Oriental motor

HM-7471-2

2-Phase/5-Phase Stepping Motors

PK Series

OPERATING MANUAL

Table of contents

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.

1 Introduction

1-1 Before using the product

Only qualified personnel of electrical and mechanical engineering should work with the product.
Use the product properly after thoroughly reading the section "2 Safety precautions" on p.3. 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 it for any other purpose. Oriental Motor Co., Ltd. is not responsible for any compensation for damage caused through failure to observe this warning.

2 Safety precautions

The precautions described below are intended to ensure the safe and proper use of the product and to prevent the user and other personnel from exposure to the risk of injury. Use the product only after carefully reading and fully understanding these instructions.

Description of signs

⚠WARNING	Handling the product without observing the instructions that accompany a "WARNING" symbol may result in serious injury or death.
⚠CAUTION	Handling the product without observing the instructions that accompany a "CAUTION" symbol may result in injury or property damage.
Note	The items under this heading contain important handling instructions that the user should observe to ensure safe use of the product.

Description of graphic symbols

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

⚠WARNING	
	• 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 forcibly bend, pull, or pinch the motor lead wires or cable. Doing so may result in fire. • Do not disassemble or modify the product. Doing so may result in injury.
	• Assign qualified personnel to the task of installing, wiring, operating, inspecting, and troubleshooting the product. Handling by unqualified personnel may result in fire or injury. • When using the product in a vertical drive such as elevating equipment, be sure to take a measure to hold the moving part in position. Failure to do so may result in injury or damage to equipment. • Install the product in an enclosure. Failure to do so may result in injury. • Connect the product securely according to the connection diagram. Failure to do so may result in fire. • 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.

⚠CAUTION	
	• Do not use the product beyond the specifications. Doing so may result in injury or damage to equipment. • Keep fingers and objects out of the openings in the product. Failure to do so may result in fire or injury. • Do not touch the product during operation or immediately after stopping. The surface is hot, and this may cause a skin burn(s). • Do not lift the motor by holding the output shaft, motor lead wire or cable. Doing so may result in injury. • 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. • Do not touch the rotating part (output shaft) during operation. Doing so may result in injury.
	• Provide a cover over the rotating part (output shaft) of the motor. Failure to do so may result in injury. • Use a motor and driver only in the specified combination. An incorrect combination may cause a fire. • Provide an emergency stop device or emergency stop circuit external to the equipment so that the entire system will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury. • If any abnormality is observed, stop operation immediately to disconnect the power supply. Failure to do so may result in fire or 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 during operation, affix a warning label on a conspicuous place as shown in the figure. The surface is hot, and this may cause a skin burn(s).  Warning label

3 Precautions for use

- **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 driver connected may result in damage to the product.

- **Use the motor in a condition where a radial load and an axial load are equal to or less than the permissible values.**

  Continuing to operate the motor under excessive radial load or axial load may cause damage to the bearings (ball bearings). Be sure to operate the motor within the specified values for the radial load and the axial load.

- **Motor surface temperature**

  The surface temperature of the motor case may exceed 100 °C (212 °F) depending on operating conditions such as ambient temperature, operating speed, operating duty, and others. To prevent the bearings (ball bearings) from reaching the end of their useful life prematurely, use the motor in a condition where the surface temperature of the motor case does not exceed 100 °C (212 °F).
  Use the geared type in a condition where the case temperature of the gear unit does not exceed 70 °C (158 °F) to prevent deterioration of the grease and parts in the gear unit.

- **Grease leakage measures**

  In rare cases, a small amount of grease may ooze out from the gear unit. If there is concern about potential environmental damage from grease leakage, check for grease stains during periodic inspections. Alternatively, install an oil pan or other device to prevent damage resulting from contamination. Oil leakage may cause problems in the customer's equipment or products.

- **Permissible torque**

  When operating the motor at a constant speed, do not exceed the permissible torque specified in the specifications. Operating the motor in excess of the permissible torque may damage the gear unit.

- **Speed range**

  Operate the motor within the speed range in the specifications. Operating the motor beyond the speed range may shorten the life of the gear unit.

- **Backlash**

  There is backlash on the gearhead output shaft. To suppress the effect of backlash, perform positioning operation in either the CW or CCW direction.

- **Rotation direction of gearhead output shaft**

  The rotation direction of the motor output shaft and that of the gearhead output shaft change as follows depending on the gear ratio of the gearhead.

Gearhead type	Model	Gear ratio	Rotation direction of gearhead output shaft
SH geared type	**PK22**	7.2, 36	Same direction as the motor output shaft
		9, 10, 18	Opposite direction to the motor output shaft
	PK26	3.6, 7.2, 9, 10, 50, 100	Same direction as the motor output shaft
		18, 36	Opposite direction to the motor output shaft
	PK29	3.6, 7.2, 9, 10, 18	Same direction as the motor output shaft
		36	Opposite direction to the motor output shaft
TH geared type	**PK24** **PK26**	3.6, 7.2, 10	Same direction as the motor output shaft
		20, 30	Opposite direction to the motor output shaft
PS geared type	**PK22**	All gear ratios	Same direction as the motor output shaft
PL geared type	**PK24** **PK26**	All gear ratios	Same direction as the motor output shaft

4 Preparation

4-1 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.

- Motor ..... 1 unit
- Connection cable [0.6 m (2 ft.)] . .....1 piece *1
- Mounting screws .....4 pieces *2
- Instructions and Precautions for Safe Use .....1 copy

*1 Included with **PKE□-L**, **PK□-L**

*2 Included with **PK26□-SG**, **PK29□-SG**

4-2 How to identify the product model

Check the model name of the motor against that shown on the nameplate. Refer to "4-3 Information about nameplate" on p.8 for how to identify the nameplate.

■ 2-Phase

PK2 4 3 M D 15 A _
1 2 3 4 5 6 7

1	Motor frame size	**4**: 42 mm (1.65 in.) **5**: 50 mm (1.97 in.) **6**: 56.4 mm (2.22 in.) * **9**: 85 mm (3.35 in.)
2	Motor length	
3	Motor type	Blank: Standard type **M**: High-resolution type **J**: High-torque type
4	Number of lead wires	Blank: 6 Leads **D**: 4 Leads **-E** or **-F**: 8 Leads
5	A value indicating the specifications of the motor windings may be entered. Example: **-01**, **15**, **2.0**	
6	Shape	**A**: Single shaft **B**: Double shaft
7	Motor identification	**A**: Products for USA

* 60 mm (2.36 in.) for **PK26□J**

■ 2-Phase (High-torque/High-efficiency type)

PKE2 4 3 D A _
1 2 3 4 5

1	Motor frame size	**4**: 42 mm (1.65 in.)
2	Motor length	
3	Number of lead wires	Blank: 6 Leads **D**: 4 Leads
4	Shape	**A**: Single shaft **B**: Double shaft
5	Connection cable	**-L**: With connection cable Blank: Without connection cable

■ 2-Phase (Geared type)

PK2 4 3 _ _ A _ 1 _ - SG 10 -L
1 2 3 4 5 6 7 8 9 10 11

1	Motor frame size	**2**: 28 mm (1.10 in.) **4**: 42 mm (1.65 in.) **6**: 60 mm (2.36 in.) **9**: 90 mm (3.54 in.)
2	Motor length	
3	Motor classification	The code "**P**" may be entered.
4	Number of lead wires	**D**: 4 Leads Blank: 6 Leads *
5	Shape	**A**: Single shaft **B**: Double shaft
6	Motor identification	**E**: 8 Leads
7	A value indicating the specifications of the motor windings may be entered.	
8	Motor identification	**A**: Products for USA
9	Gearhead type	**SG**: **SH** geared type **T**: **TH** geared type **PS**: **PS** geared type **PL**: **PL** geared type
10	Gear ratio	
11	Connection cable	**-L**: With connection cable Blank: Without connection cable

* The number of lead wires is 8 pieces when "Motor identification" of the number "6" is **E**.

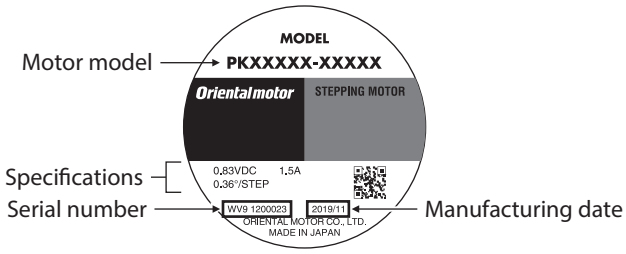
■ 5-Phase

PK5 6 4 H - A _
1 2 3 4 5

1	Motor frame size	**4**: 42 mm (1.65 in.) **6**: 60 mm (2.36 in.) **9**: 85 mm (3.35 in.)
2	Motor length	
3	Motor type	Blank: Standard type **H**: High-speed type
4	Shape	**A**: Single shaft **B**: Double shaft
5	Motor identification	

4-3 Information about nameplate

The figure shows an example.



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

5 Connection

5-1 Notes when the connection cable is used (connector-coupled type only)

■ When inserting the connector

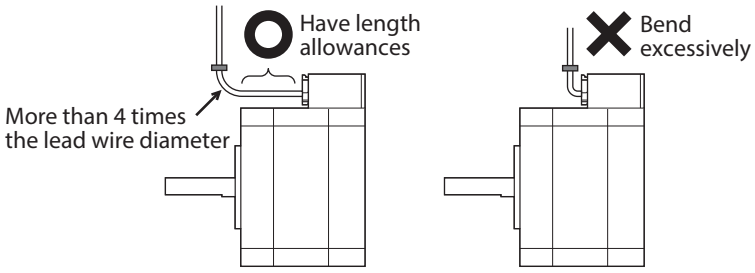
Hold the connector body, and insert it straight and securely. Inserting the connector while it is tilted may cause damage to the terminals or a connection failure.

■ When pulling out the connector

Pull out the connector in straight while releasing the lock part of the connector. Pulling out the connector while holding the lead wires may cause damage to the connector.

■ Bending radius of cable

Use the cable in a condition where the bending radius of the cable is more than four times the diameter of the lead wire.
Do not excessively bend the motor lead wire near the connection part of the connector. Applying stress on the motor lead wire may cause poor contact or disconnection, resulting in malfunction or heat generation.



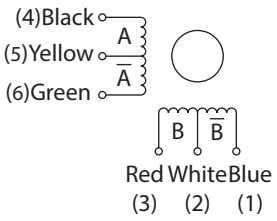
Note Fix the motor lead wires of the connection part of the connector so that no stress is applied to the connector or the terminals by bending the lead wires or their own weight.

5-2 Connection diagram

■ Connector-coupled type

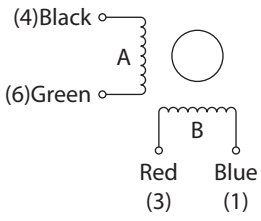
The lead wire colors and the pin numbers of the Oriental Motor connection cable are shown in the figures.

- **6 Lead wires type**

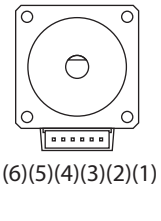


- **4 Lead wires type**

The pins No.2 and No.5 are not used.



- **Pin arrangement**



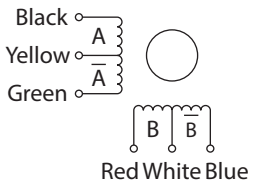
- **Applicable connector and lead wire**

Model	Type	Part number
PK22	Connector housing	51065-0600 (Molex, LLC)
	Contact	50212-8XXX (Molex, LLC)
	Designated crimp tool	57176-5000 (Molex, LLC)
	Applicable lead wire	• Electrical wire size: AWG30 to 24 (0.05 to 0.2 mm^2) • Outer diameter of wire insulation: ø1.4 mm (0.055 in.) or less • Stripping length of wire insulation: 1.3 to 1.8 mm (0.051 to 0.071 in.)
PK24	Connector housing	51103-0600 (Molex, LLC)
	Contact	50351-8XXX (Molex, LLC)
	Designated crimp tool	57295-5000 (Molex, LLC)
	Applicable lead wire	• Electrical wire size: AWG28 to 22 (0.08 to 0.3 mm^2) • Outer diameter of wire insulation: ø1.15 to 1.8 mm (0.045 to 0.071 in.) • Stripping length of wire insulation: 2.3 to 2.8 mm (0.091 to 0.11 in.)
PK26	Connector housing	51067-0600 (Molex, LLC)
	Contact	50217-9XXX (Molex, LLC)
	Designated crimp tool	57189-5000, 57190-5000 (Molex, LLC)
	Applicable lead wire	• Electrical wire size: AWG24 to 18 (0.2 to 0.75 mm^2) • Outer diameter of wire insulation: ø1.4 to 3 mm (0.055 to 0.118) • Stripping length of wire insulation: 3 to 3.5 mm (0.118 to 0.138 in.)

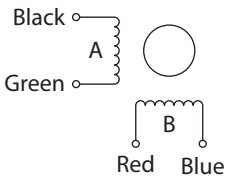
■ Lead wire type (2-Phase)

The lead wire colors are shown in the figures.

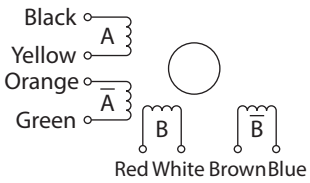
- **Unipolar**
  6 Lead wires type



- **Bipolar**
  4 Lead wires type

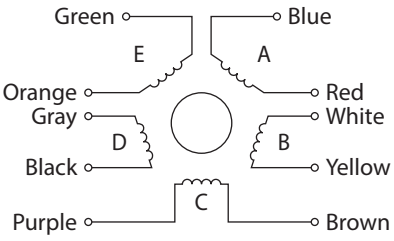


- **8 Lead wires type**



■ Lead wire type (5-Phase)

The lead wire colors are shown in the figure.



6 Installation

6-1 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:

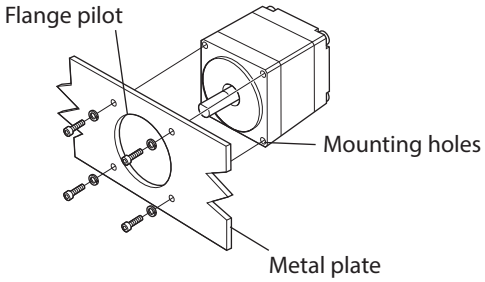
- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature: –10 to +50 °C [+14 to 122 °F] (non-freezing)
- Operating ambient humidity: 85 % or less (non-condensing)
- Area free of explosive atmosphere, toxic gas (such as sulfuric gas), or liquid
- Area not exposed 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 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

6-2 Installation method

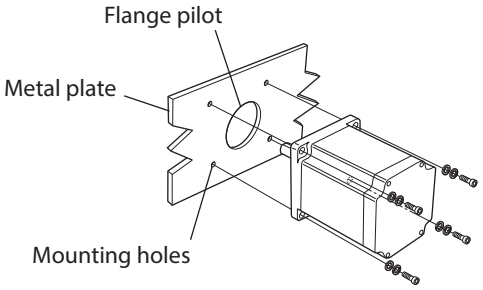
Install the motor onto an appropriate flat metal plate having excellent vibration resistance and heat conductivity. When installing the motor, use all mounting holes to secure the motor with screws (not included *) so that there is no gap between the motor and the metal plate.

* They are included with **PK26□-SG** and **PK29□-SG**.

- **Installation method 1**



- **Installation method 2**



- **Screw size, tightening torque, installation method**

The values of the tightening torque are recommended. Tighten the screws to an appropriate torque according to the design conditions of the metal plate to be installed.

- **Products other than the geared type**

Model	Screw size	Tightening torque [N·m (oz-in)]	Effective depth of screw thread [mm (in.)]	Installation method
PK54, **PK24**, **PKE24**	M3 P0.5 No.4-40UNC *	1 (142)	4.5 (0.18)	1
PK56, **PK25**, **PK26**	M4 No.8-32UNC	2 (280)	–	2
PK59, **PK29**	M5 No.10-24UNC	3 (420)		

* Products for USA

- **Geared type**

Gearhead type	Model	Screw size	Tightening torque [N·m (lb-in)]	Effective depth of screw thread [mm (in.)]	Installation method
SH geared type	**PK22**	M2.5 P0.45	0.5 (4.4)	4 (0.16)	1
	PK26	M4 P0.7 No.8-32UNC *	2 (17.7)	8 (0.315)	1
	PK29	M6 P1.0 No.1/4-20UNC *	3 (26)	15 (0.591)	1
TH geared type	**PK24** **PK26**	M4	2 (17.7)	8 (0.315)	1
PS geared type	**PK22**	M3	1 (8.8)	6 (0.236)	1
PL geared type	**PK24**	M4	2 (17.7)	8 (0.315)	1
	PK26	M5	2.5 (22)	10 (0.394)	1

* Products for USA

Note Do not loosen the screws (4 pieces) that secure the motor and gearhead.

6-3 Installing a load

When installing a load on the motor, align the axis of rotation of the output shaft with that of the load in a straight line.
When installing a coupling or pulley on the output shaft, be careful not to damage to the output shaft or the bearing (ball bearings).

6-4 Permissible radial load and permissible axial load

Make sure that the radial load and axial load applied to the output shaft do not exceed the permissible values shown in the table below.

- **Products other than the geared type**

Model	Permissible radial load [N (lb.)]					Permissible axial load [N (lb.)]
	Distance from output shaft end [mm (in.)]					
	0 (0)	5 (0.20)	10 (0.39)	15 (0.59)	20 (0.79)	
PK54 **PK24** **PKE24**	20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	–	10 (2.2)
PK56	63 (14.1)	75 (16.8)	95 (21)	130 (29)	190 (42)	20 (4.5)
PK25 **PK26**	54 (12.1)	67 (15.0)	89 (20)	130 (29)	–	
PK26□J	50 (11.2)	60 (13.5)	75 (16.8)	100 (22)	150 (33)	
PK59 **PK29**	260 (58)	290 (65)	340 (76)	390 (87)	480 (108)	60 (13.5)

- **Geared type**

Gearhead type	Model	Gear ratio	Permissible radial load [N (lb.)]					Permissible axial load [N (lb.)]
			Distance from output shaft end [mm (in.)]					
			0 (0)	5 (0.20)	10 (0.39)	15 (0.59)	20 (0.79)	
SH geared type	**PK223**	All gear ratios	15 (3.3)	17 (3.8)	20 (4.4)	23 (5.1)	–	10 (2.2)
	PK243	All gear ratios	10 (2.2)	15 (3.3)	20 (4.5)	30 (6.7)	–	15 (3.3)
	PK264	3.6, 7.2, 9, 10	30 (6.7)	40 (9)	50 (11.2)	60 (13.5)	70 (15.7)	30 (6.7)
		18, 36, 50, 100	80 (18)	100 (22)	120 (27)	140 (31)	160 (36)	
	PK296	All gear ratios	220 (49)	250 (56)	300 (67)	350 (78)	400 (90)	100 (22)
TH geared type	**PK24**	All gear ratios	10 (2.2)	14 (3.1)	20 (4.5)	30 (6.7)	–	15 (3.3)
	PK26	All gear ratios	70 (15.7)	80 (18)	100 (22)	120 (27)	150 (33)	40 (9)
PS geared type	**PK22**	All gear ratios	45 (10.1)	60 (13.5)	80 (18)	100 (22)	–	20 (4.5)
PL geared type	**PK24**	5, 10	73 (16.4)	84 (18.9)	100 (22)	123 (27)	–	50 (11.2)
		36	109 (24)	127 (28)	150 (33)	184 (41)	–	
	PK26	5	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	100 (22)
		10	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
		36	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	

7 Inspection and maintenance

7-1 Inspection

It is recommended that periodic inspections are conducted for the items listed below after each operation of the motor. If any abnormality occurs, discontinue use of the product and contact your nearest Oriental Motor sales office.

Inspection item

- Check to see if any of the mounting screws of the motor are loose.
- Check to see if the bearing (ball bearings) of the motor generates unusual noises.
- Check to see if the motor lead wire is not damaged or stressed.
- Check to see if any of the connection parts with the connector or the driver are loose.
- Check to see if the output shaft and the load shaft are not misaligned.

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

Check on the Oriental Motor Website for the product specifications.

■ General specifications

Degree of protection		IP20
Operating 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 or dust. No exposure to 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 or dust. No exposure to water or oil.
Insulation resistance	100 MΩ or more when 500 VDC megger is applied between the the windings and the case.	
Dielectric strength	Sufficient to withstand the following between the windings and the case for 1 minute. • 2-Phase **PK22**, **PK24**, **PKE24**: 0.5 kVAC 50/60 Hz **PK25**, **PK26**, **PK29**: 1.0 kVAC 50/60 Hz • 5-Phase **PK54**: 0.5 kVAC 50/60 Hz **PK56**, **PK59**: 1.0 kVAC 50/60 Hz	

9 Regulations and standards

9-1 RoHS Directive

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

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• Please contact your nearest Oriental Motor office for further information.

ORIENTAL MOTOR U.S.A. CORP.
Technical Support Tel:800-468-3982
8:30am EST to 5:00pm PST (M-F)

ORIENTAL MOTOR (EUROPA) GmbH
Schiessstraße 44, 40549 Düsseldorf, Germany
Technical Support Tel:00 800/22 55 66 22

ORIENTAL MOTOR (UK) LTD.
Unit 5 Faraday Office Park, Rankine Road,
Basingstoke, Hampshire RG24 8QB UK
Tel:+44-1256347090

ORIENTAL MOTOR (FRANCE) SARL
Tel:+33-1 47 86 97 50

ORIENTAL MOTOR ITALIA s.r.l.
Tel:+39-02-93906347

ORIENTAL MOTOR ASIA PACIFIC PTE. LTD.
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SHANGHAI ORIENTAL MOTOR CO., LTD.
Tel:400-820-6516

INA ORIENTAL MOTOR CO., LTD.
Korea
Tel:080-777-2042

ORIENTAL MOTOR CO., LTD.
4-8-1 Higashiueno, Taito-ku, Tokyo
110-8536 Japan
Tel:+81-3-6744-0361
www.orientalmotor.co.jp/ja