



OPERATING MANUAL

Stepping motor α STEP AR Series FR geared type Motor Edition



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Introduction

■ Before use

Only qualified personnel of electrical and mechanical engineering should work with the product.

Use the product correctly after thoroughly reading the section "Safety precautions." In addition, be sure to observe the contents described in warning, caution, and note in this manual.

The product described in this manual is designed and manufactured to be incorporated in general industrial equipment. Do not use for any other purpose. Oriental Motor Co., Ltd. is not responsible for any compensation for damage caused through failure to observe this warning.

■ Related operating manuals

For operating manuals, download from Oriental Motor Website Download Page or contact your nearest Oriental Motor sales office.

- AR Series FR geared type OPERATING MANUAL Motor Edition (this document)
- AR Series/Motorized Actuator equipped with AR Series USER MANUAL
- APPENDIX UL Standards for AR Series

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.

Description of signs

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

Thank you for purchasing an Oriental Motor product.

This Operating Manual describes product handling procedures and safety precautions.

- Please read it thoroughly to ensure safe operation.
- Always keep the manual where it is readily available.

WARNING

General

- Do not use the motor 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, electric shock, or injury.
- Assign qualified personnel to the task of installing, wiring, operating/controlling, inspecting, and troubleshooting the motor. Handling by unqualified personnel may result in fire, electric shock, injury, or damage to equipment.
- Do not transport, install, connect, or inspect the motor while the power is supplied. Always turn the power off before carrying out these operations. This may result in electric shock.
- Take measures to keep the moving part in position if the motor is used in vertical operations such as elevating equipment. The motor loses the holding torque when the power is shut off, allowing the moving parts to fall and possibly cause injury or damage to equipment.
- The brake mechanism of the electromagnetic brake motor is used for the purpose to hold the moving part and motor in position. Do not use the brake mechanism of the electromagnetic brake motor for braking or as a safety brake. Doing so may result in injury or damage to equipment.

Installation

- When installing the motor, prevent from directly touching the motor, or make sure to ground it. Failure to do so may result in electric shock.

Connection

- Connect the motor securely according to the motor connection method explained in the [USER MANUAL](#). Failure to do so may result in fire or electric shock.
- Do not forcibly bend, pull, or pinch the connection cable. Doing so may result in fire or electric shock.

Repair, disassembly, and modification

- Do not disassemble or modify the motor. Doing so may result in electric shock or injury. Refer all such internal inspections and repairs to the Oriental Motor sales office from which you purchased the product.

CAUTION

General

- Do not use the motor beyond its specifications. Doing so may result in electric shock, injury, or damage to equipment.
- Do not touch the motor during operation or immediately after stopping. The surface is hot, and this may cause a skin burn(s).

Transportation

- Do not carry the motor by holding the motor output shaft, the load shaft, or the cable. Doing so may result in injury.

Installation

- Install the safety cover on the output shaft. Failure to do so may result in injury.
- Do not leave anything around the motor that would obstruct ventilation. Doing so may result in damage to equipment.

Operation

- Do not touch the motor output shaft or the load shaft during operation. Doing so may result in injury.
- Provide an emergency stop device or emergency stop circuit external to the equipment 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.
- 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).
- For a DC power supply for electromagnetic brake, use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.



Warning label

Inspection and maintenance

- Do not touch the terminals while conducting the insulation resistance measurement or the dielectric strength test. Doing so may result in electric shock.

Precautions for use

This section covers restrictions and requirements the user should consider when using the product.

- Be sure to use our cable to connect the motor and the driver.**

Check the cable models on p.7.

- When conducting the insulation resistance measurement or the dielectric strength test, be sure to separate the connection between the motor and the driver.**

Conducting the insulation resistance measurement or the dielectric strength test with the motor and the driver connected may result in damage to the product.

- Do not apply a radial load and axial load in excess of the specified permissible limit.**

Continuing to operate the motor under an excessive radial load or axial load may damage the bearings (ball bearings) of the motor. Be sure to operate the motor below the specified permissible limits of the radial load and axial load. Refer to p.6 for details.

- Use the motor in a condition where the motor surface temperature does not exceed 100 °C (212 °F).**

The motor does not have a function to protect from overheating. The surface temperature on the motor case may exceed 100 °C (212 °F) depending on operating conditions such as ambient temperature, operating speed, duty cycle, and others. To prevent the bearings (ball bearings) of the motor from reaching its usable life quickly, use the motor in a condition where the surface temperature does not exceed 100 °C (212 °F).

Also, use in a condition where the surface temperature of the gearhead does not exceed 70 °C (158 °F) in order to prevent deterioration of grease and parts in the gearhead.

If the motor is to be operated continuously, install the motor in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 250×250×6 mm (9.84×9.84×0.24 in.)] is ensured.

- Holding torque at standstill**

The motor holding torque is reduced by the current cutback function of the driver at motor standstill. When selecting a motor, check the holding torque at motor standstill in the specifications on the catalog.

- Do not use the electromagnetic brake for braking or as a safety brake.**

Do not use the electromagnetic brake as a means to brake and stop the motor. The brake hub of the electromagnetic brake will wear significantly and the braking force will drop.

Since the power off activated type electromagnetic brake is equipped, it helps maintain the position of the load when the power is cut off, but this brake is not a mechanism that holds the load in place securely. Do not use the electromagnetic brake as a safety brake. To use the electromagnetic brake to hold the load in place, do so after the motor has stopped.

- Noise elimination measures**

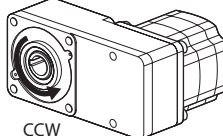
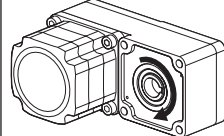
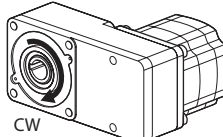
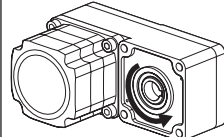
Refer to the [USER MANUAL](#) for the noise elimination measures.

- Peak torque**

Always operate the motor under a load not exceeding the peak torque. If the load exceeds the peak torque, the gear will be damaged.

- Rotation direction of the output shaft**

The rotation direction of the output shaft is set with the "Motor rotation direction" parameter. The rotation direction of the output shaft with respect to the setting of the "Motor rotation direction" parameter is shown below.

Setting of parameter	Viewed from front face	Viewed from rear face
Positive = CW or Positive direction = CW	 CCW	 CW
Positive = CCW or Positive direction = CCW	 CW	 CCW

- Do not perform push-motion operation**

Doing so may result in damage to the motor or gearhead.

- Grease measures**

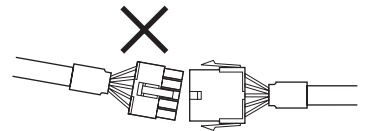
On rare occasions, a small amount of grease may ooze out from the motor. If there is concern over possible environmental damage resulting from the leakage of grease, check for grease stains during regular inspections. Alternatively, install an oil pan or other device to prevent leakage from causing further damage. Oil leakage may lead to problems in the customer's equipment or products.

■ Notes when the connection cable is used

Note the following points when our cable is used. The connector cover is not shown in the figure.

- When inserting the connector**

Hold the connector main body, and insert it in straight securely. Inserting the connector in an inclined state may result in damage to terminals or a connection failure.

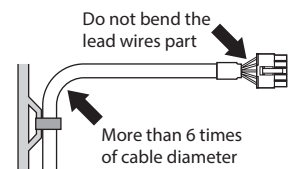


- When pulling out the connector**

Pull out the connector in straight while releasing the lock part of the connector. Pulling out the connector with holding the cable may result in damage to the connector.

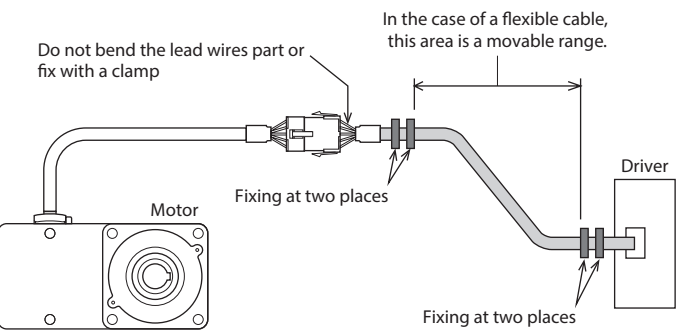
- Bending radius of cable**

Use the cable in a state where the bending radius of the cable is more than six times of the cable diameter. Do not bend the lead wires part or fix it with a clamp. Doing so may cause damage to the connector.



• How to fix the cable

Fix the cable near the connectors at two places as shown in the figure or fix it with a wide clamp to take measures to prevent stress from being applied to the connectors.



Preparation

■ 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.

- Motor1 unit
- Hexagonal socket head screw set1 set
(Hexagonal socket head screw, hexagonal nut, plain washer, spring washer4 pcs. each)
- Parallel key1 pc. *1
- Safety cover1 pc.
- Safety cover mounting screw (M3).....2 pcs.
- Varistor.....1 pc. *2
- OPERATING MANUAL Motor Edition (this manual)1 copy
- APPENDIX UL Standards for AR Series.....1 copy

*1 Included with the hexagonal socket head screw set.
*2 Included with the electromagnetic brake motor

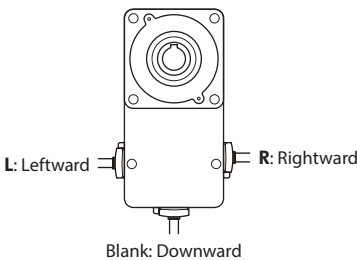
■ How to identify the product model

Verify the model name of the purchased product against the model name shown on the nameplate.

ARM 9 8 A K - FR 10 R
1 2 3 4 5 6 7 8

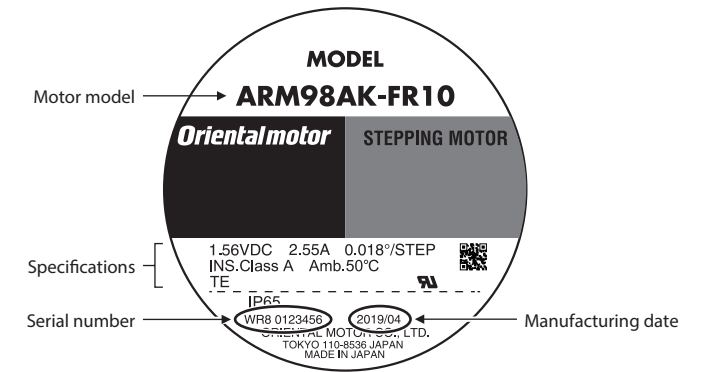
1	Series name	ARM: AR Series motor
2	Motor frame size	9: 90 mm (3.54 in.)
3	Motor length	
4	Motor type	A: Single shaft M: With electromagnetic brake
5	Motor power supply input	K: DC power input type
6	Type of gear	FR: FR geared
7	Gear ratio	
8	Cable outlet direction *	Blank: Downward R: Rightward L: Leftward

* The cable outlet direction represents that as viewed from the front face in a state where the output shaft is placed upward.



■ Information about nameplate

The figure shows an example.

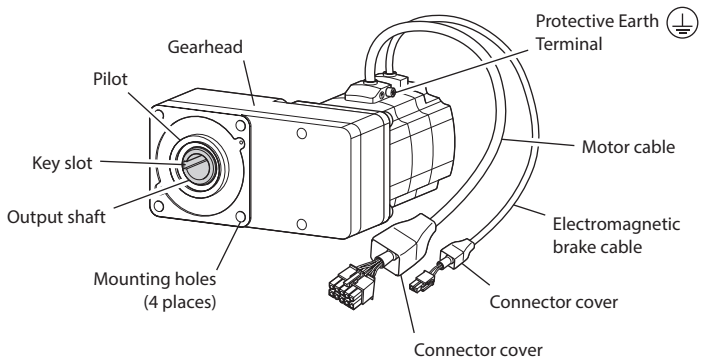


The position describing the information may vary depending on the product.

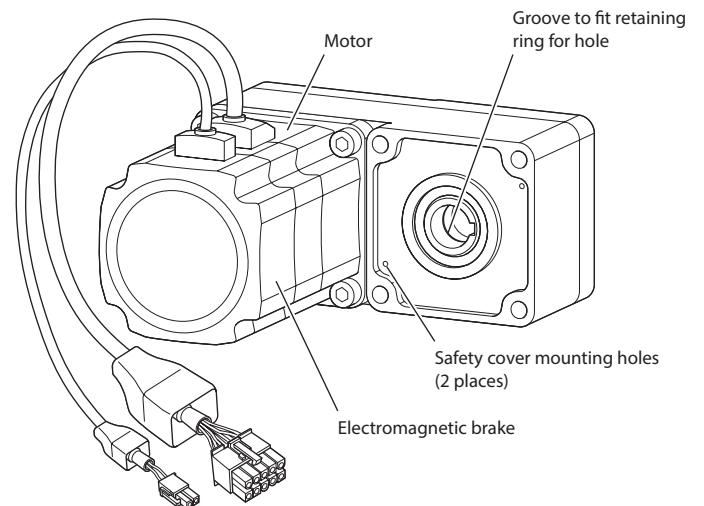
■ Names of parts

The figure shows an electromagnetic brake motor which cable outlet direction is rightward.

• Front face



• Rear face



Installation

■ Installation location

The motor is designed and manufactured to be incorporated in equipment. 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 +50 °C (+32 to +122 °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 vibrations 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

■ Installation direction

The motor can be installed in any direction.

■ Installation method

To allow for heat dissipation and prevent vibration, install the motor on a metal surface of sufficient strength.

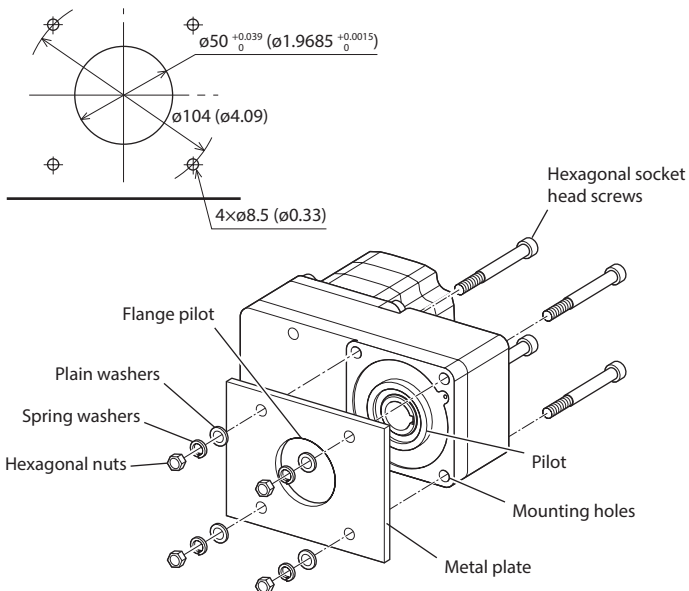
Use the included hexagonal socket head screw set to install the product.

- Nominal size of hexagonal socket head screw: M8
- Tightening torque: 12 N·m (106 lb·in)
- Board thickness: 12 mm (0.47 in.) or less

● Using the front face as the mounting surface

The center axes of the motor and the metal plate can be aligned using the pilot.

- Mounting holes dimension [unit: mm (in.)]

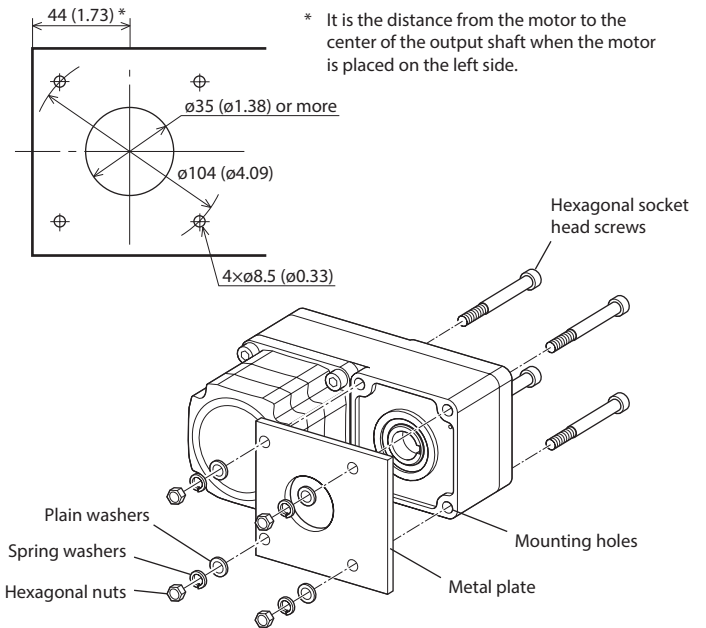


● Using the rear face as the mounting surface

When installing using the rear face, the center axes of the motor and the metal plate cannot be aligned due to no pilot.

If the centering is needed, adjust the center axes by yourself.

- Mounting holes dimension [unit: mm (in.)]



■ Installing the load shaft

Install the load shaft from the front face of the motor.

When installing the load shaft to the motor, align the center lines of the load shaft and the output shaft.

A key slot is provided on the output shaft. Form a key slot on the load side and secure the load and the output shaft using the included parallel key.

Note

- Apply grease (molybdenum disulfide grease, etc.) on the surface of the load shaft and inner walls of the output shaft to prevent seizure between them.
- When installing the load shaft to the output shaft, do not apply excessive force onto the output shaft or the bearings (ball bearings) or damage them. Forcing in the load shaft by driving it with a hammer or the like may break the bearings (ball bearings).
- Do not modify or machine the output shaft. Doing so may damage the bearings, leading to damage to the motor and the gearhead.

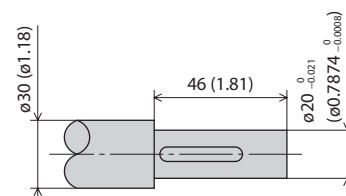
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If a large impact occurs at instantaneous stop or a large radial load is applied, use a stepped load shaft to install according to "Installation using end plate" on p.5. The position displacement of the output shaft and the load shaft can be prevented.

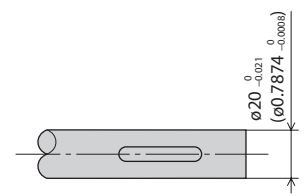
● Recommended load shaft installation dimensions

Inner diameter of output shaft [mm (in.)]	$\phi 20^{+0.033}_0$ ($\phi 0.7874^{+0.0013}_0$)
Nominal size	M6
Nominal diameter of retaining ring for hole [mm (in.)]	$\phi 20$ ($\phi 0.79$)
Thickness of the spacer [mm (in.)]	5 (0.20)

- Stepped load shaft [unit: mm (in.)]



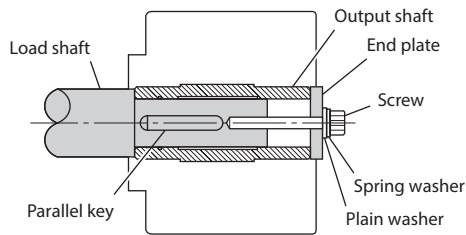
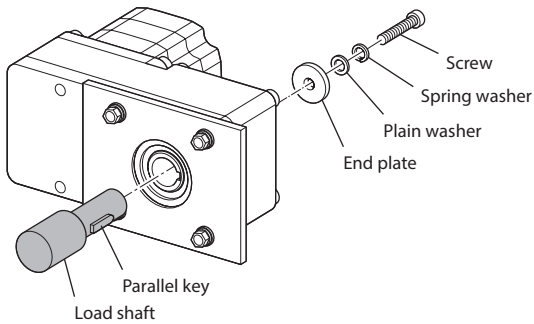
- Non-stepped load shaft [unit: mm (in.)]



● When the stepped load shaft is installed

● Installation using end plate

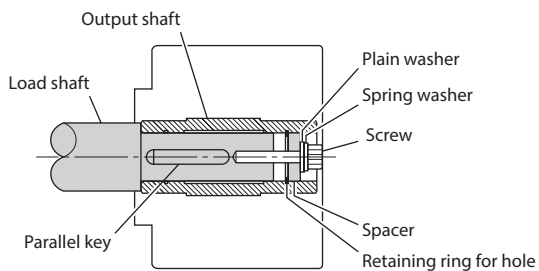
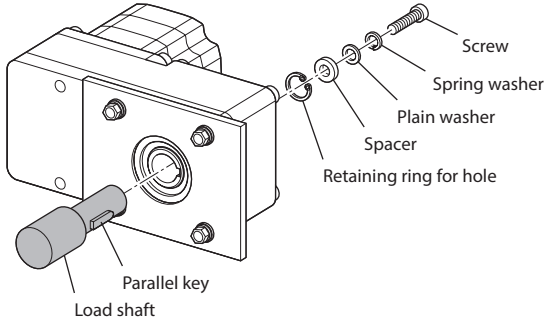
Use an end plate, a plain washer, and a spring washer to secure the load shaft with a screw.



When installing the load shaft using an end plate, the included safety cover cannot be installed because it touches the screw. Other measures to protect the output shaft is required by yourself.

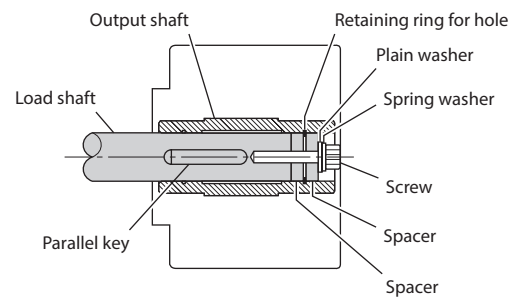
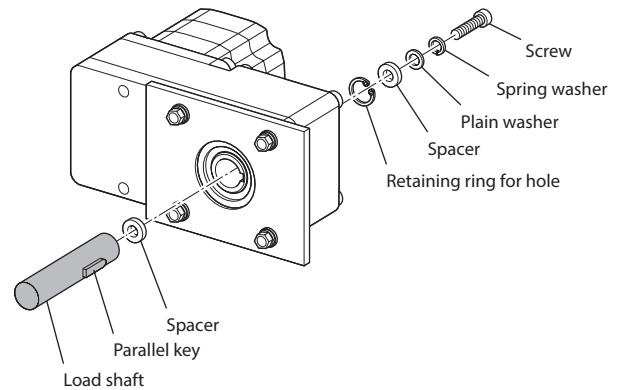
● Installation using retaining ring for hole

First, put a retaining ring for hole. Then, use a spacer, a plain washer, and a spring washer to secure the load shaft with a screw.



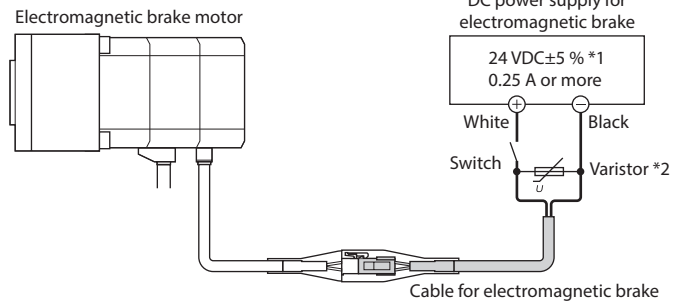
● When the non-stepped load shaft is installed

First, put a retaining ring for hole. Then, use spacers, a plain washer, and a spring washer to secure the load shaft with a screw. Also, put the spacer to the load shaft side.



● Electromagnetic brake motor

To release the electromagnetic brake and install the load, a DC power supply is needed to power the electromagnetic brake. Use a cable for electromagnetic brake to connect a DC power supply of 24 VDC to the motor.



*1 If the distance between the motor and driver is extended to 20 m (65.6 ft.) to 30 m (98.4 ft.), use a power supply of 24 VDC ± 4 %.

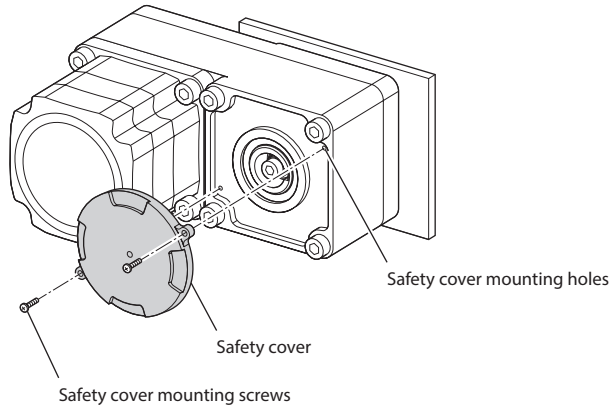
*2 Connect the included varistor to protect the contact of the switch or to prevent electrical noise.



The lead wires of the cable for electromagnetic brake have polarities, so connect them in the correct polarities. If the lead wires are connected with their polarities reversed, the electromagnetic brake will not operate properly.

■ Installing the safety cover

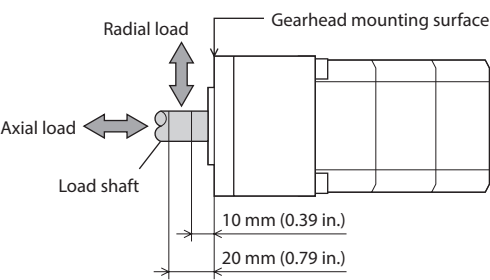
After installing the load shaft, install the included safety cover in order not to touch the output shaft.
Install the safety cover on the rear face.
Tightening torque: 0.45 N·m (63 oz-in)



Note When installing the load shaft using an end plate, the included safety cover cannot be installed because it touches the screw. Other measures to protect the output shaft is required by yourself.

■ Permissible radial load and permissible axial load

Note If the radial load or axial load exceeds the specified permissible value, repeated load applications may cause the bearings (ball bearings) or output shaft of the motor to undergo a fatigue failure.



Gear ratio	Permissible radial load [N (lb.)]		Permissible axial load [N (lb.)]
	Distance from the gearhead mounting surface		
	10 mm (0.39 in.)	20 mm (0.79 in.)	
10	900 (200)	770 (173)	500 (112)
20	1,300 (290)	1,110 (240)	
30, 50	1,500 (330)	1,280 (280)	

Connection

■ Connection with the driver

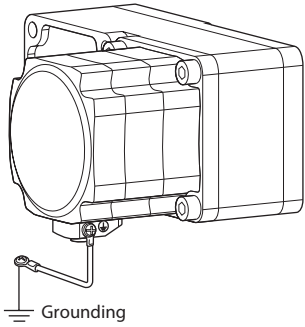
Refer to the USER MANUAL for the connection method.
Cover the connected connectors using a connector cover.

■ Grounding the motor

Make sure to ground the Protective Earth Terminal of the motor. (It is no need to ground when the driver power supply voltage is 24 VDC.)

- Nominal size: M4
- Tightening torque: 1.2 N·m (170 oz-in)

Use a grounding wire of AWG18 (0.75 mm²) or more.
When grounding, use a round terminal and secure it with a screw with a washer. A grounding wire and a crimp terminal are not included.



Inspection and maintenance

■ Inspection

It is recommended that periodic inspections be conducted for the items listed below after each operation of the motor. If an abnormal condition is noted, discontinue any use and contact your nearest Oriental Motor sales office.

- Inspection item
- Check if any of the screws having installed the motor is loose.
- Check if the bearings (ball bearings) of the motor or the gear meshing part of the gearhead generates unusual noises.
- Check if the output shaft and the load shaft are out of alignment.
- Check if a damage or stress is applied on the cable.
- Check if the connection part between the motor and driver is loose.

■ Warranty

Check on the Oriental Motor Website for the product warranty.

■ Disposal

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

Specifications

Check on the catalog for the product specifications.

General specifications

Degree of protection	IP65 (Excluding the mounting surface and connectors)	
Operating environment	Ambient temperature	0 to +50 °C (+32 to +122 °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	Ambient temperature	–20 to +60 °C (–4 to +140 °F) (non-freezing)
Shipping environment	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
Insulation resistance	100 MΩ or more when 500 VDC megger is applied between the following places: • Case - Motor and sensor windings • Case - Electromagnetic brake windings	
Dielectric strength	Sufficient to withstand the following for 1 minute: • Case - Motor and sensor windings 1.0 kVAC 50/60 Hz • Case - Electromagnetic brake windings 1.0 kVAC 50/60 Hz	

Regulations and standards

■ UL Standards

Check the [APPENDIX UL Standards for AR Series](#) for recognition information about UL Standards.

■ CE Marking

The motor conforms to the EMC Directive in a state where the motor is connected with the driver. Refer to the [USER MANUAL](#) for details.

■ RoHS Directive

This product does not contain the substances exceeding the restriction values.

Cables



When installing the motor on a moving part, use a flexible cable.

■ Connection cables

These cables are used when connecting a motor and a driver.
The cable set for electromagnetic brake motors consists of two cables, one for motor and the other for electromagnetic brake.

● Connection cable set model name

Length [m (ft.)]	For standard type	For electromagnetic brake type
1 (3.3)	CC010VAF2	CC010VAFB2
2 (6.6)	CC020VAF2	CC020VAFB2
3 (9.8)	CC030VAF2	CC030VAFB2
5 (16.4)	CC050VAF2	CC050VAFB2
7 (23)	CC070VAF2	CC070VAFB2
10 (32.8)	CC100VAF2	CC100VAFB2
15 (49.2)	CC150VAF2	CC150VAFB2
20 (65.6)	CC200VAF2	CC200VAFB2
30 (98.4)	CC300VAF2	CC300VAFB2

● Flexible connection cable set model name

Length [m (ft.)]	For standard type	For electromagnetic brake type
1 (3.3)	CC010VAR2	CC010VARB2
2 (6.6)	CC020VAR2	CC020VARB2
3 (9.8)	CC030VAR2	CC030VARB2
5 (16.4)	CC050VAR2	CC050VARB2
7 (23)	CC070VAR2	CC070VARB2
10 (32.8)	CC100VAR2	CC100VARB2
15 (49.2)	CC150VAR2	CC150VARB2
20 (65.6)	CC200VAR2	CC200VARB2
30 (98.4)	CC300VAR2	CC300VARB2

■ Extension cables

Use if the length of the connection cable used is not enough when extending the distance between a motor and a driver.
Extend the distance by connecting the extension cable to the connection cable.

The cable set for electromagnetic brake motors consists of two cables, one for motor and the other for electromagnetic brake.



When extending the wiring length by connecting an extension cable to the connection cable, keep the total cable length to be 30 m (98.4 ft.) or less.

● Extension cable set model name

Length [m (ft.)]	For standard type	For electromagnetic brake type
1 (3.3)	CC010VAF2	CC010VAFB2
2 (6.6)	CC020VAF2	CC020VAFB2
3 (9.8)	CC030VAF2	CC030VAFB2
5 (16.4)	CC050VAF2	CC050VAFB2
7 (23)	CC070VAF2	CC070VAFB2
10 (32.8)	CC100VAF2	CC100VAFB2
15 (49.2)	CC150VAF2	CC150VAFB2
20 (65.6)	CC200VAF2	CC200VAFB2

● Flexible extension cable set model name

Length [m (ft.)]	For standard type	For electromagnetic brake type
1 (3.3)	CC010VART2	CC010VARBT2
2 (6.6)	CC020VART2	CC020VARBT2
3 (9.8)	CC030VART2	CC030VARBT2
5 (16.4)	CC050VART2	CC050VARBT2
7 (23)	CC070VART2	CC070VARBT2
10 (32.8)	CC100VART2	CC100VARBT2
15 (49.2)	CC150VART2	CC150VARBT2
20 (65.6)	CC200VART2	CC200VARBT2

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