

## OPERATING MANUAL

### Hollow Rotary Actuator DH Series Actuator 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.

### Overview of the product





The hollow rotary actuator DH Series (hereinafter referred to as "actuator") is an actuator that a hollow table is used for the output shaft of a 5-phase stepping motor.

## 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.

You must not operate the actuator (operate the equipment for the specified purpose) if the machine in which the actuator is installed does not satisfy the related safety standards. The factory safety manager or safety personnel in charge of the applicable machine must ensure that the machine is operated only by qualified personnel who are familiar with the operation of electronic equipment, and thereby prevent injury or damage to the equipment.

The term "qualified personnel" refers to persons who have received the necessary training or education and have pertinent experience; who are familiar with the relevant standards, regulations, accident-prevention rules and inspection conditions; who are authorized by the factory safety manager to engage in the necessary activities; and who have the ability to discern and prevent potential dangers.

|   |  |
|---|--|
|   | 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 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.
- Assign qualified personnel to the task of installing, wiring, operating/controlling, inspecting, and troubleshooting the product. Handling by unqualified personnel may result in fire, injury, or damage to equipment.
- Do not transport, install, connect or inspect the product while the power is supplied. Doing so may result in electric shock.
- 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.
- When an alarm is generated in the driver (any of the driver's protective functions is triggered), take measures to hold the moving part in a specific position since the actuator stops and loses its holding torque. Failure to do so may result in injury or damage to equipment.
- When having replaced the driver, set the resolution, the traveling direction or others before operating. If the actuator is operated without setting the resolution or the traveling direction, the output table may move to unexpected directions or run at unexpected speeds, leading to injury or mechanical damage.

### Installation

- Install the actuator inside an enclosure. Failure to do so may result in injury.
- When installing the actuator, install it inside an enclosure so that it is out of the direct reach of users. Be sure to ground if users can touch it. Failure to do so may result in electric shock.

### Connection

- Do not forcibly bend, pull, or pinch the lead wire or cable. Doing so may result in fire.

### Repair, disassembly, and modification

- Do not disassemble or modify the actuator. Doing so may result in injury or damage to equipment.

## CAUTION

### General

- Do not use the actuator beyond its specifications. Doing so may result in injury or damage to equipment.
- Keep your fingers and objects out of the openings in the actuator. Failure to do so may result in fire, electric shock or injury.
- Do not touch the actuator during operation or immediately after stopping. The surface is hot, and this may cause a skin burn(s).
- Do not carry the actuator by holding the moving part, lead wire, or cables. Doing so may cause injury.

### Installation

- Do not place combustibles around the actuator. Doing so may result in fire or a skin burn(s).
- Do not leave anything around the actuator that would obstruct ventilation. Doing so may result in damage to equipment.

### Operation

- Use an actuator and a driver only in the specified combination. An incorrect combination may cause a fire.
- Do not touch the moving part during operation. Doing so may cause injury.
- While the actuator is operated, do not make the lead wire contact with the moving part. Doing so may result in disconnection in the lead wire, leading to electric shock or damage.
- The motor surface temperature may exceed 70 °C (158 °F) even under normal operating conditions. If the operator is allowed to approach the actuator in operation, affix a warning label shown in the figure on a conspicuous position.



Warning label

## Precautions for use

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

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

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

- **Do not apply an axial load and moment load in excess of the specified permissible limit**

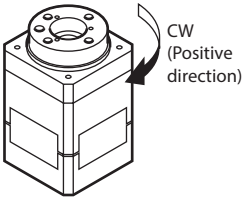
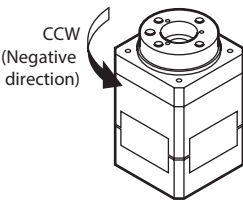
Be sure to operate the actuator within the specified permissible limit of axial load and moment load. Continuing to operate the actuator under a axial load or moment load exceeding the permissible value may cause malfunction or shorter service life of the actuator.

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

If the motor surface temperature exceeds 100 °C (212 °F) due to the operating conditions (ambient temperature, operating speed, operating duty, etc.), the motor windings may burn out or the lifetime of the bearings (ball bearings) may be reduced.

- **Rotation direction of output table**

The rotation direction of the output table varies depending on the setting of the travel amount or the input method of the pulse signal.

| Setting  | Rotation direction of output table  |
|--|---|
| <b>Operation by setting of parameter</b><br>Set the travel amount to the positive (+) direction  |  CW<br>(Positive direction)   |
| <b>Operation by pulse signal</b><br>• 2-pulse input mode<br>Input the pulse signal to the CW input<br>• 1-pulse input mode<br>Input the pulse signal to the PLS input while the DIR input is ON.   |   |
| <b>Operation by setting of parameter</b><br>Set the travel amount to the negative (-) direction  |  CCW<br>(Negative direction) |
| <b>Operation by pulse signal</b><br>• 2-pulse input mode<br>Input the pulse signal to the CCW input<br>• 1-pulse input mode<br>Input the pulse signal to the PLS input while the DIR input is OFF. |   |

- **Holding torque at standstill**

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

- **Notes when the connection cable is used**

Note the following points when our cable is used.

- **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 connector or a connection failure.

- **When pulling out the connector**

Hold both ends of the connector main body, and pull out it straight. Pulling out the connector with holding the lead wire may result in damage to the connector.



Secure the lead wires at the connection part of the connector to prevent the connector or terminals from receiving stress due to bending or self-weight of lead wires. Also, do not excessively bend the lead wires near the connection part of the connector. Applying stress on the lead wires may cause poor contact or disconnection, leading to malfunction or heat generation.

## 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.

- Hollow rotary actuator ..... 1 unit
- Instructions and Precautions for Safe Use ..... 1 copy

### How to identify the product model

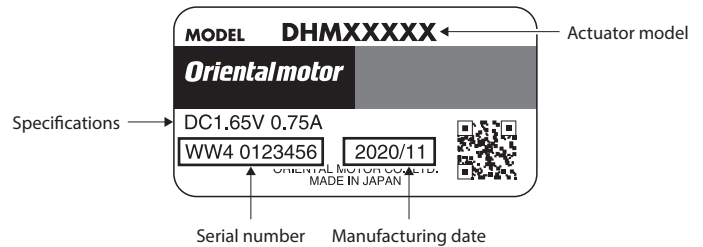
**DHM 28 P A K 2**

1 2 3 4 5 6

|   |                        |  |
|---|------------------------|--|
| 1 | Series                 | <b>DHM: DH Series</b>                                      |
| 2 | Motor frame size       | <b>28:</b> 28 mm (1.10 in.)<br><b>42:</b> 42 mm (1.65 in.) |
| 3 | Type of motor          | <b>P:</b> 5-phase stepping motor                           |
| 4 | Shape of motor         | <b>A:</b> Standard   |
| 5 | Specification of motor | <b>K:</b> DC power input type                              |
| 6 | Reference number       |  |

### Information about nameplate

The figure shows an example.

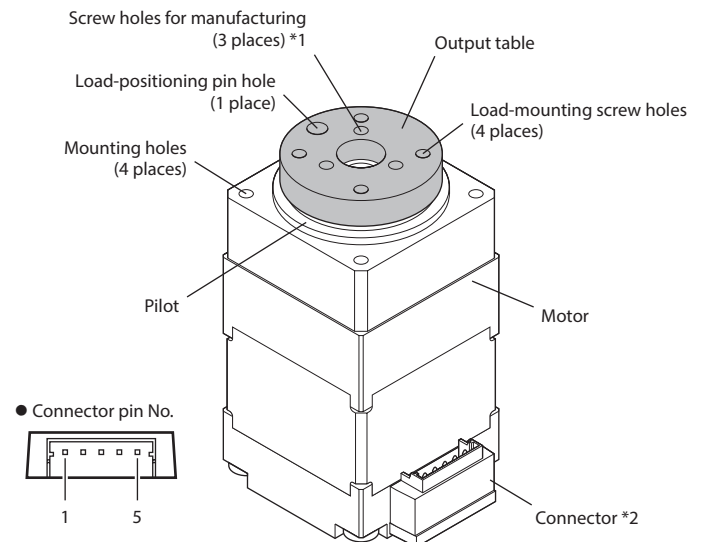


The position describing the information may vary depending on the product.

### Names and functions of parts

The area indicated in gray color represents a moving part.

The figure shows the **DHM28PAK2**.



\*1 These are holes for manufacturing. Do not use them.

\*2 The **DHM42PAK** is an actuator of the lead wire type.

## Applicable connector and lead wire

| Actuator model | Type                     | Manufacturer model   |
|----------------|--------------------------|--|
| DHM28PAK2      | Connector housing        | 51065-0500 (Molex, LLC)  |
|                | Contact                  | 50212-8XXX (Molex, LLC)  |
|                | Designated crimping tool | 63819-0500 (Molex, LLC)  |
|                | Applicable lead wire     | AWG24 (0.2 mm <sup>2</sup> )<br>Outer sheath diameter:<br>ø1.4 mm (ø0.055 in.) or less<br>Stripping length of wire insulation:<br>1.3 to 1.8 mm (0.051 to 0.071 in.) |

## Drivers possible to combine

| Actuator model        | Driver model                        |                           |                          |
|-----------------------|-------------------------------------|---------------------------|--------------------------|
|                       | Pulse input type                    | RS-485 communication type | Built-in controller type |
| DHM28PAK2<br>DHM42PAK | CVD507BR-K<br>CVD507B-K<br>CVD507-K | CVD5BR-KR<br>CVD5B-KR     | CRD507-KD                |

## Installation

This section explains the installation environment and installation method of the actuator, and the installation method of a load.

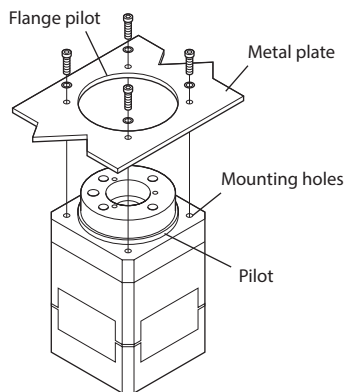
### Installation location

The actuator 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 +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 vibrations or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum
- 1,000 m (3,300 ft.) or lower above sea level

### Installation method

The actuator can be installed in any direction. Install the actuator onto an appropriate flat metal plate having excellent vibration resistance and heat conductivity. When installing the actuator, use four mounting holes and secure the actuator with four screws (not included) so that there is no gap between the actuator and the metal plate. Values of the tightening torque are recommended. Tighten the screws with a suitable torque according to the design conditions of the load.



**Note** Fit the pilot located on the actuator mounting surface into a flange pilot.

| Model     | Nominal size | Tightening torque  | Effective depth of screw thread |
|-----------|--------------|--------------------|---------------------------------|
| DHM28PAK2 | M2.5         | 0.5 N·m (71 oz-in) | 5 mm (0.20 in.)                 |
| DHM42PAK  | M3           | 1 N·m (142 oz-in)  |                                 |

## Installing a load

Install a load with screws using the load-mounting screw holes (four places) on the output table. Use the load-positioning pin hole (one place) of the output table when positioning a load.

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

### Specifications of load-mounting screw holes

| Model     | Nominal size | Tightening torque  | Effective depth of screw thread |
|-----------|--------------|--------------------|---------------------------------|
| DHM28PAK2 | M2.5         | 0.5 N·m (71 oz-in) | 3 mm (0.12 in.)                 |
| DHM42PAK  | M4           | 2 N·m (280 oz-in)  | 4 mm (0.16 in.)                 |

### Specifications of load-positioning pin hole

| Model     | Diameter  | Depth           |
|-----------|---|-----------------|
| DHM28PAK2 | ø3 <sup>+0.01</sup> <sub>0</sub> mm (0.1181 <sup>+0.0004</sup> <sub>0</sub> in.)  | 3 mm (0.12 in.) |
| DHM42PAK  | ø4 <sup>+0.012</sup> <sub>0</sub> mm (0.1575 <sup>+0.0005</sup> <sub>0</sub> in.) | 4 mm (0.16 in.) |

**Note** Be sure to secure the positioning pin to the load side. Driving the positioning pin to the output table may damage bearings due to an impact or an excessive moment of inertia.

## Permissible axial load and permissible moment load

The axial load and moment load on the output table must be kept the under the permissible values listed in the table below.

| Model     | Permissible axial load | Permissible moment load |
|-----------|------------------------|-------------------------|
| DHM28PAK2 | 40 N (9 lb.)           | 0.1 N·m (14.2 oz-in.)   |
| DHM42PAK  | 150 N (33 lb.)         | 0.4 N·m (56 oz-in.)     |

**Note** If the operation is continued in a state where the axial load or moment load in excess of the permissible values is applied, causing the output table or bearings (ball bearings) to damage.

## How to calculate loads

This example explains how to calculate a load when an external force  $F$  (N) is applied to a position that is extended  $L$  (m) in the horizontal direction from the center of the output flange.

### How to read a code

- $\Delta M$ : Load moment (N·m)
- $F$ : External force (N)
- $L$ : Overhang distance (m)
- $M$ : Permissible moment load (N·m)
- $\Delta F$ : Load applied on the output flange surface (N)
- $m$ : Mass of a load (kg)
- $g$ : Gravitational acceleration (m/s<sup>2</sup>)
- $F_s$ : Permissible axial load (N)

- Load moment

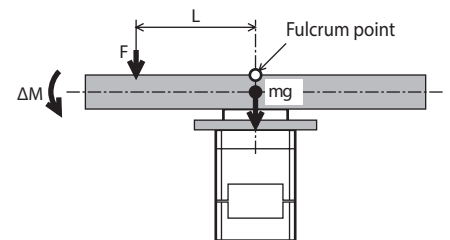
$$\Delta M = F \cdot L$$

$$\Delta M \leq M$$

- Axial load

$$\Delta F = F + m \cdot g$$

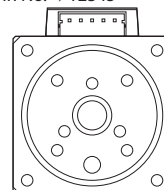
$$\Delta F \leq F_s$$



## Connection

Refer to the following table when connecting with the drivers of Oriental Motor. For details, refer to operating manual of the driver.

Pin No. → 12345



| Driver Pin No. | Connector-coupled type |                   | Lead wires type |
|----------------|------------------------|-------------------|-----------------|
|                | Pin No.                | Lead wire color * | Lead wire color |
| 1              | 1                      | Blue              | Blue            |
| 2              | 2                      | Red               | Red             |
| 3              | 3                      | Orange            | Orange          |
| 4              | 4                      | Green             | Green           |
| 5              | 5                      | Black             | Black           |

\* It indicates the lead wire color of the connection cable of Oriental Motor.

## Inspection and maintenance

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

### ■ Maintenance item

- Check if any of the screws having installed the actuator is loose.
- Check if an unusual noise is generated from the actuator.
- Check if a damage or stress is applied on the lead wire.
- Check if the connection part between the actuator 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

### ■ Product specification

Check on the Oriental Motor Website for the product specifications.

### ■ General specifications

|   |  |  |
|---|--|--|
| Operation environment                       | Ambient temperature  | 0 to +40 °C (+32 to +104 °F) (non-freezing)  |
|   | Ambient humidity   | 85 % or less (non-condensing)                |
|   | Altitude   | Up to 1,000 m (3,300 ft.) above sea level    |
| Shipping environment<br>Storage environment | Ambient temperature  | -20 to +60 °C (-4 to +140 °F) (non-freezing) |
|   | Ambient humidity   | 85 % or less (non-condensing)                |
|   | Altitude   | Up to 3,000 m (10,000 ft.) above sea level   |
| Heat resistance class                       | 130 (B)  |  |
| Insulation resistance                       | 100 MΩ or more when 500 VDC megger is applied between the case and the motor windings.   |  |
| Dielectric strength                         | Sufficient to withstand the following conditions applied between the case and the motor windings for 1 minute.<br><b>DHM28:</b> AC0.5 kV 50 Hz or 60 Hz<br><b>DHM42:</b> AC1.0 kV 50 Hz or 60 Hz |  |

## Regulations and standards

### ■ CE Marking

#### ● EMC Directive

The EMC test is conducted in a state where the actuator is connected to the driver. The driver that is combined with the actuator complies with the EMC Directive. Refer to the operating manual of the driver for details.

#### ■ RoHS Directive

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