

# Mitsubishi Industrial Robot

**RV-2F Series** 

# **INSTRUCTION MANUAL**

**ROBOT ARM SETUP & MAINTENANCE** 





### 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.

### 

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

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

♠ DANGER	When automatic operation of the robot is performed using multiple control
	devices (GOT, programmable controller, push-button switch), the interlocking of

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.)

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.

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.

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.

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.

**⚠** DANGER

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

**⚠** DANGER

Do not remove the SSCNET III cable while power is supplied to the controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

♠ DANGER

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

**A** CAUTION

Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors 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.

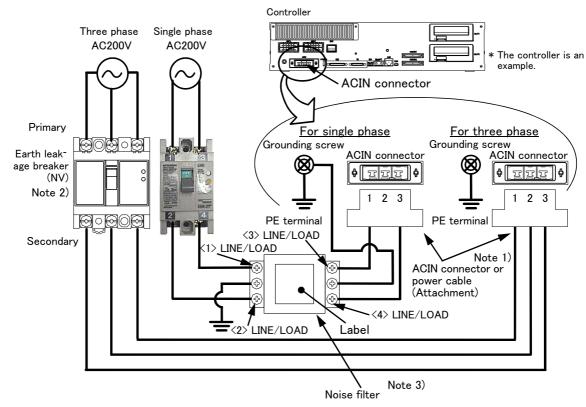
**A** CAUTION

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.

Notes of the basic component are shown.

### **A** 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.



- Note 1) Crimping swage is recommended for connecting the attachment ACIN connector (soldering is also possible)
  Recommendation compression tools: 234171-1(Tyco Electronics)
- Note 2) The earth leakage breaker is the customer preparation. Always use the cover below.

  Recommendation: For single primary power supply ......... NV30FAU-2P-10A-AC100-240V-30mA, (Cover: TCS-05FA2)

  For three primary power supply ............. NV30FAU-3P-10A-AC100-240V-30mA, (Cover: TCS-05FA3)
- Note 3) If necessary, as shown in the figure, connects the noise filter between ACIN terminal blocks and primary power supply.

  (Recommended noise filter: SUP-EL20-ER6 \*OKAYA ELECTRIC INDUSTRIES)
  - Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary power supply (AWG #14 (2mm<sup>2</sup> or above), cables to ground the primary power supply (AWG #12 (3.5mm<sup>2</sup> or above).
    - The secondary power cable (with the ACIN connector) for single phase or three phase power is supplied with the product to match the specifications. When you build a cable suitable for your environment using the ACIN connector and the ACIN terminal supplied, prepare a secondary power cable (AWG #14 (2mm<sup>2</sup>) or above).
  - 2) Confirm that the primary power matches the specifications.
  - 3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.
  - 4) Connect the secondary power cable.
    - a) When using the supplied power cable with the ACIN connector

Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.

b) When building a power cable using the ACIN connector and the ACIN terminals supplied

Connect the ACIN terminals with the secondary power cable (prepared by customers), and insert the ACIN terminals to the ACIN connector pins with the following numbers. Crimping caulking is recommended to connect the ACIN terminals.

For single phase: 1 and 3
For three phase: 1, 2, and 3

Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.

- 5) Connect this ACIN connector to the ACIN connector on the front of the controller.
- 6) Connect the grounding cable to the PE terminal. (M4 screw)
- 7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

#### Revision history

Date of Point	Instruction Manual No.	Revision Details
2012-06-21	BFP-A8904	• First print
2012-10-03	BFP-A8904-A	<ul> <li>The movement direction of the joint jog and 3-axis XYZ jog of the J5 axis was corrected (error in writing).</li> <li>The notes about installation of the controller and the robot arm were added. (neither direct rays nor the heat of lighting)</li> </ul>
2012-11-19	BFP-A8904-B	<ul> <li>The lithium battery type was added to "Table 5-6: Consumable part list".</li> <li>The statement about trademark registration was added.</li> </ul>
2012-12-21	BFP-A8904-C	The connection place of machine cable connector CN2 of the CR751 controller was corrected. (Error in writing)
2013-07-18	BFP-A8904-D	<ul> <li>Description of "2.2.5 Connecting with the controller" were modified.</li> <li>J5 axis origin setting (mechanical stopper method) was corrected.</li> </ul>
2013-09-20	BFP-A8904-E	• "Table 2-2: Strength of the installation side (reference)" was added.
2014-01-07	BFP-A8904-F	<ul> <li>The illustration of the dummy connector was corrected.</li> <li>The descriptions of default charge amount of lubrication oil was deleted.</li> <li>How to choose the origin setting method when an origin resetting is required was added.</li> <li>Lubrication amounts are given in both g and ml.</li> <li>The cover to be removed when origin setting of J5 and J6 axis by jig method was corrected to the No.2 arm cover R.</li> </ul>
2014-03-31	BFP-A8904-G	<ul> <li>Ex-T control function was added.</li> <li>The procedures of installing the operating range change (option) were added.</li> </ul>
2014-08-20	BFP-A8904-H	The cover and corporate logo mark of this manual was changed. The explanation of CR751 controller was added.
2014-12-19	BFP-A8904-J	<ul> <li>"(1) Replacing the battery (robot arm)" was changed.</li> <li>The explanation of the origin setting method were added. The description of the setting range of ABS origin method was added.</li> <li>How to set the parameter MORG when changing the operating range of J1 and J2 axis were added.</li> <li>The corporate logo mark of illustrations in this manual was changed.</li> <li>The recommended grease gun is changed to KH-120. (formerly: KH-32)</li> </ul>
2015-03-10	BFP-A8904-K	The description about the specification of RV-2FL/2FLB were added.
2016-04-06	BFP-A8904-M	• "2.2.2 Transportation procedures (Transportation by people)" was supplemented.

#### \*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-2F/2FB/2FL/2FLB

Note) Indicates it as RV-2F series.

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- $\boldsymbol{\cdot}$  The details of this manual are subject to change without notice.
- 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." or "alarm may occur".

Please contact your nearest dealer if you find any doubtful, wrong or skipped point.

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#### 1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions. Moreover, handling and operation of a teaching pendant (T/B) are described based on R32TB (R33TB) in instruction manuals. If using other T/B, such as R56TB (R57TB), refer to a supplied instruction manual of the T/B.

#### 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 Manua
--------------

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		
	iQ Platform			
	Controller	Indicates the controller which controls the robot arm. It consists of the robot CPU system and the drive unit.		
Item	The robot CPU unit or robot CPU	Indicates the CPU unit for the robots which installed to the sequencer base unit (Q3 $\square$ 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.		
	Stand-alone type			
Item	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, CR751-06HD/Q, CR751-12HD/Q, CR751-20HD/Q, CR751-03HRD/Q, CR751-02VD/Q, CR751-04VD/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

### **/**NWARNING

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.

### <u>∕!\</u> DANGER

When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.

### <u>/!</u>\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.

### /i\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.

### <u>/!</u>\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.

### ∕<u>i</u>∖ 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.

### **⚠**CAUTION

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

### /!\ DANGER

Do not connect the Handy GOT to a programmable controller when using an iQ Platform compatible product with the CR750-Q/CR751-Q/CR760-Q controller. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

### /!\ DANGER

Do not remove the SSCNET III cable while power is supplied to the multiple CPU system or the servo amplifier. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables of the Motion CPU or the servo amplifier. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

### /!\DANGER

Do not remove the SSCNET III cable while power is supplied to the controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

### /!\DANGER

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

### **⚠**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

### /!\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.

#### 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".

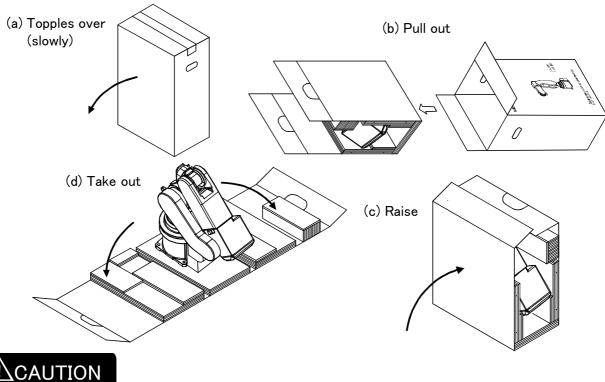
Table 2-1: Standard configuration

No.	Part name	Туре	Qty.	Remarks	
1	Robot arm	RV-2F series	1 unit		
2	Guarantee card		1 сору		
3	Installation bolts	M8x35	4 pcs.		
4	Spring washer for installation bolts	For M8	4 pcs.		
5	Plain washer for installation bolts	For M8	4 pcs.		
6	Fixing plate A		1 pc.	This is installed in the robot arm at the time of shipment.	
7	Safety socket for fixing plate A	M5x12	3 pcs.		
8	Plain washer for fixing plate A	For M5	3 pcs.	- - -	
6	Fixing plate B		1 pc.		
7	Safety socket for fixing plate B	M5x12	3 pcs.		
8	Plain washer for fixing plate B	For M5	3 pcs.		
6	Fixing plates C		1 pc.	This is installed in the RV-2FL/2FLB robot arm at the time of shipment.	
7	Safety socket for fixing plate C	M3x12	2 pcs.		
9	Grease nipple	For J5 and J6 gears	3 pcs.		

#### 2.2 Installation

#### 2.2.1 Unpacking

#### (1) RV-2F/2FB



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

Notes) The packing material is required at re-transportation. Please keep it with care.

Fig.2-1: Unpacking the robot arm (RV-2F/2FB)

The robot is shipped from the factory in cardboard and plywood packing. Always refer to Fig. 2-1 and unpack the

Handle the robot arm according to "2.2.2Transportation procedures (Transportation by people)".



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.

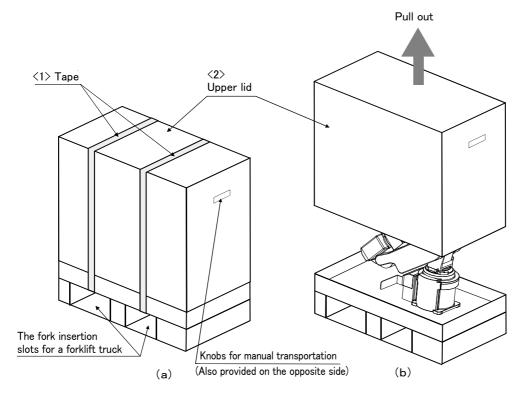
- 1) The cardboard box is toppled over horizontally slowly. Take care so that a shock may not be given (Fig. 2-1 (a))
- 2) Using a knife, etc., slit the tape fixing the upper lid of the cardboard box.
- 3) Pull out inner box horizontally with the handle. (Fig. 2-1 (b))
- 4) Raise the inner box and the robot simultaneously. (Fig. 2-1 (c))
- 5) Remove the robot from the inner box. (Fig. 2-1 (d))

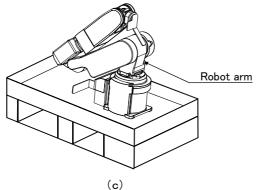
[Note] Do not remove the fixing plate A and B until installation finishes. Always attach the fixing plates while transporting the robot.



When repackaging the robot in the wooden frame, always use the fixing plates.

#### (2) RV-2FL/2FLB





## **ACAUTION**

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

### **ACAUTION**

An unopened package shall be transported by a forklift truck or by manually (with two workers).

Notes) The packing material is required at re-transportation. Please keep it with care.

Fig.2-2: Unpacking the robot arm (RV-2FL/2FLB)

The robot is shipped from the factory in cardboard and plywood packing. Always refer to Fig. 2–2 and unpack the robot. Handle the robot arm according to "2.2.2Transportation procedures (Transportation by people)".



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. 2-2 (a))
- 2) Pull the upper lid <2> of the cardboard box off with both hands. (Fig. 2-2 (b))
- 3) Remove the hexagon socket bolts <3> (four positions) connecting the sleeper and the base unit. (Fig. 2-2 (c))

[Note] Do not remove the fixing plate A, B, and C until installation finishes. Always attach the fixing plates while transporting the robot.



When repackaging the robot in the wooden frame, always use the fixing plates.

#### 2.2.2 Transportation procedures (Transportation by people)

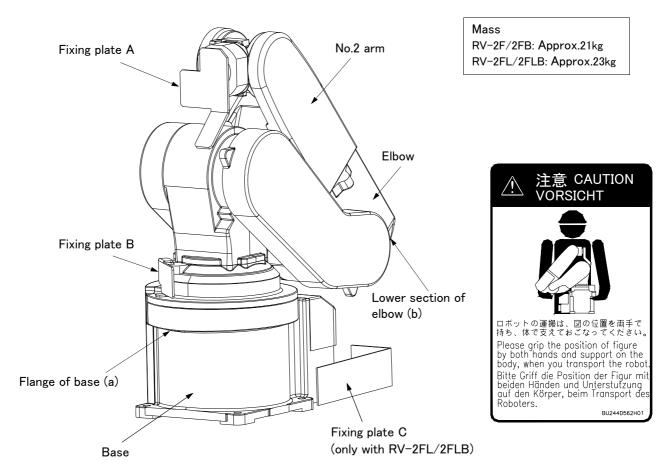
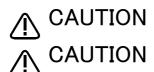


Fig.2-3: Transportation of robot arm (Transportation by people)

- 1) The robot be transported by one worker. Place the robot on a dolly, etc. and move it to the vicinity of the installation site.
- 2) Raises the robot as supports the robot's left side by your body with having the flange of base (a) and the lower section of elbow (b).
  - Please be sure to avoid holding the robot from the front/back side or by the cover because the robot may tilt over and the cover may be damaged or dropped, which may lead to accidents.
- 3) When transporting the robot, do not apply force on the cover, or apply a strong impact on the robot
- 4) Remove the fixing plates after installing the robot.

  In RV-2FL/2FLB, reattach two screws (M3) to plug the holes after removing the fixing plate C. Otherwise, a protection specification (IP30) is not satisfied.
- 5) Always attached the fixing plate, and 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 holded without using the specified fixing plates, or if it is holded 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.



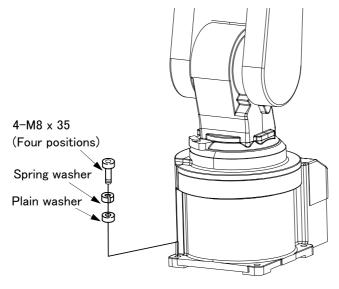
To prevent accidents, do not hold the robot from the front/back sides, or hold covers that have no grips.

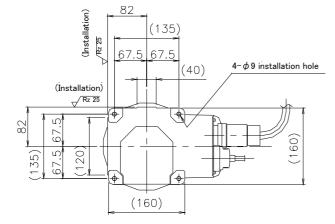
If it is difficult to follow the transportation procedure shown in this section, take countermeasures not to allow the joints of the robot arm freely move by fixing the robot arm in such a way as to take advantage of the screw holes for fixing plates or the like. Otherwise, applying an excessive power on the joints by external forces may cause a malfunction. Do not apply an excessive load to the robot arm while fixing it. Otherwise, the robot arm may be damaged.

#### 2.2.3 Installation procedures

The installation procedure of the robot arm is shown below.

- 1) The robot installation surface has been machine finished. Use the installation holes  $(4-\phi 9 \text{ holes})$  opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (M8 x 35 hexagon socket bolts).
- 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".
- The installation surface must have sufficient strength to withstand the arm reaction during moving the robot at high speed.

Fig.2-4: Installation dimensions

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

Item		Unit	Value
Falling moment : ML		N m	240
Twist moment : MT		N m	150
Horizontal translation power	: FH	N	700
Vertical translation power	: FV	N	820



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

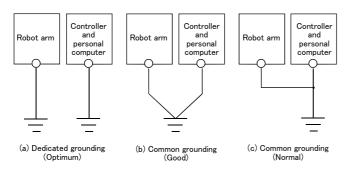


Fig.2-5: Grounding methods

- 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  $100\,\Omega$  or less). Dedicated grounding separated from the other devices should be used.
- 3) Use a AWG#11(4.2mm²) or more stranded wire for the grounding wire. The grounding point should be as close to the robot arm and controller as possible, and the length of the grounding wire should be short.

#### (2) Grounding procedures

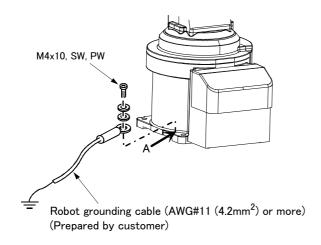


Fig.2-6: Connecting the grounding cable

- 1) Prepare the grounding cable (AWG#11(4.2mm<sup>2</sup>) 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.
- Connect the grounding cable to the grounding screw section.

#### 2.2.5 Connecting with the controller

#### (1) CR750 controller

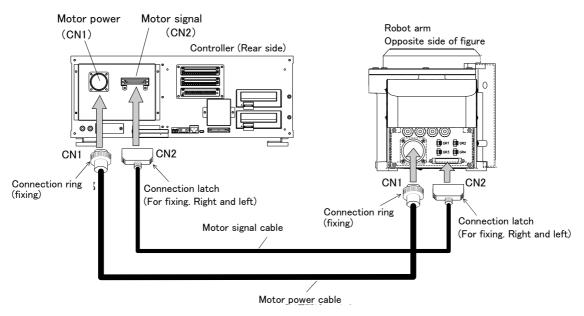


Fig.2-7: Connecting the machine cables (CR750)

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

- 1) Make sure that the power switch on the front of the controller is turned OFF.
- 2) Refer to Fig. 2-7 and connect the machine cable to its corresponding connector on the robot arm side and controller.

Connect the CN2 first at connection. Conversely, remove the CN1 first at removal.

After CN1 unites the key slot with each other's connector, insert the connector. And rotates the connection ring section to fix it securely.

Pick the latch of both sides on CN2 connector, and inserts CN2. CN2 is fixed when the latch is released.



Please connect the connector securely.

If it inserts by force, the pin will break. And it becomes the cause of failure.



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.



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

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

#### (2) CR751 controller

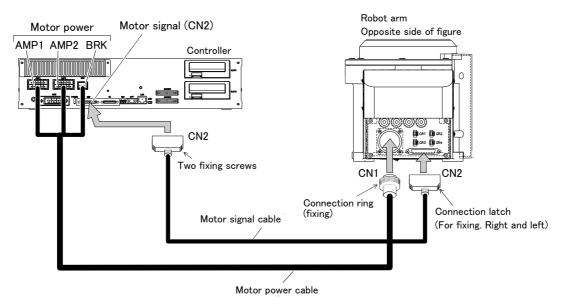


Fig.2-8: Connecting the machine cables (CR751)

Carry out the following procedure after installing the controller and the robot arm referring to the separate "Controller Setup, Basic Operation and Maintenance" and Page 10, "2.2.3 Installation procedures".

And attach a cable fixation plate to the controller referring to the separate "Controller Setup, Basic Operation and 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.
- 2) Refer to Fig. 2-8 and connect the machine cable to its corresponding connector on the robot arm side and controller.
- 3) Connect the machine cable to its corresponding connector CN1 and CN2 on the robot arm side. The robot arm side connects CN2 first. Conversely, when removing, remove the CN1 first. Pick the latch of both sides on CN2 connector, and insert CN2. CN2 is fixed when the latch is released. CN1 connector (robot arm side) unites the key slot with each other's connector, insert the connector. And rotates the connection ring section to fix it securely.
- 4) Connect the machine cable to the corresponding connectors AMP1, AMP2, BRK and CN2 of the controller. Fix CN2 connector by two tightening screws. Tighten the fixing screw of CN2 by 0.06-0.07 Nm.

The connection of machine cables is completed.



Please connect the connector securely.

If it inserts by force, the pin will break. And it becomes the cause of failure.

**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

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

#### 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 80, "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 80, "5.6 Resetting the origin" and reset the origin using the jig method, mechanical stopper 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.

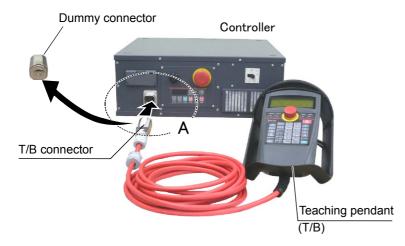


Please do not pull the cable of T/B strongly or do not bend it too much. It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself.

#### (1) 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. 2-9, 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.2-9: 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) 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. 2-10.

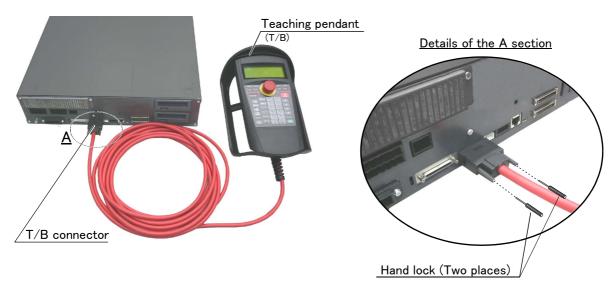


Fig. 2-10: Installing and removing the T/B (CR751controller)

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

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 J1 motor cover. (Refer to Fig. 2-11).

Referring to Page 59, "5.3.2 Installing/ removing the cover", remove the cover above and confirm the value.

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

Fig.2-11: Origin data label (an example)

\* The origin data to input is found on also the robot examination report sheet.



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

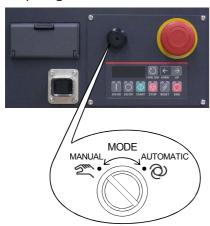
Confirm that there are no operators near the robot before turning the power ON.

1) Turn the controller [POWER] switch ON.

The CR750 controller turns ON the front power switch.

The CR751 controller turns ON the switch of the earth leakage breaker of installation outside.

#### (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)



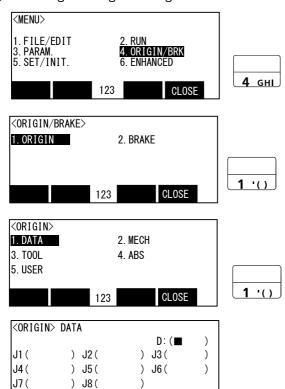
2) Set the T/B [ENABLE] switch to "ENABLE". The menu selection screen will appear.

The following operations are carried out with the T/B.

#### ♦♦♦ 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

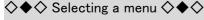


1) Press the [4] key on the menu screen, and display the ORIGIN/BRAKE screen.

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

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

4) Display the origin data input screen



The menu can be selected with one of the following methods.

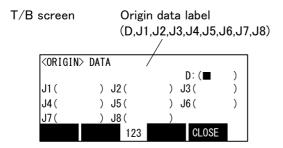
**CLOSE** 

- A: Press the numeral key for the No. of the item to be selected.
- B: Using the  $[\ \downarrow\ ]$  and  $[\ \uparrow\ ]$  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

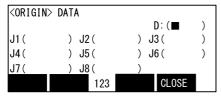


Input the value confirmed in section Page 16, "(1) Confirming the origin data".

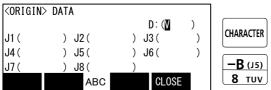
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-12.

Fig.2-12: Correspondence of origin data label and axis

The method for inputting the origin data is explained below. The value shown in Fig. 2-11 will be input as an example.



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

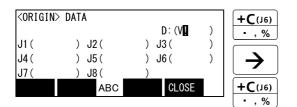


2) Input the D value "V!%S29".

#### Inputting "V"

Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen)

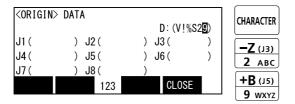
Press the [TUV] key three times. "V" will be set.



#### Inputting "!"

Press the [ , % ] key five times. "!" will be set. Press the [  $\rightarrow$  ] key once and advance the cursor.

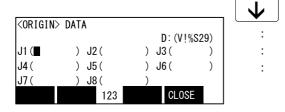
Press the [ , % ] key twice (input "%"), and press the [PQRS] key four times (input "S").



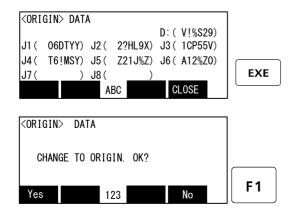
Press the [CHARACTER] key and set to the numeral input mode. (Condition that "123" was displayed under the screen)

Press the [2] key (input "2"), and press the [9] key (input "9")

"V!%S29" will appear at the "D" data on the teaching pendant screen.



- 3) Press the [  $\downarrow$  ] 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.



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

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

- $\diamondsuit \spadesuit \diamondsuit$  Moving the cursor  $\diamondsuit \spadesuit \diamondsuit$ Press the  $[\uparrow], [\downarrow], [\leftarrow]$  and  $[\rightarrow]$  keys.
- ♦♦ Inputting characters ♦♦♦

  Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen). The displayed character is scrolled each time at pressing the key.
- ♦♦♦ Correcting an input ♦♦♦
  After returning one character by pressing the [CLEAR] key, input the character again.
- (6) Installing the J1 motor cover.

Return the J1 motor cover removed in section Page 16, "(1) Confirming the origin data" to its original position. This completes the setting of the origin with the origin data input method.



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



### 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.



### 

To check whether the origin of the robot deviates, move the robot arm to the position where the ABS marks align each other, and check the displayed joint coordinates of the position.

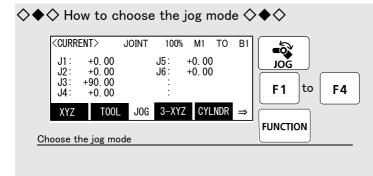
For the details of the ABS mark position and the joint coordinates, refer to Page 80, "5.6 Resetting the origin", and Page 104, "5.6.3 ABS origin method".



### 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.

In such a case, the robot may operate beyond the software-defined operating range, which will cause interference or collisions between the robot mechanical sections. Refer to Page 14, "2.3 Setting the origin" for details on setting the origin.



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).

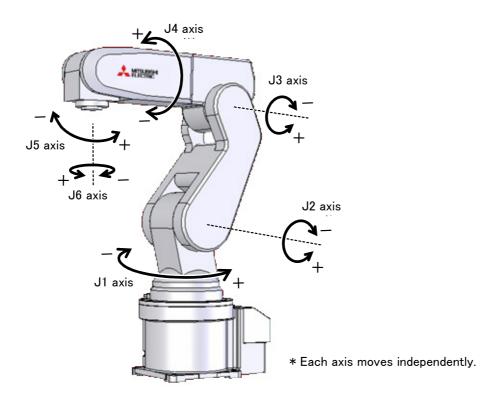


Fig.2-13: JOINT jog operation

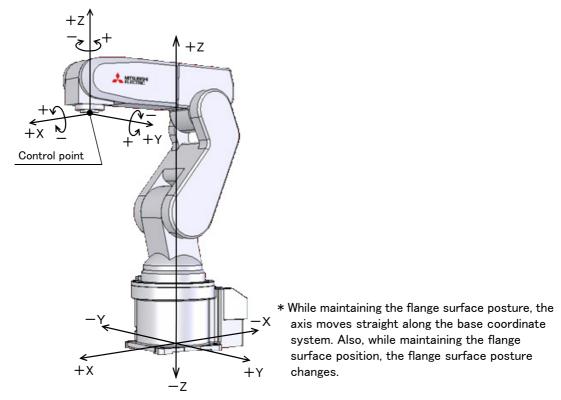
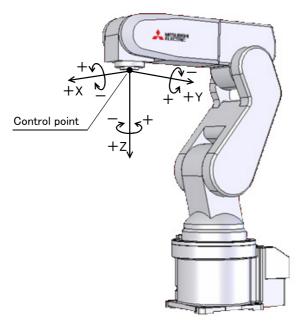
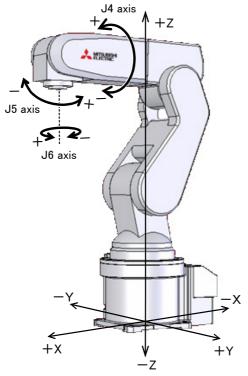


Fig.2-14: XYZ jog operation



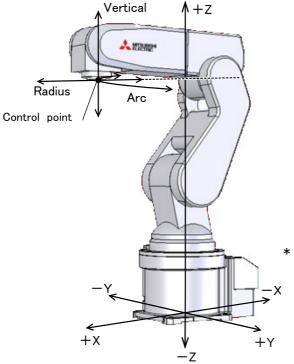
\* While maintaining the flange surface posture, the axis moves straight along the tool coordinate system. Also, while maintaining the flange surface position, the flange surface posture changes.

Fig.2-15: TOOL jog operation



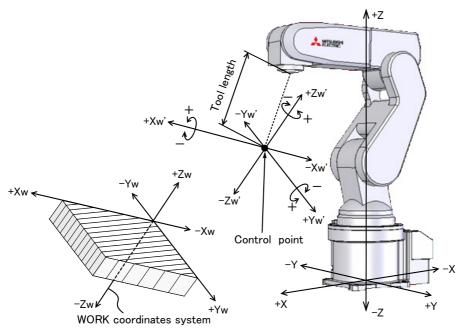
\* The axis moves straight along the base coordinate system. At this time, the flange surface posture is not maintained. Also, the flange surface posture changes. The flange surface position does not change at this time. It is effective to change the posture of the wrist, with the position maintained.

Fig.2-16: 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.2-17: CYLINDER jog operation

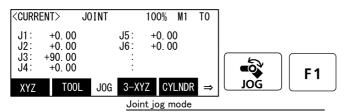


- \* While maintaining the flange surface posture, the axis moves straight along the work coordinate system. Also, while maintaining the flange surface position, the flange surface posture changes.
- \* When the controller software version is R5 (F-Q series)/S5 (F-D series) or later, jog operation around the work coordinates system is available for the 6-axis type (EX-T jog). In this jog operation, when the jog operation is performed for the posture elements, the posture rotates on the Xw axis, Yw axis, or Zw axis of the work coordinates system while the control point is changed.

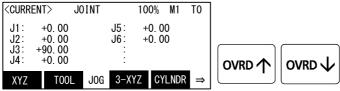
Fig.2-18: WORK jog operation

#### (1) JOINT jog operation

#### Select joint jog mode



#### Set jog speed



Setting the speed

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

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

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

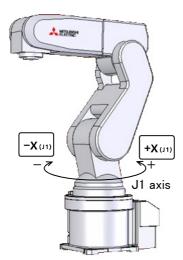
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

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

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

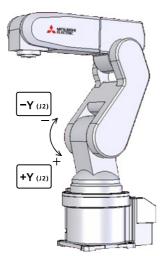
Set the override to 10% here for confirmation work.

#### J1 axis jog operation



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

#### J2 axis jog operation

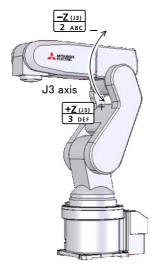


• When the [+Y (J2)] keys are pressed, the J2 axis will rotate in the plus direction. When the [-Y (J2)] keys are pressed, rotate in the minus direction.

### ♦♦♦ When the robot is in the transportation posture ♦♦♦

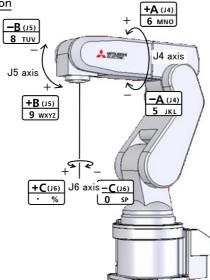
The axes may be outside the movement area. Move these axes toward the inner side of the movement area.

#### J3 axis jog operation



• When the [+Z (J3)] keys are pressed, the J3 axis will rotate in the plus direction. When the [-Z (J3)] keys are pressed, rotate in the minus direction.

# J4, J5 and J6 axis jog operation



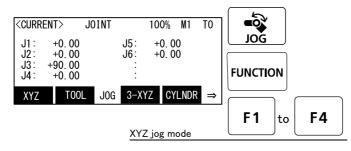
- When the [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction. When the [-A (J4)] keys are pressed, rotate in the minus direction.
- When the [+B (J5)] keys are pressed, the J5 axis will rotate in the plus direction When the [-B (J5)] keys are pressed, rotate in the minus direction.
- 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.

## $\diamondsuit \spadesuit \diamondsuit$ If the buzzer of T/B sounds and the robot does not move $\diamondsuit \spadesuit \diamondsuit$

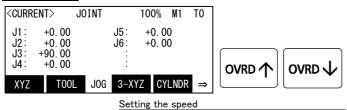
If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

## (2) XYZ jog operation

## Select XYZ jog mode



#### Set jog 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)

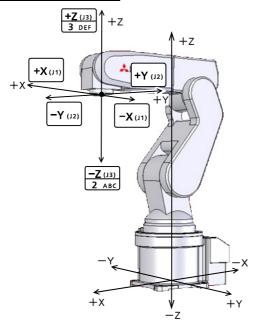
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

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.

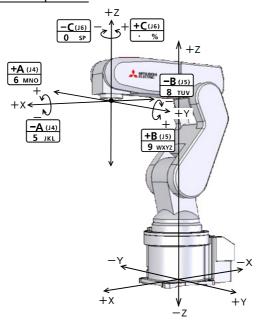
### $\Diamond \blacklozenge \Diamond$ When the robot is in the transportation posture $\Diamond \blacklozenge \Diamond$

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 25, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

 $\diamondsuit \spadesuit \diamondsuit$  If the buzzer of T/B sounds and the robot does not move  $\diamondsuit \spadesuit \diamondsuit$ 

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 ♦♦♦

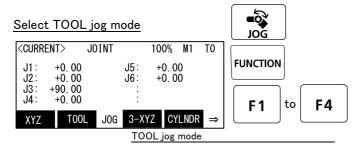
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

## ♦ Tool length

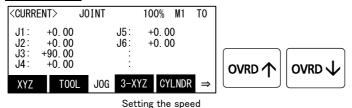
The default tool length is 0mm, and the control point is the center of the end axis.

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



### Set jog 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)

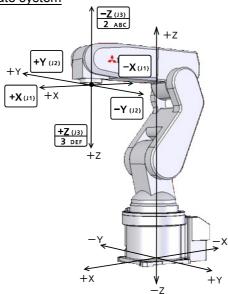
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Whenever it presses the key of [OVRD  $\uparrow$  ], the override goes up. Conversely, if the [OVRD  $\downarrow$  ] 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.

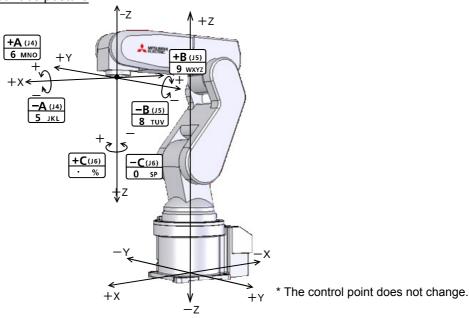
#### $\Diamond \blacklozenge \Diamond$ When the robot is in the transportation posture $\Diamond \blacklozenge \Diamond$

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 25, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

 $\diamondsuit \spadesuit \diamondsuit$  If the buzzer of T/B sounds and the robot does not move  $\diamondsuit \spadesuit \diamondsuit$ 

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



- 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 ♦♦♦

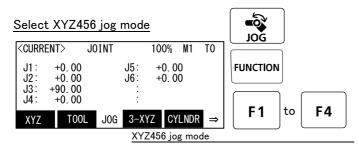
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

## ♦ Tool length

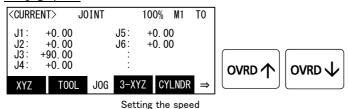
The default tool length is 0mm, and the control point is the center of the end axis.

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



## Set jog 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)

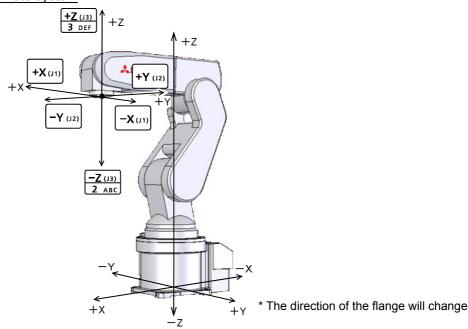
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Whenever it presses the key of [OVRD  $\uparrow$  ], the override goes up. Conversely, if the [OVRD  $\downarrow$  ] key is pressed, it will go down.

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

Set the override to 10% here for confirmation work.

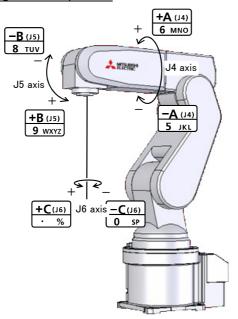
# Moving along the base coordinate system



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

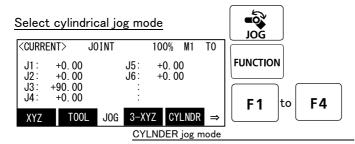
  Use XYZ jog to maintain the posture.

# Changing the flange surface posture

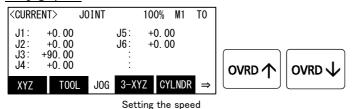


- \* The wrist pose can be changed maintaining the flange's position.
- When the [+A (J4)] keys are pressed, the J4-axis will rotate in the plus direction. At this time, to maintain the flange's position, other axes move simultaneously except J5 and J6. When the [-A (J4)] keys are pressed, rotate in 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



## Set jog 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)

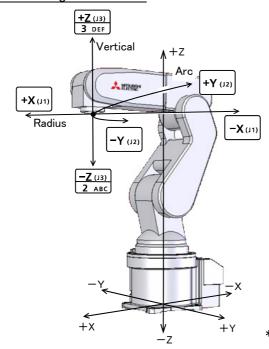
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

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

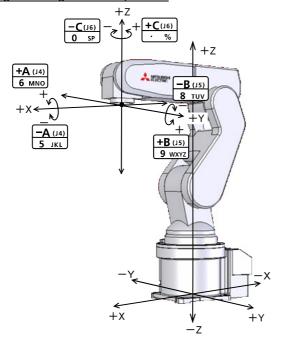


\* The direction of the frange will not change.

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

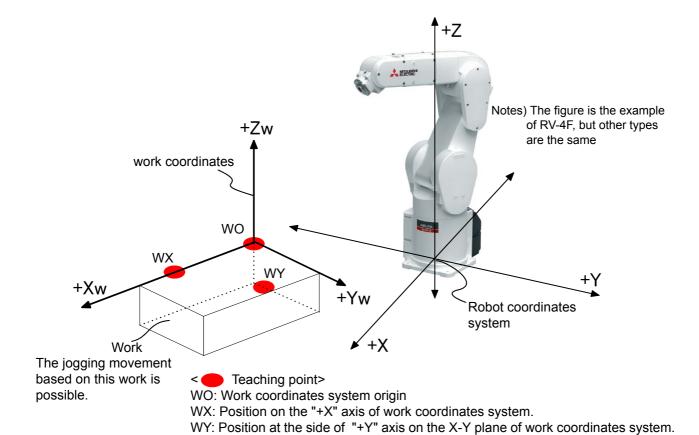
Setting of the work coordinates system is necessary.

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).



[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)

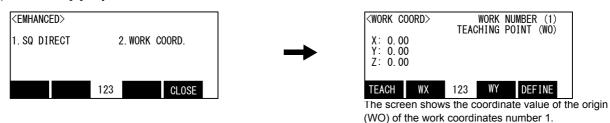
Fig.2-19: Setting of the work coordinates system (teaching point)

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."



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



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



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. 2-19. 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.



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

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



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.



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.

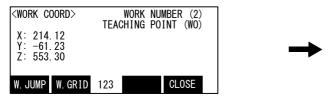


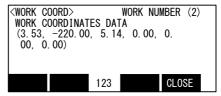
# 6) Finishing of setting the work coordinates

Press the [FUNCTION] keys, and display "CLOSE" function. Press the function key corresponding to "CLOSE". Returns to the <MENU> screen.



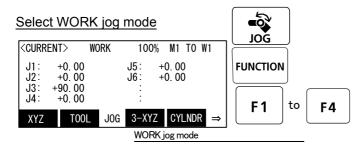
Although setting of work coordinates is finishing above, confirmation of work coordinates can be done by pressing the function key corresponding to "W GRID."([F2])





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.



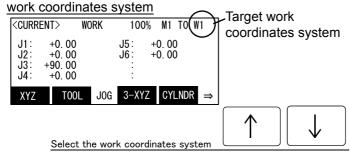
[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

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



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]

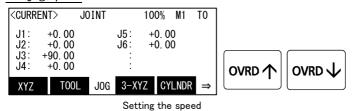
Push the key [Upper arrow], the number will increase. (W1, W2, ..... W8) Conversely, push the key [Lower arrow], the number will decrease



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



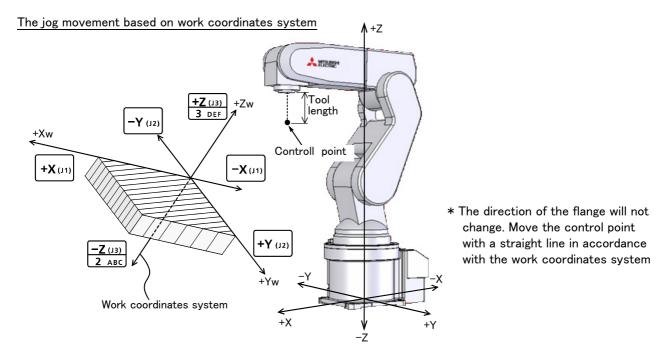
Whenever it presses the key of [OVRD(Upper arrow)], the override goes up. Conversely, if the [OVRD(Lower arrow)] key is pressed, it will go down.

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

When the software version is R5 (F-Q series)/S5 (F-D series) or later, the additional WORK jog operation, Ex-T jog, is available. The conventional WORK jog operation and the Ex-T jog operation can be switched by setting the parameters WK1JOGMD to WK8JOGMD of each work coordinates system. The respective operations are as follows.

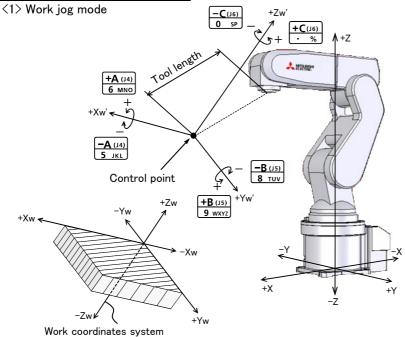
WORK jog operation mode	Conventional WORK jog	Ex-T jog
Parameters WKnJOGMD (n is 1 to8) setting	0 (initial value)	1
XYZ key operation	Moves along each axis of the work coordinates system	Same as the conventional WORK jog
ABC key operation	With the control point position maintained, the direction changes along the work coordinates system.	While the control point position is changed, the direction changes on each axis of the work coordinates system.



- When the [+X (J1)] keys are pressed, the robot will move along the X axis (Xw) 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 (Yw) 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 (Zw) plus direction on the work coordinates system.
  - When the [-Z (J3)] keys are pressed, Move along the minus direction.

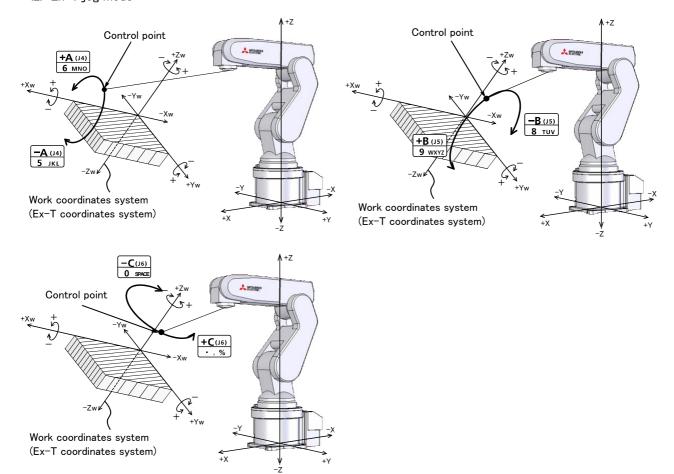
When the X, Y, or Z keys are used, the operation is the same in the WORK jog and the Ex-T jog modes.

# 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.

## <2> Ex-T jog mode



- \* The control point rotates around each axes of work coordinates system (Ex-T coordinates system). When the [+A (J4)] or the [-A (J4)] key is pressed, the control point rotates around the Xw axis. When the [+B (J5)] or the [-B (J5)] key is pressed, the control point rotates around the Yw axis. When the [+C (J6)] or the [-C (J6)] key is pressed, the control point rotates around the Zw axis.
  - •When the [+A (J4)] keys are pressed, the control point will rotate in the plus direction around the X axis (Xw) of work coordinates system (Ex-T coordinates system).

When the [-A (J4)] keys are pressed, the control point will rotate in the minus direction.

- When the [+B (J5)] keys are pressed, the control point will rotate in the plus direction around the Y axis (Yw) of work coordinates system. (Ex-T coordinates system).
- When the [-B (J5)] keys are pressed, the control point will rotate in the minus direction.
- When the [+C (J6)] keys are pressed, the control point will rotate in the plus direction around the Z axis (Zw) of work coordinates system. (Ex-T coordinates system).

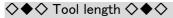
When the [-C (J6)] keys are pressed, the control point will rotate in the minus direction.

## $\Diamond \blacklozenge \Diamond$ When the robot is in the transportation posture $\Diamond \blacklozenge \Diamond$

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 25, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

## $\Diamond \blacklozenge \Diamond$ If the buzzer of T/B sounds and the robot does not move $\Diamond \blacklozenge \Diamond$

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.



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 operating range change

# 3.1.1 Installing the J1 axis operating range change

The configuration, changeable angle, and installation outline of J1 axis operating range change (1S-DH-11J1) are shown below.

## (1) Configuration

The configuration parts of this option are shown in Table 3-1. Please confirm.

Table 3-1: Configuration devices

No.	Part name	Qty.	Mass (kg)	Remarks
<1>	Variable stopper block	1		
<2>	Fixing stopper	2	0.5	
<3>	Screw (M5x20)	6		Screw with a captive washer for installing the stoppers.
<1> v	'ariable stopper block <2> F	Fixing stopper		<3> Screw

# (2) Changeable angle

The changeable angle of J1 axis is shown in Table 3-2. Refer to Table 3-2 to confirm the installation position of the fixing stopper corresponding to the angle to change or setting value of a parameter. Refer to Fig. 3-1 for details of the installation positions of the stoppers.

Table 3-2: Changeable angle of J1 axis

1	ng range AR) setting value)	Mechanical stopper angle		Fixing stopper installation position Note1)	
- (minus) side	+ (plus) side	- (minus) side + (plus) side (Parameter (MORG) setting value)			
-240	+240	-243	+243	Not equipp	ed (Default)
-90	+210	-93	+217	,	4
-150	+150	-155	+155	ı	3
-210	+90	-217	+93	(	0
-90	+150	-93	+155	Α	В
-90	+90	-93	+93	Α	С
-150	+90	-155	+93	В	С

Note1) Characters A, B, and C in this table are correspond to the same characters in Fig. 3-1.

#### (3) Installation procedure

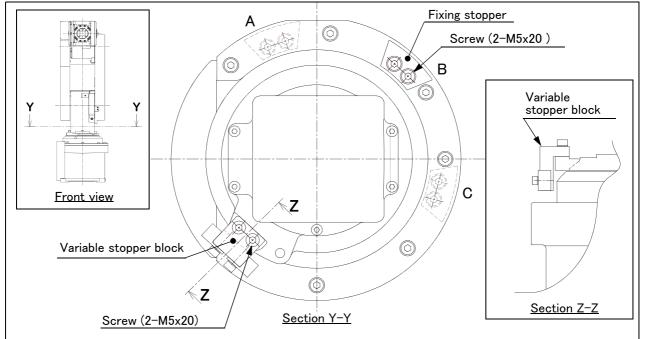
The installation procedure of the J1 axis operating range change is shown below.

When installing this option, you should move the J1 axis to the 0 degrees by jog operation previously, and do this work



When installing this option for safety, you should cut off the power supply of the con-

Each screw should be tightened with 9.5 Nm torque. Please confirm the screws are surely tightened by 9.5 Nm torque before moving the robot.



- \* Characters A, B, and C in this illustration correspond to the same characters in Table 3-2.
  - This illustration is an example of installing the fixing stopper at position B. When the fixing stopper is attached to the position of A or C, the stopper will be attached as the dashed line showed.
  - The variable stopper block is always attached to the position shown in this illustration irrespective of a changed angle of the J1 axis operating range.

Fig.3-1: Installation procedure of optional stoppers

- 1) Refer to Table 3-2 and confirm the installation position of the fixing stopper corresponding to the angle to change.
  - With the combination of angles of a plus side and a minus side, the fixing stoppers are required to install on two places.
- 2) Refer to Fig. 3-1 and install the fixing stopper to the installation position corresponding to the angle to change. Tighten the screw firmly to fix the fixing stopper. (Tightening torque: 9.5 Nm)
- 3) Install the variable stopper block to the position shown in Fig. 3-1. Tighten screws firmly to fix the variable stopper block as well as the fixing stopper. (Tightening torque: 9.5 Nm)

#### (4) Setting the parameter

Specify the operating range to parameter MEJAR and the mechanical stopper angle to parameter MORG with appropriate values (variable angles given in Table 3-2) 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, \*\*\*, \*\*\*, \*\*\*, \*\*\*, ...).
- 3) Set up the + side mechanical stopper angle changed into parameter MORG. MORG: (J1 plus (+) side mechanical stopper angle, \*\*\*, \*\*\*, ...).

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.

The changing of the J1 axis operating range is completed.

## 3.1.2 Installing the J2 axis operating range change

The configuration, changeable angle, and installation outline of J2 axis operating range change (1S-DH-11J2) are shown below.

## (1) Configuration

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

Table 3-3: Configuration devices

No.	Part name	Qty.	Mass (Kg)	Remarks
<1>	Stopper A	1		
<2>	Stopper B	1	0.1	
<3>	Screw (M4x10)	4		Screw with a captive washer for installing the stoppers.
<1> s	Stopper A	<2> Stopper B		<3> Screw

# (2) Changeable angle

The changeable angle of J2 axis is shown in Table 3-4. Refer to Table 3-4 to confirm the installation position of the stopper corresponding to the angle to change or setting value of a parameter. Refer to Fig. 3-2 for details of the installation position of the stoppers.

Table 3-4: Changeable angle of J2 axis

Operating range (Parameter (MEJAR) setting value)		Mec	Channau	
- (minus) side	+ (plus) side	- (minus) side + (plus) side (Parameter (MORG) setting value)		Stopper
-120: RV-2F/2FB -117: RV-2FL/2FLB	+120	-121: RV-2F/2FB -118: RV-2FL/2FLB	+121	Not equipped (Default)
-120: RV-2F/2FB -117: RV-2FL/2FLB	+30	-121: RV-2F/2FB -118: RV-2FL/2FLB	+33	Stopper A
-30	+120	-33	+121	Stopper B
-30	+30	-33	+33	Stopper A and B

#### (3) Installation procedure

The installation procedure of the J2 axis operating range change is shown below.

When installing this option, you should move the J2 axis to the 0 degrees by jog operation previously, and do this work.



When installing this option for safety, you should cut off the power supply of the con-

Each screw should be tightened with 4.6 Nm torque. Please confirm the screws are surely tightened by 4.6 Nm torque before moving the robot.

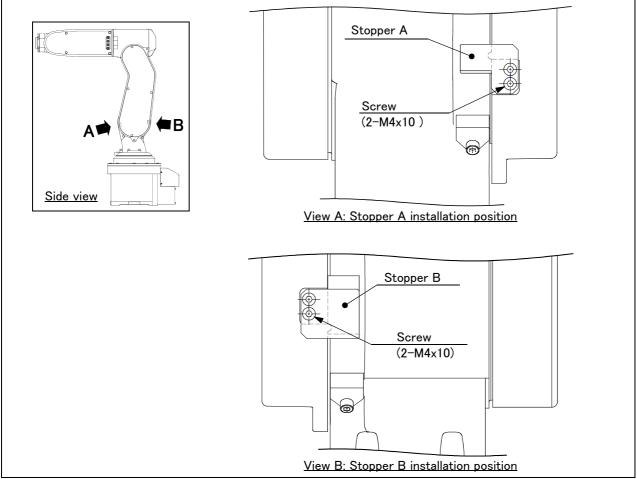


Fig.3-2: Installation procedure of optional stoppers

- 1) Refer to Table 3-4 and confirm the stopper corresponding to the angle to change. With the combination of angles of a plus side and a minus side, both A and B stoppers are required to be installed.
- 2) Refer to Fig. 3-2 and install the required stopper to the installation position. Tighten screws firmly to fix the stopper. (Tightening torque: 4.6 Nm)

# (4) Setting the parameter

Specify the operating range to parameter MEJA and the mechanical stopper angle to parameter MORG with appropriate values (variable angles given in Table 3-4) by the following steps.

- 1) Turn on the power supply.
- 2) Set up the operating range changed into parameter MEJAR. MEJAR: (\*\*\*, \*\*\*, J2 minus (-) side, J2 plus (+) side, \*\*\*, \*\*\*, ...).
- 3) Set up the side mechanical stopper angle changed into parameter MORG. MORG: (\*\*\*, J2 minus (-) side mechanical stopper angle, \*\*\*, ...).

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.

THe changing of the J2 axis operating range is completed.

#### 3.1.3 Installing the J3 axis operating range change

The configuration, changeable angle, and installation outline of J3 axis operating range change (1S-DH-11J3) are shown below.

# (1) Configuration

The configuration parts of this option are shown in Table 3-5. Please confirm.

Table 3-5: Configuration devices

No.	Part name	Qty.	Mass (Kg)	Remarks
<1>	Stopper	1		
<2>	Screw (M4x10)	1	0.1	Screw with a captive washer for installing the stoppers.
<3>	Screw (M4x25)	1		Screw with a captive washer for installing the stoppers.
<1> s	Stopper		<2> Scr	rew <3> Screw

# (2) Changeable angle

The changeable angle of J3 axis is shown in Table 3-6. Refer to Table 3-6 to confirm the setting value of a parameter.

Table 3-6: Changeable angle of J3 axis

Operating range (Parameter (MEJAR) setting value)		Mechanical s	stopper angle	Stopper
- (minus) side	+ (plus) side	- (minus) side	+ (plus) side	
0	+160	-1	+161	Not equipped (Default)
+70	+160	+69	+161	Equipped

#### (3) Installation procedure

The installation procedure of the J3 axis operating range change is shown below.

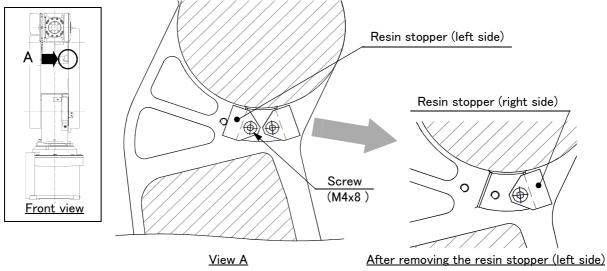
When installing this option, you should move the J3 axis to the +160 degrees by jog operation previously, and do this work.



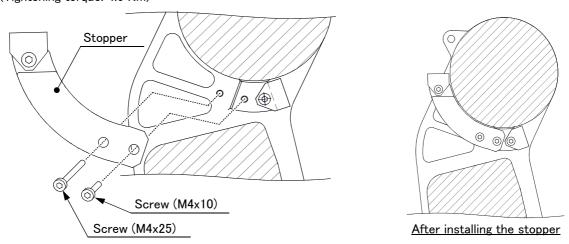
When installing this option for safety, you should cut off the power supply of the con-

Each screw should be tightened with 4.6 Nm torque. Please confirm the screws are surely tightened by 4.6 Nm torque before moving the robot.

1) Remove the resin stopper (left side) installed to the robot arm. The resin stopper (right side) must not remove.



2) Install the stopper of the operating range change (option). Tighten screws firmly to fix the stopper. (Tightening torque: 4.6 Nm)



#### (4) Setting the parameter

Specify the operating range to parameter MEJAR with appropriate values (variable angles given in Table 3-6) by the following steps.

- 1) Turn on the power supply.
- 2) Set up the operating range changed into parameter MEJAR. MEJAR: (\*\*\*, \*\*\*, \*\*\*, \*\*\*, J3 minus (-) side, J3 plus (+) side, ...).

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

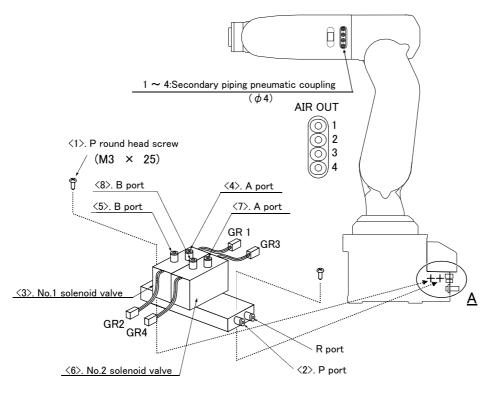
# (5) Check the operating range

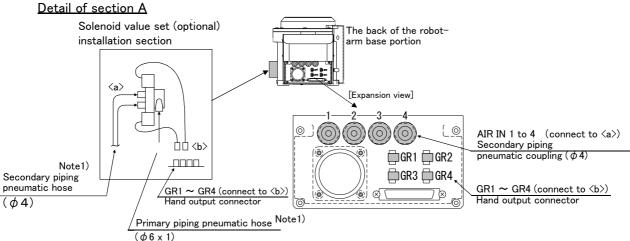
After changing the parameter, turn off the controller power and turn on again. And, move the axis changed by joint jog operation to the limit of the operating range. Confirm that the robot stops by limit over at the changed angle.

The changing of the J3 axis operating range is completed.

## 3.2 Installing the solenoid valve set

The installation summary of the solenoid valve is shown in Fig. 3-3. Turn the controller's power OFF before this installing operation. Refer to Page 59, "5.3.2 Installing/removing the cover" for removing/ installing the cover.





Note1) Please prepare by the customer the pneumatic hose to connect the solenoid valve set.

Fig.3-3: Solenoid valve installation procedures

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

- 1) Using the screw holes on the base of the robot arm, install the solenoid valve with the enclosed screw <1> (M3 x 25: 2 screws).
- 2) Connect the primary air supply air hose ( $\phi$  6, prepared by customer) to the quick joint (P port)  $\langle 2 \rangle$  of the solenoid valve.

- 3) Connect the AIR IN "1" mark secondary piping coupler to the A port <4> of the No. 1 solenoid valve <3> with an air hose ( $\phi$ 4 approx. 250mm, prepared by customer.)
  - In the same manner, connect the AIR IN "2" mark secondary piping coupler to the B port 5 of the No. 1 solenoid valve.
  - For a double valve (1E-VD02), connect the following:
  - Connect the AIR IN "3" mark secondary coupler to the A port <7> of the No. 2 solenoid valve <6>.
  - Connect the AIR IN "4" mark secondary coupler to the B port <8> of the No. 2 solenoid valve <6>.
- 4) Connect the GR1 plug from the No. 1 solenoid valve <3> to the GR1 connector on the back of the robot arm. Connect the GR2 plug from the No. 1 solenoid valve <3> to the GR2 connector on the back of the robot arm. For a double valve (1E-VD02), connect the following:
  - Connect the GR3 plug from the No. 2 solenoid valve <6> to the GR3 connector on the back of the robot arm. Connect the GR4 plug from the No. 2 solenoid valve <6> to the GR4 connector on the back of the robot arm.

# 4 Basic operations

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

## 5 Maintenance and Inspection

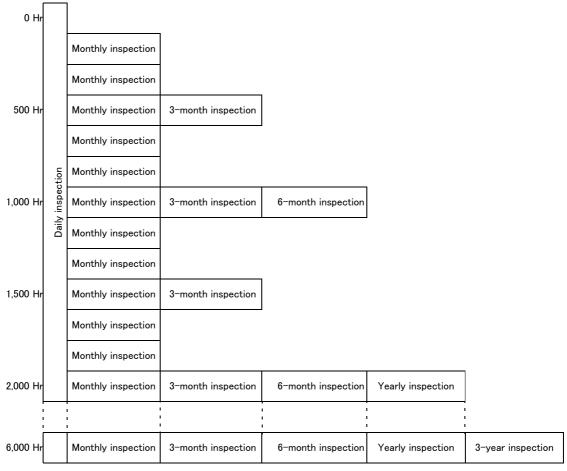
The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

# 5.1 Maintenance and inspection interval

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

#### (1) Inspection schedule

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



Operating time

<Guideline for inspection period>

For one shift

8 Hr/day  $\times$  20 days/month  $\times$  3 months = approx. 500 Hr 10 Hr/day  $\times$  20 days/month  $\times$  3 months = approx. 600 Hr For two shifts

15 Hr/day × 20 days/month × 3 months = approx. 1000 Hr

[Caution] When using two lines, the 3-month inspection, 6-month inspection and yearly inspection must be carried out when half the time has passed.

Fig.5-1: Inspection schedule

# 5.2 Inspection items

The inspection items for the robot arm are shown below.

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

# 5.2.1 Daily inspection items

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

Table 5-1 : Daily inspection items (details)

14510 0 1	. Daily inspection items (details)	_
Procedure	Inspection item (details)	Remedies
Before turni	ng 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 opera	ition (try running with an original program)	
1	Check whether the movement points are deviated? Check the following points if there is any deviation.  1. Are any installation bolts loose? 2. Are any hand installation section bolts loose. 3. Are the positions of the jigs other than the robot deviated? 4. If the positional deviation cannot be corrected, refer to "Troubleshooting", check and remedy.	Follow the troubleshooting section.
2	Is there any abnormal motion or abnormal noise? (Visual)	Follow the troubleshooting section.

# 5.2.2 Periodic inspection

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

Table 5-2 : Periodic inspection items (details)

Procedure	Inspection item (details)	Remedies		
Monthly inspection items				
1	Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.		
2	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.		
3-month ins	pection items			
1	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.		
6-month ins	pection items			
1	Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.		
Yearly inspe	ction items			
1	Replace the backup battery in the robot arm.	Exchange it referring to Page 76, "5.3.5 Replacing the backup battery".		
2	Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.		
3	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.		
3-year inspe	ection items			
1	Lubricate the grease at the reduction gears for each axis.	Lubricate it referring to Page 74, "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 79, "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. Each part is as shown below.

1) The rotation of the J1 axis motor <1> arranged in the base is conveyed to the reduction gears <3> via the timing belt  $\langle 2 \rangle$  to rotate the J1 axis.

RV-2F/2FL: Brakes are not mounted in the J1 axis motor.

RV-2FB/2FLB: Non-excitation magnetic brakes are mounted in the J1 axis motor.

2) The rotation of the J2 axis motor <4> arranged in the No.1 arm is conveyed to the reduction gears <6> via the timing belt <5> to rotate the J2 axis.

Non-excitation magnetic brakes are mounted in the J2 axis motor.

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.

Non-excitation magnetic brakes are mounted in the J3 axis motor.

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

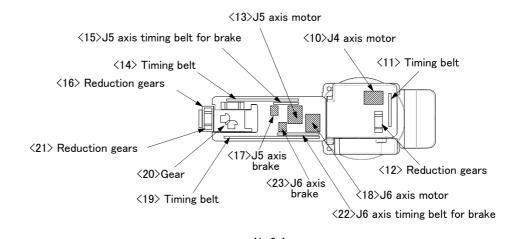
RV-2F/2FL: Brakes are not mounted in the J4 axis motor.

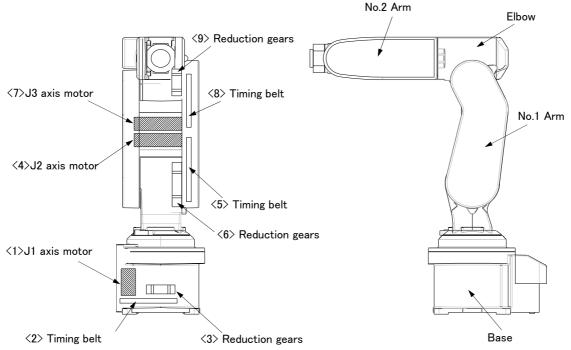
RV-2FB/2FLB: Non-excitation magnetic brakes are mounted in the J4 axis motor.

- 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. Non-excitation magnetic brakes <17> are mounted via the timing belt <15> in the J5 axis motor.
- 6) The J6 axes differ as follows depending on the type

RV-2F/2FL: 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. Brakes are not mounted in the J6 axis motor.

RV-2FB/2FLB: 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. Nonexcitation magnetic brakes <23> are mounted via the timing belt <22> in the J6 axis motor.

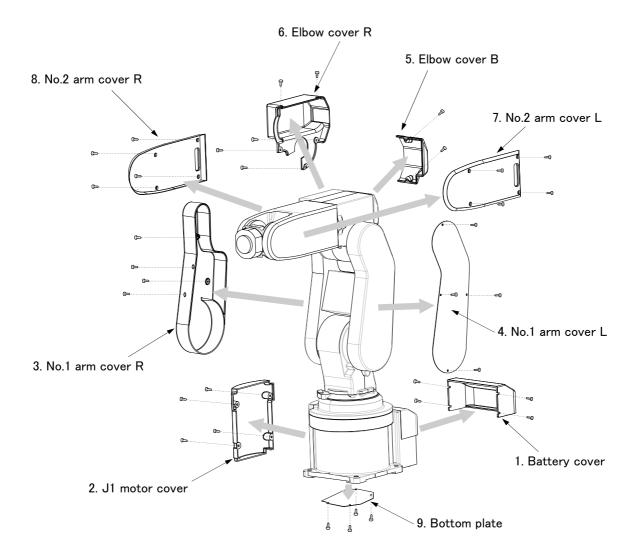




Note) <22> J6 axis brake timing belt and <23> J6 axis brake are only RV-2FB (all axes have the brake).

Fig.5-2: Outline structure drawing of robot arm

# 5.3.2 Installing/removing the cover



 ${\sf Fig.5-3:Installing/removing\ the\ cover}$ 

Table 5-3: Cover names

No	Cover names	Qty	Installation screw
<1>	Battery cover	1	Bind screw M3
<2>	J1 motor cover	1	Bind screw M3
<3>	No. 1 arm cover R	1	Bind screw M3
<b>&lt;4&gt;</b>	No. 1 arm cover L	1	Low head safety socket M3 (Nickel plating)
<5>	Elbow cover B	1	Bind screw M3
<6>	Elbow cover R	1	Bind screw M3
<7>	No. 2 arm cover L	1	Bind screw M3
<8>	No. 2 arm cover R	1	Bind screw M3
<9>	Bottom plate	1	Low head safety socket M3 (Nickel plating)

- (1) Refer to Fig. 5-3 and remove the covers.
- (2) The names of the covers are given in Table 5-3.
- (3) Depending on the robot's posture, some covers are hard to be removed. In such a case, change the robot's posture by performing jog operation to remove the covers.
- (4) When attaching the cover after maintenance and inspection, use the detaching procedure in reverse.

The part No. and symbols in Table 5-3 correspond to Fig. 5-3.

## 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.

In addition, it is serviceable if there is 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 73, "(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.



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.



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

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-4.

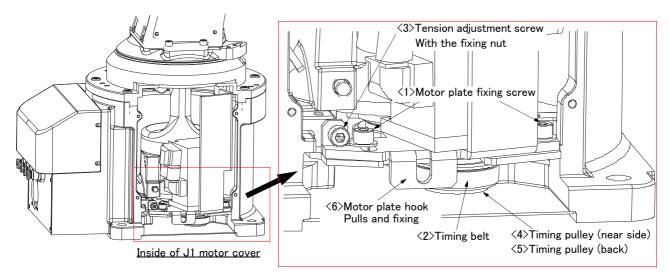


Fig.5-4: Inspection, maintenance and replacement of J1 axis timing belt

#### ■ Inspecting the J1 axis timing belt

- 1) Confirm that the robot controller power is OFF.
- 2) Refer to Page 59, "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>. (Do not loosen too much.)
- 3) Loosen the nut fixing tension adjustment screw <3>. And lightly loosen tension adjustment screw <3>.

 $\langle 5 \rangle$ , or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.

- 4) In the condition that hook <6> of the motor plate is pulled by 31-39N, fix the motor plate fixing screws <1> tight. (two pc.) 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) After adjustment, fixes the fixing nut and certainly fix tension adjustment screw <3>.

#### ■ Replacing the J1 axis timing belt

Timing belt replacement of the J1 axis removes the bottom plate in the robot-arm bottom, and replace the belt from the robot's bottom. For this reason, it is necessary to remove the robot arm from the installation surface and to place it sideways. Remove the machine cable or piping, etc. corresponding to the usage condition, and put the robot on the floor sideways.



When removing and placing the robot arm, place J1 motor cover upward. Moreover, also to turn the No.1 arm cover upward, turn the J1 axis to the front by jog operation beforehand. (joint angle is near 0 degree) This is the necessity to not damaging the resin cover.

Topple slowly so that a shock may not be given. If you have the resin cover, there is a possibility that the cover may be broken.

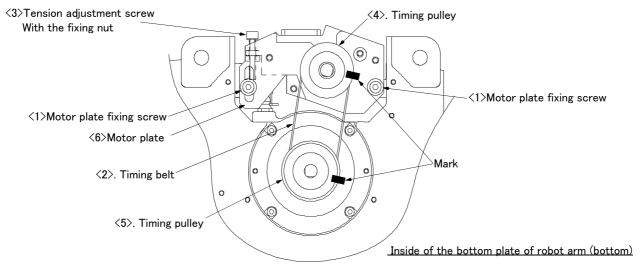


Fig.5-5: Replacing the J1 axis timing belt

- 1) Turn the J1 axis to the front by jog operation beforehand. (joint angle is near 0 degree)
- 2) Turn off the robot controller.
- 3) Remove the machine cable or piping, etc. corresponding to the usage condition, and place the robot on the floor sideways. Turn J1 motor cover upward, and place sideways slowly so that a shock may not be given to the robot arm.
- 4) Please remove J1 motor cover and the bottom plate with reference to Page 59, "5.3.2 Installing/removing the cover".
- 5) The image figure inside the bottom plate of the robot arm is shown in Fig. 5-5.
- 6) 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.
- 7) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-5 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
- 8) Lightly loosen the motor plate fixing screw <1>. (two pc.) (Do not loosen too much.)
- 9) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.
- 10) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
- 11) Align the new timing belt with the marks on the timing pulleys  $\langle 4 \rangle$  and  $\langle 5 \rangle$ , and install.
- 12) 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. Confirm that the belt tension is adjusted to slacken approx. 1.0mm when the center of the belt is lightly pressed with a finger (approx. 2.0N).
- 13) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten motor plate fixing screws <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.
- 14) Reinstall the robot arm just as before.
- 15) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 80, "5.6 Resetting the origin", and reset the origin position.

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

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

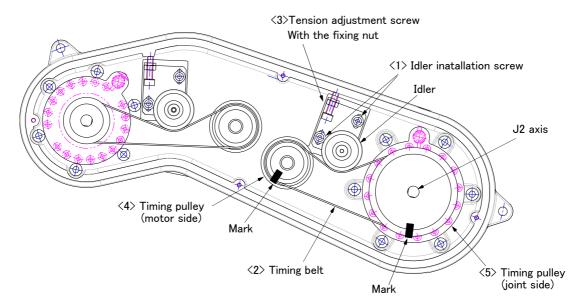


Fig.5-6: Inspection, maintenance and replacement of J2 axis timing belt

- Inspecting the J2 axis timing belt
  - 1) Confirm that the robot controller power is OFF.
  - 2) Refer to Page 59, "5.3.2 Installing/removing the cover", and remove the No. 1 arm cover.
  - 3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt <2>.
  - 4) Confirm that the belt tension is adjusted to slacken approx. 1.4mm when the center of the belt is lightly pressed with a finger (approx. 2N) as shown in "Fig.5-13: Belt tension".

### Adjusting the J2 axis timing belt

- 1) Carry out steps "1)" and "2)" indicated in " Inspecting the J2 axis timing belt" above.
- 2) Lightly loosen the two idler installation bolts <1>. (Do not loosen too much.)
- 3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and adjust the tension of timing belt  $\langle 2 \rangle$ .
  - When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen. Confirm that the belt tension is adjusted to slacken approx. 1.4mm when the center of the belt is lightly pressed with a finger (approx. 2.0N).
  - 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 idler fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

### ■ Replacing the J2 axis timing belt

- 1) Carry out steps 1) and 2) indicated in " Inspecting the J2 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  $\langle 2 \rangle$  and timing pulleys  $\langle 4 \rangle$  and  $\langle 5 \rangle$  with a felt-tip pen as shown in Fig. 5-6 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
- 4) Lightly loosen the two idler installation bolts <1>.(Do not loosen too much.)
- 5) Loosen the nut fixing tension adjustment screw  $\langle 3 \rangle$ . Loosen the tension adjustment screw  $\langle 3 \rangle$ , and remove
- 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 J2 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 80, "5.6 Resetting the origin", and reset the origin position.

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

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-7.

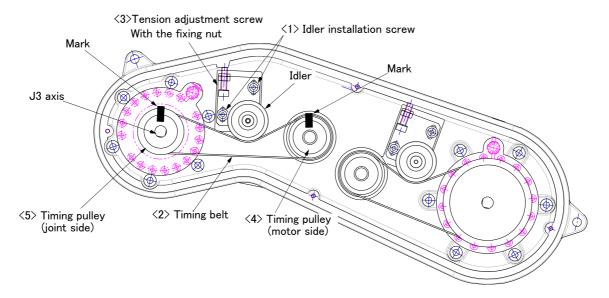


Fig.5-7: Inspection, maintenance and replacement of J3 axis timing belt

## ■ Inspecting the J3 axis timing belt

- 1) Confirm that the robot controller power is OFF.
- 2) Refer to Page 59, "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  $\langle 2 \rangle$ .
- 4) Confirm that the belt tension is adjusted to slacken approx. 1.6mm when the center of the belt is lightly pressed with a finger (approx. 2N) as shown in "Fig.5-13: 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 idler 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  $\langle 2 \rangle$ .
  - When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen. Confirm that the belt tension is adjusted to slacken approx. 1.6mm when the center of the belt is lightly pressed with a finger (approx. 2.0N).
  - 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 idler installation screws <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

## ■ Replacing the J3 axis timing belt

- 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  $\langle 2 \rangle$  and timing pulleys  $\langle 4 \rangle$  and  $\langle 5 \rangle$  with a felt-tip pen as shown in Fig. 5-7 so that the engagement of the timing belt  $\langle 2 \rangle$  and timing pulleys  $\langle 4 \rangle$  and  $\langle 5 \rangle$  does not deviate.
- 4) Lightly loosen the two idler 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 80, "5.6 Resetting the origin", and reset the origin position.

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

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

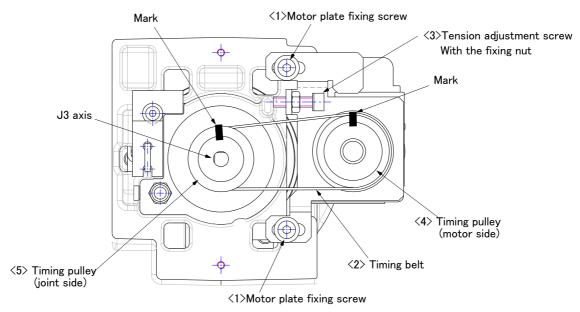


Fig.5-8: Inspection, maintenance and replacement of J4 axis timing belt

#### ■ Inspecting the J4 axis timing belt

- 1) Confirm that the robot controller power is OFF.
- 2) Refer to Page 59, "5.3.2 Installing/removing the cover", and remove the elbow cover B and 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 approx. 0.8mm when the center of the belt is lightly pressed with a finger (approx. 1.3N) as shown in "Fig.5-13: 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  $\langle 2 \rangle$ .
  - When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen. Confirm that the belt tension is adjusted to slacken approx. 0.8mm when the center of the belt is lightly pressed with a finger (approx. 1.3N).
  - If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and  $\langle 5 \rangle$ , 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

- 1) Carry out steps 1) and 2) indicated in " Inspecting the J4 axis timing belt" above.
- 2) Make sure that the pulleys do not move while replacing the belt. If the timing pulley  $\langle 4 \rangle$  and  $\langle 5 \rangle$  position relation deviates, the position could deviate.
- 3) Make marks on the timing belt  $\langle 2 \rangle$  and timing pulleys  $\langle 4 \rangle$  and  $\langle 5 \rangle$  with a felt-tip pen as shown in Fig. 5-8 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
- 4) Lightly loosen the two 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  $\langle 4 \rangle$  and  $\langle 5 \rangle$ , and install.
- 8) Refer to " Adjusting the J4 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 80, "5.6 Resetting the origin", and reset the origin position.

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

The J5 axis has the timing belt rotating the J5 axis and the brake timing belt conveying the brake. The inspection, maintenance and replacement method of each belt is shown below.

A)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. 5-9.

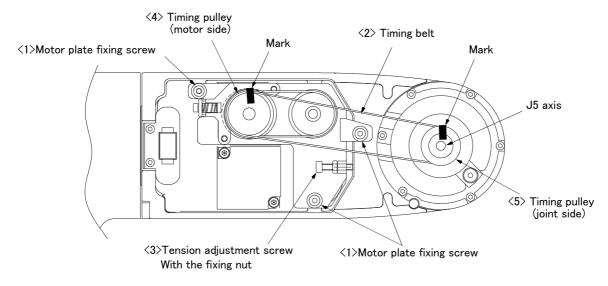


Fig.5-9: Inspection, maintenance and replacement of J5 axis timing belt

- Inspecting the J5 axis timing belt
  - 1) Confirm that the robot controller power is OFF.
  - 2) Refer to Page 59, "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 approx. 2.0mm when the center of the belt is lightly pressed with a finger (approx. 1.3N) as shown in "Fig.5-13: 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 three 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. Confirm that the belt tension is adjusted to slacken approx. 2.0mm when the center of the belt is lightly pressed with a finger (approx. 1.3N).
    - 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. (three pc.) Improper tightening can cause the belt to loosen with vibration.
- Replacing the J5 axis timing belt
  - 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  $\langle 2 \rangle$  and timing pulleys  $\langle 4 \rangle$  and  $\langle 5 \rangle$  with a felt-tip pen as shown in Fig. 5-9 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
  - 4) Lightly loosen the three 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  $\langle 4 \rangle$  and  $\langle 5 \rangle$ , 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 80, "5.6 Resetting the origin", and reset the origin position.

B)Inspection, maintenance and replacement of J5 axis brake timing belt

The reference figure at inspection, adjustment, and replacement of the brake timing belt is shown in Fig. 5-10. After adjustment of J5 axis brake timing belt, the adjustment of the timing belt which rotates the J5 axis is also needed. Moreover, it is necessary to remove J5 axis timing belt for the replacement of brake timing belt.

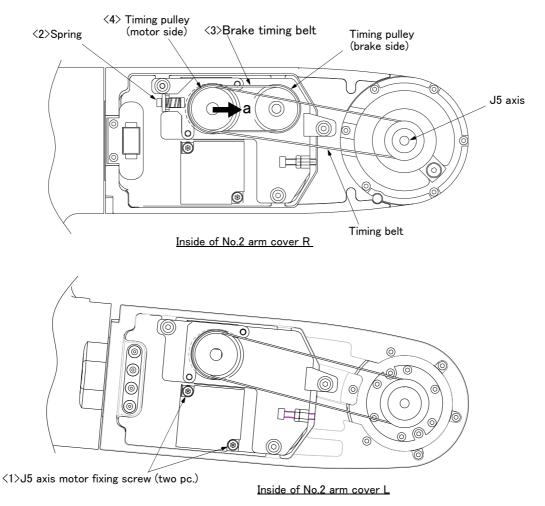


Fig.5-10: Inspection, maintenance and replacement of J5 axis brake timing belt

- Inspecting the J5 axis brake timing belt
  - 1) Confirm that the robot controller power is OFF.
  - 2) Refer to Page 59, "5.3.2 Installing/removing the cover", and remove the No. 2 arm cover R and L.
  - 3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
  - 4) Adjust the tension of the belt with referring to " Adjusting the J5 axis brake timing belt".
- Adjusting the J5 axis brake timing belt
  - 1) Carry out steps 1) and 2) indicated in " Inspecting the J5 axis brake timing belt" above.
  - 2) Loosen J5 axis motor fixing screw (1). (two pc.) (Loosen so that it may not escape from nut.) By loosening the screw, the tension of brake timing belt <3> is automatically adjusted by the work of spring <2> installed in the motor plate.
  - 3) After adjustment, securely tighten the two motor installation screws <1>. Improper tightening can cause the belt to loosen with vibration.
  - 4) Adjust J5 axis timing belt. Adjust the tension of J5 axis timing belt with referring to " Adjusting the J5 axis timing belt".

- Replacing the J5 axis brake timing belt
  - 1) Carry out steps 1) and 2) indicated in " Inspecting the J5 axis brake timing belt" above.
  - 2) Remove J5 axis timing belt with referring to above " Replacing the J5 axis timing belt".
  - 3) Loosen motor fixing screw (1). (two pc.) (Do not loosen too much.)
  - 4) Move motor side timing belt pulley (4) in the direction of the arrow "a" of Fig. 5-10, and remove the brake timing belt..
  - 5) Install the new brake timing belt. The operations of matching the position for brake timing belt is unnecessary.
  - 6) After replacement, securely tighten the two motor installation screws <1>. (Tension is automatically adjusted by the work of the spring.) Improper tightening can cause the belt to loosen with vibration.
  - 7) Install J5 axis timing belt with reference to above " Replacing the J5 axis timing belt", and adjust tension.

(7) Inspection, maintenance and replacement of J6-axis timing belt and brake timing belt. The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-11. In the RV-2SDB the J6 axis has the timing belt rotating the J6 axis and the brake timing belt conveying the brake. Also inspection, maintenance and replace the brake timing belt simultaneously.

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

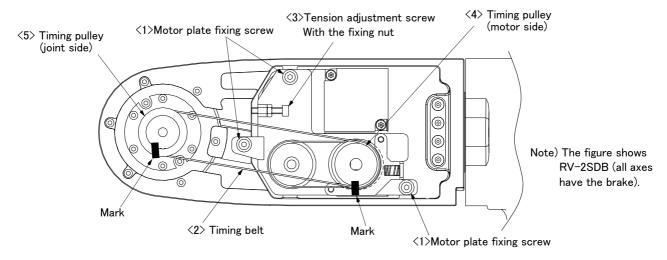


Fig.5-11: Inspection, maintenance and replacement of J6 axis timing belt

### ■ Inspecting the J6 axis timing belt

- 1) Confirm that the robot controller power is OFF.
- 2) Refer to Page 59, "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 approx. 2.0mm when the center of the belt is lightly pressed with a finger (approx. 1.3N) as shown in "Fig.5-13: 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 three motor plate fixing screws  $\langle 1 \rangle$ . (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. Confirm that the belt tension is adjusted to slacken approx. 2.0mm when the center of the belt is lightly pressed with a finger (approx. 1.3N).
  - If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys  $\langle 4 \rangle$  and  $\langle 5 \rangle$ , 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. (three pc.) Improper tightening can cause the belt to loosen with vibration.

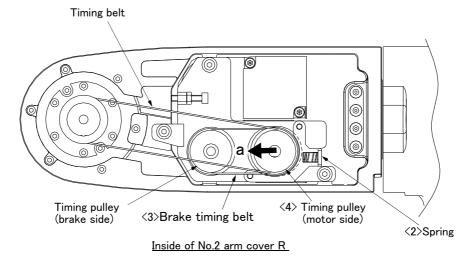
#### ■ Replacing the J6 axis timing belt

- 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. 5-11 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
- 4) Lightly loosen the three 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 80, "5.6 Resetting the origin", and reset the origin position.

#### B)Inspection, maintenance and replacement of J6 axis brake timing belt

The reference figure at inspection, adjustment, and replacement of the brake timing belt is shown in Fig. 5-12. After adjustment of J6 axis brake timing belt, the adjustment of the timing belt which rotates the J6 axis is also needed. Moreover, it is necessary to remove J6 axis timing belt for the replacement of brake timing belt.



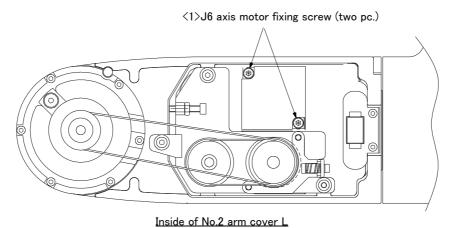
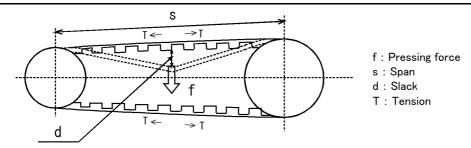


Fig.5-12: Inspection, maintenance and replacement of J6 axis brake timing belt

- Inspecting the J6 axis brake timing belt
  - 1) Confirm that the robot controller power is OFF.
  - 2) Refer to Page 59, "5.3.2 Installing/removing the cover", and remove the No. 2 arm cover R and L.
  - 3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
  - 4) Adjust the tension of the belt with referring to " Adjusting the J6 axis brake timing belt".
- Adjusting the J6 axis brake timing belt
  - 1) Carry out steps 1) and 2) indicated in " Inspecting the J6 axis brake timing belt" above.
  - 2) Loosen J6 axis motor fixing screw (1). (two pc.) (Loosen so that it may not escape from nut.) By loosening the screw, the tension of brake timing belt <3> is automatically adjusted by the work of spring <2> installed in the motor plate.
  - 3) After adjustment, securely tighten the two motor installation screws <1>. Improper tightening can cause the belt to loosen with vibration.
  - 4) Adjust J6 axis timing belt. Adjust the tension of J6 axis timing belt with referring to " Adjusting the J6 axis timing belt".

- Replacing the J6 axis brake timing belt
  - 1) Carry out steps 1) and 2) indicated in " Inspecting the J6 axis brake timing belt" above.
  - 2) Remove J6 axis timing belt with referring to above " Replacing the J6 axis timing belt".
  - 3) Loosen motor fixing screw (1). (two pc.) (Do not loosen too much.)
  - 4) Move motor side timing belt pulley (4) in the direction of the arrow "a" of Fig. 5-12, and remove the brake timing belt.
  - 5) Install the new brake timing belt. The operations of matching the position for brake timing belt is unnecessary.
  - 6) After replacement, securely tighten the two motor installation screws <1>. (Tension is automatically adjusted by the work of the spring.) Improper tightening can cause the belt to loosen with vibration.
  - 7) Install J6 axis timing belt with reference to above " Replacing the J6 axis timing belt", and adjust tension.

## (8) Timing belt tension



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

Axis	Preset value		Tension: Used belt (N)		Tension: New belt (N)		Force of pulling the	
AXIS	wait	width	span	Minimum	Maximum	Minimum	Maximum	motor plate <sup>note 1)</sup>
J1	2.5	6	61	26	32	37	43	31(N) ~ 39(N)
J2	2.5	6	88	26	32	37	43	Note 1) The force when pulling the
J3	2.5	6	103 (RV-2F/2FB) 106 (RV-2FL/2FLB)	26	32	37	43	motor plate for belt adjustment of the J1 axis is shown.
J4	2.5	4	52	18	22	26	30	
J5	2.5	4	131	18	22	26	30	
J6	2.5	4	131	18	22	26	30	

The sound wave type belt tension gauge of the standard Maker: Gates Unitta Asia Company, Type: U-505

### ■ Belt specification

Axis	Belt type	Span : s (mm)
J1	210-3GT-6	61
J2	324-3GT-6	88
J3	303-3GT-6 (RV-2F/2FB)	103
US	324-3GT-6 (RV-2FL/2FLB)	106
J4	186-3GT-4	52
J5	336-3GT-4	131
J5 (brake)	174-3GT-4	42
J6	345-3GT-4	131
J6 (brake)	174-3GT-4	42

#### ■ Inspection

Axis	Tension : T (N)	Slack : d (mm)	Pressing force : f (N)
J1	14.7 ~ 43	1.0	1.0 ~ 2.9
J2	14.7 ~ 43	1.4	1.0 ~ 2.9
J3	14.7 ~ 43	1.6	1.0 ~ 2.9
J4	10 ~ 30	0.8	0.7 ~ 2
J5	10 ~ 30	2.0	0.7 ~ 2
J6	10 ~ 30	2.0	0.7 ~ 2

### ■ Adjustment

Axis	Tension : T (N)	Slack : d (mm)	Pressing force : f (N)
J1	29	1.0	1.9
J2	29	1.4	1.9
J3	29	1.6	1.9
J4	20	0.8	1.3
J5	20	2.0	1.3
J6	20	2.0	1.3

### **■** Exchange (New article installation)

- 1				
	Axis	Tension : T (N)	Slack : d (mm)	Pressing force : f (N)
	J1	40	1.0	2.7
	J2	40	1.4	2.7
	J3	40	1.6	2.7
	J4	28	0.8	1.9
	J5	28	2.0	1.9
	J6	28	2.0	1.9

### <Note>

The tension of brake timing belt of the J5 and the J6 axis is automatically adjusted by the work of spring installed in the motor plate.

Fig.5-13: 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. 5-13.

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. 5-14. The lubrication specifications for each place are shown in Table 5-4. Refer to the Page 59, "5.3.2 Installing/removing the cover" for the method of removing and installing the cover.

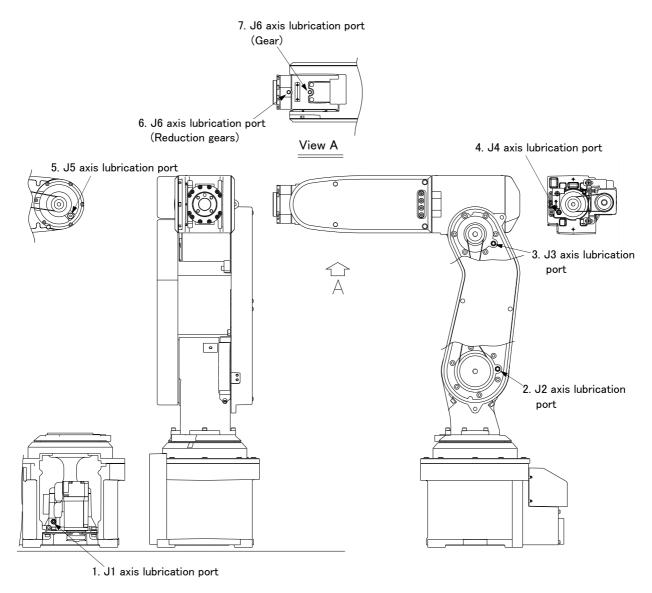


Fig.5-14: Lubrication positions

Table 5-4: Lubrication specifications

No.	Parts to be lubricated Note1)	Oiling method	Lubrication oil (maker)	Lubrication interval	Lubrication amount	Cover to remove
1	J1 axis reduction gears				3ml (2.8g)	J1 motor cover
2	J2 axis reduction gears		Grease Harmonic grease SK-1A 6,000Hr (Harmonic Drive Systems Inc.)		2.5ml (2.3g)	No1. Arm cover plate
3	J3 axis reduction gears			6,000Hr	2.5ml (2.3g)	
4	J4 axis reduction gears	Grease nipple WA-610			0.5ml (0.5g)	Elbow cover B
5	J5 axis reduction gears				0.5ml (0.5g)	_
6	J6 axis reduction gears				0.5ml (0.5g)	_
7	J6 axis gear				1.4ml (1.3g)	_

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.
- · 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 the Table 5-4 correspond to the supply positions in Fig. 5-14.
- · 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. 5-14.
- 2) Refer to Page 59, "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) J5 axis lubrication port <5>, the J6 axis lubrication port <6> (reduction gears), and the J6 axis lubrication port <7> (gear) should remove the bolt, and should install the attached grease nipple. Securely tighten the grease nipple by 4.7 Nm to 6.3 Nm.
- 5) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple.
- 6) J5 axis lubrication port <5>, the J6 axis lubrication port <6> (reduction gears), and the J6 axis lubrication port  $\langle 7 \rangle$  (gear) should remove the grease nipple, and should install the original bolt. Securely tighten the bolt by 4.7 Nm to 6.3 Nm.
- 7) Replace the covers with the removal procedure in reverse.
- 8) 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).



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.

A grease gun that fits the grease nipple is required.

Recommended grease gun: CH-400

(manufacture: Yamada Corporation Inc.,)

The CH-400 gun is a cartridge-type grease gun. Contact your dealer and use commercially available grease cartridges.

When a grease can is used, following hand grease gun is recommended.

Recommended grease gun: KH-120 (amount: 140ml)

(manufacture: Yamada Corporation Inc.,)

The KH-120 comes with a short nozzle (HSP-1) as standard. If this short nozzle does not reach the desired areas, depending on installation location, it may be useful to use a long nozzle (HSP-2). CH-400 has a long nozzle as standard equipment.

## 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	
	7520	The battery consumption time was exceeded	D 1 11 1 11	
oller	7510	Battery voltage low	Replace the battery	
Controller	7500	No battery voltage	The backup data cannot be guaranteed if this error occurs.	
	7520 The battery consumption time was exceeded		Replace the battery	
arm	133n <sup>Note1)</sup>	Encoder battery voltage low。	Replace the battery	
Robot	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

About the purchase of the battery, refers to Page 79, "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)

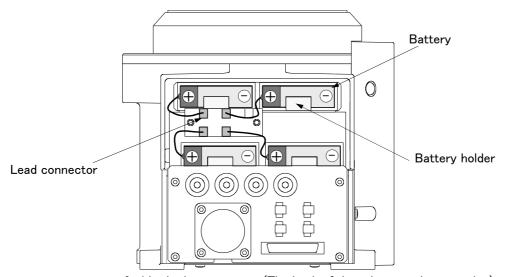


The power supply for the encoder is supplied by cable connected with battery board. The cable must be connected while replacing the battery or operating usually. Thus, if the cable connection is incomplete, the encoder position data will be lost, and resetting the origin is necessary.



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. 5-15. Refers to the figure and replaces the batteries in the following procedures.



Inside the battery cover (The back of the robot-arm base portion)

Fig.5-15: Replacing the battery

- 1) Turn the controller control power OFF.
- 2) Remove battery cover <1>, referring to Page 59, "5.3.2 Installing/removing the cover".
- 3) Replaces the backup battery one by one. The battery holder is located inside the battery cover <1>. Remove the old battery from the holder, and disconnect the lead connector.
- 4) Insert the new battery into the holder, and connect the lead connector. The "+" pole is left-hand side. Replace all batteries with new ones at the same time.
- 5) All the batteries should be checked that it has been exchanged newly. If the old battery is contained, gener ating heat and damaging may occur.
- 6) Install the battery cover <1> as before. Be careful so that the cable may not be inserted.
- 7) 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 80, "5.6 Resetting the origin" and reset the origin using the 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 arm and 36,000 hours for the controller). (See Fig. 5–16.) For specific information about parts to be replaced and timing of overhaul, contact your local service representative.

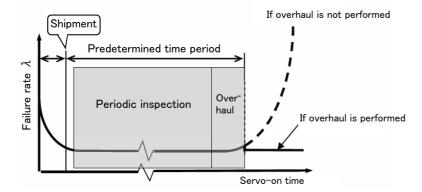


Fig.5-16: Periodic inspection/overhaul periods

## 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	Туре	Usage place	Q'ty	Supplier
1	Timing belt		J1 axis	1	
2			J2 axis	1	
3			J3 axis	1	
4			J4axis	1	
5			J5axis	1	Mitsubishi Electric System &
6			For J5 axis brakes	1	Service;Co.,Ltd.
7			J6 axis	1	
8			For J6 axis brakes Note1)	1	
9	Grease		Reduction gears of each axis	A small amount	
10	Lithium battery	ER6	Inside the battery cover	4	

Note1) Only for RV-2FB.

Table 5-7: Spare parts list

No.	Names	Usage place	Q'ty	Supplier
RV-2F	series (common)			
1	AC servo motor	J1,J2,J3 axis	3	Mitsubishi Electric
2		J4,J5,J6 axis	3	WILSUDISHI Electric
RV-2F	7/2FB (Standard arm type)			
3	Reduction gears	J1 axis	1	
4		J2 axis	1	
5		J3 axis	1	Mitsubishi Electric
6		J4, J5 axis	2	
7		J6 axis	1	
RV-2F	L/2FLB (Long arm type)			
8	Reduction gears	J1 axis	1	
9		J2 axis	1	
10		J3 axis	1	Mitsubishi Electric
11		J4, J5 axis	2	
12		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 origin setting methods and when each origin setting method is required are shown in Table 5-8.

Table 5-8: Origin setting method

No	Method	Explanation	Cases when setting the origin is required	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B. Use this method at the initial startup.	At the initial startup     When the controller is replaced     When the data is lost due to flat     battery of the robot controller     (when C7500 occurs)	The setting method is explained in Page 14, "2.3 Setting the origin".
2	Jig method	The origin posture is set with the calibration jig installed.	When a structural part of the robot (motor, reduction gear, timing belt, etc.) is replaced     When deviation occurred by a col- lision.	The setting method is explained in Page 92, "5.6.2 Jig method".
3	Mechanical stopper method	This origin posture is set by contacting each axis against the mechanical stopper.	When a structural part of the robot (motor, reduction gear, timing belt, etc.) is replaced     When deviation occurred by a collision.	The accuracy is lower than that of the jig method. The setting method is explained in Page 81, "5.6.1 Mechanical stopper method".
4	ABS origin method	This method is used when the encoder backup data lost in the cause such as battery cutting.	When the encoder data is lost due to flat battery of the robot arm (when H112n occurs)	Before using this method, the origin must be set with the other method with same encoder. The setting method is explained in Page 104, "5.6.3 ABS origin method".
5	User origin method	A randomly designated position is set as the origin posture.	When an arbitrary position is set as the origin	Before using this method, the origin must be set with the other method. The setting method is explained in Page 107, "5.6.4 User origin method".

#### [Caution]

- The origin is set using the jig method (No.2) at factory default.
- The value set with the jig method is encoded and used as the origin data to be input at the initial startup after shipment. When the robot arm does not mechanically deviate (for example caused by replacement of the reduction gear, motor, or timing belt) or does not lose the encoder data, the origin data input method at shipment can be used to set the origin.
- The origin data is inherent to the serial number of each robot arm.
- The ABS origin method is used to restore the previous data by aligning the triangular marks to each other for each axis to set the lost origin data.
  - (Although the setting position is confirmed visually, deviations within a half rotation of the motor can be compensated.)

### [Remarks]

- The ABS origin method cannot be used when the robot arm mechanically deviates (for example caused by replacement of the reduction gear, motor, or timing belt).
- After the origin setting is completed, move the robot arm to the position where the ABS marks align each other, and check that the displayed joint coordinates of the position are correct. For the details of the ABS mark position and the joint coordinates, refer to Page 104, "5.6.3 ABS origin method".

## 5.6.1 Mechanical stopper method

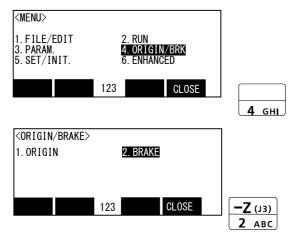
The method for setting the origin with the transportation jig is explained below.

This operation is carried out with the T/B. Set the controller mode to "MANUAL", and set the T/B [ENABLE] switch to "ENABLE" to validate the T/B.

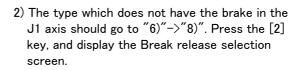


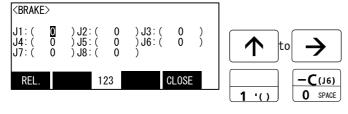
Here, if an axis is equipped with a brake, release the brake and move the arm with both hands. At this point release the brakes and move the arm with both hands. To ensure safety, the brake-release procedure described below should always be done by two persons.

(1) J1 axis origin setting(mechanical stopper)

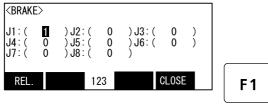


1) Press the [4] key on the menu screen, and display the Origin/BRK selection screen.

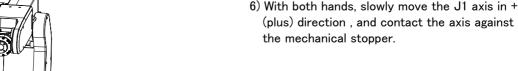


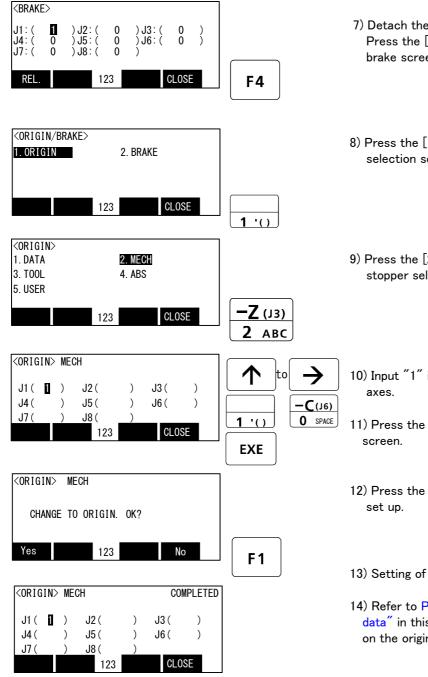


3) Release the brake of the J1 axis. Input "1" into the J1 axis. Set "0" to other axes.



- 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.





- 7) Detach the [F1] key and work the brake.

  Press the [F4] key and return to the origin /
  brake screen.
- 8) Press the [1] key, and display the Origin setting selection screen.
- 9) Press the [2] key, and display the Mechanical stopper selection screen.
- 10) Input "1" into the J1 axis. Set "0" to other axes.
- 11) Press the [EXE] key, and display Confirmation screen.
- 12) Press the [F1] key, and the origin position is set up.
- 13) Setting of the origin is completed.
- 14) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

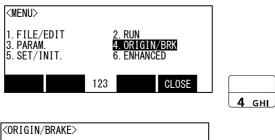
## ♦ Release the brake

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.

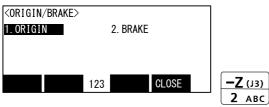
♦♦♦ Select the axis of origin setting ♦♦♦

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".

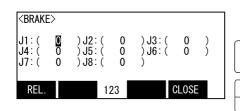
(2) J2 axis origin setting(mechanical stopper)

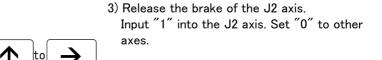


1) Press the [4] key on the menu screen, and display the Origin/BRK selection screen.



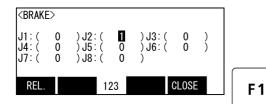
2) Press the [2] key, and display the Break release selection screen.



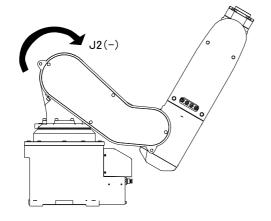


**– (**(J6) O SPACE

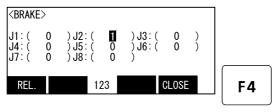
1 ()



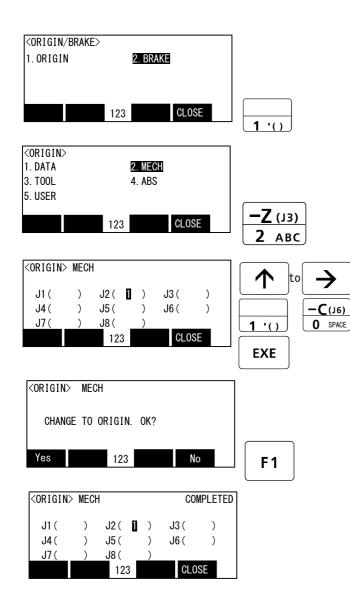
- 4) Confirm the axis for which the brakes are to be released.
- 5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.



6) With both hands, slowly move the J2 axis in -(minus) direction, and contact the axis against the mechanical stopper.



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



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

9) Press the [2] key, and display the Mechanical stopper selection screen.

- 10) Input "1" into the J2 axis. Set "0" to other axes
- 11) Press the [EXE] key, and display Confirmation screen.
- 12) Press the [F1] key, and the origin position is set up.
- 13) Setting of the origin is completed.
- 14) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

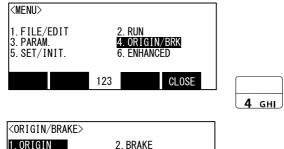
## ♦♦♦ Release the brake ♦♦♦

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.

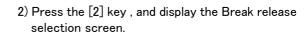
♦♦♦ Select the axis of origin setting ♦♦♦

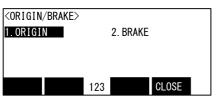
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

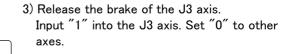
(3) J3 axis origin setting(mechanical stopper)

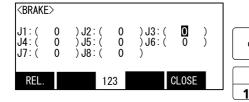


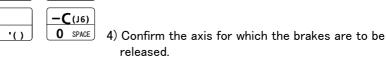
**–Z** (J3) **2** ABC 1) Press the [4] key on the menu screen, and display the Origin/BRK selection screen.

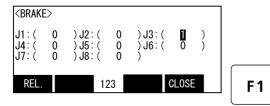




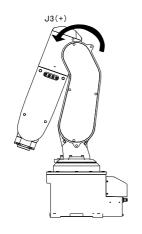




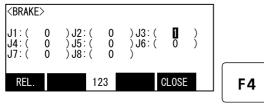




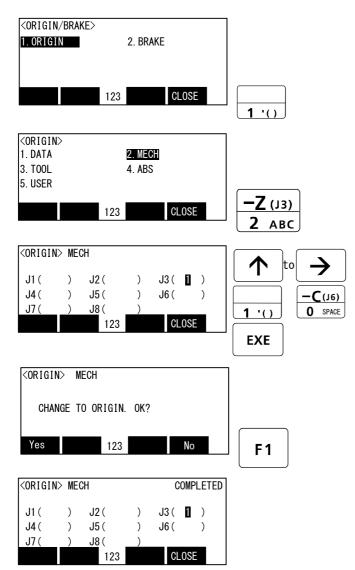
5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.



6) With both hands, slowly move the J3 axis in + (plus) direction, and contact the axis against the mechanical stopper.



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



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

9) Press the [2] key, and display the Mechanical stopper selection screen.

- 10) Input "1" into the J3 axis. Set "0" to other axes
- Press the [EXE] key , and display Confirmation screen.
- 12) Press the [F1] key, and the origin position is set up.
- 13) Setting of the origin is completed.
- 14) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

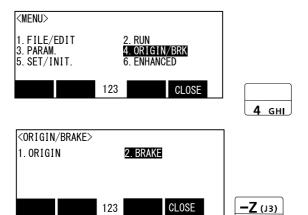
## ♦♦♦ Release the brake ♦♦♦

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.

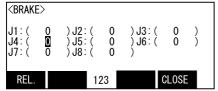
♦ Select the axis of origin setting

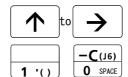
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(4) J4 axis origin setting(mechanical stopper)



- 1) Press the [4] key on the menu screen, and display the Origin/BRK selection screen.
- 2) The type which does not have the brake in the J4 axis should go to 6->8. Press the [2] key, and display the Brake release selection screen.





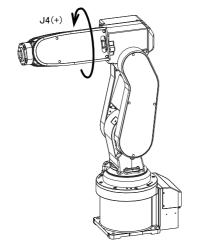
**2** ABC

F1

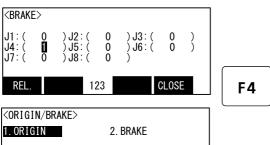
3) Press the [Arrow] key, move the cursor to the J4 axis and press the [1] key. Set [0] to other axes.



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



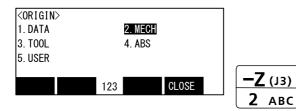
6) With both hands, slowly move the J4 axis in + (plus) direction, and contact the axis against the mechanical stopper.



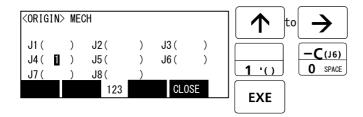
CLOSE

123

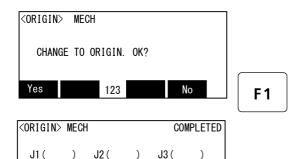
- 7) Detach the [F1] key and work the brake. Press the [F4] key and return to the Origin / BRK screen.
- 8) Press the [1] key, and display the Origin setting selection screen.



9) Press the [2] key, and display the Mechanical stopper selection screen.



- 10) Press the [Arrow] key, move the cursor to the J4 axis and press the [1] key. Set [0] to other axes.
- 11) Press the [EXE] key, and display Confirmation screen.

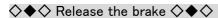


J6 (

**CLOSE** 

)

- 12) Press the [F1] key, and the origin position is set up.
- 13) Setting of the origin is completed.
- 14) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.



J5 (

J8 (

123

J4( 1 )

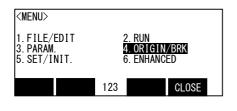
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is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

♦ Select the axis of origin setting ♦ ♦ ♦

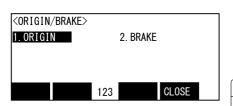
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(5) J5/J6 axis origin setting(mechanical stopper)

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

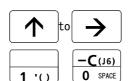


1) Press the [4] key on the menu screen, and display the Origin/BRK selection screen.



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





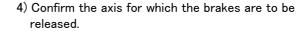
**4** GHI

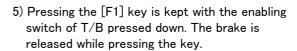
**–Z** (J3) **2** ABC

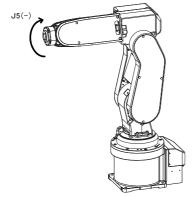
F1

3) 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









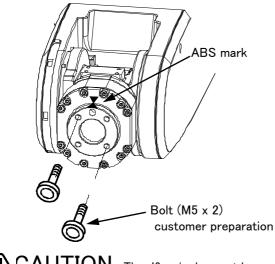
6) With both hands, slowly move the J5 axis in -(minus) direction, and contact the axis against the mechanical stopper.

\*The figure shows the J4 axis is in the 0 degree position.



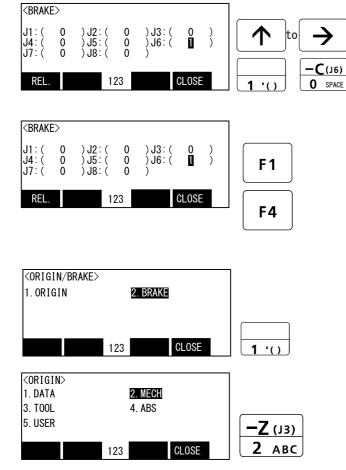
7) Detach the [F1] key and work the brake.

Then, set the J6 axis posture.

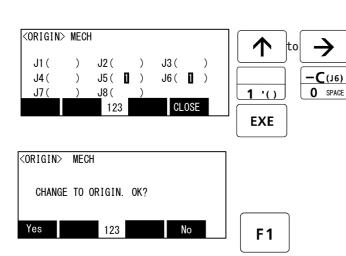


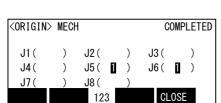
- CAUTION The J6-axis dose not have a mechanical stopper.
  - When setting the origin position, do not rotate the axis more than the motion range( $\pm 200$  deg.).

- 8) Install the bolt (M5: 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.
  - The type which has the brake in the J6 axis releases the brake. The type which does not have the brake should go to "13)".
  - Press the [Arrow] key, move the cursor to the J6 axis and press the [1] key. Set [0] to other axes.
- 9) Confirm the axis for which the brakes are to be released.
- 10) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
- 11) 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.



- 12) If the ABS mark is aligned detach the [F1] key and work the brake.
- 13) Press the [F4] key and return to the origin / brake screen.
- 14) Press the [1] key, and display the Origin setting selection screen.
- 15) Press the [2] key, and display the Mechanical stopper selection screen.





- 16) Press the [Arrow] key, move the cursor, and set "1" to the J5 axis and J6 axis. Set [0] to other axes.
- 17) Press the [EXE] key, and display Confirmation
- 18) Press the [F1] key, and the origin position is set up.
- 19) Setting of the origin is completed.
- 20) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

The origin settings are completed by the mechanical stopper 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.

## $\Diamond \blacklozenge \Diamond$ Select the axis of origin setting $\Diamond \blacklozenge \Diamond$

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 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. 5-17.

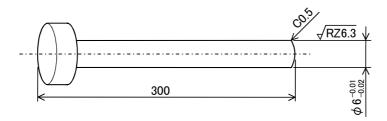


Fig.5-17: Reference dimension of origin setting tool

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

This operation is carried out with the teaching pendant. Set the mode of the controller to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.

The origin setting can be performed for the target axis only instead of for all axes. Go to steps for the target axis to set the origin.

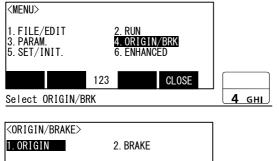
Do the following operations, pressing down the enabling switch of T/B lightly.



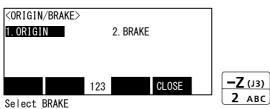
In the following procedure, the J3 axis brake is released to move its shaft with both

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

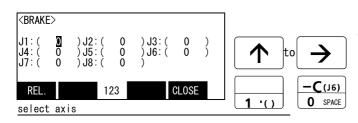
## (1) J1 axis origin setting



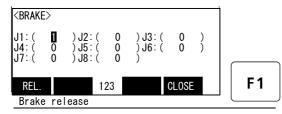
1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.



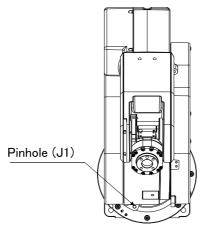
2) The type which does not have the brake in the J1 axis should go to "6" -> "8". Press the [2] key, and display the Brake release selection screen.



3) Release the brake of the J1 axis. Input "1" into the J1 axis. Set "0" to other axes.

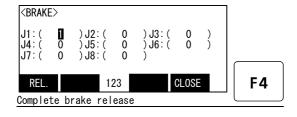


- 4) Confirm the axis for which the brakes are to be released.
- 5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.

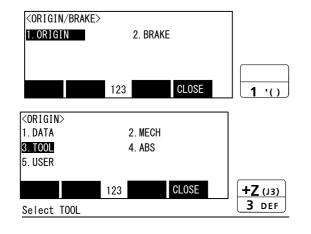


6) Move the J1 axis slowly toward the front using both hands. Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig ( $\phi$ 6) into the pinholes and fasten.

## Diagram of the robot viewed from the top

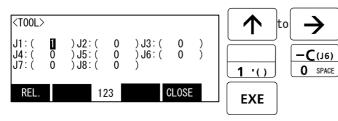


7) Detach the [F1] key and work the brake. Press the [F4] key and return to the origin / brake screen.

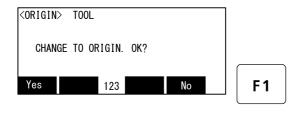


8) Press the [1] key, and display the Origin setting selection screen.

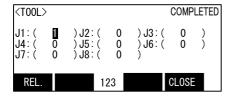
9) Press the [3] key, and display the Tool selection screen.



- 10) Input "1" into the J1 axis. Set "0" to other axes.
- 11) Press the [EXE] key, and display Confirmation screen.



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



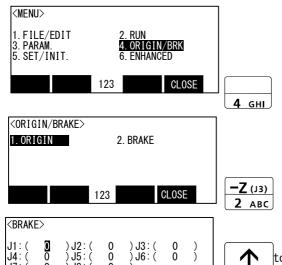
- 13) Setting of the origin is completed.
- 14) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

# ♦♦♦ 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.

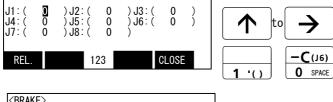
♦ Select the axis of origin setting ♦ ♦ ♦
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

## (2) J2 axis origin setting

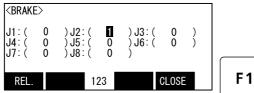


1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.

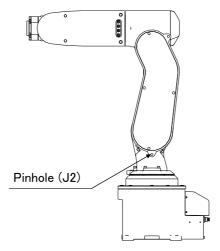
2) Press the [2] key, and display the Brake release selection screen.



3) Release the brake of the J2 axis. Input "1" into the J2 axis. Set "0" to other axes.

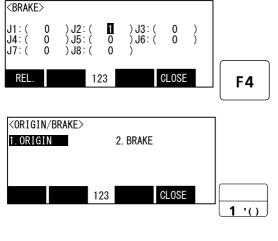


- 4) Confirm the axis for which the brakes are to be released.
- 5) One worker must securely support the upper arm with both hands.
- 6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
- 7) Move the J2 axis slowly toward the front using both hands. Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig ( $\phi$ 6) into the pinholes and fasten.



/I\ CAUTION

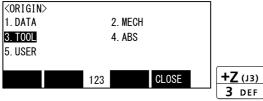
For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.



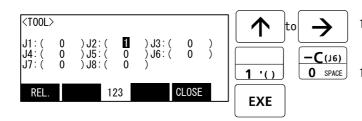
8) Detach the [F1] key and work the brake.

Press the [F4] key and return to the origin /
brake screen.

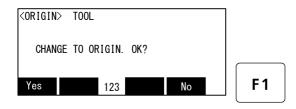
9) Press the [1] key, and display the Origin setting selection screen.



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



- 11) Input "1" into the J2 axis. Set "0" to other axes.
- 12) Press the [EXE] key, and display Confirmation screen.



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



- 14) Setting of the origin is completed.
- 15) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

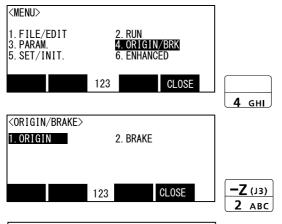
## ♦♦♦ Release the brake ♦♦♦

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.

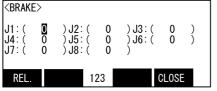
♦ Select the axis of origin setting ♦ ♦ ♦
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

## (3) J3 axis origin setting

<BRAKE>



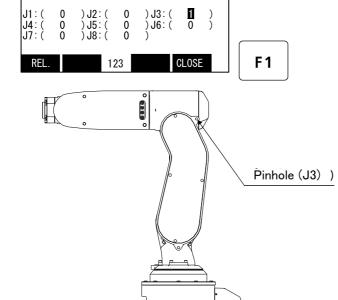
- 1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.
- 2) Press the [2] key, and display the Brake release selection screen.



3) Release the brake of the J3 axis. Input "1" into the J3 axis. Set "0" to other axes. **–C**(J6)

O SPACE

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



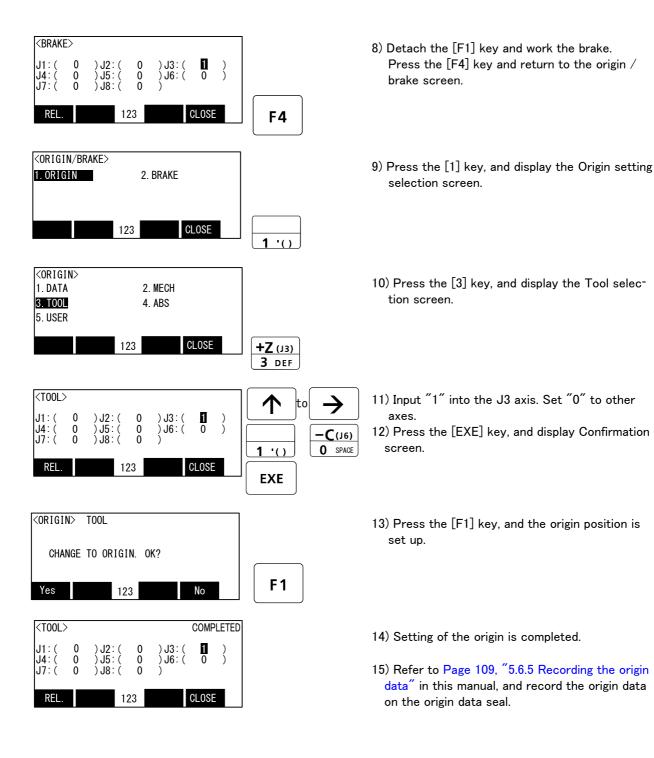
- 6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
- 7) Move the J3 axis slowly toward the front using both hands. Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig ( $\phi$ 6) into the pinholes and fasten.



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.

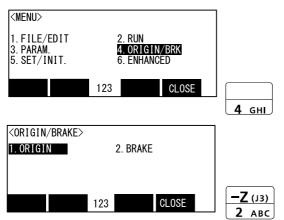


## ♦ Release the brake

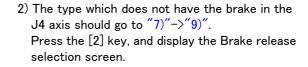
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is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

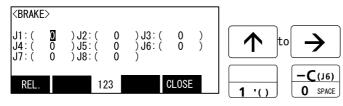
♦ Select the axis of origin setting ♦ ♦ ♦
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

# (4) J4 axis origin setting

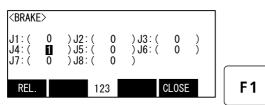


1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.

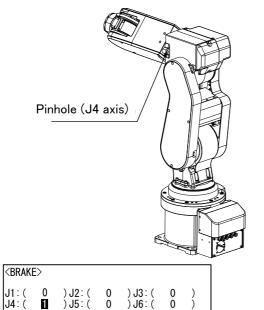




3) Release the brake of the J4 axis. Input "1" into the J4 axis. Set "0" to other axes.



- 4) Confirm the axis for which the brakes are to be released.
- 5) One worker must securely support the upper arm with both hands.
- 6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.

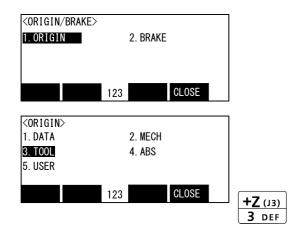


123

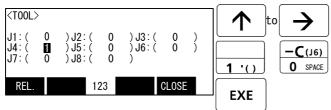
**F4** 

7) Slowly rotate the J4 axis in the direction of minus with both hands. Align the pinholes of the No. 2 arm and elbow, feed through the origin jig ( $\phi$ 6) into the pinholes and fasten.

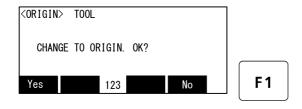
8) Detach the [F1] key and work the brake. Press the [F4] key and return to the origin / brake screen.



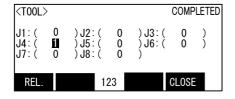
- 9) Press the [1] key, and display the Origin setting selection screen.
- Press the [3] key, and display the Tool selection screen.



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



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



- 14) Setting of the origin is completed.
- 15) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

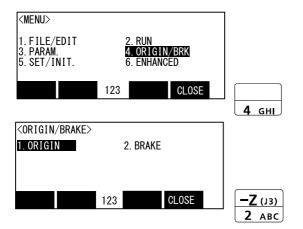
# ♦♦♦ Release the brake

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.

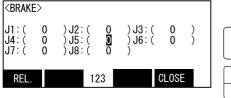
♦ Select the axis of origin setting ♦ ♦ ♦
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

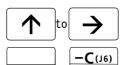
(5) Origin setting of J5 axis and J6 axis (jig)

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



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





1 ()

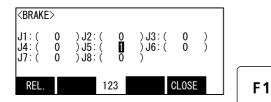
O SPACE

4) Brake release of the J5 axis

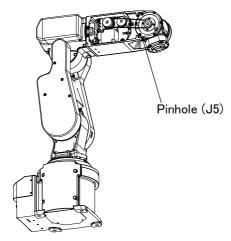
Press the [Arrow] key, move the cursor to the

J5 axis and press the [1] key. Set [0] to other

axes.



- 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 housing , feed through the origin jig ( $\phi$ 6) into the pinholes and fasten.



**⚠** 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.

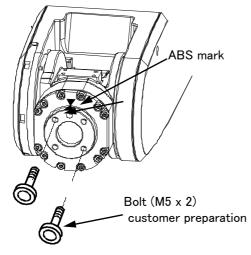
**⚠** CAUTION

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



Next, set the J6 axis posture.

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



10) Install the bolt (M5: 2, customer preparation) in the diagonal position at the J6 axis.

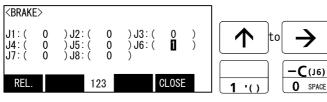
Hold the bolts with hands, rotate them slowly and align the ABS mark of the J6 axis with the ABS mark of the wrist area.

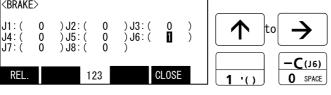
The type which has the brake in the J6 axis releases the brake. The type which does not have the brake should go to "15)".

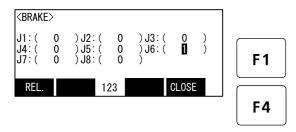
[Press the [Arrow] key, move the cursor to the J6 axis and press the [1] key. Set [0] to other

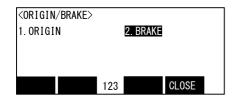


The J6-axis dose not have a mechanical stopper. When setting the origin position do not rotate the axis more than the motion range( $\pm 200$  deg.).

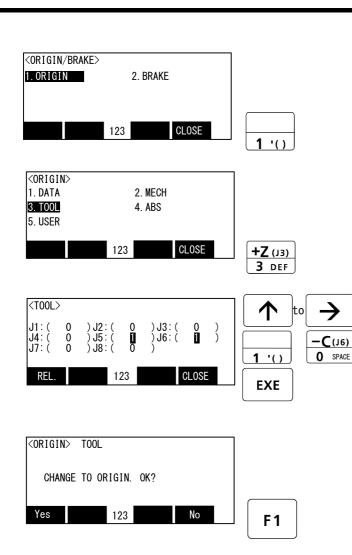




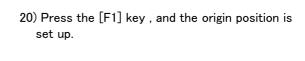




- 11) Confirm the axis for which the brakes are to be released.
- 12) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
- 13) Hold the bolts with hands, rotate them slowly and align the ABS mark of the J6 axis with the ABS mark of 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.



- 16) Press the [1] key, and display the Origin setting selection screen.
- 17) Press the [3] key, and display the Tool selection screen.
- 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.



- 21) Setting of the origin is completed.
- 22) Refer to Page 109, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

The origin settings are completed by the jig method.

COMPLETED

# ♦♦♦ Release the brake

<T00L>

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".

## 5.6.3 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.

To align the ABS marks, view the robot from the front. The deviation between the end points of the two triangular marks must be 1 mm or less.

The positions where the ABS mark is attached are shown in below. Refer to Page 21, "2.4 Confirming the operation" for details on the jog operation.

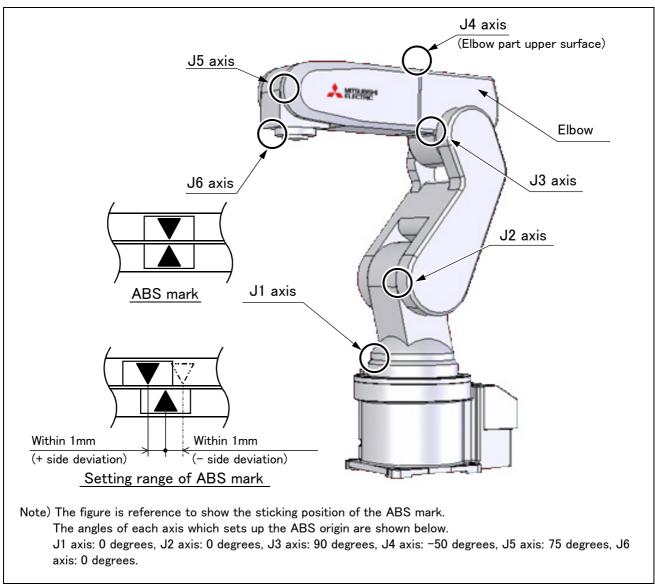
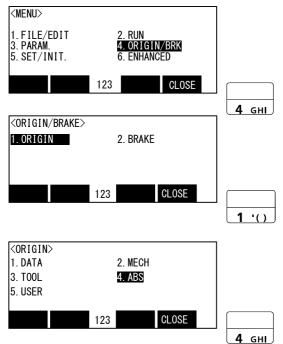


Fig.5-18: ABS mark attachment positions

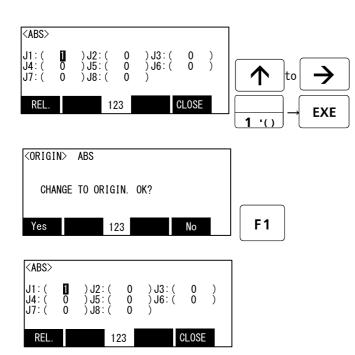
The procedures for setting the origin with the ABS method are explained below.

(1) Select the T/B

Do the following operations with pressing the enabling switch of T/B lightly.



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



- 4) Input "1" into the axis to origin setting. Press the [EXE] key, and display Confirmation screen. Note) Always perform origin setting of the J5 axis and the J6 axis simultaneously.
- 5) Press the [F1] key, and the origin position is set up.

The origin settings are completed by the ABS method.



CAUTION After setting the origin, when the joint coordinates of the ABS mark position deviate from the coordinates of the ABS origin by  $1.5^{\circ}$  or more, align the end points of the ABS marks and set the origin using the ABS origin method again.



CAUTION When the ABS mark label of the axis other than the J6 axis is peeled off, align the pinholes used to set the origin with the jig method. The joint coordinates are the same between the ABS origin method and the jig method.

## 5.6.4 User origin method



CAUTION Before using this method, the origin must be set with the other method. The setting method is explained in Page 80, "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.

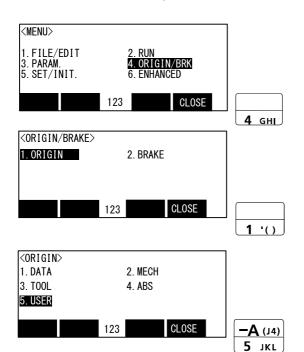
When setting the origin for the first time using this method, carry out the operations in order from step 1). For the second and following time, move the robot arm to the user origin position with jog operation, and accurately position all axes. Then start the procedure from step "4".

1) Determine the user origin position Move the robot to the position to be set as the origin with jog operation. Refer to Page 21, "2.4 Confirming the operation" for details on the jog operation.

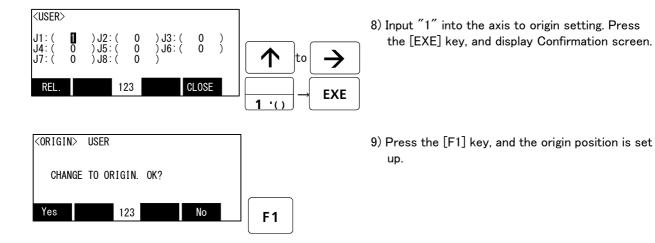


Choose the user origin position as the position where it doesn't move by the gravity. This position is left as a guideline to position all axes with jog operation when setting the origin again with this method.

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



- 4) Next, set the origin. Display the menu screen.
- 5) Press the [4] key on the menu screen, and display 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.



The origin settings are completed by the user origin method.

## 5.6.5 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 J1 motor cover.

The teaching pendant operation method and J1 motor cover removal method for confirming the origin data is the same as the methods for setting the origin with the origin data input method. Refer to Page 16, "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 J1 motor cover.

Refer to Page 59, "5.3.2 Installing/removing the cover", and remove the J1 motor cover.

#### (2) Confirming the origin data

Confirm the value displayed on the teaching pendant's Origin Data Input screen.

Refer to Page 16, "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 J1 motor cover. Refer to Page 16, "Fig.2-11: Origin data label (an example)", and Page 19, "Fig.2-12: Correspondence of origin data label and axis" for details on the origin data label.

#### (4) Installing the cover

Install the J1 motor cover removed in step "(1)Confirming the origin data label" above. Refer to Page 59, "5.3.2 Installing/removing the cover", and replace the J1 motor cover.

The recording of the origin data is completed.

# 6 Appendix

# Appendix 1: Configuration flag

The configuration flag indicates the robot posture.

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

The types of configuration flags are shown below.

#### (1) RIGHT/LEFT

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

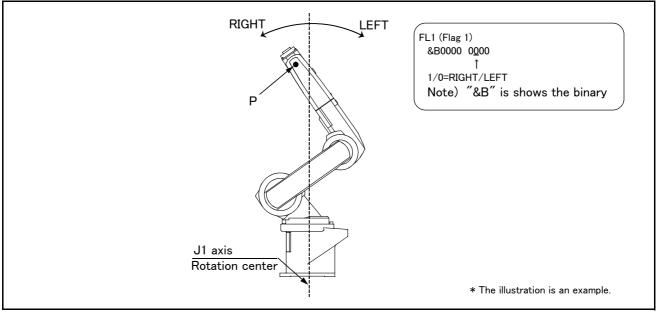


Fig.6-1: Configuration flag (RIGHT/LEFT)

#### (2) ABOVE/BELOW

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

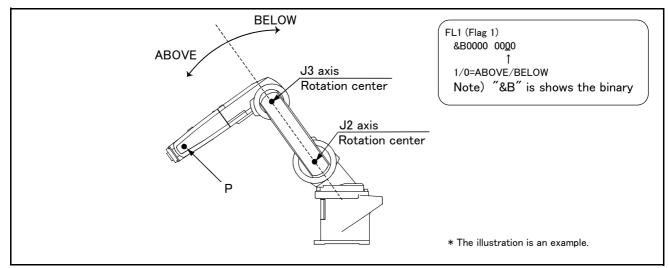


Fig.6-2: Configuration flag (ABOVE/BELOW)

## (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.

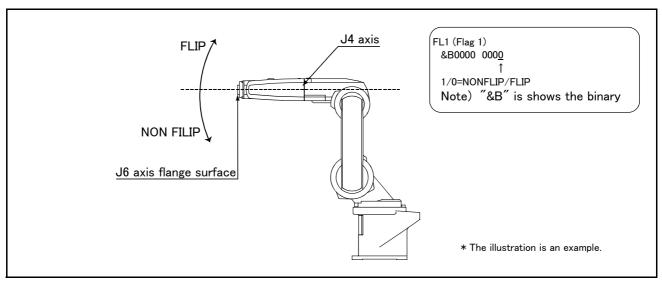


Fig.6-3 : Configuration flag (NONFLIP/FLIP)

# MITSUBISHI ELECTRIC CORPORATION HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN NAGOYA WORKS: 5-1-14, YADA-MINAMI, HIGASHI-KU NAGOYA 461-8670, JAPAN

Authorised representative:
MITSUBISHI ELECTRIC EUROPE B.V. GERMANY
Gothaer Str. 8, 40880 Ratingen / P.O. Box 1548, 40835 Ratingen, Germany