MITSUBISHI ELECTRIC

Mitsubishi Electric Industrial Robot

RH-3CRH/6CRH INSTRUCTION MANUAL

ROBOT ARM SETUP & MAINTENANCE

RH-3CRH series
RH-6CRH series

MELFA
BFP-A3609-H

⚠ Safety Precautions

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

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

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

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

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

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

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

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

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

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 operation rights of the devices, etc. must be designed by the customer.
⚠ CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠ CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠ CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠ CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠ CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠ CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to errors or faults.
⚠ WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠ WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠ CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠ WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠ CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠ CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

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

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

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

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

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

⚠ 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 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 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.

⚠ 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.

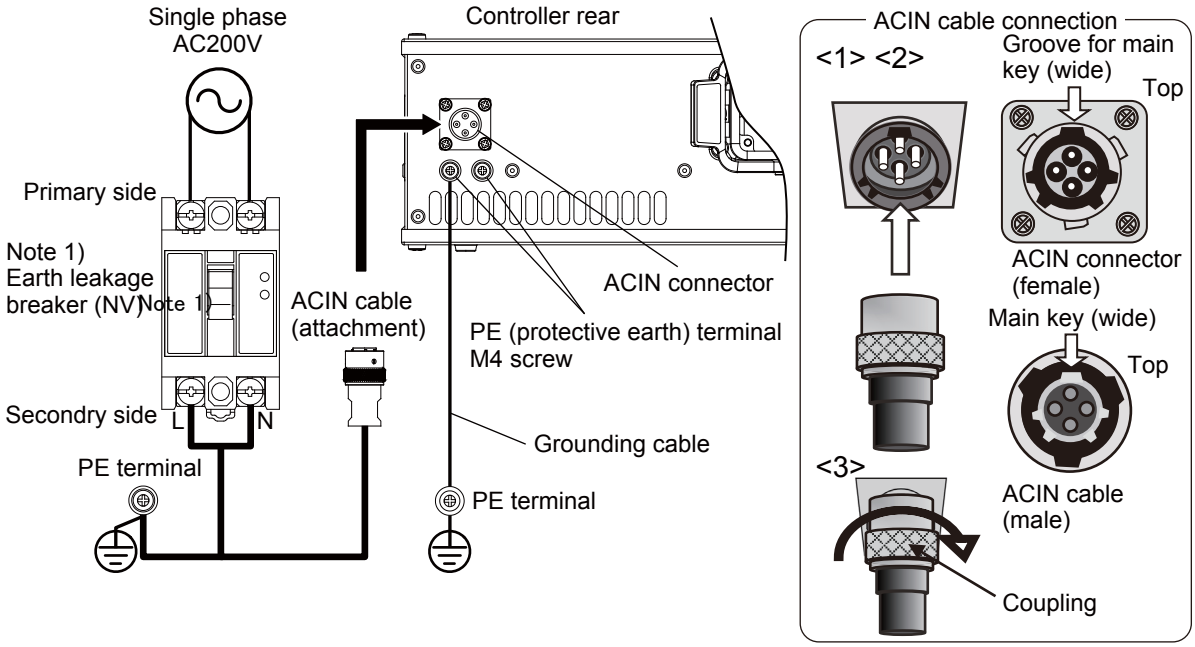
⚠ CAUTION

To maintain the security (confidentiality, integrity, and availability) of the robot and the system against unauthorized access, DoS[*1] attacks, computer viruses, and other cyberattacks from unreliable networks and devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.
Mitsubishi Electric shall have no responsibility or liability for any problems involving robot trouble and system trouble by unauthorized access, DoS attacks, computer viruses, and other cyberattacks.
*1 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

*CR800 controller

Notes of the basic component are shown.

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



Note 1) Always use the terminal cover for the earth leakage breaker.

1) Prepare the following items.

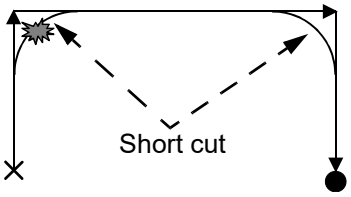
Part name	Specifications	Remarks
Earth leakage breaker	The following is recommended product. Single phase: NV30FAU-2P-10A-AC100-240V-30mA (Terminal cover: TCS-05FA2)	Prepared by customer.
Cable for primary power supply	AWG14 ($2mm^2$) or above	Prepared by customer. Tightening torque for terminal fixing screw is 2 ～ 3Nm.
Grounding cable	AWG14 ($2mm^2$) or above	Prepared by customer. Tightening torque for terminal fixing screw is 2 ～ 3Nm.
ACIN cable	Terminal: M5, cable length: 3m	Supplied with the product.

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 ACIN cable to the breaker.
   Connect the power terminals of the ACIN cable to the secondary side terminals of the earth leakage breaker. Also, ground the FG terminal of the cable.
5) Connect the ACIN cable to the ACIN connector on the rear of the controller.
   <1> Face the main key on the ACIN cable plug upwards. (Refer to the "ACIN cable connection" illustration.)
   <2> Align the main key of the ACIN cable plug with the grooves on the ACIN connector. Push the plug into the connector as far as it will go.
   The plug may be damaged if it is not correctly aligned with the connector.
   <3> Tighten the coupling on the ACIN cable, turning it to the right until it locks.
6) Connect one end of the grounding cable to the PE (protective earth) terminal on the controller and ground the other end (2-point grounding) in order to comply with the requirements of EN 61800-5-1 for the touch current of 3.5 mA AC or more.
7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

⚠ CAUTION Be careful of interference with peripheral equipment.
Especially don't give a shock to the shaft (J3 axis). When you install the hand, be careful not to knock at the shaft end by the hammer etc. The shaft may be damaged.

Take care also of the following items.

(1)The robot's locus of movement may change with specified speed.
Especially as for the corner section, short cut distance may change. Therefore, when beginning automatic operation, moves at low speed at first, and you should gather speed slowly with being careful of interference with peripheral equipment.



Arch movement (example)

(2)It can be confirmed whether the specified position exist in the defined area by using the instruction command "Zone". It can utilize as one of the methods for collision evasion. Refer to the "detailed description of the instructions manual/function, and operation" of the separate volume for the details of the instruction command.

Revision history

Date of Print	Instruction Manual No.	Revision Details
2018-03-01	BFP-A3609	• First print
2018-12-25	BFP-A3609-A	• Added further explanation of the ACIN cable. • Revised the instructions for replacing machine cables (replaceable type). • Revised the instructions for replacing the backup battery. • Revised the positions of the ABS marks.
2020-01-24	BFP-A3609-B	• Corrected the type of timing belt used for the J3 axis of the RH-6CRH. • Added information on the recommended tightening torque for installation bolts.
2020-10-30	BFP-A3609-C	• Amended the precautions regarding the prevention of unauthorized access. • Corrected the battery name. (ER6 → ER6V) • Corrected other mistakes and changed some sections.
2022-02-24	BFP-A3609-D	• Software version C2d supported. Added descriptions to "2.3.2 Turning ON the control power". Added the parameter HNDCHK to "Table 2-5: Hand parameter".
2022-11-30	BFP-A3609-E	• Added CAUTION to "2.2.5 Connecting with the controller". • Corrected other mistakes and changed some sections.
2023-04-17	BFP-A3609-F	• Software version C2j supported. Added precautions to "5.6.4 User origin method". • Corrected other mistakes and changed some sections.
2023-09-14	BFP-A3609-G	• Added Caution to "5.3.5 (1) Replacing the battery of the robot arm". • Changed some sections.
2024-04-05	BFP-A3609-H	• Amended "2.2.1 Unpacking". • Corrected other mistakes and changed some sections.

*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

•RH-3CRH/-S15/-S19
•RH-6CRH/-S15/-S19
Note) Only the standard models (RH-3CH, RH-6CH) are available in Japan and China.

CONTENTS

CONTENTS

1 Before starting use

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

1.1 Using the instruction manuals

1.1.1 Details of each instruction manual

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.

Manual name	Description
Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller setup, basic operation, and maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed explanations 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	Explains the control function and specifications of conveyor tracking.
GOT Direct Connection Extended Function	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures about the GOT (standalone type robot).
Ethernet Function	Explains the measures to perform communication with personal computers on Ethernet with the TCP/IP protocol.

1.1.2 Symbols used in instruction manual

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

Table 1-1:Symbols in instruction manual

Terminology	Item/Symbol	Meaning
Item	iQ Platform compatible type	
	Controller	Indicates the controller which controls the robot arm.
	The robot CPU unit or robot CPU	Indicates the CPU unit for the robots which installed to the sequencer base unit of MELSEC iQ-R series. It is connected with the controller 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.
	Standalone type	
	Controller	Indicates the controller which controls the robot arm.
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. Descriptions in this manual are based on R32TB.

1.2 Safety Precautions

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

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

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

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

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

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

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

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

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

1.2.1 Precautions given in the separate Safety Manual

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

⚠DANGER	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.
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⚠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 errors or faults.
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⚠CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
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⚠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.
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⚠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).)

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⚠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.

⚠CAUTION To maintain the security (confidentiality, integrity, and availability) of the robot and the system against unauthorized access, DoS[*1] attacks, computer viruses, and other cyberattacks from unreliable networks and devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.
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*1 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

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 Manual".

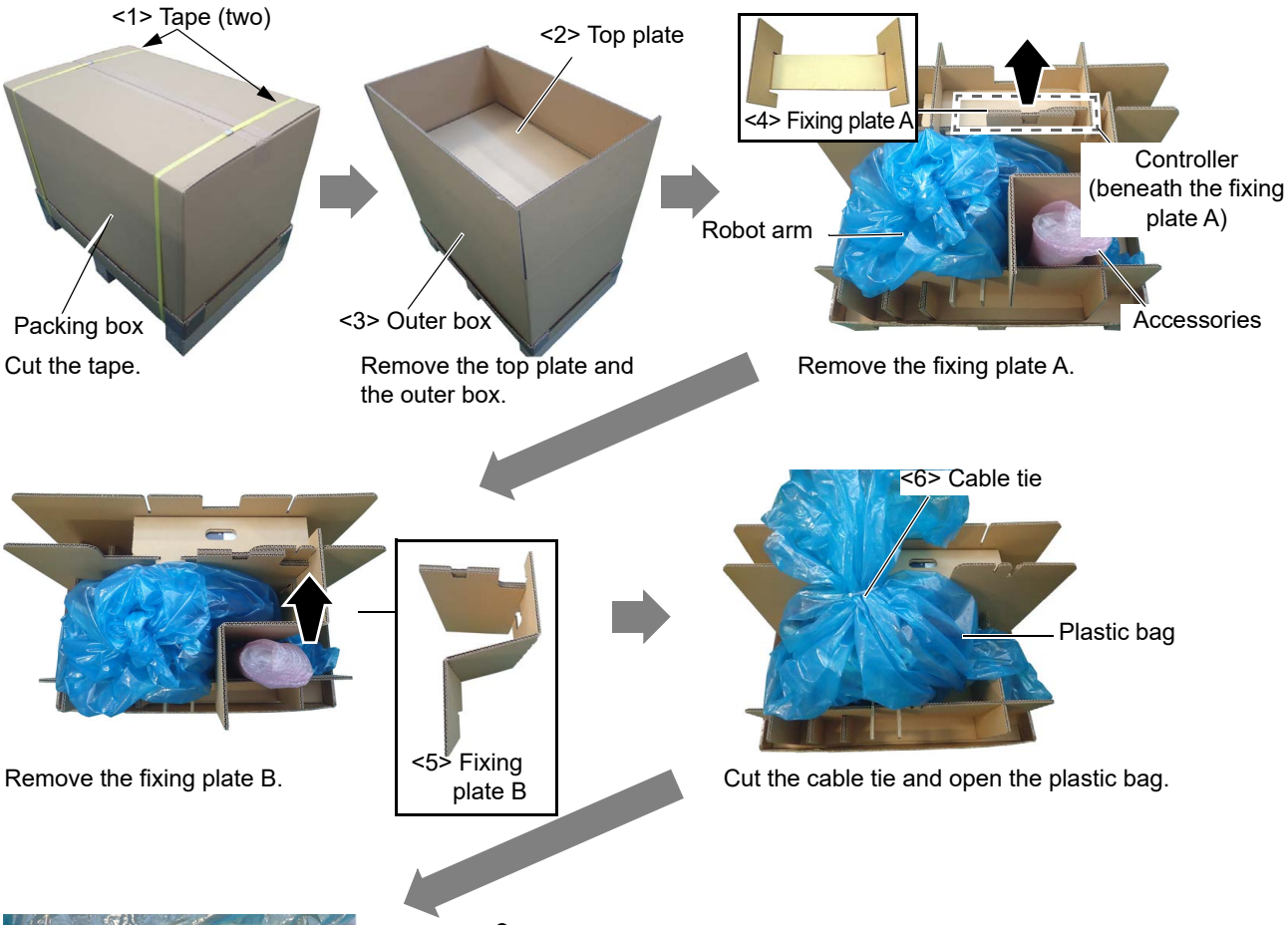
Table 2-1:Standard configuration

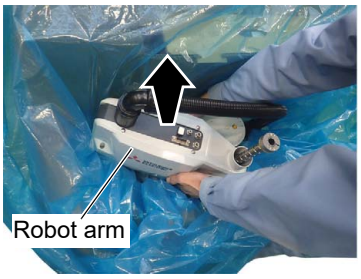
No.	Part name	Type	Qty.	Remarks
RH-3CRH				
1	Robot arm		1 unit	
2	Installation bolts	M8×30	4 pcs.	For robot arm installation
3	Spring washer for installation bolts	For M8	4 pcs.	
4	Plain washer for installation bolts	For M8	4 pcs.	
5	D-sub connector set		2 sets	Connector for fixing the tool wiring
RH-6CRH				
1	Robot arm		1 unit	
2	Installation bolts	M8×30	4 pcs.	For robot arm installation
3	Spring washer for installation bolts	For M8	4 pcs.	
4	Plain washer for installation bolts	For M8	4 pcs.	
5	D-sub connector set		2 sets	Connector for fixing the tool wiring

Note) Items No. 2 to 5 are contained in the plastic bag of attachment in the robot arm.

2.2 Installation

2.2.1 Unpacking





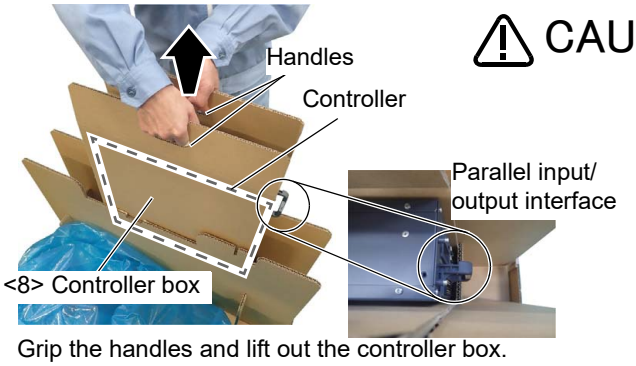
Take the robot arm out of the box.

⚠CAUTION Take the robot out of the box slowly. Be careful not to get injured with the edge of the robot

⚠CAUTION The robot does not stand on its own in the posture after the unpacking. Fix the robot securely in place for installation.

⚠CAUTION Always unpack the robot at a flat place. Otherwise, the robot may fall down.

* The grease for preventing rust is applied at the tip of the shaft (J3 axis) of the robot.



Grip the handles and lift out the controller box.

⚠CAUTION Take the controller box straight up slowly. Be careful not to let the controller slip out of the box.

⚠CAUTION The parallel I/O interface is installed on the controller. Do not hold the parallel I/O interface section when taking out the controller. Otherwise, the interface may be fractured.

* The figure shown is an example. Although the package varies depending on the model, the basic unpacking procedure is the same.

Fig.2-1:Unpacking of the robot arm

The unpacking procedure is shown below.

1) Cut the tape <1> around the packing box with scissors etc.
2) Lift and remove the top plate <2> and the outer box <3>.
3) Lift and remove the fixing plate A <4> and the fixing plate B <5> one after another.
4) Cut the cable tie <6> with nippers etc. and open the plastic bag.
5) Take the robot arm out of the box.
   Note that the robot does not stand on its own in the posture after the unpacking.
6) Grip the handles of the controller box <8> and take out the controller.

Unpacking is completed.

2.2.2 Transportation procedures

(1) Transportation procedure when unpacking

Weight
RH-3CRH: Approx. 14 kg
RH-6CRH6020: Approx. 17 kg
RH-6CRH7020: Approx. 18 kg

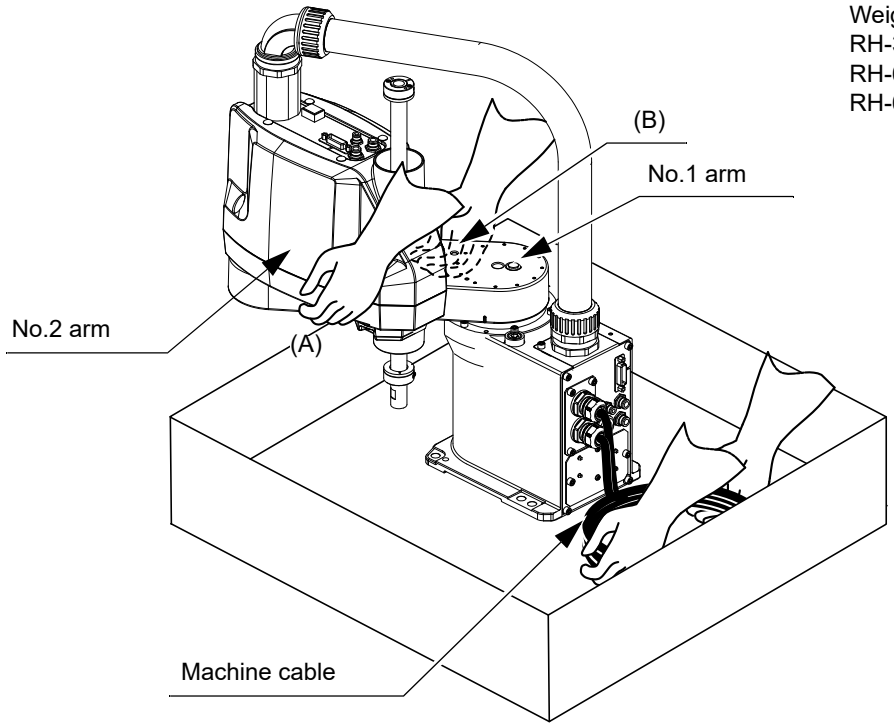


Fig.2-2:Transportation posture and method

1) The robot must be transported by two workers. Use a cart or other device for transporting the robot near the installation place. The following instructions for carrying the robot are applicable only when the robot is transferred onto the stand or another cart, or moved for positioning.
2) The robot will fall down when the robot is not installed with installation bolts. Support the robot arm with one hand while removing the installation bolts.
3) For carrying the robot arm, one person should hold the No.2 arm <A> and No.1 arm <B> and another person should hold the machine cable.
   Do not hold the cover of the robot for carrying it. Otherwise, the robot may fall down, the cover may be broken or fall, or other accidents may occur.
   Do not apply force to the cover or avoid strong impact on the robot while carrying the robot.
4) Transfer the robot slowly. Be careful not to get injured with the edge of the robot arm.
5) Transport the robot with fixing it to the packing box at delivery again for secondary transportation such as changing the installation place. If the robot is lifted while it is in the operation posture, its components may be damaged or its gravity position may be inappropriate, resulting in danger at transportation.
   If it is difficult to follow the above transportation procedures, refer to Page 10, "(2) Transportation procedure at secondary transportation"

⚠CAUTION Do not hold the cover of the robot during transportation to prevent accidents.

⚠CAUTION Do not apply force to the shaft (J3 axis). Otherwise, the shaft may be damaged, resulting in an overload error.

⚠CAUTION When transferring the robot again, adjust the posture of each axis of the robot as specified in Table 2-2.

⚠CAUTION Do not place the robot facing sideways. Otherwise, grease leaks or malfunction may occur.

Table 2-2:Transportation posture

Axis	RH-3CRH	RH-6CRH
J1	0°	0°
J2	145.7°	154.2°
J3	100 mm (not fixed)	100 mm (not fixed)
J4	Not fixed	Not fixed

(2) Transportation procedure at secondary transportation

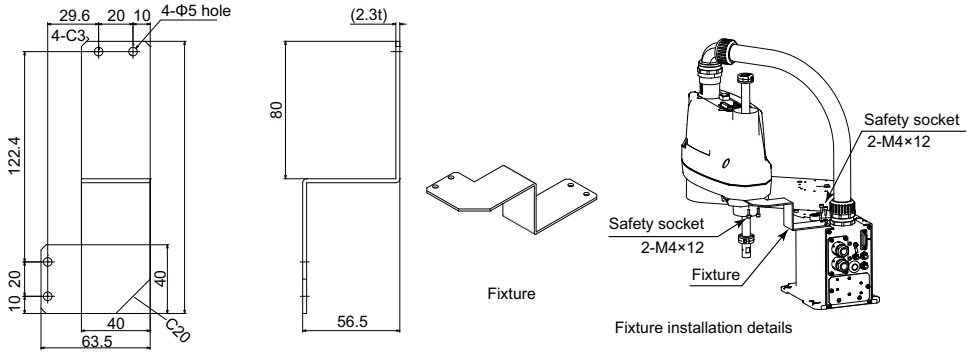
If it is difficult to follow the transportation procedure at secondary transportation described in Page 9, "(1) Transportation procedure when unpacking", take countermeasures not to allow the joints of the robot arm freely move by fixing the robot arm in such a way as to take advantage of the screw holes for fixing plates or the like. Do not apply an excessive load to the robot arm while fixing it.

If the robot arm is transported with its joints unfixed, applying an excessive power on the joints by external forces may cause a malfunction.

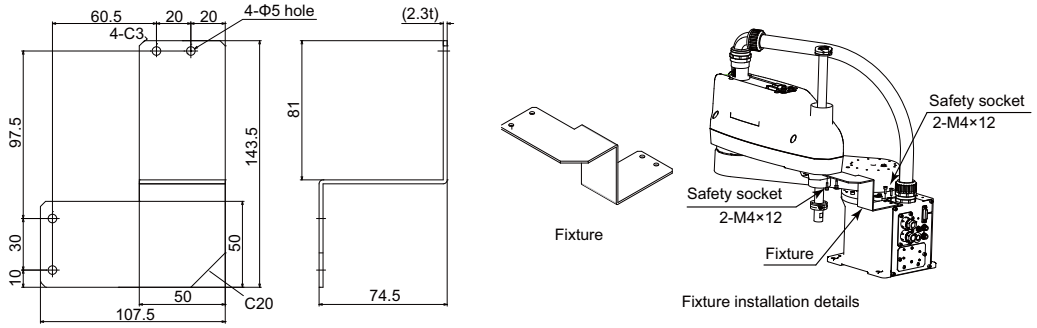
When fixtures for fixing the joints of the robot arm are required, please consult your local Mitsubishi Electric.

The reference figure of the fixture is shown in Fig. 2-3.

<RH-3CRH series>



<RH-6CRH6020 series>



<RH-6CRH7020 series>

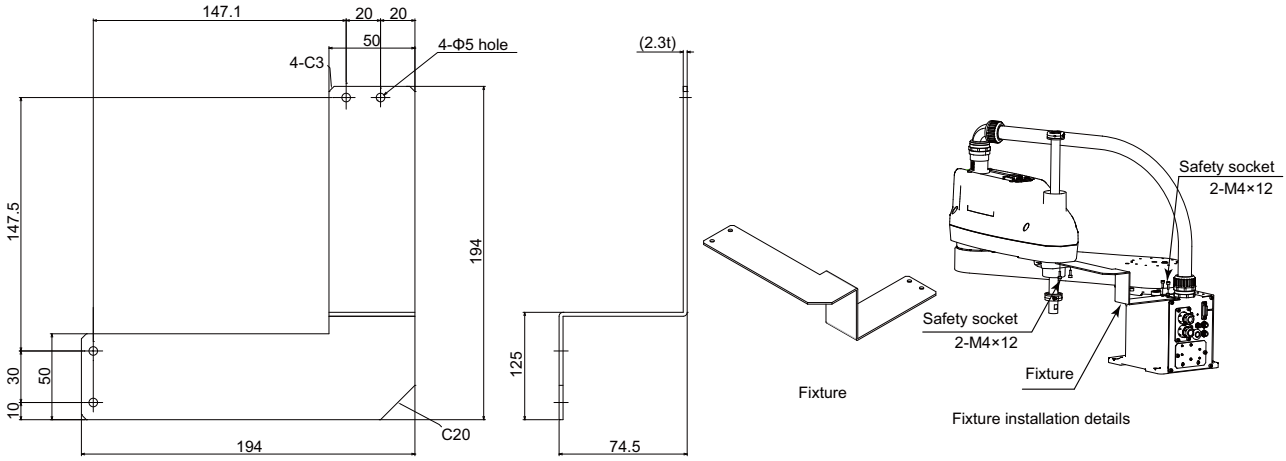


Fig.2-3:Reference figure of the fixture

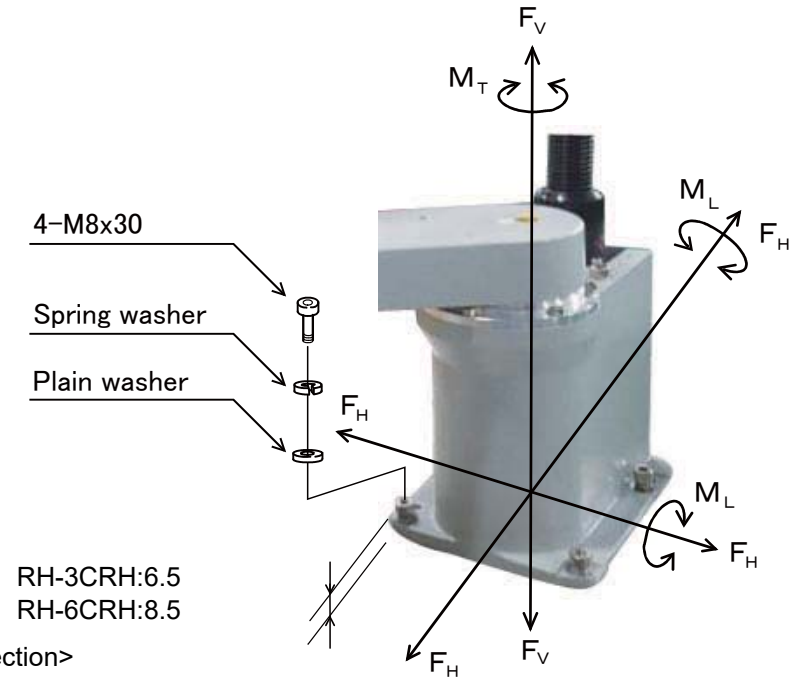
Before installing fixtures, adjust the posture of each axis of the robot as specified in Table 2-3.

Table 2-3:Fixture installation posture

Axis	RH-3CRH	RH-6CRH6020	RH-6CRH7020
J1	50°	30°	30°
J2	130°	150°	150°
J3	90 mm (not fixed)	90 mm (not fixed)	90 mm (not fixed)
J4	Not fixed	Not fixed	Not fixed

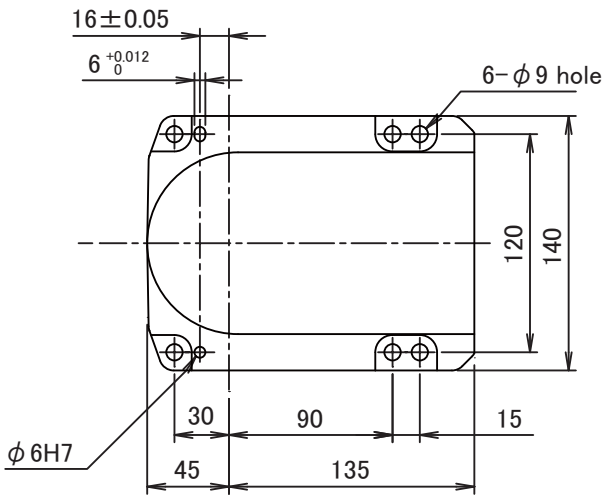
2.2.3 Installation procedures

The installation procedure of the robot arm is shown below.



<Top view of the base section>

RH-3CRH



RH-6CRH

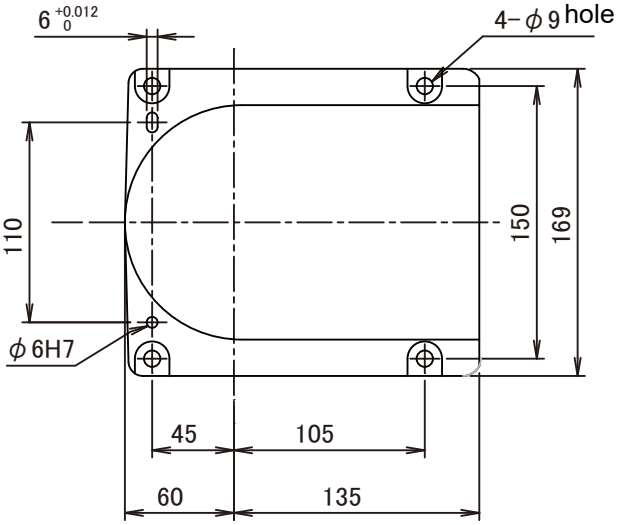


Fig.2-4:Installation dimensions

1) The robot installation surface has been machine finished. Use the installation holes (6-ϕ9 for RH-3CRH, 4-ϕ9 for RH-6CRH) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (hexagon socket bolts). (Recommended tightening torque: 26.5 N•m)
2) Install the robot on a level surface.
3) It is recommended that the surface roughness of the table onto which the robot is to be installed by 6.3 Ra 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) If you operate the robot at a high speed, reaction forces are applied to the installation stand by the robot's operation. Make sure that the installation stand on which the robot is placed has sufficient strength and rigidity. Table 2-4 shows the maximum reaction force (design values) that may be applied to an installation stand. Please use these values as reference when designing the installation stand.

Table 2-4:Magnitude of each reaction force

Item	Unit	Value
RH-3CRH		
Tilt moment : M_L	N · m	220
Torsional moment : M_T	N · m	180
Horizontal direction translation force : F_H	N	820
Vertical direction translation force : F_V	N	320
RH-6CRH6020		
Tilt moment : M_L	N · m	410
Torsional moment : M_T	N · m	260
Horizontal direction translation force : F_H	N	800
Vertical direction translation force : F_V	N	640
RH-6CRH7020		
Tilt moment : M_L	N · m	500
Torsional moment : M_T	N · m	370
Horizontal direction translation force : F_H	N	960
Vertical direction translation force : F_V	N	670

⚠CAUTION Secure the maintenance space necessary at rear for connection of the machine cable and for replacement of the backup battery. For the dimensions of the maintenance space, refer to "Outside dimensions/Operating range diagram" in the Standard Specifications Manual.

⚠CAUTION Do not install the robot arm in areas where direct sunlight is present or heat is generated from lighting.
The skin temperature of the robot arm may rise, and the error may occur.

2.2.4 Grounding procedures

(1) Grounding methods

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

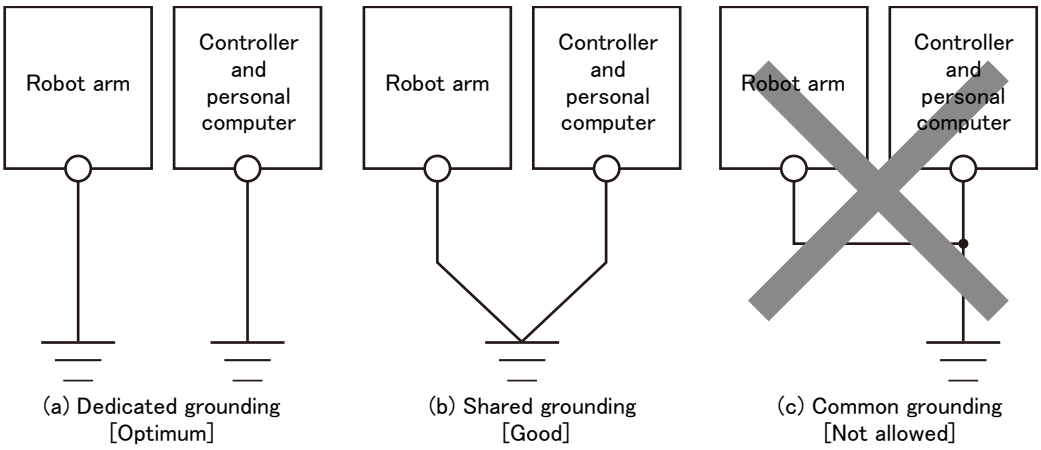
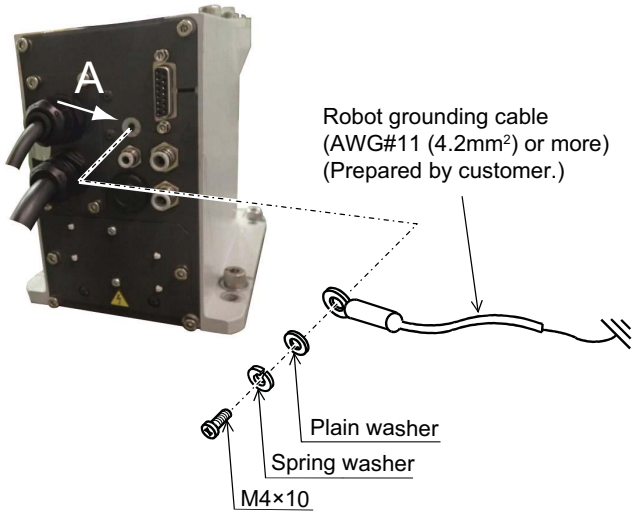


Fig.2-5:Grounding methods

(2) Grounding procedures



1) Prepare a grounding cable (AWG#11 (4.2 mm^2) or more) and the installation screw and washer for the robot.

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

3) Connect the grounding cable to the grounding screw section.

Fig.2-6:Connecting the grounding cable

2.2.5 Connecting with the controller

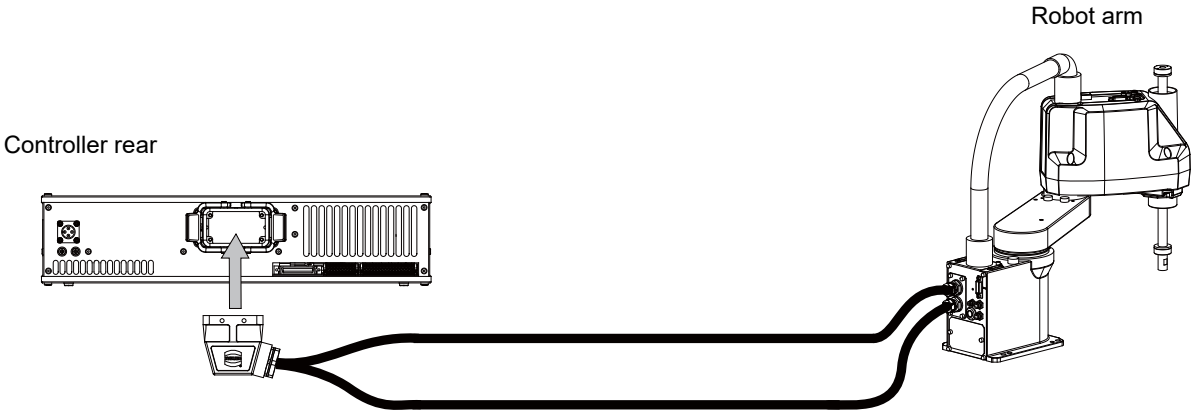
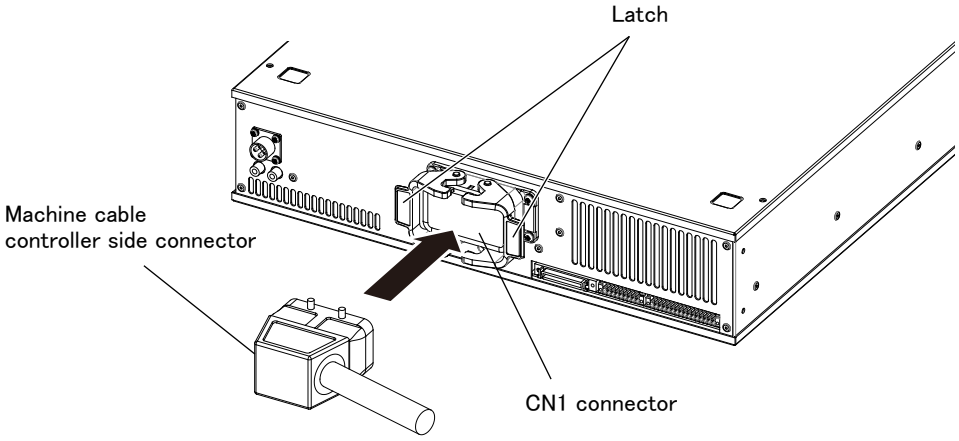


Fig.2-7:Connecting the machine cables

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



1) Make sure that the power of the controller is turned OFF.
2) Connect the controller side connector of the machine cable to CN1 connector on the rear side of the controller.
3) To fix the inserted connector, close the latches of the CN1 connector.
4) The connection method is the same for the optional machine cables (replaceable type). However, refer to the separate "Standard Specifications Manual" for information on how to fix a flexible cable.

Connecting the machine cable is completed.

⚠ CAUTION When connecting and disconnecting the connector, be careful not to get your hand pinched.

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

⚠ CAUTION To disconnect the cable, open the latches, hold the connector part, and pull out the cable. Pulling the cable part may cause the cable to come off or break.

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

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

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

⚠ CAUTION When connected, the model is automatically selected; therefore, when the current model is replaced with a different model, H1601 (model mismatch error) will occur.
Change the parameter ATMESEL to "1" and turn the power ON again.
After the change of the parameter as above, the other parameters and programs will be lost. Back up the data beforehand.

2.3 Confirming the operation

After the robot is connected to the controller, the origin data is automatically written.
Then, manually move the robot 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, the Work jog that moves along the work coordinate system, and the CYLNDER jog that moves along the circular arc.
This operation is carried out while pressing the deadman switch on the back of the T/B.
Note) The figure of the robot which indicated to the explanation page in each jog mode is an example.

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

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

⚠ CAUTION 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 68, "5.6 Resetting the origin".

2.3.1 Installing the teaching pendant (T/B)

Installing the T/B, with turning off the controller power.

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

Explain the installation method of T/B below.

1) Check that the controller's power supply is OFF.
2) Refer to Fig. 2-8 and connect T/B connector to the robot controller.
   Use as the upper surface the lock lever, and push in until there is sound.
3) Pressing down the lock lever to lock the connector as shown below.

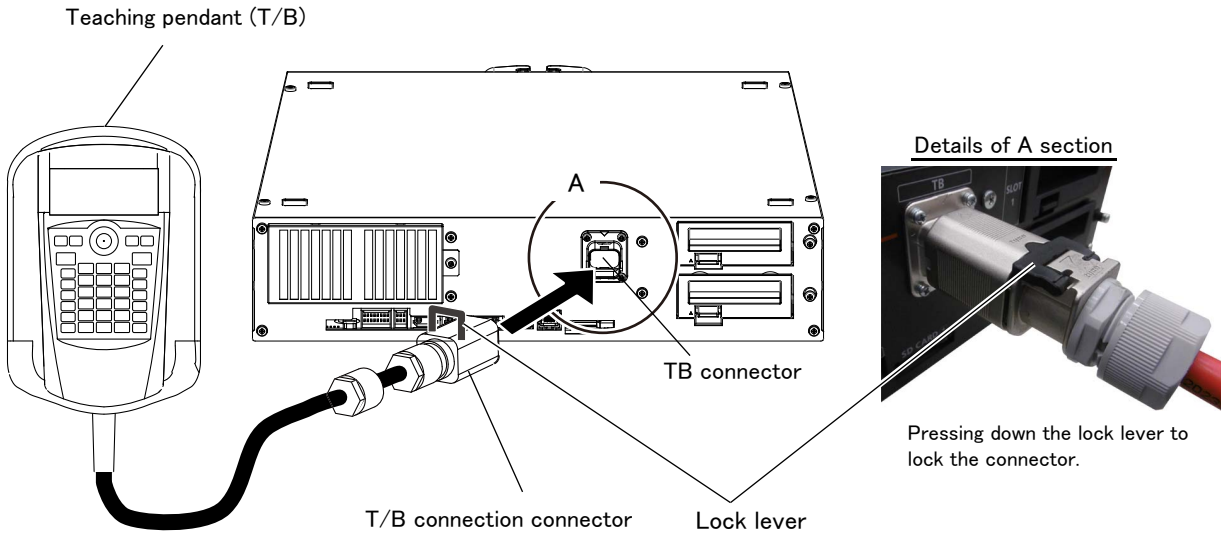


Fig.2-8:Installing the T/B

The installation of T/B is finished.

2.3.2 Turning ON the control power

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

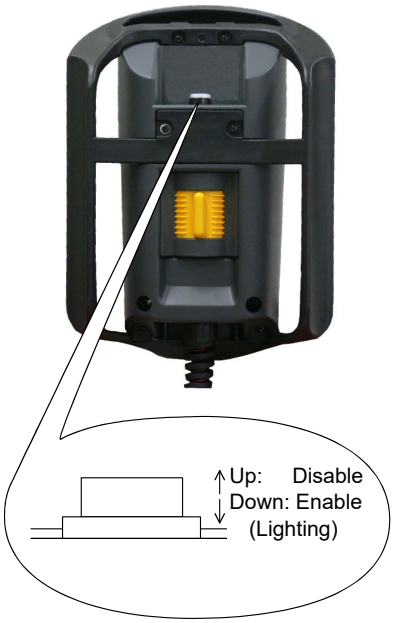
1) Turn the controller power switch ON.
   Turns ON the switch of the earth leakage breaker of installation outside.

* Controller software version C2d or later
  If the hand conditions (weight, size, and center of gravity) have not been set, error C0330 (Undefined hand condition) will occur upon power on.
  Clear the error from the teaching pendant or RT ToolBox3 until the hand conditions are set.
  Set the hand conditions using the parameter HNDDAT* (* = 0 to 8).
  For further information, refer to "Movement parameter" in the "Instruction Manual/Detailed explanations of functions and operations".

2.3.3 Preparing the T/B

Next, prepare to use the T/B

1) Set the mode of the controller to "MANUAL".



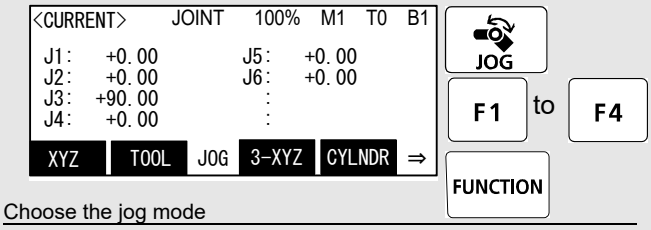
2) Set the T/B [ENABLE] switch to "ENABLE". The menu selection screen will appear.

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

◇◆◇ Operating from the T/B ◇◆◇

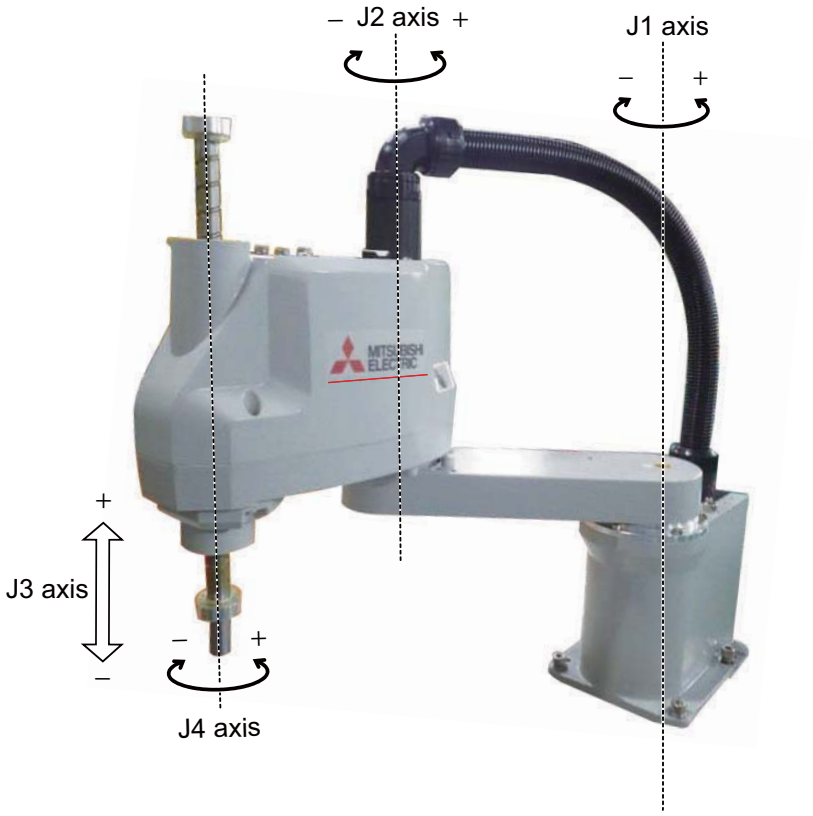
Always set the mode of the controller to "MAMNUAL", and then set the T/B [ENABLE] switch to "ENABLE". When the T/B is valid, only operations from the T/B are possible. Operations from the external signals will not be accepted. The stop-related operations such as an emergency stop can be performed regardless of the valid/invalid setting.

◇◆◇ How to choose the jog mode ◇◆◇



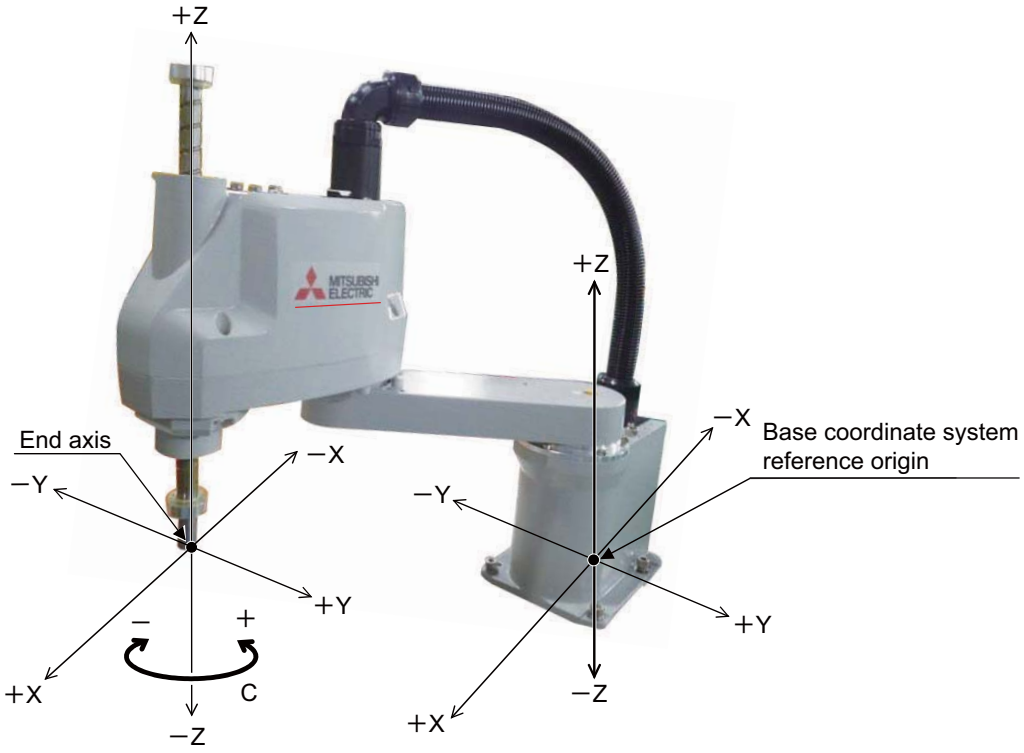
Choose the jog mode

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 (T0), and the base coordinate number (B1) are displayed on the upside of the screen following the present jog mode (JOINT).



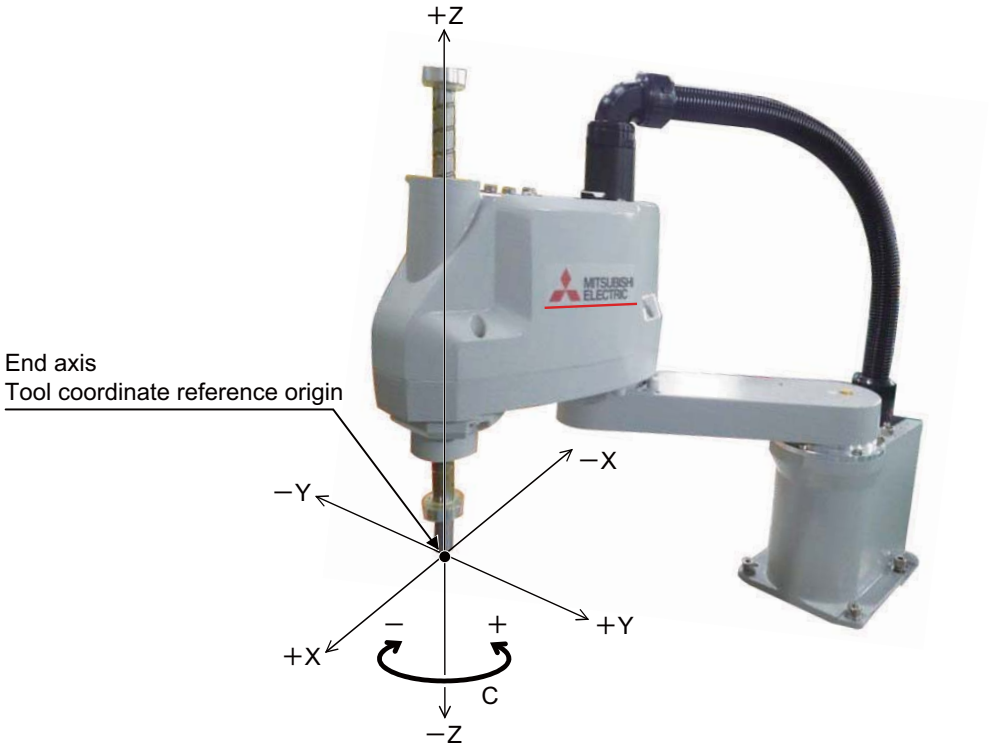
* Each axis moves independently.

Fig.2-9:JOINT jog operation



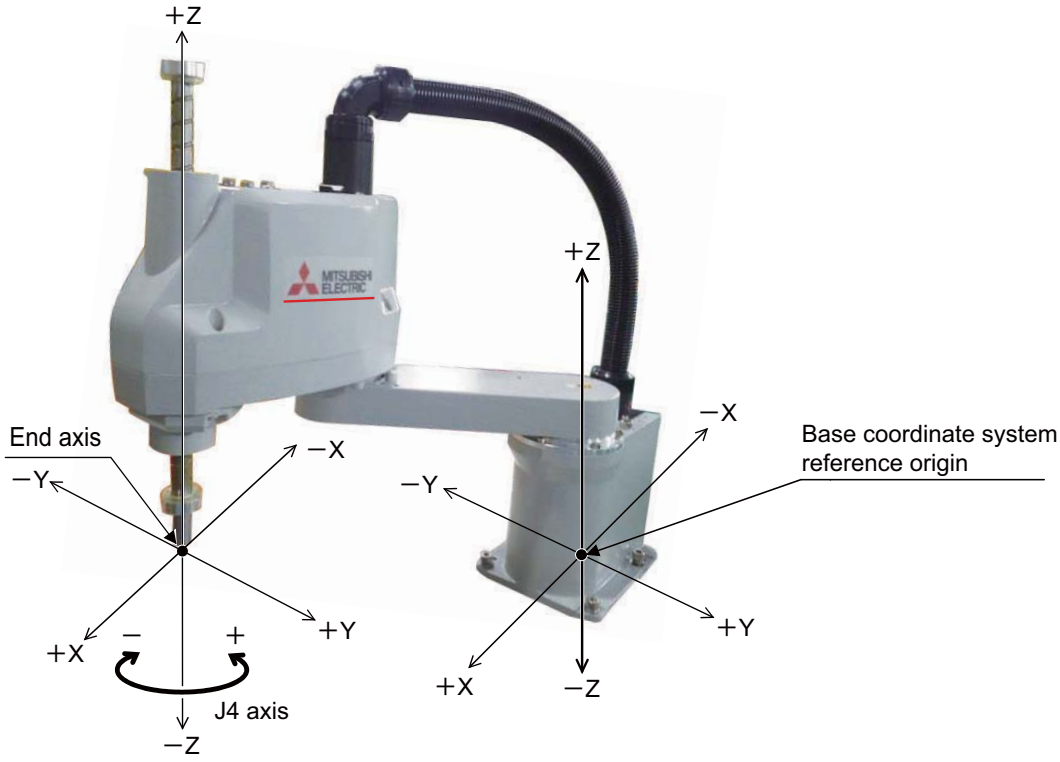
* While maintaining the end axis posture, the axis moves straight along the base coordinate system.
Also, while maintaining the end axis position, the end axis posture changes.

Fig.2-10:XYZ jog operation



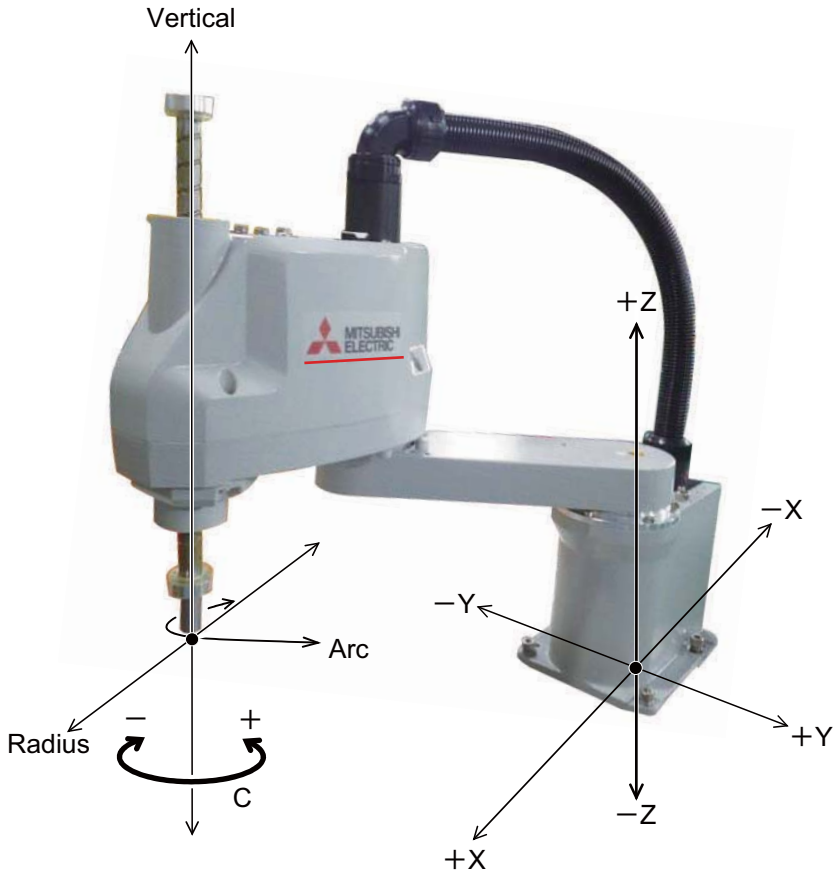
* While maintaining the end axis posture, the axis moves straight along the tool coordinate system.
  Also, while maintaining the end axis position, the end axis posture changes

Fig.2-11:TOOL jog operation



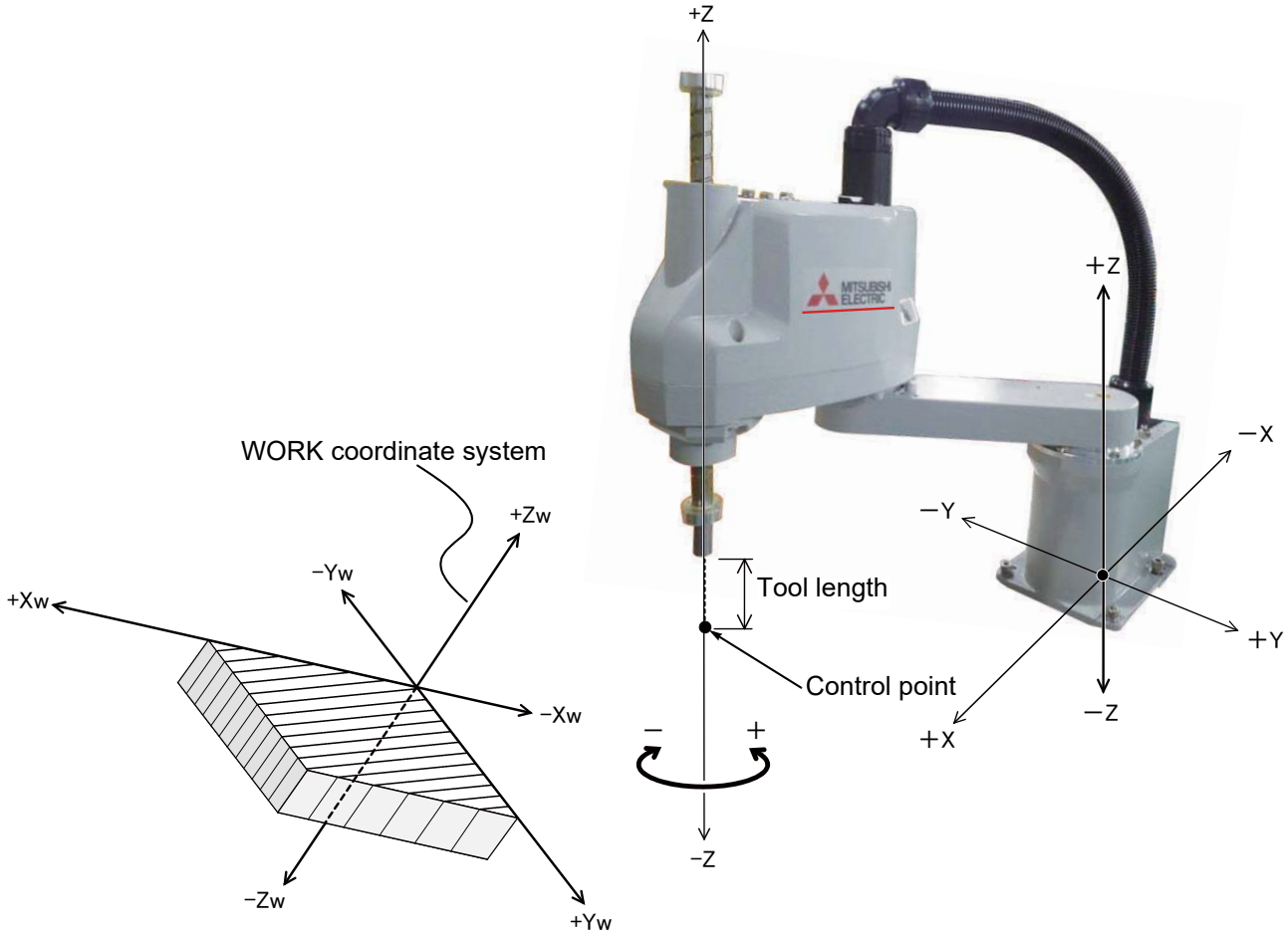
* The axis moves straight along the base coordinate system. At this time, the end axis posture is not maintained.
  Also, the end axis posture changes.

Fig.2-12:3-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 end axis posture is maintained. Also, while maintaining the axis posture position, the end axis posture changes.

Fig.2-13:CYLINDER jog operation

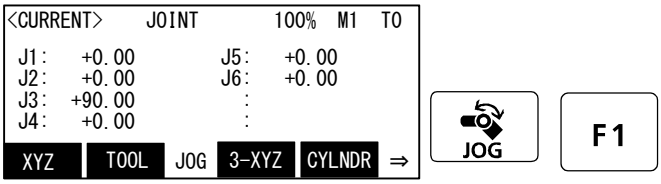


* While maintaining the end axis posture, the axis moves straight along the work coordinate system. Also, while maintaining the end axis position, the end axis posture changes.
* Jog operation around the work coordinates system is available (EX-T jog). In this jog operation, when the jog operation is 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.2-14:WORK jog operation

(1) JOINT jog operation

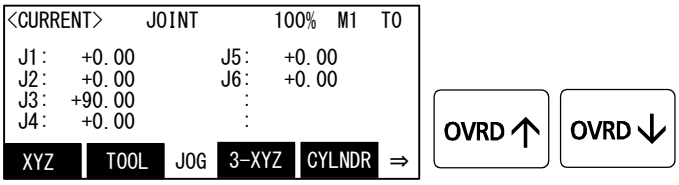
Select joint jog mode



Joint jog mode

[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."

Set jog speed



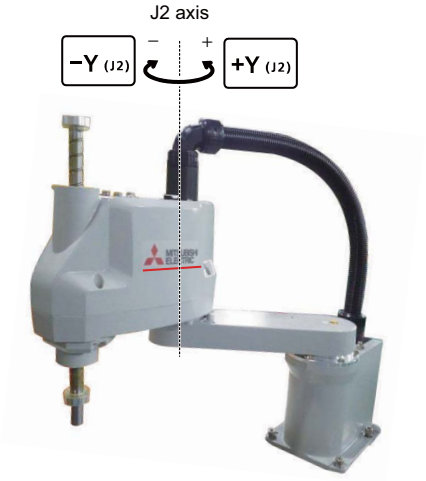
Setting the speed

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 the screen upper right.
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

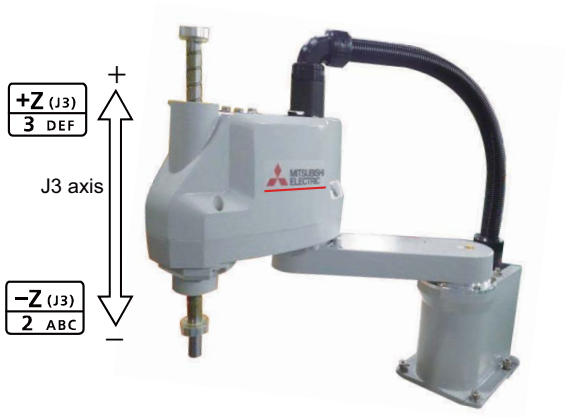


- When the [+Y (J2)] keys are pressed, the J2 axis will rotate in the plus direction.
  When the [-Y (J2)] keys are pressed, rotate in the minus direction.

◇◆◇ 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 axis jog operation

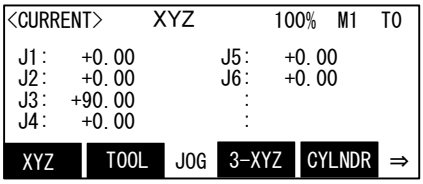
- When the [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
  When the [-A (J4)] keys are pressed, rotate in the minus direction.

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

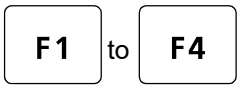
If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

(2) XYZ jog operation

Select XYZ jog mode

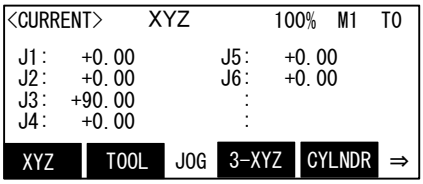


XYZ jog mode

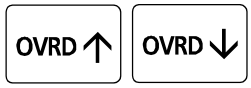


[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "XYZ" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ." (If the jog mode which he wishes under the screen is not displayed, 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."

Set jog speed

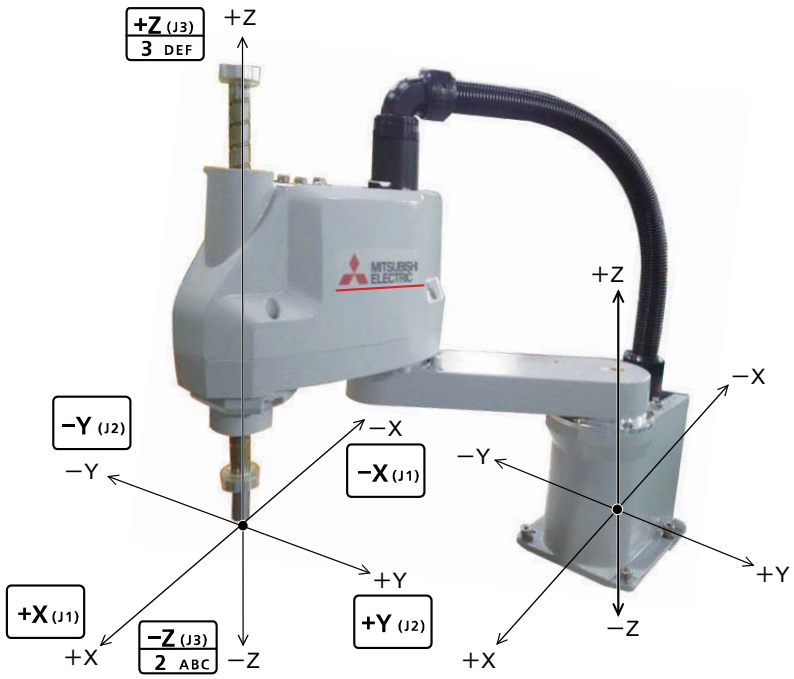


Setting the speed



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 the screen upper right. 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.

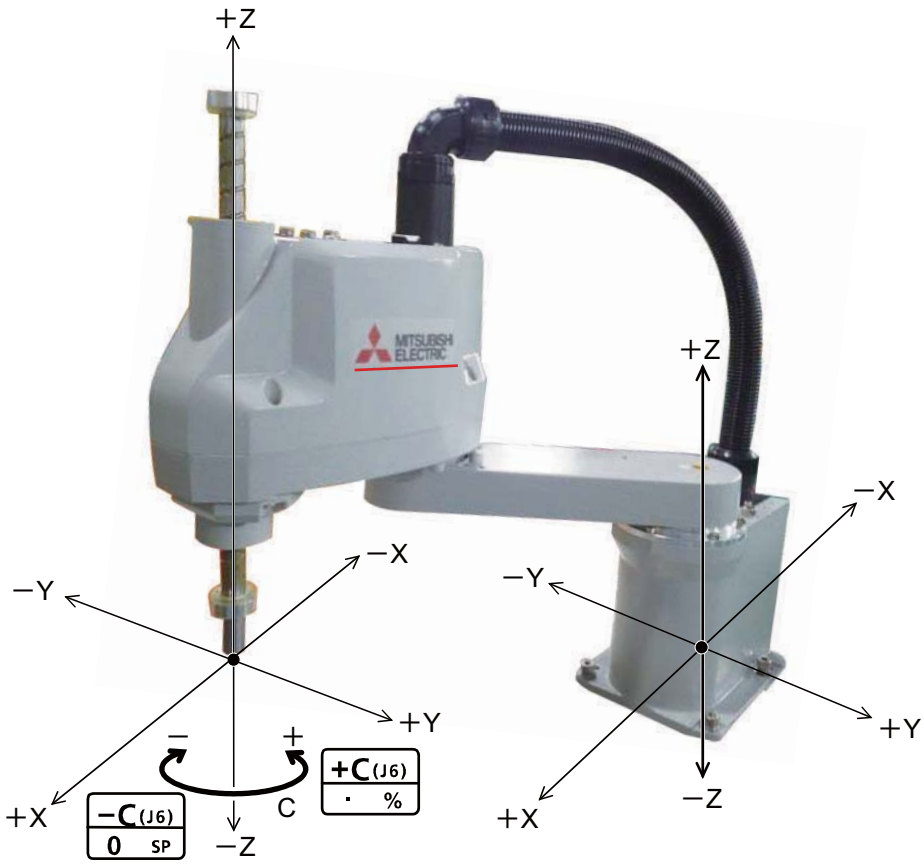
◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to Page 24, "(1) JOINT jog operation", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

Changing the end axis posture



*The Position of the end axis will not change.

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

◇◆◇ When alarm No. 5150 occurs ◇◆◇

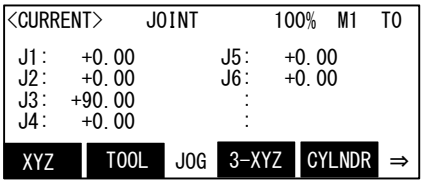
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

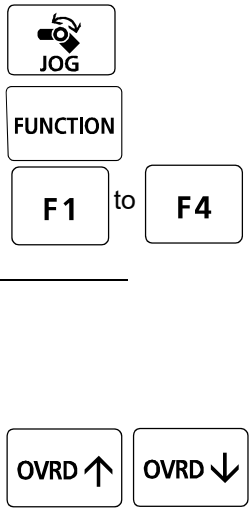
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

Select TOOL jog mode

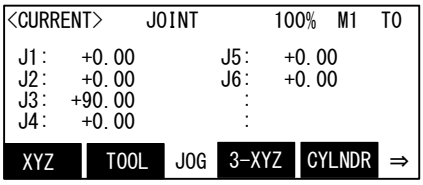


TOOL jog mode



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

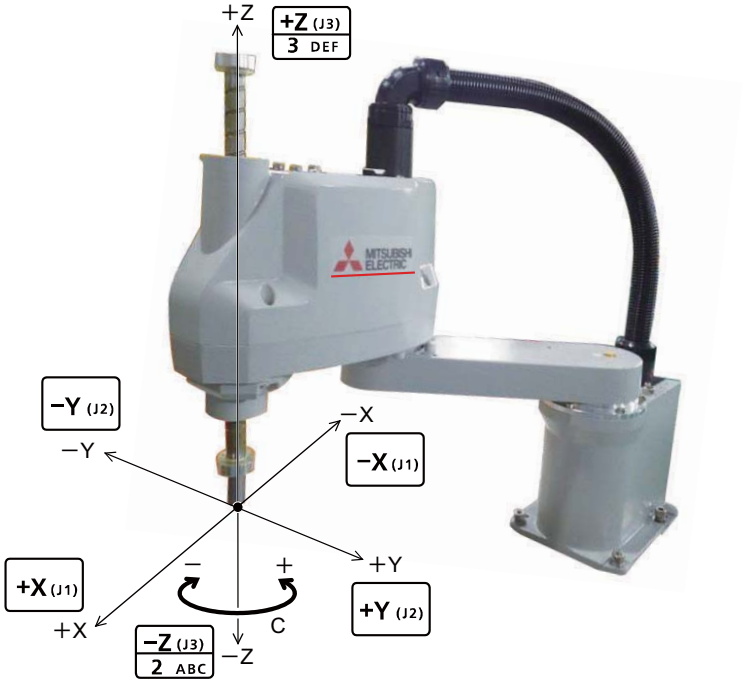
Set jog speed



Setting the speed

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 the screen upper right.
Set the override to 10% here for confirmation work.

Moving along the tool coordinate system



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

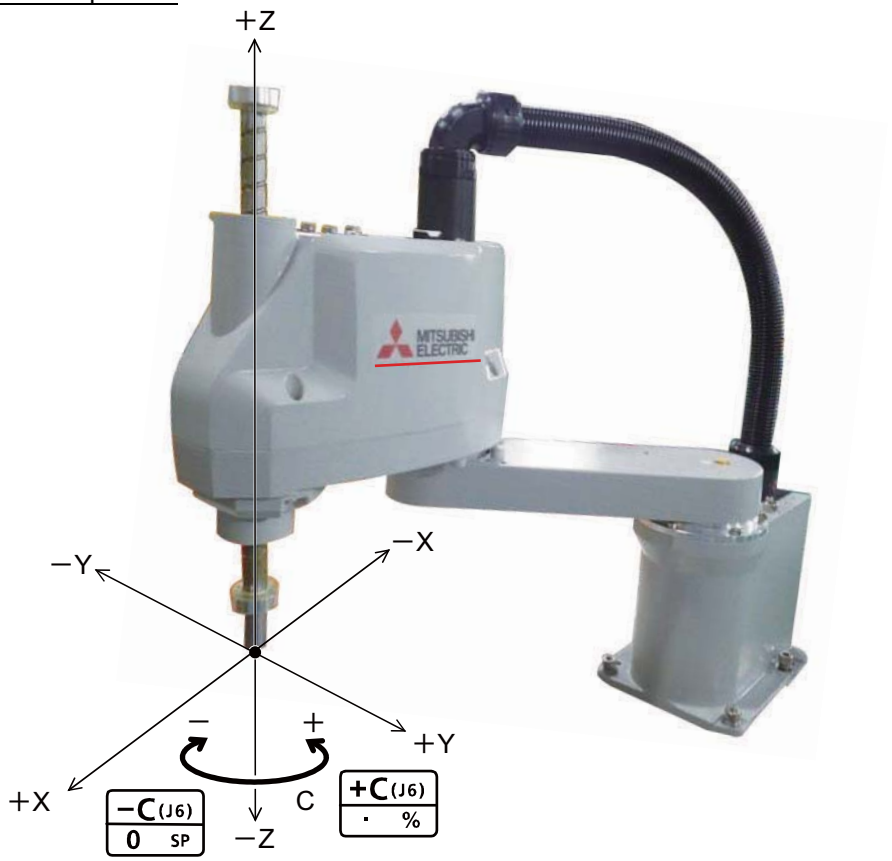
◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to Page 24, "(1) JOINT jog operation", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

Changing the end axis posture



*The Position of the end axis will not change.

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

◇◆◇ When alarm No. 5150 occurs ◇◆◇

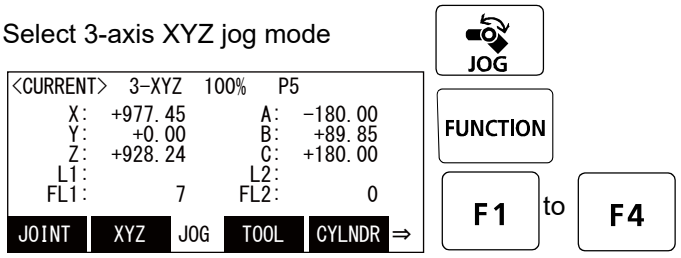
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

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

(4) 3-axis XYZ jog operation

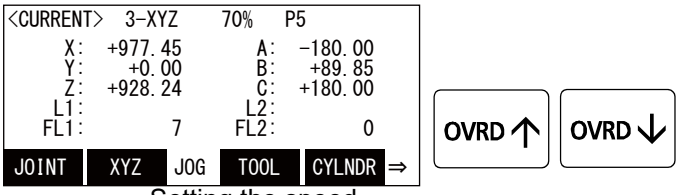
Select 3-axis XYZ jog mode



3-axis XYZ jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "3-XYZ" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "3-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."

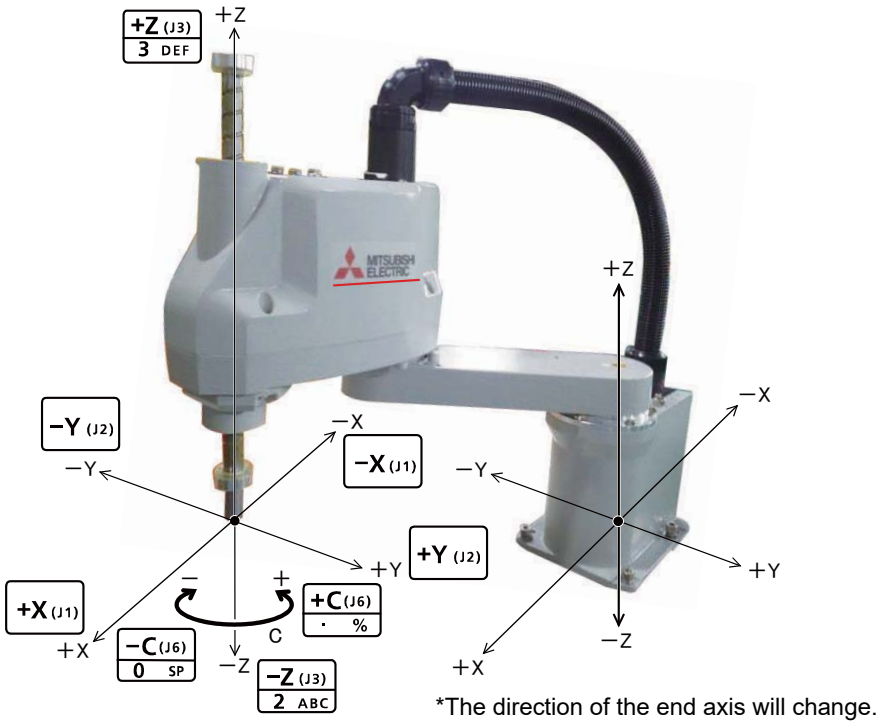
Set jog speed



Setting the speed

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 the screen upper right.
Set the override to 10% here for confirmation work.

Moving along the base coordinate system

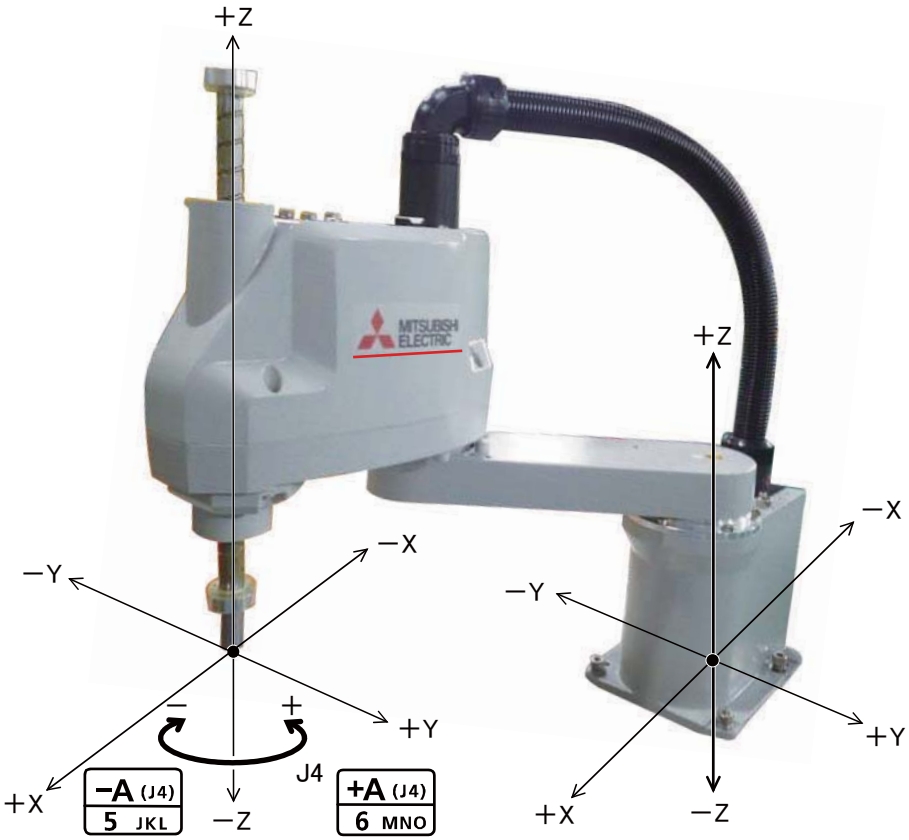


*The direction of the end axis will change.

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

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

Changing the end axis posture

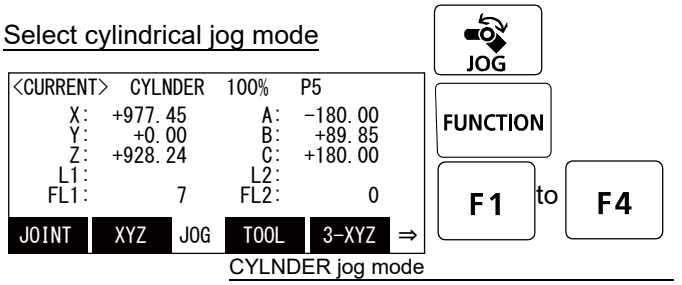


*The Position of the end axis will not change.

- When the[+C (J6)] keys are pressed, the J4-axis will rotate in the plus direction.
  When the[-C (J6)] keys are pressed, rotate in the minus direction.

(5) CYLNDER jog operation

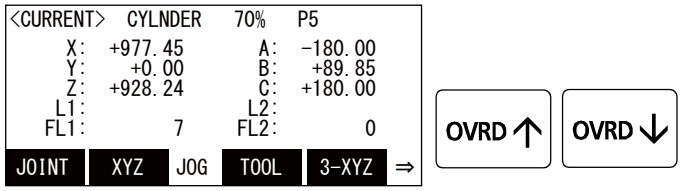
Select cylindrical jog mode



CYLNDER jog mode

[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."

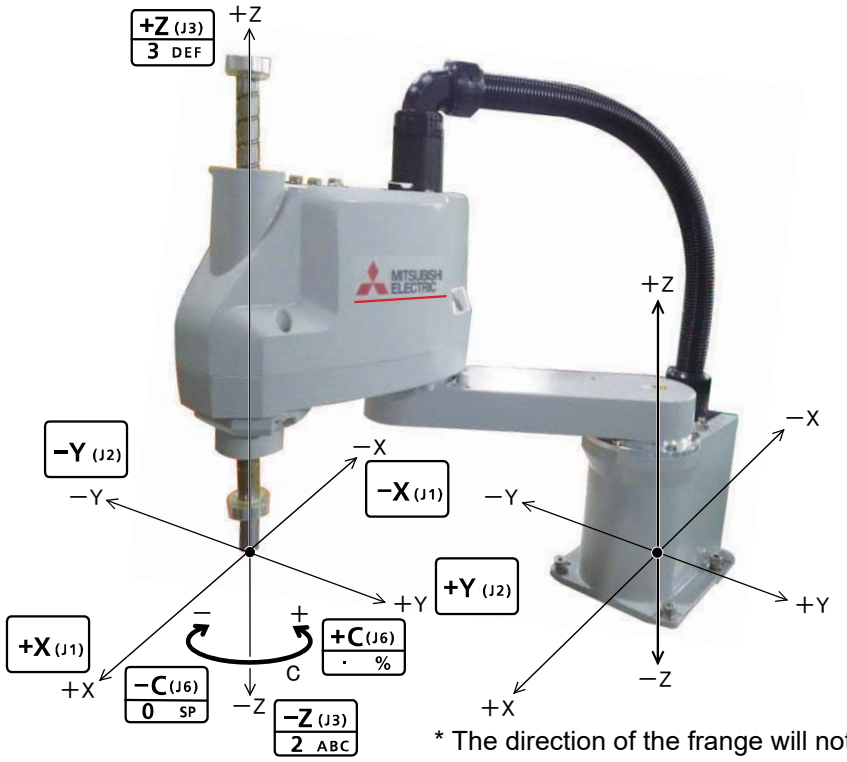
Set jog speed



Setting the speed

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 the screen upper right.
Set the override to 10% here for confirmation work.

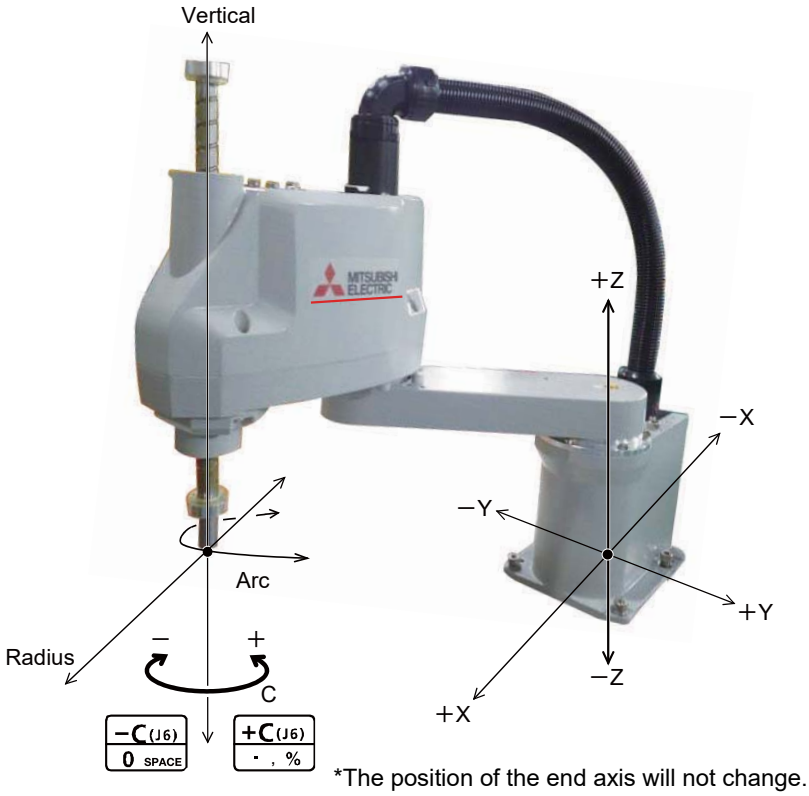
Moving along an arc centering on the Z axis



* 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.



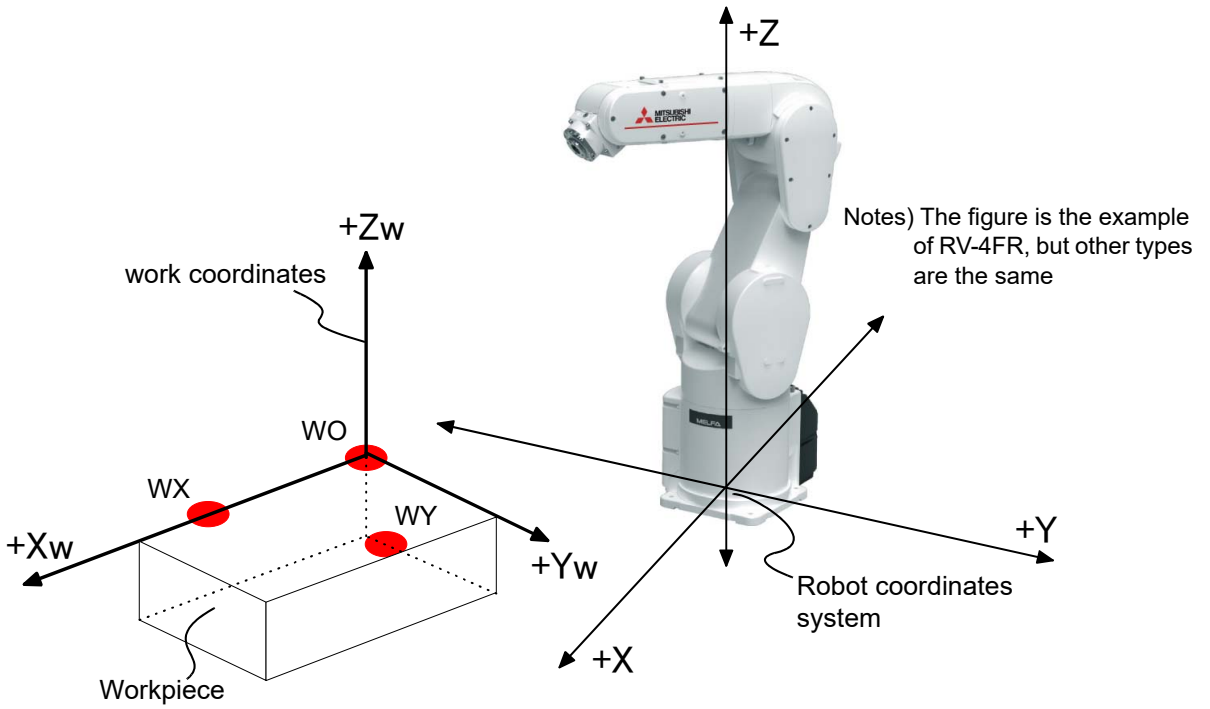
*The position of the end axis will not change.

- 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 (R33TB) is shown in the following.
(Parameter: Setting the coordinate value to WKnCORD ("n" is meaning the number (1-8) of work coordinates) can also set up the work coordinates system. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details of parameter.)

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



Notes) The figure is the example of RV-4FR, but other types are the same

The jogging movement based on this work is possible.

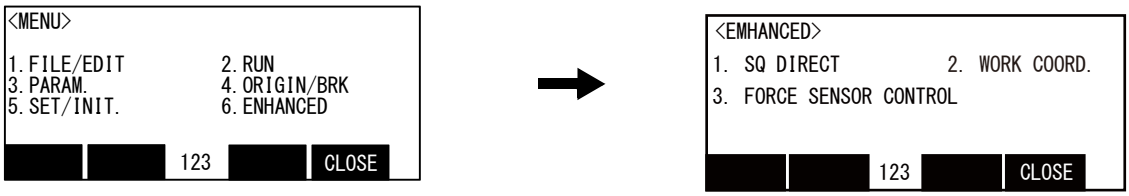
< ● Teaching point>
WO: Work coordinates system origin
WX: Position on the "+X" axis of work coordinates system.
WY: Position at the side of "+Y" axis on the X-Y plane of work coordinates system.

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

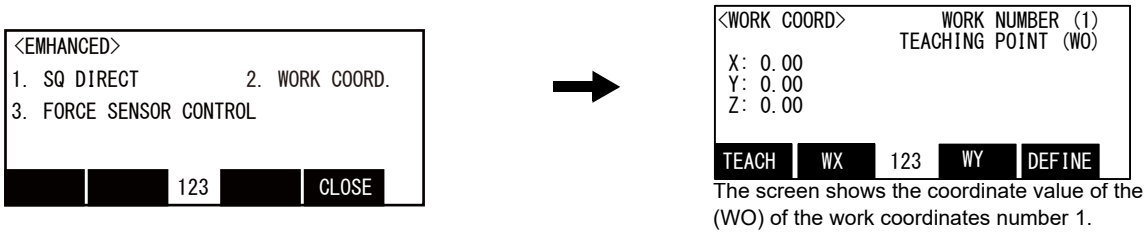
Fig.2-15:Setting of the work coordinates system (teaching point)

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

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



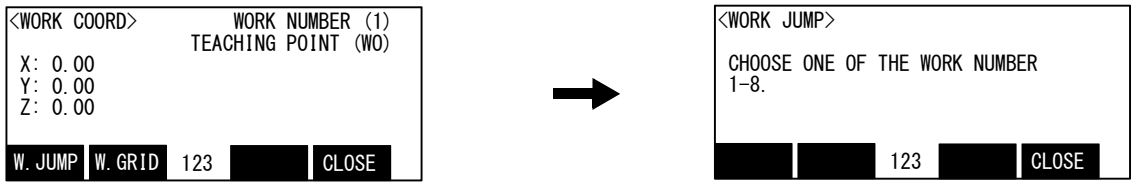
2) Press the [2] keys in the menu screen and select "2. WORK COORD."



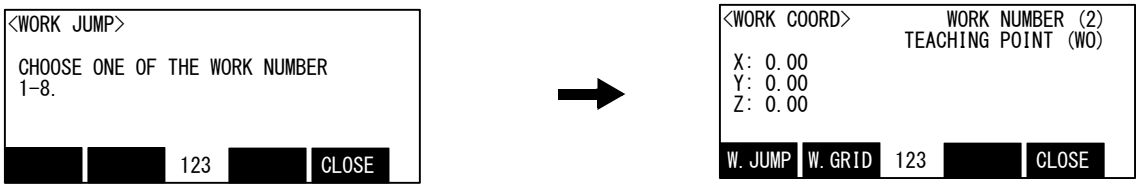
The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

3) Selection of the work coordinates number

Press the [FUNCTION] keys, and display "W: JUMP" function. Press the function key corresponding to "W: JUMP"



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

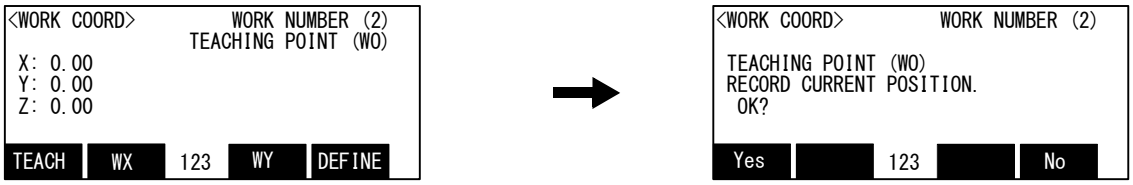


Operation will be canceled if the [CLOSE] key is pressed.

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

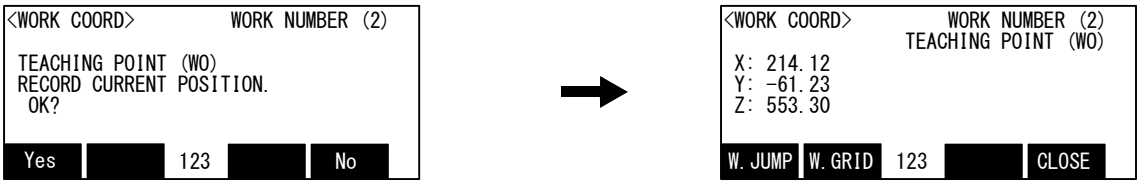
4) The teaching of the work coordinates system

Teach the three points shown in Fig. 2-15. 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]

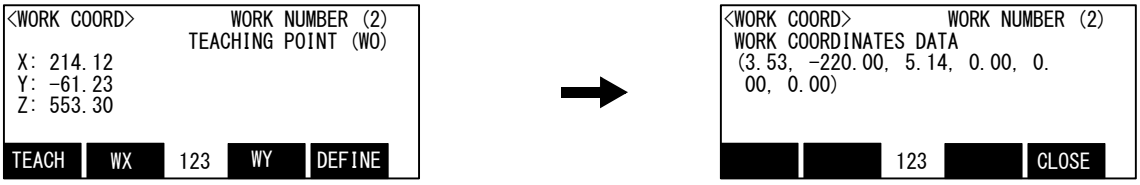
Presses the function key corresponding to"Yes", the robot's current position is registered, and the registered coordinates value is displaye. Operation will be canceled if the [CLOSE] key is pressed.



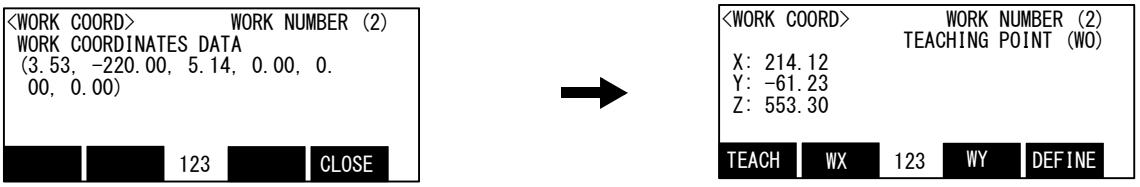
Teach the three points, WO, WX, and WY, by the same operation.
The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)

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

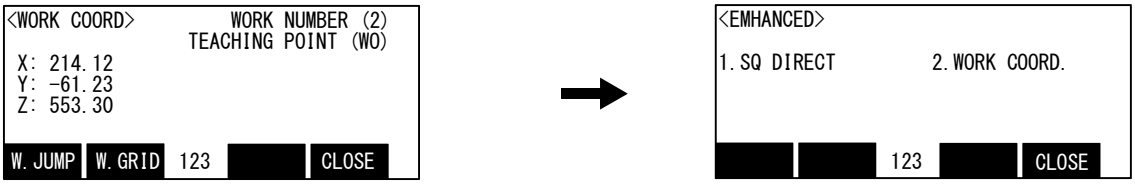
5) Setting of work coordinates (definition)
If the function key corresponding to "DEFINE" ([F1]) is pressed, the work coordinates system will be calculated using the three points, and the result will be displayed.



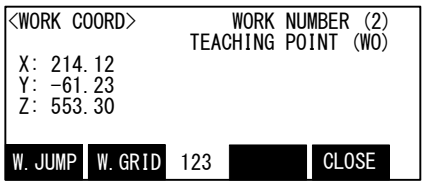
The alarm occurs if the work coordinates system is incalculable. (There are the three points on the straight line, or the two points have overlapped) In this case, reset alarm and re-teach the three points.
This work coordinate data is registered into parameter: WKnCORD. ("n" means the work coordinates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

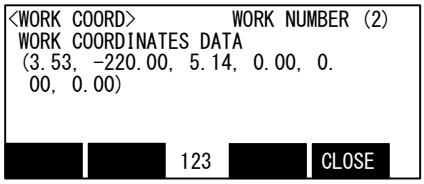


6) Finishing of setting the work coordinates
Press the [FUNCTION] keys, and display "CLOSE" function. Press the function key corresponding to "CLOSE". Returns to the <MENU> screen.



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])

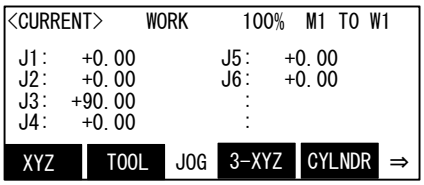


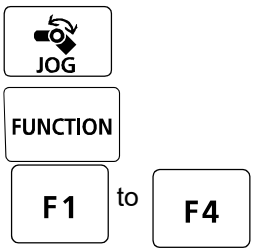


Return to the previous screen by pressing the [CLOSE] ([F4]) key.

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

Select WORK jog mode



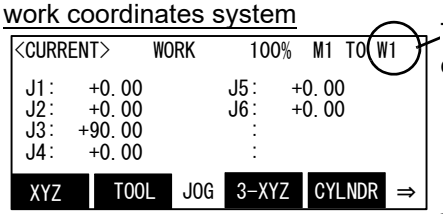


WORK jog mode

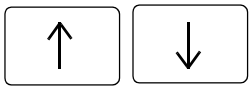
Note) The displayed values are based on the XYZ coordinate system.

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

Confirmation and selection of the work coordinates system



Target work coordinates system

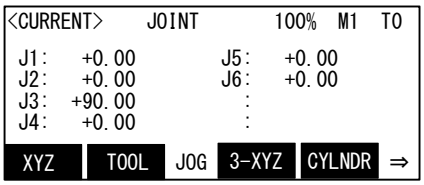


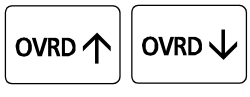
Select the work coordinates system

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

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

Set jog speed





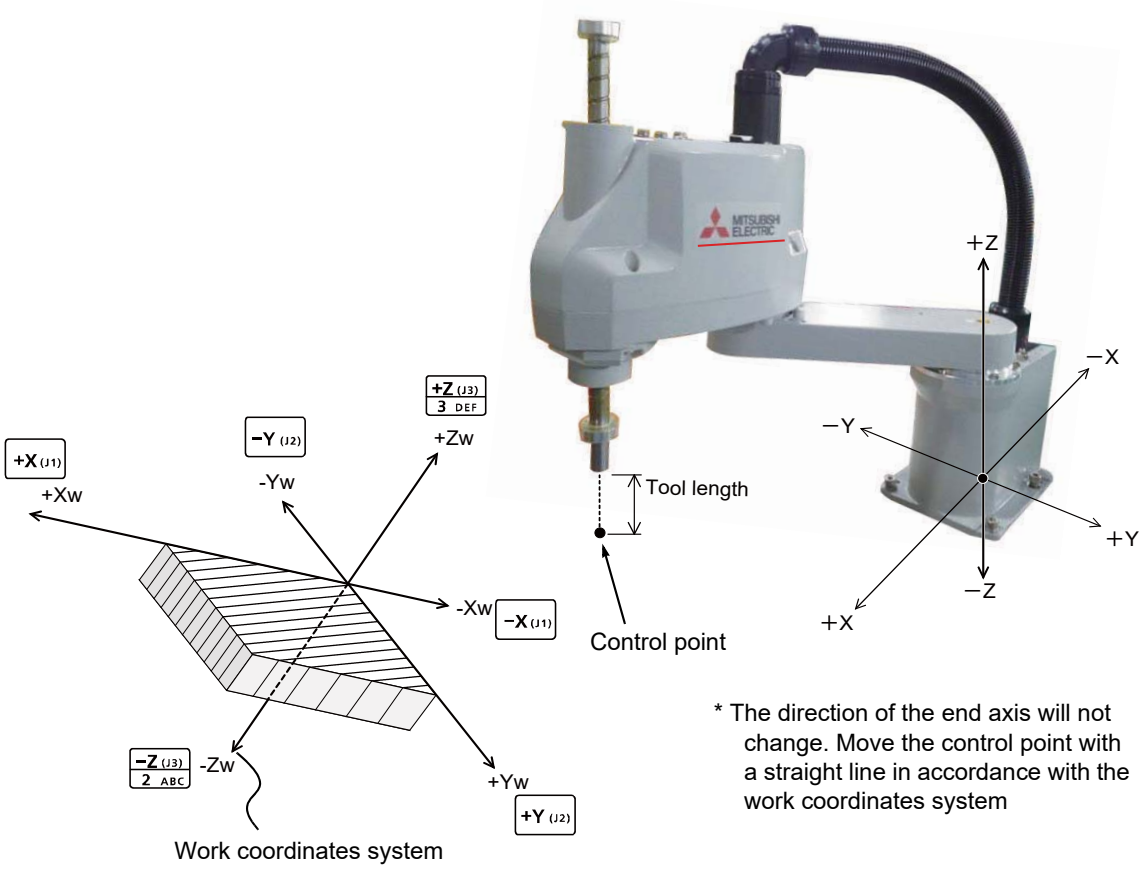
Setting the speed

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

The WORK jog operation and the Ex-T jog operation can be switched by setting the parameters WK1-JOGMD 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
C 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 the Z axis of the work coordinates system (Zw).
AB key operation	The robot does not move.	The robot does not move.

The jog movement based on work coordinates system

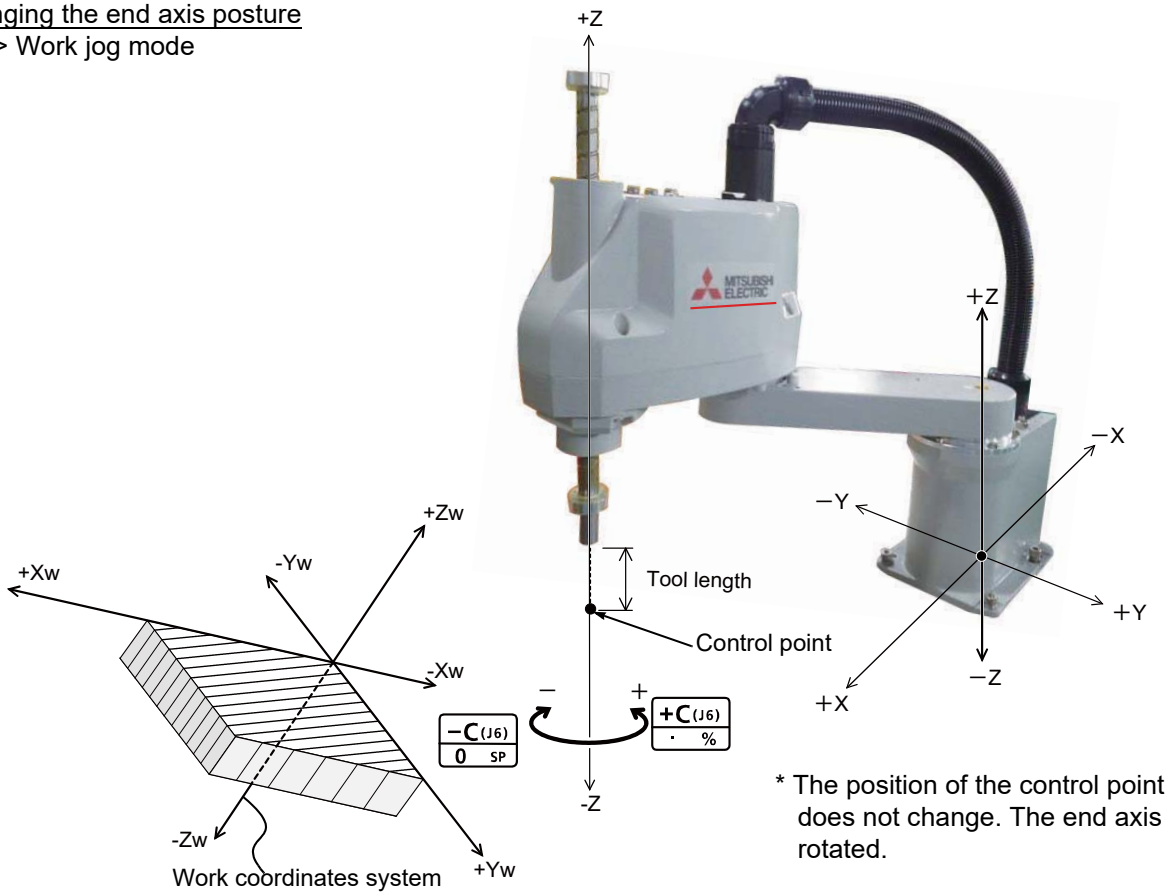


- When the [+X (J1)] keys are pressed, the robot will move along the X axis (Xw) plus direction on the work coordinates system.
  When the [-X (J1)] keys are pressed, Move along the minus direction.
- When the [+Y (J2)] keys are pressed, the robot will move along the Y axis (Yw) plus direction on the 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 end axis posture

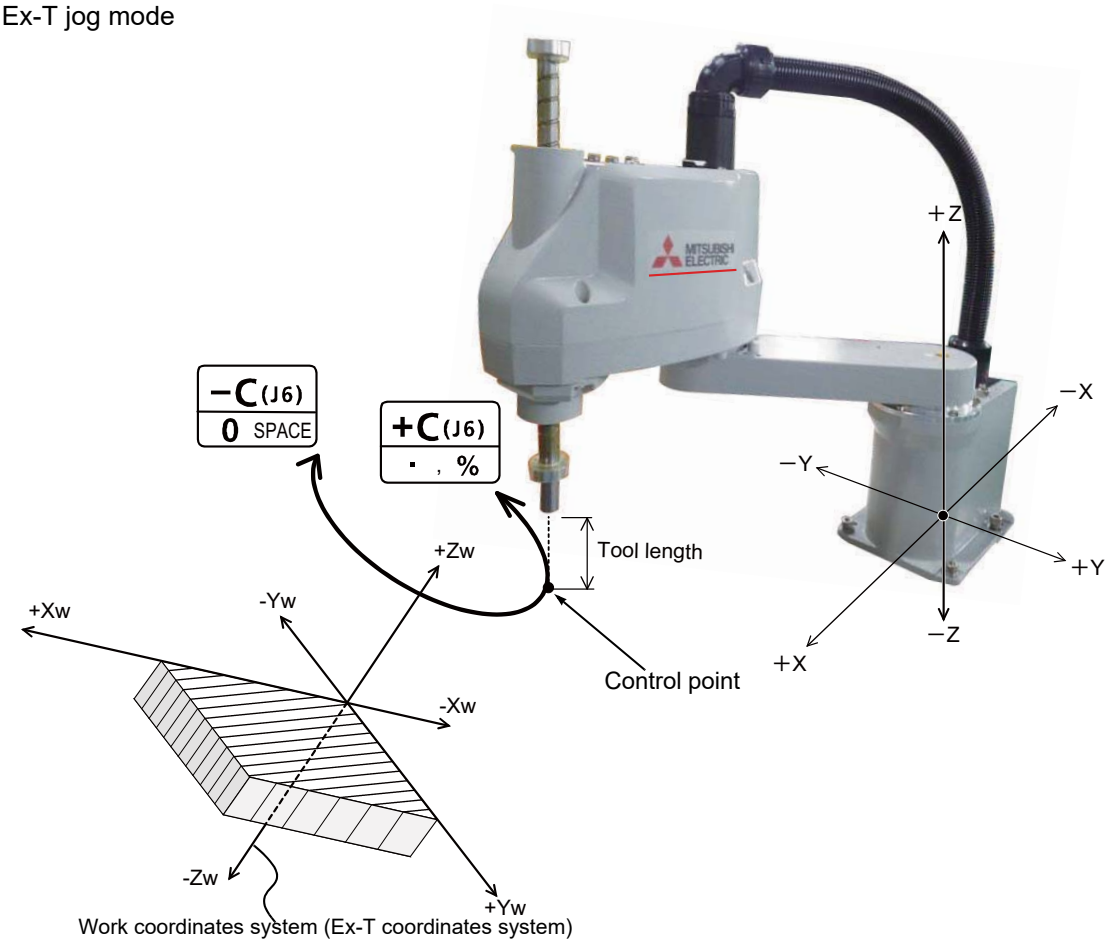
<1> Work jog mode



* The position of the control point does not change. The end axis is rotated.

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

<2> Ex-T jog mode



- 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.

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

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to Page 24, "(1) JOINT jog operation", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

◇◆◇ Tool length ◇◆◇

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

2.3.4 Setting the hand parameters

Set the parameters to set the hand I/O type and the hand condition according to the robot hand to be used. Refer to the separate volume, "Instruction Manual/Detailed Explanations of Functions and Operations" for how to set parameters.

Table 2-5:Hand parameter

Parameter	Parameter name	Details explanation	Factory setting
Hand I/O type	HIOTYPE	Set either the sink type or the source type for the solenoid valve and the logic of the hand input signal. -1: Not set 0: Source type 1: Sink type	-1
Hand condition	HNDDAT* * is 0 to 8	Set the initial condition of the hand. (Specify with the tool coordinate system.) (Weight, size X, size Y, size Z, center of gravity X, center of gravity Y, center of gravity Z) Unit: Kg, mm ⚠ CAUTION Set the hand and workpiece conditions correctly. If a value lower than the actual load is set, the life of robot mechanical parts may be shortened.	The setting varies depending on the model.
Hand condition setting check	HNDCHK	Enable or disable whether to notify that the HNDDAT parameter is not set. 0: Disabled 1: Enabled When this parameter is set to "1" (enabled), error C0330 will occur upon power on of the controller if all the values of the hand condition parameter HNDDAT* (* = 0 to 8) are not set (not changed from the initial values). When this parameter is set to "0" (disabled), the above settings are not checked, and error C0330 does not occur even if the hand conditions are not set. This parameter is available with controller software version C2d or later.	1

3 Installation of optional equipment

3.1 Operation range change

The operation range of the J1 axis can be limited. Change the mechanical stopper settings and the operation range inside the region between the mechanical stoppers.
When there is possibility of interference with peripheral devices or it is necessary to limit the operation range, set the range as follows.

(1) Angle setting for changing the operation range

The operation range can be set with the angles shown in Table 3-1.

Table 3-1:Angle setting for changing the operation range

Model	Axis	Direction[Note1)]	Standard	Angle setting for changing the operation range[Note2) Note3)]	Customer-prepared items
RH-3CRH	J1 axis	Positive	+132°	+110°	—
		Mechanical stopper angle	+133.5°	+111.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P11	
		Negative	-132°	-110°	—
		Mechanical stopper angle	-133.5°	-111.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P12	
	J2 axis	Positive	+141°	+125°	—
		Mechanical stopper angle	+145.7°	+127.7°	Move the bolt at P13.
		Mechanical stopper position	P13	P14	
		Negative	-141°	-125°	—
		Mechanical stopper angle	-145.7°	-127.7°	Move the bolt at P15.
		Mechanical stopper position	P15	P16	
RH-6CRH6020	J1 axis	Positive	+132°	+115°	—
		Mechanical stopper angle	+133.8°	+117.7°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P11	
		Negative	-132°	-115°	—
		Mechanical stopper angle	-133.8°	-117.7°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P12	
	J2 axis	Positive	+150°	+125°	—
		Mechanical stopper angle	+154.2°	+130.2°	Move the bolt at P13.
		Mechanical stopper position	P13	P14	
		Negative	-150°	-125°	—
		Mechanical stopper angle	-154.2°	-130.2°	Move the bolt at P15.
		Mechanical stopper position	P15	P16	
RH-6CRH7020	J1 axis	Positive	+132°	+115°	—
		Mechanical stopper angle	+133°	+116.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P11	
		Negative	-132°	-115°	—
		Mechanical stopper angle	-133°	-116.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P12	
	J2 axis	Positive	+150°	+125°	—
		Mechanical stopper angle	+154.2°	+130.2°	Move the bolt at P13.
		Mechanical stopper position	P13	P14	
		Negative	-150°	-125°	—
		Mechanical stopper angle	-154.2°	-130.2°	Move the bolt at P15.
		Mechanical stopper position	P15	P16	

Note1) Refer to Fig. 3-1 for the mechanical stopper position.
Note2) The angles in Table 3-1 for the axes show the movable range set by software.
The mechanical stopper angles in the table show the angles limited by the mechanical stoppers. Care should be needed in designing the layout.
Note3) The positive and negative angles can be set separately.

(2) Operation range change method

*Installing the mechanical stoppers

1) Turn off the controller's power supply.
2) Refer to Table 3-1 and Fig. 3-1, and install the stoppers in the screw holes at the angles to be set. Fig. 3-1 shows the mechanical stopper positions. When the screw holes are hidden under the arm, slowly move the No.1 arm by hand.

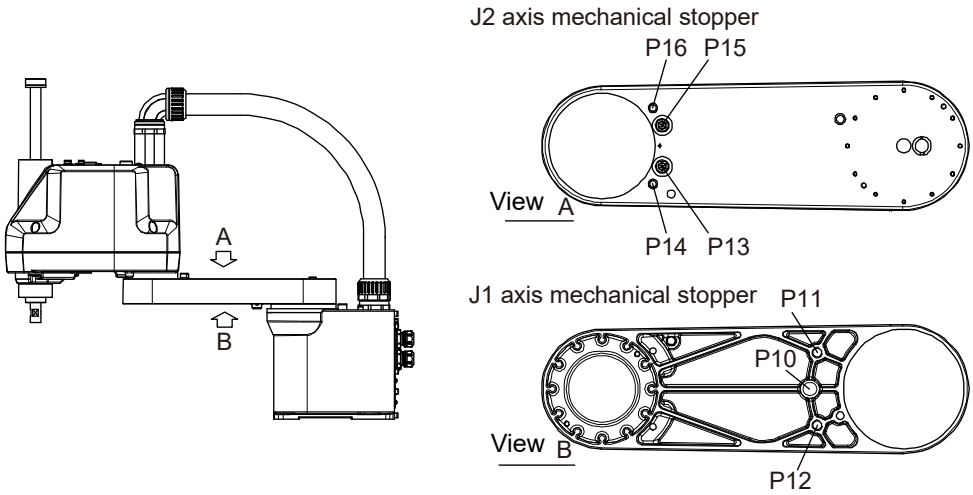


Fig.3-1:Mechanical stopper position

*Changing the operation range parameter

Set the operation range (angle setting in Table 3-1) in the joint operation range parameter MEJAR.

1) Turn on the controller's power supply.
2) Set the operation range after the change in the parameter MEJAR.
   MEJAR: (J1 negative direction operation range, J1 positive direction operation range, [], [], ...)

*Checking the operation range

Turn off and on the controller's power supply after changing the setting of this parameter. Then, move the axis by joint jog operation to the limit of the operation range to check that the robot stops at the angle after the change.

The operation range change is completed.

3.2 Replacement procedure for machine cables (replaceable type)

The replacement method for optional machine cables (replaceable type) is explained.
The robot arm comes with standard accessory machine cables installed before shipment.

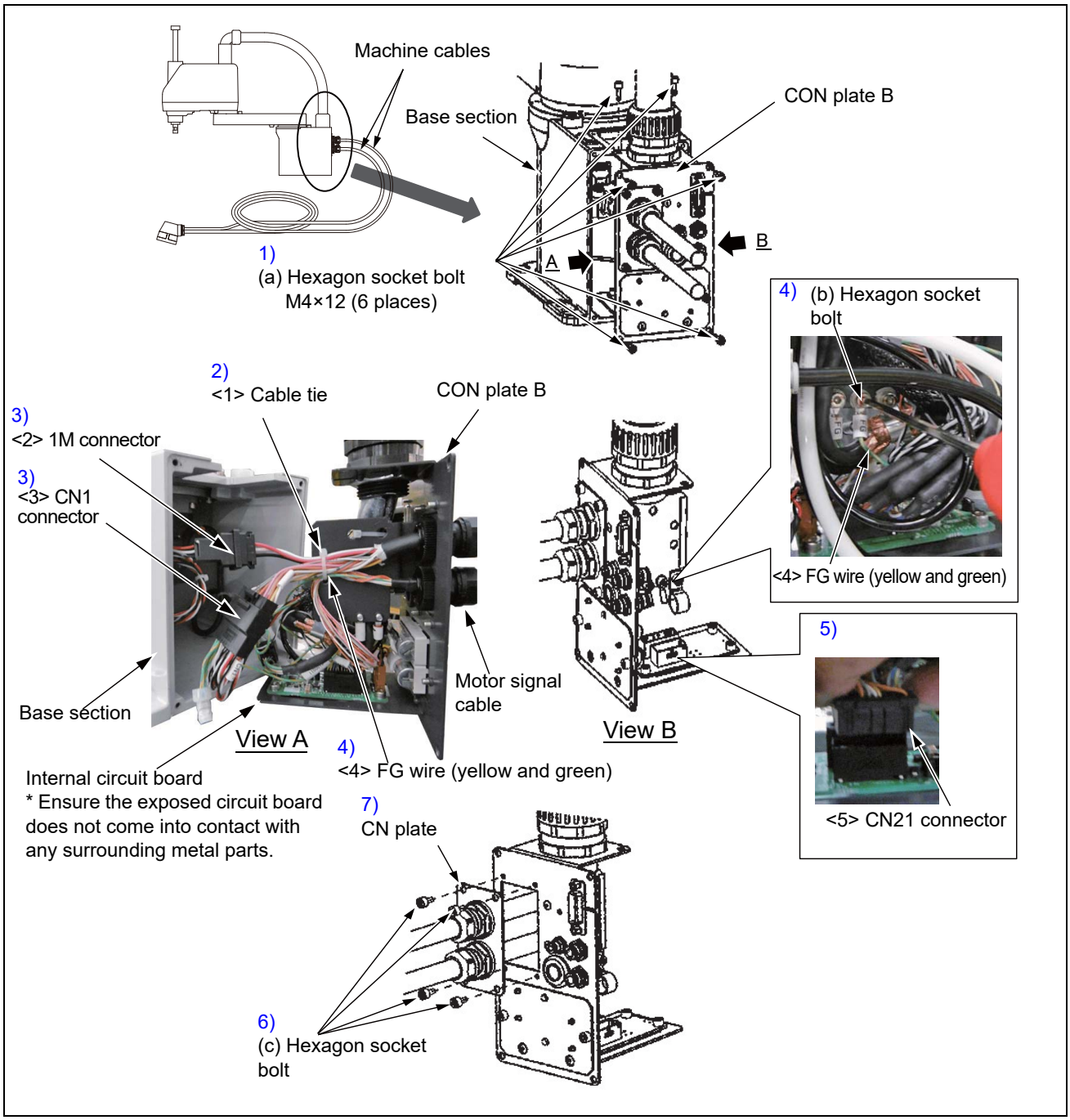


Fig.3-2:Replacement method for machine cables (replaceable type)

1) Remove the installation screws (a) from CON plate B on the back of the base, and pull CON plate B forward.

⚠ CAUTION When pulling out CON plate B, ensure the exposed circuit board does not come into contact with any surrounding metal parts.

2) Cut the cable tie <1> with nippers, and remove the cables from the plate. The cables use the two holes on the plate and are fixed with cable ties.

⚠ CAUTION Do not cut cable ties other than the cable tie <1>.
Also, be careful not to cut the cables when cutting the cable tie.

3) Remove the 1M connector <2> and CN1 connector <3>.
4) Remove the FG wire <4> of the motor signal cable. Remove the installation screw (b) used to fix the FG wire terminal.
5) Remove the CN21 connector <5>.

⚠ CAUTION The origin data will be erased if you remove a connector other than the CN21 connector <5>.
Refer to Page 68, "5.6 Resetting the origin" and set the origin again.

6) Remove the installation screws (c) from the CN plate.
7) Confirm that <1> to <5> are all removed, and pull the connector out from the rectangular hole on CON plate B, and remove the machine cables together with the CN plate.

Follow the removal procedure from 1) to 7) in reverse to install the optional machine cables (replaceable type).
When installing the CON plate B and the CN plate, use a bolting torque of 1.39 to 1.89 N·m for the installation screws.

⚠ CAUTION When installing CON plate B and the CN plate, ensure that the cables are not pinched by the plates.

This completes replacement of the machine cables (replaceable type).

4 Basic operations

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

5 Maintenance and Inspection

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

5.1 Type of inspection and maintenance works

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.
Table 5-1 lists the type of inspection and maintenance works.

Table 5-1:Type of inspection and maintenance works

No.	Type of inspection and maintenance works		Description	Operating time Note1)
1	Daily inspection		Inspection works to be performed every day before starting operation for the safe use of the robot.	-
2	Periodic inspection	Monthly inspection	Inspection and maintenance works to be performed every month.	Every 300hr
3		3-month inspection	Inspection and maintenance works to be performed every 3 months.	Every 900hr
4		2-year inspection	Inspection and maintenance works to be performed every 2 years.	Every 7,200hr
5		Battery replacement	Replacement of the backup battery of the robot. Replace the battery every year regardless of the operating hours.	-
6		Lubrication	Lubrication of each axis (including the shaft) of the robot. Refer to Page 59, "5.3.4 Lubrication" for the lubrication schedule.	-

Note1) The operating hours assume the robot operation of 15 hours per day for 20 days per month. When the robot operates for 8 hours per day, the operating hours per month become about a half of the one under the above condition. Then, the monthly inspection is required every two months. To check the periodic inspection schedule and calculate the operating hours, refer to Page 50, "(2) 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

Table 5-2 shows the procedure and inspection items. If you notice any abnormal condition, take appropriate measures.

Table 5-2:Daily inspection items (details)

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

5.2.2 Periodic inspection

The inspection items and timings for the robot arm are shown below.

(1) Inspection item

Carry out periodic inspection given in Table 5-3.

Table 5-3:Periodic inspection items (details)

Inspection item (details)	Remedies
Monthly inspection	
Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.
Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
3-month inspection	
Is the oil leaking from the felt attached to the ball screw/spline section? If the leaked oil is adhered to the cover, the cover may be deteriorated and cracked.	Exchange it referring to Page 65, "5.3.6 Felt replacement".
2-year inspection[Note1)]	
Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.
Is the timing belt tension value more than the guideline value? Does any position mismatch occur?	When the tension value becomes less than the guideline value, the timing belt must be replaced.
Battery replacemenet	
Replace the backup battery in the robot arm. Replace the battery every year regardless of the operating hours.	Replace it referring to Page 63, "5.3.5 Replacing the backup battery".
Lubrication	
Check the lubrication schedule for each axis, and perform lubrication. The lubrication schedule differs according to the model.	Lubricate it referring to Page 59, "5.3.4 Lubrication".
Is enough grease applied on the shaft? (Greasing is required approximately every 2000 km.)	

Note1) When the robot is operated 24 hours a day or with a heavy load, it is recommended to be inspected every 6 months (1,800hr).

(2) Schedule

The following shows the schedule for the periodic inspection works. Perform the periodic inspection works as appropriate according to the following table.

Operating time Note1)	Inspection schedule		Type of periodic inspection works Note2)				
	15 hours per day	8 hours per day	Monthly inspection	3-month inspection	2-year inspection	Battery replacement	Lubrication
300hr	1 month	2 months	○			Every year Note3)	As appropriate Note4)
600hr	2 months	4 months	○				
900hr	3 months	6 months	○	○			
1,200hr	4 months	8 months	○				
1,500hr	5 months	10 months	○				
1,800hr	6 months	12 months	○	○			
:	:		:				
3,600hr	12 months	24 months	○	○			
:	:		:				
7,200hr	24 months	48 months	○	○	○		
:	:		:				
10,800hr	36 months	72 months	○	○			

Note1)The following shows examples of calculation of the operating hours.

- Operating hours when the robot operates 15 hours per day for 20 days per month for three months:
  15 hr/day ×20 days/month ×3 months = 900hr
- Operating hours when the robot operates 8 hours per day for 20 days per month for three months:
  8 hr/day× 20 days/month × 3 months = 480hr ... Approx. 500 hr

Note2)The item marked with the circle (○) is to be performed. According to the guideline of the operating hours, perform the inspection to check the items described in Table 5-3.

Note3)Replace the battery every year regardless of the operating hours.

Note4)Check the lubrication interval described in Page 59, "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 67, "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 of the robot arm is shown below.

<RH-3CRH, RH-6CRH>

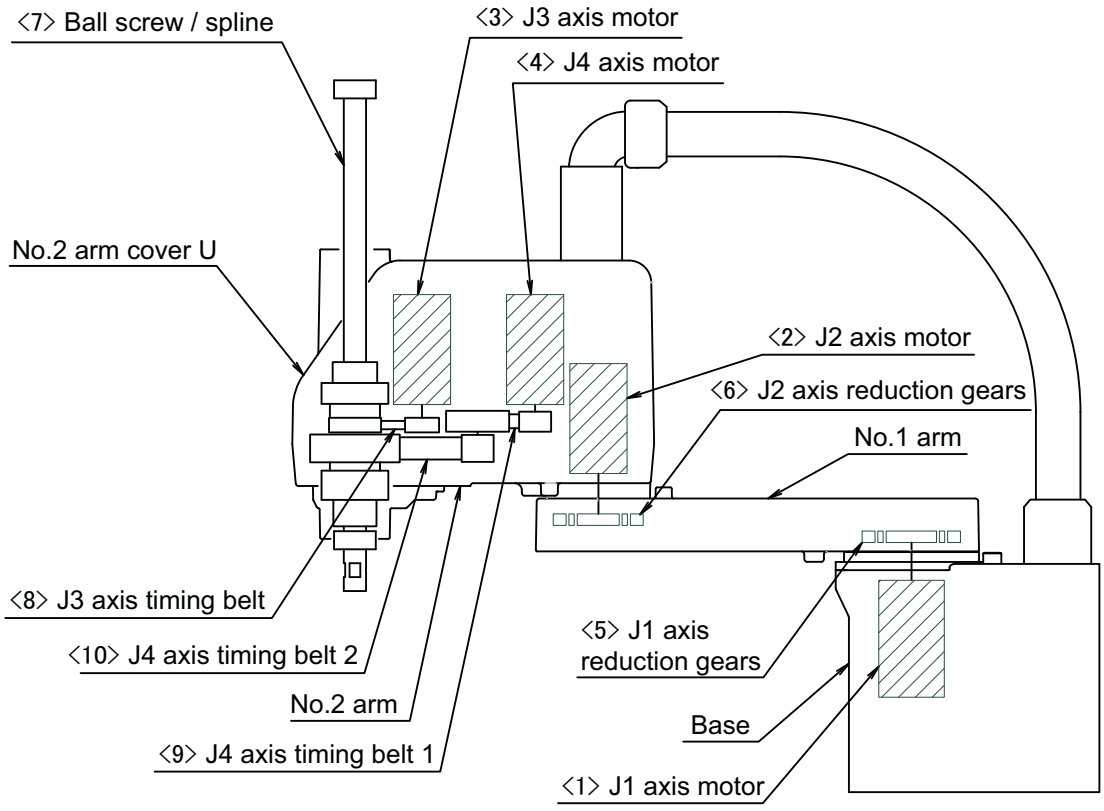


Fig.5-1:Outline structure drawing of robot arm (RH-3CRH, RH-6CRH)

5.3.2 Installing/removing the cover

<RH-3CRH, RH-6CRH>

Fig.5-2:Installing/removing the cover (RH-3CRH, RH-6CRH)

Table 5-4:Cover fixing screw list

No.	Cover name	Installation screw name: Qty. Note1), Note2)	Remarks
Common for RH-3CRH and RH-6CRH			
<1>	No.2 arm cover U	Truss screw M4×10: 8	
<2>	Battery cover	Hexagon socket bolt, M4×8: 2	

Note1) Use a bolting torque of 1.39 to 1.89 N・m for the installation screws <1> and <2>.
Note2) Use a bolting torque of 4.02 to 5.00 N・m for the installation screw <3>.

(1) Refer to Fig. 5-2 and Fig. 5-3 to remove the covers.
(2) The names of the covers are given in Table 5-4.
(3) When installing the cover after maintenance and inspection, use the procedure of removal in reverse. Bolt the installation screw with the torque shown in Table 5-4.

5.3.3 Inspection replacement of timing belt

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

Please prepare the sound wave type belt tension gauge in inspection of the timing belt. Refer to the Page 58, "(4) Timing belt tension" for the tension of the timing belt.

The recommendation gauge is shown below.
Manufacture: Gates Unitta Asia Company
Type: U-550

Fig.5-3:Tension adjustment method of timing belt

⚠CAUTION

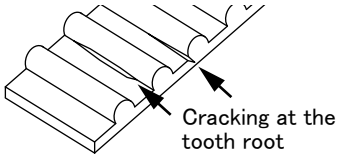
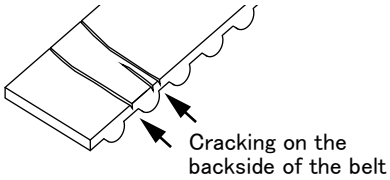
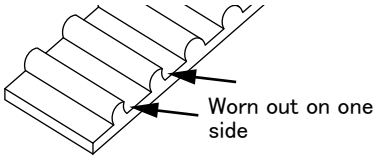
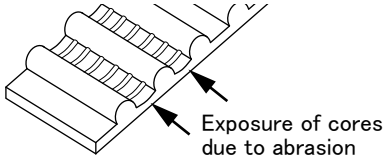
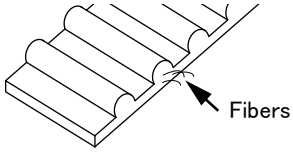
When the timing belt has to be removed for repair or some other reason, measure the tension before removing the belt.
When the belt is reinstalled, the tension must be the same as the one measured before removal. Otherwise, the life of the belt and the relevant parts may be shortened.

(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) The belt tension value becomes less than the guideline value.
2) A position mismatch or gear teeth skipping occurs.
3) The belt is damaged as shown in Table 5-5.

Table 5-5:Typical damage conditions of the timing belt

Damage condition	Appearance	Cause
Gear tooth crack		Overload
Backside crack		Deterioration of rubber due heat to or ozone
Worn teeth		Overload Excessive or insufficient tension
Tooth bottom abrasion and exposure of cores		Excessive tension
The following is not a belt damage.		
Fibers coming out of the side face of the belt		Manufacturing related factor. This is not a belt damage.

⚠CAUTION Due to the manufacturing of the timing belt, initial wear will occur. Wear chips may accumulate in the cover after approx. 300 hr of operating the robot, but this is not a fault.

⚠CAUTION When the belt is replaced, the machine system origin may deviate. After the replacement, ensure to reset the origin.

(2) Timing belt tension measurement

Rotate the timing pulley A to one direction while visually checking its position, and measure the belt tension at every 90 degrees, four times in total. The average of the four measurements is used as the timing belt tension value.

The timing belt must be pulled tight before the tension is measured. For this purpose, rotate the timing pulley A 90 degrees before measurement. Measure the tension of the belt to be pulled by the movement of the timing pulley A.

When the temperature of the robot arm is high, the timing belt tension is increased. To ensure reliability of the measurement, take measurements at least 30 minutes after the robot stops its movement.

Low ambient temperature may make accurate measurements using a tension gauge impossible. In this case, perform the automatic operation or jog operation at measuring target axis for a few minutes, then measure the tension of the belt.

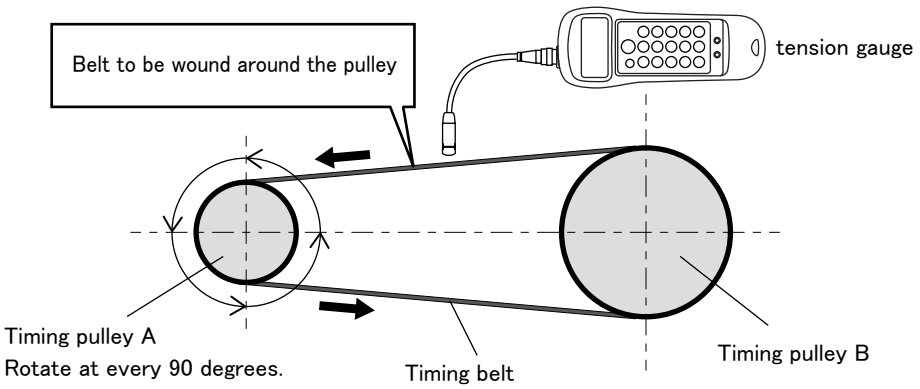


Fig.5-4:Timing belt tension measurement

The procedure is shown below.

1) Turn on the controller's power supply.
2) Rotate the timing pulley A to one direction in jog operation while visually checking its position, and measure the belt tension at every 90 degrees, four times in total (for one turn of the timing pulley A). The amount of movement of each axis when the timing pulley A is rotated 90 degrees are shown in Page 58, "(5) Amount of movement of each axis during the timing belt tension measurement".
3) Take an average of the four measurements to determine the timing belt tension value. During inspection of the timing belt, check that the belt tension exceeds the replacement guideline value in Page 58, "(4) Timing belt tension". When the belt tension value becomes less than the guideline value, the belt must be replaced immediately.

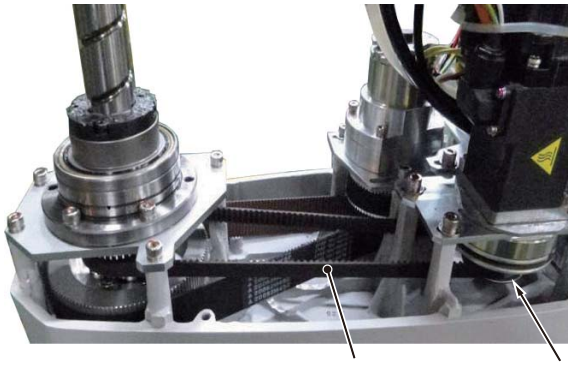
(3) Inspection of timing belt

The parts related to the inspection of the timing belt are shown in Fig. 5-5. The picture is the image which removed the No.2 arm cover.

Replacement of the timing belt will be performed by Mitsubishi Electric.

Check the serial numbers of the robot arm and the controller, and contact Mitsubishi Electric.

<J3 axis>



Note) This figure shows the RH-3CRH series. The same configuration is applied to the RH-6CRH series.

<J4 axis>

Fig.5-5:Inspecting the timing belt

The procedure for inspecting the timing belt is shown below.

1) Refer to Page 52, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U.
2) Visually confirm that the symptoms indicated in Page 55, "(1) Timing belt replacement period" have not occurred with the timing belt.
3) Refer to Page 56, "(2) Timing belt tension measurement", and confirm the belt tension.
4) Install the No.2 arm cover U securely as before and finish inspection.

(4) Timing belt tension

The following table shows the preset values of the sonic belt tension gauge, the tension value for new belt installation, and the tension value as the replacement guideline.

Table 5-6:Belt tension

Axis	Belt type	Preset value			Tension for new belt installation (N)	Replacement guideline tension (N)
		M(g/m)	W(mm/R)	S(mm)		
RH-3CRH series						
J3	60 MTS3M 309 G	2.0	6	103	31 to 38	12
J4 (motor side)	226-2GT-10	1.3	10	61	40 to 45	15
J4 (shaft side)	160 S2M 272 GB	1.3	16	65	44 to 52	16
RH-6CRH series						
J3	60 MTS3M 489 G	2.0	6	187	31 to 38	12
J4 (motor side)	226-2GT-10	1.3	10	61	40 to 45	15
J4 (shaft side)	452-2GT-20	1.3	20	144	84 to 95	30

(5) Amount of movement of each axis during the timing belt tension measurement

The amount of movement of each axis when the timing pulley A is rotated 90 degrees are shown in Table 5-7.

Table 5-7:Amount of movement of each axis during the tension measurement

Model	Amount of movement		
	J3 axis	J4 axis (Timing belt A)	J4 axis (Timing belt B)
RH-3CRH series	2.8mm	8.0°	22.1°
RH-6CRH series	3mm	6.5°	18.0°

5.3.4 Lubrication

(1) Lubrication position and specifications

The grease nipple position is shown in Fig. 5-6. The lubrication specifications for each place are shown in Table 5-8. Refer to the Page 52, "5.3.2 Installing/removing the cover" for the method of removing and installing the cover.

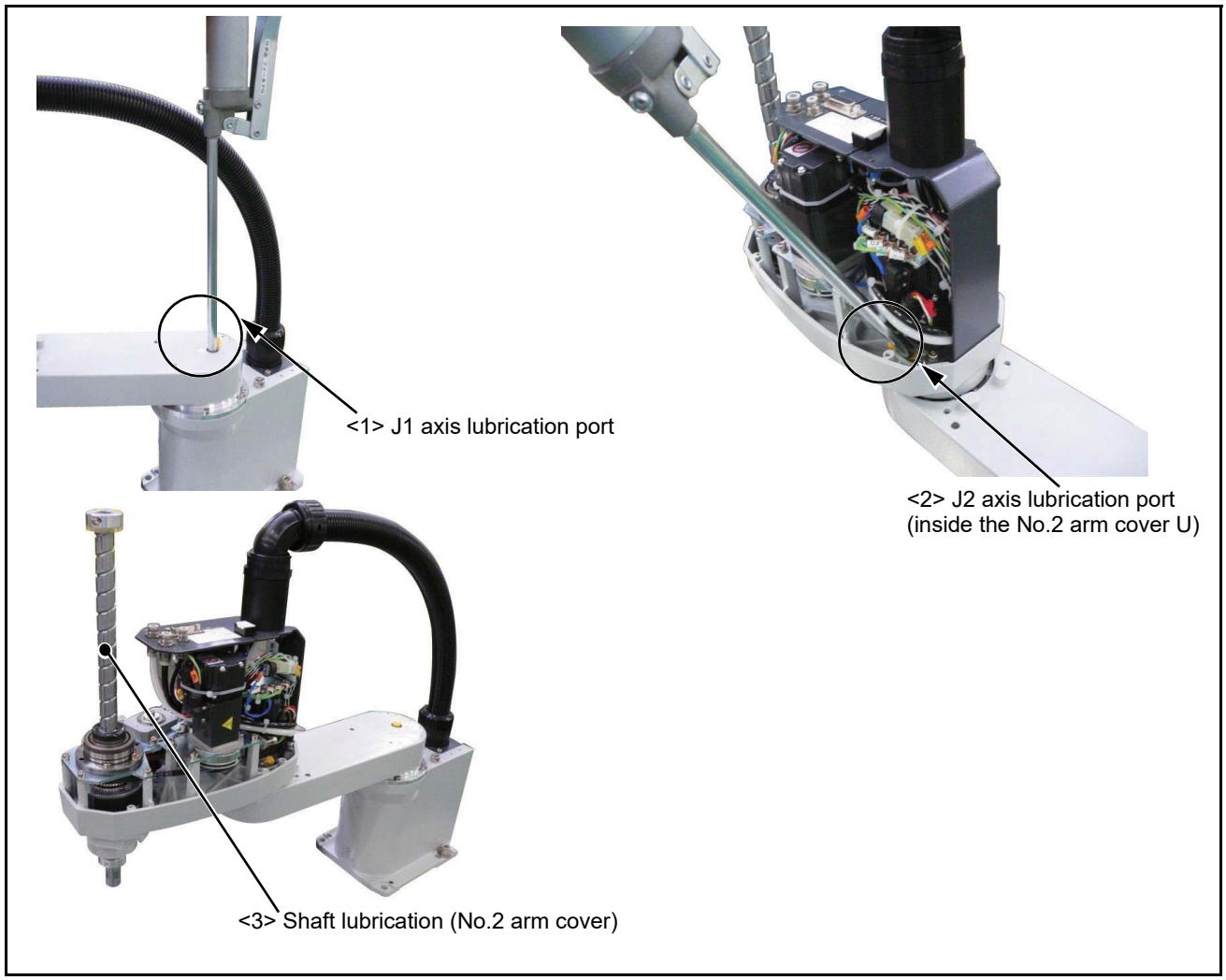


Fig.5-6:Lubrication positions

Table 5-8:Lubrication specifications

No.		Parts to be lubricated	Oiling method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
RH-3CRH							
	<1>	J1 axis reduction gears	Grease nipple WA-610	SK-1A (Harmonic Drive Systems Inc.)	6,000 Hr	8 g	-
	<2>	J2 axis reduction gears	Grease nipple WA-610		6,000 Hr	5 g	No.2 arm cover U
	<3>	Shaft (Ball screw/spline)	Wipe the old grease, and paint	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 2000km movement	1 g	
RH-6CRH							
	<1>	J1 axis reduction gears	Grease nipple WA-610	SK-1A (Harmonic Drive Systems Inc.)	6,000 Hr	12 g	-
	<2>	J2 axis reduction gears	Grease nipple WA-610		6,000 Hr	8 g	No.2 arm cover U
	<3>	Shaft (Ball screw/spline)	Wipe the old grease, and paint	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 2000km movement	1 g	

[Caution]
•The brand name of the grease shown in the Table 5-8 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.
For the shaft, the lubrication interval should be shorter than one in Table 5-8 when the operation is repeated with a short stroke.
•The maintenance forecast function of RT ToolBox3 (option) estimates the lubrication interval depending on the operating conditions.
•The numbers in the Table 5-8 correspond to the supply positions in Fig. 5-6.

(2) Lubrication method to the J1, J2 axis

1) Then, turn off the controller's power supply.
2) Refer to Page 52, "5.3.2 Installing/removing the cover", and remove the covers necessary.
3) Insert the grease shown in Table 5-8 using a grease gun from the lubrication grease nipple. Apply the specified amount of grease. Too much lubrication causes grease leakage.

⚠CAUTION

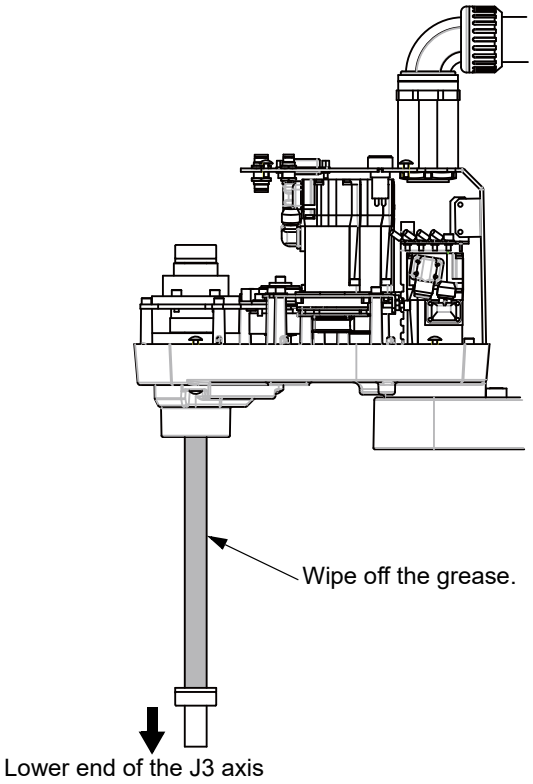
Use manual grease gun, and inject grease with pressure 0.03Mpa or less. Do not use the grease gun, which derived by the factory air presser to avoid injecting by too high pressure.
A grease gun that fits the grease nipple is required.
Recommended grease gun: KH-120 (capacity: 140 ml) or KH-32 (capacity: 200 ml)
(manufacturer: Yamada Corporation)
The above-mentioned grease gun comes with a short nozzle (HSP-1) as standard. If this short nozzle does not reach the desired areas, depending on the robot model and installation location, it may be useful to use a long nozzle (HSP-2).

4) Install the covers with the removal procedure in reverse.
5) If the maintenance forecast function is enable, please reset the accumulated data about grease. Carries out the resetting operation by RT ToolBox3 (option) or parameter (MFGRST). Refer to separate "RT ToolBox3 / RT ToolBox3 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).

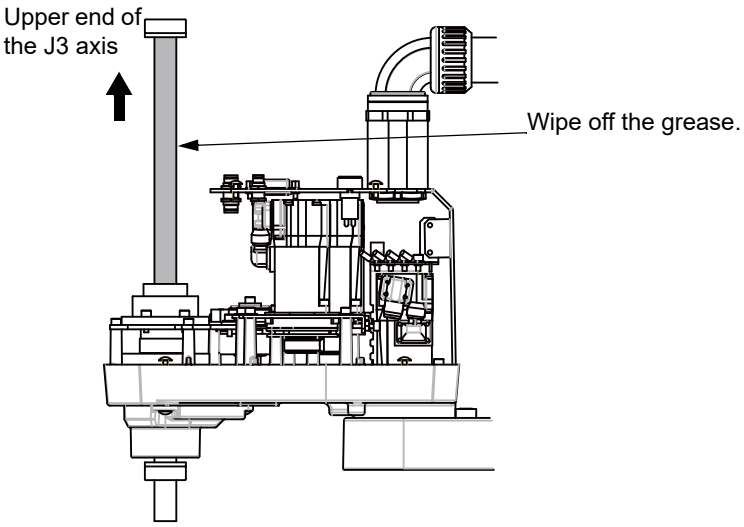
The lubricating to J1 and J2 axes is completed.

(3) Lubrication method to the shaft

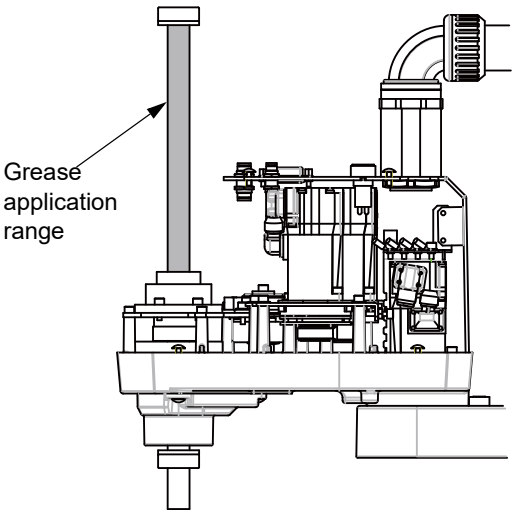
1) Move the J3 axis to the lower end limit by jog operation. Then, turn off the controller's power supply.
2) Refer to Page 52, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U.
3) Wipe off the old grease on the shaft. Also, wipe off the grease scattered inside the No.2 arm cover U.



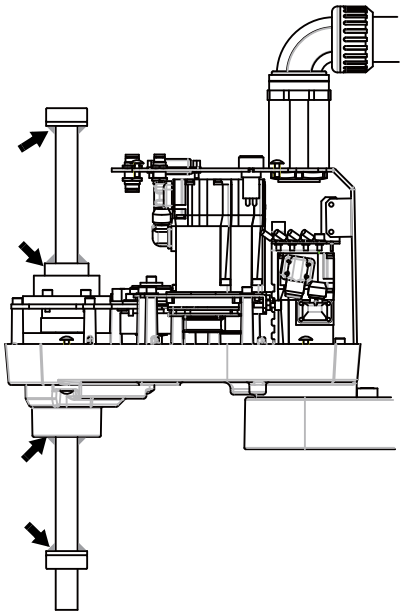
4) Turn on the controller's power supply, and move the J3 axis to the upper end limit by jog operation. Then, turn off the controller's power supply again.
5) Wipe off the old grease on the shaft, which was hidden beneath the ball screw spline nut.



6) Apply the specified amount of grease to the shaft. Fill the shaft grooves with the grease.
Also, apply the grease lightly to the areas other than the grooves on the shaft surface to prevent rusting.



7) Turn on the controller's power supply. Move the J3 axis up and down for several times using the jog operation to distribute the grease inside the ball spline nut and the ball screw nut.
8) Move the J3 axis to a position around the center of the stroke using the jog operation. Then, turn off the controller's power supply.
9) Wipe off the grease adhering around the shaft ends or the nuts of the ball screw spline (indicated with the arrows below).
When the ball spline and the ball screw are moved with extra grease on them, a large amount of grease is scattered inside the arm. The grease may reach the timing belt inside the No.2 arm, causing the timing belt to deteriorate early.



10) Reinstall the No.2 arm cover U.

Lubrication to the shaft is completed.

⚠CAUTION When applying grease to the shaft, prevent the grease from adhering to the No.2 arm cover U. If the grease is adhered to the cover, wipe it off. If the grease is adhered around the screw installation section for a long time, the cover may be deteriorated and cracked.

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. 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 5-9. If error 7500 occurs, please exchange the battery of the robot arm and the controller simultaneously.

Table 5-9:The error about the battery

Error number	Description	Measure
7510	Encoder battery voltage low	Replace the battery as soon as possible.
7500	No encoder battery voltage	
112n[Note1)]	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.
About the purchase of the battery, refers to Page 67, "5.5 Maintenance parts".

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

(1) Replacing the battery (robot arm)

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

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

The battery installation position is shown in Fig. 5-7. Refer to the figure and replaces the batteries in the following procedures.

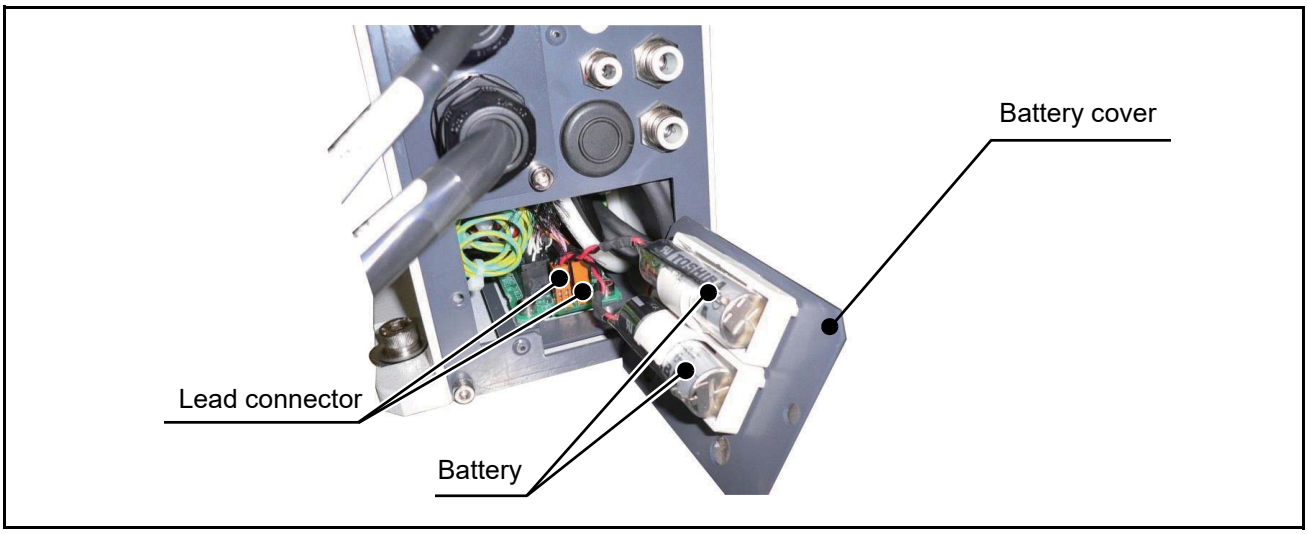


Fig.5-7:Replacing the battery

1) Turn the controller control power OFF.
2) Remove the two battery cover installation screws to detach the battery cover.
3) Replaces the backup battery one by one. The battery holder is located on the back side of the battery cover. Remove the old battery from the holder, and disconnect the lead connector.
   To remove the lead connector, squeeze the retaining latch while pulling on the connector.
4) Insert the new battery into the holder, and connect the lead connector. 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, generating heat and damaging may occur.
6) Reinstall the battery cover. 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 68, "5.6 Resetting the origin" and reset the origin using the ABS origin method.
[Caution] When inserting and removing a lead connector of the backup battery, pay sufficient attention to the following points to prevent excessive force from being applied to the connector: Do not twist the connector during removal, and do not forcibly insert the connector when not mated properly.

5.3.6 Felt replacement

If the felt attached to the ball screw/spline section is saturated with the grease oil, replace the felt. If the oil is leaking from the felt and adheres to the cover, the cover may be deteriorated and cracked.

(1) Replacing the felt

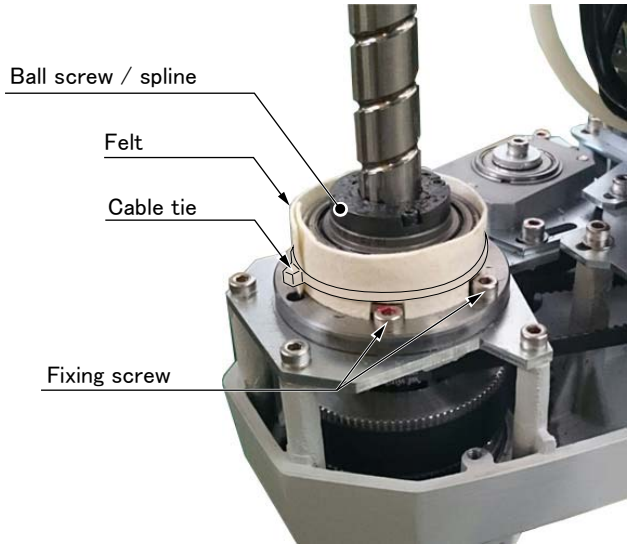


Fig.5-8:Replacing the felt

1) Remove the No.2 arm cover U.
2) Remove the cable tie securing the old felt and remove the felt.
3) Wrap the new felt around the ball screw/spline and secure it with a cable tie. At this time, align the cutout parts of the felt with the position of the ball screw/spline fixing screws.
4) Install the No.2 arm cover U.

The felt replacement is complete.

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. As a rule of thumb, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the specified time (24,000 hours for the robot arm and 36,000 hours for the controller). (See Fig. 5-9.) However, the degree of the equipment's wear and deterioration presumably varies depending on their operating conditions. Especially for operation with high load and frequency, the maintenance cycle may be shorter. For details on the part selection for replacement and the timing of overhaul, contact your dealer.

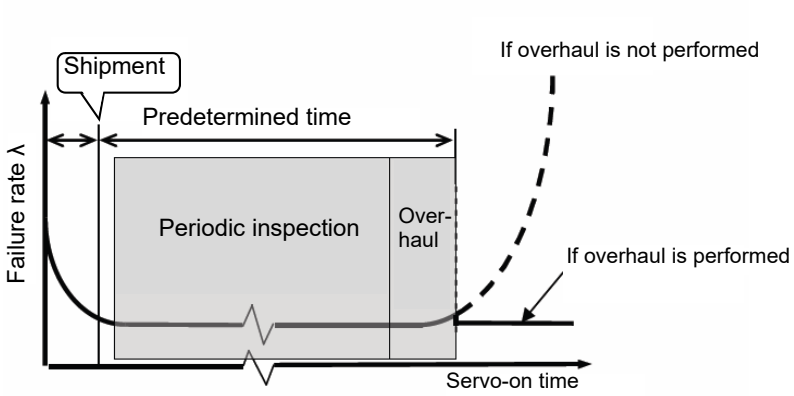


Fig.5-9:Periodic inspection/overhaul periods

5.5 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-10, and spare parts that may be required during repairs are shown in Table 5-11. Purchase these parts from the dealer when required.
[Note] 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 5-10:Consumable part list

No.	Part name	Usage place	Q'ty	Refer to section	Supplier
1	Grease	Reduction gears of each axis	A small amount	"5.3.4Lubrication"	Mitsubishi Electric
2		shaft	A small amount		
3	Lithium battery (battery:ER6V)	Inside the battery cover	2	"5.3.5Replacing the backup battery"	
RH-3CRH					
4	Timing belt	J3 axis	1	"5.3.3Inspection replacement of timing belt"	Mitsubishi Electric
5		J4 axis motor side	1		
6		J4 axis shaft side	1		
7	Felt	Ball screw / spline	1	"5.3.6Felt replacement"	
RH-6CRH					
8	Timing belt	J3 axis	1	"5.3.3Inspection replacement of timing belt"	Mitsubishi Electric
9		J4 axis motor side	1		
10		J4 axis shaft side	1		
11	Felt	Ball screw / spline	1	"5.3.6Felt replacement"	

Table 5-11:Spare parts list

No.	Names	Usage place	Q'ty	Supplier
RH-3CRH				
1	AC servo motor	J1 axis	1	Mitsubishi Electric
2		J2 axis	1	
3		J3 axis	1	
4		J4 axis	1	
5	Reduction gears	J1 axis	1	
6		J2 axis	1	
7	Ball screw spline	J3 axis	1	
RH-6CRH				
1	AC servo motor	J1 axis	1	Mitsubishi Electric
2		J2 axis	1	
3		J3 axis	1	
4		J4 axis	1	
5	Reduction gears	J1 axis	1	
6		J2 axis	1	
7	Ball screw spline	J3 axis	1	

5.6 Resetting the origin

The origin is set so that the robot can be used with a high accuracy. The origin is set so that the robot can be used with a high accuracy. Setting is required if the motor is replaced or an encoder error occurs.
The origin setting methods and when each origin setting method is required are shown in Table 5-12.

Table 5-12: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.	• When the data is lost due to flat battery of the robot controller (when C7500 occurs)	The setting method is explained in Page 69, "5.6.1 Setting the origin with the origin data input method" . If origin data has been changed from the factory default, input the latest origin data.
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 collision.	The setting method is explained in Page 73, "5.6.2 Jig method".
3	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 85, "5.6.5 Recording the origin data".
4	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 83, "5.6.4 User origin method".

[Remarks]
- The origin is set using the jig method (No.2) at factory default.
- 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.)

[Caution]
- 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 85, "5.6.5 Recording the origin data".

5.6.1 Setting the origin with the origin data input method

(1) Confirming the origin data

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

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

(O: 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 history table attached on the side of the base part of the robot arm. (Refer to Fig. 5-10).

Check the origin data.

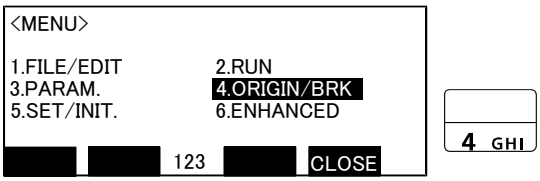
The value given in the default setting column is the origin settings set with the calibration jig before shipment.

Fig.5-10:Origin data label (an example)

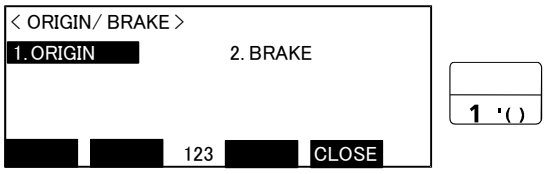
* The origin data to input is found on also the robot examination report sheet.

⚠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.

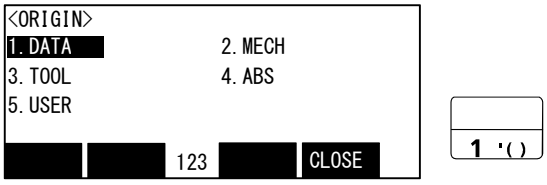
(2) Selecting the origin setting method



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

◇◆◇ Selecting a menu ◇◆◇

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

◇◆◇ The input method of numeral ◇◆◇

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

(3) Inputting the origin data

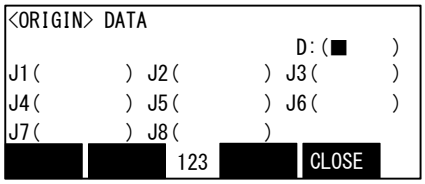
T/B screen

Origin data label
(D,J1,J2,J3,J4,J5,J6,J7,J8)

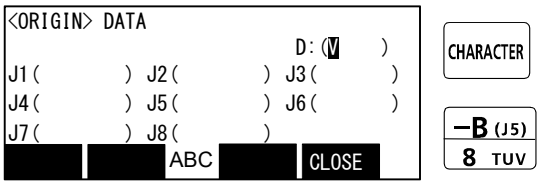
Input the value confirmed in section Page 69, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 5-11.

Fig.5-11:Correspondence of origin data label and axis

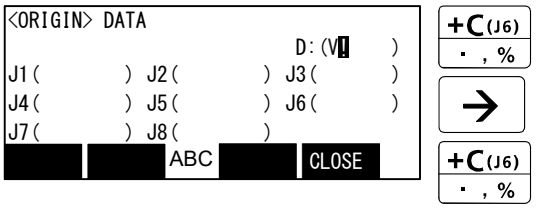
The method for inputting the origin data is explained below. The value shown in Fig. 5-10 will be input as an example.



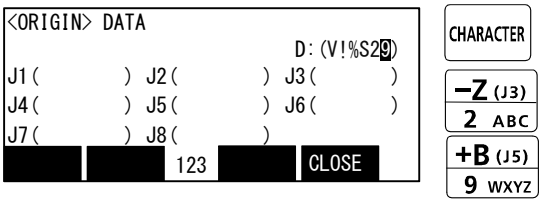
1) Confirm that the cursor is at the "D" position on the T/B display screen.



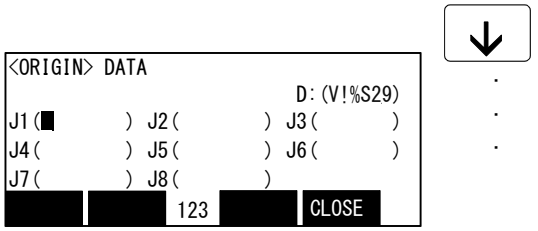
2) Input the D value "V!%S29".
Inputting "V"
Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen)
Press the [TUV] key three times. "V" will be set.



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

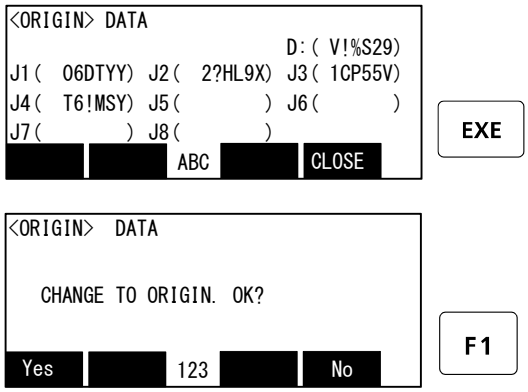


Press the [CHARACTER] key and set to the numeral input mode. (Condition that "123" was displayed under the screen)
Press the [2] key (input "2"), and press the [9] key (input "9").
"V!%S29" will appear at the "D" data on the teaching pendant screen.



3) Press the [↓] 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 and J4 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

◇◆◇ Moving the cursor ◇◆◇

Press the [↑], [↓], [←] and [→] keys.

◇◆◇ Inputting characters ◇◆◇

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

◇◆◇ How to input symbols ◇◆◇

The symbol is allocated to ['()], [@=], and [,%] key. Please repress each key until the symbol to wish is displayed.

a) ['()] key ..... ' ( ) " ^ : ; \ ?
b) [@=] key..... @ = + - * / < >
c) [,%] key....., % # $! & _ .

◇◆◇ Correcting an input ◇◆◇

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

◇◆◇ 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.

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. 5-12.

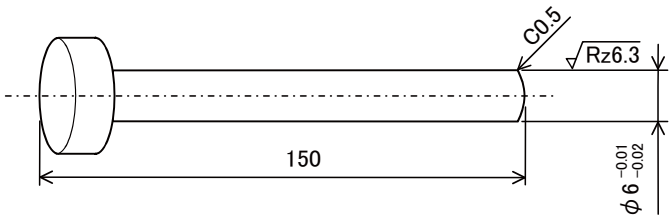


Fig.5-12:Reference dimension of origin setting tool

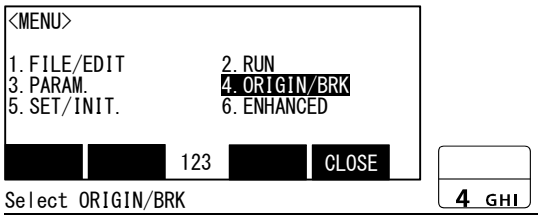
The procedure of setting the origin with the origin setting tool is shown below.
The origin setting can be performed for the target axis only instead of for all axes. Go to steps for the target axis to set the origin.

⚠ CAUTION

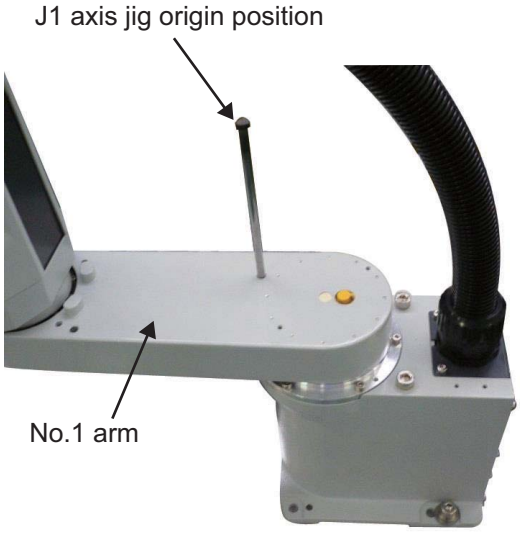
In the following procedure, the J3 axis brake is released to move its shaft with both hands.
When the brake is released, the J3 axis falls by its own weight.
To ensure safety, take appropriate measures such as supporting the axis to avoid the free fall.

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

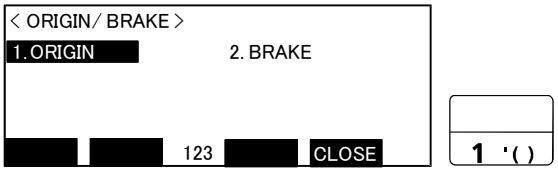
(1) J1 axis origin setting



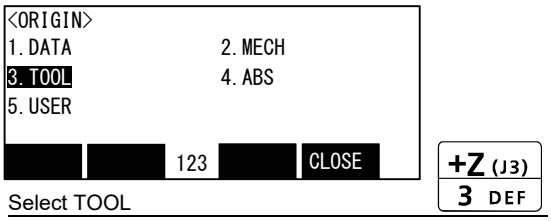
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



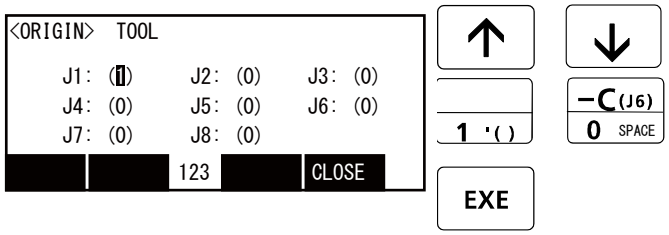
2) Move the J1 axis slowly toward the front using both hands. Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig into the pinholes and fas-ten.



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

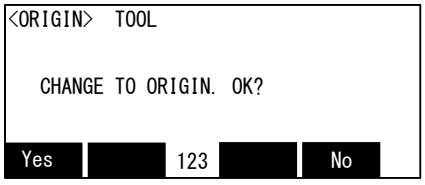


4) Press the [3] key, and display the Tool selection screen.



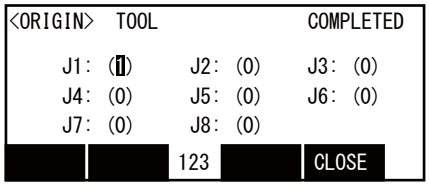
5) Input "1" into the J1 axis. Set "0" to other axes.

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



F1

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



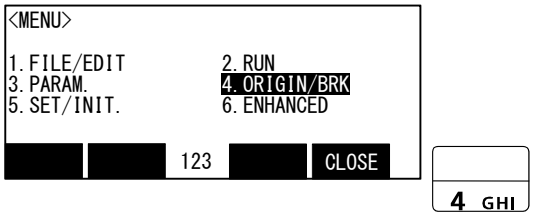
8) Setting of the origin is completed.

9) Refer to Page 85, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

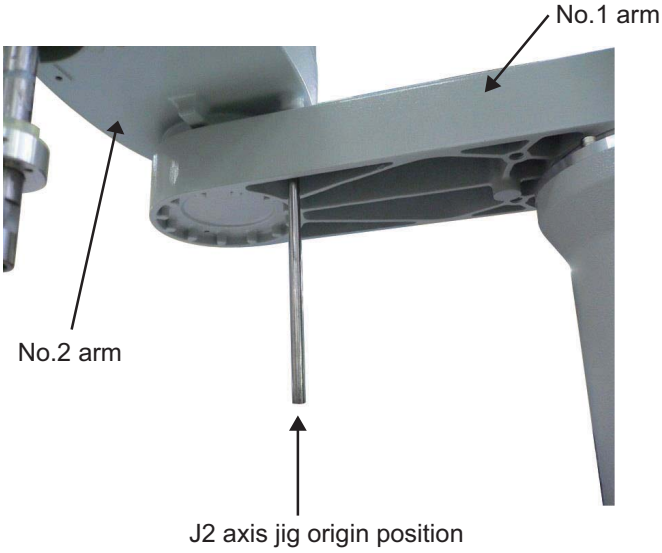
◇◆◇ Select the axis of origin setting ◇◆◇

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".

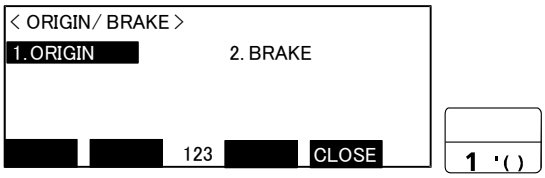
(2) J2 axis origin setting



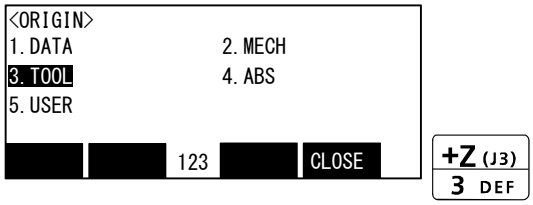
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



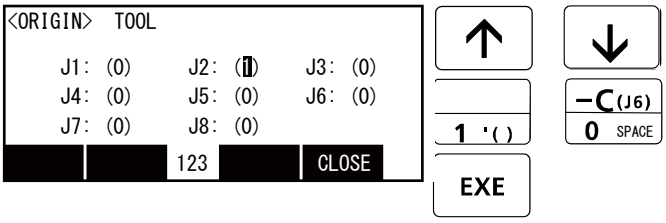
2) Move the J2 axis slowly using both hands. Align the pinholes of the No. 1 and No. 2 arms, feed through the origin jig into the pinholes and fasten.
The posture angle is +89 degrees for RH-3CRH, and +110 degrees for RH-6CRH.



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

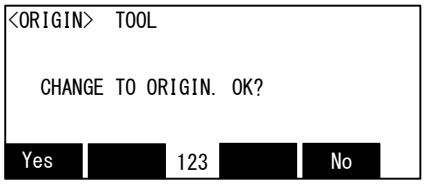


4) Press the [3] key, and display the Tool selection screen.

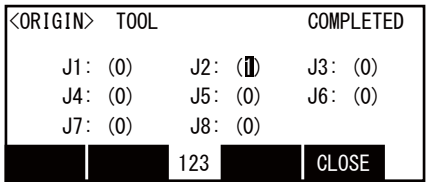


5) Input "1" into the J2 axis. Set "0" to other axes.

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



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



8) Setting of the origin is completed.

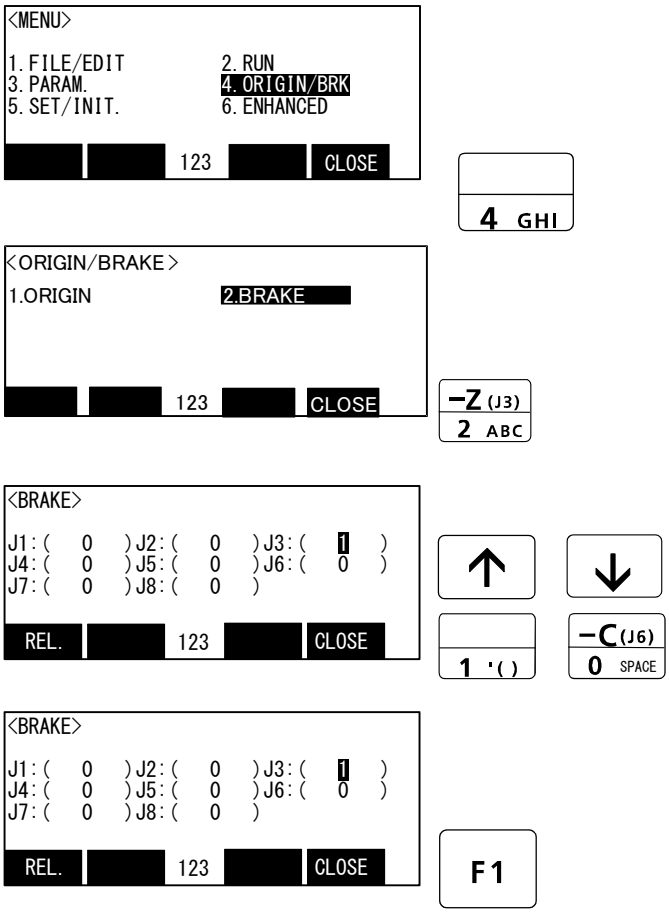
9) Refer to Page 85, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ 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 and J4 axis origin setting

Always perform origin setting of the J3 axis and the J4 axis simultaneously.

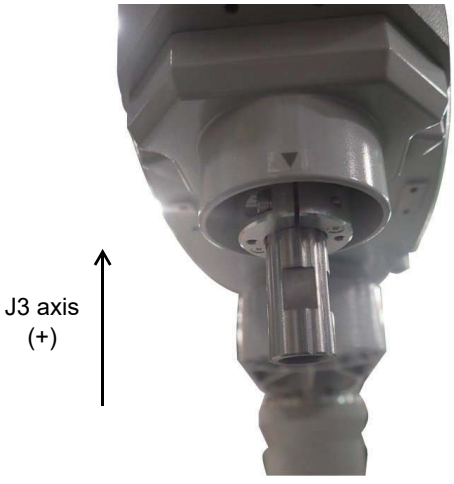


1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

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

3) Release the brake of the J3 axis for RH-3CRH.
Input "1" into the J3 axis. Set "0" to other axes.
Release the brake of the J3 axis and J4 axis for RH-6CRH.

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



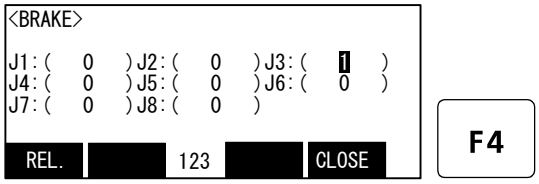
5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
Note) To prevent sudden fall of the J3 axis, release and lock the brake of the following axis repeatedly at intervals of about 200 ms. (Intermittent releasing of the brake)

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

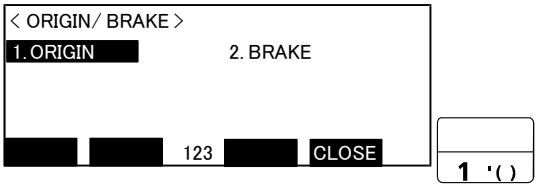
⚠CAUTION When the brake is released, the J3 axis falls by its own weight.
To ensure safety, take appropriate measures such as supporting the axis to avoid the free fall.

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

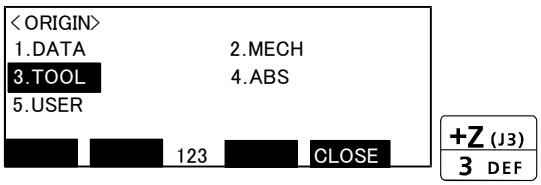
7) Hold the J4 axis with your hand and rotate it slowly to align the slit with the ABS mark.
*Move the J4 axis with maintaining the condition that the releasing brake of the J3 axis and the J3 axis contact to the mechanical stopper.



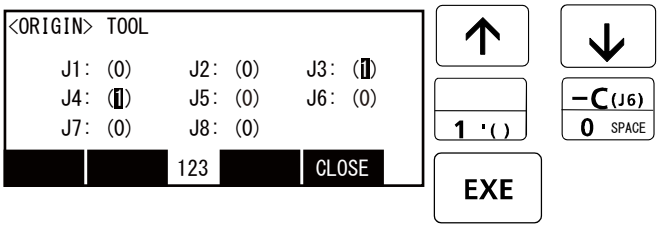
8) Detach the [F1] key and work the brake. Press the [F4] key and return to the origin / brake screen.



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

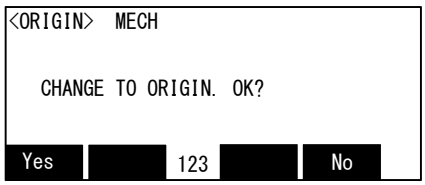


10) Press the [3] key, and display the Tool selection selection screen.



11) Input "1" into the J3 and 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 85, "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.

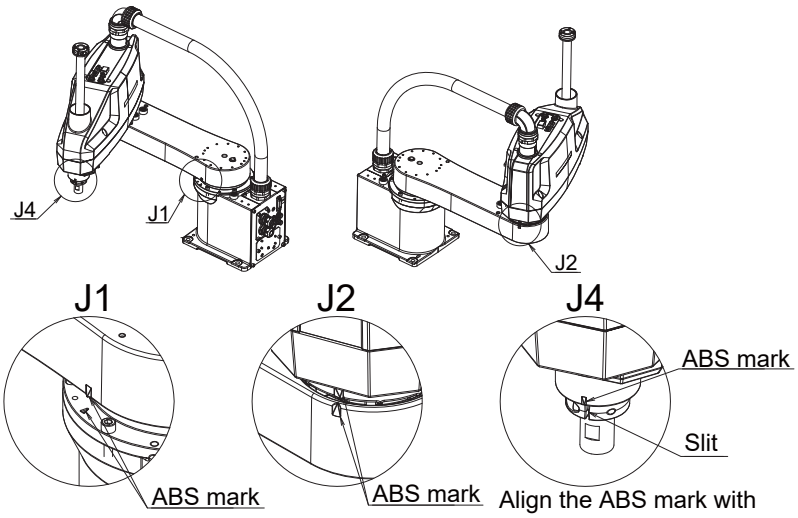
◇◆◇ Select the axis of origin setting ◇◆◇

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".

5.6.3 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 mode of the controller 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 17, "2.3 Confirming the operation" for details on the jog operation.



Note) There is no alignment mark of the J3 axis. The posture to be set is the same with the mechanical stopper method. Refer to Page 78, "(3) J3 and J4 axis origin setting".

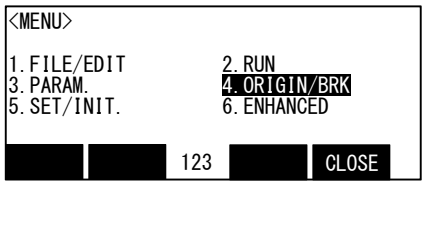
The angles of each axis which sets up the ABS origin are shown below.

Model	J1 axis	J2 axis	J3 axis	J4 axis
RH-3CRH	0°	89°	148mm	0°
RH-6CRH	0°	110°	159mm	0°

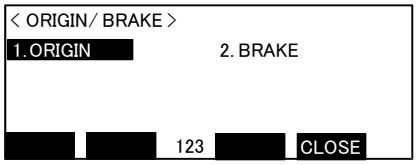
Fig.5-13:ABS mark attachment positions

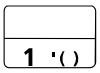
The procedures for setting the origin with the ABS method are explained below.

(1) Origin setting procedure

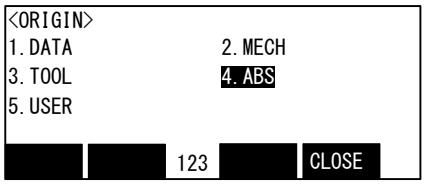


1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

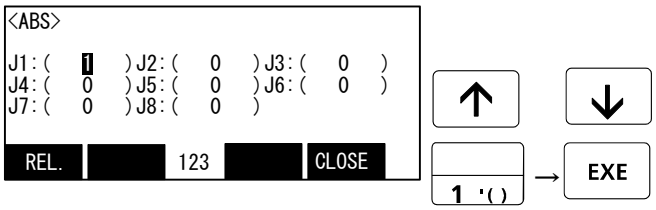




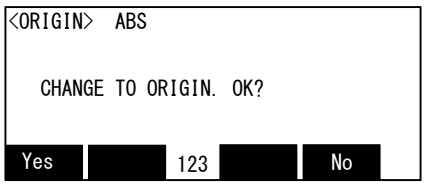
2) Press the [1] key, and display the Origin setting selection screen.



3) 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.



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

6) Refer to Page 85, "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 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° or more, align the end points of the ABS marks and set the origin using the ABS origin method again.

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 68, "Table 5-12: 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 mode of the controller to "MAMNUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown below.

Software version "C2j" or later has the "user origin data setting specification parameter (UORGSPEC)". Changing the setting value to "1" (high accuracy) will perform compensation considering sagging due to the gravity applied to the robot. This improves the accuracy of setting the origin with this method.
However, if the setting value is changed to "1" (high accuracy), reset the user origin position and origin.
With software version earlier than "C2j", after setting the user origin position and changing the parameter (UORGSPEC) to "1" (high accuracy), setting the origin will deteriorate the accuracy. Therefore, perform the above steps without fail.
This function is available for the RV-FR series. As the RH-FRH series are not subject to sagging, the settings are not effective.

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 axis. Then start the procedure from step 4).

1) Determine the user origin position

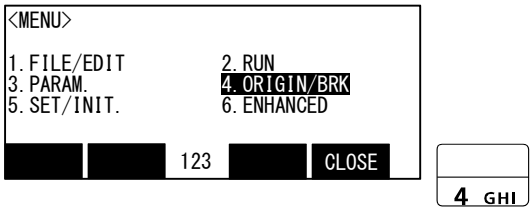
Operations required before configuring the settings

The same hand and workpiece conditions must be applied for the user origin position and user origin settings. Be sure to perform the following operations.
- Disable the "robot mechanism thermal compensation function".
- Set the hand and workpiece conditions (HNDDAT0, WRKDAT0) beforehand.

Move the robot to the position to be set as the origin with jog operation. Refer to Page 17, "2.3 Confirming the operation" for details on the jog operation.

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

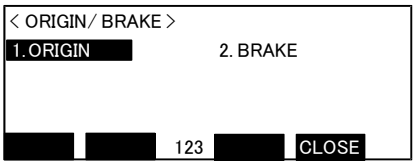
2) Enter the JOINT jog mode, and display the joint coordinates on the teaching pendant screen. Record the value of the axis for which the origin is to be set.
3) Input the value recorded in the "user designated origin parameter (USERORG)".
The parameter details and input methods are described in the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

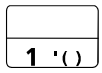


Before performing step 4), refer to Page 83, " Operations required before configuring the settings".

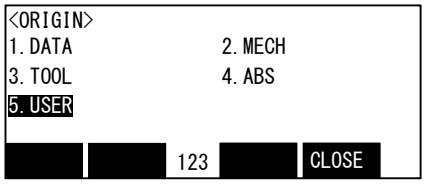
4) Next, set the origin.
Display the menu screen.

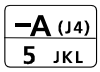
5) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



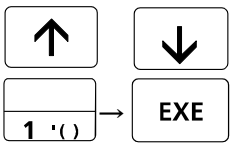


6) Press the [1] key, and display the Origin setting selection screen.

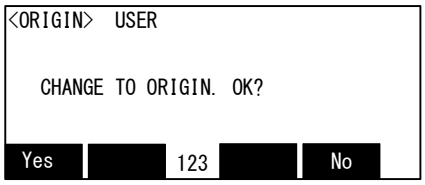




7) Press the [5] key, and display the User selection screen.



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



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

10) Refer to Page 85, "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 User origin method.

5.6.5 Recording the origin data

Confirm the origin data on the teaching pendant screen (origin data input screen). The origin data label is attached on the side of the base part of the robot arm.
The teaching pendant operation method and the battery 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 69, "5.6.1 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

Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to Page 69, "5.6.1 Setting the origin with the origin data input method", "(3)Inputting the origin data" and display the Origin Data Input screen on the teaching pendant display screen.

(2) Recording the origin data

Write the origin data displayed on the teaching pendant to the origin data label mentioned above. Refer to Page 69, "Fig.5-10: Origin data label (an example)", and Page 71, "Fig.5-11: Correspondence of origin data label and axis" for details on the origin data label.

The recording of the origin data is completed.

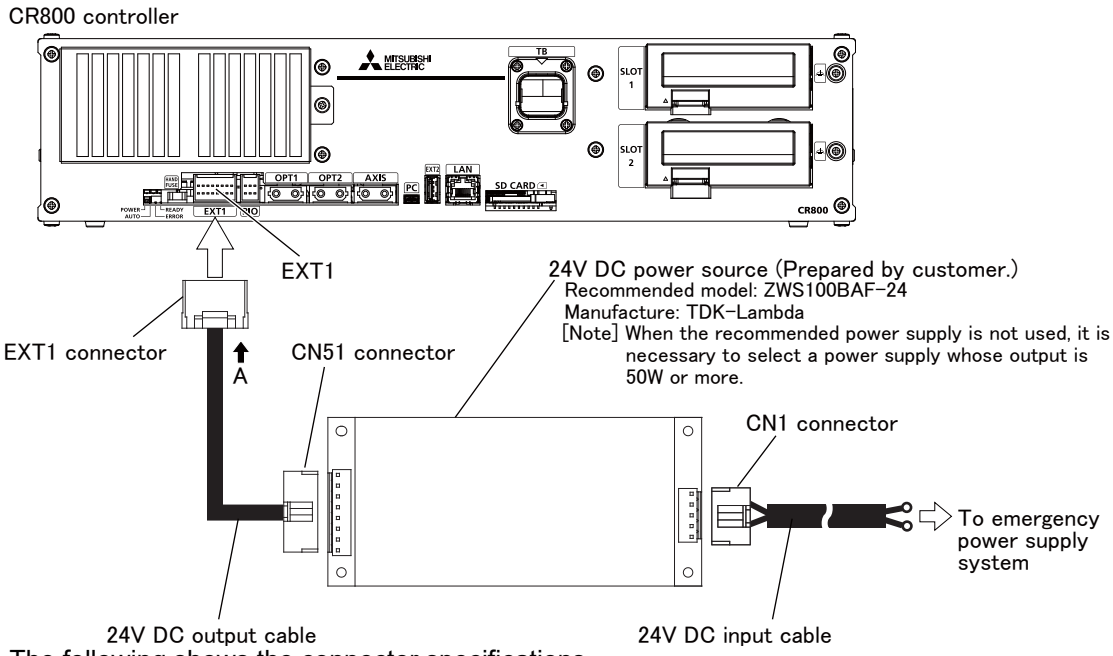
5.7 How to release the brake in an emergency

The following describes how to release the brake using the emergency power supply in an emergency. Using an emergency power supply system separated from the primary power supply of the robot prevents the robot from moving accidentally during the brake release operation, which contributes to enhancing customer safety.

An emergency here means an emergency stop of robot operation, which requires the brake release operation to set the robot in an evacuation posture temporarily.

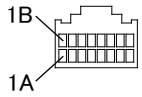
[Note] Do not connect an emergency power supply to multiple robots and release their brakes at the same time.

1) Connect the teaching pendant to the robot controller.
2) Connect the 24V DC power supply to EXT1 of the controller as shown in the figure below.
   To prevent accidental power supply from the primary power supply of the robot, prepare an emergency power supply system separated from the primary power supply of the robot to supply AC power to the 24V DC power supply.



The following shows the connector specifications.

EXT1 connector
Connector: J21DF-16V-KX
Contact: SJ2F-01GF-P1.0
Manufacture: JST



Pin assignment

Pin number	Signal name
8A	24V
8B	
3B	
7A	GND
7B	
3A	

CN51 connector (recommended)
Connector: VHR-8N
Contact: SVH-41T-P1.1
Manufacture: JST

Pin assignment

Pin number	Signal name
1	GND
2	
3	
4	
5	24V
6	
7	
8	

CN1 connector (recommended)
Connector: VHR-5N
Contact: SVH-41T-P1.1
Manufacture: JST

Pin assignment

Pin number	Signal name
1	L
3	N
5	FG

3) When the 24V DC power supply is turned on, the controller starts and then errors (H0712, H0090, H0212) will occur.
4) Release the brake using the teaching pendant.
   For the brake release operation using the teaching pendant, refer to "Explanation of operation methods" in the separate volume, "Instruction Manual/Detailed Explanations of Functions and Operations".

6 Appendix

Appendix 1:Configuration flag

The configuration flag indicates the robot posture.
For the 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
Indicates the location of the end axis relative to the line that passes through both the rotational center of the J1 axis and the rotational center of the J2 axis.

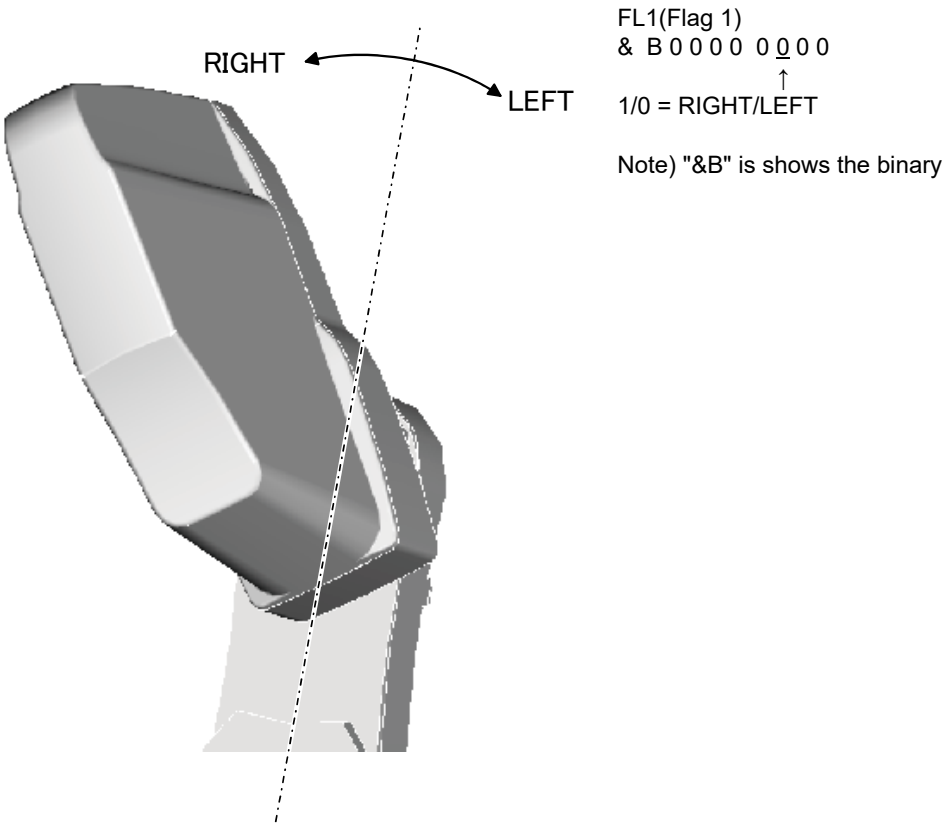


Fig.6-1:Configuration flag(RIGHT/LEFT)

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