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NSK

Robot Modules System

- Module Main Unit
- EXC Controller

User's Manual 1

= Product Description and Installation =

1 Product Description and Installation

1. Introduction
2. Safety Precautions
3. System Configuration
4. Reference Number · Name of the Parts
5. Specifications and Dimensions
6. Transportation, Storage and Unpacking
7. Installation
8. Assembly
9. Wiring
10. Start Up
11. Initial Setting
12. Trial Running

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Appendix 4: Regeneration Processing

NSK Ltd.

Precision Machinery & Parts Technology Centre

Mechatronics Products Engineering Dept.

Document Number: K20010-01

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Product Description and Installation - Introduction

- This is [1] "Product Description and Installation" of the instruction manual for the robot module system.
- Section 3 to Section 5 describe the functions of the robot module.
- Read through the manual carefully to be well informed of the operations and functions of the robot module before transport, store or unpack the product.
- Section 6 to Section 12 describe the installation and startup procedures of the robot module and precautions.
- Hereafter, you are going to handle the robot module by hand actually. Observe the instructions and precautions for safe operations.
- Be sure to read the other two manuals below.
  - [2] Programming and Operation
  - [3] Maintenance

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Patents issued and patents pending.

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1. Introduction

2. Safety Precautions

3. System Configuration

4. Reference Number · Name of the Parts

5. Specifications and Dimensions

6. Transportation, Storage and Unpacking

7. Installation

8.Assemble

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10. Start Up

11. Initial Setting

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1. Introduction

- This manual describes how to build the robot system configured with the Module main units (standard, clean series and specially ordered) and EXC multi-axis controller.
- The manual provides information on the function, installation, interface, programming, operation and maintenance of the robot module system. Especially the manual is for the person who designs and / or builds the robot system or the machinery using the robot module.
- User's manual of the Robot module consists of three parts.

[1] Description of Products and Installation

○ Introduction, Safety Precaution, Description of Products, Specifications, Unpacking, Assemble, Installation and Wiring, Initialization and Basic operation.

[2] Programing and Operation

○ Teaching, Programming, Operation and Special Features. (Remote control, Pulse train output and Memory card.)

[3] Maintenance

○ Maintenance, Safety and Protection, Alarms, Trouble Shooting and Appendix.

Note : ① If the reference numbers of your modules are different from the information on this manual, some part of the explanation may not be applied to your model. In such case, ask for your local NSK representative for more details.

② The information for EXC controller on this manual is applied to version 04.

Example of EXC controller reference No.: M-EXC30A331A00-[04]
→ Version No.

1.1. Safety Precautions

- Before operating the robot module system, you should first thoroughly read this manual.
- Following notice is added to the clause of safety precautions to have your attention.

(Danger) : Might cause serious injuries.

(Warning) : Might cause injuries.

(Caution) : Might damage the equipment (machine) and / or the load.

- Refer to the applicable regulations specifying the requirements for the safety of industrial-use robots. Pay great attention to safety.
- Do not use the robot module system in any manner not shown in this manual.

1.2. General Description

- The robot modules and EXC controller can be combined into up to 3 axes Cartesian robot.
- In addition to it, EXC controller can output pulse train for user devices. NSK Megatorque Motor can be used for theta (θ) axis of user device.
- EXC controller is capable positioning control and other control features for pick & place, palletizing, sealing, machining and inspection operations.

1.3. Notes to Users

1.3.1. Axis Indication

- The following table shows the relationship between the axes indicated by the program, axis marks of the jog key on the teaching box, and axis unit numbers of the controller.

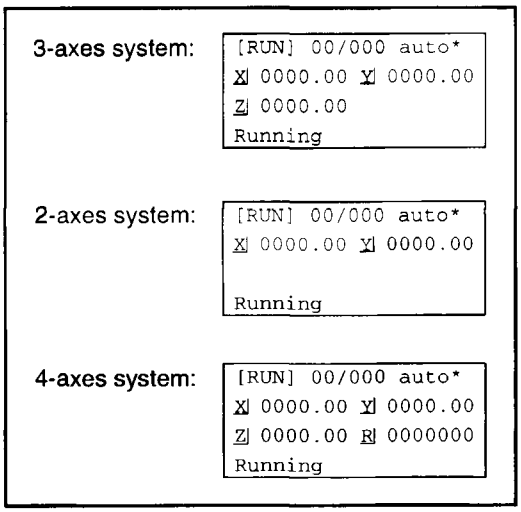
Table 1-1

Axis of Controller	Program Axis Definition & Jog Key Marks on Teaching Box
1st Axis	X-axis
2nd Axis	Y-axis
3rd Axis	Z-axis

Note : If the 2nd axis of a dual-axis type (EXC2 controller) is a vertical axis, it is still indicated as the Y-axis.

- In this manual, indication of teaching box is mainly described as three-axes system. For dual-axis system, the 3rd axis will not be indicated as Z-axis. For the four-axes system using pulse train output function, R-axis is added and indicated as fourth axis on the teaching box.

Figure 1-1: Axis indication example



1.3.2. Regeneration

- When decelerating or descending a heavy load, the servo motor of the module main unit will be a generator. This phenomenon is called regeneration.

- The dump resistor of EXC controller will dissipate generated energy by the motor. However, when regeneration continues or occurs frequently, the dump resistor will be overheated due to its limited capacity and "Over-heat" alarms will be on.

- When an over-heat alarm is detected, following remedies shall be taken.
  - Reduce duty cycle
  - Decrease deceleration
  - Lower operation speed

- Refer to Appendix 4. Regeneration and contact you local NSK office if necessary.

2. Safety Precautions

2.1. Robot Module System

Danger : *If the robot module makes an unexpected motion due to an error in the robot module or EXC controller or mal-operation or, even in normal operation, a person exists in the moving range of the robot module while the robot module is operating at a high speed, the person may be crushed, caught or drawn in.*

① In daily operations, surround the robot module with a safety fence or take other safety measures in order to prevent any personnels from entering the moving range of the robot module.

② If a personnel needs to go beyond the fence for adjustment or teaching, he should work in a place out of the moving range where the motion of the robot module is seen well. In such a case, select a robot moving speed below the safe speed (250 mm/second).

* The jogging and teaching speed is adjusted to 50 mm/second before shipment.

③ Before starting maintenance or other work which requires operations in the moving range of the robot module, be sure to turn off the power of the robot module.

④ If it is necessary to go beyond the fence without turning off the power in troubleshooting or the like, follow the instructions shown in Chapter 21. Troubleshooting. In other cases, do not enter the robot moving range without turning off the power.

Danger : *If an external force is applied in the axial direction, such as the vertical axis, with the power turned off, use a robot module with a brake. If a brake-less robot module is used, the slider (or the main unit if it is a moving axis type robot) drops when the power is turned off.*

Warning : *All models of robot modules employ the same type of connectors.*

- Before turning on the power, check if the robot module is connected with the controller properly.
- If the robot module is operated under the condition where it is connected improperly, the robot module may move unexpectedly or the motor may be broken. See "10.1.1. Preparation for Turning on Power".

Warning : *Special EMC (Electro Magnetic Compatibility) measures are not taken for the robot module system. Do not use the robot module system in an environment subject to much external noises. In an environment where noises produced by the robot module system cause bad influences, shield the EXC controller, use a noise filter or take other countermeasures.*

- The following shows the noise resistance of the EXC controller itself.

Table 2-1

Item	Specification	Reference
Line noise resistance	1000V, 1μs	Checked by noise simulator
Static noise resistance	3kV	

Caution : *The EXC20 and EXC30 (rack mount type) controllers have no brake power supply units. Be sure to supply 24 VDC from outside.*

CN2, pin 13: +24 V
CN2, pin 22: 0 V

If the robot module system is kept running without supplying brake power, the brake may be broken.

Caution : *Before turning off the controller power, be sure to deactivate the servo system. If the power is turned off with the servo system active, the slider (or the module main unit if it is a moving axis type robot) of a vertical axis may drop by approximately 5 to 10 mm.*

* If critical failures occur or the robot module system is stopped in emergency, the hardware immediately deactivates the servo system forcedly. The slider (or the module main unit of a moving axis type robot module) of a vertical axis may drop by approximately 5 to 10 mm, since there is a time lag between deactivating the servo system and locking the brake. This does not imply any error.

Caution : *The acceleration speed of each axis should not exceed the transportable moment of the module. (The acceleration speed is included in the initial setting items of the controller. For the transportable moment of the module, see "5.1.1. Transportable Moment".) When moments act in two or three directions at the same time, each moment should be not more than 60% of the transportable moment. If the robot module is kept running at an acceleration speed exceeding this limit, the main unit may be broken or the service life is reduced.*

Caution : • *Set the system parameters in accordance with the main unit. If the encoder resolution, ball screw lead, motor installation or brake setting does not fit the module, the robot module may malfunction. See "11.4. Motor Parameters" and "11.5. Control Parameters" and set the parameters properly.*

• *If a memory error occurs, initialize the system parameters to reset the system. In such a case, set the system parameters again in accordance with the module main unit.*

Caution : *The robot module is a precision machinery component. Handle it with great care not to apply shocks to it.*

2.2. EXC Controller

(Danger) : *Install and operate the EXC controller in the environmental conditions shown below.*

Table 2-2

Items		Conditions
Temperature	Operating	0°C ~ 50°C
	Storage	-10°C ~ 70°C
Humidity	Operating	20% ~ 85%
	Storage	
Environment		• Free from contamination and corrosive, flamable and explosive gas. • Free from cutting oil and cooling water.

- Failure to meet these environmental conditions may result in not only a breakdown of the controller and shorter service life but also electric shock, fire or other serious accidents.

(Danger) : *The controller incorporates large-capacity electrolytic capacitors. Even after the power is turned off, the capacitors stays charged electrically for several minutes. Do not remove the case unless necessary (such as replacing the batteries). If it is necessary to remove the case, turn off the power and wait for five minutes or more. See "19.2.2.2. Periodical Replacement".*

(Danger) : *Be sure to ground the FG terminal of the EXC controller in order to avoid electric shock. For grounding, see "9.2.5. Grounding".*

(Caution) : *Do not carry out an insulation resistance test of the EXC controller.*

2.3. Module Main Unit

(Danger) : *Do not disassemble the parts not shown in the maintenance manual.*

(Danger) : *Do not use the robot module in an atmosphere exposed to dust, fine particles, corrosive gas, inflammable gas or explosive gas.*

(Caution) : *Each module has, at both stroke ends, stoppers which absorb shocks. However, make every effort to avoid hitting stoppers. If a module hits at the stroke end, check it as shown in "21.2.5. Actions in Case of Runaway or Hitting", then restart it.*

(Caution) : *Install the module main unit on a flat and smooth surface. (Recommended flatness: 0.1 mm or less)*

(Caution) : *When installing the module main unit on the frame or the end effector (*) on the module or slider, do not screw the fixing bolts exceeding the depths shown in Figs. 5-4, 5-5, 5-6 and 5-7.*

(Caution) : *It is impossible to restrict the motion of the robot module with external stoppers. If pushing and pulling are done by means of the thrust, the moment applied to the module should be less than the transportable moment. See "5.1.1. Transportable Moment".*

(Caution) : *The module main unit is sealed with seal belts to keep out foreign matters. However, it is not drip or water resistant. Be careful not to splash drips or oil onto the module.*

(Caution) : *Use the module at an ambient temperature between 0 and 40°C. No dew condensation is allowed. In particular, since the motor produces heat, do not install it near a heat source.*

* End effector: A generic name of the hand units, etc. which are installed in the moving mechanism of the robot module by the user

3. System Configuration

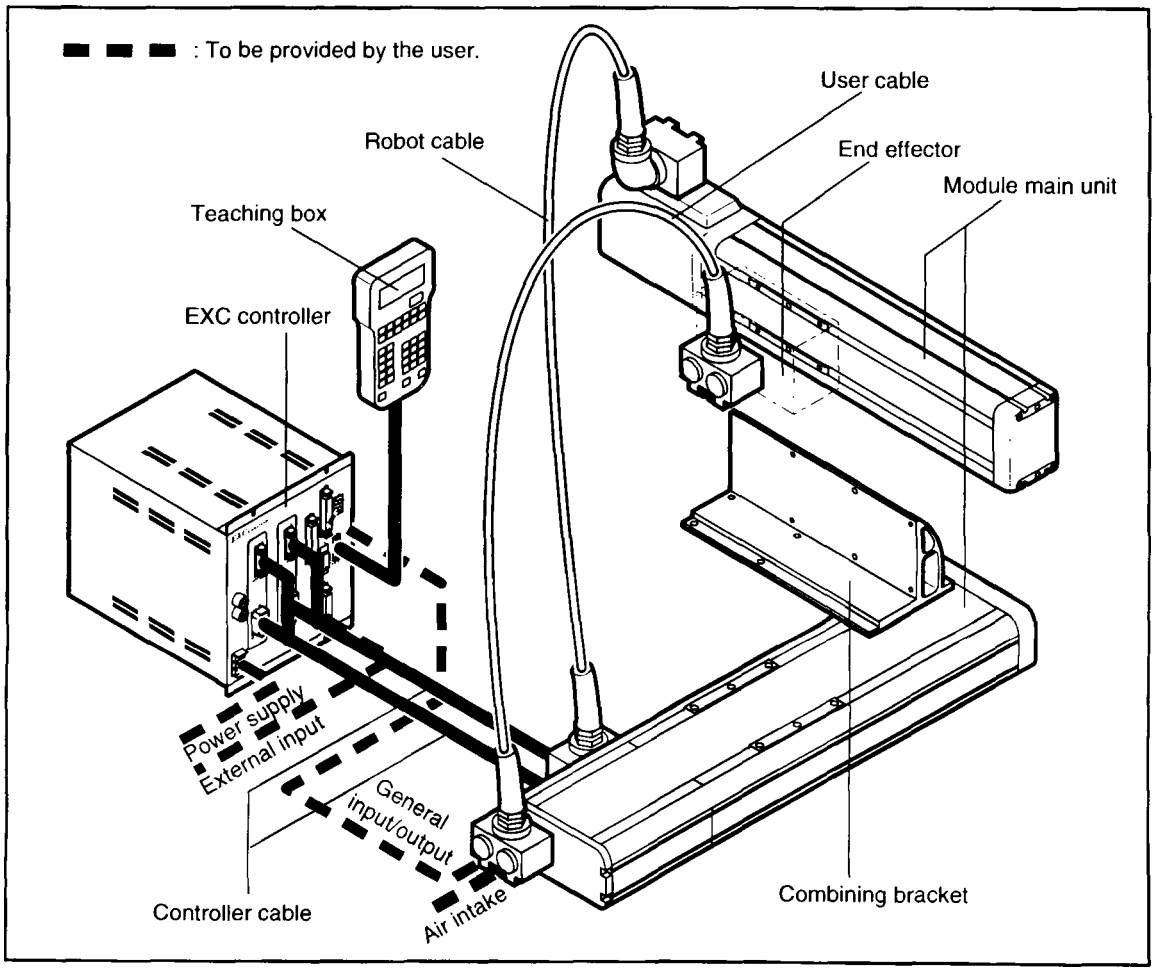
- The robot module consists of the module main unit and EXC controller.

3.1. General System Configuration

- Connect the module main unit and EXC controller with the controller cables and robot cables.
- The controller cables cannot be connected to the moving part. Use the robot cables for such parts. Connect the moving axis to the stationary axis with the robot cable, then connect the stationary axis to the EXC controller with the controller cable, or use the flexure resistant controller cable for moving parts (order made).
- A robot cable has a motor power cable, encoder signal cable, over-travel sensor signal cable and two air tubes.

  These two air tubes need not be connected since the robot module does not use them. They can be used to supply air to the end effector. (Maximum service pressure: 588 kPa or 6 kgf/cm^2)
- For a long stroke operation, the cable support unit is needed, instead of the robot cable.
- A controller cable has a motor power cable, encoder signal cable, and over-travel sensor signal cable.
- Module main units are combined each other using the combining bracket. Fix them with hexagon socket cap screws.
- If an end effector is installed on the slider, it is possible to control operation with the general output signals of the EXC controller by using the robot cable as a user cable.

Note : For combinations and assembly procedures, see "Chapter 8. Assembly".



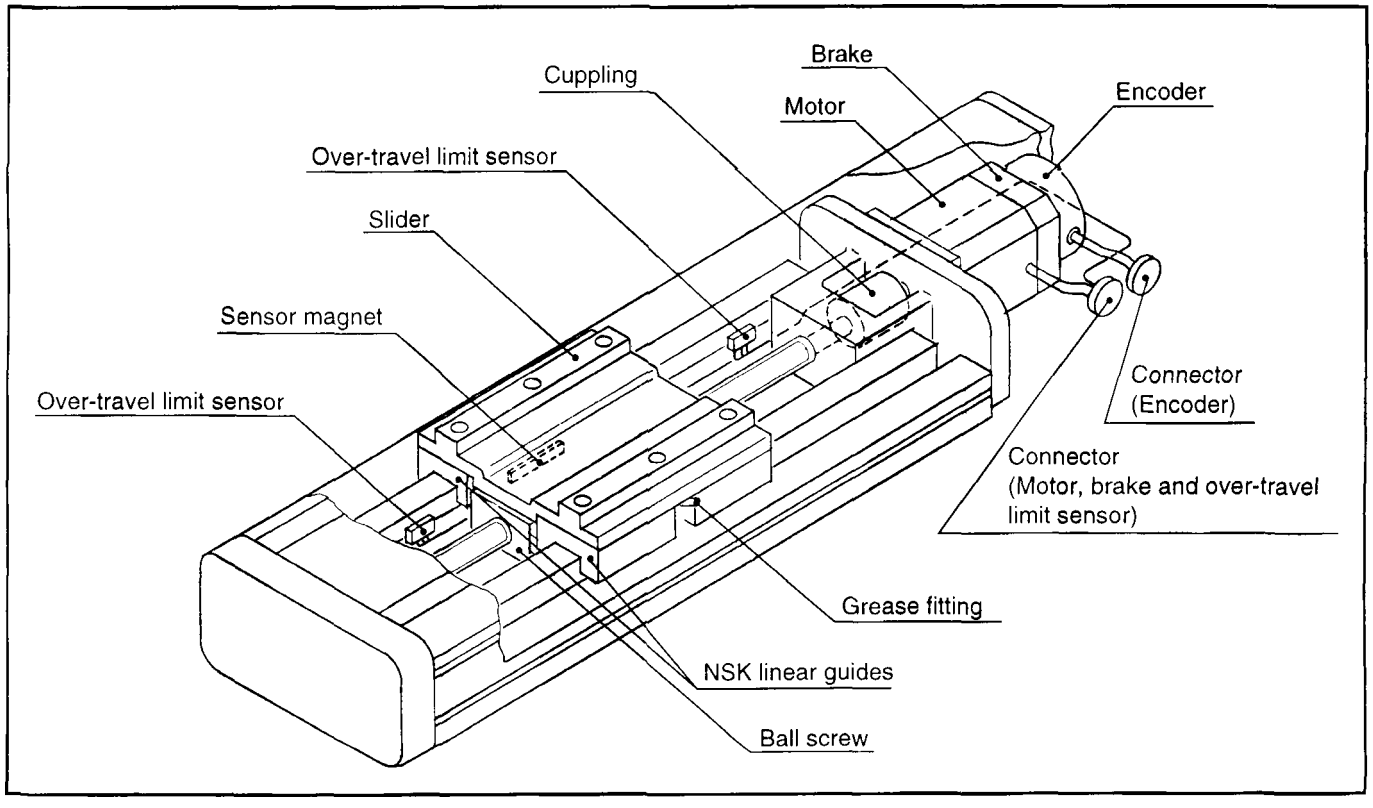
3.2. Configuration of Module Main Unit

- The following table shows the elements of the module main unit and their functions.

Table 3-1

Names	Functions
Motor	• Produces a driving force (rotational torque) using current supplied by the EXC controller.
Encoder	• Outputs electrical signals according to the rotational angles of the motor to the EXC controller.
Coupling	• Couples the motor shaft with the ball screw shaft and transmits the rotational torque of the motor to the ball screw shaft.
Ball screw	• Converts the rotational torque (rotational motion) of the screw shaft into the thrust (linear motion) of the nut.
NSK linear guides	• Works as the guide way. Supports vertical, lateral and rotational load applied to the slider.
Slider	• Couples the ball screw nut and linear guide bearing for precision linear motion. • Used to fix the end effector or the combining bracket.
Over-travel sensor	• Detects the stroke end of the main unit body and outputs it to the controller.
Brake	• Release the brake when current is applied by the EXC controller. Applies the brake when the current from the controller is cut off.

Figure 3-2



3.3. System Configuration of Controller

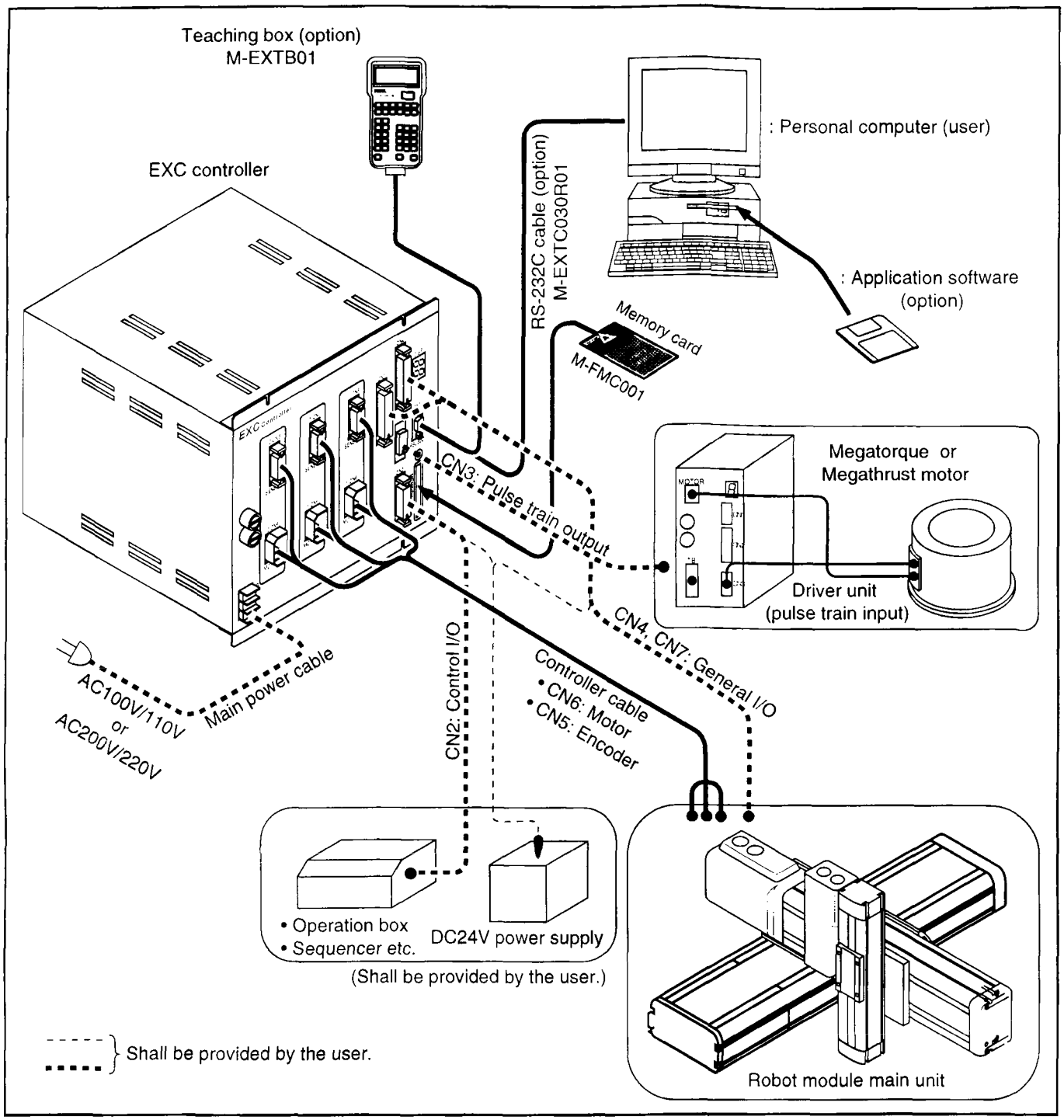
- The following table shows the elements of the EXC controller system and their functions.

Table 3-2

Names	Functions	Remarks
EXC controller	• Controls the robot module system completely. • Supplies current for operating the robot module to the motor according to the preset programs and system parameters, when operation starts. • Uses the encoder signals as the positional feed-back signals and executes high-precision positioning.	
Teaching box	• Used for manual operations of the EXC controller such as inputting programs, setting the parameters, executing jogging, returning to the home position, starting the program, etc.	Sold separately from the EXC controller.
Operation box, sequencer and 24 VDC power supply unit	• Used to input control signals from outside when the EXC controller is in the external control mode. • The stand-alone type incorporates a 24 VDC power supply unit. (Current capacity: 2 A)	Should be prepared by the user.
Pulse train input unit	• Allows the pulse train output function to be used for an additional axis. Megatorque Motors and Megathrust Motors can be used.	Please contact NSK.
Memory card	• Stores programs and parameters. • Stored programs and parameters can be used for backup in case the programs should be corrupted.	• Please specify the memory card type controller when placing an order. • The memory card itself is optional.
Personal computer application software	• Software for the NEC PC9801. • Creates the EXC controller programs, sets the parameters and creates backup copies.	Supplied in a floppy disk. Sold separately from the EXC controller.
Personal computer	• Controls the EXC controller remotely (through the communication interface of the personal computer) and runs the personal computer application software.	Should be prepared by the user.
RS-232C cable	• Connects the EXC controller and personal computer for remote control of the EXC controller (through the communication interface of the personal computer). • Also used to run the personal computer application software shown above.	Sold separately from the EXC controller.
Power cable	• Supplies power to the EXC controller.	Should be prepared by the user.
CN2: Control I/O cable	• Connects the EXC controller with the operation box, sequencer or another external control unit.	Should be prepared by the user.* (The connectors are supplied.)
CN4 and CN7: General I/O cables	• Transmit general input and output signals for controlling the end effector, etc.	Should be prepared by the user.* (The connectors are supplied.)
CN3: Pulse train output cable	• Connects the pulse train input unit with the EXC controller.	Should be prepared by the user.* (The connectors are supplied.)

* The Control I/O cable (CN2), general I/O cables (CN4 and CN7) and pulse train output cable (CN3) should be shielded cables.

Figure 3-3



Note : ① Specify main power line voltage when ordering.

② Memory card is optional. Specify when ordering.

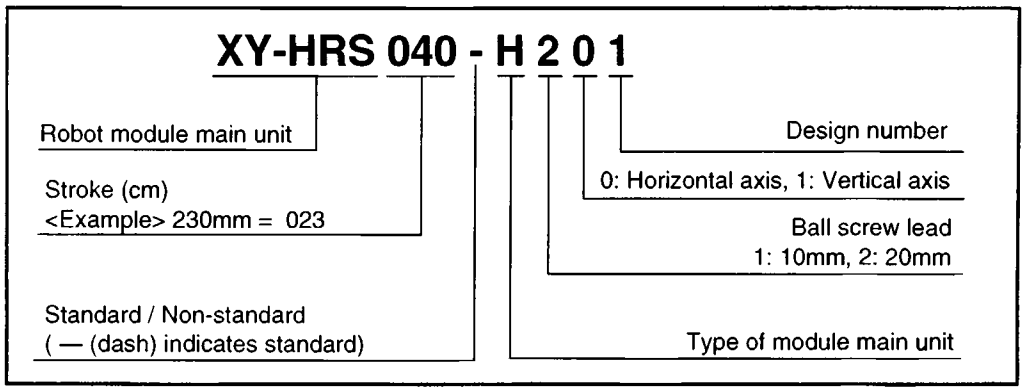
③ DC24V power supply is only provided with stand-alone type EXC controller. For rack-mount type EXC controller, user must provide the power supply.

4. Reference Number • Name of the Parts

4.1. Module Main Unit

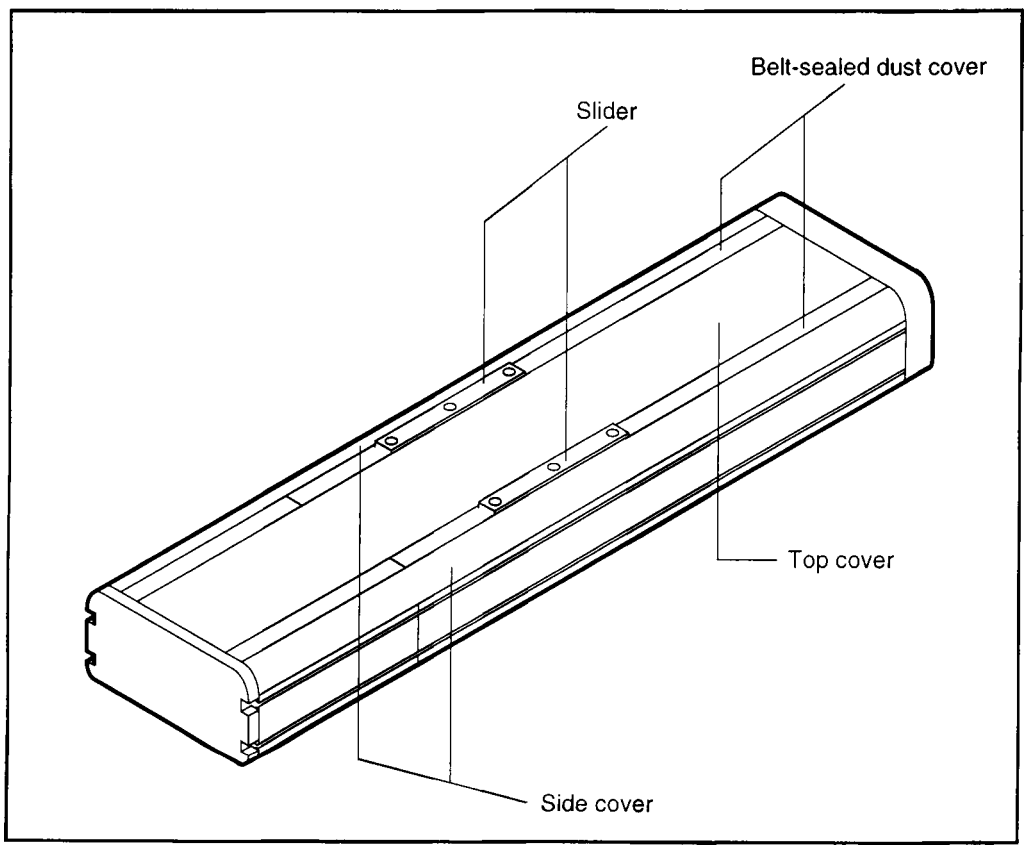
- Module main unit is a linear actuator configured with NSK linear guide, ball screw, AC servo motor and over travel limit sensor.

Figure 4-1: Reference number configuration of Module main unit



- For a special or clean room module main unit, refer to "5.2. Special Module Main Unit" or "5.3. Clean Room Module Main Unit" respectively.

Figure 4-2: Name of the parts (Module main unit)



4.2. Mounting Bracket

- Use a mounting bracket when fixing a module main unit from top side using bolts. We recommend that you use, 2 or 3 sets of the bracket according to stroke. (Refer to Figure 5-4, 5-5 and 5-6 for more details.)

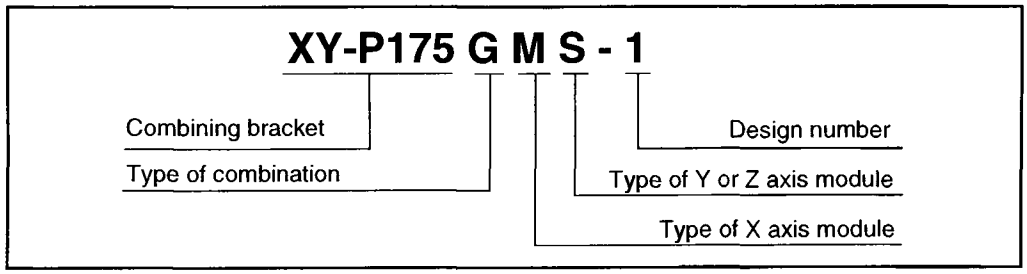
Figure 4-3: Mounting bracket reference number

H module main unit	**XY-P170H-1**
M module main unit	**XY-P170M-1**
S module main unit	**XY-P170S-1**

4.3. Combining Bracket

- Use a combining bracket when building a multi-axis robot.

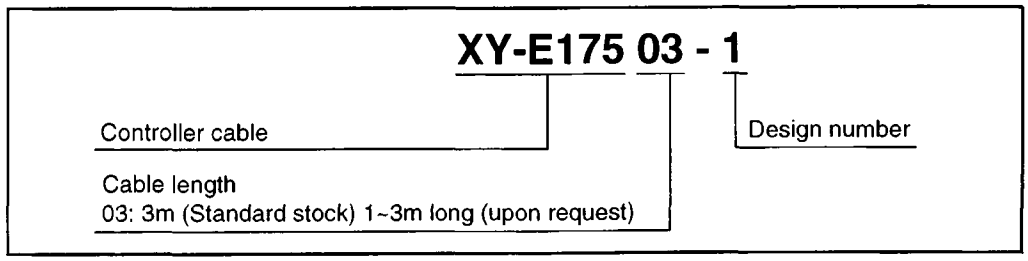
Figure 4-4: Combining bracket reference number (Example)



4.4. Controller Cable

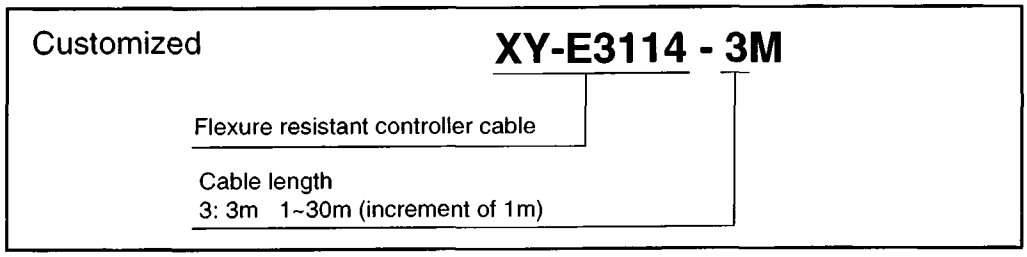
- Use a controller cable to connect a module main unit and EXC or EXA controller.

Figure 4-5: Controller cable reference number



- When connecting the controller to a moving part, use a flexure resistant controller cable.

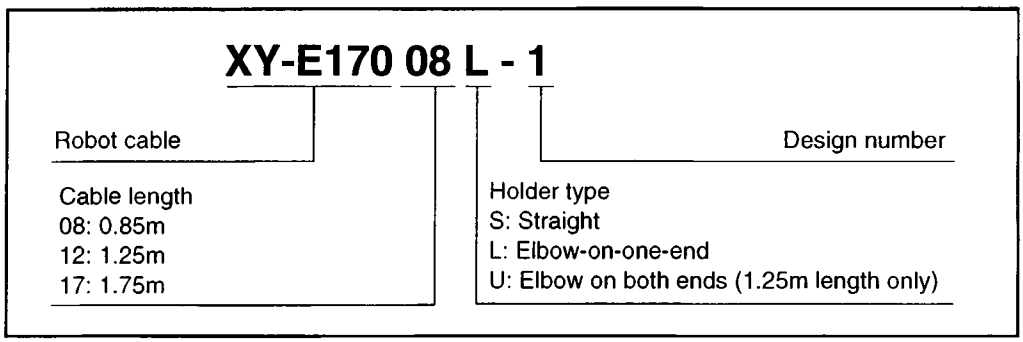
Figure 4-6: User cable reference number



4.5. Robot Cable

- Use a robot cable to connect a moving axis (upper axis) and the controller cable. The robot cable is a flexure resistant cable.

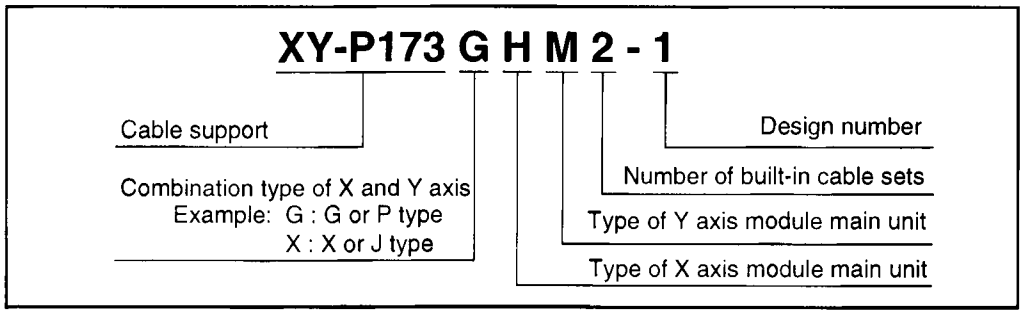
Figure 4-7: Robot cable reference number



4.6. Cable Support

- Use cable support (optional) for connecting the moving module main unit and the controller cable. The cable support can be used for a long stroke X axis for which a robot cable can not be used due to its limited length.

Figure 4-8: Cable support reference number



4.7. EXC Controller

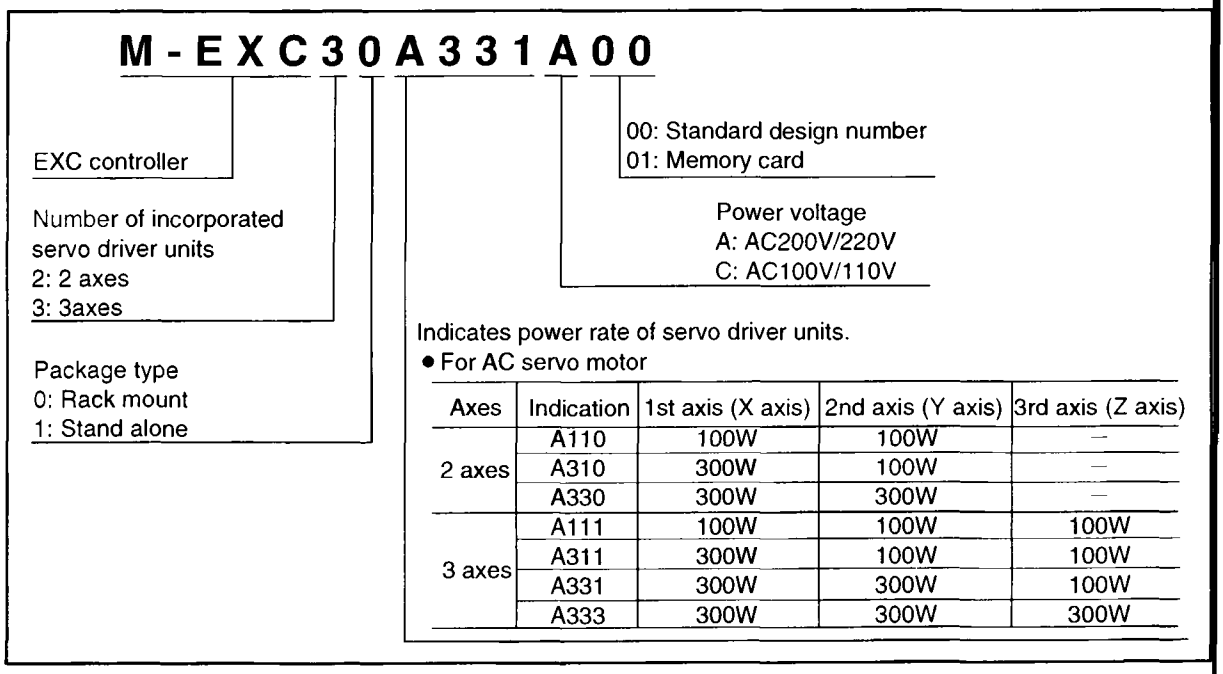
- The EXC controller is a multi-function, multi-axis controller with a dual-axis or triple-axis servo driver. It provides the following controls:
  - ○ Sequence commands: Timer, conditional jumping, repetition, etc.
  - ○ Move commands: Triple-axis linear interpolation, dual-axis circular interpolation, and continue pass
  - ○ Palletizing command
  - ○ Controls of the hand and other slave units through 32 general I/Os
  - ○ 100 programs and a maximum of 5000 steps*

  In addition, the EXC controller is capable of smooth sine acceleration and deceleration, feed forward compensation, digital filtration and other control functions for high-level motion control.

- Two types of controllers are available: A compact rack mount type controller for easy installation on the electric panel, and an all-in-one stand-alone type controller with built-in 24 VDC power supply unit, emergency stop switch, etc.

* The number of steps differs with the combinations of the program commands. For details, see "13.2.1. Programming Area".

Figure 4-9: Reference number configuration of EXC controller



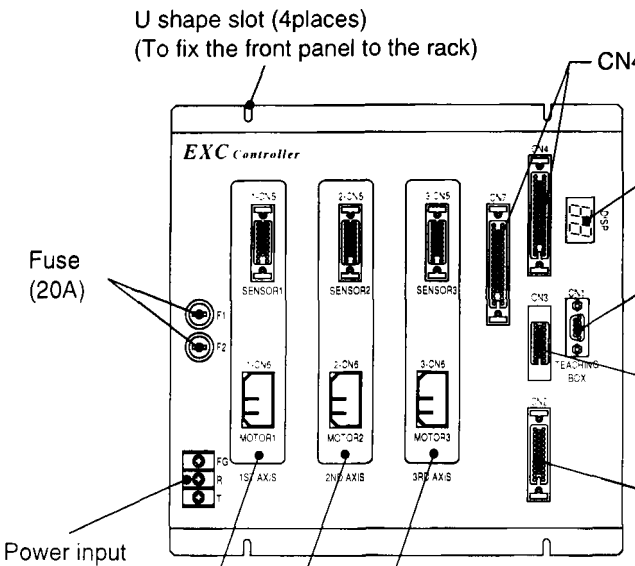
Axes	Indication	1st axis (X axis)	2nd axis (Y axis)	3rd axis (Z axis)
2 axes	A110	100W	100W	—
	A310	300W	100W	—
	A330	300W	300W	—
3 axes	A111	100W	100W	100W
	A311	300W	100W	100W
	A331	300W	300W	100W
	A333	300W	300W	300W

Table 4-1: Functional difference (Rack mount and Stand-alone)

	Rack mount	Stand-alone
Emergency stop switch (Mushroom button) on the front panel	×	
24V external power supply	×	(built-in)
Main power switch	×	

4.7.1. Rack Mount Type

Figure 4-10: Appearance of rack mount type



CN4 & CN7 connectors
- General I/O. Use to control end-effectors or input conditional branch signals in programmed operation.

7-segment LED indicator
- Displays alarm states. Display " ⊡ " in the normal condition.

CN1: Teaching box connector
- Can be used for RS-232C connector.

CN3: Pulse train I/O connector
- Use to control an additional axis using pulse train output.

CN2: Control I/O connector
- Signal I/O connector to control EXC controller.

3rd (Third) axis (Z-axis)
2nd (Second) axis (Y-axis)
1st (First) axis (X-axis)
} Motor and encoder connector

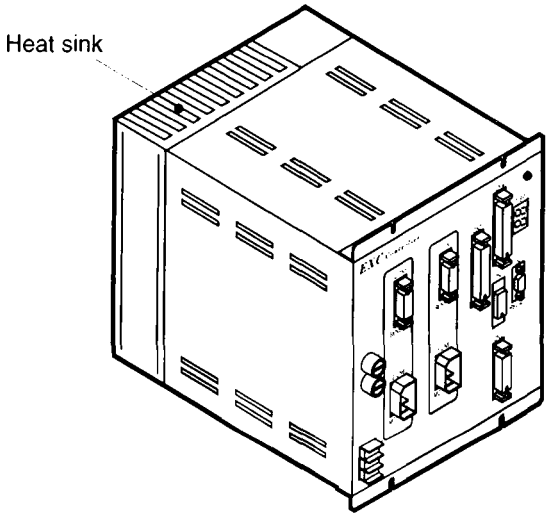
CN6: Motor connector
CN5: Connector for encoder and over travel limit sensor.

* A set of CN5 and CN6 is provided for each axis.

1st (First) axis	(X-axis)	: 1-CN5, 1-CN6
2nd (Second) axis	(Y-axis)	: 2-CN5, 2-CN6
3rd (Third) axis	(Z-axis)	: 3-CN5, 3-CN6

3rd axis connector is not provided for 2-axis EXC controller.

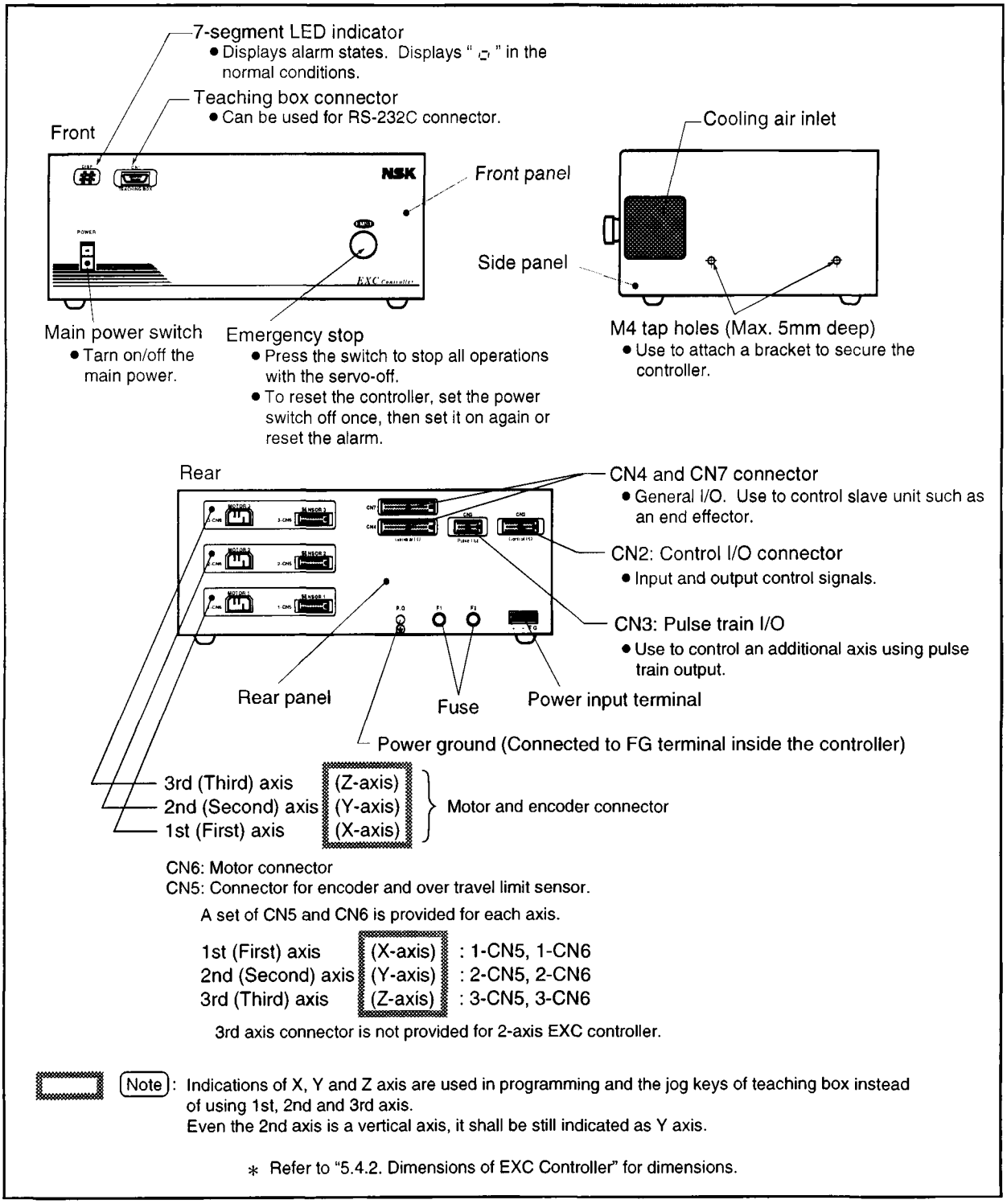
Note: Indications of X, Y and Z axis are used in programming and the jog keys of teaching box instead of using 1st, 2nd and 3rd axis.
Even the 2nd axis is a vertical axis, it shall be still indicated as Y axis.



* Refer to "5.4.2. Dimensions of EXC Controller" for dimensions.

4.7.2. Stand-Alone Type

Figure 4-11: Appearance of stand-alone type



CN6: Motor connector
CN5: Connector for encoder and over travel limit sensor.

A set of CN5 and CN6 is provided for each axis.

1st (First) axis	(X-axis)	: 1-CN5, 1-CN6
2nd (Second) axis	(Y-axis)	: 2-CN5, 2-CN6
3rd (Third) axis	(Z-axis)	: 3-CN5, 3-CN6

3rd axis connector is not provided for 2-axis EXC controller.

Note: Indications of X, Y and Z axis are used in programming and the jog keys of teaching box instead of using 1st, 2nd and 3rd axis.
Even the 2nd axis is a vertical axis, it shall be still indicated as Y axis.

* Refer to "5.4.2. Dimensions of EXC Controller" for dimensions.

4.8. Teaching Box

- The teaching box is used for programming, initializing and trial operation.

Figure 4-12: Teaching box reference number

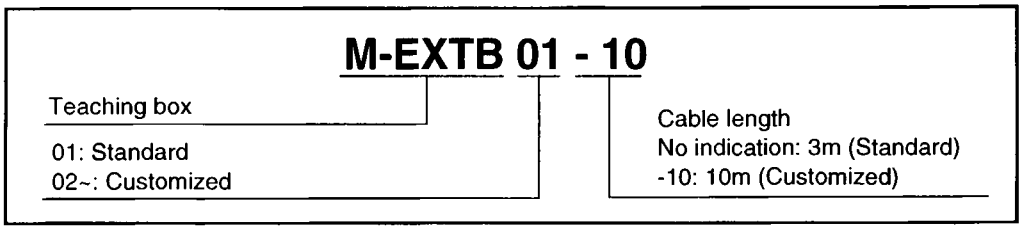


Figure 4-13: Keys on the teaching box and their functions

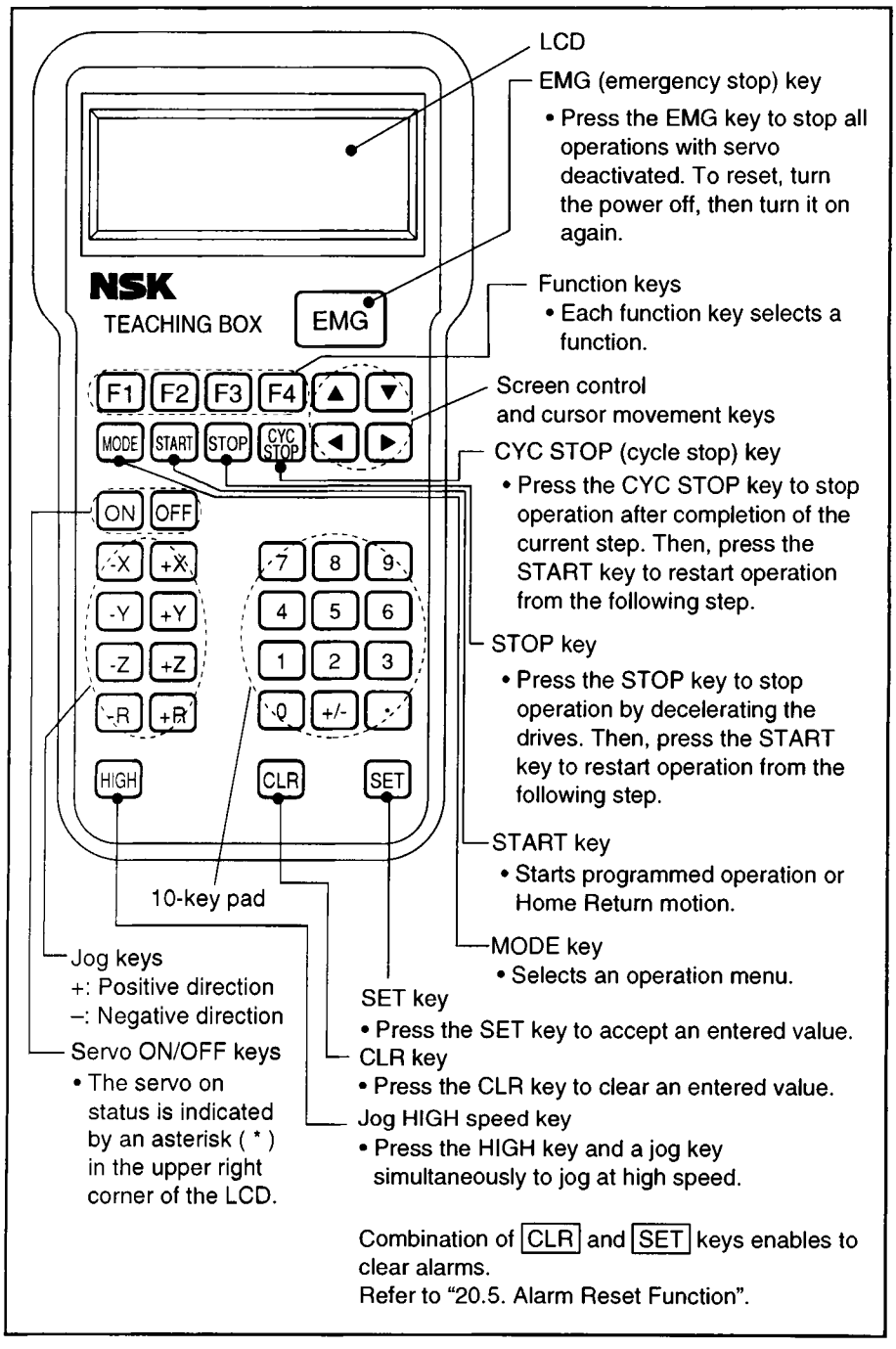
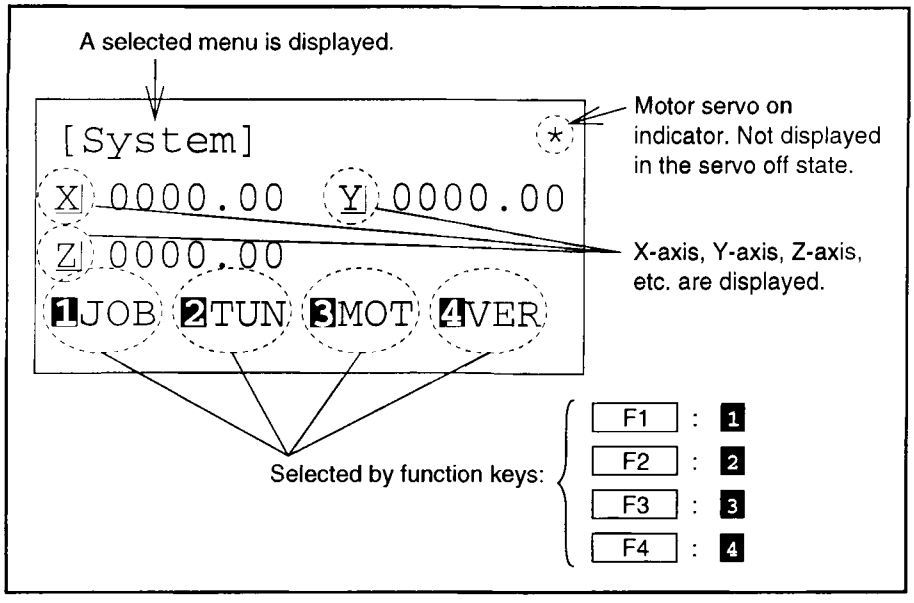


Figure 4-14: Display example on LCD



4.9. Memory Card

- Programs and parameters can be written in a program card for making a backup copy.
- The memory card is 32KB EEPROM.
- The memory card uses no batteries, eliminating the necessity of replacing batteries.

Figure 4-15: Memory card reference number

M-FMC 001

4.10. Personal Computer Application Software

- Program editing software designed for the NEC PC9801 Series.
- This software creates programs, sets the parameters and creates backup copies.
- This software is supplied in a floppy disk.

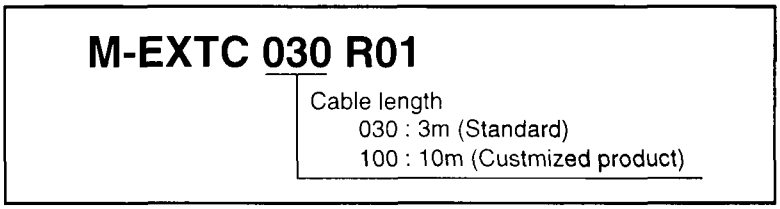
Figure 4-16: Reference number of application software

M-EXTA 01

4.11. RS-232C Cable

- The RS-232C cable connects the EXC controller with the personal computer for remote control of the EXC controller (through the communication interface of the personal computer) or using the personal computer application software.
- The RS-232C cable has a standard D-sub 25-pins connector on the personal computer side, not a half-pitch connector.

Figure 4-17: Reference number of RS-232C cable



4.12. Technical Terms

◉ Safety fence

○ A fence or cover installed around the robot in order to prevent any persons from entering the moving range of the robot while the robot is running.

◉ Safe speed

○ The low moving speed which allows a person to avoid the robot even when the robot moves unexpectedly. The recommended safe speed is 250 mm/second or less.

◉ Moving speed

○ The maximum speed of the movable part of the robot (i.e., the slider or the module main unit of a moving axis type robot), which is reached on completion of acceleration.

◉ Moving acceleration and deceleration speed

○ The acceleration and deceleration speed of the movable part of the robot (i.e., the slider or the module main unit of a moving axis type robot) when it is moving. The acceleration speed of the EXC controller is equal to the deceleration speed.

◉ Operation duty

○ The frequency of operations. The ratio of stopping time to the operating time. Or, in some case, the frequency of acceleration and deceleration in the unit time. If acceleration and deceleration are repeated at all times or frequently, the operation duty is great.

◉ Moving range

○ The largest area occupied by the robot when the robot is combined with all axes, end effectors are installed, a work piece is set, and the slider of each axis (or the module of a moving axis type robot) moves to the stroke end. If a person exists in this area, he may possibly be hit, caught or drawn in.

◉ Servo ON condition

○ The condition where the servo is active and the motor can accept an operation command. If no move command is input in the servo ON condition, the servo driver keeps the current position. Such a condition is called the servo lock condition.

◉ Servo OFF condition

○ In this condition, no current flows through the motor and the motor does not accept an operation command. Unless the movable part is secured with a brake, it is moved by an external force.

◉ CPU

○ A microprocessor which controls the EXC controller.

◉ Slider movement and moving axis

○ Normally, the slider moves linearly as the motor rotates. This is called the slider movement. If the slider is fixed, the module main unit moves linearly. This is called the moving axis.

◉ Motion by inertia

○ Motion of the moving part by inertia. Even after the electric power to the motor is cut off, the motor keeps moving by the kinetic energy acquired until then.

◉ Interpolation

○ In a multi-axis system where the movable parts of these axes move simultaneously, a linear resultant trace of the axes is called the linear interpolation and its circular trace is called the circular interpolation. A two-dimensional trace is called the dual-axis interpolation. A three-dimensional trace is called the triple-axis interpolation.

◉ Work piece

○ An object of robot operation (such as machining, assembly, packing or sealing) is called a work piece.

◉ End effector

○ A tool for conducting operation for work pieces, the hand of the robot, or another additional device of the robot module.

◉ EMC

○ Electromagnetic compatibility for noises. If both the EMI (electromagnetic interference: Emission) and EMS (electromagnetic sensitivity: Immunity) measures have been taken, it can be said that the EMC measures have been taken.

5. Specifications and Dimensions

5.1. Specifications of Standard Module Main Unit

Table 5-1: Specifications

		H module	M module	S module	S module-Vertical
Stroke (mm)		300, 400, 500 600, 800, 1000	250, 350, 450 550, 750, 950	130, 230, 330 430, 530	130, 230
Maximum speed (mm/s)		1200	1200	*1200	600
Horizontally transportable load (kg)		60	40	20	(Vertical) 15
Rated thrust force (N)		300	300	**120	240
Transportable moment (Refer to chapter 5.1.1.)	Rolling (N • m)	600	70	27	27
	Pitching (N • m)	400	120	10	10
	Yawing (N • m)	350	120	10	10
Repeatability (mm)		±0.010	±0.010	±0.010	±0.010
Motor output (W)		300	300	100	100 (With brake)
Controller main power voltage (V)		200	200	200	200
Ball screw lead (mm)		20	20	***20	10
Motor mount position		Direct mount	Direct mount	Right side	Left side
Operating temperature		0~40°C			
Operating humidity		20~85% (None condensing)			

* : The maximum speed for 130mm and 230mm stroke modules is 600mm per second

** : The rated thrust force for 130mm and 230mm stroke modules is 240N.

***: The lead for 130mm and 230mm stroke modules is 10mm.

SI unit	1N ≒ 0.102kgf 1N • m ≒ 0.102kgf • m

5.1.1. Transportable Moment

(1) The transportable moment denotes the maximum moment which the module body can bear in operation. The estimated life distance is 5000 km, provided the module runs at the transportable moment.

(2) If moments are applied simultaneously in two or three directions, each moment should be not more than 60% of the transportable moment. (See Examples 1 and 2 in Fig. 5-1.)

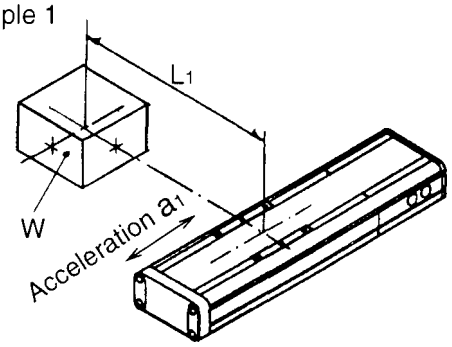
(3) The moment applied to the module depends on the "weight of the end effector installed on the slider", "position of the center of the gravity" and "operation acceleration (set on the controller)". This moment should be less than the transportable moment. (See Fig. 5-1.)

Caution : (1) If a moment exceeding the transportable moment is applied to the module, the module may be damaged.

(2) The moments caused by the weight of the Y and Z modules should be taken into account to find the X-axis moment in a multi-axis system. (The center of the gravity of each module should be the center of the overall length.)

Figure 5-1: Calculation of moment

Example 1



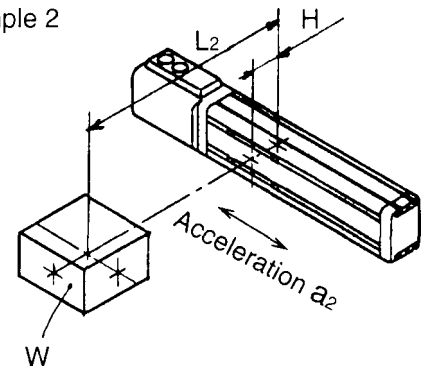
Rolling moment

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

Yawing moment

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

Example 2



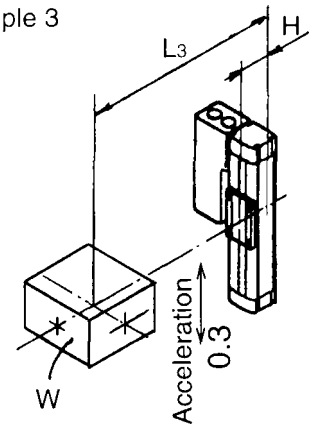
Rolling moment

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

Pitching moment

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

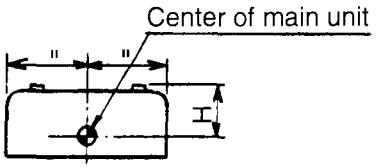
Example 3



Pitching moment

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

Figure 5-2: Position of module main unit center H



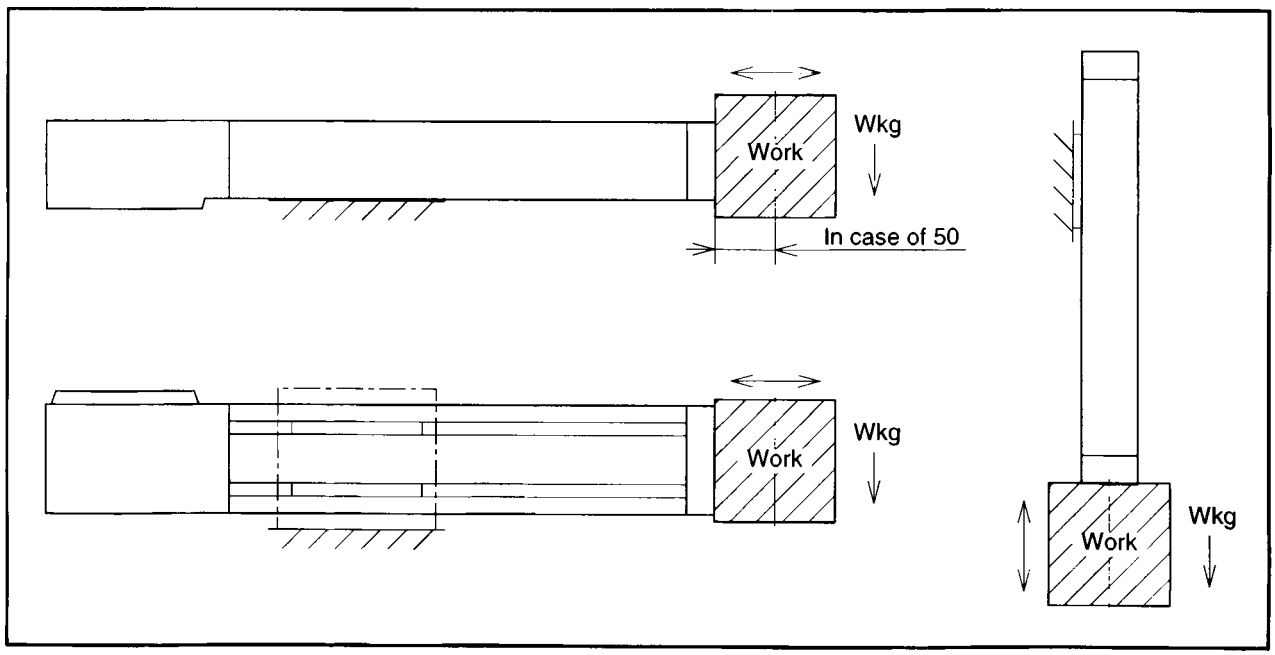
H module: H = 0.04		[m]
M module: H = 0.065		[m]
S module: H = 0.045		[m]

5.1.2. Transportable Load of Moving Axis

Table 5-2

Horizontal axis						Vertical axis	
H module		M module		S module		S module vertical axis	
Stroke [mm]	Transportable load W [kg]	Stroke [mm]	Transportable load W [kg]	Stroke [mm]	Transportable load W [kg]	Stroke [mm]	Transportable load W [kg]
300	40	250	25	130	3	130	10
400	40	350	20	230	1.4	230	9
500	40	450	16				
600	36	550	12				
800	25	750	7				
1000	17	950	3				

Figure 5-3



(Caution) : *If the whole module main unit of a multi-axis system moves, the transportable load may be less than shown in Table 5-2 due to the restrictions of the transportable moment. In such a case, investigate the moment. (See "5.1.1. Transportable moment" above.)*

5.1.3. Module Dimensions and Mass

- For dimensions of module main unit, refer to Figure 5-4, 5-5, 5-6 and 5-7.

Figure 5-4: H module

H module

Ref. number	Stroke (mm)	L (mm)	SA (mm)	SB (mm)	Weight (kg)
XY-HRS100-H201	1000	1440	800	540	34
XY-HRS080-H201	800	1240	600	440	29
XY-HRS060-H201	600	1040	400	340	25
XY-HRS050-H201	500	940	300	290	23
XY-HRS040-H201	400	840	200	240	21
XY-HRS030-H201	300	740	100	190	19

Note: The *-marked tap hole in the drawing shown below is 8-M8, depth 12, for the XY-HRS040-H201.

Mounting bracket kit (sold separately)

Ref. number:	XY-P170H-1

Note: Each kit has one bracket. We recommend that you use 2 kits for models with a stroke of 600 mm or less, and 3 kits for models with a stroke of 800 mm or more.

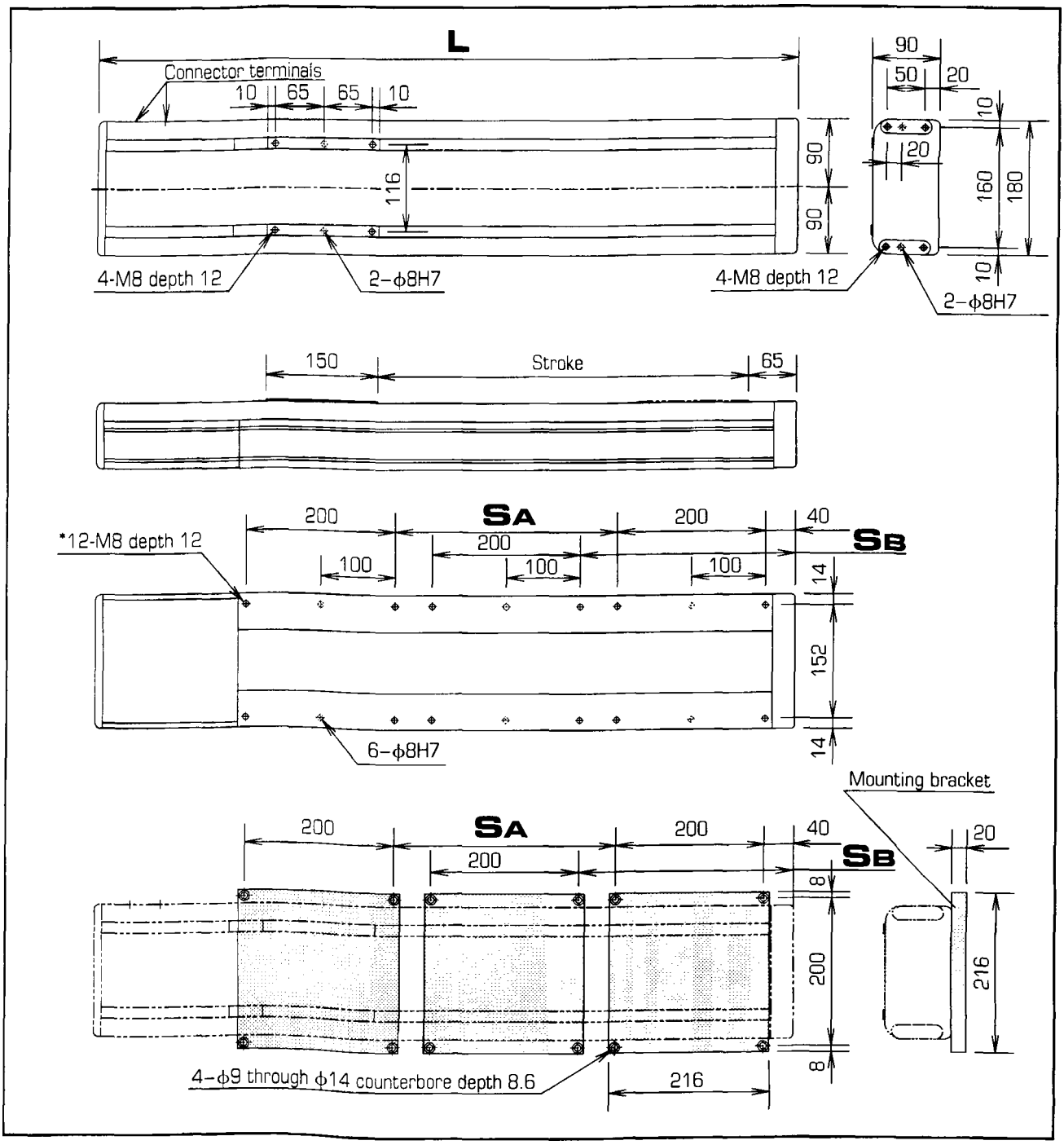


Figure 5-5: M module

M module

Ref. number	Stroke (mm)	L (mm)	SA (mm)	SB (mm)	Weight (kg)
XY-HRS095-M201	950	1420	770	527	20.0
XY-HRS075-M201	750	1220	570	427	17.0
XY-HRS055-M201	550	1020	370	327	14.5
XY-HRS045-M201	450	920	270	277	13.5
XY-HRS035-M201	350	820	170	227	12.5
XY-HRS025-M201	250	720	70	177	11.5

Mounting bracket kit (sold separately)

Ref. number:	XY-P170M-1

Note: Each kit has one bracket. We recommend that you use 2 kits for models with a stroke of 550 mm or less, and 3 kits for models with a stroke of 750 mm or more.

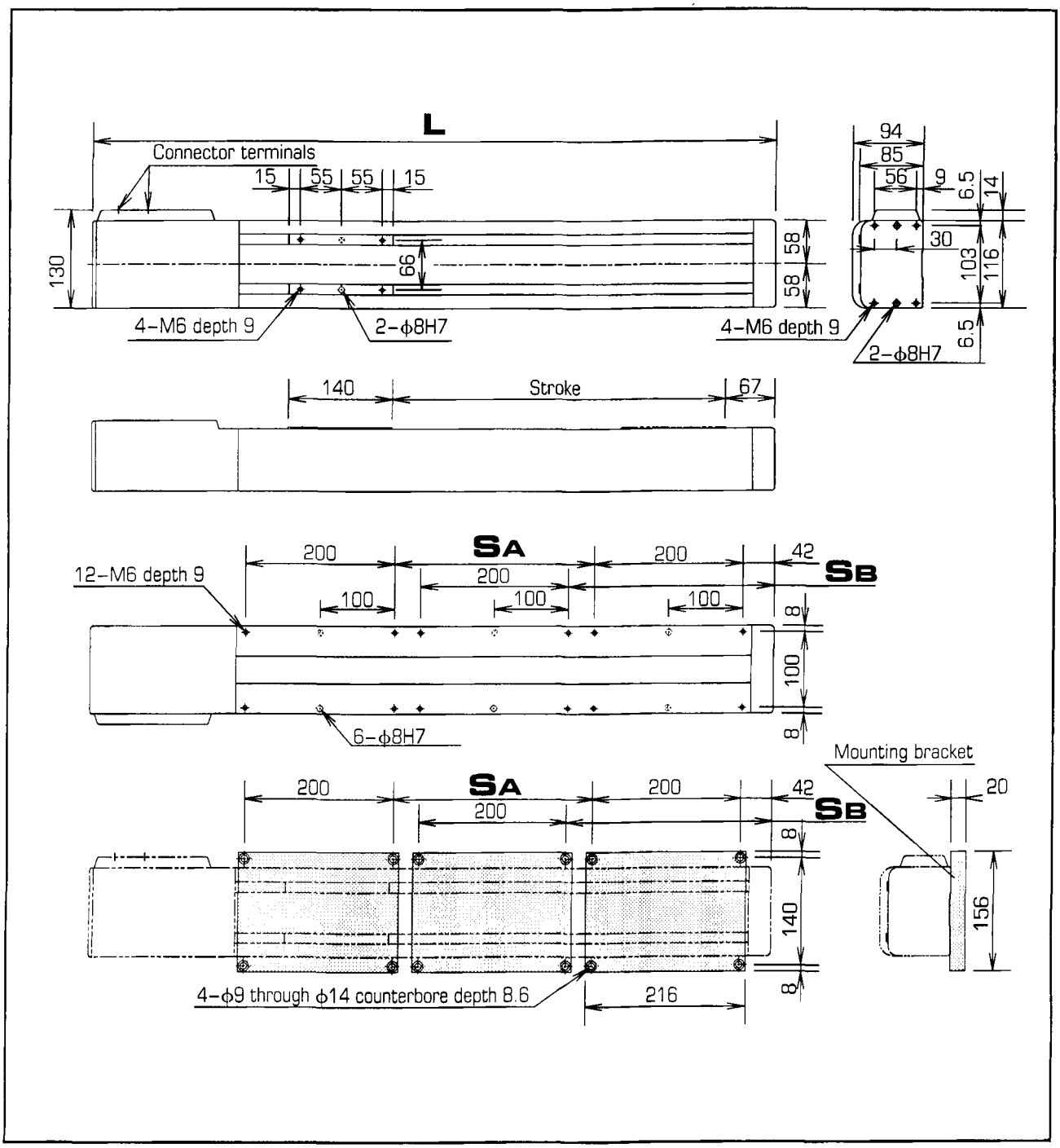


Figure 5-6: S module horizontal axis

S module horizontal axis

Ref. number	Stroke (mm)	L (mm)	SA (mm)	SB (mm)	SC (mm)	Weight (kg)
XY-HRS053-S201	530	760	460	330	560	8.0
XY-HRS043-S201	430	660	360	280	460	7.3
XY-HRS033-S201	330	560	260	230	360	6.6
XY-HRS023-S101	230	460	160	180	260	6.0
XY-HRS013-S101	130	360	60	130	160	5.3

Mounting bracket kit (sold separately)

Ref. number:	XY-P170S-1

Note: Each kit has one bracket. We recommend that you use 2 kits.

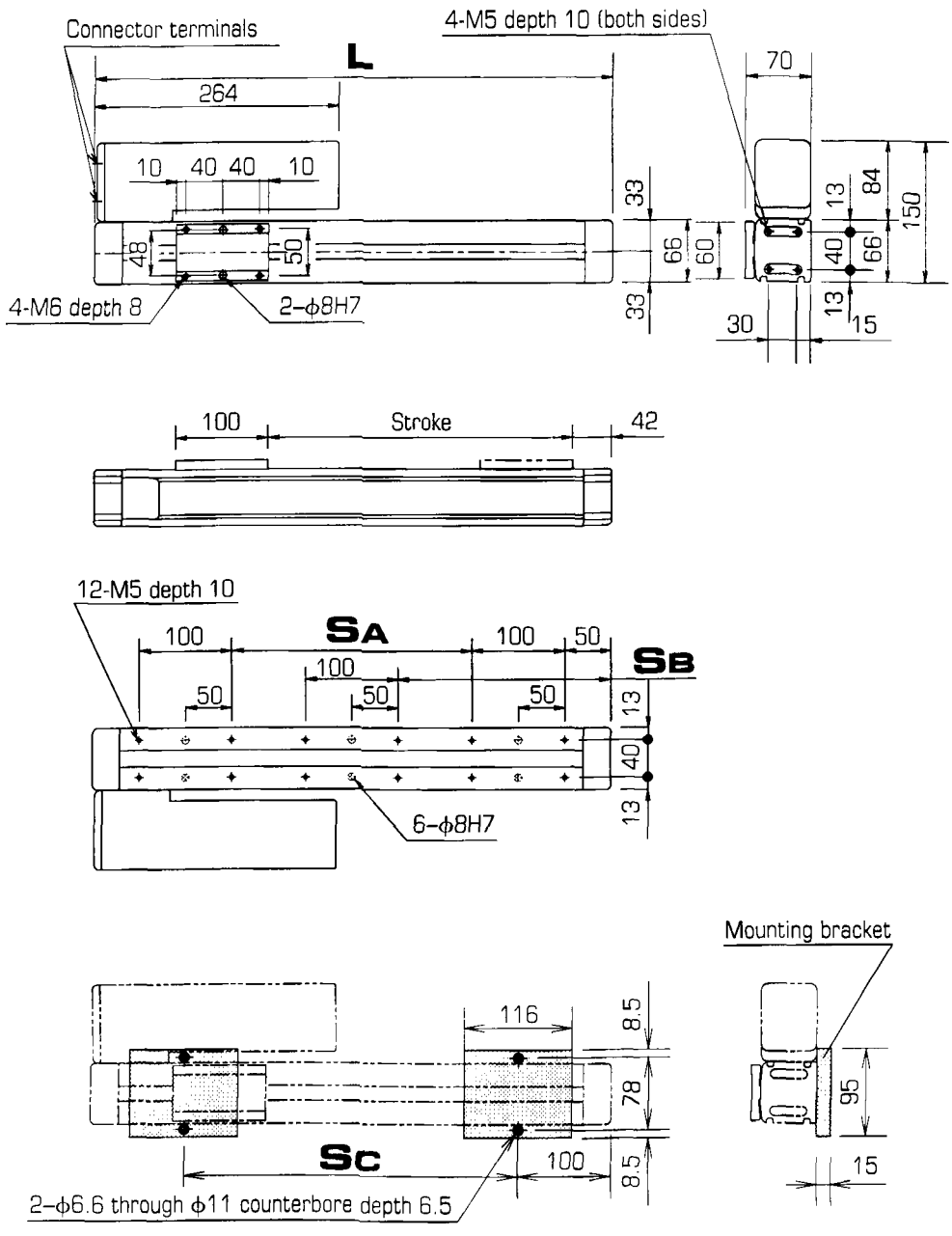
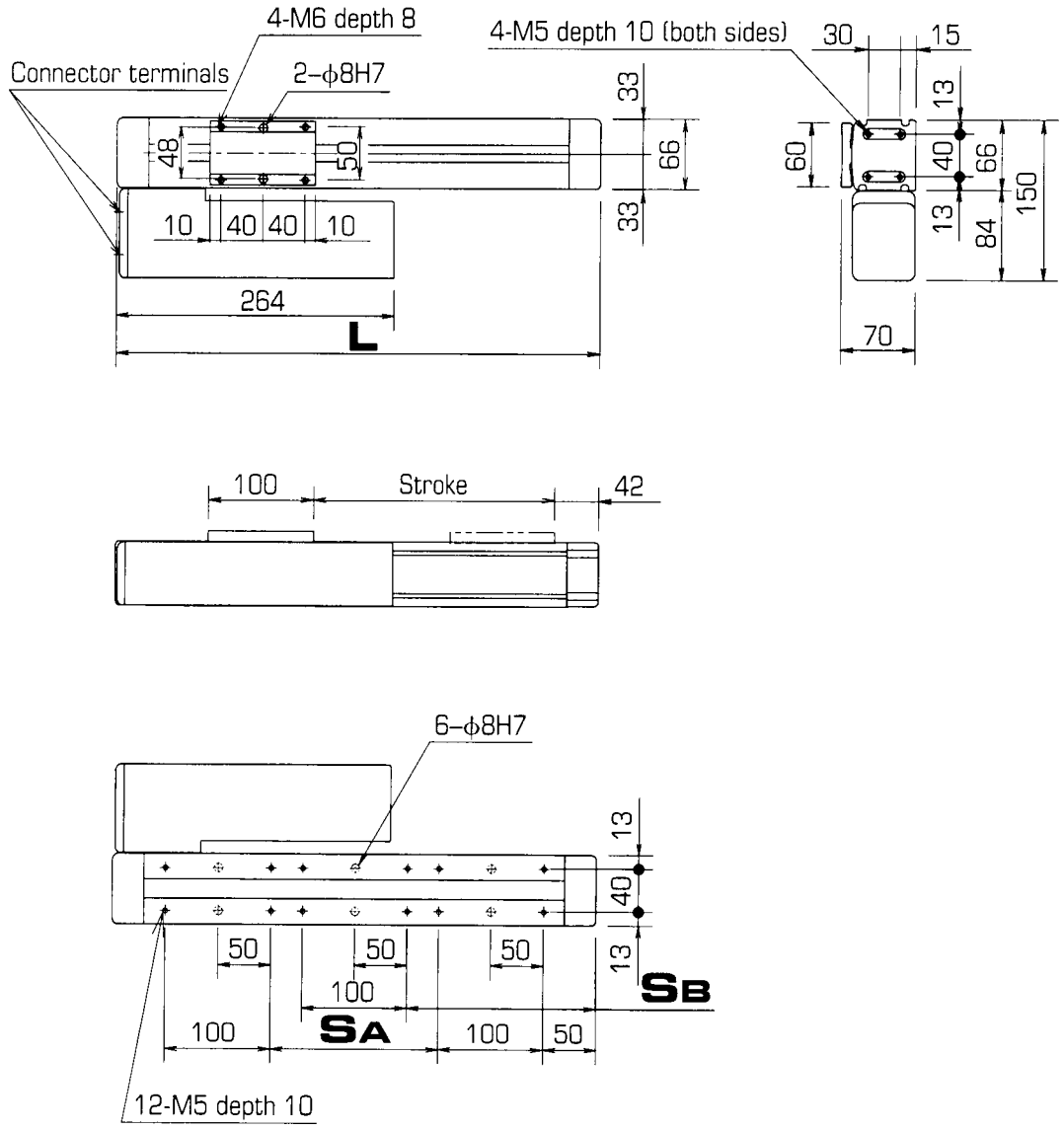


Figure 5-7: S module vertical axis

S module vertical axis

Ref. number	Stroke (mm)	L (mm)	SA (mm)	SB (mm)	Weight (kg)
XY-HRS023-S1B1	230	460	160	180	6.2
XY-HRS013-S1B1	130	360	60	130	5.5

Note: You can use the same type of mounting bracket as for the S-module standard axes.



5.2. Optional Modules Specifications

- This section describes the specifications of the optional module main units. The specifications which are not shown in this section are the same as that of standard modules.
- Apply the stroke in centimeter(cm) for ××× in the reference number.
  - Example: Stroke 300 mm → XY-HRS030A
- Restrictions in transportable moment are the same as standard modules.

Table 5-3 : Specifictions

◉Power voltage : AC 100V

Module	H						M						S					S module, vertical axis	
Reference number	XY-HRS×××AH216						XY-HRS×××AM216						XY-HRS×××AS120		XY-HRS×××AS220			XY-HRS×××AS126	
Stroke (mm)	300	400	500	600	800	1000	250	350	450	550	750	950	130	230	330	430	530	130	230
Dimensions	Figure 5-4						Figuer 5-5						Figure 5-6					Figure 5-7	

* Only main power suppy voltage is different from the standard modules.

◉Long stroke module

Module	H					M			S	S module, vertical axis			
Refernce Number	XY-HRS×××AH404					XY-HRS×××AM404			XY-HRS063AS204	XY-HRS×××AS110			
Stroke (mm)	1200	1400	1600	1800	2000	1150	1350	1550	630	330	430	530	630
Maximum speed (mm/sec)	1200	1080	840	680	560	1200	1080	840	1200	600			
Repeatability (mm)	+0.02								±0.01				
Ball screw lead (mm)	40 (Motor speed is reduced to 1/2. Slider moves 20mm when the motor makes one turn.)								20	10			
Motor mount position	Right									Left			
Dimensions	Figure 5-8					Figure 5-11			Figure 5-14	Figure 5-15			

◉High speed module

Module	H			M		
Reference number	XY-HRS×××AH400			XY-HRS×××AM400		
Stroke (mm)	600	800	1000	550	750	950
Maximum speed (mm/sec)	2400					
Maximum transportable load (horizontal) (kg)	20					
Rated thrust force (N)	150					
Repeatability (mm)	±0.02					
Ball screw lead (mm)	40					
Dimensions	Figure 5-4			Figure 5-5		

(Caution) :The 20mm of ball screw lead is the maximum lead set in parameters of EXC controller. When programming a high speed module, of which lead is 40 mm,use 20mm instead as a ball screw lead and note that one half of the actual values must be input for moving distance, speed and acceleration/deceleration.

◉Vertical axis

- The motor has a bult-in brake (negative action type) . It engages when the power is off.

Module	H						M						S		
Reference number	XY-HRS×××AH102						XY-HRS×××AM102						XY-HRS×××AS106		
Stroke (mm)	300	400	500	600	800	1000	250	350	450	550	750	950	330	430	530
Maximum speed (mm/sec)	600						600						600		
Transportable load (kg) (vertical)	40						40						15		
Transportable load (kg) (horizontal)	200						40						20		
Rated thrust force (N)	600						600						240		
Ball screw lead (mm)	10						10						10		
Motor mount position	Direct						Direct						Right		
Dimensions	Figure 5-10						Figure 5-13						Figure 5-14		

◉Motor mount position: Right

Module	H						M						S module, vertical axis	
Reference number	XY-HRS×××AH204						XY-HRS×××AM204						XY-HRS×××AS106	
Stroke (mm)	300	400	500	600	800	1000	250	350	450	550	750	950	330	430
Transportable load (kg) (horizontal)	50						40						Vertically transportable load 15	
Dimensions	Figure 5-8						Figure 5-11						Figure 5-14	

◉Motor mount position: Left

Module	H						M						S				
Reference number	XY-HRS×××AH208						XY-HRS×××AM208						XY-HRS×××AS108		XY-HRS×××AS208		
Stroke (mm)	300	400	500	600	800	1000	250	350	450	550	750	950	130	230	330	430	530
Transportable load (kg) (horizontal)	50						40						20				
Dimensions	Figure 5-9						Figure 5-12						Figure 5-15				

Figure 5-8: H module: Long stroke

Motor mount podition : Right

H Module: Long stroke unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS200AH404	2000	2330	1800	1040	59
XY-HRS180AH404	1800	2130	1600	940	55
XY-HRS160AH404	1600	1930	1400	840	51
XY-HRS140AH404	1400	1730	1200	740	46
XY-HRS120AH404	1200	1530	1000	640	42

H Module: Motor mount position: Right unit : mm

Model number	Stroke	L	SA	SB	No.of n	Weight (kg)
XY-HRS100AH204	1000	1330	800	540	12	38
XY-HRS080AH204	800	1130	600	440	12	33
XY-HRS060AH204	600	930	400	340	12	29
XY-HRS050AH204	500	830	300	290	12	27
XY-HRS040AH204	400	730	200	240	8	25
XY-HRS030AH204	300	630	100	190	12	23

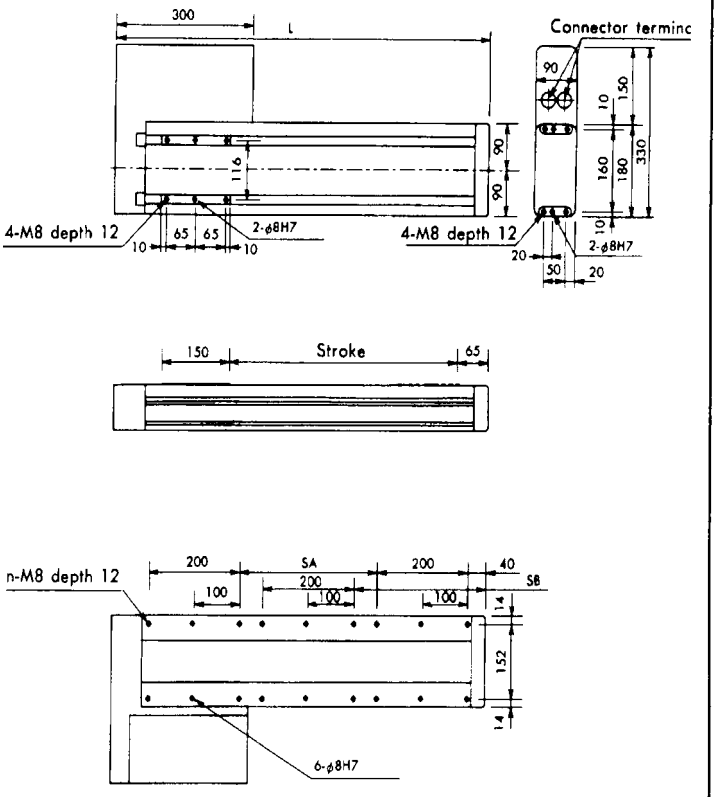


Figure 5-9: H module: Motor mount position: Left

unit : mm

Model number	Stroke	L	SA	SB	No.of n	Weight (kg)
XY-HRS100AH208	1000	1330	800	540	12	38
XY-HRS080AH208	800	1130	600	440	12	33
XY-HRS060AH208	600	930	400	340	12	29
XY-HRS050AH208	500	830	300	290	12	27
XY-HRS040AH208	400	730	200	240	8	25
XY-HRS030AH208	300	630	100	190	12	23

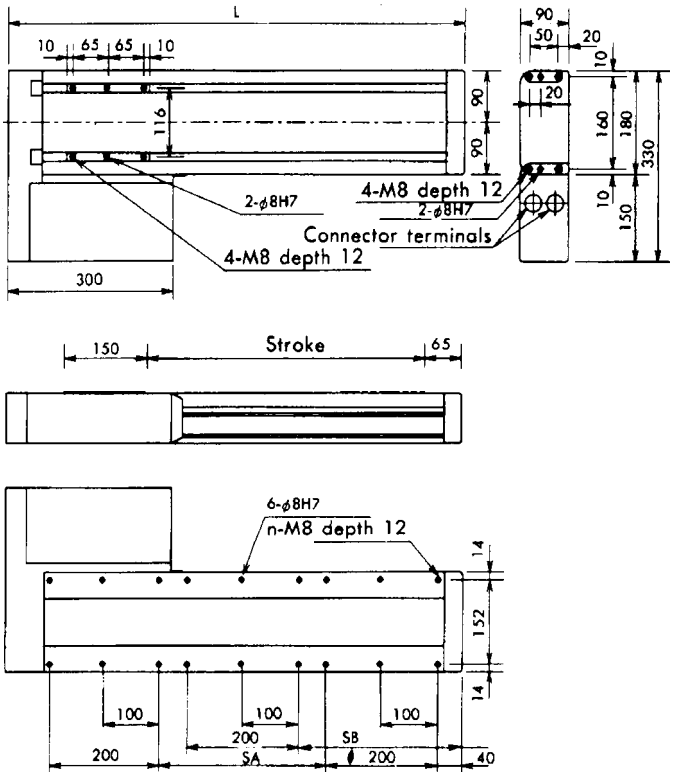


Figure 5-10: H module: Vertical axis

unit : mm

Model number	Stroke	L	SA	SB	No.of n	Weight (kg)
XY-HRS100AH102	1000	1470	800	540	12	34
XY-HRS080AH102	800	1270	600	440	12	30
XY-HRS060AH102	600	1070	400	340	12	26
XY-HRS050AH102	500	970	300	290	12	24
XY-HRS040AH102	400	870	200	240	8	22
XY-HRS030AH102	300	770	100	190	12	20

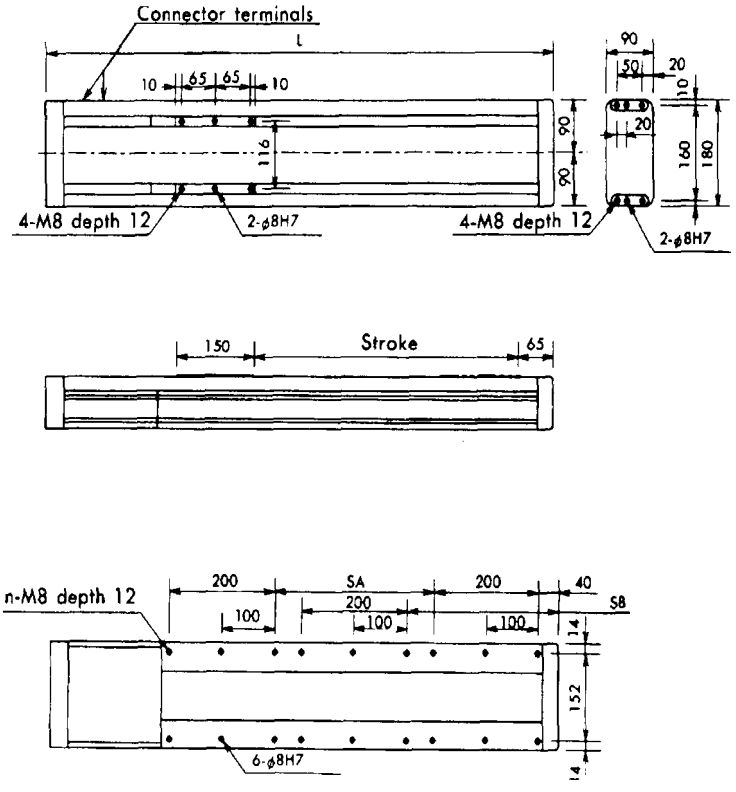


Figure 5-11: M module: Long stroke

Motor mount position: Right

M module: Long stroke unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS155AM404	1550	1915	1370	827	33
XY-HRS135AM404	1350	1715	1170	727	30
XY-HRS115AM404	1150	1515	970	627	27

M module: Motor mount position: Right unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS095AM204	950	1315	770	527	24
XY-HRS075AM204	750	1115	570	427	21
XY-HRS055AM204	550	915	350	327	18.5
XY-HRS045AM204	450	815	270	277	17.5
XY-HRS035AM204	350	715	170	227	16.5
XY-HRS025AM204	250	615	70	177	15.5

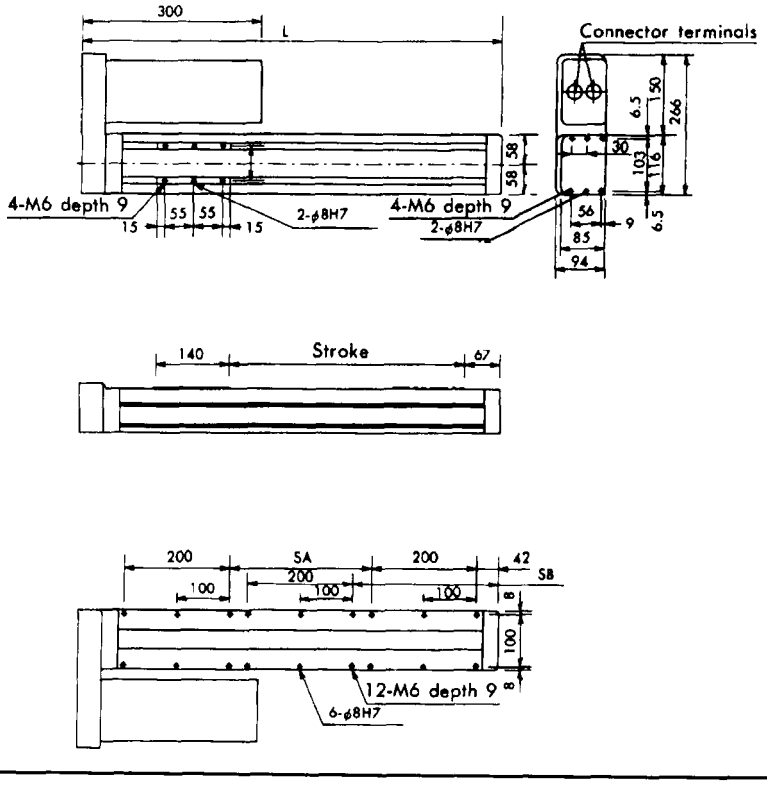


Figure 5-12: M module: Motor mount position: Left

unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS095AM208	950	1315	770	527	24
XY-HRS075AM208	750	1115	570	427	21
XY-HRS055AM208	550	915	370	327	18.5
XY-HRS045AM208	450	815	270	277	17.5
XY-HRS035AM208	350	715	170	227	16.5
XY-HRS025AM208	250	615	70	177	15.5

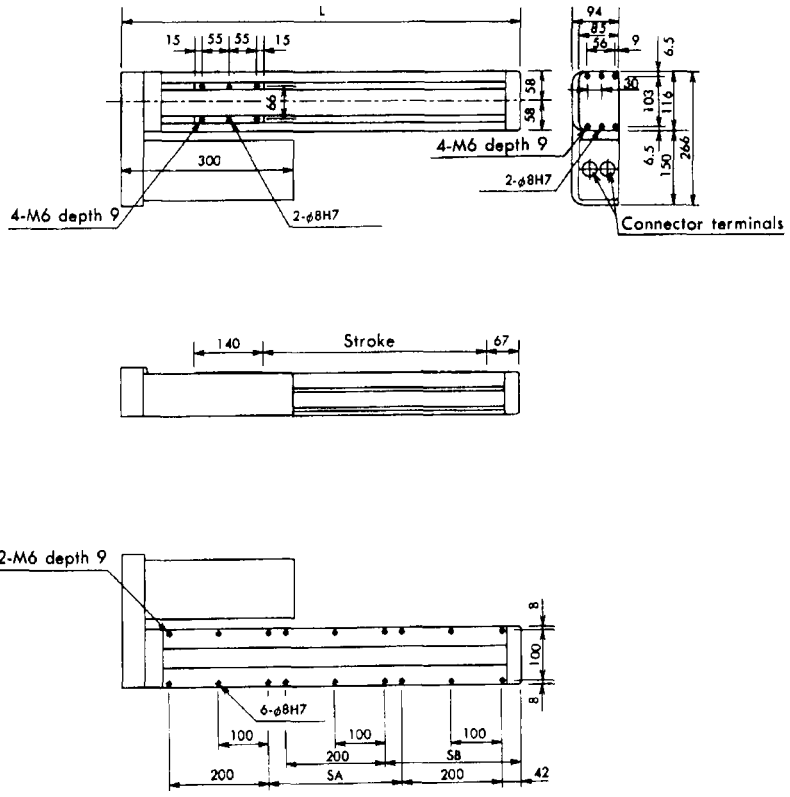


Figure 5-13: M module: Vertical axis

unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS095AM102	950	1450	770	527	20
XY-HRS075AM102	750	1250	570	427	18
XY-HRS055AM102	550	1050	370	327	15.5
XY-HRS045AM102	450	950	270	277	14.5
XY-HRS035AM102	350	850	170	227	13.5
XY-HRS025AM102	250	750	70	177	12.5

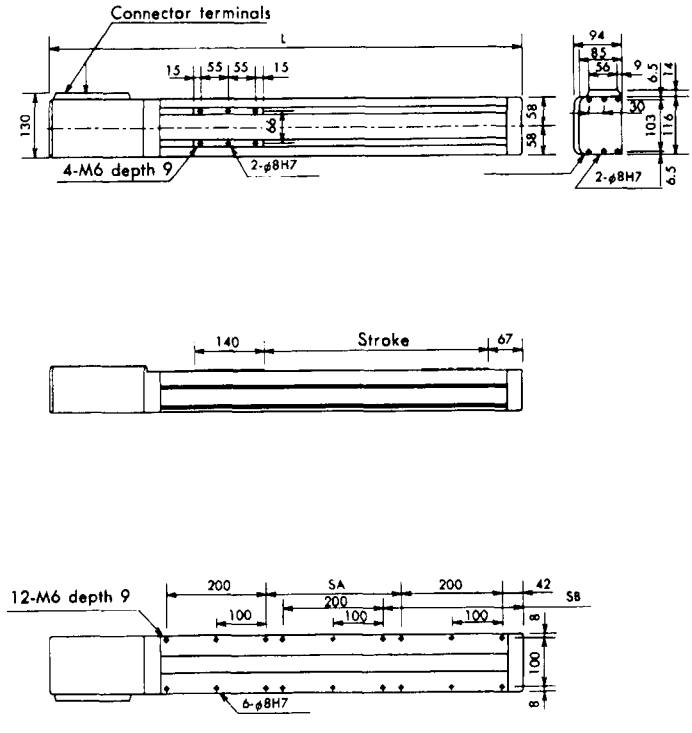


Figure 5-14: S module: Long stroke

Motor mount position: Right

S module: Long stroke unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS063AS204	630	860	560	380	8.7

S module: Motor mount position: Right unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS053AM106	530	760	460	330	8.2
XY-HRS043AM106	430	660	360	280	7.5
XY-HRS033AM106	330	560	260	230	6.8
XY-HRS023AM106	230	460	160	180	6.2
XY-HRS013AM106	130	360	60	130	5.5

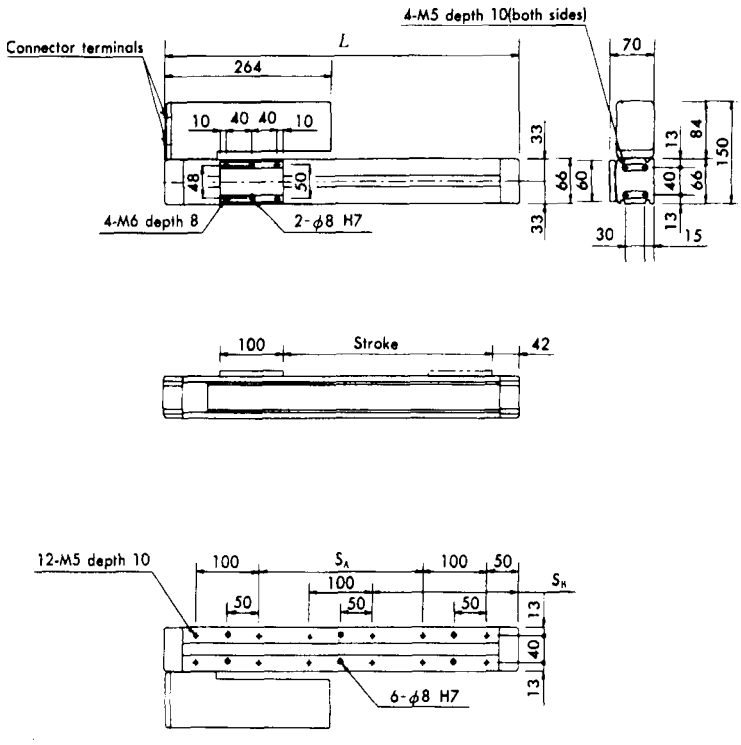


Figure 5-15: S module: Vertical axis long stroke

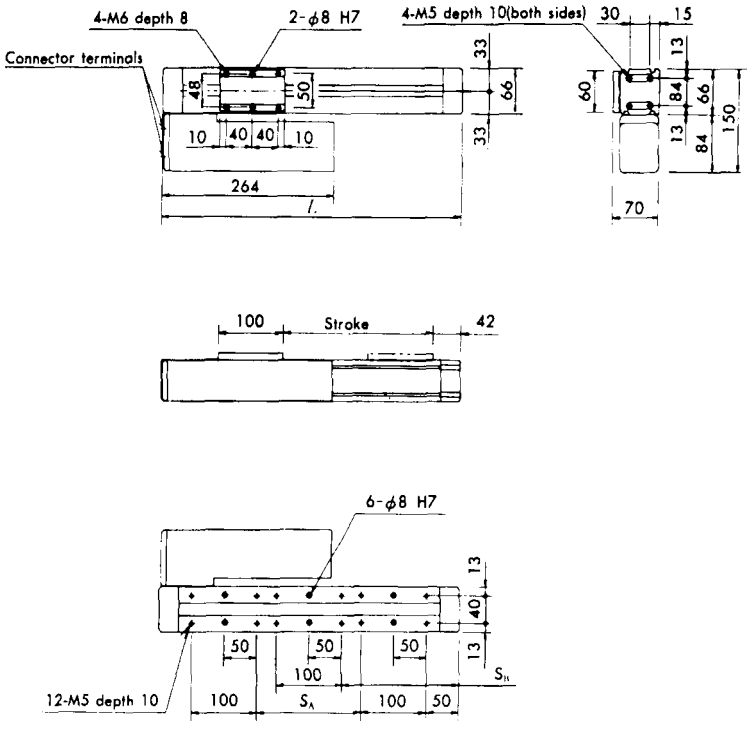
Motor mount position: Left

S module: Vertical axis long stroke unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS063AS110	630	860	560	330	8.9
XY-HRS053AS110	530	760	460	330	8.2
XY-HRS043AS110	430	650	360	280	7.5
XY-HRS033AS110	330	560	260	230	6.8

S module: Motor mount position: Left unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS053AM204	530	760	460	330	8
XY-HRS043AM204	430	660	360	280	7.3
XY-HRS033AM204	330	560	260	230	6.6
XY-HRS023AM204	230	460	160	180	6.0
XY-HRS013AM204	130	360	60	130	5.3



5.3. Module Main Unit, Clean Type

- Restrictions for transportable moment are the same as the standard main unit. Refer to "5.1.1. Transportable Moment."

Figure 5-16

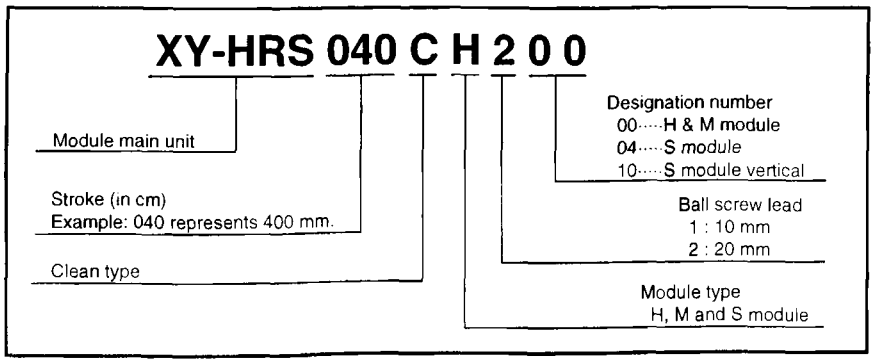


Table 5-4: Specifications

Item		H module			M module			S module			S module, vertical axis	
Stroke (mm)		300	400	500	250	350	450	130	230	330	130	230
		600	800	1000	550	750	950	430	530			
Max. speed (mm/sec)		1200			1200			1200 (1)			600	
Transportable load (horizontal) (kg)		60			40			20			(Vertical) 15	
Rated thrust force (N)		300			300			120 (2)			240	
Transportable moment (Refer to "5.1.1.")	Rolling (N·m)	600			55			24			24	
	Pitching (N·m)	300			80			10			10	
	Yawing (N·m)	300			80			10			10	
Repeatability (mm)		±0.010			±0.010			±0.010			±0.010	
Motor output (W)		300			300			100			100 (Incorporated brake)	
Power voltage (VAC)		200			200			200			200	
Ball screw lead (mm)		20			20			20 (3)			10	

Note: (1) The maximum speed of 130 and 230mm stroke modules is 600 mm/sec.
(2) Rated thrust force of 130 and 230 mm stroke modules is 240N.
(3) Ball screw lead of 130 and 230mm stroke modules is 10mm.

Figure 5-17: H module, clean type

unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS100CH200	1000	1440	800	540	34
XY-HRS080CH200	800	1240	600	440	29
XY-HRS060CH200	600	1040	400	340	25
XY-HRS050CH200	500	940	300	290	23
XY-HRS040CH200	400	840	200	240	21
XY-HRS030CH200	300	740	100	190	19

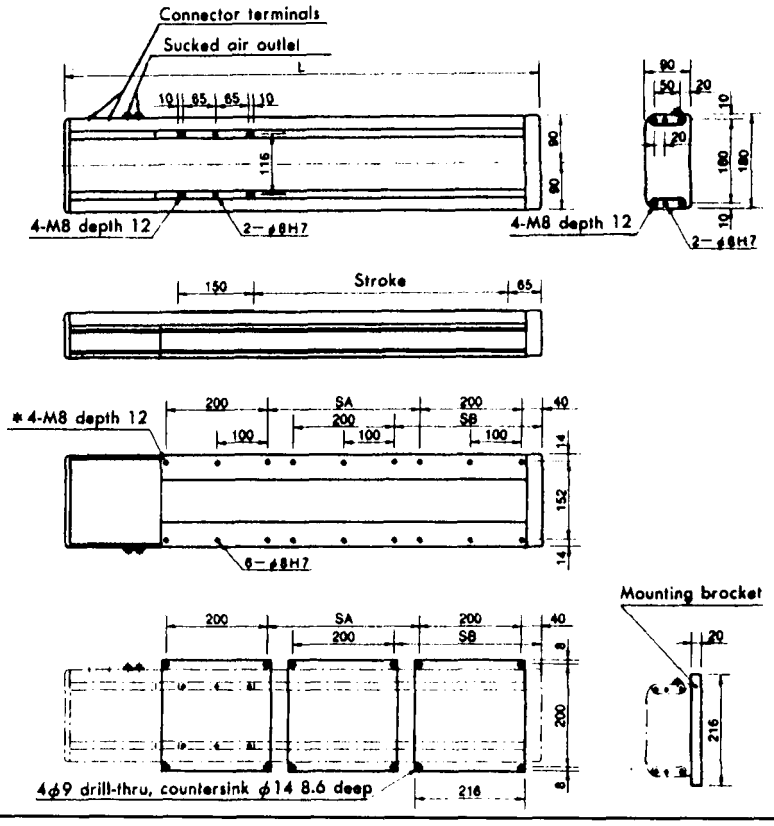


Figure 5-18: M module, clean type

unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS095CM200	950	1420	770	527	20.0
XY-HRS075CM200	750	1220	570	427	17.0
XY-HRS055CM200	550	1020	370	327	14.5
XY-HRS045CM200	450	920	270	277	13.5
XY-HRS035CM200	350	820	170	227	12.5
XY-HRS025CM200	250	720	70	177	11.5

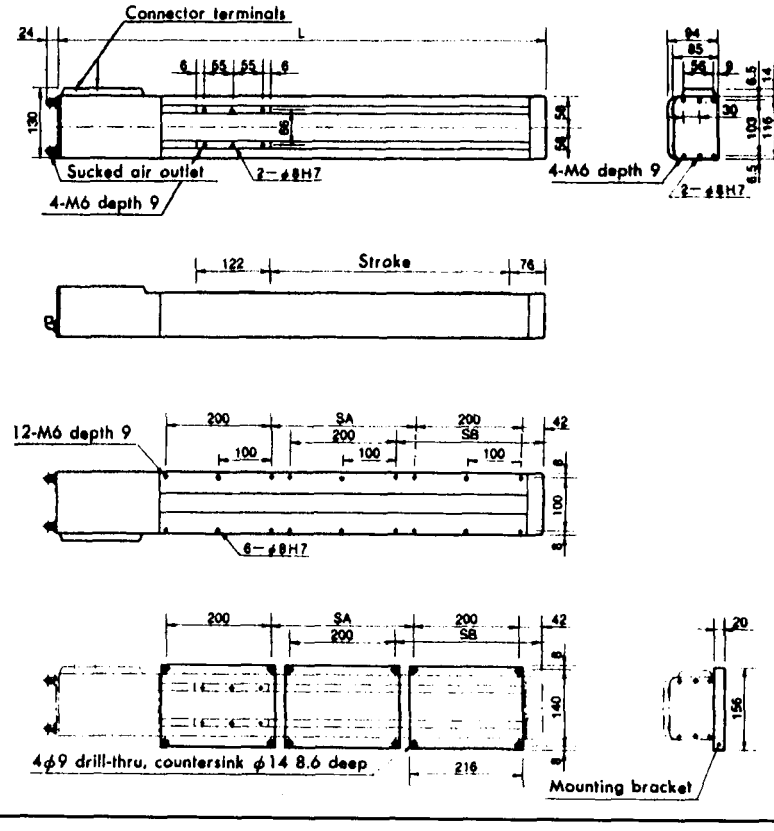


Figure 5-19: S module, clean type

unit : mm

Model number	Stroke	L	SA	SB	SC	Weight (kg)
XY-HRS053CS204	530	759	460	330	560	8.0
XY-HRS043CS204	430	659	360	280	460	7.3
XY-HRS033CH204	330	559	260	230	360	6.6
XY-HRS023CH104	230	459	160	180	260	6.0
XY-HRS013CH104	130	359	60	130	160	5.3

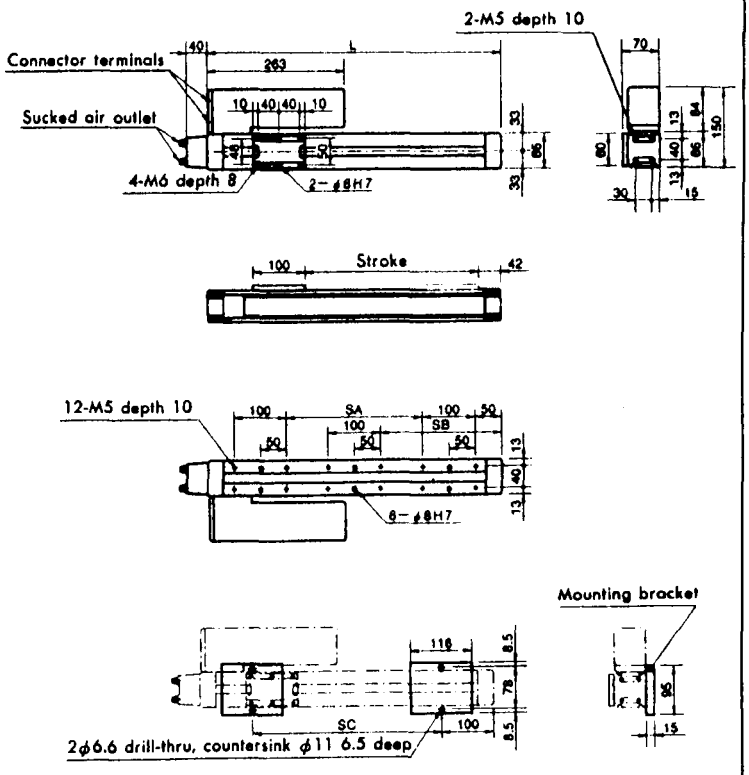
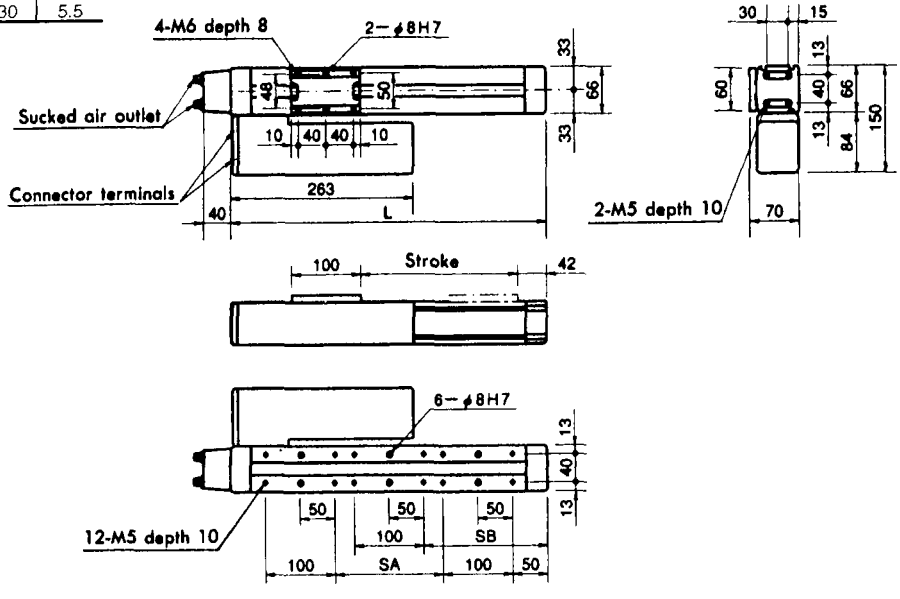


Figure 5-20: S module vertical axis, clean type

unit : mm

Model number	Stroke	L	SA	SB	Weight (kg)
XY-HRS023CS110	230	459	160	180	6.2
XY-HRS013CS110	130	359	60	130	5.5



5.4. EXC Controller Specifications

5.4.1. List of Controller Specifications

◉ Power source and environment

Table 5-5

Item		EXC2	EXC3
Power supply		100/110VAC ±10% or 200/220VAC ±10%, single-phase	
Power capacity*		2kVA max.	3kVA max.
Total capacity of built-in driver		600W max.	900W max.
Noise resistance	Line noise	1000V, 1μS (By a noise simulator)	
	Static noise	3kV (By noise simulator)	
Operating ambient temperature		0 ~ 50°C	
Operating ambient humidity		20 ~ 85% (No dew condensation)	
Storage temperature		-10 ~ +70°C	

Note* The power capacity does not include rush current when the power is turned on. It is a value when the motor output reaches the instantaneous maximum output (300% of the rating).

◉ Inrush current and leakage current

Table 5-6

	AC100V/110V power supply		AC200V/220V power supply	
	EXC2 (Dual axes)	EXC3 (Triple axes)	EXC2 (Dual axes)	EXC3 (Triple axes)
Inrush current	About 60A	About 80A	About 160A	About 260A
Leakage current (~1kHz)	About 10A		About 40A	

◉ Package specification

Table 5-7

Rack Mount Type : Models EXC20 & EXC30	Stand-Alone Type: Models EXC21 & EXC31
—	With 24VDC power supply circuit* (for brake and I/O), emergency stop switch, and power switch

◉ Functional specifications

Table 5-8

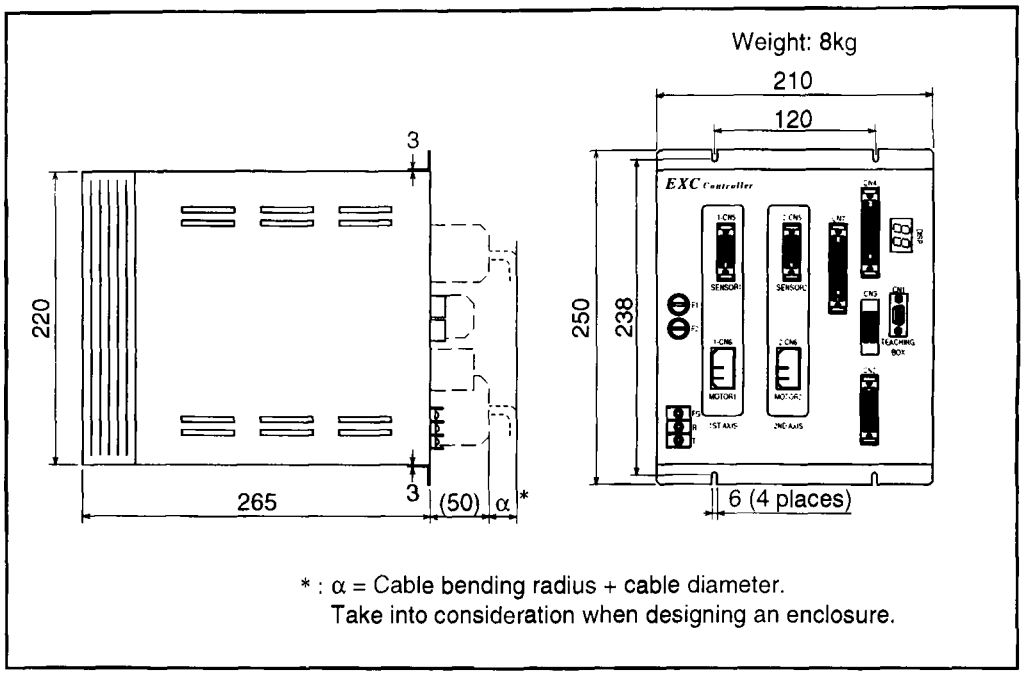
Item			Descriptions
Controlled Axes			EXC2 model: Built-in dual-axis servo driver + dual-axis pulse train output EXC3 model: Built-in triple-axis servo driver + single-axis pulse train output
Built-In Servo Driver Capacity			100W/axis or 300W/axis
Teaching			Inputting numeric values or teaching
Teaching Device			Teaching box (sold separately)
Program	Program Capacity		100 programs, 5000 steps maximum*
	Backup Battery		Lithium battery
	Velocity Setting		Variable in 1% steps from 1 to 100% with respect to the set velocity (Maximum set speed: 1200mm/s)
	Acceleration Setting		Variable in 1% steps from 1 to 100% with respect to the set acceleration (Maximum set acceleration: 35m/s²)
	Acceleration Pattern		Trapezoidal or smooth sine acceleration and deceleration
	Command	Travel	Triple-axis linear interpolation, dual-axis circular interpolation, palletization, and Home Return
		Sequence	General I/O, timer, conditional and unconditional jump
		Others	Repeating, subroutine calling, and interruption
	Editing		Step insertion, and deletion
Control Function			Feed forward compensation, digital filter, integration limiter, and dead band
Coordinate Setting			Software overtravel, home offset, and coordinate reversing
Alarm And Protection			Overtravel, battery life, CPU error, memory error, encoder disconnection, positional over-deviation, line voltage error, over-current, over-heat, over-load
I/O	Exclusive Input		Servo on, emergency stop, cycle stop, stop, activating Home Return motion, activating programmed operation, switching operation modes, program selection, and halfway re-sttart of program
	Exclusive Output		Ready, alarm, completion of Home Return, programmed operation complete, and In position
	General I/O		Each 32 inputs and outputs
Brake output			Relay contact output for negative functioning type retaining brake

Note* Capacity for number of steps varies with setup of program commands.
See "13.2.1. Programming Area" for more details.

5.4.2. Controller Dimensions

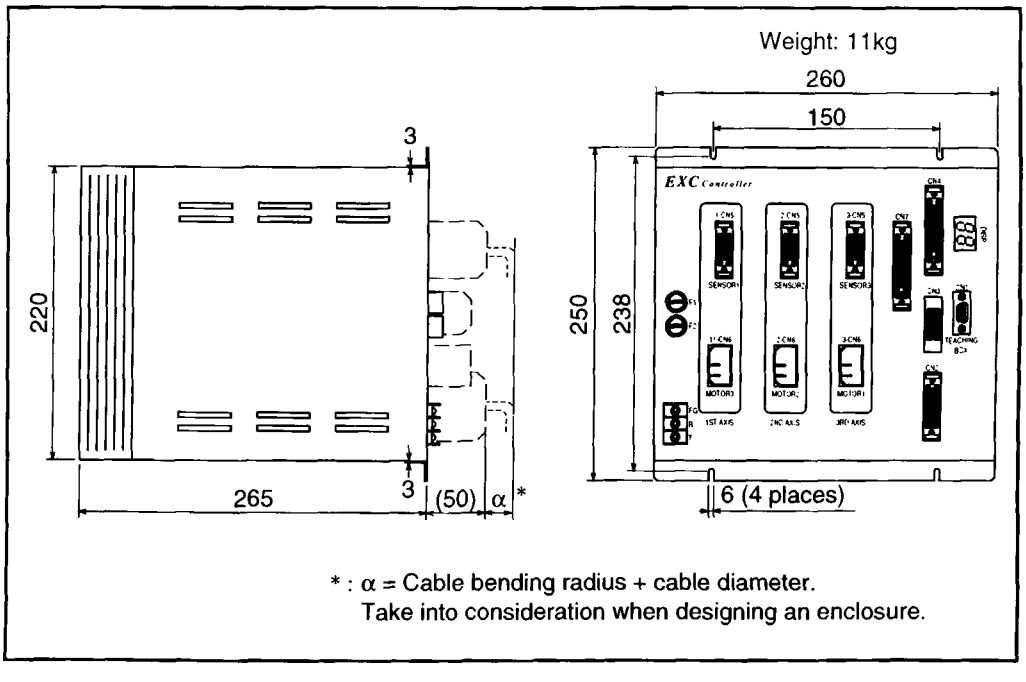
◉ Rack mount type (EXC20, EXC30)

Figure 5-21: EXC20 (Built in dual-axis servo drivers)



* : α = Cable bending radius + cable diameter.
Take into consideration when designing an enclosure.

Figure 5-22: EXC30 (Built in triple-axis servo drivers)



* : α = Cable bending radius + cable diameter.
Take into consideration when designing an enclosure.

◉ Stand alone type (EXC21, EXC31)

Figure 5-23: EXC21 (Built in dual-axis servo drivers)

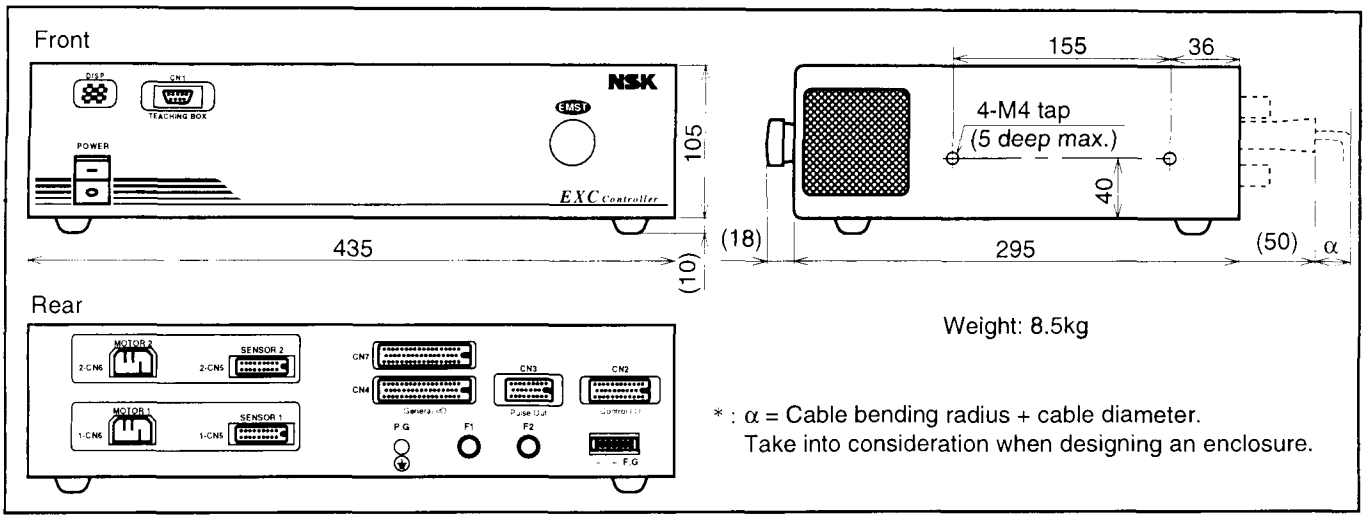
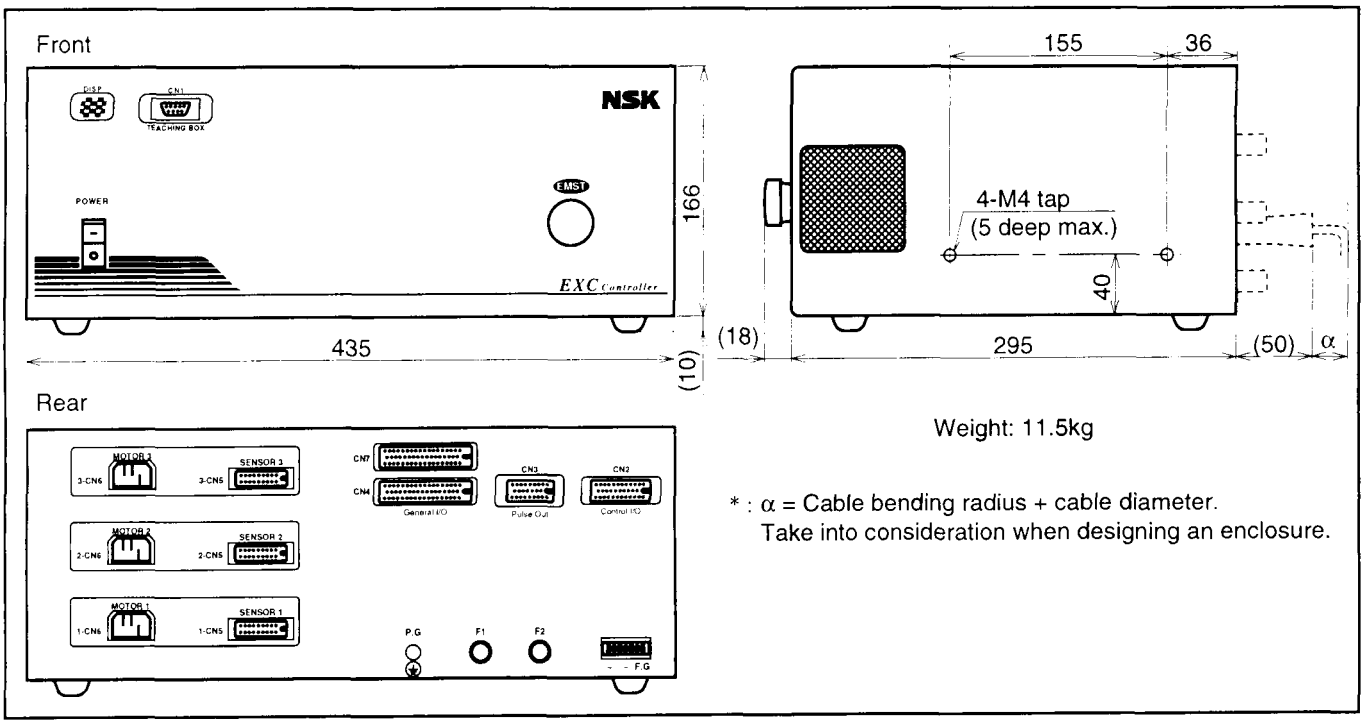


Figure 5-24: EXC (Built in triple servo drivers)



5.5. Teaching Box Specifications

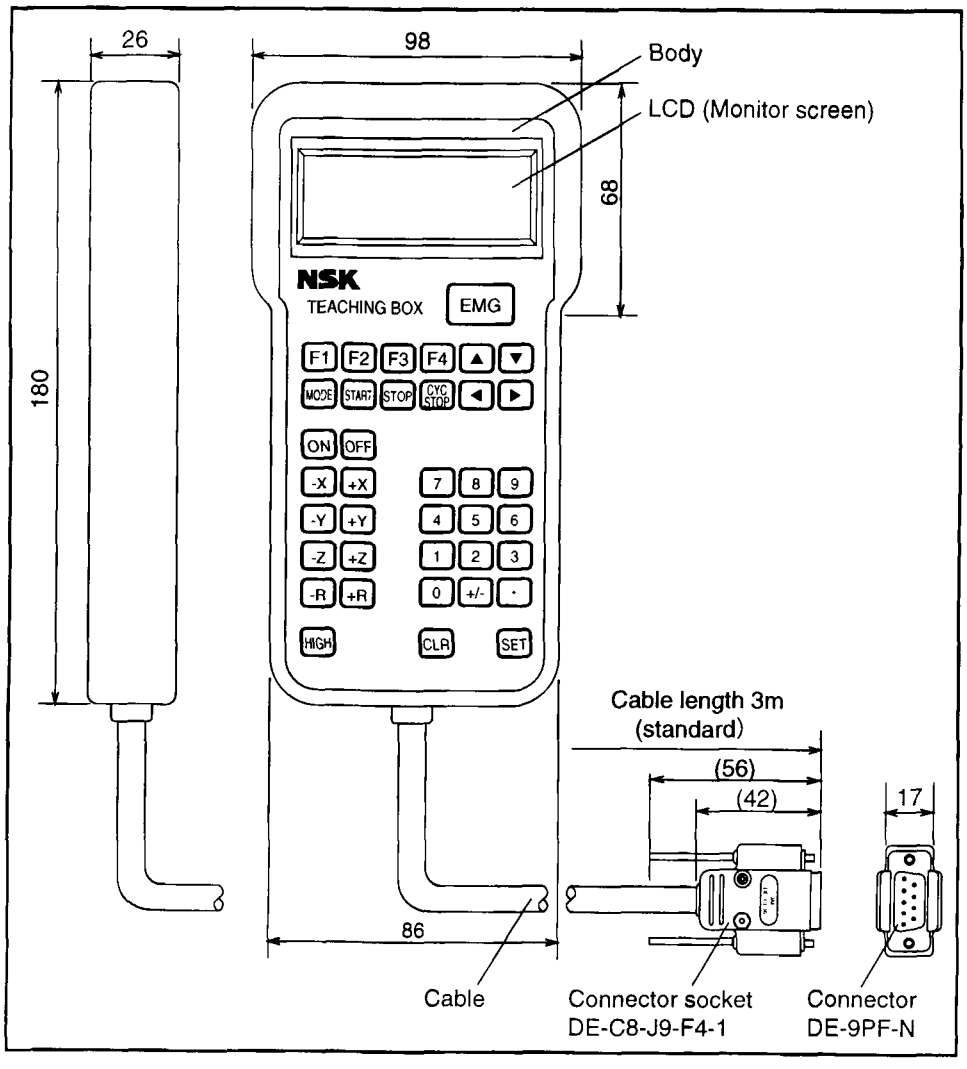
5.5.1. Teaching Box Function

Table 5-9

Setting, Programming	• Internal parameter setting, adujusting servo gain • Programming, teaching
Operation start/stop	• Jog, Home Return, start/stop of programmed operation, emergency stop
Output	• Exclusive output, General output, Brake output ON/OFF
Monitor indication	• Alarm • Exclusive output and general output monitoring • Programmed operation monitor ••• General I/O and exclusive I/O status position of each axis, status of executing program data registor and coordinate of teaching.
Others	• Alarm reset

5.5.2. Teaching Box Dimensions

Figure 5-25



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6. Transportation, Storage and Unpacking

6.1. Caution for Transportation and Storage

- Store the product indoors in a clean environment not exposed to the wind, rain or direct sunlight. For the storage temperature and humidity, see the power source and environmental specifications in "5.4.1. List of Controller Specifications".

Caution : The robot module has no special environmental protection for transportation or storage. Trouble may take place or the service life may be reduced unless it is handled with great care as a precision instrument.

6.2. Unpacking

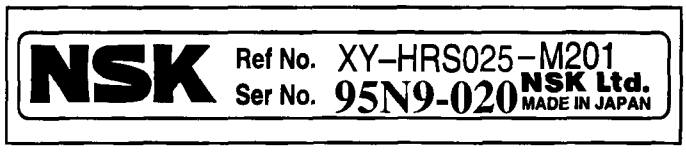
6.2.1. Checking product

6.2.1.1. Module Main Unit

① Collation with ordered reference number

- Check if the number indicated on the affixed seal on the side of the module main unit (on the connector side) is identical to the ordered number.

Figure 6-1: Affixed seal



② Checking 200 VAC type product (standard) or 100 VAC product (option)

- Check if the voltage rating marked near the connector of the module main unit is identical to the voltage rating of the ordered product.

6.2.1.2. EXC Controller

① Checking lacking parts and defective parts

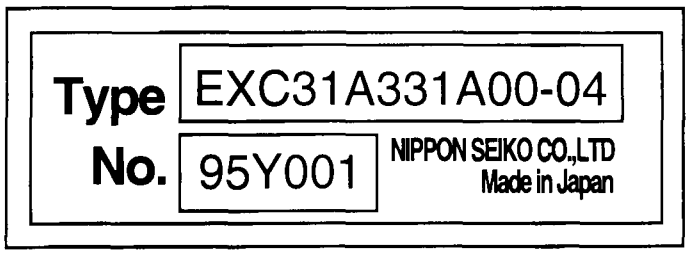
- Open the packing, and check if no parts are lacking or defective.

② Collation with ordered reference number

- See Figure 4-9 Reference number configuration of EXC Controller to check if the number indicated on the affixed seal on the EXC controller panel is identical to the ordered number.

- Seal position
  - o Rack mount type EXC controller: Front panel
  - o Stand-alone type EXC controller: Rear panel

Figure 6-2: Affixed seal



- Data indicated on seal
  - o Type: The reference number without "M-" is indicated. "-04" at the end shows the version number. A later version product has a different number.
  - o No.: A serial number

③ Checking accessories

- The accessories shown in the table below are supplied with the robot module. Make sure that all accessories are supplied without omission.

Table 6-1

Part names	Functions	Q'ties	Remarks
Dummy connector for teaching box	• Insert the dummy connector to CN1 instead of the teaching box, when operating the EXC controller without the teaching box. • A circuit for shorting the emergency stop circuit for the teaching box is connected in the dummy connector.	1	—
Control I/O connector and connector cover	• A connector and connector cover for a cable to be connected by the user to CN2 of the EXC controller.	One each	HONDA MR-34M, MR-34L
General I/O connector and connector cover	• Connectors and connector covers for cables to be connected by the user to CN4 and CN7 of the EXC controller.	Two each	HONDA MR-50M, MR-50L
Pulse train output connector and connector cover	• A connector and connector cover for a cable to be connected by the user to CN3 of the EXC controller.	One each	HONDA MR-25M, MR-25NSA
Fuse	• A 20A back up fuse	2	BUSMAN MDA-20A
Instruction manual	• Instruction manual of robot module: Functions and installation of product	1	Document No. K20010
	• Instruction manual of robot module: Programming and operations	1	Document No. K20011
	• Instruction manual of robot module: Maintenance	1	Document No. K20012

6.2.2. Checking Combination

Checking combination of module main unit and EXC controller

- Check if the module main unit and EXC controller are properly combined as shown in the catalog or as specified in the order.

(Caution) : If the module main unit and EXC controller are improperly connected, the motor or drive unit may be burnt.

① Check if the rated voltage of the module main unit and/or controller is proper.

- Check the voltage rating affixed seal near the connector on the module main unit to see if the voltage rating is proper.
  - ○ If no seal is stuck, make an inquiry. When making an inquiry, inform us of the product reference number.

- Check the voltage rating seal in the power terminal block on the controller.

  Example: Be careful not to connect a 200 VAC type controller to a 100 V type module main unit.

② Check if the capacities and axis constructions of the module main unit and controller are proper.

- Check the reference number of the controller to see if the motor capacity is proper. (See "4.7. EXC Controller".)

- Module main unit

  H and M module : 300W

  S module, S module vertical : 100W

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7. Installation

- To assure safety and proper operation, the robot module must be fixed to solid and stable place.

7.1. Installation of Module Main Unit

(Danger) : If the main unit is not fixed properly, it may result in not only mechanical damage but also injuries.

① The base main unit of a multi-axis combination must be firmly fixed to the mounting base or surface using specified bolts and bolt holes.

② In case of multi-axis combination, combine each main unit securely using specified combining bracket and bolts.

③ When operating multi axis robot module system, be fully careful not to be crushed due to interference of each axis. Be careful not to breake the robot module system.

- Hexagon socket cap screws are recommend for fixing bolts.

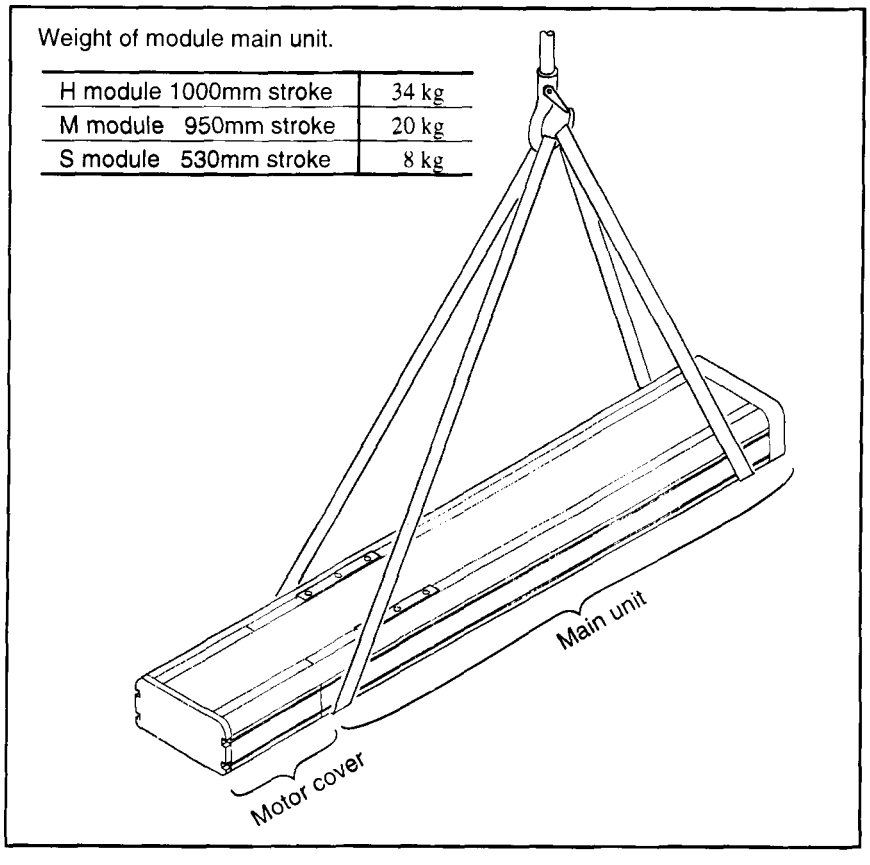
Table 7-1

Bolt size	M8	M6	M5
Thread pitch	1.25mm	1.0mm	0.8mm

7.1.1. Transportation

- Mono Axis: Slinging and fixing for the purpose of transportation must be done on the main unit portion (Figure 7-1).
- Multi-Axis Combination: Fix the unit with rope or brackets. So that the unit will not move or hit other object during transportation. To mount brackets, the screw holes shown in Figures 5-4, 5-5, 5-6 and 5-7 may be used. Do not use other screw holes.

Figure 7-1



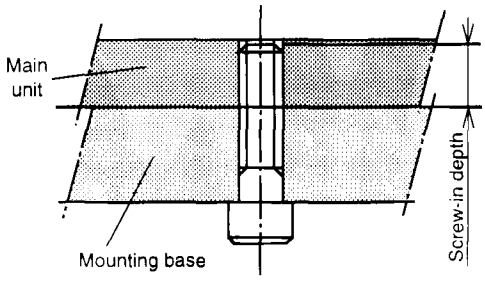
7.1.2. Fixing Main Unit

- Refer to Figures 5-4, 5-5, 5-6 and 5-7 for dimensions.
- The main unit may be fixed in two different ways. (See ① and ② below.)
- The mounting surface should be a finished surface with a flatness of about 0.1 mm, and free from harmful projections.
- When the bolt fixing portions are lifted, use shims to adjust the flatness.

① Direct fixing, using tap holes on the main unit rear surface

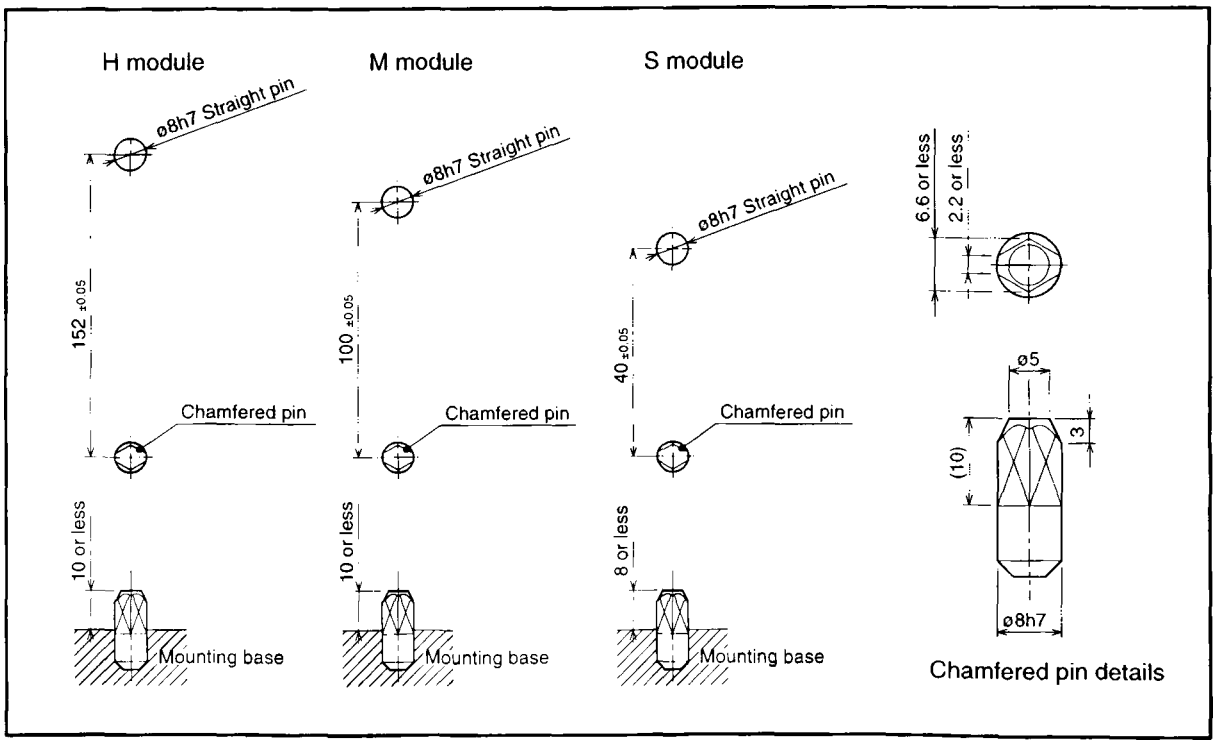
- Drill through holes on the mounting base and fix a main unit from the rear side (see Figure 7-2)
- The mounting bolts should meet the specifications given in Figure 7-2.
- It is possible to determine the fixing position with reference to the ø8 H7 hole on the rear surface of the main unit. The pin on the base side must be a chamfered pin, and must be as shown in Figure 7-3.

Figure 7-2



	H module	M module	S module
Bolt diameter	M8	M6	M5
Screw-in depth	12~16 mm	9~12 mm	7~9 mm
Tightening torque	33.3 N•m {340 kgf•cm}	14.7 N•m {150 kgf•cm}	5.9 N•m {60 kgf•cm}

Figure 7-3



② Fixing from upper surface of mounting bracket

- Use optional mounting bracket (XY-P170X-1).
- Drill screw holes on the mounting base and fix mounting brackets from the upper surface.
- Follow Table 7-2 for installing the mounting bracket on the main unit.

Table 7-2

	H module	M module	S module
Bolt diameter × length	M8×20	M6×20	M5×16
Tightening torque	33.3N•m {340kgf•cm}	14.7N•m {150kgf•cm}	5.9N•m {60kgf•cm}

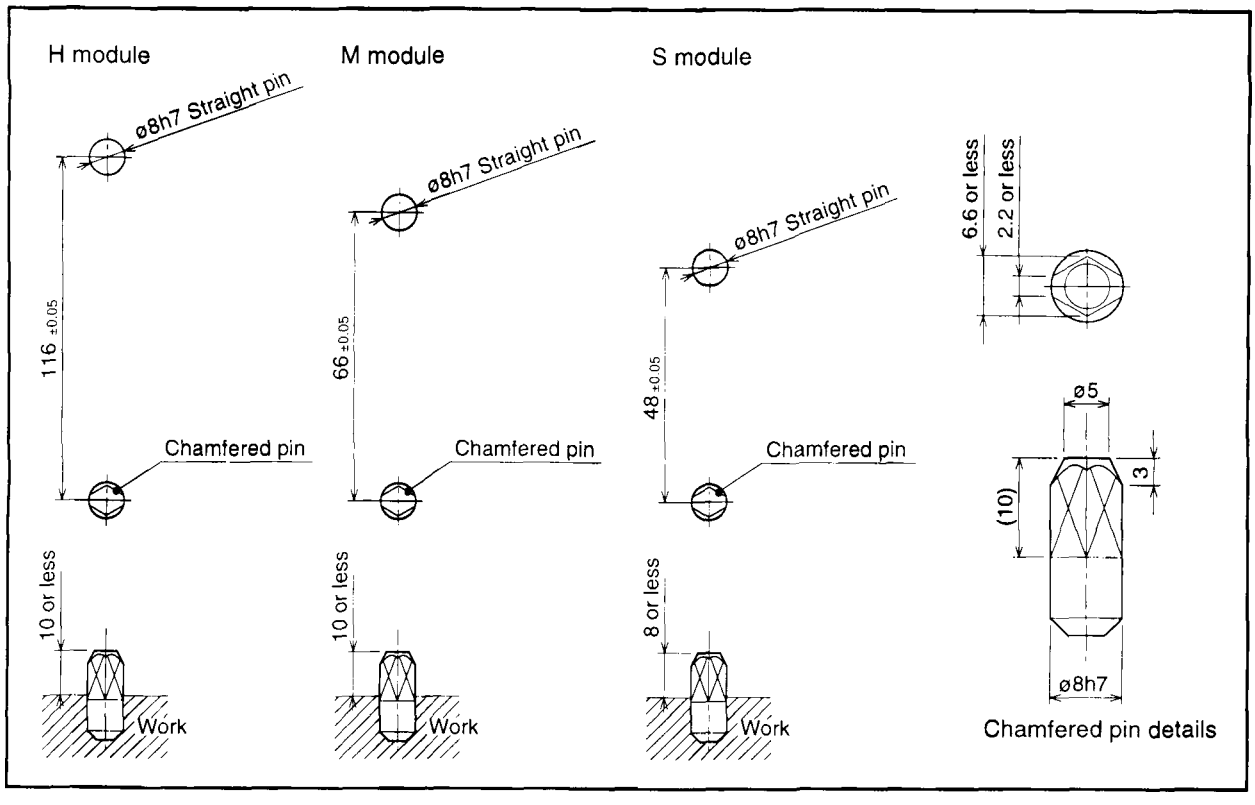
7.1.3. Mounting an End Effector to the Slider

- Refer to Figure 5-4, 5-6 and 5-7 for dimensions.
- Use fixing bolts specified in Table 7-3.
- When using the ø8 H7 hole on the upper surface, the pin on the other side must be chamfered pin, and must be as specified in Figure 7-4.

Table 7-3

	H module	M module	S module
Bolt diameter	M8	M6	M5
Screw-in depth	12~16 mm	9~12 mm	6~8 mm
Tightening torque	33.3 N•m {340 kgf•cm}	14.7 N•m {150 kgf•cm}	11.7 N•m {120 kgf•cm}

Figure 7-4



7.1.4. Mounting End Effector to the End of Main Unit

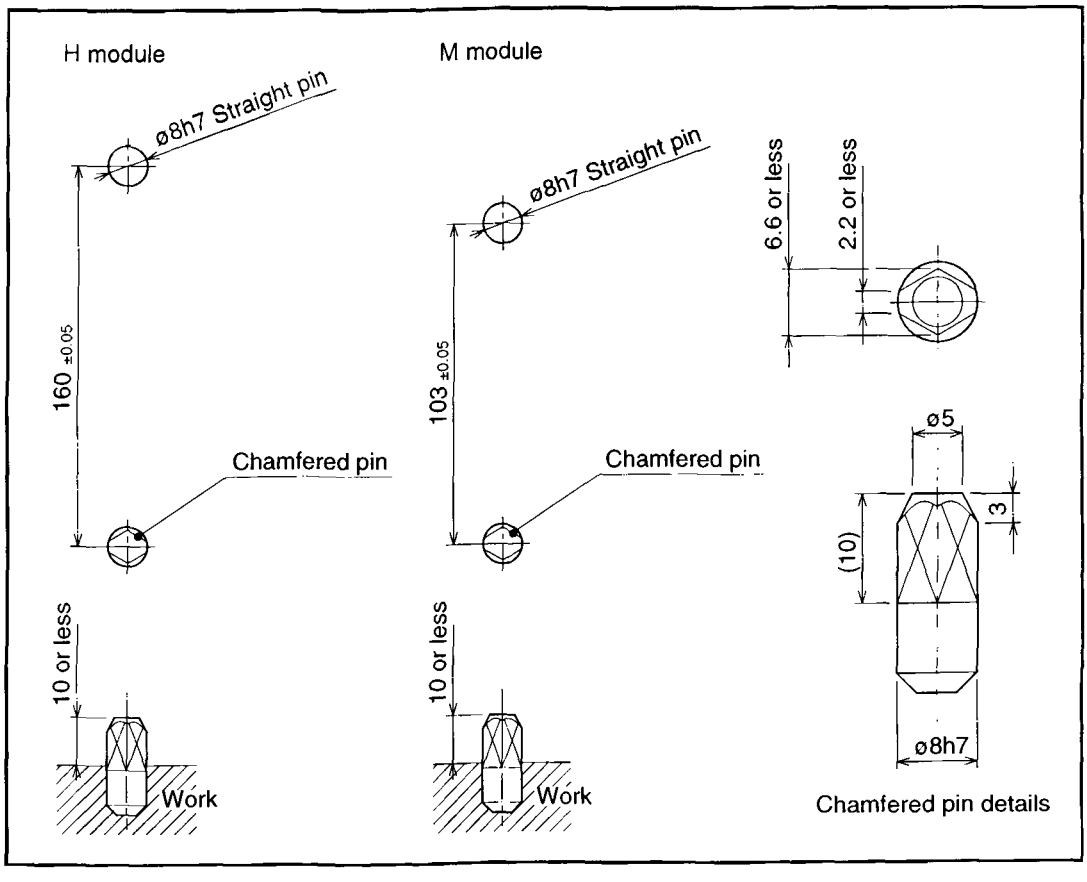
- End effector mounting tap holes are provided on the counter-motor end face of the main unit (on both end faces for S module).
- Use fixing bolts specified in Table 7-4.
- When using the ø8 H7 hole on the end face (only possible on H and M modules), the pin on the other side must be a chamfered pin, and must be as specified in Figure 7-5.
- For the transportable work weight, see "5.1.2. Specifications, Horizontally (Vertical) Transportable Load" for single axis, and "8.2. Method of Combination" for Multi-axis.

Danger : You may not fix the main unit with this fixing bolt. Follow "7.1.2. Fixing Main Unit".

Table 7-4

	H module	M module	S module
Bolt diameter	M8	M6	M5
Screw-in depth	12~16 mm	9~12 mm	8~10 mm
Tightening torque	33.3 N•m {340 kgf•cm}	14.7 N•m {150 kgf•cm}	5.9 N•m {60 kgf•cm}

Figure 7-5



7.2. Installation of EXC Controller

7.2.1. Installation of Rack Mount Type EXC Controller

- Prepare a base having the enough strength to bear the weight of the controller body. Bolt the EXC controller to the base firmly using the U slots for on-panel installation.

* For the weight of the controller body, see 5.4.2 "Outside Dimensions of Controller".

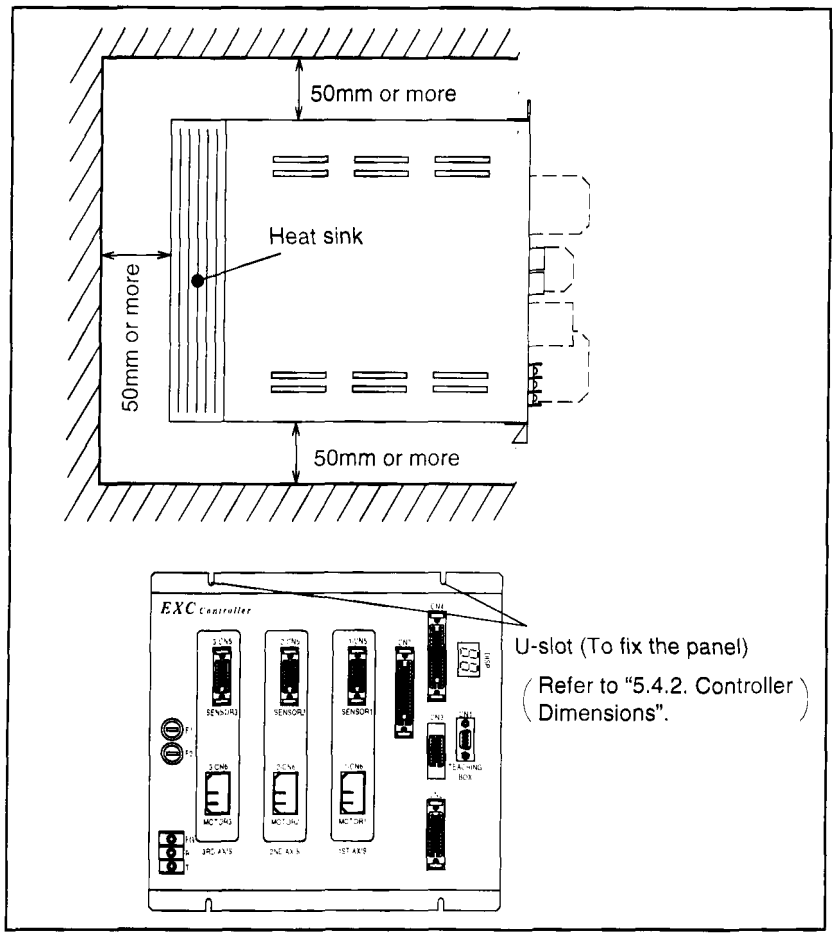
(Danger) : *Use the controller at ambient humidity between 20 and 85% (with no dew condensation). Protect the controller to keep out water or oil. Also protect it to keep out conductive fine particles, corrosive gas, inflammable gas or explosive gas. Improper protection may result in a fire, malfunctioning or breakdown.*

(Caution) : *(1) After installing the EXC controller, make sure that it will not move when a force is applied to it externally and there is no possibility of danger.*

(2) The rack mount type controller makes use of natural convection air cooling. Leave enough spaces above, below and behind it. Insufficient natural convection may cause an overheat alarm or excessive temperature rise inside the controller, resulting in malfunctioning or reduced service life.

(3) Adjust the ambient temperature around the controller between 0° and 50°C. The controller used at a temperature over or below this range can not guarantee the normal operation. If the ambient temperature is close to 50°C, it is recommended that a forced cooling system be used.

Figure 7-6



7.2.2. Installation of Stand-Alone Type EXC Controller

- Install the controller in a stable place where it will not slip or drop.
- If it is necessary to fix the controller using brackets (prepared by the user), use the M4 tapped holes in the side panels.

Caution : (1) The depth of the M4 tapped holes in the side panel is 5 mm. Do not use longer bolts. If too long bolts are used, the internal electrical parts may be damaged.

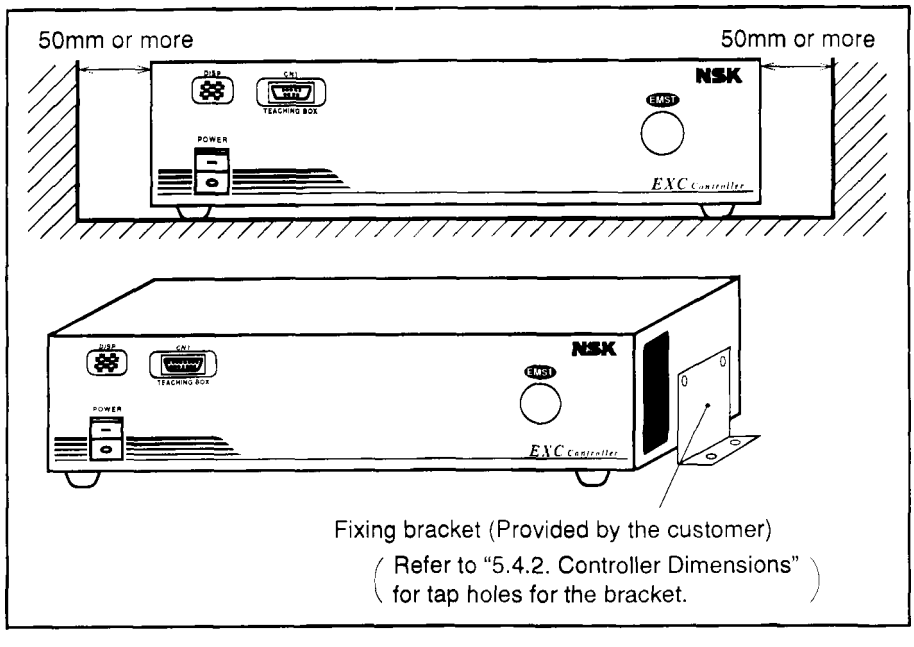
(2) The stand-alone type controller is air cooled forcedly by a built-in fan. To secure sufficient air flow, leave a 50 mm or more space on each side. Insufficient air flow may cause an overheat alarm or excessive temperature rise inside the controller, resulting in malfunctioning or reduced service life.

(3) If fine particles are contained in the atmosphere, they are collected inside the controller by the fan, resulting in malfunctioning or troubles. Use the controller in a clean environment.

(4) Adjust the ambient temperature around the controller between 0° and 50°C. The controller used at a temperature over or below this range can not guarantee the normal operation. If the ambient temperature is close to 50°C, it is recommended that a forced cooling system be used.

(5) Use the controller at ambient humidity between 20 and 85% (with no dew condensation). Protect the controller to keep out water or oil. Also protect it to keep out conductive fine particles or corrosive gas. Improper protection may result in a fire, malfunctioning or breakdown.

Figure 7-7



8. Assembly

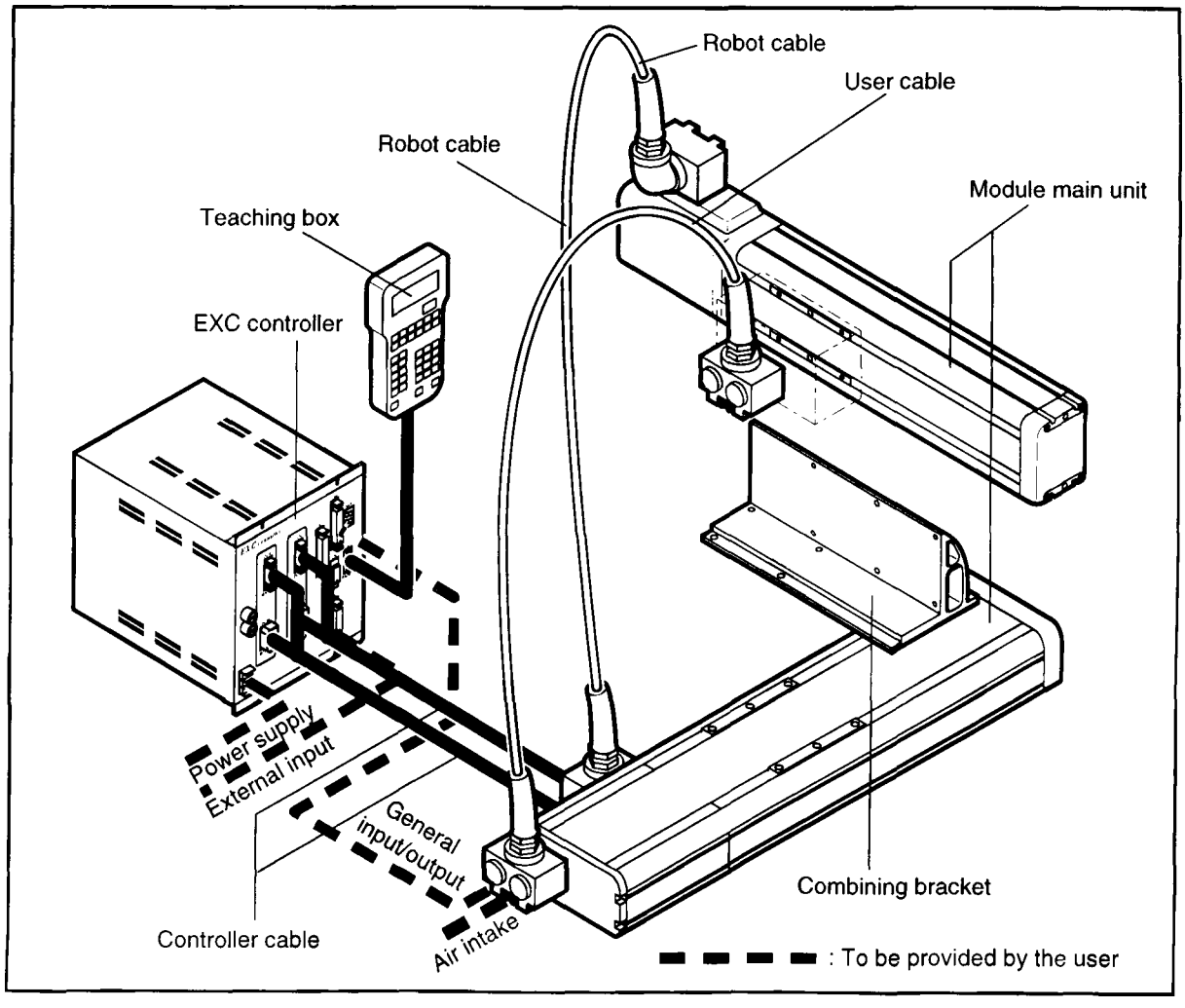
8.1. Outline of Multi-Axis System and Precautions

(Caution) : *This section describes the assembly procedures of the standard module main unit. A special model or clean room type model has different combinations and transportable load. Make an inquiry for such a model.*

- The robot modules can easily be made into a multi-axis system using combining brackets (optional).
- Chapter "8.2. Assembly Procedures" gives explanations according to the combinations. See only the description about the combination you use.

8.1.1. System Configuration

Figure 8-1



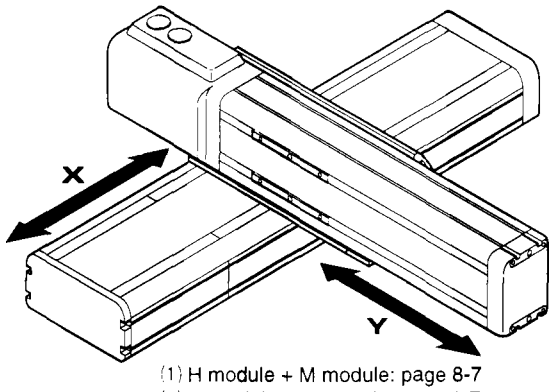
(Caution) : *For long stroke combination, the support cable unit is required.*

8.1.2. Multi-Axis Combination

Note : Sv module denotes S module vertical axis.

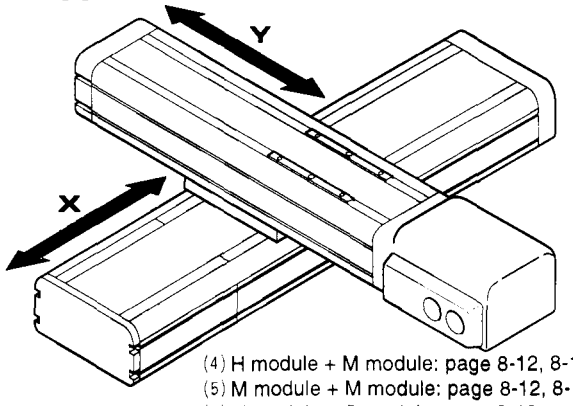
Figure 8-2

G type 2 axes (X and Y)



(1) H module + M module: page 8-7
(2) M module + S module: page 8-7
(3) S module + S module: page 8-7

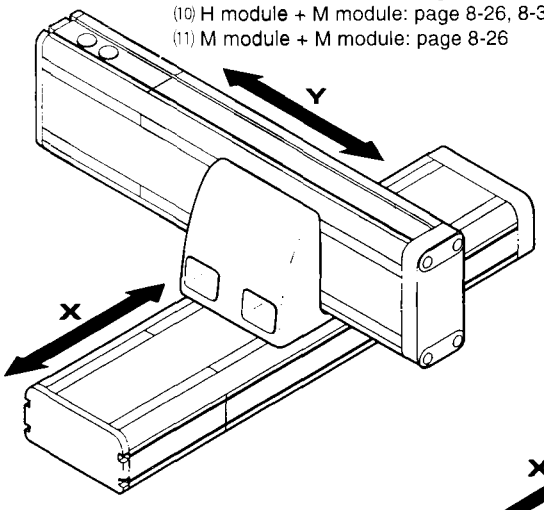
D type 2 axes (X and Y)



(4) H module + M module: page 8-12, 8-15
(5) M module + M module: page 8-12, 8-15
(6) M module + S module: page 8-18
(7) S module + S module: page 8-21

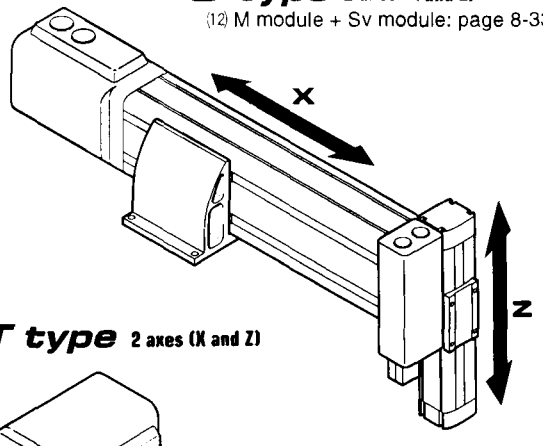
X type 2 axes (X and Y)

(9) H module + H module: page 8-26, 8-30
(10) H module + M module: page 8-26, 8-30
(11) M module + M module: page 8-26

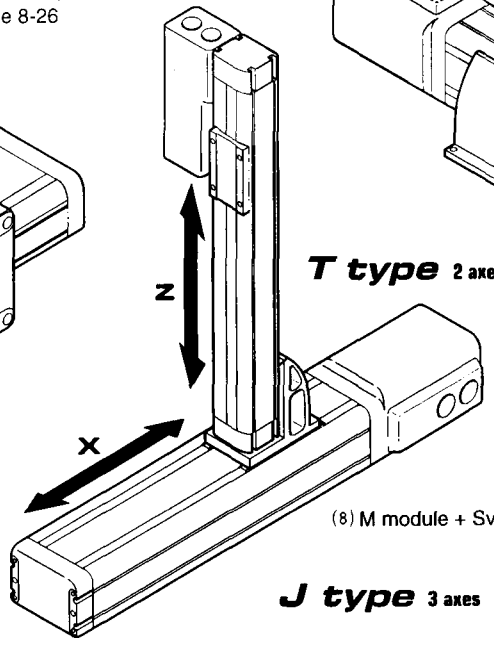


C type 2 axes (X and Z)

(12) M module + Sv module: page 8-33

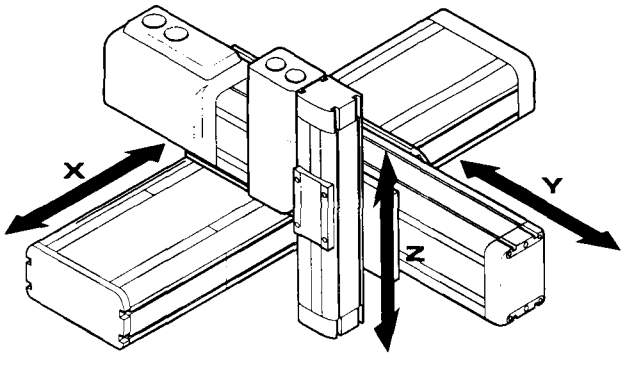


T type 2 axes (X and Z)



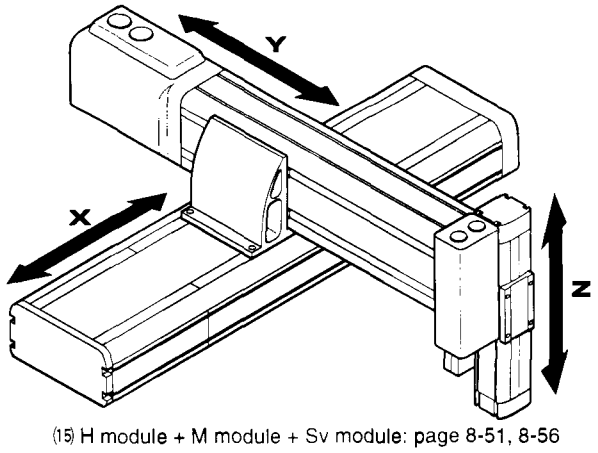
(8) M module + Sv module: page 8-26

P type 3 axes



(13) H module + M module + Sv module: page 8-38, 8-43
(14) M module + S module + Sv module: page 8-46

J type 3 axes



(15) H module + M module + Sv module: page 8-51, 8-56

8.1.3. Precautions for Combination

Danger : *When robot modules are combined, there is a danger of being caught between the modules or between a module and end effector. If the worker should enter the moving range of a running robot module, it is necessary to prevent the worker from being caught.*

Caution : *(1) It may be necessary to reduce the transportable load shown in the assembly drawing in "8.2. Assembly Procedures" depending on the center of the gravity of the end effector or acceleration and deceleration speed of each axis (set on the controller). See "5.1.1. Transportable moment" and decide the proper load weight suitable to the use conditions.*

(2) Since the drive pins of the combining bracket are precisely engaged with the pin holes in the module main unit, they may not be inserted easily in some cases. Press them strongly in such a case with care not to twist them.

(3) The directions and positions of the combining brackets and Y-and Z-axes should be as shown in the drawing in "8.2. Assembly Procedures". If they are different from shown in the drawing in "8.2. Assembly Procedures", check the following.

- Move the module main unit by hand before turning on the power to make sure that the axes do not interfere with each other.
- Make sure that the robot cable is not pulled over the length shown in Figure 8-3.

(4) The controller cable should be used for a stationary part. Never use it for a movable part. Otherwise, the cable may be broken. If it is necessary to use the controller cable for a movable part, follow the instructions shown in Figs. 8-4 and 8-5.

(5) The robot cable and cable support are consumable parts. It is recommended that they should be replaced every 5 million reciprocal motions in order to prevent unexpected shut down caused by broken cable.

Figure 8-3: Robot cable span limit

Cable span limit S (mm)

Reference Number \ H (mm)	100	200	500	800
XY-E17008x-1	640	560	—	—
XY-E17012x-1	880	880	780	—
XY-E17017x-1	1340	1340	1230	1100

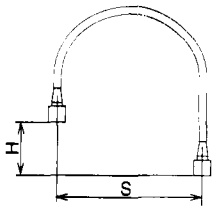


Figure 8-4: Flexure controller cable (not uprighting type)

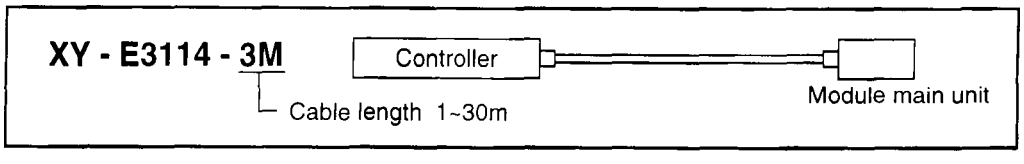
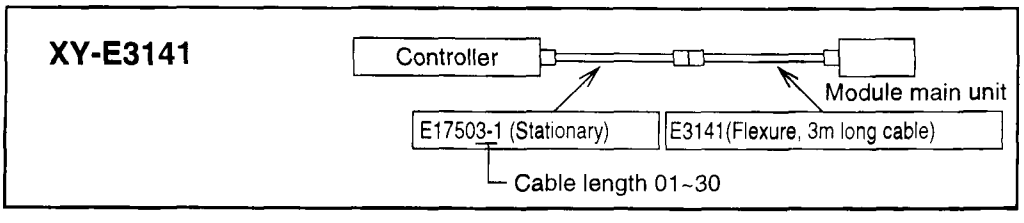


Figure 8-5: Cable inside the cable support (Additional cable for cable support or for repair)



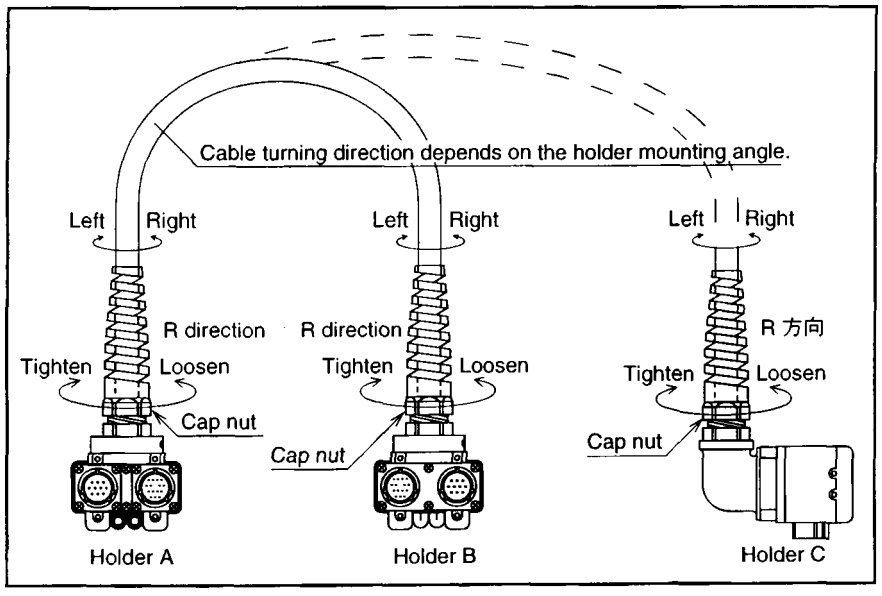
8.1.4. Procedures to Assemble Robot Cable

- See "8.2. Multi-Axis Combinations" for combining main units and combining brackets. In this section, commom procedures to assemble a robot cable are described.

8.1.4.1. Preparation before Assembly

- When the cable is boxed, the cable holders are set in such a way that the cable is not twisted and bent. After unpacked, loosen cap nuts of cable holder A and B (or C) to give the cable free rotation in R direction.

Figure 8-6



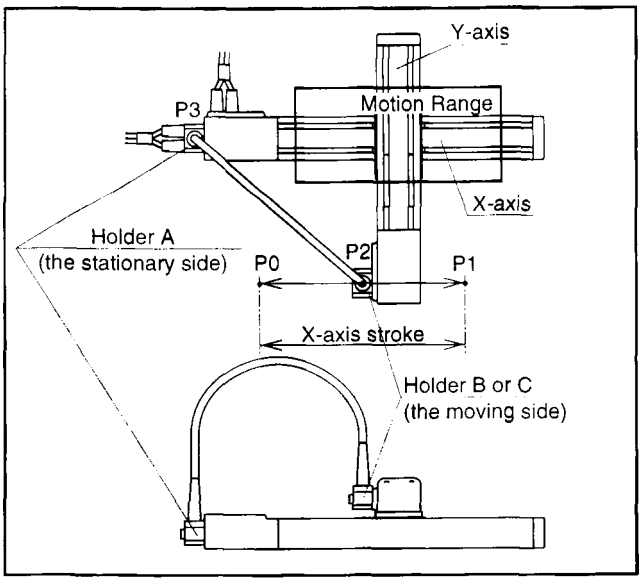
8.1.4.2. Assemble to Main Unit

(1) Move X-axis to center of stroke. (For 3-axes combination, do same for Y and Z axis)

(2) Fix holder A (the stationary side) to X-axis with provided bolts.
(Provided bolts. M3 × 57 long, tightening torque 1.47N • m {15kg • cm})

(3) Fix holder B or C (the moving side) to Y-axis connector with provided bolts.
(Provided bolts. M3 × 57 long, tightening torque 1.47N • m {15kg • cm})

Figure 8-4

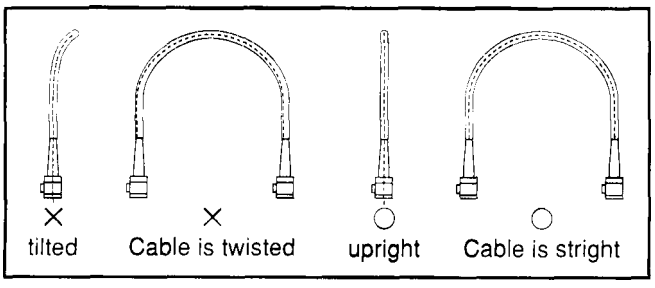


8.1.4.3. Adjusting Holders Angle

- At the holder positions P3-P2 in the Figure 8-7, adjust angle of holders and the cable in direction R in such a way that
  - ○ the cable stands upright by itself
  - ○ the cable is not twisted
  - ○ the cable is not tiltted against the line P3-P2.

Caution : The limit of cable rotation from the starting position is ±90°. If it is not observed, breakage of cable may occur.

Figure 8-8



8.1.4.4. Clumping Cable

- Fasten the cap nut. Hold the cable not to be turned with the cap nut while fastening it. (Cap nut tightening torque 7.5~9.0 N • m {77~92 kgf • cm}

8.1.4.5. Check

- Move X-axis to point P0 and P1, check that the cable stays in upright position or tilts slightly against upright line. (For 3-axes combination, do same for Y-axis.)
- If the cable is not in upright position at both points P0 and P1, readjust holders angle. (Back to procedure "8.1.4.3. Adjusting Holders Angle".)

Caution : If you skip the procedure "8.1.4.3. Adjusting Holders Angle", the cable may be tilted or twisted. Make sure to adjust holder and cable in R direction in such a way that the cable is not tilted at the point P_2 (center of the stroke).

8.1.5. Precautions to Assemble Cable Support

- See "8.2. Multi-Axis Combinations" for combining main units and combining brackets. In this section, common procedures to assemble a cable support are described.

  ① Before fixing a cable support to a main unit, check that the cables inside the cable support are not twisted.

  ② The moving end of the built-in cable must be tied with the cable support using the provided Insulock. Do not tie the other end (stationary side).

  ③ When cables for two or more axes are inside the support, be sure not to mis-connect to the connectors. Check for seals affixed to the connectors and connect them properly. (Y and Z axis)

  ④ When adding cables to the cable support, refer to Figure 8-10 for coss section limit of cables.

Figure 8-9

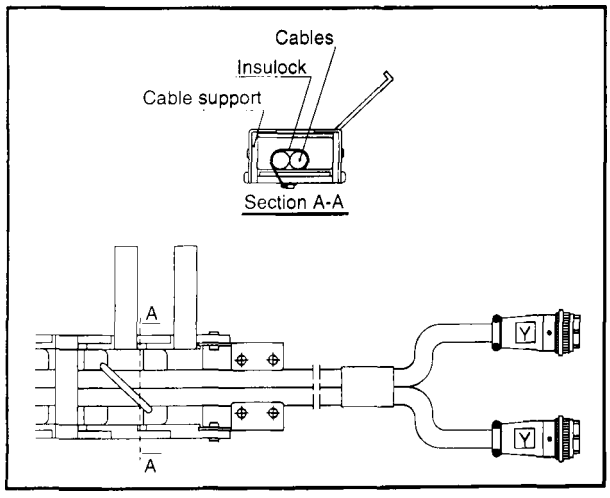
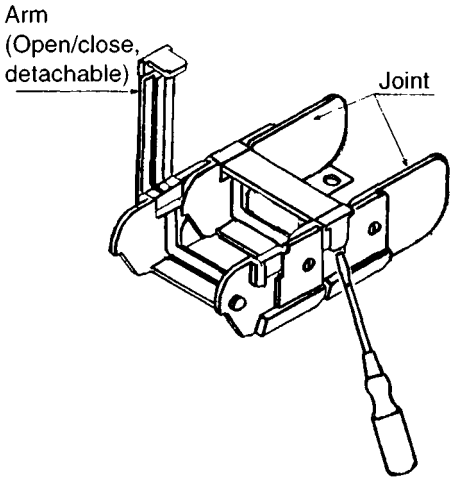
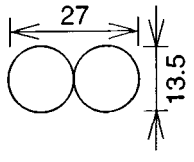
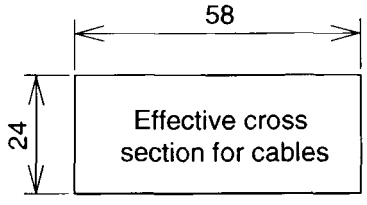


Figure 8-10





Built in cable
(For one axis)



Ref-number	Built in cable axis	Cross section limit of additional cables
XY-E173***1-1	1	470mm² max.
XY-E173***2-1	2	106mm² max.

8.2. Multi-Axis Combinations

8.2.1. G Type Combination

G-1: H + M module main units

G-2: M + S module main units

G-3: S + S module main units

① Units Required (Check that all the required units are ready.)

Table 8-1

	X-axis main unit	Y-axis main unit	Combining bracket	Controller
G-1	XY-HRS**0-H201	XY-HRS0*5-M201	XY-P175GHM-1	M-EXC2*A330A00
G-2	XY-HRS0*5-M201	XY-HRS0*3-S*01	XY-P175GMS-1	M-EXC2*A310A00
G-3	XY-HRS0*3-S*01	XY-HRS0*3-S*01	XY-P175GSS-1	M-EXC2*A110A00

	Robot cable	Controller cable	Teaching box
Common	XY-E170**L-1	XY-E17503-1 × 2	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Assemble procedures

ⓐ Fix the X-axis on the mounting base. "See 7.1.2. Fixing Main Unit".

ⓑ Mount the combining bracket on the upper surface of the X-axis slider and fix with bolts. The pins on the bracket fits into the pin holes at the center of the slider.

ⓒ Set the motor side pin holes on the Y-axis rear surface to the pins on the side of the bracket, and fix with bolts.

ⓓ Assemble the robot cable.

Table 8-2

G-1	• Fix holder C on Y-axis connector and holder A on tap holes on X-axis motor side end face with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
G-2	• Loosen two holder C elbow fixing screws, pull out elbow about 5 mm, turn clockwise by 90 degrees, push in and then tighten fixing screws (M5 hexagon socket head cap screw, tightening torque 1.47 N•m {15 kgf•cm}). • Fix holder C on Y-axis connector and holder A on tap holes on the side of X-axis motor side with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}). • Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.
G-3	• Loosen two holder C elbow fixing screws, pull out elbow about 5 mm, turn clockwise by 90 degrees, push in and then tighten fixing screws (M5 hexagon socket head cap screw, tightening torque 1.47 N•m {15 kgf•cm}). • Fix holder C on Y-axis connector and holder A on the mounting base in parallel with X-axis connector with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}). • Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓔ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]

[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]

Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

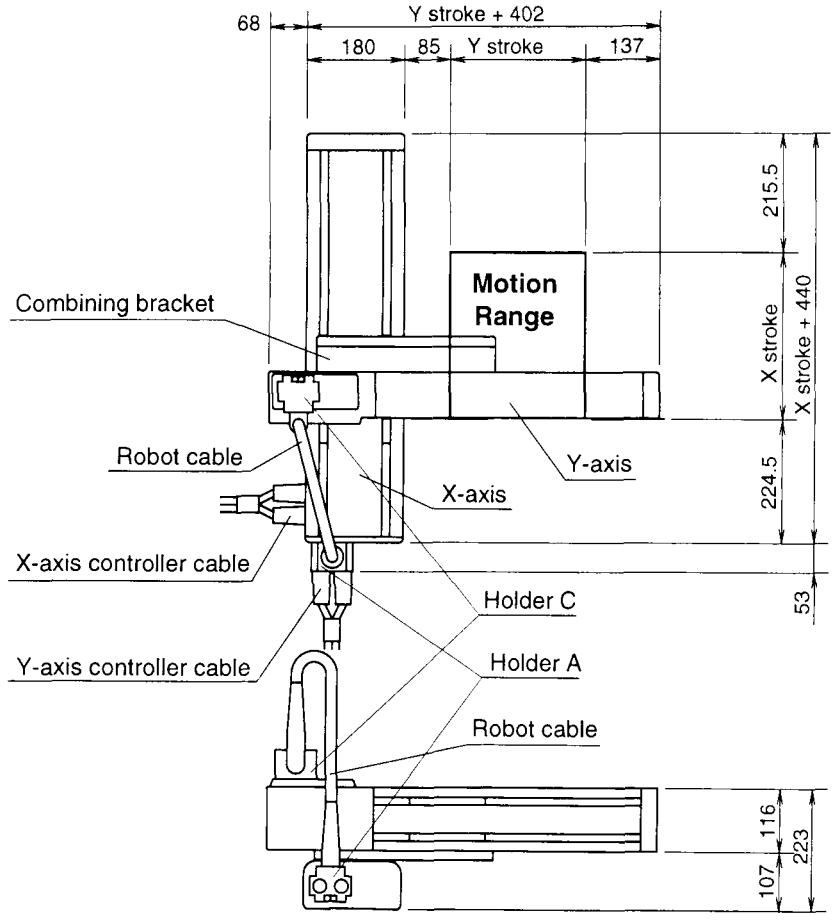
○ We recommend to affix the seals supplied with the main unit (6 each: X , Y , Z , and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-11

G – 1

X axis: H module
Y axis: M module

Y stroke [mm]	250 to 550	750	950
Transportable load [kg]	40	35	30



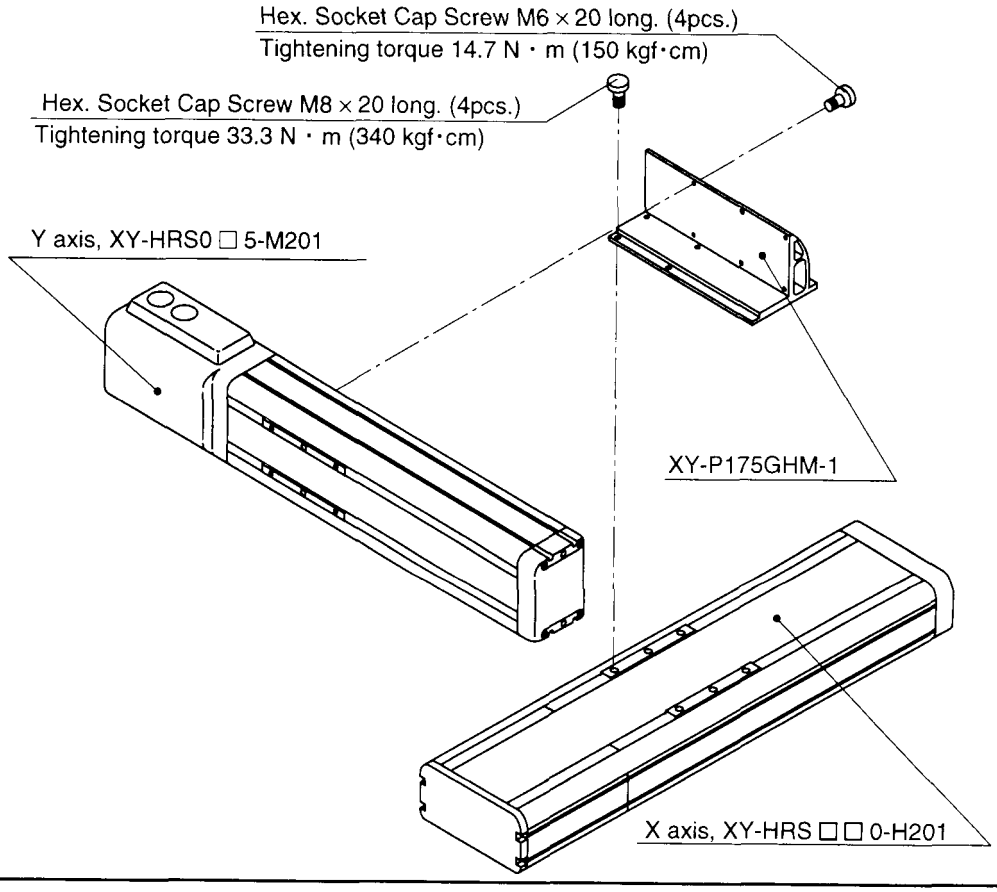
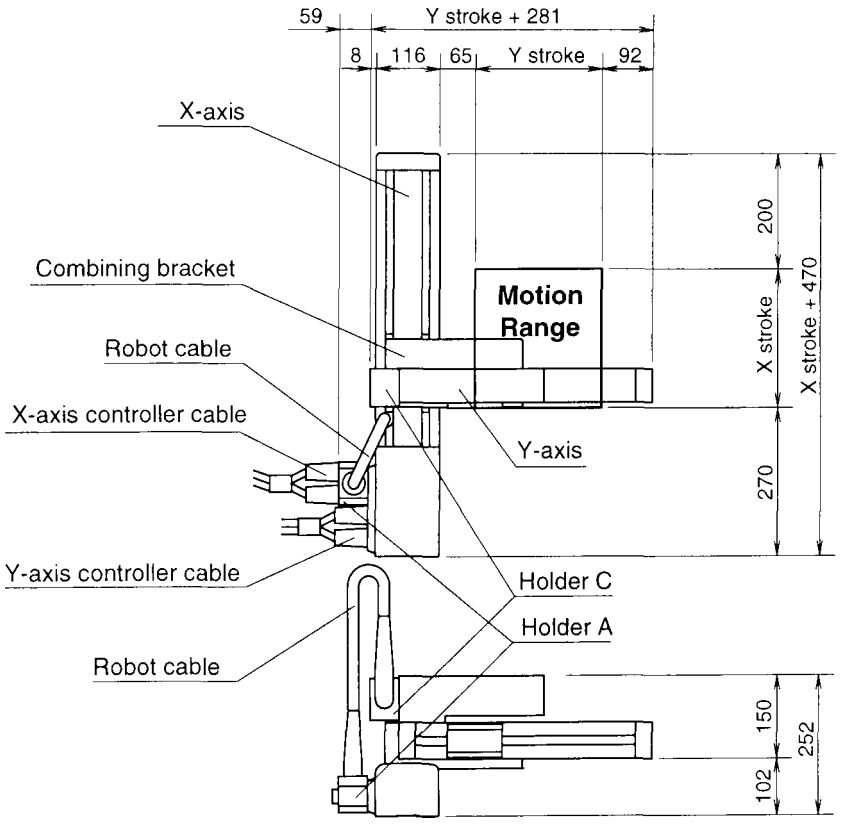


Figure 8-12

G - 2

X axis: M module
Y axis: S module

Y stroke	[mm]	130	230	330	430	530
Transportable load	[kg]	20	16	11	8	5



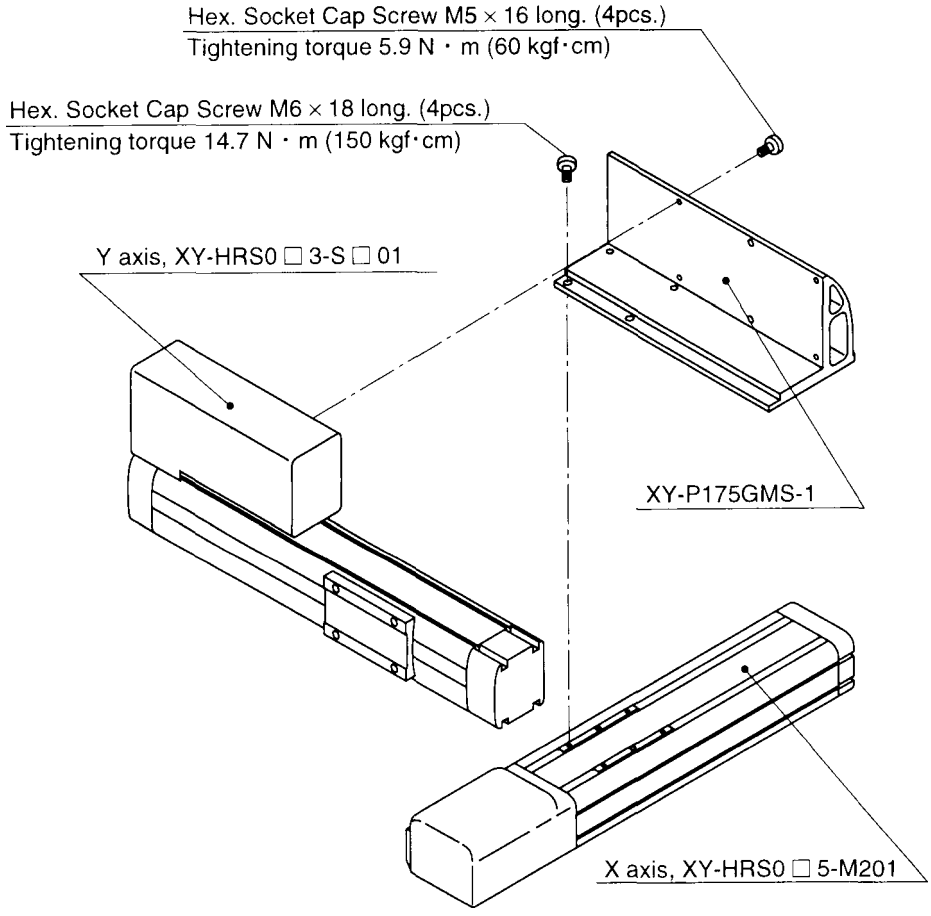
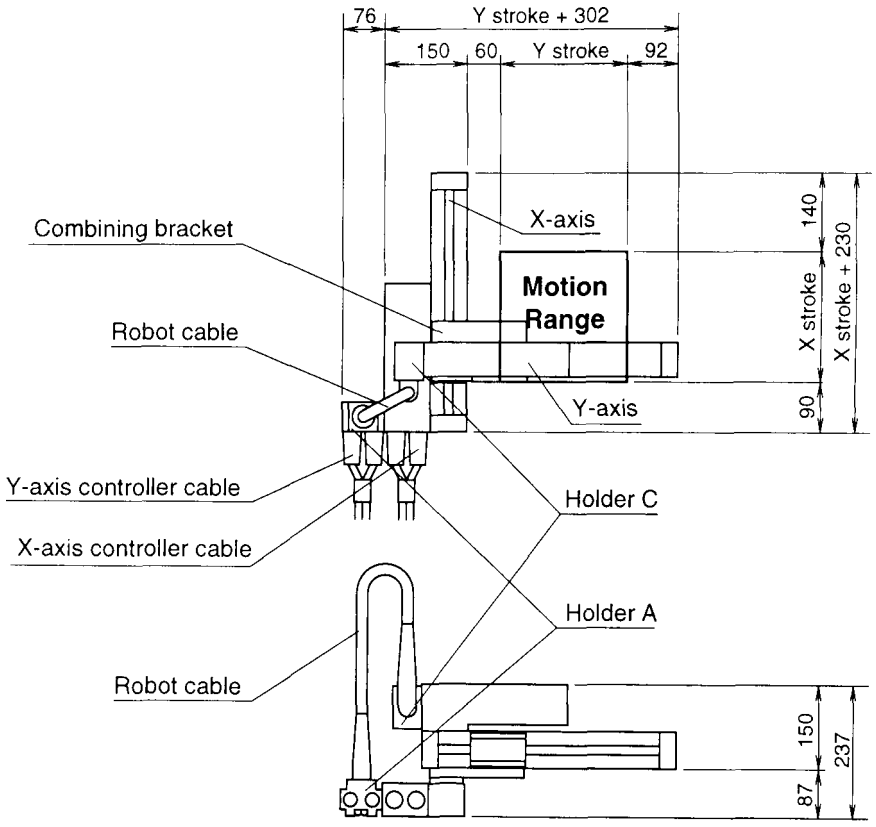


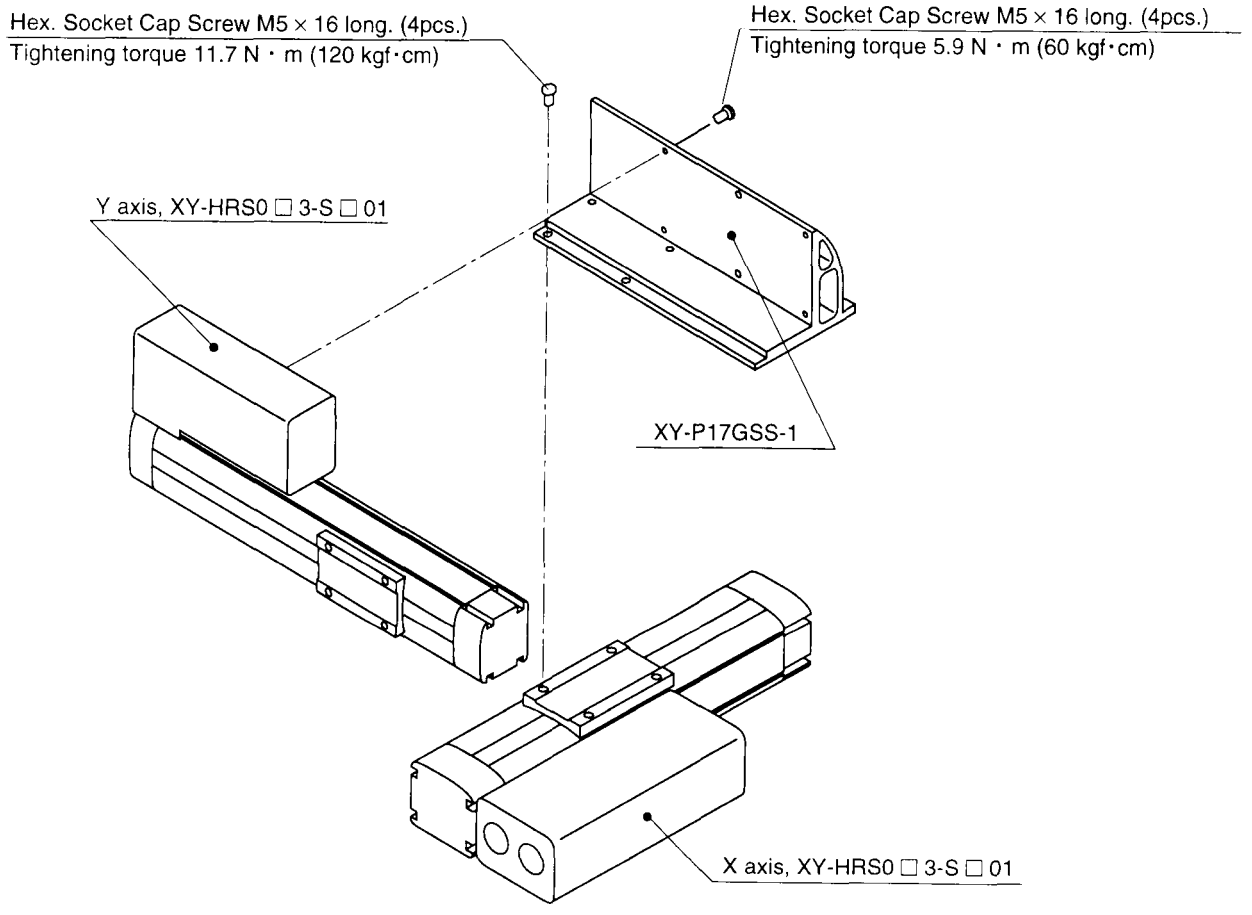
Figure 8-13

G – 3

X axis: S module
Y axis: S module

Y stroke	[mm]	130	230	330
Transportable load	[kg]	8	4	2





8.2.2. D Type Combination

8.2.2.1. Standard Combination

D-1: H + M module main units

D-2: M + M module main units

① Units Required (Check that all the required units are ready.)

Table 8-3

	X-axis main unit	Y-axis main unit	Combining bracket	Controller
D-1	XY-HRS**0-H201	XY-HRS0*5-M201	XY-P175DHM-1	M-EXC2*A330A00
D-2	XY-HRS0*5-M201	XY-HRS0*5-M201	XY-P175DMM-1	M-EXC2*A330A00

	Robot cable	Controller cable	Teaching box
Common	XY-E170**S-1	XY-E17503-1 × 2	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Fix the X-axis on a base. See "7.1.2. Fixing Main Unit".

ⓑ Mount the combining bracket on the upper surface of the X-axis slider and fix with bolts. The pins on the bracket fits into the pin holes at the center of the slider.

ⓒ Set the motor side pin holes on the Y-axis rear surface to the pins on the side of the bracket, and fix with bolts.

ⓓ Assemble the robot cable.

- ○ Fix holder B on Y-axis connector and holder A on tap hole on X-axis motor side end face with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9 N•m {77 to 92 kgf•cm}.

ⓔ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]

[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]

Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

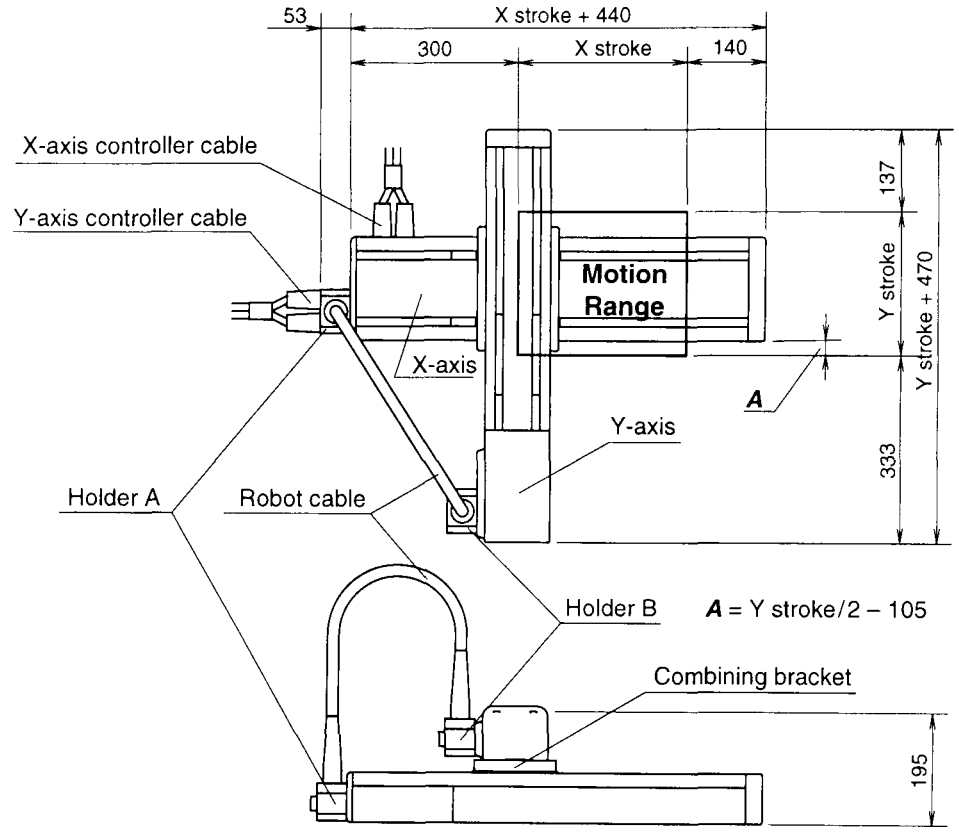
- ○ We recommend to affix the seals supplied with the main unit (6 each: X, Y, Z, and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-14

D – 1

X axis: H module
Y axis: M module

Y stroke [mm]	250 to 750	950
Transportable load [kg]	40	38



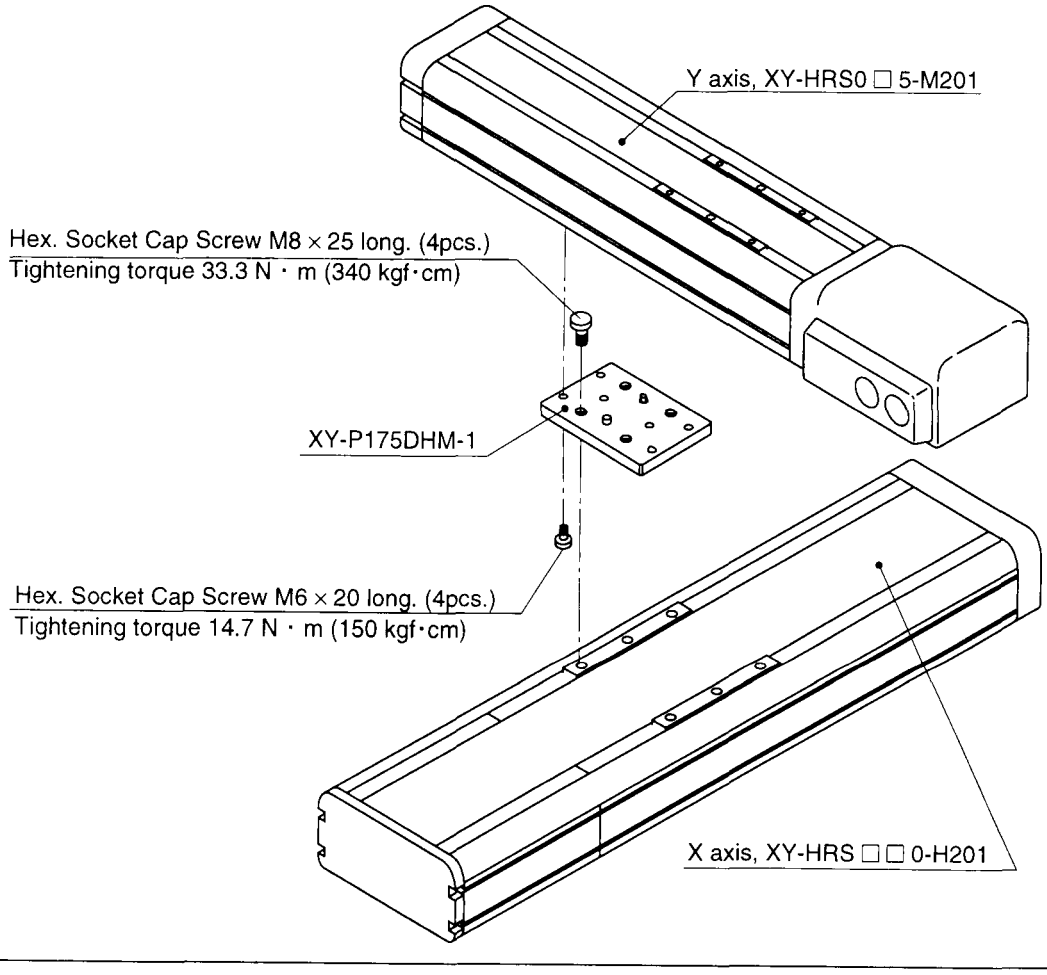
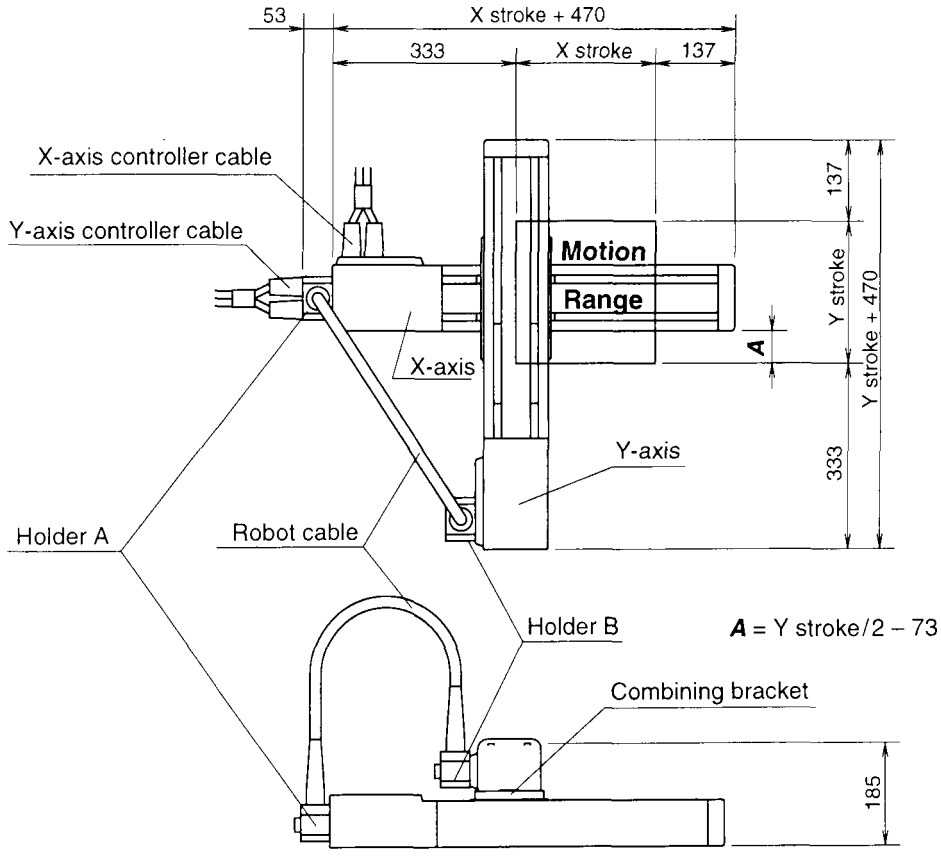


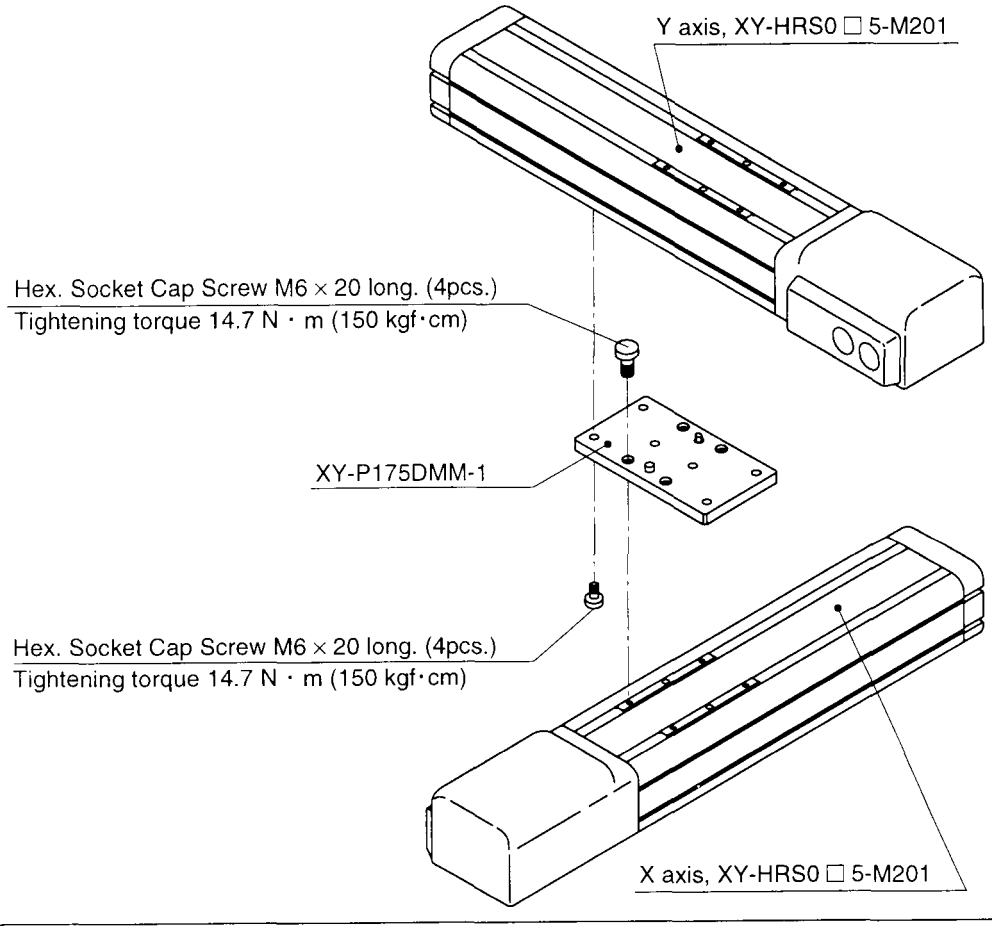
Figure 8-15

D – 2

X axis: M module
Y axis: M module

Y stroke [mm]	250	350	450	550	750	950
Transportable load [kg]	28	27	26	24	18	14





8.2.2.2. Long Stroke Combination

D-1 Long stroke: H + M module main units

D-2 Long stroke: M + M module main units

① Units Required (Check that all the required units are ready.)

Table 8-4

	X-axis main unit	Y-axis main unit	Combining bracket	Controller
D-1 Long stroke	XY-HRS100-H201	XY-HRS0*5-M201	XY-P175DHM-1	M-EXC2*A330A00
D-2 Long stroke	XY-HRS095-H201	XY-HRS0*5-M201	XY-P175DMM-1	M-EXC2*A330A00

	Cable support	Controller cable	Teaching box
Common	XY-E173DHM-1	XY-E17503-1 × 2	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Assemble procedures

ⓐ Drill M6 × 1.0 tap holes on the mounting base as shown in the Figure 8-18 to the right.

ⓑ Set the main units to two axes (Follow the same procedures a and b of D-1 / D-2 standard combination).

ⓒ Fix the cable support bracket (the moving side) to the Y-axis motor cover with provided bolts (M3, 6 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓓ Fix the cable support fixture (the stationary side) to the mounting base with provided bolts (M6, 10 mm long).

ⓔ Connect the cable support cable to the Y-axis connector.

ⓕ Tie the cable to the cable support at the support bracket (the moving side) with the provided Insulock. Do not fix the other end (the stationary side). [See "Cable Support Instruction Manual 2. Precaution" Fig. 2-A]

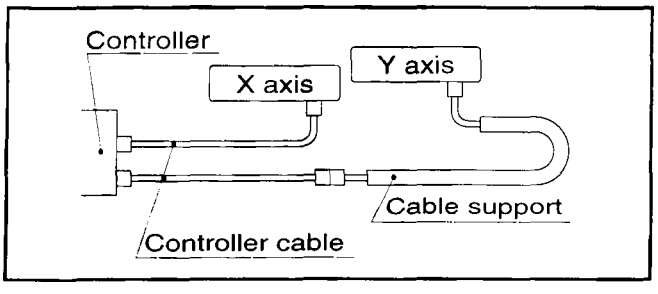
ⓖ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]

[Y-axis cable connector (cable support)] ↔ [Controller connector 2nd axis]

○ See cable system diagram shown below.

Figure 8-16



Caution : *Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.*

○ We recommend to affix the seals supplied with the main unit (6 each: X , Y , Z , and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-17

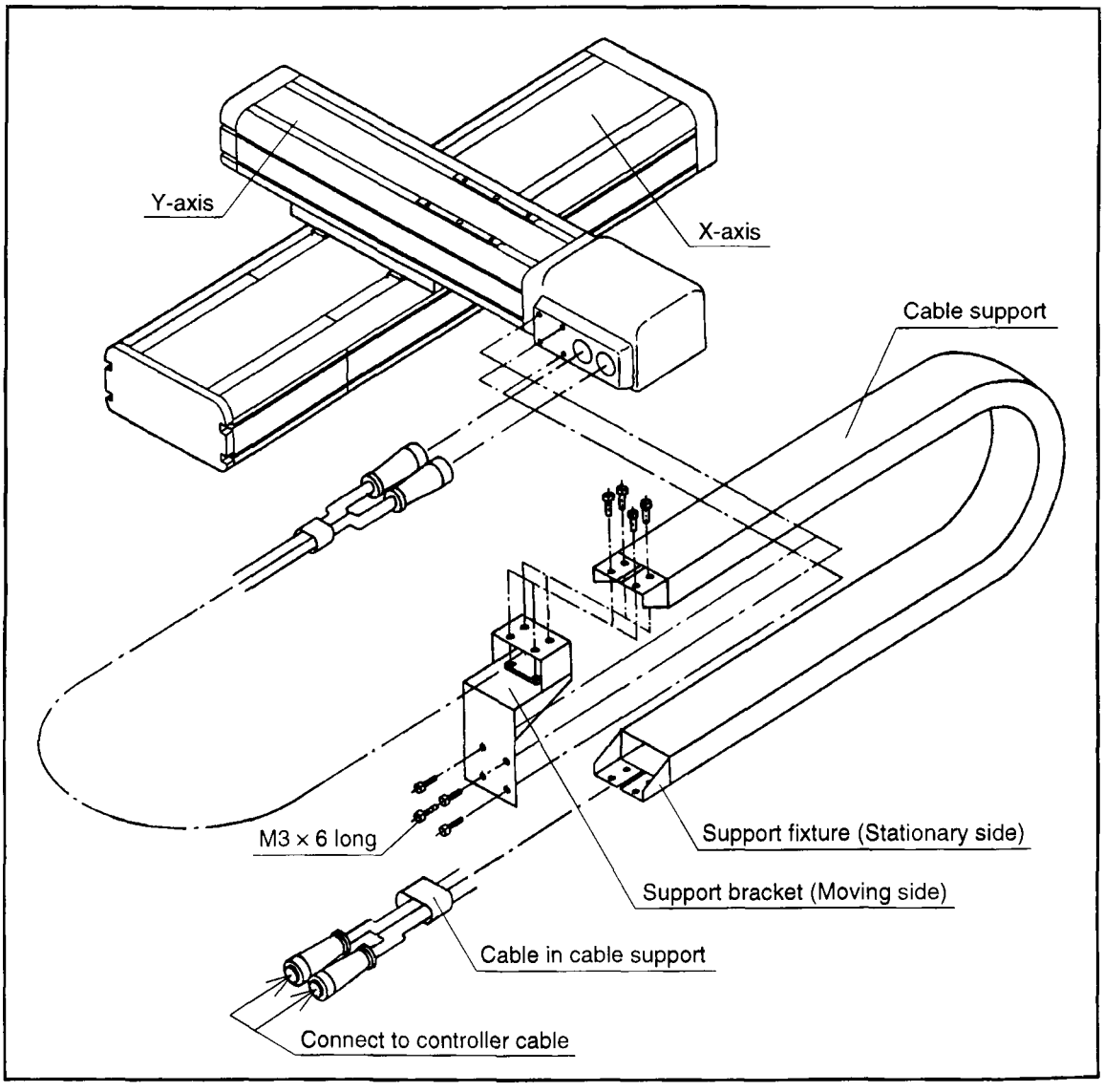


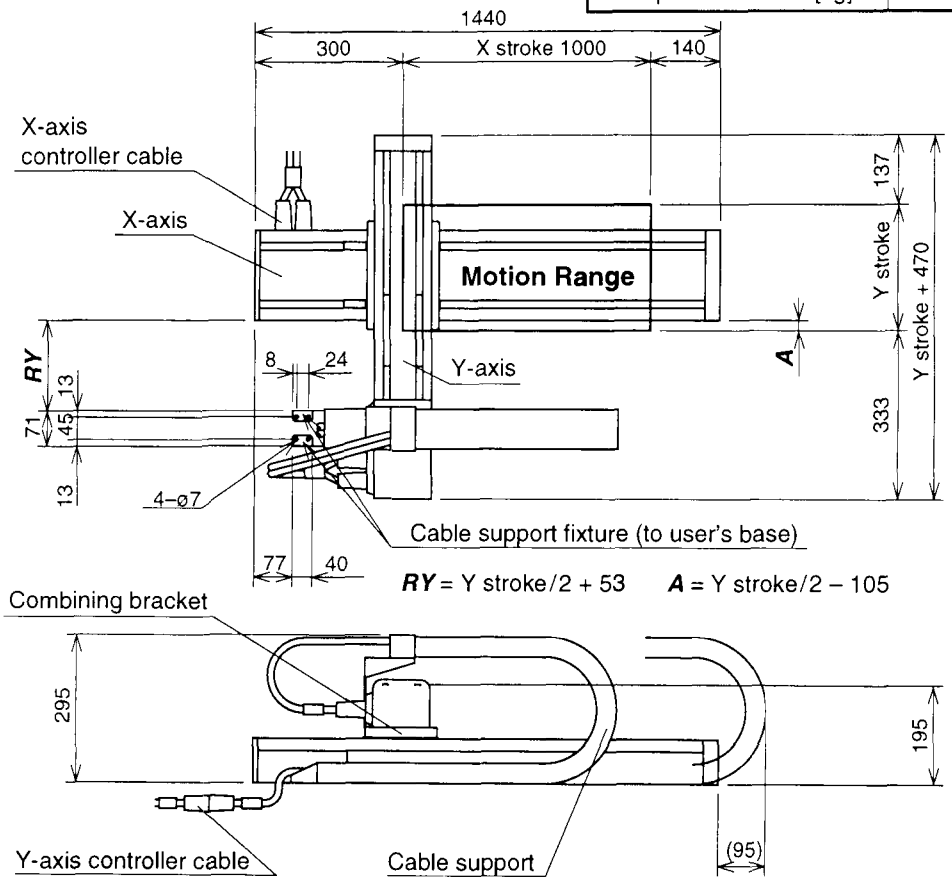
Figure 8-18

D – 1

X axis: H module
Y axis: M module

Long stroke

Y stroke [mm]	250 to 750	950
Transportable load [kg]	40	38

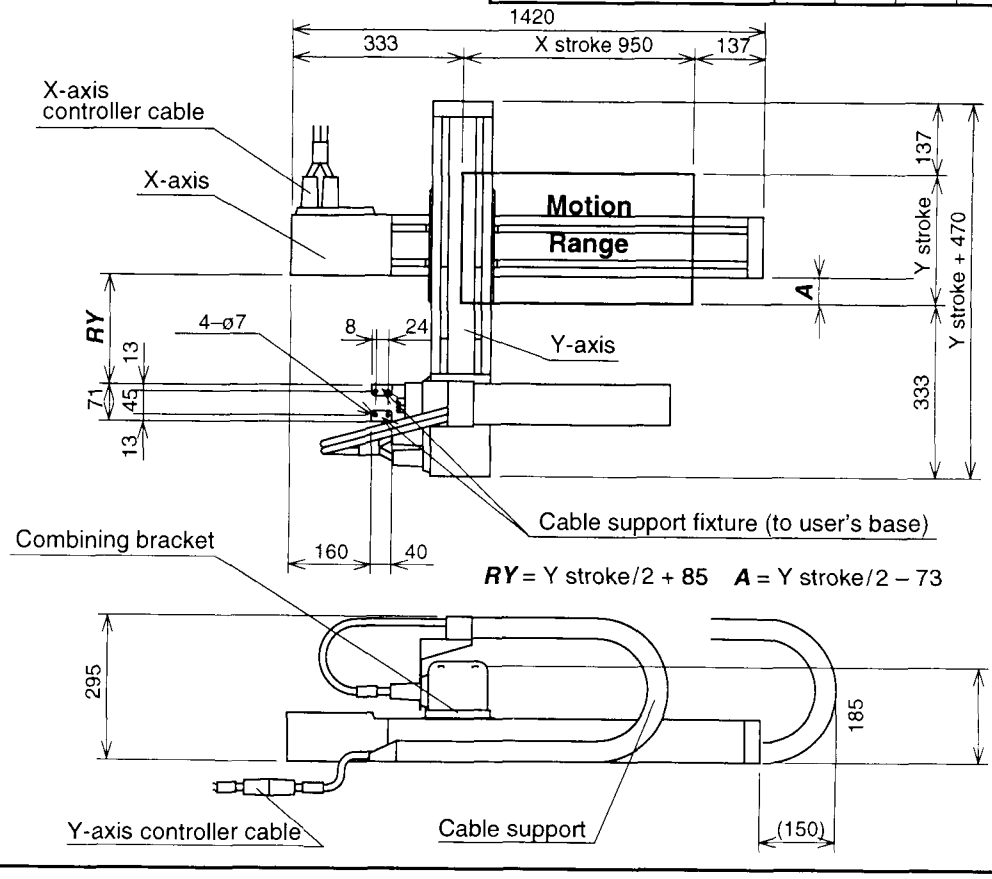


D – 2

X axis: H module
Y axis: M module

Long stroke

Y stroke [mm]	250	350	450	550	750	950
Transportable load [kg]	28	27	26	24	18	14



8.2.2.3. D-3 Type Combination

D-3: M + S module main units

① Units Required (Check that all the required units are ready.)

Table 8-5

X-axis main unit	XY-HRS0*5-M201
Z-axis main unit	XY-HRS0*3-S*01
Combining bracket	XY-P175DMS-1
Controller	M-EXC2*A310A00
Robot cable	XY-E170**S-1
Controller cable	XY-E17503-1 × 2
Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Driving the Y-axis pin.

- ○ Drive one each chamfered and straight pin attached to the bracket with a plastic hammer. (Projection 8 mm, see the figure to the right).
- ○ Be careful of the chamfering direction of the chamfered pin. The opposite surface is provided with pins for X-axis. Be sure not to push them.

ⓑ Fix the X-axis on a base. See "7.1.2. Fixing Main Unit".

ⓒ Set the bracket with Y-axis mounted to the X-axis slider surface and fix with bolts. The pins on the bracket fits into the pin holes at the center holes of the slider.

ⓓ Mount the combining bracket on the Y-axis. Set the center pin holes on the Y-axis rear surface to the pins on the bracket upper surface and fix with bolts.

ⓔ Assemble the robot cable.

- ○ Fix holder B on Y-axis connector and holder A on tap holes on X-axis motor side end face with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓕ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]
[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]

Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

- ○ We recommend to affix the seals supplied with the main unit (6 each: [X], [Y], [Z], and [θ]) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-19

D – 3

X axis: M module
Y axis: S module

Transportable load: 20kg

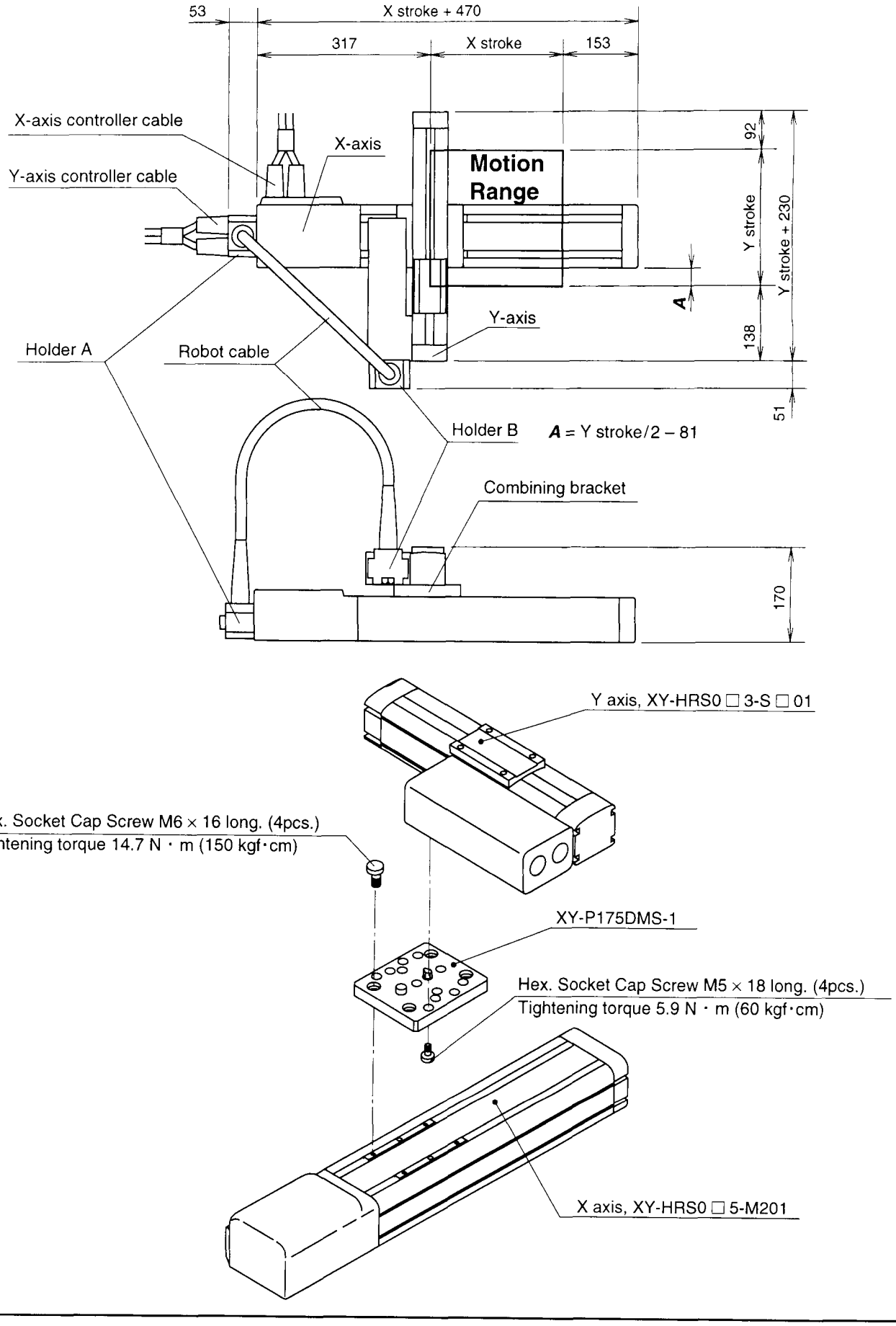
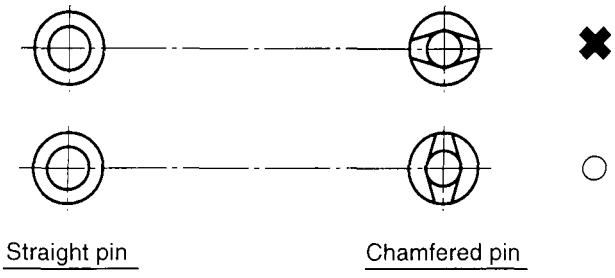


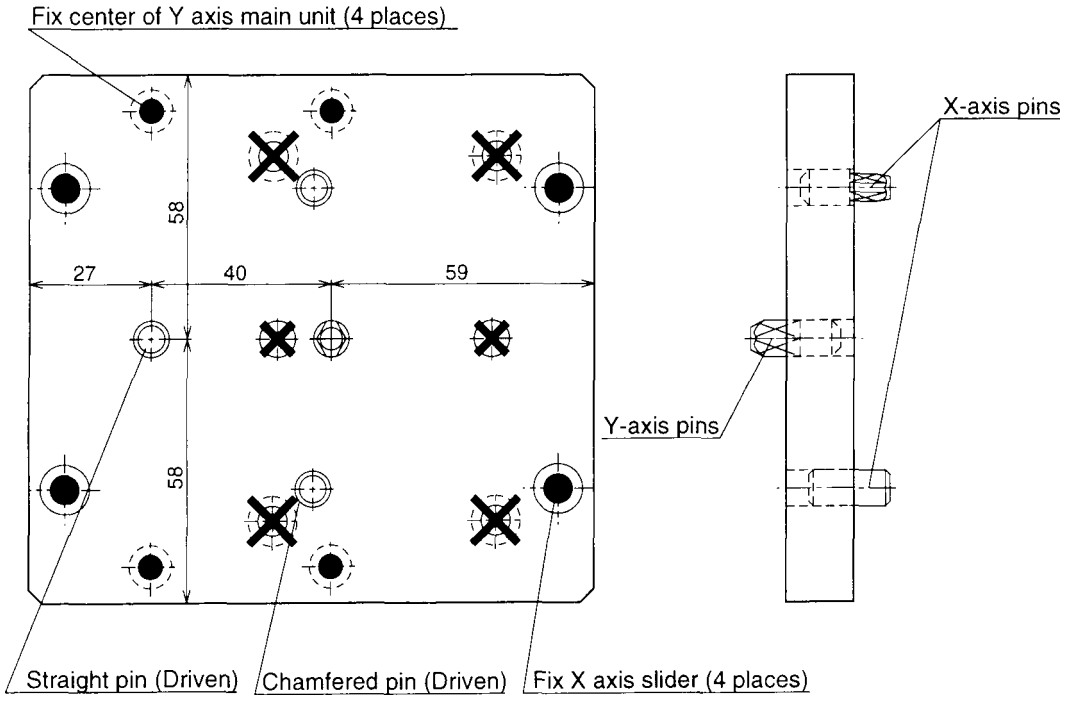
Figure 8-20

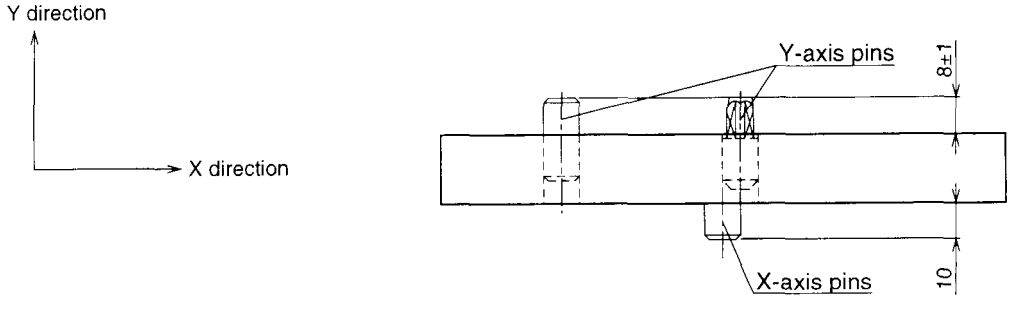
Chamfered pin driving direction



Details of combining bracket (XY-P175DMS-1)

✖: Not applicable for D-3 combination





8.2.2.4. D-4 Type Combination

D-4: S + S module main units

① Units Required (Check that all the required units are ready.)

Table 8-6

X-axis main unit	XY-HRS0*3-S*01
Y-axis main unit	XY-HRS0*3-S*01
Combining bracket	XY-P175DSS-1
Controller	M-EXC2*A110A00
Robot cable	XY-E170**S-1
Controller cable	XY-E17503-1 × 2
Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

- ○ Combining bracket is a set of 2 plates.
- ○ The smaller size plate is to fix the Y axis robot cable holder on the X-axis end face.

② Procedures

ⓐ Driving the Y-axis pin

- ○ Drive one each chamfered and straight pin attached to the bracket with a plastic hammer. (Projection 8 mm, See the figure to the right.)
- ○ Be careful of the chamfering direction of chamfered pin.
- ○ The opposite surface is provided with pins for X-axis. Be sure not to push them.

ⓑ Fix X-axis on a base. See "7.1.2. Fixing Main Unit".

ⓒ Set the center pin holes on the Y-axis rear surface to the pins on the bracket upper surface and fix with bolts.

ⓓ Set the bracket with Y-axis mounted to the X-axis slider surface and fix with bolts. In this instance, the pins on the bracket fits in the center pin holes of the slider.

ⓔ Assemble the robot cable.

- ○ Fix the smaller plate on the X-axis motor end face with bolts.
- ○ Fix holder B on Y-axis connector and holder A on tap holes on the smaller plate with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓕ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]
[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]

Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

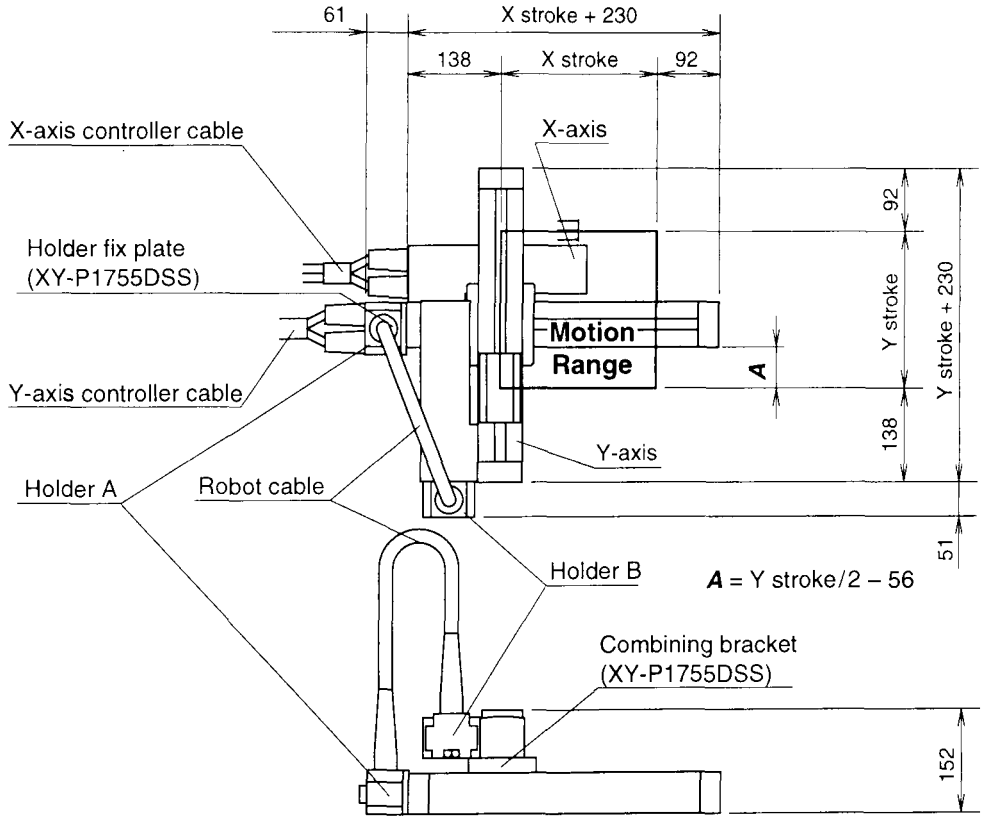
- ○ We recommend to affix the seals supplied with the main unit (6 each: X , Y , Z , and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-21

D – 4

X axis: S module
Y axis: S module

Y stroke [mm]	130	230	330	430	530
Transportable load [kg]	14	13	12	11	10



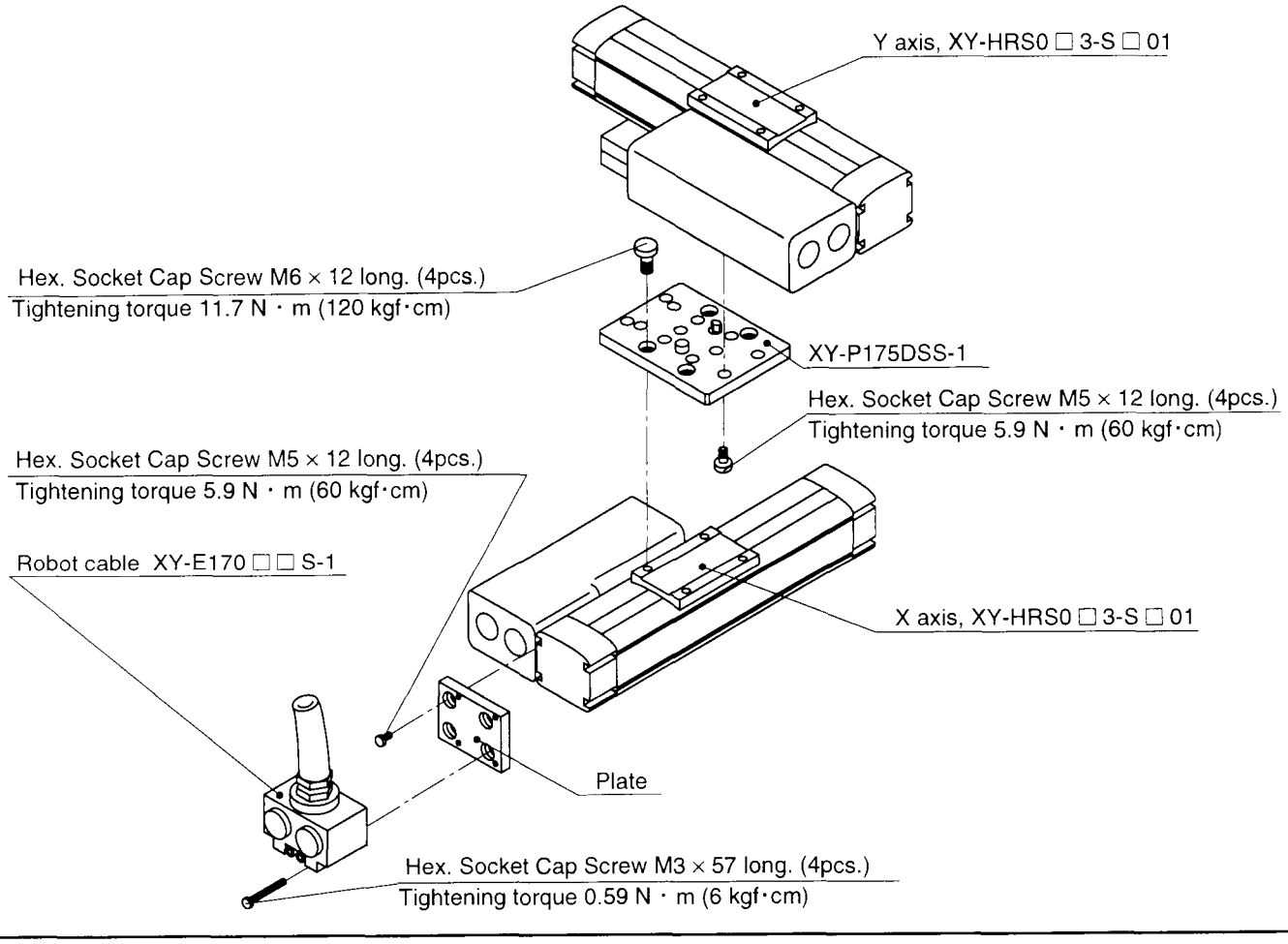
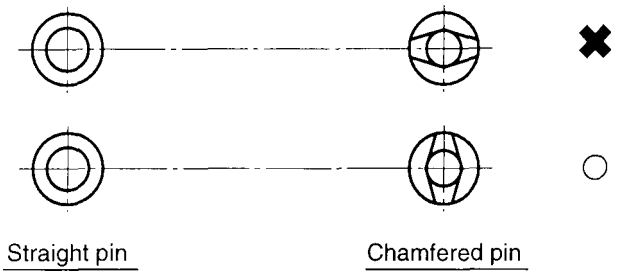


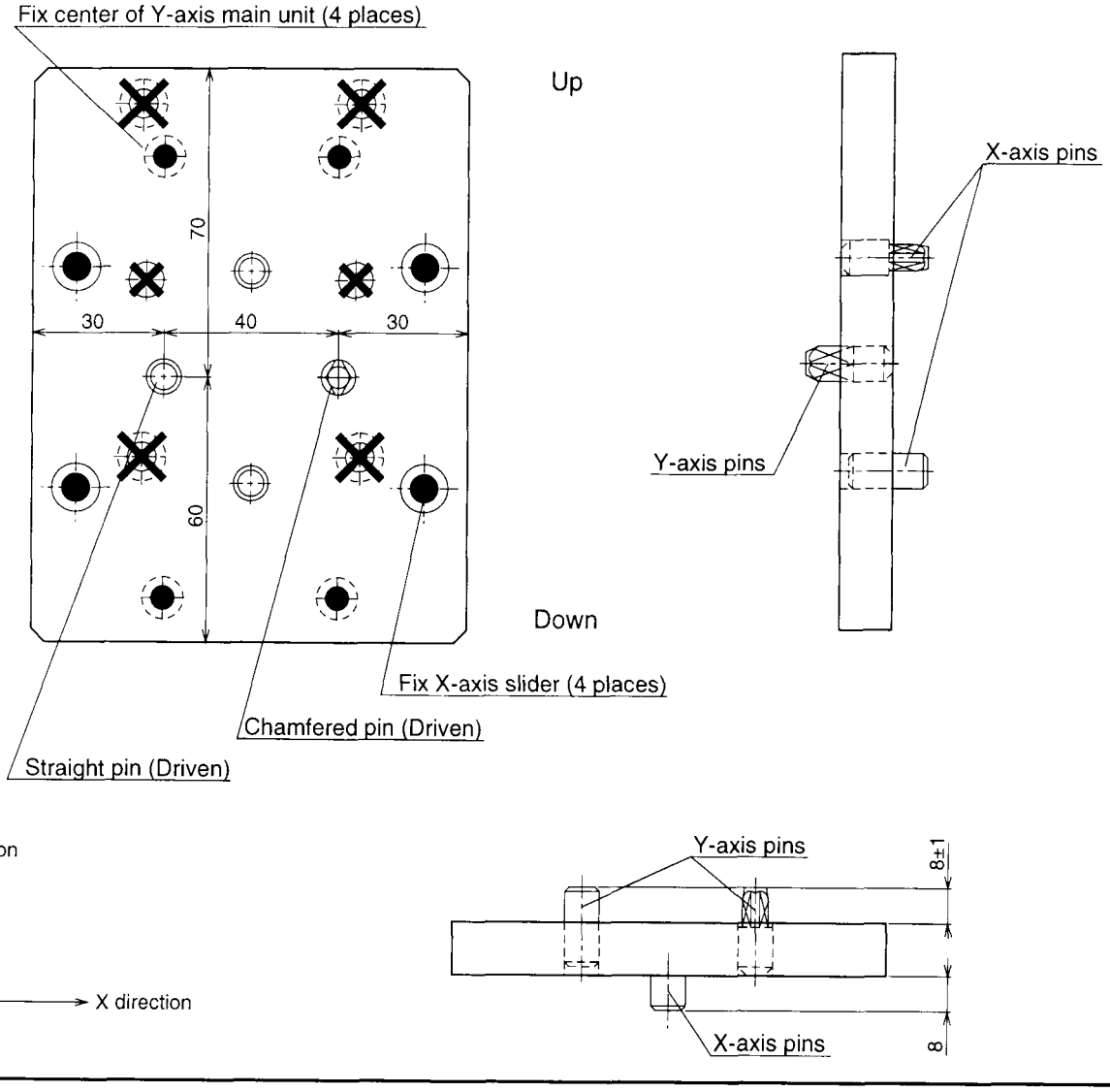
Figure 8-22

Chamfered pin driving direction



Details of combining bracket (XY-P175DMS-1)

✖: Not applicable for D-3 combination



8.2.3. T Type Combination

T: M + S modules for Vertical Axis

① Units Required (Check that all the required units are ready.)

Table 8-7

X-axis main unit	XY-HRS0*5-M201
Z-axis main unit	XY-HRS0*3-S1B1
Combining bracket	XY-P175DMS-1
Controller	M-EXC2*A310A00
Robot cable	XY-E170**S-1
Controller cable	XY-E17503-1 × 2
Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Fix the X-axis on a base See "7.1.2. Fixing Main Unit".

ⓑ Mount the L-shaped bracket on the upper surface of the X-axis slider and fix with bolts. The pins on the bracket fits into the pin holes at the center of the slider.

ⓒ Fix the plate bracket on the mounting holes on the Z-axis counter motor side with bolts.

ⓓ Fix the plate bracket with Z-axis on the L-shaped bracket with bolts. In this instance, the pins on the L-shaped bracket runs through the loose holes on the plate bracket to fit into the pin holes on the Z-axis main unit.

ⓔ Assemble the robot cable.

- Fix holder C on Z-axis connector and holder A on tap hole on X-axis motor side end face with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓕ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]

[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]

Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

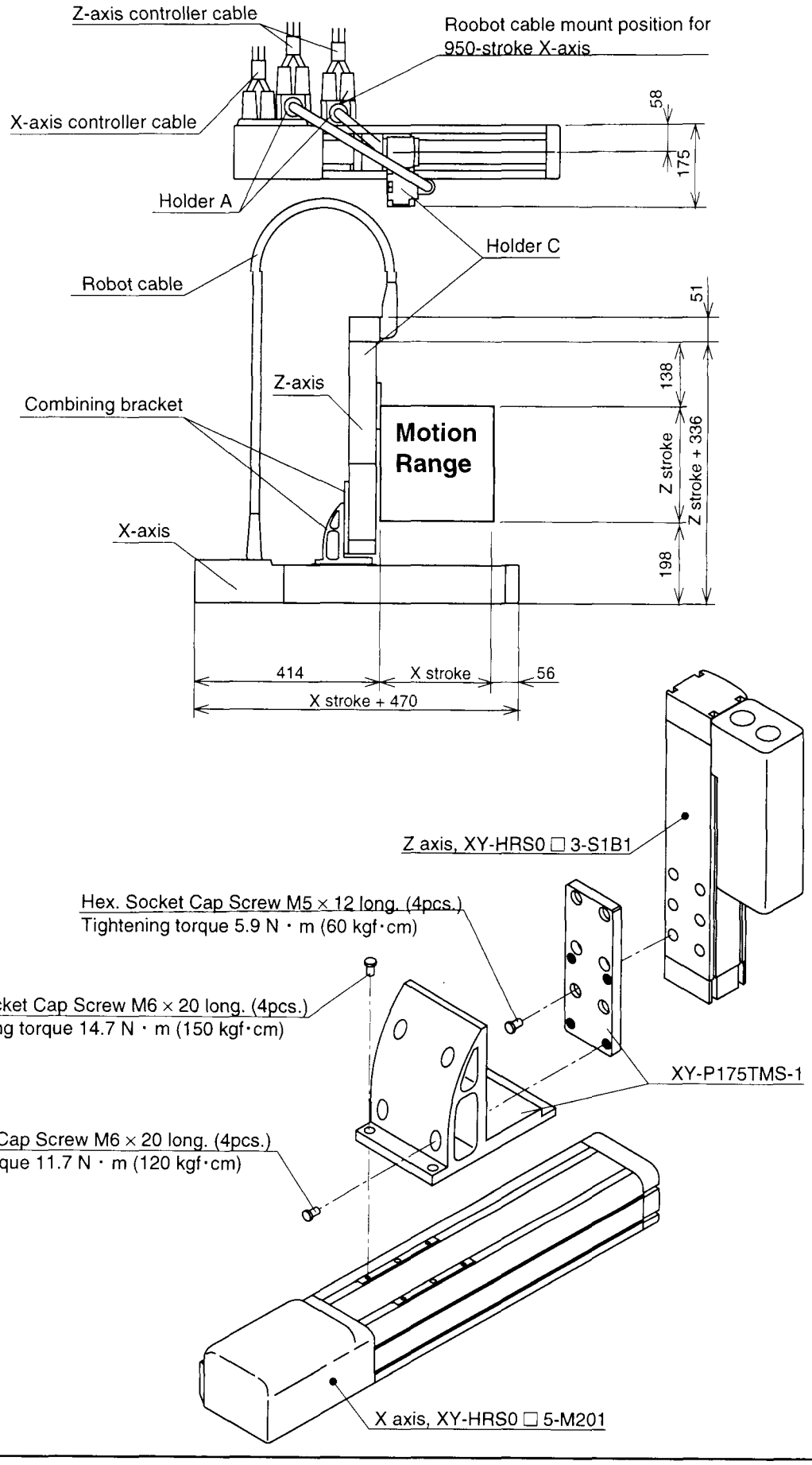
- We recommend to affix the seals supplied with the main unit (6 each: [X], [Y], [Z], and [θ]) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-23

T

X axis: M module
Y axis: S module

Transportable load: 15kg



8.2.4. X Type Combination

8.2.4.1. Standard Combination

X-1: H + H module main units

X-2: H + M module main units

X-3: M + M module main units

① Units Required (Check that all the required units are ready.)

Table 8-8

	X-axis main unit	Y-axis main unit	Combining bracket	Controller
X-1	XY-HRS**0-H201	XY-HRS0*0-H201	XY-P175XHH-1	M-EXC2*A330A00
X-2	XY-HRS0*0-M201	XY-HRS0*5-M201	XY-P175XHM-1	M-EXC2*A330A00
X-3	XY-HRS0*5-M201	XY-HRS0*5-M201	XY-P175XMM-1	M-EXC2*A330A00

	Robot cable	Controller cable	Teaching box
Common	XY-E170**L-1	XY-E17503-1 × 2	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Fix the X-axis on a base. See "7.1.2. Fixing Main Unit".

ⓑ Mount the combining bracket on the upper surface of the X-axis slider and fix with bolts. The pins on the bracket fits into the pin holes at the center of the slider.

ⓒ Set the motor side pin holes on the Y-axis rear surface to the pins on the side of the bracket, and fix with bolts.

ⓓ Assemble the robot cable.

- ○ Fix holder C on Y-axis connector and holder A on tap holes on X-axis motor side end face with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓕ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]
[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]

Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

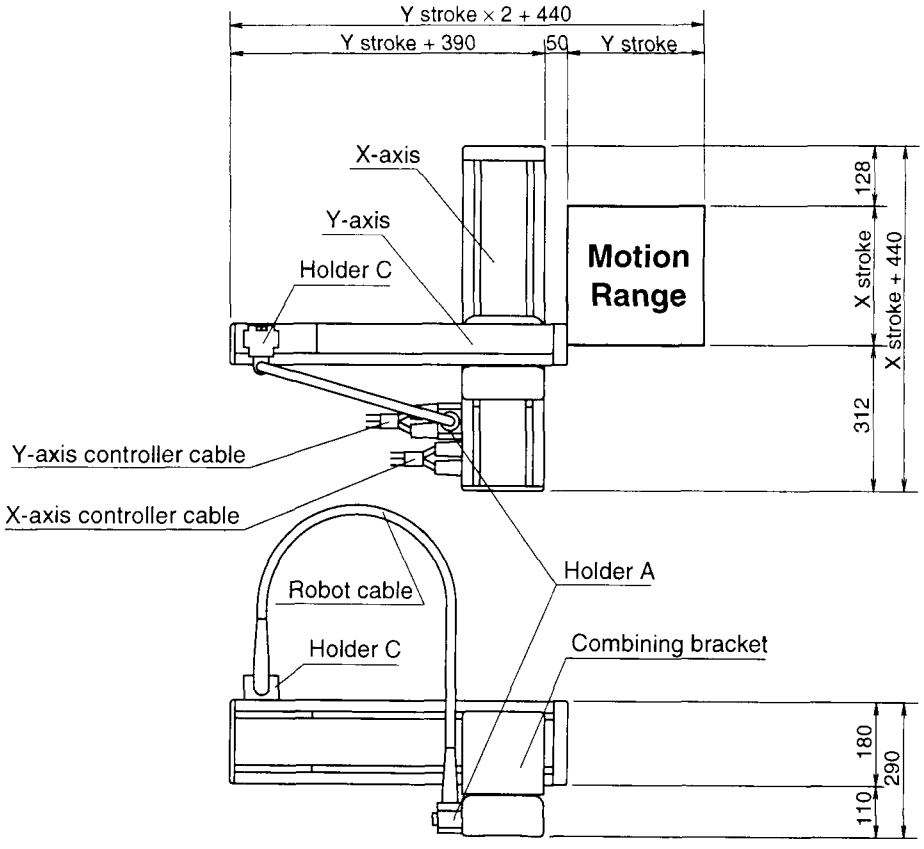
○ We recommend to affix the seals supplied with the main unit (6 each: [X], [Y], [Z], and [θ]) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-24

X – 1

X axis: H module
Y axis: H module

Y Stroke [mm]	300	400	500	600	800	1000
Transportable load [kg]	37	35	33	31	27	20



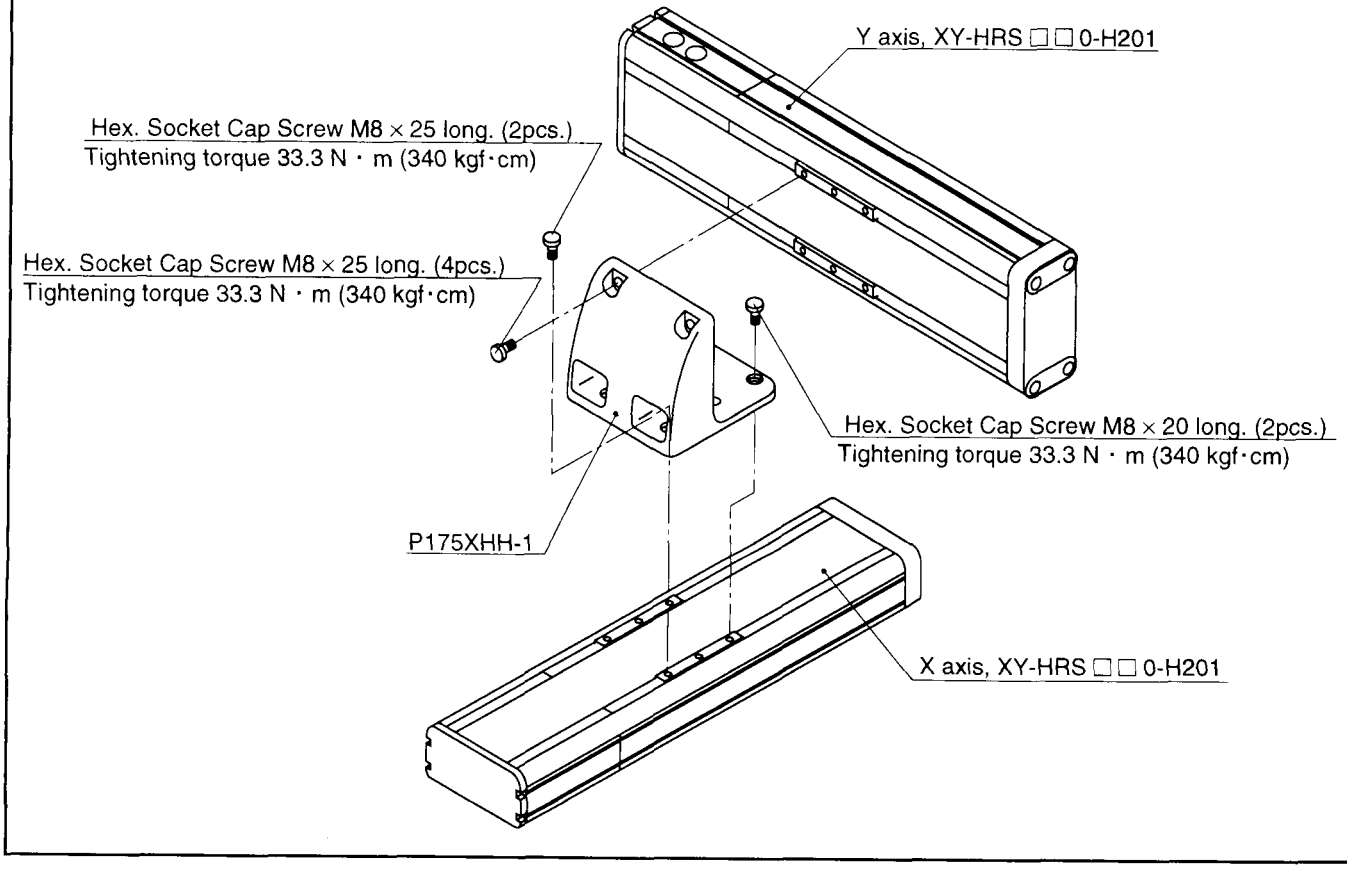
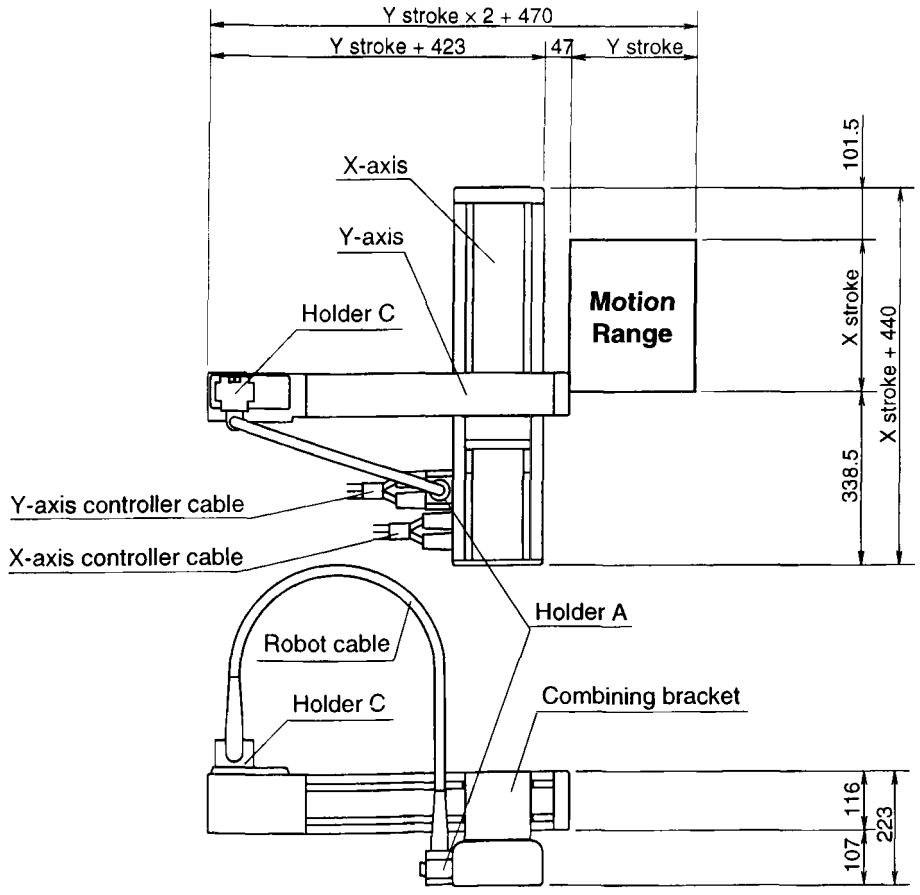


Figure 8-25

X – 2

X axis: H module
Y axis: M module

Y Stroke [mm]	250	350	450	550	750	950
Transportable load [kg]	23	17	13	10	5	3



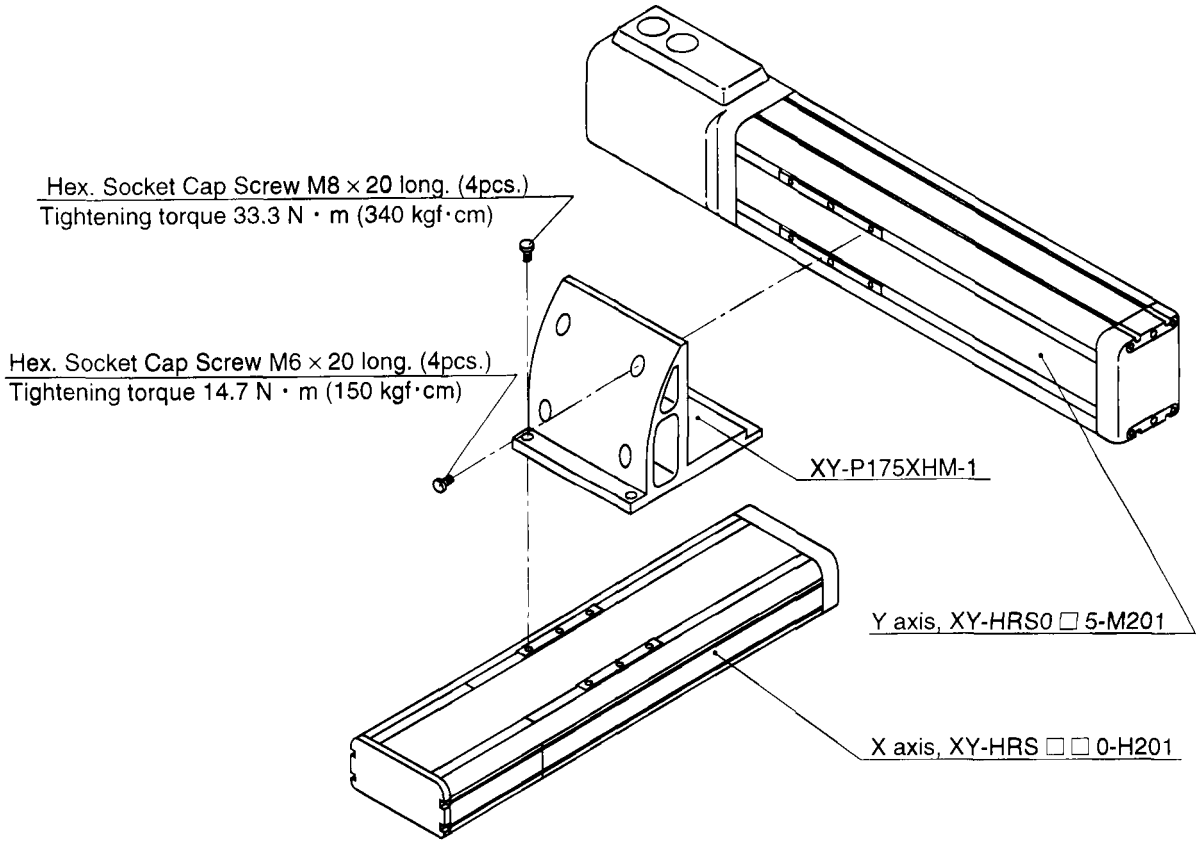
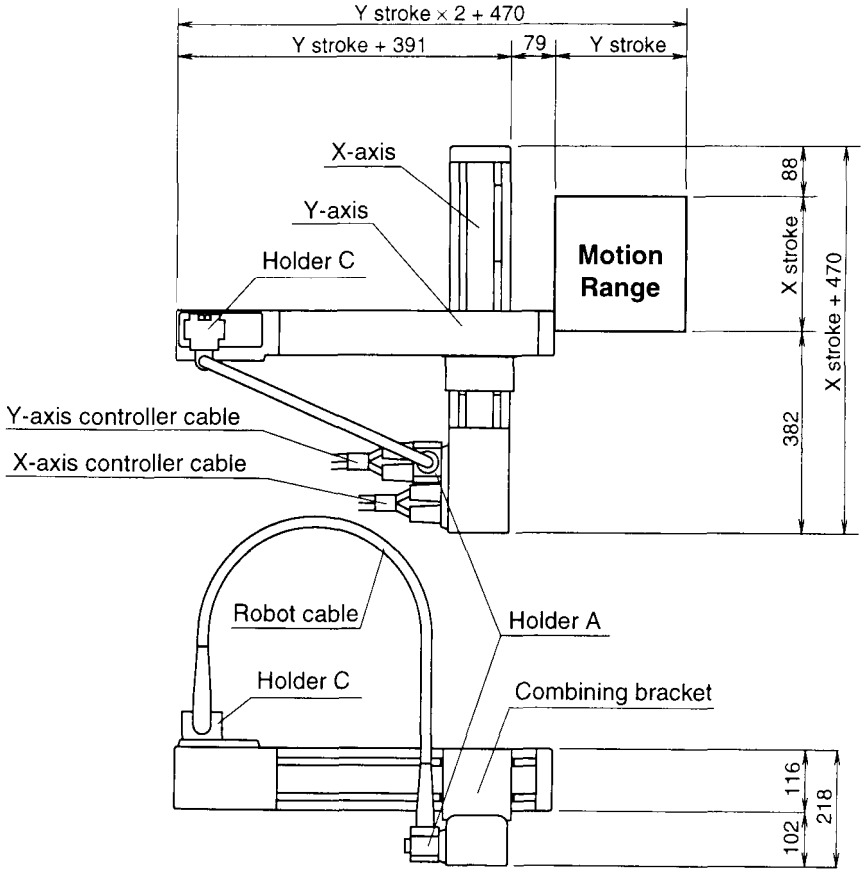


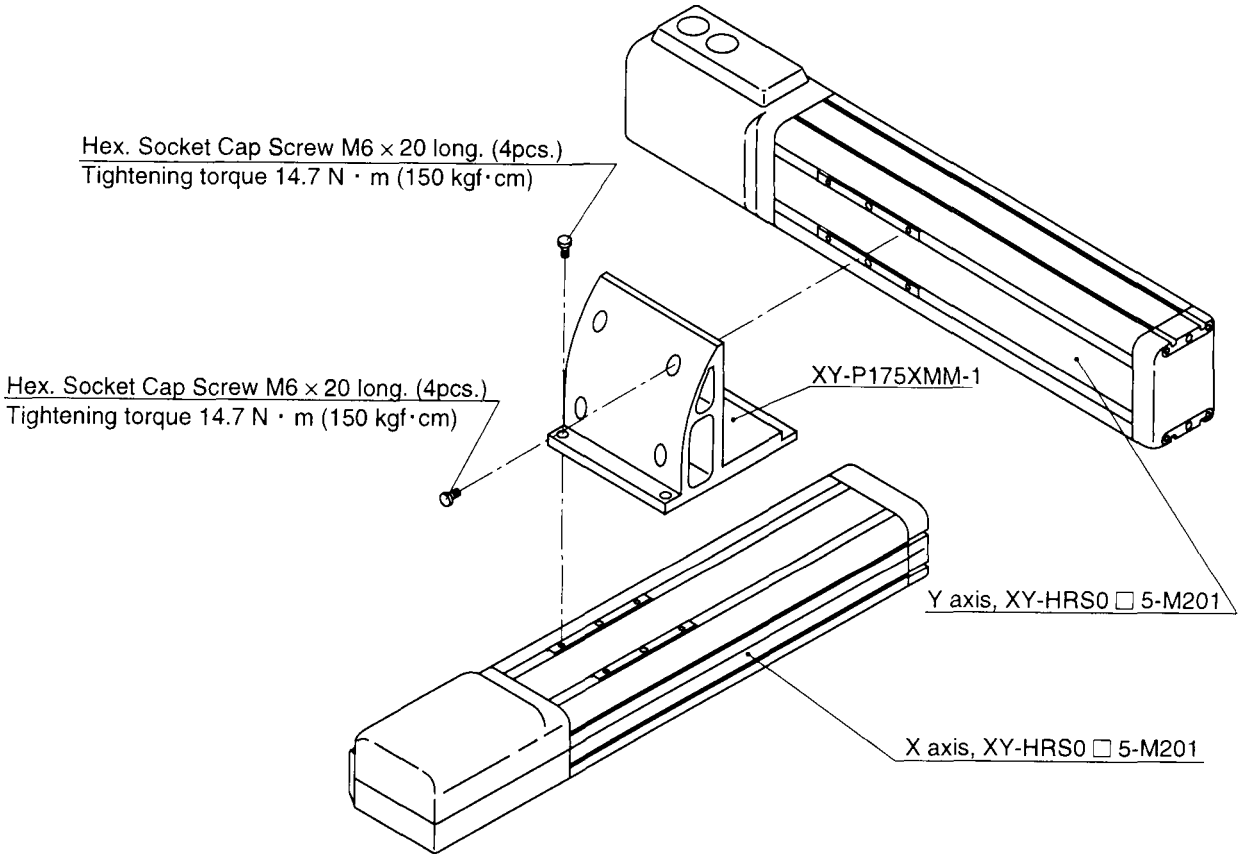
Figure 8-26

X – 3

X axis: M module
Y axis: M module

Y stroke	[mm]	250	350	450	550
Transportable load	[kg]	11	8	6	3





8.2.4.2. Long Stroke Combination

X-1 Long stroke: H + H module main units

X-2 Long stroke: H + M module main units

① Units Required (Check that all the required units are ready.)

Table 8-9

	X-axis main unit	Y-axis main unit	Combining bracket	Controller
X-1 Long stroke	XY-HRS**0-H201	XY-HRS**0-H201	XY-P175XHH-1	M-EXC2*A330A00
X-2 Long stroke	XY-HRS**0-H201	XY-HRS**5-M201	XY-P175XHM-1	M-EXC2*A330A00

	Cable support	Robot cable	Controller cable	Teaching box
X-1 Long stroke	XY-E173XHH1-1	XY-E170**L-1	XY-E17503-1 × 2	M-EXTB01
X-2 Long stroke	XY-E173XHM1-1	XY-E170**L-1	XY-E17503-1 × 2	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Set the main units to two axes (Follow the same procedures ⓐ to ⓒ of X-1, X-2 standard combination).

ⓑ Fix two cable support rests to the T slot on the X-axis side with provided guide keys and bolts. One must be fixed to the end of X-axis and the other must be fixed to the middle of X-axis end and the point CX (M3, 6mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓒ Fix the cable support fixture (the stationary side) to the T slot on the X-axis side using a guide key in the position specified in the figure to the page 38 and 39 (Cable lead out channel, CX) with provided bolts (M3. 6mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓓ Fix the cable support bracket (the moving side) to the combining bracket with provided bolts (M4, 6mm long, tightening torque 2.9 N•m {30 kgf•cm}).

ⓔ Fix the holder mounting plate to the back of the combining bracket with provided bolts. Use a provided stud in back of those places where the bracket is countersunk (M5, 6 mm long, tightening torque 5.9 N•m {60 kgf•cm}).

ⓕ Assemble robot cable and cable support.

(i) Move X-axis to center of stroke.

(ii) Fix holder C (elbow side) on Y-axis connector with bolts provided with robot cable.
(M3, 57 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

(iii) Fix holder A (straight side) on the holder mounting plate with provided bolts.
(M3, 57 mm long, tightening torque 1.47 N•m {15 kgf•cm}).
Loosen cap nut of holder A and C temporarily, twist cable in such a way that it stands upright, and tighten cap nuts to torque 7.5 to 9.0 N•m (77 to 92 kgf•cm).

(iv) Connect the cable in the cable support to the robot cable.

(v) Tie the cable to the cable support at the cable support bracket (the moving side) with the provided Insulock. Do not fix the other end.

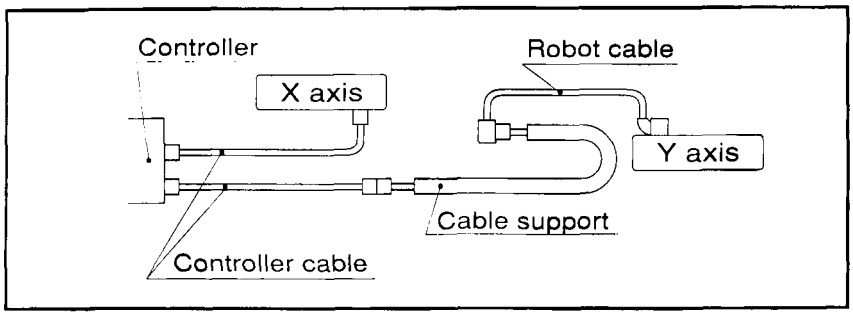
ⓖ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]

[Y-axis connector in cable support] ↔ [Controller connector 2nd axis]

○ See cable system diagram shown below.

Figure 8-27



Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

○ We recommend to affix the seals supplied with the main unit (6 each: [X], [Y], [Z], and [θ]) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-28

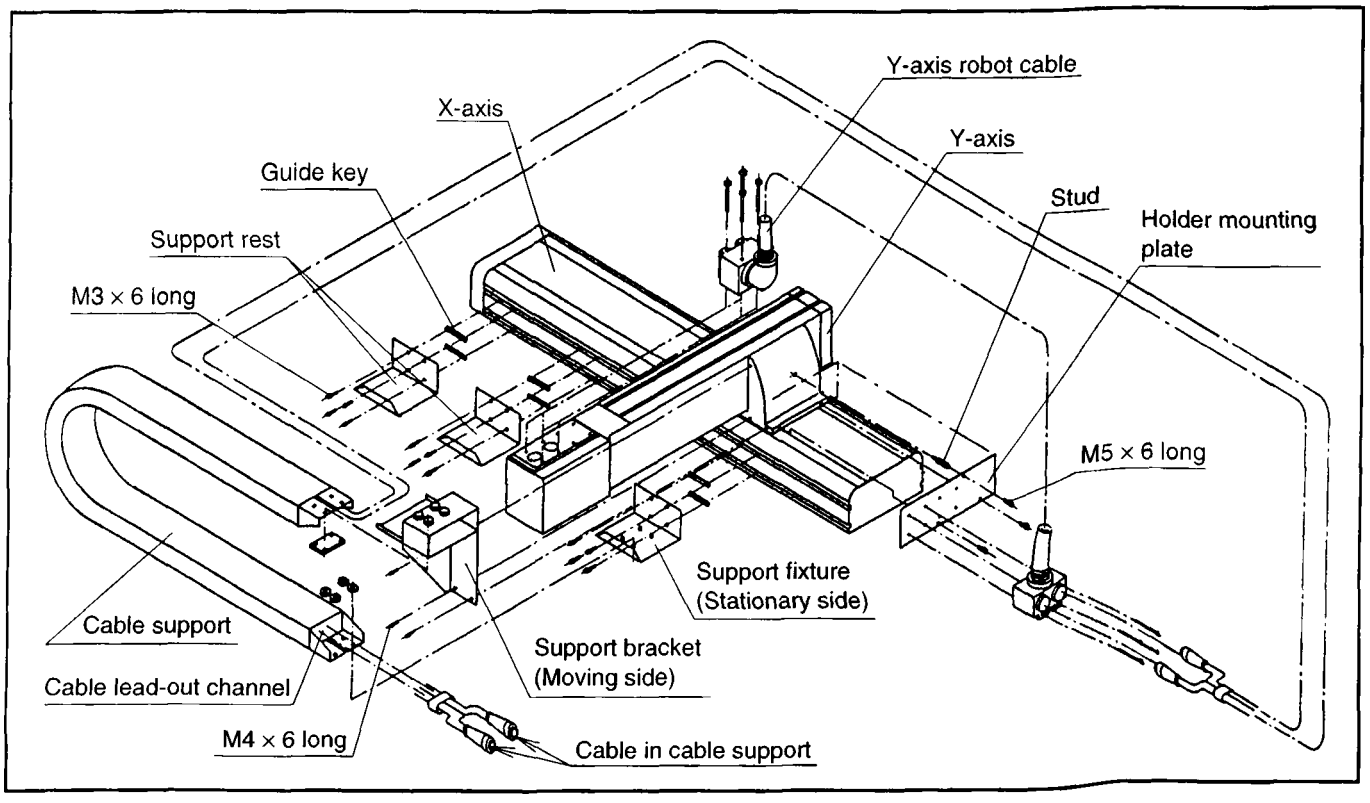


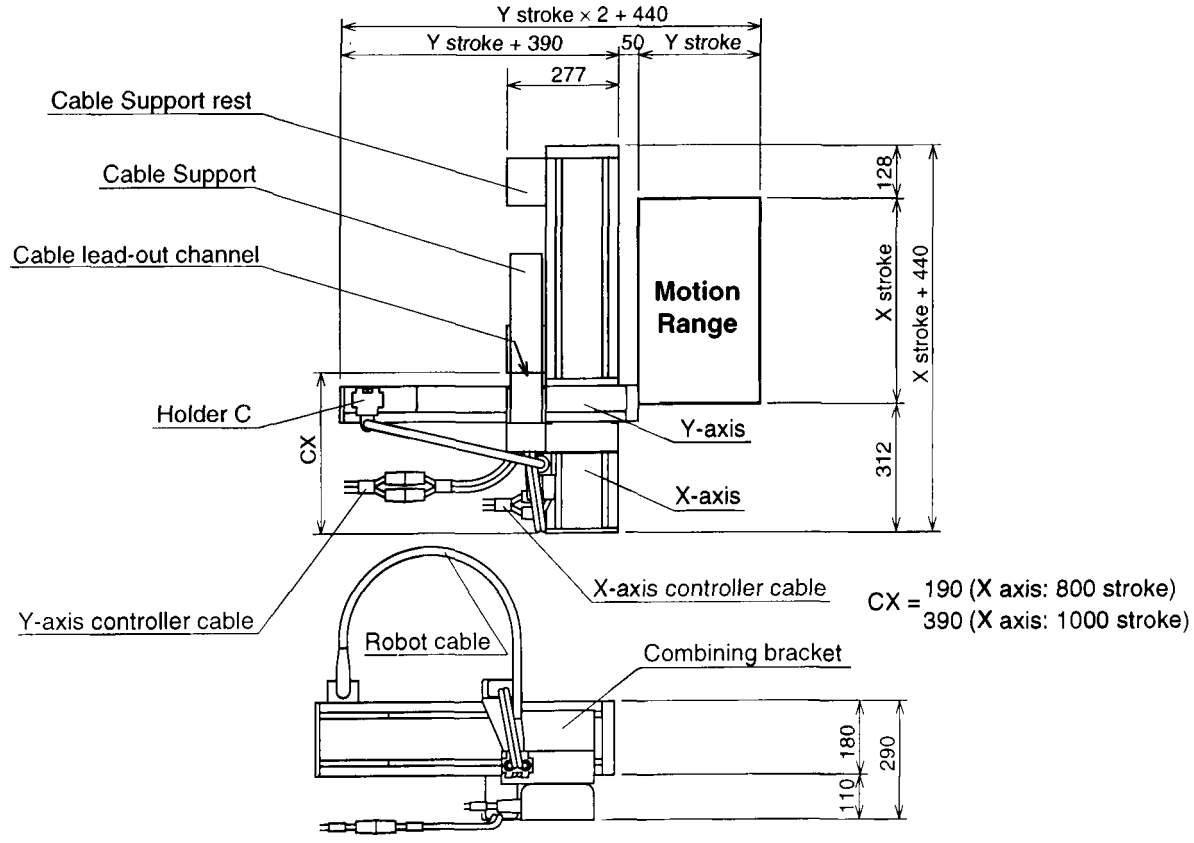
Figure 8-29

X – 1

X axis: H module
Y axis: H module

Long stroke

Y Stroke [mm]	300	400	500	600	800	1000
Transportable load [kg]	37	35	33	31	27	20



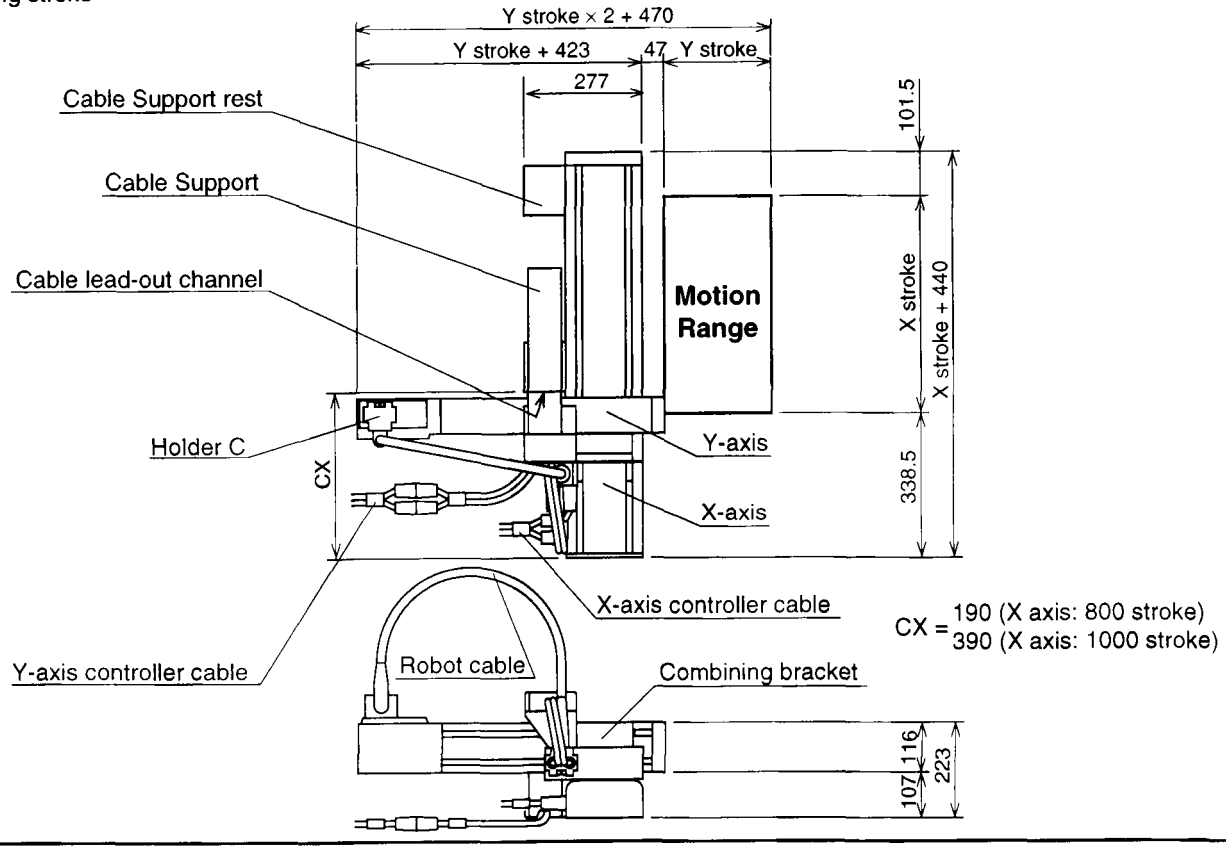
CX = 190 (X axis: 800 stroke)
390 (X axis: 1000 stroke)

X – 2

X axis: H module
Y axis: M module

Long stroke

Y Stroke [mm]	250	350	450	550	750	950
Transportable load [kg]	23	17	13	10	5	3



CX = 190 (X axis: 800 stroke)
390 (X axis: 1000 stroke)

8.2.5. C Type Combination

M + Sv module main units

① Units Required (Check that all the required units are ready.)

Table 8-10

X-axis main unit	XY-HRS0*5-M201
Z-axis main unit	XY-HRS0*3-S1B1
Combining bracket	XY-P175XHM-1
Combining bracket	XY-P175CMS-1
Controller	M-EXC2*A310A00
Robot cable	XY-E170**L-1 × 2
Controller cable	XY-E17503-1 × 2
Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Driving the Z-axis pin.

- ○ Identify two plates (one set) of XY-P175CMS-1. Drive one each chamfered and straight pin (provided with the bracket) to the plate with [4-M5 tap] out of the above two plates with a plastic hammer. The position varies with the Z-axis combination direction (slider move/ main unit move). (Projection 16 mm, see Figure 8-30).
- ○ Be careful of the chamfering direction of the chamfered pin. The opposite surface is provided with a pins for X-axis. Be sure not to push them.

ⓑ Fix the L-shaped bracket XY-P175XHM-1 on the base.

- ○ Drill pin holes on the mounting base as shown in the upper right-hand figure on figure 8-30, and the bracket pins will fit into the holes.
- ○ When fixing with the pins is not required, strike the pins off with a plastic hammer.

ⓒ Set the pin holes on the X-axis slider to the pins on the side of the bracket, and fix with bolts.

ⓓ Set the bracket a above on the X-axis end face, and fix with bolts.

ⓔ Fix the other plate of XY-P175CMS-1 on Z-axis in the position below.

(i) Z-axis slider stroke - Screw holes on counter motor side on the Z-axis rear surface.

(ii) Z-axis main body stroke - Screw holes on Z-axis slider.

ⓕ Set the bracket e above, with Z-axis mounted, to the bracket on the X-axis end face and fix with bolts. In this instance, the pins driven in step a fits into the pin holes on Z-axis through the loose holes on the bracket.

ⓖ Assemble the robot cable.

- ○ Fix holder C on X and Z-axis connectors and holder A on the base placed in position shown (near XY-P175XHM-1) with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X-axis to center of stroke, loosen cap nut of holder A temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓗ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]

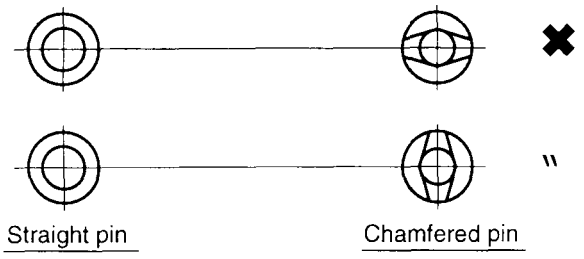
[Z-axis robot cable connector] ↔ [Controller connector 2nd axis]

Caution : Reconfirm that the X and Y-axes are correctly connected to controller connector 1st and 2nd axis respectively.

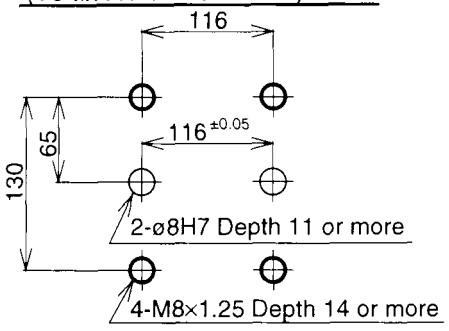
○ We recommend to affix the seals supplied with the main unit (6 each: X , Y , Z , and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-30

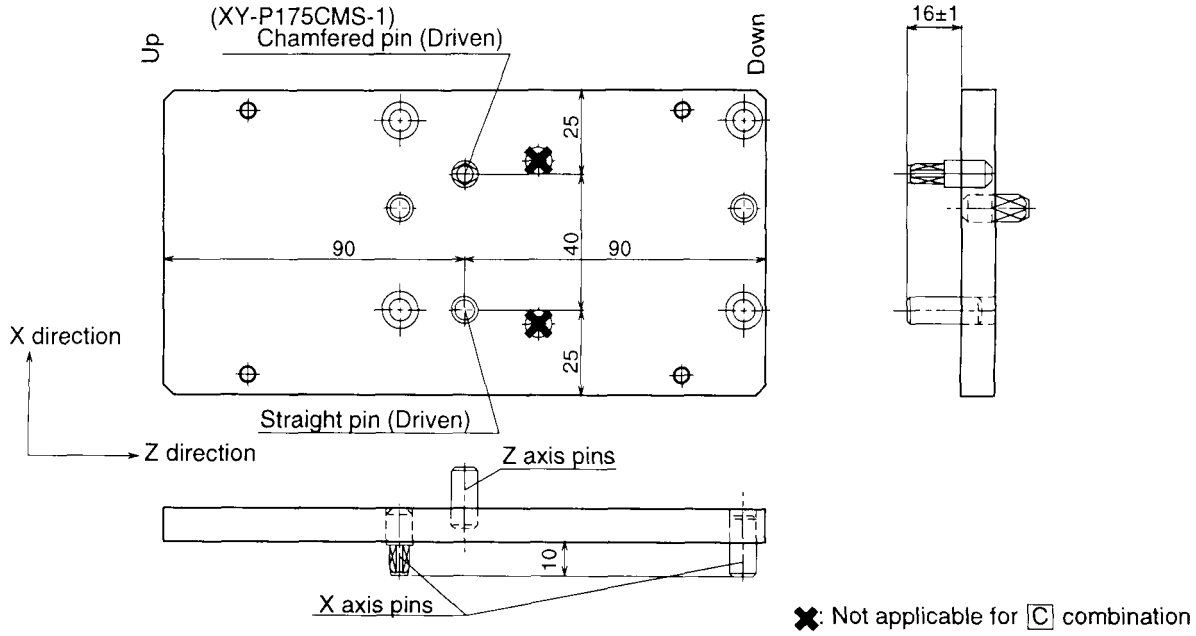
Chamfered pin driving direction



(Drill Holes Position of the base)
(To fix XY-P175XHM-1)

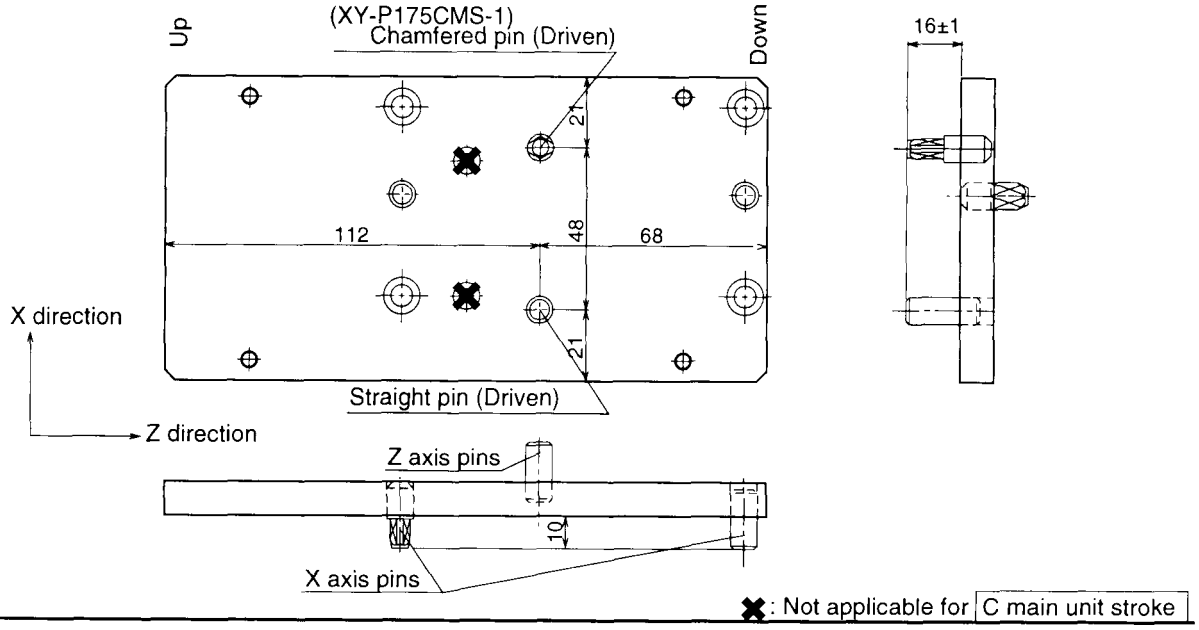


Slider stroke (details of combining bracket)



✖: Not applicable for C combination

Main unit stroke (details of combining bracket)



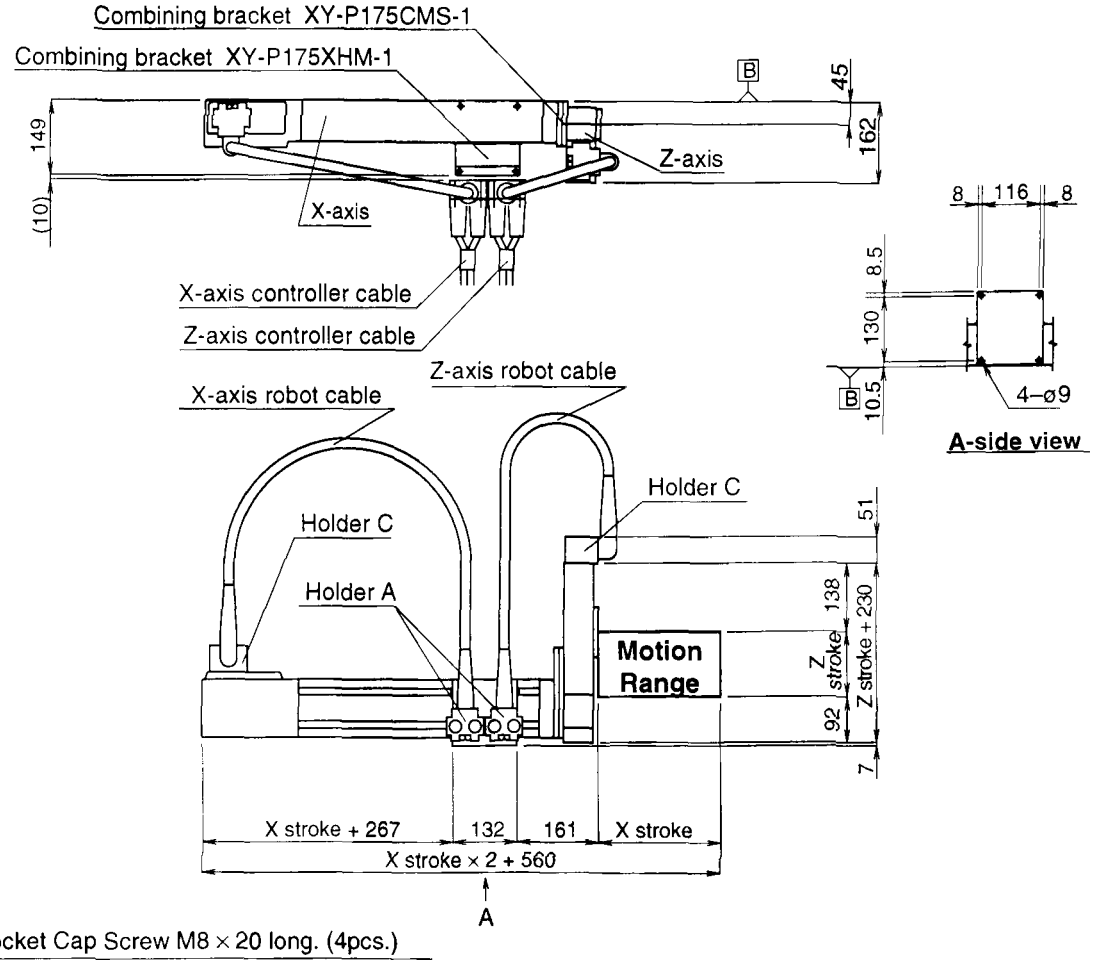
✖: Not applicable for C main unit stroke

Figure 8-31

C

X axis: M module
Z axis: Sv module

Z stroke [mm] \ X stroke [mm]	250	350	450	550
Transportable load [kg] 130	15	10	6	3
Transportable load [kg] 230	15	9	5	2



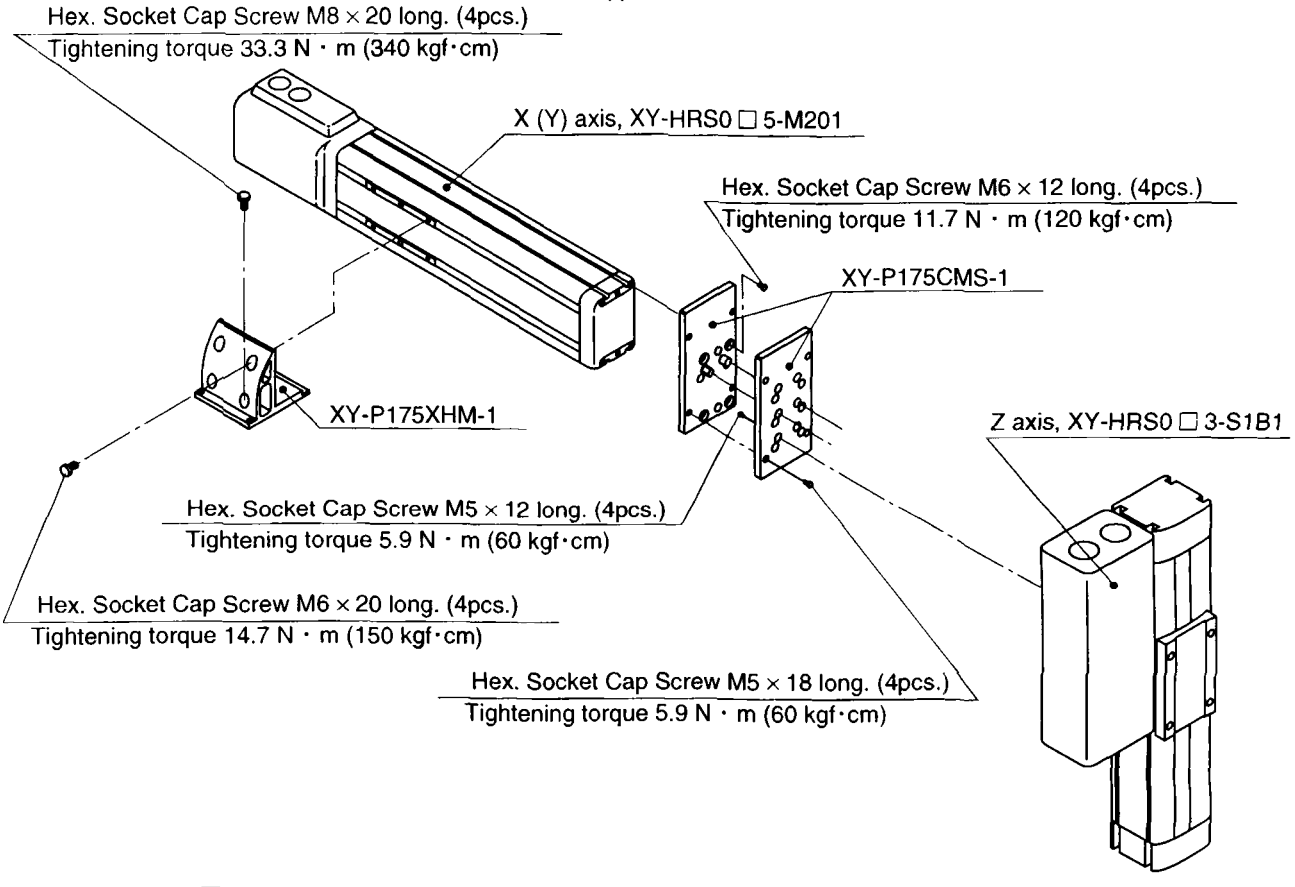


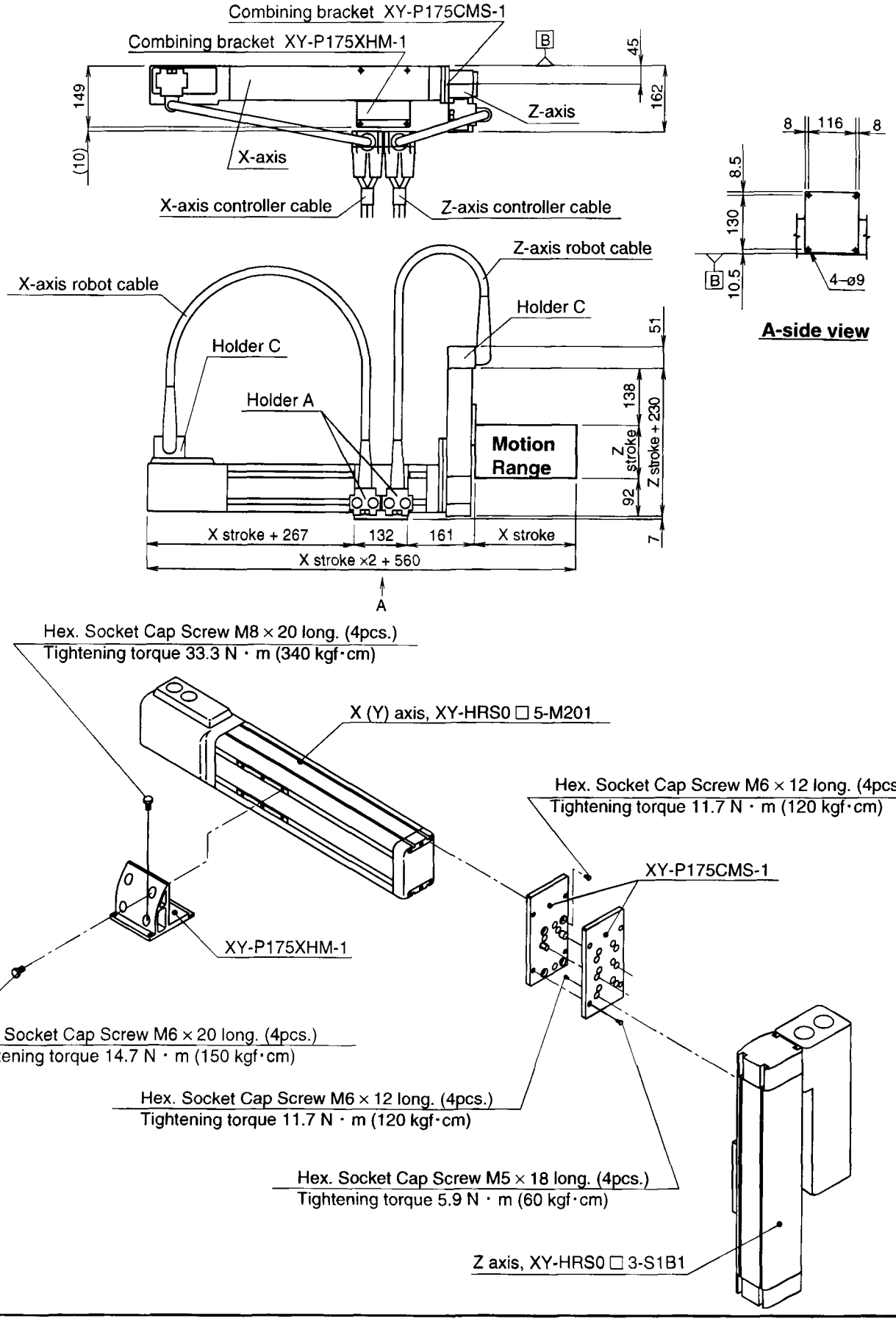
Figure 8-32

C

X axis: M module
Z axis: Sv module

Main Unit Stroke

	Z stroke [mm] \ X stroke [mm]	250	350	450	550
Transportable load [kg]	130	15	10	6	3
	230	15	9	5	2



8.2.6. P Type Combination

8.2.6.1. Standard Combination

P-1: H + M + Sv module main units

① Units Required (Check that all the required units are ready.)

Table 8-11

X-axis main unit	XY-HRS**0-H201
Y-axis main unit	XY-HRS0*5-M201
Z-axis main unit	XY-HRS0*3-S1B1
Combining bracket	XY-P175GHM-1
Combining bracket	XY-P175DMS-1
Controller	M-EXC3*A331A00
Robot cable	XY-E170**L-1 × 2
Controller cable	XY-E17503-1 × 3
Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Driving the Z-axis pin. (XY-P175DMS-1)

- ○ Drive one each chamfered and straight pin attached to the combining bracket XY-P175DMS-1 with a plastic hammer.
- ○ The position varies with the Z-axis combination direction (slider stroke/main unit stroke). (Projection 8 mm, see the Figure 8-33.)
- ○ Be careful of the chamfering direction of the chamfered pin. The opposite surface is provided with pins for X-axis. Be sure not to push them.

ⓑ Fix X-axis on a base. [See "7.1.2. Fixing Main Unit".]

ⓒ Set the L-shaped combining bracket XY-P175GHM-1 on the upper surface of the X-axis slider, and fix with bolts. The bracket pins will fit into the pin holes at the center of the slider.

ⓓ Set the motor side pin holes on the rear surface of Y-axis to the pins on the side of the bracket, and fix with bolts.

ⓔ Set the bracket a above on Z-axis in position discribed below, and fix with bolts.

(i) Z-axis slider stroke - Screw holes on counter motor side on the Z-axis rear surface.

(ii) Z-axis main unit stroke - Screw holes on Z-axis slider.

ⓕ Set the bracket e above, with Z-axis mounted, to the Y-axis slider and fix with bolts.

ⓖ Assemble the robot cable.

- ○ Fix holder C on Y and Z-axis connectors and holder A on the X-axis motor side end face, with bolts provided with cable (M3 ¥ 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X and Y-axis to center of stroke, loosen cap nut of holder A of each axis temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓗ Connect the controller cable.

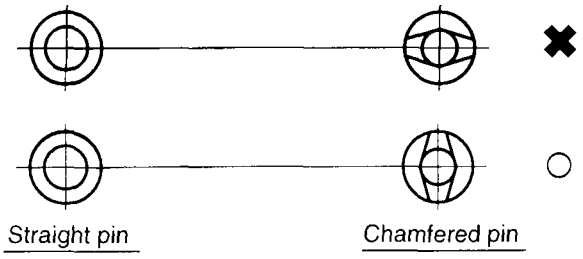
[X-axis connector] ↔ [Controller connector 1st axis]
[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]
[Z-axis robot cable connector] ↔ [Controller connector 3rd axis]

Caution : *Reconfirm that the X, Y and Z-axes are correctly connected to controller connector 1st, 2nd and 3rd axis respectively.*

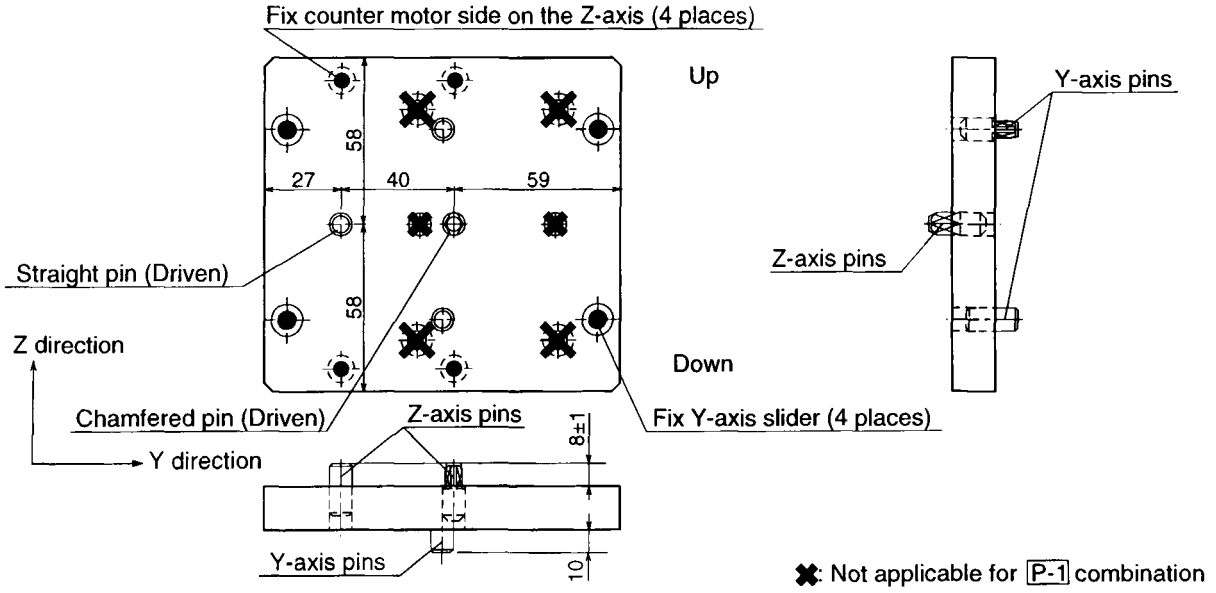
○ We recommend to attach the seals supplied with the main unit (6 each: X , Y , Z , and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-33

Chamfered pin driving direction



Slider stroke (details of combining bracket)



Main unit stroke (details of combining bracket)

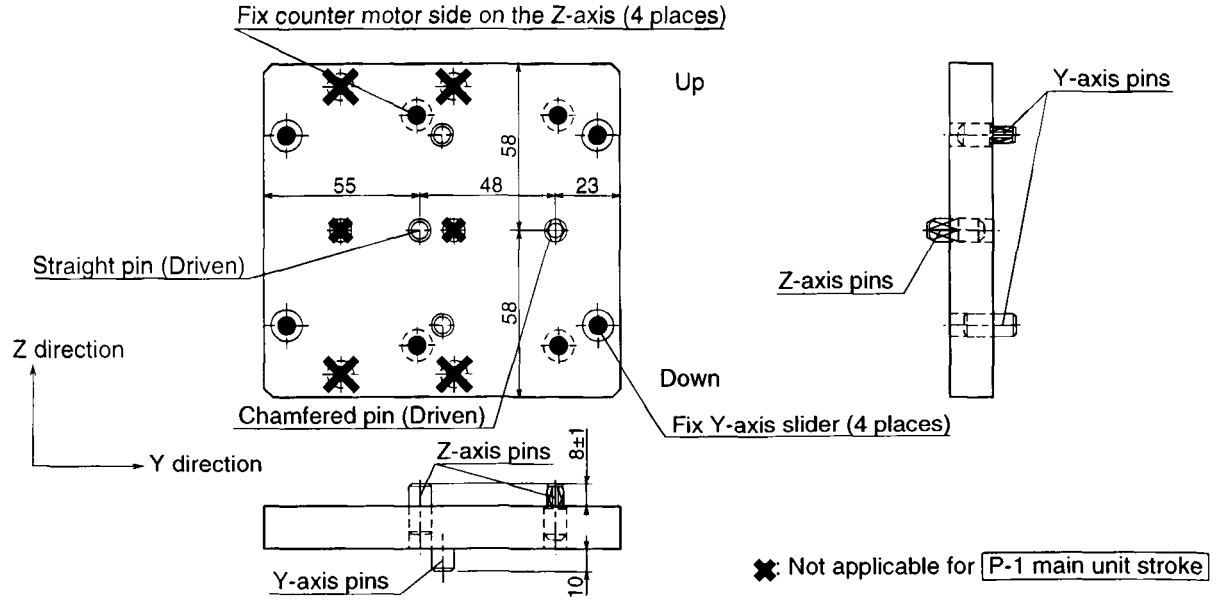


Figure 8-34

P – 1

X axis: H module
Y axis: M module
Z axis: Sv module

Transportable load: 15kg

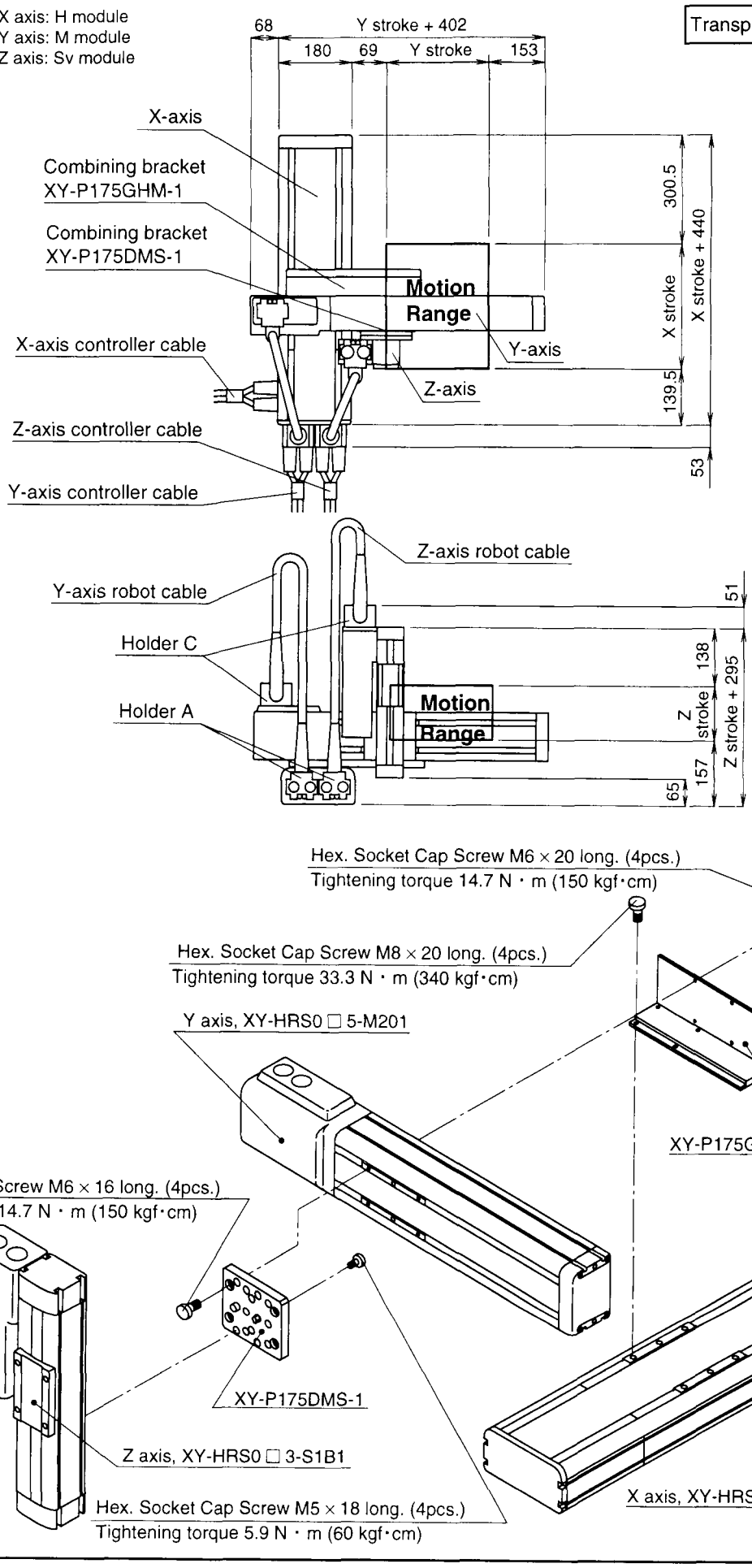
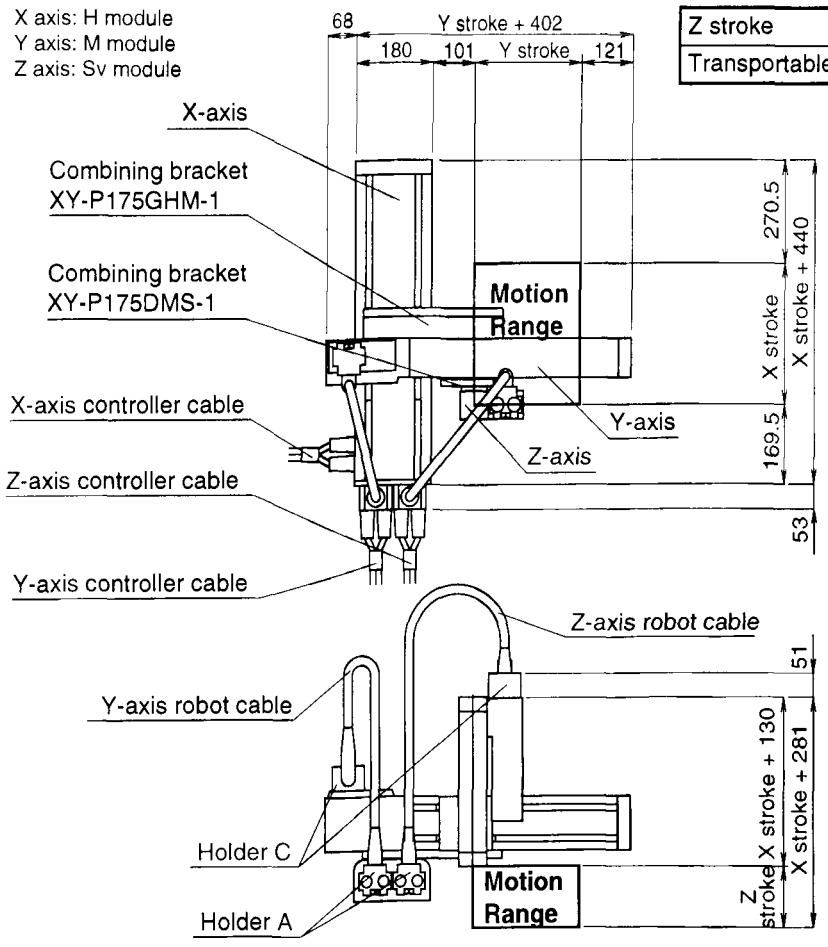


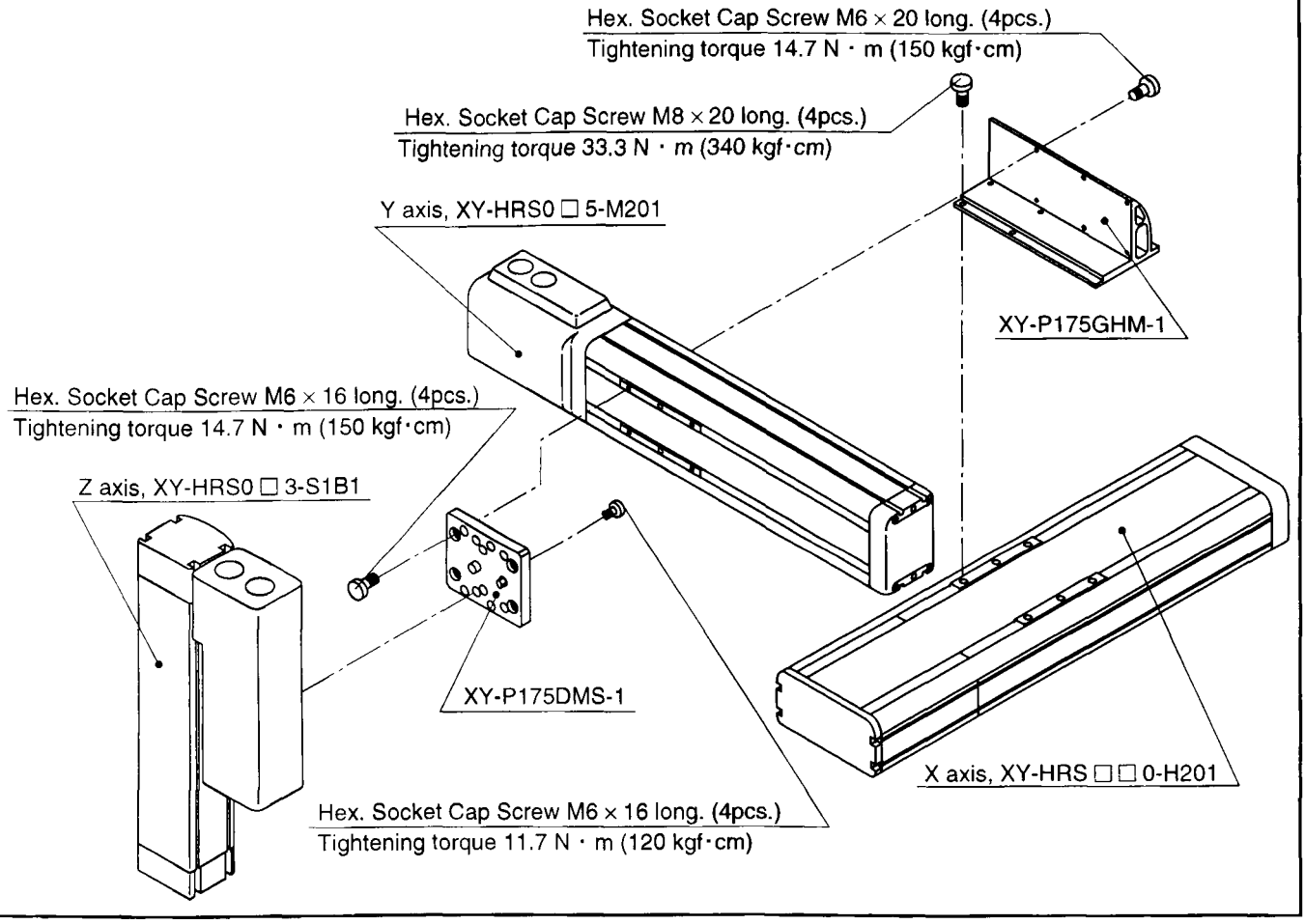
Figure 8-35

P – 1
Main Unit Stroke

X axis: H module
Y axis: M module
Z axis: Sv module

Z stroke	[mm]	130	230
Transportable load	[kg]	10	9





8.2.6.2. Long Stroke Combination

P-1 Long stroke: H+M+Sv module main units

① Units Required (Check that all the required units are ready.)

Table 8-12

X-axis main unit	XY-HRS**0-H201	Controller	M-EXC3*A331A00
Y-axis main unit	XY-HRS0*5-M201	Controller cable	XY-E17503-1 × 3
Z-axis main unit	XY-HRS0*3-S1B1	Robot cable	XY-E17012U-1
Combining bracket	XY-P175GHM-1	Cable support	XY-E173GHM2-1
	XY-P175DMS-1	Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Set the main unit to three axes.

○ Follow the procedures ⓐ to ⓕ of P-1 standard combination.

ⓑ Fix the cable support bracket (moving side) to the Y-axis motor cover with provided bolts. (M3, 6 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓒ Fix the cable support fixture (stationary side) to T slots on the X-axis side, using provided guide keys and bolts, in the position to keep "Cable lead-out" point CX specified in Figure 8-38. (M3, 6 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓓ Fix two cable support rests to T slots on the X-axis side using provided guide keys and bolts. Fix one of them to the end of the X-axis and the other in the middle of the X-axis end and the support fixture. (M3, 6 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓔ Fix the cable support to the support bracket.

ⓕ Assemble Z-axis robot cable.

(i) The robot cable is "double-end-elbow" type. (XY-E17012U-1)

(ii) Move X and Y-axis to center of stroke.

(iii) Connect the robot cable to the Z-axis connector. Secure the holder with the provided bolts. (M3, 57 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

(iv) Fix the holder C to the T slots on the Y-axis side with provided bolts. (M3, 57 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

(v) Loosen cap nut of one holder C temporality, twist cable in such a way that it stands upright and tighten the cap nut to torque 7.5 to 9.0 N•m (77 to 92 kgf•cm)

ⓖ Connect cables in cable support to Y-axis connector on Y-axis side.

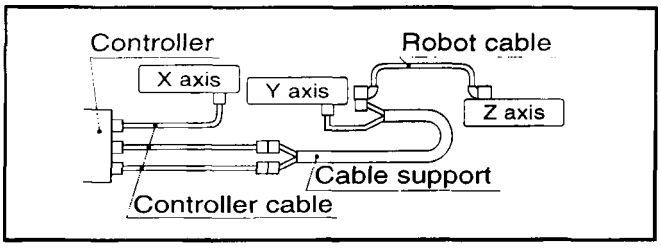
ⓗ Tie the cable to the cable support at the support bracket (moving side) with the provided Insulock.) Do not tie the other end (stationary side).

ⓘ Connect the controller cable.

[X-axis connector] ↔ [Controller connector 1st axis]
[Y-axis connector (cable support)] ↔ [Controller connector 2nd axis]
[Z-axis connector (cable support)] ↔ [Controller connector 3rd axis]

○ See cable system diagram shown below.

Figure 8-36



Caution : *Reconfirm that the X, Y and Z-axes are correctly connected to controller connector 1st, 2nd and 3rd axis respectively.*

○ We recommend to affix the seals supplied with the main unit (6 each: [X], [Y], [Z], and [θ]) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-37

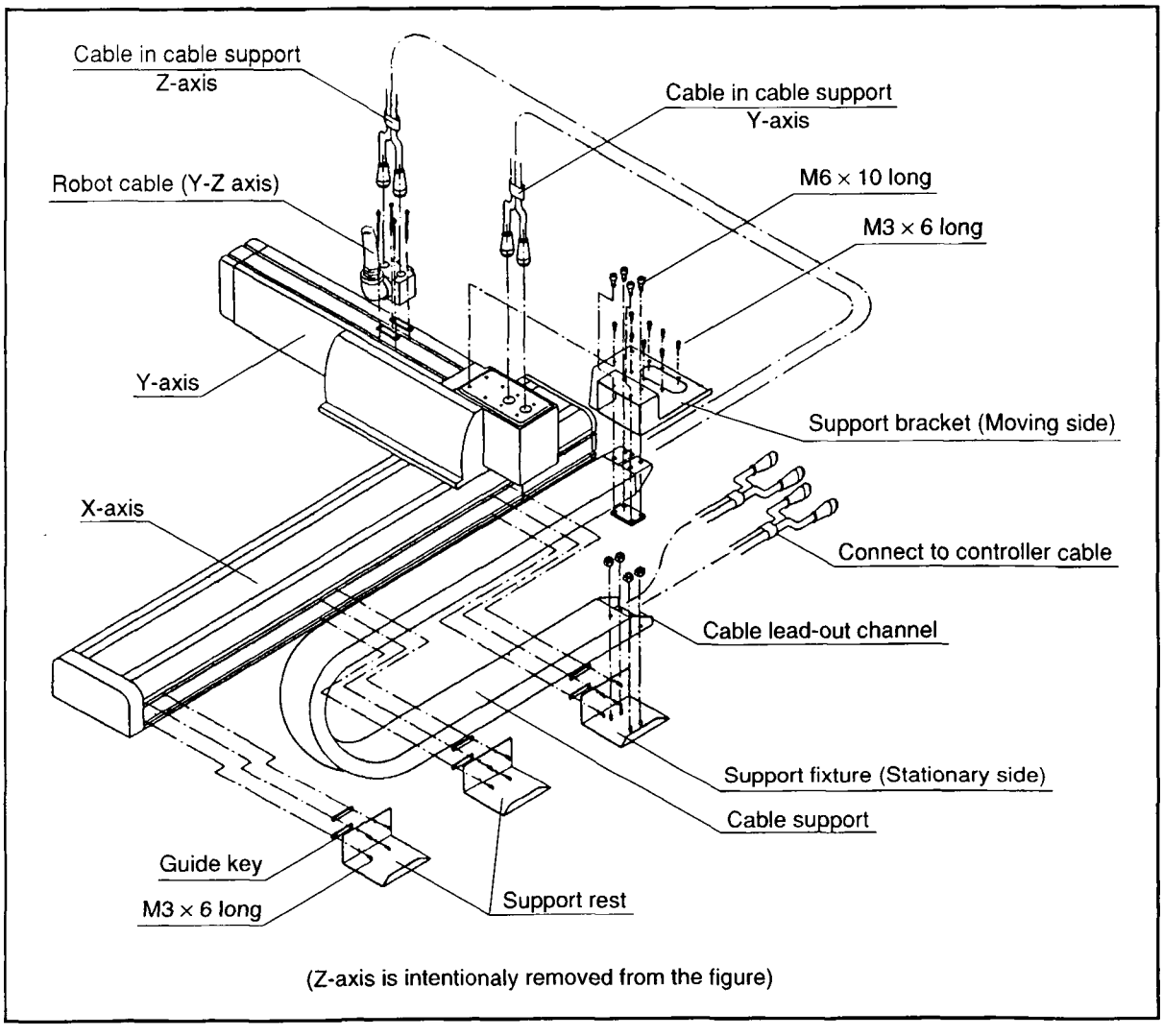
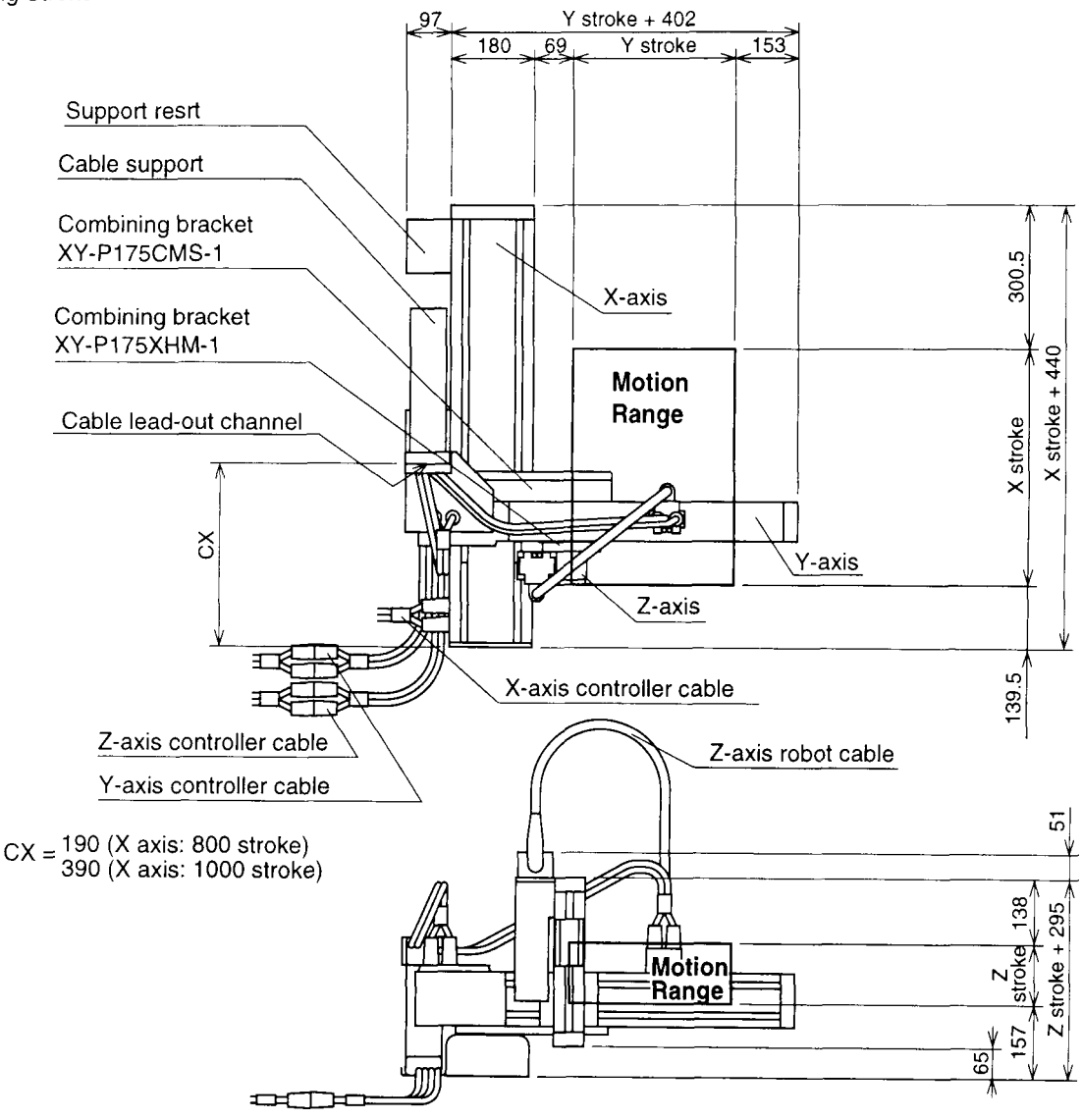


Figure 8-38

P - 1
Long Stroke

X axis: H module
Y axis: M module
Z axis: Sv module

Transportable load: 15kg



CX = 190 (X axis: 800 stroke)
390 (X axis: 1000 stroke)

8.2.6.3. P-2 Type Combination

P-2: M module main unit

S module main unit

Sv module main unit (Slider stroke/main unit stroke)

① Units Required (Check that all the required units are ready.)

Table 8-13

X-axis main unit	XY-HRS0*5-M201
Y-axis main unit	XY-HRS0*3-S*01
Z-axis main unit	XY-HRS0*3-S1B1
Combining bracket	XY-P175GMS-1
Combining bracket	XY-P175DSS-1
Controller	M-EXC3*A331A00
Robot cable	XY-E170**L-1 × 2
Controller cable	XY-E17503-1 × 3
Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Driving the Z-axis pin.

- ○ Drive one each chamfered and straight pin attached to the combining bracket XY-P175DSS-1 with a plastic hammer.
- ○ The position varies with the Z-axis combination direction (slider stroke/main unit stroke). (Projection 8 mm, see Figure 8-39.)
- ○ Be careful of the chamfering direction of the chamfered pin. The opposite surface is provided with pins for X-axis. Be sure not to push them.

ⓑ Fix X-axis on a base. See "7.1.2. Fixing Main Unit".

ⓒ Set the L-shaped combining bracket XY-P175GMS-1 on the upper surface of the X-axis slider, and fix with bolts. The bracket pins will fit into the pin holes at the center of the slider.

ⓓ Set the motor side pin holes on the rear surface of Y-axis to the pins on the side of the bracket, and fix with bolts.

ⓔ Set the bracket a above on Z-axis in position described below, and fix with bolts.

(i) Z-axis slider stroke - Screw holes on counter motor side on the Z-axis rear surface.

(ii) Z-axis main unit stroke - Screw holes on Z-axis slider.

ⓕ Set the bracket e above, with Z-axis mounted, to the Y-axis slider and fix with bolts.

ⓖ Assemble the robot cable.

- ○ Loosen two fixing screws for holder C elbow on the Y-axis cable, pull out the elbow about 5 mm, turn it 90 degrees clockwise, push in, and tighten the fixing screws (M5 hexagon socket head cap screw, tightening torque 1.47 N•m {15 kgf•cm}.
- ○ Fix holder C on Y and Z-axis connector and holder A on X-axis motor side face and end face with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X and Y-axis to center of stroke, loosen cap nut of holder A of each axis temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓗ Connect the controller cable.

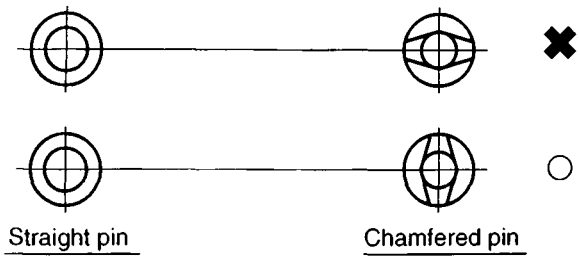
[X-axis connector] ↔ [Controller connector 1st axis]
[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]
[Z-axis robot cable connector] ↔ [Controller connector 3rd axis]

Caution : Reconfirm that the X, Y and Z-axes are correctly connected to controller connector 1st, 2nd and 3rd axis respectively.

○ We recommend to affix the seals supplied with the main unit (6 each: X , Y , Z , and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

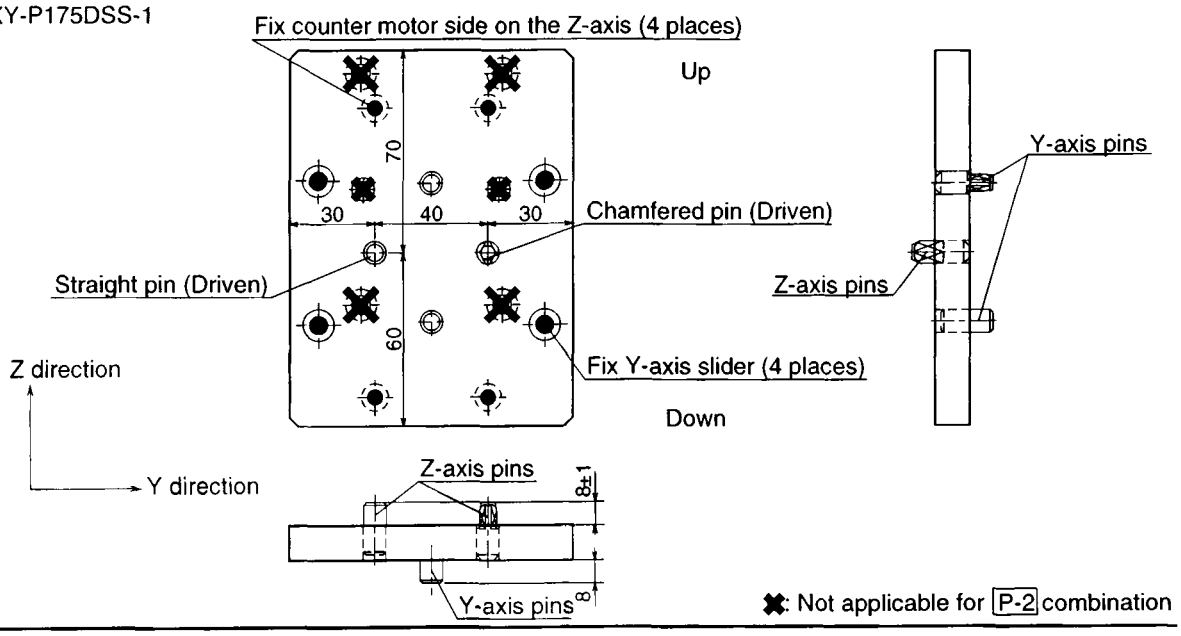
Figure 8-39

Chamfered pin driving direction



Slider stroke (details of combining bracket)

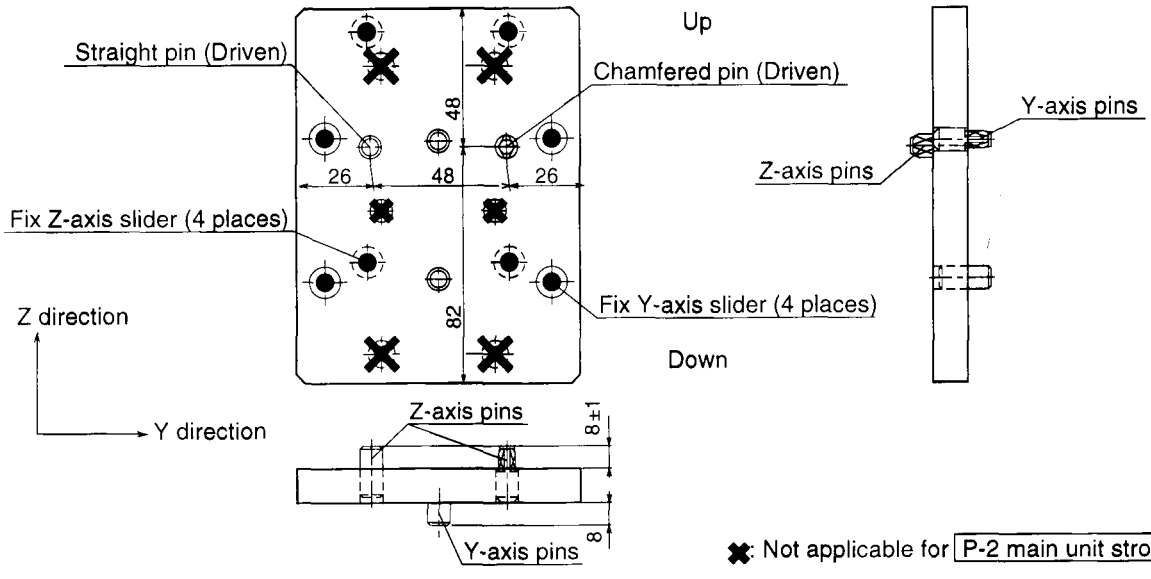
XY-P175DSS-1



✖: Not applicable for P-2 combination

Main unit stroke (details of combining bracket)

XY-P175DSS-1



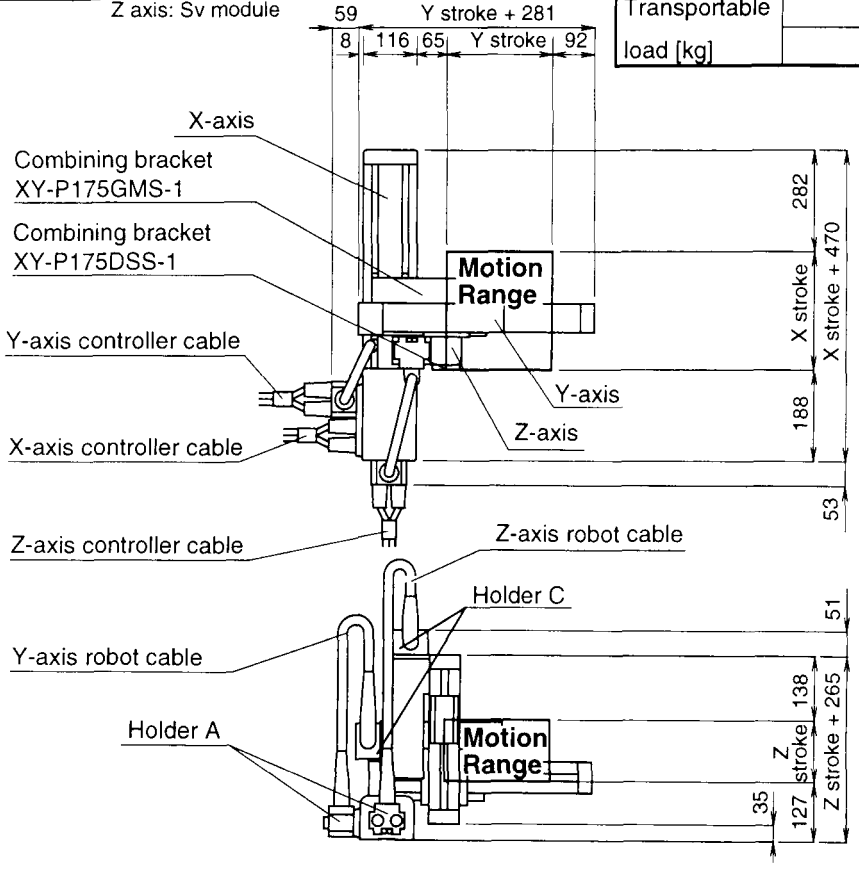
✖: Not applicable for P-2 main unit stroke

Figure 8-40

P - 2

X axis: M module
Y axis: S module
Z axis: Sv module

	Y stroke [mm] / Z stroke [mm]	130	230	330	430
Transportable load [kg]	130	14	10	5	2
	230	13	9	4	—



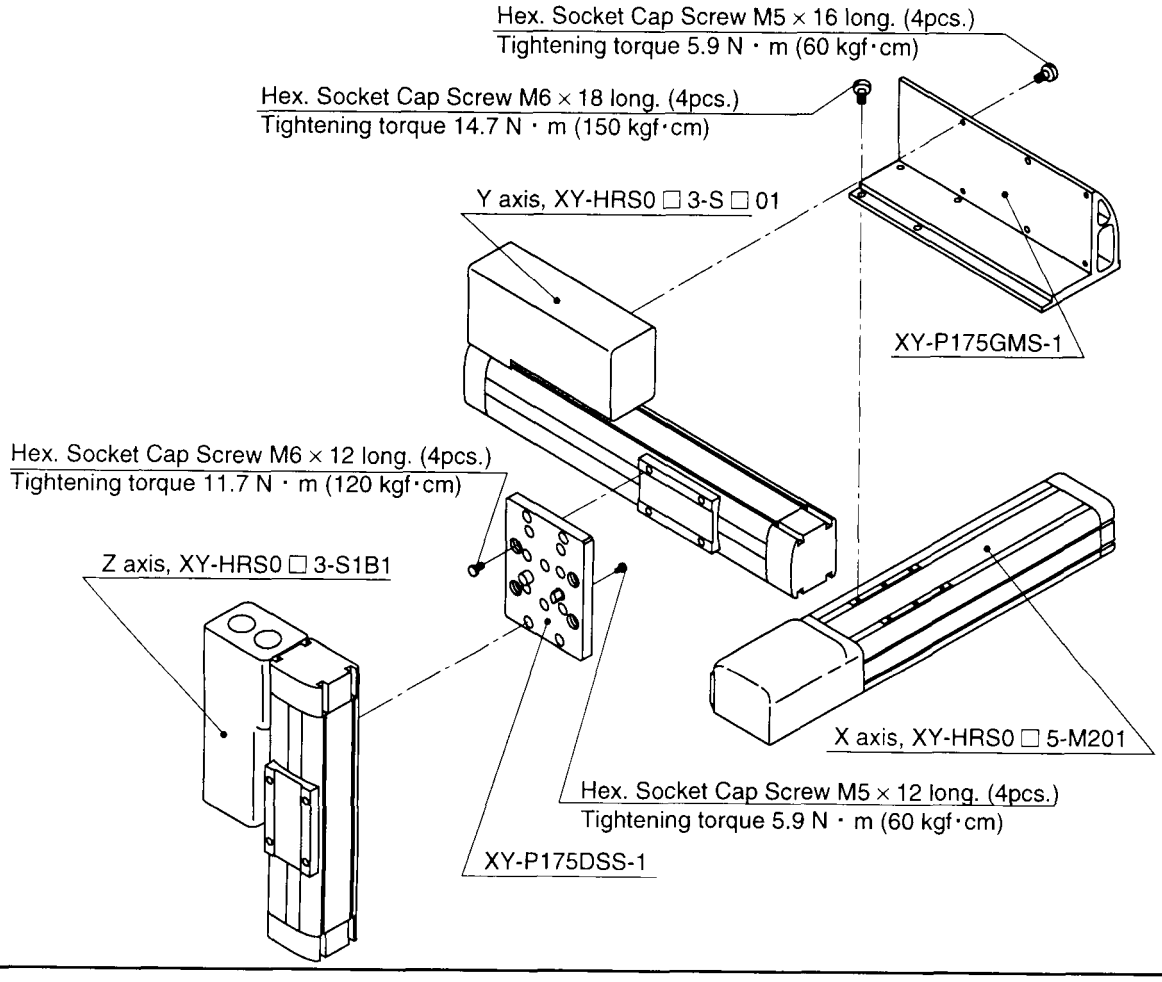


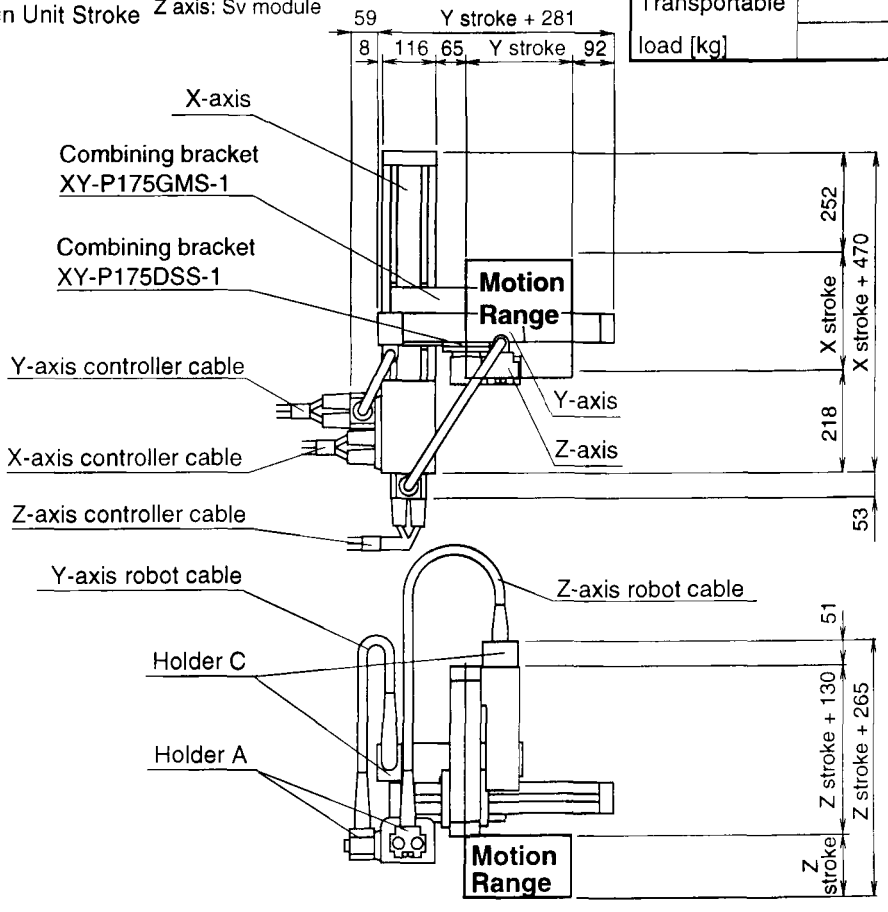
Figure 8-41

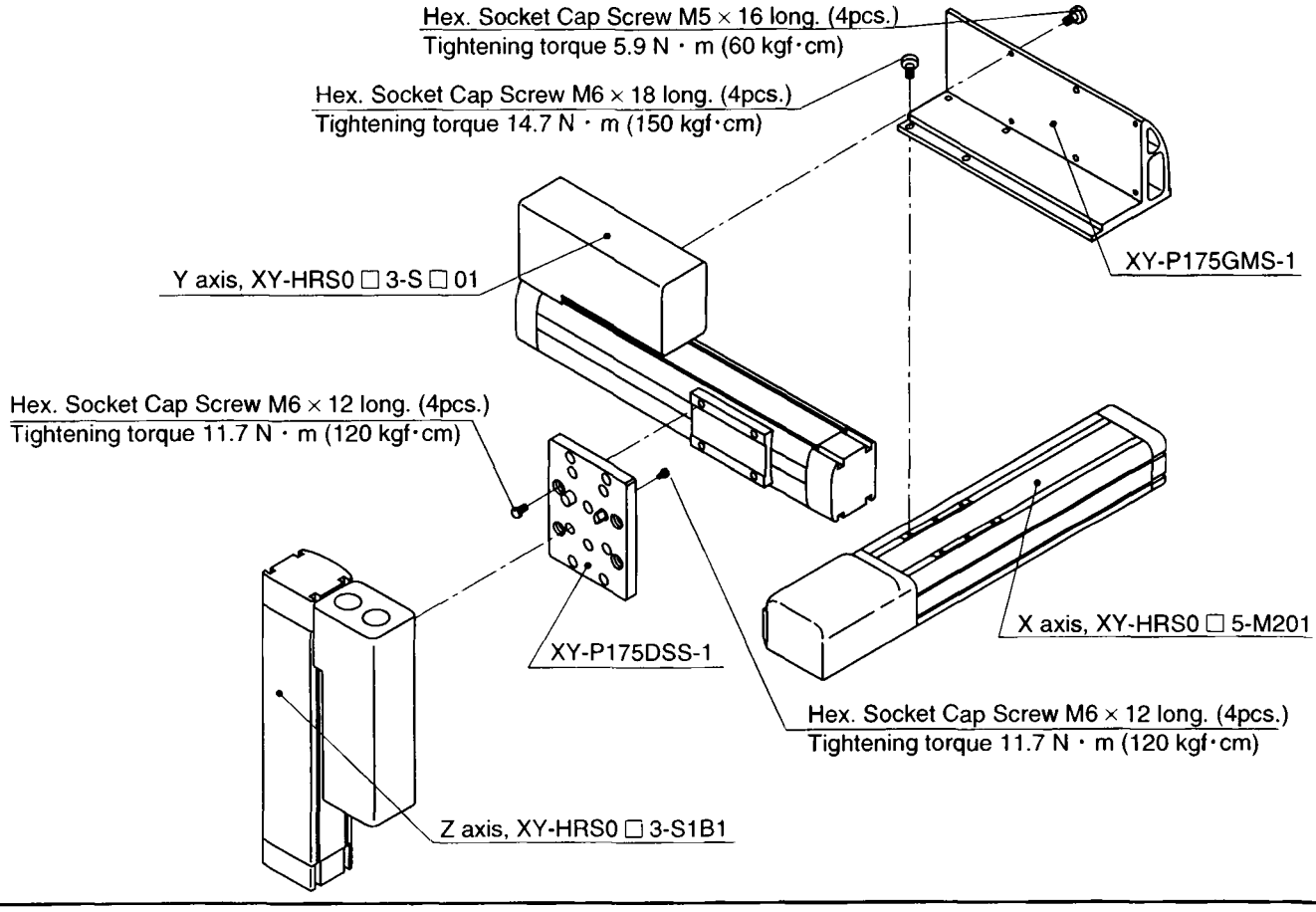
P - 2

Main Unit Stroke

X axis: M module
Y axis: S module
Z axis: Sv module

Z stroke [mm] \ Y stroke [mm]	130	230	330	430
Transportable load [kg]	130	10	10	5	2
	230	9	9	4	—





8.2.7. J Type Combination

8.2.7.1. Standard Combination

J: H module main unit

M module main unit

Sv module main unit (Slider stroke/main unit stroke)

① Units Required (Check that all the required units are ready.)

Table 8-14

X-axis main unit	XY-HRS**0-H201
Y-axis main unit	XY-HRS0*5-M201
Z-axis main unit	XY-HRS0*3-S1B1
Combining bracket	XY-P175XHM-1
Combining bracket	XY-P175CMS-1
Controller	M-EXC3*A311A00
Robot cable	XY-E170**L-1 × 2
Controller cable	XY-E17503-1 × 2
Teaching box	M-EXTB01

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Driving the Z-axis pin.

- ○ Identify two plates (one set) of XY-P175CMS-1. Drive one each chamfered and straight pin attached to the plate with [4-M5 tap] out of the above two plates with a plastic hammer. The position varies with the Z-axis combination direction (slider stroke/main unit stroke). (Projection 16 mm, see Figure 8-42.)
- ○ Be careful of the chamfering direction of the chamfered pin. The opposite surface is provided with pins for Y-axis. Be sure not to push them.

ⓑ Fix X-axis on a base. [See "7.1.2. Fixing Main Unit".]

ⓒ Set the XY-P175XHM-1 on the upper surface of the X-axis slider, and fix with bolts. The bracket pins will fit into the pin holes at the center of the slider.

ⓓ Set the Y-axis slider pin holes to the pins on the side of the bracket, and fix with bolts.

ⓔ Set the bracket ⓐ above on Y-axis end face and fix with bolts.

ⓕ Fix the other of XY-P175CMS-1 on Z-axis with bolt in position below.

(i) Z-axis slider stroke - Screw holes on counter motor side on the Z-axis rear surface.

(ii) Z-axis main unit stroke - Screw holes on Z-axis slider.

ⓖ Set the bracket ⓕ above, with Z-axis mounted, to the bracket on the Y-axis end face and fix with bolts. In this instance, the pins, driven in step ⓐ above, will fit into the Z-axis pin holes through the loose holes on the bracket.

ⓗ Assemble the robot cable.

- ○ Fix holder C on Y and Z-axis connector and holder A on X-axis motor side face and end face with bolts provided with cable (M3 × 57, tightening torque 1.47 N•m {15 kgf•cm}).
- ○ Move X and Y-axis to center of stroke, loosen cap nut of holder A of each axis temporarily, twist cable in such a way that it stands upright, and tighten nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓘ Connect the controller cable.

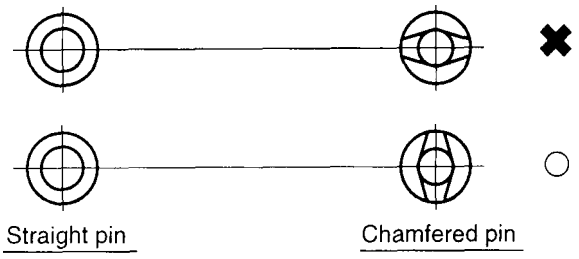
[X-axis connector] ↔ [Controller connector 1st axis]
[Y-axis robot cable connector] ↔ [Controller connector 2nd axis]
[Z-axis robot cable connector] ↔ [Controller connector 3rd axis]

Caution : Reconfirm that the X, Y and Z-axes are correctly connected to controller connector 1st, 2nd and 3rd axis respectively.

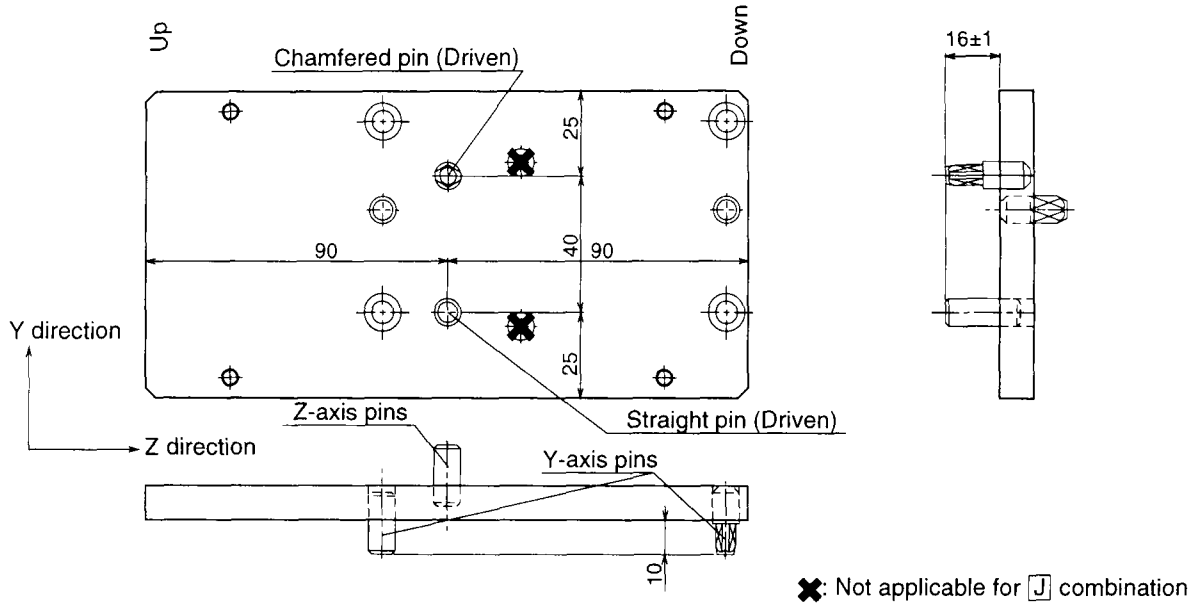
○ We recommend to affix the seals supplied with the main unit (6 each: [X], [Y], [Z], and [θ]) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-42

Chamfered pin driving direction

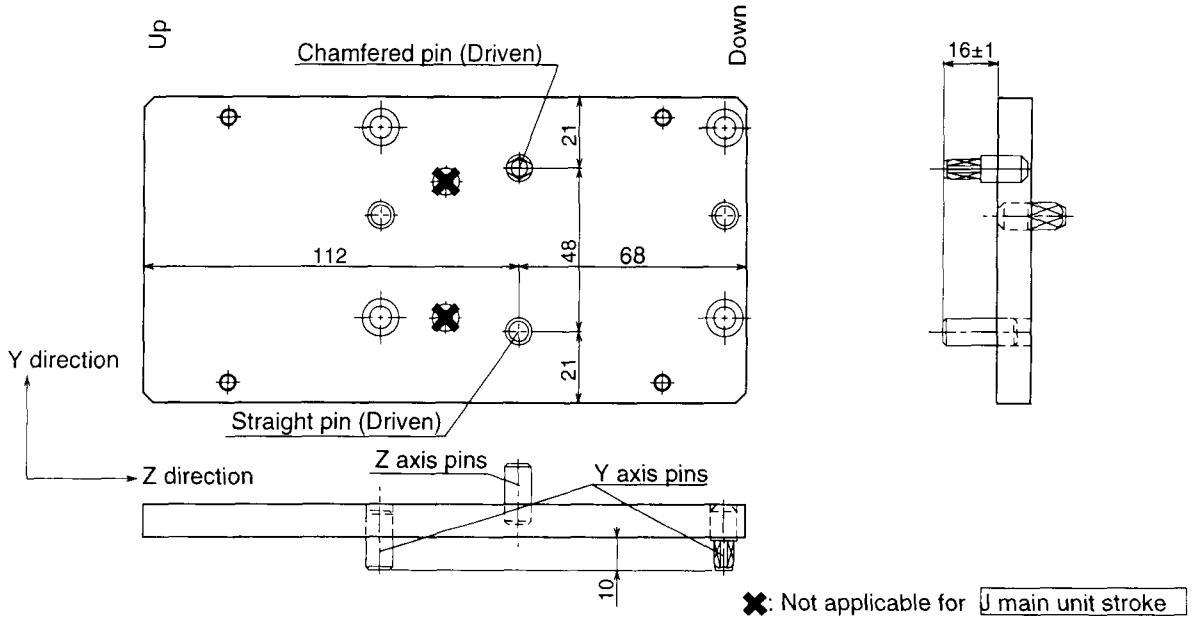


Slider stroke (details of combining bracket)



✖: Not applicable for J combination

Main unit stroke (details of combining bracket)



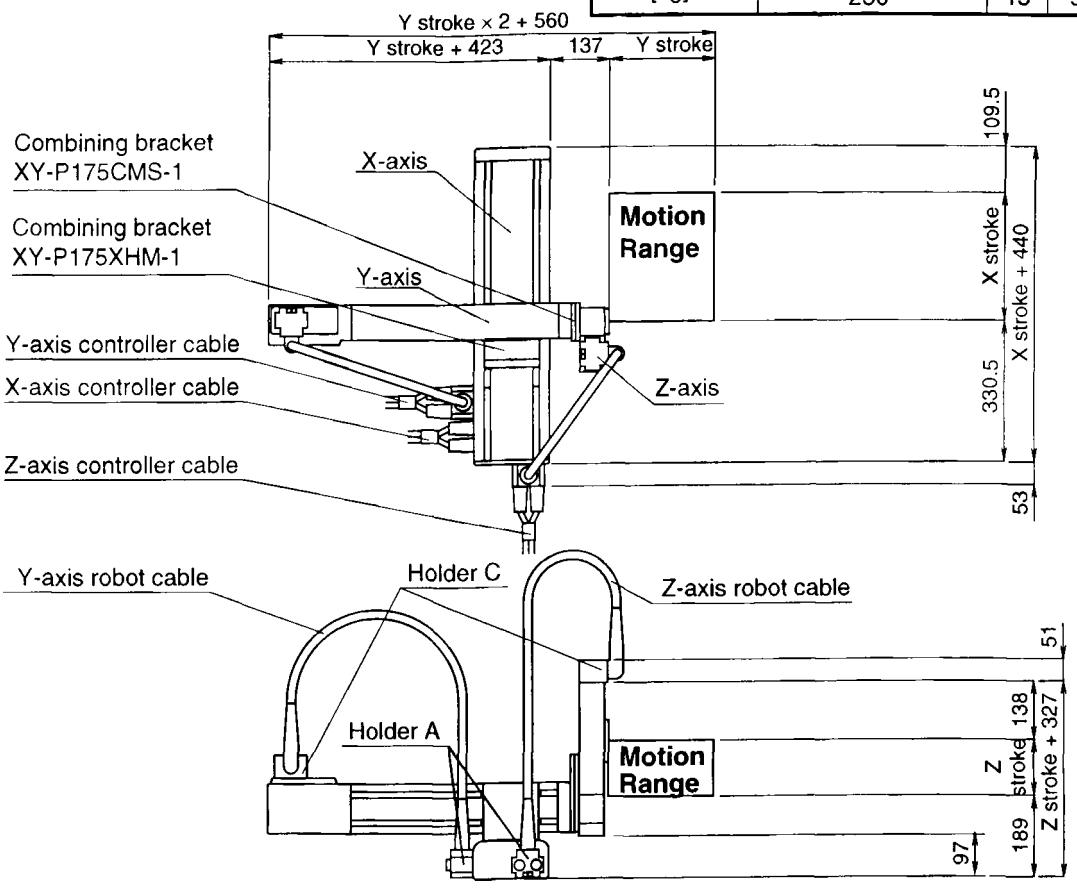
✖: Not applicable for J main unit stroke

Figure 8-43

J

X axis: H module
Y axis: M module
Z axis: Sv module

	Z stroke [mm] \ Y stroke [mm]	250	350	450	550
Transportable load [kg]	130	15	10	6	3
	230	15	9	5	2



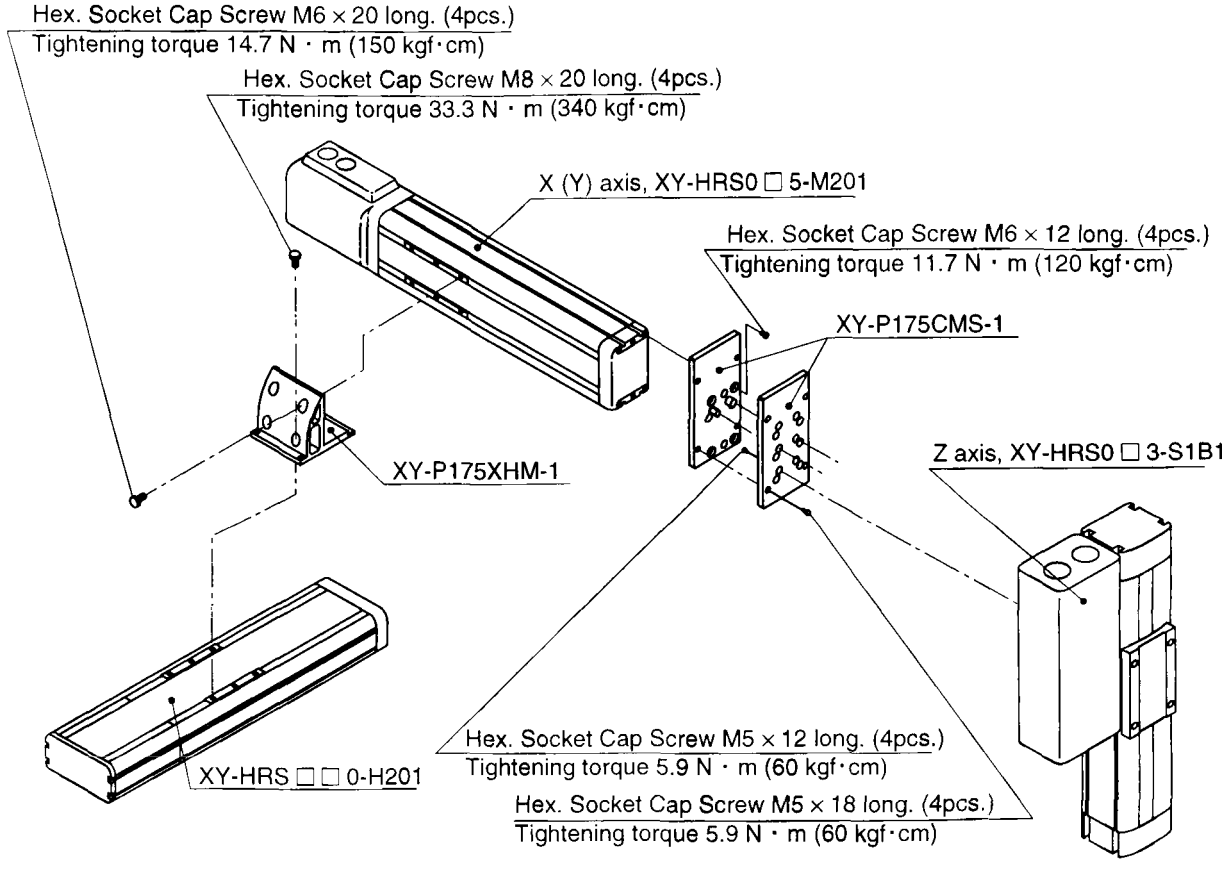
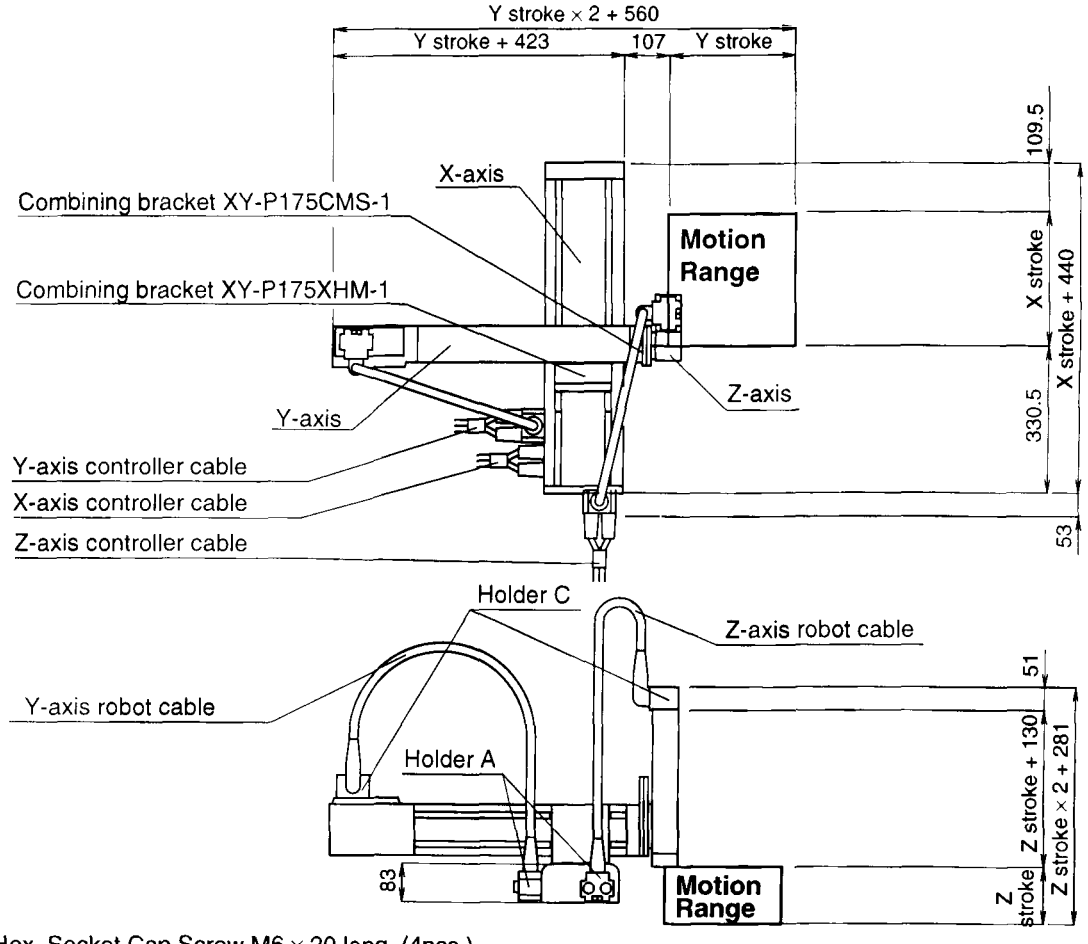


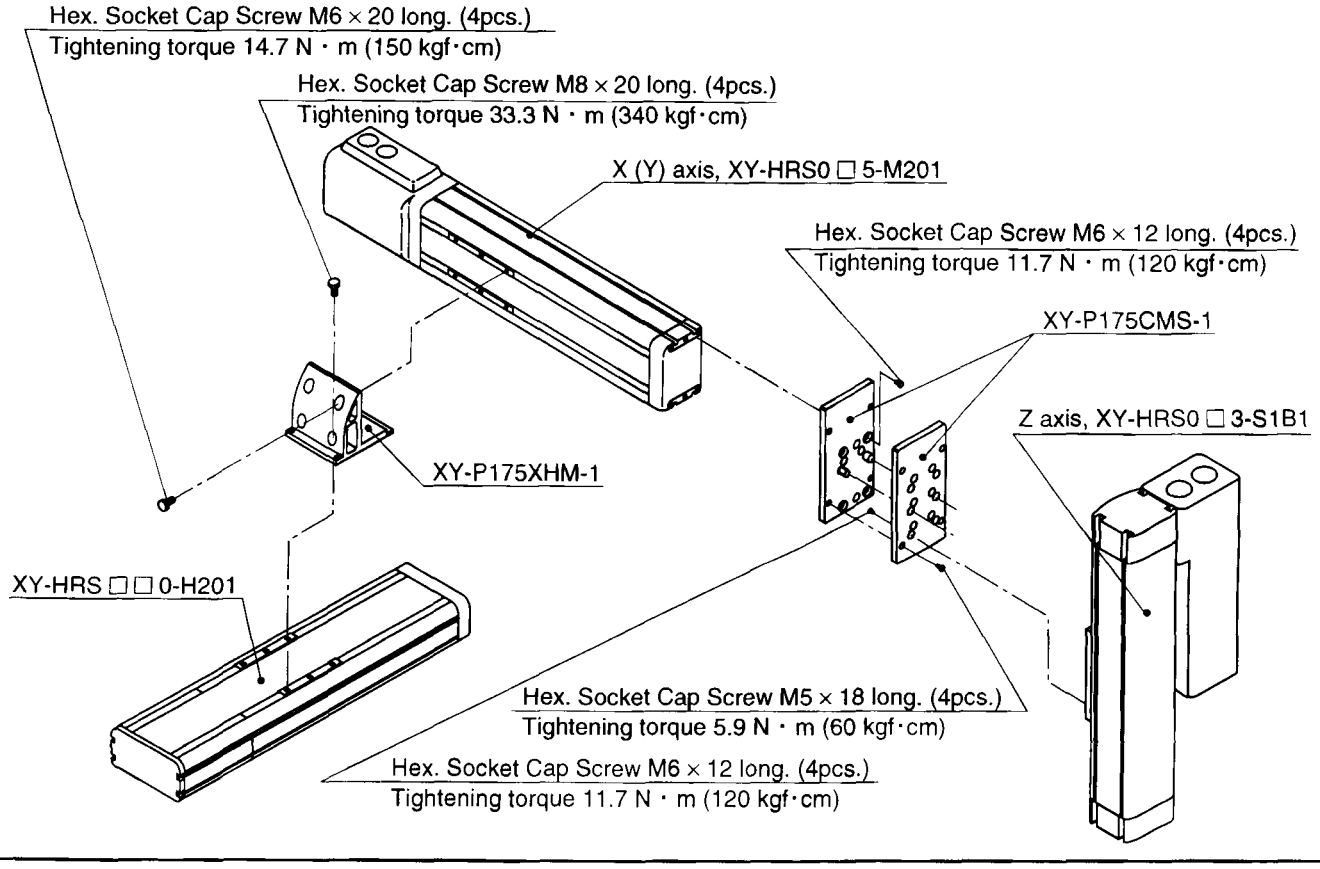
Figure 8-44

J
Main Unit Stroke

X axis: H module
Y axis: M module
Z axis: Sv module

	Z stroke [mm] \ Y stroke [mm]	250	350	450	550
Transportable load [kg]	130	10	10	6	3
	230	9	9	5	2





8.2.7.2. Long Stroke Combination

J Long stroke: H module main unit (Stroke 800 and 1000 mm)

M module main unit

Sv module main unit

Table 8-15

X-axis main unit	XY-HRS**0-H201
Y-axis main unit	XY-HRS**5-M201
Z-axis main unit	XY-HRS**3-S1B1
Combining bracket	XY-P175XHM-1
	XY-P175CMS-1
Controller	M-EXC3*A331A00
Controller cable	XY-E17503-1X3
Robot cable	XY-E170**L-1X3
Cable support	XY-E173GHM2-1
Teaching box	M-EXTB01

① Units Required (Check that all the required units are ready).

Note : Positions with an asterisk (*) vary with axis stroke and controller type. See the catalog for details.

② Procedures

ⓐ Set the main unit to three axes.

○ Follow the procedures ⓐ to ⓖ of J standard combination).

ⓑ Fix the cable support bracket (moving side) to the combining bracket (XY-P175XHM-1) with provided bolts. (M4, 6 mm long, tightening torque 2.9 N•m {30 kgf•cm}).

ⓒ Fix the cable support fixture (stationary side) to the T slots on the X-axis side, using provided guide keys, in the position to keep "cable lead-out" point CX specified in the Figure 8-47. (M3, 6 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓓ Fix two support cable rests to the T slots on the X-axis side using provided guide keys and bolts. Set one of them to the end of the X-axis and the other in the middle of the X-axis end and the support fixture. (M3, 6 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

ⓔ Fix the holder mounting plate to the back of the combining bracket (XY-P175XHM-1) with provided bolts. Use a provided stud in back of those places where the bracket is countersunk. (M5, 6 mm long, tightening torque 5.9 N•m {60 kgf•cm}).

ⓕ Move Y and Z-axis to center of stroke.

ⓖ Assemble the robot cable. (Y and Z-axis)

(i) Holder A (straight): Fix the holder mounting plate.

(ii) Holder C (vertical): Fix to the main unit (Y or Z-axis) connector.

(Provided bolts, M3, 57 mm long, tightening torque 1.47 N•m {15 kgf•cm}).

○ Loosen the cap nut of holders temporarily, twist cable in such a way that it stands upright, and tighten the nut to torque 7.5 to 9.0 N•m {77 to 92 kgf•cm}.

ⓗ Connect the robot cables and cables in the cable support. Tie the cable to the cable support at the support bracket (moving side) with provided Insulock. Do not fix the other end.

ⓙ Connect the controller cable.

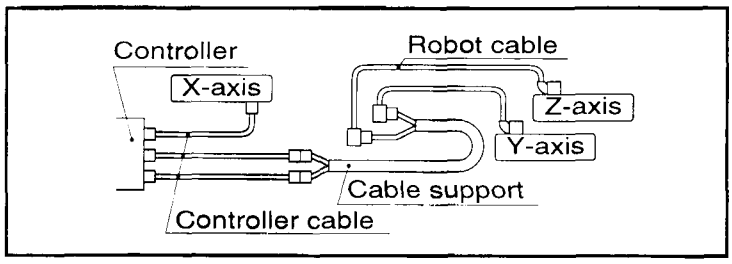
[X-axis connector] ↔ [Controller connector 1st axis]

[Y-axis connector (cable support)] ↔ [Controller connector 2nd axis]

[Z-axis connector (cable support)] ↔ [Controller connector 3rd axis]

○ See cable system diagram shown below.

Figure 8-45



Caution *: Reconfirm that the X, Y and Z-axes are correctly connected to controller connector 1st, 2nd and 3rd axis respectively.*

○ We recommend to affix the seals supplied with the main unit (6 each: X , Y , Z , and θ) to the main unit connector, robot cable, controller cable at both ends and controller connector to prevent mis-connection in the later stage.

Figure 8-46

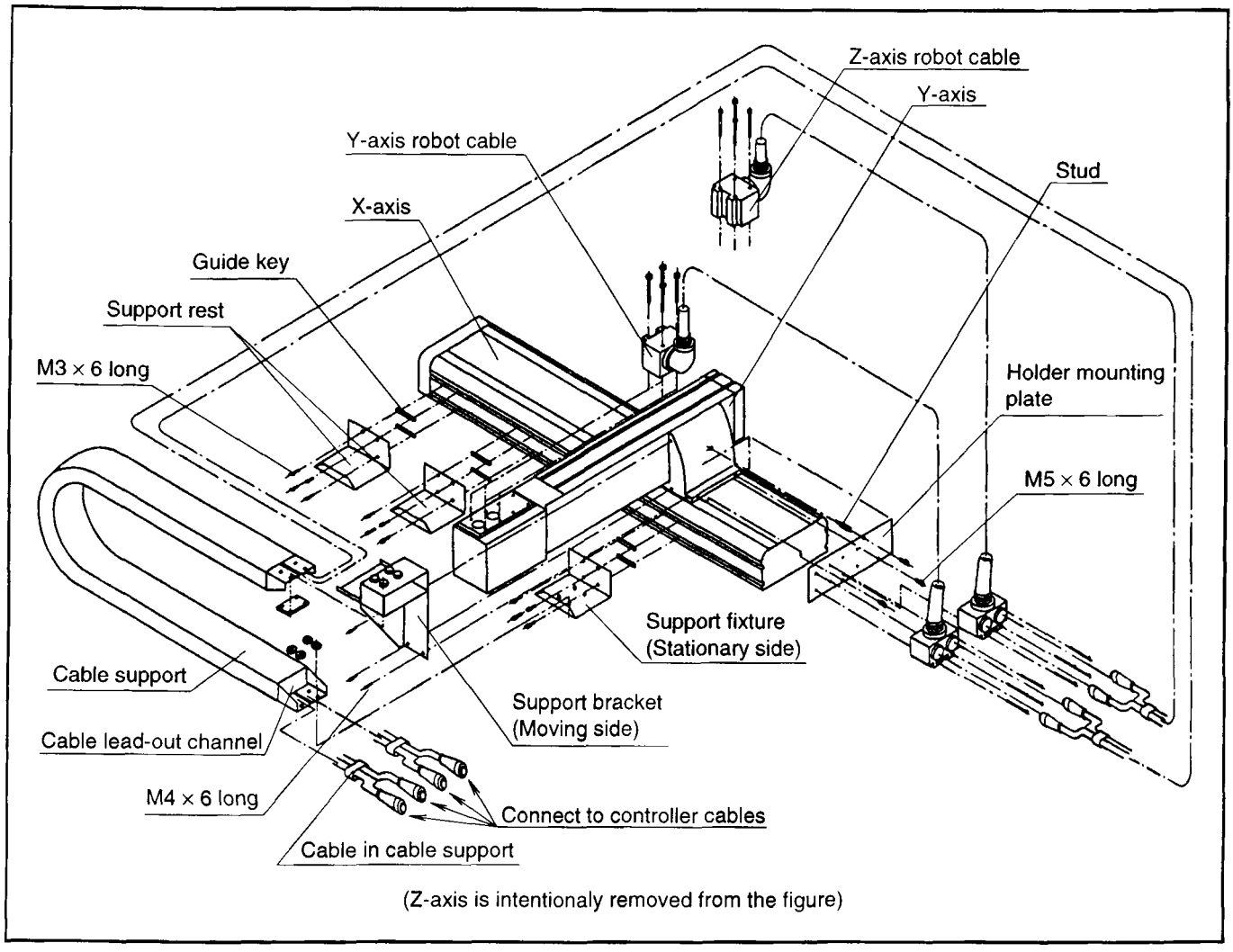
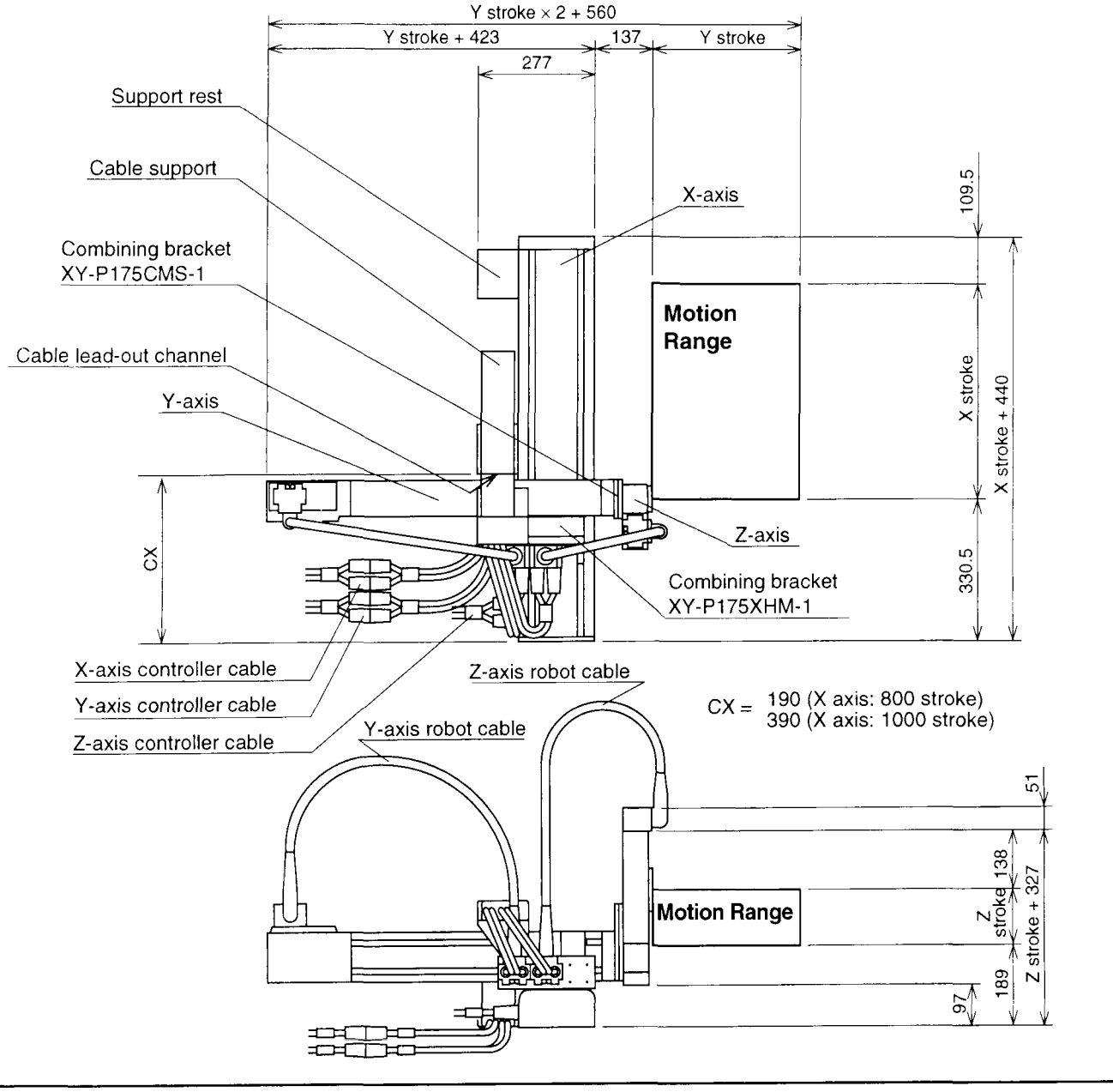


Figure 8-47

J
Long Stroke

X axis: H module
Y axis: M module
Z axis: Sv module

	Y stroke[mm] / Z stroke[mm]	250	350	450	550
Transportable load [kg]	130	10	10	6	3
	230	9	9	5	2



9. Wiring

9.1. Connector List for Wiring

- The connectors shown below are used for external wiring of the EXC controller.
- For the positions of the connectors, see "4.7. EXC Controller" and "5.4.2. Outside Dimensions of Controller".

Table 9-1

Connector Nos.	Applications	Cables
CN1	• A connector for the teaching box.	• Connect the cable supplied with the teaching box.
	• Can be used for an RS-232C communication cable. * If communication is to be done through the RS-232C interface, disconnect the teaching box.	• An RS-232C communication cable exclusive for the EXC controller is available. (Optional) See "4.11. RS-232C Cable". • If the user is going to make a cable, see "Appendix 3 Remote Control Wiring". * No cable is needed unless communication is to be done through the RS-232C interface.
CN2	• A control I/O connector for controlling the EXC controller. • Connect with the sequencer or operation box (prepared by the user).	• See "9.4. CN2: Control I/O Signal Connector" and make a cable. • The connector and connector cover are included in the accessories.
CN3	• A pulse train output connector of the EXC controller. • Megatorque motor or Megathrust motor made by NSK or other pulse train input unit can be used as an additional axis.	• If the pulse train output function is to be used, see "16. Pulse Train Output Function" and make a cable. • The connector and connector cover are included in the accessories. * No wiring is required if the pulse Train output function is not used.
CN4 CN7	• The connector is for the general I/O. • General output : It can be activated (ON) and deactivated (OFF) on the program. • General inputs : It is used for the conditional branching input of conditional jump command on the program.	• See "9.5. CN4 and CN7: General-Purpose I/O Signal Connectors" and make cables. • The connectors and connector covers are included in the accessories. * No cables are needed if the general I/Os are not used.
CN5 CN6	• Connectors for motor and encoder. CN5: For encoder over-travel sensor CN6: For motor brake	• An exclusive controller cable for the robot module is available. (Optional) • For the controller cable reference number, see "4.4. Controller Cables". * The specifications of the connectors CN5 and CN6 are shown in "Appendix 1 CN5 : Encoder and Over-Travel Sensor Connector" and "Appendix 2 CN6 : Motor and Brake Connector".
Power input	• Power terminal block for inputting AC power.	• See "9.6. Power Terminal Block" and make a cable.

9.2. Precautions for Wiring

9.2.1. Precautions for Making Cables

- When making cable and selecting wiring parts, follow the wiring instructions of the connector.
  - ○ "9.4.1. Precautions for Wiring CN2"
  - ○ "9.5.1. Precautions for Wiring CN4 and CN7"
  - ○ "9.6.1. Precautions for Wiring Power Terminal Block"

(Warning) : *Use the optional controller cable made by NSK for the motor encoder. Do not try to make a connector cable or modify (i.e., extend or shorten or disconnect) our controller cable in order to avoid improper wiring. If the user should make or modify a connector cable, be very careful to avoid improper wiring. Improper wiring may result in damages to the equipment or runaway of the robot module.*

* We do not compensate for troubles or accidents caused by improper wiring conducted by the user.

9.2.2. Precautions for Cable Connection

(Danger): *Do not disconnect any cable with the EXC controller electrified. Such an action may cause short-circuit, malfunctioning, etc.*

(Warning) : *(1) When connecting the motor and encoder cables to the controller, connect the cables to the proper axes.*

Example of mistake: Connecting the Z-axis module (with a 100 W motor) to the X-axis connector (for 300 W motor) of the controller.

- The outputs of the motor of modules are as shown below. Seals indicating the output wattages are stuck at the CN5 and CN6 connector positions on the controller. Connect the cables properly.

Table 9-2

H module	300W
M module	
S module	100W
S module vertical axis	

(2) Make sure that the rated input voltage of the controller is identical to the voltage rating of the module main unit. See "4. Reference Number· Name of the parts", and check the reference number to see if the voltage rating is proper.

Example of mistake: Connecting a 100 V type module to a 200 V type controller.

If the power is turned on and operation is carried out without following the instructions (1) and (2), the motor may be burnt or runaway.

9.2.3. Fixing Connectors

- Insert a connector to the very end firmly.
- If a connector is provided with screws, use the screws to fix the connector. If a connector has no screws, make sure that it is locked.
- If an external force may be applied to the connector through the cable, fix the cable to disable an external force from being applied to the connector.

Caution : *If a connector is not secured satisfactorily, the connector is unplugged or contact becomes poor while the robot is operating, resulting in malfunctioning.*

Table 9-3

Fixing screw type connector	CN1,CN2,CN4,CN7,CN5 Power input terminals
Self-lock type connector	CN3,CN6

9.2.4. Measures against Noises

Caution : *In order to eliminate influences of excessive noises, follow the instructions shown below in wiring.*

(1) Connect the FG terminal of the controller to the ground securely.

(2) Separate the AC power line and motor power line from the operation signal line (DC line) from each other. Never lay these lines in a same duct.

(3) Use shielded cables as the signal cables. Connect the end of the shield to the ground.

* Also see "9.4.1. Precautions for Wiring CN2" and "9.5.1. Precautions for Wiring CN4 and CN7".

(4) Use a controller having sufficient AC power capacity. Use the controller under the condition where no external equipment causes source voltage fluctuation. Do not connect the controller and robot modules to the same power source to which a welding machine, compressor, ultrasonic cleaning machine or other noise producing machine is connected.

(5) Do not use a thin and long AC power cable. Use as thick and short power cable as possible.

(6) Follow the instructions below in signal cable wiring.

① If CN2 and EMSTA / $\overline{\text{EMSTA}}$ are used, short-circuit the cable in the connector case on the EXC controller side. Do not pull out the wires out of the connector case. The EMSTA / $\overline{\text{EMSTA}}$ signal wires are not insulated and connected to the connector. Thus, they are easily affected by external noises.

② Likewise, cut the CN4 analog monitor output wires at the connector on the EXC controller side after using them for adjustment. Do not pull out the wires out of the connector.

Caution : *In application subject to much electrostatic noises, ground the portion carrying electrostatic noises (such as the slider of the module main unit) in order to prevent electrostatic noises from being applied to the EXC controller.*

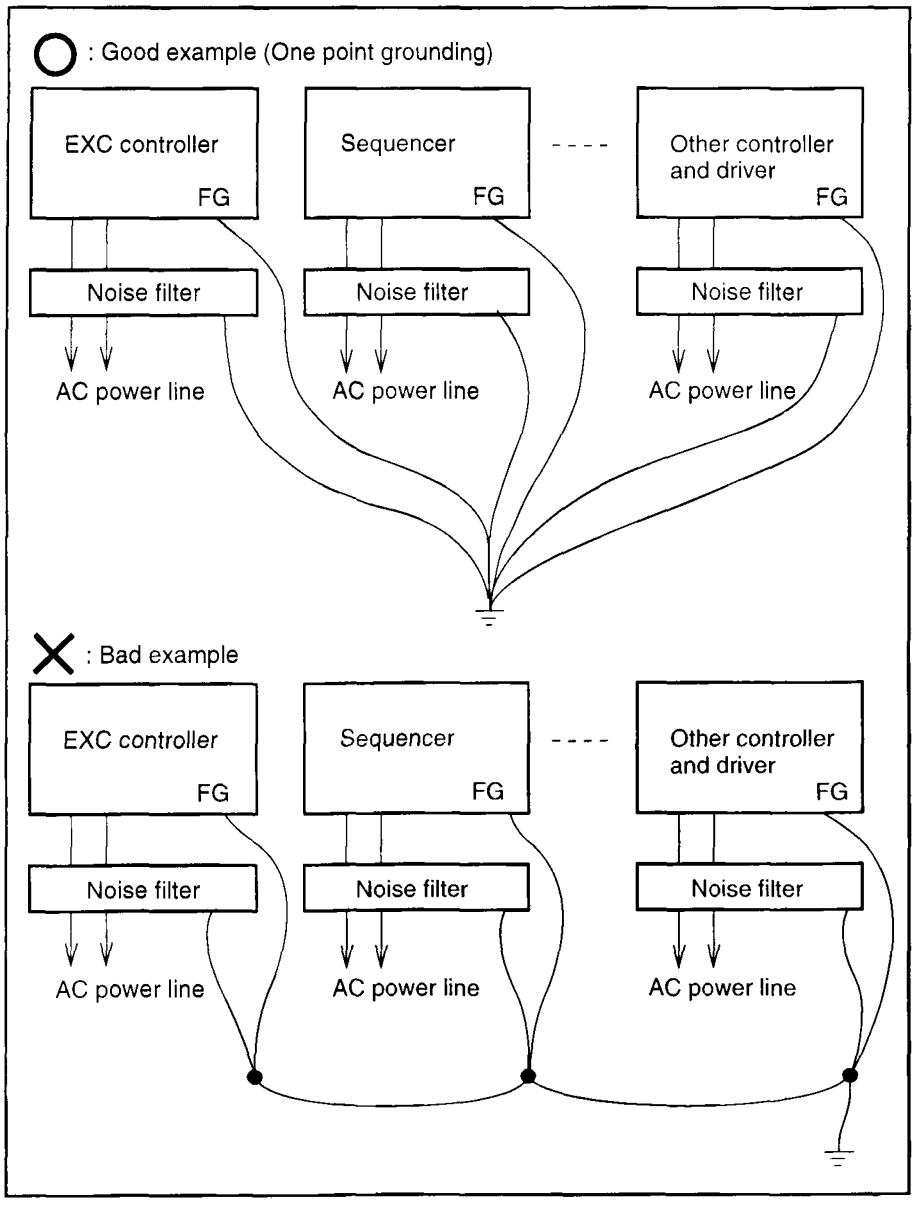
9.2.5. Grounding

(Danger) : *The system must be grounded properly to avoid electric shock or malfunctioning due to noises.*

- ○ Use a one-point class 3 grounding. (Ground resistance: 100Ω or less)
- ○ If another equipment is mounted in the same electric panel, ground the equipment and devices at one point.
- ○ Use as thick a cable as possible such as a flat braided copper wire or 3.5 square mm wire for grounding the controller.

Note : The FG pin of each connector of the EXC controller is connected to the FG connector of the power input terminal of the controller.

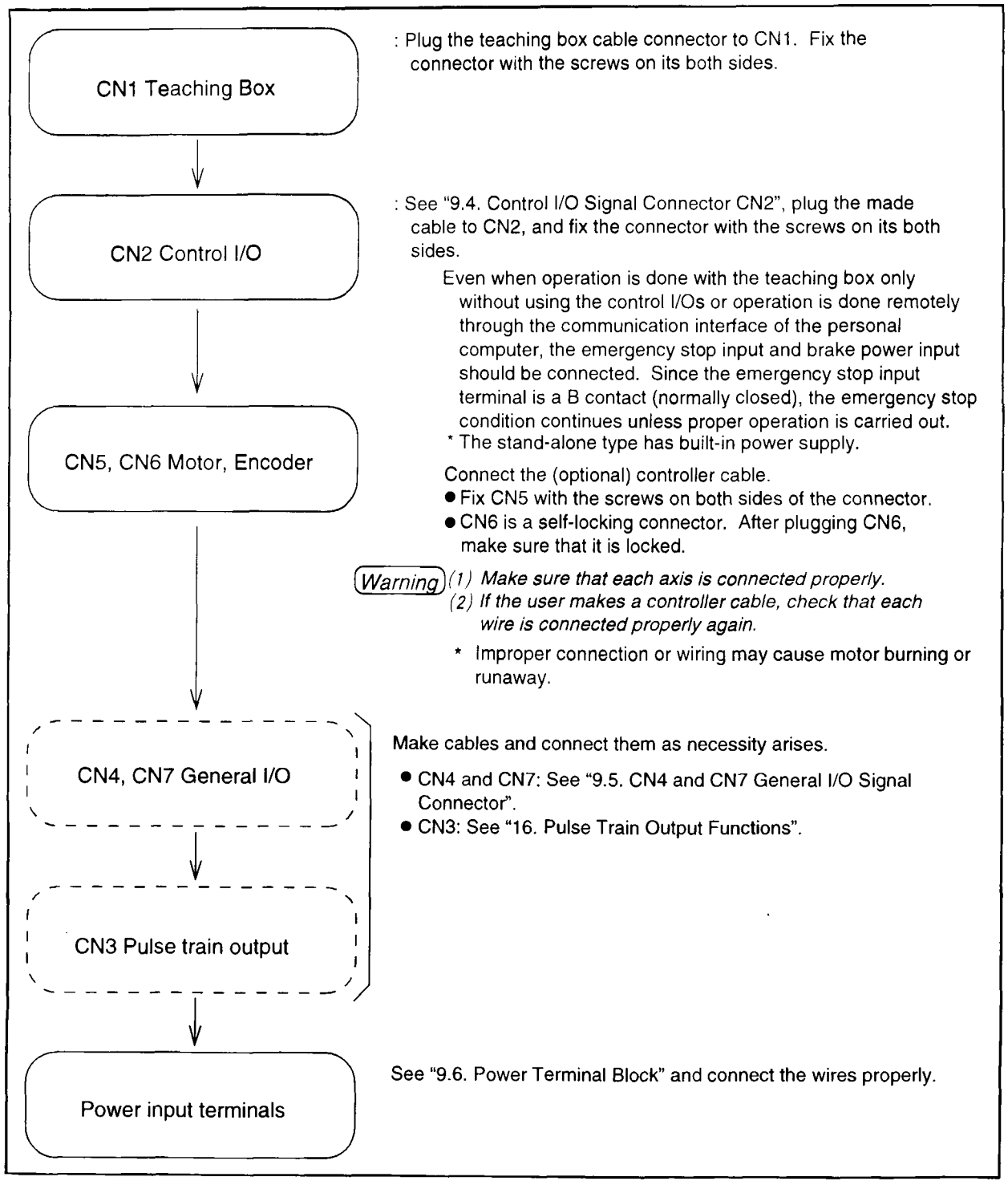
Figure 9-1



9.3. Wiring Procedures

9.3.1. Wiring Procedures

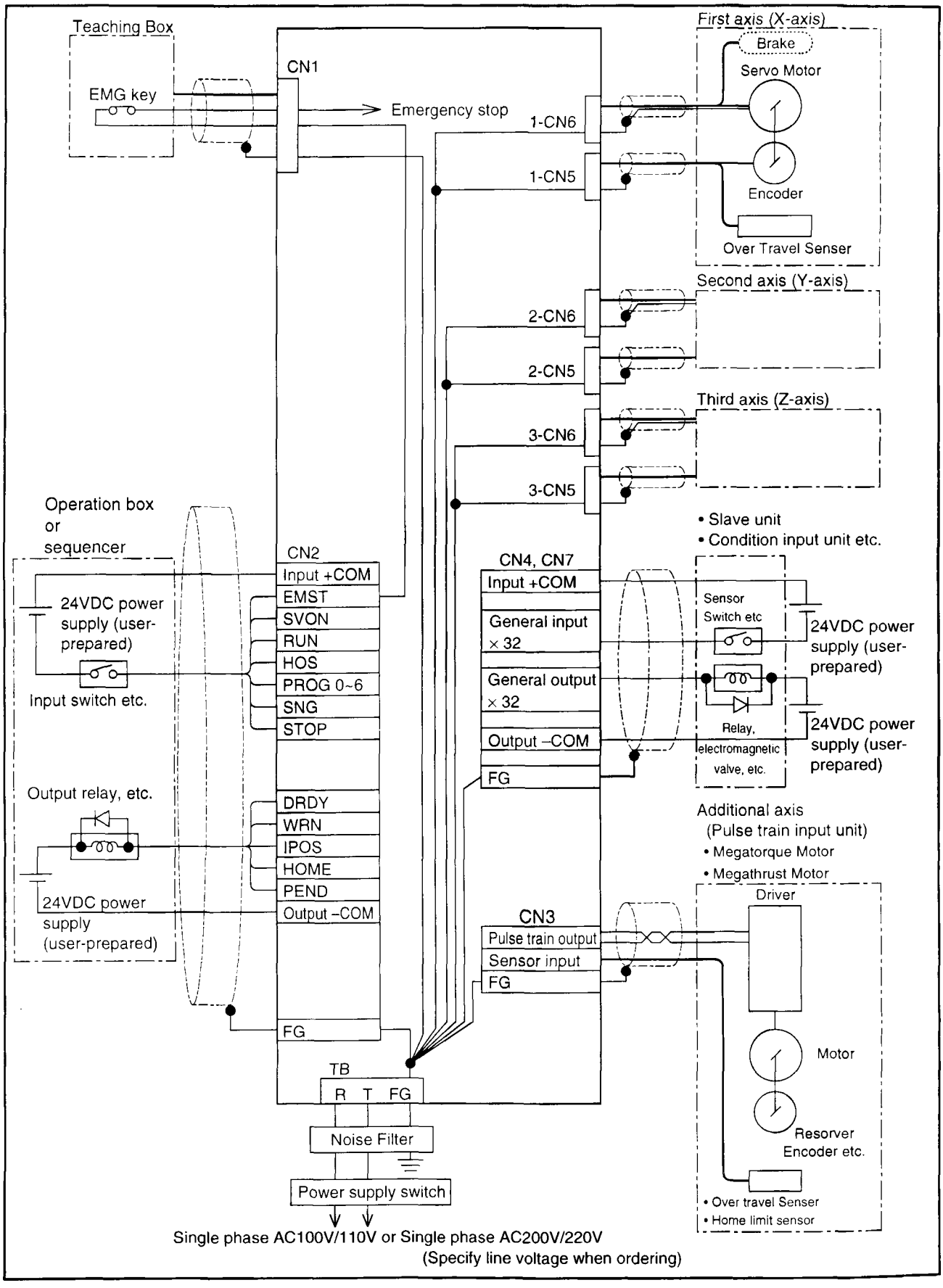
Figure 9-2



9.3.2. Wiring Example

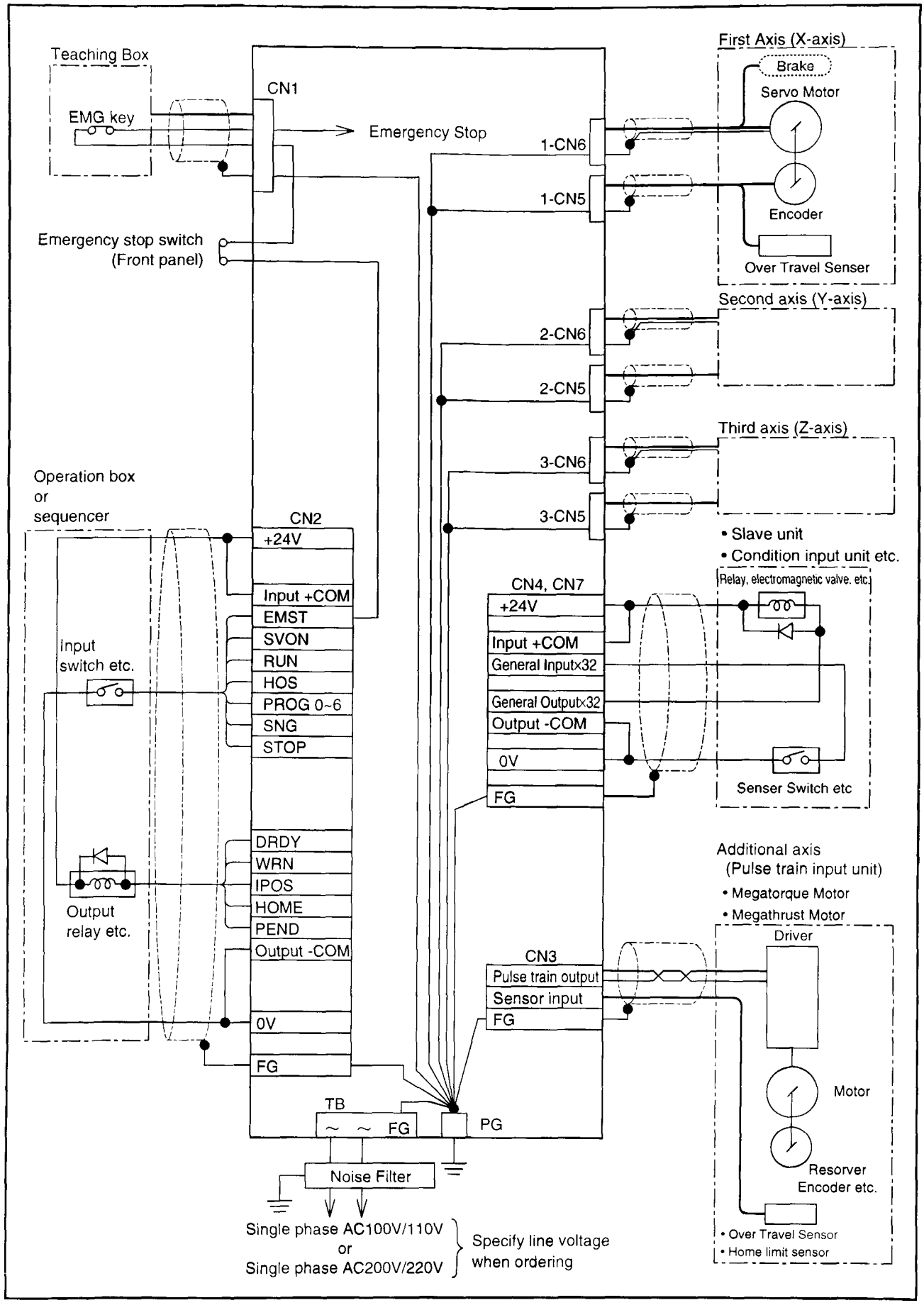
9.3.2.1. Example for Rack Mount Type EXC Controller

Figure 9-3



9.3.2.2. Example for Stand Alone Type EXC Controller

Figure 9-4



9.4. CN2: Control I/O Signal Connector

- Connect the control I/O signal wires necessary for controlling the EXC controller through user's controller or sequencer.

- Even when operation is conducted with the teaching box without using the control I/Os or conducted remotely through the communication interface of the personal computer in trial running or the like, connect wires to the EMST (emergency stop) input terminals.

EMST input is B contact (normally closed).

Caution : *Be sure to connect the 24 VDC brake power cable (pin 13: positive, pin 22: negative) of the rack mount type connector (EXC20 or EXC30) even if operation is not conducted through CN2. Unless brake power is supplied, the motor runs without releasing the brake, resulting in damages to the brake.*

Note: The 24 VDC power supply should have the current capacity of 2 A for the EXC controller (including the brake).

Note: Use a 24 VDC power supply whose voltage reaches 24 V quickly. If the voltage fails to reach 24 VDC when the EXC controller has started, the EMST input goes inactive, causing the emergency stop condition.

→ If the voltage reaches 24 VDC slowly, turn on the 24 VDC power before starting the EXC controller.

* It takes approximately 1 or 2 seconds for the EXC controller to start up.

- Table 9-4 shows the parts of the connector CN2.

Table 9-4: CN2 connector parts

Connector on EXC Controller	MR-34RFA made by Honda Communication Co.
Applicable Connector (User's Equipment) *	MR-34M made by Honda Communication Co.
Applicable Cover (User's Equipment) *	MR-34L made by Honda Communication Co.

* Packed as accessories.

9.4.1. Precautions for Wiring CN2

- Be sure to use a shielded cable. Ground the shield (i.e., connect it to frame ground pin 34).
- When short-circuiting pins 30 and 31 (i.e., using the emergency stop input as a contact A normally open), short-circuit them at the root of the connector pins in the connector case. Do not extend the shorting wire outside the connector case.
- To connect a relay to the output, be sure to connect a surge killer to the relay.
- Lay the CN2 cable apart from the power line (power cable, motor cable, etc.) . Do not lay these cables in the same duct.
- Use the CN2 cable as short as possible (below 3 meters). If a long cable is needed, take proper measures to keep out noises.

Caution : Disobedience to the instructions shown above may result in malfunctioning or memory data corruption due to noises.

Caution : Follow the electrical specifications shown in the table below. In particular, any of the following three may lead to breakage of the input and output signal elements.

① Source voltage (24 VDC ± 10%) out of the allowable range
② Reverse-phase connection of the power source (24 VDC)
③ Output signal exceeding the maximum open/close limits

Table 9-5: CN2 signal specifications

I/O	Item	Specification
Input Signal	Input Voltage	24VDC ±10%
	Input Impedance	3.3kΩ
	Max. Input Current	10mA (per one point)
Output Signal	Max. Open/Close Capability	24VDC/100mA
	Saturation Voltage	2V or less

9.4.2. CN2 Signal Functions

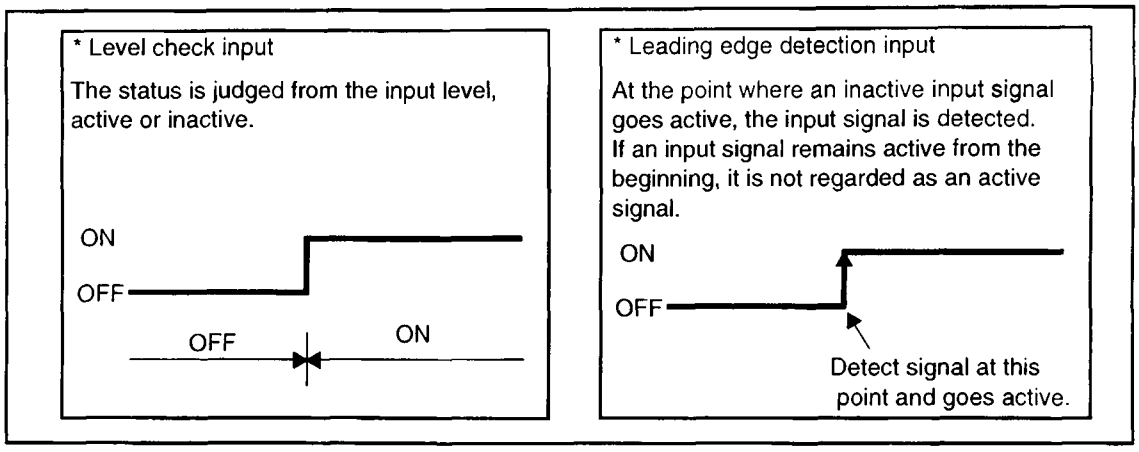
● Input Signals

Table 9-6

Types	Signal name	Functions
Status control	SVON	Changes the motor servo status. (A level check input.*) ● While SVON input is active: The motor servo is active. ○ The motor servo may be inactive when an alarm occurs or in other error condition. ● While SVON input is inactive: The motor servo is inactive.
	ACLR	Clears an alarm. (A leading edge detection input.*) (Some alarms cannot be cleared. See "20.5 Alarm Resetting Function".)
Starting	HOS	Starts Home returning motion. (A leading edge detection input.*)
	RUN	Starts program operation. (A leading edge detection input.*)
Programmed operation control	PROG0 ~ PROG6	Determines a program to be started. (A level check input.*) ● The number of a program to be started depends on the ON and OFF combinations of PROG0 to PROG6 immediately after the RUN input signal goes active.
	SNG	Determines whether to execute a program step by step (step operation) or to execute a program continuously (continuous operation). (A level check input.*) ● SNG input signal active: Every time the RUN input signal goes active, a program is executed by one step. ● SNG input signal inactive: When the RUN input signal goes active, a program is executed continuously to the end (END command).
	RSTA	Restarts a program if the RSTA input signal is active immediately after the RUN input signal goes active (provided the program restart conditions are met). (A level check input.*)
Stopping	EMST	Causes the emergency stop condition when the EMST input goes inactive. The motor servo is deactivated. Once the emergency stop condition is established, operation cannot be started unless the emergency stop is canceled.
	STOP	Stops operation immediately if the STOP input goes active during operation. The program is terminated forcedly. The motor servo is locked. (A level check input.*) Operation cannot be restarted under the condition where the STOP input remains inactive. Operation will not restart even if the STOP input goes active. Starting operation should be executed again.
	(SNG)	Completes a step being executed and stops operation (cycle stop) when the SNG input goes active during continuous programmed operation. The motor servo is locked. If the RUN input goes active in the cycle stop condition, the program is restarted from the following step.
	HLD	Discontinues (stops temporarily) operation immediately when the HLD input goes active in programmed operation. The motor servo is locked. If the HLD input goes inactive and the RUN input goes active in the HLD condition, the programmed operation restarts from the stopping position. (A level check input.*) Operation cannot be restarted with the HLD input active.
Others	EMSTA EMST$\overline{A}$	Reverses the logic of the EMST input when the EMSTA input and EMST$\overline{A}$ input are shorted. (Normally close logic is changed into the normally open logic.) Do not connect in normal use.

Note: * For input format, see Figure 9-5.

Figure 9-5: Level check input and Leading edge detection input**

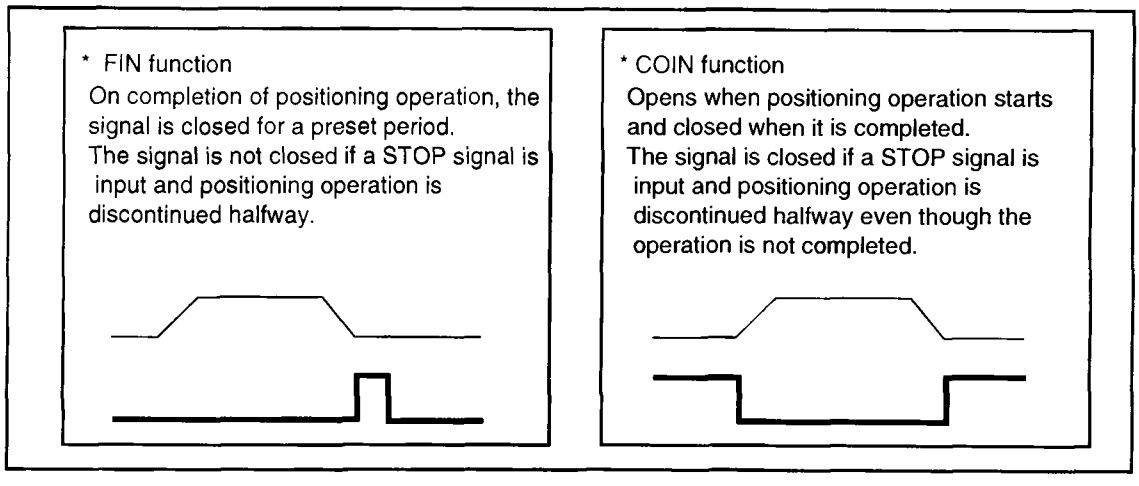


● Output Signal

Table 9-7

Types	Signal names	Functions
Error status indication	DRDY+ DRDY−	Opens in case of a serious error. Normally closed.
	WRN	Closed in case of a minor error. Normally opened.
Completion indication	HOME	Closed when the Home returning motion is completed. This signal is output to indicate completion of Home returning motion, not to indicate the Home position area. Opens when another operation command is input and remains open even when the mechanisms return to the Home in positioning operation.
	IPOS	A positioning operation completion output signal. Either the FIN* or COIN* function can be selected. (See Figure 9-6.)
	PEND	Opens when a program operation starts and closes when it is completed.
Stopping status indication	CSTP	Closed in the cycle stop conditions of a program operation.
	HLDA	Closed when a program operation is discontinued temporarily.

Figure 9-6: FIN function and COIN* function*



- For the operation timing, see "14.4. Operations in External Control Mode".

9.4.3. CN2 Signal Specifications for Rack Mount Type

◉ Pin assignment and signal names (EXC20,EXC30)

Figure 9-7

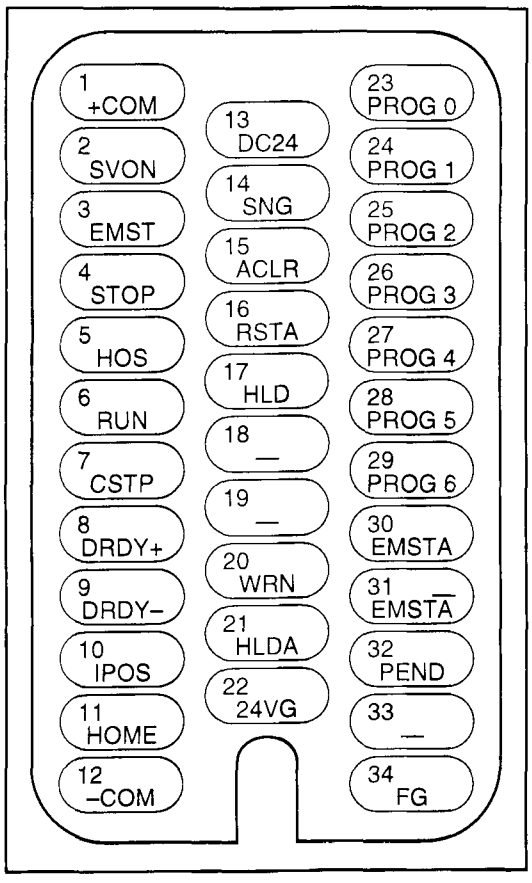
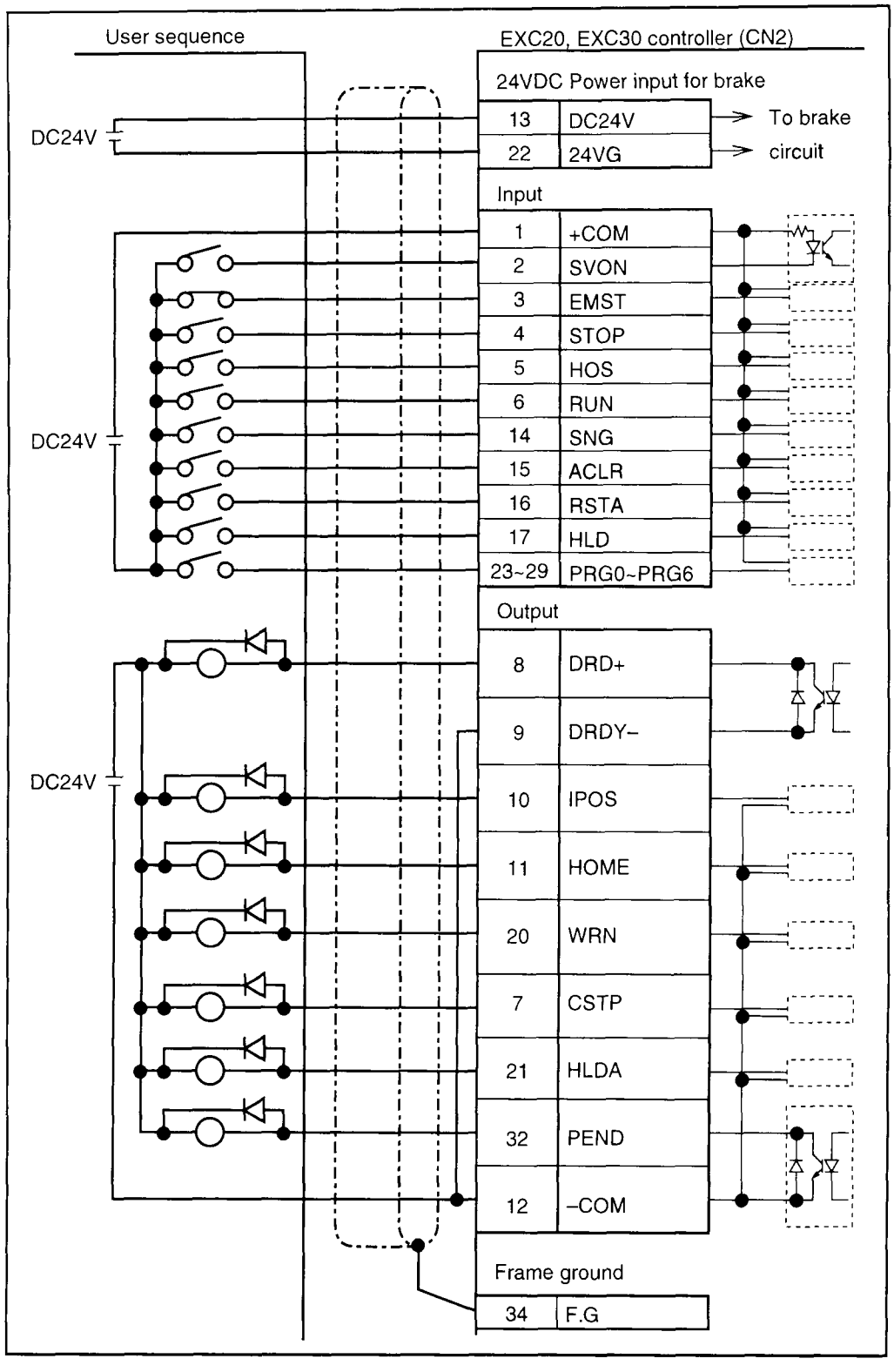


Table 9-8

Pin	Signal Name	I/O	Description
1	+COM	I	Common of input signals
2	SVON	I	Servo on
3	EMST	I	Emergency stop
4	STOP	I	Stop by deceleration
5	HOS	I	Activating Home Return motion
6	RUN	I	Activating programmed operation
7	CSTP	O	(Connection disabled)
8	DRDY+	O	EXC controller ready (+)
9	DRDY–	O	EXC controller ready (–)
10	IPOS	O	Positioning complete
11	HOME	O	Home Return complete
12	–COM	O	Common of output signals
13	DC24	I	+ of 24VDC power for brake
14	SNG	I	Automatic programmed operation step switching
15	ACLR	I	Alarm reset
16	RSTA	I	Selection : resume programmed operation
17	HLD	I	Tentatively stop programmed operation
18	—	—	(Connection disabled)
19	—	—	(Connection disabled)
20	WRN	O	Warning
21	HLDA	O	Tentatively stopping programmed operation
22	24VG	I	– of 24VDC power for brake
23	PROG0	I	Internal program selection 0
24	PROG1	I	Internal program selection 1
25	PROG2	I	Internal program selection 2
26	PROG3	I	Internal program selection 3
27	PROG4	I	Internal program selection 4
28	PROG5	I	Internal program selection 5
29	PROG6	I	Internal program selection 6
30	EMSTA	I	The EMST input is changed from B contact into
31	EMSTA	I	A contact if pins 30 and 31 are short-circuited.
32	PEND	O	Programmed operation complete
33	—	—	(Connection disabled)
34	FG	—	Frame ground

◉ Connection wiring (EXC20,EXC30)

Figure 9-8



9.4.4. CN2 Signal Specifications for Stand Alone Type (EXC21,EXC31)

◉ Pin assignment and signal names

Figure 9-9

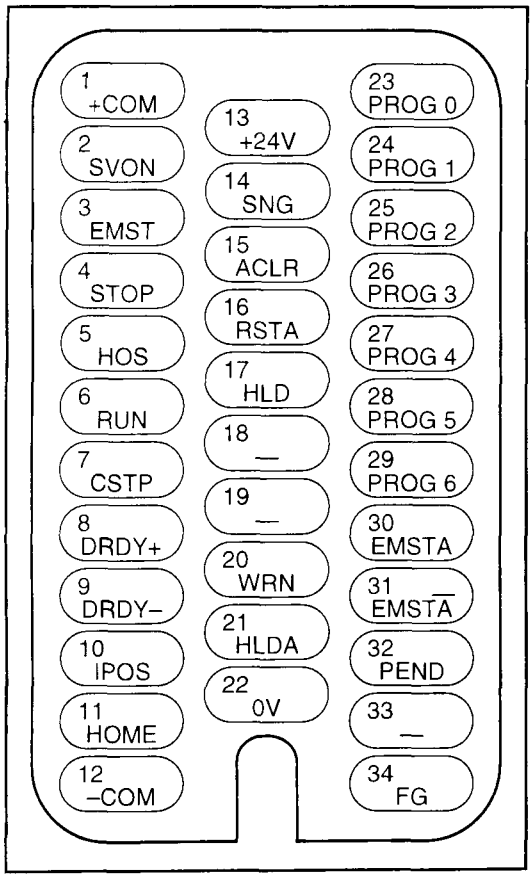
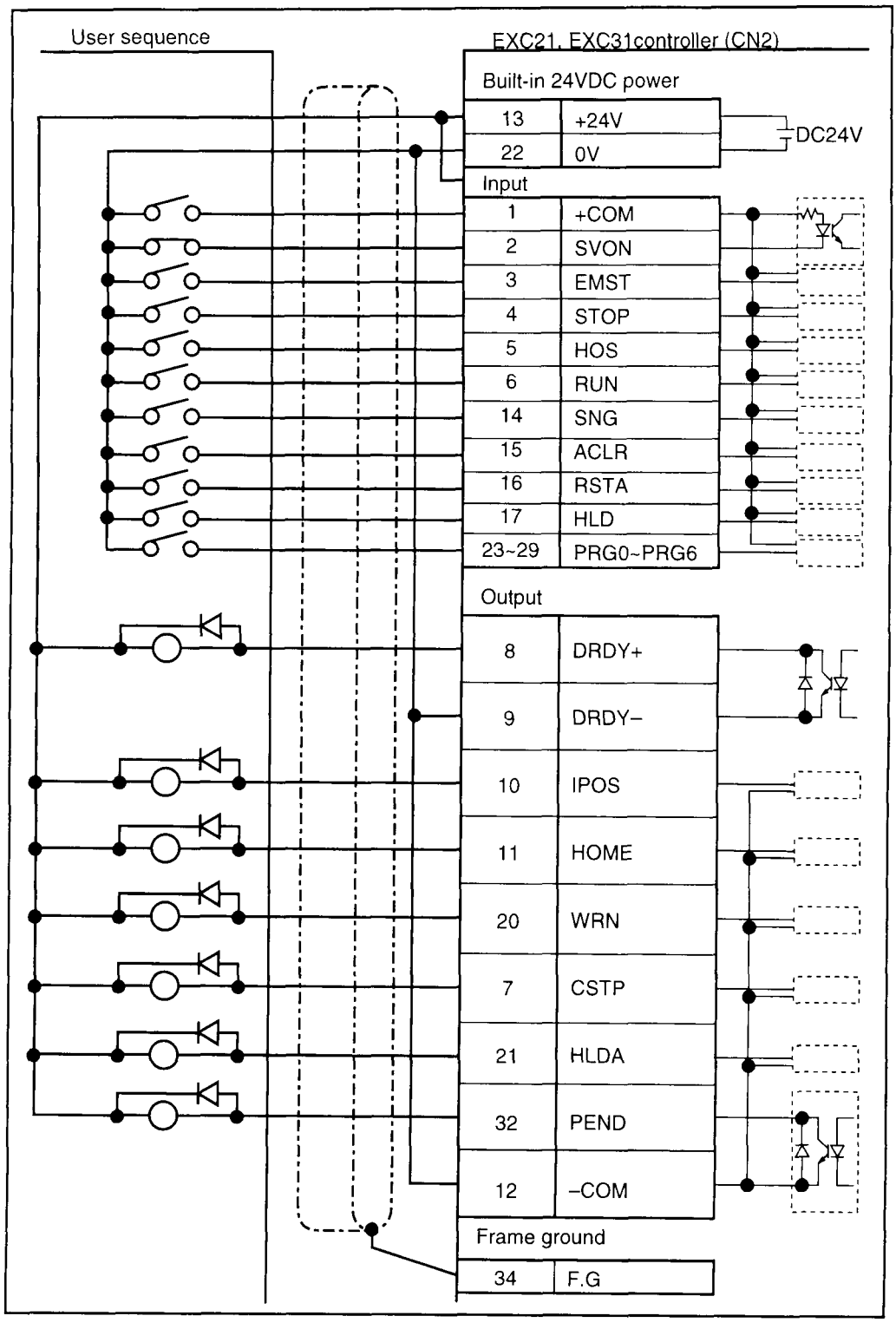


Table 9-9

Pin	Signal Name	I/O	Description
1	+COM	I	Common of input signals
2	SVON	I	Servo on
3	EMST	I	Emergency stop
4	STOP	I	Stop by deceleration
5	HOS	I	Activating Home Return motion
6	RUN	I	Activating programmed operation
7	CSTP	O	(Connection disabled)
8	DRDY+	O	EXC controller ready (+)
9	DRSY–	O	EXC controller ready (–)
10	IPOS	O	Positioning complete
11	HOME	O	Home Return complete
12	–COM	O	Common of output signals
13	+24V	O	+ of 24VDC power
14	SNG	I	Automatic programmed operation step switching
15	ACLR	I	Alarm reset
16	RSTA	I	Selection : resume programmed operation
17	HLD	I	Tentatively stop programmed operation
18	—	—	(Connection disabled)
19	—	—	(Connection disabled)
20	WRN	O	Warning
21	HLDA	O	Tentatively stopping programmed operation
22	0V	I	– of 24VDC power
23	PROG0	I	Internal program selection 0
24	PROG1	I	Internal program selection 1
25	PROG2	I	Internal program selection 2
26	PROG3	I	Internal program selection 3
27	PROG4	I	Internal program selection 4
28	PROG5	I	Internal program selection 5
29	PROG6	I	Internal program selection 6
30	EMSTA	I	The EMST input is changed from B contact into
31	$\overline{\text{EMSTA}}$	I	A contact if pins 30 and 31 are short-circuited.
32	PEND	O	Programmed operation complete
33	—	—	(Connection disabled)
34	FG	—	Frame ground

◉ Connection wiring (EXC21,EXC31)

Figure 9-10



9.5. CN4,CN7: General Purpose I/O Signal Connectors

Table 9-10: CN4,CN7: Connector parts

Connector on EXC Controller	MR-50RFA made by Honda Communication Co.
Applicable Connector (User's Equipment)*	MR-50M made by Honda Communication Co.
Applicable Cover (User's Equipment)*	MR-50L made by Honda Communication Co.

* Packed as accessories

9.5.1. Precautions for Wiring CN4 and CN7

- Be sure to use shielded cables. Ground the shields (i.e., connect them to FG pin 50.)
- The analog monitor output terminals (pins 26 and 27 of CN4) shall be able to be used when starting operation or for adjustment only. On completion of starting operation or adjustment, disconnect the wires from pins 26 and 27. Do not leave the wires connected and extended to the outside.
- If a relay or solenoid valve is connected to the output, be sure to use a surge killer.
- Lay the CN4 and CN7 cables apart from the power line (i.e., power cable, motor cable and so forth). Do not lay these cables in the same duct.
- Use as short cables (3 meters or less) as possible for CN4 and CN7. If longer cables are to be used, take proper measures against external noises.

Caution : Unless the instructions shown above are observed, the system may malfunction or data in the memory may be corrupted due to noises.

Caution : Follow the electrical specifications shown in the table below. In particular, any of the following three may lead to breakage of the input and output signal elements.

① Source voltage (24 VDC ±10%) out of the allowable range
② Reverse-phase connection of the power source (24 VDC)
③ Output signal exceeding the maximum open/close limits

Table 9-11: CN4,CN7 Signal specifications

I/O	Item	Specification
Input Signal	Input Voltage	24VDC ±10%
	Input Impedance	3.3kΩ
	Max. Input Current	10mA (per one point)
Output Signal	Max. Open/Close Capability	24VDC/100mA
	Saturation Voltage	2V or less

9.5.2. CN4,CN7 Signal Specifications for Rack Mount Type

◉ CN4, Pin assignment and signal names (EXC20,EXC30)

Figure 9-11

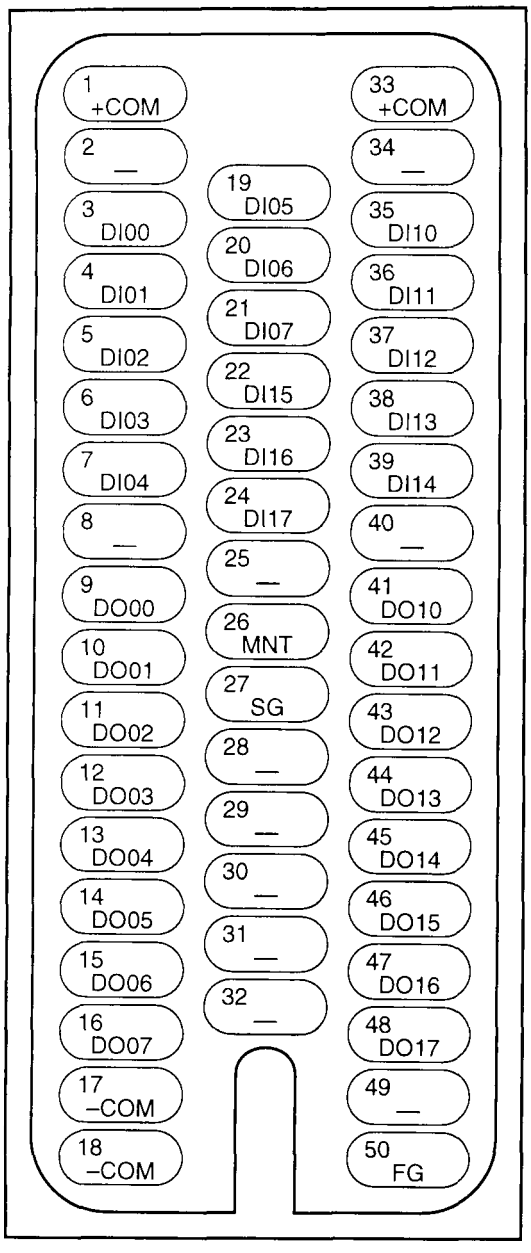


Table 9-12

Pin	Signal Name	I/O	Description
1	+COM	I	Common of input signals
2	—	—	(Connection disabled)
3	DI00	I	General input port 0, bit 0
4	DI01	I	General input port 0, bit 1
5	DI02	I	General input port 0, bit 2
6	DI03	I	General input port 0, bit 3
7	DI04	I	General input port 0, bit 4
8	—	—	(Connection disabled)
9	DO00	O	General output port 0, bit 0
10	DO01	O	General output port 0, bit 1
11	DO02	O	General output port 0, bit 2
12	DO03	O	General output port 0, bit 3
13	DO04	O	General output port 0, bit 4
14	DO05	O	General output port 0, bit 5
15	DO06	O	General output port 0, bit 6
16	DO07	O	General output port 0, bit 7
17	–COM	O	Common of output signals
18	–COM	O	Common of output signals
19	DI05	I	General input port 0, bit 5
20	DI06	I	General input port 0, bit 6
21	DI07	I	General input port 0, bit 7
22	DI05	I	General input port 1, bit 5
23	DI16	I	General input port 1, bit 6
24	DI17	I	General input port 1, bit 7
25	—	—	(Connection disabled)
26	MNT	O	Analog monitor output signal
27	SG	O	Analog monitor output GND
28	—	—	(Connection disabled)
29	—	—	(Connection disabled)
30	—	—	(Connection disabled)
31	—	—	(Connection disabled)
32	—	—	(Connection disabled)
33	+COM	I	Common of input signals
34	—	—	(Connection disabled)
35	DI10	I	General input port 1, bit 0
36	DI11	I	General input port 1, bit 1
37	DI12	I	General input port 1, bit 2
38	DI13	I	General input port 1, bit 3
39	DI14	I	General input port 1, bit 4
40	—	—	(Connection disabled)
41	DO10	O	General output port 1, bit 0
42	DO11	O	General output port 1, bit 1
43	DO12	O	General output port 1, bit 2
44	D013	O	General output port 1, bit 3
45	DO14	O	General output port 1, bit 4
46	DO15	O	General output port 1, bit 5
47	DO16	O	General output port 1, bit 6
48	DO17	O	General output port 1, bit 7
49	—	—	(Connection disabled)
50	FG	—	Frame ground

◉ CN7, Pin assignment and signal names (EXC20,EXC30)

Figure 9-12

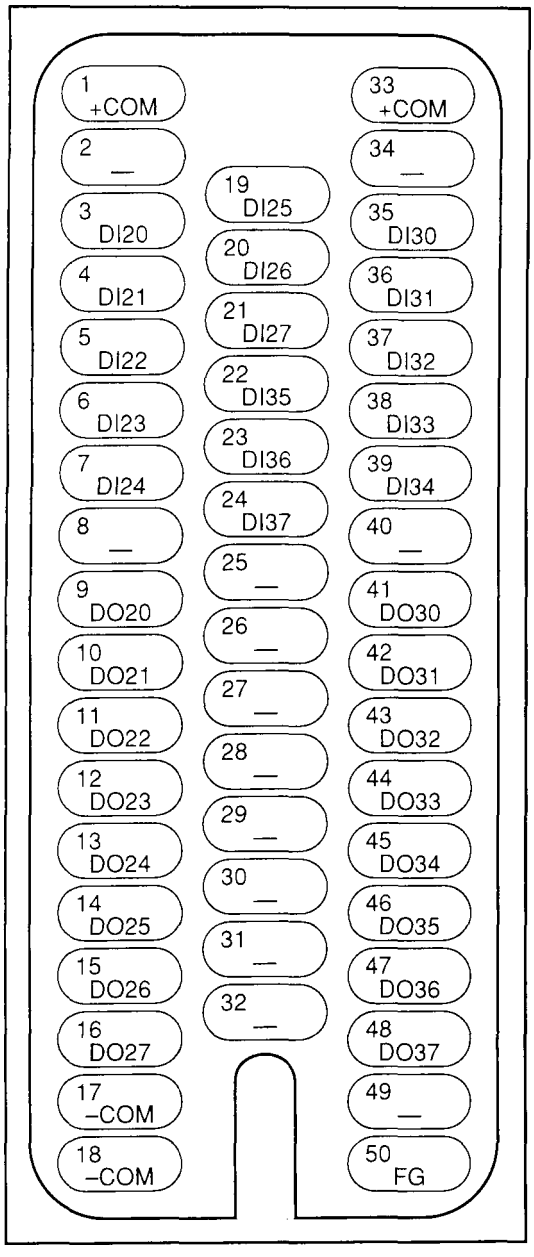
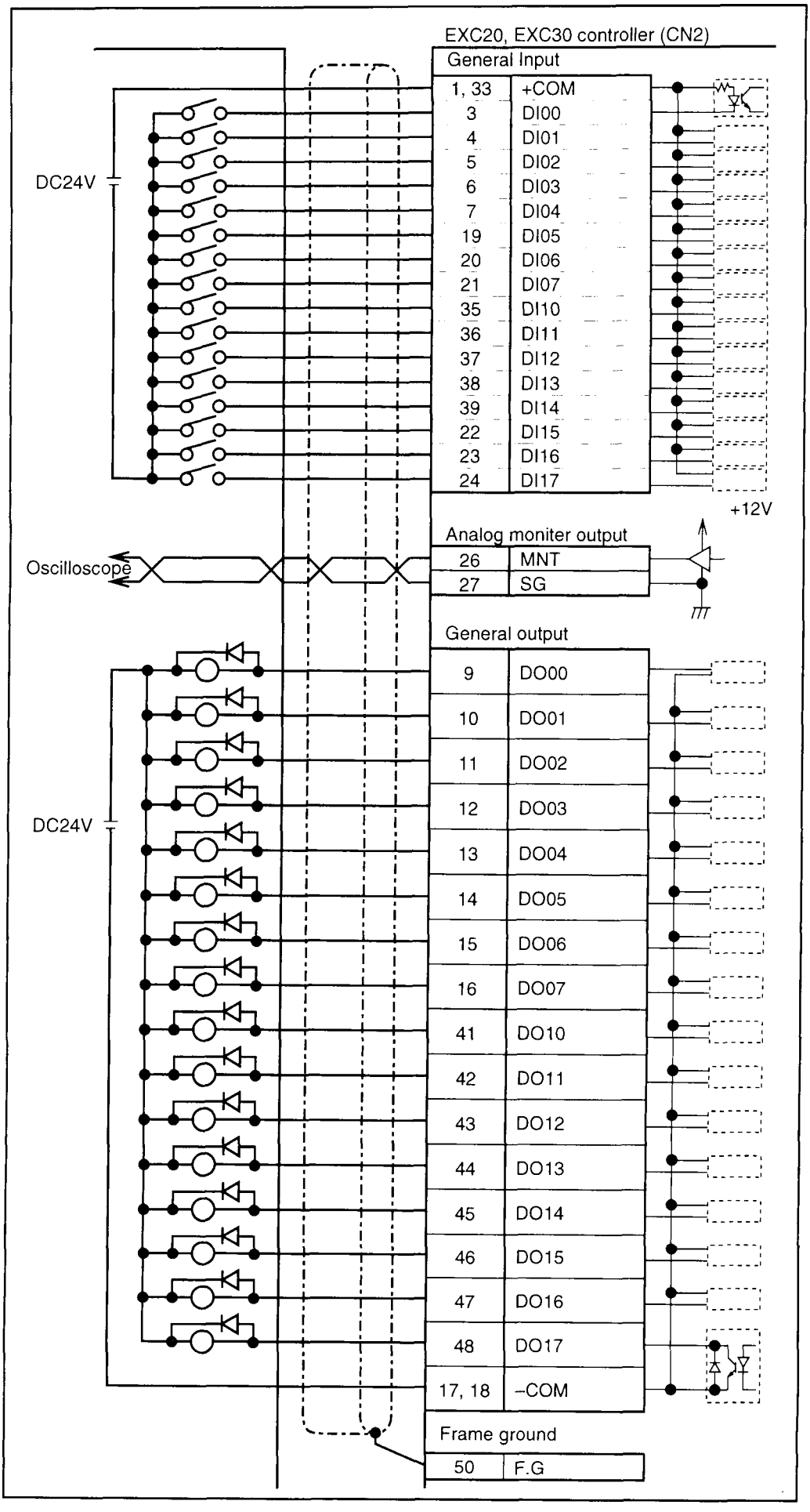


Table 9-13

Pin	Signal Name	I/O	Description
1	+COM	I	Common of input signals
2	—	—	(Connection disabled)
3	DI20	I	General input port 2, bit 0
4	DI21	I	General input port 2, bit 1
5	DI22	I	General input port 2, bit 2
6	DI23	I	General input port 2, bit 3
7	DI24	I	General input port 2, bit 4
8	—	—	(Connection disabled)
9	DO20	O	General output port 2, bit 0
10	DO21	O	General output port 2, bit 1
11	DO22	O	General output port 2, bit 2
12	DO23	O	General output port 2, bit 3
13	DO24	O	General output port 2, bit 4
14	DO25	O	General output port 2, bit 5
15	DO26	O	General output port 2, bit 6
16	DO27	O	General output port 2, bit 7
17	–COM	O	Common of output signals
18	–COM	O	Common of output signals
19	DI25	I	General input port 2, bit 5
20	DI26	I	General input port 2, bit 6
21	DI27	I	General input port 2, bit 7
22	DI35	I	General input port 3, bit 5
23	DI36	I	General input port 3, bit 6
24	DI37	I	General input port 3, bit 7
25	—	—	(Connection disabled)
26	—	—	(Connection disabled)
27	—	—	(Connection disabled)
28	—	—	(Connection disabled)
29	—	—	(Connection disabled)
30	—	—	(Connection disabled)
31	—	—	(Connection disabled)
32	—	—	(Connection disabled)
33	+COM	I	Common of input signals
34	—	—	(Connection disabled)
35	DI30	I	General input port 3, bit 0
36	DI31	I	General input port 3, bit 1
37	DI32	I	General input port 3, bit 2
38	DI33	I	General input port 3, bit 3
38	DI34	I	General input port 3, bit 4
40	—	—	(Connection disabled)
41	DO30	O	General output port 3, bit 0
42	DO31	O	General output port 3, bit 1
43	DO32	O	General output port 3, bit 2
44	DO33	O	General output port 3, bit 3
45	DO34	O	General output port 3, bit 4
46	DO35	O	General output port 3, bit 5
47	DO36	O	General output port 3, bit 6
48	DO37	O	General output port 3, bit 7
49	—	—	(Connection disabled)
50	FG	—	Frame ground

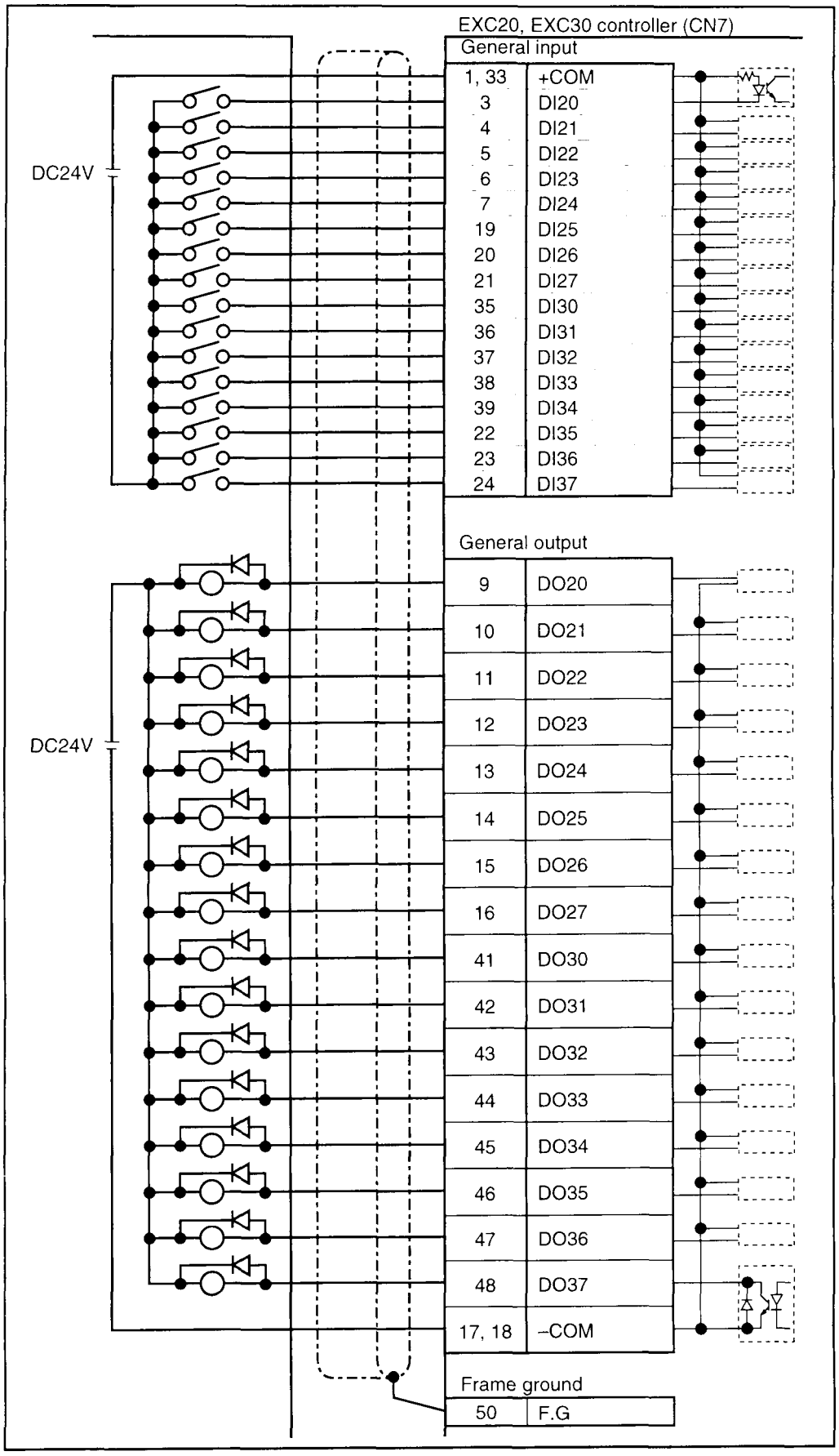
◉ CN4, Connection wiring (EXC20,EXC30)

Figure 9-13



◉ CN7, Connection wiring (EXC20,EXC30)

Figure 9-14



9.5.3. CN4,CN7: Signal Specifications for Stand Alone Type

◉ CN4, Pin assignment and signal names (EXC21,EXC31)

Figure 9-15

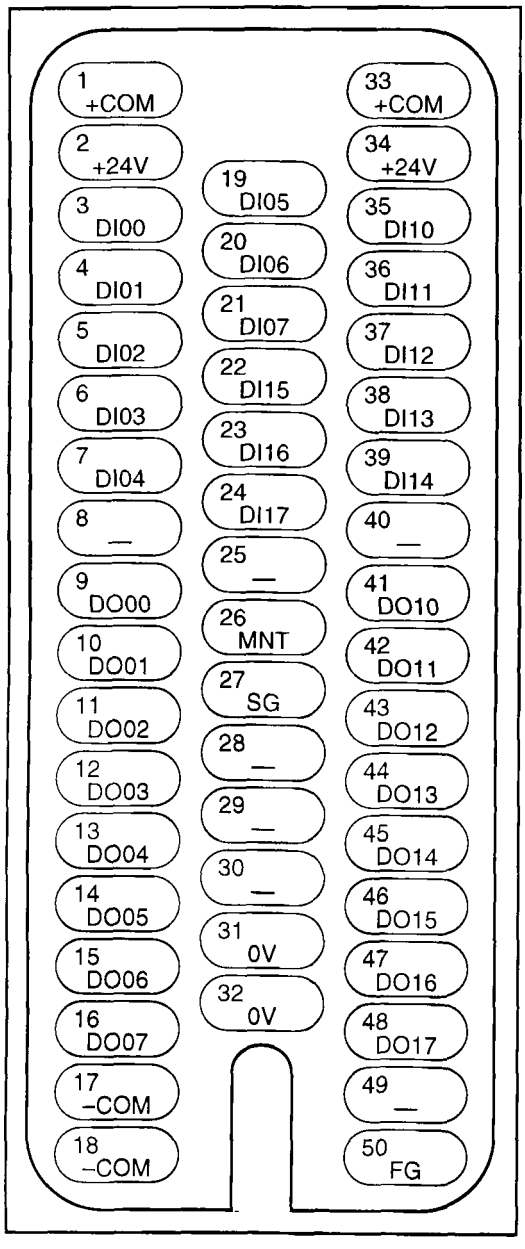


Table 9-14

Pin	Signal Name	I/O	Descriptions
1	+COM	I	Common of input signals
2	+24V	O	+ output of built-in 24VDC power supply
3	DI00	I	General input port 0, bit 0
4	DI01	I	General input port 0, bit 1
5	DI02	I	General input port 0, bit 2
6	DI03	I	General input port 0, bit 3
7	DI04	I	General input port 0, bit 4
8	—	—	(Connection disabled)
9	DO00	O	General output port 0, bit 0
10	DO01	O	General output port 0, bit 1
11	DO02	O	General output port 0, bit 2
12	DO03	O	General output port 0, bit 3
13	DO04	O	General output port 0, bit 4
14	DO05	O	General output port 0, bit 5
15	DO06	O	General output port 0, bit 6
16	DO07	O	General output port 0, bit 7
17	-COM	O	Common of output signals
18	-COM	O	Common of output signals
19	DI05	I	General input port 0, bit 5
20	DI06	I	General input port 0, bit 6
21	DI07	I	General input port 0, bit 7
22	DI15	I	General input port 1, bit 5
23	DI16	I	General input port 1, bit 6
24	DI17	I	General input port 1, bit 7
25	—	—	(Connection disabled)
26	MNT	O	Analog monitor output signal
27	SG	O	Analog monitor output GND
28	—	—	(Connection disabled)
29	—	—	(Connection disabled)
30	—	—	(Connection disabled)
31	0V	O	- output of built-in 24VDC power supply
32	0V	O	- output of built-in 24VDC power supply
33	+COM	I	Common of input signals
34	+24V	O	+ output of built-in 24VDC power supply
35	DI10	I	General input port 1, bit 0
36	DI11	I	General input port 1, bit 1
37	DI12	I	General input port 1, bit 2
38	DI13	I	General input port 1, bit 3
38	DI14	I	General input port 1, bit 4
40	—	—	(Connection disabled)
41	DO10	O	General output port 1, bit 0
42	DO11	O	General output port 1, bit 1
43	DO12	O	General output port 1, bit 2
44	DO13	O	General output port 1, bit 3
45	DO14	O	General output port 1, bit 4
46	DO15	O	General output port 1, bit 5
47	DO16	O	General output port 1, bit 6
48	DO17	O	General output port 1, bit 7
49	—	—	(Connection disabled)
50	FG	—	Frame ground

◉ CN7, Pin assignment and signal names (EXC21,EXC31)

Figure 9-16

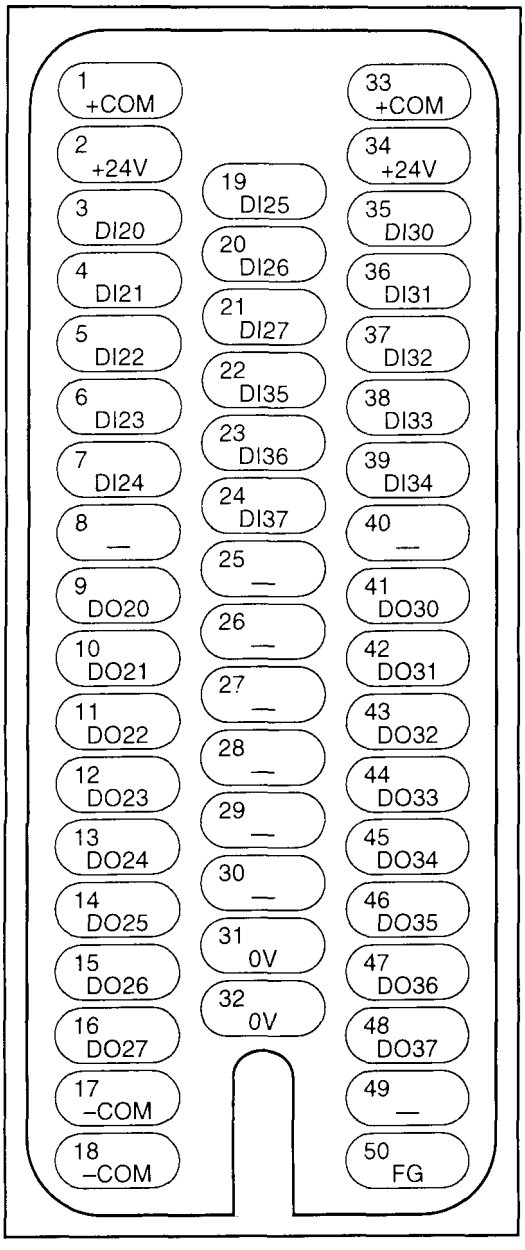
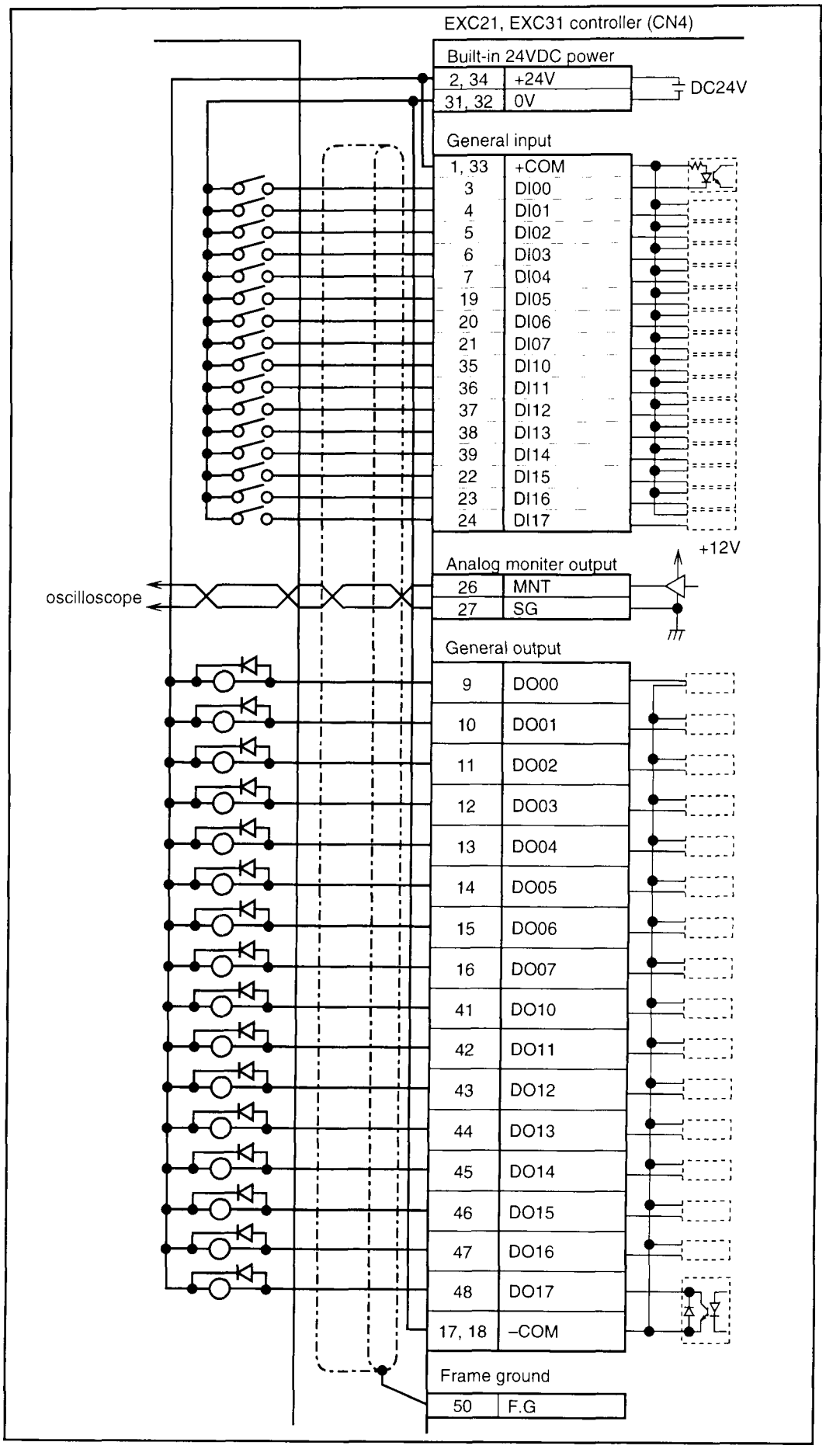


Table 9-15

Pin	Signal Name	I/O	Description
1	+COM	I	Common of input signals
2	+24VDC	O	+ output of built-in 24VDC power supply
3	DI20	I	General input port 2, bit 0
4	DI21	I	General input port 2, bit 1
5	DI22	I	General input port 2, bit 2
6	DI23	I	General input port 2, bit 3
7	DI24	I	General input port 2, bit 4
8	—	—	(Connection disabled)
9	DO20	O	General output port 2, bit 0
10	DO21	O	General output port 2, bit 1
11	DO22	O	General output port 2, bit 2
12	DO23	O	General output port 2, bit 3
13	DO24	O	General output port 2, bit 4
14	DO25	O	General output port 2, bit 5
15	DO26	O	General output port 2, bit 6
16	DO27	O	General output port 2, bit 7
17	–COM	O	Common of output signals
18	–COM	O	Common of output signals
19	DI25	I	General input port 2, bit 5
20	DI26	I	General input port 2, bit 6
21	DI27	I	General input port 2, bit 7
22	DI35	I	General input port 3, bit 5
23	DI36	I	General input port 3, bit 6
24	DI37	I	General input port 3, bit 7
25	—	—	(Connection disabled)
26	—	—	(Connection disabled)
27	—	—	(Connection disabled)
28	—	—	(Connection disabled)
29	—	—	(Connection disabled)
30	—	—	(Connection disabled)
31	0V	O	– output of built-in 24VDC power supply
32	0V	O	– output of built-in 24VDC power supply
33	+COM	I	Common of input signals
34	+24V	O	+ output of built-in 24VDC power supply
35	DI30	I	General input port 3, bit 0
36	DI31	I	General input port 3, bit 1
37	DI32	I	General input port 3, bit 2
38	DI33	I	General input port 3, bit 3
38	DI34	I	General input port 3, bit 4
40	—	—	(Connection disabled)
41	DO30	O	General output port 3, bit 0
42	DO31	O	General output port 3, bit 1
43	DO32	O	General output port 3, bit 2
44	DO33	O	General output port 3, bit 3
45	DO34	O	General output port 3, bit 4
46	DO35	O	General output port 3, bit 5
47	DO36	O	General output port 3, bit 6
48	DO37	O	General output port 3, bit 7
49	—	—	(Connection disabled)
50	FG	—	Frame ground

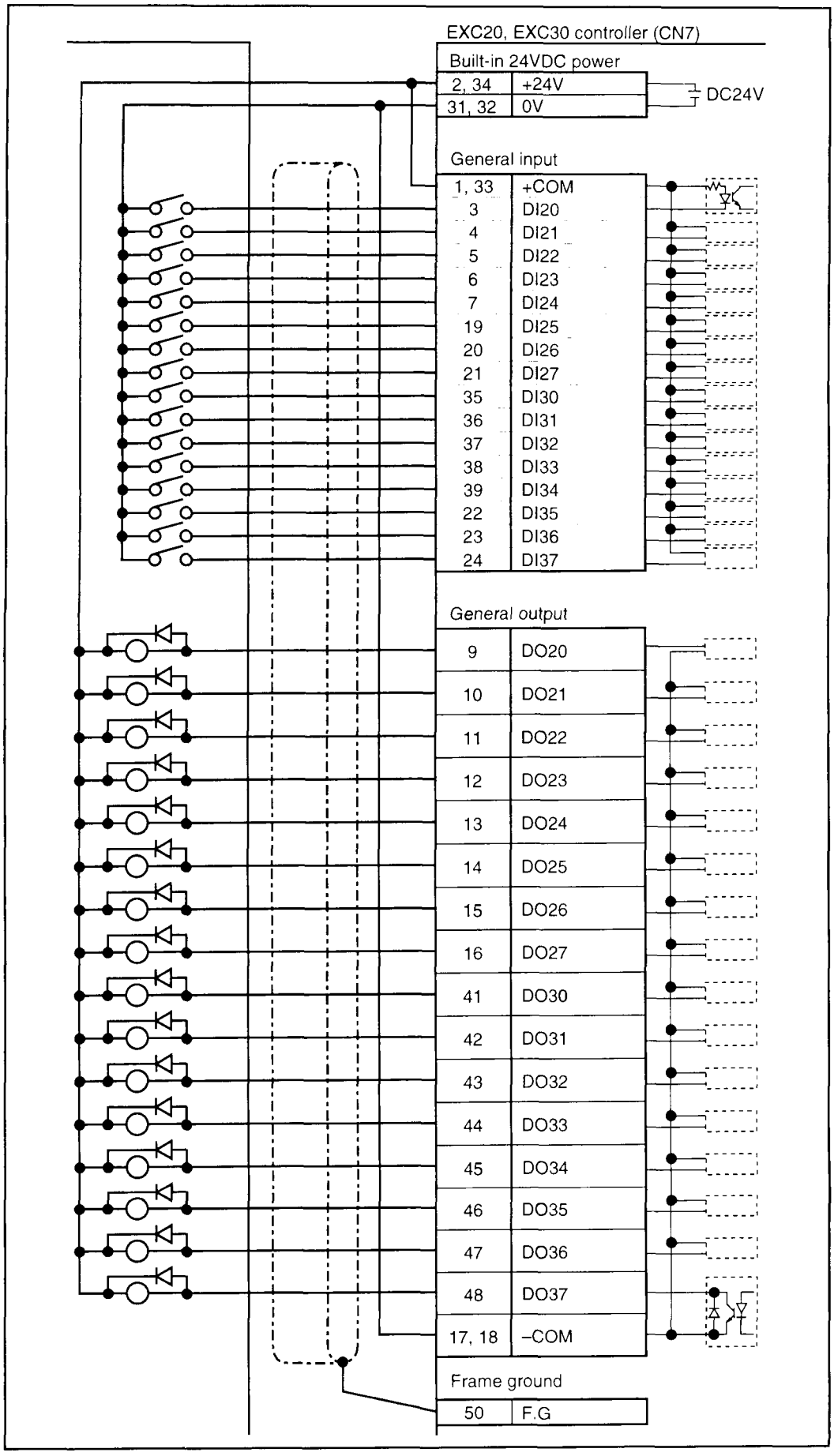
◉ CN4, Connection wiring (EXC21,EXC31)

Figure 9-17



◉ CN7, Connection wiring (EXC21,EXC31)

Figure 9-18



9.6. Power Terminal Block

9.6.1. Precautions for Wiring Power Terminal Block

- Secure the power capacity necessary for the controller.

Table 9-16

Motor output	100W	300W
Motor power capacity (for one axis)	0.33kVA	1kVA

Example: In case of the EXC30A331A00 (X-axis: 300 W, Y-axis: 300 W, Z-axis: 100 W)

300 W x 2 -> 2 kVA

100 W x 1 -> 0.33 kVA Therefore, 2.3 kVA are needed in total.

- Use a 1.25 square mm power cable for 1.5 kVA or less capacity. Use a 2 mm square or more power cable for 1.5 to 3 kVA capacity.

- The rack mount type EXC controller has no power switch. The user should prepare a power switch.
  ① The switch must have enough capacity for the controller power capacity and an inrush current.

(Danger) : *Connect the FG terminal (or PG terminal on the stand-alone type) to the ground securely. Improper grounding may cause electric shock, damages to the equipment or malfunctioning due to noises. For the grounding method, see "9.2.5. Grounding".*

(Danger) : *Tighten the screws of the power input terminals firmly. Do not leave them loose. After wiring, attach the terminal block cover (made of transparent plastic supplied on the terminal block) in order to prevent any personnels from touching the power terminals.*

(Caution) : *Improper source voltage may damage the motor. See "Figure 4-9 : Reference number of EXC Controller" to check the source voltage rating.*

Table 9-17: Power voltage specifications

Code on reference number	Specified voltage	Input voltage range	Affixed seal
A	AC200/220V	Single-phase AC180~AC242V	AC 200V
C	AC100/110V	Single-phase AC90~AC121V	AC 100V

(Caution) : *If it is necessary to provide the power line with a magnet switch or earth leakage breaker, add the inrush current flowing when turning on the power and leak current to the power capacity shown above. If the capacity is insufficient, the contacts may fuse.*

For the inrush current and leakage current, see "5.4.1. Controller Specifications".

- ○ Use a magnet switch having the current rating of 30 A or more.
- ○ Be sure to connect surge killers to the coils of the magnet switches, relays and solenoids.

- In order to keep out external noises, connect a noise filter between the power source and drive unit.

- Separate the primary side wire of the noise filter from the secondary side wire, and lay them in separate routes.

- Install the noise filter and driver unit as close to each other as possible. Do not connect a magnet switch or relay between them.

9.6.2. Power Line Wiring for Rack Mount Type

- Terminals and function (EXC20,EXC30)

Table 9-18

Terminal Symbol	Function
R	100/110VAC or 200/220VAC, single-phase power input terminals
T	
FG	Frame ground

- Connection wiring (EXC20,EXC30)

Figure 9-19

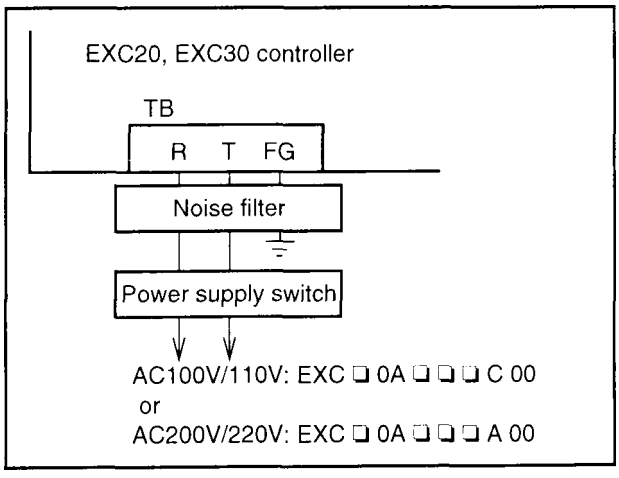
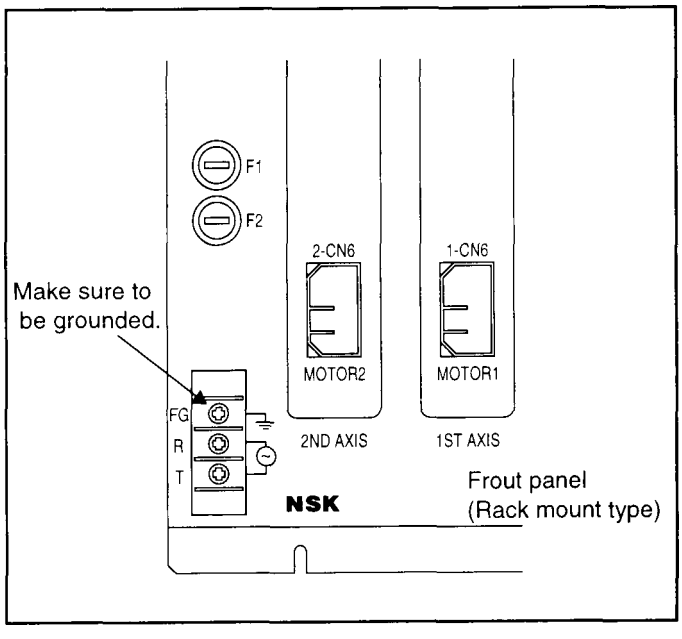


Figure 9-20



9.6.3. Power Line Wiring for Stand Alone Type

- Terminal symbol and function (EXC21,EXC31)

Table9-19

Terminal Symbol	Function
~	100/110VAC or 200/220VAC, single-phase power input terminals
FG	Frame ground

- Connection wiring (EXC21,EXC31)

Figure 9-21

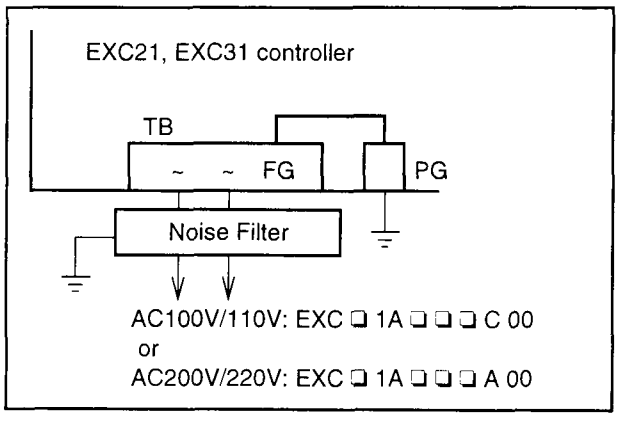
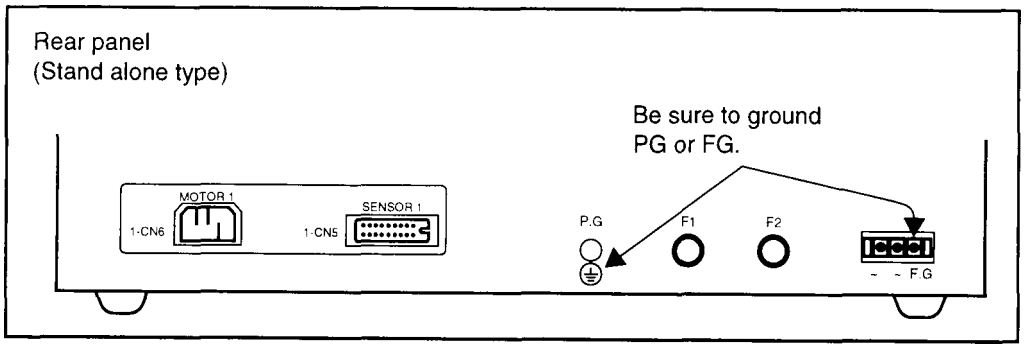


Figure 9-22



9.7. Connecting Controller Cables

- Connect the controller cable between the EXC controller and each module main unit.
- The indentical cables are used for the robot modules. Be sure to connect the cables properly.

Caution : *Improper cabling may cause burning of the motor or driver unit.*

(1) Before connecting cables

- EXC controller : The axis designation seals (X, Y and Z) are stuck on the connectors CN5 and CN6 for the controller cable.
- Controller cable : Be sure to afix the axis designation seals supplied in the package on both ends of the cable.
- Robot cables : Be sure to afix the axis designation seals supplied in the package on both ends of each cable.
- Module main unit : Be sure to afix the axis designation seals supplied in the package near the module connectors according to the axis configuration.
- Make sure again that the driver output capacity of the combined controller is the same as the motor output capacity of the module main unit.

  Example of mistake: The X-axis motor output capacity of the module main unit is 100 W though the X-axis driver output capacity of the controller is 300 W.

(2) On completion of the above work, connect the cables to the proper axes.

Example of mistake: Connecting the X-axis and Z-axis cables to the controller improperly

Caution : *Make sure that the voltage rating of the module main unit is the same as the voltage rating of the EXC controller. If they are not the same, the motor may be burnt.*

10. Start Up

10.1. Turning on Power

10.1.1. Preparation before Turning on Power

1) Check wiring between the controller and robot modules.

- Check the axis designation seals to see that the cables are connected properly.

2) Cancel the emergency stop.

- ○ Cancel the emergency stop of the connector CN2.
- ○ Reset the emergency stop switch (mushroom push-button) on the front panel. (Only the stand-alone type has the emergency stop switch.)

3) Prepare the 24 VDC power supply.

- Make sure that 24 VDC power is supplied to the rack mount type EXC controller.

4) Connect the teaching box.

5) Check for the safety.

Danger : Check if the joint bolts of the robot modules are screwed firmly.

- ○ Loose bolting may cause an unexpected accident resulting in injury or death when the robot begins to move.

Danger : Check if the vertical axis is secured by the brake.

- ○ If it is not secured, it may drop by its weight, causing an accident resulting in injury or death or damages to the robot or peripheral devices.

Danger : Do not allow any personnels in the moving range of the robot when starting operation or in adjustment or trial running.

- ○ Never enter the robot moving range not in the case of maintenance. Otherwise, a serious accident may occur.
- ○ In maintenance work, observe the instructions shown in "21. Troubleshooting".

Warning : Check if any cable is not connected or improperly connected.

- ○ If a cable is connected improperly, the system fails to demonstrate its full performances or the controller or motor may become defective. Check connection with great care.

Warning : Check if there is no obstacle in the stroke of each axis when the axis is moved to the stroke limit.

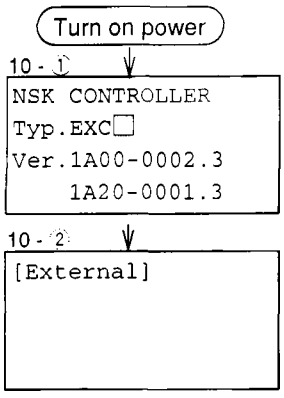
- ○ Mechanical interference causes damages to not only the robot but the peripheral devices.

10.1.2. Checking Points When Turning on Power

- Turn on the power.
  - ○ In the case of the stand-alone type EXC controller, turn on the power switch on the front panel of the controller.
  - ○ In the case of the rack mount type EXC controller, turn on the power switch prepared by the user.

- After turning on the power, make sure that "o" is displayed on the 7-segment LED indicator on the front panel of the EXC controller and the normal state is given on the teaching box display.

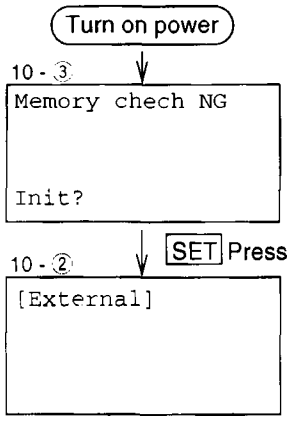
Teaching box display



: The system software version is displayed for approximately two seconds.

: After approximately two seconds, [External] is displayed.

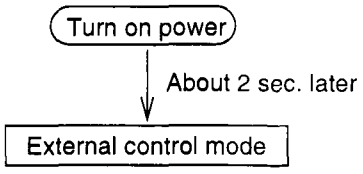
- If an alarm takes place, see "20. Alarms" and "21. Troubleshooting" and eliminate the alarm cause.
  - * If the backup memory data in the controller has been corrupted by noises or the like, the teaching box displays as shown below. In such a case, press the SET key on the teaching box. The memory data is deleted and the system starts up normally. Carry out programming and initial setting again.



Caution : *Initial setting not suitable to the specifications of the module main unit may result in malfunctioning. When the stored data is deleted, be sure to set data properly.*

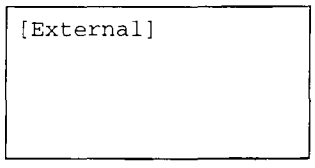
10.2. Operation Mode Selection

- If there is no error after turning on the power, the external control mode is automatically established.



  - ○ In the external control mode, all operations including starting and stopping are executed using the control I/O signals of the EXC controller (through CN2).
  - ○ This mode is always established when the power is turned on.
  - ○ In this mode, only the MODE and EMG keys on the teaching box are functional. (See "14.4. Operations in External Control Mode".)

Teaching box display



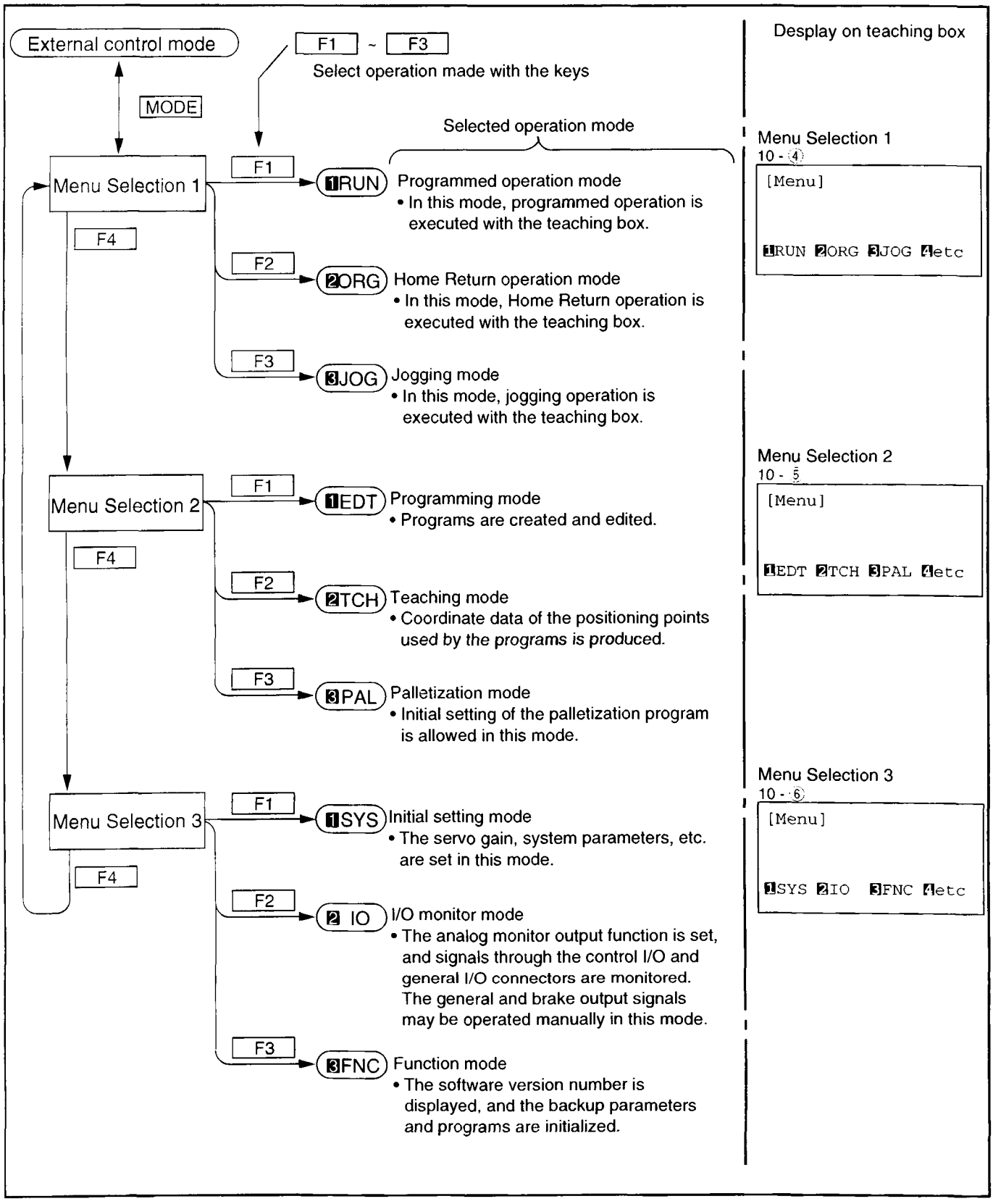
- To carry out initial setting, programming, or operations on the teaching box, press the MODE key to exit the external control mode.

Change the operation mode on the teaching box.

→ For the key operations on the teaching box, see "4.8. Teaching Box".

- When the [MODE] key is pressed in the external control mode, a menu appears. There are three menus, which are switched by pressing the [F4] key. To return to the external control mode, press the [MODE] key when the [menu] is displayed.
- The [F1], [F2] and [F3] keys are used to select operating mode such as initial setting, programming and operations which are shown on the selected [Menu] display.

Figure 10-1



11. Initial Setting

- Set the system parameters and servo parameters of the EXC controller according to the specifications of the module main units to be combined.
- Note that the system may malfunctions unexpectedly if the system parameters shown below are set improperly.

Table 11-1

Parameter	Item	Description	Factory Setting
Motor parameter MOT/ENC	ENC resolution	• Specify the resolution of each axis encoder.	100W AC servomotor: 1000 300W AC servo motor: 2000
	Ball screw lead	• Specify ball screw lead of each axis.	X axis: 20mm Y axis: 20mm Z axis: 10mm
MOT/JNT	Motor mount position *1(Joint)	• Specify the mount position of the motor. (Direct/Indirect)	All axes: Direct
Control parameter	Set the axis which has the brake.	• Specify the axis to which the brake signal being output	EXC20: Y axis EXC30: Z axis

Note *1: Motor mount position

Direct: The motor is coupled directly to the ball screw shaft. (A coupling is used.)

Indirect: Pullies are used to connect motor and ball screw shaft.

Caution : *(1) Be sure to set the encoder resolution, ball screw lead , motor mount position and brake axis according to the specifications of the module main units.*

Improper setting may result in unexpected motion or damages to the module main units.

(2) If a memory error occurs, the system parameters must be initialized. In such a case, set the system parameters according to the specifications of the module main units.

Table 11-2

Module	Motor Output	Encoder Resolution	Ball Screw Lead	Motor Mounting	Brake
H module	300W	2000	20mm	Direct	None
M module	300W	2000	20mm	Direct	None
S module	100W	1000	20mm	Indirect	None
S module vertical	100W	1000	10mm	Indirect	Yes.

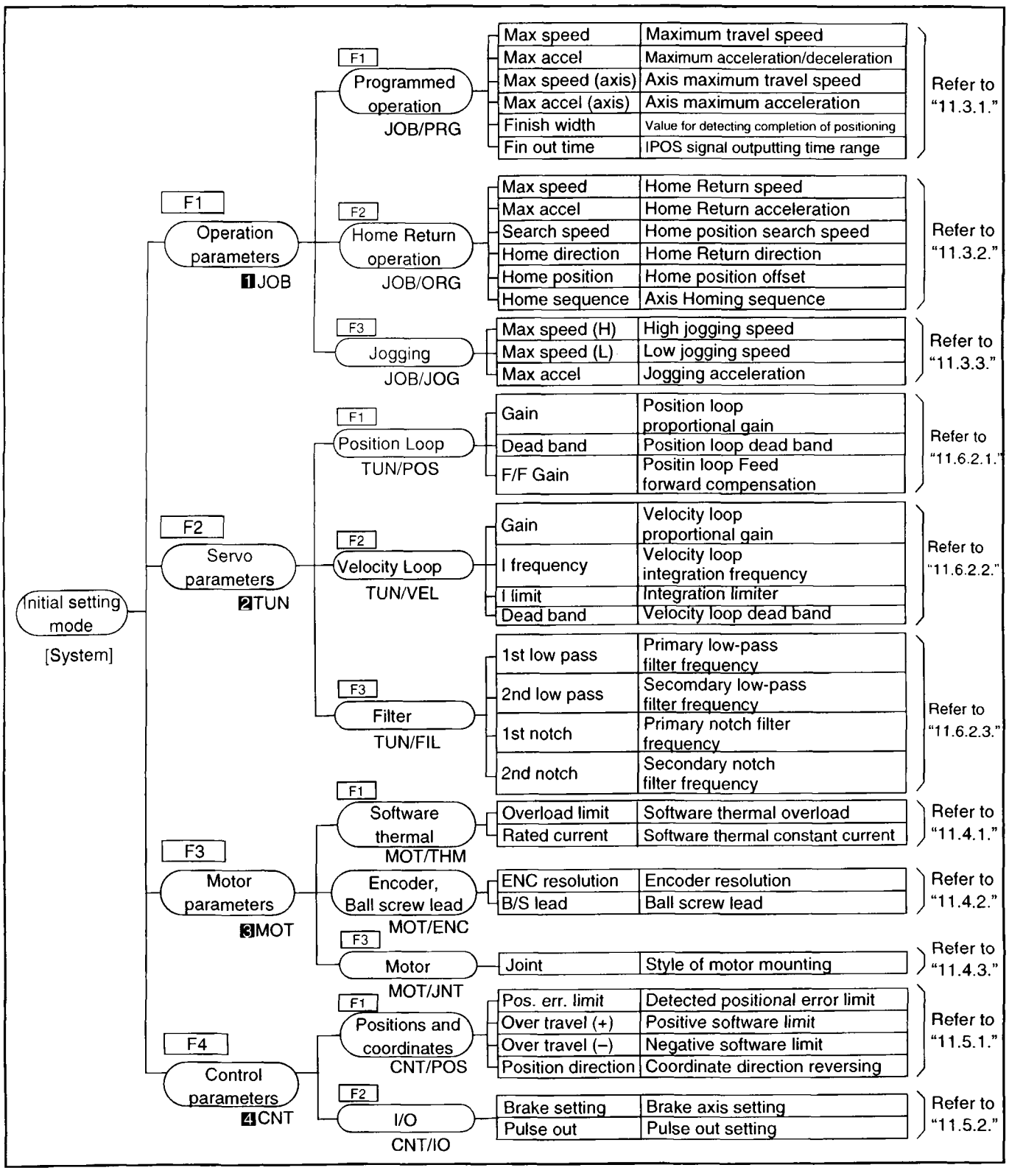
* As for the non-standard modules, see "5.2. Specifications of Optional Modules" and "5.3. Specifications of Modules for Clean Room".

* For a high speed module with ball screw lead of 40 mm, use 20 mm parameter setting in Table 11-1 as the maximum ball screw lead is set to 20 mm for EXC controller. In such a case, note that input data for stroke, speed and acceleration must be a half of actual values.

11.1. Initial Setting Procedures

- Select the initial setting mode on the teaching box, and carry out initial setting. (See "10.2. Operation Mode Selection".)
- The initial setting modes have the tree structure as shown in Figure 11-1. Select and set each item on the teaching box. For detailed setting procedures, see "11.3. Operation Parameters" and subsequent sections.

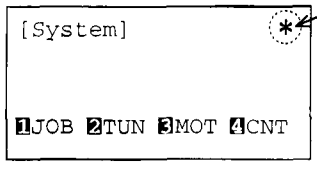
Figure 11-1



11.2. Initial Setting List

- Table 11-1 shows the factory settings of the system parameters and servo parameters.
- If the user changes the set values, it is recommended that the changed values be recorded in the spaces on the right. (Table 11-3)
- Once the parameters are set, they are stored in the memory even after the power is turned off. They are not changed unless new values are set or the values stored in the memory are deleted.

Caution : *Make sure that the servo is inactive while the system parameters are being set. Do not press the ON key on the teaching box.*



Make sure that this mark is not displayed. Then, carry out initial setting.

Caution : *The system parameters include the parameters for changing the coordinate system. On completion of initial setting, be sure to return the mechanisms to the Home position once. On completion of returning to the Home position, the initially set coordinate system goes effective.*

Caution : *If the memory is initialized, the parameters are cleared. Thus, reset them. In particular, remember to reset the parameters when the memory data is deleted due to a memory error when turning on the power.*

Table 11-3: Initial setting list

Item 1	Item 2	Item 3	Unit	Setting Range	Factory Setting	User Setting			
						X axis	Y axis	Z axis	R axis
Operations parameter (JOB)	Programmed operation (PRG)	Max speed	[mm/s]	0.1~1200	600				
		Max accel	[m/s²]	0.1~35	0.5				
		Max speed (axis)	[mm/s]	0.1~1200	600				
		Max accel (axis)	[m/s²]	0.1~35	0.5				
		Finish width	[mm]	0-9999.99	××××.××				
		Fin out time	[esc]	0-9999.99	××.××				
	Home return operation (ORG)	Max speed	[mm/s]	1~50	20				
		Max accel	[m/s²]	0.1~35	0.5				
		Search speed	[mm/s]	0.1~10.0	1.0				
		Home direction		0 or 1	0				
		Home position	[mm]	+/-9999.99	0				
		Home sequence		1,2,3,4	- - -				
	Jogging (JOG)	Max speed (L)	[mm/s]	0.1~1200	50				
		Max speed (H)	[mm/s]	0.1~1200	100				
		Max accel	[m/s²]	0.1~35	0.5				
Servo parameters (TUN)	Position loop (POS)	Gain		0.01~31.00	0.4				
		Dead band	[pulse]	0~4095	0				
		F/F Gain		0~1.00	0				
	Velocity loop (VEL)	Gain		0.1~255.0	15.0				
		I frequency	[Hz]	0.1~127.0	3.0				
		I limit	[%]	0~100.0	100.0				
		Dead band	[pulse]	0~4095	0				
	Filter (FIL)	1st low pass	[Hz]	10~400	×××				
		2nd low pass	[Hz]	10~400	×××				
		1st notch	[Hz]	10~400	×××				
		2nd notch	[Hz]	10~400	×××				
Motor Parameters (MOT)	Software thermal (THM)	Over load limit	[%]	0~100	23 or 28				
		Ratde current	[%]	0~100	33				
	Encoder, Ball screw lead(ENC)	ENC resolution	[div]	1000,2000	1000 or 2000				
		B/S lead	[mm]	5,10,20	20				
	Motor coupling(JNT)	Joint		0 or 1	0				
Control parameters (CNT)	Positions and coordinates (POS)	Pos.err.limit	[mm]	+/-9999.99	××××.××				
		Over travel (+)	[mm]	+/-9999.99	××××.××				
		Over travel (-)	[mm]	+/-9999.99	××××.××				
		Pos. direction		0,1	0				
	I/O (IO)	Brake setting		0,1	0				
		Pulse out		0,1	0				

11.3. Operation Parameters

- There are three types of operation parameters:
  1. Programmed operation parameters.
  2. Home Return operation parameters.
  3. Jogging.

11.3.1. Programmed Operation Parameters

11.3.1.1. List of Programmed Operation Parameters

Table 11-4

Item	Description	Units	Setting Rang	Factory Setting
Max speed *	• Specifies the maximum resultant speed of the axes in programmed operation.	mm/s	0.1 ~ 1200.0	600.0
Max accel **	• Specifies the maximum resultant acceleration of the axes in programmed operation.	m/s^2	0.1 ~ 35.0	0.5
Max speed (axis) *	• Specifies the maximum speed of each axis. • The upper limit speed can be specified for each axis if it is necessary independently from the Max speed (maximum resultant speed) shown above. • The lower one of Max speed and Max speed (axis) is valid.	mm/s	0.1 ~ 1200.0	1200.0
Max accel (axis) **	• Set Max speed (axis) to 1200 mm/s normally. • Like Max speed (axis) shown above, the maximum acceleration can be specified if it is necessary independently from the maximum resultant acceleration/deceleration. • The lower one of Max accel and Max accel (axis) is valid.	m/s^2	0.1 ~ 35.0	35.0
Finish width ***	• Specifies the value for detecting completion of positioning. • The IPOS output (CN2) is closed when a detected value falls below this set value. • The IPOS signal is output when pulse distribution is complete, if ××××.×× is specified.	mm	0.00 to 9999.99 or ××××.××	××××.××
Fin out time ***	• Specifies the time range where the IPOS output (CN2) is closed. • ××××.××indicates infinite time range, i.e., the IPOS signal remains closed until operation starts for the next time.	second	0.00 to 99.99 or ××××.××	0.1

Note * Refer to "11.3.1.2. Travel Speed in Programmed Operation".

** Refer to "11.3.1.3. Acceleration and Deceleration in Programmed Operation".

*** Refer to "14.5.2. In Position Signal Output".

11.3.1.2. Travel Speed in Programmed Operation

- Specify the traveling speed in programmed operation as an axial resultant speed (i.e., linear interpolation traveling speed or circular interpolation traveling speed) using the programmed operation parameter "Max speed".

- If a VEL (velocity regulation) command is specified in programmed operation, the traveling speed is found as shown below.

$$\underset{[mm/s]}{\text{Travel speed (Axes resultant speed)}} = \underset{[mm/s]}{\text{"Max speed" setting}} \times \underset{[\%]}{\text{VEL command setting}} \times \frac{1}{100}$$

Caution : *The actual maximum speed is restricted by the lead of the ball screw of the module main unit as shown below:*

- ○ Ball screw lead of 20 mm : Maximum speed is 1200 mm/s.
- ○ Ball screw lead of 10 mm : Maximum speed is 600 mm/s.

* For the lead of the ball screw of the module main unit, see "5.1. Specifications of Standard Modules", "5.2. Specifications of Optional Modules" and "5.3. Specifications of Clean Room Modules".

- If a main unit with 10 mm ball screw lead is used, the controller automatically regulates the axial resultant speed so that the speed of that axis does not exceed 600 mm/s.

- Therefore, the moving speed may be 1200 mm/s or less in some cases even if the "Max speed" parameter is set to 1200 mm/s.

  → Once the "Max speed" parameter is set to 1200 mm/s, the controller takes account of the restricted speed of each axis and finds the maximum resultant speed. Thus, the robot module system is capable of traveling at maximum resultant traveling speed.

Caution : *If a long stroke module (1200 mm or more) is used, the maximum speed must be restricted to avoid natural vibrations of the ball screw.*

Example: If the stroke is 1400 mm, the maximum allowable speed is 540 mm/s. (Ball screw lead: 20 mm)

- In such a case, use the "Max speed (axis)" parameter to set the allowable speed of each axis. (Set "Max speed (axis)" to 540 mm/s in the above example.) The controller restricts the axial resultant speed so that the allowable speed of each axis is not exceeded.

  → As for the allowable speed for a long stroke over 1200 mm, contact us.

Caution : *"Max speed" can be set down to 0.1 m/s. However, too low speed increases velocity ripples and accordingly disables smooth motion.*

Table 11-5: Velocity ripple reference data (Not the guaranteed values)

Motor Revolution Speed	Velocity Ripple (reference data)
Maximum revolution speed *	1%
Maximum revolution speed *×10%	5%
Maximum revolution speed *×1%	30%

* Maximum speed: 1200 mm/s (When ball screw lead is 20mm)

11.3.1.3. Acceleration and Deceleration in Programmed Operation

- The acceleration and deceleration in programmed operation is set as the axial resultant acceleration and deceleration using the programmed operation parameter "Max accel".
- If an ACC (acceleration and deceleration restriction) command is set in the program, the acceleration and deceleration are found as shown below.

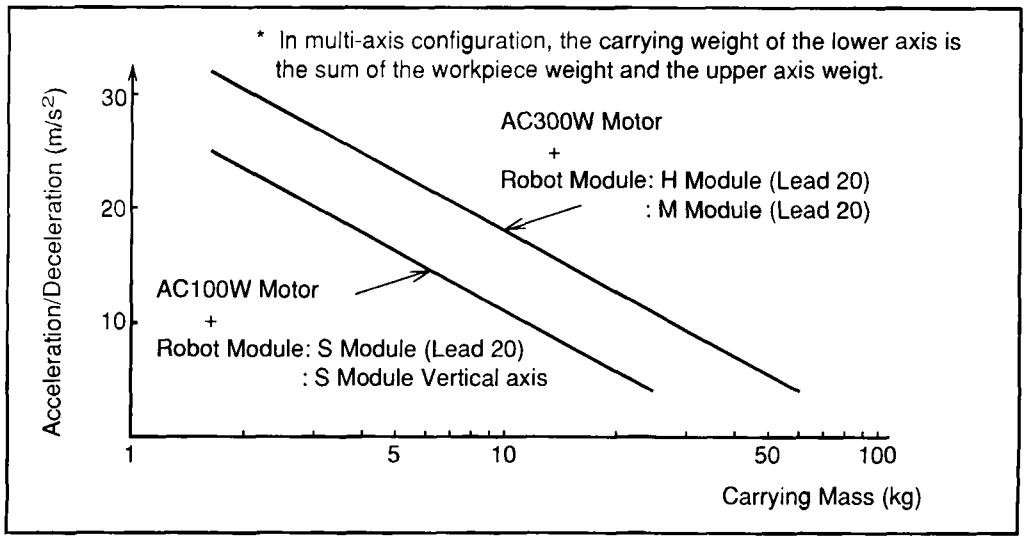
Travel acceleration/deceleration (axes resultant acceleration/deceleration)	=	"Max speed" setting	×	ACC command setting	×	$\frac{1}{100}$
[m/s^2]		[m/s^2]		[%]		

Cautions : (1) If "Max accel (axis)" is set, the controller regulates the resultant acceleration and deceleration so that the set "Max accel (axis)" value is not exceeded in the same manner as described about the traveling speed above.

* See "11.3.1.2. Travel Speed in Programmed Operation" above.

(2) If the load weight is large or the combined modules have insufficient rigidity, excessive acceleration and deceleration may result in overshoot or vibrations. Figure 11-2 below shows the allowable maximum acceleration and deceleration when the module is used independently. Find the allowable maximum acceleration and deceleration of each axis, and set "Max speed" to the minimum value.

Figure 11-2



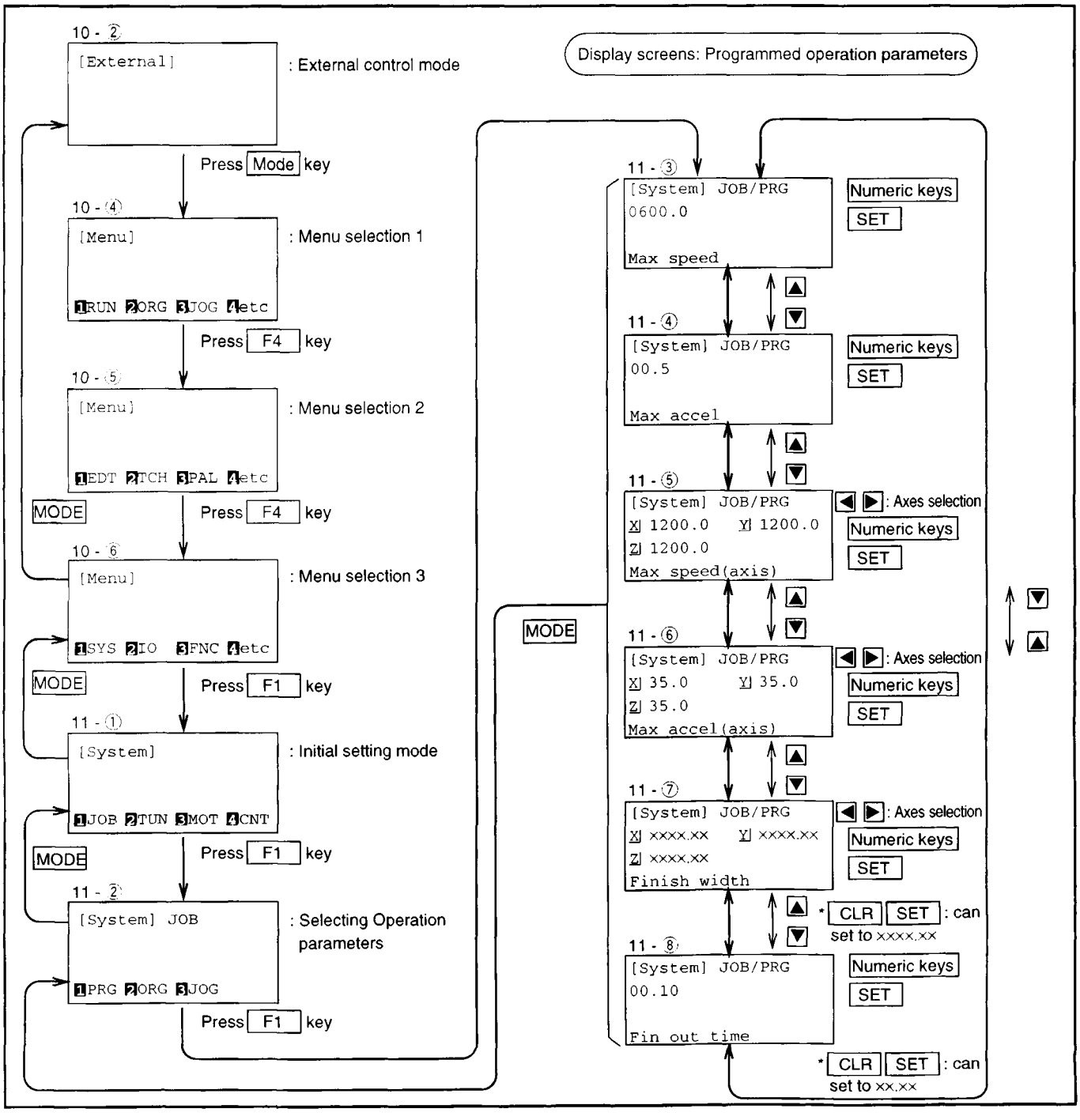
(3) If excessive acceleration and deceleration is specified, the moment rigidity of the module main unit is exceeded and the module may be damaged, depending on the combination of modules. See "5.1.1. Transportable Moment Load".

If the acceleration and deceleration should be less than the allowable maximum value of each axis shown in Caution (2) above, set the smaller value.

11.3.1.4. Setting Procedure for Programmed Operation

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting" mode.
- Referring to "11.1. Initial Setting" set to "Parameter Setting for Programmed Operation" mode through "Initial Setting" → "Operation Parameters" → "Programmed Operation Parameters". In this mode, the parameters for programmed operation can be set.
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with the ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.
- When setting "Finish width" or "Fin out time", pressing the CLR key changes setting values to ××××.×× or ××.××.

Figure 11-3



11.3.2. Parameters for Home Return

11.3.2.1. Parameters List for Home Return

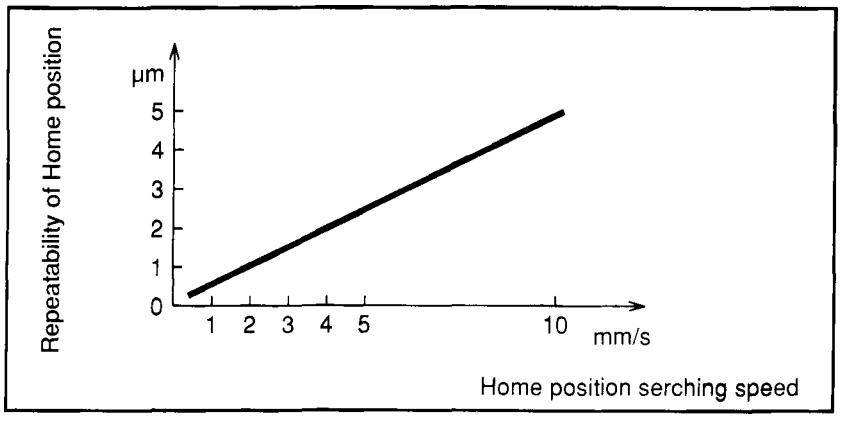
- Refer to "14.5.1. Home Return Operation" for more details.

Table 11-6

Item	Description	Units	Setting Ranges	Factory Settings
Max speed	• Specifies the speed of Home Return.	mm/s	0.1 ~ 50.0	20
Max accel	• Specifies the acceleration of Home Return speed.	m/s^2	0.1 ~ 35.0	0.5
Search speed	• Specifies searching speed of Home position.	mm/s	0.1 ~ 10.0	1.0
Home direction	• Specifies the direction of Home Return. 0: Toward the motor 1: Opposite to the motor	—	0, 1	0
Home position	• Specifies the offset of the home position.	mm	-9999.99 ~9999.99	0
Home sequence	• Specifies the order of axes performing Home Return. Homing will begin with the axis labeled "1" and continue in ascending order. If axes are set with the same value, the axes will home in the sequence R, Z, Y and X.	—	1 ~ 3	EXC2: X=2, Y=1 EXC3: X=3, Y=2, Z=1

Caution : Repeatability of Home position is worsened when home position search speed is increased. Set "search speed" taking into consideration of required system accuracy.

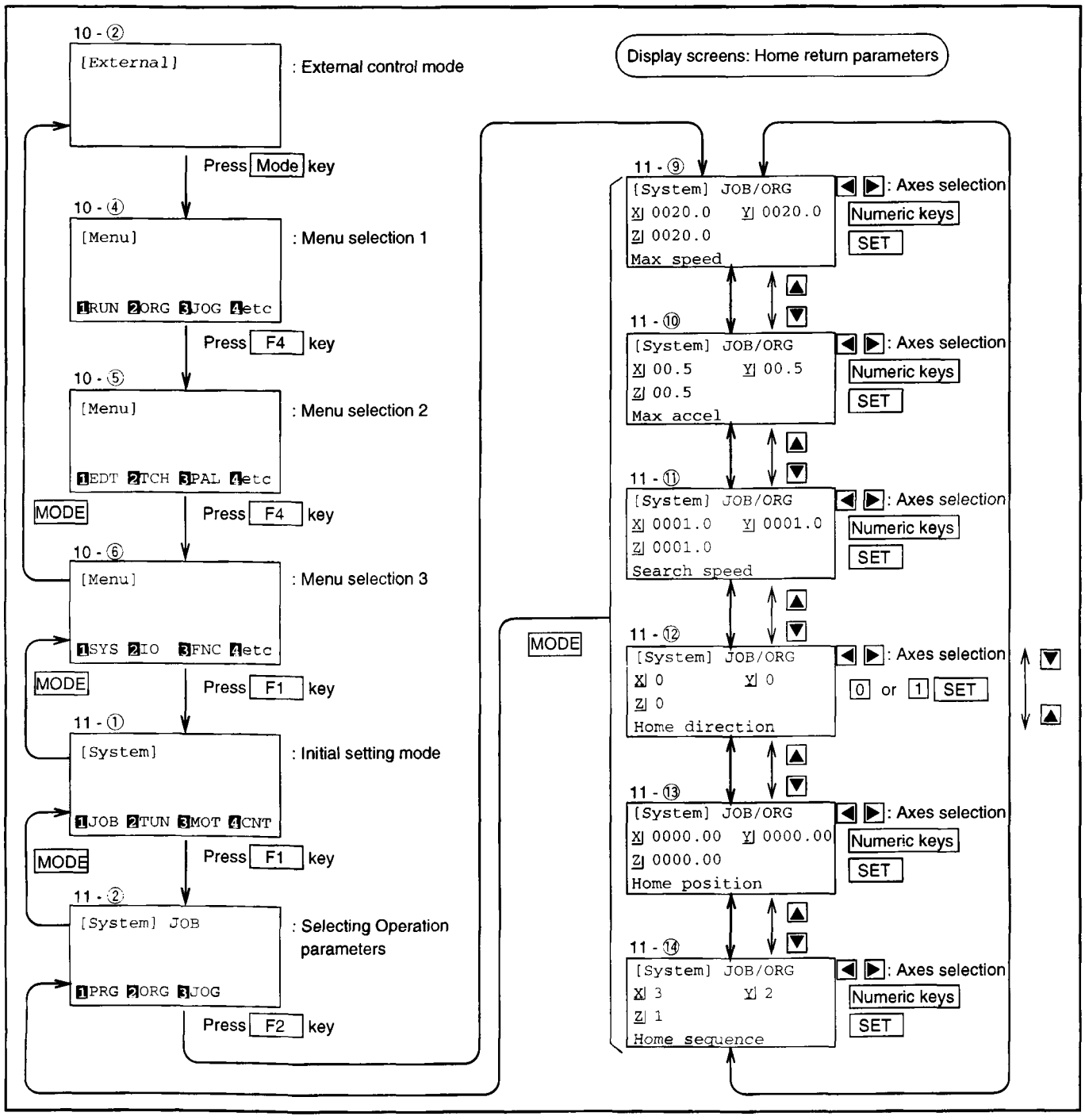
Figure 11-4



11.3.2.2. Setting Procedures for Home Return

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting" mode.
- Referring "11.1. Initial Setting", set to "Home Return Parameters" through "Initial Setting" → [F1] "Operation Parameters" → [F2] "Home Return Parameters".
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

Figure 11-5



11.3.3. Jogging Parameters

11.3.3.1. Jogging Parameter List

- Refer to "14.3.2. Jogging" for more details.

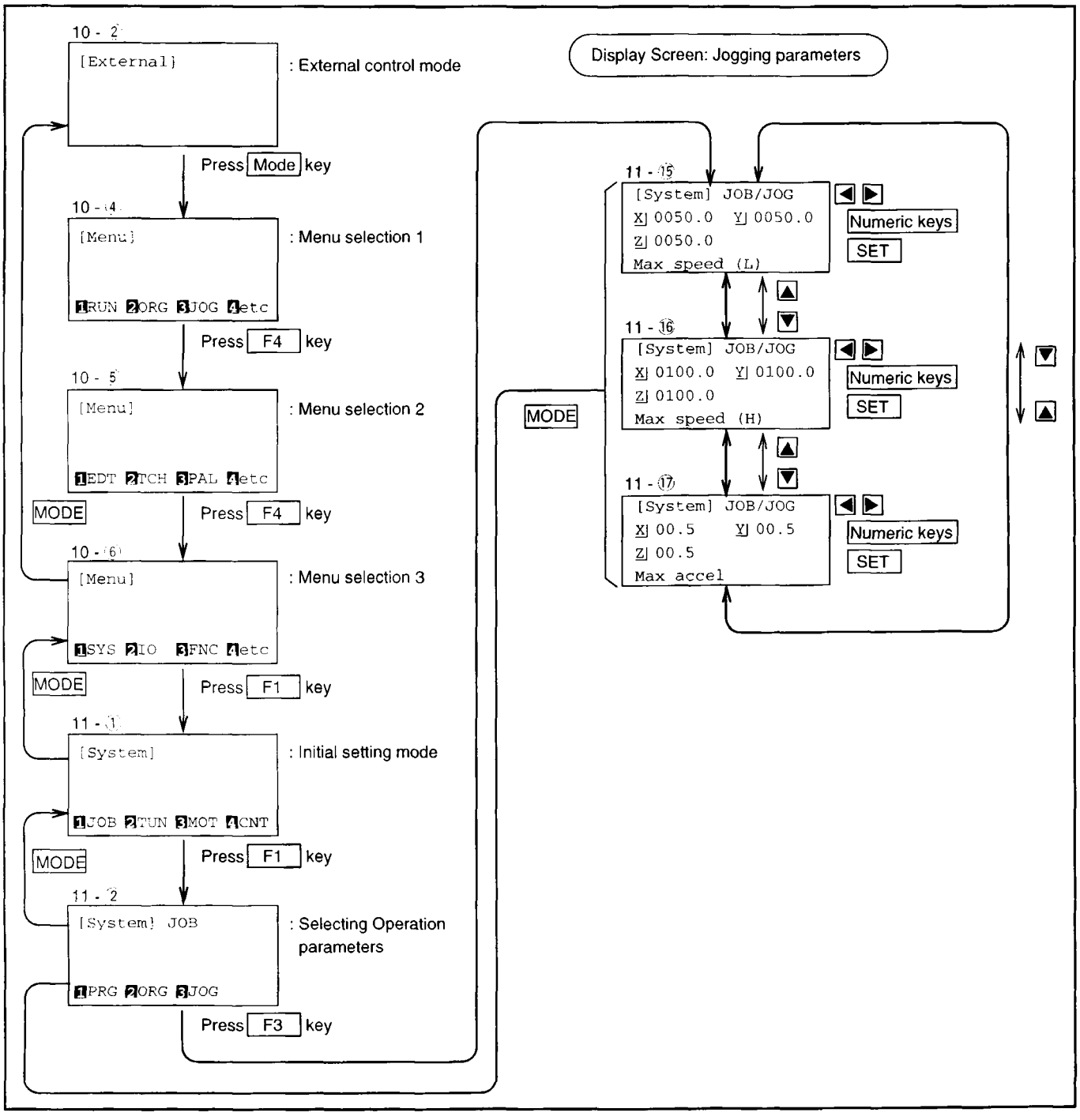
Table 11-7

Item	Description	Units	Setting Range	Factory Setting
Max speed (L)	• Specifies the jogging speed.	mm/s	0.1 ~ 1200.0	50
Max speed (H)	• Specifies the jogging speed when a jog key and the HIGH key are pressed simultaneously.	mm/s	0.1 ~ 1200.0	100
Max accel	• Specifies the jog acceleration/deceleration.	m/s^2	0.1 ~ 35.0	0.5

11.3.3.2. Setting Procedure.

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting" mode.
- Referring to "11.1. Initial Setting", set to "Jog" mode display screen through "Initial Setting" $\xrightarrow{F1}$ "Operation Parameters" $\xrightarrow{F3}$ "Jogging".
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

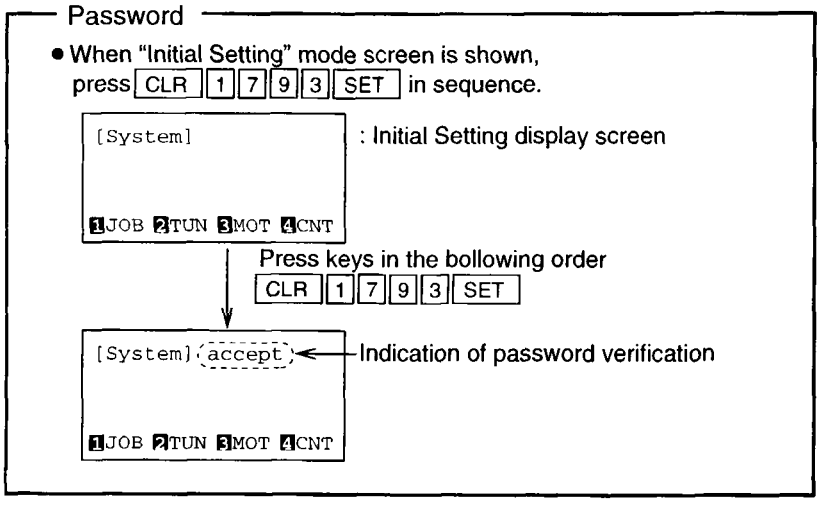
Figure 11-6



11.4. Motor Parameters

- There are three motor parameter settings as shown below:
  - 1 Software thermal
  - 2 Encoder
  - 3 Motor

- The password should be input to specify the motor parameters.



11.4.1. Software Thermal

- The software thermal function means the software function which checks if the motor does not run over the rating to prevent the motor from being burnt due to over-rating.

- The motor rating is specified. If the set value is exceeded, the software gives a thermal alarm and stops the motor.

- The software thermal value is set properly before shipment. If the memory data is deleted, it should be set again. See Table 11-8 and set it properly.

Table 11-8

Item	100W AC motor		300W AC motor	
RC	33	• S module	33	• H module
OL	23	• S module vertical axis	28	• M module

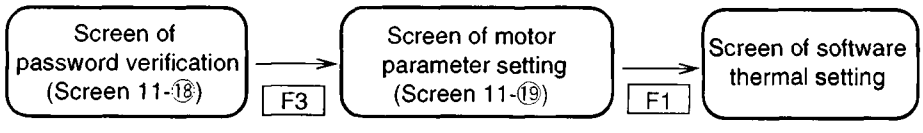
* If the memory data is deleted, the motor parameter of each axis is set to 100W AC.

11.4.1.1. Software Thermal Value Setting Procedures

- See "10.2. Operation Mode Selection" set to "Initial Setting" mode.

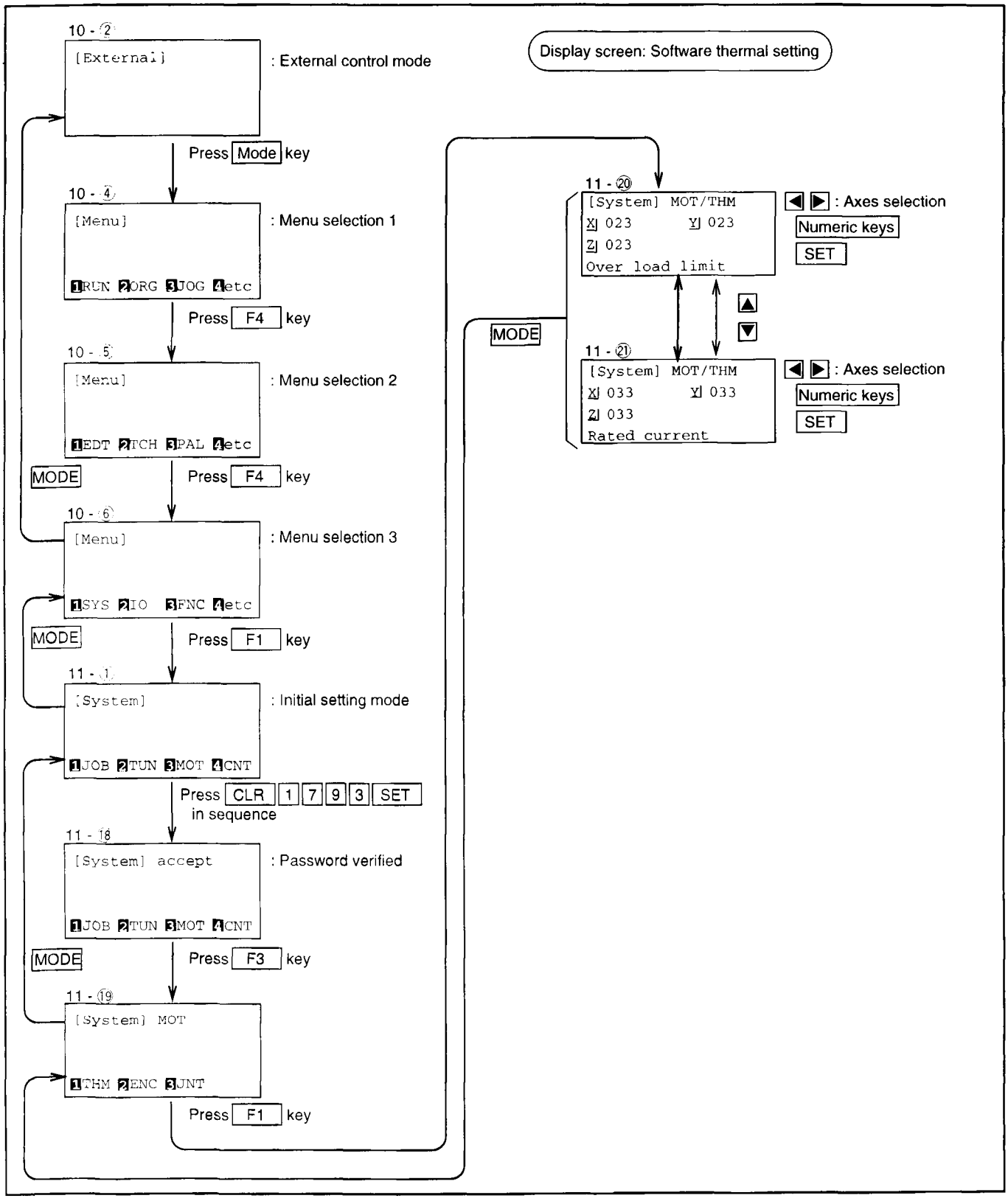
- When the screen 11- ① is shown, press the CLR, 1, 7, 9, 3 and SET keys in sequence. The screen 11- ⑧ appears, and the software thermal value can be specified.

- On the screen where the password is accepted, press the F3 and F1 keys to open the software thermal value setting screen.



- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

Figure 11-7



11.4.2. Encoder and Ball Screw Lead Parameter

11.4.2.1. Parameter List

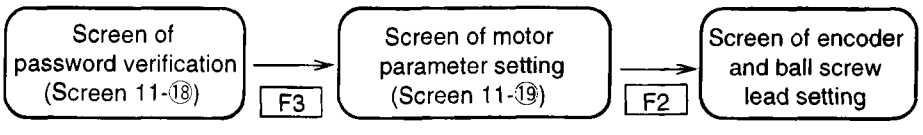
Table 11-9

Item	Description	Units	Setting Range	Factory Setting
ENC resolution	• Specifies the resolution of each axis encoder. • The standard type EXC controller has following settings: Built-in driver capacity 300W AC motored axis: 2000 Other axes: 1000	counts/rev.	1000 or 2000	AC300W: 2000 AC100W: 1000
B/S lead	• Specify the ball screw lead of each axis.	mm	5, 10, 20	20

Caution : When the resolution of encorder and ball screw lead are not properly set to the module main unit, the system (or a module main unit) does not operate as programmed.

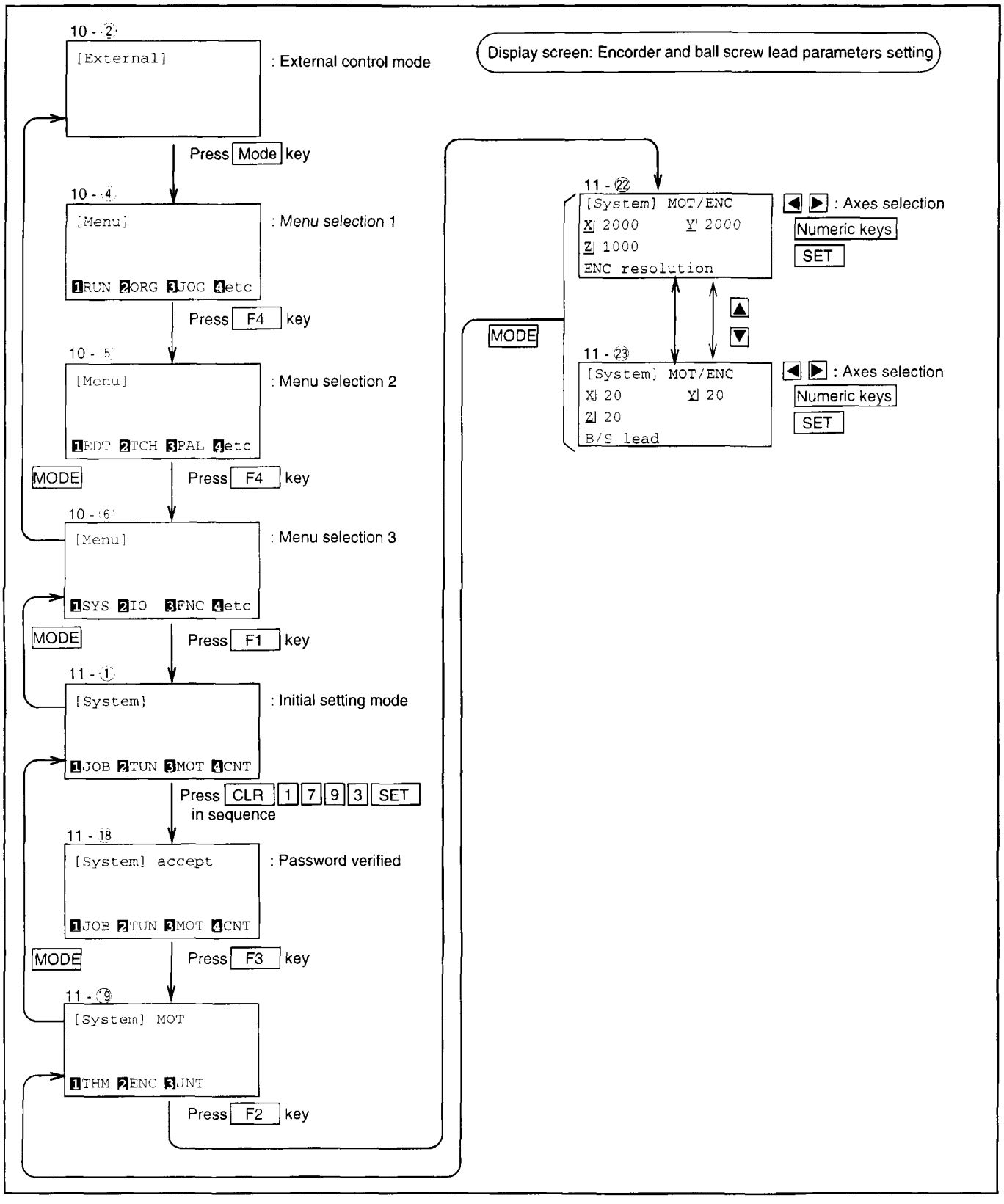
11.4.2.2. Setting Procedures

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting" mode.
- The password should be input to specify the encoder and ball screw lead parameters.
- When the screen 11- ① is shown, press the CLR, 1, 7, 9, 3 and SET keys in sequence.
- When the screen 11-⑱ accepted, press the F1 and F2 keys to set the encorder and ball screw lead setting screen.



- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

Figure 11-8



11.4.3. Motor Mounting Parameters

11.4.3.1. Parameters List

Table 11-10

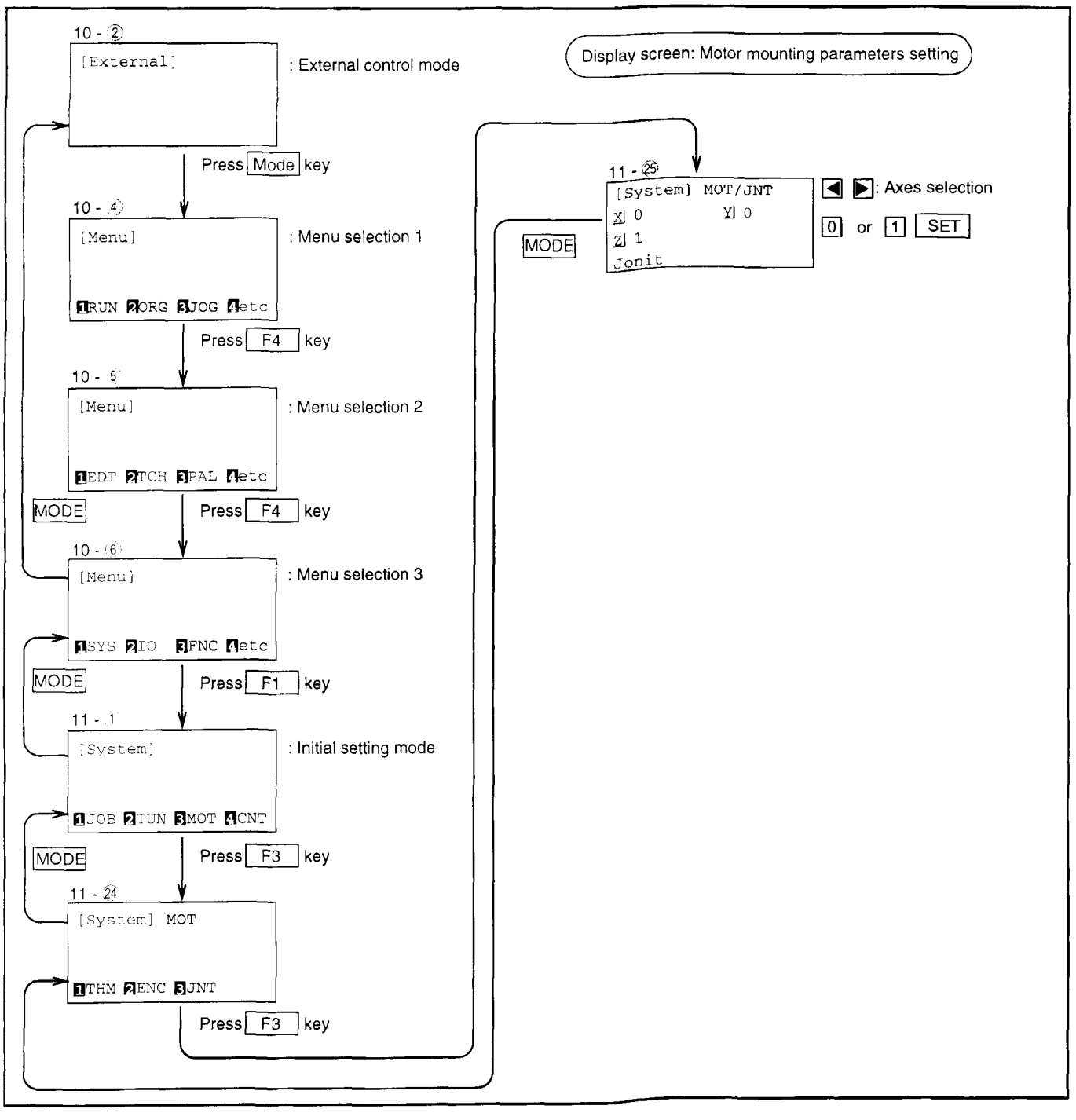
Item	Description	Units	Setting Range	Factory Setting
Joint	• Specify the direction of mounting the motor of each axis. 0: Direct 1: Indirect	—	0, 1	0

(Caution) : If the joint setting is not properly set for a given module main unit, the direction of Home Return and coordinates are reversed.

11.4.3.2. Setting Procedures

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting" mode.
- Referring to "11.1. Initial Setting", set the setting screen of motor mounting parameters through "Initial Setting" → "Motor Parameter" → "Mounting".
  [F3] [F3]
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

Figure 11-9



11.5. Control Parameters

- There are Two Parameters for the control parameters:
  1. Position and coordinate
  2. Input / Output

11.5.1. Position and Coordinate Parameters

11.5.1.1. List of Parameters

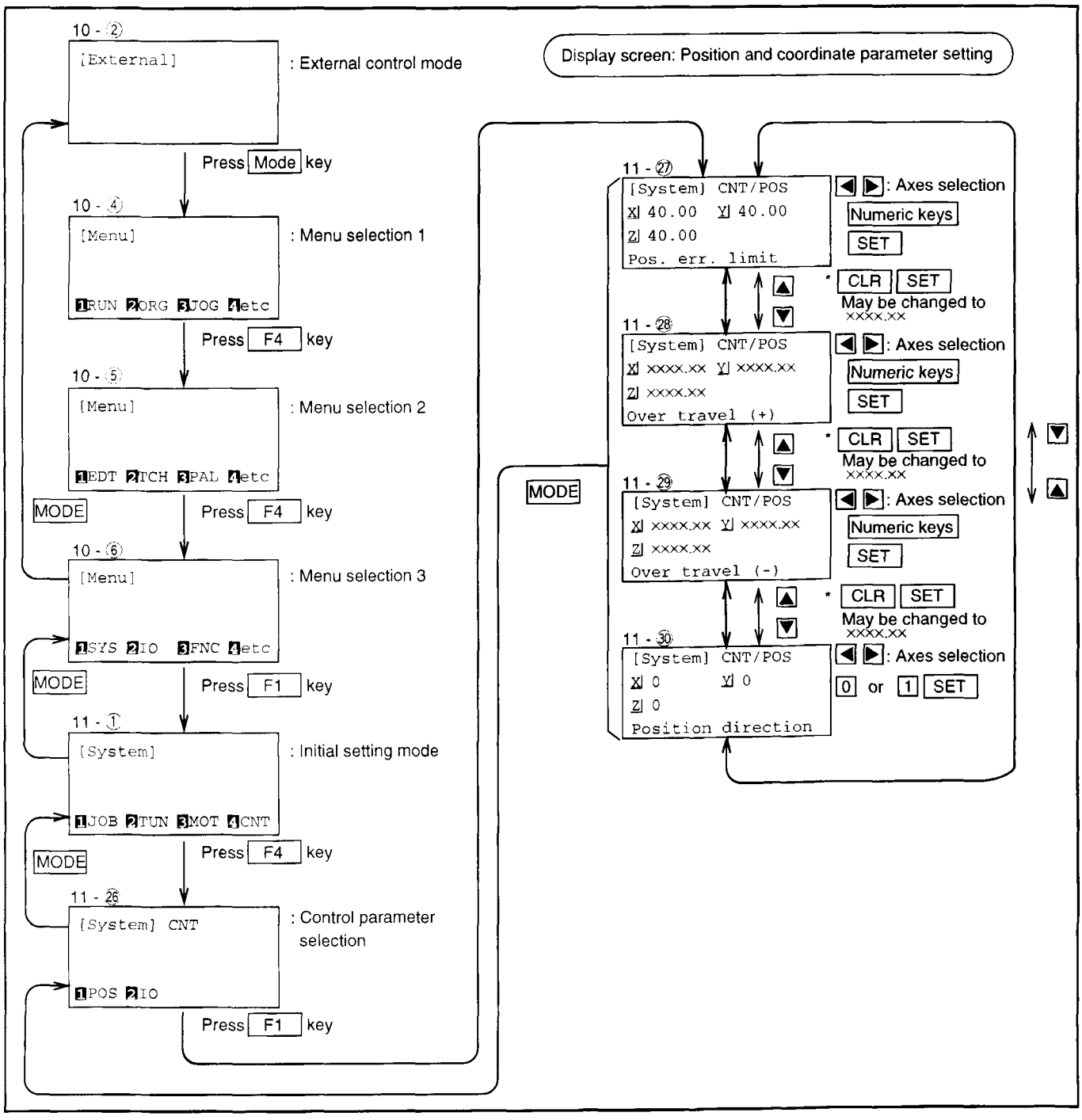
Table 11-11

Item	Description	Units	Setting Range	Factory Setting
Pos.err.limit	• Specifies the value for detecting a position error limit. • For detection of a position error limit, see " 18.3.4. Excessive Position Error Detection". • If xxxx.xx is specified, no position error is detected.	mm	0 to 9999.99 or xxxx.xx	40.00
Over travel (+) Over travel (–)	• Over travel (+): Specifies the software over travel value in the positive direction. • Over travel (–): Specifies the software over travel value in the negative direction. • See "18.3.3. Over Travel Detection". • If xxxx.xx is specified, no over travel is detected.	mm	0 to 9999.99 or xxxx.xx	xxxx.xx
Position direction	• Specifies the positive or negative direction of coordinates of each axis. 0: The direction opposite from the motor is the positive direction. 1: The direction toward the motor is the positive direction.	—	0 or 1	0

11.5.1.2. Setting Procedures

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting" mode.
- Referring to "11.1. Initial Setting", set the display screen for position and coordinate parameter setting through "Initial Setting" → "Control Parameter" (F4) → "Position and Coordinate" (F1).
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.
- When setting "Pos err limit" and "Over travel", numeric value indication may be changed to ××××.×× with pressing CLR key.

Figure 11-10



11.5.2. Input and Output Parameters

11.5.2.1. Parameters List

Table 11-12

Item	Description	Units	Setting Range	Factory Setting
Brake setting	• Specifies the braked axis. 0: Axis not braked 1: Braked axis * Only one axis may be braked. Select one axis.	—	0 or 1	EXC2:X=0 Y=1 EXC3:X=0 Y=0 Z=1
Pulse out	• Specifies to use pulse out function or not. 0: Default 1: Pulse out	—	0 or 1	0

(Danger) : *A vertical axis must be specified to use the brake. If it is not specified, the slider of vertical axis (or mojule main unit for a moving a moving axis configuration).*

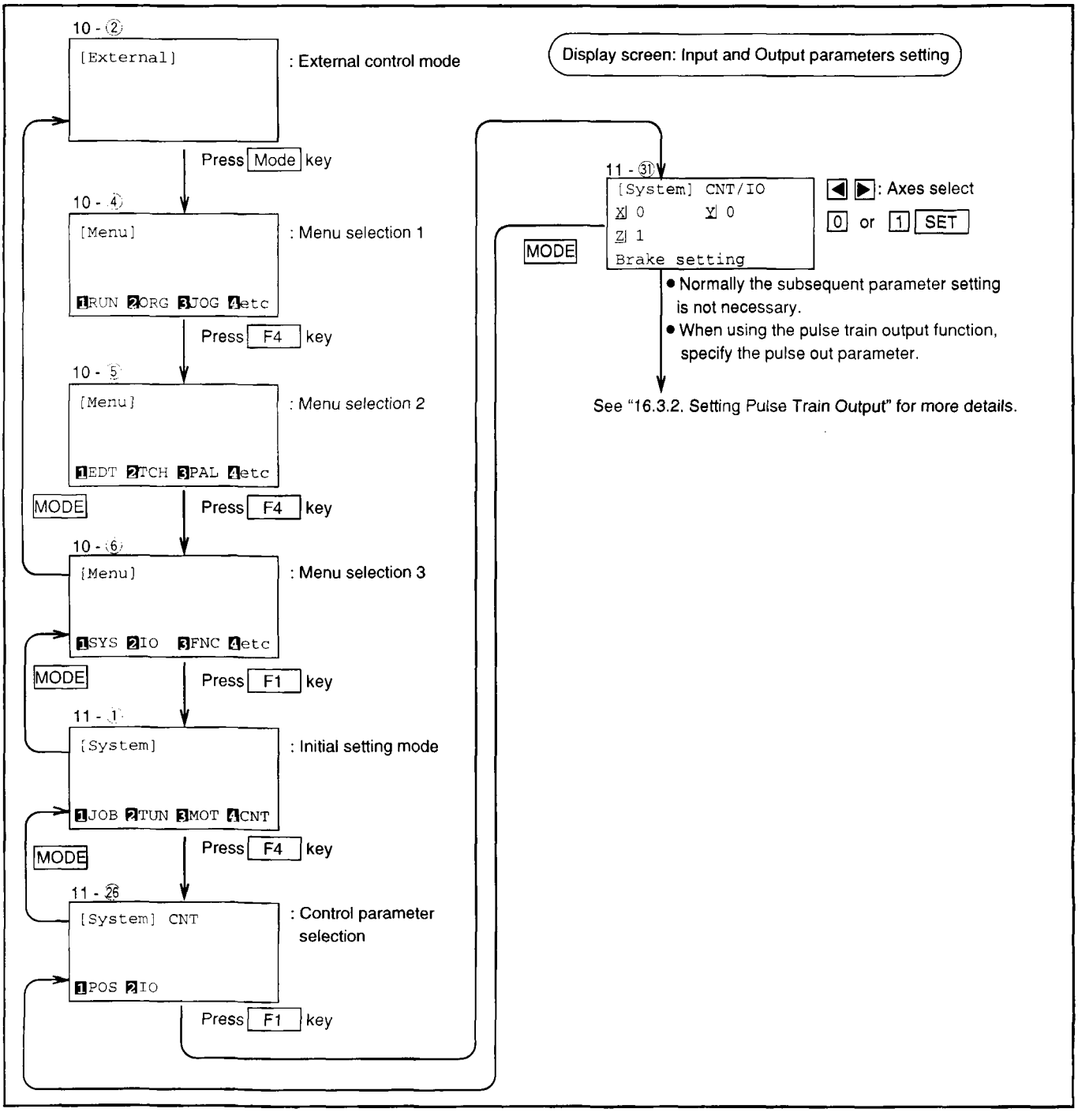
(Caution) : *If the pulse train output function is not used, the parameter must be always 0. If the parameter is set to 1 without completing the wiring related to the pulse train output function, an alarm may be activated.*

* Refer to "16. Pulse Train Output Function" for the pulse train output.

11.5.2.2. Parameters Setting Procedures

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting" mode.
- Referring "11.1. Initial Setting", set the display screen for the input and output parameter setting through "Initial Setting" → "Control Parameter" [F4] → "Input and Output Parameter" [F2].
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

Figure 11-11



11.6. Servo Parameters

- Specify the servo gain, filter and other adjustment parameters of the EXC controller.
- The servo parameters have been set to the normal value before shipment. Thus, they need not be adjusted normally.

* If the factory setting does not provide sufficient performances or causes noises or vibrations, see "11.6.1. Adjustment" and adjust the servo parameters.

11.6.1. Adjustment

- Be sure to check for the safety around the system, then start adjustment. If the gain is set unsuitably to the system, hunting (much vibrations) may be produced. Thus, be very careful.

(Danger) : Check if the joint bolts of the robot modules are screwed firmly.

○ Loose bolting may cause an unexpected accident resulting in a serious injury when the robot begins to move.

(Danger) : Do not allow any personnels in the moving range of the robot.

○ Never enter the robot moving range. Otherwise, a serious accident may occur.

(Warning) : Check if any cable is not connected or improperly connected.

○ If a cable is connected improperly, the system fails to demonstrate its full performances or the controller or motor may become defective. Check connection with great care.

(Warning) : Check if there is no obstacle in the stroke of each axis when the axis is moved to the stroke limit.

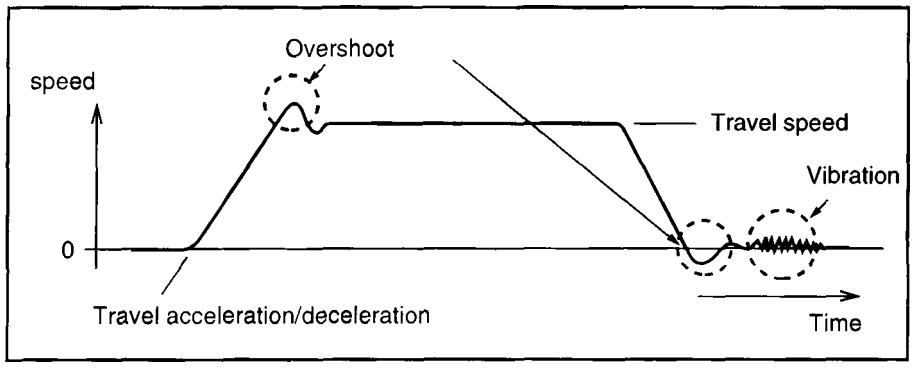
○ Mechanical interference causes damages to not only the robot but the peripheral devices.

● Analog monitor

- The connector CN4 has an analog monitor output pin. Use it for adjustment.
- Use the velocity monitor of the analog monitor function. For details, see "21.4.1. Analog Monitor".

Velocity Monitor Example: Observing signals output through the analog monitor pin on an oscilloscope in positioning

Figure 11-12

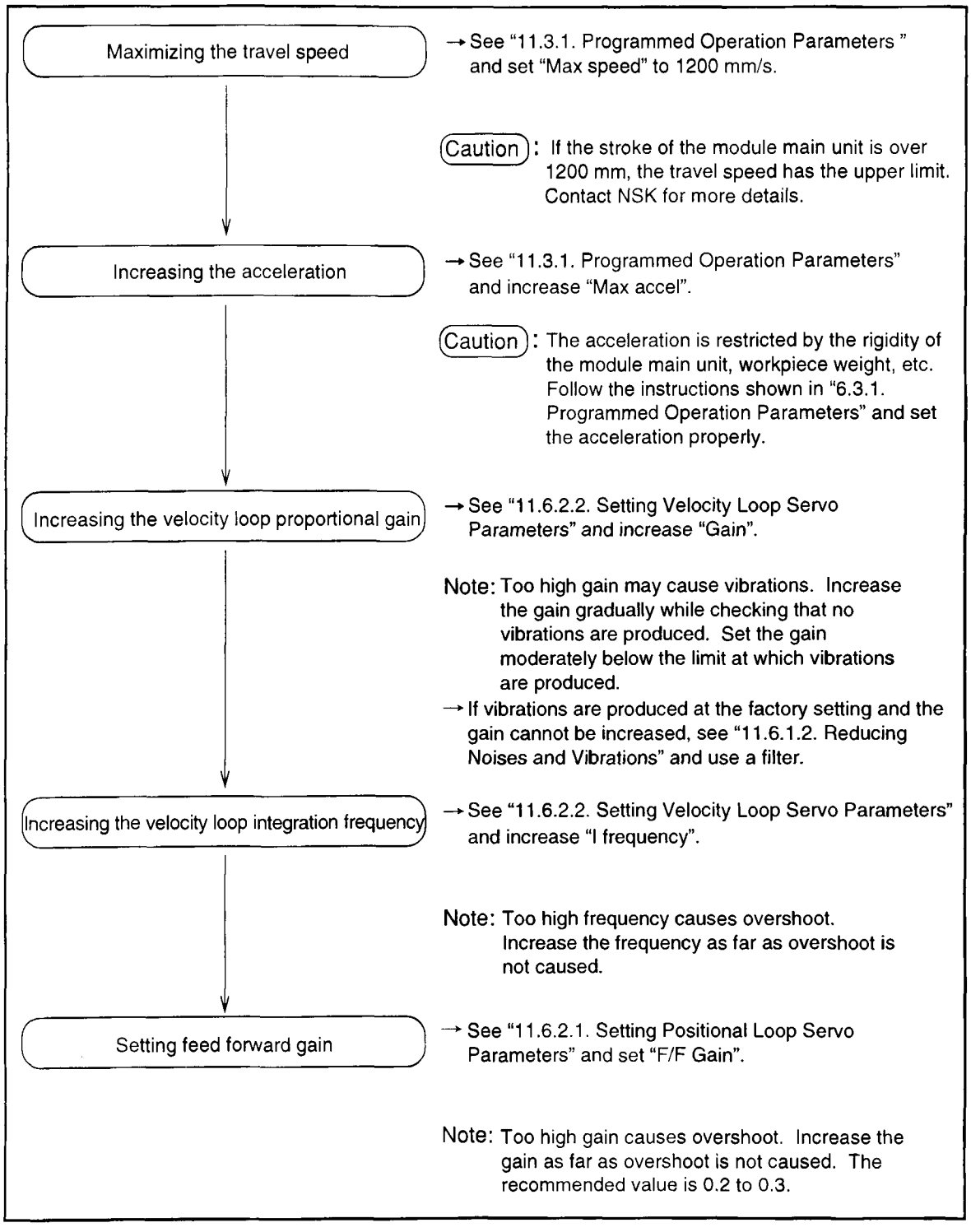


- The ideal velocity waveform should accurately represent a command free from overshoot or vibrations. (The above example shows a trapezoidal wave.) You need not be so anxious about the fidelity of the waveform if noises, vibrations, and positioning time cause no troubles in practical use.

11.6.1.1. Reducing Positioning Time

- To reduce the positioning time, follow the adjustment procedures shown below.

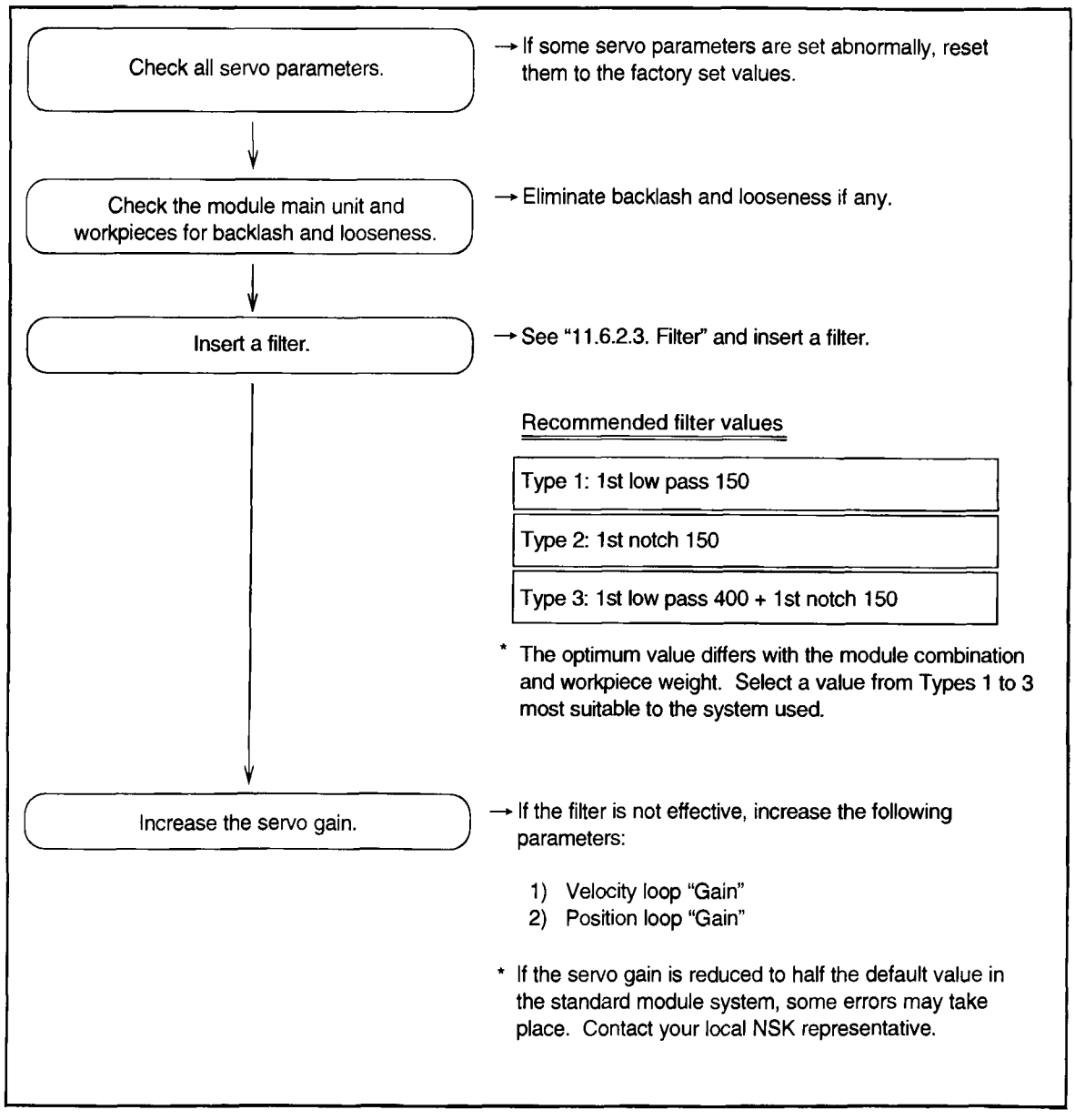
Figure 11-13



11.6.1.2. Reducing Noises and Vibrations

- If much vibrations or high frequency vibrations (over 100 Hz) are generated, carry out adjustment in the following procedures.

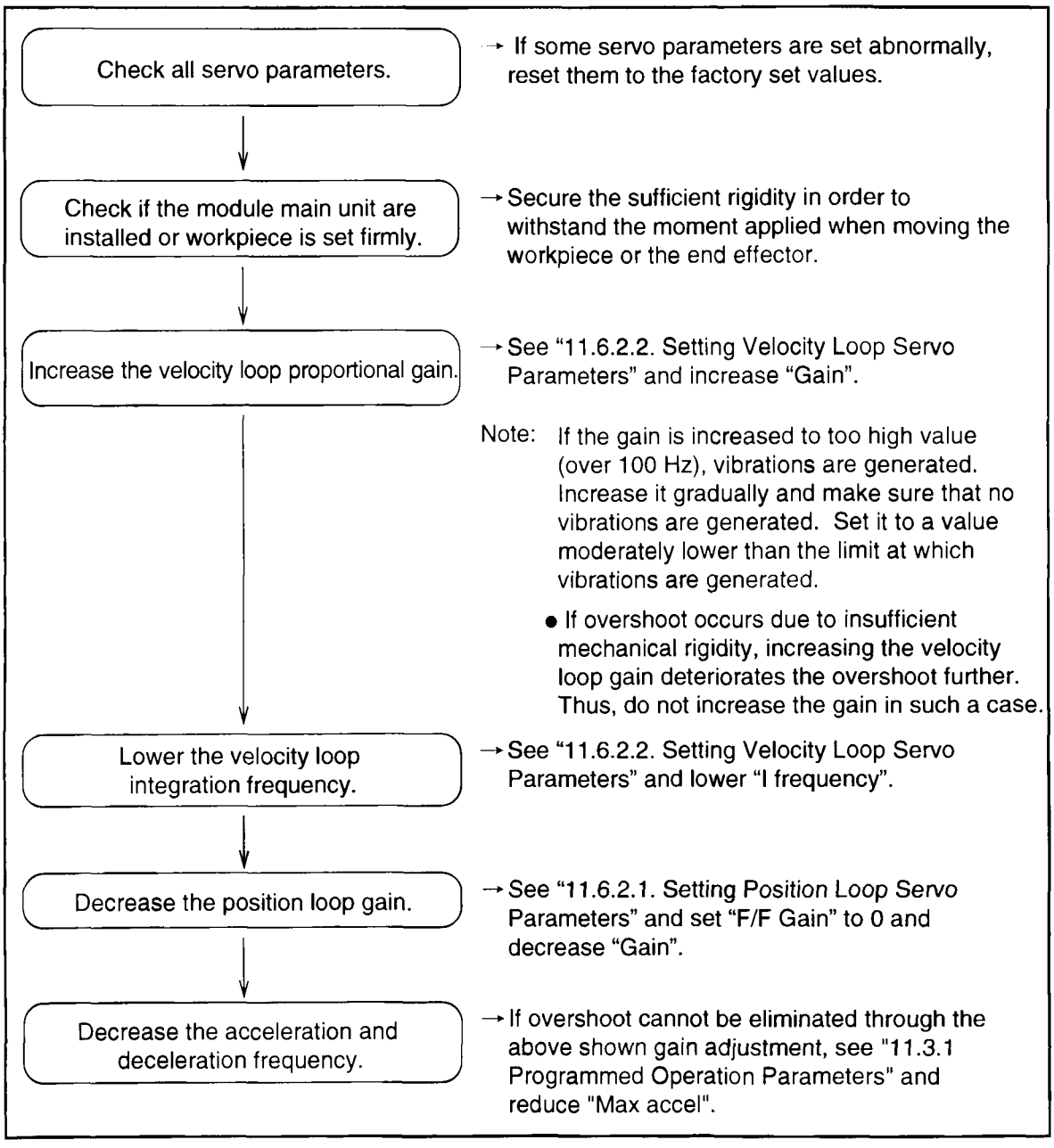
Figure 11-14



11.6.1.3. Reducing Overshoot

- If a great overshoot occurs or low frequency vibrations (below 100 Hz) are generated in positioning, carry out adjustment in the following procedures.

Figure 11-15



11.6.2. Servo Parameter Settings

- There are three types of servo parameters.
  1. Position loop
  2. Velocity loop
  3. Filters

11.6.2.1. Position Loop Servo Parameters

- The following shows the list of position loop adjusting parameters and their setting procedures.
- Dead band and F/F gain need not to be adjusted normally.

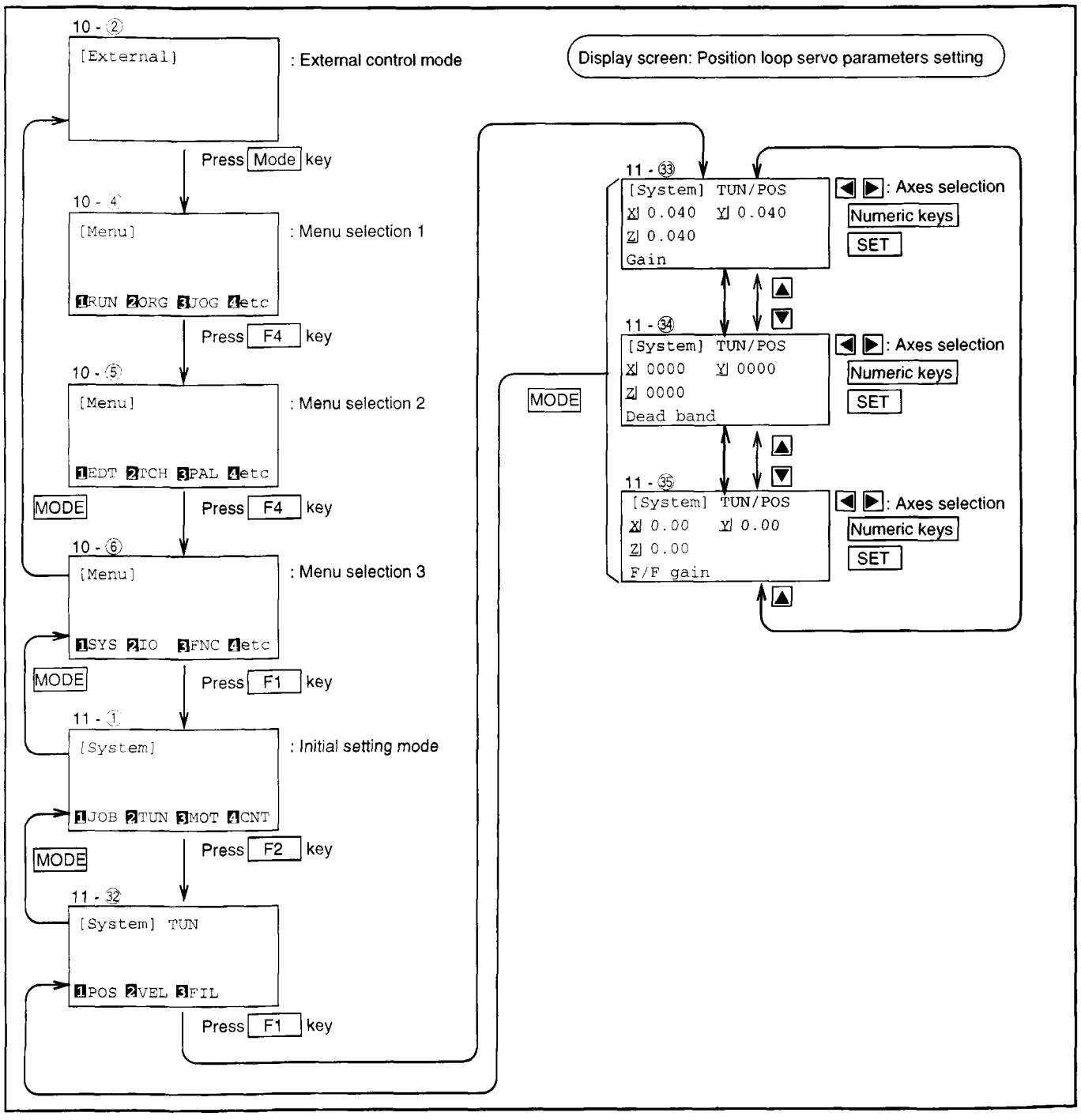
Table 11-13

Item	Description	Units	Setting Range	Factory Setting
Gain	• Position loop proportional gain • The positioning time is shorter with a greater gain. However, a greater gain causes greater overshoot or vibrations.	—	0.01 ~ 31.00	0.4
Dead band	• In the dead band, the velocity command is zeroed with a position error less than a set value in order to reduce minute vibrations due to small errors.	counts	0 ~ 4095	0 (no function)
F/F Gain	• Position loop feed forward compensation gain • Traceability to a command is better with a greater F/F gain. However, a greater gain causes greater overshoot or vibrations. A gain less than 0.5 is recommended.	—	0.00 ~ 1.00	0.00 (no function)

◉ Setting proceduses of position loop servo parameters

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting", mode.
- Referring "11.1. Initial Setting", set the display to "Position loop" servo gain setting through "Initial Setting" → "Servo Parameter selection" → "Position loop servo gain setting". In this screen, the servo parameters can be specified.
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

Figure 11-16



11.6.2.1. Velocity Loop Servo Parameters

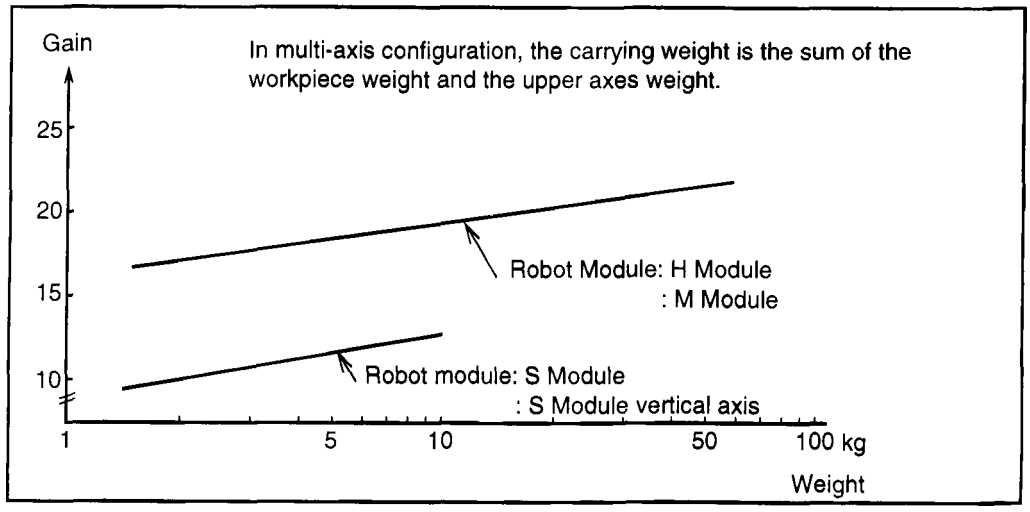
- The following shows the list of velocity loop adjusting parameters and their setting procedures.
- "I limit" and Dead band need not to be adjusted normally.

Table 11-14

Item	Description	Units	Setting Range	Factory Setting
Gain	• Velocity loop proportional gain • The velocity trace is more accurate with a greater gain. However, a greater gain causes more vibrations. • For adjustment, see Figure 11-17.	—	0.1 ~ 255.0	15
I frequency	• Velocity loop integration frequency • The positioning time is shorter with a greater I frequency. However, a greater I frequency causes more overshoot or hunting.	Hz	0.1 ~ 127.0	3.0
I limit	• The I limit gives an upper limit to pulses collected by integration to improve overshoot.	%	0.0 ~ 100.0	100.0 (no function)
Dead band	• In the dead band, the torque command is zeroed with a position error less than a set value in order to reduce minute vibrations due to small errors.	counts	0 ~ 4095	0 (no function)

- The proper setting of velocity loop proportional gain varies with the transporting load. Figure 11-17 shows the guide line of the gain setting.

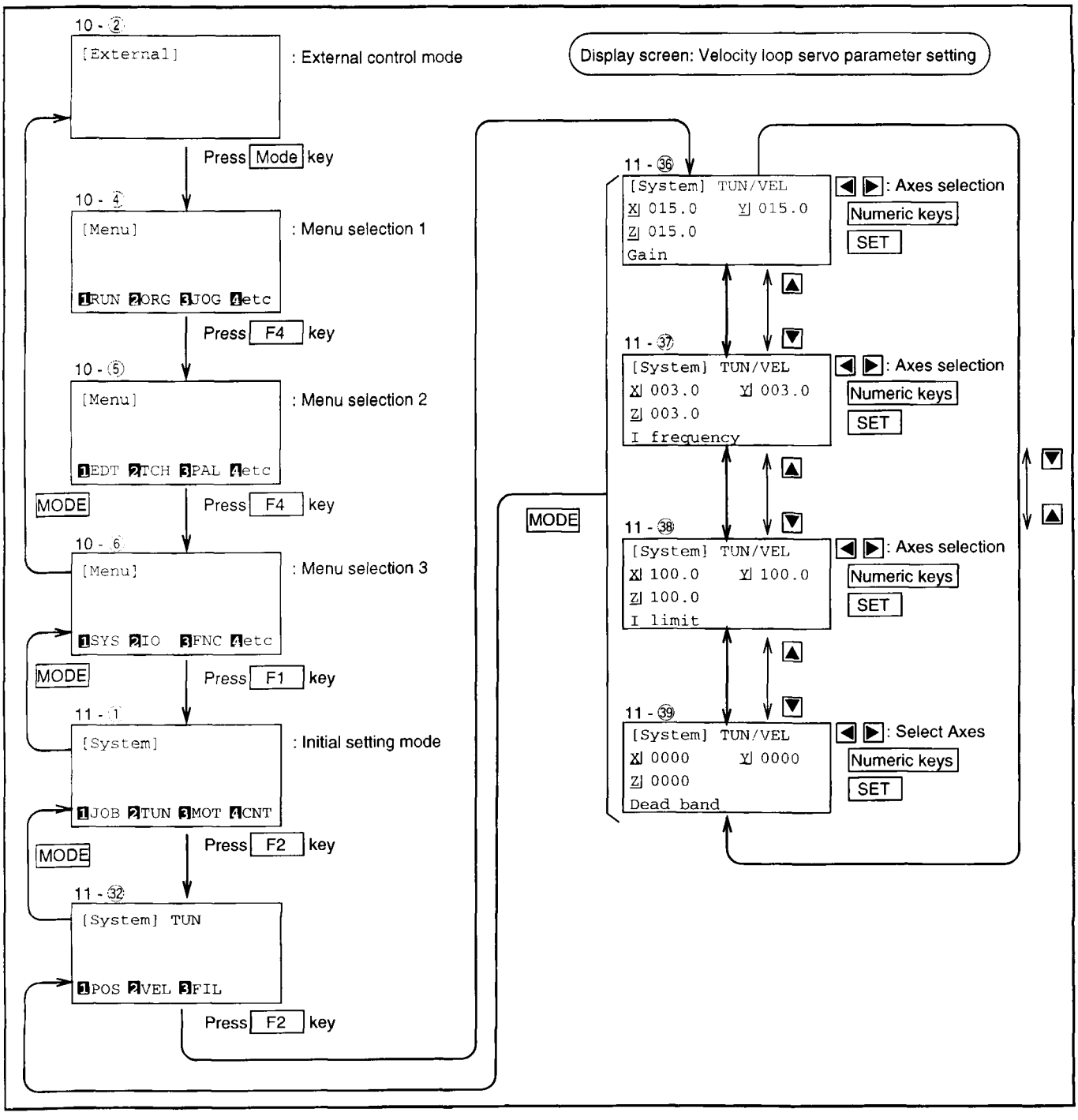
Figure 11-17: Reference for gain setting



● Setting procedures of velocity loop servo parameters.

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting", mode.
- Referring "11.1. Initial Setting", set the display to a screen for velocity loop servo parameters screen through "Initial Setting" → "Servo Parameter Selection" → "Velocity Loop Servo Parameters".
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.

Figure 11-18



11.6.2.2. Filters

- When noises and / or vibrations are excessive, proper setting of filters reduces them without lowering the gain (without loosing positioning accuracy).

- The following shows the list of the filter adjusting parameters and their setting procedures.

Table 11-15

Item	Description	Units	Setting Range	Factory Setting
1st low pass	• Cut-off frequency of the first low-pass filter	Hz	xxx: no function 10 ~ 400	xxx (no filter)
2nd low pass	• Cut-off frequency of the second low-pass filter	Hz	xxx: no function 10 ~ 400	xxx (no filter)
1st notch	• Center frequency of the first notch filter	Hz	xxx: no function 10 ~ 400	xxx (no filter)
2nd notch	• Center frequency of the second notch filter	Hz	xxx: no function 10 ~ 400	xxx (no filter)

Caution : (1) Vibrations occur due to phase delay when multi-stage filters are set. Use two filters utmost.

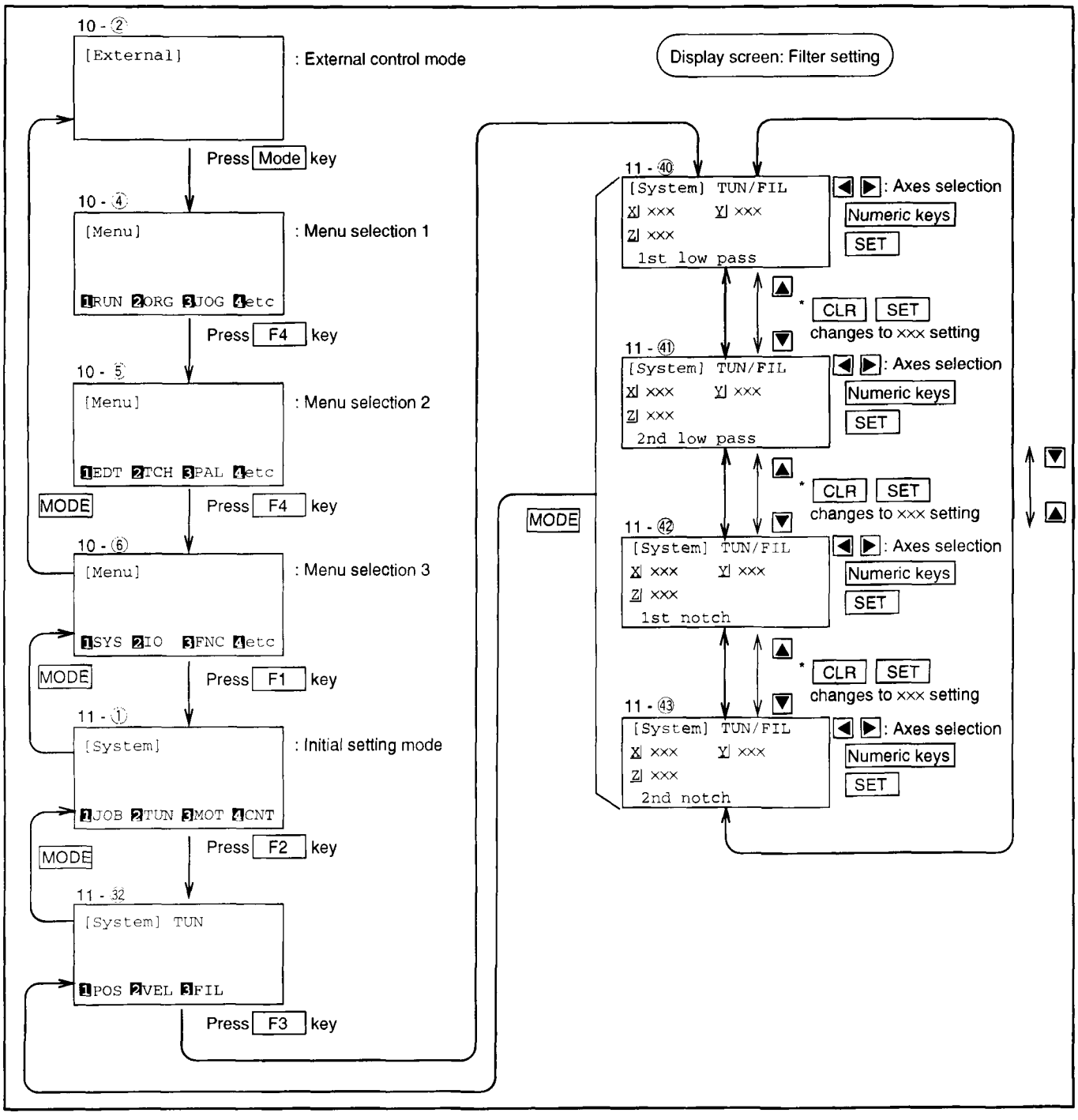
(Example : 1 st low pass filter : 400HZ + 1st notch : 150HZ)

(2) Normally set the filter frequency over 100HZ. Too low frequency causes vibrations.

● Setting Procedures of filters

- Refer to "10.2. Operation Mode Selection" and set to "Initial Setting", mode.
- Referring "11.1. Initial Setting", set the display to "Filter setting" screen through "Initial Setting" → [F2] "Servo Parameter Selection" → [F3] "Filter Setting".
- The display screen is scrolled with ▲ and ▼ keys.
- Select axes with ◀ and ▶ keys.
- To return to a previous display screen, press the MODE key once.
- Pressing CLR key changes numeric values to ×××setting.

Figure 11-19



12. Trial Running

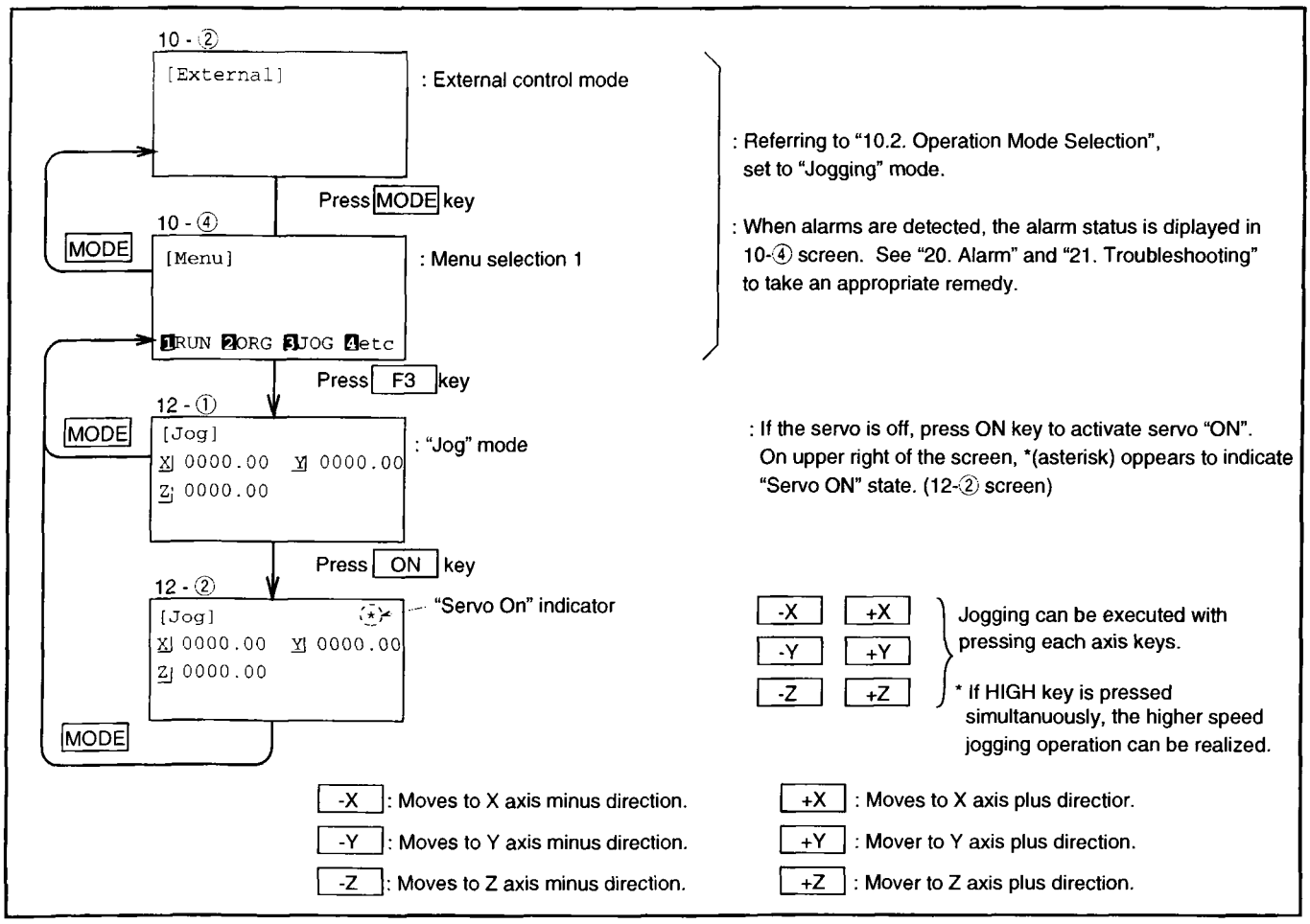
- Check the basic functions in the procedures shown below.
- In trial running, do not input any external signals such as "Servo On" or "RUN" from CN2 connector.

(Danger): *If there is a personnel in the operating range of the robot, a dangerous accident may break out. Before starting operation, make sure that there is no personnel in the area.*

12.1. Manual (Jogging) Operation Procedures

- See "10.2. Operation Mode Selection" and select the jogging operation mode.
- Carry out jogging motion in the jogging motion procedures using the teaching box. (See Figure 12-1.)
- The system keeps jogging while the jog key (-X, +X, -Y, +Y, -Z, +Z) is being pressed. Jogging motion stops by releasing the finger from the jog key.
- It is impossible to execute jogging motions of two or more axes. Carry out jogging axis by axis.
- Make sure that the robot moves smoothly along each axis.
- Make sure that an over-travel alarm occurs and operation stops at either stroke end using the teaching box and the LED indicators on the EXC controller.
- On completion of jogging, press the MODE key. Menu 1 reappears.

Figure 12-1

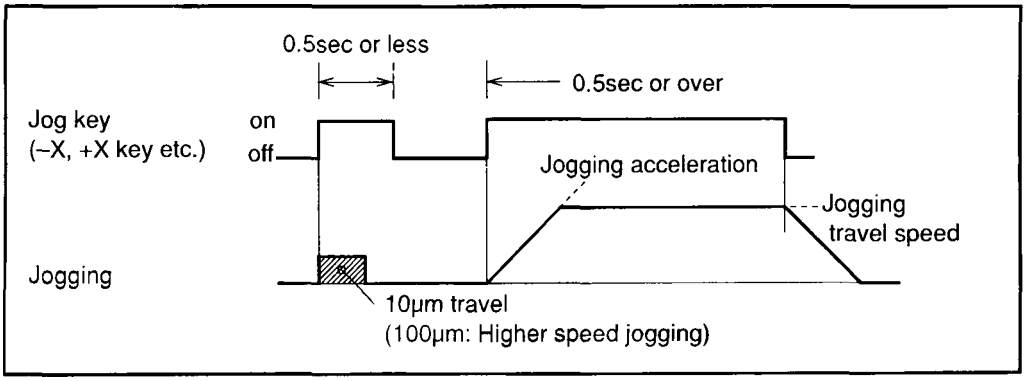


Caution : The motor side corresponds to the negative (–) jogging direction, and the opposite side corresponds to the positive (+) jogging direction. Note that these directions are reversed in either of the following cases.

① The coordinate system direction is reversed in initial setting. (See "11.5. Control Parameters".)

② The motor mounting parameter (direct or indirect) specified in initial setting does not meet the specifications of the module main unit.

Figure 12-2: Jogging operation timing



- If a jog key is pressed for a period less than 0.5 second, the feed pitch is 10 μm. If it is pressed together with the HIGH key, the feed pitch is 100 μm.
- The jogging operation acceleration and deceleration jogging travel speed, and higher speed jogging are specified in initial setting. See "11.3.3. Jogging Operation Parameters".

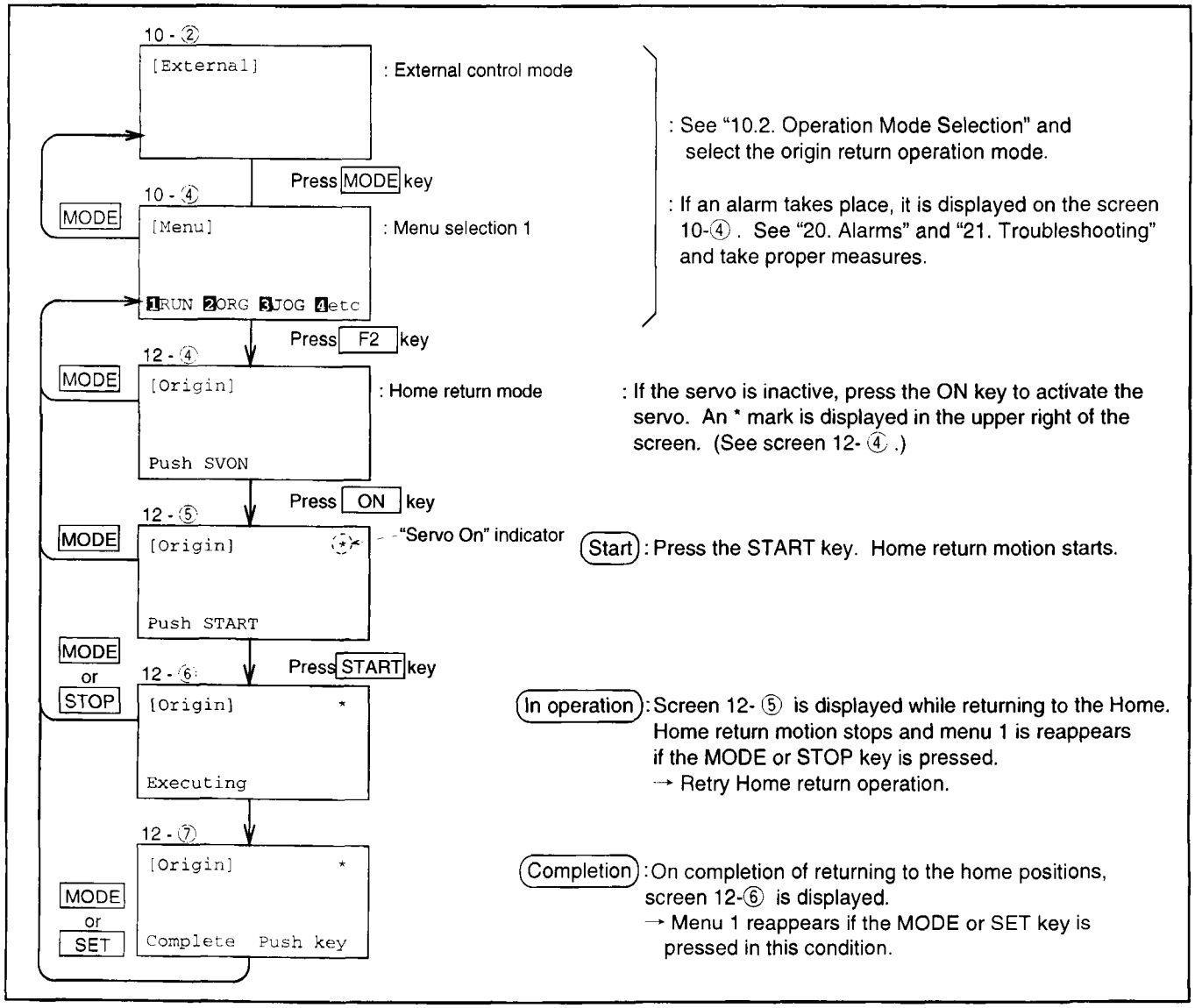
12.2. Returning to Home Position

- See "10.2. Operation Mode Selection" and select the home return mode.
- Carry out home return operation in the home return operation procedures.
- Check display on the teaching box to confirm that each axis of the robot returns to the home positions, and such motion is completed.
- On completion of returning to the home positions, make sure that no alarm is given.
- For the initial setting of returning to the home positions, see "11.3.2. Home Returning Operation Parameters".

● Home returning procedures

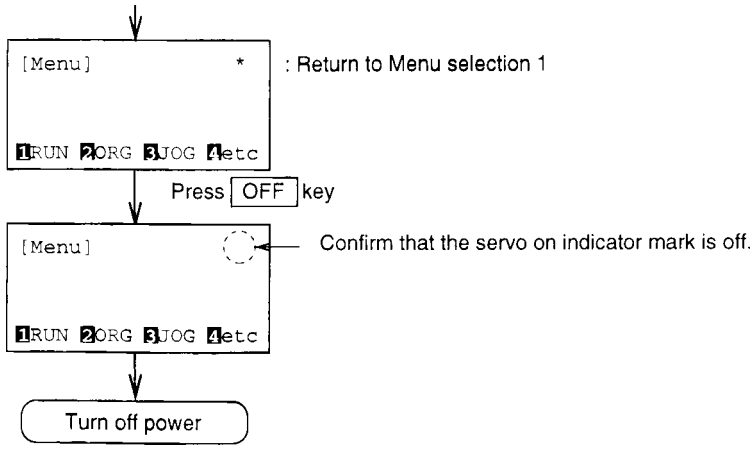
- Carry out home returning operation using the teaching box in the procedures shown in Figure 12-3.

Figure 12-3



12.3. Turning OFF Power

- On completion of trial running, turn off the power.
  - ① Return to menu 1.
  - ② Press the OFF key on the menu 1 to deactivate the servo.
  - ③ Turn off the power.
    - ○ In the case of the stand-alone type EXC controller, turn off the power switch on the panel.
    - ○ In the case of the rack mount type EXC controller, turn off the power switch prepared by the user.



Caution : *If the power of a system having a vertical axis is turned off under the condition where the servo is inactive, the slider (or the main unit of a module moving configuration) may drop by 5 to 10 mm.*

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Robot Modules System

• Module Main Unit

• EXC Controller

User's Manual 1

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