MITSUBISHI
Mitsubishi Industrial Robot

RV-1A/2AJ Series INSTRUCTION MANUAL

ROBOT ARM SETUP & MAINTENANCE

MELFA

BFP-A8052-D

⚠ 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.

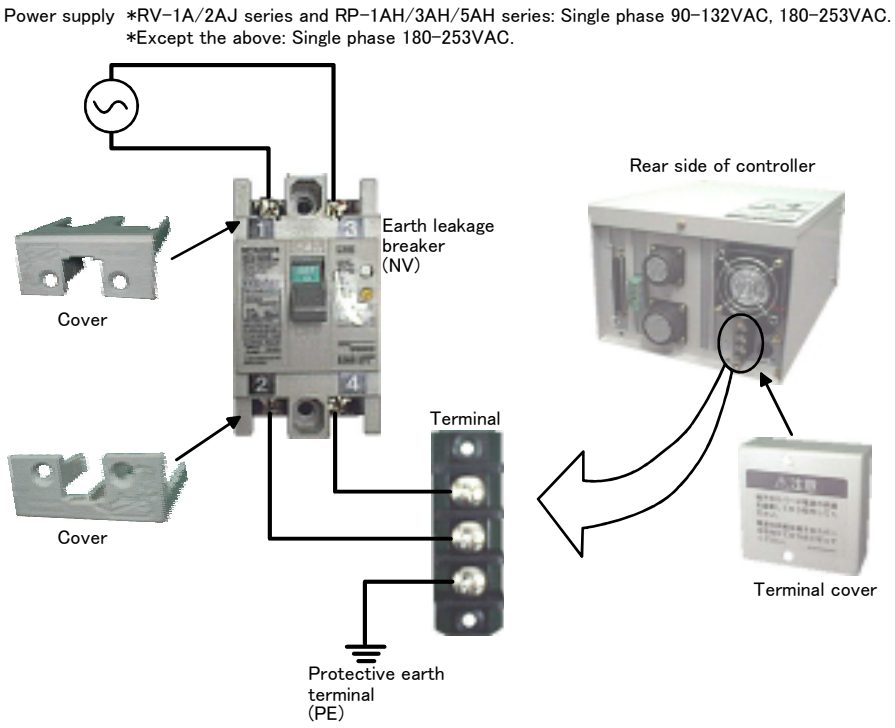
⚠WARNING When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ 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.

C.Precautions for the basic configuration are shown below.(When CR1-571 is used for the controller.)

⚠ CAUTION

Provide an earth leakage breaker that packed together on the primary power supply of the controller as protection against electric leakage. Confirm the setting connector of the input power supply voltage of the controller, if the type which more than one power supply voltage can be used. Then connect the power supply.
Failure to do so could lead to electric shock accidents.



Revision history

Date of Point	Instruction Manual No.	Revision Details
2000-02-17	BFP-A8052Z	First print
2000-04-05	BFP-A8052	Formal style
2000-05-10	BFP-A8052-A	Error in writing correction.
2000-07-12	BFP-A8052-B	Spare parts (option) list was added. Error in writing correction.
2001-03-21	BFP-A8052-C	Error in writing correction.
2002-06-05	BFP-A8052-D	RV-1AC-SB, RV-2AJC-SB (Clean specification) was added. Error in writing correction.

■ 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

Page

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.
Explanations of MOVEMASTER COMMANDS	Explains details on the MOVEMASTER commands used in the program. (For RV-1A/2AJ and RV-2A/3AJ series)
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.

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

Symbol	Meaning
⚠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.
[JOINT]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
[+／ＦＯＲＷＤ] ＋ [＋Ｘ] （Ａ） （Ｂ）	This indicates to press the (B) key while holding down the (A) key. In this example, the [+/Forward] key is pressed while holding down the [+X/+Y] key.
[ＳＴＥＰ／ＭＯＶＥ] ＋([ＣＯＮＤ]→[ＲＰＬ ↓]) （Ａ） （Ｂ） （Ｃ）	This indicates to hold down the (A) key, press and release the (B) key, and then press the (C) key. In this example, the [Step/Move] key is held down, the [Condition] key is pressed and released, and the [Replace ↓ key is pressed.
Ｔ／Ｂ	This indicates the teaching pendant.

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.

⚠ 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.

2 Unpacking to Installation

2.1 Confirming the product

The standard configuration of the robot arm, 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 "Standard Specifications".

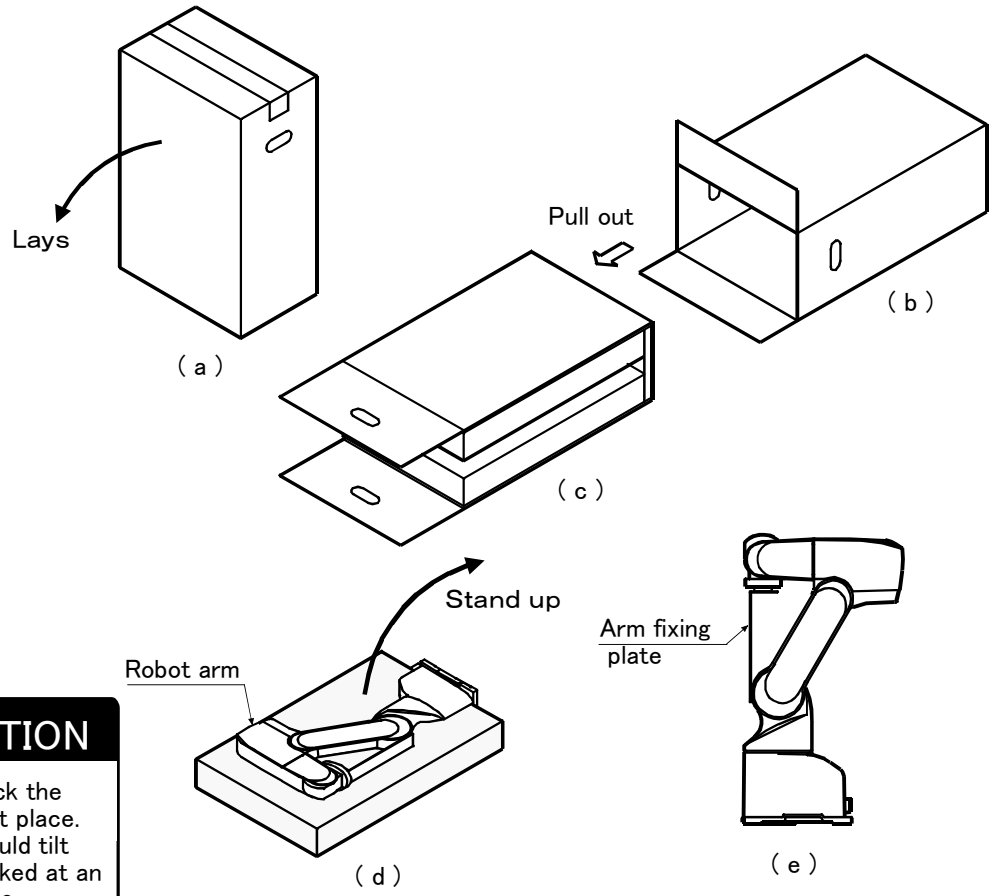
Table 2-1 : Standard configuration

No.	Part name	Type	Qty.	Remarks
1	Robot arm	RV-1A, RV-2AJ, RV-1AC-SB or RV-2AJC-SB	Either 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8x30	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M8	4 pcs.	
5	Plain washer for installation bolts	For M8	4 pcs.	
6	Suspension fitting		1 pcs.	For robot arm transportation
7	Suspension fitting installation bolt	M5x10	4 pcs.	
8	Nylon clamp (Three kinds one each)		3 pcs.	For wiring and piping for optional hand
9	Nylon clamp installation bolts	M3x22	1 pcs.	
10	Plain washer for Nylon clamp installation bolts	For M3	1 pcs.	

Note) The number 3 - 5, 8-10 are in the plastic bag of the robot arm attachment.

2.2 Installation

2.2.1 Unpacking



⚠CAUTION

Always unpack the robot at a flat place. The robot could tilt over if unpacked at an unstable place.

Note) The cushioning material will be required if the robot is transported again , so save it in a safe place.

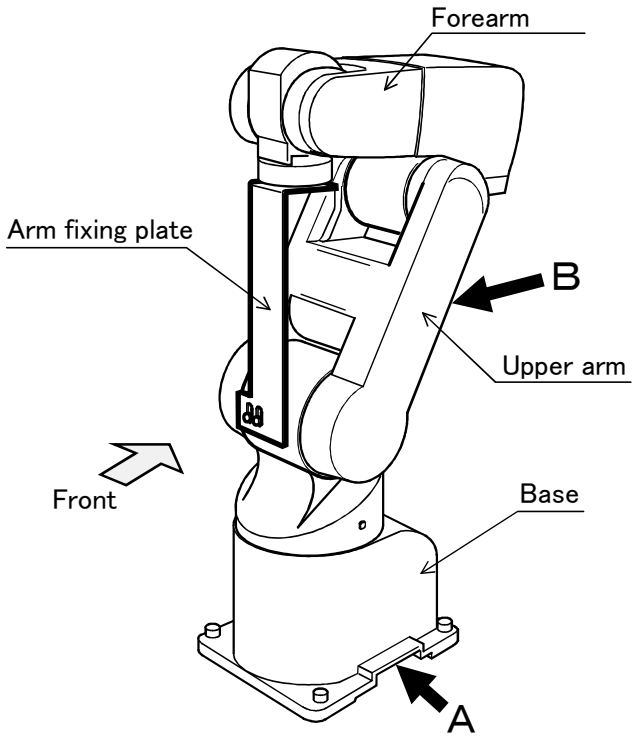
Fig.2-1 : Unpacking the robot arm

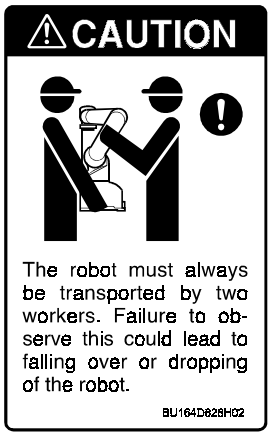
The robot is shipped from the factory in cardboard packing. Always refer to Fig. 2-1 and unpack the robot.
Handle the robot arm according to"2.2.2 Transportation procedures"
The unpacking process is shown below.

1) Carefully lay the cardboard box on its side while taking care not to apply impacts. (Fig. 2-1 (a))
2) Using a knife, cut the tape fixing the opening of the cardboard box. (Fig. 2-1 (b))
3) Horizontally pull out the inner box onto the floor. (Fig. 2-1 (c))
4) Remove the inner box and upper cushioning material. (Fig. 2-1 (d))
5) Pull up the robot arm together with the lower cushioning material. (Fig. 2-1 (e))

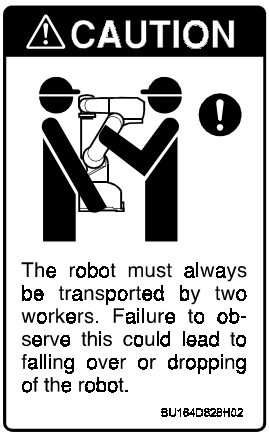
⚠ CAUTION When repackaging the robot in the cardboard box, always use the fixing plates.

2.2.2 Transportation procedures





6-axis type



5-axis type

Note) The figure shows the 6-axis type, but this also applies for the 5-axis type.

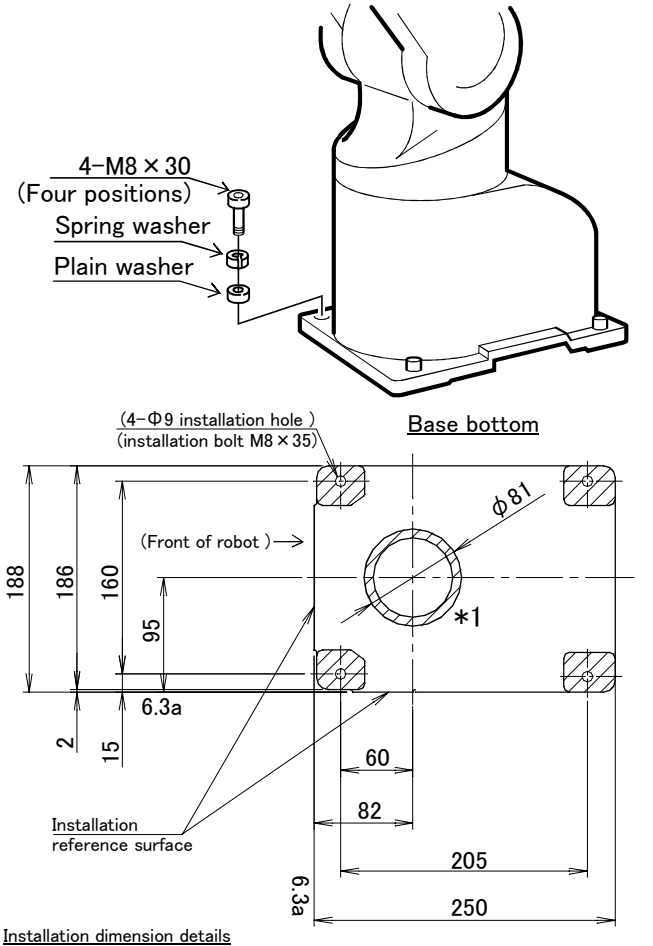
Fig.2-2 : Transportation of robot arm

1) The robot must be transported by two workers. Place the robot on a dolly, etc., and move it to near the installation place. Transporting the robot with the following grips should be limited to placing the robot on the frame or dolly, and to positioning.
2) When transporting with the grips, one worker should hold the grip (A) at the base, and support the arm from the front with his body. The other worker should support the back of the upper arm (B). If the robot is held from the left/right sides or if a cover is held, the robot could tilt over, the cover could be damaged, or accidents such as dropping could occur.
3) When transporting the robot, do not apply force on the cover, or apply a strong impact on the robot
4) Remove the fixing plates after installing the robot.

⚠ CAUTION To prevent accidents, do not hold the robot from the left/right sides, or hold covers that have no grips.

⚠ CAUTION When installing the fixing plates again, set each axis of the robot to J1=0 degree, J2=-30 degree, J3=120 degree, J4=0 degree (6-axis type only), J5=90 degree, and J6=0 degree.

2.2.3 Installation procedures



Installation dimension details
- The contact section shown with shading on the robot installation surface must be finished to 6.3a.
- The section marked with *1 must be contacted against the installation surface to ensure the robot rigidity.

Fig.2-3 : Installation dimensions

1) The robot installation surface has been machine finished. Use the installation holes (4-ϕ18 holes) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (M8 x 30 hexagon socket bolts).

2) Install the robot on a level surface.

3) It is recommended that the surface roughness of the table onto which the robot is to be installed by 6.3a or more. If the installation surface is rough, the contact with the table will be poor, and positional deviation could occur when the robot moves.

4) When installing, use a common table to prevent the position of the devices and jigs subject to robot work from deviating.

5) The installation surface must have sufficient strength to withstand the arm reaction during operation, and resistance against deformation and vibration caused by the static (dynamic) load of the robot arm and peripheral devices, etc.

6) When installing on the ceiling, use the ceiling suspension jig available from Mitsubishi. Contact Mitsubishi or your dealer for the ceiling suspension jig.

7) Remove the fixing plates after installing the robot.

2.2.4 Grounding procedures

(1) Grounding methods

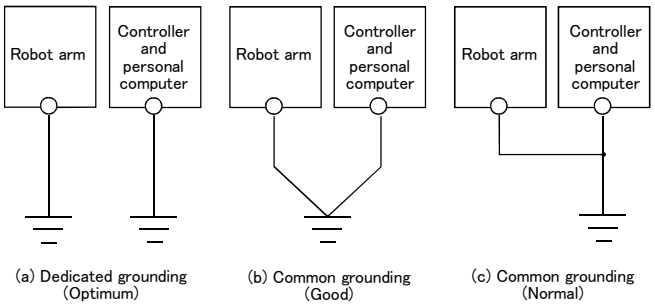


Fig.2-4 : Grounding methods

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 100Ω or less).
   Dedicated grounding separated from the other devices should be used.
3) Use a AWG#14(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.

(2) Grounding procedures

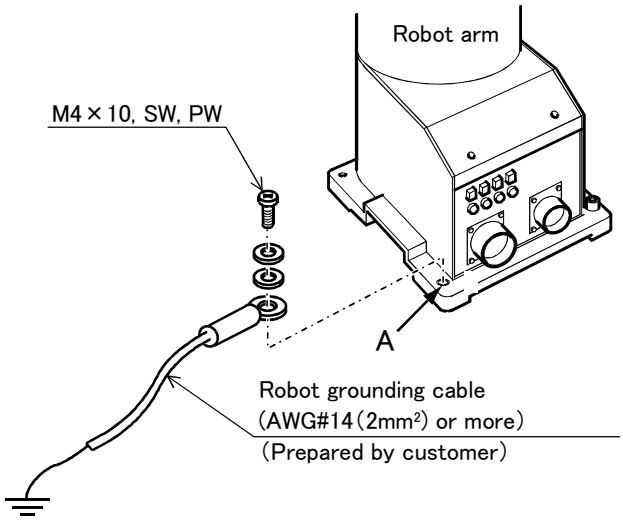


Fig.2-5 : Connecting the grounding cable

1) Prepare the grounding cable (AWG#14(2mm^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.

2.2.5 Connecting with the controller

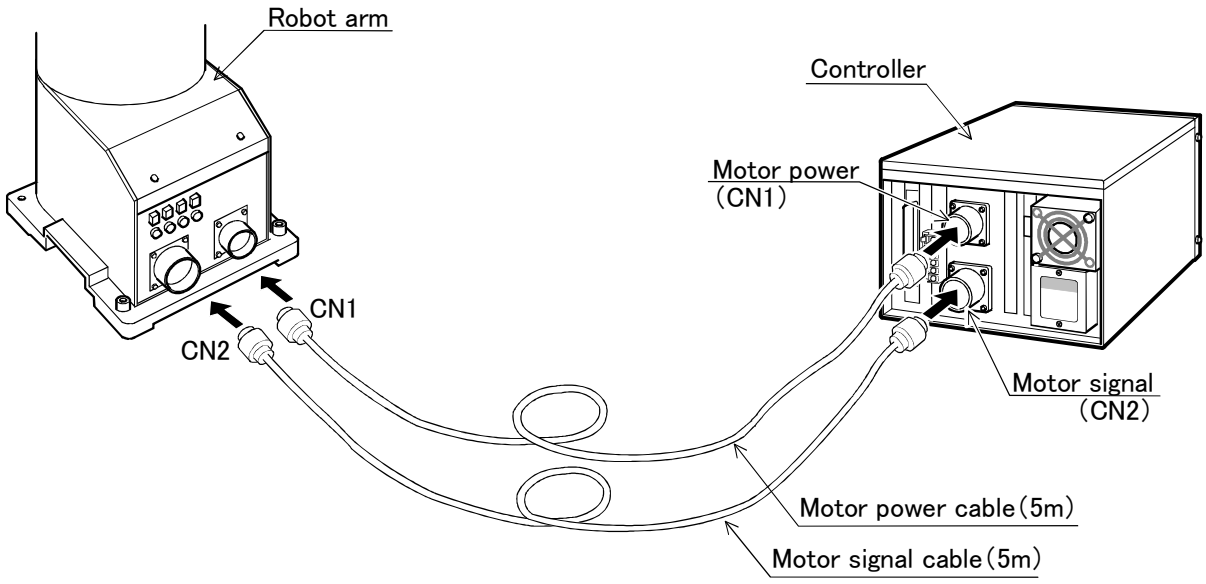


Fig.2-6 : Connecting the machine cables

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.

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 "5.5 Resetting the origin" on page 56 for the other methods.

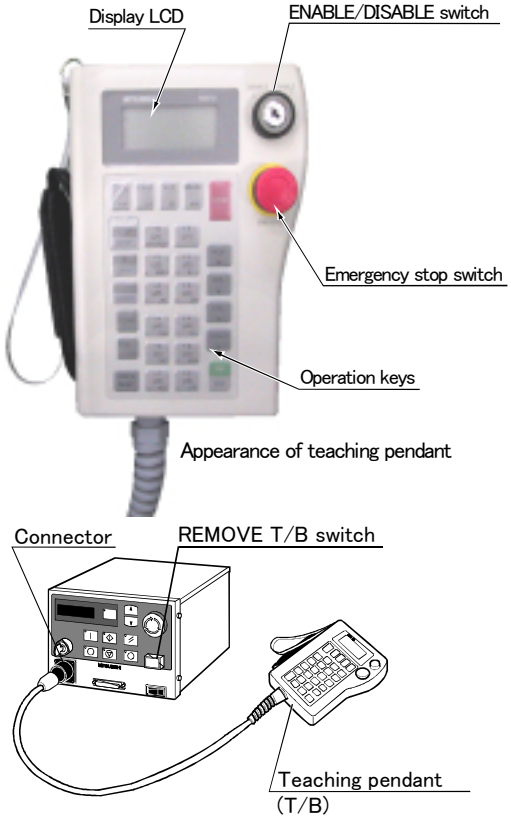
The teaching pendant is required for this operation.

2.3.1 Installing the teaching pendant (T/B)

By using the "REMOVE T/B" switch, the T/B can be installed and removed while the controller's control power is ON. However, in this procedure, the teaching pendant will be installed with the control power OFF.

Refer to the separate "Controller setup, basic operation, and maintenance" for details on installing the teaching pendant with the control power ON.

(1) Installing with the control power OFF



1) Confirm that the controller's power supply switch is OFF.

2) Connect the T/B connector to the RS-422 (T/B) connector on the controller.

3) Do not pull the cable with force or bend it excessively, as the cable could break or the connector could be damaged.

4) Confirm that the [REMOVE T/B] switch on the side of the controller is not depressed (is projected).

5) Set the T/B [ENABLE/DISABLE] switch to "DISABLE".

Fig.2-7 : Installing the T/B (control power OFF)

◇◆◇ [REMOVE T/B] switch ◇◆◇

When using the robot with the T/B, this switch is used to invalidate the emergency stop from the T/B. This is also used to install the T/B with turning the controller's power supply ON.

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			
J 1	06DTYY			
J 2	2?HL9X			
J 3	1CP55V			
J 4	T6!M$Y			
J 5	Z2IJ%Z0			
J 6	A12%Z0			
Method	E	E・N・SP	E・N・SP	E・N・SP

(O: AlphabetO, 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 "5.3.2 Installing/removing the cover" on page 44, 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.
Note that the 5-axis type does not have the J4 axis.

Fig.2-8 : Origin data label (an example)

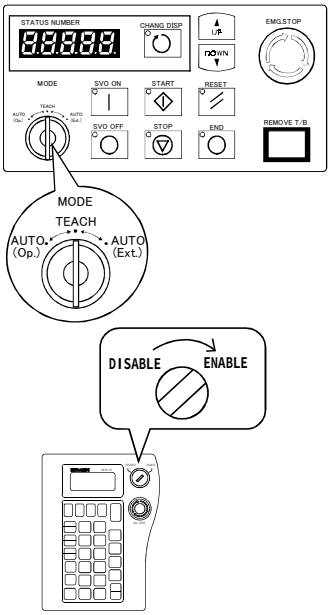
⚠ WARNING Always install/remove the cover with the controller control power turned OFF. Failure to do so could lead to physical damage or personal injury should the robot start moving due to incorrect operations.

(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 " □ . 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 "TEACH".

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

◇◆◇ Operating from the T/B ◇◆◇

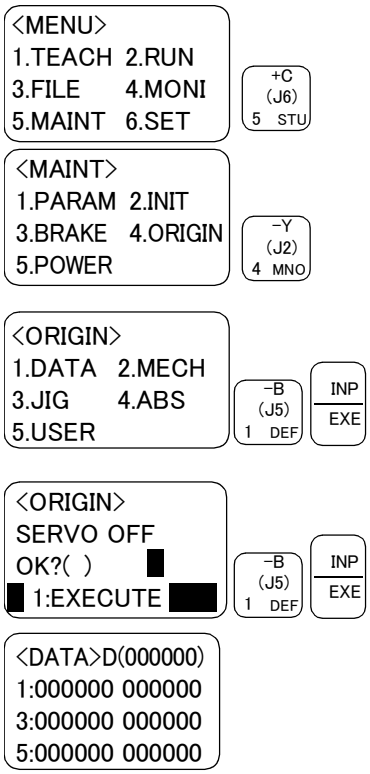
Always set the [MODE] switch (mode selection key switch) on the front of the controller to "TEACH", and then set the T/B [ENABLE/DISABLE] switch to "ENABLE".
When the T/B is valid, only operations from the T/B are possible. Operations from the controller or external signals will not be accepted.

◇◆◇ When T/B operations are mistaken ◇◆◇

The displayed screen will return to the "menu selection screen" when the [MENU] key is pressed. Carry out the operations again from this screen. Operations can also be carried out again by setting the T/B [ENABLE/DISABLE] switch to "DISABLE" once and then setting to "ENABLE".

(4) Selecting the origin setting method

<T/B screen> [Keys used]



1) Press the [5] key on the menu screen, and display the maintenance screen.

2) Press the [4] key on the maintenance screen, and display the origin setting method selection screen.

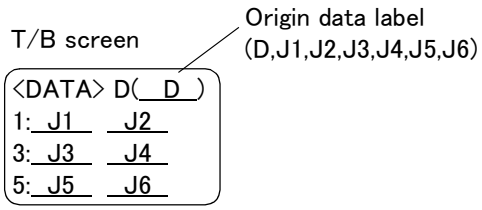
3) Press the [1] key on the origin setting method selection screen, and select the data input method.
The origin data input method will be selected, and the screen for turning OFF the servo power will appear.

4) Press the [1] and [INP] keys to turn OFF the servo power. The screen for inputting the origin data will appear.

◇◆◇ 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.

(5) Inputting the origin data

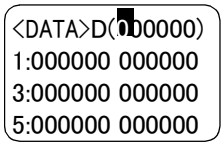


Input the value confirmed in section "(1) Confirming the origin data" on page 12.
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-9.(For the 5-axis robot, the J4 axis is meaningless.)

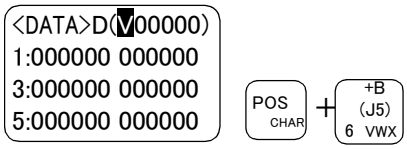
Fig.2-9 : Correspondence of origin data label and axis

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

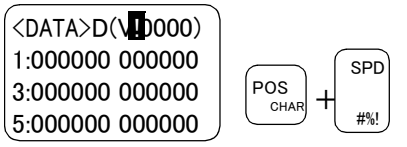
<T/B screen> [Keys used]



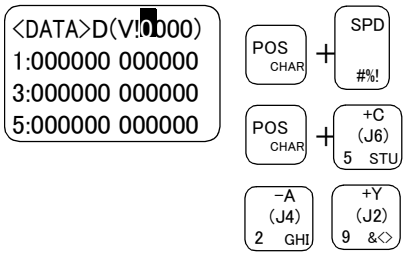
1) Confirm that the cursor is at the "D" position on the T/B display screen.



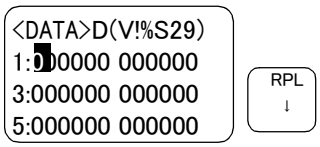
2) Input the D value V!%S29.
Inputting "V"
Press the [VWX] key once while holding down the [CHAR] key. "V" will appear, so release the [CHAR] key. "V" will be set.



Inputting "!"
Press the [#%!] key three times while holding down the [CHAR] key. "!" will appear, so release the [CHAR] key. "!" will be set.

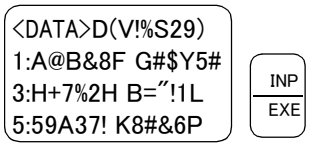


In the same manner, while holding down the [CHAR] key, press the ["%"] key twice, and the [STU] key once (input "S").
Release the [CHAR] key, and press the [2] key (input "2") and then the [9] key (input "9").
V!%S29 will appear at the "D" data on the teaching pendant screen.

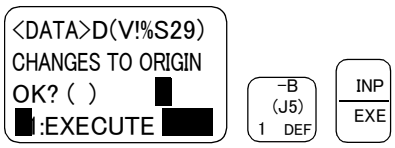


3) Press the [↓] key, and move the cursor to the J1 input position.
4) Input the J1 value in the same manner as above.

5) Input the J2, J3, J4, J5 and J6 values in the same manner. Note that the J4 axis is not required for the 5-axis type.



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



7) Press [1] (-B/-P) and [INP] key to end the origin setting

◇◆◇ Moving the cursor ◇◆◇

Press the [↑], [↓], [←] and [→] keys.

◇◆◇ Inputting characters ◇◆◇

Hold down the [CHAR] key and press the key with the character to be input on the lower right. Three characters wi scroll each time the character key is pressed.

◇◆◇ Correcting an input ◇◆◇

After returning one character by pressing the [DEL] key, input the character again.

(6) Installing the connector box cover

Return the connector box cover, removed in section "(1) Confirming the origin data" on page 12 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.

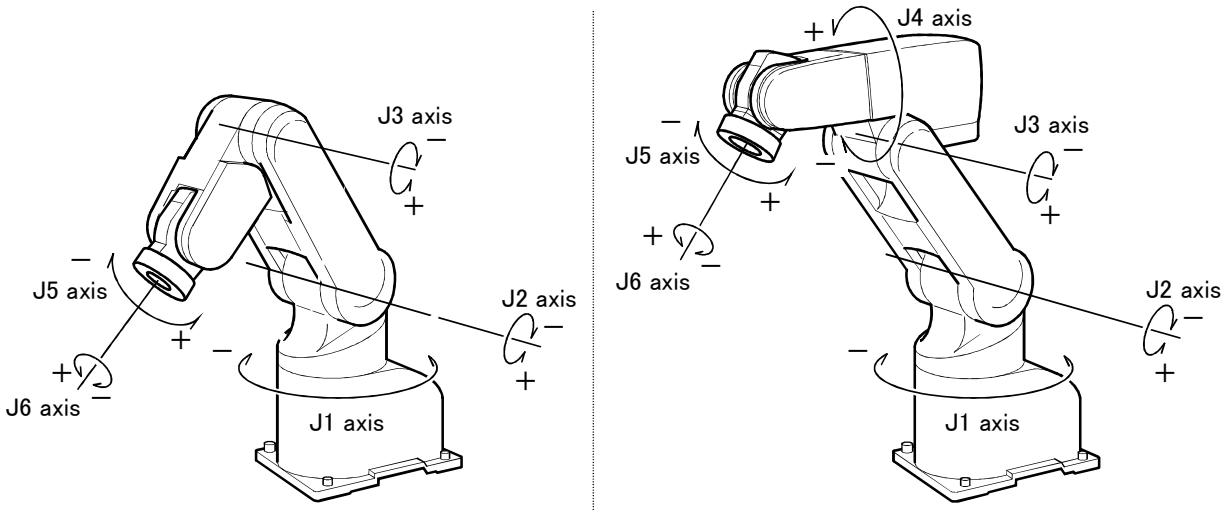
2.4 Confirming the operation

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.

CAUTION 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 "2.3 Setting the origin" on page 11 for details on setting the origin.

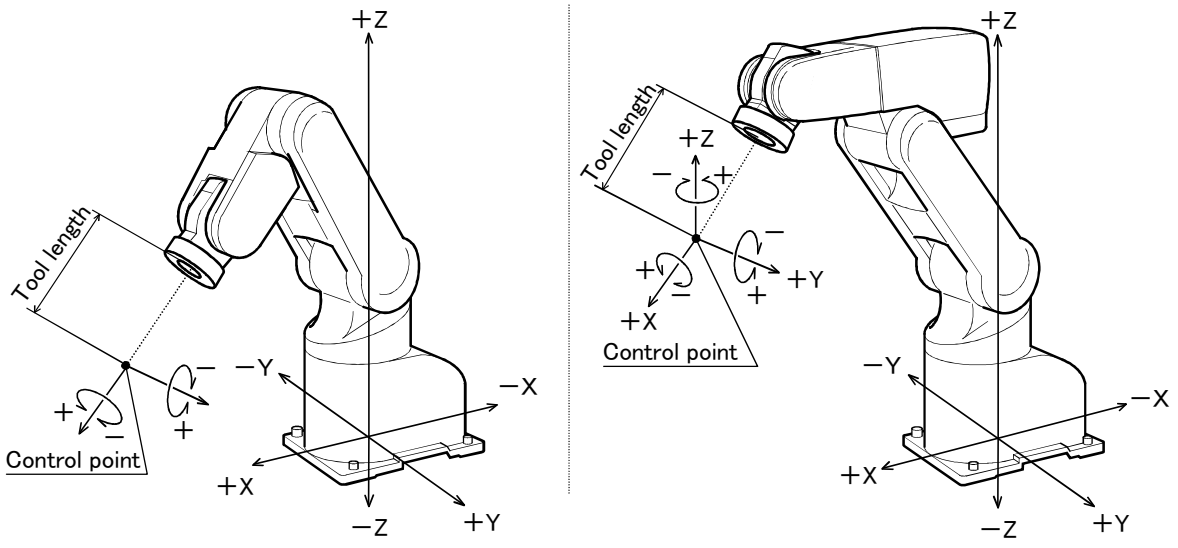


5-axis type

6-axis type

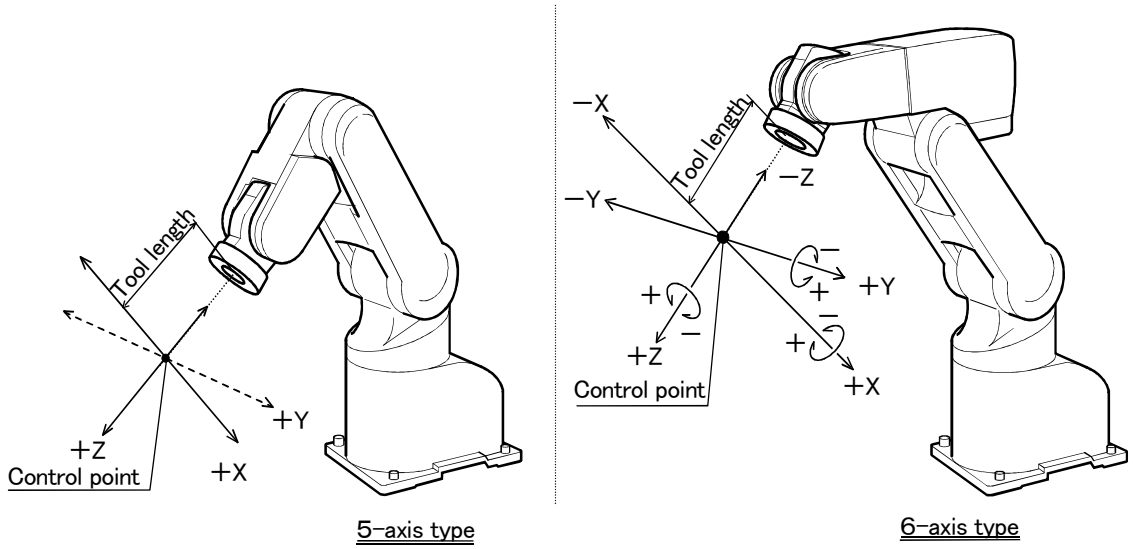
* Each axis moves independently.
The 5-axis type does not have the J4 axis.

Fig.2-10 : JOINT jog operation



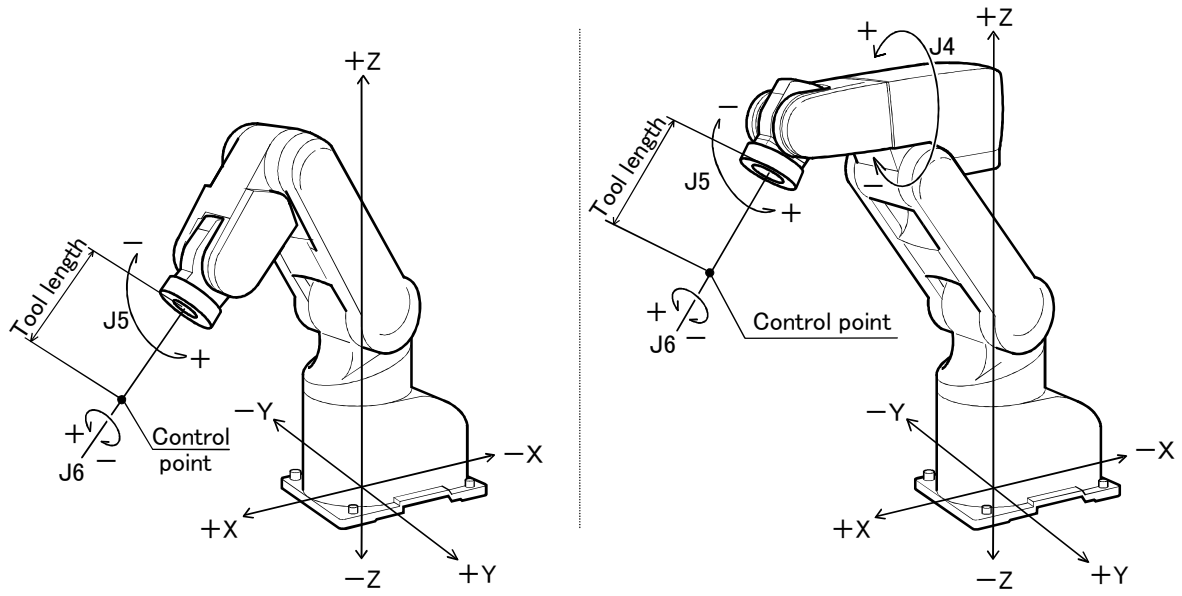
* While maintaining the flange surface posture, the axis moves straight along the base coordinate system.
Also, while maintaining the flange surface position, the flange surface posture changes.

Fig.2−11 : XYZ jog operation



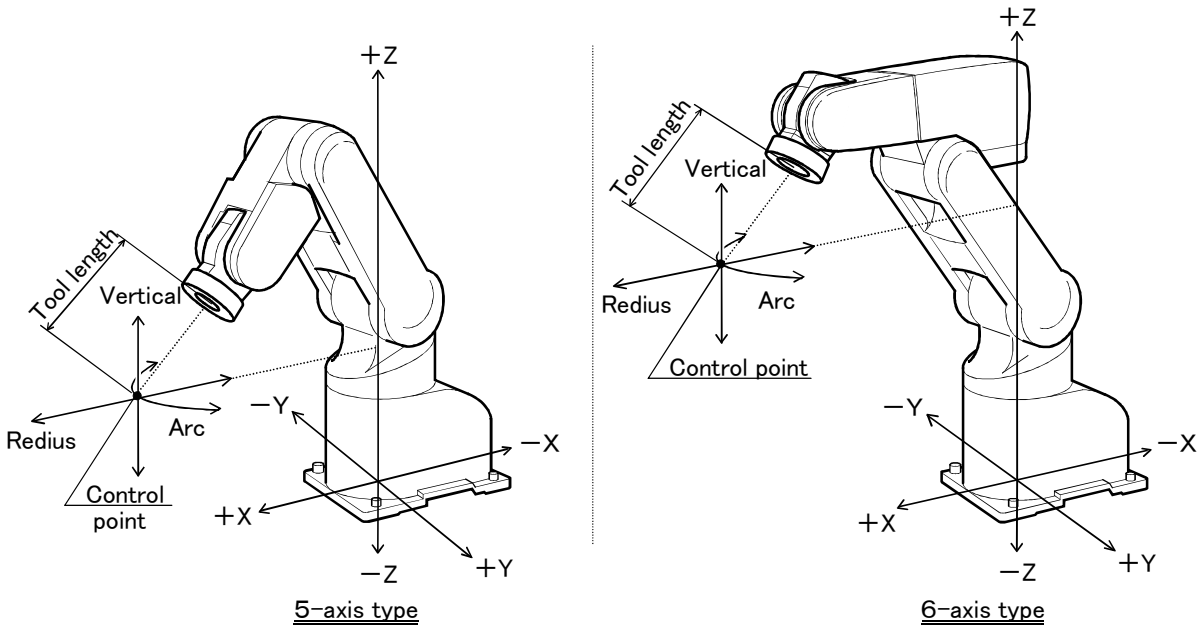
* While maintaining the flange surface posture, the axis moves straight along the tool coordinate system.
Also, while maintaining the flange surface position, the flange surface posture changes.
With the 5−axis type, the axis moves only in the X and Y axis directions of the tool coordinates.

Fig.2−12 : TOOL jog operation



∗ The axis moves straight along the base coordinate system. At this time, the flange surface posture is not maintained.
Also, the flange surface posture changes. The flange surface position changes at this time.

Fig.2−13 : 3−axis XYZ jog operation

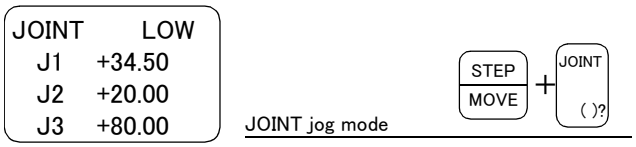


∗ The current position is set as the arc centering on the Z axis, and the axis moves along that arc, expands and contracts in the radius direction, and moves vertically. At this time, for the 6−axis type, the flange surface posture is maintained. Also, while maintaining the flange surface position, the flange surface posture changes.

Fig.2−14 : CYLINDER jog operation

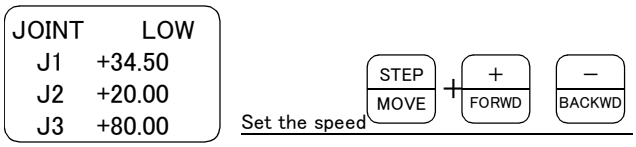
(1) JOINT jog operation

Select the JOINT jog mode



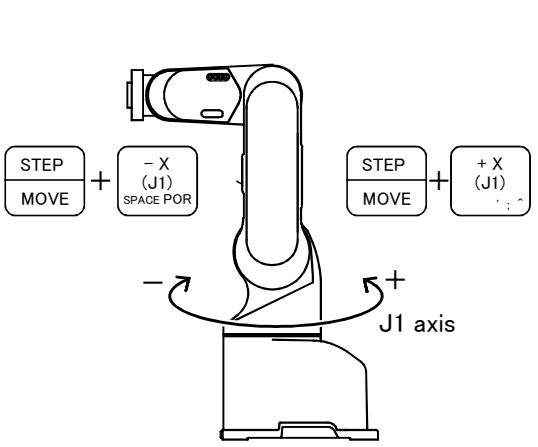
Press the [MOVE] + [JOINT] keys to select the JOINT jog mode. "JOINT" will appear at the upper left of the screen.

Set the jog speed

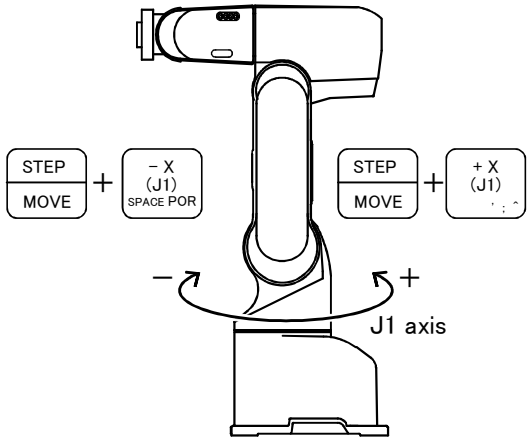


Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%.
When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order.
The currently set speed will appear on the upper right of the screen.
Set the override to 10% here for confirmation work.

J1 axis jog operation



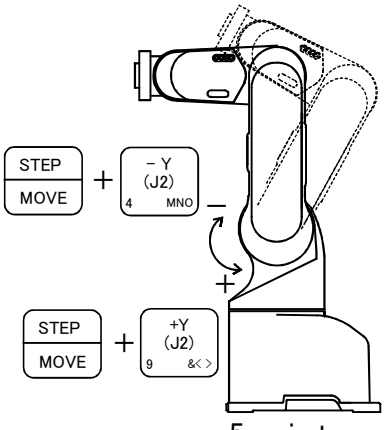
5-axis type



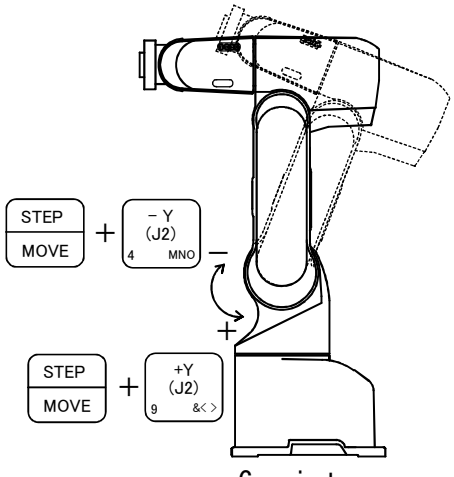
6-axis type

・When the [MOVE] + [+X (J1)] keys are pressed, the J1 axis will rotate in the plus direction.
When the [MOVE] + [−X (J1)] keys are pressed, Rotate in the minus direction.

J2 axis jog operation



5-axis type



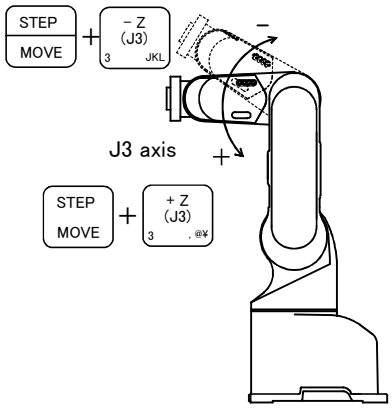
6-axis type

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

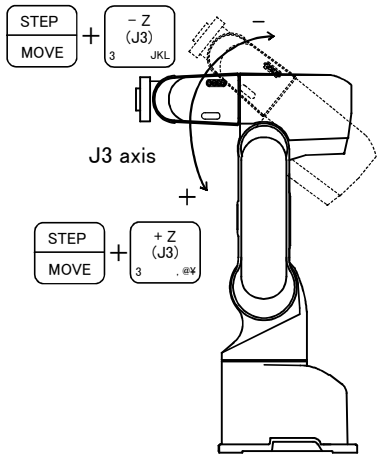
◇◆◇ When the robot is in the transportation posture ◇◆◇

The axes may be outside the movement area. Move these axes toward the inner side of the movement area. If moved outward, an X will appear on the T/B screen, and the robot will not move.

J3 axis jog operation



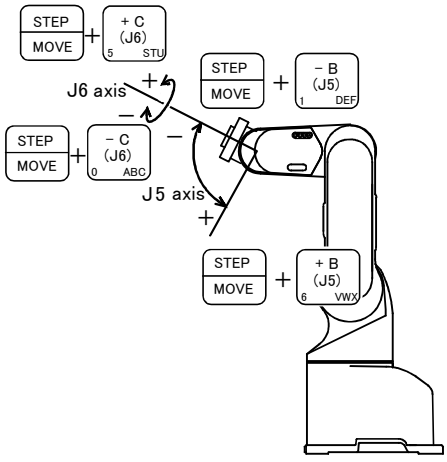
5−axis type



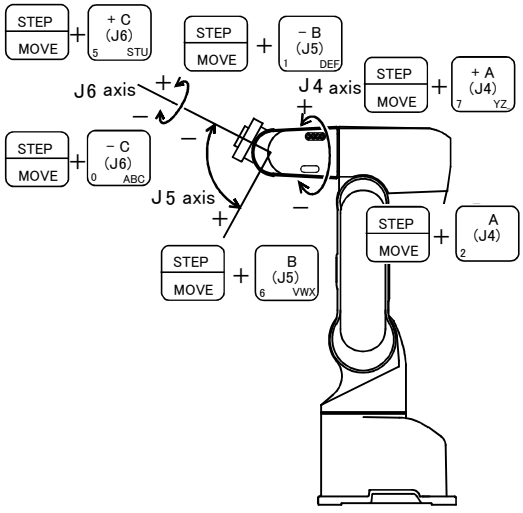
6−axis type

・When the [MOVE] + [+Z (J3)] keys are pressed, the J3 axis will rotate in the plus direction.
When the [MOVE] + [−Z (J3)] keys are pressed, Rotate in the minus direction.

J4, J5 and J6 axis jog



5−axis type



6−axis type

・When the [MOVE] + [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
When the [MOVE] + [−A (J4)] keys are pressed, Rotate in the minus direction. (6−axis type only)
・When the [MOVE] + [+B (J5)] keys are pressed, the J5 axis will rotate in the plus direction
When the [MOVE] + [−B (J5)] keys are pressed, Rotate in the minus direction.
・When the [MOVE] + [+C (J6)] keys are pressed, the J6 axis will rotate in the plus direction
When the [MOVE] + [−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ When an X appears on the T/B screen display ◇◆◇

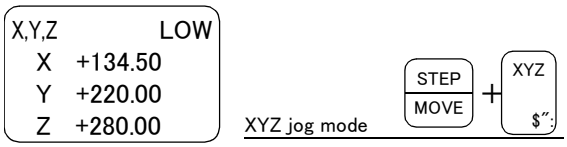
If the robot is moved outside the movement area, an X will appear. In this case, move the axis in the opposite direction.

```
JOINT      LOW
XJ1   +160.00
  J2   +20.00
  J3   +80.00
```

In the example on the left, the J1 axis is at the limit of the plus side movement area.

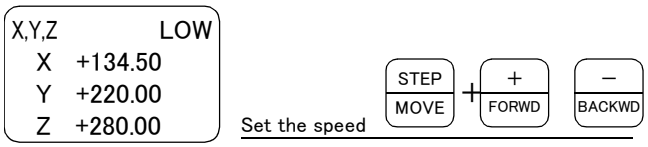
(2) XYZ jog operation

Select the XYZ jog mode



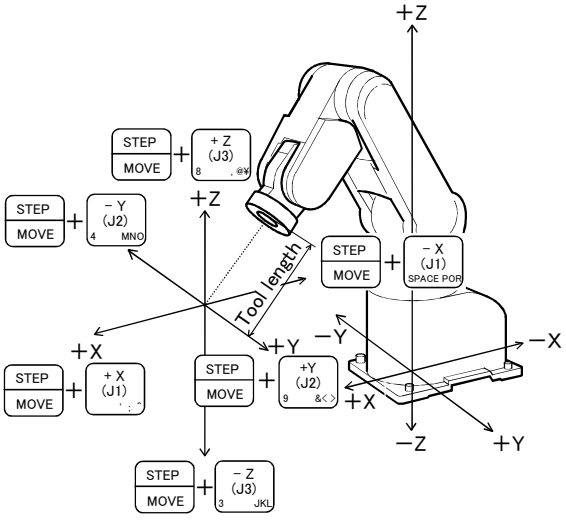
Press the [MOVE] + [XYZ] keys to select the XYZ jog mode. "XYZ" will appear at the upper left of the screen.

Set the jog speed

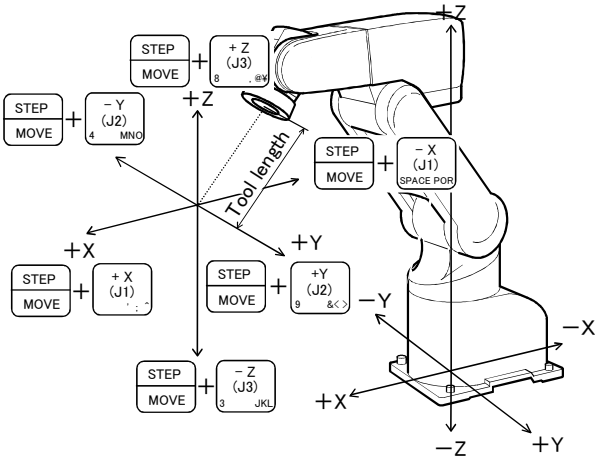


Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the base coordinate system



5−axis type



6−axis type

※ The direction of the frange will not change

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

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

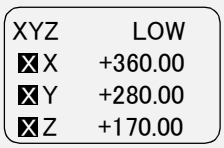
- When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
  When the [MOVE] + [−Z (J3)] keys are pressed, Move along the minus direction.

◇◆◇ 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, an X will appear on the T/B screen, and the robot will not move. Refer to section "(1) JOINT jog operation" on page 20", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

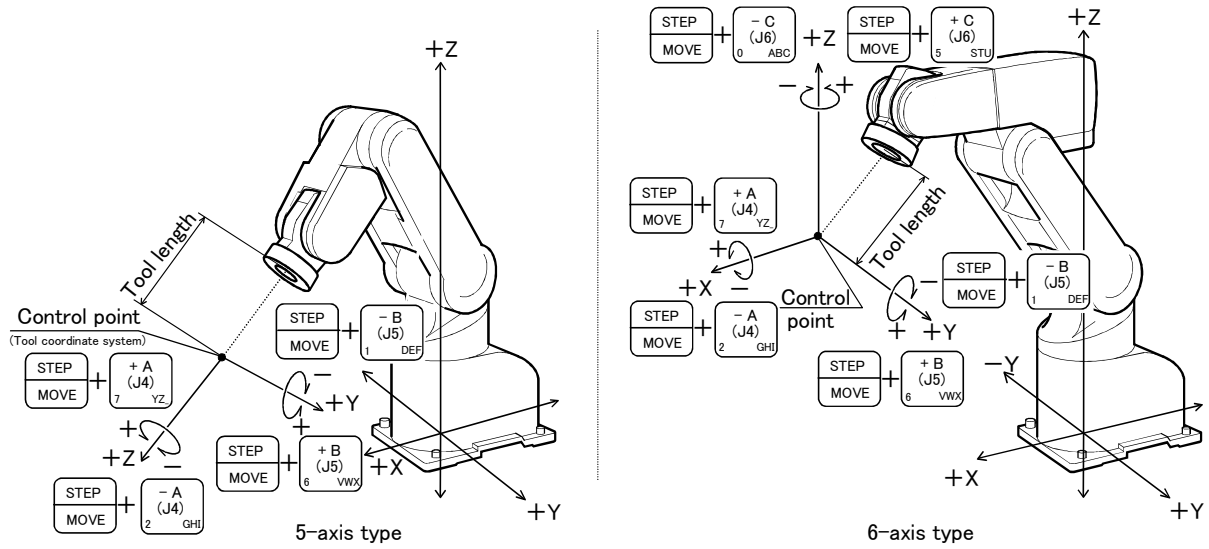
◇◆◇ When an X appears on the T/B screen display ◇◆◇

If the robot is moved outside the movement area with any of the axes, an X will appear. In this case, move the axis in the opposite direction.



In the example on the left, further linear movement in the same direction is not possible.

Changing the flange surface posture



5−axis type

6−axis type

＊ The control point does not change.

・When the [MOVE] + [+A (J4)] keys are pressed,
6−axis type: The X axis will rotate in the plus direction.
5−axis type: The Z axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [−A (J4)] keys are pressed, Rotate in the minus direction.

・When the [MOVE] + [+B (J5)] keys are pressed,
6−axis type: The Y axis will rotate in the plus direction.
5−axis type: The Y axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [−B (J5)] keys are pressed, Rotate in the minus direction.

・When the [MOVE] + [+C (J6)] keys are pressed,
6−axis type: The Z axis will rotate in the plus direction.
5−axis type: There is no operation.
When the [MOVE] + [−C (J6)] keys are pressed,
6−axis type: Rotate in the minus direction.
5−axis type: There is no operation.

◇◆◇ 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 ◇◆◇

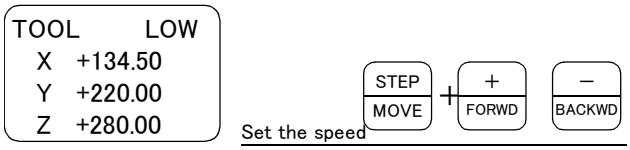
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

Select the TOOL jog mode

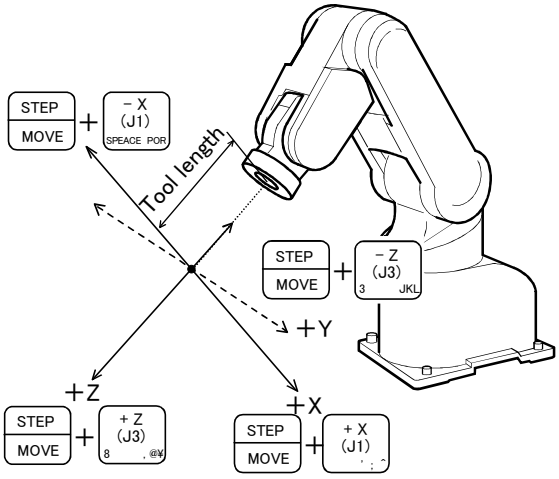
Press the [MOVE] + [TOOL] keys to select the TOOL jog mode. "TOOL" will appear at the upper left of the screen.

Set the jog speed

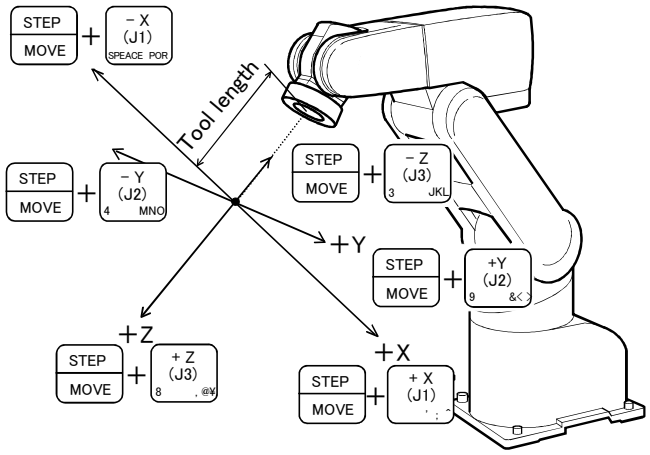


Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the tool coordinate system



5−axis type



6−axis type

∗ The direction of the frange will not change.

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

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

・When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
When the [MOVE] + [−Z (J3)] keys are pressed, Move along 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, an ☒ will appear on the T/B screen, and the robot will not move. Refer to section "(1) JOINT jog operation" on page 20, and move the robot to a position where linear movement is possible, and then carry out TOOL jog.

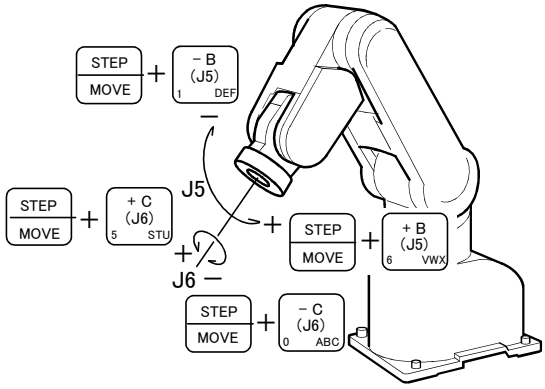
◇◆◇ When an ☒ appears on the T/B screen display ◇◆◇

If the robot is moved outside the movement area with any of the axes, an ☒ will appear. In this case, move the axis in the opposite direction.

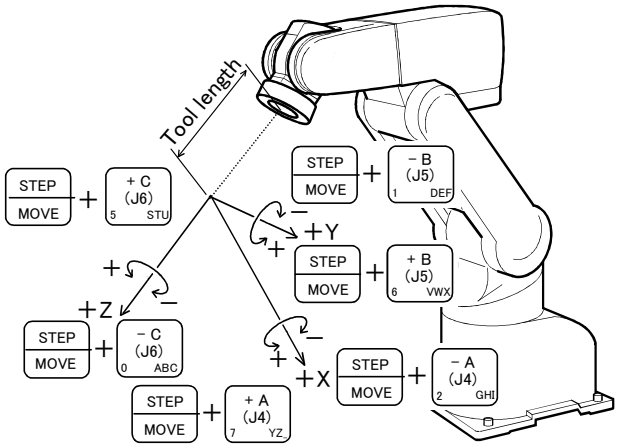
TOOL	LOW
☒X	+360.00
☒Y	+280.00
☒Z	+170.00

In the example on the left, further linear movement in the same direction is not possible.

Changing the flange surface posture



5−axis type



6−axis type

＊ The control point does not change.

・When the [MOVE] + [+A (J4)] keys are pressed,
6−axis type: The X axis will rotate in the plus direction of the tool coordinate system.
5−axis type: There is no operation.
When the [MOVE] + [−A (J4)] keys are pressed,
6−axis type: Rotate in the minus direction.
5−axis type: There is no operation.

・When the [MOVE] + [+B (J5)] keys are pressed,
6−axis type: The Y axis will rotate in the plus direction of the tool coordinate system.
5−axis type: The J5 axis will rotate in the plus direction.
When the [MOVE] + [−B (J5)] keys are pressed, Rotate in the minus direction.

・When the [MOVE] + [+C (J6)] keys are pressed,
6−axis type: The Z axis will rotate in the plus direction of the tool coordinate system.
5−axis type: The J6 axis will rotate in the plus direction.
When the [MOVE] + [−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

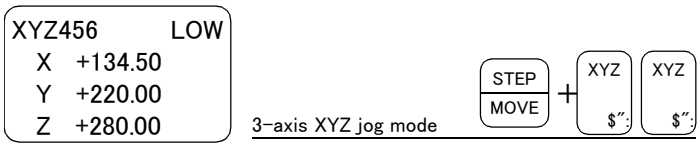
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ 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.

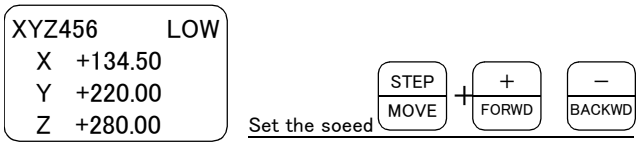
(4) 3-axis XYZ jog operation

Select the 3-axis XYZ jog mode



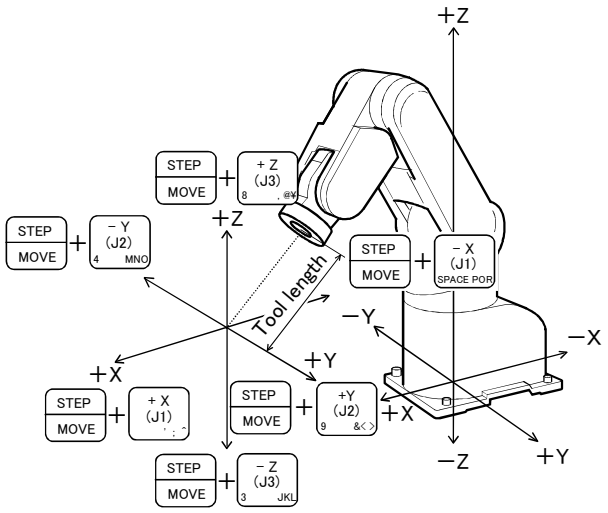
Press the [MOVE] + [XYZ] keys, and then press only the [XYZ] key. "XYZ456" will appear at the upper left of the screen.

Set the jog speed

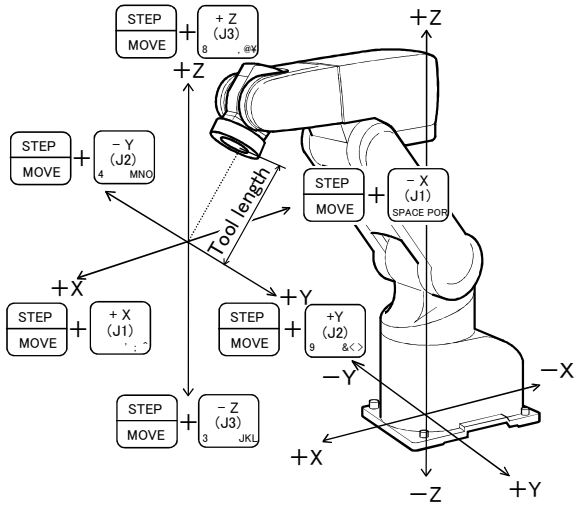


Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the base coordinate system



5-axis type



6-axis type

* The flange position does change.

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

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

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

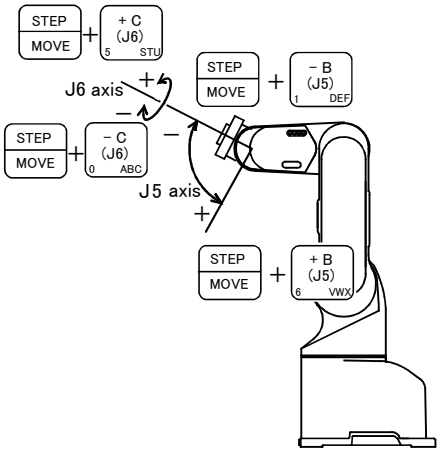
◇◆◇ Jog mode will change when only [XYZ] key is pressed again ◇◆◇

When the [MOVE] + [XYZ] keys are pressed and then only the [XYZ] key is pressed, the upper left display will change in the order of "XYZ" → "XYZ456" → "CYLNDER". Each jog mode can be selected.

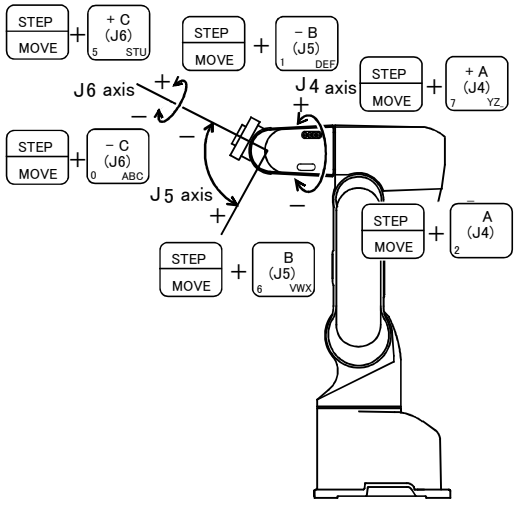
◇◆◇ The flange surface end axis posture cannot be maintained with 3-axis XYZ jog. ◇◆◇

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 flange surface posture



5−axis type



6−axis type

＊The flange position changes.
This is the same as the J4, J5 and J6 axis JOINT jog operation.

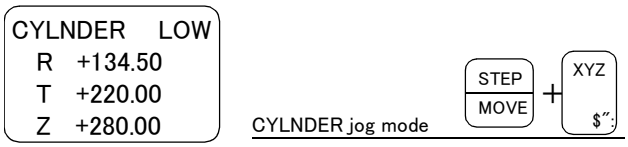
- When the [MOVE] + [+A (J4)] keys are pressed, the J4−axis will rotate in the plus direction.
  When the [MOVE] + [−A (J4)] keys are pressed, Rotate in the minus direction. (6−axis type only)

- When the [MOVE] + [+B (J5)] keys are pressed, the J5−axis will rotate in the plus direction.
  When the [MOVE] + [−B (J5)] keys are pressed, Rotate in the minus direction.

- When the [MOVE] + [+C (J6)] keys are pressed, the J6−axis will rotate in the plus direction.
  When the [MOVE] + [−C (J6)] keys are pressed, Rotate in the minus direction.

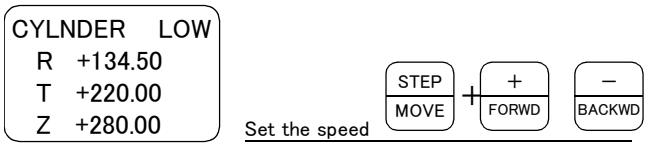
(5) CYLNDER jog operation

Select the cylindrical jog mode



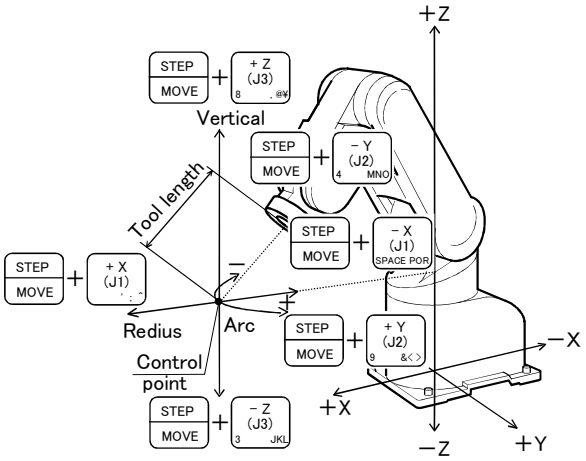
Press the [MOVE] + [XYZ] keys, and then press only the [XYZ] key. "CYLNDER" will appear at the upper left of the screen.

Set the jog speed

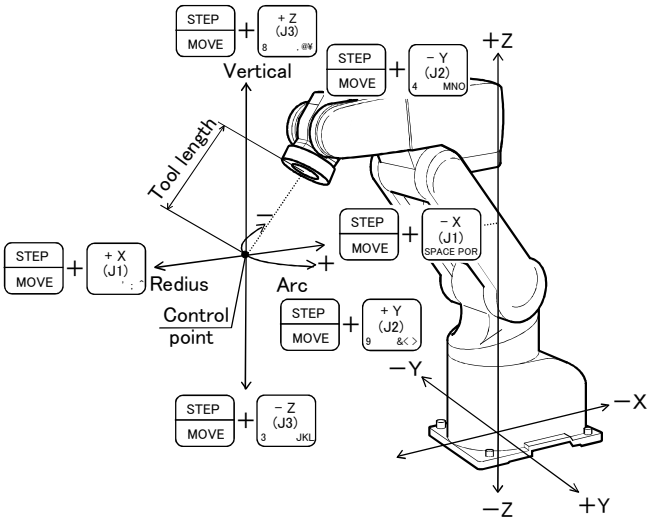


Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along an arc centering on the Z axis



5-axis type



6-axis type

∗ The direction of the frange will not change.

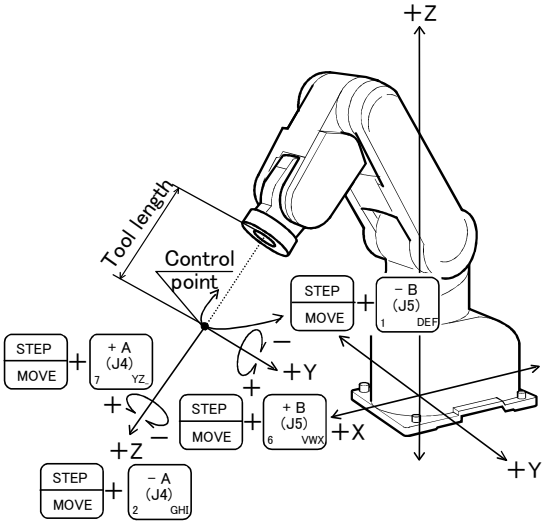
Assuming that the current position is on an arc centering on the Z axis, the robot moves along that arc.

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

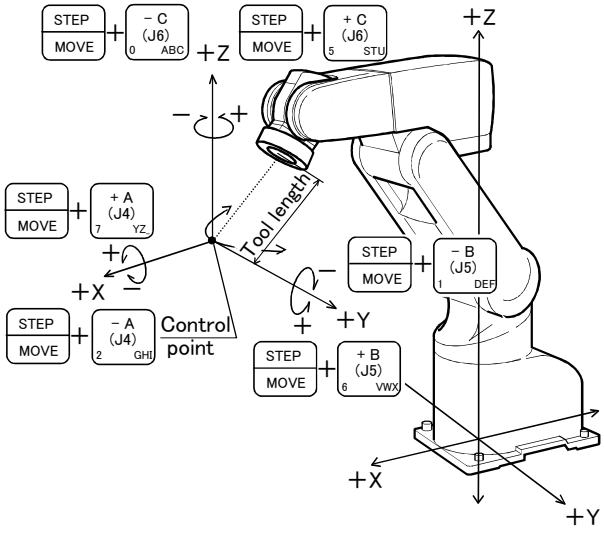
- When the [MOVE] + [+X (J1)] keys are pressed, the robot will expand in the radial direction.
  When the [MOVE] + [−X (J1)] keys are pressed, Contract in the radial direction.

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

Changing the flange surface posture



5−axis type



6−axis type

＊ The flange position does not change.
This is the same as the A, B and C axis XYZ jog operation.

・When the [MOVE] + [+A (J4)] keys are pressed,
6−axis type: The X axis will rotate in the plus direction.
5−axis type: The Z axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [−A (J4)] keys are pressed, Rotate in the minus direction.

・When the [MOVE] + [+B (J5)] keys are pressed,
6−axis type: The Y axis will rotate in the plus direction.
5−axis type: The Y axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [−B (J5)] keys are pressed, Rotate in the minus direction.

・When the [MOVE] + [+C (J6)] keys are pressed,
6−axis type:The Z axis will rotate in the plus direction.
5−axis type: There is no operation.
When the [MOVE] + [−C (J6)] keys are pressed,
6−axis type:Rotates in the minus direction.
5−axis type: There is no operation.

3 Installing the option devices

3.1 Installing the solenoid valve set (1E-VD01/VD01E/VD02/VD02E)

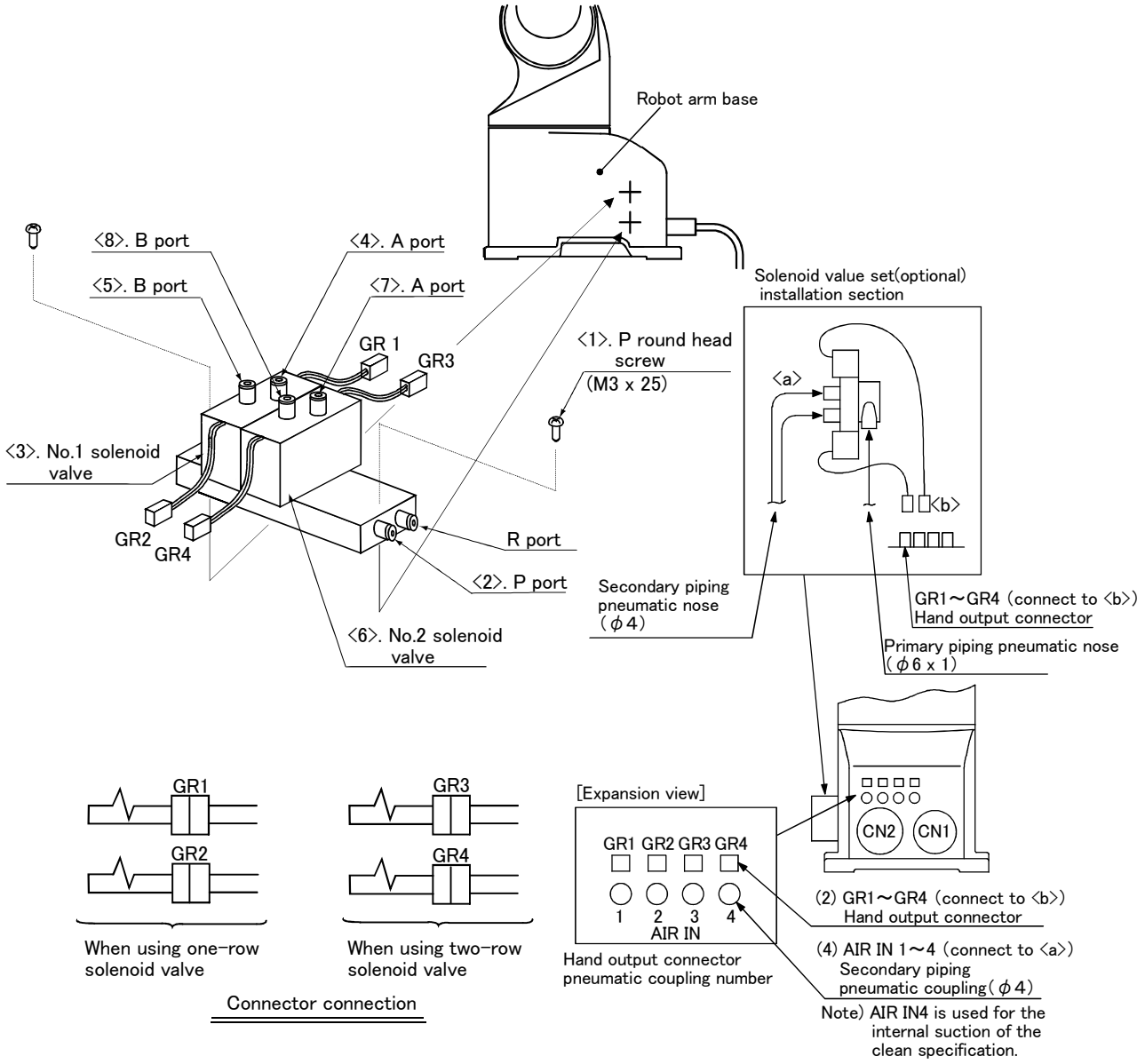


Fig.3-1 : Solenoid valve installation procedures

Fig. 3-1 shows the solenoid valve installation procedures and the solenoid valve connector connection procedures. The installation procedures are as follow. This work must be carried out with the controller power turned OFF.

1) Using the screw holes on the base of the robot arm, install the solenoid valve with the enclosed screw <1> (M3 x 25: 2 screws).
2) Connect the primary air supply air hose (φ6, prepared by customer) to the quick joint (P port) <2> of the solenoid valve.
3) Connect the AIR IN "1" mark secondary piping coupler on the back of the robot arm to the A port <4> of the No. 1 solenoid valve <3> with an air hose (φ4 approx. 250mm, prepared by customer.)
   In the same manner, connect the AIR IN "2" mark secondary piping coupler to the B port 5 of the No. 1 solenoid valve.
   For a double valve (1E-VD02/VD02E), connect the following:
   Connect the AIR IN "3" mark secondary coupler to the A port <7> of the No. 2 solenoid valve <6>.
   Connect the AIR IN "4" mark secondary coupler to the B port <8> of the No. 2 solenoid valve <6>.

4) Connect the GR1 plug from the No. 1 solenoid valve <3> to the GR1 connector on the back of the robot arm.
Connect the GR2 plug from the No. 1 solenoid valve <3> to the GR2 connector on the back of the robot arm.
For a double valve (1E-VD02/VD02E), connect the following:
Connect the GR3 plug from the No. 2 solenoid valve <6> to the GR3 connector on the back of the robot arm.
Connect the GR4 plug from the No. 2 solenoid valve <6> to the GR4 connector on the back of the robot arm.

The connections after the installation appear as in Table 3-1 for single type valves, hand 2 is not applicable.

Table 3-1 : Solenoid valve ports and hoses: Correspondence of couplings and hand ports

Hand	Hand port	Fore arm coupling No. AIR OUT	Robot arm back side coupling No. AIR IN	Solenoid valve port	Solenoid valve used
Hand 1	OPEN	1	1	A	First set
	CLOSE	2	2	B	
Hand 2	OPEN	3	3	A	Second set
	CLOSE	4	4	B	

3.2 Installation the pneumatic hand set （4A-HP01/HP01E）

Table 3-1 shows the construction of the pneumatic hand set and the installation procedure and Table 3-1 shows the configuration equipment which correspond with the Table 3-1.

.

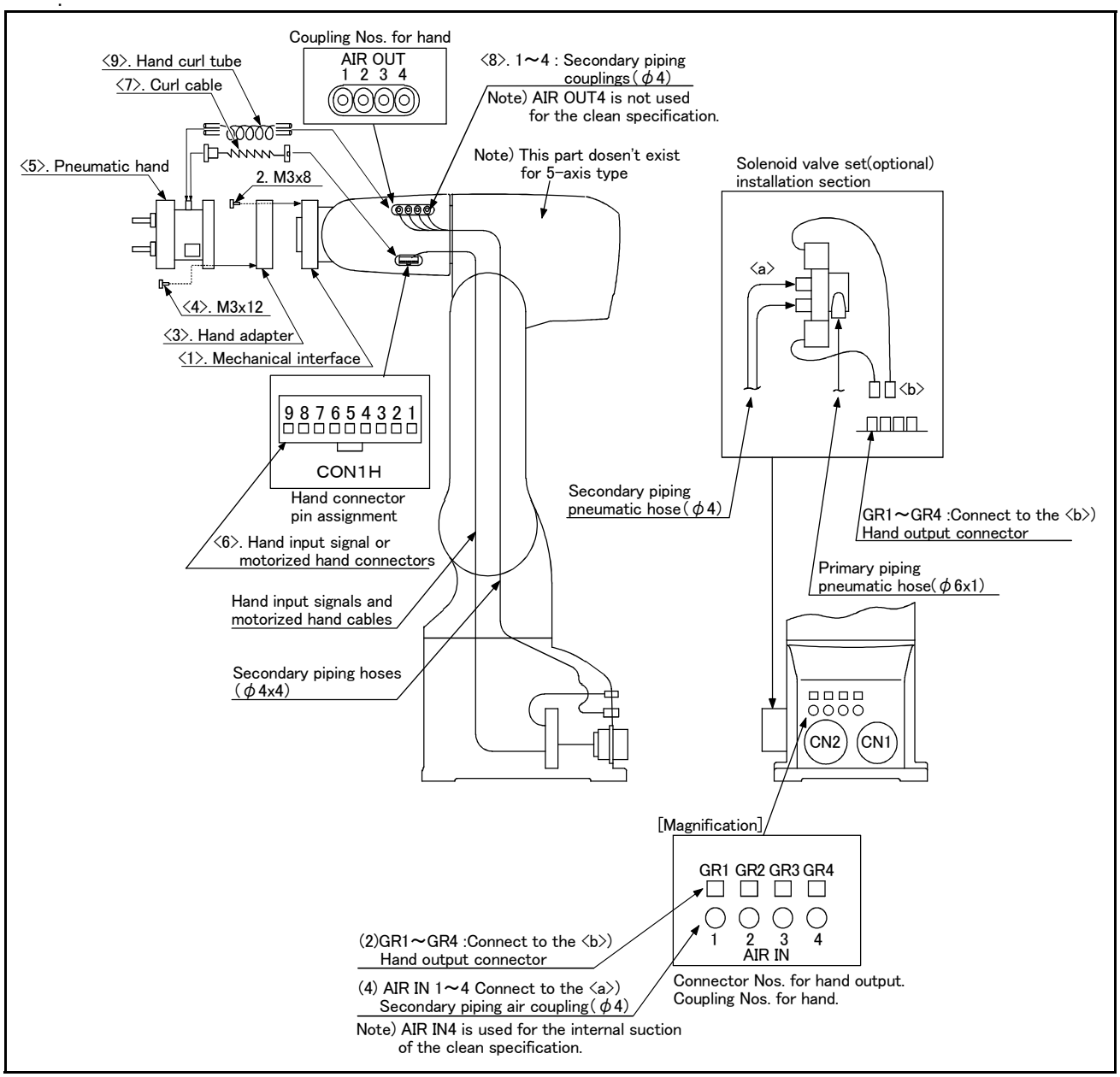


Fig.3-2 : Pneumatic hand set installation procedures

Fig. 3-2 shows the procedures for installing the pneumatic hand set. To install the pneumatic hand set, the pneumatic hand must be installed, the solenoid valve set must be installed and wired, and the pneumatic hand interface must be installed on the controller.

Carry out this work with the controller power turned OFF.

1) Install the hand adaptor <3> on the robot arm's mechanical interface <1> with the enclosed screw M3 x 8 <2>.
2) Install the pneumatic hand <5> onto the hand adaptor <3> with the enclosed screw M3 x 12 <4>.
3) Connect the pneumatic hand <5> and the robot arm's hand input signal connector <6> with the hand curled cable <7>.
4) Pipe the "0" mark piping coupler on the pneumatic hand <5> with the "1" mark secondary piping coupler <8> on the robot arm, and the "C" mark piping coupler on the pneumatic hand <5> with the "2" mark secondary piping coupler <8> on the robot arm with the hand curl tube <9>.

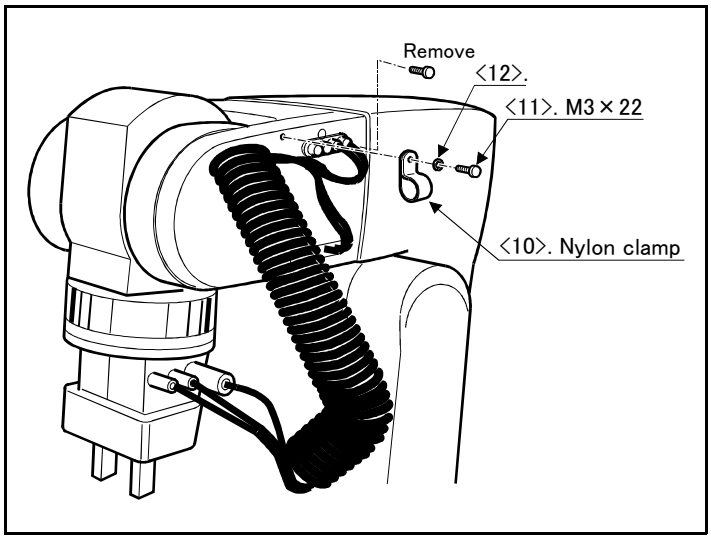


Fig.3-3 : Fix the air hand cable

5) Bundle the hand curl cable <7> and hand curl tube <9>. (Fig. 3-3)
6) Remove the installation screw on the top of the forearm cover, and fix the hand curl cable <7> and hand curl tube <9> with the nylon clamp 10, M3 x 22 <11> and flat washer <12> enclosed with the robot arm. (Tighten with the cover) Fix so that force is not applied on the hand input signal connector <6> or secondary piping coupler when the robot's J5 axis and J6 axis move.
(Adjust the fixing force with the size of the nylon clamp.) Cut and adjust both ends of the hand curl tube <7> to match the robot movement.

⚠ CAUTION If the cable is incorrectly fixed and force is repeatedly applied on the connectors due to the robot movement, wire breakage could occur at the connector section.

7) Follow "3.1Installing the solenoid valve set (1E-VD01/VD01E/VD02/VD02E)", and install the solenoid valve set (single row). The air hose (ϕ4, 250mm) for connecting the solenoid valve and the AIR IN secondary piping coupler on the back of the robot arm is enclosed with the pneumatic hand set.
8) Refer to the separate "Standard Specifications", and install the pneumatic hand interface on the controller.

This completes the installation of the pneumatic hand set.

3.3 Installation the motorized hand set （4A-HM01）

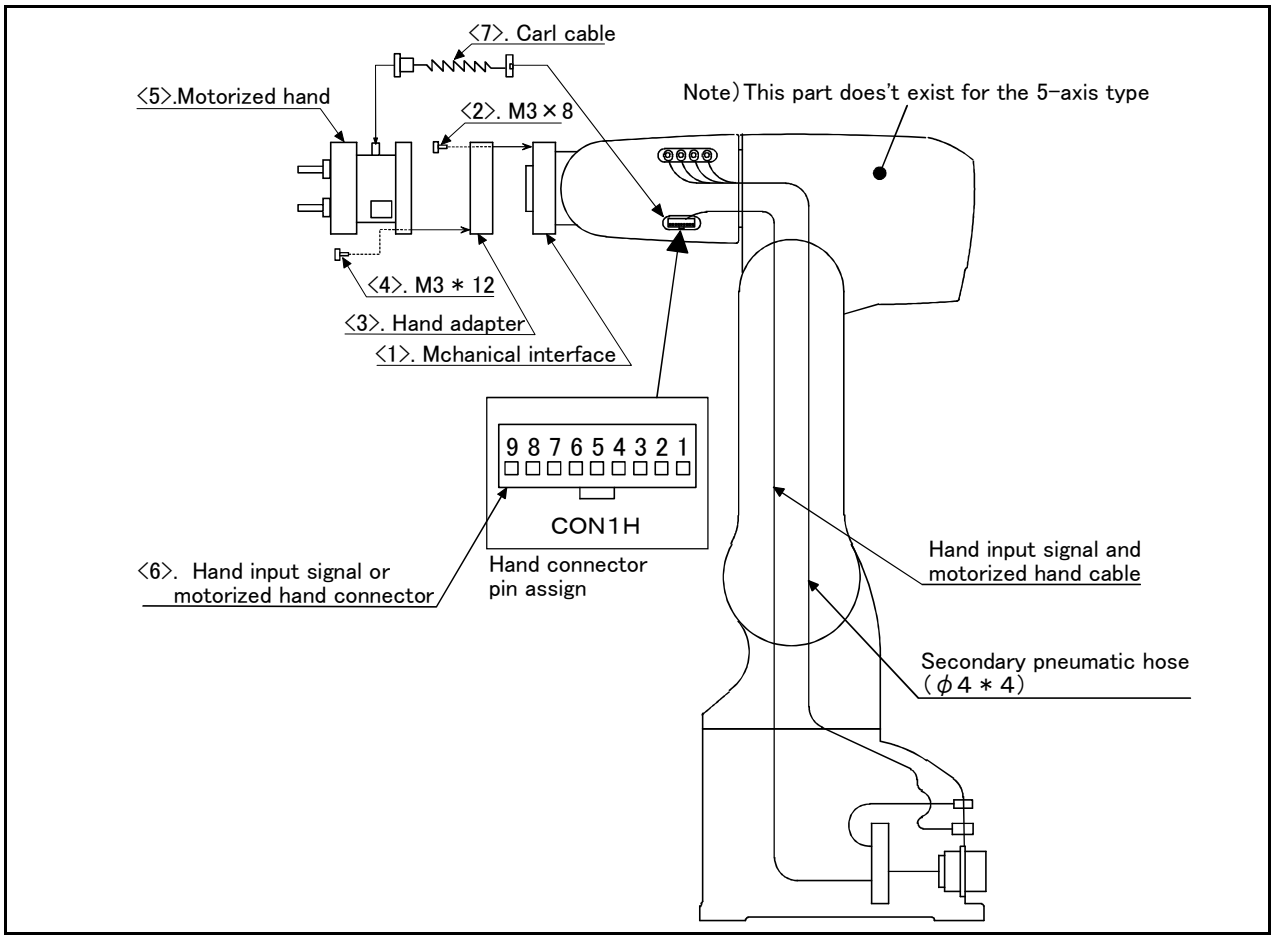
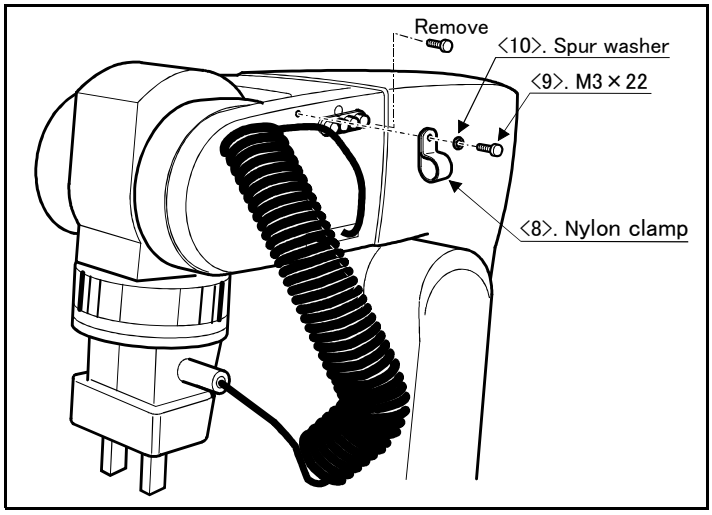


Fig.3-4 : Motorized hand set installation procedures

Fig. 3-4 shows the procedures for installing the motorized hand set. To install the motorized hand set, the motorized hand must be installed and wired, and the motorized hand interface must be installed on the controller. Carry out this work with the controller power turned OFF.

1) Install the hand adaptor <3> on the robot arm's mechanical interface <1> with the enclosed screw M3 x 8 <2>.
2) Install the motorized hand <5> onto the hand adaptor <3> with the enclosed screw M3 x 12 <4>.
3) Connect the motorized hand <5> and the robot arm's motorized hand connector <6> with the hand curled cable <7>.



4) Remove the installation screw on the top of the forearm cover, and fix the hand curl cable <7> with the nylon clamp <8>, M3 x 22 <9> and flat washer <10> enclosed with the robot arm. (Tighten with the cover) Fix so that force is not applied on the motorized hand connector <6> when the robot's J5 axis and J6 axis move.
(Adjust the fixing force with the size of the nylon clamp.) (Fig. 3-5)

Fig.3-5 : Fix the motorized hand cable

⚠CAUTION If the cable is incorrectly fixed and force is repeatedly applied on the connectors due to the robot movement, wire breakage could occur at the connector section.

5) Refer to the separate "Instruction Manual/Controller setup, basic operation, and maintenance", and install the motorized hand interface (RZ-364) on the controller.
The motorized hand interface is mounted on the RZ-386 or RZ-387 card in the controller's control unit.

This completes the installation of the motorized hand set.

3.4 Hand output cable (1E-GR35S)

This hand output cable is used by the customer to connect to the handle output connector on the shoulder section of the robot arm.
Refer to section "3.1Installing the solenoid valve set (1E-VD01/VD01E/VD02/VD02E)", 4) Table 3-1 on page 32 for the connection methods.

3.5 Installing the hand input cable (1A-HC20) and hand curl tube (1A-ST040*C)

The hand input cable and hand curl tube are used to connect to the hand and sensor manufactured by the customer.
Refer to section "3.2Installation the pneumatic hand set (4A-HP01/HP01E) " 5) and 6) on page 33 for the installation methods.

3.6 Installing the hand adaptor (1A-HA01)

The hand adaptor is used to change the RV-1A/2AJ mechanical interface to the RV-M1 interface.
Refer to section "3.2Installation the pneumatic hand set (4A-HP01/HP01E) " 1) on page 33 for the installation methods.

4 Basic operations

The basic operations from creating the program to automatic operation are explained in section ″4. Basic operations″ in the ″From Controller Setup to Maintenance″ manual. Refer that manual as necessary.

5 Maintenance and Inspection

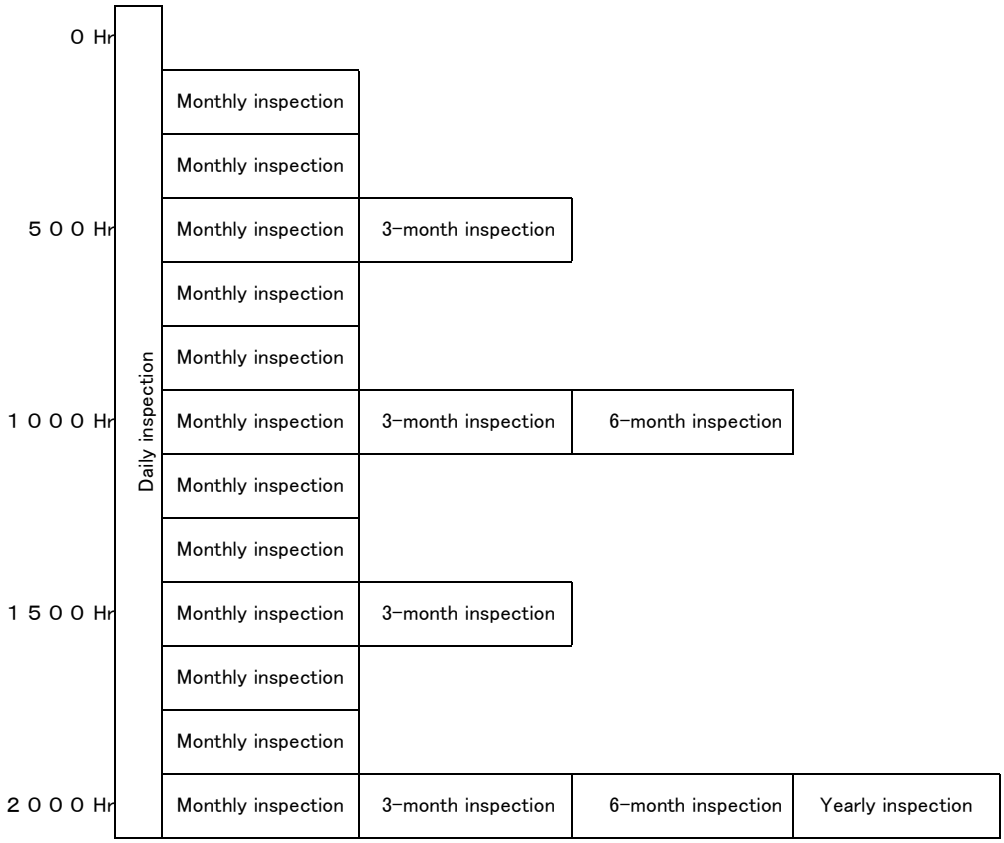
The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

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).



<Guideline for inspection period>

For one shift

8 Hr/day × 20 days/month × 3 months = approx. 500 Hr

10 Hr/day × 20 days/month × 3 months = approx. 600 Hr

For two shifts

15 Hr/day × 20 days/month × 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.
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.	Exchange it referring to "5.3.5Replacing the backup battery" on page 54.
2-year inspection items		
1	Lubricate the grease at the harmonic reduction gears for each axis.	Lublicate it referring to "5.3.4Lubrication" on page 52.

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 customer to carry out maintenance and inspection are described in "5.4Maintenance parts" on page 55 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

An outline structure drawing of the 5-axis type robot arm is shown in Fig. 5-2, and of the 6-axis type robot arm in Fig. 5-3. Each part is as shown below.

1) The J1 axis rotation is driven by the J1 axis motor <1> and reduction gears <2> arranged in the shoulder.
Non-excitation magnetic brakes are mounted in the J1axis motor <1>.

2) The rotation of the J2 axis motor <3> arranged in the shoulder is conveyed to the reduction gears <5> via the timing belt <4> to rotate the upper arm and following parts.
Non-excitation magnetic brakes are mounted in the J2 axis motor <3>.

3) The rotation of the J3 axis motor <6> arranged in the shoulder is conveyed to the reduction gears <8> via the timing belt <7> to rotate the elbow block and following parts.
Non-excitation magnetic brakes are mounted in the J3 axis motor <6>.

4) J4 axis rotation section (only 6-axis type)
The rotation of the J4 axis motor <9> arranged in the 6-axis type elbow block is conveyed to the reduction gears <11> via the timing belt <10> to rotate the forearm and following parts.

5) The rotation of the J5 axis motor <12> arranged in the forearm is conveyed to the reduction gears <14> via the timing belt <13> to rotate the wrist housing and following parts.
Non-excitation magnetic brakes are mounted in the J5 axis motor <12.

6) The rotation of the J6 axis is driven by the J6 axis motor <15> arranged in the wrist housing and the reduction gears <16>.

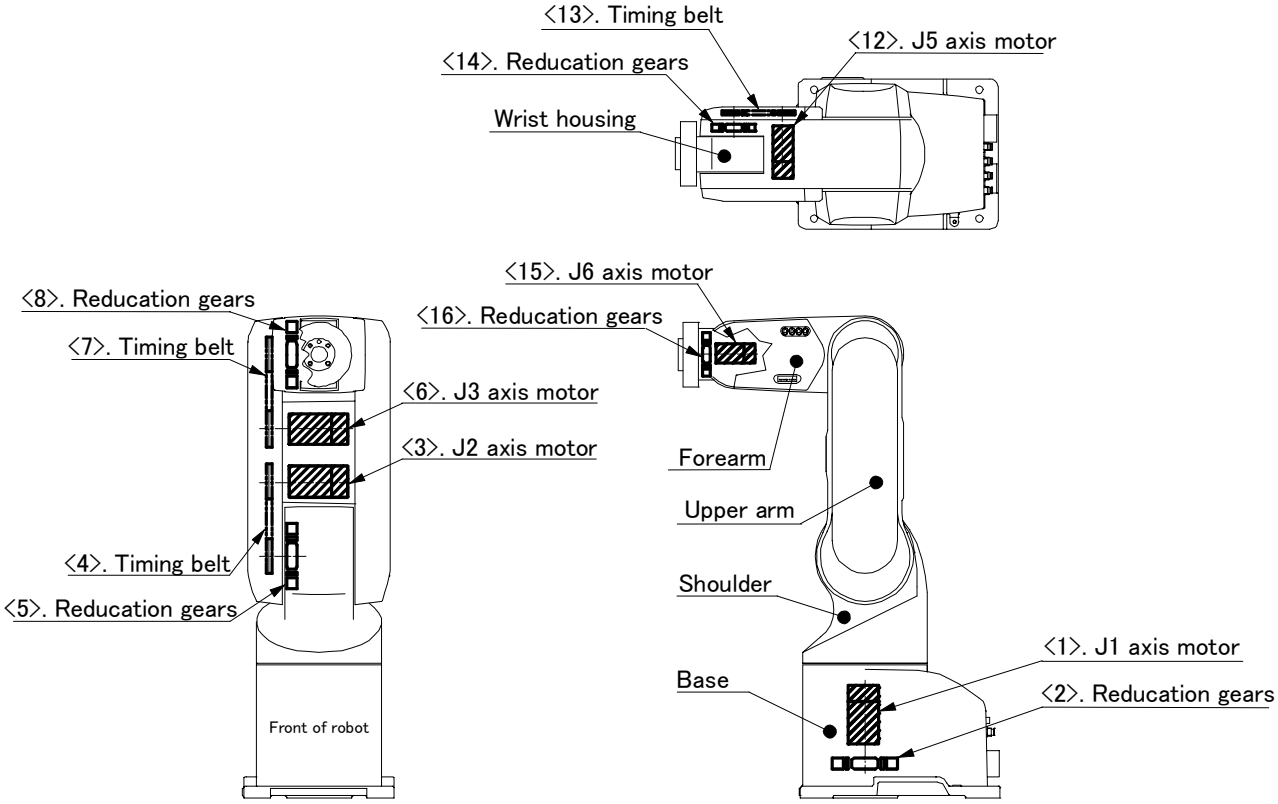


Fig.5-2 : Outline structure drawing of robot arm (5-axis type)

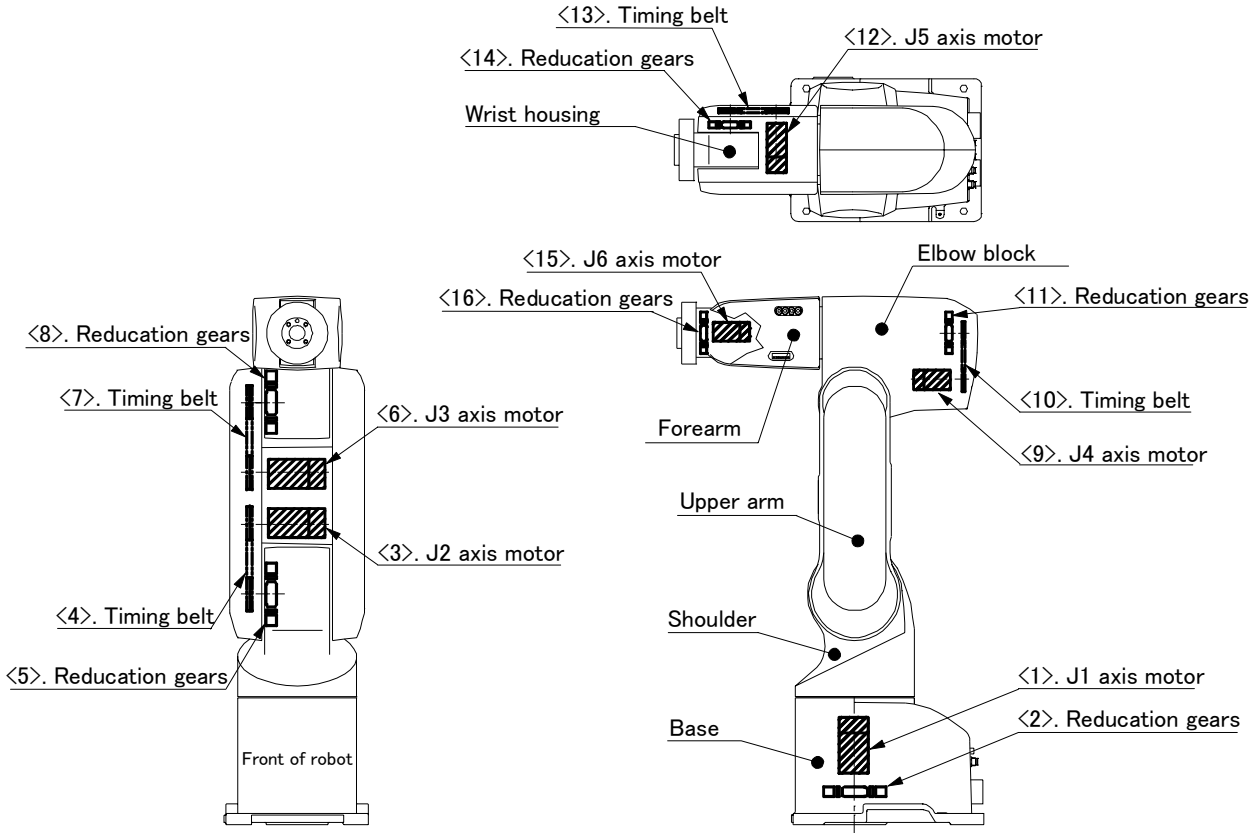


Fig.5-3 : Outline structure drawing of robot arm (6-axis type)

5.3.2 Installing/removing the cover

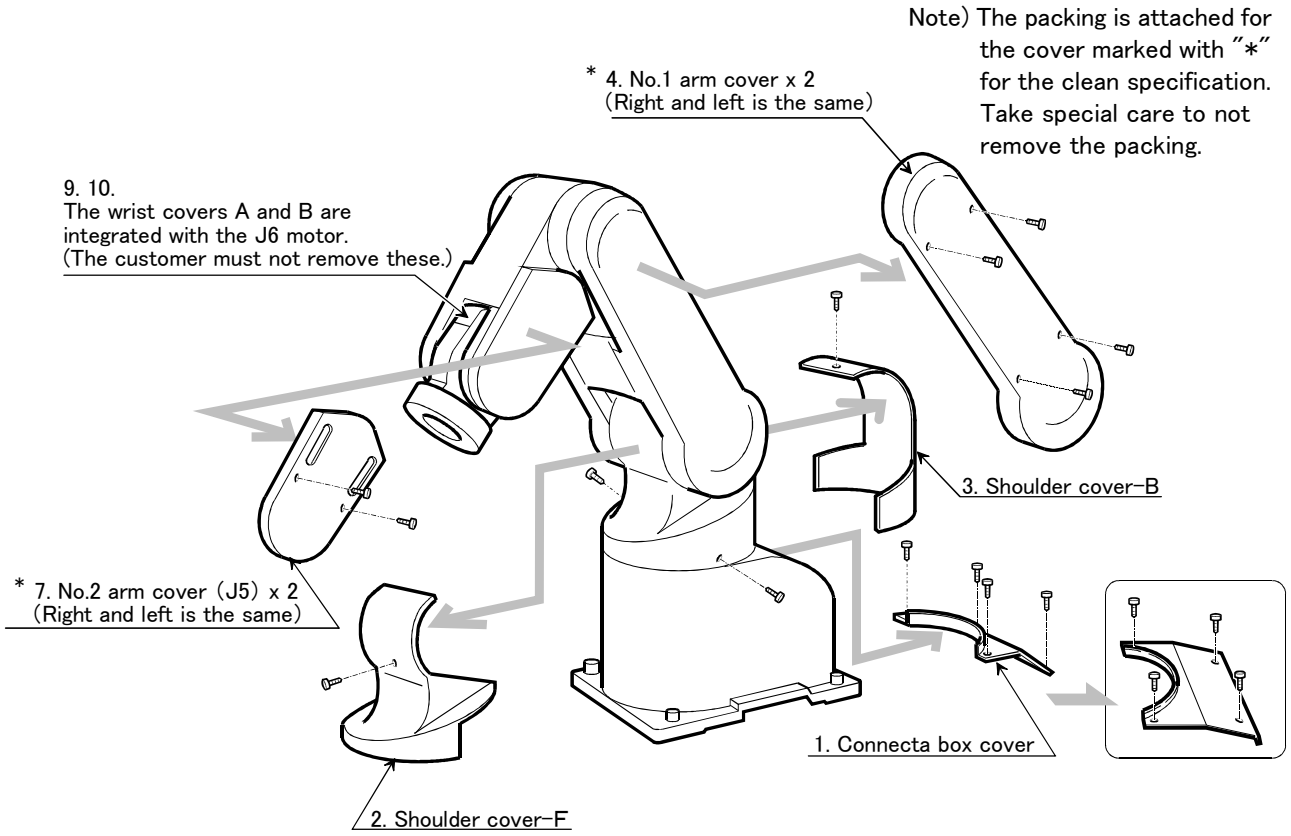


Fig.5-4 : Installing/removing the cover (5-axis type)

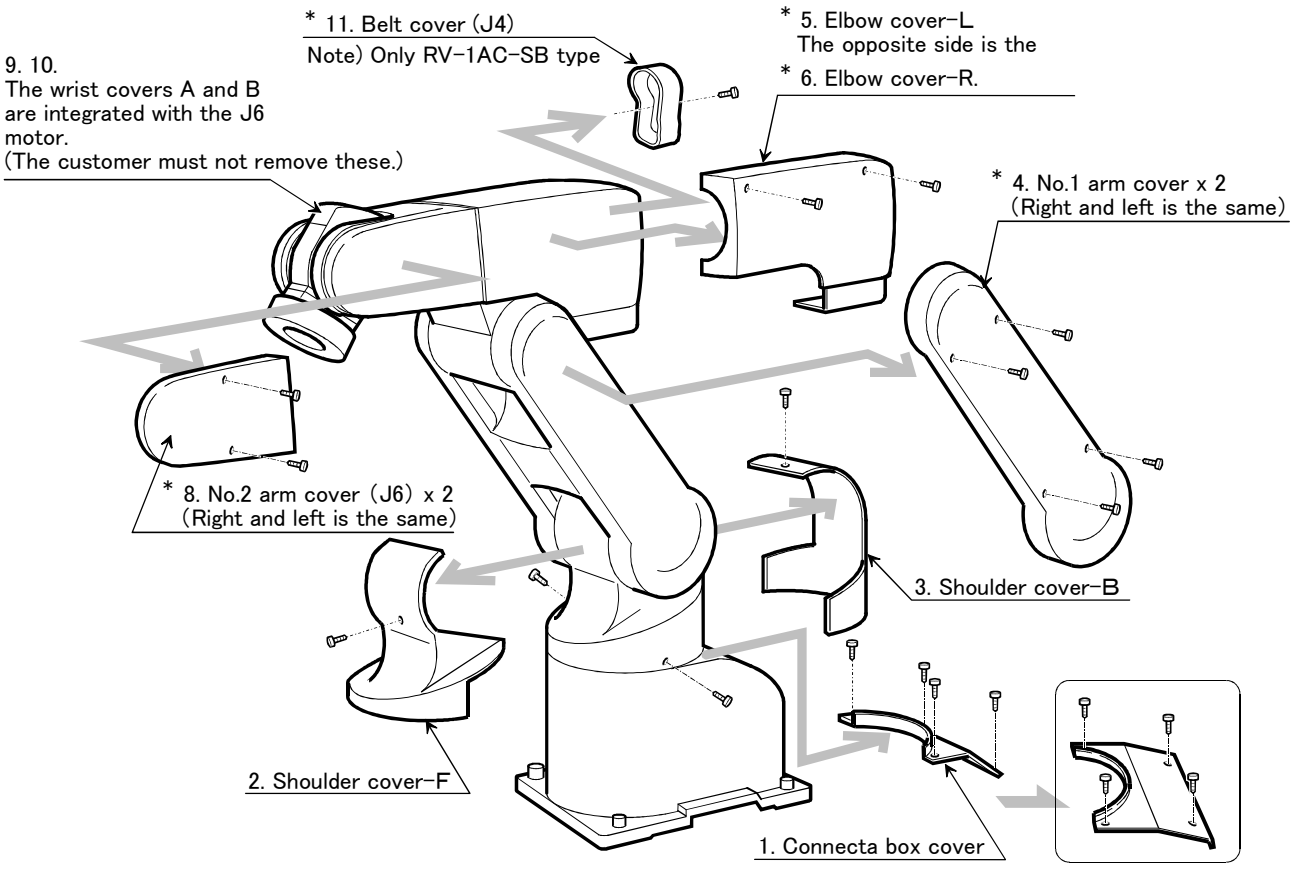


Fig.5-5 : Installing/removing the cover (6-axis type)

Table 5-3 : Cover names

No	Cover names	Qty.		Remarks
		For 5-axis type	For 6-axis type	
1	Connector box cover	1	1	
2	Shoulder cover F	1	1	
3	Shoulder cover B	1	1	
4	No. 1 arm cover	2	2	The packing is attached for the clean specification.
5	Elbow cover L	—	1	The packing is attached for the clean specification.
6	Elbow cover R	—	1	The packing is attached for the clean specification.
7	No. 2 arm cover (J5)	2	—	The packing is attached for the clean specification.
8	No. 2 arm cover (J6)	—	2	The packing is attached for the clean specification.
9	Wrist cover A	(1)	(1)	
10	Wrist cover B	(2)	(2)	
11	Belt cover (J4)	—	1	Only RV-1AC-SB type. The packing is attached for the clean specification.

Note) In the case of clean specification, there are some places using the packing on the cover of no.4 to 8, and 11 shown in Table 5-3. Take special care to not remove the packing at removing/installing the cover.

Table 5-4 : Cover installation screw list

Installation screw name	Qty.	Remarks
Socket bolt M3 × 10 (nickel plated)	23	For 5-axis type
	31	For 6-axis type

(1) Refer to Fig. 5-4 when using the 5-axis type robot arm, and Fig. 5-5 when using the 6-axis type robot arm, and remove the cover.
(2) The names of the covers are given in Table 5-3, and a list of the cover installation screws is given in Table 5-4.
(3) There are some covers that may be difficult to remove due to the robot posture. In this case, change the robot posture with jog operation, and then remove the cover.
(4) When attaching the cover after maintenance and inspection, use the detaching procedure in reverse.

The part Nos. and symbols in Table 5-3 and Table 5-4 correspond to Fig. 5-4 and Fig. 5-5.

⚠ CAUTION Wrist cover A is also used as the J6 axis encoder cover. Do not remove it.

5.3.3 Inspection, maintenance and replacement of timing belt

This robot uses a timing belt for the drive conveyance system of the J5 axis. 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 from 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 machine system origin may deviate. In this case, the position data must be reviewed.

(2) Inspection, maintenance and replacement of J2-axis timing belt

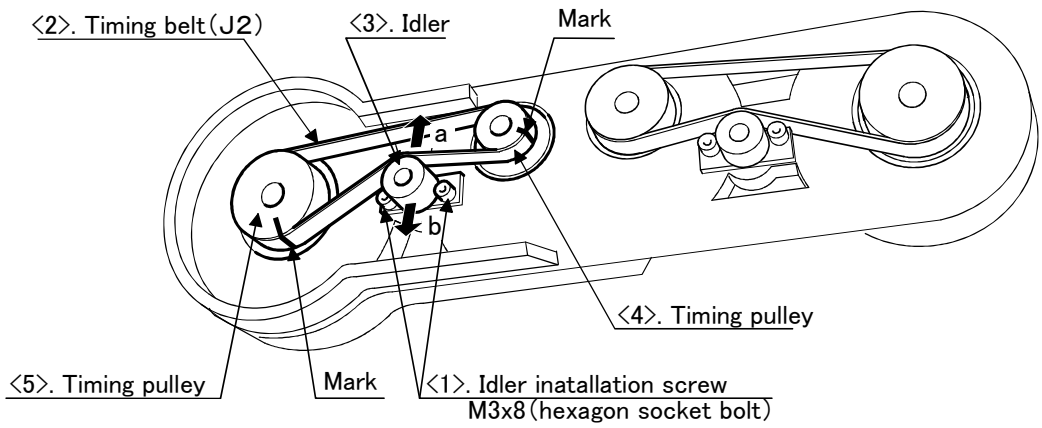


Fig.5-6 : Inspection, maintenance and replacement of J2-axis timing belt

■ Inspecting the J2 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to "5.3.2Installing/removing the cover" on page 44, and remove the No. 1 arm cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken approx. 1.5mm when the center of the belt is lightly pressed with a finger (approx. 2N) as shown in "Fig.5-10 : Belt tension".

■ Adjusting the J2 axis timing belt

1) Carry out steps "1)" and "2)" indicated in " ■ Inspecting the J2 axis timing belt" above.
2) Lightly loosen the two idler installation bolts <1>. (Do not loosen too much.)
3) While confirming the tension of the timing belt <2>, move the idler <3> in the direction of the arrow shown in the figure. Move until the belt slackens approx. 1.5mm when the center of the belt is lightly pressed with a finger (approx. 2N).
4) The belt tension will increase when moved in the direction of arrow "a", and will decrease when moved in the direction of arrow "b".
5) If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
6) After adjusting, securely tighten the two idler installation bolts <1>. Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J2 axis timing belt

1) Fig. 5-6 shows the methods for inspecting, adjusting and replacing the timing belt.
2) Move the robot posture with the teaching pendant so that the J2 axis contacts the mechanical stopper. The J2 axis brakes must be released.
3) Make sure that the pulleys do not move while replacing the belt.
4) If the pulley <4> and <5> position relation deviates, the position could deviate.
5) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-6 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
6) Loosen the two idler installation bolts <1>, and remove the belt.
7) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
8) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
9) Refer to steps "3)" to "6)" in " ■ Adjusting the J2 axis timing belt" and "(6)Timing belt tension" to adjust the tension.
10) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to "5.5Resetting the origin" on page 56, and reset the origin position.

(3) Inspection, maintenance and replacement of J3-axis timing belt

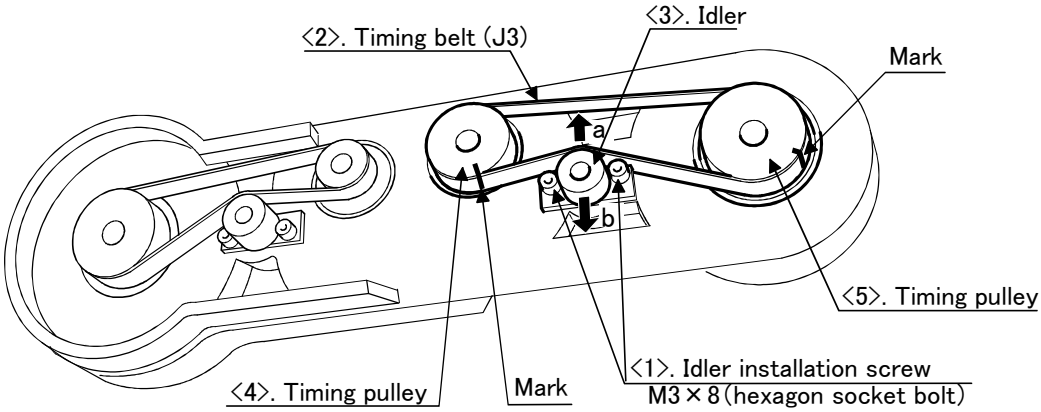


Fig.5-7 : Inspection, maintenance and replacement of J3-axis timing belt

■ Inspecting the J3 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Fig. 5-4 or Fig. 5-5, and remove the No. 1 arm cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken approx. 1.6mm when the center of the belt is lightly pressed with a finger (approx. 2N) as shown in "Fig.5-10 : Belt tension".

■ Adjusting the J3 axis timing belt

1) Carry out steps 1) and 2) indicated in " ■ Inspecting the J2 axis timing belt" above.
2) Lightly loosen the two idler installation bolts <1>. (Do not loosen too much.)
3) While confirming the tension of the timing belt <2>, move the idler <3> in the direction of the arrow shown in the figure. Move until the belt slackens approx. 1.6mm when the center of the belt is lightly pressed with a finger (approx. 2N).
4) The belt tension will increase when moved in the direction of arrow a, and will decrease when moved in the direction of arrow b.
5) If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
6) After adjusting, securely tighten the two idler installation bolts <1>. Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J3 axis timing belt

1) Fig. 5-7 shows the methods for inspecting, adjusting and replacing the timing belt.
2) Move the robot posture with the teaching box so that the J3 axis contacts the mechanical stopper. The J3 axis brakes must be released.
3) Make sure that the pulleys do not move while replacing the belt.
4) If the pulley <4> and <5> position relation deviates, the position could deviate.
5) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-7 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
6) Loosen the two idler installation bolts <1>, and remove the belt.
7) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
8) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
9) Refer to steps 3) to 6) in " ■ Adjusting the J2 axis timing belt" and "(6)Timing belt tension" to adjust the tension.
10) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to "5.5Resetting the origin" on page 56, and reset the origin position.

(4) Inspection, maintenance and replacement of J4-axis timing belt

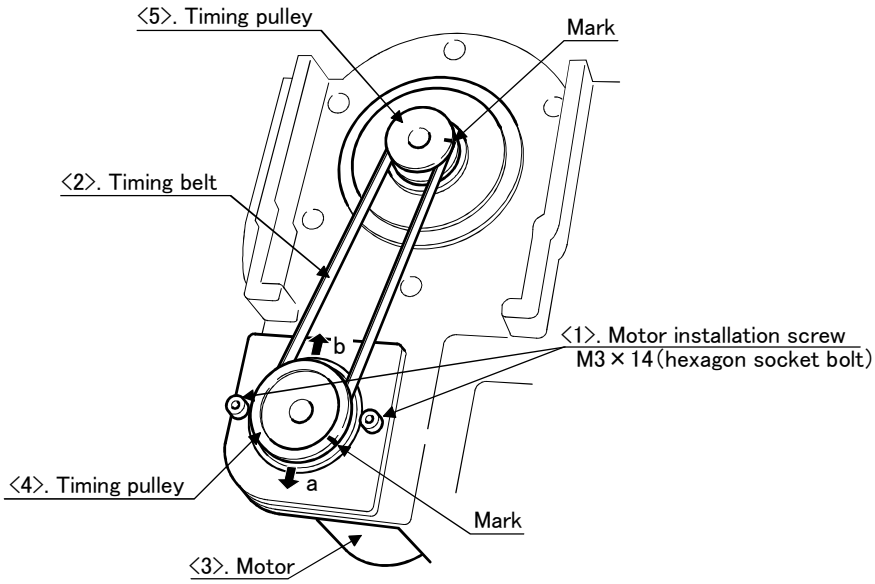


Fig.5-8 : Inspection, maintenance and replacement of J4-axis timing belt

■ Inspecting the J4 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Fig. 5-4 or Fig. 5-5, and remove the elbow covers L and R.
   In the case of the clean specification, remove the belt cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken approx. 1.4mm when the center of the belt is lightly pressed with a finger (approx. 0.4N) as shown in "Fig.5-10 : Belt tension".

■ Adjusting the J4 axis timing belt

1) Carry out steps 1) and 2) indicated in " ■ Inspecting the J2 axis timing belt" above.
2) Lightly loosen the two motor installation bolts <1>. (Do not loosen too much.)
3) While confirming the tension of the timing belt <2>, move the motor <3> in the direction of the arrow shown in the figure. Move until the belt slackens approx. 1.4mm when the center of the belt is lightly pressed with a finger (approx. 0.4N).
4) The belt tension will increase when moved in the direction of arrow a, and will decrease when moved in the direction of arrow b.
5) If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
6) After adjusting, securely tighten the two motor installation bolts <1>. Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J4 axis timing belt

1) Fig. 5-8 shows the methods for inspecting, adjusting and replacing the timing belt.
2) Move the robot posture with the teaching box so that the J4 axis contacts the mechanical stopper. The J4 axis must be moved by hand after the servo is turned OFF.
3) Make sure that the pulleys do not move while replacing the belt.
4) If the pulley <4> and <5> position relation deviates, the position could deviate.
5) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-8 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
6) Loosen the two motor installation bolts <1>, and remove the belt.
7) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
8) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
9) Refer to steps 3) to 6) in " ■ Adjusting the J2 axis timing belt" and "(6)Timing belt tension" to adjust the tension.
10) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to "5.5Resetting the origin" on page 56, and reset the origin position.

(5) Inspection, maintenance and replacement of J5-axis timing belt

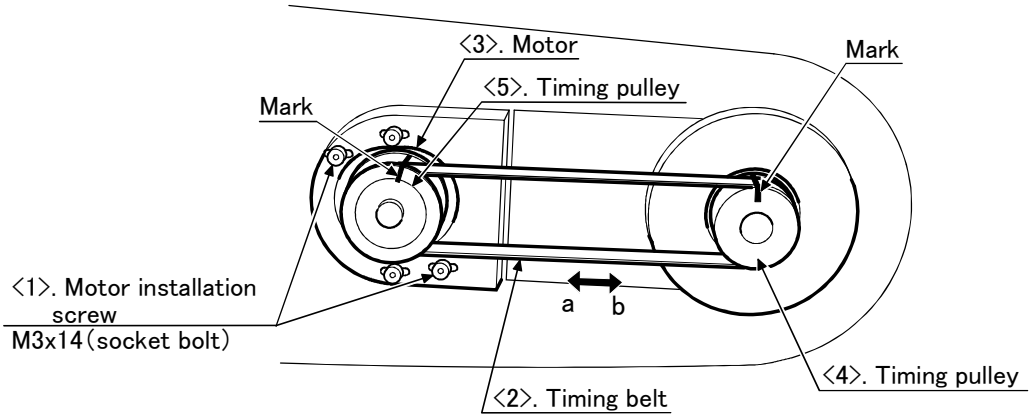


Fig.5-9 : Inspection, maintenance and replacement of J5-axis timing belt

■ Inspecting the J5 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Fig. 5-4 or Fig. 5-5, and remove the No.2 arm cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken approx. 1.4mm when the center of the belt is lightly pressed with a finger (approx. 0.4N) as shown in "Fig.5-10 : Belt tension".

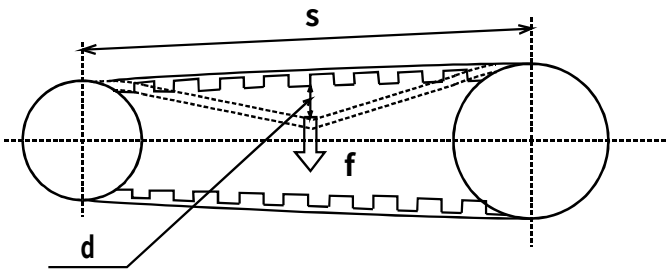
■ Adjusting the J5 axis timing belt

1) Carry out steps 1) and 2) indicated in " ■ Inspecting the J2 axis timing belt" above.
2) Lightly loosen the two motor installation bolts <1>. (Do not loosen too much.)
3) While confirming the tension of the timing belt <2>, move the motor <3> in the direction of the arrow shown in the figure. Move until the belt slackens approx. 1.4mm when the center of the belt is lightly pressed with a finger (approx. 0.4N).
4) The belt tension will increase when moved in the direction of arrow a, and will decrease when moved in the direction of arrow b.
5) If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
6) After adjusting, securely tighten the four motor installation bolts <1>. Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J5 axis timing belt

1) Fig. 5-9 shows the methods for inspecting, adjusting and replacing the timing belt.
2) Move the robot posture with the teaching box so that the J5 axis contacts the mechanical stopper. The J5 axis must be moved by hand after the servo is turned OFF.
3) Make sure that the pulleys do not move while replacing the belt.
4) If the pulley <4> and <5> position relation deviates, the position could deviate.
5) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-9 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
6) Loosen the two motor installation bolts <1>, and remove the belt.
7) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
8) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
9) Refer to steps 3) to 6) in " ■ Adjusting the J2 axis timing belt" and "(6)Timing belt tension" to adjust the tension.
10) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to "5.5Resetting the origin" on page 56, and reset the origin position.

(6) Timing belt tension



f : Pressing force
s : Span
d : Slack

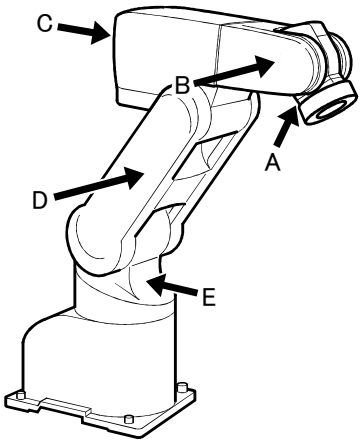
Axis	Belt type	Span : s (mm)	Slack : d (mm)	Pressing force : f (N)
J2	291-3GT-6	100	1.5	2
J3	315-3GT-6	102.5	1.6	2
J4	210-2GT-3	75	1.2	0.4
J5	230-2GT-3	85	1.4	0.4

Fig.5-10 : Belt tension

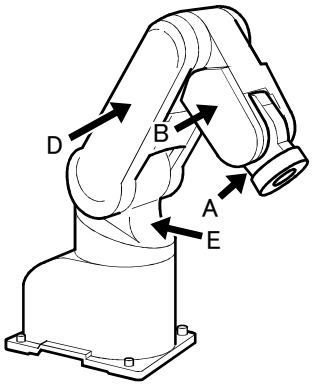
The timing belt can satisfactorily convey the drive and keep a durable force only when it has an adequate tension. The belt tension should not be too tight or too lose. Instead, it should be adjusted to a degree that elasticity is felt when the belt is pressed with the thumb. If the belt tension is too weak, 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.
The detailed adjustment (tension) is shown in Fig. 5-10.
Check and adjust with the belt pressing force f and the slack amount d between span s.

5.3.4 Lubrication

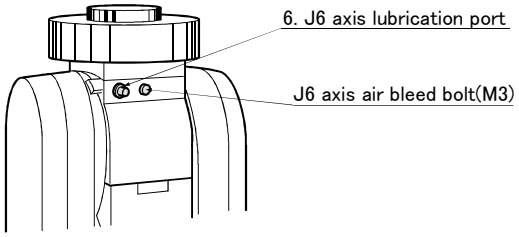
(1) Lubrication position and specifications



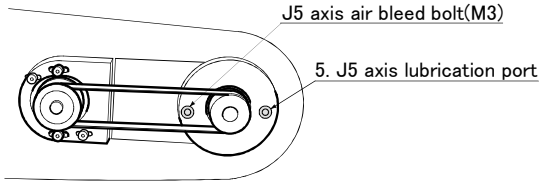
6 axis type



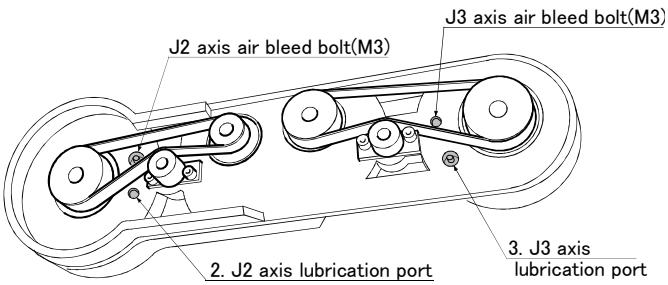
5 axis type



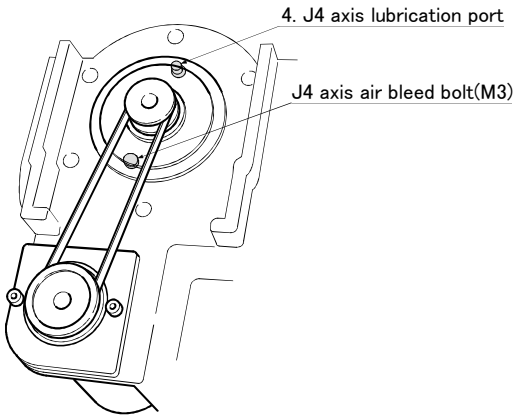
View A (J6 axis)



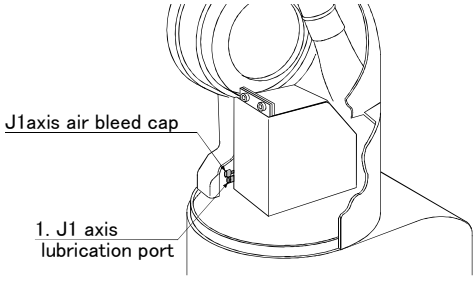
View B (J5 axis)



View D (J2, J3 axis)



View C (J4 axis)



View E (J1 axis)

Fig.5-11 : Lubrication positions

Table 5-5 : Lubrication specifications

No.	Parts to be lubricated	Oiling method	Lubrication oil Default charge amount (maker)	Lubrication intervalLubrication amount guide*1	Cover to remove
1	J1 axis reduction gears	Grease nipple WC-610	Grease Harmonic grease SK-1A 10g (Japan Harmonic Systems)	2000Hr 3g	Shoulder cover F
2	J2 axis reduction gears				No.1arm cover
3	J3 axis reduction gears				
4	J4 axis reduction gears (6-axis type only)	Grease nipple WA-610	Grease Harmonic grease SK-1A 4 g (Japan Harmonic Systems)	2000Hr 1g	Elbow cover
5	J5 axis reduction gears				No.2arm cover
6	J6 axis reduction gears				—

Table 5-6 : Lubrication specifications

The grease nipple position is shown in Fig. 5-11. The lubrication specifications for each place are shown in Table 5-5. Before lubricating, refer to "Fig. 5-4Installing/removing the cover (5-axis type)" on page 44 for the 5-axis type, and "Fig. 5-5Installing/removing the cover (6-axis type)" on page 44 for the 6-axis type, and remove the required covers.

[Caution]
- The brands of grease given in Table 5-5 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 has been suspended, or if the designated speed is slow, the lubrication time can be lengthened in proportion. (The hours marked with a "*1 " are based on the yearly inspection.)
- 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 Table 5-5 correspond to the supply positions in Fig. 5-11.

(2) Lubrication method

1) Refer to the "5.3.2Installing/removing the cover" on page 44 and remove the covers.
2) Remove the drain bolt.
3) Insert the grease shown in Table 5-5 using a grease gun from the lubrication grease nipple.
4) Install the drain bolt.
5) Replace the covers with the removal procedure in reverse.

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. When the battery life nears, the "Battery cumulative time over alarm (Alarm No. 7520)" will occur. Once the alarm occurs, replace all batteries in the robot arm and controller as soon as possible. Lithium batteries (type: A6BAT and ER6) are used in both the controller and robot arm. The battery replacement procedures are as follow.

(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.

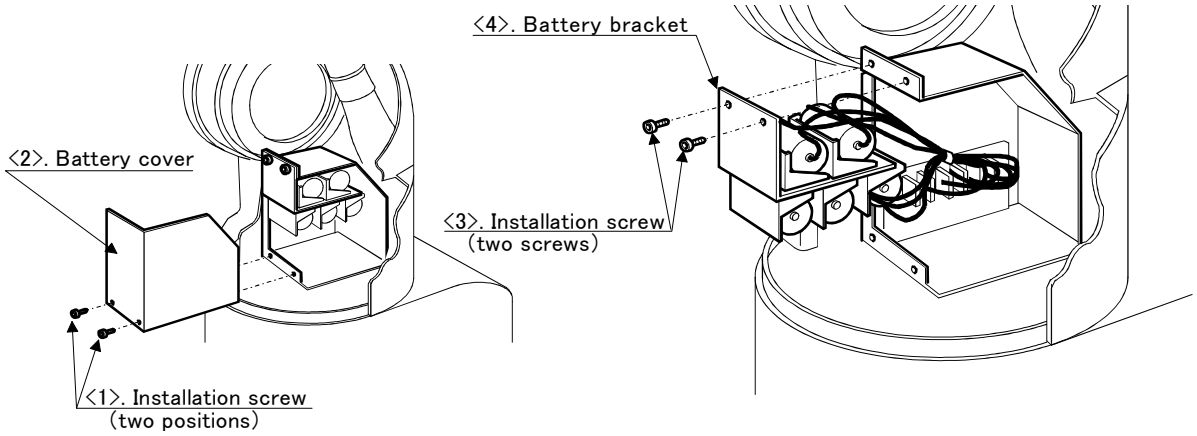


Fig.5-12 : Replacing the battery

1) Confirm that the robot arm and controller are connected with a cable.
2) Turn the controller control power ON.
   The position data is retained by the power supplied from the controller while replacing the battery. Thus, if the cable is not connected correctly, or if the controller power is OFF, the position data will be lost.
3) Move to J2 = −20° , J3 = 90° and J5 =90° with JOG operations so that the cover can be removed.
4) Press the emergency stop button to set the robot in the emergency stop state. This is a measure for safety, and must always be carried out.
5) Remove the shoulder cover F from the robot. (Refer to "5.3.2Installing/removing the cover" on page 44.)
6) Remove the two installation screws <1>, and remove the battery cover <2>.
7) Remove the two installation screws <3>, and remove the battery bracket <2>.
8) The battery holder is located in the battery bracket <5>. Remove the old battery from the holder, and disconnect the lead connector.
9) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
10) Carry out steps "5)" to "7)" in reverse to install the parts.
11) 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.

5.4 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-7, and spare parts that may be required during repairs are shown in Table 5-8. 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 5-7 : Consumable part list

No.	Part name	Type	Usage place	Q'ty	Supplier
1	Timing belt	291-3GT-6	J2 axis	1	Mitsubishi Electric
2		315-3GT-6	J3 axis	1	
3		210-2GT-3	6-axis type:J4 axis	1	
4		230-2GT-3	J5 axis	1	
5	Grease	SK-1A	Reduction gears of each axis	An needed	
6	Lithium battery	A6BAT	In shoulder cover F	5	

Table 5-8 : Spare parts list

No.	Part name	Type	Usage place	Q'ty	Supplier
1	AC servo motor	BU220C795G51	J1 axis	1	Mitsubishi Electric
2		BU220C795G52	J2 axis	1	
3		BU220C795G53	J3 axis	1	
4		BU220C793G54	6-axis type:J4 axis	1	
5		BU220C793G65	J5 axis	1	
6		BU220C794G51	J6 axis	1	
7	Reduction gears	BKO-FA0530H09	J1, J2, J3 axis	3	
8		BKO-FA0530H10	6-axis type:J4 axis	1	
9		BKO-FA0530H10	J5, J6 axis	2	

Note) Confirm the robot arm serial No., and contact the dealer for the type.

Table 5-9 : Spare parts (option) list

No.	Part name	Type	Usage place	Q'ty	Supplier
1	Carl cable	1A-GHCD	Pneumatic hand set, Motorized hand set	1	Mitsubishi Electric

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 5-10.

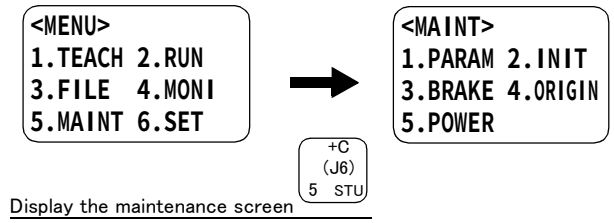
Table 5-10 : Origin setting method

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 "2.3Setting the origin" on page 11 .
2	Mechanical stopper method	This origin posture is set by contacting each axis against the mechanical stopper.	The setting method is explained in "5.5.1Mechanical stopper method" on page 57 .
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 or Mechanical stopper method. The setting method is explained in "5.5.2User origin method" on page 69.

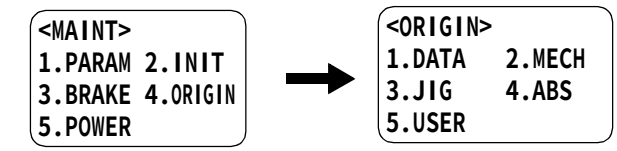
5.5.1 Mechanical stopper method

The method for setting the origin with the transportation jig is explained below.
This operation is carried out with the T/B. Set the [MODE] switch on the front of the controller to "TEACH", and set the T/B [ENABLE/DISABLE] switch to "ENABLE" to validate the T/B. Move the J4 axis to the upper end with jog operation beforehand.

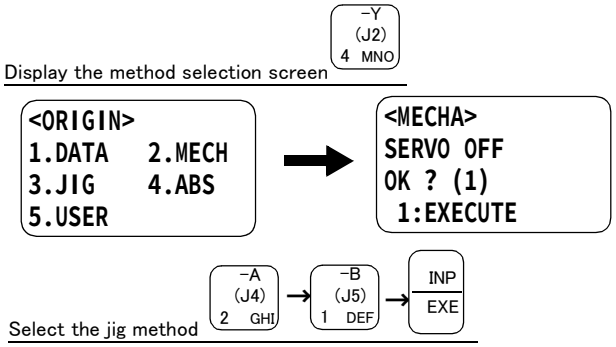
(1) Select the T/B



1) Press the [5] key on the menu screen, and display the maintenance screen.



2) Press the [4] key on the maintenance screen, and display the origin setting method selection screen.



3) Press the [2] key and select the jig method. Then, press the [1] key and the [INP] key to turn the servo OFF.
Securely fix the transportation jig A to the base with the fixing bolts (M4 × 12, 2 bolts) in this state

When setting the origin, all axes can be set, or only random axes can be set.
The methods corresponding to the axes to be set are described below, so select the corresponding explanation and set the origin.

⚠ CAUTION The brakes are released here, and the arm is moved with both hands.
For safety purposes, the brakes must be released by two workers.

(2) J1 axis origin setting

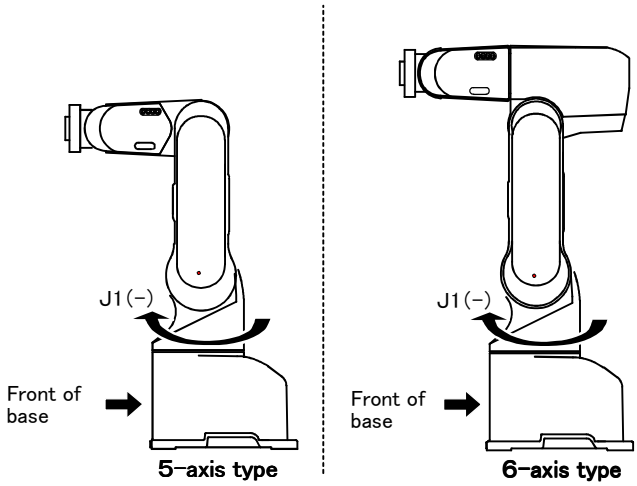
```
<MECHA>   12345678
BRAKE    (10000000)
SET AXIS (11101000)
ORIGIN   :NOT DEF
```

Designate the origin setting axis

−B (J5) 1 DEF

1) Press the [1] key. "1" will display at the 1 position to set the brake release.

2) Confirm the axis for which the brakes are to be released.



3) While holding down the deadman switch, hold down the [MOVE] + [+X] keys. The brakes will be released while the keys are held down.

4) With both hands, slowly move the J1 axis in − (minus) direction , and contact the axis against the mechanical stopper.

Move the cursor

RPL ↓

5) Press the [↓] key. The cursor will move to "SET AXIS".

```
<MECHA>   12345678
BRAKE    (10000000)
SET AXIS(10000000)
ORIGIN   :NOT DEF
```

Designate the origin setting axis

−B (J5) 1 DEF • −C (J6) 0 ABC → INP EXE

6) Designate the axis for which the origin is to be set.
Set "1" for the 1 axis, and set "0" for the other axes. Then, press [INP]. Next, a confirmation screen will appear.

```
<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE
```

Set the origin

−B (J5) 1 DEF → INP EXE

7) Press the [1] and [INP] keys.
The origin posture will be set.

```
<MECHA>   12345678
BRAKE    (10000000)
SET AXIS(10000000)
ORIGIN :COMPLETED
```

8) Setting of the origin is completed.

9) Refer to "5.5.3Recording the origin data" on page 70 in this manual, and record the origin data on the origin data seal.

◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] 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 [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] 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".

(3) J2 axis origin setting

<MECHA> 12345678
BRAKE (01000000)
SET AXIS (11101000)
ORIGIN :NOT DEF

−B (J5) 1 DEF

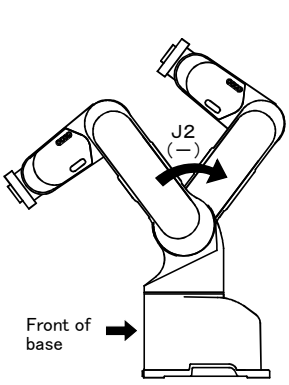
Designate the origin setting axis

1) Press the [0] key and then press the [1] key. "1" will display at the 2 position to set the brake release.
2) Confirm the axis for which the brakes are to be released.

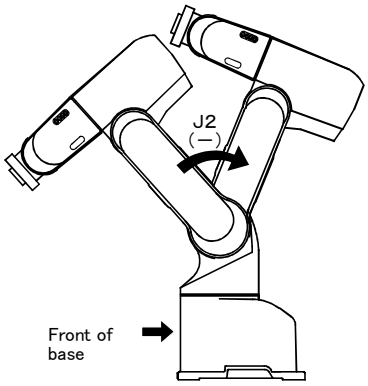
3) One worker must securely support the upper arm with both hands.
4) While holding down the deadman switch, hold down the [MOVE] + [+X] keys. The brakes will be released while the keys are held down.
5) With both hands, slowly move the J2 axis in − (minus) direction , and contact the axis against the mechanical stopper.

⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.

⚠ CAUTION If the T/B [+X] key or the deadman switch is released, the brakes will be applied immediately.



5-axis type



6-axis type

RPL ↓

Move the cursor

6) Press the [↓] key. The cursor will move to SET AXIS.

<MECHA> 12345678
BRAKE (01000000)
SET AXIS (01000000)
ORIGIN :NOT DEF

−C (J6) 0 ABC • −B (J5) 1 DEF → INP EXE

Designate the origin setting axis

7) Designate the axis for which the origin is to be set.
Set "1" for the 2 axis, and set "0" for the other axes. Then, press [INP]. Next, a confirmation screen will appear.

<MECHA>
SET ORIGIN
OK?(1)
 1:EXECUTE

−B (J5) 1 DEF → INP EXE

Set the origin

8) Press the [1] and [INP] keys.
The origin posture will be set.

<MECHA> 12345678
BRAKE (01000000)
SET AXIS(01000000)
ORIGIN :COMPLETED

9) Setting of the origin is completed.

10) Refer to "5.5.3Recording the origin data" on page 70 in this manual, and record the origin data on the origin data seal.

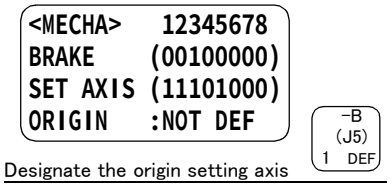
◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] 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 [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] 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".

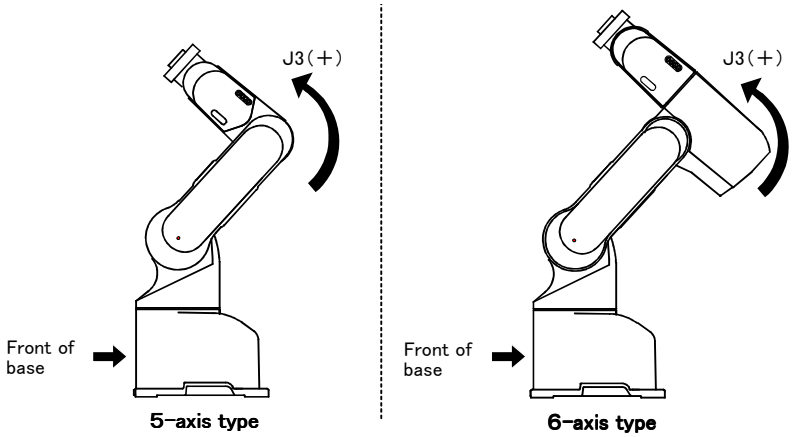
(4) J3 axis origin setting

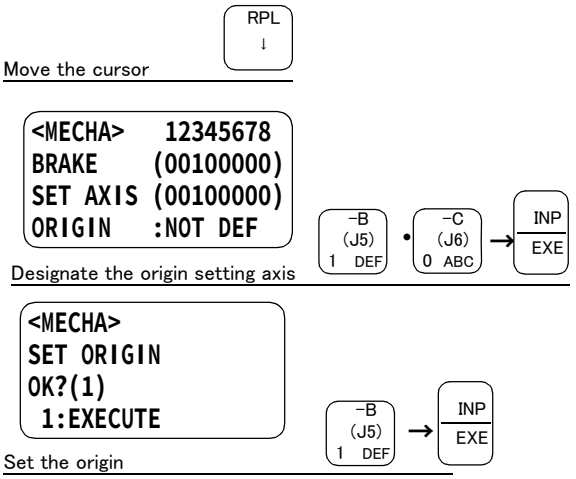


1) Press the [0] key twice and then press the [1] key. "1" will display at the 3 position to set the brake release.
2) Confirm the axis for which the brakes are to be released.
3) One worker must securely support the fore arm with both hands.
4) While holding down the deadman switch, hold down the [MOVE] + [+X] keys. The brakes will be released while the keys are held down.
5) With both hands, slowly move the J3 axis in + (plus) direction, and contact the axis against the mechanical stopper.

⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.

⚠ CAUTION If the T/B [+X] key or the deadman switch is released, the brakes will be applied immediately.





6) Press the [↓] key. The cursor will move to AXIS.

7) Designate the axis for which the origin is to be set..
Set "1" for the 3 axis, and set "0" for the other axes. Then, press [INP]. Next, a confirmation screen will appear.

8) Press the [1] and [INP] keys.
The origin posture will be set.

9) Setting of the origin is completed.

10) Refer to "5.5.3Recording the origin data" on page 70in this manual, and record the origin data on the origin data seal.

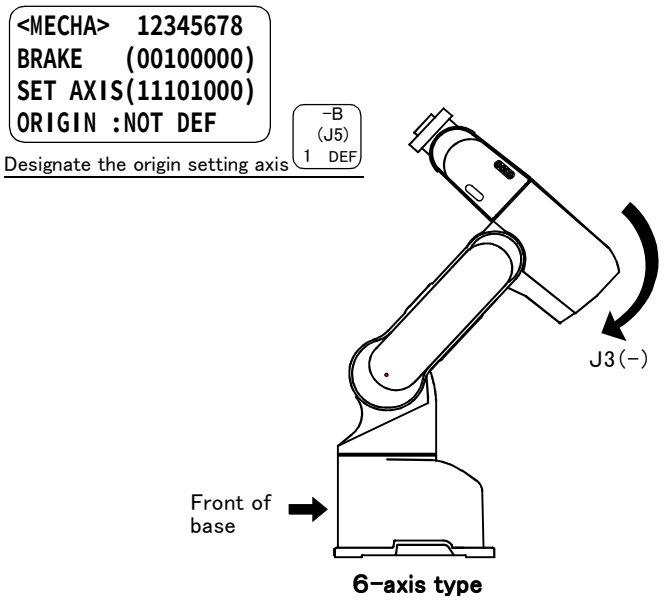
◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] 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 [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] 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) J4 axis origin setting (Only 6-axis type)

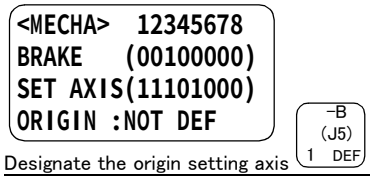


6-axis type

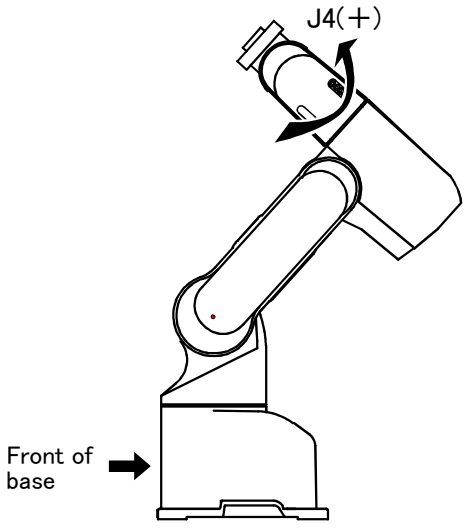
1) Before moving the twist axis, move the J3 axis to prevent arm interference.
   Press the [0] key twice and then press the [1] key. "1" will display at the 3 position to set the brake release.
2) Confirm the axis for which the brakes are to be released.
3) One worker must securely support the fore arm with both hands.
4) While holding down the deadman switch, hold down the [MOVE] + [+X] keys. The brakes will be released while the keys are held down.
5) With both hands, slowly move the J3 axis in – (minus) direction. Stop at a position where the arm will not interfere even if the J4 axis is rotated, and then apply the brakes.
   Then, set the J4 axis origin.

⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.

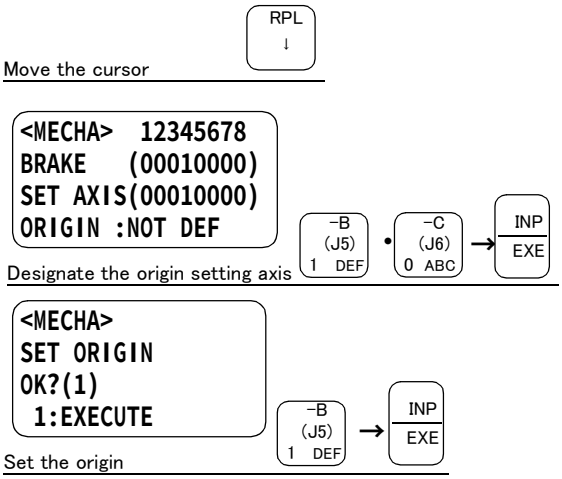
⚠ CAUTION If the T/B [+X] key or the deadman switch is released, the brakes will be applied immediately.



6) With both hands, slowly move the J4 axis in + (plus) direction, and contact the axis against the mechanical stopper.



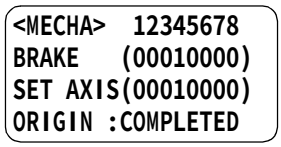
6-axis type



7) Press the [↓] key. The cursor will move to AXIS .

8) Designate the axis for which the origin is to be set.
Set "1" for the 4 axis, and set "0" for the other axes. Then, press [INP]. Next, a confirmation screen will appear.

9) Press the [1] and [INP] keys.
The origin posture will be set.



10) Setting of the origin is completed.

11) Refer to "5.5.3Recording the origin data" on page 70 in this manual, and record the origin data on the origin data seal.

◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] 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 [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] 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".

(6) J5 axis origin setting

<MECHA> 12345678
BRAKE (00001000)
SET AXIS(11101000)
ORIGIN :NOT DEF

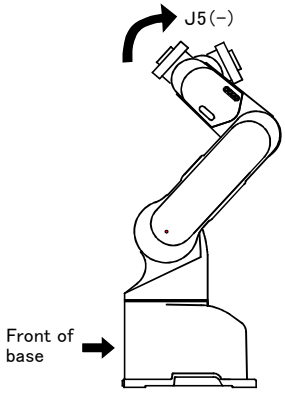
Designate the origin setting axis

−B (J5) 1 DEF

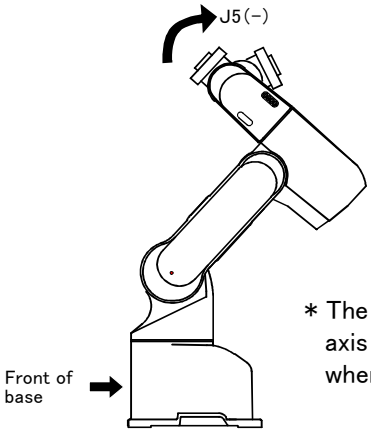
1) Press the [0] key four times and then press the [1] key. "1" will display at the 5 position to set the brake release.
2) Confirm the axis for which the brakes are to be released.
3) One worker must securely support the wrist arm with both hands.
4) While holding down the deadman switch, hold down the [MOVE] + [+X] keys. The brakes will be released while the keys are held down.
5) With both hands, slowly move the J5 axis in − (minus) direction, and contact the axis against the mechanical stopper.

⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.

⚠ CAUTION If the T/B [+X] key or the deadman switch is released, the brakes will be applied immediately.



5-axis type



6-axis type

* The J5 axis direction for the 6-axis type indicates the direction when the J4 axis is at 0° .

RPL ↓

Move the cursor

6) Press the [↓] key. The cursor will move to SET AXIS.

<MECHA> 12345678
BRAKE (00001000)
SET AXIS(00001000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF • −C (J6) 0 ABC → INP EXE

7) Designate the axis for which the origin is to be set.
Set "1" for the 5 axis, and set "0" for the other axes. Then, press [INP]. Next, a confirmation screen will appear.

<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE

Set the origin

−B (J5) 1 DEF → INP EXE

8) Press the [1] and [INP] keys.
The origin posture will be set.

<MECHA> 12345678
BRAKE (00001000)
SET AXIS(00001000)
ORIGIN :COMPLETED

9) Setting of the origin is completed.

10) Refer to "5.5.3Recording the origin data" on page 70 in this manual, and record the origin data on the origin data seal.

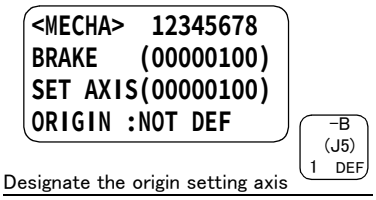
◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] 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 [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

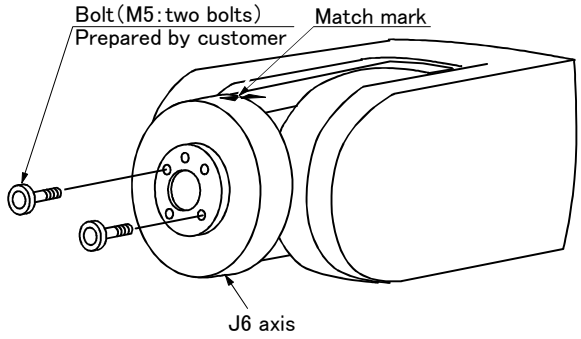
Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(7) J6 axis origin setting

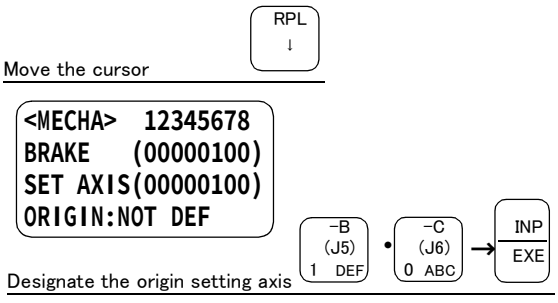


1) Install the hand (option) or bolt (two M5 bolts prepared by customer) at opposing positions on the mechanical interface.

2) Hold onto the hand or bolt installed in step 1, and slowly rotate the mechanical interface to the match marks.

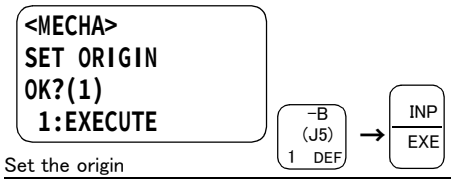


⚠ CAUTION The J6-axis dose not have a mechanical stopper.
When setting the origin position , do not rotate the axis more than themotion range(± 200 deg.).



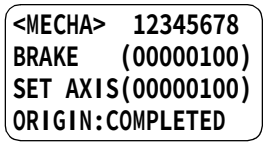
3) Press the [↓] key. The cursor will move to SET AXIS.

4) Designate the axis for which the origin is to be set.
Set "1" for the 6 axis, and set "0" for the other axes. Then, press [INP]. Next, a confirmation screen will appear.



Set the origin

5) Press the [1] and [INP] keys.
The origin posture will be set.



6) Setting of the origin is completed.

7) Refer to "5.5.3Recording the origin data" on page 70 in this manual, and record the origin data on the origin data seal.

◇◆◇ Releasing the brakes ◇◆◇

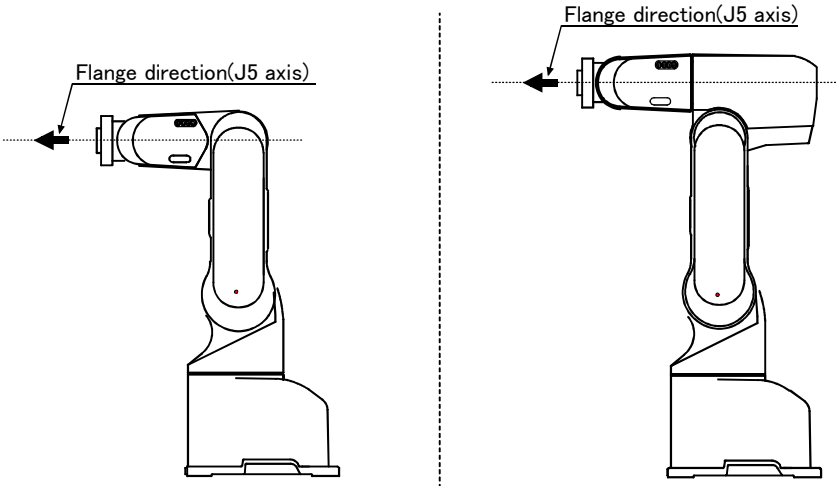
To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] key.
The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0".
If the [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

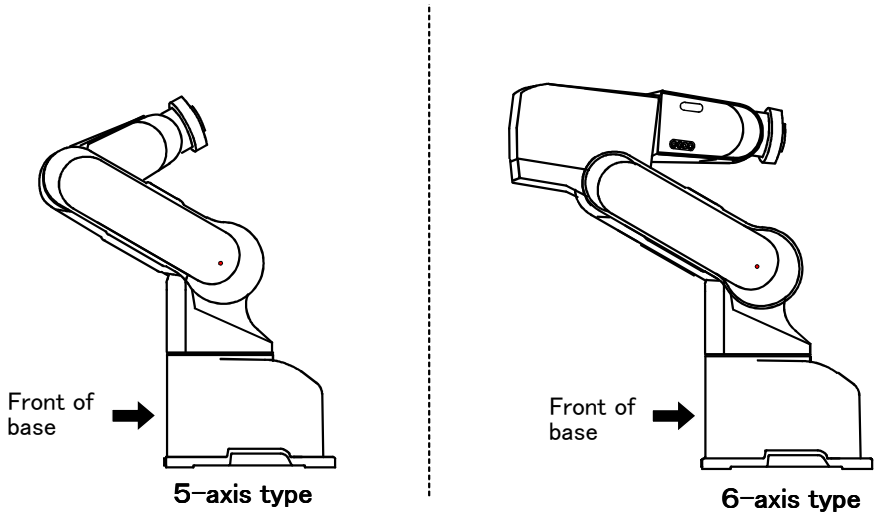
Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

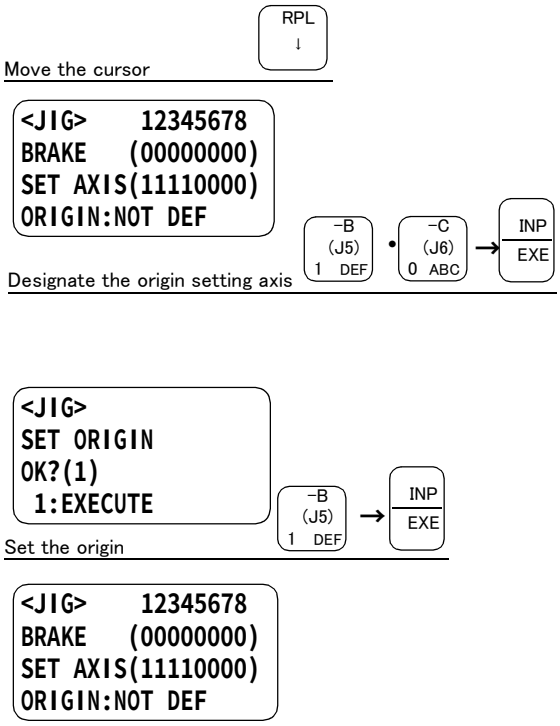
(8) All axis origin setting

1) First, refer to step "(6)J5 axis origin setting" on page 64 and set the origin of the J5 axis.
2) To prevent impacts of the J5 axis on the robot arm, move the J5 axis to near 0 degrees with joint jog operation refer to "(1)JOINT jog operation" on page 20 in this manual.



3) For the 6-axis robot, refer to "(5)J4 axis origin setting (Only 6-axis type)" on page 62 and set the J4 axis origin position. The following steps are carried out simultaneously with the other axes, so they can be skipped here. For the 5-axis robot, proceed to step 4.
4) Refer to "(2)J1 axis origin setting" on page 58 and "(3)J2 axis origin setting" on page 59, "(4)J3 axis origin setting" on page 60, "(7)J6 axis origin setting" on page 65, and set the origin positions of the J1 axis, J2 axis, J3 axis and J6 axis.
The following steps for setting each axis are carried out simultaneously with the other axes, so they can be skipped here.
5) When completed with all work, the robot posture should be as bellow.





6) Press the [↓] key. The cursor will move to SET AXIS .

7) Designate the axis for which the origin is to be set.
The origin setting of the 5 axis has been completed with the first operation, so set the 5 axis to 0, and set all of the other axes to "1". Then, press [INP]. The 5-axis robot does not have the 4 axis, so set 0.
Next, a confirmation screen will appear.

8) Press the [1] and [INP] keys.
The origin posture will be set.

9) Setting of the origin is completed.

10) Refer to "5.5.3Recording the origin data" on page 70 in this manual, and record the origin data on the origin data seal.

◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] 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 [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] 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 origin data input method or Mechanical stopper method.

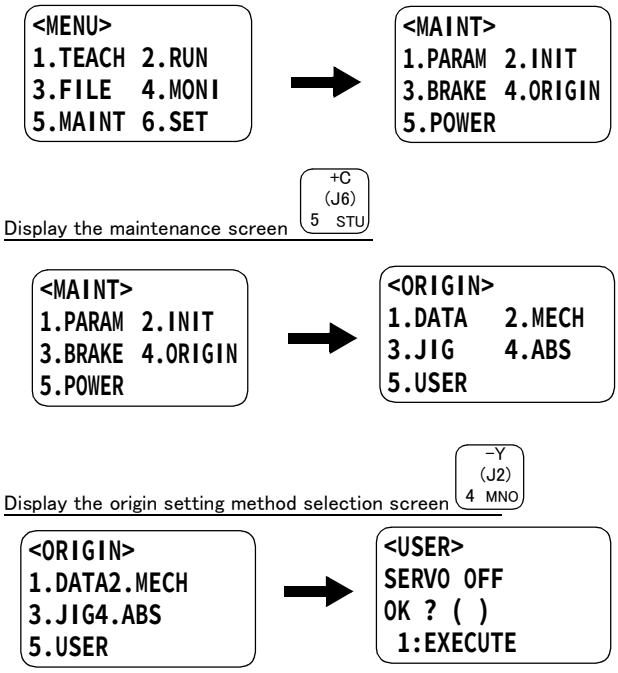
The procedure for setting the origin with the user origin method is explained below.
This operation is carried out with the teaching pendant. Set the [MODE] switch on the front of the controller to "TEACH", and set the [ENABLE/DISABLE] switch on the teaching pendant to "ENABLE" to enable the teaching 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 "2.4Confirming the operation" on page 17 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.

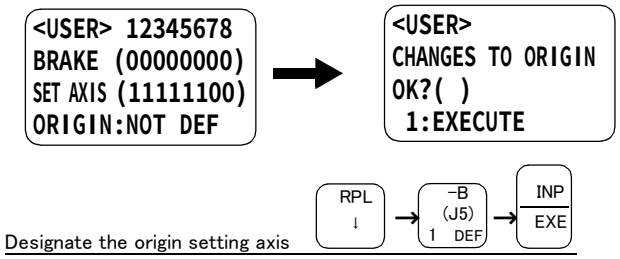
2) Enter the JOINT jog mode, and display the joint coordinates on the teaching pendant screen. Record the value of the axis for which the origin is to be set.
3) Input the value recorded in the "user designated origin parameter (USERORG)".
   The parameter details and input methods are described in the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



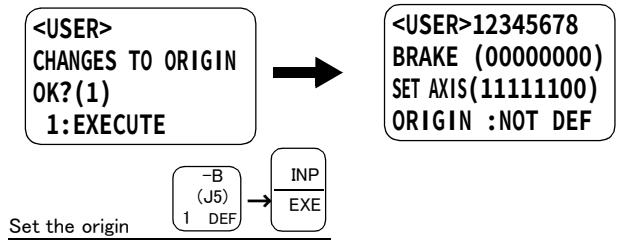
4) Next, set the origin.
   Press the [MENU] key to display the Menu screen.
5) Press the [5] key to display the Maintenance screen.

6) Press the [4] key to select the Origin Setting screen.

7) Press the [5] key to select the user origin method.
   Then, press [1] key and [INP] key to turn OFF the servo.



8) Press the [↓] key, and input "1" for the axis for which the origin is to be set. Press the [INP] key to display the Confirmation screen.



9) Press the [1] key and then the [INP] key. The origin will be set

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 "2.3.2Setting the origin with the origin data input method" on page 12, 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 "5.3.2Installing/removing the cover" on page 44, 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 "2.3.2Setting the origin with the origin data input method""(5)Inputting the origin data" , 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. 2-8Origin data label (an example)" on page 12, and "Fig. 2-9Correspondence of origin data label and axis" on page 15 for details on the origin data label.

(4) Installing the cover
Install the connector box cover removed in step "(1)Confirming the origin data label" above.
Refer to "5.3.2Installing/removing the cover" on page 44, and replace the connector box cover.

This completes the recording of the origin data.

6 Appendix

Appendix 1 : Configuration flag

The configuration flag indicates the robot posture.

For the 6-axis type robot, the robot hand end is saved with the position data configured of X, Y, Z, A, B and C. However, even with the same position data, there are several postures that the robot can change to. The posture is expressed by this configuration flag, and the posture is saved with FL1 in the position constant (X, Y, Z, A, B, C) (FL1, FL2).

The types of configuration flags are shown below.

(1) RIGHT/LEFT

P is center of flange in comparison with the plane through the J1 axis vertical to the ground.

Q is center of J5 axis rotation in comparison with the plane through the J1 axis vertical to the ground.

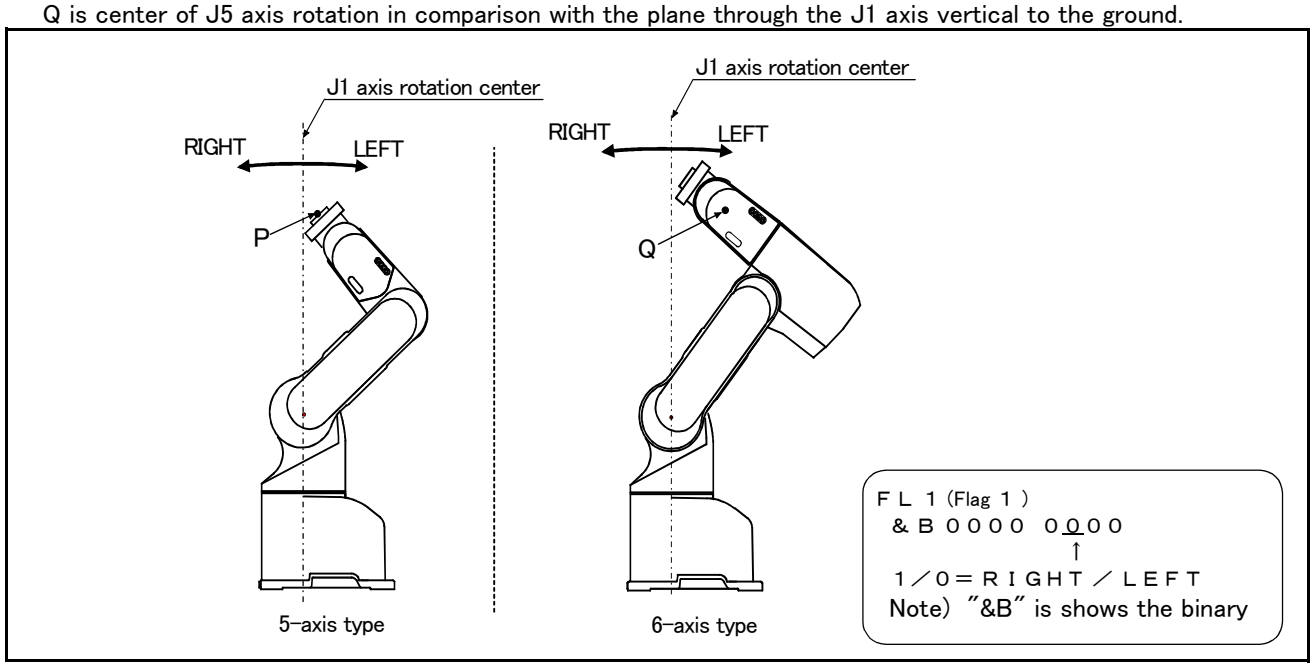


Fig.6-1 : Configuration flag (RIGHT/LEFT)

(2) ABOVE/BELOW

Q is center of J5 axis rotation in comparison with the plane through both the J3 and the J2 axis.

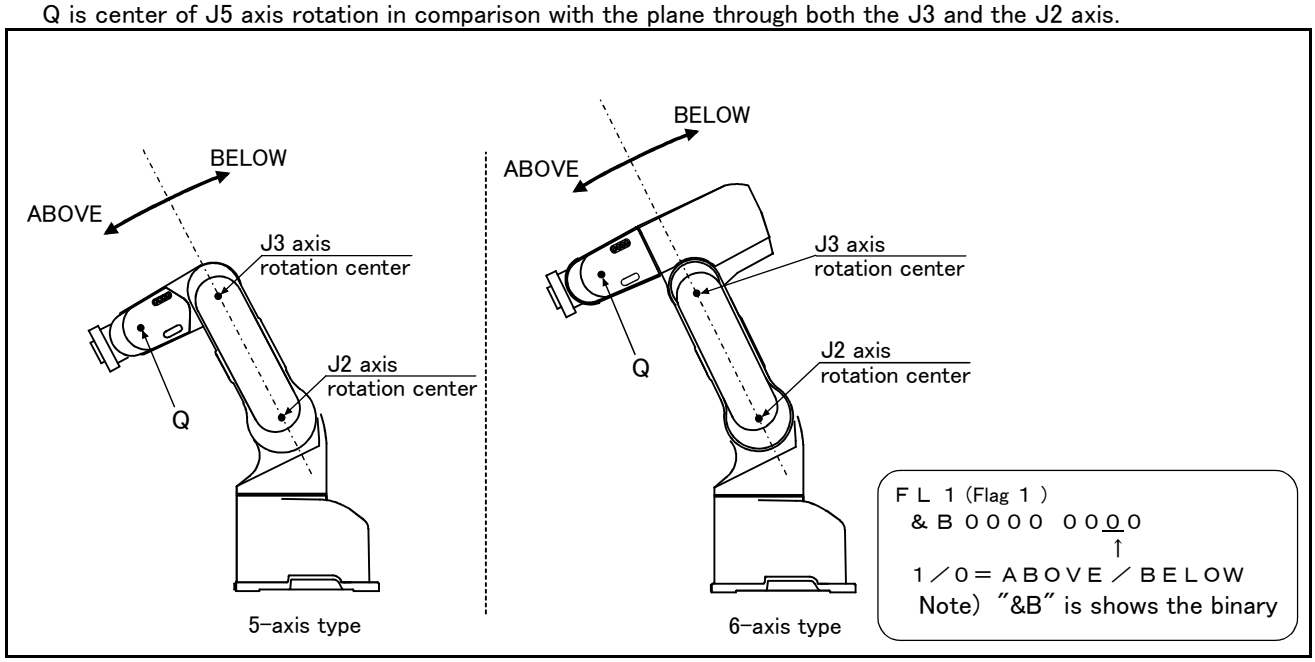


Fig.6-2 : Configuration flag (ABOVE/BELOW)

(3) NONFLIP/FLIP (6-axis robot only.)

This means in which side the J6 axis is in comparison with the plane through both the J4 and the J5 axis.

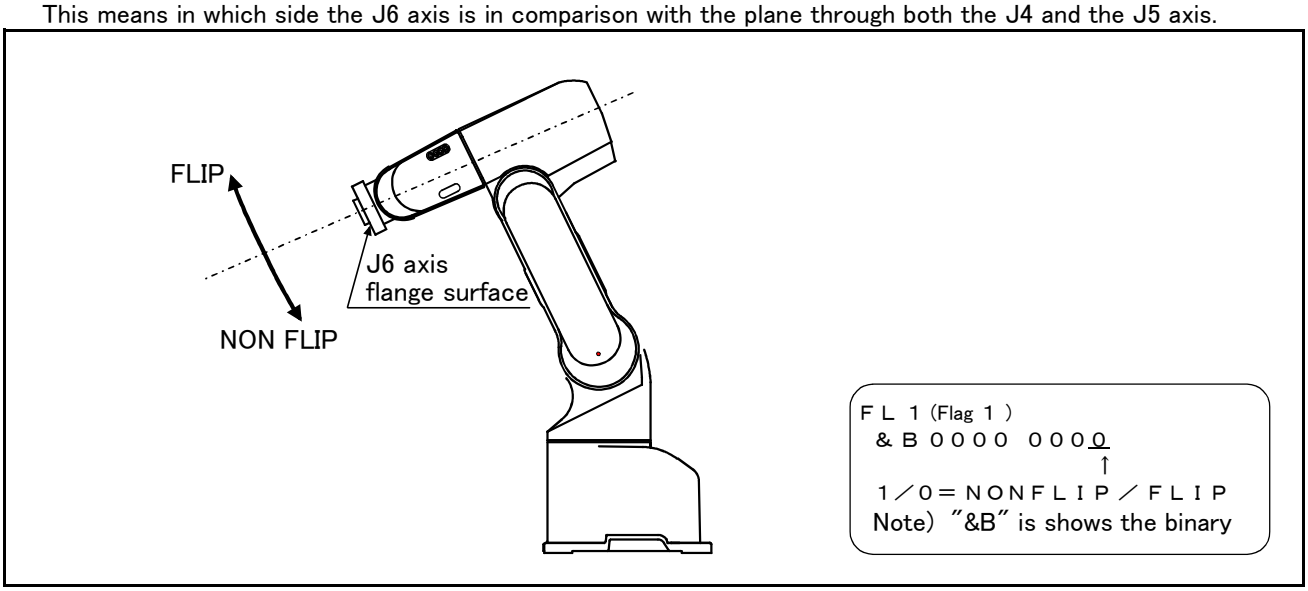


Fig.6-3 : Configuration flag (NONFLIP/FLIP)

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE : MITSUBISHI DENKI BLDG MARUNOUCHI TOKYO 100-8310 TELEX : J24532 CABLE MELCO TOKYO
NAGOYA WORKS : 1-14, YADA-MINAMI 5, HIGASHI-KU, NAGOYA, JAPAN

JUN..2002 MEE Printed in Japan on recycled paper.