YAMAHA MOTOR CO., LTD.

YAMAHA SINGLE-AXIS ROBOT

FLIP-X series

User's Manual

ENGLISH E

YAMAHA MOTOR CO., LTD.
IM Operations
882 Soude, Naka-ku, Hamamatsu, Shizuoka 435-0054.Japan
URL http://www.yamaha-motor.jp/robot/index.html

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Before using the single-axis robot FLIP-X series (Be sure to read the following notes.)

Thanks for your purchasing YAMAHA single-axis robot FLIP-X series.
Before using this robot, read the following notes and set the origin position.

The "X" series single-axis and XY robots use absolute position detectors that do not require return-to-origin after turning on the controller power. However, when the controller power is turned on in the following cases, return-to-origin must be performed just the very first time.

(1) When robot cable was first connected after delivery from YAMAHA.
(2) When robot cable was disconnected from the controller and then reconnected.
(3) When no absolute battery is connected.
(4) When a motor or cable was replaced.

At this point, any of the following errors is issued immediately after controller power is turned on, but **this is not a malfunction**. The controller will operate normally by restarting.

When using an SR1 controller:

15 : FEEDBACK ERROR 2
23 : ABS.BAT.L-VOLTAGE
24 : ABS.DATA.ERROR
...etc.

When using an RCX240, RCX222 controller:

17.81 : D?.ABS.battery wire breakage
17.92 : D?.Resolver disconnected during power off
17.93 : D?.Position backup counter overflow
...etc.

When using an TS-X controller:

82 ENCODER ERROR
83 ABS. ENCODER ERR.
8A ABS. BATTERY ERR.
8B ABS. COUNT ERROR
8D ABS. OVERFLOW ERR.
...etc.

Setting the origin position

Set the origin position while referring to the following section in the robot controller user's manual.

When using an SR1 controller:
See "9.1.1 Return-to-origin by the search method" in Chapter 9 of the "HPB Operation Guide" section.

When using an RCX240 controller:
See "11.9 Absolute reset" in Chapter 4.

When using an RCX222 controller:
See "11.8 Absolute reset" in Chapter 4.

When using an TS-X controller:
See "6.2 Origin search (return-to-origin)" in "6. Operating the robot" of the "HT1 Operation Guide" section.

⚠CAUTION

Changing the origin position to the opposite side of the initial position may cause a position shift or robot breakdowns, so use caution.
Avoid changing the origin detection method since it is dangerous in some cases.
If the origin position must be changed, please consult our sales office or dealer.

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Introduction

The YAMAHA FLIP-X series is a family of single-axis industrial robots that use the absolute positioning method as a standard feature to improve ease of use, resistance to environmental conditions and maintenance work. A wide varaiety of product lineup allows you to select the desired robot model that best matches your application.

This user's manual describes the safety measures, handling, adjustment and maintenance of FLIP-X 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 user's manual should be used with the robot and considered an integral part of it. When the robot is moved, transferred or sold, send this manual to the new user along with the robot. Be sure to explain to the new user the need to read through this manual.
- Specifications of robot models other than standard models may be omitted in this manual if they are common to those of standard models. In this case, refer to the specifications of standard models.
- For details on specific operation of the robot, refer to the separate user's manual for the robot controller being used.

NOTES

- The contents of this manual are subject to change without prior notice.
- While every effort has been made to ensure the contents of this manual are correct, please contact us if you find any part of this manual to be unclear, confusing or inaccurate.

YAMAHA MOTOR CO., LTD.
IM Operations

MEMO

Chapter 1

About Safety

MEMO

1-1 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, bystanders or persons inspecting or repairing the robot.

⚠ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the robot operator, bystanders or persons inspecting or repairing the robot.

⚠ CAUTION

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

NOTE

Explains the key point in the operation in a simple and clear manner.

Refer to the user's manual by any of the following methods to operate or adjust the robot safely and correctly.

1. Operate or adjust the robot while referring to the printed version of the user's manual (available for an additional fee).
2. Operate or adjust the robot while viewing the CD-ROM version of the user's manual on your computer screen.
3. Operate or adjust the robot while referring to a printout of the necessary pages from the CD-ROM version of the user's manual.

It is not possible to list all safety items in detail 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.
For specific safety information and standards, refer to the applicable local regulations and comply with the instructions. This manual and warning labels supplied with or attached to the robot are written in English. Unless the robot operators or service personnel understand English, do not permit them to handle the robot.

* Cautions regarding the official language of EU countries
  For equipment that will be installed in EU countries, the language used for the user's manuals, CE declarations, and operation screen characters is English only.
  Warning labels only have pictograms or else include warning messages in English.
  In the latter case, Japanese messages might be added.

1-2 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.

- 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.
- The warning labels 1 (Fig. 1-1) are supplied with the robot and should be affixed to conspicuous spots 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.

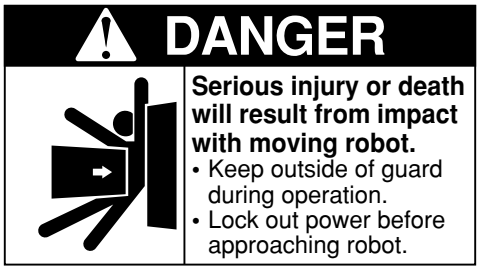


Fig. 1-1 Warning label 1

(2) Use caution to prevent hands or fingers from being pinched or crushed.
Warning labels 2 (Fig. 1-2) are affixed to the robot.

⚠ WARNING

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

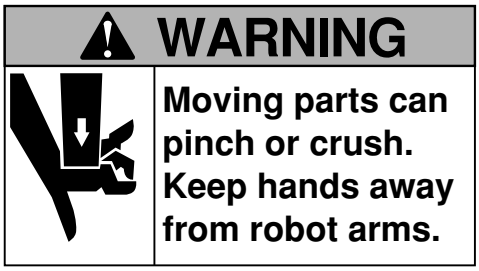


Fig. 1-2 Warning label 2

(3) Follow the instructions on listed on warning labels and in this manual.

- Be sure to read the warning labels and this manual carefully and make sure you thoroughly understand their contents before attempting installation and operation of the robot.
- Before starting robot operation, be sure to reread the procedures and cautions relating to your work as well as descriptions in 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.
- The warning labels 3 (Fig. 1-3) are supplied with the robot and should be affixed to the robot or conspicuous spots near the robot.

⚠WARNING

Improper installation or operation can result in serious injury or death.
Read the user's manual and all warning labels before operation.

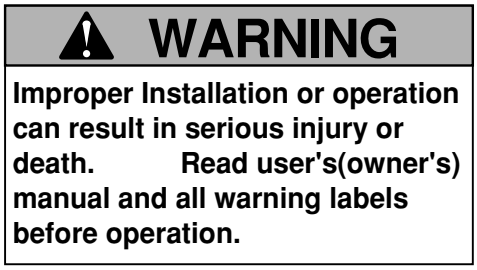


Fig. 1-3 Warning label 3

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

⚠WARNING

If warning labels are removed or difficult to see, then essential precautions might not be taken, resulting in accidents.

- Do not remove, alter or stain the warning labels on the robot.
- Do not allow the warning labels to be hidden by devices installed onto the robot by the user.
- Provide proper lighting so that the symbols and instructions on the warning labels can be clearly seen even from outside the safeguard enclosure.

(5) 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 might otherwise result.

(6) 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. Malfunctions might otherwise occur.

(7) Use caution when releasing the brake of a vertical use robot.

⚠ WARNING

The vertical axis will slide down when the brake is released, causing a hazardous situation.

- Press the emergency stop button and prop up the vertical axis with a support stand before releasing the brake.
- Be careful not to let your body get caught between the vertical axis and installation base when releasing the brake to perform direct teach.

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

⚠ WARNING

- End effectors must be designed and manufactured so that they create no hazards (for example, a workpiece that comes loose) 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.

(9) Use caution when removing the motor. (Vertical use robots)

⚠ WARNING

The vertical axis will slide down when the motor is released, causing a hazardous situation.

- Turn off the robot controller and prop up the vertical axis with a support stand before removing the motor.
- Be careful not to let your body get caught between the vertical axis parts and installation base.

(10) Be careful not to touch the motor or speed reduction gear casing when hot.

⚠ WARNING

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

(11) Take the following safety precautions 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.
- Refer to the “YAMAHA Robot Controller User’s Manual” for precautions on handling the controller.

(12) Use caution not to touch the controller 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.

(13) Consult us for corrective action when the robot is damaged or malfunctions occur.

⚠WARNING

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

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

(14) Protective bonding

⚠WARNING

Be sure to ground the robot and controller to prevent electrical shock.

(15) 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 these are not correct, drive unit service life may end prematurely, and damage to robot parts or residual vibration during positioning may result.

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

⚠CAUTION

Avoid using the belt-driven type robots for tasks which utilize motor thrust (press-fitting, burr removal, etc.). These tasks may cause malfunctions in the robot.

(17) Follow the specified procedures when installing, adjusting or inspecting the robot.

⚠WARNING

Always follow the specified procedures when installing, adjusting or inspecting the robot. Never attempt any procedure not described in this manual.

(18) Do not attempt any repair, parts replacement and modification.

⚠ WARNING

Do not attempt any repair, parts replacement and modification unless described in this manual.

These works require technical knowledge and skill, and may also involve work hazards.

(19) Location for installing the controller and the programming box or Handy Terminal

The robot controller, programming box, and Handy Terminal should be installed at a location that is outside the robot movement range yet where it is easy to operate and view the robot performing tasks.

(20) Protect electrical wiring and hydraulic/pneumatic hoses as needed.

Install a cover or similar item to protect the electrical wring and hydraulic/pneumatic hoses from possible damage.

(21) Install an operation status light.

Install an operation status light (signal light tower, etc.) at an easy-to-see position so the operator will know whether the robot is merely stopped or is in emergency-error stop.

(22) Clean work tools, etc.

Work tools such as welding guns and paint nozzles which are mounted in the robot arm will preferably be cleaned automatically.

(23) Provide adequate lighting.

Make sure to provide enough lighting to ensure safety during work.

(24) Prevent the gripped object from flying outwards.

If the object or workpiece gripped by the robot might fly outward or drop and create a hazard to the operator, then protective equipment should be installed by taking the size, weight, temperature and chemical properties of the object into account.

(25) Draw up "work instructions" and makes sure the operator learns them well.

Decide on "work instructions" for the following items in cases where personnel must work within the robot movement range to perform teaching, maintenance or inspection. Make sure the workers know these "work instructions" well.

(1) Robot operating procedures needed for tasks such as startup procedures and handling switches
(2) Robot speeds used during tasks such as teaching
(3) Methods for workers to signal each other when two or more workers perform tasks
(4) Steps that the worker should take when a problem or emergency occurs
(5) Steps to take after the robot has come to a stop when the emergency stop device was triggered, including checks for cancelling the problem or error state and safety checks in order to restart the robot.
(6) In cases other than above, the following actions should be taken as needed to prevent hazardous situations due to sudden or unexpected robot operation or faulty robot operation, as listed below.
1. Show a display on the operator panel
2. Ensure the safety of workers performing tasks within the robot movement range
3. Clearly specify position and posture during work
Position and posture where worker can constantly check robot movements and immediately move to avoid trouble if an error/problem occurs
4. Install noise prevention measures
5. Use methods for signaling operators of related equipment
6. Use methods to decide that an error has occurred and identify the type of error

Implement the "work instructions" according to the type of robot, installation location, and type of work task.
When drawing up the "work instructions", make an effort to include opinions from the workers involved, equipment manufacture's technicians, and workplace safety consultants, etc.

(26) Display a sign on operation panel during work

Display an easy to understand sign or message on the programming box, Handy Terminal, and operation panel during the job task, to prevent anyone other than the operators for that job task from mistakenly operating a start or selector switch. If needed, take other measures such as locking the cover on the operation panel.

(27) Make daily and periodic inspections.

(1) Always make sure that daily and periodic inspections are performed, and make a pre-work check to ensure there are no problems with the robot or related equipment. If a problem or abnormality is found, then promptly repair it or take other measures as necessary.
(2) When you make periodic inspections or repairs, make a record and store it for at least 3 years.

1-3 Industrial Robot Operating and Maintenance Personnel

Operators or persons who handle the robot such as for teaching, programming, movement check, inspection, adjustment, and repair must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must read the user's manual carefully to understand its contents before attempting the robot operation.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and safety standards for industrial robots.

1-4 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 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.
Note: The working envelope is the area limited by soft limits.

⚠ WARNING

Soft limits must be set within the movement range (mechanical stopper). If the soft limit is set outside the movement range, the robot axis may collide with the mechanical stopper at high speed, causing the object gripped by the end effector to fly or drop and the robot to malfunction.

(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 rotating axis.
Note: The movement range is the area limited by mechanical stoppers.

⚠ WARNING

Axis movement will not stop immediately after the servo power supply is shut off by emergency stop or other safety functions.

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

⚠ WARNING

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

1-5 Safety Measures for the System

Since the robot is commonly used in conjunction with an automated system, dangerous situations are 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.

1-6 Trial Operation

After making installations, adjustments, inspections, or maintenance or repairs to the robot, make a trial run using the following procedures.

(1) If a safeguard enclosure 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 sturdy, stable posts which will not fall over easily.
2. The rope or chain should be easily visible by everyone around the robot.
3. Place a sign to keep 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 enclosure.
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 enclosure and interlock working as intended?
8. Does the robot move correctly during automatic operation?

1-7 Work Within the Safeguard Enclosure

(1) Work within the safeguard enclosure

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 touching the controller switch or operation panel, except for the following cases.

1) Soft limit settings
2) Teaching

For item 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 a visual check.
   2. Check that the programming box/Handy Terminal 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.

1-8 Automatic Operation

Automatic operation described here includes all operations in AUTO mode.

(1) Check the following before starting automatic operation.

1. No one is within the safeguard enclosure.
2. The programming box/Handy Terminal are in their specified locations.
3. The alarm or error lamps on the robot and peripheral equipment do not flash.
4. The safeguard enclosure 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 enclosure 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 touching the start switch and restarting the robot.

1-9 Warranty

For information on the product warranty, please contact your local agent where you purchased your product.

MEMO

Chapter 2

Installation and Connections

MEMO

2-1 Checking the product

After unpacking, make sure that all components and accessories are included (as specified in your order). Also check the product for any damage on the exterior which might have occurred during transportation.
If there are any missing parts or damage due to transportation, please notify your YAMAHA sales office or dealer immediately.

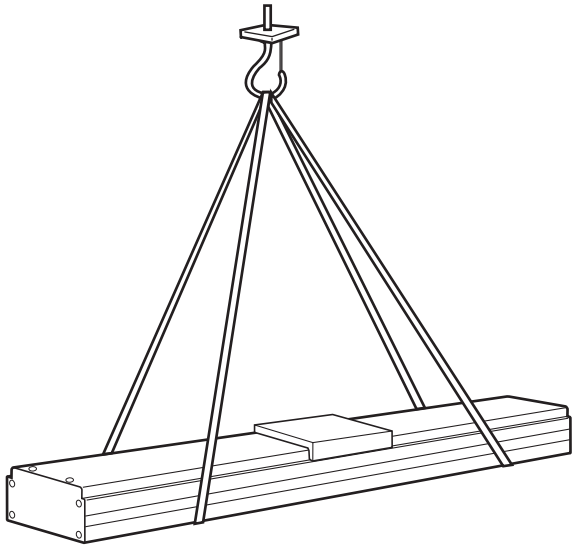
Example
Controller: SR1
Robot: B10, B14 or B14H

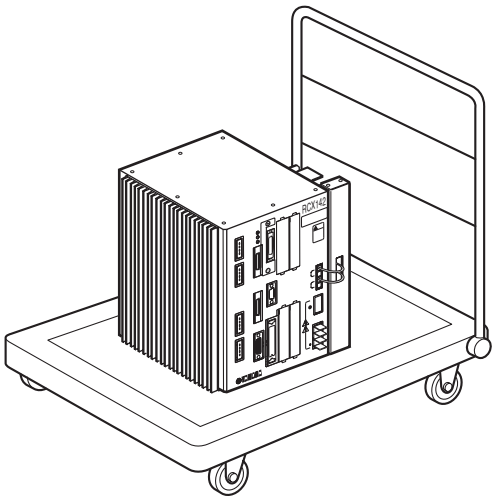
Product name	Qty	
Single-axis robot	1	
SR1	1	
Robot cable	1	
I/O connector	1	
Battery	1	
Battery attachment	1set	
Warning label 1 (Danger label)	1	Affix to a conspicuous spot in the system.
Warning label 3 (Warning label)	1	Affix to a conspicuous spot in the system.
Belt tension adjusting bolt	1	See page 3-5.
Cover seal (long stroke model only)	3	See page 4-20.
HPB	1	Option
POPCOM	1	Option
SD memory card	1	Option

2-2 Moving the robot

Using a hoist, carrying cart (dolly) or forklift is recommended for moving a single-axis robot or controller. Use sufficient caution when moving robot models with a long stroke or designed for large payload, since they are heavy.

Moving the robot





⚠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 balance might shift while being carried, and the robot topple over causing accidents.
- Always wear a safety helmet, shoes and gloves during work.
- When moving the robot by equipment such as a forklift 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.

⚠CAUTION

When moving or carrying the robot by hand, avoid placing the hand and fingers on the shutter of the robot. Pressing down on the shutter, even by a little force, may cause the shutter to warp or deform, resulting in a premature life end of the related parts.

2-3 Robot Installation Conditions

2-3-1 Installation environments

Be sure to install the robot in the following environments.

Items	Specifications
Allowable ambient temperature	0 to 45°C
Allowable ambient humidity	35 to 85% RH (non condensation)
Altitude	0 to 1000 meters above sea level
Ambient environments	Avoid installing near water, cutting water, oil, dust, metallic chips and organic solvent.
	Avoid installation near corrosive gas and corrosive materials.
	Avoid installation in atmosphere containing inflammable gas, dust and liquid.
	Avoid installation near objects causing electromagnetic interference, electrostatic discharge and radio frequency interference.
Vibration	Do not subject to impacts or vibrations.
Working space	Allow sufficient space margin to perform jobs (teaching, inspection, repair, etc.)

For detailed information on how to install the robot controller, refer to the separate "YAMAHA Robot Controller User's Manual".

⚠ WARNING

Avoid installing the robot in locations where the ambient conditions may exceed the allowable temperature or humidity, or in environments where excessive moisture, corrosive gases, metallic powder or dust are generated. Malfunctions, failures 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. Malfunctions 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.

2-3-2 Installation base

To mount the robot, use an installation base that satisfies the following conditions.

1) The installation base is subjected to a great deal of stress while the robot is in operation. Prepare a sufficiently rigid and stable installation base, taking into account the robot weight including the end effector (gripper) and workpiece.

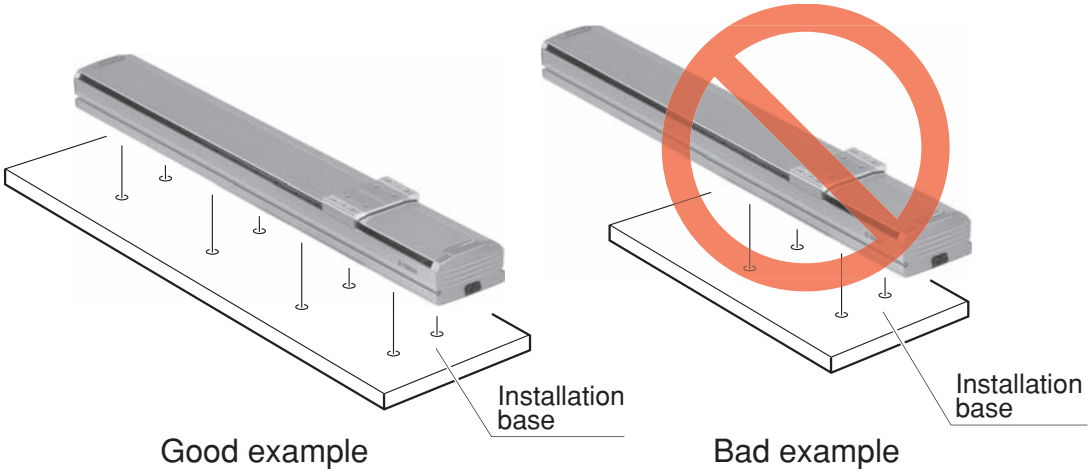
⚠CAUTION

If the installation base is not sufficiently rigid and stable, vibration (resonance) may occur during operation, causing adverse effects on the robot work.

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

⚠CAUTION

The robot positioning accuracy might decrease if the installation surface precision is insufficient.



3) Use an installation base of sufficient size to match the robot body so that the robot can be installed with the specified number of bolts. Avoid installing the robot with less than the specified number of bolts or installing the robot closer to one end as shown at the lower right.

⚠CAUTION

Using less than the specified number of bolts to install the robot may cause vibration and poor positioning accuracy.

NOTE

Refer to the external view and dimensions for each robot model shown in “4.1 Robot specifications” for machining dimensions and positions of screw holes.

• Ensure that the controller is off before connecting the robot cable to the controller.

2-4 Installing the robot

2-4-1 T6

To install the T6 robot, tap holes into the installation base and secure the robot to the base with M4 bolts from inside of the robot frame.

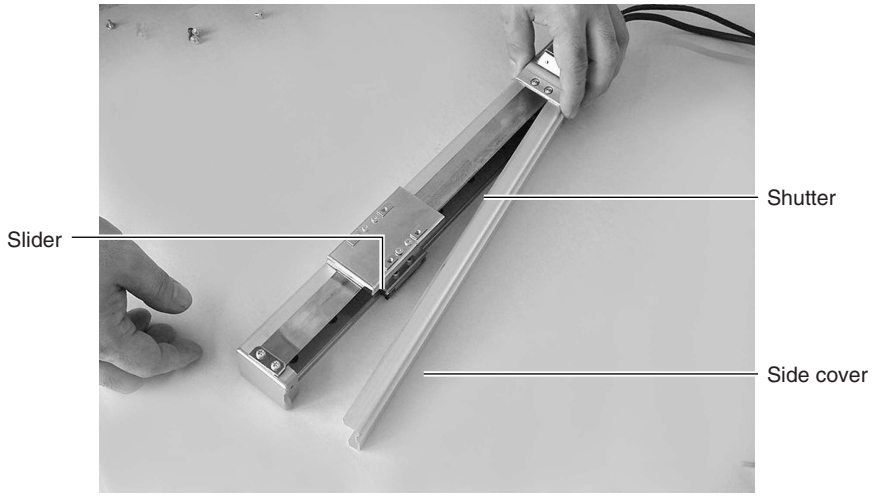
⚠WARNING

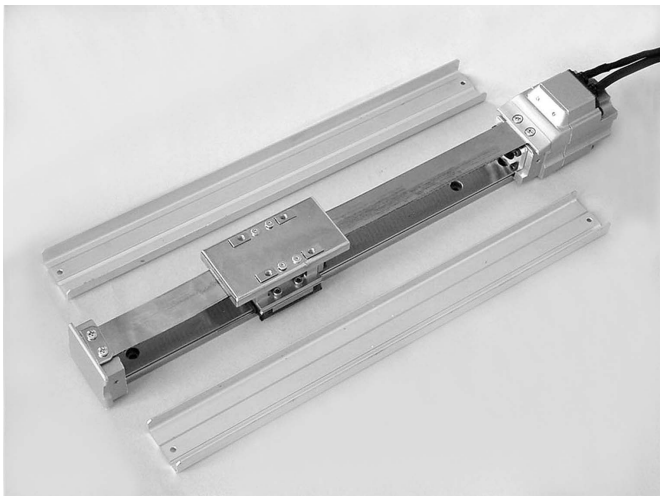
Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

Installation method

1) Tap M4 holes into the installation base where the robot is to be secured.
   For hole pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)

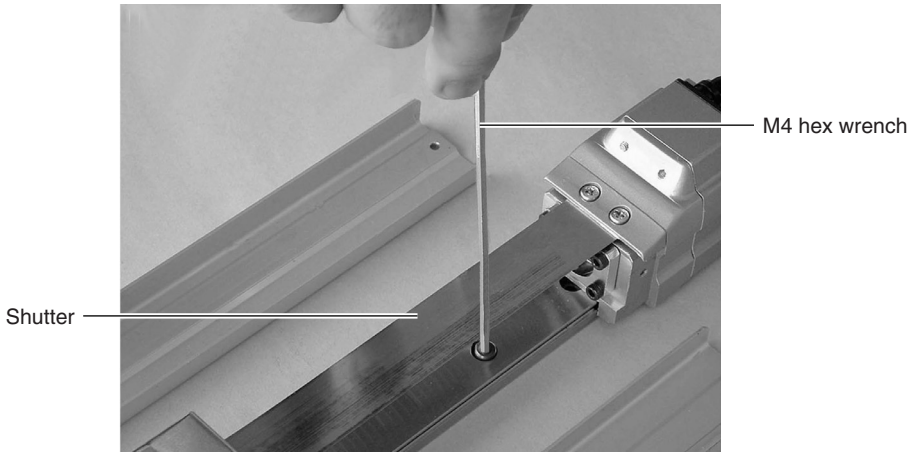
2) Remove the screws securing the side covers of the robot and remove the side covers (on both sides). If necessary, move the slider to a location where it does not block the installation holes on the bottom of the robot frame.





3) Secure the robot to the base with the specified bolts and torque.
The bolts and tightening torque are shown below.

Bolt	Hex socket-head M4 bolt, strength: 8.8T, length: longer than 20mm
Tightening torque	30kg-cm to 45kg-cm



⚠CAUTION

Be careful not to damage the shutter when tightening the bolts.

⚠WARNING

Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.

4) Reattach the side covers after installing the robot.

2-4-2 T7

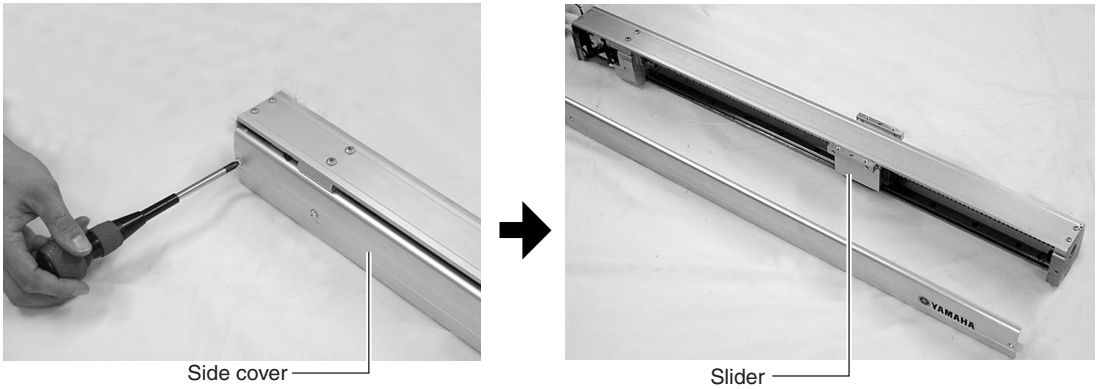
To install the T7 robot, tap holes into the installation base and secure the robot to the base with M4 bolts from inside of the robot frame.

⚠WARNING

Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

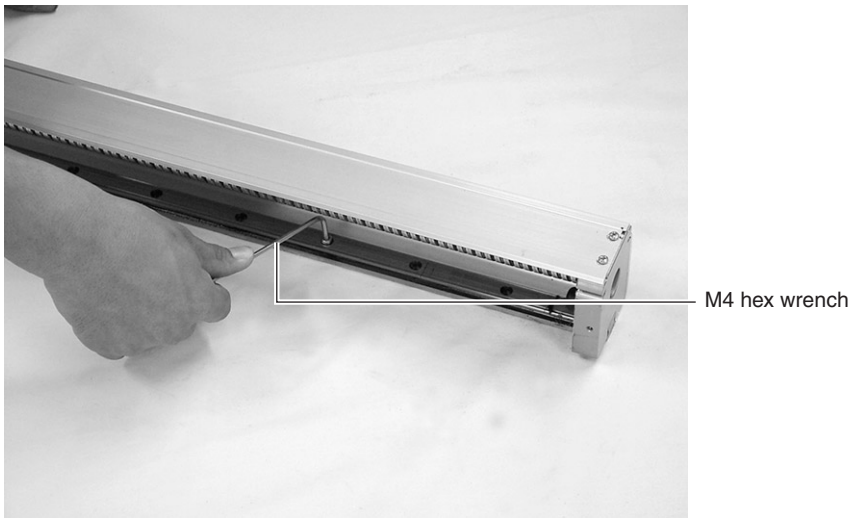
●Installation method

1) Tap M4 holes into the installation base where the robot is to be secured.
   For hole pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)
2) Remove the screws securing the side cover of the robot and remove the side cover (on one side).
   If necessary, move the slider to a location where it does not block the installation holes on the bottom of the robot frame.



3) Secure the robot to the base with the specified bolts and torque.
   The bolts and tightening torque are shown below.

Bolt	Hex socket-head M4 bolt, strength: 8.8T, length: longer than 20mm
Tightening torque	30kg-cm to 45kg-cm



⚠WARNING

Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.

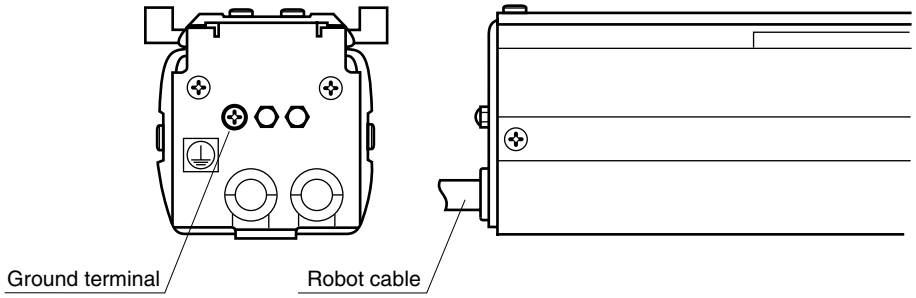
4) Reattach the side cover after installing the robot.

●Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

Always use the ground terminal (M4 screw) on the robot unit to make ground connection. The ground terminal location is shown below.



⚠CAUTION

A secure ground connection (less than 100-ohm resistance to ground) is recommended.
Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠WARNING

Always turn off the power to the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.

(Symbol 417-IEC5019)

2-4-3 T9/T9H

To install the T9/T9H robot, use either of the following two methods.

Method A : Drill holes through the installation base and secure the robot to the base with M8 bolts from the bottom.
(M8 tapped holes are already machined on the bottom of the robot frame.)

Method B : Tap holes into the installation base and secure the robot to the base with M8 bolts from inside of the robot frame.

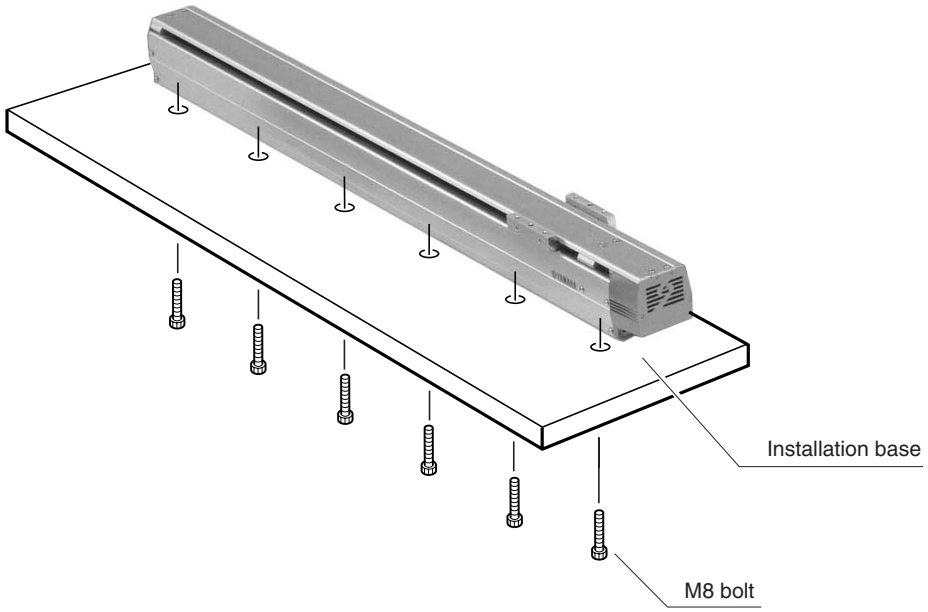
⚠WARNING

Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

●Installation method A

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the bottom. The bolts and tightening torque are shown below.

Bolt	Hex socket-head M8 bolt, strength: 8.8T, length: installation base thickness + 12mm (maximum)
Tightening torque	230kg·cm to 370kg·cm



⚠WARNING

- Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.
- Do not use a bolt longer than the specified length. A bolt that is too long will penetrate inside the robot frame and cause operating defects or malfunctions.

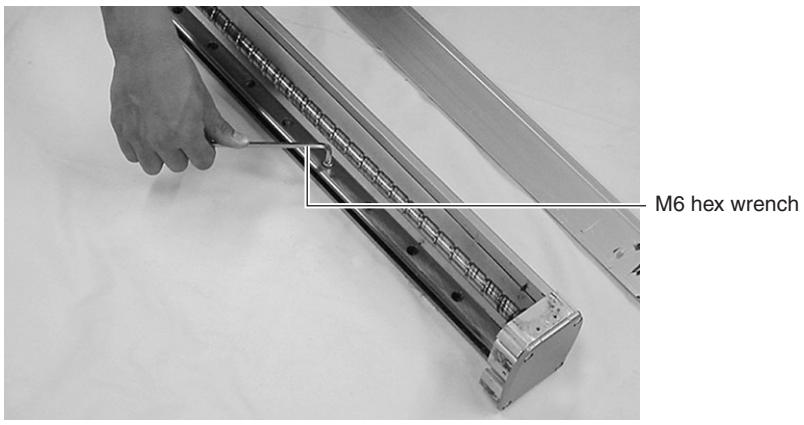
●Installation method B

1) Tap M6 holes into the installation base where the robot is to be secured.
For hole pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)

2) Remove the screws securing the side cover of the robot and remove the side cover (on one side).
If necessary, move the slider to a location where it does not block the installation holes on the bottom of the robot frame, or else remove the upper cover.

3) Secure the robot to the base with the specified bolts and torque.
The bolts and tightening torque are shown below.

Bolt	Hex socket-head M6 bolt, strength: 8.8T, length: longer than 25mm
Tightening torque	100kg·cm to 130kg·cm



⚠WARNING

Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.

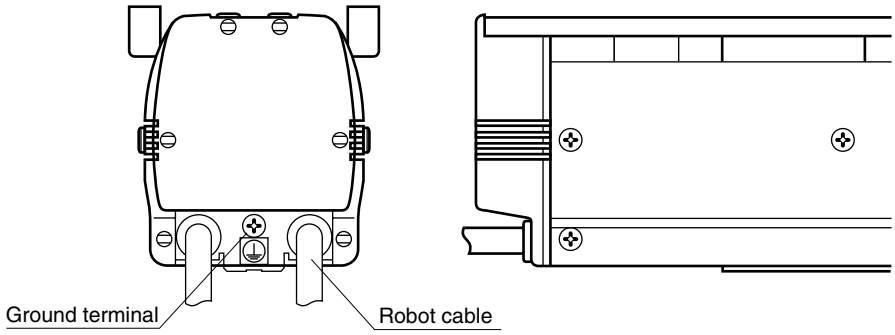
4) Reattach the side cover (and upper cover if removed) after installing the robot.

●Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

Always use the ground terminal (M4 screw) on the robot unit to make ground connection. The ground terminal location is shown below.



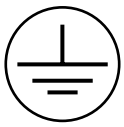
⚠CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠WARNING

Always turn off the power to the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.



(Symbol 417-IEC5019)

2-4-4 F10

To install the F10 robot, use either of the following two methods.

Method A : Drill holes through the installation base and secure the robot to the base with M5 bolts from the bottom.
(M5 tapped holes are already machined on the bottom of the robot frame.)

Method B : Tap holes into the installation base and secure the robot to the base with M5 bolts from inside of the robot frame.

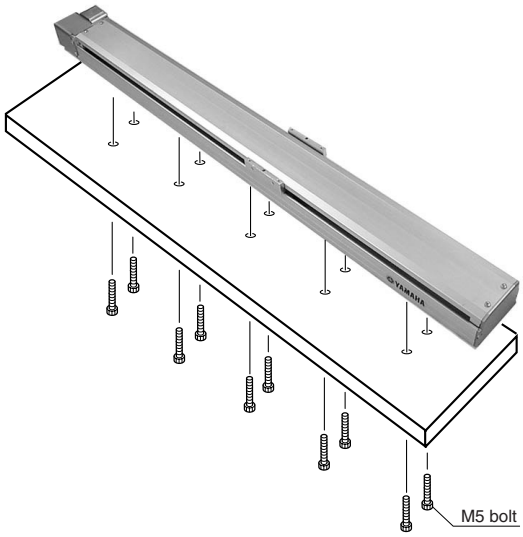
⚠WARNING

Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

●Installation method A

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the bottom. The bolts and tightening torque are shown below.

Bolt	Hex socket-head M5 bolt, strength: 8.8T, length: installation base thickness + 9mm (maximum)
Tightening torque	60kg·cm to 90kg·cm



⚠WARNING

- Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.
- Do not use a bolt longer than the specified length. A bolt that is too long will penetrate inside the robot frame and cause operating defects or malfunctions.

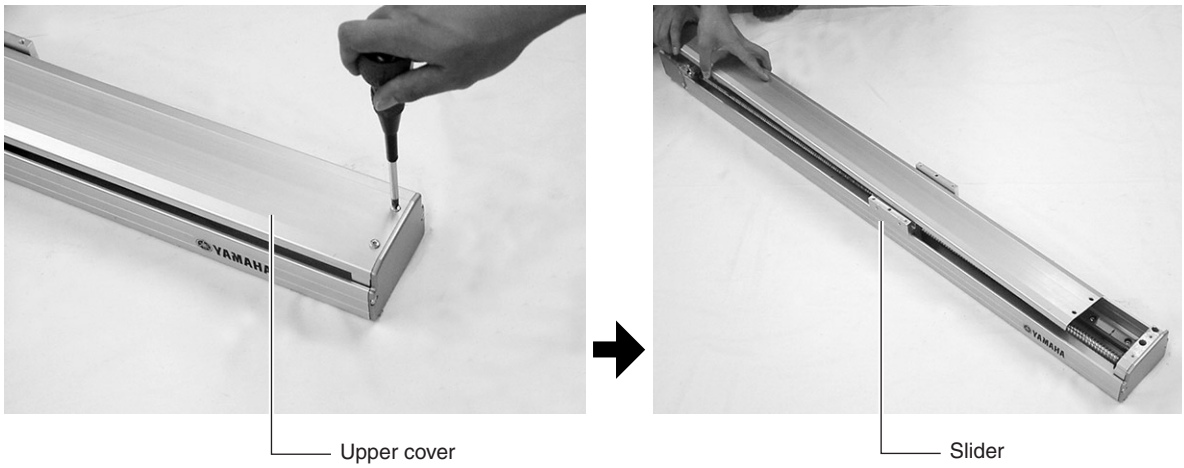
⚠CAUTION

The robot frame is made of aluminum so be careful not to damage the screw threads when tightening the bolt.

●Installation method B

1) Tap M5 holes into the installation base where the robot is to be secured.
For hole pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)

2) Remove the screws securing the upper cover of the robot and remove the upper cover.
If necessary, move the slider to a location where it does not block the installation holes on the bottom of the robot frame.



3) Secure the robot to the base with the specified bolts and torque.
The bolts and tightening torque are shown below.

Bolt	Hex socket-head M5 bolt, strength: 8.8T, length: longer than 20mm
Tightening torque	60kg·cm to 90kg·cm

⚠WARNING

Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.

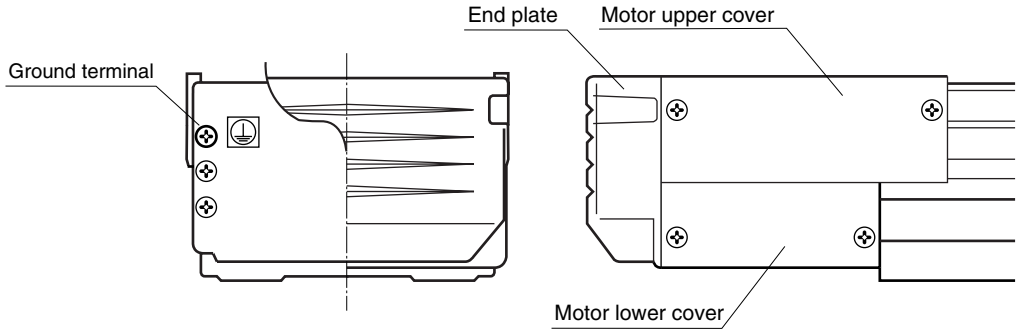
4) Reattach the upper cover after installing the robot.

●Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

Always use the ground terminal (M4 screw) inside the robot unit to make ground connection. The ground terminal location is shown below. (When you remove the upper and lower covers for the motor and also the end plate, you will see the ground terminal as shown.)



⚠CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠WARNING

Always turn off the power to the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.

(Symbol 417-IEC5019)

2-4-5 F14/F14H

To install the F14/F14H robot, use either of the following two methods.

Method A: Drill holes through the installation base and secure the robot to the base with M6 bolts from the bottom.
(M6 tapped holes are already machined on the bottom of the robot frame.)

Method B: Tap holes into the installation base and secure the robot to the base with M6 bolts from inside of the robot frame.

⚠ WARNING

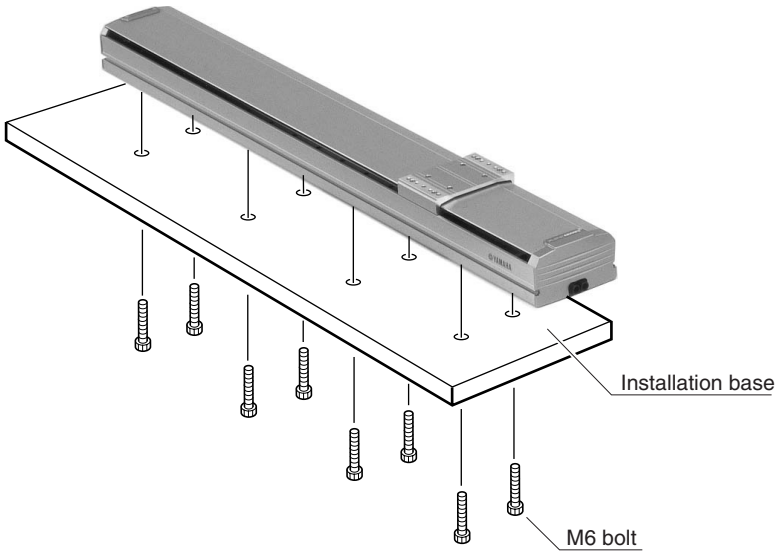
Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

●Installation method A

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the bottom. The bolts and tightening torque are shown below.

Bolt	Hex socket-head M6 bolt, strength: 8.8T, length: installation base thickness + 10mm (maximum) is recommended*
Tightening torque	100kg·cm to 130kg·cm

* A bolt size of installation base thickness +20mm (maximum) can be used since the robot frame interior is hollow. Even in this case, the screw thread length that actually engages is 10mm.



⚠WARNING

- Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.
- Do not use a bolt longer than the specified length. A bolt that is too long will penetrate inside the robot frame and cause operating defects or malfunctions.

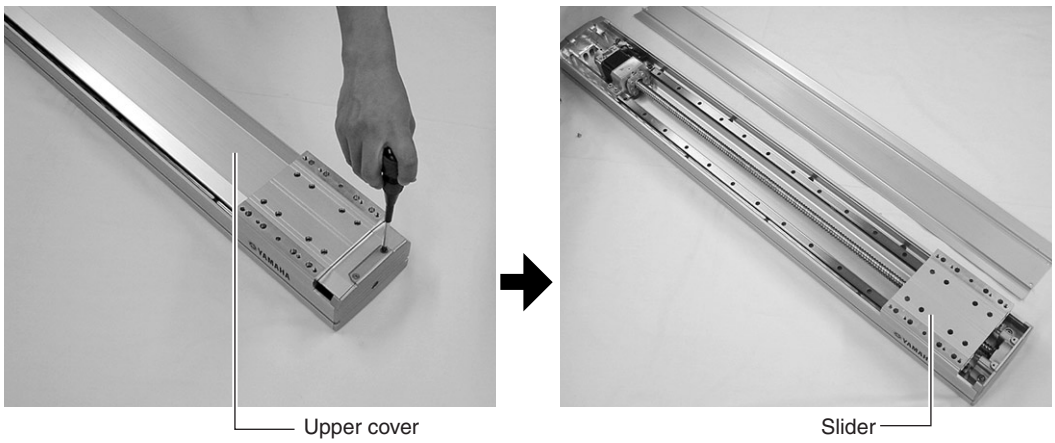
⚠CAUTION

The robot frame is made of aluminum so be careful not to damage the screw threads when tightening the bolt.

●Installation method B

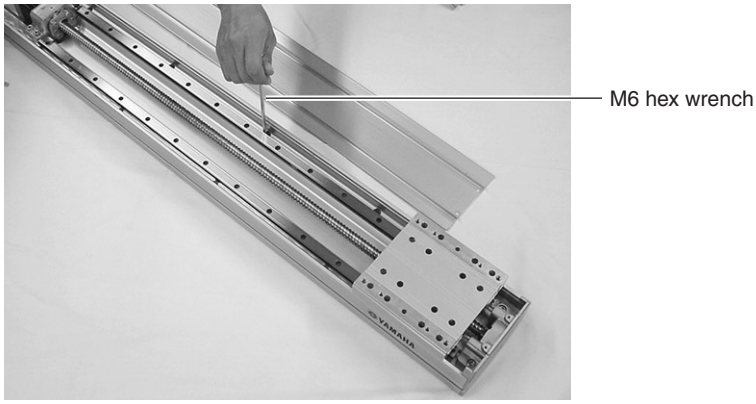
1) Tap M6 holes into the installation base where the robot is to be secured.
   For hole pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)

2) Remove the screws securing the upper cover of the robot and remove the upper cover.
   If necessary, move the slider to a location where it does not block the installation holes on the bottom of the robot frame.



3) Secure the robot to the base with the specified bolts and torque.
The bolts and tightening torque are shown below.

Bolt	Hex socket-head M6 bolt, strength: 8.8T, length: longer than 20mm
Tightening torque	100kg·cm to 130kg·cm



⚠WARNING

Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.

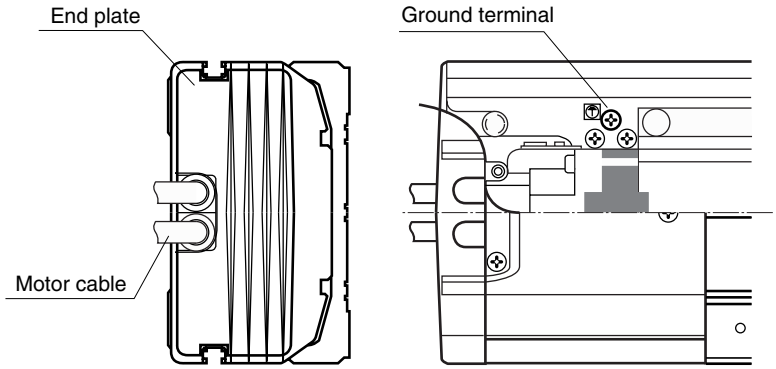
4) Reattach the upper cover after installing the robot.

●Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

Always use the ground terminal (M4 screw) inside the robot unit to make ground connection. The ground terminal location is shown below.



⚠CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠WARNING

Always turn off the power to the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.

(Symbol 417-IEC5019)

2-4-6 F17/F20

To install the F17/F20 robot, tap holes into the installation base and secure the robot to the base with M8 bolts from inside of the robot frame.

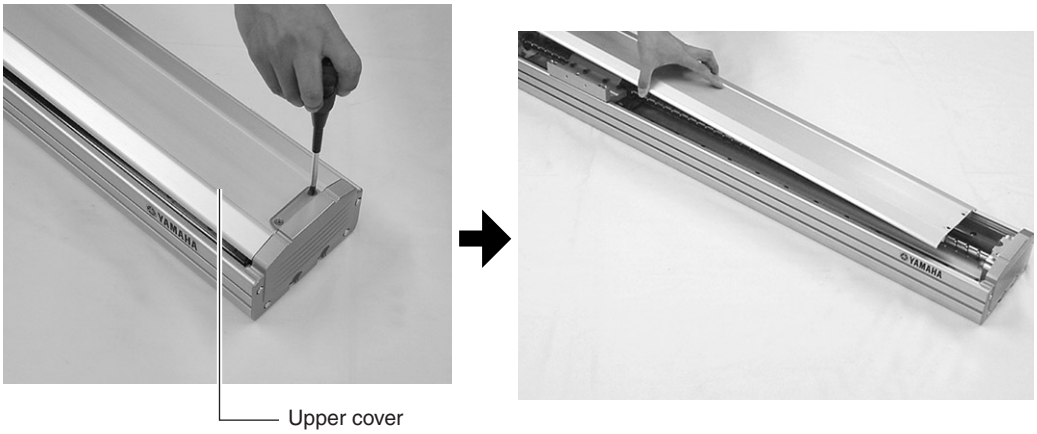
⚠WARNING

Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

●Installation method

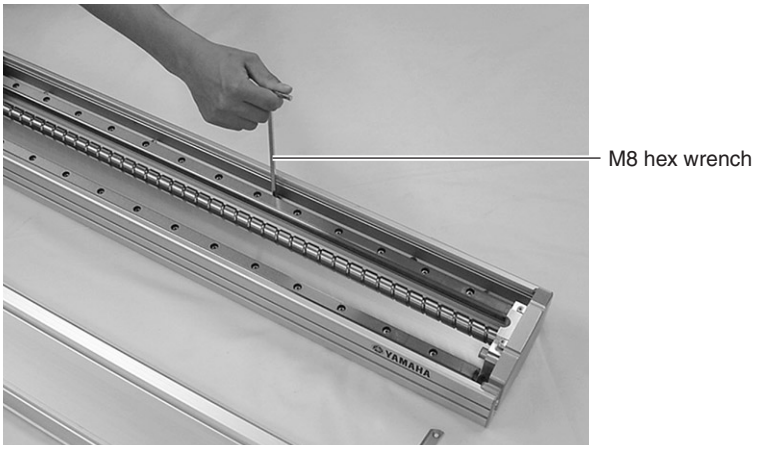
1) Tap M8 holes into the installation base where the robot is to be secured.
   For hole pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)

2) Remove the screws securing the upper cover of the robot and remove the upper cover.
   If necessary, move the slider to a location where it does not block the installation holes on the bottom of the robot frame.



3) Secure the robot to the base with the specified bolts and torque.
   The bolts and tightening torque are shown below.

Bolt	Hex socket-head M8 bolt, strength: 8.8T, length: longer than 45mm (F17), longer than 50mm (F20)
Tightening torque	230kg-cm to 370kg-cm



⚠WARNING

Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.

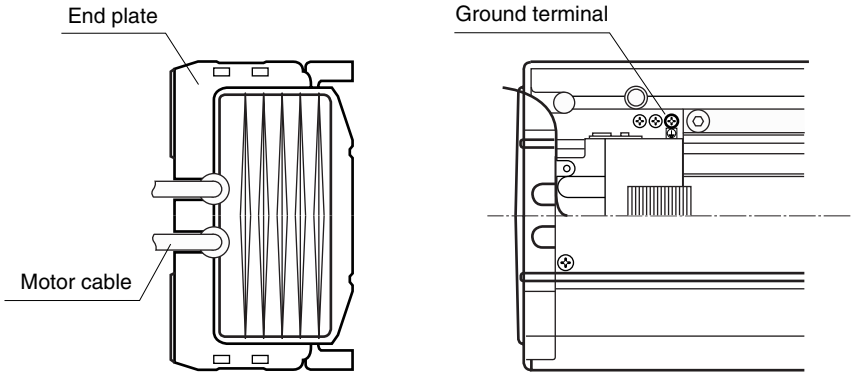
4) Reattach the upper cover after installing the robot.

●Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

Always use the ground terminal (M4 screw) inside the robot unit to make ground connection. The ground terminal location is shown below.



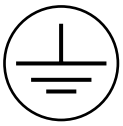
⚠CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠WARNING

Always turn off the power to the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.



(Symbol 417-IEC5019)

2-4-7 R5/R10/R20

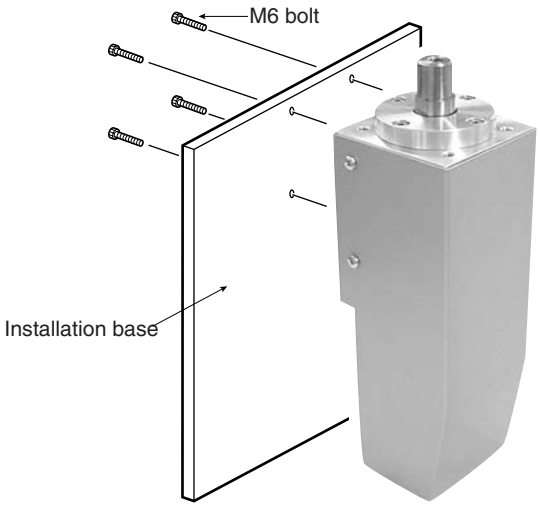
To install the R5/R10/R20 robot, tap holes into the installation base and secure the robot to the base as shown below.

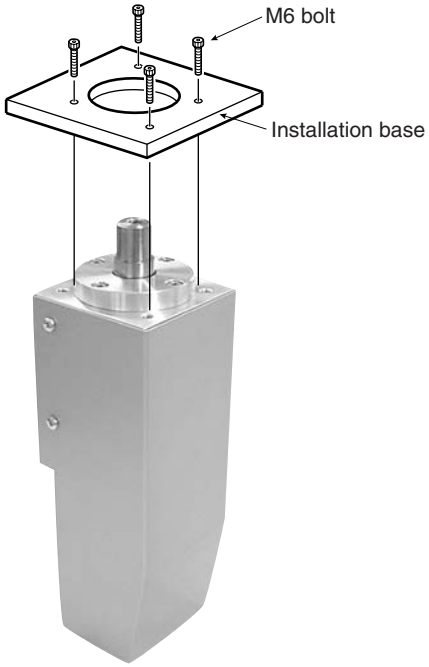
⚠WARNING

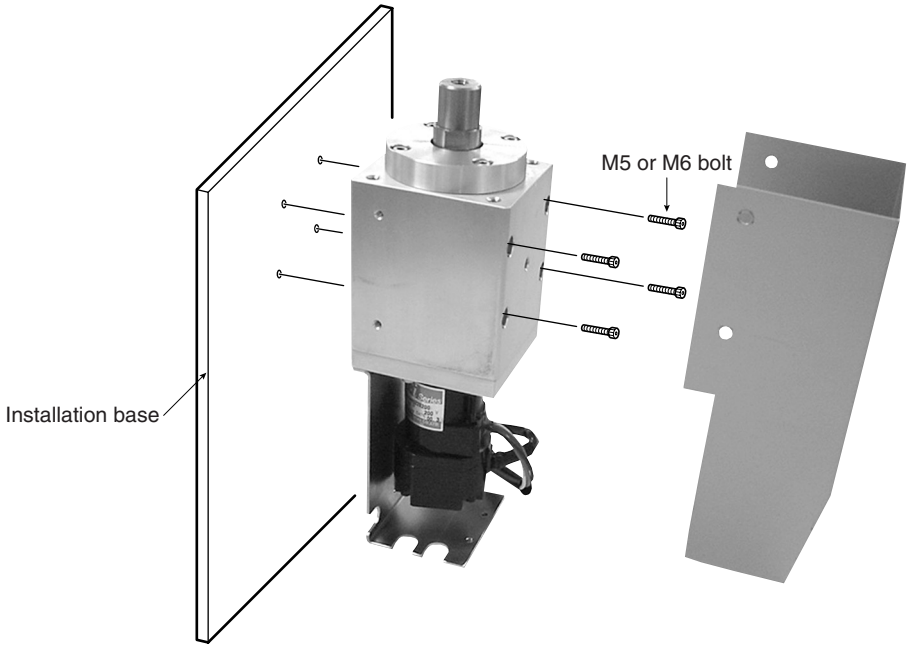
Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

●Installation method

Tap holes into the installation base where the robot is to be secured.
For hole diameter and pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)







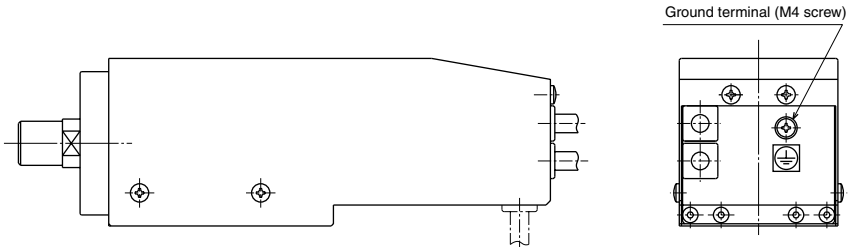
Bolt	Hex socket-head M5 or M6 bolt, strength: 8.8T, length: installation base thickness + 12mm (maximum)
Tightening torque	M5: 60kg-cm to 90kg-cm M6: 100kg-cm to 130kg-cm

●Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

Always use the ground terminal (M4 screw) inside the robot unit to make ground connection. The ground terminal location is shown below.



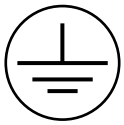
⚠WARNING

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠ WARNING

Always turn off the power to the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.



(Symbol 417-IEC5019)

●Origin position

The Flip-X series uses the absolute method so performing return-to-origin is not necessary after the power is turned on. However, data containing the origin position may be lost if the absolute battery is removed from the controller or the battery dies. When this happens, origin return (or origin reset) must be performed after the battery is reconnected. The R5, R10 and R20 robots utilize the mark method (refer to controller manual) that does not use sensors. Use a triangular seal enclosed in the package to affix it at the desired position, and perform origin return (or origin reset). When the next time origin return is required, this seal can be used as the matching mark to ensure reproducibility. We recommend affixing the seal as far away from the R5, R10 and R20 shaft center as possible to achieve high reproducibility.

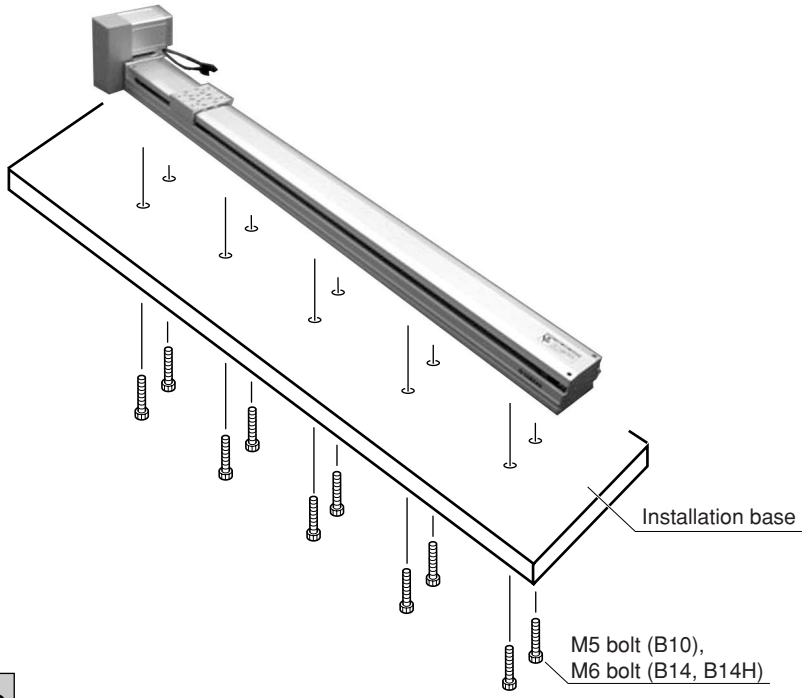
2-4-8 B10/B14/B14H

⚠WARNING

Always turn off the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the bottom. The bolts and tightening torque are shown below.

Robot model	Bolt	Tightening torque
B10	Hex socket-head M5 bolt Strength: 8.8T Length: installation base thickness + 10mm (maximum)	60kg·cm to 90kg·cm
B14, B14H	Hex socket-head M6 bolt Strength: 8.8T Length: installation base thickness + 10mm (maximum)	100kg·cm to 130kg·cm



⚠WARNING

- Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.
- Do not use a bolt longer than the specified length. A bolt that is too long will penetrate inside the robot frame and cause operating defects or malfunctions.

⚠CAUTION

The robot frame is made of aluminum so be careful not to damage the screw threads when tightening the bolt.

2-4-9 F20N

To install the F17/F20 robot, tap holes into the installation base and secure the robot to the base with M8 bolts from inside of the robot frame.

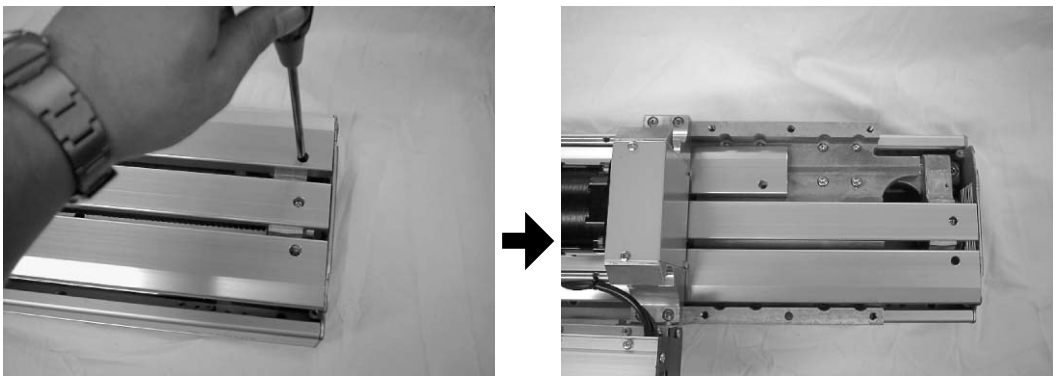
⚠WARNING

Always turn off the power to the controller before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

●Installation method

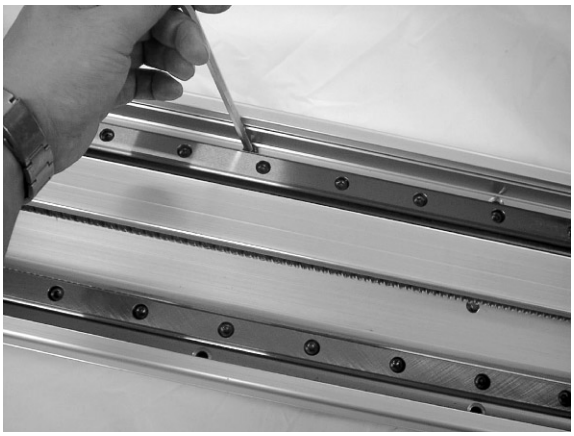
1) Tap M8 holes into the installation base where the robot is to be secured.
   For hole pitch, see the external view and dimensions in "5.1 Robot Specifications" of Chapter 5.)

2) Remove the screws securing the upper cover of the robot and remove the upper cover.
   If necessary, move the slider to a location where it does not block the installation holes on the bottom of the robot frame.



3) Secure the robot to the base with the specified bolts and torque.
   The bolts and tightening torque are shown below.

Bolt	Hex socket-head M8 bolt, strength: 8.8T, length: longer than 45mm (F17), longer than 50mm (F20)
Tightening torque	230kg-cm to 370kg-cm



⚠WARNING

Be sure to tighten the bolt to the correct torque. The wrong torque may not only cause robot position errors but also lead to serious accidents.

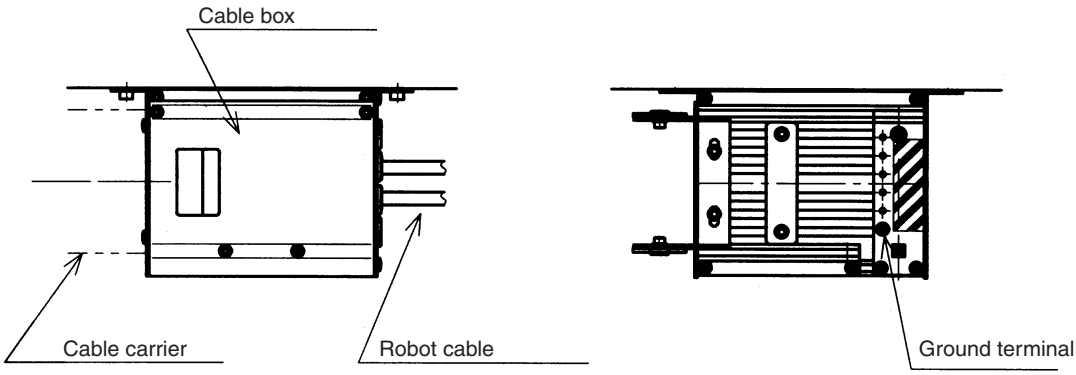
4) Reattach the upper cover after installing the robot.
Refer to Chapter 3 “3-3 Installing and removing the cover (F20N)”, and install the cover.

●Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

A grounding terminal (M4 screw) is provided inside the cable box, so always ground the unit. The position of the grounding terminal is shown below.



⚠CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠WARNING

Always turn off the power to the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.

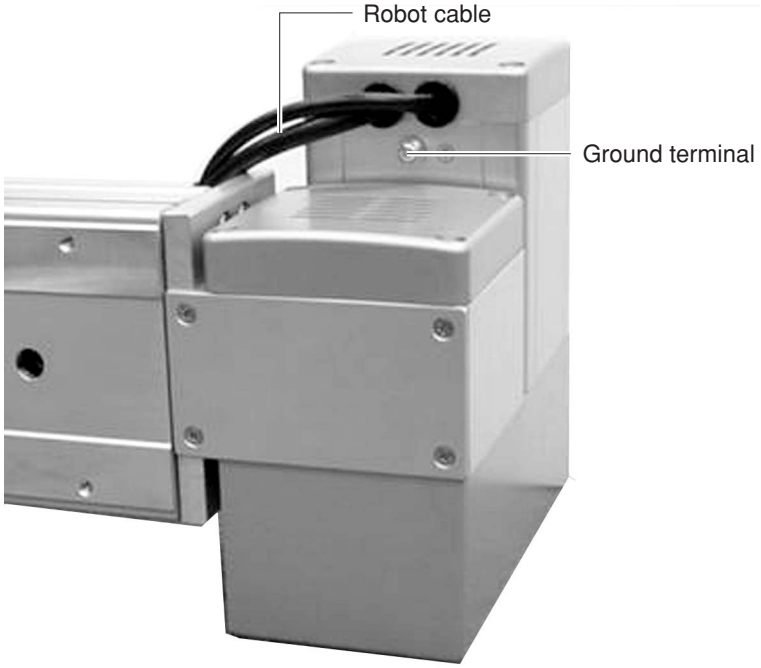
(Symbol 417-IEC5019)

2-5 Protective bonding

⚠WARNING

Always ground the robot and controller unit to prevent electrical shock.

Always use the ground terminal (M4 screw) of the robot unit to make ground connection. The ground terminal location is shown below.



⚠CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.

⚠WARNING

Always turn off the controller before making the ground connection.

Provide a terminal marked “PE” as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.

(Symbol 417-IEC5019)

2-6 Connections

2-6-1 Connecting the robot cables

Connect the robot cables to the mating connectors on the controller as shown. Refer to the SR1 robot controller user's manual for the controller connectors.

⚠ WARNING

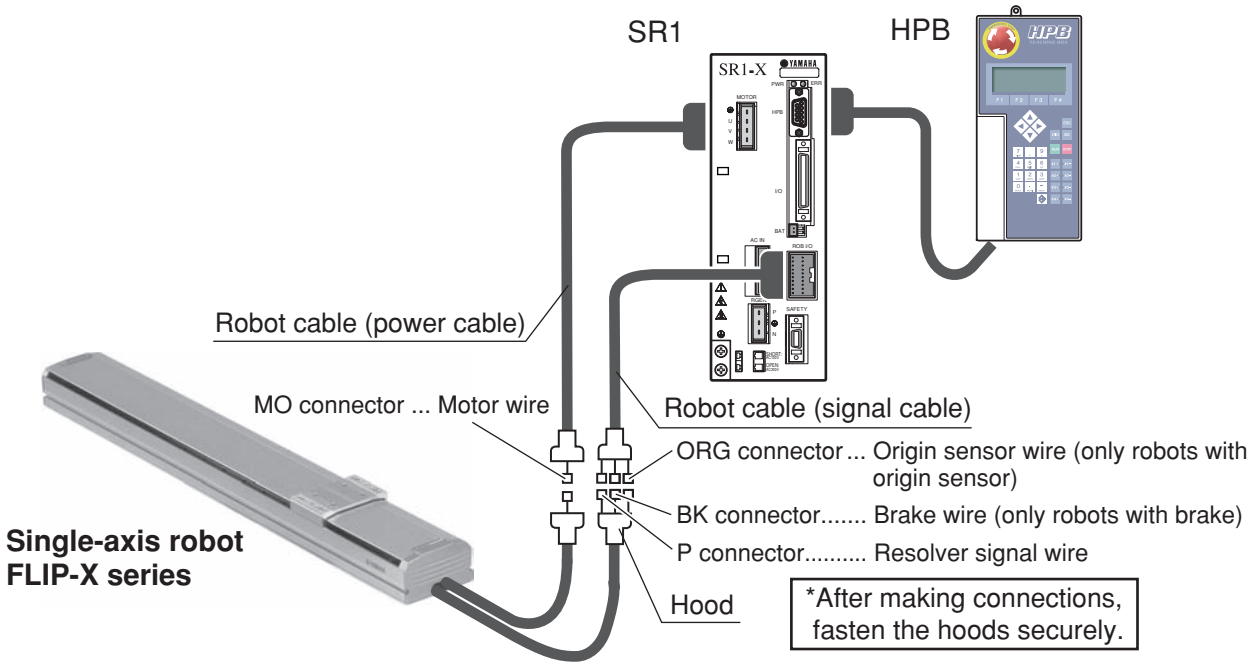
Before connecting the cables, check that there are no bends or breaks in the robot cable connector pins and that the cables are not damaged. Bent or broken pins or cable damage may cause robot malfunctions.

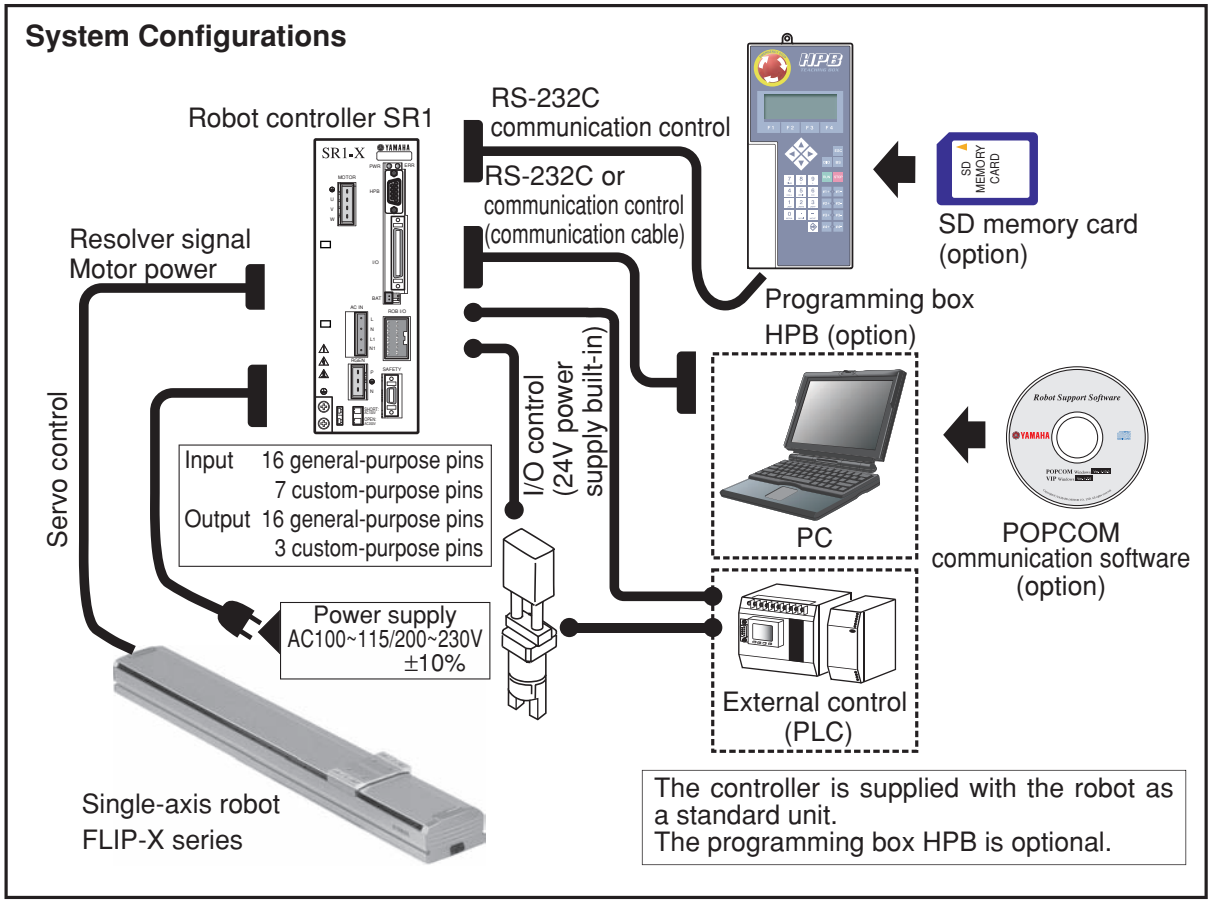
⚠ CAUTION

After connecting the relay connectors on the robot cables, fit the connector hoods together securely.

● Robot cable connections

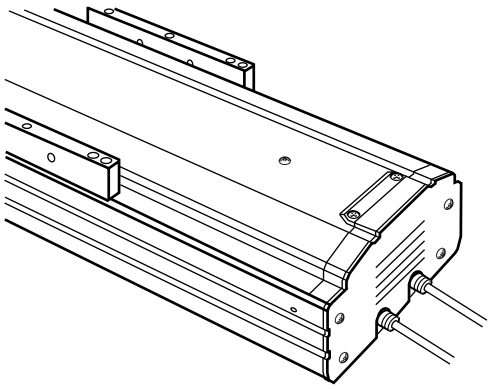
Refer to “5-2 AC servo motor cable termination” and “5-3 Robot cable” when wiring the cables.





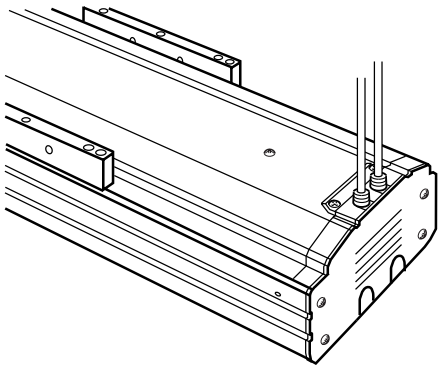
2-6-2 Changing the cable routing direction (F Type)

The cable in F type robots (F10, F14, F17, F20 series) can be run out (extracted) in any direction. Limits on wiring directions have been eliminated and vertical or horizontal installations are made possible for efficient use of space. Methods for changing the cable routing (extraction) direction are shown below. (The standard cable extraction slot is on the rear side when shipped from the factory.)

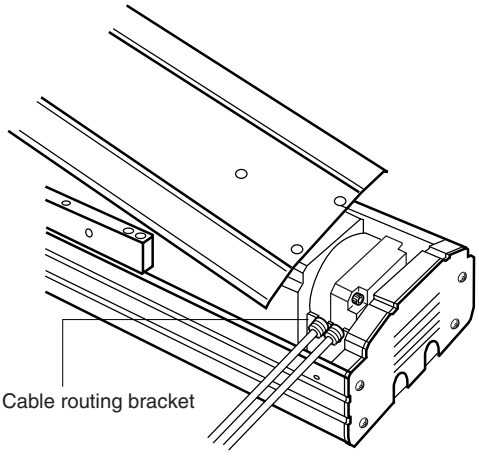


Standard cable extraction direction

1) Remove the upper cover and motor endplate. (On the F10, remove both upper and lower motor covers and endplate.)
2) Remove the robot cable from the endplate.
3) Change the cable extraction (routing) direction.
   Top extraction : Clip the endplate cable installation slot with wire nippers or similar tool, fit a robot cable grommet into that slot and route the cable out through that slot.
   Side extraction : Fit a robot cable grommet into the side routing bracket and route the cable out through that slot. (Side extraction is not possible on the F10.)



Top extraction



Side extraction

NOTE

When routing the cable from the opposite side, you must change the clamping position of the cable routing bracket. (Change the ground wire installation position to the opposite side at this time.)

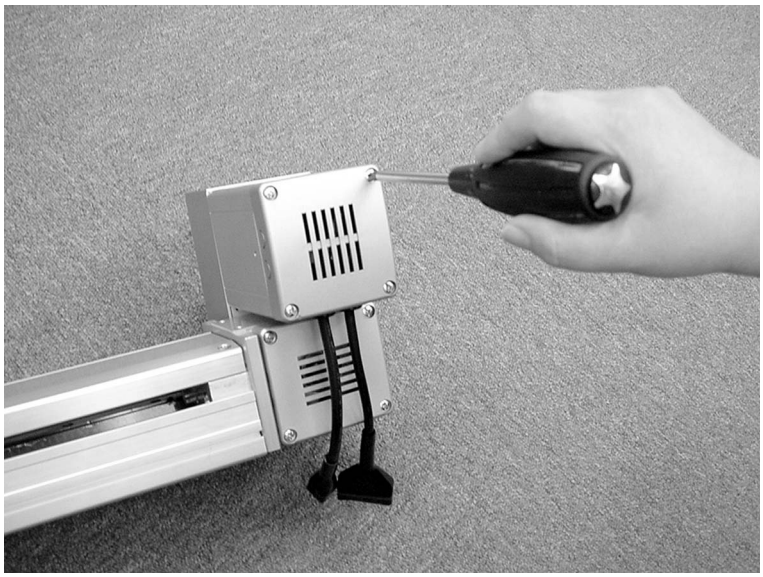
4) Reattach the endplate and upper cover (or motor upper and lower covers) back to their original positions.

2-6-3 Changing the cable routing direction (B Type)

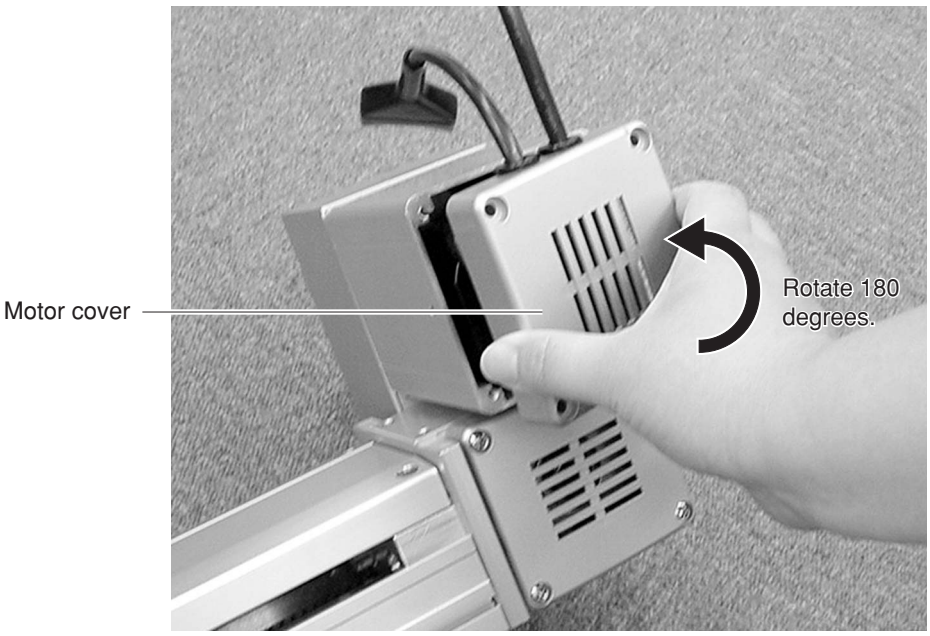
The cables in B type robots (B10, B14, B14H series) can be run out (extracted) in any direction. Limits on wiring directions have been eliminated so available space can be efficiently used. Methods for changing the cable routing (extraction) direction are shown below.

When rotating 180 degrees

1) Remove the four screws securing the motor cover.



2) Remove the motor cover and rotate it 180 degrees.

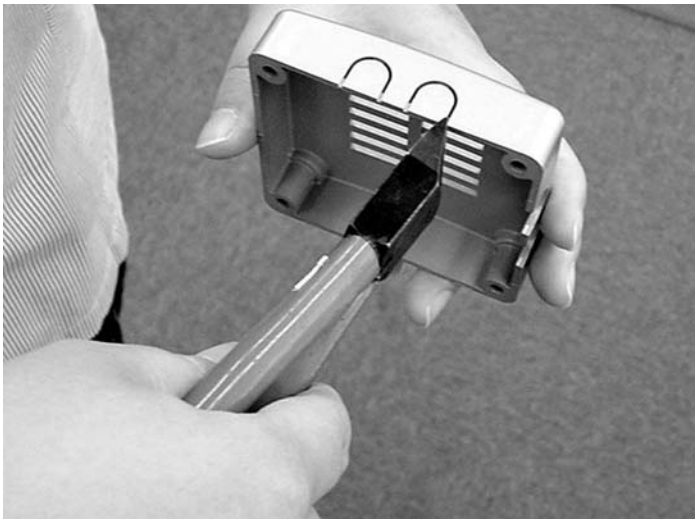


3) Reattach the motor cover and tighten the four screws to secure the motor cover and cables.

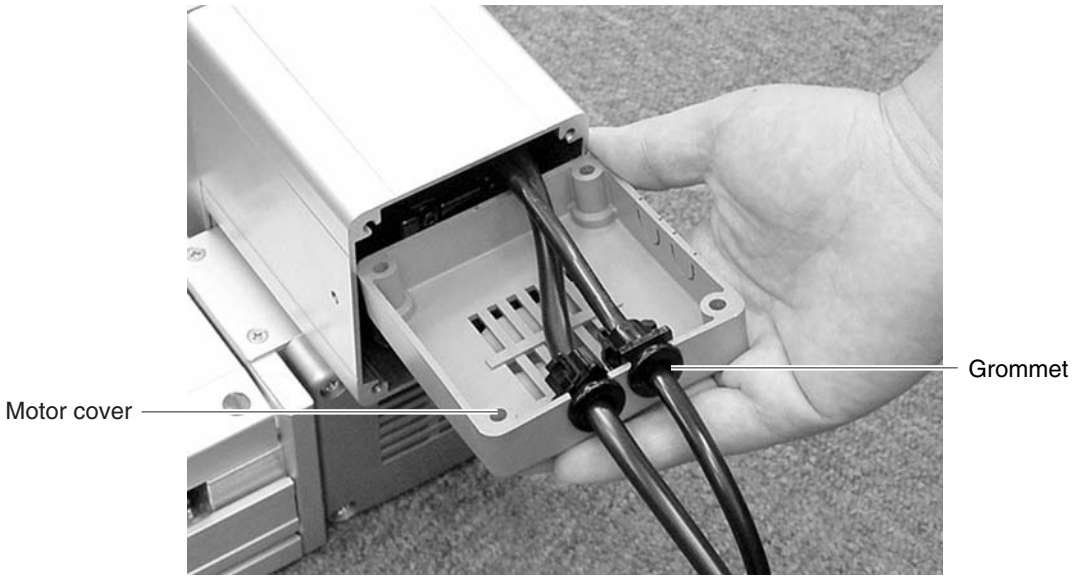
When rotating 90 degrees

1) Remove the four screws securing the motor cover and remove the motor cover.

2) Remove the cables from the motor cover and trim the unused cable extraction slots with wire nippers or similar tool.



3) Fit the robot cable grommets into the new cable extraction slots and route the cables out through those slots.



4) Reattach the motor cover and tighten the four screws to secure the motor cover and cables.

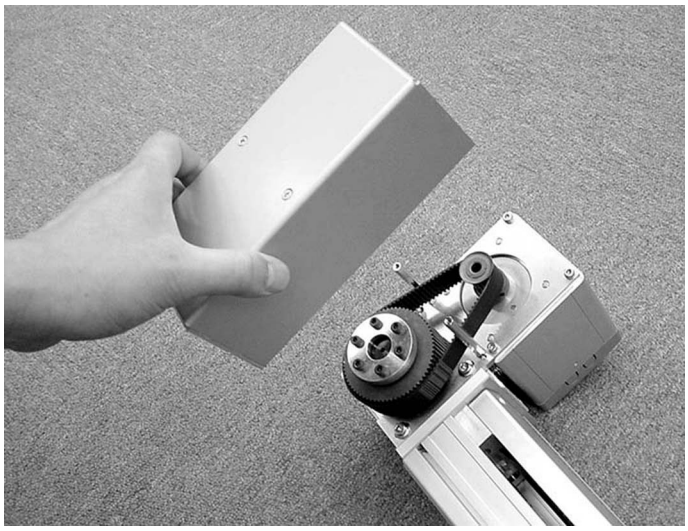
2-6-4 Changing the motor orientation (B type)

⚠ WARNING

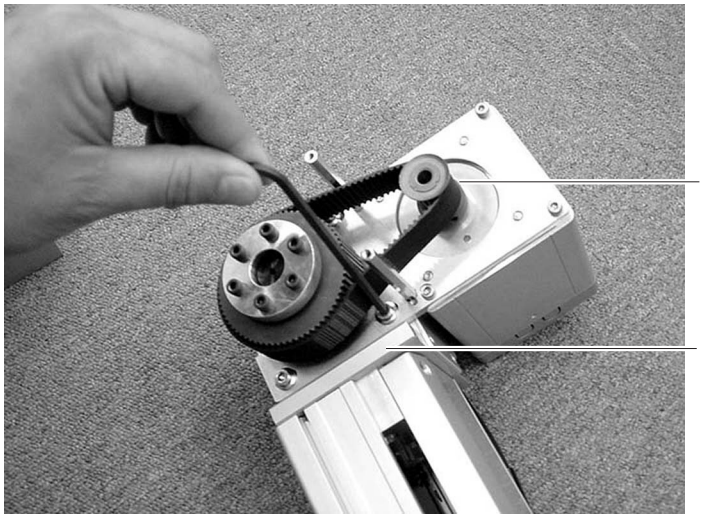
Always turn off the controller before beginning work. Serious accidents might occur if the robot starts to operate during work.

Motor orientation in B type robots (B10, B14, B14H series) can be changed to use space more efficiently. If the motor case is hanging up on an object and hampers installation of the robot, use the following method to change the motor orientation.

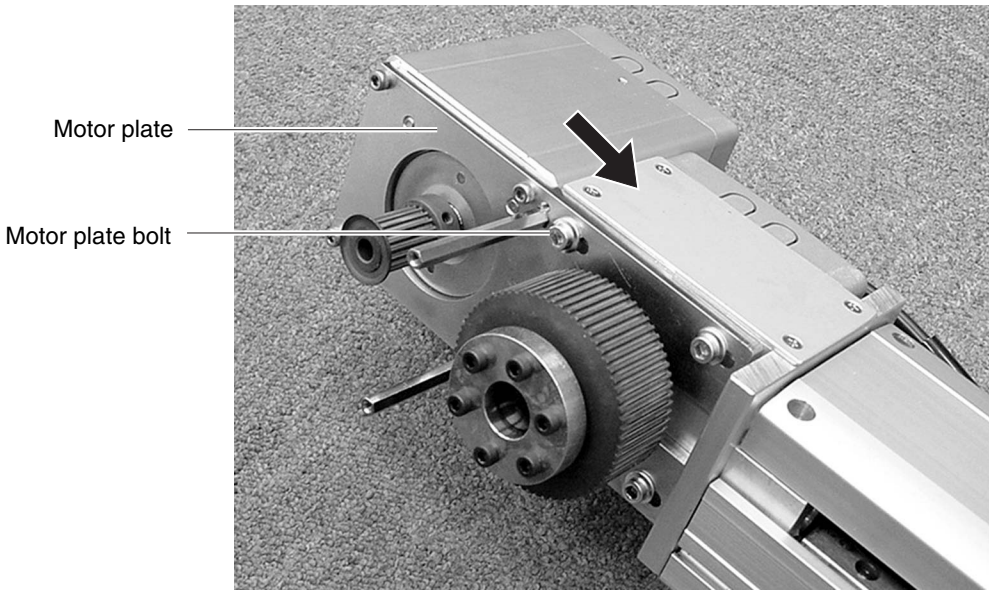
1) Remove the screws securing the belt cover and remove the belt cover.



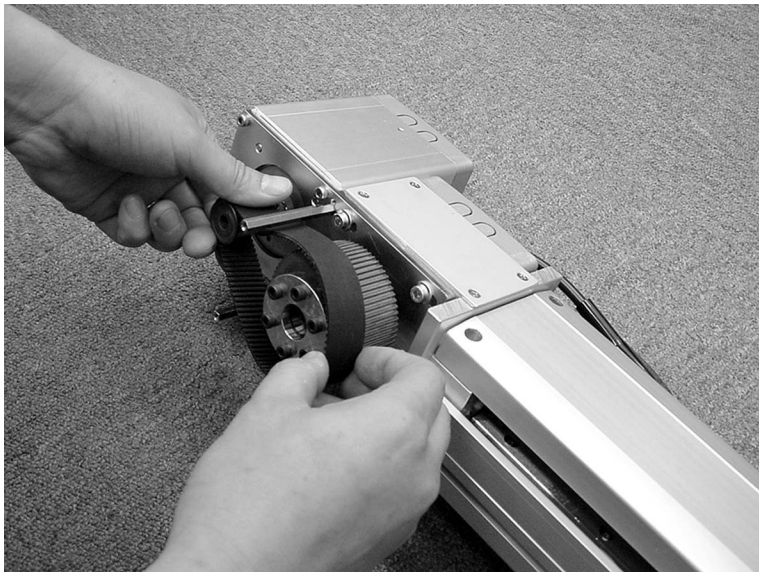
2) Remove the motor plate bolts (4 pieces).



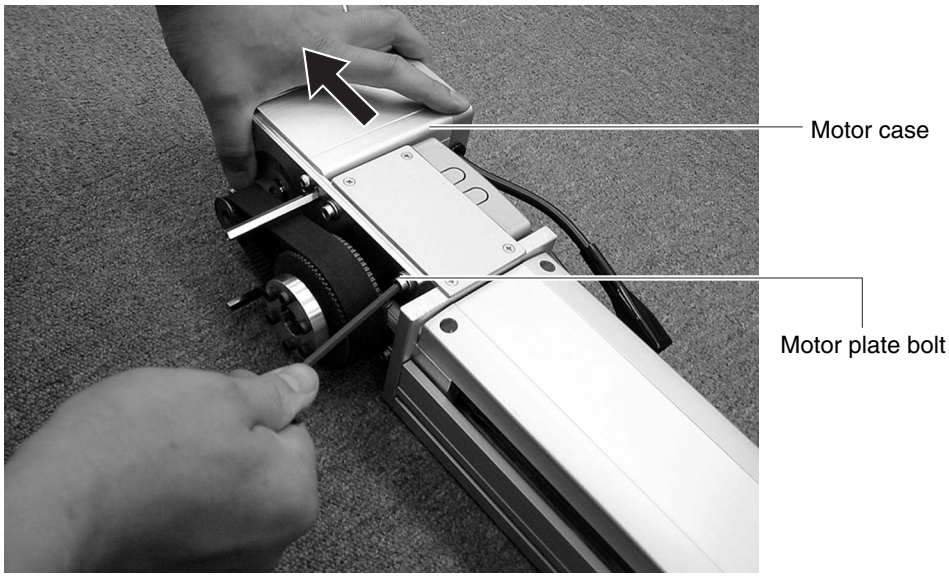
3) Detach the belt from the pulleys, change the motor orientation as desired and lightly tighten the motor plate bolts (4 pieces). Now shift the motor case towards the large pulley as shown by the arrow.



4) First fit the belt onto the (small) motor pulley and then onto the large pulley.



5) Pull the motor in the direction that increases tension on the belt, and lightly tighten the motor plate bolts.



6) Adjust the belt tension.
See “3-2-2 Adjusting the speed reduction belt tension” in Chapter 3.

7) Reattach the belt cover.

⚠CAUTION

Check that the belt teeth correctly mesh with the large pulley teeth. A poor intermesh may cause positioning errors or shorten the belt service life.

⚠CAUTION

Since a positional shift occurs after adjusting the belt tension, absolute reset, and the point data.

2-6-5 User wiring

Cable carrier

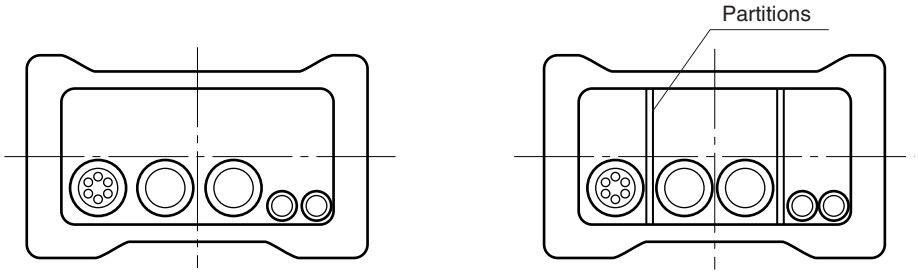
Observe the following precautions when using a cable carrier with the FLIP-X series.

⚠CAUTION

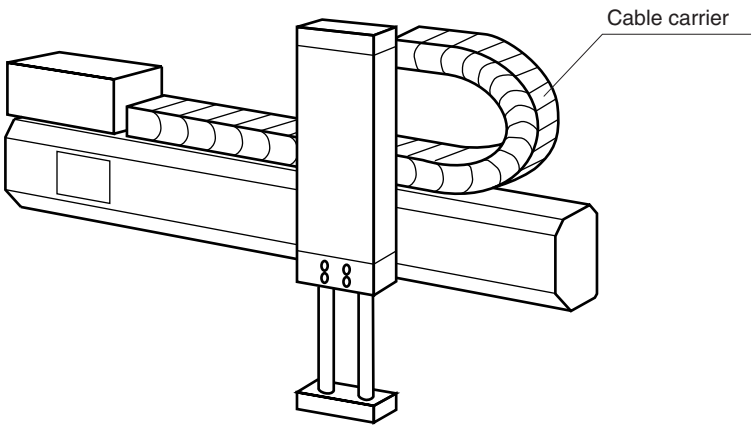
- Use a cable carrier that maintains an R50 or larger cable bend diameter.
- When fitting the robot cables into the cable carrier, keep the space used within 30 percent of the total space including other cables and air hoses. Lay the cables and air hoses in rows inside the cable carrier so they do not cross each other.
- The cables and tubes inside the cable carrier will move during robot operation applying tension to both ends. Gently secure the cables to allow for some slack so a large amount of force is not applied to cable connector during robot movement.
- Breaks or electrical discontinuity may occur if the cables are fastened too tightly with snap bands or fastening ties so allow for some slack and gently secure the cables.

NOTE

Separating the robot cables from the user cables in the cable carrier with plate partitions (see drawing below) improves reliability and makes maintenance easier.



Cross section view inside cable carrier



Typical single-axis robot using cable carrier

2-7 Setting the operating conditions

2-7-1 Payload

Optimal acceleration for the YAMAHA Single-axis robot FLIP-X series is automatically determined by setting the controller payload parameters. Set the total weight of the workpiece and the end effectors such as grippers attached to the robot slider in the payload parameter as shown below.

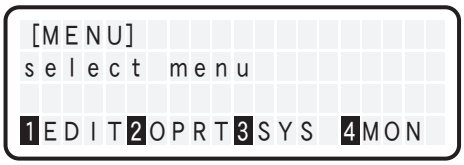
⚠CAUTION

Be sure to enter an accurate value when making this setting, since a mistake will cause troubles such as vibration or a shorter machine service life span.

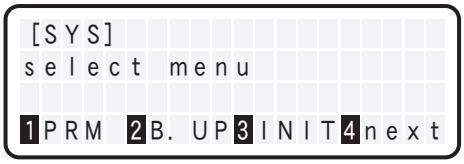
● To set the payload parameter

Use the following method when setting the payload parameter on a single-axis robot controller (SR1). When setting this parameter on other controllers (RCX142, RCX222) refer to their controller user's manuals.

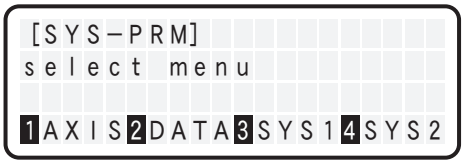
1) Press F 3 (SYS) on the initial menu screen.
The SYS (system) mode screen appears.

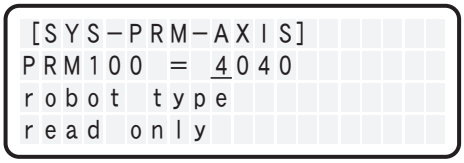


2) Press F 1 (PRM) to enter the parameter setting mode.
The SYS-PRM mode screen appears.



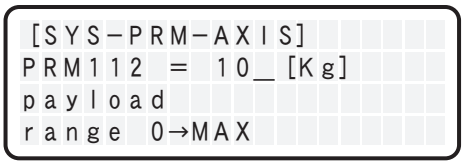
3) Select the parameter group.
Press F 1 (AXIS) to select the axis parameter.
The current setting for PRM100 (Robot type) appears on the screen.





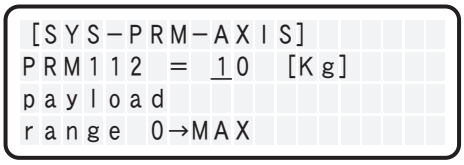
4) Display PRM112 (payload).

   Press the ▲ ▼ keys to scroll up or down the parameter list and select the parameter you want to set.



5) Set the parameter.
   Enter the parameter value with the number keys and press ⇨.

   The parameter setting range is shown on the bottom line of the screen. When setting is complete, the cursor moves back to the beginning of the parameter data.



2-7-2 Maximum speed setting

In operation of a single-axis robot with a long stroke ball screw, resonance of the ball screw may occur. In this case, the maximum speed must be reduced to an appropriate level. The maximum speed can be reduced by lowering the SPEED setting in automatic operation or by programming. Use the desired method that matches your application. For maximum speed setting versus the robot stroke length, see Chapter 4, "Specifications"
If the maximum speed does not reach a hazardous level, reducing the speed is unnecessary even when a robot has a long stroke axis.

⚠CAUTION

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

2-7-3 Duty

To achieve maximum service life for the YAMAHA single-axis robots, the robot must be operated within the allowable duty (50%).
The duty is calculated as follows:

$$\text{Duty (\%)} = \frac{\text{Operation time}}{\text{Operation time + Non-operation time}} \times 100$$

If the robot duty is too high, an error such as "overload" or "overheat" occurs. In this case, increase the stop time to reduce the duty.

Chapter 3

Adjusting the robot

MEMO

3-1 Attaching the upper cover (B10/B14/B14H)

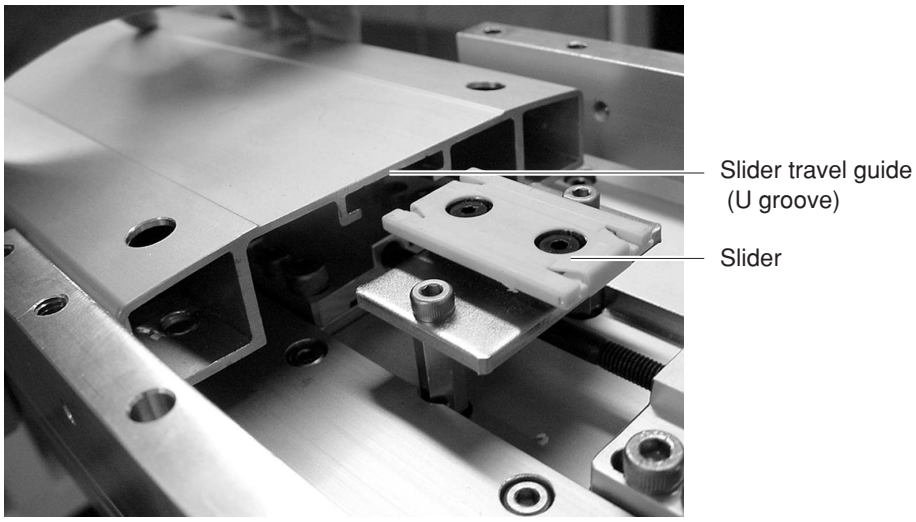
On robot models having a long stroke, a slider travel guide (U groove) is provided inside the upper cover. The slider must be aligned with this U groove when attaching the upper cover.

⚠CAUTION

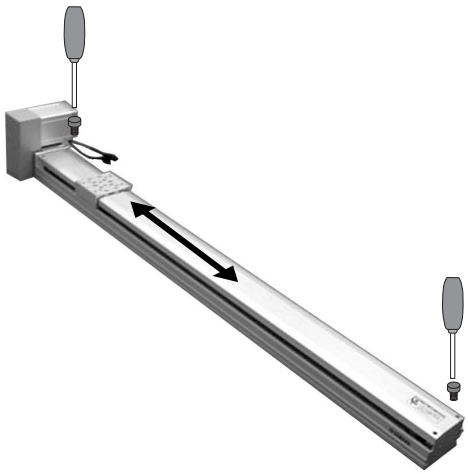
If the slider and upper cover alignment is poor, the slider may wear out prematurely. Insert the slider into the U groove correctly so that the slider is not worn away or damaged by the edge of the upper cover.

1) Turn off the controller.

2) Insert the slider into the U groove provided along the center of the upper cover, while holding the upper cover in parallel with the robot movement axis.



3) Lightly tighten the four screws to temporarily secure the upper cover, move the slider table from the motor side all the way to the non-motor side, and fully tighten the screws on the non-motor side. Then move the slider table back to the motor side and fully tighten the two screws on the motor side to secure the upper cover.



4) Move the slider table by hand to check that it travels along the upper cover smoothly.

3-2 Adjusting the timing belt tension (B10/B14/B14H)

The B10, B14 and B14H series robots use a timing belt to move the slider table. If the belt becomes slack, use the following procedure to apply belt tension.

⚠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 parts have cooled.

⚠WARNING

Injury can occur if hands or fingers are squeezed between the drive pulley and belt. Always turn off the controller and use caution when handling these parts.

⚠CAUTION

Since a positional shift occurs after adjusting the belt tension, absolute reset, and the point data.

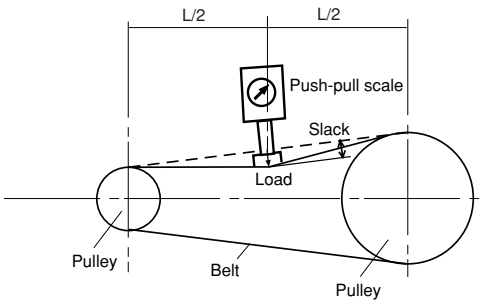


Fig. 2-1 Adjustment of speed reduction belt tension

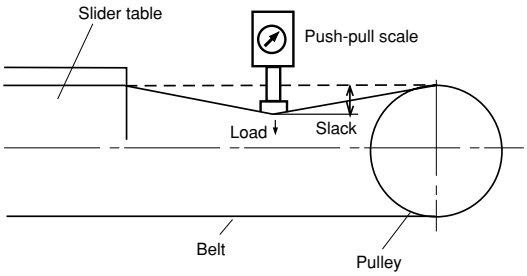


Fig. 2-2 Adjustment of drive belt tension

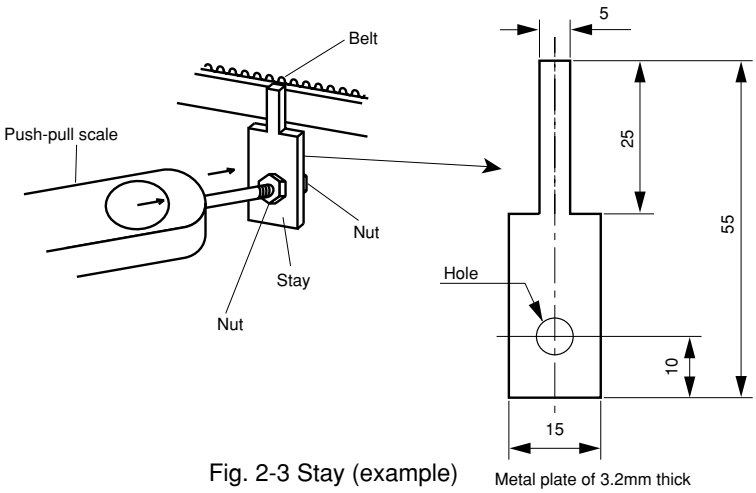


Fig. 2-3 Stay (example)

Metal plate of 3.2mm thick

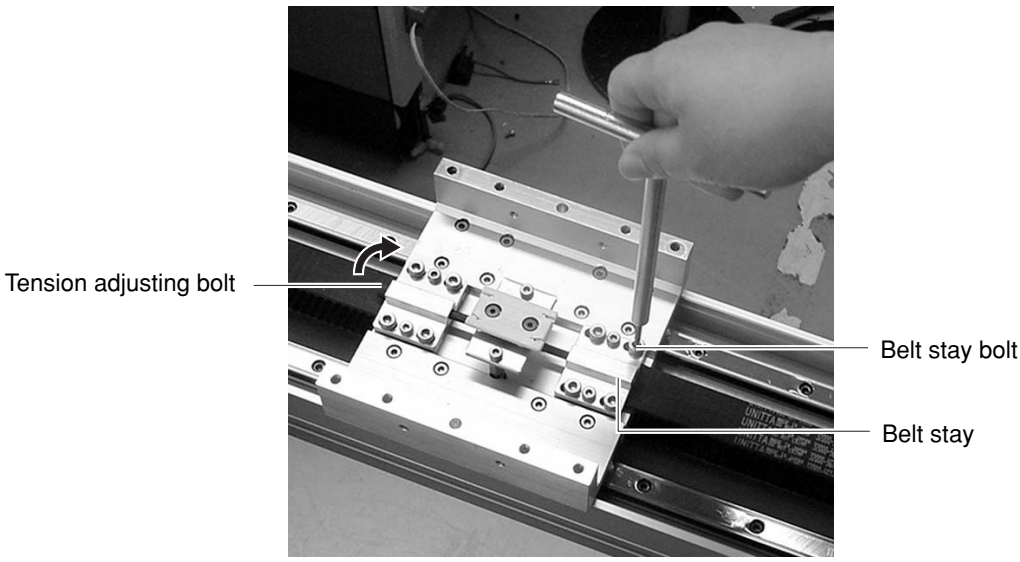
3-2-1 Adjusting the drive belt tension

1) Turn off the controller.
2) Take off the end cover.
3) Remove the screws securing the upper cover and remove the upper cover.

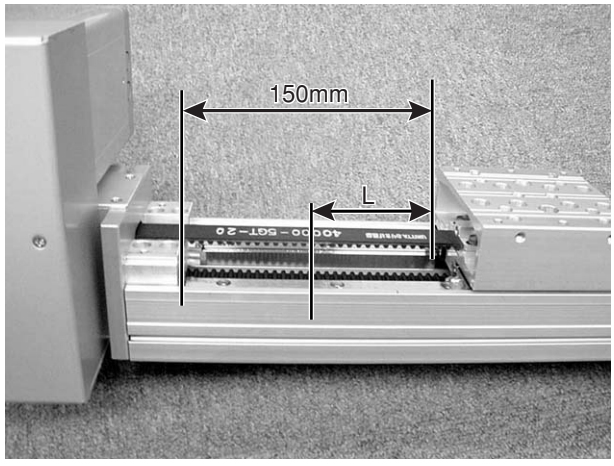
⚠CAUTION

On robot models having a long stroke, the slider is fitted in the travel guide (U groove) inside the upper cover, so remove the upper cover by sliding it along the direction the robot moves.

4) Attach the belt tension adjusting bolt (supplied) as shown and loosen the eight bolts (4 bolts on each side) securing the belt stays. Then turn the belt tension adjusting bolt to apply tension.



5) Move the slider by hand to a position at which the distance from the slider edge to the base block edge is 150mm. Apply a load to the belt at a position 115mm (B10) or 129mm (B14 , B14H) away from the slider edge.



6) Lightly tighten the belt stay bolts and check the belt tension. The correct load and resulting slack to be applied to each robot are shown in Tables 2-1. When the load producing the specified slack is within this range, no adjustment is required. If not within this range, adjust the tension by repeating steps 4) and 5).

Table 2-1 Load and slack for drive belt tension

Robot model	Load (N)	Load (kgf)	Slack (mm)
B10	4.9 to 5.9	0.5 to 0.6	2
B14, B14H	5.9 to 6.9	0.6 to 0.7	2

7) Tighten the belt stay bolts and remove the belt tension adjusting bolt.

8) Reattach the upper cover and then the end cover.
See “3-1 Attaching the upper cover” in Chapter 3.

Reference: Adjusting drive belt tension with a tension meter

We recommend using a tension meter to adjust the belt tension more accurately.
Recommended tension meter: U-505 (Made by UNITTA)

Measurement method

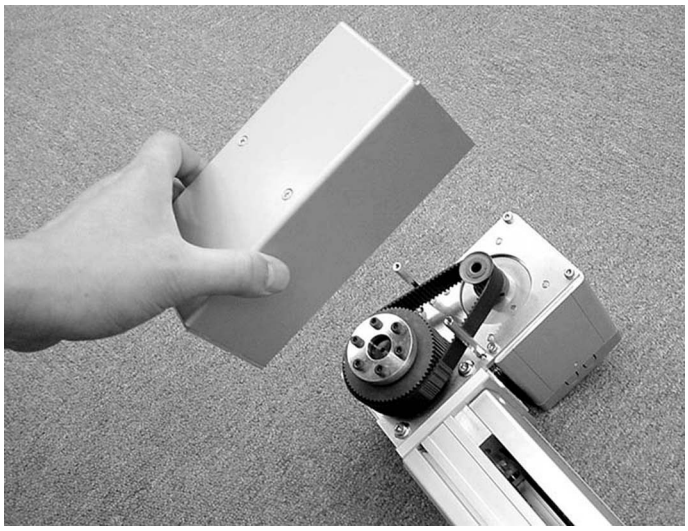
To make the drive belt tension adjustment of step 5), pull the belt to a position where a load is to be applied and adjust the belt tension by measuring the frequency with the tension meter while referring to the table below.
For details on how to use the tension meter, refer to the tension meter instruction manual.

Robot model	Tension (N)	Frequency (Hz)	Span length (mm)	Belt width (mm)	Unit mass (g/width [mm] _ length [m])
B10	127 to 147	86 to 93	230	20	4.0
B14, B14H	169 to 188	79 to 84	258	25	4.0

3-2-2 Adjusting the speed reduction belt tension

1) Turn off the controller.

2) Remove the belt cover.

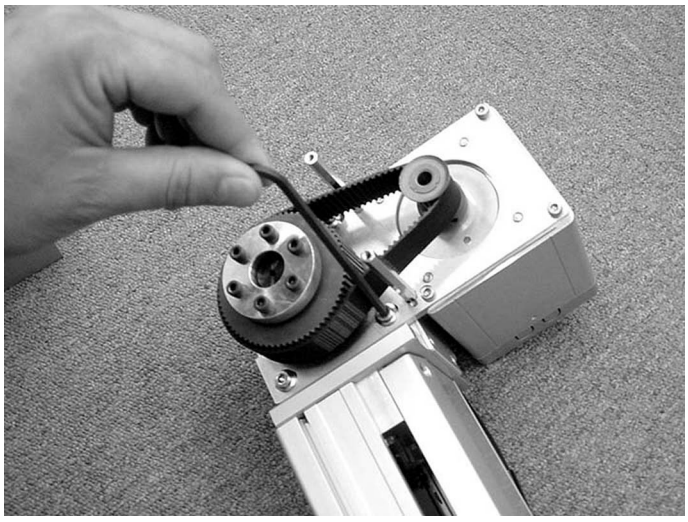


3) Apply a load shown in Table 2-2 at the center between the two pulleys and measure the slack (or tension). When the slack is within the allowable range, no adjustment is required. If not within allowable range, adjust the tension (or slack) with the procedure below.

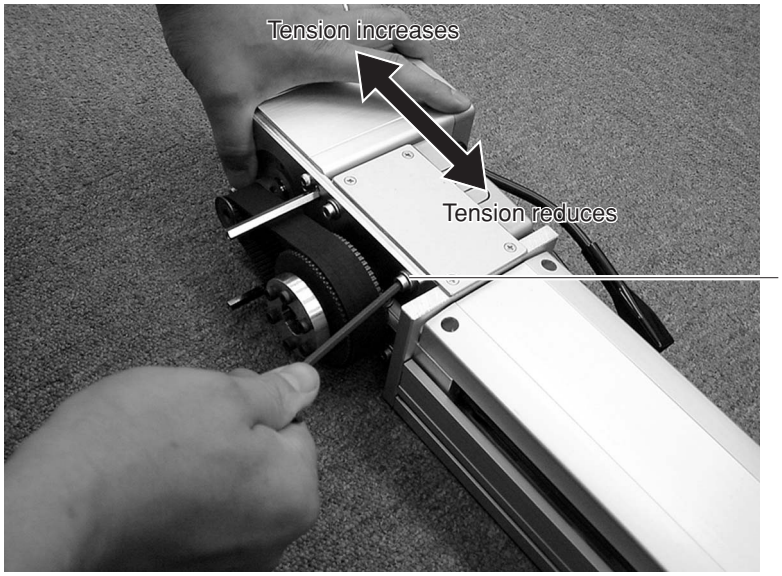
Table 2-2 Load and slack for speed reduction belt tension

Robot model	Load (N)	Load (kgf)	Slack (mm)
B10	5.9 to 6.9	0.6 to 0.7	3
B14,B14H	5.9 to 6.9	0.6 to 0.7	3

4) If the belt tension must be adjusted, loosen the motor plate bolts.



5) If the slack (or tension) measured in step 3 is smaller than the range specified in Table 2-2, move the motor case in the direction that increases belt tension. If the slack or tension is greater than the range in Table 2-2, move in the direction that reduces belt tension. Then, temporarily retighten the motor plate bolts.



6) Measure the belt tension again as in step 3).
When the load producing the specified slack (or tension) is within the allowable range in Table 2-2, no adjustment is required. If not within that range, adjust the tension (or slack) by repeating steps 3) to 5).

7) Tighten the motor plate bolts securely.

8) Reattach the belt cover.

Reference: Adjusting speed reduction belt tension with a tension meter

We recommend using a tension meter to adjust the belt tension more accurately.
Recommended tension meter: U-505 (Made by UNITTA)

Measurement method

To make the drive belt tension adjustment of step 3), pull the belt to a position where a load is to be applied and adjust the belt tension by measuring the frequency with the tension meter while referring to the table below.
For details on how to use the tension meter, refer to the tension meter instruction manual.

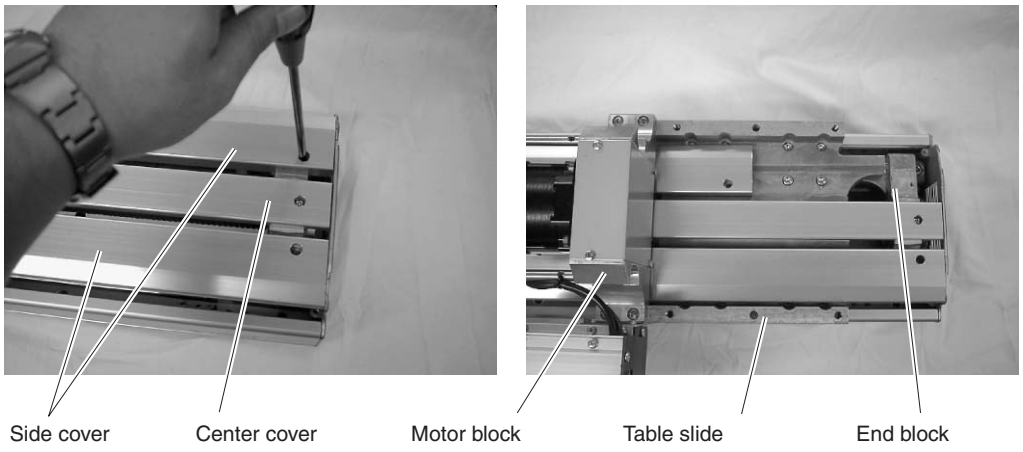
Robot model	Tension (N)	Frequency (Hz)	Span length (mm)	Belt width (mm)	Unit mass (g/width [mm] _ length [m])
B10	44 to 49	180 to 190	82	20	2.5
B14, B14H	44 to 49	180 to 190	82	20	2.5

3-3 Installing and removing the cover (F20N)

3-3-1 Stroke cover

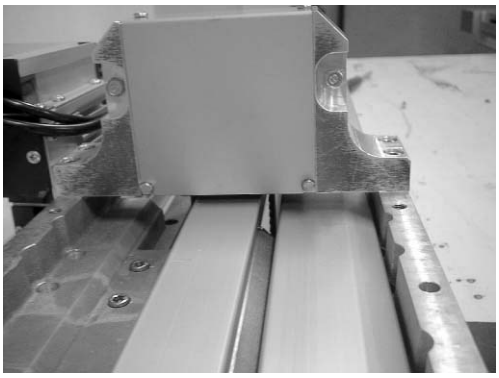
Removing the stroke cover

1) Remove the fixing screws (M4, pan-head) on both ends.
2) Place the table slide near the stroke end, and pull off the cover.

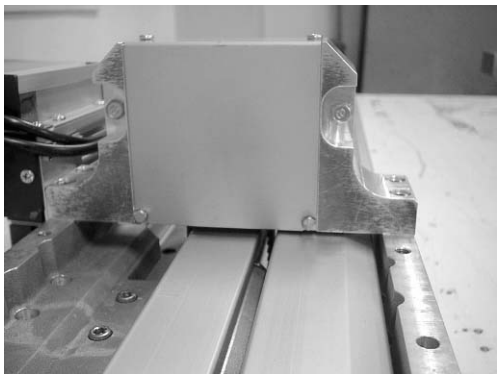


Installing the stroke cover

1) Place the table slide near the stroke end, and pass the cover between the table slide and motor block.
2) Fix the cover to the end block. At this time, move the table slide to the stroke center, and confirm that it does not interfere with the cover. If the table slide interferes with the cover, adjust by tightening the fixing screw. (Refer to following photographs.)



When cover contacts table slide
⇒Tighten the cover fixing screw

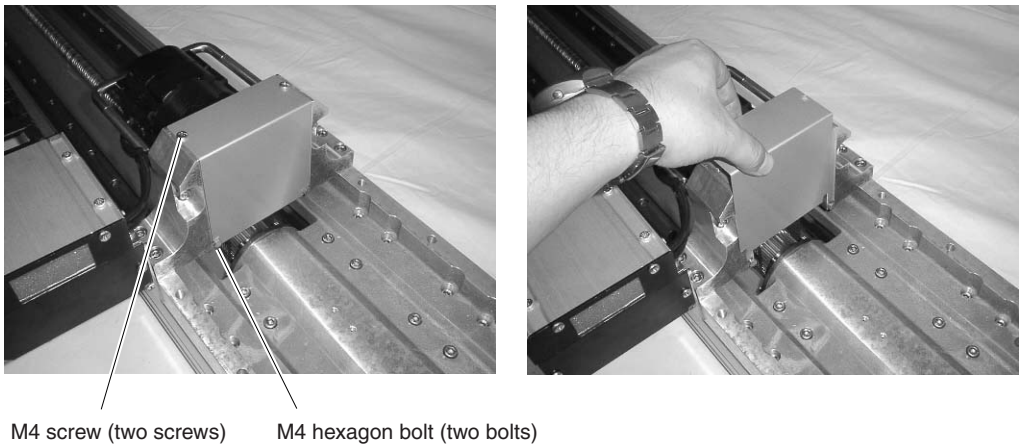


When cover contacts motor block
⇒Loosen the cover fixing screw

3-3-2 Belt cover

Removing the belt cover

1) Loosen the hexagon bolts (M4, two bolts) on the front with a spanner or socket wrench. After removing the M4 screws on the top, pull the cover upward and off. (Refer to the following photograph.)



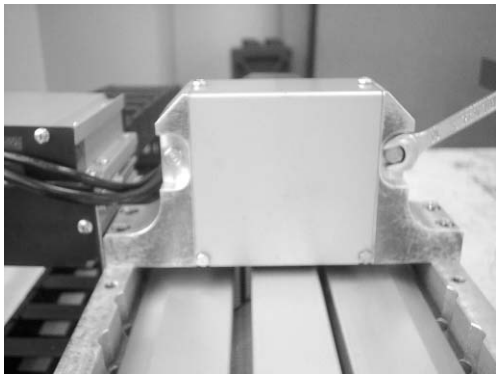
Installing the belt cover

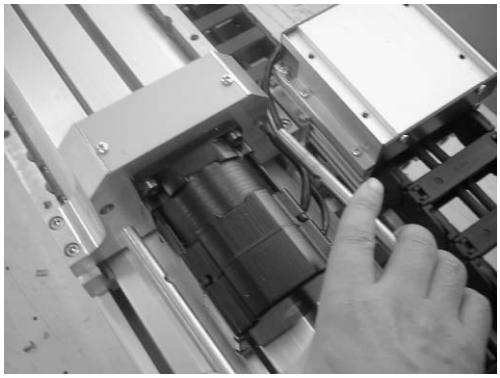
1) Fit the cover so that the notch on the cover passes between the hexagon bolts. Tighten the hexagon bolts with a spanner or socket wrench, and then fix from above with the M4 screws.

3-3-3 Motor cover

Removing the motor cover

1) Cut the Insulock-tie binding the motor cable with a pair of nippers, and remove.
2) Remove the two M6 hexagon bolts, and pull the motor cover upward and off. (Refer to the following photograph.)



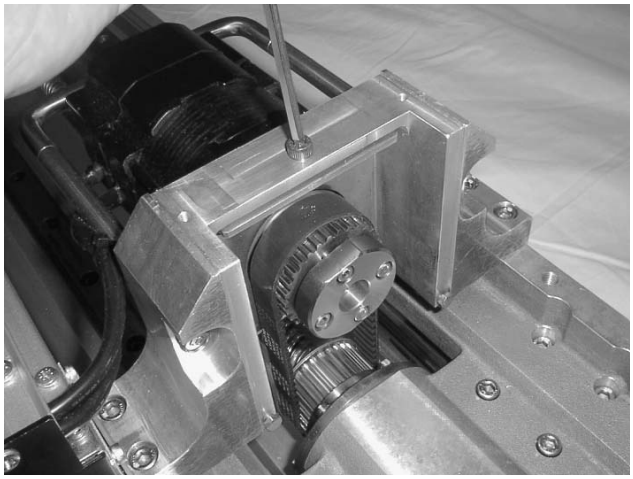


Installing the motor cover

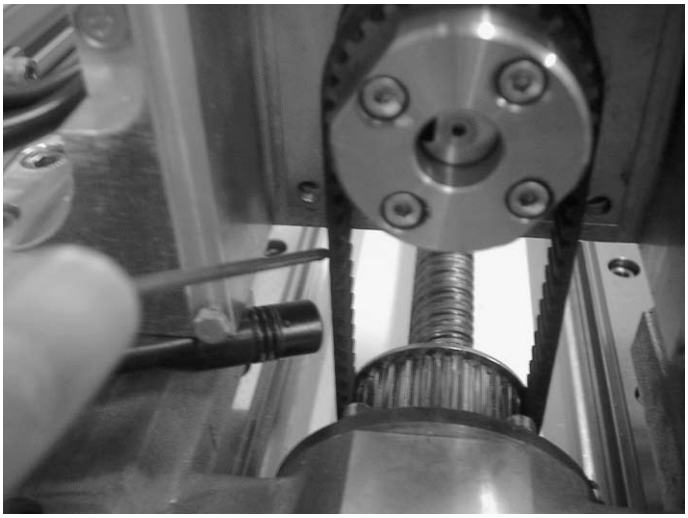
1) Insert the motor cover into the installation hole, and fix with two M6 hexagon bolts.
2) Using the o5 hole open on the motor cover, fix the motor cable with an Insulock-tie.

3-4 Adjusting the timing belt tension (F20N)

1) Temporarily tighten the motor installation bolt.
2) Remove the belt cover, and install the adjustment bolt (M5). Apply belt tension. (Refer to the following photograph.)



3) Tighten the motor fixing bolt.
4) Place the measuring head of the tension meter near the belt, and flip the belt at the middle of the belt span with a hex wrench or similar tool.



5) Adjust the belt tension by measuring the frequency with the tension meter while referring to the table below.

Recommended tension meter: U505 (made by UNITTA)

Frequency (Hz)	Tension (N)	Tension (kg)	Span length (mm)	Belt unit weight (kg/m)
207 to 219	88 to 98	9 to 10	100	0.051

6) When the appropriate tension has been set, tighten the motor installation bolt, and measure the tension again.
   (Note that the tension will increase as the bolt is tightened.)
7) Remove the adjustment bolt, and install the belt cover.

Chapter 4

Periodic Inspection

MEMO

4-1 Before beginning work

Periodic inspection and maintenance are essential to ensure safe and efficient operation of YAMAHA robots. This chapter describes periodic inspection items and procedures for the FLIP-X series. Before beginning work, read the precautions below and also in Chapter 1 “About Safety” and follow the instructions.

⚠ DANGER

If the inspection or maintenance procedure calls for operation of the robot, stay out of the working area of the robot during operation. Do not touch any parts inside the controller.
Keep watching the robot 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 switch board.
- Do not touch internal parts of the controller for 10 minutes after the controller has been turned off.
- Use only lubricant and greases specified by YAMAHA sales office or dealer.
- Use only parts specified by YAMAHA sales office or dealer. Take sufficient care not to allow any foreign matter to contaminate them during adjustment, parts replacement or reassembly.
- Do not modify any parts on the robot or controller. Modification may result in unsatisfactory specifications or threaten operator safety.
- When adjustment or maintenance is complete, retighten the bolts and screws securely.
- During robot adjustment or maintenance, place a sign indicating that the robot is being adjusted or serviced, to prevent others from touching the control keys or switches. Provide a lock on the switch keys or ask someone to keep watch as needed.

When applying grease to the ball screws and linear guide, take 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 fires.

Emergency Treatment:

- If grease gets in the eyes, wash liberally with pure water for about 15 minutes and consult a physician for treatment.
- If 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 proper treatment.

4-2 Periodic inspection

4-2-1 Daily inspection

Check the following points on a daily basis, before and after robot operation.

Checkpoints	Check items	Notes
Cables and shutter	Check for scratches, dents, and excessively tight bends.	Replace if necessary. See "4-4" in this chapter.
Ball screws and bearings	Check for unusual vibration and noise.	
Motor	Check for unusual vibration and noise, and for abnormal temperature rise.	

4-2-2 Three-month inspection

Check the following points every 3 months and apply grease if needed.

Checkpoints	Check items	Notes
Ball screw, linear guide and ball bushing	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. Recommended grease is as follows: Standard model: Use Alvania No. (Showa Shell), Daphne Eponex No.2 (Idemitsu) Clean room model: Use LG-2 (NSK)	See "4-3" in this chapter. See "4-3-3" in this chapter.
Shutter	Check for slack. Adjust if necessary.	See "4-4-2" in this chapter.

⚠CAUTION

Using a grease other than recommended by YAMAHA may shorten the service life of the ball screw, linear guide and linear bushing shaft.

4-2-3 Six-month inspection

Check the following points every six months, and make adjustments or apply grease if necessary.

Checkpoints	Check items	Notes
Main bolts and screws on robot	Check for looseness. If loose, tighten.	
Ball screw and linear guide	Check for looseness in the ball screw and 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 office or dealer.	If problem is not solved or wear and backlash are found, please contact us.
Controller	Check for loose terminals. Check for loose connectors.	See "4-3" in this chapter
Lubrication of ball screw nut and linear guides	Apply Alvania No.2 (Showa Shell), Daphne Eponex No.2 (Idemitsu Sekiyu) to the ball screw nut and linear guides.	
Belt	Check the timing belt for wear, cracks or cuts. Check the timing belt tension. (See “3-2 Adjusting the timing belt tension” in chapter 3.)	
Slider (Belt type or F20N)	On robot models using a long stroke, check the slider inside the upper cover for abnormal wear or damage. (See “3-1 Attaching the upper cover” in Chapter 3.)	

⚠CAUTION

Using a grease other than recommended by YAMAHA may shorten the service life of the ball screw, linear guide and linear bushing shaft.

4-2-4 Three-year inspection

Inspect the following points once every three years, and contact us if any problem is found. Set an earlier inspection interval if parts are subject to long-term or frequent usage.

Checkpoints	Check items	Notes
Ball screw nut sections and linear guides	Check for wear and looseness in the ball screw, nut and linear guide.	Contact us if trouble is found.

4-3 Applying grease

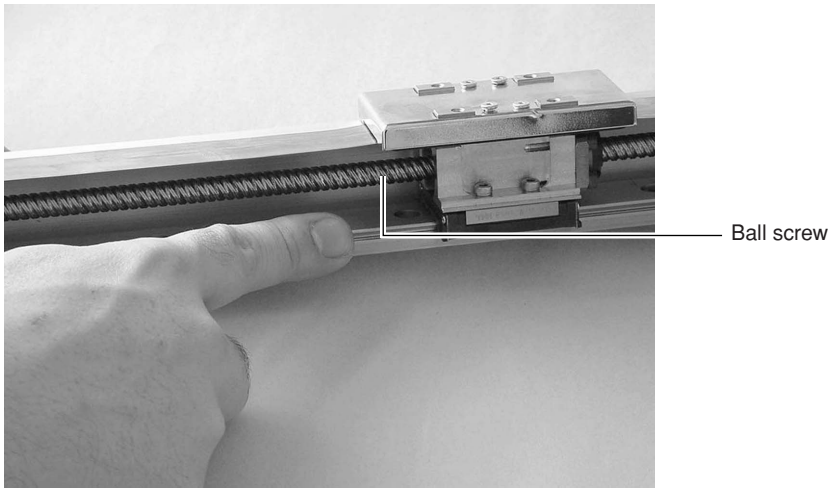
4-3-1 Applying grease (T6/T7 type)

Follow these instructions when applying grease to the T6/T7 robot ball screws and linear guides during periodic maintenance.

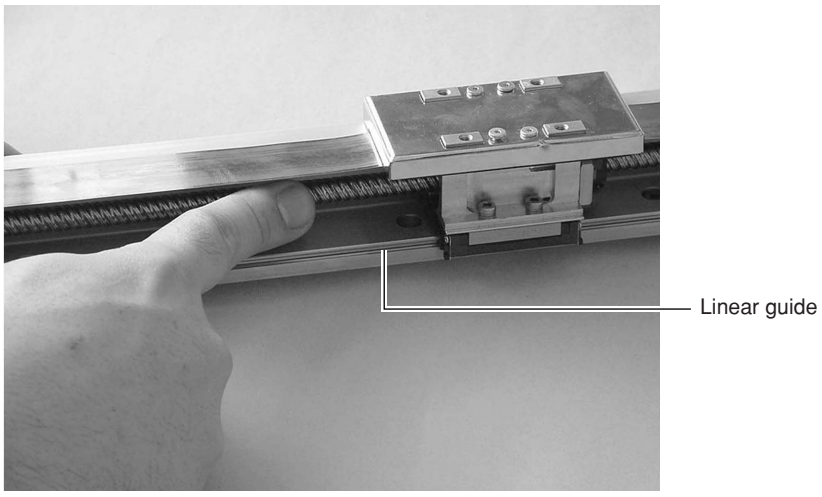
1) Check that the controller power switch is turned off.

2) Remove the screw securing the robot side covers and remove the side covers.

3) Coat the ball screw and linear guides with grease by hand and move the slider back and forth to spread the grease.



Applying grease to the ball screw



Applying grease to the linear guide

4) Reattach the side covers.

4-3-2 Applying grease (T9/F types)

Follow these instructions when applying grease to the ball screws and linear guides during periodic maintenance.
On the T9 and F7 types, the grease can be applied to the nut of the ball screw by using the grease nipple. In this case, prepare a grease nipple (M6) before starting work.

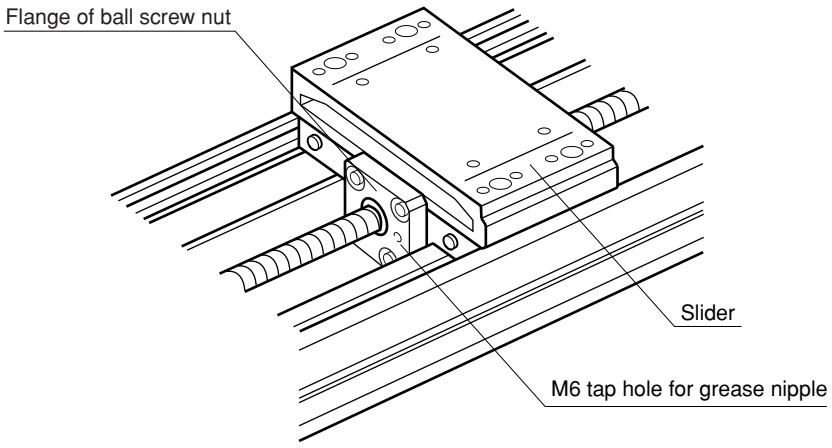
1) Check that the controller power switch is turned off.

2) Remove the screws securing the robot upper cover and remove the upper cover.

3) Apply grease using either of the following methods.

   Method A: Coat the ball screw and linear guides with grease by hand and move the slider back and forth to spread the grease.

   Method B: Fit the grease nipple into the M6 tap hole on the flange of the ball screw nut. Supply grease to the grease nipple and move the slider back and forth to spread the grease.



⚠CAUTION

Be sure to always remove the grease nipple after applying grease with method B.

4) Reattach the upper cover.

4-3-3 Applying grease (B type)

Apply grease to the linear guide every 3 months.
Using the following grease gun and grease will ensure correct refills of grease.

Grease gun model	: MG70 (made by THK) or equivalent
Nozzle type	: N type (made by THK) or equivalent
Grease	: AFB grease (made by THK, 70 g cartridge) or equivalent

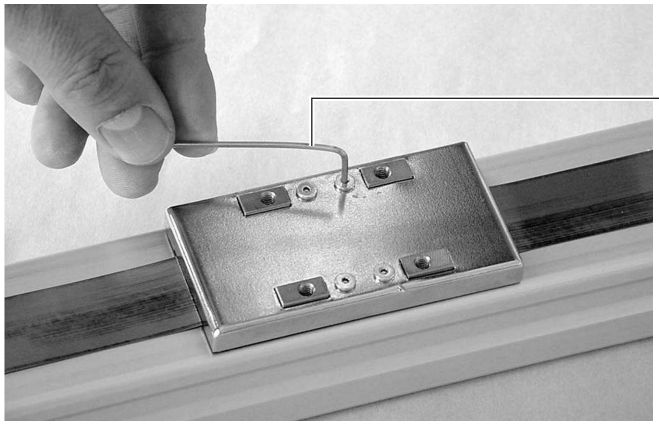
4-4 Adjusting and replacing a loose shutter

4-4-1 Replacing the shutter (T6)

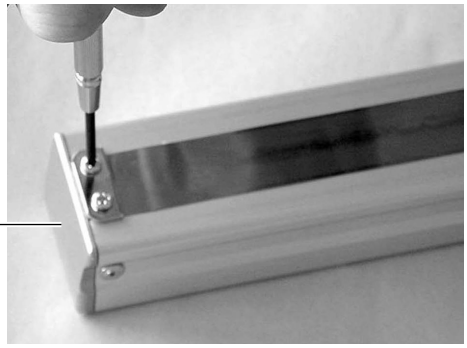
Use the following procedure when the T6 shutter must be replaced.

1) Check that the controller power switch is turned off.

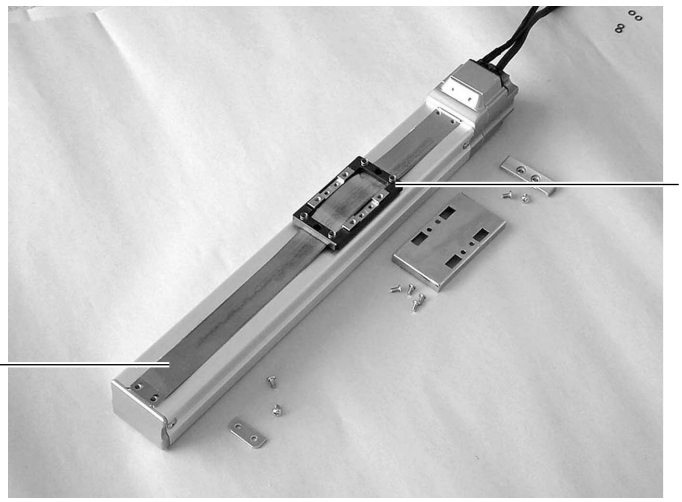
2) Remove the 4 screws securing the slider cover and take off the slider cover.



3) Remove the screws securing the shutter.
Remove the 2 screws on the endplate side and the 2 screws on the motor side.



4) Remove the shutter from the shutter guide and pass the new shutter through it.

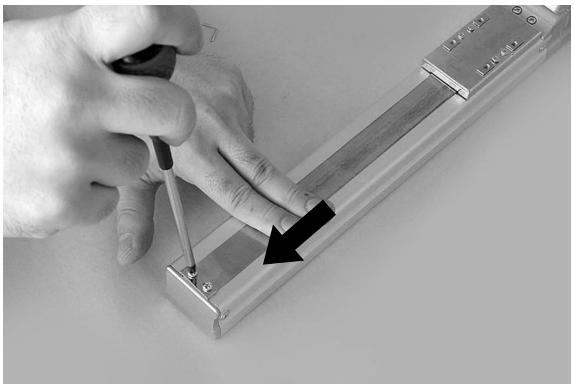


5) Reinstall the shutter and the slider cover using the reverse of the above procedure.

NOTE

Do not fully tighten the screws to secure the shutter on the endplate side at this time.
Fully tighten these screws after adjusting for shutter looseness in step 6.

6) Tighten the screws while pulling on the shutter with your fingers so that there is no looseness in the shutter.



⚠CAUTION

Do not press down on the shutter with excessive force.
Pressing down hard on the shutter may cause the shutter to warp.

4-4-2 Adjusting shutter looseness (T6)

The shutter may elongate with continued use. In such cases, adjust as follows.

1) Slightly loosen the two screws securing the endplate side of the shutter. (Do not remove.)

2) While pulling on the shutter with your fingers, tighten the screws so that there is no looseness. See step 6 of “4-4-1 Replacing the shutter (T6)”.

4-5 Replacing the motor

4-5-1 Replacing the motor (B10/B14/B14H)

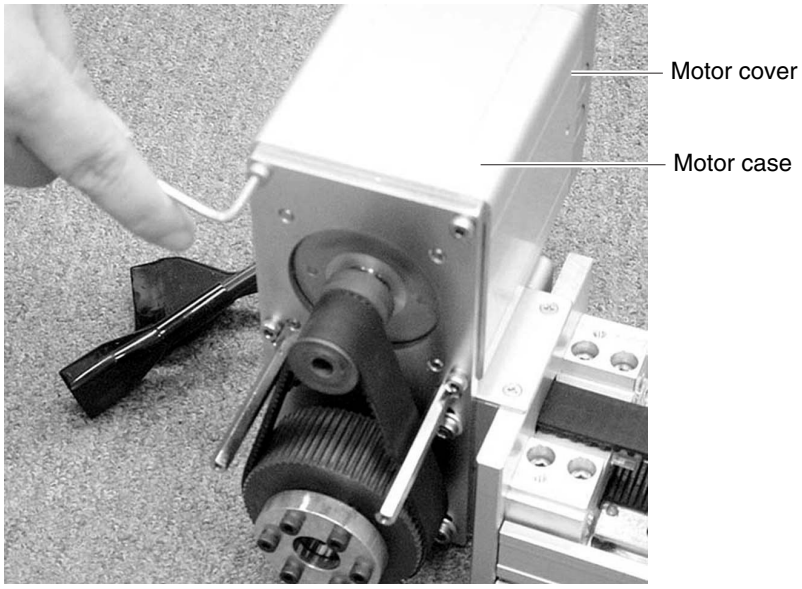
⚠CAUTION

Since a positional shift occurs after replacing the motor, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.

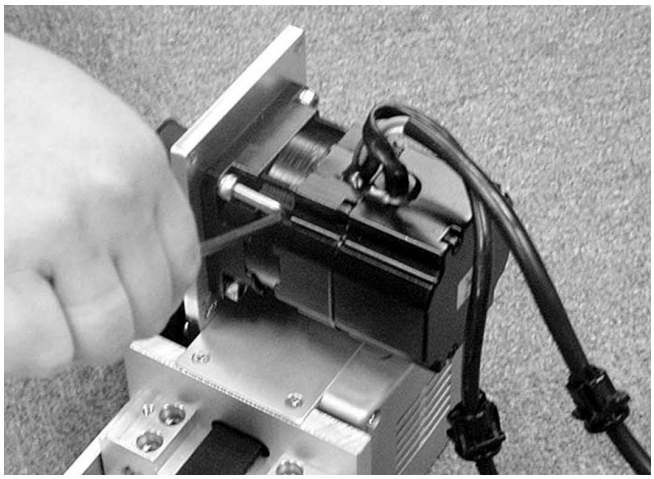
1) Turn off the controller.

2) Remove the belt cover.

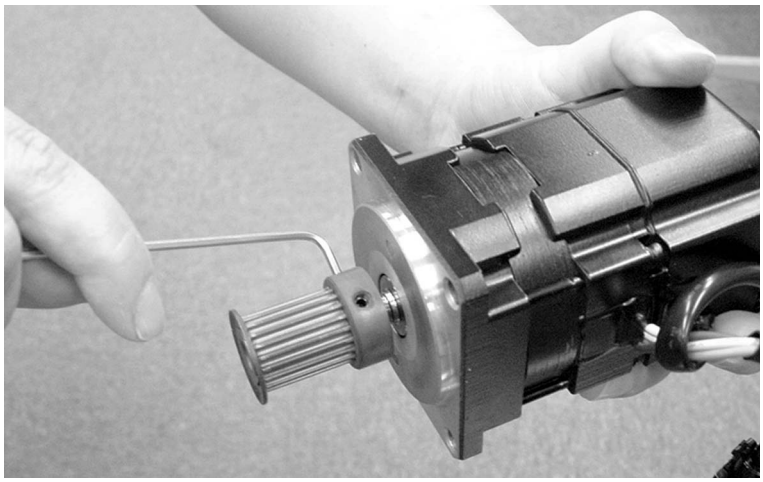
3) Remove the motor case and motor cover.



4) Remove the four bolts installing the motor to the motor plate and remove the motor.



5) Loosen the two motor pulley set screws and remove the pulley from the motor shaft.



6) Fit the pulley onto the shaft of the new motor.
The motor shaft has two flat faces. Insert the pulley so that the set screws make perpendicular contact with the flat faces of the motor shaft. (To make sure this is correct, tighten each set screw so their tips slightly protrude inwards about 0.1 to 0.2mm and then insert the pulley onto the motor shaft.)

7) Install the motor to the motor plate.

8) Fit the belt onto the pulleys.

9) Adjust the belt tension.
See “3-2 Adjusting the timing belt tension” in Chapter 3.

10) Reattach the motor case and cover.

11) Reattach the belt cover.

4-5-2 Replacing the motor (F20N)

⚠CAUTION

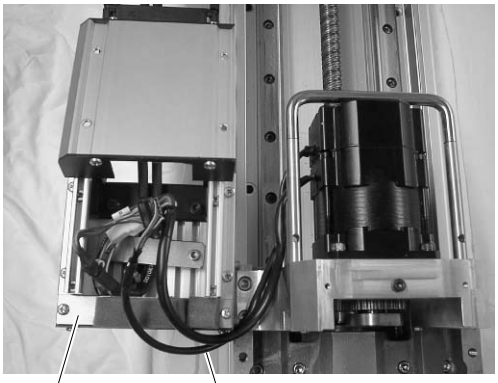
Since a positional shift occurs after replacing the motor, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.

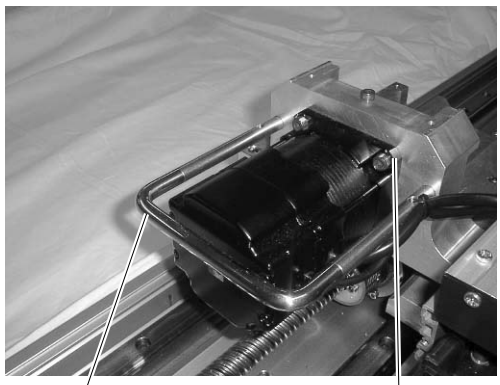
1) Turn the controller power OFF.

2) Remove the belt cover and motor cover. (Refer to Chapter 3 “3-3-3 Installing and removing the cover”.)

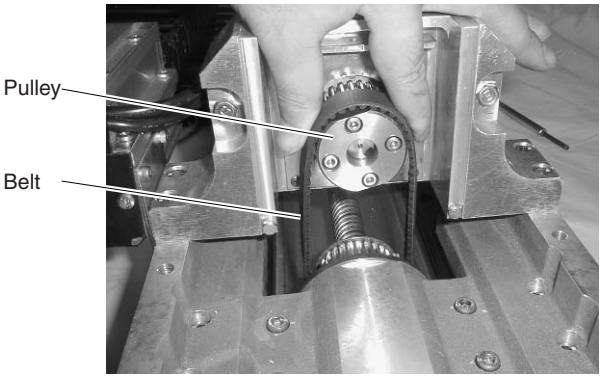
3) Open the cover of the box fixed onto the table slide, and disconnect the motor wiring connector.

4) Remove the motor installation bolts (M6: 4 bolts).



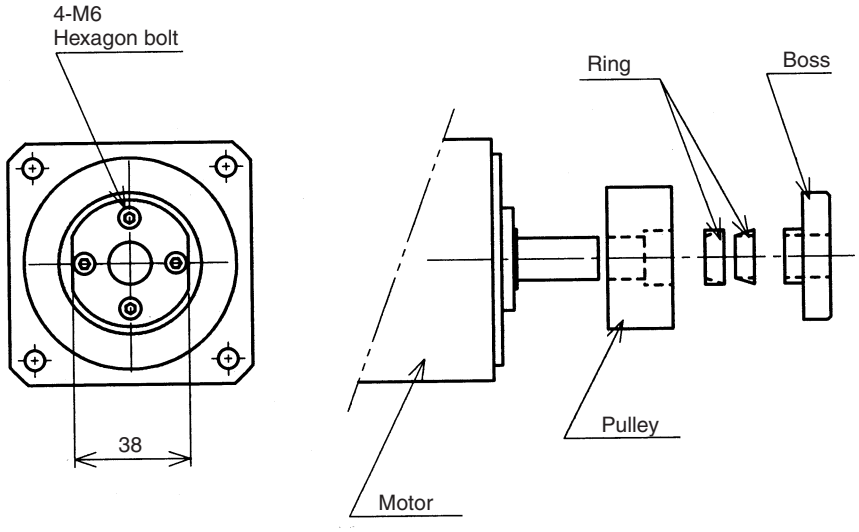


5) Pull the belt off the pulley. (Refer to the following photograph.)



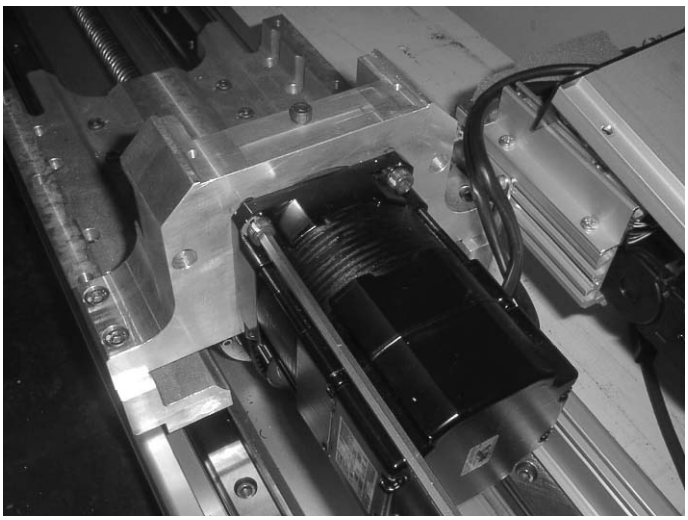
6) Remove the motor.

7) Remove the fixing bolts (M6: four bolts) from the pulley connection boss, and pull the pulley off the motor.
(Loosen the bolts while fixing the surface machined section of the boss with a pair of pliers, etc.)



8) Replace the motor, and install the pulley onto the motor. (Refer to the drawing above.) Take care to the orientation and order of the rings at this time.

9) Install the motor onto the block. Temporarily tighten the fixing bolts.



10) Install the belt.
Refer to Chapter 3 “3-3-4 Adjusting the timing belt (F20N)”, and adjust the belt tension.

11) Install the motor cover and belt cover.

12) Connect the motor wiring connector, store inside the box, and install the cover.

4-6 Replacing the drive belt (B10/B14/B14H)

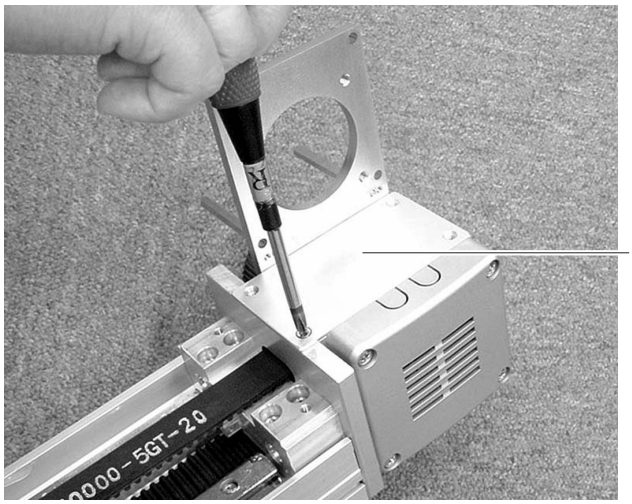
⚠CAUTION

Since a positional shift occurs after replacing the belt, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.

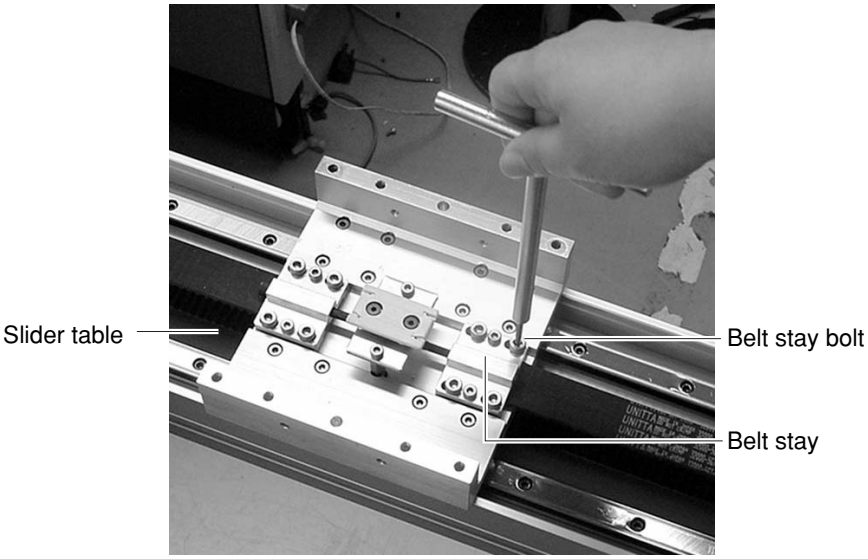
1) Remove the end cover on the non-motor side and then remove the upper cover. (On robot models having a long stroke, remove the upper cover by sliding it along the axis of robot movement. This is required because the slider is fitted in the travel guide (U groove) inside the upper cover.)

2) Remove the motor. (See the procedure in "4-5 Replacing the motor" in Chapter 4.) It is unnecessary to remove the motor if installed horizontally or downwards.

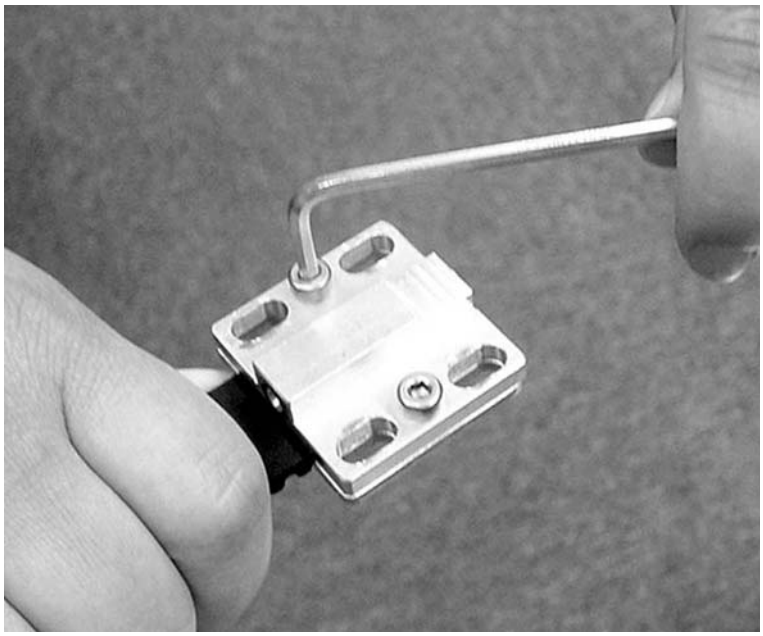
3) Remove the cover 1 shown in the photo.



4) Remove the eight bolts (4 bolts on each side) securing the belt stays and remove the belt stays from the slider table.

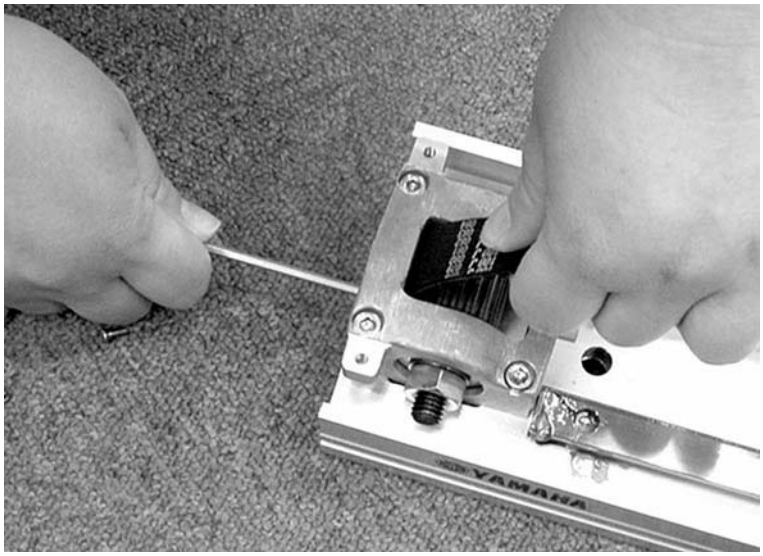


5) Remove the two center bolts on each of the belt stays and remove the belt from the stays.

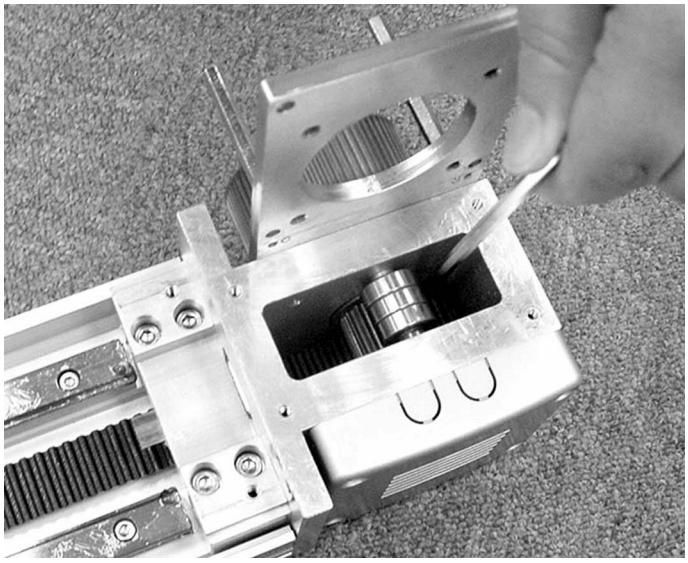


6) Set the new belt along the robot axis as instructed below.

7) First route the belt edge onto the idle pulley and use a narrow rod or similar tool to push out the belt edge as shown.



8) Pass the belt through from the lower side of the slider table and route the belt edge under the drive pulley. Then, use a narrow rod or similar tool to make the belt edge face upwards.



9) Finally, while making the belt mesh between the drive pulley and drive pulley idler, turn the drive pulley so the belt comes out upwards.

10) Attach the belt stays to both ends of the belt.

11) Install the belt stays onto the slider table and lightly tighten the bolts to temporarily secure the stays.

12) Adjust the belt tension. (See the procedure explained in “3-2 Adjusting the timing belt tension” in Chapter 3.)

13) Reattach the upper cover. (See the procedure explained in “3-1 Attaching the upper cover” in Chapter 3.)

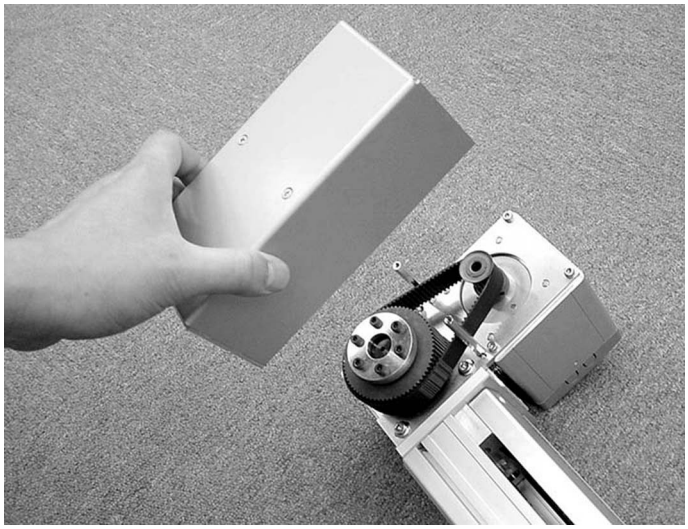
14) Reattach the end cover.

4-7 Replacing the speed reduction belt (B10/B14/B14H)

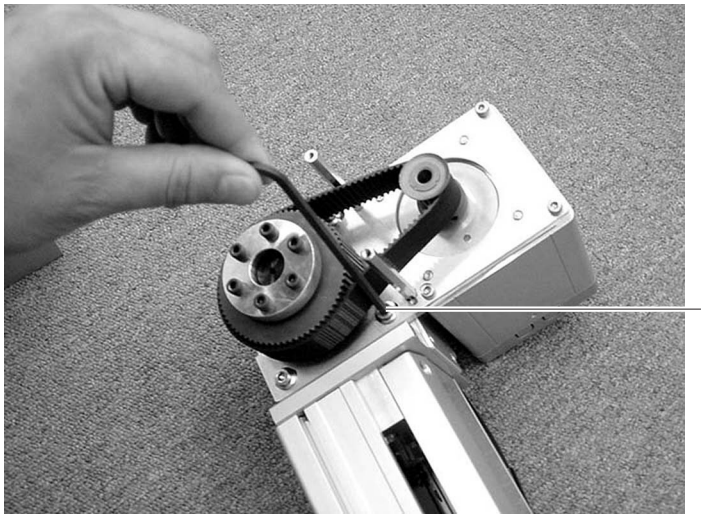
⚠CAUTION

Since a positional shift occurs after replacing the belt, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.

1) Remove the belt cover.

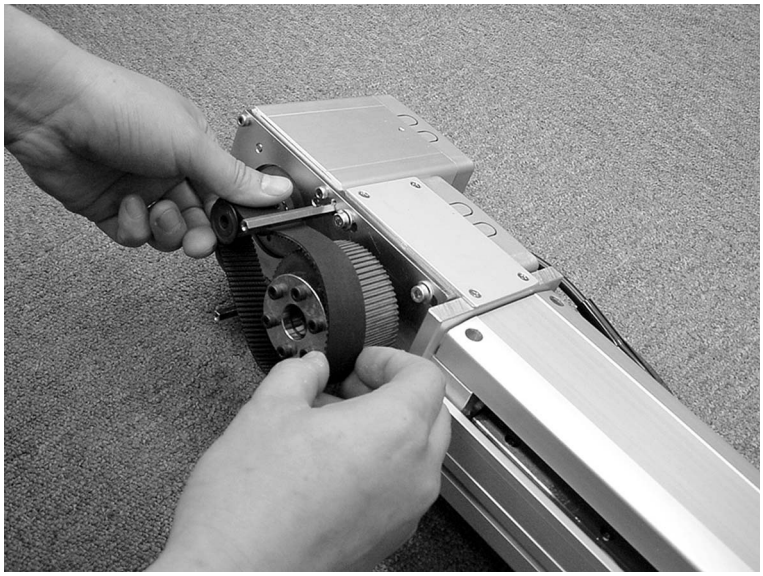


2) Remove the motor plate bolts (4 pieces).



3) Bring the motor plate close to the large pulley and detach the belt from the pulleys.

4) First fit the new belt onto the motor pulley (small pulley) and then onto the large pulley.



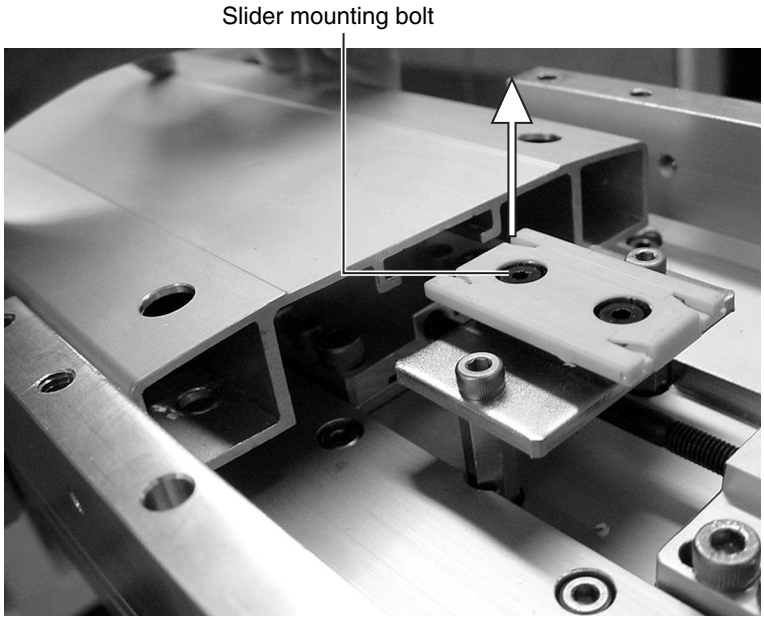
5) Adjust the belt tension. (See the procedure explained in “3-2-2 Adjusting the speed reduction belt tension” in Chapter 3.

6) Reattach the belt cover.

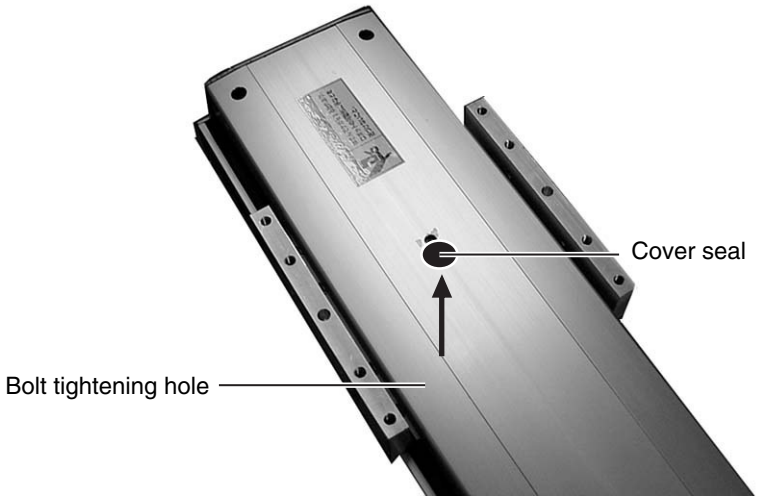
4-8 Replacing the slider

4-8-1 Replacing the slider (B10/B14/B14H)

1) Turn off the controller.
2) Remove the screws securing the upper cover and remove the upper cover by sliding it along the direction the robot moves.
3) Remove the slider mounting bolts (2 pieces).



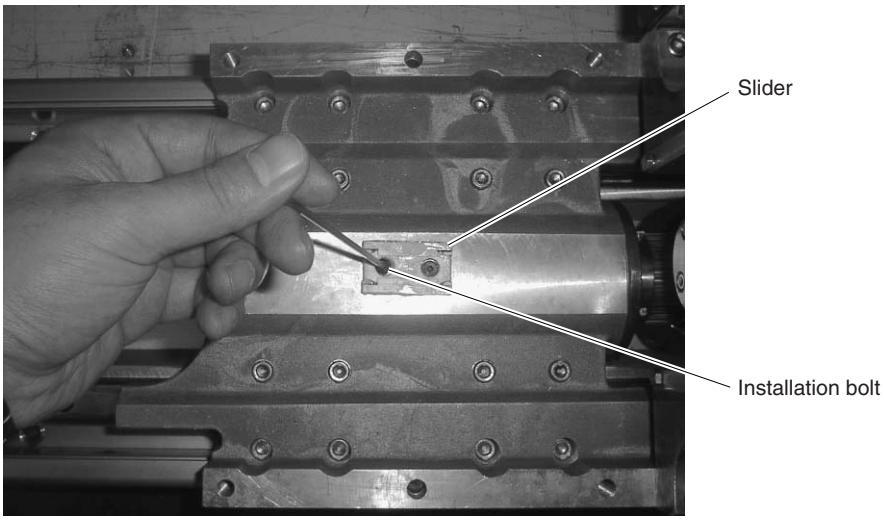
4) Replace the slider and lightly tighten the two bolts on the new slider.
5) Reattach the upper cover. (See the procedure explained in “3-1 Attaching the upper cover” in Chapter 3.
6) Move the slider table back and forth along the axis a few times.
7) Remove the cover seal (12mm diameter) affixed to the upper cover on the non-motor side. (A hole appears under the cover seal.) Move the slider to the point where you can see the slider mounting bolt through this hole.



8) Tighten the slider mounting bolts fully, then again shift the slider table 20mm to align the other bolt with the hole and fully tighten to secure the slider table.
9) Affix the new seal (supplied) to cover the hole.

4-8-2 Replacing the slider (F20N)

1) Turn the controller power OFF.
2) Remove the top center cover.
3) Remove the two slider installation bolts.



4) Replace the slider and fix with the installation bolt.
5) Install the top center cover. Refer to Chapter 3 “3-3-3 Installing the cover”.

MEMO

Chapter 5

Specifications

MEMO

5-1 Robot specifications

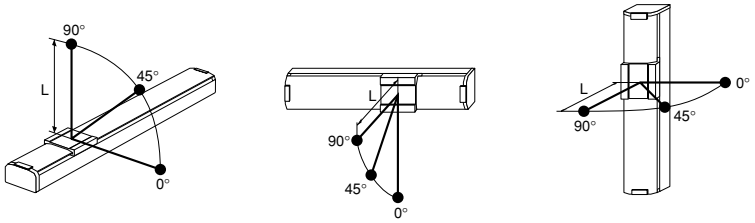
5-1-1 T6

■Mechanical unit specifications

AC servo motor output (W)		60	
Maximum speed (mm/sec)*1		±0.02	
Deceleration mechanism		Ball screw (Class C10)	
Ball screw lead (mm)		12	6
Maximum speed (mm/sec)		800	400
Maximum payload(kg)	Horizontal	12	30
	Vertical	4	8
Continuous rated thrust(N)		78	156
Stroke(mm)		50-600(50 pitch)	
Cable length(m)		3.5(Standard),5,10	
Controller	Horizontal	SRCX-05	
	Vertical	SRCX-05	

*1 Repeatability for single oscillation

■Tolerable overhang amount *2



•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead12	3kg	220	295	600
	8kg	95	130	290
	12kg	70	110	210
Lead6	5kg	270	390	650
	10kg	95	115	280
	30kg	40	106	220

•During wall installation use

(Unit: mm)

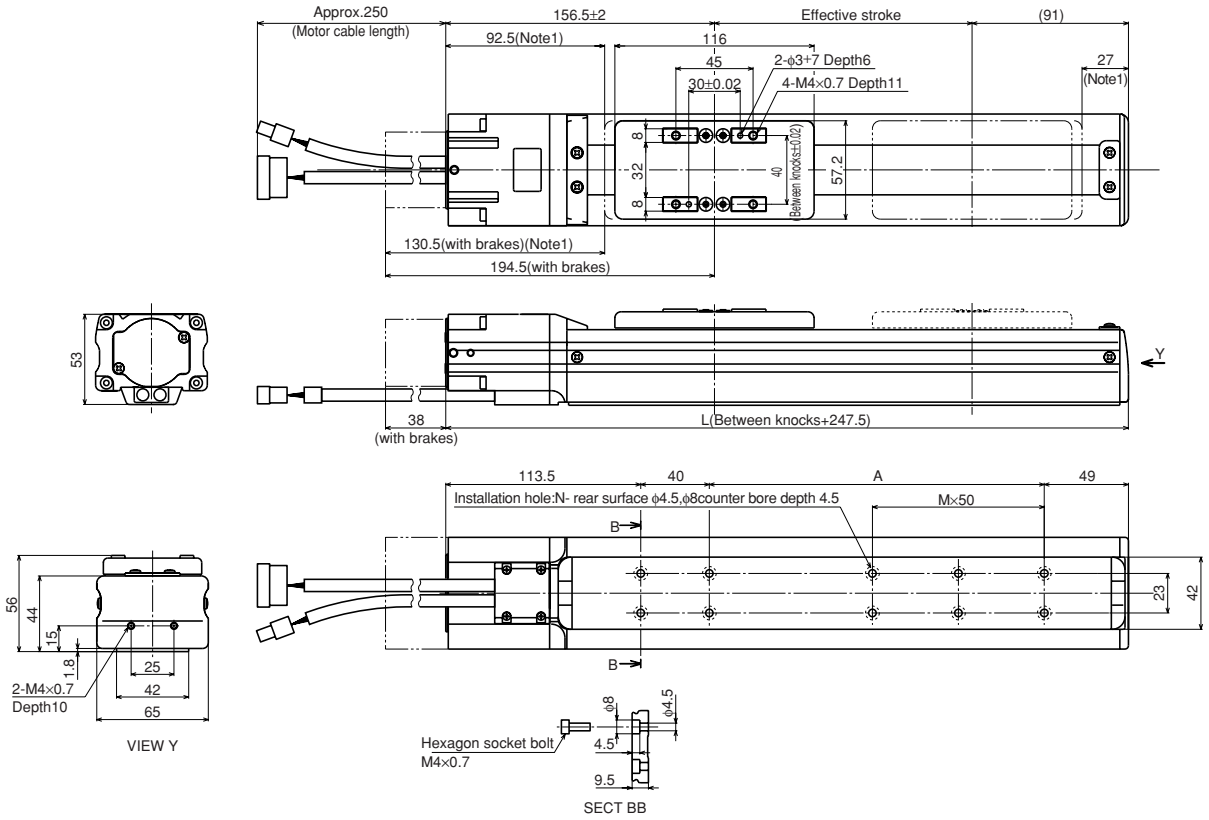
		0°	45°	90°
Lead12	3kg	280	170	200
	8kg	95	50	50
	12kg	55	21	20
Lead6	5kg	550	230	145
	15kg	135	35	25
	30kg	0	0	0

•During vertical use

(Unit: mm)

		0°	45°	90°
Lead12	1kg	220	168	260
	2kg	100	70	120
	3kg	60	45	70
Lead6	2kg	140	105	215
	4kg	60	55	70
	6kg	32	25	40

★2 *2 Distance from center of slider top to center of gravity of object being transported.



Effective stroke	50	100	150	200	250	300	350	400	450	500	550	600
L	297.5	347.5	397.5	447.5	497.5	547.5	597.5	647.5	697.5	747.5	797.5	847.5
A	95	145	195	245	295	345	395	445	495	545	590	645
M	0	1	2	3	4	5	0	1	2	3	4	5
N	6	8	10	12	14	16	6	8	10	12	14	16
Weight (kg)	2.5	2.7	3.1	3.3	3.5	3.7	4.0	4.2	4.5	4.7	5.0	5.2

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.

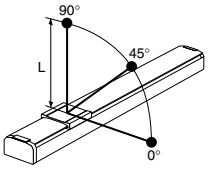
5-1-2 T7

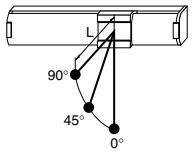
■Mechanical unit specifications

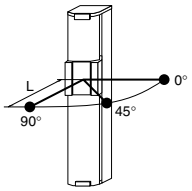
AC servo motor output (W)		60
Repeatability (mm)		±0.02
Deceleration mechanism		Ball screw (Class C10)
Ball screw lead (mm)		12
Maximum speed (mm/sec)		600
Maximum payload (kg)	Horizontal	8
	Vertical	3
Continuous rated thrust(N)		78
Stroke(mm)		150-550(100 pitch)
Cable length(m)		3.5(Standard),5,10
Controller	Horizontal	SRCX-05
	Vertical	SRCX-05

*1 Repeatability for single oscillation

■Tolerable overhang amount *2







•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead12	3kg	206	245	813
	5kg	118	141	504
	8kg	68	83	344

•During wall installation use

(Unit: mm)

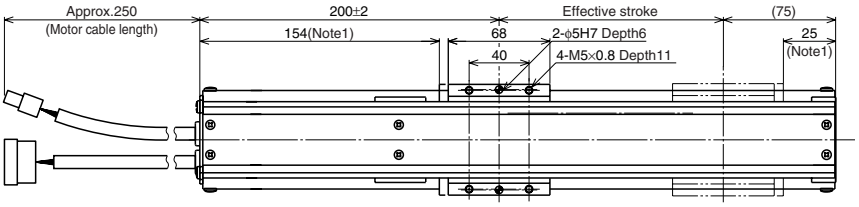
		0°	45°	90°
Lead12	3kg	317	123	109
	5kg	146	47	40
	8kg	0	0	0

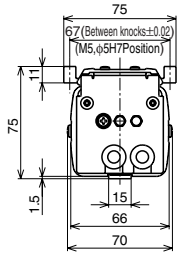
•During vertical use

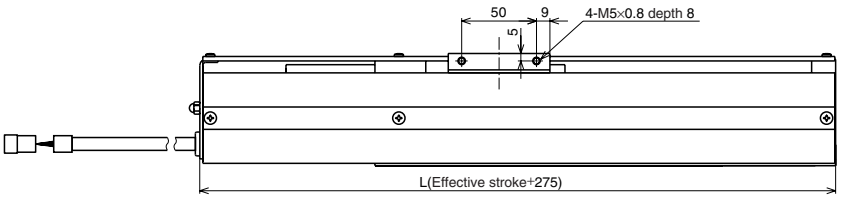
(Unit: mm)

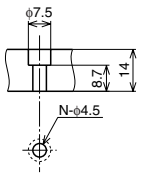
		0°	45°	90°
Lead12	1kg	807	570	807
	2kg	369	261	369
	3kg	224	158	224

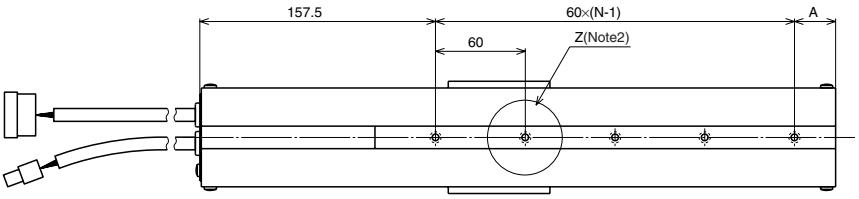
*2 Distance from center of slider top to center of gravity of object











Z section detailed chart (Note 2)

Effective stroke	150	250	350	450	550
L	425	525	625	725	825
A	27.5	67.5	47.5	27.5	67.5
N	5	6	8	10	11
Weight (kg)	3.2	3.7	4.1	4.5	4.9

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.
Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.
Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-3 T9

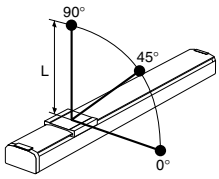
■Mechanical unit specifications

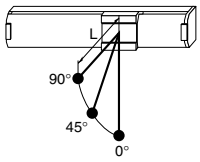
AC servo motor output (W)		100		
Repeatability (mm)*1		±0.01		
Deceleration mechanism		Ball screw (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec)*3		1200	600	300
Maximum payload (kg)	Horizontal	30	55	80
	Vertical	4	10	20
Continuous rated thrust(N)		78	156	312
Stroke(mm)		150-1050(100 pitch)		
Cable length(m)		3.5(Standard),5,10		
Controller	Horizontal	SRCX-05		
	Vertical	SRCX-05*2		

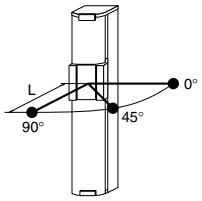
*1. Repeatability for single oscillation
*2. The regenerative control RGU2 is required when using in the vertical position.
*3. If the stroke exceeds 750mm, resonance of the ball screw may occur depending on the motion range (hazardous speed). In this case, adjust the speed in the program using the following maximum speeds as a guideline. This is not required if resonance does not occur.

Stroke (mm)	Maximum speed (mm/sec)	SPEED setting
750	960/480/240	80%
850	780/390/195	65%
950	600/300/150	50%
1050	540/270/135	45%

■Tolerable overhang amount *4







•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead20	5kg	391	454	796
	15kg	139	169	366
	30kg	77	102	373
Lead10	20kg	100	130	364
	40kg	46	61	225
	55kg	31	42	205
Lead5	50kg	39	55	345
	60kg	31	43	304
	80kg	20	29	215

•During wall installation use

(Unit: mm)

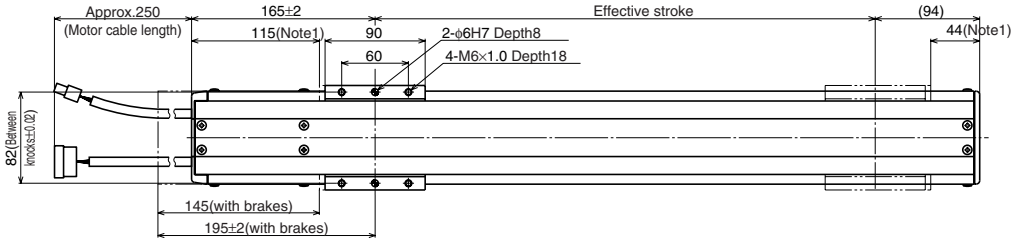
		0°	45°	90°
Lead20	5kg	581	324	320
	15kg	184	82	69
	30kg	0	0	0
Lead10	10kg	391	199	161
	20kg	202	53	38
	30kg	0	0	0
Lead5	10kg	1176	237	172
	20kg	420	58	41
	30kg	0	0	0

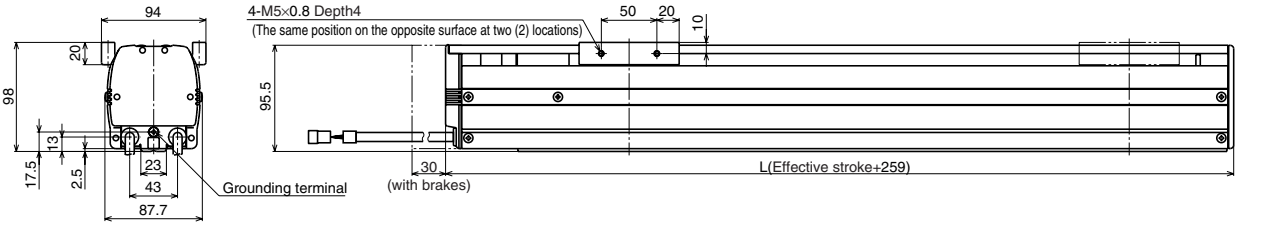
•During vertical use

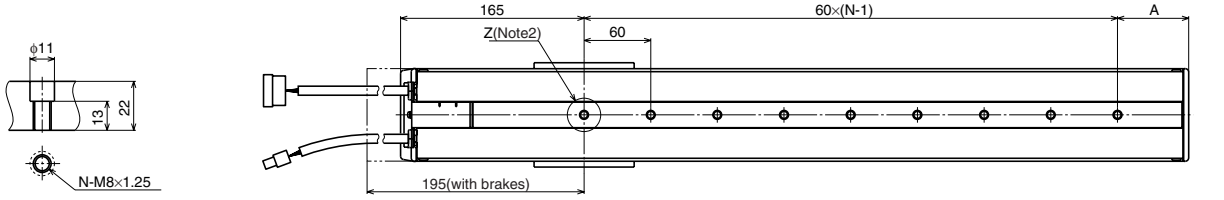
(Unit: mm)

		0°	45°	90°
Lead20	1kg	1428	1010	1428
	2kg	715	505	715
	4kg	356	252	356
Lead10	4kg	500	354	500
	8kg	236	167	236
	10kg	183	129	183
Lead5	10kg	144	102	144
	15kg	85	60	85
	20kg	55	39	55

*4 Distance from center of slider top to center of gravity of object being transported.







Z section detailed chart (Note 2)

Effective stroke	150	250	350	450	550	650	750	850	950	1050
L	409	509	609	709	809	909	1009	1109	1209	1309
A	64	44	84	64	44	84	64	44	84	64
N	4	6	7	9	11	12	14	16	17	19
Weight (kg)(Note 3)	5.5	6.2	6.9	7.6	8.3	9.0	9.7	10.3	11.0	11.7

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.
Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.
Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-4 T9H

■Mechanical unit specifications

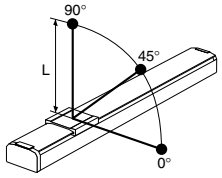
AC servo motor output (W)		100		
Repeatability (mm)*1		±0.01		
Deceleration mechanism		Ball screw (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec)*2		1200	600	300
Maximum payload (kg)	Horizontal	40	80	100
	Vertical	8	20	30
Continuous rated thrust(N)		78	156	312
Stroke(mm)		150-1050(100 pitch)		
Cable length (m)		3.5(Standard),5,10		
Controller	Horizontal	SRCX-10		
	Vertical	SRCX-10-R		

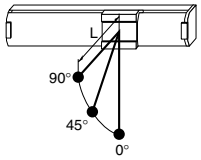
*1. Repeatability for single oscillation

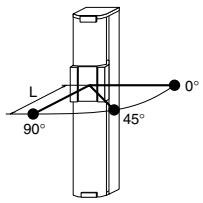
*2. If the stroke exceeds 750mm, resonance of the ball screw may occur depending on the motion range (hazardous speed). In this case, adjust the speed in the program using the following maximum speeds as a guideline. This is not required if resonance does not occur.

Stroke (mm)	Maximum speed (mm/sec)	SPEED setting
750	960/480/240	80%
850	780/390/195	65%
950	600/300/150	50%
1050	540/270/135	45%

■Tolerable overhang amount*3







•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead20	10kg	194	224	404
	20kg	94	106	199
	40kg	43	48	101
Lead10	30kg	63	81	230
	50kg	34	44	160
	80kg	18	24	126
Lead5	60kg	31	43	240
	80kg	20	28	198
	100kg	14	19	165

•During wall installation use

(Unit: mm)

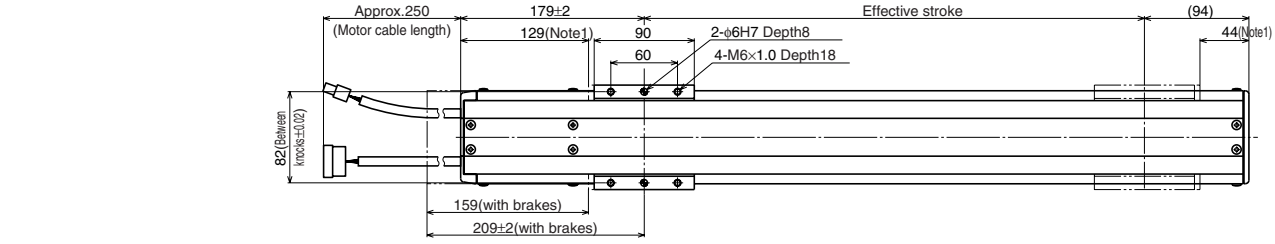
		0°	45°	90°
Lead20	10kg	259	137	128
	20kg	81	38	29
	40kg	0	0	0
Lead10	30kg	186	52	38
	50kg	95	19	13
	80kg	0	0	0
Lead5	60kg	508	58	40
	80kg	268	20	14
	100kg	0	0	0

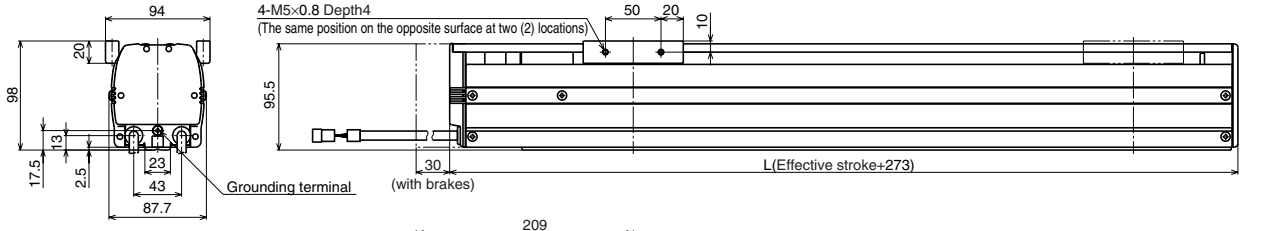
•During vertical use

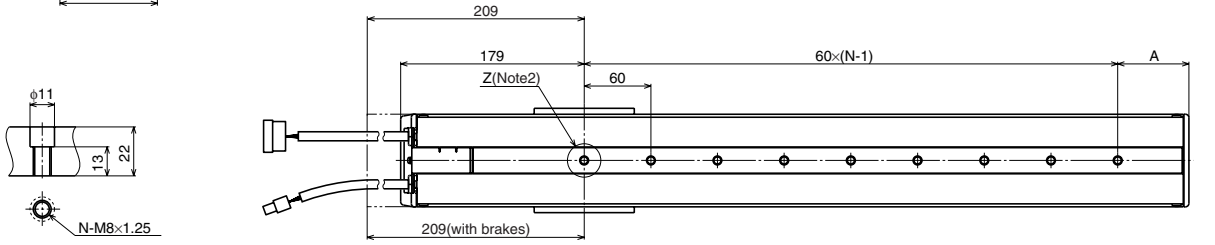
(Unit: mm)

		0°	45°	90°
Lead20	4kg	324	229	324
	6kg	208	147	208
	8kg	150	106	150
Lead10	10kg	182	129	182
	15kg	111	78	111
	20kg	75	53	75
Lead5	15kg	85	60	85
	20kg	55	39	55
	30kg	26	18	26

*3 Distance from center of slider top to center of gravity of object being transported.







Z section detailed chart (Note 2)

Effective stroke	150	250	350	450	550	650	750	850	950	1050
L	423	523	623	723	823	923	1023	1123	1223	1323
A	64	44	84	64	44	84	64	44	84	64
N	4	6	7	9	11	12	14	16	17	19
Weight (kg)(Note 3)	5.8	6.5	7.3	8.0	8.8	9.5	10.2	11.0	11.7	12.5

Note 1: This is the position at which the slideris stopped by mechanical stoppers at both ends.

Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.

Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-5 F10

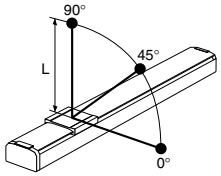
■Mechanical unit specifications

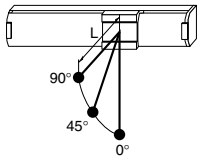
AC servo motor output (W)		100		
Repeatability (mm)*1		±0.01		
Deceleration mechanism		Ball screw (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec)*3		1200	600	300
Maximum payload (kg)	Horizontal	20	40	60
	Vertical	4	10	20
Continuous rated thrust(N)		78	156	312
Stroke(mm)		150-1050(100 pitch)		
Cable length(m)		3.5(Standard),5,10		
Controller	Horizontal	SRCX-05		
	Vertical	SRCX-05*2		

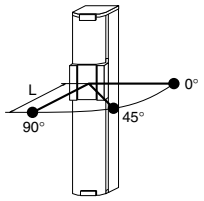
*1. Repeatability for single oscillation
*2. The regenerative control RGU2 is required when using in the vertical position.
*3. If the stroke exceeds 750mm, resonance of the ball screw may occur depending on the motion range (hazardous speed). In this case, adjust the speed in the program using the following maximum speeds as a guideline. This is not required if resonance does not occur.

Stroke (mm)	Maximum speed (mm/sec)	SPEED setting
750	960/480/240	80%
850	780/390/195	65%
950	600/300/150	50%
1050	540/270/135	45%

■Tolerable overhang amount*4







•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead20	5kg	242	291	547
	10kg	120	146	302
	20kg	55	70	181
Lead10	15kg	67	87	227
	30kg	22	29	89
	40kg	7	9	40
Lead5	30kg	23	33	319
	50kg	1	2	52
	60kg	0	0	0

•During wall installation use

(Unit: mm)

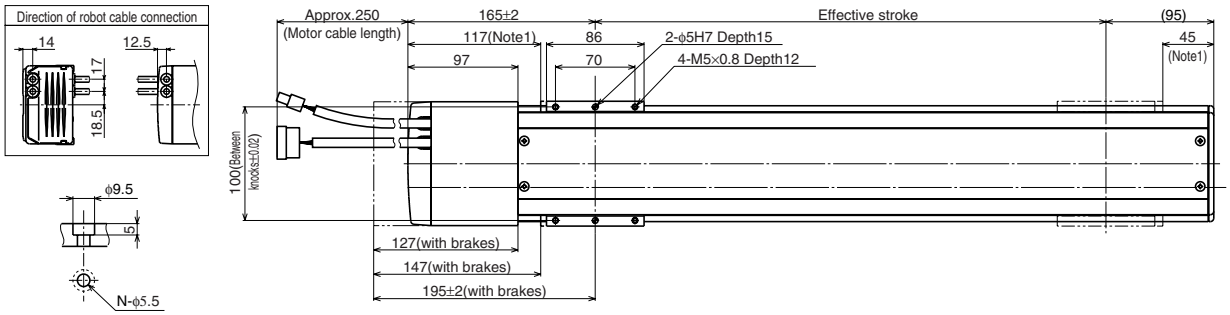
		0°	45°	90°
Lead20	5kg	445	223	195
	10kg	237	106	78
	20kg	116	32	18
Lead10	10kg	247	127	94
	20kg	151	35	22
	30kg	0	0	0
Lead5	10kg	610	149	106
	20kg	283	38	27
	30kg	0	0	0

•During vertical use

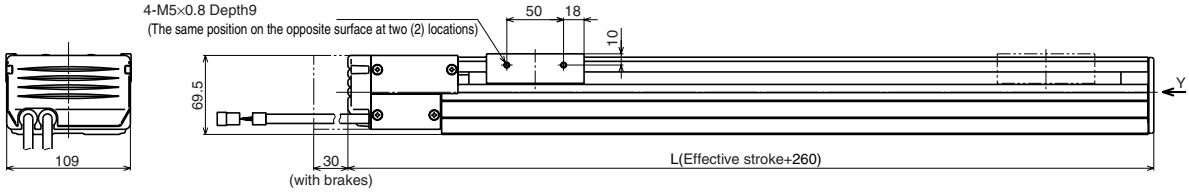
(Unit: mm)

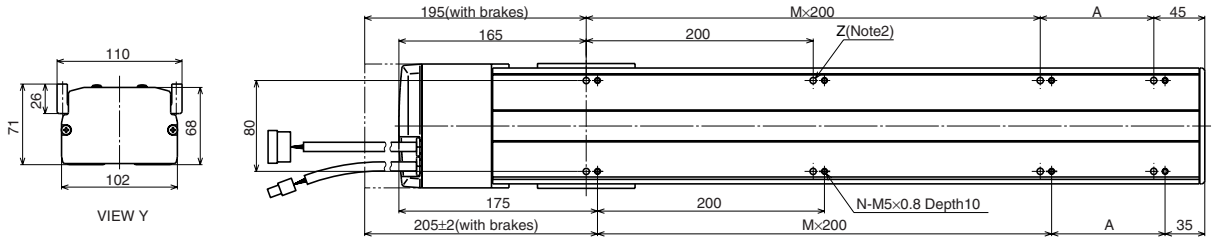
		0°	45°	90°
Lead20	1kg	835	590	793
	2kg	423	299	381
	4kg	216	152	174
Lead10	4kg	302	214	260
	8kg	147	104	105
	10kg	116	82	74
Lead5	10kg	93	66	51
	15kg	59	41	17
	20kg	42	29	0

*4 Distance from center of slider top to center of gravity of object being transported.



Z section detailed chart (Note 2)





VIEW Y

Effective stroke	150	250	350	450	550	650	750	850	950	1050
L	410	510	610	710	810	910	1010	1110	1210	1310
A	200	100	200	100	200	100	200	100	200	100
M	0	1	1	2	2	3	3	4	4	5
N	4	6	6	8	8	10	10	12	12	14
Weight (kg)(Note 3)	5.0	5.8	6.5	7.3	8.1	8.8	9.6	10.4	11.1	11.9

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.
Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.
Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-6 F14

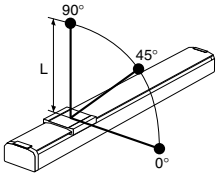
■Mechanical unit specifications

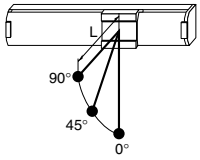
AC servo motor output (W)		100		
Repeatability (mm)*1		±0.01		
Deceleration mechanism		Ball screw (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec)*3		1200	600	300
Maximum payload (kg)	Horizontal	30	55	80
	Vertical	4	10	20
Continuous rated thrust(N)		78	156	312
Stroke(mm)		150-1050(50 pitch)		
Cable length(m)		3.5(Standard),5,10		
Controller	Horizontal	SRCX-05		
	Vertical	SRCX-05*2		

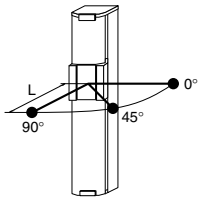
*1. Repeatability for single oscillation
*2. The regenerative control RGU2 is required when using in the vertical position.
*3. If the stroke exceeds 750mm, resonance of the ball screw may occur depending on the motion range (hazardous speed). In this case, adjust the speed in the program using the following maximum speeds as a guideline. This is not required if resonance does not occur.

Stroke (mm)	Maximum speed (mm/sec)	SPEED setting
750	960/480/240	80%
850	780/390/195	65%
950	600/300/150	50%
1050	540/270/135	45%

■Tolerable overhang amount *4







•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead20	5kg	776	786	1537
	15kg	319	339	726
	30kg	217	280	747
Lead10	20kg	273	337	579
	40kg	159	200	370
	55kg	128	166	378
Lead5	50kg	167	230	587
	60kg	145	200	517
	80kg	103	144	420

•During wall installation use

(Unit: mm)

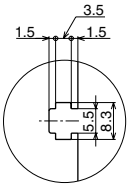
		0°	45°	90°
Lead20	5kg	934	585	871
	15kg	436	233	245
	30kg	368	128	111
Lead10	20kg	540	231	206
	40kg	258	64	42
	55kg	0	0	0
Lead5	30kg	953	148	103
	40kg	576	52	37
	60kg	0	0	0

•During vertical use

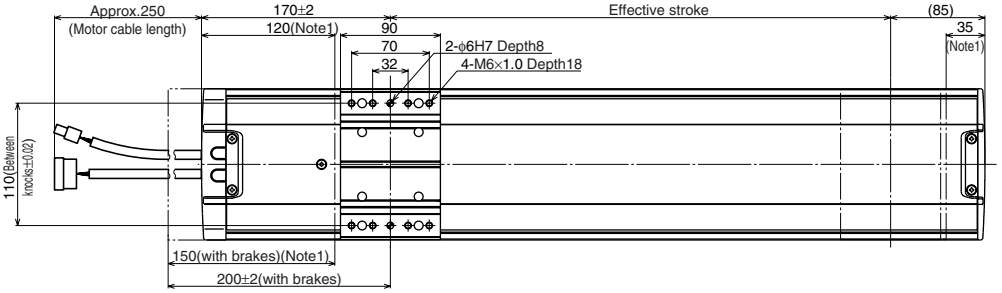
(Unit: mm)

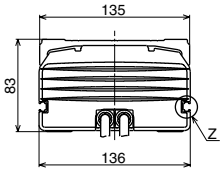
		0°	45°	90°
Lead20	1kg	1029	1233	2118
	2kg	530	626	1066
	4kg	280	320	538
Lead10	4kg	361	504	995
	8kg	179	246	479
	10kg	143	195	377
Lead5	10kg	105	150	312
	15kg	66	94	194
	20kg	47	66	135

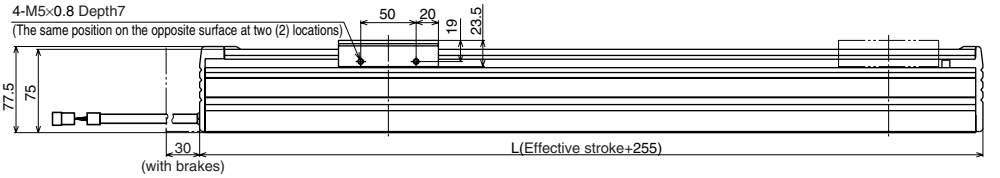
*4 Distance from center of slider top to center of gravity of object being transported.

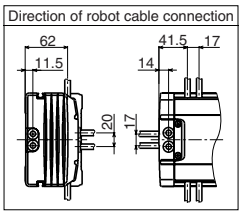


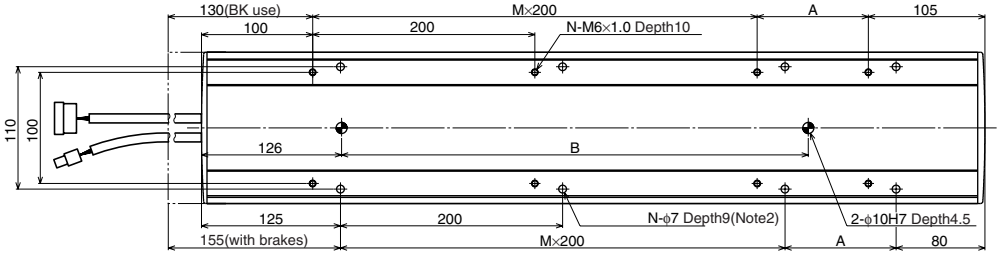
Z section detailed chart











Effective stroke	150	250	350	450	550	650	750	850	950	1050
L	405	505	605	705	805	905	1005	1105	1205	1305
A	200	100	200	100	200	100	200	100	200	100
M	0	1	1	2	2	3	3	4	4	5
N	4	6	6	8	8	10	10	12	12	14
B	240	240	420	420	600	600	780	780	960	960
Weight (kg)(Note 3)	6.2	7.5	8.8	10.1	11.4	12.6	13.9	15.2	16.5	17.8

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.
Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.
Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-7 F14H

■Mechanical unit specifications

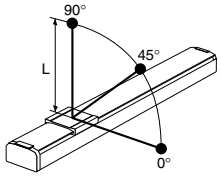
AC servo motor output (W)		200		
Repeatability (mm)*1		±0.01		
Deceleration mechanism		Ball screw (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec)*2		1200	600	300
Maximum payload (kg)	Horizontal	40	80	100
	Vertical	8	20	30
Continuous rated thrust(N)		156	312	625
Stroke(mm)		150-1050(100 pitch)		
Cable length(m)		3.5(Standard),5,10		
Controller	Horizontal	SRCX-10		
	Vertical	SRCX-10-R		

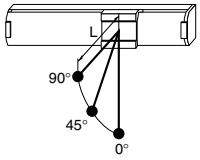
*1. Repeatability for single oscillation

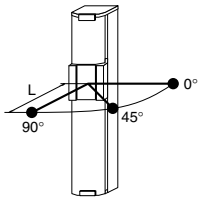
*2. If the stroke exceeds 750mm, resonance of the ball screw may occur depending on the motion range (hazardous speed). In this case, adjust the speed in the program using the following maximum speeds as a guideline. This is not required if resonance does not occur.

Stroke (mm)	Maximum speed (mm/sec)	SPEED setting
750	960/480/240	80%
850	780/390/195	65%
950	600/300/150	50%
1050	540/270/135	45%

■Tolerable overhang amount*3







•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead20	10kg	833	881	1836
	20kg	454	490	1067
	40kg	258	317	691
Lead10	30kg	363	479	1106
	50kg	235	315	822
	80kg	164	224	706
Lead5	60kg	237	331	1630
	80kg	187	262	1396
	100kg	157	220	1228

•During wall installation use

(Unit: mm)

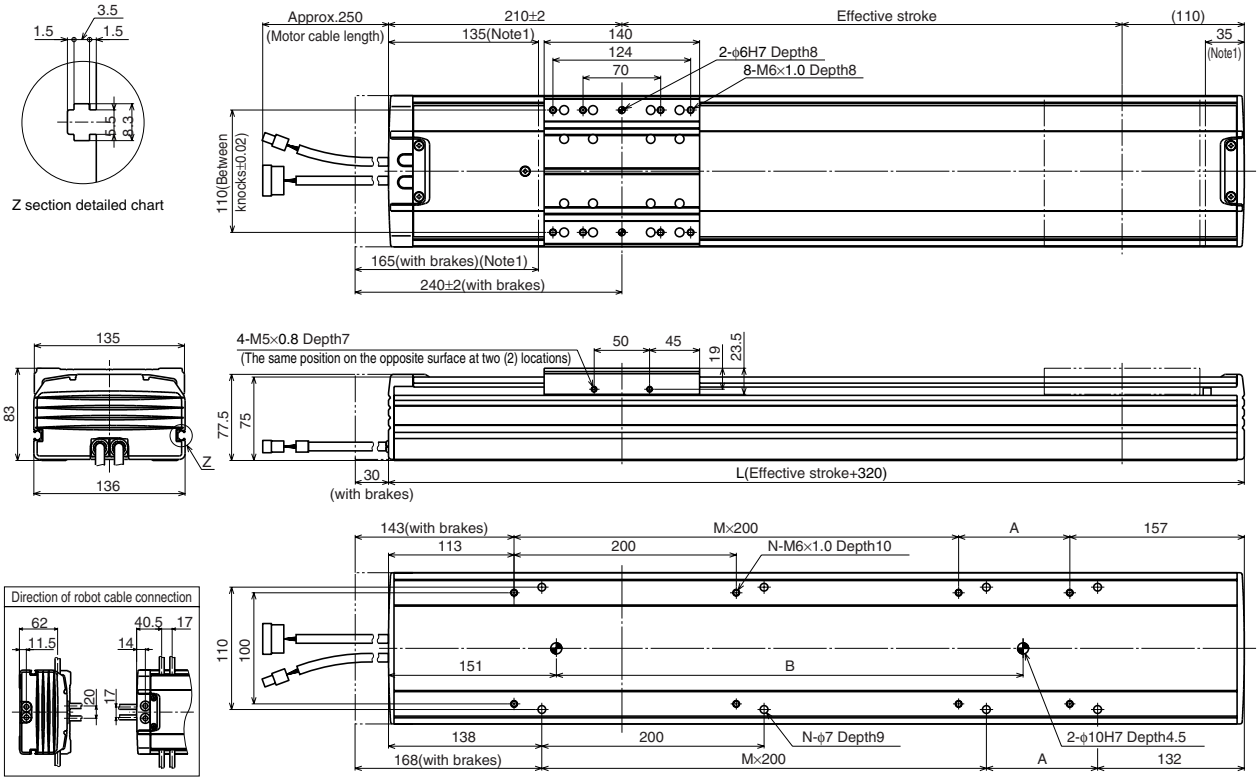
		0°	45°	90°
Lead20	10kg	943	517	557
	20kg	531	290	298
	40kg	307	134	126
Lead10	30kg	1040	342	282
	50kg	690	167	120
	80kg	401	43	30
Lead5	60kg	734	62	43
	80kg	359	12	8
	100kg	0	0	0

•During vertical use

(Unit: mm)

		0°	45°	90°
Lead20	4kg	704	840	1439
	6kg	473	562	962
	8kg	357	422	723
Lead10	10kg	418	578	1122
	15kg	276	380	734
	20kg	206	281	541
Lead5	20kg	151	218	451
	25kg	119	171	353
	30kg	98	140	286

*3 Distance from center of slider top to center of gravity of object being transported.



Effective stroke	150	250	350	450	550	650	750	850	950	1050
L	470	570	670	770	870	970	1070	1170	1270	1370
A	200	100	200	100	200	100	200	100	200	100
M	0	1	1	2	2	3	3	4	4	5
N	4	6	6	8	8	10	10	12	12	14
B	240	240	420	420	600	600	780	780	960	960
Weight (kg)(Note 3)	7.5	8.8	10.1	11.4	12.7	13.9	15.2	16.5	17.8	19.1

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.

Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.

Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-8 F17

■Mechanical unit specifications

AC servo motor output (W)		400	
Repeatability (mm)*1		±0.01	
Deceleration mechanism		Ball screw (Class C7)	
Ball screw lead (mm)		20	10
Maximum speed (mm/sec)*2		1200	600
Maximum payload (kg)	Horizontal	80	120
	Vertical	15	35
Continuous rated thrust(N)		312	625
Stroke(mm)		250-1250(100 pitch)	
Cable length(m)		3.5(Standard),5,10	
Controller	Horizontal	SRCX-20	
	Vertical	SRCX-20-R	

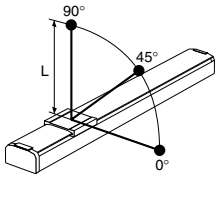
*1. Repeatability for single oscillation

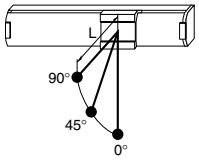
*2. If the stroke exceeds 750mm, resonance of the ball screw may occur depending on the motion range (hazardous speed). In this case, adjust the speed in the program using the following maximum speeds as a guideline. This is not required if resonance does not occur.

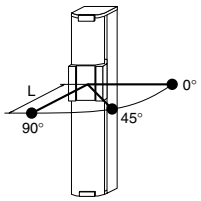
Stroke (mm)	Maximum speed (mm/sec)	SPEED setting
850	1020/510/225	80%
950	840/420/210	70%
1050	720/360/180	60%
1150	600/300/150	50%
1250	480/240	40%

*3. A regenerative unit RGU2 is required.

■Tolerable overhang amount*3







•During horizontal use

(Unit: mm)

		0°	45°	90°
Lead20	30kg	775	932	1759
	50kg	474	581	1216
	80kg	308	395	1040
Lead10	60kg	399	536	1403
	100kg	229	313	1103
	120kg	184	252	959

•During wall installation use

(Unit: mm)

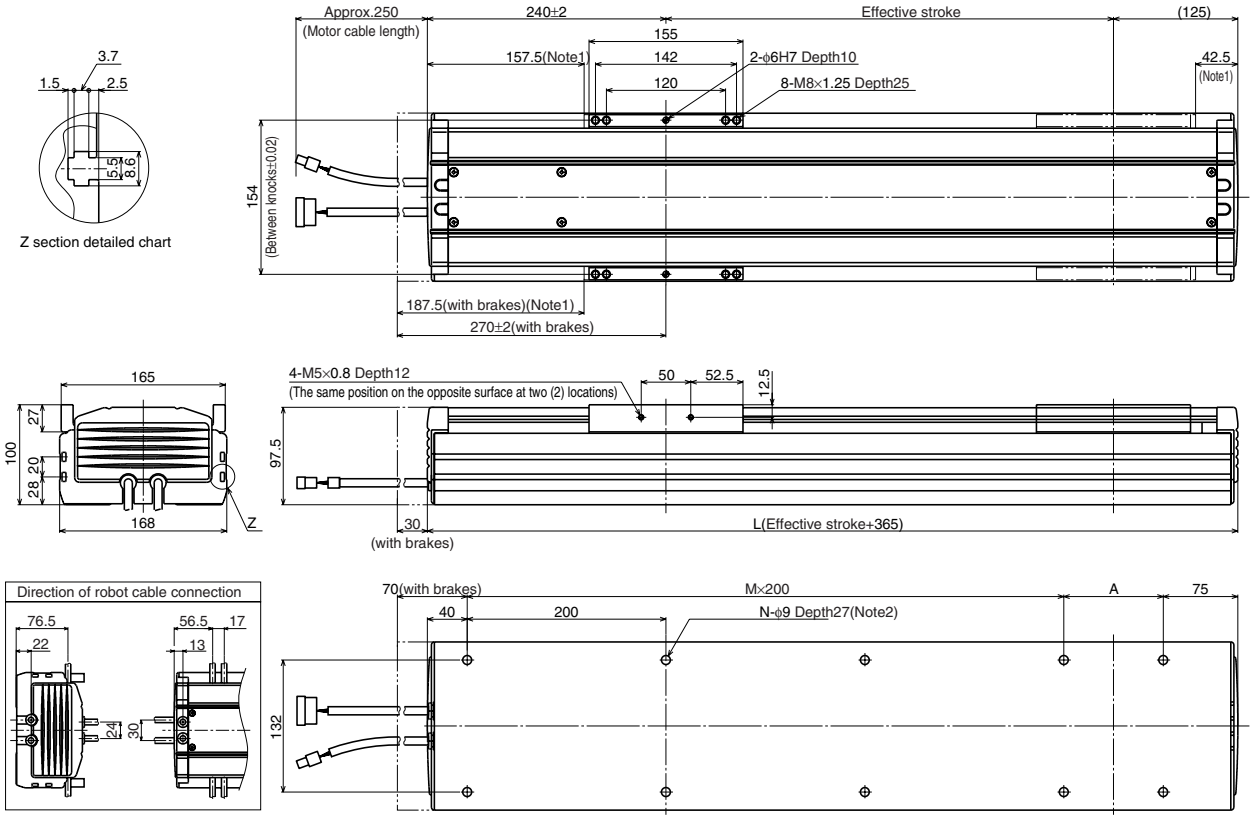
		0°	45°	90°
Lead20	30kg	1098	566	564
	50kg	735	339	328
	80kg	586	218	197
Lead10	60kg	1325	490	395
	100kg	962	266	202
	120kg	800	202	152

•During vertical use

(Unit: mm)

		0°	45°	90°
Lead20	5kg	2367	1674	2367
	10kg	1214	858	1214
	15kg	820	580	820
Lead10	15kg	1624	1148	1624
	25kg	962	680	962
	35kg	676	478	676

*3 Distance from center of slider top to center of gravity of object being transported.



Effective stroke	250	350	450	550	650	750	850	950	1050	1150	1250
L	615	715	815	915	1015	1115	1215	1315	1415	1515	1615
A	100	200	100	200	100	200	100	200	100	200	100
M	2	2	3	3	4	4	5	5	6	6	7
N	8	8	10	10	12	12	14	14	16	16	18
Weight (kg)(Note 3)	15.3	17.0	18.6	20.3	21.9	23.6	25.2	26.9	28.5	30.2	31.8

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.

Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.

Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-9 F20

■ Mechanical unit specifications

AC servo motor output (W)		600	
Repeatability (mm)*1		±0.01	
Deceleration mechanism		Ball screw (Class C7)	
Ball screw lead (mm)		20	10
Maximum speed (mm/sec)*2		1200	600
Maximum payload (kg)	Horizontal	120	–
	Vertical	25	45
Continuous rated thrust(N)		468	936
Stroke(mm)		250-1250(100 pitch)	
Cable length(m)		3.5(Standard),5,10	
Controller	Horizontal	SRCX-20	
	Vertical	SRCX-20-R	

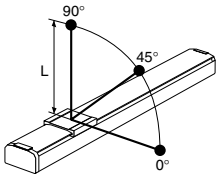
*1. Repeatability for single oscillation

*2. If the stroke exceeds 850mm, resonance of the ball screw may occur depending on the motion range (hazardous speed). In this case, adjust the speed in the program using the following maximum speeds as a guideline. This is not required if resonance does not occur.

Stroke (mm)	Maximum speed (mm/sec)	SPEED setting
850	1020/510/225	80%
950	840/420/210	70%
1050	720/360/180	60%
1150	600/300/150	50%
1250	480/240	40%

*3. A regenerative unit RGU2 is required.

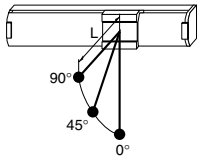
■ Tolerable overhang amount*3



•During horizontal use

(Unit: mm)

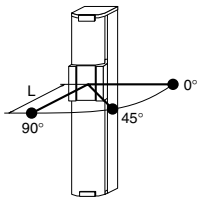
		0°	45°	90°
Lead20	50kg	877	1085	2267
	80kg	566	721	1769
	120kg	407	544	1869



•During wall installation use

(Unit: mm)

		0°	45°	90°
Lead20	50kg	1403	658	642
	80kg	1056	425	396
	120kg	1049	311	259

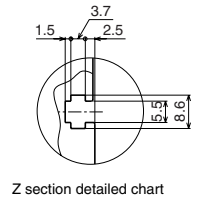


•During vertical use

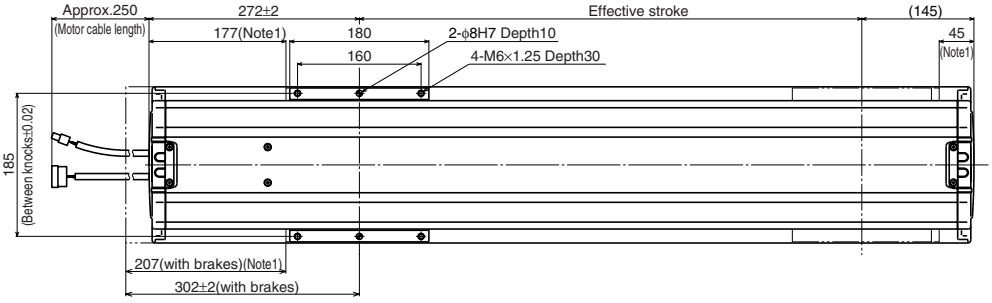
(Unit: mm)

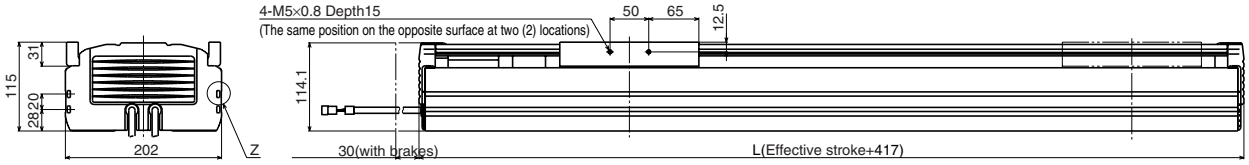
		0°	45°	90°
Lead20	15kg	1331	941	1331
	20kg	993	702	993
	25kg	816	577	816
Lead10	20kg	2043	1444	2043
	30kg	1352	956	1352
	45kg	887	627	887

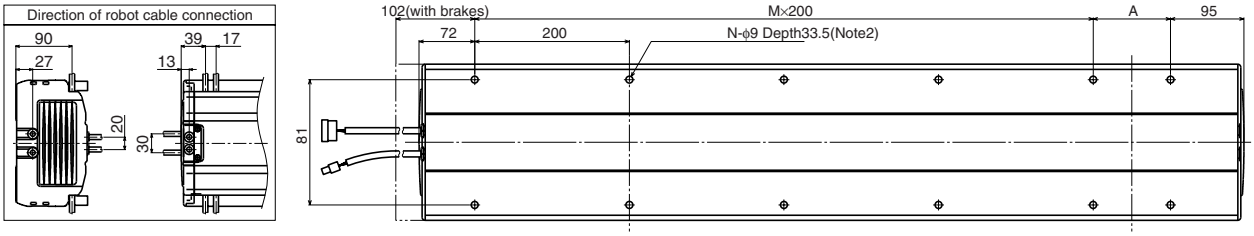
*4 Distance from center of slider top to center of gravity of object being transported.



Z section detailed chart







Effective stroke	250	350	450	550	650	750	850	950	1050	1150	1250
L	667	767	867	967	1067	1167	1267	1367	1467	1567	1667
A	100	200	100	200	100	200	100	200	100	200	100
M	2	2	3	3	4	4	5	5	6	6	7
N	8	8	10	10	12	12	14	14	16	16	18
Weight (kg)(Note 3)	22.0	23.8	25.7	27.5	29.4	31.2	33.0	34.9	36.7	38.6	40.4

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.

Note 2: When installing the unit, washers, etc., cannot be used in the counter bore hole.

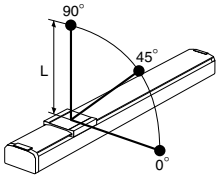
Note 3: This is the weight of models without a break. The models equipped with a brake are 0.5kg heavier than these values.

5-1-10 F20N

■ Mechanical unit specifications

AC servo motor output (W)	400
Repeatability (mm)*1	±0.04
Deceleration mechanism	Ball screw (Class C10)
Ball screw lead (mm)	20
Maximum speed (mm/sec)	1000 (1200*2)
Maximum payload (kg)	80
Continuous rated thrust(N)	312
Stroke(mm)	1150 to 2050 (100 pitch)
Cable length(m)	3 (Standard), 5,10
Controller	SRCX-20

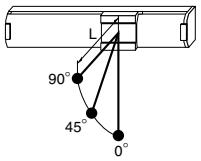
*1. Repeatability for single oscillation
*2. A regenerative unit RGU2 is required.



•During horizontal use

(Unit: mm)

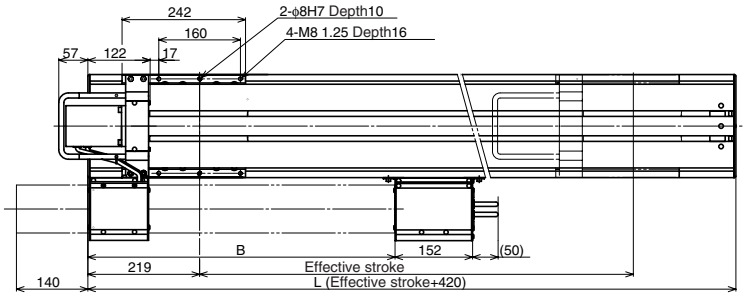
		0°	45°	90°
Lead20	20kg	2209	2612	4576
	40kg	1141	1401	2787
	60kg	784	1000	2384
	80kg	616	816	2518

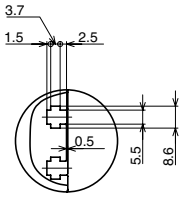


•During wall installation use

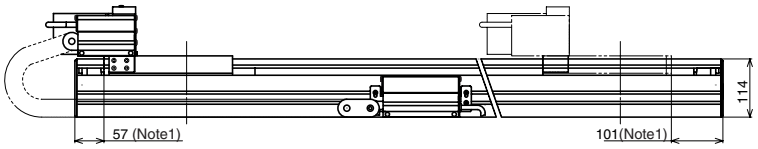
(Unit: mm)

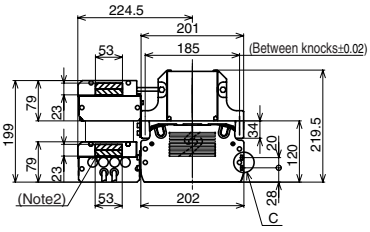
		0°	45°	90°
Lead20	20kg	3510	1998	2032
	40kg	2108	1055	1026
	60kg	1760	741	693
	80kg	1797	601	529

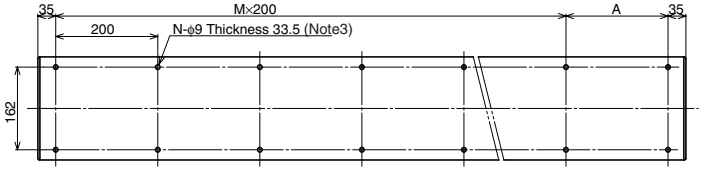


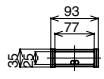


C section detailed chart









Cross section of cable guide

Effective stroke	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050
L	1570	1670	1770	1870	1970	2070	2170	2270	2370	2470
A	100	200	100	200	100	200	100	200	100	200
B	602	648	694	740	786	832	978	924	970	1016
M	7	7	8	8	9	9	10	10	11	11
N	18	18	20	20	22	2.2	24	24	26	26
Weight (kg)	54	56.2	58.4	606	62.9	65.1	67.3	69.6	71.8	74

Note 1: This is the position at which the slider is stopped by mechanical stoppers at both ends.
Note 2: Shaded area indicates the user cable extraction slot.
Note 3: When installing the robot, do not use any washer inside the robot frame.

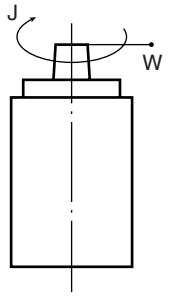
5-1-11 R5

Mechanical unit specifications

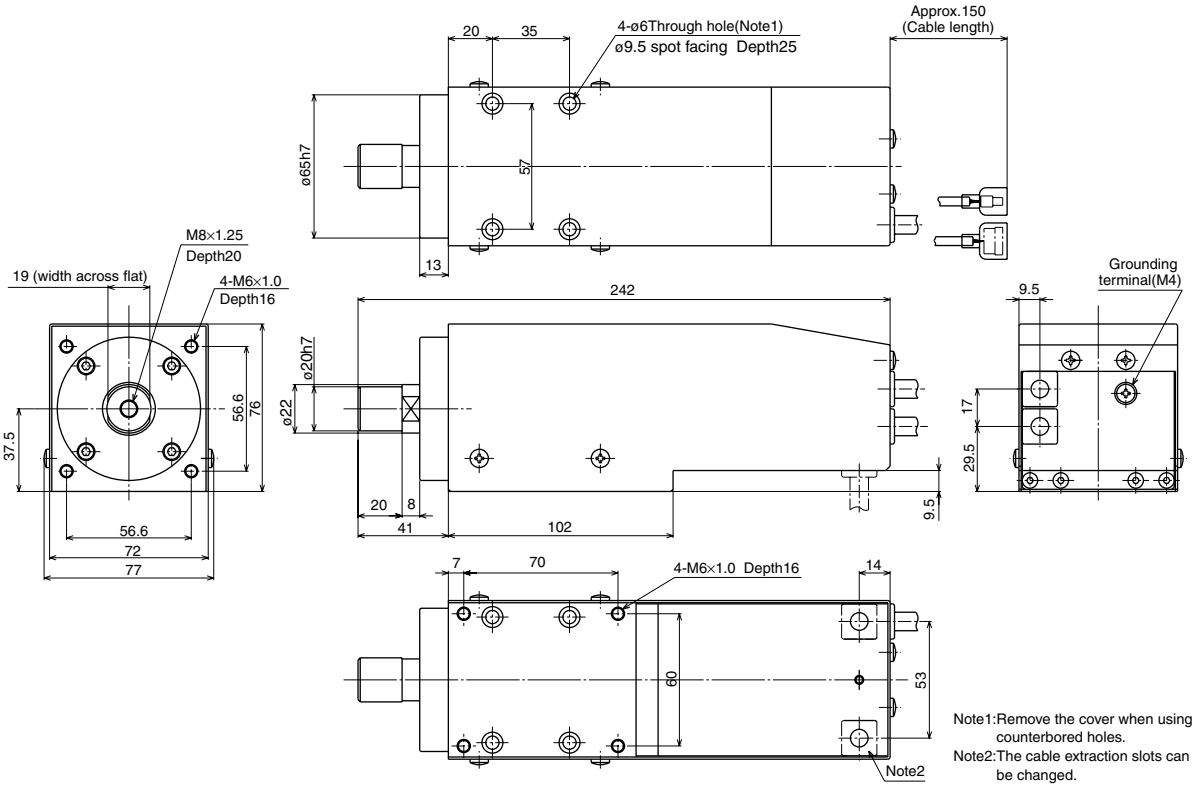
AC servo motor output (W)	50
Maximum speed (deg/sec)	360
Repeatability (sec)	±30
Maximum Allowable Moment Inertia	1.2kgf·cm·sec^2 (0.12kg·m^2)
Rated torque (kg·m)	0.54
Speed reduction ratio	1/50
Rotation range (deg)	360
Cable length (m)	3.5(Standard),5,10
Controller	SRCX-05

Allowable Moment Inertia

payload parameters W(kg)	1	2	3	4	5	6	7	8	9	10
Allowable Moment Inertia J (kgf·cm·sec^2)	0.12	0.24	0.36	0.48	0.60	0.72	0.84	0.96	1.08	1.20



Note: When the weight of a tool or workpiece attached to the shaft R5 is W (kg), its moment of inertia (J) must be smaller than the values shown in the table above. (For example, enter 4kg if W is 3kg and J is 0.48kgf cm sec^2.) Enter the above mass parameter value for the controller, and optimum acceleration is automatically set based on this value.



Note1:Remove the cover when using counterbored holes.
Note2:The cable extraction slots can be changed.

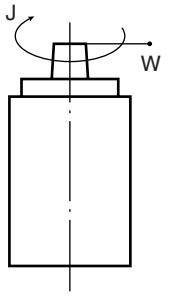
5-1-12 R10

Mechanical unit specifications

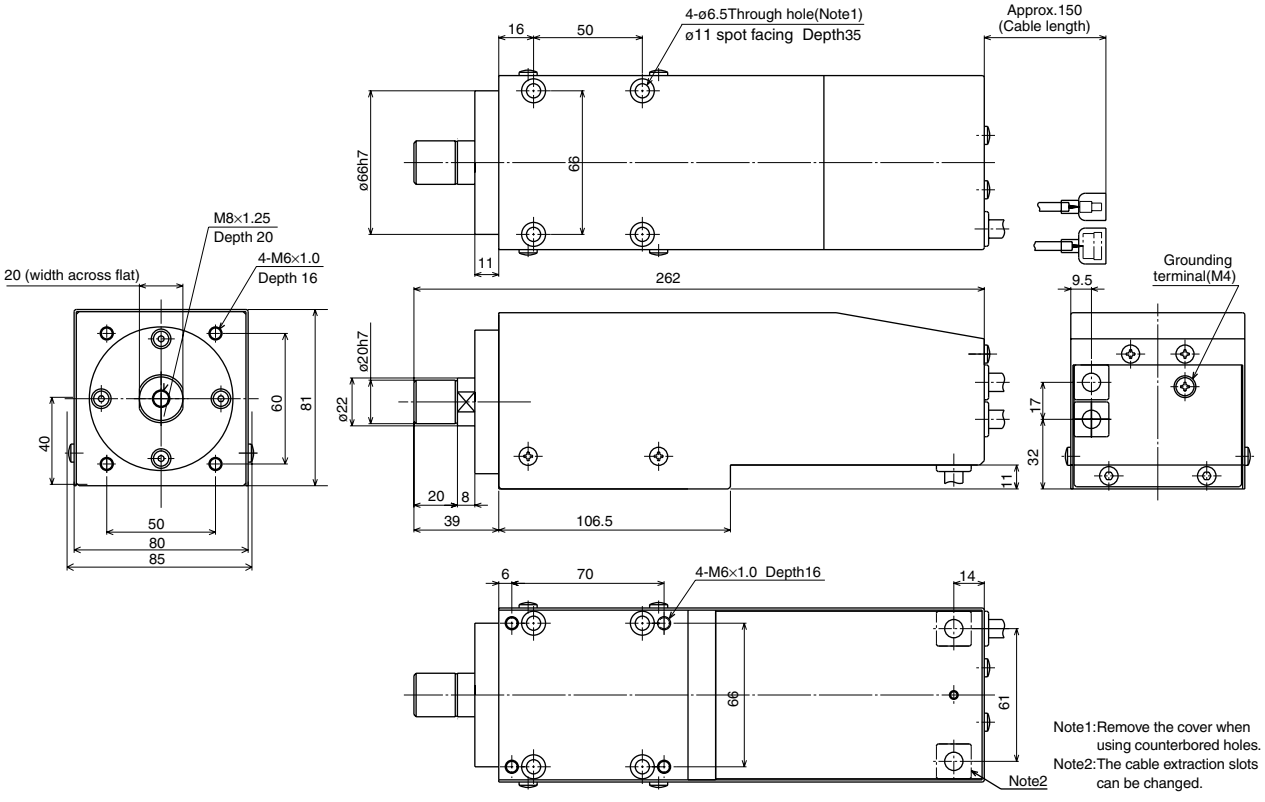
AC servo motor output (W)	100
Maximum speed (deg/sec)	360
Repeatability (sec)	±30
Maximum Allowable Moment Inertia	3.71kgf·cm·sec^2 (0.36kgm^2)
Rated torque (kg·m)	1.10
Speed reduction ratio	1/50
Rotation range (deg)	360
Cable length (m)	3.5(Standard),5,10
Controller	SRCX-05

Allowable Moment Inertia

payload parameters W(kg)	1	2	3	4	5	6	7	8	9	10
Allowable Moment Inertia J (kgf·cm·sec^2)	0.25	0.49	0.74	0.99	1.24	1.48	1.73	1.98	2.23	2.47
payload parameters W(kg)	11	12	13	14	15					
Allowable Moment Inertia J (kgf·cm·sec^2)	2.72	2.97	3.22	3.46	3.71					



Note: When the weight of a tool or workpiece attached to the shaft R10 is W (kg), its moment of inertia (J) must be smaller than the values shown in the table above. (For example, enter 4kg if W is 3kg and J is 0.99kgf cm sec^2.) Enter the above mass parameter value for the controller, and optimum acceleration is automatically set based on this value.



Note1: Remove the cover when using counterbored holes.
Note2: The cable extraction slots can be changed.

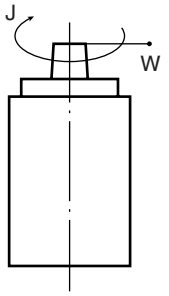
5-1-13 R20

Mechanical unit specifications

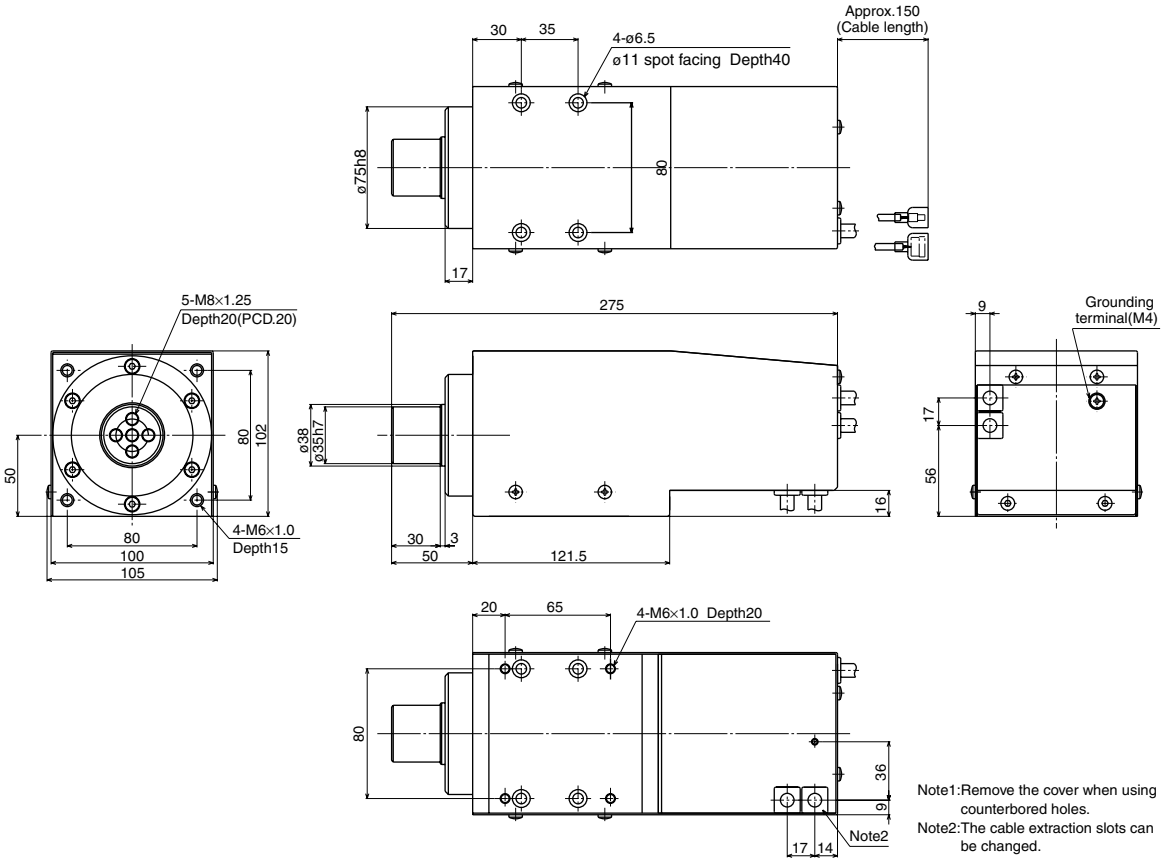
AC servo motor output (W)	200
Maximum speed (deg/sec)	360
Repeatability (sec)	±30
Maximum Allowable Moment Inertia	18.7kgf·cm·sec^2 (1.83kgm^2)
Rated torque (kg·m)	2.19
Speed reduction ratio	1/50
Rotation range (deg)	360
Cable length (m)	3.5(Standard),5,10
Controller	SRCX-10

Allowable Moment Inertia

payload parameters W(kg)	1	2	3	4	5	6	7	8	9	10
Allowable Moment Inertia J (kgf·cm·sec^2)	0.93	1.8	2.8	3.7	4.6	5.6	6.5	7.4	8.4	9.3
payload parameters W(kg)	11	12	13	14	15	16	17	18	19	20
Allowable Moment Inertia J (kgf·cm·sec^2)	10.2	11.2	12.1	13.1	14.0	14.9	15.9	16.8	17.7	18.7



Note: When the weight of a tool or workpiece attached to the shaft R20 is W (kg), its moment of inertia (J) must be smaller than the values shown in the table above. (For example, enter 4kg if W is 3kg and J is 3.7kgf cm sec^2.) Enter the above mass parameter value for the controller, and optimum acceleration is automatically set based on this value.



Note1:Remove the cover when using counterbored holes.
Note2:The cable extraction slots can be changed.

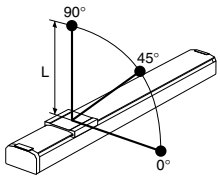
5-1-14 B10

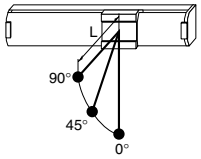
■Mechanical unit specifications

AC servo motor output (W)		100
Repeatability (mm)*1		±0.04
Deceleration mechanism		Timing belt
Lead (mm)		25
Maximum speed (mm/sec)		1875
Maximum payload (N)	Horizontal	98
	Vertical	-
Continuous rated thrust(N)		-
Stroke(mm)		150-2550(100 pitch)
Cable length(m)		3.5(Standard),5,10
Return to origin		- (stroke end)
Controller		SRCX-05

*1. Repeatability for single oscillation

■Tolerable overhang amount*2





•During horizontal use

(Unit: mm)

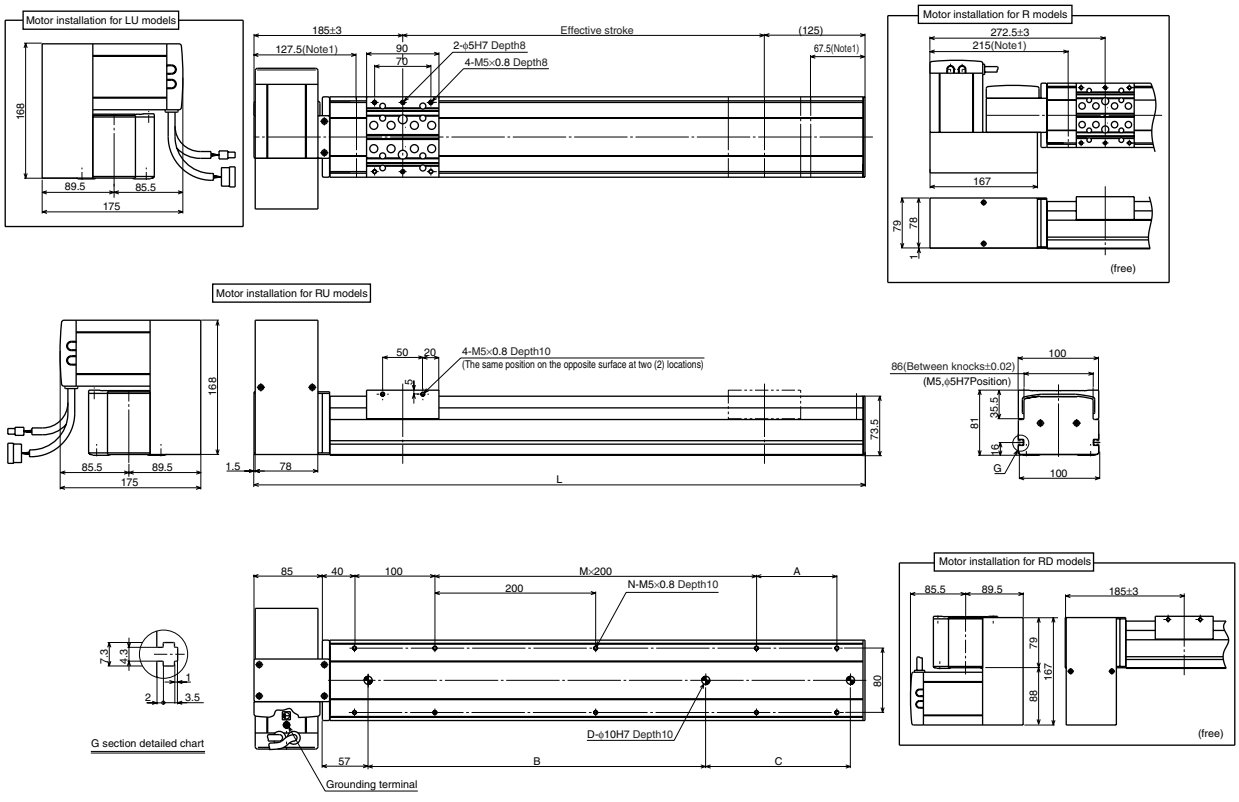
		0°	45°	90°
Lead25	3kg	598	589	1035
	5kg	391	394	731
	8kg	270	285	585
	10kg	230	253	564

•During wall installation use

(Unit: mm)

		0°	45°	90°
Lead25	3kg	901	578	639
	5kg	632	376	400
	8kg	499	260	262
	10kg	476	222	215

*2 Distance from center of slider top to center of gravity of object being transported.



Note 1: Stop positions set by mechanical stoppers at both ends.
Note 2: Motor can be installed in upward, downward or horizontal positions versus the robot movement axis.
Note 3: Motor can be installed on the right or left side of the robot movement axis.
Note 4: Cables can be extracted in upward, downward, forward or rearward directions.

Effective stroke	150	250	350	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350	2450	2550
L	460	560	660	760	860	960	1060	1160	1260	1360	1460	1560	1660	1760	1860	1960	2060	2160	2260	2360	2460	2560	2660	2760	2860
A	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200
B	240	240	420	600	600	780	780	960	960	1140	1140	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320
C	-	-	-	-	-	-	-	-	-	-	-	-	-	240	240	420	420	600	780	780	960	960	1140	1140	1320
D	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
M	-	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
N	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30

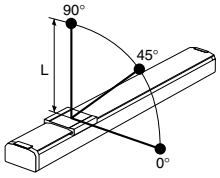
5-1-15 B14

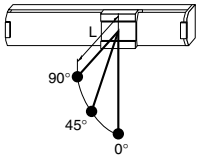
■Mechanical unit specifications

AC servo motor output (W)		100
Repeatability (mm)*1		±0.04
Deceleration mechanism		Timing belt
Lead (mm)		25
Maximum speed (mm/sec)		1875
Maximum payload (N)	Horizontal	196
	Vertical	-
Continuous rated thrust(N)		-
Stroke(mm)		150-3050(100 pitch)
Cable length(m)		3.5(Standard),5,10
Return to origin		- (stroke end)
Controller		SRCX-05

*1. Repeatability for single oscillation

■Tolerable overhang amount *2





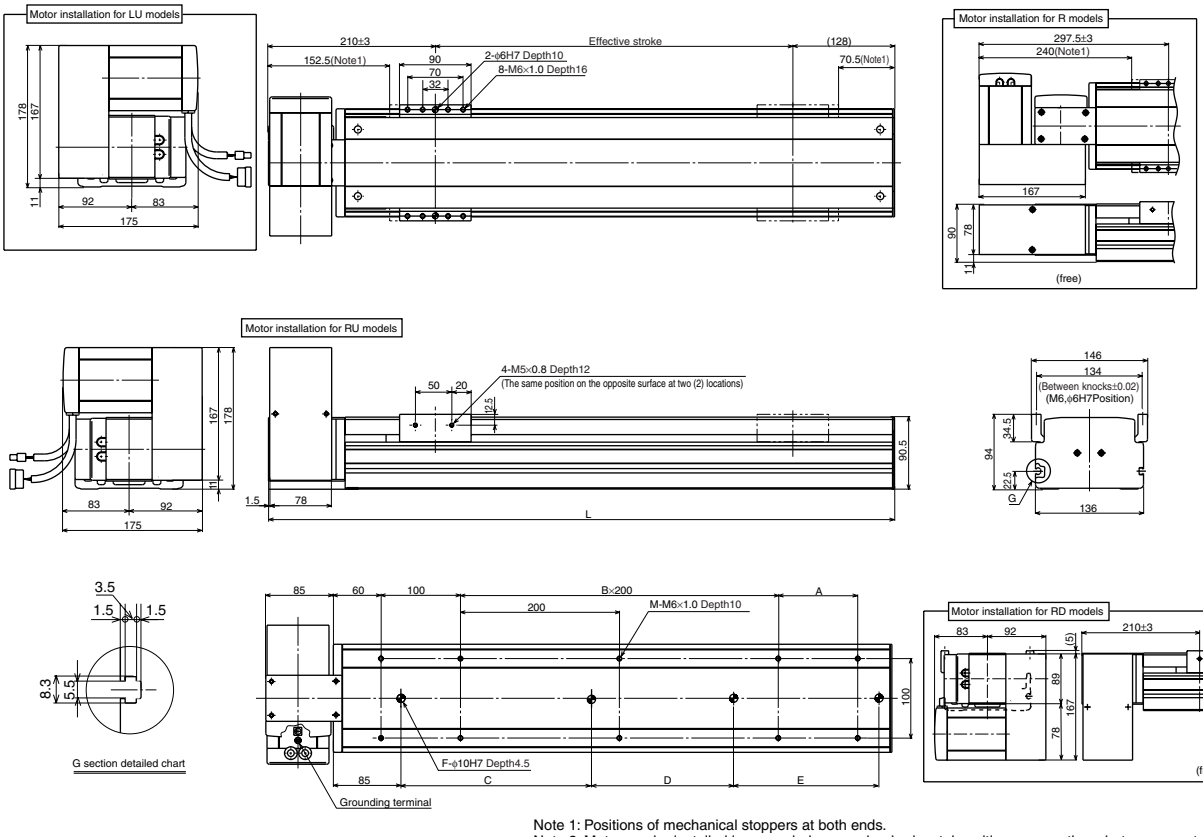
•During horizontal use

		0°	45°	90°
Lead25	5kg	511	456	799
	10kg	334	316	601
	20kg	201	198	402

•During wall installation use

		0°	45°	90°
Lead25	5kg	686	417	516
	10kg	473	261	304
	20kg	260	132	145

*2 Distance from center of slider top to center of gravity of object being transported.



Note 1: Positions of mechanical stoppers at both ends.
Note 2: Motor can be installed in upward, downward or horizontal positions versus the robot movement axis.
Note 3: Motor can be installed on the right or left side of the robot movement axis.
Note 4: Cables can be extracted in upward, downward, forward or rearward directions.

Effective stroke	150	250	350	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350	2450	2550	2650	2750	2850	2950	3050
L	488	588	688	788	888	988	1088	1188	1288	1388	1488	1588	1688	1788	1888	1988	2088	2188	2288	2388	2488	2588	2688	2788	2888	2988	3088	3188	3288	3388
M	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36
A	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100
B	-	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15
C	240	240	420	600	600	780	780	960	960	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140
D	-	-	-	-	-	-	-	-	-	-	-	240	240	420	420	600	600	780	780	960	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140
E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	240	240	420	600	600	780	780
F	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4

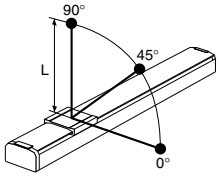
5-1-16 B14H

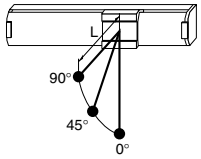
■Mechanical unit specifications

AC servo motor output (W)		200
Repeatability (mm)*1		±0.04
Deceleration mechanism		Timing belt
Lead (mm)		25
Maximum speed (mm/sec)		1875
Maximum payload (N)	Horizontal	294
	Vertical	-
Continuous rated thrust(N)		-
Stroke(mm)		150-3050(100 pitch)
Cable length(m)		3.5(Standard),5,10
Return to origin		- (stroke end)
Controller		SRCX-05*2

*1. Repeatability for single oscillation
*2. An RGU-2 is needed if the maximum speed is more than 1250mm/sec.

■Tolerable overhang amount*3





•During horizontal use

(Unit: mm)

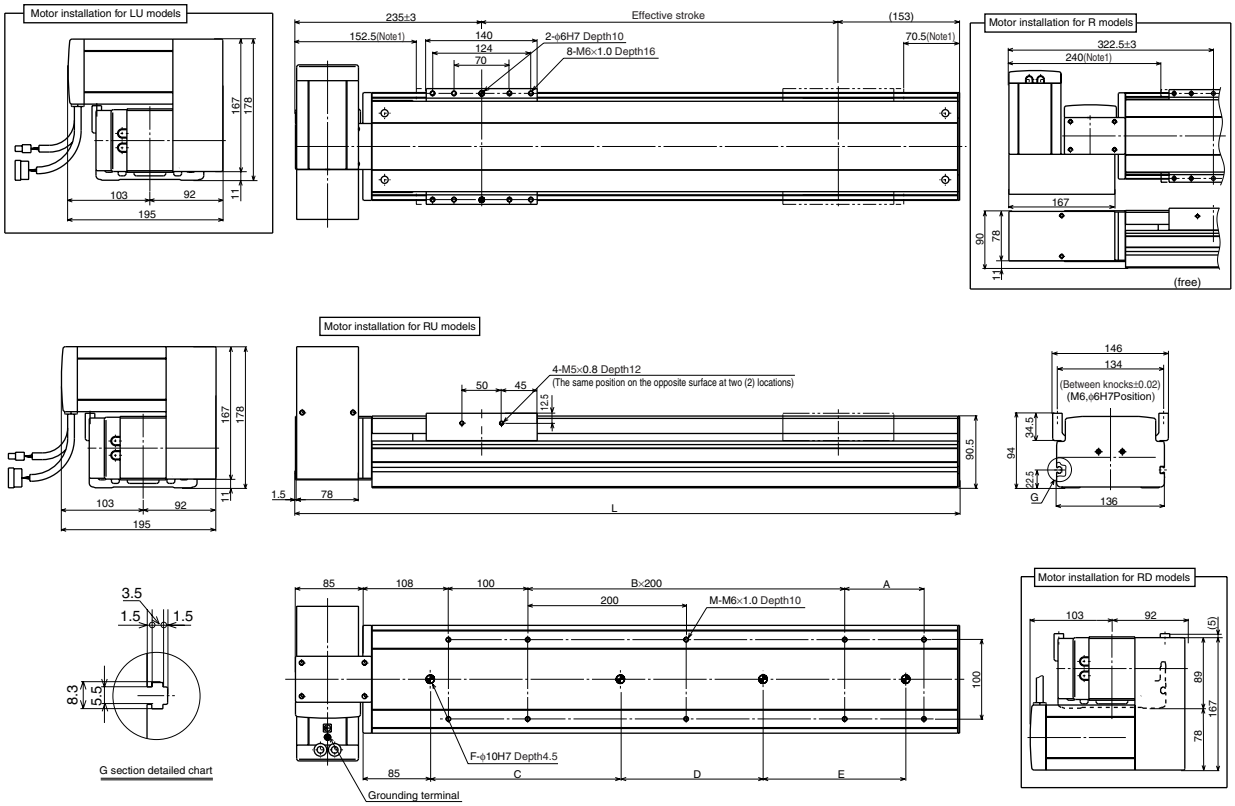
		0°	45°	90°
Lead25	5kg	1300	1284	2632
	10kg	712	724	1561
	20kg	434	480	1217
	30kg	312	354	955

•During wall installation use

(Unit: mm)

		0°	45°	90°
Lead25	5kg	2342	1221	1368
	10kg	1326	654	710
	20kg	939	388	383
	30kg	665	254	240

*3 Distance from center of slider top to center of gravity of object being transported.



Note 1: Positions of mechanical stoppers at both ends.
Note 2: Motor can be installed in upward, downward or horizontal positions versus the robot movement axis.
Note 3: Motor can be installed on the right or left side of the robot movement axis.
Note 4: Cables can be extracted in upward, downward, forward or rearward directions.

Effective stroke	150	250	350	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350	2450	2550	2650	2750	2850	2950	3050
L	538	638	738	838	938	1038	1138	1238	1338	1438	1538	1638	1738	1838	1938	2038	2138	2238	2338	2438	2538	2638	2738	2838	2938	3038	3138	3238	3338	3438
M	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36
A	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100
B	-	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15
C	240	420	420	600	600	780	780	960	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140
D	-	-	-	-	-	-	-	-	-	-	-	240	240	420	600	600	780	780	960	960	1140	1140	1140	1140	1140	1140	1140	1140	1140	1140
E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	240	240	420	420	600	600	780	960
F	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4

5-2 AC servo motor termination (T/F Type)

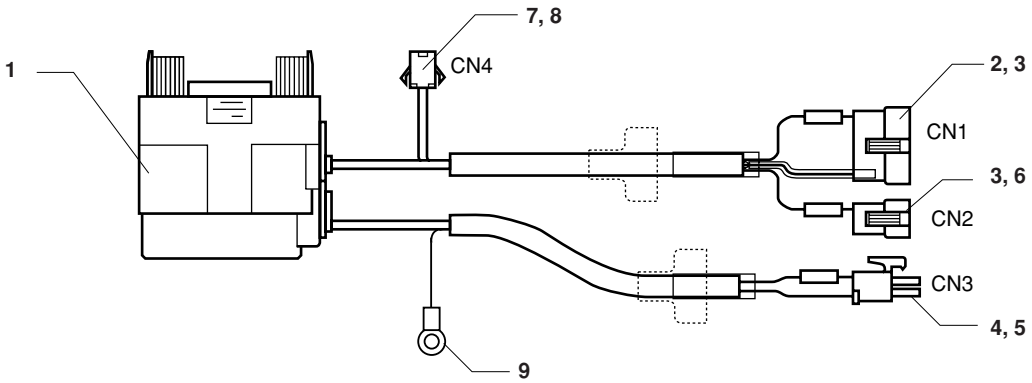
Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	BYM-001T-P0.6	JST	9	CN1, CN2
4	Plug housing	176273-1	AMP	1	CN3 (4 polarities)
5	Receptacle	175156-2	AMP	4	CN3
6	Receptacle housing	SMR-02V-B	JST	1	CN2 (2 polarities)
7	Plug housing	SMP-02V-BC	JST	1	CN4 (2 polarities)
8	Socket contact	BHF-001T-0.8BS	JST	2	CN4
9	Round terminal	1.25-M4		1	

Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow	P	Motor
	2	S4	Blue		
	3	S1	Red		
	4	S3	Black		
	5	R1	White		
	6	R2	Green		
	7	Shield	Black *		
CN2	1	BK	Gray		1
	2	BK	Brown		2
CN3	1	U	Red	M	Motor
	2	V	White		
	3	W	Black		
	4	PE	Yellow/green		Round terminal

* Heat shrinkable tube



5-3 AC servo motor termination (R/B Type, F20N)

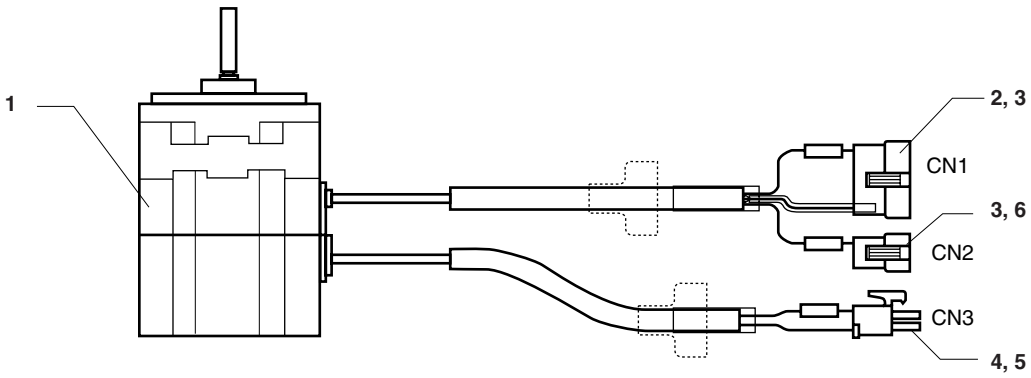
Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	BYM-001T-P0.6	JST	9	CN1, CN2
4	Plug housing	176273-1	AMP	1	CN3 (4 polarities)
5	Receptacle	175156-2	AMP	4	CN3
6	Receptacle housing	SMR-02V-B	JST	1	CN2 (2 polarities)

Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow	P	Motor
	2	S4	Blue		
	3	S1	Red		
	4	S3	Black		
	5	R1	White		
	6	R2	Green		
	7	Shield	Black *		
CN2	1	BK	Yellow		Motor with brake
	2	BK	Yellow		
CN3	1	U	Red	M	Motor
	2	V	White		
	3	W	Black		
	4	PE	Yellow/green		

* Heat shrinkable tube

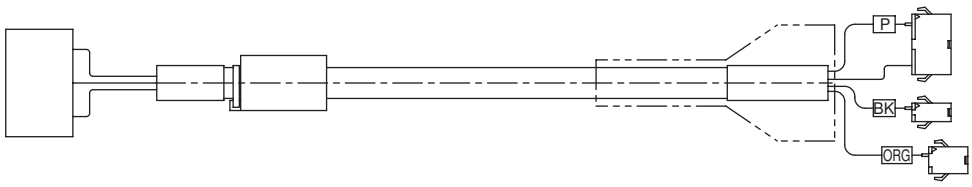


5-4 Robot cables

Signal cable

To controller

To robot

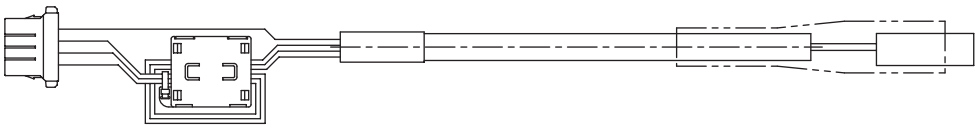


Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Controller CN1	S2	1		1	Resolver	0.3sq Blue	SPMCU-14K
	S4	2		2		Orange	
	S1	3		3		Green	
	S3	4		4		Brown	
	R1	5		5		Grey	
	R2	6		6		Red	
	D.G	9		7		Clear	Shield
	BK+	17		1	Brake	Black	
	BK-	18		2		Yellow	
	ORG	12		2	ORG	Pink	
	24V	13		1		White	
	GND24	15		3		Blue/Red	

Power cable

To controller

To robot



Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Motor wire	FG	1		4		0.75sq	Yellow/Green
	U	2		1		0.75sq	Red
	V	4		2		0.75sq	White
	W	3		3		0.75sq	Black

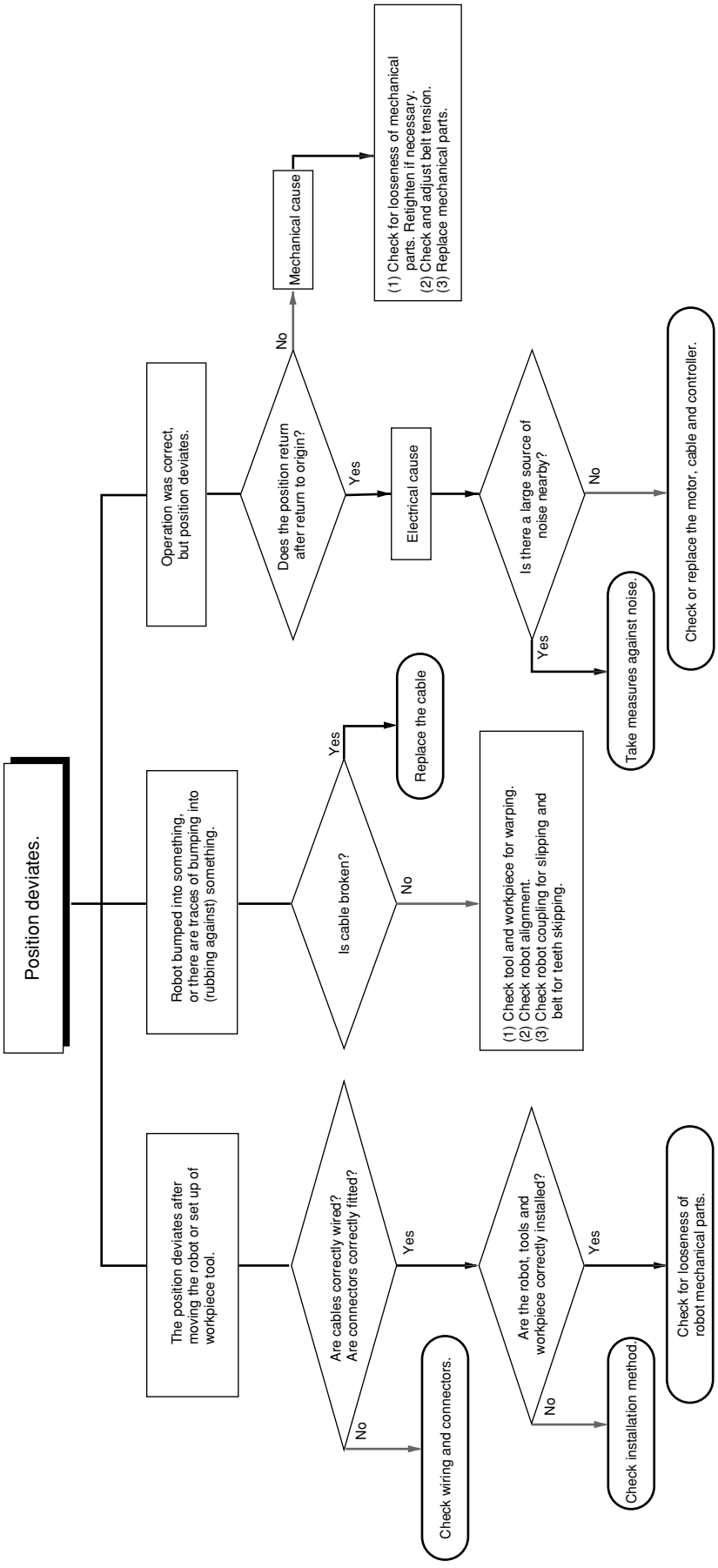
MEMO

Chapter 6

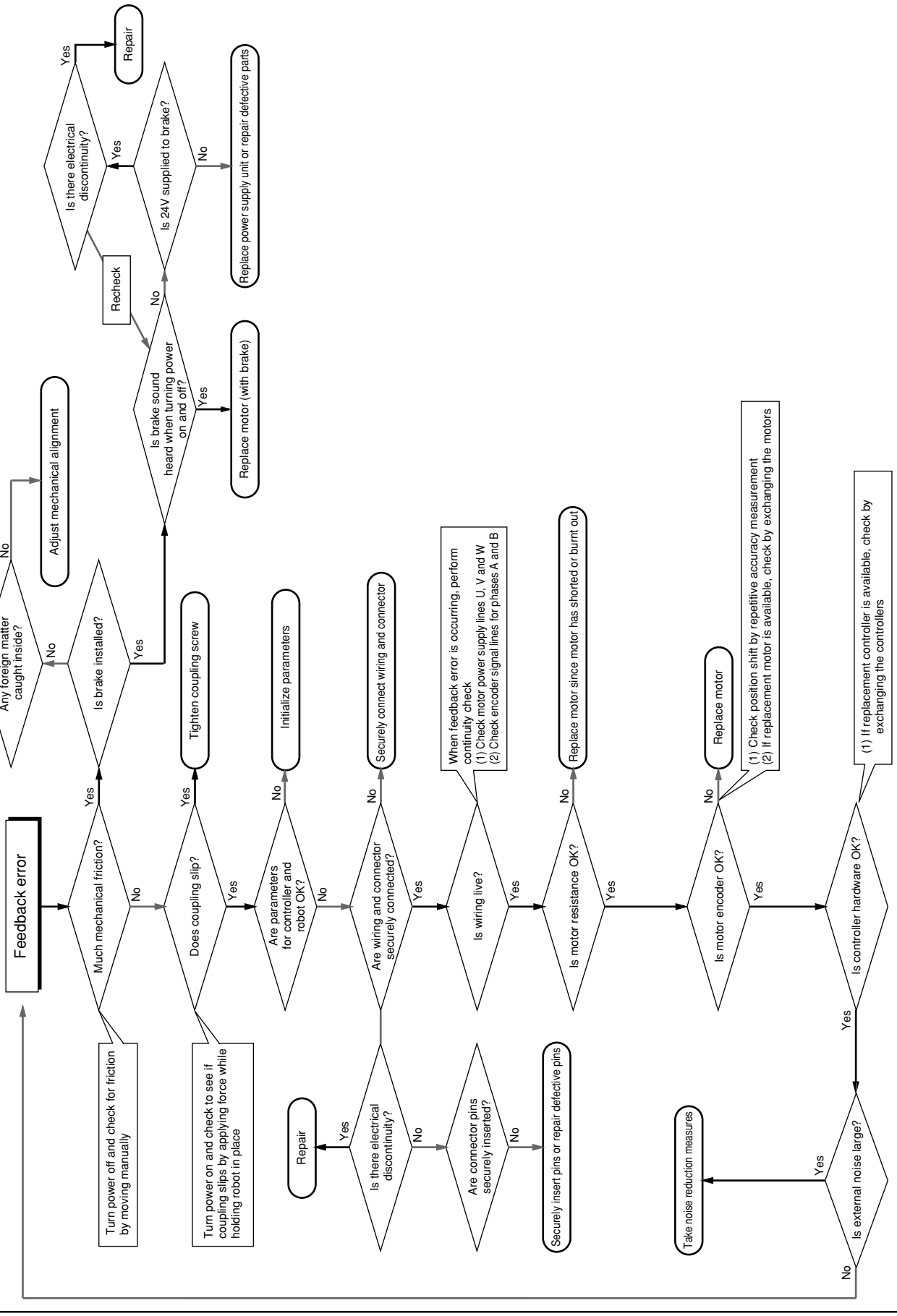
Troubleshooting

MEMO

6-1 Positioning error



6-2 Feedback error



Appendix

MEMO

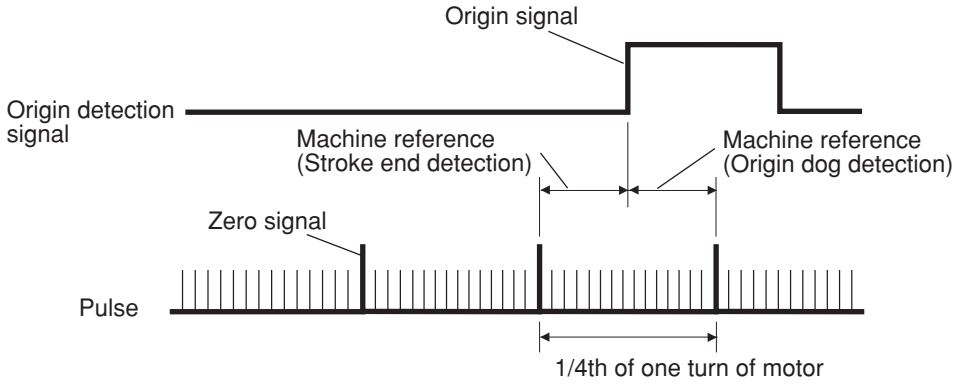
About machine reference

The position detector built into the motor issues a "0" pulse each time the motor rotates 1/4th of one turn. When return-to-origin is performed, a difference in distance occurs between the position where the origin signal is detected and the point at which the next "0" pulse is received. This is called the machine reference and is usually expressed as a percent, with 100% being equal to 1/4th of one turn of the motor. The machine reference value must be within the allowable range (25 to 75%) to maintain axis movement repeatability.
To check the machine reference value, an optional programming box (HPB, MPB or RPB) is needed. The machine reference value is displayed on the LCD screen of the programming box when return-to-origin is complete. (See the figure below.)

NOTE

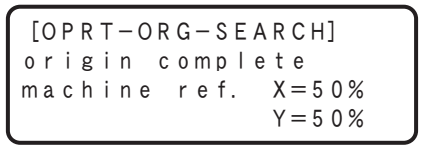
The FLIP-X series uses an absolute type position detector. You do not have to perform return-to-origin each time the robot controller is turned on and readjust the machine reference value. If for some reason the machine reference adjustment becomes necessary, please contact YAMAHA sales office or dealer.

Machine reference

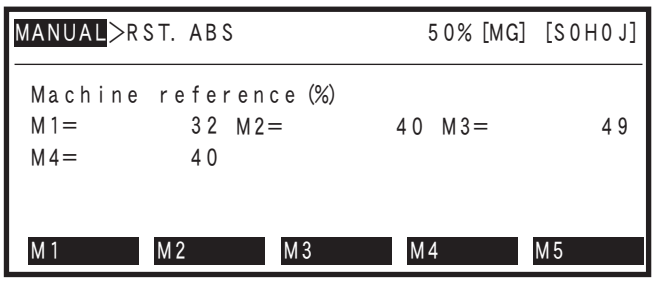


Machine reference value display examples

SR1



DRCX (Two FLIP-X control)



RCX142 (Multiple FLIP-X control)

Equation of moment of inertia calculation

⚠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.

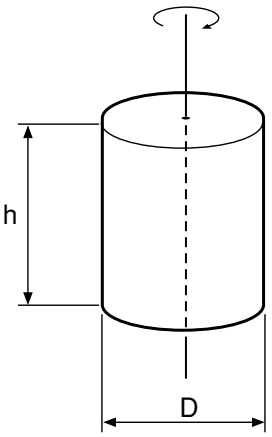
Usually the R axis load is not a simple form, and the calculation of the moment of inertia is not easy.
As a method, the load is replaced with several factors that resemble a simple form for which the moment of inertia can be calculated. The total of the moment of inertia for these factors is then obtained.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

1. Moment of inertia for cylinder

   The moment of inertia (J) for a cylinder having a rotation center such as shown below is given by

$$J = \frac{\rho\pi D^4 h}{32g} = \frac{WD^2}{8g} \quad (kgf \cdot cm \cdot sec^2)$$

$$= \frac{mD^2}{8} \quad (kgm^2)$$



ρ : Density (kg/cm^3)
g : Gravitational acceleration (cm/sec^2)
W : Weight of cylinder (kgf)
m : Mass of cylinder (kg)

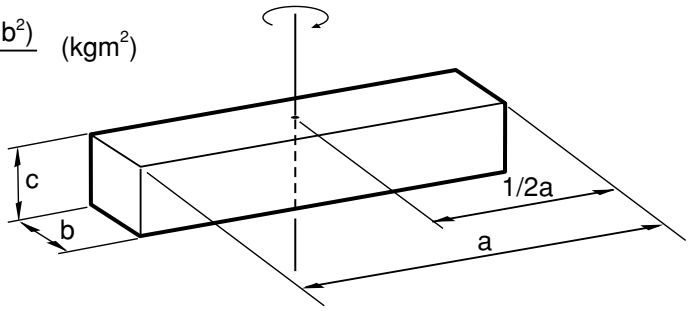
2. Moment of inertia for rectangular parallelepiped

The moment of inertia (J) for a rectangular parallelopiped having a rotation center as shown below is given by

$$J = \frac{\rho abc\,(a^2 + b^2)}{12g} = \frac{W\,(a^2 + b^2)}{12g} \quad (kgf \cdot cm \cdot sec^2)$$

$$= \frac{m\,(a^2 + b^2)}{12} \quad (kgm^2)$$

ρ : Density (kg/cm^3)
g : Gravitational acceleration (cm/sec^2)
W : Weight of prism (kgf)
m : Mass of prism (kg)



3. When the object's center line is offset from the rotation center.

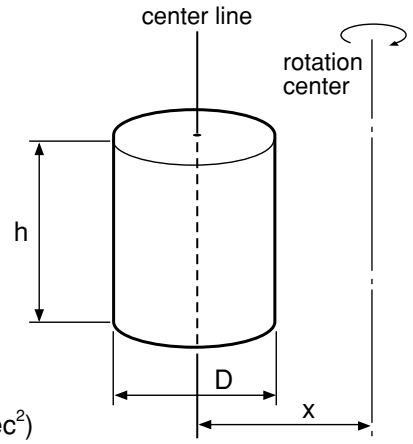
The moment of inertia (J) when the center of the cylinder is offset by a distance "x" from the rotation center as shown below is given by

$$J = \frac{\rho\pi D^4\ h}{32g} + \frac{\rho\pi D^2\ hx^2}{4g}$$

$$= \frac{WD^2}{8g} + \frac{Wx^2}{g} \quad (kgf \cdot cm \cdot sec^2)$$

$$= \frac{mD^2}{8} + mx^2 \quad (kgm^2)$$

W : Weight of cylinder (kgf)
m : Mass of cylinder (kg)
e : Density (kg/cm^3)
g : Gravitational acceleration (cm/sec^2)



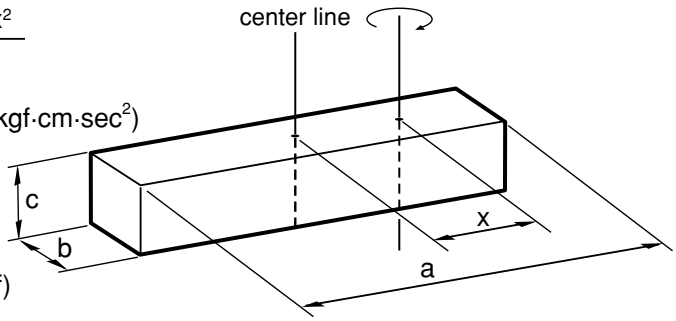
In the same manner, the moment of inertia (J) of a prism as shown below is given by

$$J = \frac{\rho abc\,(a^2 + b^2)}{12g} + \frac{\rho abcx^2}{g}$$

$$= \frac{W(a^2 + b^2)}{12g} + \frac{Wx^2}{g} \quad (kgf \cdot cm \cdot sec^2)$$

$$= \frac{m(a^2 + b^2)}{12} + mx^2 \quad (kgm^2)$$

W : Weight of prism (kgf)
m : Mass of prism (kg)



Revision record

Manual version	Issue date	Description
Ver. 1.19	Jun. 2011	The description regarding "Warranty" was changed. Clerical error corrections.

User's Manual

YAMAHA Single-axis Robots **FLIP-X series**

Jun. 2011
Ver. 1.19
This manual is based on Ver. 1.19 of Japanese manual.