MITSUBISHI

Mitsubishi Industrial Robot

RP-1ADH/3ADH/5ADH-S15 Series

INSTRUCTION MANUAL
ROBOT ARM SETUP & MAINTENANCE

MELFA
BFP-A8922

⚠ Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠ **CAUTION** All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training

⚠ **CAUTION** For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan

⚠ **WARNING** Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch

⚠ **CAUTION** During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress

⚠ **WARNING** Provide a fence or enclosure during operation to prevent contact of the operator and robot.
Installation of safety fence

⚠ **CAUTION** Establish a set signaling method to the related operators for starting work, and follow this method.
Signaling of operation start

⚠ **CAUTION** As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
Indication of maintenance work in progress

⚠ **CAUTION** Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠ CAUTION — Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

⚠ CAUTION — Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

⚠ CAUTION — Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

⚠ CAUTION — Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

⚠ CAUTION — Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

⚠ CAUTION — Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.

⚠ WARNING — Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

⚠ WARNING — Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

⚠ CAUTION — Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

⚠ WARNING — When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

⚠ CAUTION — Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

⚠ CAUTION — After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

⚠ CAUTION — Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

⚠ CAUTION — Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.

⚠ WARNING — When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ **CAUTION**   Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected. Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

⚠ **CAUTION**   Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

⚠ **CAUTION**   Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB, RS-232 or LAN. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

C.Notes of the basic component are shown.
　　*SD series: CR1DA-700 series

⚠ **CAUTION**   Please install the earth leakage breaker in the primary side supply power supply of the controller because of leakage protection.
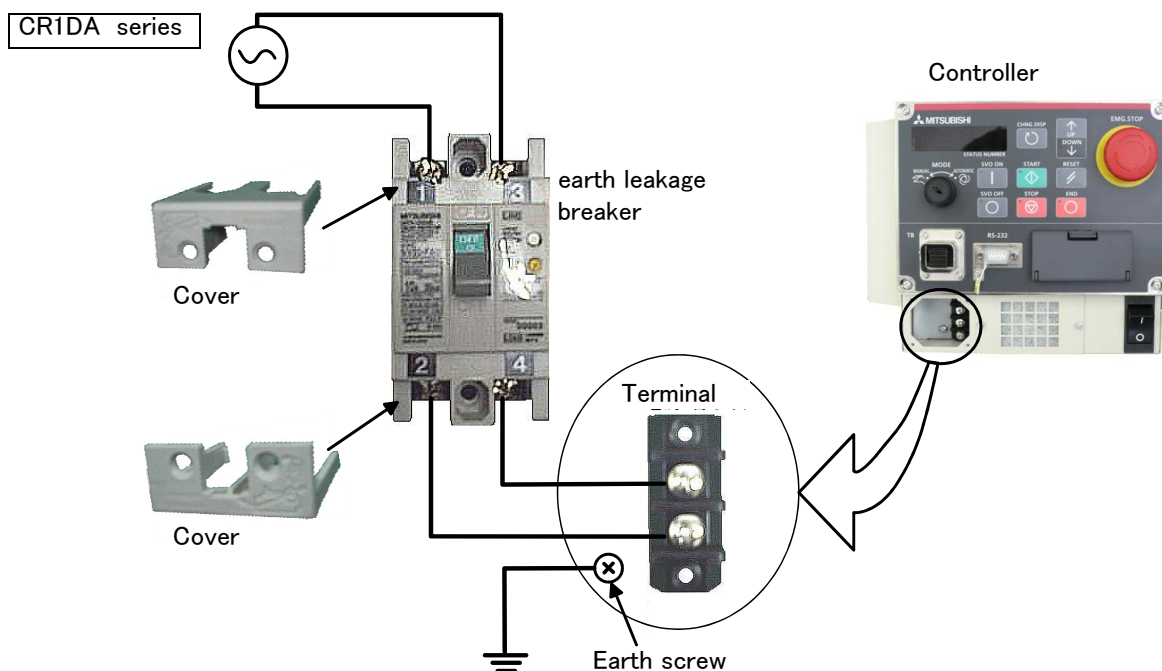
Revision history

Date of Point	Instruction Manual No.	Revision Details
2012-06-01	BFP-A8922	・First print
2012-06-01	BFP-A8922	・First print

■ Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual explains procedures to be taken for unpacking, installing, servicing and inspecting the robot arm.
Always read through this manual before starting use to ensure correct usage of the robot.

Contents

Contents

1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.

For special specifications, a separate instruction manual describing the special section may be enclosed.

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.
Additional axis function	Explains the specifications, functions and operations of the additional axis control.
Tracking Function Manual	Explains the control function and specifications of conveyor tracking
Extended Function Instruction Manual	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures about the GOT.

1.1.2 Symbols used in instruction manual

The symbols and expressions shown in Table 1-1 are used throughout this instruction manual. Learn the meaning of these symbols before reading this instruction manual.

Table 1-1 : Symbols in instruction manual

Terminology	Item/Symbol	Meaning
Item	The "Robot controller" or the "Controller"	Indicates the controller which controls the robot arm. Indicates the box which arranged control parts, such as robot CPU, servo amplifier, and the safety circuit.
Symbol	⚠ DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
	[JOG]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
	[RESET] + [EXE] (A) (B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [RESET] key is pressed while holding down the [+EXE] key.
	T/B	This indicates the teaching pendant.
	O/P	This indicates the operating panel on the front of the controller(drive unit).

1.2 Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠ CAUTION — All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training

⚠ CAUTION — For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan

⚠ WARNING — Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch

⚠ CAUTION — During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress

⚠ DANGER — Provide a fence or enclosure during operation to prevent contact of the operator and robot.
Installation of safety fence

⚠ CAUTION — Establish a set signaling method to the related operators for starting work, and follow this method.
Signaling of operation start

⚠ CAUTION — As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
Indication of maintenance work in progress

⚠ CAUTION — Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
Inspection before starting work

1.2.1 Precautions given in the separate Safety Manual
The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠ **DANGER**   If the automatic operation of the robot is operated by two or more control equipment, design the right management of operation of each equipment of the customer.

⚠ **CAUTION**   Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

⚠ **CAUTION**   Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

⚠ **CAUTION**   Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

⚠ **CAUTION**   Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

⚠ **CAUTION**   Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

⚠ **CAUTION**   Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.

⚠ **WARNING**   Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

⚠ **WARNING**   Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

⚠ **CAUTION**   Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

⚠ **WARNING**   When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

⚠ **CAUTION**   Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

⚠ **CAUTION**   After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

⚠ **CAUTION**   Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.

⚠ **WARNING**   When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ CAUTION

Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

⚠ CAUTION

Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters , the internal information of the robot controller may be damaged.

⚠ DANGER

When the SSCNETⅢ cable is removed, install the cap in the connector.
If the cap is not installed, there is a possibility of malfunctioning by adhesion of the dust etc.

⚠ DANGER

Don't remove the SSCNETⅢ cable, when the power supply of the robot controller is turned on. Don't face squarely the light emitted from the tip of the SSCNETⅢ connector or the cable. If light strikes the eyes, there is a possibility of feeling the sense of incongruity for the eyes. (The light source of SSCNETⅢ is equivalent to the class 1 specified to JISC6802 and IEC60825-1.)

2 Unpacking to Installation

2.1 Confirming the product

The standard configuration of the robot arm section, part of the purchased product, is shown in Table 2-1.
Confirm the parts.
Users who have purchased optional products should refer to the separate "RP-1ADH/3ADH/5ADH-S15 Series Standard Specifications".

Table 2-1 : Standard configuration

No.	Part name	Type	Qty. according to type-identifier			Remarks
			RP-1ADH-S15	RP-3ADH-S15	RP-5ADH-S15	
1	Robot arm	RP-1ADH-S15, RP-3ADH-S15, or RP-5ADH-S15	Either one unit			
2	Guarantee card		1 copy			
3	Installation bolts	M6 x 35	4 pcs.	–		
		M8 x 45	–	4 pcs.		
4	Spring washer for installation bolts	For M6	4 pcs.	–		
		For M8	–	4 pcs.		
5	Insulock tie	SKB-1M	2 pcs.			
6	Arm fixing plates	Transportation jigs A	1 pc.	–		
		Transportation jigs B	2 pcs.			
		Transportation jigs D	–	1 pcs.		
7	Arm fixing plate installation bolt	M4 x 12	2 pcs.	–		For fixing transportation jig A
		M3 x 14	2 pcs.			For fixing transportation jig B
		M4 x 14	–	2 pcs.		For fixing transportation jig D

2.2 Installation

2.2.1 Unpacking

Manuals, etc.

Upper fixing material

Connector box retainer

Robot arm

Connector box
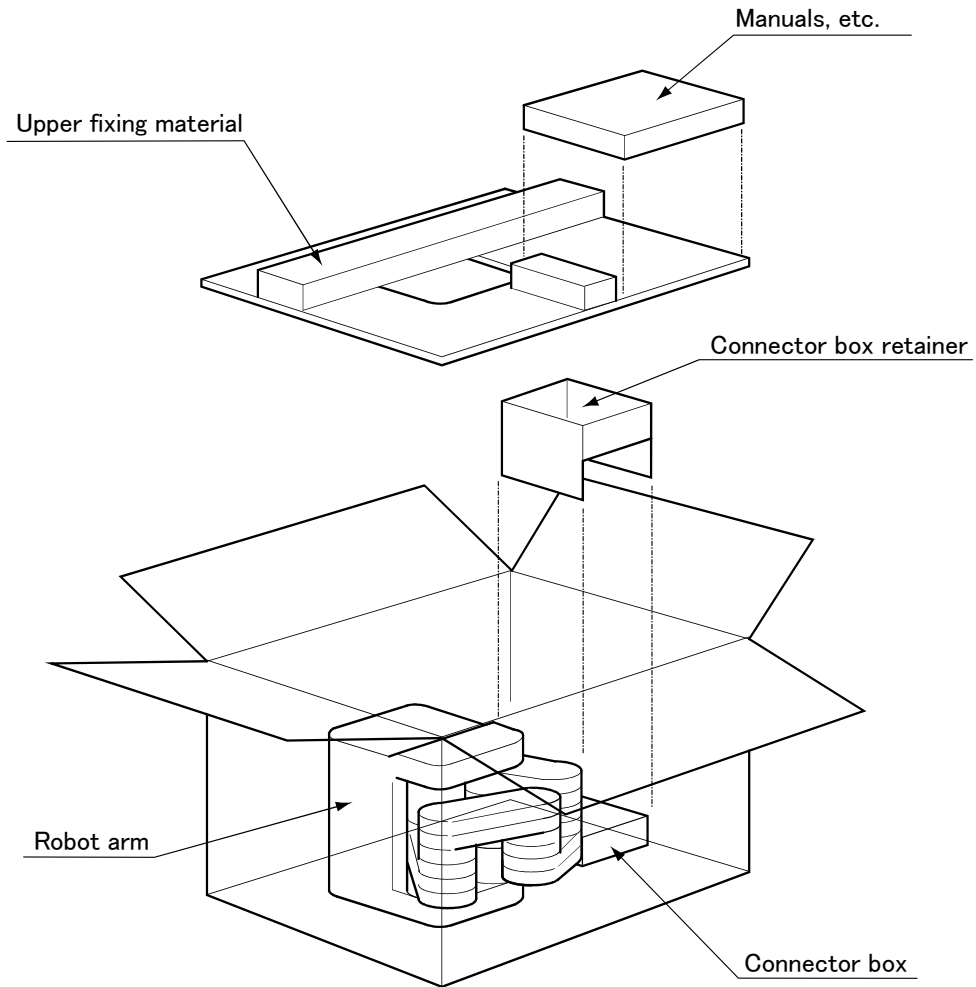
Fig.2-1 : Unpacking the robot arm

The robot is shipped from the factory in cardboard packaging. Refer to Table 2-1 and unpack the robot. Handle the robot arm following "2.2.2Transportation procedures".

2.2.2 Transportation procedures

Transportation jig A（RP-1ADH-S15）
Transportation jig D（RP-3ADH-S15, RP-5ADH-S15）
Transportation jig A fixing bolt M4×12
Transportation jig D fixing bolt M4×12

Transportation jig B

Transportation jig B fixing bolt
M3 × 14

Support for transportation
（2nd worker）

Connector box
（3rd worker）

Base handle
（1st worker）

Mass
RP-1ADH-S15: Approx. 14kg
RP-3ADH-S15: Approx .26kg
RP-5ADH-S15: Approx. 27kg

⚠CAUTION
The robot must be transported by three workers as shown in the drawing. Other transportation methods could cause the robot arm to tilt over or drop.
BU164D612H01

Fig.2-2 : Transportation posture, transportation method, and fixing positions

1) Open the cardboard box, and remove the cushioning material fixing the robot arm and connector box.
2) When transporting the robot, leave the transportation jigs A and B in place to protect the arm from external force. Three workers must transport the robot for safety purposes.
   As shown in "Fig. 2-2: Transportation posture, transportation method, and fixing positions", one worker must hold the handle on the robot arm base, another worker must hold the robot arm, and a third worker must hold the connector box.

⚠ **CAUTION**   To prevent accidents, do not hold the axis section on the end of the robot, or pull the cables.

3) Avoid applying vibration or impact when transferring the robot to the installation place.
4) Remove the transportation jigs A and B after installing at the installation place. Always remove transportation jigs A and B before starting the robot operation.
5) Use the same transportation procedures described above during secondary transportation, such as when changing the installation place. If the arm section is lifted without using the designated transportation jigs, or if the robot is transferred in the work posture, hazards could occur during the transportation work, such as the configuration devices being damaged or the center of gravity position being deviated.

2.2.3 Installation procedures

M6×35 hexagon socket bolt（4 places）（RP-1ADH-S15）

M8×40 hexagon socket bolt（4 places）（RP-3ADH-S15, RP-5ADH-S15）

Spring washer （RP-1ADH-S15）

Small plain washer （RP-3ADH-S15, RP-5ADH-S15）

M4×10 hexagon socket bolt （4 places）

Spring washer

Small plain washer

4-φ7 installation hole

2-φ4H7 for positioning

(Installation reference surface)

6.3a

82

162

150

38

48

95

76

200

6.3a

(Installation reference surface)

Bottom side of base （RP-1ADH-S15）

4-φ9 installation hole

2-φ6H7 for positioning

(Installation reference surface)

6.3a

110

216

200

50

62.5

125

100

263.5

6.3a

(Installation reference surface)

Bottom side of base （RP-3ADH-S15, RP-5ADH-S15）

180

30

120

5

165

155

4-φ5 installation hole

Bottom side of connectore box (For each type)

Fig.2-3 : Installation procedures and installation dimensions

The installation surface of the robot arm has been machined finished, so securely fix the robot arm with the installation holes (RP-1ADH-S15: 4-ϕ7 hole, RP-3ADH-S15, RP-5ADH-S15: 4-ϕ9 hole) provided at the four corners of the base and the enclosed installation bolts (RP-1ADH-S15: M6 x 35 hexagon socket bolts, RP-3ADH-S15, RP-5ADH-S15: M8 x 40 hexagon socket bolts).

Installation of the robot arm is a very important step for ensuring the optimum functions of the robot. Observe the following points when designing.
1) Keep the installation surface flat.
2) The surface roughness of the installation surface should be 6.3a or more. If the installation surface is rough, the robot seating will be poor, and positional deviation could occur when the robot is operated.
3) It is recommended to use a common table when installing to prevent positional deviation of the devices and jigs targeted for robot work.
4) Make sure that the installation surface has sufficient rigidity to prevent deformation or vibration caused by the arm reaction during operation, and from the static (dynamic) load of the robot arm and peripheral devices.
5) Fix the connector box with M4 hexagon socket bolts. (To be prepared by user. Should have length of 10mm or more.)

2.2.4 Grounding procedures
(1) Grounding methods
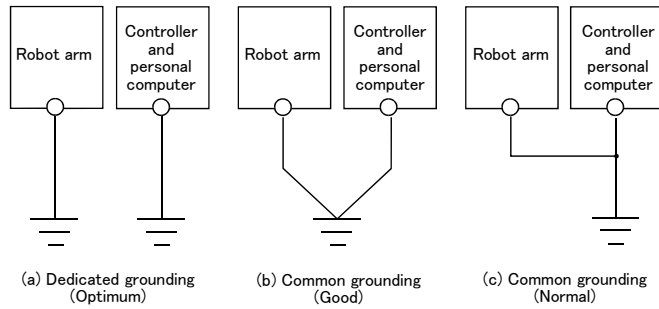
1) There are three grounding methods as shown in Fig. 2-4 , but the dedicated grounding (Fig. 2-4 (a)) should be used for the robot arm and controller when possible. (Refer to the separate "Controller setup, basic operation, and maintenance" for details on the controller grounding.)

2) Use Class D grounding (grounding resistance 100 Ω or less).
Dedicated grounding separated from the other devices should be used.

3) Use a $2mm^2$ or more stranded wire for the grounding wire. The grounding point should be as close to the robot arm and controller as possible, and the length of the grounding wire should be short.

Fig.2-4 : Grounding methods

(2) Grounding procedures

1) Prepare the grounding cable (2 mm^2 or more) and robot side installation screw and washer.

2) If there is rust or paint on the grounding screw section (A), remove it with a file, etc.

3) Connect the grounding cable to the grounding screw section.
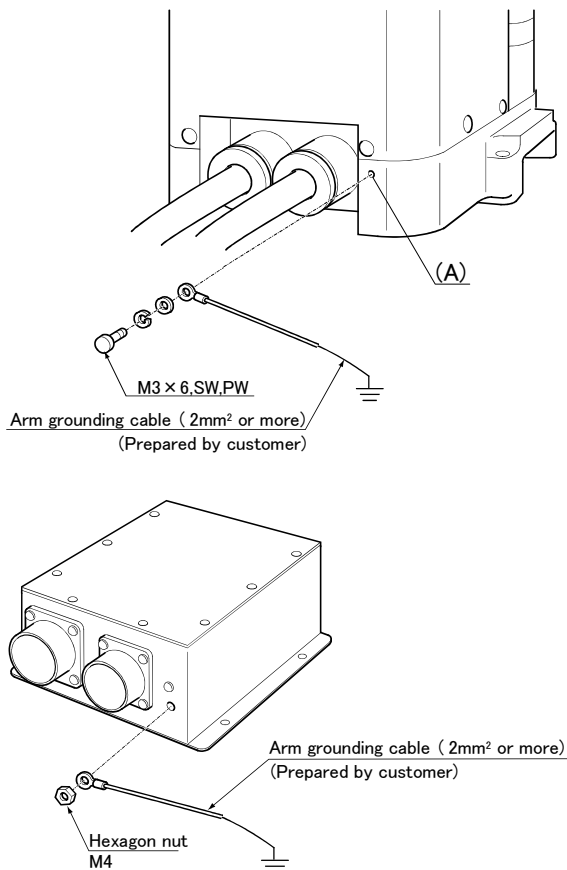
Fig.2-5 : Connecting the grounding cable

2.2.5 Connecting with the controller
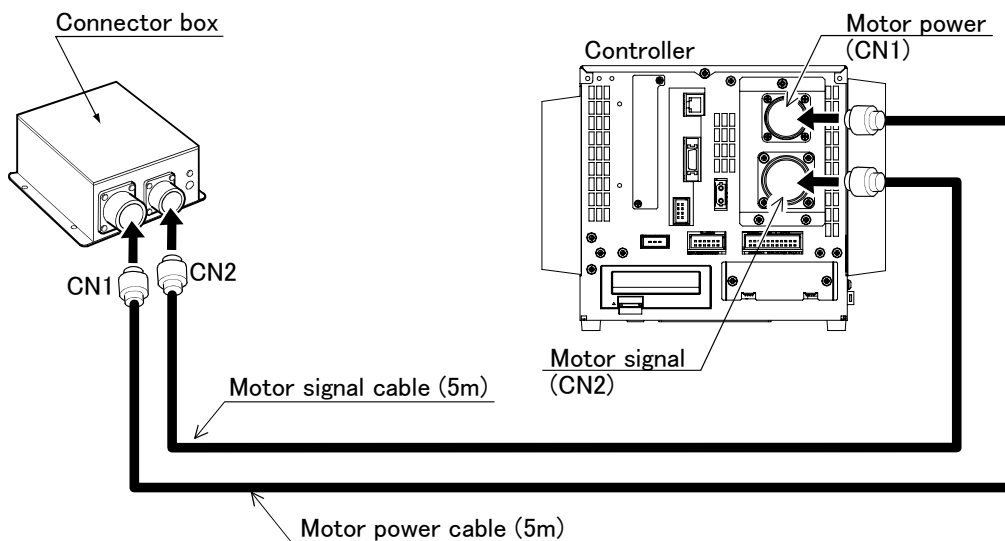
Fig.2-6 : Connecting the machine cables

Carry out the following procedure after installing the controller referring to the separate "Controller setup, basic operation, and maintenance" manual.

1) Make sure that the power switch on the front of the controller is turned OFF.
2) Connect the machine cable to the robot arm and the corresponding connector on the controller.

⚠ CAUTION   The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠ CAUTION   Take special care to the leading of the connection cable. If the cable is pulled with force or bent excessively, wires could break or the connector could be damaged.

[Reference]: Please carry out the measures against the noise if necessary.

Installs the ferrite core (reference type: E04SR301334, maker: SEIWA ELECTRIC MFG. Co. Ltd.) to the motor signal cable of the robot arm side.
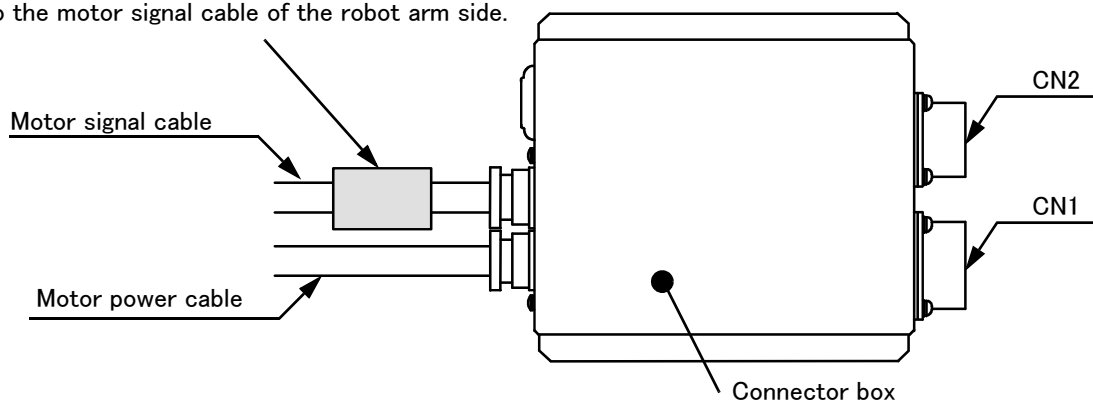
2.3 Setting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. This step must also be carried out if the combination of robot and controller being used is changed.

There are several methods for setting the origin, but the origin data input method will be explained here. Refer to page 61, "5.5 Resetting the origin" for the other methods.

The teaching pendant is required for this operation.

[Caution] If the origin data at shipment is erased due to out of battery, it is necessary to set the origin again. Refer to page 61, "5.5 Resetting the origin" and reset the origin using the jig method or ABS method.

2.3.1 Installing the teaching pendant (T/B)

When installing and removing the T/B, turn off the controller power supply. If T/B is installed or removed in the state of power supply ON, emergency stop alarm will occur.

If you use the robot wherein T/B is removed, please install the attached dummy connector. With the connector, put the dummy connector or draw it out.

⚠ **CAUTION** Please do not pull the cable of T/B strongly or do not bend it too much.
It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself.

Explain the installation method of T/B below.
1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Connects T/B connector to the robot controller. Use as the upper surface the lock lever shown in Fig. 2-7, and push in until there is sound.
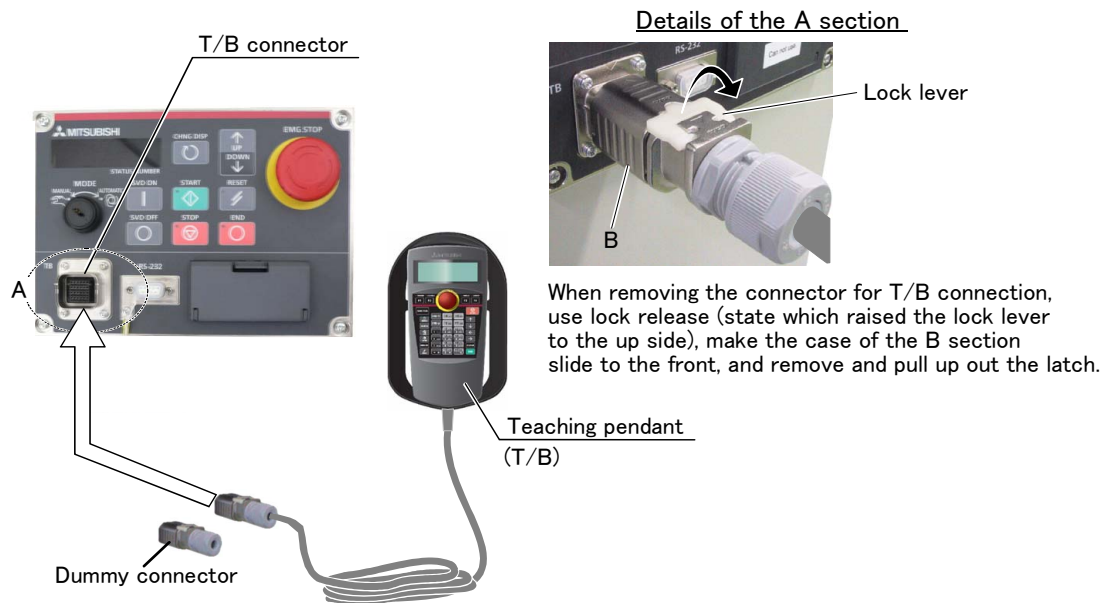
Fig.2-7 : Installing and removing the T/B

The installation of T/B is finished.

◇◆◇ If error C0150 occurs ◇◆◇
At the time of the first power supply injection, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.
Parameter: Please input the serial number of the robot body into RBSERIAL. Refer to "instructions manual / controller setup, and basic operation & maintenance" for the operation method.

2.3.2 Setting the origin with the origin data input method
(1) Confirming the origin data

● Origin data history table (Origin Data History) Serial No.ES804008

Date	Default	. . .	. . .	. . .
D	V!#S29			
J1	06DTYY			
J2	2?HL9X			
J3	1CP55V			
J4	T6!M$Y			
J5				
J6				
Method	E	E・N・SP	E・N・SP	E・N・SP

(O: Alphabet O, 0: Zero)
Note) Meanings of symbols in method column
E: Jig method
N: Not used
SP: Not used

The origin data to be input is noted in the origin data sheet enclosed with the arm, or on the origin data history table attached to the back side of the connector box cover. (Refer to Fig. 2−8).

Referring to page 57 ″Fig. 5−10: Replacing the battery″, remove the connector box cover, and confirm the value.

The value given in the default setting column is the origin settings set with the calibration jig before shipment.

Fig.2−8 : Origin data label an example

⚠ **WARNING** Always install/remove the cover with the controller control power turned OFF. Failure to do so could lead to physical damage or personal injury should the robot start moving due to incorrect operations.

(2) Turning ON the control power

⚠ **CAUTION** Confirm that there are no operators near the robot before turning the power ON.

1) Turn the controller [POWER] switch ON.
   The control power will be turned ON, and ″o. 100″ will appear on the STATUS NUMBER display on the front of the controller.

(3) Preparing the T/B
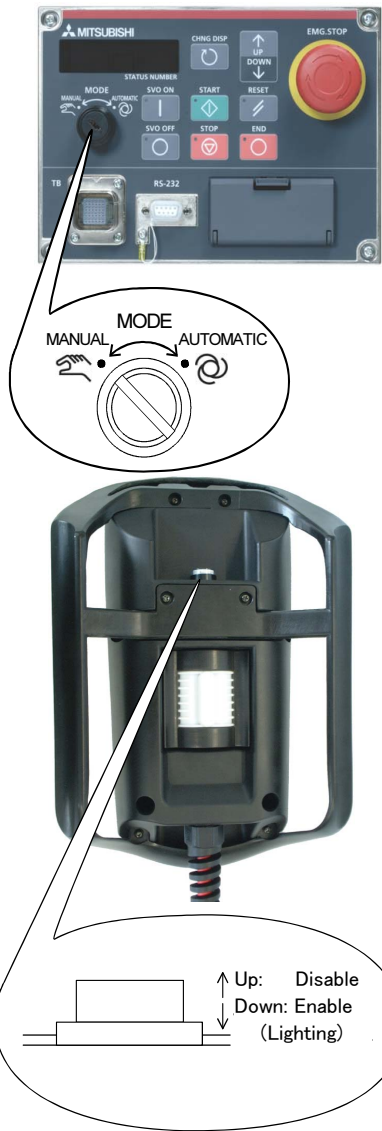
Next, prepare to use the T/B

1) Set the [MODE] switch on the front of the controller to "MANUAL".

2) Set the T/B [ENABLE] switch to "ENABLE". The menu selection screen will appear.
The following operations are carried out with the T/B.

↑ Up: Disable
Down: Enable
    (Lighting)

◇◆◇ Operating from the T/B ◇◆◇
Always set the [MODE] switch (mode selection key switch) on the front of the controller to "MAMNUAL", and then set the T/B [ENABLE] switch to "ENABLE".
When the T/B is valid, only operations from the T/B are possible. Operations from the controller or external signals will not be accepted.

(4) Selecting the origin setting method

```
<MENU>
1.FILE/EDIT      2. RUN
3. PARAM.        4. ORIGIN/BRK
5. SET/INIT.     6. ENHANCED

            123        CLOSE
```

[4 GHI]

1) Press the [4] key on the menu screen, and display the ORIGIN/BRAKE screen.

```
<ORIGIN/BRAKE>
1.ORIGIN          2. BRAKE



            123        CLOSE
```

[1 '()]
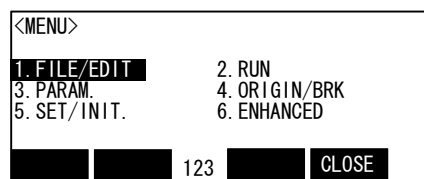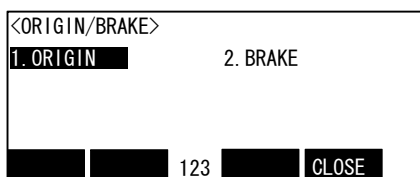
2) Press the [1] key on the ORIGIN/BRAKE screen, and display the origin setting method selection screen.

```
<ORIGIN>
1. DATA           2. MECH
3. TOOL           4. ABS
5. USER

            123        CLOSE
```

[1 '()]
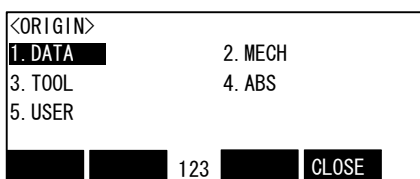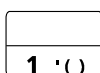
3) Press the [1] key on the origin setting method selection screen, and select the data input method.

```
<ORIGIN> DATA
                    D:(■    )
J1(       ) J2(        ) J3(        )
J4(       ) J5(        ) J6(        )
J7(       ) J8(        )
            123        CLOSE
```
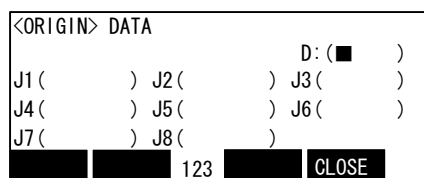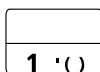
4) Display the origin data input screen

◇◆◇ Selecting a menu ◇◆◇
The menu can be selected with one of the following methods.
A: Press the numeral key for the No. of the item to be selected.
B: Using the [↓] and [↑] keys, etc., move the cursor to the item to be selected, and then press the [INP] key.

◇◆◇ The input method of numeral ◇◆◇
The number can be inputted if the key displayed on the lower left of each key is pressed. Press the [CHARACTER] key, and in the condition that "123" is displayed on the screen lower side, press the number key.

(5) Inputting the origin data

T/B screen   Origin data label
                    (D,J1,J2,J3,J4,J5,J6,J7,J8)

```
<ORIGIN> DATA
                        D:(■    )
J1(        ) J2(       ) J3(        )
J4(        ) J5(       ) J6(        )
J7(        ) J8(       )
            123        CLOSE
```

Input the value confirmed in section page 14, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-9.

Fig.2-9 : Correspondence of origin data label and axis

The method for inputting the origin data is explained below. The value shown in Fig. 2-8 will be input as an example.

```
<ORIGIN> DATA
                        D:(■    )
J1(        ) J2(       ) J3(        )
J4(        ) J5(       ) J6(        )
J7(        ) J8(       )
            123        CLOSE
```
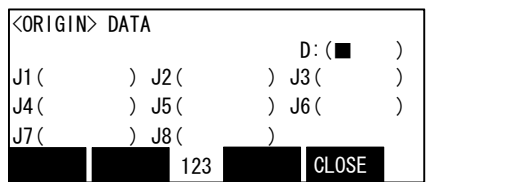
1) Confirm that the cursor is at the "D" position on the T/B display screen.

```
<ORIGIN> DATA
                        D:(V    )
J1(        ) J2(       ) J3(        )
J4(        ) J5(       ) J6(        )
J7(        ) J8(       )
            ABC        CLOSE
```

[CHARACTER]

[−B (J5)]
[8 TUV]
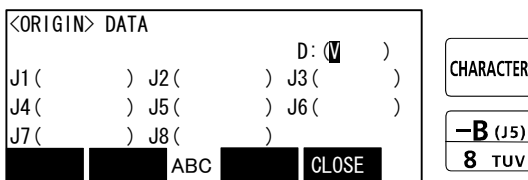
2) Input the D value "V!%S29".
Inputting "V"
Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen)
Press the [TUV] key three times. "V" will be set.

```
<ORIGIN> DATA
                        D:(V!   )
J1(        ) J2(       ) J3(        )
J4(        ) J5(       ) J6(        )
J7(        ) J8(       )
            ABC        CLOSE
```

[+C (J6)]
[・ , %]

[→]

[+C (J6)]
[・ , %]
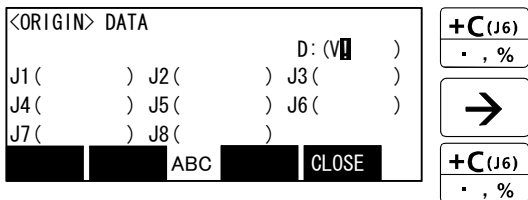
Inputting "!"
Press the [, %] key five times. "!" will be set.
Press the [→] key once and advance the cursor.
Press the [, %] key twice (input "%"), and press the [PQRS] key four times (input "S").

```
<ORIGIN> DATA
                        D:(V!%S29)
J1(        ) J2(       ) J3(        )
J4(        ) J5(       ) J6(        )
J7(        ) J8(       )
            123        CLOSE
```

[CHARACTER]

[−Z (J3)]
[2 ABC]

[+B (J5)]
[9 WXYZ]
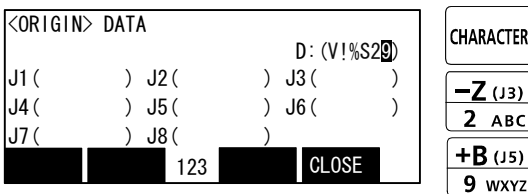
Press the [CHARACTER] key and set to the numeral input mode. (Condition that "123" was displayed under the screen)
Press the [2] key (input "2"), and press the [9] key (input "9").
"V!%S29" will appear at the "D" data on the teaching pendant screen.

[↓]

:
:
:
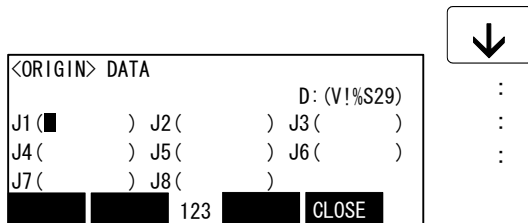
3) Press the [↓] key, and move the cursor to the J1 input position.
4) Input the J1 value in the same manner as above.

```
<ORIGIN> DATA
                        D:(V!%S29)
J1(■       ) J2(       ) J3(        )
J4(        ) J5(       ) J6(        )
J7(        ) J8(       )
            123        CLOSE
```

Input the J2, J3, J4, J5 and J6 values in the same manner.

```
<ORIGIN> DATA
                    D:( V!%S29)
J1( O6DTYY) J2( 2?HL9X) J3( 1CP55V)
J4( T6!MSY) J5( Z21J%Z) J6( A12%ZO)
J7(       ) J8(       )
            ABC       CLOSE
```

EXE

5) After inputting all of the values, press the [EXE] key. The origin setting confirmation screen will appear.

```
<ORIGIN> DATA

   CHANGE TO ORIGIN. OK?


Yes        123       No
```

F1

6) Press [F1] (Yes) to end the origin setting

◇◆◇ Moving the cursor ◇◆◇
Press the [↑], [↓], [←] and [→] keys.

◇◆◇ Inputting characters ◇◆◇
Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen). The displayed character is scrolled each time at pressing the key.

◇◆◇ Correcting an input ◇◆◇
After returning one character by pressing the [CLEAR] key, input the character again.

(6) Installing the connector cover
Return the connector cover, removed in to its original position.
This completes the setting of the origin with the origin data input method.

⚠ WARNING   Always remove and install the cover with the controller power turned OFF. Failure to do so could lead to the robot moving because of incorrect operations, or to physical damage or personal injury.

◇◆◇ If the origin input data is incorrect ◇◆◇
If the origin input data is incorrect, the alarm No. 1760 (origin setting data illegal) will occur when origin data input.
In this case, reconfirm the value input for the origin data.

2.4 Confirming the operation

In this section, the robot will be moved manually using the T/B to confirm that the operation is correct.
Moving the robot manually is called ″jog operation″. This operation includes the JOINT jog that moves each axis, the XYZ jog that moves along the base coordinate system, the TOOL jog that moves along the tool coordinate system, and the CYLNDER jog that moves along the circular arc.
This operation is carried out while pressing the deadman switch on the back of the T/B.

⚠ **CAUTION** The robot will move during this operation. Make sure that there are no operators near the robot, and that there are no obstacles, such as tools, in the robot operation range.

⚠ **CAUTION** To immediately stop the robot, release the deadman switch on the back of the T/B. The servo power will turn OFF, and the robot will stop.
The robot will also stop if the [EMG.STOP] switch (emergency stop switch) on the front of the T/B or the [EMG.STOP] switch (emergency stop) on the front of the controller is pressed.

⚠ **WARNING** Confirm that the origin has been set. If the origin has not been set, ″****″ will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.
Refer to page 13, ″2.3 Setting the origin″ for details on setting the origin.
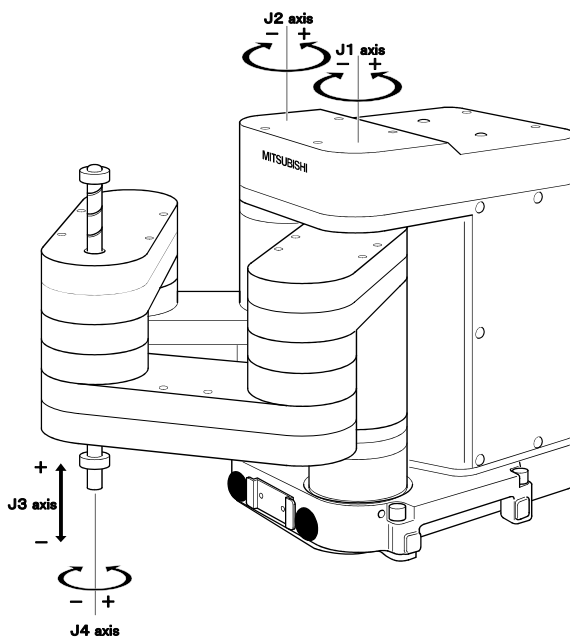
* Each axis moves independently.

Fig.2-10 : JOINT jog operation
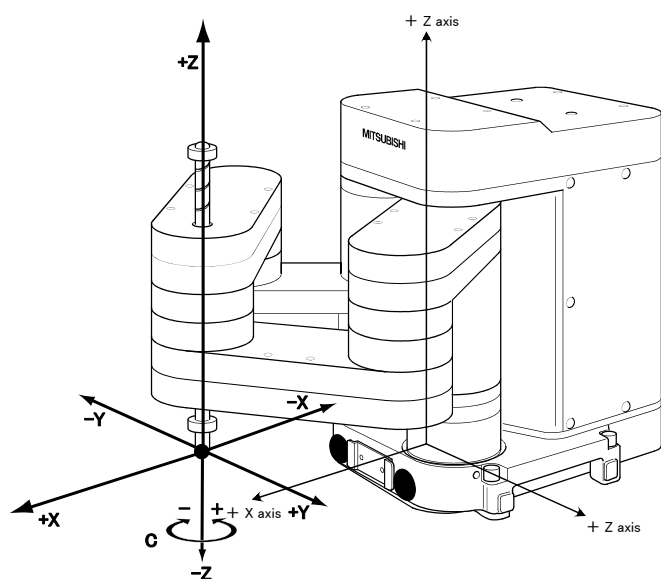
Fig.2-11 : XYZ jog operation

* While maintaining the posture of the end axis, the robot moves straight along the xyz coordinate system.
The end axis rotates.

Fig.2-12 : TOOL jog operation
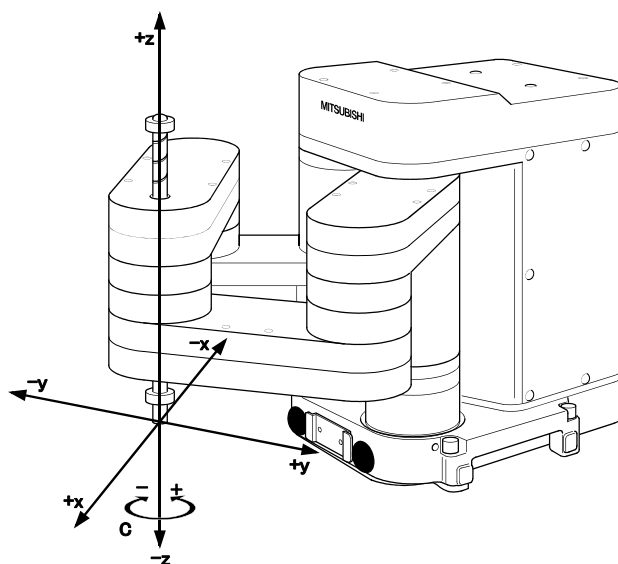
* While maintaining the posture of the end axis, the robot moves straight along the tool coordinate system.
The end axis changes directions while maintaining its position.
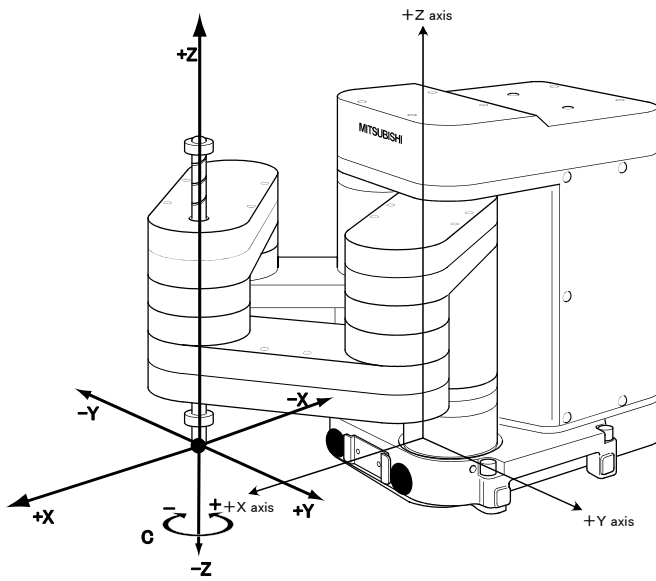
* The robot moves straight along
the xyz coordinate system. The
direction of the end axis is not
maintained during this type.
The direction of the end axis
changes. At this time, the end axis
position will change.

Fig.2-13 : 3-axis XYZ jog operation
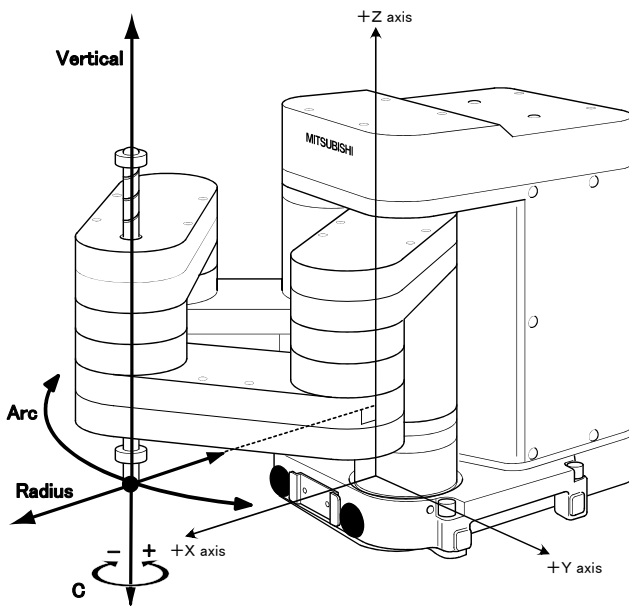
* With an arc using the end axis
position as the center of the Z axis,
the robot moves over the arc,
expands and contracts in the radial
direction, and moves vertically. At
this time, the posture of the end
axis is maintained. The direction is
changed while maintaining the end
axis position.

Fig.2-14 : CYLNDER jog operation

+Z

+Z axis

MITSUBISHI

+Zw

+Xw

-Yw

-Xw

Tool length

+X axis

+Y axis

Controll
point

-Z

-Zw

-Yw

+Yw

WORK coordinate system

* While maintaining the end axis
posture, the axis moves straight
along the work coordinate system.
Also, while maintaining the end axis
position, the end axis posture
changes.
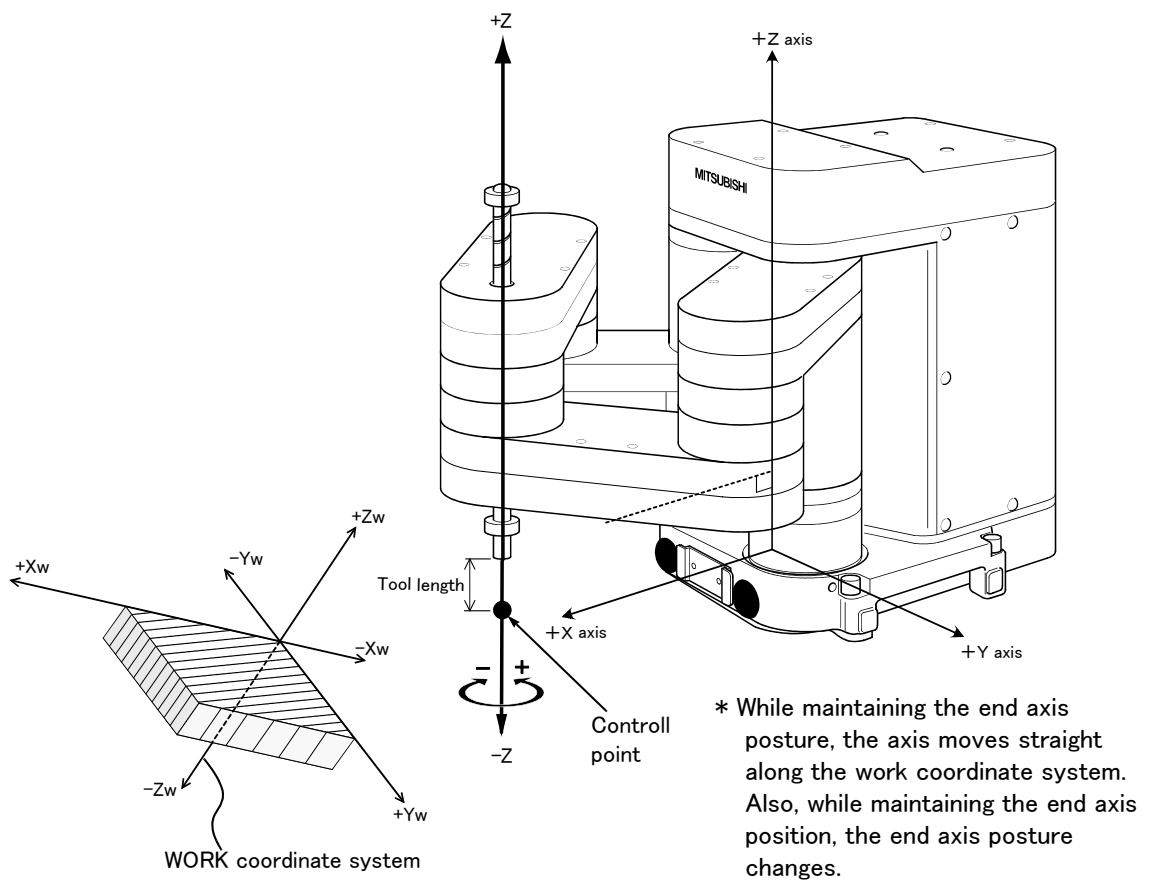
Fig.2-15 : Work jog operation

(1) JOINT jog operation

Select joint jog mode
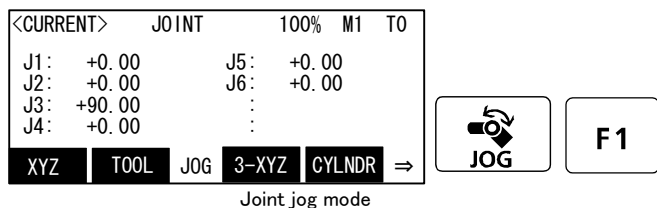
```
<CURRENT>    JOINT      100%  M1  TO
J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00         :
J4:   +0.00         :
XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```

Joint jog mode

Set jog speed

```
<CURRENT>    JOINT      100%  M1  TO
J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00         :
J4:   +0.00         :
XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```

Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "joint" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "joint." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work
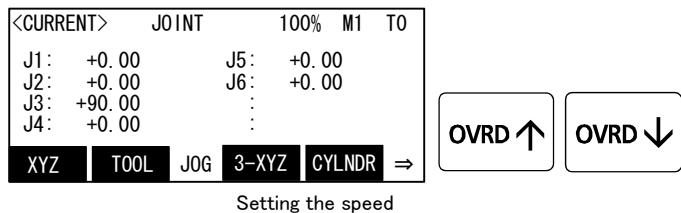
J1 axis jog operation
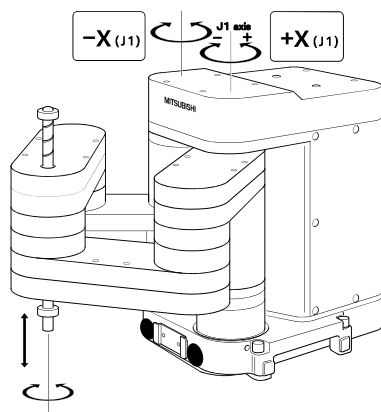
When the [+X (J1)] keys are pressed, the J1 axis will rotate in the plus direction.
When the [−X (J1)] keys are pressed, rotate in the minus direction.

J2 axis jog operation
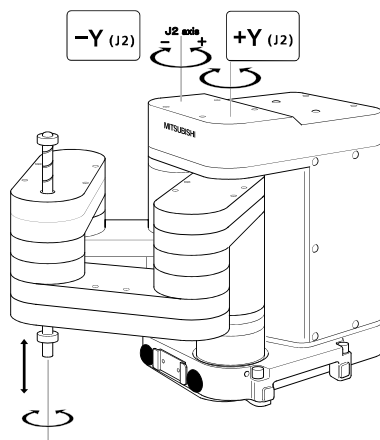
When the [+Y (J2)] keys are pressed, the J2 axis will rotate in the plus direction.
When the [−Y (J2)] keys are pressed, rotate in the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇
The axes may be outside the movement area. Move these axes toward the inner side of the movement area.

J3 axis jog operation
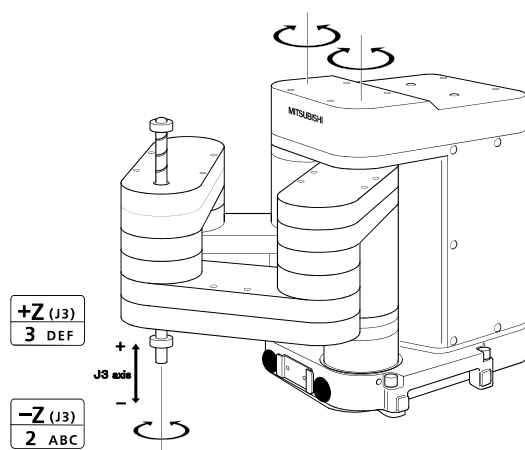
When the [+Z (J3)] keys are pressed, the J3 axis will move to the plus direction (up).
When the [−Z (J3)] keys are pressed, the J3 axis will move to the minus direction (down).

+Z (J3)
3 DEF

+
J3 axis
−

−Z (J3)
2 ABC

J4 axis jog operation
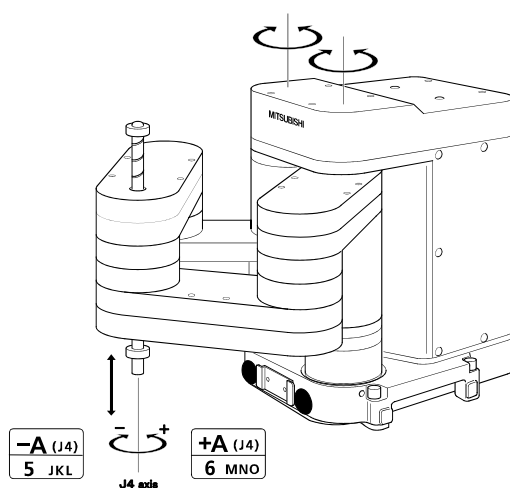
When the [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
When the [−A (J4)] keys are pressed, the J4 axis will rotate in the minus direction.

−A (J4)
5 JKL

−   +
J4 axis

+A (J4)
6 MNO

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇
If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

(2) XYZ jog operation

Select XYZ jog mode
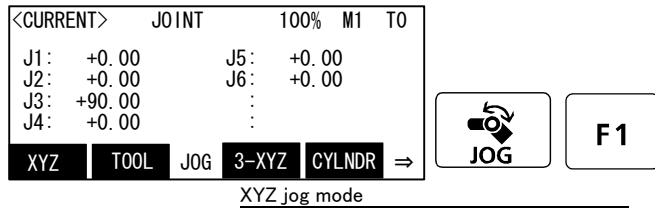
```
<CURRENT>    JOINT       100%  M1  T0
J1:    +0.00      J5:    +0.00
J2:    +0.00      J6:    +0.00
J3:   +90.00        :
J4:    +0.00        :
 XYZ   TOOL  JOG  3-XYZ  CYLNDR  ⇒
```

XYZ jog mode

Set jog speed

```
<CURRENT>    JOINT       100%  M1  T0
J1:    +0.00      J5:    +0.00
J2:    +0.00      J6:    +0.00
J3:   +90.00        :
J4:    +0.00        :
 XYZ   TOOL  JOG  3-XYZ  CYLNDR  ⇒
```

Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom) Check that the "XYZ" in jog mode is displayed on the screen.

If other jog modes are displayed, please press the function key corresponding to the "XYZ." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)

If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.

Set the override to 10% here for confirmation work

Moving along the base coordinate system

When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction. When the [−X (J1)] keys are pressed, move along the minus direction.

When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction. When the [−Y (J2)] keys are pressed, move along the minus direction.

When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction. When the [−Z (J3)] keys are pressed, move along the minus direction.

∗ The direction of the end axis will not change.

◇◆◇ When the robot is in the transportation posture ◇◆◇
There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section page 23, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇
If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

Changing the direction of the end axis

When the ［+C（J6）］keys are pressed, the Z axis will rotate in the plus direction.

When the ［−C（J6）］keys are pressed, the Z axis will rotate in the minus direction.
The position of the end axis will not move.

＊ The Position of the end axis will not change.

◇◆◇ When alarm No. 5150 occurs ◇◆◇
If alarm No. 5150（ORIGIN NOT SET）occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

Select TOOL jog mode

```
<CURRENT>    JOINT      100%  M1  T0
J1:    +0.00      J5:    +0.00
J2:    +0.00      J6:    +0.00
J3:   +90.00       :
J4:    +0.00       :
XYZ    TOOL   JOG   3-XYZ   CYLNDR  ⇒
```
TOOL jog mode

Set jog speed

```
<CURRENT>    JOINT      100%  M1  T0
J1:    +0.00      J5:    +0.00
J2:    +0.00      J6:    +0.00
J3:   +90.00       :
J4:    +0.00       :
XYZ    TOOL   JOG   3-XYZ   CYLNDR  ⇒
```
Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "TOOL" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "TOOL." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along the tool coordinate system
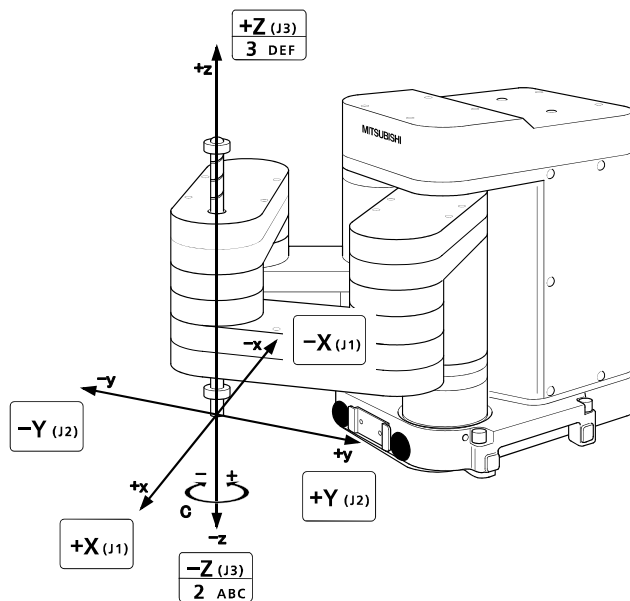
When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction of the tool coordinate system.
When the [−X (J1)] keys are pressed, move along the minus direction.

When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction of the tool coordinate system.
When the [−Y (J2)] keys are pressed, move along the minus direction. (6-axis type only)

When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
When the [−Z (J3)] keys are pressed, move along the minus direction.

∗ The direction of the frange will not change.

◇◆◇ When the robot is in the transportation posture ◇◆◇
There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section page 23, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

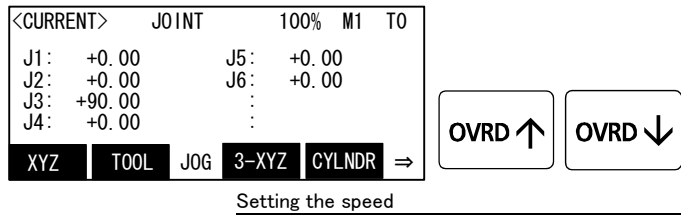◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇
If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

Rotating the end axis
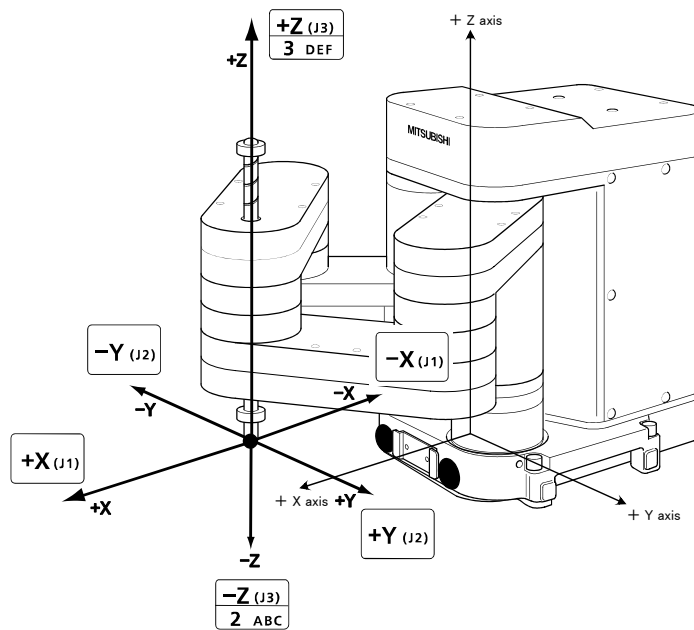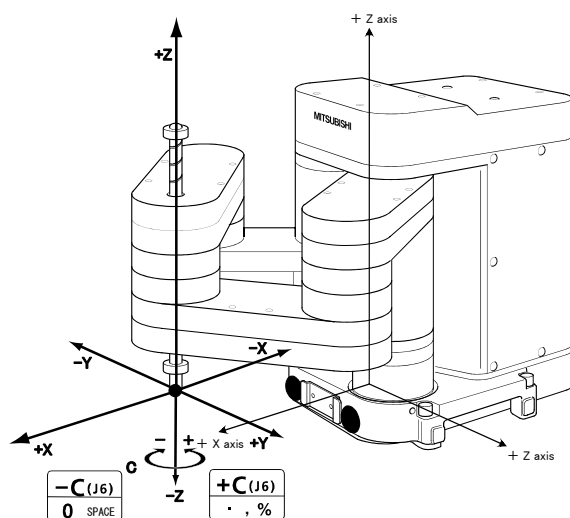

When the[+C (J6)] keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system.
When the[−C (J6)] keys are pressed, the Z axis will rotate in the minus direction.

＊ The position of the end axis will not change.

◇◆◇ When alarm No. 5150 occurs ◇◆◇
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.
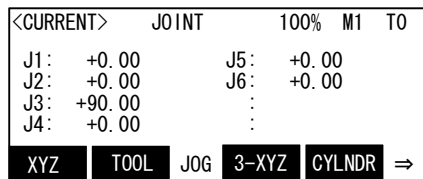
◇◆◇ Tool length ◇◆◇
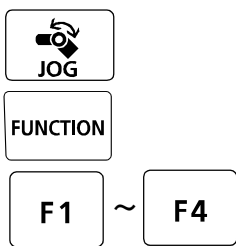The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(4) 3-axis XYZ jog operation
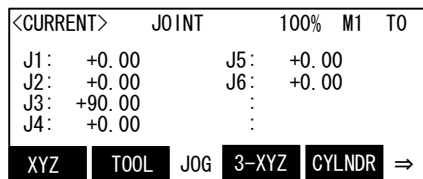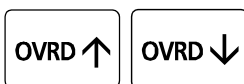
Select XYZ456 jog mode
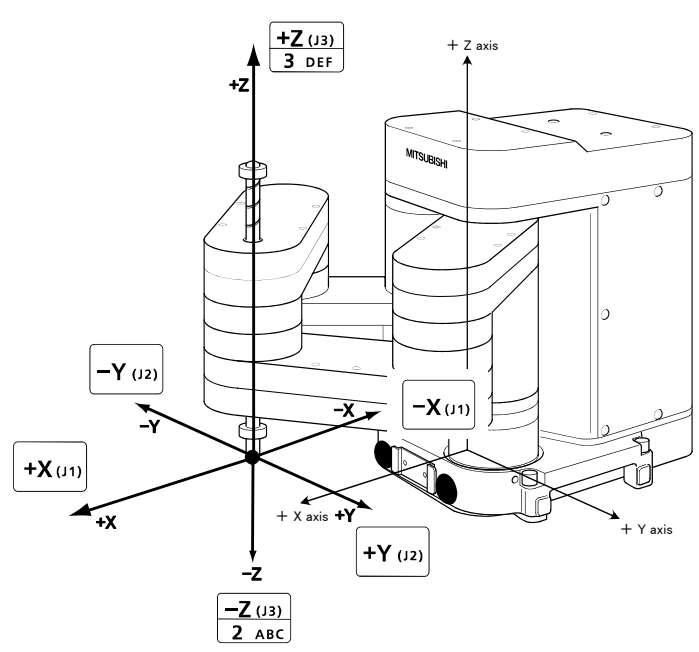
```
<CURRENT>     JOINT      100%  M1  TO
J1:   +0.00     J5:   +0.00
J2:   +0.00     J6:   +0.00
J3:  +90.00       :
J4:   +0.00       :
  XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
XYZ456 jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "XYZ456" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ456." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Set jog speed

```
<CURRENT>     JOINT      100%  M1  TO
J1:   +0.00     J5:   +0.00
J2:   +0.00     J6:   +0.00
J3:  +90.00       :
J4:   +0.00       :
  XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Setting the speed

Moving along the base coordinate system

When the[+X (J1)] keys are pressed, the robot will move along the X axis plus direction.
When the[−X (J1)] keys are pressed, move along the minus direction.

When the[+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction.
When the[−Y (J2)] keys are pressed, move along the minus direction.

When the[+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the[−Z (J3)] keys are pressed, move along the minus direction.

* The direction of the end axis will not change.

◇◆◇ The flange surface end axis posture cannot be maintained with 3-axis XYZ jog. ◇◆◇
   With 3-axis XYZ jog, the flange surface end axis posture (orientation) is not maintained when moving linearly in the X, Y or Z axis direction.
   Use XYZ jog to maintain the posture.

Changing the end axis direction
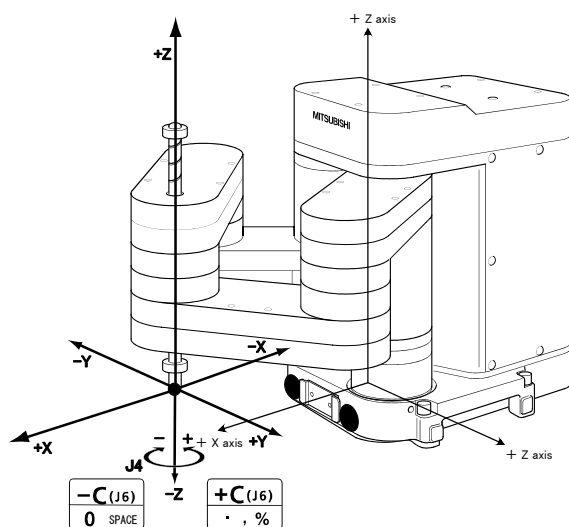
When the[+C (J6)] keys are pressed, the Z axis will rotate in the plus direction.
When the[−C (J6)] keys are pressed, the Z axis will rotate in the minus direction.

＊ The position of the end axis will not change.

（5）CYLNDER jog operation

Select cylindrical jog mode

```
<CURRENT>    JOINT      100%  M1  TO

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00       :
J4:   +0.00       :

 XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
CYLNDER jog mode

Set jog speed

```
<CURRENT>    JOINT      100%  M1  TO

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00       :
J4:   +0.00       :

 XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "CYLNDER" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "CYLNDER."
(If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNC-TION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along an arc centering on the Z axis
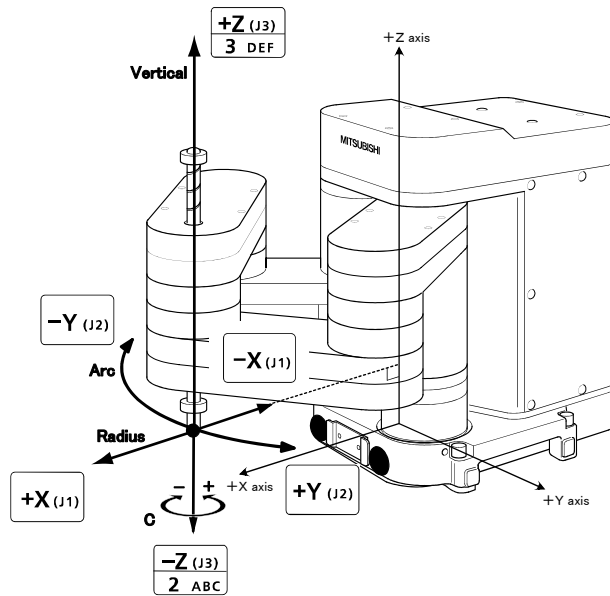
* The direction of the frange will not change.

Assuming that the current position is on an arc centering on the Z axis, the robot moves along that arc.

When the[+X (J1)] keys are pressed, the robot will expand in the radial direction.
When the[−X (J1)] keys are pressed, contract in the radial direction.

When the[+Y (J2)] keys are pressed, the robot will move along the arc in the plus direction.
When the[−Y (J2)] keys are pressed, move in the minus direction.

When the[+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
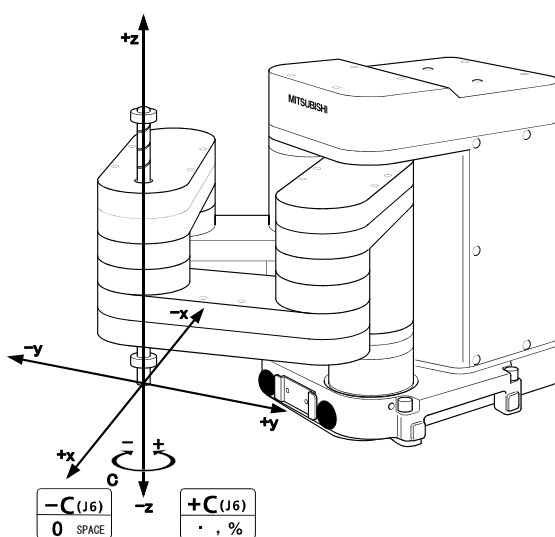When the[−Z (J3)] keys are pressed, move along the minus direction.

Changing the end axis direction
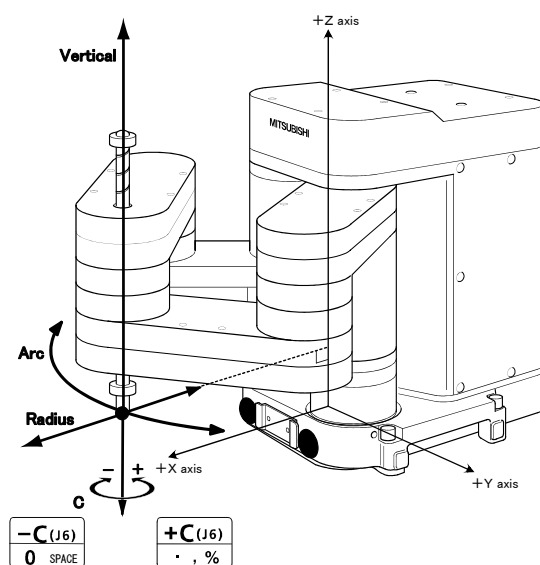
When the [+C (J6)] keys are pressed, the Z axis will rotate in the plus direction.
When the [−C (J6)] keys are pressed, the Z axis will rotate in the minus direction.
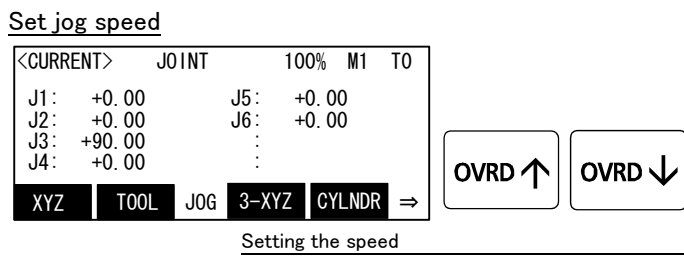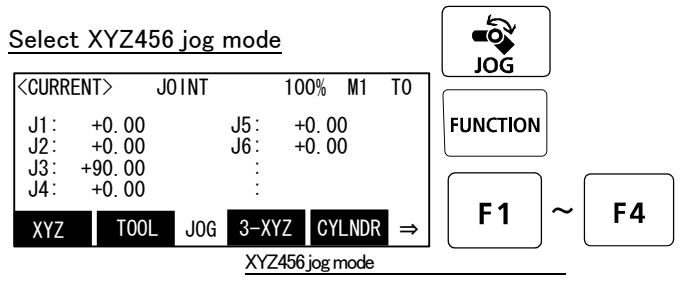
＊ The position of the end axis will not change.

(6) Work jog operation

Setting of the work coordinates system is necessary.

By this jog operation, robot can be move along with the direction of work (or working table etc.), so teaching operations get easier.

When jog operation, select by which work coordinates the robot moves

The setting method of the work coordinates system using T/B (R32TB) is shown in the following. (Parameter: Setting the coordinate value to WKnCORD ("n" is meaning the number (1-8) of work coordinates) can also set up the work coordinates system. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details of parameter.)

In addition, this jog operation is available at the following software versions. The below-mentioned "6.ENHANCED" menu is not displayed in the other versions.

    T/B   :Ver.1.3 or later
    SD series :P8 or later

The work coordinates system teaches and sets up the three points (WO, WX, WY).

Notes) The figure is the example of RV-6SD, but other types are the same

The jogging movement based on this work is possible.

< ● Teaching point>
WO: Work coordinates system origin
WX: Position on the "+X" axis of work coordinates system.
WY: Position at the side of "+Y" axis on the X-Y plane of work coordinates system
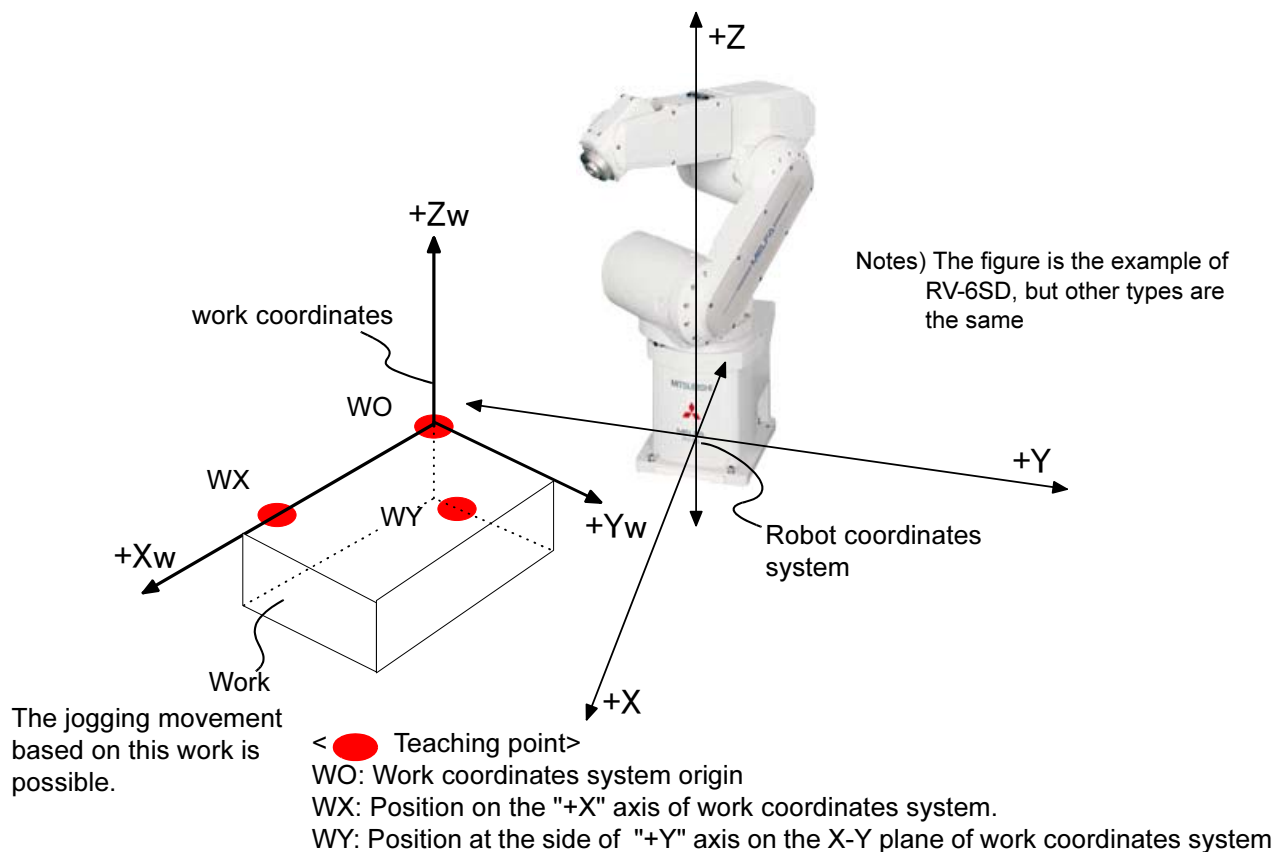
[Supplement] : The coordinate values which use all three teaching points for setting of the work coordinates system are each only X, Y, and the Z-axis. Although the coordinate value of A, B, and C axis is not used, positioning will get easy if the XYZ jog or TOOL jog movement is effected with the same value. (The direction of the hand is the same)

Fig.2-16 : Setting of the work coordinates system (teaching point)

The setting (definition) method of the work coordinates system is shown in the following.

1) Select "6.ENHANCED" screen on the <MENU> screen.

```
<MENU>

1.FILE/EDIT      2.RUN
3.PARAM.         4.ORIGIN/BRK
5.SET/INIT.      6.ENHANCED

              123        CLOSE
```

➡

```
<EMHANCED>

1.SQ DIRECT        2.WORK COORD.



              123        CLOSE
```

2) Press the [2] keys in the menu screen and select "2. WORK COORD."

```
<EMHANCED>

1.SQ DIRECT        2.WORK COORD.



              123        CLOSE
```

➡

```
<WORK COORD>      WORK NUMBER (1)
                 TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

TEACH   WX   123   WY   DEFINE
```
The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

3) Selection of the work coordinates number
Press the [FUNCTION] keys, and display "W: JUMP" function. Press the function key corresponding to "W: JUMP"

```
<WORK COORD>      WORK NUMBER (1)
                 TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

W.JUMP  W.GRID  123      CLOSE
```

➡

```
<WORK JUMP>

CHOOSE ONE OF THE WORK NUMBER
1-8.



              123        CLOSE
```

Press numeral key [1] - [8] and specify the work coordinates number. The coordinate value of the specified work coordinates system is displayed.

```
<WORK JUMP>

CHOOSE ONE OF THE WORK NUMBER
1-8.



              123        CLOSE
```

➡

```
<WORK COORD>      WORK NUMBER (2)
                 TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

W.JUMP  W.GRID  123      CLOSE
```

Operation will be canceled if the [CLOSE] key is pressed.

The screen is the example which specified the work coordinates number 2. ("2" at the upper right of the screen)

4) The teaching of the work coordinates system
Teach the three points shown in Fig. 2-16. Confirm the name currently displayed on the "TEACHING POINT" at the upper right of the screen. If it differs, press the function key corresponding to each point(WO, WX, WY) to teach. Move the robot's arm by jog operation (other jogging movement), and press the function key corresponding to "TEACH."([F1]) The confirmation screen is displayed.

```
<WORK COORD>      WORK NUMBER (2)
                 TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

TEACH   WX   123   WY   DEFINE
```

➡

```
<WORK COORD>      WORK NUMBER (2)

TEACHING POINT (WO)
RECORD CURRENT POSITION.
 OK?

Yes          123         No
```

Specify the teaching point [WO],[WX],[WY]
teaching the position [TEACH]

Presses the function key corresponding to"Yes", the robot's current position is registered, and the registered coordinates value is displaye. Operation will be canceled if the [CLOSE] key is pressed.

```
<WORK COORD>      WORK NUMBER (2)

TEACHING POINT (WO)
RECORD CURRENT POSITION.
  OK?

  Yes          123          No
```

```
<WORK COORD>      WORK NUMBER (2)
                TEACHING POINT (WO)
X: 214.12
Y: -61.23
Z: 553.30

W.JUMP W.GRID 123         CLOSE
```
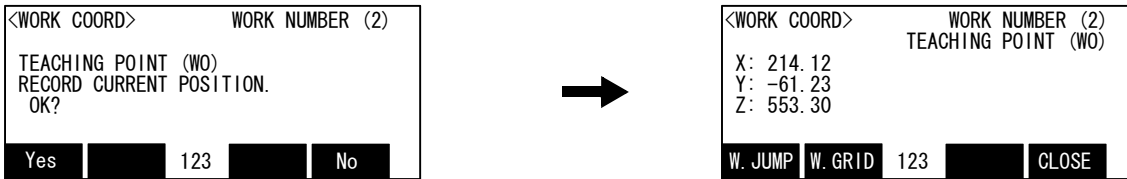
Teach the three points, WO, WX, and WY, by the same operation.
The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)
    WO= parameter: WKnWO
    WX= parameter: WKnWX
    WY= parameter: WKnWY

5) Setting of work coordinates (definition)
   If the function key corresponding to "DEFINE" ([F1]) is pressed, the work coordinates system will be calculated using the three points, and the result will be displayed.

```
<WORK COORD>      WORK NUMBER (2)
                TEACHING POINT (WO)
X: 214.12
Y: -61.23
Z: 553.30

TEACH   WX   123   WY   DEFINE
```

```
<WORK COORD>      WORK NUMBER (2)
WORK COORDINATES DATA
(3.53, -220.00, 5.14, 0.00, 0.
 00, 0.00)

              123         CLOSE
```
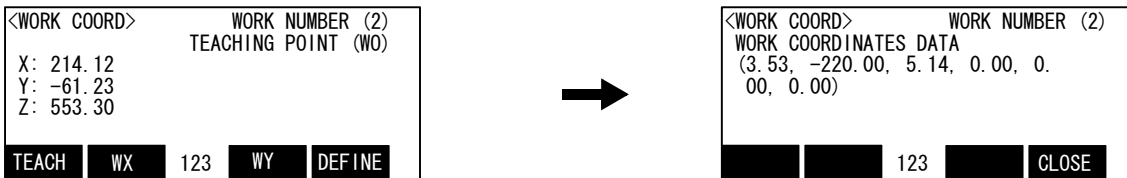
The alarm occurs if the work coordinates system is incalculable. (There are the three points on the straight line, or the two points have overlapped)   In this case, reset alarm and re-teach the three points.
This work coordinate data is registered into parameter: WKnCORD. ("n" means the work coordinates numbers 1-8)
If the function key corresponding to "CLOSE" is pressed, it will return to the previous screen.

```
<WORK COORD>      WORK NUMBER (2)
WORK COORDINATES DATA
(3.53, -220.00, 5.14, 0.00, 0.
 00, 0.00)

              123         CLOSE
```

```
<WORK COORD>      WORK NUMBER (2)
                TEACHING POINT (WO)
X: 214.12
Y: -61.23
Z: 553.30

TEACH   WX   123   WY   DEFINE
```
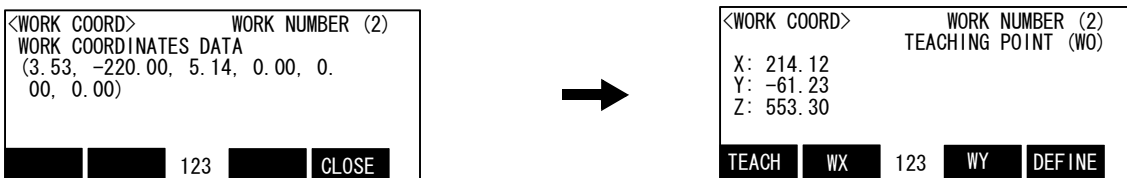
6) Finishing of setting the work coordinates
   Press the [FUNCTION] keys, and display "CLOSE" function. Press the function key corresponding to "CLOSE". Returns to the <MENU> screen.

```
<WORK COORD>      WORK NUMBER (2)
                TEACHING POINT (WO)
X: 214.12
Y: -61.23
Z: 553.30

W.JUMP W.GRID 123         CLOSE
```

```
<EMHANCED>

1.SQ DIRECT        2.WORK COORD.



              123         CLOSE
```
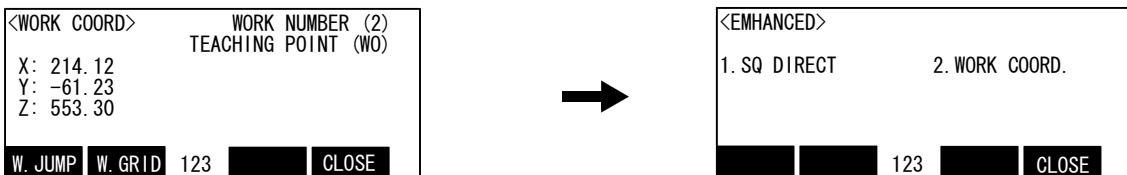
Although setting of work coordinates is finishing above, confirmation of work coordinates can be done by pressing the function key corresponding to "W GRID."([F2])

```
<WORK COORD>        WORK NUMBER (2)
                  TEACHING POINT (WO)
X: 214.12
Y: -61.23
Z: 553.30

W.JUMP W.GRID 123          CLOSE
```

➡

```
<WORK COORD>        WORK NUMBER (2)
WORK COORDINATES DATA
(3.53, -220.00, 5.14, 0.00, 0.
 00, 0.00)



            123          CLOSE
```
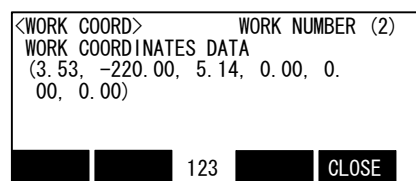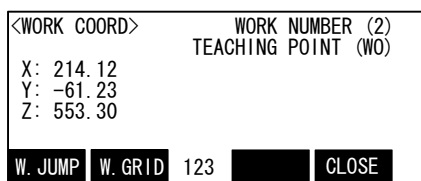
Return to the previous screen by pressing the [CLOSE] ([F4]) key.

Then, the operation method of the work jog is shown.
Change to the work jog after nearing the work.

Select WORK jog mode
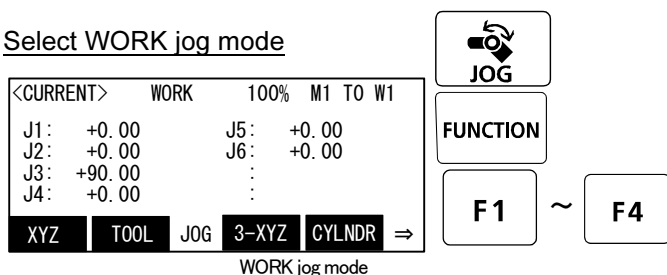
```
<CURRENT>    WORK      100%   M1 TO W1

J1:   +0.00        J5:   +0.00
J2:   +0.00        J6:   +0.00
J3:  +90.00           :
J4:   +0.00           :
XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
WORK jog mode

[JOG]
FUNCTION
F1 ~ F4

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "WORK" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "WORK."
(If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Confirmation and selection of the work coordinates system

```
<CURRENT>    WORK      100%   M1 TO W1

J1:   +0.00        J5:   +0.00
J2:   +0.00        J6:   +0.00
J3:  +90.00           :
J4:   +0.00           :
XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Select the work coordinates system

— Target work coordinates system

↑ ↓
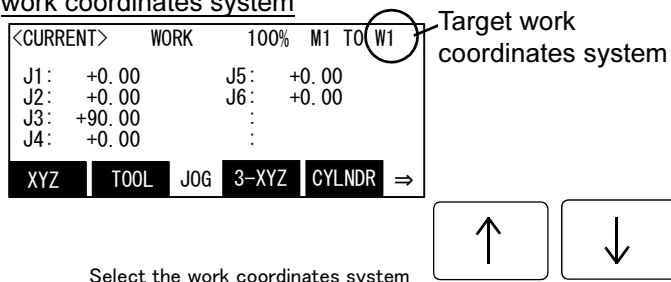
Confirm the target work coordinates system.
The current target number is displayed on the screen upper right. (W1 - W8)
The number of work coordinates can be changed by the arrow key [Upper arrow], [Lower arrow]
Push the key [Upper arrow], the number will increase. (W1, W2, ... W8) Conversely, push the key [Lower arrow], the number will decrease

⚠ CAUTION Always confirm that the number of the target work coordinates system is displayed correctly (Display of W1-W8 at the upper right of the screen)
If mistaken, the robot will move in the direction which is not meant and will cause the damage and the personal injuries.

Set jog speed

```
<CURRENT>    JOINT     100%   M1   TO

J1:   +0.00        J5:   +0.00
J2:   +0.00        J6:   +0.00
J3:  +90.00           :
J4:   +0.00           :
XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Setting the speed

OVRD↑ OVRD↓
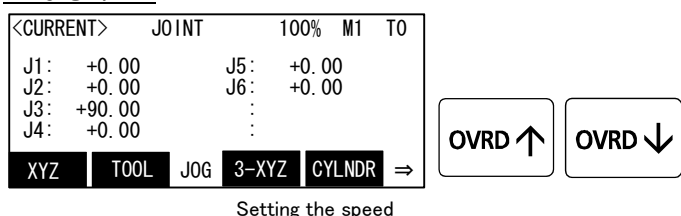
Whenever it presses the key of [OVRD(Upper arrow)], the override goes up. Conversely, if the [OVRD(Lower arrow)] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

The jog movement based on work coordinates system
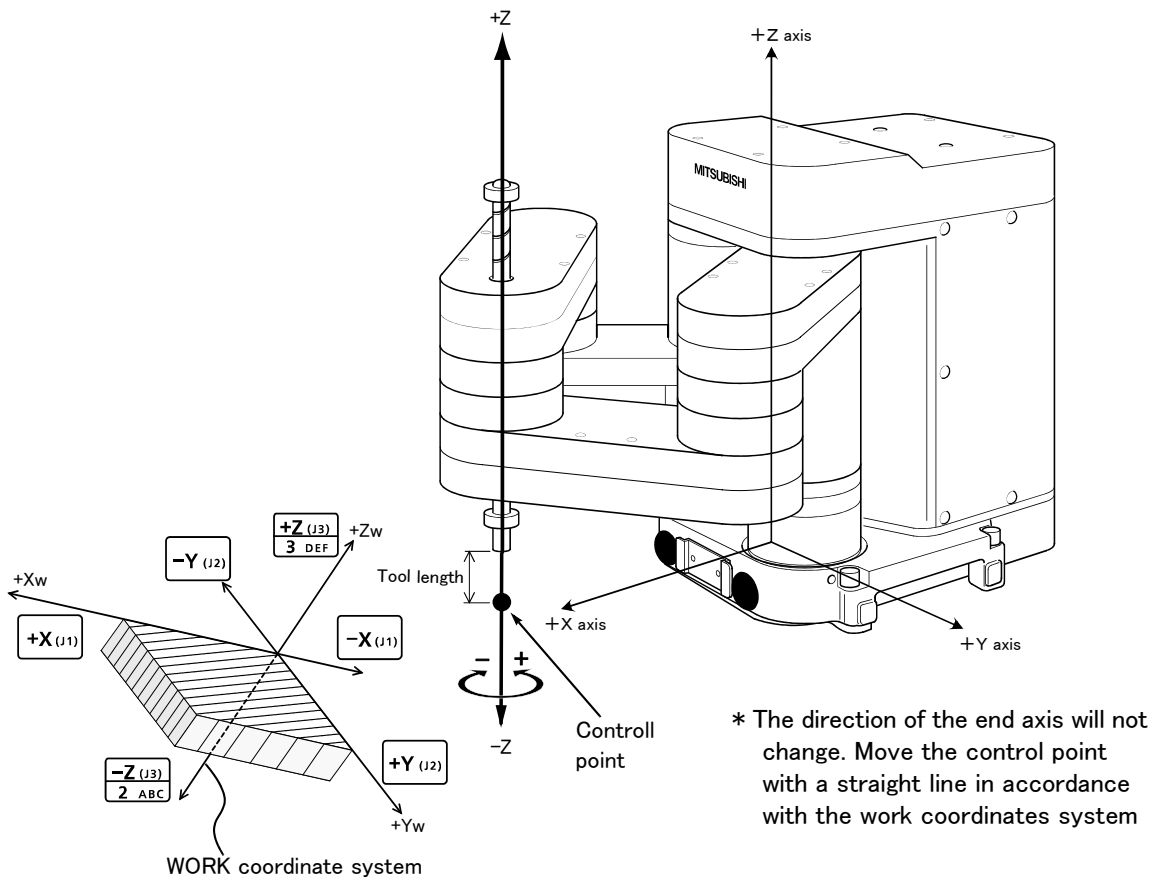
WORK coordinate system

* The direction of the end axis will not change. Move the control point with a straight line in accordance with the work coordinates system

・ When the[+X (J1)] keys are pressed, the robot will move along the X axis plus direction on the work coordinates system.
 When the[−X (J1)] keys are pressed, Move along the minus direction.
・ When the[+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction on the work coordinates system.
 When the[−Y (J2)] keys are pressed, Move along the minus direction.
・ When the[+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction on the work coordinates system.
 When the[−Z (J3)] keys are pressed, Move along the minus direction.

Changing the end axis posture

+Z

+Z axis

MITSUBISHI

+Zw

+Xw

Tool length

+X axis

+Y axis

$-C(J6)$ / 0 SP — + $+C(J6)$ / · %

Controll point

-Z

+Yw

Work coordinates system

* The position of the control point does not change. The end axis is rotated.
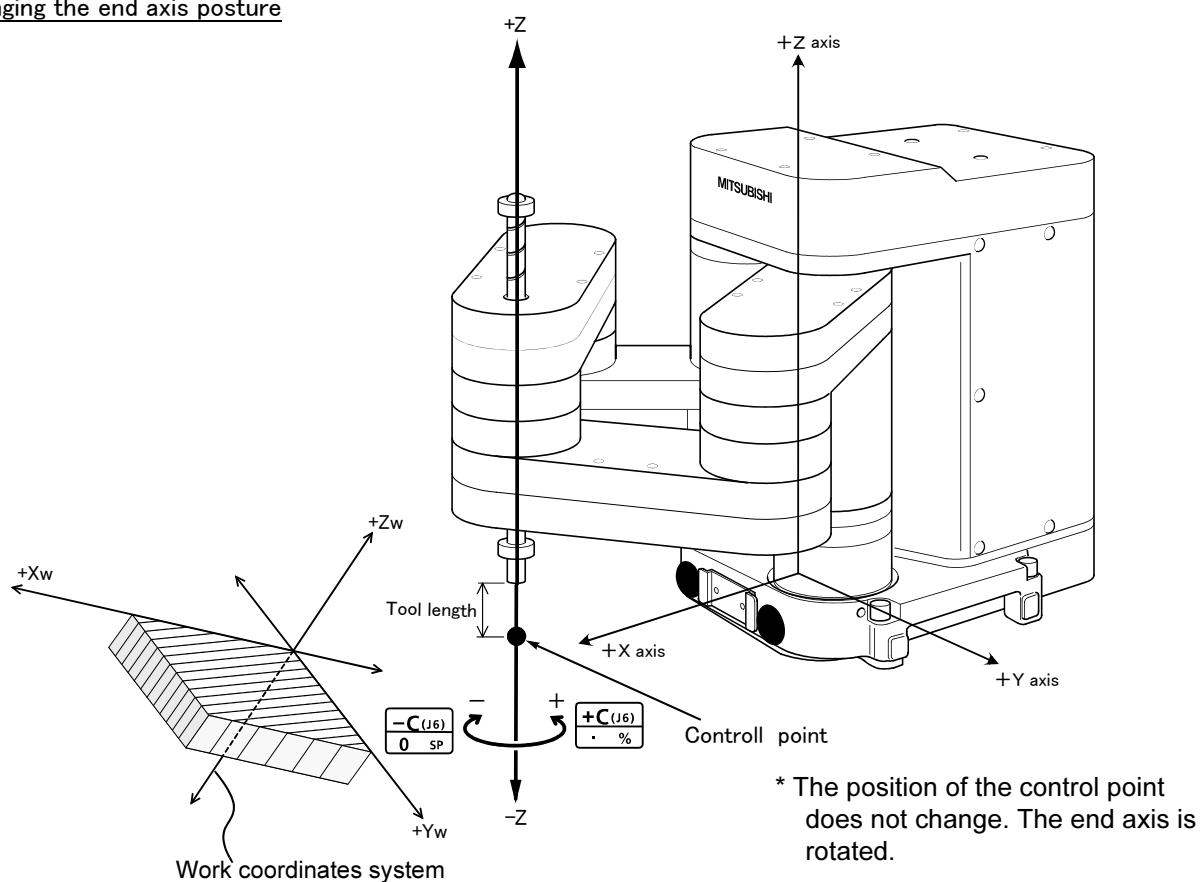
・When the[+C (J6)] keys are pressed, The Z axis will rotate in the plus direction of the XYZ coordinate system. When the[−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇
There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section page 23, ″(1) JOINT jog operation″″, and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇
If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

◇◆◇ Tool length ◇◆◇
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual ″Detailed Explanation of Functions and Operations″ for details.

3 Installing the option devices

3.1 Installing the solenoid valve set (1A-VD04-RP/1A-VD04E-PR)
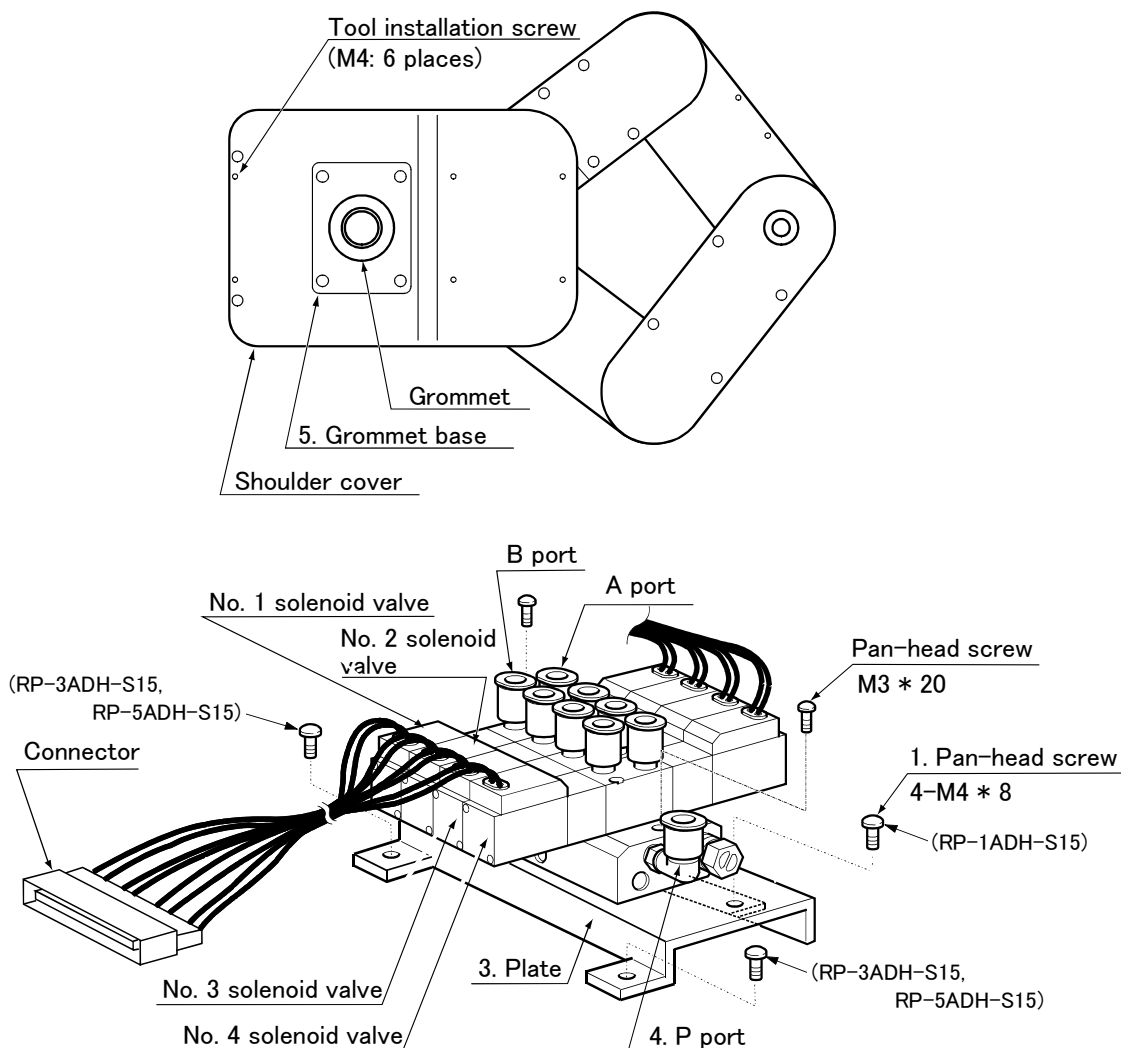
Fig.3-1 : Solenoid valve installation procedures

   The procedures for installing the solenoid valve and connecting the connector are shown in Fig. 3-1. The installation procedures are as follow.

   1) Using the tool installation screw holes (M4 screws; 6 places) on the top of the shoulder cover, install the plate 3 onto which the solenoid valve is installed.
   2) Connect the user-prepared air hose ϕ6 to the quick-coupling (P port) 4 of the solenoid valve.
   3) Remove the grommet base 5 installed on the top of the shoulder cover.
   4) Using a knife, cut the center of the grommet on the removed grommet base 5. Pass the solenoid valve side connector through the hole, and connect to the connector (GR) installed on the connector base.
   5) Return the grommet base 5 to its original position.

4 Basic operations

The basic operations from creating the program to automatic operation are explained in section "4. Basic operations" in the "Controller setup, basic operation, and maintenance" manual. Refer that manual as necessary.

5 Maintenance and Inspection

The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

5.1 Maintenance and inspection interval

Maintenance and inspection are divided into the inspections carried out daily, and the periodic inspections carry out at set intervals. Always carry these out to prevent unforeseen trouble, to maintain the product for a long time, and to secure safety.

（1）Inspection schedule
In addition to the monthly inspection, add the following inspection items every three months (estimated at 500 Hr operation hours).

Operating time	Daily inspection	Monthly inspection	3-month inspection	6-month inspection	Yearly/6-years
0 Hr		Monthly inspection			
		Monthly inspection			
500 Hr		Monthly inspection	3-month inspection		
		Monthly inspection			
		Monthly inspection			
1000 Hr		Monthly inspection	3-month inspection	6-month inspection	
		Monthly inspection			
		Monthly inspection			
1500 Hr		Monthly inspection	3-month inspection		
		Monthly inspection			
		Monthly inspection			
2000 Hr		Monthly inspection	3-month inspection	6-month inspection	Yearly inspection
12000 Hr		Monthly inspection	3-month inspection	6-month inspection	6-years inspection

＜Guideline for inspection period＞
    For one shift
        8 Hr/day x 20 days/month x 3 months = approx. 500 Hr
        10 Hr/day x 20 days/month x 3 months = approx. 600 Hr
    For two shifts
        15 Hr/day x 20 days/month x 3 months = approx. 1000 Hr
    [Caution] When using two lines, the 3-month inspection, 6-month inspection and yearly
          inspection must be carried out when half the time has passed.

Fig.5-1 : Inspection schedule

5.2 Inspection items

The inspection items for the robot arm are shown below.

Also refer to section "5 Maintenance and Inspection" in the "Controller setup, basic operation, and maintenance" manual, and inspect the controller.

5.2.1 Daily inspection items

Carry out the daily inspections with the procedures given in Table 5-1.

Table 5-1 : Daily inspection items (details)

Procedure	Inspection item (details)	Remedies
Before turning power ON (Check the following items before turning the power ON.)		
1	Are any of the robot installation bolts loose? (Visual)	Securely tighten the bolts.
2	Are any of the cover tightening screws loose? (Visual)	Securely tighten the screws.
3	Are any of the hand installation bolts loose? (Visual)	Securely tighten the bolts
4	Is the power supply cable securely connected? (Visual)	Securely connect.
5	Is the machine cable between the robot and controller securely connected? (Visual)	Securely connect.
6	Are there any cracks, foreign contamination or obstacles on the robot and controller cover?	Replace with a new part, or take remedial measures.
7	Is any grease leaking from the robot arm? (Visual)	After cleaning, replenish the grease.
8	Is there any abnormality in the pneumatic system? Are there any air leaks, drain clogging or hose damage? Is the air source normal? (Visual)	Drain the drainage, and remedy the air leaks (replace the part).
After turning the power ON (Turn the power ON while monitoring the robot.)		
1	Is there any abnormal motion or abnormal noise when the power is turned ON?	Follow the troubleshooting section.
During operation (try running with an original program)		
1	Check whether the movement points are deviated? Check the following points if there is any deviation. 1. Are any installation bolts loose? 2. Are any hand installation section bolts loose? 3. Are the positions of the jigs other than the robot deviated? 4. If the positional deviation cannot be corrected, refer to "Troubleshooting", check and remedy.	Follow the troubleshooting section.
2	Is there any abnormal motion or abnormal noise? (Visual)	Follow the troubleshooting section.

5.2.2 Periodic inspection

Carry out periodic inspection with the procedures given in Table 5-2.

Table 5-2 : Periodic inspection items (details)

Procedure	Inspection item (details)	Remedies
Monthly inspection items		
1	Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.
2	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
3	Remove the cover at each section, and check the cables for wear damage and adherence of foreign matter.	Check and eliminate the cause. If the cables are severely damaged, contact the Mitsubishi Service Department.
4	It runs out of grease on the ball screw?	Lubricate it.(The grease)
3-month inspection items		
1	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.
6-month inspection items		
1	Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.
Yearly inspection items		
1	Replace the backup battery in the robot arm.	
6-years inspection items		
1	Lubricate the grease at the harmonic reduction gears for each axis.	

5.3 Maintenance and inspection procedures

The procedures for carrying out the periodic maintenance and inspection are described in this section. Thoroughly read the contents, and follow the instructions. This work can be commissioned to the Mitsubishi Service Department for a fee. (Never disassemble, etc., the parts not described in this manual.)

The maintenance parts, etc., required for the user to carry out maintenance and inspection are described in section "5.4 Maintenance parts" on page 59 of this manual. Always contact your dealer when parts are needed.

⚠️ **CAUTION**   The origin of the machine system could deviate when this work is carried out. "Review of the position data" and "re-teaching" will be required.

5.3.1 Robot arm structure
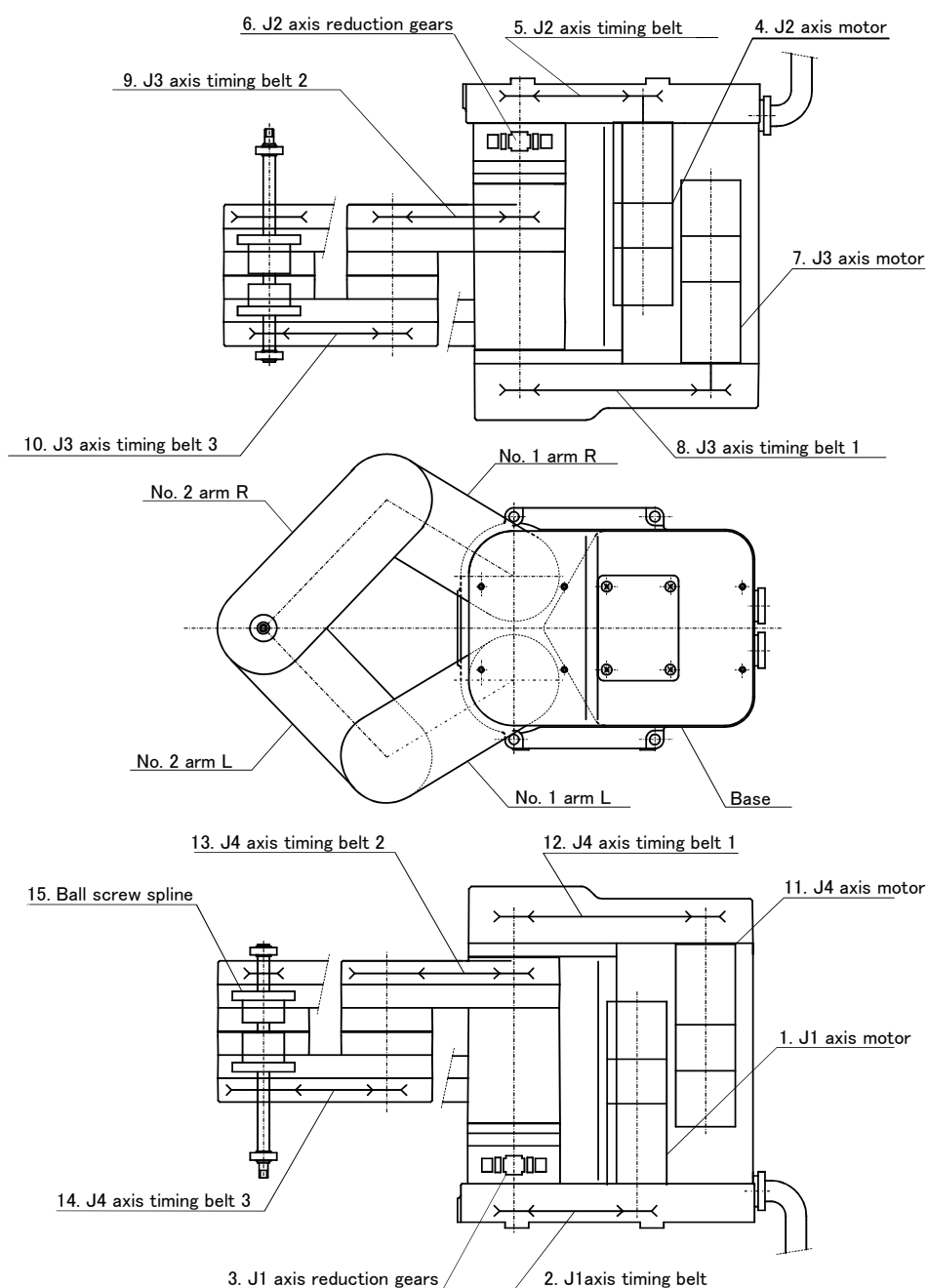
Fig.5-2 : Outline structure of robot arm

（1）J1 axis
The rotation of the J1 axis motor 1 installed on the base, is conveyed through the timing belt 2 to the reduction gears 3 to drive the J1 axis.
Non-excitation magnetic brakes are mounted on the J1 axis motor 1.

（2）J2 axis
The rotation of the J2 axis motor 4 installed on the base, is conveyed through the timing belt 5 to the reduction gears 6 to drive the J2 axis.
As with the J1 axis, non-excitation magnetic brakes are mounted on the J2 axis motor 4.

（3）J3 axis
The rotation of the J3 axis motor 7 installed on the base is conveyed through the timing belt 1 8, timing belt 29 and timing belt 3 10, to the ball screw nut of the ball screw spline 15 to drive the J3 axis vertically. As with the J1 axis, non-excitation magnetic brakes are mounted on the J3 axis motor 7.

（4）J4 axis
The rotation of the J4 axis motor 11 installed on the base is conveyed through the timing belt 1 12, timing belt 2 13 and timing belt 3 14, to the spline nut of the ball screw spline 15 to drive the J4 axis.

5.3.2 Installing/removing the cover

Fig.5-3 : Installing/removing the cover
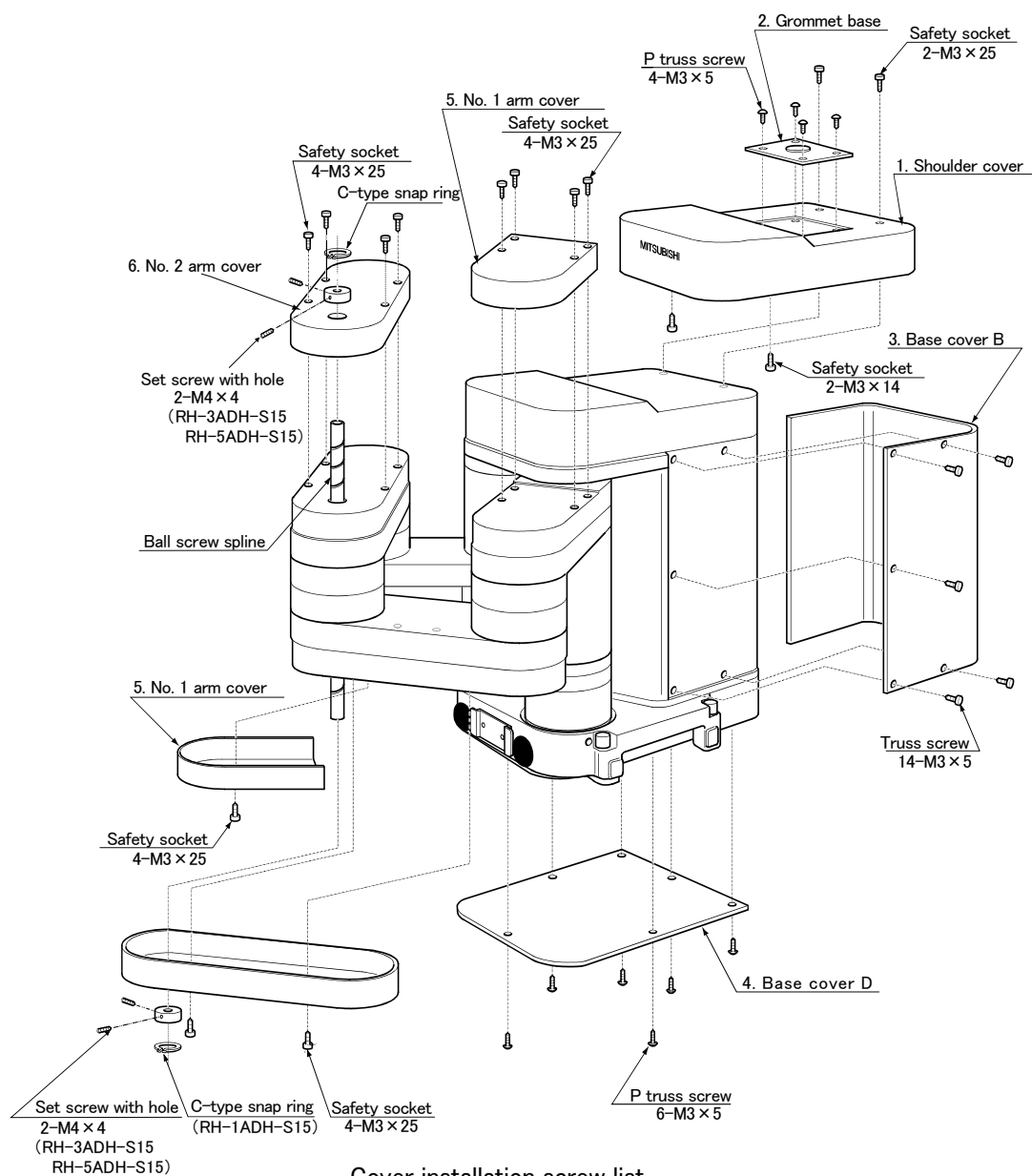
Cover installation screw list

No.	Installation screw name	RP-1ADH-S15		RP-3ADH-S15 RP-5ADH-S15	
		Size	Q'ty	Size	Q'ty
1	P truss screw	M3 x 5	6	M4 x 8	6
2	Truss screw		14		14
3	Safety socket	M3 x 14	2	M4 x 10	3
4	Safety socket	M3 x 25	2	M4 x 30	2
5	P truss screw	M3 x 5	4	M3 x 5	4
6	Safety socket	M3 x 20	4 each	M3 x 16	4 each
7	Safety socket				
8	Safety socket				
9	Safety socket				

(1) Refer to Fig. 5-3 and remove the cover. A list of the cover installation screw is given in the drawing.
(2) When installing the cover after maintenance and inspection, install using the removal procedure in reverse.

5.3.3 Inspecting, servicing, replacing and cleaning the timing belt

This robot uses a timing belt for the drive conveyance system. Compared to gears and chains, the timing belt does not require lubrication and has a low noise. However, if the belt usage method and tension adjustment are inadequate, the life could drop and noise could be generated. Sufficient aging to remove the initial elongation of the belt, and adjustment of the belt tension have been carried out before shipment from the factory.

However, depending on the robot working conditions, elongation will occur gradually over a long time. The tension must be confirmed during the periodic inspection. The timing belt must be replaced in the following cases.

（1）Timing belt replacement period

The timing belt life is greatly affected by the robot working conditions, so a set time cannot be given. However, if the following symptoms occur, replace the belt.

　　1）When cracks form at the base or back of the belt teeth.
　　2）When the belt expands due to adherence of oil, etc.
　　3）When the belt teeth wear (to approx. half of the tooth width).
　　4）When the belt teeth jump due to belt teeth wear.
　　5）When the belt snaps.

⚠ **CAUTION**　Due to the manufacturing of the timing belt, initial wear will occur. Wear chips may accumulate in the cover after approx. 300 Hr of operating the robot, but this is not a fault. If the wear chips appear soon after wiping them off, replace the belt.

⚠ **CAUTION**　When the belt is replaced, the origin of the machine system could deviate. In this case, review the position data.

(2) Inspecting, adjusting and replacing the upper base timing belt
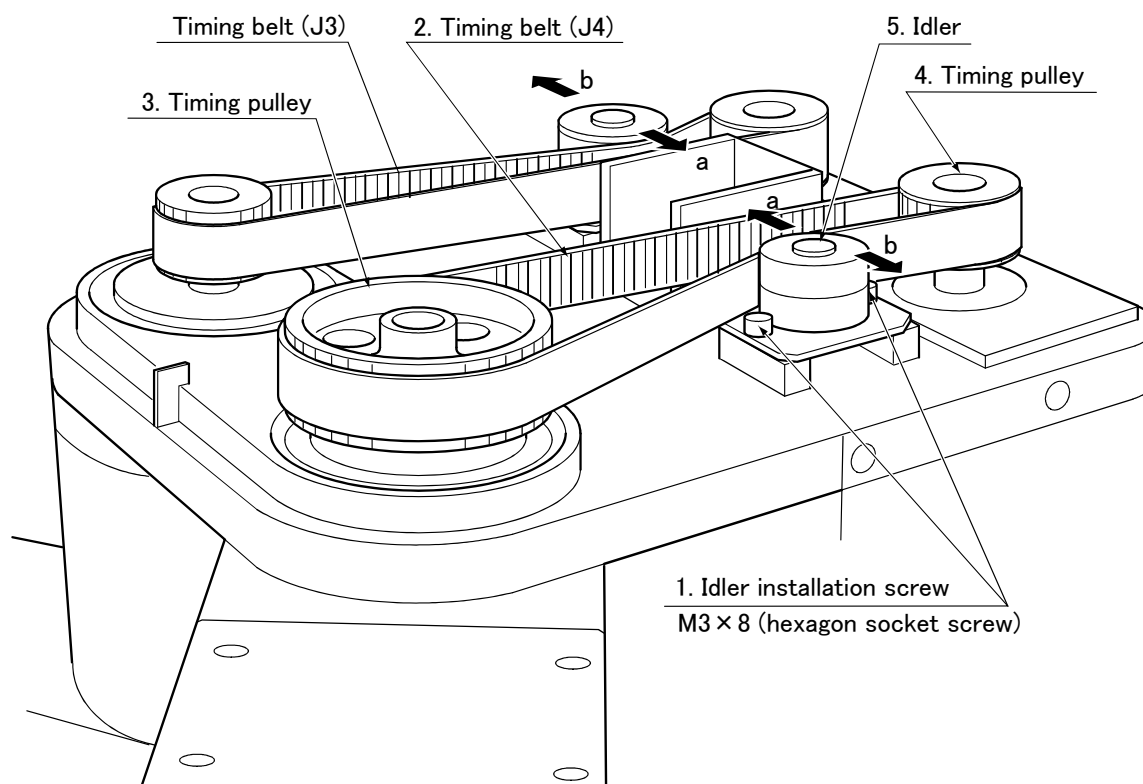
Fig.5-4 : Inspecting, adjusting and replacing the upper base timing belt

■ Inspection method
1) Confirm that the robot controller power is OFF.
2) Following "Fig. 5-3: Installing/removing the cover" on page 46 remove the shoulder cover.
3) Visually check that the symptoms listed in "(1) Timing belt replacement period" on page 47 above have not occurred on the belt.
4) Refer to "(6) Timing belt tension" on page 53 for the belt tension, and confirm that the belt deflection is adequate.

■ Adjustment method
1) Carry out steps 1) and 2) in the "■ Inspection method" above.
2) Loosen the two idler screws 1. (Do not loosen too far.)
3) While checking the timing belt 2 tension degree, move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 53.
4) When moved in the direction of arrow a in the drawing, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
5) Do not loosen the belt too much causing it to come off the timing pulleys 3 and 4, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.
7) Adjust the other belt with the same method.

■ Replacement method
1) Carry out steps 1) and 2) in the "■ Inspection method" above.
2) Loosen the two idler installation screws 1.
3) Remove the old belt, and install a new one.
4) Move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 53.
5) After replacing the belt, refer to "5.5 Resetting the origin" on page 61, and reset the origin.

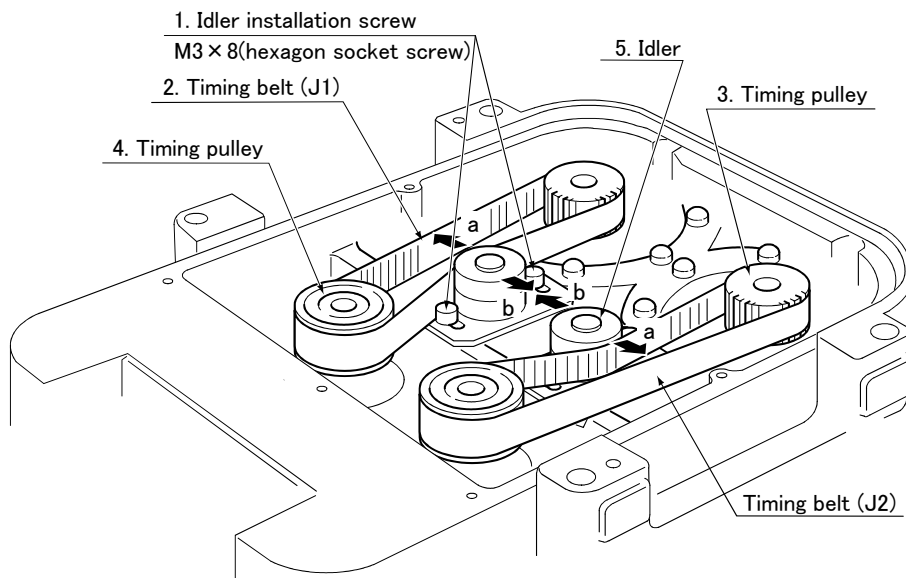(3) Inspecting, adjusting and replacing the lower base timing belt

Fig.5-5 : Inspecting, adjusting and replacing the lower base timing belt

■ Inspection method
1) Move the robot to near the following position by jog operation.
   Position: RP-1ADH-S15 ....(X,Y,Z) = (95,0,0)
               RP-3ADH-S15, RP-5ADH-S15 ....(X,Y,Z) = (175,0,0)
2) Turn the robot controller power OFF.
3) Referring to Fig. 5-5, install so that the robot arm installation surface faces upward.

⚠ CAUTION   Take special care so that the load is not applied on the ball screw spline axis when the robot is tilted.

4) Following "Fig. 5-3: Installing/removing the cover" on page 46, remove the base cover D.
5) Visually check that the symptoms listed in "(1) Timing belt replacement period" on page 47 above have not occurred on the belt.
6) Refer to "(6) Timing belt tension" on page 53" for the belt tension, and confirm that the belt deflection is adequate.

■ Adjustment method
1) Carry out steps 1) and 2) in the "■ Inspection method" above.
2) Loosen the two idler screws 1. (Do not loosen too far.)
3) While checking the timing belt 2 tension degree, move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 53.
4) When moved in the direction of arrow a in the drawing, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
5) Do not loosen the belt too much causing it to come off the timing pulleys 3 and 4, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.
7) Adjust the other belt with the same method.

■ Replacement method
1) Carry out steps 1) and 2) in the "■ Inspection method" above.
2) Loosen the two idler screws 1.
3) Remove the old belt, and install a new one.
4) Move the idler 5 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 53.
5) After replacing the belt, refer to "5.5 Resetting the origin" on page 61, and reset the origin.

(4) Inspecting, adjusting and replacing the timing belt in No. 1 arm

5. Timing pulley

3. Idler

1. Idler installation screw
M3 × 8 (hexagon socket screw)

2. Timing belt (J4)

a

b

No. 1 arm L

4. Timing pulley

[Caution]
This drawing shows the timing belt for the J4 axis.
The J3 axis timing belt is also mounted with the same structure under the No. 1 arm R on the opposite side.

<u>(a) Inspecting, adjusting and replacing methods</u>

7. Installation screw

7. Installation screw

6. Pulley housing

8. M3 screw hole

8. M3 screw hole

9. Shaft

6. Pulley housing
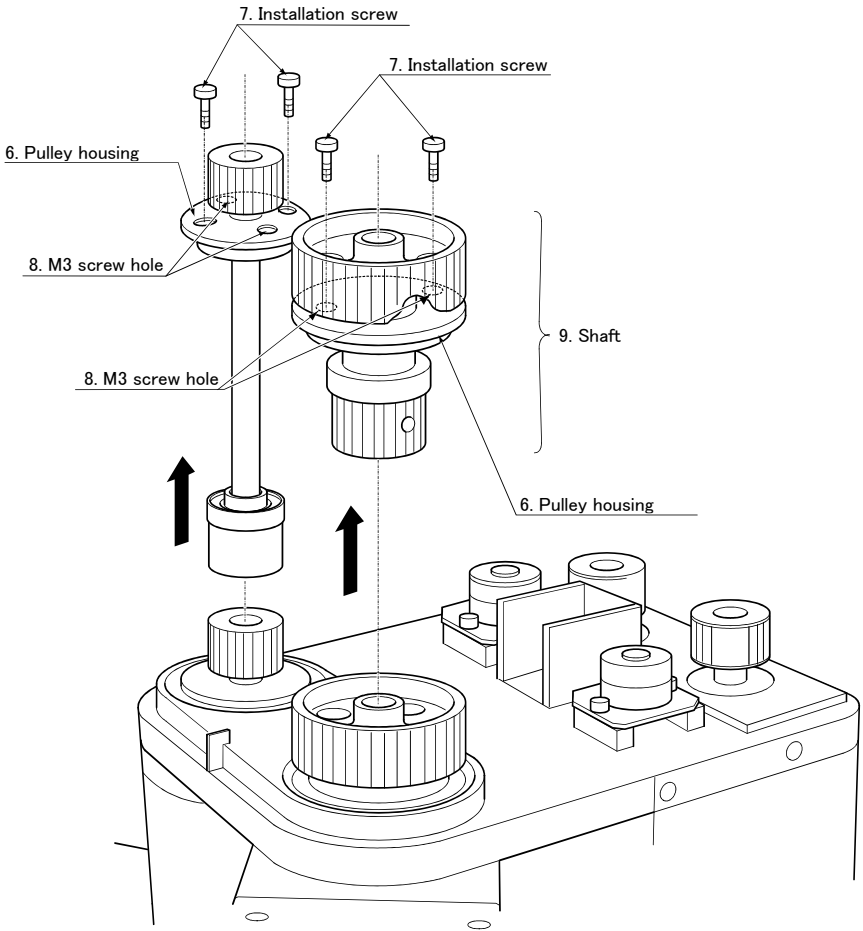
<u>(b) Removing the shaft</u>

Fig.5-6 : Inspecting, adjusting and replacing the timing belt in No. 1 arm

■ Inspection method
    1) Confirm that the robot controller power is OFF.
    2) Following *"Fig. 5-3: Installing/removing the cover" on page 46*, remove the No. 1 arm covers (L) and (R).
    3) Visually check that the symptoms listed in *"(1) Timing belt replacement period" on page 47* above have not occurred on the belt.
    4) Refer to *"(6) Timing belt tension" on page 53* for the belt tension, and confirm that the belt deflection is adequate.
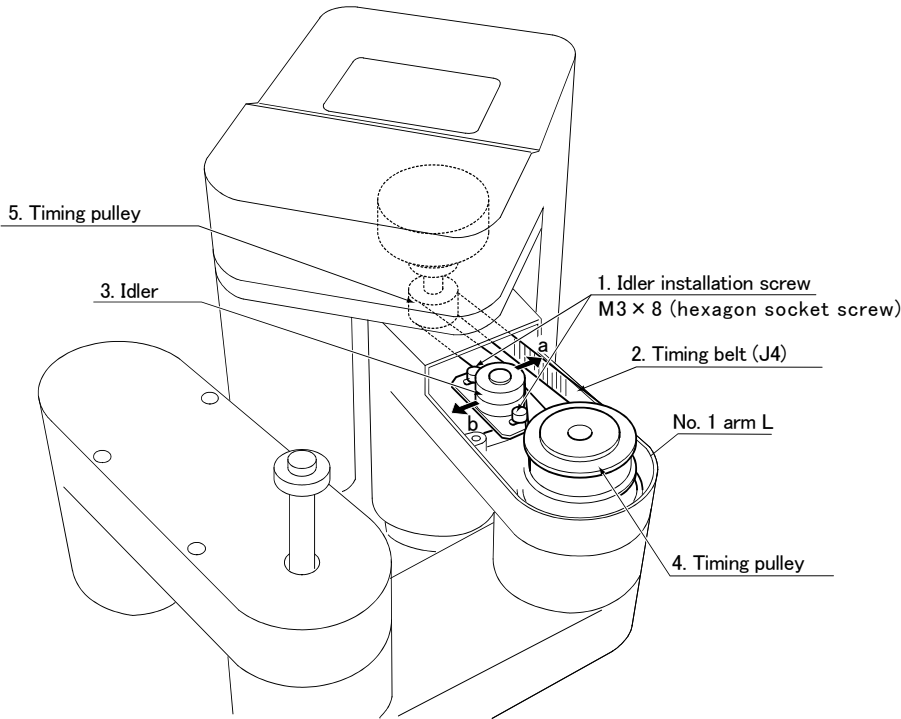
■ Adjustment method
    1) Carry out steps 1) and 2) in the *"■ Inspection method"* above.
    2) Loosen the two idler screws 1. (Do not loosen too far.)
    3) While checking the timing belt 2 tension degree, move the idler 3 in the direction of the arrow in the drawing until it is at the adequate tension position given in *"(6) Timing belt tension" on page 53*.
    4) When moved in the direction of arrow a, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
    5) Do not loosen the belt too much causing it to come off the timing pulleys 4 and 5, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
    6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.

■ Replacement method
    1) Carry out steps 1) and 2) in the *"■ Inspection method"* above.
    2) Loosen the two idler screws 1.
    3) Refer to *"(2) Inspecting, adjusting and replacing the upper base timing belt" on page 48*, and remove the timing belt on the upper base.
    4) Remove the two 7 installation screws for the 6 pulley housing fixing the pulley on the front of the robot at the upper base.
    5) Pull the shaft installed on the pulley in the direction of the arrow in the drawing, and remove the belt. (If the shaft is rigid and cannot be removed, screw the 7 installation screws, removed previously, into the two 8 M3 screw holes, and tighten each equally. The pulley housing will come off easier.)
    6) nstall the new timing belt. Also install the timing belt on the upper base.
    7) Adjust the tension referring to *"(6) Timing belt tension" on page 53*.
    8) After replacing the belt, refer to *"5.5 Resetting the origin" on page 61*, and reset the origin.

(5) Inspecting, adjusting and replacing the timing belt in No. 2 arm
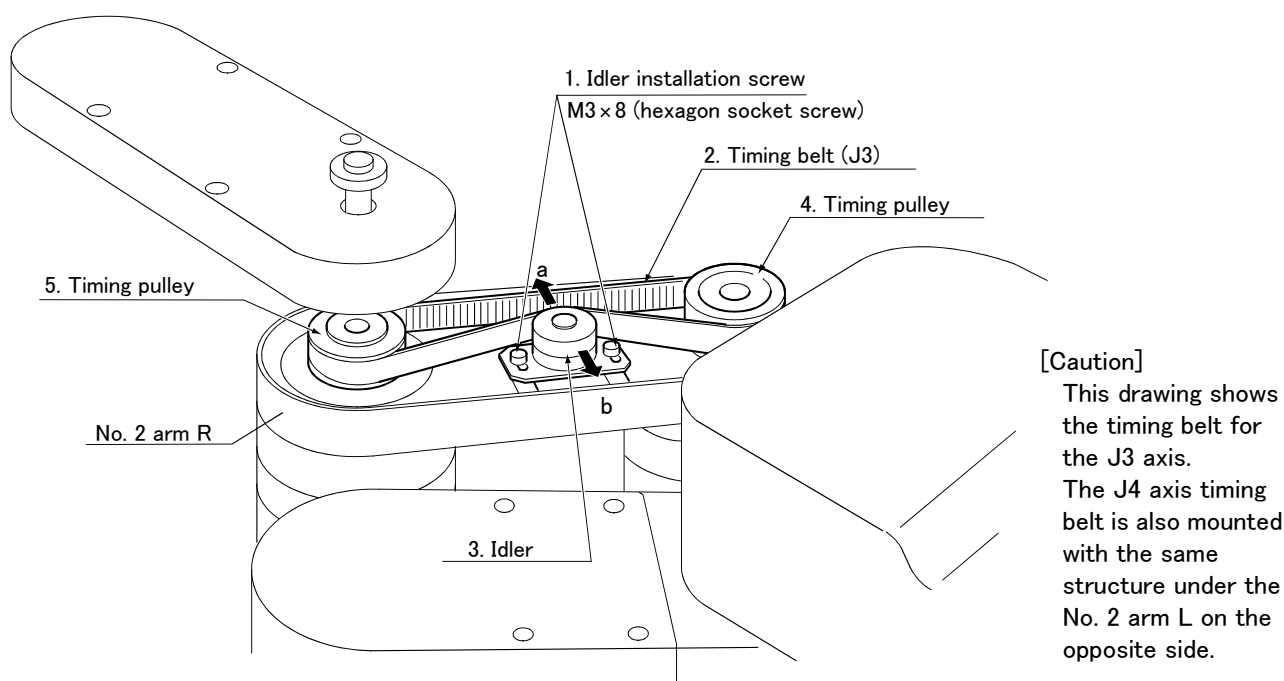
Fig.5-7 : Inspecting, adjusting and replacing the timing belt in No. 2 arm

■ Inspection method
  1) Confirm that the robot controller power is OFF.
  2) Following "Fig. 5-3: Installing/removing the cover" on page 46, remove the No. 1 arm cover (L) and (R).
  3) Visually check that the symptoms listed in "(1) Timing belt replacement period" on page 47 above have not occurred on the belt.
  4) Refer to "(6) Timing belt tension" on page 53 for the belt tension, and confirm that the belt deflection is adequate.

■ Adjustment method
  1) Carry out steps 1) and 2) in the "■ Inspection method" above.
  2) Loosen the two idler screws 1. (Do not loosen too far.)
  3) While checking the timing belt 2 tension degree, move the idler 3 in the direction of the arrow in the drawing until it is at the adequate tension position given in "(6) Timing belt tension" on page 53".
  4) When moved in the direction of arrow a in the drawing, the belt will be tensed, and when moved in the direction of arrow b, the belt will be loosened.
  5) Do not loosen the belt too much causing it to come off the timing pulleys 4 and 5, or deviate the belt and pulley teeth engagement when adjusting the tension. Doing so could cause the machine system's origin to deviate.
  6) After adjusting, securely tighten the two idler installation screws 1. If the idler is improperly tightened, it could loosen due to vibration.

■ Replacement method
  1) Carry out steps 1) and 2) in the "■ Inspection method" above.
  2) Loosen the two idler screws 1.
  3) Remove the old belt, and install a new one.
  4) Adjust the tension referring to "(6) Timing belt tension" on page 53.
  5) After replacing the belt, refer to "5.5 Resetting the origin" on page 61, and reset the origin.
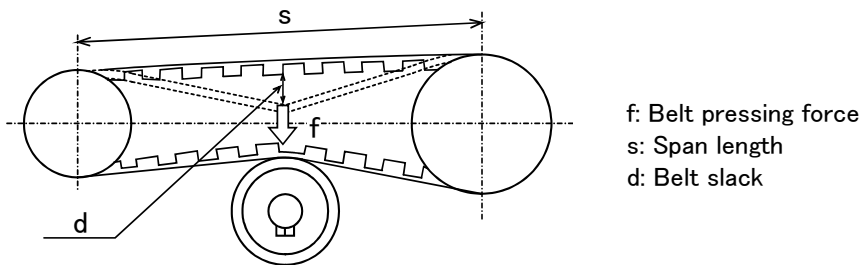
(6) Timing belt tension

f: Belt pressing force
s: Span length
d: Belt slack

Belt adjustment value

Axis	Part No.	Belt type	Span: s （mm）	Slack: d （mm）	Pressing force: f （N）
Type: RP-1ADH-S15					
J1 axis	2	246-3GT-9	86.5	1.3	3.0
J2 axis	5	246-3GT-9	86.5	1.3	3.0
J3 axis	8	327-3GT-9	128	2.0	3.0
	9	270-3GT-9	100	1.6	3.0
	10	382-2GT-4	140	2.0	0.3
J4-axis	12	363-3GT-9	127	2.0	3.0
	13	315-3GT-9	100	1.6	3.0
	14	393-3GT-6	140	2.0	1.0
Type: RP-3ADH-S15					
J1 axis	2	318-3GT-12	107.5	1.7	4.0
J2 axis	5	318-3GT-12	107.5	1.7	4.0
J3 axis	8	444-3GT-9	170	2.7	3.0
	9	375-3GT-9	140	2.2	3.0
	10	543-3GT-9	200	3.1	3.0
J4-axis	12	513-3GT-	180	2.8	3.0
	13	444-3GT-9	140	2.2	3.0
	14	558-3GT-9	200	3.1	3.0
Type: RP-5ADH-S15					
J1 axis	2	318-3GT-12	107.5	1.7	4.0
J2 axis	5	318-3GT-12	107.5	1.7	4.0
J3 axis	8	444-3GT-9	170	2.7	3.0
	9	495-3GT-9	200	3.1	3.0
	10	666-3GT-9	260	4.1	3.0
J4-axis	12	513-3GT-9	180	2.8	3.0
	13	561-3GT-9	200	3.1	3.0
	14	681-3GT-9	260	4.1	3.0

Fig.5-8 : Belt tension

The timing belt can satisfactorily convey the drive and keep a durable force only when it has an adequate tension. The belt tension should not be too tight or too loose. Instead, it should be adjusted to a degree that elasticity is felt when the belt is pressed with the thumb. If the belt tension is too weak, （Range of adjustment of slack: ±10% of the value） the belt loosening side will vibrate. On the other hand, if the belt tension is too strong, a sharp sound will be heard and the belt tension side will vibrate. If tension adjustment is inadequate, there is a possibility that the position deviates, the belt wears out early, and the bearing which supports the belt breaks down. Please note. The adjustment value for the tension degree is shown in Fig. 5-8.
Check and adjust with the belt pressing force f and the slack amount d between span s.

5.3.4 Lubrication
(1) Lubrication positions and specifications
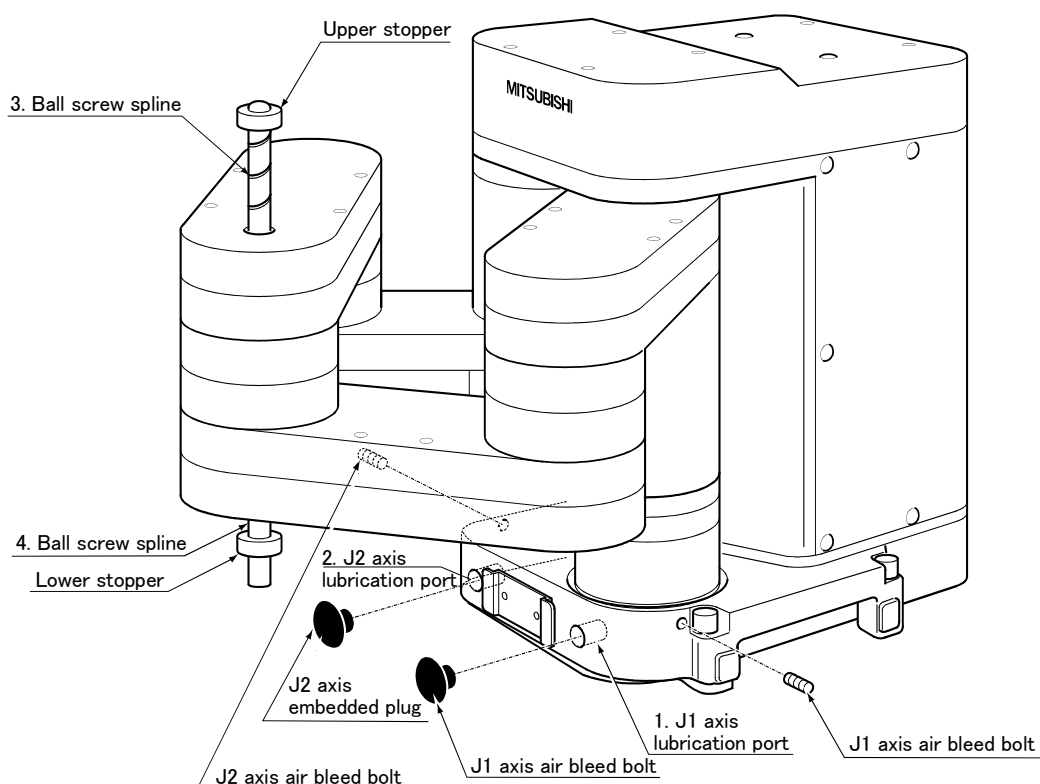
Fig.5-9 : Lubrication positions

Table 5-3 : Lubricant specifications

No.	Lubrication position	Lubrication method	Supplied lubricant Amount charged at shipment	Lubrication time guideline Lubrication amount guideline
1	J1 axis reduction gears	Grease nipple WC-610	Harmonic grease 4B No. 2 RP-1ADH-S15: 0.5g RP-3ADH-S15: 16g RP-5ADH-S15: 16g	12000Hr RP-1ADH-S15: 3.5g RP-3ADH-S15: 10g RP-5ADH-S15: 10g
2	J2 axis reduction gears			
3,4	Ball screw spline	Hand painting	Marutenpu PS No.2 RP-1ADH-S15: 0.2cc RP-3ADH-S15: 0.8cc RP-5ADH-S15: 0.8cc	250Hr RP-1ADH-S15: 0.2cc RP-3ADH-S15: 0.8cc RP-5ADH-S15: 0.8cc

[Caution]
＊ The brands of grease given in Table 5-3 are those filled when the robot is shipped.
＊ The lubrication time is a cumulative value of the operation at the maximum speed. If the operation is intermittent, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
＊ Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
＊ The numbers in the above table correspond to the supply positions in Fig. 5-9.

(2) Lubrication method of J1, J2 axis reduction gears
  1) Set the robot to the posture shown in Fig. 5-9. Take care not to put the ball screw spline axis near the grease lubrication port at this time.
  2) Remove the embedded plug shown in Fig. 5-9.
  3) Remove the air bleed bolt.
  4) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple.
  5) Install the air bleed bolt.
  6) Install the embedded plugs using the procedure in reverse.

  [Note]Check the timing belt of 6-month inspection items together. At this time, confirm the grease doesn't leak out. Please lubricate a regulated amount of grease. if the amount of the grease lubricating is too much, grease might leak. Please confirm the amount of discharge of a grease gun beforehand. Wipe it out beautifully when the grease leak out and it sticks to the timing belt, and so on.

(3) Lubrication method of ball screw spline
  1) Release the brake of J3 axis, and move up until the lower stopper of the ball screw spline interferes in the cover
  Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for the method of releasing the brake.
  2) Turn off the controller's power supply and wipe the old grease on the exposed ball screw spline, and then paint the grease shown in the Table 5-3.
  3) Turn on the controller's power supply and release the brake of J3 axis, and move down until the upper stopper of the ball screw spline interferes in the cover, and let applied grease get used. Wipe out the grease left after it got used.
  4) Turn off the controller's power supply and wipe the old grease on the exposed ball screw spline, and then paint the grease shown in the Table 5-3.
  5) Turn on the controller's power supply and release the brake of J3 axis, and move up until the lower stopper of the ball screw spline interferes in the cover, and let applied grease get used. Wipe out the grease left after it got used.

5.3.5 Replacing the backup battery

An absolute encoder is used for the position detector, so the position must be saved with the backup battery when the power is turned OFF. The controller also uses a backup battery to save the program, etc. These batteries are installed when the robot is shipped from the factory, but as these are consumable parts, they must be replaced periodically by the customer.

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state.

Error No. 7520 :Battery consumption time is over
Error No. 133n :Encoder battery voltage low. (n indicates the axis number.)
　　　　　　　　(The encoder battery voltage of the robot arm is low.)
Error No. 7510 :Battery voltage low (R/C)
　　　　　　　　(The battery voltage of the controller is low.)
Error No. 7500 :No battery voltage
　　　　　　　　(The battery of the controller is depleted.)

⚠ **CAUTION**　If error No. 7500 occurs, the program data and other data in the controller is lost and it becomes necessary to load the data again.
　　　　　　　　If any of the battery-related errors above occur and the robot continues to be used, the data integrity of the memory cannot be guaranteed. If an error occurs, replace the batteries of both the robot arm and controller promptly.
　　　　　　　　It is also recommended to save programs and position data on the personal computer side via the personal computer support software and so forth in advance.

（1）Replacing the robot arm battery

⚠ **CAUTION**   Don't disconnect connector, etc. While replacing the battery, the encoder position data is saved by the power supplied from the controller. Thus, if the cable connection is incomplete, the encoder position data will be lost when the controller power is turned OFF. Several batteries are used in the robot arm, but replace all old batteries with new batteries at the same time.

2. Installation screws（10 pcs.）

1.Connector box cover

Part A

Lead connector

3. Connector box
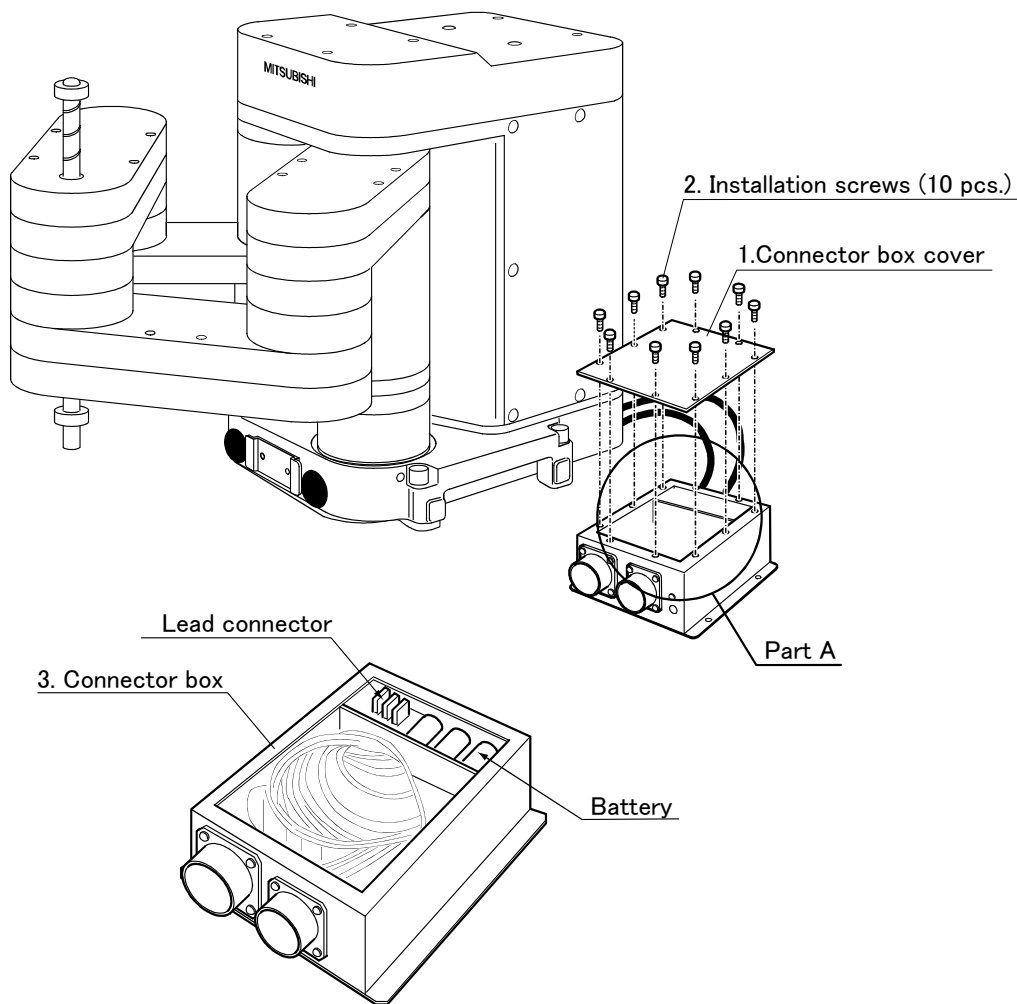
Battery

Details of part A

Fig.5-10 : Replacing the battery

1）Check that the cable between the robot unit's connector box and controller is securely connected.
2）Turn the controller power ON.
   While replacing the battery, the position data is saved by the power supplied from the controller. Thus, if the cable connection is incomplete or if the controller power is OFF, the position data will be lost.
3） Press the emergency stop button to place the robot in the emergency stop state. This must be carried out for safety purposes.
4）Remove the installation screws 2 shown in Fig. 5-10, and remove the connector box cover 1.
5）There is a battery holder in the connector box 3. Remove the old battery from the holder, and disconnect the lead connector.
6）Insert the new battery into the holder, and connect the lead connector. Make sure to replace all batteries with new ones.
7）Install the connector box cover 1 with the above steps in reverse.
8）Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

⚠ CAUTION   The encoder position data will be lost if the battery does not function correctly due to a disconnected connector, etc. While replacing the battery, the encoder position data is saved by the power supplied from the controller. Thus, if the cable connection is incomplete, the encoder position data will be lost when the controller power is turned OFF.

5.4 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-4, and spare parts that may be required during repairs are shown in Table 5-5. Purchase these parts from the dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 5-4 : Consumable part list

No.	Part name	Type Note1)	Q'ty	Usage place	Supplier
Type: Each type commonness					
1	Lithium battery	A6BAT	3	Connector box	
2	Grease	Harmonic grease 4 B N o .2	An needed	Reduction gears of J1, J2 axis	Mitsubishi Electric
3		Marutenpu PS No.2	An needed	Ball screw spline	

Note1) Confirm the robot arm serial No., and contact the dealer or service branch of Mitsubishi Electric Co., for the type.

Table 5-5 : Spare parts list

No.	Part name	Type	Q'ty	Usage place	Supplier
Type: RP-1ADH-S15					
1	Timming belt	3 2 7 - 3 G T - 9	1	Shoulder cover	
2		3 6 3 - 3 G T - 9	1	Shoulder cover	
3		2 4 6 - 3 G T - 9	2	Base	
4		3 1 5 - 3 G T - 9	1	No.1 arm L	
5		2 7 0 - 3 G T - 9	1	No.1 arm R	
6		3 9 3 - 3 G T - 6	1	No.2 arm L	
7		3 8 2 - 2 G T - 4	1	No.2 arm R	
8	AC servo motor (In the case of serial No. less than "AB001001".)	B U 1 4 9 C 7 0 7 G 6 1	1	J1 axis	
9		B U 1 4 9 C 7 0 7 G 6 2	1	J2 axis	
10		B U 1 4 9 C 7 0 7 G 6 3	1	J3 axis	Mitsubishi Electric
11		B U 1 4 9 C 7 0 7 G 6 4	1	J4 axis	
12	AC servo motor (In the case of serial No. is "AB001001" or more.)	B U 1 4 9 C 6 6 0 G 5 1	1	J1 axis	
13		B U 1 4 9 C 6 6 0 G 5 2	1	J2 axis	
14		B U 1 4 9 C 6 6 0 G 5 3	1	J3 axis	
15		B U 1 4 9 C 6 6 0 G 5 4	1	J4 axis	
16	Reduction gears	B U 1 4 6 C 9 1 1 H 0 3	2	J1, J2 axis	
Type: RP-3ADH-S15					
1	Timming belt	4 4 4 - 3 G T - 9	2	Shoulder cover,No.1 arm L	
2		5 1 3 - 3 G T - 9	1	Shoulder cover	
3		3 1 8 - 3 G T - 1 2	2	Base	Mitsubishi Electric
4		3 7 5 - 3 G T - 9	1	No.1 arm R	
5		5 5 8 - 3 G T - 9	1	No.2 arm L	
6		5 4 3 - 3 G T - 9	1	No.2 arm R	

No.	Part name	Type	Q'ty	Usage place	Supplier
7	AC servo motor (In the case of serial No. less than "AB002031".)	ＢＵ１４９Ｃ６７４Ｇ６１	1	J1 axis	Mitsubishi Electric
8		ＢＵ１４９Ｃ６７４Ｇ６２	1	J2 axis	
9		ＢＵ１４９Ｃ６７４Ｇ６３	1	J3 axis	
10		ＢＵ１４９Ｃ７０７Ｇ６４	1	J4 axis	
11	AC servo motor (In the case of serial No. is "AB002031" or more.)	ＢＵ１４９Ｃ６７４Ｇ５１	1	J1 axis	
12		ＢＵ１４９Ｃ６７４Ｇ５２	1	J2 axis	
13		ＢＵ１４９Ｃ６７４Ｇ５３	1	J3 axis	
14		ＢＵ１４９Ｃ６６０Ｇ５４	1	J4 axis	
15	Reduction gears	ＢＵ１４６Ｃ７８５Ｈ０１	2	J1, J2 axis	

Type: RP−5ADH−S15

No.	Part name	Type	Q'ty	Usage place	Supplier
1	Timming belt	４４４−３ＧＴ−９	1	Shoulder cover	Mitsubishi Electric
2		５１３−３ＧＴ−９	1	Shoulder cover	
3		３１８−３ＧＴ−１２	2	Base	
4		５６１−３ＧＴ−９	1	No.1 arm L	
5		４９５−３ＧＴ−９	1	No.1 arm R	
6		６８１−３ＧＴ−９	1	No.2 arm L	
7		６６６−３ＧＴ−９	1	No.2 arm R	
8	AC servo motor (In the case of serial No. less than "AB002052".)	ＢＵ１４９Ｃ６７４Ｇ６１	1	J1 axis	
9		ＢＵ１４９Ｃ６７４Ｇ６２	1	J2 axis	
10		ＢＵ１４９Ｃ６７４Ｇ６３	1	J3 axis	
11		ＢＵ１４９Ｃ７０７Ｇ６４	1	J4 axis	
12	AC servo motor (In the case of serial No. is "AB002052" or more.)	ＢＵ１４９Ｃ６７４Ｇ５１	1	J1 axis	
13		ＢＵ１４９Ｃ６７４Ｇ５２	1	J2 axis	
14		ＢＵ１４９Ｃ６７４Ｇ５３	1	J3 axis	
15		ＢＵ１４９Ｃ６６０Ｇ５４	1	J4 axis	
16	Reduction gears	ＢＵ１４６Ｃ７８５Ｈ０１	2	J1, J2 axis	

5.5 Resetting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. The origin must be reset if the combination of robot and controller being used is changed or if the motor is changed causing an encoder area.

The types of origin setting methods are shown in Table 5-6.

Table 5-6 : Origin setting method

No	Method	Explanation	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B.	The setting method is explained in "2.3 Setting the origin" on page 13.
2	Jig method	The transportation jig is installed, and the transportation posture is set as the origin posture.	The setting method is explained in "5.5.1 Jig method" on page 61.
3	User origin method	A randomly designated position is set as the origin posture.	Before using this method, the origin must be set with the origin data input method (No. 1 above) or jig method (No. 2 above).The setting method is explained in "5.5.2 User origin method" on page 64.

5.5.1 Jig method

The method for setting the origin with the transportation jig is explained below.

This operation is carried out with the teaching pendant. Set the [MODE] switch on the front of the controller to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant. Do the following operations, pressing down the enabling switch of T/B lightly. Move the J4 axis to the upper end with jog operation beforehand.

```
<MENU>

1. FILE/EDIT      2. RUN
3. PARAM.         4. ORIGIN/BRK
5. SET/INIT.      6. ENHANCED

              123        CLOSE
Select ORIGIN/BRK
```
[4 GHI]

1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

```
<ORIGIN/BRAKE>

1. ORIGIN         2. BRAKE



              123        CLOSE
Select BREAK
```
[-Z (J3) / 2 ABC]

2) Press the [2] key, and display the Break release selection screen.

```
<BRAKE>

J1:(  0  )J2:(  0  )J3:(  0  )
J4:(  0  )J5:(  0  )J6:(  0  )
J7:(  0  )J8:(  0  )

REL.          123        CLOSE
select axis
```
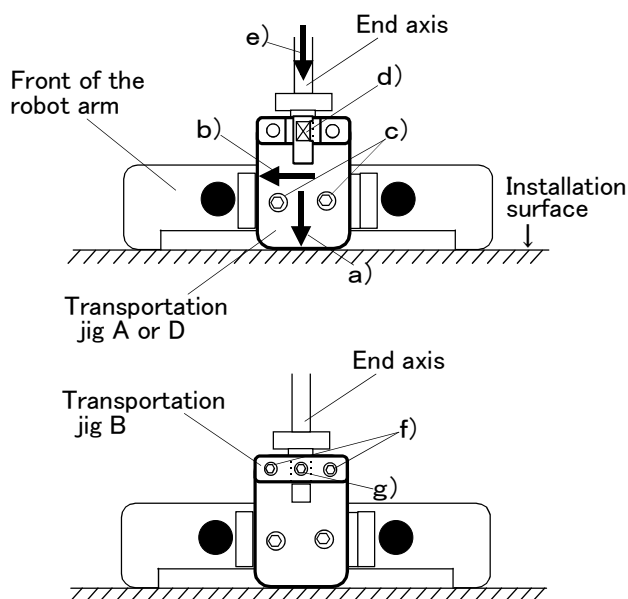[↑ ~ →] [1 '()] [-C (J6) / 0 SPACE]

3) Release the brake of all axes.
   Input "1" into the J1-J4 axis.

```
<BRAKE>

J1:(  1  )J2:(  1  )J3:(  1  )
J4:(  1  )J5:(  0  )J6:(  0  )
J7:(  0  )J8:(  0  )

REL.          123        CLOSE
Brake release
```
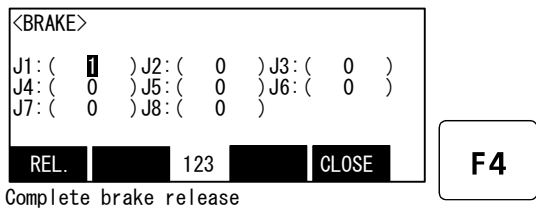[F 1]

4) Confirm the axis for which the brakes are to be released.
5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.

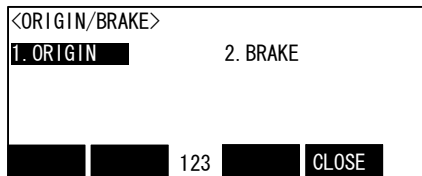6) Origin posture of the robot arm is shown in the following.
   The brake of each axis is released, and the end axis is fixed with the transportation jig.
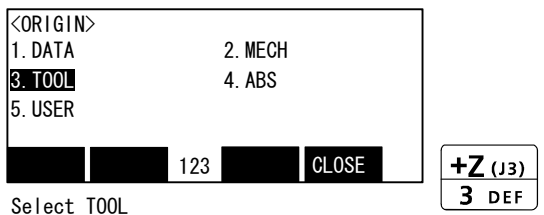   The process is shown in the following.

Ball screw spline

Transportation jig A
fixing bolts : M4 x 12

Transportation jig D
fixing bolts : M4 x 14

Transportation
jig A or D

Transportation
jig B fixing bolts
M3 x 14

Transportation
jig B

Transportation
jig B

Transportation
jig A or D

Side view

Top view

End axis

RH-1ADH-S15

RH-3ADH-S15
RH-5ADH-S15

Cut side

Standard position
of Z-axis

Cut side
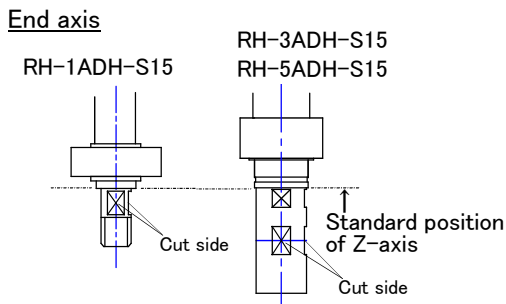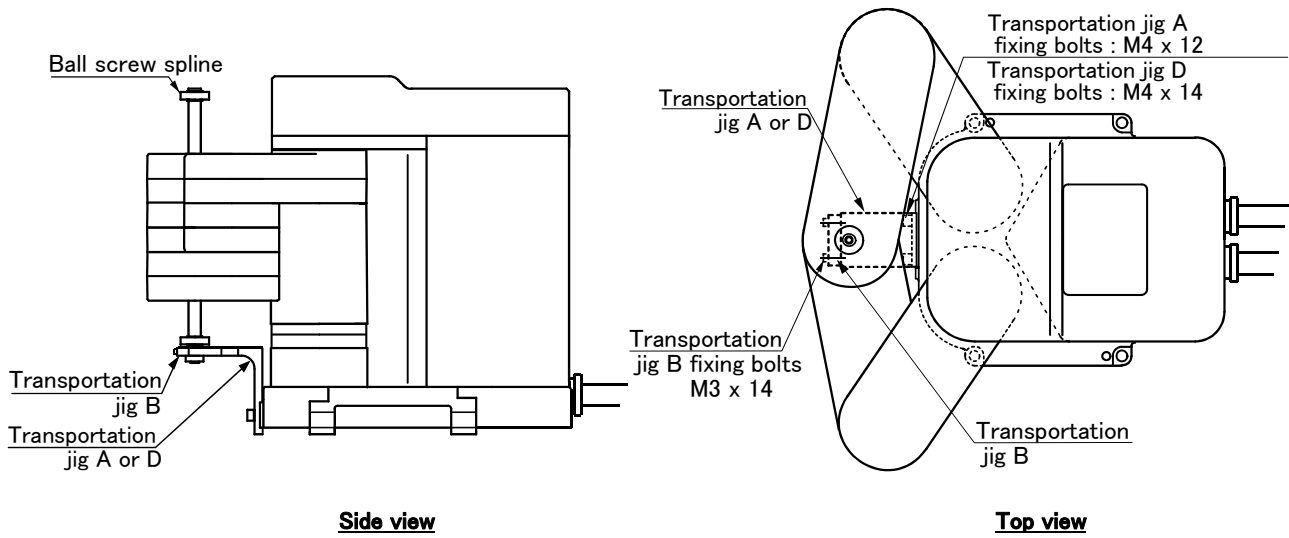
a)The transportation jig A (or, D) is pressed against
to the installation surface.

b)The transportation jig A (or, D) is pressed against
to the left side of the jig installation section on
front of the robot arm as it is.

c)The transportation jig A (or, D) is fixed securely
with the fixing bolts under this condition.

d)Release the brakes of all axis, and take the end
axis of the robot to the V-cut position of the
transportation jig A(or, D).

e)As it is, lower an end axis until the standard
position of Z-axis hits a transportation jig A (or,
D).

f)Install the transportation jig B. Tighten the fixing
bolts gradually with releasing of brake.

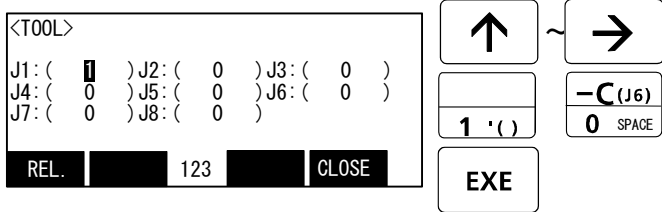g)Tighten the central screw of the transportation jig
B with releasing of brake.

End axis

Front of the
robot arm

Installation
surface

Transportation
jig A or D

End axis

Transportation
jig B

```
<BRAKE>
J1:(  1  )J2:(  0  )J3:(  0  )
J4:(  0  )J5:(  0  )J6:(  0  )
J7:(  0  )J8:(  0  )

  REL.        123        CLOSE
Complete brake release
```

F4

7) Detach the [F1] key and work the brake. Press the [F4] key and return to the origin / brake screen.

```
<ORIGIN/BRAKE>
1.ORIGIN        2. BRAKE



             123        CLOSE
```

8) Press the [1] key, and display the Origin setting selection screen.

```
<ORIGIN>
1. DATA          2. MECH
3. TOOL          4. ABS
5. USER

             123        CLOSE
Select TOOL
```

+Z (J3)
3 DEF

9) Press the [3] key, and display the Tool selection screen.

```
<TOOL>
J1:(  1  )J2:(  0  )J3:(  0  )
J4:(  0  )J5:(  0  )J6:(  0  )
J7:(  0  )J8:(  0  )

  REL.       123        CLOSE
```

↑ ~ →
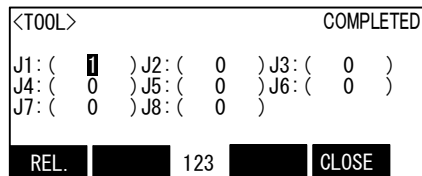**1 '( )**   **−C (J6)**
             0 SPACE
EXE

10) Input "1" into the J1−J4 axis. Set "0" to other axes.

11) Press the [EXE] key, and display Confirmation screen.

```
<ORIGIN>  TOOL

   CHANGE TO ORIGIN. OK?


  Yes        123         No
```

F1

12) Press the [F1] key , and the origin position is set up.

```
<TOOL>                  COMPLETED
J1:(  1  )J2:(  0  )J3:(  0  )
J4:(  0  )J5:(  0  )J6:(  0  )
J7:(  0  )J8:(  0  )

  REL.       123        CLOSE
```
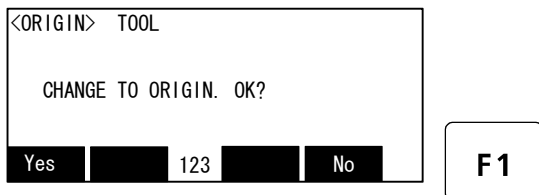
13) Setting of the origin is completed.

14) Refer to "5.5.3 Recording the origin data" on page 65 in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇
   Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

◇◆◇ Select the axis of origin setting ◇◆◇
   Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

5.5.2 User origin method

⚠ **CAUTION** Before using this method, the origin must be set with the other method.
The setting method is explained in "Table 5-6 : Origin setting method" on page 61.

The procedure for setting the origin with the user origin method is explained below.
This operation is carried out with the teaching pendant. Set the [MODE] switch on the front of the controller to "AMNUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant. The operation method is shown below.

When setting the origin for the first time using this method, carry out the operations in order from step 1). For the second and following time, move the robot arm to the user origin position with jog operation, and accurately position all axes. Then start the procedure from step 4).

1) Determine the user origin position
Move the robot to the position to be set as the origin with jog operation. Refer to "2.4 Confirming the operation" on page 19 for details on the jog operation.
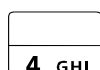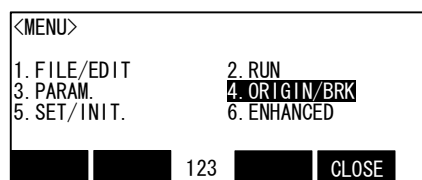
⚠ **CAUTION** Choose the user origin position as the position where it doesn't move by the gravity.
This position is left as a guideline to position all axes with jog operation when setting the origin again with this method.

2) Enter the JOINT jog mode, and display the joint coordinates on the teaching pendant screen. Record the value of the axis for which the origin is to be set.
3) Input the value recorded in the "user designated origin parameter (USRORG)".
The parameter details and input methods are described in the separate "Instruction Manual/Detailed Explanation of Functions and Operations". Refer to that manual and input the user designated origin position.

```
<MENU>
1.FILE/EDIT        2.RUN
3.PARAM.           4.ORIGIN/BRK
5.SET/INIT.        6.ENHANCED

              123           CLOSE
```

```
 4  GHI
```

```
<ORIGIN/BRAKE>
1.ORIGIN          2.BRAKE



              123           CLOSE
```

```
 1  '()
```

```
<ORIGIN>
1.DATA            2.MECH
3.TOOL            4.ABS
5.USER

              123           CLOSE
```
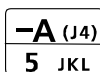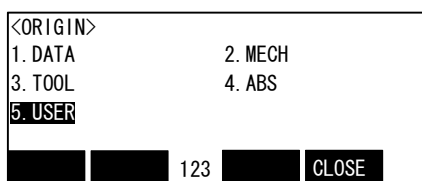
```
-A (J4)
 5  JKL
```
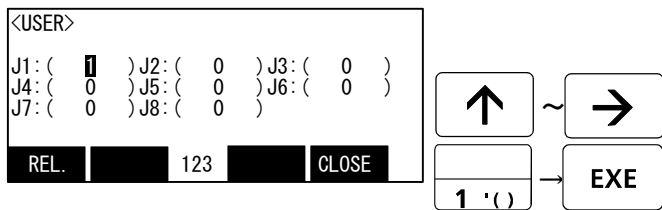
4) Next, set the origin.
Display the menu screen.

5) Press the [4] key on the menu screen, and display the Origin/Break selection screen.
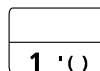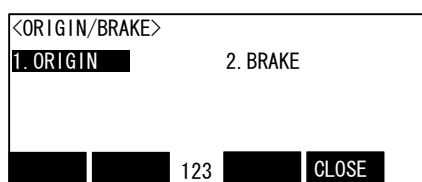
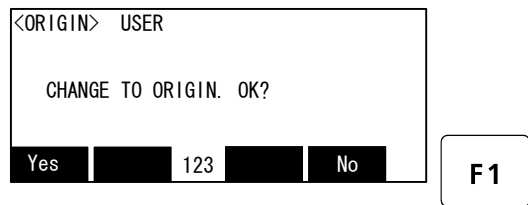6) Press the [1] key, and display the Origin setting selection screen.

7) Press the [5] key, and display the User selection screen.

```
<USER>
J1:(   1  )J2:(   0  )J3:(   0  )
J4:(   0  )J5:(   0  )J6:(   0  )
J7:(   0  )J8:(   0  )
 REL.         123        CLOSE
```

↑ ~ →

1 '() → EXE

8) Input ″1″ into the axis to origin setting. Press the [EXE] key, and display Confirmation screen.

```
<ORIGIN>  USER

   CHANGE TO ORIGIN. OK?


 Yes          123          No
```

F1

9) Press the [F1] key, and the origin position is set up.

This completes the setting of the origin with the user origin method.

5.5.3 Recording the origin data

When the origin has been set with the jig method, record that origin data on the origin data label. With this, the origin can be set with the origin data input method the next time.

Confirm the origin data on the teaching pendant screen (origin data input screen). The origin data label is enclosed with the arm or attached on the back of the connector box cover.
The teaching pendant operation method and connector box cover removal method for confirming the origin data is the same as the methods for setting the origin with the origin data input method. Refer to ″2.3.2 Setting the origin with the origin data input method″ on page 14, and write the origin data displayed on the teaching pendant onto the origin label.

(1) Confirming the origin data label
Remove the connector box cover.
Refer to ″5.3.5 Replacing the backup battery″ on page 56, and remove the connector box cover.

(2) Confirming the origin data
Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to ″(5) Inputting the origin data″ on page 17, and display the Origin Data Input screen on the teaching pendant display screen.

(3) Recording the origin data
Write the origin data displayed on the teaching pendant to the origin data label attached to the back of the connector box cover. Refer to ″Fig. 2-6: Connecting the machine cables″ on page 12, and ″Fig. 2-7: Installing and removing the T/B″ on page 13 for details on the origin data label.

(4) Installing the connector box cover
Install the connector box cover removed in step ″(1) Confirming the origin data label″ above.
Refer to ″5.3.5 Replacing the backup battery″ on page 56, and replace the connector box cover.

This completes the recording of the origin data.

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