

Industrial Training Robot Motion System Master

Technical Reference



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Thank you for purchasing an Oriental Motor product.

This document describes product handling procedures and safety precautions.

- Please read it thoroughly to ensure safe operation.
- Always keep the document where it is readily available.
- Any reference to "Oriental Motor Co., Ltd." or "Oriental Motor" in this manual includes its subsidiaries and affiliates.

1 Introduction

1-1 Before use

This product is indented for use in industrial environments, including training simulators for industrial applications. This product does not apply to the scope of ANSI/CAN/UL 3300. This product is designed for the purpose of learning about industrial robot mechanisms and control. DO NOT USE FOR ANY OTHER PURPOSE.

This technical reference is intended for people with expertise in electrical and mechanical engineering and safety. If the user of this product does not have such expertise, a person with such expertise should provide appropriate guidance and supervision based on this technical reference.

Use the product correctly after thoroughly reading the "2 Safety precautions" on p.3. In addition, be sure to observe the contents described in warning, caution, and note in this document.

Oriental Motor Co., Ltd. is not responsible for any compensation for damage caused through failure to observe this warning.

1-2 Related operating manuals

For operating manuals and technical reference, contact your nearest Oriental Motor sales office.

- Industrial Training Robot **Motion System Master** technical reference (this document)
- Robot Controller **MRC01** USER MANUAL
- **AZ** Series/Motorized actuator equipped with **AZ** Series DC power input OPERATING MANUAL Driver Edition

This document mainly describes the robot. For information not included in this document, such as the installation and connection of the controller and driver, and control methods, please also refer to the operating manual listed above.

1-3 Overview of the product

This product is a small desktop robot consisting of the **AZ** series equipped with a battery-free absolute sensor. Customers can replace the arm parts themselves, which allows customization such as changing the arm length. The set includes the robot (including the motor), controller, drivers, and cables, so it can be used immediately after purchase. DC power supply and end effector are sold separately.

2 Safety precautions

The precautions described below are intended to ensure the safe and correct use of the product, and to prevent the customer and others from exposure to the risk of injury. Use the product only after carefully reading and fully understanding these instructions.

 WARNING	Handling the product without observing the instructions that accompany a "WARNING" symbol may result in death or serious bodily injury.
 CAUTION	Handling the product without observing the instructions that accompany a "CAUTION" symbol may result in bodily injury or property damage.
 Note	The items under this heading contain important handling instructions that the user should observe to ensure the safe use of the product.
 memo	The items under this heading contain related information and contents to gain a further understanding of the text in this document.

WARNING

General

- Never use the product in connection with the maintenance or management of human life or health.
- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, in places subjected to splashing water, or near combustibles. Doing so may result in fire or injury.
- Do not transport, install, connect or inspect the product while the power is supplied. Doing so may result in electric shock.
- Be careful not to get your hands caught in the moving parts of the product. Doing so may result in injury and/or damage to equipment.
- After installing the product or after replacing the arm, make sure to perform a risk assessment that identifies and evaluates the hazards associated with the robot's operation and area. Based on hazards identified, implement risk reduction measures as necessary. A risk assessment process is available at ISO 12100. Failure to perform a risk assessment may result in injury and/or damage to equipment.
- Implement appropriate safety measures so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury. Refer Operation under the section "2 Safety precautions" on p.3, the Section "7 Maintenance" on p.18 and the robot controller **MRC01** USER MANUAL.

Installation and wiring

- Do not pull or forcibly bend the arm or cables, or lift the product body by holding the arm or cables. Doing so may result in injury or damage to equipment.
- The product body should be securely fixed according to the instructions. Failure to do so may result in injury or damage to equipment.
- Wiring and connection are done reliably according to the instructions. Failure to do so may result in fire or damage to equipment.
- To prevent fire caused by large current from the power supply side, install an external fuse as necessary.

Operation

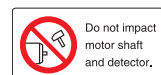
- Before operating a robot, check the condition of the surrounding area to ensure safety. This may cause injury or damage to equipment.
- Take appropriate safety measures when placing the motor in a non-excitation state. Failure to do so may result in injury or damage to equipment.
- When powering on the driver, make sure that no signal is input from the host controller. The product may start to move unintentionally, which may cause injury or damage to the equipment.
- If any abnormality is observed, immediately stop operation and cut off the power to the motor that drives the product. Failure to do so may result in injury or damage to the equipment.
- Do not turn off the power or input a signal to place the motor in a non-excitation state during operation. The robot may move unexpectedly, causing injury or damage to equipment.
- When operating the product after the driver power supply is turned on or the power to the motor is turned off, adjust the position at low speed to ensure safety.
- In the event of a power outage, turn off the power to the driver. The product may suddenly start up when the power is restored, resulting in injury or equipment damage to equipment.

Maintenance and inspection

- Perform pre-work (daily) inspections and periodic inspections in accordance with the instructions in the instruction manual and technical materials, and confirm that there are no abnormalities in the product and related equipment before starting work. Failure to do so may result in injury or damage to the equipment.
- **WARNING** Risk of personal injury. Sensors and controls shall only be serviced by a skilled person.
- Do not replace the motor of the product. Doing so may result in injury or damage to equipment.

CAUTION

- Do not use the product beyond its specifications. Doing so may result in injury or damage to equipment.
- Use the driver and cable connected to the motor in the specified combination. Failure to do so may cause fire, injury, or equipment damage.
- When connecting the motor and driver, be careful not to mix them up incorrectly. Incorrect wiring may result in unexpected operation. This may cause injury or damage to the equipment.
- Keep the area around the product free of combustible materials. Failure to do so may result in fire or a skin burn(s).
- Do not leave anything around the product that would obstruct ventilation. Doing so may result in damage to equipment.
- When conducting the insulation resistance measurement or the dielectric strength test, be sure to separate the connection between the product and the driver. Failure to do so may result in damage to the equipment.
- When installing and wiring, take measures against EMC. Failure to take effective measures against EMI from the product to the surrounding control system equipment, as well as the EMS of the product and driver, can cause serious damage to the functioning of the equipment. Check the EMC compatibility of the completed equipment. Failure to do so may result in injury or damage to equipment.
- When handling, take measures such as static electricity. The encoder (ABZO sensor) or driver of the motor that drives the product may malfunction or be damaged due to static electricity, etc. Failure to do so may result in injury or damage to the equipment.
- Do not move the encoder (ABZO sensor) toward a strong magnetic field. Doing so may cause damage to the encoder (ABZO sensor) or malfunction of the product. Doing so may cause injury or damage to the equipment.
- Do not enter within the robot's range of motion while it is in operation. Doing so may result in injury.
- If abnormal sound or vibration occurs during operation, stop operation. Failure to do so may result in injury or damage to the equipment.
- Be careful not to get your fingers caught in the stoppers that restricts the movement of the robot's L-axis (M2: lower arm) and U-axis (M3: upper arm). Failure to do so may cause injury.
- The motor surface temperature may exceed 70 °C (158 °F) even under normal operating conditions. If the operator is allowed to approach the motor in operation, affix a warning label shown in the figure on a conspicuous position. Failure to do so may result in a skin burn(s).
- To protect the encoder (ABZO sensor), use the motor at the case surface temperature of 80 °C (176 °F) or less. Failure to do so may result in damage to the equipment.
- Do not subject the encoder (ABZO sensor) to strong impact. Damage to the encoder (ABZO sensor) may cause the product to malfunction, resulting in injury or damage to equipment. The label shown in the diagram is attached to the motor.



3 Preparation

3-1 Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the Oriental Motor sales office from which you purchased the product.

■ Set (MSER-V)

- Robot **MSE3039K1-V** 1 unit
- Positioning pin 1 pc.
- Controller **MRC01** 1 unit
[CN1 connector (3 pins), CN4 connector (20 pins): each 1 pc.]
- Drivers **AZD-KD** 3 units
[CN1 connector (5 pins), CN4 connector (24 pins): each 3 pc.]
- Cables for motor **CC010VZR2-M** 3 pc.
- Cables for encoder **CC010VNR-E2** 3 pc.
- RS-485 communication cables **CC001-RS4** 4 pc.
- Unpacking instructions 1 copy
- Instructions and Precautions for Safe Use 1 copy

■ Robot (MSE3039K1-V)

- Robot **MSE3039K1-V** 1 unit
- Positioning pin 1 pc.
- Unpacking instructions 1 copy

3-2 How to identify the product model

■ Set

MSER - **V**
1 2

1	Motion System Master	
2	Robot type	V : Vertically articulated

■ Robot

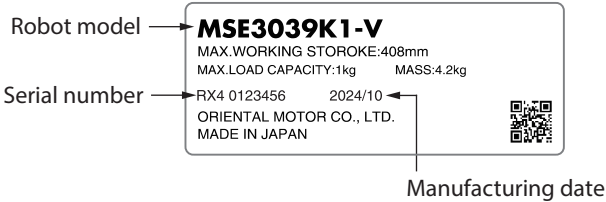
MSER **3** **039** **K** **1** - **V**
1 2 3 4 5

1	Number of axes	3 : 3-axis
2	Reach length	039 : 390 mm (15.35 in.)
3	Power supply input	K : 24 VDC
4	Payload	1 : 1 kg (2.2 lb.)
5	Robot type	V : Vertically articulated

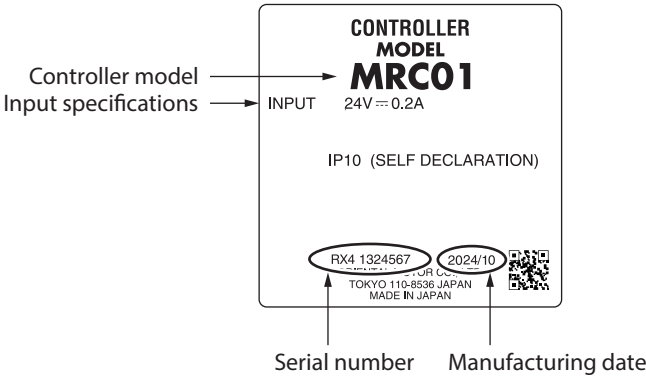
3-3 Information about nameplate

The figure shows an example.

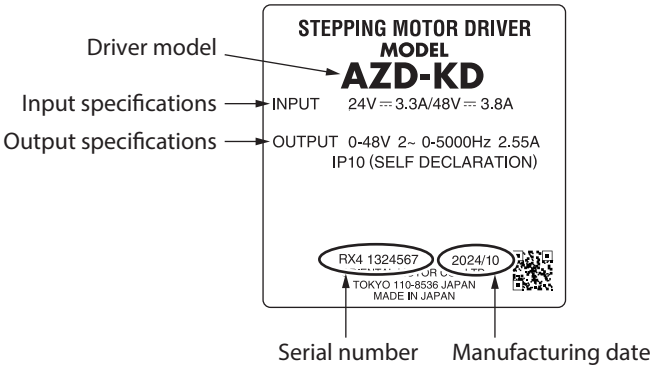
■ Robot



■ Controller



■ Driver



3-4 Names and functions of parts

The robot consists of 3 axes: S-axis (M1: swing), L-axis (M2: lower arm), U-axis (M3: upper arm). All motors are of the **AZ** Series equipped with a battery-free absolute encoder (ABZO sensor). There is no mechanism to hold the robot. Turning off the power or inputting a signal to place the motor in a non-excitation state will cause the arm to fall. The axis name can also be found by the number on the back of the motor.

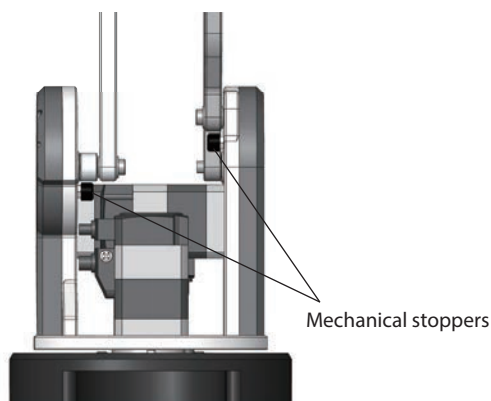


Axis	Axis name	Motor	Gear ratio
S-axis	M1	AZM46	18
L-axis	M2		
U-axis	M3		

3-5 Rotation limiting mechanical stopper

The L-axis (M2: lower arm) and U-axis (M3: upper arm) are equipped with mechanical stoppers that limit the range of motion.

Note The rotation limit mechanical stoppers are not intended to protect the axis (axes) from falling. Check to ensure safety to use.



4 Installation

4-1 Installation location

Install it in a well-ventilated location that provides easy access for inspection. The location must also satisfy the following conditions:

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature: 0 to +40 °C [+32 to +104 °F] (non-freezing)
- Operating ambient humidity: 85 % or less (non-condensing)
- Area free of explosive atmosphere, toxic gas (such as sulfuric gas), or liquid
- Area not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area not subject to splashing water (rain, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibration or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum
- Up to 1,000 m (3,300 ft.) above sea level

4-2 How to unpack

WARNING

Only for use by professionals under expert supervision.

1. Place the box on a horizontal, flat surface and unpack it. Remove the packaging materials and accessories.



2. Take out the robot and place it on a flat surface. When moving the robot, hold the gear case of the L-axis (M2: lower arm) and the gear case of the U-axis (M3: upper arm) with both hands. If you hold the product incorrectly, such as by holding it with one hand or only by the arm, the arm may move in an unexpected direction, resulting in a fall or injury.



3. Place the robot base on the flat surface and make sure the robot stay stable.
4. Rest the end of the arm on the flat surface. Be noted the arms and the base may move when handling the robot.



5. Once all the products have been removed, take out the white box.

Note

- There is no mechanism to hold the robot. Use caution when moving the robot.
- When placing the robot, be careful not to let any cables or connectors get caught between the robot and the mounting plate.

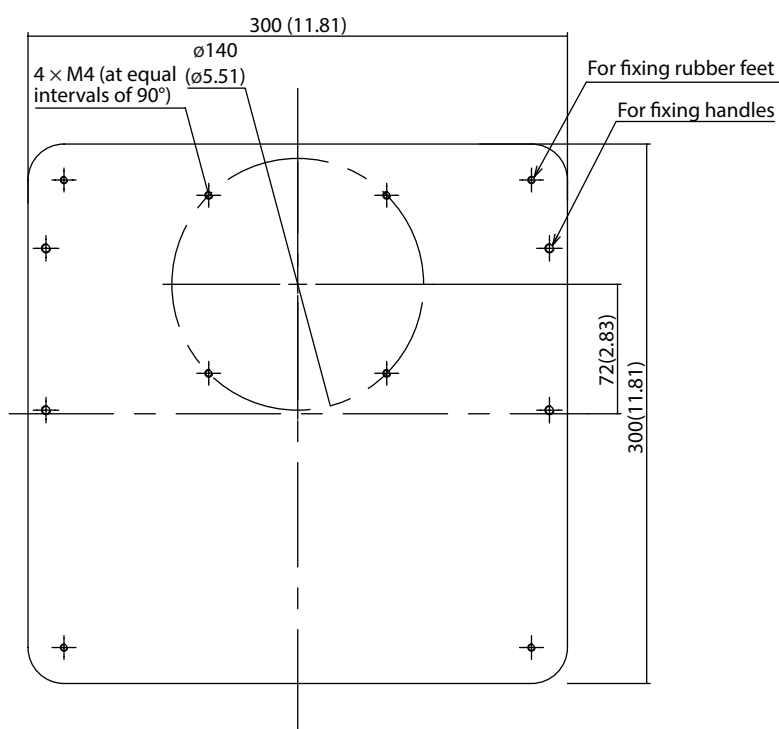
4-3 Installation method

Mounting plate is not provided. Prepare a mounting plate with screw holes. Install the robot with the installation surface facing down. Values of the tightening torque are recommended. Tighten the screws with a suitable torque according to the design conditions of the mounting plate.

⚠ WARNING

It is very important to mount the robot on the mounting plate as directed in this manual. If the robot is not mounted properly, the robot may tip-over and cause injury or damage.

■ Design for mounting plate [reference] [unit: mm (in.)]



● **Mounting plate specifications**

Mounting plate	Thickness	5 mm (0.20 in.) or more
	Material	Steel or aluminum
Mounting holes	Nominal size	M4
	Tightening torque	2 N·m (280 oz-in)

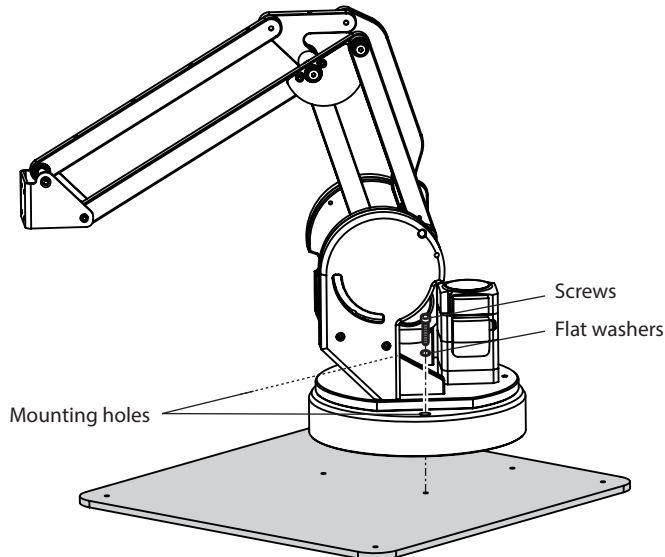
■ **Procedure**

When mounted properly the orientation of the arms should be towards the larger side of the base.

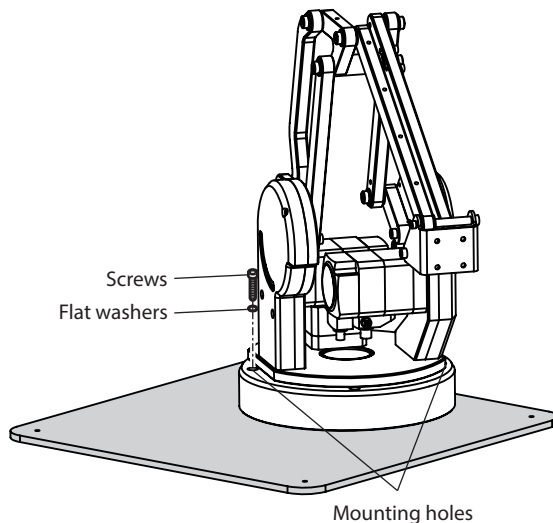
⚠ WARNING After installation, perform a risk assessment based on ISO 12100.

- Note**
- Ensure that the installation location has enough work space to safely perform teaching and maintenance inspections.
 - Be sure to install the robot from the upper side of the mounting plate. It cannot be installed from below the mounting plate.
 - When installing the product, do so in a stable condition so that the product does not tilt.
 - To prevent vibration, install the product on a metal surface of sufficient strength.

1. Use the diagonally spaced mounting holes (2 places) to attach the robot with screws.



2. Rotate the top of the robot and secure the remaining mounting holes (2 places).

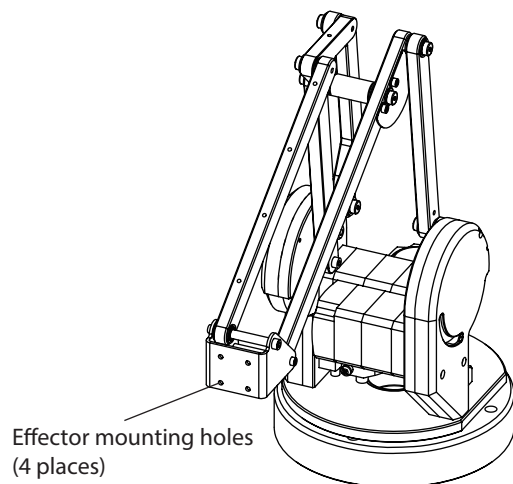


■ Attaching the end effector

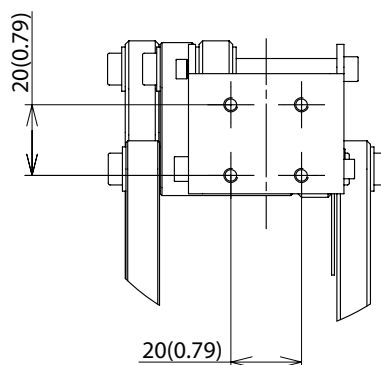
Use the end effector mounting holes (4 places) to attach the end effector with screws.

Values of the tightening torque are recommended. Tighten the screws with a suitable torque according to the design conditions of the mounting plate.

Nominal size	M4
Tightening torque	2 N·m (280 oz-in)
End effector mounting plate material	Steel or aluminum

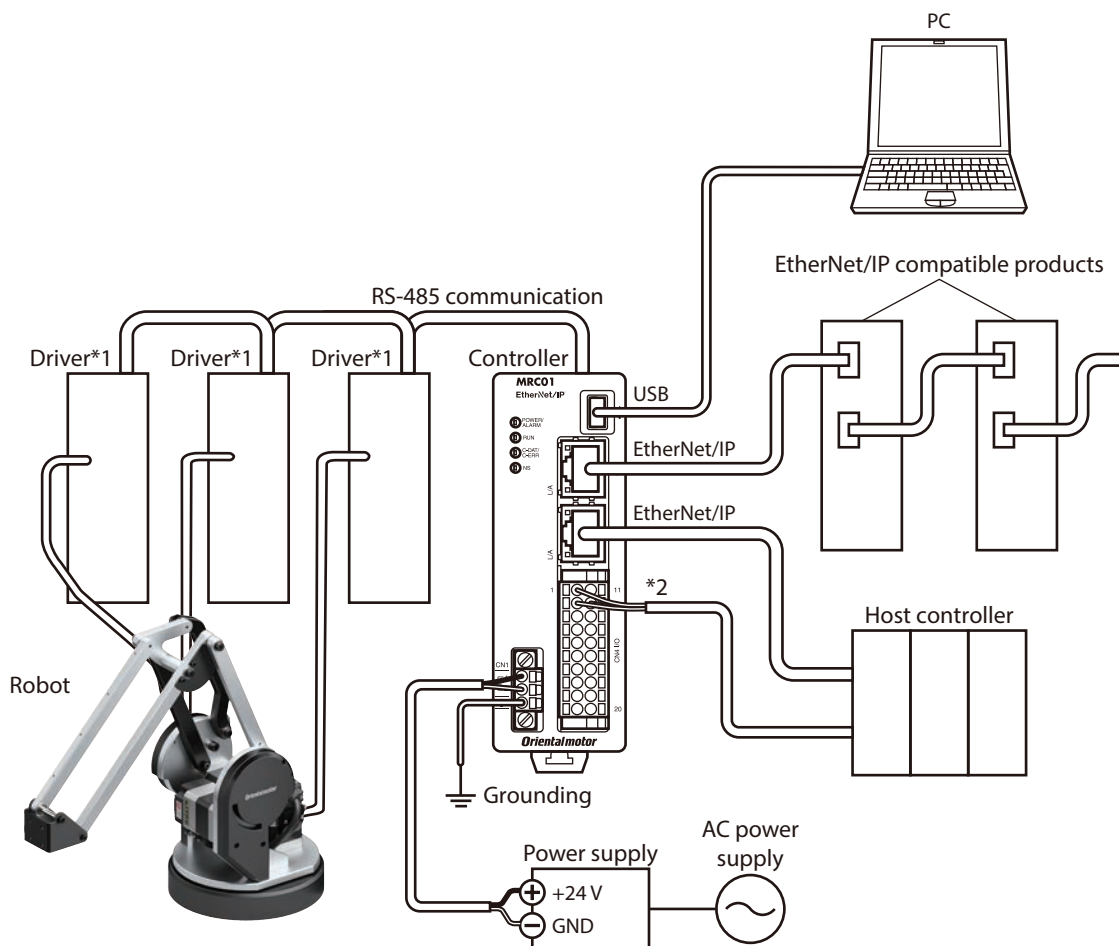


Mounting surface [unit: mm (in.)]



5 Before starting operation

5-1 System configuration



*1 Connect a power supply to each driver.

*2 Connect when using direct I/O or sensors.

⚠ WARNING

- The power supply should be connected by qualified personnel. Failure to do so may result in fire, injury, or damage to equipment.
- Use a DC power supply with reinforced insulation on its primary and secondary sides for a power supply. Failure to do so may result in electric shock.
- Ensure all connections are secure. Insufficient connection of cable connectors may result in unpredictable product behavior, which could cause personal injury or damage to the equipment.

Note

- If the motor cable or the power supply cable generates an undesirable amount of noise depending on the wiring or configuration, shield the cable or install a ferrite core.
- Keep 20 m (65.6 ft.) or less for the wiring distance between a motor and a driver.

5-2 Setup

Set the information of the robot with the **MRC Studio** software.

1. Start the **MRC Studio** software.
2. Click [COM port] to select "**MRC01**."
3. Click [Setup] on the start screen.
4. Set the robot type and the mechanism information according to the instructions on the screen.
The robot has three positioning pin holes for setting the origin. Use these when setting up the robot.
Pin size: $\varnothing 3\text{mm}$ ($\varnothing 0.1181\text{ in.}$)

Positioning pin insertion position

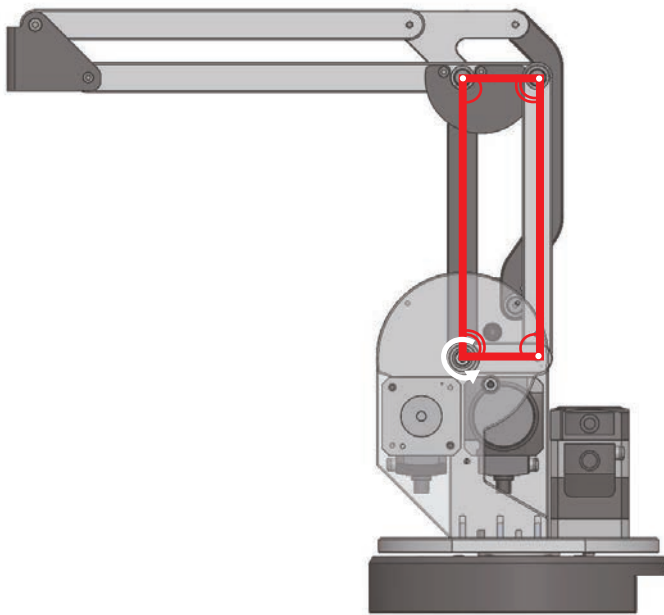


6 Customization

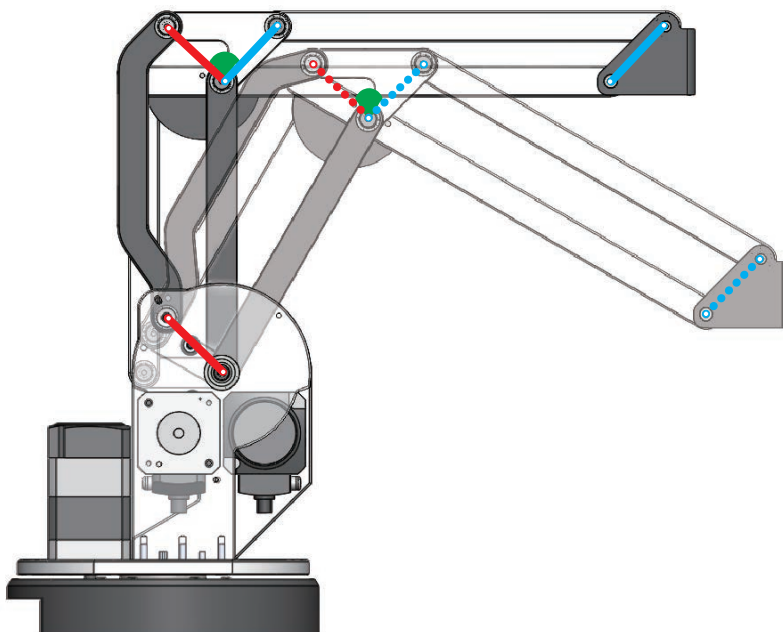
The robot's arms are replaceable. The range of motion can be expanded by customizing the length and shape of the arms. Even if you change the length of the arms, you can still operate the robot by simply changing the settings in **MRC Studio**.

■ Parallel linkage mechanism

In a robot with a parallel linkage mechanism, the opposing links are equal in length and form a parallelogram. Therefore, when you change the link angle by rotating the motor at the base, the link angle at the top also changes, and the end of the arm moves. Since the motor can be placed at the base, it has the characteristic of having a large payload.

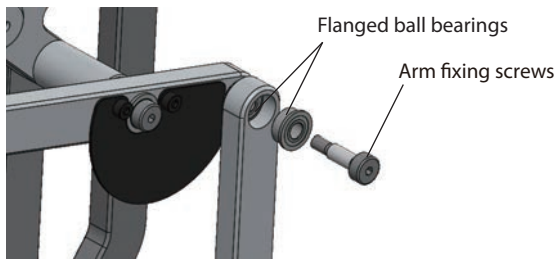


The opposing links of the red lines and blue lines are equal in length and form a parallelogram, so the red lines and blue lines always maintain the same angle to the installation surface. The angle of the green part where the red and blue lines intersect is also maintained. Therefore, the angle of the tip of the robot can always be kept horizontal, enabling stable horizontal transport.

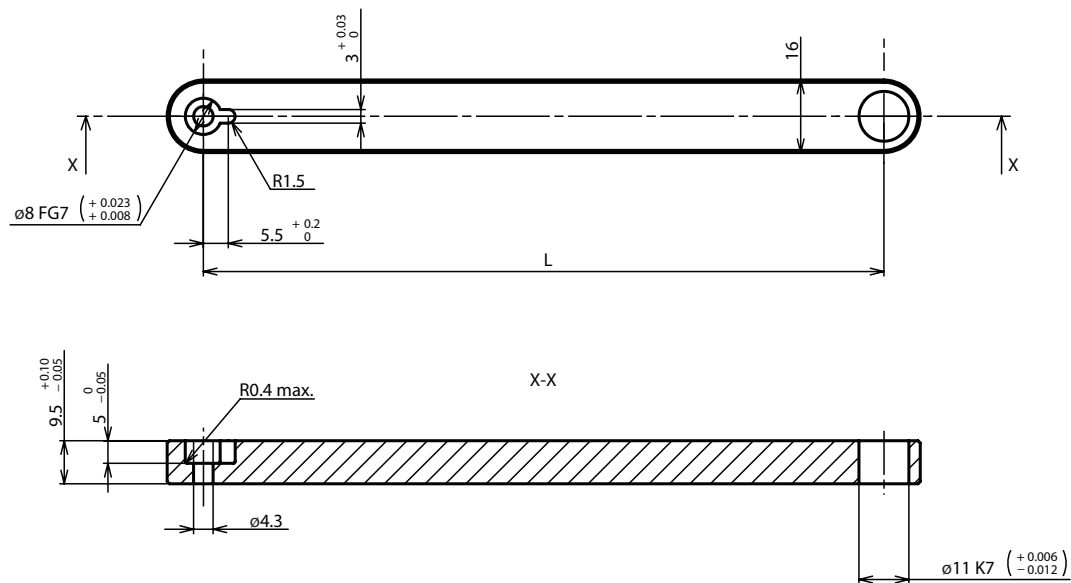


■ Arm Shape

The arm is clamped by a flanged ball bearing.
When designing the arm, please refer to the fitting dimensions below.



Arm design [reference] (unit: mm)



⚠ CAUTION

Be sure to chamfer the arm parts. Failure to do so may result in injury.

■ Procedure

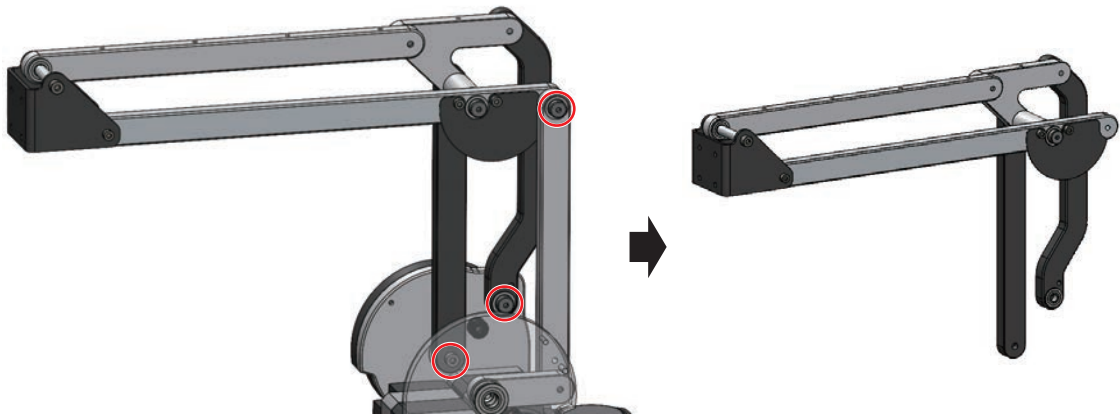
⚠ WARNING

- After replacing the arm, please perform the setup again in **MRC Studio**. If you operate the robot without performing the setup again, the robot may behave unexpectedly, which may result in injury or damage to the equipment.
- After replacing the arm, perform a risk assessment based on ISO 12100. Failure to do so may result in injury or damage to equipment.
- Be sure to fasten the arm with the specified tightening torque. If the arm is not fastened with the specified tightening torque, it may come off during operation, which may result in injury or damage to the equipment.

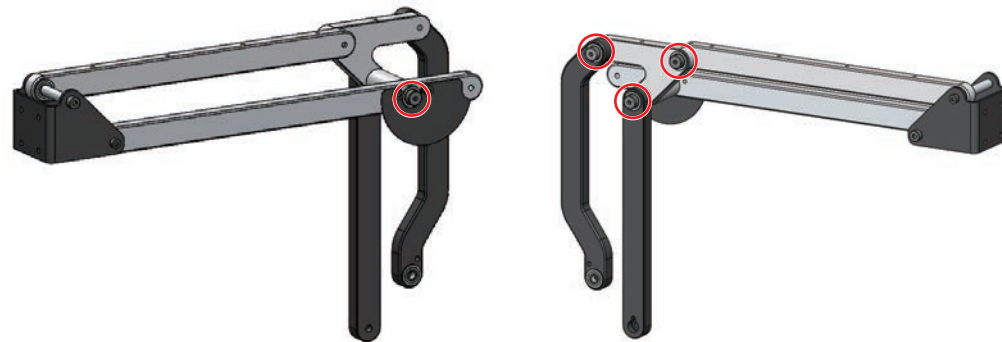
Note

Do not loosen or remove any screws not specified in the procedure, as this may result in a decrease in positioning accuracy or damage to the product.

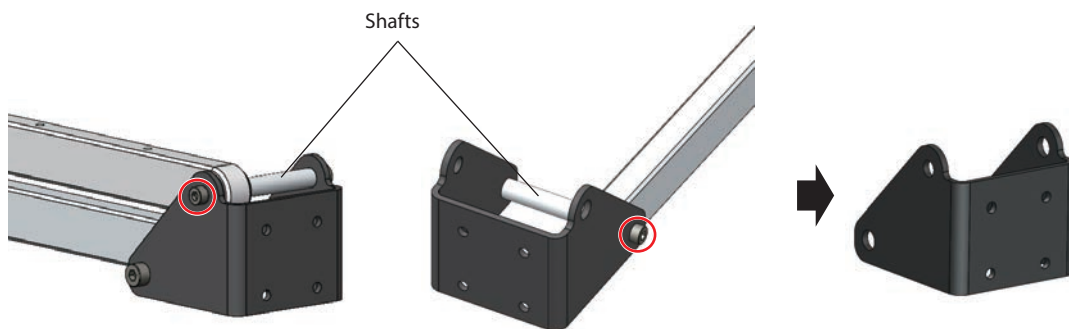
1. Remove the arm fixing screws (M4, 3 places) and remove the arm (black).



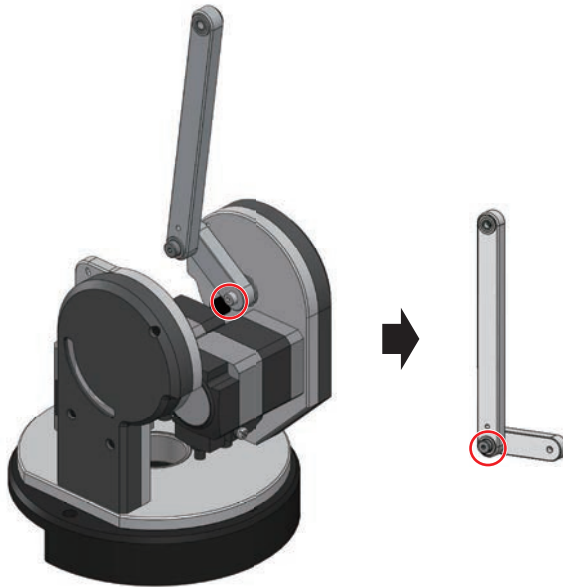
2. Remove the arm fixing screws (M4, 4 places) from the arm (black) and disassemble the arm.



3. While fixing the shaft, remove the arm fixing screws (M3, 2 places) and remove the end effector mounting parts.



4. Remove the arm fixing screw (M4, 1 place) and remove the arm (silver).
Remove the arm fixing screw (M4, 1 place) from the arm (silver) and disassemble the arm.



5. Replace and reinstall the arm. Follow the steps in reverse order to how you removed the arm.
Tightening torque (M3): 1 N·m (142 oz-in)
Tightening torque (M4): 2 N·m (280 oz-in)

■ Thread Locking

Threadlocking adhesive is applied to the screws that secure the arm.

If a screw is removed, clean both the male and female threads with a brush or similar tool before reassembly to remove any dirt and residual threadlocking adhesive.

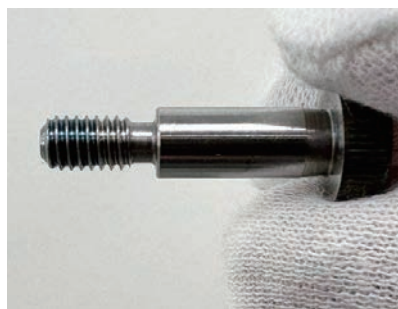
⚠ CAUTION

When retightening the screws, it is recommended to apply threadlocking adhesive. Ensure that the adhesive does not come into contact with bearings or surrounding components.

Excess adhesive around the screws may not cure properly and must be wiped off. Adhesive contamination of bearings or surrounding components may result in malfunction.

Threadlocking adhesive: LOCTITE 241 (Henkel AG & Co. KGaA)

✓ Proper application



The threadlocking adhesive is properly contained within the threads.

✗ Excessive application



The threadlocking adhesive is accumulated at the screw tip or extends beyond the threads.

7 Maintenance

Daily and periodic inspections should be carried out by workers with sufficient knowledge and experience in accordance with "2 Safety precautions" on p.3. Be sure to perform these inspections to prevent malfunctions and ensure safety, and confirm that there are no abnormalities in the product and related equipment before starting work. If you find any abnormality, please stop using it immediately and take any necessary repairs or other measures.

7-1 Inspection

■ Inspection interval

If the robot is operated eight hours a day, perform maintenance according to the applicable period specified in the table. Reduce maintenance intervals accordingly if the operating rate is high such as continuous operation for twenty-four hours.

Maintenance timing	Inspection	Cleaning
When operated for the first time	✓	—
Six months after initial operation	✓	—
Every six months thereafter	✓	—
As needed	—	✓

■ Inspection item

- Check if any of the screws having installed the product is loose.
- Check if any of the screws having installed a load is loose.
- Check if a damage or stress is applied on the cable.
- Check if the connection part between the motor and driver is loose.
- Check if an unusual noise or vibration is generated from a bearing part (ball bearings) when before and after turning on the power.
- Check if the operating position does not shift during return-to-home operation and during operation (original program operation).

WARNING

Ensure power is OFF to the robot before performing any inspections. Failure to power the robot off prior to performing an inspection may result in injury. If powering on the robot is absolutely necessary to complete the inspection, use additional caution and perform the inspections outside the moving range when possible.

Note

- When carrying out each inspection, please record the inspection results and special notes on the daily inspection sheet.
- When repairs are performed during inspection, please record the details and save it for at least 3 years.

■ Cleaning

- Wipe off any dirt and stains using a soft cloth. To remove stubborn stains, wipe the area using a soft cloth moistened with neutral detergent.
- Do not apply compressed air. Dust may enter through gaps.
- Do not use petroleum solvents, since they will damage the coated surface.

7-2 Warranty

Check on the Oriental Motor Website for the product warranty.

7-3 Disposal

Dispose the product correctly in accordance with laws and regulations, or instructions of local governments.

8 Specifications

8-1 Product specifications

Check on the Oriental Motor Website for the product specifications.

8-2 General specifications

Operating environment	Ambient temperature	0 to +40 °C [+32 to +104 °F] (non-freezing)
	Humidity	85 % or less (non-condensing)
	Altitude	Up to 1,000 m (3,300 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil
Storage environment Shipping environment	Ambient temperature	–20 to +60 °C [–4 to 140 °F] (non-freezing)
	Humidity	85 % or less (non-condensing)
	Altitude	Up to 3,000 m (10,000 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil

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Published in July 2026

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