



## OPERATING MANUAL

### 2-Phase Stepping Motor PKP Series SH Geared Type

#### Introduction

##### ■ Before use

Only qualified personnel of electrical and mechanical engineering should work with the product. Use the product correctly after thoroughly reading the "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 has been 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 damage caused through failure to observe this warning.

#### Safety precautions

The precautions described below are intended to prevent danger or injury to the user and other personnel through safe, correct use of the product. 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.

##### Description of graphic symbols

	Indicates "prohibited" actions that must not be performed.
	Indicates "compulsory" actions that must be performed.

<b>WARNING</b>	
	<ul style="list-style-type: none"> <li>Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. This may cause fire or injury.</li> <li>Do not forcibly bend, pull or pinch the motor lead wire or cable. This may cause fire.</li> <li>Do not disassemble or modify the product. This may cause injury.</li> </ul>
	<ul style="list-style-type: none"> <li>Assign qualified personnel the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Failure to do so may result in fire or injury.</li> <li>If this product is used in a vertical application, be sure to provide a measure for the position retention of moving parts. Failure to do so may result in injury or damage to equipment.</li> <li>Install the product in an enclosure. Failure to do so may result in injury.</li> <li>Connect the cables securely according to the wiring diagram. Failure to do so may result in fire.</li> <li>For the power supply, use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may cause electric shock.</li> </ul>

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.

<b>CAUTION</b>	
	<ul style="list-style-type: none"> <li>Do not use the product beyond its specifications. This may cause injury or damage to equipment.</li> <li>Keep your fingers and objects out of the openings in the product. Failure to do so may result in fire or injury.</li> <li>Do not touch the product while operating or immediately after stopping. This may cause a skin burn(s).</li> <li>Do not carry the motor by holding the motor output shaft, motor lead wire or cable. Doing so may cause injury.</li> <li>Keep the area around the product free of combustible materials. Failure to do so may result in fire or a skin burn(s).</li> <li>Leave nothing around the product that would obstruct ventilation. Failure to do so may result in damage to equipment.</li> <li>Do not touch the rotating part (output shaft) while operating the motor. Doing so may result in injury.</li> </ul>
	<ul style="list-style-type: none"> <li>Provide a cover over the rotating part (output shaft) of the motor. Failure to do so may result in injury.</li> <li>Use a motor and driver only in the specified combination. Failure to do so may result in fire.</li> <li>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.</li> <li>When an abnormal condition has occurred, immediately stop operation and turn off the driver power. Failure to do so may result in fire or injury.</li> <li>The motor surface temperature may exceed 70 °C (158 °F) even under normal operating conditions. If the operator is allowed to approach the running motor, attach a warning label as shown below in a conspicuous position. Failure to do so may result in a skin burn(s).</li> </ul>



#### Precautions for use

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

Conducting the insulation resistance measurement or withstand voltage test with the motor and driver connected may result in injury or damage to equipment.

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

Operating the motor under an excessive radial load or axial load may damage the motor bearings (ball bearings). Be sure to operate the motor within the specified permissible limit of radial load and axial load.

- **Motor surface temperature**

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 motor bearings (ball bearings) from reaching its usable life quickly, use the motor in conditions where the surface temperature will not exceed 100 °C (212 °F).

Use the geared motor in a condition where the gear case temperature does not exceed 70 °C (158 °F), in order to prevent deterioration of grease and parts in the gear part.

- **Grease leakage**

On rare occasions, a small amount of grease may ooze out from the geared 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.

● **Holding torque at standstill**

The motor holding torque is reduced by the current cutback function of the driver at motor standstill. When operating the motor, take account of the motor torque drop at the time of stopping.

● **Allowable torque**

When operating the motor at a constant speed, use so that the torque does not exceed the allowable torque in the specifications. Operating the motor in excess of the allowable torque may cause damage to the gear part.

● **Speed range**

Operate the motor at speeds within the speed range. Operating the motor at a speed outside the speed range may result in a shorter gear life.

● **Backlash**

The gear output shaft is subject to backlash. To reduce the effect of backlash, perform positioning operations from one direction only-either from the CW direction or the CCW direction.

● **Rotating direction of the gear output shaft**

The relationship between the rotating direction of the motor shaft and that of the gear output shaft changes as follows, depending on the gear type and gear ratio.

Model	Gear ratio	Rotation direction of the gear output shaft
PKP223	7.2, 36	Same as the motor output shaft
	9, 10, 18	Opposite to the motor output shaft
PKP243 PKP264	3.6, 7.2, 9, 10	Same as the motor output shaft
	18, 36	Opposite to the motor output shaft

**Preparation**

■ **Checking the product**

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

- Motor ..... 1 unit
- Connection cable [0.6 m (2 ft.)] ..... 1 pc. (PKP□-L only)
- Instructions and Precautions for Safe Use..... 1 copy

■ **How to identify the product name**

Check the model number of the motor against the number shown on the nameplate.

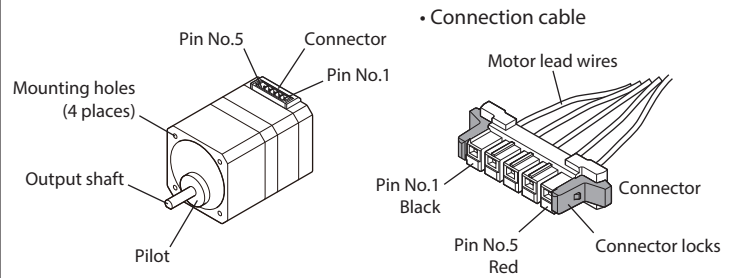
PKP2 □ □ D □ □ □ - SG □ - L  
 1 2 3 4 5 6 7 8 9

1	Motor frame size	2: 28 mm (1.10 in.) 4: 42 mm (1.65 in.) 6: 60 mm (2.36 in.)
2	Motor length	
3	Number of lead wire	D: 4 pcs. U: 5 pcs. or 6 pcs.
4	Motor winding specification	Representative example 09: Rated current 0.95 A/phase 28: Rated current 2.8 A/phase
5	Shape	A: Single shaft B: Double shaft
6	Motor identification	2: Model A None: Model B
7	Gear type	SG: SH geared type
8	Gear ratio	
9	Connection cable	-L: Supplied with a connection cable None: Without connection cable

■ **Names of parts**

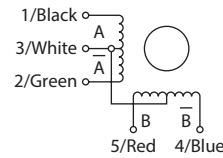
The pin numbers as well as the colors of lead wires are shown in the figures. The connection diagrams show our connection cable.

● **Motors of Model A**

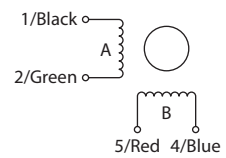


**Wiring connection diagram**

• Unipolar 5 lead wires type



• Bipolar 4 lead wires type \*

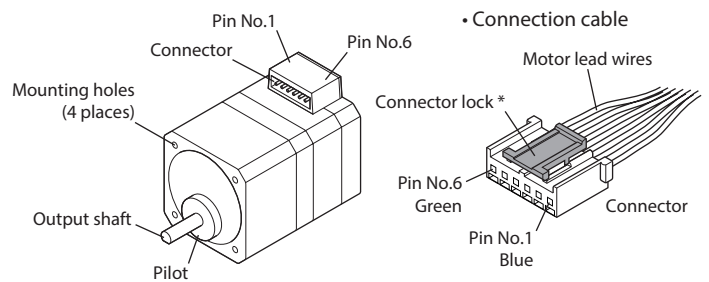


\* The pin No.3 is not used for the 4 lead wires type.

**Applicable connector/lead wire**

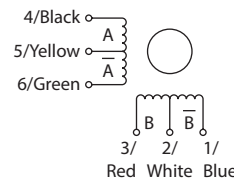
Type	Model
Connector housing	MDF97A-5S-3.5C (HIROSE ELECTRIC CO., LTD.)
Contact	MDF97-22SC (HIROSE ELECTRIC CO., LTD.)
Designated crimping tool	HT801/MDF97-22S (HIROSE ELECTRIC CO., LTD.)
Applicable lead wire	- AWG24 to 22 (0.2 to 0.3 mm <sup>2</sup> ) - Outer sheath diameter: ø1.24 to 1.38 mm (ø0.049 to 0.054 in.) - Strip length of the insulation cover: 1.8 to 2.3 mm (0.071 to 0.091 in.)

● **Motors of Model B**

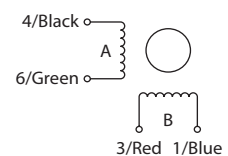


**Wiring connection diagram**

• Unipolar 6 lead wires type



• Bipolar 4 lead wires type \*



\* The pin Nos.2 and 5 are not used for the 4 lead wires type.

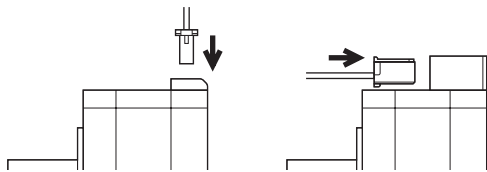
## Applicable connector/lead wire

Motor model	Type	Model
PKP223	Connector housing	51065-0600 (Molex)
	Contact	50212-8XXX (Molex)
	Designated crimping tool	63819-0500 (Molex)
	Applicable lead wire	<ul style="list-style-type: none"> <li>When the current value is less than 1 A/phase: AWG28 to 24 (0.08 to 0.2 mm<sup>2</sup>)</li> <li>When the current value is 1 A/phase or more: AWG26 to 24 (0.14 to 0.2 mm<sup>2</sup>)</li> <li>When the current value is 1.5 A/phase or more: AWG24 (0.2 mm<sup>2</sup>)</li> </ul> – Outer sheath diameter: ø0.8 to 1.4 mm (ø0.031 to 0.055 in.) – Strip length of the insulation cover: 1.3 to 1.8 mm (0.051 to 0.071 in.)
PKP243	Connector housing	51103-0600 (Molex)
	Contact	50351-8XXX (Molex)
	Designated crimping tool	63811-8100 (Molex)
	Applicable lead wire	<ul style="list-style-type: none"> <li>When the current value is less than 1.5 A/phase: AWG28 to 22 (0.08 to 0.3 mm<sup>2</sup>)</li> <li>When the current value is 1.5 A/phase or more: AWG26 to 22 (0.14 to 0.3 mm<sup>2</sup>)</li> <li>When the current value is 2 A/phase or more: AWG24 to 22 (0.2 to 0.3 mm<sup>2</sup>)</li> </ul> – Outer sheath diameter: ø1.15 to 1.8 mm (ø0.045 to 0.071 in.) – Strip length of the insulation cover: 2.3 to 2.8 mm (0.091 to 0.11 in.)
PKP264	Connector housing	51067-0600 (Molex)
	Contact	50217-9XXX (Molex)
	Designated crimping tool	63811-8300 (Molex)
	Applicable lead wire	– AWG24 to 18 (0.2 to 0.75 mm <sup>2</sup> ) – Outer sheath diameter: ø1.4 to 3 mm (ø0.055 to 0.118 in.) – Strip length of the insulation cover: 3 to 3.5 mm (0.118 to 0.138 in.)

## Connection

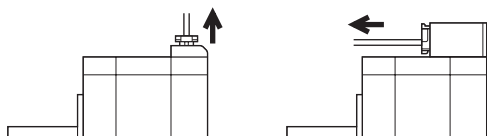
### • When inserting the connector

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.



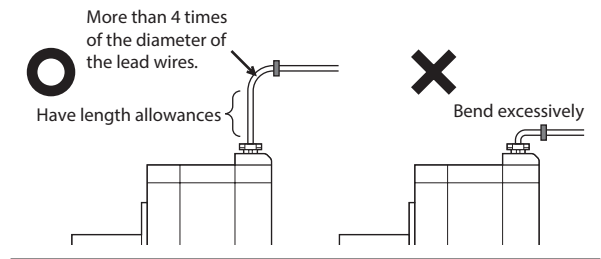
### • When pulling out the connector

Pull out the connector in straight while releasing the lock part of the connector. Having the motor lead wires or pulling out the connector in a state of being locked may damage the connector.



## Note

Secure the lead wires at the connection part to prevent the connection part from receiving stress due to the flexing of the lead wires or the lead wires' own mass. Also, do not excessively bend the lead wires near the connection part of the connector. Applying stress on the motor lead wires may cause poor contact or disconnection, leading to malfunction or heat generation.



## ■ Connection with the drivers of Oriental Motor

Refer to the following table when connecting with the drivers of Oriental Motor. "Color" in the table shows the colors of lead wires of our connection cable.

## Note

The motors of the model A and model B are different in pin assignments. Wrong connection will not cause the motor to operate properly.

### • Connection with the CVD Series

Driver CN2 Pin No.	Model A		Model B	
	Pin No.	Color	Pin No.	Color
1	4	Blue	1	Blue
2	5	Red	3	Red
3	–	–	–	–
4	2	Green	6	Green
5	1	Black	4	Black

### • Connection with the CMD driver

Driver CN3 Pin No.	Model A		Model B	
	Pin No.	Color	Pin No.	Color
1	4	Blue	1	Blue
2	3	White	2	White
3	5	Red	3	Red
4	1	Black	4	Black
5	–	–	5	Yellow
6	2	Green	6	Green

## Installation

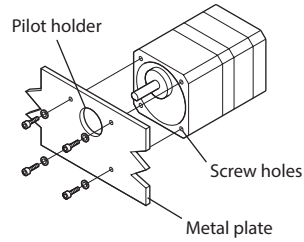
### ■ Location for installation

The motor is designed and manufactured for installation 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 –10 to +50 °C (+14 to +122 °F) (non-freezing)
- Operating ambient humidity 85% or less (non-condensing)
- Area that is free of explosive atmosphere or toxic gas (such as sulfur 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 (rains, 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
- 1,000 m (3,300 ft.) or lower above sea level

## Installation method

Install the motor onto an appropriate flat metal plate having excellent vibration resistance and heat conductivity. When installing the motor, secure it with four screws (not supplied) through the four screw holes provided. Leave no gap between the motor and plate.



Model	Nominal size	Tightening torque [N·m (oz·in)]	Effective depth of screw thread [mm (in.)]
PKP223	M2.5 P0.45	0.5 (71)	4 (0.157)
PKP243	M3 P0.5	1 (142)	7 (0.278)
PKP264	M4 P0.7	2 (280)	8 (0.315)

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



Do not loosen the gearhead-attaching screws (four pcs.).

## Installing a load

When connecting a load to the motor, align the centers of the motor's output shaft and load shaft. Be careful not to damage the output shaft or the bearings when installing a coupling or pulley to the motor's output shaft.

## Permissible radial load and permissible axial load

The radial load and axial load on the motor output shaft must be kept under the permissible values listed below.

### Permissible radial load

Model	Permissible radial load [N (lb.)]				
	Distance from the tip of motor output shaft [mm (in.)]				
	0 (0)	5 (0.2)	10 (0.39)	15 (0.59)	20 (0.79)
PKP223	15 (3.3)	17 (3.8)	20 (4.5)	23 (5.1)	–
PKP243	10 (2.2)	15 (3.3)	20 (4.5)	30 (6.7)	–
PKP264 (gear ratio: 3.6 to 10)	30 (6.7)	40 (9)	50 (11.2)	60 (13.5)	70 (15.7)
PKP264 (gear ratio: 18 to 36)	80 (18)	100 (22)	120 (27)	140 (31)	160 (36)

### Permissible axial load

Model	Permissible axial load [N (lb.)]
PKP223	10 (2.2)
PKP243	15 (3.3)
PKP264	30 (6.7)

## Maintenance/inspection

### 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 office.

#### During inspection

- Are any of motor mounting screws loose?
- Are there any abnormal noises in the motor bearings (ball bearings) or other moving parts?
- Are there any scratches, signs of stress in the motor lead wires?
- Are there any loose connections on the connector or driver?
- Are the motor's output shaft and load shaft out of alignment?

### 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 Oriental Motor Website for the product specifications.

## General specifications

Degree of protection		IP20
Operation environment	Ambient temperature	–10 to +50 °C (+14 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, 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
Insulation resistance	100 MΩ or more when 500 VDC megger is applied between the case and motor windings.	
Dielectric strength	Sufficient to withstand the following conditions applied between the winding and the case for 1 minute: <ul style="list-style-type: none"> <li>• PKP23, PKP24: 0.5 kVAC 50/60 Hz</li> <li>• PKP26: 1.0 kVAC 50/60 Hz</li> </ul>	

## Regulations and standards

### RoHS Directive

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

- Unauthorized reproduction or copying of all or part of this manual is prohibited.
- Oriental Motor shall not be liable whatsoever for any problems relating to industrial property rights arising from use of any information, circuit, equipment or device provided or referenced in this manual.
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- Please contact your nearest Oriental Motor office for further information.

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