



## Brushless Motor and Driver Package

# BLH Series

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# 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

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## ■ Before using the motor unit

This product is designed to be incorporated into general industrial machinery, and must not be used for other purposes. For the power supply use a DC power supply with reinforced insulation on its primary and secondary sides. It should be noted that we are not responsible for any damages caused by ignoring this warning.

## ■ Overview of the product

The **BLH** series is a brushless motor unit that adopts a slim, high-torque brushless motor and an open-case high-precision compact driver of 24 VDC input type. The product is available in three types; a round shaft type which is the optimum for high speed requirements and a combination type\* equipped with a special-purpose gearhead which is best suited to high-torque operation by gear speed reduction (a pinion shaft type\* compatible with the accessory special-purpose gearhead).

\* The motor with a frame size of 42 mm (1.65 in.) is a geared type. There is no pinion shaft type available.

## ■ Standards and CE Marking

This product is recognized by UL and certified by CSA, and bears the CE Marking (EMC Directive) in compliance with the EN Standards.

### ● Applicable Standards

	Applicable Standards	Certification Body	Standard File No.
<b>BLH015</b> <b>BLH230</b> <b>BLH450</b> <b>BLH5100</b>	UL 60950-1 CSA C22.2 No.60950-1	UL	E208200

\* The names of products certified to conform with relevant standards are represented by applicable unit model motor and driver part numbers.

### ● Installation conditions

- The product is to be used as a component within other equipment.
- Overvoltage category: I
- Pollution degree: 2
- Protection against electric shock: Class III equipment

- **For Low Voltage Directive**

- Since this product is based on 24 VDC power supply input, it is outside the application scope of Low Voltage Directives.
- When applying the equipment incorporating this product to the Low Voltage Directive, connect the driver power supply input to the DC power supply where the primary and secondary sides are provided with reinforced insulation.
- Install this product in the equipment built-in type enclosure.
- Enclosure classification  
Motor: IP65 (Lead wire type: IP40)  
Driver: IP00

- **For EMC Directive**

This product has received EMC measures under the conditions specified in “Example of motor and driver installation and wiring” on page 28. Be sure to conduct EMC measures with the product assembled in your equipment by referring to 5.9 “Installing and wiring in compliance with EMC Directive” on page 25.

- **Hazardous substances**

The products do not contain the substances exceeding the restriction values of RoHS Directive (2011/65/EU).



# 2 Safety precautions

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Only qualified personnel should work with the product.

Use the product correctly after thoroughly reading the section “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.

 <b>Warning</b>	Handling the product without observing the instructions that accompany a “Warning” symbol may result in serious injury or death.
 <b>Caution</b>	Handling the product without observing the instructions that accompany a “Caution” symbol may result in injury or property damage.
<b>Note</b>	The items under this heading contain important handling instructions that the user should observe to ensure safe use of the product.

 <b>Warning</b>
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## 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 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, injury or equipment damage.
- When the driver’s protection function is triggered, first remove the cause and then clear the protection function. Continuing the operation without determining the cause of the problem may cause malfunction of the motor, leading to injury or damage to equipment.

## Installation

- Install the motor (gearhead) and driver in their enclosures in order to prevent injury.

## Connection

- Keep the driver’s power supply input voltage within the specified range to avoid fire.
- Connect the cables securely according to the wiring example in order to prevent fire.
- Do not forcibly bend, pull or pinch the cable. Doing so may result in 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.

## Operation

- Turn off the driver power supply 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 use it in a vertical applications. When the driver protection function is triggered, the motor will stop operating. The moving parts fall and may cause injury or damage to equipment.

## Repair, disassembly and modification

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



**Caution**

## General

- Do not use the motor, gearhead and driver beyond their specifications, or injury or damage to equipment may result.
- Do not touch the motor or driver during operation or immediately after stopping. The surfaces are hot and may cause a burn.

## Transportation

- Do not hold the motor (gearhead) 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 burn.
- 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 (gearhead) 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.
- Immediately when trouble has occurred, stop running and turn off the driver power supply. Failure to do so may result in fire, electric shock or injury.
- Provide a cover over the rotating parts (output shaft) of the motor to prevent injury.
- Release all driver input signals before turning on the power supply to the driver. Otherwise, the motor may start suddenly and cause injury or damage to equipment.

## 2 Safety precautions

- Before moving the motor directly with the hands (as in the case of manual positioning), confirm that the driver operation input is “OFF” to prevent injury.
- Do not perform the motor’s starting and stopping operations by turning the power supply on and off. Perform them by inputting START/STOP and RUN/BRAKE. This may cause injury or damage to the equipment.
- The motor’s surface temperature may exceed 70 °C, even under normal operating conditions. If a motor is accessible during operation, post a warning label shown in the figure in a conspicuous position to prevent the risk of burns.



Warning label

### Disposal

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

# 3 Precautions for use

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This chapter explains the restrictions and other items you should take heed of when using the **BLH** series.

- **Do not perform gravitational load operation**

With the **BLH** series, any operation in which the motor output shaft is turned from the load side (gravitational load operation) will disable the motor speed control. In addition, a gravitational load operation will cause the driver's primary inverter voltage to exceed the allowable value, thereby triggering a protection function and causing the motor to stop spontaneously. If this happens, there is a possibility that the load will drop.

- **Grease measures**

On rare occasions a small amount of grease may leak from the gearhead. If leaked grease is feared to contaminate the surrounding environment, check for grease leakage during regular inspections or provide an oil pan or other device to prevent damage resulting from contamination. Leaking oil is a cause of malfunction in your equipment or product.

- **Apply grease on the output shaft of the hollow shaft flat gearhead**

If you are using a gearhead, apply grease (molybdenum disulfide grease, etc.) on the surface of the load shaft and inner walls of the hollow output shaft to prevent seizure.

- **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.

- **Noise elimination measures**

Provide the following noise elimination measures to prevent a motor or driver malfunction caused by external noise.

### Wiring the motor

To extend the wiring between the motor and driver, use the accessory extension cable (sold separately).

### Wiring the I/O signals cable

- Minimize the wiring length of the I/O signals cable.
- Provide a minimum clearance of 100 mm (4 in.) between the I/O signals cable and any inductive load such as an electromagnetic relay or any power line (power supply, motor, etc.). Do not place the I/O signals cable and a power line in the same duct or pipe or bundle them together.
- For more effective elimination of noise, use a shielded I/O signals cable or attach ferrite cores if a non-shielded cable is used.

# 4 Preparation

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The following describes the items to be confirmed, names and functions of individual components.

## 4.1 Checking the product

Open the package and make sure that the following items are supplied.

The supplied items vary depending on the product. If there is any shortage or damage, contact the sales office where you bought the product.

The unit model of the product you bought should be checked by reference to the model on the label of the package.

Check the models of the motor, gearhead and driver by reference to the models on the name plate of each product.

Unit models for motor, gearhead and driver combinations are listed in section 4.2 "Combination tables."

### Geared type, round shaft type and pinion shaft type

- Motor 1 unit (Geared type is motor with gearhead)
- Driver 1 unit
- I/O signals cable [300 mm (12 in.)] 1 pc.
- Power supply cable [300 mm (12 in.)] 1 pc.
- Operating manual (This manual) 1 copy

### Combination type parallel shaft gearhead

- Motor with gearhead 1 unit
- Parallel key 1 pc.
- Driver 1 unit
- I/O signals cable [300 mm (12 in.)] 1 pc.
- Power supply cable [300 mm (12 in.)] 1 pc.
- Hexagonal socket head screw set (four each of screws, washers and nuts) 1 set
- Operating manual (This manual) 1 copy

### Combination type hollow shaft flat gearhead

- Motor with gearhead 1 unit
- Parallel key 1 pc.
- Driver 1 unit
- I/O signals cable [300 mm (12 in.)] 1 pc.
- Power supply cable [300 mm (12 in.)] 1 pc.
- Hexagonal socket head screw set (four each of screws, washers and nuts) 1 set
- Safety cover 1 pc.
- Safety cover mounting screws (M3) 2 pcs.
- Operating manual (This manual) 1 copy



## 4.2 Combination tables

### ■ Geared type

The motor and gearhead are integrated. The combination of motor and gearhead cannot be changed.

Unit model	Components model	
	Motor model	Driver model
<b>BLH015K-□</b>	BLHM015K-□	BLHD15K

□ in the model names indicates a number representing the gear ratio (**5, 10, 15, 20, 30, 50** or **100**).

### ■ Combination type parallel shaft gearhead

The motor comes preassembled with a parallel shaft gearhead.

Unit model*	Components model		
	Motor model*	Gearhead model	Driver model
<b>BLH230KC-□</b>	BLHM230KC-GFS	GFS2G□	BLHD30K
<b>BLH450KC-□</b>	BLHM450KC-GFS	GFS4G□	BLHD50K
<b>BLH5100KC-□</b>	BLHM5100KC-GFS	GFS5G□	BLHD100K

□ in the model names indicates a number representing the gear ratio (**5, 10, 15, 20, 30, 50, 100** or **200**).

\* For the lead wire type, “KC” of the unit model and motor model are replaced by “K”.

### ■ Combination type hollow shaft flat gearhead

The motor comes preassembled with a hollow shaft flat gearhead.

Unit model*	Components model		
	Motor model*	Gearhead model	Driver model
<b>BLH230KC-□FR</b>	BLHM230KC-GFS	GFS2G□FR	BLHD30K
<b>BLH450KC-□FR</b>	BLHM450KC-GFS	GFS4G□FR	BLHD50K
<b>BLH5100KC-□FR</b>	BLHM5100KC-GFS	GFS5G□FR	BLHD100K

□ in the model names indicates a number representing the gear ratio (**5, 10, 15, 20, 30, 50, 100** or **200**).

\* For the lead wire type, “KC” of the unit model and motor model are replaced by “K”.

### ■ Round shaft type

Unit model*	Components model	
	Motor model*	Driver model
<b>BLH015K-A</b>	BLHM015K-A	BLHD15K
<b>BLH230KC-A</b>	BLHM230KC-A	BLHD30K
<b>BLH450KC-A</b>	BLHM450KC-A	BLHD50K
<b>BLH5100KC-A</b>	BLHM5100KC-A	BLHD100K

\* For the lead wire type, “KC” of the unit model and motor model are replaced by “K” (except for **BLH015** type).

### ■ Pinion shaft type

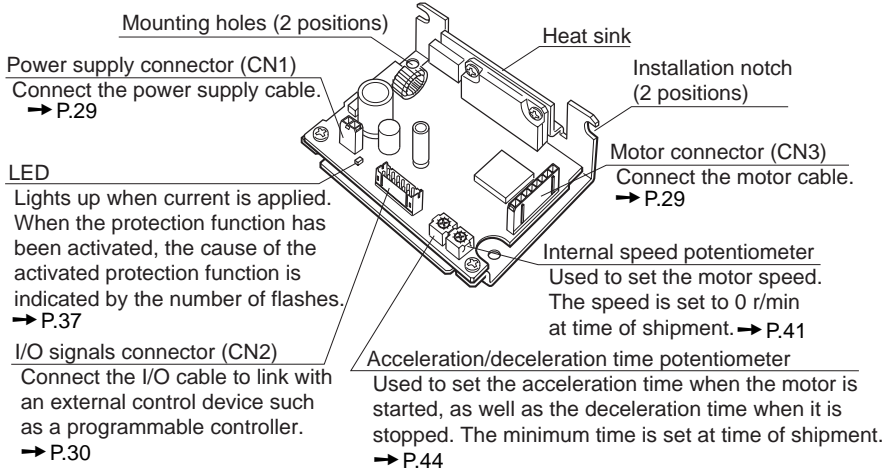
Unit model*	Components model	
	Motor model*	Driver model
<b>BLH230KC-GFS</b>	BLHM230KC-GFS	BLHD30K
<b>BLH450KC-GFS</b>	BLHM450KC-GFS	BLHD50K
<b>BLH5100KC-GFS</b>	BLHM5100KC-GFS	BLHD100K

\* For the lead wire type, “KC” of the unit model and motor model are replaced by “K”.

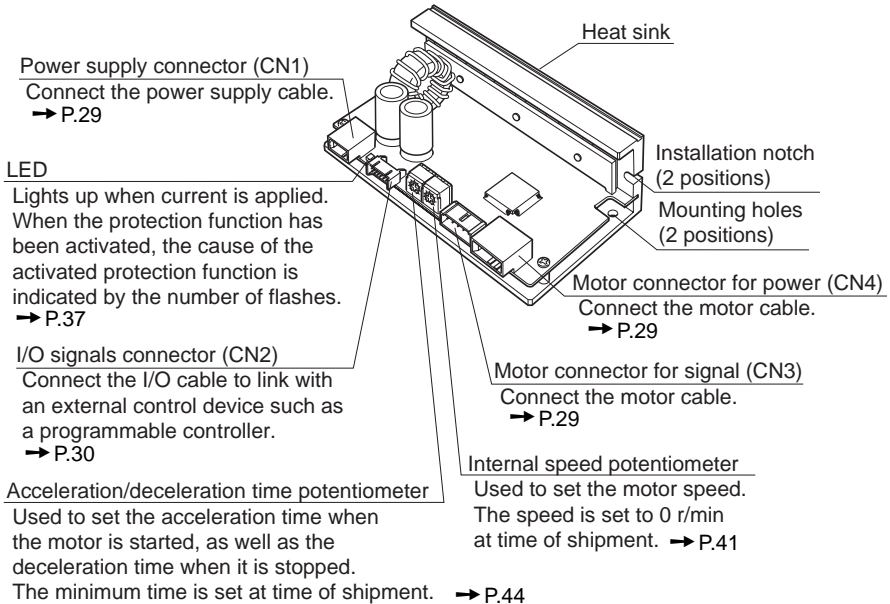
### 4.3 Names and function of parts

The following describes the names and functions of individual components of the driver.

Driver model: BLHD15K, BLHD30K, BLHD50K



Driver model: BLHD100K



# 5 Installation

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This chapter explains the installation location and installation methods of the motor and driver, as well as how to install a load. Read the applicable sections carefully to install each item correctly.

Geared type	P.13, 19
Combination type parallel shaft gearhead	
Combination type hollow shaft flat gearhead	P.15, 22
Round shaft type	P.18, 19
Pinion shaft type	Parallel shaft gearhead: P.13, 19 Hollow shaft flat gearhead: P.15, 22

## 5.1 Installation location

The motor and driver are designed and manufactured for use as internal components of equipment.

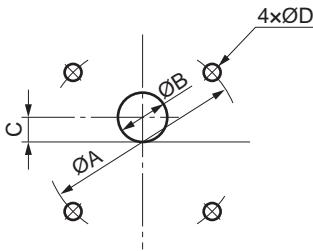
Install the motor and driver in a well-ventilated place where they can be inspected easily and the following conditions are satisfied:

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature: 0 to +50 °C (+32 to +122 °F) (non-freezing)
- Operating ambient humidity: 85% or less (non-condensing)
- Area that is free of explosive atmosphere or toxic gas (such as 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 (rains, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibration or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum

Install the motor to a flat mounting plate offering excellent vibration resistance and high heat conductivity.

## 5.2 Installing the geared type, combination type parallel shaft gearhead

1. Open mounting holes in the mounting plate.



[Unit: mm (in.)]

Unit model	ØA	ØB	C	ØD
<b>BLH015</b>	43.8 (1.72)	16 (0.63)	8 (0.31)	4.5 (0.177)
<b>BLH230</b>	70 (2.76)	24 (0.94)	10 (0.39)	4.5 (0.177)
<b>BLH450</b>	94 (3.70)	34 (1.34)	13 (0.51)	6.5 (0.256)
<b>BLH5100</b>	104 (4.09)	40 (1.57)	18 (0.71)	8.5 (0.335)

ØB indicates the external dimension of the product.

Provide a hole with a diameter of “ØB +1 mm or more.”

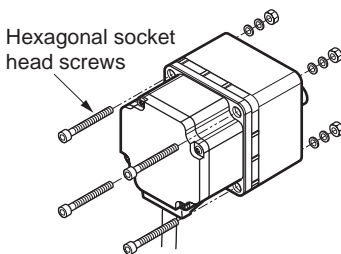
### Maximum applicable plate thickness

Unit model	Maximum applicable plate thickness
<b>BLH230</b>	5 mm (0.20 in.)
<b>BLH450</b>	8 mm (0.31 in.)
<b>BLH5100</b>	12 mm (0.47 in.)

\* The figures in the table apply when the supplied hexagonal socket head screw is used.  
(**BLH015** is not attached)

2. Install the supplied hexagonal socket head screw in the four mounting holes you just opened and tighten the nuts until no gaps remain between the motor and mounting plate.

### • Combination type parallel shaft gearhead

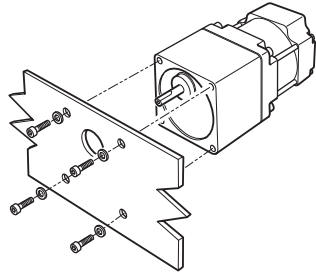


Unit model	Nominal thread size	Tightening torque
<b>BLH230</b>	M4	1.8 N·m (15.9 lb-in)
<b>BLH450</b>	M6	6.4 N·m (56 lb-in)
<b>BLH5100</b>	M8	15.5 N·m (137 lb-in)

- **Geared type**

To install the motor, use the four installation holes and mount the motor with four bolts (not provided) so that there is no gap with the mounting plate.

Effective depth of bolt: 8 mm (0.31 in.)



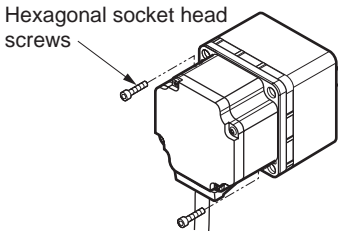
Unit model	Nominal thread size	Tightening torque
<b>BLH015</b>	M4	1.8 N·m (15.9 lb-in)

**Note** Fit the boss on the gearhead mounting surface into a counterbore or through pilot-receiving hole.

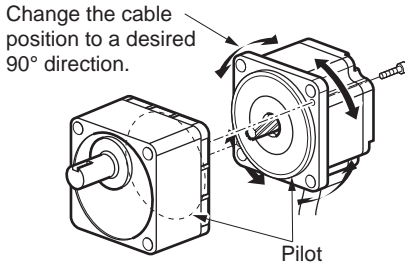
### ■ Changing the motor cable's routing direction

The gearhead can be removed and the motor cable position changed to a desired 90° direction. (**BLH015** is removed)

1. Remove the hexagonal socket head screws (2 pcs.) assembling the motor and gearhead and detach the motor from the gearhead.



2. Using the pilot sections of the motor and gearhead as guides, install the motor to the gearhead and tighten the hexagonal socket head screws. At this time, the motor cable position can be changed to a desired 90° direction. When installing the gearhead, slowly rotate it clockwise/counterclockwise to prevent the pinion of the motor output shaft from contacting the side panel or gear of the gearhead. Also, confirm that no gaps remain between the motor flange surface and the end face of the gearhead's pilot section.



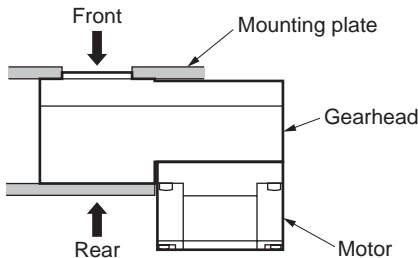
Unit model	Nominal thread size	Tightening torque
<b>BLH230</b> <b>BLH450</b>	M2.6	0.4 N·m (3.5 lb-in)
<b>BLH5100</b>	M3	0.6 N·m (5.3 lb-in)

**Note**

- Do not forcibly assemble the motor and gearhead. Also, do not let metal objects or other foreign matters enter the gearhead. The pinion or gear of the motor output shaft may be damaged, resulting in noise or shorter service life.
- Do not allow dust to attach to the pilot sections of the motor and gearhead. Also, assemble the motor and gearhead carefully by not pinching the O-ring at the motor's pilot section. If the O-ring is crushed or severed, grease may leak from the gearhead.
- The hexagonal socket head screws (2 pcs.) assembling the motor and gearhead are affixing the motor and gearhead only temporarily. When installing the gearhead, be sure to use the supplied four hexagonal socket head screws.

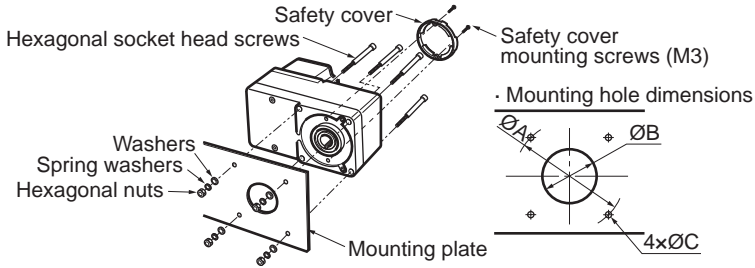
### 5.3 Installing the combination type hollow shaft flat gearhead

A gearhead can be installed by using either its front or rear side as the mounting surface. Install the supplied hexagonal socket head screw in the four mounting holes you opened and tighten the nuts until no gaps remain between the motor and mounting plate. Also, attach the supplied safety cover to the hollow output shaft on the end opposite from the one where the load shaft is installed.

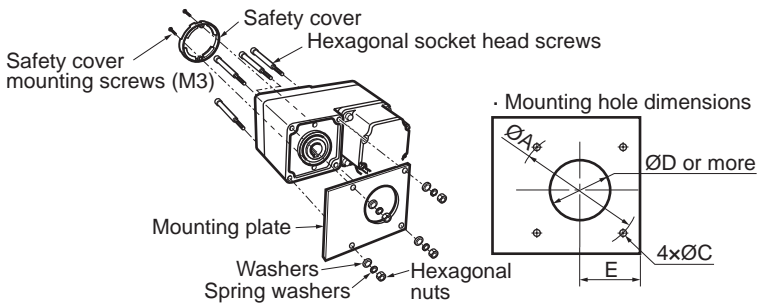


• Using the front side as the mounting surface

When the gearhead is installed by using its front side as the mounting surface, use the boss of the output shaft to align the center.



• Using the rear side as the mounting surface



[Unit: mm (in.)]

Unit model	Nominal thread size	Tightening torque	ØA	ØB	ØC	ØD	E
<b>BLH230</b>	M5	3.8 N·m (33 lb-in)	70 (2.76)	$34^{+0.039}_0$ ( $1.34^{+0.0015}_0$ )	5.5 (0.217)	25 (0.98)	29 (1.14)
<b>BLH450</b>	M6	6.4 N·m (56 lb-in)	94 (3.70)	$38^{+0.039}_0$ ( $1.50^{+0.0015}_0$ )	6.5 (0.256)	30 (1.18)	39 (1.54)
<b>BLH5100</b>	M8	15.5 N·m (137 lb-in)	104 (4.09)	$50^{+0.039}_0$ ( $1.97^{+0.0015}_0$ )	8.5 (0.335)	35 (1.38)	44 (1.73)

**Note**

When installing the gearhead by using its rear side as the mounting surface, prevent contact between the mounting plate and motor by keeping dimension E below the specified value.



## Maximum applicable plate thickness

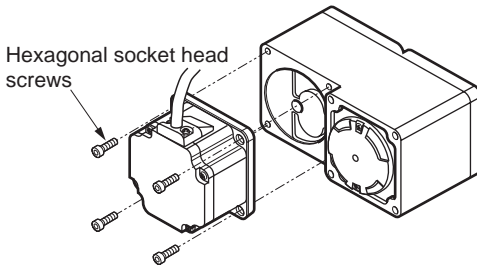
Unit model	Maximum applicable plate thickness
<b>BLH230</b>	5 mm (0.20 in.)
<b>BLH450</b>	8 mm (0.31 in.)
<b>BLH5100</b>	12 mm (0.47 in.)

\* The figures in the table apply when the supplied hexagonal socket head screw is used.

## ■ Changing the motor cable's routing direction

The gearhead can be removed and the motor cable position changed to one of three 90° directions. Note that the motor cable cannot be positioned in the direction where the cable faces the gearhead output shaft.

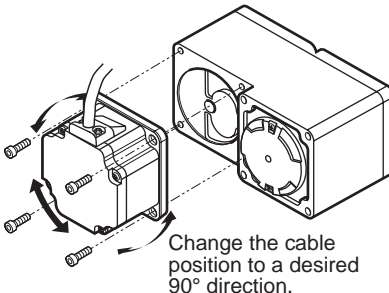
1. Remove the hexagonal socket head screws (4 pcs.) attaching the gearhead and motor and detach the motor from the gearhead.



2. Using the pilot sections of the motor and gearhead as guides, install the motor to the gearhead and tighten the hexagonal socket head screws. At this time, the motor cable position can be changed to one of three 90° directions.

When installing the gearhead, slowly rotate it clockwise/counterclockwise to prevent the pinion of the motor output shaft from contacting the side panel or gear of the gearhead.

Also, confirm that no gaps remain between the motor flange surface and the end face of the gearhead's pilot section.



Unit model	Nominal thread size	Tightening torque
<b>BLH230</b>	M4	1.8 N·m (15.9 lb-in)
<b>BLH450</b>	M6	6.4 N·m (56 lb-in)
<b>BLH5100</b>	M8	15.5 N·m (137 lb-in)

**Note**

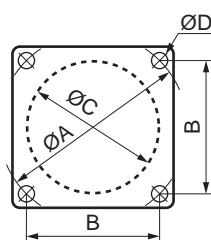
- Do not forcibly assemble the motor and gearhead. Also, do not let metal objects or other foreign matters enter the gearhead. The pinion or gear of the motor output shaft may be damaged, resulting in noise or shorter service life.
- Do not allow dust to attach to the pilot sections of the motor and gearhead. Also, assemble the motor and gearhead carefully by not pinching the O-ring at the motor's pilot section. If the O-ring is crushed or severed, grease may leak from the gearhead.

## 5.4 Installing the round shaft type

Install the motor to a mounting plate of the following size or larger, so that the motor case temperature will not exceed 90 °C (194 °F) (The **BLH015** has no limitation on the mounting plate size.).

Unit model	Size of mounting plate	Thickness • Material
<b>BLH230</b>	115×115 mm (4.53×4.53 in.)	Thickness: 5 mm (0.20 in.) Material: Aluminum
<b>BLH450</b>	135×135 mm (5.31×5.31 in.)	
<b>BLH5100</b>	200×200 mm (7.87×7.87 in.)	

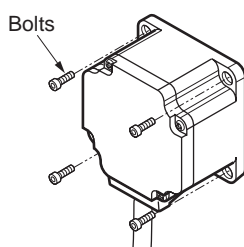
1. Open mounting holes in the mounting plate [Unit: mm (in.)].



Unit model	ØA	B	ØC	ØD
<b>BLH015</b>	48 (1.89)	33.94 (1.34)	37.6 <sup>+0.025</sup> <sub>0</sub> (1.4803 <sup>+0.0010</sup> )	3.5 (0.138)
<b>BLH230</b>	70 (2.76)	49.5 (1.95)	54 <sup>+0.030</sup> <sub>0</sub> (2.1260 <sup>+0.0012</sup> )	4.5 (0.177)
<b>BLH450</b>	94 (3.70)	66.47 (2.62)	73 <sup>+0.030</sup> <sub>0</sub> (2.8740 <sup>+0.0012</sup> )	6.5 (0.256)
<b>BLH5100</b>	104 (4.09)	73.54 (2.90)	83 <sup>+0.035</sup> <sub>0</sub> (3.2677 <sup>+0.0014</sup> )	8.5 (0.335)

ØC indicates the pilot diameter on the flange.

2. Install four bolts (not supplied) in the four mounting holes you just opened and tighten the nuts until no gaps remain between the motor and mounting plate.



Unit model	Nominal thread size	Tightening torque
<b>BLH015</b>	M3	1 N·m (8.8 lb-in)
<b>BLH230</b>	M4	1.8 N·m (15.9 lb-in)
<b>BLH450</b>	M6	6.4 N·m (56 lb-in)
<b>BLH5100</b>	M8	15.5 N·m (137 lb-in)

**Note**

Fit the boss on the motor mounting surface into a counterbore or through pilot-receiving hole.

## 5.5 Installing the pinion shaft type

A pinion shaft motor is used with a parallel shaft gearhead or hollow shaft flat gearhead assembled to it.

Installing a parallel shaft gearhead: P.13, 19

Installing a hollow shaft flat gearhead: P.15, 22

## 5.6 Installing a load on the geared type, combination type parallel shaft gearhead and round shaft type

When installing a load on the motor (gearhead), align the center of the motor output shaft (gearhead output shaft) with the center of the load shaft.

### Note

- When coupling the motor (gearhead) with a load, pay attention to centering, belt tension, parallelism of pulleys, etc. Also, securely affix the tightening screws of the coupling or pulleys. Also, securely affix the tightening screws of the coupling or pulleys.
- When installing a load, do not damage the motor output shaft (gearhead output shaft) or bearing. Forcing in the load by driving it with a hammer, etc., may break the bearing. Do not apply any excessive force to the output shaft.
- Do not modify or machine the motor (gearhead) output shaft. The bearing may be damaged or motor (gearhead) may break.

### ■ Output shaft shape

#### Combination type parallel shaft gearhead

A key groove is provided on the output shaft of gearhead. Form a key groove on the load side and affix the load using the supplied parallel key.

Unit model	Parallel key dimension
<b>BLH230</b>	4 mm (0.1575 in.)
<b>BLH450</b>	5 mm (0.1969 in.)
<b>BLH5100</b>	6 mm (0.2362 in.)

#### Geared type, round shaft type

A flat section is provided on the motor output shaft of each geared type, round shaft type. Apply a double-point screw, etc., at the flat section to securely affix the load and prevent it from spinning.

## ■ How to install a load

- Using a coupling

Align the centerline of the motor (gearhead) output shaft with the centerline of the load shaft.

- Using a belt

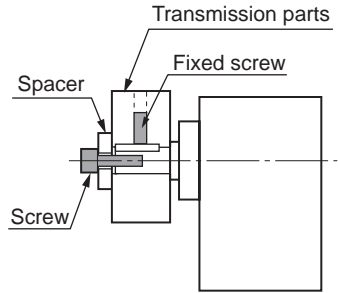
Adjust the motor (gearhead) output shaft to lie parallel with the load shaft and form right angles between the output shaft/load shaft and the line connecting the centers of both pulleys.

- Using a gear

Adjust the motor (gearhead) output shaft to lie parallel with the gear shaft and allow the output shaft to mesh correctly with the centers of the gear teeth.

- When using the output axis tip screw hole of a gearhead

Use a screw hole [M6, effective depth 12 mm (0.47 in.)] provided at the tip of the output shaft of GFS5G□ as an auxiliary means for preventing the transfer mechanism from disengaging.



The example of output axis tip screw hole use

## ■ Permissible overhung load and permissible thrust load

Make sure the overhung load and thrust load received by the motor (gearhead) output shaft will not exceed the allowable values shown in the table below.

### Note

If the overhung load or thrust load exceeds the specified allowable value, repeated load applications may cause the bearing or output shaft of the motor (gearhead) to undergo a fatigue failure.

### Geared type, combination type parallel shaft gearhead

Unit model*	Distance from tip of gearhead output shaft and permissible overhung load [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
<b>BLH015K-□</b>	50 (11.2)	-	30 (6.7)
<b>BLH230KC-5</b>	100 (22)	150 (33)	40 (9)
<b>BLH230KC-10, 15, 20</b>	150 (33)	200 (45)	
<b>BLH230KC-30, 50, 100, 200</b>	200 (45)	300 (67)	
<b>BLH450KC-5</b>	200 (45)	250 (56)	100 (22)
<b>BLH450KC-10, 15, 20</b>	300 (67)	350 (78)	
<b>BLH450KC-30, 50, 100, 200</b>	450 (101)	550 (123)	
<b>BLH5100KC-5</b>	300 (67)	400 (90)	150 (33)
<b>BLH5100KC-10, 15, 20</b>	400 (90)	500 (112)	
<b>BLH5100KC-30, 50, 100, 200</b>	500 (112)	650 (146)	

□ in the model names indicates a number representing the gear ratio (**5, 10, 15, 20, 30, 50, or 100**).

\* For the lead wire type, “KC” of the unit model is replaced by “K” (except for **BLH015** type).

### Round shaft type

Unit model*2	Distance from tip of motor output shaft and permissible overhung load [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
<b>BLH015K-A</b>	50 (11.2)	-	Not to exceed one-half the motor's dead weight*1
<b>BLH230KC-A</b>	70 (15.7)	100 (22)	
<b>BLH450KC-A</b>	120 (27)	140 (31)	
<b>BLH5100KC-A</b>	160 (36)	170 (38)	

\*1 Minimize the thrust load. If a thrust load must be applied, do not let it exceed one-half the motor's dead weight.

\*2 For the lead wire type, “KC” of the unit model is replaced by “K” (except for **BLH015** type).

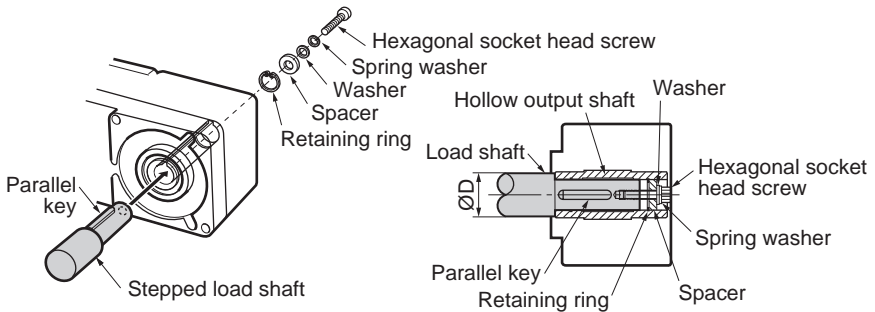
## 5.7 Installing a load on the combination type hollow shaft flat gearhead

If the motor receives a significant impact upon instantaneous stop or is subject to a large overhung load, affix the stepped load shaft.

**Note** | Apply grease (molybdenum disulfide grease, etc.) on the surface of the load shaft and inner walls of the hollow output shaft to prevent seizure.

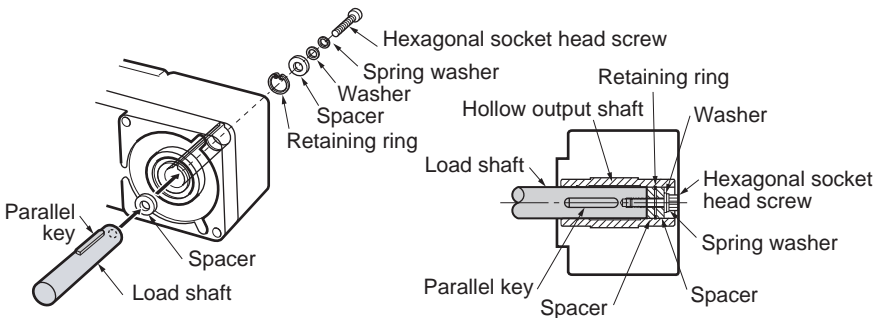
- **Stepped load shaft**

Install each hexagonal socket head screw over a retaining ring, spacer, washer and spring washer and securely affix the ring.



- **Non-stepped load shaft**

Install each hexagonal socket head screw over a retaining ring, spacer, washer and spring washer and securely affix the ring. Also, insert a spacer on the load shaft side.



## Recommended load shaft installation dimensions [Unit: mm (in.)]

Unit model	Inner diameter of hollow shaft	Recommended tolerance of load shaft	Nominal diameter of retaining ring
<b>BLH230</b>	$\varnothing 12^{+0.027}_0$ ( $\varnothing 0.4724^{+0.0011}_0$ )	$\varnothing 12_{-0.018}^0$ ( $\varnothing 0.4724_{-0.0007}^0$ )	$\varnothing 12$ ( $\varnothing 0.47$ )
<b>BLH450</b>	$\varnothing 15^{+0.027}_0$ ( $\varnothing 0.5906^{+0.0011}_0$ )	$\varnothing 15_{-0.018}^0$ ( $\varnothing 0.5906_{-0.0007}^0$ )	$\varnothing 15$ ( $\varnothing 0.59$ )
<b>BLH5100</b>	$\varnothing 20^{+0.033}_0$ ( $\varnothing 0.7874^{+0.0013}_0$ )	$\varnothing 20_{-0.021}^0$ ( $\varnothing 0.7874_{-0.0008}^0$ )	$\varnothing 20$ ( $\varnothing 0.79$ )

Unit model	Applicable screw	Spacer thickness	Outer diameter of stepped shaft ( $\varnothing$ )
<b>BLH230</b>	M4	3 (0.12)	20 (0.79)
<b>BLH450</b>	M5	4 (0.16)	25 (0.98)
<b>BLH5100</b>	M6	5 (0.20)	30 (1.18)

### ■ Permissible overhung load and permissible thrust load

Make sure the overhung load and thrust load received by the output shaft will not exceed the allowable values shown in the table below.

#### Note

If the overhung load or thrust load exceeds the specified allowable value, repeated load applications may cause the bearing or output shaft of the gearhead to undergo a fatigue failure.

#### Combination type hollow shaft flat gearhead

Unit model*	Distance from gearhead mounting surface and permissible overhung load [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
<b>BLH230KC-5, 10FR</b>	450 (101)	370 (83)	200 (45)
<b>BLH230KC-15, 20, 30, 50, 100, 200FR</b>	500 (112)	400 (90)	
<b>BLH450KC-5, 10FR</b>	800 (180)	660 (148)	400 (90)
<b>BLH450KC-15, 20, 30, 50, 100, 200FR</b>	1200 (270)	1000 (220)	
<b>BLH5100KC-5, 10FR</b>	900 (200)	770 (173)	500 (112)
<b>BLH5100KC-15, 20FR</b>	1300 (290)	1110 (240)	
<b>BLH5100KC-30, 50, 100, 200FR</b>	1500 (330)	1280 (280)	

\* For the lead wire type, "KC" of the unit model is replaced by "K".

## 5.8 Driver installation

### ■ Direction of installation

The driver is designed on the basis of heat radiation by air convection and heat conduction to the housing.

When installing the driver in the housing, use four installation holes on the driver and install it in the vertical or horizontal direction.

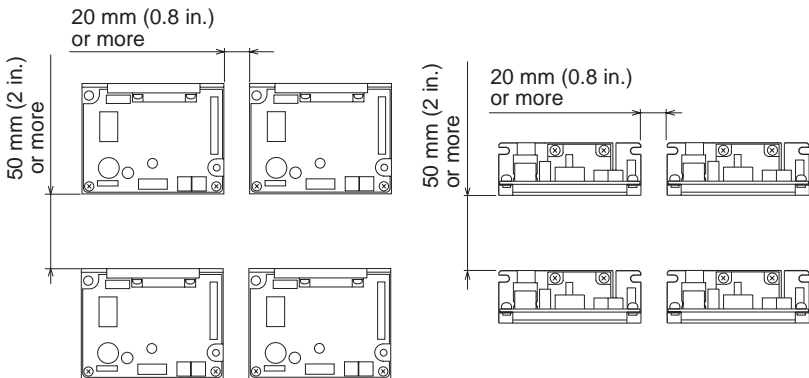
### ■ Method of installation

Install the driver on a flat metallic plate having an excellent resistance to vibration and heat conduction.

Using the driver installation hole or notch, lock the driver with two bolts (M3: not provided) so that there is no gap with the metallic plate.

There must be a clearance of at least 25 mm (1 in.) and 50 mm (2 in.) in the horizontal and vertical directions, respectively, between the driver and enclosure or other equipment.

When two or more drivers are to be installed in parallel, separate them by 20 mm (0.8 in.) or more in the horizontal direction and by 50 mm (2 in.) or more in the vertical direction as illustrated.



#### Note

- Do not place any equipment generating much heat or noise around the driver.
- If temperature around the driver is higher than 50 °C (122 °F), recheck the ventilation conditions and use a fan to provide forced cooling of the driver.



## 5.9 Installing and wiring in compliance with EMC Directive

### ■ For EMC Directive

The **BLH** series has been designed and manufactured for incorporation in general industrial machinery. The EMC Directive requires that the equipment incorporating this product comply with these directives.

The installation and wiring method for the motor and driver are the basic methods that would effectively allow the customer's equipment to be compliant with the EMC Directive.

The compliance of the final machinery with the EMC Directive will depend on such factors as configuration, wiring, layout and risk involved in the control-system equipment and electrical parts. It therefore must be verified through EMC measures by the customer of the machinery.

### ■ Applicable Standards

EMI	Emission Tests	EN 61000-6-4
EMS	Immunity Tests	EN 61000-6-2

### ■ Installing and wiring in compliance with EMC Directive

Effective measures must be taken against the EMI that the **BLH** series may give to adjacent control-system equipment, as well as the EMS of the **BLH** series itself, in order to prevent a serious functional impediment in the machinery.

The use of the following installation and wiring methods will enable the **BLH** series to be compliant with the EMC Directive (the aforementioned compliance standards).

### ■ About power supply

The **BLH** series products are of the DC power supply input specification. Use a DC power supply (such as a switching power supply) that is optimally compliant with the EMC Directive. If a transformer is used in the power supply, be sure to connect a mains filter to the input side of the transformer.

## ■ Connecting mains filter for power supply line

Install a mains filter in the AC input line to the DC power supply in order to prevent the noise generated within the driver or control system from propagating outside via the DC power supply. For mains filters, use the products as shown in the chart, or an equivalent.

Manufacturer	Model
TDK Corporation	ZAG2210-11S
TDK-Lambda Corporation	MC1210
Schaffner EMC	FN2330Y-10-06, FN2310X-10-06
Tyco Electronics CORCOM	10ESK1

Install the mains filter as close to the AC input terminal of the DC power supply as possible, and use cable clamps and other means to secure the input and output cables firmly to the surface of the enclosure. Connect the ground terminal of the mains filter to the grounding point, using as thick and short a wire as possible. Do not place the AC input cable parallel with the mains filter output cable. Parallel placement will reduce mains filter effectiveness if the enclosure's internal noise is directly coupled to the power supply cable by means of stray capacitance.

## ■ Motor cable connection

When extending the motor cable, use the accessory extension cable. The maximum extension distance including the cable length of the motor itself should be 2 m (6.6 ft.).

## ■ Ferrite core

Use the ferrite core for extending the motor cable. The ferrite core reduces the negative effects of external noise. Use ferrite core 7427122 (Würth Elektronik GmbH & Co.KG), ZCAT3035-1330 (TDK Corporation) or its equivalent. Connect the ferrite cores as close as possible to the driver.

## ■ Wiring the signal cable

Use a braided screen cable of AWG26 (0.14 mm<sup>2</sup>) or more in diameter for the driver signal cable, and keep it as short as possible.

To ground a braided screen cable, use a metal clamp or similar device that will maintain contact with the entire circumference of the braided screen cable. Attach a cable clamp as close to the end of the cable as possible, and connect it to an appropriate grounding point as shown in the figure.



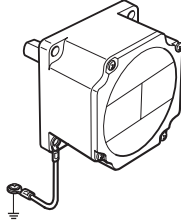
## ■ How to ground

The wire used to ground the motor and driver must be as thick and short to the grounding point as possible so that no potential difference is generated. Choose a large, thick and uniformly conductive surface for the grounding point.

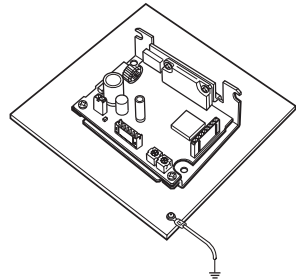
- How to ground the motor

Connect the grounding wire along with a set screw to the grounding point, using a crow washer.

For the **BLH015** geared type models, remove the paint from the mounting surface of the geared motor, and install it to a metal surface that has grounded.



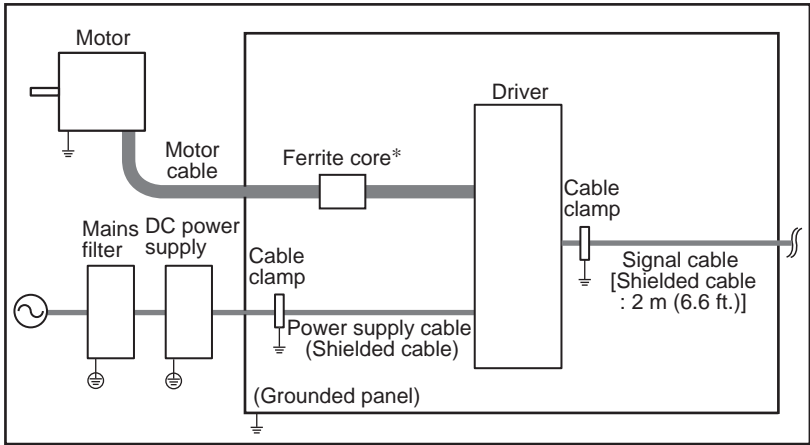
- How to ground the driver



## ■ Notes about installation and wiring

- Connect the motor, driver and other peripheral control equipment directly to the grounding point so as to prevent a potential difference from developing 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 cables as short as possible without coiling and bundling 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 (4 to 8 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



\* Use the ferrite core for extending the motor cable.

## ■ Precautions about static electricity

Static electricity may cause the driver to malfunction or suffer damage. Be careful when handling the driver with the power supply on. Always use an insulated screwdriver when adjusting the internal speed potentiometer or acceleration/deceleration time potentiometer.

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

# 6 Connection

The following shows the method of connecting the motor and driver, power supply, external potentiometer, earth connection method, an example of connection and I/O signals.

## 6.1 Motor and driver connection

Insert the motor cable connector into the motor connector of the driver.

Unit model	Motor connector
<b>BLH015, BLH230, BLH450</b>	CN3
<b>BLH5100</b>	CN3, CN4

### Note

- Firmly insert the connector in position. Incomplete connection of the connector may cause operation failure, or may damage the motor or driver.
- Do not push or pull the cable. Handle only the plastic connector instead. Do not apply force in any direction other than that in which the connector is inserted or pulled out. Improper application of force may damage the connector and driver.

When extending the motor cable, use the accessory extension cable. The maximum extension distance including the cable length of the motor itself should be 2 m (6.6 ft.).

## 6.2 Connecting the power supply

Input power supply voltage is 24 VDC  $\pm 10\%$ .

Insert the power supply cable connector into the driver power supply connector (CN1). The specific connections vary depending on the outputs. If the supplied power supply cable is not used, use a cable of the applicable wire size shown in the table below.

Unit model	Power supply cable size
<b>BLH015, BLH230, BLH450</b>	AWG22 (0.3 mm <sup>2</sup> ) or more
<b>BLH5100</b>	AWG18 (0.75 mm <sup>2</sup> ) or more

### Note

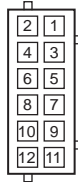
- Sufficient care must be taken not to mistake the power supply polarity. Connection with incorrect polarity may damage the driver.
- Do not route the driver power supply cable in the same conduit with other power supply lines or motor cables.
- When you want to turn on the power supply again or pull out the motor cable connector, do so 5 s or more after power supply has been turned off.

## 6.3 Connection of input signal and output signal

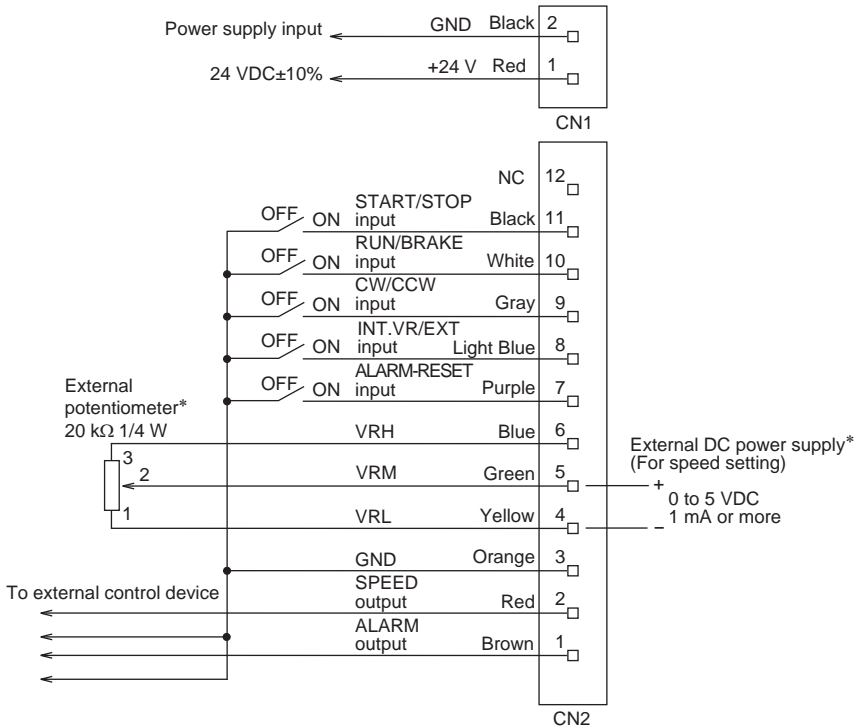
### ■ Connection with driver

Insert the connector of the I/O signals cable into the connector of the I/O signals cable (CN2) of the driver. The colors in the figure indicate the colors of supplied cables.

Connector pin assignments of I/O cable (CN2)

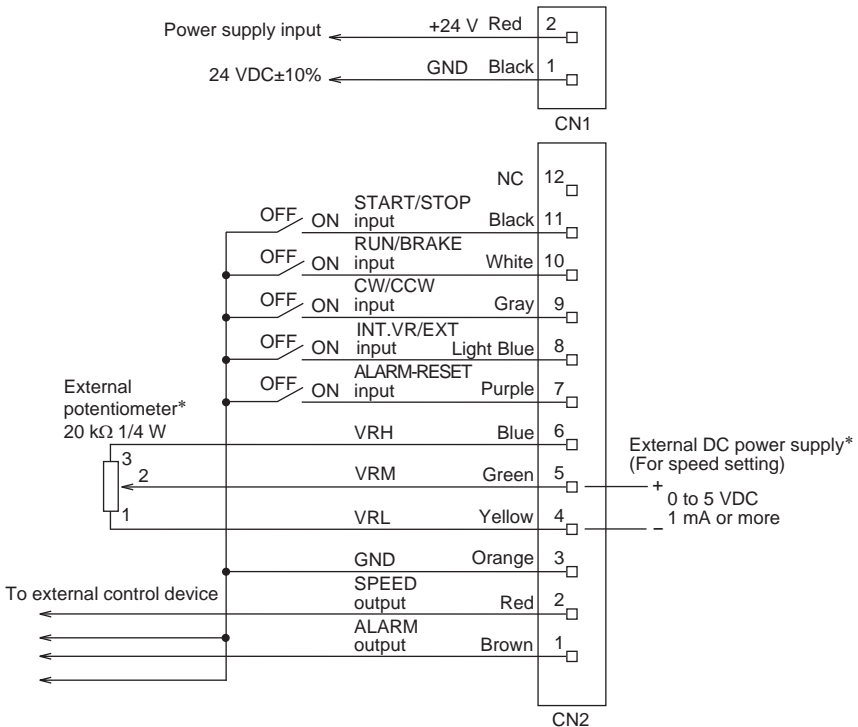


### • BLH015, BLH230, BLH450



\* Connect either the external potentiometer (accessory) or DC power supply for the external speed setting.

## • BLH5100



\* Connect either the external potentiometer (accessory) or DC power supply for the external speed setting.

### Note

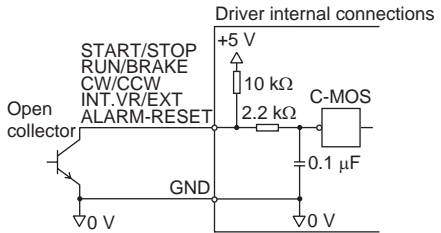
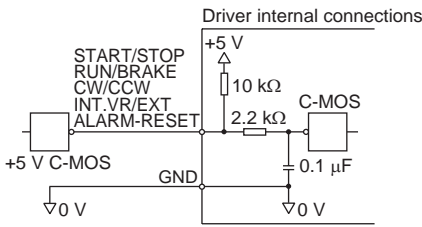
- When extending the I/O signals cable, the length must not exceed 2 m (6.6 ft.). To minimize noise, it should be as short as possible.
- The I/O signals cable must be located 200 mm (8 in.) or more away from such inductive loads as electromagnetic relay, and must cross power supply and motor cables, not parallel to them.
- If you are not using all cables from the terminals provided on the non-connector side of the I/O signals cable, insulate the unused cables to prevent them from contacting other devices, or depending on the applications of these signals connect them to 5 VDC from a user-provided external control device or to a signal ground.

## 6.4 Driver I/O circuit and example connection

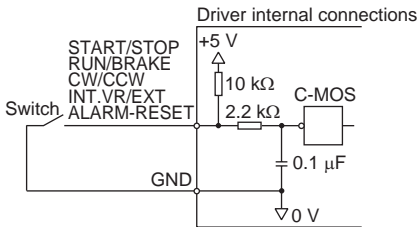
### ■ Input signal

The driver's signal input is a C-MOS input. The signal status indicates "0 to 0.5 V (L level) when ON," or "4 to 5 V (H level) when OFF."

- External control device output is a 5 V C-MOS output
- External control device output is an open-collector output

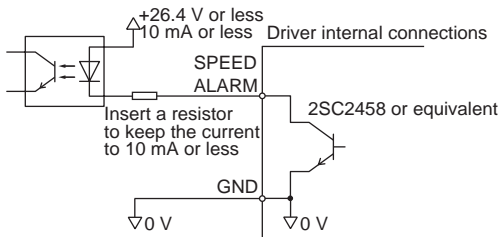


- Switch connection



### ■ Output signal

The driver's signal output is a transistor open-collector output. The signal status does not indicate the voltage level of the signal, but it indicates "ON (energized)" or "OFF (not energized)" of the internal transistor.





# 7 Operation

## 7.1 Input signals and output signals



### Caution

Do not perform the motor's starting and stopping operations by turning the power supply on and off. Perform them by inputting START/STOP and RUN/BRAKE. This may cause injury or damage to the equipment.

### Note

- The input signals (START/STOP, RUN/BRAKE, CW/CCW, INT.VR/ EXT, ALARM-RESET) must be ON for at least 10 ms. It may cause malfunction of the motor.
- Do not operate (switch the ON/OFF status) of the START/STOP input, RUN/BRAKE input, CW/CCW input and INT.VR/EXT input simultaneously. After switching a given input, wait at least 10 ms before switching another input.
- The motor temperature rise is sharper as friction load and inertial load are higher, and start, instantaneous stop and reversing frequency is higher. It must be used when motor case temperature does not exceed 90 °C (194 °F), and driver heat radiation plate temperature does not exceed 90 °C (194 °F).

### ■ START/STOP input and RUN/BRAKE input

To switch between motor running and instantaneous stop (or stop), use START/STOP input, RUN/BRAKE input.

	START/STOP input	RUN/BRAKE input	Motor operation
Signal level	ON	ON	Running* <sup>1</sup>
	ON	OFF	Instantaneous stop
	OFF	ON	Stop* <sup>2</sup>

\*1 The motor speed can be made to reach the set speed by any one of the internal potentiometer, external potentiometer or external DC voltage.

The motor accelerates over the time set by the acceleration/deceleration time potentiometer.

\*2 The motor decelerates over the time set by the acceleration/deceleration time potentiometer.

### Note

- The BRAKE takes precedence when START/STOP and RUN/BRAKE inputs are turned off simultaneously.
- The actual acceleration/deceleration time is affected by the use condition, load inertia, load torque and other conditions implemented by the user.

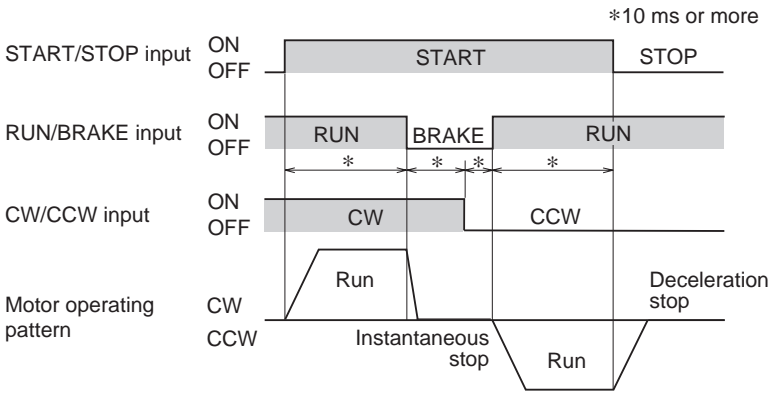
### ■ START/STOP input

START is selected when the input is ON, and motor starts running. The motor accelerates over the time set by the acceleration/deceleration time potentiometer. STOP is selected when the input is OFF, and motor stops. The motor decelerates over the time set by the acceleration/deceleration time potentiometer.

### ■ RUN/BRAKE input

RUN is selected when the input is ON, and motor starts running.

BRAKE is selected when the input is OFF, and motor stops instantaneously.



**Note** | Once the motor stops, the output shaft will become free.

### ■ CW/CCW input

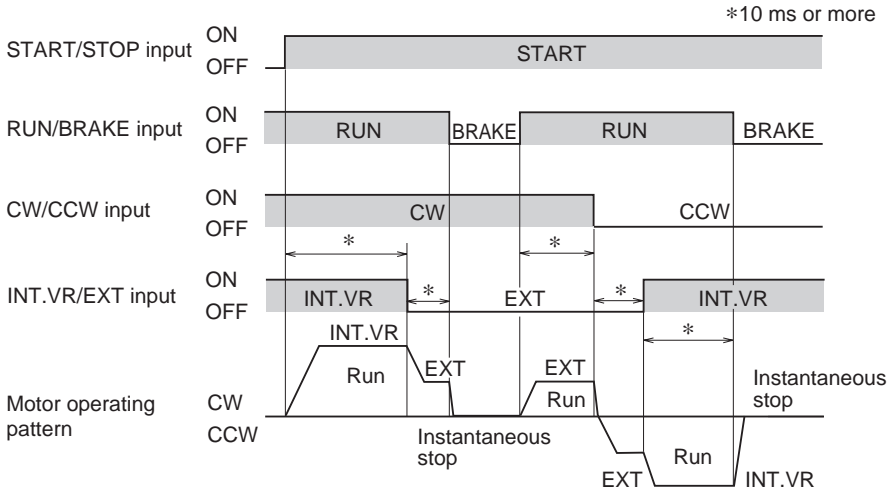
CW is selected when the input is ON. CCW is selected when the input is OFF.

The drive direction is the same as that of the motor output shaft when viewed from the motor output side.

**Note** | Depending on the gearhead ratio, the drive direction of the gear output shaft may be opposite of that of the motor. Check the drive direction by referring to 7.2, "Rotating direction of the motor output shaft" on page 40.

## ■ INT.VR/EXT input

INT.VR is selected when the input is ON, and the setting speed of internal potentiometer is enabled. EXT is selected when the input is OFF, and the setting speed of external potentiometer or external DC voltage is enabled. Switching this signal allows combined use of the external potentiometer or external DC voltage or two-speed switching operation. When the internal potentiometer is not used, there is no necessity even if there is no connection.



## ■ ALARM-RESET input

Use the ALARM-RESET input if you need to move the motor to a specified position or the mechanical home position after the motor has stopped in the middle of operation due to an actuation of the driver's protective function (ALARM output: OFF).

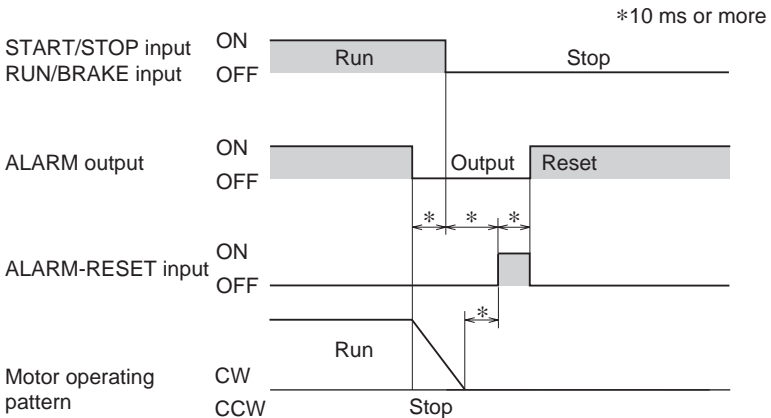
After the motor has been moved, check and remove the cause of the alarm and then reset the alarm.

The ALARM can also be reset when the power supply is cycled.

For ALARM conditions, see page 37.

When the motor is stopped, turn on this signal; then turn it off. This will allow ALARM to be reset.

Before inputting the ALARM-RESET, reset either the START/STOP or RUN/BRAKE input to the OFF. If both are ON, ALARM-RESET input will not be accepted.



### Note

- The START/STOP input and RUN/BRAKE input are not accepted until the ALARM output is reset.
- Turn ON the ALARM-RESET input after confirming that the motor (gearhead) output shaft has stopped completely.

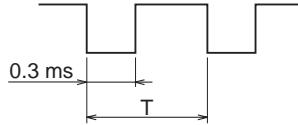
## ■ SPEED output

Pulse signals (pulse width: 0.3 ms) of 30 pulses per revolution of the motor output shaft are output in synchronism with the motor drive.

Motor speed can be calculated by measuring the SPEED output frequency.

$$\text{Motor speed}^* [\text{r/min}] = \frac{\text{SPEED output frequency} [\text{Hz}]}{30} \times 60$$

$$\text{SPEED output frequency} = \frac{1}{T}$$

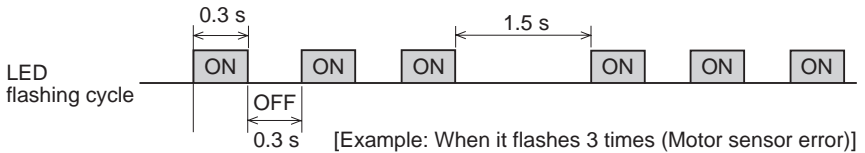


\* The speed of the gear output shaft of a pinion shaft type, geared type or combination type is obtained by dividing the motor speed by the gear ratio.

## ■ ALARM output

The protection function of the driver activates in following cases, and the ALARM output is turned OFF, thereby stopping the motor.

In this case, you can check the contents of the protection function, which was operating by the number of LED flashes. The LED lights for 0.3 s and goes off for 0.3 s. After a specified number of flashes, flashing is performed at intervals of 1.5 s.



### ⚠ Warning

When the driver's protection function is triggered, first remove the cause and then clear the protection function. Continuing the operation without determining the cause of the problem may cause malfunction of the motor, leading to injury or damage to equipment.

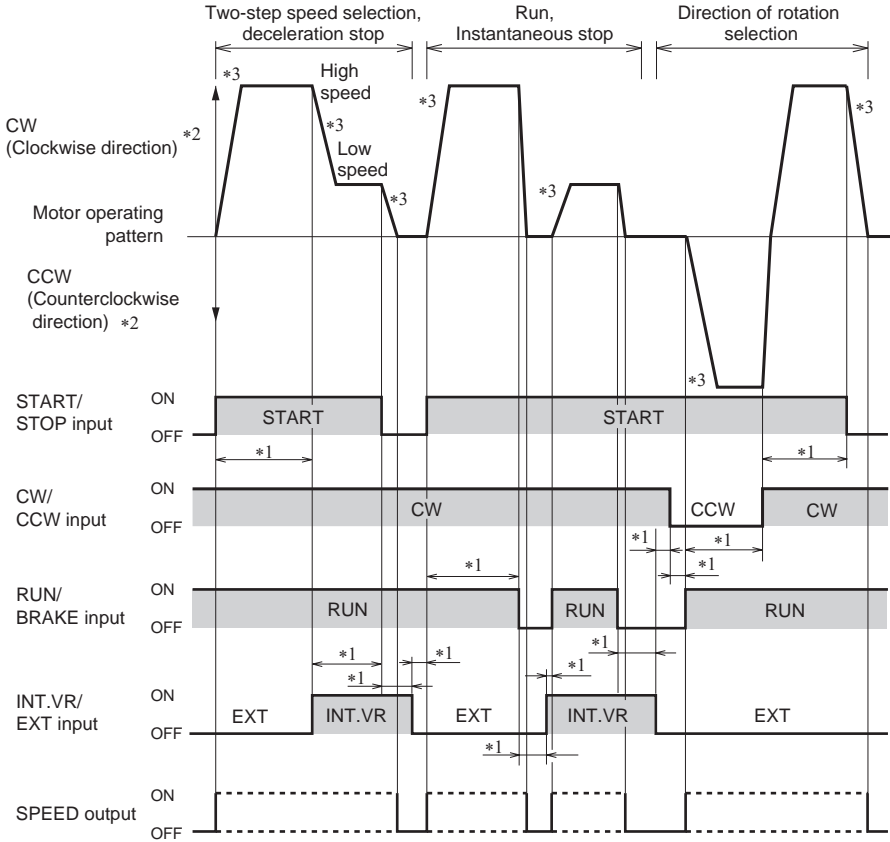
Protection function	Number of ALARM LED flashes	Assumed causes
Overload protection function	2 times	<ul style="list-style-type: none"> <li>• When a load in excess of the rated torque was applied to the motor for about 5 s or more.</li> <li>• When the motor running/instantaneous stop and drive direction switching was repeated in a short time.</li> </ul>
Motor sensor error	3 times	When the sensor cable in the motor cable was disconnected.
Overvoltage protection function	4 times	<ul style="list-style-type: none"> <li>• When the motor was used in an elevating/lowering application or with a load in excess of the permissible load inertia.</li> <li>• When voltage applied to the driver has exceeded the voltage setting (24 VDC) by 15% or greater.</li> </ul>
Insufficient voltage protection function	5 times	When voltage applied to the driver was less than the voltage setting (24 VDC) by 25% or greater.
Overspeed protection function	6 times	When motor speed has reached an excess of 3500 r/min.

If the connection example on page 32 is followed, the ALARM output should remain ON while the driver is normal and turn OFF if an alarm has occurred.

If the ALARM output has turned OFF, stop the motor operation and then remove the cause that triggered the applicable protective function by referring to the number of times the LED flashes. After remove the cause for activation of the protection function, reset the ALARM (for ALARM-RESET input, see page 36).

**Note** | The START/STOP input and RUN/BRAKE input are not accepted when the ALARM is OFF.

## ■ Timing chart



\*1 10 ms or more

\*2 The direction of rotation is the case of the motor alone. It depends on the gear ratio.

\*3 The motor starts and stops over the time set by the acceleration/deceleration time potentiometer.

## 7.2 Rotating direction of the motor output shaft

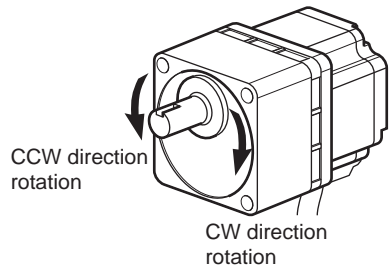
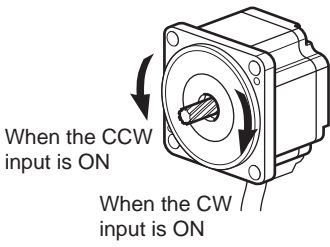
The rotating direction of the motor output shaft is defined as clockwise (CW) or counterclockwise (CCW) as viewed from the motor output shaft. However, the rotating direction of the motor output shaft may vary from that of the gearhead output shaft depending on the gear ratio of the gearhead.

### Rotating direction of the gearhead output shaft

- Gear type
  - Ratio **5, 10, 15, 50, 100** ..... Same direction as the motor
  - Ratio **20, 30** ..... Opposite direction to the motor
- Combination type parallel shaft gearhead
  - Ratio **5, 10, 15, 20, 200** ..... Same direction as the motor
  - Ratio **30, 50, 100** ..... Opposite direction to the motor

Motor output shaft

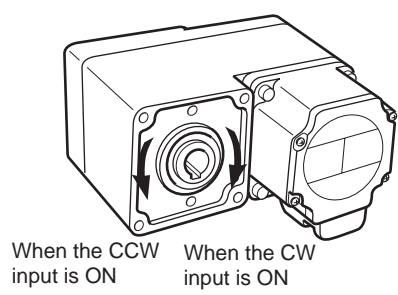
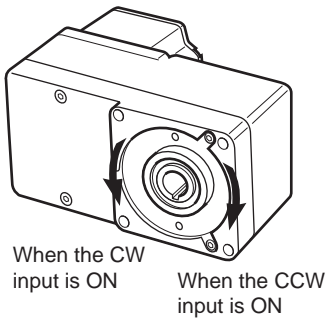
Gearhead output shaft



- Combination type hollow shaft flat gearhead
  - At all gear ratios, the output shaft turns in the opposite direction to the motor as viewed from the front of the gearhead.
  - With a combination type hollow shaft flat gearhead, the rotating direction will vary depending on whether the motor unit is viewed from the front or rear of the gearhead. Check the direction by referring to the figure below.

Viewed from front

Viewed from rear





## 7.3 Setting the running speed

Set the operating speed of the motor using the internal speed potentiometer, external speed potentiometer or external DC voltage. The motor speed range is from 100 to 3000 r/min for the case of the motor alone.

Two running speeds can be set by combining the internal potentiometer and external potentiometer, or the internal potentiometer and external DC voltage.

### ■ Setting by internal potentiometer

This potentiometer is used when running speed setting is not frequently changed, or when two-step speed switching is performed in combination with external speed setting.

Adjust the potentiometer using an insulated screwdriver. Clockwise rotation will increase the set speed. The speed is set to 0 r/min at time of shipment.

When the motor is driven at the speed set by the internal potentiometer, turn on the INT.VR/EXT input.

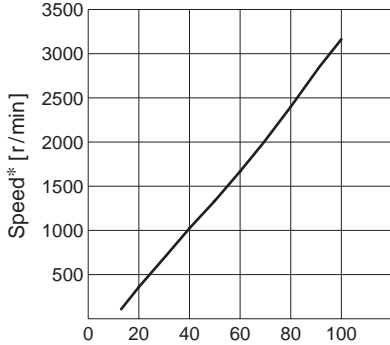
When you want to use only the internal speed setting potentiometer to set the operation speed, you do not have to connect the VRH, VRM and VRL.

## ■ Setting by external potentiometer

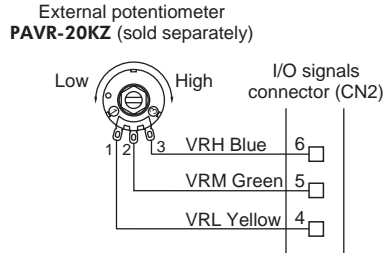
This potentiometer is used when the speed is set away from the driver or when two-step speed switching is performed in combination with the internal potentiometer.

Use the accessory **PAVR-20KZ** as the external potentiometer.

Clockwise rotation will increase the set speed.



External potentiometer graduation – speed characteristics (typical value)



\* Indicates the speed of the motor alone. The speed of the gear output shaft of a geared type or combination type is obtained by dividing the motor speed by the gear ratio.

To drive the motor at the speed set on the external potentiometer, turn off the INT.VR/EXT input.

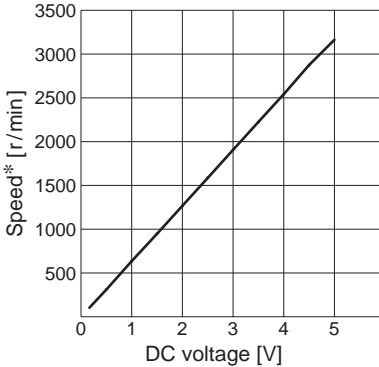
- To set the running speed only by the external potentiometer, there is no problem if the INT.VR/EXT input is not connected.
- To perform operation by switching the motor running speed, use the INT.VR/EXT to switch the external potentiometer and internal potentiometer.

**Note** To use a shielded cable for connection with the external potentiometer, connection should be made close to the I/O signals cable connector. Connect the shielded wire to the pin No.3 GND.

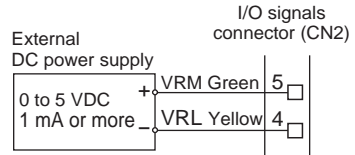
## ■ Setting by external DC voltage

External DC voltage is used when the speed is set by D/A output from an external control device such as a programmable controller, or when the speed is switched over two levels during operation in combination with the internal speed potentiometer.

For external DC voltage, use DC power supply (0 to 5 VDC, 1 mA or more) where the primary and secondary sides are provided with reinforced insulation.



External DC voltage – speed characteristics  
(typical value)



\* Indicates the speed of the motor alone. The speed of the gear output shaft of a geared type or combination type is obtained by dividing the motor speed by the gear ratio.

To drive the motor set at the external DC voltage, turn off the INT.VR/EXT input.

- To set the running speed only by the external speed setter, there is no problem if the INT.VR/EXT input is not connected.
- To perform operation by switching the motor running speed, use the INT.VR/EXT to switch the external DC voltage and internal potentiometer.

### Note

- The external DC power supply voltage must not exceed 5 VDC. Otherwise, the driver may be damaged.
- When connecting the external DC power supply, sufficient care must be taken not to mistake power polarity. Connection with incorrect polarity may damage the driver.
- To use a shielded cable for connection with the external DC power supply, connection should be made close to the I/O signals cable connector. Connect the shielded wire to the pin No.3 GND.

## 7.4 Setting the acceleration time and deceleration time

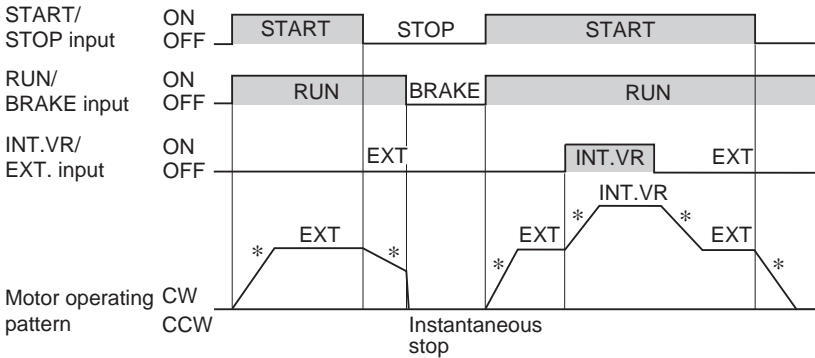
Set the acceleration time and deceleration time using the acceleration/deceleration time potentiometer (page 11). The acceleration time and deceleration time are always identical.

Adjust the potentiometer using an insulated screwdriver. Turning the potentiometer clockwise increases the time. You can set a desired time in a range of 0.5 to 10 seconds. The minimum time is set at time of shipment.

“Acceleration time” indicates the time required by the motor to reach the rated speed from a stopped condition.

“Deceleration time” indicates the time required by the motor to stop from the rated speed.

With the **BLH015**, the acceleration/deceleration time indicates the time needed by the motor to reach 3000 r/min from a stopped condition or to stop from 3000 r/min (under no load). With the **BLH230**, **BLH450** and **BLH5100**, it indicates the time needed by the motor to reach 2500 r/min from a stopped condition or to stop from 2500 r/min (under no load). The actual acceleration/deceleration time is affected by the use condition, load inertia, load torque and other conditions implemented by the user.



\* The motor starts and stops over the time set by the acceleration/deceleration time potentiometer.

## 7.5 Parallel operation

If two or more motors are to be operated at the same speed, they can be controlled from the DC power supply or external potentiometer.

### Use external DC power supply

- Use a DC power supply whose current capacity is at least the value calculated by the formula below:

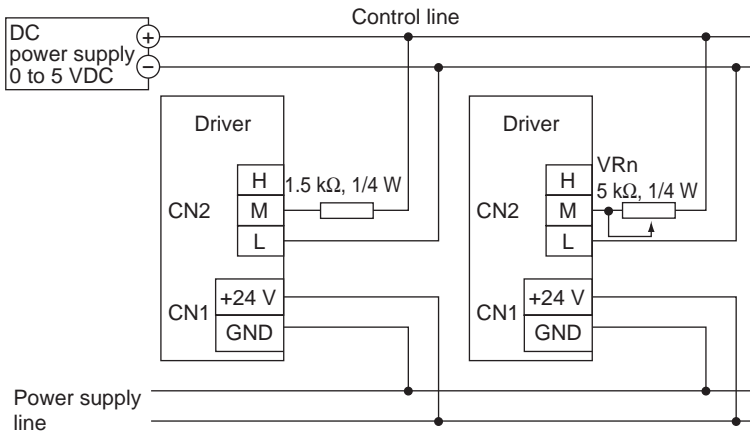
Current capacity when N drivers are connected:  $I = 1 \times N$  (mA)

Example: If two drivers are connected, the current capacity should be at least 2 mA.

- All I/O signals other than the one used for speed setting should be connected to each driver.
- If multiple motors are used with speed differences among them, make the following adjustments:

First motor: Connect a resistor of 1.5 k $\Omega$ , 1/4 W to the driver's M terminal.

Second and subsequent motors: Connect a variable resistor (VRn) of 5 k $\Omega$ , 1/4 W to the applicable driver's M terminal.



### Use an external potentiometer

Use common lines for the power supply and speed control and set the speed using VRx, as shown below.

- Obtain the resistance for the external speed potentiometer as follows:

Resistance when N drivers are connected:  $VRx = 20/N$  (k $\Omega$ ), N/4 (W)

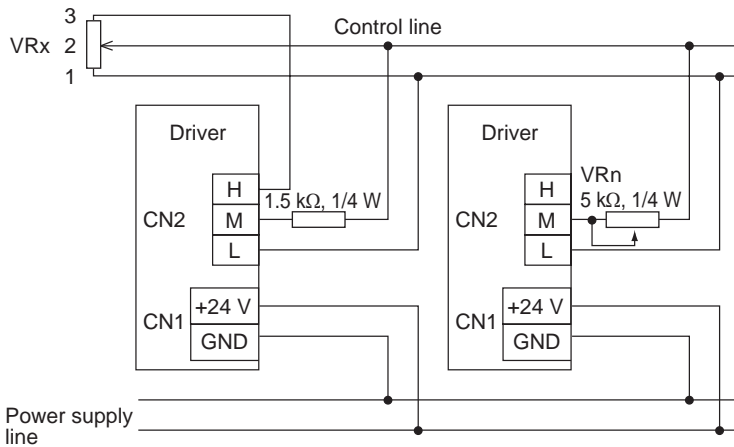
Example: If two drivers are connected, the current capacity should be 10 k $\Omega$ , 1/2 W.

- All I/O signals other than the one used for speed setting should be connected to each driver.
- If multiple motors are used with speed differences among them, make the following adjustments:

First motor: Connect a resistor of 1.5 k $\Omega$ , 1/4 W to the driver's M terminal.

Second and subsequent motors: Connect a variable resistor (VRn) of 5 k $\Omega$ , 1/4 W to the applicable driver's M terminal.

- Keep the number of drivers to five or less in parallel operation using an external potentiometer.



# 8 Inspection

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It is recommended to check the following four items after motor operation. If any failure is found, stop the operation, and please contact your local sales office.

## Inspection items

- Check if abnormal noise is produced from the motor bearing section (ball bearing).
- Check if abnormal noise is produced from the gearhead bearing (ball bearing) and gear meshing section.
- Check if the motor cable is damaged or stressed. Also, check if the connections with the driver are loosened.
- Check if there is any misalignment between motor (gearhead) output and load shafts.
- Check if dust is deposited on the driver.

**Note**

Conduct the insulation resistance measurement or withstand voltage test separately on the motor and the driver.

# 9 Troubleshooting and remedial actions

During motor running, the motor and driver may not operate correctly due to speed setting error or connection error. If normal motor operation cannot be ensured, see the following description and take appropriate countermeasures. If normal operation cannot be ensured even after that, please contact your local sales office.

Phenomenon	Estimated cause	Measure
The motor fails to turn.	Either START/STOP input or RUN/BRAKE input is not set to the ON.	Make sure that both START/STOP input or RUN/BRAKE input are set to the ON.
	The internal potentiometer is not adjusted.	Turn the internal potentiometer slightly in the clockwise direction. The speed is set to 0 r/min at time of shipment.
	When the internal potentiometer is used, INT.VR/EXT input is not set to the ON.	Set the INT.VR/EXT input to the ON. When the INT.VR/EXT input is set to the ON, the internal potentiometer is selected.
	The external potentiometer contact is faulty.	Check for connection of the external potentiometer.
	When the external potentiometer is used, INT.VR/EXT input is not set to the OFF.	Set the INT.VR/EXT input to the OFF. When the INT.VR/EXT input is set to the OFF, the external potentiometer is selected.
	The external DC voltage contact is faulty.	Check for connection of the external DC voltage.
	When an external DC voltage is used, INT.VR/EXT input is not set to the OFF.	Set the INT.VR/EXT input to the OFF. When the INT.VR/EXT input is set to the OFF, external DC voltage is selected.
<ul style="list-style-type: none"> <li>• The motor fails to turn.</li> <li>• The motor stops halfway.</li> </ul>	Protection function has activated.	Check the LED flashings. See page 37 and check the causes in conformity to the activated protection function. Take the appropriate measures.



Phenomenon	Estimated cause	Measure
The motor is driven opposite of the specified direction.	Incorrect CW/CCW input or faulty connection.	The motors driven in the CW direction when the CW/CCW input is set to the ON. CCW direction when the CW/CCW input is set to the OFF.
	Speed reduction ratios 30:1, 50:1 and 100:1 are used in the combination type parallel shaft gearhead, or 20:1 and 30:1 are used in the geared type.	When these speed reduction ratios are used, drive direction is opposite to that of the motor. Reverse the CW/CCW input operation.
	A combination type hollow shaft gearhead is used.	With a combination type hollow shaft flat gearhead, the rotating direction will vary depending on whether the motor unit is viewed from the front or rear of the gearhead (P.40).
<ul style="list-style-type: none"> <li>• The motor does not run.</li> <li>• Motor vibration too great.</li> </ul>	The motor (gearhead) output shaft and load shaft are not aligned with each other.	Make sure that the motor (gearhead) output shaft and load shaft are connected in an appropriate manner.
	Affected by noise.	Check for running only with the motor, driver and external potentiometer required for running. If noise influence has been confirmed, take the appropriate measures such as separation from noise generating source, re-connection of wiring, replacement of the signal cable by a shielded cable, and installation of a ferrite core.
The motor fails to stop instantaneously.	The motor is stopped by START/STOP input.	Stop the motor by RUN/BRAKE input.
	Load inertia may be excessive.	For this check, increase the frictional load or reduce the load inertia.
	The deceleration time is too long.	Check the setting of the acceleration/deceleration time potentiometer.

# 10 Appendix

## 10.1 Accessories (sold separately)

### ■ Extension cable

Use this cable to extend the wiring distance between the motor and driver.

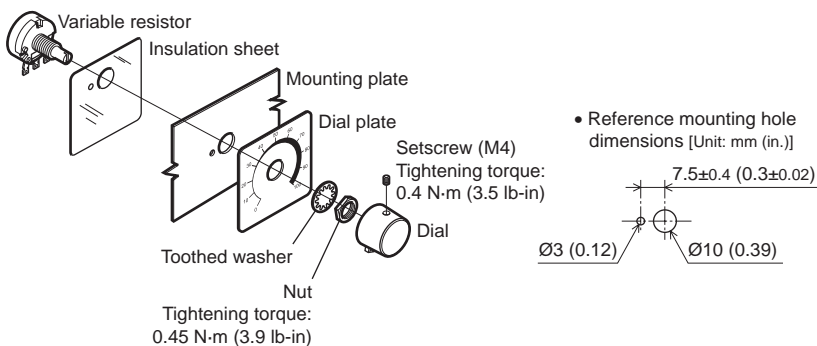
Model	Length	Applicable product
CC02BLH	1.5 m	BLH015, BLH230, BLH450
CC02AXH2	(4.9 ft.)	BLH5100

### ■ External potentiometer

Model: **PAVR-20KZ**

#### • How to install the external potentiometer

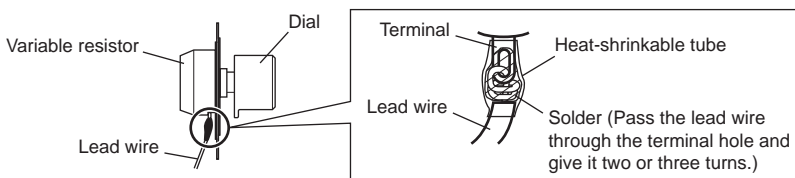
Insert the external potentiometer as shown below.



#### • Soldering the variable resistor terminals and the lead wires

Cover a heat-shrinkable tube over the soldered part to insulate.

Soldering condition: 235 °C (455 °F), less than 5 sec.



## ■ Digital speed indicator

Model: **SDM496**

Use this unit to display the rotating speed of the motor output shaft or reduced rotating speed of the gearhead output shaft.

### Note

The digital speed indicator **SDM496** is not certified under the safety standards. If the **SDM496** is combined with the **BLH** series, conformance of the **BLH** series with the safety standards is not guaranteed.

## 10.2 Recommended peripherals

### ■ Mains filter for power supply line

Manufacturer	Model
TDK Corporation	ZAG2210-11S
TDK-Lambda Corporation	MC1210
Schaffner EMC	FN2330Y-10-06, FN2310X-10-06
Tyco Electronics CORCOM	10ESK1

\* Overvoltage category II applies to AC line filters.

### ■ Ferrite core

Manufacturer	Model
Würth Elektronik GmbH & Co.KG	7427122
TDK Corporation	ZCAT3035-1330

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