



2-Phase Stepping Motor Unit

RBK Series

OPERATING 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.

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1 Introduction

■ Before use

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 driver's 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.

■ Overview of the product

The **RBK** series is a unit product consisting of an encased microstep driver with built-in smooth drive function, and a 2-phase stepping motor or a geared motor designed for high torque.

■ Standards and CE Marking

This product is recognized by UL and certified by CSA, and bears the CE Marking (Low Voltage Directive, EMC Directive) in compliance with the EN Standards (terminal box type motor and driver only).

• Applicable Standards

	Applicable Standards	Certification Body	Standard File No.	CE Marking
Standard type motor High-torque type motor PL geared type motor PS geared type motor	—	—	—	—
Terminal box type motor	UL 1004, UL 2111 CSA C22.2 No.77 CSA C22.2 No.100	UL	E64199	Low Voltage Directive, EMC Directive
	EN 60034-1 EN 60034-5 EN 60950-1 EN 60664-1	—	—	
Driver	UL 508C*1 CSA C22.2 No.14	UL	E171462	Low Voltage Directive*2, EMC Directive
	EN 50178*2	—	—	

*1 For UL Standard (UL 508C), the product is recognized for the condition of Maximum Surrounding Air Temperature 40 °C (104 °F).

*2 The RBD215A-K and RBD228A-K are not subject to the Low Voltage Directive, because their input voltages are 20 to 40 VDC.

- The names of products certified to conform with relevant standards are represented by applicable unit model motor and driver part numbers.
- For unit models, Oriental Motor declares conformance with the EMC Directive individually.
- The temperature-rise test, as required by the UL Standards, is conducted with the aluminum heat sink attached. The size and thickness of the heat sink are as described below.

		Size [mm (in.)]	Thickness [mm (in.)]
Motor	PK26□	400 × 400 (15.75 × 15.75)	10 (0.39)
	PK29□	200 × 200 (7.87 × 7.87)	
Driver	RBD□	200 × 100 (7.87 × 3.94)	2 (0.08)

• Installation conditions (EN Standard)

Motor and driver are to be used as a component within other equipment.

Overvoltage category: II

Pollution degree: 2 (or 3 in case of a terminal box type motor excluding the gap between the shaft and the flange)

Protection against electric shock: Class I

■ Compliance with the EC Directives

• For Low Voltage Directive

This product is designed for use as a built-in component.

- Install the product within an enclosure in order to avoid contact with the hands.
- Be sure to maintain a Protective Earth in case the hands should make contact with the product. Securely ground the Protective Earth Terminals of the motor and driver.

• For EMC Directive (89/336/EEC, 92/31/EEC)

This product has received EMC measures under the conditions specified in “Example of motor and driver installation and wiring” on p.24.

Be sure to conduct EMC measures with the product assembled in your equipment by referring to 5.6 “Installing and wiring in compliance with EMC Directive” on p.22.

■ WARNING FOR UL MARKING ON DRIVER

These drivers have not been evaluated for motor overload protection. Consideration should be given as to how determine if the motor has experienced an overload condition.

■ Hazardous substances



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

■ Degree of protection

PK26□T and PK29□T are the IP65 rated motor (excluding the gap between the shaft and the flange).



2 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.
 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.

 **Warning**

General

- 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, electric shock 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, electric shock or injury.
- Do not transport, install the product, perform connections or inspections when the power is on. Always turn the power off before carrying out these operations. Failure to do so may result in electric shock.
- The terminals on the driver’s front panel marked with   symbol indicate the presence of high voltage. Do not touch these terminals while the power is on to avoid the risk of fire or electric shock.
- Provide a means to hold the 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 cause injury or damage to equipment.
- When the driver’s protective function is triggered, shut off the power immediately. Turn the power back on only after determining the cause. Continuing the operation without determining the cause of the problem may cause malfunction of the motor, leading to injury or damage to equipment.

Installation

- To prevent the risk of electric shock, use the motor and driver for class I equipment only.
- Install the motor and driver in their enclosures in order to prevent electric shock or injury.
- Install the motor and driver so as to avoid contact with hands, or ground them to prevent the risk of electric shock.

Connection

- Keep the driver's input power voltage within the specified range to avoid electric shock or fire.
- For the driver's 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.
- Connect the cables securely according to the wiring diagram in order to prevent electric shock or fire.
- Do not forcibly bend, pull or pinch the power cable and motor cable. Doing so may result in electric shock or fire.
- Do not touch the connection terminals of the driver immediately after the power is turned off. To avoid electric shock of the residual voltage, wait more than 5 seconds after POWER LED is off.

Operation

- Turn off the driver power in the event of a power failure, or the motor may suddenly start when the power is restored and may cause injury or damage to equipment.
- Do not turn the AWO (all windings off) input to ON while the motor is operating. The motor will stop and lose its holding ability, which may result in injury or damage to equipment.

Repair, disassembly and modification

- Do not disassemble or modify the motor or driver. This may cause electric shock or injury. Refer all such internal inspections and repairs to the branch or sales office from which you purchased the product.



General

- Do not use the motor and driver beyond their specifications, or electric shock, injury or damage to equipment may result.
- Keep your fingers and objects out of the openings in the motor and driver, or fire, electric shock or injury may result.
- Do not touch the motor or driver during operation or immediately after stopping. The surfaces are hot and may cause a skin burn(s).

Transportation

- Do not hold the motor output shaft or motor cable. This may cause injury.

Installation

- Keep the area around the motor and driver free of combustible materials in order to prevent fire or a skin burn(s).
- To prevent the risk of damage to equipment, leave nothing around the motor and driver that would obstruct ventilation.
- Provide a cover over the rotating parts (output shaft) of the motor to prevent injury.

Operation

- 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 equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Before supplying power to the driver, turn all control inputs to the driver to OFF. Otherwise, the motor may start suddenly and cause injury or damage to equipment.
- To prevent bodily injury, do not touch the rotating parts (output shaft) of the motor during operation.
- Before moving the motor directly (as in the case of manual positioning), confirm that the driver AWO (all windings off) input is ON to prevent injury.
- Immediately when trouble has occurred, stop running and turn off the driver power. Failure to do so may result in fire or injury.
- To prevent electric shock, use only an insulated precision screwdriver to adjust the driver switches.
- The motor's surface temperature may exceed 70 °C (158 °F), even under normal operating conditions. If a motor is accessible during operation, post the warning label shown in the figure in a conspicuous position to prevent the risk of skin burn(s).



Warning label

Maintenance and inspection

- To prevent the risk of electric shock, do not touch the terminals while measuring the insulation resistance or conducting a withstand voltage test.

Disposal

- To dispose of the motor or driver, disassemble it into parts and components as much as possible and dispose of individual parts/components as industrial waste.

3 Precautions for use

This section covers limitations and requirements the user should consider when using the **RBK** series.

- Do not operate the driver internal switches other than the SW1, SW2, RUN and DATA

Changing the switch settings may cause a product malfunction or cause damage to the product. See p.42 for details on the switches.

- 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.

- Do not apply an overhung load and thrust load in excess of the specified permissible limit

Be sure to operate the motor within the specified permissible limit of overhung load and thrust load. Operating it under an excessive overhung load and thrust load may damage the motor bearings (ball bearings). See p.17 for details.

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

The motor casing's surface temperature may exceed 100 °C (212 °F) under certain conditions (ambient temperature, operating speed, duty cycle, 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).

- Maximum static torque at excitation

Maximum static torque at excitation represents a value obtained when the motor is excited using the rated current. When the motor is combined with a dedicated driver, the maximum static torque at excitation drops to approximately 50% (factory setting) due to the current down function that suppresses the rise in motor temperature in a standstill state. Acceleration and operation at the maximum static torque at excitation is possible in start-up, but it only has approximately 50% holding power after it has stopped. When selecting a motor for your application, consider the fact that the holding power will be reduced to approximately 50% after the motor has stopped.

- Preventing electrical noise

See 5.6 "Installing and wiring in compliance with EMC Directive" on p.22 for measures with regard to noise.

- Check the colors of motor leads and the terminal numbers, and connect them correctly and securely

Wrong connection of leads or poor contact may damage the driver.

- **Geared type motor**

Backlash

The **PL** gear and **PS** gear output shaft is subject to backlash of 20' to 35'. Backlash refers to the looseness at the gear output shaft, as generated when the input side of the gear is fixed. To reduce the effect of backlash, positioning should be from one direction only either from the CW direction or the CCW direction.

Maximum torque

Always operate geared types with loads not exceeding their maximum torque. If a geared type is operated with a load exceeding the maximum torque, the gear will be damaged.

Rotating direction of the gear output shaft

The rotating direction of the motor shaft and that of the gear output shaft are same direction.

Grease of geared motor

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.

- **Regeneration**

When a large inertial load is operated at high speed, regenerative energy will generate and increase the power supply voltage, causing the protective function to be triggered. Review the operating condition and make sure an excessive regenerative voltage will not be generated.

4 Preparation

This section covers the points to be checked along with the names and functions of the respective parts.

4.1 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. See 4.2 “Combinations of motors and drivers” on p.10 for the motor and driver combinations.

- Motor 1 unit
- Driver 1 unit
- OPERATING MANUAL (this manual)..... 1 copy
- Connector lead wire [0.6 m (2 ft.)] * 1 pc.

* Connector lead wire is supplied with high-torque type motor, **PL** geared type motor and **PS** geared type motor.

Note

- The cable for connecting the terminal box type motor and driver, and the D-Sub (15-pin) connector for connecting to the driver's CN1 connector are not included. They must be supplied separately.
- When removing the driver from the conductive protection bag, make sure your hands are not charged with static electricity. This is to prevent damage to the driver due to static electricity.

4.2 Combinations of motors and drivers

■ Standard type motor

Unit model		Motor model		Driver model
Single shaft	Double shaft	Single shaft	Double shaft	
RBK264A	RBK264B	PK264DA	PK264DB	RBD242A-V
RBK266A	RBK266B	PK266DA	PK266DB	
RBK268A	RBK268B	PK268DA	PK268DB	
RBK296A	RBK296B	PK296DA	PK296DB	RBD245A-V
RBK299A	RBK299B	PK299DA	PK299DB	
RBK2913A	RBK2913B	PK2913DA	PK2913DB	
RBK296AA	RBK296BA	PK296DAA	PK296DBA	
RBK299AA	RBK299BA	PK299DAA	PK299DBA	
RBK2913AA	RBK2913BA	PK2913DAA	PK2913DBA	

■ High-torque type motor

Unit model		Motor model		Driver model
Single shaft	Double shaft	Single shaft	Double shaft	
RBK223PA	RBK223PB	PK223PDA	PK223PDB	RBD215A-K
RBK224PA	RBK224PB	PK224PDA	PK224PDB	
RBK225PA	RBK225PB	PK225PDA	PK225PDB	
RBK233PA	RBK233PB	PK233PDA	PK233PDB	
RBK235PA	RBK235PB	PK235PDA	PK235PDB	
RBK244PA	RBK244PB	PK244PDA	PK244PDB	
RBK246PA	RBK246PB	PK246PDA	PK246PDB	
RBK264PA	RBK264PB	PK264PDA	PK264PDB	RBD228A-K
RBK266PA	RBK266PB	PK266PDA	PK266PDB	
RBK268PA	RBK268PB	PK268PDA	PK268PDB	
RBK264PAA	RBK264PBA	PK264PDAA	PK264PDBA	
RBK266PAA	RBK266PBA	PK266PDAA	PK266PDBA	
RBK268PAA	RBK268PBA	PK268PDAA	PK268PDBA	

■ PL geared type motor

Unit model		Motor model		Driver model
Single shaft	Double shaft	Single shaft	Double shaft	
RBK244PA-P5	RBK244PB-P5	PK244PDA-P5	PK244PDB-P5	RBD215A-K
RBK244PA-P10	RBK244PB-P10	PK244PDA-P10	PK244PDB-P10	
RBK244PA-P36	RBK244PB-P36	PK244PDA-P36	PK244PDB-P36	
RBK266PA-P5	RBK266PB-P5	PK266PDA-P5	PK266PDB-P5	RBD228A-K
RBK266PA-P10	RBK266PB-P10	PK266PDA-P10	PK266PDB-P10	
RBK264PA-P36	RBK264PB-P36	PK264PDA-P36	PK264PDB-P36	

■ PS geared type motor

Unit model		Motor model		Driver model
Single shaft	Double shaft	Single shaft	Double shaft	
RBK223PA-PS5	RBK223PB-PS5	PK223PDA-PS5	PK223PDB-PS5	RBD215A-K
RBK223PA-PS10	RBK223PB-PS10	PK223PDA-PS10	PK223PDB-PS10	

■ Terminal box type motor

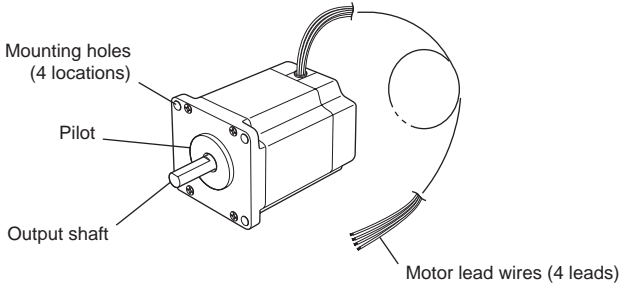
Unit model		Motor model		Driver model
Single shaft	Double shaft	Single shaft	Double shaft	
RBK264T	—	PK264D1T	—	RBD242A-V
RBK266T	—	PK266D1T	—	
RBK268T	—	PK268D1T	—	
RBK296T	—	PK296DT	—	RBD245A-V
RBK299T	—	PK299DT	—	
RBK2913T	—	PK2913DT	—	

4.3 Names and functions of parts

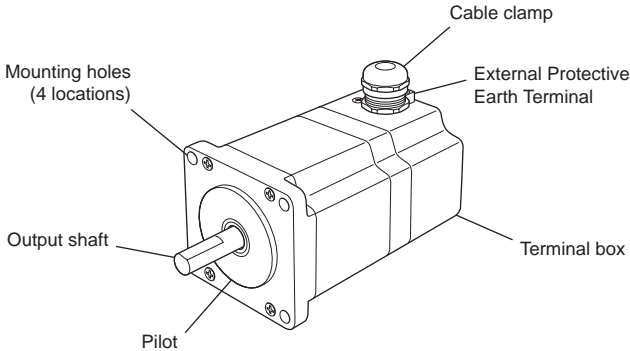
This section covers the names and functions of parts in the motor and driver.

- Standard type motor, high-torque type motor, **PL** geared type motor and **PS** geared type motor

Illustration shows the PK26□ type.



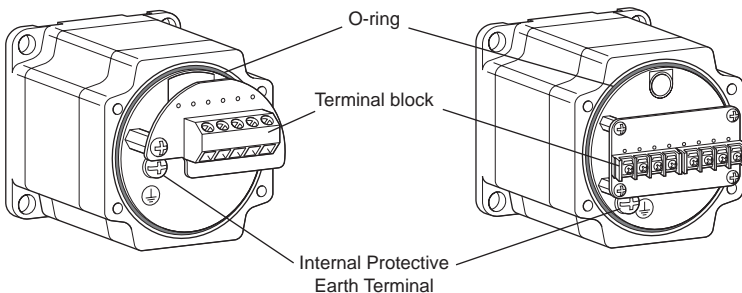
- Terminal box type motor



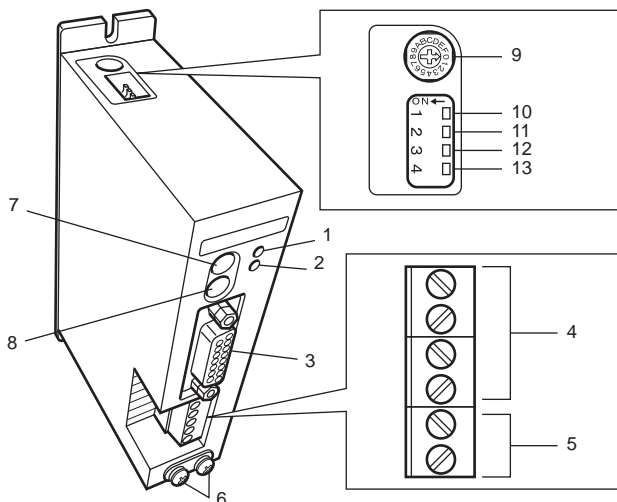
- Terminals of motor (View with the terminal block removed)

• RBK26□

• RBK29□



- Driver



No.	Name	Description
1	POWER LED (green)	Lit when the power is on.
2	ALARM LED (red)	This LED blinks when the protective function was triggered and the ALARM output has turned OFF as a result. The triggered protective function can be checked by counting the number of times the LED blinks.
3	I/O signals connector (CN1)	Connect to I/O signals.
4	Motor terminal	Connect to motor.
5	Power supply terminal	Connect to power supply.
6	Protective Earth Terminal	Make ground connection by installing a grounding wire of AWG18 (0.75 mm ²) or larger.
7	Motor operating current setting switch (RUN)	Set the operating current of the motor.
8	Step angle setting switch (DATA)	Select a desired motor step angle from among the 16 preset levels.
9	Third harmonic waveform correction function (SW1)	This function sets a correction value to be applied to motor drive current waveforms.
10	Smooth drive function switch (SW2-1)	This function lets you reduce vibration and noise during low-speed operation.
11	Vibration suppression function (SW2-2)	This function reduces vibration during medium-speed operation.
12	SW2-3	Not used. (Keep this switch in the OFF position).
13	Motor standstill current setting switch (SW2-4)	Set the current when the motor is at a standstill.

5 Installation

This chapter explains the installation location and installation methods of the motor and driver, as well as how to install a load. The installation and wiring methods in compliance with the EMC Directive are also explained.

5.1 Location for installation

The motor and driver are designed and manufactured for installation in equipment. Install them 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
Motor: -10 to $+50$ °C ($+14$ to $+122$ °F) (non-freezing)
Driver: 0 to $+40$ °C ($+32$ to $+104$ °F) (non-freezing)
- Operating ambient humidity 85% or less (non-condensing)
- Operating surrounding atmosphere
Standard type motor, high-torque type motor, **PL** geared type motor, **PS** geared type motor and driver:
Area that is free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
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
Terminal box type motor:
Area that is free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
- Area not exposed to direct sun
- 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

5.2 Installing the motor

■ Installation direction

The motor can be installed in any direction.

■ Installation method

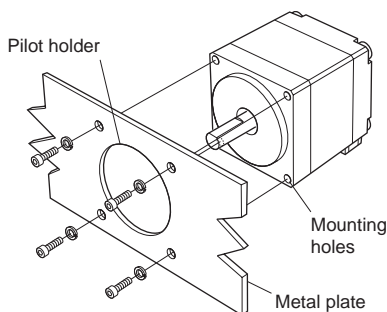
Install the motor onto an appropriate flat metal plate having excellent vibration resistance and heat conductivity.

When installing the motor, secure it with four bolts (not supplied) through the four mounting holes provided. Do not leave a gap between the motor and metal plate. Insert the pilot located on the motor's installation surface into the mounting plate's countersunk or through hole.

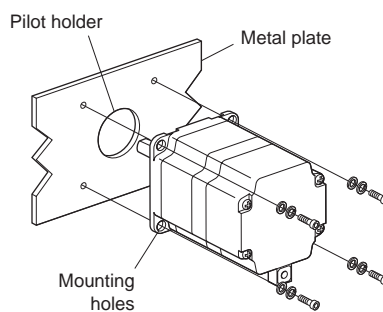
The temperature-rise test, as required by the UL Standards, is conducted with the aluminum heat sink attached. The size and thickness of the heat sink are as described below.

Motor model	Size [mm (in.)]	Thickness [mm (in.)]
PK26□	400 × 400 (15.75 × 15.75)	10 (0.39)
PK29□	200 × 200 (7.87 × 7.87)	

• Installation method A



• Installation method B



Motor type		Nominal size	Tightening torque [N·m (oz·in)]	Effective depth of bolt [mm (in.)]	Installation method
Standard type Terminal box type	PK26□	M4 No.8-32UNC	2 (280)	—	B
	PK29□	M5 No.10-24UNC	3 (420)	—	B
High-torque type	PK22□P	M2.5	0.5 (71)	2.5 (0.098)	A
	PK23□P	M3	1 (142)	4.5 (0.177)	A
	PK24□P	M3	1 (142)	4.5 (0.177)	A
	PK26□P	M4 No.8-32UNC	2 (280)	—	B
PL geared type	PK244P-P	M4	2 (280)	8 (0.315)	A
	PK26□P-P	M5	2.5 (350)	10 (0.394)	A
PS geared type	PK223P-PS	M3	1 (142)	6 (0.236)	A

5.3 Installing a load

When connecting a load to the motor, align the centers of the motor's output shaft and load shaft. Also, keep the overhang load and thrust load under the permissible values.

- **Using a coupling**

Align the centers of the motor's output shaft and load shaft in a straight line.

- **Using a belt drive**

Align the motor's output shaft and load shaft in parallel with each other, and position both pulleys so that the line connecting their centers is at a right angle to the shafts.

- **Using a gear drive**

Align the motor's output shaft and gear shaft in parallel with each other, and let the gears mesh at the center of the tooth widths.

- **Connecting with a key (Geared motor)**

With a geared motor, to connect a load to the gear output shaft having a key groove, first provide a key groove on the load and fix the load with the gear output shaft using the supplied key.

Note

- When coupling the load to the motor, pay attention to the centering of the shafts, belt tension, parallelism of the pulleys, and so on. Securely tighten the coupling and pulley set screws.
- Be careful not to damage the output shaft or bearings when installing a coupling or pulley to the motor's output shaft.
- Do not modify or machine the motor's output shaft. Doing so may damage the bearings and destroy the motor.
- When inserting a parallel key into the gear output shaft, do not apply excessive force by using a hammer or similar tool. Application of strong impact may damage the output shaft or bearings.

5.4 Permissible overhung load and permissible thrust load

The overhung load and the thrust load on the motor's output shaft must be kept under the permissible values listed below.

Note

Failure due to fatigue may occur when the motor bearings and output shaft are subject to repeated loading by an overhung or thrust load that is in excess of the permissible limit.

Motor type		Permissible overhung load [N (lb.)]					Permissible thrust load
		Distance from the tip of motor's output shaft [mm (in.)]					
		0 (0)	5 (0.20)	10 (0.39)	15 (0.59)	20 (0.79)	
Standard type	PK264	54 (12.1)	67 (15)	89 (20)	130 (29)	—	0.45 (0.99) *
	PK266						0.7 (1.54) *
	PK268						1 (2.2) *
	PK296	260 (58)	290 (65)	340 (76)	390 (87)	480 (108)	1.7 (3.7) *
	PK299						2.8 (6.2) *
	PK2913						3.8 (8.4) *
High-torque type	PK223P	25 (5.6)	34 (7.6)	52 (11.7)	—	—	0.11 (0.24) *
	PK224P						0.14 (0.31) *
	PK225P						0.2 (0.44) *
	PK233P	20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	—	0.18 (0.4) *
	PK235P						0.285 (0.63) *
	PK244P						0.3 (0.66) *
	PK246P						0.5 (1.1) *
	PK264PD□	61 (13.7)	73 (16.4)	90 (20)	110 (24)	160 (36)	0.46 (1.01) *
	PK266PD□						0.73 (1.61) *
	PK268PD□						1.1 (2.4) *
	PK264PD□A	54 (12.1)	67 (15)	89 (20)	130 (29)	—	0.46 (1.01) *
	PK266PD□A						0.73 (1.61) *
	PK268PD□A						1.1 (2.4) *

* The allowable thrust loads are the motor's mass [kg (lb.)]. The thrust load should not exceed the motor's dead mass.

Motor type		Permissible overhung load [N (lb.)]					Permissible thrust load
		Distance from the tip of motor's output shaft [mm (in.)]					
		0 (0)	5 (0.20)	10 (0.39)	15 (0.59)	20 (0.79)	
PL geared type	PK244PD□-P5	73 (16.4)	84 (18.9)	100 (22)	123 (27)	–	50 (11.2)
	PK244PD□-P10						
	PK244PD□-P36	109 (24)	127 (28)	150 (33)	184 (41)	–	50 (11.2)
	PK266PD□-P5	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	100 (22)
	PK266PD□-P10	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	100 (22)
	PK264PD□-P36	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	100 (22)
PS geared type	PK223PD□-PS5	45	60	80	100	–	20 (4.5)
	PK223PD□-PS10	(10.1)	(13.5)	(18)	(22)		
Terminal box type	PK264□T	54 (12.1)	67 (15)	89 (20)	130 (29)	–	0.6 (1.32) *
	PK266□T						0.9 (1.98) *
	PK268□T						1.2 (2.6) *
	PK296□T	260 (58)	290 (65)	340 (76)	390 (87)	480 (108)	2.1 (4.6) *
	PK299□T						3.2 (7) *
	PK2913□T						4.3 (9.5) *

* The allowable thrust loads are the motor's mass [kg (lb.)]. The thrust load should not exceed the motor's dead mass.

5.5 Installing the driver

■ Installation direction

The driver is designed so that heat is dissipated via air convection and conduction through the enclosure.

When installing the driver in an enclosure, it must be placed in a perpendicular (vertical) orientation.

There must be a clearance of at least 25 mm (0.98 in.) in the horizontal and vertical directions, respectively, between the driver and enclosure or other equipment within the enclosure. When two or more drivers are to be installed side by side, provide 20 mm (0.79 in.) and 25 mm (0.98 in.) clearances in the horizontal and vertical directions, respectively.

Note

- Install the driver in an enclosure.
- Do not install any equipment that generates a large amount of heat or noise near the driver.
- Do not install the driver underneath the controller or other equipment vulnerable to heat.
- Check ventilation if the ambient temperature of the driver exceeds 40 °C (104 °F).

■ Installation method

Install the driver on a flat metal plate having excellent vibration resistance and heat conductivity.

If the driver's input power supply voltage is 48 V or below, the driver can be installed onto a DIN rail using an optional DIN rail mounting plate (sold separately).

If vibration is noticeable, however, do not install the driver onto a DIN rail, but install it directly onto a metal plate using the mounting holes provided in the driver.

The temperature-rise test, as required by the UL Standards, is conducted with the aluminum heat sink attached. The size and thickness of the heat sink are as described below.

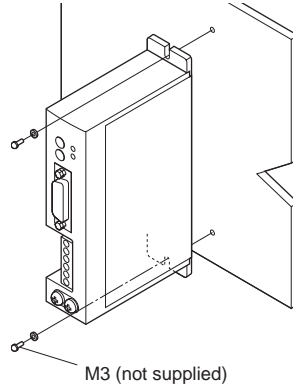
Size [mm (in.)]	Thickness [mm (in.)]
200 × 100 (7.87 × 3.94)	2 (0.08)

Note

If the driver's input power supply voltage exceeds 48 V, do not install the driver onto a DIN rail. Sufficient heat dissipation cannot be achieved and the driver's overheat protection function may be triggered as a result. In such a case, install the driver onto a metal plate directly.

- Using driver mounting holes

Install the driver by securing it with two screws (M3, not supplied) through the mounting holes provided. Leave no gap between the driver and metal plate.



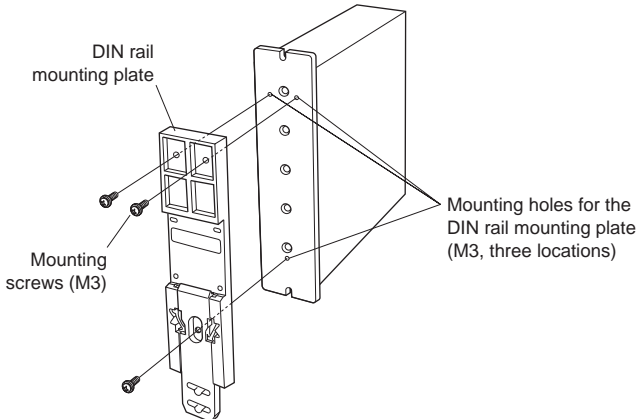
- Mounting to DIN rail

Use a DIN rail 35 mm (1.38 in.) wide to mount the driver.

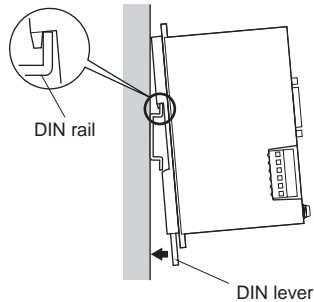
Note

If the driver's input power supply voltage exceeds 48 V, do not install the driver onto a DIN rail. Sufficient heat dissipation cannot be achieved and the driver's overheat protection function may be triggered as a result. In such a case, install the driver onto a metal plate directly.

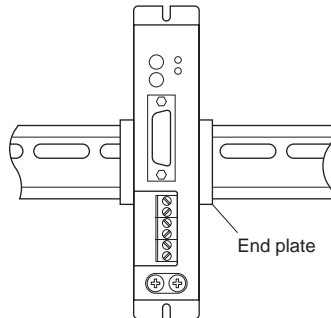
1. Attach the DIN rail mounting plate (model number: **PADP01**) to the back of the driver using the screws supplied with the plate.
Tightening torque: 0.3 to 0.4 N·m (42 to 56 oz-in)



2. Pull the DIN lever down, engage the upper hooks of the DIN rail mounting plate over the DIN rail, and push the DIN lever until it locks in place.

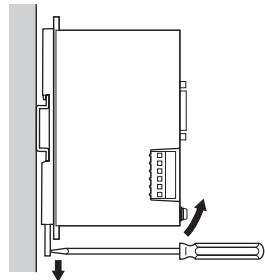


3. Secure the driver with end plate.


Note

- Do not use the mounting holes (M3, three locations) for the DIN rail mounting plate provided in the back of the driver for any purpose other than securing the DIN rail mounting plate.
- Be sure to use the supplied screws when securing the DIN rail mounting plate. The use of screws that would penetrate 3 mm (0.12 in.) or more through the surface of the driver may cause damage to the driver.
- Removing from DIN rail

Pull the DIN lever down until it locks using a flat tip screwdriver, and lift the bottom of the driver to remove it from the rail.


Note

Use force of about 10 to 20 N (2.2 to 4.5 lb.) to pull the DIN lever to lock it. Excessive force may damage the DIN lever.

5.6 Installing and wiring in compliance with EMC Directive

Effective measures must be taken with regard to EMI (electromagnetic interference) caused by the **RBK** series motor and/or driver in the control system equipment operating nearby and EMS (electromagnetic susceptibility) of the **RBK** series motor and/or driver. Failure to do so may result in serious impairment of the machine’s functionality.

The use of the following installation and wiring methods will enable the **RBK** series motor and/or driver to be compliant with the EMC Directive.

Oriental Motor conducts EMC measurements its **RBK** series motors and drivers in accordance with “Example of motor and driver installation and wiring” on p.24. The user is responsible for ensuring the machine’s compliance with the EMC Directive, based on the installation and wiring explained below.

Applicable Standards

EMI	Emission Tests	EN 61000-6-4
	Radiated Emission Test	EN 55011
EMS	Immunity Tests	EN 61000-6-2
	Radiation Field Immunity Test	IEC 61000-4-3
	Electrostatic Discharge Immunity Test	IEC 61000-4-2
	Fast Transient/Burst Immunity Test	IEC 61000-4-4
	Conductive Noise Immunity Test	IEC 61000-4-6

■ Power supply

The **RBK** series products are specifically designed for DC power supply input. Use a DC power supply (such as a switching power supply) compliant with the EMC Directive.

■ Mains filter

Connect a mains filter on the input side of the DC power supply so as to prevent the noise generated in the driver from being transmitted externally via the power supply line. When a power supply transformer is used, be sure to connect a mains filter on the AC input side of the power supply transformer. For mains filters, use FN2070 (Schaffner EMC), or an equivalent.

- Install the mains filter as close to the AC input terminal of DC power supply as possible. Also, secure the I/O cables (AWG18: 0.75 mm² or more) using cable clamps or the like so that the cables won’t lift from the surface of the enclosure panel.
- The cable used to ground the mains filter must be as thick and short to the grounding point as possible.
- Do not wire the AC input cable (AWG18: 0.75 mm² or more) and the output cable of the mains filter (AWG18: 0.75 mm² or more) in parallel. If these two cables are wired in parallel, noise inside the enclosure will be connected to the power supply cable via stray capacitance, reducing the effect of the mains filter.

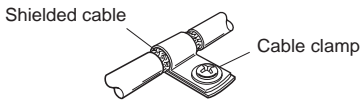
■ Grounding method

When grounding the driver and mains filter, use a cable of the largest possible size and connect to the ground point over the shortest distance so that no potential difference will be generated at the grounded position. The ground point must be a large, thick and uniform conductive surface. Install the motor onto a grounded metal surface.

■ Wiring the power supply cable and I/O signals cable

Use a shielded cable of AWG18 (0.75 mm^2) or more in diameter for the driver power supply cable. Use a shielded cable of AWG26 (0.14 mm^2) or more in diameter for the driver I/O signals cable, and keep it as short as possible.

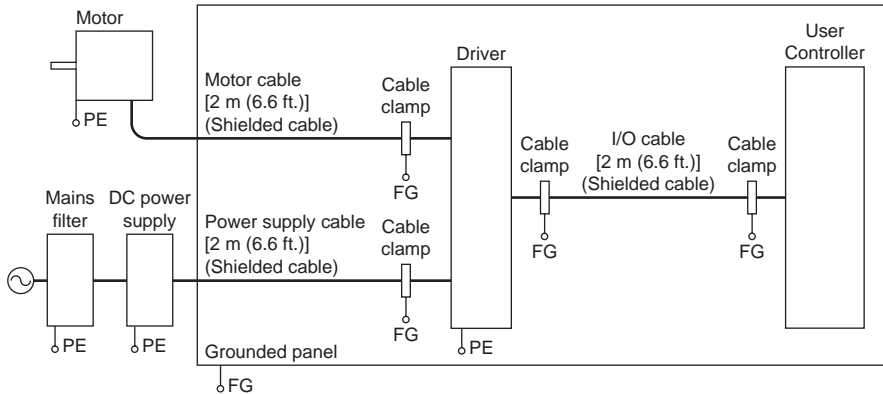
Use a metal cable clamp that contacts the shielded cable along its entire circumference to secure/ground the power supply cable or I/O signals cable. Attach a cable clamp as close to the end of the cable as possible, and connect it as shown in the figure.



■ Notes about installation and wiring

- Connect the motor, driver and any surrounding control system equipment directly to the grounding point so as to prevent a potential difference from generating between grounds.
- When relays or electromagnetic switches are used together with the system, use mains filters and CR circuits to suppress surges generated by them.
- Keep the cable lengths as short as possible. Do not wind or bundle extra lengths.
- Separate the power source cables such as motor cable and power supply cable from the signal cables, and wire them apart by around 100 to 200 mm (3.94 to 7.87 in.). If a power source cable must cross over a signal cable, wire them at right angles. Keep an appropriate distance between the AC input cable and output cable of the mains filter.

■ **Example of motor and driver installation and wiring**



■ **Precautions about static electricity**

Static electricity may cause the driver to malfunction or suffer damage. Be careful when handling the driver with the power on.

Always use an insulated precision screwdriver when adjusting the motor current using the control on the driver.

Note | Do not come close to or touch the driver while the power is on.

6 Connection

This section covers the methods and examples of connecting and grounding the driver, motor, power and controller, as well as the input/output signals.

6.1 Connection example

Either 5 or 24 VDC can be used as the signal voltage for the PLS input, and DIR input.

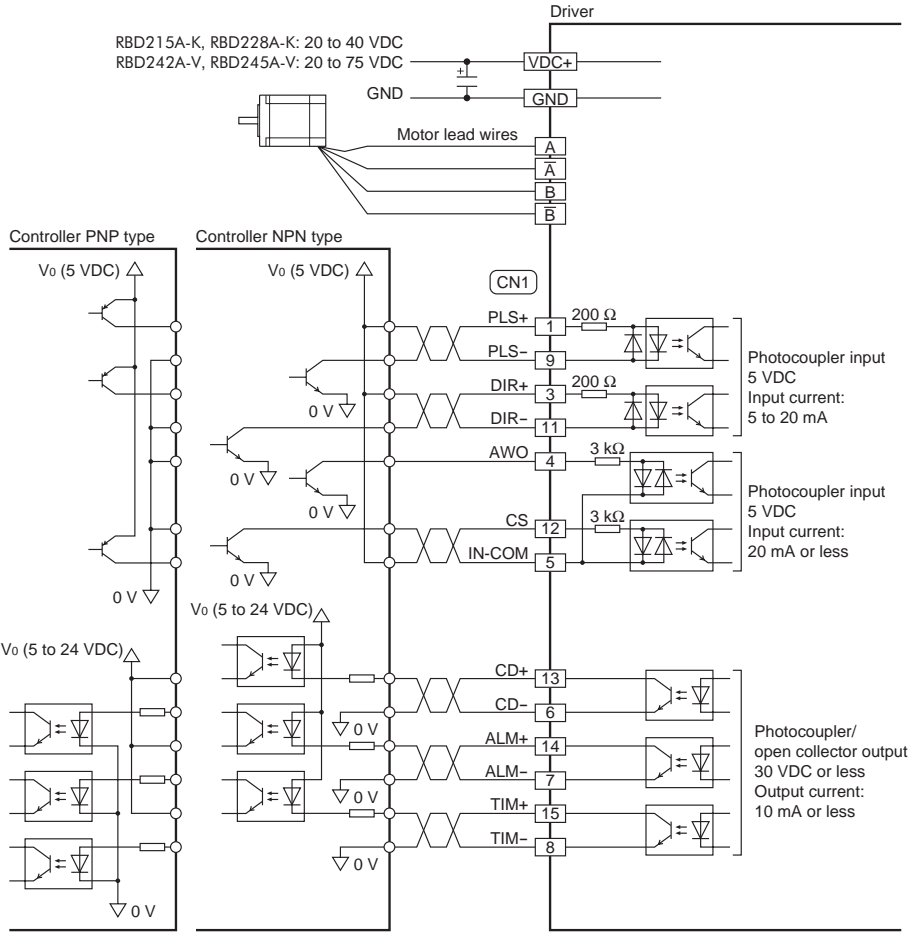
Line driver input is also supported.

Note

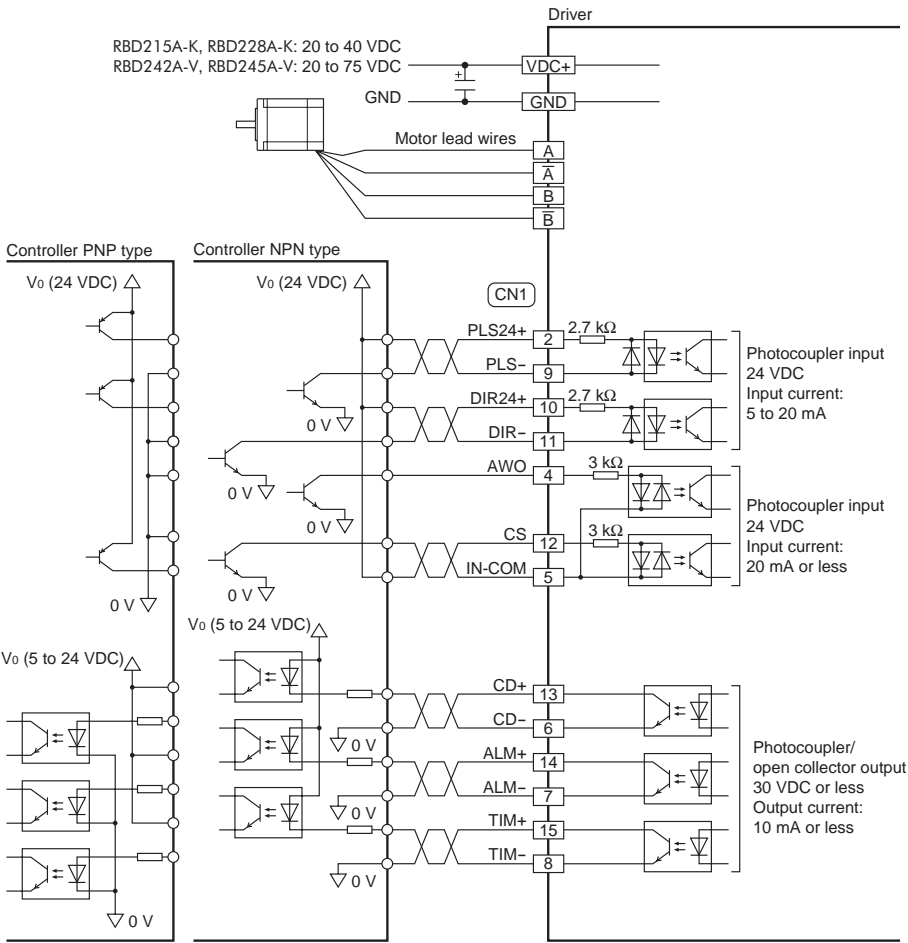
- The pin numbers corresponding to the PLS input and DIR input change in accordance with the signal voltage.
 5 VDC or line driver input:
 PLS input pin 1 and pin 9
 DIR input pin 3 and pin 11
 24 VDC:
 PLS input pin 2 and pin 9
 DIR input pin 10 and pin 11
- Be certain the I/O signals cable that connects the driver and controller is as short as possible. The maximum input frequency will decrease as the cable length increases.
- Check the colors of motor leads and the terminal numbers, and connect them correctly and securely. Wrong connection of leads or poor contact may damage the driver.

Signal name	Description	Standard type motor High-torque type motor PL geared type motor PS geared type motor	Terminal box type motor	
			Terminal block No. of RBK26□	Terminal block No. of RBK29□
A	A-phase output	Black	2	1
\overline{A}	\overline{A} -phase output	Green	3	4
B	B-phase output	Red	4	5
\overline{B}	\overline{B} -phase output	Blue	5	8


■ 5 VDC or line driver input:



■ 24 VDC:



6.2 Connecting the power supply

**Warning**

For the driver's 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.

Connecting the power supply to the driver's power supply terminal.
Use a power supply that can supply the following current capacity.

Driver model	Power supply input voltage	Power supply current capacity
RBD215A-K	20 to 40 VDC	1.7 A or more
RBD228A-K		3.7 A or more
RBD242A-V	20 to 75 VDC	4.9 A or more
RBD245A-V		5.2 A or more

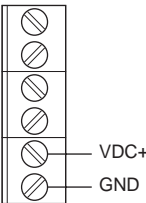
Use a cable of AWG18 (0.75 mm²). Keep the wiring distance as short as possible [less than 2 m (6.6 ft.)] to suppress the effect of noise.

The power supply terminals are provided on a terminal block. Strip the cable sheath by 8 mm (0.31 in.), then insert the lead wire into the terminal and tighten with terminal screws.

Tightening torque: 0.5 to 0.6 N·m (71 to 85 oz·in)

• Pin assignments of power supply terminal

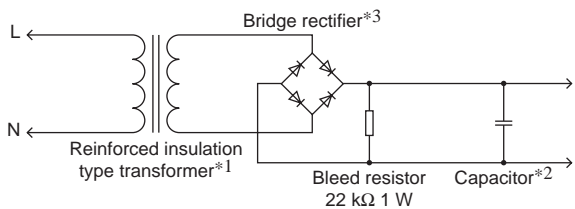
Signal name	Description
VDC+	DC power supply input
GND	GND



Note

- Pay attention to polarity when connecting the power supply. Connecting the power supply in reverse polarity may damage the driver.
- Do not wire the driver's power supply cable in the same conduit in which another power line or the motor cable is wired.
- If the motor cable or power supply cable generates an undesirable amount of noise, shield the cable or install a ferrite core.

• Recommended driver power supply circuit



Driver model	Transformer capacity (*1)	Capacitor capacity (*2)	Bridge rectifier (*3)
RBD215A-K	100 VA	4700 μF	5 A
RBD228A-K	400 VA		10 A
RBD242A-V			
RBD245A-V			

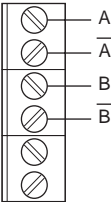
6.3 Connecting and grounding the standard type motor, high-torque type motor, PL geared type motor and PS geared type motor

■ Connecting method

Connecting the motor leads to the driver’s motor terminal.
The power supply terminals are provided on a terminal block. Strip the cable sheath by 8 mm (0.31 in.), then insert the lead wire into the terminal and tighten with terminal screws.
Tightening torque: 0.5 to 0.6 N·m (71 to 85 oz-in)

• Pin assignments of motor terminal

Signal name	Description	Color of motor leads
A	A-phase output	Black
\overline{A}	\overline{A} -phase output	Green
B	B-phase output	Red
\overline{B}	\overline{B} -phase output	Blue



Note

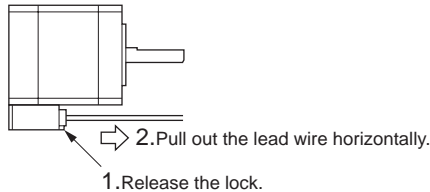
- Check the colors of motor leads and connect them correctly and securely. Wrong connection of leads or poor contact may damage the driver.
- If the motor cable or power supply cable generates an undesirable amount of noise, shield the cable or install a ferrite core.

• Connector type motor

With a high-torque type, **PL** geared type and **PS** geared type a connector is used for connection on the motor side. Use the supplied connector lead wire.

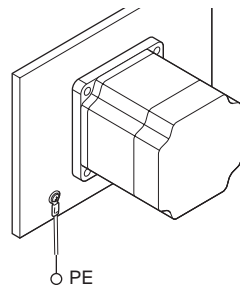
Note

- When connecting a motor, affix the lead wire at the connection part to prevent the connection part from receiving stress due to the flexing of the lead wire. Make the lead wire's radius of curvature as large as possible.
- Have the connector plugged in securely. Insecure connection may cause malfunction or damage to the motor or driver.
- To connect/disconnect the connector, turn off the power and then wait for at least 5 seconds after the POWER LED has turned off.
- When disconnecting the connector type lead wire, pull the connector horizontally along the output shaft to remove. The motor may be damaged if force is applied in any other direction.
- The connector lead wires that come with the high-torque type **RBK23□P**, **RBK24□P**, **RBK26□P**, **PL** geared type and **PS** geared type have a connector with a lock mechanism. When removing these types of lead wire, release the connector lock first. Forcibly pulling out the lead wire without releasing the connector lock may damage the motor and connector.



■ Grounding method

Install the motor to the grounded metal plate.
Use a grounding wire thicker than AWG18 (0.75 mm²).
When grounding, use a round terminal and affix it with a mounting screw over a crow washer.



6.4 Connecting and grounding the terminal box type motor

Pin assignments of motor terminal

Signal name	Description	Terminal block No. of RBK26□	Terminal block No. of RBK29□
A	A-phase output	2	1
\bar{A}	A-phase output	3	4
B	B-phase output	4	5
\bar{B}	B-phase output	5	8

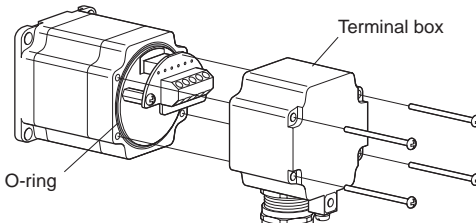
Note

Check the terminal numbers, and connect them correctly and securely. Wrong connection of leads or poor contact may damage the driver.

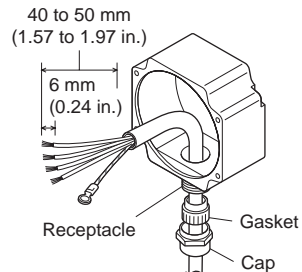
■ Connecting method of the RBK26□

Use a multi-core cable [outer diameter: 7 to 13 mm (0.28 to 0.51 in.)] of AWG22 to 16 (0.3 to 1.25 mm²) for connection with the motor.

1. Loosen the 4 terminal block cover screws (M3) and remove the terminal block cover from the motor.



2. Remove the cable clamp cap and gasket, and guide the cable into the terminal block cover.
3. Strip the cable sheath by 40 to 50 mm (1.57 to 1.97 in.) from the end, strip the lead wire sheath by 6 mm.

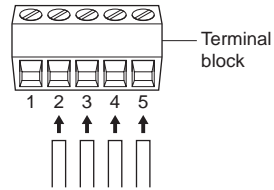


Note

Do not strip the cable sheath by more than 50 mm (1.97 in.) It will result in loss of the sealing effect of the cable clamp.

4. Loosen the terminal block screws, insert the lead wire into the opening, and then tighten the screws.

Tightening torque: 0.6 N·m (85 oz-in)

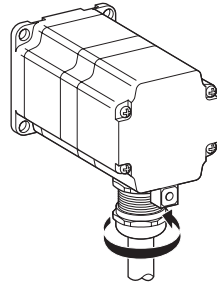


Note | Terminal No. 1 is not used. Do not connect any cables.

5. If an internal Protective Earth Terminal is used, ground the Protective Earth Terminal by referring to “Grounding method” on p.34.
6. After confirming that an O-ring is set, align the terminal box cover and motor case and tighten the terminal box screws (M3).
Tightening torque: 0.5 N·m (71 oz-in)

7. Insert the gasket into the receptacle, confirm that the sheath of the multi-core cable is securely sealed with the gasket, and then tighten the cap.

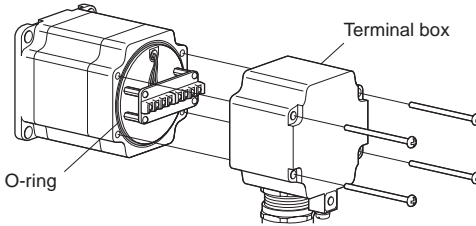
Tightening torque: 4 to 5 N·m (560 to 710 oz-in)
Adjust the tightening torque depending on the diameter and material of the cable.



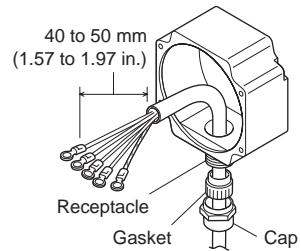
■ Connecting method of the RBK29□

Use a multi-core cable [outer diameter: 7 to 13 mm (0.28 to 0.51 in.)] of AWG22 to 16 (0.3 to 1.25 mm²) and round terminal for connection with the motor.

1. Loosen the 4 terminal block cover screws (M3) and remove the terminal block cover from the motor.

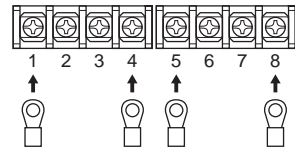


2. Remove the cable clamp cap and gasket, and guide the cable into the terminal block cover.
3. Strip the cable sheath by 40 to 50 mm (1.57 to 1.97 in.) from the end, crimp the round terminal (M3) to a lead wire.



Note Do not strip the cable sheath by more than 50 mm (1.97 in.) It will result in loss of the sealing effect of the cable clamp.

4. Connect the round terminal (M3) to the terminal block, and then tighten the screws.
Tightening torque: 0.8 N·m (113 oz-in)

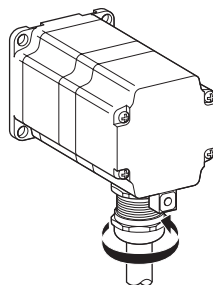


Note Terminal No. 2, 3, 6 and 7 is not used. Do not connect any cables.

5. If an internal Protective Earth Terminal is used, ground the Protective Earth Terminal by referring to "Grounding method" on p.34.
6. After confirming that an O-ring is set, align the terminal box cover and motor case and tighten the terminal box screws (M3).
Tightening torque: 0.5 N·m (71 oz-in)

7. Insert the gasket into the receptacle, confirm that the sheath of the multi-core cable is securely sealed with the gasket, and then tighten the cap.

Tightening torque: 4 to 5 N·m (560 to 710 oz-in)
Adjust the tightening torque depending on the diameter and material of the cable.



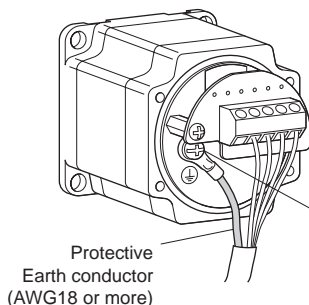
■ Grounding method

Ground either the internal Protective Earth Terminal or external Protective Earth Terminal. Use a grounding wire thicker than AWG18 (0.75 mm^2). In a potentially corrosive environment, use the internal Protective Earth Terminal. If the wiring distance between the motor and driver is long, use the external Protective Earth Terminal.

- When using the internal Protective Earth Terminal

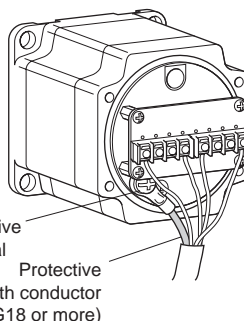
Crimp the round terminal (M4) to a Protective Earth conductor.
Tightening torque: 1.2 N·m (170 oz-in)

• RBK26□



Internal Protective
Earth Terminal

• RBK29□

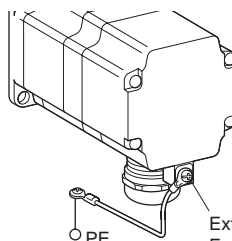


Protective
Earth conductor
(AWG18 or more)

- When using the external Protective Earth Terminal

Two screw holes are provided for connecting a Protective Earth Terminal. Use a round terminal (M4) to connect one of the two points to the ground.

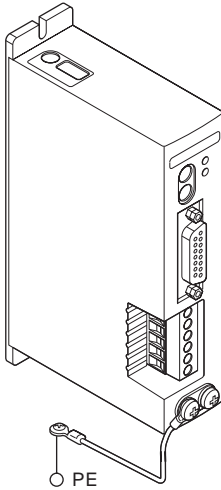
Tightening torque: 1.2 N·m (170 oz-in)



External Protective
Earth Terminal

6.5 Grounding the driver

Be sure to ground the Protective Earth Terminal (screw size: M4) of the driver.
Use a grounding wire of AWG18 (0.75 mm^2) or more in diameter, and ground the cable near the driver with a round terminal.
Do not share the grounding wire with a welder or power equipment.



6.6 Connecting the I/O signals

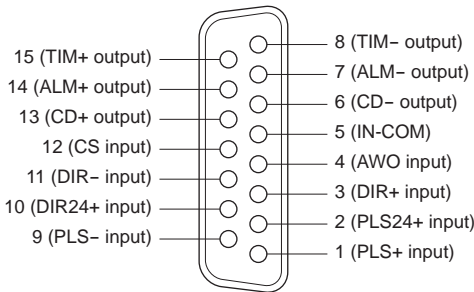
Connecting the I/O signals to the driver's CN1.

Keep the wiring distance as short as possible [less than 2 m (6.6 ft.)] to suppress the effect of noise.

Note

- The D-Sub (15-pin) connector and the hood for connecting to the driver's CN1 connector are not included. Please prepare as follows;
 - D-Sub (15-pin) connector
 - Hood (the screw: No.4-40UNC)
- Separate I/O signals cable at least 100 mm (3.94 in.) from electromagnetic relays and other than inductance loads. Additionally, route I/O signals cable perpendicular to power supply cables and motor cables, rather than in a parallel fashion.

CN1 pin assignments



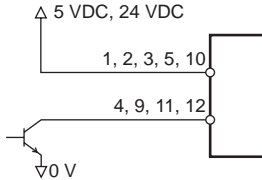
Pin No.	Signal name	Description
1	PLS+ input	Pulse input
2	PLS24+ input	Pulse input (24 VDC)
3	DIR+ input	Rotation direction input
4	AWO input	All windings off input
5	IN-COM	Common input
6	CD- output	Current down output
7	ALM- output	Alarm output
8	TIM- output	Excitation timing output
9	PLS- input	Pulse input
10	DIR24+ input	Rotation direction input (24 VDC)
11	DIR- input	Rotation direction input
12	CS input	Step angle switching input
13	CD+ output	Current down output
14	ALM+ output	Alarm output
15	TIM+ output	Excitation timing output

6.7 Input/output signals

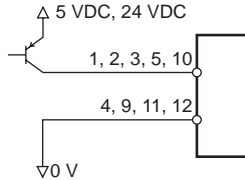
■ Input signals

The signal state represents the “ON: Carrying current” or “OFF: Not carrying current” state of the internal photocoupler.

- Example of connection with a current sink output circuit



- Example of connection with a current source output circuit



- PLS (pulse) input, DIR (rotating direction) input

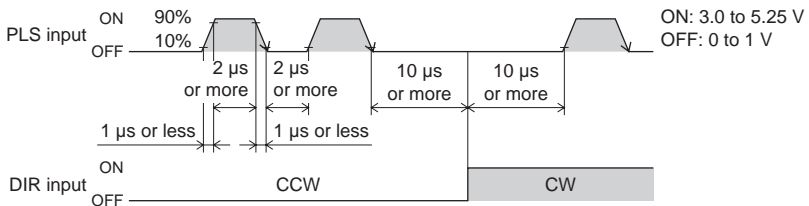
Either 5 VDC or 24 VDC can be used as the signal voltage for the PLS input, and DIR input.

Line driver input is also supported.

5 VDC

The controller pulses are connected to the PLS+ input (pin No.1) or the PLS- input (pin No.9), and the rotation direction is connected to the DIR+ input (pin No.3) or DIR- input (pin No.11).

- When the DIR input is ON, a fall of the PLS input from ON to OFF will rotate the motor one step in the CW direction.
- When the DIR input is OFF, a fall of the PLS input from ON to OFF will rotate the motor one step in the CCW direction.



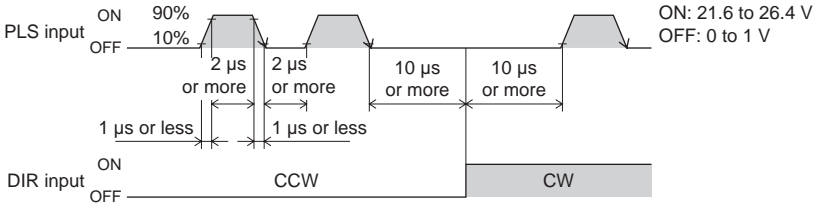
Note

The interval for switching the motor direction represents the response time of the circuit. Set this interval to an appropriate time after which the motor will respond.

24 VDC

The controller pulses are connected to the PLS24+ input (pin No.2) or the PLS- input (pin No.9), and the rotation direction is connected to the DIR24+ input (pin No.10) or DIR- input (pin No.11).

- When the DIR input is ON, a fall of the PLS input from ON to OFF will rotate the motor one step in the CW direction.
- When the DIR input is OFF, a fall of the PLS input from ON to OFF will rotate the motor one step in the CCW direction.



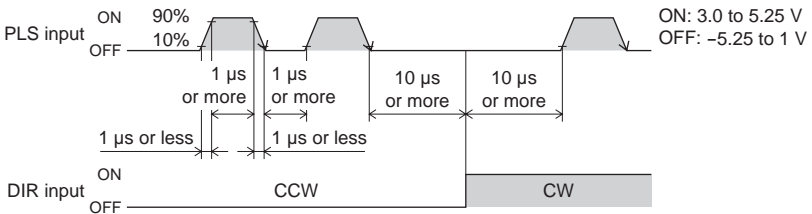
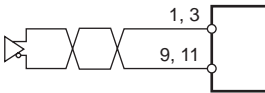
Note

The interval for switching the motor direction represents the response time of the circuit. Set this interval to an appropriate time after which the motor will respond.

Line driver input

The controller pulses are connected to the PLS+ input (pin No.1) or the PLS- input (pin No.9), and the rotation direction is connected to the DIR+ input (pin No.3) or DIR- input (pin No.11).

- When the DIR input is ON, a fall of the PLS input from ON to OFF will rotate the motor one step in the CW direction.
- When the DIR input is OFF, a fall of the PLS input from ON to OFF will rotate the motor one step in the CCW direction.



Note

The interval for switching the motor direction represents the response time of the circuit. Set this interval to an appropriate time after which the motor will respond.

- **AWO (all windings off) input**

Use the signal only when the motor's output shaft must be rotated manually for position adjustment (ON: 4.5 to 26.4 V, OFF: 0 to 1 V).

- When the AWO input is turned ON, the driver stops supplying current to the motor and the motor's holding torque is lost. You to adjust the load position manually.
- When the AWO input is turned OFF, the current supply to the motor resumes, thereby restoring the motor's holding torque.

- **CS (step angle switching) input**

(ON: 4.5 to 26.4 V, OFF: 0 to 1 V)

- When the CS input is turned ON, the motor will operate at the base step angle regardless of the settings of the step angle setting switches.
- When the CS input is turned OFF, the motor will operate at the step angle set by the step angle setting switches.

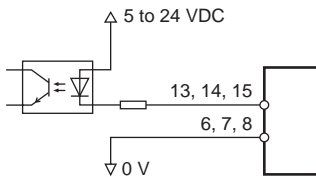
Note

Do not switch the CS input while the motor is operating, or the motor may misstep and stall.

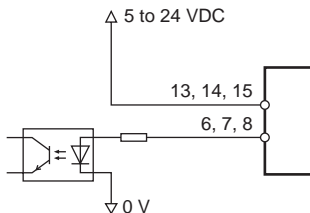
■ Output signals

Driver output signals are photocoupler/open-collector output. The signal state represents the “ON: Carrying current” or “OFF: Not carrying current” state of the internal photocoupler.

- Example of connection with a current source input circuit



- Example of connection with a current sink input circuit



- **CD (current down) output**

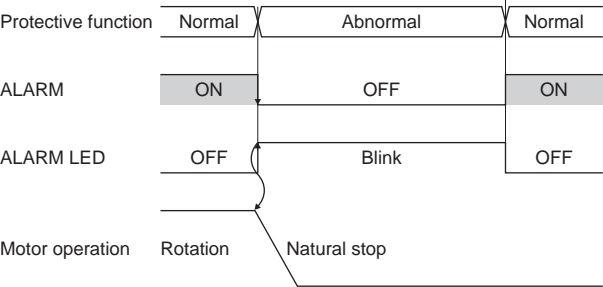
The CD output remains ON while the automatic current down function is active.

• ALM (alarm) output

ALM output remains ON when the driver is operating normally, then turns OFF when a protective function is triggered.

Error detection by the driver, such as overheat, overvoltage and overcurrent during motor operation, turns the ALM output OFF, blinks the ALARM LED on the driver, and simultaneously shuts off the motor current to stop motor operation.

Count the number of the ALARM LED blinks to identify the particular protective function that has been triggered. For details, refer to p.47.

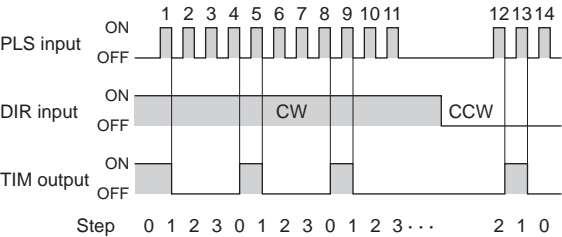


• TIM (excitation timing) output

When the motor-excitation state (combined phases of current flowing) is in the excitation home position (step [0]), the driver switches on the timing output. The motor-excitation state is reset to the excitation home position when the power supply is switched on.

When the motor has a base step angle of 1.8°/step, the TIM output turns ON with a rotation of every 7.2° from the excitation home position in synchronization with a pulse input. The TIM output behaves differently depending on the combined motor and the microstep resolution.

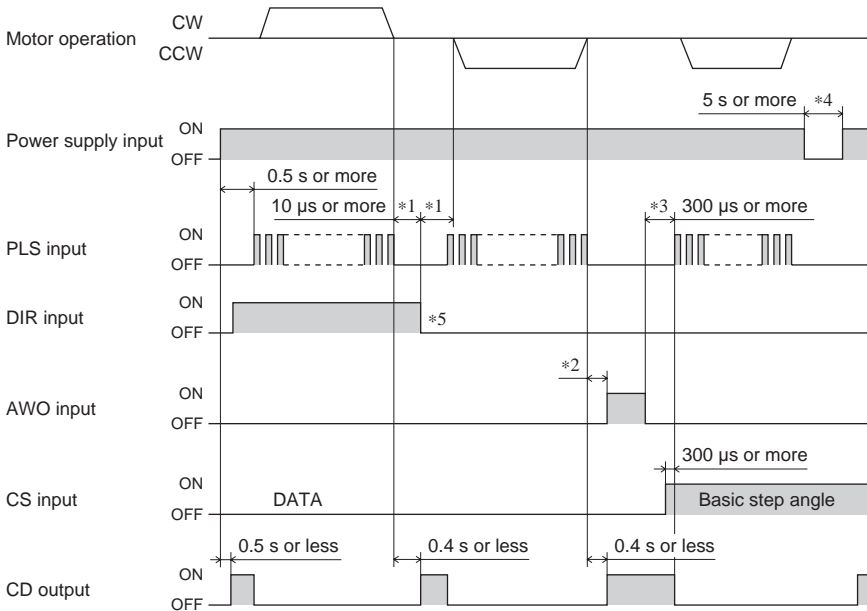
Also, when detecting the mechanical home position for a mechanical device, by making an AND circuit for the mechanical home position sensor and the TIM output, the variation in the motor stop position within the mechanical home position sensor can be reduced and the mechanical home position made more precise.



Note

- When using the TIM output, stop the motor's output shaft at an integer multiple of 7.2°.
- When switching the step angle, do this with the motor stopped and the TIM output ON.

6.8 Timing chart



The shaded section indicates that the photocoupler diode is emitting light.

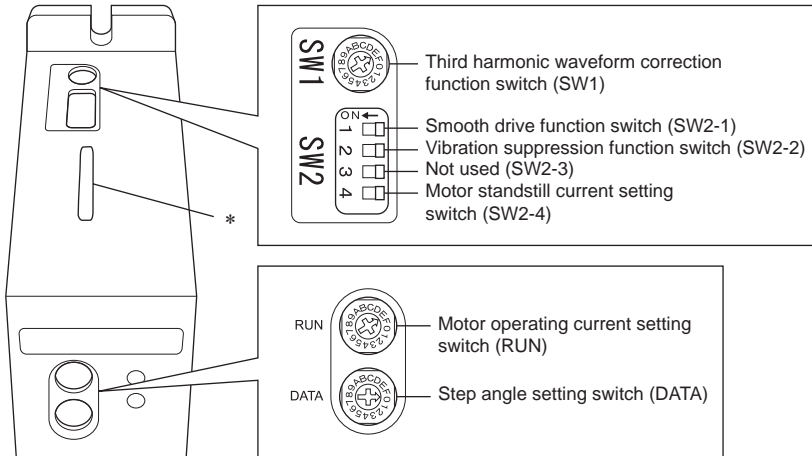
- *1 “10 μs or more” indicated in connection with the DIR input select time indicates a circuit response time. Set it to the time required for the motor to respond to the applicable pulse input.
- *2 The specific duration varies depending on the load inertial moment, load torque, self-starting frequency, etc.
- *3 Do not input pulse signals immediately after switching the AWO input to OFF, given that it will affect the motor's starting characteristics.
- *4 To cycle the power, turn off the power and then wait for at least 5 seconds after the POWER LED has turned off.
- *5 The minimum interval time needed for switching the direction of rotation will vary, depending on the operating speed and size of the load. Do not shorten the interval time any more than is necessary.

Note

The maximum response frequency is 250 kHz at a pulse duty of 50%. Response can be obtained up to 500 kHz in the line driver input mode.

7 Settings

This chapter explains how to set the driver functions.



Note

Do not operate the driver internal switches other than the SW1, SW2, RUN and DATA. Changing the switch settings may cause a product malfunction or cause damage to the product.

Setting of the switches indicated by *



7.1 Smooth drive function

This function lets you reduce vibration and noise during low-speed operation without having to change the step angle setting. This is achieved by automatically dividing the step angle in accordance with the input pulses. This function makes it not necessary to change the pulse speed or pulse count from the controller. Use an insulated precision screwdriver to change the ON/OFF position of the smooth drive function switch (SW2-1).

Factory setting: OFF (used)

- When the smooth drive function is not used, set the smooth drive function switch to ON.
- When the smooth drive function is used, set the smooth drive function switch to OFF.

7.2 Vibration suppression function

This function reduces vibration during medium-speed operation.

Use an insulated precision screwdriver to change the ON/OFF position of the vibration suppression function switch (SW2-2).

Factory setting: OFF (used)

- When the vibration suppression function is not used, set the vibration suppression function switch to ON.
- When the vibration suppression function is used, set the vibration suppression function switch to OFF.

7.3 Third harmonic waveform correction function

This function sets a correction value to be applied to motor drive current waveforms.

Use an insulated precision screwdriver to change the dial of the third harmonic waveform correction function switch (SW1).

- RBD215□, RBD242□ and RBD245□

Factory setting: E (−4%)

Dial	Correction value
C	0% (No correction)
D	−2%
E	−4%
F	−6%

Note Do not set SW1 to “0 to B.” Doing so will cause the motor torque to drop.

- RBD228□

Factory setting: A (−4%)

Dial	Correction value
8	0% (No correction)
9	−2%
A	−4%
B	−6%

Note Do not set SW1 to “0 to 7” and “C to F”. Doing so will cause the motor torque to drop.

7.4 Step angle

Select a desired motor step angle from among the 16 preset levels.

Use an insulated precision screwdriver to change the dial of the step angle setting switch (DATA).

The step angle is calculated by dividing the base step angle of the motor by the number of divisions.

Factory setting: 0 (Number of divisions 1)

Dial setting	Number of divisions	Resolution	Step angle
0	1	200	1.8°
1	2	400	0.9°
2	4	800	0.45°
3	5	1000	0.36°
4	8	1600	0.225°
5	9	1800	0.2°
6	10	2000	0.18°
7	16	3200	0.1125°
8	18	3600	0.1°
9	20	4000	0.09°
A	32	6400	0.05625°
B	36	7200	0.05°
C	40	8000	0.045°
D	64	12800	0.028125°
E	80	16000	0.0225°
F	128	25600	0.0140625°

Note

- Step angles are theoretical values.
- The step angle set by the step angle setting switches becomes effective when the CS input is OFF.
- Do not switch the CS input or the step angle setting switch while the motor is operating, or the motor may misstep and stall. Set the step angle setting switches when the TIM output is ON.

7.5 Motor current

Set the motor current using the motor operating current setting switch (RUN) and motor standstill current setting switch (SW2-4).

When the load is light and there is a margin for motor torque, the motor's operating vibration and the temperature increase of the motor and driver can be held down by lowering the motor's operating current and standstill current.

■ Operating current

A desired operating current can be set via selection from among the 16 preset levels. Use an insulated precision screwdriver to change the dial of the motor operating current setting switch (RUN).

Factory setting: RBD215□ F (motor's rated current)
 RBD228□ E (motor's rated current)
 RBD242□ E (motor's rated current)
 RBD245□ F (motor's rated current)

Operating current (A/phase) [Representative values]

Dial setting	RBD215□	RBD228□	RBD242□, RBD245□
0	0.09	0.19	0.28
1	0.19	0.38	0.56
2	0.28	0.56	0.84
3	0.38	0.75	1.13
4	0.47	0.94	1.4
5	0.56	1.13	1.7
6	0.66	1.3	2
7	0.75	1.5	2.25
8	0.84	1.7	2.5
9	0.94	1.9	2.8
A	1.03	2.05	3.1
B	1.13	2.25	3.4
C	1.22	2.45	3.65
D	1.31	2.6	3.95
E	1.41	2.8	4.2
F	1.5	3	4.5

Note

- Set the motor's operating current to a value not exceeding the rated current of the motor.
- The actual operating current may vary from the applicable value in the table depending on the motor used.

■ Standstill current

Set a rate of reduction with respect to the set operating current.

The standstill current is calculated by multiplying the operating current with the specified rate of reduction.

Use an insulated precision screwdriver to change the ON/OFF position of the motor standstill current setting switch (SW2-4).

Factory setting: OFF (50% of the rated current)

- When this switch is set to ON, the rate of reduction becomes 25%.
- When this switch is set to OFF, the rate of reduction becomes 50%.

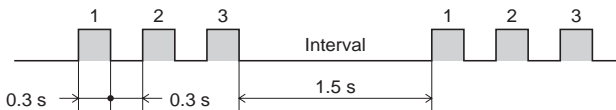
When pulse output is stopped, the motor current will automatically drop to the standstill current within approx. 0.3 second.

8 Protective functions

This section covers the driver-protection functions and methods used to clear the triggered function.

8.1 Descriptions of protective functions and numbers of LED blinks

The driver is provided with functions that protect the driver from overheat, overvoltage and overcurrent. When a protective function is triggered, the ALM output turns OFF, blinks the ALARM LED on the driver, and simultaneously shuts off the motor current to stop motor operation.



The number of ALARM LED blinks varies according to the nature of the triggered protective function, and you can check the cause that triggered the protective function by counting the number of blinks.

The table below gives descriptions of protective functions and their corresponding numbers of blinks.

No. of blinks	Protective function	Conditions
2	Overheat protection	When the driver temperature exceeds a specified value.
3	Overvoltage protection	When the driver inverter's primary voltage exceeds a permissible value.
5	Overcurrent protection	When an excessive current flows through the driver inverter's power element.

8.2 How to clear a protective function

If the ALM output turned OFF as a result of actuation of any of the driver's protective functions, reset the ALM output (turn the signal ON) by cycling the driver power.

Note

To clear the ALM output, be sure to remove the cause of the problem that has triggered the protective function before turning the power back on. To cycle the power, turn off the power and then wait for at least 5 seconds after the POWER LED has turned off.

9 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, stop the use and contact your nearest office.

Inspection items

- Are the motor installation screws loose?
- Are there any abnormal sounds from the motor's bearing section (ball bearings) or elsewhere?
- Do any of the motor leads have damage or stress, or is there any play at the section for connection with the driver?
- Is there any deviation between the centers of the motor's output shaft and load shaft?
- Are the driver installation screws or connector sections loose?
- Is there any dust or dirt on the driver?
- Are there any strange smells or other abnormalities at the driver?

Note

The driver uses semiconductor elements. Handle the driver carefully. There is a danger of the driver being damaged by static electricity, etc.

10 Troubleshooting and remedial actions

During motor operation, the motor or driver may fail to function properly due to an improper speed setting or wiring. When the motor cannot be operated correctly, refer to the contents provided in this section and take appropriate action. If the problem persists, contact your nearest office.

Phenomenon	Possible cause	Remedial action
<ul style="list-style-type: none"> The motor is not energized. The motor's output shaft can be turned easily by hand. 	Connection error in the motor or power supply.	Check that the connections between the motor, driver and power supply are correct.
	Current potentiometer incorrectly set. If the setting is too low, the motor torque will also be too low and operation will be unstable.	Return the current potentiometer to its factory setting and check.
	The AWO input is set to ON.	Switch the AWO input to OFF and confirm that the motor is excited.
The motor does not run.	Pulse input line connection error.	<ul style="list-style-type: none"> Check the controller and driver connections. Check the pulse input specifications (voltage and width).
Motor operation is unstable.	Motor connection error.	Check that the driver and motor connections are correct.
	Current potentiometer incorrectly set. If the setting is too low, the motor torque will also be too low and operation will be unstable.	Return the current potentiometer to its factory setting and check.

Phenomenon	Possible cause	Remedial action
Loss of synchronization during acceleration or running.	The centers of the motor's output shaft and load shaft are not aligned.	Check the connection condition of the motor output shaft and load shaft.
	The load or load fluctuation is too high.	Check for large load fluctuations during motor operation. If adjusting the motor's operating speed to low and high torque eliminates the problem, it is necessary to review the load conditions.
	The speed of the starting pulse is too high.	Lower the speed of the starting pulse.
	The acceleration (deceleration) time is too short.	Lengthen the acceleration (deceleration) time.
	Electrical noise	Check running with only the motor, driver and required controller. If the impact of noise is recognized, take countermeasures, such as rewiring for greater distance from the noise source, changing the signal cables to shielded wire, or mounting a ferrite core.
Motor does not move the set amount.	Mistake in switching CS input.	Check the CS input state.
	Wrong step angle settings.	Check the settings of the step angle setting switches.
	Pulse output count is too low or too high.	Check whether or not the number of pulses required for operation at the set step angle are being output.
Motor is too hot.	Long continuous operation time of the motor.	Decrease the operation time of the motor per session or increase the standstill time. Make sure that the motor case temperature will not exceed 100 °C (212 °F).
	Motor standstill current adjustment is too high.	Lower the motor standstill current.
TIM output does not work.	CS input switched to ON when TIM output is not being output.	Switch the CS input to ON when TIM output is being output.

Phenomenon	Possible cause	Remedial action
Motor vibration is too great.	The centers of the motor's output shaft and load shaft are not aligned.	Check the connection condition of the motor output shaft and load shaft.
	Motor is resonating.	<p>If the vibration decreases when the operating pulse speed is changed, it means the motor is resonating. Vibration can be suppressed by taking the following measures:</p> <ul style="list-style-type: none"> • Change the operating pulse speed setting. • Change the third harmonic waveform correction value. • Install a clean damper (sold separately).
	Load is too small.	<p>Turn the motor operating current setting switch slightly in the counterclockwise direction in order to lower the current. Vibration will increase if the motor's output torque is too large for the load.</p>

11 Options (sold separately)

■ Connector lead wire

Used for connecting the motor of the high-torque type, **PL** geared type and **PS** geared type.

Model	Length	Applicable product
LC2B06A	0.6 m (2 ft.)	RBK22□P
LC2B06B	0.6 m (2 ft.)	RBK23□P, RBK24□P
LC2B06C	0.6 m (2 ft.)	RBK26□P

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