



OPERATING MANUAL

5-Phase Stepping Motor

PK Series

Introduction

■ Before using the motor

Only qualified personnel should work with the product. Use the product correctly after thoroughly reading the section "Safety precautions".

The product described in this manual has been designed and manufactured for use in general industrial machinery, and must not be used for any other purpose. For the power supply use a DC power supply with reinforced insulation on its primary and secondary sides. Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

■ Hazardous substances

RoHS (Directive 2002/95/EC 27Jan.2003) compliant

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.

Warning

Handling the product without observing the instructions that accompany a "Warning" symbol may result in serious injury or death.

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire or injury.
- 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.
- Provide a means to hold moving parts in place for applications involving vertical travel. The motor loses holding torque when the power is shut off, allowing the moving parts to fall and possibly causing injury or damage to equipment.
- Install the motor in an enclosure in order to prevent injury.
- Keep the input-power voltage within the specified range to avoid fire.
- Connect the cables securely according to the wiring diagram in order to prevent fire.
- Do not forcibly bend or push the connector. Doing so may fire.
- Do not forcibly bend, pull or pinch the cable. Doing so may fire.
- For the power supply use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.
- Turn off the power in the event of a power failure, or the motor will suddenly start when the power is restored and may cause injury or damage to equipment.
- Do not disassemble or modify the motor. This may cause injury. Refer all such internal inspections and repairs to the branch or sales office from which you purchased the product.

Caution

Handling the product without observing the instructions that accompany a "Caution" symbol may result in injury or property damage.

- Do not use the motor beyond its specifications, or injury or damage to equipment may result.
- Do not touch the motor during operation or immediately after stopping. The surface is hot and may cause a burn.
- Do not hold the motor output shaft or motor cable. This may cause 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.

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.

- Conduct the insulation resistance measurement or withstand voltage test separately on 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.
- To prevent bodily injury, do not touch the rotating parts (output shaft) of the motor during operation.
- Immediately when trouble has occurred, stop running and turn off the driver power. Failure to do so may result in fire or injury.
- To dispose of the motor, disassemble it into parts and components as much as possible and dispose of individual parts/components as industrial waste.

Checking the product

Open the package and confirm that all of the following items are available. To verify that the unit you've purchased is the correct one, check the model number shown on the nameplate. Should you find any item missing or damaged, contact the Oriental Motor sales office where you purchased the product.

- Motor 1 pc.
- Operating manual (this manual)..... 1 copy

Precautions for use

- Operate the motor with a surface temperature not exceeding 100 °C (212 °F).

The motor case surface temperature may exceed 100 °C (212 °F) under certain conditions (ambient temperature, operating speed, duty, etc.). Keeping the surface temperature of the motor casing below 100 °C (212 °F) will also maximize the life of the motor bearings (ball bearings).

- Do not apply strong physical impact to the motor's shaft.

The motor's shaft is equipped with an optical encoder. To prevent damage to the encoder, when transporting the motor or connecting a load, please handle the motor shaft carefully so as to protect it from strong impact.

Installation

■ Location for installation

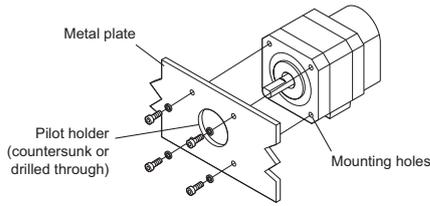
The motor is designed and manufactured for installation in equipment. Install it in a well-ventilated location that provides easy access for inspection. The location must also satisfy the following conditions:

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature
-10 °C to +50 °C (+14 °F to +122 °F) (non-freezing)
- Operating ambient humidity 85%, maximum (non-condensing)
- Area that is free from an explosive nature or toxic gas (such as sulfuric gas) or liquid
- Area not exposed to direct sun
- Area free of excessive amount dust, iron particles or the like
- Area not subject to splashing water (storms, 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

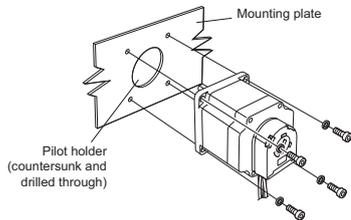
■ How to install the motor

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

Installation method A



Installation method B



Motor type	Bolt size	Tightening torque [N·m (oz·in)]	Effective depth [mm (in.)]	Installation method
• Standard type				
PK51□	M2	0.25 (35)	2.5 (0.098)	A
PK52□	M2.5	0.5 (71)	2.5 (0.098)	
PK54□	M3	1 (142)	4.5 (0.177)	
PK56□	M4	2 (280)	-	B
PK59□	M5	3 (420)		
• TH geared type				
PK523□-T□	M2.5	0.5 (71)	4 (0.157)	A
PK543□-T□	M4	2 (280)	8 (0.315)	
PK564□-T□				
PK596□-T□	M8	4 (560)	15 (0.591)	
• PS geared, PN geared types				
PK523□-□	M3	1 (142)	6 (0.236)	A
PK54□-□	M4	2 (280)	8 (0.315)	
PK56□-□	M5	2.5 (350)	10 (0.394)	
PK59□-□	M8	4 (560)	15 (0.591)	
• Harmonic geared type				
PK513□-H□S	M2	0.25 (35)	5 (0.197)	A
PK523□-H□S	M3	1 (142)	6 (0.236)	
PK543□-H□S	M4	2 (280)	8 (0.315)	
PK564□-H□S	M5	2.5 (350)	10 (0.394)	B
PK596□-H□	M8	4 (560)	-	

* The square box (□) in the motor type will contain letters and/or numbers representing the motor length, motor type, gear type encoder model, electromagnetic brake model, terminal box model and single or double shaft type motors.

■ Permissible overhung load and permissible thrust load

The overhung load on the motor's output shaft or gear output shaft must be kept within the permissible values listed below. The thrust load must not exceed the motor's mass. Please visit our website, www.orientalmotor.com, for more specific information for each motor type.

Motor type	Permissible overhung load [N (lb.)]				
	Distance from tip of motor's output shaft [mm (in.)]				
	0 (0)	5 (0.2)	10 (0.4)	15 (0.6)	20 (0.8)
• Standard type					
PK51□	12 (2.7)	15 (3.3)	-	-	-
PK52□	25 (5.6)	34 (7.6)	52 (11.7)	-	-
PK54□	20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	-
PK56□	63 (14.1)	75 (16.8)	95 (21)	130 (29)	190 (42)
PK56□PM□	90 (20)	100 (22)	130 (29)	180 (40)	270 (60)
PK59□	260 (58)	290 (65)	340 (76)	390 (87)	480 (108)

Motor type	Permissible overhung load [N (lb.)]				
	Distance from tip of motor's output shaft [mm (in.)]				
	0 (0)	5 (0.2)	10 (0.4)	15 (0.6)	20 (0.8)

• TH geared type					
PK523□-T□	15 (3.3)	17 (3.8)	20 (4.5)	23 (5.1)	-
PK543□-T□	10 (2.2)	14 (3.1)	20 (4.5)	30 (6.7)	-
PK564□-T□	70 (15.7)	80 (18)	100 (22)	120 (27)	150 (33)
PK596□-T□	220 (49)	250 (56)	300 (67)	350 (78)	400 (90)

• PS geared, PN geared types					
PK523□-□	45 (10.1)	60 (13.5)	80 (18)	100 (22)	-
PK543□-PS□	109 (24)	127 (28)	150 (33)	184 (41)	-
PK545□-PS□	73 (16.4)	84 (18.9)	100 (22)	123 (27)	-
PK54□-N□	100 (22)	120 (27)	150 (33)	190 (42)	-
PK564□-□25	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)
PK564□-□36					
PK564□-□50					
PK566□-□5	200 (45)	220 (49)	250 (56)	280 (36)	320 (72)
PK566□-PS7	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)
PK566□-N7.2					
PK566□-□10					
PK596□-PS25	850 (191)	940 (210)	1050 (230)	1190 (260)	1380 (310)
PK596□-N25	850 (191)	940 (210)	1050 (230)	1110 (240)	1190 (260)
PK596□-PS36	930 (200)	1030 (230)	1150 (250)	1310 (290)	1520 (340)
PK596□-N36	930 (200)	1030 (230)	1150 (250)	1220 (270)	1300 (290)
PK596□-PS50	1050 (230)	1160 (260)	1300 (290)	1480 (330)	1710 (380)
PK596□-N50	1050 (230)	1160 (260)	1300 (290)	1380 (310)	1490 (330)
PK599□-PS5	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)
PK599□-N5	480 (108)	520 (117)	550 (123)	580 (130)	620 (1239)
PK599□-□7.2	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)
PK599□-□10					

• Harmonic geared type					
PK513□-H□S	50 (11.2)	75 (16.8)	-	-	-
PK523□-H□S	110 (24)	135 (30)	175 (39)	250 (56)	-
PK543□-H□S	180 (40)	220 (49)	270 (60)	360 (81)	510 (114)
PK564□-H□S	320 (72)	370 (83)	440 (99)	550 (123)	720 (162)
PK596□-H□	1090 (240)	1150 (250)	1230 (270)	1310 (290)	1410 (310)

* The square box (□) in the motor type will contain letters and/or numbers representing the motor length, motor type, gear type encoder model, electromagnetic brake model, terminal box model and single or double shaft type motors.

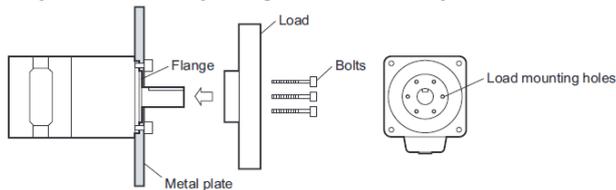
■ Installing a load

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.

Note Do not apply strong impact to the motor's shaft, since it can damage the encoder.

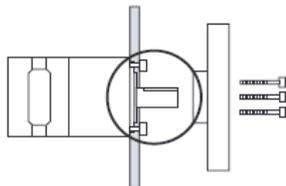
■ Installing on the flange surface (Harmonic geared type)

With a harmonic geared type, a load can be installed directly to the gear using the load mounting holes provided on the flange surface.



Motor type	Bolt size	Number of bolts	Tightening torque [N·m (oz-in)]	Effective depth [mm (in.)]
PK513□	M2	3	0.35 (49)	3 (0.118)
PK523□	M3	4	1.4 (198)	4 (0.157)
PK543□	M3	6	1.4 (198)	5 (0.2)
PK564□	M4	6	2.5 (350)	6 (0.24)
PK596□	n/a			

- Note**
- When installing a load on the flange surface, the load cannot be affixed using the key groove in the output shaft.
 - Design an appropriate installation layout so that the load will not contact the metal plate or bolts used for installing the motor.

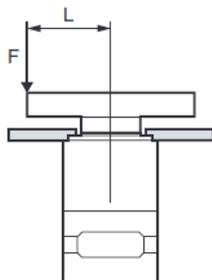


■ Permissible moment load of the harmonic geared type

When installing an arm or table on the flange surface, calculate the moment load using the formula below if the flange surface receives any eccentric load. The moment load should not exceed the permissible value specified in the table.

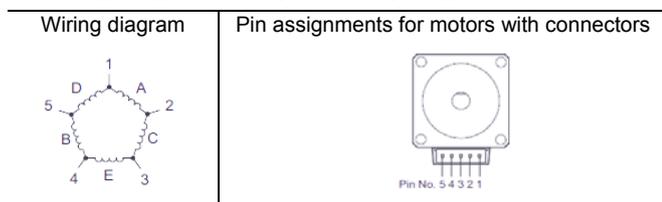
Moment load: $M [N \cdot m (oz \cdot in)] = F \times L$

Motor type	Permissible moment load [N·m (oz-in)]
PK513□	0.7 (99)
PK523□	2.9 (410)
PK543□	5.6 (790)
PK564□	11.6 (1640)
PK596□	n/a



Connection

■ Wiring diagram for 5-phase stepping motors



• Connector pin assignments for motor's with a connector

Pin Number	Description
1	Blue Motor Lead
2	Red Motor Lead
3	Orange Motor Lead
4	Green Motor Lead
5	Black Motor Lead

For connector type motors, use the supplied motor cable. If you are using the connector set or when you are providing your own connector or cable, connect based on the pin numbers shown. The applicable connectors and the cables are as follows.

■ Applicable motor connectors and cables

Motor type	PK51□P PK52□P	PK54□P	PK56□P
Housing (Molex)	51065-0500	51103-0500	51144-0500
Contact (Molex)	50212-8100	50351-8100	50539-8100
Crimping tool (Molex)	57176-5000	57295-5000	57189-5000
Wire size	AWG24 (0.2mm ²)	AWG22 (0.3mm ²)	AWG22 (0.3mm ²)

- Note**
- Secure the motor connector cable in place so that the connection won't be subjected to stress induced by a bent cable or the cable's own mass. The cable's radius of curvature should be as large as possible.
 - When removing the motor cable, pull it out horizontally toward the output shaft. The motor may be damaged if force is applied in any other direction. The motor cable (both supplied and sold separately) employs a connector with a lock. When removing this type of cable, release the connector lock first. Forcibly pulling out the cable without releasing the connector lock may damage the motor.

Encoder specifications

- Note**
- Use the encoder motor within the encoder motors' specifications.
 - The encoder specifications are designed to guarantee operation based on a response frequency of 100 kHz. However, the encoder can be operated at a minimum response frequency of 100 kHz.

The following characteristic values assume operation under the recommended operating conditions:

■ TTL output type encoders

Item	Value			
Encoder type	Incremental			
Resolution (P/R)	500		1000	
Number of Channels	2 (PK□-R17)	3 (PK□-R27)	2 (PK□-R18)	3 (PK□-R28)
Output type	A, B	A, B, Index	A, B	A, B, Index
Supplied voltage (V)	5.0			
Supply current (mA)	17 (typ.)	57 (typ.)	17 (typ.)	57 (typ.)
Output type	TTL (Low: ≤0.4V, High: ≥2.0V)			
Response frequency (kHz)	100 (max)			

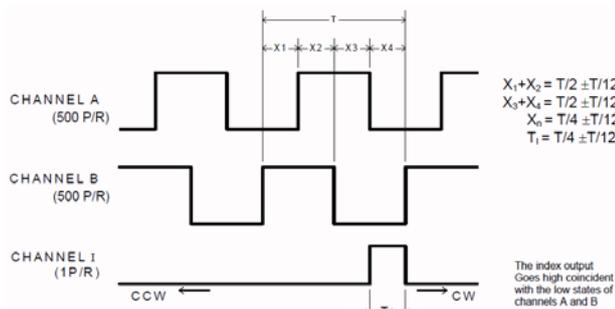
• Connector pin assignments for TTL output type encoder

Pin Number	Signal
1	GND
2	Index
3	Channel A
4	+5VDC
5	Channel B

■ Applicable TTL output type encoder connectors and cables

Part	Manufacturer	Model Number
Housing	Molex	50-57-9405
Contact	Molex	16-02-0104
Cable	AWG24 to 22 (0.33 to 0.2 mm ²) Cable outer diameter Ø1.09 to 1.65 mm (0.043 to 0.065 in.) Cable Strip length 2.54 to 3.17 mm (0.1 to 0.125 in.)	
Optional Preassembled Cables	Oriental Motor	LCR04060A (2 channel) LCR05060A (3 channel)

■ TTL type output waveform



■ Differential (Line driver) output type encoders

Item	Value
Encoder type	Incremental
Resolution (P/R)	500 (PK□-R27L) 1000 (PK□M-R28L)
Output type	3 Channels: A, B, Index
Supplied voltage (V)	5.0
Supply current (mA)	58 (typ.)
Output type	Differential (Low: ≤0.4V, High: ≥2.0V)
Response frequency (kHz)	100 (max)

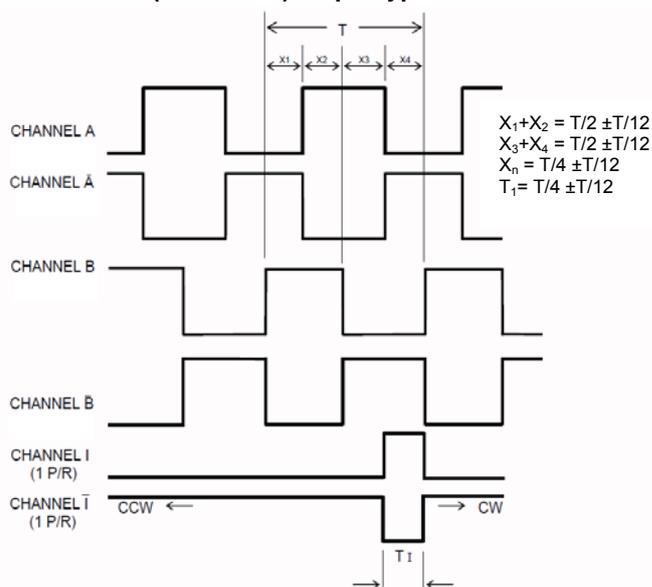
- Connector pin assignments for Differential (line driver) output type encoder

Pin Number	Signal	Pin Number	Signal
1	N/C	6	Channel A +
2	+5VDC	7	Channel B -
3	GND	8	Channel B +
4	N/C	9	Index -
5	Channel A -	10	Index +

■ Applicable Differential output type encoder connectors and cables

Part	Manufacturer	Model Number
Interim clip	Molex	15-04-5104
Housing	Molex	50-57-9305
Contact	Molex	16-02-0104
Cable	AWG24 to 22 (0.33 to 0.2 mm ²) Cable outer diameter Ø1.09 to 1.65 mm (0.043 to 0.065 in.) Cable Strip length 2.54 to 3.17 mm (0.1 to 0.125 in.)	
Optional Preassembled Cables	Oriental Motor	LCR09060A (3 channel)

■ Differential (Line driver) output type waveform



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.

- Check for any unusual noises in the motor's bearings (ball bearings) or other moving parts.
- Are there any loose connector connections, or any scratches or signs of stress in the motor cable?
- Are the motor's output shaft and load shaft out of alignment?

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