

EPSON

EZ MODULES / RC700-A

X5 series

MANIPULATOR MANUAL

Rev.1

EM16XR3321F

MANIPULATOR MANUAL EZ MODULES X5 series Rev.1

EZ MODULES

X5 series Manipulator Manual

Rev.1

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FOREWORD

Thank you for purchasing our robot products.

This manual contains the information necessary for the correct use of the EZ modules X5 series Manipulator.

Please carefully read this manual and other related manuals before installing the robot system.

Keep this manual handy for easy access at all times.

WARRANTY

The robot and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with our high performance standards.

Product malfunctions resulting from normal handling or operation will be repaired free of charge during the normal warranty period. (Please ask your Regional Sales Office for warranty period information.)

However, customers will be charged for repairs in the following cases (even if they occur during the warranty period):

1. Damage or malfunction caused by improper use which is not described in the manual, or careless use.
2. Malfunctions caused by customers' unauthorized disassembly.
3. Damage due to improper adjustments or unauthorized repair attempts.
4. Damage caused by natural disasters such as earthquake, flood, etc.

Warnings, Cautions, Usage:

1. If the robot or associated equipment is used outside of the usage conditions and product specifications described in the manuals, this warranty is void.
2. If you do not follow the WARNINGS and CAUTIONS in this manual, we cannot be responsible for any malfunction or accident, even if the result is injury or death.
3. We cannot foresee all possible dangers and consequences. Therefore, this manual cannot warn the user of all possible hazards.

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TRADEMARK NOTATION IN THIS MANUAL

Microsoft® Windows® XP Operating system

Throughout this manual, Windows XP or Windows refer to above operating system.

NOTICE

No part of this manual may be copied or reproduced without authorization.

The contents of this manual are subject to change without notice.

Please notify us if you should find any errors in this manual or if you have any comments regarding its contents.

MANUFACTURER

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Regarding battery disposal



The crossed out wheeled bin label that can be found on your product indicates that this product and incorporated batteries should not be disposed of via the normal household waste stream. To prevent possible harm to the environment or human health please separate this product and its batteries from other waste streams to ensure that it can be recycled in an environmentally sound manner. For more details on available collection facilities please contact your local government office or the retailer where you purchased this product. Use of the chemical symbols Pb, Cd or Hg indicates if these metals are used in the battery.

This information only applies to customers in the European Union, according to DIRECTIVE 2006/66/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC and legislation transposing and implementing it into the various national legal systems.

For other countries, please contact your local government to investigate the possibility of recycling your product.

The battery removal/replacement procedure is described in the following manuals:

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1. Safety




Installation and transportation of Manipulators and robotic equipment shall be performed by qualified personnel and should conform to all national and local codes.

Please read this manual and other related manuals before installing the robot system or before connecting cables.

Keep this manual handy for easy access at all times.

1.1 Conventions

Important safety considerations are indicated throughout the manual by the following symbols. Be sure to read the descriptions shown with each symbol.


 WARNING	This symbol indicates that a danger of possible serious injury or death exists if the associated instructions are not followed properly.
 WARNING	This symbol indicates that a danger of possible harm to people caused by electric shock exists if the associated instructions are not followed properly.
 CAUTION	This symbol indicates that a danger of possible harm to people or physical damage to equipment and facilities exists if the associated instructions are not followed properly.


1.2 Design and Installation Safety

Only trained personnel should design and install the robot system. Trained personnel are defined as those who have taken robot system training and maintenance training classes held by the manufacturer, dealer, or local representative company, or those who understand the manuals thoroughly and have the same knowledge and skill level as those who have completed the training courses.

To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the *Installation and Design Precautions* in the *Safety* chapter of the EPSON RC+ User's Guide.

The following items are safety precautions for design personnel:


 WARNING	<ul style="list-style-type: none"> ■ Personnel who design and/or construct the robot system with this product must read the <i>Safety</i> chapter in the EPSON RC+ User's Guide to understand the safety requirements before designing and/or constructing the robot system. Designing and/or constructing the robot system without understanding the safety requirements is extremely hazardous, may result in serious bodily injury and/or severe equipment damage to the robot system, and may cause serious safety problems.
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 <p>WARNING</p>	<ul style="list-style-type: none"> ■ The Manipulator and the Controller must be used within the environmental conditions described in their respective manuals. This product has been designed and manufactured strictly for use in a normal indoor environment. Using the product in an environment that exceeds the specified environmental conditions may not only shorten the life of the product but may also cause serious safety problems. ■ The robot system must be used within the installation requirements described in the manuals. Using the robot system outside of the installation requirements may not only shorten the life cycle of the product but also cause serious safety problems.
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Further precautions for installation are mentioned in the *chapter 4. Installation*. Please read this chapter carefully to understand safe installation procedures before installing the robots and robotic equipment.


1.3 Operation Safety

The following items are safety precautions for qualified Operator personnel:

 <p>WARNING</p>	<ul style="list-style-type: none"> ■ Please carefully read the <i>Safety-related Requirements</i> in the <i>Safety</i> chapter of the <i>Safety and Installation</i> manual. Operating the robot system without understanding the safety requirements is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system. ■ Do not enter the operating area of the Manipulator while the power to the robot system is turned ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even if it seems to be stopped. ■ Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted status (low speeds and low power) to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly. ■ Immediately press the Emergency Stop switch whenever the Manipulator moves abnormally during operation. Continuing the operation while the Manipulator moves abnormally is extremely hazardous and may result in serious bodily injury and/or severe equipment change to the robot system.
--	--

 <p>WARNING</p>	<ul style="list-style-type: none"> ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, pull out the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
--	--

 WARNING	<ul style="list-style-type: none"> ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not insert or pull out the motor connectors while the power to the robot system is turned ON. Inserting or pulling out the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.
---	---

 CAUTION	<ul style="list-style-type: none"> ■ Do not apply any excessive force to the module and peripheral equipment. Applying excessive force to the module and peripheral equipment may result in damage to them.
---	--

1.4 Emergency Stop

If the Manipulator moves abnormally during operation, immediately press the Emergency Stop switch. Pressing the Emergency Stop switch immediately changes the manipulator to deceleration motion and stops it at the maximum deceleration speed.

However, avoid pressing the Emergency Stop switch unnecessarily while the Manipulator is running normally. Otherwise, the Manipulator may hit the peripheral equipment since the operating trajectory until the robot system stops is different from that in normal operation.

Do not press the Emergency Stop switch unnecessarily while the Manipulator is operating. Pressing the switch during operation makes the brakes work. This will shorten the life of the brakes due to the worn friction plates.

Normal brake life cycle: About 2 years (when the brakes are used 100 times/day)
 Also, the Emergency Stop during operation applies impact on the reduction gear unit, and it may result in the short life of the reduction gear unit.

To place the robot system in emergency mode during normal operation, press the Emergency Stop switch while the Manipulator is not moving.

Refer to the Robot Controller manual for instructions on how to wire the Emergency Stop switch circuit.



When the Manipulator is stopped by the emergency stop function (the electric current for the motor is cut off), the J1 and J2 axes may overrun a maximum of 150 mm from their servo motion target points. Therefore, design the layout of the robot system so that the end effector does not collide with peripheral equipment.

When the Manipulator is stopped by the emergency stop while it is moving with large load being applied, an error may occur. If the error occurs, reset it by the Reset command.

Example: If the Emergency Stop switch is pressed while the RH module is carrying an 80 kg workpiece.

The following error occurs:

5040: Motor torque output failure in high power state.

Do not turn OFF the Controller while the Manipulator is operating.

If you attempt to stop the Manipulator in emergency situations such as “Safeguard Open”, make sure to stop the Manipulator using the Emergency Stop switch of the Controller.

If the Manipulator is stopped by turning OFF the Controller while it is operating, the following problems may occur.

Reduction of the life and damage of the reduction gear unit

Position gap at the joints

In addition, if the Controller was forced to be turned OFF by blackouts and the like while the Manipulator is operating, make sure to check the following points after power restoration.

Whether or not the reduction gear is damaged

Whether or not the joints are in their proper positions

If there is a position gap, perform calibration by referring to the 4.13. *Calibration* in this manual.

Before using the Emergency Stop switch, be aware of the followings.

- The Emergency Stop (E-STOP) switch should be used to stop the Manipulator only in case of emergencies.
- To stop the Manipulator operating the program except in emergency, use Pause (halt) or STOP (program stop) commands.
Pause and STOP commands do not turn OFF the motors. Therefore, the brake does not function.
- For the Safeguard system, do not use the circuit for E-STOP.

For details of the Safeguard system, refer to the following manuals.

EPSON RC+ User's Guide 2. *Safety - Installation and Design Precautions*

 - *Safeguard System*

Safety and Installation 2.6 *Connection to EMERGENCY Connector*

To check brake problems, refer to the following manuals.

Safety and Installation 5.1.1 *Manipulator*

 - *Inspection While the Power is ON (Manipulator is operating)*

1.5 Moving sliders by hand in emergency mode


When the system is placed in emergency mode, move the modules by hand as follows:

RH module.....Push the slider by hand.

RM modulePush the slider by hand.

RSz module.....The axis cannot be moved up/down by hand because the electromagnetic brake is applied to the axis. Move the axis up/down while pushing the Z axis brake release switch.

RU module.....Rotate the end effector or flange by hand.





 CAUTION	<p>■ Be careful not to allow the Z axis and end effector to move down by their own weight while pressing the Z axis brake release switch.</p>
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1.6 Manipulator Labels

The following labels are attached at locations on the Manipulator where specific dangers exist.

Be sure to comply with descriptions and warnings on the labels to operate and maintain the Manipulator safely.

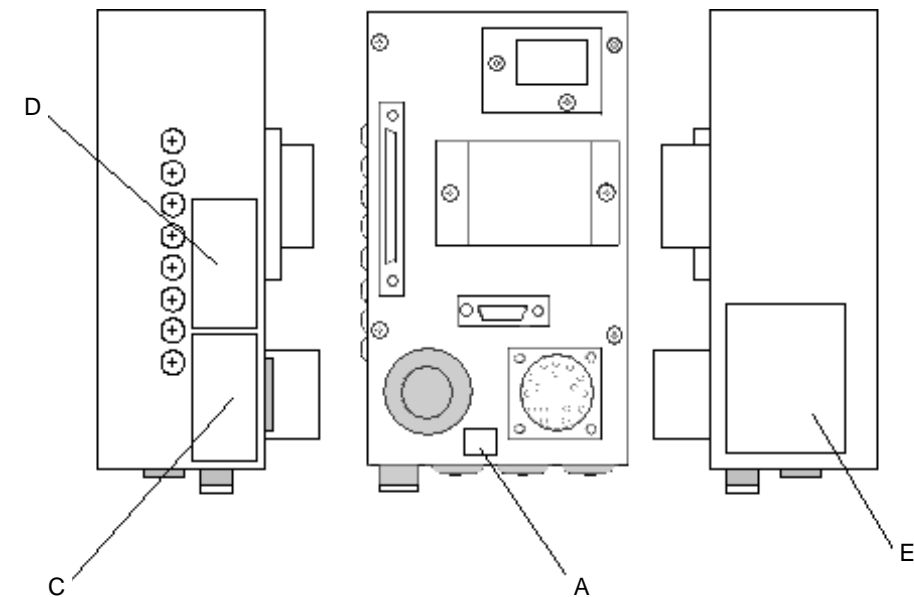
Do not tear, damage, or remove the labels. Use meticulous care when handling those parts or units to which the following labels are attached as well as the nearby areas:

Location	Label	NOTE
A		Do not touch current-carrying part to avoid electric shock.
B		This label is on the top face of the module.
C		Only authorized personnel should perform sling work and operate a crane and a forklift. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.
D		Be careful of the hand falling / rotation while the brake release button is being pressed.

1.6 Manipulator Labels

Location	Label	NOTE
E	<div><div>MODEL : R 1 1 4 X 5 H 0 4 0</div><div>SERIAL NO. : 0 0 0 0 1</div><div>MANUFACTURED : 1 0 / 2 0 1 6</div><div>WEIGHT : 2 1 k g</div><div>MOTOR POWER : 4 0 0 W</div><div>SEIKO EPSON CORPORATION</div></div>	Refer to 4.5 Relations between the Stroke and the Code of the Module.

Location of Labels



NOTE
☞ Label D is for the manipulator of up/down axis.

2. Model Numbers and Specifications

2.1 Features of EZ Modules

The features of EZ modules are as follows:

- (1) A wide range of module stroke lengths and various module combinations
 - EZ modules provide a wide range of module stroke lengths. (RH, RM, RSz, and RU)
 - Due to this wide range of module stroke lengths, the module combinations variety: single-axis modules, multi-axis manipulators, two-axis XY manipulators, and two-axis YZ manipulator.
- (2) Controllability of two or more manipulators by one controller
 - When the additional module is installed (a two-axis manipulator is installed to a two-axis manipulator, a single-axis module is installed to a three-axis manipulator, etc.), the RC700-A robot controller can control multiple manipulators by unified managing of the point data.
 - With the Multi-Manipulator feature, the RC700-A robot controller can control up to 16 single-axis modules separately. (Control unit: 8, Drive unit1: 4 + Drive unit2: 4 + Drive unit3: 4) However, there is a limit to the maximum capacity. Please contact us for the details.
- (3) Available for Large-load
 - EZ modules are available for large-load.
Max. Payload: from 80 kg (Single-axis) to 10 kg (four-axis)
The capacity for large-load has been improved by enhanced allowable moment of inertia of Axis 4.
 - Optimal control for load makes the handling in large-load stable.

Constituent module

Model ^{*1}			Constituent module ^{*2}			
			RH module	RM module	RSz module	RU module
Single axis		RH	✓	—	—	—
		RM	—	✓	—	—
Two axis	XY	RG-HM	✓	—	—	
	YZ	YZ-MS	—	✓	—	
Three axis	XYZ	RP-HMSz	✓	✓	✓	—
Four axis	XYZU	RU-HMSz	✓	✓	✓	✓

Additional Modules

Model ^{*1}			Constituent module ^{*2}			
			RH module	RM module	RSz module	RU module
Single axis		RH	✓	—	—	—
		RM	—	✓	—	—
Two axis	XY	RG-HM	✓	—	—	—

2.2 Model Numbers

*1: For the figures of respective models, refer to 2.2 *Model Numbers*.

*2: Outline of each module

RH module : Large payload

RM module : Medium payload

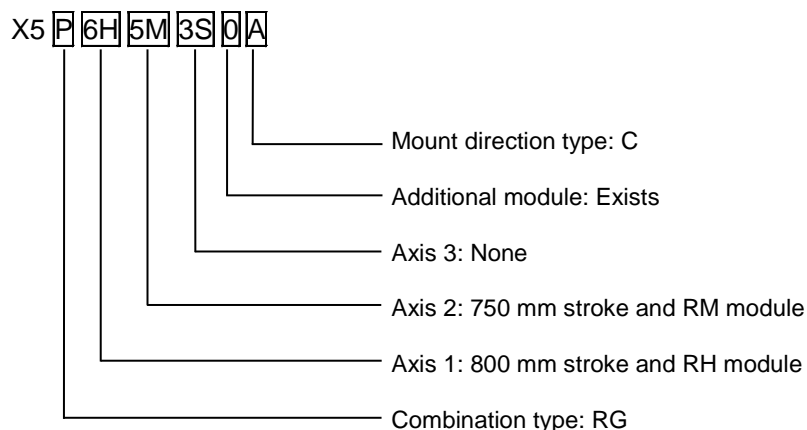
RSz module : For vertical axis (Z axis)

RU module : For rotation axis (U axis)

2.2 Model Numbers

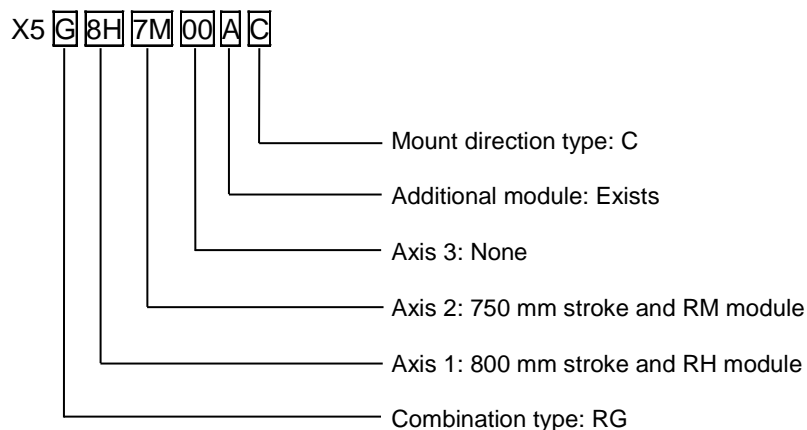
Example 1: RP-HMSz

(RH: 600 mm stroke, RM: 500 mm stroke, RSz: 300 mm stroke, Mount direction type: A)



Example 2: RG-HM (Additional module)

(RH: 800 mm stroke, RM: 750 mm stroke, Mount direction type: C)



The second digit from the right in the model number means that Axis 4 (RU module) exists or not. For the additional module, the second digit from the right means that the additional module exists or not.

The “model number” is the number for an aggregate of parts that are necessary for manipulator assembly.

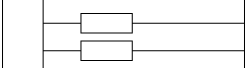
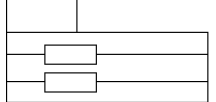
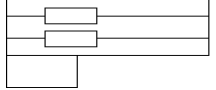
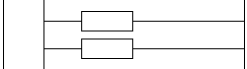
The “code” in Chapter 4 and later chapters is the number for each part, parts set, and module.

Do not confuse the model number and the code.

Model numbers shown in the software

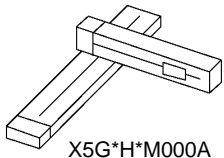
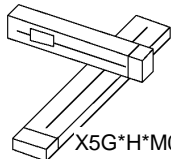
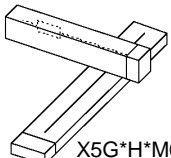
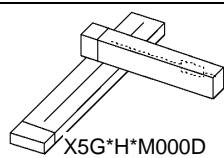
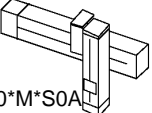
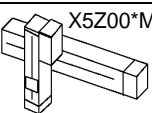
Combination		Model Number & Model Number shown in the software
Two axis	RG-HM	X5G□□□□□□□□ ex.: X5G8H7M000C
Three axis	RP-HMSz	X5P□□□□□□□□ ex.: X5P6H5M3S0A
Four axis	RU-HMSz	X5U□H□M□S□□ ex.: X5U6H5M3S1A

2.2.1 Single Axis

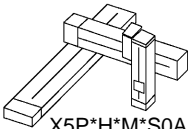
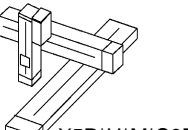
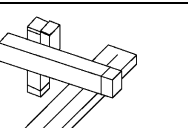
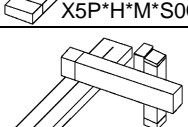
Single Axis (RH, RM)							
Item	Combination	Axis 1	Axis 2	Axis 3	Axis 4 (Additional module)	Mount Direction	
X5	S	0H	00	00	0	A	
X5	S: Single Axis	6H : RH600 8H : RH800 0H : RH1000	00: none	00: none	0: none A: Additional module	A: Standard	
	S: Single Axis	0L : RH2000	00: none	00: none	0: none A: Additional module	A: Standard	
						B: Left side mount	
	S: Single Axis	3M : RM350 5M : RM550	00: none	00: none	0: none A: Additional module	A: Standard	

2.2 Model Numbers

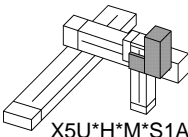
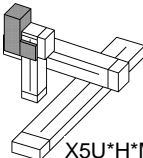
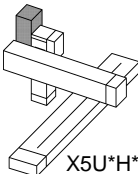
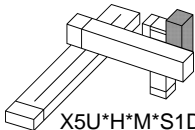
2.2.2 Two Axis Manipulators

Two Axis Manipulators (RG-HM, YZ-MS)								
Item	Combination		Axis 1	Axis 2	Axis 3	Axis 4 (Additional module)	Mount Direction	
X5	G		8H	7M	00	0	C	
X5	G: RG	-HM	8H: RH800	5M: RM550 7M: RM750	00: none	0: none A: Additional module	A: standard	 X5G*H*M000A
							B: Y mirrored	 X5G*H*M000B
							C: Y slider mirrored	 X5G*H*M000C
							D: Slider mirrored	 X5G*H*M000D
X5	Z		00	7M	2S	0	A	
X5	Z: YZ	-MS	00: none	7M: RM750	2S: RSz200	0: none	A: standard	 X5Z00*M*S0A
							B: Y mirrored	 X5Z00*M*S0B


2.2.3 Three Axis Manipulators

Three Axis Manipulators (RP-HMSz)								
Item	Combination		Axis 1	Axis 2	Axis 3	Axis 4	Mount Direction	
X5	P		6H	5M	3S	0	A	
X5	P: RP	-HMSz	4H: RH400	3M: RM350	2S: RSz200	0: none	A: standard	 X5P*H*M*S0A
			6H: RH600	5M: RM550	3S: RSz300		B: Y mirrored	 X5P*H*M*S0B
			8H: RH800				C: YZ mirrored	 X5P*H*M*S0C
							D: Z mirrored	 X5P*H*M*S0D

2.2.4 Four Axis Manipulators


Four Axis Manipulators (RU-HMSz)								
Item	Combination		Axis 1	Axis 2	Axis 3	Axis 4 (RU module)	Mount Direction	
X5	U		6H	5M	3S	1	A	
X5	U: RU	-HMSz	4H: RH400 6H: RH600 8H: RH800	3M: RM350 5M: RM550	2S: RSz200 3S: RSz300	1: RU module	A: standard	 X5U*H*M*S1A
							B: Y mirrored	 X5U*H*M*S1B
							C: YZ mirrored	 X5U*H*M*S1C
							D: Z mirrored	 X5U*H*M*S1D

2.3 Relation between end effector mass W and moment arm length L

 CAUTION	<ul style="list-style-type: none"> ■ The total weight of the end effector and the work piece must be within the specified values for each Manipulator. Always set the weight parameters according to the load. Setting a value that is smaller than the actual load may cause errors, excessive shock, insufficient function of the Manipulator, and/or shorten the life cycle of parts/mechanisms. ■ The moment of inertia of the load (weight of the end effector and work piece) must be set within the specified values for each module. ■ The eccentric quantity of the load (weight of the end effector and work piece) must be set within the specified values for each module.
--	---

Moment of Inertia and the INERTIA Setting

The moment of inertia is defined as “the ratio of the torque applied to a rigid body and its resistance to motion”. Set INERTIA parameter considering the weight of the end effector and work piece attached to the RU rotation center.

 CAUTION	<ul style="list-style-type: none"> ■ The moment of inertia of load (weight of the end effector and work piece) must be 0.12 kg·m² or less. RU module is not designed to work with moment of inertia exceeding 0.12 kg·m². Always set the moment of inertia (INERTIA) parameter according to the moment of inertia. Setting a value that is smaller than the actual moment of inertia may cause errors, excessive shock, insufficient function of the module, and/or shorten the life cycle of parts/mechanisms.
--	--

The acceptable moment of inertia of load for RU module is 0.04 kg·m² at the rating and 0.12 kg·m² at the maximum. When the moment of inertia of load exceeds the rating, change the setting of moment of inertia (INERTIA) parameter of load of INERTIA command. After the setting is changed, the maximum acceleration/deceleration speed of Axis 4 is corresponding to “moment of inertia” is set automatically.

Moment of inertia of load on the RU rotation center

The moment of inertia of load (weight of the end effector and work piece) on the RU rotation center can be set by the “moment of inertia (INERTIA)” parameter of the INERTIA command.

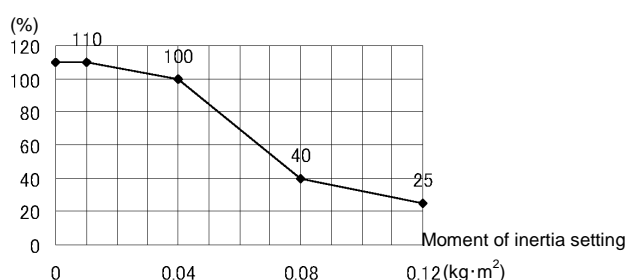
The method for setting the parameter varies with the software used.

EPSON
RC+

Enter the combined total moment of inertia of the end effector and work piece into the [Eccentricity:] box on the [Inertia] panel ([Tool] - [Robot Manager]).

You may also execute the Inertia command from the [EPSON RC+ Monitor Window].

Automatic acceleration/deceleration setting of Axis 4 by INERTIA (moment of inertia)



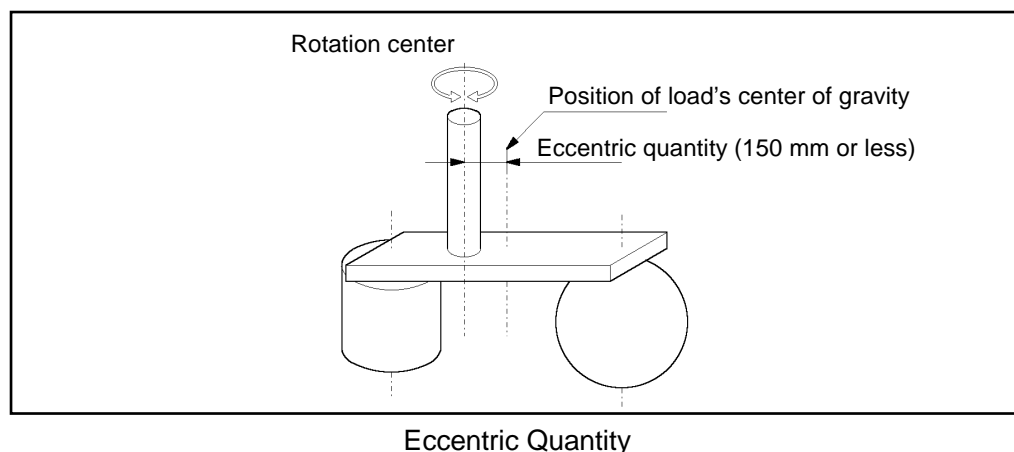
* The percentage in the graph is based on the speed at rated moment of inertia (0.04 kg·m²) as 100%.

Eccentric Quantity and the INERTIA Setting



- The eccentric quantity of load (weight of the end effector and work piece) must be 150 mm or less. RU module is not designed to work with eccentric quantity exceeding 150 mm. Always set the eccentric quantity parameter according to the eccentric quantity. Setting a value that is smaller than the actual eccentric quantity may cause errors, excessive shock, insufficient function of the module, and/or shorten the life cycle of parts/mechanisms.

The acceptable eccentric quantity of load for RU module is 150 mm at the maximum. When the eccentric quantity of load exceeds 0 mm, change the setting of eccentric quantity parameter of INERTIA command. After the setting is changed, the maximum acceleration/deceleration speed of Manipulator corresponding to “eccentric quantity” is set automatically.



Eccentric quantity of load on the RU rotation center

The eccentric quantity of load (weight of the end effector and work piece) on the RU rotation center can be set by the “eccentric quantity” parameter of the INERTIA command. The method for setting the parameter varies with the software used.

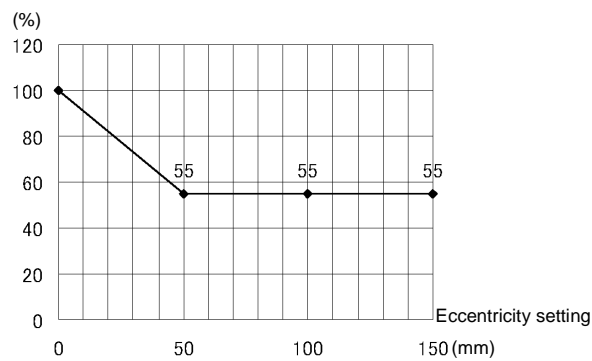
EPSON
RC+

Enter the combined total moment of inertia of the end effector and work piece into the [Eccentricity:] box on the [Inertia] panel ([Tool] - [Robot Manager]).

You may also execute the Inertia command from the [EPSON RC+ Monitor Window].

2.3 Relation between end effector mass W and moment arm length L

Automatic acceleration/deceleration setting by INERTIA (eccentric quantity)

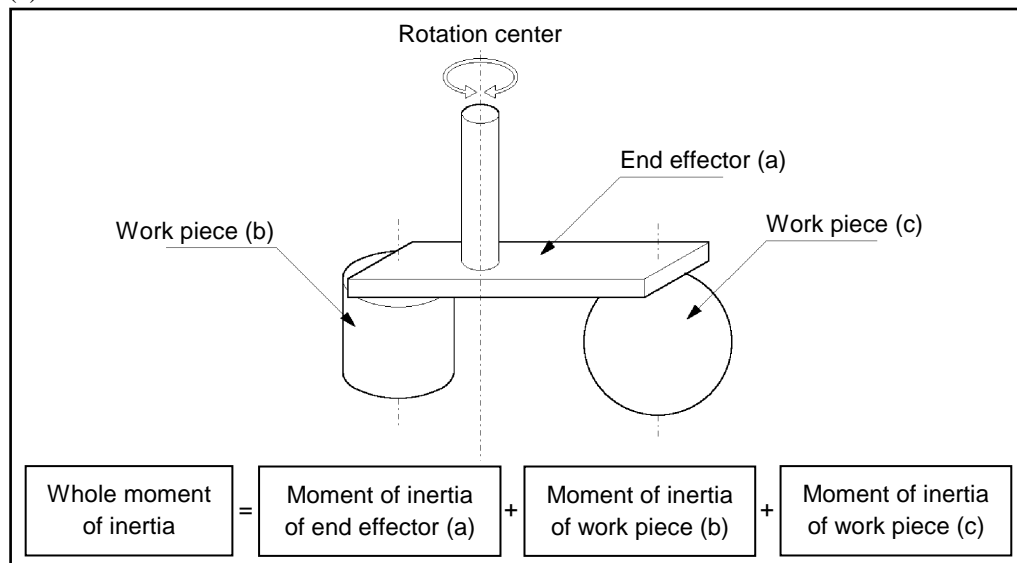


* The percentage in the graph is based on the speed at no eccentricity (0 mm) as 100%.

Calculating the Moment of Inertia

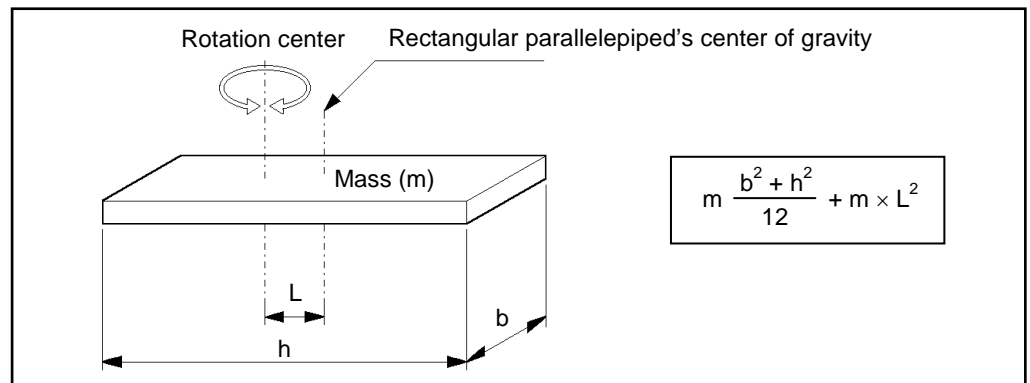
Refer to the following examples of formulas to calculate the moment of inertia of load (end effector with work piece).

The moment of inertia of the entire load is calculated by the sum of each part (a), (b), and (c).

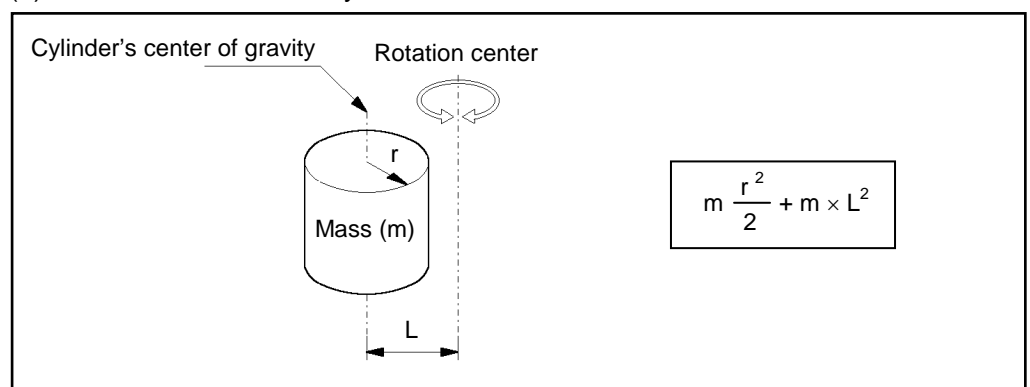


The methods for calculating the moment of inertia for (a), (b), and (c) are shown on this page or the next page. Find the whole moment of inertia using the basic formulas on the next page.

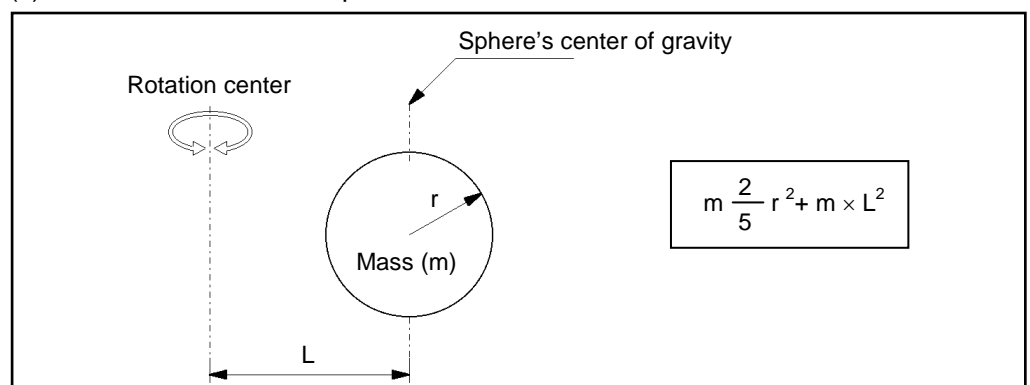
(a) Moment of inertia of a rectangular parallelepiped



(b) Moment of inertia of a cylinder



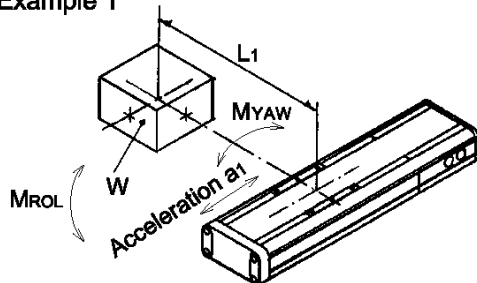
(c) Moment of inertia of a sphere



2.4 Concept and direction of moment

Apply the roll, yaw, and pitch moments that are generated by payload within the transportable moment.

Example 1



Roll moment M_{ROL}

Weight component :

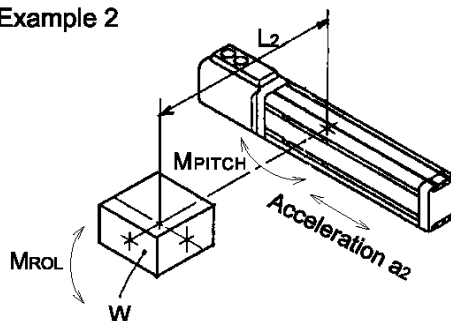
$$M_{ROL}[N \cdot m] = W[kg] \times L_1[m] \times 9.8[m/s^2]$$

Yaw moment M_{YAW}

Acceleration component :

$$M_{YAW}[N \cdot m] = W[kg] \times L_1[m] \times a_1[m/s^2]$$

Example 2



Roll moment M_{ROL}

Weight component :

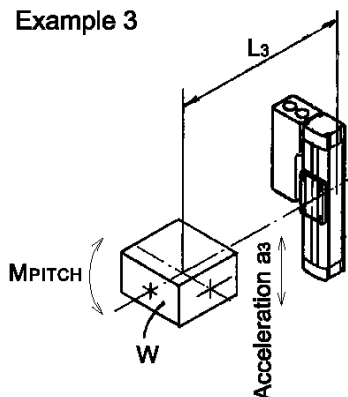
$$M_{ROL}[N \cdot m] = W[kg] \times L_2[m] \times 9.8[m/s^2]$$

Pitch moment M_{PITCH}

Acceleration component :

$$M_{PITCH}[N \cdot m] = W[kg] \times L_2[m] \times a_2[m/s^2]$$

Example 3



Pitch moment M_{PITCH}

Weight component + acceleration component:

$$M_{PITCH}[N \cdot m] = W[kg] \times L_3[m] \times (9.8 + a_3)[m/s^2]$$

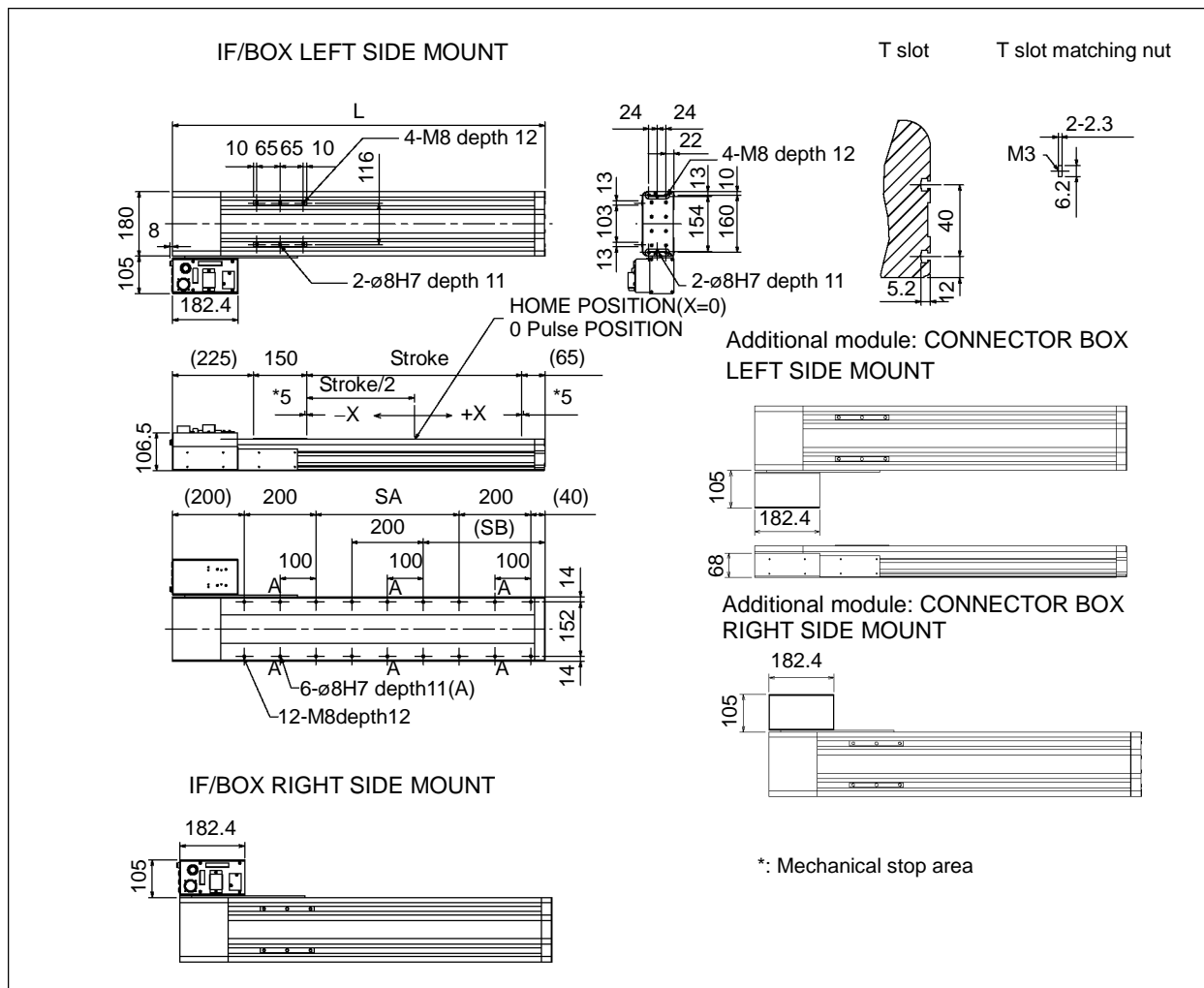
2.5 Dimensions

2.5.1 Single Axis

2.5.1.1 RH Type

Outer Dimensions (Model number: X5S#H0000#A)

[Unit: mm]



X5S#H0000#A

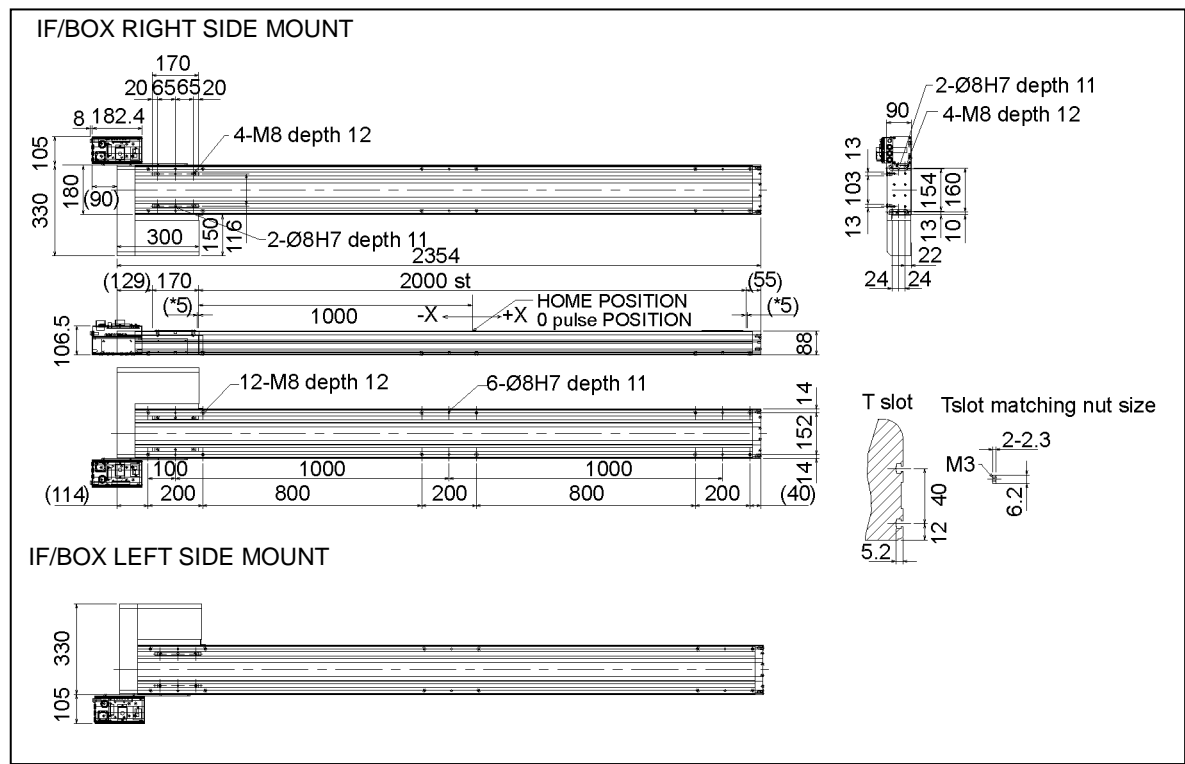
0	: Standard
A	: Additional module
Xst	
6	: 600 mm
8	: 800 mm
0	: 1000 mm

Stroke	L	SA	SB
600 mm	1040	400	340
800 mm	1240	600	440
1000 mm	1440	800	540

2.5 Dimensions

Outer Dimensions (Model number: X5S#H0000#A)

[Unit: mm]



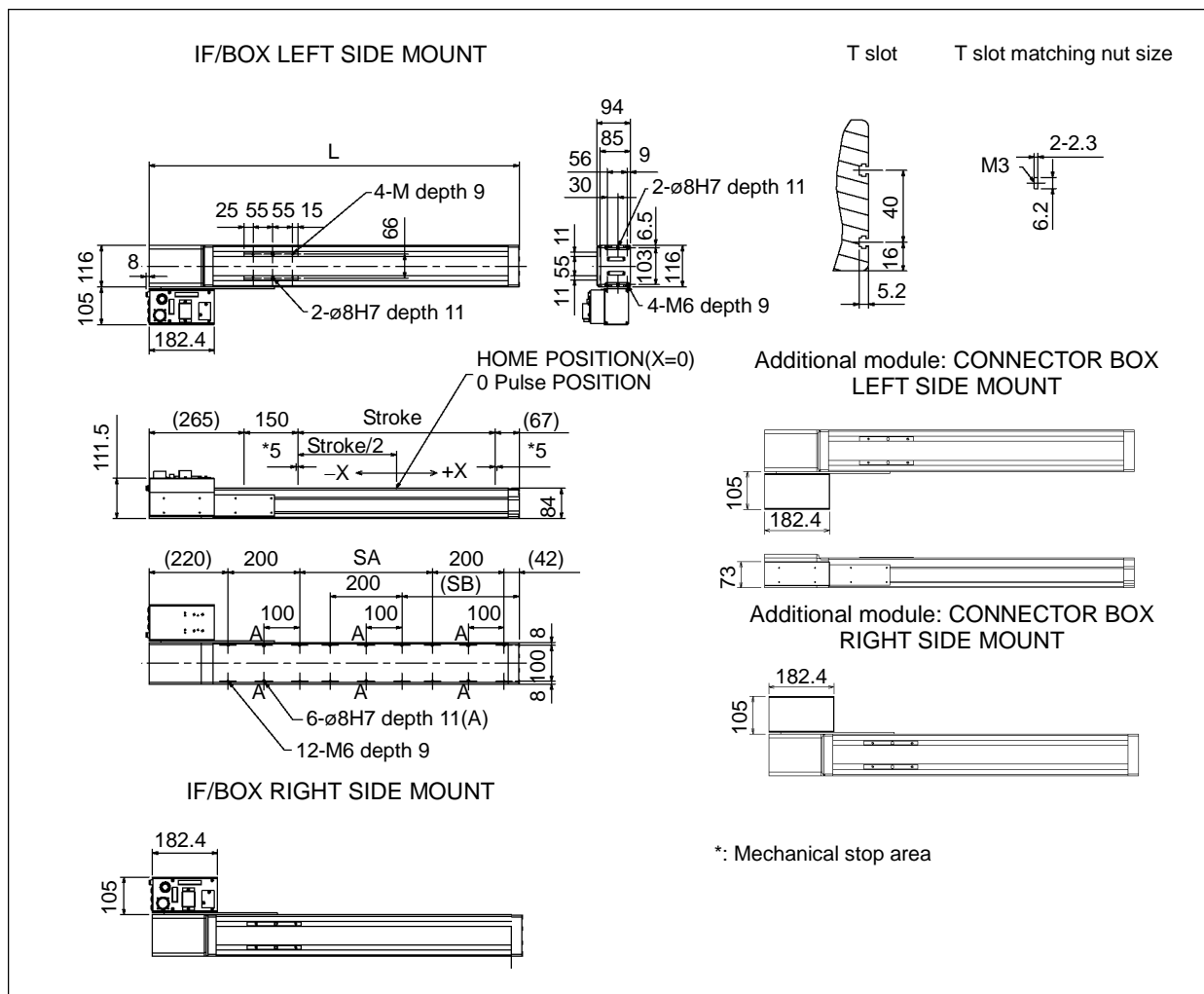
X5S0C00000#

Mount
A : Standard
B : Left side mount

2.5.1.2 RM Type

Outer Dimensions (Model number: X5S#M0000#A)

[Unit: mm]



X5S#M0000#A

0 : Standard
A : Additional module

Xst
3 : 350 mm
5 : 550 mm

Stroke	L	SA	SB
350 mm	832	170	227
550 mm	1032	370	327

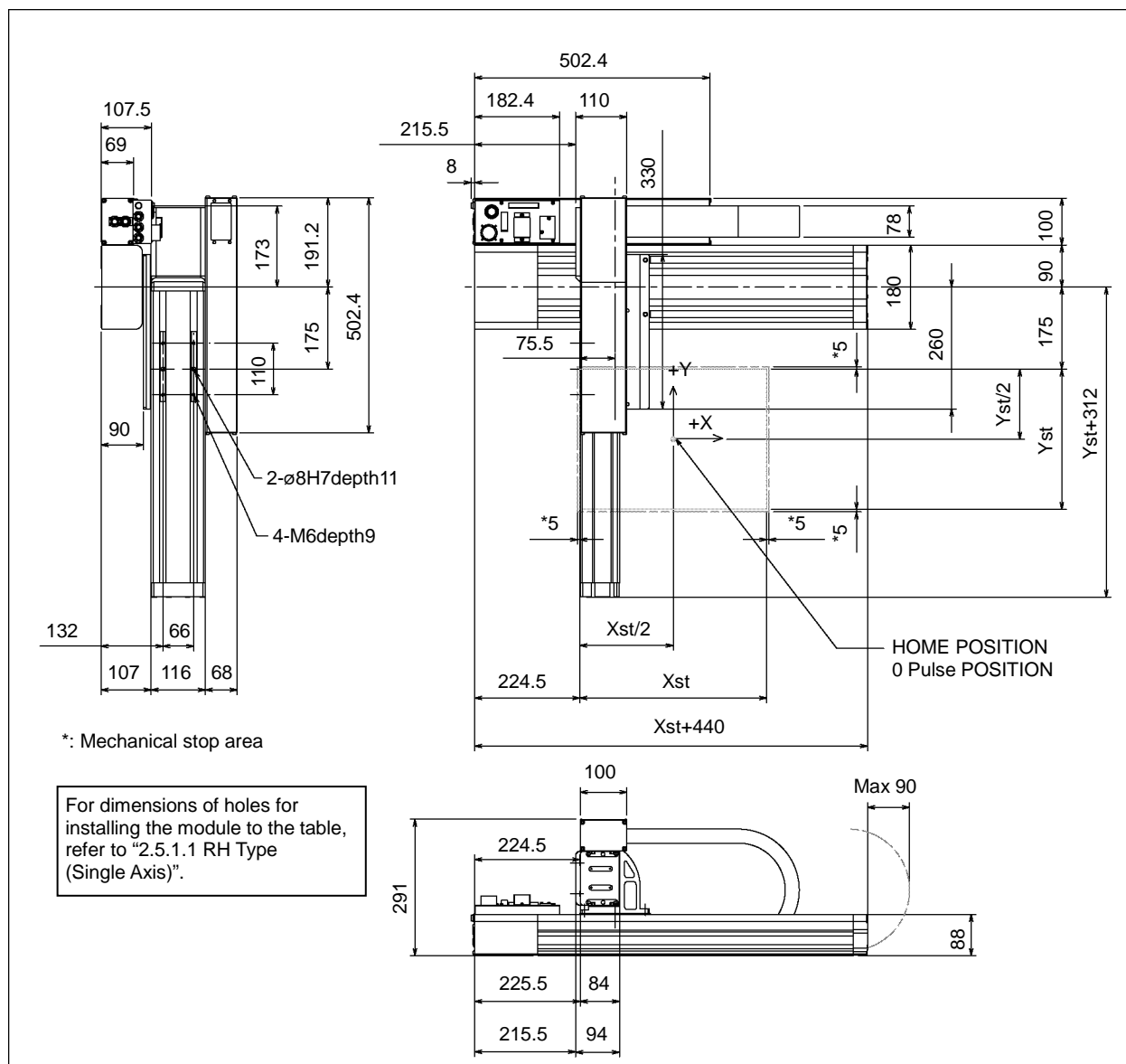
2.5 Dimensions

2.5.2 Two Axis Manipulators

2.5.2.1 RG-HM

A Type: Outer Dimensions (Model number: X5G8H#M000A)

[Unit: mm]



X5G8H#M000A

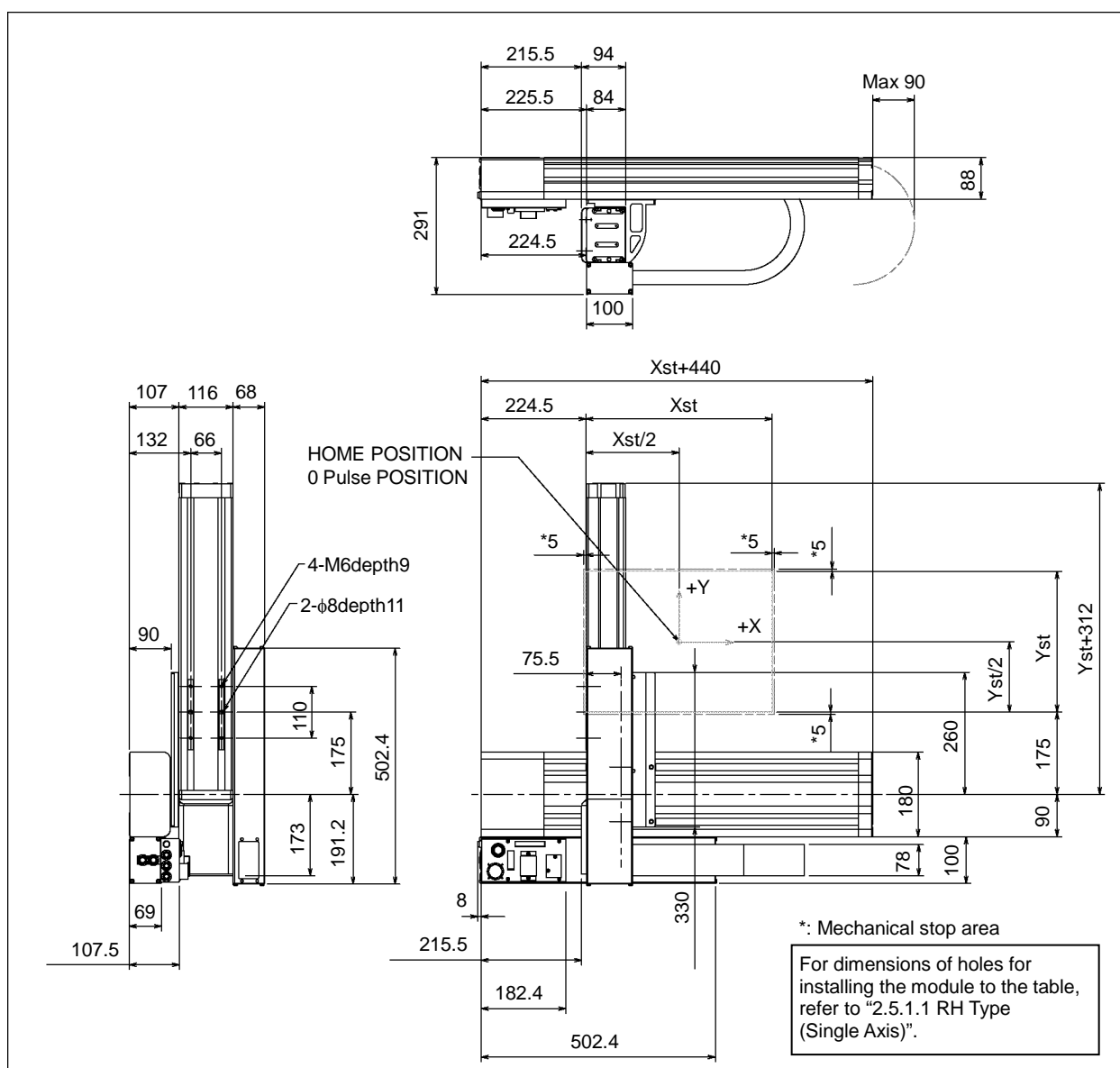


Yst

5	: 550 mm
7	: 750 mm

B Type: Outer Dimensions (Model number: X4G8H#M000B)

[Unit: mm]



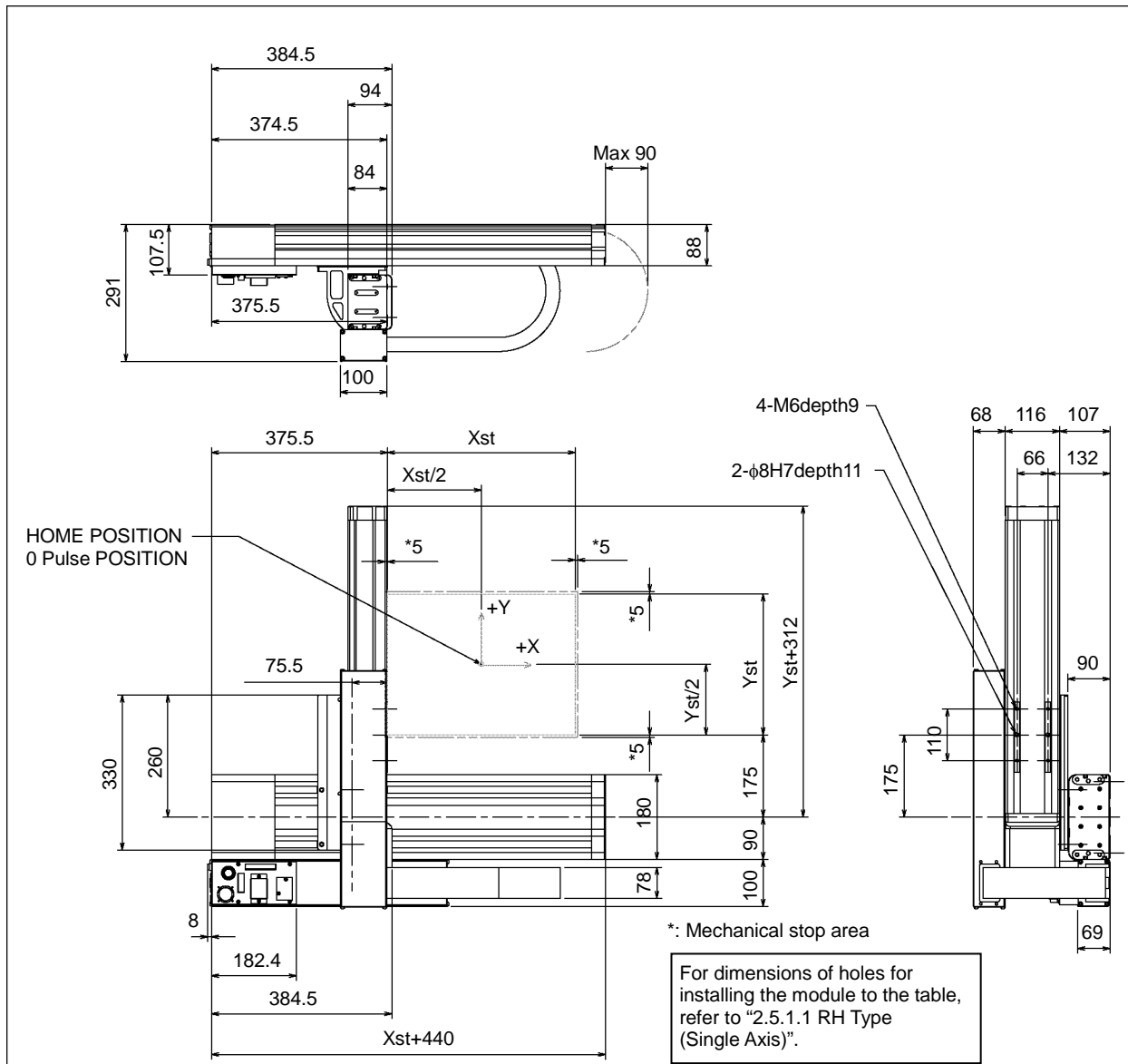
X5G8H#M000B

Yst	
5	: 550 mm
7	: 750 mm

2.5 Dimensions

C Type: Outer Dimensions (Model number: X5G8H#M000C)

[Unit: mm]



X5G8H#M000C

Yst

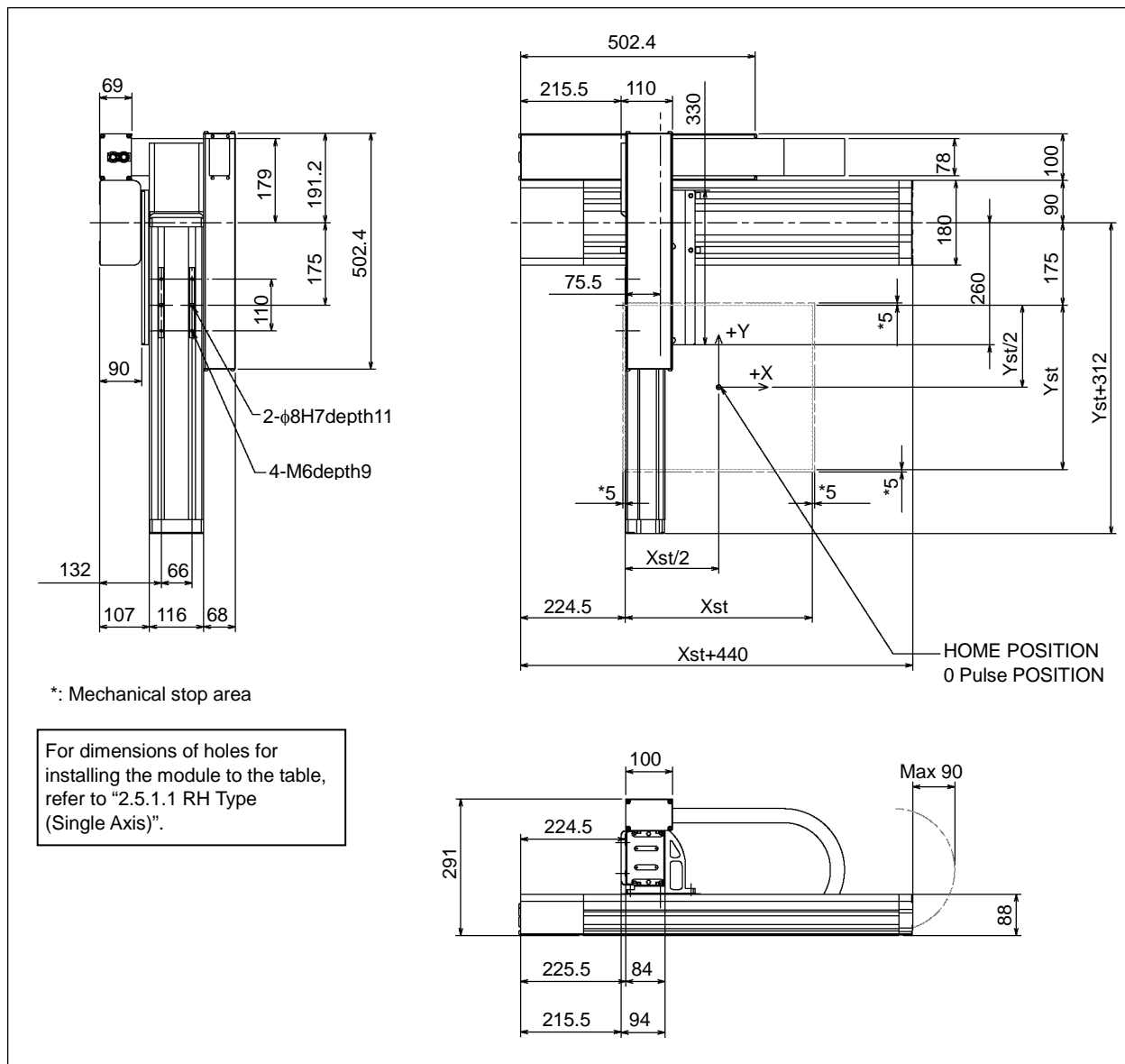
5	: 550 mm
7	: 750 mm

2.5 Dimensions

2.5.2.2 RG-HM (Additional Module)

A Type: Outer Dimensions (Model number: X5G8H#M00AA)

[Unit: mm]

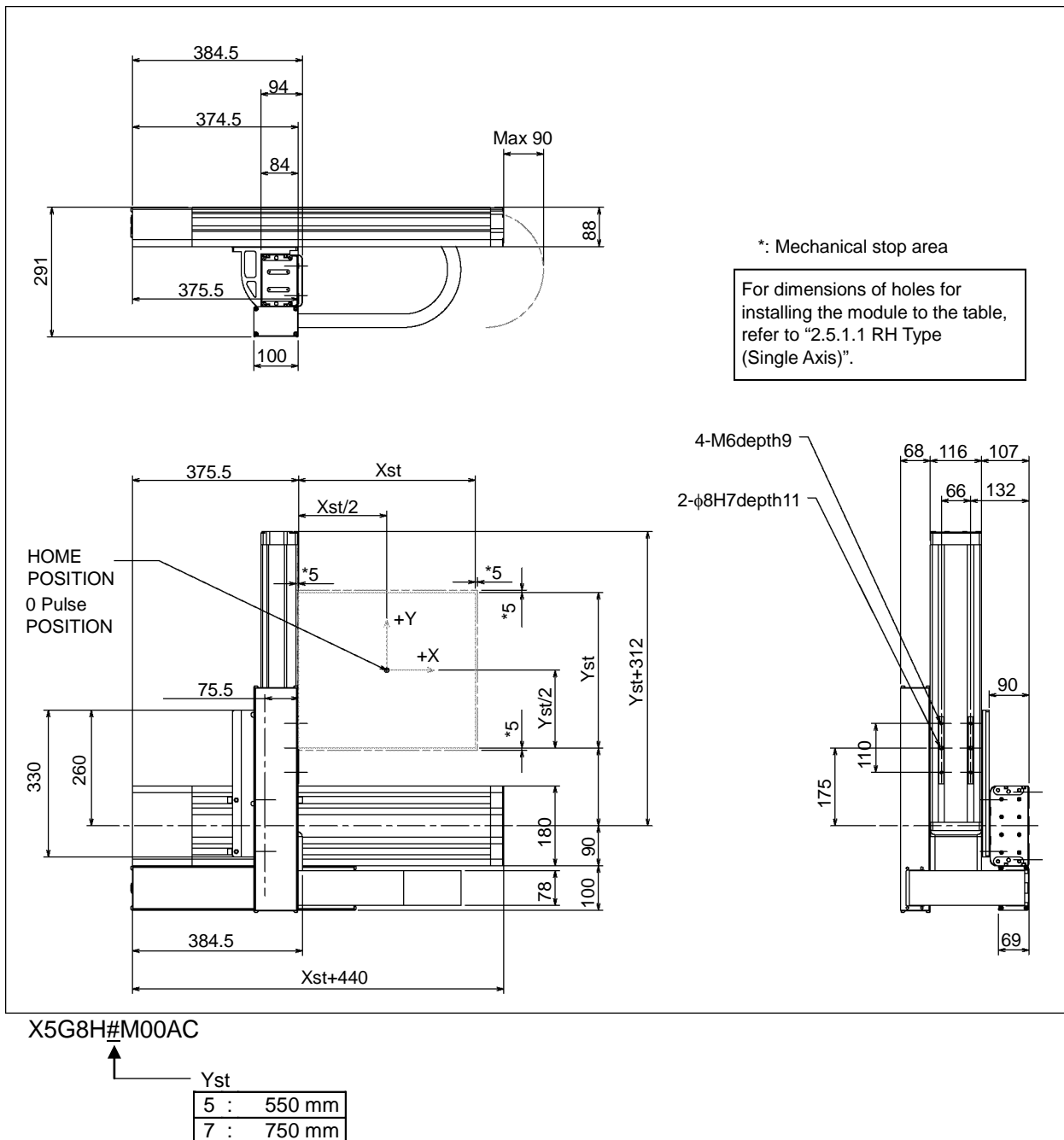


X5G8H#M00AA

- Yst

5 :	550 mm
7 :	750 mm

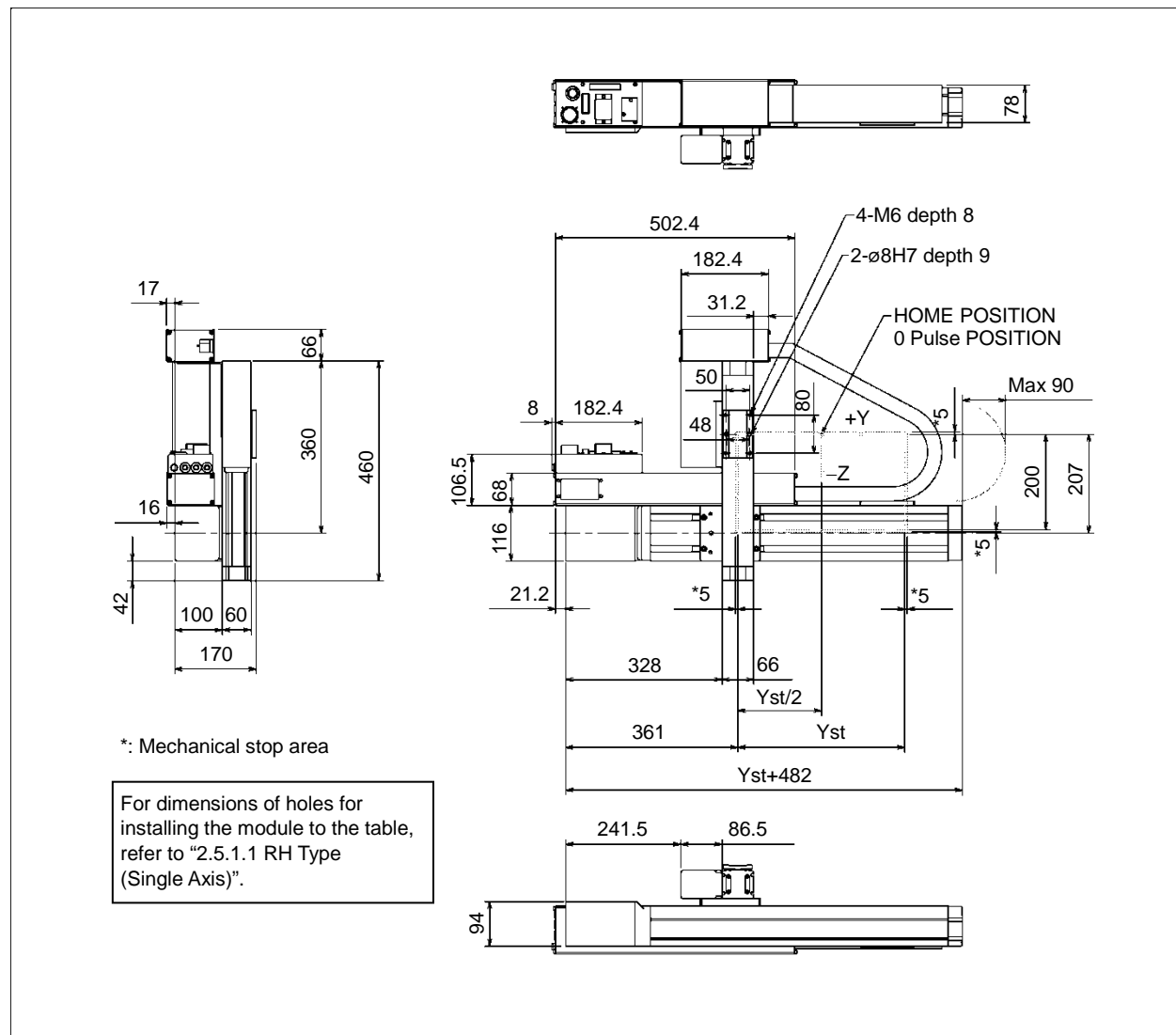
[Unit: mm]



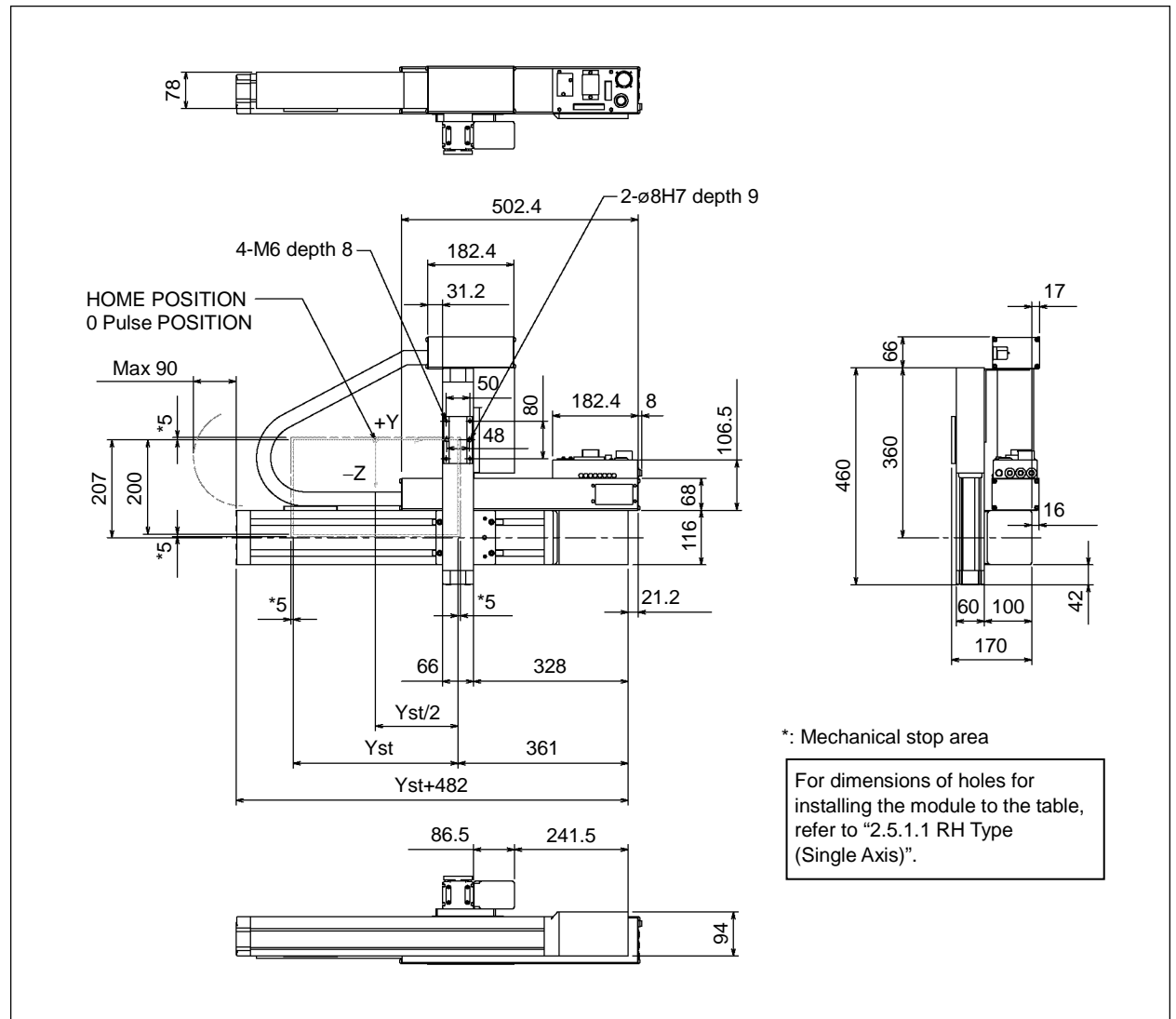
2.5 Dimensions

2.5.2.3 YZ-MS (Z axis stroke: 200 mm)

A Type: Outer Dimensions (Model number: X5Z007M2S0A Z axis stroke = 200 mm) [Unit: mm]



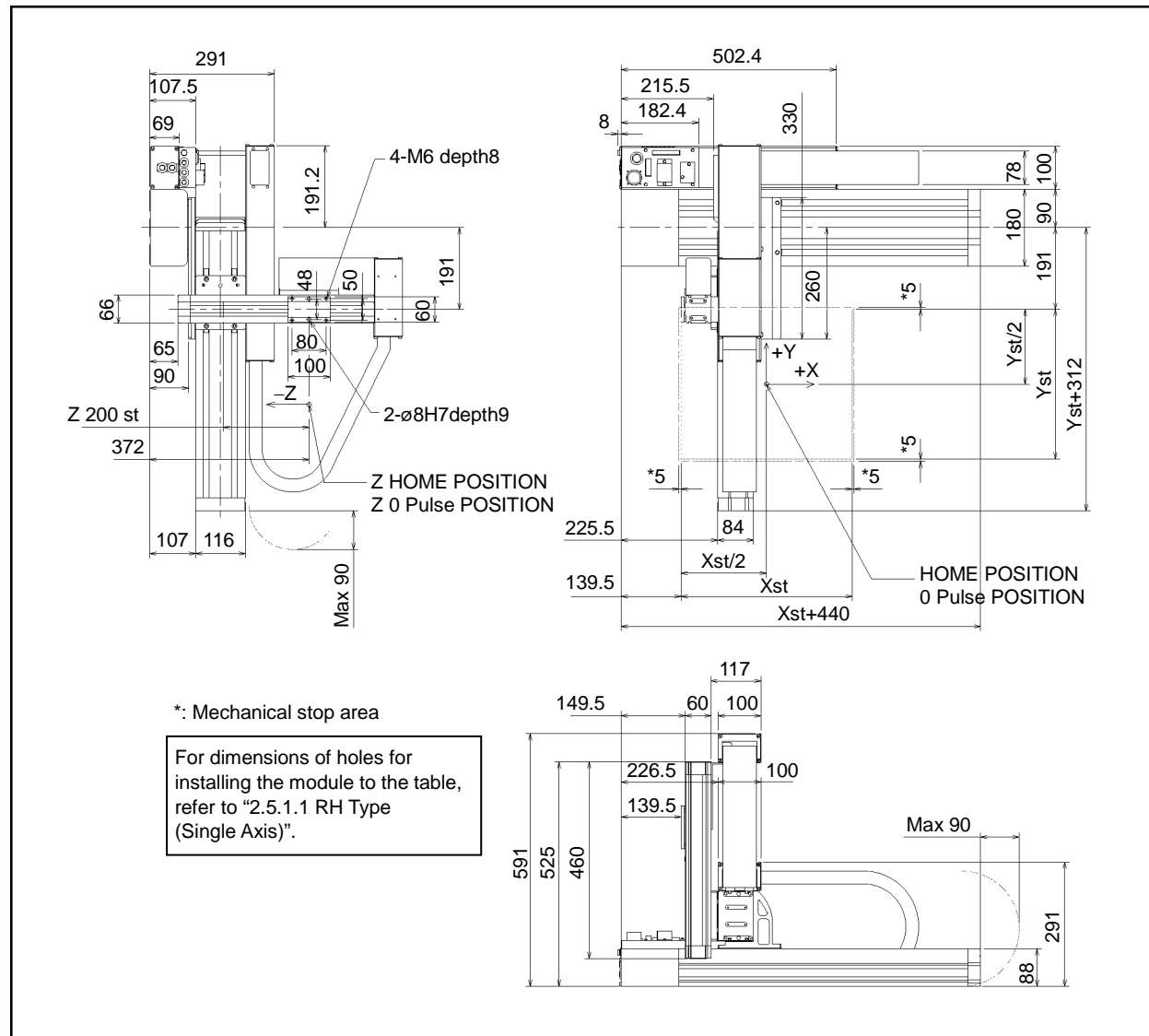
B Type: Outer Dimensions (Model number: X5Z007M2S0B Z axis stroke = 200 mm) [Unit: mm]



2.5.3 Three Axis Manipulators

2.5.3.1 RP-HMSz (Z axis stroke: 200 mm)

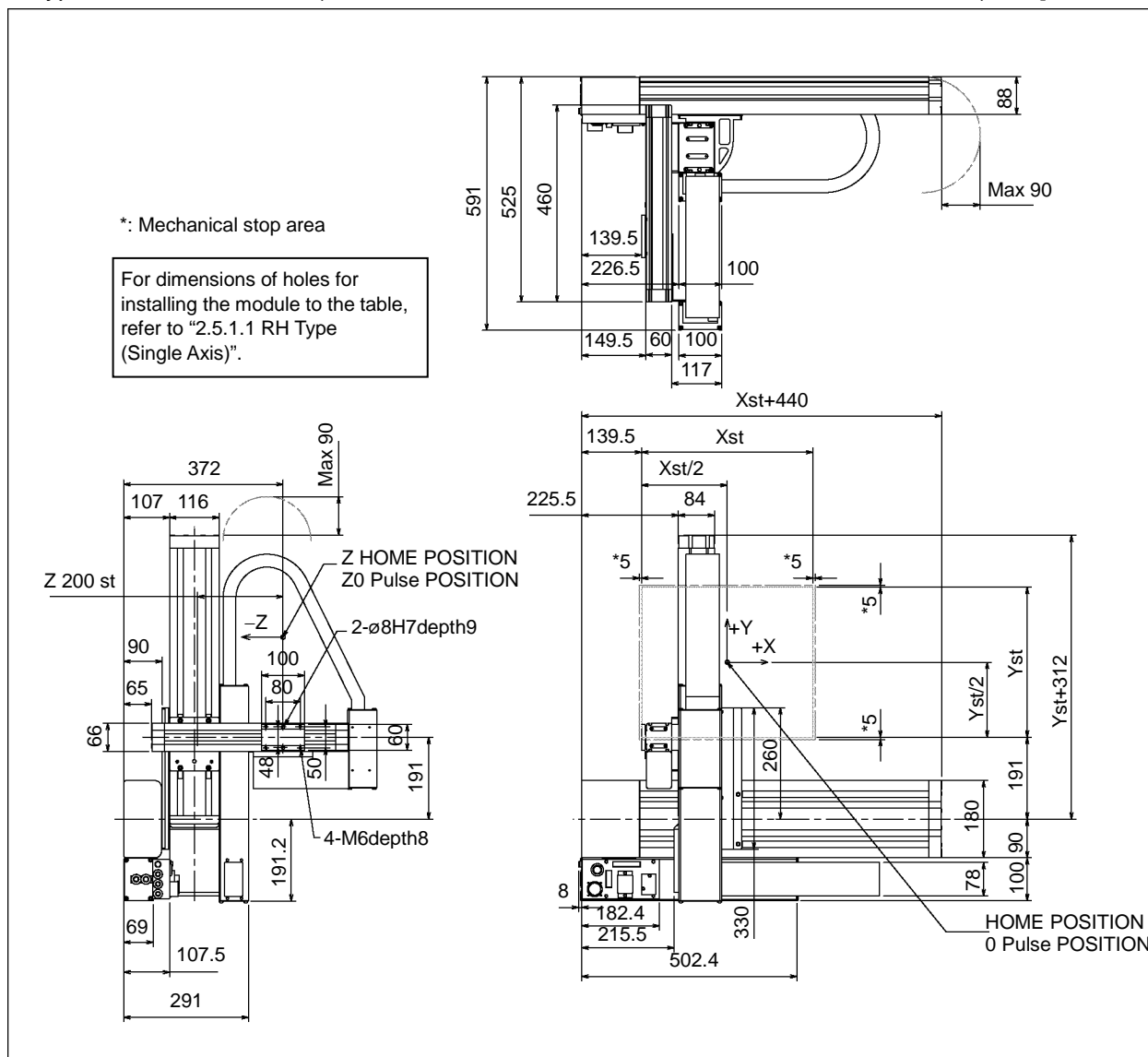
A Type: Outer Dimensions (Model number: X5P#H#M2S0A Z axis stroke = 200 mm) [Unit: mm]



X5P#H#M2S0A

Yst	
3	: 350 mm
5	: 550 mm
Xst	
4	: 400 mm
6	: 600 mm
8	: 800 mm

B Type: Outer Dimensions (Model number: X5P#H#M2S0B Z axis stroke = 200 mm) [Unit: mm]

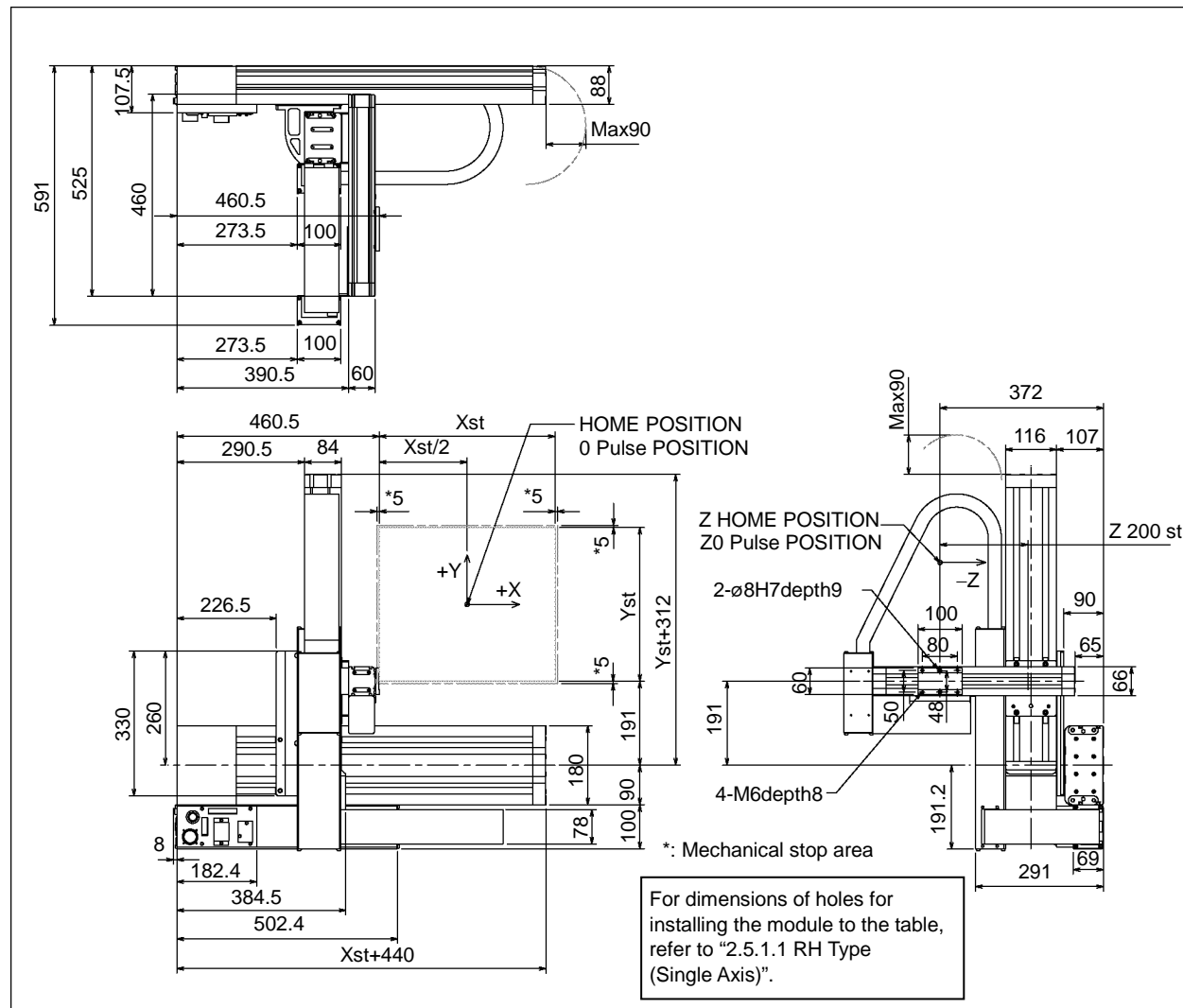


X5P#H#M2S0B

Yst	
3	: 350 mm
5	: 550 mm
Xst	
4	: 400 mm
6	: 600 mm
8	: 800 mm

2.5 Dimensions

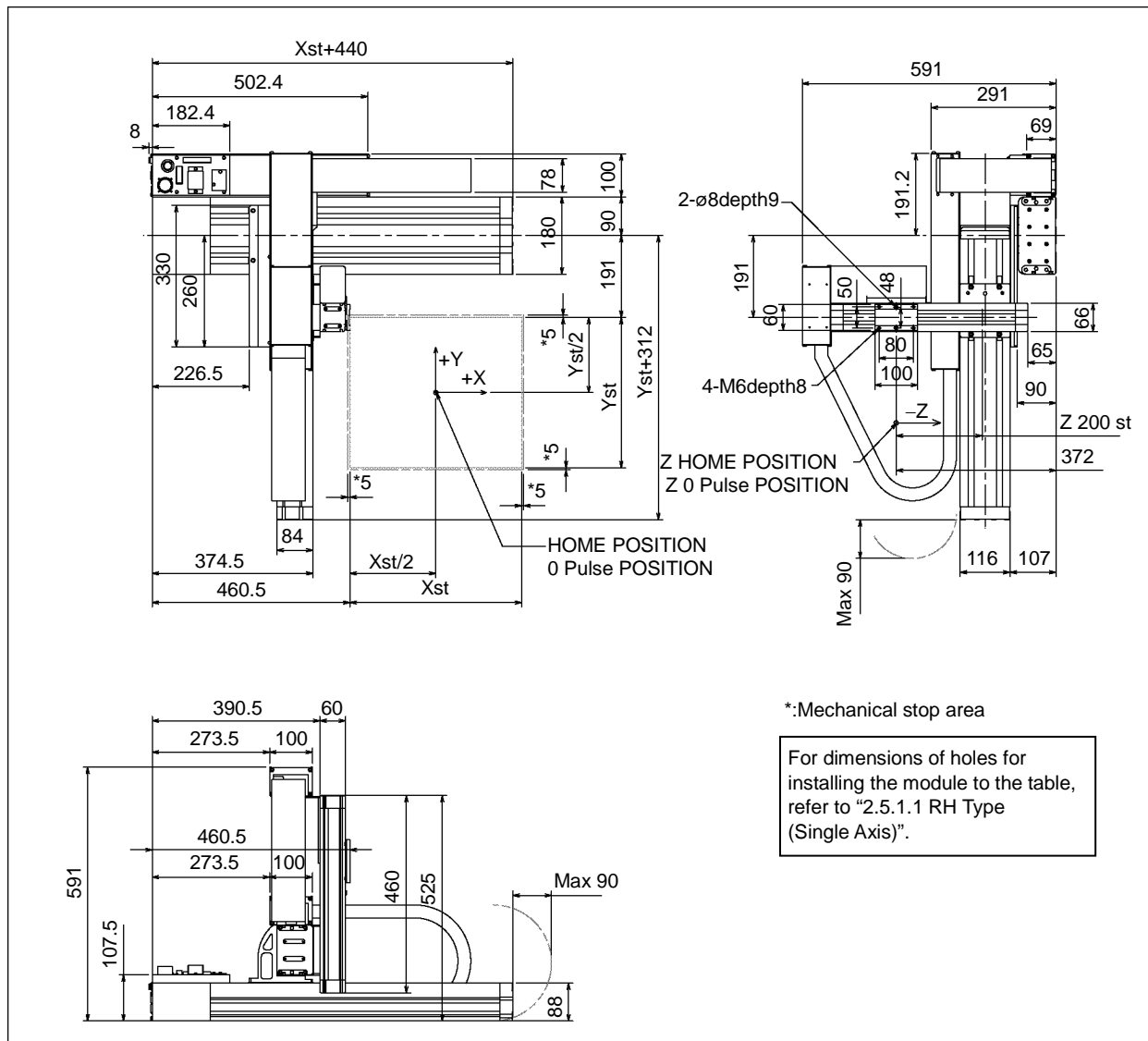
C Type: Outer Dimensions (Model number: X5P#H#M2S0C Z axis stroke = 200 mm) [Unit: mm]



X5P#H#M2S0C

Yst	
3	: 350 mm
5	: 550 mm
Xst	
4	: 400 mm
6	: 600 mm
8	: 800 mm

D Type: Outer Dimensions (Model number: X5P#H#M2S0D Z axis stroke = 200 mm) [Unit: mm]



X5P#H#M2S0D

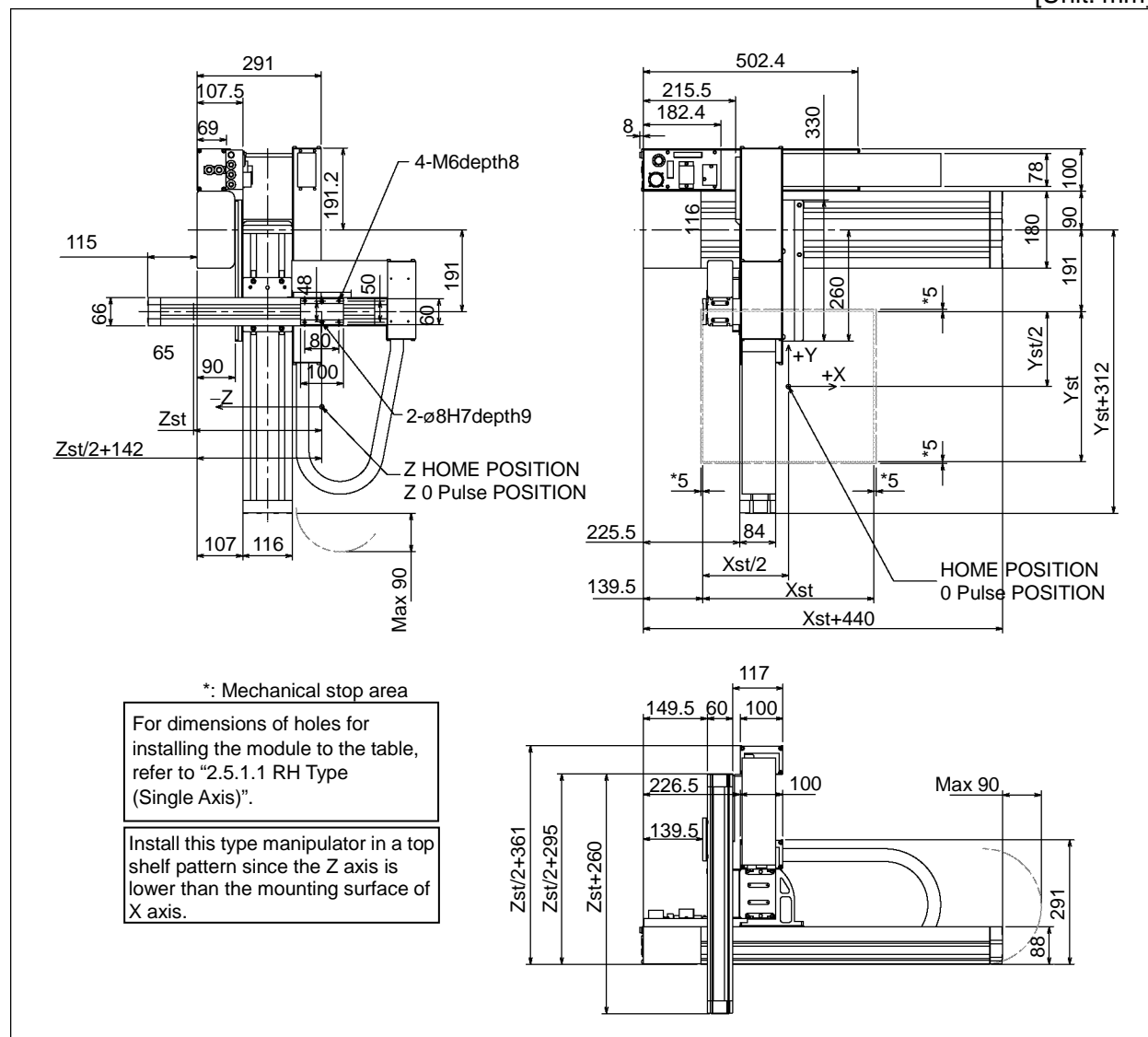
Yst	
3	: 350 mm
5	: 550 mm
Xst	
4	: 400 mm
6	: 600 mm
8	: 800 mm

2.5 Dimensions

2.5.3.2 RP-HMSz (Z axis stroke: 300 mm)

A Type: Outer Dimensions (Model number: X5P#H#M3S0A Z axis stroke = 300 mm)

[Unit: mm]



X5P#H#M3S0A

$$Y_{st}$$

3 : 350 mm

5 : 550 mm

Xst

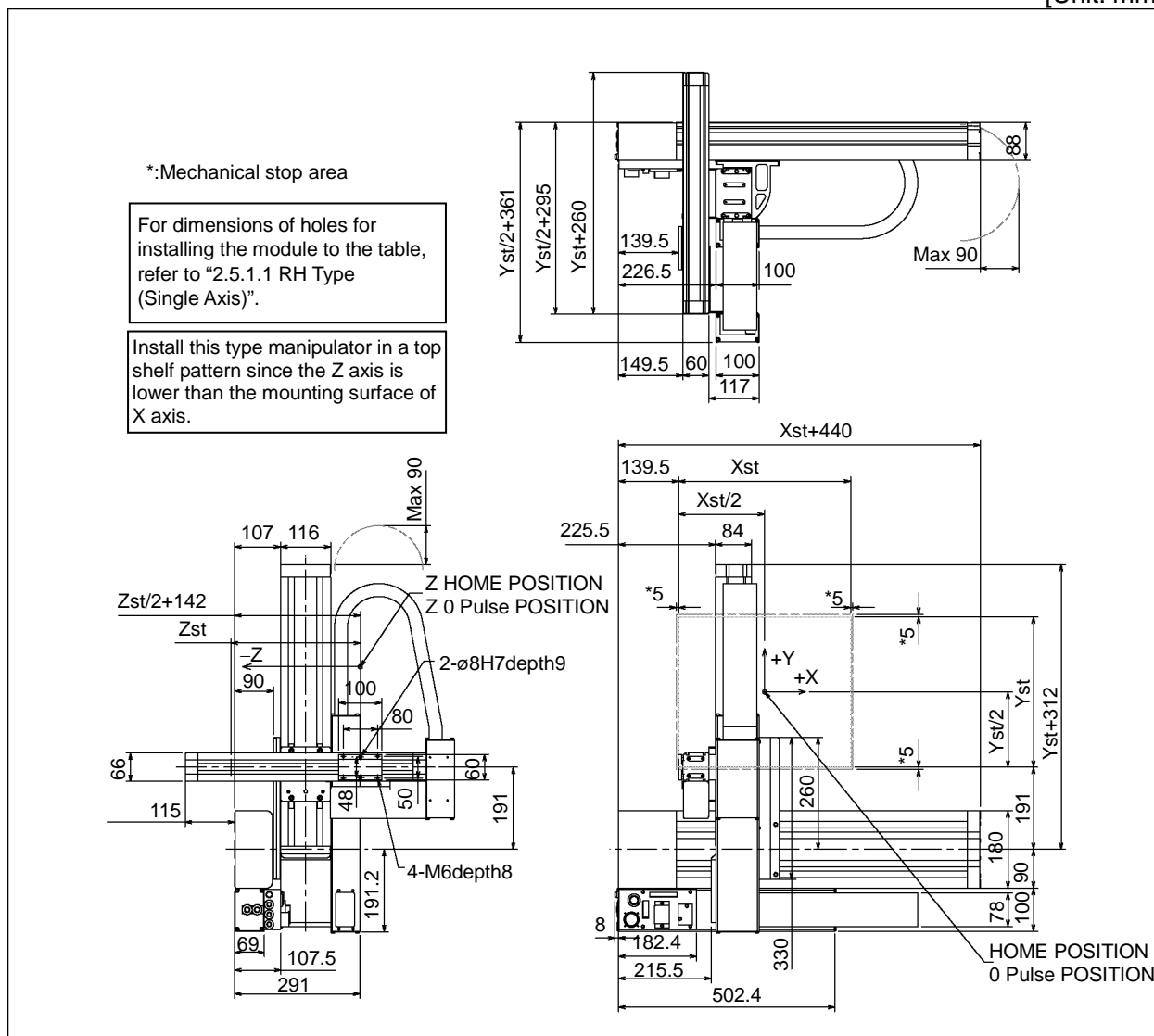
4 : 400 mm

6 : 600 mm

8 : 800 mm

B Type: Outer Dimensions (Model number: X5P#H#M3S0B Z axis stroke = 300 mm)

[Unit: mm]



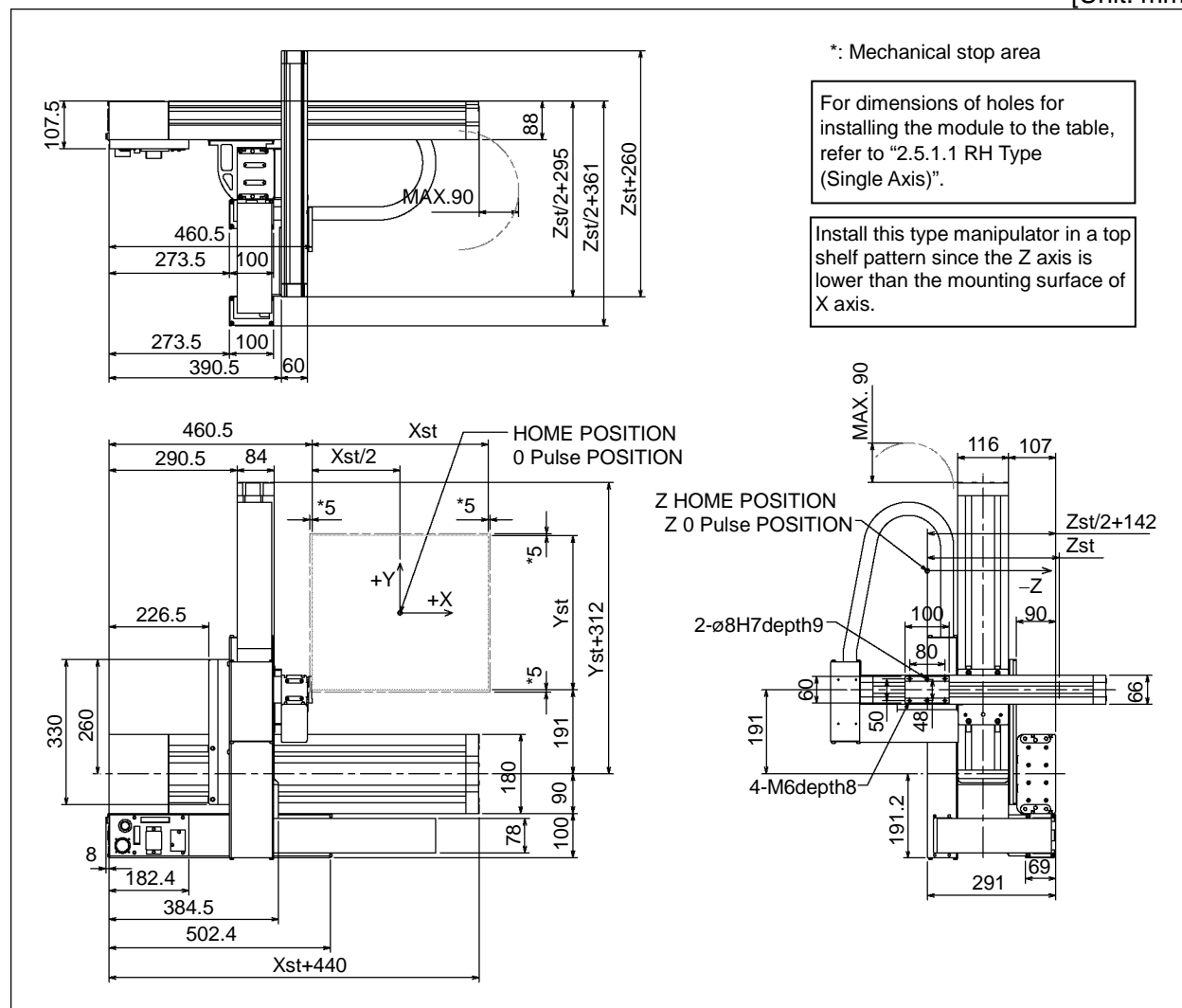
X5P#H#M3S0B

Yst	3 : 350 mm
	5 : 550 mm
Xst	4 : 400 mm
	6 : 600 mm
	8 : 800 mm

2.5 Dimensions

C Type: Outer Dimensions (Model number: X5P#H#M3S0C Z axis stroke = 300 mm)

[Unit: mm]

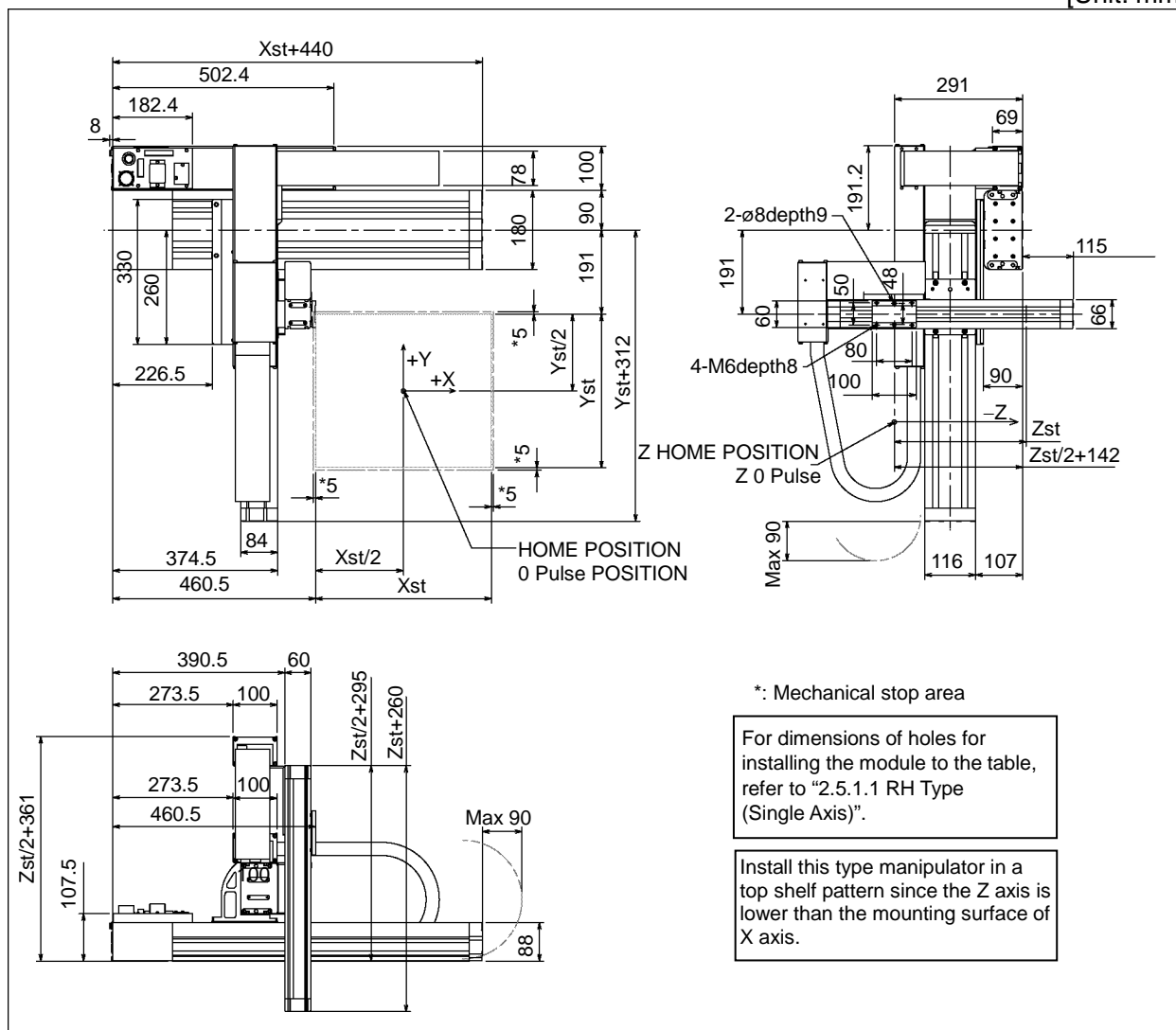


X5P#H#M3S0C

Yst	3 : 350 mm
	5 : 550 mm
Xst	4 : 400 mm
	6 : 600 mm
	8 : 800 mm

D Type: Outer Dimensions (Model number: X5P#H#M3S0D Z axis stroke = 300 mm)

[Unit: mm]



X5P#H#M3S0D

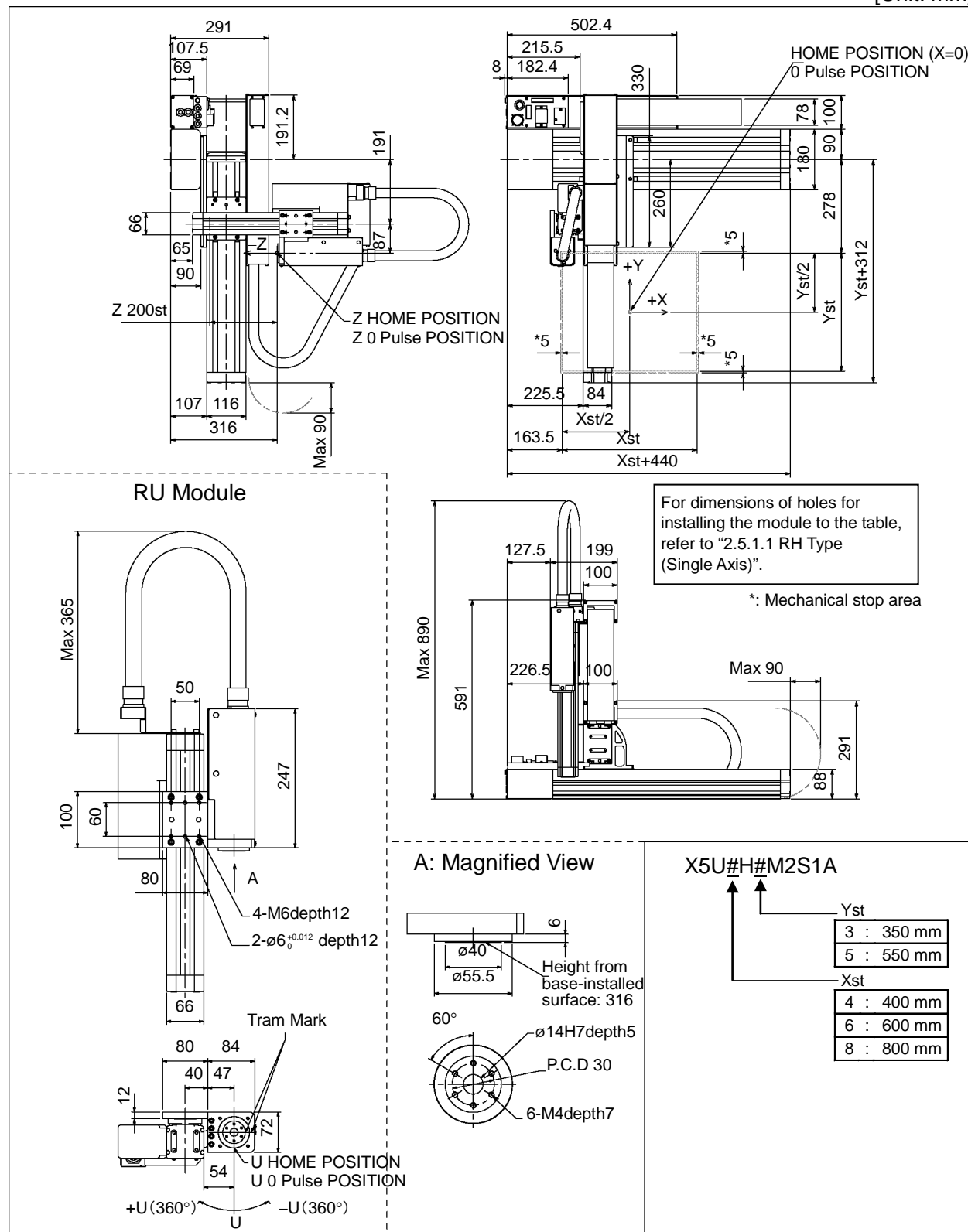
Yst	
3	: 350 mm
5	: 550 mm
Xst	
4	: 400 mm
6	: 600 mm
8	: 800 mm

2.5.4 Four Axis Manipulators

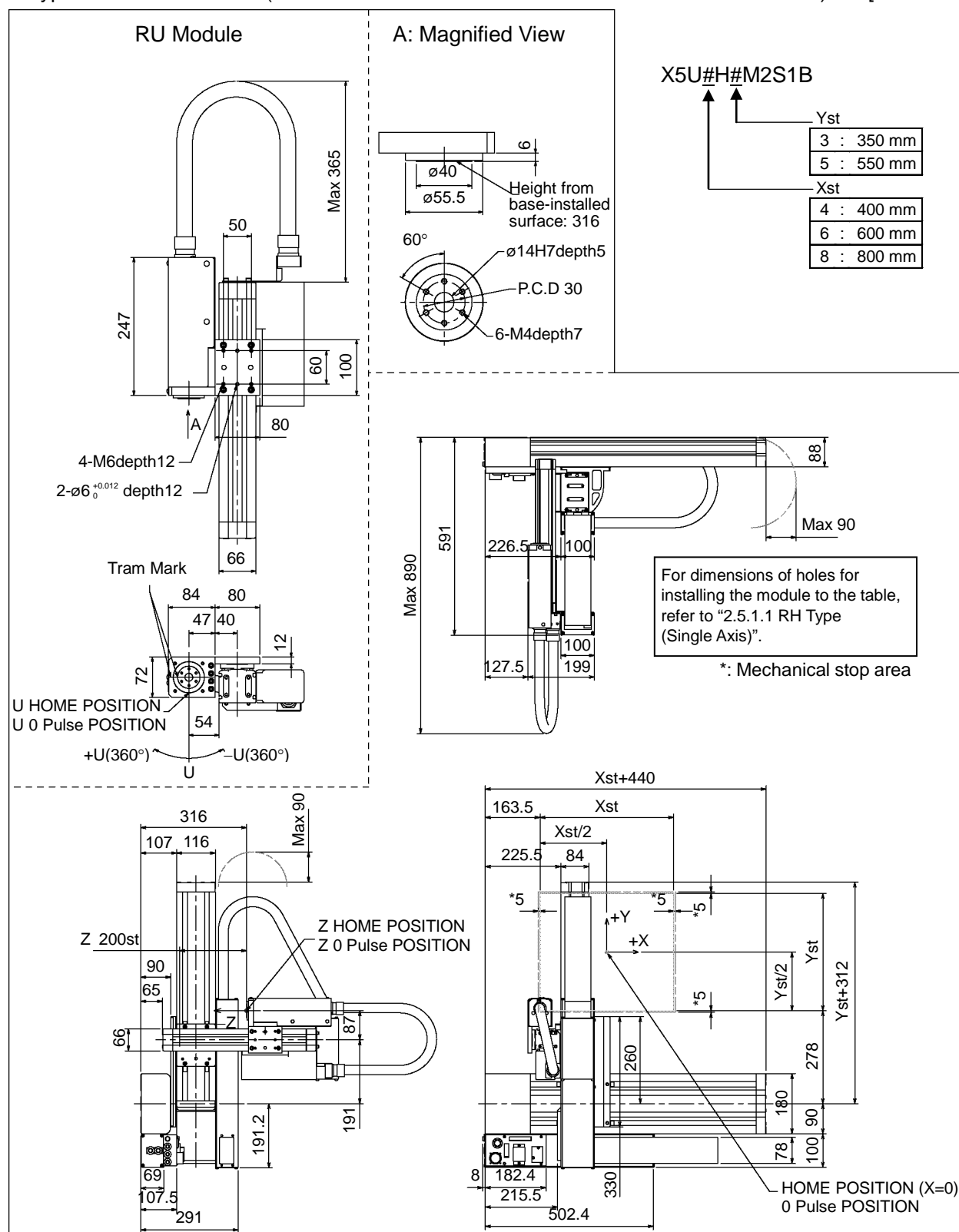
2.5.4.1 RU-HMSz (Z axis stroke: 200 mm)

A Type: Outer Dimensions (Model number: X5U#H#M2S1A Z axis stroke = 200 mm)

[Unit: mm]

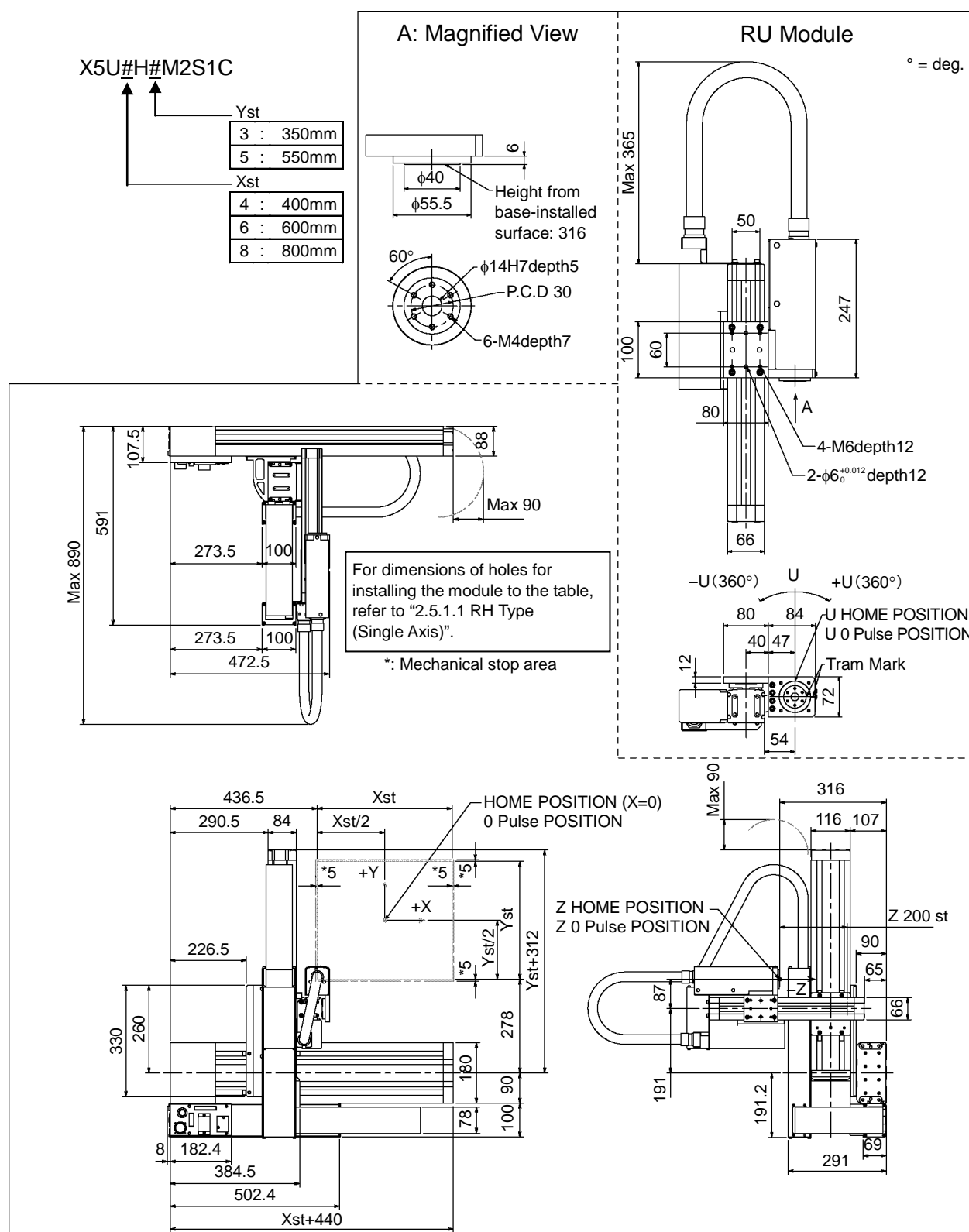


B Type: Outer Dimensions (Model number: X5U#H#M2S1B Z axis stroke = 200 mm) [Unit: mm]

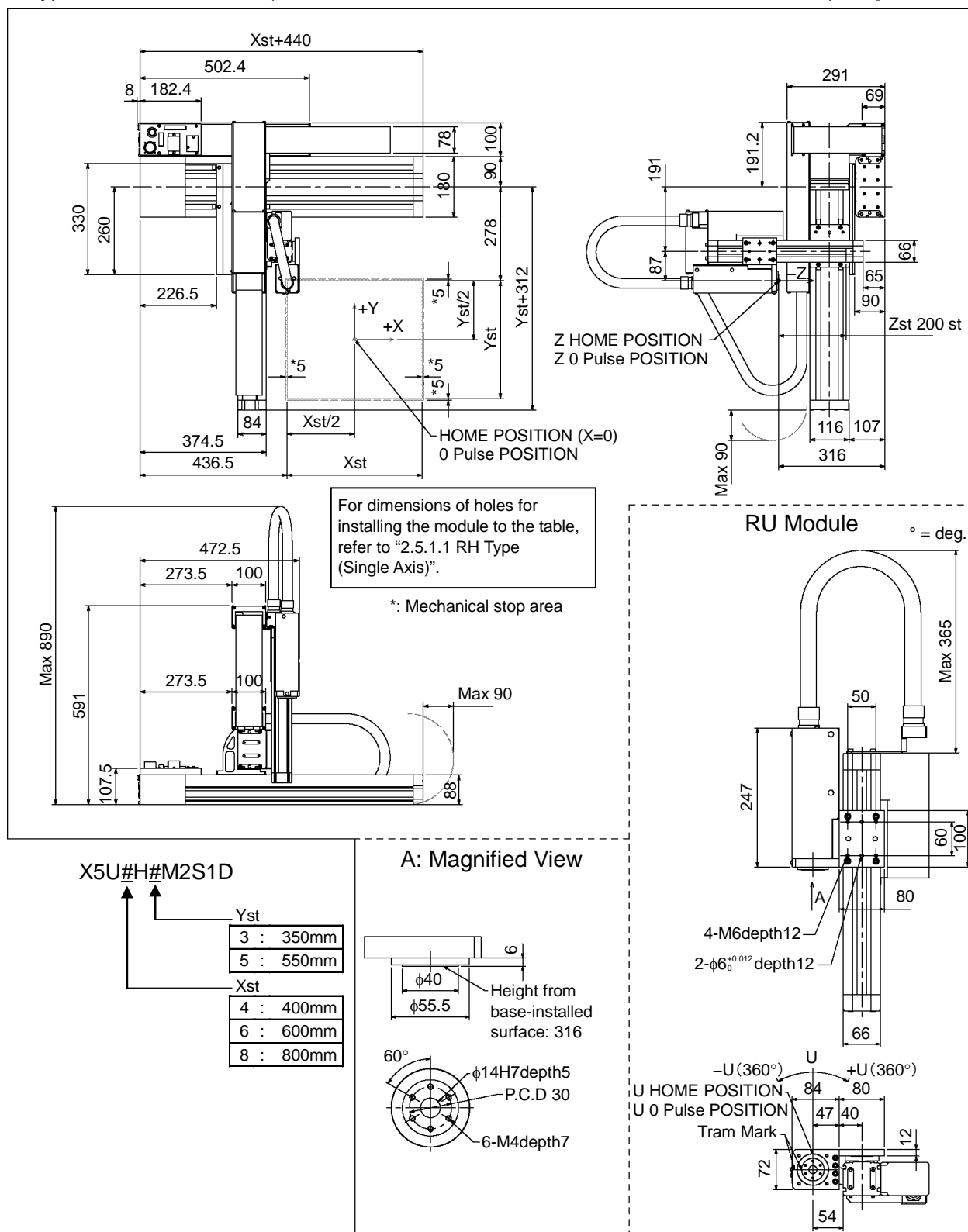


2.5 Dimensions

C Type: Outer Dimensions (Model number: X5U#H#M2S1C Z axis stroke = 200 mm) [Unit: mm]

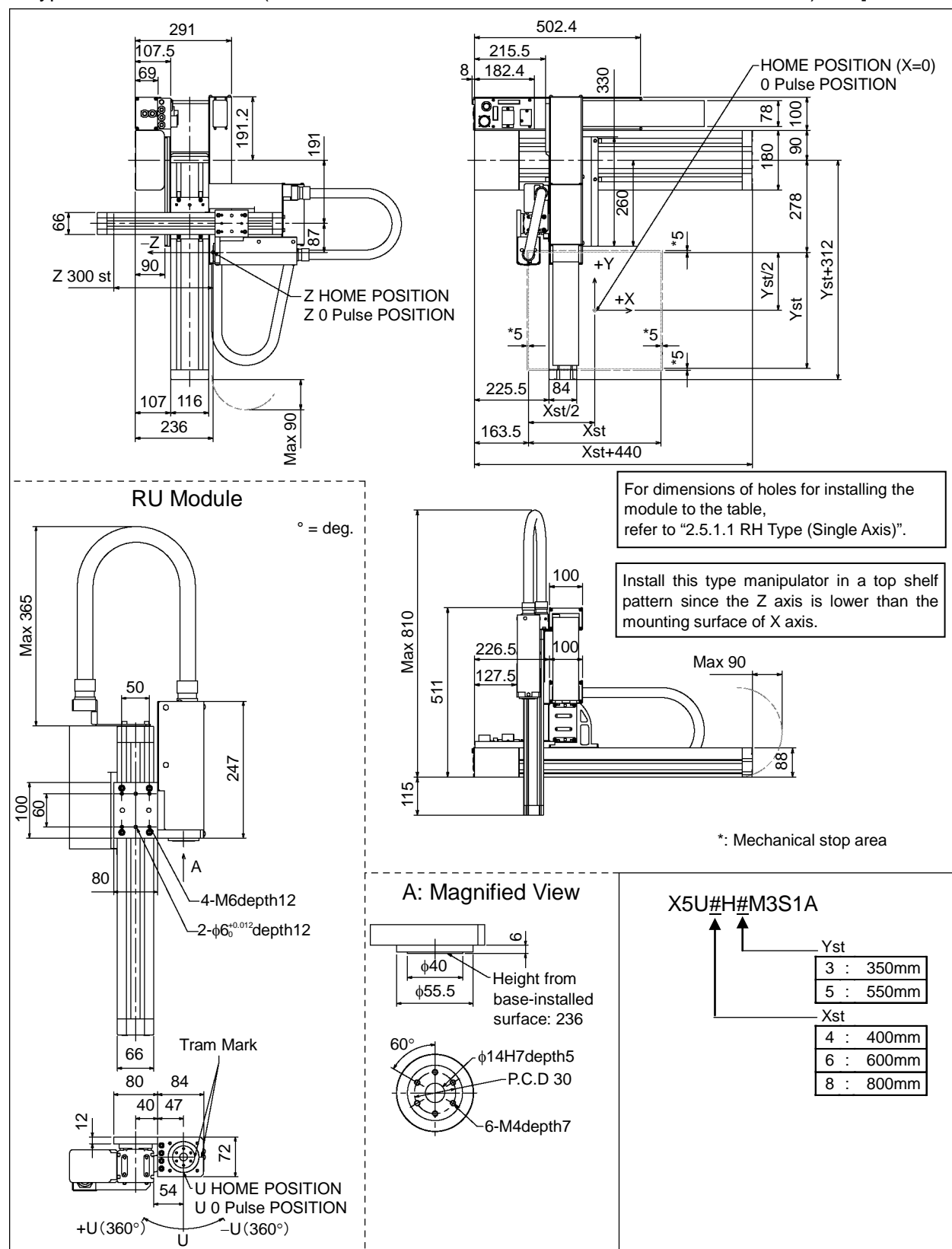


D Type: Outer Dimensions (Model number: X5U#H#M2S1D Z axis stroke = 200 mm) [Unit: mm]

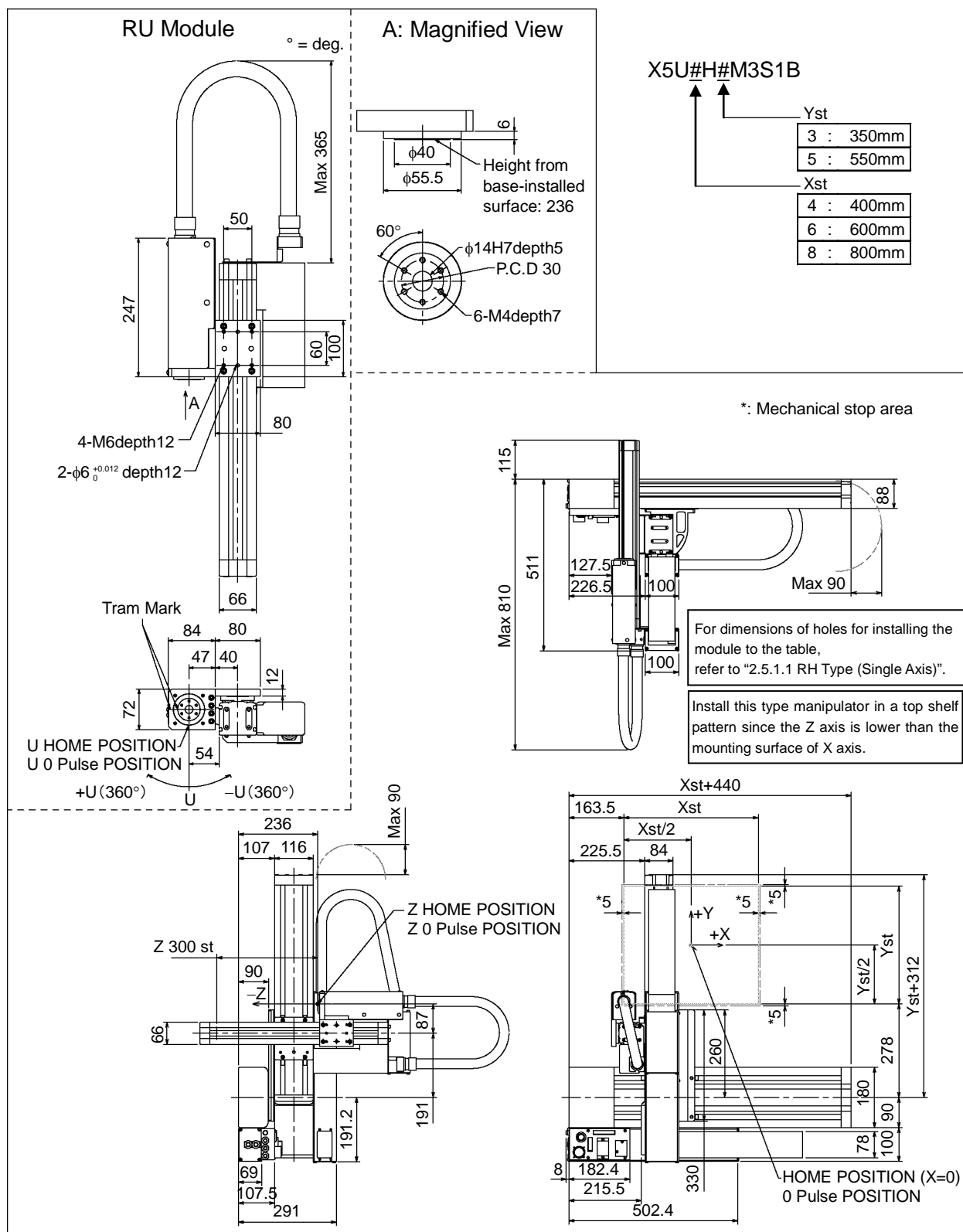


2.5.4.2 RU- HMSz (Z axis stroke: 300 mm)

A Type: Outer Dimensions (Model number: X5U#H#M3S1A Z axis stroke = 300 mm) [Unit: mm]



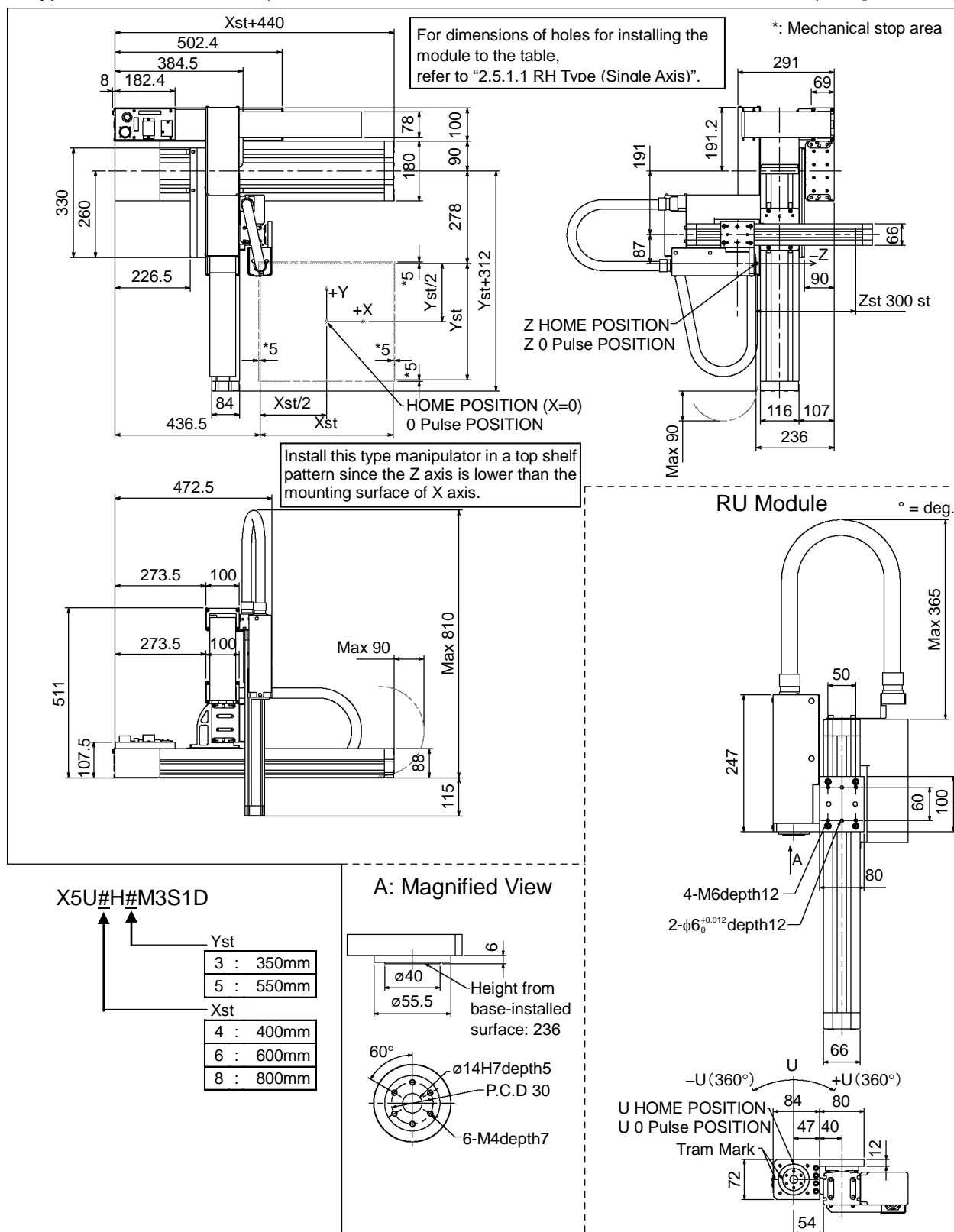
B Type: Outer Dimensions (Model number: X5U#H#M3S1B Z axis stroke = 300 mm) [Unit: mm]



C Type: Outer Dimensions (Model number: X5U#H#M3S1C Z axis stroke = 300 mm) [Unit: mm]



D Type: Outer Dimensions (Model number: X5U#H#M3S1D Z axis stroke = 300 mm) [Unit: mm]



2.6 Specifications

2.6.1 Single Axis

Item		RH module (including additional module)	RM module (including additional module)
Installation ^{*1}		Floor / Side / Ceiling / Top shelf	
Applicable controller		RC700-A	
Stroke length		600 mm 800 mm 1000 mm 2000 mm	350 mm 550 mm
Max. pulse range		600mm : $\pm 1966080p$ 800mm : $\pm 2621440p$ 1000mm : $\pm 3276800p$ 2000mm : $\pm 6553600p$	350mm : $\pm 1146880p$ 550mm : $\pm 1802240p$
Weight		600 mm: 25 kg 800 mm: 29 kg 1000 mm: 34 kg 2000 mm : 61kg	350 mm: 12 kg 550 mm: 14 kg
Repeatability		± 0.010 mm (RH2000 : ± 0.020 mm)	
Lead		20 mm	
Motor installation		Direct	Direct
Motor power		400 W	400 W
Transportable moment	Roll moment	600 N·m	70 N·m
	Pitch moment	450 N·m	120 N·m
	Yaw moment	400 N·m	120 N·m
Payload	Rated	40 kg	20 kg
	Max.	80 kg	40 kg
Resolution		0.0001526 mm/p	
Mechanical calibration method		Mechanical Calibration Free (All axes absolute encoder system)	
Equivalent continuous A-weighted sound pressure level ^{*2}		LAeq = 75.3 dB (A) or under	LAeq = 76.5 dB (A) or under
Safety standard conformity		CE Mark (EMC Directive, Machinery Directive, RoHS Directive)	
Environmental requirements	Ambient temperature	$+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$	
	Ambient relative humidity	10% to 80% (no condensation)	
	First transient burst noise	2 kV or less	
	Electrostatic noise	4 kV or less	
	Installation Environment	- Install indoors. - Keep away from direct sunlight. - Keep away from dust, oily smoke, salinity, metal power or other contaminants. - Keep away from flammable or corrosive solvents and gases. - Keep away from water. - Keep away from shock or vibration. - Keep away from sources electric noise.	
Max. operating speed (Rated payload)		600 mm: 1500 mm/s 800 mm: 1500 mm/s 1000 mm: 1200 mm/s 2000 mm : 560 mm/s	1500 mm/s
Set value of during the CP Motion Default value (Max. setting values)	SpeedS	50 (1120)	
	AccelS	200 (5000)	
Base bracket (Option)		RH 600: 2 pcs. RH800, 1000, 2000: 3 pcs.	RM350, 550: 2 pcs.
Camera bracket (Option)		R12B031905	

Automatic speed and acceleration/deceleration setting by WEIGHT	RH module 2000 mm						
	WEIGHT parameter (kg)	0	5	10	20	40	80
	Speed rate (%)	100	100	100	100	100	100
	Acc./Dec. rate (%)	100/100	100/100	100/100	100/100	100/100	70/70
	RH module 1000 mm						
	WEIGHT parameter (kg)	0	5	10	20	40	80
	Speed rate (%)	100	100	100	100	100	85
	Acc./Dec. rate (%)	116/116	116/116	116/116	116/116	100/100	100/100
	RH module 800 mm						
	WEIGHT parameter (kg)	0	5	10	20	40	80
	Speed rate (%)	100	100	100	100	100	60
	Acc./Dec. rate (%)	100/100	100/100	100/100	100/100	100/100	65/65
	RH module 600 mm						
	WEIGHT parameter (kg)	0	5	10	20	40	80
	Speed rate (%)	100	100	100	100	100	60
	Acc./Dec. rate (%)	170/170	170/170	150/150	120/120	100/100	50/50
	RM module 350,550 mm						
	WEIGHT parameter (kg)	0	2	5	10	20	40
	Speed rate (%)	100	100	100	100	100	80
	Acc./Dec. rate (%)	180/180	160/160	140/140	120/120	100/100	65/65

*1: Refer to "4.4.1 Installation Patterns".

*2: Conditions of Manipulator at measurement as follows:

Operating conditions: Under rated load, maximum speed, maximum acceleration, and duty 50%.

Measurement point: At the front of Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

2.6 Specifications

2.6.2 Two Axis Manipulator

Item		RG-HM (including additional module)	
Installation ^{*1}		Floor / Top shelf	
Applicable controller		RC700-A	
Mount direction type		A/B/C/D type	
Stroke length		Axis 1 (X): RH module 800 mm	Axis 2 (Y): RM module 550 mm 750 mm
Max. pulse range		Axis 1 (X): RH module $\pm 2621440p$	Axis 2 (Y): RM module 550 mm : $\pm 1802240p$ 750 mm : $\pm 2457600p$
Weight		RH module 29 kg	RM module 550 mm: 14 kg 750 mm: 17 kg
Repeatability		Axis 1: ± 0.010 mm	Axis 2: ± 0.010 mm
Motor power		Axis 1 (X): RH module 400 W	Axis 2 (Y): RM module 400 W
Payload	Rated	15 kg	
	Max.	25 kg	
Axis 3 down force		—	
Resolution		0.0001526 mm/p	
Mechanical calibration method		Mechanical Calibration Free (All axes absolute encoder system)	
Equivalent continuous A-weighted sound pressure level ^{*2}		LAeq = 75.1 dB (A) or under	
Safety standard conformity		CE Mark (EMC Directive, Machinery Directive, RoHS Directive)	
Environmental requirements	Ambient temperature	$+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$	
	Ambient relative humidity	10% to 80% (no condensation)	
	First transient burst noise	2 kV or less	
	Electrostatic noise	4 kV or less	
	Installation Environment	<ul style="list-style-type: none"> - Install indoors. - Keep away from direct sunlight. - Keep away from dust, oily smoke, salinity, metal powder or other contaminants. - Keep away from flammable or corrosive solvents and gases. - Keep away from water. - Keep away from shock or vibration. - Keep away from sources electric noise. 	
Max. operating speed (Rated payload)		1500 mm/s	
Set value of during the CP Motion	SpeedS	50 (1120)	
Default value (Max. setting values)	AccelS	200 (5000)	
CP max. operating speed		1120 mm/s	
CP max. acceleration		5000 mm/s^2	
Base bracket (Option)		RH800: 3 pcs.	
Camera bracket (Option)		R12B031905	

Automatic speed and acceleration/deceleration setting by WEIGHT	RG-HM: RH800mm-RM750mm						
	WEIGHT parameter (kg)	0	2	5	10	15	25
	Speed rate (%)	100	100	100	100	100	100
	Acc./Dec. rate of X (%)	100/100	100/100	100/100	100/100	100/100	80/80
	Acc./Dec. rate of Y (%)	100/100	100/100	100/100	100/100	100/100	80/80
	RG-HM: RH800mm-RM550mm						
	WEIGHT parameter (kg)	0	2	5	10	15	25
	Speed rate (%)	100	100	100	100	100	100
	Acc./Dec. rate of X (%)	100/100	100/100	100/100	100/100	100/100	80/80
	Acc./Dec. rate of Y (%)	233/233	210/210	160/160	130/130	100/100	80/80
Automatic speed and acceleration/deceleration setting by Axis 2 position	<p>RG-HM (RH: 800 mm) Axis 2 automatic Acc./Dec.</p> <p>Automatic Acc./Dec. [%]</p> <p>Axis 2 position [mm]</p>						

*1: Refer to "4.4.1 Installation Patterns".

*2: Conditions of Manipulator at measurement as follows:

Operating conditions: Under rated load, two-axis simultaneous motion, maximum speed, maximum acceleration, and duty 50%.

Measurement point: At the front of Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

* For transportable moment, refer to respective values (Single Axis).

2.6 Specifications

Item		YZ-MS				
Installation ^{*1}		Floor (Optional base brackets are required.) / Side				
Applicable controller		RC700-A				
Mount direction type		A/B type				
Stroke length		Axis 2 (Y): RM module 750 mm		Axis 3 (Z): RSz module 200 mm		
Max. pulse range		Axis 2 (Y): RM module ±2457600 p		Axis 3 (Z): RSz module −2621440 / 0 p		
Weight		RM module 17 kg		RSz module 7 kg		
Repeatability		Axis 2: ±0.010 mm		Axis 3: ±0.010 mm		
Motor power		Axis 2 (Y): RM module		Axis 3 (Z): RSz module		
		400 W		150 W (with brake)		
Payload	Rated	10 kg				
	Max.	15 kg				
Axis 3 down force		200 N				
Resolution		0.0001526 mm/p		0.0000763 mm/p		
Mechanical calibration method		Mechanical Calibration Free (All axes absolute encoder system)				
Equivalent continuous A-weighted sound pressure level ^{*2}		Laeq = 76.8 dB (A) or under				
Safety standard conformity		CE Mark (EMC Directive, Machinery Directive, RoHS Directive)				
Environmental requirements	Ambient temperature	+5 °C to + 40 °C				
	Ambient relative humidity	10 % to 80 % (no condensation)				
	First transient burst noise	2 kV or less				
	Electrostatic noise	4 kV or less				
	Installation Environment	<div>- Install indoors.</div> <div>- Keep away from direct sunlight.</div> <div>- Keep away from dust, oily smoke, salinity, metal power or other contaminants.</div> <div>- Keep away from flammable or corrosive solvents and gases.</div> <div>- Keep away from water.</div> <div>- Keep away from shock or vibration.</div> <div>- Keep away from sources electric noise.</div>				
Max. operating speed (Rated payload)		RM module 1500 mm/s		RSz module 750 mm/s		
CP max. operating speed		1120 mm/s				
CP max. acceleration		5000 mm/s ²				
Base bracket (Option)		RM750: 2 pcs.				
Camera bracket (Option)		R12B031905				
Automatic speed and acceleration/deceleration setting by WEIGHT		YZ-MS: RM750 mm-RSz (200) mm				
		WEIGHT parameter (kg)	0	5	10	15
		Speed rate (%)	100	100	100	100
		Acc./Dec. rate of X (%)	100/100	100/100	100/100	80/80
		Acc./Dec. rate of Y (%)	200/200	200/200	100/100	80/80

*1: Refer to 4.4.1 Installation Patterns.

*2: Conditions of Manipulator at measurement as follows:

Operating conditions: Under rated load, two-axis simultaneous motion, maximum speed, maximum acceleration, and duty 50%.

Measurement point: At the front of Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

* For transportable moment, refer to respective values (Single Axis).

2.6.3 Three Axis Manipulator

Item		RP-HMSz		
Installation ^{*1}		Floor (only for 200 mm Z axis stroke) / Top shelf		
Applicable controller		RC700-A		
Mount direction type		A/B/C/D type		
Stroke length		Axis 1 (X): RH module 400 mm 600 mm 800 mm	Axis 2 (Y): RM module 350 mm 550 mm	Axis 3 (Z): RSz module 200 mm 300 mm
Max. pulse range		Axis 1 (X): RH module 400 mm : ± 1310720 p 600 mm : ± 1966080 p 800 mm : ± 2621440 p	Axis 2 (Y): RM module 350mm : ± 1146880 p 550mm : ± 1802240 p	Axis 3 (Z): RSz module 200mm : $-2621440 / 0$ p 300mm : $-3932160 / 0$ p
Weight		RH module 400 mm: 21 kg 600 mm: 25 kg 800 mm: 29 kg	RM module 350 mm: 12 kg 550 mm: 14 kg	RSz module 200 mm: 7 kg 300 mm: 7.6 kg
Repeatability		Axis 1: ± 0.010 mm	Axis 2: ± 0.010 mm	Axis 3: ± 0.010 mm
Motor power		Axis 1 (X): RH module 400 W	Axis 2 (Y): RM module 400 W	Axis 3 (Z): RSz module 150 W (with brake)
Payload	Rated	10 kg		
	Max.	15 kg		
Axis 3 down force		200 N		
Resolution		0.0001526 mm/p		0.0000723 mm/p
Mechanical calibration method		Mechanical Calibration Free (All axes absolute encoder system)		
Equivalent continuous A-weighted sound pressure level ^{*2}		L _{aeq} = 76.2 dB (A) or under		
Safety standard conformity		CE Mark (EMC Directive, Machinery Directive, RoHS Directive)		
Environmental requirements	Ambient temperature	$+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$		
	Ambient relative humidity	10% to 80% (no condensation)		
	First transient burst noise	2 kV or less		
	Electrostatic noise	4 kV or less		
	Installation Environment	-Install indoors. -Keep away from direct sunlight. -Keep away from dust, oily smoke, salinity, metal power or other contaminants. -Keep away from flammable or corrosive solvents and gases. -Keep away from water. -Keep away from shock or vibration. -Keep away from sources electric noise.		
Max. operating speed (Rated payload)		RH module 400 mm: 1500 mm/s 600 mm: 1500 mm/s 800 mm: 1500 mm/s	RM module 1500 mm/s	RSz module 750 mm/s
Set value of during the CP Motion Default value (Max. setting values)	SpeedS	50 (1120)		
	AccelS	200 (5000)		
CP max. operating speed		1120 mm/s		
CP max. acceleration		5000 mm/s ²		
Base bracket (Option)		RH400, 600: 2 pcs. RH800: 3 pcs.		
Camera bracket (Option)		R12B031905		

2.6 Specifications

Automatic speed and acceleration/deceleration setting by WEIGHT	RP-HMSz: RH800 mm-RM (350, 550) mm-RSz (200, 300) mm				
	WEIGHT parameter (kg)	0	5	10	15
	Speed rate (%)	100	100	100	100
	Acc./Dec. rate of X (%)	100/200	100/200	100/100	50/50
	Acc./Dec. rate of Y (%)	166.7/187.5	166.7/187.5	100/100	50/50
	Acc./Dec. rate of Z (%)	200/200	200/200	100/100	50/50
	RP-HMSz: RH (400, 600) mm-RM (350, 550) mm-RSz (200, 300) mm				
	WEIGHT parameter (kg)	0	5	10	15
	Speed rate (%)	100	100	100	100
	Acc./Dec. rate of X (%)	100/168	100/168	100/100	50/50
	Acc./Dec. rate of Y (%)	166.7/187.5	166.7/187.5	100/100	50/50
	Acc./Dec. rate of Z (%)	200/200	200/200	100/100	50/50
Automatic speed and acceleration/deceleration setting by Axis 2 position	<p>RP-HMSz Axis 2 automatic Acc./Dec.</p>				

*1: Refer to 4.4.1 Installation Patterns.

*2: Conditions of Manipulator at measurement as follows:

Operating conditions: Under rated load, three-axis simultaneous motion, maximum speed, maximum acceleration, and duty 50%.

Measurement point: At the front of Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

* For transportable moment, refer to respective values (Single Axis).

2.6.4 Four Axis Manipulator

Item		RU-HMSz			
Installation ^{*1}		Floor (only for 200 mm Z axis stroke) / Top shelf			
Applicable controller		RC700-A			
Mount direction type		A/B/C/D type			
Stroke length		Axis 1 (X): RH module 400 mm 600 mm 800 mm	Axis 2 (Y): RM module 350 mm 550 mm	Axis 3 (Z): RSz module 200 mm 300 mm	Axis 4 (U): RU module ±360 deg.
Max. pulse range		Axis 1 (X): RH module 400 mm : ±1310720 p 600 mm : ±1966080 p 800 mm : ±2621440 p	Axis 2 (Y): RM module 350 mm : ±1146880 p 550 mm : ±1802240 p	Axis 3 (Z): RSz module 200 mm : −2621440 / 0 p 300 mm : −3932160 / 0 p	Axis 4 (U): RU module ± 360° : ±2752512 p
Weight		RH module 400 mm: 21 kg 600 mm: 25 kg 800 mm: 29 kg	RM module 350 mm: 12 kg 550 mm: 14 kg	RSz module 200 mm: 7 kg 300 mm: 7.6 kg	RU module 2.6 kg
Repeatability		Axis 1: ±0.010 mm	Axis 2: ±0.010 mm	Axis 3: ±0.010 mm	Axis 4: ±0.005 deg.
Motor power		Axis 1 (X): RH module 400 W	Axis 2 (Y): RM module 400 W	Axis 3 (Z): RSz module 150 W (with brake)	Axis 4 (U): RU module 150 W
Payload	Rated	5 kg			
	Max.	10 kg			
Axis 4 allowable moment of inertia	Rated	0.04 kg·m ²			
	Max.	0.12 kg·m ²			
Axis 3 down force		200 N			
Resolution		0.0001526 mm/p	0.0000723 mm/p	0.0001308 °/p	
Mechanical calibration method		Mechanical Calibration Free (All axes absolute encored system)			
Equivalent continuous A-weighted sound pressure level ^{*2}		LAeq = 76.2 dB (A) or under			
Safety standard conformity		CE Mark (EMC Directive, Machinery Directive, RoHS Directive)			
Environmental requirements	Ambient temperature	+5 °C to + 40 °C			
	Ambient relative humidity	10 % to 80 % (no condensation)			
	First transient burst noise	2 kV or less			
	Electrostatic noise	4 kV or less			
	Installation Environment	- Install indoors. - Keep away from direct sunlight. - Keep away from dust, oily smoke, salinity, metal power or other contaminants. - Keep away from flammable or corrosive solvents and gases. - Keep away from water, shock or vibration. - Keep away from sources electric noise.			
Max. operating speed (Rated payload)		RH module 400 mm: 1500 mm/s 600 mm: 1500 mm/s 800 mm: 1500 mm/s	RM module 1500 mm/s	RSz module 750 mm/s	RU module 1428 deg./s
Set value of during the CP Motion	SpeedS	50 (1120)			
Default value (Max. setting values)	AccelS	200 (5000)			
CP max. operating speed		1120 mm/s			
CP max. acceleration		5000 mm/s ²			
Base bracket (Option)		RH400, 600: 2 pcs., RH800: 3 pcs.			
Camera bracket (Option)		R12B031905			

2.6 Specifications

Automatic speed and acceleration/deceleration setting by WEIGHT	RU-HMSz: RH800 mm-RM (350, 550) mm-RSz (200, 300) mm-RU												
	WEIGHT parameter (kg)	0	5	10									
	Speed rate (%)	100	100	100									
	Acc./Dec. rate of X (%)	100/200	100/100	50/50									
	Acc./Dec. rate of Y (%)	166.7/187.5	100/100	50/50									
	Acc./Dec. rate of Z (%)	200/200	100/100	50/50									
	Acc./Dec. rate of U (%)	121/121	100/100	50/50									
	RU-HMSz: RH (400, 600) mm-RM (350, 550) mm-RSz (200, 300) mm-RU												
	WEIGHT parameter (kg)	0	5	10									
	Speed rate (%)	100	100	100									
	Acc./Dec. rate of X (%)	100/168	100/100	50/50									
	Acc./Dec. rate of Y (%)	166.7/187.5	100/100	50/50									
	Acc./Dec. rate of Z (%)	200/200	100/100	50/50									
	Acc./Dec. rate of U (%)	121/121	100/100	50/50									
Automatic speed and acceleration/deceleration setting by Axis 2 position													
	<div>RU-HMSz Axis 2 automatic Acc./Dec.</div> <table><thead><tr><th>Axis 2 position [mm]</th><th>Automatic Acc./Dec. [%]</th></tr></thead><tbody><tr><td>0</td><td>100</td></tr><tr><td>350</td><td>100</td></tr><tr><td>550</td><td>100</td></tr><tr><td>750</td><td>30</td></tr></tbody></table>				Axis 2 position [mm]	Automatic Acc./Dec. [%]	0	100	350	100	550	100	750
Axis 2 position [mm]	Automatic Acc./Dec. [%]												
0	100												
350	100												
550	100												
750	30												

*1: Refer to 4.4.1 Installation Patterns.

*2: Conditions of Manipulator at measurement as follows:

Operating conditions: Under rated load, four-axis simultaneous motion, maximum speed, maximum acceleration, and duty 50%.

Measurement point: At the front of Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

* For transportable moment, refer to respective values (Single Axis).

2.7 How to Set the Model



CAUTION

- Do not change the setting of the Manipulator model. The Manipulator model for your system is set at shipping. It is normally not required to change the model. However, if it is necessary to change it, be sure to set the model properly. Improper settings of the Manipulator model may result in abnormal or no operation of the Manipulator and/or cause serious safety problems.


Refer to the chapter *Robot Configuration* in EPSON RC+ User's Guide.

Combination		Model Number & Series Name to be selected
Two axis	RG-HM	X5G□□□□□□□□ ex.: X5G8H7M000C
Three axis	RP-HMSz	X5P□□□□□□□□ ex.: X5P6H5M3S0A
Four axis	RU-HMSz	X5U□□□□□□□□ ex.: X5U6H5M3S1A

3. Transportation, Storage, Unpacking, Handling

THE INSTALLATION SHALL BE MADE BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES.

3.1 Transportation and Storage

 <p>CAUTION</p>	<ul style="list-style-type: none"> ■ To carry the Manipulator, have two or more people to work on it and use the delivery equipment. When holding the bottom of the module by hand, be very careful not to get hands or fingers caught. ■ The robot modules are not provided any special measures against environmental problems for transportation and storage. Problems may arise or the service life may be reduced unless it is handled with great care as a precision instrument.
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When transporting the Manipulator for a long distance, secure it to the delivery equipment so that the Manipulator cannot fall. If necessary, pack the Manipulator in the same way as it was delivered.

When the Manipulator is used for a robot system again after long-term storage, perform a test run to verify that it works properly, and then operate it thoroughly.


Transport and store the Manipulator in the range of -25°C to +55°C.
Humidity within 10% to 90% is recommended.


When condensation occurs on the Manipulator during transport or storage, turn ON the power only after the condensation dries.

Do not shock or shake the Manipulator during transport.

Store the modules indoors in a clean environment, and do not expose to wind, rain or direct sunlight.

3.2 Unpacking and Handling

 <p>WARNING</p>	<ul style="list-style-type: none"> ■ Only authorized personnel should perform sling work and operate a crane or forklift. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system. ■ When pulling out a module from the container, keep it in its horizontal position. If you put a module without a motor brake in a vertical position, the slider may fall by its own weight (back drive), which is extremely hazardous, and could cause injury.
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 <p>CAUTION</p>	<ul style="list-style-type: none"> ■ Stabilize the Manipulator with your hands when hoisting it. Unstable hoisting is extremely hazardous and may result in fall of the Manipulator.
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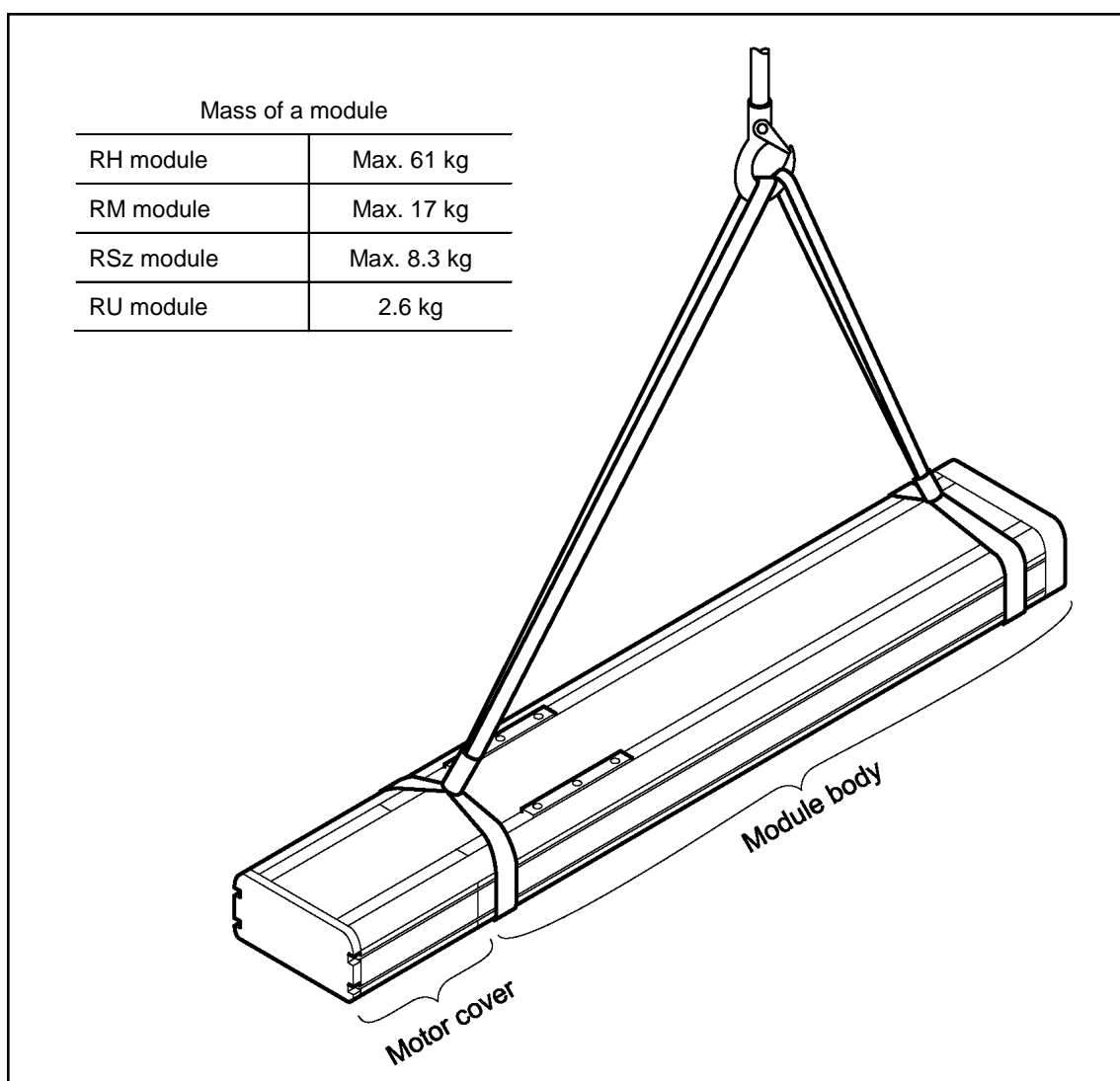
Contents check

Unpack all containers and compare parts with a provided checklist to check for damaged or missing parts. Unnecessary parts for your model can be included in the containers because some parts are common to different models.

How to Handle

- (1) Single module : Use the module body for slinging or mounting to handle for transport.
- (2) Multi-axis manipulator : Secure the robot using ropes or a fixture so that it won't move in transit.

Basically transport the manipulator by each module.







4. Installation

INSTALLATION SHALL BE PERFORMED BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES.

The base table must not only be able to bear the weight of the Manipulator but should also be able to withstand the dynamic movement of the Manipulator when the Manipulator operates at maximum acceleration. Ensure that there is enough strength on the base table by attaching reinforcing components such as crossbeams.

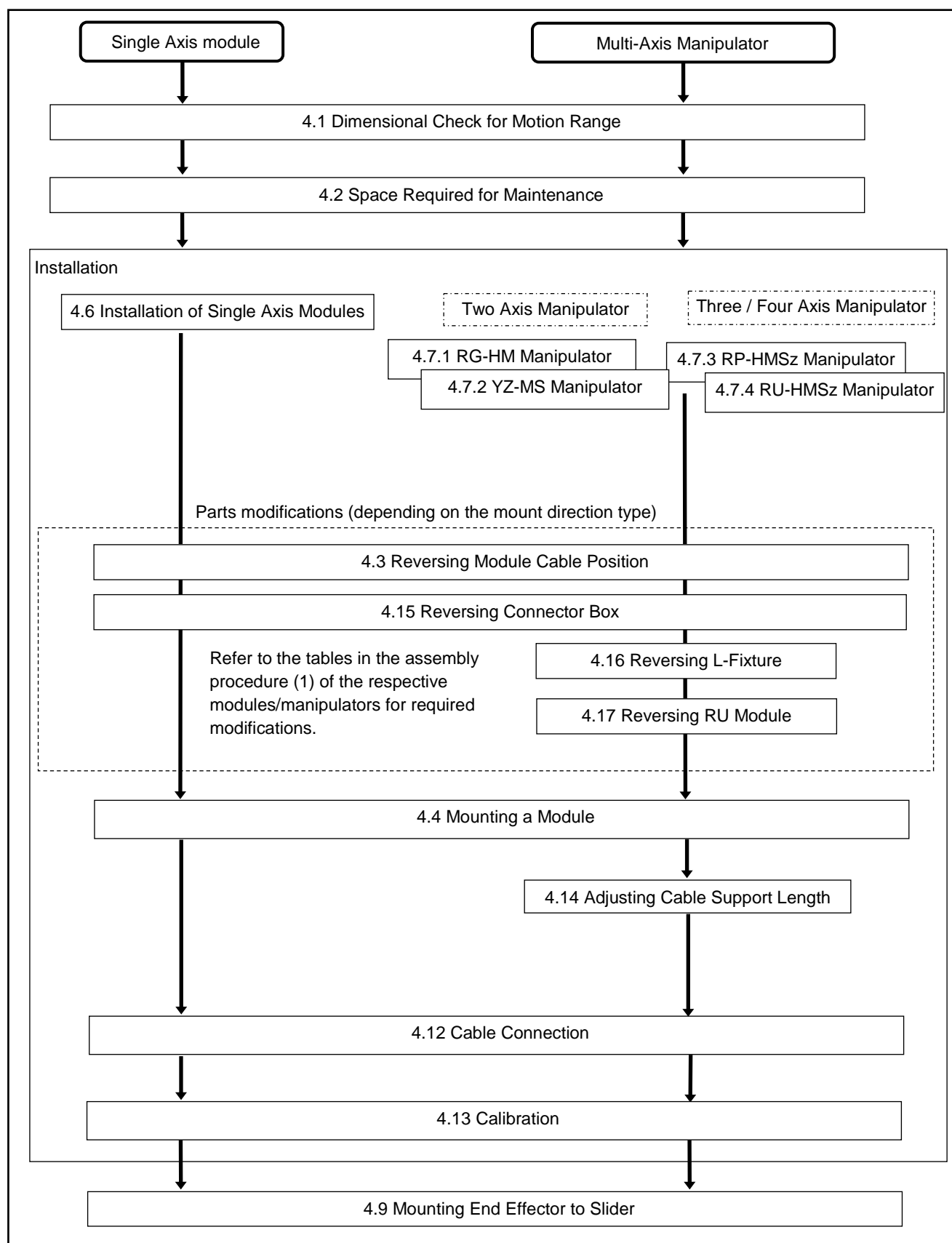
The controller has been set up for the robot system configuration before shipping. Refer to respective controller manuals for installation procedures.

 WARNING	<ul style="list-style-type: none"> ■ To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the User's Guide. ■ Improper mounting of a module may result in mechanical breakage of the equipment and / or personal injuries. <ul style="list-style-type: none"> - The base axis module of a multi-axis manipulator must be firmly attached to the mounting surface using the specified bolts and mounting holes. - For a multi-axis manipulator, attach the modules securely to each other using the specified combining bracket and bolts. - Be especially careful not to cause damage to the robot module system by mechanical interference, and also not to cause harm to yourself and others.
 WARNING	<ul style="list-style-type: none"> ■ Before performing any installation procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any installation procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Grounding the manipulator is done by connecting with the controller. Ensure that the controller is grounded and the cables are correctly connected. If the ground wire is improperly connected to ground, it may result in the fire or electric shock.
 CAUTION	<ul style="list-style-type: none"> ■ Do not change the setting of the Manipulator model. The Manipulator model for your system is set before shipping. It is normally not required to change the model. However, if it is necessary to change it, be sure to set the model properly. Improper settings of the Manipulator model may result in abnormal or no operation of the Manipulator and/or cause serious safety problems. ■ When connecting the Manipulator and the Controller, make sure that the serial numbers on each equipment match. Improper connection between the Manipulator and Controller may not only cause improper function of the robot system but also serious safety problems. The connection method varies with the Controller used. For details on the connection, refer to the controller manual.

 CAUTION	<ul style="list-style-type: none">■ When limiting the motion range for safety, set it by pulse range.■ When carrying a multi-axis manipulator or a single axis manipulator with an end effector, the sliders of these robots may back-drive and pinch your hands. Secure the slider using a rope or similar means so the slider will not move while carrying the robot.■ Do not grab motor cover, connector box or cables when carrying a module.■ The robot system must be installed to avoid interference with buildings, structures, utilities, other machines and equipment that may create a trapping hazard or pinch points.
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4.1 Dimensional Check for Motion Range

Installation procedure



4.1 Dimensional Check for Motion Range

The specified stroke of a module is between 0 (zero) position and just before the end of stroke at both sides. There is approximately 5 mm allowance for the dead end at both sides. Add 10 mm or more allowance to the end of the specified stroke for the motion range of the robot system for the floor plan so that the robot does not interfere with peripheral equipment.

4.2 Space Required for Maintenance

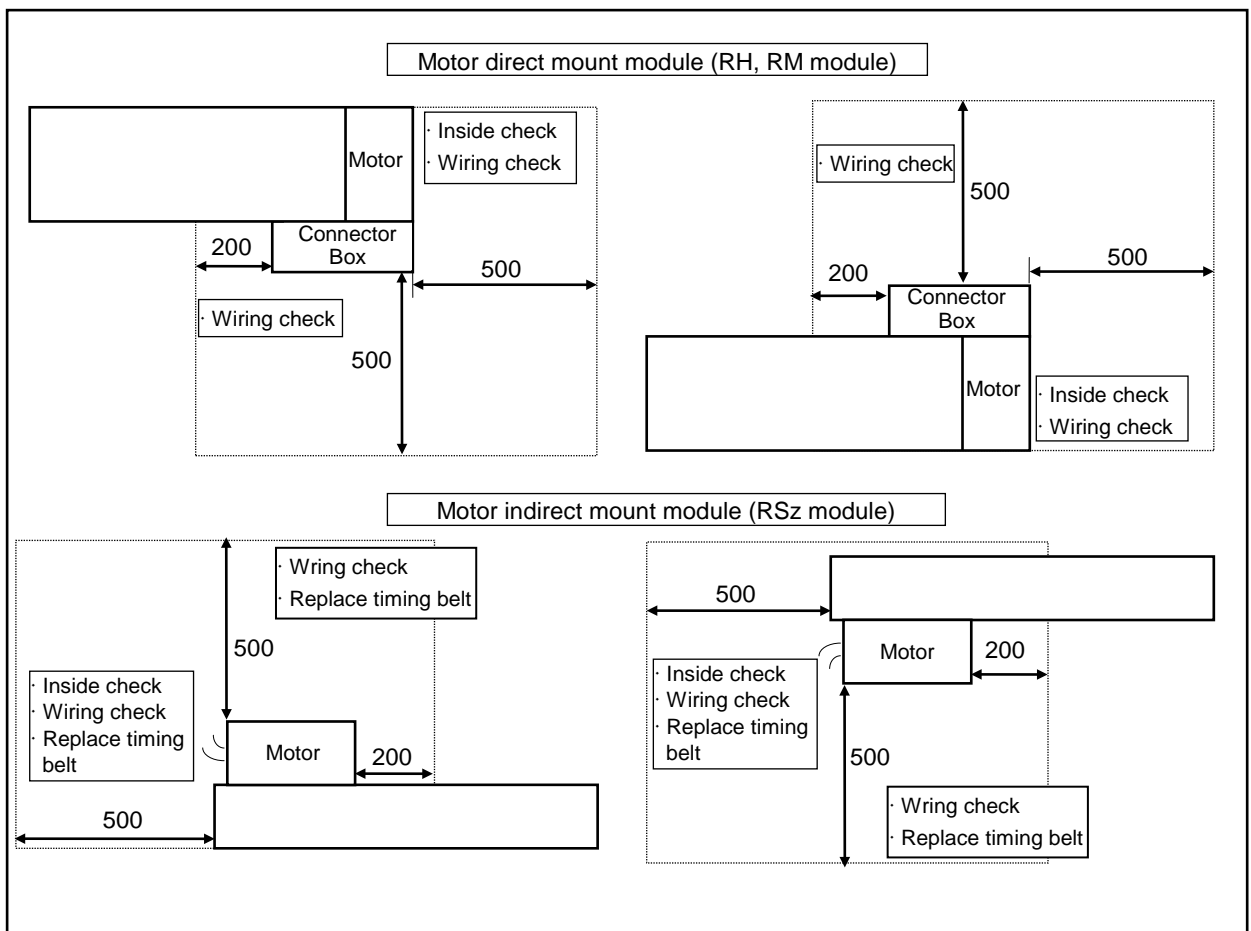
We recommend allowing an open space for maintenance work. If the space is not wide enough you may need to dismount a module for maintenance work.

Single axis : Clear upper side of the module and the area shown in Figure 4-2.

Multi-axis manipulator : The area shown in Figure 4-2 is required for motion range and each axis end.

Space required for maintenance

[Unit: mm]



4.3 Reversing Module Cable Position

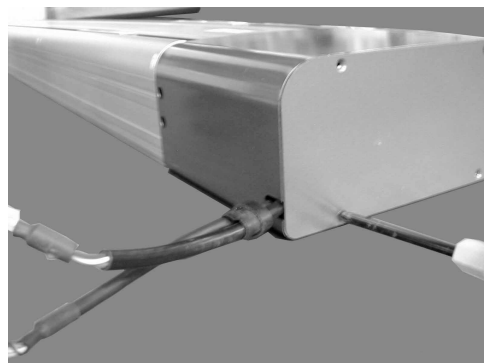
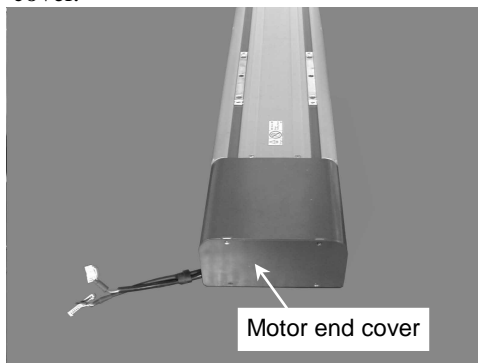


- To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. **DO NOT** connect it directly to a factory power source.
- Before performing any replacement procedure, turn **OFF** the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power **ON** is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

4.3.1 RH, RM Module

All procedures hereunder are common to RH and RM modules. The RH module is shown as an example in the following photographs.

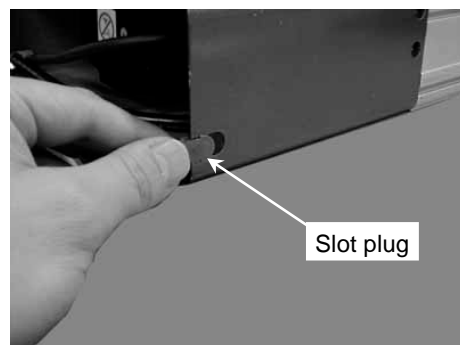
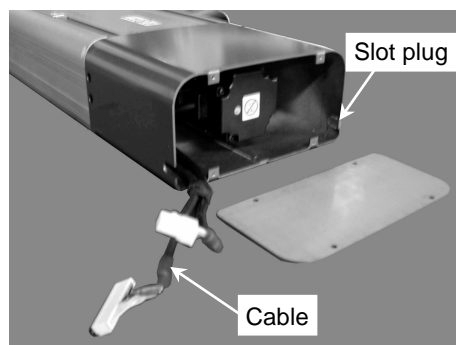
- (1) Remove the counter-sunk head screws for the end cover. Remove the motor end cover.



- (2) Remove the cables from the opening. Then, remove the slot plug from the opening on the other side.

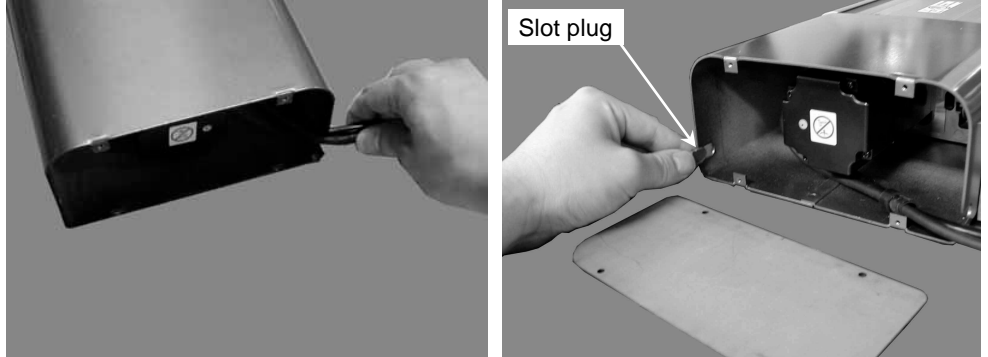


NOTE Be careful not to lose the slot plug.

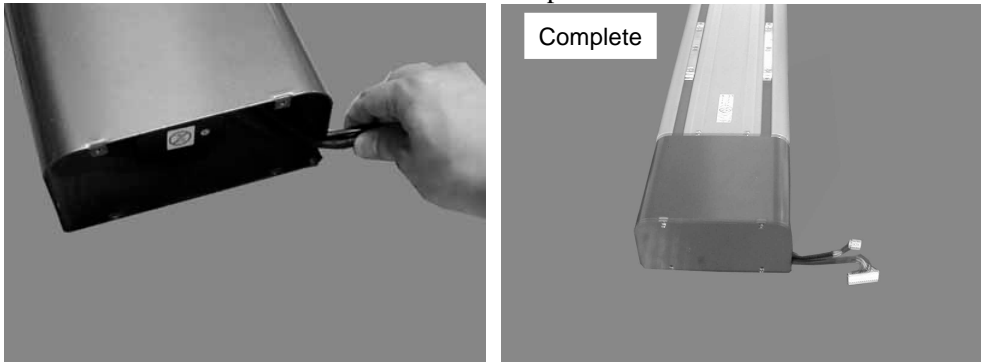


- (3) Insert the part of the cable bound with rubber in the opening where the slot plug was inserted before.

Bend the cable in as large a radius as possible to minimize the force applied to the cable outlet of the motor cover. Insert the slot plug in the groove on the other side.



- (4) Attach the motor end cover. Be careful not to pinch the cables in the cover.



4.4 Mounting a Module



- When mounting a module manipulator on a wall, do not remove the support until all the anchor bolts are secured. Removing the support while the anchor bolts are not secured sufficiently is extremely hazardous and may cause the Manipulator to fall.



- When removing or installing a module, there must be two or more people to work on it so that at least one of them can support the module while others are removing the bolts. Removing the bolts without supporting the module may result in the module falling, bodily injury, and/or malfunction of the robot system.

Maximum Reaction Force

A base table for anchoring the Manipulator is not supplied. Please make or obtain the base table by yourself.

The base table must not only be able to bear the weight of the Manipulator but should also be able to withstand the dynamic movement of the Manipulator when the Manipulator operates at maximum acceleration. Ensure that there is enough strength on the base table by attaching reinforcing components such as crossbeams.

The torque and reaction force produced by the movement of the Manipulator.

	Single Axis	Two Axis		Three Axis	Four Axis
	RH, RM	RG-HM	YZ-MS	RP-HMSz	RU-HMSz
Max. Horizontal reaction force	1400 N	2000 N	1400 N	2000 N	2000 N
Max. Vertical reaction force	—	—	1050 N	1050 N	1050 N
Max. Reaction torque on the horizontal plate	—	—	—	—	40 Nm

Surface for mounting the module

The following two methods of mounting are available:

1. Attach the module directly to mounting surface using the tapped holes on its bottom.
2. Attach the module to mounting surface using the optional base bracket.

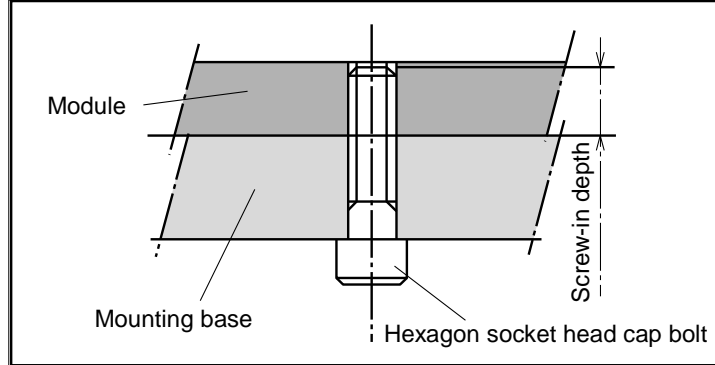
For both methods, the flatness of the mounting base shall be 0.1 mm or less and the surface shall be free of interfering protrusions.

Adjust the flatness of mounting base using shims when clearance exists between the module surface and the mounting base around the mounting holes.

1. Attach the module directly to mounting surface using the tapped holes on its bottom.

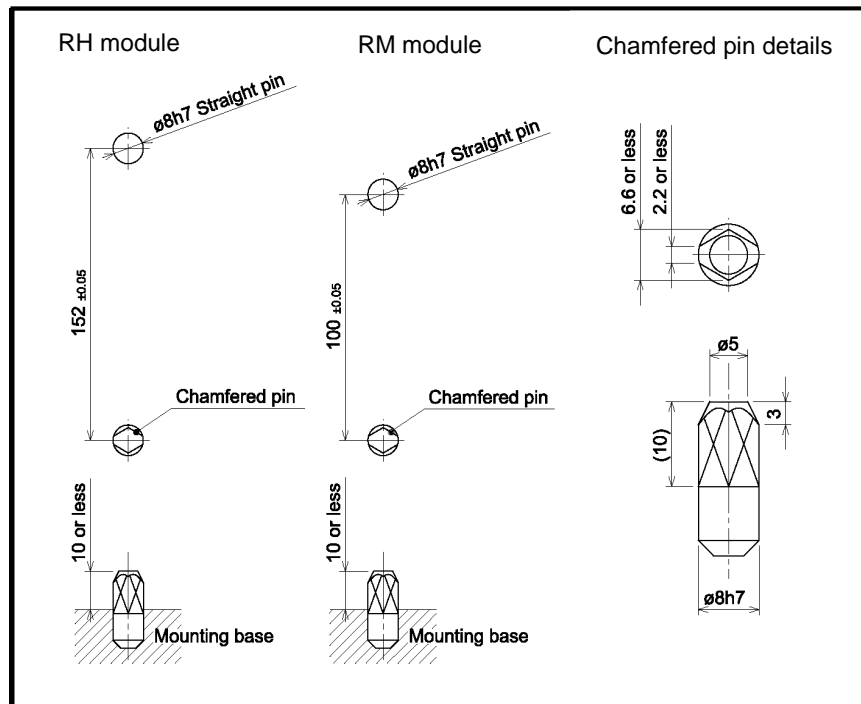
Drill holes through the mounting base and attach the module from its rear side.

ø8H7 holes on its bottom may be used for locating pins to secure the position of the module. Refer to Figure for specifications of the locating pins.



	RH module	RM module
Bolt diameter	M8	M6
Screw-in depth	12 to 16 mm	9 to 12 mm
Tightening torque (max.)	33.3 N·m	14.7 N·m

[Unit: mm]



4.4 Mounting a Module

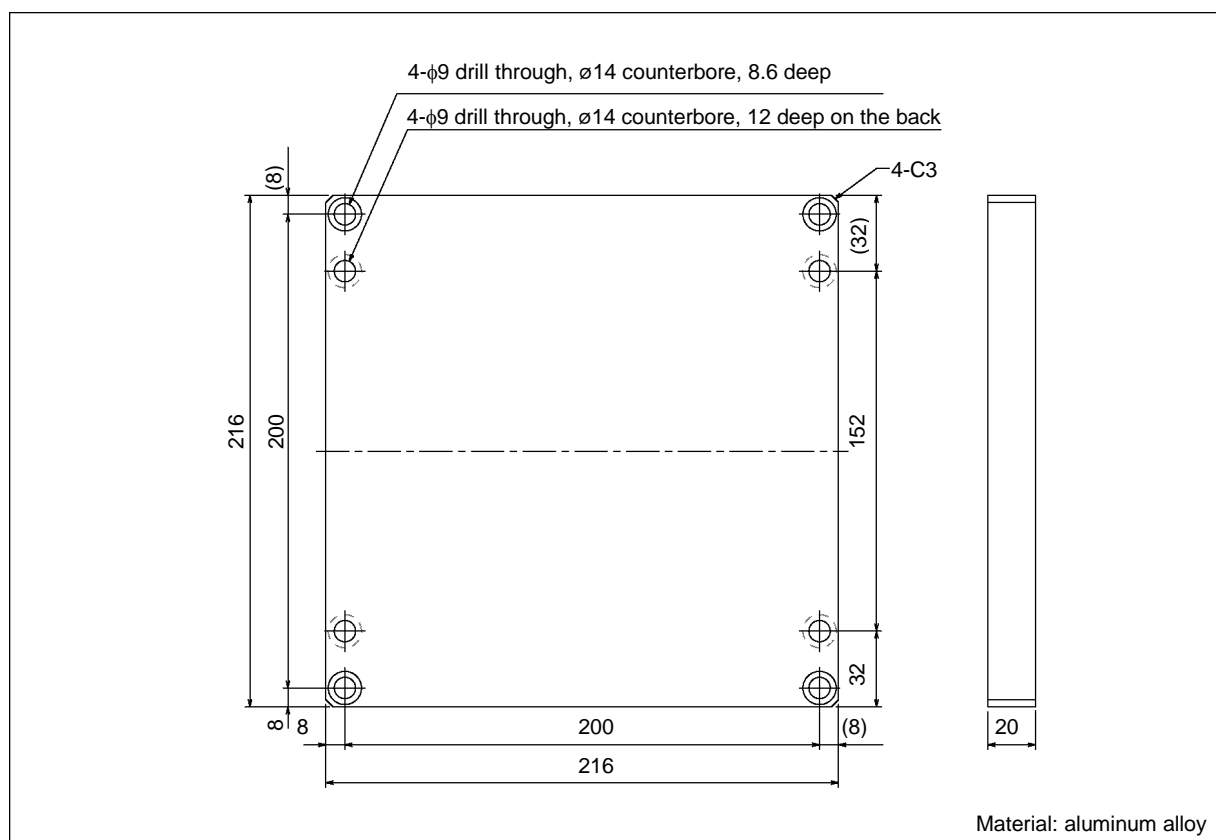
2. Attach the module to mounting surface using the optional base bracket.

- (1) Attach the base bracket to the module using the bolts provided with the base bracket.
- (2) Tap on the mounting base and secure the module to the mounting base.

	RH module base bracket	RM module base bracket	YZ-MS base bracket
Code	R114X4E001	R114X4E002	R114X4E005
Bolt diameter × length (number of bracket)	M8×20 (4)	M6×20 (4)	M8×20 (4) M6×20 (4)
Tightening torque	33.3 N·m	14.7 N·m	33.3 N·m (M8) 14.7 N·m (M6)
Recommended number of bracket for mounting	RH600: 2 RH800: 3 RH1000: 3	RM350: 2 RM550: 2	RM350: 1 RM750: 2
Weight	Approx. 2.4 kg	Approx. 1.8 kg	Approx. 3.6 kg
Applicable modules / manipulators	RH RG-HM RP-HMSz RU-HMSz	RM	YZ-MS

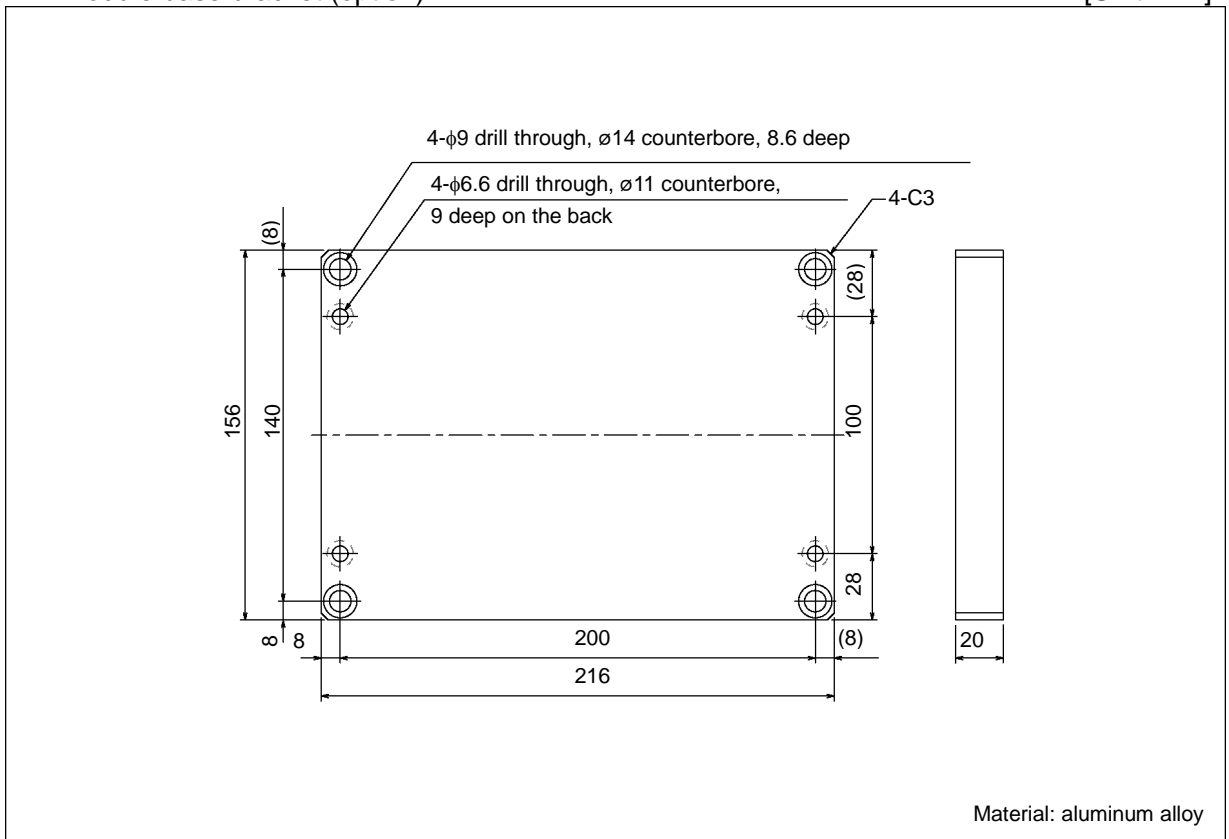
RH module base bracket (option)

[Unit: mm]



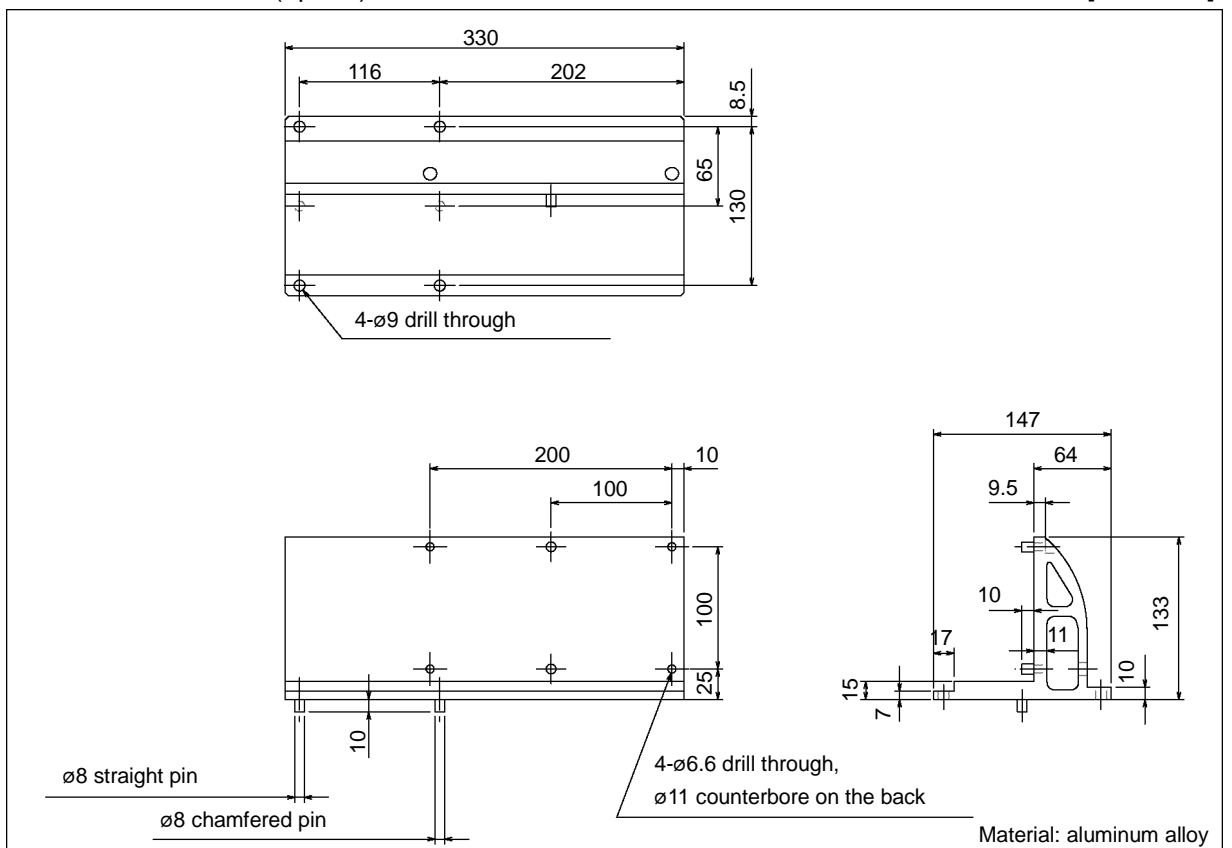
RM module base bracket (option)

[Unit: mm]




YZ-MS base bracket (option)

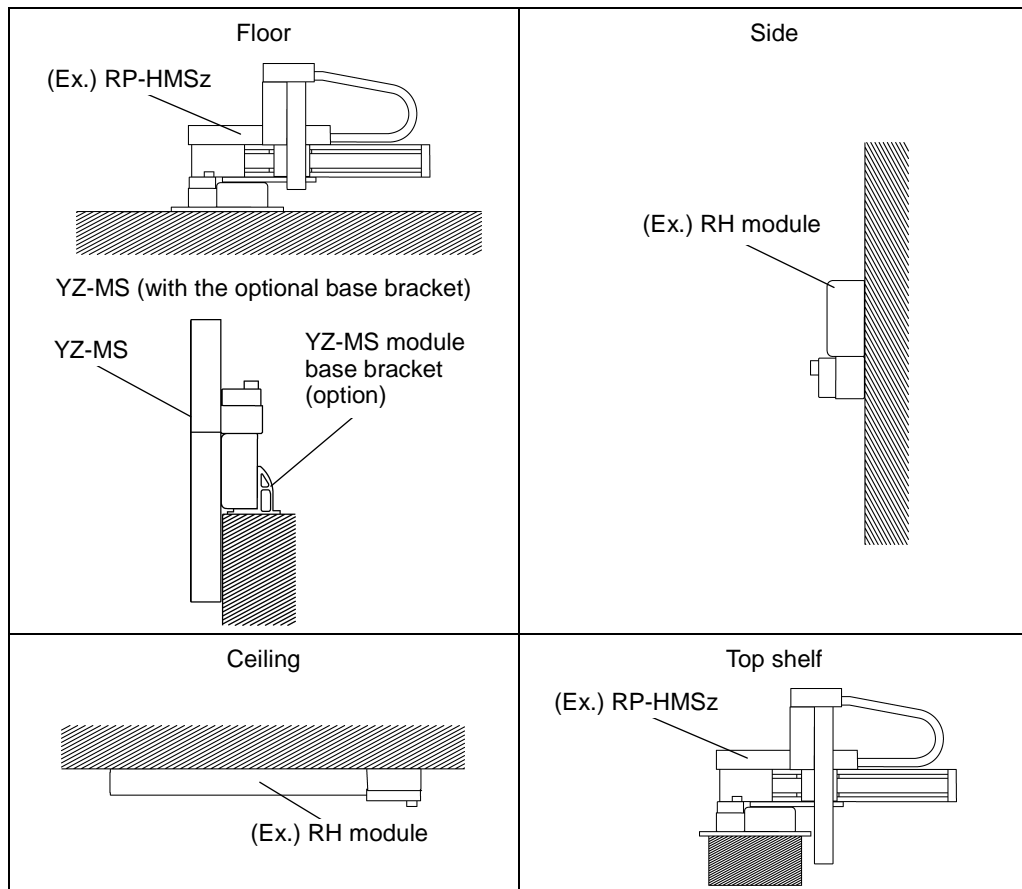
[Unit: mm]




4.4.1 Installation Patterns

 WARNING	<ul style="list-style-type: none"> ■ Install the manipulator with two or more people. Be careful not to get hands, fingers, or feet caught and/or have equipment damage by the fall of the manipulator. ■ When mounting the manipulator on the wall, do not remove the support until all the anchor bolts are secured. Removing the support while the anchor bolts are not secured sufficiently is extremely hazardous and may result in fall of the manipulator.
---	---

Each module has mounting holes available for following installation patterns.



NOTE  Design and make the base table for anchoring the manipulators so that it does not touch any cable connected to the interface box.

Available Installation Patterns

		Floor	Side	Ceiling	Top Shelf
Single Axis	RH, RM	✓	✓	✓	✓
Two Axis	RG	✓	—	—	✓
	YZ	✓*	✓	—	—
Three Axis	RP-HMSz (Z = 200 mm)	✓	—	—	✓
	RP-HMSz (Z = 300 mm)	—	—	—	✓
Four Axis	RU (Z = 200 mm)	✓	—	—	✓
	RU (Z = 300 mm)	—	—	—	✓

*: Optional base brackets are required.

4.5 Relations between the Stroke and the Code of the Module

The code of the module differs according to the stroke length.

The “code” is the number for each part, parts set, and module.

The “model number” in Chapter 2 is the number for an aggregate of parts that are necessary for manipulator assembly.

Do not confuse the code and the model number.

A label for the “code” and “serial number” is attached to each module.

Check the code and serial number when unpacking the module.

Please refer to this code and serial number when contacting us about your module.

MODEL	: R 1 1 4 X 5 H 0 4 0	← Code
SERIAL NO.	: 0 0 0 0 1	← Serial No.
MANUFACTURED	: 1 0 / 2 0 1 6	
WEIGHT	: 2 1 k g	
MOTOR POWER	: 4 0 0 W	
SEIKO EPSON CORPORATION		

Module	Stroke	Code				
RH		R 1 1 4 X 5	H	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	600 mm			0	6	0
	800 mm			0	8	0
	1000 mm			1	0	0
	(A) Left 2000 mm			2	0	1
	(B) Right 2000 mm			2	0	2
RM		R 1 1 4 X 5	M	0	<input type="checkbox"/>	<input type="checkbox"/>
	350 mm				3	0
	550 mm				5	0
RSz (A/C) Left		R 1 1 4 X 5	S	0	<input type="checkbox"/>	6
	200 mm				2	
	300 mm				3	
RSz (B/D) Right		R 1 1 4 X 5	S	0	<input type="checkbox"/>	5
	200 mm				2	
	300 mm				3	
RU		R 1 1 4 X 5	U	0	0	1

4.6 Installation of Single Axis Modules (RH, RM)



- Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.



- When removing or installing the module, there must be two or more people to work on it so that at least one of them can support the module while others are removing the bolts. Removing the bolts without supporting the module may result in the module falling, bodily injury, and/or malfunction of the robot system.

Shows the codes of the components of RH and RM modules. Find the codes of the components with the model number and make sure that all components are ready.

Name of Components	Model Number ^{*1}	
	X5S□H00000A	X5S□M00000A
RH Module	R114X5H□□□ ^{*2}	—
RM Module	—	R114X5M0□□ ^{*2}
Accessory kit	R114X4A0S0	R114X4A0S0
Interface box	R114X5B010	R114X5B010

^{*1}: For details of numbers substituted by □ and the mount direction type (the last alphabet) in the model number, refer to 2.2 *Model Numbers*.

^{*2}: Numbers substituted by □ in the code vary with stroke. Refer to 4.5 *Relations between the Stroke and the Code of the Module*.

Single axis module assembly procedures (Photographs in this section are B type.)

- (1) The mount direction types of the following parts have been set at the factory.

X axis module: A type

Connector box: B type

When using these parts in different mount direction type, refer to Table 4-7 and change the position for the module cable outlet and the orientation of the part as required.

Mount Direction Type ^{*1}	A	B
X axis module	Not necessary	Reverse of cable outlet position ^{*2}
Connector box	Reverse of connector box ^{*3}	Not necessary

^{*1}: Refer to 2.2 *Model Numbers*.

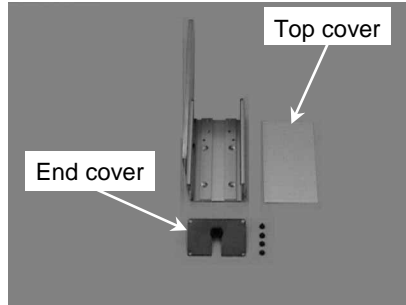
^{*2}: Refer to 4.3.1 *RH, RM Module (Reversing Module Cable Position)*.

^{*3}: Refer to 4.15.2 *Single Axis Modules (Reversing Connector Box)*.

- (2) Attach the module to the mounting base. Refer to *4.4 Mounting a Module*.
- (3) Remove the end cover and top cover.

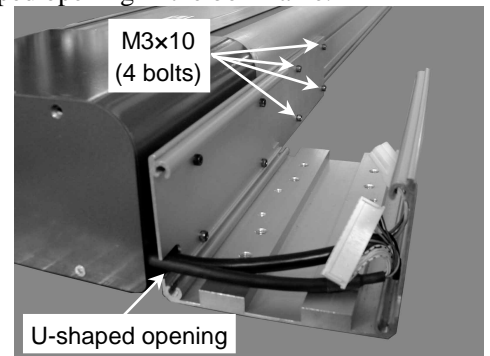
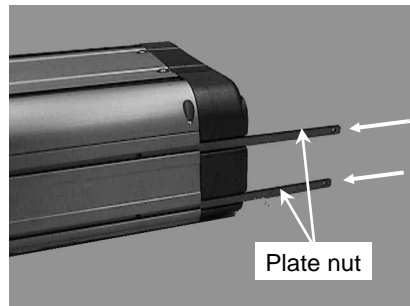


Be careful not to lose any parts since they are provided in exact number.



- (4) Insert two plate nuts into the T-slots located on the cable side opposite from the end with the motor.

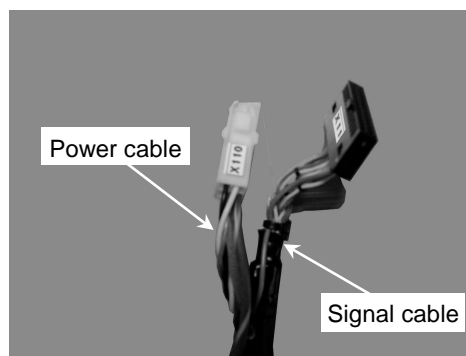
Attach the connector box to the module using four screws (M3×10, tightening torque: 0.8 N·m). Insert the cable into the U-shaped opening in the box frame.



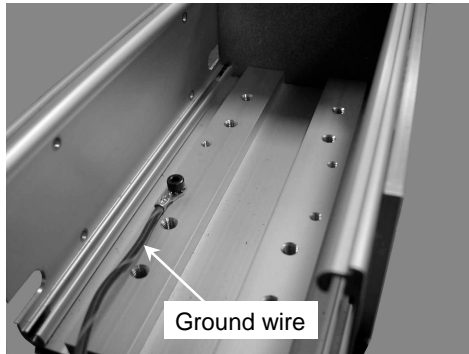
- (5) Affix labels*, which are provided with the interface box, to their respective cable connectors.

(The connectors are common to all modules regardless of the motor power specifications. Be sure to affix them to avoid miss-connection.)

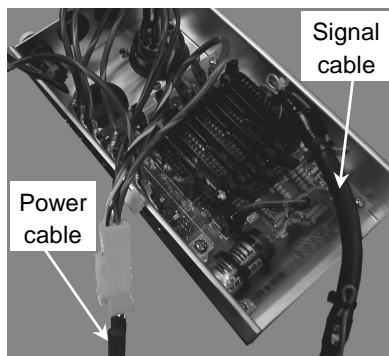
* Refer to *4.10.1 Single Module Type (Block Diagrams)* and affix the labels correctly.



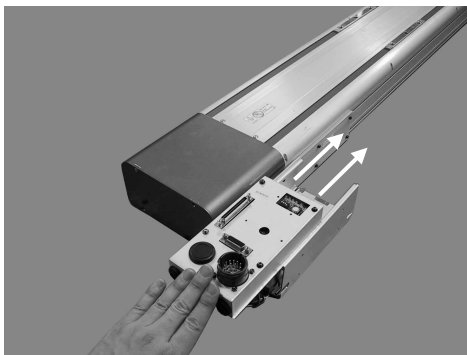
- (6) To secure the ground wire (green) to the connection box, put a crown washer and a ground terminal on the box (in that order), and tighten a bolt (M4×8).



- (7) Connect the power and signal cables to the interface box
Refer to 4.10.1 Single Module Type (Block Diagrams) and connect the cables properly.



- (8) Put the connected cables in the interface box while bending the cables into as large a radius as possible. Put projections under the interface box on the grooves of the connector box and push the interface box.

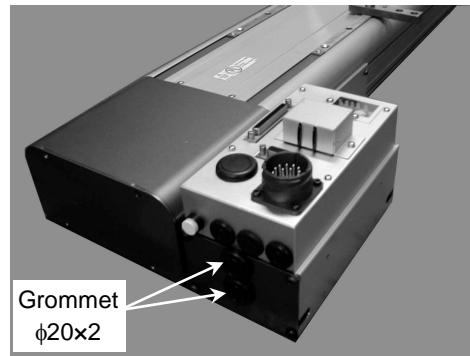


WARNING

- When installing the interface box, be careful not to allow the cables to interfere with the box mounting and do not bend these cables forcibly to push them into the box. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
When routing the cables, observe the cable locations after removing the interface box. Be sure to place the cables back to their original locations.

- (9) Secure both end covers. (M5×10, 8 bolts, button head cap bolt)

Then, put the grommets for the interface box in openings on the end cover.





- (10) Connect the module to the controller referring to *4.12 Cable Connection*.

Then, perform the calibration referring to *4.13 Calibration*.

4.7 Installation of Multi-axis Manipulators

4.7.1 RG-HM Manipulator

 WARNING	<ul style="list-style-type: none"> When passing the cables through the cable support, be careful not to rub or tangle the cables. Adjust the links of the cable support to prevent the cables from stretching too tight, getting too loose, or twisting. Rubbing or tangling the cables may result in damage to the cables. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
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 CAUTION	<ul style="list-style-type: none"> When removing or installing a module, there must be two or more people to work on it so that at least one of them can support the module while others are removing the bolts. Removing the bolts without supporting the module may result in the module falling, bodily injury, and/or malfunction of the robot system.
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The following shows the codes of RG-HM components.

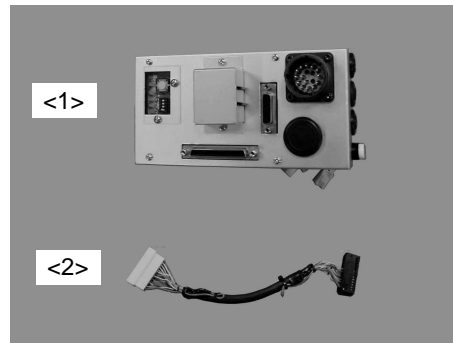
Check the codes of the components with the model number and make sure that all components are ready.

Name of Components	Model Number ^{*1}			
	X5G□H□M000A	X5G□H□M000B	X5G□H□M000C	X5G□H□M000D
RH module	R114X5H□□□ ^{*2}			
RM module	R114X5M0□□ ^{*2}			
Accessory kit	R114X4A0G0	R114X4A0G1	R114X4A0G0	R114X4A0G1
Cable set 1	R114X5C001			
Interface box	R114X5B010			

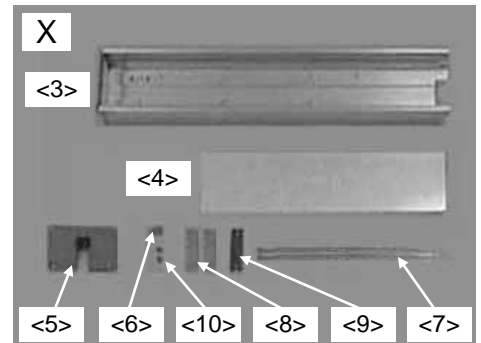
^{*1}: For details of numbers substituted by □ and the mount direction type (the last alphabet) in the model number, refer to “2.2 Model Numbers”.

^{*2}: Numbers substituted by □ in the code vary with stroke. Refer to 4.5 *Relations between the Stroke and the Code of the Module*.

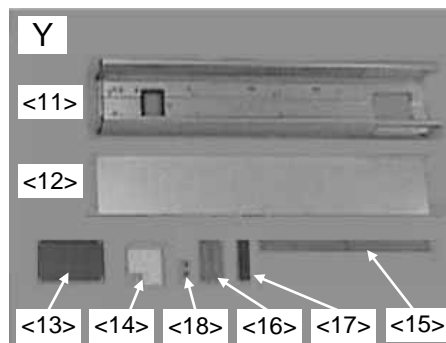
Be sure that all parts of the interface box (<1>, <2>) and accessory kit (<3> to <22>) are ready before proceeding.



Ø20 grommet × 2, connector label × 2, M4×8 (1 bolt),
M4 crown washer × 1

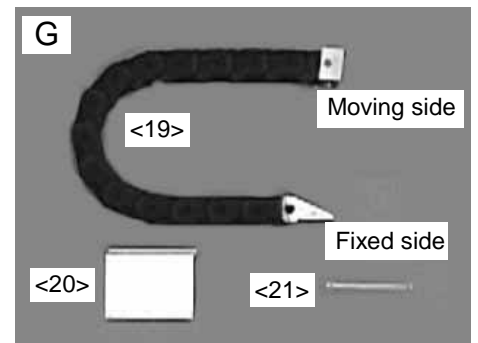


M5×10 (4 bolts, button head cap bolt),
M4×25 (2 bolts), M3×6 (6 bolts)



M5×10 (4 bolts, button head cap bolt),
M4×25 (2 bolts), M4×20 setscrew (2 screws*),
M3×6 (6 bolts)

* One of the screws is a spare.



M6×10 (4 bolts),
M5×10 (8 bolts, button head cap bolt),
M3×6 (2 bolts)



M8×20 (4 bolts), M6×20 (4 bolts)

The labels marked with “X”, “Y”, and “G” are attached to the respective packages of the accessory kit.



Be careful not to lose any parts since they are provided in exact number.

4.7 Installation of Multi-axis Manipulators

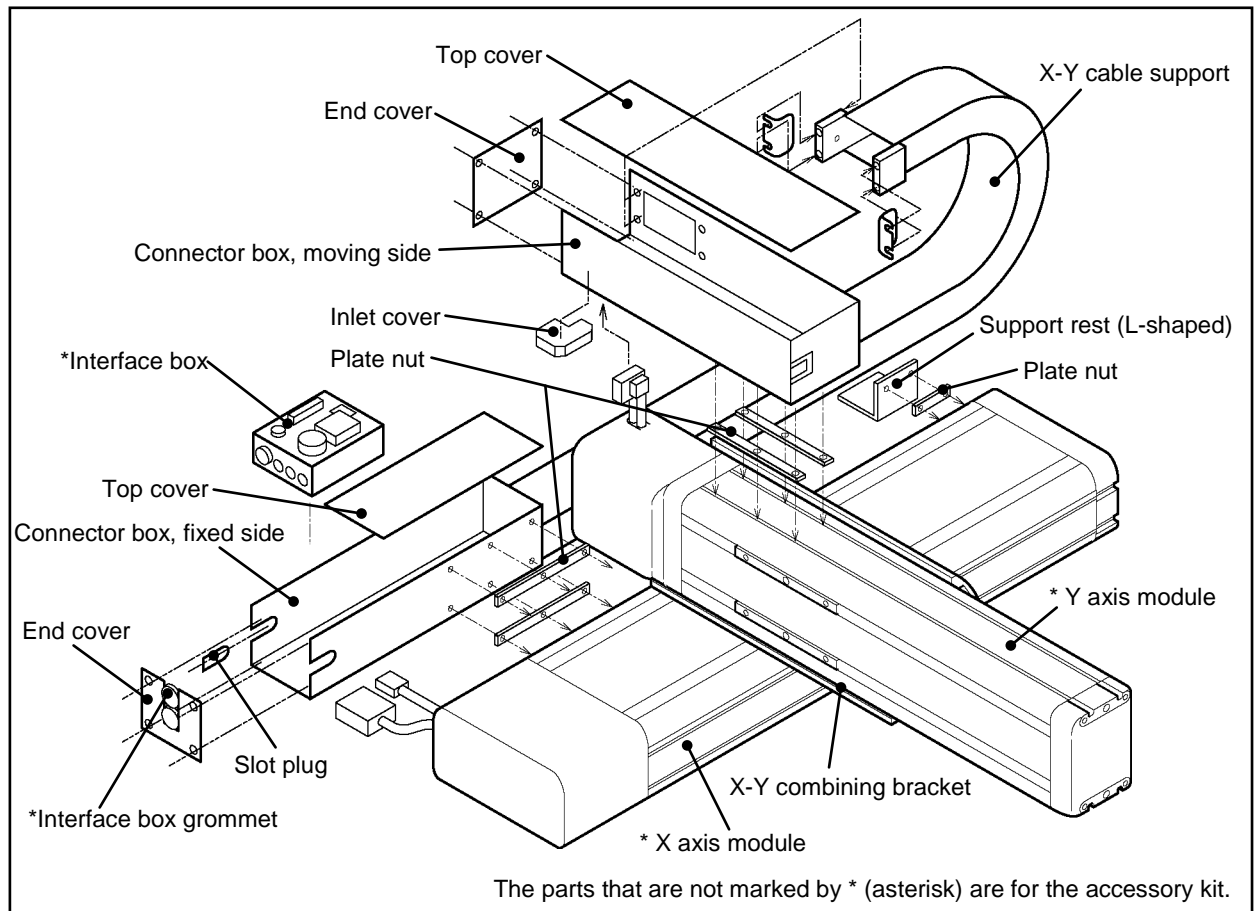
Interface box

Name of section		Part No.	Name	Quantity	Hexagon socket head cap bolt
–	Interface box (attach to X axis connector box)	<1>	Interface box	1	M4×8 (1 bolt)
		<2>	Signal short cable	1	

Accessory kit

Name of section		Part No.	Name	Quantity	Hexagon socket head cap bolt
X	Connector box, fixed side (attach to X axis)	<3>	Connector box	1	M5×10 (4 button head cap bolts)
		<4>	Top cover	1	
		<5>	End cover	1	
		<6>	Slot plug	1	
		<7>	Plate nut	2	M3×6 (6 bolts)
		<8>	Clamp base	2	
		<9>	Cable clamp	1	M4×25 (2 bolts)
		<10>	Spacer	2	
Y	Connector box, moving side (attach to Y axis)	<11>	Connector box	1	M5×10 (4 button head cap bolts)
		<12>	Top cover	1	
		<13>	End cover	1	
		<14>	Inlet cover	1	M4×20 setscrew (2 screws*) * One of the screws is a spare.
		<15>	Plate nut	2	M3×6 (6 bolts)
		<16>	Clamp base	2	
		<17>	Cable clamp	1	M4×25 (2 bolts)
		<18>	Spacer	2	
G	Cable support	<19>	X-Y cable support	27 links	M6×10 (4 bolts), M5×10 (8 button head cap bolts)
		<20>	Support rest (L-shaped)	1	
		<21>	Plate nut	1	M3×6 (2 bolts)
–	Bracket	<22>	X-Y combining bracket	1	M8×20 (4 bolts) M6×20 (4 bolts)

RG-HM (Example: A type)



No cables of the cable set are shown in the figure above.

RG-HM manipulator assembly procedures (Photographs in this section are A type.)

- (1) The mount direction types of the following parts have been set at the factory.

Y axis module: A/C type

X axis module, and moving-side connector box: A/D type

When using these parts in different mount direction type, refer to Table 4-11 and change the position for the module cable outlet and the orientation of the parts as required.

Mount Direction Type ^{*1}	A	B	C	D
X axis module	Not necessary	Reverse of cable outlet position ^{*2}		Not necessary
Y axis module	Not necessary	Reverse of cable outlet position ^{*2}	Not necessary	Reverse of cable outlet position ^{*2}
Connector box, fixed side	Not necessary			
Connector box, moving side	Not necessary	Reverse of connector box ^{*3}		Not necessary

*1: Refer to 2.2 *Model Numbers*.

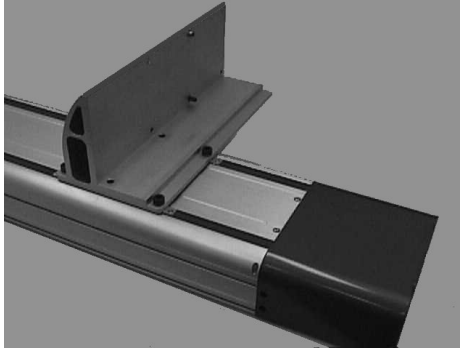
*2: Refer to 4.3.1 *RH, RM Module (Reversing Module Cable Position)*.

*3: Refer to 4.15.1 *RG, RP, RU Manipulators*.

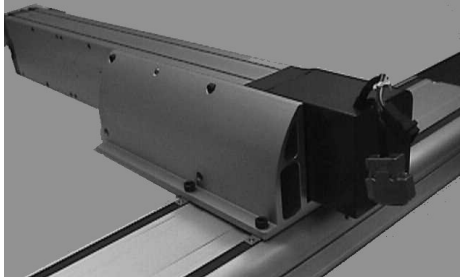
- (2) Refer to 4.4 *Mounting a Module* and attach the X axis module to the mounting base.



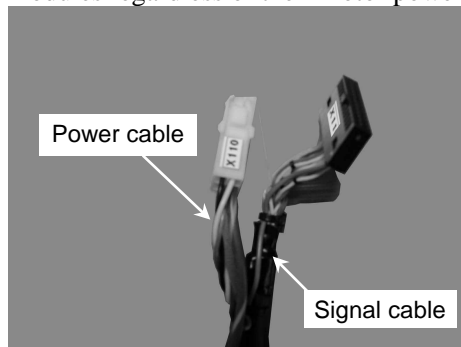
- (3) Attach the X-Y combining bracket to the slider of the X axis module.
(M8×20, 4 bolts, tightening torque: 27.5 to 33.3 N·m)



- (4) Attach the Y axis module to the combining bracket.
(M6×20, 4 bolts, tightening torque: 9.8 to 11.8 N·m)



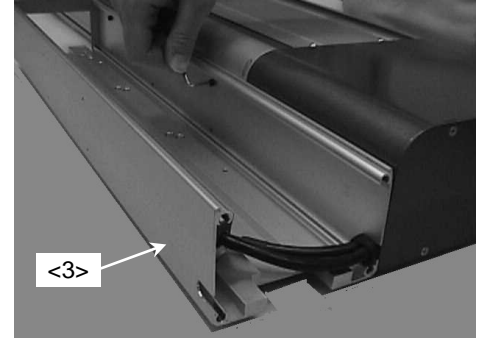
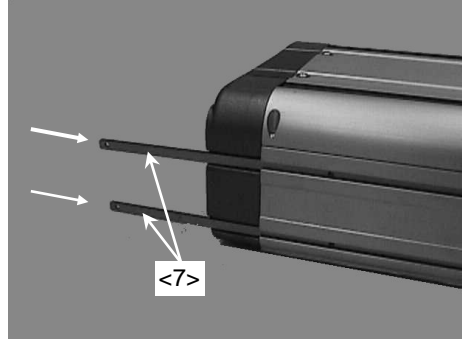
- (5) Affix labels*, which are provided with the interface box, to their respective cable connectors. (We recommend affixing the labels to the connectors to avoid miss-connection in multi-axis manipulators because the connector is common to all modules regardless of their motor power specifications.)



* Refer to 4.10.2 *RG Type (Block Diagrams)* and affix the labels correctly.

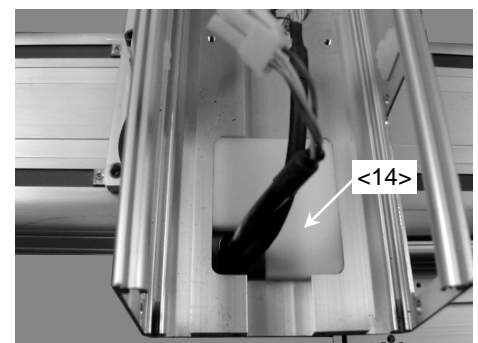
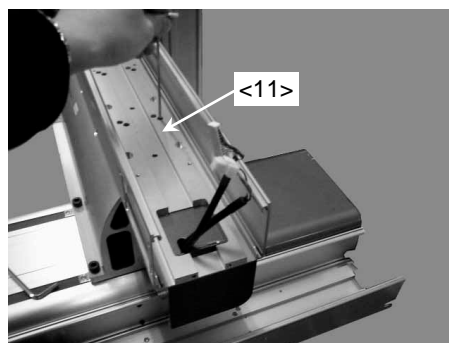
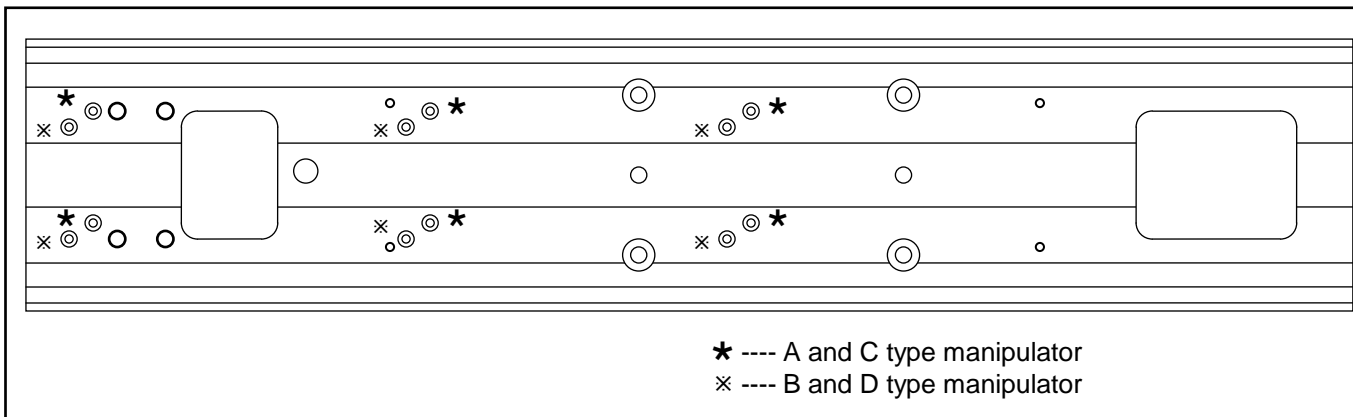
- (6) Insert the plate nuts <7> into the T slots on the side of the X axis module opposite from the side for the motor.

Attach the fixed-side connector box <3> to the module. (M3×6, 6 bolts, tightening torque: 0.8 N·m)

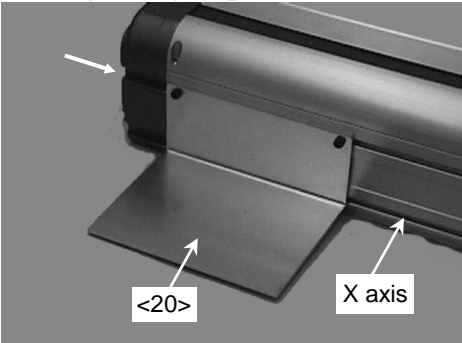


- (7) Insert the plate nuts <15>, the same as the procedure (6), into the T slots on the side of the Y axis module opposite from the side of the motor. (Tightening torque: 0.8 N·m) Then attach the moving-side connector box <11> to the module.

Use bolt holes in the bottom as shown in the figure below to fix it. (M3×6, 6 bolts) Locations of the bolt holes are different according to manipulator type. Pass the cables through the bottom opening of the connector box. Attach the inlet cover <14> to the connector box as shown in the photo and attach it from the end side of the module. (M4×20, 1 hexagon socket setscrew)



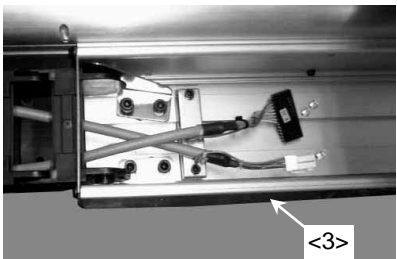
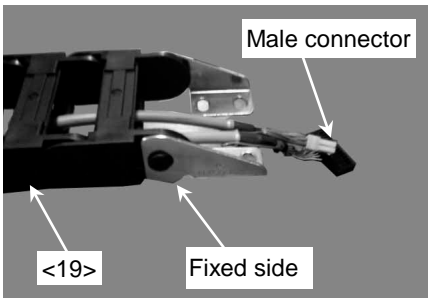
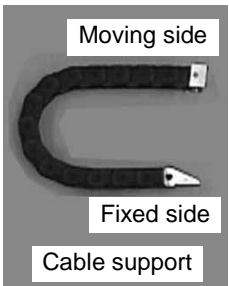
- (8) Attach the support rest <20> to the X axis module. Insert the plate nut <21> into the T slot as described in procedure (6) and secure the support rest <20> by M3×6 (2 bolts, tightening torque: 0.8 N·m).



- (9) Adjust the length of the X-Y cable support ^{*1}. Pass the power cable and signal cable through the cable support <19> ^{*2}. (Be careful to observe the tangle of cables and the direction of the cable.) Attach the cable to the fixed-side connector box <3> (M6×10, 4 bolts).

^{*1}: Refer to 4.14 Adjusting Cable Support Length.
^{*2}: When connecting the user cable and pneumatic tubes, refer to 4.18 User Cables and Pneumatic Tubes.

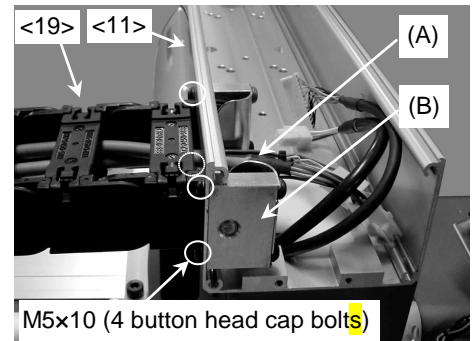
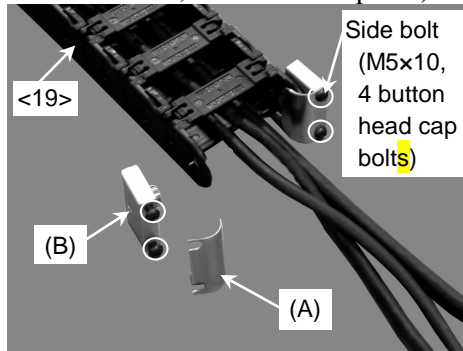
X axis stroke	Y axis stroke	Length of cable support
800mm	550mm	23 links
	750mm	



- (10) Attach the moving side of the cable support to the moving-side connector box <11>.

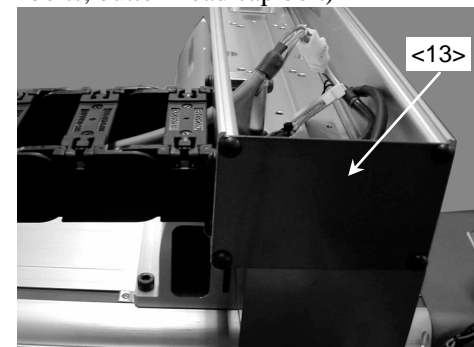
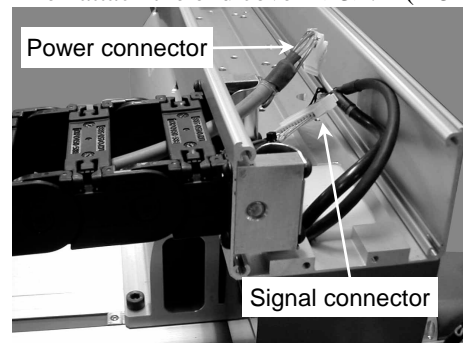
Unfasten side bolts of each side of the cable support and remove covers (A) and blocks (B) from the cable support temporarily (both sides of the cable support).
(M5×10, 2 bolts each side, button head cap bolt)

Put the cable support and the cables through an opening of the moving-side connector box <11>, then attach the covers (A) and the blocks (B) to the cable support using the side bolts. Then, attach the blocks to the connector box using bolts. (M5×10, 2 bolts each side, button head cap bolt)

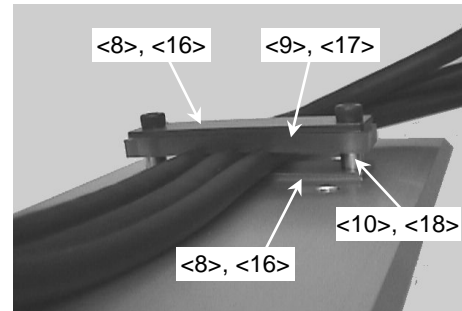
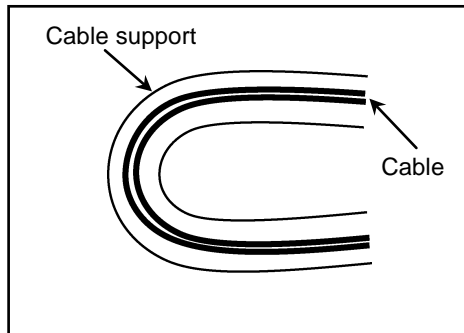


- (11) Connect the power cable (2 m) and signal cable (2 m) to the Y axis module (2 connectors).

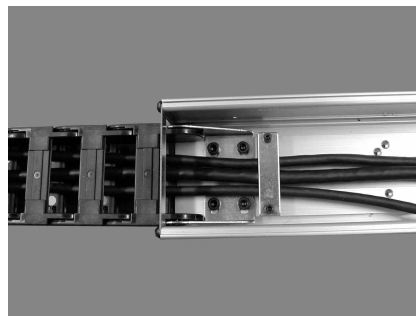
Then attach the end cover <13>. (M5×10, 4 bolts, button head cap bolt)



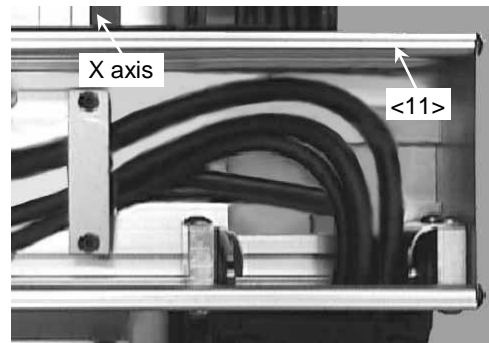
- (12) Put the cables through the center of the cable support as shown in Figure so that a full stroke operation does not strain the cables. Use a large bending radius for the cables as much as possible when installing them in the connector boxes. Then secure the cables with the clamps <8> to <10>, <16> to <18>, and M4×25 (2 bolts). (2 places: put the clamp base under the cables, set the cables on it and clamp them with the cable clamp. Do not screw the bolts too tight. Screwing the bolt too tight may result in damaged cables or disconnection.)



Details of clamping cables



Connector box, fixed side

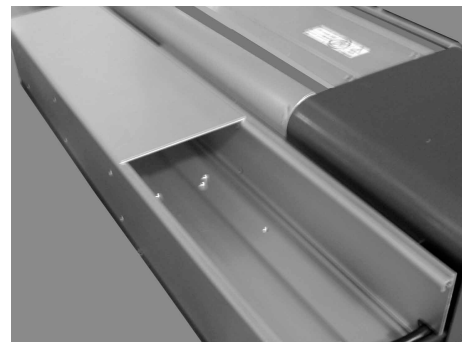


Connector box, moving side

- (13) Attach the top covers to their respective connector boxes*.

Hook the edge of top cover to a groove on the side of connector box as shown in the photo and push the other side edge to the other groove.

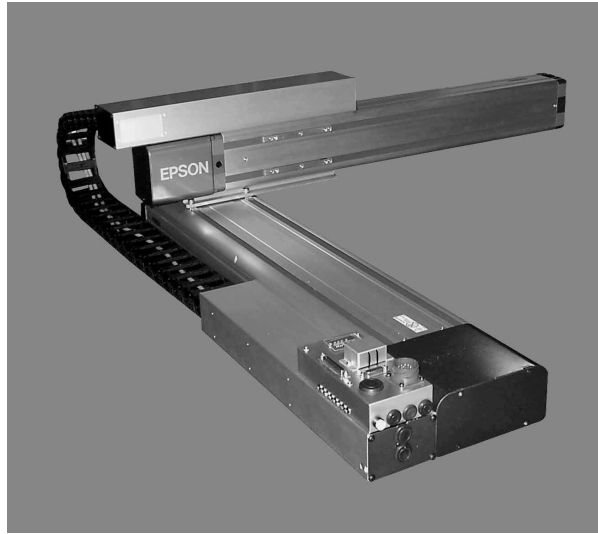
* For the top cover of the fixed-side connector box, attach the top cover at the bottom end of the connector box.



- (14) Refer to the step (6) through (9) in 4.6 *Installation of Single Axis Modules (RH, RM)* and install the ground, cables*, interface box, end cover, and grommet.

* For cable connection, refer to 4.10.2 *RG Type (Block Diagrams)* and connect the cables correctly.

Completion of RG-HM manipulator assembly



- (15) Connect the manipulator to the controller referring to *4.12 Cable Connection*.
Then, perform the calibration referring to *4.13 Calibration*.

4.7.2 YZ-MS Manipulator



 WARNING	<p>■ When passing the cables through the cable support, be careful not to rub or tangle the cables. Adjust the links of the cable support to prevent the cables from stretching too tight, getting too loose, or twisting. Rubbing or tangling the cables may result in damage to the cables. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.</p>
 CAUTION	<p>■ When removing or installing a module, there must be two or more people to work on it so that at least one of them can support the module while others are removing the bolts. Removing the bolts without supporting may the module result in the module falling, bodily injury, and/or malfunction of the robot system.</p>

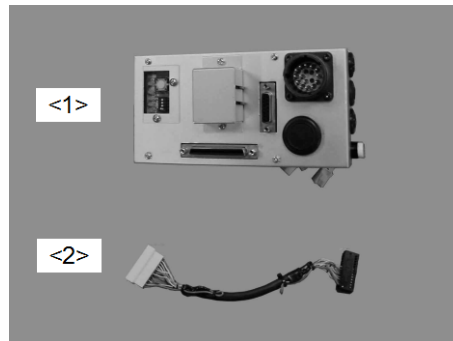
Table shows the codes of components of YZ-MS manipulator. Find the codes of the components with the model number and make sure that all components are ready.

Name of Components	Model Number ^{*1}	
	X5Z□M□S000A	X5Z□M□S000B
RM module	R114X4M0□□ ^{*2}	
RSz module	R114X5S0□6 ^{*2}	R114X5S0□5 ^{*2}
Accessory kit	R114X4A1Z0	
Cable set 1	R114X5C001	
Interface box	R114X5B010	

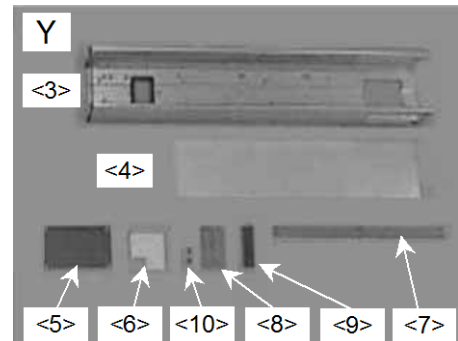
*1: For details of numbers substituted by □ and the mount direction type (the last alphabet) in the model number, refer to 2.2 *Model Numbers*.

*2: Numbers substituted by □ in the code vary with stroke. Refer to 4.5 *Relations between the Stroke and the Code of the Module*.

Be sure that all parts of the interface box (<1>, <2>) and accessory kit (<3> to <20>) are ready before proceeding.

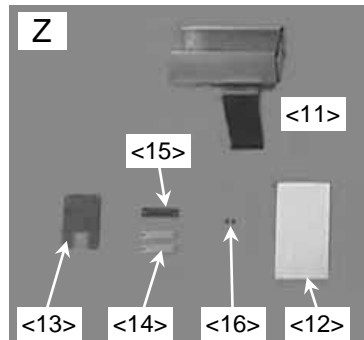


ø20 grommet × 2,
connector label × 2,
M4×8 (1 bolt),
M4 crown washer × 1

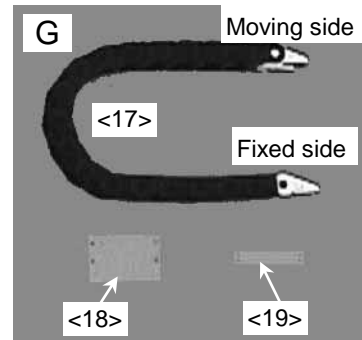


M5×10 (4 bolts, button head cap bolt),
M4×25 (2 bolts)
M4×20 setscrew (2 screws*),
M3×6 (6 bolts)

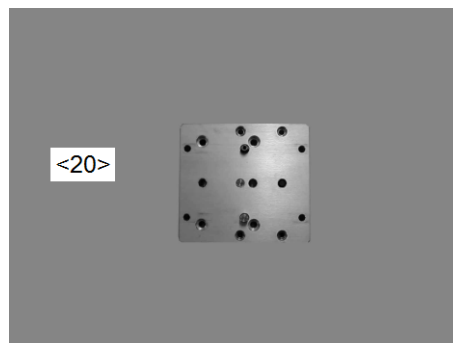
*: One of the screws is a spare.



M5×10 (8 button head cap bolts),
M4×25 (2 bolts)



M6×10 (8 bolts), M3×6 (2 bolts)



M6×16 (4 bolts), M5×18 (4 bolts)

The labels marked with “Y”, “Z”, and “G” are attached to the respective packages of the accessory kit.



Be careful not to lose any parts since they are provided in exact number.

4.7 Installation of Multi-axis Manipulators

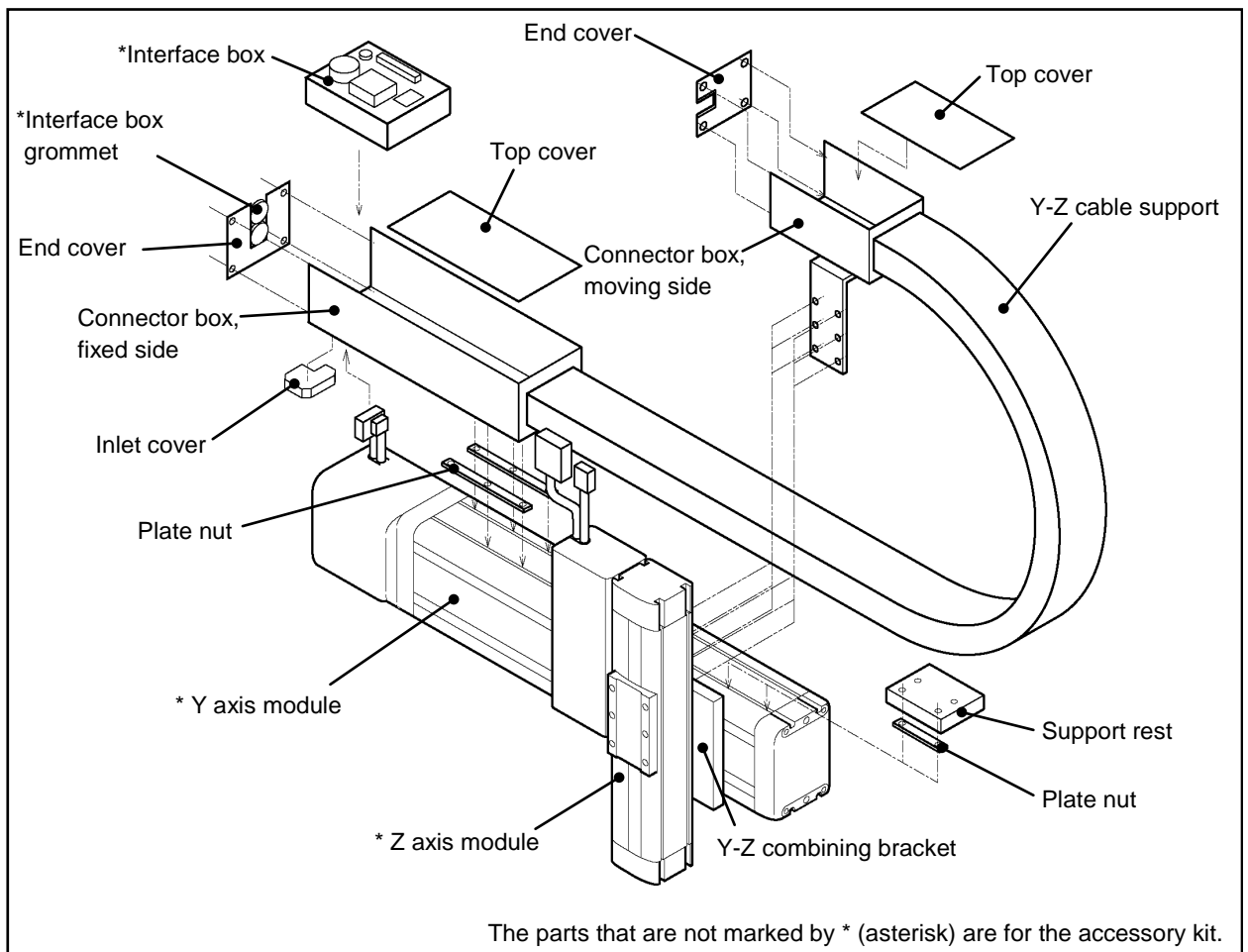
Interface box

Name of section		Part No.	Name	Quantity	Hexagon socket head cap bolt
–	Interface box (attach to Y axis connector box)	<1>	Interface box	1	M4×8 (1 bolt)
		<2>	Signal short cable	1	

Accessory kit

Name of section		Part No.	Name	Quantity	Hexagon socket head cap bolt
Y	Connector box, fixed side (attach to Y axis)	<3>	Connector box	1	M5×10 (4 button head cap bolts)
		<4>	Top cover	1	
		<5>	End cover	1	
		<6>	Inlet cover (plastic)	1	M4×20 setscrew (2 screws*) *: One of the screws is a spare.
		<7>	Plate nut	2	M3×6 (6 bolts)
		<8>	Clamp base	2	
		<9>	Cable clamp	1	M4×25 (2 bolts)
Z	Connector box, moving side (attach to Z axis)	<10>	Spacer	2	
		<11>	Connector box	1	M5×10 (8 button head cap bolts)
		<12>	Top cover	1	
		<13>	End cover	1	
		<14>	Clamp base	2	
		<15>	Cable clamp	1	M4×25 (2 bolts)
G	Cable support	<16>	Spacer	2	
		<17>	Y-Z cable support	28 links	M6×10 (8 bolts)
		<18>	Support rest (plastic)	1	
–	Bracket	<19>	Plate nut	1	M3×6 (2 bolts)
		<20>	Y-Z combining bracket	1	M6×16 (4 bolts), M5×18 (4 bolts)

YZ-MS (Example: A Type)



No cables of the cable set are shown in the figure above.

YZ-MS manipulator assembly procedure (Photographs in this section are A type.)

- (1) The mount direction types of the following parts have been set at the factory.

Y axis module and moving-side connector box: A type

When using these parts in B type, refer to Table and change the position for the module cable outlet and the orientation of the parts as required.

Mount Direction Type ^{*1}	A	B
Y axis module	Not necessary	Reverse of cable outlet position ^{*2}
Z axis module	Not necessary	
Connector box, fixed side	Not necessary	
Connector box, moving side	Not necessary	Reverse L-fixture ^{*3}

*1: Refer to 2.2 Model Numbers.

*2: Refer to 4.3.1 RH, RM Module (Reversing Module Cable Position).

*3: Refer to 4.16.1 YZ, RP-HMSz, RU Manipulators (Reversing L-fixture).

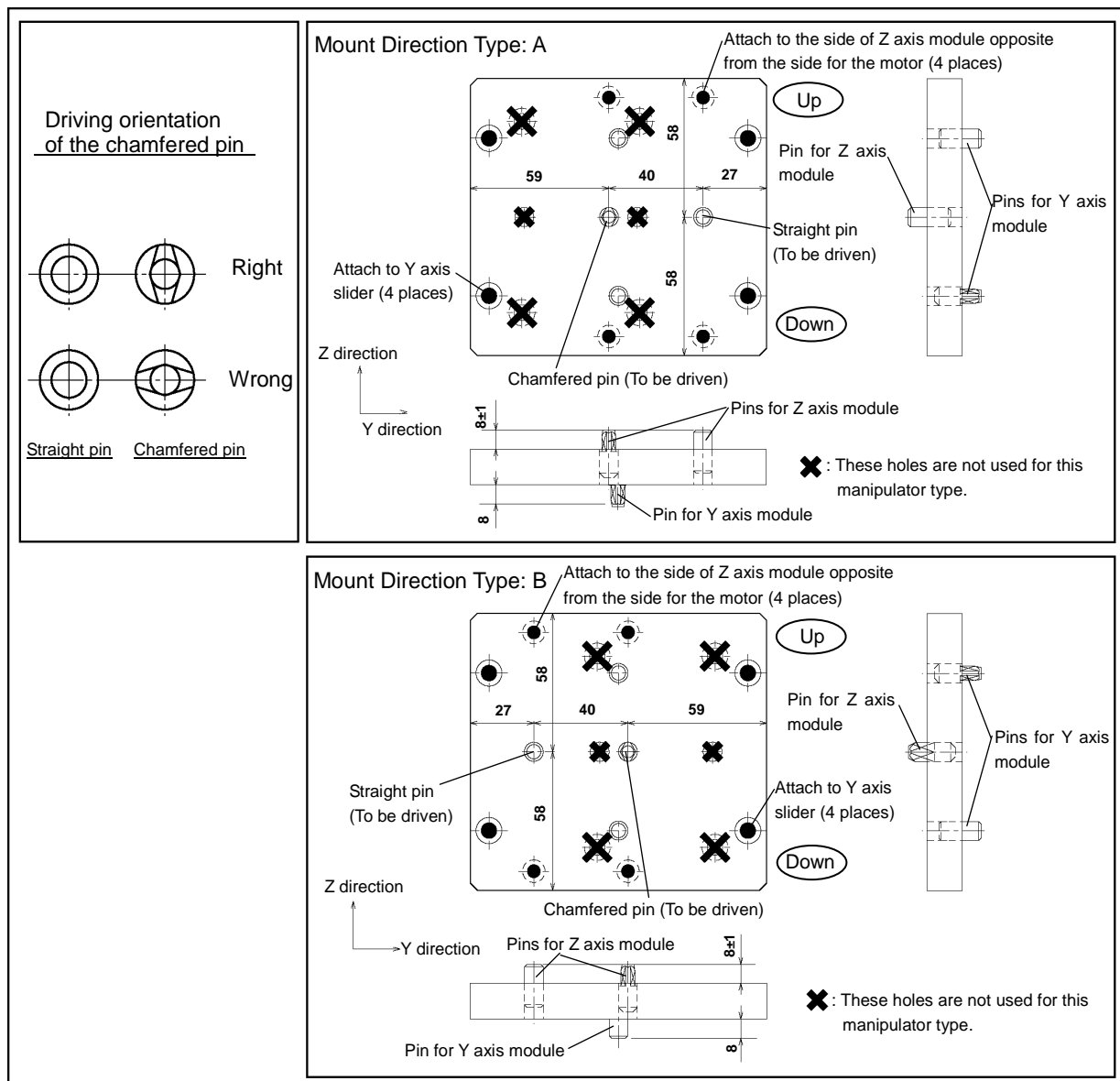
(2) Drive the pins to Y-Z combining bracket.

Drive a chamfered pin and a straight pin with a plastic hammer in the bracket for the locations shown in Figure below. The pins are provided with the Y-Z combining bracket.



Be careful with the orientation of the chamfered pin.

Be careful not to push in pins for Y axis module on the back when driving the pins.



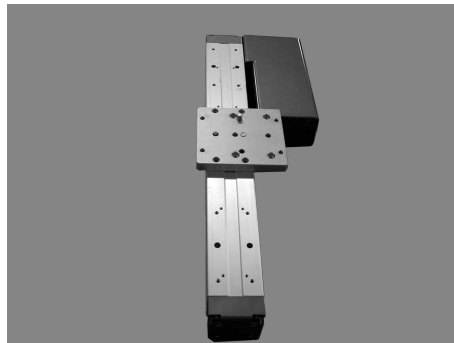
- (3) Refer to *4.4 Mounting a Module* and mount the Y axis module to the mounting base.



- (4) Turn the Z axis module over and attach the Y-Z combining bracket to its mounting surface. (M5×18, 4 bolts: tightening torque 4.9 to 5.9 N·m)

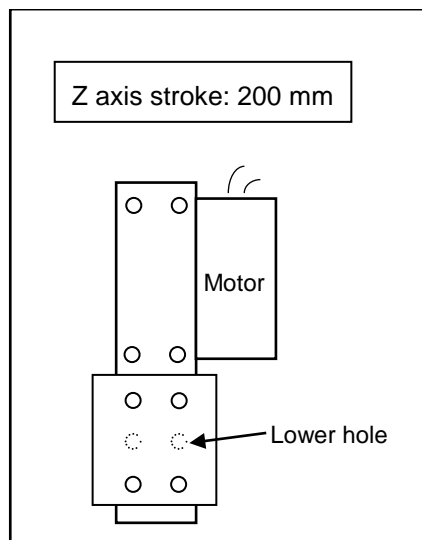
Then attach the Y-Z combining bracket with Z axis unit to the slider of Y axis.

(M6×16, 4 bolts: tightening torque 9.8 to 11.8 N·m)



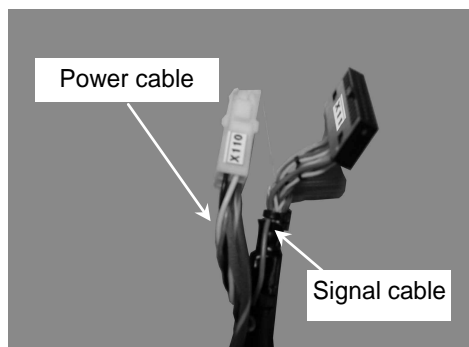
When the Z axis stroke is 200 mm, insert the pins into the lower holes to mount the bracket.

Insert the pins into the center holes to mount the bracket. Inserting the pins into incorrect holes may increase vibration, and it may result in insufficient function of the robot system and/or severe equipment damage to the robot system.



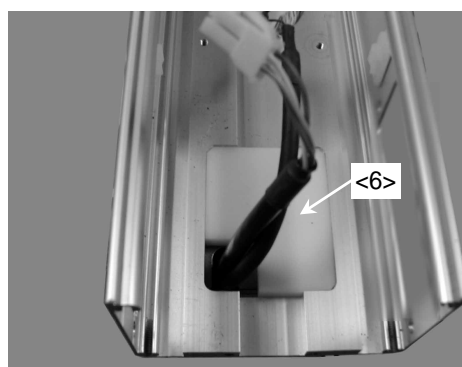
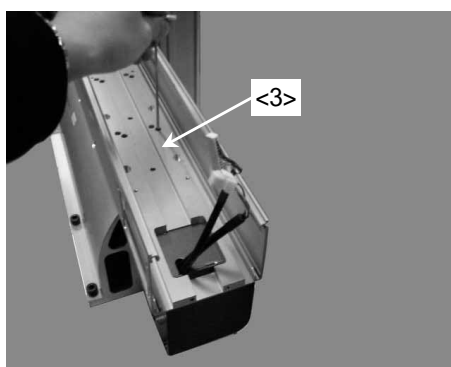
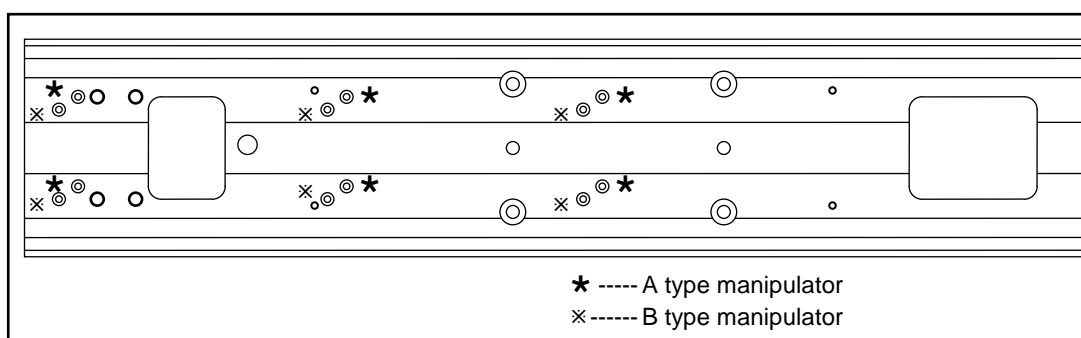
- (5) Affix labels*, which are provided with the interface box, to their respective cable connectors. (We recommend affixing the labels to the connectors to avoid miss-connection in multi-axis manipulator because the connector is common to all modules regardless their motor power specifications.)

* Refer to 4.10.3 YZ Type (Block Diagrams) and affix the labels correctly.



- (6) Insert two plate nuts <7> into T-slots on the side of Y axis module opposite from the side for the motor. Attach the fixed-side connector box <3> to the module. Use holes shown in the figure below to mount the connector box. (M3×6, 6 bolts, tightening torque: 0.8 N·m)

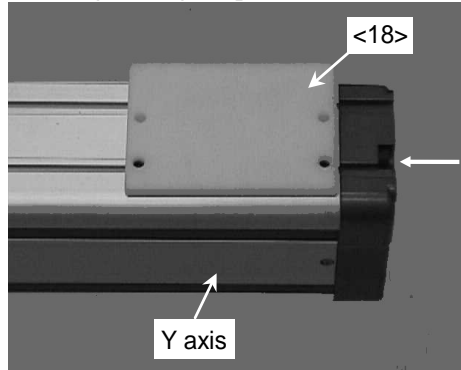
Put the cables of module through the bottom opening of the connector box, then install the inlet cover <6> on to plug the opening and secure it from the end. (M4×20, 1 hexagon socket setscrew)



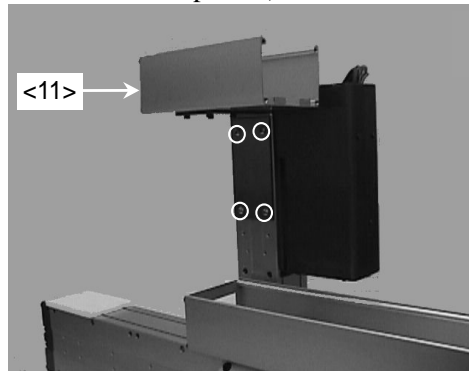
- (7) Attach the support rest to the Y axis module.

Y axis : <18> (plastic)

Insert the plate nut <19> to T-slot, and then attach the support rest <18>. (M3×6, 2 bolts, tightening torque: 0.8 N·m)



- (8) Attach the moving-side connector box <11> to the back of Z axis module. (M5×10, 4 button head cap bolts)



- (9) Adjust the length of the Y-Z cable support^{*1}.

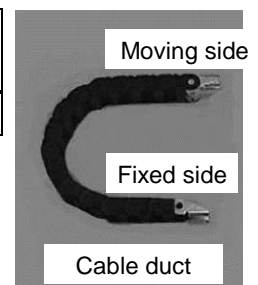
Put the power cable and signal cable through Y-Z cable support <17>^{*2}. (Be careful to observe the tangle of cables and the direction of the cable.)

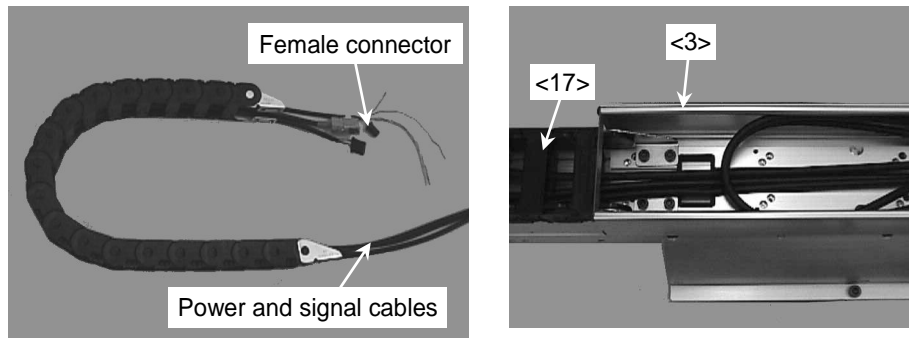
Attach the fixed side of Y-Z cable support <17> (bracket with holes) to the fixed-side connector box <3>. (M6×10, 4 bolts)

^{*1}: Refer to 4.14 *Adjusting Cable Support Length*.

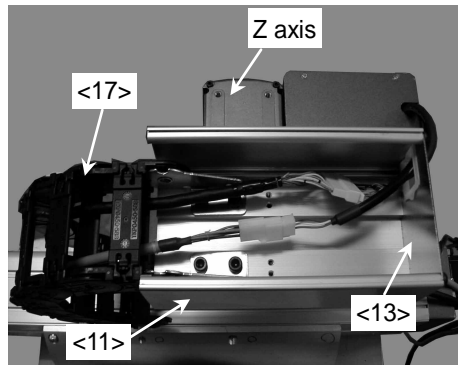
^{*2}: When connecting the user cable and pneumatic tubes, refer to 4.18 *User Cables and Pneumatic Tubes*.

Y axis stroke	Z axis stroke	Length of cable support
750mm	200mm	25 links

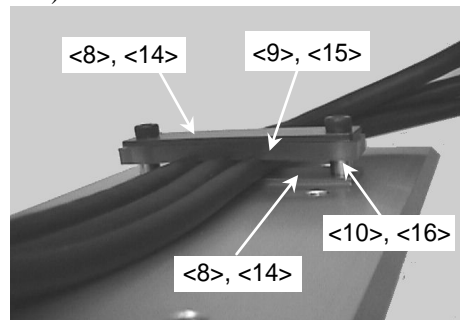
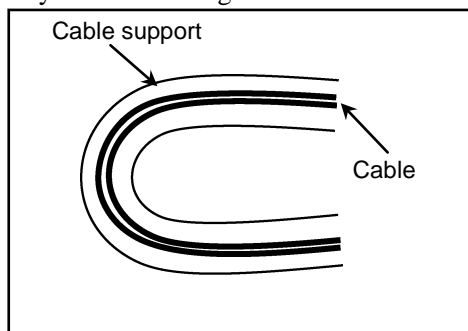




- (10) Attach the other end (moving side) of the cable support to the moving-side connector box <11> using the procedure described in (9). (M6×10, 4 bolts) Install the cables of Z axis module through an edge saddle of the end cover <13> and attach the end cover to the connector box. (M5×10, 4 button head cap bolts) Then connect the cables of Z axis module and the power cable (2 m) and signal cable (2 m).



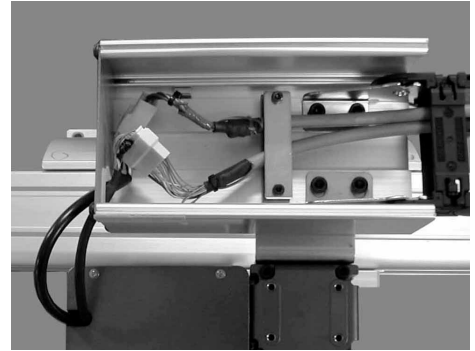
- (11) Insert the cables through the center of the cable support as shown in Figure 4-24 so that they are not strained. Use as large of a bending radius as possible, then secure the cables with the clamping parts <8> to <10>, <14> to <16>, and M4×25 (2 bolts). (2 places: put the clamp base under the cables, set the cables on it and clamp them with the cable clamp. Do not screw the bolts too tight. Screwing the bolts too tight may result in damaged cables or disconnection.)



Details of clamping cables



Connector box, fixed side

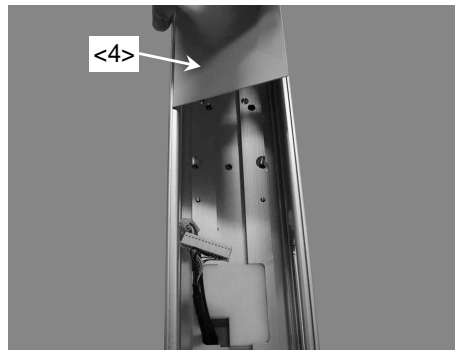


Connector box, moving side

- (12) Attach the top covers to each connector box*.

Hook the edge of the top cover to the groove on the side of connector box as shown in the photo and push in the other side of the top cover.

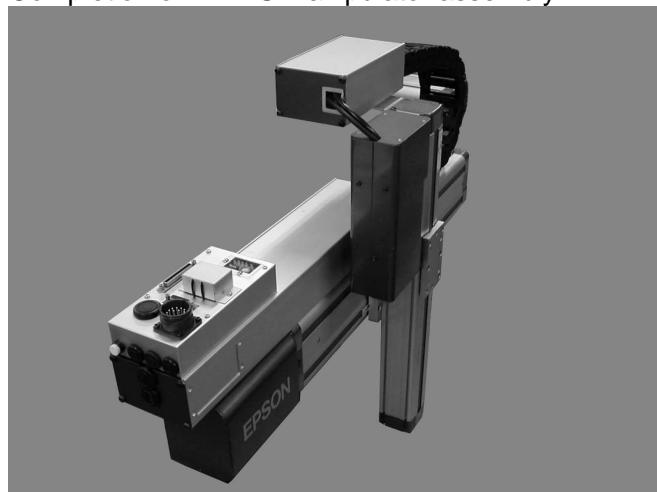
* For the top cover of the fixed-side connector box, attach the top cover at the bottom end of the connector box.



- (13) Refer to the step (6) through (9) in 4.6 *Installation of Single Axis Modules (RH, RM)* and install the ground, cables*, interface box, end cover, and grommet.


* For cable connection, refer to 4.10.3 *YZ Type (Block Diagrams)* and connect the cables properly.

Completion of YZ-MS manipulator assembly



- (14) Connect the manipulator to the controller referring to 4.12 *Cable Connection*.
Then, perform the calibration referring to 4.13 *Calibration*.

4.7.3 RP-HMSz Manipulator

 WARNING	<p>■ When passing the cables through the cable support, be careful not to rub or tangle the cables. Adjust the links of the cable support to prevent the cables from stretching too tight, getting too loose, or twisting. Rubbing or tangling the cables may result in damage to the cables. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.</p>
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 CAUTION	<p>■ When removing or installing a module, there must be two or more people to work on it so that at least one of them can support the module while others are removing the bolts. Removing the bolts without supporting the module may result in the module falling, bodily injury, and/or malfunction of the robot system.</p>
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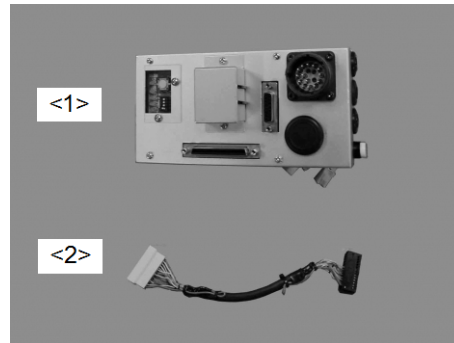
Table shows the codes of components of RP-HMSz manipulator. Find the codes of the components with the model number and make sure that all components are ready.

Name of Components	Model Number ^{*1}			
	X5P□H□M□S0A	X5P□H□M□S0B	X5P□H□M□S0C	X5P□H□M□S0D
RH module	R114X5H□□□ ^{*2}			
RM module	R114X5M0□□ ^{*2}			
RSz module	R114X5S0□6 ^{*2}	R114X5S0□5 ^{*2}	R114X5S0□6 ^{*2}	R114X5S0□5 ^{*2}
Accessory kit	R114X4A0P0	R114X4A0P1	R114X4A0P0	R114X4A0P1
Cable set 5	R114X5C007			
Interface box	R114X5B010			

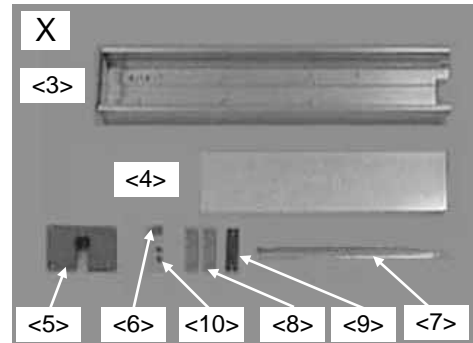
*1: For details of numbers substituted by □ and the mount direction type (the last alphabet) in the model number, refer to 2.2 *Model Numbers*.

*2: Numbers substituted by □ in the code vary with stroke. Refer to 4.5 *Relations between the Stroke and the Code of the Module*.

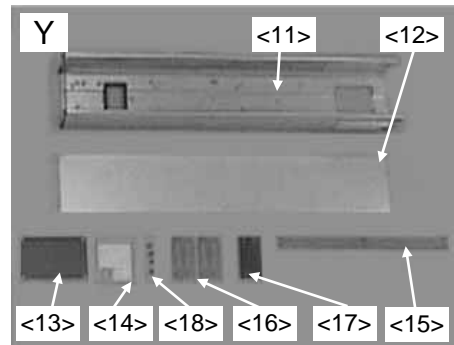
Be sure that all parts of the interface box (<1>, <2>) and accessory kit (<3> to <31>) are ready before proceeding.



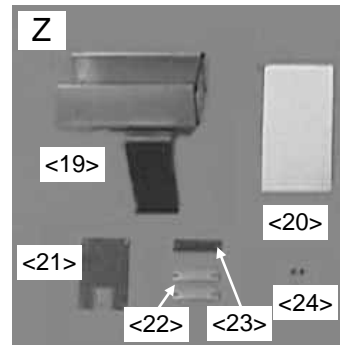
φ20 grommet × 2, connector label × 2,
M4×8 (1 bolt), M4 crown washer × 1



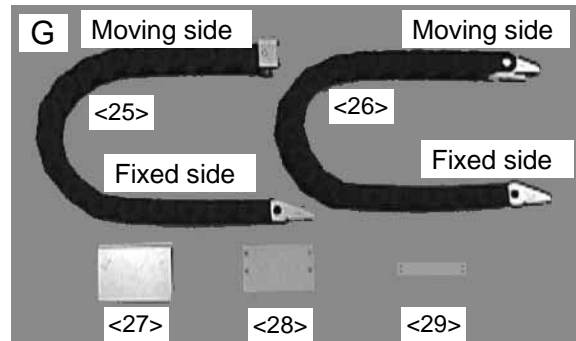
M5×10 (4 bolts, button head cap bolt),
M4×25 (2 bolts), M3×6 (6 bolts)



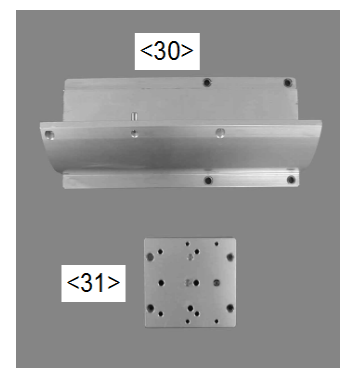
M5×10 (4 bolts, button head cap bolt),
M4×25 (4 bolts),
M4×20 setscrew (2 screws*),
M3×6 (6 bolts)



M5×10 (8 bolts, button head cap bolt),
M4×25 (2 bolts)



M6×10 (12 bolts),
M5×10 (8 button head cap bolts),
M3×6 (4 bolts)



M8×20 (4 bolts), M6×20 (4 bolts),
M6×16 (4 bolts), M5×18 (4 bolts)

The labels marked with “X”, “Y”, “Z”, and “G” are attached to the respective packages of the accessory kit.



Be careful not to lose any parts since they are provided in exact number.

4.7 Installation of Multi-axis Manipulators

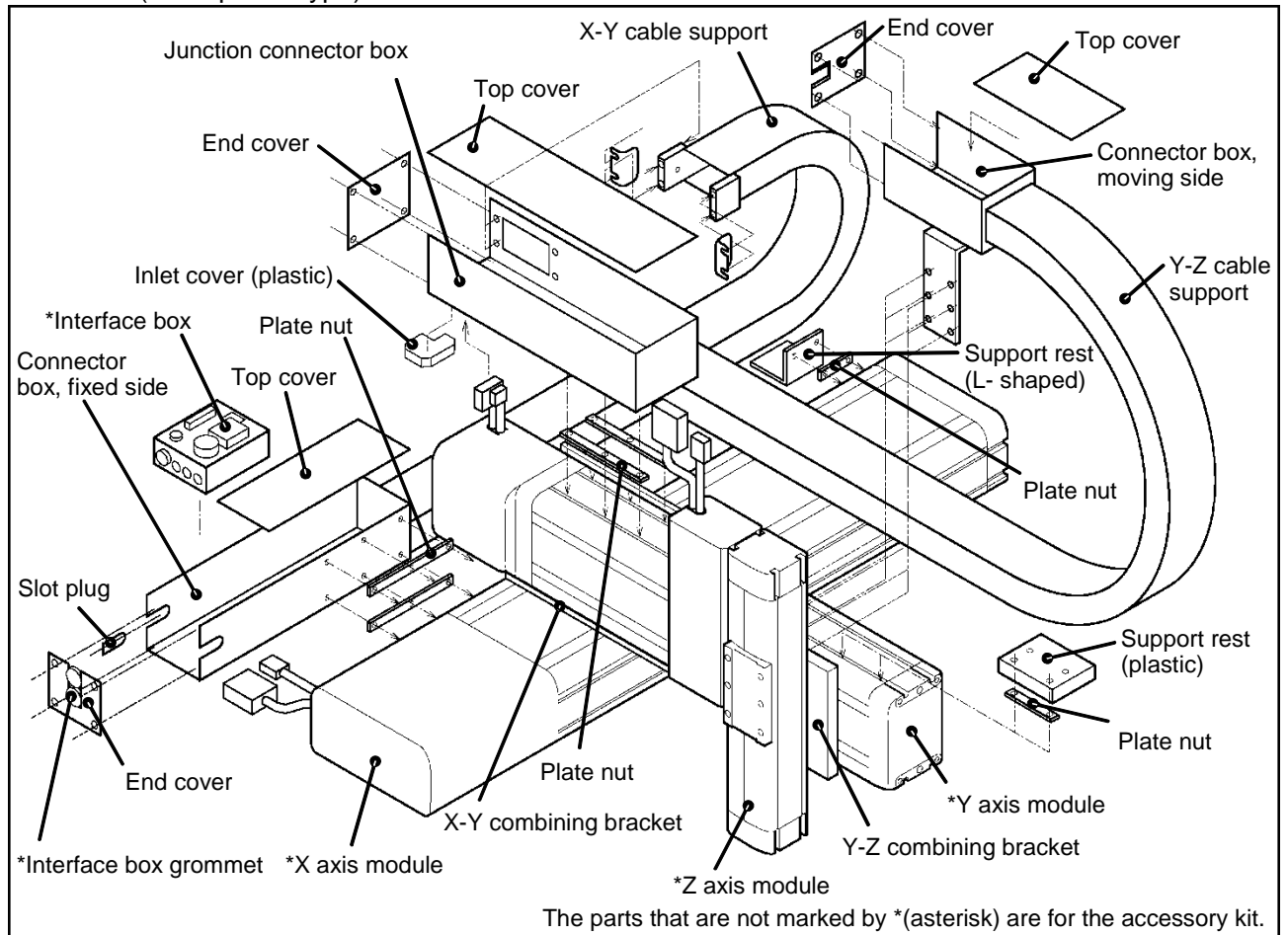
Interface box

	Name of section	Part No.	Name	Quantity	Hexagon socket head cap bolt
–	Interface box (attach to X axis connector box)	<1>	Interface box	1	M4×8 (1 bolt)
		<2>	Signal short cable	1	

Accessory kit

	Name of section	Part No.	Name	Quantity	Hexagon socket head cap bolt
X	Connector box, fixed side (attach to X axis)	<3>	Connector box	1	M5×10 (4 head cap bolts)
		<4>	Top cover	1	
		<5>	End cover	1	
		<6>	Slot plug	1	
		<7>	Plate nut	2	M3×6 (6 bolts)
		<8>	Clamp base	2	
		<9>	Cable clamp	1	M4×25 (2 bolts)
		<10>	Spacer	2	
Y	Junction connector box (attach to Y axis)	<11>	Junction connector box	1	M5×10 (4 button head cap bolts)
		<12>	Top cover	1	
		<13>	End cover	1	
		<14>	Inlet cover (plastic)	1	M4×20 setscrew (2 screws*) *: One of the screws is a spare.
		<15>	Plate nut	2	M3×6 (6 bolts)
		<16>	Clamp base	4	
		<17>	Cable clamp	2	M4×25 (4 bolts)
		<18>	Spacer	4	
Z	Connector box, moving side (attach to Z axis)	<19>	Connector box	1	M5×10 (8 button head cap bolts)
		<20>	Top cover	1	
		<21>	End cover	1	
		<22>	Clamp base	2	
		<23>	Cable clamp	1	M4×25 (2 bolts)
		<24>	Spacer	2	
G	Cable support	<25>	X-Y cable support	27 links	M6×10 (4 bolts), M5×10 (8 button head cap bolts)
		<26>	Y-Z cable support	28 links	M6×10 (8 bolts)
		<27>	Support rest (L-shaped)	1	
		<28>	Support rest (plastic)	1	
		<29>	Plate nut	2	M3×6 (4 bolts)
–	Bracket	<30>	X-Y combining bracket	1	M8×20 (4 bolts), M6×20 (4 bolts)
		<31>	Y-Z combining bracket	1	M6×16 (4 bolts), M5×18 (4 bolts)

RP-HMSz (Example: A Type)



No cables of the cable set are shown in the figure above.

RP-HMSz manipulator assembly procedure

(Photographs in this section are A type.)

- (1) The mount direction types of the following parts have been set at the factory.

Y axis module, and Moving-side connector box : A/C type

X axis module, and Junction connector box : A/D type

When using these parts in different mount direction type, refer to Table and change the position for the module cable outlet and the orientation of the parts as required.

Mount Direction Type ^{*1}	A	B	C	D
X axis module	Not necessary	Reverse of cable outlet position ^{*2}		Not necessary
Y axis module	Not necessary	Reverse of cable outlet position ^{*2}	Not necessary	Reverse of cable outlet position ^{*2}
Z axis module	Not necessary			
Connector box, fixed side	Not necessary			
Junction connector box	Not necessary	Reverse of connector box ^{*3}		Not necessary
Connector box, moving side	Not necessary	Reverse of L-fixture ^{*4}	Not necessary	Reverse of L-fixture ^{*4}

*1: Refer to 2.2 Model Numbers.

*2: Refer to 4.3.1 RH, RM Module (Reversing Module Cable Position).

*3: Refer to 4.15.1 RG, RP, RU Manipulators.

*4: Refer to 4.16.1 YZ, RP-HMSz, RU Manipulators.

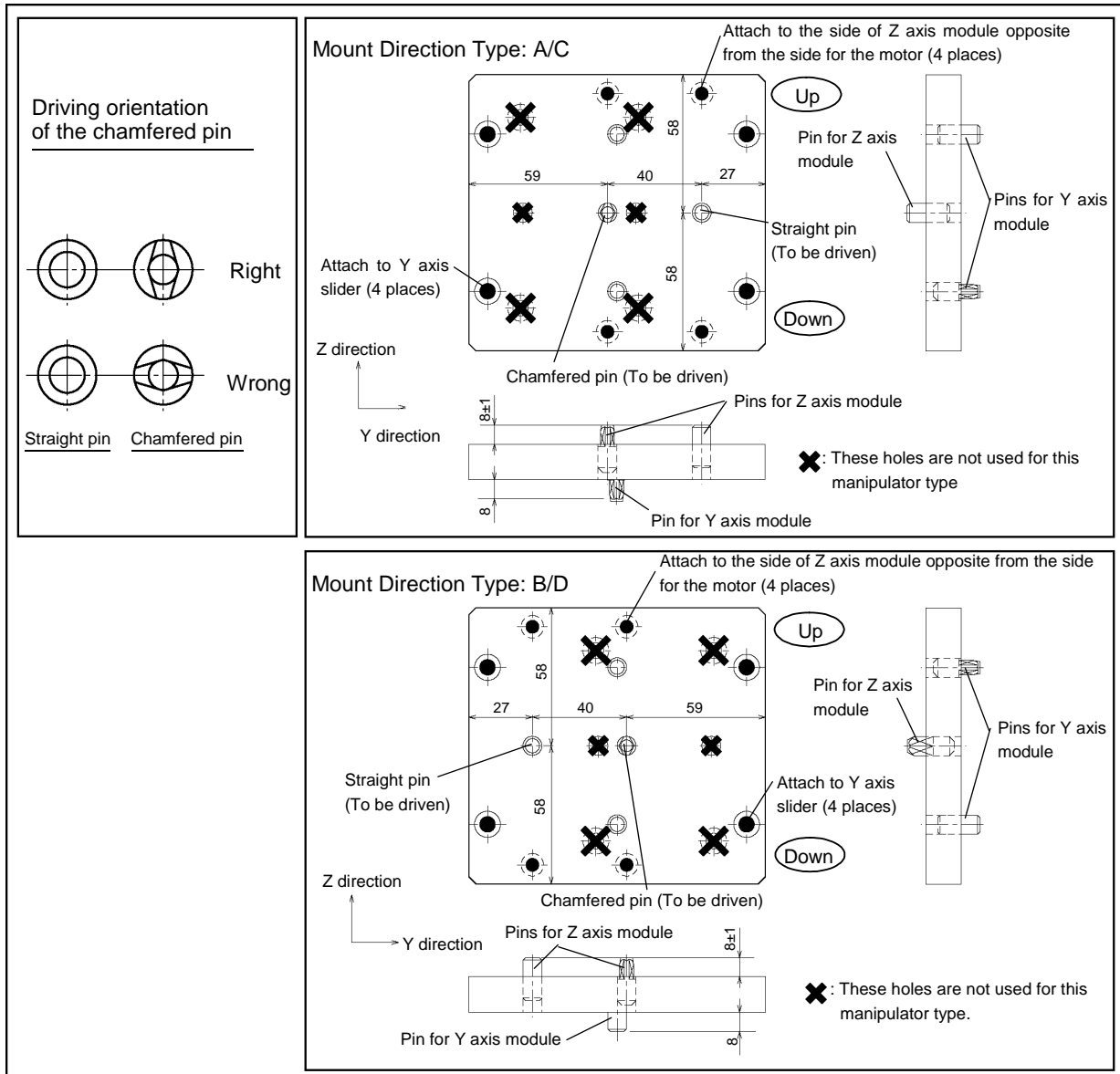
4.7 Installation of Multi-axis Manipulators

(2) Drive the pins to Y-Z combining bracket.

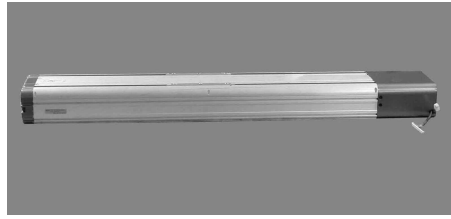
Drive a chamfered pin and a straight pin with a plastic hammer in the bracket for the locations shown in Figure below. The pins are provided with the Y-Z combining bracket.



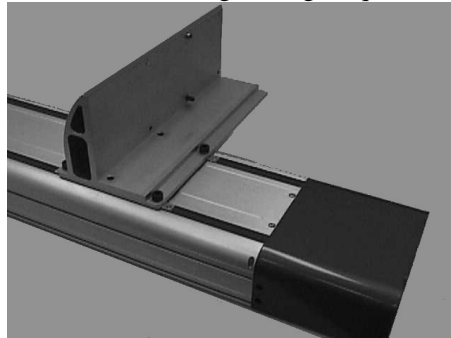
Be careful with the orientation of the chamfered pin. See Figure for the orientation.
Be careful not to push in pins for Y axis module on the back when driving the pins.



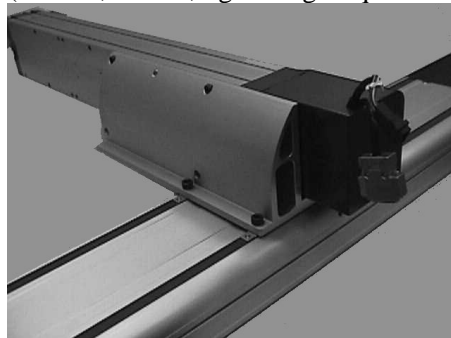
- (3) Refer to *4.4 Mounting a Module* and mount the X axis module to the mounting base.



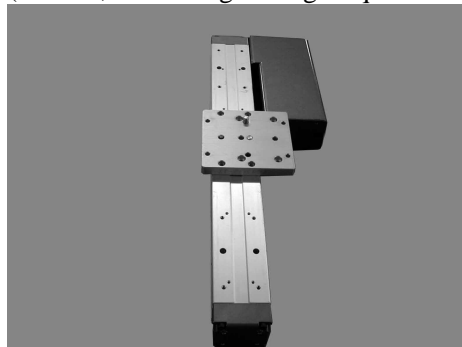
- (4) Attach the X-Y combining bracket to the slider of X axis module.
(M8×20, 4 bolts, tightening torque: 27.5 to 33.3 N·m)



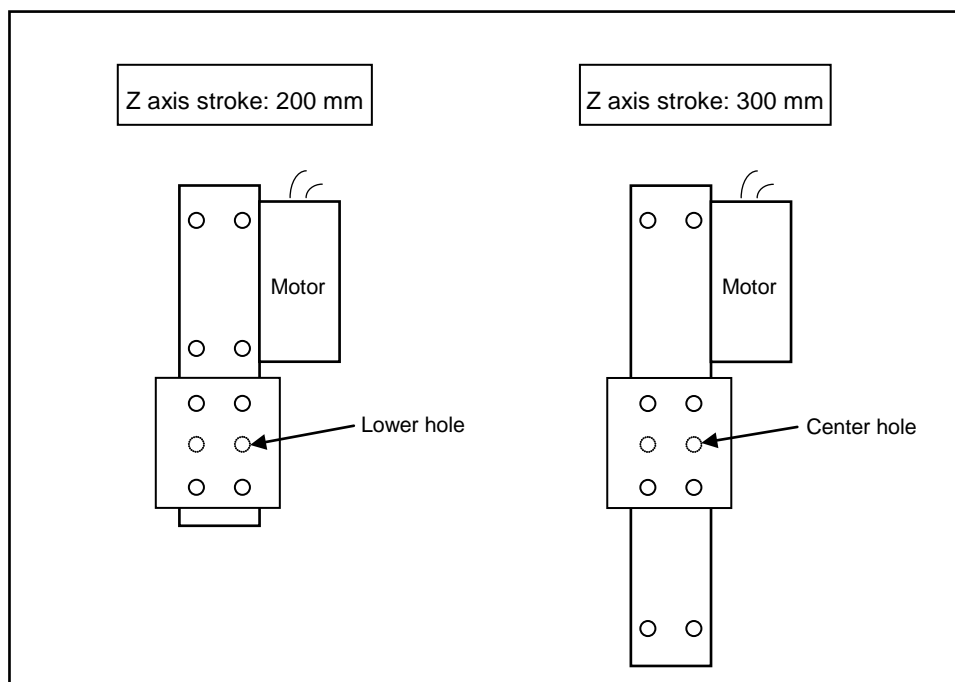
- (5) Secure the X-Y combining bracket to the Y axis module.
(M6×20, 4 bolts, tightening torque: 9.8 to 11.8 N·m)



- (6) Turn the Z axis module over and attach the Y-Z combining bracket to its mounting surface. (M5×18, 4 bolts: tightening torque 4.9 to 5.9 N·m)
Then, attach the Y-Z combining bracket with the Z axis module to the slider of Y axis.
(M6×16, 4 bolts: tightening torque 9.8 to 11.8 N·m)

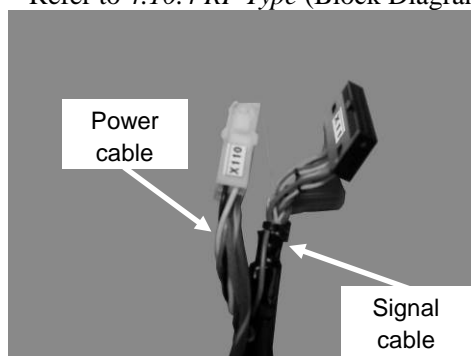


When the Z axis stroke is 200 mm, insert the pins into the lower holes to mount the bracket. When it is 300 mm, insert the pins into the center holes to mount the bracket. Inserting the pins into incorrect holes may increase vibration. Increasing vibration may result in insufficient function of the robot system and/or severe equipment damage to the robot system.

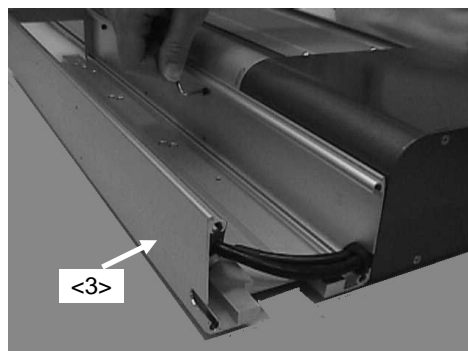
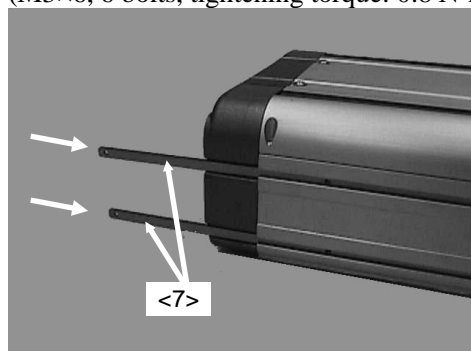


- (7) Affix labels*, which are provided with the interface box, to their respective cable connectors. (We recommend affixing the labels to the connectors to avoid miss-connection in multi-axis manipulator because the connector is common to all modules regardless their motor power specifications.)

* Refer to 4.10.4 RP Type (Block Diagrams) and affix the labels correctly.

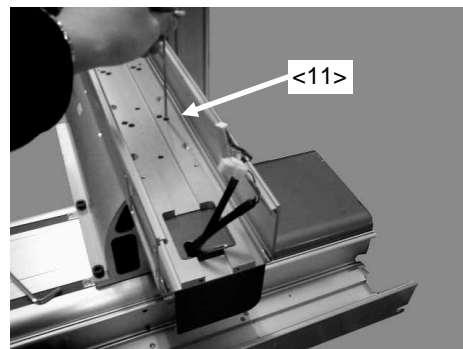
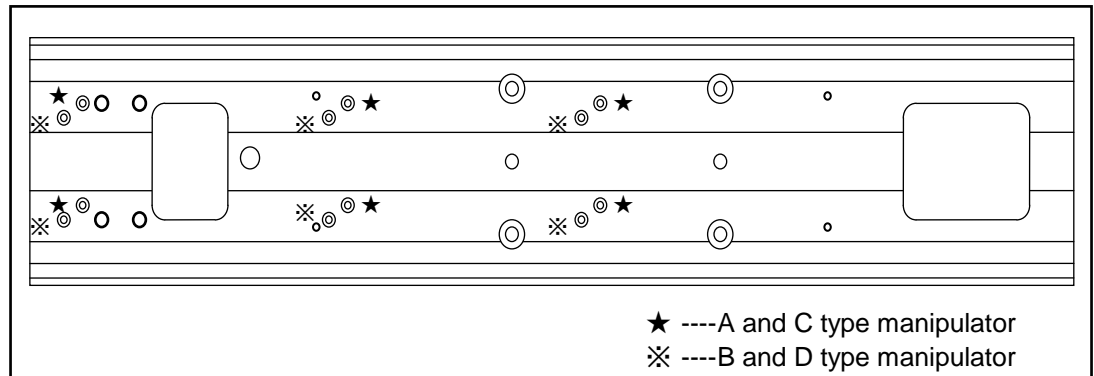


- (8) Insert the plate nuts <7> into the T slots on the side of the X axis module opposite from the side for the motor. Secure the fixed-side connector <3> to the module. (M3×6, 6 bolts, tightening torque: 0.8 N·m)



- (9) Insert the plate nuts <15>, the same as the procedure (8), into the T slots on the side of the Y axis module opposite from the side of the motor. Then attach the junction connector box <11> to the module (tightening torque: 0.8 N·m).

Use bolt holes in the bottom as shown in Figure to secure it. (M3×6, 6 bolts)
Locations of the bolt holes are different according to manipulator type. Pass the cables through the bottom opening of the connector box. Attach the inlet cover <14> to the junction connector box <11> as show in Photo and attach it from the end side of the module. (M4×20, 1 hexagon socket setscrew)

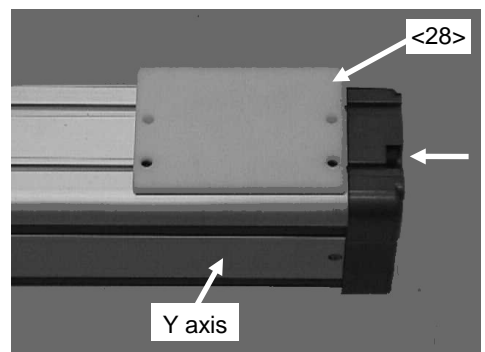
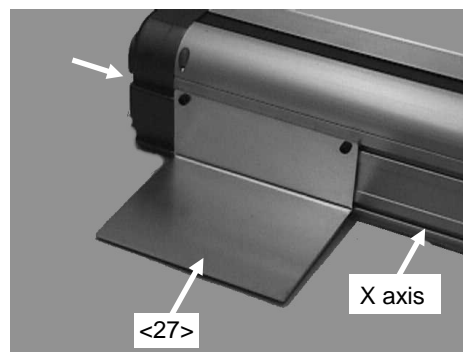


- (10) Attach the respective support rests to the X axis and Y axis modules.

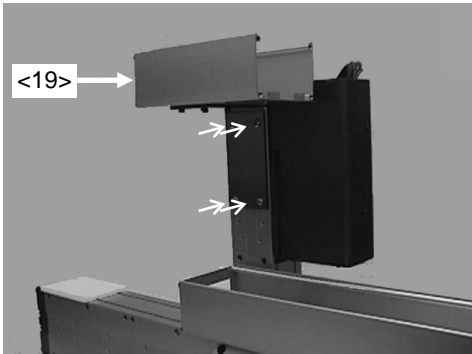
For the X axis: <27> (L-shaped)

For the Y axis: <28> (plastic)

Insert the plate nut <29> into the T slot as described in procedure (8) and secure each support rest by M3×6 (2 bolts, tightening torque: 0.8 N·m).



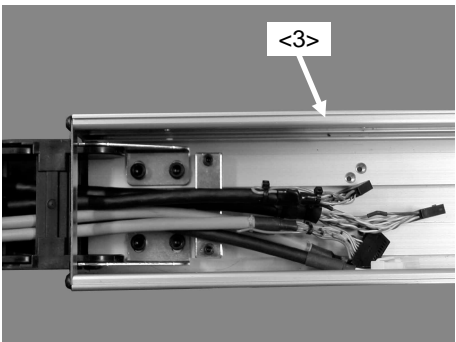
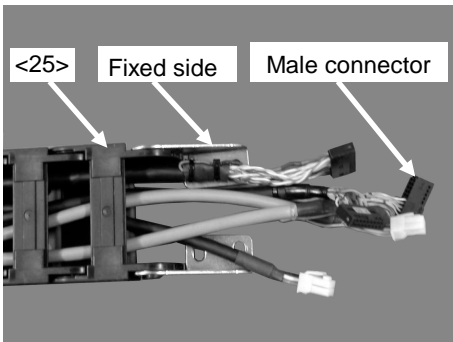
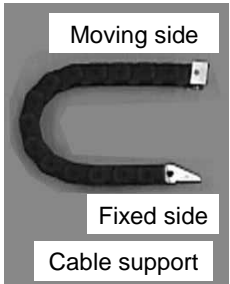
- (11) Attach the moving-side connector box <19> to the back of Z axis module. (M5×10, 4 bolts, button head cap bolt)



- (12) Adjust the length of the X-Y cable support^{*1}.
Put the power cable and signal cable through the X-Y cable support <25>^{*2}. (Be careful to observe the tangle of cables and the direction of the cable.)
Attach the X-Y cable support <25> to the fixed-side connector box <3>. (M6×10, 4 bolts)

^{*1}: Refer to 4.14 Adjusting Cable Support Length.
^{*2}: When connecting the user cable and pneumatic tubes, refer to 4.18 User Cables and Pneumatic Tubes.

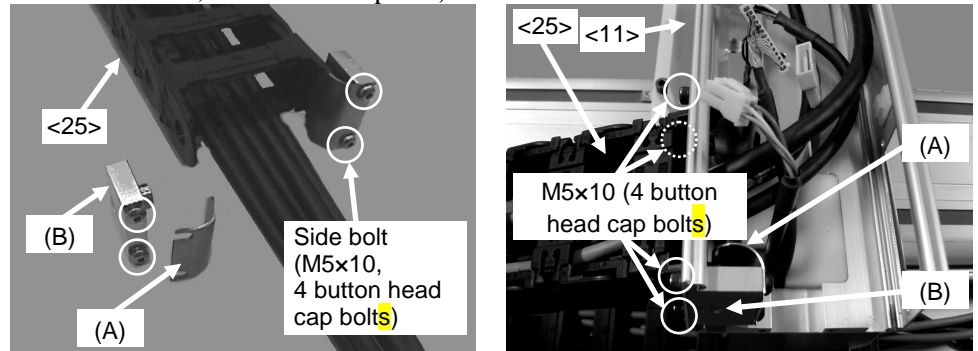
X axis stroke	Y axis stroke	Length of cable support
400mm	350mm	15 links
	550mm	
600mm	350mm	19 links
	550mm	
800mm	350mm	23 links
	550mm	



- (13) Attach the moving side of cable support to the junction connector box <11>.

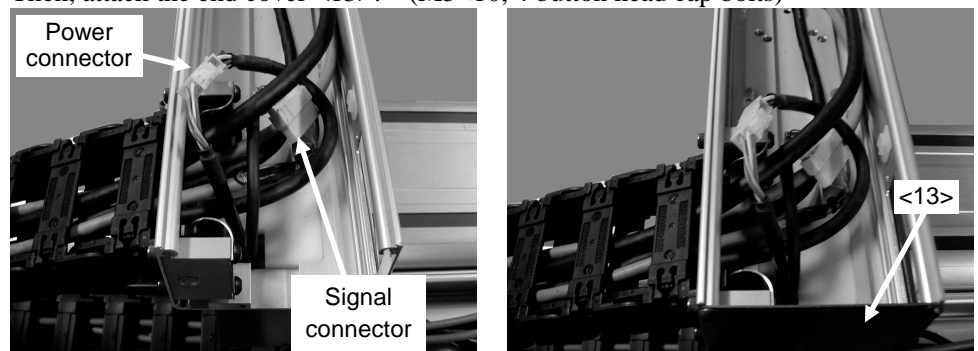
Unfasten side bolts of each side of the cable support and remove covers (A) and blocks (B) from the cable support temporarily (both sides of the cable support). (M5×10, 2 bolts each side, button head cap bolt)

Put the cable support and the cables through an opening of the junction connector box <11>, then attach the covers (A) and the blocks (B) to the cable support using the side bolts. Then, secure the blocks to the junction connector box using bolts. (M5×10, 2 bolts each side, button head cap bolt)



- (14) Connect the power cable (3.6 m) and signal cable (3.6 m) to the Y axis module. (2 connectors)

Then, attach the end cover <13>. (M5×10, 4 button head cap bolts)



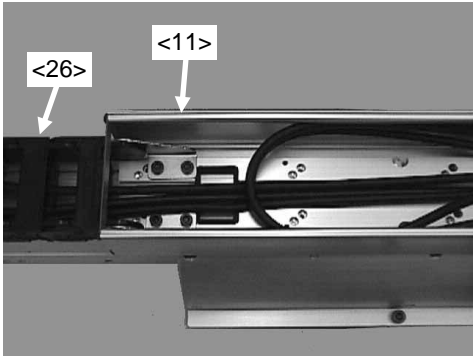
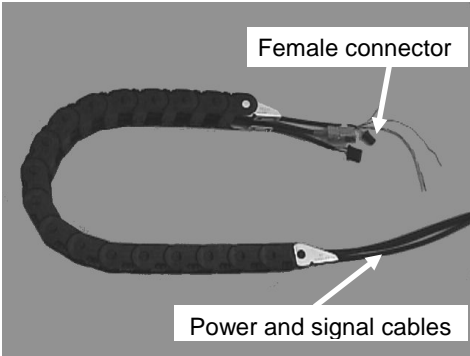
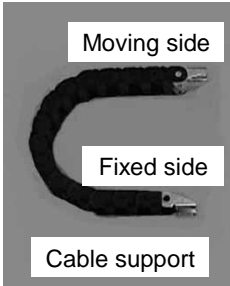
(15) Adjust the length of the Y-Z cable support*.

Pass the power cable and signal cable through the Y-Z cable support <26>. (Be careful to observe the tangle of cables and the direction of the cable.)

Attach the fixed side (bracket with holes) of the Y-Z cable support <26> to the junction connector box <11>. (M6×10, 4 bolts)

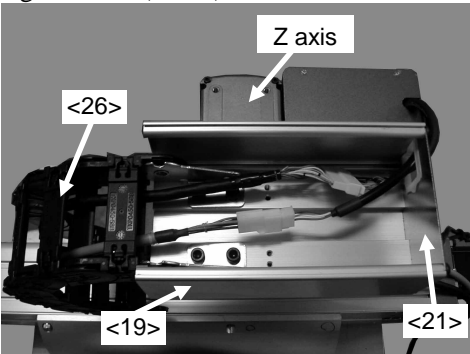
* Refer to 4.14 Adjusting Cable Support Length.

Y axis stroke	Z axis stroke	Length of cable support
350mm	200mm	17 links
	300mm	15 links
550mm	200mm	21 links
	300mm	20 links

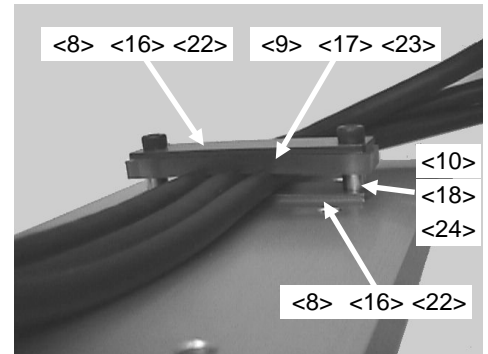
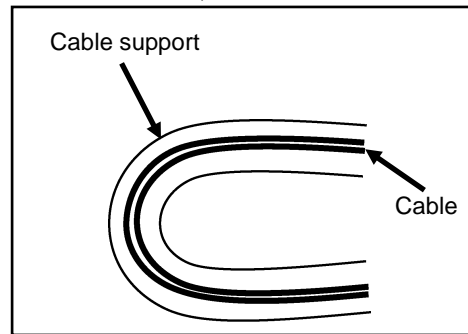


(16) Attach the other end (moving side) of cable support <26> to the moving-side connector box <19> using the procedure described in (15). (M6×10, 4 bolts)

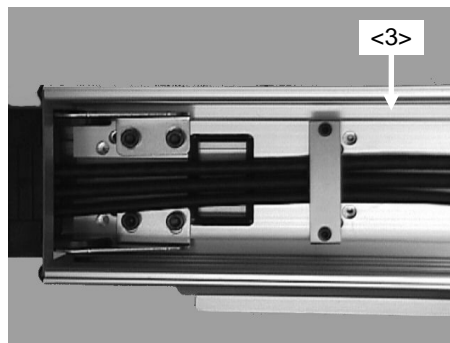
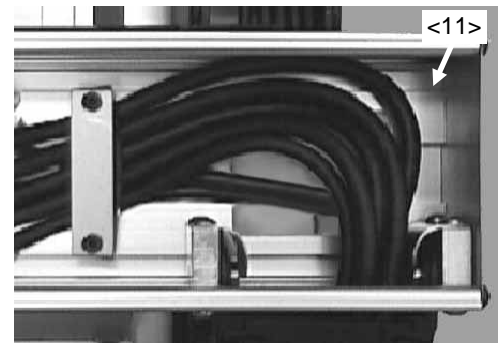
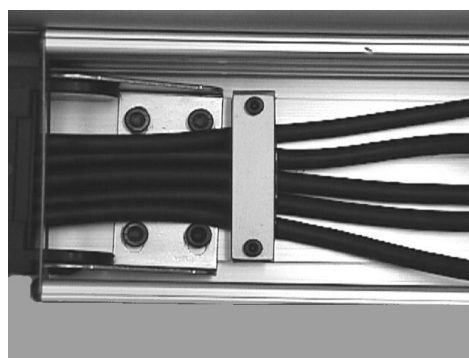
Install the cables of Z axis module through an edge saddle of the end cover <21> and attach the end cover to the moving-side connector box (M5×10, 4 bolts, button head cap bolt), then connect the cables of Z axis module to the power cable (3.6 m) and signal cable (3.6 m).



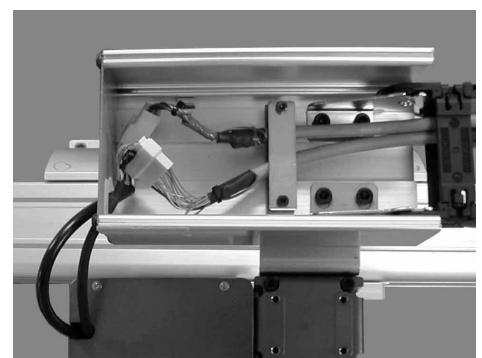
- (17) Insert the cables through the center of the cable support as shown in Figure 4-29 so that they are not strained. Use as large of a bending radius as possible when fix them to the connector boxes. Then fasten them with the clamping parts <8> to <10>, <16> to <18>, <22> to <24>, and M4×25 (2 bolts). (4 places: put the clamp base under the cables, set the cables on it and clamp them with the cable clamp. Do not screw the bolts too tight. Screwing the bolts too tight may result in damaged cables or disconnection.)



Details of clamping cables

Junction connector box
Y-Z cable support sideJunction connector box
X-Y cable support side

Connector box, fixed side

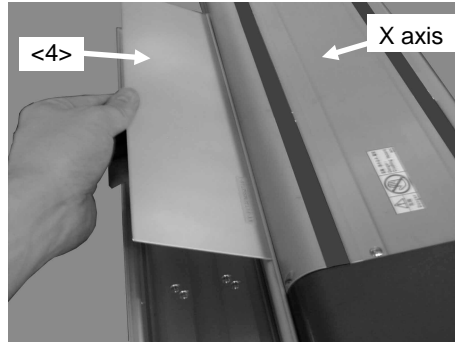


Connector box, moving side

- (18) Attach the top covers to their respective connector boxes*.

Hook the edge of the top cover to the groove on the side of connector box as shown in the photo and push the other side edge to other groove.

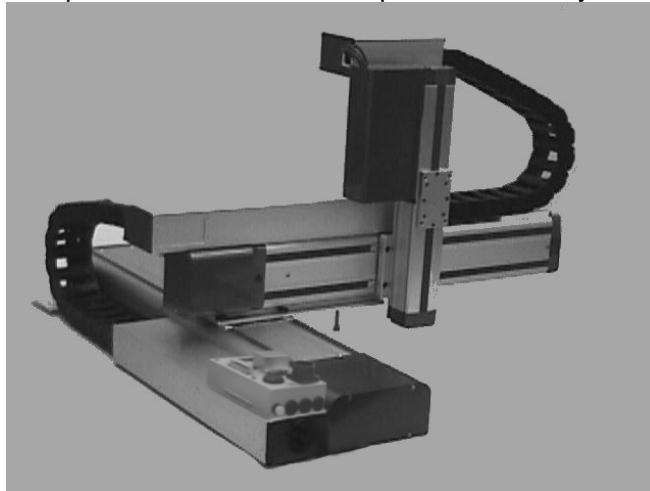
* For the top cover of the fixed-side connector box, attach the top cover at the bottom end of the connector box.



- (19) Refer to the step (6) through (9) in “4.6 Installation of Single Axis Modules (RH, RM)” and install the ground, cables*, interface box, end cover, and grommet.


* For cable connection, refer to 4.10.4 *RP Type (Block Diagrams)* and connect the cables properly.


Completion of RP-HMSz manipulator assembly



- (20) Connect the manipulator to the controller referring to 4.12 *Cable Connection*.
Then, perform the calibration referring to 4.13 *Calibration*.

4.7.4 RU-HMSz Manipulator

 WARNING	<ul style="list-style-type: none"> When passing the cables through the cable support, be careful not to rub or tangle the cables. Adjust the links of the cable support to prevent the cables from stretching too tight, getting too loose, or twisting. Rubbing or tangling the cables may result in damage to the cables. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
---	--

 CAUTION	<ul style="list-style-type: none"> When removing or installing a module, there must be two or more people to work on it so that at least one of them can support the module while others are removing the bolts. Removing the bolts without supporting the module may result in the module falling, bodily injury, and/or malfunction of the robot system.
---	---

The following shows the codes of RU-HMSz manipulator components.

Check the codes of the components with the model number and make sure that all components are ready.

Name of Components	Model Number ^{*1}			
	X5U□H□M□S1A	X5U□H□M□S1B	X5U□H□M□S1C	X5U□H□M□S1D
RH module	R114X5H□□□ ^{*2}			
RM module	R114X5M0□□ ^{*2}			
RSz module	R114X5S0□6 ^{*2}	R114X5S0□5 ^{*2}	R114X5S0□6 ^{*2}	R114X5S0□5 ^{*2}
RU module ^{*3}	R114X5U001			
Accessory kit	R114X4A0P0	R114X4A0P1	R114X4A0P0	R114X4A0P1
Cable set 5	R114X5C007			
Interface box	R114X5B010			

*1: For details of numbers substituted by □ and the mount direction type (the last alphabet) in the model number, refer to 2.2 *Model Numbers*.

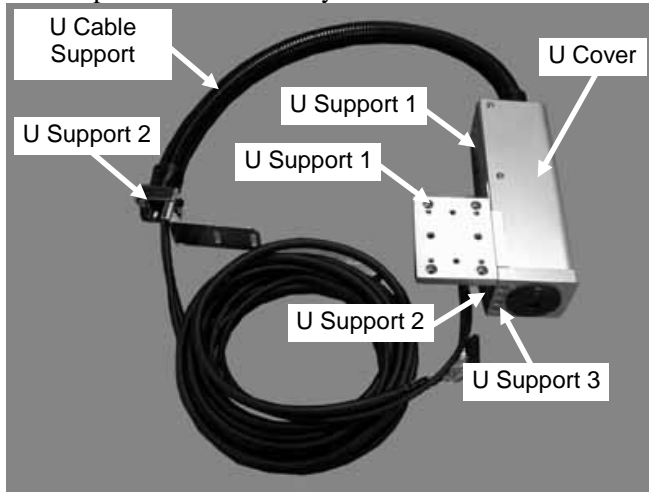
*2: Numbers substituted by □ in the code vary with stroke. Refer to 4.5 *Relations between the Stroke and the Code of the Module*.

*3: Cables are provided along with RU module.

4.7 Installation of Multi-axis Manipulators

Be sure that all parts of the accessory kit, interface box (4.7.3 RP-HMSz), and RU module are ready before proceeding.

For the parts of the accessory kit and interface box.

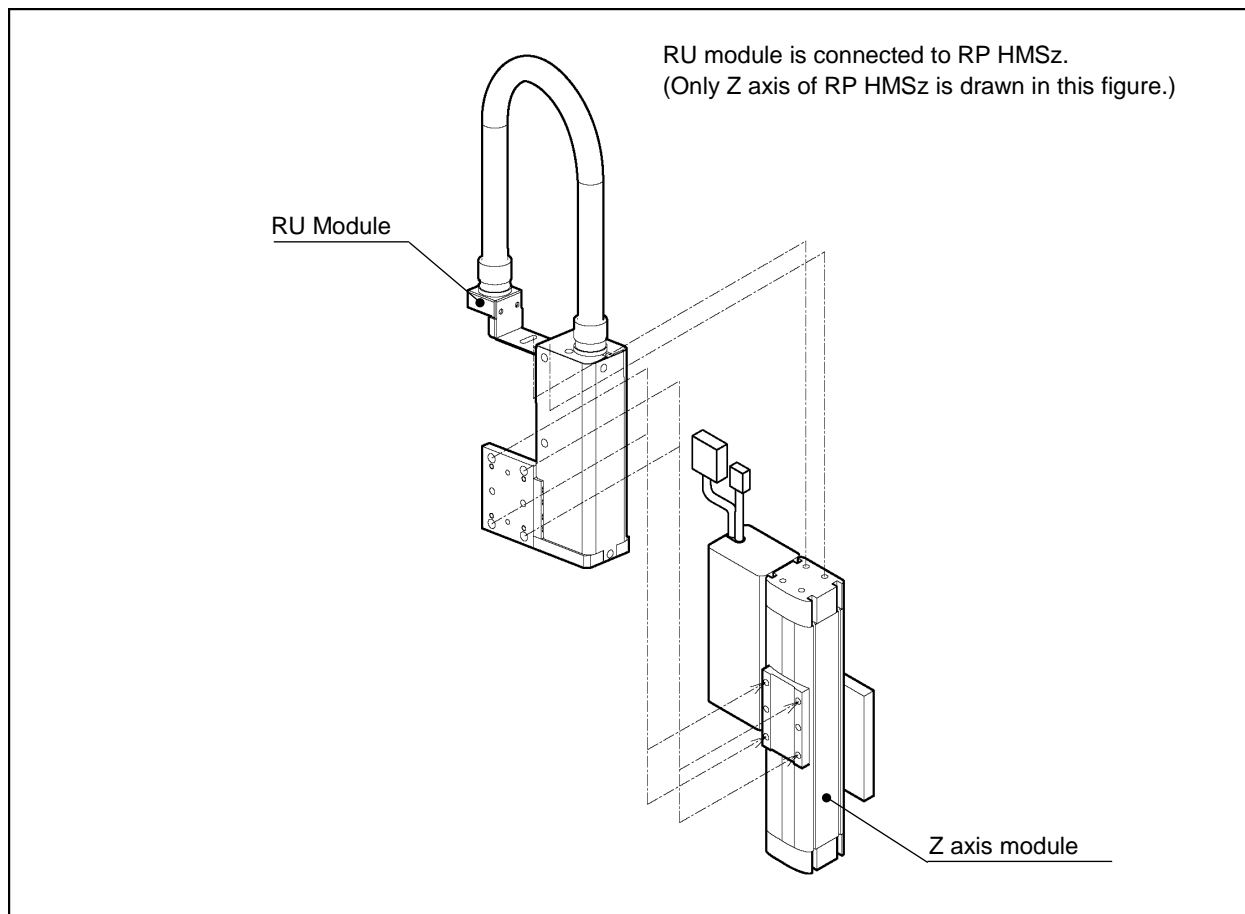


Hexagon socket head cap bolt M6×12 (4 bolts)

Hexagon socket head cap bolt M5×10 (2 bolts)

Plain washer M5 (2 pcs.)

RU-HMSz (Example: A/C Type)



No cables of the cable set are shown in the figure above.

RU-HMSz manipulator assembly procedure
(Photographs in this section are A type.)

- (1) The mount direction types of the following parts have been set at the factory.

Y axis module, RU module, and Moving-side connector box: A/C type

X axis module, and Junction connector box: A/D type

When using these parts in different mount direction type, refer to Table and change the position for the module cable outlet and the orientation of the parts as required.

Mount Direction Type ^{*1}	A	B	C	D
X axis module	Not necessary	Reverse of cable outlet position ^{*2}		Not necessary
Y axis module	Not necessary	Reverse of cable outlet position ^{*2}	Not necessary	Reverse of cable outlet position ^{*2}
Z axis module	Not necessary			
RU module	Not necessary	Reverse of RU module ^{*5}	Not necessary	Reverse of RU module ^{*5}
Connector box, fixed side	Not necessary			
Junction connector box	Not necessary	Reverse of connector box ^{*3}		Not necessary
Connector box, moving side	Not necessary	Reverse of L-fixture ^{*4}	Not necessary	Reverse of L-fixture ^{*4}

*1: Refer to 2.2 *Model Numbers*.

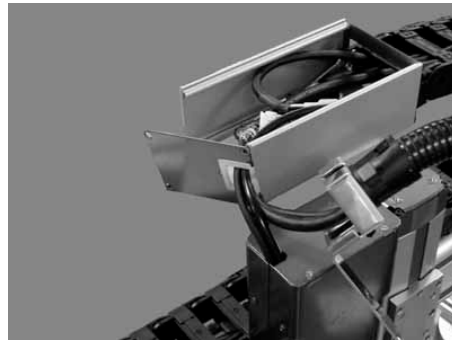
*2: Refer to 4.3.1 *RH, RM Module (Reversing Module Cable Position)*.

*3: Refer to 4.15.1 *RG, RP, RU Manipulators*.

*4: Refer to 4.16.1 *YZ, RP-HMSz, RU Manipulators*.

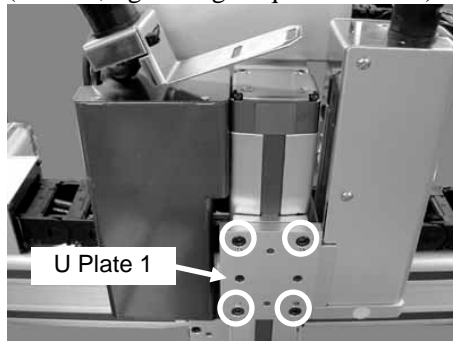
*5: Refer to 4.17 *Reversing RU Module*.

- (2) Refer to the section 4.7.3 *RP-HMSz Manipulator* (from the beginning to the assembly procedure (16)) and install Axis 1, Axis 2, and Axis 3.
- (3) Install the cables of RU module through an edge saddle of the end cover on the moving-side connector box.

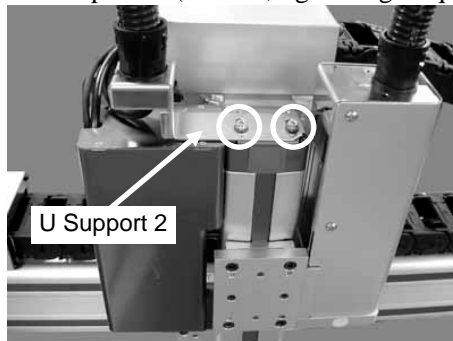


- (4) Insert the cables through the Y-Z cable support and then X-Y cable support. Binding the connectors with tape (gummed tape, etc.) can allow you to insert the cables through the cable supports easily.
- (5) Refer to assembly procedure (17) in 4.7.3 *RP-HMSz Manipulator* and secure the cables to the respective connector boxes.
- (6) Refer to assembly procedure (18) and (19) in 4.7.3 *RP-HMSz Manipulator*, and install the top cover, ground wire, cable, interface box, end cover, and grommet to the respective connector boxes.

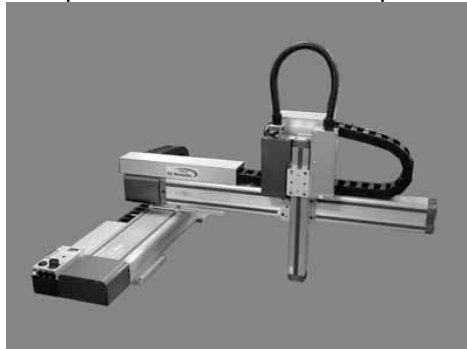
- (7) Attach the U plate 1 to the slider of Z axis with four hexagon socket head cap bolts (M6×12, tightening torque: 11.7 N·m).



- (8) Secure the U support 2 to the top side of the Z axis module with two hexagon socket head cap bolts (M5×10, tightening torque: 5N·m) and two plain washers (M5).



Completion of RP-HMSz manipulator assembly



- (9) Connect the manipulator to the controller referring to *4.12 Cable Connection*. Then, perform the calibration referring to *4.13 Calibration*.

4.8 Installation of Additional Modules



- Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.



- When removing or installing the module, there must be two or more people to work on it so that at least one of them can support the module while others are removing the bolts. Removing the bolts without supporting the module may result in the module falling, bodily injury, and/or malfunction of the robot system.



The interface box has the power connectors and signal connectors that are available for up to four axes. To add new modules to the robot system, use unused connectors and external cables. The total number of manipulators allowed in the robot system is four. However, some type of modules cannot be added.

Available Combinations of Additional Modules

First Manipulator: Single Axis

First Manipulator		Second, Third, Forth Manipulators (Additional)				
Specifications	TYPE	Single axis			Two axis manipulator	
		RH	RM	RSz	RG-HM	YZ-MS
Single axis	RH	Max.3	Max.3	–	1	–
	RM	Max.3	Max.3	–	1	–

Max.3: Up to three additional modules can be installed.

1: One additional module can be installed.

–: No additional module can be installed.

First Manipulator: Two Axis

First Manipulator		Second, Third, Forth Manipulators (Additional)				
Specifications	TYPE	Single axis			Two axis manipulator	
		RH	RM	RSz	RG-HM	YZ-MS
Two axis	RG-HM	Max.2	Max.2	–	1	–
	YZ-MS	Max.2	Max.2	–	1	–

Max.2: Up to two additional modules can be installed.

1: One additional module can be installed.

–: No additional module can be installed.

First Manipulator: Three Axis

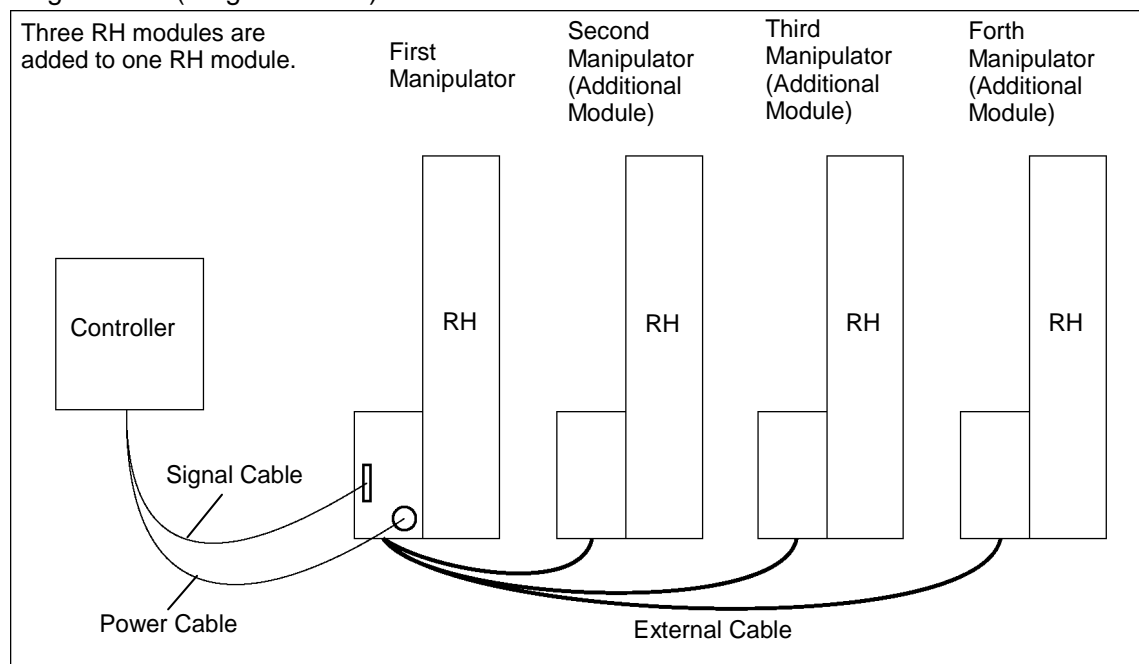
First Manipulator		Second, Third, Forth Manipulators (Additional)				
Specifications	TYPE	Single axis			Two axis manipulator	
		RH	RM	RSz	RG-HM	YZ-MS
Three axis	RP-HMSz	1	1	–	–	–

1: One additional module can be installed.

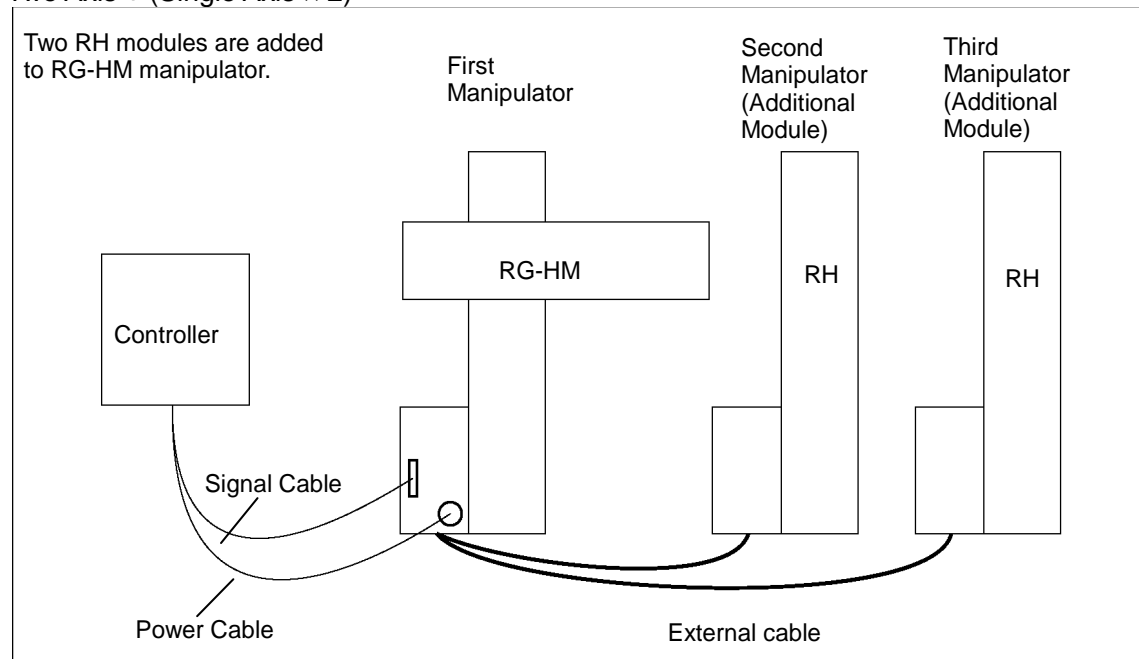
–: No additional module can be installed.

Connection Diagrams of Additional Modules

Single Axis + (Single Axis × 3)

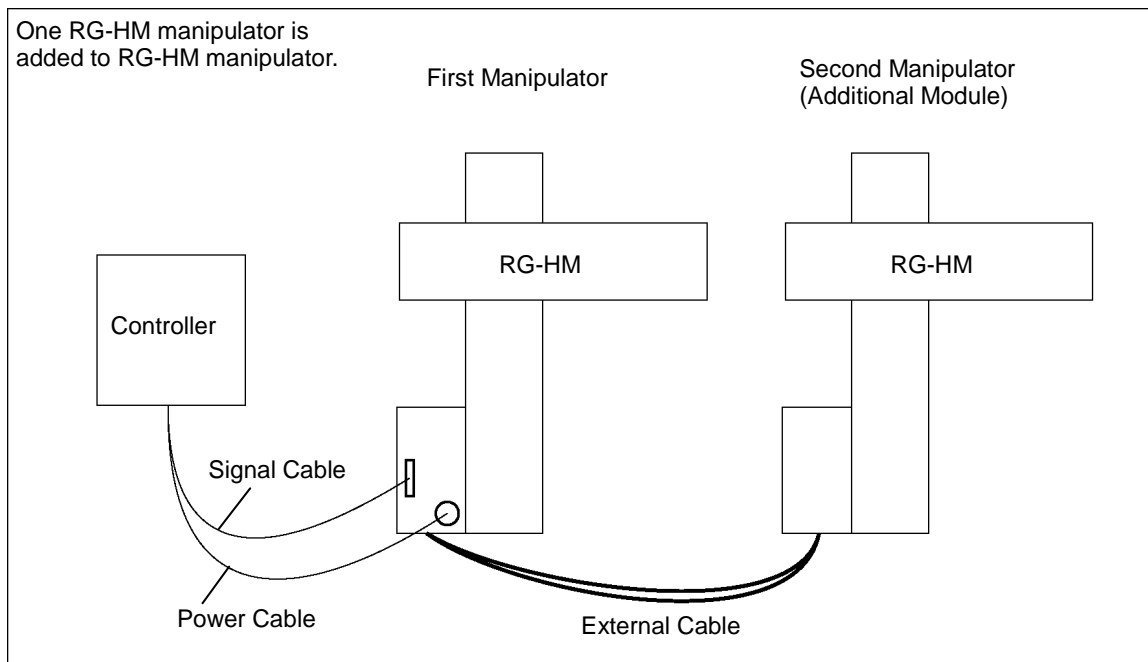


Two Axis + (Single Axis × 2)



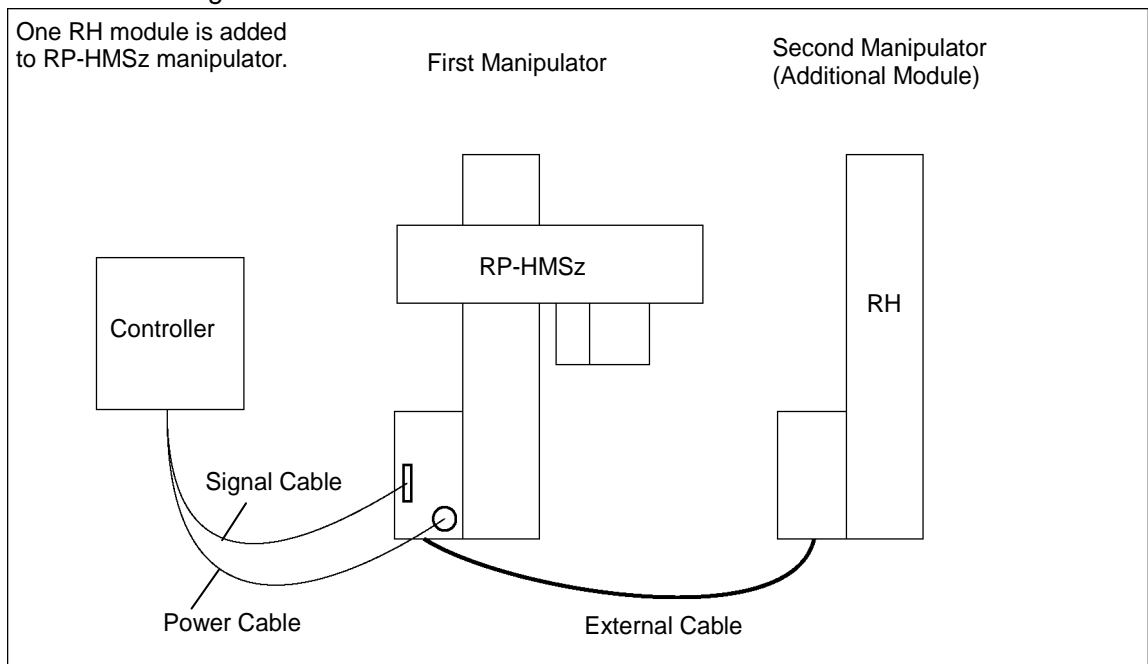
Two Axis + Two Axis

One RG-HM manipulator is added to RG-HM manipulator.



Three Axis + Single Axis

One RH module is added to RP-HMSz manipulator.



4.8 Installation of Additional Modules

Required parts are listed in tables below. Find the codes of the components with the model number and make sure that all components are ready.

RH, RM Module (Additional Module)

Name of Components	Model Number ^{*1}	
	X5S□H0000AA	X5S□M0000AA
RH module	R114X5H□□□ ^{*2}	—
RM module	—	R114X5M0□□ ^{*2}
Accessory kit	R114X4A0S0	R114X4A0S0
External cable	R114X5C000	
Connector cover	R114X4B020	

RG-HM Manipulator (Additional Modules)

Name of Components	Model Number ^{*1}			
	X5G□H□M00AA	X5G□H□M00AB	X5G□H□M00AC	X5G□H□M00AD
RH module	R114X5H□□□ ^{*2}			
RM module	R114X5M0□□□ ^{*2}			
Accessory kit	R114X4A0G0	R114X4A0G1	R114X4A0G0	R114X4A0G1
Cable set 3	R114X5C003			
Connector cover	R114X4B020			

*1: For details of numbers substituted by □ and the mount direction type (the last alphabet) in the model number, refer to 2.2 *Model Numbers*.

*2: Numbers substituted by □ in the code vary with stroke. Refer to 4.5 *Relations between the Stroke and the Code of the Module*.

4.8.1 First Manipulator

- (1) Remove the end cover from the fixed-side connector box. Then, remove two grommets on the end cover and the interface box.

- (2) Affix labels, which are provided with the interface box, to respective cable connectors.

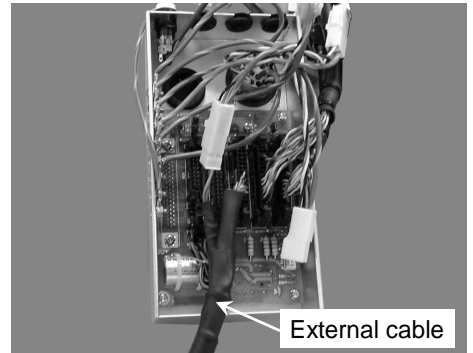
Refer to respective block diagrams in *4.10.6 Examples for Additional Modules* and affix the labels correctly.

(We recommend affixing the labels to the connectors to avoid miss-connection in multi-axis combination because the connector is common to all modules regardless their motor power specifications.)



- (3) Connect the power connector and signal connector of the external cable to the interface box.

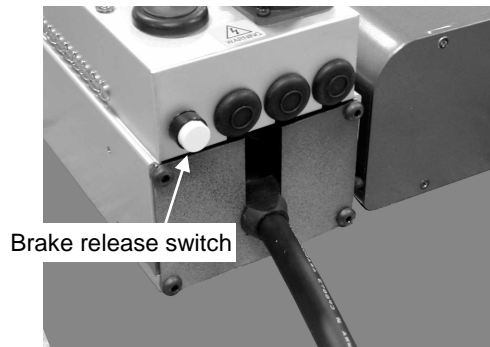
Refer to respective block diagrams in *4.10.6 Examples for Additional Modules*, and connect them correctly.



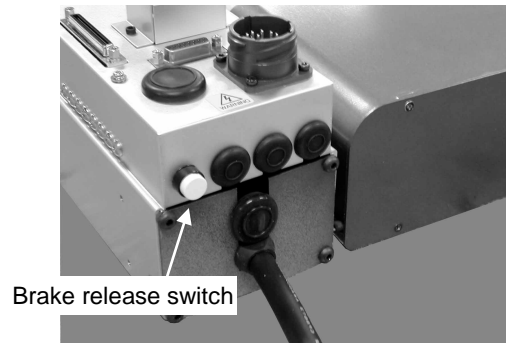
- (4) Mount the interface box on the connector box.



- (5) Insert the stopper of the external cable to the opening on the end cover of the connector box, and secure the end cover.



- (6) When you do not insert any other cable to the opening on the end cover, attach one of the grommets removed in step (1) to the opening.



4.8.2 Second, Third, Forth Manipulators

All procedures hereunder are common to RG-HM and RM modules. The additional RH module is shown as an example in the following photographs.

- (1) Affix labels, which are provided with the interface box or cable set, to respective cable connectors. Refer to respective block diagrams in *4.10.6 Examples for Additional Modules* and affix the labels correctly.

(We recommend affixing the labels to the connectors to avoid miss-connection in multi-axis combination because the connector is common to all modules regardless their motor power specifications.)

- (2) Refer to respective procedures below and install an additional module.

RH, RM: From the beginning to (4) in *4.6 Installation of Single Axis Modules (RH, RM)*

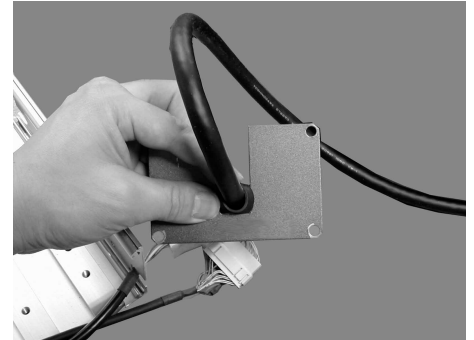
RG-HM: From the beginning to (13) in *4.7.1 RG-HM Manipulator*



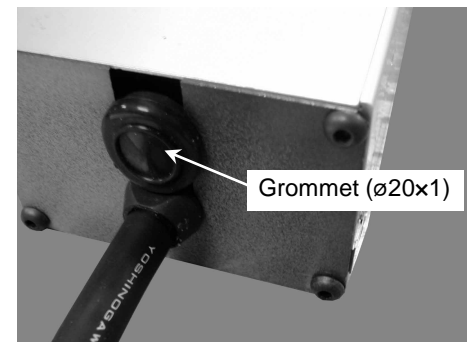
- (3) Connect the external cables whose other sides are connected to the first manipulator to the power and signal cables from the additional module.
Refer to respective block diagrams in *4.10.6 Examples for Additional Modules* and connect the cables correctly.



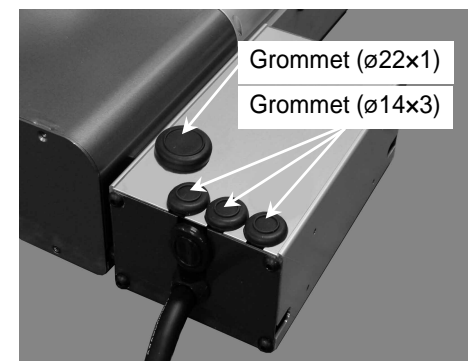
- (4) Insert the stopper of the external cable to the opening on the end cover of the connector box, and secure the top cover and end cover.



- (5) When you do not insert any other cable to the opening on the end cover, attach the provided $\varnothing 20$ grommet to the opening.



- (6) Attach the provided grommets ($\varnothing 22 \times 1$ and $\varnothing 14 \times 3$) to the connector cover.



- (7) Connect the manipulator to the controller referring to *4.12 Cable Connection*.
Then, perform the calibration referring to *4.13 Calibration*.

4.9 Mounting End Effector to Slider



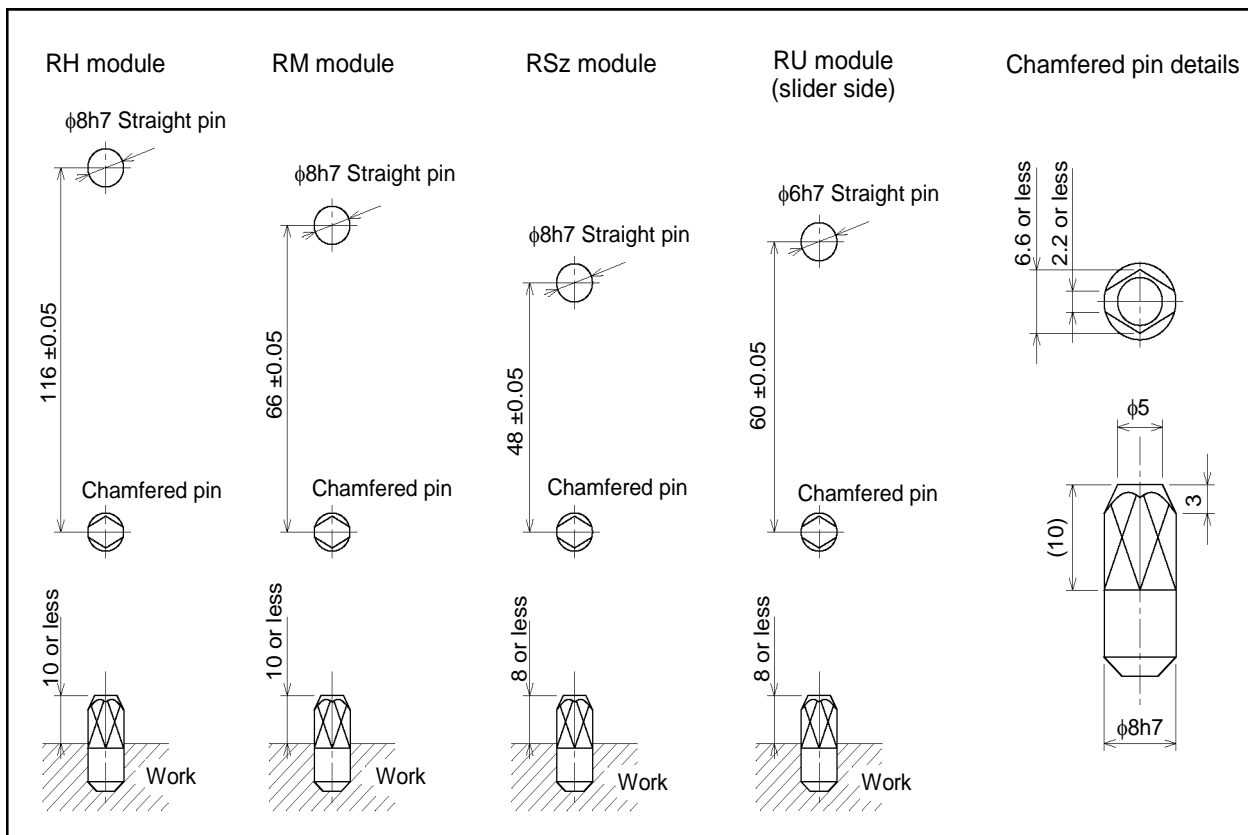
- If you use an end effector equipped with a gripper or chuck, connect wires and/or pneumatic tubes properly so that the gripper does not release the work piece when the power to the robot system is turned OFF. Improper connection of the wires and/or pneumatic tubes may damage the robot system and/or work piece as the work piece is released when the Emergency Stop switch is pressed. I/O outputs are configured at the factory so that they are automatically shut off (0) by power disconnection, the Emergency Stop switch, or the safety features of the robot system.
- After mounting an end effector to the slider, make sure that, by moving the slider manually, no interference to peripheral equipment exists.

Mounting bolts

	RH module	RM module	RSz module	RU module (Slider side)	RU module (U axis rotating side)
Bolt diameter	M8	M6	M6	M6	M4
Screw-in depth	12 to 16 mm	9 to 12 mm	6 to 8 mm	9 to 12 mm	7 mm
Tightening torque	33.3 N·m (340 kgf·cm)	14.7 N·m (150 kgf·cm)	11.7 N·m (120 kgf·cm)	11.7 N·m (120 kgf·cm)	4.9 N·m (50 kgf·cm)

Dimensions of locating pins when using $\phi 8H7$ pin holes

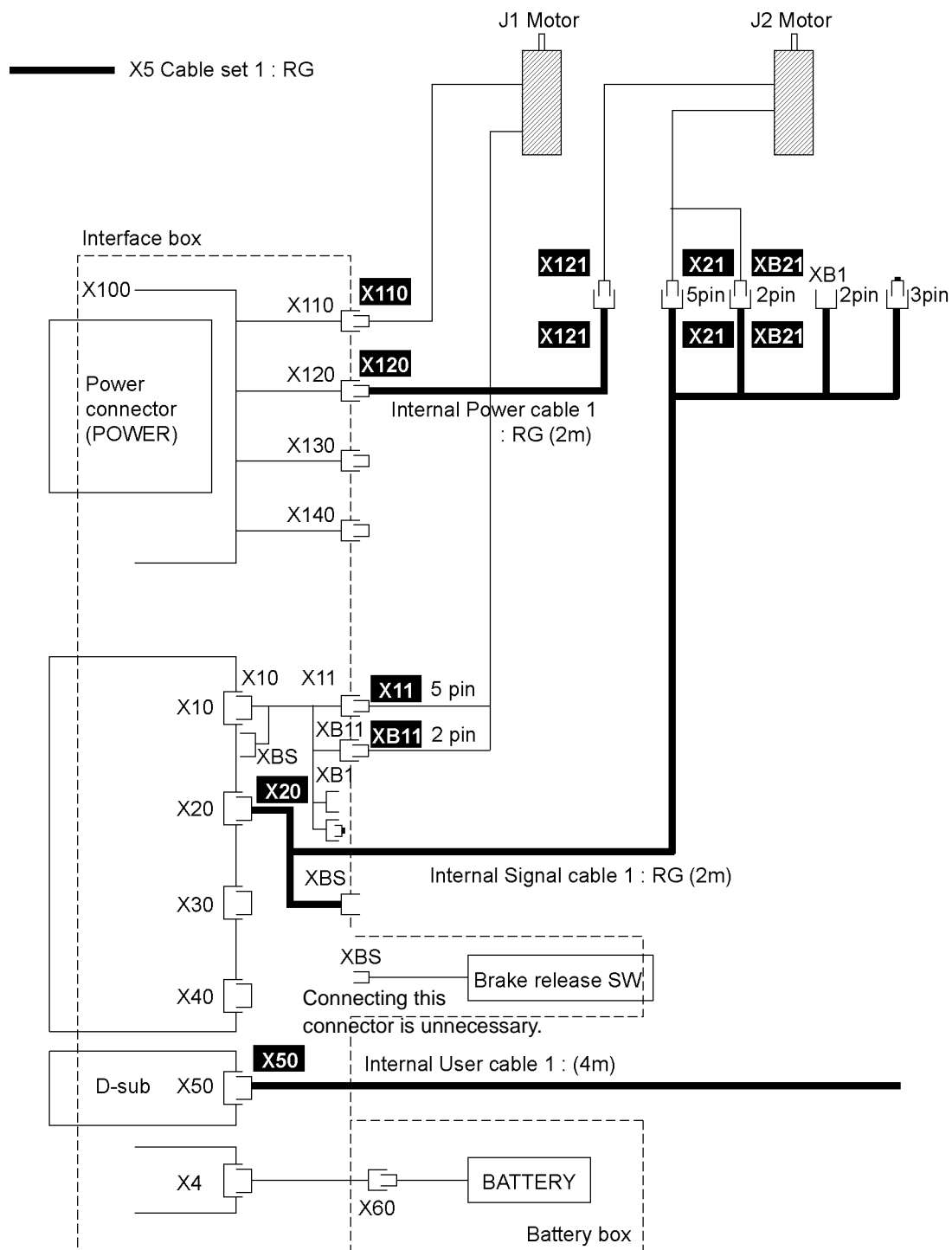
[Unit: mm]



For details of RU module (U axis rotating side), refer to the outer dimensions in 2.5.4 *Four Axis Manipulators*. When designing an end effector, consider the transportable moment in 2.6 *Specifications*.

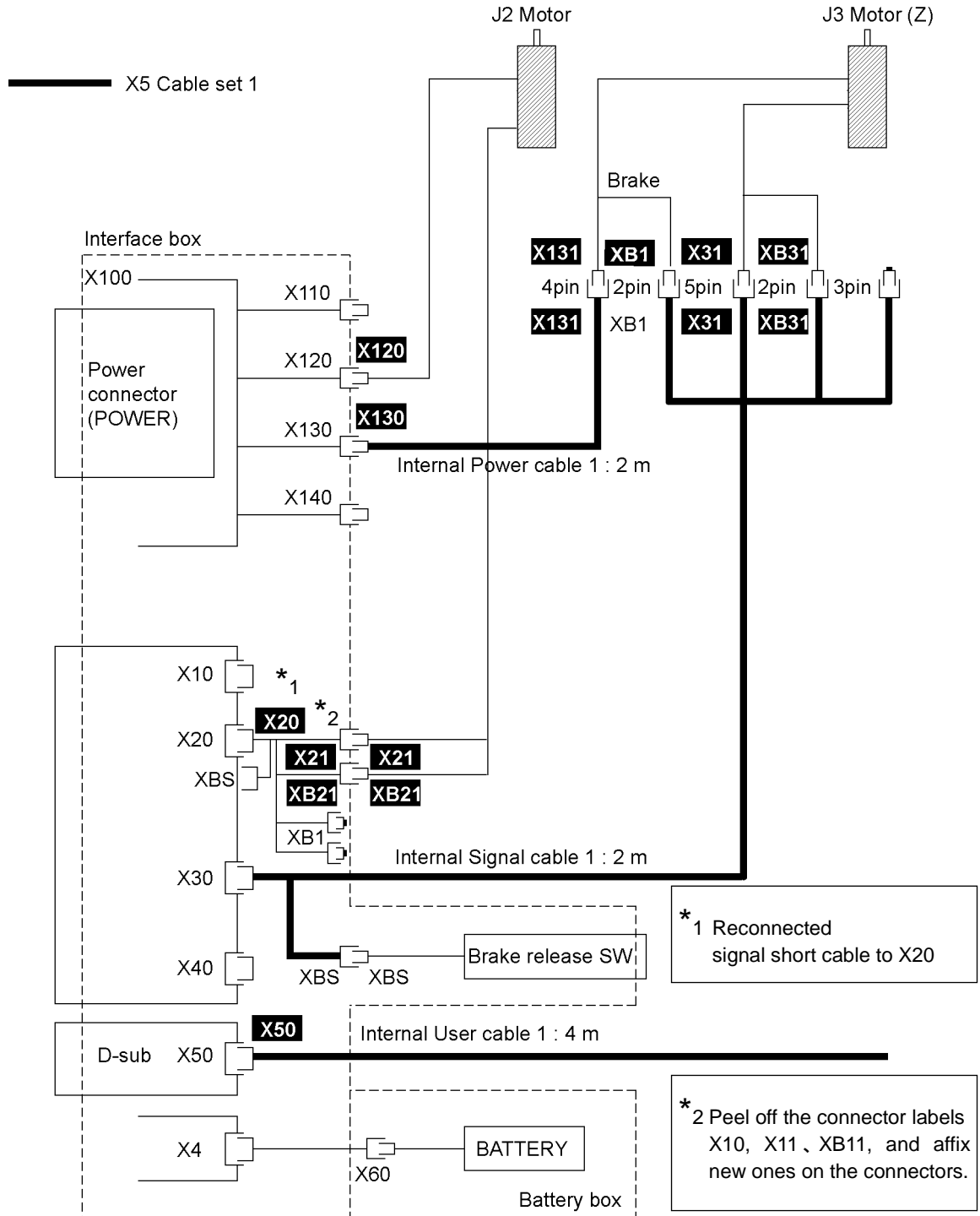
4.10.2 RG Type

This diagram is for the case where the RG-type modules are connected to J1 and J2 axes. When the RG-type modules are connected to the other axes, connect them as shown in this diagram. However, the connector numbers should be changed according to the axes.



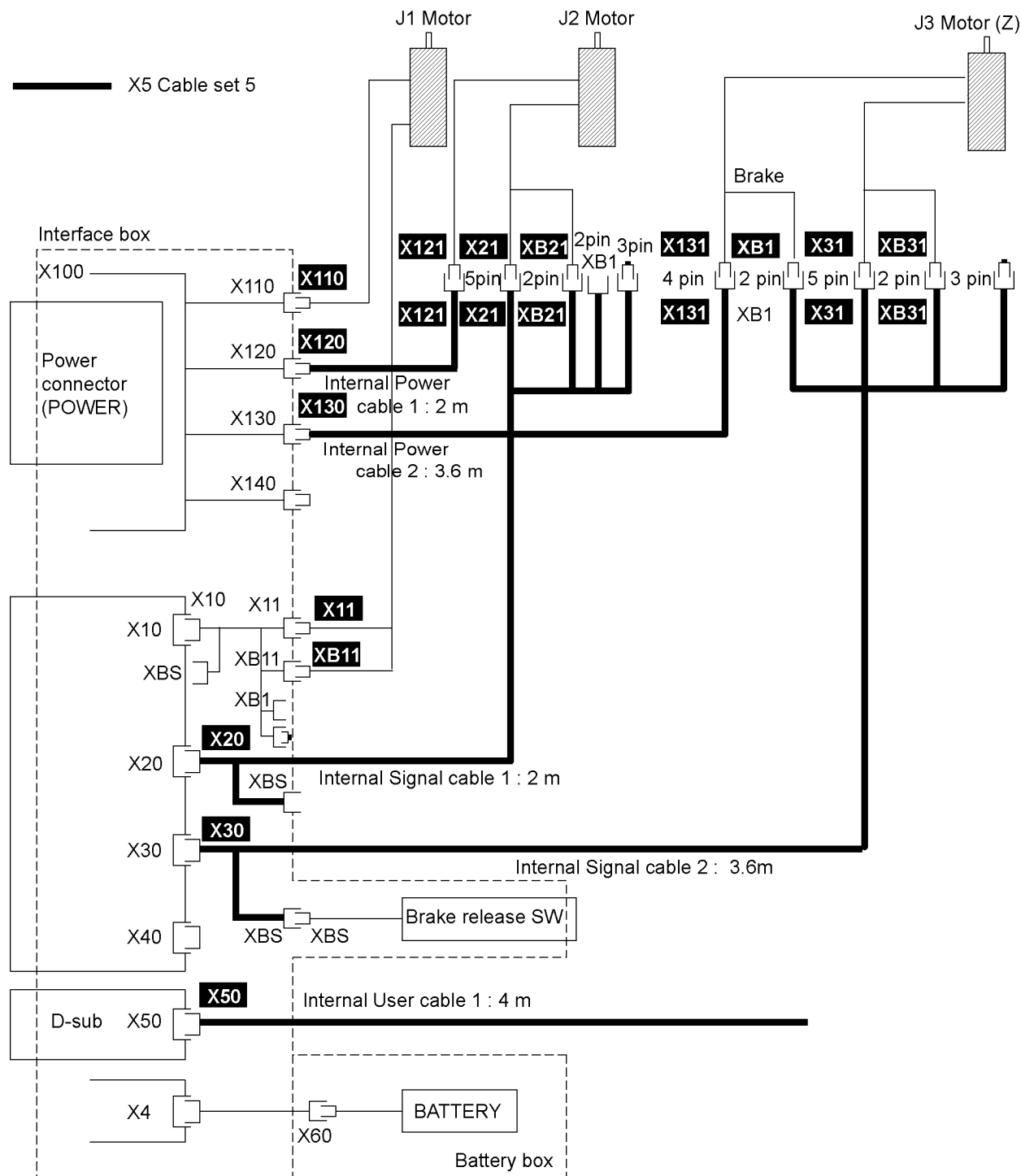
4.10.3 YZ Type

This diagram is for the case where the YZ-type modules are connected to J1 and J2 axes. When the YZ-type modules are connected to the other axes, connect them as shown in this diagram. However, the connector numbers should be changed according to the axes.



4.10.4 RP Type

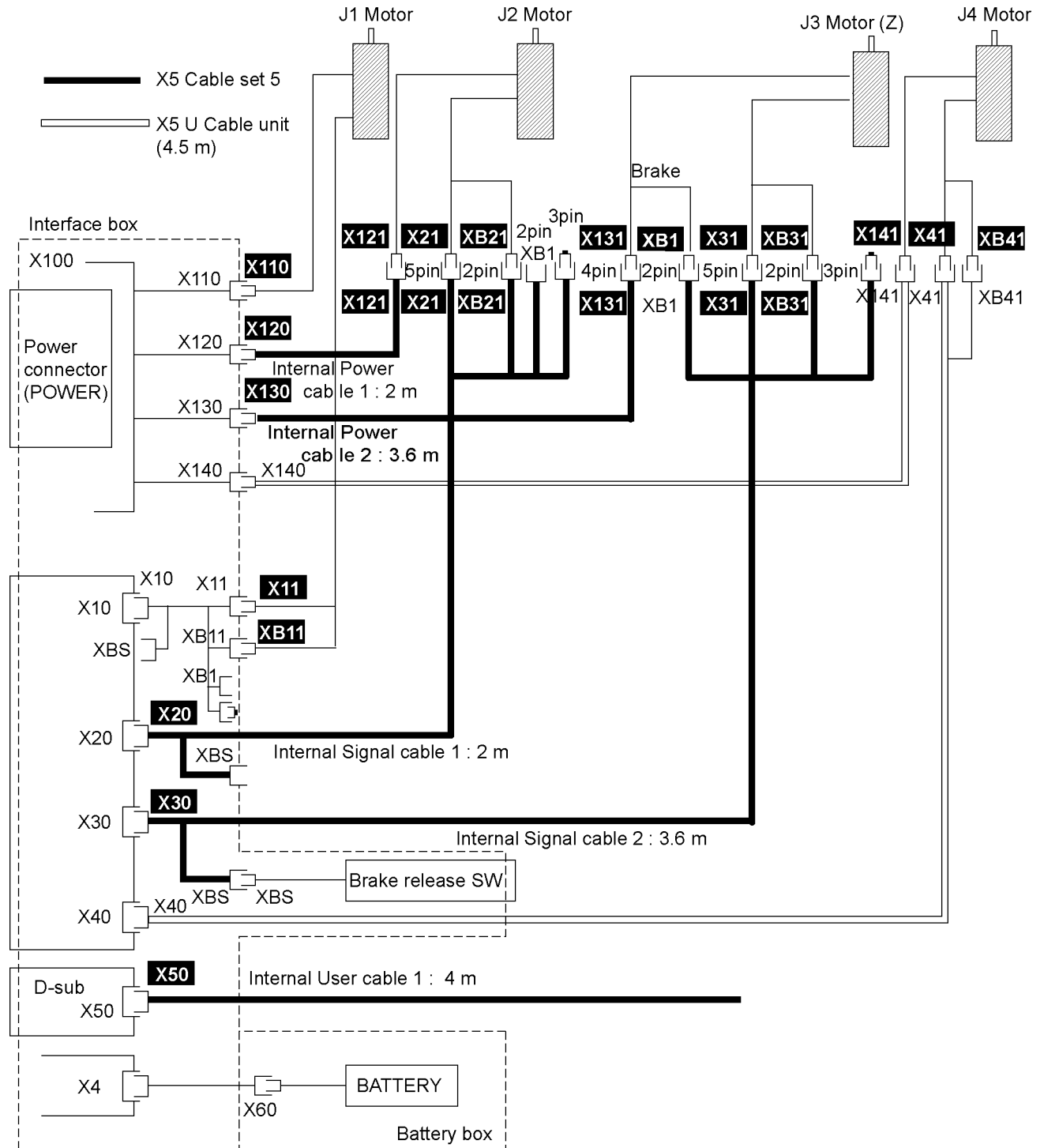
This diagram is for the case where the RP-type modules are connected to J1, J2, and J3 axes. When the RP-type modules are connected to the other axes, connect them as shown in this diagram. However, the connector numbers should be changed according to the axes.



4.10.5 RU Type

Connect the RU-type modules to J1, J2, J3, and J4 axes.

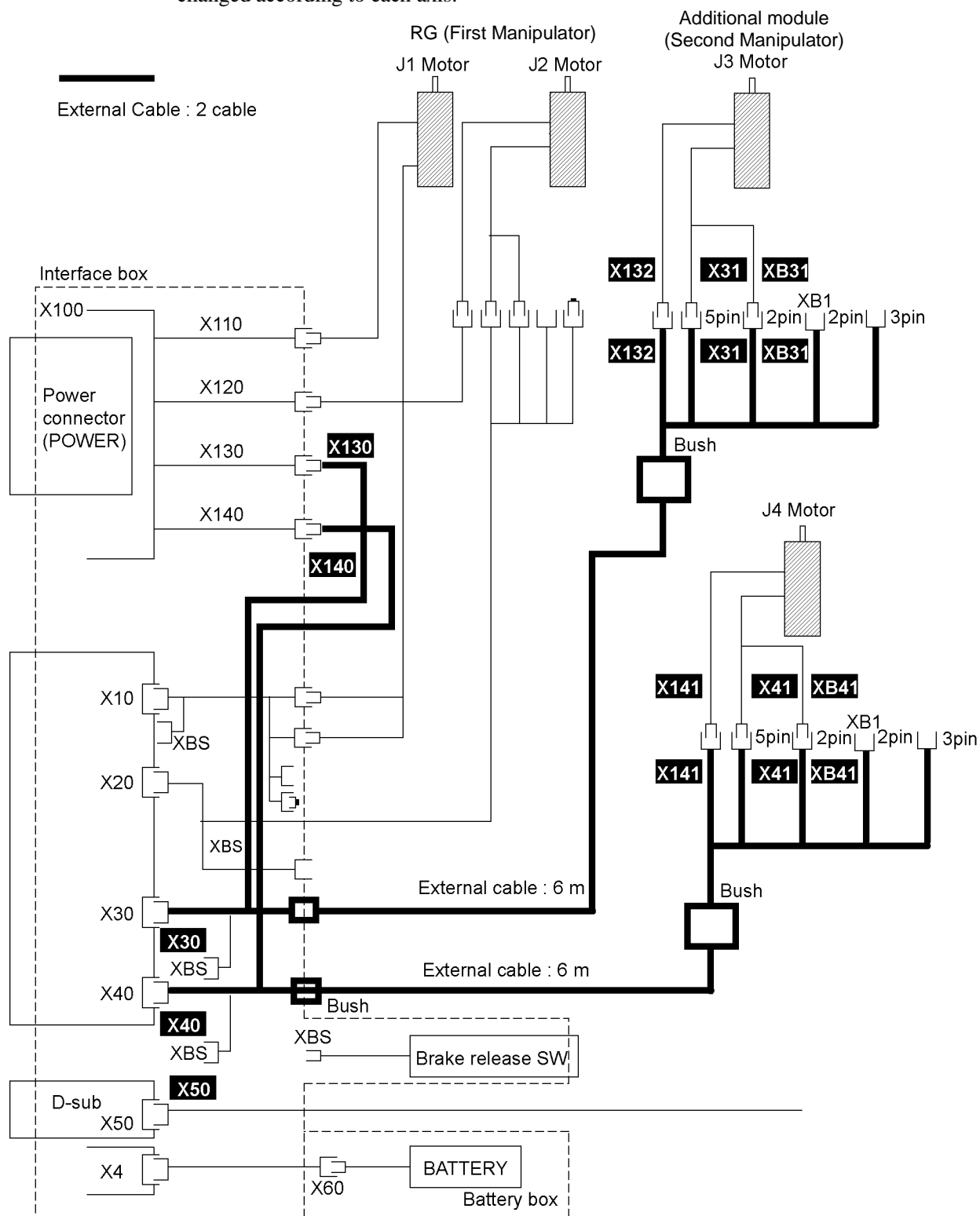
When the RU-type modules are connected to the other axes, connect them as shown in this diagram. However, the connector numbers should be changed according to the axes.



4.10.6 Examples for Additional Modules

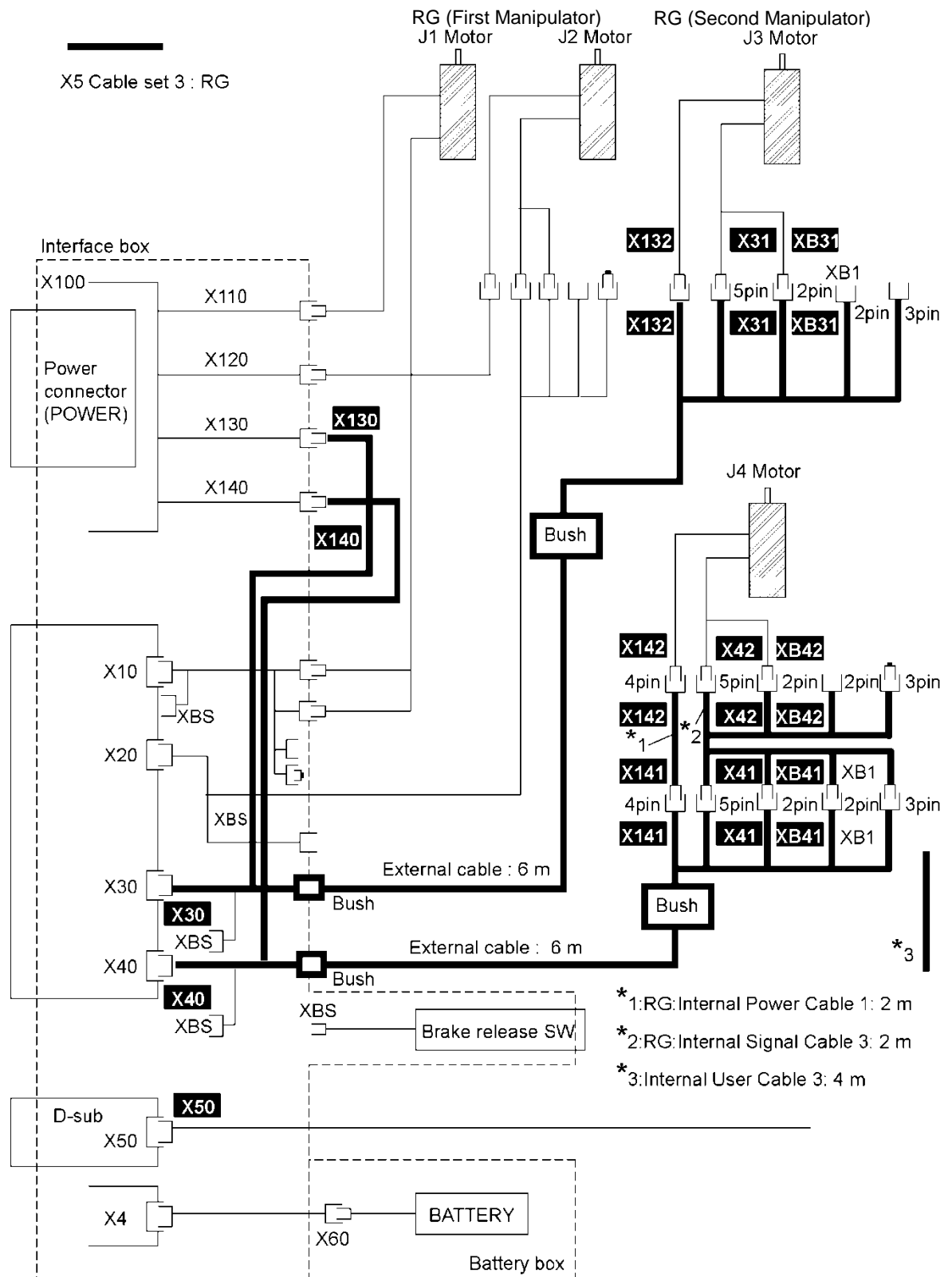
4.10.6.1 RG + Additional Modules (Adding single modules to J3 and J4 axes)

The RG-type modules are connected to J1 and J2 axes and additional single modules are connected to J3 and J4 axes. When these modules are connected to different axes, connect them as shown in this diagram. However, the connector numbers should be changed according to each axis.



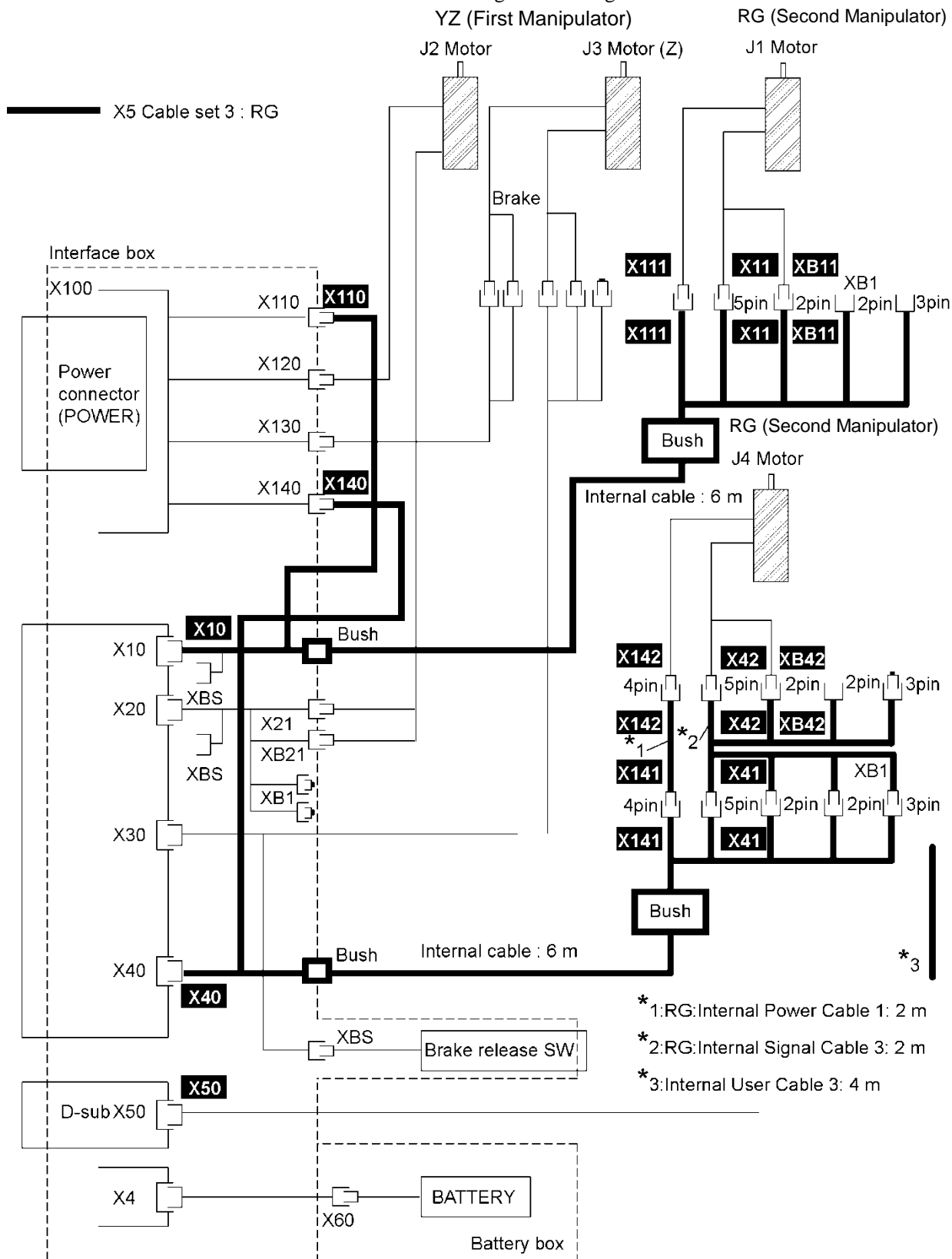
4.10.6.2 RG + Additional Modules (Adding two-axis modules to J3 and J4 axes)

The RG-type modules are connected to J1 and J2 axes and additional modules are connected to J3 and J4 axes. When these modules are connected to different axes, connect them as shown in this diagram. However, the connector numbers should be changed according to each axis.



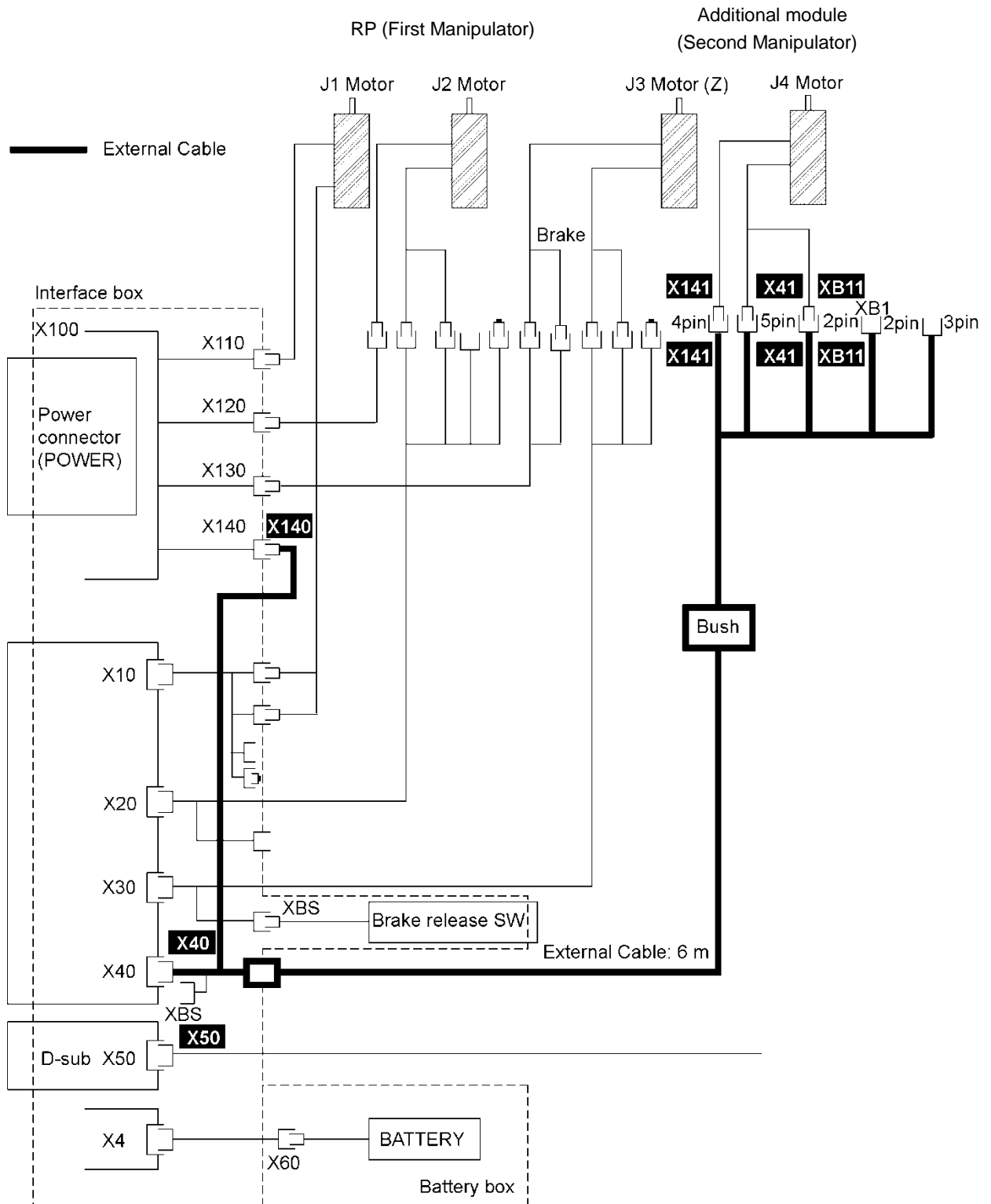
4.10.6.3 YZ + Additional Modules (Adding two-axis modules to J1 and J4 axes)

This diagram is for the case where the YZ-type modules are connected to J2 and J3 axes and additional modules are connected to J1 and J4 axes. When these modules are connected to different axes, connect them as shown in this diagram. However, the connector numbers should be changed according to each axis.




4.10.6.4 RP + Additional Module (Adding single-axis module to J4 axis)

This diagram is for the case where the RP-type modules are connected to J1, J2, and J3 axes, and one additional module is connected to J4 axis. When these modules are connected to different axes, connect them as shown in this diagram. However, the connector numbers should be changed according to each axis.



4.10.7 Connector Label



CAUTION

■ To avoid miss-connection in multi-axis combination, affix the provided connector labels to the connectors that are enclosed with in the diagram.

× 2 sets											
	User cable	Power cable connector				Signal cable connector					
AXIS	—	1	2	3	4	1	2	3	4	—	—
I/F Box	—	X110	X120	X130	X140	X10	X20	X30	X40	—	—
Motor	—	X111	X121	X131	X141	X11	X21	X31	X41	—	—
Additional	—	X112	X122	X132	X142	X12	X22	X32	X42	—	—
Brake release sw	—	—	—	—	—	—	—	—	—	XBS	
Brake	—	—	—	—	—	—	—	—	—	XB1	XB2
Battery		XB11	XB21	XB31	XB41	XB12	XB22	XB32	XB42		
User	X50	—	—	—	—	—	—	—	—	—	

Refer to the block diagram for each type and affix the labels to the connectors.

4.11 Connector Pin Assignments

I/F BOX

Power connector

No.	
1	1U
3	1V
6	1W
10	2U
14	2V
16	2W
15	3U
13	3V
9	3W
4	4U
2	4V
7	4W
5	FGND
17	FGND
8	N.C.
12	N.C.
11	N.C.

Connector X110

No.	Line color
1	BLK
2	WHT
3	RED
4	GRN/YLW

Connector X120

1	BLK
2	WHT
3	RED
4	GRN/YLW

Connector X130

1	BLK
2	WHT
3	RED
4	GRN/YLW

Connector X140

1	BLK
2	WHT
3	RED
4	GRN/YLW

FG

FG

FG

FG

FG

FG

X10, X20, X30, X40 Single Relay Board

No.		Connect to
1A	FGND	
1B	N.C.	
2A	*S	
2B	*S-	
3A	N.C.	
3B	N.C.	
4A	N.C.	
4B	EMB+	
5A	N.C.	
5B	N.C.	
6A	ENC+5V	
6B	EGND	
7A	BAT+	
7B	BAT-	
8A	N.C.	
8B	N.C.	
9A	N.C.	
9B	N.C.	
10A	N.C.	
10B	N.C.	
11A	N.C.	
11B	BRK-	
12A	N.C.	
12B	+V24	
13A	N.C.	
13B	N.C.	

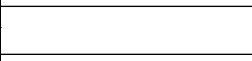
X5 Battery Extension Cable

Signal Relay Board Side

No.	Line color
1	ORN
2	WHT

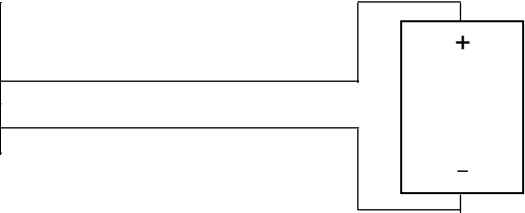
X60 Connector

No.	Line color
1	ORN
2	WHT



X60 Battery Connector

No.	Line color
1	RED
2	BLK



Motor Power Connector

No.		Line color
1	U	BLK
2	V	WHT
3	W	RED
4	FGND	GRN/YLW

Motor Signal Cable

No.		Line color
1	S	SKY
2	S-	SKY/(WHT)
3	ENC_PWR	RED
4	ENC_GND	BLK
5	FG	FG

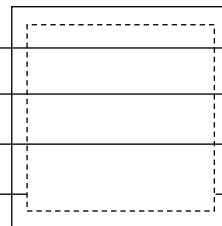
Motor Brake Lead (Only for RSz module)

No.		Line color
1	Brake terminal	BLK
2	Brake terminal	BLK

Internal Power cable 1 : 2 m in length
 X5 U Cable Unit (Power) : 4.5 m in length
 RH2000 Cable Unit (Power) : 1.2 m in length

Connector on the I/F Box side (male)

No.	Line color
1	BLK
2	WHT
3	RED
4	GRN Shield



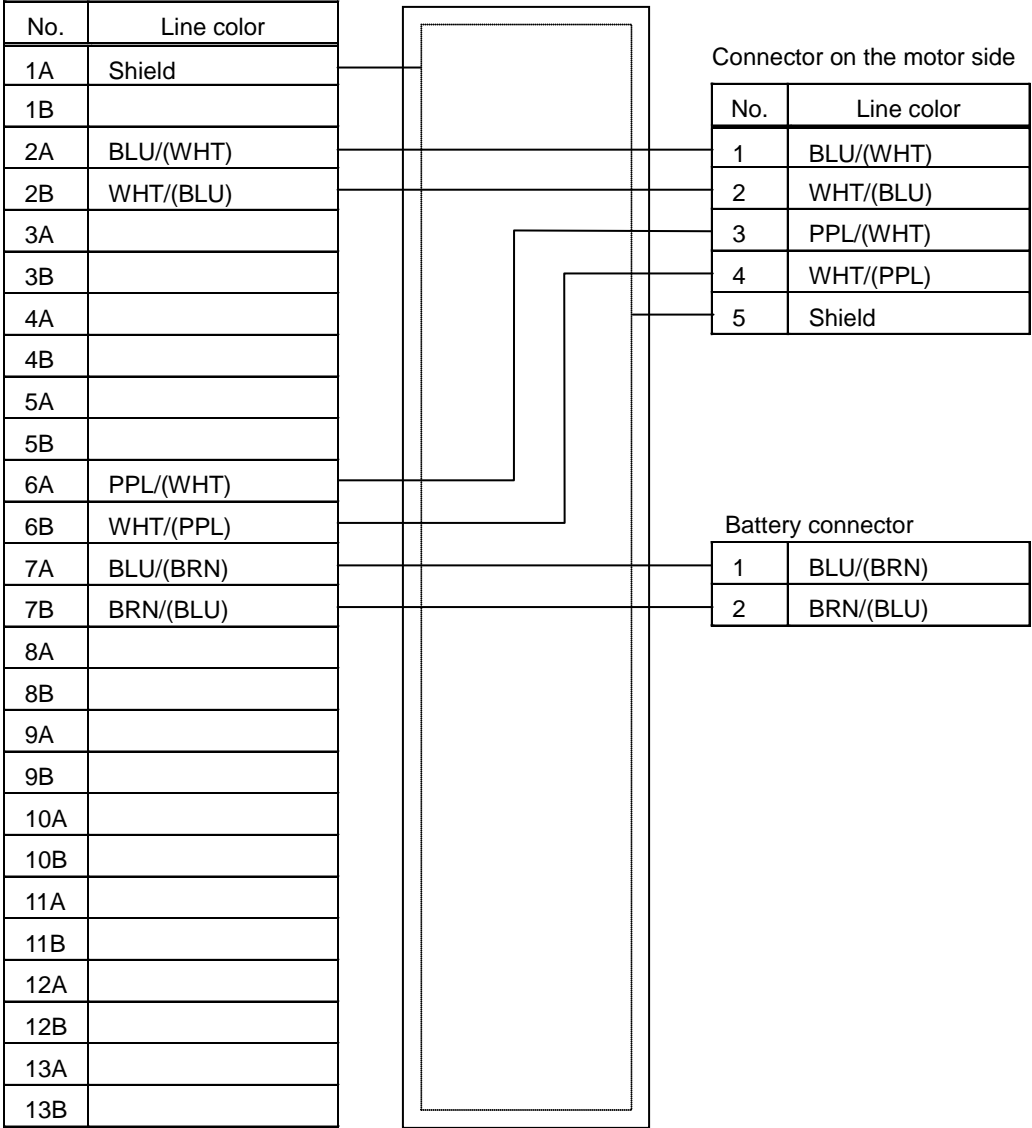
Connector on the motor side (female)

No.	Line color
1	BLK
2	WHT
3	RED
4	GRN Shield

4.11 Connector Pin Assignments

X5 U Cable Unit (Signal) : 4.5 m in length
RH2000 Cable Unit (Signal) : 1.2 m in length

Connector on the signal relay board side



Internal Signal cable 1 : 2 m in length

Internal Signal cable 2 : 3.6 m in length

Connector on the signal relay board side

No.	Line color
1A	Shield
1B	
2A	BLU/(WHT)
2B	WHT/(BLU)
3A	
3B	
4A	
4B	RED/(WHT)
5A	
5B	
6A	PPL/(WHT)
6B	WHT/(PPL)
7A	BLU/(BRN)
7B	BRN/(BLU)
8A	
8B	
9A	
9B	
10A	
10B	
11A	
11B	WHT/(RED)
12A	
12B	BLU
13A	
13B	

1	BLU
2	WHT/(YLW)

XBS: Brake release sw connector
(Only for the module with brake)

Connector on the motor side

No.	Line color
1	BLU/(WHT)
2	WHT/(BLU)
3	PPL/(WHT)
4	WHT/(PPL)
5	Shield

Battery connector

1	BLU/(BRN)
2	BRN/(BLU)

XB1: Brake connector

(Only for the module with brake)

1	WHT/(RED)+BLU
2	RED/(WHT)+WH

Diode connector

1	WHT/(YLW)+WHT	1	
2	BLU	2	
3		3	

4.11 Connector Pin Assignments

Internal Signal cable 3 : 2 m in length
Internal Signal cable 4 : 3.6 m in length
Signal short cable : 0.2 m in length

Connector on the external cable side

No.	Line color
1	BLU/(WHT)
2	WHT/(BLU)
3	PPL/(WHT)
4	WHT/(PPL)
5	Shield

Battery connector

1	BLU/(BRN)
2	BRN/(BLU)

XB1: Brake connector

1	WHT/(RED)
2	RED/(WHT)

1	WHT/(YLW)
2	
3	

Connector on the motor side

No.	Line color
1	BLU/(WHT)
2	WHT/(BLU)
3	PPL/(WHT)
4	WHT/(PPL)
5	Shield

Battery connector

1	BLU/(BRN)
2	BRN/(BLU)

XB2: Brake connector

	WHT/(RED)+BLU
	RED/(WHT)+WHT

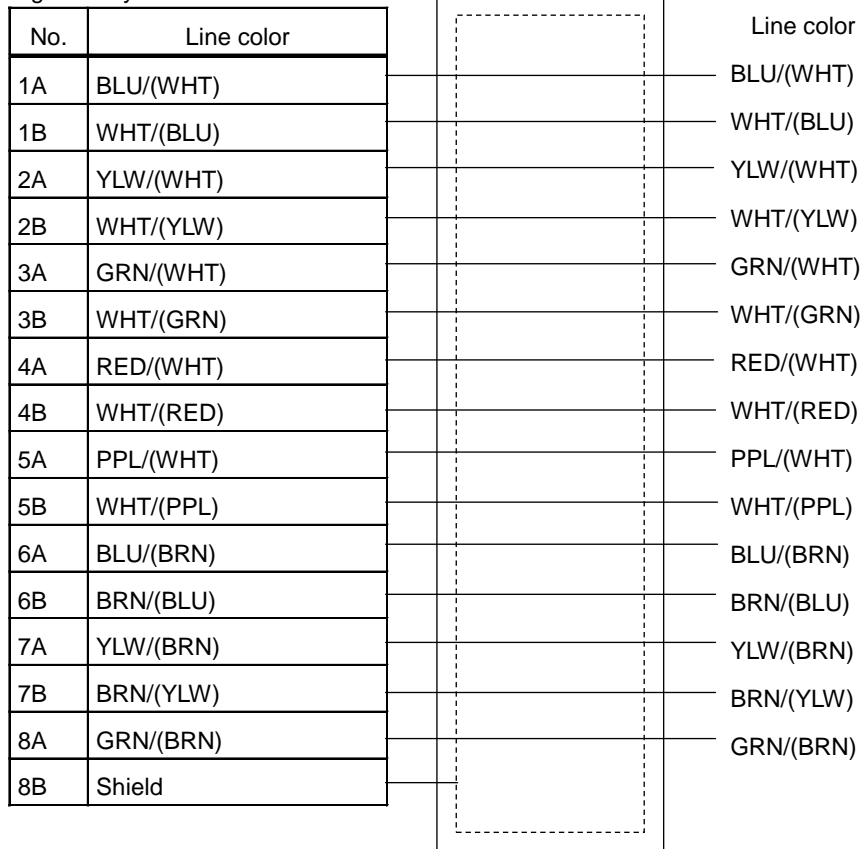
1	WHT/(YLW) +WHT
2	
3	

Diode connector

1	
2	
3	

Internal User cable 1 : 4 m in length

Signal relay board side: X50



Redundant line: BRN/(GRN)

4.11 Connector Pin Assignments

External cable : 6 m in length

I/F

No.	Line color
1	BLK
2	WHT
3	RED
4	GRN Shield

No.	Line color
1A	Shield
1B	
2A	BLU/(WHT)
2B	WHT/(BLU)
3A	
3B	
4A	
4B	RED/(WHT)
5A	
5B	
6A	PPL/(WHT)
6B	WHT/(PPL)
7A	BLU/(BRN)
7B	BRN/(BLU)
8A	
8B	
9A	
9B	
10A	
10B	
11A	
11B	WHT/(RED)
12A	
12B	BLU
13A	
13B	

1	BLU
2	WHT/(YLW)

XBS: Brake release sw connector
(Only for the module with brake)

Connector on the motor

No.	Line color
1	BLK
2	WHT
3	RED
4	GRN Shield

No.	Line color
1	BLU/(WHT)
2	WHT/(BLU)
3	PPL/(WHT)
4	WHT/(PPL)
5	Shield

Battery connector

1	BLU/(BRN)
2	BRN/(BLU)

XB1: Brake connector
(Only for the module with brake)

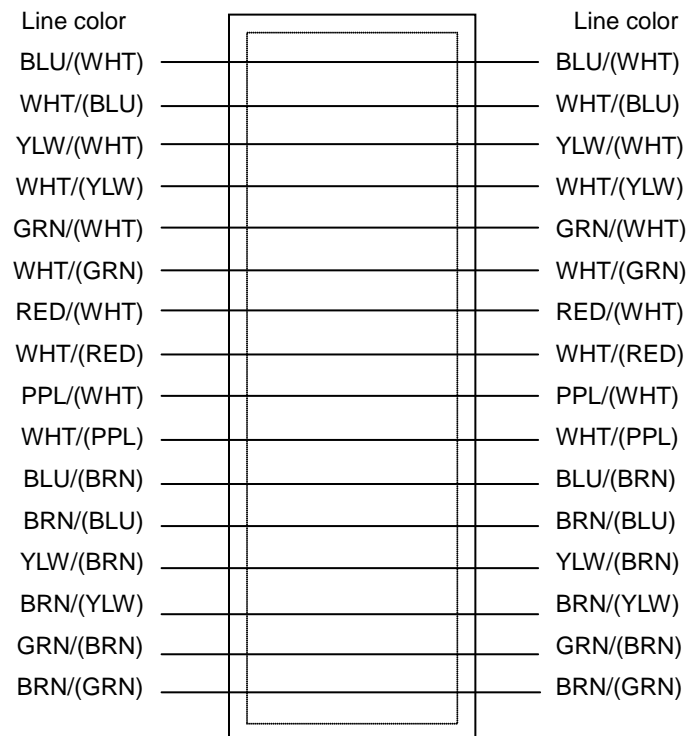
1	WHT/(RED)+BLU
2	RED/(WHT)+WHT

1	WHT/(YLW)+WHT
2	BLU
3	

Diode connector

1	
2	
3	

Internal User cable 3 : 4 m in length



4.12 Cable Connection



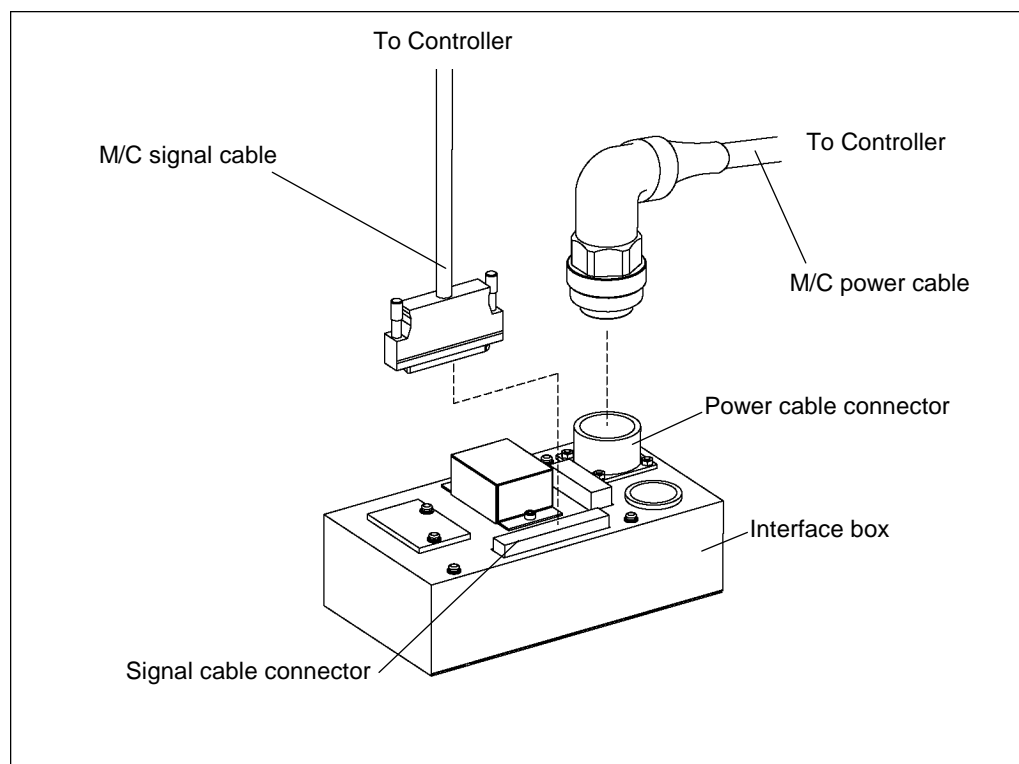
 <p>WARNING</p>	<ul style="list-style-type: none"> ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnections, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
 <p>CAUTION</p>	<ul style="list-style-type: none"> ■ When connecting the manipulator and the controller, make sure that the serial numbers on each equipment match. Improper connection between the manipulator and controller may not only cause improper function of the robot system but also serious safety problems. The connection method varies with the controller used. For details on the connection, refer to the controller manual.

Figure for Cable Connection

Connect an M/C power cable to the power cable connector. Connect an M/C signal cable to the signal cable connector.

The connection method for the controller side varies with the controller used. For details, refer to the controller manual.





4.13 Calibration

After parts have been replaced (motors, timing belts, etc.), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Controller.

After replacing the parts, it is necessary to match these origins.

The process of aligning the two origins is called “Calibration”. Note that calibration is not the same as teaching*.

* “Teaching” means to teach the Controller coordinate points (including poses) anywhere in the operating area of the Manipulator.

 WARNING	<ul style="list-style-type: none"> ■ To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the <i>Installation and Design Precautions</i> in the <i>Safety</i> chapter of the EPSON RC+ User's Guide. ■ Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted status (low speeds and low power) to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems if the Manipulator moves unexpectedly.
 CAUTION	<ul style="list-style-type: none"> ■ Calibrate the Z axis first when aligning origins of more than one axis. When the Z axis is too low, it may collide with peripheral equipment during the calibration of the other axes and may damage the peripheral equipment.

Calibration procedures

- (1) Turn ON the Controller.
- (2) Check whether an error occurs or not.

Immediately after a new module is installed or after a new motor is replaced for maintenance, an error may occur since the super-capacitor (condenser) in the motor encoder is not charged enough.

For EPSON RC+, an error message: "Encoder alarm has occurred. Check robot battery. EPSON RC+ must be restarted." is displayed.

In both cases, leave the power ON for 3 or more minutes to sufficiently charge the capacitor. Then, go to the next step (3) below. (The error or error message is still displayed.)

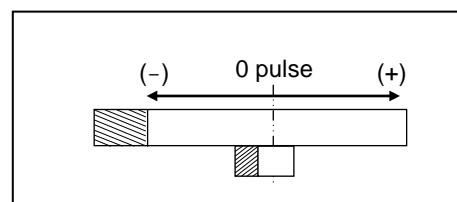
- (3) Manually move the axis that needs origin alignment to its approximate 0 pulse position*.

RH module:

RM module:

0 pulse position*:

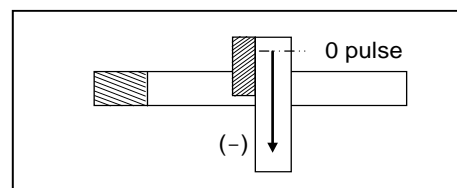
the center of its motion range



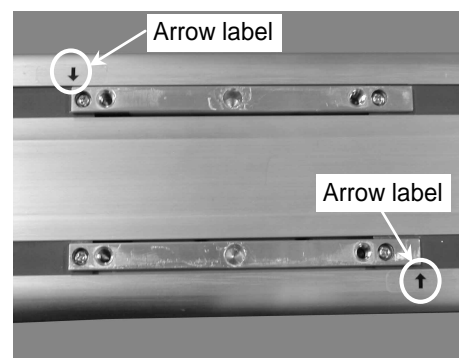
RSz module:

0 pulse position*: upper limit

Push up the module to its upper limit while pressing the J3 (Z) axis brake release switch.



* Arrow labels are affixed at 0 pulse position. Align both edges of the slider with the arrow labels as shown in Photo.

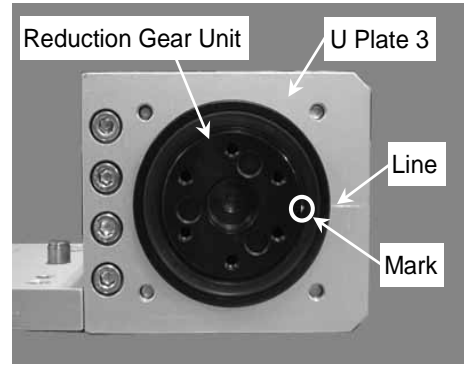


RU module:

0 pulse position:
where the mark on the reduction
gear unit is aligned with the line
on the U plate 3



The U axis home position varies
depending on the mount direction.
For the details, refer to the respective
dimensions in *2.5.4 Four Axis
Manipulators*.



- (4) Execute the encoder initialization command.

Input one of the following commands to the [Command Window] according to the
joint being calibrated.

Joint #1: >EncReset 1
Joint #2: >EncReset 2
Joint #3: >EncReset 3
Joint #4: >EncReset 4
All axes: >EncReset 1, 2, 3, 4

- (5) Reboot the controller. Select EPSON RC+ menu | Tools | Controller and click the
<Reset Controller> button.



This window will be disappeared when the controller starts up.

- (6) Enter the position pulses as 0 in the [Monitor Window] (EPSON RC+) to perform the
calibration.

>CALPLS 0, 0, 0, 0

- (7) Perform a rough calibration of the axis.

Input one of the following commands to the [Command Window] according to the
joint being calibrated.

Joint #1: >Calib 1
Joint #2: >Calib 2
Joint #3: >Calib 3
Joint #4: >Calib 4
All axes: >Calib 1, 2, 3, 4

- (8) Display the current pulse values.

```
>PULSE
  Here is:
    :
    :
  Pulse  1:0    2:0    3:0    4:0
```

- (9) Move the modules to respective end positions. Make sure that the modules do not touch the mechanical stops and that the modules are in the motion range.

4.14 Adjusting Cable Support Length



- When passing the cables through the cable support, be careful not to rub or tangle the cables. Adjust the links of the cable support to prevent the cables from stretching too tight, getting too loose, or twisting. Rubbing or tangling cables may result in damage to the cables. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.



- Take appropriate safety measures when shortening the cable support. (e.g. wearing gloves and glasses)
- Be careful not to pinch your fingers in the rungs or links of the cable support.

A standard cable support can be used for several multi-axis manipulator types by adjusting for stroke length. You can shorten dimensions of the cable support projection by reducing the number of links.

For installation, refer to Table and perform the step (2) and (3) in the following procedure while no cables are in the cable support.

RG-HM

X axis stroke	Y axis stroke	Length of cable support
800mm	550mm	23 links
	750mm	

YZ-MS

X axis stroke	Y axis stroke	Length of cable support
750mm	200mm	25 links

RP-HMSz

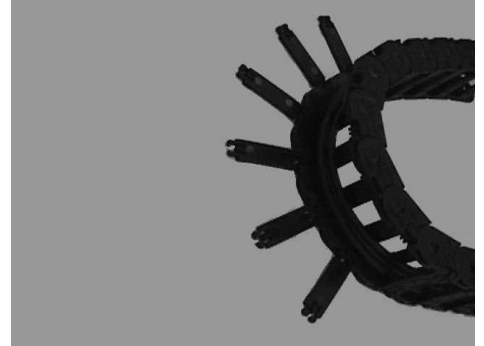
X axis stroke	Y axis stroke	Length of cable support	X axis stroke	Y axis stroke	Length of cable support
400mm	350mm	15 links	350mm	200mm	17 links
	550mm			300mm	15 links
600mm	350mm	19 links	550mm	200mm	21 links
	550mm			300mm	20 links
800mm	350mm	23 links			
	550mm				

RU-HMSz,

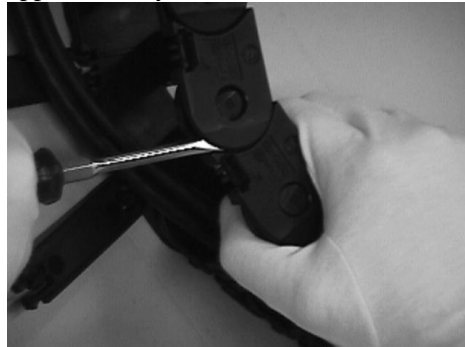
X axis stroke	Y axis stroke	Length of cable support	X axis stroke	Y axis stroke	Length of cable support
400mm	350mm	15 links	350mm	200mm	17 links
	550mm			300mm	15 links
600mm	350mm	19 links	550mm	200mm	21 links
	550mm			300mm	20 links
800mm	350mm	23 links			
	550mm				

Procedures for adjusting a cable support

- (1) Open the links to be removed, and a rung in front and behind of the portion being removed. Put a flat screwdriver in a clearance at the side of a rung, then pry the rung off of the cable support. (both sides)

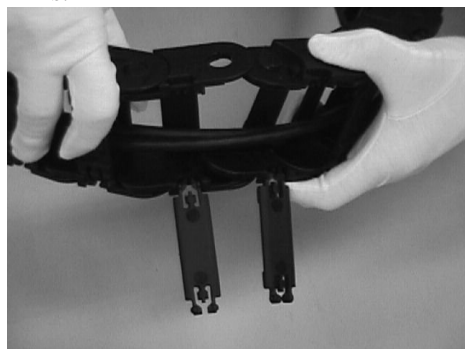


- (2) Take off a link at both ends of the cable support to be removed. Put a flat screwdriver in a clearance between two adjacent links and turn the screwdriver approximately 90°.



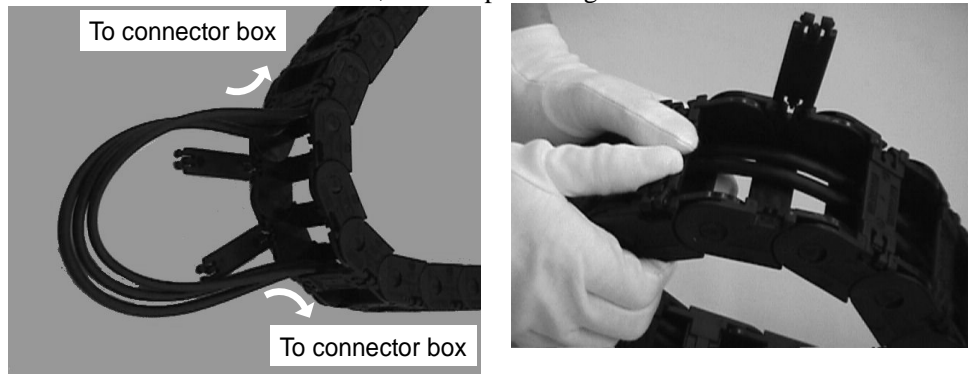
- (3) Connect the links.

Insert the pin of link to the pin hole of other one and push in the other side of the links.



4.14 Adjusting Cable Support Length

- (4) Connect the links on both sides. Do not fold the cables in the cable support. Push the cables into the connector box, then snap the rungs to close.



CAUTION

- Move the module sliders for full stroke to check for any disturbance after the cable has been shortened. Reduction of stroke or breakage of the cable support can occur if the cable support is shortened too much.

4.15 Reversing Connector Box

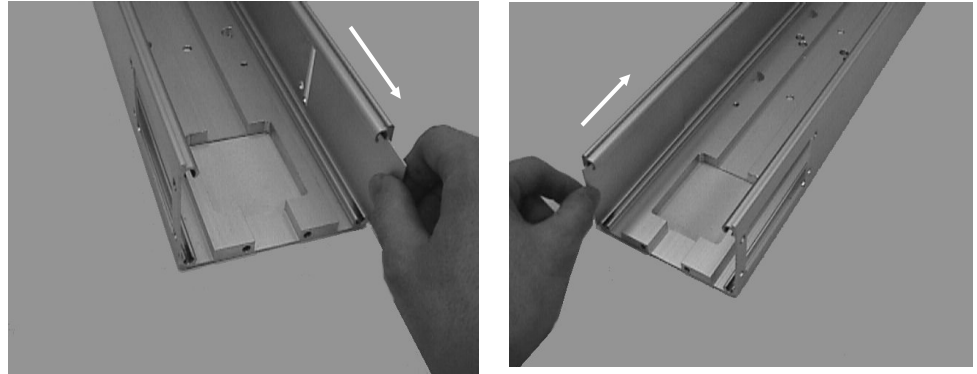
4.15.1 RG, RP, RU Manipulators

RG-HM: Reverse the moving-side connector box.

RP-HMSz: Reverse the junction connector box.

RU-HMSz: Reverse the junction connector box.

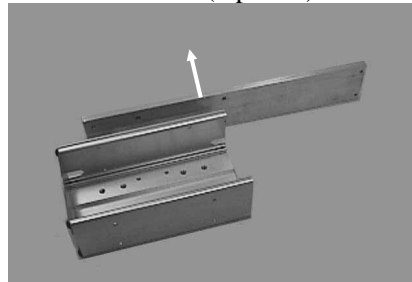
- (1) Remove the cover from the connector box, and then insert it into the other side.



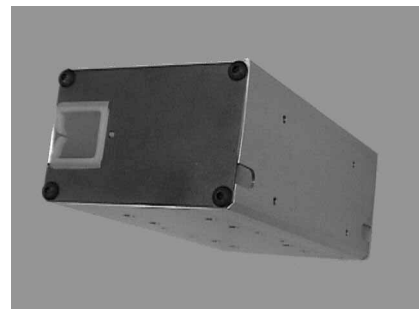
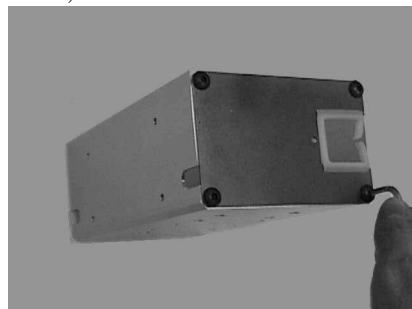
4.15.2 Single Axis Modules, RD Manipulators

Single axis module (A type) : Reverse the connector box.

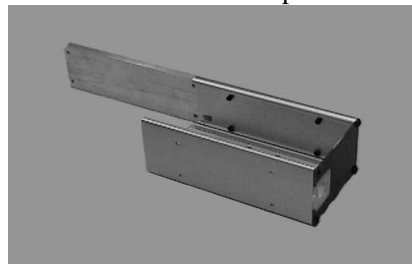
- (1) Loosen M3 bolts (4 places) and remove the connector plate.



- (2) Loosen M5 bolts (4 places) and remove the end cover. Then, attach it to the other side of the connector box.



- (3) Re-attach the connector plate to the connector box as shown in Photo.



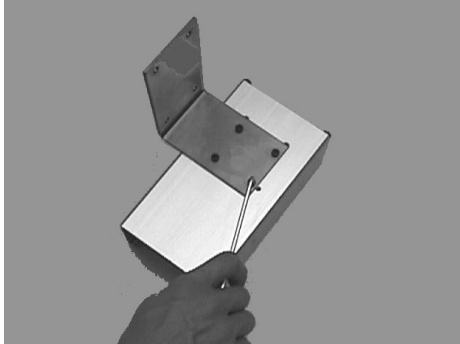
4.16 Reversing L-fixture

4.16.1 YZ, RP-HMSz, RU Manipulators

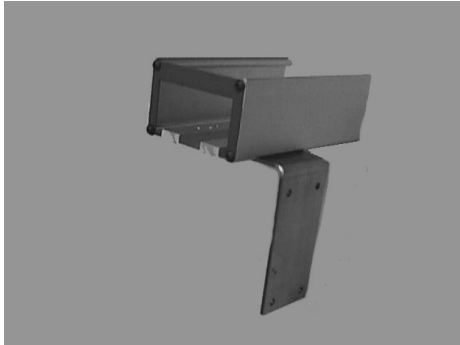
- (1) Prepare the moving-side connector box.



- (2) Remove M4 bolts (4 places) to detach the L-fixture.



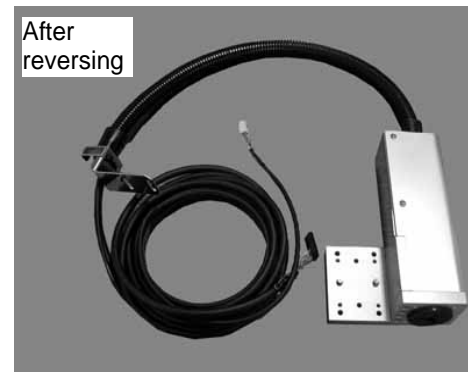
- (3) Reverse the L-fixture and attach it to the connector box.



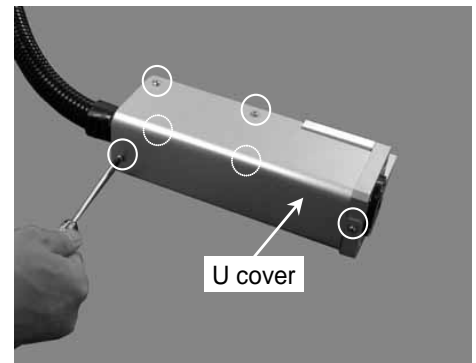
4.17 Reversing RU Module

The mount direction type of RU module has been set to A/C type* at the factory. To use RU module in B/D type*, reverse it.

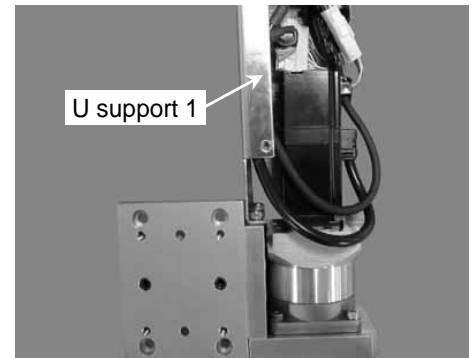
*: For details of the mount direction type (A, B, C, and D), refer to “2.2 Model Numbers”.



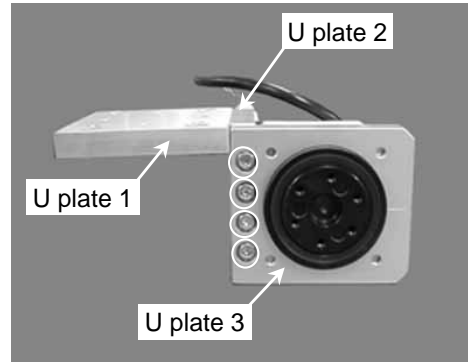
- (1) Unscrew six truss head screws (M4×8) and remove the U cover.



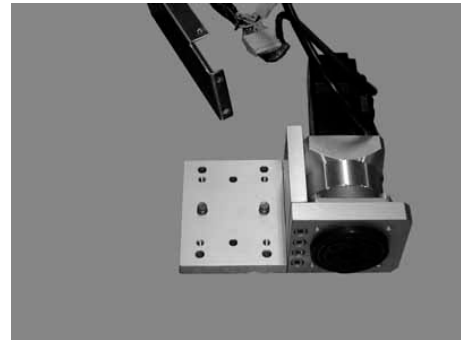
- (2) Unscrew two hexagon socket head cap bolts (M5×12) and remove the U support 1.



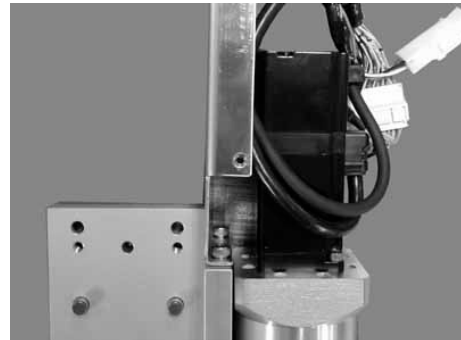
- (3) Unscrew four hexagon socket head cap bolts (M5×20) that secure the U plate 2 from the bottom of the U plate 3. Then, remove the U plate 1 and U plate 2.



- (4) Join the U plate 1 to the U plate 2 as shown in Photo 4.17-7. Then, secure them to the U plate 3 with four hexagon socket head cap bolts (M5×20).



- (5) Secure the U support 1 with two hexagon socket head cap bolts (M5×12).



- (6) Attach the U cover and secure it with six truss head screws (M4×8). Bend the cables using as large a radius as possible to minimize the force applied to the cable outlet.



4.18 User Cables and Pneumatic Tubes



WARNING

- When passing the cables through the cable support, be careful not to rub or tangle the cables. Adjust the links of the cable support to prevent the cables from stretching too tight, getting too loose, or twisting. Rubbing or tangling the cables may result in damage to the cables. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.



CAUTION

- Do not pass pneumatic tubes through the cable support more than allowance. Passing pneumatic tubes through the cable support more than the allowance and improper usage may shorten the life cycle of the cables in the cable support.

User Cables

The end of the user cable on the moving side is not connected to anywhere yet during the assembly procedures. Connect the end of the user cable as you desire.

(Refer to “4.11 Connector Pin Assignments”.)

Pneumatic Tubes

Prepare necessary pneumatic tubes and connect them.

Allowable Number of Pneumatic Tubes in Cable Support

	φ6 Pneumatic Tube	φ8 Pneumatic Tube
Two axis	13 tubes	7 tubes
Three axis	8 tubes	4 tubes
Four axis	4 tubes	2 tubes

Table shows the allowable number of pneumatic tubes when either φ6 or φ8 pneumatic tubes are passed through the cable support.

How to connect the user cable and pneumatic tube

- (1) When using the user cable, affix the label (X50), which is provided with the interface box, to the user cable connector.
(Be sure to affix the label to avoid miss-connection.)
- (2) Pass the user cable and pneumatic tube through the cable support with the power cable and signal cable during the installation. (The user cable and pneumatic tube are passed between the fixed-side connector box and the moving-side connector box.)
- (3) Remove the grommet on the end cover of the fixed-side connector box. Then, let out the ends of the user cable and pneumatic tube on the fixed side from the opening on the end cover.
- (4) Let out the other ends of the user cable and pneumatic tube on the moving side from the edge saddle on the end cover of the moving-side connector box.
- (5) When using the user cable and pneumatic tube for the RU-type (four axis) manipulator, let out the user cable and pneumatic tube from the edge saddle on the end cover of the moving-side connector box and let them pass along the outside of the RU cable support. (Do not pass them through the RU cable support.)

4.19 Brake Release Setting (RC700-A)



CAUTION

- If the electromagnetic brake cannot be released properly, it may break the manipulator with heat and wear caused by dragging motion.

X axis of the X5 series manipulator has the electromagnetic brake installed to hold the orientation.

For the X5 series with the Z axis (2-axis YZ / 3-axis XYZ / 4-axis XYZU), if the manipulator structure is changed as below, you also need to change the brake release setting.

1. Install the X5 series additionally to your controller
2. Replace the G series or RS series with the X5 series

In addition, if you purchased a set of X5 series and RC700-A Controller, this setting is done before shipment. And please contact us for the details of brake release setting procedure.

5. Maintenance and Inspection

We recommend conducting periodic inspections and replace the parts as shown in Table 5-1 to avoid an unexpected system failure due to the breakdown of parts.

Ball screws and linear guides used for the modules are equipped with a unique lubrication system, which consists of the K1 lubrication unit* and high load grease. Because of this lubrication system, you do not need replenish the grease if the robot system is going to be operated in the conditions described hereunder.

* K1 lubrication unit: Made of a porous synthetic resin that contains a large amount of lubricating oil and supplies the lubrication oil for a long time.

- (1) Clean environment and no contamination.
- (2) Ambient temperature is 0°C to 40°C and no condensation.
- (3) Load conditions, transportable mass and moment are in the criteria as specified in “2.6 Specifications”.

Inspections	Recommended intervals ^{*1}	Inspection items	Section in manual
Routine inspections	Once a week	Loose bolts, connectors and cables	5.2.1
Periodic inspections	Every half year	Inspect timing belt for damage and looseness. ^{*2}	5.3.1
Periodic replacement of expendable parts	Every two years	Replace cables.	5.4.1
		Replace timing belt. ^{*2}	5.4.2
	Every three years	Replace lithium battery.	5.4.3
Overhaul	Approximately every five years	Thorough inspection, replace parts if necessary. (Please ask suppliers about details.)	5.7

*1 Increase the frequency of inspection if your operating condition exceeds the standard operation pattern.

*2 This check is not necessary for a motor direct mount module. (Timing belt is not used.)

5.1 Safety Precautions for Maintenance



Please read this chapter, this manual, and other relevant manuals carefully to understand safe maintenance procedures before performing any routine maintenance.


Only authorized personnel who have taken safety training should be allowed to maintain the robot system.

Safety training is the program for industrial robot operators that follow the laws and regulations of each nation.

The personnel who have taken safety training acquire knowledge of industrial robots (operations, teaching, etc.), knowledge of inspections, and knowledge of related rules/regulations.

The personnel who have completed the robot system-training and maintenance-training classes held by the manufacturer, dealer, or locally-incorporated company are allowed to maintain the robot system.


 <p>WARNING</p>	<ul style="list-style-type: none"> ■ Do not remove any parts that are not covered in this manual. Follow the maintenance procedure strictly as described in this manual. Improper removal of parts or improper maintenance may not only cause improper function of the robot system but also serious safety problems. ■ Keep away from the Manipulator while the power is ON if you have not taken the training courses. Do not enter the operating area while the power is ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even it seems to be stopped. ■ When you check the operation of the Manipulator after replacing parts, be sure to check it while you are outside of the safeguarded area. Checking the operation of the Manipulator while you are inside of the safeguarded area may cause serious safety problems as the Manipulator may move unexpectedly. ■ Before operating the robot system, make sure that both the Emergency Stop switches and safeguard switch function properly. Operating the robot system when the switches do not function properly is extremely hazardous and may result in serious bodily injury and/or serious damage to the robot system as the switches cannot fulfill their intended functions in an emergency.
 <p>WARNING</p>	<ul style="list-style-type: none"> ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.


 WARNING	<ul style="list-style-type: none">■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
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5.2 Routine Inspections

5.2.1 Inspection of Bolts and Cables

Be sure to perform the routine inspection before the operation.

 WARNING	<ul style="list-style-type: none"> ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
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 CAUTION	<ul style="list-style-type: none"> ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. <p>When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.</p>
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To prevent an accident due to loose bolts, perform following inspections listed in the table below.

Inspection point	Description
Bolts for securing the module	Check for a loose bolts by tightening them. *
Bolts for securing the end effector	
Cables	<ul style="list-style-type: none"> - Replace a cable or flexible tube if it has serious crack or breakage. - Check for loose bolts by tightening them.

*: Refer to "4.4 Mounting a Module" and "4.9 Mounting End Effector to Slider" for the tightening torque of the bolts.

5.3 Periodic Inspections

Be sure to perform the periodic inspections by following the schedule and inspection items.

 WARNING	<ul style="list-style-type: none"> ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
 CAUTION	<ul style="list-style-type: none"> ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. <p>When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.</p>

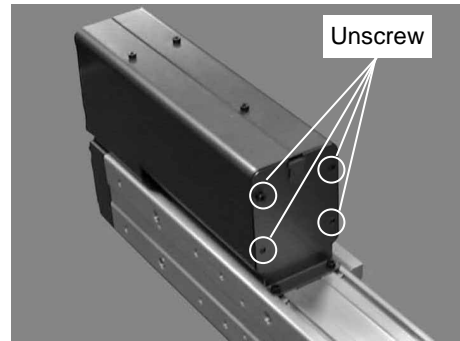
5.3.1 Inspection of Timing Belt (Only for RSz module)

The timing belt is treated as an expendable part. The manufacturer has no obligation to the timing belt beyond the warranty period. Be sure to perform the periodic inspections to prevent from malfunctioning of the system, colliding against an obstacle and free-falling of a vertical axis slider.

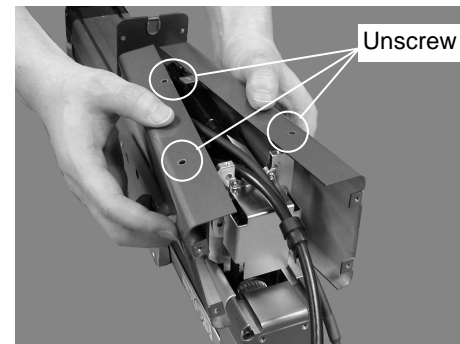
- (1) Turn OFF the power of the controller.
- (2) Unscrew four counter-sunk head screws (M3×6) on the motor end cover on the cable side.
Remove the motor end cover.



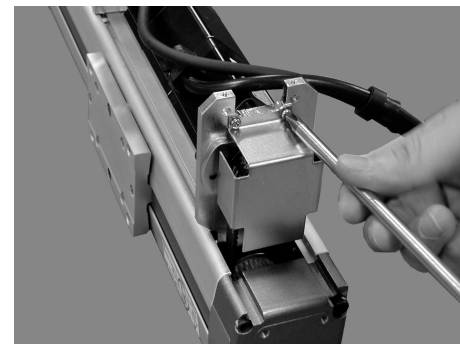
- (3) Unscrew four pan head screws (M3×6) on the motor end cover on the bottom side.



- (4) Unscrew three pan head screws (M3×6) that secure the motor covers, and remove the motor covers.


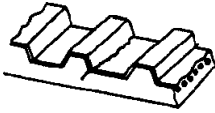


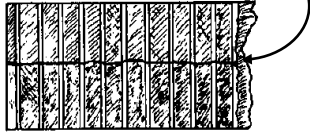

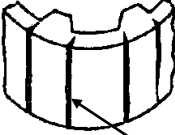
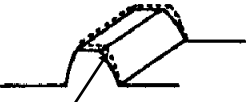
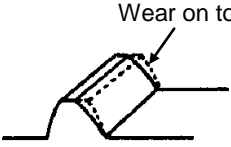


- (5) Unscrew two pan head screws (M3×4) on the pulley cover, and remove the pulley cover.





- (6) Move the slider manually and inspect the timing belt visually for damage. Replace the timing belt if it is damaged as described in Table 5-3. Refer to “5.4.2 Replacement of Timing Belt”.
- (7) Attach the covers again if there is no damage on the timing belt.

Criteria for replacing timing belt

		Appearance	Description
(1)	The teeth are worn off.		The duck of teeth are worn off. - The duck fiber is fuzzed up and texture is getting vague. - The surface rubber is removed and faded to whitish.
(2)	The teeth are sheared.		Cracks in the root of teeth
(3)	The side face is fuzzed and worn off.	Core thread got frayed.  Abnormal wear	The edges are worn out and the thread is getting frayed.
(4)	The belt is partially damaged.		The belt is partially cracked. In some case, it may be accompanied by scores in the other part of belt, which are caused by foreign matters.
(5)	Scored in lengthwise.	Scores caused by running on pulley flange. 	The belt has run on the pulley flange.
(6)	The rubber of the back surface have softened and got sticky.		Softened rubber stuck to the back surface. (Use of an idle pulley may be the cause.) The back surface is sticky. (Stuck oil may be the cause.)
(7)	Cracks in the back surface	 Crack	Cracks in the back surface are parallel to the teeth. (due to high or low temperature)
(8)	Wear on pulley teeth	 Pressure angle is changed due to wear.  Wear on tooth edge	May be caused by improper pulley material or existence of fine particles.

5.4 Periodic Replacement of Expendable Parts

 <p>WARNING</p>	<ul style="list-style-type: none"> ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ When installing the interface box, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the interface box. Be sure to place the cables back to their original locations.
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 <p>CAUTION</p>	<ul style="list-style-type: none"> ■ If the connectors have been disconnected during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Refer to the block diagrams. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to “4.11 Connector Pin Assignments”. ■ Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them. ■ Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.
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Before replacing the Z axis motor, always move the Z axis down to its lower limit.

To move the shaft down, push and hold the Z axis brake release switch while the power to the controller is turned **ON**. Be careful that the end effector does not hit peripheral equipment. Then, turn **OFF** the controller.

A brake is mounted on the Z axis motor to prevent the Z axis from moving down due to the weight of the end effector while the power to the controller is **OFF** or while the motor is in **OFF** status (**MOTOR OFF**). Note that the brake will not work during the replacement procedure.

5.4.1 Replacement of Cable

 CAUTION	<ul style="list-style-type: none"> ■ Do not remove the interface box forcibly. Removing the interface box forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the interface box, be careful not to allow the cables to interfere with the box mounting and do not bend these cables forcibly to push them into the box. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the interface box. Be sure to place the cables back to their original locations.
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The cable is an expendable part. We recommend replacing it periodically to avoid system failure due to a sheared cable.

Cable for replacement

Name	Code	Contents
X5 cable set 1	R114X5C001	Power cable: 1 Signal cable: 1 User cable: 1
X5 cable set 3	R114X5C003	Power cable: 1 Signal cable: 1 User cable: 1
X5 cable set 5	R114X5C007	Power cable: 2 Signal cable: 2 User cable: 1
X5 U cable unit	R13B020041	Power cable: 1 Signal cable: 1
External cable	R114X5C000	
Additional user cable	R114X4C005	

The length of the cable differs according to the multi-axis manipulator. Refer to 5.9 *Maintenance Parts List*.

5.4.1.1 Before Replacing the Cables

Before replacing the cables, turn ON the Controller and keep it ON for 30 or more minutes. Then, turn OFF the Controller.

This preparation is necessary to charge the super-capacitors that provide the power to retain the position data.

A super-capacitor is mounted on each motor. The charged motors can keep their position data for about 2 hours after the motors are disconnected from the lithium battery on the signal relay board.

Since the power is supplied to each motor from the lithium battery on the signal relay board via signal connector, the position data will not be lost when the Controller is turned OFF. When the signal connectors are disconnected, only the super-capacitors in the motors will retain the position data.

When the data storage time of the super-capacitors is exceeded, the position data will be lost, and an error* will occur when the Controller is turned ON.

* : In case of EPSON RC+, the error message that “Encoder alarm has occurred” is displayed.

If the error occurs, perform the calibration of all axes. For details on the calibration method, refer to *4.13 Calibration*.

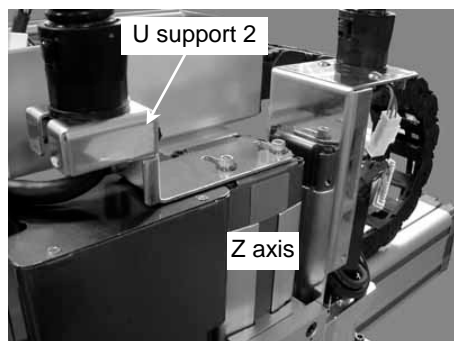
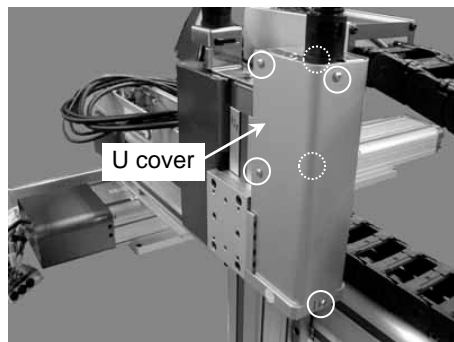
5.4.1.2 Replacement procedures

- (1) Turn OFF the controller.
- (2) Remove an end cover of respective connector boxes and pull out the interface box and the top covers.
- (3) Detach the cable clamps and cable holders, and disconnect both connectors of the cable to be replaced. Then, pull out the cable from the cable support.
- (4) Fix the cable to the connector box with the cable clamp and the cable holders.
- (5) Attach the top covers, interface box, and end the end covers to respective connector boxes in reversed order of procedure (2).
- (6) Move the modules respectively and check for jerking of cable in the cable support.
- (7) Leave the operating area of the robot and turn ON the controller.

5.4.1.3 Replacement of Cables for RU Module

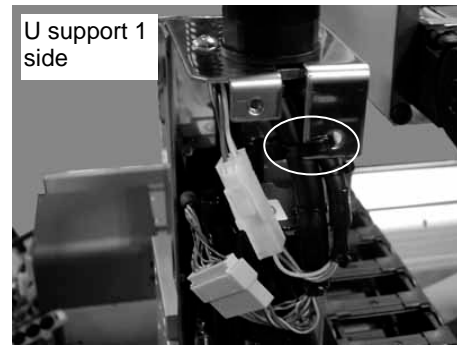
Removal

- (1) Turn OFF the controller.
- (2) Remove an end cover of respective connector boxes and pull out the interface box and the top covers.
- (3) Detach the cable clamps and cable holders, and disconnect the power connector and signal connector of the U cable unit from the interface box.
- (4) Pull out the cables of the U cable unit from the X-Y cable support and the Y-Z cable support. Then, remove the cable from the edge saddle on the moving-side connector box.
- (5) Unscrew six truss head screws (M4×8) and remove the U cover.
- (6) Unscrew two hexagon socket head cap bolts (M5×10) and two plain washers (M5). Then, remove the U support 2 from the Z axis.

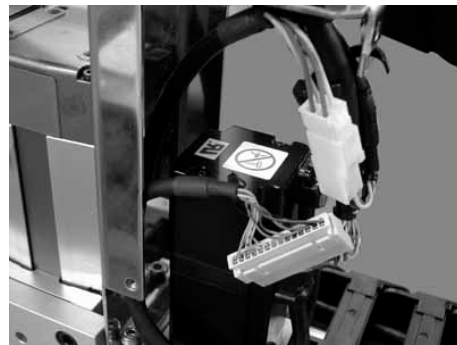


5.4 Periodic Replacement of Expendable Parts

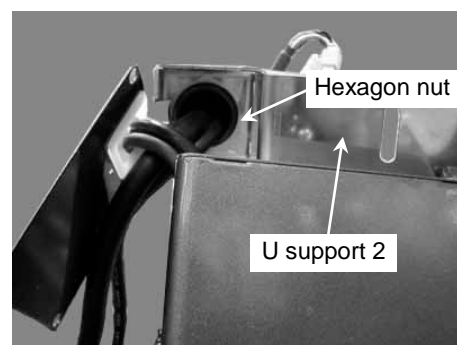
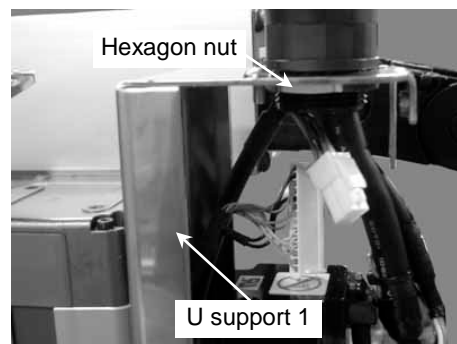
- (7) Cut off the two wire ties securing the cables. (Photo 5.4-4 and 5.4-5)



- (8) Disconnect the power cable and signal cable.



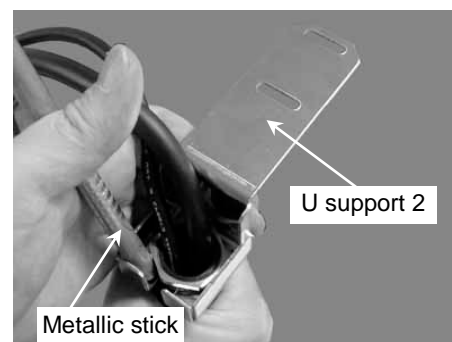
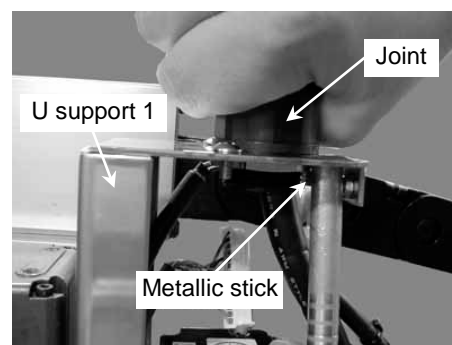
- (9) Remove two hexagon nuts. Then, remove the cable unit from the U support 1 and U support 2.



Installation

- (1) Secure the cable unit to the U support 1 and U support 2 with the hexagon nuts as shown in Photo.

Attach the joint to the U support turning the joint. At that time, use a metallic stick, etc. to prevent the hexagon nut from rotating.



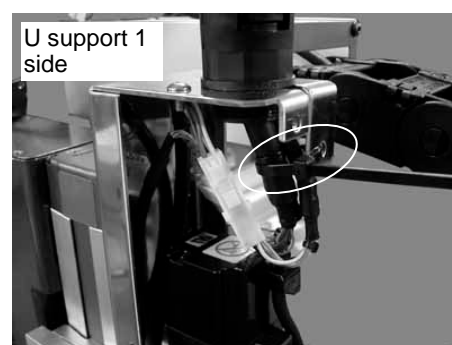
- (2) Connect the power connector and signal connector.



- (3) Secure the cables with a wire tie.

Put the wire tie through the hole on the U support 1 and fasten the cables with the wire tie at the position where the wire tie is 80 mm apart from the end of the cable connector.

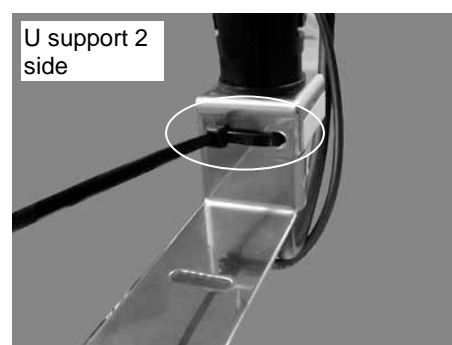
Cut off the extra part of the wire tie.



Put the wire tie through two holes on the U support 2 and fasten the cables with the wire tie.

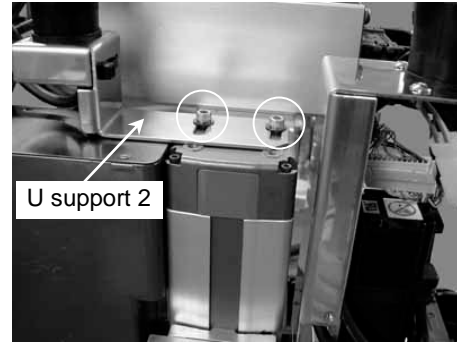
Cut off the extra part of the wire tie.

Be sure to stretch the cables tight in the U cable support.

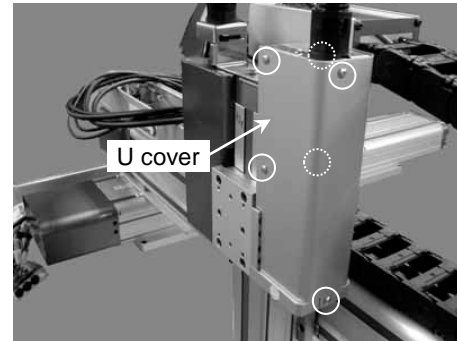


5.4 Periodic Replacement of Expendable Parts

- (4) Secure the U support 2 to the Z axis with two hexagon socket head cap bolts (M5×10, tightening torque: 5 N·m) and two plain washers (M5).



- (5) Secure the U cover with six truss head screws (M4×8). (Photo 5.4-15)



- (6) Insert the power cable and signal cable into the edge saddle on the moving-side connector box.



- (7) Insert the cables of U cable unit through the Y-Z cable support and then X-Y cable support. Binding the connectors with tape (gummed tape, etc.) can allow you to insert the cables through the cable supports easily.

- (8) Adjust the length of the cables to prevent them from tangling. Then, secure the cables to the fixed-side, junction, and moving-side connector boxes with cable clamps and cable holders.



- (9) Connect the power cable and signal cable of the U cable unit to the interface box. Refer to 4.10.5 RU Type (Block Diagrams) and connect the cables correctly.

- (10) Attach the top covers, interface box, and end covers to respective connector boxes.

- (11) Move each axis to its stroke end by hand and make sure that the cables do not stretch too tight in the cable supports.

(12) Leave the operating area of the robot and turn ON the controller.

5.4.2 Replacement of Timing Belt (Only for RSz module)

The timing belt is treated as a expendable part. The manufacturer is not liable for damage when it is out of the warranty. We recommend replacing it periodically to avoid the system malfunction, collision to an obstacle and free-falling of slider of a vertical axis module.

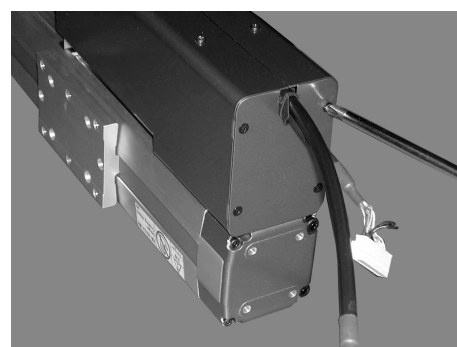
No.	Code	Applicable module
1	R13B030201	RSz module

Removal

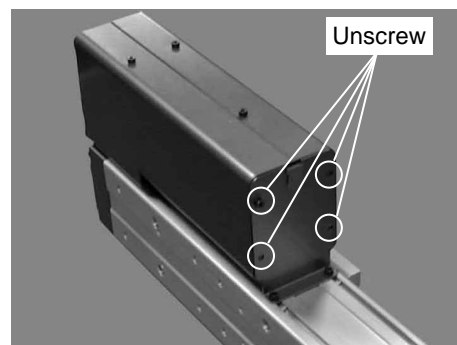
When you replace the timing belt of RSz module, bind the module and end effector with string to prevent the end effector from falling down.

- (1) Unscrew four counter-sunk head screws (M3×6) on the motor end cover on the cable side.

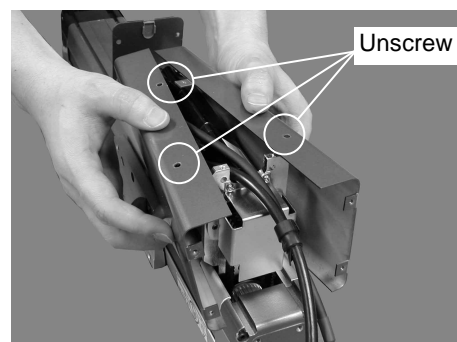
Remove the motor end cover.



- (2) Unscrew four pan head screws (M3×6) on the motor end cover on the bottom side.

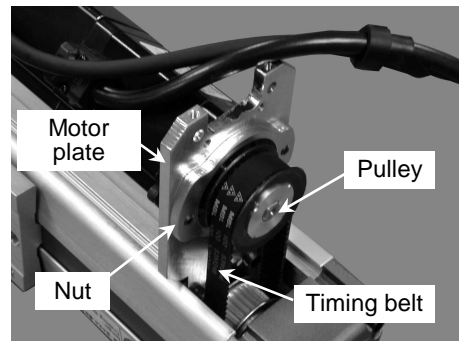
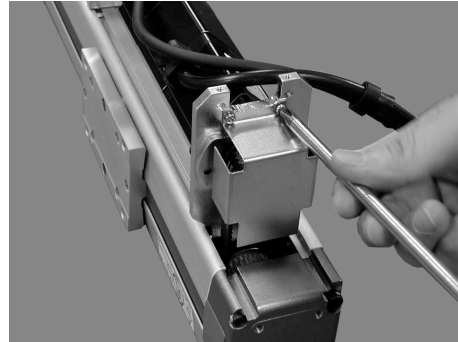


- (3) Unscrew three pan head screws (M3×6) that secure the motor covers, and remove the motor covers.



5.4 Periodic Replacement of Expendable Parts

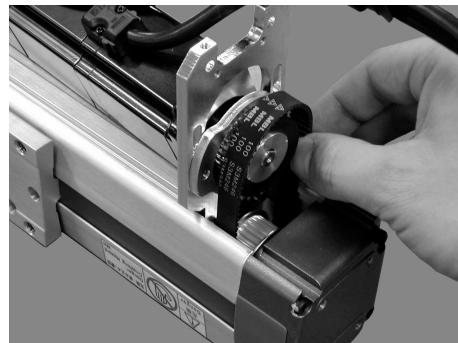
- (4) Unscrew two pan head screws (M3×4) on the pulley cover, and remove the pulley cover.



- (5) Hold the motor and unscrew two hexagon socket head cap bolts (M4×15) that secure the motor to the motor plate.



- (6) Remove the timing belt from the pulleys on the motor side and the module side.



Installation

- (1) Put the timing belt on the pulleys on the module side and the motor side.



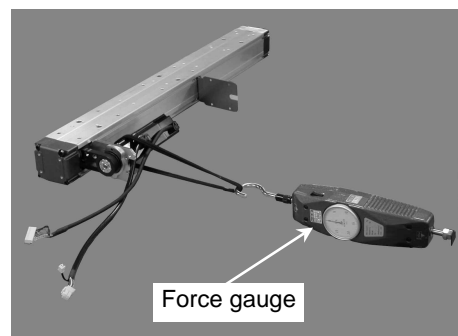
- (2) Loosely tighten the two hexagon socket head cap bolts (M4×15) that secure the motor.



- (3) Apply the proper tension ($70\text{ N} \pm 5$) to the timing belt, and secure the motor (tightening torque: $3\text{ N}\cdot\text{m}$).

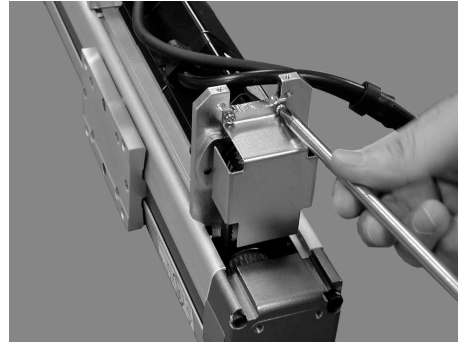
Pass a suitable cord or string around the motor flange. Then, pull the cord using a force gauge or similar tool to apply the specified tension.

Rotate the pulley on the motor side, and make sure that the gear teeth of the belt mesh with the pulleys completely.



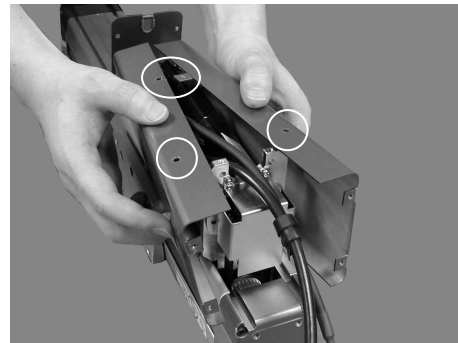
5.4 Periodic Replacement of Expendable Parts

- (4) Mount the pulley cover to the pulley, and secure the cover with the two pan head screws (M3×4).



- (5) Mount the motor covers to the motor, and secure the covers with three pan head screws (M3×6).

Make sure that the positions of the screw holes are correct.



- (6) Tighten the four pan head screws (M3×6) on the motor end cover on the bottom side and secure it to the motor covers.

Tighten the screws in a crisscross pattern.





- (7) Mount the motor end cover on the cable side to the motor covers. Secure the motor end cover with the four counter-sunk head screws (M3×6).



- (8) Refer to *4.13 Calibration* and perform the calibration.

5.4.3 Replacing the Lithium Battery (Battery Unit)

 WARNING	<ul style="list-style-type: none"> ■ Do not insert or pull out the motor connectors while the power to the robot system is turned ON. Inserting or pulling out the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not remove the interface box forcibly. Removing the interface box forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the interface box, be careful not to allow the cables to interfere with the box mounting and do not bend these cables forcibly to push them into the box. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the interface box. Be sure to place the cables back to their original locations. 										
 WARNING	<ul style="list-style-type: none"> ■ Use meticulous care when handling the lithium battery. Improper handling of the lithium battery as mentioned below is extremely hazardous, may result in heat generation, leakage, explosion, or inflammation, and may cause serious safety problems. <Improper Handling> <table border="0" style="margin-left: 20px;"> <tr> <td>-Battery Charge</td><td>-Deformation by Pressure</td></tr> <tr> <td>-Disassembly</td><td>-Short-circuit (Polarity; Positive/Negative)</td></tr> <tr> <td>-Incorrect Installation</td><td>-Heating (85°C or more)</td></tr> <tr> <td>-Exposing to Fire</td><td>-Soldering the terminal of the lithium battery directly</td></tr> <tr> <td>-Forced Discharge</td><td></td></tr> </table> ■ When disposing of the battery, consult with the professional disposal services or comply with the local regulation. Spent battery or not, make sure the battery terminal is insulated. If the terminal contacts with the other metals, it may short and result in heat generation, leakage, explosion, or inflammation. 	-Battery Charge	-Deformation by Pressure	-Disassembly	-Short-circuit (Polarity; Positive/Negative)	-Incorrect Installation	-Heating (85°C or more)	-Exposing to Fire	-Soldering the terminal of the lithium battery directly	-Forced Discharge	
-Battery Charge	-Deformation by Pressure										
-Disassembly	-Short-circuit (Polarity; Positive/Negative)										
-Incorrect Installation	-Heating (85°C or more)										
-Exposing to Fire	-Soldering the terminal of the lithium battery directly										
-Forced Discharge											

5.4 Periodic Replacement of Expendable Parts

When the lithium battery power is low, an error will occur to warn the user about the low battery status when the Controller is turned ON (when software is started up).

When the error occurs, the position data in the motors will be lost and all axes need to be completely calibrated again.

The life span of the lithium battery is 3 years. Even if the Manipulator is constantly connected to power, the lithium battery needs to be replaced every 3 years.

Part Name	Code	Note
Lithium battery (Battery unit)	R13ZA00600300	

5.4.3.1 Before Replacing the Lithium Battery

Before replacing the lithium battery, turn ON the Controller and keep it ON for 30 or more minutes. Then, turn OFF the Controller.

This preparation is necessary to charge the super-capacitors that retain the position data.

A super-capacitor is mounted on each motor. The charged motors can keep their position data for about 2 hours after the motors are disconnected from the lithium battery on the signal relay board.

Since the power is supplied to each motor from the lithium battery on the signal relay board via signal connector, the position data will exist even when the Controller is turned OFF. When the signal connectors are disconnected, only the super-capacitors in the motors will keep the position data.

When the data storage time of the super-capacitors is exceeded, the position data will be lost, and an error* will occur when the Controller is turned ON.

* In case of EPSON RC+, the error message that “Encoder alarm has occurred” is displayed.

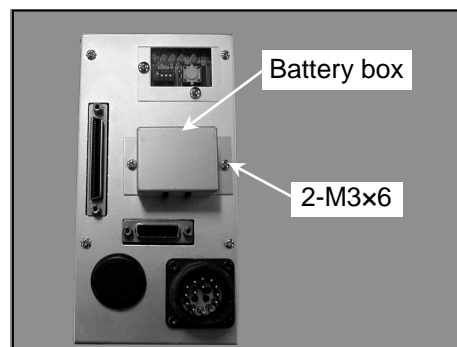
If the error occurs, perform the calibration of all axes. For details on the calibration method, refer to *4.13 Calibration*.

5.4.3.2 How to Replace the Lithium Battery

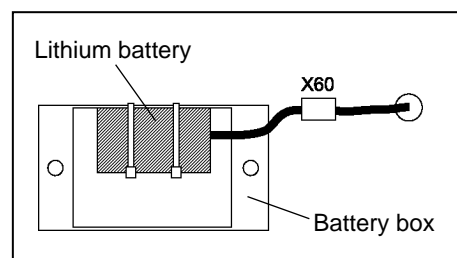
Removal

(1) Disconnect all the connectors and tubes from the interface box (outside).

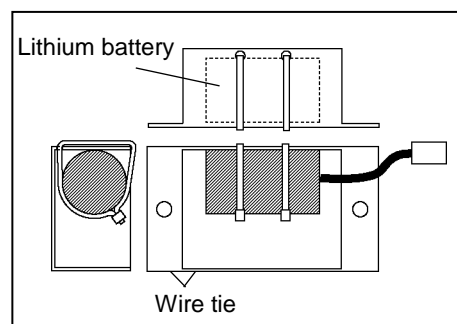
(2) Remove the battery box from the interface box.



(3) Disconnect the X60 connector from the lithium battery.



(4) Cut off the wire ties securing the lithium battery, and then remove the lithium battery.



5.4 Periodic Replacement of Expendable Parts

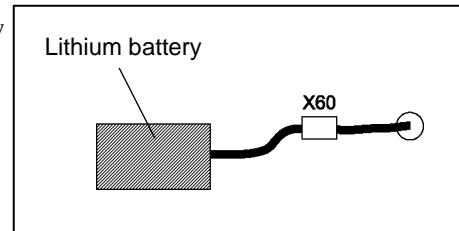
NOTE



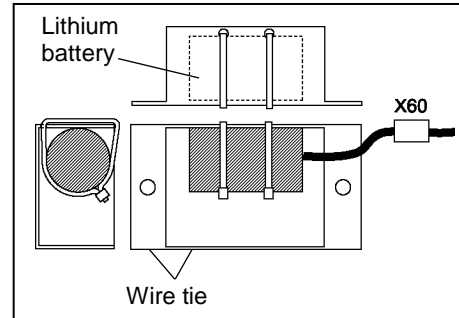
Be sure to use the specified lithium battery (Code: R13ZA00600300).
Observe polarity (positive/negative) when connecting the lithium battery.

Installation

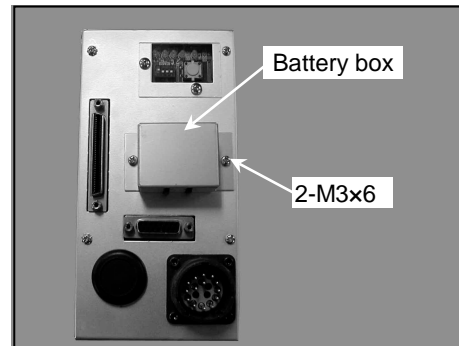
- (1) Connect the X60 connector to the new lithium battery.



- (2) Secure the lithium battery to the battery box.



- (3) Mount the battery box on the interface box.



- (4) Connect the connectors to the interface box (outside).
- (5) Turn ON the Controller.
- (6) Check if the Manipulator moves to points (poses) correctly.

To do so, select 2 points (poses) or more from the registered points (poses) and move the Manipulator to the points (poses).

- (7) If the Manipulator does not move to the points (poses) correctly, perform the calibration of all axes.

For details on the calibration method, refer to *4.13 Calibration*.

5.5 Replacing the Motors



WARNING

- Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.
- To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source.
- Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.



CAUTION

- Be careful not to apply excessive shock to the motor shaft when replacing the motors. The shock may shorten the life cycle of the motors and encoder and/or damage them.
- Never disassemble the motor and encoder. A disassembled motor and encoder will cause a positional gap and cannot be used again.

NOTE



After parts have been replaced (motors, timing belts, etc.), the Manipulator cannot operate properly because a mismatch exists between the origin stored in each motor and its corresponding origin stored in the Controller.

After replacing the parts, it is necessary to match these origins.

The process of aligning the two origins is called “Calibration”.

Refer to *4.13 Calibration* and perform the calibration.

NOTE



The motor as a maintenance part is provided without a pulley or a timing belt. Therefore, be careful not to lose them during motor replacement.

5.5.1 Types of Motors

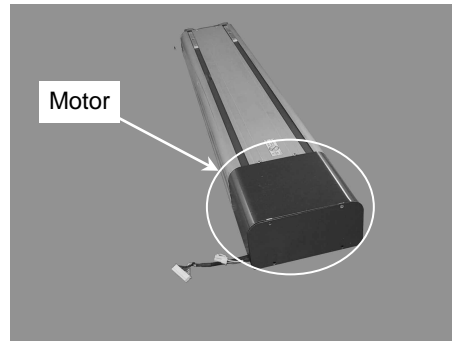
The motor types used in the X5 series Manipulators are shown in the table below.

When ordering a motor for replacement, check the motor type. Then, specify the code from the table below.

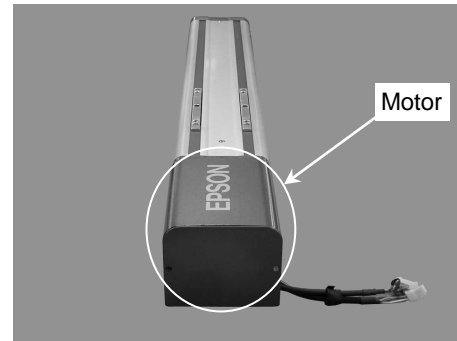
Part Name	Code	Note
400W motor	R13B000616	For RH, RM
150W motor	R13B000615	For RU
150W motor (with brake)	R13B000622	For RSz

5.5.2 Location of Motors

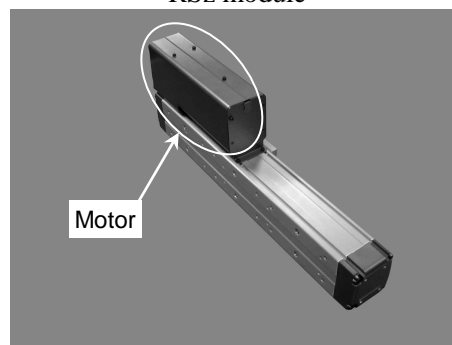
RH module



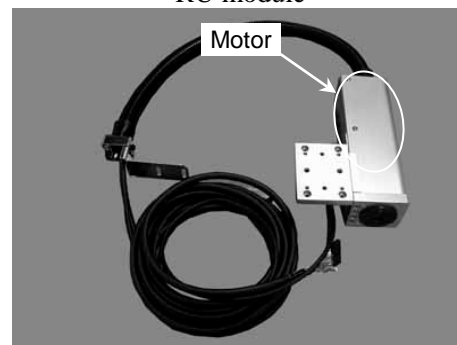
RM module



RSz module



RU module

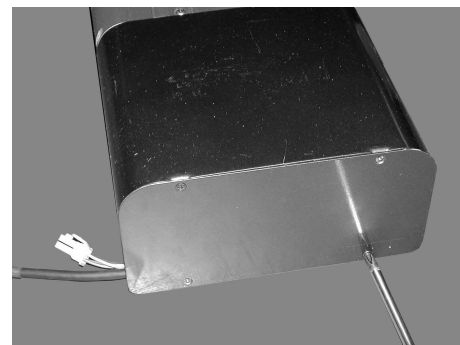


5.5.3 Replacing the Motor on Each Module

5.5.3.1 RH Module

Removal

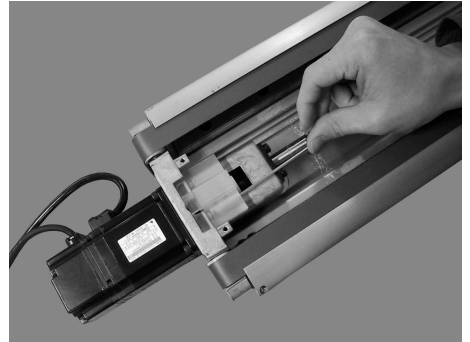
- (1) Unscrew four counter-sunk head screws on the motor end cover, and remove the motor end cover.
- (2) Unscrew four hexagon socket head cap bolts on both sides of the motor cover (M4×8, 2 bolts on each side), and remove the motor cover.



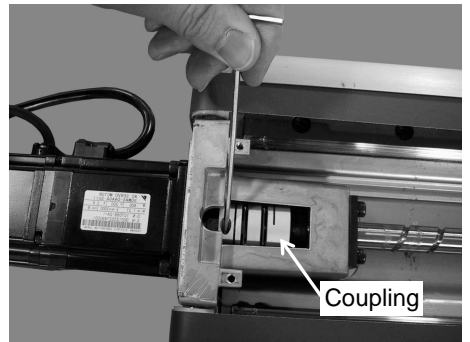
- (3) Unscrew four round head screws on both ends of the slider cover (M4×8, 2 screws on each end), and remove the slider cover.



- (4) Unscrew two hexagon socket head cap bolts (M4×10) on the stop (yellow) on the motor side. Remove the stop.



- (5) Loosen the clamping bolt on the coupling on the motor shaft side.



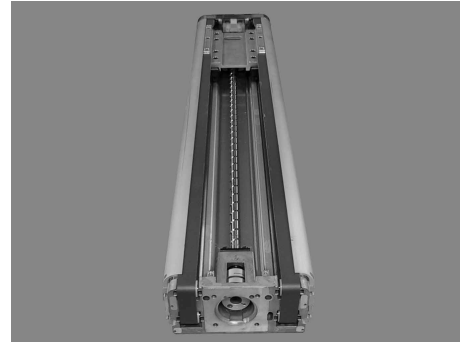
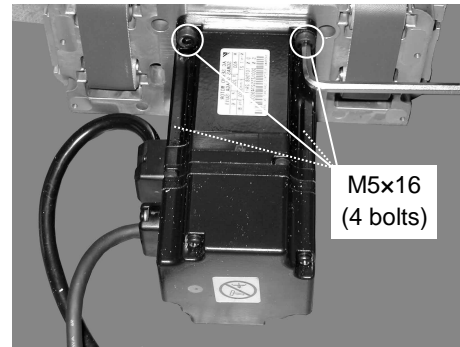
NOTE



Loosen the clamping bolt on the coupling sufficiently. Pulling the motor forcibly while the clamping bolt on the coupling is tightened may cause a slack of the spring in the coupling. When the spring gets slack, the accuracy is not obtained.

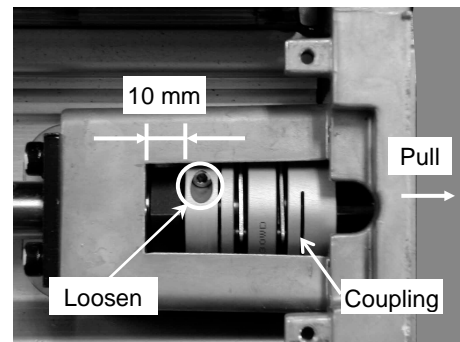
5.5 Replacing the Motors

- (6) Unscrew four motor mounting bolts (M5×16), and remove the motor from the module body.



When replacing the coupling, turn the coupling by hand and loosen the mounting bolt of the coupling opposite from the side of the motor. Then, pull the coupling out of the module.

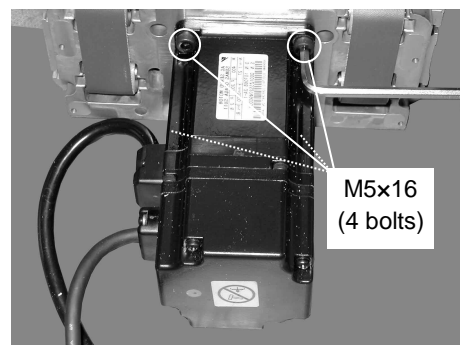
Secure a new coupling in the position. (Tightening torque: 1.5 N·m)



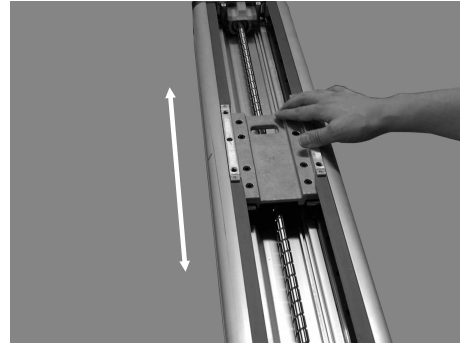
Installation

- (1) Make sure that the clamping bolt on the coupling on the motor shaft side is loosened.
- (2) Mount the motor to the module body so that the motor cables are on the right side of the motor when you face the motor end cover.

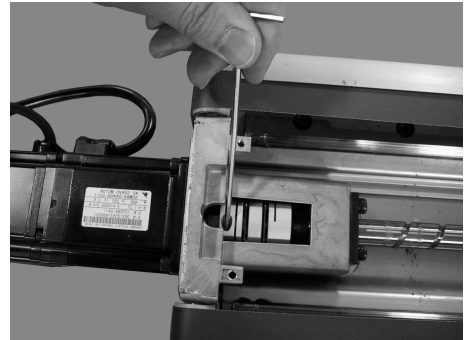
Tighten the four motor mounting bolts (M5×16, tightening torque: 5 N·m) in a crisscross pattern.



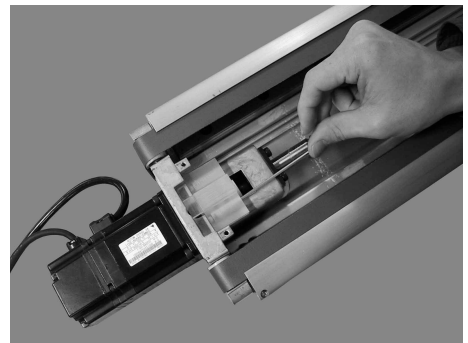
- (3) Move the slider so that the motor shaft fits in the coupling.



- (4) Tighten the clamping bolt on the coupling.
(Tightening torque: 1.5 N·m)



- (5) Mount the stop in the module body and secure the stop with the two hexagon socket head cap bolts (M4×10).



- (6) Move the slider to the end of the module.
(Either the motor side end or the other side end)

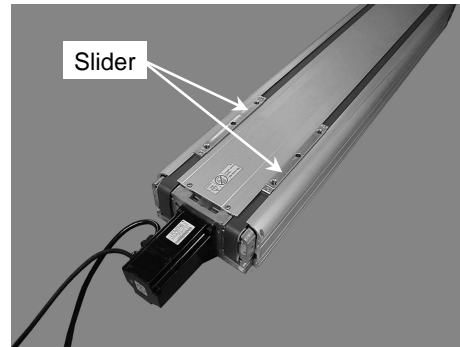


- (7) Install the slider cover in the module body and secure the slider cover with the four round head screws on both ends (M4×8, 2 screws on each end).

It is not necessary to put the slider belts into the grooves of the slider cover at this step.



- (8) Move the slider to the stop on the opposite side. The slider belts automatically fit into the grooves of the slider cover.



- (9) Make sure that the slider belts fit into the grooves correctly. If the slider belts do not fit into the grooves, move the slider from end to end again.

- (10) Mount the motor cover to the motor, and secure the cover with the four hexagon socket head cap bolts on both sides (M4×8, 2 bolts on each side).



- (11) Put the cables into the opening where they were previously installed.

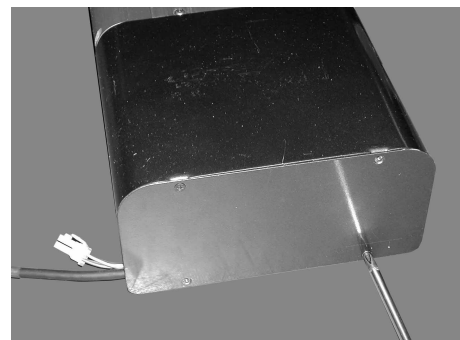
Bend the cables using as large a radius as possible to minimize the force applied to the cable outlet of the motor cover.

Put tape around the cables to prevent them from being damaged on the edge of the opening.



Insert the slot plug into the opening on the other side.

- (12) Mount the motor end cover to the motor cover, and secure the motor end cover with the four counter-sunk head screws.



RM Module

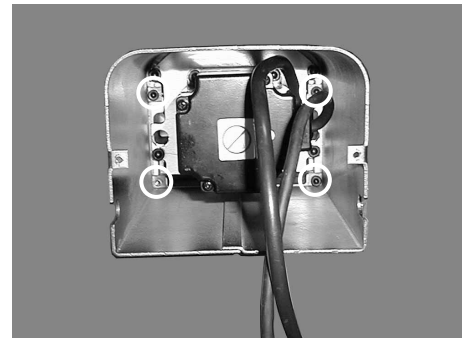
Removal

- (1) Unscrew two counter-sunk head screws on the motor end cover, and remove the motor end cover.



- Be careful not to cut your hand on the edge of motor cover or parts inside the cover when you unscrew the bolts in the motor cover.

- (2) Unscrew four hexagon socket head cap bolts (M4×8) in the motor cover, and remove the motor cover.




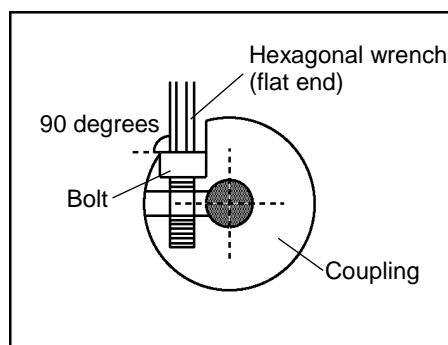
- (3) Insert a flat screwdriver between the maintenance hole and the cut part of the cover, and remove the cover.



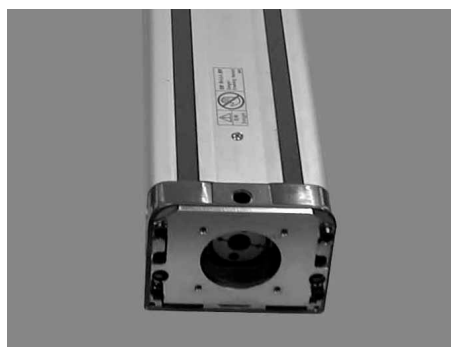
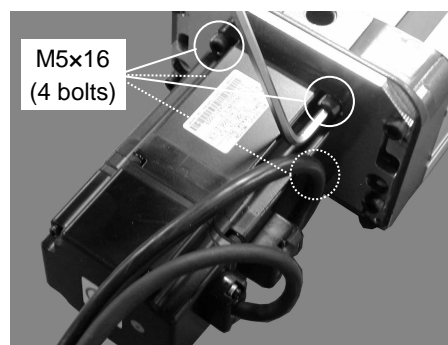
- (4) Move the slider, and find the clamping bolt on the coupling from the maintenance hole.

Insert a flat end of hexagonal wrench through the maintenance hole vertically, and loosen the clamping bolt on the coupling.

NOTE  Loosen the clamping bolt on the coupling sufficiently. Pulling the motor forcibly while the clamping bolt on the coupling is tightened may cause a slack of the spring in the coupling. When the spring gets slack, loss of accuracy may occur.



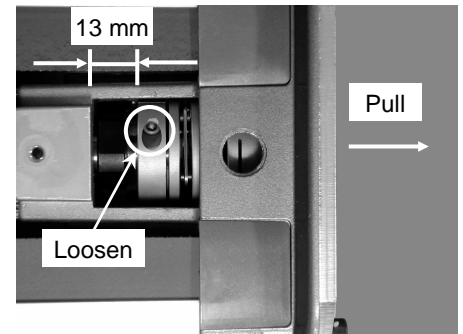
- (5) Unscrew four motor mounting bolts (M5×16), and remove the motor from the module body.



When replacing the coupling, unscrew the round head screws on both ends of the slider cover. Then, move the slider cover.



Turn the coupling by hand and loosen the mounting bolt of the coupling opposite from the side of the motor.
Then, secure a new coupling in the position.
(Tightening torque: 1.5 N·m)



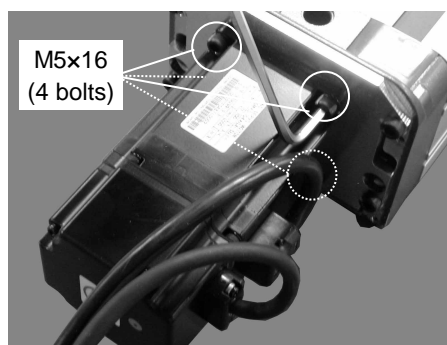
5.5 Replacing the Motors

Installation

- (1) Make sure that the clamping bolt on the coupling is loosened.

- (2) Mount the motor to the module body so that the motor cables are on the right side of the motor when you face the motor end cover.

Tighten the four motor mounting bolts (M5×16, tightening torque: 5 N·m) in a crisscross pattern.



- (3) Move the slider so that the motor shaft fits in the coupling.



- (4) Insert a hexagonal wrench through the maintenance hole, and tighten the clamping bolt on the coupling. (Tightening torque: 1.5 N·m)



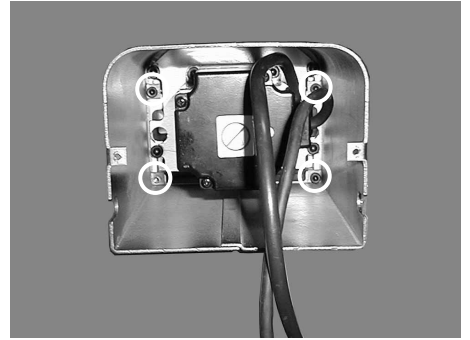
- (5) Insert the cover into the maintenance hole.



CAUTION

- Be careful not to cut your hand on the edge of motor cover or parts inside the cover when you tighten the bolts in the motor cover.

- (6) Mount the motor cover to the module body, and tighten the four hexagon socket head cap bolts (M4×8) in the motor cover.



- (7) Insert the cables into the opening where they were previously installed.

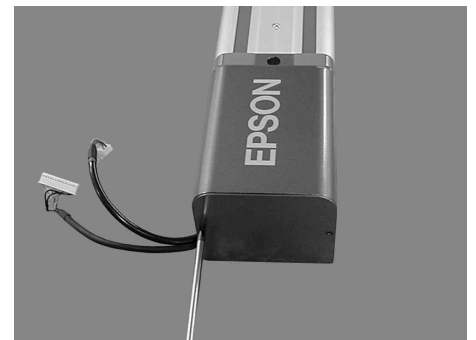
Bend the cable using as large a radius as possible to minimize the force applied to the cable outlet of the motor cover.

Put tape around the cables to prevent them from being damaged on the edge of the opening.



Insert the slot plug in the opening on the other side.

- (8) Mount the motor end cover to the motor cover, and secure the motor end cover with the two counter-sunk head screws.



5.5.3.3 RSz Module

Removal

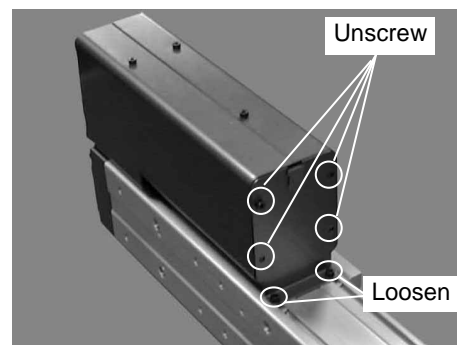
When you replace the timing belt of RSz module, bind the module and end effector with string to prevent the end effector from falling down.

- (1) Unscrew four counter-sunk head screws (M3×6) on the motor end cover on the cable side.

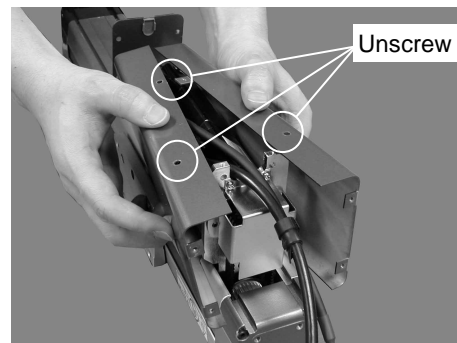
Remove the motor end cover.



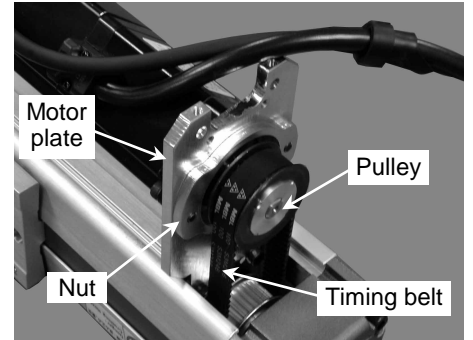
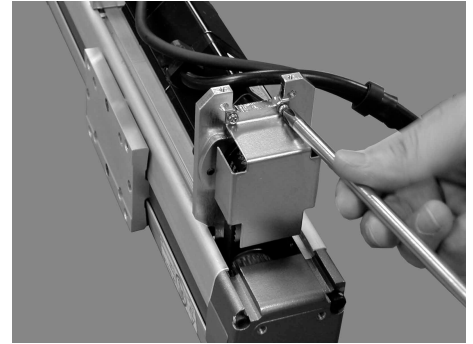
- (2) Unscrew four pan head screws (M3×6) on the motor end cover on the bottom side, and loosen two hexagon socket head cap bolts (M3×6) that secure the cover to the module body. Then, move the motor end cover horizontally.



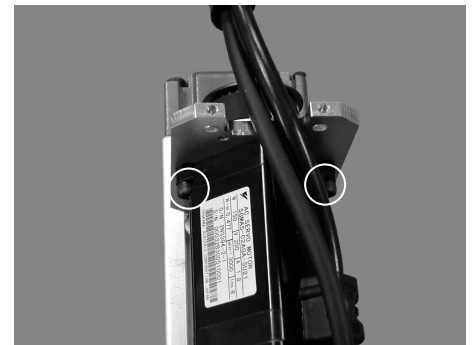
- (3) Unscrew three pan head screws (M3×6) that secure the motor covers, and remove the motor covers.



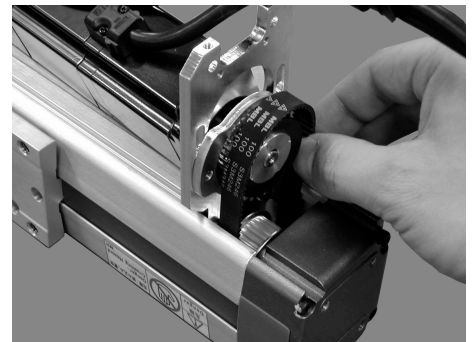
- (4) Unscrew two pan head screws (M3×4) on the pulley cover, and remove the pulley cover.



- (5) Hold the motor and unscrew two hexagon socket head cap bolts (M4×15) that secure the motor to the motor plate.

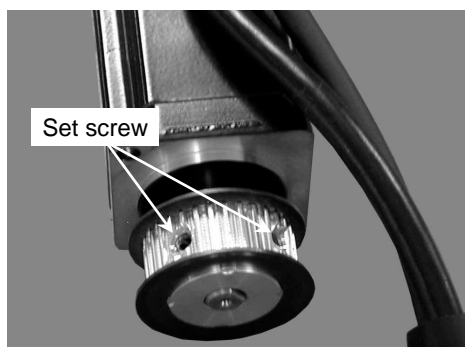


- (6) Remove the timing belt from the pulley. Then, pull out the motor.



- (7) Unscrew two setscrews (M5×8) that secure the pulley to the motor, and remove the pulley from the motor.

There is a brass bushing in one of the setscrew holes. Be careful not to lose it.



Installation

- (1) Mount the pulley on the motor so that the tip of the motor shaft sticks out 2 mm from the pulley (tightening torque: 2.9 N·m).

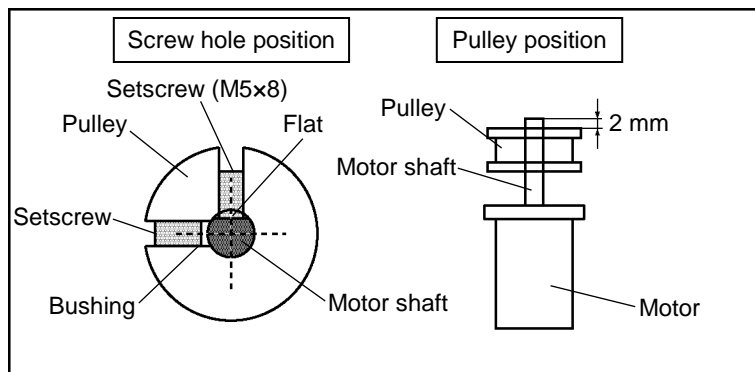
Screw one of the setscrews for the flat of the motor shaft until the setscrew just touches the surface. Insert a bushing into the other setscrew hole to prevent damage to the motor shaft.

Loosely tighten the setscrew on the flat of the motor shaft.

Then, loosely tighten the other setscrew with the bushing.

Unscrew the setscrew on the flat, and securely tighten it.

Securely tighten the setscrew with the bushing until the setscrew presses the bushing.



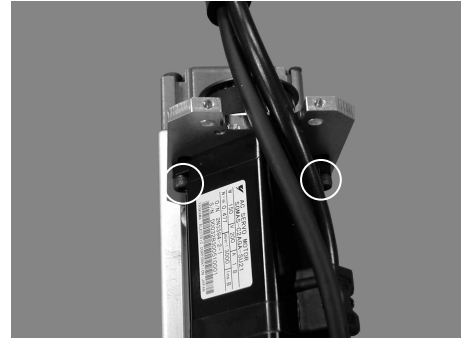
- (2) Insert the motor into the motor plate and nut so that the cables of the motor are set in the opening of the motor plate.



- (3) Put the timing belt on the pulley on the motor side. Make sure that the timing belt is put on the other pulley in the module.

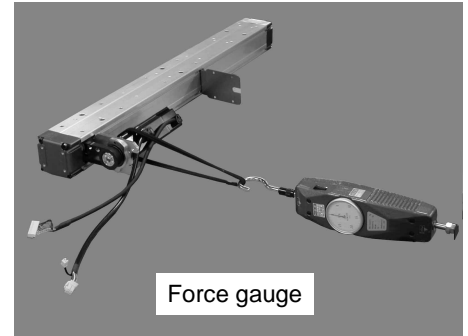


- (4) Loosely tighten the two hexagon socket head cap bolts (M4×15) that secure the motor.



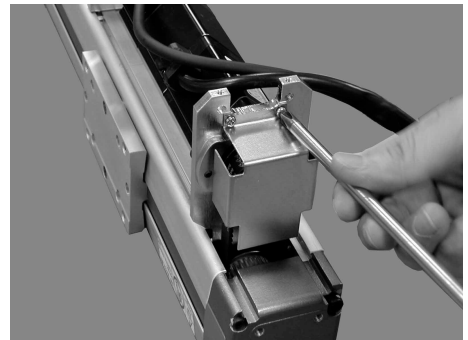
- (5) Apply the proper tension ($70\text{ N} \pm 5$) to the timing belt, and secure the motor. (Tightening torque: $3\text{ N}\cdot\text{m}$)

Pass a suitable cord or string around the motor flange. Then, pull the cord using a force gauge or similar tool to apply the specified tension.



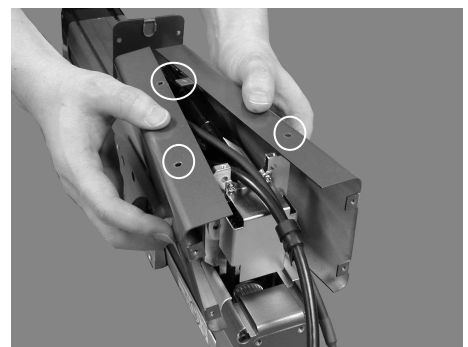
Rotate the pulley on the motor side, and make sure that the gear teeth of the belt mesh with the pulleys completely.

- (6) Mount the pulley cover to the pulley, and secure the cover with the two pan head screws (M3×4).



- (7) Mount the motor covers to the motor, and secure the covers with three pan head screws (M3×6).

Make sure that the positions of the screw holes are correct.



5.5 Replacing the Motors

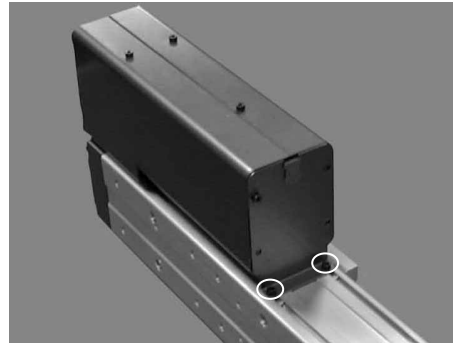
- (8) Re-install the motor end cover on the bottom side.

Tighten the four pan head screws (M3×6) on the same motor end cover and secure it to the motor covers.

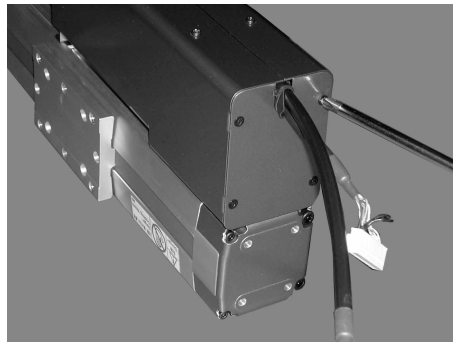
Tighten the screws in a crisscross pattern.



- (9) Tighten the two hexagon socket head cap bolts (M3×6) and secure the motor end cover to the module body.



- (10) Mount the motor end cover on the cable side to the motor covers. Secure the motor end cover with the four counter-sunk head screws. (M3×6)

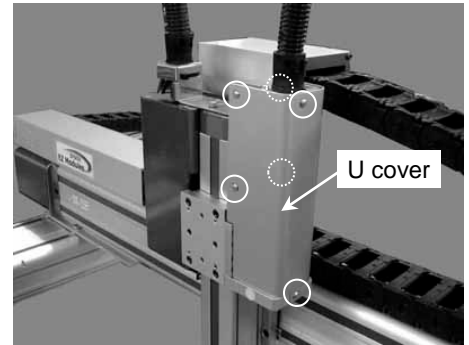


- (11) Refer to “4.13 Calibration” and perform the calibration.

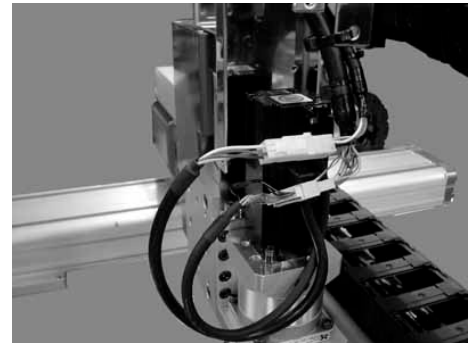
5.5.3.4 RU Module (Including the Reduction Gear Unit Replacement)

Removal

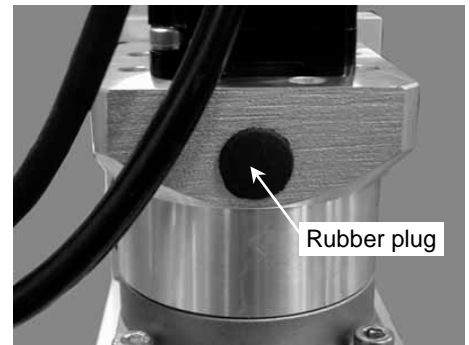
- (1) Unscrew six truss head screws (M4×8), and remove the U cover.



- (2) Disconnect the power connector and signal connector.

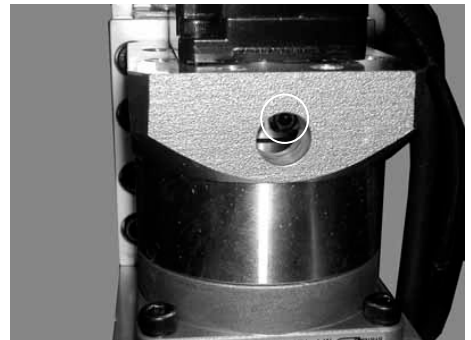



- (3) Remove the rubber plug from the maintenance hole on the reduction gear unit.

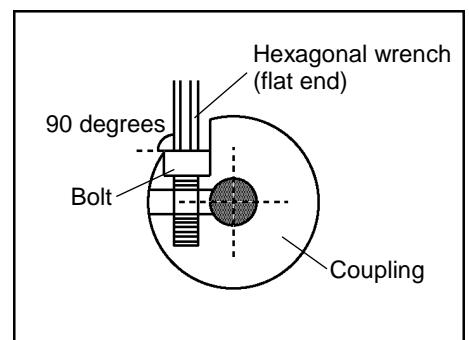


- (4) Find the clamping bolt (M3) on the coupling from the maintenance hole turning the input axis joint of reduction gear unit.

Insert a flat end of hexagonal wrench through the maintenance hole vertically, and loosen the clamping bolt (M3) on the coupling.

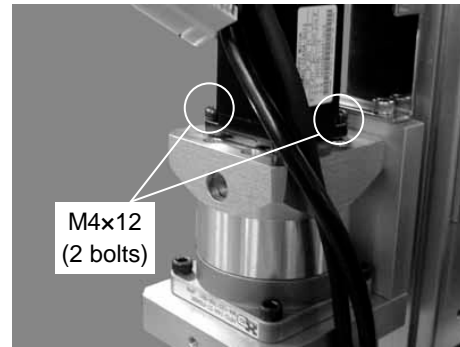


NOTE  Loosen the clamping bolt on the coupling sufficiently. Pulling the motor forcibly while the clamping bolt on the coupling is tightened maybe cause a slack of the spring in the coupling. When the spring gets flack, loss of accuracy may occur.

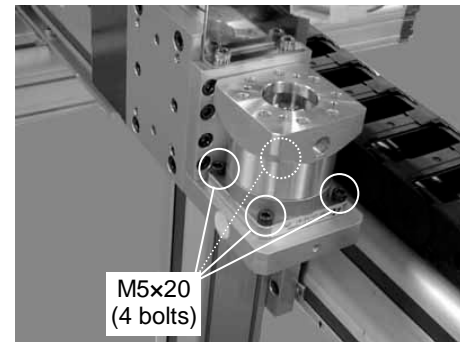


5.5 Replacing the Motors

- (5) Unscrew two hexagon socket head cap bolts (M4×12) that secure the motor.
Then, remove the motor.



- (6) When replacing the reduction gear unit:
Unscrew four bolts (M5×20) that secure the reduction gear unit.
Then, remove the reduction gear unit.

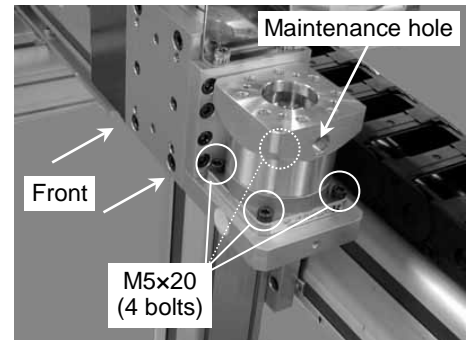


Installation

- (1) Make sure that the clamping bolt on the coupling is loosened.

- (2) Place the reduction gear unit so that the maintenance hole on it is on the right side as you face the front. Then secure the reduction gear unit with four bolts (M5×20, tightening torque: 9.8 N·m).

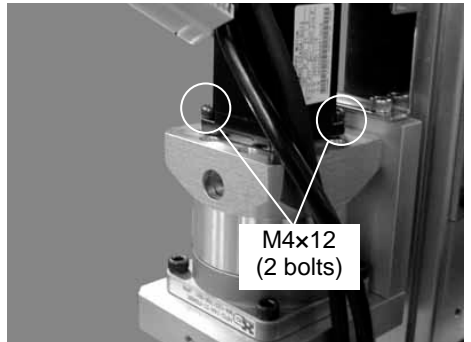
Tighten the bolts in a crisscross pattern.



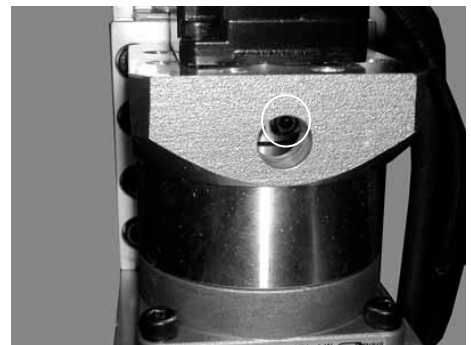
- (3) Place the motor so that its cables come to the maintenance hole side.

Insert the motor into the reduction gear unit slowly and secure the motor with the two hexagon socket head cap bolts (M4×12). (Tightening torque: 3.1 N·m)

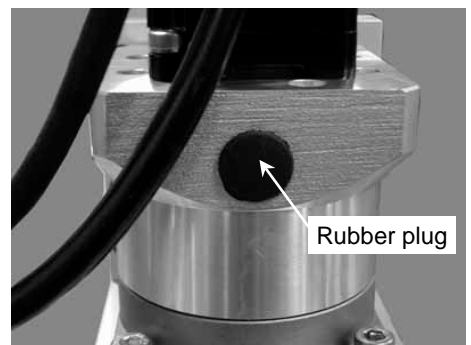
Do not insert the motor at a tilt.



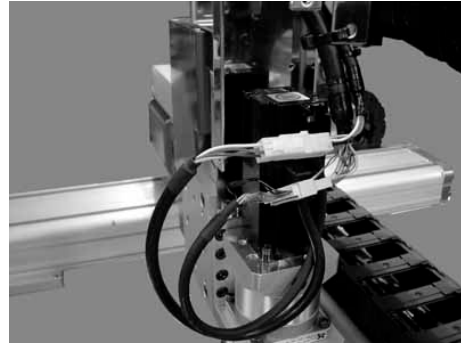
- (4) Insert a hexagonal wrench through the maintenance hole and tighten the clamping bolt (M3) on the coupling. (Tighten torque: 2 N·m)



- (5) Put the rubber plug in the maintenance hole.

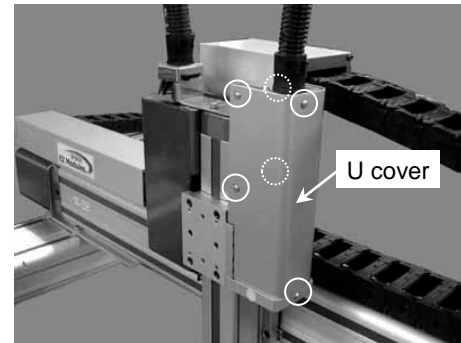


- (6) Connect the power connector and signal connector.



- (7) Secure the U cover with six truss head screws (M4×8).

Bend the cable using as large a radius as possible to minimize the force applied to the cable outlet.



- (8) Refer to *4.13 Calibration* and perform the calibration.

5.6 Replacing the Signal Relay Board



- Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.
- To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source.
- Before performing any replacement procedure, turn OFF the controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Do not remove the interface box forcibly. Removing the interface box forcibly may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
- When installing the interface box, be careful not to allow the cables to interfere with the box mounting and do not bend these cables forcibly to push them into the box. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
When routing the cables, observe the cable locations after removing the interface box. Be sure to place the cables back to their original locations.

5.6.1 Before Replacing the Signal Relay Board

Before replacing the signal relay board, turn ON the Controller and keep it ON for 30 or more minutes. Then, turn OFF the Controller.

This preparation is necessary to charge the super-capacitors that retain the position data.

A super-capacitor is mounted on each motor. The charged motors can keep their position data for about 2 hours after the motors are disconnected from the lithium battery on the signal relay board.

Since the power is supplied to each motor from the lithium battery on the signal relay board via signal connector, the position data will not be lost when the Controller is turned OFF. When the signal connectors are disconnected, only the super-capacitors in the motors will retain the position data.

When the data storage time of the super-capacitors is exceeded, the position data will be lost, and an error* will occur when the Controller is turned ON.

* : In case of EPSON RC+, the error message that “Encoder alarm has occurred” is displayed.

If the error occurs, perform the calibration of all axes. For details on the calibration method, refer to “4.13 Calibration”.

5.6.2 How to Replace the Signal Relay Board

Removal

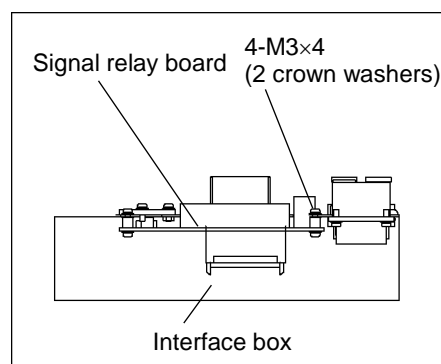
- (1) Disconnect all the connectors and tubes from the interface box (outside).
- (2) Remove the interface box from the connector box.
- (3) Disconnect the connectors (X10, X20, X30, X40, X50, and X4) from the signal relay board.
To do so, open up the top and bottom clips of the connectors.



NOTE Connect motors and the signal relay board with a new cable unit within 2 hours after the connectors are removed. When the motors and the signal relay board are connected with a new cable unit after 2 hours have passed, the position data in motors will be lost and calibration will be required again.

- (4) Remove the signal relay board from the interface box.

The signal relay board is secured from the outside of the interface box.



Installation

- (1) Install a new signal relay board to the interface box.
Secure the board from the outside of the box.
- (2) Connect the connectors (X10, X20, X30, X40, X50, and X4) to the signal relay board.



WARNING

- Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.

- (3) Install the interface box.
For details on the installation method, refer to step (6) to (9) in “4.6 Installation of Single Axis Modules (RH, RM)”.
- (4) Connect the connectors and tubes to the interface box (outside).
- (5) Turn ON the Controller.
- (6) Check if the Manipulator moves to points (poses) correctly.
To do so, select 2 points (poses) or more from the registered points (poses) and move the Manipulator to the points (poses).

- (7) If the Manipulator does not move to the points (poses) correctly, perform the calibration of all axes.

For details on the calibration method, refer to “4.13 Calibration”.

5.7 Overhaul

We recommend that you periodically overhaul the manipulator to prevent system failure due to wear and/or deterioration.

Recommended overhaul period : 5 years

Method of overhaul : Please ask suppliers about details.

5.8 Precautions for Disposal of Modules

When disposing the modules, refer to respective precautions and procedures of the transportation and maintenance, and pay attention to safety.

5.9 Maintenance Parts List

Specify the code when ordering maintenance parts.

Part Name			Code	Note	Reference
RH module	1000 mm		R13B080001	No motor	2.1 2.2.1 2.5.1.1 2.5.1.2
	800 mm		R13B080002		
	600 mm		R13B080003		
RM module	550 mm		R13B080006		
	350 mm		R13B080007		
RSz module	300 mm	R	R13B080016	No motor	2.1 2.2.22.2.3
		L	R13B080017	No pulley on the motor	
RSz module	200 mm	R	R13B080018	shaft side	
		L	R13B080019	No timing belt	
400W motor			R13B000616	For RH, RM	
150W motor			R13B000615	For RU ^{*1}	
150W motor		With brake	R13B000622	For RSz ^{*1}	
Timing belt			R13B030201	For RSz	5.4.2
X5 cable set 1	2 m (User cable is 4 m.)		R114X5C001	RG-HM、YZ-MS	5.4.1
X5 cable set 3	2 m (User cable is 4 m.)		R114X5C003	For Additional RG	
X5 cable set 5			R114X5C007	For RP-HMSz, RU-HMSz	
X5 U cable unit	4.5 m		R13B020041	For RU-HMSz	
External cable	6 m		R114X4C000		
Additional user cable	4 m		R114X4C005		
Cable support	28 links		R13B031901	Refer to <i>4.14 Adjusting Cable Support Length</i> and adjust the links.	4.14
Coupling			R13B031501	For RH, RM	5.5.3
Signal relay board			R13ZA00450400		5.6
Lithium battery (Battery unit)			R13ZA00600300	ER17330V (TOSHIBA)	5.4.3
Brake release switch			R13B030001		4.8.1
Pulley (on the motor shaft side)			R13B031101	For RS, RSz	5.5.3
Reduction gear unit			R13B010001	For RU-HMSz	5.5.3

*1: Use a 200W motor driver module for RU and RSz modules.

For the codes of the motor diver modules, refer to the maintenance parts list in the robot controller manual.