MITSUBISHI

Mitsubishi Industrial Robot

RV-4F/7F/13F/20F Series

INSTRUCTION MANUAL
ROBOT ARM SETUP & MAINTENANCE

MELFA

BFP-A8935-E

⚠ Safety Precautions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

⚠ **CAUTION**   Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.
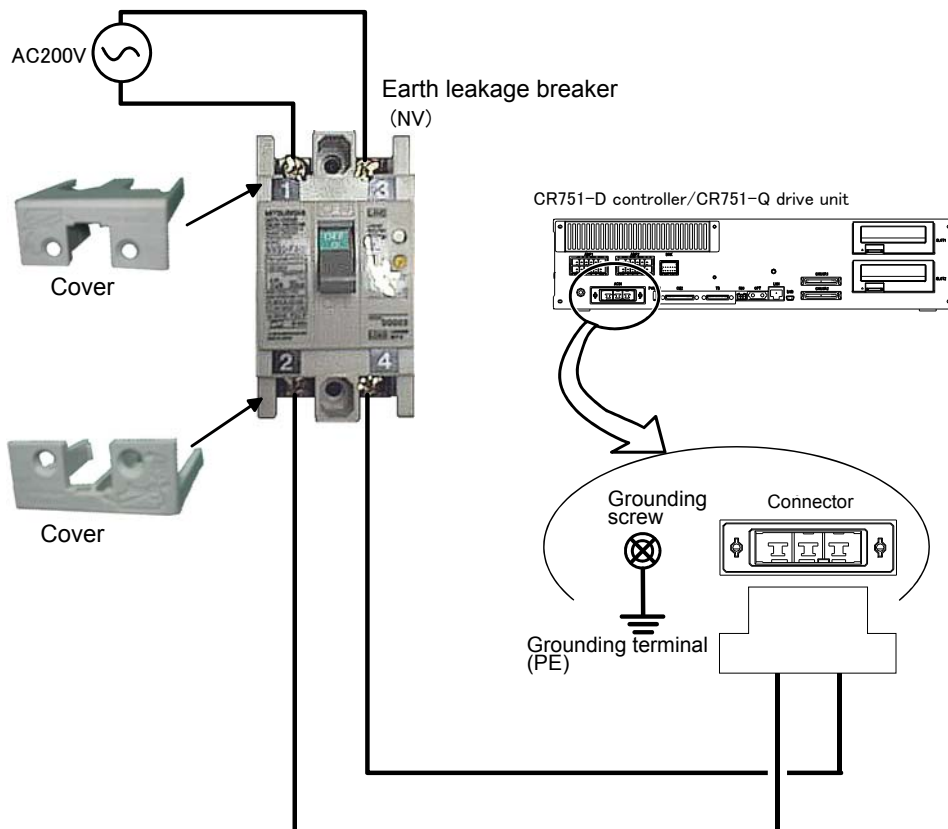
⚠ **CAUTION**   Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

*CR751-D or CR751-Q controller
　Notes of the basic component are shown.

⚠ **CAUTION**   Please install the earth leakage breaker in the primary side supply power supply of the controller of CR751-D or CR751-Q because of leakage protection.

Revision history

Date of Point	Instruction Manual No.	Revision Details
2012-09-27	BFP-A8935	・First print
2012-10-03	BFP-A8935-A	・The notes about installation of the controller and the robot arm were added. (neither direct rays nor the heat of lighting) ・Cross-reference places, in the Inspection, maintenance and replacement of timing belt etc, were corrected. (Error in writing) ・Fixing screws of the Cable clamp box, No.1 arm cover U, CONBOX cover and CONBOX cover R were corrected. (formerly M4x12) ・Seal washers of screws which fixes cable clamp box and CONBOX cover R were corrected to attachment only at protection specification.
2012-11-20	BFP-A8935-B	・The lithium battery type was added to "Table 5-6: Consumable part list". ・The statement about trademark registration was added.
2013-01-09	BFP-A8935-C	・The grease nipple of attachments was corrected. (table of Standard configuration and Lubrication specifications) ・The quantity of screw for suspension fittings was changed. ・J1 axis operating range change (option) was added. ・The precautions to hand input cable installation were added. ・The couplings were added to "Table 2-1: Standard configuration" ・The grounding method to the Base external wiring set was added.
2013-03-21	BFP-A8935-D	・The description of RV-7FLL, RV-13F and RV-20F were added.
2013-04-04	BFP-A8935-E	・The installation method of the optional solenoid valve set (1F-VD0*-03/1F-VD0*E-03) was corrected.

＊Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual explains the method of unpacking, installation and maintenance and inspection of the robot arm.
Always read through this manual before starting use to ensure correct usage of the robot.
The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed."

This document explains for the following robot type.

Robot type　　　・RV-4F/4FL series .... Note) Indicates it as RV-4F series.
　　　　　　　　　・RV-7F/7FL series .... Note) Indicates it as RV-4F series.
　　　　　　　　　・RV-7FLL *1)
　　　　　　　　　・RV-13F/13FL series *1)
　　　　　　　　　・RV-20F series *1)
　　　　　　　　　　＊1) Indicates it as "RV-13F series" for a general name of these robots.

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CONTENTS

1 Before starting use

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

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

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

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

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.
Additional axis function	Explains the specifications, functions and operations of the additional axis control.
Tracking Function Manual	Explains the control function and specifications of conveyor tracking
Extended Function Instruction Manual	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures, about the PLC(CR750-Q/CR751-Q controller) and the GOT(CR750-D/CR751-D controller).

1.1.2 Symbols used in instruction manual

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

Table 1-1:Symbols in instruction manual

Terminology	Item/Symbol	Meaning
Item	iQ Platform	
	Controller	Indicates the controller which controls the robot arm. It consists of the robot CPU system and the drive unit.
	The robot CPU unit or robot CPU	Indicates the CPU unit for the robots which installed to the sequencer base unit (Q3 □ DB) of MELSEC-Q series. It is connected with the drive unit by the dedicated cable.
	The robot CPU system	Multi-CPU system. It consists of MELSEC units, such as the sequencer base unit, the sequencer CPU unit, and the robot CPU unit, etc.
	Drive unit	Indicates the box which mounts the servo amplifier for robot, and the safety circuit, etc.
Item	Stand-alone type	
	Controller	Indicates the box which arranged control parts, such as robot CPU, servo amplifier, and the safety circuit.
Symbol	⚠ DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
	[JOG]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
	[RESET] + [EXE] (A) (B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [RESET] key is pressed while holding down the [EXE] key.
	T/B	This indicates the teaching pendant.
	O/P	Indicates the operating panel on the front of controller or drive unit for the controller which installed the operating panel
	CR751 (Thin type) CR751 (Heavy type)	There are two kinds of CR751 controller; one is "Thin type" (the height is 98mm) and the other is "Heavy type" (the height is 174mm), each of which are different in height. Thin type: CR751-03HD/Q, CR751-02VD/Q, CR751-04VD/Q, CR751-07VD/Q. Heavy type: CR751-13VD/Q, CR751-20VD/Q, CR751-07VLD/Q. * Refer to separate Standard Specifications Manual for the outside dimension of CR751 controller.

1.2 Safety Precautions

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

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

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

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

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

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

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

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

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

1.2.1 Precautions given in the separate Safety Manual

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

⚠DANGER Don't remove the SSCNETIII cable, when the power supply of the robot controller is turned on. Don't face squarely the light emitted from the tip of the SSCNETIII connector or the cable. If light strikes the eyes, there is a possibility of feeling the sense of incongruity for the eyes. (The light source of SSCNETIII is equivalent to the class 1 specified to JIS C 6802 and IEC 60825-1.)

⚠CAUTION Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in failures, such as the emergency stop not being released. In order to prevent from occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed

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
RV-4F series				
1	Robot arm	RV-4F series	Each 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 x 40	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	Grease nipple	WA-610	5 pc.	
7	Coupling	φ4	As needed	Is needed quantity attachment only to Internal wiring and piping specification types.
8	Suspension fitting		2 sets	
9	Suspension fitting installation bolt	M6 x 20	6 pcs.	
10	Plain washer for suspension fitting installation bolt	For M6	6 pcs.	
11	Eye bolt	M10	4 pcs.	
12	Nut for eye bolt	For M10	4 pcs.	
13	Fixing plate		1 set	
14	Fixing plate installation bolt	M15 x 12	4 pcs.	
15	Plain washer for fixing plate	For M5	4 pcs.	
RV-7F series				
1	Robot arm	RV-7F series	Each 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 x 40	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	Grease nipple	WA-610	4 pcs.	
7	Coupling	φ4	As needed	Is needed quantity attachment only to Internal wiring and piping specification types.
8	Suspension fitting		2 sets	
9	Suspension fitting installation bolt	M8 x 25	4 pcs.	
10	Plain washer for suspension fitting installation bolt	For M8	4 pcs.	
11	Eye bolt	M10	4 pcs.	
12	Nut for eye bolt	For M10	4 pcs.	
13	Fixing plate		1 set	
14	Fixing plate installation bolt	M15 x 12	4 pcs.	
15	Plain washer for fixing plate	For M5	4 pcs.	
RV-13F series				
1	Robot arm	RV-13F series	Each 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M12 x 55	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M12	4 pcs.	
5	Plain washer for installation bolts	For M12	4 pcs.	
6	Grease nipple	WA-110	3 pcs.	
		WA-610	4 pcs.	
7	Coupling	φ4	As needed	Is needed quantity attachment only to Internal wiring and piping specification types.
8	Suspension fitting		2 sets	
9	Suspension fitting installation bolt	M10 x 45	4 pcs.	

No.	Part name	Type	Qty.	Remarks
10	Plain washer for suspension fitting installation bolt	For M10	4 pcs.	
11	Eye bolt	M12	4 pcs.	
12	Nut for eye bolt	For M12	4 pcs.	
13	Fixing plate		1 set	
14	Fixing plate installation bolt	M6 x 14	4 pcs.	
15	Plain washer for fixing plate	For M6	4 pcs.	

Note1) The numbers 3 to 7 are contained in the plastic bag of attachment in the robot arm

The numbers 8 to 15 are mounted on the robot arm.

2.2 Installation

2.2.1 Unpacking

Pull off

⟨1⟩ Tape

⟨2⟩ Upper lid

The fork insertion
slots for a forklift truck

(a)

(b)

Robot arm

(c)

⚠️ **CAUTION**

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

Note) Although the figure is the example of RV-4F other types are
the same also.
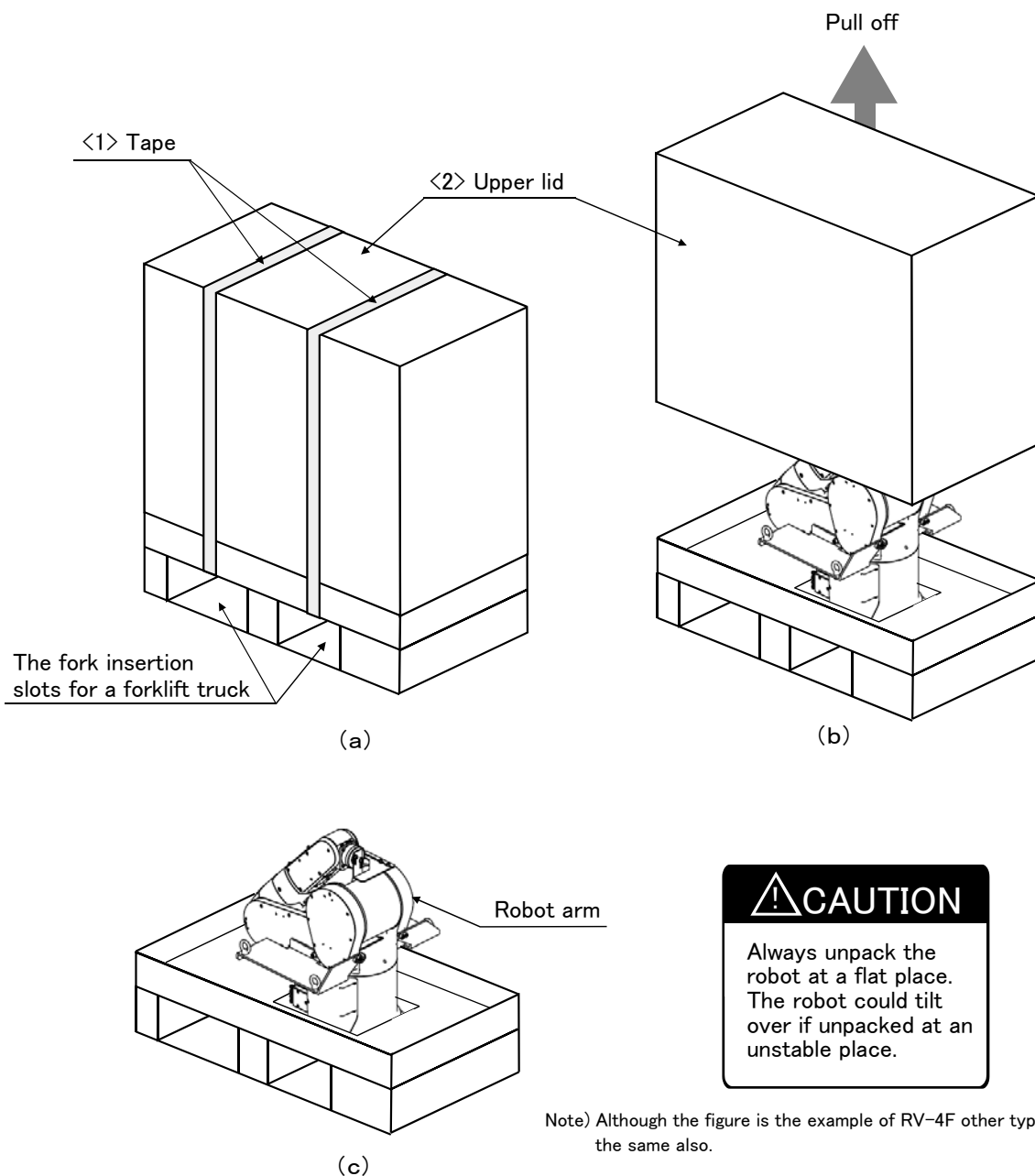
Fig.2-1 : Unpacking the robot arm

The robot is shipped from the factory in cardboard and plywood packing. Always refer to Fig. 2-1 and unpack the
robot.
Handle the robot arm according to "2.2.2Transportation procedures (Transporting with a crane)".

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

The unpacking process is shown below.
    1) Using a knife, etc., slit the tape ⟨1⟩ fixing the upper lid ⟨2⟩ of the cardboard box. (Fig. 2-1 (a))
    2) Pull the upper lid ⟨2⟩ of the cardboard box off with both hands. (Fig. 2-1 (b))
    3) Remove the hexagon socket bolts ⟨3⟩ (four positions) connecting the sleeper and the base unit. (Fig. 2-1
       (c))
    4) This completes the unpacking.

2.2.2 Transportation procedures (Transporting with a crane)

The transportation procedure is shown in Fig. 2-2 for (RV-4F/7F series) and Fig. 2-3 (RV-13F series).

RV-4F/RV-7F series

Wire

Fixing plate

Suspension fitting

Front

Side

Mass
RV-4F series: Approx. 39kg
RV-4FL series: Approx. 41kg
RV-7F series: Approx. 65kg
RV-7FL series: Approx. 67kg

Note) The figure is the RV-4 F/
RV-4FL series. The shape
and installation screw of
the suspension fitting of
RV-7F/RV-7FL series
differ.
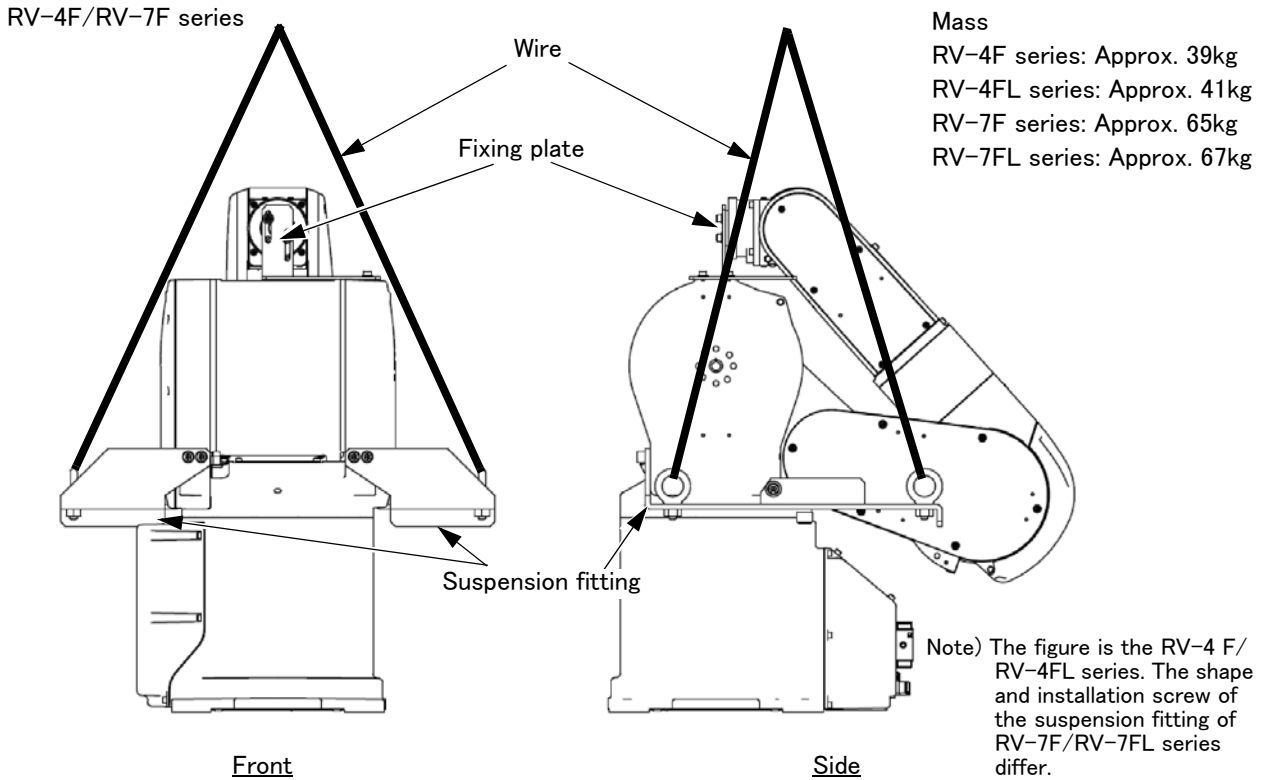
Fig.2-2 : Transportation procedure (transporting with a crane: RV-4F/7F series)

RV-13F series

Wire

Fixing plate

Suspension fitting

Front

Side

Mass
RV-13F series: Approx. 137kg
RV-13FL series: Approx. 145kg
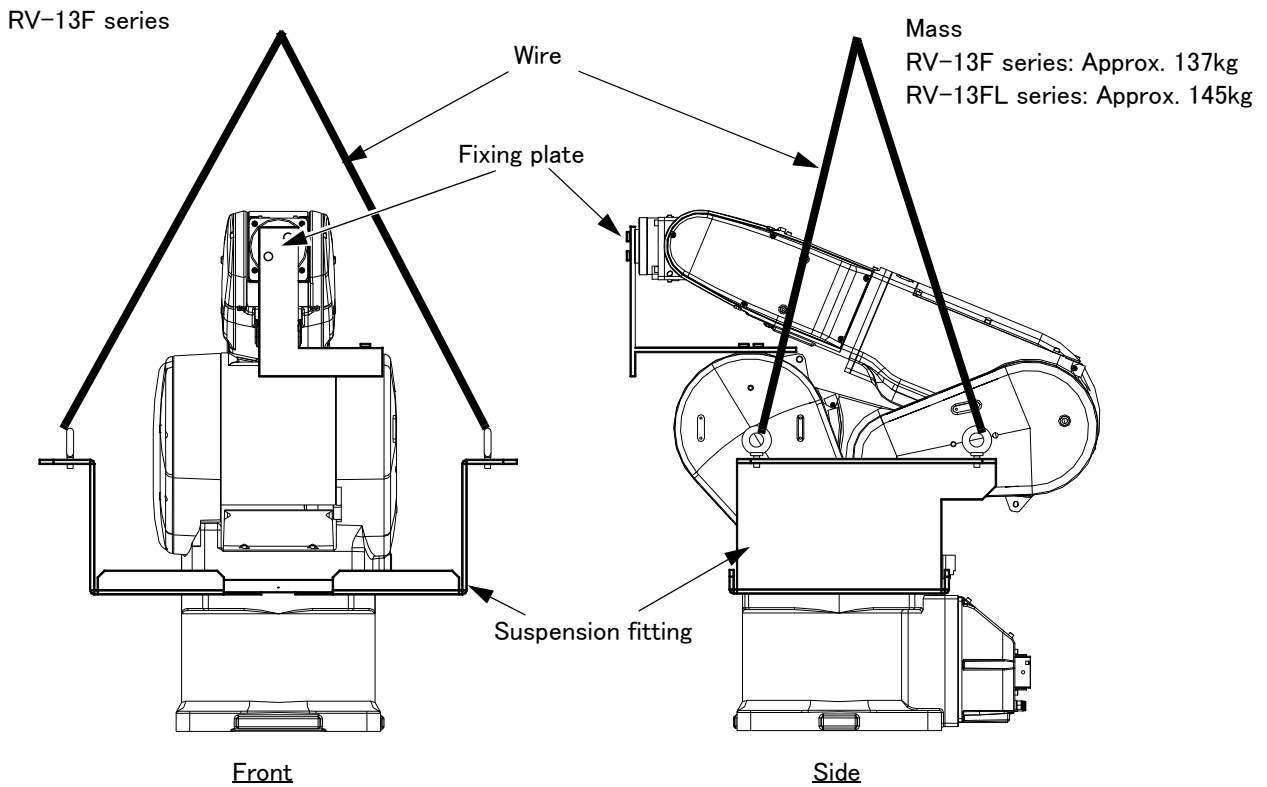
Fig.2-3 : Transportation procedure (transporting with a crane: RV-13F series)

1) Attach the suspension fittings to the left and right sides of the shoulder section, and securely fix with screws and plain washers. (RV-4F series: M6x20, each three screws for the right and left. RV-7F series: M8x25, each two screws for the right and left. RV-13F series: M10x45, each two screws for the right and left.)
(The suspension fittings are mounted on robot arm at factory shipping)

2) Catch wires in the eye bolts installed on the suspension fittings, and quietly suspend the arm.
Note) At this time, make sure that the wires, etc., do not interfere with the robot arm or covers. Always place cloth, etc., at interfering places.

3) When transferring to the installation place, take care not to apply vibration or impact.

4) After installing at the installation place, remove the above suspension fittings.

5) Always follow the above procedures and methods to transport the robot for secondary transportation, such as when changing the installation position.
If the arm is directly suspended without using the specified suspension fittings, or if it is suspended in the work posture, the configuration devices could be damaged, and the transportation workers will be subject to risk due to an inadequate center of gravity position.

2.2.3 Installation procedures

The installation procedure of the robot arm is shown below.
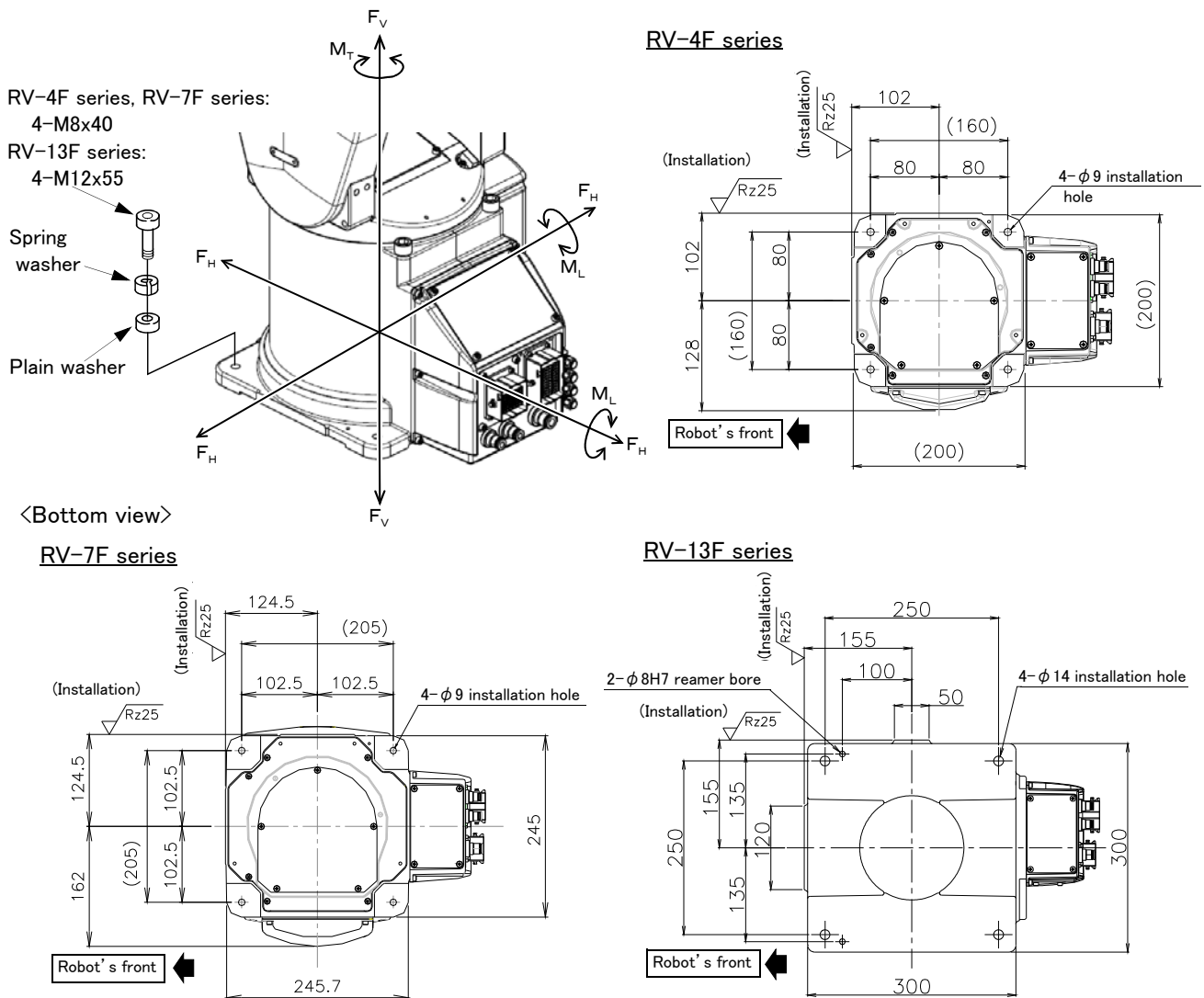
Fig.2-4 : Installation dimensions

1) The robot installation surface has been machine finished. Use the installation holes (RV-4F series and RV-7F series: 4-ϕ9 holes, RV-13F series: 4-ϕ14 holes) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (RV-4F series and RV-7F series: M8 hexagon socket head cap screws, RV-13F series: M12 hexagon socket head cap screws).

2) Installation of the robot arm is a very important step for ensuring the optimum functions of the robot. Observe the following points when designing. 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) Remove the fixing plates after installing the robot. The fixing plate is needed in re-transportation. Please keep it carefully.

7) When the robot is installed by hanging from the ceiling or on the wall, the MEGDIR parameter must be changed. For more information about parameters and how to change the parameters, refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations".

8) The installation surface must have sufficient strength to withstand the arm reaction during moving the robot at high speed.

Table 2-2 : Strength of the installation side (reference)

Item	Unit	Value	
		RV-4F/7F series	RV-13F series
Falling moment : ML	N m	900	2,060
Twist moment : MT	N m	900	2,060
Horizontal translation power : FH	N	1,000	1,750
Vertical translation power : FV	N	1,700	2,900

⚠ **CAUTION** Please secure the maintenance space required for connection of the machine cable and exchange the backup battery in the rear side, and also space for J1 axis belt in the right side. And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

2.2.4 Grounding procedures
（1）Grounding methods

(a) Dedicated grounding (Optimum)　(b) Common grounding (Good)　(c) Common grounding (Normal)

Fig.2-5 : Grounding methods
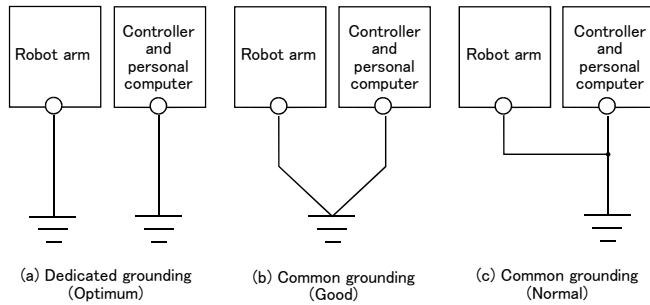
1) There are three grounding methods as shown in Fig. 2-5, but the dedicated grounding (Fig. 2-5 (a)) should be used for the robot arm and controller when possible. (Refer to the separate " Controller Setup, Basic Operation and Maintenance" for details on the controller grounding.)
2) Use Class D grounding (grounding resistance 100Ω or less).
Dedicated grounding separated from the other devices should be used.
3) Use a AWG#11(4.2mm^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

M4x10
Spring washer
Plain washer
A

Robot grounding cable (AWG#11 (4.2mm^2) or more) (Prepared by customer)

Note) Although the figure is the example of RV-4F other types are the same also.

Fig.2-6 : Connecting the grounding cable
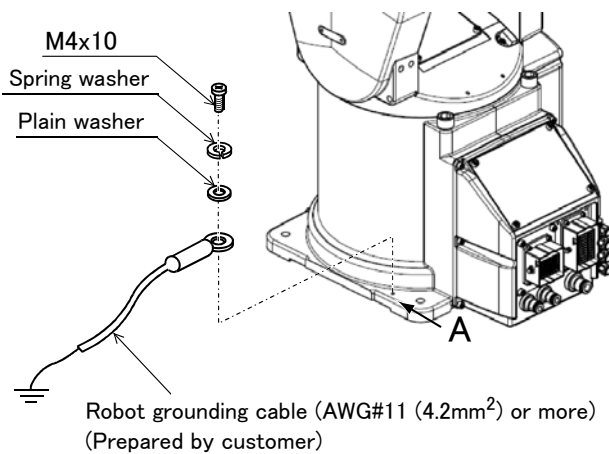
1) Prepare the grounding cable (AWG#11(4.2mm^2) or more) and robot side installation screw and washer.

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
(1) CR750 controller

Motor power
(CN1)　Motor signal
(CN2)

Robot arm
(Rear of the base.)

CN1　　　CN2

Latch　　Latch

Latch

Motor signal cable

CN1　　CN2

Latch

Latch

Note) Although the figure is the
example of RV-4F other types
are the same also.

Motor power cable
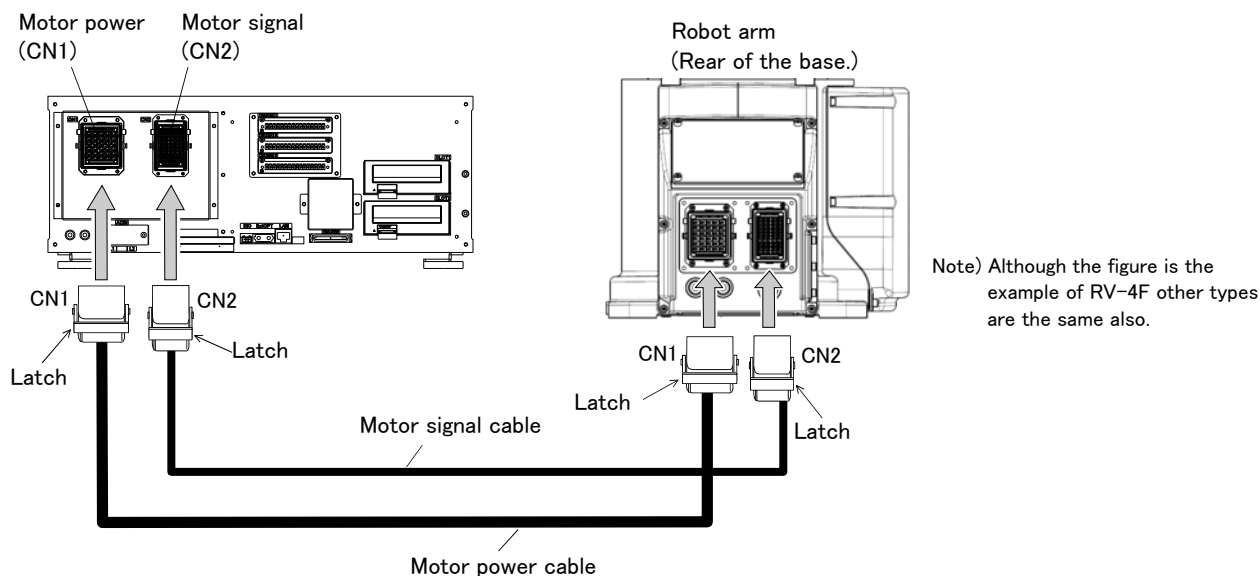
Fig.2-7 : Connecting the machine cables

Carry out the following procedure after installing the controller referring to the separate "Controller Setup, Basic Operation and Maintenance" manual.

Robot arm

Connector on the
robot arm side

Hook

Projection

Connector on the
machine cable side

Hook

Projection
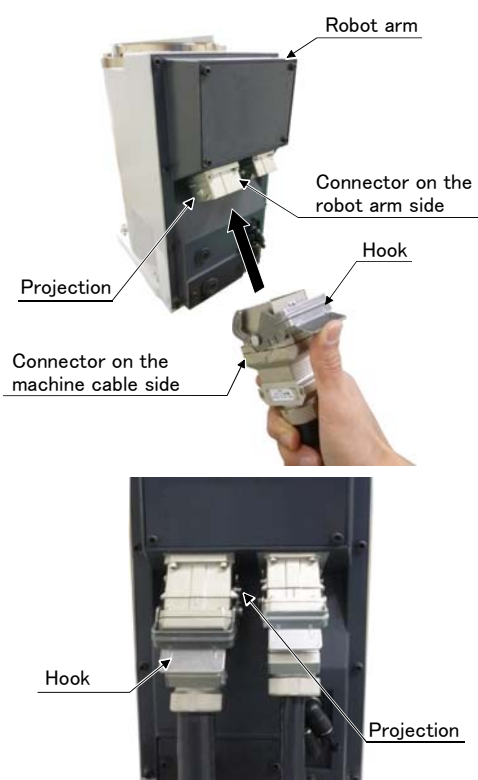
1) The procedure of connecting the machine cable is shown below.

2) Make sure that the power switch on the front of the controller is turned OFF.
　Note) Although the figure is RH-6FH, also in other robots with same connector type, the connection method is the same.

3) Connect the machine cable to its corresponding connector on the robot arm side.

4) After connecting the connector, insert the hook attached to the connector on the machine cable side to the rear of the projection of the robot arm connector to fix securely in place.

⚠CAUTION Be careful not to get your hand pinched.

This complete the connection of machine cable.
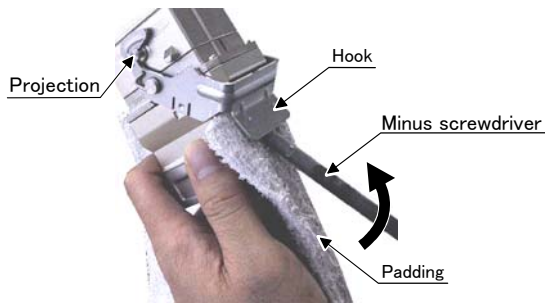
To remove the cable, insert a minus screwdriver into the hook while padding with a cloth, and remove the cable by lifting the hook.

⚠ CAUTION

When installing or removing the connector, to the connector of the other party in parallel, install or remove. If load strong against one side is applied, the connector pin may be damaged and it may not be connected securely.

⚠ 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.

⚠ CAUTION   Connect the machine cable at the place without the effect of the dust or oil mist. Please keep the dust and oil mist from being applied to of the robot-arm connector section, in the condition that the machine cable is removed.   Since it becomes the cause of failure.

⚠ CAUTION   Please be careful not to catch the hand at installation and removal.

(2) CR751 controller

Motor power (CN1)   Motor signal (CN2)

AMP1 AMP2 BRK

Note1) Controller

Robot arm
Opposite side of figure   Note2)

CONBOX cover

CN1

Two fixing screws

CN2

Two fixing screws

Motor signal cable

Motor power cable

Note1) Although the figure is RV-4F/7F series controller, and RV-13F series is also the same.
Note2) The robot arm photo is for illustrative purposes only. Refer to Table 2-3 for packing pose of actual products.

Fixing screws (2 places)

Battery fixing plate

AMP2   CN2   Controller side   Machine cables

AMP1

CON cover
(Eight fixing screws)
Only for clean/oil-mist specification

Pass into the opening

Robot arm side

Cable clamp fixing plate
(Two plate with four screws each)   *1)

*1) The size of the cable clamp fixed plate fixed screw (four screws each.) is as follows.
・Standard specification: M4x12
・Clean/oil-mist specification: M4x16

Connection condition

Table 2-3 : The packing pose for each type (reference)   (Unit: degree)

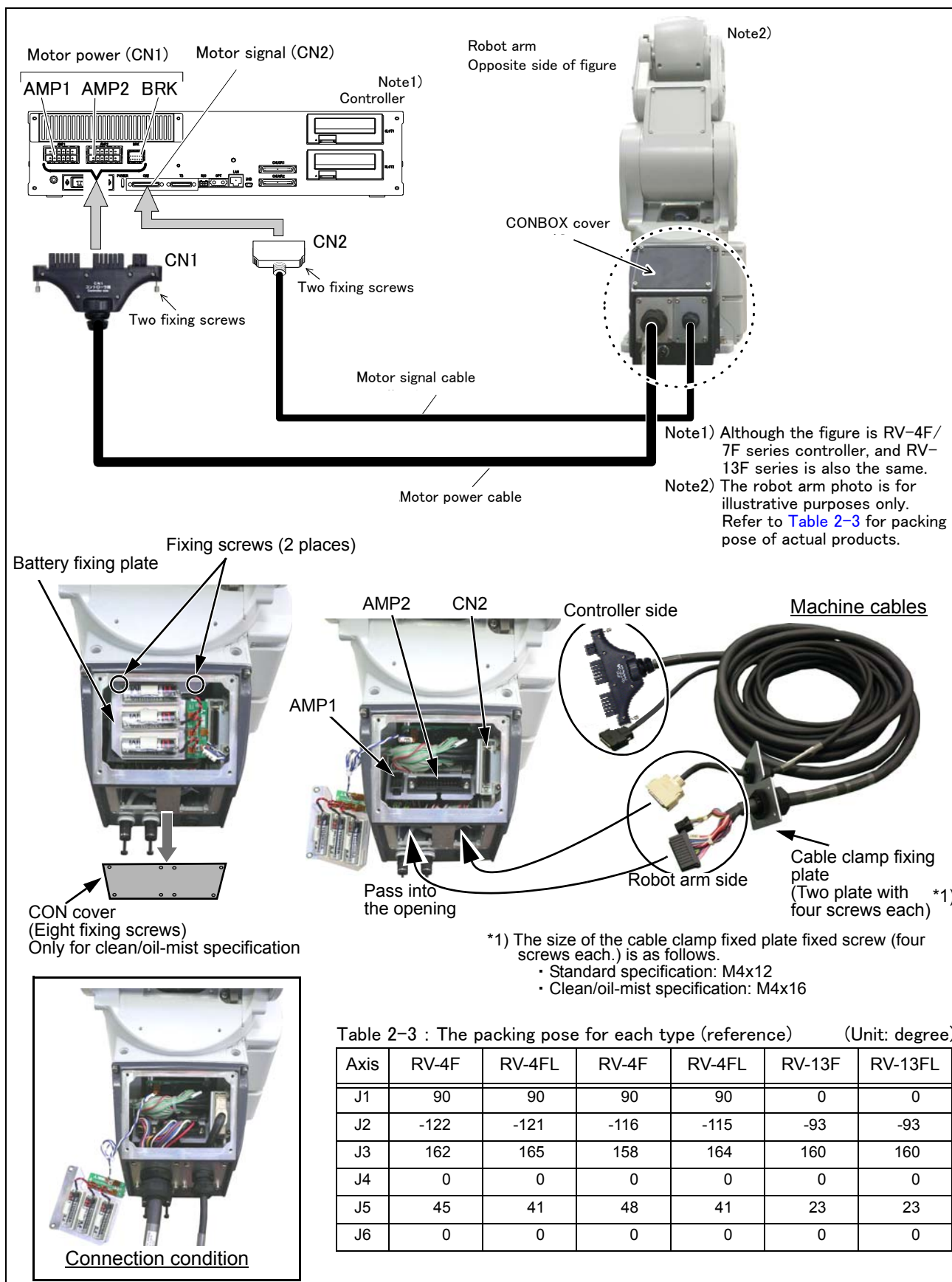| Axis	RV-4F	RV-4FL	RV-4F	RV-4FL	RV-13F	RV-13FL
J1	90	90	90	90	0	0
J2	-122	-121	-116	-115	-93	-93
J3	162	165	158	164	160	160
J4	0	0	0	0	0	0
J5	45	41	48	41	23	23
J6	0	0	0	0	0	0

Fig.2-8 : Connecting the machine cables (CR751)

Carry out the following procedure after installing the controller and the robot arm referring to the separate "Controller Setup, Basic Operation and Maintenance" and "ROBOT ARM SETUP & MAINTENANCE" manual. The connection outline is shown in Fig. 2-8.

1) Make sure that the power switch on the front of the controller is turned OFF.
   Note) Although the figure is RV-4F series, also in other robots with same connector type, the connection method is the same.
2) Connect the machine cable connectors to its corresponding connectors on the robot arm side.
   a) Remove the four screws holding the CONBOX cover, and remove the cover. (Refer to Page 76, "5.3.2 Installing/removing the cover" for details.)
   And, the CON cover is installed to clean / oil-mist specification. Removes the eight fixing screws and removes the CON cover. The opening which passes the connector is seen.
   b) The battery fixing plate is inside the CONBOX cover. Remove the two fixing screws and remove the battery fixing plate.
   Note) Do not disconnecting the battery cable and connector.
   c) Feed the connectors of robot side to the opening on the back of the robot base and Connect with the corresponding connector. Connect the connector (AMP1, AMP2, CN2) securely.
   d) Fix the cable clamp fixed plate of the machine cable with the attached fixing screw. Fix both cables securely with the four screws, respectively.
   e) Install the battery fixing plate securely as before. Be careful not to insert the cable.
   f) Install the CONBOX cover securely as before. Be careful not to insert the cable.

3) Connects the machine cable to the corresponding connector of the controller. Connects the connector (CN1(AMP1, AMP2, BRK), CN2) surely. Fix the two fixing screws securely, respectively. Tighten the fixing screw of CN2 by 0.06-0.07 Nm.

This complete the connection of machine cable.

⚠ 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.

⚠ CAUTION   Connect the machine cable at the place without the effect of the dust or oil mist. Please keep the dust and oil mist from being applied to of the robot-arm connector section, in the condition that the machine cable is removed. Since it becomes the cause of failure.

⚠ CAUTION   Please be careful not to catch the hand at installation and removal.

2.2.6 About oil mist specification
(1) Piping for pressurization inside robot arm

In use in oil mist environment, please connect the $\phi 8$ air hose to the coupling for pressurization of the robot arm base portion "AIR PURGE",
and pressurize the inside of the robot arm.
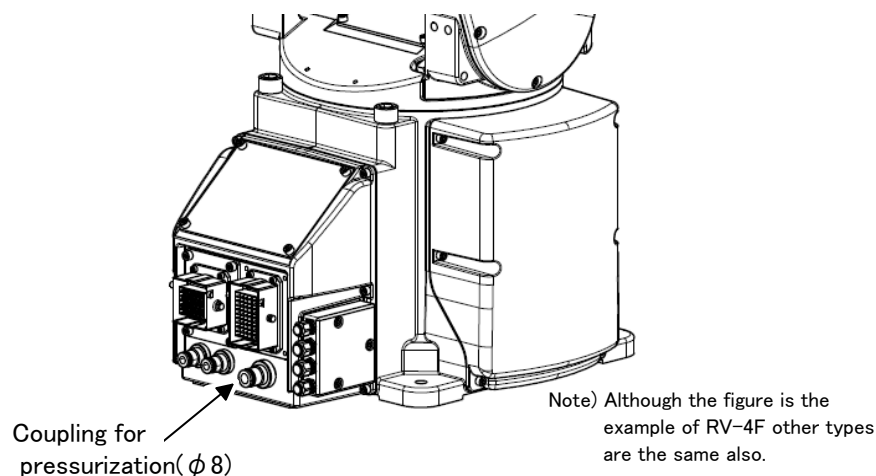Refer to the separate "Standard specifications manual" for specification of air purge.

Coupling for
pressurization($\phi 8$)

Note) Although the figure is the
example of RV-4F other types
are the same also.

Fig.2-9 : Air purge

2.2.7 About clean specification
(1) Piping for suction inside robot arm

In use of the robot of clean specification, please connect the $\phi 8$ air hose to the coupling for suction of the robot body base portion "VACUUM", and suck the inside of the robot arm.
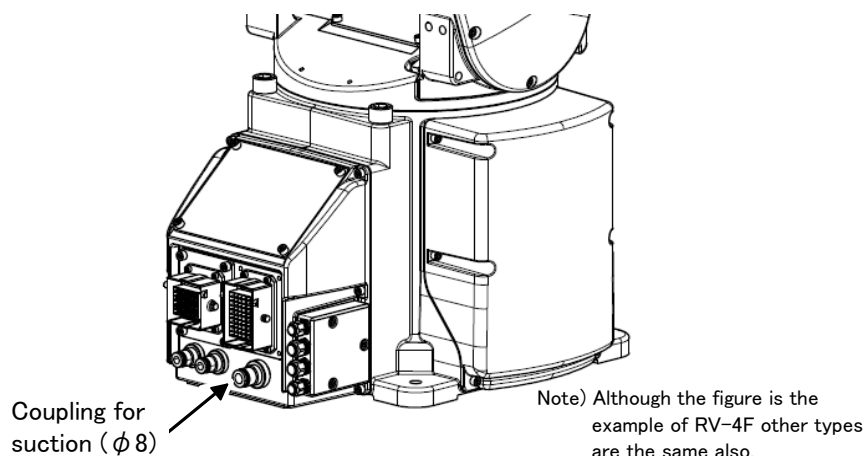Refer to the separate "Standard specifications manual" for vacuum condition.

Coupling for
suction ($\phi 8$)

Note) Although the figure is the
example of RV-4F other types
are the same also.

Fig.2-10 : Vacuum

2.3 Setting the origin

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

There are several methods for setting the origin, but the origin data input method will be explained here. Refer to Page 98, "5.6 Resetting the origin" for the other methods.

The teaching pendant is required for this operation.

[Caution] If the origin data at shipment is erased due to out of battery, it is necessary to set the origin again. Refer to Page 98, "5.6 Resetting the origin" and reset the origin using the jig method or ABS method.

2.3.1 Installing the teaching pendant (T/B)

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

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

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

(1) Installing the T/B (CR750 controller)

Explain the installation method of T/B below.

1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Connects T/B connector to the robot controller. Use as the upper surface the lock lever shown in Fig. 2-11, and push in until there is sound.
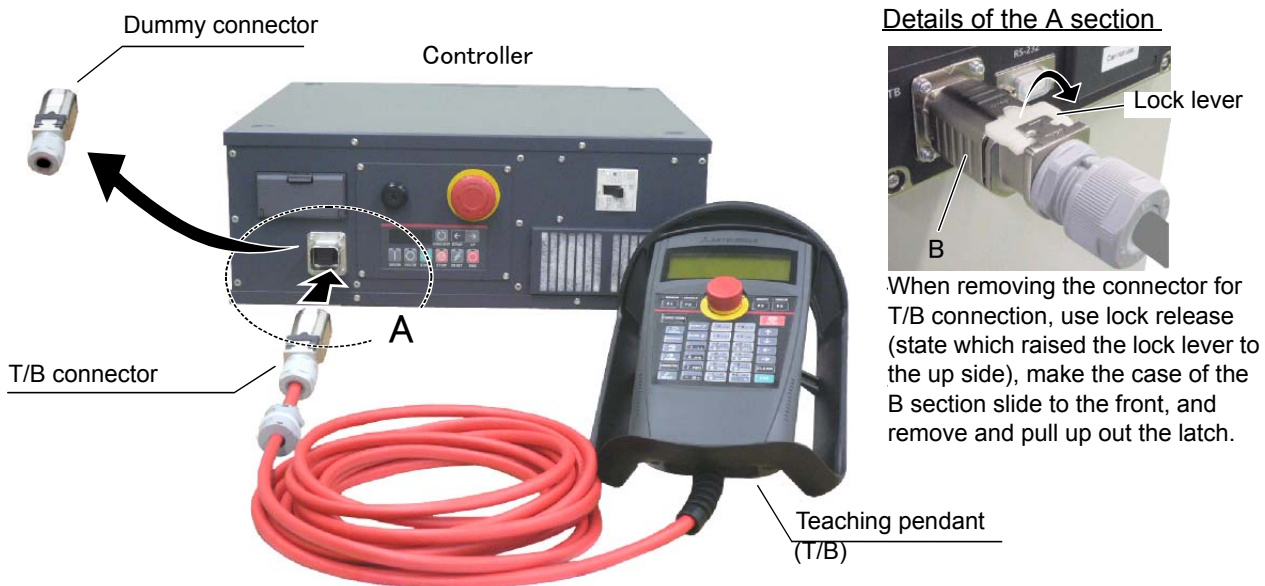

Details of the A section

When removing the connector for T/B connection, use lock release (state which raised the lock lever to the up side), make the case of the B section slide to the front, and remove and pull up out the latch.

Fig.2-11 : Installing and removing the T/B (CR750 controller)

The installation of T/B is finished.

◇◆◇ If error C0150 occurs ◇◆◇

At the time of the first power supply injection, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.

Parameter: Please input the serial number of the robot body into RBSERIAL. Refer to "instructions manual / controller setup, and basic operation & maintenance" for the operation method.

(2) Installing the T/B (CR751 controller)

Explain the installation method of T/B below.

1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Connect the T/B connector to the controller's T/B connector. Make sure to fix it securely by fastening the hand locks (in 2 places), as shown in Fig. 2-12.

Controller

T/B connector

Note) Although the figure is RV-4F/7F series controller, and RV-13F series is also the same.
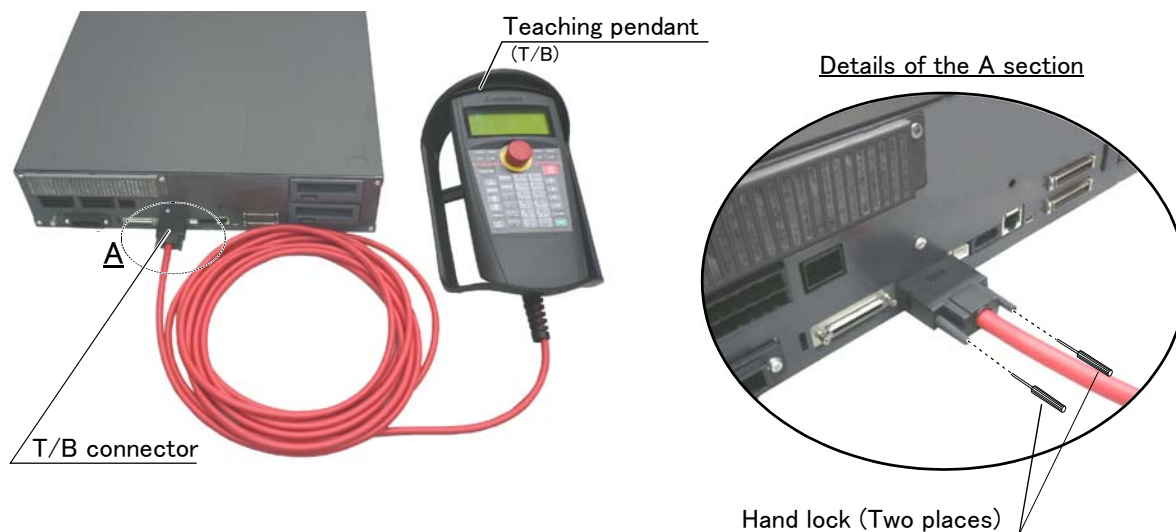
Teaching pendant
(T/B)

Details of the A section

A

T/B connector

Hand lock (Two places)

Fig. 2-12 : Installing and removing the T/B (CR751controller)

The installation of T/B is finished.

◇◆◇ If error C0150 occurs ◇◆◇

At the time of the first power supply injection, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.

Parameter: Please input the serial number of the robot body into RBSERIAL. Refer to "instructions manual / controller setup, and basic operation & maintenance" for the operation method.

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

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

Date	Default	. . .	. . .	. . .
D	V!#S29			
J 1	06DTYY			
J 2	2?HL9X			
J 3	1CP55V			
J 4	T6!M$Y			
J 5	Z2IJ%Z			
J 6	A12%Z0			
Method	E	E・N・SP	E・N・SP	E・N・SP

(O: O(Alphabet), 0: Zero)

Note) Meanings of symbols in method column
E: Jig method
N: Not used
SP: Not used

Fig.2-13 : Origin data label (an example)

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 CON-BOX cover. (Refer to Fig. 2-13).

Referring to Page 76, "5.3.2 Installing/removing the cover", remove the CON-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.

⚠ **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

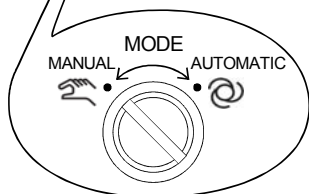⚠ **CAUTION**   Confirm that there are no operators near the robot before turning the power ON.

1) Turn the controller [POWER] switch ON.
   The CR750 controller turns ON the front power switch.

(3) Preparing the T/B

Next, prepare to use the T/B
1) Set the mode of the controller to "MANUAL".
　(The figure is example for CR750 controller)

MODE
MANUAL　　　　AUTOMATIC

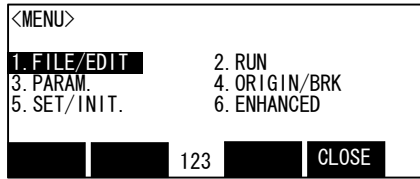2) Set the T/B [ENABLE] switch to "ENABLE". The menu selection
　screen will appear.
　The following operations are carried out with the T/B.

Up:　　Disable
Down: Enable
　　(Lighting)
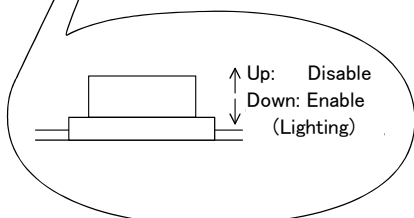
◇◆◇ Operating from the T/B ◇◆◇
　Always set the mode of the controller to "MAMNUAL", and　then set the T/B [ENABLE] switch to "ENABLE".
When the T/B is valid, only operations from the T/B are possible. Operations from the controller or external
signals will not be accepted.
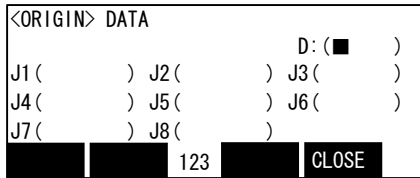
(4) Selecting the origin setting method

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

              123          CLOSE
```

`4  GHI`

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

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



              123          CLOSE
```

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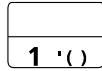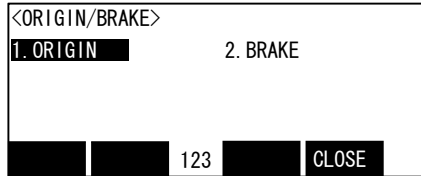
2) Press the [1] key on the ORIGIN/BRAKE screen, and display the origin setting method selection screen.

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

              123          CLOSE
```

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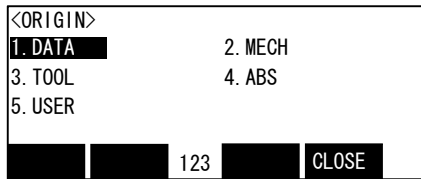
3) Press the [1] key on the origin setting method selection screen, and select the data input method.

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

4) Display the origin data input screen

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

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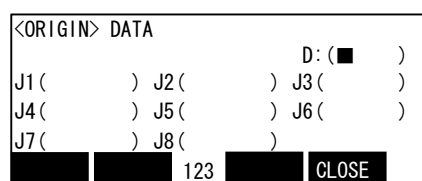
(5) Inputting the origin data

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

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

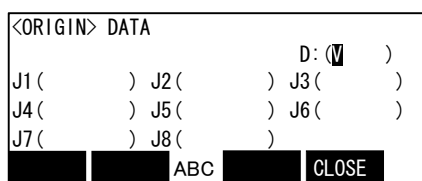Input the value confirmed in section Page 21, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-14.

Fig.2-14 : Correspondence of origin data label and axis

The method for inputting the origin data is explained below. The value shown in Fig. 2-13 will be input as an example.

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

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

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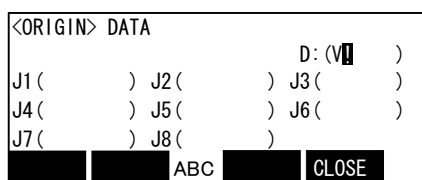
CHARACTER

−B (J5)
8 TUV

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

```
<ORIGIN> DATA
                    D:(V■   )
J1(      ) J2(      ) J3(      )
J4(      ) J5(      ) J6(      )
J7(      ) J8(      )
            ABC        CLOSE
```
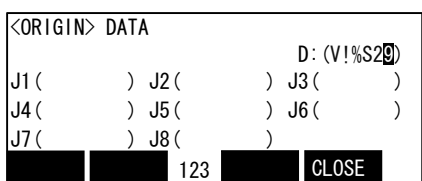
+C (J6)
· , %

→

+C (J6)
· , %

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

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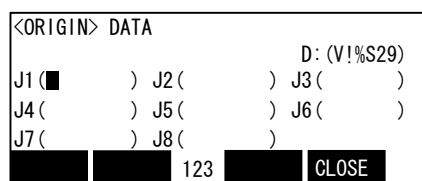
CHARACTER

−Z (J3)
2 ABC

+B (J5)
9 WXYZ

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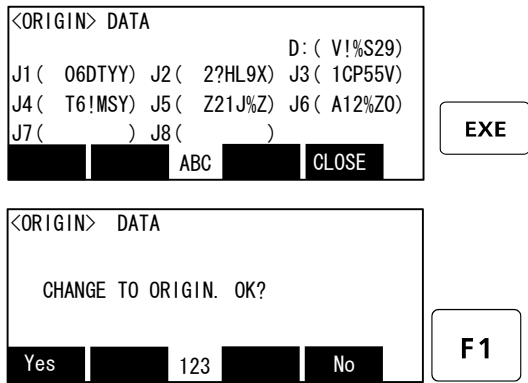"V!%S29" will appear at the "D" data on the teaching pendant screen.

↓

:
:
:

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

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.

```
<ORIGIN> DATA
                        D:( V!%S29)
J1( O6DTYY) J2( 2?HL9X) J3( 1CP55V)
J4( T6!MSY) J5( Z21J%Z) J6( A12%Z0)
J7(        ) J8(        )
              ABC        CLOSE
```

EXE

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

```
<ORIGIN> DATA

   CHANGE TO ORIGIN. OK?

Yes        123        No
```

F1

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

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

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

◇◆◇ How to input symbols ◇◆◇
The symbol is allocated to ['()], [@=], and [,%] key. Please repress each key until the symbol to wish is displayed.
a) ['()] key .... ' ( ) ″ ＾ : ; ¥ ?
b) [@=] key......................... @ = + − ＊ / 〈 〉
c) [,%] key........................... , % # $! & _ .

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

(6) Installing the CONBOX cover.
Return the CONBOX cover removed in section Page 21, ″(1) Confirming the origin data″ to its original position. This completes the setting of the origin with the origin data input method.

⚠ WARNING Removing and installing the cover by always turning off the controller power.
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.
Note) The figure of the robot which indicated to the explanation page in each jog mode is an example.

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

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

⚠ WARNING   Confirm that the origin has been set. If the origin has not been set, "****" will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.
Refer to Page 19, "2.3 Setting the origin" for details on setting the origin.

◇◆◇ How to choose the jog mode ◇◆◇

```
<CURRENT>     JOINT   100%  M1  TO  B1

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

  XYZ   |  TOOL  | JOG | 3-XYZ | CYLNDR  ⇒
Choose the jog mode
```

JOG   F1 ～ F4   FUNCTION
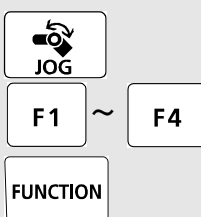
Press the [JOG] key, the jog screen will be displayed, and display the jog mode which can be chosen at the bottom of the screen. Because these correspond to the function key of [F1] – [F4], press the function key corresponding to the jog mode to wish. And, if the [FUNCTION] key is pressed, selection in jog modes other than the present display is possible. The override (100%), the mechanism number (M1), and the tool number (T1), and the base coordinate number (B1) are displayed on the upside of the screen following the present jog mode (JOINT).
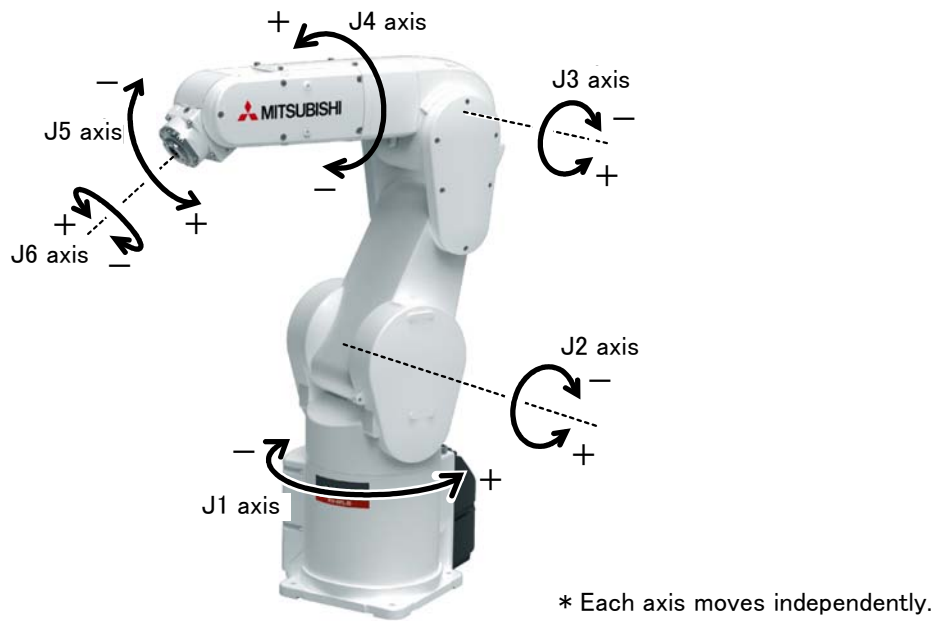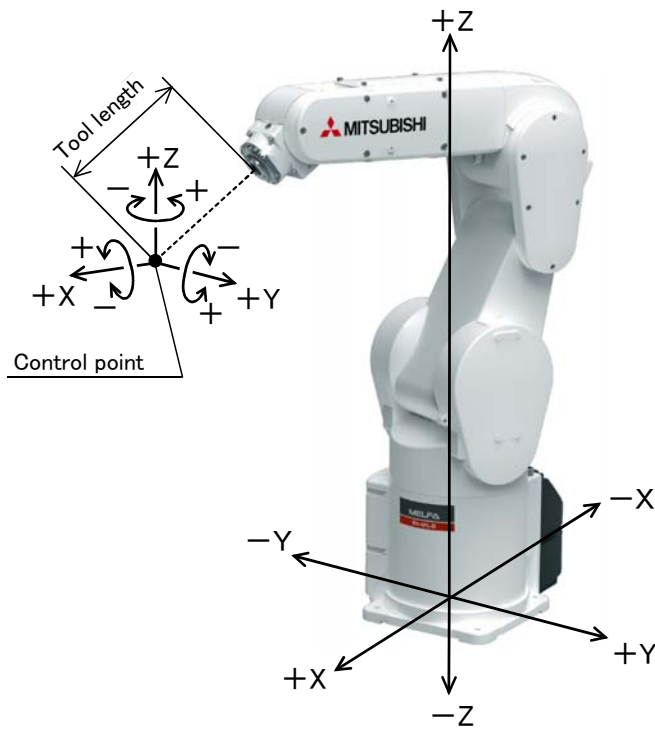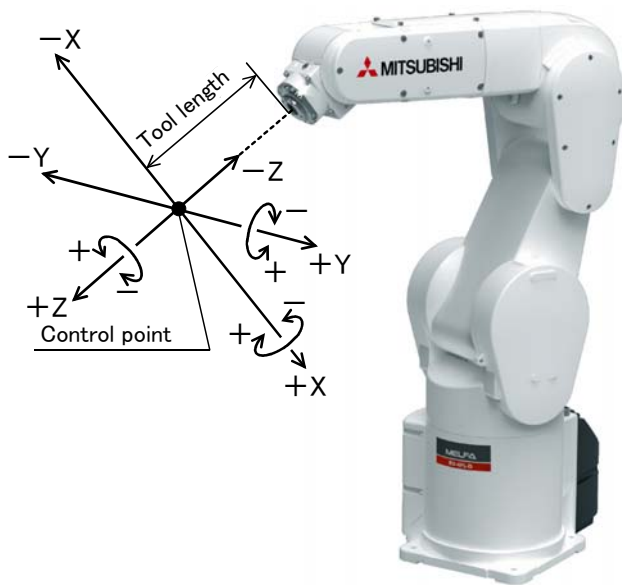
* Each axis moves independently.
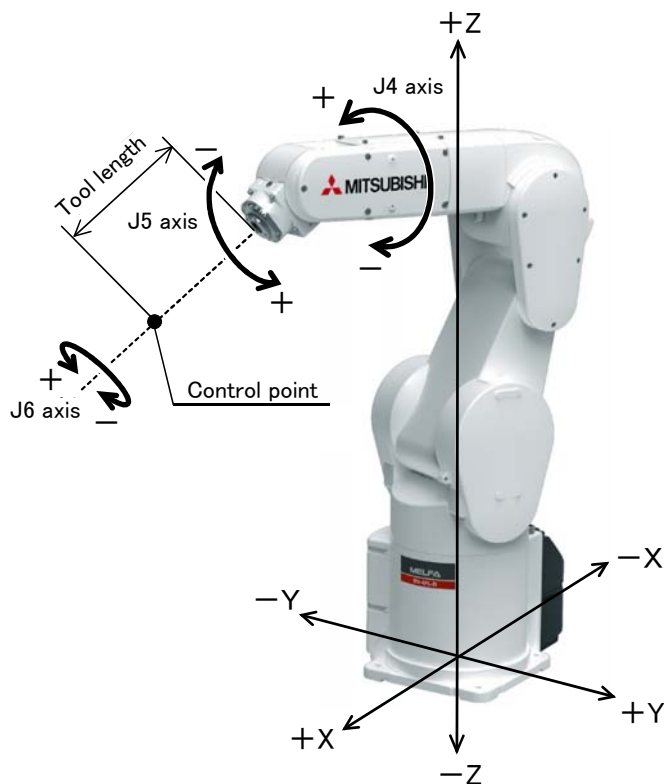
Fig.2-15 : JOINT jog operation

* 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.
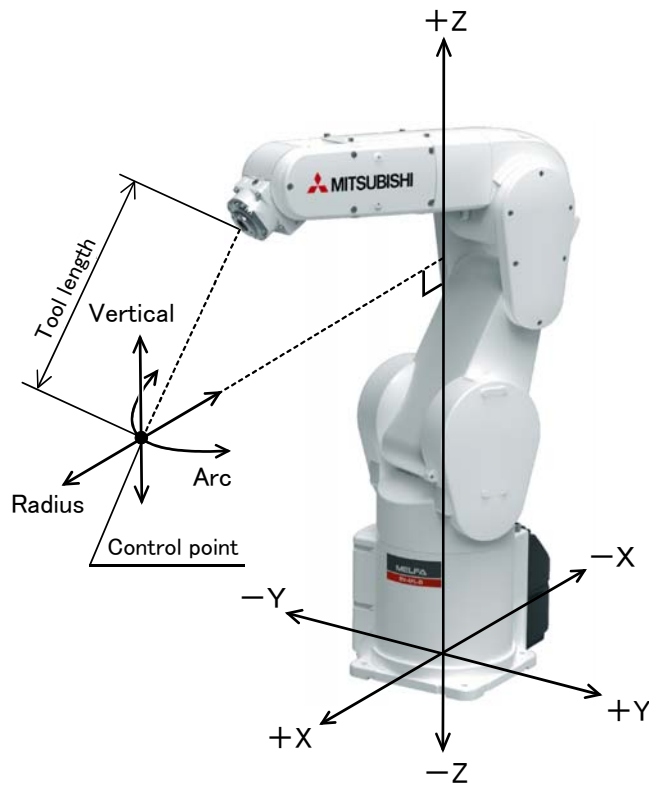
Fig.2-16 : XYZ jog operation

＊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.

Fig.2-17 : 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 does not
change at this time. It is effective to change the posture of the wrist, with the position maintained.

Fig.2-18 : 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, the flange surface posture is maintained. Also, while maintaining the flange surface position, the flange surface posture changes.

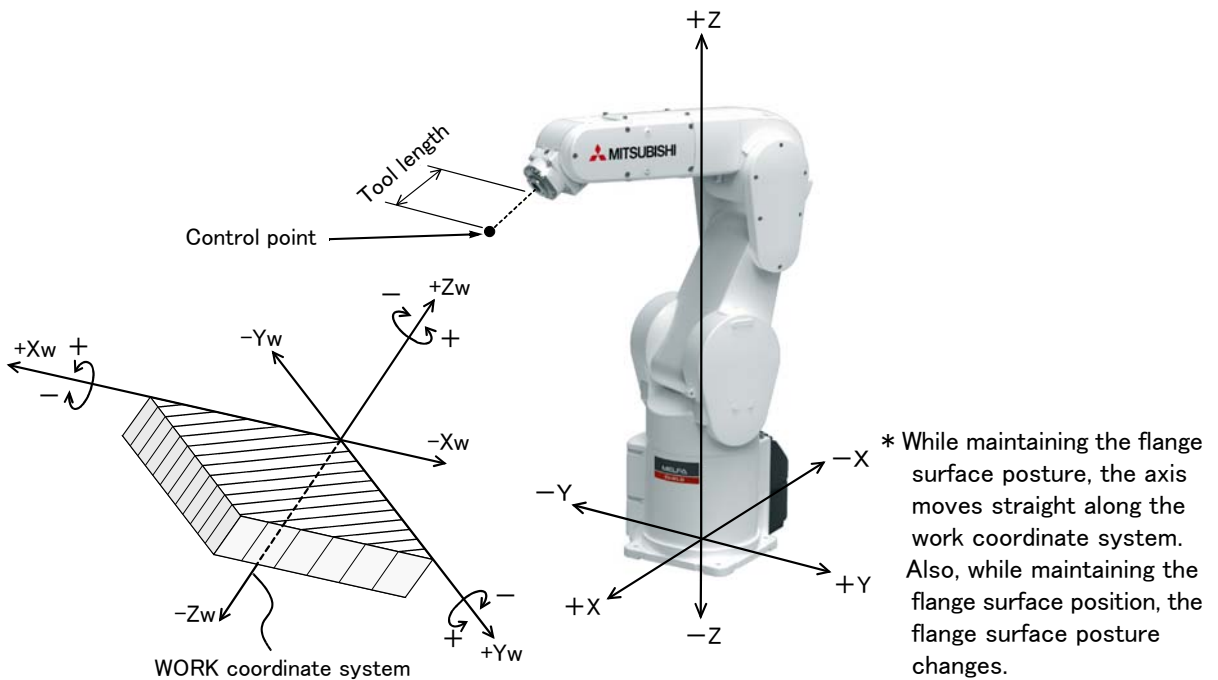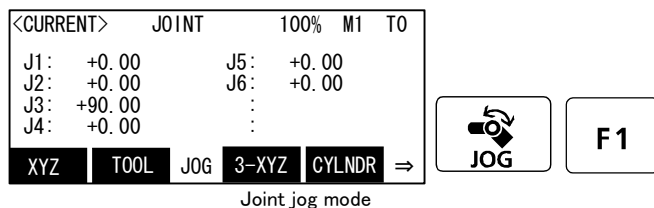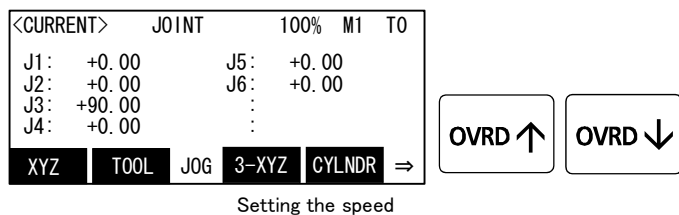Fig.2-19 : CYLINDER jog operation

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

Fig.2-20 : WORK jog operation

(1) JOINT jog operation

Select joint jog mode

```
<CURRENT>    JOINT      100%   M1   T0

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

Set jog speed

```
<CURRENT>    JOINT      100%   M1   T0

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

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

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

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

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

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

Set the override to 10% here for confirmation work

J1 axis jog operation
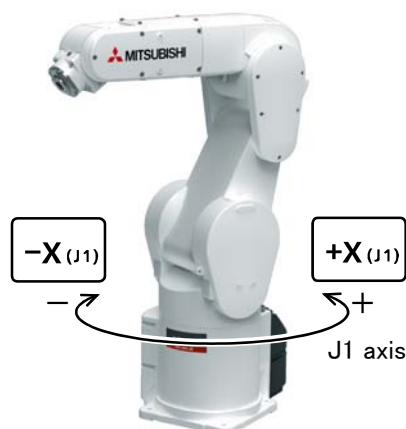
J1 axis

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

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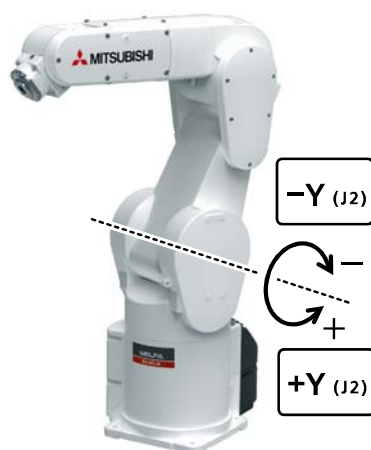
- When the [+Y (J2)] keys are pressed, the J2 axis will rotate in the plus direction.
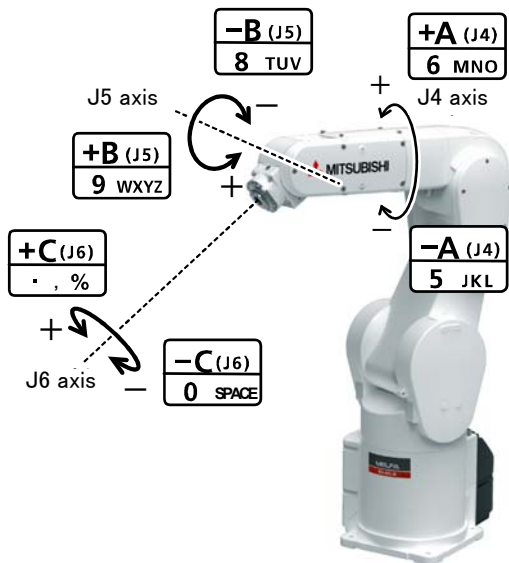 When the [-Y (J2)] keys are pressed, Rotate in the minus direction.

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

J3 axis jog operation

−Z (J3)
2 ABC

J3 axis

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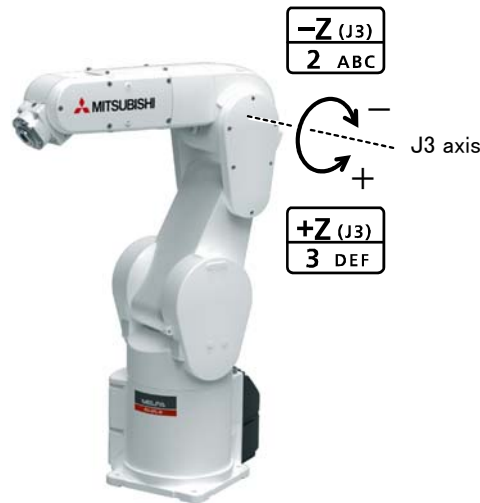
· When the ［+Z (J3)］ keys are pressed, the J3 axis will rotate in the plus direction.
  When the ［−Z (J3)］ keys are pressed, Rotate in the minus direction.

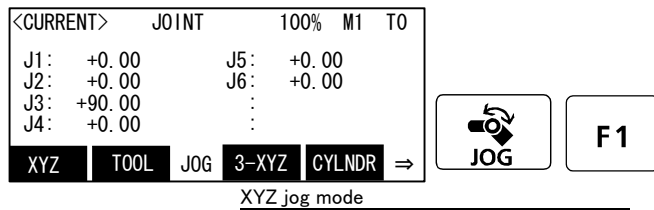J4, J5 and J6 axis jog operation

−B (J5)
8 TUV

+A (J4)
6 MNO

J5 axis

J4 axis

+B (J5)
9 WXYZ

+C (J6)
· , %

−A (J4)
5 JKL

J6 axis

−C (J6)
0 SPACE

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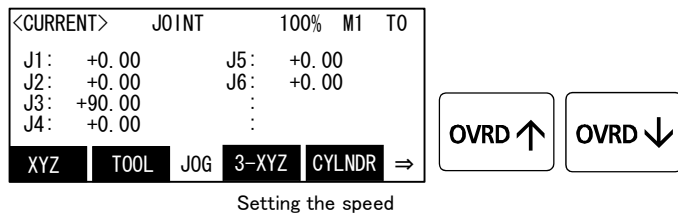 When the ［−C (J6)］ keys are pressed, Rotate in the minus direction.

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

(2) XYZ jog operation

Select XYZ jog mode

```
<CURRENT>    JOINT      100%  M1  T0

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

Set jog speed

```
<CURRENT>    JOINT      100%  M1  T0

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

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

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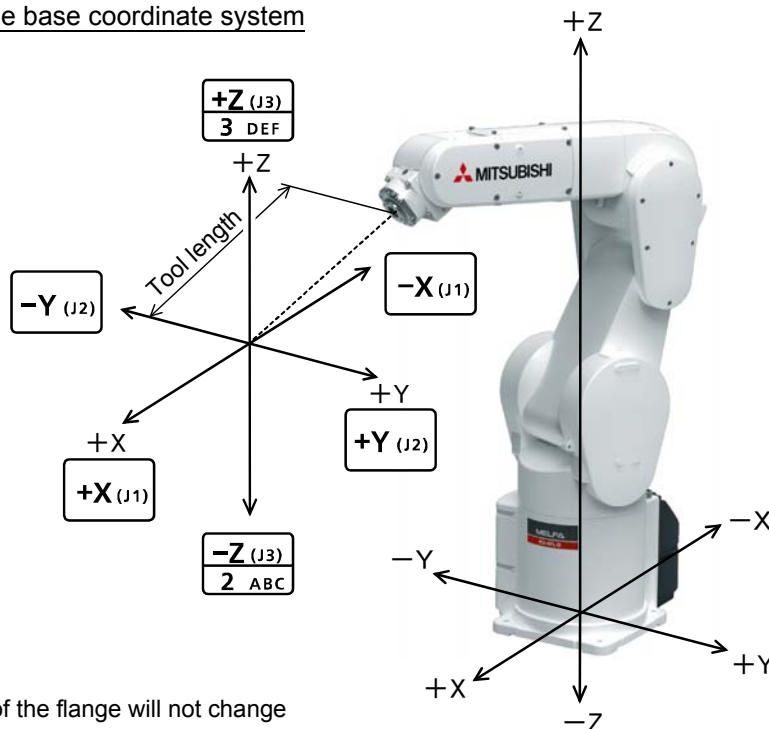
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

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

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

Set the override to 10% here for confirmation work.

Moving along the base coordinate system

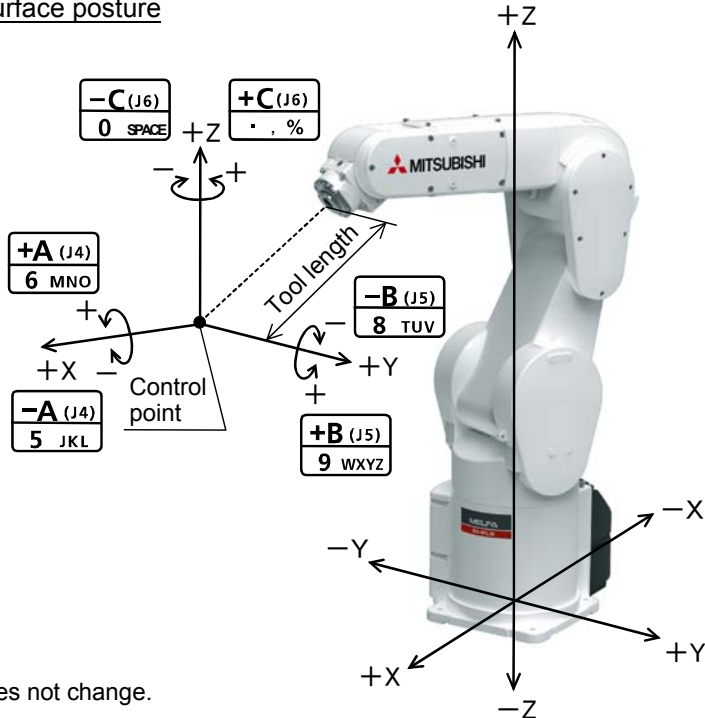* The direction of the flange will not change

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

◇◆◇ When the robot is in the transportation posture ◇◆◇
There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 30, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

Changing the flange surface posture

* The control point does not change.

・When the ［+A (J4)］ keys are pressed, The X axis will rotate in the plus direction.
  When the ［−A (J4)］ keys are pressed, Rotate in the minus direction.
・When the ［+B (J5)］ keys are pressed, The Y axis will rotate in the plus direction.
  When the ［−B (J5)］ keys are pressed, Rotate in the minus direction.
・When the ［+C (J6)］ keys are pressed, The Z axis will rotate in the plus direction.
  When the ［−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.
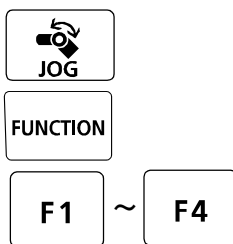
（3）TOOL jog operation

Select TOOL jog mode

```
<CURRENT>    JOINT       100%  M1  T0

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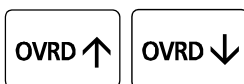TOOL jog mode

Set jog speed

```
<CURRENT>    JOINT       100%  M1  T0

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

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

Moving along the tool coordinate system
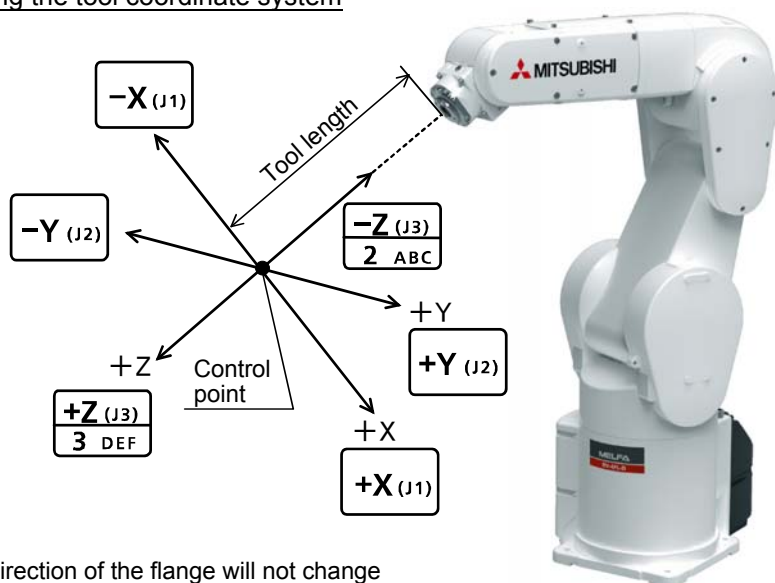
* The direction of the flange will not change

・When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction of the tool coordinate system.
　When the [-X (J1)] keys are pressed, Move along the minus direction.
・When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction of the tool coordinate system.
　When the [-Y (J2)] keys are pressed, Move along the minus direction.
・When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
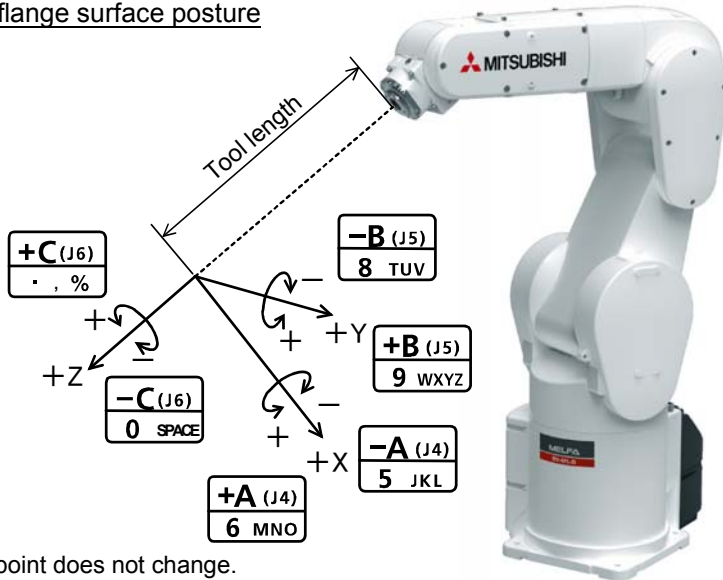　When the [-Z (J3)] keys are pressed, Move along the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇
　There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 30, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇

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

Changing the flange surface posture

+C (J6)
· , %

−B (J5)
8 TUV

+B (J5)
9 WXYZ

−C (J6)
0 SPACE

−A (J4)
5 JKL

+A (J4)
6 MNO

Tool length

+Z   +Y   +X

* The control point does not change.

· When the[+A (J4)] keys are pressed, The X axis will rotate in the plus direction of the tool coordinate system. When the[−A (J4)] keys are pressed, Rotate in the minus direction.
· When the[+B (J5)] keys are pressed, The Y axis will rotate in the plus direction of the tool coordinate system. When the[−B (J5)] keys are pressed, Rotate in the minus direction.
· When the[+C (J6)] keys are pressed, The Z axis will rotate in the plus direction of the tool coordinate system. When the[−C (J6)] keys are pressed, 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.
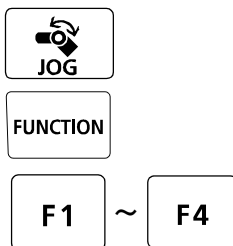
(4) 3-axis XYZ jog operation

Select XYZ456 jog mode

```
<CURRENT>    JOINT      100%  M1  T0

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

XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
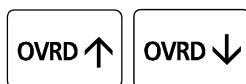XYZ456 jog mode

Set jog speed

```
<CURRENT>    JOINT      100%  M1  T0

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

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

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

Moving along the base coordinate system
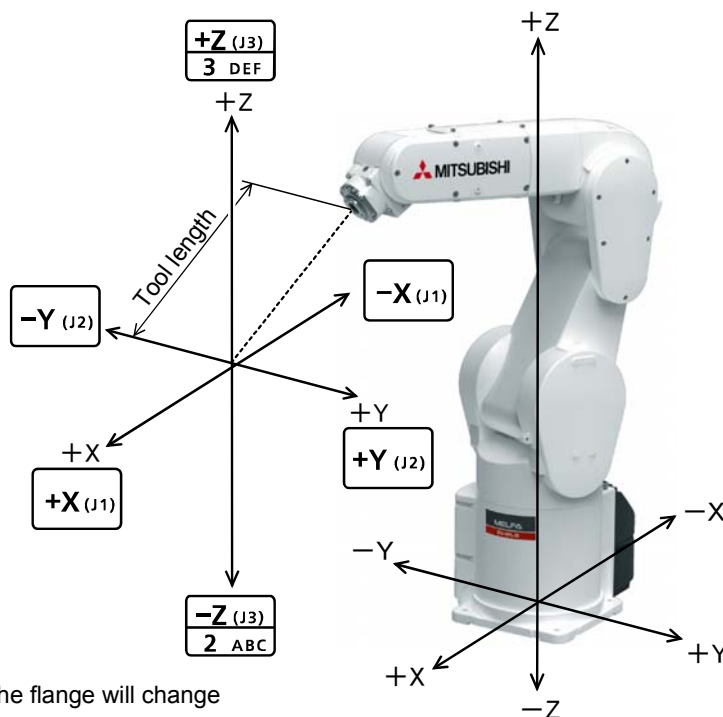
* The direction of the flange will change

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

◇◆◇ The 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

| −B (J5) |
| 8 TUV |

| +A (J4) |
| 6 MNO |

J5 axis

J4 axis

| +B (J5) |
| 9 WXYZ |

| −A (J4) |
| 5 JKL |

| +C (J6) |
| . , % |

J6 axis

| −C (J6) |
| 0 SPACE |
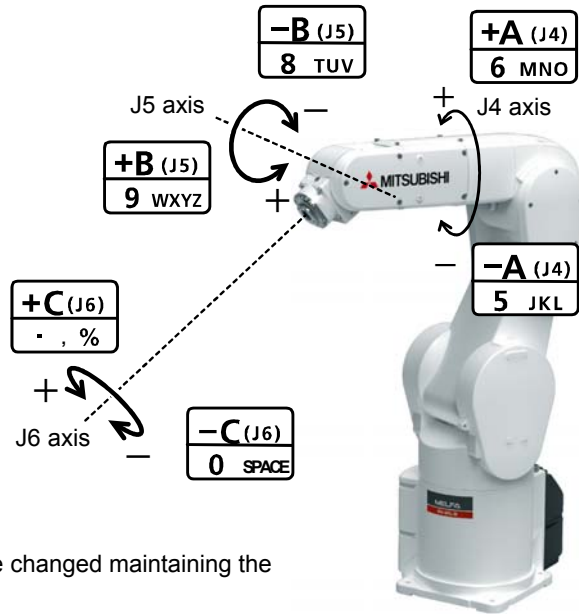
* The wrist pose can be changed maintaining the flange's position.

・When the[+A (J4)] keys are pressed, the J4-axis will rotate in the plus direction.
 At this time, to maintain the flange's position, other axes move simultaneously except J5 and J6.
 When the[−A (J4)] keys are pressed, Rotate in the minus direction.
・When the[+B (J5)] keys are pressed, the J5-axis will rotate in the plus direction.
 At this time, to maintain the flange's position, other axes move simultaneously except J4 and J6.
 When the[−B (J5)] keys are pressed, Rotate in the minus direction.
・When the[+C (J6)] keys are pressed, the J6-axis will rotate in the plus direction.
 When the[−C (J6)] keys are pressed, Rotate in the minus direction.

(5) CYLNDER jog operation

Select cylindrical jog mode

```
<CURRENT>     JOINT      100%   M1   T0

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

Set jog speed

```
<CURRENT>     JOINT      100%   M1   T0

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

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

Check that the "CYLNDER" in jog mode is displayed on the screen.

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

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

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

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
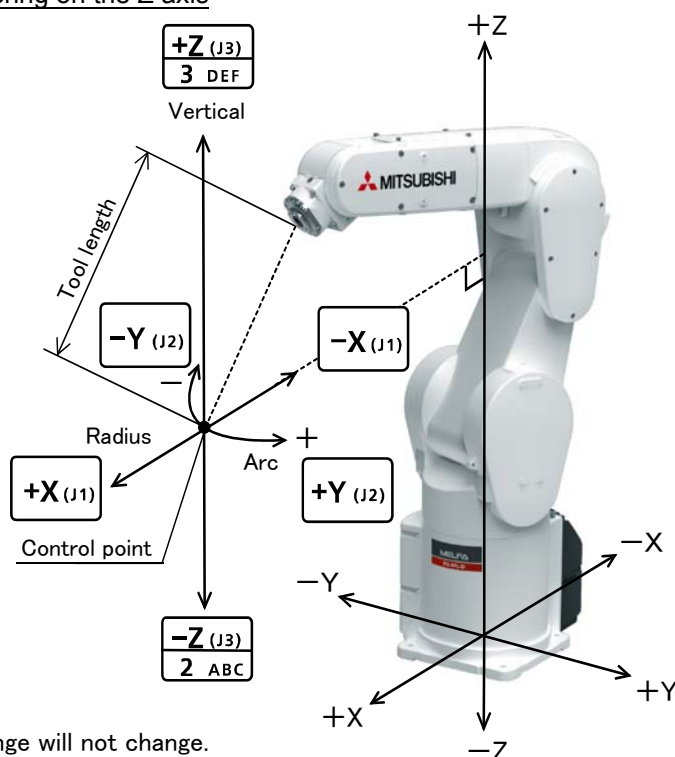
Set the override to 10% here for confirmation work

Moving along an arc centering on the Z axis

＊ The direction of the frange will not change.

Assuming that the current position is on an arc centering on the Z axis, the robot moves along that arc.
- When the[+X (J1)] keys are pressed, the robot will expand in the radial direction.
  When the[−X (J1)] keys are pressed, Contract in the radial direction.
- When the[+Y (J2)] keys are pressed, the robot will move along the arc in the plus direction.
  When the[−Y (J2)] keys are pressed, Move in the minus direction.
- When the[+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
  When the[−Z (J3)] keys are pressed, Move along the minus direction.

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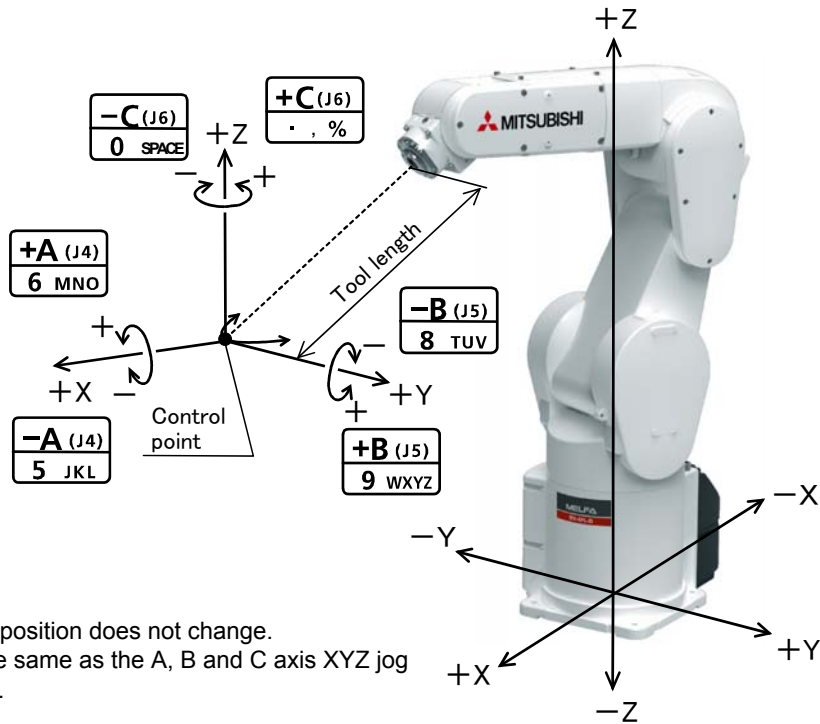
* The flange position does not change.
  This is the same as the A, B and C axis XYZ jog
  operation.

・When the [+A (J4)] keys are pressed, The X axis will rotate in the plus direction.
  When the [−A (J4)] keys are pressed, Rotate in the minus direction.

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

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

(6) Work jog operation

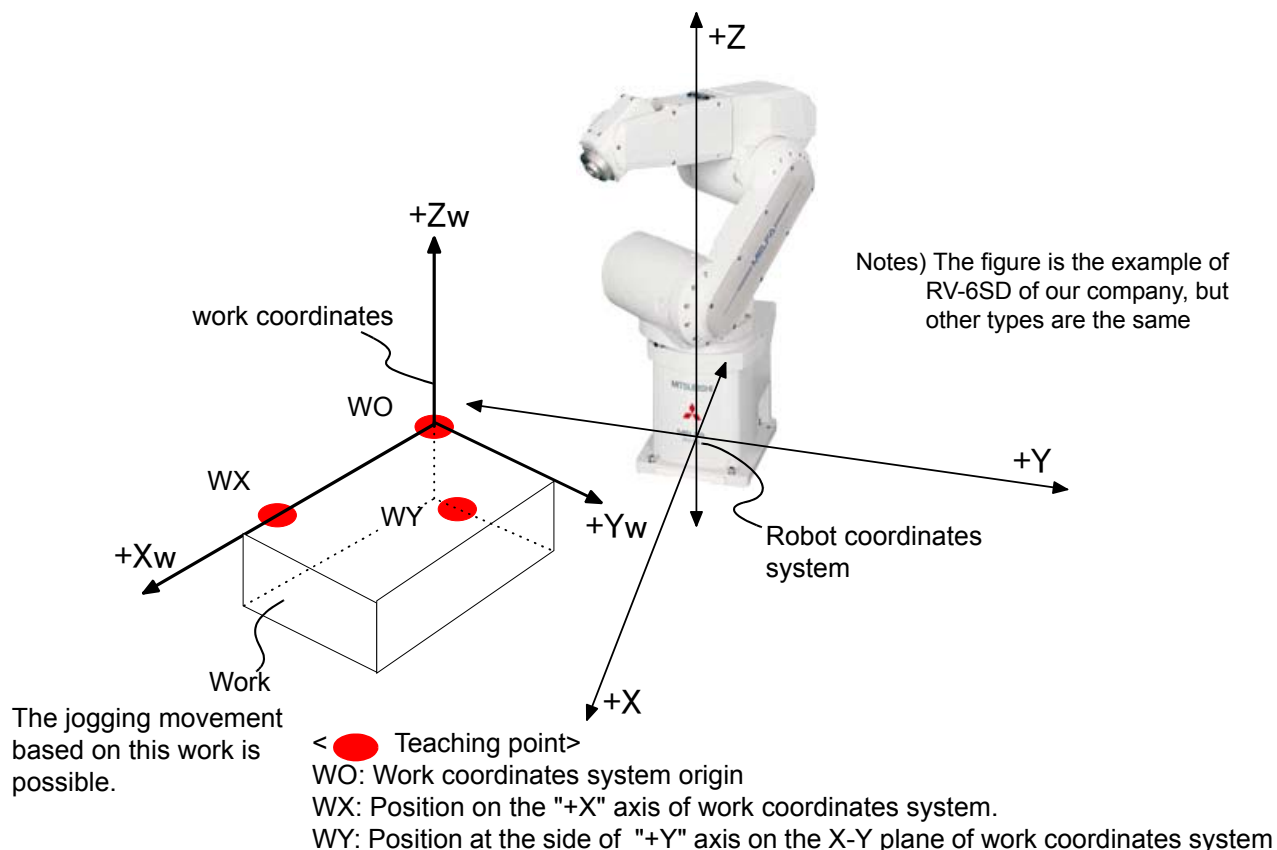Setting of the work coordinates system is necessary.

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

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

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

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

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

The jogging movement based on this work is possible.

< 🔴 Teaching point>

WO: Work coordinates system origin

WX: Position on the "+X" axis of work coordinates system.

WY: Position at the side of "+Y" axis on the X-Y plane of work coordinates system

[Supplement] : The coordinate values which use all three teaching points for setting of the work coordinates system are each only X, Y, and the Z-axis. Although the coordinate value of A, B, and C axis is not used, positioning will get easy if the XYZ jog or TOOL jog movement is effected with the same value. (The direction of the hand is the same)
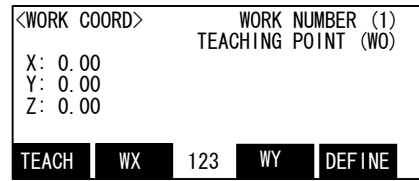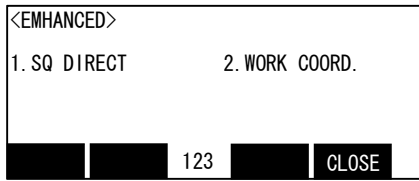
Fig.2-21 : Setting of the work coordinates system (teaching point)

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

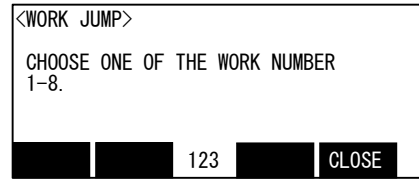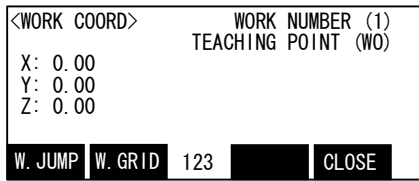1) Select "6.ENHANCED" screen on the <MENU> screen.
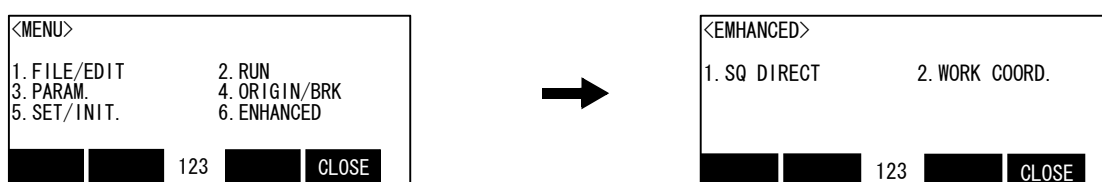
2) Press the [2] keys in the menu screen and select "2. WORK COORD."

```
<EMHANCED>

1.SQ DIRECT        2.WORK COORD.


          123              CLOSE
```

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

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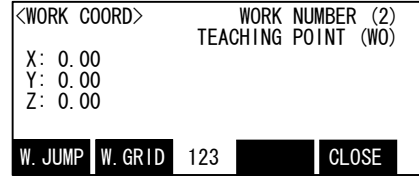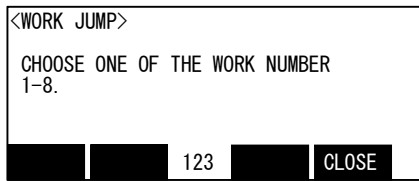The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

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

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

 W. JUMP W. GRID 123          CLOSE
```

```
<WORK JUMP>


 CHOOSE ONE OF THE WORK NUMBER
 1-8.


          123              CLOSE
```

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

```
<WORK JUMP>


 CHOOSE ONE OF THE WORK NUMBER
 1-8.


          123         CLOSE
```

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

 W. JUMP W. GRID 123          CLOSE
```

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

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

4) The teaching of the work coordinates system
   Teach the three points shown in Fig. 2-21. Confirm the name currently displayed on the "TEACHING POINT" at the upper right of the screen. If it differs, press the function key corresponding to each point(WO, WX, WY) to teach. Move the robot's arm by jog operation (other jogging movement), and press the function key corresponding to "TEACH."([F1]) The confirmation screen is displayed.
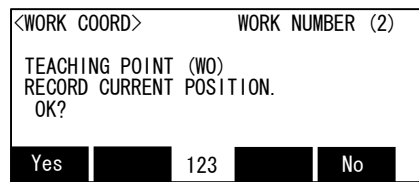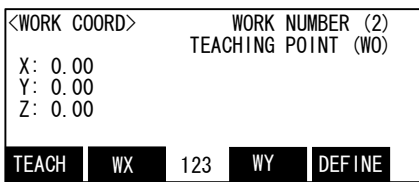
```
<WORK COORD>       WORK NUMBER (2)
                   TEACHING POINT (WO)
 X: 0.00
 Y: 0.00
 Z: 0.00

 TEACH   WX   123   WY   DEFINE
```
Specify the teaching point [WO],[WX],[WY] teaching the position [TEACH]

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

 TEACHING POINT (WO)
 RECORD CURRENT POSITION.
  OK?

 Yes          123          No
```

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

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

TEACHING POINT (WO)
RECORD CURRENT POSITION.
 OK?

  Yes          123          No
```

➡

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

W.JUMP W.GRID 123           CLOSE
```

Teach the three points, WO, WX, and WY, by the same operation.
The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)

    WO= parameter: WKnWO
    WX= parameter: WKnWX
    WY= parameter: WKnWY

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

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

TEACH   WX   123    WY   DEFINE
```

➡

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


              123           CLOSE
```

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

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


              123           CLOSE
```

➡

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

TEACH   WX   123    WY   DEFINE
```

6) Finishing of setting the work coordinates
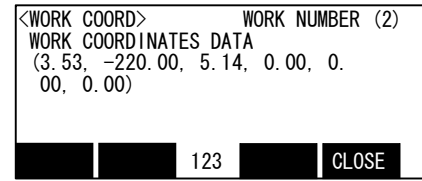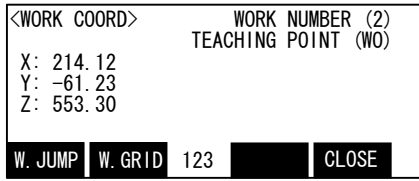Press the [FUNCTION] keys, and display ″CLOSE″ function. Press the function key corresponding to ″CLOSE″. Returns to the <MENU> screen.

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

W.JUMP W.GRID 123           CLOSE
```

➡

```
<EMHANCED>

1.SQ DIRECT        2.WORK COORD.



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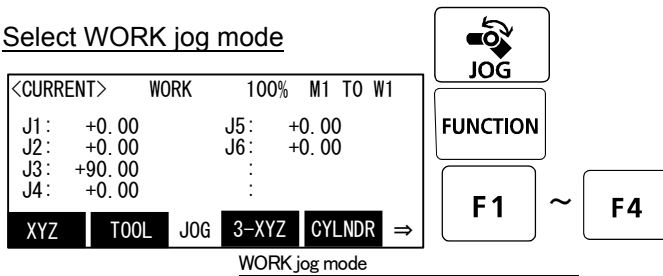
Although setting of work coordinates is finishing above, confirmation of work coordinates can be done by pressing the function key corresponding to "W GRID."([F2])

```
<WORK COORD>      WORK NUMBER (2)
                  TEACHING POINT (W0)
X: 214.12
Y: -61.23
Z: 553.30

W. JUMP  W. GRID  123        CLOSE
```

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


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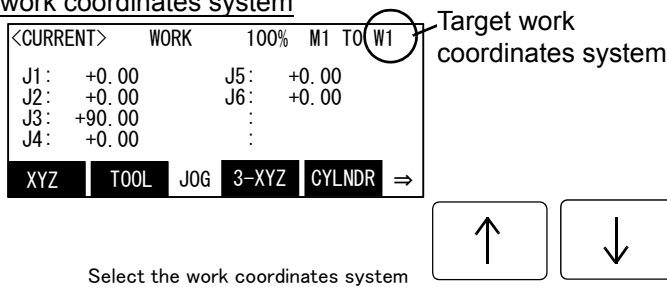
Return to the previous screen by pressing the [CLOSE] ([F4]) key.

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

Select WORK jog mode

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

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

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

Confirmation and selection of the work coordinates system

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

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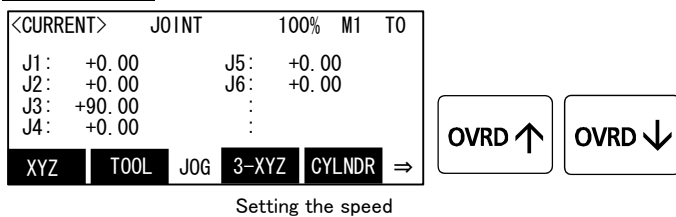
Select the work coordinates system

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

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

Set jog speed

```
<CURRENT>   JOINT    100%  M1  TO

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

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

The jog movement based on work coordinates system
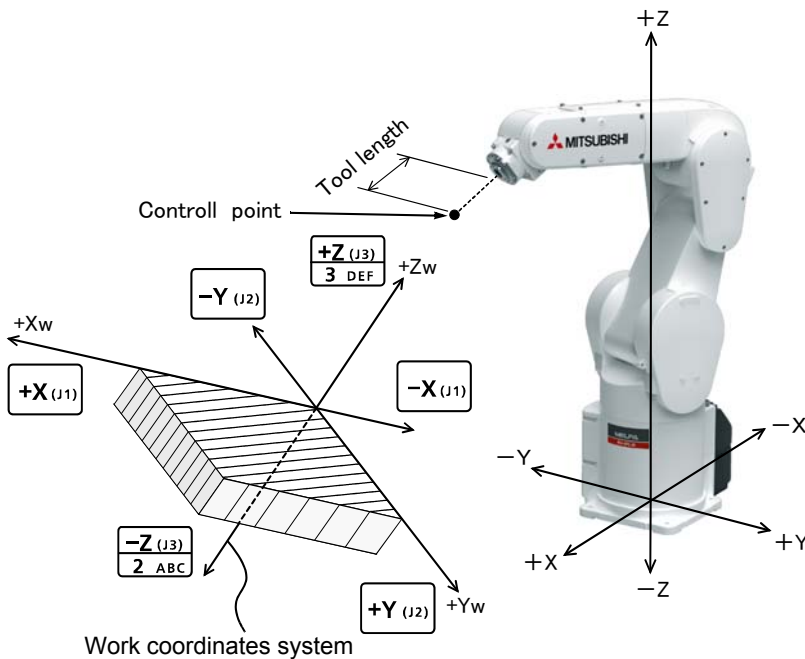
* The direction of the flange will not change. Move the control point with a straight line in accordance with the work coordinates system

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

Changing the flange surface posture
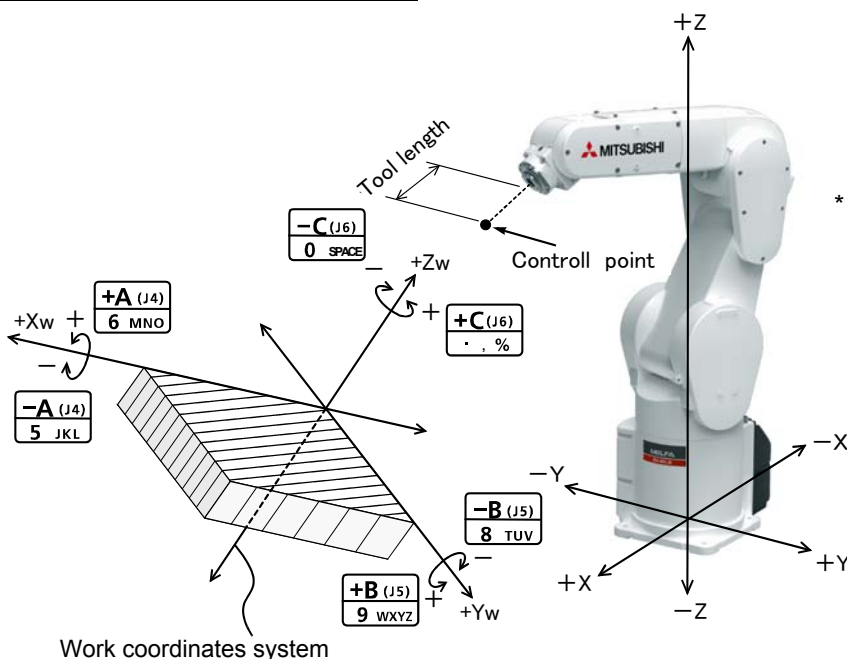
* The position of the control point does not change. Change the direction of the flange in accordance with the work coordinates system.

・When the[+A (J4)] keys are pressed, The X axis will rotate in the plus direction of the work coordinate system.
  When the[−A (J4)] keys are pressed, Rotate in the minus direction.
・When the[+B (J5)] keys are pressed, The Y axis will rotate in the plus direction of the work coordinate system.
  When the[−B (J5)] keys are pressed, Rotate in the minus direction.
・When the[+C (J6)] keys are pressed, The Z axis will rotate in the plus direction of the work coordinate system.
  When the[−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇
There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 30, ″(1) JOINT jog operation″″, and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

3 Installing the option devices

3.1 Installing the J1 axis operating range change

The configuration, changeable angle and installation outline of J1 axis operating range change are shown below.
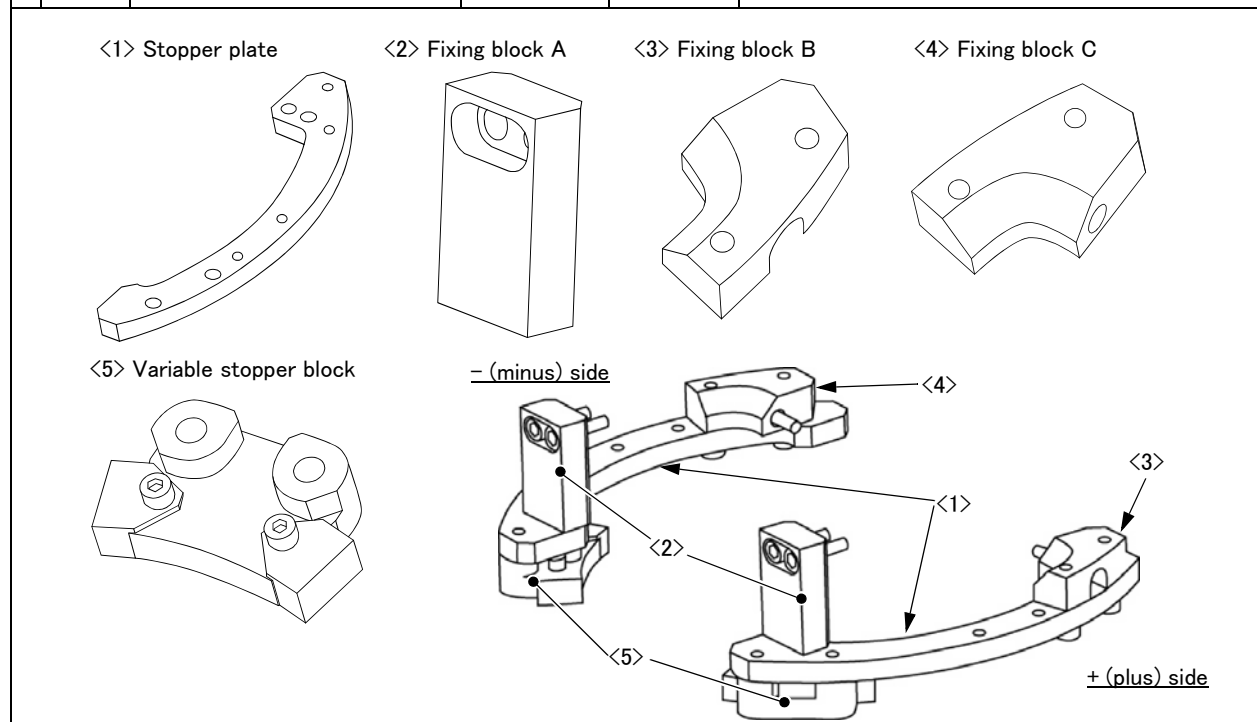
3.1.1 RV-4F/7F series (RV-4F : 1F-DH-03、RV-7F : 1F-DH-04)
(1) Configuration

The configuration parts of this option are shown in Table 3-4. Please confirm.

Table 3-1 : Configuration devices

No.		Part name	Qty.	Mass (kg)	Remarks
RV-4F series					
	⟨1⟩	Stopper plate	2		One piece each for + side/− side
	⟨2⟩	Fixing block A	2		One piece each for + side/− side
	⟨3⟩	Fixing block B	1		+ side
	⟨4⟩	Fixing block C	1		− side
	⟨5⟩	Variable stopper block	2	1.1	One piece each for + side/− side
	⟨6⟩	Screw (M10x20)	2		Use for mechanical stopper screw A and B
	⟨7⟩	Screw (M6x25)	2		For fixing
	⟨8⟩	Screw (M6x20)	16		For fixing
RV-7F series					
	⟨1⟩	Stopper plate	2		One piece each for + side/− side
	⟨2⟩	Fixing block A	2		One piece each for + side/− side
	⟨3⟩	Fixing block B	1		+ side
	⟨4⟩	Fixing block C	1		− side
	⟨5⟩	Variable stopper block	2	1.1	One piece each for + side/− side
	⟨6⟩	Screw (M12x25)	2		Use for mechanical stopper screw A and B
	⟨7⟩	Screw (M8x25)	14		For fixing
	⟨8⟩	Screw (M8x20)	4		For fixing

⟨1⟩ Stopper plate　　　⟨2⟩ Fixing block A　　　⟨3⟩ Fixing block B　　　⟨4⟩ Fixing block C

⟨5⟩ Variable stopper block

− (minus) side

⟨4⟩

⟨3⟩

⟨1⟩

⟨2⟩

⟨5⟩

+ (plus) side

(2) Changeable angle

The changeable angle of RV-4F series is shown in Table 3-2, and of RV-7F series is shown in Table 3-3. Use as reference for the installation position of Variable stopper block to the wished angle and use/disuse of the Mechanical stopper screw A/B and the parameter setup value.

Table 3-2 : Changeable angle (RV-4F series)

Item	Standard	Changeable angle (combination of + side/- side) (Unit: Degree)			
+ (plus) side	+240	+30	+73	+103	+146
Variable stopper block angle	-	+33	+76	+106	+149
Variable stopper block position Note1)	-	(a)	(b)	(a)	(b)
Mechanical stopper screw A Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	+240	+30	+73	+103	+146
+ (minus) side	-240	-30	-73	-103	-146
Variable stopper block angle	-	-33	-76	-106	-149
Variable stopper block position Note1)	-	(d)	(c)	(d)	(c)
Mechanical stopper screw B Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	-240	-30	-73	-103	-146

Note1)Symbol: "(a)" - "(d)" in the Table 3-2 is related with the symbol of "Fig. 3-1: Installation image of J1axis operating range change option".
Note2)In the table, it means that "Disuse" does not install the screw, and "Use" does install the screw.
Note3)Mechanical stopper screw which is either one of the two is always necessary. For this reason, the combination enclosed by the thick line of the square in the table (both of + (plus) side and - (minus) side are 103 or 146) cannot be used.
Example) Setting + 146 degree and -103 degree simultaneously cannot be used. The other combination can be set up.

Table 3-3 : Changeable angle (RV-7F series)

Item	Standard	Changeable angle (combination of + side/- side) (Unit: Degree)			
+ (plus) side	+240	+35	+77	+99	+141
Variable stopper block angle	-	+38	+80	+102	+144
Variable stopper block position Note1)	-	(a)	(b)	(a)	(b)
Mechanical stopper screw A Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	+240	+35	+77	+99	+141
+ (minus) side	-240	-35	-77	-99	-141
Variable stopper block angle	-	-38	-80	-102	-144
Variable stopper block position Note1)	-	(d)	(c)	(d)	(c)
Mechanical stopper screw B Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	-240	-35	-77	-99	-141

Note1)Symbol: "(a)" - "(d)" in the Table 3-3 is related with the symbol of "Fig. 3-1: Installation image of J1axis operating range change option".
Note2)In the table, it means that "Disuse" does not install the screw, and "Use" does install the screw.
Note3)Mechanical stopper screw which is either one of the two is always necessary. For this reason, the combination enclosed by the thick line of the square in the table (both of + (plus) side and - (minus) side are 99 or 141) cannot be used.
Example) Setting + 146 degree and -103 degree simultaneously cannot be used. The other combination can be set up.

The installation procedure of the J1 axis operating range change is shown below.

When installing this option to the minus side, should move the J1 axis to the +70 degrees using jog operation previously, and do this work.

[Note] When installing this option for safety, you should cut off the power supply of the controller.

Surely fix the screw of M6 by 15.7Nm, and the screw of M10 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot. Although the following shows the procedure installed to +(plus) side, −(minus) side is the same also.
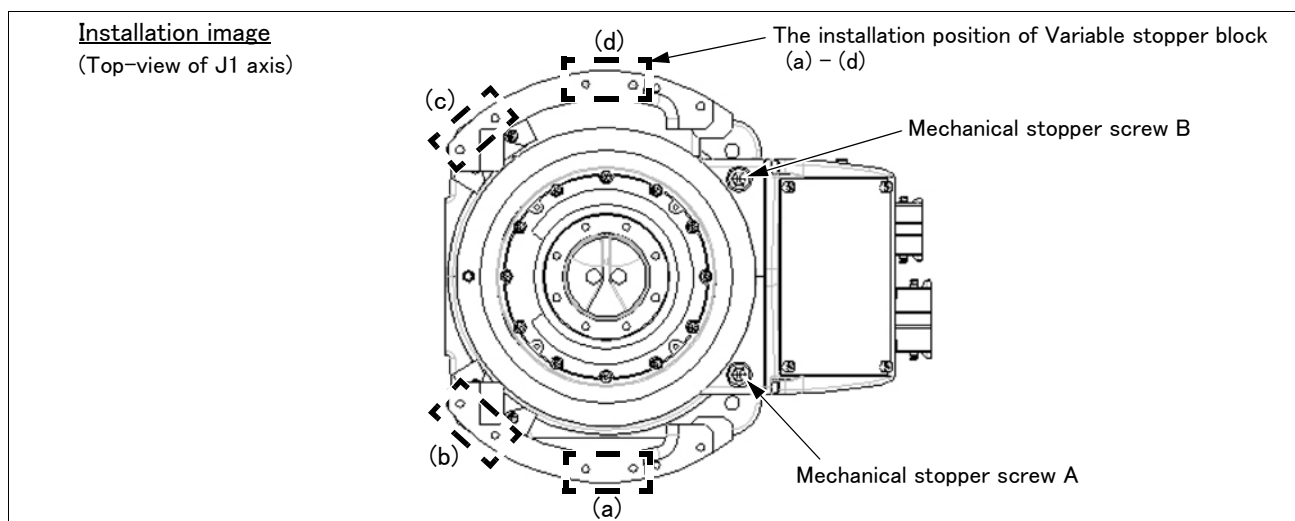

Fig.3-1 : Installation image of J1axis operating range change option

[Example] In the RV-7F series, when limiting the +side to +35 degree, and the −side to −141 degree, install as following.

Variable stopper block: Installs in the position of (a), and the position of (c).
Mechanical stopper screw A: Install.
Mechanical stopper screw B: Do not install.

(3) Installation procedure

The installation procedure of the J1 axis operating range change is shown below.

When installing this option to the minus side, should move the J1 axis to the +70 degrees using jog operation previously, and do this work.

⚠ **CAUTION**   When installing this option for safety, you should cut off the power supply of the controller.
Surely fix the screw of M6 by 15.7Nm, and the screw of M10 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot.
Although the following shows the procedure installed to +(plus) side, −(minus) side is the same also.

1) Fix the Fixing block A <2> and the Fixing block B <3> to the robot arm as temporary.
   Fix the Fixing block A <2> by using the two screws <8>, and fix the Fixing block B <3> by using a screw <7>.


<2> Fixing block A   <3> Fixing block B
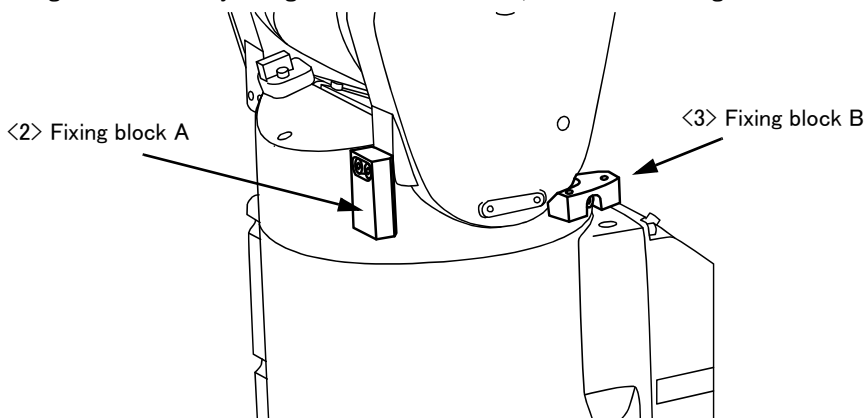
2) Install the Stopper plate <1>. Install by using each two screws (RV-4F: screw <8>, RV-7F: screw <7>), adjusting the combination position of the Fixing block A <2> and the Fixing block B <3>. Finally fix <1>,<2>,<3> securely.

<2> Fixing block A   <3> Fixing block B

<1> Stopper plate
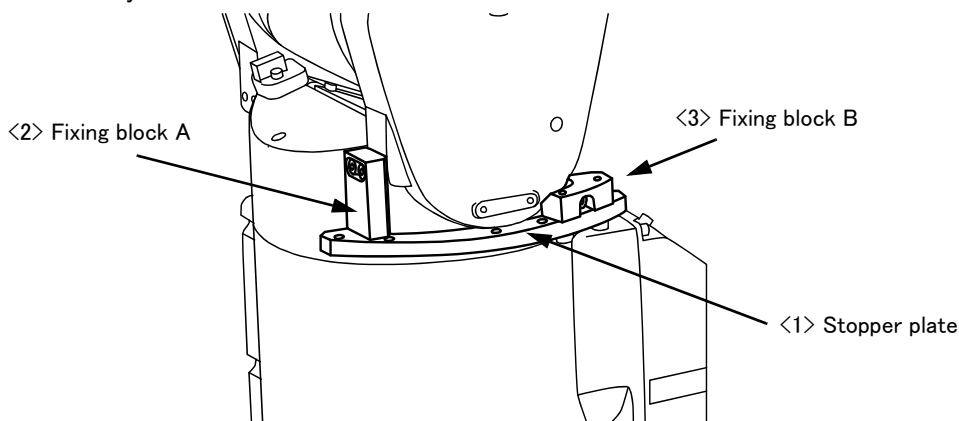
3) Install the Variable stopper block <5> by using two screws (RV-4F: screw <8>, RV-7F: screw <7>). There are two installation positions in the +/- side respectively. Install to the position of the angle which limits the operating range with referring to Table 3-2 and Table 3-3.
Install the minus side in the same way. Move the J1 axis to the +70 degrees using jog operation previously, and install. (Turn on the power supply and move the J1 axis by jog operation) After installation, turn on the power supply and move the J1 axis to the 0 degree by jog operation.

<5> Variable stopper block
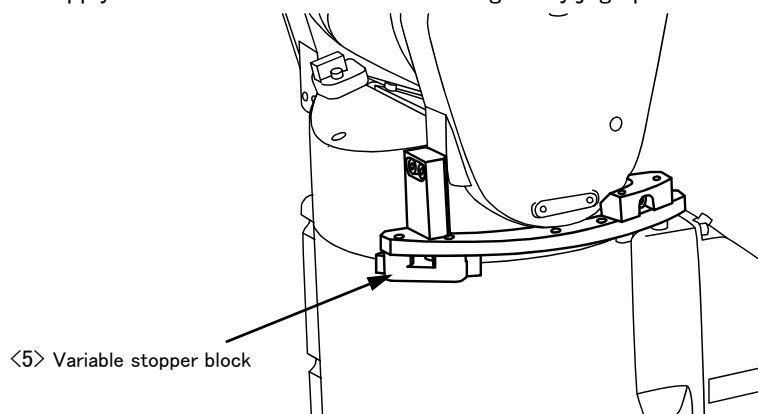
4) Install the Mechanical stopper screw A or B. Install the necessary screw with referring to Table 3-2 and Table 3-3.
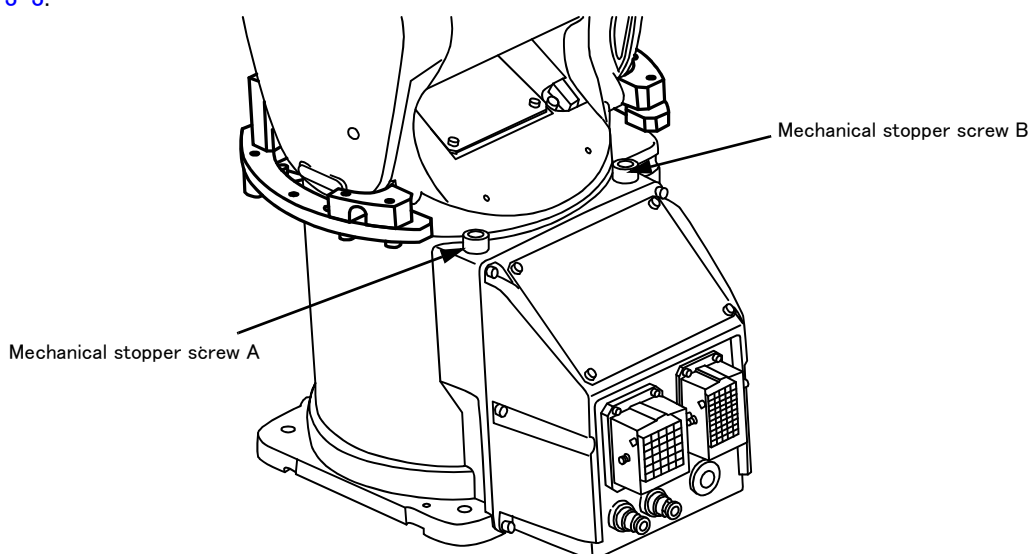
Mechanical stopper screw B

Mechanical stopper screw A

(4) Setting the parameter
Specify the operating range to parameters MEJAR with appropriate values (variable angles given in Table 3-2 or Table 3-3) by the following steps.
1) Turn on the power supply.
2) Set up the operating range changed into parameter MEJAR.
MEJAR: (J1 minus (-) side, J1 plus (+) side, ***, ***, ***, …).

Note) Refer to the separate "Instruction manual/Detailed Explanation of Functions and Operations"" for the details of the setting method.

(5) Check the operating range
After changing the parameter, turn off the controller power and turn on again. And, move the axis changed by joint jog operation to the limit of the operating range. Confirm that the robot stops by limit over at the changed angle.

This completes the procedure to change the operating range.
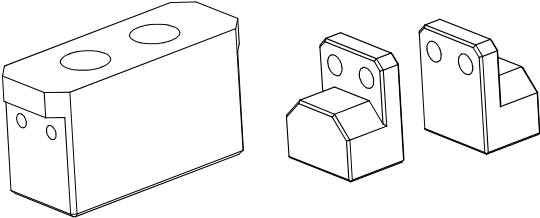
3.1.2 RV-13F series (1F-DH-05J1)

(1) Configuration

The configuration parts of this option are shown in Table 3-4. Please confirm.

Table 3-4 : Configuration devices

No.	Part name	Qty.	Mass (kg)	Remarks
<1>	Stopper Block J1	1		
<2>	Resin Stopper B	2		One piece each for + side/- side
<3>	Screw (M12×20)	2	0.3	Mechanical Stopper screw
<4>	Screw (M10×40)	2		For Stopper Block J1 fixing
<5>	Screw (M4×12)	4		For Resin Stopper B fixing

<1>Stopper Block J1   <2>Resin Stopper B

(2) Changeable

The changeable angle of RV-13F series is shown in Table 3-5. Use as reference for the installation position of Mechanical Stopper screw and the parameter setup value.

Table 3-5 : Changeable angle (RV-13F series)

Item	Standard	Changeable angle	
+ (plus) side	+190	+30	+120
Mechanical Stopper screw position Note1)	–	(A)	(B)
Mechanical Stopper position	+193	+32.5	+122.5
Parameter (MEJAR) setting value	+190	+30	+120
+ (minus) side	−190	−30	−120
Mechanical Stopper screw positionNote1)	–	(D)	(C)
Mechanical Stopper position	−193	−32.5	−122.5
Parameter (MEJAR) setting value	−190	−30	−120

Note1)Symbol: "(A)" – "(D)" in the Table 3-5 is related with the symbol of "Fig. 3-2: Installation image of J1axis operating range change option (RV-13F series)".

The installation procedure of the J1 axis operating range change is shown below.

[Note] When installing this option for safety, you should cut off the power supply of the controller. Surely fix the screw of M4 by 15.7Nm, and the screw of M10 by 26.5Nm, and the screw of M12 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot.
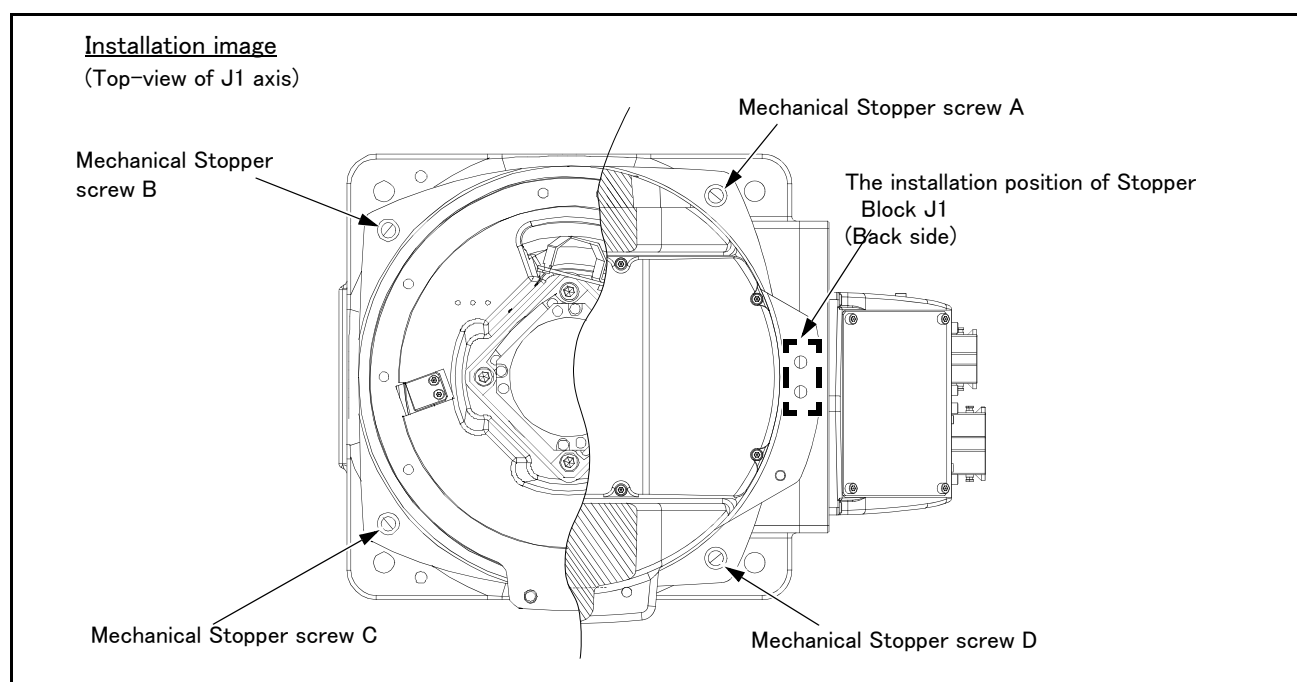

Installation image
(Top-view of J1 axis)

Mechanical Stopper screw A

The installation position of Stopper Block J1 (Back side)

Mechanical Stopper screw B

Mechanical Stopper screw C

Mechanical Stopper screw D

Fig.3-2 : Installation image of J1axis operating range change option (RV-13F series)

[Example] In the RV-13F series, when limiting + side to +32.5 degree and − side to −122.5 degree, install the Mechanical Stopper screw in the position of (A) and (C).

(3) Installation procedure

The installation procedure of the J1 axis operating range change is shown below.

[Note] Previously, move the J1 axis to the position of the +90 degrees or the −90 degrees by jog operation.

⚠ **CAUTION** When installing this option for safety, you should cut off the power supply of the controller.

Surely fix the screw of M4 by 15.7Nm, and the screw of M10 by 26.5Nm, and the screw of M12 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot.

Although the following shows the procedure installed to +(plus) side, −(minus) side is the same also.

1) Install <2> Resin Stopper B (two pieces) to the both sides of <1> Stopper Block J1 in with the two attached <5> screws, and fix securely.
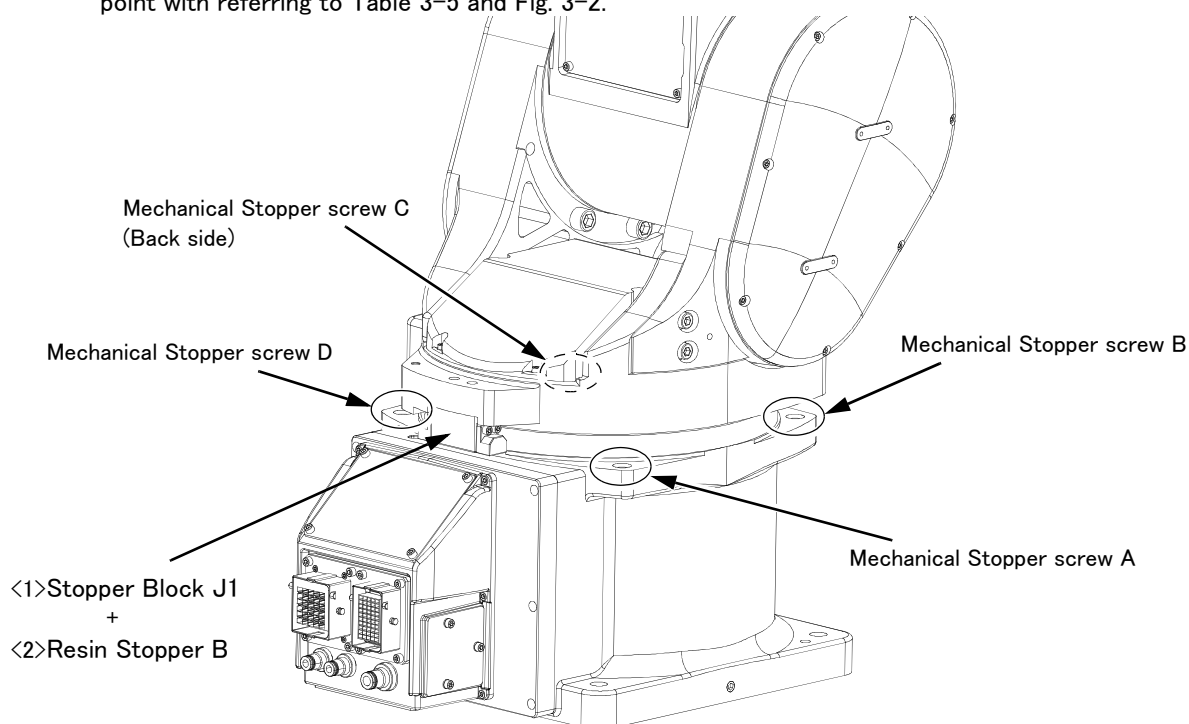

<1> Stopper Block J1

<5> Two screws

<5> Two screws
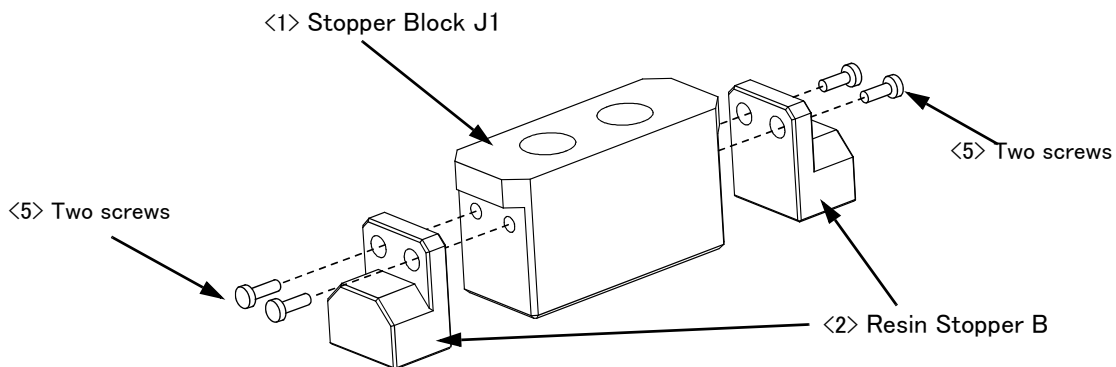
<2> Resin Stopper B

2) Install <1> Stopper Block J1 which combined with <2> Resin Stopper B to behind the J1 axis of robot arm by <4> two attached screws.

J1 axis of robot arm

<1>Stopper Block J1
+
<2>Resin Stopper B
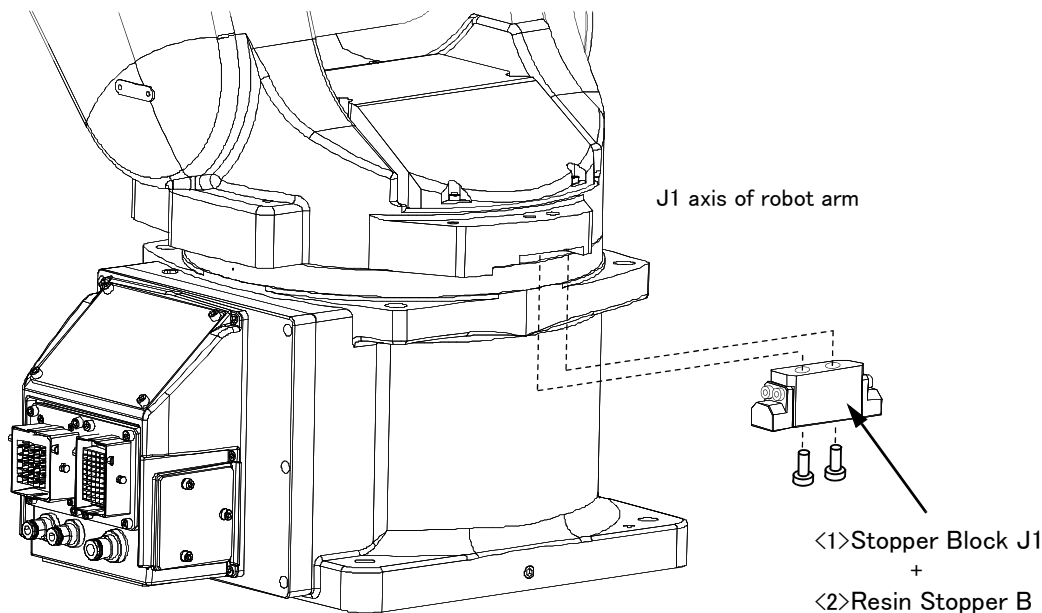
3) Because to install the Mechanical Stopper screw, once move the J1 axis to the position of 0 degree. Turn on the power supply and move the J1 axis by jog operation.

<1>Stopper Block J1
+
<2>Resin Stopper B
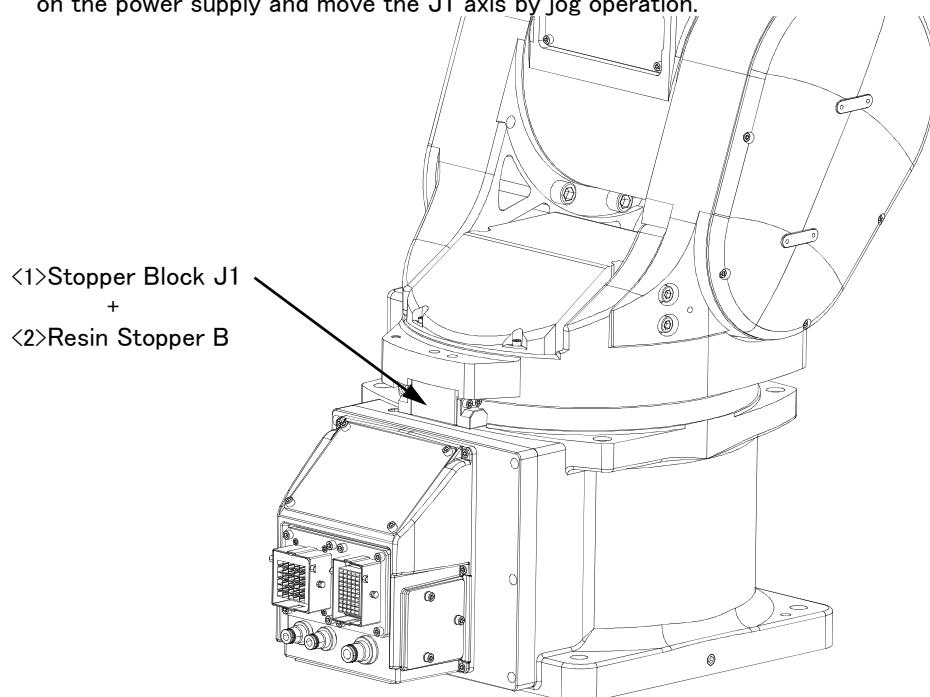
4) Install the <3> Mechanical Stopper screw. Install the <3> attached Mechanical Stopper screw to the needed point with referring to Table 3-5 and Fig. 3-2.

Mechanical Stopper screw C
(Back side)

Mechanical Stopper screw D

Mechanical Stopper screw B

Mechanical Stopper screw A

<1>Stopper Block J1
+
<2>Resin Stopper B

(4) Setting the parameter

Specify the operating range to parameters MEJAR with appropriate values (variable angles given in Table 3-5) by the following steps.

1) Turn on the power supply.
2) Set up the operating range changed into parameter MEJAR.
   MEJAR: (J1 minus (−) side, J1 plus (+) side, ***, ***, ***, …).

Note) Refer to the separate "Instruction manual/Detailed Explanation of Functions and Operations"" for the details of the setting method.

(5) Check the operating range

After changing the parameter, turn off the controller power and turn on again. And, move the axis changed by joint jog operation to the limit of the operating range. Confirm that the robot stops by limit over at the changed angle.

This completes the procedure to change the operating range.

3.2 Installing the solenoid valve set

As shown in Fig. 3-3, install the solenoid valve set on the forearm.

Note) Although the robot's figure described to each page is RV-4F series, the method is the same on other robot series.

Solenoid valve set

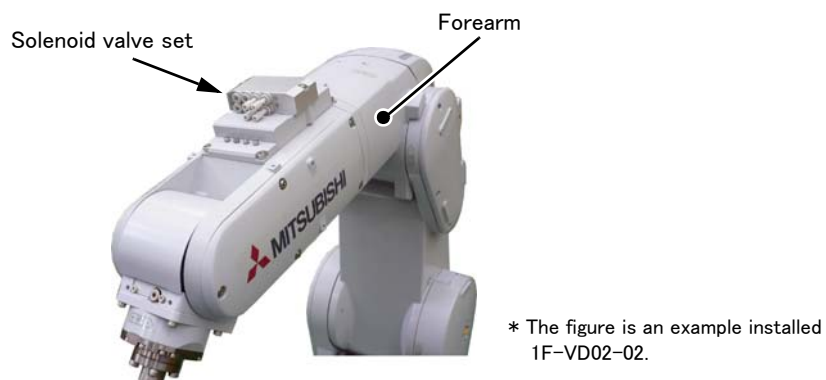Forearm

＊ The figure is an example installed 1F-VD02-02.

Fig.3-3 : The installation image of the solenoid valve set

The installation procedure of solenoid valve is shown below.
Turn the controller's power OFF before this installing operation.
When using the robot which has no Internal wiring and piping (standard type), do from procedure of the "3)".
(removing the No.2 arm cover)

1) Removes the plug and installs the coupling. (When your robot is the internal wiring and piping specification)
Remove the plug of the position to use as shown in the figure. Install the attached coupling for front side (φ4 front side) in the screw hole which removed the plug. Turn the solenoid valve set over and install the back side coupling in the same way.

1F-VD0∗-02/1F-VD0∗E-02   1F-VD0∗-03/1F-VD0∗E-03
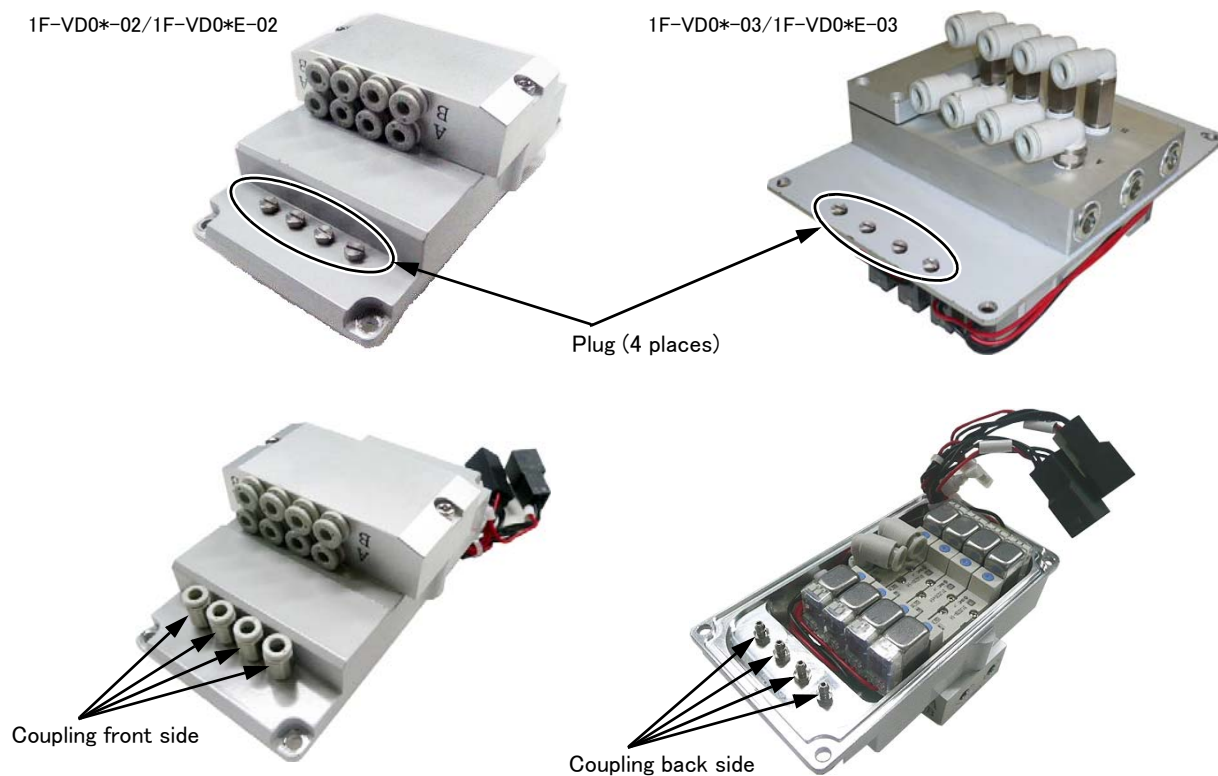
Plug (4 places)

Coupling front side

＊ Although the figure is 1F-VD0∗-02/1F-VD0∗E-02,
and 1F-DV0∗-03/1F-VD0∗E-03 are also the same.

Coupling back side

＊ Although the figure is 1F-VD0∗-02/1F-VD0∗E-02,
and 1F-DV0∗-03/1F-VD0∗E-03 are also the same.

2) Installs the air hose.
   Connects the A/B port of solenoid valve to use and the coupling on the front side installed by above-mentioned "1)" by air hoses.
   When using the 1F-VD0*-03/1F-VD0*E-03 type solenoid valve, first, install attached conversion couplings (φ6 to φ4) to port A/B on the solenoid valve. And then, connect the air hose.

Install attached conversion coupling (φ6 to φ4) before connecting the air hose.

* The figure is an example which connected the first and second solenoid valve. (1F-DV*-02)
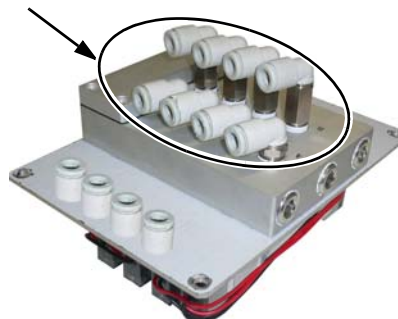
1F-VD0*-03/1F-VD0*E-03

3) Loosen the four fixing screws of No.2 arm cover U (forearm upside) and remove the cover. (Mounts the solenoid-valve set instead of the removed cover) The connectors (GR1, GR2) and air hoses (AIR IN, RETURN) connected to the solenoid-valve set inside the cover.

No.2 arm cover U

Air hose: AIR IN (white hose)   Air hose: RETURN (black hose)

Connectors:
GR1, GR2

4) Connects the air hoses and the connectors.
   a) Connects the hand output cable inside the forearm (GR1 and GR2) to the connectors of the solenoid-valve set. Connect with the same names.
     Note) In the solenoid-valve set of one set or two sets, connects only connector GR1.
   b) The two air hoses equipped inside the forearm, connects AIR IN (white) to "P" port coupling of the solenoid-valve set, and connects RETURN (black) to "R" port coupling of the solenoid-valve set. The AIR IN (white) air hose is connected with the AIR IN coupling of the robot arm base rear, and the RETURN (black) air hose is connected with the RETURN coupling.

⚠ CAUTION   Because the long length air hoses are equipped, please cut and connect it to the suitable length. If that is not right, the air hose breaks within the arm and it becomes the cause that the solenoid valve operation is abnormal.

⚠ CAUTION   When connecting the RETURN air hose, be sure to remove the dust cap attached at the RETURN coupling on the robot base section. If the cap is not removed, exhaust air pressure will increase and the solenoid valve may not operate properly. By connecting the exhaust air hose (ϕ6: customer preparation) to this RETURN air coupling, exhaust air from the solenoid valve is able to escape to the designated point.
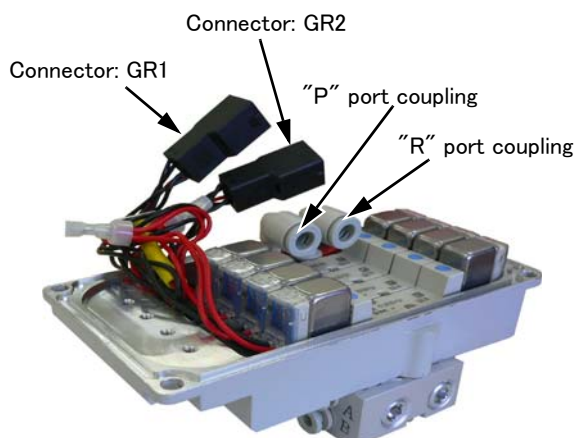
* The figure is an example of 1F-VD04-02.
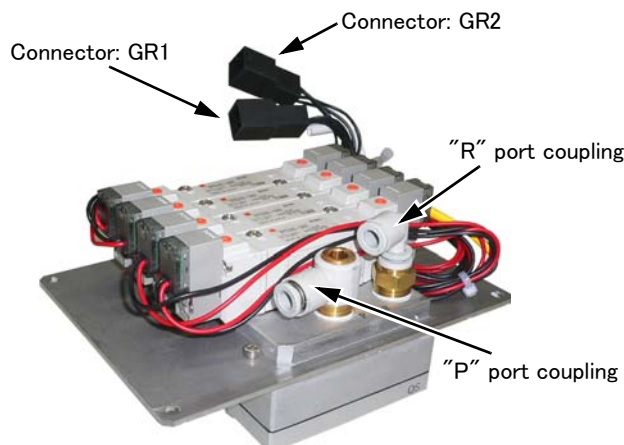
* The figure is an example of 1F-VD04-03.

The image after the connection

* The figure is the example of 1F-VD02-02.

c) When your robot is the Internal wiring and piping specification, connect the piping inside the wrist.
Cuts the air hose inside of the wrist to suitable length, and connect to the coupling on the back side of solenoid valve set. The number indicated on the air hoses inside of the wrist is same as the air hoses pulled out of the mechanical interface, so make it the reference at the piping to the tool.

Air hose inside of the wrist
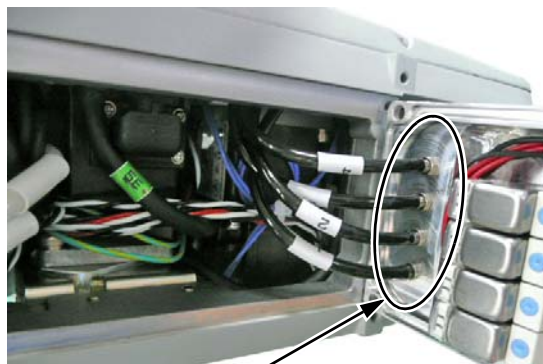
Connect to the coupling

5) Installs the solenoid valve set on the forearm upside.
Installs the solenoid valve set instead of the No.2 arm cover U removed above.

⚠ CAUTION   When you install the solenoid valve set, be careful to not put the cable and air hose between the cover and arm and do not break the air hose.
If the cable is inserted, it will become the cause that the cable be broken. And, if the air hose is put or it breaks, it becomes the cause that the solenoid valve operation is abnormal.

Confirms having inserted neither the cable nor the air hose and that the air hose has not broken, and fix the No.2 arm cover U securely by the original fixing screws. Confirms that the air hose has not broken by removing the No.2 arm cover L. Specially, confirms that it has been the course as shown in the figure, without the air hose breaking.

A

Solenoid valve set

Forearm

No.2 arm cover L

MITSUBISHI
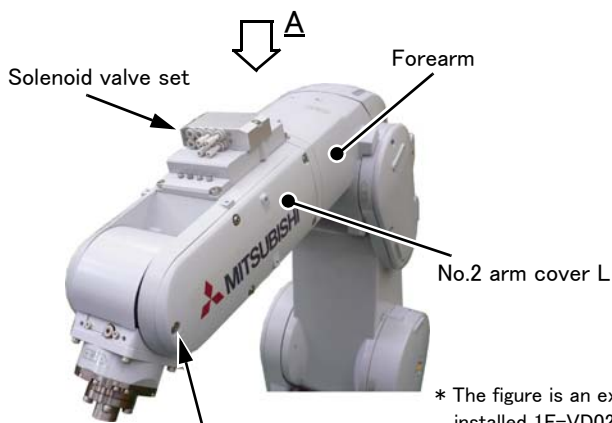
No.2 arm cover fixing screws
M4 x 12 (five screws.)

＊ The figure is an example
installed 1F-VD02-02.

Connector storage position
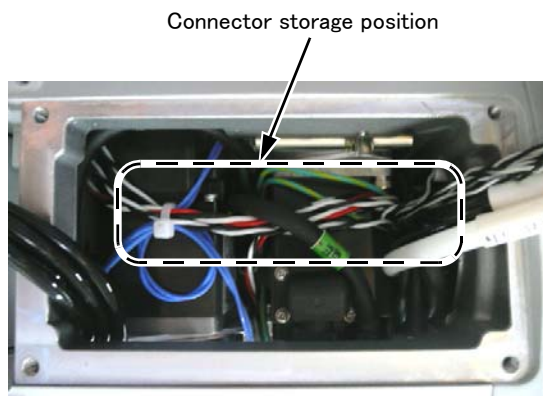
View A

6) Connect the tool prepared by the customer with solenoid valve port A and B.
Please refer to Table 3-6 and connect to the necessary ports. Covers the unused solenoid valve coupling with the plugs included.

Table 3-6 : Solenoid valve ports and hand number

Hand	Hand condition	Coupling number	The solenoid valve set in use
Hand 1	OPEN	1	One set
	CLOSE	2	
Hand 2	OPEN	3	Two sets
	CLOSE	4	
Hand 3	OPEN	5	Three sets
	CLOSE	6	
Hand 4	OPEN	7	Four sets
	CLOSE	8	

1F-VD0*-02
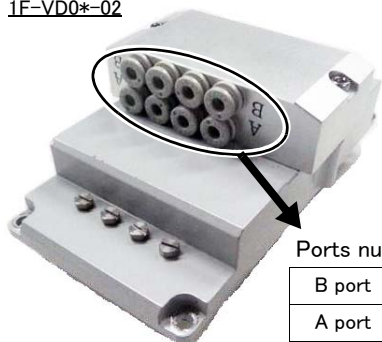
Ports number

B port	2	4	6	8
A port	1	3	5	7

1F-VD0*-03
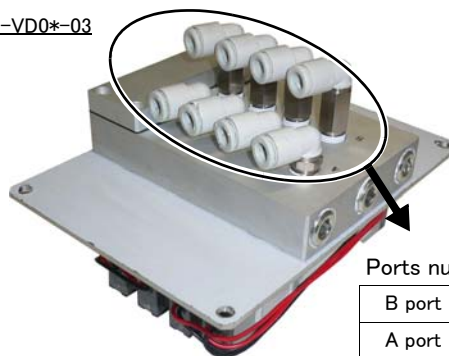
Ports number

B port	2	4	6	8
A port	1	3	5	7

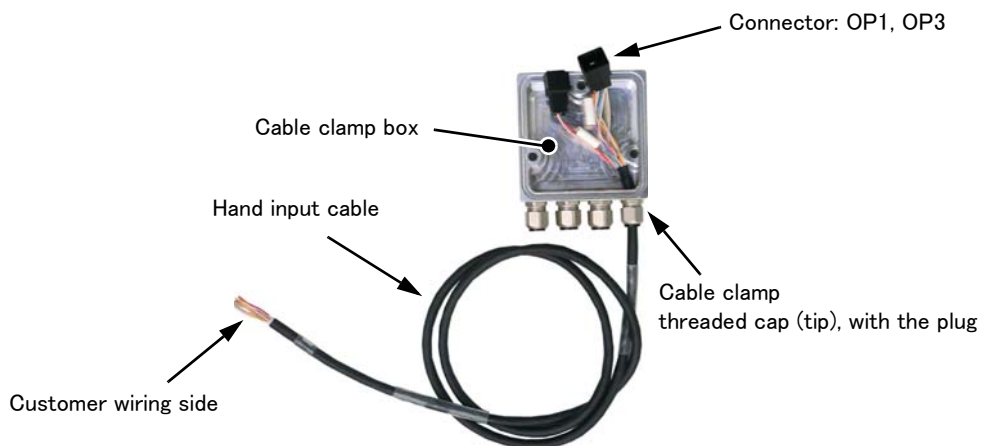## 3.3 Installing the hand input cable

The installation procedure of the hand input cable is shown below. Turn the controller's power OFF before this installing operation.

Note) Although the robot's figure described to each page is RV-4F series, the method is the same on other robot series.

1) Loosen the fixing screws (three M4x16 screws) of cable clamp box (under forearm) and remove the cover. Becomes easy to do work by reversing the J4 axis by jog operation previously.
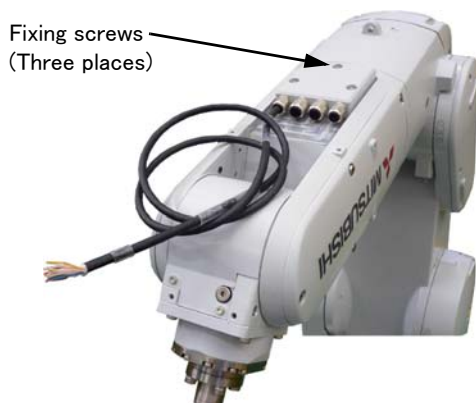
Cable clamp box
(under forearm)

Fixing screws (Three places)
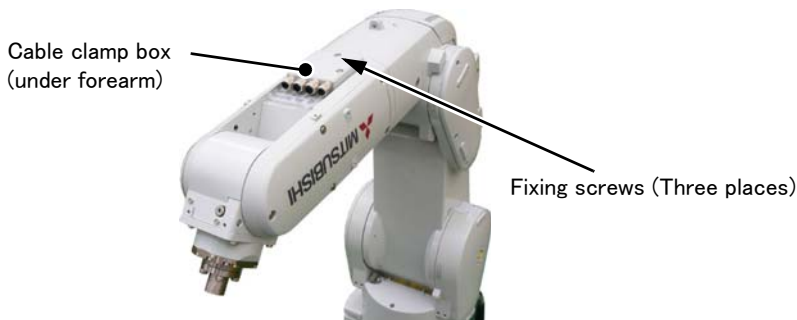
2) Feed and fix the optional hand input cable through the inside of cable clamp mounted on the cable clamp box. Uses either one in the cable clamp of both ends.
a) Loosens the threaded cap of the cable clamp and removes the plug. Use either one place of both ends.
b) Pass the customer wiring side of cable from inner side. Pass the cable with little by little, and fix the cable securely by tightening the threaded cap as shown in the following figure.

Connector: OP1, OP3

Cable clamp box

Hand input cable

Cable clamp
threaded cap (tip), with the plug

Customer wiring side

3) Connects the connector inside the forearm (OP1 and OP3) to the connector of the hand input cable. Connect with the same names.
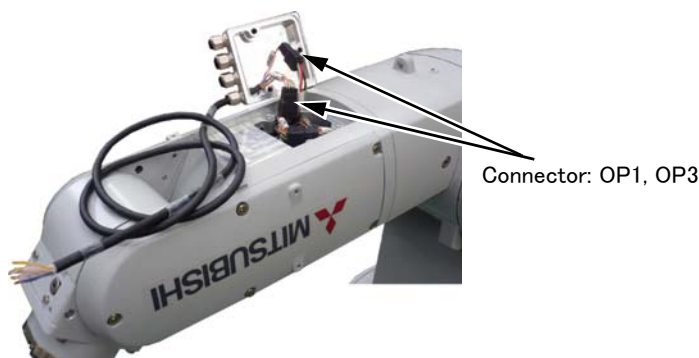
Connector: OP1, OP3

4) Fixes the cable clamp box securely by the fixing screws as before. Installs carefully so that the cable may not be inserted.

Fixing screws
(Three places)

⚠ CAUTION When you install the cable clamp box, be careful to not put the cable between the cable clamp box and arm. If the cable is inserted, it will become the cause that the cable be broken.

⚠ CAUTION When this cable is connected to the robot the power supply is applied to the end of this cable. The end of the cable is free at factory shipping. so, if the tool side is not connected it may be cause of the trouble such as broken the fuse by short circuit. Before connecting to the robot, customer should check whether or not the cable tip has been properly treated.

This completes installing the cable clamp box. Pin assign of the hand input cable is shown in Table 3-7.

Table 3-7 : Pin assign of hand input cable

Color	Connector Note1)	Pin number: names	Color	Connector Note1)	Pin number: names
Purple	OP1	A1: HC1	Yellow	OP2	A1: +24V
Brown		A2: HC2	Green		A2: +24G (RG)
Blue		A3: HC3	* Reserved		B1: +24V
Black		A4: HC4	* Reserved		B2: +24G (RG)
Red		B1: HC5			
White		B2: HC6			
Gray		B3: HC7			
Pink		B4: HC8			

Note1)The connector shows the connector name connected to the robot-arm side.

3.4 Installing the hand output cable

As shown in Fig. 3-4, connects with connector GR1 and GR2 inside the forearm, and pulls out the hand output cable from the cable clamp box at the forearm lower part.

Note）・When installing the hand output cable for the safety, turn OFF the power supply of the controller.
The cable clamp box in Fig. 3-4 shows the example of four-clamps type.
・Although the robot's figure described to each page is RV-4F series, the method is the same on other robot series.

Cable clamp box
(under forearm)

Forearm

Hand output cable

＊ The figure is the example to which the J4 axis was
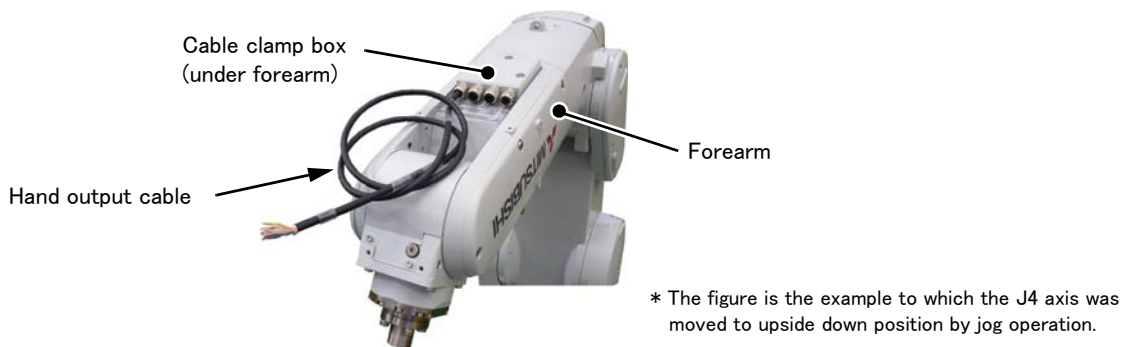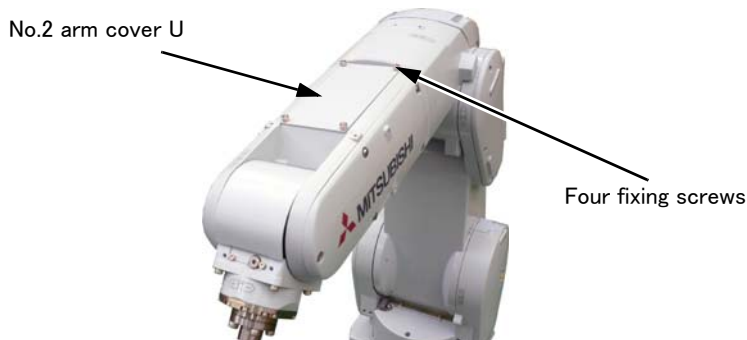moved to upside down position by jog operation.

Fig.3-4 : Image which pulled out hand output cable

The installation procedure of the hand output cable is shown below. Turn the controller's power OFF before this installing operation.

1) Loosen the fixing screws (four M4x12 screws) of No.2 arm cover U and remove the cover.

No.2 arm cover U

Four fixing screws

2) Loosen the fixing screws (three M4x16 screws) of cable clamp box (under forearm) and remove it. Becomes easy to do work by moving the J4 axis to upside down position by the jog operation. (pose of following figure)
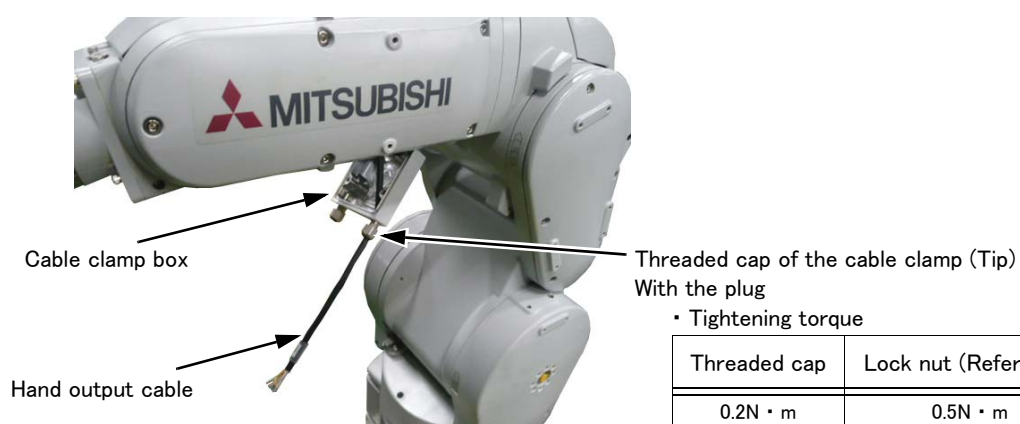
Cable clamp box
(under forearm)

Three fixing screws
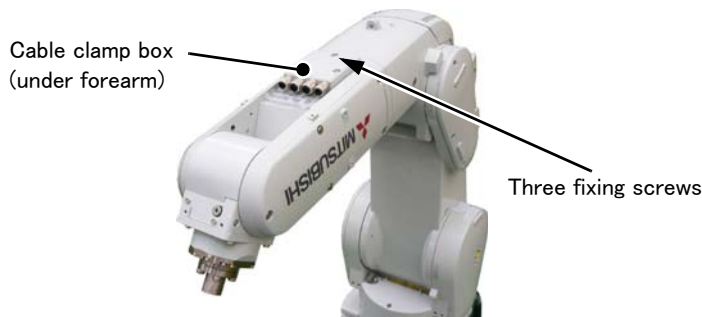
3) Feed the hand output cable through to the cable clamp box side from No.2 arm cover U side inside the arm. When the cable inside the No.2 arm cover U is pulled out, it will become easy. Feed the hand output cable through between the motors. (ellipse position of following figure)

Hand output cable

Motor

Feeds through between the motors.

4) Connects the connector inside the forearm (GR1 and GR2) to the connector of the hand output cable. Connect with the same names.

Hand output cable

Connector: GR1, GR2

5) Feed the hand output cable through the cable clamp box.
Loosens the threaded cap of the cable clamp and removes the plug of the cable clamp box. (Tip) Pass the cable with little by little, and pulls out the needed length, and fix the cable securely by tightening the threaded cap.
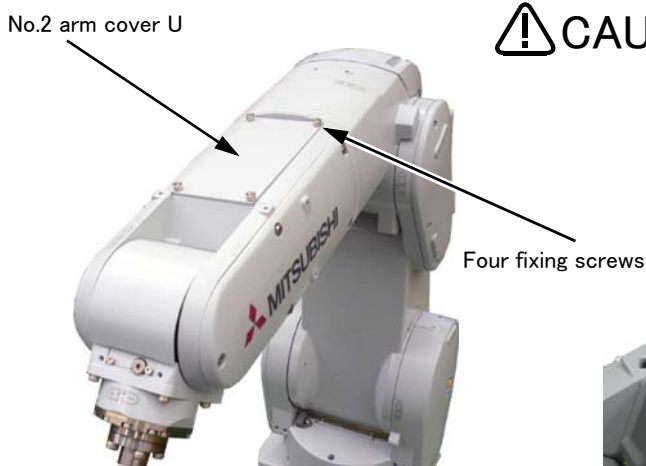
Cable clamp box

Hand output cable

Threaded cap of the cable clamp (Tip)
With the plug
・Tightening torque

Threaded cap	Lock nut (Reference)
0.2N・m	0.5N・m

6) Fixes the cable clamp box securely by the fixing screws as before. Installs carefully so that the cable may not be inserted.

Fixing screws
(Three places)
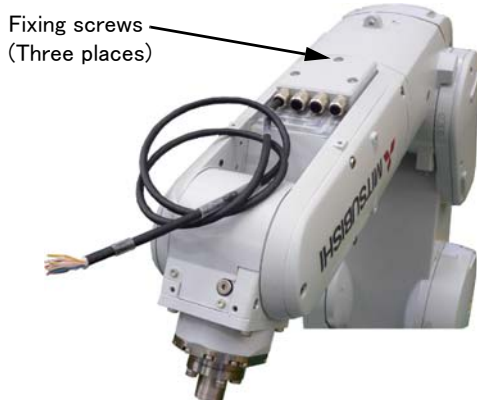
⚠CAUTION When you install the cable clamp box, be careful to not put the cable between the cable clamp box and arm. If the cable is inserted, it will become the cause that the cable be broken.

7) Fixes the No.2 arm cover U securely by the fixing screws as before. Installs carefully so that the cable may not be inserted.

No.2 arm cover U

⚠CAUTION When you install the No.2 arm cover U, be careful to not put the cable between the cable clamp box and arm. If the cable is inserted, it will become the cause that the cable be broken.

Four fixing screws

The condition of storing the cable inside the No.2 arm cover U

This completes installing the cable clamp box. Pin assign of the hand output cable is shown in Table 3-8.

Table 3-8 : Pin assign of hand output cable

Color	Connector	Pin number: names	Color	Connector	Pin number: names
Yellow		A1: +24V	Green		A1: +24V
–		A2: Reserved	–		A2: Reserved
Purple		A3: GR1 (Hand output 1)	Red		A3: GR5 (Hand output 5)
Brown	GR1	A4: GR2 (Hand output 2)	White	GR2	A4: GR6 (Hand output 6)
Blue		B1: GR3 (Hand output 3)	Gray		B1: GR7 (Hand output 7)
Black		B2: GR4 (Hand output 4)	Pink		B2: GR8 (Hand output 8)
–		B3: Reserved	–		B3: Reserved
–		B4: Reserved	–		B4: Reserved

3.5 Installing the Forearm external wiring set/ Base external wiring set

The installation procedure of Forearm external wiring set/ Base external wiring set is shown below. To pull out the cable of the same purpose as the forearm side and the base side, you should use this option in pair. Turn the controller's power OFF before this installing operation. Refer to Page 76, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

Note) Although the robot's figure described to each page is RV-4F series, the method is the same on other robot series.

(1) Installing the Forearm external wiring set

The installation summary of the Forearm external wiring set is shown in Fig. 3-5. Mounts this option instead of the removed cable clamp box. Becomes easy to do work by reversing the J4 axis by jog operation previously.

1) Loosen the fixing screws (three M4x16 screws) of cable clamp box (under forearm) and remove the box.
2) Connects the connector of robot arm side inside the forearm to the connector of Forearm external wiring set. Connect with the same names, and keep it into the forearm. The connector to connect is shown in Table 3-9.
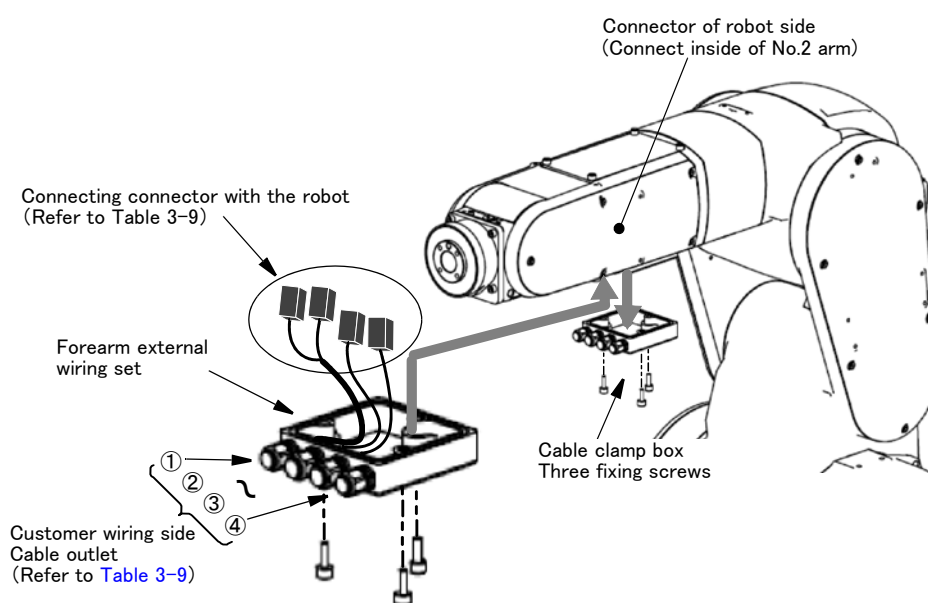

Fig.3-5 : Installing the Forearm external wiring set

Table 3-9 : Cable to pull out and robot side connection connector

Forearm external wiring set	Cable to pull out			Robot side connection connector
	Outlet	Name	Purpose of use	
1F-HB01S-01	①	HC	Hand input cable Note1)	OP1, OP3
	②	LAN	Vision sensor controller	LAN
	③		Reserved	
	④	E・F1	Force sensor	OP4, OP2
1F-HB02S-01	①		Reserved	
	②	LAN	Vision sensor controller	LAN
	③	E・F1	Reserved	OP1, OP3
	④	E・F2	Force sensor	OP4, OP2

Note1) Although the connector is attached to the customer wiring side of the hand input cable, it can use by cutting. Pin assign of the hand input cable is shown in Table 3-10.

3) Install Forearm external wiring set on the position where cable clamp box was being installed, by using original three fixing screws. Installs carefully so that the cable etc may not be inserted.

4) Connects the cable pulled out to the tool or sensor etc which customer will use. The Outlet and cable names of each cables are shown in Table 3-9. You can fix the cable by using the screw holes on the robot arm. (refer to separate "Standard Specifications Manual")

Note) Although the connector is attached to the customer wiring side of the hand input cable, it can use by cutting. Pin assign of the hand input cable is shown in Table 3-10.

Table 3-10 : Pin assign of hand input cable

Color	Signal name	Connector (HC) Note1)	Color	Signal name	Connector (HC) Note1)
Purple	HC1	A1	Red	HC5	B1
Brown	HC2	A2	White	HC6	B2
Blue	HC3	A3	Gray	HC7	B3
Black	HC4	A4	Pink	HC8	B4
Yellow	+24V	A6	Green	+24G(RG)	B6

Note1) Shows the pin number of the connector previously attached to the customer wiring side.
Connector type: 1-1827864-6, Pin type: 1827570-2, Maker: Tyco Electronics Japan G.K.

5) Confirms after the connection that the cable interferes with neither the robot arm nor the peripheral device and the not having receive stress. And, confirms that the tool, the sensor, etc. operate correctly.

This completes installing the Forearm external wiring set.

(2) Installing the Base external wiring set

The installation summary of the Base external wiring set is shown in Fig. 3-6. Mounts this option instead of the CONBOX cover R.

1) Loosen the fixing screws (three M4x16 screws) of CONBOX cover R and remove the box.

2) The connector: LAN, CNOP1 is in CONBOX cover R. The connector is previously attached to the connector LAN. Removes this connector.

3) Connects the connector of Base external wiring set to the connector of robot arm side. Connect with the same name.
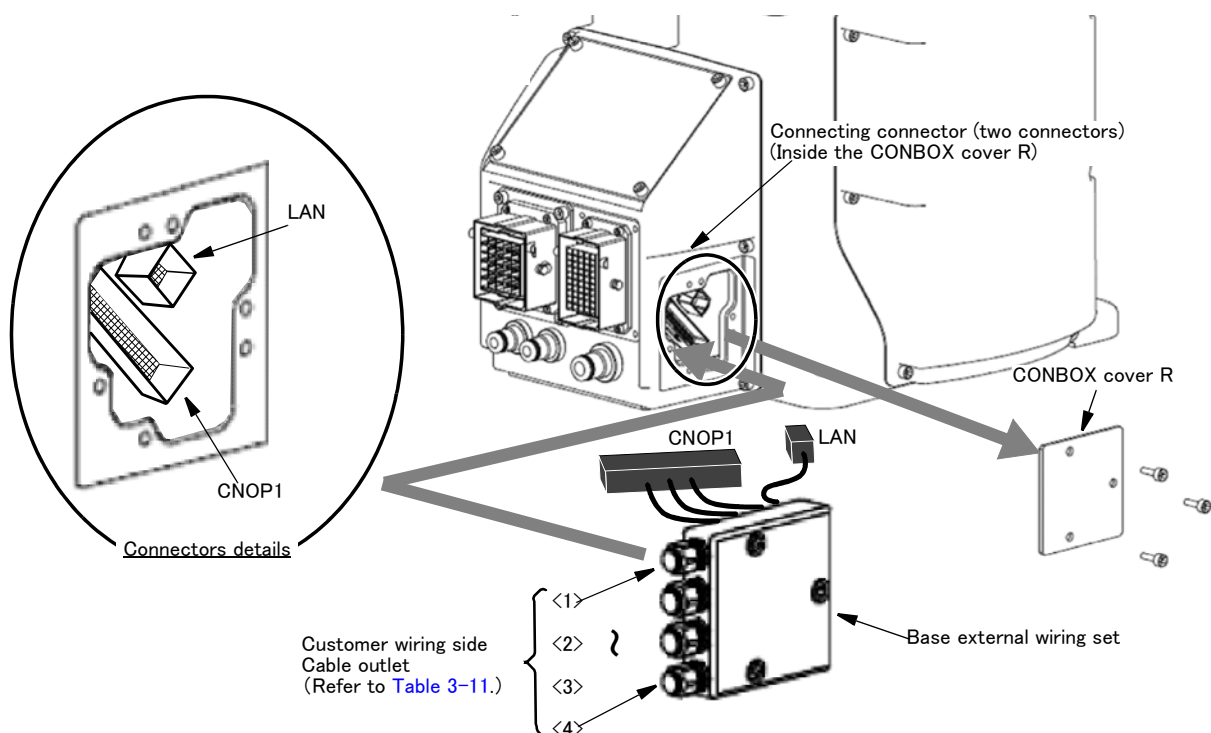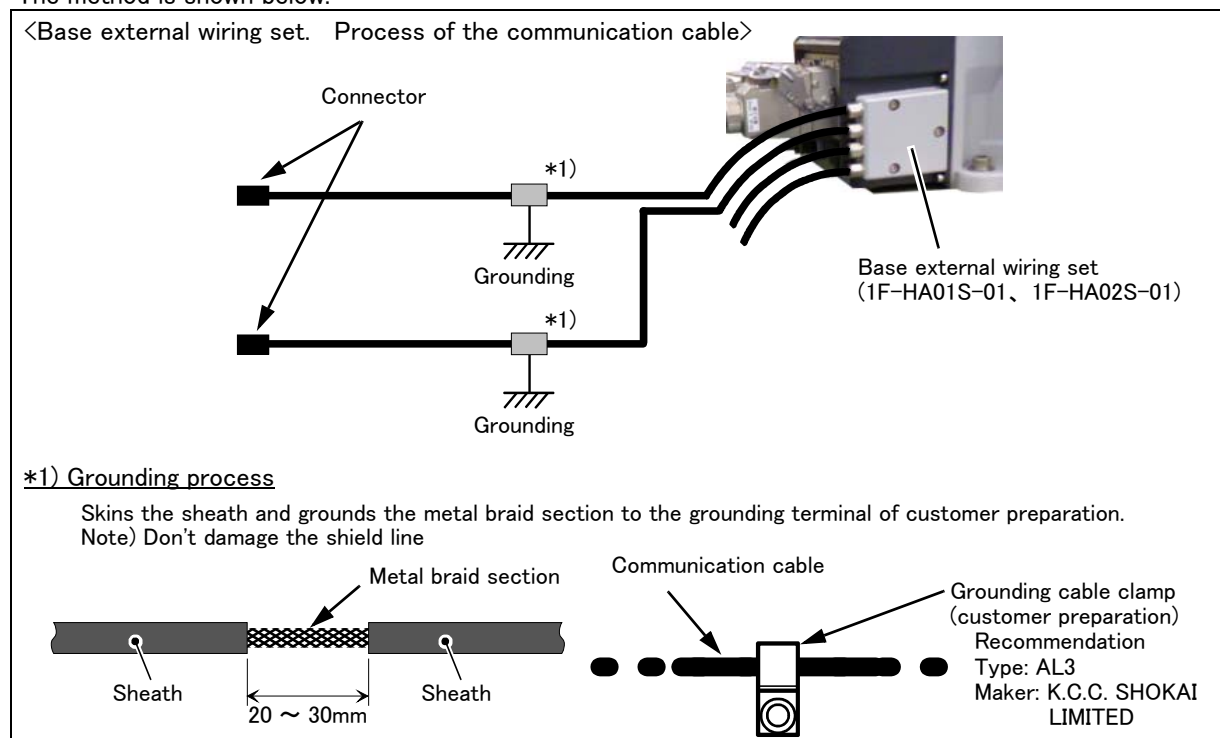

Fig.3-6 : Installing the Base external wiring set

4) Install Base external wiring set on the position where CONBOX cover R was being installed, by using original three fixing screws. Installs carefully so that the cable etc may not be inserted.
5) Connects the cable of Base external wiring set to the force sensor interface etc which customer will use. The Outlet and cable names of each cables are shown in Table 3-11.

Table 3-11 : Cable to pull out and outlet

Base external wiring set	Cable to pull out			Robot side connection connector	Grounding process
	Outlet	Name	Purpose of use		
1F-HA01S-01	⟨1⟩	E・F1	Force sensor interface	CNOP1	Require
	⟨2⟩		Reserved		
	⟨3⟩	LAN	Vision sensor controller	LAN	Not require
	⟨4⟩	RIO	Reserved	CNOP1	Require
1F-HA02S-01	⟨1⟩	E・F2	Force sensor interface	CNOP1	Not require
	⟨2⟩	E・F1	Reserved	CNOP1	Require
	⟨3⟩	LAN	Vision sensor controller	LAN	Not require
	⟨4⟩	RIO	Reserved	CNOP1	Require

6) The cable which connects the force sensor interface needs grounding.
The method is shown below.

⟨Base external wiring set.　Process of the communication cable⟩

Connector

*1)

Grounding

*1)

Grounding

Base external wiring set
(1F-HA01S-01、1F-HA02S-01)

*1) Grounding process

Skins the sheath and grounds the metal braid section to the grounding terminal of customer preparation.
Note) Don't damage the shield line

Metal braid section

Communication cable

Grounding cable clamp
(customer preparation)
Recommendation
Type: AL3
Maker: K.C.C. SHOKAI
LIMITED

Sheath

Sheath

20 ~ 30mm

This completes installing the Base external wiring set.

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.
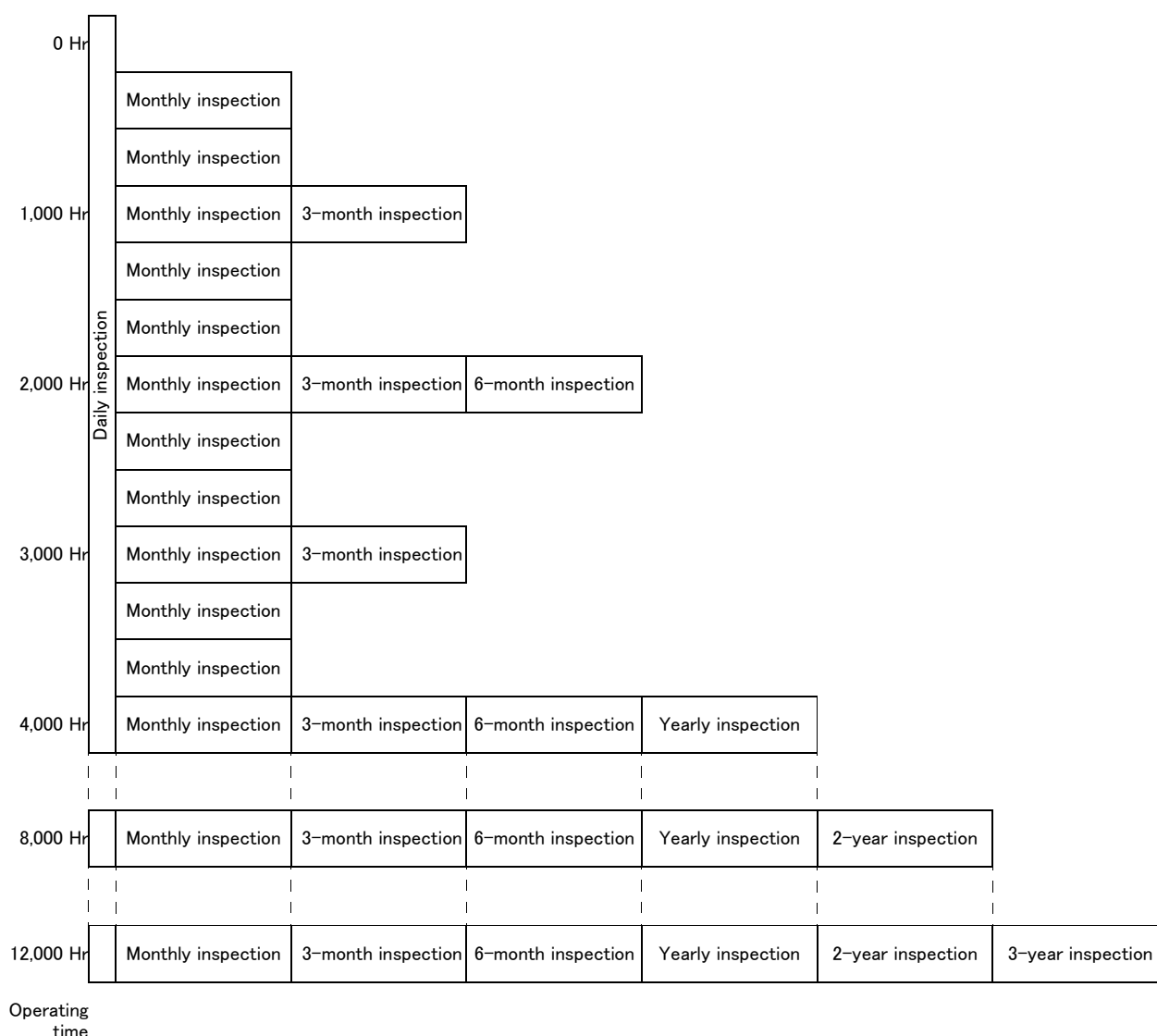
5 Maintenance and Inspection

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 1,000 Hr operation hours).

Operating time	Daily inspection	Monthly	3-month	6-month	Yearly	2-year	3-year
0 Hr							
		Monthly inspection					
		Monthly inspection					
1,000 Hr		Monthly inspection	3-month inspection				
		Monthly inspection					
		Monthly inspection					
2,000 Hr		Monthly inspection	3-month inspection	6-month inspection			
		Monthly inspection					
		Monthly inspection					
3,000 Hr		Monthly inspection	3-month inspection				
		Monthly inspection					
		Monthly inspection					
4,000 Hr		Monthly inspection	3-month inspection	6-month inspection	Yearly inspection		
8,000 Hr		Monthly inspection	3-month inspection	6-month inspection	Yearly inspection	2-year inspection	
12,000 Hr		Monthly inspection	3-month inspection	6-month inspection	Yearly inspection	2-year inspection	3-year inspection

<Guideline for inspection period>
For one shift………. 10 Hr/day ×20 days/month × 3 months = approx. 600 Hr
For two shifts…….. 15 Hr/day ×20 days/month ×3 months = approx. 1,000 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 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 (3-month, 6-month) 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.
Yearly inspection items		
1	Replace the backup battery in the robot arm.	Exchange it referring to Page 92, "5.3.5 Replacing the backup battery".
2-year 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.
2	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.

Note) Supply the grease to each axis with referring to Page 88, "5.3.4 Lubrication".

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 Page 96, "5.5 Maintenance parts" 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 is shown in Fig. 5-2 (RV-4F/7F series) and Fig. 5-3 (RV-13F series). Each part is as shown below. Non-excitation magnetic brakes are mounted in all axis motor.

(1) RV-4F/7F series
　　1) The rotation of the J1 axis motor <1> arranged in the base is conveyed to the reduction gears <3> via the timing belt <2> to rotate the J1 axis.

　　2) The J2 axis rotation is driven by the J2 axis motor <4> and reduction gears <5>.

　　3) The rotation of the J3 axis motor <7> arranged in the No.1 arm is conveyed to the reduction gears <9> via the timing belt <8> to rotate the J3 axis.

　　4) The rotation of the J4 axis motor <10> arranged in the elbow is conveyed to the reduction gears <12> via the timing belt <11> to rotate the J4 axis.

　　5) The rotation of the J5 axis motor <13> arranged in the No.2 arm is conveyed to the reduction gears <16> via the timing belt <14> to rotate the J5 axis.

　　6) The rotation of the J6 axis motor <18> arranged in the No.2 arm is conveyed to the reduction gears <21> via the timing belt <19> and gear <20> to rotate the J6 axis.

(2) RV-13F series
　　1) The J1 axis rotation is driven by the J1 axis motor <1> and reduction gears <2>.

　　2) The J2 axis rotation is driven by the J2 axis motor <3> and reduction gears <4>.

　　3) The J3 axis rotation is driven by the J3 axis motor <5> and reduction gears <6>.

　　4) The rotation of the J4 axis motor <7> arranged in the elbow is conveyed to the reduction gears <9> via the timing belt <8> to rotate the J4 axis.

　　5) The rotation of the J5 axis motor <10> arranged in the No.2 arm is conveyed to the reduction gears <12> via the timing belt <11> to rotate the J5 axis.

　　6) The rotation of the J6 axis motor <13> arranged in the No.2 arm is conveyed to the reduction gears <16> via the timing belt <14> and gear <15> to rotate the J6 axis.

RV-4F/7F series
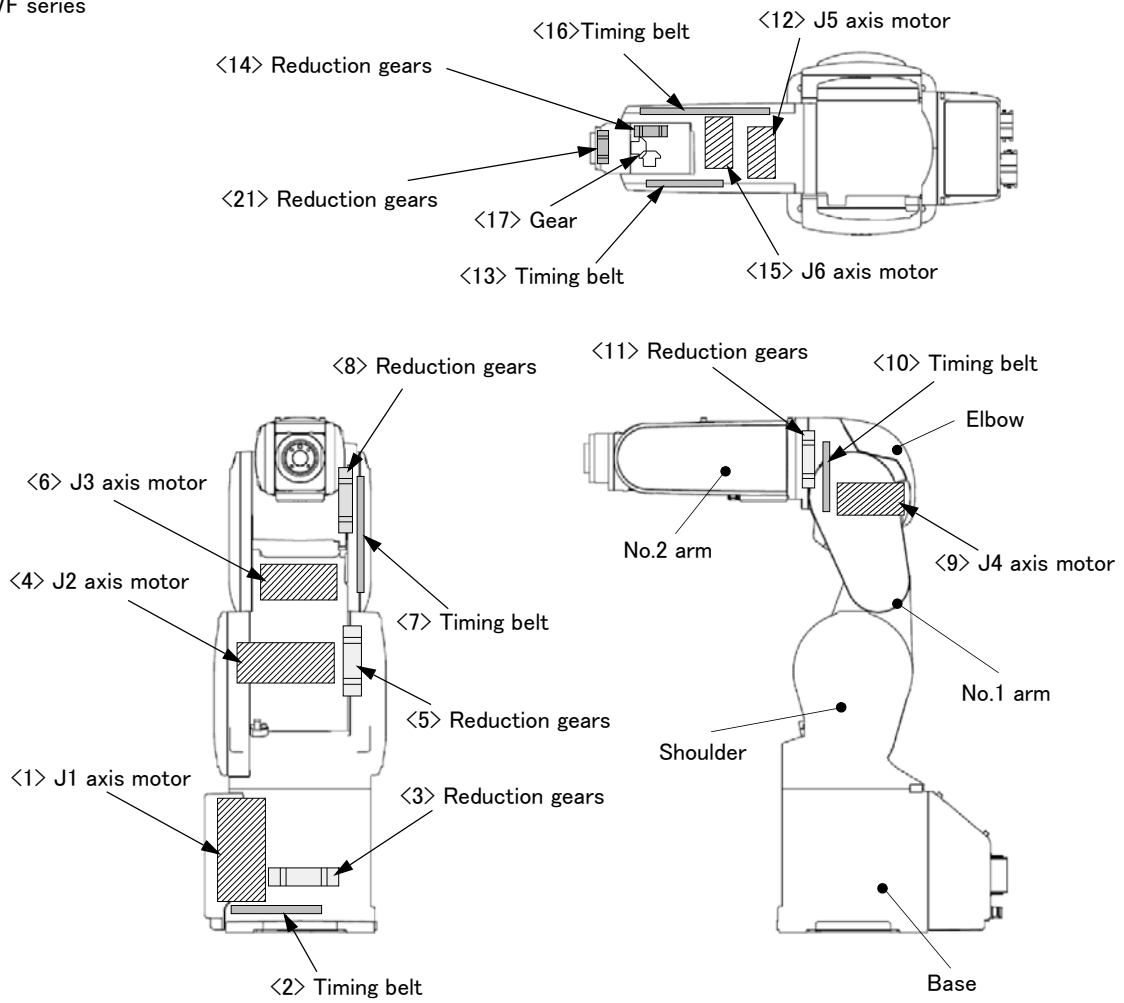
Fig 5-2 : Outline structure of robot arm (RV-4F/7F series)
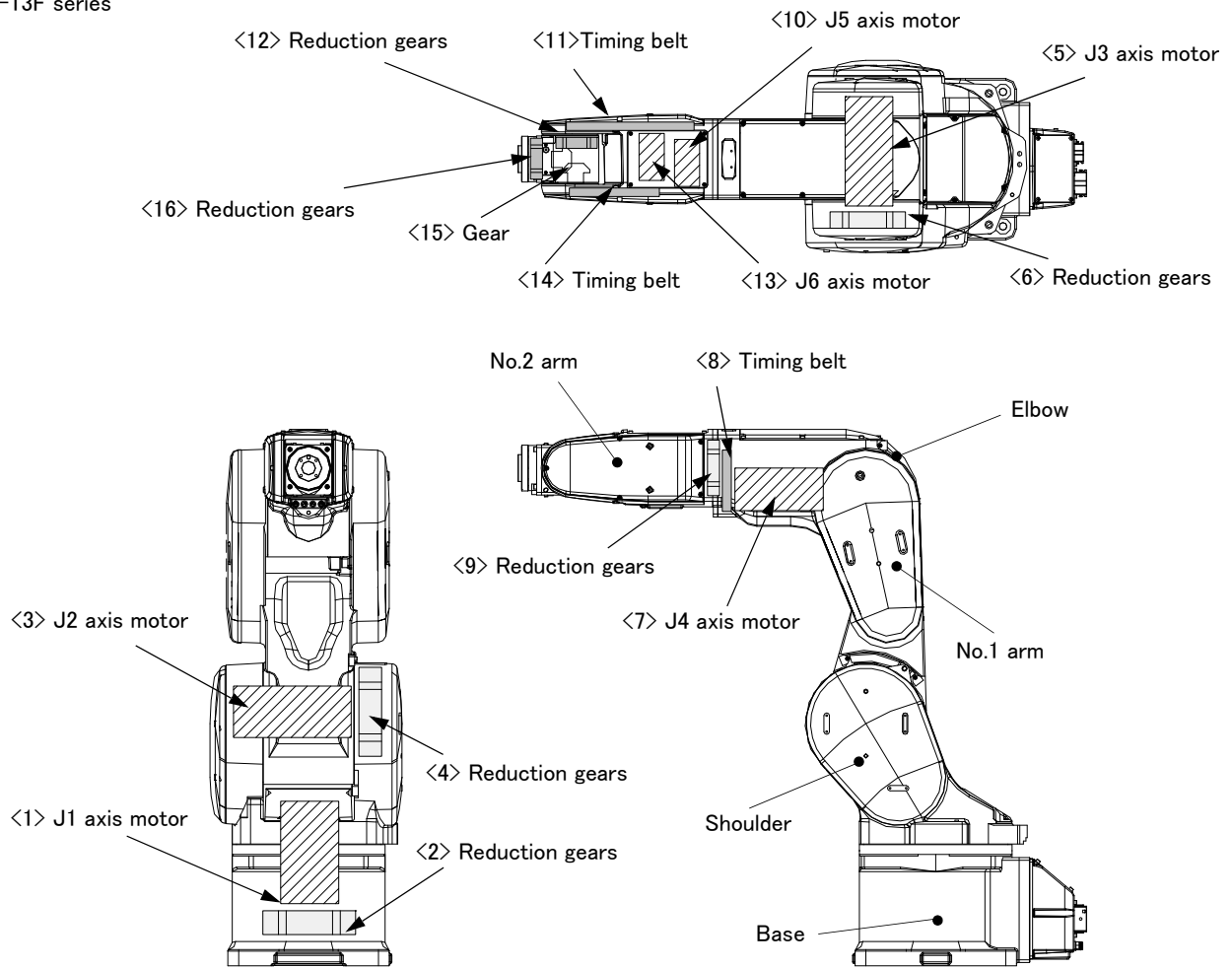
RV-13F series

<12> Reduction gears   <11>Timing belt   <10> J5 axis motor   <5> J3 axis motor

<16> Reduction gears

<15> Gear

<14> Timing belt   <13> J6 axis motor   <6> Reduction gears

No.2 arm   <8> Timing belt

Elbow

<9> Reduction gears

<7> J4 axis motor   No.1 arm

<3> J2 axis motor

<4> Reduction gears

<1> J1 axis motor   <2> Reduction gears

Shoulder

Base

Fig 5-3 : Outline structure of robot arm (RV-13F series)

5.3.2 Installing/removing the cover
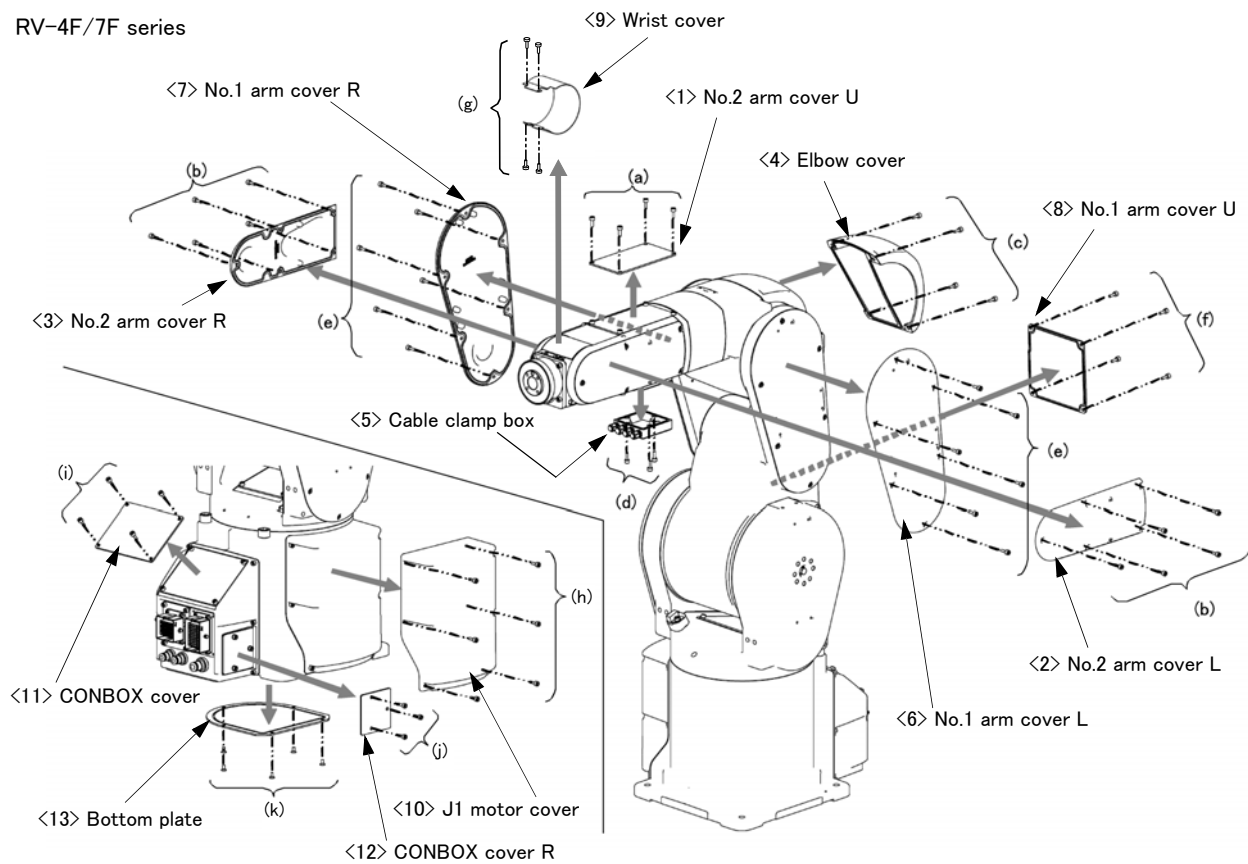
RV-4F/7F series

Fig.5-4 : Installing/removing the cover (RV-4F/7F series)

RV-13F series
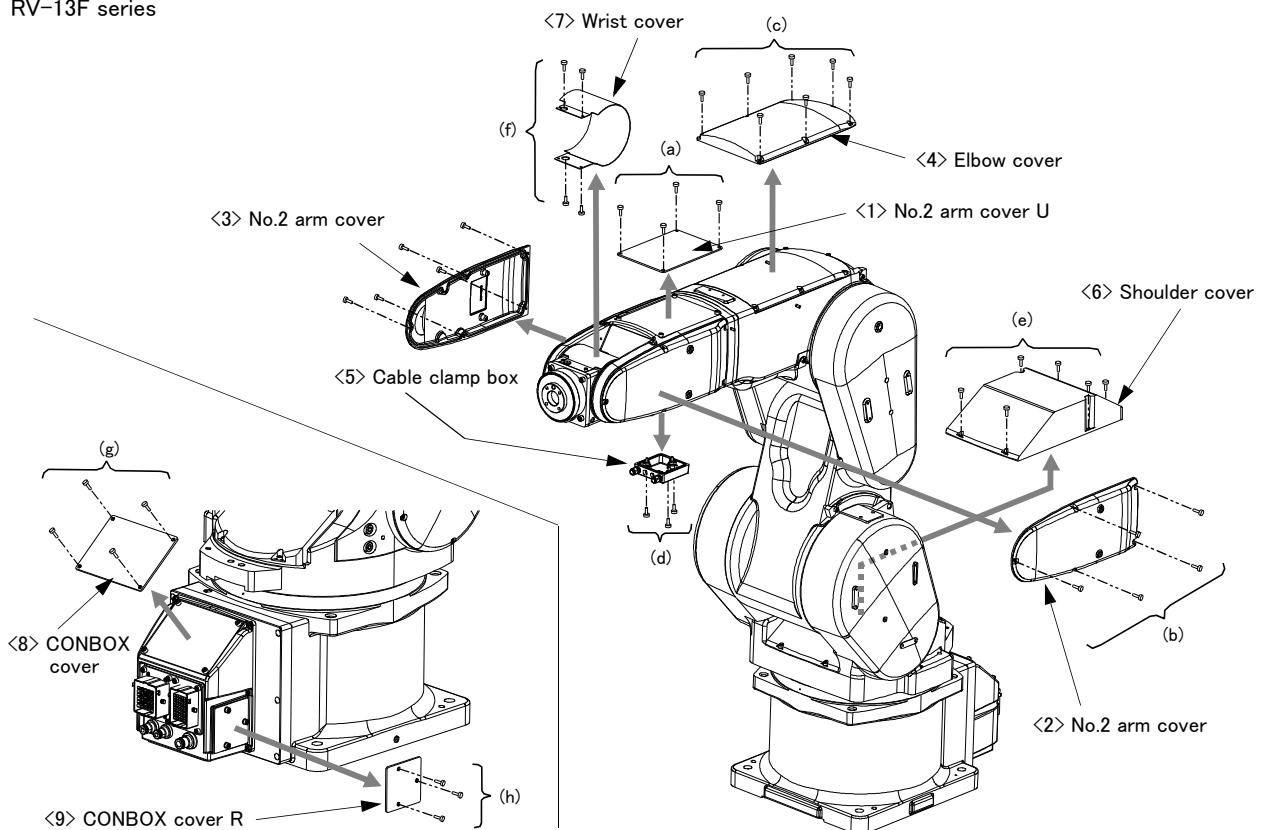
Fig.5-5 : Installing/removing the cover (RV-13F series)

Table 5-3 : Cover fixing screw list

Symbols	Installation screws Note1)	Qty	Remarks
RV-4F/7F series			
(a)	Hexagon socket head cap screw, M4 x 12	4	
(b)	Hexagon socket head cap screw, M4 x 12	5/one side	Fix five screws on one side.
(c)	Hexagon socket head cap screw, M4 x 12	4	
(d)	Hexagon socket head cap screw, M4 x 16	3	Only protection specification has seal washer M4
(e)	Hexagon socket head cap screw, M4 x 12	5/one side	For RV-4F/7F series. Fix five screws on one side.
		6/one side	For RV-4FL/7FL series. Fix six screws on one side.
(f)	Hexagon socket head cap screw, M4 x 8	4	For RV-4F/7F series
		6	For RV-4FL/7FL series
(g)	Low head cap screw, M3 x 8	4	
(h)	Hexagon socket head cap screw, M4 x 12	6	
(i)	Hexagon socket head cap screw, M4 x 8	4	
(j)	Hexagon socket head cap screw, M4 x 16	3	Only protection specification has seal washer M4
(k)	Flat head screw, M4 x 8	5	
RV-13F series			
(a)	Hexagon socket head cap screw, M4 x 12	4	
(b)	Hexagon socket head cap screw, M4 x 12	5/one side	Fix five screws on one side.
(c)	Hexagon socket head cap screw, M4 x 12	7	
(d)	Hexagon socket head cap screw, M4 x 16	3	Only protection specification has seal washer M4
(e)	Hexagon socket head cap screw, M4 x 12	6	
(f)	Low head cap screw, M3 x 8	4	For RV-7FLL
	Hexagon socket head cap screw, M3 x 8	4	For RV-13F/13FL/20F
(g)	Hexagon socket head cap screw, M4 x 8	4	
(h)	Hexagon socket head cap screw, M4 x 16	4	

Note1) The tightening torque of each screws are shown below.
M3 screw: 0.608 – 0.824 N·m
M4 screw: 1.39 – 1.89 N·m

(1) Refer to Fig. 5-4 (RV-4F/7F series) or Fig. 5-5 (RV-13F series), and remove the cover.
(2) The names of the covers are given in Fig. 5-4 (RV-4F/7F series) or Fig. 5-5 (RV-13F series), and a list of the cover fixing screws is given in Table 5-3.
(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 removing the wrist cover, move the J5 axis to the position of +90 degrees by jog operation.
(5) When attaching the cover after maintenance and inspection, use the detaching procedure in reverse.

The part Nos. and symbols in Table 5-3 correspond to Fig. 5-4 (RV-4F/7F series) or Fig. 5-5 (RV-13F series).

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 replacement is necessary if the timing belt is in the condition which showed in "(1)Timing belt replacement period". The inspection and adjustment and replacement method of the timing belt of each axis is shown below. Please check, and adjust and replace if necessary.

Prepare the sound wave type belt tension gauge in inspection and adjustment of the timing belt. The recommendation gauge is shown below. Please prepare by customer. Refer to the Page 87, "(8) Timing belt tension" for the tension adjustment value of the timing belt.

  Maker:Gates Unitta Asia Company,
  Type:U–505

(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 J1-axis timing belt (RV-4F/7F series only)

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-6.
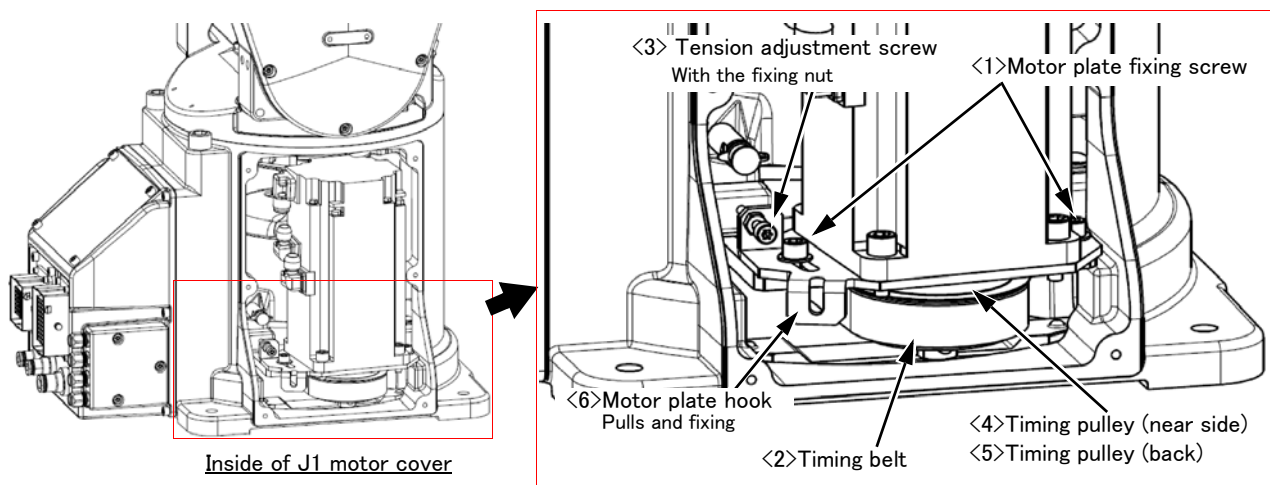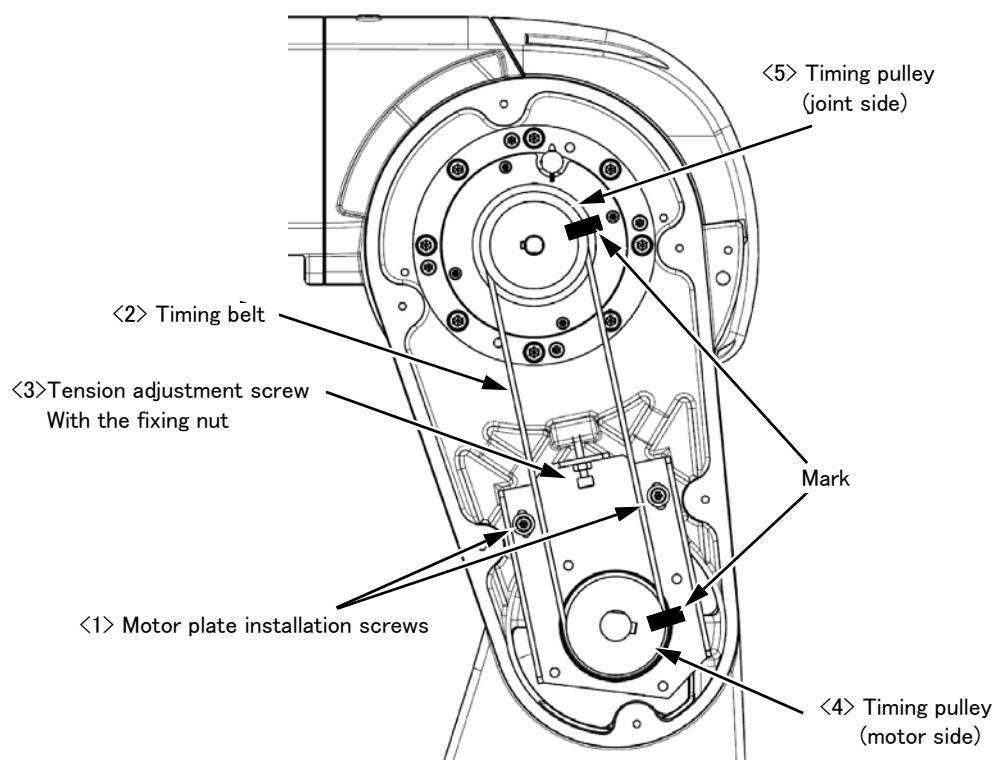

Fig.5-6 : Inspection, maintenance and replacement of J1 axis timing belt

■ Inspecting the J1 axis timing belt
1) Confirm that the robot controller power is OFF.
2) Refer to Page 76, "5.3.2 Installing/removing the cover", and remove the J1 motor cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Adjust the belt with reference to following "■ Adjusting the J1 axis timing belt".

■ Adjusting the J1 axis timing belt
1) Carry out steps "1)" and "2)" indicated in "■ Inspecting the J1 axis timing belt" above.
2) Lightly loosen the motor plate fixing screw <1>.(two pc.) (Do not loosen too much.)
3) Loosen the nut fixing tension adjustment screw <3>. And lightly loosen tension adjustment screw <3>.
4) In the condition that hook <6> of the motor plate is pulled by the force shown below, fix the motor plate fixing screws <1> tight. (two pc.)
   Force which pulls the hook <6>:
      RV-4F series...................used belt: 53-65N, new belt: 80-98N
      RV-7F series...................used belt: 82-100N, new belt: 123-151N
   The tension of J1 axis timing belt is adjusted with this method. Certainly fix two motor plate fixing screws <1>. Improper tightening can cause the belt to loosen with vibration.
   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.
5) After adjustment, fixes the fixing nut and certainly fix tension adjustment screw <3>.

■ Replacing the J1 axis timing belt
   Note) Make sure that the pulleys do not move while replacing the belt. If the pulley <4> and <5> position relation deviates, the position could deviate.

1) Loosen the nut of the tension adjustment screw <3>, and loosen the tension adjustment screw <3>.
2) Remove the motor plate fixing screw <1>, and remove the timing belt <2> from the timing pulley (this side) <4>.
3) Remove the J1 axis motor, and remove the timing belt <2>.
4) Install the new timing belt to the timing pulley (back) <5> and timing pulley (this side) <4>, and install the J1 axis motor to the original position by motor plate fixing screw <1>.
5) Refer to "■ Adjusting the J1 axis timing belt" and "(8)Timing belt tension" to adjust the tension.
6) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 98, "5.6 Resetting the origin", and reset the origin position.

(3) Inspection, maintenance and replacement of J3-axis timing belt (RV-4F/7F series only)
　　The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-7.

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 Page 76, "5.3.2 Installing/removing the cover", and remove the No. 1 arm cover L.
　3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt <2>.
　4) Confirm that the belt tension is adjusted to slacken as shown in "Fig.5-14 : Belt tension".

■ Adjusting the J3 axis timing belt
　1) Carry out steps 1) and 2) indicated in "■ Inspecting the J3 axis timing belt" above.
　2) Lightly loosen the two motor plate installation screws <1>. (Do not loosen too much.)
　3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and adjust the tension of timing belt <2>.
　　When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
　　Adjust the belt tension slack to within the range as shown in "Fig.5-14 : Belt tension".
　　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.
　4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten motor plate installation screws <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J3 axis timing belt

⚠ **CAUTION**　If the timing belt of the J3 axis is removed, the forearm will drop by the self-weight. And, if the positional relation between the timing pulley (4) and (5) deviated, it will become the cause of the position deviation. For the safety before replacing the timing belts, hit the J3 axis against mechanical stopper with releasing brake.

　1) Carry out steps "1)" and "2)" indicated in "■ Inspecting the J3 axis timing belt" above.
　2) Make sure that the pulleys do not move while replacing the belt. If the timing pulley <4> and <5> position relation deviates, the position could deviate.

3) 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.

4) Lightly loosen the two motor plate installation screws <1>. (Do not loosen too much.)

5) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.

6) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.

7) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.

8) Refer to ″■ Adjusting the J3 axis timing belt″ and ″(8)Timing belt tension″ to adjust the tension.

9) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 98, ″5.6 Resetting the origin″, and reset the origin position.

(4) Inspection, maintenance and replacement of J4-axis timing belt (For RV-4F/7F series)

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-8.
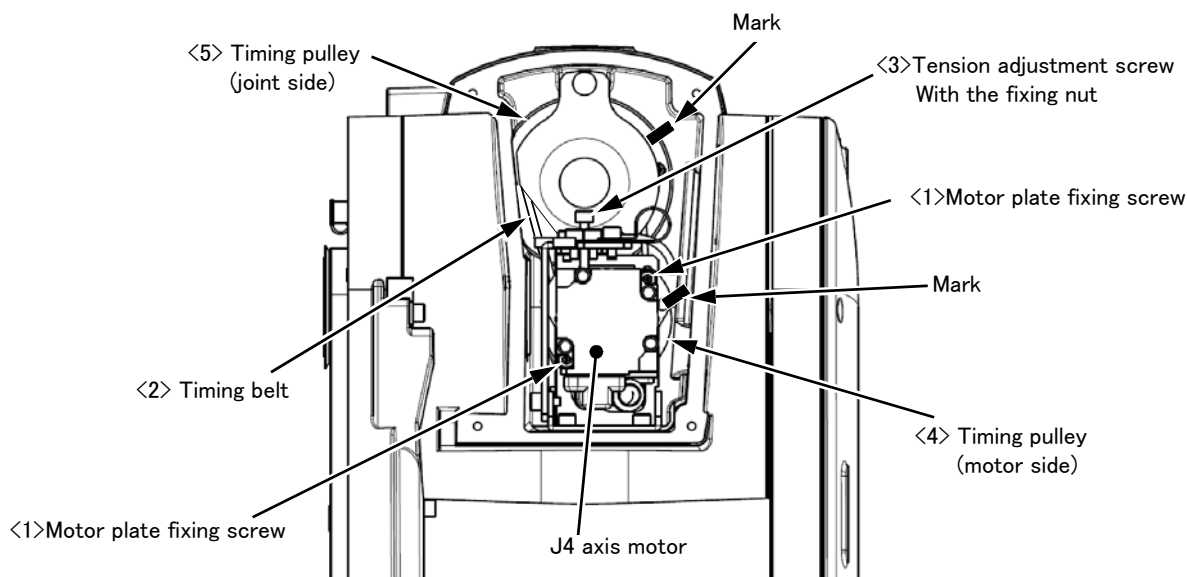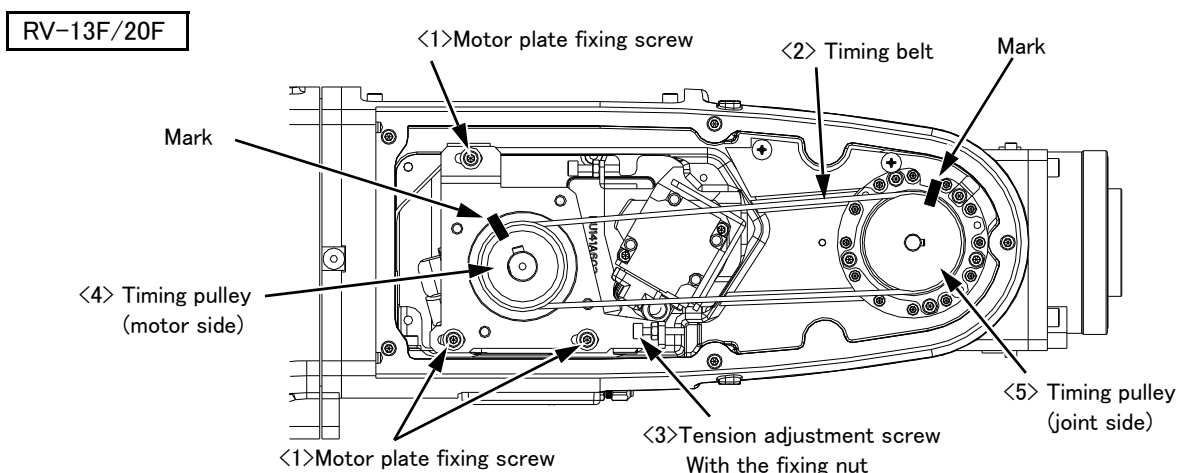

Fig.5-8 : Inspection, maintenance and replacement of J4 axis timing belt (RV-4F/7F series)

■ Inspecting the J4 axis timing belt

1) Confirm that the robot controller power is OFF.

2) Refer to Page 76, ″5.3.2 Installing/removing the cover″, and remove the .

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 as shown in ″Fig.5-14 : Belt tension″.

■ Adjusting the J4 axis timing belt

1) Carry out steps 1) and 2) indicated in ″■ Inspecting the J4 axis timing belt″ above.

2) Lightly loosen the two motor plate fixing screws <1>. (Do not loosen too much.)

3) The nut which is fixing tension adjustment screw <3> is loosened, turn the tension adjustment screw <3>, and adjust the tension of timing belt <2>.
When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
Adjust the belt tension slack to within the range as shown in ″Fig.5-14 : Belt tension″.
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.

4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten motor plate fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J4 axis timing belt

Carries out the replacement of the timing belt of the J4 axis by our service provider. Please contact our service provider after confirming the robot arm and the serial number of the controller.

（5）Inspection, maintenance and replacement of J4-axis timing belt (For RV-13F series)
　　　The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-9.
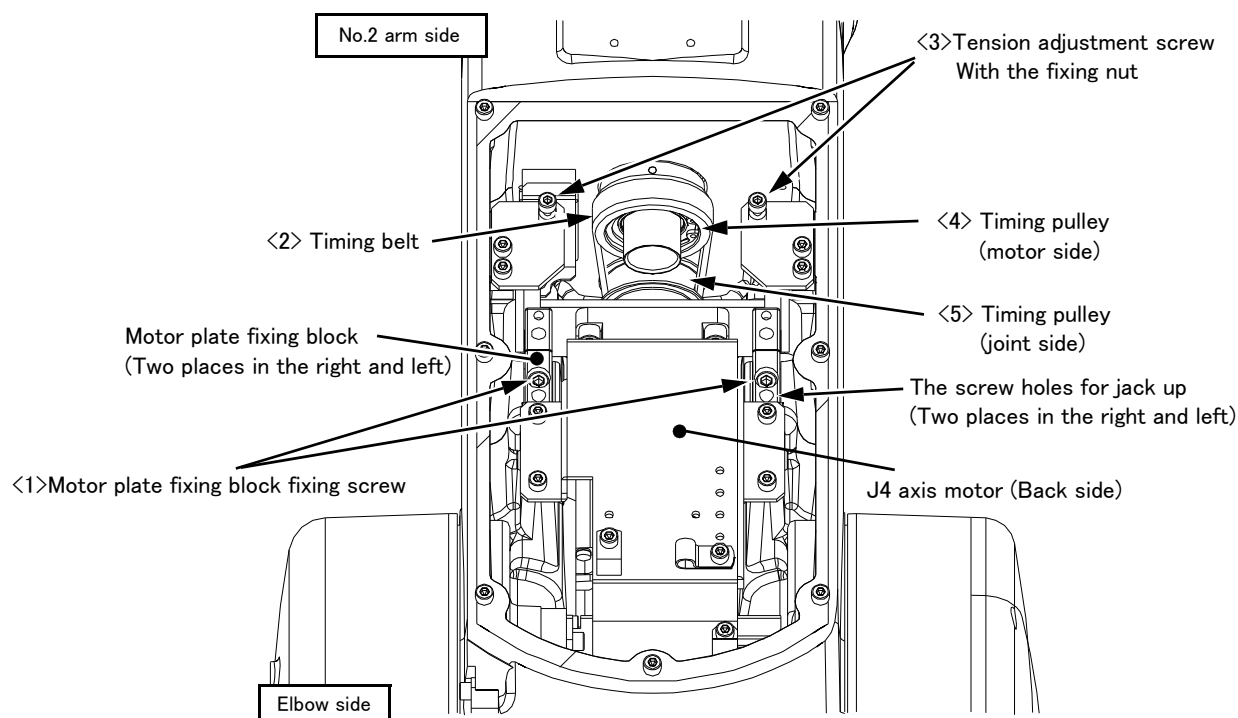
Fig.5-9 : Inspection, maintenance and replacement of J4 axis timing belt (RV-13F series)

■ Inspecting the J4 axis timing belt
　　1) Confirm that the robot controller power is OFF.
　　2) Refer to Page 76, "5.3.2 Installing/removing the cover", and remove the elbow 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 as shown in "Fig.5-14 : Belt tension".

■ Adjusting the J4 axis timing belt
　　1) Carry out steps 1) and 2) indicated in "■ Inspecting the J4 axis timing belt" above.
　　2) Lightly loosen the two tension adjustment screws <3>.
　　3) Loosens the motor plate fixing block. (Two right and left)
　　　Remove fixing-screw <1> of the motor plate fixing block, tighten it to the screw hole for the jack ups, and loosen the motor plate fixing block. Loosen both the right and left in the same way.
　　4) Turn the tension adjustment screw <3>, and adjust the tension of timing belt <2>.
　　　When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
　　　Adjust the belt tension slack to within the range as shown in "Fig.5-14 : Belt tension".
　　　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.
　　5) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten motor plate fixing block fixing screw <1> certainly. (two pc.)
　　　Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J4 axis timing belt
　　　Carries out the replacement of the timing belt of the J4 axis by our service provider. Please contact our service provider after confirming the robot arm and the serial number of the controller.

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

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-10 (RV-4F/7F series, RV-7FLL) or Fig. 5-11 (RV-13F/20F).
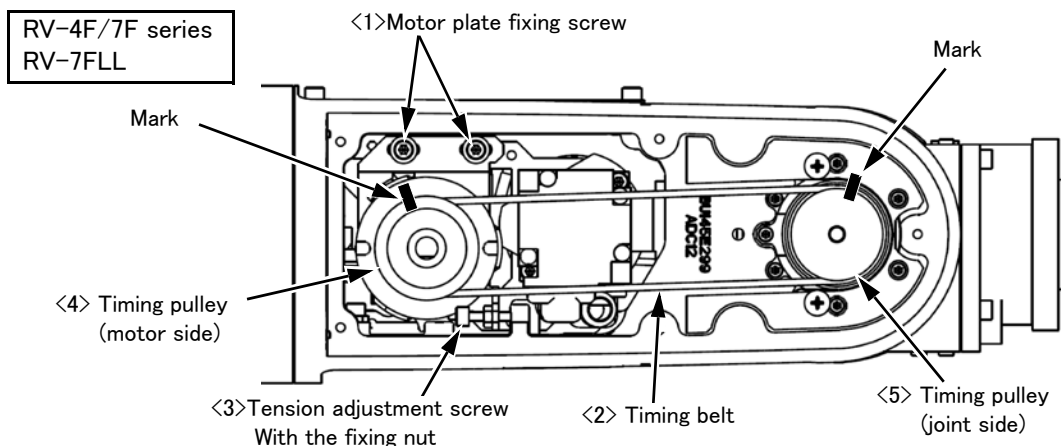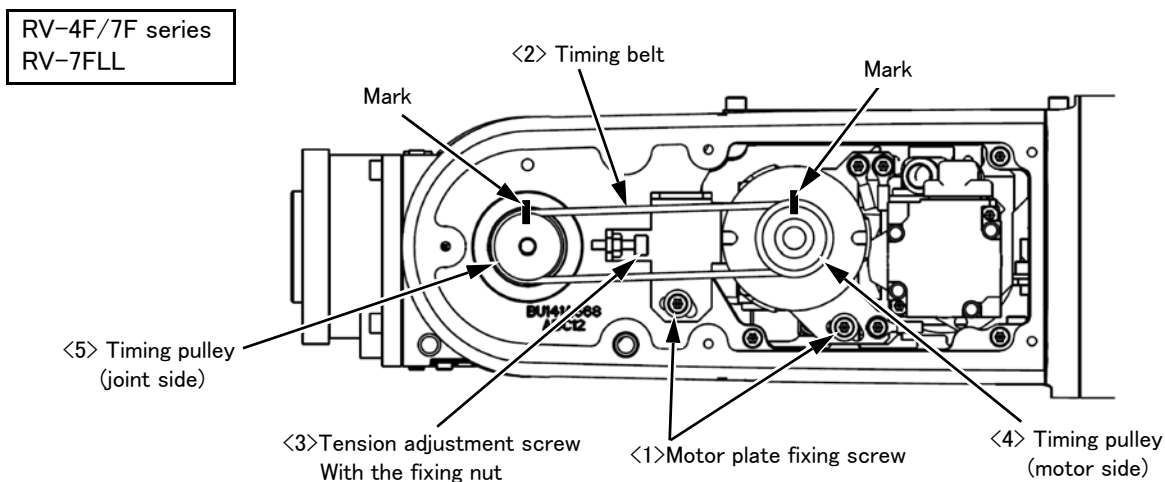

Fig.5-10 : Inspection, maintenance and replacement of J5 axis timing belt (RV-4F/7F series, RV-7FLL)
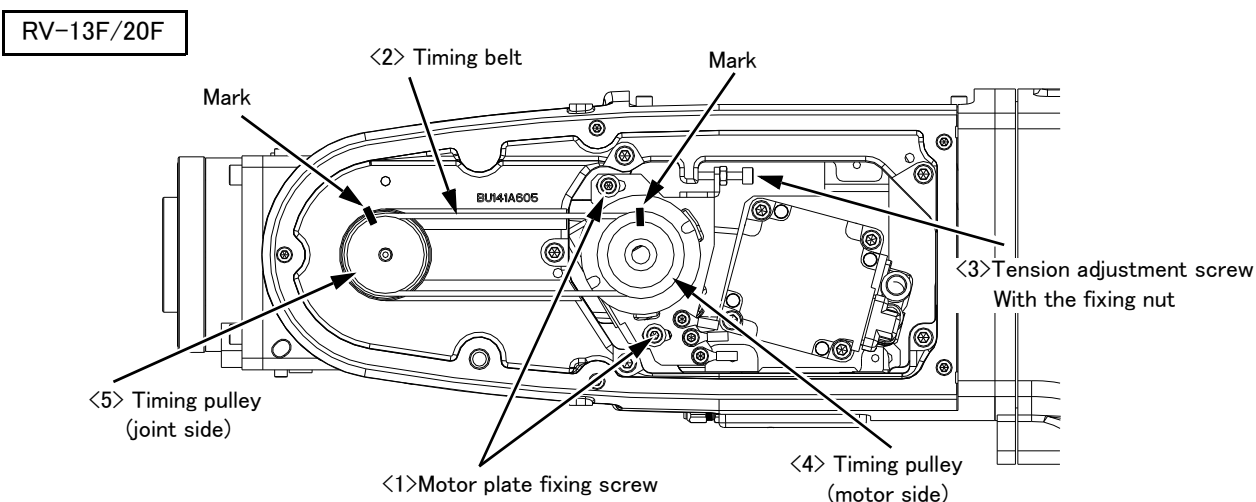

Fig.5-11 : Inspection, maintenance and replacement of J5 axis timing belt (RV-13F/20F)

■ Inspecting the J5 axis timing belt
1) Confirm that the robot controller power is OFF.
2) Refer to Page 76, "5.3.2 Installing/removing the cover", and remove the No. 2 arm cover L.
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 as shown in "Fig.5-14 : Belt tension".

■ Adjusting the J5 axis timing belt
1) Carry out steps 1) and 2) indicated in "■ Inspecting the J5 axis timing belt" above.
2) Lightly loosen the two (R-4F/7F series, RV-7FLL) or three (RV-13F/RV-20F) motor plate fixing screws <1>. (Do not loosen too much.)
3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and adjust the tension of timing belt <2>.
When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen. Adjust the belt tension slack to within the range as shown in "Fig.5-14 : Belt tension".
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.
4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten motor plate fixing screw <1> certainly. (RV-4F/7F series and RV-7FLL: two pc. RV-13F/20F: three pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J5 axis timing belt

⚠ **CAUTION**   If the timing belt of the J3 axis is removed, the forearm will drop by the self-weight. (faces in the downward) And, if the positional relation between the timing pulley (4) and (5) deviated, it will become the cause of the position deviation. For the safety before replacing the timing belt, move the J3 axis so that it may face in the downward by jog operation.

1) Carry out steps 1) and 2) indicated in ″■ Inspecting the J5 axis timing belt″ above.
2) Make sure that the pulleys do not move while replacing the belt. If the timing pulley <4> and <5> position relation deviates, the position could deviate.
3) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-10 (RV-4F/7F series, RV-7FLL) or Fig. 5-11 (RV-13F/20F), so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
4) Lightly loosen the three motor plate fixing screws <1> (RV-4F/7F series: two pc. RV-13F series: three pc.).
5) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.
6) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
7) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
8) Refer to ″■ Adjusting the J5 axis timing belt″ and ″(8)Timing belt tension″ to adjust the tension.
9) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 98, ″5.6 Resetting the origin″, and reset the origin position.

(7) Inspection, maintenance and replacement of J6-axis timing belt

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-12 (RV-4F/ 7F series, RV-7FLL) or Fig. 5-13 (RV-13F/20F).

RV-4F/7F series
RV-7FLL

<2> Timing belt

Mark

Mark

<5> Timing pulley
(joint side)

<3>Tension adjustment screw
With the fixing nut

<1>Motor plate fixing screw

<4> Timing pulley
(motor side)

Fig.5-12 : Inspection, maintenance and replacement of J6 axis timing belt (RV-4F/7F series, RV-7FLL)

RV-13F/20F

<2> Timing belt

Mark

Mark

<5> Timing pulley
(joint side)

<3>Tension adjustment screw
With the fixing nut

<1>Motor plate fixing screw

<4> Timing pulley
(motor side)

Fig.5-13 : Inspection, maintenance and replacement of J6 axis timing belt (RV-13F/20F)

■ Inspecting the J6 axis timing belt
1) Confirm that the robot controller power is OFF.
2) Refer to Page 76, "5.3.2 Installing/removing the cover", and remove the No. 2 arm cover R
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 as shown in "Fig.5-14 : Belt tension".

■ Adjusting the J6 axis timing belt
1) Carry out steps 1) and 2) indicated in "■ Inspecting the J6 axis timing belt" above.
2) Lightly loosen the two motor plate fixing screws <1>. (Do not loosen too much.)
3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and adjust the tension of timing belt <2>.
   When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
   Adjust the belt tension slack to within the range as shown in "Fig.5-14 : Belt tension".
   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.
4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>.Moreover, also fasten motor plate fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J6 axis timing belt
    1) Carry out steps 1) and 2) indicated in ″ ■ Inspecting the J6 axis timing belt″ above.
    2) Make sure that the pulleys do not move while replacing the belt. If the pulley <4> and <5> position relation deviates, the position could deviate.
    3) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-12 (RV-4F/7F series, RV-7FLL) or Fig. 5-13 (RV-13F/20F), so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
    4) Lightly loosen the two pc. motor plate fixing screws <1>. (Do not loosen too much.)
    5) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.
    6) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
    7) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
    8) Refer to ″ ■ Adjusting the J6 axis timing belt″ and ″(8)Timing belt tension″ to adjust the tension.
    9) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 98, ″5.6 Resetting the origin″, and reset the origin position.

（8）Timing belt tension

f : Pressing force
s : Span
d : Slack
F : Tension
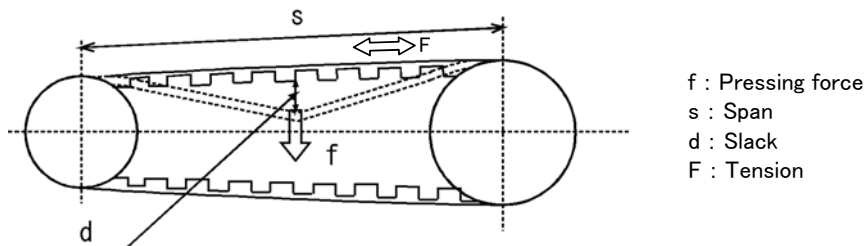
■ RV-4F series

The preset value and adjustment value in the sound wave type belt tension gauge

Axis	Belt type	Preset value			Standard tension[Note1]	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J1	315-3GT-12	2.5	12	85.5	79.7 – 97.4 (80 – 98N)	53.1 – 64.9 (53 – 65N)
J3	381-3GT-6	2.5	6	118.4	39.2 – 47.9	26.1 – 31.9
J4	240-3GT-4	2.5	6	56.4		
J5	393-3GT-4	2.5	4	149.8	27.0 – 33.0	18.0 – 22.0
J6	270-3GT-4	2.5	4	96.0		

Note1) The value inside the parenthesis shown in the column of tension of the J1 axis shows the force which pulls the motor plate hook at belt adjustment.

■ RV-7F series

The preset value and adjustment value in the sound wave type belt tension gauge

Axis	Belt type	Preset value			Standard tension[Note1]	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J1	405-5GT-15	4.0	15	107.5	129.6 – 158.4 (123 – 151N)	86.4 – 105.6 (82 – 100N)
J3	501-3GT-9	2.5	9	178.5	59.4 – 72.6	39.6 – 48.4
J4	237-3GT-6	2.5	6	54.9	39.2 – 47.9	26.1 – 31.9
J5	408-3GT-6	2.5	6	150.0		
J6	270-3GT-4	2.5	4	96.0	27.0 – 33.0	18.0 – 22.0

Note1) The value inside the parenthesis shown in the column of tension of the J1 axis shows the force which pulls the motor plate hook at belt adjustment.

■ RV-7FLL

The preset value and adjustment value in the sound wave type belt tension gauge

Axis	Belt type	Preset value			Standard tension	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J4	252-3GT-9	2.5	9	60.0	59.4– 72.6	39.6 – 48.4
J5	408-3GT-6	2.5	6	150.0	39.2 – 47.9	26.1 – 31.9
J6	270-3GT-4	2.5	4	96.0	27.0 – 33.0	18.0 – 22.0

■ RV-13F/20F

The preset value and adjustment value in the sound wave type belt tension gauge

Axis	Belt type	Preset value			Standard tension	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J4	252-3GT-9	2.5	9	60.0	59.4– 72.6	39.6 – 48.4
J5	495-3GT-9	2.5	9	181.0		
J6	330-3GT-6	2.5	6	111.0	39.2 – 47.9	26.1 – 31.9

Fig.5-14 : Belt tension

The timing belt can satisfactorily convey the drive and keep a durable force only when it has an adequate tension. The belt tension should not be too tight or too loose. Instead, it should be adjusted to a degree that elasticity is felt when the belt is pressed with the thumb. If the belt tension is too weak, 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. 5-14.

Check and adjust with the belt pressing force f and the slack amount d between spans.

5.3.4 Lubrication

(1) Lubrication position and specifications

The grease nipple position is shown in Fig. 5-15 (RV-4F/7F series) or Fig. 5-16 (RV-13F series). The lubrication specifications for each place are shown in Table 5-4. Refer to the Page 76, "5.3.2 Installing/removing the cover" for the method of removing and installing the cover.
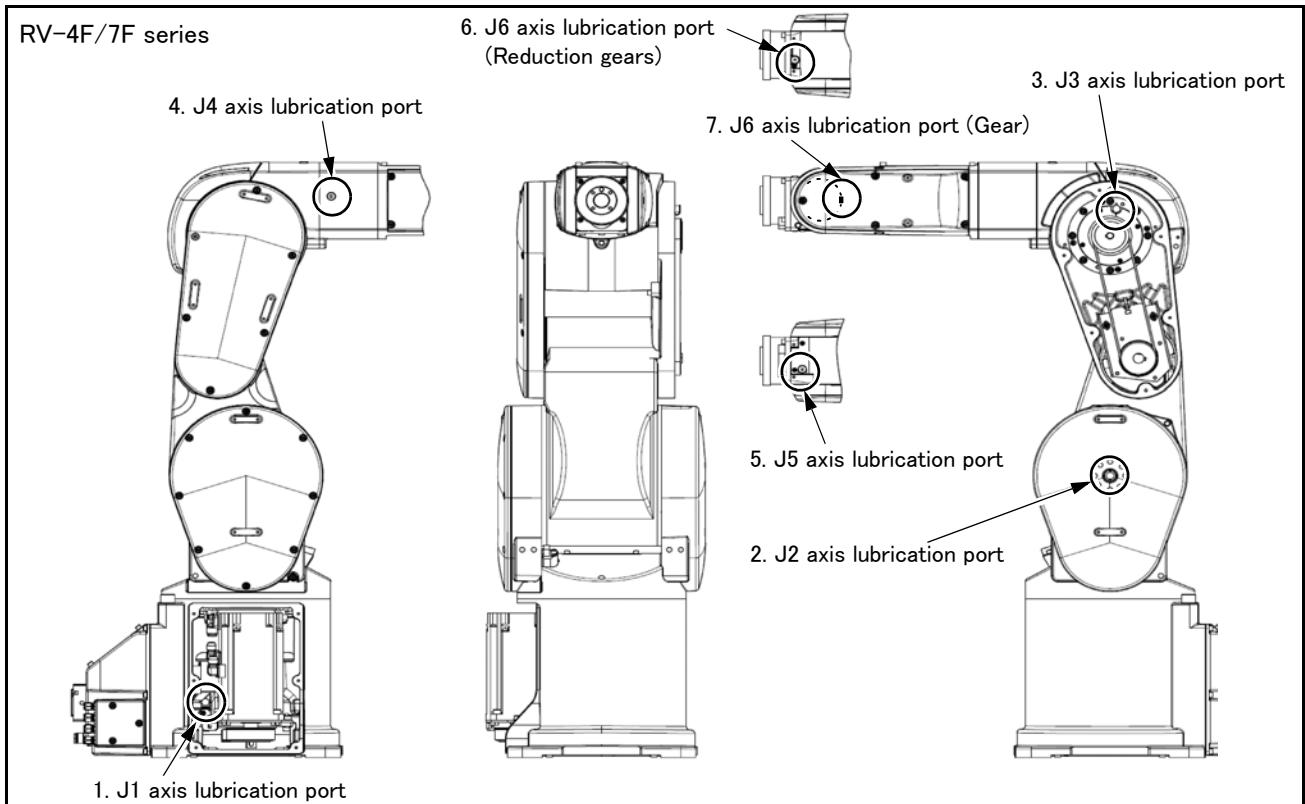
Fig.5-15 : Lubrication positions (RV-4F/7F series)
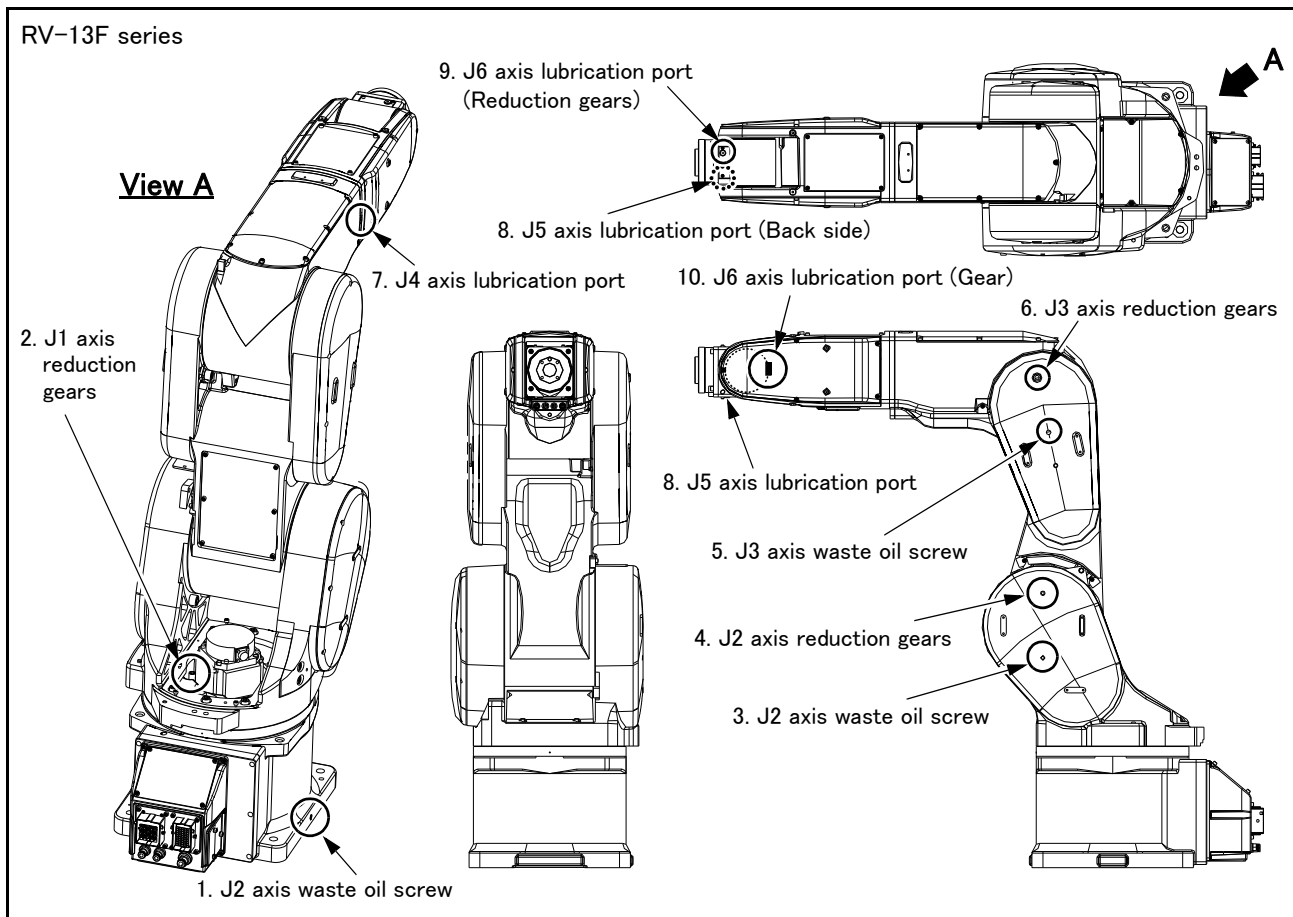
Fig.5-16 : Lubrication positions (RV-13F series)

Table 5-4 : Lubrication specifications

No.	Parts to be lubricated Note1)	Oiling method	Lubrication oil (maker)	Default charge amount	Lubrication interval	Lubrication amount	Cover to remove
RV-4F series							
1	J1 axis reduction gears	Grease nipple WA-610	4BNo2 (Japan Harmonic Systems)	52.5g	24,000Hr	8g	J1 motor cover
2	J2 axis reduction gears			45g		8g	
3	J3 axis reduction gears			24g		4g	No.2 arm cover L
4	J4 axis reduction gears			19.5g		4g	
5	J5 axis reduction gears			13.5g		2g	
6	J6 axis reduction gears			9.15g		2g	
7	J6 axis gears			11g		1.3g	Wrist cover
RV-7F series							
1	J1 axis reduction gears	Grease nipple WA-610	4BNo2 (Japan Harmonic Systems)	105g	24,000Hr	12g	J1 motor cover
2	J2 axis reduction gears			90g		12g	
3	J3 axis reduction gears			45g		8g	No.2 arm cover L
4	J4 axis reduction gears			19.5g		4g	
5	J5 axis reduction gears			13.5g		2g	
6	J6 axis reduction gears			9.15g		2g	
7	J6 axis gears			11g		1.3g	Wrist cover

No.	Parts to be lubricated Note1)	Oiling method	Lubrication oil (maker)	Default charge amount	Lubrication interval	Lubrication amount	Cover to remove
RV-7FLL							
2	J1 axis reduction gears	Grease nipple WA-110	VIGO GREASE (Nabtesco Co., Ltd.)	255g	20,000Hr	255g	Shoulder cover
4	J2 axis reduction gears			251g		251g	
6	J3 axis reduction gears			150g		150g	
7	J4 axis reduction gears	Grease nipple WA-610	4BNo2 (Japan Harmonic Systems)	25g	24,000Hr	7g	
8	J5 axis reduction gears			13.5g		2g	
9	J6 axis reduction gears			9.15g		2g	
10	J6 axis gears			11g		1.3g	Wrist cover
RV-13F/20F							
2	J1 axis reduction gears	Grease nipple WA-110	VIGO GREASE (Nabtesco Co., Ltd.)	255g	20,000Hr	255g	Shoulder cover
4	J2 axis reduction gears			251g		251g	
6	J3 axis reduction gears			150g		150g	
7	J4 axis reduction gears	Grease nipple WA-610	4BNo2 (Japan Harmonic Systems)	25g	24,000Hr	7g	
8	J5 axis reduction gears			17.5g		3g	
9	J6 axis reduction gears			8g		2g	
10	J6 axis gears			13g		1.5g	Wrist cover

Note1) When the screw is installed in the illustrated lubrication point, install the attached grease nipple and supply the grease.

［Caution］
・ The brand name of the grease shown in the Table 5-4 is the grease put in at shipping.
・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 "Lubrication interval " in Table 5-4 is usually based on the three-year 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.
・ By the maintenance forecast function of RT ToolBox2 (option) computes the guide of the lubrication hours put together with the customer's operation status.
・ The numbers in theTable 5-4 correspond to the supply positions in Fig. 5-15 (RV-4F/7F series) or Fig. 5-16 (RV-13F series).
・Because excessive lubrication leads to the grease leak, avoid it. And, the number of times of lubrication limits to 3 times. The maintenance after it needs the overhaul work which replaces internal grease. Please ask dealer.

(2) Lubrication method
1) Set the robot to the posture shown in Fig. 5-15 (RV-4F/7F series) or Fig. 5-16 (RV-13F series).
2) Refer to the Page 76, "5.3.2 Installing/removing the cover" and remove the covers.
3) Please protect the timing belt with the cloth etc. so that the grease does not take for the timing belt at the time of oil supply.
4) Remove the following screws, and install the attached grease nipples.
  RV-4F series: J3 axis lubrication port ⟨3⟩, J4 axis lubrication port ⟨4⟩, J5 axis lubrication port ⟨5⟩, J6 axis
    lubrication port ⟨6⟩ (reduction gears) and J6 axis lubrication port ⟨7⟩ (gear).
  RV-7F series: J4 axis lubrication port ⟨4⟩, J5 axis lubrication port ⟨5⟩, J6 axis lubrication port ⟨6⟩
    (reduction gears) and J6 axis lubrication port ⟨7⟩ (gear).
  RV-13F series: Removes J1 axis waste oil screw ⟨1⟩, the J2 axis waste oil screw ⟨3⟩, and the J3 axis waste
    oil screw ⟨5⟩. Because the oil appears from the screw hole, please wipe off with the rag etc.
    Remove the screw of from J1 axis lubrication point ⟨2⟩ to the J6 axis lubrication point (gear)
    ⟨7⟩, and install the attached grease nipple.
  Securely tighten the grease nipple by 4.7 N·m to 6.3 N·m
5) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple.
6) In the RV-13F series, installs waste oil screw (1)(3)(5) which was removed above as before.

7) Removes the grease nipple installed above and installs the original screw bolt. Tighten the screw bolt by 4.7N·m – 6.3N·m.

8) Replace the covers with the removal procedure in reverse.

9) If the maintenance forecast function is enable, please reset the accumulated data about grease. Carries out the resetting operation by RT ToolBox or parameter (MFGRST). Refer to separate "RT ToolBox2 / RT ToolBox2 mini User's Manual" for the operation method of RT ToolBox, and refer to separate "Instruction Manual/ Detailed Explanation of Functions and Operations" for details of parameter (MFGRST).

⚠ CAUTION Use manual grease gun, and inject grease with pressure 0.03Mpa or less. Do not use the grease gun, which derived by the factory air presser to avoid injecting by too high pressure.

5.3.5 Replacing the backup battery

An absolute encoder is used for the position detector, so while power of controller is turned off the position must be saved by the backup battery. The controller also uses a backup battery to save the program, etc. The battery is the lithium battery. 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. There exists the kinds of the errors about the battery shown in Table 5-5. If error 7500 occurs, please exchange the battery of the robot arm and the controller simultaneously.

Table 5-5 : The error about the battery

Item	Error number	Description	Measure
Controller	7520	The battery consumption time was exceeded	Replace the battery
Controller	7510	Battery voltage low	Replace the battery
Controller	7500	No battery voltage	The backup data cannot be guaranteed if this error occurs.
Robot arm	7520	The battery consumption time was exceeded	Replace the battery
Robot arm	133n[Note1]	Encoder battery voltage low。	Replace the battery
Robot arm	112n	Encoder ABS position data lost	The backup data cannot be guaranteed if this error occurs.

Note1) "n" indicates the axis number

The method of replacing the battery of robot arm is shown below.
refer to the separate "Instruction manual/Controller setup, basic operation, and maintenance" about controller's battery.
About the purchase of the battery, refers to Page 96, "5.5 Maintenance parts".

⚠ **CAUTION** If error 7500 or 112n occurs, the program data and other data in the controller is lost and it becomes necessary to load the data such as program and origin data again.

(1) Replacing the battery (robot arm)

⚠ **CAUTION** The power supply for the encoder is supplied by cable connected with battery board. The cable must be connected while replacing the battery or operating usually. Thus, if the cable connection is incomplete, the encoder position data will be lost, and resetting the origin is necessary.

⚠ **CAUTION** Replace the battery one by one . If all batterys are removed the encoder data will be lost, and resetting the origin is necessary.

The battery installation position is shown in Fig. 5-17. Refers to the figure and replaces the batteries in the following procedures.

Hexagon socket head cap screw (4 pc.)

CONBOX cover

Battery holder

Battery

Lead connector

Note) Although the figure is the example of RV-4F other types are the same also.
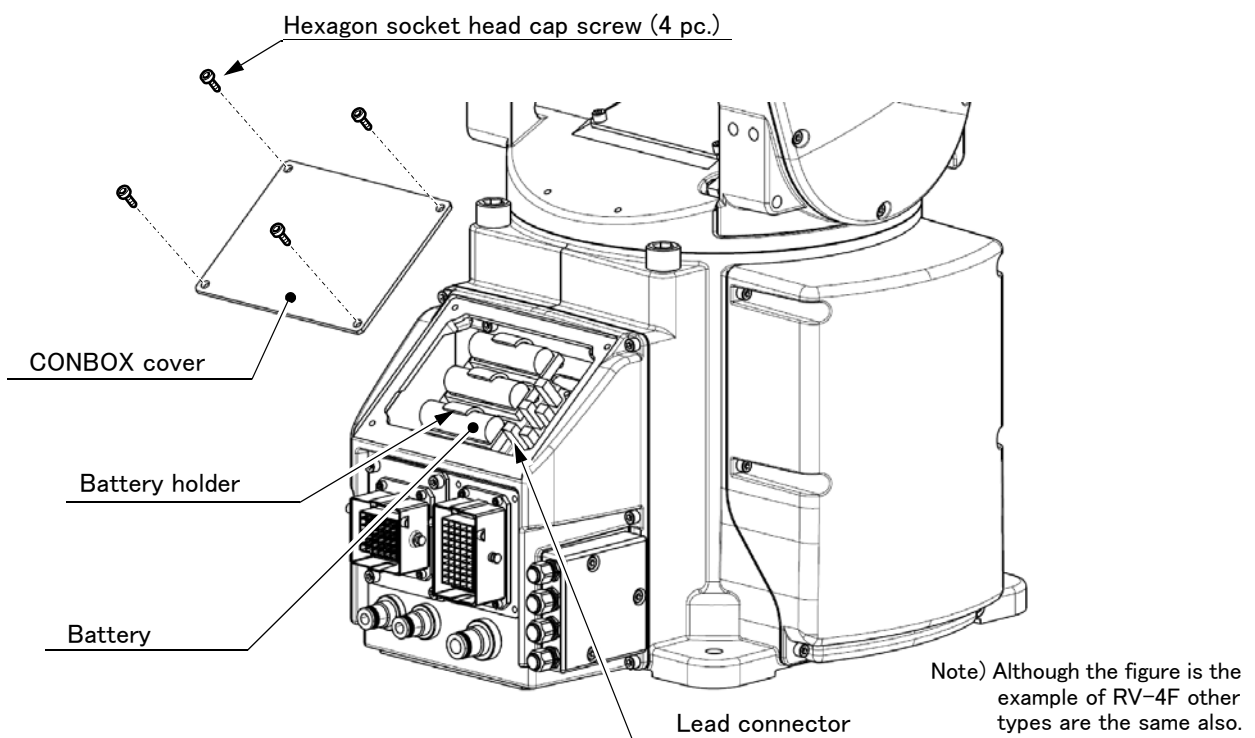
Fig.5-17 : Replacing the battery

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) 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.
4) Remove CONBOX cover <1>, referring to Page 76, "5.3.2 Installing/removing the cover".
5) The battery holder is located in the CONBOX cover <1>. Remove the old battery from the holder, and disconnect the lead connector.
6) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
7) Replaces the backup battery one by one in the above-mentioned procedure.
8) All the batteries should check that it has been exchanged newly. If the old battery is contained, generating heat and damaging may occur.
9) Install CONBOX cover <1>.
10) Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the

separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again. Refer to Page 98, "5.6 Resetting the origin" and reset the origin using the jig method or ABS origin method.

5.4 About Overhaul

Robots which have been in operation for an extended period of time can suffer from wear and other forms of deterioration. In regard to such robots, we define overhaul as an operation to replace parts running out of specified service life or other parts which have been damaged, so that the robots may be put back in shape for continued use. Overhaul interval for robots presumably varies with their operating conditions and thus with the degree of the equipment's wear and loss of performance. As a rule of thumb, however, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the predetermined levels (24,000 hours for the robot body and 36,000 hours for the controller). (See Fig. 5-18.) For specific information about parts to be replaced and timing of overhaul, contact your local service representative.
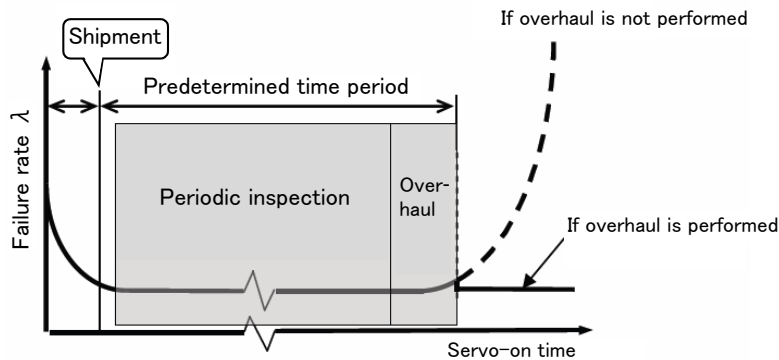
Fig.5-18 : Periodic inspection/overhaul periods

5.5 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-6, and spare parts that may be required during repairs are shown in Table 5-7. 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 5-6 : Consumable part list

No.	Part name	Type	Usage place	Q'ty	Supplier
1	Timing belt		J1 axis	1	
2			J3 axis	1	
3			J4 axis	1	
4			J5 axis	1	Mitsubishi Electric
5			J6 axis	1	
6	Grease		Reduction gears of each axis	An needed	
7	Lithium battery	ER6	Inside the CONBOX cover	3	

Table 5-7 : Spare parts list

No.	Names	Usage place	Q'ty	Supplier
RV-4F series (common)				
1	AC servo motor	J1, J2 axis	2	
2		J3 axis	1	Mitsubishi Electric
3		J4, J5 axis	2	
4		J6 axis	1	
RV-4F series (For standard arm type)				
5	Reduction gears	J1, J2 axis	2	
6		J3 axis	1	
7		J4 axis	1	Mitsubishi Electric
8		J5 axis	1	
9		J6 axis	1	
RV-4F series (For long arm type)				
10	Reduction gears	J1 axis	1	
11		J2, J3 axis	2	
12		J4 axis	1	Mitsubishi Electric
13		J5 axis	1	
14		J6 axis	1	
RV-7F series (common)				
15	AC servo motor	J1, J2 axis	2	
16		J3 axis	1	Mitsubishi Electric
17		J4, J5 axis	2	
18		J6 axis	1	
RV-7F series (For standard arm type)				
19	Reduction gears	J1, J2 axis	2	
20		J3 axis	1	
21		J4 axis	1	Mitsubishi Electric
22		J5 axis	1	
23		J6 axis	1	
RV-7F series (For long arm type)				
24	Reduction gears	J1 axis	1	
25		J2, J3 axis	2	
26		J4 axis	1	Mitsubishi Electric
27		J5 axis	1	
28		J6 axis	1	
RV-7FLL				
29	AC servo motor	J1, J2 axis	2	
30		J3 axis	1	
31		J4 axis	1	Mitsubishi Electric
32		J5 axis	1	
33		J6 axis	1	
34	Reduction gears	J1 axis	1	
35		J2 axis	1	
36		J3 axis	1	
37		J4 axis	1	Mitsubishi Electric
38		J5 axis	1	
39		J6 axis	1	

No.	Names	Usage place	Q'ty	Supplier
RV-13F/20F (common)				
40	AC servo motor	J1, J2 axis	2	Mitsubishi Electric
41		J3 axis	1	
42		J4 axis	1	
43		J5 axis	1	
44		J6 axis	1	
RV-13F (For standard arm type)/RV-20F				
45	Reduction gears	J1 axis	1	Mitsubishi Electric
46		J2 axis	1	
47		J3 axis	1	
48		J4 axis	1	
49		J5 axis	1	
50		J6 axis	1	
RV-13F (For long arm type)				
51	Reduction gears	J1 axis	1	Mitsubishi Electric
52		J2 axis	1	
53		J3 axis	1	
54		J4 axis	1	
55		J5 axis	1	
56		J6 axis	1	

5.6 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 5-8.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again.Reset the origin using the jig method or ABS origin method.

.
Table 5-8 : 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 Page 19, "2.3 Setting the origin" .
2	Jig method	The origin posture is set with the calibration jig installed.	The setting method is explained in Page 99, "5.6.1 Jig method" .
3	ABS origin method	This method is used when the encoder backup data lost in the cause such as battery cutting.	Before using this method, the origin must be set with the other method with same encoder. The setting method is explained in Page 113, "5.6.2 ABS origin method".
4	User origin method	A randomly designated position is set as the origin posture.	The setting method is explained in Page 116, "5.6.3 User origin method".

5.6.1 Jig method

This method is using the origin setting tool. If the origin setting tool is required, please ask nearby dealer. The reference figure of the origin setting tool is shown in Fig. 5-19.
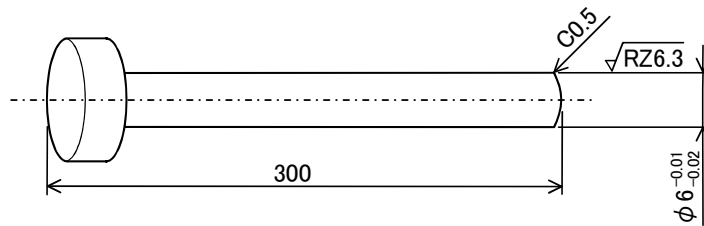
Fig.5-19 : Reference dimension of origin setting tool

The procedure of setting the origin with the origin setting tool is shown below.

Carry out this method for each axis.
First, set each axis by the origin position. There are the method of releasing the brake and adjusting with the origin position manually and the method of adjusting with the origin position by jog feed. Here, explain operation by brake release.
Then, do origin setting operation and set up the origin.

⚠ CAUTION To ensure safety, the brake-release procedure described below should always be done by two persons.

This operation is carried out with the teaching pendant. Set the controller mode to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
Do the following operations, pressing down the enabling switch of T/B lightly.

(1) J1 axis origin setting
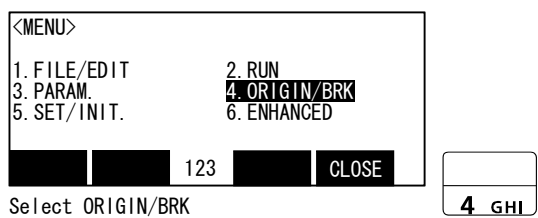
```
<MENU>

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


            123           CLOSE
Select ORIGIN/BRK
```

`4 GHI`

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

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



            123           CLOSE
Select BRAKE
```

`−Z (J3)` `2 ABC`

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

```
<BRAKE>

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

REL.        123           CLOSE
select axis
```

`↑` ~ `→`
`1 '()` `−C(J6)` `0 SPACE`
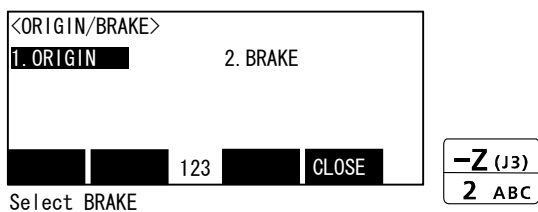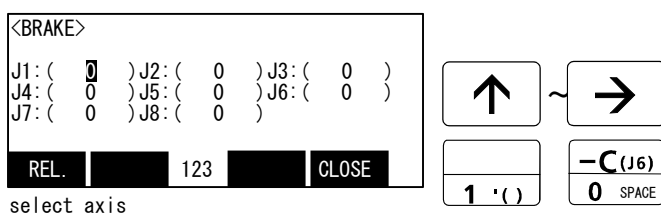
3) Release the brake of the J1 axis.
Input "1" into the J1 axis. Set "0" to other axes.

```
<BRAKE>

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

REL.        123           CLOSE
 Brake release
```

`F1`
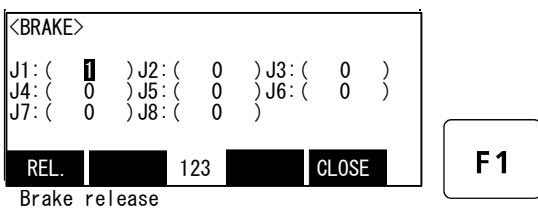
4) Confirm the axis for which the brakes are to be released.
5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
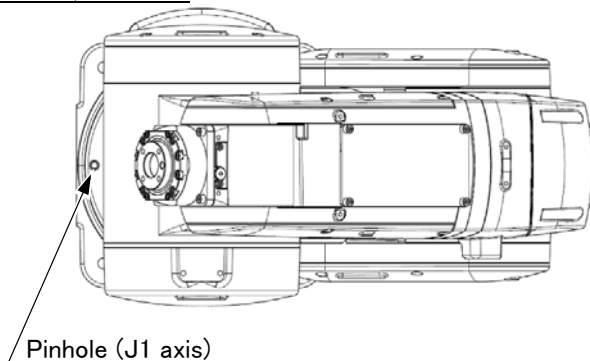
6) Move the J1 axis slowly toward the front using both hands. Align the pinhole of the lower part of the shoulder and the pinhole at the base section, feed through the origin jig (ϕ6) into the pinholes and fasten.

RV-4F/7F series
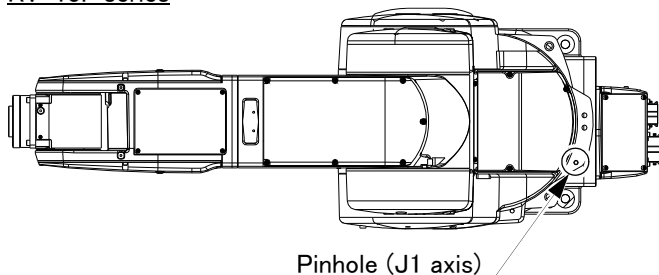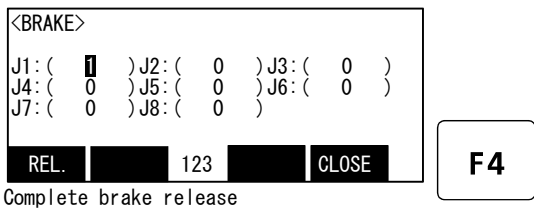
Pinhole (J1 axis)

Diagram of the robot viewed from the top

RV-13F series

Pinhole (J1 axis)

Diagram of the robot viewed from the top

```
<BRAKE>

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

  REL.           123          CLOSE
Complete brake release
```

F4

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

```
<ORIGIN/BRAKE>

1.ORIGIN       2. BRAKE



               123          CLOSE
```

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

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

               123          CLOSE
Select TOOL
```

+Z (J3)
3 DEF

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

```
<TOOL>

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

  REL.           123          CLOSE
```

↑ ~ →

1 '( )   **−C (J6)**
              0 SPACE

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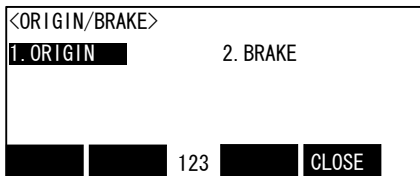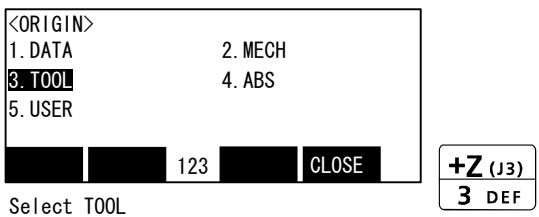
10) Input "1" into the J1 axis. Set "0" to other axes.

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

```
<ORIGIN>  TOOL

   CHANGE TO ORIGIN.  OK?


  Yes            123            No
```

F1

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

```
<TOOL>                  COMPLETED

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

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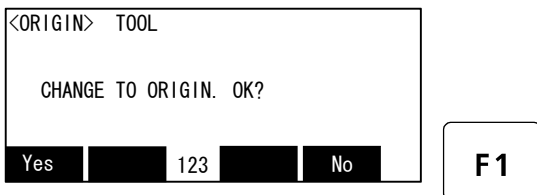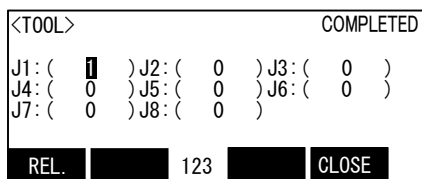
13) Setting of the origin is completed.

14) Refer to Page 118, "5.6.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

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

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

(2) J2 axis origin setting
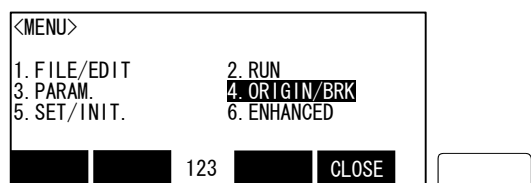
<MENU>

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

123   CLOSE

4 GHI

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

<ORIGIN/BRAKE>

1. ORIGIN   2. BRAKE

123   CLOSE

−Z (J3)
2 ABC

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

<BRAKE>

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

REL.   123   CLOSE

↑ ~ →

1 '( )   **−C (J6)** **0** SPACE
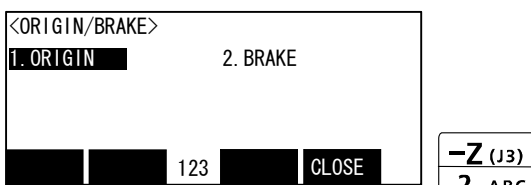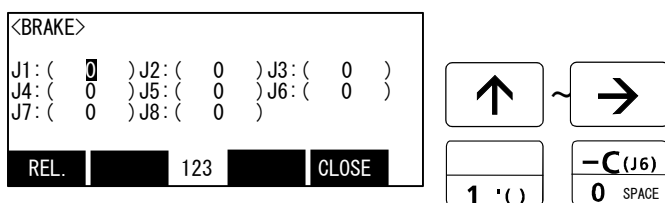
3) Release the brake of the J2 axis.
Input "1" into the J2 axis. Set "0" to other axes.
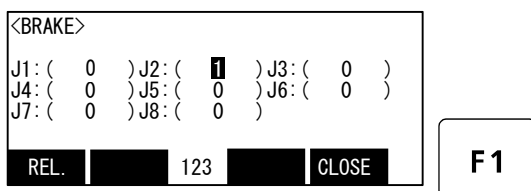
<BRAKE>

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

REL.   123   CLOSE

F1

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

5) One worker must securely support the upper arm with both hands.

6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
Note) In the RV-13F series, brake is released in an off-and-on way, because to drop J2 axis slowly.
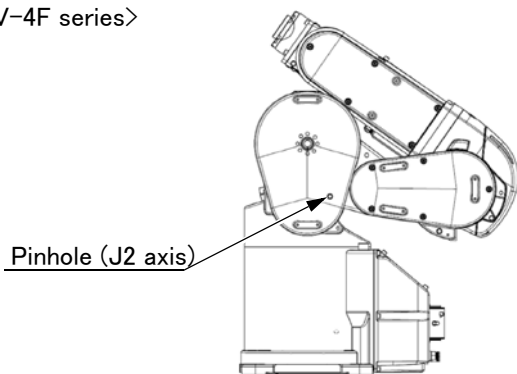
7) With both hands, slowly move the J2 axis to − (minus)107 degree direction (RV-4F series), to 0 degree direction (RV-7F/13F series). Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig (ϕ6) into the pinholes and fasten.

<RV-4F series>

Pinhole (J2 axis)

<RV-7F series>

Pinhole (J2 axis)

<RV-13F series>

Pinhole (J2 axis)

⚠ 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 [F1] key or enable switch of T/B is released, the brakes will be work immediately.

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

[F4]

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

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


              123        CLOSE
```

[1 '()]

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

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

[+Z (J3) / 3 DEF]

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

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

[↑] ~ [→]
[1 '()] [−C (J6) / 0 SPACE]
[EXE]

11) Input "1" into the J2 axis. Set "0" to other axes.

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

```
<ORIGIN>  TOOL

  CHANGE TO ORIGIN. OK?


 Yes          123         No
```

[F1]

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

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

14) Setting of the origin is completed.

15) Refer to Page 118, "5.6.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇

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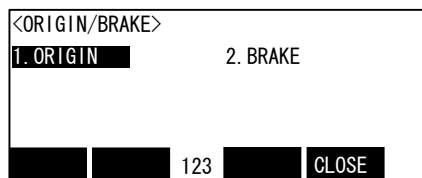
◇◆◇ Select the axis of origin setting ◇◆◇

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

(3) J3 axis origin setting
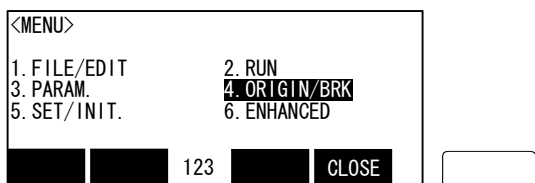
<MENU>

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

```
          123        CLOSE
```

4 GHI

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

<ORIGIN/BRAKE>

1. ORIGIN   2. BRAKE

```
          123        CLOSE
```

−Z (J3)
2 ABC

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

<BRAKE>

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

```
REL.      123        CLOSE
```

↑ ~ →

1 '()   **−C (J6)**
            0 SPACE
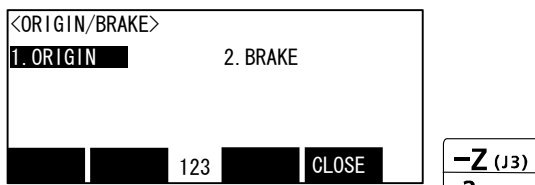
3) Release the brake of the J3 axis.
   Input "1" into the J3 axis. Set "0" to other axes.
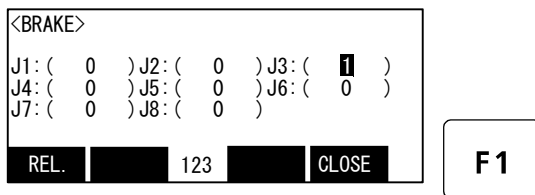
4) Confirm the axis for which the brakes are to be released.

5) One worker must securely support the upper arm with both hands.

<BRAKE>

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

```
REL.      123        CLOSE
```

F1

6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
   Note) In the RV−13F series, brake is released in an off−and−on way, because to drop J2 axis slowly.

<RV−4F series>

Pinhole (J3 axis)

<RV−7F series>
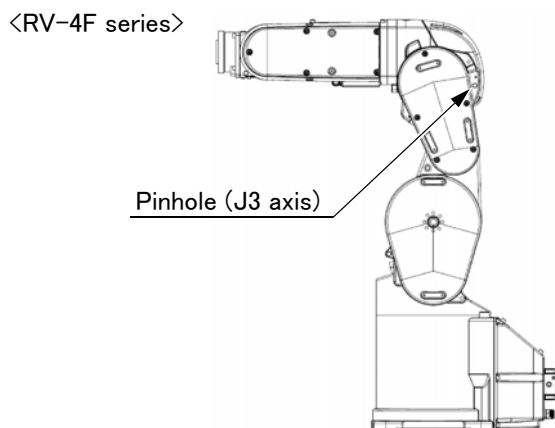
Pinhole (J3 axis)

7) With both hands, slowly move the J3 axis to + (plus) 90 degree direction (RV−4F series), to + (plus) 115 degree direction (RV−7F/13F series). Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig (ϕ6) into the pinholes and fasten.
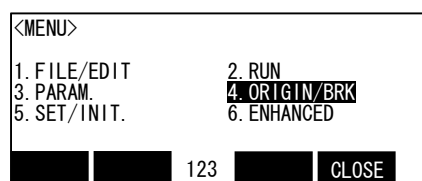
<RV−13F series>

Pinhole (J3 axis)
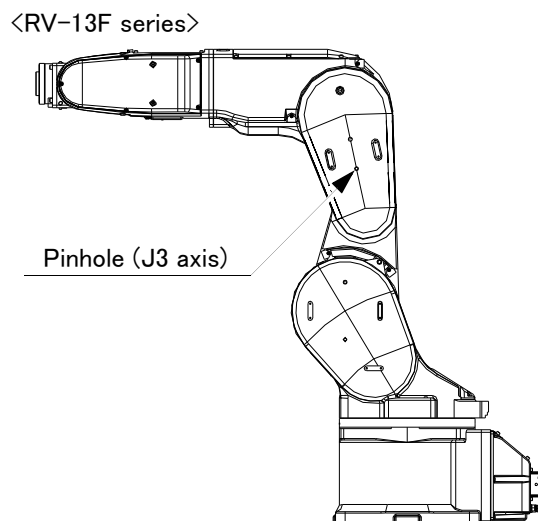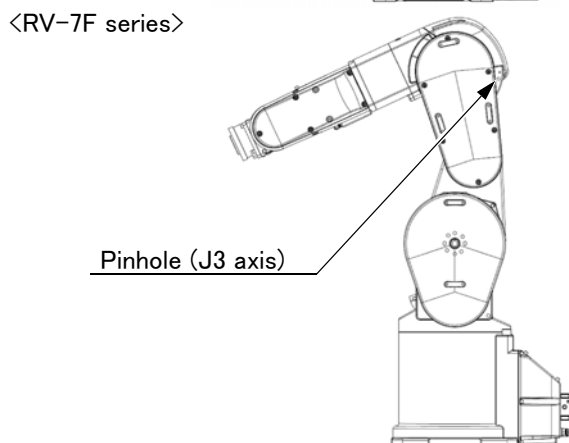
⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.

⚠ CAUTION If [F1] key or enable switch of T/B is released, the brakes will be work immediately.

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

 REL.          123          CLOSE
```

F4

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

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



               123          CLOSE
```

1 '( )

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

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

               123          CLOSE
```

+Z (J3)
3 DEF

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

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

 REL.          123          CLOSE
```

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

11) Input "1" into the J3 axis. Set "0" to other axes.
12) Press the [EXE] key, and display Confirmation screen.

```
<ORIGIN>  TOOL

   CHANGE TO ORIGIN. OK?


 Yes           123           No
```

F1

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

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

 REL.          123          CLOSE
```

14) Setting of the origin is completed.

15) Refer to Page 118, "5.6.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇

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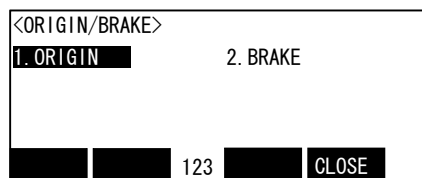
◇◆◇ Select the axis of origin setting ◇◆◇

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

（4）J4 axis origin setting
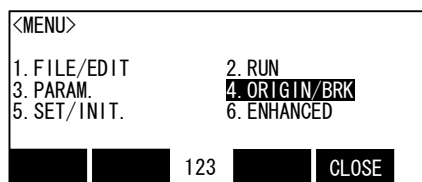
```
<MENU>

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


            123          CLOSE
```

```
 4  GHI
```

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

```
<ORIGIN/BRAKE>

1. ORIGIN         2. BRAKE



            123          CLOSE
```

```
-Z (J3)
 2  ABC
```

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

```
<BRAKE>

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

REL.        123          CLOSE
```

```
  ↑     ~    →


 1  '()    0  SPACE
           -C (J6)
```
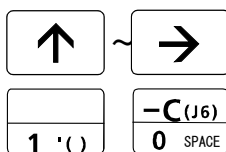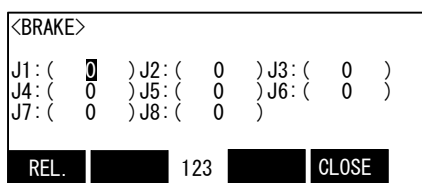
3) Release the brake of the J4 axis.
   Input "1" into the J4 axis. Set "0" to other axes.
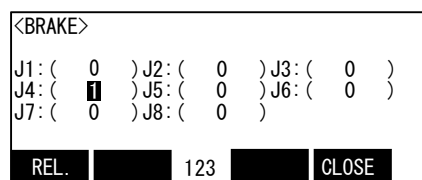
```
<BRAKE>

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

REL.        123          CLOSE
```

```
 F1
```

4) Confirm the axis for which the brakes are to be released.
5) One worker must securely support the upper arm with both hands.

6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
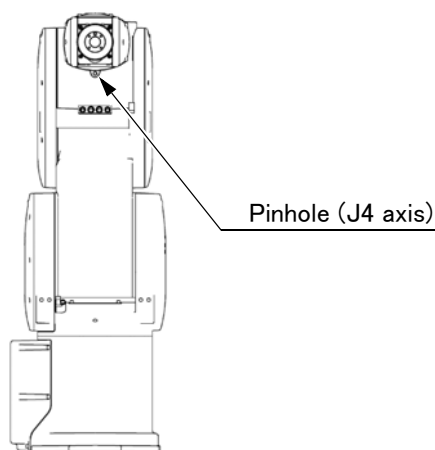
Pinhole（J4 axis）

7) With both hands, slowly move the J4 axis to 0 degree direction, and align the pinholes of the No. 2 arm, feed through the origin jig（φ6）into the pinholes and fasten.

```
<BRAKE>

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

REL.        123          CLOSE
```

```
 F4
```

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

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



           123        CLOSE
```

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

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

           123        CLOSE
```

```
+Z (J3)
3  DEF
```

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

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

```
↑  ~  →

1 '()    −C (J6)
          0 SPACE
EXE
```

11) Input "1" into the J4 axis. Set "0" to other axes.
12) Press the [EXE] key, and display Confirmation screen.

```
<ORIGIN>  TOOL

   CHANGE TO ORIGIN. OK?


Yes        123        No
```

```
F1
```

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

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

14) Setting of the origin is completed.

15) Refer to Page 118, "5.6.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

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

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

(5) Origin setting of J5 axis and J6 axis (jig)

Always perform origin setting of the J5 axis and the J6 axis simultaneously. First, set the J5 axis posture.

```
<MENU>

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


              123         CLOSE
```

`4 GHI`

1) Remove the No.2 arm cover L. The pin hole is inside the cover.
2) Press the [4] key on the menu screen, and display the Origin/BRK selection screen.

```
<ORIGIN/BRAKE>

1. ORIGIN         2. BRAKE




              123         CLOSE
```

`−Z (J3)`
`2 ABC`

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

```
<BRAKE>

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

REL.          123         CLOSE
```

`↑` ~ `→`

`1 '()`   `−C (J6)` `0 SPACE`
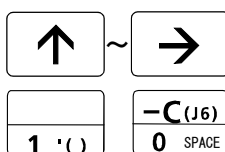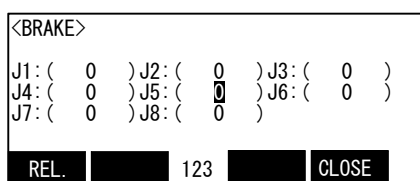
4) Brake release of the J5 axis
Press the [Arrow] key, move the cursor to the J5 axis and press the [1] key. Set [0] to other axes.

```
<BRAKE>

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

REL.          123         CLOSE
```

`F1`
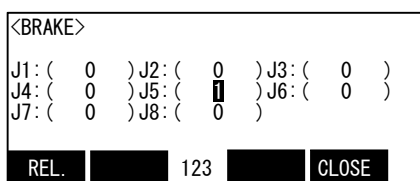
5) Confirm the axis for which the brakes are to be released.

6) The one person needs to support the list part securely with both hands.

7) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.

8) Slowly rotate the J5 axis in the direction of plus 90 degree with both hands. Align the pinholes of the No. 2 arm and wrist , feed through the origin jig (ϕ6) into the pinholes and fasten.
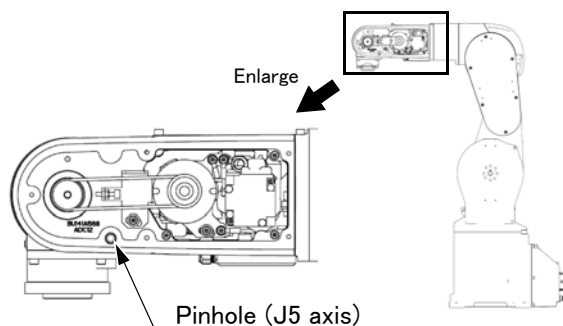
Enlarge

Pinhole (J5 axis)

⚠ **CAUTION** To ensure safety, the brake−release procedure described below should always be done by two persons.
Be careful that the robot arm will fall by the self−weight depending on the posture if the brake is released.

⚠ **CAUTION** If the [F1] key or the enabling switch of T/B is detached, the brake will work immediately.

```
<BRAKE>
J1:(    0   )J2:(    0   )J3:(    0   )
J4:(    0   )J5:(    1   )J6:(    0   )
J7:(    0   )J8:(    0   )
  REL.           123          CLOSE
```
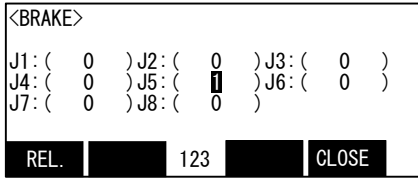
Next, set the J6 axis posture.

Bolt (M6 x 2)
customer preparation

ABS mark
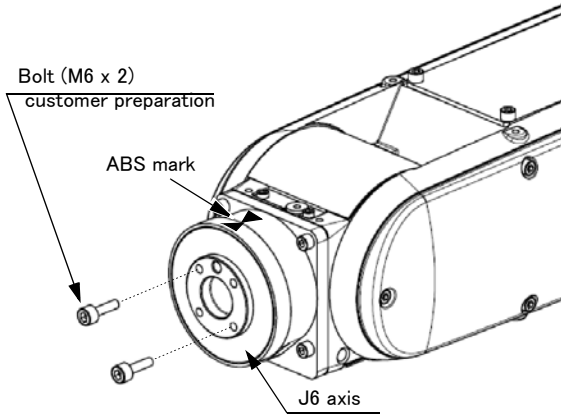
J6 axis

⚠ **CAUTION** The J6 axis of internal wiring and piping specification type have mechanical stopper, but the standard specification type is without mechanical stopper. Please do not move to the position exceeding the operating range (+/−360 degree)

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

↑ ~ →

1 '()   0 SPACE   −C(J6)

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

F1

F4

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


                123          CLOSE
```

9) Detach the [F1] key and work the brake.

10) Install the bolt (M6: 2, customer preparation) in the diagonal position at the J6 axis.
Hold the bolts with hands, rotate them slowly and align the ABS mark of the J6 axis with the ABS mark of the wrist area.
[Press the [Arrow] key, move the cursor to the J6 axis and press the [1] key. Set [0] to other axes.
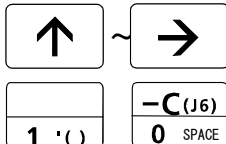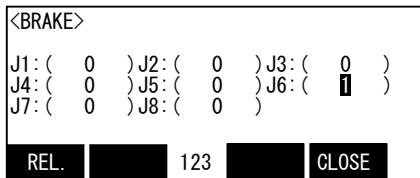
11) Confirm the axis for which the brakes are to be released.

12) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
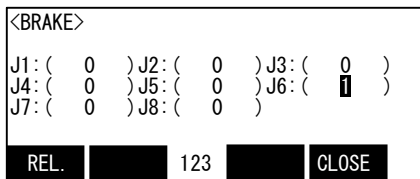
13) Hold the bolts with hands, rotate them slowly and align the ABS mark of the J6 axis with the ABS mark of the wrist area.

14) If the ABS mark is aligned detach the [F1] key and work the brake.
15) Press the [F4] key and return to the origin / brake screen.
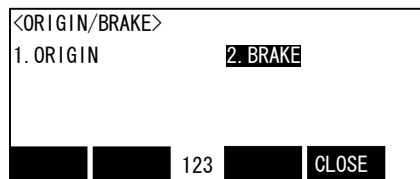
```
<ORIGIN/BRAKE>
1.ORIGIN        2. BRAKE



              123         CLOSE
```

```
 1 '()
```

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

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

              123         CLOSE
```

```
+Z (J3)
 3  DEF
```

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

```
<TOOL>

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

```
↑  ~  →
```

```
 1 '()
```

```
−C (J6)
 0  SPACE
```

```
EXE
```

18) Press the [Arrow] key, move the cursor, and set "1" to the J5 axis and J6 axis. Set [0] to other axes.

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

```
<ORIGIN>  TOOL

   CHANGE TO ORIGIN.  OK?


Yes            123          No
```

```
F 1
```

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

21) Setting of the origin is completed.

```
<TOOL>                    COMPLETED

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

22) Refer to Page 118, "5.6.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

This complete the Origin setting by the Jig method.

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

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

5.6.2 ABS origin method

When the origin setting of the robot is performed for the first time, this product records the angular position of the origin within one rotation of the encoder as the offset value. If the origin setting is performed according to the ABS origin method, this value is used to suppress variations in the origin setting operations and to reproduce the initial origin position accurately.

This operation is carried out with the teaching pendant. Set the controller mode to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
First, set to the ABS mark arrow of the axis for which the origin is to be set with jog operation. This can be set for all axes simultaneously or each axis independently.
When setting the ABS mark, always view the operations from the mark, and set at the end of the triangular mark.
The positions where the ABS mark is attached are shown in below. Refer to Page 26, "2.4 Confirming the operation" for details on the jog operation.
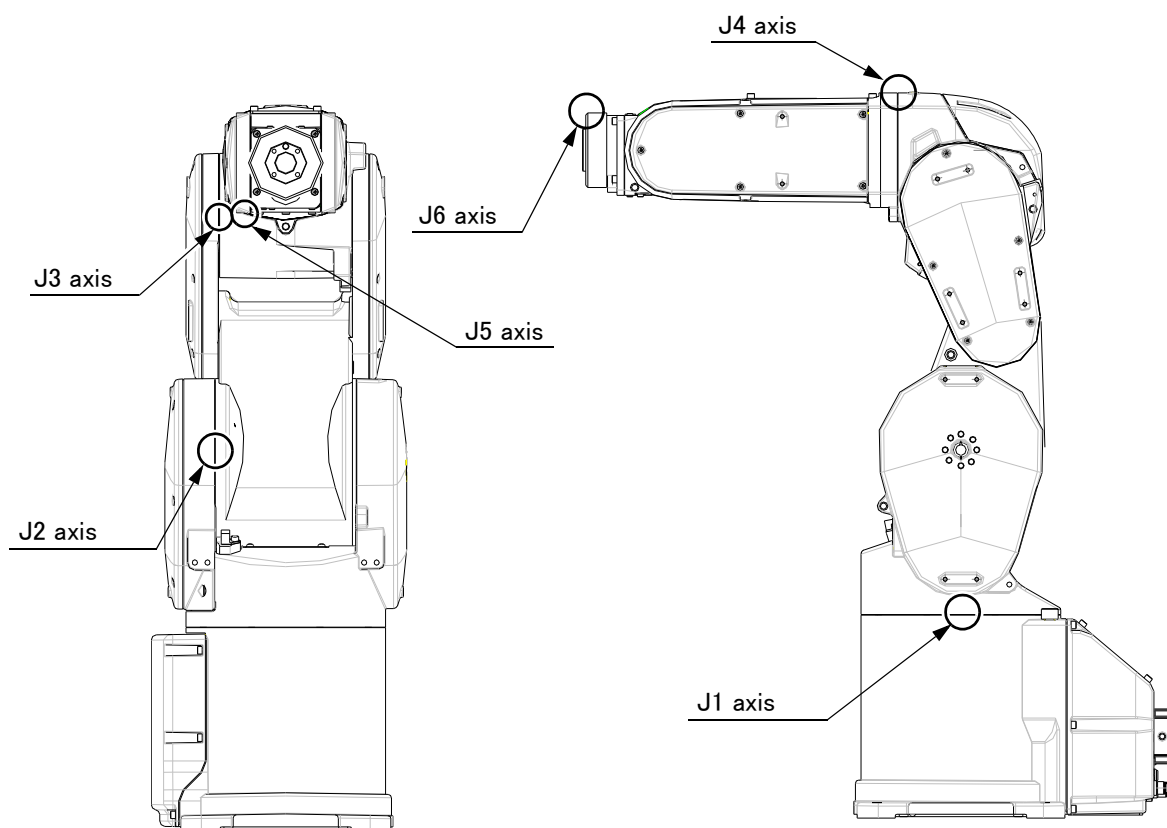
Fig.5-20 : ABS mark attachment positions (RV-4F/7F series)
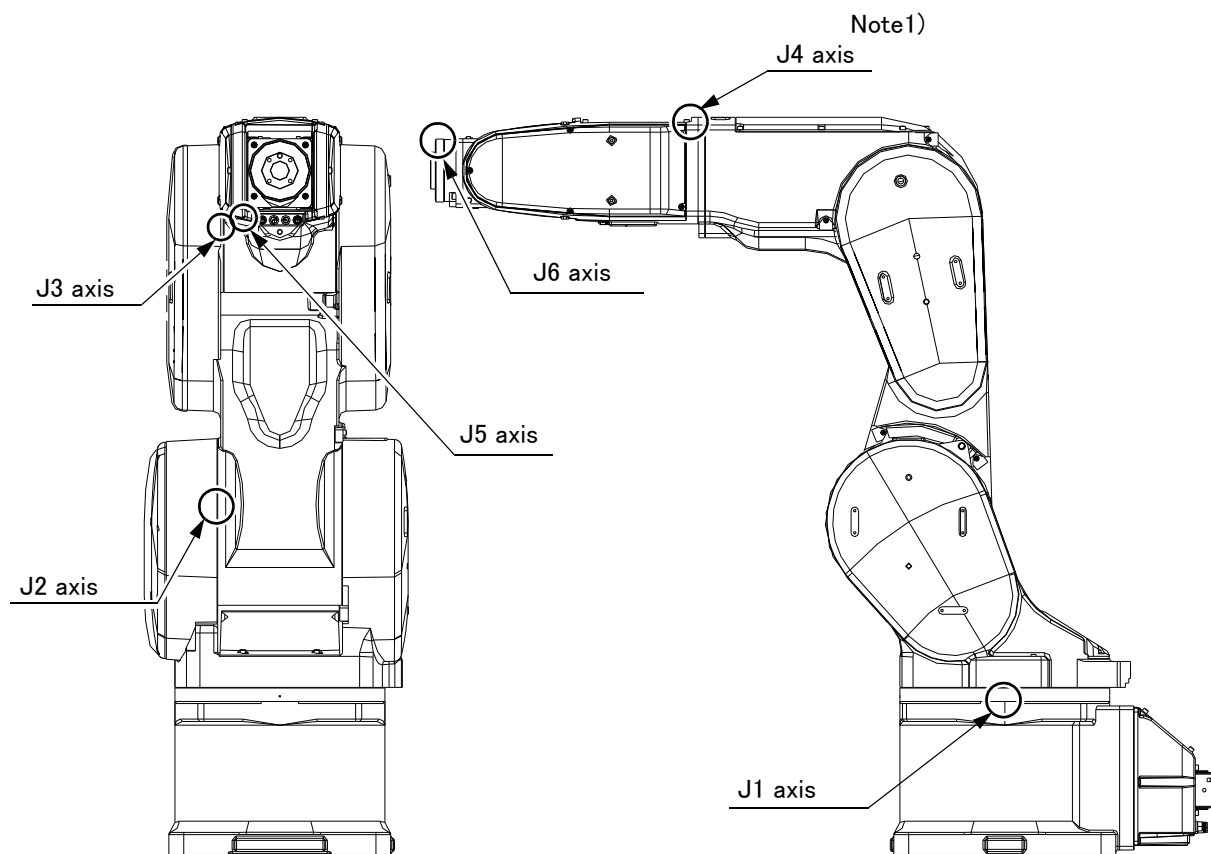
Note1) Refer to Fig. 5-20 for J4 axis mark attachment position.

Fig.5-21 : ABS mark attachment positions (RV-13F series)

The procedures for setting the origin with the ABS method are explained below.

(1) Select the T/B

Do the following operations with pressing the enabling switch of T/B lightly.
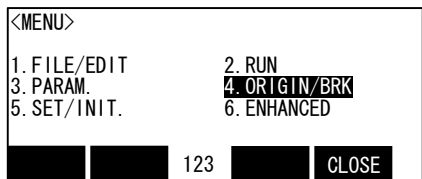
```
<MENU>

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

            123           CLOSE
```

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

4 GHI

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



            123           CLOSE
```

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

1 '( )

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

            123           CLOSE
```
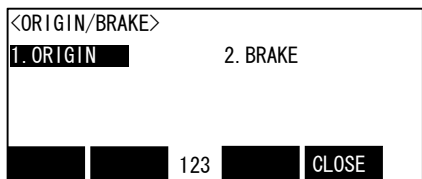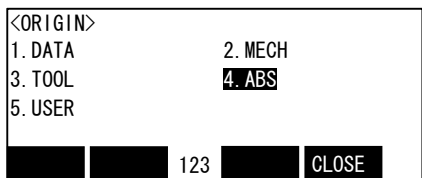
3) Press the [4] key, and display the ABS selection screen.
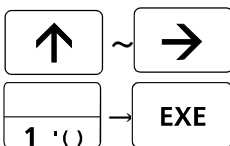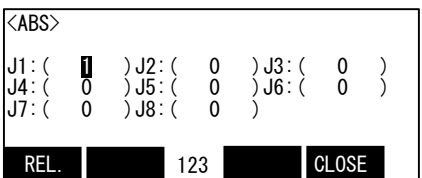
4 GHI

```
<ABS>

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

REL.        123           CLOSE
```

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

↑ ~ →

1 '( ) → **EXE**

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

```
<ORIGIN>  ABS


   CHANGE TO ORIGIN.  OK?


Yes         123            No
```

F1

```
<ABS>

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

REL.        123           CLOSE
```
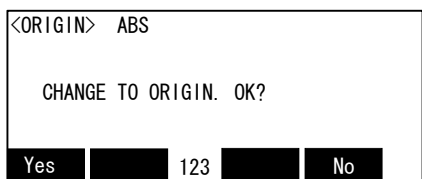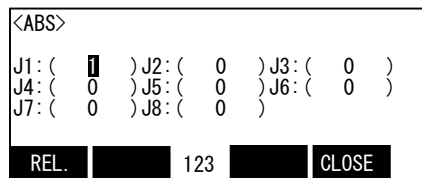
This complete the Origin setting by the ABS method.

5.6.3 User origin method

⚠ CAUTION Before using this method, the origin must be set with the other method.
The setting method is explained in Page 98, "Table 5-8 : Origin setting 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 controller mode to "MANUAL", and set the
[ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown below.

When setting the origin for the first time using this method, carry out the operations in order from step 1). For the
second and following time, move the robot arm to the user origin position with jog operation, and accurately posi-
tion 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 Page 26, "2.4 Confirming
the operation" for details on the jog operation.

⚠ CAUTION Choose the user origin position as the position where it doesn't move by the gravity.
This position is left as a guideline to position all axes with jog operation when setting
the origin again with this method.

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

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

          123          CLOSE
```
[4 GHI]

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



          123          CLOSE
```
[1 '()]

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

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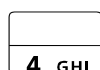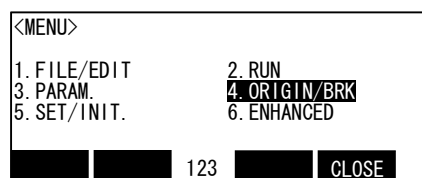
4) Next, set the origin.
Display the menu screen.

5) Press the [4] key on the menu screen, and dis-
play the Origin/Brake selection screen.
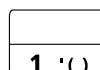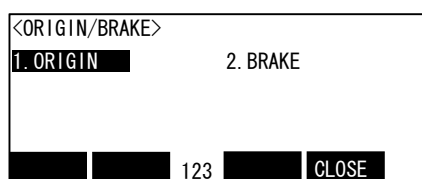
6) Press the [1] key, and display the Origin setting
selection screen.
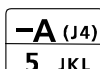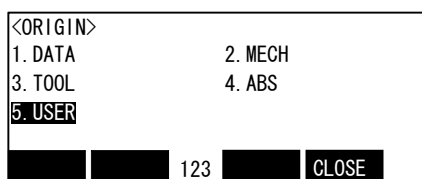
7) Press the [5] key, and display the User selection
screen.
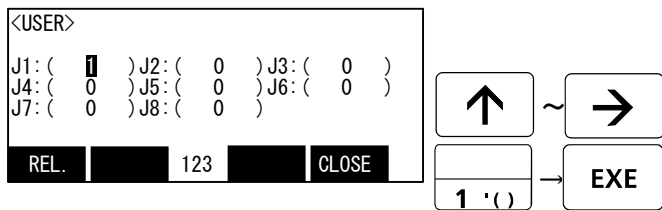
```
<USER>
J1:(   1   )J2:(   0   )J3:(   0   )
J4:(   0   )J5:(   0   )J6:(   0   )
J7:(   0   )J8:(   0   )

 REL.          123          CLOSE
```

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

↑ ~ →

1 '( ) → EXE

```
<ORIGIN>  USER

    CHANGE TO ORIGIN. OK?


 Yes           123           No
```

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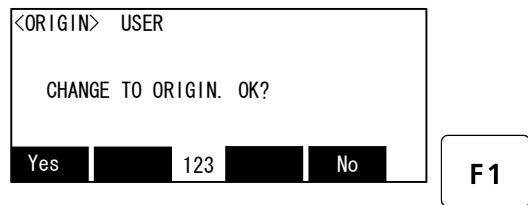
9) Press the [F1] key, and the origin position is set up.

This complete the Origin setting by the User origin method.

5.6.4 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 CONBOX cover.
The teaching pendant operation method and 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 Page 21, "2.3.2 Setting the origin with the origin data input method", and write the origin data displayed on the teaching pendant onto the origin label.

(1) Confirming the origin data label
Remove the CONBOX cover.
Refer to Page 76, "5.3.2 Installing/removing the cover", and remove the CONBOX cover.

(2) Confirming the origin data
Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to Page 21, "2.3.2 Setting 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 CONBOX cover. Refer to Page 21, "Fig.2-13 : Origin data label (an example)", and Page 24, "Fig.2-14 : Correspondence of origin data label and axis" for details on the origin data label.

(4) Installing the cover
Install the CONBOX cover removed in step "(1)Confirming the origin data label" above.
Refer to Page 76, "5.3.2 Installing/removing the cover", and replace the CONBOX 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

Q is center of J5 axis rotation in comparison with the plane through the J1 axis vertical to the ground.
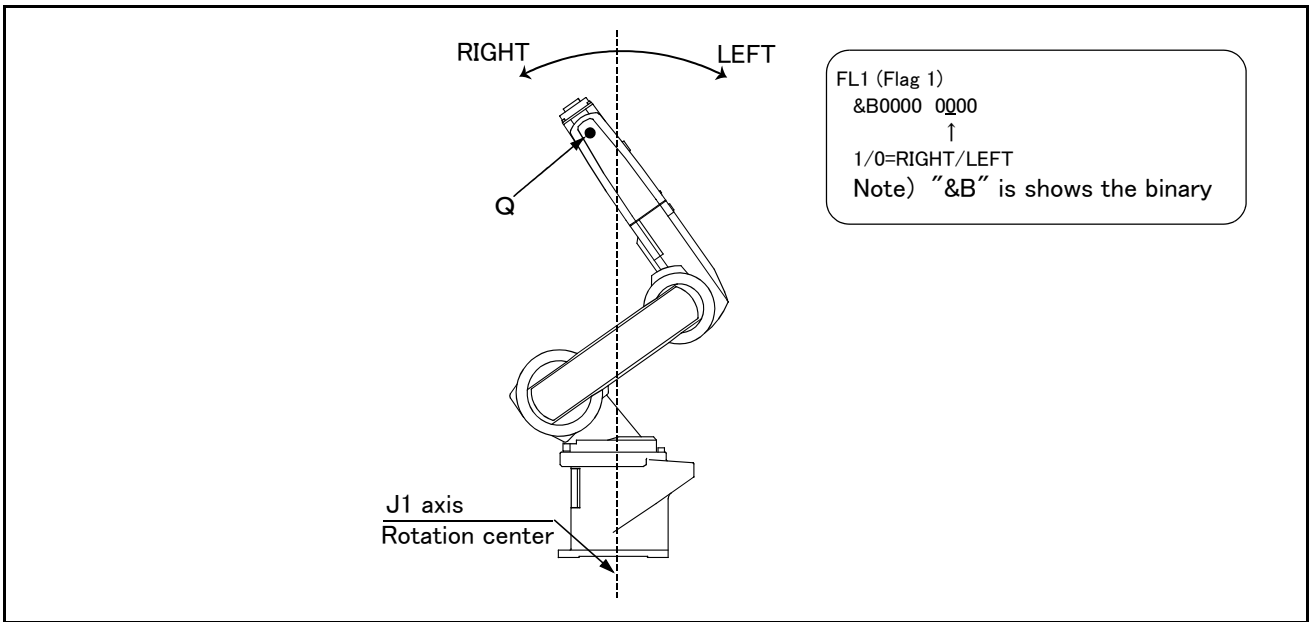
Fig.6-1 : Configuration flag (RIGHT/LEFT)

(2) ABOVE/BELOW

Q is center of J5 axis rotation in comparison with the plane through both the J3 and the J2 axis.
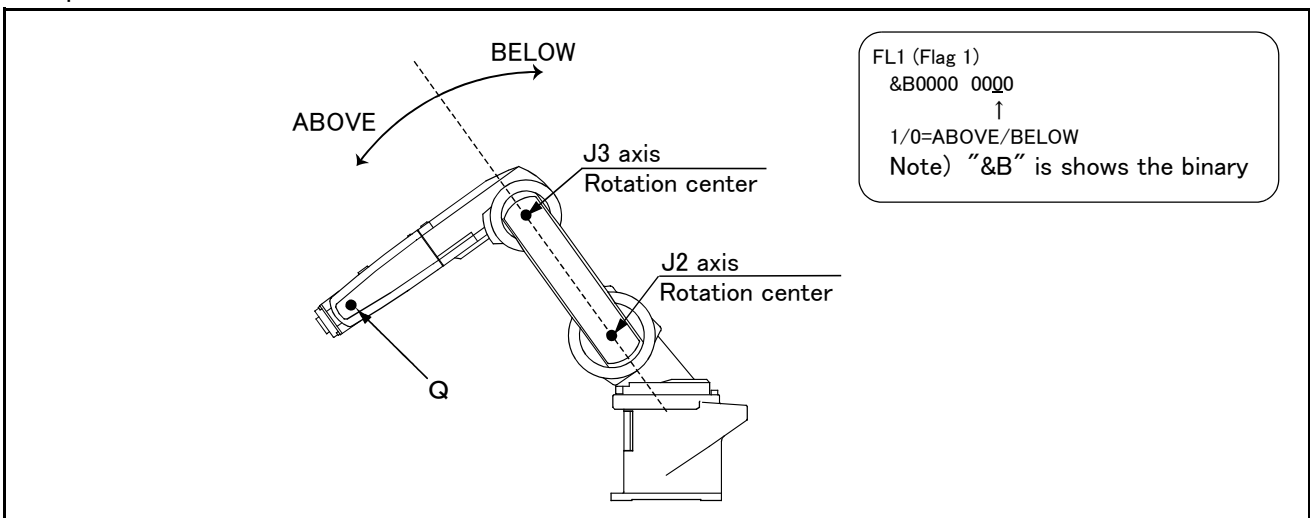
Fig.6-2 : Configuration flag (ABOVE/BELOW)

(3) NONFLIP／FLIP
   This means in which side the J6 axis is in comparison with the plane through both the J4 and the J5 axis.

FLIP

J4 axis

NON FILIP

J6 axis flange surface

FL1 (Flag 1)
 &B0000 000<u>0</u>
            ↑
 1/0=NONFLIP/FLIP
 Note) ″&B″ is shows the binary
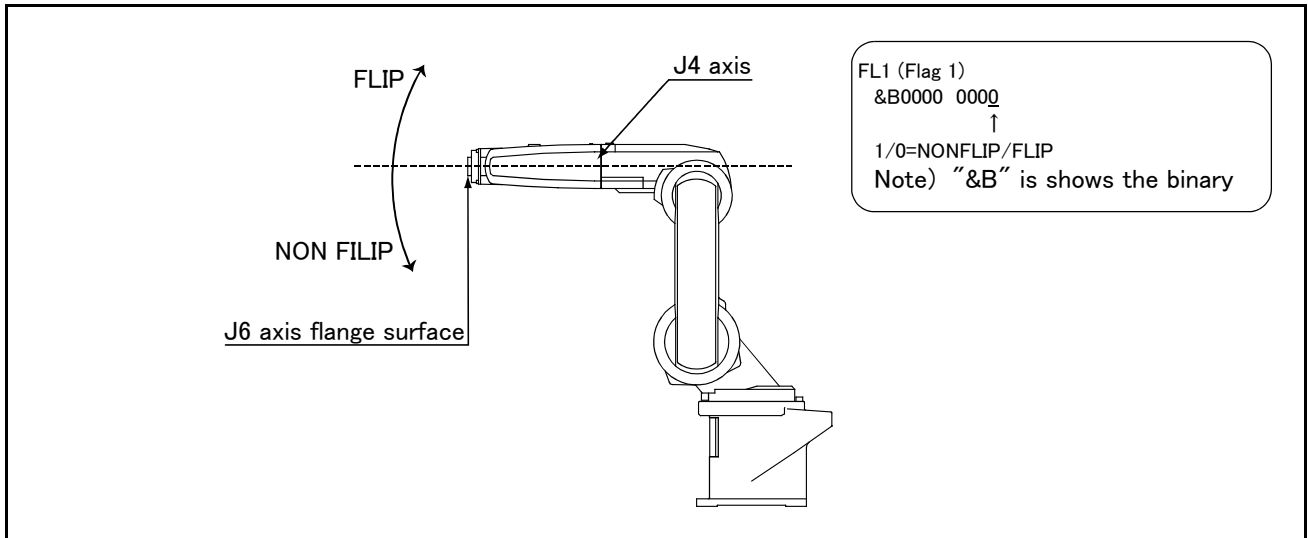
Fig.6-3 : Configuration flag (NONFLIP／FLIP)

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