use the following procedures to tense the belt when replacing the belt or when the belt has stretched.

**CAUTION**

If the belt tension is insufficient, the position could deviate due to tooth skipping or the belt life could be decreased.

**WARNING**

Confirm that the robot controller power and external wiring panel switches are OFF before adjusting the belt tension.

---

4-1 FXYt

1. Turn the controller power OFF.

2. Remove the X axis or Y axis top cover.

3. Loosen the two lock bolts, turn the adjusting bolt, and tense the belt.

4. Move the slide plate by hand so that the distance between the slide plate end and belt tensioner end is approx. 150mm.

5. The tension is favorable if there is an approx. 2.5mm deflection when a load of 0.6kg ±10% is applied at the approximate center of the 150mm.

6. Tighten the lock bolt, and install the top cover.
1. Turn the controller power OFF.

2. Remove the X axis or Y axis top cover. The top cover is removed by pulling it in the axial direction after removing the axis end cover.

3. Loosen the two lock bolts, turn the adjusting bolt, and tense the belt.

4. Move the slide plate by hand so that the distance between the slide plate end and belt tensioner end is approx. 150mm.

5. The tension is favorable if there is an approx. 2.5mm deflection when a load of 1.7kg ±10% is applied at the approximate center of the 150mm.

6. Tighten the lock bolt, and install the top cover.
CHAPTER 5

Maintenance

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2 Precautions ............................................................................. 5-1
3 Daily Checklist ......................................................................... 5-2
4 Three Month Checklist ............................................................. 5-2
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1 Introduction

Regular maintenance of the YAMAHA robot system is essential in order to ensure safe and proper operation. Follow the procedures listed in this chapter and set up a regular maintenance schedule according to the checklists.

Maintenance procedures are grouped according to three basic periods:

- Everyday Procedures
- Procedures for Every Three Months
- Procedures for Every Six Months
- Procedures for Every Three Years

2 Precautions

Before beginning maintenance, read the safety precautions described in [Using the Robot Safely] in Chapter 1 and follow the instructions.

Some important instructions are listed again below as a double check.

⚠️ DANGER ⚠️

- If the adjustment or maintenance procedure calls for operation of the robot, stay out of the working area of the manipulator while it is operating. Do not touch any parts inside the controller. Keep watching the manipulator movement and surrounding area so that the operator can press the emergency stop button if any danger occurs.

⚠️ WARNING ⚠️

- When the robot does not need to be operated during adjustment or maintenance, always turn off the controller and the external power distribution panel.
- Do not touch the internal parts of the controller for several seconds after the power to the controller has been turned off.
- When performing electrical maintenance which does not require manipulator movement, keep the emergency stop button pressed.
- When adjustment or maintenance is complete, retighten the bolts or screws securely.
- During robot adjustment or maintenance, place a sign indicating that the robot is being adjusted or inspected, to prevent other persons from inadvertently touching the control keys or switches. Provide a lock on the switch keys or ask someone to keep watch as needed.
3 Daily Checklist

The following is a list of maintenance operations that must be performed every day before and after operating the robot.

<table>
<thead>
<tr>
<th>CHECK POINT</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Area Guards</td>
<td>Check to see if guards are securely installed in place</td>
</tr>
<tr>
<td>Cables</td>
<td>Check for scratches, dents, kinks and chemical adhesion.</td>
</tr>
<tr>
<td>Motor, Encoder, Harmonic Drive</td>
<td>Check for excessive vibration and noise, overheating, etc.</td>
</tr>
</tbody>
</table>
| Air Pressure                     | • Check air pressure reading.  
                                       • Check for air leaks.  
                                       • Drain.  
                                       • Check air filter. |

4 Three Month Checklist

Check the following items every 3 months and replenish grease if needed.

<table>
<thead>
<tr>
<th>CHECK POINT</th>
<th>PROCEDURE</th>
</tr>
</thead>
</table>
| Lubrication of the X, Y, Z axis ball screws, linear guides, and ball splines. | Check for dirt or grime. If dirt or grime is found, clean the part. Apply grease after cleaning. Apply grease if the items checked are dry or do not have enough grease.  
                                       Standard model: Use Albania No. 2 (Showa Shell),  
                                       Daphney Eponex No.2 (Idemitsu)  
                                       Clean room model: Use LG-2 (NSK) |
The following is a list of maintenance operations to be performed every six months.

<table>
<thead>
<tr>
<th>Inspection or replacement place</th>
<th>Inspection or replacement details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main bolts and screws on the robot</td>
<td>Check for looseness. If loose, tighten.</td>
</tr>
</tbody>
</table>
| X axis, Y axis drive section (Ball screw, linear guide) | • Check for looseness in the X and Y axis drive sections (ball screw, linear guide). Tighten if necessary.  
   • Check for vibration during operation. Tighten drive section, and X and Y axis installation bolts if necessary.  
   • Check for wear and backlash. If any abnormality is found, contact YAMAHA sales representatives.              |
| Z axis ball spline, ball screw                        | Check for backlash. If any abnormality is found, contact YAMAHA sales representatives.                                                                             |
| Z or R axis timing belt                               | • Check the tension.  
   • Check for abnormalities (cracks, cuts) in the timing belt.                                                                                                     |
| Machine reference                                    | Perform origin to return and confirm that the machine reference is optimum. (Refer to "Chapter 4").                                                              |
| Origin sensor and dog of each axis                   | Clean if necessary.                                                                                                                                                    |
| Wiring in robot                                       | • Check for damages or scratches on the cables, etc.  
   • Check for looseness in the relay connectors, etc.                                                                                                               |
| Interior of controller                                | • Check for looseness at the terminals.  
   • Check for looseness in the connectors.                                                                                                                                |
| Fan for air-cooling on rear side of controller        | • Check that the fan rotates.  
   • Check that the fan is not blocked.  
   • Check for abnormal sounds during rotation. Visually check if necessary. If any foreign matter is found, remove it. If no foreign matter is found, contact YAMAHA sales representative.  
   • Check for dirt on the fan cover. Remove and clean if dirty.                                                                                                           |
6 Three Year Checklist

Inspect the following items every three years and make the necessary adjustments or replacements.

<table>
<thead>
<tr>
<th>Inspection place</th>
<th>Inspection details</th>
</tr>
</thead>
<tbody>
<tr>
<td>R axis speed reducer (Harmonic drive)</td>
<td>Refer to &quot;R Grease Replenishment&quot; in Chapter 5.</td>
</tr>
<tr>
<td>X, Y and Z axis drive sections (Ball screw nut sections and linear guides)</td>
<td>Check for wear and looseness in the ball screw, nut and linear guide.</td>
</tr>
</tbody>
</table>
7 Grease Replenishment

Grease should be applied to the following points on the X, Y and Z axis. Use the specified grease according to the Three month checklist. When a grease nipple is provided, replenish the grease with the grease gun. If a grease nipple is not provided, apply a thin coat by hand.

Replenishing the grease

When lubricating the ball screw, spline shaft and linear busing shaft, observe the following precautions.

⚠️ WARNING ⚠️

Precautions when handling grease:
- Inflammation may occur if this gets in the eyes. Before handling the grease, wear your safety goggles to ensure the grease will not come in contact with the eyes.
- Inflammation may occur if the grease comes into contact with skin. Be sure to wear protective gloves to prevent contact with skin.
- Do not take orally or eat. (Eating will cause diarrhea and vomiting.)
- Hands and fingers might be cut when opening the container, so use protective gloves.
- Keep out of the reach of children.
- Do not heat the grease or place near an open flame since this could lead to sparks and fire.

Emergency Treatment:
- If this grease gets in the eyes, wash liberally with pure water for about 15 minutes and consult a physician for treatment.
- If this grease comes in contact with the skin, wash away completely with soap and water.
- If taken internally, do not induce vomiting but promptly consult a physician for treatment.
8 Grease Replenishment

The XY series robots use a harmonic drive as the speed reducer for the R axis (ZRL, ZRH, ZRF units). Harmonic grease HC-1A (made by Harmonic Drive Systems Inc.) is used to lubricate the harmonic drive. When this grease deteriorates with operating time, the service life of the harmonic drive may shorten.

Replace the harmonic grease every three years, or use the guideline explained below to determine the replacement period and replace the used grease.

⚠️ WARNING ⚠️

The motor and speed reduction gear casing are extremely hot after automatic operation, so burns may occur if these are touched. Before touching these parts, turn off the controller, wait for a while and check that the temperature has cooled.

⚠️ WARNING ⚠️

Precautions when handling harmonic grease, cleaning oil:
- Inflammation may occur if they get in the eyes.
  Before handling them, wear your safety goggles to ensure they will not come in contact with the eyes.
- Inflammation may occur if they come into contact with skin. Be sure to wear protective gloves to prevent contact with skin.
- Do not take orally or eat. (Eating will cause diarrhea and vomiting.)
- Hands and fingers might be cut when opening the container, so use protective gloves.
- Keep out of the reach of children.
- Do not heat them or place near an open flame since this could lead to sparks and fires.

Emergency Treatment:
- If they get in the eyes, wash liberally with pure water for about 15 minutes and consult a physician for treatment.
- If they come in contact with the skin, wash away completely with soap and water.
- If taken internally, do not induce vomiting but promptly consult a physician for treatment.

⚠️ WARNING ⚠️

Disposing of harmonic grease, cleaning oil and the container:
- Proper disposal is compulsory under federal, state and local regulations. Take appropriate measures in compliance with legal regulations.
- Do not pressurize the empty container. Pressurizing may cause the container to rupture.
- Do not attempt to weld, heat up, drill holes or cut this container. This might cause the container to explode and the remaining materials inside it to ignite.
monic drive service life may decline drastically if the grease recommended by YAMAHA is not used.

**CAUTION**

Harmonic drive

- Do not apply strong shocks or impacts to these parts such as with a hammer. Also, do not scratch, scar or dent these parts by dropping, etc. Such actions will damage the harmonic drive.
- The specified performance cannot be maintained if any part of the harmonic drive is used in a damaged state. This damage or wear may also lead to trouble with the harmonic drive.

---

**8-1 Replacement period**

The harmonic grease replacement period is determined by the total number of turns of the wave generator used in the harmonic drive. We recommend replacement of the harmonic grease when the total number of turns has reached $1.5 \times 10^8$ (-10 to +40°C). This means that the replacement period will differ depending on the following operating conditions.

- $n$ : Number of arm movements per minute
- $q$ : Average turn per arm movement
- $N$ : 1/reduction ratio
- $h$ : Operation time per day
- $D$ : Operation days per year

For example, when the robot is used under the following conditions, the replacement period can be calculated as follows.

- $n$ : 10
- $\theta$ : 1/4 turn
- $N$ : 80
- $h$ : 24 hours per day
- $D$ : 240 days per year

Replacement period

$\text{Replacement period} = \frac{1.5 \times 10^8}{n \times q \times D \times N \times \theta}$

$= 1.5 \times 10^8/ (10 \times 60 \times 24 \times 240 \times 80 \times 1/4) = 2.17 \text{ years}$
8-2 Replacing the harmonic grease

The following explains the procedure for replacing the harmonic grease used for the R axis of the ZRL unit. Basically, use the same procedure to replace the harmonic grease for other units (ZRH, ZRF units, etc.)

⚠️ CAUTION ⚠️

After the grease has been replaced, the machine reference adjustment (Chapter 4) and point data setting must be performed again because of position shifts during the grease replacement.

1. Prepare the specified grease and necessary tools.
   - Harmonic grease HC-1A
   - Cleaning oil (white gasoline, etc.)
   - Waste cloth, air gun
   - Tools (Phillips screwdriver, hex wrench, torque wrench, etc.)

2. Loosen the screws of the cover of the R axis cover and remove the R axis cover.

3. Loosen and remove the bolts (6 pieces) of the motor installation plate, and remove the plate along with the motor.

Removing the cover of the R axis and the motor installation plate
4. Loosen the bolts (4 pieces) securing the motor to the plate. At this point, be careful not to bring the speed reducer (wave generator) installed with the motor into contact with the plate.

5. Place a wrench between the motor and the plate, so it contacts the two surfaces of the motor shaft.

6. While holding the motor shaft with the wrench, loosen and remove the hex socket head bolt at the end of the motor shaft, then slowly pull out the wave generator.

**Removing the wave generator**

7. Loosen and remove the hex socket head bolts (6 pieces), and gently remove the cup-shaped speed reducer (flexible spline).

8. Loosen and remove the bolts (6 pieces) of the circular spline, and gently remove the circular spline.

**Removing the flexible spline and circular spline**
9. Using an air gun or waste cloth, remove the used grease from the wave generator, circular spline and flexible spline. If grease degradation is widespread, clean each part with cleaning oil (white gasoline, etc.).

10. Apply new harmonic grease to each component as illustrated below.

**Applying the harmonic grease**

- Apply grease with thickness equal to ball diameter
- Apply grease to cover all keys
- Apply grease to entire surface of oldham's coupling
- Apply grease to sufficiently cover space between balls
- Lightly apply grease around the outer surface

(Circular spline)  (Flexible spline)  (Wave generator)

11. Reassemble each component in the reverse of the above procedure.
   - Tighten each bolt to the following torque.
     - M4 bolts: 46kgf-cm
     - M5 bolts: 92kgf-cm
     - M6 bolts: 156kgf-cm

**CAUTION**

Take sufficient care not to allow dirt and foreign matter to adhere to the harmonic drive or grease during disassembly and reassembly.
9 Replacing the Motor

To replace the motor of each axis, follow the procedures below.

**WARNING**
Before beginning the work, ensure that the robot controller and external switch board are turned off.

**CAUTION**

1. The position will deviate when the motor is replaced. After replacing the motor, the machine reference amount must be adjusted and the point data must be reset.
2. When removing each part, make sure to remember the relation of the installation positions.

9-1 HXYLt (X axis)

1. Loosen the screws of the motor and pulley covers and remove these covers.
2. Disconnect all connectors connected to the motor.
3. Using the 4mm hex wrench, loosen the bolts securing the motor installation plate to the manipulator frame, and remove the belt from the motor pulley.
4. Loosen the bolt securing the pulley to the motor shaft and remove the pulley.
5. Remove the bolts securing the motor to the installation plate and remove the motor.
6. Install the new motor in place and tighten the bolts securely.
7. Attach the pulley just removed, to the new motor and tighten the bolt.
8. Retighten the belt to its correct tension and tighten the bolts to secure the installation plate to the manipulator frame.

9. Connect the connectors disconnected in step 8.
   Check the mark tubes so that the connections are not mistaken.

10. Readjust the machine reference.
    Refer to 2-3-1 in Chapter 4.

11. Reattach the motor covers.
1. Loosen the installation screws for the motor's top cover and end plate, and remove the cover and end plate.
   When removing the X axis motor's top cover, remove the wiring box with it.

2. Disconnect all connectors connected to the motor.

3. Using the 4mm hex wrench, loosen the bolt securing the coupling on the motor side. (motor side only)
   To loosen the bolt, align it with the hole of the coupling assembly.

4. Remove the bolts securing the motor to the coupling assembly and remove the motor.

5. Install the new motor in place and tighten the bolts to secure the motor to the coupling assembly.

6. Tighten the bolt to secure the motor shaft to the coupling.

7. Connect the connectors disconnected in step 6.
   Check the mark tubes so that the connections are not mistaken.

8. Readjust the machine reference
   Refer to 2-3-2 in Chapter 4.

9. Reattach the motor cover and end plate.
1. Loosen the installation screws for the motor's top cover and end plate, and remove the cover and end plate. When removing the X axis motor's top cover, remove the wiring box with it.

2. Disconnect all connectors connected to the motor.

3. Using the 2.5mm hex wrench, loosen the bolt securing the coupling on the motor side. (motor side only)
   To loosen the bolt, align it with the hole of the coupling assembly.

4. Remove the bolts securing the motor to the coupling assembly and remove the motor.

5. Install the new motor in place and tighten the bolts to secure the motor to the coupling assembly.

6. Tighten the bolt to secure the motor shaft to the coupling.

7. Connect the connectors disconnected in step 2.
   Check the mark tubes so that the connections are not mistaken.

8. Readjust the machine reference.
   Refer to 2-3 or 2-4 in Chapter 4.

9. Reattach the motor cover and end plate.
1. Loosen the screws of the motor and pulley covers, and remove these covers.
2. Disconnect all connectors connected to the motor.
3. Using the 4mm hex wrench, loosen the bolts securing the motor installation plate to the manipulator frame, and remove the belt from the motor pulley.
4. Remove the bolts securing the motor to the installation plate and remove the motor.
5. Loosen the setscrew securing the pulley to the motor shaft and remove the pulley.
6. Attach the pulley just removed, to the new motor and tighten the setscrew.
7. Install the new motor in place and tighten the bolts securely.
8. Retighten the belt to its correct tension and tighten the bolts (3 pieces) to secure the installation plate to the manipulator frame.
9. Connect the connectors disconnected in step x.
   Check the mark tubes so that the connections are not mistaken.
10. Readjust the machine reference.
   Refer to 2-3-5 in Chapter 4.
11. Reattach the motor and pulley covers.
1. Remove the two plastic side covers, and slide the motor cover to the side to remove it.

2. Disconnect all connectors connected to the motor.

3. Remove the four bolts securing the motor.

4. Loosen the setscrew securing the motor pulley to the motor shaft and remove the pulley.

5. Attach the pulley just removed to the new motor and tighten the setscrew.

6. Install the new motor on the main unit. Make sure that the belt is caught properly on the pulleys at this time.

7. Move the slide table by hand, and check that the belt and pulleys are correctly engaged and that the belt is tense.

8. Connect the connectors disconnected in step 2.
   Check the mark tubes so that the connections are not mistaken.
   Readjust the machine reference.

9. Readjust the machine reference. Refer to 2-3-6 in Chapter 4.

10. Reattach the motor cover and side covers.
9-6 R axis (ZRF, ZRL, ZRH)

1. Loosen the screws of the motor cover and remove the motor cover.
2. Disconnect the motor code and encoder code connectors.
3. Remove the bolts securing the motor to the harmonic drive.
4. Using the 2mm hex wrench, loosen the setscrew securing the wave generator to the motor shaft and remove the wave generator.
5. Fit the wave generator just removed, onto the shaft of the new motor.
   For ZRL and ZRH units, first fit the ring onto the shaft and then the wave generator while pressing it all the way to the inside.
   For ZRF units, check with a caliper that the wave generator is at the position shown in the drawing below.

**Installing the wave generator to the motor**
6. Tighten the setscrew to secure the wave generator.
   At this point, apply a small amount of "Screwlock" to the setscrew and then tighten.

7. Install the new motor in place and tighten the bolts to secure the motor to the harmonic drive.

NOTE
To install the motor smoothly, insert the wave generator gently into the harmonic drive while turning the R axis output shaft to the right and left. Take care not to apply impacts or shocks to the motor and harmonic drive.

8. Connect the connectors disconnected in step 5.
   Check the mark tubes so that the connections are not mistaken.

9. Readjust the machine reference.
   Refer to 2-5 in Chapter 4.

10. Reattach the motor cover.
(1) ZRS  Z axis

1. Remove the contor and left cover looking at the ZNS from the front.

2. Disconnect all connectors connected to the motor.

3. Using the 4mm hex wrench, remove the two bolts securing the motor installation plate to the manipulator frame.

4. Loosen the setscrew securing the pulley to the motor shaft and remove the pulley.

5. Remove the motor installation plate from the motor.

6. Install the new motor onto the motor installation plate.

7. Attach the motor pulley to the new motor and tighten the setscrew.

8. Retighten the belt to its correct tension and tighten the bolts (2 pieces) to secure the installation plate to the manipulator frame.

9. Connect the connectors disconnected in step 2. Check the mark tubes so that the connections are not mistaken.

10. Readjust the machine reference.
    Refer to 2-4-4 in Chapter 4.

11. Reattach the cover.
Chapter 5  Maintenance

(1) ZRS  R axis

1. Remove the center and left cover looking at the ZRS from the front.

2. Disconnect all connectors connected to the motor.

3. Using the 2mm hex wrench, loosen the two setscrews fixing the motor shaft and ball reduction gears.
   The setscrews can be confirmed from the hole on the holder between the motor and ball reduction gears.
   The setscrews only need to be loosened, and should not be removed.

4. Remove the four bolts fixing the motor to the holder, and pull out the motor.

5. Install the new motor onto the holder. Align the setscrews and motor shaft face at this time.

6. After tightening the setscrews, fix the motor onto the holder with the bolts.

7. Connect the connectors disconnected in step 2. Check the mark tubes so that the connections are not mistaken.

8. Readjust the machine reference. Refer to 2-5-2 in Chapter 4.

9. Reattach the cover.
1. Remove the cover on the motor. Disconnect all connectors connected to the motor.

2. Using the 4mm hex wrench, remove the two bolts securing the motor installation plate to the manipulator frame.

3. Loosen the setscrew securing the motor pulley to the motor shaft and remove the pulley.

4. Remove the four bolts securing the motor and plate and remove the motor.

5. Install the new motor onto the motor pulley and plate.

6. Retighten the belt to its correct tension and tighten the bolts (2 pieces) to secure the installation plate to the manipulator frame.

7. Connect the connectors disconnected in step 1. Check the mark tubes so that the connections are not mistaken.

8. Readjust the machine reference.

9. Reattach the cover.
Motor type No.

<table>
<thead>
<tr>
<th>Model name</th>
<th>Motor type No.</th>
<th>Remarks</th>
</tr>
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<tbody>
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<td>FXYt</td>
<td>X axis 90K50-511332</td>
<td>100W</td>
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<td>60W</td>
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<tr>
<td></td>
<td>90K50-4W2322</td>
<td>60W with brakes</td>
</tr>
<tr>
<td>SXYL1</td>
<td>X axis 90K50-521340</td>
<td>200W</td>
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<tr>
<td></td>
<td>Y axis 90K50-521340</td>
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<td>100W</td>
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<tr>
<td></td>
<td>90K50-513330</td>
<td>100W with brakes, dedicated for pole type</td>
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<tr>
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<td>ZF 90K50-412322</td>
<td>100W with brakes, for flexible cable</td>
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<td>90K50-412352</td>
<td>100W with brakes, for cable guide</td>
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<tr>
<td></td>
<td>90K50-74333Y</td>
<td>400W with brakes, dedicated for pole type</td>
</tr>
</tbody>
</table>
10 Replacing the Belt

The FXYt and SXYLt use a timing belt in the drive section. If there is any abnormality in this belt such as cracks, missing teeth or abnormal wear, replace the belt. If use is continued in the abnormal state, position deviation, abnormal noise or belt ripping could occur.

⚠️ WARNING ⚠️

Confirm that the robot controller power and external wiring panel switches are OFF before adjusting the belt tension.

⚠️ CAUTION ⚠️

1. The position will deviate when the motor is replaced. After replacing the motor, the machine reference amount must be adjusted and the point data must be reset.
2. When removing each part, make sure to remember the relation of the installation positions.

10-1 FXYt

1. Turn the controller power OFF.

2. Remove the X axis or Y axis top cover.

3. Insert a wrench from the side (axial direction) of the slide plate, and remove the two hexagon bolts.

4. Shift the slide plate position without moving the drive belt, and expose the belt stay and belt presser plate.

5. Loosen the bolt for the belt stay and belt presser plate that are sandwiching the drive belt, and remove them from the belt.

6. Install the new belt. At this time, make sure that the belt teeth are securely engaged with the pulleys at both ends. Sandwich the belt with the belt stay and belt pressure plate, and fix with the bolts.

7. Apply tension to the belt (refer to Chapter 4). Move the belt by hand and confirm that the belt moves smoothly.

8. Fix the belt stay and slide plate with the hexagon bolts. Move the slide plate by hand and confirm that the belt moves smoothly.

9. Adjust the machine reference amount (refer to Chapter 4).
1. Turn the controller power OFF.

2. Remove the X axis or Y axis top cover. The top cover is removed by pulling it in the axial direction after removing the axis end cover.

3. Insert a wrench from the side (axial direction) of the slide plate, and remove the four hexagon bolts.

4. Shift the slide plate position without moving the drive belt, and expose the belt stay and belt presser plate.

5. Loosen the bolt for the belt stay and belt presser plate that are sandwiching the drive belt, and remove them from the belt.

6. Install the new belt. At this time, make sure that the belt teeth are securely engaged with the pulleys at both ends. Sandwich the belt with the belt stay and belt pressure plate, and fix with the bolts.

7. Apply tension to the belt (refer to Chapter 4). Move the belt by hand and confirm that the belt moves smoothly.

8. Fix the belt stay and slide plate with the hexagon bolts. Move the slide plate by hand and confirm that the belt moves smoothly.

9. Adjust the machine reference amount (refer to Chapter 4).
CHAPTER 6

Specification

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1-1 X and Y axis linear guide static tolerable moment

When an external force is applied to the manipulator in the still state, the tolerable range is as follows:

<table>
<thead>
<tr>
<th></th>
<th>SXYt/SXYLt</th>
<th>MXYt</th>
<th>HXYt/HXYLt</th>
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<td>X Axis</td>
<td>Y Axis</td>
<td>X Axis</td>
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<td>6</td>
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</tr>
<tr>
<td>Roll</td>
<td>36</td>
<td>9</td>
<td>87</td>
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</table>

kgf·m
1-2  R axis tolerable moment of inertia

(1)  R axis tolerable moment of inertia
The load that can be installed to the R axis is limited by the R axis motor, speed reducer and timing belt strength specifications. Operating the robot with a load exceeding this limit will lead to a premature life reduction or mechanical damage of the above drive parts and residual vibrations during positioning.

The limits of this R axis load are shown below with a term called the R axis tolerable moment of inertia.

<table>
<thead>
<tr>
<th>Tip load weight</th>
<th>ZRS</th>
<th>ZRF</th>
<th>ZRL (ZRH)</th>
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<tr>
<td>1</td>
<td>0.015</td>
<td>0.12</td>
<td>0.93</td>
</tr>
<tr>
<td>2</td>
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<td>5</td>
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<td>0.6</td>
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<td>6</td>
<td>—</td>
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</tr>
<tr>
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<tr>
<td>10</td>
<td>—</td>
<td>—</td>
<td>9.3</td>
</tr>
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</table>

[Unit: kg·cm·sec²]

⚠️ CAUTION ⚠️
Refer to the calculated examples of the moment of inertia shown on the subsequent pages and check that the moment of inertia of the R axis load does not exceed the tolerable value.
(2) Equation for moment of inertia calculation

Usually the R axis load is not a simple form, and the calculation of the moment of inertia is not easy. As a method, the load is replaced with several factors that resemble a simple form for which the moment of inertia can be calculated. The total of the moment of inertia for these factors is then obtained. The objects and equations often used for the calculation of the moment of inertia are shown below.

1. Moment of inertia for cylinder

The equation for the moment of inertia \((J)\) for a cylinder that has a rotation center such as shown in Figure is given below.

\[
J = \frac{\rho \pi D^2 h}{32g} = \frac{WD^2}{8g} \quad (\text{kg} \cdot \text{cm} \cdot \text{sec}^2) \quad \ldots (4.1)
\]

\(\rho\) : Density (kg/cm\(^3\))
\(g\) : Gravitational acceleration (cm/sec\(^2\))
\(W\) : Weight of the cylinder (kg)

![Cylinder diagram]

2. Moment of inertia for rectangular parallelepiped

The equation for the moment of inertia \((J)\) for a rectangular parallelepiped that has a rotation center such as shown in Figure is given as follows:

\[
J = \frac{\rho abc(a^2 + b^2)}{12g} = \frac{W(a^2 + b^2)}{12g} \quad \ldots (4.2)
\]

\(\rho\) : Density (kg/cm\(^3\))
\(g\) : Gravitational acceleration (cm/sec\(^2\))
\(W\) : Weight of the rectangular parallelepiped (kg)

![Parallelepiped diagram]
3. When the objects center line is offset from the rotation center.

When the center of the cylinder is offset by the distance "x" from the rotation center as shown in Figure, the equation for the moment of inertia \( J \) is given as follows.

\[
J = \frac{\rho \pi D^2 h}{32g} + \frac{\rho \pi D^2 hx^2}{4g} = \frac{WD^2}{8g} + \frac{Wx^2}{g} \text{ (kg cm sec}^2) \quad \ldots (4.3)
\]

\( W \) : Weight of the cylinder (kg)

In the same manner, the equation for a rectangular parallelepiped is given as follows.

\[
J = \frac{\rho abc(a^2 + b^2)}{12g} + \frac{\rho abcx^2}{g} = \frac{W(a^2 + b^2)}{12g} + \frac{Wx^2}{g} \text{ (kg cm sec}^2) \quad \ldots (4.4)
\]

\( W \) : Weight of the rectangular parallelepiped (kg)
(3) Example of moment of inertia calculation

Let's discuss an example in which the chuck and workpiece are at a position offset by 10cm from the R axis by a stay as shown in Figure. The moment of inertia is calculated with the following three factors, assuming that the load material is steel and its density \( \rho \) is 0.0078 kg/cm³.

1. Moment of inertia of the stay

\[ W_s = \rho abc = 0.0078 \times 12 \times 2 \times 2 = 0.37 \text{ (kg)} \]

From equation (4.4), the moment of inertia \( (J_s) \) is:

\[ J_s = \frac{0.37 \times (12^2 + 2^2)}{12 	imes 980} + \frac{0.37 \times 10^7}{980} = 0.042 \text{ (kg} \cdot \text{cm} \cdot \text{sec}^2) \]
2. Moment of inertia of the chuck

When the chuck form resembles that shown in Figure, the width and moment of inertia (Ic) of chuck (Wc) is

\[ Wc = 0.0078 \times 2 \times 4 \times 6 = 0.37 \text{(kg)} \]

\[ Ic = \frac{0.37 \times (2^2 + 4^2)}{12 \times 980} = \frac{0.37 \times 10^2}{980} = 0.038 \text{ (kg \cdot cm \cdot sec}^2) \]

3. Moment of inertia of workpiece

From figure, the weight (Ww) and the moment of inertia (Jw) of the workpiece is

\[ Ww = \frac{\rho \pi \ D \ h}{4} = \frac{0.0078 \pi \times 2 \times 4}{4} = 0.097 \text{(kg)} \]

\[ Jw = \frac{0.097 \times 2^2}{8 \times 980} + \frac{0.097 \times 10^2}{980} = 0.010 \text{ (kg \cdot cm}^2 \cdot \text{sec}^2) \]
4. Total weight
   The equation for the total weight (W) is given as follows.

   \[ W = W_s + W_c + W_w = 0.83 \text{ (kg)} \]

5. Total moment of inertia
   The equation for the total moment of inertia (J) is given as follows.

   \[ J = J_s + J_c + J_w = 0.09 \text{ (kg \cdot cm \cdot sec^2)} \]
## 2 Robot Control Signals

### DRCH, QRCH (2 axes type)

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6-8
### MRCH, QRCH (3 or 4 axes type)

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6-10
3  Robot Cable Connection

DRCH, QRCH (2 axes type)

Inside of robot

DRCH, QRCH controller side

6-11
QRCH, MRCH (3 or 4 axis type)
4 Using the Cable Carrier

Cable carriers are provided as standard equipment on the XY robots. Additional cables and hoses can be installed inside these cable carriers. The cable carriers and cables provided as standard equipment are shown below. There is no problem as long the cross section area of the cable already in the carrier plus the new cable together take up only 30% of the cable storage area. Even if the cables take up a larger area, it is unlikely they will break soon. Over a long term period, however, the more space taken up in the cable carrier, the more likely wire breakage is to occur.

- Area used inside cable carrier = \( \frac{\text{Standard cable cross section area} + \text{Additional cable cross section area}}{\text{Cross section area of cable storage area}} \)

- Cross section storage area in XY cable carrier : \( 25\text{mm} \times 77\text{mm} = 1925\text{mm}^2 \) (Igus Japan Runnerflex 250.07)
- Cross section storage area in YZ and ZR cable Carrier : \( 25\text{mm} \times 57\text{mm} = 1425\text{mm}^2 \) (Igus Japan Runnerflex 250.05)
- Standard cable:
  - Cable A (1-axis encoder wire, O.D. \( \phi 9.2 \)) cross section area 66.5\( \text{mm}^2 \)
  - Cable B (1-axis power cable, O.D. \( \phi 7.6 \)) cross section area 45.4\( \text{mm}^2 \)
  - Cable C (2-axis encoder cable, O.D. \( \phi 11.8 \)) cross section area 109.4\( \text{mm}^2 \)
  - Cable D (2-axis power cable, O.D. \( \phi 9.8 \)) cross section area 75.4\( \text{mm}^2 \)
  - Cable E (user wire, 0.3sq. 10-conductor wire, O.D. \( \phi 9.2 \)) cross section area 66.5\( \text{mm}^2 \)

(FXYt, SXYt, SXYLt, MXYt, HXYt)

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<thead>
<tr>
<th>2-Axis Models (XY)</th>
<th>3-Axis Models (XYZ)</th>
<th>4 Axis Models (XYZR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>XY Cable Carrier</strong></td>
<td>Cable A ( \times 1 ), Cable B ( \times 1 ), Cable E ( \times 1 ) total of 3</td>
<td>Cable C ( \times 1 ), Cable D ( \times 1 ), Cable E ( \times 1 ) total of 3</td>
</tr>
<tr>
<td><strong>YZ Cable Carrier</strong></td>
<td>————</td>
<td>Cable A ( \times 1 ), Cable B ( \times 1 ), Cable E ( \times 1 ) (Note 1) (Note 2) total of 3</td>
</tr>
<tr>
<td><strong>ZR Cable Carrier</strong></td>
<td>————</td>
<td>————</td>
</tr>
</tbody>
</table>

Note 1: Has one cable E when optional I/O cable is used.
Note 2: Has one cable E and one \( \phi 6 \)-diameter air tube when Z axis is air cylinder
Note 3: Has one each of cables A, B, E when Z axis is ZH or ZHB.
Note 4: Has two each of cables A, B and one cable E when ZR axis is ZRH or ZRHB.
## CHAPTER 6 Specification

### (HXYLT)

<table>
<thead>
<tr>
<th></th>
<th>2-Axis Models (XY)</th>
<th>3-Axis Models (XYZ)</th>
<th>4-Axis Models (XYZR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XY Cable Carrier</td>
<td>Cable C × 1, Cable D × 1,</td>
<td>Cable A × 1, Cable B × 1,</td>
<td>Cable C × 1, Cable D × 1,</td>
</tr>
<tr>
<td></td>
<td>Cable E × 1</td>
<td>Cable C × 1, Cable D × 1,</td>
<td>Cable E × 1</td>
</tr>
<tr>
<td></td>
<td>total of 3</td>
<td>total of 5</td>
<td>total of 5</td>
</tr>
<tr>
<td>YZ Cable Carrier</td>
<td>---</td>
<td>Cable A × 1, Cable B × 1,</td>
<td>Cable C × 1, Cable D × 1,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cable E × 1</td>
<td>Cable E × 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>total of 3</td>
<td>total of 3</td>
</tr>
<tr>
<td>ZR Cable Carrier</td>
<td>---</td>
<td>---</td>
<td>Cable A × 1, Cable B × 1,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cable E × 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Note 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>total of 3</td>
</tr>
</tbody>
</table>

**Note 1:** Has one each of cables A, B, E when Z axis is ZH or ZHB.

**Note 2:** Has two each of cables A, B and one cable E when ZR axis is ZRH or ZRHB.

---

**WARNING**

- The more space used within the cable carrier, the more wires tend to break causing robot malfunctions. So, check the space within the cable carrier.
- Maintain a curvature diameter of at least R50 for cables within the cable carrier.
- Arrange cables and air tubes neatly within the cable carrier so that they do not cross each other.
- Avoid fastening the cables or tubes within the cable carrier with plastic tie strap or similar items. The cables and tubes will be prone to breakage if fastened.
- Leave some surplus in the length of the cable within the cable carrier to allow for slight movement or play.
- Installing partitions (divider plates) inside the cable Carriers will allow neat arrangement of wiring and improve reliability.

---

![Diagram](image-url)
CHAPTER 6 Specification

5 User Wiring

User-dedicated wiring, which can be used, is laid in the robot's cable bearer or independent cable.

- Wiring ....... One 10-core cable, mark tube indication [I/O], connector is JST SM connector
- Piping ....... Two ø 4 air tubes (note this is only for the whipover cable.)

6 Maximum sound pressure level

<table>
<thead>
<tr>
<th>Maximum sound pressure level of robot</th>
<th>77dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot Model</td>
<td>HXYL1</td>
</tr>
<tr>
<td>Position of maximum sound pressure level</td>
<td>1.0m away from the front of the robot, at 1.6m height</td>
</tr>
</tbody>
</table>
# Maximum Speed Setting

In order to prevent resonance (hazardous speed) of the ball screws, reduce the maximum speed to a value shown in the tables below. It is unnecessary to reduce the maximum speed for other axes not listed below.

The maximum speed can be reduced by lowering the SPEED setting in automatic operation or by programming. Select the desired method that matches your application.

However, if the maximum speed does not reach a hazardous level, it is not necessary to reduce the speed even when a long-stroke axis is used.

(X axis of SXYI)

<table>
<thead>
<tr>
<th>Stroke (mm)</th>
<th>Maximum speed (mm/sec)</th>
<th>Maximum speed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>800</td>
<td>80</td>
</tr>
<tr>
<td>950</td>
<td>650</td>
<td>65</td>
</tr>
<tr>
<td>1050</td>
<td>550</td>
<td>55</td>
</tr>
</tbody>
</table>

(X axis of MXYI)

<table>
<thead>
<tr>
<th>Stroke (mm)</th>
<th>Maximum speed (mm/sec)</th>
<th>Maximum speed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>950</td>
<td>850</td>
<td>85</td>
</tr>
<tr>
<td>1050</td>
<td>700</td>
<td>70</td>
</tr>
<tr>
<td>1150</td>
<td>600</td>
<td>60</td>
</tr>
<tr>
<td>1250</td>
<td>500</td>
<td>50</td>
</tr>
</tbody>
</table>

(XY axis of HXYI)

<table>
<thead>
<tr>
<th>Stroke (mm)</th>
<th>Maximum speed (mm/sec)</th>
<th>Maximum speed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>950</td>
<td>850</td>
<td>85</td>
</tr>
<tr>
<td>1050</td>
<td>700</td>
<td>70</td>
</tr>
<tr>
<td>1150</td>
<td>600</td>
<td>60</td>
</tr>
<tr>
<td>1250</td>
<td>500</td>
<td>50</td>
</tr>
</tbody>
</table>

(Y axis of HXYLI)

<table>
<thead>
<tr>
<th>Stroke (mm)</th>
<th>Maximum speed (mm/sec)</th>
<th>Maximum speed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>950</td>
<td>850</td>
<td>85</td>
</tr>
<tr>
<td>1050</td>
<td>700</td>
<td>70</td>
</tr>
<tr>
<td>1150</td>
<td>600</td>
<td>60</td>
</tr>
<tr>
<td>1250</td>
<td>500</td>
<td>50</td>
</tr>
</tbody>
</table>

⚠️ **CAUTION**

Do not operate the robot if the ball screw is vibrating. The ball screw may otherwise wear prematurely.
8 Mechanical stopper

A urethane damper is installed to absorb the shock when an impact occurs with the mechanical stopper, so a certain amount of overrun occurs when the robot strikes the mechanical stopper. Use caution and take overrun into account since the end effector may interfere with the robot body and peripheral equipment or the robot body may interfere with the peripheral equipment. Maximum overrun amounts are listed below (for normal operation, maximum load mass, maximum speed).

<table>
<thead>
<tr>
<th>Model name</th>
<th>Motor side</th>
<th>Opposite side</th>
</tr>
</thead>
<tbody>
<tr>
<td>FXYt</td>
<td>XY axis</td>
<td>3mm</td>
</tr>
<tr>
<td>ZF</td>
<td></td>
<td>2mm</td>
</tr>
<tr>
<td>SXYt</td>
<td>X axis</td>
<td>4mm</td>
</tr>
<tr>
<td></td>
<td>Y axis</td>
<td>3mm</td>
</tr>
<tr>
<td>Z3, ZR3</td>
<td></td>
<td>3mm</td>
</tr>
<tr>
<td>ZF</td>
<td></td>
<td>6mm</td>
</tr>
<tr>
<td>SXYLt</td>
<td>X axis</td>
<td>4mm</td>
</tr>
<tr>
<td>SXYLt</td>
<td>Y axis</td>
<td>3mm</td>
</tr>
<tr>
<td>MXYt</td>
<td>X axis</td>
<td>7mm</td>
</tr>
<tr>
<td>MXYt</td>
<td>Y axis</td>
<td>4mm</td>
</tr>
<tr>
<td>Zr, ZP, ZM</td>
<td></td>
<td>6mm</td>
</tr>
<tr>
<td>HXYt</td>
<td>X axis</td>
<td>6mm</td>
</tr>
<tr>
<td></td>
<td>Y axis</td>
<td>7mm</td>
</tr>
<tr>
<td>ZL, ZH, ZPH</td>
<td></td>
<td>4mm</td>
</tr>
</tbody>
</table>

⚠️ CAUTION

Since the R-axis has no mechanical stoppers, make certain that the end effector wiring and tubing do not become entangled during operation or return-to-origin.

⚠️ WARNING

The mechanical stopper position of the XY Series Cartesian robots cannot be changed, so select the robot with the optimum movement range taking the overrun shown above into account.
Chapter 6 Specification

FXYt-S-F1-X-ZP

Note 1:
The moving range when returning to origin and the stop position when stopping by the mechanical stopper.

Note 2: When brake is no staked.

Grounding terminal (㎜)
For motor body

Grounding terminal (㎜)
For motor

With brakes optional

Note: Z-axis brake is optional

Cable carrier specifications

Whipover specifications

6-19
Chapter 6 Specification

SXYt-S-A1-XY

Detailed drawing of B

Grounding terminal (SMO) (For user)

X stroke 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
L 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
K 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
M 22 22 22 22 22 22 22 22 22 22 22 22 22 22 22
N 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8

SXYt-S-A1-XV

Detailed drawing of B

Grounding terminal (SMO) (For user)

X stroke 150 250 350 450 550 650 750 850 950 1050 1150 1250 1350 1450 1550
L 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
K 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
M 22 22 22 22 22 22 22 22 22 22 22 22 22 22 22
N 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8

Note 1:
The moving range when returning to origin and the stop position when stopping by the mechanical stopper.

2.5mm Depth

3.5mm Depth
Chapter 6 Specification

SXYt-S-M1-XY

Note 1:
The moving range when returning to origin and the stop position when stepping by the mechanical stopper

SXYt-S-M1-XYB

Note 1:
The moving range when returning to origin and the stop position when stepping by the mechanical stopper.

The total of X-stroke and Y-stroke is 1500 mm.
Note 1:
The stowing range when returning to origin and the stop position when stowing by the mechanical stopper.

X stroke:
<table>
<thead>
<tr>
<th>X stroke</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>450</th>
<th>500</th>
<th>550</th>
<th>600</th>
<th>650</th>
<th>700</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>800</td>
<td>808</td>
<td>808</td>
<td>808</td>
<td>808</td>
<td>1008</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
</tr>
<tr>
<td>M</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>N</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

Y stroke:
<table>
<thead>
<tr>
<th>Y stroke</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>450</th>
<th>500</th>
<th>550</th>
<th>600</th>
<th>650</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>N</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

The stroke of the slide is limited to 1,000 mm max.

Note 2:
The error of X stroke and Y stroke is ±0.005 mm max.
Chapter 6 Specification

ZF

Cable carrier specifications

<table>
<thead>
<tr>
<th>Dimension B</th>
<th>Dimension C</th>
<th>Dimension D</th>
</tr>
</thead>
<tbody>
<tr>
<td>125.5 (SXY)</td>
<td>207 (SXY)</td>
<td>83 (SXY)</td>
</tr>
<tr>
<td>137.5 (XYL)</td>
<td>195 (XYL)</td>
<td>94 (XYL)</td>
</tr>
</tbody>
</table>

(Moving-arm type)

ZRF

Cable carrier specifications

<table>
<thead>
<tr>
<th>Z Stroke</th>
<th>150</th>
<th>250</th>
<th>350</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension B</td>
<td>100</td>
<td>150</td>
<td>180</td>
</tr>
</tbody>
</table>

(Moving-arm type)

Whipover specifications

Detailed drawing of A
Chapter 6 Specification

MXY1-S-A-XYB

Note 1:
The negative range when returning to origin and the step position when stopping by the mechanical stopper.

Note 1:
The negative range when returning to origin and the step position when stopping by the mechanical stopper.

MXY1-C-M1-XY

Note 1:
The negative range when returning to origin and the step position when stopping by the mechanical stopper.
Chapter 6 Specification

MXYt-S-M1-XY

![Diagram of MXYt-S-M1-XY]

**Note 1:**
- The movable range when returning to origin and the stop position when stopping by the mechanical stopper.

<table>
<thead>
<tr>
<th>X stroke</th>
<th>250</th>
<th>300</th>
<th>400</th>
<th>550</th>
<th>680</th>
<th>760</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>M</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>N</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

**Y stroke**
- 150 | 250 | 350 | 450 | 550

The total of X stroke and Y stroke is 3000 or less.

---

MXYt-S-M1-XYB

![Diagram of MXYt-S-M1-XYB]

**Note 1:**
- The movable range when returning to origin and the stop position when stopping by the mechanical stopper.

<table>
<thead>
<tr>
<th>X stroke</th>
<th>250</th>
<th>300</th>
<th>400</th>
<th>550</th>
<th>680</th>
<th>760</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>M</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>N</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

**Y stroke**
- 150 | 250 | 350 | 450 | 550

The total of X stroke and Y stroke is 3000 or less.

---

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Chapter 6 Specification

HX1t-C-P2-XY

Note 1:
The measuring range when returning to origin and the stop position when stopping by the mechanical stopper.

<table>
<thead>
<tr>
<th>L</th>
<th>740</th>
<th>440</th>
<th>1048</th>
<th>1148</th>
<th>1248</th>
<th>1348</th>
<th>1448</th>
<th>1548</th>
<th>1648</th>
<th>1748</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>550</td>
<td>600</td>
<td>650</td>
</tr>
</tbody>
</table>

The total of Xatrice and Xatrice is 1100 or less.

HX1t-S-P1-XY

Note 1:
The measuring range when returning to origin and the stop position when stopping by the mechanical stopper.

<table>
<thead>
<tr>
<th>L</th>
<th>340</th>
<th>440</th>
<th>540</th>
<th>640</th>
<th>740</th>
<th>840</th>
<th>940</th>
<th>1040</th>
<th>1140</th>
<th>1240</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>550</td>
<td>600</td>
<td>650</td>
</tr>
</tbody>
</table>

The total of Xatrice and Xatrice is 1100 or less.
Chapter 6 Specification

HXYt-C-F1-X-ZH

Note 1:
The moving range when returning to origin and the stop position when stopping by the mechanical shaper.

HXYt-S-F1-X-ZH

Note 1:
The moving range when returning to origin and the stop position when stopping by the mechanical shaper.
Chapter 6 Specification

ZL

Detail drawing of A

(Arm type)

Cable carrier specitions

Whipover specitions

ZH

(Arm type)

Cable carrier specitions

(Arm type)

(Moving arm type)

Whipover specitions
Chapter 6 Specification

ZRH

Cable carrier specifications

Whipover specifications

ZRL

Cable carrier specifications

Whipover specifications
### 9-7 Weight of each axis

#### 9-7-1 FXYt

<table>
<thead>
<tr>
<th>Axis</th>
<th>Stroke</th>
<th>150mm</th>
<th>250mm</th>
<th>350mm</th>
<th>450mm</th>
<th>550mm</th>
<th>650mm</th>
<th>750mm</th>
<th>850mm</th>
<th>950mm</th>
<th>1050mm</th>
<th>1150mm</th>
<th>1250mm</th>
<th>1350mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
<td>6.8</td>
<td>7.6</td>
<td>8.4</td>
<td>9.2</td>
<td>10.0</td>
<td>10.7</td>
<td>11.5</td>
<td>12.3</td>
<td>13.1</td>
<td>13.9</td>
<td>14.7</td>
<td>15.4</td>
<td>16.2</td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td>4.2</td>
<td>4.7</td>
<td>5.3</td>
<td>5.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Axis</th>
<th>Stroke</th>
<th>1450mm</th>
<th>1550mm</th>
<th>1650mm</th>
<th>1750mm</th>
<th>1850mm</th>
<th>1950mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
<td>17.0</td>
<td>17.8</td>
<td>18.5</td>
<td>19.3</td>
<td>20.1</td>
<td>20.9</td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td>10.2</td>
<td>11.5</td>
<td>12.9</td>
<td>14.2</td>
<td>15.6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(kg)</th>
<th>ZP</th>
<th>ZAF</th>
<th>Other accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z axis</td>
<td>3</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>2-axis model</td>
<td>3-axis model</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 9-7-2 SXYt

<table>
<thead>
<tr>
<th>Axis</th>
<th>Stroke</th>
<th>150mm</th>
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Appendix
# Request for service

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**Request description**

- [ ] Complaint
- [ ] Paid repair
- [ ] Periodical inspection
- [ ] Other
- [ ] Call.
- [ ] Visit.
- [ ] Problem part is sent for repair.
- [ ] Other

**Product**

- Date of delivery:
- Mechanism type:
- Mechanism manufacturing number:
- Controller model:
- Controller manufacturing number:

**Problem description**

Positioning error, abnormal noise, error messages, frequency of occurrence, etc.

**Remarks**
# Request for owner's manual correction

## To Your Distributor

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<tr>
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<th>XY series</th>
<th>QRC series</th>
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