

IX

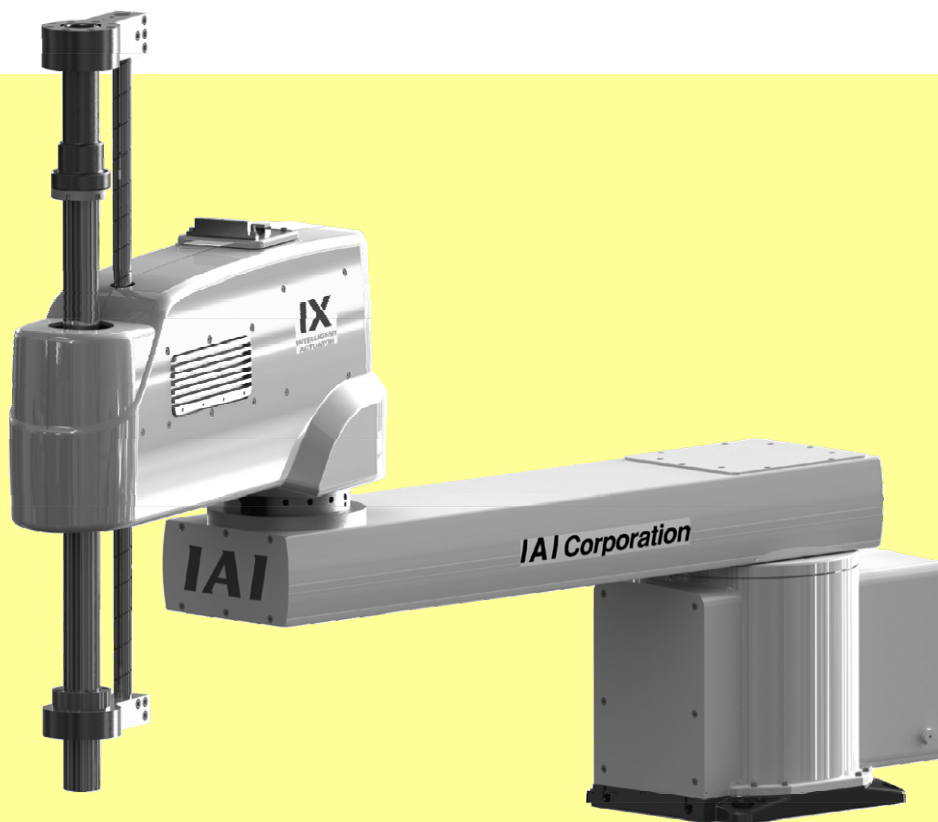
INTELLIGENT ACTUATOR

**Horizontal Articulated Robot – IX Series
Tabletop Type, Arm Length 1000/1200**

IX-NNN10040

IX-NNN12040

Operation Manual Fourth Edition



Please Read Before Use

Thank you for purchasing our product.

This instruction manual explains the handling methods, structure and maintenance of this product, providing the information you need in order to use the product safely.

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.

Please download the user's manual from our website.

You can download it free of charge. User registration is required for the first time downloading.

URL : www.iai-robot.co.jp/data_dl/CAD_MANUAL/

When using the product, print out of the necessary portions of the relevant manual, or please display it on your computer, tablet terminal, etc. so that you can check it immediately.

After reading the instruction manual, keep it in a convenient place so that whoever is handling the product can refer to it quickly when necessary.

[Important]

- This instruction manual is an original document dedicated for this product.
- This product cannot be used in ways not shown in this instruction manual. IAI shall not be liable for any result whatsoever arising from the use of the product in any other way than what is noted in the manual.
- The information contained in this instruction manual is subject to change without notice for the purpose of product improvement.
- If any issues arise regarding the information contained in this instruction manual, contact our customer center or the nearest sales office.
- Use or reproduction of this instruction manual in full or in part without permission is prohibited.
- The company names, names of products and trademarks of each company shown in the text are registered trademarks.

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Safety Guide

“Safety Guide” has been written to use the machine safely and so prevent personal injury or property damage beforehand. Make sure to read it before the operation of this product.

Safety Precautions for Our Products

The common safety precautions for the use of any of our robots in each operation.

No.	Operation Description	Description
1	Model Selection	- This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of the following applications. 1) Medical equipment used to maintain, control or otherwise affect human life or physical health. 2) Mechanisms and machinery designed for the purpose of moving or transporting people (For vehicle, railway facility or air navigation facility) 3) Important safety parts of machinery (Safety device, etc.) - Do not use the product outside the specifications. Failure to do so may considerably shorten the life of the product. - Do not use it in any of the following environments. 1) Location where there is any inflammable gas, inflammable object or explosive 2) Place with potential exposure to radiation 3) Location with the ambient temperature or relative humidity exceeding the specification range 4) Location where radiant heat is added from direct sunlight or other large heat source 5) Location where condensation occurs due to abrupt temperature changes 6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid) 7) Location exposed to significant amount of dust, salt or iron powder 8) Location subject to direct vibration or impact - For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.

No.	Operation Description	Description
2	Transportation	• When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane. • When the work is carried out with 2 or more persons, make it clear who is to be the “leader” and who to be the “follower(s)” and communicate well with each other to ensure the safety of the workers. • When in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped. • Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the instruction manual for each model. • Do not step or sit on the package. • Do not put any heavy thing that can deform the package, on it. • When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work. • When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment’s capability limit. • Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength. • Do not get on the load that is hung on a crane. • Do not leave a load hung up with a crane. • Do not stand under the load that is hung up with a crane.
3	Storage and Preservation	• The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation. • Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.
4	Installation and Start	(1) Installation of Robot Main Body and Controller, etc. • Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. Also, be equipped for a fall-over or drop due to an act of God such as earthquake. • Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life. • When using the product in any of the places specified below, provide a sufficient shield. 1) Location where electric noise is generated 2) Location where high electrical or magnetic field is present 3) Location with the mains or power lines passing nearby 4) Location where the product may come in contact with water, oil or chemical droplets

No.	Operation Description	Description
4	Installation and Start	(2) Cable Wiring • Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool. • Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error. • Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error. • When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction. • Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product. • Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire. (3) Grounding • The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise-resistance ability and control the unnecessary electromagnetic radiation. • For the ground terminal (PE) on the AC power cable of the controller and the grounding plate in the control panel, make sure for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment standards and criteria). For detail, follow the description in [an instruction manual of each controller or controller built-in actuator]. • Conduct functional grounding on the FG terminal for a controller supplying 24V DC or a controller built-in type actuator. In order to minimize influence to mechanical operation given by electromagnetic interference (noise) to an electrical device or insulation failure, conduct grounding on a terminal or a conductor that is electrically stable. The reference impedance should be Type D (Former Class 3, ground resistance 100Ω or less).

No.	Operation Description	Description
4	Installation and Start	(4) Safety Measures • When the work is carried out with 2 or more persons, make it clear who is to be the “leader” and who to be the “follower(s)” and communicate well with each other to ensure the safety of the workers. • When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot’s movable range. When the robot under operation is touched, it may result in death or serious injury. • Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation. • Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product. • Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input. • When the installation or adjustment operation is to be performed, give clear warnings such as “Under Operation; Do not turn ON the power!” etc. Sudden power input may cause an electric shock or injury. • Take the measure so that the work part is not dropped in power failure or emergency stop. • Wear protection gloves, goggle or safety shoes, as necessary, to secure safety. • Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire. • When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.
5	Teaching	• When the work is carried out with 2 or more persons, make it clear who is to be the “leader” and who to be the “follower(s)” and communicate well with each other to ensure the safety of the workers. • Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well. • When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. • When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. • Place a sign “Under Operation” at the position easy to see. • When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.

No.	Operation Description	Description
6	Trial Operation	• When the work is carried out with 2 or more persons, make it clear who is to be the “leader” and who to be the “follower(s)” and communicate well with each other to ensure the safety of the workers. • After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation. • When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation. • Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc. • Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.
7	Automatic Operation	• Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence. • Before starting automatic operation, make sure that all peripheral equipment is in an automatic-operation-ready state and there is no alarm indication. • Make sure to operate automatic operation start from outside of the safety protection fence. • In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product. • When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.

No.	Operation Description	Description
8	Maintenance and Inspection	- When the work is carried out with 2 or more persons, make it clear who is to be the “leader” and who to be the “follower(s)” and communicate well with each other to ensure the safety of the workers. - Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well. - When the work is to be performed inside the safety protection fence, basically turn OFF the power switch. - When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. - When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. - Place a sign “Under Operation” at the position easy to see. - For the grease for the guide or ball screw, use appropriate grease according to the instruction manual for each model. - Do not perform the dielectric strength test. Failure to do so may result in a damage to the product. - When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. - The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation. - Pay attention not to lose the removed cover or screws, and make sure to put the product back to the original condition after maintenance and inspection works. Use in incomplete condition may cause damage to the product or an injury. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.
9	Modification and Dismantle	Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.
10	Disposal	- When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. - When removing the actuator for disposal, pay attention to drop of components when detaching screws. - Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.
11	Other	- Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device. - See Overseas Specifications Compliance Manual to check whether complies if necessary. - For the handling of actuators and controllers, follow the dedicated instruction manual of each unit to ensure the safety. - Using the devise in a way not indicated by IAI may lose the protection performance equipped to the device.

Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the instruction manual for each model.

Level	Degree of Danger and Damage	Symbol
Danger	This indicates an imminently hazardous situation which, if the product is not handled correctly, will result in death or serious injury.	 Danger
Warning	This indicates a potentially hazardous situation which, if the product is not handled correctly, could result in death or serious injury.	 Warning
Caution	This indicates a potentially hazardous situation which, if the product is not handled correctly, may result in minor injury or property damage.	 Caution
Notice	This indicates lower possibility for the injury, but should be kept to use this product properly.	 Notice

Caution in Handling

1. Make sure to follow the usage condition, environment and specification range of the product.
In case it is not secured, it may cause a drop in performance or malfunction of the product.
2. Positioning Repeatability Does Not Change Even If the Positioning Band is Changed.
It would not improve the positioning accuracy repeatability even if setting the positioning band narrower than it originally was at the delivery. The change of the positioning width is to change the timing to output the positioning complete signal when a positioning is conducted. The positioning complete signal is output when the residual amount of movement gets into the range that is set as the positioning band.
3. Make sure to attach Robot properly by following this operation manual.

 **Danger:** Not holding or fixing the robot securely may cause not only to generate abnormal noise and vibration, to malfunction or to shorten the life, but also to lead to an unexpected operation, which may result in a critical accident such as a destruction of the unit, work piece or peripherals, or death or heavy injury.
4. Make sure to connect the robot and controller with the same serial number.
Even if the controller is a model that is applicable for the robot, a misalignment in position will occur if the serial number is not matched.

International Standards Compliances

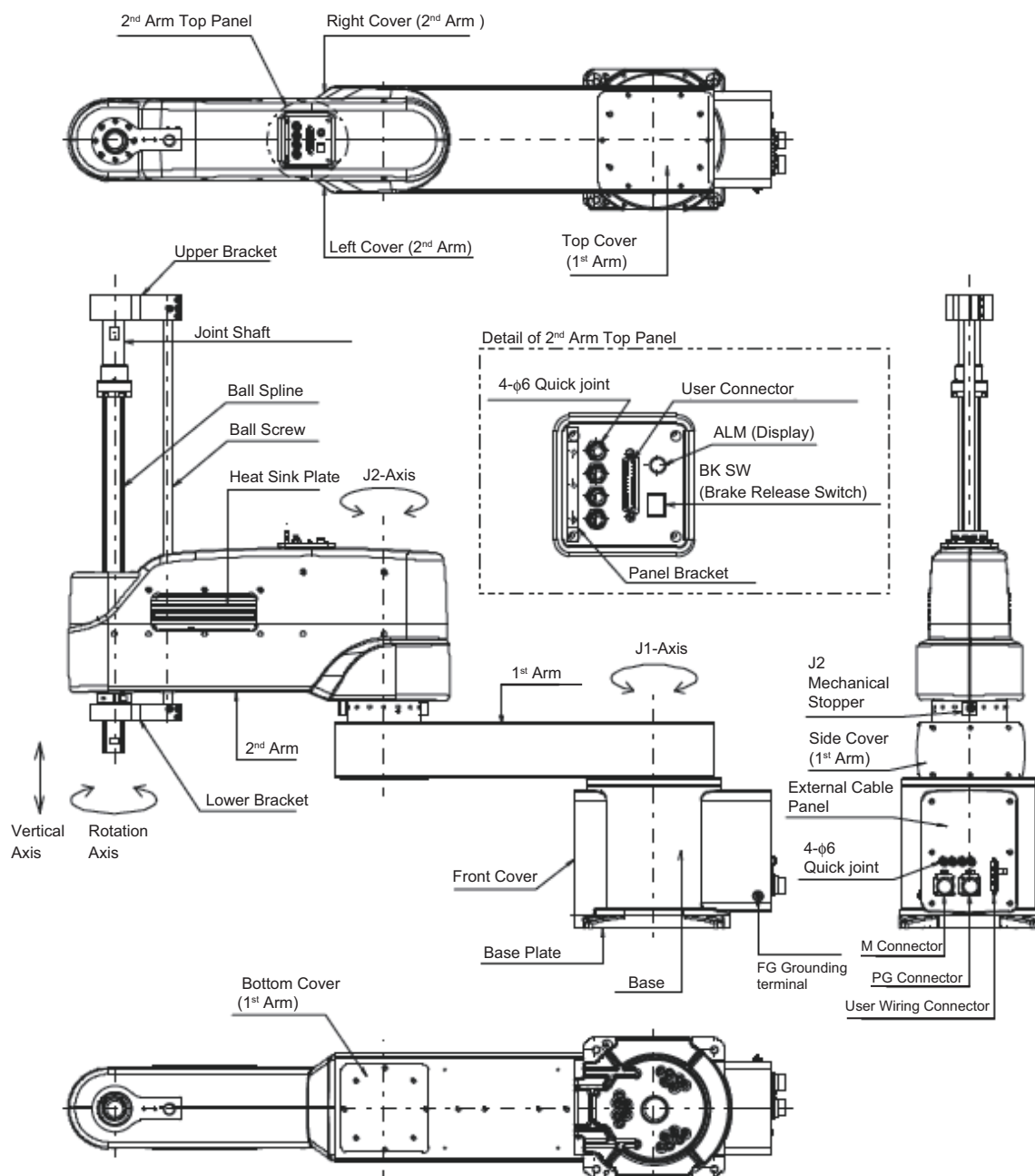
This product complies with the following overseas standard.
Refer to Overseas Standard Compliance Manual (ME0287) for more detailed information.

RoHS3 Directive	CE Marking
◎	○

◎: Complied in Standard

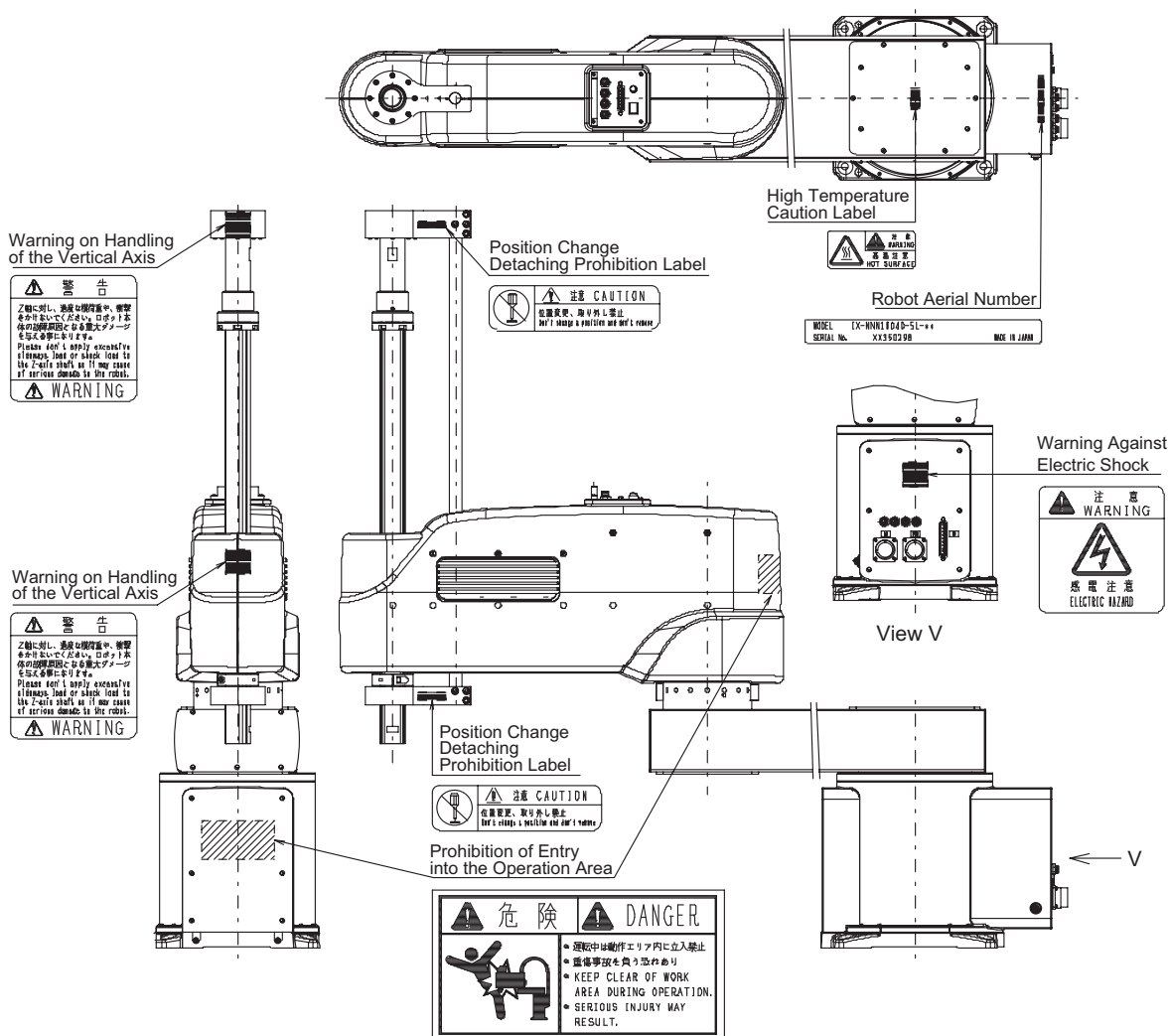
○: Option

Names of the Parts



[Labels]

On the unit body, there are some labels attached as shown in the figures below. Caution and warning labels describe the necessary things in order to use the robot safely.



1. Specifications Check

1.1 Product Check

The standard configuration of this product is comprised of the following parts.
See the component list for the details of the enclosed components. If you find any fault or missing parts, contact your local IAI distributor.

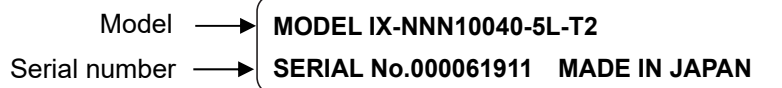
1.1.1 Parts

No.	Item	Model number	Quantity	Remarks
1	Robot	Refer to "How to Read the Model Nameplate" and "How to Read the Model Number."	1 set	
2	Dedicated Controller		1 set	
Accessories				
3	Motor • Encoder Cables		1 set	Refer to 1.4 Motor • Encoder Cables
4	D-Sub Connector with 25 Pins		1	2 nd arm side user connector
5	Hood Set (D-Sub Connector with 25 Pins)		1	
6	D-Sub Connector with 37 Pins		1	Base side user connector
7	Hood Set (D-Sub Connector with 37 Pins)		1	
8	Hex Socket Button Head Screw M10×15		1	For the cover on tapped hole for eyebolt
9	Safety Guide		1	

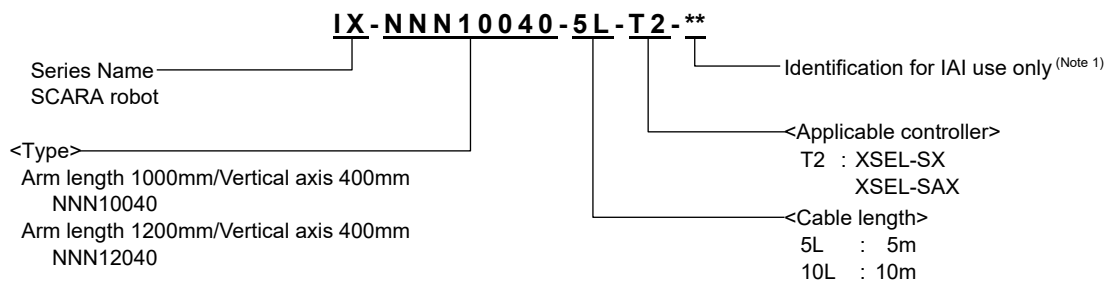
1.1.2 Operation Manuals related to this product

No.	Item	Control No.
1	Instruction Manual for RA/SA/RAX/SAX/RAXD/SAXD Controller	ME0359
2	Operation Manual for XSEL-R/S/RX/SX/RXD/SXD Controller	ME0313
3	Operation Manual for XSEL-P/Q/PCT/QCT/PX/QX/R/S/RX/SX/RXD/SXD – RC Gateway Function	ME0188
4	Operation Manual for PC Software IA-101-X-MW/IA-101-X-USBMW	ME0154
5	Operation Manual for Teaching Pendant SEL-T/TD/TG	ME0183
6	Instruction Manual for Touch Panel Teaching TB-01/01D/01DR Applicable for Program Controller	ME0325
7	Instruction Manual for Touch Panel Teaching TB-02/02D Applicable for Program Controller	ME0356
8	Operation Manual for DeviceNet	ME0124
9	Operation Manual for CC-Link	ME0123
10	Operation Manual for PROFIBUS	ME0153
11	Operation Manual for EtherNet/IP	ME0309
12	Operation Manual for EtherCAT	ME0308
13	Operation Manual for IA Net	ME0307

1.1.3 How to Read the Model Nameplate



1.1.4 How to Read the Model Number



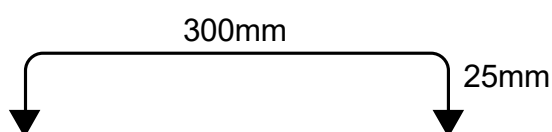
Note 1 Identification for IAI use only: This may be marked for the purpose of IAI. It is not an ID to describe the model type.

1.2 Specifications

1.2.1 Basic Specifications List

Item		Specifications	
		IX-NNN10040	IX-NNN12040
Vertical axis lead length	mm	10	10
Degrees of freedom		Four degrees of freedom	Four degrees of freedom
Overall arm length	mm	1000	1200
1 st Arm length		500	700
2 nd Arm length		500	500
Movement range	J1-Axis (1 st Arm)	degree	±140
	J2-Axis (2 nd Arm)	degree	±150
	Vertical axis	mm	400
	Rotation axis	degree	±360
Maximum composite speed (J1-Axis + J2-Axis) (Note 1)	mm/s	7356	8308
Maximum speed	J1-Axis (1 st Arm)	degree/s	273
	J2-Axis (2 nd Arm)	degree/s	298
	Vertical axis	mm/s	1000
	Rotation axis	degree/s	1197.3
Positioning repeatability precision (Note 2)	On horizontal plane (J1-Axis + J2-Axis)	mm	±0.040
	Vertical axis	mm	±0.020
	Rotation axis	degree	±0.010
Standard cycle time (Note 3)	sec	0.59	0.66
Loading capacity	Rated	kg	20
	Maximum	kg	50
Vertical Axis Rated Thrust (Note 4)	N	1020	1020
Rotation Axis	Allowable load moment (Note 5)	kg•m ²	0.5
	Permissible torque	N•m	20.0
	Allowable load moment	N•m	50.0
Allowable load diameter (Note 6)	mm	90	240
Encoder		Absolute encoder	
User wiring		D-sub 25-pin (socket) with 25-core AWG26 shielded connector	
User tubing		4 air tubes (outer diameter: φ6, inner diameter: φ4)	
Environment	Surrounding air temperature	0 to 40°C	
	Surrounding humidity	Humidity: 20 to 85%RH or less (non-condensing)	
	Surrounding environment	Refer to "2.2 Installation and Storage • Preservation Environment"	
	Surrounding storage temperature	0 to 60°C	
	Surrounding storage humidity	Humidity: 20 to 85%RH or less (non-condensing)	
	Protection class	IP20	
Noise	dB	78	78
Weight	kg	93	97

- Note 1 Assuming PTP instruction operation. The maximum composite speed is not the maximum speed of CP operation.
- Note 2 Positioning precision when the robot is operated repeatedly to one specified position from the same starting position at the same speed and acceleration/deceleration using the same arm (at a constant surrounding air temperature of 20°C).
It is not the absolute positioning accuracy.
Also, when the arm system is changed over or when positioning to one setting position is made from several different positions, there may be a possibility that the robot may get out of the specification range of the positioning accuracy repeatability.
- Note 3 It is the required time to run back and forth between positions that enable the fastest motion under the following condition.
It is the time for back and forth cycle with 2kg of carrier, 25mm of vertical movement and 300mm of horizontal movement.

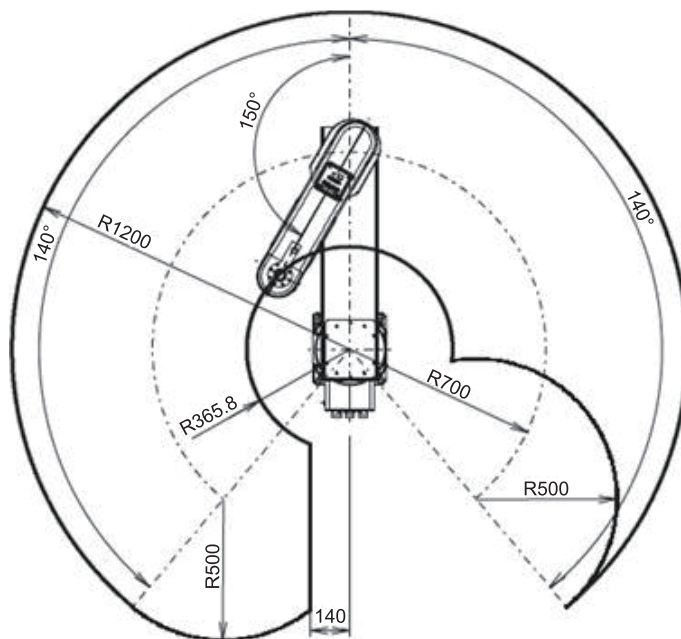


(Note) Even though the standard cycle time is the required time determined under the fastest movement, continuous operation in the fastest movement cannot be conducted.

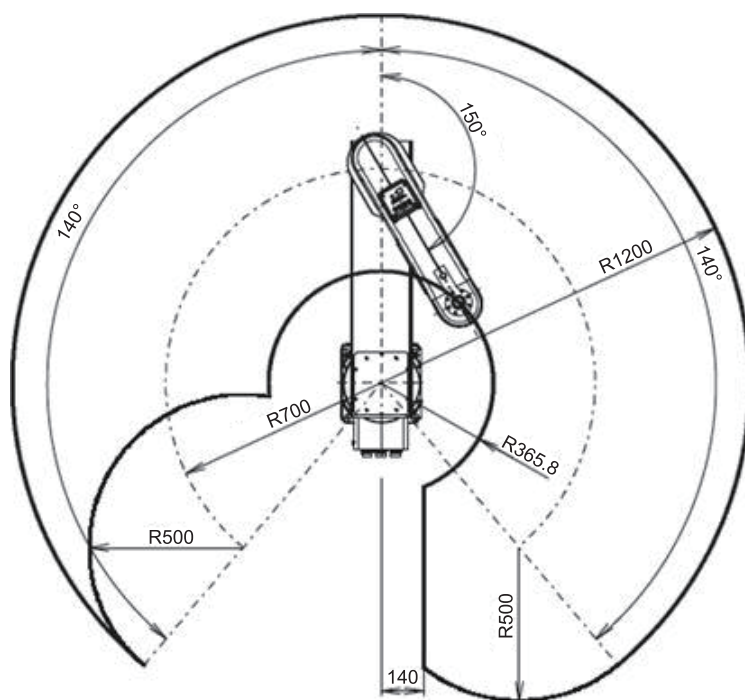
- Note 4 Pressing operation cannot be performed.
- Note 5 It is the allowable moment of inertia converted to the center of the revolution in the rotation axis.
[Refer to 2.3.2 [2] Attachment of Load for the offset from the revolution center of the 4th axis to the center of gravity of the load] If the center of gravity of the load is off the center of the 4th axis, it may cause vibration depending on the profile or attachment stiffness of the load. In such a case, reduce the speed and acceleration till the vibration disappears.
- Note 6 If the load is larger than the allowable diameter, it interferes with the robot body.
[Refer to 2.3.2 [2] Attachment of Load]

- Caution:**
- If the robot is operated at a speed or acceleration/deceleration exceeding the allowable value, abnormal noise or vibration, failure, or shorter life may result.
 - If the robot is operated under a load equal to or greater than the allowable load moment, abnormal noise or vibration, failure, or shorter life may result. In an extreme case, flaking may occur.
 - Attaching a load beyond the allowable overhang length may generate vibration or abnormal noise.

(3) IX-NNN12040 Arm Length 1200 Right arm System



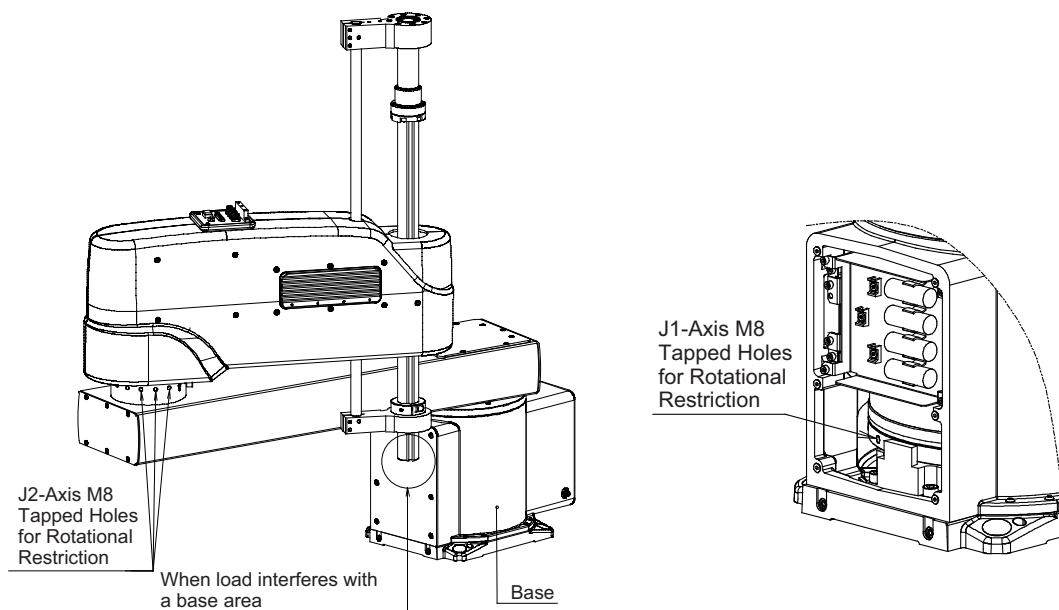
(4) IX-NNN12040 Arm Length 1200 Left arm System



[2] Operation Restriction

When a load or the arm of the robot interferes with the base or other equipment, restrict the operation by attaching hex socket head screws (M8×15) to the M8 tapped holes for operation restriction on the J1-axis or J2-axis that are shown in the figure below, and make the stopper interfering absolute reset effective.

[Refer to (1) J1-Axis Operation Restriction Angles and (2) J2-Axis Operation Restriction Angles for the angles to be able to restrict the operation.]



When the operation restriction is applied, make sure to change the parameters in the software limitation in Each Axis Parameter No. 7 and No. 8.

[Refer to (1) J1-Axis Operation Restriction Angles and (2) J2-Axis Operation Restriction Angles for the soft limit values.]

Also, when having the stopper interfering absolute reset in the direction of operation restriction, make sure to acquire the position of the stopper in Stopper Position Acquiring Mode after that, and perform the stopper interfering absolute reset.

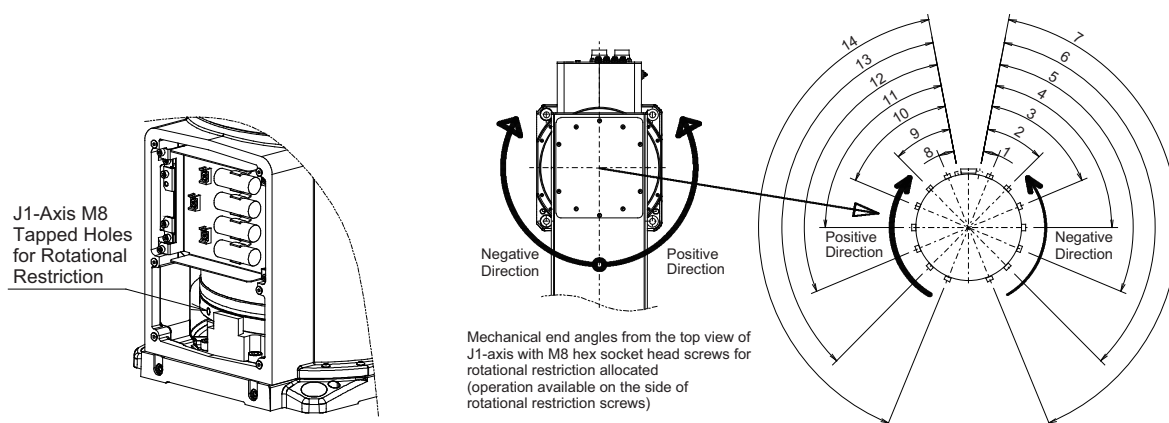
It is necessary to have a stopper interfering absolute reset in such cases as when replacing the absolute backup batteries. Note that, if interference exists, the absolute reset process cannot be executed, thus the recovery process faces difficulty.

Especially, the J2-axis with its arm length 1000 has a possibility that a load interferes with the base without the operation restriction.

(1) J1-Axis Operation Restriction Angles

J1-axis of the angles of the mechanical ends, angles of the operation restrictions and the parameters are as shown in the figures and table below.

When limiting the moveable angle, attach the M8x15 hex socket head screw for movement limitation to an M8 tapped hole for J1-axis rotational limitation and change the soft limit, and then acquire the stopper position and conduct the stopper push type absolute reset. [Refer to 4.9, "Absolute Reset"]



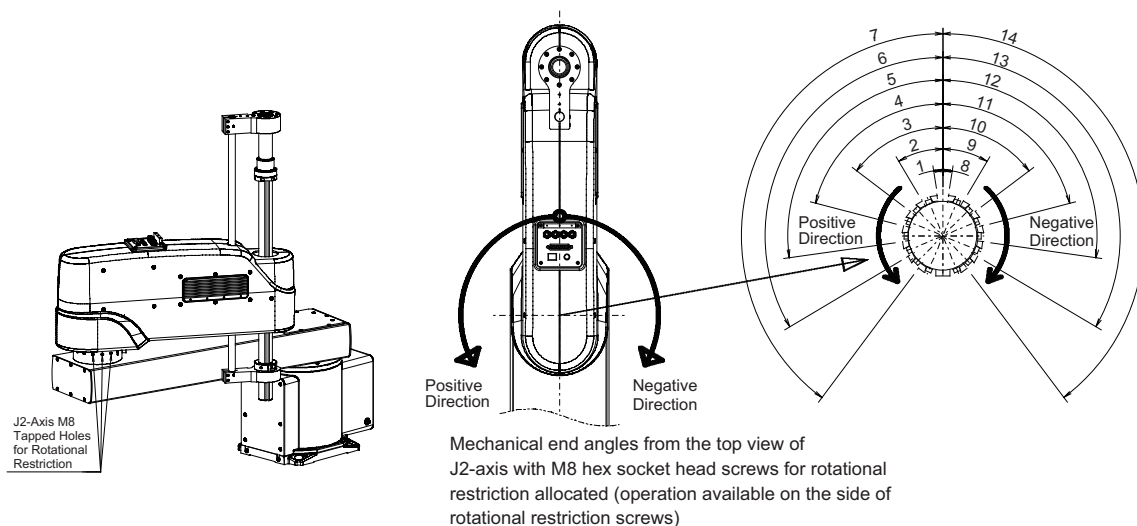
J1-Axis Operation Restriction Angles and Parameters

No.	Angle of Stopper Position (ME) [degree]	Angle of Software Limitation [degree]	Angle from Software Limitation to ME [degree]	Software Limitation Parameter (Each Axis Parameter No. 7 Software Limitation + J1-Axis)
Positive Direction of Coordinate	1	11.5	1.5	91500
	2	34.0	24.0	114000
	3	56.5	46.5	136500
	4	79.0	69.0	159000
	5	101.5	91.5	181500
	6	124.0	114.0	204000
	7	146.5	136.5	226500
	Default	150.0	140.0	230000
No.	Angle of Stopper Position (ME) [degree]	Angle of Software Limitation [degree]	Angle from Software Limitation to ME [degree]	Software Limitation Parameter (Each Axis Parameter No. 8 Software Limitation - J1-Axis)
Negative Direction of Coordinate	1	-11.5	-1.5	88500
	2	-34.0	-24.0	66000
	3	-56.5	-46.5	43500
	4	-79.0	-69.0	21000
	5	-101.5	-91.5	-1500
	6	-124.0	-114.0	-24000
	7	-146.5	-136.5	-46500
	Default	-150.0	-140.0	-50000

(2) J2-Axis Operation Restriction Angles

J2-axis of the angles of the mechanical ends, angles of the operation restrictions and the parameters are as shown in the figures and table below.

When limiting the moveable angle, attach the M8x15 hex socket head screw for movement limitation to an M8 tapped hole for J2-axis rotational limitation and change the soft limit, and then acquire the stopper position and conduct the stopper push type absolute reset. [Refer to 4.9, "Absolute Reset"]



J2-Axis Operation Restriction Angles and Parameters

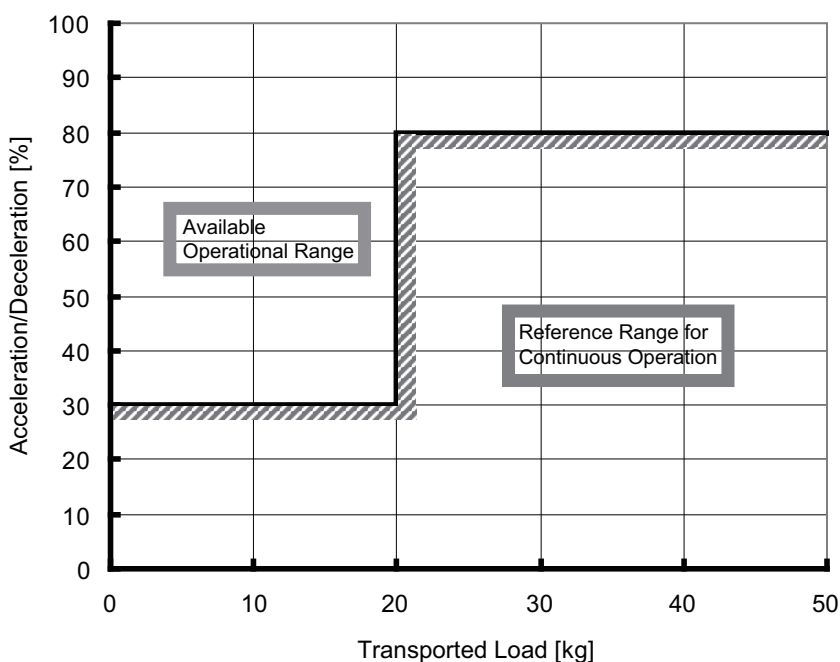
J2-Axis Operation Restriction Angles and Parameters					
No.		Angle of Stopper Position (ME) [degree]	Angle of Software Limitation [degree]	Angle from Software Limitation to ME [degree]	Software Limitation Parameter (Each Axis Parameter No. 7 Software Limitation + J2-Axis)
Positive Direction of Coordinate	1	8.0	-2.0	10	-2000
	2	30.5	20.5	10	20500
	3	53.0	43.0	10	43000
	4	75.5	65.5	10	65500
	5	98.0	88.0	10	88000
	6	120.5	110.5	10	110500
	7	143.0	133.0	10	133000
	Default	160.0	150.0	10	150000
No.		Angle of Stopper Position (ME) [degree]	Angle of Software Limitation [degree]	Angle from Software Limitation to ME [degree]	Software Limitation Parameter (Each Axis Parameter No. 7 Software Limitation - J2-Axis)
Negative Direction of Coordinate	1	-8.0	2.0	10	2000
	2	-30.5	-20.5	10	-20500
	3	-53.0	-43.0	10	-43000
	4	-75.5	-65.5	10	-65500
	5	-98.0	-88.0	10	-88000
	6	-120.5	-110.5	10	-110500
	7	-143.0	-133.0	10	-133000
	Default	-160.0	-150.0	10	-150000

1.2.3 Acceleration/Deceleration and Transfer Load

(Note) The servo-motor gain of this SCARA Robot is different in the case of 20kg or less and in the case of above 20kg for the rated transportable weight set in the weight of WGHT Command or WGT2 Command.
Therefore be aware that the graph of acceleration/deceleration and transportable load changes at the rated transportable weight 20kg as a border.

[1] PTP Operation

Shown in the graph below is a reference for the acceleration setting against the transported load. Refer to this graph for setting and make sure to tune the acceleration/deceleration so it would not overload.

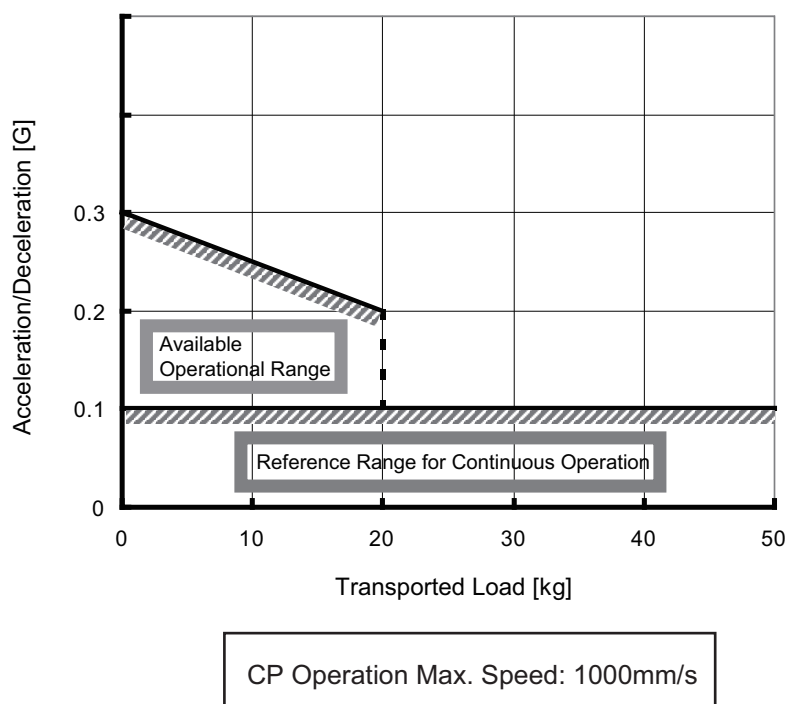


[2] CP Operation

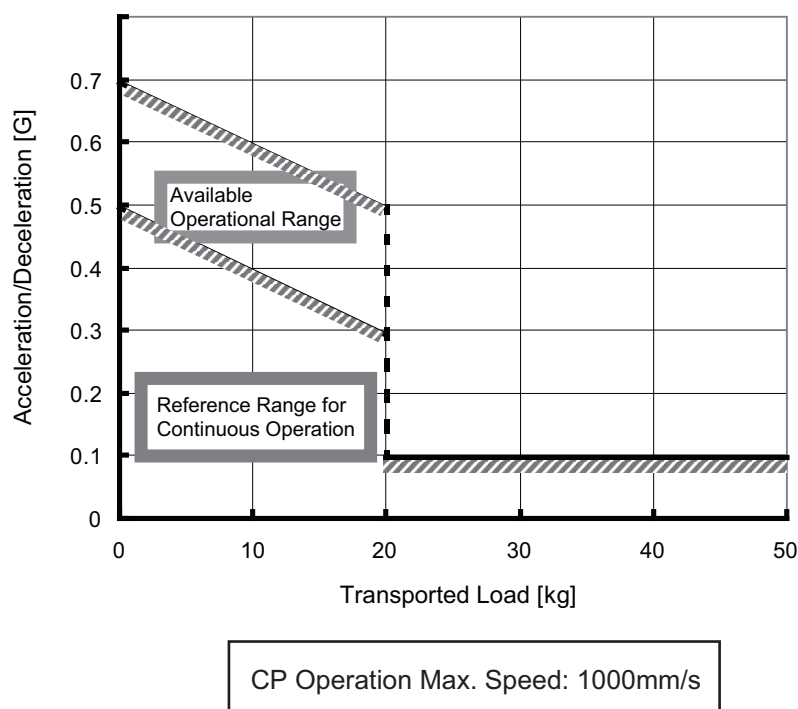
For CP Operation, the available operational range differs depending on if it includes the vertical axis operation or not.

Shown in the graph below is a reference for the acceleration setting against the transported load. Refer to this graph for setting and make sure to tune the acceleration/deceleration so it would not overload.

(1) In the case that vertical axis operation is included



(2) In the case that vertical axis operation is excluded

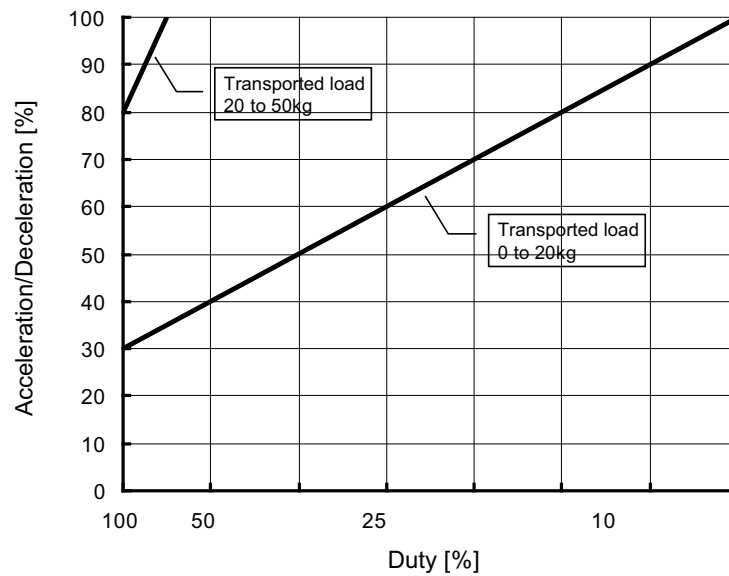


1.2.4 Acceleration/Deceleration and Duty

(Note) The servo-motor gain of this SCARA Robot is different in the case of 20kg or less and in the case of above 20kg for the rated transportable weight set in the weight of WGHT Command or WGT2 Command.
Therefore be aware that the graph of acceleration/deceleration and duty changes at the rated transportable weight 20kg as a border.

[1] PTP Operation

Shown in the graph below is a reference for the acceleration setting against the duty. Duty is the rate of operation expressed in % that presents the time of the SCARA Robot being operated in 1 cycle of operation. Refer to this graph for setting and make sure to tune the acceleration/deceleration so it would not overload.

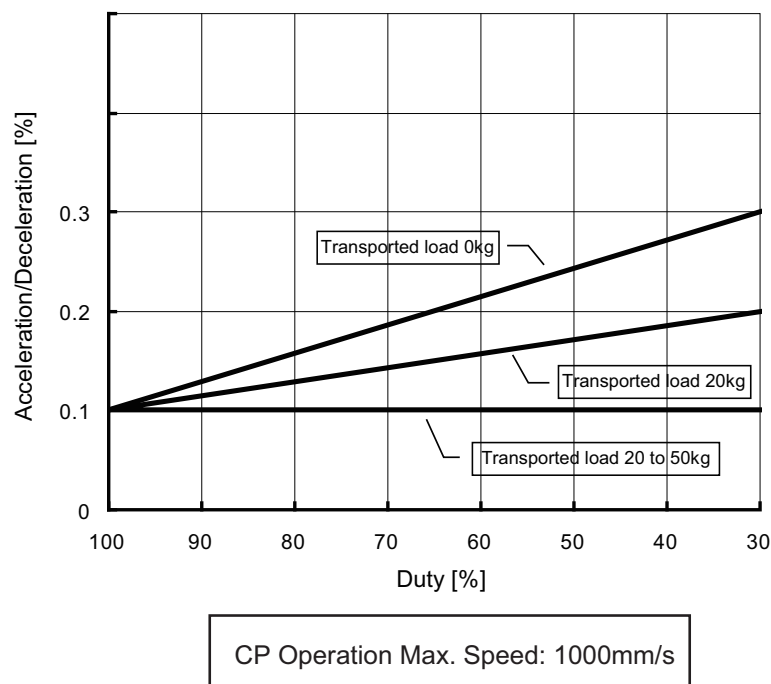


[2] CP Operation

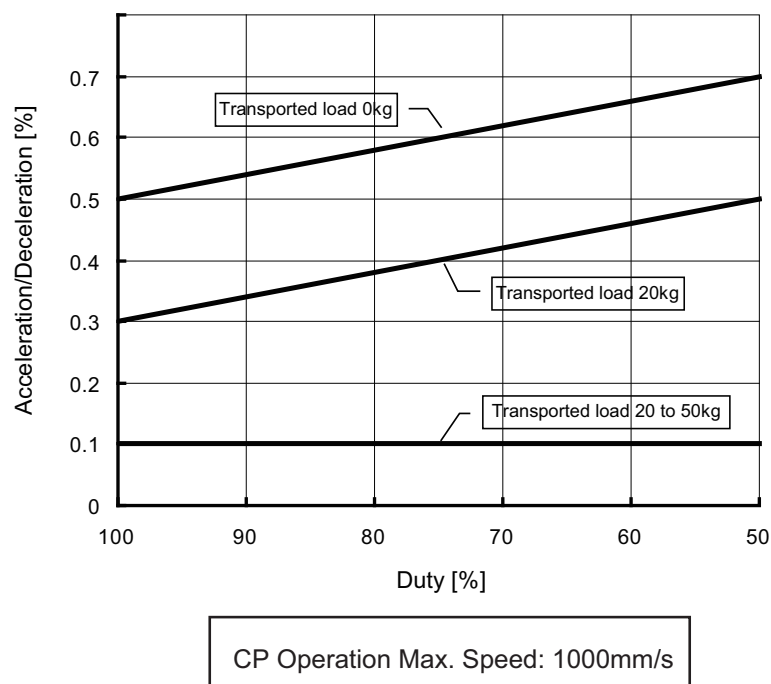
For CP Operation, the available operational range differs depending on if it includes the vertical axis operation or not.

Shown in the graph below is a reference for the acceleration setting against the duty. Duty is the rate of operation expressed in % that presents the time of the SCARA Robot being operated in 1 cycle of operation. Refer to this graph for setting and make sure to tune the acceleration/deceleration so it would not overload.

(1) In the case that vertical axis operation is included



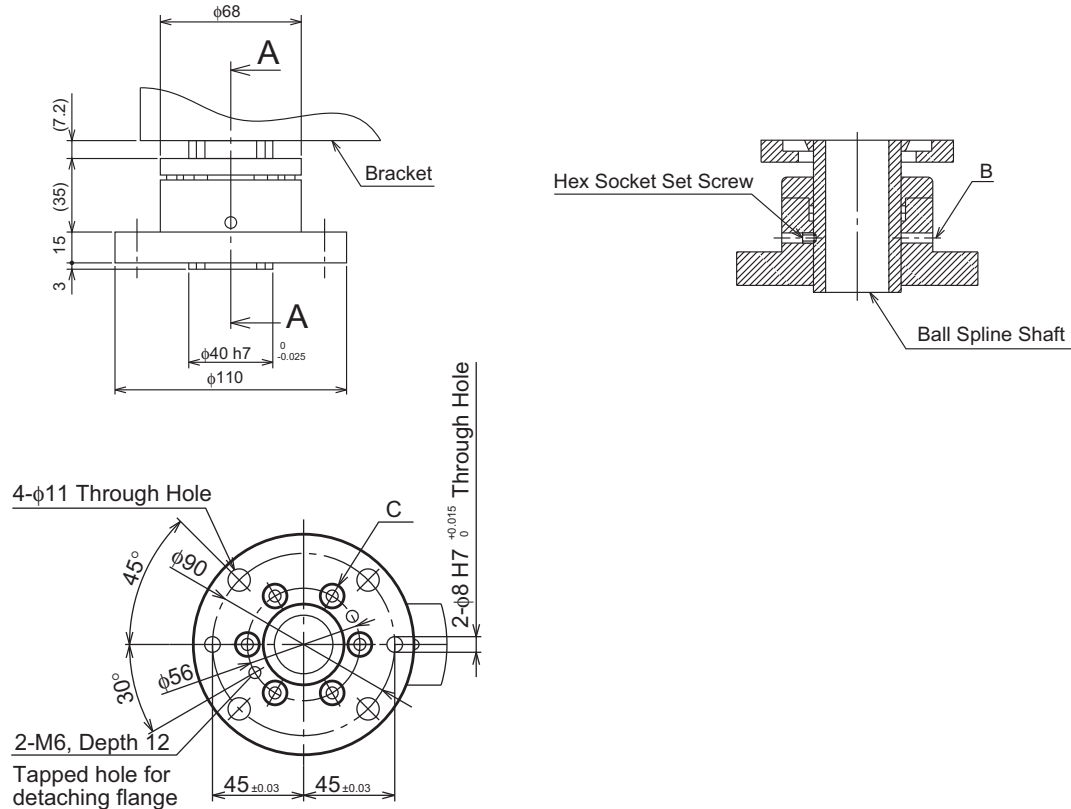
(2) In the case that vertical axis operation is excluded



-  **Caution:**
- For PTP operation, use WGHT Command or WGT2 Command in the program to set up the weight and the moment of inertia before having the operation. Use WGT2 Command when the load is offset from the center of Z-axis. Setup can be held with WGHT Command when there is no offset. Also, when using WGHT Command or WGT2 Command, select four axes of SCARA Robot in GRP Command.
[Refer to SEL Language Programing Manual (ME0224) for more details.]
 - When overload error occurs, either reduce the acceleration speed or make the stop time longer referring to the graph in 1.2.4 Acceleration/Deceleration and Duty.
 - If the robot is required to make horizontal movement in high speed, run the vertical axis near the upper end as much as possible. It will decrease the moment of inertia of the load.

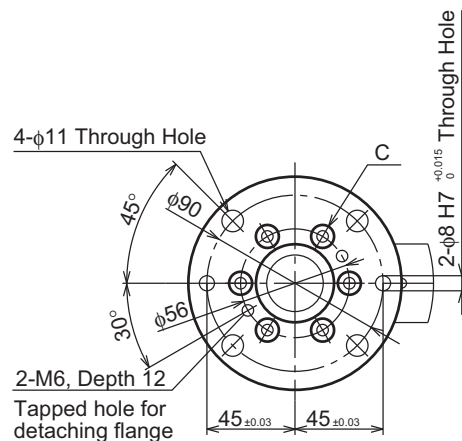
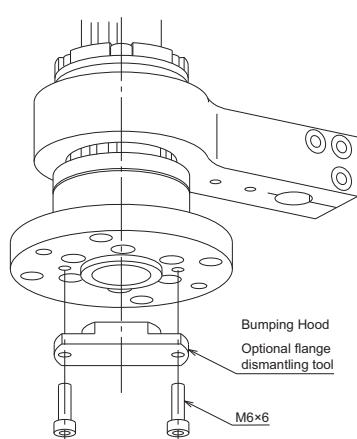
1.3 Flange (Option Model: IX-FL-5)

It is the flange to be used when attaching a load on the end of the vertical axis arm.



⚠ Caution:

1. Vertical axis flange option is held on with a locking assembly. To remove the flange, it is necessary either to loosen the screws in Part C, or to use an equivalent tool (e.g. pulley dismantler) to pull it out. Do not attempt to put impact on the flange to remove it.



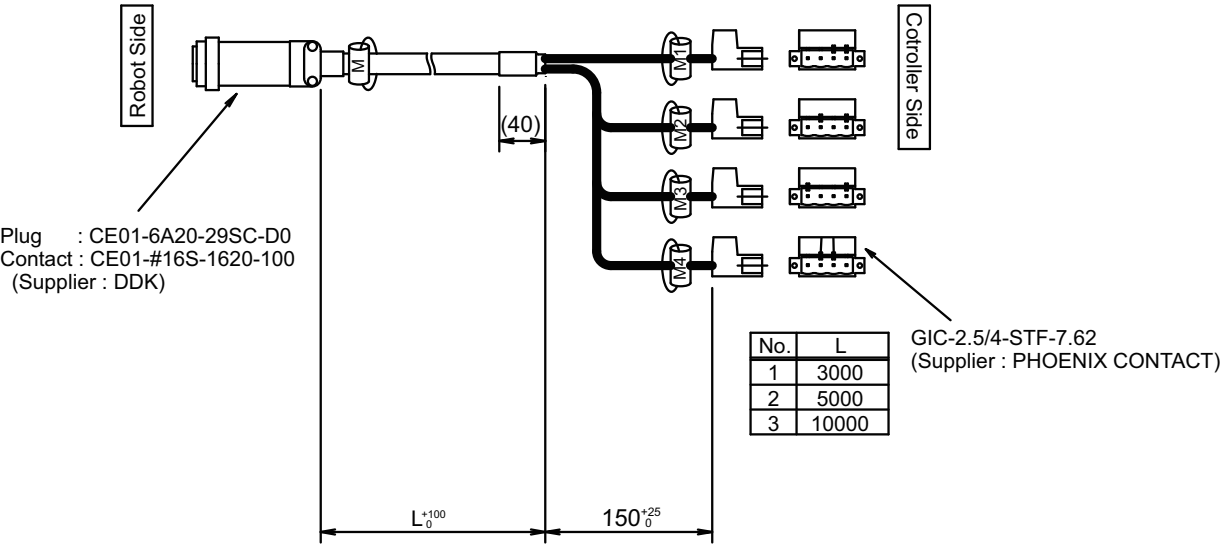
2. The tightening torque for the screws (M6) in Area C is 12.3N·m. Do not tighten the screws with the specified torque all at once. Tighten the screws with half of the specified torque temporarily, first, and then tighten again with the specified torque afterwards. Also, always tighten the screws diagonally.
The tightening torque for M6×6 hex socket set screws is 5.9N·m.

1.4 Motor • Encoder Cables

1.4.1 Motor cable

Model : CB-SX4-MA□□□

□□□ indicates the cable length L (Example. 030 = 3m). Max.10m



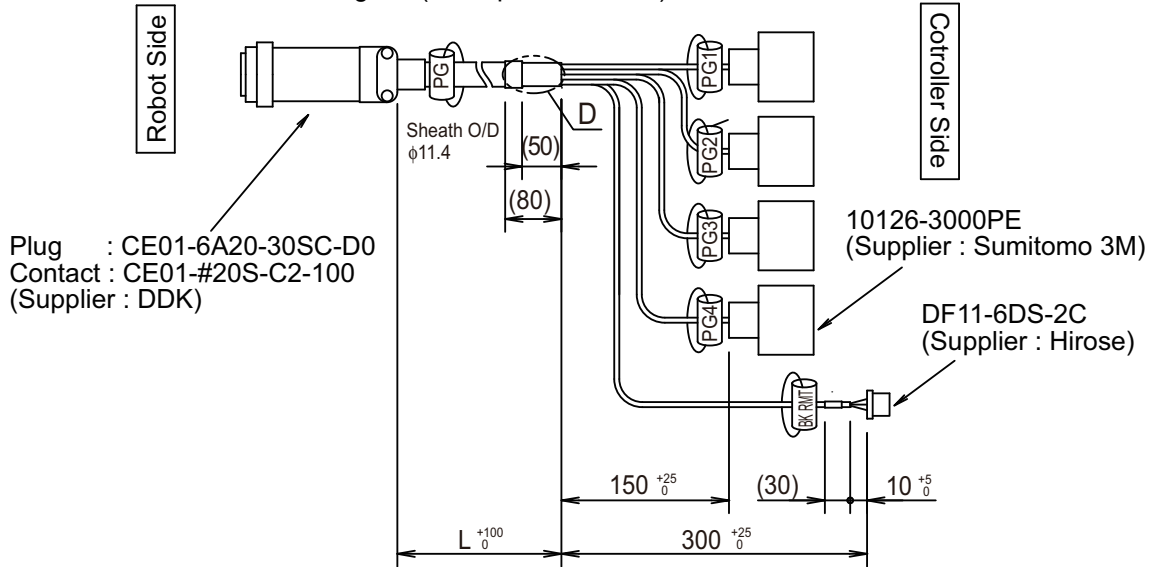
Allocate on the connector side and heat shrink

Robot Side			Controller Side			
ID No.	Signal Name	Pin No	Pin No	Signal Name	ID No.	Sheath Symbol
1	U	1	1	C.G	4	M1
2	V	2	2	U	1	
3	W	3	3	V	2	
4	C.G	4	4	W	3	
5	U	5	1	C.G	8	M2
6	V	6	2	U	5	
7	W	7	3	V	6	
8	C.G	8	4	W	7	
9	U	9	1	C.G	12	M3
10	V	10	2	U	9	
11	W	11	3	V	10	
12	C.G	12	4	W	11	
13	U	13	1	C.G	16	M4
14	V	14	2	U	13	
15	W	15	3	V	14	
16	C.G	16	4	W	15	
-	-	17				

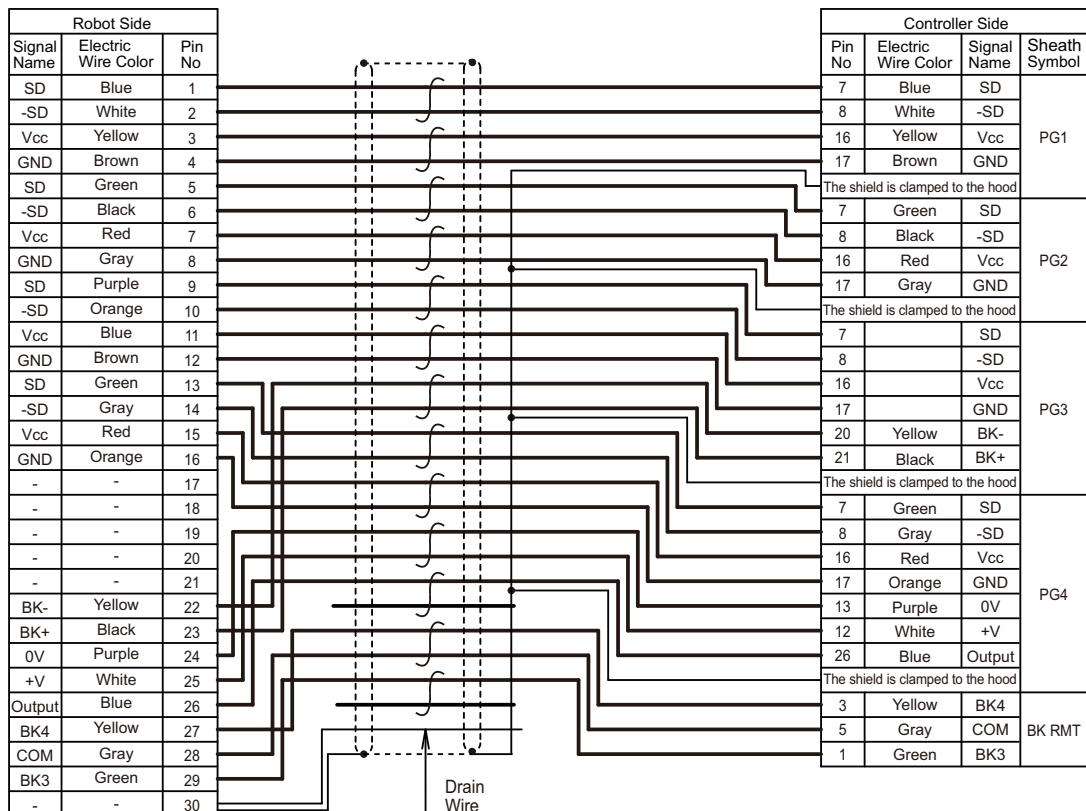
1.4.2 Encoder cable

Model : CB-SX4-PA□□□

□□□ indicates the cable length L (Example. 030 = 3m). Max.10m



No.	L
1	3000
2	5000
3	10000



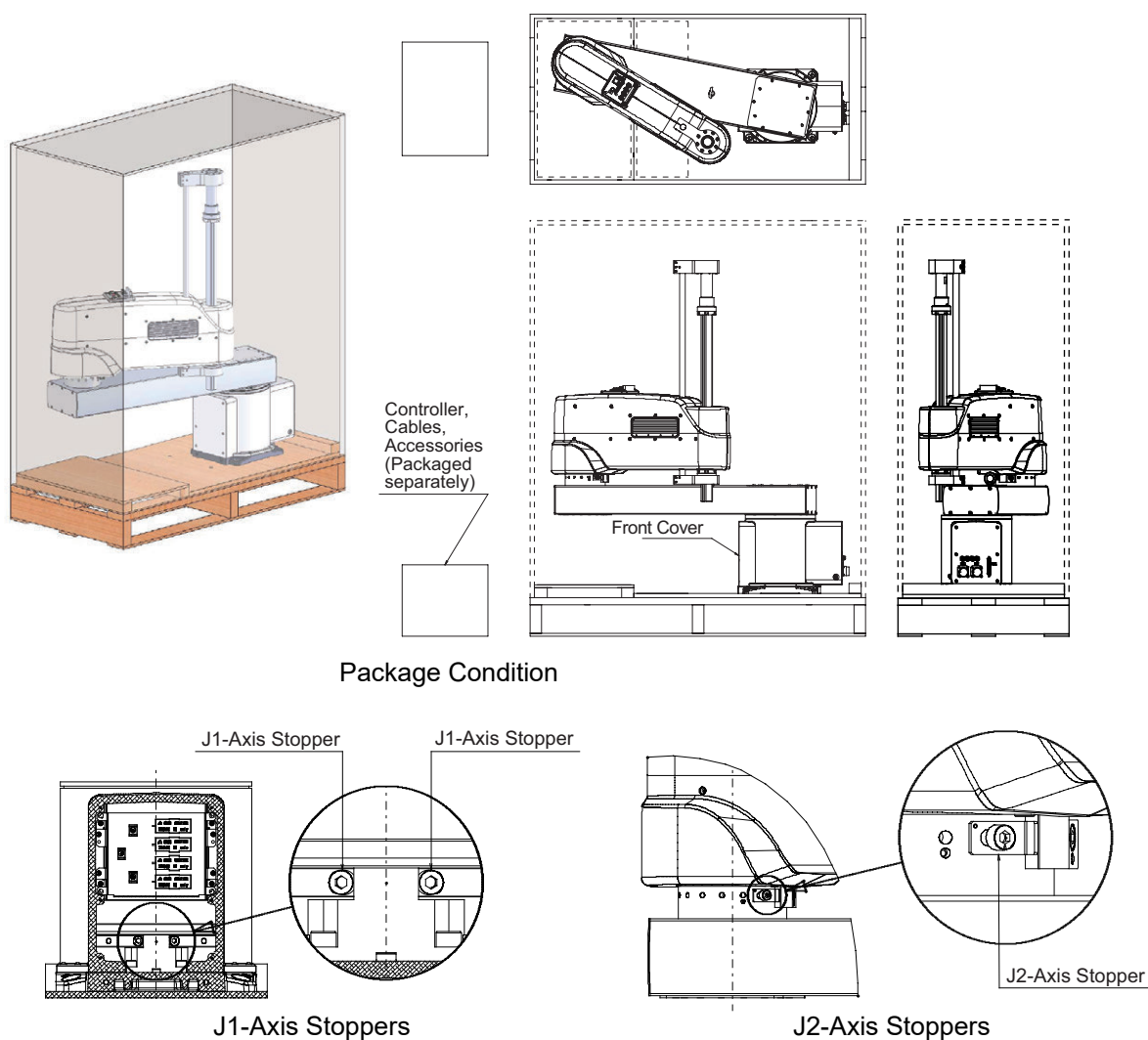
2. Installation

2.1 Transportation

2.1.1 Handling of the Robot

Unless otherwise specified, the robot is delivered in the package as shown in the figure below. There are stoppers attached on the J1 and J2 axes.

! Notice: Remove the stoppers before starting to operate the robot. Keep the removed stoppers, and use them to hold the robot when it is necessary to transport or carry the robot.

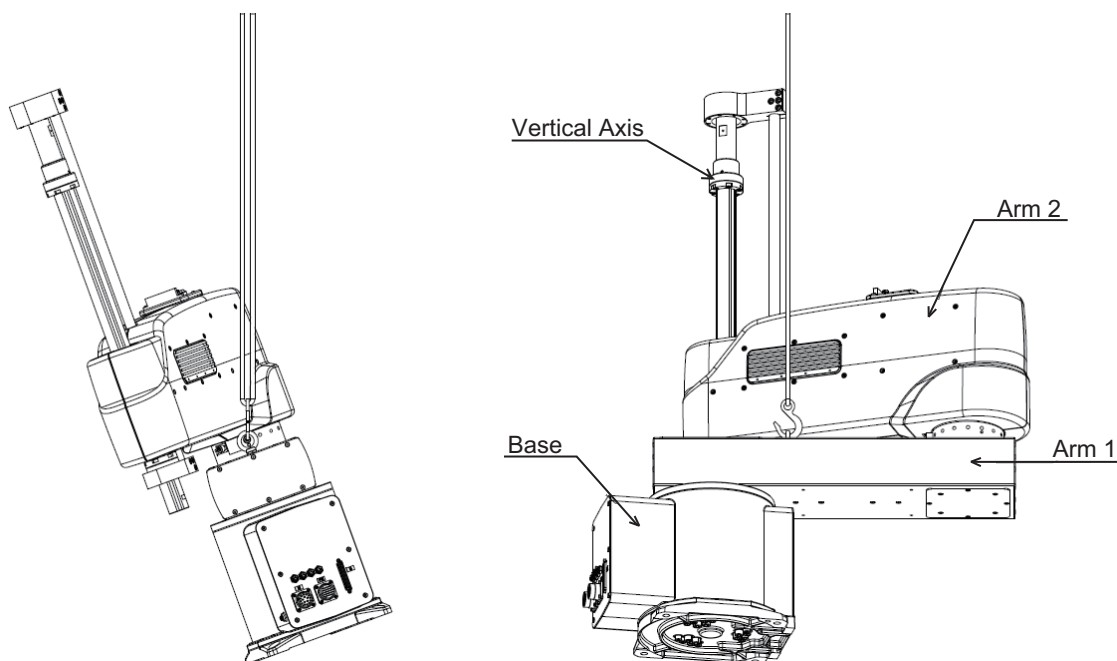


[1] Handling of the Carton

- Do not damage or drop. The package is not applied with any special treatment that enables it to resist an impact caused by a drop or crash.
- An operator should never attempt to carry on their own. Also, use an appropriate way for transportation.
- When placing the package, settle it horizontally following the posture instruction of the package.
- Do not step or sit on the package.
- Do not put any load that may cause a deformation or breakage of the package.

[2] Handling after Unpackaged

- Carry the robot using the eyebolts to hang on a hook.
When pulling up the robot, hold the 1st arm, 2nd arm or the base to keep the robot horizontal and pull it up slowly.
- When carrying a robot, it has to be done by a person who is certified for sling work and crane operation.
- Carry the robot with stoppers attached on J1 and J2 axes.
- Do not attempt to hold the Z-axes or 2nd arm for transportation.
- Do not apply too much force on each part of the robot.



! Notice: After the transportation work is finished, detach the eyebolts for hanging and keep them in a place you would not lose them.
After removing the eye bolts, cover up the tapped holes with the (enclosed) hex socket head screws sized M10×15.

2.1.2 Handling of the Robot Mounted on Mechanical Equipment (System)

The following are the cautions for when transporting robot installed in the machinery equipment (system) in the whole system.

- Transportation must be carried out with stoppers applied on J1 and J2-axes.
- When suspending the mechanical equipment (system) with ropes, avoid applying force to robot, connector, etc. Also, avoid the cables being pinched or caused an excessive deformation.

2.2 Installation and Storage • Preservation Environment

[1] Installation Environment

Do not use this product in the following environments.

Also make sure to keep enough work space necessary for maintenance.

- Location exposed to radiant heat from a huge heat source such as the heat treatment
- Location where the surrounding air temperature exceeds the range of 0 to 40°C
- Location where condensation occurs due to abrupt temperature changes
- Location where relative humidity smaller than 20% or larger than 85%RH
- Location exposed to direct sunlight
- Location exposed to corrosive gases or combustible gases
- Location exposed to significant amount of dust, salt or iron powder (Outside of an ordinary assembly plant)
- Location where water, oil (includes oil mist and cutting fluid) or a chemical is splashed
- Location where the product main body receives vibration or hit impact

When using the product in any of the locations specified below, provide a sufficient shield.

- Place subject to electrostatic noise
- Location where exposed to the influence of strong electric or magnetic field
- Location where exposed to the influence of ultraviolet or radiant rays

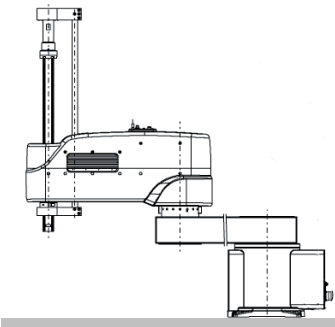
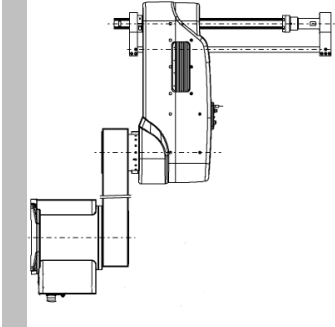
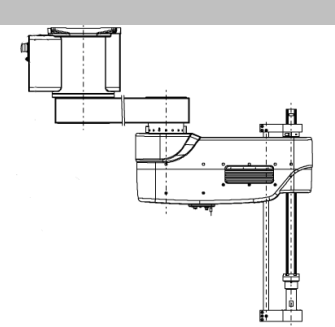
[2] Storage • Preservation Environment

- The storage and preservation environment should comply with the same standards as those for the installation environment. In particular, when the machine is to be stored for a long time, pay close attention to environmental conditions so that no dew condensation forms.
- Unless specially specified, moisture absorbency protection is not included in the package when the machine is delivered. In the case that the machine is to be stored and preserved in an environment where dew condensation is anticipated, take the condensation preventive measures from outside of the entire package, or directly after opening the package.
- For storage and preservation temperature, the machine withstands temperatures up to 60°C for a short time, but in the case of the storage and preservation period of 1 month or more, control the temperature to 50°C or less.
- Storage and preservation should be performed in the horizontal condition. In the case it is stored in the packaged condition, follow the orientation instruction if any displayed on the package.

2.3 How to Install

2.3.1 Installation Orientation

○ : Available × : Not available

Horizontally Oriented Mount	Wall-Mount	Ceiling-Mount
		
○	×	×

2.3.2 Installation

[1] Installation of the Main Unit

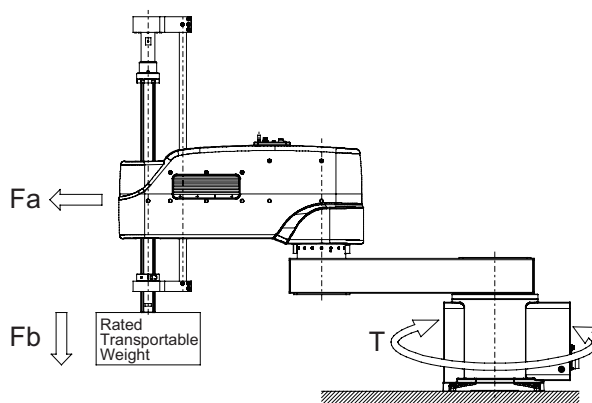
The platform on which to install the robot receives a significant reactive force. Be certain the platform has sufficient rigidity to withstand the anticipated force.

(1) Installation Platform

- The surface on which the robot is fixed must have a thickness of 25mm or more. The levelness of the robot installation surface must be at least 0.05mm or less.
- Make a tapped hole of M12 with the effective length 24mm or more on the mounting surface of the platform.
- There will be a reaction force as shown in the figure below applied to the robot during an operation.
For the platform to attach the robot, consider enough strength, stiffness and stableness to endure the reaction force generated during the operations listed in the table as well as to stand the weight of the robot.

Maximum Reaction Force during Robot Operation

Model Number	Fa (Max.)		Fb (Max.)		T (Max.)	
	N	kgf	N	kgf	N·m	kgf·m
IX-NNN10040	5167	527	668	68	898	92
IX-NNN12040	5668	578	698	71	898	92



(2) Installation of the Platform

- Affix the platform on the floor to make sure it would not be moved during the robot operation.
- Install the platform to have the robot installed on in horizontally.

(3) Installation of the Robot

- The robot body has to be securely fastened with using hex socket cap screws and steel ring plain washers (13 × 24 × 2.5) (4pcs each).

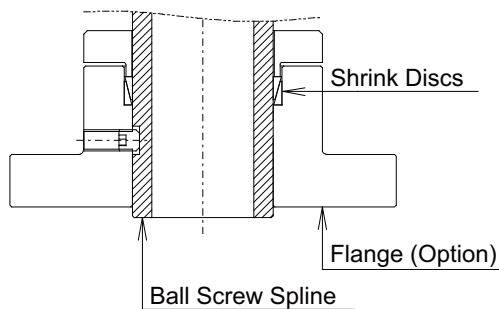
Attachment hole	Attachment screw	Tightening Torque
φ13.5 through φ25 counterbore (Dimension from the seat to the installation surface is 8mm)	M12	104N·m

- Apply high-tensile bolts with 10.9 or more of the tensile class for the attachment bolts.

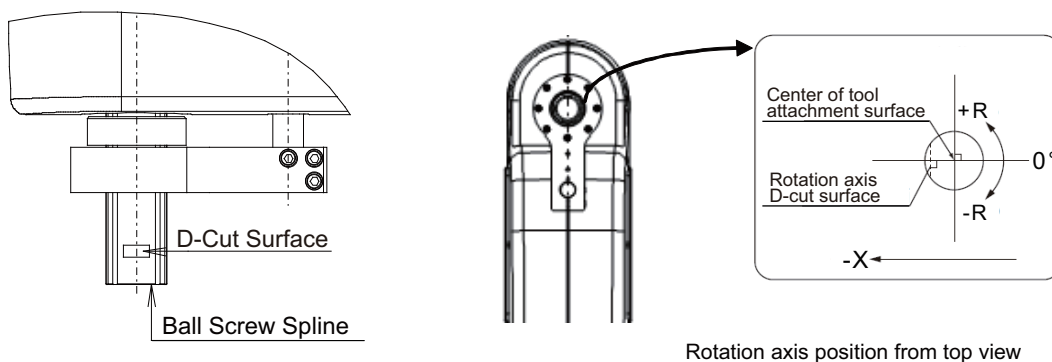
[2] Attachment of the load

- To attach the load, use a bracket with tightening force that possesses enough strength and stiffness, and would not slip.

Shown in the figure below is an example of attachment when the optional flange is used. Please take this as a reference.

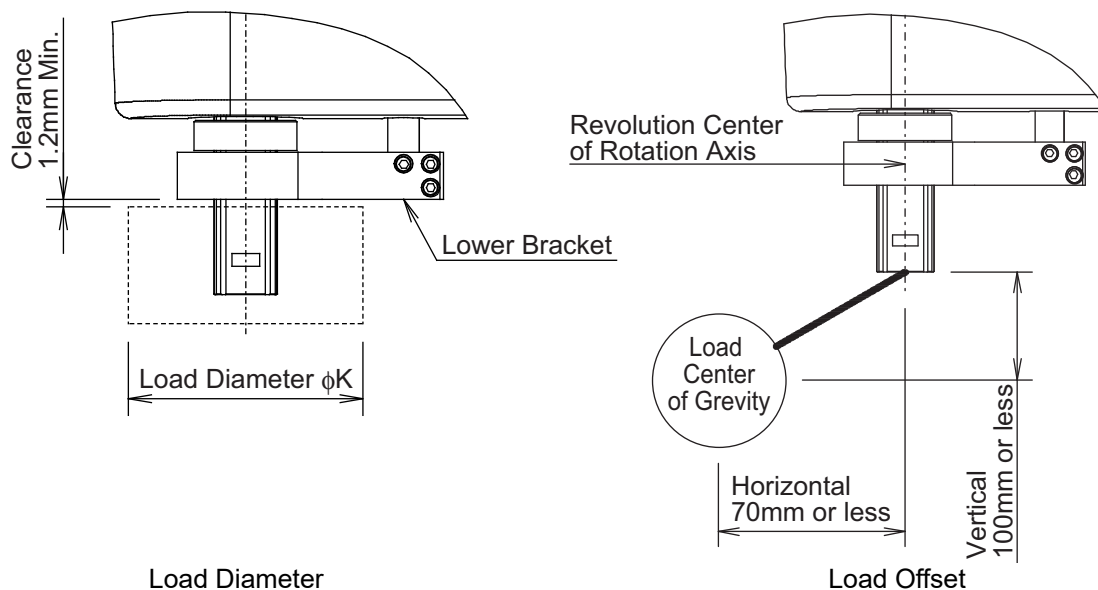


- Utilize the D-shaped flat face on the end of rotation axis for positioning (in rotational direction) of rotation axis.



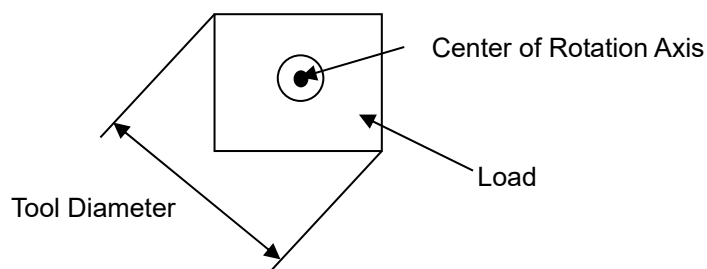
(Note) The D-cut surface is not for attachment purpose. Do not attempt to hold a bolt or set screw against this surface to fix a load. Use such tools as split cramp or locking assemblies to mount a load.

- For the attachment of the load, make sure to keep it below the allowable load diameter, load offset, transportable weight and allowable moment of inertia.



Model Number	Load Diameter K (Note 1) [mm]	Load Center of Gravity (positions of centers) and Offset		Transported Weight [kg]		Rotation Axis Allowable Moment of Inertia [kg·m ²]
		Horizontal l	Vertical	Rated	Max.	Rated and Maximum
IX-NNN10040	90	70mm or less [See the next page]	100mm or less	20	50	0.5
IX-NNN12040	240					

(Note 1) Load diameter is determined by the furthest point from the revolution center. For example, if the load is in a rectangular shape, the tool diameter is a diagonal line as shown in the figure below.

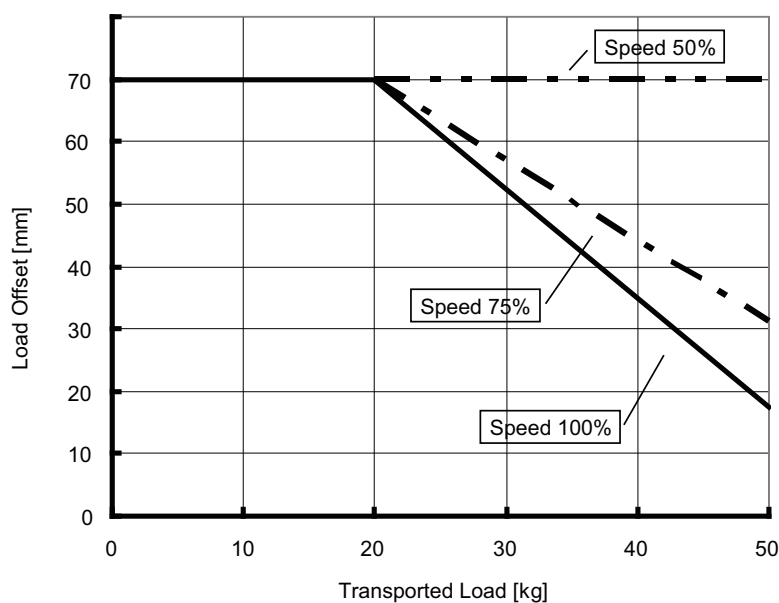


- (Note) • In case the load diameter exceeds the value specified in the table, the tool will interfere with the base part. Use it by changing the operation restriction and the values in the software limitation for J2-axis. [Refer to 1.2.2 [2]. Operation Restriction]
Also, make sure to use within the allowable range for the moment of inertia for the load.
- Have at least 1.2mm or more for the clearance between the load and Lower Bracket.
 - If the center of the load in horizontal direction exceeds the offset stated in the table, put some weight on the other side to balance and shift the center of the gravity to the range of allowance. Also the speed setting will be limited due to the overhang length and the mass of transportation. [Refer to the next page]
 - If the center of the load gravity in vertical direction exceeds the offset stated in the table, it may cause vibration to the vertical axis (ball spline) or damage the vertical axis. In case it is required to use the actuator above this limitation, it is necessary to change the value in All Axes Common Parameter No. 140 to that considering to add the amount of overhang from the end of the vertical axis. This parameter is disabled for a change on the customer's site. Please contact IAI if it is desired to make a change.
(e.g. In case of overhanging to vertical direction is 200mm, add $200 \times 1000 = 200000$ to the parameter in No. 140.)

[Load and Offset]

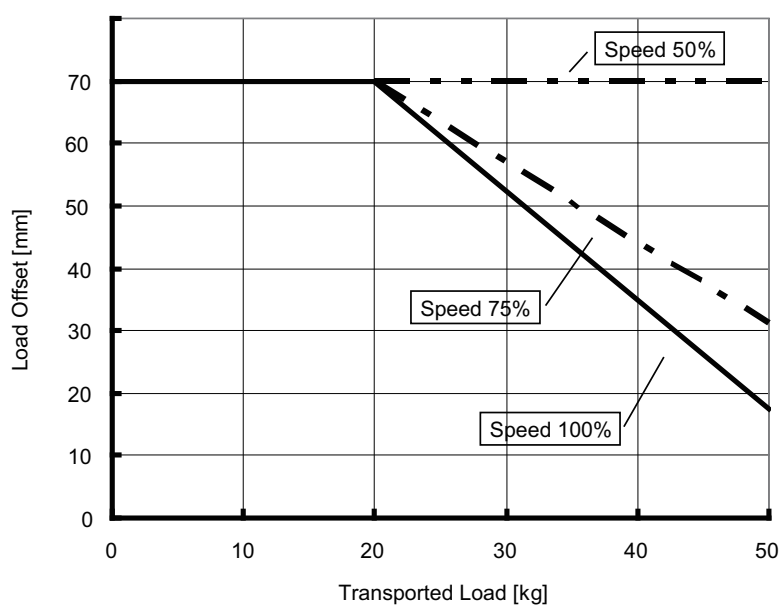
©PTP Operation

In the case that the actuator is moved with a transfer load of 10kg or less and a speed of 50% or less, set the load offset to 70mm or less as shown in the following graph. When the speed is at 50%, the load offset is 70mm no matter what the transported load weight is.



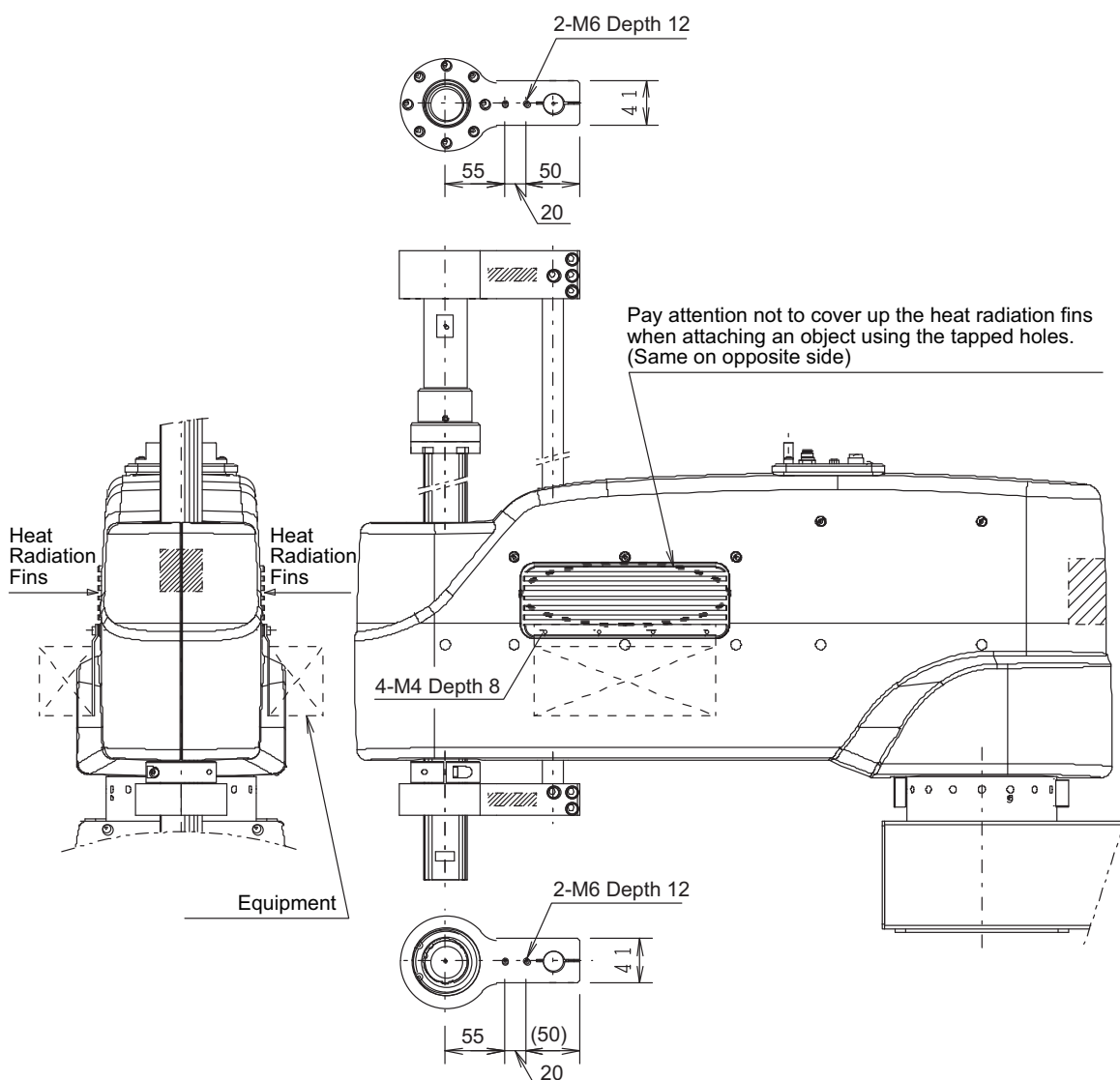
©CP Operation

In the case that the actuator is moved with a transfer load of 20kg or less and a speed of 50% or less, set the load offset to 70mm or less as shown in the following graph. When the speed is at 50%, the load offset is 70mm no matter what the transported load weight is.



[3] Attachment using tapped holes on 2nd arm

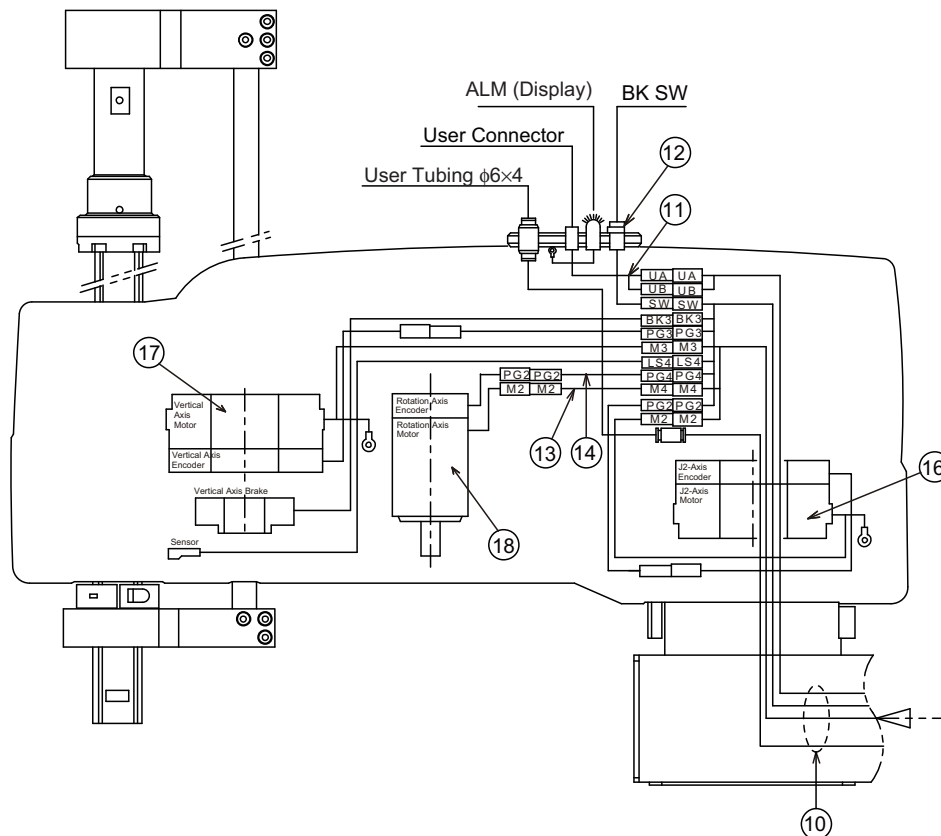
- It is available to attach an object using the tapped holes on the sides of the 2nd arm cover.
- (Note) Pay attention not to cover up the heat radiation fins.
- It is available to attach an object using the tapped holes on the top of vertical axis.
- (Note) Make sure to have an attachment not to disturb the operation of vertical and rotation axes.



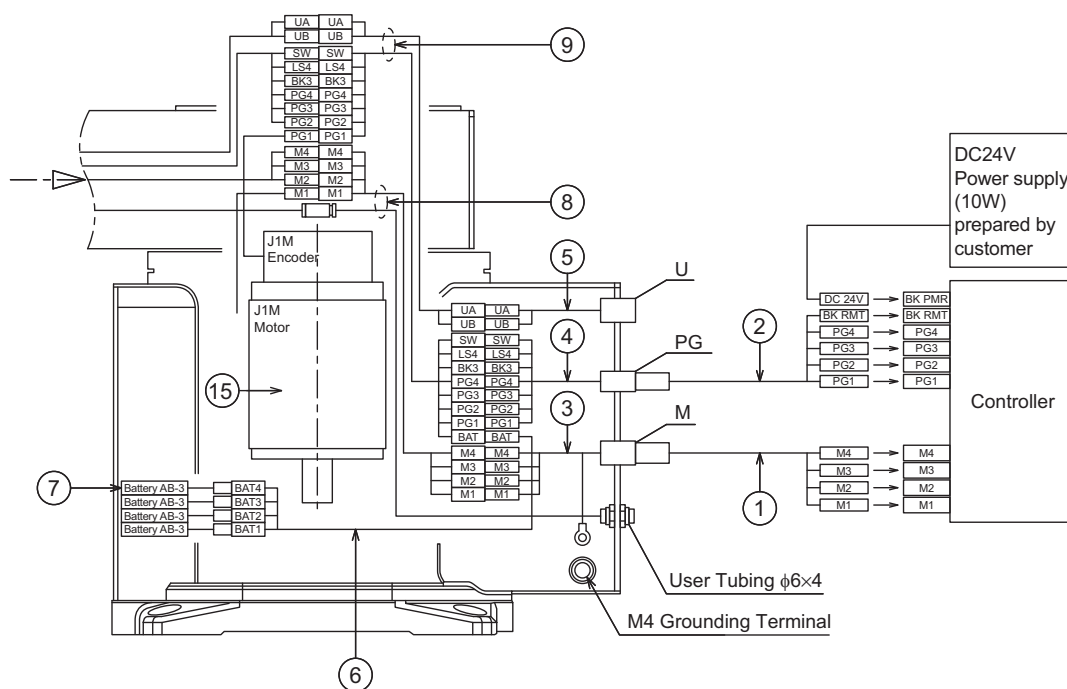
3. Wiring and Tubing

3.1 Wiring and Tubing in the Body

(1) 2nd Arm



(2) Base Part



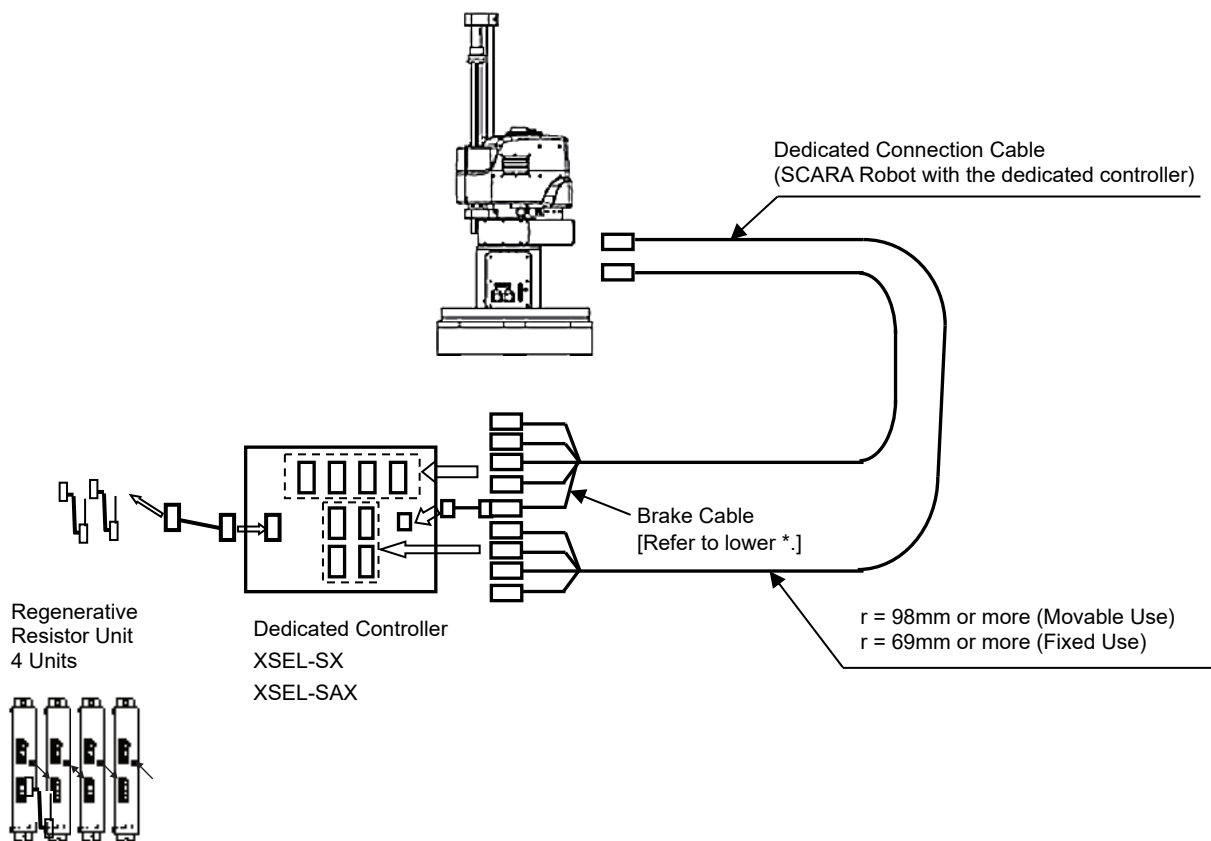
Number	Parts Name	Remarks
1	Motor Cable (between robot and controller)	230V circuit component Electric wire to be used : Rated 300V, 105C° Complied with UL VW-1, cUL FT1 Size 16AWG Oil and Heat Resistance Fireproof Robot Cable
2	Encoder Cable (between robot and controller)	
3	Motor (M) Connector Wiring (Base)	
4	Encoder (PG) Connector Wiring (Base)	
5	User (U) Connector Wiring (Base, D-sub)	
6	BAT Cable (Base)	
7	AB-3 Absolute Data Backup Battery	
8	J1_N160_Cable Assy_M ◆Motor (M) Cable (Base)	230V circuit component Electric wire to be used : Rated 300V, 105C° Complied with UL VW-1, cUL FT1 Size 16AWG, 18AWG Oil and Heat Resistance Fireproof Robot Cable
9	J1_N170_Cable Assy_PG ◆Encoder (PG) Cable (Base) ◆User (U) Cable (Base)	
10	Arm1_N020_internal wiring Assy_1 ◆Motor (M) Cable (Arm 1) ◆Encoder (PG) Cable (Arm 1) ◆User (U) Cable (Arm 1)	Motor (M) Cable (Arm 1) 230V circuit component Electric wire to be used : Rated 300V, 80C° Complied with UL 2464 Size 18AWG Oil and Heat Resistance Fireproof Robot Cable
11	Panel Wiring Assy (on top of Arm 2)	
12	Brake release switch	
13	Motor (M) Converter Cable	
14	Encoder (PG) Converter Cable	
15	J1-Axis Servo Motor	230V circuit component
16	J2-Axis Servo Motor	230V circuit component
17	Vertical Axis Servo Motor	230V circuit component
18	Rotation Axis Servo Motor	230V circuit component

[Refer to 1.4 Motor • Encoder Cables for the wiring layout of Motor Cable and Encoder Cable.]

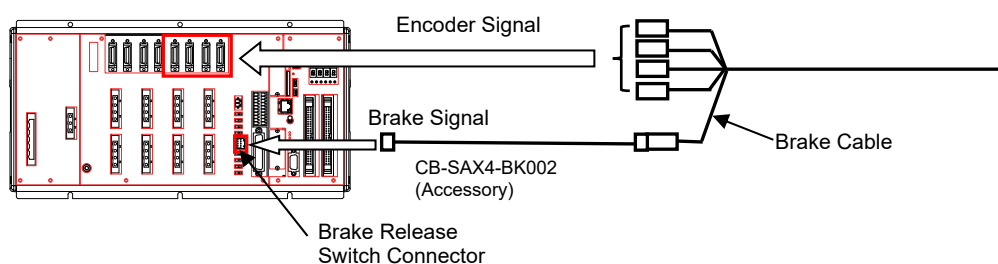
3.2 Connection to the Controller

[XSEL-SX/SAX Connecting to the Controller]

Horizontal Articulated Robot

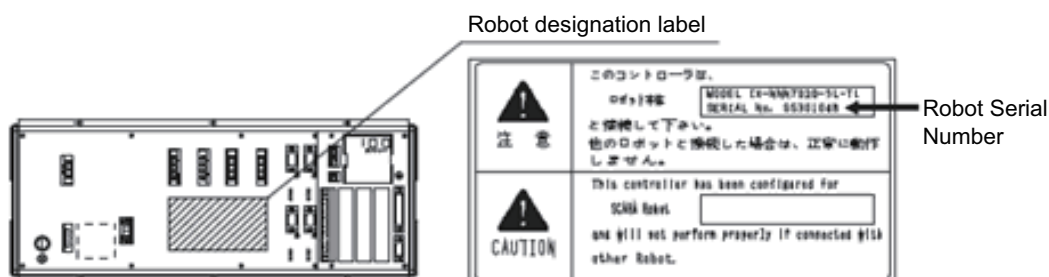


* Connecting to the Brake Cable



- Motor Cable CB-SX4-MA□□□
 - Encoder Cable CB-SX4-PA□□□
- indicates the cable length L
Example. 030 = 3m

- ⚠ Warning:
- Connect to the robot of the serial number specified on the robot designation label provided on the front panel of the controller. The controller will not operate properly if any other robot is connected. Failure to observe this warning may cause the robot to malfunction, resulting in a serious accident.

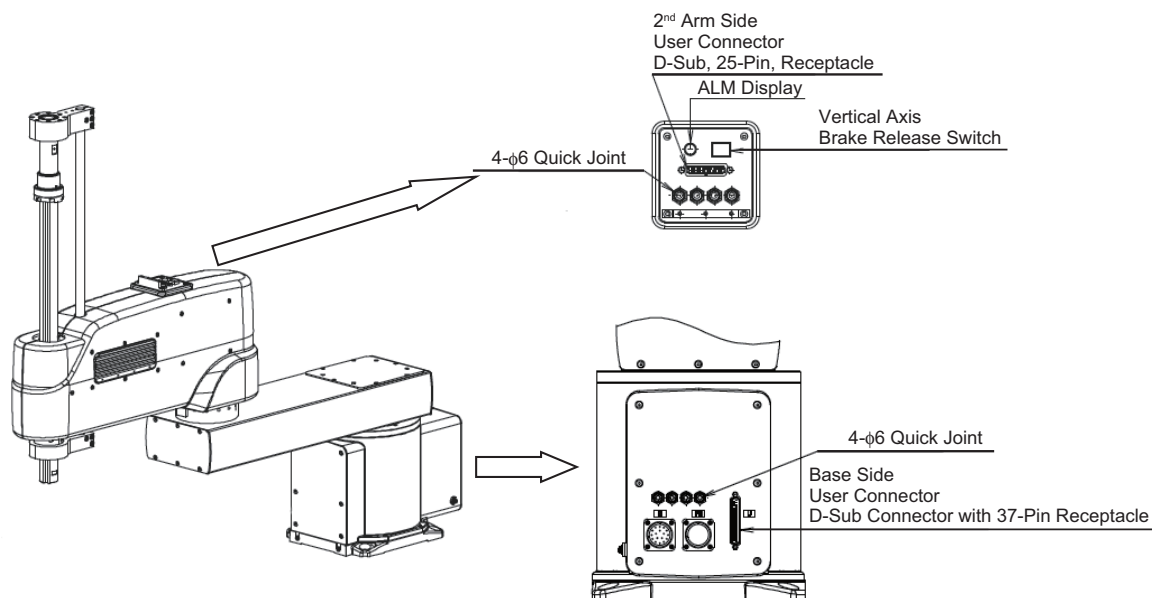


- Do not attempt to use a cable out of the dedicated cable for connection. Doing so may cause not only error operation or malfunction, but also may cause a critical accident such as fire or injury.
- When the cable is connected or disconnected, make to turn off the power to the controller.
Working with the power being kept on may cause the robot to have an error operation, which may lead to a critical accident resulting in injury or death.
- When the connector connection is not correct, it would be dangerous because of a malfunction of the robot. Rigidly fix the connectors with the screws equipped to them.
- Connect the cables securely after confirming that they are free from damage or bent connector pins.
- A mistake in the connector connections may cause an error operation. Check the connector name before plugging in.
Connect each cable by aligning the indication on the marking tube on the cable with the indication on the controller panel.
- When installing the PG connector (D-sub connector), ensure correct orientation of the connector.
- Since the brake power supply circuit is on the primary side (high voltage side) for the horizontal articulated robot, prepare a dedicated 24V DC power source for it. Do not attempt to use the power source for the secondary circuit such for I/O power supply in common.
The brake power to be supplied to the controller should be 24V DC $\pm 10\%$ with the current wattage of 10W.
It is necessary to increase the capacity of the brake power source when a brake-equipped actuator is connected to a controller. [Refer to the section of Power Source Capacity and Heat Generation in the instruction manual of the controller.]

Refer to the operation manuals for the controller and PC software for the procedures to connect the I/O cable, controller power cable, PC connection cable, etc.

3.3 User Wiring and Tubing

The unit is equipped with some wires and tubes free for you to use.
Make sure to use them within the specifications.

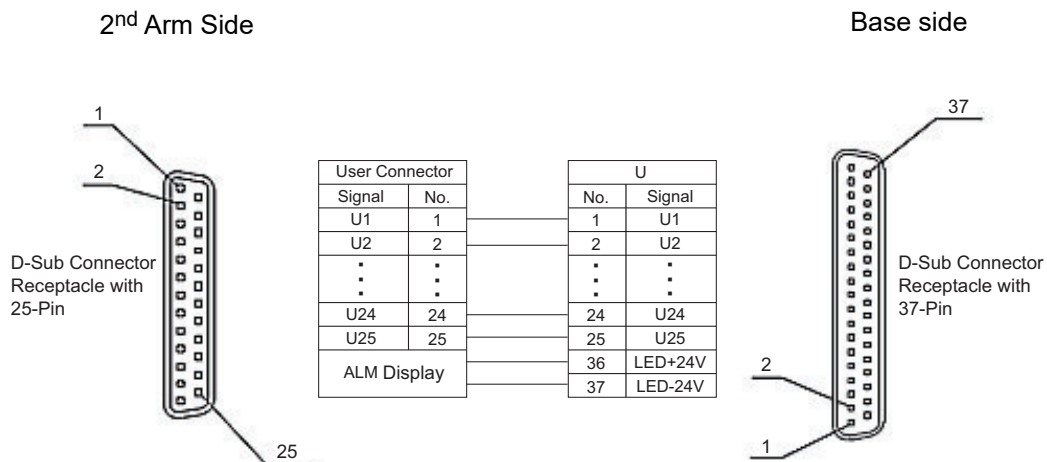


(1) User Wiring

D-sub 25-pin plug and D-sub 37-pin plug are enclosed in standard.
The plugs are solder type.

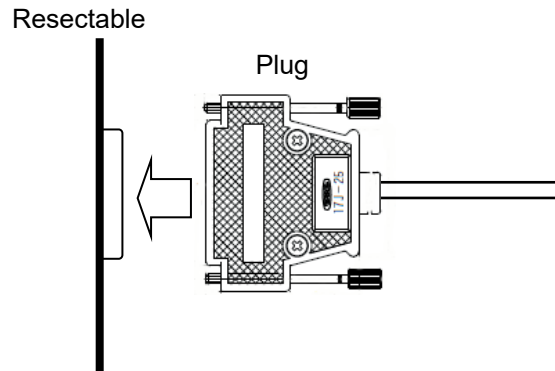
Specifications

Rated Voltage	30V
Permissible Current	1.1A
Conductor Size and Number of Wires	AWG26 (0.15mm ²) 25 wires



Wiring inside Unit between Receptacle on Base Side and Receptacle on 2nd Arm Side

Connect the Resectable and plug as shown in the figure below.



©ALM Display

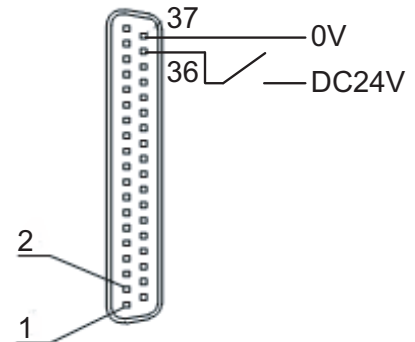
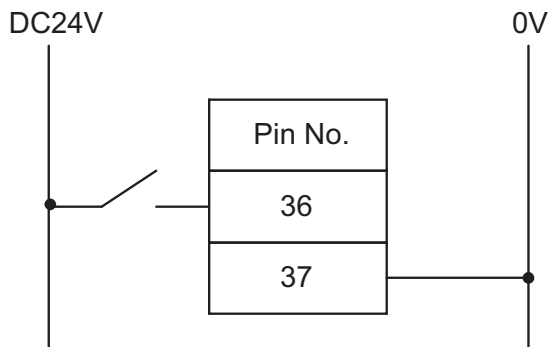
If 24V DC current is flown to pins 36 and 37 on the D-sub 37-pin connector on the base side, ALM display lamp turns on.

For instance, connect it to the controller or I/O and detect the robot alarm, and it enables to inform an occurrence of an alarm by ALM display lamp turned on.

Specifications

Rated Voltage	24V DC
Rated Current	12mA
Illumination Color	Red LED

Base side D-Sub Connector Receptacle with 37-Pin



(2) User Tubing

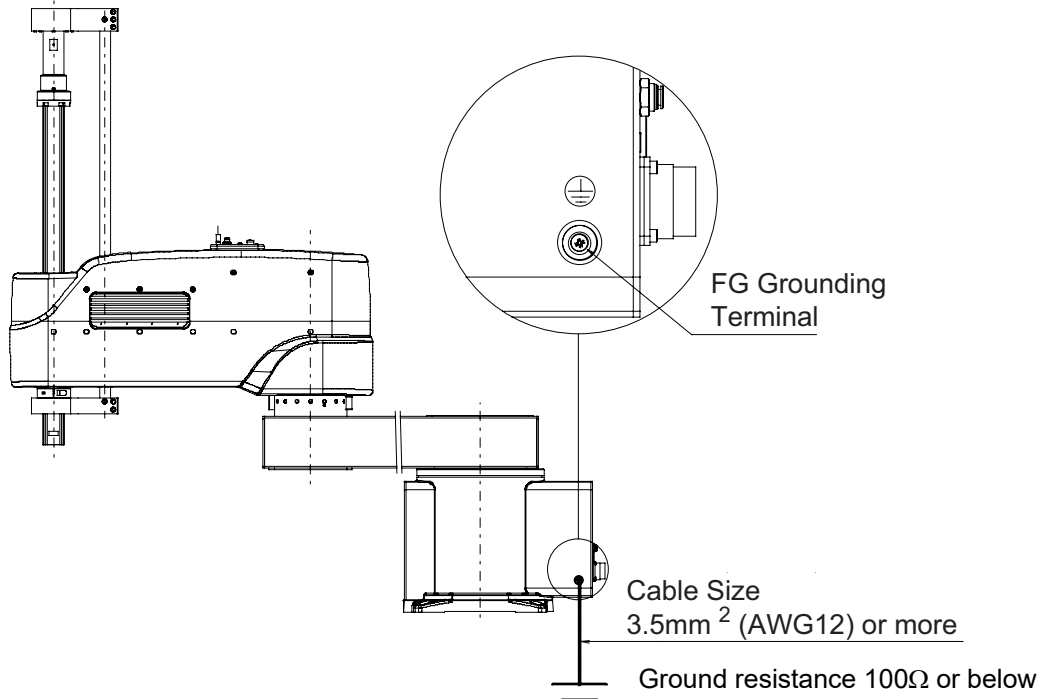
Connect an air tube that you have prepared to the quick joint.

Specifications

Normal Service Pressure	0.8MPa
Dimensions (outer diameter • inner diameter) and Number of Tubes	$\phi 6\text{mm} \times \phi 4\text{mm}$ 4 pieces
Working Medium	Air

3.4 Grounding

On the robot body, use a grounding terminal shown in the figure for grounding.



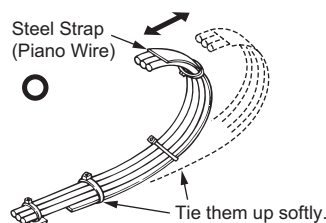
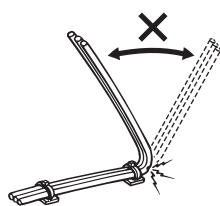
(Note) Have a grounding cable and grounding wiring layout dedicated for the unit. Do not share them with other devices.

3.5 Caution for Wiring and Tubing

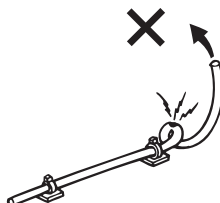


Warning: For wiring, please follow the warnings stated below. When constructing a system as the machinery equipment, pay attention to the wiring and connection of each cable so they are conducted properly. Not following them may cause not only a malfunction such as cable breakage or connection failure, or an operation error, but also electric shock or electric leakage, or may even cause a fire.

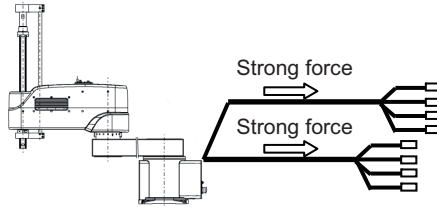
- Do not attempt to cut a dedicated cable with connectors on both ends to extend, shorten or re-joint it.
- Hold the dedicated cable to avoid mechanical force being applied to the terminals and connectors.
- Use a cable pipe or duct to have an appropriate protection when there is a possibility of mechanical damage on a dedicated cable.
- In case a dedicated cable is to be used at a moving part, make sure to lay out the cable without applying any force to pull the connector or extreme bend on the cable. Do not attempt to use the cable with a bending radius below the allowable value.
- Make certain that the connectors are plugged properly. Insufficient connection may cause an operation error, thus it is extremely risky.
- Do not lay out the cables to where the machine runs over them.
- Pay attention to the cable layout so it would not hit peripherals during an operation. In case it does, have an appropriate protection such as a cable carrier.
- When a cable is used hanging on the ceiling, prevent an environment that the cable swings with acceleration or wind velocity.
- Make sure there is not too much friction inside the cable storage equipment.
- Do not apply radiated heat to power line or cables.
- Have a sufficient radius for bending, and avoid a bend concentrating on one point.



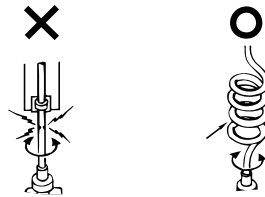
- Do not let the cable bend, kink or twist.



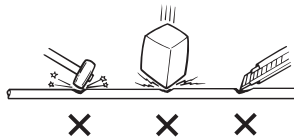
- Do not pull the cable with a strong force.



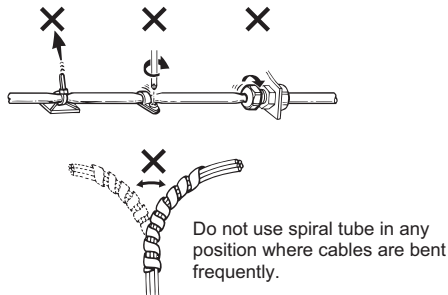
- Pay attention not to concentrate the twisting force to one point on a cable.



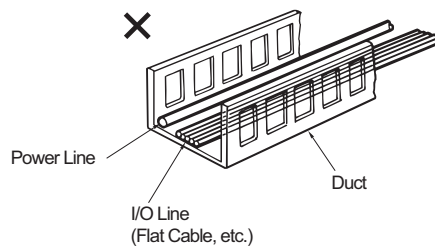
- Do not pinch, drop a heavy object onto or cut the cable.



- When a cable is fastened to affix, make sure to have an appropriate force and do not tighten too much.



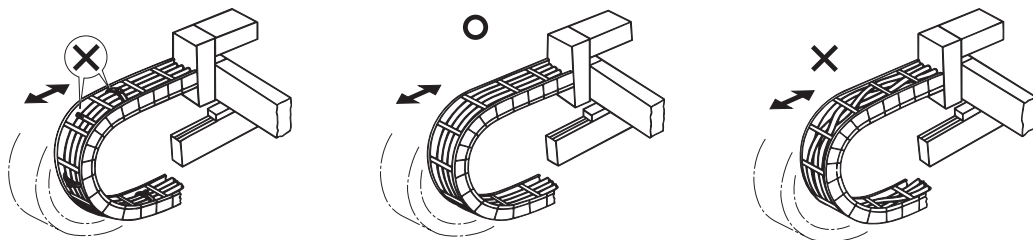
- PIO line, communication line, power and driving lines are to be put separately from each other and do not tie them together. Arrange so that such lines are independently routed in the duct.



Follow the instructions below when using a cable carrier.

- If there is an indication to the cable for the space factor in a cable carrier, refer to the wiring instruction given by the supplier when storing the cable in the cable carrier.
- Avoid the cables to get twined or twisted in the cable carrier, and also to have the cables move freely and do not tie them up. (Avoid tension being applied when the cables are bent.)

Do not pile up cables. It may cause faster abrasion of the sheaths or cable breakage.



4. Maintenance inspection

-  **Warning:** Do not attempt to disassemble or cut the cable of the following items. By doing so, recovery to normal condition cannot be done, and it may cause a critical accident such as error operation, fire or malfunction.
- Disassembly of the servo motor
 - Disassembly of the ball reduction gear
 - Disassembly of the ball screw and spline shaft
 - Disassembly of the bearing
 - Disassembly of the harmonic speed reducer
 - Disassembly of the brake
 - Cutting of the cable

4.1 Inspection Items and Periods

Have daily inspections and regular inspections to use the robot in a stable condition for a long term.

Make sure to follow the caution for maintenance and inspection in Safety Guide.

[1] Daily Maintenance Inspections

Have a maintenance and inspection for those described below before starting up in everyday operation, and if any problem is found, have an appropriate treatment.

Maintenance Inspection Area	Maintenance Inspection Details
Safety Cage	Correct the deformation or positional shift of the cage. Confirm that the interlock mechanism is operating properly.
Appearance of Robot	Check the exterior for abnormality, flaws, dents, etc. (If the robot has flaws or other abnormalities, please contact IAI.)
Operation of Robot	Check for abnormal operation, vibration or noise
Cables	Check for damage and pinch of cables Check the cable mounting parts for looseness.
Emergency-Stop Switch	Confirm that the emergency-stop switch functions properly.

[2] Half a Year Maintenance Inspection

Have a maintenance and inspection for the following items once in half a year (every 6 months).
If the robot main body has flaws or other abnormalities, please contact IAI.

Maintenance Inspection Area	Maintenance Inspection Details
Robot Main Body	Check for any looseness of the attachment bolts on the robot body and play on cover related components. (Tighten if any loosened bolt is found.)
Ball Screw, Ball Spline	Supply grease to ball screw and ball splined. (Applied Grease: AFG+70 Grease by THK) [Refer to 4.2, "Grease Supply on the Vertical Axis".]
Connectors	Check the connectors for looseness.

[3] Yearly Maintenance Inspection

Have a maintenance and inspection for the following items every year.

Maintenance Inspection Area	Maintenance Inspection Details
Robot Main Body Arm Attachment Bolts	Check for any looseness of the bolts on the arm. (If any play is found on the arm attachment, tighten up the bolts.) [Refer to 4.3, "Check for Looseness of Arm Attachment Bolts".]

[4] 2.5 Years Maintenance Inspection

Have a maintenance and inspection for the following items once every 2.5 years.

If the robot main body has flaws or other abnormalities, please contact IAI.

Maintenance Inspection Area	Maintenance Inspection Details
Battery Replacement	Replace the absolute data backup battery. The battery life may vary depending on the condition and environment of the robot use, but it is approximately three years. It is recommended to have the battery replaced every 2.5 years. (Battery model code: AB-3, Quantity to use: 4 units) [Refer to 4.4, "Replacement of Absolute Backup Battery".]
J1 axis and J2 axis speed reducer	Grease supply on J1 axis speed reducer ^(Note 1) (Applied Grease: VIGOGREASE RE0 by Nabtesco) [Refer to 4.5, "Grease Supply on the J1 Axis".] Grease supply on J2 axis speed reducer ^(Note 1) (Applied Grease: Harmonic Grease 4B No. 2 by Harmonic Drive Systems inc.) [Refer to 4.6, "Grease Supply on the J2 Axis".] (Please contact IAI if any abnormality is found.) (Note) It is unnecessary to have maintenance on rotary axis speed reducer.

Note 1: In case the duty of the robot operation is high, or ambient temperature is high, supply the grease frequently (every year).

[5] 5 Years Maintenance Inspection

Have a maintenance and inspection for the following items once every 5 years.

After 5 years has passed, have a maintenance and inspection for the following items every year.

If the robot main body has flaws or other abnormalities, please contact IAI.

Maintenance Inspection Area	Maintenance Inspection Details
J1 axis and J2 axis speed reducer Bearings on joints	Lost motion measurement If the lost motion value exceeds the allowable range, it is considered the end of life for speed reducer or bearing. It is necessary to have the unit disassembled for such work as replacement of the speed reducer. (Please contact IAI if any abnormality is found.) (Note) The life of the speed reducer may vary depending on the duration of operation, speed or load, but it is approximately five to seven years. [Refer to 4.7, "How to Measure Lost Motion".]
Rotary axis belt	Visual inspection on the timing belt on the rotary axis to check if there is any damage or remarkable abrasion on the teeth side surface It is necessary to have the timing belt replaced if any abnormality is found. (Please contact IAI if any abnormality is found.) [Refer to 4.8, "How to Inspect Visually on Timing Belt for Rotary Axis".]

4.2 Grease Supply on the Vertical Axis

The ball screw and ball spline on the vertical axis require grease to be supplied.

4.2.1 Applicable Grease and Supply Period

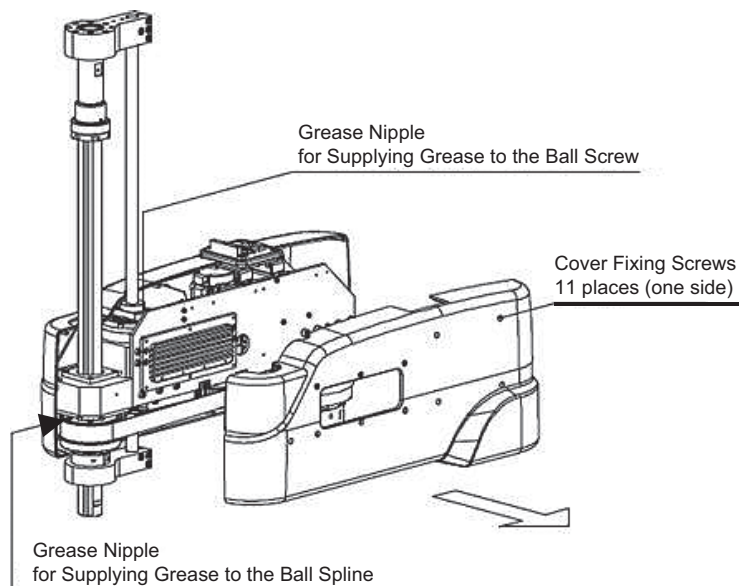
Grease to Apply		Supply Period
THK	AFG+70	Every half a year

Warning: Do not attempt to apply fluorine grease. When mixed with lithium grease, not only decrease the grease characteristics, but also may damage the driving part.

4.2.2 Grease Supply

To supply grease, take off one of the 2nd arm covers on either the right or left side, and supply 6 to 10cc at two places via the grease nipples by using a grease gun. Also, do not forget to wipe away excess grease. To take off the arm, refer to the figure. After supplying grease is finished, move the vertical axis so the supplied grease spreads out evenly over the steel balls inside the nut. To make the vertical axis operate, either release the brake in order to have a manual operation or perform a JOG operation.

Recommended Grease Gun	MG70 (by THK)
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Caution: In case the grease got into your eye, immediately go see the doctor to get appropriate care. After finishing the grease supply work, wash your hands carefully with water and soap to rinse the grease off.

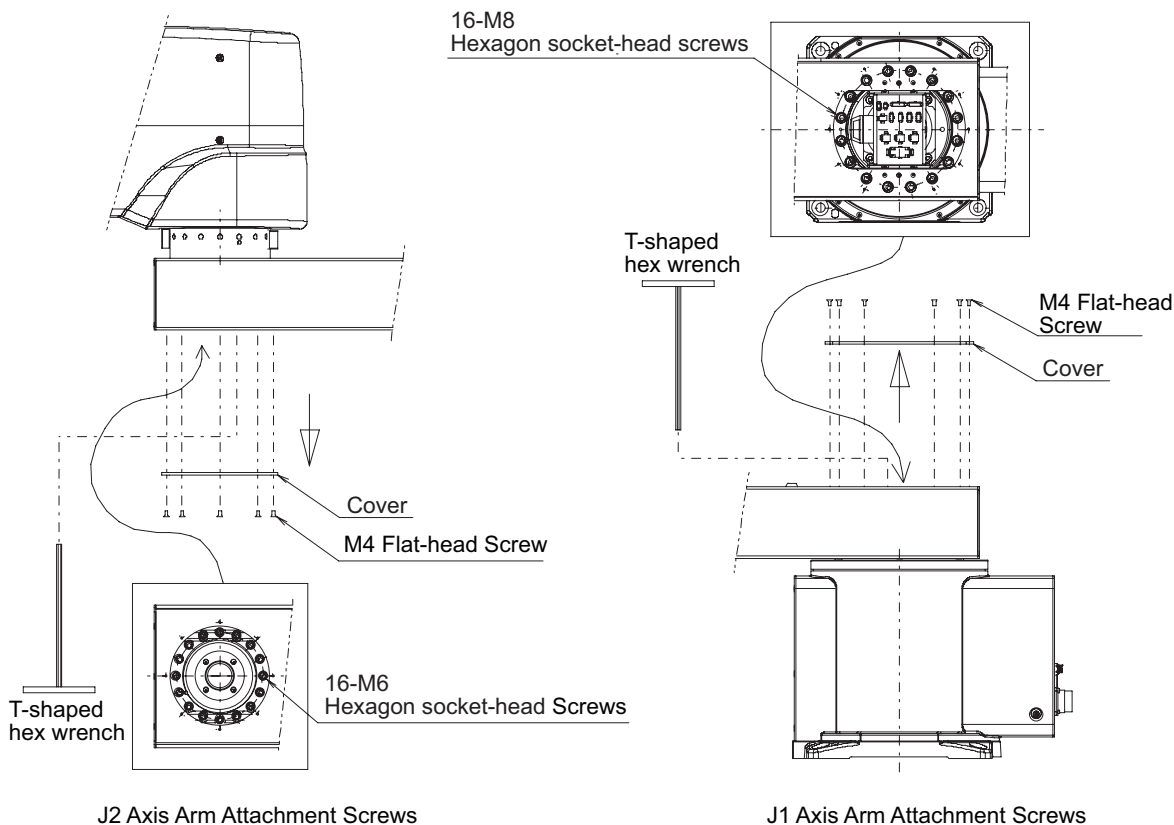
4.3 Check for Looseness of Arm Attachment Screws

Tools necessary to check arm attachment screws

T-shaped hex wrench (5mm and 6mm sized, 200mm or more in total length), Hex wrench set

Procedure

- 1) Remove the cover. Attachment screws for each arm will appear.
- 2) Check for looseness of attachment screws on each arm with using a T-shaped hex wrench.
(Tighten if any loosened screw is found.)



Arm Attachment Screw Tightening Torque

Arm Length	Tightening Torque [N•m]		Remarks
	J1 axis	J2 axis	
1000/1200	30.0	12.3	J1 axis: Hexagon socket-head screws M8 Strength Class 10.9 J2 axis: Hexagon socket-head screws M6 Strength Class 10.9

(Note) Tightening torque for M4 flat-head screw is 1.72N•m.

4.4 Replacement of Absolute Backup Battery

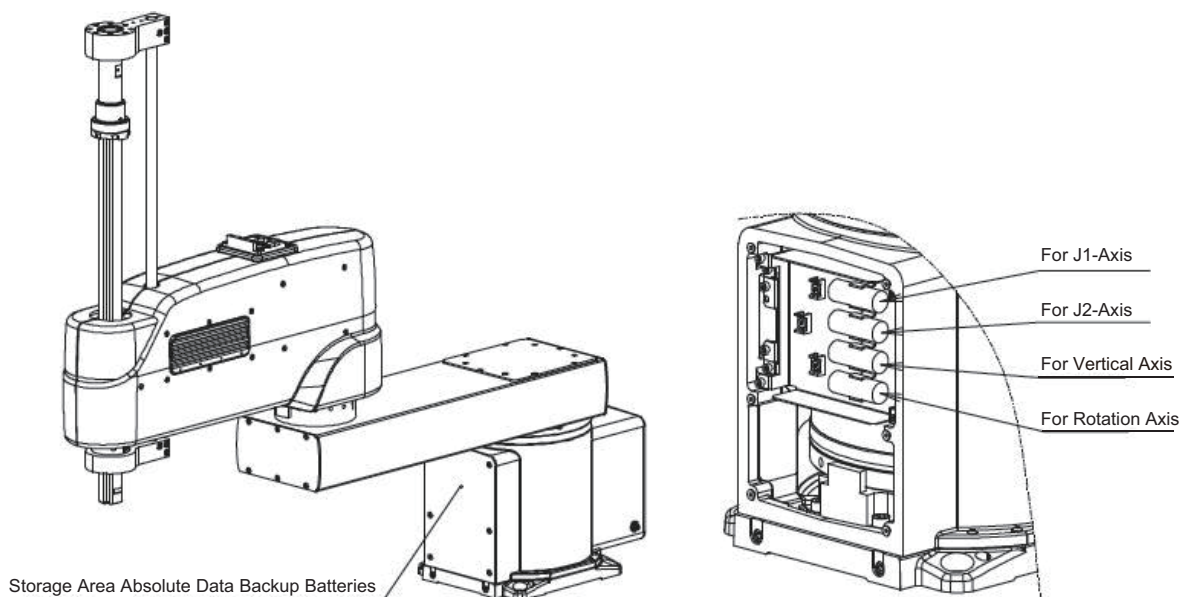
Alarms described in the list could be generated in relation to the absolute data backup battery voltage. In case of occurrence, have the battery replaced immediately.

Alarm	Code	Status
Absolute Backup Battery Voltage Drop Alarm	A03, A23	It is an alarm to tell the battery voltage drop. Time till the battery voltage error (914, CA2) is approximately 10 hours as a reference if the power to the controller is supplied in the normal condition.
Absolute Data Backup Battery Voltage Error	914, CA2	It is the end of the backup battery life. Replace to a new one immediately. The absolute data would not be lost as long as the controller control power is turned on and the encoder cable does not get disconnected. ^(Note 1)

Note 1 If turning OFF the control power of the robot controller while “Absolute Data Backup Battery Voltage Error” is generated, the absolute data will be lost and the stopper interfering absolute reset will be necessary.
 In case the absolute reset is lost, “Absolute Data Backup Battery Voltage Error” will continue to be on even after replacing the batteries. Have a stopper interfering absolute reset conducted.
 [Refer to 4.9, “Absolute Reset”.]

Replacement procedure

- 1) Until finishing the battery replacement, keep the controller turned on and do not disconnect the encoder cable. (It is to protect from losing the absolute data even in a case of the battery voltage error while the controller is booted (while the control power is ON).)
- 2) When replacing the batteries, make sure to set the condition to the emergency stop (driving power is OFF) while the controller is booted (control power is ON), remove the cover on the robot base part while paying attention to the safety of the surroundings, and have the replacement work for the absolute data backup batteries. The absolute data backup batteries are located in the place as shown in the figure below.
- 3) After the battery replacement work, have the software reset or turn OFF the power to the robot controller once and reboot it to start up the robot controller again.



Absolute Data Backup Batteries

Model No.	Product Life
AB-3	3 years

4.5 Grease Supply on the J1 Axis

The ball screw and ball spline on the J1 axis require grease to be supplied.

4.5.1 Applicable Grease and Supply Period

Grease to Apply		Supply Period
Nabtesco	VIGOGREASE RE0	Every 2.5 years

⚠ Warning: Do not use any grease, such as fluoric grease, but lithium based one. When mixed with lithium grease, not only decrease the grease characteristics, but also may damage the driving part.

4.5.2 Grease Supply

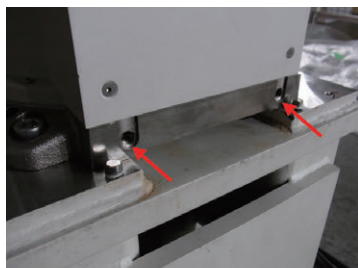
Tool necessary for work

Grease, grease gun, Tray, Sealing tape, Hexagon Wrench Set, Wrench (10mm), Cloth, Air gun and air source

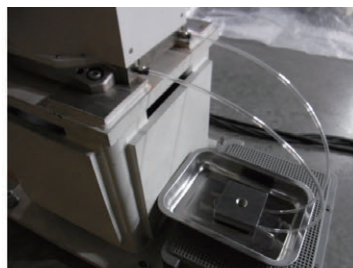
Grease Nipple A type JIS(R1/8), $\phi 8$ Air Pipe Joint (R1/8), $\phi 8$ Air Tube 2 pieces each

Procedure

- 1) Detach the bolts at two places on the bottom grease inlets as shown in the figure below, and plug in air pipe joints (R1/8) and air tubes.



Bottom Grease Inlets

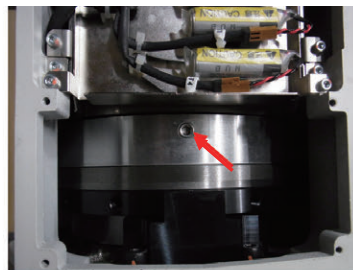


After piping on bottom grease inlets

- 2) Move Arm 1 to the position shown in the figure below and remove the front cover. The upper grease inlet will appear as shown in the figure below. (There is another inlet on the opposite side.)
The upper grease inlets are covered with a screw. Remove the screw (1 place).

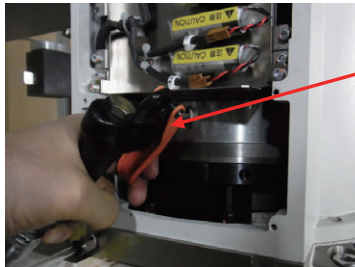


Arm Position

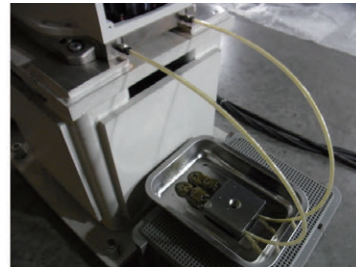


Upper Grease Inlet

- 3) Pressurize inside the speed reducer with air from the upper grease inlet as shown in the figure below. Dirty grease will be discharged from the bottom grease inlets.
(Once it is confirmed there is not much grease coming out any more, turn around J1 Axis and pressurize the speed reducer again.)



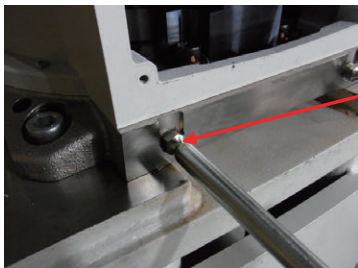
Air Gun



Discharge of Dirty Grease

Pressurizing Inside Speed Reducer

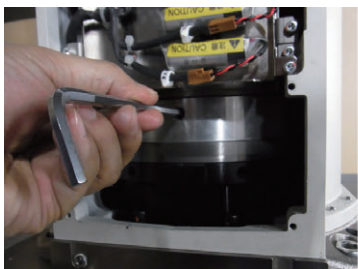
- 4) Detach the joints and tubes on the bottom grease inlets, and attach grease nipples.



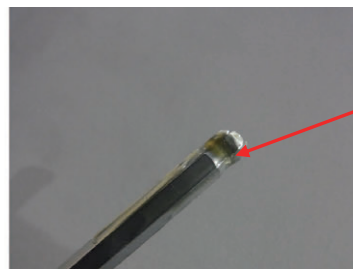
Grease Nipples

Grease Supply on J1 Axis

- 5) Supply 200 to 300cc (174 to 261g) of VIGOGREASE-RE0 grease manufactured by Nabtesco evenly from the grease nipples on the right and left.
Avoid supplying the grease at once, and attempt to supply in 3 to 4 times to check the volume of supply each time. Turn J1 Axis several times while in the supply.
To check the volume of grease supply, stick a hex wrench into the upper grease inlet till the wrench hits an internal component, and check the new grease is applied on the end of the wrench as shown in the figure below.



Check of Grease Supply Volume



Grease being applied

Check for New Grease

Recommended Grease Gun	G401 (by AZ) 400g Bellows / Manual supply in common CH-400 (by YAMADA CORPORATION) 400g Bellows / Dedicated
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- 6) Take off the grease nipples and cover up with the bolts. Also, cover up the upper grease inlet. At this time, make sure to have sealing tape applied on.

⚠ Caution: In case the grease got into your eye, immediately go see the doctor to get appropriate care. After finishing the grease supply work, wash your hands carefully with water and soap to rinse the grease off.

4.6 Grease Supply on the J2 Axis

The ball screw and ball spline on the J2 axis require grease to be supplied.

4.6.1 Applicable Grease and Supply Period

Grease to Apply		Supply Period
Harmonic Drive Systems inc.	Harmonic Grease 4B No. 2	Every 2.5 years

 **Warning:** Do not use any grease, such as fluoric grease, but urea based one. When mixed with urea grease, not only decrease the grease characteristics, but also may damage the driving part.

4.6.2 Grease Supply

Tool necessary for work

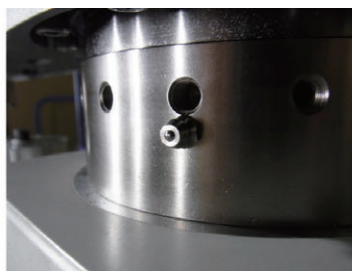
Grease, Grease Nipple A type (M6x1.0) 2 pieces, grease gun, Sealing tape, Hexagon Wrench Set, Wrench (7mm), Cloth

Procedure

- 1) As shown in the figures below, remove the screws at 2 places (also on the opposite side) and attach grease nipples.



J2 Axis Grease Inlet



Attachment of Grease Nipple

- 2) Supply 15 to 20cc (13 to 17g) of Harmonic Grease 4B No. 2 grease manufactured by Harmonic evenly from the two grease nipples.
Avoid supplying the grease all at once, and attempt to supply in 3 to 4 times to check the volume of supply each time. Turn J2 Axis several times while in the supply.
(Note) Do not attempt to pressurize inside the speed reducer with air. Grease may splash out.
- 3) Take off the grease nipples and cover up with the bolts. At this time, make sure to have sealing tape applied on.

Recommended Grease Gun	G301 80g Bellows / Manual supply in common (by AZ)
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 **Caution:** In case the grease got into your eye, immediately go see the doctor to get appropriate care. After finishing the grease supply work, wash your hands carefully with water and soap to rinse the grease off.

4.7 How to Measure Lost Motion

Tools necessary for lost motion measurement

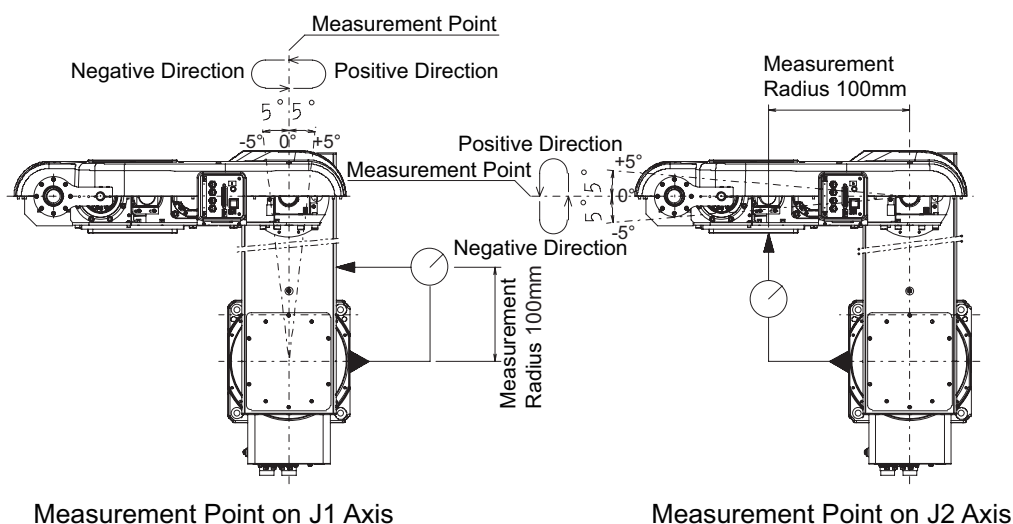
Digimatic Indicator (Measurement range 10mm or more, minimum display 0.001mm) or equivalent acceptable

Magnet stand

How to measure

- 1) Create a position and a program to operate 1st Axis and 2nd Axis in $\pm 5\text{deg}$ with PTP Operation.
- 2) Take off the cover (on Arm 2) on one side and allocate the measurement equipment as shown in the figure below.

- Measurement Point: See figure below
- Operation Command: PTP Operation (MOV P Command)
- Operation Speed: 30%
- Acceleration/Deceleration : 30%



- a. Move the axis from $+5\text{deg}$ towards 0deg , the measurement point, in the positive direction, and measure the position.
- b. After moving from 0deg towards -5deg in the positive direction, move it from -5deg towards 0deg , the measurement point, in the negative direction, and measure the position.
- c. In addition, after moving from 0deg towards $+5\text{deg}$ in the negative direction, move it from $+5\text{deg}$ towards 0deg , the measurement point, in the positive direction, and measure the position.

Repeat the measurements of b and c for seven times in each positive and negative direction. The difference of the average of the measurement results is determined as the lost motion.

Example for Lost Motion Measurement

Number of Times	Positive Direction	Negative Direction
1	+0.003	-0.003
2	-0.003	+0.003
3	+0.003	+0.005
4	-0.003	-0.005
5	+0.003	-0.005
6	+0.003	-0.004
7	+0.003	-0.006
Average	+0.0013	-0.0021
Difference (mm)	$ +0.0013 - (-0.0021) = 0.0034$	
Measurement Radius (mm)	100	
Lost Motion (arc min)	$[\tan(0.0034/100)] \times 60$ nearly equals 0.12	

How to decide

It is normal as long as the figured out values are below the allowable values shown in the table below.

Lost Motion Allowance

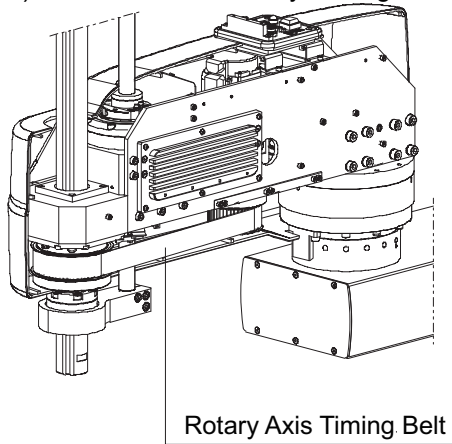
Lost Motion (arc min.)		Measurement Radius (mm)
J1 axis	J2 axis	
1.0	1.0	100

4.8 How to Inspect Visually on Timing Belt for Rotary Axis

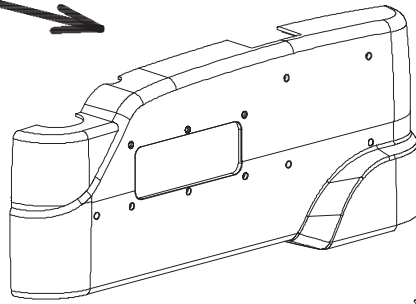
Tools necessary for visual inspection
Hex Wrench Set

How to measure

- 1) Remove the cover on one side of Arm 2 as shown in the figure below.
The timing belt for the rotary axis will appear once the cover is taken off.
- 2) Check if there is any damage or remarkable abrasion on the teeth side surface.



Rotary Axis Timing Belt



Rotary Axis Timing Belt

4.9 Absolute Reset

In case the absolute data is lost, conduct “Stopper push type absolute reset”. [4.9.1 How to Operate the Push Type Absolute Reset]

In the following case, conduct “Stopper pressing position acquirement” before having the absolute reset.

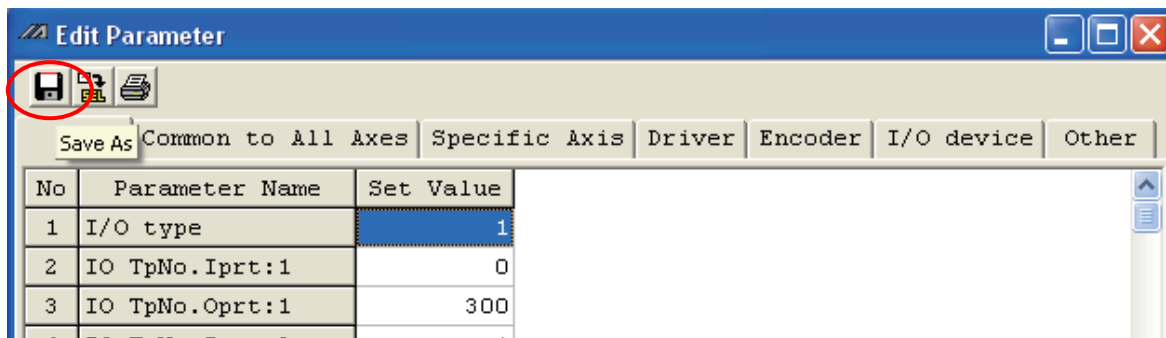
Do not execute it after it comes to a circumstance that requires the absolute reset. Have it done while the normal operation can be performed.

[4.9.2 How to Acquire the Stopper Interfering Point]

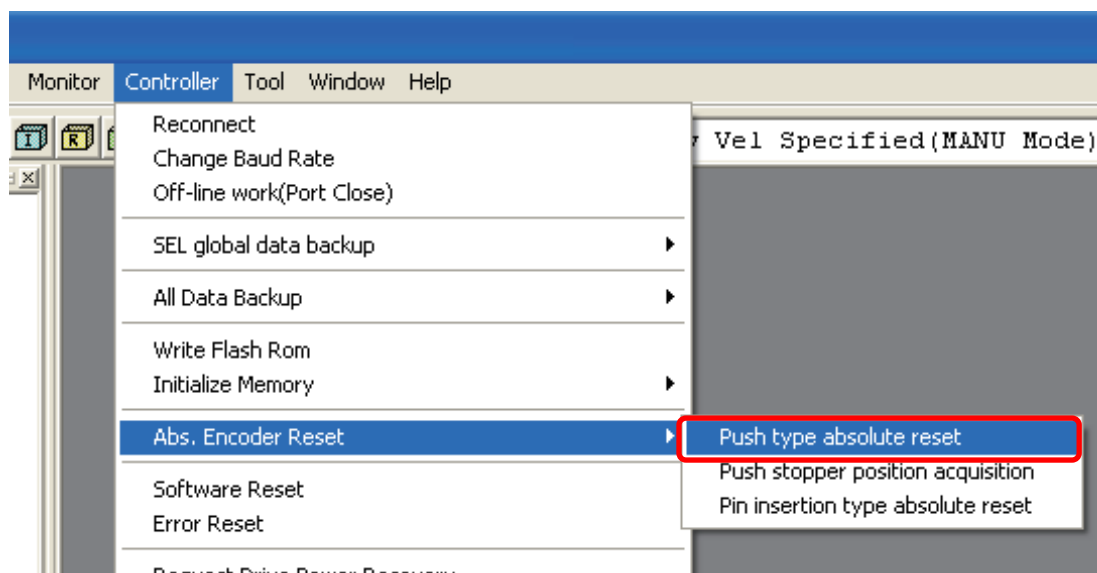
- When the absolute reset cannot be performed in the direction of the stopper interfering movement with the initial posture at the delivery from the factory due to such reasons as interference to the peripheral equipment.
- There was a change in the stopper position due to such reasons as a removal of the stopper of the vertical axis.

4.9.1 How to Operate the Push Type Absolute Reset

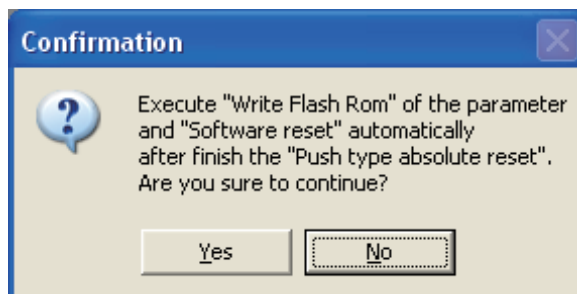
- 1) Backup the parameters so that they can be put back anytime to those before changing them. Select "Parameter (P)" → "Edit (E)" from PC Software Menu to show the Edit Parameter window. Press the "Save As" button in the Edit Parameter window to store the parameters in the file.



- 2) Select "Controller" → "Abs. Encoder Reset" → "Push type absolute reset" from the menu.



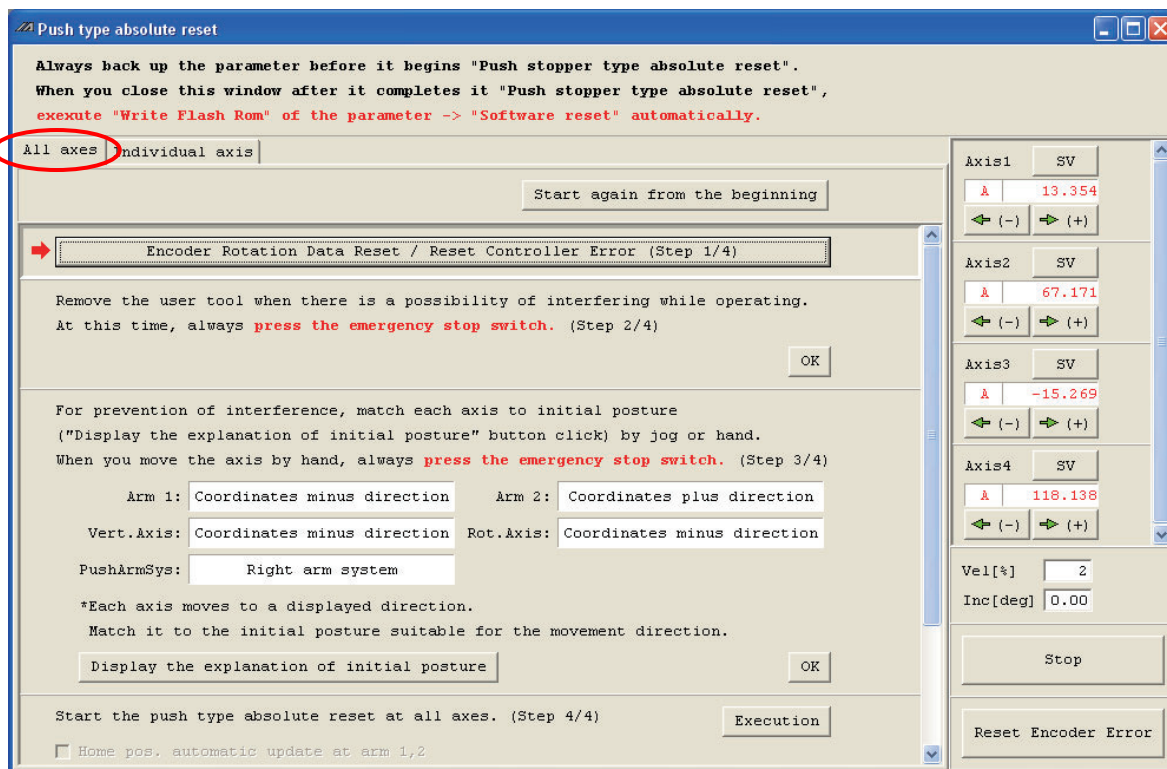
- 3) A Confirmation window shows up. Click "Yes".



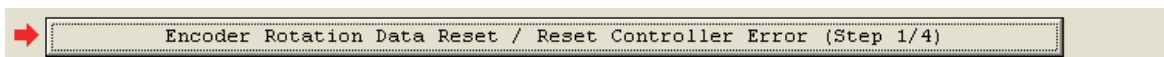
If conducting on all the axes at once, follow the process of [1].
When not all the axes, but having one or some of the 4 axes to be conducted, follow the process of [2].

- [1] When Performing Stopper Pressing Type Absolute Reset to All Axes at Once
To have the push stopper type absolute reset for all the axes at once, follow the steps shown below.

1) Select "All axes".



2) Click "Encoder Rotation Data Reset / Reset Controller Error (Step 1/4)".



- 3) In case there is a concern that a load may interfere with surroundings at the absolute reset, detach the load. Have the work during the emergency stop condition. After the work is finished, click on the "OK" button.

➔ Remove the user tool when there is a possibility of interfering while operating.
At this time, always **press the emergency stop switch.** (Step 2/4)



- 4) By referring to the displayed movement direction for each axis, adjust the axes to the initial posture. The posture differs depending on the movement direction. Click on "Display the explanation of initial posture" to check the explanations. Make to work on with the emergency stop when moving the axes by hand. Click on the "OK" button after the work is finished.

➔ For prevention of interference, match each axis to initial posture ("Display the explanation of initial posture" button click) by jog or hand.
When you move the axis by hand, always **press the emergency stop switch.** (Step 3/4)

Arm 1:	Coordinates minus direction	Arm 2:	Coordinates plus direction
Vert.Axis:	Coordinates minus direction	Rot.Axis:	Coordinates minus direction
PushArmSys:	Right arm system		

*Each axis moves to a displayed direction.

Match it to the initial posture suitable for the movement direction.

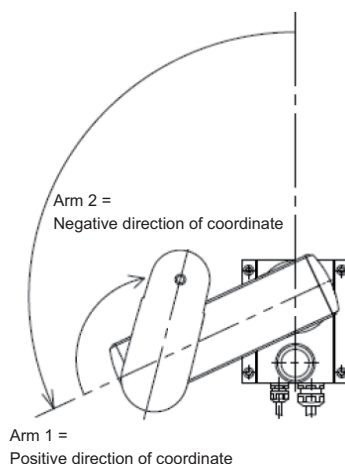
Display the explanation of initial posture



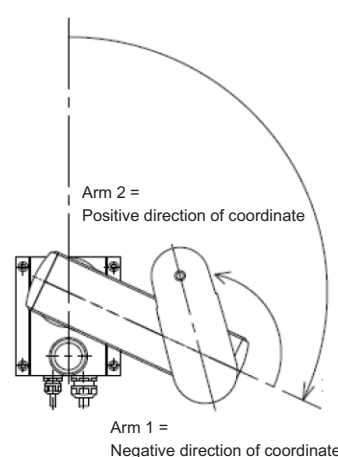
[Initial posture]

◎ Arm1, Arm 2

Considering the stopper pressing position, adjust the posture to either of right arm system or left arm system. When the product is delivered, it is set to the right arm system. Adjust to the right arm system. In case the arm interferes with the peripheral in the right arm system, set it to the left arm system in advance, conduct "stopper pressing position acquirement" and then adjust to the left arm system. [4.4.2 Refer to How to Acquire the Stopper Interfering Point]



Initial posture of left arm system
Arm 1 = Negative direction of coordinate
Arm 2 = Positive direction of coordinate



Initial posture of right arm system (At the delivery)
Arm 1 = Positive direction of coordinate
Arm 2 = Negative direction of coordinate

For the position, put it apart from the stopper position for 10deg or more.
Setting it too close to the stopper, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

◎ Vertical Axis

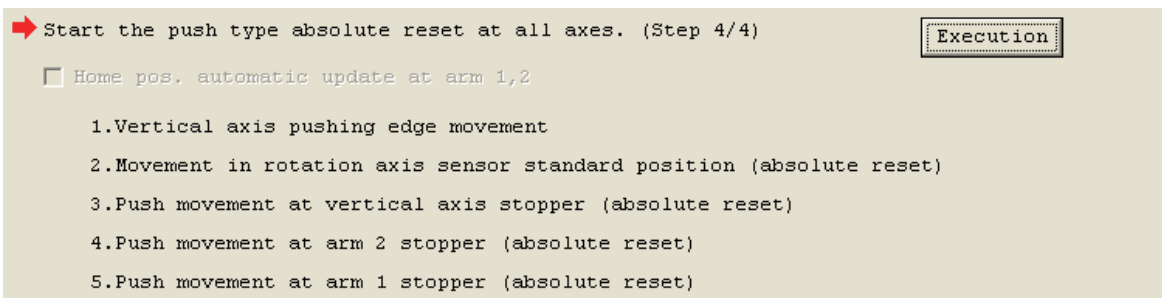
For the position, put it apart from the coordinate 0mm (upward end) for 10mm or more.
Setting it at 10mm or less, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

◎ Rotation Axis

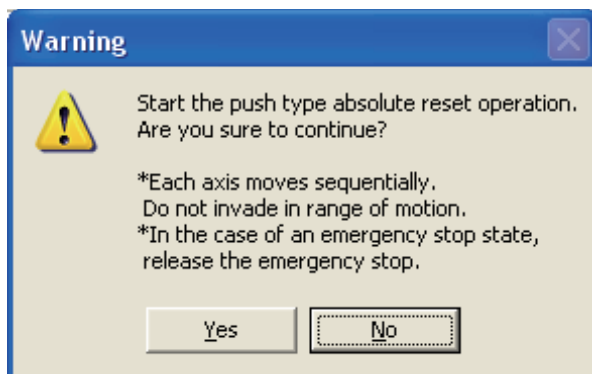
There is no specific indication for the position of rotation shaft. It can be set at any position.
When having the absolute reset executed with the chuck or hand kept attached, make sure to take the following caution note into account.

Caution: Make sure the cables and air tubes on the chucks and hands are not twisted before having the absolute reset executed.
The rotary axis resets the coordinates at the position that the sensor is detected.
Having an absolute reset with the cables and air tubes being twisted, the coordinates will get reset with them kept twisted.
Rotating the axis should twist the cables and air tubes even more, which could cause to break cables and tubes.
If it is necessary to have the absolute reset executed with the cables and air tubes kept attached, operate the axis manually or in low speed after having the reset to make sure that there is not impact applied to the cables and tubes.
In case there is an impact, turn the rotation axis back till the twist is solved and then have the absolute reset executed again or have the cables and tubes connected again.

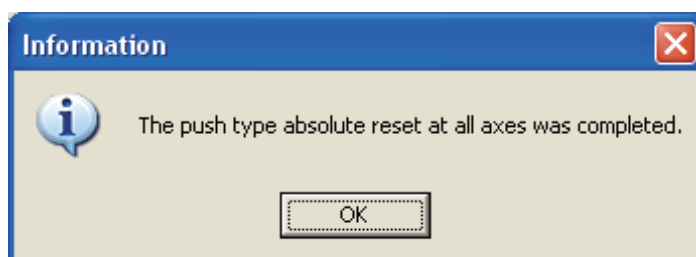
5) Click on the "Execution" button.



6) A Warning window shows up. Click on the "Yes". Each operation for the push type absolute reset starts.



- 7) Once the push type absolute reset for all the axes is finished, the Information window will appear. Click "OK" button.

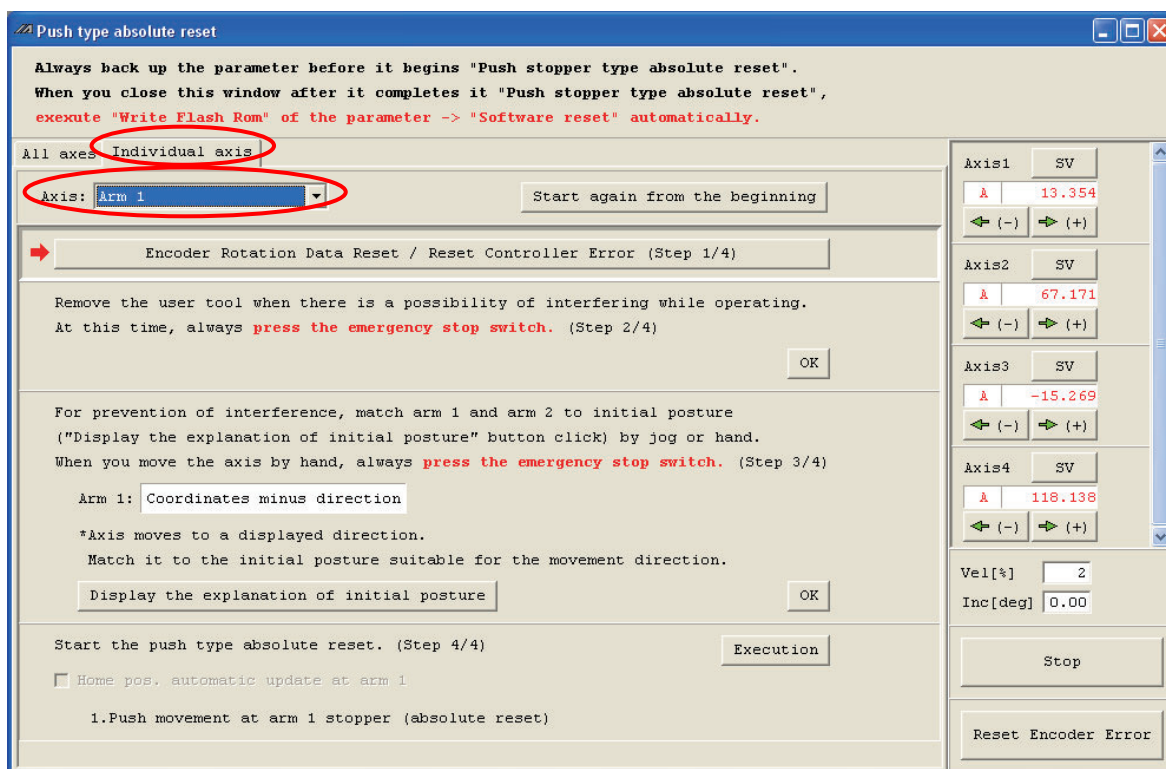


- 8) Close the Push stopper position acquisition window by clicking "x" on the upper right side of the window. Once the window is closed, the parameters start to be written automatically to the flash ROM, and controller is rebooted by the software reset.

- [2] When performing Stopper Pressing Type Absolute Reset on Each Axis One by One
To have the push stopper type absolute reset for each axis one by one, follow the steps shown below.

(1) 1st Arm and 2nd Arm

- 1) Select "Individual axis" in the push type absolute reset window, and set Axis to "Arm 1" (or Arm 2).



- Click "Encoder Rotation Data Reset / Reset Controller Error (Step 1/4)".

Encoder Rotation Data Reset / Reset Controller Error (Step 1/4)

- In case there is a concern that a load may interfere with surroundings at the absolute reset, detach the load. Have the work during the emergency stop condition. After the work is finished, click on the "OK" button.

Remove the user tool when there is a possibility of interfering while operating.
At this time, always **press the emergency stop switch.** (Step 2/4)

OK

- By referring to the displayed movement direction for each axis, adjust the axes to the initial posture. The posture differs depending on the movement direction. Click on "Display the explanation of initial posture" to check the explanations. Make sure to work on with the emergency stop activated when moving the axes with hand. Click on the "OK" button after the work is finished.

For prevention of interference, match arm 1 and arm 2 to initial posture ("Display the explanation of initial posture" button click) by jog or hand.
When you move the axis by hand, always **press the emergency stop switch.** (Step 3/4)

Arm 1: Coordinates minus direction

*Axis moves to a displayed direction.

Match it to the initial posture suitable for the movement direction.

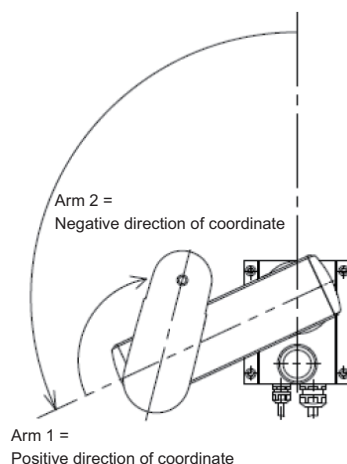
Display the explanation of initial posture

OK

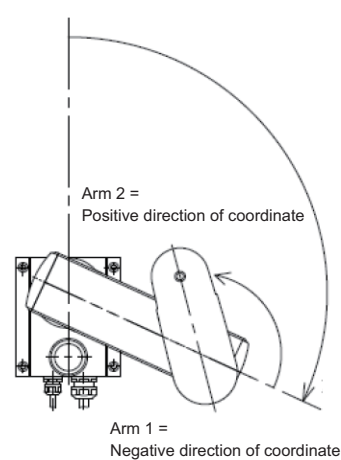
[Initial posture]

© Arm1, Arm 2

Considering the stopper pressing position, adjust the posture to either of right arm system or left arm system. When the product is delivered, it is set to the right arm system. Adjust to the right arm system. In case the arm interferes with the peripheral in the right arm system, set it to the left arm system in advance, conduct "stopper pressing position acquirement" and then adjust to the left arm system. [4.9.2 Refer to How to Acquire the Stopper Interfering Point]



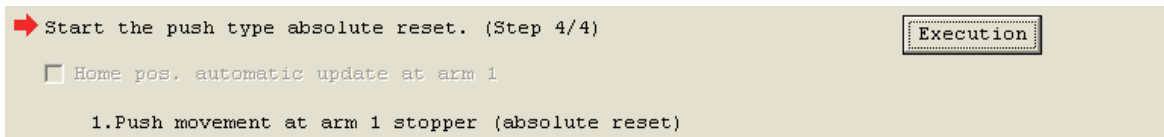
Initial posture of left arm system
Arm 1 = Negative direction of coordinate
Arm 2 = Positive direction of coordinate



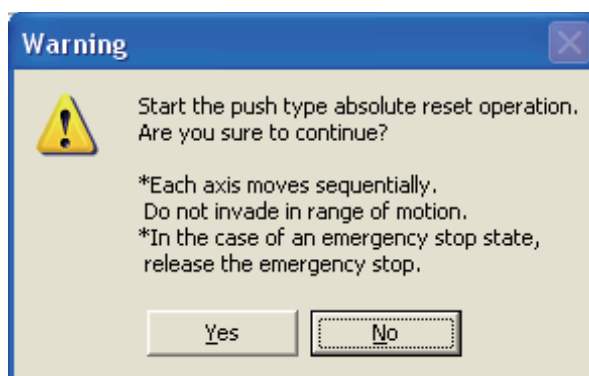
Initial posture of right arm system (At the delivery)
Arm 1 = Positive direction of coordinate
Arm 2 = Negative direction of coordinate

For the position, put it apart from the stopper position for 10deg or more.
Setting it too close to the stopper, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

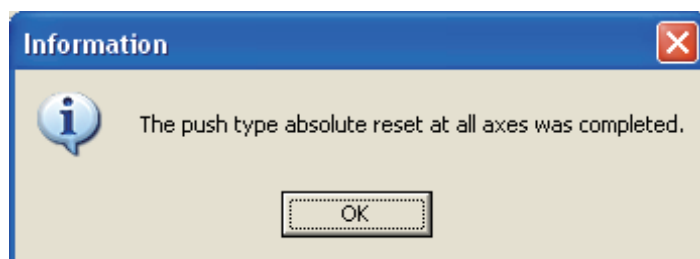
- 5) Click on the "Execution" button.



- 6) A Warning window shows up. Click on the "Yes". Each operation for the push type absolute reset starts.



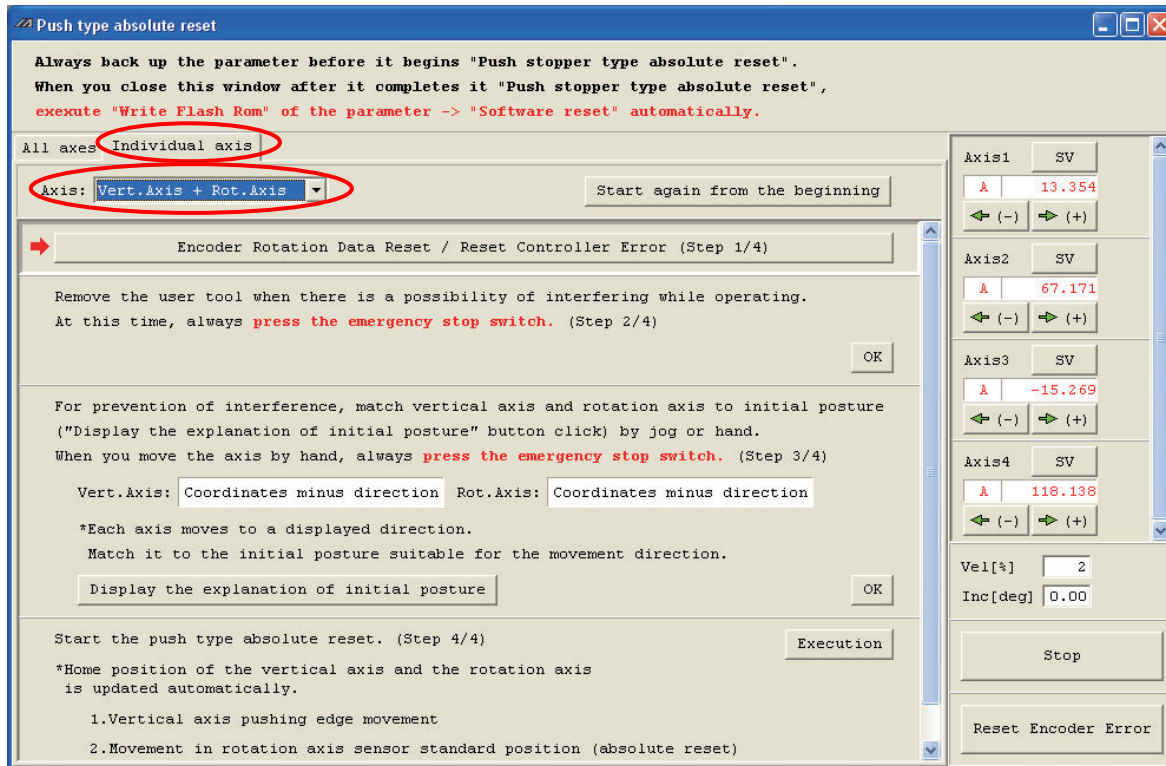
- 7) Once the push type absolute reset, the Information window will appear. Click "OK" button.



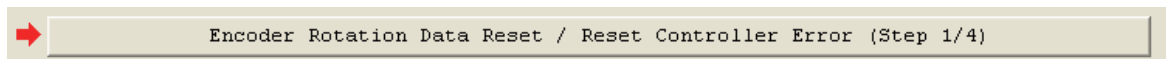
- 8) If it is necessary to have the push type absolute reset for another axis, move on to the axis selection. When finishing the process, click "x" on the upper right side of the window. Once the window is closed, the parameters start to be written automatically to the flash ROM, and controller is rebooted by the software reset.

(2) Vertical Axis, Rotation Axis

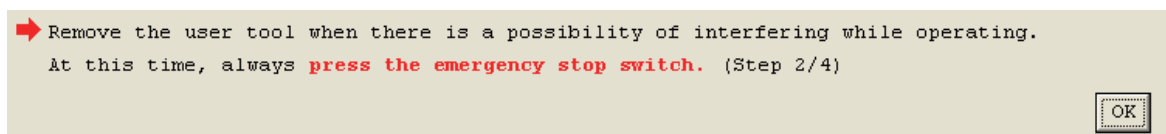
- 1) Select "Individual axis" in the Push stopper type absolute reset window, and set Axis to "Vert. Axis + Rot. Axis".



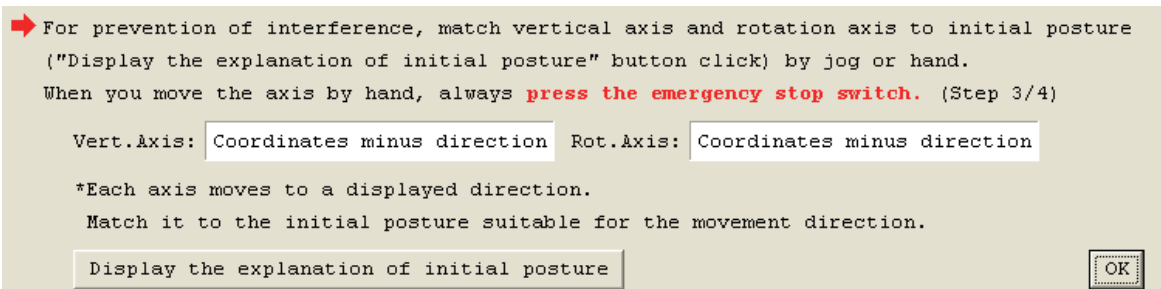
- 2) Click "Encoder Rotation Data Reset / Reset Controller Error (Step 1/4)".



- 3) In case there is a concern that a load may interfere with surroundings at the absolute reset, detach the load. Have the work during the emergency stop condition. After the work is finished, click on the "OK" button.



- 4) By referring to the displayed movement direction for each axis, adjust the axes to the initial posture. The posture differs depending on the movement direction. Click on "Display the explanation of initial posture" to check the explanations. Make to work on with the emergency stop activated when moving the axes with hand. Click on the "OK" button after the work is finished.



[Initial posture]

Ⓒ Vertical Axis

For the position, put it apart from the coordinate 0mm (upward end) for 10mm or more. Setting it at 10mm or less, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

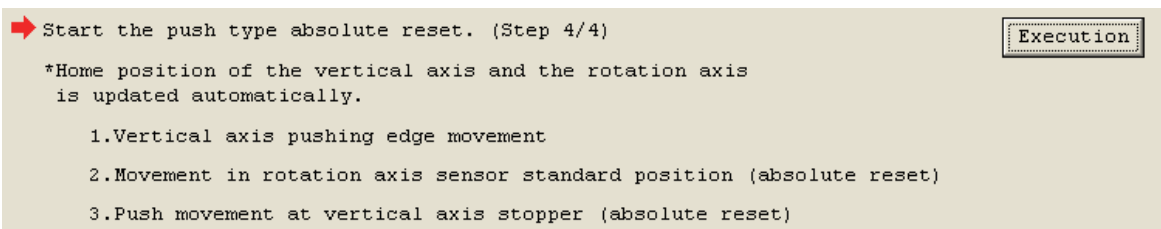
Ⓒ Rotation axis

There is no specific indication for the position of rotation shaft. It can be set at any position. When having the absolute reset executed with the chuck or hand kept attached, make sure to take the following caution note into account.

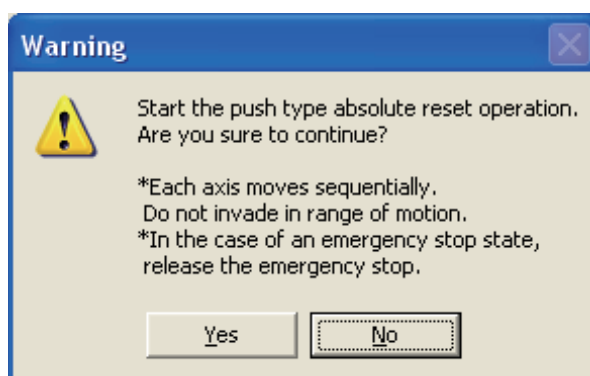


Caution: Make sure the cables and air tubes on the chucks and hands are not twisted before having the absolute reset executed. The rotary axis resets the coordinates at the position that the sensor is detected. Having an absolute reset with the cables and air tubes being twisted, the coordinates will get reset with them kept twisted. Rotating the axis should twist the cables and air tubes even more, which could cause to break cables and tubes. If it is necessary to have the absolute reset executed with the cables and air tubes kept attached, operate the axis manually or in low speed after having the reset to make sure that there is not impact applied to the cables and tubes. In case there is an impact, turn the rotation axis back till the twist is solved and then have the absolute reset executed again or have the cables and tubes connected again.

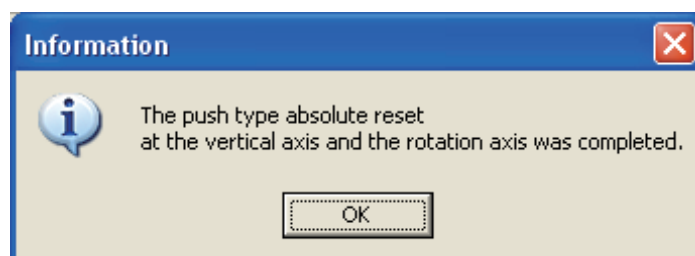
- 5) Click "Execution" button.



- 6) A Warning window shows up. Click "Yes". The operation for the push type absolute reset starts.



- 7) Once the push type absolute reset for the axis is complete, the information window will appear. Click "OK" button.



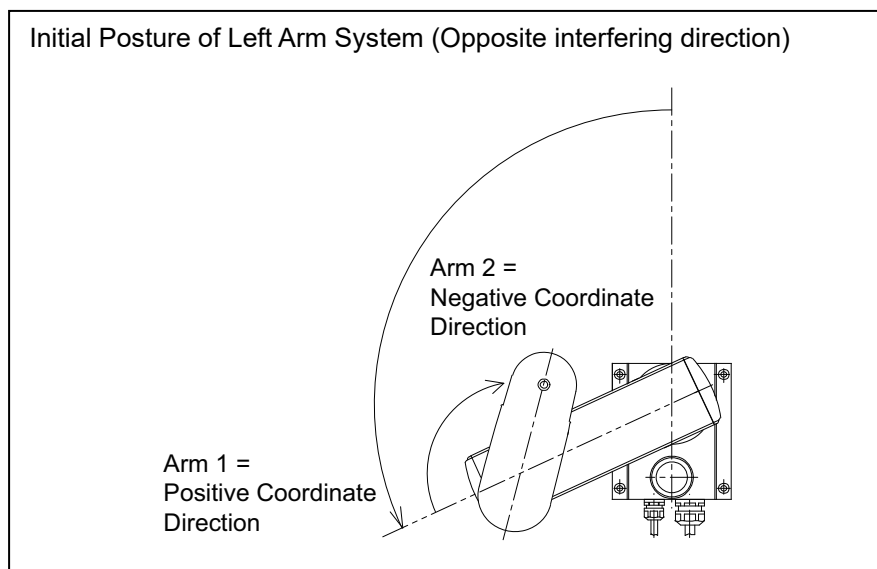
- 8) When finishing the process, click "x" on the upper right side of the window. Once the window is closed, the parameters start to be written automatically to the flash ROM, and controller is rebooted by the software reset.

4.9.2 How to Acquire the Stopper Interfering Point

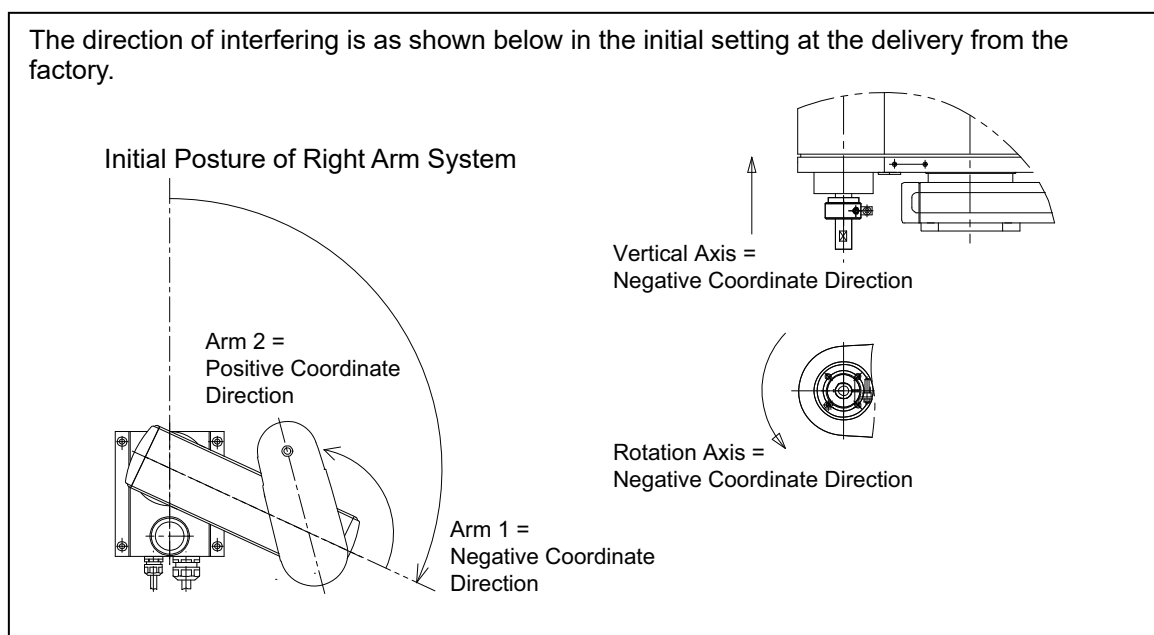
In the following case, conduct “Stopper pressing position acquirement ^(Note 1)” before having the absolute reset.

- When the absolute reset cannot be performed in the direction of the stopper interfering movement with the initial posture at the delivery from the factory due to such reasons as interference to the peripheral equipment
- There was a change in the stopper position due to such reasons as a removal of the stopper of the vertical axis

Note 1 In case that the absolute reset cannot be performed with the stopper pressing movement direction of the initial posture set at the delivery due to such as interference with peripheral devices, change the setting to the initial posture of the left arm system (stopper pressing direction on opposite side) and conduct the stopper pressing position acquirement.

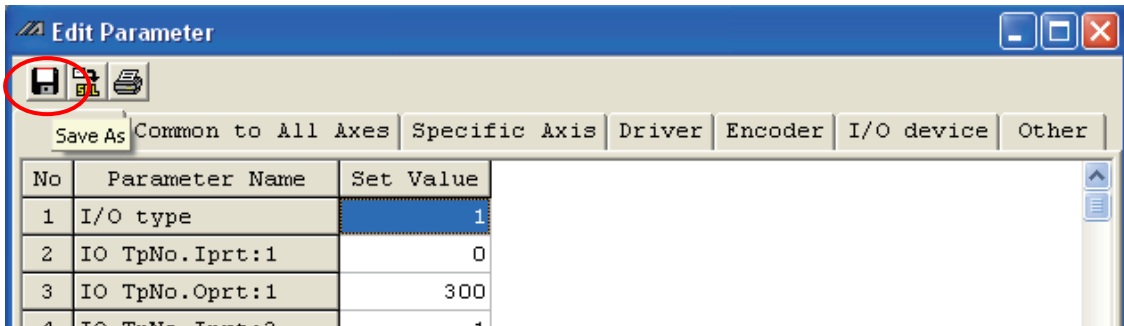


(Reference)

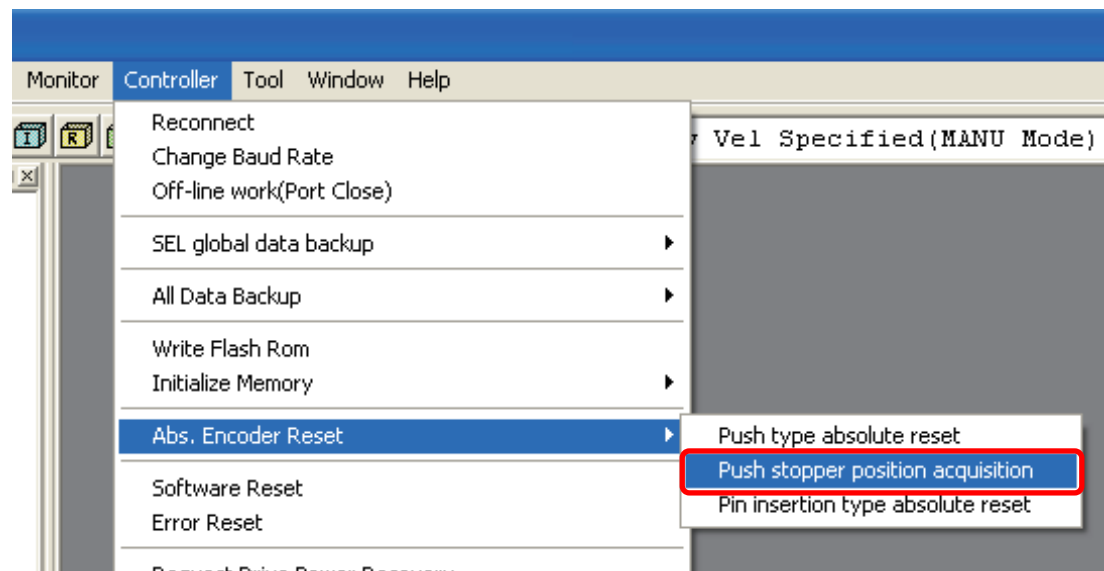


Push stopper position acquisition with the process shown below.

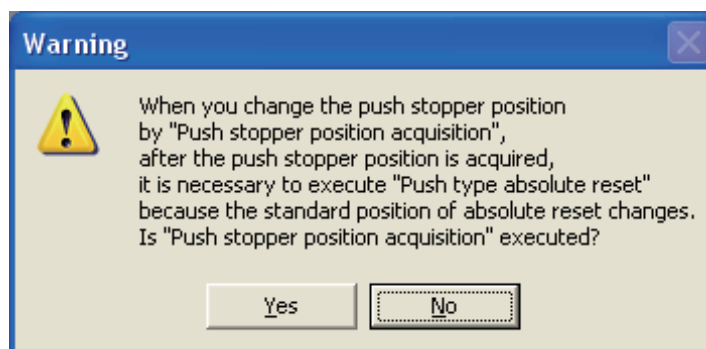
- 1) Backup the parameters so that they can be put back anytime to those before changing them. Select "Parameter (P)" → "Edit (E)" from PC Software Menu to show the Edit Parameter window. Press the "Save As" button in the Edit Parameter window to store the parameters in the file.



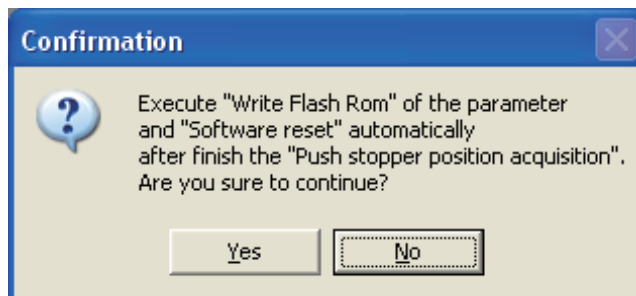
- 2) Select "Controller" → "Abs. Encoder Reset" → "Push stopper position acquisition" from the menu.



- 3) A Warning window shows up. Click "Yes".



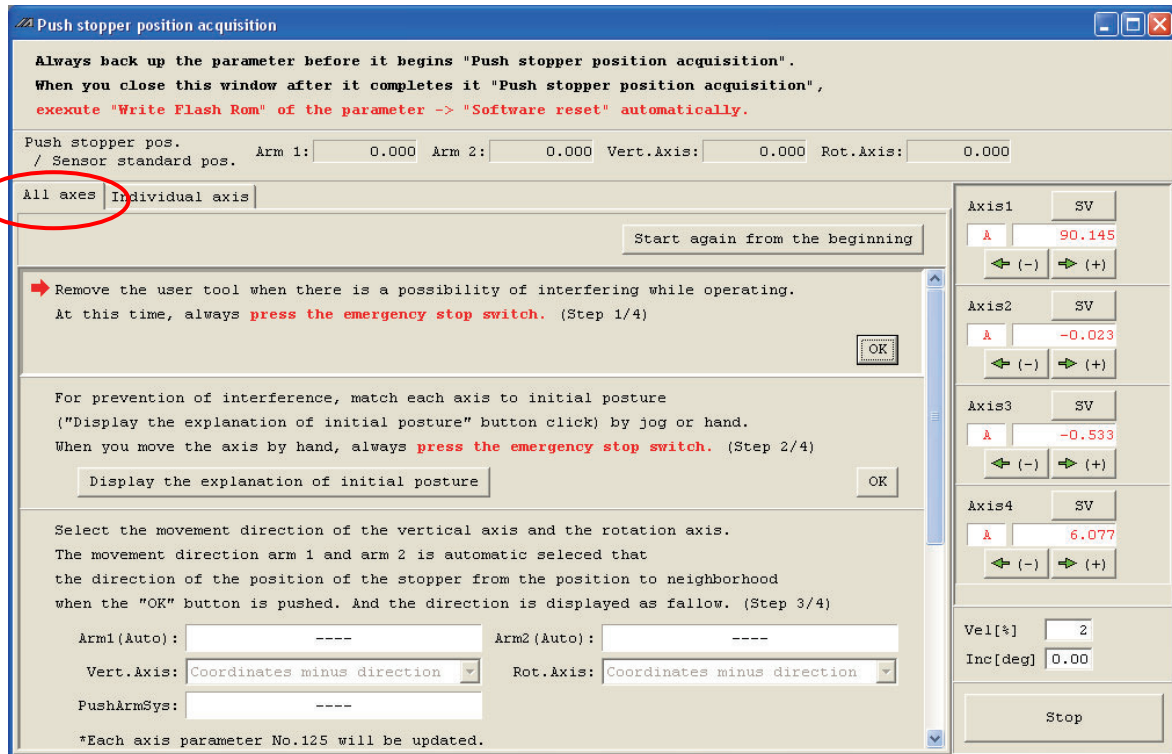
- 4) A Confirmation window shows up. Click "Yes".



If conducting on all the axes at once, have the process of [1].
When not all the axes, but having one or some of the 4 axes to be conducted, have the process of [2].

- [1] When Acquiring Stopper Pressing Position for All Axes at Once
To acquire the push stopper position for all the axes at once, follow the steps shown below.

1) Select "All axes" in the Push stopper position acquisition window.



Push stopper position acquisition

Always back up the parameter before it begins "Push stopper position acquisition".
When you close this window after it completes it "Push stopper position acquisition",
execute "Write Flash Rom" of the parameter -> "Software reset" automatically.

Push stopper pos. / Sensor standard pos. Arm 1: 0.000 Arm 2: 0.000 Vert.Axis: 0.000 Rot.Axis: 0.000

All axes Individual axis

Start again from the beginning

Remove the user tool when there is a possibility of interfering while operating.
At this time, always **press the emergency stop switch.** (Step 1/4)

For prevention of interference, match each axis to initial posture
("Display the explanation of initial posture" button click) by jog or hand.
When you move the axis by hand, always **press the emergency stop switch.** (Step 2/4)

Display the explanation of initial posture

Select the movement direction of the vertical axis and the rotation axis.
The movement direction arm 1 and arm 2 is automatic selected that
the direction of the position of the stopper from the position to neighborhood
when the "OK" button is pushed. And the direction is displayed as fallow. (Step 3/4)

Arm1(Auto): ---- Arm2(Auto): ----

Vert.Axis: Coordinates minus direction Rot.Axis: Coordinates minus direction

PushArmSys: ----

*Each axis parameter No.125 will be updated.

Axis1 SV
A 90.145
(-) (+)

Axis2 SV
A -0.023
(-) (+)

Axis3 SV
A -0.533
(-) (+)

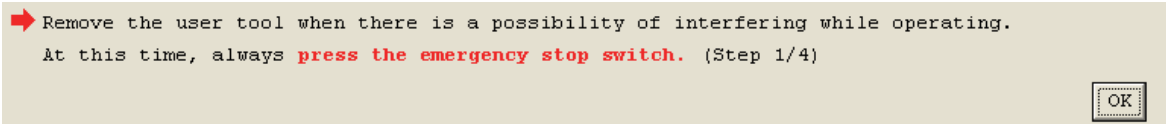
Axis4 SV
A 6.077
(-) (+)

Vel[%] 2
Inc[deg] 0.00

Stop

OK

2) In case there is a concern that a load may interfere with surroundings at the absolute reset, detach the load. Have the work during the emergency stop condition. After the work is finished, click on the "OK" button.



Remove the user tool when there is a possibility of interfering while operating.
At this time, always **press the emergency stop switch.** (Step 1/4)

OK

- 3) Adjust each axis to the initial posture. The posture differs depending on the movement direction. Click on "Display the explanation of initial posture" to check the explanations. Make to work on with the emergency stop activated when moving the axes with hand. Click on the "OK" button after the work is finished.

➔ For prevention of interference, match each axis to initial posture ("Display the explanation of initial posture" button click) by jog or hand. When you move the axis by hand, always **press the emergency stop switch**. (Step 2/4)

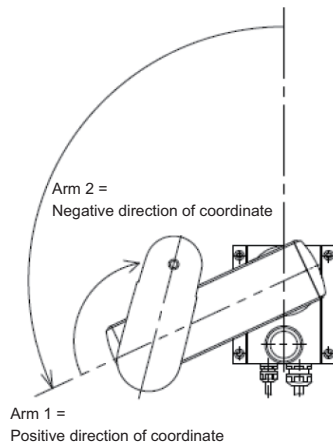
Display the explanation of initial posture

OK

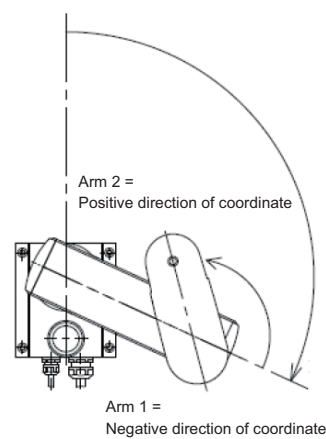
[Initial posture]

◎ Arm1, Arm 2

Remove all the interferences of the peripheral devices, and set the posture to either of the left arm system or the right arm system. It is set to right arm system when the unit is shipped out.



Initial posture of left arm system
Arm 1 = Negative direction of coordinate
Arm 2 = Positive direction of coordinate



Initial posture of right arm system (At the delivery)
Arm 1 = Positive direction of coordinate
Arm 2 = Negative direction of coordinate

For the position, put it apart from the stopper position for 10deg or more.

Setting it too close to the stopper, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

◎ Vertical Axis

For the position, put it apart from the coordinate 0mm (upward end) for 10mm or more.

Setting it at 10mm or less, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

◎ Rotation axis

There is no specific indication for the position of rotation shaft. It can be set at any position. When having the absolute reset executed with the chuck or hand kept attached, make sure to take the following caution note into account.



Caution: Make sure the cables and air tubes on the chucks and hands are not twisted before having the absolute reset executed.
 The rotary axis resets the coordinates at the position that the sensor is detected.
 Having an absolute reset with the cables and air tubes being twisted, the coordinates will get reset with them kept twisted.
 Rotating the axis should twist the cables and air tubes even more, which could cause to break cables and tubes.
 If it is necessary to have the absolute reset executed with the cables and air tubes kept attached, operate the axis manually or in low speed after having the reset to make sure that there is not impact applied to the cables and tubes.
 In case there is an impact, turn the rotation axis back till the twist is solved and then have the absolute reset executed again or have the cables and tubes connected again.

- 4) Select the direction to move for the vertical axis and rotation axis. It is not necessary to change the direction to move for the vertical axis and rotation axis. Make the vertical axis is in the coordinates minus direction.
 Once the selection is made, click on the "OK" button. At this time, the direction of movement from the current position of the initial posture to Arm 1 (1st arm) and Arm 2 (2nd arm) is automatically selected. Check the selected movement direction.

➔ Select the movement direction of the vertical axis and the rotation axis.
 The movement direction arm 1 and arm 2 is automatic selected that the direction of the position of the stopper from the position to neighborhood when the "OK" button is pushed. And the direction is displayed as follow. (Step 3/4)

Arm1(Auto):	----	Arm2(Auto):	----
Vert.Axis:	Coordinates minus direction	Rot.Axis:	Coordinates minus direction
Push&ArmSys:	----		

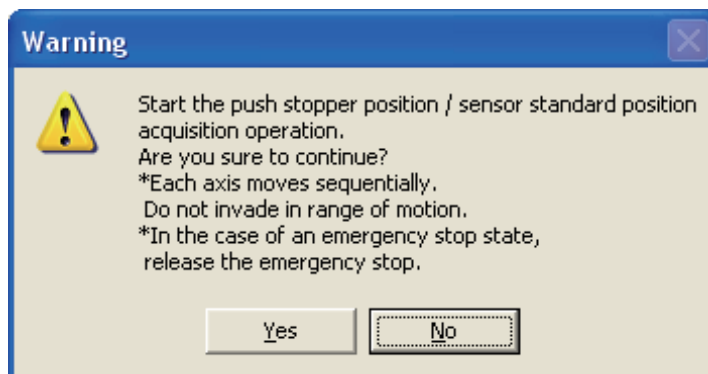
*Each axis parameter No.125 will be updated.

- 5) Click on the "Execution" button.

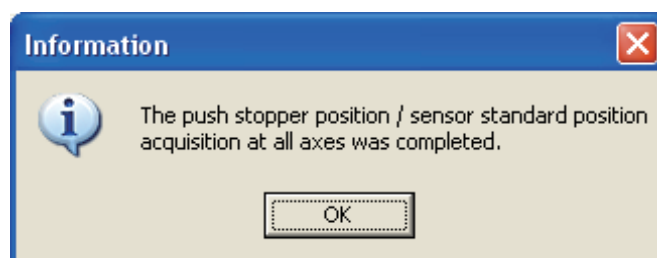
➔ Start the push stopper position / sensor standard position acquisition of all axes. (Step 4/4)

- 1.Vertical axis pushing edge movement
- 2.Movement in rotation axis sensor standard position (sensor standard position acquisition)
- 3.Push movement at vertical axis stopper (push stopper position acquisition)
- 4.Push movement at arm 2 stopper (push stopper position acquisition)
- 5.Push movement at arm 1 stopper (push stopper position acquisition)

- 6) A Warning window shows up. Click "Yes". Process to acquire the push stopper position will start.



- 7) Once the push stopper position acquisition for all the axes is complete, the Information window will appear. Click "OK" button.

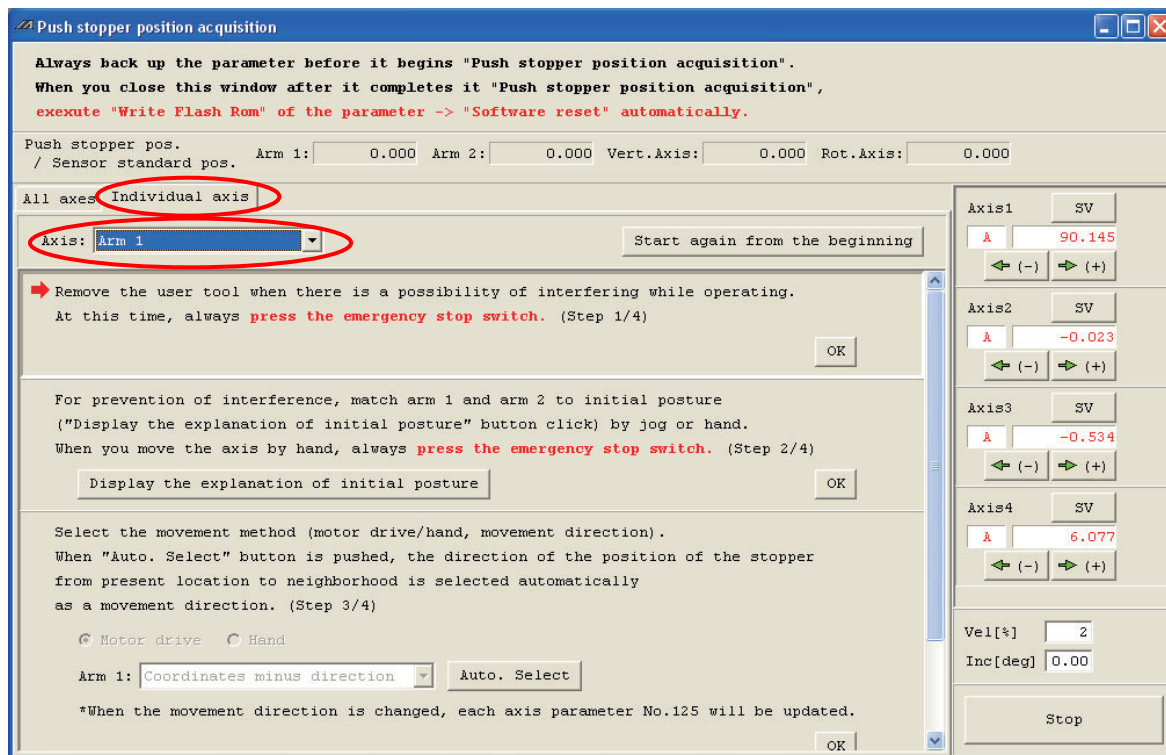


- 8) Close the Push stopper position acquisition window by clicking "x" on the upper right side of the window. Once the window is closed, the parameters start to be written automatically to the flash ROM, and controller is rebooted by the software reset.
- 9) Once the controller reboot is finished, conduct the push type absolute reset on all the axes together.

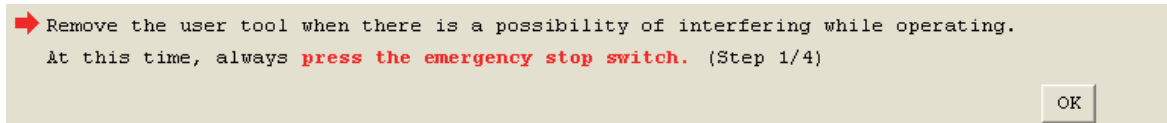
- [2] When Acquiring Stopper Pressing Position on Each Axis One by One
To have an acquirement on each axis, follow the steps below.

(1) 1st Arm and 2nd Arm

- 1) Select "Individual axis" in the Push stopper position acquisition window, and set Axis to "Arm 1" (or Arm 2).



- 2) In case there is a concern that a load may interfere with surroundings at the absolute reset, detach the load. Have the work during the emergency stop condition. After the work is finished, click on the "OK" button.



- 3) Adjust 1st Arm and 2nd Arm to the initial posture. The posture differs depending on the movement direction. Click on "Display the explanation of initial posture" to check the explanations. Make to work on with the emergency stop activated when moving the axes with hand. Click on the "OK" button after the work is finished.

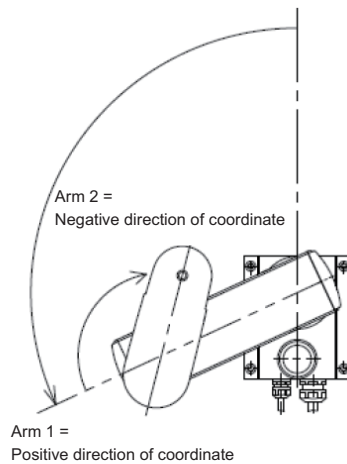
➔ For prevention of interference, match arm 1 and arm 2 to initial posture ("Display the explanation of initial posture" button click) by jog or hand.
When you move the axis by hand, always **press the emergency stop switch.** (Step 2/4)

Display the explanation of initial posture OK

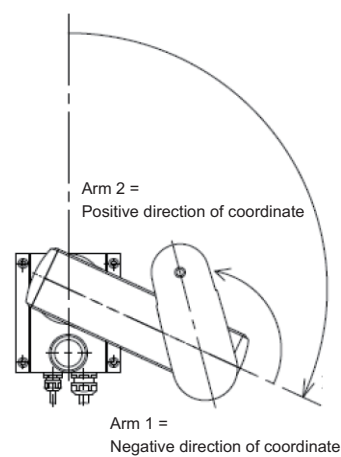
[Initial posture]

◎ Arm1, Arm 2

Remove all the interferences of the peripheral devices, and set the posture to either of the left arm system or the right arm system. It is set to right arm system when the unit is shipped out.



Initial posture of left arm system
Arm 1 = Negative direction of coordinate
Arm 2 = Positive direction of coordinate



Initial posture of right arm system (At the delivery)
Arm 1 = Positive direction of coordinate
Arm 2 = Negative direction of coordinate

For the position, put it apart from the stopper position for 10deg or more.
Setting it too close to the stopper, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

- 4) Select the movement method. Make to select motor drive on the selection of motor drive/hand. Change the movement direction if necessary. If clicking on "Auto. Select" button, the direction of movement from the current position of the initial posture is automatically selected. Once the selection is made, click on the "OK" button.

➔ Select the movement method (motor drive/hand, movement direction).
When "Auto. Select" button is pushed, the direction of the position of the stopper from present location to neighborhood is selected automatically as a movement direction. (Step 3/4)

☒ Motor drive ☐ Hand

Arm 1:

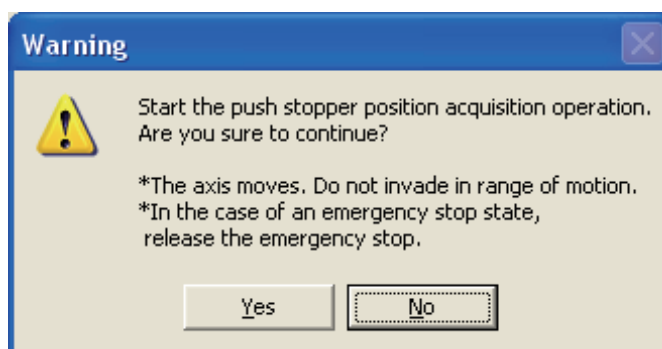
*When the movement direction is changed, each axis parameter No.125 will be updated.

- 5) Click "Execution" button.

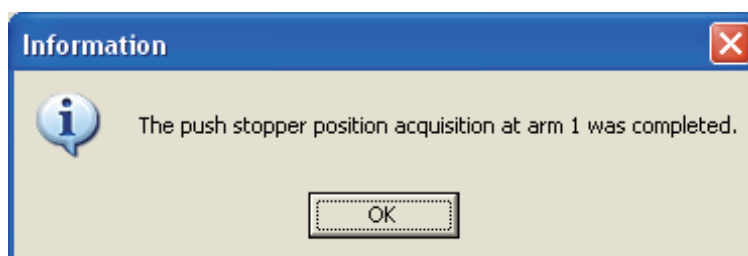
➔ Start push stopper position acquisition. (Step 4/4)

1.Push movement at arm 1 stopper
(push stopper position acquisition)

- 6) A Warning window shows up. Click "Yes". Process to acquire the push stopper position will start.



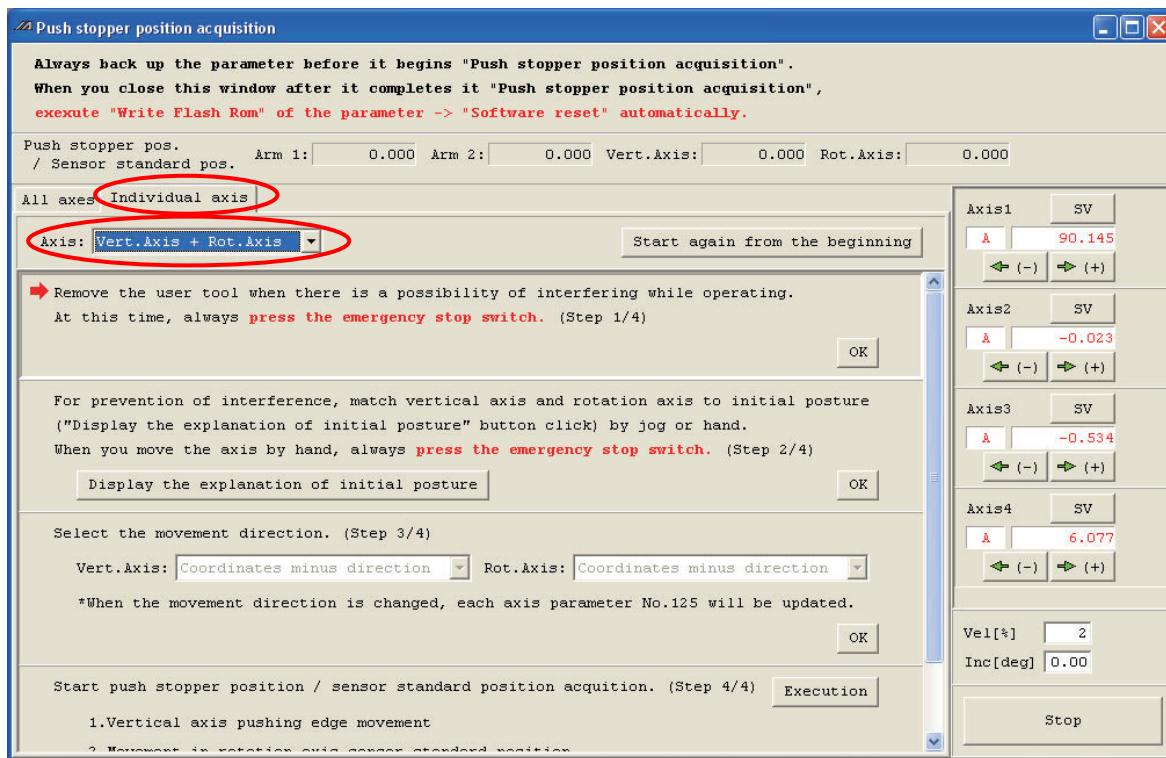
- 7) Once the push stopper position acquisition is complete, the Information window will appear. Click "OK" button.



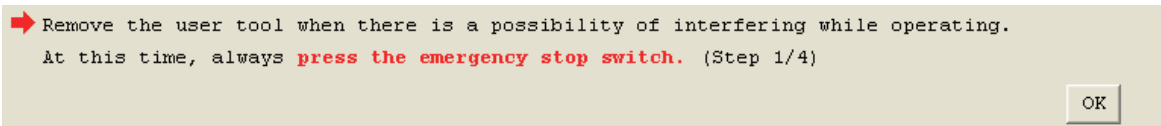
- 8) If it is necessary to have the push stopper position a acquisition for another axis, move on to the axis selection. When finishing the process, click "x" on the upper right side of the window. Once the window is closed, the parameters start to be written automatically to the flash ROM, and controller is rebooted by the software reset.
- 9) Once the controller reboot is finished, conduct the push type absolute reset on the axis with the push stopper position acquisition.

(2) Vertical Axis, Rotation Axis

- 1) Select "Individual axis" in the Push stopper position acquisition window, and set Axis to "Vert. Axis + Rot. Axis".



- 2) In case there is a concern that a load may interfere with surroundings at the absolute reset, detach the load. Have the work during the emergency stop condition. After the work is finished, click on the "OK" button.



- 3) Adjust vertical axis to the initial posture. The posture differs depending on the movement direction. Click on "Display the explanation of initial posture" to check the explanations. Make to work on with the emergency stop activated when moving the axes with hand. Click on the "OK" button after the work is finished.

➔ For prevention of interference, match vertical axis and rotation axis to initial posture ("Display the explanation of initial posture" button click) by jog or hand.
When you move the axis by hand, always **press the emergency stop switch.** (Step 2/4)

Display the explanation of initial posture OK

[Initial posture]

⊙ Vertical Axis

For the position, put it apart from the coordinate 0mm (upward end) for 10mm or more. Setting it at 10mm or less, Error No. B0D "Stopper Pressing Operation Start Position Error" may occur at operation.

⊙ Rotation axis

There is no specific indication for the position of rotation shaft. It can be set at any position. When having the absolute reset executed with the chuck or hand kept attached, make sure to take the following caution note into account.

Caution: Make sure the cables and air tubes on the chucks and hands are not twisted before having the absolute reset executed.
The rotary axis resets the coordinates at the position that the sensor is detected.
Having an absolute reset with the cables and air tubes being twisted, the coordinates will get reset with them kept twisted.
Rotating the axis should twist the cables and air tubes even more, which could cause to break cables and tubes.
If it is necessary to have the absolute reset executed with the cables and air tubes kept attached, operate the axis manually or in low speed after having the reset to make sure that there is not impact applied to the cables and tubes.
In case there is an impact, turn the rotation axis back till the twist is solved and then have the absolute reset executed again or have the cables and tubes connected again.

- 4) It is not necessary to change the direction to move for the vertical axis and rotation axis. Make the vertical axis is in the coordinates minus direction. Once the selection is made, click on the "OK" button.

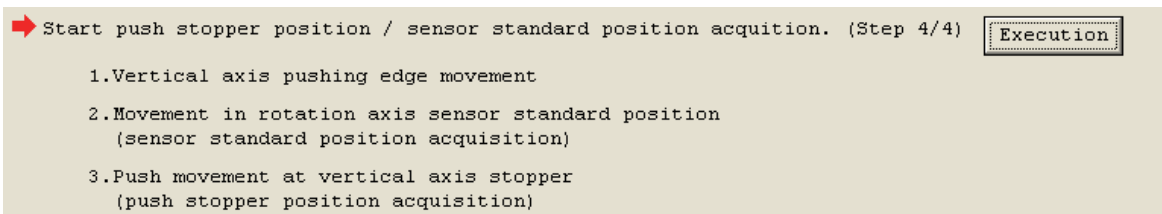
➔ Select the movement direction. (Step 3/4)

Vert.Axis: Coordinates minus direction Rot.Axis: Coordinates minus direction

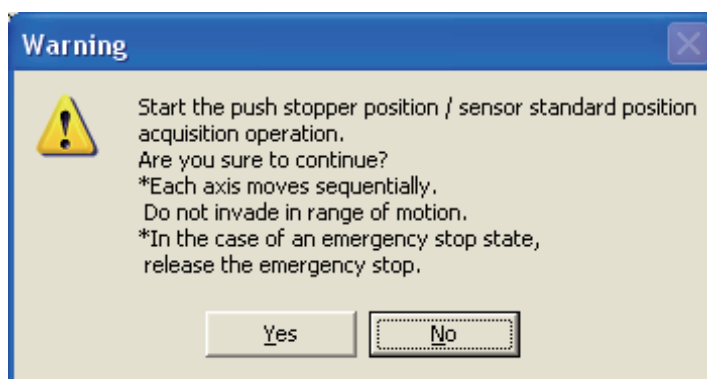
*When the movement direction is changed, each axis parameter No.125 will be updated.

OK

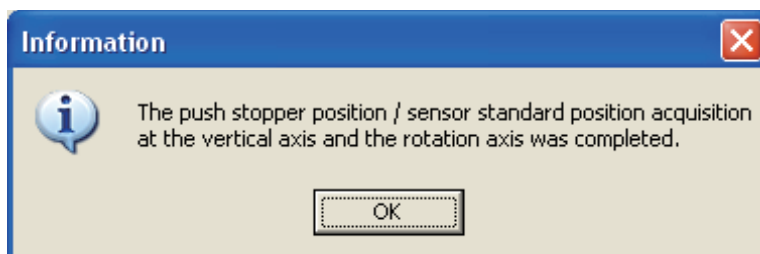
5) Click "Execution" button.



6) A Warning window shows up. Click "Yes". Process to acquire the push stopper position will start.

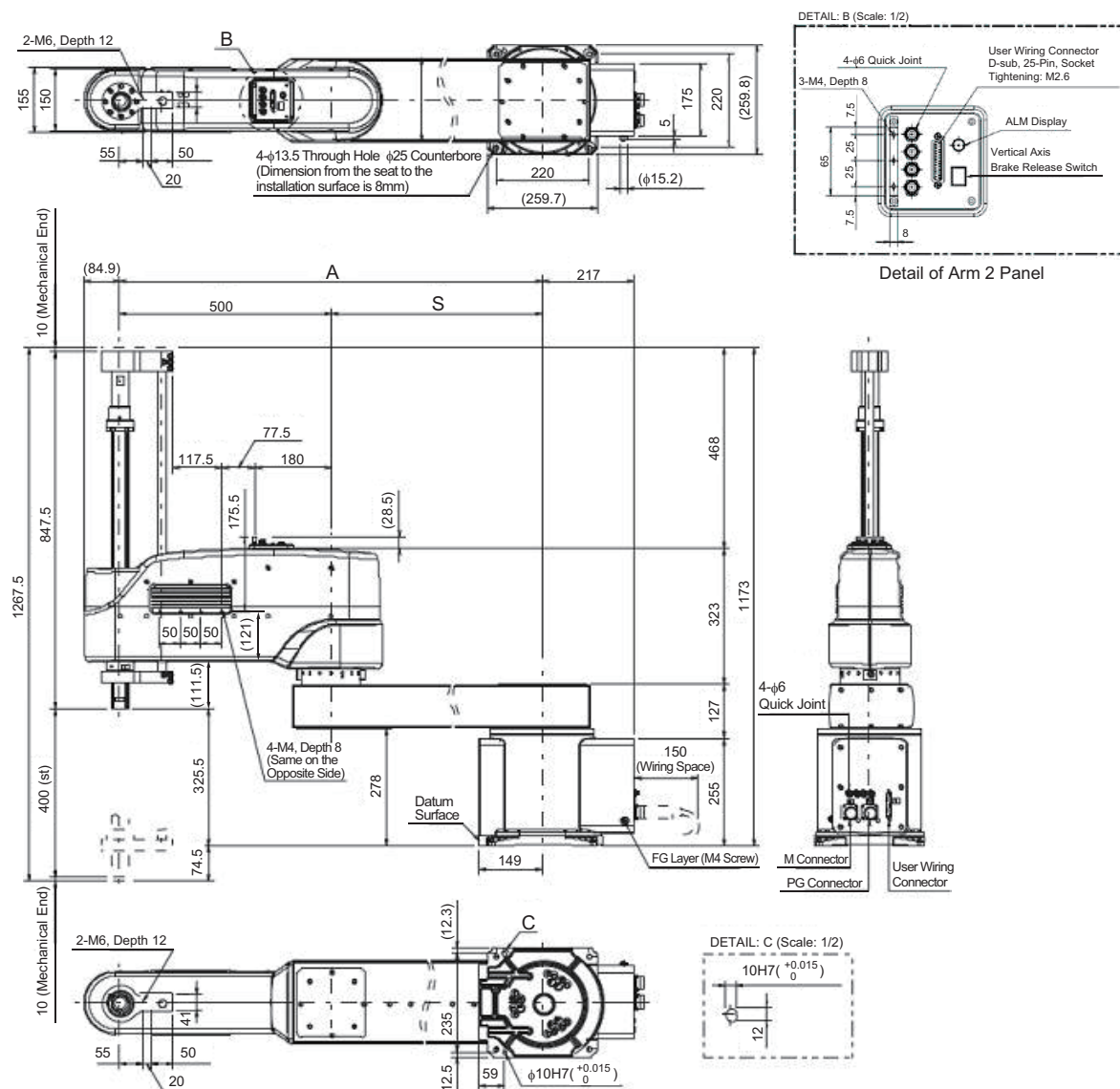


7) Once the push stopper position acquisition is complete, the Information window will appear. Click "OK" button.

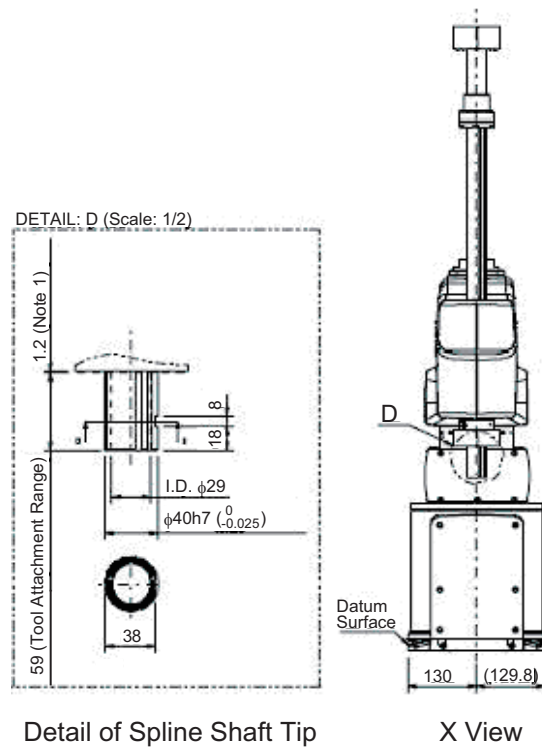


- 8) When finishing the process, click "x" on the upper right side of the window. Once the window is closed, the parameters start to be written automatically to the flash ROM, and controller is rebooted by the software reset.
- 9) Once the controller reboot is finished, conduct the push type absolute reset on the axis with the push stopper position acquisition.

5. External Dimensions



No.	Model	A	S	Mass (kg)
1	IX-NNN10040	1000	500	93
2	IX-NNN10040	1200	700	97



Note 1 Ensure clearance otherwise (Rotary Axis) would not be able to operate.

6. Warranty

6.1 Warranty Period

One of the following periods, whichever is shorter:

- 18 months after shipment from IAI
- 12 months after delivery to the specified location
- 2,500 hours of operation

6.2 Scope of the Warranty

Our products are covered by warranty when all of the following conditions are met. Faulty products covered by warranty will be replaced or repaired free of charge:

- (1) The breakdown or problem in question pertains to our product as delivered by us or our authorized dealer.
- (2) The breakdown or problem in question occurred during the warranty period.
- (3) The breakdown or problem in question occurred while the product was in use for an appropriate purpose under the conditions and environment of use specified in the operation manual and catalog.
- (4) The breakdown of problem in question was caused by a specification defect or problem, or by a quality issue with our product.

Note that breakdowns due to any of the following reasons are excluded from the scope of warranty:

- [1] Anything other than our product
- [2] Modification or repair performed by a party other than us (unless we have approved such modification or repair)
- [3] Anything that could not be easily predicted with the level of science and technology available at the time of shipment from our company
- [4] A natural disaster, man-made disaster, incident or accident for which we are not liable
- [5] Natural fading of paint or other symptoms of aging
- [6] Wear, depletion or other expected result of use
- [7] Operation noise, vibration or other subjective sensation not affecting function or maintenance

Note that the warranty only covers our product as delivered and that any secondary loss arising from a breakdown of our product is excluded from the scope of warranty.

6.3 Honoring the Warranty

As a rule, the product must be brought to us for repair under warranty.

6.4 Limit in Responsibility

- (1) We shall assume no liability for any special damage, consequential loss or passive loss such as a loss of expected profit arising from or in connection with our product.
- (2) We shall not be liable for any program or control method created by the customer to operate our product or for the result of such program or control method.

6.5 Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications

- (1) If our product is combined with another product or any system, device, etc., used by the customer, the customer must first check the applicable standards, regulations and/or rules. The customer is also responsible for confirming that such combination with our product conforms to the applicable standards, etc. In such a case we will not be liable for the conformance of our product with the applicable standards, etc.
- (2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:
 - [1] Medical equipment pertaining to maintenance or management of human life or health
 - [2] A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
 - [3] Important safety parts of mechanical equipment (such as safety devices)
 - [4] Equipment used to handle cultural assets, art or other irreplaceable items
- (3) Contact us at the earliest opportunity if our product is to be used in any condition or environment that differs from what is specified in the catalog or operation manual.

6.6 Other Items Excluded from Warranty

The price of the product delivered to you does not include expenses associated with programming, the dispatch of engineers, etc. Accordingly, a separate fee will be charged in the following cases even during the warranty period:

- [1] Guidance for installation/adjustment and witnessing of test operation
- [2] Maintenance and inspection
- [3] Technical guidance and education on operating/wiring methods, etc.
- [4] Technical guidance and education on programming and other items related to programs

Change History

Revision Date	Description of Revision
2013.01	First edition
2013.04	Second edition Pg. 15 Noise value changed from 73dB to 78dB Pg. 16 Note added to tell pressing operation cannot be performed Pg. 22, 24 Note added stating that graph change at rated transportable weight 20kg as boarder Pg. 26 Note added for use of WGT2 Command Pg. 34 Change made to maximum reaction force during robot operation
2013.06	Edition 2B Note corrected
2013.07	Third edition Pg. 12 Label attachment drawing changed Pg. 30 Package drawing changed because body and controller to be packaged separately. Pg. 36, 37 Value of offset added in vertical direction. Caution note added. Pg. 39 Instruction added for attachment using tapped hole on 2nd Arm Pg. 50, 51 Change made in contents of maintenance inspection. Maintenance inspection added for 2.5 and 5 years Pg. 53 4.3, "Check for Looseness of Arm Attachment Screws" added Pg. 56 4.5, "Grease Supply on the J1 Axis" added Pg. 58 4.6, "Grease Supply on the J2 Axis" added Pg. 59 4.7, "How to Measure Lost Motion" added Pg. 61 4.8, "How to Inspect Visually on Timing Belt for Rotary Axis" added Pg. 88 A and S dimensions and weight added in table in Appearance Drawing IX-NNN12040
2014.07	Fourth edition Correction made in 65, 69, 79, 83 and 86.
2015.08	Edition 4C Correction made in 65, 69, 79 and 83 of figure At the delivery, Initial posture of right arm system. Pg. 88 Correction made in dimensions of External Dimensions
2017.10	Edition 4D Pg. 13, 14, 42 XSEL-SAX controller added
2018.01	Edition 4E Pg. 42 Connecting to the Brake Cable added
2018.02	Edition 4F Pg. 88, 89 Correction made in dimensions of External Dimensions

Revision Date	Description of Revision
2018.05	Edition 4G Pg. 45 Correction made in wiring diagram of connector
2019.09	Edition 4H Pg. 14 3L : 3m deleted from "Cable length" in "How to Read the Model Number"
2020.01	Edition 4I Pg. 66, 73 to 74, 79 to 81, 86 to 87 Caution note added for absolute reset for rotation axis
2021.05	Edition 4J Pg. 51 Correction made from AB-6 to AB-3 for battery model code
2023.07	Edition 4K Pg. 58 Description changed for applicable grease
2026.02	Edition 4L Description revised in International Standards Compliances Change made in accordance with discontinuation of including First Step Guide
2026.06	Edition 4M Terms integrated (cable carrier)



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