



## Brushless DC Motor and Driver Package

# **BLF Series**

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## OPERATING MANUAL



(Motor)



(Driver)



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

This product must be handled by qualified personnel.

Before using motor unit, read Chapter 2 “Safety precautions” on p.6 carefully to understand its correct use.

The **BLF** series is designed and manufactured for use as an internal component of general industrial equipment. Do not use it for any other purpose. Oriental Motor will not be liable for whatever damage arises from failure to observe this warning.

## ■ Product overview

The **BLF** series is a line of high-function brushless DC motor units combining a compact, high-torque brushless DC motor and a driver offering digital setting/display capability.

The series features a wide range of functions including the digital operator on the driver that lets you set data and operate the motor with ease.

You can choose a combination-type motor preassembled with a gearhead, round-shaft motor, or pinion-shaft motor. The motor can be combined with a gearhead of one of two types: the parallel-shaft gearhead achieving a longer life and quieter operation, or the hollow shaft flat gearhead ensuring high rigidity.

## ■ Standards and CE Marking

This product is recognized by UL and by CSA. The CE Marking (Low Voltage Directive and EMC Directive) is affixed to the product in accordance with EN Standards.

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

### • Applicable Standards

	Applicable Standards	Certification Body	Standards File No.	CE Marking
Motor	UL 1004 CSA C22.2 No.100	UL	E62327	Low Voltage Directives EMC Directives
	EN 60950-1 EN 60034-1 EN 60034-5 IEC 60664-1	Conform to EN/IEC Standards		
Driver	UL 508C CSA C22.2 No.14	UL	E171462	
	EN 60950-1 EN 50178	Conform to EN Standards		

### • Installation conditions

Motor	Driver
Motor is to be used as a component within other equipment. Overvoltage category: III Pollution degree: Class 3 Protection against electric shock: Class I	Driver is to be used as a component within other equipment. Overvoltage category: III Pollution degree: Class 2 Protection against electric shock: Class I

### • Low Voltage Directive

The product is a type with machinery incorporated, so it should be installed within an enclosure.

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

### • EMC Directives

This product bears the CE mark under the conditions specified in “Installation/Wiring example of the motor and driver” on p.30.

Be sure to conduct EMC measures with the product assembled in your equipment by referring to 5.10 “Installing and wiring in compliance with EMC Directives (89/336/EEC, 92/31/EEC)” p.28.

■ **WARNING FOR UL/cUL LISTING MARKING ON DRIVER**

- Use 60/75 °C CU wire only or equivalent.
- Maximum surrounding air temperature 50 °C.
- Solid state motor overload protection is provided in each model.
- Install device in pollution degree 2 environment.
- Tightening torque and wire range for field wiring terminals are listed as below.

Location	Tightening torque	Wire range
Power connection terminal and cable	1.0 N·m	AWG18 to 14*
Motor connection terminal and cable	0.8 to 1.0 N·m	AWG14

\* Wire range of **BLFD200A2** type is AWG14.

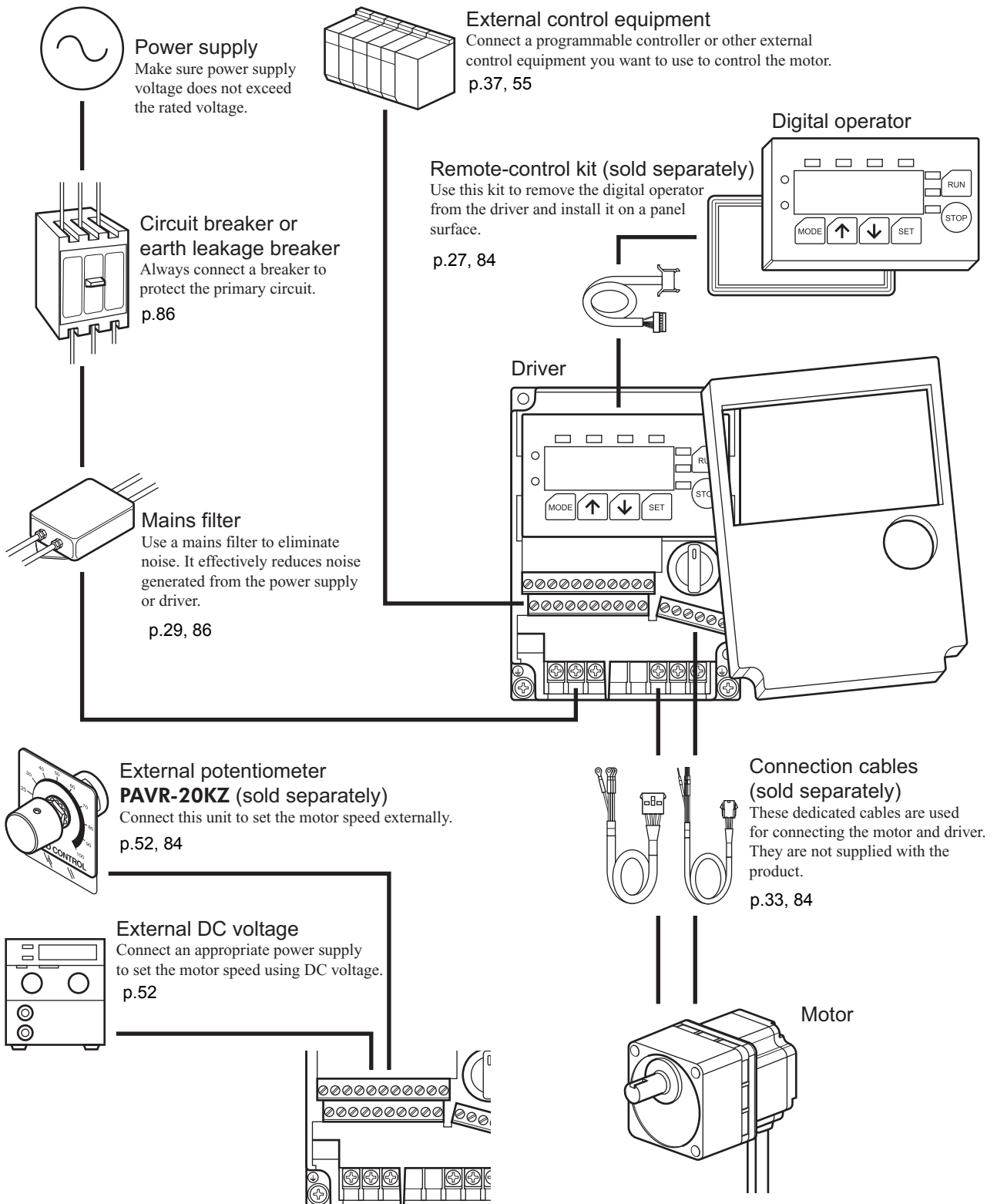
■ **Hazardous substances**

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

## ■ System configuration


An example of system configuration using the **BLF** series is shown below.


The power supply can be chosen from three specifications: single-phase 100–120 V, 50/60 Hz; single-phase 200–240 V, 50/60 Hz; or three-phase 200–240 V, 50/60 Hz.



## 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. Please read and understand these precautions thoroughly before using the product.

 **Warning** Handling the product without observing the instructions that accompany a “Warning” symbol may result in death or serious bodily injury.

 **Caution** Handling the product without observing the instructions that accompany a “Caution” symbol may result in bodily injury or property damage.

### Note

The items under this heading contain important handling instructions that the user should observe to ensure the safe use of the product.

### Warning

#### General

- Do not use the product in a place exposed to explosive, flammable or corrosive gases or water splashes or near combustible materials. Doing so may result in fire, electric shock or injury.
- Only qualified personnel should be allowed to perform installation, connection, operation and inspection/troubleshooting of the product. Handling by unqualified personnel may result in fire, electric shock, injury or equipment damage.
- Do not move, install, connect or inspect the product while the power is supplied. Perform these operations after turning off the power. Failure to observe these instructions may result in electric shock.
- Do not use this product in a lift device. If the driver’s protection function is activated, the motor will stop and the moving part of the equipment will drop, thereby causing injury or equipment damage.
- If the driver’s protection function has been activated, remove the cause and then reset the protection function. Continuing to operate the equipment without removing the cause of problem will lead to a motor or driver malfunction, resulting in injury or equipment damage.
- Use a specified motor (gearhead) and driver combination. Failure to do so may result in fire, electric shock or equipment damage.

#### Installation

- Use the motor and driver only in class I equipment. Installing them in equipment of other classes may result in electric shock.
- Install the motor and driver in an enclosure. Failure to do so may result in electric shock or injury.
- When installing the motor and driver, connect their Protective Earth Terminals. Failure to do so may result in electric shock.

#### Connection

- Securely connect the cables in accordance with the connection examples. Failure to do so may result in fire or electric shock.
- Do not forcibly bend, pull or pinch the cables. Doing so may result in fire or electric shock.
- Do not machine or modify the motor cable, signal cable or dedicated connection cable (sold separately). Doing so may result in electric shock or fire.
- Be sure to observe the specified cable sizes. Use of unspecified cable sizes may result in fire.
- Observe the specified screw tightening torque when connecting terminals to the terminal block. Failure to do so may result in electric shock or equipment damage.
- Be sure to install the front cover and terminal block cover once connections are completed. Failure to do so may result in fire or electric shock.
- Insulate the connection terminal for an external potentiometer. Failure to do so may result in electric shock.

#### Operation

- Always keep the driver’s power supply voltage below the rating. Failure to do so may result in fire or electric shock.

## Maintenance/Inspection

- Always turn off the power before performing maintenance/inspection. Failure to do so may result in electric shock.
- Do not touch the motor or driver when measuring insulation resistance or performing a dielectric strength test. Accidental contact may result in electric shock.
- Do not touch the connection terminals on the driver immediately (within 1 minute) after the power is turned off. Residual voltage may cause electric shock.
- Regularly check the openings in the driver for attachment of dust. Attached dust may cause fire.
- Do not disassemble or modify the motor (gearhead) and driver. Doing so may result in electric shock, injury or equipment damage. Should you require inspection or repair of internal parts, please contact the Oriental Motor branch or sales office from which you purchased the product.



**Caution**

## General

- Do not use the product in conditions exceeding the motor (gearhead) or driver specifications. Doing so may result in electric shock, fire, injury or equipment damage.
- Do not insert an object into the openings in the driver. Doing so may result in fire, electric shock or injury.
- Do not touch the motor (gearhead) or driver during the operation or immediately after the operation has stopped. Touching a hot motor (gearhead) or driver surface may cause burns.

## Transportation

- Do not carry the product by the motor (gearhead) output shaft or any of the cables. Doing so may result in injury.

## Installation

- Do not place around the motor and driver any object blocking the air flows. Doing so may result in equipment damage.
- Do not touch the motor output shaft (key groove or pinion) with bare hands. Doing so may result in injury.
- When assembling the motor (pinion shaft) with the gearhead, exercise caution not to pinch your fingers or other parts of your body between the motor and gearhead. Injury may result.
- Securely affix the motor (gearhead) and driver to their respective mounting plates. Inappropriate installation may cause the motor/driver to detach and fall, resulting in equipment damage.
- Provide a cover on the rotating part (output shaft) of the motor (gearhead). Failure to do so may result in injury.
- When installing the motor (gearhead) in the equipment, exercise caution not to pinch your fingers or other parts of your body between the equipment and motor or gearhead. Injury may result.
- Securely install the load on the motor output shaft. Inappropriate installation may result in injury.

## Operation

- 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. Failure to do so may result in fire, electric shock or injury.
- Do not touch the rotating part (output shaft) during operation. Doing so may result in injury.
- The motor surface temperature may exceed 70 °C (158 °F) even in a normal operating condition. If the operator is allowed to approach the running motor, attach a warning label as shown below in a conspicuous position. Failure to do so may result in burns.



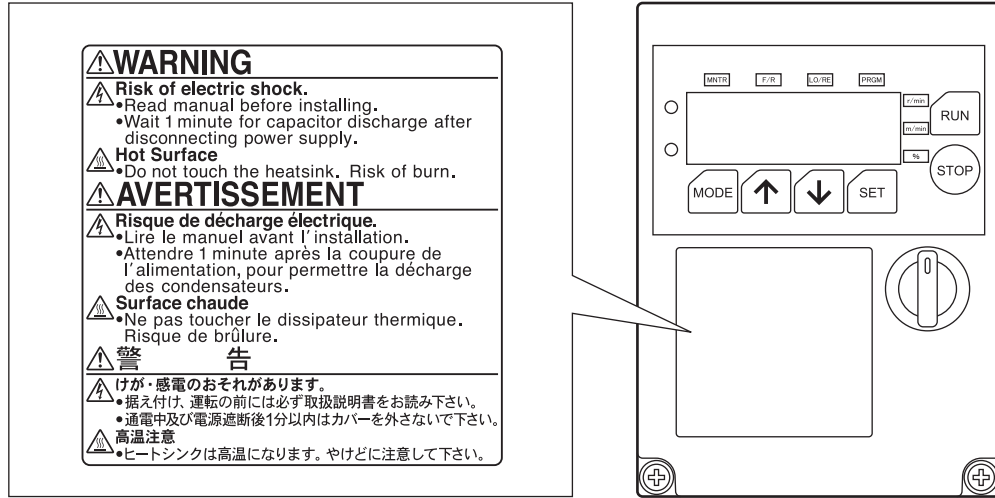
Warning label

## Disposition

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

## ■ Warning information

A warning label with handling instructions is attached on the front cover of the driver.  
Be sure to observe the instructions on the label when handling the driver.





## 3 Precautions for use

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

- **Connect protective devices to the power line**

Connect a circuit breaker or earth leakage breaker to the driver's power line to protect the primary circuit. If an earth leakage breaker is to be installed, use one incorporating high-frequency noise elimination measures. Refer to 13.3 "Recommended peripherals" on p.86 for the selection of appropriate protective devices.
- **Do not perform gravitational load operation**

With the **BLF** 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. Once the motor stops, the holding brake force will be lost and the load may drop.
- **Do not use a solid-state relay (SSR) to turn on/off the power**

A circuit that turns on/off the power via a solid-state relay (SSR) may damage the motor and driver.
- **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.
- **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 hollow shaft flat gearhead**

If you are using a hollow shaft flat 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.
- **Be sure to connect the digital operator to the driver**

Turning on the driver power without connecting the digital operator will activate a protection function and disable the driver operation.
- **Noise elimination measures**

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

### Wiring the motor

Use dedicated connection cable (sold separately) to connect the driver and motor.

### Wiring the power supply cable and I/O signal cable

Minimize the wiring length of the power supply cable and I/O signal cable.

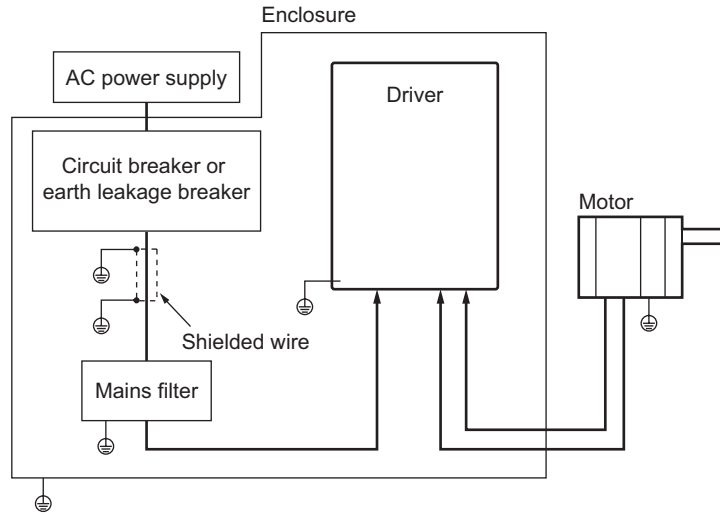
Provide a minimum clearance of 100 mm (3.94 in.) between the I/O signal cable and any inductive load such as an electromagnetic relay or any power line (power cable, motor cable, etc.).

Do not place the cable and a power line in the same duct or pipe or bundle them together.

For more effective elimination of noise, use a shielded cable or attach ferrite cores if a non-shielded cable is used.

- Connecting a mains filter for power line

- Connect a mains filter to the AC power input part of the driver to prevent external noise from reaching the driver via the power line.
- Provide a ground connection from the mains filter ground terminal using a cable of AWG18 to 14 (0.75 to 2.0 mm<sup>2</sup>)\*.
- \* **BLFD200A2** type is AWG14 (2.0 mm<sup>2</sup>).
- Be sure to ground both ends of the shielded cable used for the mains filter.



# 4 Preparation

This chapter explains what you must do before using the **BLF** series, as well as the name and function of each part of the unit.

## 4.1 Confirming the product

Open the package and confirm that all of the items listed below are included.

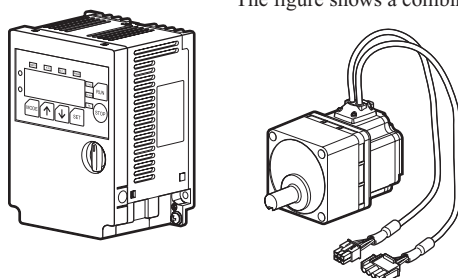
If any of the items are missing or damaged, please contact the Oriental Motor branch or sales office from where you purchased the product.

Confirm the model of the unit against the model name shown on the package label.

Confirm the models of the motor, gearhead and driver against the model names shown on their respective nameplates.

Refer to 4.3 “Combination tables” on p.12 for the allowable motor, gearhead and driver combinations for each unit model.

- Driver 1 unit
- Motor 1 unit  
The figure shows a combination type.
- Operating manual (this manual) 1 copy



Accessories for combination type parallel shaft gearhead\*

- Hexagonal socket head screw set  
(Screw, flat washer, spring washer and nut, 4 pcs. each)

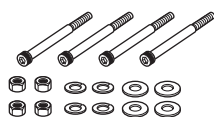


- Parallel key 1 pc.  
(For GFS6G□ type, a key is fixed on the output shaft.)



Accessories for combination type hollow shaft flat gearhead\*

- Hexagonal socket head screw set  
(Screw, flat washer, spring washer and nut, 4 pcs. each)



- Safety cover 1 pc.



- Parallel key 1 pc.



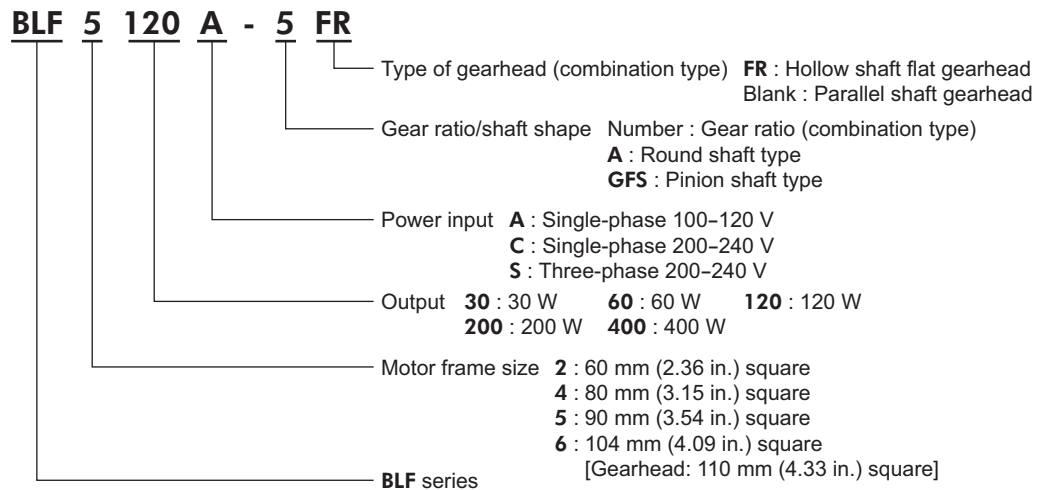
- Safety-cover mounting screw (M3) 2 pcs.



\* These parts are not supplied if the motor is of the round shaft or pinion shaft type.

**Note** Optional connection cables (sold separately) are needed to connect the driver and motor (p.84).

## 4.2 How to read the unit model



## 4.3 Combination tables

### Combination type parallel shaft gearhead

The motor comes preassembled with a parallel shaft gearhead.

Unit model *	Components		
	Motor model	Gearhead model *	Driver model
<b>BLF230A-□</b>	BLFM230-GFS	GFS2G□	BLFD30A2
<b>BLF230C-□</b>			BLFD30C2
<b>BLF230S-□</b>			BLFD30S2
<b>BLF460A-□</b>	BLFM460-GFS	GFS4G□	BLFD60A2
<b>BLF460C-□</b>			BLFD60C2
<b>BLF460S-□</b>			BLFD60S2
<b>BLF5120A-□</b>	BLFM5120-GFS	GFS5G□	BLFD120A2
<b>BLF5120C-□</b>			BLFD120C2
<b>BLF5120S-□</b>			BLFD120S2
<b>BLF6200A-□</b>	BLFM6200-GFS	GFS6G□	BLFD200A2
<b>BLF6200C-□</b>			BLFD200C2
<b>BLF6200S-□</b>			BLFD200S2
<b>BLF6400S-□</b>			BLFM6400-GFS

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

### Combination type hollow shaft flat gearhead

The motor comes preassembled with a hollow shaft flat gearhead.

Unit model *	Components		
	Motor model	Gearhead model *	Driver model
<b>BLF230A-□FR</b>	BLFM230-GFS	GFS2G□FR	BLFD30A2
<b>BLF230C-□FR</b>			BLFD30C2
<b>BLF230S-□FR</b>			BLFD30S2
<b>BLF460A-□FR</b>	BLFM460-GFS	GFS4G□FR	BLFD60A2
<b>BLF460C-□FR</b>			BLFD60C2
<b>BLF460S-□FR</b>			BLFD60S2
<b>BLF5120A-□FR</b>	BLFM5120-GFS	GFS5G□FR	BLFD120A2
<b>BLF5120C-□FR</b>			BLFD120C2
<b>BLF5120S-□FR</b>			BLFD120S2

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

## Round shaft type

Unit model	Motor model	Driver model
<b>BLF230A-A</b>	BLFM230-A	BLFD30A2
<b>BLF230C-A</b>		BLFD30C2
<b>BLF230S-A</b>		BLFD30S2
<b>BLF460A-A</b>	BLFM460-A	BLFD60A2
<b>BLF460C-A</b>		BLFD60C2
<b>BLF460S-A</b>		BLFD60S2
<b>BLF5120A-A</b>	BLFM5120-A	BLFD120A2
<b>BLF5120C-A</b>		BLFD120C2
<b>BLF5120S-A</b>		BLFD120S2
<b>BLF6200A-A</b>	BLFM6200-A	BLFD200A2
<b>BLF6200C-A</b>		BLFD200C2
<b>BLF6200S-A</b>		BLFD200S2
<b>BLF6400S-A</b>	BLFM6400-A	BLFD400S2

## Pinion shaft type

Unit model	Motor model	Driver model	Applicable gearhead *
<b>BLF230A-GFS</b>	BLFM230-GFS	BLFD30A2	<b>GFS2G□</b> <b>GFS2G□FR</b>
<b>BLF230C-GFS</b>		BLFD30C2	
<b>BLF230S-GFS</b>		BLFD30S2	
<b>BLF460A-GFS</b>	BLFM460-GFS	BLFD60A2	<b>GFS4G□</b> <b>GFS4G□FR</b>
<b>BLF460C-GFS</b>		BLFD60C2	
<b>BLF460S-GFS</b>		BLFD60S2	
<b>BLF5120A-GFS</b>	BLFM5120-GFS	BLFD120A2	<b>GFS5G□</b> <b>GFS5G□FR</b>
<b>BLF5120C-GFS</b>		BLFD120C2	
<b>BLF5120S-GFS</b>		BLFD120S2	
<b>BLF6200A-GFS</b>	BLFM6200-GFS	BLFD200A2	<b>GFS6G□</b>
<b>BLF6200C-GFS</b>		BLFD200C2	
<b>BLF6200S-GFS</b>		BLFD200S2	
<b>BLF6400S-GFS</b>	BLFM6400-GFS	BLFD400S2	

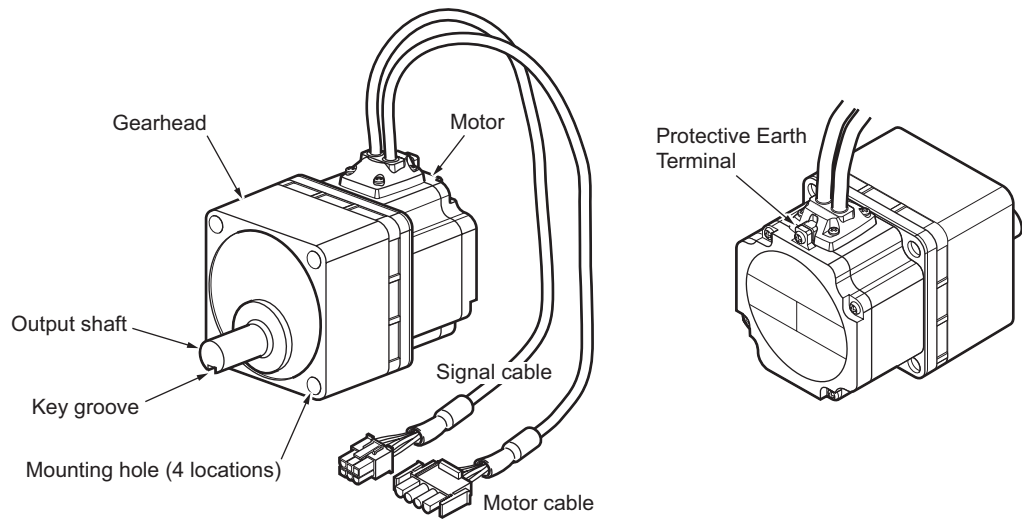
\* Gearheads are sold separately.

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

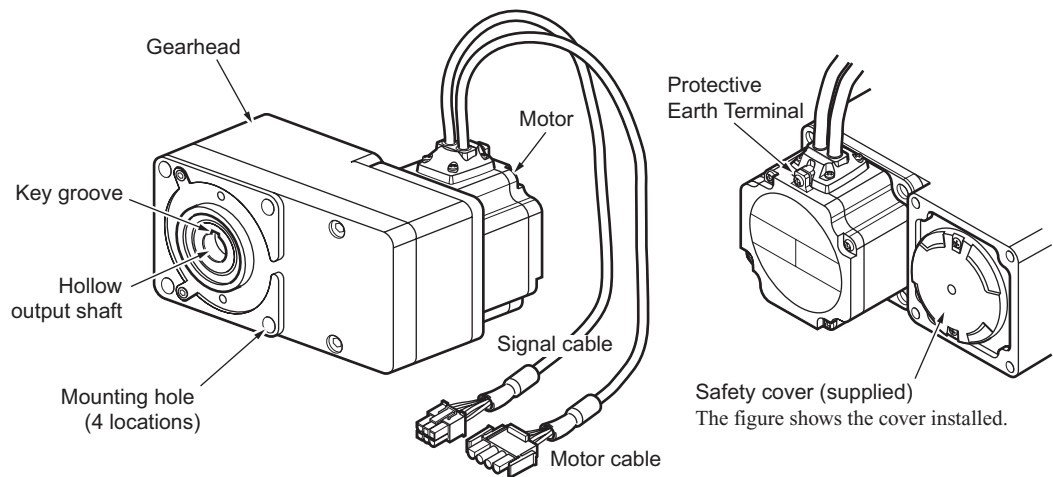
## 4.4 Name and function of each part

This section explains the name and function of each part of the motor and driver.

### ■ Combination type parallel shaft gearhead

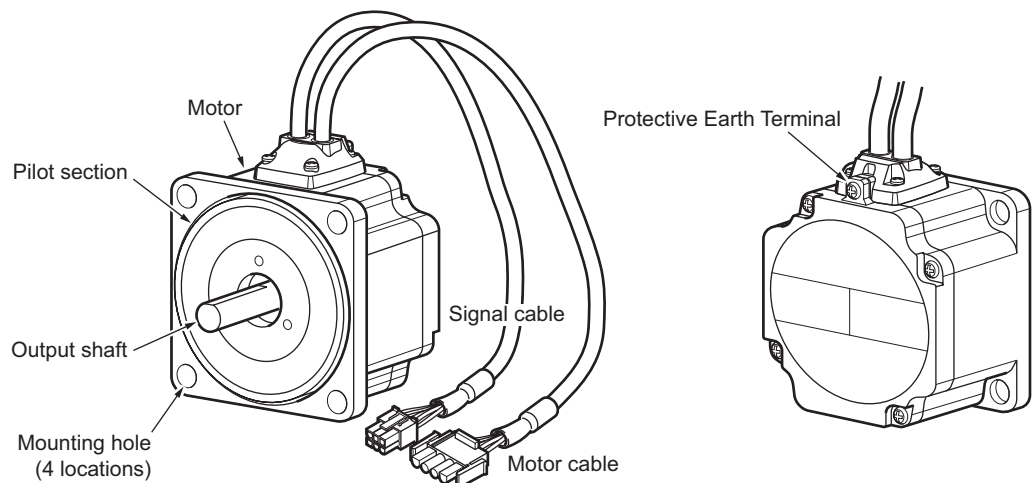


### ■ Combination type hollow shaft flat gearhead

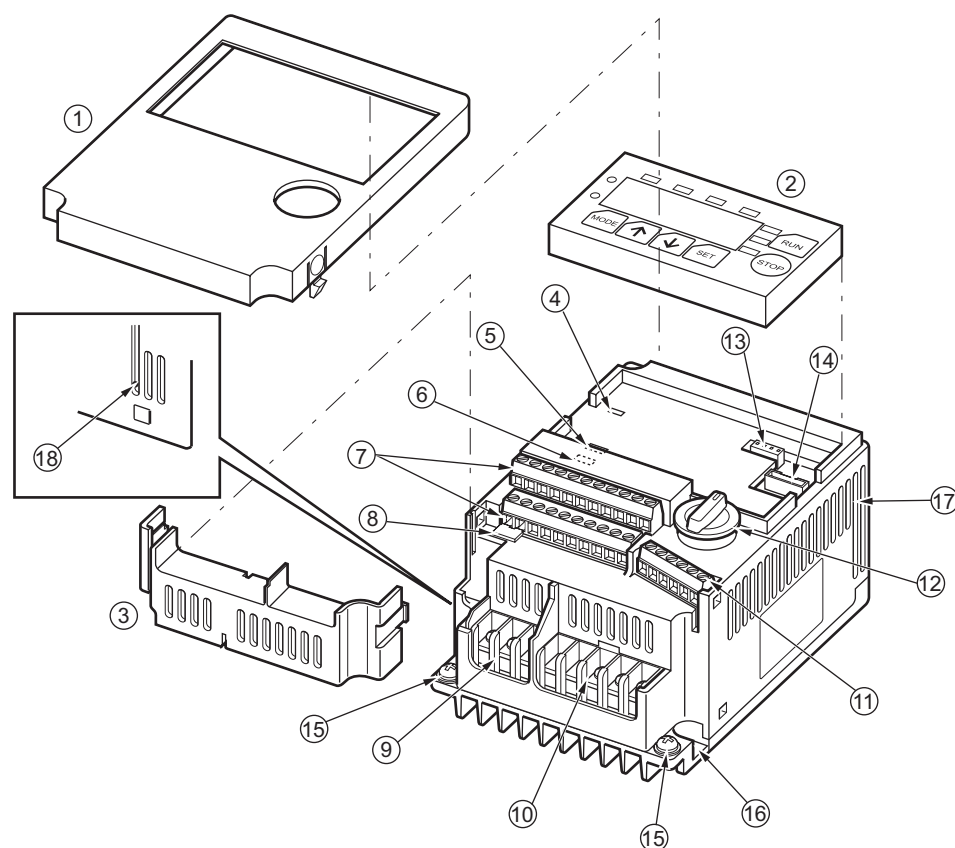


### ■ Round shaft type, pinion shaft type

The figure shows a round shaft motor.

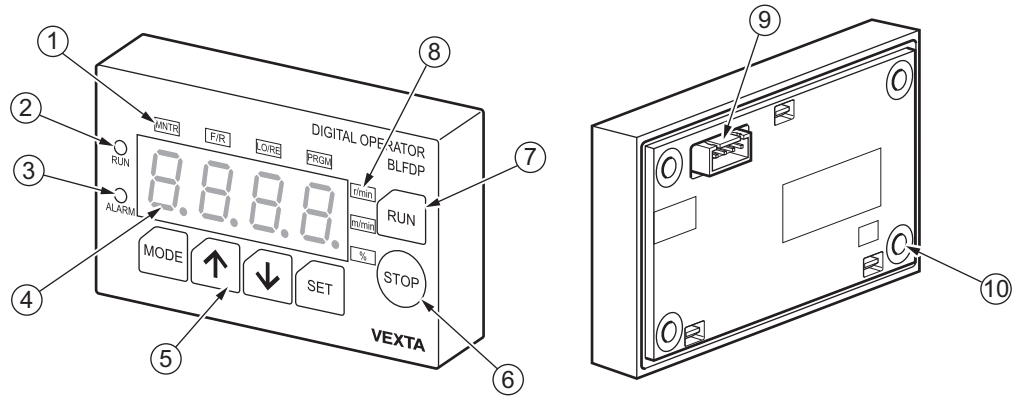


## ■ Driver



No.	Name	Explanation	Reference page
1	Front cover	-	-
2	Digital operator	Operation part of the driver	-
3	Terminal block cover	-	-
4	POWER LED	This LED will illuminate in green when the power is turned on. When the digital operator is remote-controlled, this LED can be used to check if the driver power is on.	-
5	Sink/Source input selector switch	Used for switching the input circuit between sink and source logic modes.	p.74
6	External voltage selection switch	If external DC voltage is to be used to set the speed, set this switch according to the applicable external DC voltage. Select 5 V or 10 V.	p.52
7	I/O signal connection terminals	Connect the I/O signal terminals of a programmable controller or other external control equipment here.	p.37
8	Short bar	Remove this bar when the EXT-ERROR input is used.	p.38
9	Power connection terminal	Connect the power cable here.	p.32
10	Motor connection terminal	Connect the motor connection terminal (4-core) here.	p.33
11	Signal-cable connection terminal	Connect the signal connection cable (6-core) here.	p.34
12	Internal potentiometer	A built-in potentiometer of the driver	-
13	Digital operator connector (CN1)	Link it to the connector on the rear of the digital operator.	-
14	Remote-control connector (CN2)	Connect the cable in the remote-control kit here when the digital operator is to be used away from the driver.	p.27
15	Protective Earth Terminal	Use this terminal to ground the motor and driver.	p.35
16	Mounting hole (2 locations)	Use these holes to install the driver to a mounting plate.	-
17	Radiation openings	-	-
18	CHARGE LED (BLF6200/6400 type only)	A red LED turns on while voltage is being supplied to the driver. Once the power is turned off, this LED will turn off when the residual voltage in the controller drops to a safe level.	p.60

## ■ Digital operator



No.	Name	Explanation	Reference page
1	Mode indicator LEDs	The illuminating LED indicates the current operation mode. MNTR: Monitor mode F/R: Direction setting mode LO/RE: Digital operator/external input signal setting mode PRGM: Data setting mode	-
2	RUN LED	A green light stays on during operation.	-
3	ALARM LED	A red light will come on when an alarm is generated.	-
4	Display	-	-
5	Operation keys	Use these keys to switch the mode or set data.  <div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">MODE</div> <span>: Switch the operation mode</span> </div> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">↑</div> <span>: Move to the next item or increase the value</span> </div> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">↓</div> <span>: Move to the previous item or decrease the value</span> </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">SET</div> <span>: Confirm the data</span> </div>	p.42
6	STOP	Stop the motor.	-
7	RUN	Start the motor operation.	-
8	Unit display LEDs	The illuminating LED indicates the current display unit. r/min: Speed of motor or gearhead output shaft m/min: Conveyor transfer speed %: Load factor	p.66, 71
9	Driver connector (CN3)	Link it to CN1 on the driver when connecting the digital operator to the driver. This connector also accepts the cable in the remote-control kit.	p.27
10	Mounting hole (4 locations)	Use these holes to install the digital operator to a mounting plate using the remote-control kit.	p.27



## 5 Installation

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.

Combination type parallel shaft gearhead	p.17, 22
Combination type hollow shaft flat gearhead	p.19, 24
Round shaft type	p.21, 22
Pinion shaft type	Parallel shaft gearhead: p.17, 22 Hollow shaft flat gearhead: p.19, 24

### 5.1 Installation location

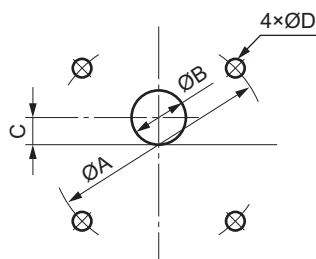
The motor and driver are designed and manufactured for use as internal components of equipment. Install the motor and driver in a well-ventilated place where they can be inspected easily and the following conditions are satisfied:

- Inside an enclosure installed indoors (provide a ventilation hole)
- Ambient temperature: 0 to +50 °C (+32 to +122 °F) (non-freezing)
- 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 combination parallel shaft gearhead

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



Unit model	ØA	ØB	C	ØD
<b>BLF230</b>	70 (2.76)	24 (0.94)	10 (0.39)	4.5 (0.177)
<b>BLF460</b>	94 (3.70)	34 (1.34)	13 (0.51)	6.5 (0.256)
<b>BLF5120</b>	104 (4.09)	40 (1.57)	18 (0.71)	8.5 (0.335)
<b>BLF6200</b> <b>BLF6400</b>	120 (4.72)	42 (1.65)	20 (0.79)	8.5 (0.335)

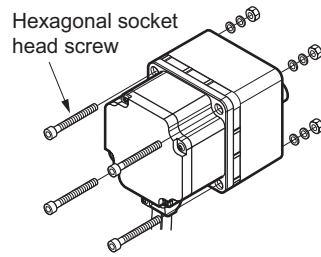
Open holes with a minimum diameter of  $\text{ØB} + 1 \text{ mm}$  (0.04 in.).

#### Maximum applicable plate thickness

Unit model	Maximum applicable plate thickness
<b>BLF230</b>	5 mm (0.20 in.)
<b>BLF460</b>	8 mm (0.31 in.)
<b>BLF5120</b> <b>BLF6200</b> <b>BLF6400</b>	12 mm (0.47 in.)

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

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.



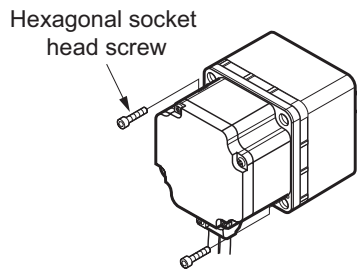
Unit model	Nominal thread size	Tightening torque
<b>BLF230</b>	M4	1.8 N·m (15.9 lb-in)
<b>BLF460</b>	M6	6.4 N·m (56 lb-in)
<b>BLF5120</b> <b>BLF6200</b> <b>BLF6400</b>	M8	15.5 N·m (137 lb-in)

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

### ■ Removing/Installing the gearhead

The gearhead can be removed and the motor cable position changed to a desired 90° direction.

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

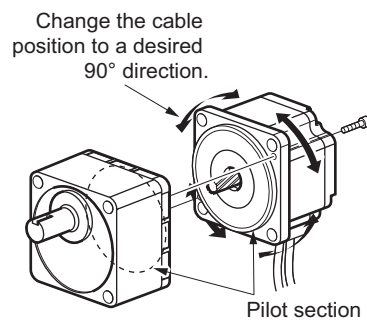


2. Using the pilot sections of the motor and gearhead as guides, install the gearhead to the motor and tighten the hexagonal socket head screws.

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.

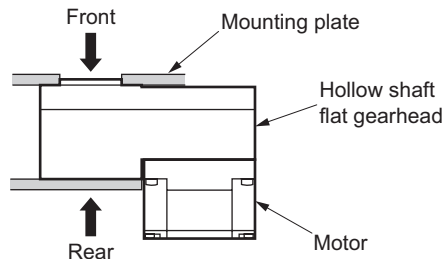


Unit model	Nominal thread size	Tightening torque
<b>BLF230</b> <b>BLF460</b>	M2.6	0.4 N·m (3.5 lb-in)
<b>BLF5120</b> <b>BLF6200</b> <b>BLF6400</b>	M3	0.6 N·m (5.3 lb-in)

- 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 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.

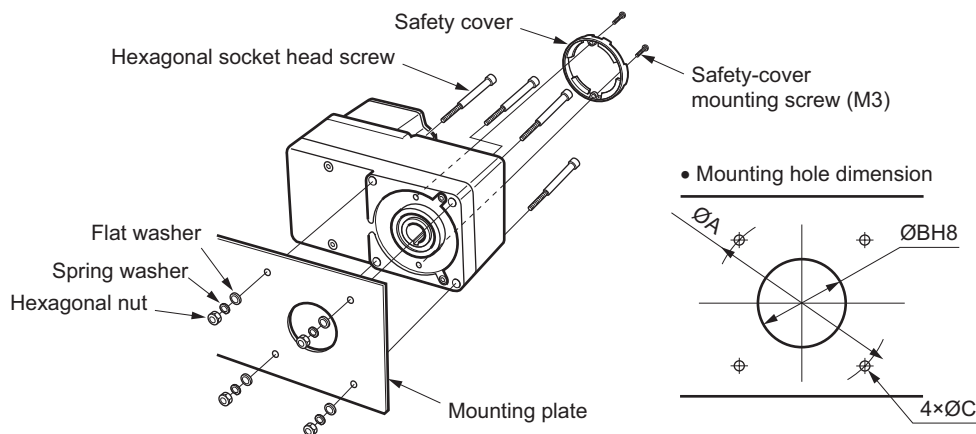
### 5.3 Installing the combination type hollow shaft flat gearhead

A combination-type hollow shaft flat gearhead can be installed by using either its front or rear side as the mounting surface. Install the supplied hexagonal socket head screw set 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.

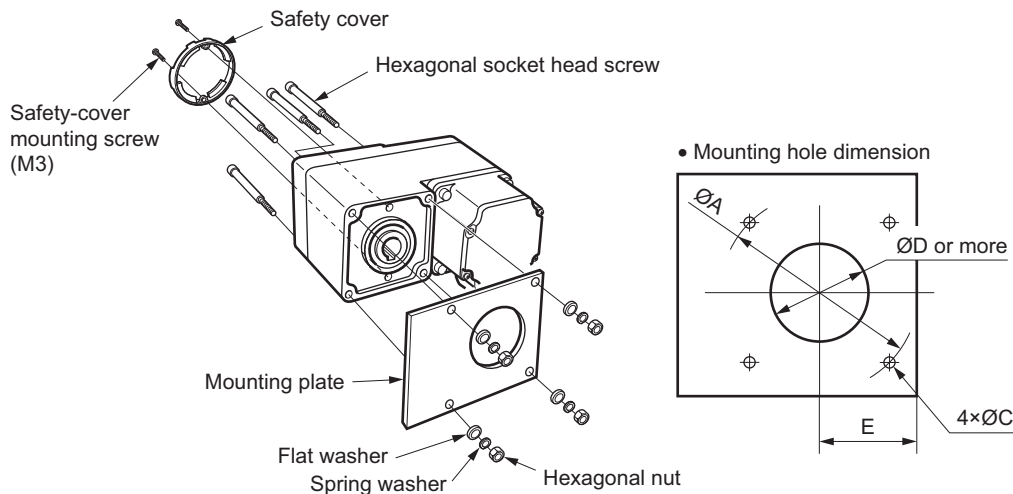


• Using the front side as the mounting surface

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	Maximum applicable plate thickness *	ØA	ØBH8	ØC	ØD	E
BLF230	M5	3.8 N·m (33 lb-in)	5	70 (2.76)	$34^{+0.039}_0$ ( $1.34^{+0.0015}_0$ )	5.5 (0.22)	25 (0.98)	29 (1.14)
BLF460	M6	6.4 N·m (56 lb-in)	8	94 (3.70)	$38^{+0.039}_0$ ( $1.50^{+0.0015}_0$ )	6.5 (0.26)	30 (1.18)	39 (1.54)
BLF5120	M8	15.5 N·m (137 lb-in)	12	104 (4.09)	$50^{+0.039}_0$ ( $1.97^{+0.0015}_0$ )	8.5 (0.33)	35 (1.38)	44 (1.73)

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

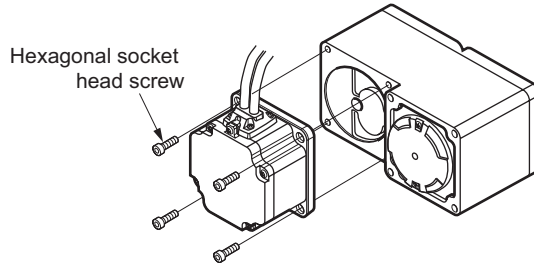
**Note** When installing the gearhead by using its rear side as the mounting surface, prevent contact between the mounting plate and motor by keeping dimension E below the specified value.

## ■ Removing/Installing the hollow shaft flat gearhead

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.

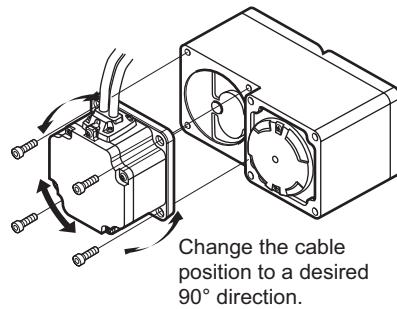


2. Using the pilot sections of the motor and gearhead as guides, install the motor to the gearhead and tighten the hexagonal socket head screws.

At this time, the motor cable position can be changed to one of three 90° directions.

Install the motor carefully to prevent the pinion of the motor output shaft from contacting the casing 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>BLF230</b>	M4	1.8 N·m (15.9 lb-in)
<b>BLF460</b>	M6	6.4 N·m (56 lb-in)
<b>BLF5120</b>	M8	15.5 N·m (137 lb-in)

### Note

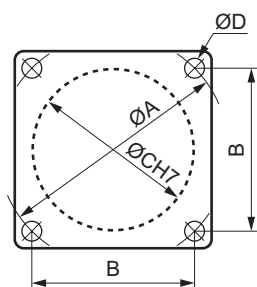
- Do not forcibly assemble the motor and gearhead. Also, do not let metal objects or other foreign matters enter the gearhead. The pinion of the motor output shaft or the gearhead itself may be damaged, resulting in noise or shorter service life.
- Do not allow dust to attach to the pilot sections of the motor and gearhead. Also, assemble the motor carefully by not pinching the O-ring at the motor's pilot section. If the O-ring is pinched, the coupling strength will drop and grease may leak from the gearhead.
- The motor cable position cannot be changed to the direction where the cable faces the gearhead output shaft, because the gearhead case will obstruct the cable.

## 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).

Unit model	Size of radiation plate	Material/Thickness
<b>BLF230</b>	115 × 115 mm (4.53 × 4.53 in.)	Material: Aluminum Thickness: 5 mm (0.20 in.)
<b>BLF460</b>	135 × 135 mm (5.31 × 5.31 in.)	
<b>BLF5120</b>	165 × 165 mm (6.50 × 6.50 in.)	
<b>BLF6200</b>	200 × 200 mm (7.87 × 7.87 in.)	
<b>BLF6400</b>	250 × 250 mm (9.84 × 9.84 in.)	Material: Aluminum Thickness: 6 mm (0.24 in.)

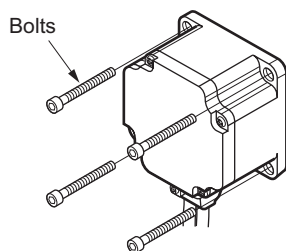
1. Open mounting holes in the mounting plate [unit: mm (in.)].



Unit model	ØA	B	ØCH7	ØD
<b>BLF230</b>	70 (2.76)	49.5 (1.949)	54 <sup>+0.030</sup> <sub>0</sub> (2.1260 <sup>+0.0012</sup> )	4.5 (0.177)
<b>BLF460</b>	94 (3.70)	66.47 (2.616)	73 <sup>+0.030</sup> <sub>0</sub> (2.8740 <sup>+0.0012</sup> )	6.5 (0.256)
<b>BLF5120</b>	104 (4.09)	73.54 (2.895)	83 <sup>+0.035</sup> <sub>0</sub> (3.2677 <sup>+0.0014</sup> )	8.5 (0.335)
<b>BLF6200</b> <b>BLF6400</b>	120 (4.72)	84.85 (3.341)	94 <sup>+0.035</sup> <sub>0</sub> (3.7008 <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>BLF230</b>	M4	1.8 N·m (15.9 lb-in)
<b>BLF460</b>	M6	6.4 N·m (56 lb-in)
<b>BLF5120</b> <b>BLF6200</b> <b>BLF6400</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.17

Installing a hollow shaft flat gearhead: p.19

## 5.6 Installing a load on the combination type parallel gearhead or 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.
- 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 each combination type parallel shaft gearhead. Form a key groove on the load side and affix the load using the supplied parallel key.

Unit model	Parallel key dimension
<b>BLF230</b>	4 mm (0.16 in.)
<b>BLF460</b>	5 mm (0.20 in.)
<b>BLF5120, BLF6200, BLF6400</b>	6 mm (0.24 in.)

\* On the GFS6G□, the parallel key is affixed to the gearhead output shaft.

#### Round shaft type

A flat section is provided on the motor output shaft of each 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

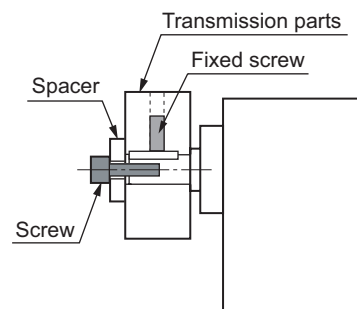
Adjust the motor (gearhead) output shaft to lie parallel with the load shaft and form right angles between the output shaft/load shaft and the line connecting the centers of both pulleys.

#### • 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□ and GFS6G□ 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.

### Combination type parallel shaft gearhead

Unit model <sup>*1</sup>	Distance from tip of gearhead output shaft and permissible overhung load <sup>*2</sup> [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
<b>BLF230□-5</b>	100 (22) [90 (20)]	150 (33) [110 (24)]	40 (9)
<b>BLF230□-10</b> <b>BLF230□-15</b> <b>BLF230□-20</b>	150 (33) [130 (29)]	200 (45) [170 (38)]	40 (9)
<b>BLF230□-30</b> <b>BLF230□-50</b> <b>BLF230□-100</b> <b>BLF230□-200</b>	200 (45) [180 (40)]	300 (67) [230 (51)]	40 (9)
<b>BLF460□-5</b>	200 (45) [180 (40)]	250 (56) [220 (49)]	100 (22)
<b>BLF460□-10</b> <b>BLF460□-15</b> <b>BLF460□-20</b>	300 (67) [270 (60)]	350 (78) [330 (74)]	100 (22)
<b>BLF460□-30</b> <b>BLF460□-50</b> <b>BLF460□-100</b> <b>BLF460□-200</b>	450 (101) [420 (94)]	550 (123) [500 (112)]	100 (22)
<b>BLF5120□-5</b>	300 (67) [230 (51)]	400 (90) [300 (67)]	150 (33)
<b>BLF5120□-10</b> <b>BLF5120□-15</b> <b>BLF5120□-20</b>	400 (90) [370 (83)]	500 (112) [430 (96)]	150 (33)
<b>BLF5120□-30</b> <b>BLF5120□-50</b> <b>BLF5120□-100</b> <b>BLF5120□-200</b>	500 (112) [450 (101)]	650 (146) [550 (123)]	150 (33)
<b>BLF6200□-5, 10, 15, 20</b>	550 (123) [500 (112)]	800 (180) [700 (157)]	200 (45)
<b>BLF6200□-30, 50</b>	1000 (220) [900 (202)]	1250 (280) [1100 (247)]	300 (67)
<b>BLF6200□-100, 200</b>	1400 (310) [1200 (270)]	1700 (380) [1400 (315)]	400 (90)
<b>BLF6400S-5, 10, 15, 20</b>	550 (123) [500 (112)]	800 (180) [700 (157)]	200 (45)
<b>BLF6400S-30, 50</b>	1000 (220) [900 (202)]	1250 (280) [1100 (247)]	300 (67)
<b>BLF6400S-100, 200</b>	1400 (310) [1200 (270)]	1700 (380) [1400 (315)]	400 (90)

\*1 □ in the model names indicates the power supply specification (**A**, **C** or **S**).

\*2 The values assume a rated speed of 3000 r/min or below. The values in [ ] are based on a rated speed of 4000 r/min.

### Round shaft type

Unit model <sup>*1</sup>	Distance from tip of gearhead output shaft and permissible overhung load <sup>*2</sup> [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
<b>BLF230□-A</b>	80 (18)	100 (22)	Not to exceed one-half the motor's dead weight <sup>*2</sup>
<b>BLF460□-A</b>	110 (24)	130 (29)	
<b>BLF5120□-A</b>	150 (33)	170 (38)	
<b>BLF6200□-A</b> <b>BLF6400S-A</b>	197 (44)	221 (49)	

\*1 □ in the model names indicates the power supply specification (**A**, **C** or **S**).

\*2 Minimize the thrust load. If a thrust load must be applied, do not let it exceed one-half the motor's dead weight.

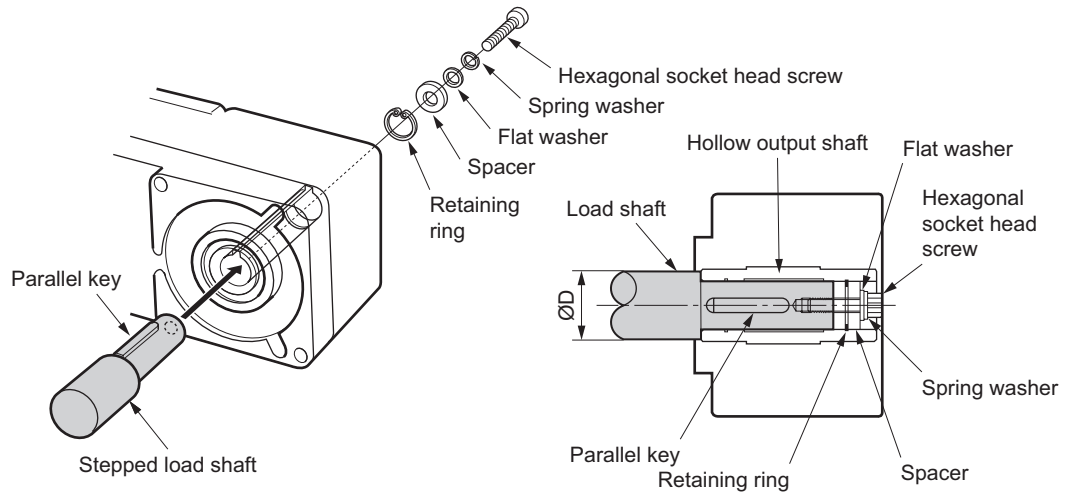
## 5.7 Installing a load on the combination type hollow shaft flat gearhead

If the motor is subject to a strong impact upon instantaneous stop or receives a large overhung load, use a 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.

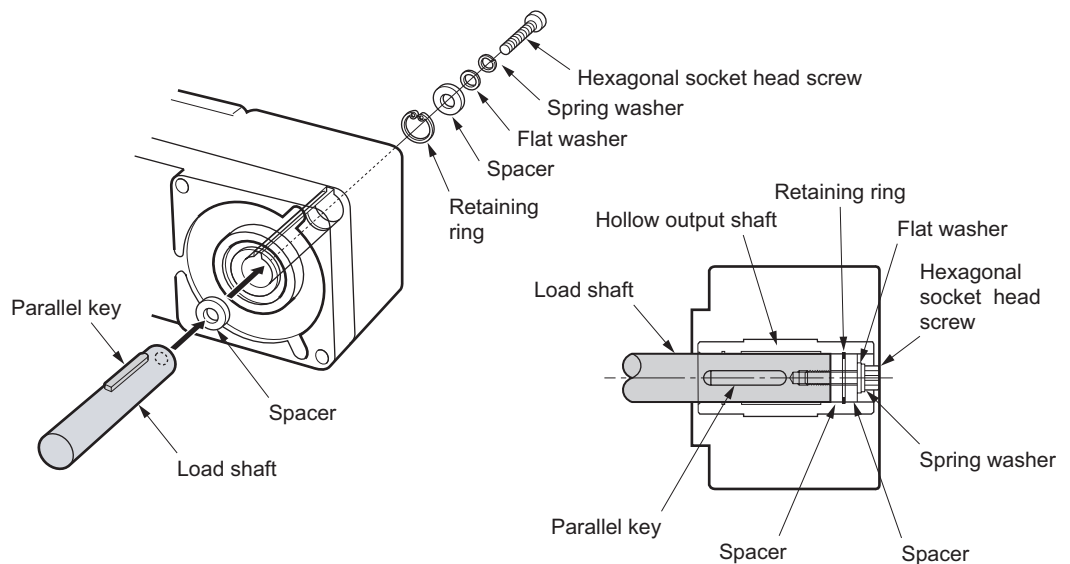
- **Stepped load shaft**

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



- **Non-stepped load shaft**

Install each hexagonal socket head screw over a retaining ring, spacer, flat 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 (H8)	Recommended tolerance of load shaft (h7)	Nominal diameter of retaining ring	Applicable screw	Spacer thickness	Outer diameter of stepped shaft (ØD)
<b>BLF230</b>	$\varnothing 12^{+0.027}_0$ ( $\varnothing 0.4724^{+0.0011}_0$ )	$\varnothing 12^{0}_{-0.018}$ ( $\varnothing 0.4724^{0}_{-0.0007}$ )	$\varnothing 12$ (Ø0.47)	M4	3 (0.12)	20 (0.79)
<b>BLF460</b>	$\varnothing 15^{+0.027}_0$ ( $\varnothing 0.5906^{+0.0011}_0$ )	$\varnothing 15^{0}_{-0.018}$ ( $\varnothing 0.5906^{0}_{-0.0007}$ )	$\varnothing 15$ (Ø0.59)	M5	4 (0.16)	25 (0.98)
<b>BLF5120</b>	$\varnothing 20^{+0.033}_0$ ( $\varnothing 0.7874^{+0.0013}_0$ )	$\varnothing 20^{0}_{-0.021}$ ( $\varnothing 0.7874^{0}_{-0.0008}$ )	$\varnothing 20$ (Ø0.79)	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 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.

Combination type hollow shaft flat gearhead [Unit: N]

Unit model *1	Distance from hollow shaft flat gearhead mounting surface and permissible overhung load *2 [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
<b>BLF230□-5FR</b> <b>BLF230□-10FR</b>	450 (101) [410 (92)]	370 (83) [330 (74)]	200 (45)
<b>BLF230□-15FR</b> <b>BLF230□-20FR</b> <b>BLF230□-30FR</b> <b>BLF230□-50 (100, 200) FR</b>	500 (112) [460 (103)]	400 (90) [370 (83)]	
<b>BLF460□-5FR</b> <b>BLF460□-10FR</b>	800 (180) [730 (164)]	660 (148) [600 (135)]	
<b>BLF460□-15FR</b> <b>BLF460□-20FR</b> <b>BLF460□-30FR</b> <b>BLF460□-50 (100, 200) FR</b>	1200 (270) [1100 (240)]	1000 (220) [910 (200)]	400 (90)
<b>BLF5120□-5FR</b> <b>BLF5120□-10FR</b>	900 (200) [820 (184)]	770 (173) [700 (157)]	500 (112)
<b>BLF5120□-15FR</b> <b>BLF5120□-20FR</b>	1300 (290) [1200 (270)]	1110 (240) [1020 (220)]	
<b>BLF5120□-30FR</b> <b>BLF5120□-50 (100, 200) FR</b>	1500 (330) [1400 (310)]	1280 (280) [1200 (270)]	

\*1 □ in the model names indicates the power supply specification (**A**, **C** or **S**).

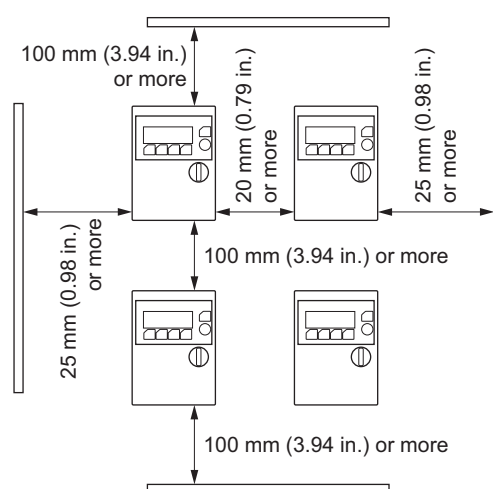
\*2 The values assume a rated speed of 3000 r/min or below. The values in [ ] are based on a rated speed of 4000 r/min.

## 5.8 Installing the driver

### ■ Installation direction

The driver is designed for use in an environment where generated heat can be released by air convection or heat conduction to an enclosure. If the driver is installed in an enclosure, be sure to position the driver vertically by using the mounting holes in the driver.

Provide a minimum clearance of 25 mm (0.98 in.) in the horizontal direction or 100 mm (3.94 in.) in the vertical direction between the driver and its enclosure or other equipment in the enclosure. If two or more drivers are installed side by side or on top of one another, provide a minimum clearance of 20 mm (0.79 in.) in the horizontal direction or 100 mm (3.94 in.) in the vertical direction between the adjacent drivers.

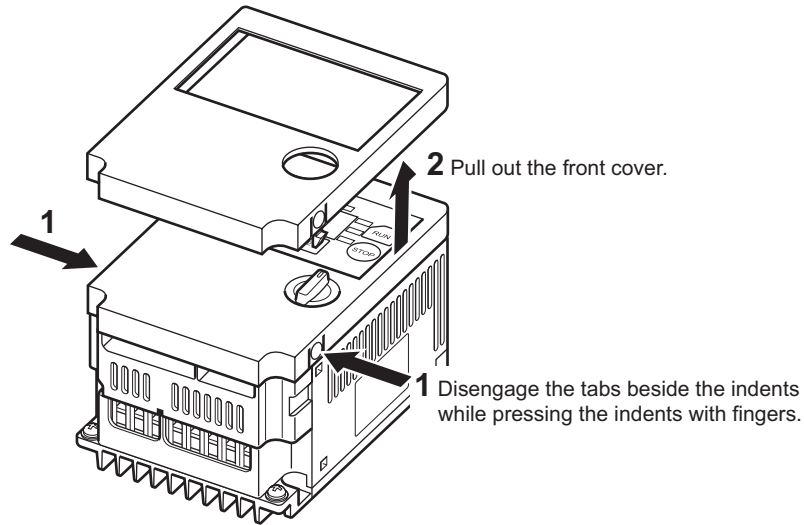


- Note**
- Install the driver vertically in an enclosure. Do not block the radiation openings.
  - Do not install around the driver any equipment generating a large amount of heat or noise.
  - If the ambient temperature of the driver exceeds 50 °C (122 °F), revise the ventilation condition or force-cool the area around the driver using a fan.

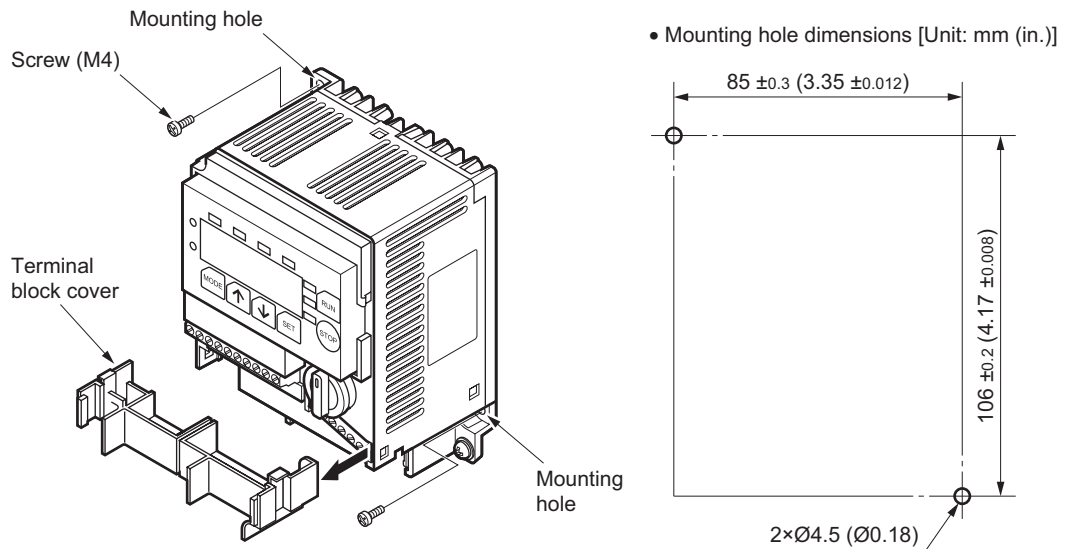
## ■ Installation method

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

1. While pressing with fingers the indents provided on both sides of the front cover, disengage the tabs beside the indents one by one and pull up the front cover to remove.  
When removing the front cover, be careful not to let the digital operator drop.



2. Pull out the terminal block cover.
3. Install screws into the two mounting holes and tighten them until no gaps remain between the driver and mounting plate.  
Thread size: M4 (not supplied)



4. Install the terminal block cover and front cover.

## 5.9 Installing the digital operator on a panel surface

The digital operator can be removed from the driver and installed on the panel surface, etc., using an optional remote-control kit (sold separately). The remote-control kit consists of a cable, connector hook and rubber gasket. Installing the rubber gasket will achieve a protection level conforming to IP65.

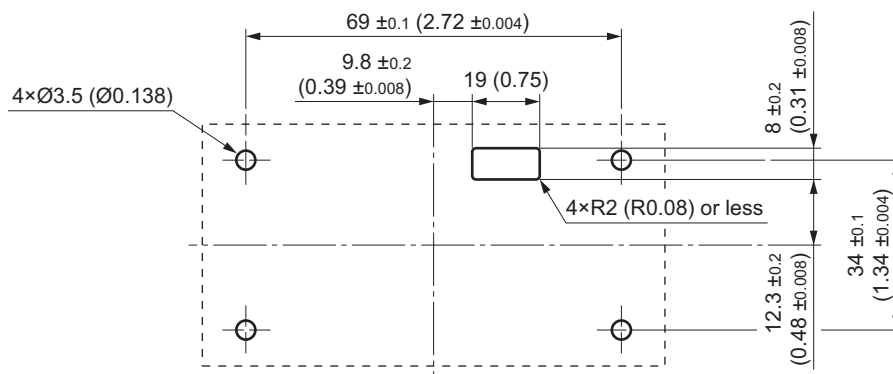
**Note** | Observe the specified installation method. IP65-level protection can be achieved only by a proper installation.

### ■ Installation method

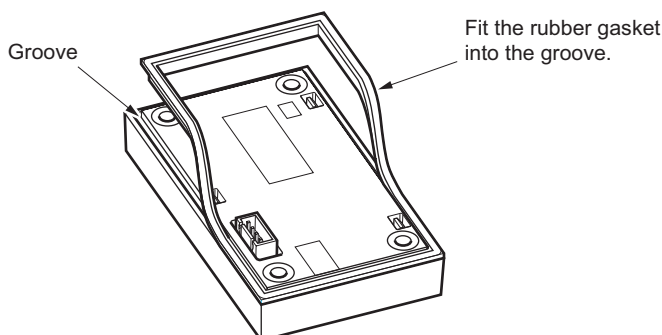
Install the digital operator to a flat metal plate offering excellent vibration resistance.

1. Open mounting screw holes and a hole for guiding the connection cable in the mounting plate [unit: mm (in.)].

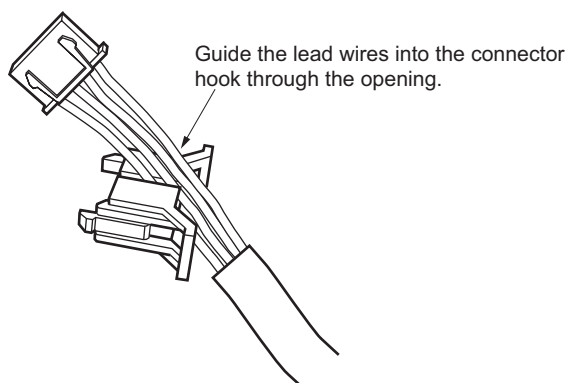
The figure is as viewed from the mounting surface of the digital operator.



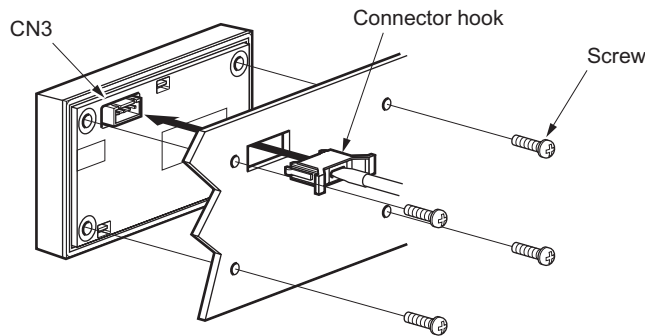
2. Remove the front cover and detach the digital operator.
3. To provide IP65-level protection, fit the rubber gasket into the groove provided around the digital operator on its rear face.



4. Install the connector hook on the cable. Guide the cable's lead wires (4 wires) into the connector hook through the opening so that all lead wires will pass through the hook.



5. Install the digital operator on the front side of the mounting plate and tighten the screws (4 locations; not supplied).  
 Thread size: M3, pitch 0.5, effective depth 4 mm (0.16 in.)  
 Tightening torque: 0.5 N·m (71 oz-in)



6. Connect the cable to CN3 on the digital operator from the rear side of the mounting plate and insert the connector hook.

## 5.10 Installing and wiring in compliance with EMC Directives (89/336/EEC, 92/31/EEC)

The **BLF** series is designed and manufactured for use as an internal component of equipment. The EMC Directives require that your mechanical equipment in which the **BLF** series is installed satisfy the applicable requirements.

The installation/wiring methods of the motor and driver explained here represent the basic methods that are effective in helping your mechanical equipment conform to the EMC Directives.

The final level of conformance of your mechanical equipment to the EMC Directives will vary depending on the control system equipment used with the motor/driver, configuration of electrical parts, wiring, layout, hazard level, and the like. Therefore, you must conduct the EMC tests on your mechanical equipment to confirm compliance.

### ■ Applicable Standards

EMI	Emission Tests	EN 61000-6-4
	Radiated Emission Test	EN 55011
	Conducted Emission Test	EN 55011
EMS	Immunity Tests	EN 61000-6-2
	Electrostatic Discharge Immunity Test	IEC 61000-4-2
	Radiation Field Immunity Test	IEC 61000-4-3
	Fast Transient / Burst Immunity Test	IEC 61000-4-4
	Surge Immunity Test	IEC 61000-4-5
	Conductive Noise Immunity Test	IEC 61000-4-6
	Power Frequency Magnetic Field Immunity Test	IEC 61000-4-8
	Voltage Dip Immunity Test	IEC 61000-4-11
Voltage Interruption Immunity Test	IEC 61000-4-11	

Without effective measures to suppress the electromagnetic interference (EMI) caused by the **BLF** series in the surrounding control system equipment or the electromagnetic spectrum (EMS) generated by the **BLF** series, the function of your mechanical equipment may be seriously affected.

The **BLF** series will conform to the EMC Directives if installed/wired using the methods specified below.

## ■ Connecting a mains filter for power line

Connect a mains filter to the AC power input part of the driver to prevent external noise from reaching the driver via the power line.

Use the following mains filters or equivalent.

Manufacturer	Single-phase 100–120 V	Single-phase 200–240 V	Three-phase 200–240 V
TDK Corporation	ZAG2210-11S	ZAG2210-11S	–
DENSEI-LAMBDA K.K.	MC1210	MC1210	MC1310
OKAYA ELECTRIC INDUSTRIES CO., LTD.	SUP-EW10-ER-6	–	–
Schaffner EMC	FN2070-10-06	FN2070-10-06	FN251-8-07
Tyco Electronics CORCOM	–	10ESK1	–

Overvoltage category II applies to mains filters.

- Install the mains filter at a point as close as possible to the driver. Also, securely affix the input and output cables using cable clamps, etc., so the cables will not separate from the enclosure panel surface.
- Use as thick a cable as possible for connection to the ground terminal of the mains filter and connect the cable to the ground point over the shortest distance.
- Do not lay the AC input cable AWG 18 to 14 (0.75 to 2.0 mm<sup>2</sup>)\* and the mains filter's output cable AWG 18 to 14 (0.75 to 2.0 mm<sup>2</sup>)\* in parallel. Parallel layout may cause the noise generated in the enclosure to enter the power cable via the stray capacitance and reduce the effectiveness of the mains filter.  
\* **BLFD200A2** type is AWG14 (2.0 mm<sup>2</sup>).

## ■ Grounding method

To prevent a potential difference from generating at the grounded point, use as thick a cable as possible to connect the driver, motor, mains filter and power cable (shielded cable) to the ground over the shortest distance. Provide each ground point as a wide, thick and uniform conductive surface. Refer 6.3 “Grounding” on p.35 for the grounding methods.

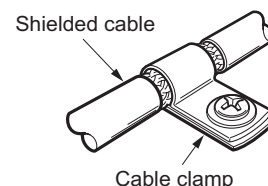
## ■ Wiring the power supply cable

Use a shielded cable of AWG 18 to 14 (0.75 to 2.0 mm<sup>2</sup>)\* in diameter for the driver signal cable and keep it as short as possible.

Strip a part of the shielded cable and ground the stripped part using a metal cable clamp that contacts the stripped cable around its entire circumference, or use a drain wire to make ground connection.

When grounding the shielded cable, connect both ends (mains filter side and power supply side) to earth to prevent potential difference from generating in the shielded cable.

\* **BLFD200A2** type is AWG14 (2.0 mm<sup>2</sup>).



## ■ Wiring the external I/O signal cable

Use a shielded cable of AWG26 to 22 (0.14 to 0.3 mm<sup>2</sup>) to wire the driver's signal cable over the shortest distance. Strip a part of the shielded cable and ground the stripped part using a metal cable clamp that contacts the stripped cable around its entire circumference. Install the cable clamp at the tip of the shielded cable and connect it to an appropriate ground point.

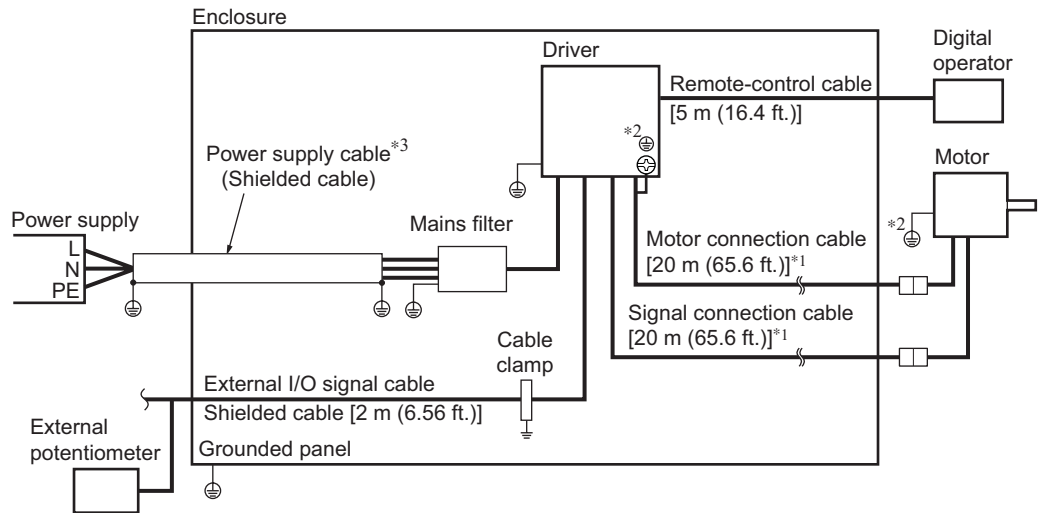
## ■ Notes about installation and wiring

- Connect the ground cables directly to their respective ground points so that a difference will not generate between the ground potential of the motor or driver and that of a surrounding control system equipment. Ground both ends of the shielded power supply cable to prevent potential difference from generating.
- When a relay or electromagnetic switch is used in the equipment, provide a mains filter or CR circuit to absorb surge voltage.
- Keep the cable lengths to a minimum, and do not wind an extra length into loops or fold it into a bundle.
- Wire the power lines such as the motor cable and power cable away from the signal cables by providing a minimum clearance of 100 mm (3.94 in.) between them. If a power line must cross with a signal cable, make sure they cross at right angles. Also, provide as long a distance as possible between the AC input and output cables of the mains filter.
- Use dedicated connection cable (sold separately) when extending the wiring distance between the motor and driver. The **BLF** series has been EMC-tested using Oriental Motor's genuine connection cables.

## ■ Electrostatic

Electrostatic can cause the driver to malfunction or sustain damage. Once the power is turned on, handle the driver carefully and do not approach or touch the driver.

## ■ Installation/Wiring example of the motor and driver



\*1 Performance has been evaluated based on connection cable lengths of up to 20 m (65.6 ft.).

\*2 The grounding method will vary depending on the length of connection cables. For details, refer to 6.3 “Grounding” on p.35.

Connection cable length of 7 m (23 ft.) or shorter: Connect the Protective Earth Terminal (green/yellow) on each connection cable to the Protective Earth Terminal on the driver.

Connection cable length of 10 m (32.8 ft.) or longer: Connect the motor’s Protective Earth Terminal directly to earth, without using the Protective Earth Terminal on the driver.

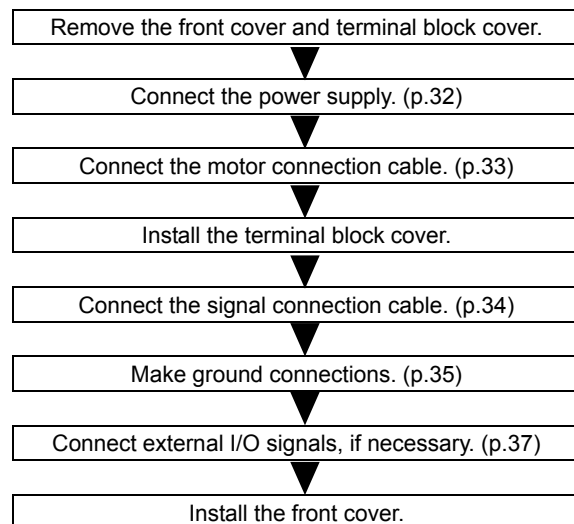
\*3 When grounding the shielded power supply cable, use cable clamps to connect both ends of the shielded cable (mains filter side and power supply side) to earth, or use a drain wire to make ground connection.

# 6 Connection

This chapter explains the connection method of the driver, power supply, motor and I/O signals, as well as the grounding method.

## ■ Connection overview

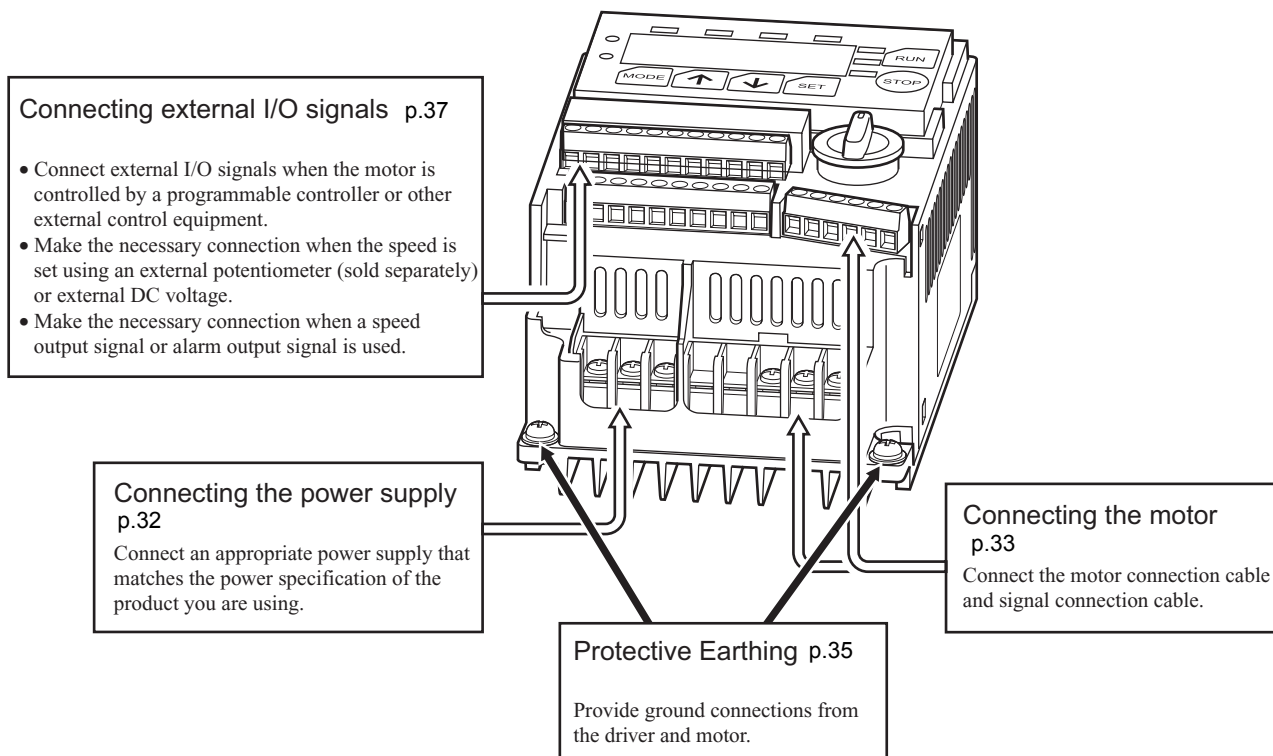
Make connections in accordance with the following flow.



The figure below shows the driver with its front cover and terminal block cover removed.

Once all connections are completed, be sure to install the front cover and terminal block cover.

Be careful not to let the digital operator drop when removing the front cover or connecting the various cables.



Refer to 6.5 “Connection example” on p.40 for an example of connection.

## 6.1 Connecting the power supply

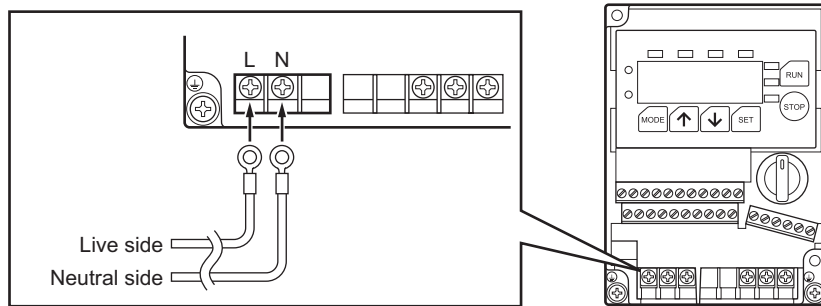
Remove the terminal block cover and connect the power cable to the power connection terminal on the driver. The connection method will vary between a single-phase 100–120/200–240 V power supply and a three-phase 200–240 V power supply.

**Note**

- Confirm the power supply voltage and the driver's rated voltage. To protect the primary circuit, connect a protective device to the driver's power line.
- Do not wire the driver's power cable with other power line or the motor cable in the same duct.
- Connect a mains filter to the AC power input part of the driver to prevent external noise from reaching the driver via the power line.

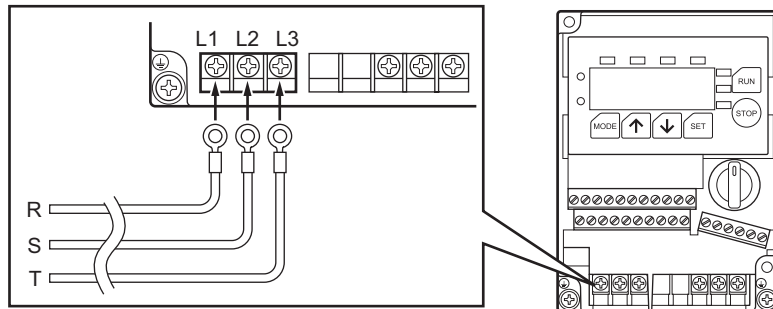
### ■ Single-phase 100–120/200–240 V

Connect the live side of the power cable to terminal L, and the neutral side to terminal N.



### ■ Three-phase 200–240 V

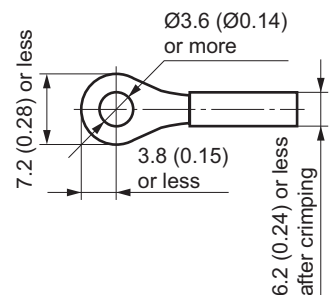
Connect phases R, S and T of the power cable to terminals L1, L2 and L3, respectively.



### ■ Power connection terminal and cable

The product does not come with a power cable. It must be prepared by the user.

- |                                  |   |
|----------------------------------|---|
| Applicable crimp terminal:       | Round crimp terminal with insulation cover        |
| Thread size of terminal:         | M3.5  |
| Tightening torque:               | 1.0 N·m (142 oz-in)                               |
| Applicable lead wire:            | AWG18 to 14 (0.75 to 2.0 mm <sup>2</sup> )*       |
|                                  | * BLFD200A2 type is AWG14 (2.0 mm <sup>2</sup> ). |
| Temperature rating of lead wire: | 60 °C, 60 or 75 °C, or 75 °C                      |
|                                  | (140 °F, 140 or 167 °F, or 167 °F)                |
| Conductive material:             | Use only copper wire.                             |

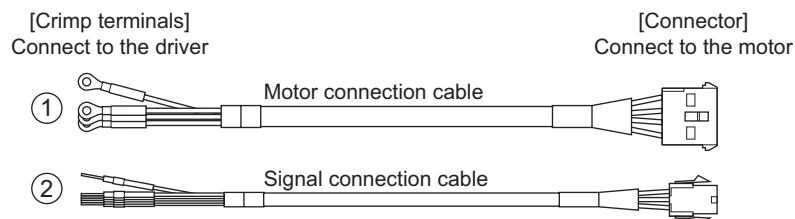




## 6.2 Connecting the motor

Connect the motor and driver using dedicated connection cable (sold separately).

Each connection cable has a connector attached on one end and crimp terminals on the other. Connect the connector end of each cable to the motor cable or signal cable, and the crimp terminals to the applicable connection terminals on the driver.



1	Crimp terminals on the motor connection cable	NICHIFU Co., Ltd. TMEN2-3.5S (3 pcs.) NICHIFU Co., Ltd. TMEN2-4M (1 pc.)*
2	Crimp terminals on the signal connection cable	NICHIFU Co., Ltd. TMENTC-0.3-9.5 (6 pcs.)

\* Not provided on cables of 10 to 20 m (32.8 to 65.6 ft.) in length.

The driver-connection end of each connection cable has color-coded lead wires with a crimp terminal attached on each wire. The connecting terminal is different for a different lead wire color, so connect the terminals correctly.

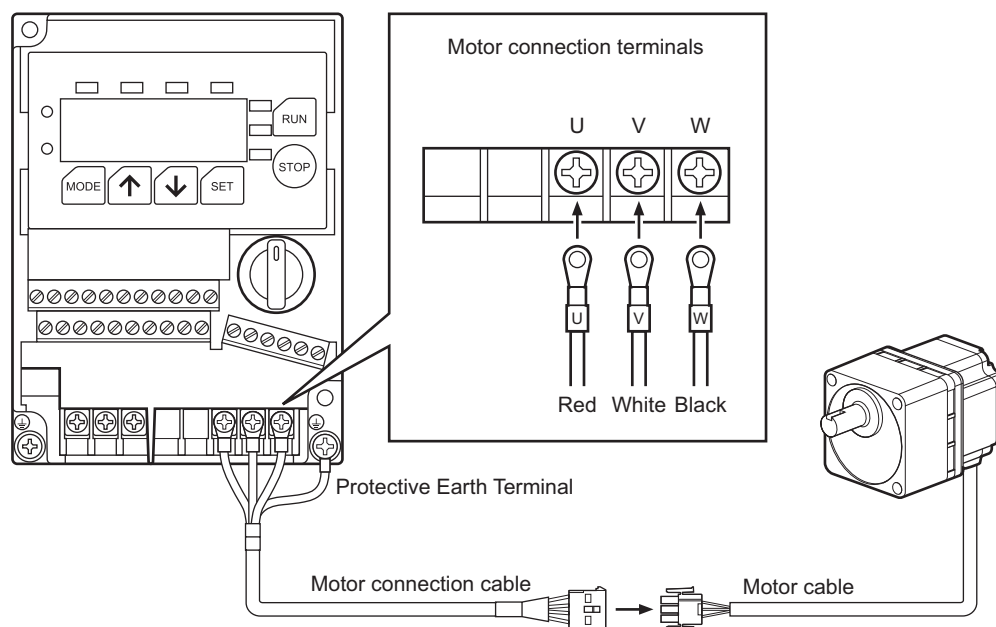
### Note

- Be sure to use the dedicated connection cable (sold separately).
- Securely connect the connectors and crimp terminals. Improper connection may cause the motor or driver to malfunction or sustain damage.

### Motor connection cable

Connect the motor connection cable to the motor connection terminals.

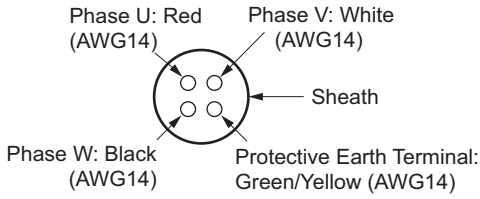
Tightening torque: 0.8 to 1.0 N·m (113.6 to 142 oz-in)



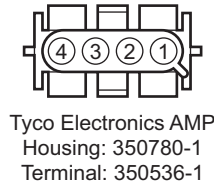
Driver terminal name	U	V	W	Protective Earth Terminal*
Lead color	Red	White	Black	Green/Yellow
Signal name	Motor phase U	Motor phase V	Motor phase W	PE
Connector pin No.	3	2	1	4

\* The Protective Earth Terminal (green/yellow) is not provided on cables of 10 to 20 m (32.8 to 65.6 ft.) in length.

- Section view of the motor connection cable



- Connector on the motor connection cable

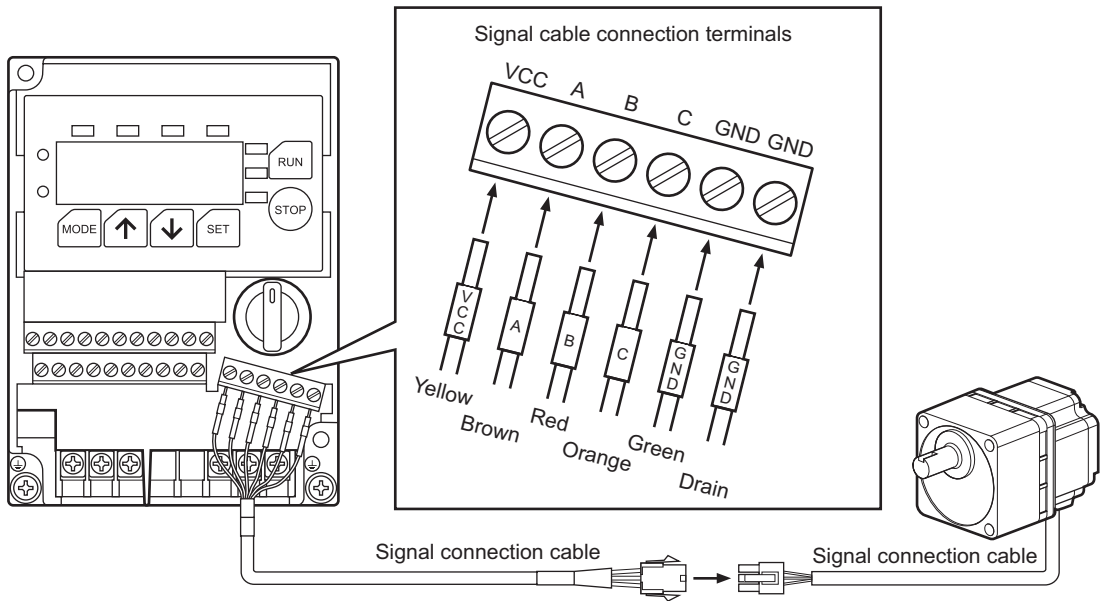


- Connector on the motor cable



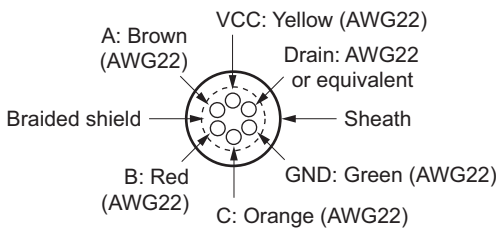
### ■ Signal connection cable

Install the terminal block cover and then connect the signal cable to the signal cable connection terminals.  
Tightening torque: 0.5 to 0.6 N·m (71 to 85.2 oz-in)

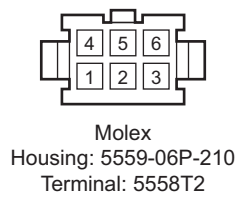


Driver terminal name	VCC	A	B	C	GND	GND
Lead color	Yellow	Brown	Red	Orange	Green	-
Signal name	Sensor power	Signal input A	Signal input B	Signal input C	GND	Drain
Connector pin No.	4	1	5	2	6	3

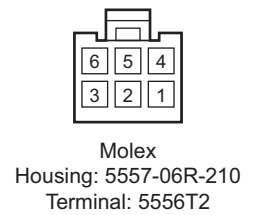
- Section view of the signal connection cable



- Connector on the signal connection cable



- Connector on the signal cable



## 6.3 Grounding

Provide ground connections from the motor and driver.

The grounding method of the motor will vary depending on the length of connection cables. Ground the motor correctly in accordance with the figures below.

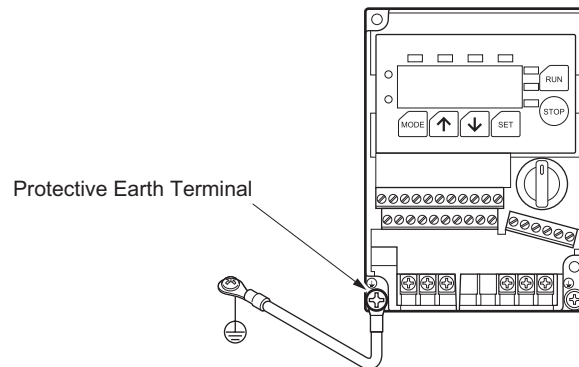
### ■ Grounding the driver

Connect the Protective Earth Terminal (M4) at the bottom left of the driver to the ground near the driver.

The driver does not come with a ground cable. Use a cable of AWG18 to 14 ( $0.75$  to  $2.0 \text{ mm}^2$ )\* and securely affix the cable using a round crimp terminal with insulation cover.

\* **BLFD200A2** type is AWG14 ( $2.0 \text{ mm}^2$ ).

Do not share the ground cable with a welder or power equipment. Also, minimize the wiring length of the ground cable.



#### • Ground terminal and cable

Applicable crimp terminal: Round crimp terminal with insulation cover

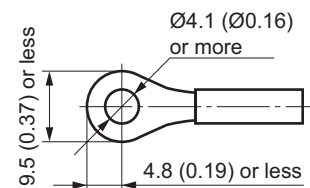
Thread size of terminal: M4

Tightening torque:  $0.8$  to  $1.0 \text{ N}\cdot\text{m}$  ( $113.6$  to  $142 \text{ oz}\cdot\text{in}$ )

Applicable lead wire: AWG18 to 14 ( $0.75$  to  $2.0 \text{ mm}^2$ )\*

\* **BLFD200A2** type is AWG14 ( $2.0 \text{ mm}^2$ ).

Unit: mm (in.)



### ■ Grounding the motor [connection cable length: 1 to 7 m (3.28 to 23 ft.)]

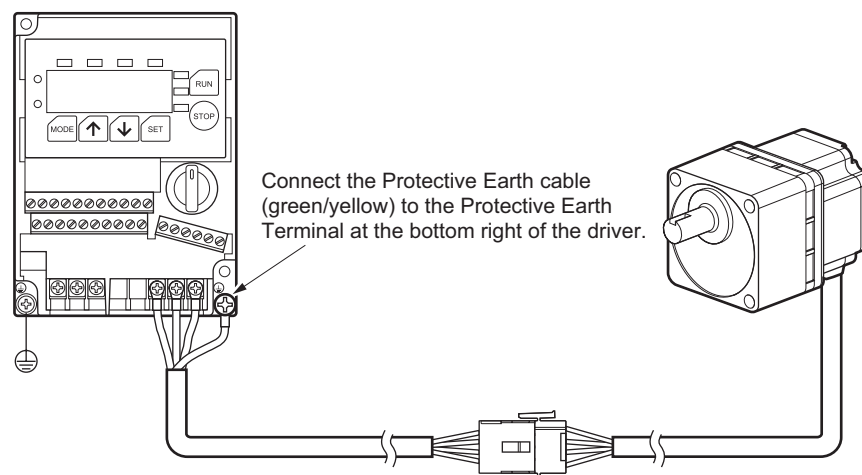
The motor can be grounded in two ways: by using the Protective Earth Terminal on the driver or using the Protective Earth Terminal on the motor.

#### • Using the Protective Earth Terminal on the driver

Connect the Protective Earth cable (green/yellow) of the motor connection cable to the Protective Earth Terminal at the bottom right of the driver.

Tightening torque:  $0.8$  to  $1.0 \text{ N}\cdot\text{m}$  ( $113.6$  to  $142 \text{ oz}\cdot\text{in}$ )

**Note** Do not connect anything to the Protective Earth Terminal on the motor.



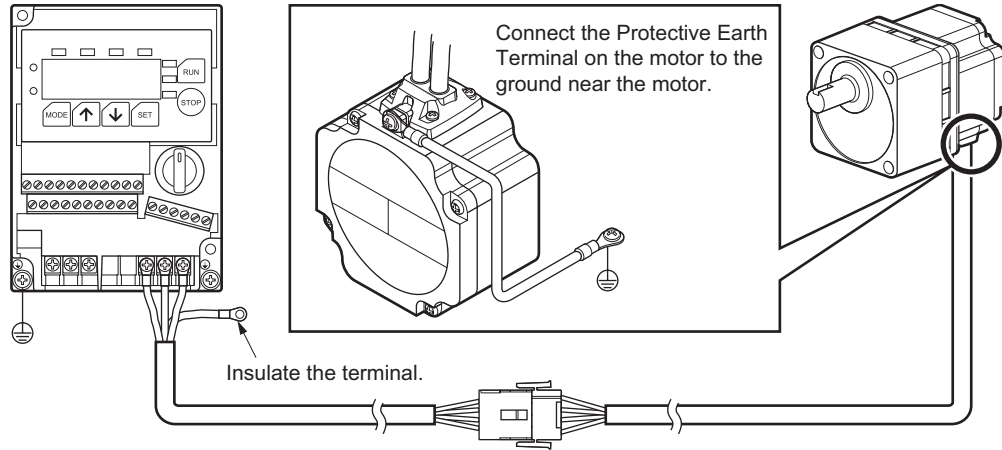
• Using the Protective Earth Terminal on the motor

Connect the Protective Earth Terminal on the motor to the ground near the motor. Minimize the wiring length of the ground cable.

Tightening torque: 0.8 to 1.0 N·m (113.6 to 142 oz-in)

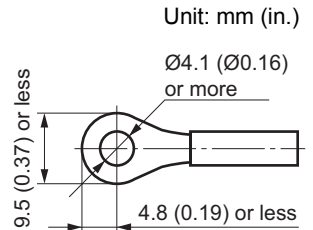
**Note**

When making a ground connection using the Protective Earth Terminal on the motor, do not use the Protective Earth cable (green/yellow) of the motor connection cable. Also, be sure to insulate the Protective Earth cable (green/yellow) of the motor connection cable.



• Ground terminal and cable

- Applicable crimp terminal: Round crimp terminal with insulation cover
- Thread size of terminal: M4
- Tightening torque: 0.8 to 1.0 N·m (113.6 to 142 oz-in)
- Applicable lead wire: AWG18 to 14 (0.75 to 2.0 mm<sup>2</sup>)

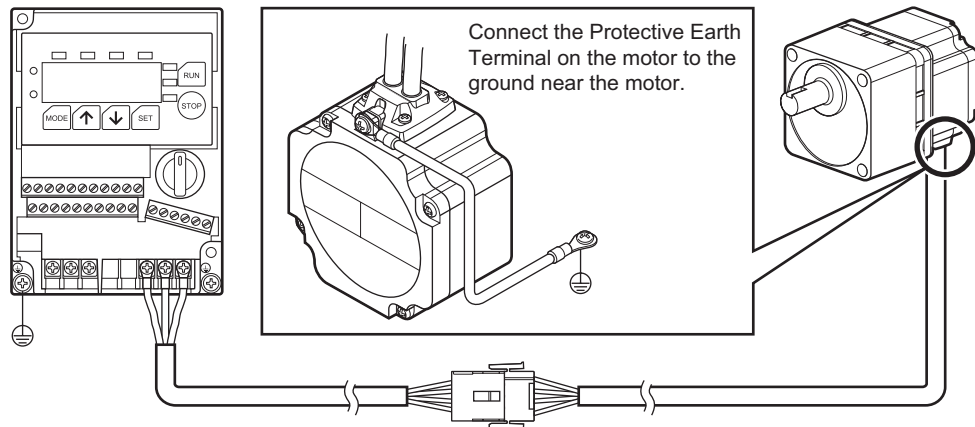


■ Grounding the motor [connection cable length: 10 to 20 m (32.8 to 65.6 ft.)]

Connect the Protective Earth Terminal on the motor to the ground near the motor. Minimize the wiring length of the ground cable.

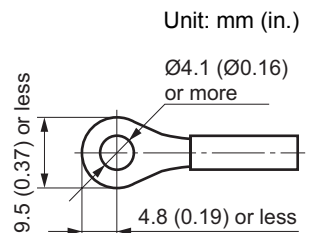
Tightening torque: 0.8 to 1.0 N·m (113.6 to 142 oz-in)

Unlike the connection cables of 1 to 7 m (3.28 to 23 ft.) in length, the 10 to 20 m (32.8 to 65.6 ft.) long motor connection cables do not have a Protective Earth Terminal.



• Ground terminal and cable

- Applicable crimp terminal: Round crimp terminal with insulation cover
- Thread size of terminal: M4
- Tightening torque: 0.8 to 1.0 N·m (113.6 to 142 oz-in)
- Applicable lead wire: AWG18 to 14 (0.75 to 2.0 mm<sup>2</sup>)

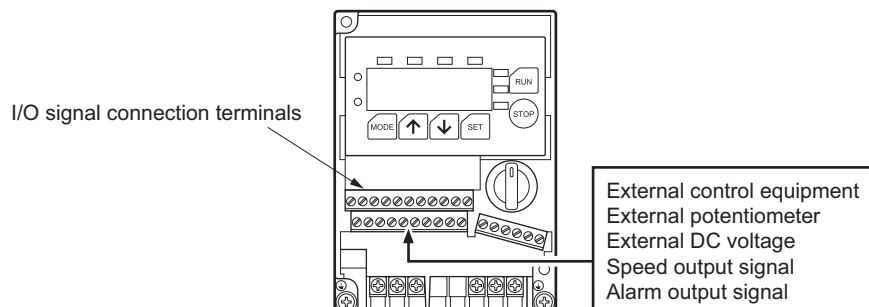


## 6.4 Connecting external I/O signals

Connect external I/O signals in the following applications:

- Connect a programmable controller or other external control equipment
- Change the speed using an external potentiometer or external DC voltage
- Output a speed output signal or alarm output signal

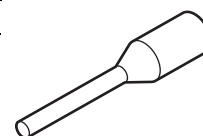
Tightening torque: 0.5 to 0.6 N·m (71 to 85.2 oz-in)



If crimp terminals are used, select the following terminals.

Manufacturer	Model	Applicable cable size
PHOENIX CONTACT GmbH & Co. KG	AI 0.25-6	AWG26 to 24 (0.14 to 0.2 mm <sup>2</sup> )
	AI 0.34-6	AWG22 (0.3 mm <sup>2</sup> )

Crimp terminal  
(bar terminal)



### ■ External input signals

External input signals must be set in accordance with the desired application.

Perform the various settings specified below using the digital operator.

Application	Necessary settings
Use input signals connected to terminals X1, X2 and X3	Switch the operation-signal input method to “external input signals” on the digital operator (p.68)
Use an external potentiometer Use external DC voltage	<ul style="list-style-type: none"> <li>• Select “external potentiometer” for operation data No.2 (p.52).</li> <li>• Short terminals M0 and C0.</li> </ul>

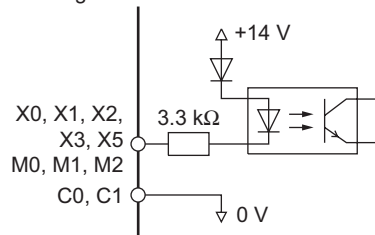
#### • Internal input circuit

The initial mode is sink logic. Switch between sink logic and source logic according to the external control equipment to be used (p.74).

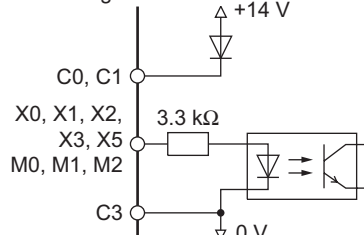
Different connection methods are used depending on whether control is implemented using relays and other contact switches or using transistors and other non-contact switches. Provide appropriate connection according to the external control equipment to be used.

The driver’s input signals are photocoupler inputs. The signal status does not indicate the voltage level of the signal, but it represents the “ON (current flow)” or “OFF (no current flow)” status of the internal photocoupler.

Sink logic



Source logic



X0: EXT-ERROR input  
X1: CW input  
X2: CCW input  
X3: STOP-MODE input  
X5: ALARM-RESET input

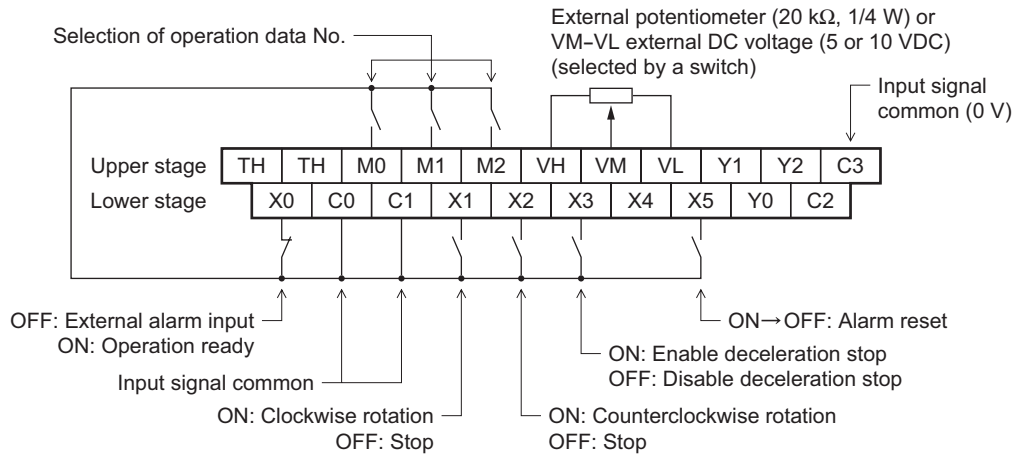
• Input signal connection terminals

Connect the input signals according to the operation method or speed setting method of your system.

Terminal position	Terminal name	Signal name	Description	Necessary settings
Lower stage	X0	EXT-ERROR input *1	External alarm input (normally closed)	Remove the short bar and connect an external control equipment.
	C0	IN-COM0	Input signal common	
	C1	IN-COM0	Input signal common	-
	X1	CW input *2	Clockwise rotation	Set the operation-signal input method to "external input signals" on the digital operator.
	X2	CCW input *2	Counterclockwise rotation	
	X3	STOP-MODE input *2	Selection of motor stop action	
	X4	NC	Not connected.	-
	X5	ALARM-RESET input	Alarm reset	-
Upper stage	TH	NC	Not connected.	-
	TH	NC	Not connected.	-
	M0	M0 input	Operation data selection for multi-speed operation Eight types of operation data can be selected by a combination of ON/OFF statuses of M0, M1 and M2 inputs.	-
	M1	M1 input		-
	M2	M2 input		-
	VH	VH input	Speed setting using an external potentiometer or external DC voltage	<ul style="list-style-type: none"> <li>• Select "external potentiometer" for operation data No.2.</li> <li>• Short M0 and C0.</li> </ul>
	VM	VM input		
	VL	VL input		
	C3	IN-COM1	Input signal common (0 V)	-

\*1 Do not remove the short bar if the EXT-ERROR input is not used.

\*2 Assuming the 3-wire input mode: p.72



\* Do not connect anything to TH and X4.

## External output signals

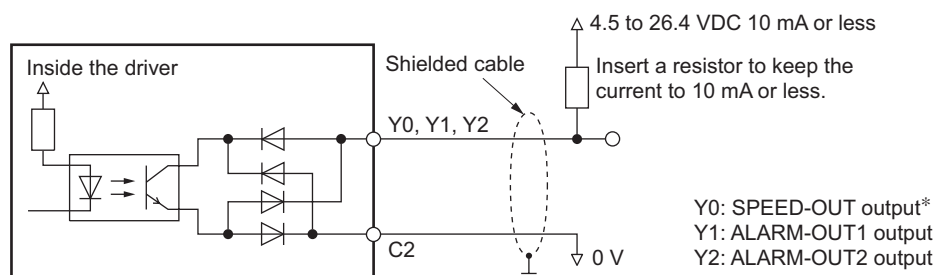
The output signals can also be used when the motor is operated from the digital operator.

To use terminal Y2 as an overload warning function, perform the necessary setting by referring to 10.1 “Setting the overload warning function” on p.78.

### Internal output circuit

The initial mode is sink logic. Switch between sink logic and source logic according to the external control equipment to be used (p.74). The driver’s output signals are transistor open-collector outputs.

The signal status does not indicate the voltage level of the signal, but it represents the “ON (current flow)” or “OFF (no current flow)” status of the internal photocoupler. The ON voltage of the output circuit is approx. 1.5 V. Exercise caution when driving other elements using the output circuit.

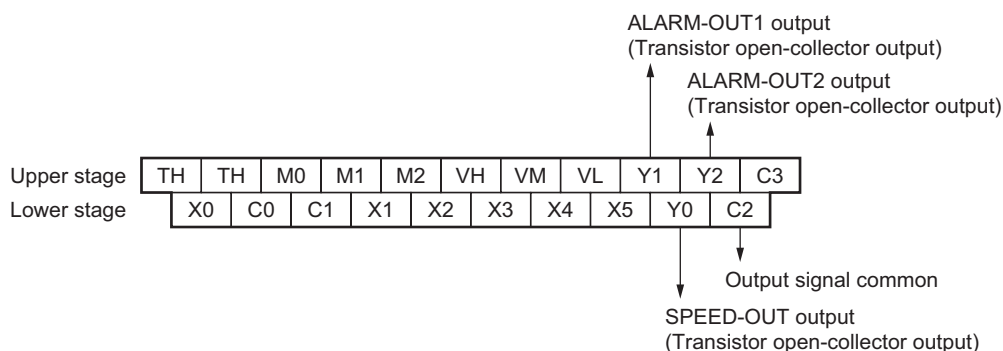


\* Adjust the current flowing to the SPEED-OUT output terminal to 5 mA or more.

### Output signal connection terminals

Connect the output signals according to the operation method or speed setting method of your system.

Terminal position	Terminal name	Signal name	Description	Necessary settings
Upper stage	Y1	ALARM-OUT1 output	This signal is output when an alarm has generated (normally closed).	-
	Y2	ALARM-OUT2 output	This signal is output when the overload protection or overload warning function has activated (normally closed).	Overload warning function
Lower stage	Y0	SPEED-OUT output	30 pulses are output per each revolution of the motor output shaft.	-
	C2	OUT-COM	Output signal common	-

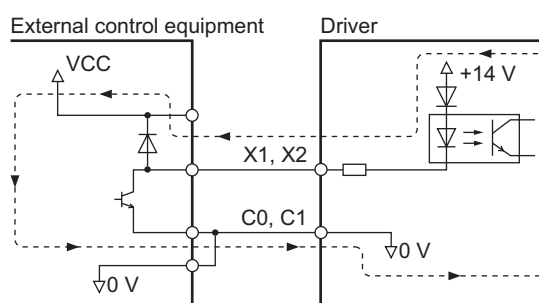


## Using a controller with a built-in clamp diode

If a controller with a built-in clamp diode is used, a sneak path may form and cause the motor to operate even when the controller power is off, as long as the driver power is on. Since the power capacity of the controller is different from that of the driver, the motor may operate when the controller and driver powers are turned on or off simultaneously.

When powering up, turn on the controller power first, followed by the driver power.

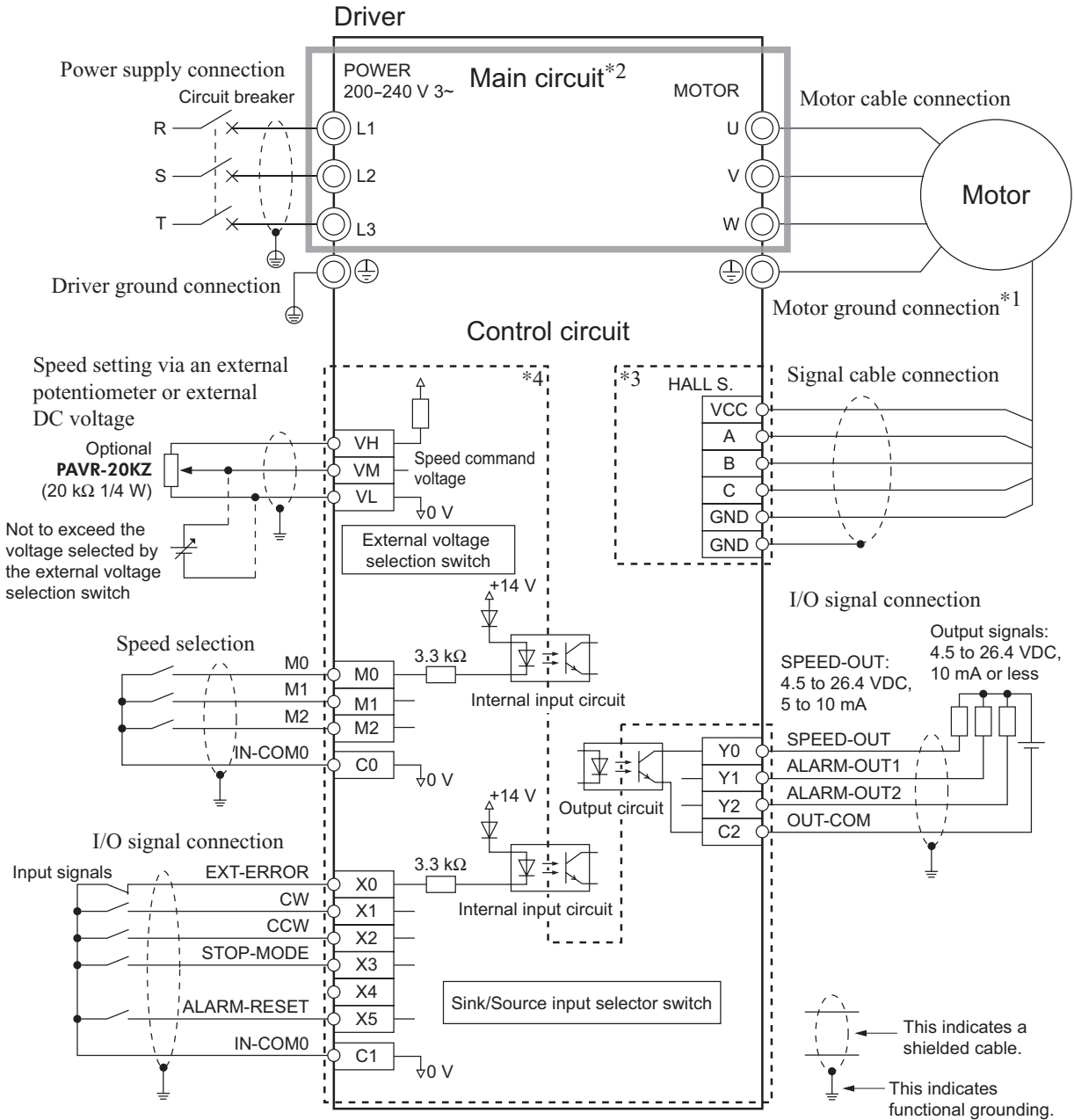
When powering down, turn off the driver power first, followed by the controller power.



## 6.5 Connection example

### ■ Sink logic: When the sink/source input selector switch is set to the SINK side

The connection example described below assumes that the motor is operated using a three-phase 200-240 V power supply along with contact switches such as relays and switches.



\*1 The grounding method will vary depending on the length of connection cables. For details, refer to 6.3 “Grounding” on p.35.

Connection cable length of 7 m (23 ft.) or shorter: Connect the Protective Earth cable (green/yellow) on each connection cable to the Protective Earth Terminal on the driver.

Connection cable length of 10 m (32.8 ft.) or longer: Connect the motor’s Protective Earth Terminal directly to earth, without using the Protective Earth Terminal on the driver.

\*2 The main circuit is isolated for protection purpose, in order to prevent electric shock due to an accidental contact.

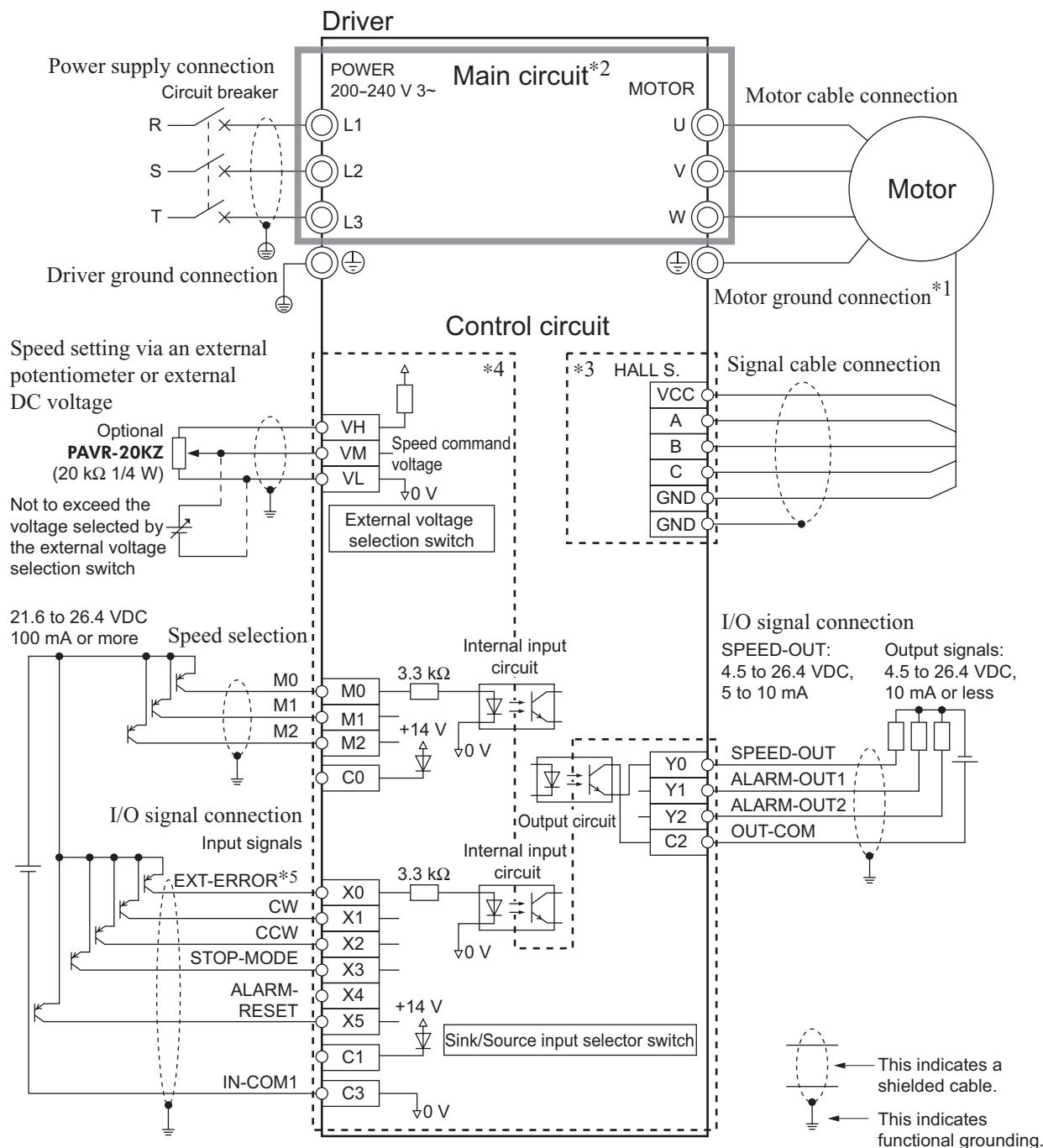
\*3 The signal-cable connection terminals and the signal cables including shielded cables form an ELV circuit. This circuit is isolated from dangerous voltages by way of basic insulation alone. Connect the shielded cable (drain) to the ground point specified in the connection diagram, not to a Protective Earth Terminal.

\*4 The I/O signal connection terminals form a SELV circuit. This circuit is isolated from dangerous voltages by way of double insulation or reinforced insulation.



## ■ Source logic: When the sink/source input selector switch is set to the SOURCE side

The connection example described below assumes that the motor is operated using a three-phase 200-240 V power supply based on sequence connection using transistors.



\*1 The grounding method will vary depending on the length of connection cables. For details, refer to 6.3 "Grounding" on p.35.

Connection cable length of 7 m (23 ft.) or shorter: Connect the Protective Earth cable (green/yellow) on each connection cable to the Protective Earth Terminal on the driver.

Connection cable length of 10 m (32.8 ft.) or longer: Connect the motor's Protective Earth Terminal directly to earth, without using the Protective Earth Terminal on the driver.

\*2 The main circuit is isolated for protection purpose, in order to prevent electric shock due to an accidental contact.








\*3 The signal-cable connection terminals and the signal cables including shielded cables form an ELV circuit. This circuit is isolated from dangerous voltages by way of basic insulation alone. Connect the shielded cable (drain) to the ground point specified in the connection diagram, not to a Protective Earth Terminal.

\*4 The I/O signal connection terminals form a SELV circuit. This circuit is isolated from dangerous voltages by way of double insulation or reinforced insulation.

\*5 X0 is an external error input. When this signal turns OFF, an alarm will be output.


# 7 Operation

This chapter gives an overview of operation using the digital operator.

**Note** In this operating manual, the digital operator keys are sometimes indicated in  .  
 Example:  ,  ,  ,  ,  , 

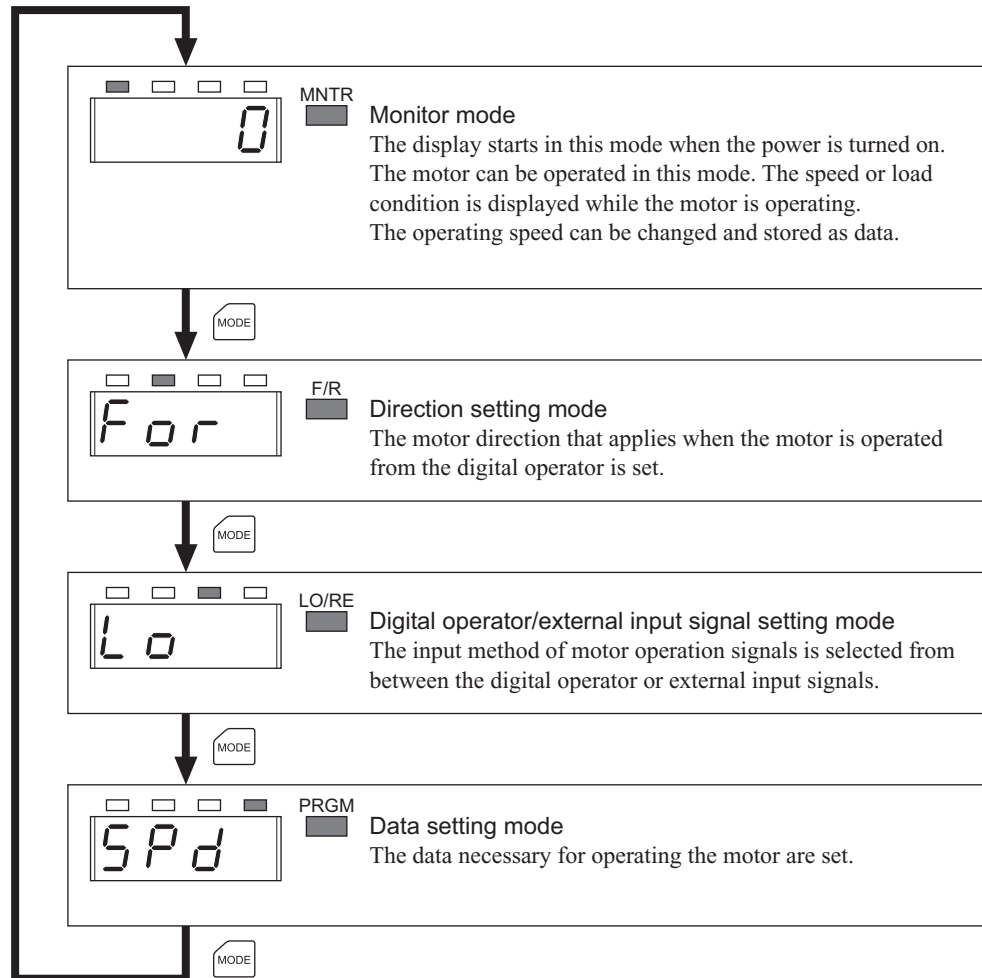
## 7.1 Switching the operation mode

The necessary settings to operate the motor are performed on the digital operator.

The digital operator has four operation modes that can be switched by pressing  .

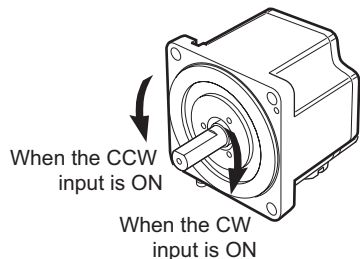
Switching to a given operation mode will illuminate the corresponding LED (green).

**Note** The motor is operated in the monitor mode. It cannot be operated in any other mode.



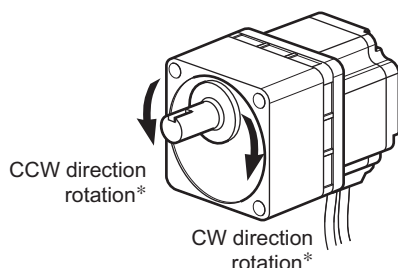
## 7.2 Rotating direction of the motor output shaft

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

- Combination type parallel shaft gearhead



Unit model	Ratio	
	Same direction as the motor	Opposite direction to the motor
<b>BLF230</b> <b>BLF460</b> <b>BLF5120</b>	<b>5 to 20, 200</b>	<b>30 to 100</b>
<b>BLF6200</b> <b>BLF6400</b>	<b>5 to 20, 100, 200</b>	<b>30, 50</b>

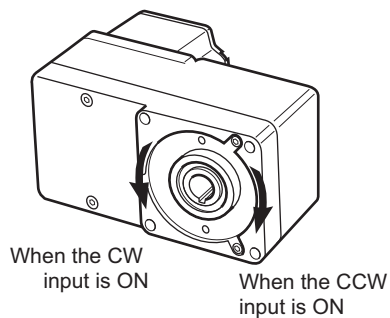
\* The rotating direction when the CW input or CCW input is ON varies depending on the gear ratio.

- Combination type hollow shaft flat gearhead

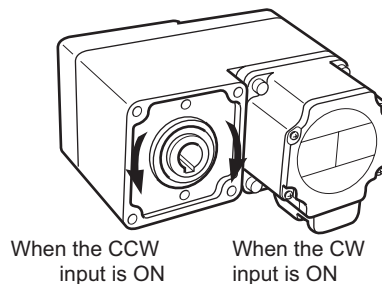
At all gear ratios, the output shaft turns in the opposite direction to the motor as viewed from the front of the gearhead.

The direction is different depending on whether the motor/gearhead assembly is viewed from the front side or rear side. Check the correct direction using the illustrations below.

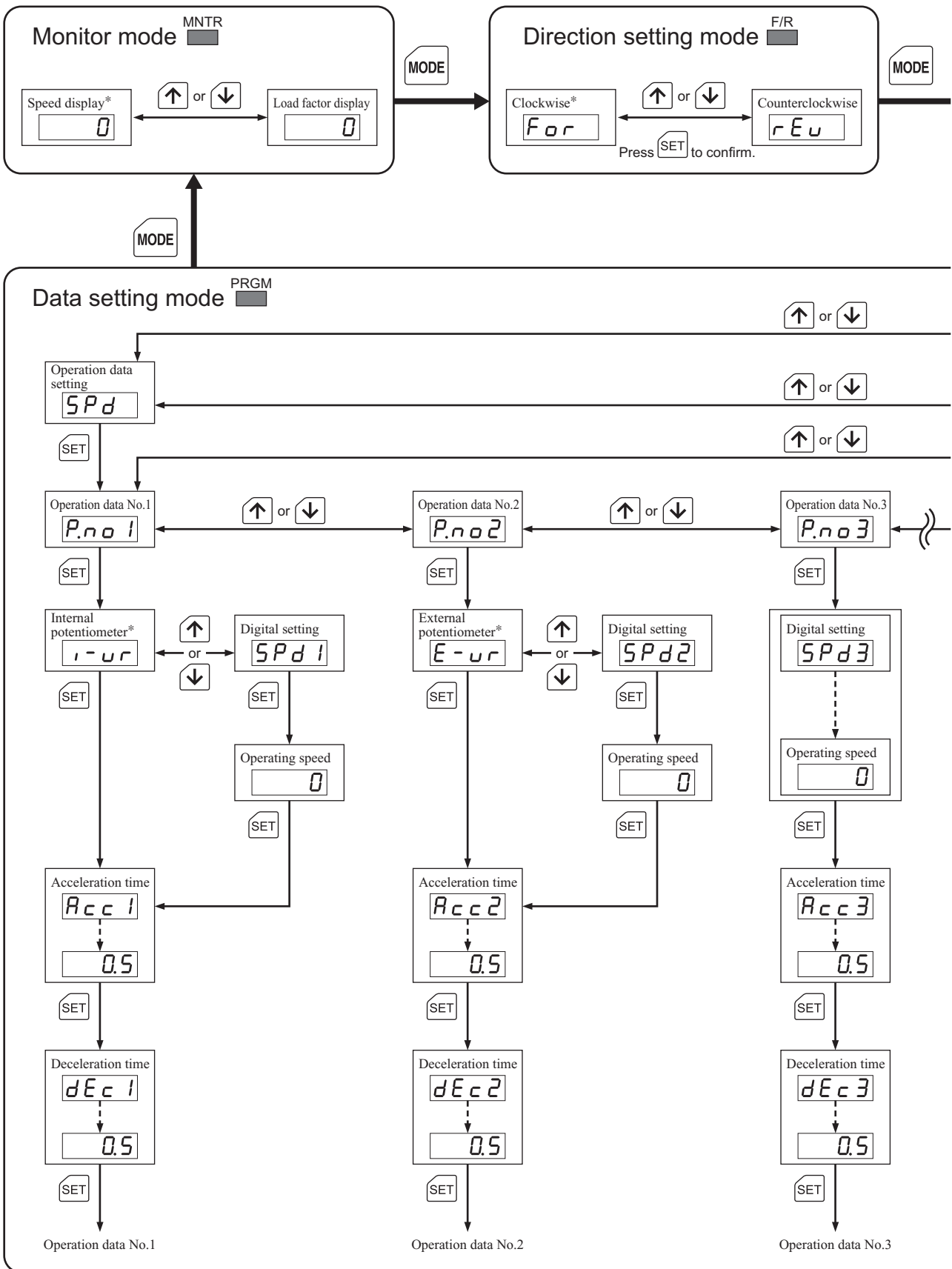
- Viewed from Front



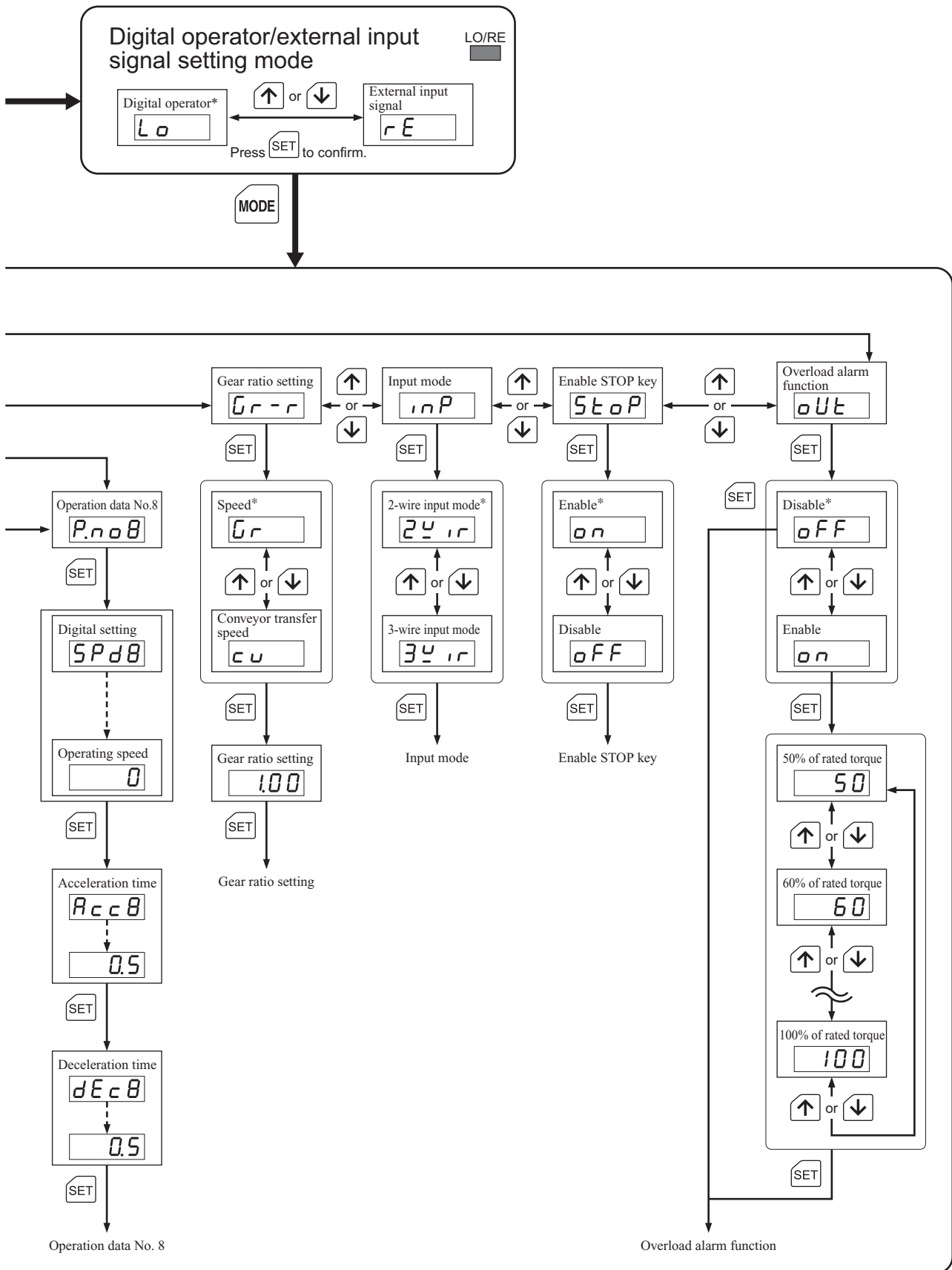
- Viewed from Rear



### 7.3 Operation mode transition



\* Initial setting: 9.13 "Initializing data" (p.77)

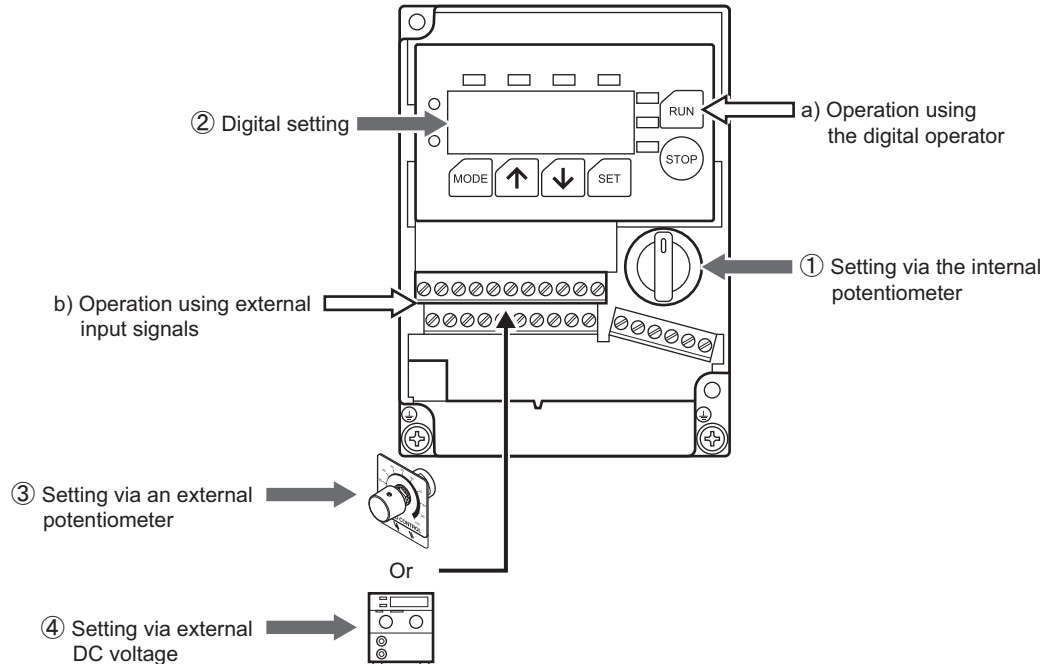


# 8 Basic operations

This chapter explains the basic operations of the motor.

## 8.1 Operation method

The **BLF** series supports four speed setting methods (① to ④) and two operation methods (a and b). Combine these methods to operate your system in an optimal manner.



### ■ Operation method

a) Operation using  ,  on the digital operator

Set the digital operator/external input signal setting mode to “digital operator.”

b) Operation using external input signals

Set the digital operator/external input signal setting mode to “external input signals.”

### ■ Speed setting method

① Setting via the internal potentiometer

You can set the speed easily by simply turning the internal potentiometer.

② Digital setting

You can set the speed easily on the digital operator. A desired speed can be set in increments of 1 r/min.

③ Setting via an external potentiometer

You can set the speed by connecting an optional external potentiometer **PAVR-20KZ** (sold separately).

④ Setting via external DC voltage

You can set the speed by connecting DC voltage.

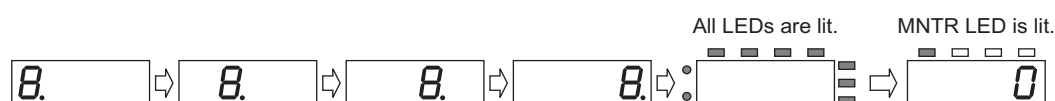
The following operations are explained in this operating manual. For the combinations not covered by the manual (those denoted by \*), refer to the pages of the corresponding speed setting method or operation method and follow the same procedures.

Speed setting method \ Operation method	①Internal potentiometer	②Digital setting	③External potentiometer	④External DC voltage
a) Digital operator	p.47	p.49	p.52	p.52
b) External input signals	*	p.55	*	*

## 8.2 Initial display after power on

When the driver power is turned on, the display will power up and show the following sequence. The driver is functioning correctly when this display sequence is followed.

It takes approx. 2 seconds before the MNTR LED illuminates and “0” is displayed. During this period no key operations are accepted. Operate the keys after confirming “0.”



## 8.3 Speed setting via the internal potentiometer

The speed is set via the internal potentiometer and the motor is operated using the digital operator.

### 1. Turn on the power.

### 2. Set the motor direction.

The initial setting is “For” (clockwise).

1. Press **MODE** to switch to the direction setting mode.

The F/R LED will illuminate.

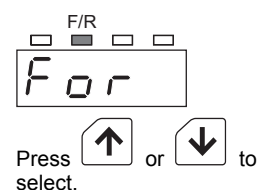
2. Press **↑** or **↓** to select a desired direction.

For: Clockwise

rEv: Counterclockwise

3. Press **SET** to confirm the selection.

The display will blink.



### 3. Set the operation method to “digital operator.”

The initial setting is “Lo” (digital operator).

1. Press **MODE** to switch to the digital operator/external input signal setting mode.

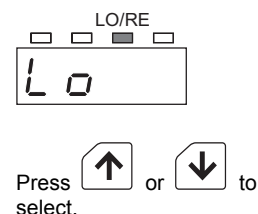
The LO/RE LED will illuminate.

2. Press **↑** or **↓** to select “Lo” (digital operator).

The LO/RE LED will illuminate.

3. Press **SET** to confirm the selection.

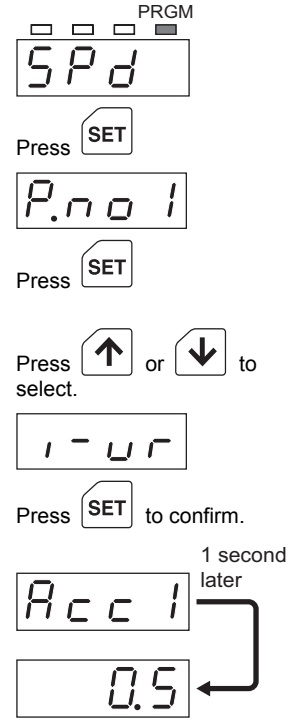
The display will blink.



#### 4. Set to “internal potentiometer” for operation data.

The initial setting is “i-vr” (internal potentiometer).

1. Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
2. Press **SET**.  
“P.no1” will be displayed.
3. Press **SET** again.  
The speed setting method will be displayed.
4. Press **↑** or **↓** to select “i-vr” (internal potentiometer).
5. Press **SET** to confirm.  
The display will blink and show “Acc1”, after which the acceleration time will be displayed.

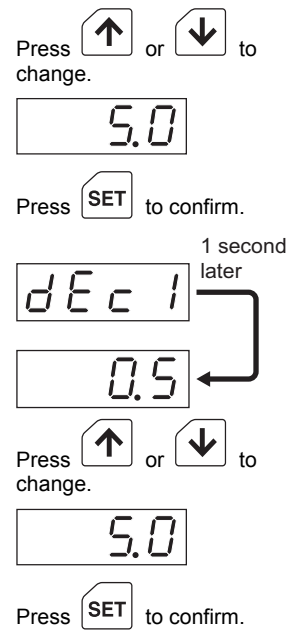


#### 5. Set the acceleration time and deceleration time after step 4.

The initial settings are both “0.5” (0.5 second). You can set desired acceleration time and deceleration time in increments of 0.1 second in the range of 0.2 to 15 seconds.

The acceleration time and deceleration time are set based on the rated speed (3000 r/min). If a speed other than the rated speed is set, a discrepancy will occur between the displayed/specified time and the actual time. Check in 9.8 “Setting the acceleration time and deceleration time” on p.69.

1. Press **↑** or **↓** to change the acceleration time (e.g., 5.0).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
2. After the acceleration time has been changed, press **SET** to confirm the new setting.  
The display will blink and show “dEc1”, after which the deceleration time will be displayed.
3. Press **↑** or **↓** to change the deceleration time (e.g., 5.0).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
4. After the deceleration time has been changed, press **SET** to confirm the new setting.  
The display will blink and show “P.no1.”
5. Press **MODE** to switch to the monitor mode.





## 6. Operate the motor and adjust the speed.

1. Press **RUN** on the digital operator.  
The RUN LED will illuminate.
2. Adjust the speed using the internal potentiometer.  
Turning the internal potentiometer clockwise will start the motor and display the speed.

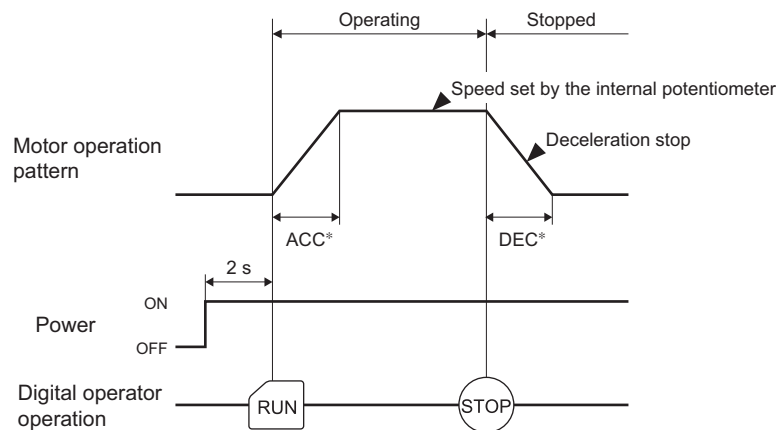


## 7. Stop the motor.

Press **STOP** on the digital operator. The motor will stop in the specified deceleration time.

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

### ■ Timing chart



\* The actual acceleration/deceleration time will vary depending on the specified speed and load condition (p.69).

## 8.4 Digital speed setting

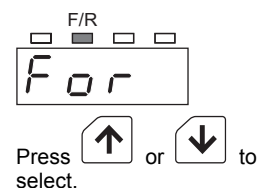
The speed is set digitally and the motor is operated using the digital operator.

### 1. Turn on the power.

### 2. Set the motor direction.

The initial setting is "For" (clockwise).

1. Press **MODE** to switch to the direction setting mode.  
The F/R LED will illuminate.
2. Press **↑** or **↓** to select a desired direction.  
For: Clockwise  
rEv: Counterclockwise
3. Press **SET** to confirm the selection.  
The display will blink.

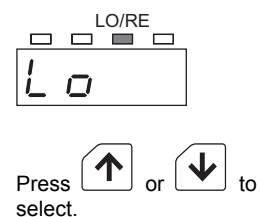


Press **SET** to confirm.

### 3. Set the operation method to "digital operator."

The initial setting is "Lo" (digital operator).

1. Press **MODE** to switch to the digital operator/external input signal setting mode.  
The LO/RE LED will illuminate.
2. Press **↑** or **↓** to select "Lo" (digital operator).



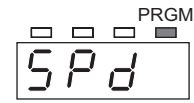
3. Press **SET** to confirm the selection.  
The display will blink.

Press **SET** to confirm.

#### 4. Set the speed in operation data No.1

The initial setting is "0" (0 r/min).

1. Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and "SPd" will be displayed.
2. Press **SET**.  
"P.no1" (operation data No.1) will be displayed.
3. Press **SET** again.  
The speed setting method will be displayed.
4. Press **↑** or **↓** to select "SPd1" (digital setting).
5. Press **SET**.  
The current speed setting will be displayed.  
The initial setting is "0."
6. Press **↑** or **↓** to change the speed (e.g., 2000 r/min).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
7. After the speed has been changed, press **SET** to confirm the new setting.  
The display will blink and show "Acc1", after which the acceleration time will be displayed.

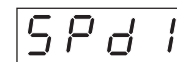


Press **SET**



Press **SET**

Press **↑** or **↓** to select.



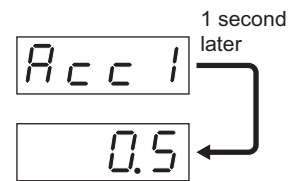
Press **SET**



Press **↑** or **↓** to change.



Press **SET** to confirm.



#### 5. Set the acceleration time and deceleration time after step 4.

The initial settings are both "0.5" (0.5 second). You can set desired acceleration time and deceleration time in increments of 0.1 second in the range of 0.2 to 15 seconds.

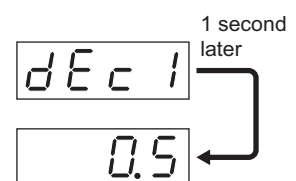
The acceleration time and deceleration time are set based on the rated speed (3000 r/min). If a speed other than the rated speed is set, a discrepancy will occur between the displayed/specified time and the actual time. Check in 9.8 "Setting the acceleration time and deceleration time" on p.69.

1. Press **↑** or **↓** to change the acceleration time (e.g., 5.0).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
2. After the acceleration time has been changed, press **SET** to confirm the new setting.  
The display will blink and show "dEc1", after which the deceleration time will be displayed.

Press **↑** or **↓** to change.



Press **SET** to confirm.



3. Press  or  to change the deceleration time (e.g., 5.0).

Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.

Press  or  to change.

4. After the deceleration time has been changed, press  to confirm the new setting.

The display will blink and show "P.no1."

Press  to confirm.

5. Press  to switch to the monitor mode.

## 6. Operate the motor and adjust the speed.

Press  on the digital operator.

The motor will start operating and the RUN LED will illuminate.

MNTN  
RUN     
○

## 7. Follow the procedure below if you want to change the motor speed while the motor is running.

1. While the motor is running, press  with the display showing the speed (e.g., 2000 r/min).

The MNTR LED will blink.

Press

MNTR

2. Press  or  to change the motor speed (e.g., 1000 r/min).

The speed will change while  or  is being pressed.

Press  or  to change.

3. After the speed has been changed, press  to confirm the new setting.

The display will blink and the new speed will be set digitally as the speed in operation No.1.

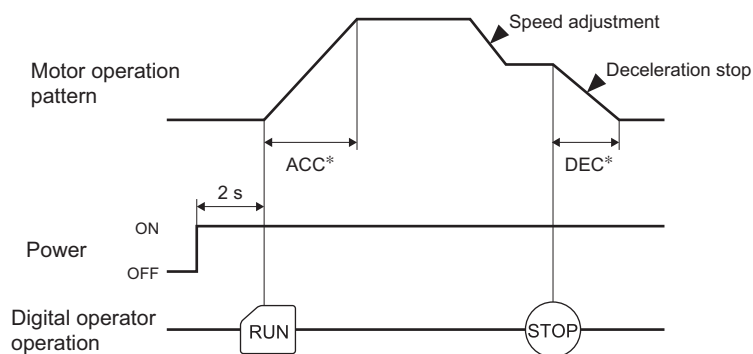
Press  to confirm.

## 8. Stop the motor.

Press  on the digital operator. The motor will stop in the specified deceleration time.

**Note** Once the motor stops, the output shaft will become free and the load will no longer be held.

### ■ Timing chart



\* The actual acceleration/deceleration time will vary depending on the specified speed and load condition (p.69).

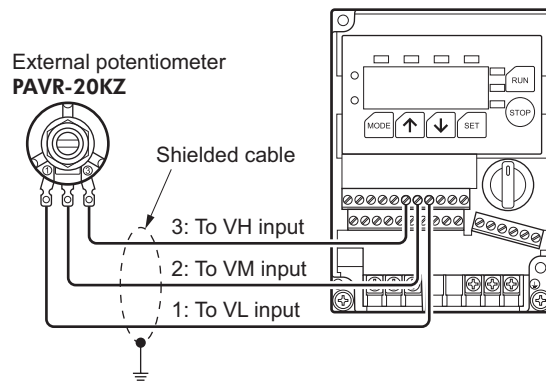
## 8.5 Speed setting via an external potentiometer (external DC voltage)

An optional external potentiometer **PAVR-20KZ** (sold separately) or external DC power supply is connected and the motor is operated using the digital operator. Refer to p.85 for the installation method of **PAVR-20KZ**.

1. Connect an optional external potentiometer **PAVR-20KZ** (sold separately) or external DC power supply to I/O signal connection terminals VH, VM and VL.

- External potentiometer

Connect an external potentiometer according to the table below.



External potentiometer terminal	Driver terminal
3	VH
2	VM
1	VL

**Note** Use a shielded cable to prevent the shielded wires from contacting other terminals.

- External DC voltage

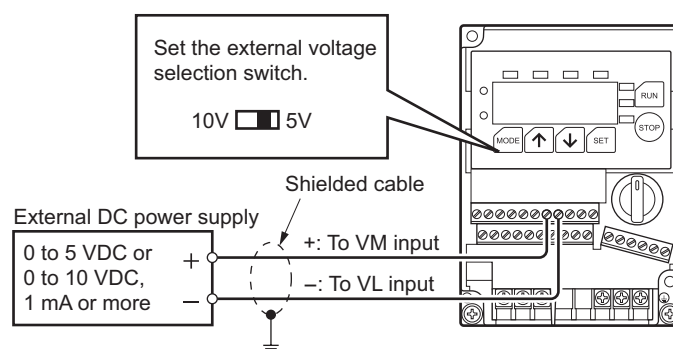
Set the external voltage selection switch on the driver according to the voltage of the external DC power supply. Remove the digital operator and switch the voltage to 5 or 10 V.

- Note**
- Be sure to set the external voltage selection switch according to the connected voltage. Impressing a voltage exceeding the value set by the external voltage selection switch may damage the driver.
  - Set the external voltage selection switch after turning off the power.

Use a DC power supply (5 or 10 VDC) with its primary and secondary circuits isolated by reinforced insulation.

The impedance between the VM and VL inputs is approx. 44 kΩ at both 5 V and 10 V.

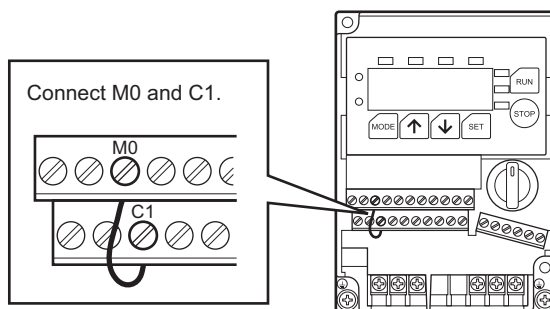
Connect the external DC power supply according to the table below.



Signal wire	Driver terminal
+	VM
-	VL

- Note**
- Connect the wires in the correct polarities. Connecting them in wrong polarities may damage the driver.
  - Use a shielded cable to prevent the shielded wires from contacting other terminals.

## 2. Connect I/O signal connection terminals M0 and C1.

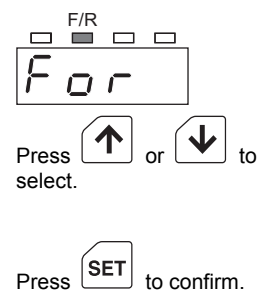


## 3. Turn on the power.

## 4. Set the motor direction.

The initial setting is “For” (clockwise).

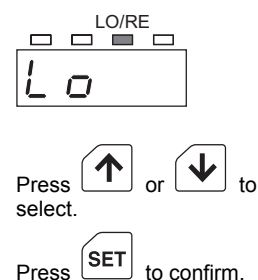
1. Press **MODE** to switch to the direction setting mode.  
The F/R LED will illuminate.
2. Press **↑** or **↓** to select a desired direction.  
For: Clockwise  
rEv: Counterclockwise
3. Press **SET** to confirm the selection.  
The display will blink.



## 5. Set the operation method to “digital operator.”

The initial setting is “Lo” (digital operator).

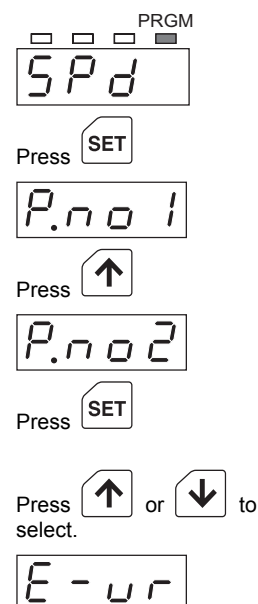
1. Press **MODE** to switch to the digital operator/external input signal setting mode.  
The LO/RE LED will illuminate.
2. Press **↑** or **↓** to select “Lo” (digital operator).
3. Press **SET** to confirm the selection.  
The display will blink.



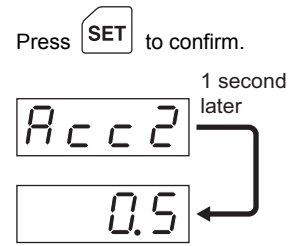
## 6. Set “external potentiometer” for operation data.

The initial setting is “E-vr” (external potentiometer).

1. Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
2. Press **SET**.  
“P.no1” will be displayed.
3. Press **↑**.  
“P.no2” will be displayed.
4. Press **SET**.  
The speed setting method will be displayed.
5. Press **↑** or **↓** to select “E-vr” (external potentiometer).



- Press **SET** to confirm the selection.  
The display will blink and show “Acc2”, after which the acceleration time will be displayed.

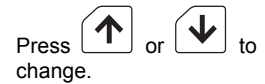


### 7. Set the acceleration time and deceleration time after step 6.

The initial settings are both “0.5” (0.5 second). You can set desired acceleration time and deceleration time in increments of 0.1 second in the range of 0.2 to 15 seconds.

The acceleration time and deceleration time are set based on the rated speed (3000 r/min). If a speed other than the rated speed is set, a discrepancy will occur between the displayed/specified time and the actual time. Check in 9.8 “Setting the acceleration time and deceleration time” on p.69.

- Press **↑** or **↓** to change the acceleration time.  
(e.g., 5.0)

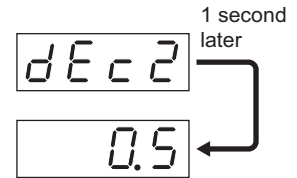


Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.

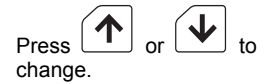
- After the acceleration time has been changed, press **SET** to confirm the new setting.



The display will blink and show “dEc2”, after which the deceleration time will be displayed.



- Press **↑** or **↓** to change the deceleration time.  
(e.g., 5.0)



Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.

- After the deceleration time has been changed, press **SET** to confirm the new setting.



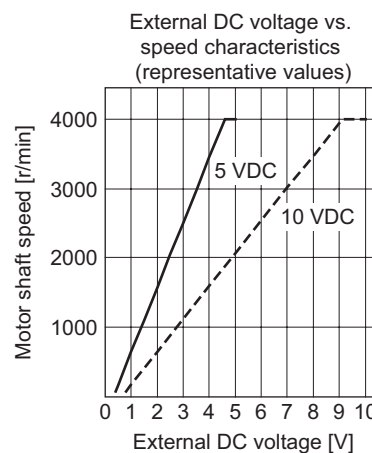
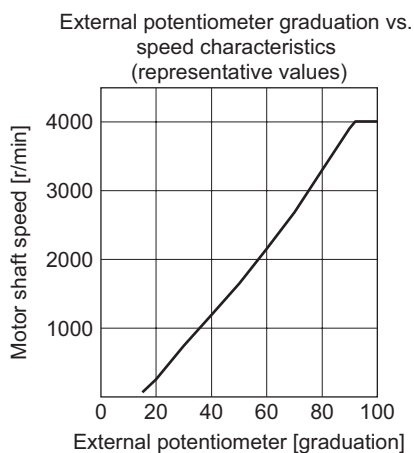
The display will blink and show “P.no2.”

- Press **MODE** to switch to the monitor mode.

### 8. Operate the motor and adjust the speed.

- Press **RUN** on the digital operator.  
The motor will start operating and the RUN LED will illuminate.

- Adjust the speed using the external potentiometer or external DC voltage.



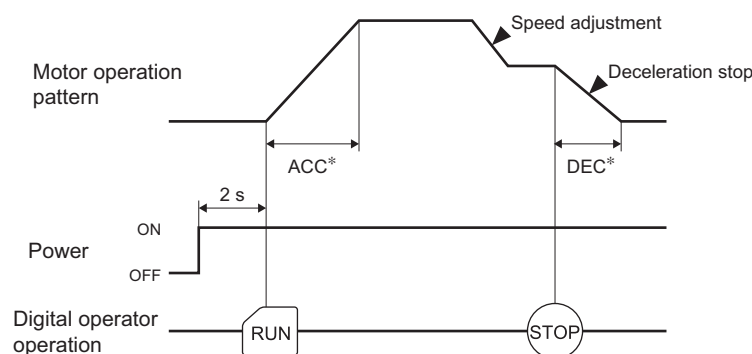
\* The above characteristics are representative values. Use them only as a reference when setting the speed.

## 9. Stop the motor.

Press **STOP** on the digital operator.

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

### ■ Timing chart



\* The actual acceleration/deceleration time will vary depending on the specified speed and load condition (p.69).

## 8.6 Operation using external input signals

The speed is set digitally and the motor is operated using external input signals.

### 1. Connect external input signals to the I/O signal connection terminals.

- M0, M1 and M2: M0, M1 and M2 inputs

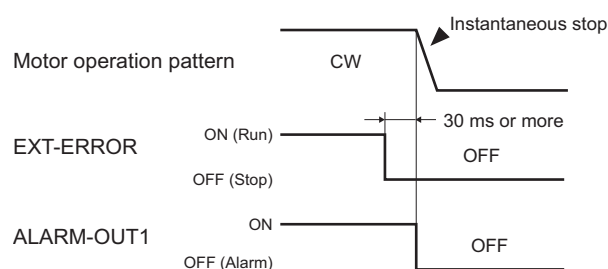
Combine the ON/OFF statuses of M0, M1 and M2 inputs to select a desired operation data. Up to eight speeds can be set (p.61).

- X0: EXT-ERROR input

This input is used to issue an external alarm signal (normally closed).

The motor runs when this signal is ON. When the signal turns OFF, the motor will stop instantaneously and the digital operator will show "AL6E."

A short bar is connected to this terminal at the factory. To connect a signal to the terminal, remove the short bar.



\* Turn OFF the EXT-ERROR input for 30 ms or more. If the OFF period is below 30 ms, the motor will not stop instantaneously.

**Note** | The EXT-ERROR input is not a signal to cut off the power. Do not use it as an emergency stop system.

- X1: CW input

This input is used to turn the motor clockwise.

The motor runs when this input is ON, and stops when it is OFF. If the STOP-MODE input is ON when this input turns OFF, the motor will stop in the specified deceleration time. If the STOP-MODE input is OFF, the motor will stop instantaneously.

The motor will also stop instantaneously if the CW and CCW inputs turn ON simultaneously.

The initial setting is 2-wire input. It can be switched to 3-wire input (switching the input mode: p.72).

• X2: CCW input

This input is used to turn the motor counterclockwise.

The motor runs when this input is ON, and stops when it is OFF. If the STOP-MODE input is ON when this input turns OFF, the motor will stop in the specified deceleration time. If the STOP-MODE input is OFF, the motor will stop instantaneously.

The motor will also stop instantaneously if the CCW and CW inputs turn ON simultaneously.

The initial setting is 2-wire input. It can be switched to 3-wire input (switching the input mode: p.72).

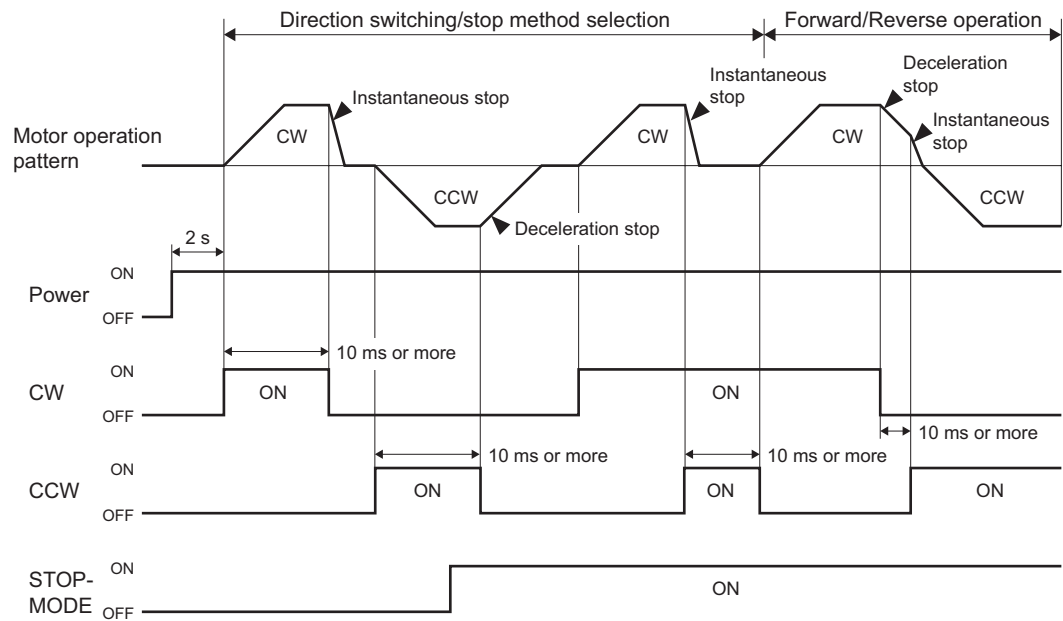
• X3: STOP-MODE input

If the STOP-MODE input is ON when the CW or CCW input is turned OFF to stop the motor, the motor will decelerate to a stop in the deceleration time set in the operation data. If the STOP-MODE input is OFF, the motor will stop instantaneously.

The initial setting is 2-wire input. It can be switched to 3-wire input (switching the input mode: p.72).

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

■ Timing chart



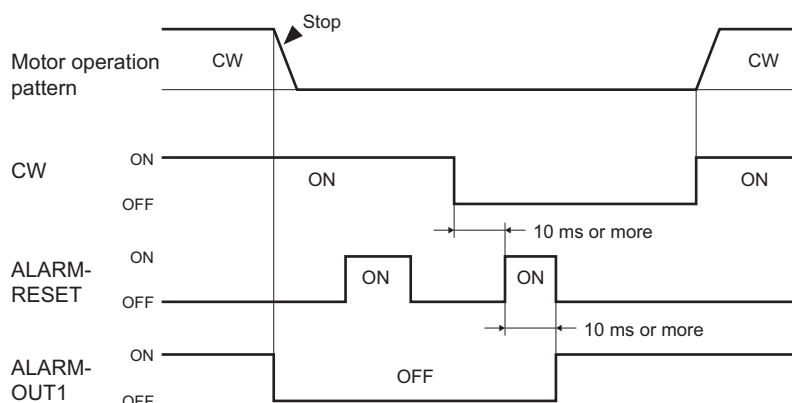


- X5:ALARM-RESET input

This input is used to reset the alarm generated by activation of the driver's protection function.

Turn OFF the ALARM-RESET input after turning OFF the CW and CCW inputs and confirming that the motor has stopped completely. If the CW or CCW input is ON, the ALARM-RESET input will not be accepted. The ALARM-RESET input is effective even when the motor is being operated using the digital operator.

**Note** Always input this signal after removing the cause of the alarm. Continuing to operate the motor without removing the cause of problem may damage the motor. Abnormal current protection (AL20), CPU error (AL29) and EEPROM error (AL41) alarms cannot be reset by the ALARM-RESET input.



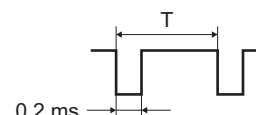
## 2. Connect external output signals to the I/O signal connection terminals.

- Y0:SPEED-OUT output

Pulse signals corresponding to 30 pulses (pulse width: 0.2 ms) are output per each revolution of the motor output shaft synchronously with the motor operation. The motor speed can be calculated by measuring the SPEED-OUT output frequency.

$$\text{SPEED-OUT output frequency (Hz)} = \frac{1}{T}$$

$$\text{Motor shaft speed (r/min)} = \frac{\text{SPEED-OUT output frequency}}{30} \times 60$$



- Y1:ALARM-OUT1 output

When the driver's protection function is activated, the ALARM-OUT1 output will turn OFF and a corresponding alarm code will be displayed on the digital operator. The motor will stop spontaneously.

To reset an alarm, be sure to turn OFF the CW and CCW inputs and remove the cause of the alarm before inputting the ALARM-RESET signal. If the alarm cannot be reset by the ALARM-RESET input, turn off the power, wait for at least 1 minute, and then turn the power back on.

- Y2:ALARM-OUT2 output

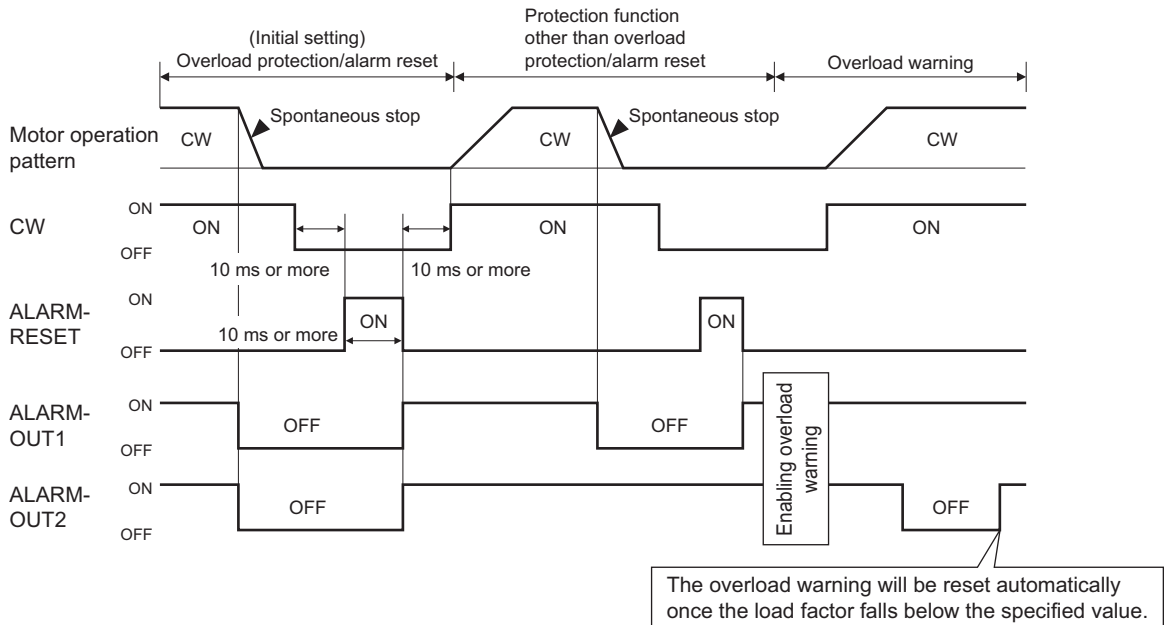
The ALARM-OUT2 output will turn OFF when the overload protection function or overload warning function activates. Activation of any other protection function will not turn OFF this output. Therefore, it is possible to identify the activated protection function as the overload protection function or not by detecting the ALARM-OUT2 output.

Type of protection function	ALARM-OUT1 output	ALARM-OUT2 output
Normal operation	ON	ON
Overload protection function	OFF	OFF
Other protection function	OFF	ON
Overload warning function	ON	OFF

It is also possible to enable the overload warning function so that a warning will be output before the overload protection function is activated. The overload warning function requires setting of a load factor with respect to the rated torque. If the load factor exceeds the specified value, the ALARM-OUT2 output will turn OFF. The output will turn ON automatically once the load factor falls below the specified value. Note that the digital operator will not show any alarm nor the motor will stop.

Refer to 10.1 “Setting the overload warning function” on p.78) for the overload warning function.

To reset the ALARM-OUT2 output, be sure to turn OFF the CW and CCW inputs and remove the cause of the alarm before inputting the ALARM-RESET signal. If the alarm cannot be reset by the ALARM-RESET input, turn off the power, wait for at least 1 minute, and then turn the power back on.



### 3. Turn on the power.

### 4. Set the operation method to “external input signals.”

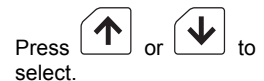
The initial setting is “Lo” (digital operator).

1. Press **MODE** to switch to the digital operator/external input signal setting mode.

The LO/RE LED will illuminate.



2. Press **↑** or **↓** to select “rE” (external input signals).



3. Press **SET** to confirm the selection.

The display will blink.

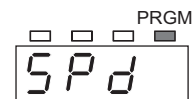


### 5. Set the speed in operation data No.1.

The initial setting is “0” (0 r/min).

1. Press **MODE** to switch to the data setting mode.

The PRGM LED will illuminate and “SPd” will be displayed.



2. Press **SET**.



“P.no1” (operation data No.1) will be displayed.





3. Press **SET** again.


The speed setting method will be displayed.



4. Press  or  to select “SPd1” (digital setting).

Press  or  to select.





5. Press .

The current speed setting will be displayed.

Press .




6. Press  or  to change the speed (e.g., 2000 r/min).

Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.



Press  or  to select.



7. After the speed has been changed, press  to confirm the new setting.

The display will blink and show “Acc1”, after which the acceleration time will be displayed.



Press  to confirm.

 1 second later  




## 6. Set the acceleration time and deceleration time after step 5.

The initial settings are both “0.5” (0.5 second). You can set desired acceleration time and deceleration time in increments of 0.1 second in the range of 0.2 to 15 seconds.


The acceleration time and deceleration time are set based on the rated speed (3000 r/min). If a speed other than the rated speed is set, a discrepancy will occur between the displayed/specified time and the actual time. Check in 9.8 “Setting the acceleration time and deceleration time” on p.69.

1. Press  or  to change the acceleration time. (e.g., 5.0)

Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.

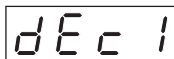

Press  or  to select.





2. After the acceleration time has been changed, press  to confirm the new setting.



The display will blink and show “dEc1”, after which the deceleration time will be displayed.

Press  to confirm.


 1 second later  


3. Press  or  to change the deceleration time. (e.g., 5.0)

Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.


Press  or  to select.



4. After the deceleration time has been changed, press  to confirm the new setting.

The display will blink and show “P.no1.”

Press  to confirm.

5. Press  to switch to the monitor mode.

## 7. Turn OFF the M0, M1 and M2 inputs to select operation data No.1.

Operation data	M0 input	M1 input	M2 input
No.1	OFF	OFF	OFF

## 8. Operate the motor and adjust the speed.

Turn ON the CW or CCW input. The motor will start operating and the RUN LED will illuminate.

## 9. Follow the procedure below if you want to change the motor speed.

1. While the motor is running, press **MODE** with the display showing the speed (e.g., 2000 r/min).  
The MNTR LED will blink.

Press **MODE**

MNTR

2. Press **↑** or **↓** to change the motor speed.  
(e.g., 1000 r/min)  
The speed will change while **↑** or **↓** is being pressed.

Press **↑** or **↓** to change.

3. After the speed has been changed, press **SET** to confirm the new setting.  
The display will blink and the new speed will be set digitally as the speed in operation No.1.

Press **SET** to confirm.

## 10. Stop the motor.

Turning OFF the input that was turned ON in step 8 will stop the motor instantaneously.  
Turning ON the STOP-MODE input and then turning OFF the input that was turned ON in step 8 will cause the motor to stop in the specified deceleration time.

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

## 8.7 Display when the power is turned off

When the power is turned off, how the display turns off varies depending on the model.

- **BLF230, BLF460, BLF5120**

After the driver power was turned off and the residual internal voltage has dropped to a safe level, the POWER LED and digital operator display turn off (within one minute).

- **BLF6200, BLF6400**

When the driver power is turned off, the POWER LED and digital operator display turn off immediately. Then, once the residual internal voltage has dropped to a safe level, the CHARGE LED turns off (within one minute).

# 9 Applied operations

The **BLF** series can be used in various ways to suit your system by combining basic operations and changing the driver settings.

## 9.1 Multi-speed operation

Multi-speed operation can be performed at up to eight speed levels by selecting operation data via the M0, M1 and M2 inputs.

Operation data No.1 allows for speed setting via the internal potentiometer or digital setting, while data No.2 allows for speed setting via an external potentiometer or digital setting.

Operation data	M0 input	M1 input	M2 input	Speed setting method
No.1	OFF	OFF	OFF	Internal potentiometer/digital setting
No.2	ON	OFF	OFF	External potentiometer/digital setting
No.3	OFF	ON	OFF	Digital setting
No.4	ON	ON	OFF	Digital setting
No.5	OFF	OFF	ON	Digital setting
No.6	ON	OFF	ON	Digital setting
No.7	OFF	ON	ON	Digital setting
No.8	ON	ON	ON	Digital setting

### ■ Operation method

Multi-speed operation can be performed using either the “digital operator” or “external input signals.”

However, the operation method must be switched to “external input signals” if you want to perform multi-speed operation with direction switching. The digital operator only allows you to switch the direction in the direction setting mode after stopping the motor. Refer to 9.7 “Switching the operation-signal input method” on p.68) for the switching of operation method.

Operation using external input signals can be performed in the 2-wire input mode (initial setting) or 3-wire input mode. Select an appropriate mode according to the specific condition of use, by referring to 9.10 “Setting the input mode” on p.72).





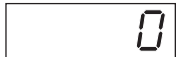



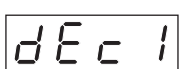

### ■ Speed setting method

Set the speed setting method by confirming the corresponding speed control method in Chapter 8 “Basic operations” on p.46.


- Internal potentiometer (p.47)
- External potentiometer, external DC voltage (p.52)
- Digital setting (p.49)


## ■ Setting operation data Nos.1 and 2 digitally

To set operation data Nos.1 and 2 digitally, the speed setting method must be switched to “digital setting.” The following explains how to set the speed in operation data No.1 digitally. Follow the same procedure to set operation data No.2.

1. Press **[MODE]** switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
 
2. Press **[SET]** .  
“P.no1” (operation data No.1) will be displayed.
 
3. Press **[SET]** .  
The speed setting method will be displayed.
 
4. Press **[↑]** or **[↓]** to select. “SPd1” (digital setting).
 
5. Press **[SET]** .  
The current speed setting will be displayed.
 
6. Press **[↑]** or **[↓]** to change the speed (e.g., 1000 r/min).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
 
7. After the speed has been changed, press **[SET]** to confirm the new setting.  
The display will blink and show “Acc1”, after which the acceleration time will be displayed.
 
8. Press **[↑]** or **[↓]** to change the acceleration time.  
(e.g., 5.0)  
You can set a desired acceleration time in increments of 0.1 second.  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.  
The actual acceleration/deceleration time will vary depending on the specified speed and load condition (p.69).
 
9. After the acceleration time has been changed, press **[SET]** to confirm the new setting.  
The display will blink and show “dEc1”, after which the deceleration time will be displayed.
 
10. Press **[↑]** or **[↓]** to change the deceleration time.  
(e.g., 5.0)  
You can set a desired deceleration time in increments of 0.1 second.  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.  
The actual acceleration/deceleration time will vary depending on the specified speed and load condition (p.69).
 

11. After the deceleration time has been changed, press **SET** to confirm the new setting.  
The display will blink and show "P.no1."  

Press **SET** to confirm.  

12. Press **↑** to switch to "P.no2" (operation data No.2).
13. Follow the same procedure just explained for operation data No.1 to set operation data No.2 digitally.  

Press **↑**  

14. When the digital setting of operation data No.2 is complete, press **MODE** to switch to the monitor mode.

### ■ Setting operation data Nos.3 to 8 digitally

Operation data Nos.3 to 8 can also be set digitally by following the same procedure.

Note that step 4 (setting of speed setting method) is not required. Pressing **↑** or **↓** when "P.no1" is displayed after step 11 will switch the operation data number.

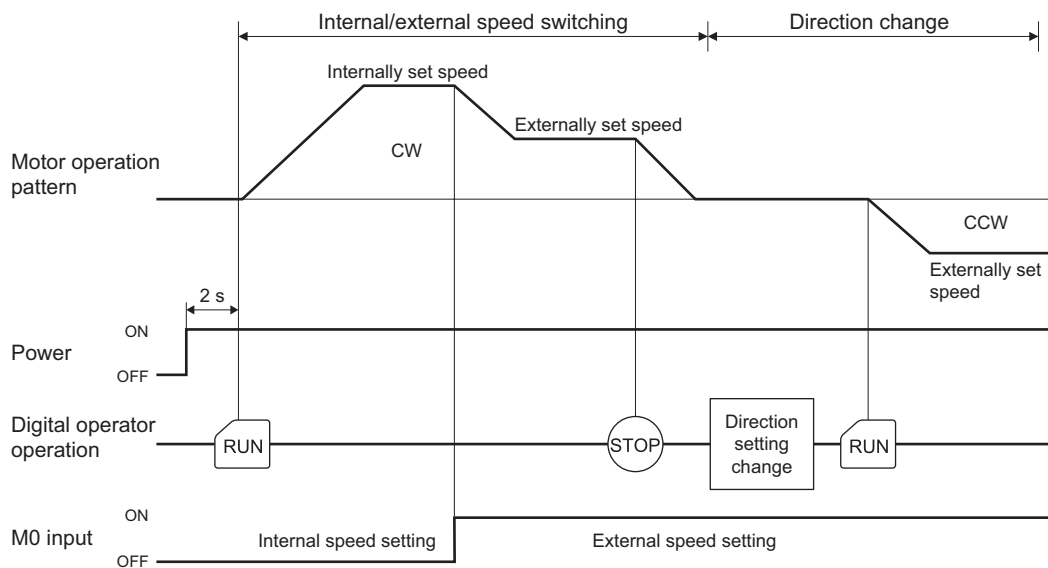
### ■ Double-speed operation using the internal potentiometer and external potentiometer

The following gives an example of switching between the internal potentiometer and external potentiometer in a digital operator operation. Perform the necessary settings and connections beforehand (p.47, 52).

You can operate the motor at the speed set by the internal potentiometer or external potentiometer by switching between operation data Nos.1 and 2 using the M0, M1 and M2 inputs and then pressing **RUN** on the digital operator.

The direction is set on the digital operator. To reverse the direction, stop the motor first and then change the direction.

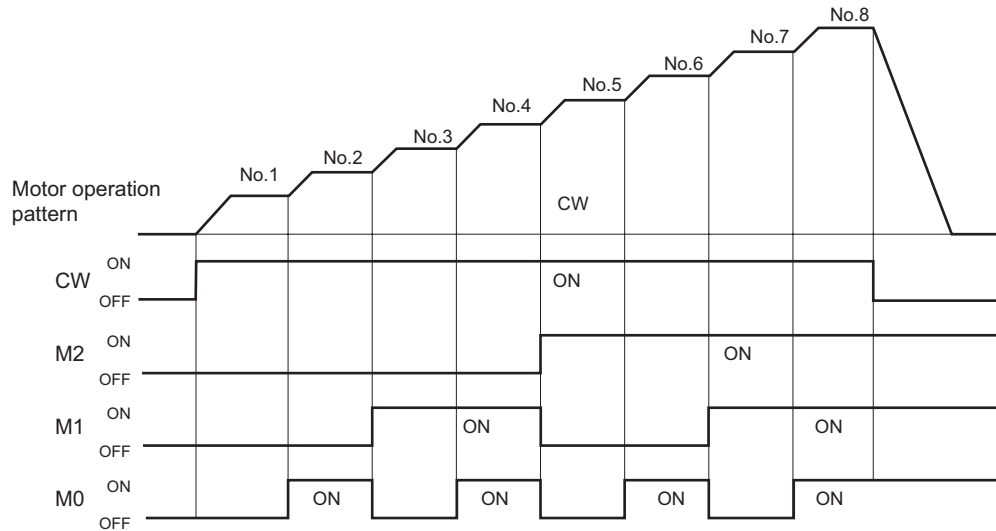
Operation data	M0 input	M1 input	M2 input	Speed setting method
No.1	OFF	OFF	OFF	Internal potentiometer
No.2	ON	OFF	OFF	External potentiometer



### ■ Eight-speed operation using digital setting

You can perform multi-speed operation at up to eight speed levels by setting desired operation data in operation data Nos.1 to 8. Perform the following settings by referring to the corresponding pages.

1. Connect the external I/O signals required for the operation and switch the operation method to “external input signals” (p.55).
2. Set the speeds in operation data Nos.1 and 2 digitally (p.62).
3. Set the speeds in operation data Nos.3 to 8 digitally in the same manner (p.63).
4. Switch the ON/OFF of M0, M1 and M2 inputs to select desired operation data (p.61).



## 9.2 Parallel operation

If two or more motors are to be operated at the same speed, they can be controlled from a single external potentiometer or external DC power supply. This type of operation is called “parallel operation.”

Parallel operation is achieved by allowing multiple drivers to share the power line and speed setting line.

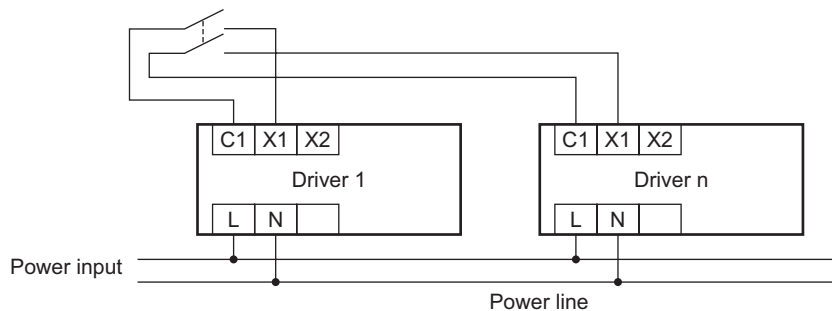
**Note**

- The connection examples explained here assume a single-phase specification. In the case of a three-phase specification, connect the power line to a three-phase power supply.
- Connect the external I/O signals to each driver.
- To perform parallel operation using an external potentiometer or external DC power supply, set the external voltage selection switch to either 5 or 10 VDC.

### ■ Using digital setting

Using the following installation layout to wire multiple drivers in which the same data are set digitally will allow the motors to be controlled using a single set of external input signals.

You can connect as many motors/drivers as desired.



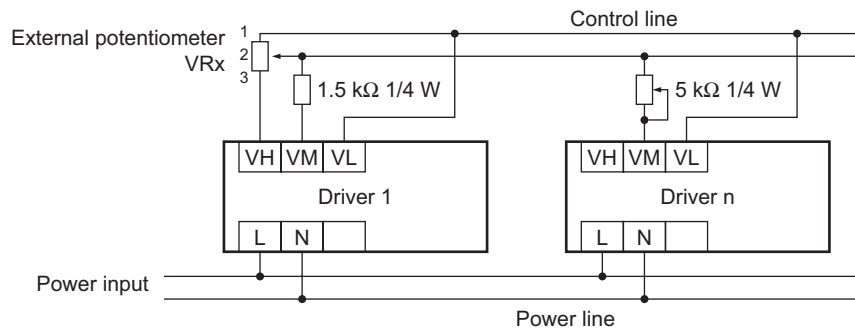
**Note**

Connect the digital operator to each driver. Motors not connected to the digital operator cannot be operated.



## ■ Using an external potentiometer

Wire the drivers as shown below.



If the number of drivers used is “n,” calculate resistance  $VR_x$  of the external potentiometer using the formula below:

$$\text{Resistance } VR_x = 20/n \text{ (k}\Omega\text{)}, n/4 \text{ (W)}$$

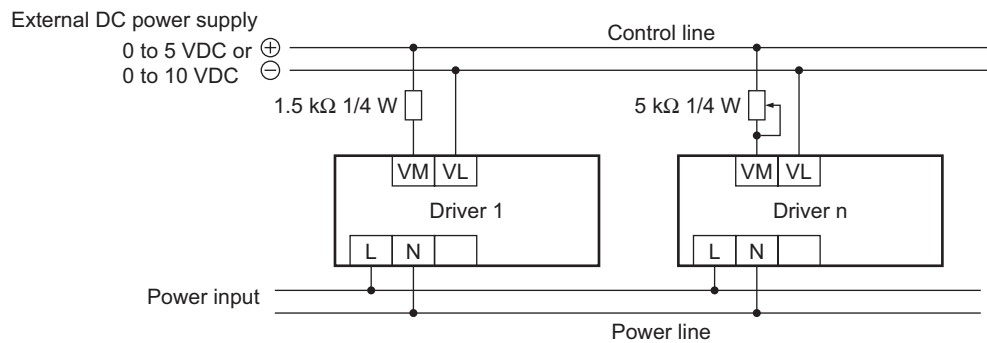
Example: If two drivers are used, resistance  $VR_x$  is calculated as 10 k $\Omega$ , 1/2 W (20/2 (k $\Omega$ ), 2/4 (W)).

If the speed will vary among the respective motors, make adjustments by connecting a resistor of 1.5 k $\Omega$ , 1/4 W to terminal M on driver 1 and connecting a variable resistor of 5 k $\Omega$ , 1/4 W to driver 2 and subsequent drivers.

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

## ■ Using external DC voltage

Wire the drivers as shown below.



If the number of drivers used is “n,” calculate the current capacity of the external DC power supply using the formula below:

$$\text{Current capacity } I = 1 \times n \text{ (mA)}$$

Example: If two drivers are used, current capacity  $I$  is calculated as 2 mA or more ( $1 \times 2$  (mA)).

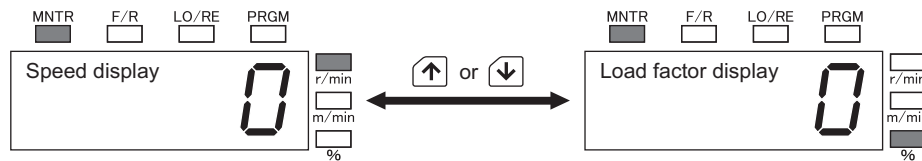
If the speed will vary among the respective motors, make adjustments by connecting a resistor of 1.5 k $\Omega$ , 1/4 W to terminal M on driver 1 and connecting a variable resistor of 5 k $\Omega$ , 1/4 W to driver 2 and subsequent drivers.

### 9.3 Switching the speed display and load factor display

You can switch the digital operator display mode between speed and load factor.

When the power is turned on, the digital operator will show the speed and the r/min LED will illuminate.

Pressing  $\uparrow$  or  $\downarrow$  will display the load factor and the % LED will illuminate.



The load factor refers to the percentage of the actual load (load applied to the motor output shaft, not to the gear output shaft) with respect to the rated torque. The load factor is 100% at the rated torque. Note the following points when the load factor display mode is selected.

#### ■ Difference from actual load

The load factor is calculated from the current flowing into the motor. Therefore, the calculated load factor is subject to error with respect to the load actually applied to the motor shaft. For example, a maximum error of 20% may occur at the rated speed and rated load.

For details on load characteristics, call our Tech Support Line.

#### ■ Display range of load factor

Load factors of 40% or below will not be displayed.

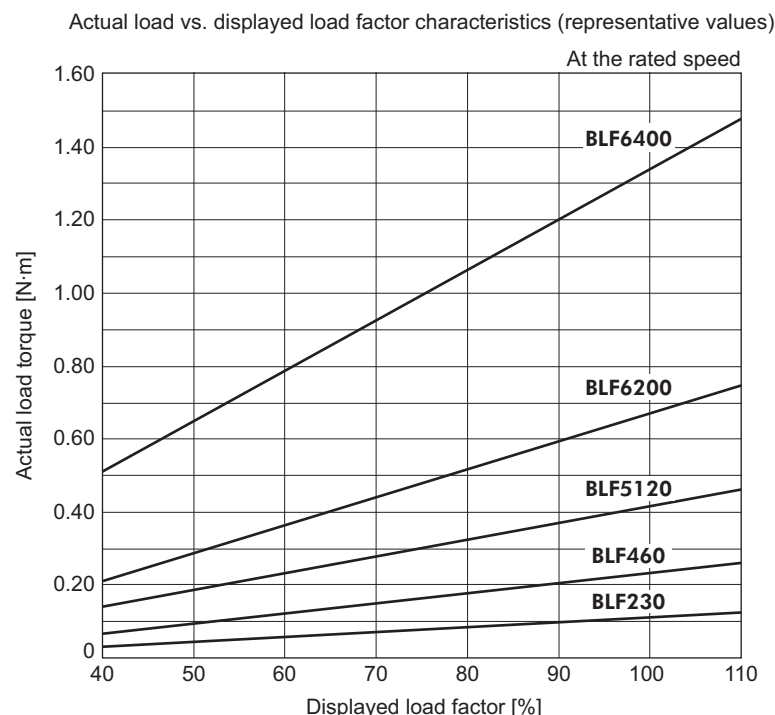


#### ■ Reference based on gearhead output shaft

In the load factor display mode, the gear ratio and gear transmission efficiency of the gearhead are not taken into consideration. Before use, confirm that the output shaft torque calculated per the formula below does not exceed the allowable torque.

If the gear ratio is 1:100 or more, the maximum allowable torque may be exceeded even when the load factor is not displayed.

$$\text{Rated motor torque (N}\cdot\text{m)} \times \text{Gear ratio} \times \frac{\text{Gear transmission efficiency}}{100} \times \frac{\text{Displayed value (\%)}}{100} < \text{Allowable torque at gearhead (N}\cdot\text{m)}$$



\* The above characteristics are representative values. Use them only as a reference when setting.

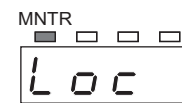
## 9.4 Digital operator key lock

Activating the key lock will disable the key operation on the digital operator.

If a key is pressed when the key lock is active, "Loc" will illuminate (indicating that the key lock is active).

1. Press **SET** for 3 seconds or more when the motor is stopped in the monitor mode.  
"Loc" will blink and the key operation will be disabled.

Press **SET** for 3 seconds or more.



2. To cancel the key lock, press **SET** for 3 seconds or more.  
"L.oFF" will blink and the key operation will be enabled.

Press **SET** for 3 seconds or more.



Even when the key lock is active, **STOP** remains enabled if the motor is in the digital operator mode. In the external input signal mode, **STOP** will be enabled only when the key is enabled by setting (p.74).

## 9.5 Teaching speed data

A speed set by the internal potentiometer, external potentiometer or external DC voltage can be written digitally.

In addition, digitally set speed data can be changed and written while the motor is running.

### ■ Internal potentiometer, external potentiometer or external DC voltage

1. While the motor is running, press **MODE** with the display showing the speed (e.g., 1000 r/min).  
The MNTR LED will blink.



Press **MODE**

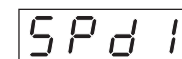


2. Change the motor speed using the internal potentiometer, etc. (e.g., 2000 r/min).  
This is the new speed to be written to operation data.



3. Press **SET**.  
"SPd1" will be displayed.

Press **SET**



4. Press **↑** or **↓** to select the operation data to write the current speed to (e.g., SPd2).

Press **↑** or **↓** to select.

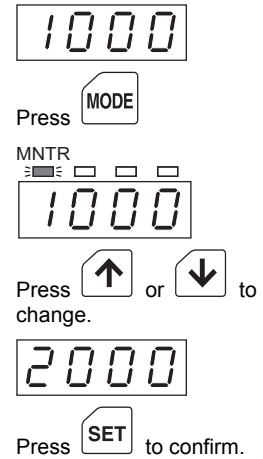


5. Press **SET**.  
The new speed will be set to the operation data digitally.

Press **SET** to confirm.

### ■ Speed data

1. While the motor is running, press **MODE** with the display showing the speed (e.g., 1000 r/min).  
The MNTR LED will blink.
2. Press **↑** or **↓** to change the motor speed.  
(e.g., 2000 r/min)  
The speed will change while **↑** or **↓** is being pressed.
3. After the speed has been changed, press **SET** to confirm the new setting.  
The new speed will be set to the current operation data digitally.



## 9.6 Switching the direction

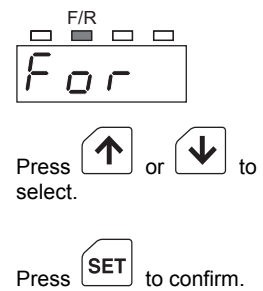
Set the motor direction that applies when the motor is operated using the digital operator.

The initial setting is “For” (clockwise).

The speed set here will become effective during operation using the digital operator. When the motor is operated using external input signals, switch the direction via external input signals.

**Note** Be sure to stop the motor before switching the direction.

1. While the motor is stopped, press **MODE** to switch to the direction setting mode.  
The F/R LED will illuminate.
2. Press **↑** or **↓** to select a desired direction.  
For: Clockwise  
rEv: Counterclockwise
3. Press **SET** to confirm the selection.  
The display will blink.



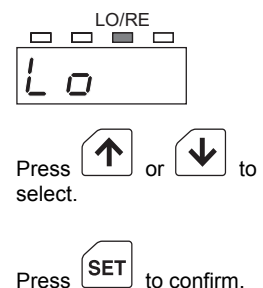
## 9.7 Switching the operation-signal input method

Switch the input method of operation signals between digital operator and external input signals.

Setting the input method to digital operator will let you start the motor by pressing **RUN** on the digital operator.

The initial setting is “Lo” (operation using the digital operator).

1. Press **MODE** to switch to the digital operator/external input signal setting mode.  
The LO/RE LED will illuminate.
2. Press **↑** or **↓** to select the operation method.  
Lo: Operation using the digital operator  
rE: Operation using external input signals
3. Press **SET** to confirm the selection.  
The display will blink.



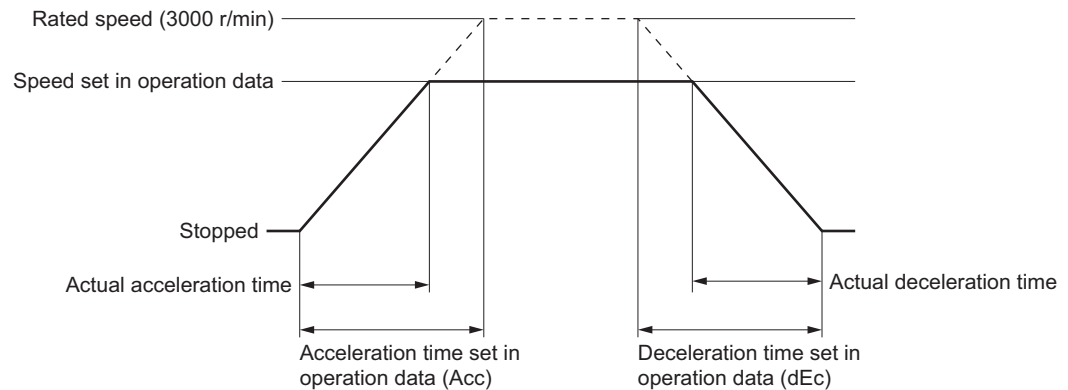
## 9.8 Setting the acceleration time and deceleration time

Set the acceleration time and deceleration time in operation data Nos.1 to 8.

The initial settings are both “0.5” (0.5 second). You can set desired acceleration time and deceleration time in increments of 0.1 second in the range of 0.2 to 15 seconds.

“Acceleration time” indicates the time required by the motor to reach the rated speed (3000 r/min) from a stopped condition.

“Deceleration time” indicates the time required by the motor to stop from the rated speed (3000 r/min).



As illustrated above, the actual acceleration time is different from the acceleration time set in operation data.

The acceleration time to be set can be calculated by the following formula:

$$\text{Acceleration time set in operation data} = \frac{\text{Rated speed (3000 r/min)}}{\text{Speed set in operation data}} \times \text{Actual acceleration time}$$

For example, if you want to accelerate the motor to 2000 r/min in 2 seconds, you should set “3.0” as the acceleration time based on the following calculation:

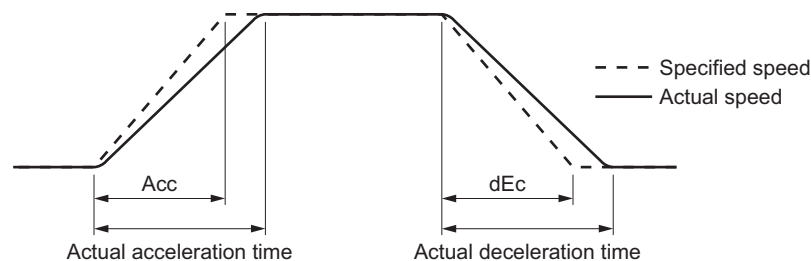
$$\begin{aligned} \text{Acceleration time set in operation data} &= \frac{3000 \text{ r/min}}{2000 \text{ r/min}} \times 2 \text{ seconds} \\ &= 3 \text{ seconds} \end{aligned}$$

Calculate the deceleration time in the same manner.

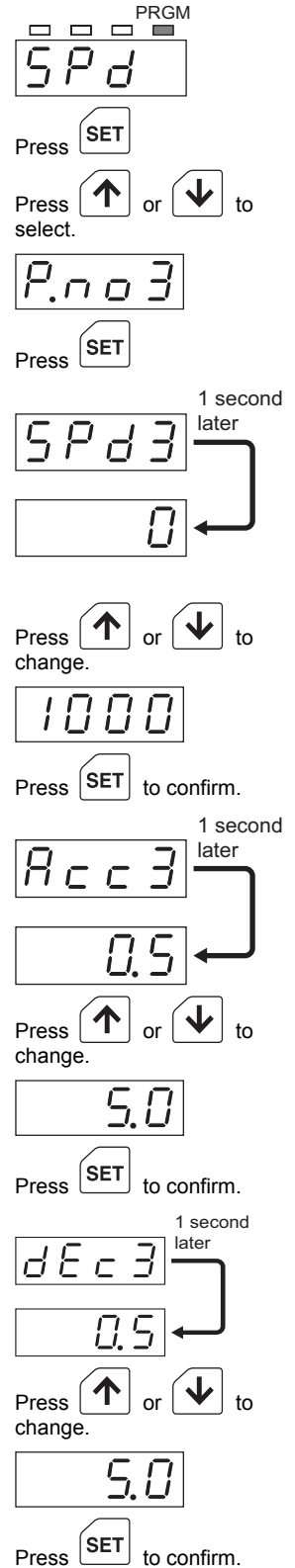
If the motor is started/stopped at a speed exceeding the rated speed, the actual acceleration/deceleration time will become longer than the specified acceleration time (Acc) or deceleration time (dEc).

Note that the actual acceleration time and deceleration time will vary depending on your use condition, load inertia, load torque, and so on.

In particular, the margin of error in acceleration/deceleration time will increase when the acceleration/deceleration time is set to 0.5 second or less. If smooth acceleration/deceleration cannot be achieved, increase the acceleration/deceleration time.



1. Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
2. Press **SET**, and then press **↑** or **↓** to select desired operation data (e.g., P.no3).
3. Press **SET**.  
After the digital setting (e.g., SPd3) is displayed, the current speed setting will be displayed.
4. Press **↑** or **↓** to change the speed (e.g., 1000 r/min).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
5. After the speed has been changed, press **SET** to confirm the new setting.  
The display will blink and show “Acc3”, after which the acceleration time will be displayed.
6. Press **↑** or **↓** to change the acceleration time (e.g., 5.0).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
7. After the acceleration time has been changed, press **SET** to confirm the new setting.  
The display will blink and show “dEc3”, after which the deceleration time will be displayed.
8. Press **↑** or **↓** to change the deceleration time (e.g., 5.0).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.
9. After the deceleration time has been changed, press **SET** to confirm the new setting.  
The display will blink.
10. Press **MODE** to switch to the monitor mode.



## 9.9 Setting the gear ratio

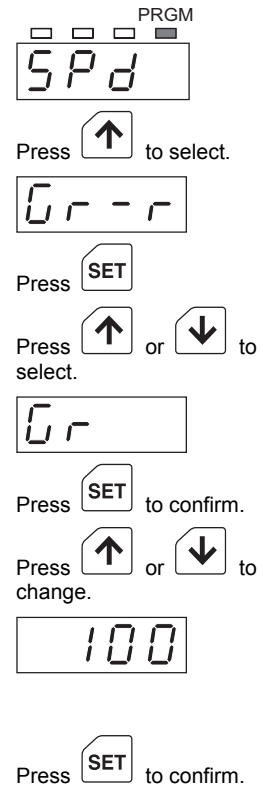
While the motor is operating, the speed of the motor output shaft is displayed on the digital operator.

To show the speed of the gearhead output shaft, set the gear ratio of the gearhead in use.

You can also show the conveyor transfer speed on the digital operator. To show the conveyor transfer speed, calculate and set an appropriate conveyor gear ratio.

The initial setting is “Gr” (speed display).

1. Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
2. Press **↑** to select “Gr-r” (gear ratio), and then press **SET**.
3. Press **↑** or **↓** to select the speed display mode (e.g., Gr), and then press **SET**.  
Gr: Speed display (the r/min LED will illuminate)  
cv: Conveyor transfer speed display (the m/min LED will illuminate)
4. Press **↑** or **↓** to change the gear ratio (e.g., 100).  
Pressing and holding the key for 3 seconds or more will increase or decrease the value successively.  
To show the conveyor transfer speed, enter the conveyor gear ratio. Refer to “Displaying the Conveyor Transfer Speed” for the calculation method.
5. After the gear ratio has been changed, press **SET** to confirm the new setting.
6. Press **MODE** to switch to the monitor mode.  
The r/min LED or m/min LED will illuminate according to the specified display mode.

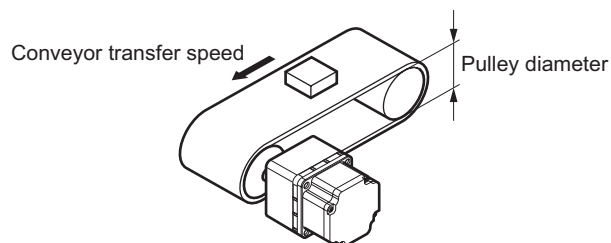


### ■ Displaying the conveyor transfer speed

To show the conveyor transfer speed on the digital operator, set the conveyor gear ratio.

Calculate the conveyor gear ratio using the formula below:

$$\text{Conveyor gear ratio} = \frac{1}{\text{Feed rate per motor revolution}} = \frac{\text{Gearhead gear ratio}}{\text{Pulley diameter (m)} \times \pi}$$



Based on the conveyor gear ratio calculated above, calculate the conveyor transfer speed using the following conversion formula:

$$\text{Conveyor transfer speed (m/min)} = \frac{\text{Motor shaft speed (r/min)}}{\text{Conveyor gear ratio}}$$

Example: When the pulley diameter is 0.1 m and gearhead gear ratio is 20

$$\text{Conveyor gear ratio} = \frac{\text{Gearhead gear ratio}}{\text{Pulley diameter (m)} \times \pi} = \frac{20}{0.1 \text{ (m)} \times \pi} \doteq 63.7$$

In this example, “63.7” is set as the conveyor gear ratio based on the formula.

Based on this conveyor gear ratio, the conveyor transfer speed at a motor speed of 1300 r/min will be displayed as follows:

$$\text{Conveyor transfer speed} = \frac{1300}{63.7} \doteq 20.4 \text{ (m/min)}$$

### ■ Gear ratio and display digits

The display of the digital operator shows up to four digits.

However, the decimal point position in the display or entry mode is not the same, because the number of valid integer digits will change depending on the motor gear ratio and conveyor gear ratio.

Gear ratio/conveyor gear ratio	Display of entered value	Display in monitor mode
1.00 or more, not exceeding 10.0	1.00 to 9.99	1 to 9999
10.0 or more, not exceeding 100	10.0 to 99.9	0.1 to 999.9
100 or more, not exceeding 1000	100 to 9999	0.01 to 99.99
1000 or more		0.001 to 9.999

## 9.10 Setting the input mode

The functions of terminals X1, X2 and X3 used for external I/O signals can be changed between the 2-wire input mode and 3-wire input mode.

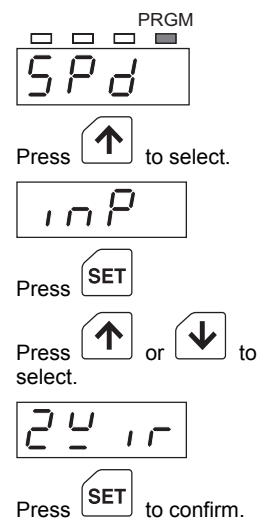
The input mode refers to the method of determining the motor direction and operation signals. In the 2-wire input mode, the motor is operated using the CW input and CCW input. In the 3-wire input mode, the motor is operated using the START/STOP input, RUN/BRAKE input and CW/CCW input.

The functions of terminals X1, X2 and X3 will change in each input mode, as follows.

Terminal name	2-wire input mode	3-wire input mode
X1	CW input	START/STOP input (ON: Run, OFF: Deceleration stop)
X2	CCW input	RUN/BRAKE input (ON: Run, OFF: Instantaneous stop)
X3	STOP-MODE input	CW/CCW input (ON: Clockwise rotation, OFF: Counterclockwise rotation)

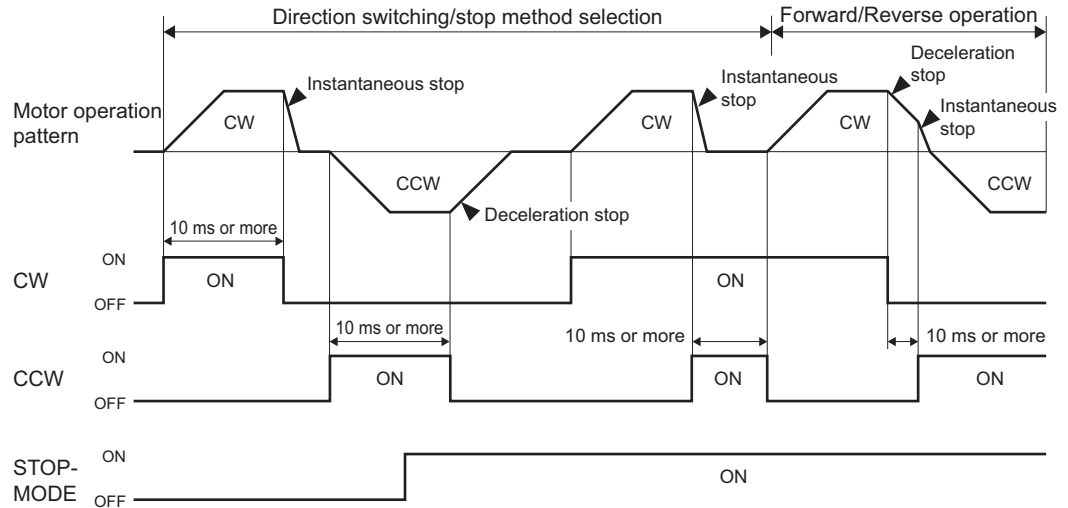
The initial setting is “2wir” (2-wire input mode).

- Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
- Press **↑** twice to select “inP” (input mode), and then press **SET**.
- Press **↑** or **↓** to select a desired input mode.  
(e.g., 2wir)  
2wir: 2-wire input mode  
3wir: 3-wire input mode
- Press **SET** to confirm the selection.
- Press **MODE** to switch to the monitor mode.

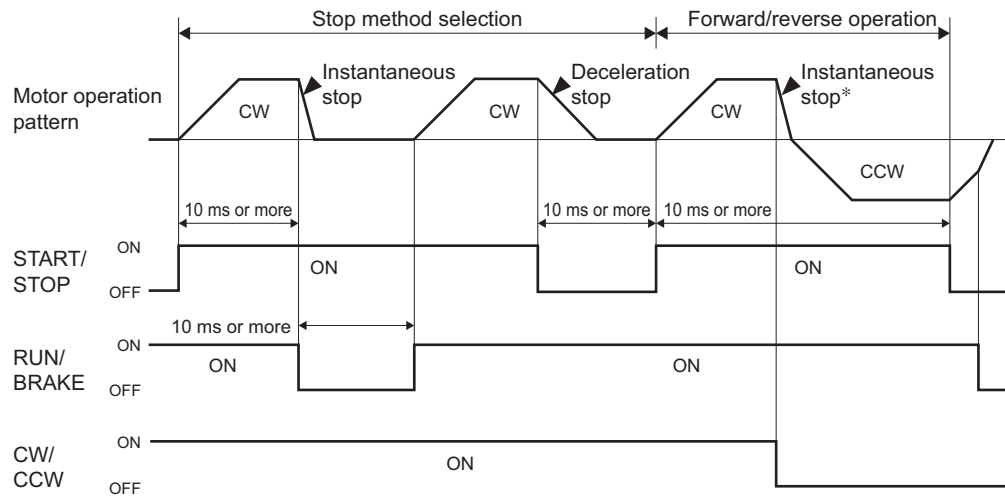




### ■ Timing chart in the 2-wire mode



### ■ Timing chart in the 3-wire mode



\* Changing the direction while the motor is running will cause the motor to stop instantaneously and then change its direction.

## 9.11 Enabling/Disabling the STOP key

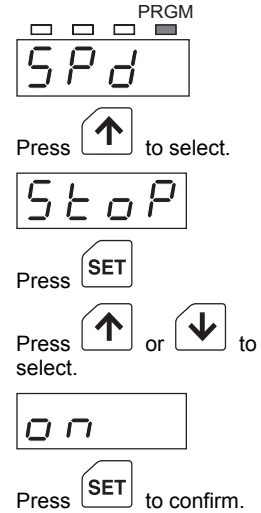
Even when the motor is operated using external input signals, it can still be stopped by pressing **STOP** on the digital operator.

Pressing **STOP** while the motor is operating in the external input signal mode will show blinking “StoP” and the motor will stop instantaneously.

The initial setting is “on” (enable the STOP key).

**Note** After pressing **STOP** turn OFF the CW and CCW inputs and confirm that the motor has stopped completely before resuming the operation.

1. Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
2. Press **↑** three times to select “StoP” (STOP key setting), and then press **SET**.
3. Press **↑** or **↓** to enable/disable the STOP key (e.g., on).  
on: Enable the STOP key  
oFF: Disable the STOP key
4. Press **SET** to confirm the selection.
5. Press **MODE** to switch to the monitor mode.



## 9.12 Switching between sink logic and source logic

Use the sink/source logic selector switch on the driver to switch the input circuit mode between sink logic and source logic.

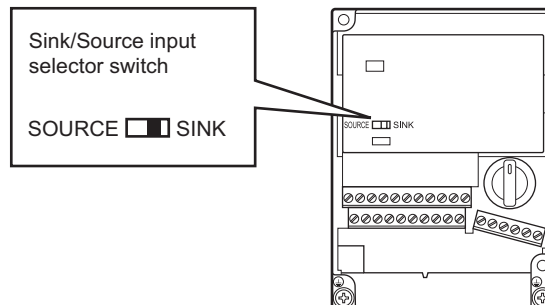
The sink/source setting of the output circuit can be switched by changing the connection.

In a sink logic circuit, a signal turns ON when current flows out of the applicable input terminal.

In a source logic circuit, a signal turns ON when current flows into the applicable input terminal.

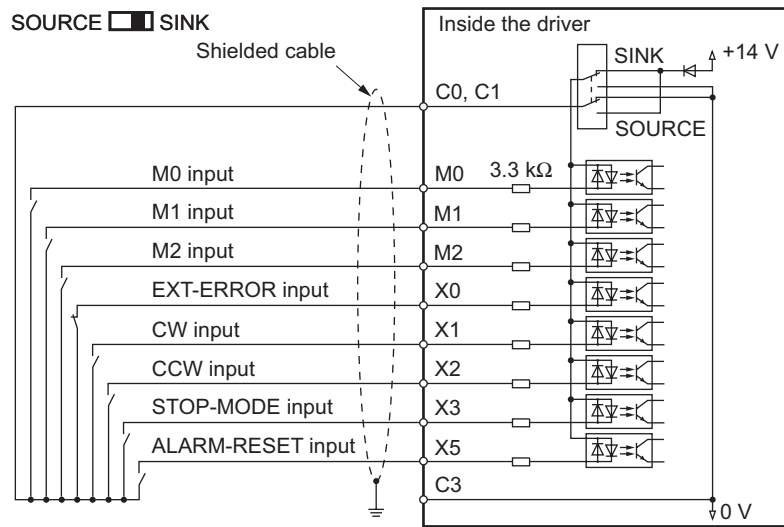
The factory setting is sink logic. Set an appropriate mode after confirming the output circuit of the external control equipment to be used.

1. Remove the front cover and digital operator.
2. Set the sink/source input selector switch to SINK or SOURCE.
3. Install the digital operator and front cover.

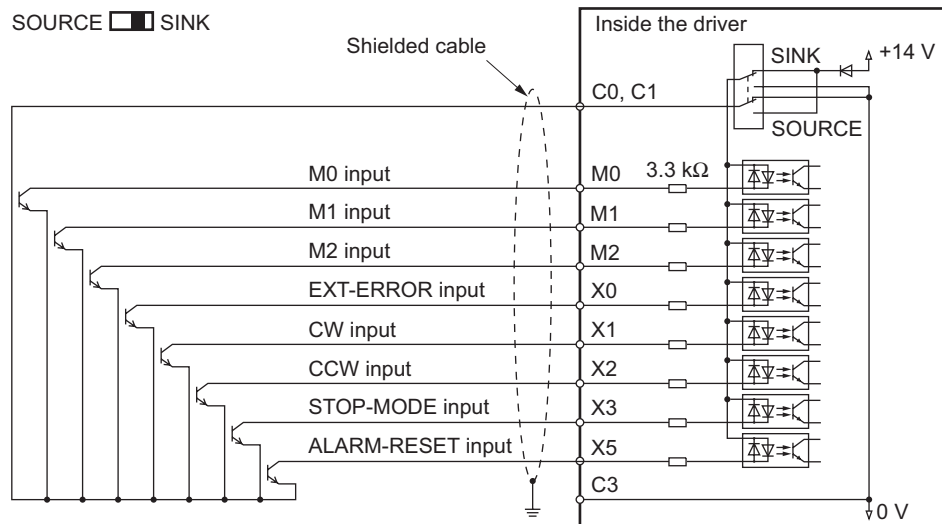


## ■ Sink logic

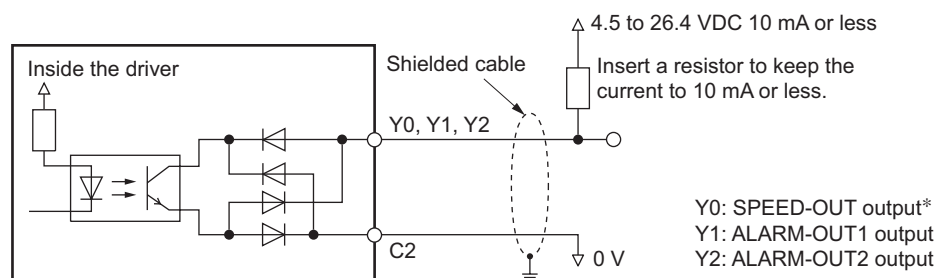
- Input circuit: When relays and other contact switches are used



- Input circuit: When transistors and other non-contact switches are used



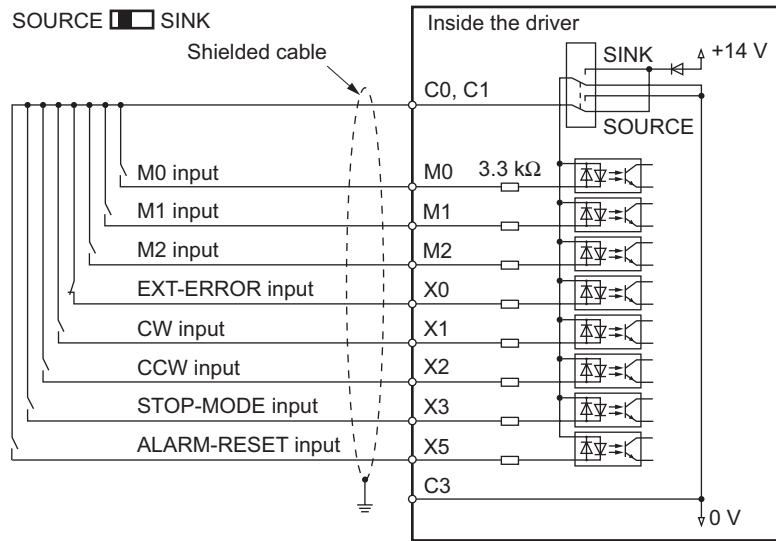
- Output circuit



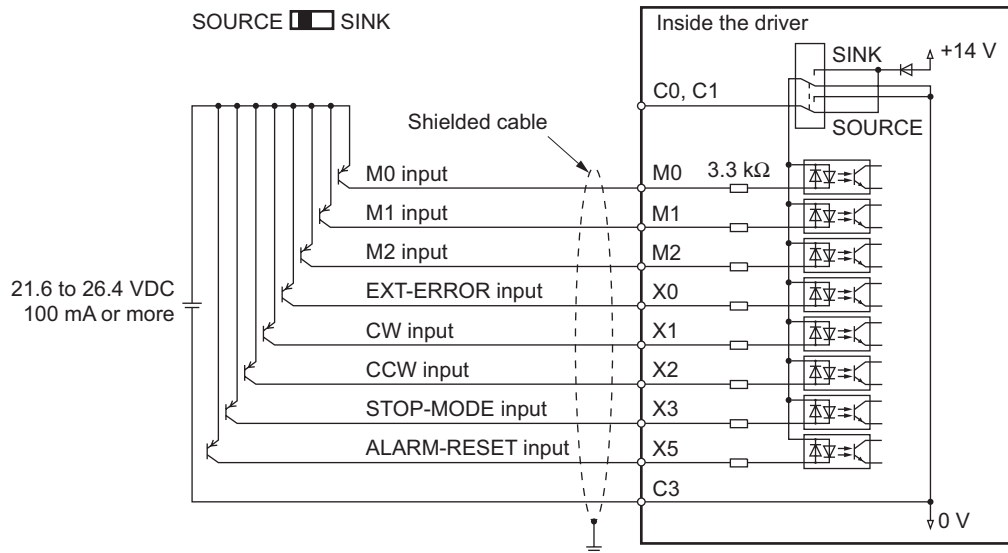
\* Adjust the current flowing to the SPEED-OUT output terminal to 5 mA or more.

### ■ Source logic

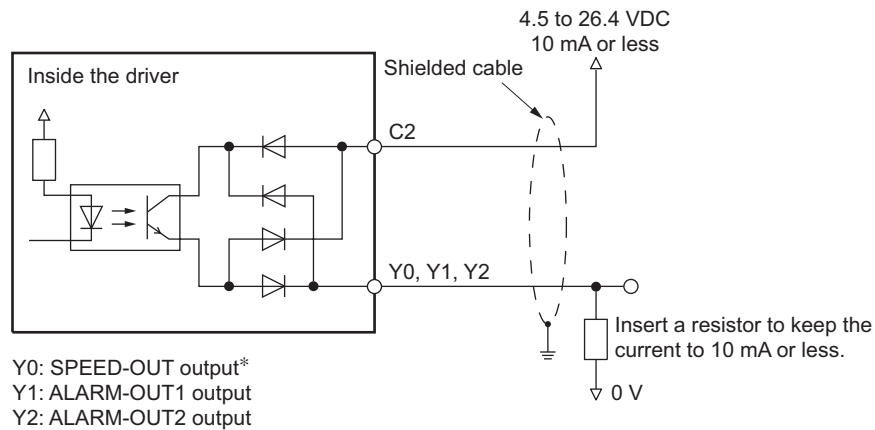
- Input circuit: When relays and other contact switches are used



- Input circuit: When transistors and other non-contact switches are used



- Output circuit



\* Adjust the current flowing to the SPEED-OUT output terminal to 5 mA or more.

## 9.13 Initializing data

Reset the current data to their initial settings (p.87).

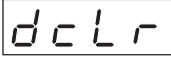
1. Turn on the power while pressing **MODE** .

The display will switch, and show “dcLr” in approx. 2 seconds.

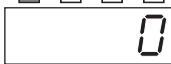
The data will be initialized and “0” will be displayed.

Turn on the power while  
pressing **MODE**

2 seconds later



MNTR



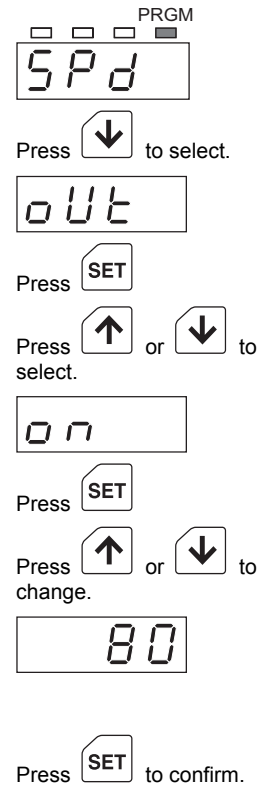
# 10 Protection functions

## 10.1 Setting the overload warning function

Enabling the overload warning function will allow a warning to be output before the overload protection function is activated. The overload warning function requires setting of a load factor with respect to the rated torque. If the load factor exceeds the specified value, the ALARM-OUT2 output will turn OFF. The output will turn ON automatically once the load factor falls below the specified value. Note that the digital operator will not show anything nor the motor will stop.

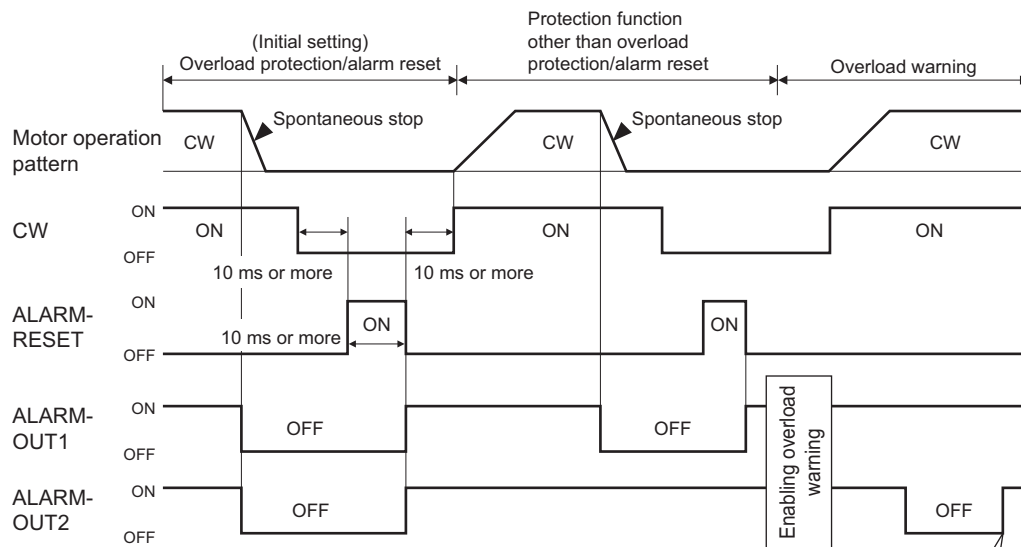
The initial setting is “oFF” (disable the overload warning function).

1. Press **MODE** to switch to the data setting mode.  
The PRGM LED will illuminate and “SPd” will be displayed.
2. Press **↓** to select “oUt” (overload warning function), and then press **SET**.
3. Press **↑** or **↓** to enable the overload warning function (e.g., on).  
oFF: Disable the overload warning function  
on: Enable the overload warning function
4. Press **SET**.
5. Press **↑** or **↓** to select the load factor at which an overload warning will be output (e.g., 80).  
When the overload warning function is set to “on,” the initial setting is “100.”  
100 to 50: Load factor at which an overload warning will be output (percentage of the rated torque; set in increments of 10%)\*
6. Press **SET** to confirm the setting.
7. Press **MODE** to switch to the monitor mode.



\* Since the load factor is calculated from the current flowing into the motor, there is a margin of error between the calculated load factor and the actual load applied to the motor shaft.

### ■ Timing chart



The overload warning will be reset automatically once the load factor falls below the specified value.

## 10.2 Protection functions of the driver

When an abnormality occurs in the driver and the driver's protection function is activated, a corresponding alarm code will be displayed on the digital operator and the ALARM LED will illuminate. Check the meaning of each alarm code using the table below.

To reset an alarm, turn OFF the CW and CCW inputs and then remove the cause of the alarm without fail before inputting the ALARM-RESET signal (p.57).

If the alarm cannot be reset by the ALARM-RESET input, turn off the power, wait for at least 1 minute, and then turn the power back on.

**Note** When a protection function is activated, the motor will stop spontaneously. Note, however, that the motor will stop instantaneously upon detection of an external error (AL6E). Once the motor stops, the output shaft will become free.

Alarm code	Alarm	Description	Action	ALARM-RESET input
AL20	Overcurrent protection	Excessive current flew through the driver due to a ground fault, etc.	Check the cables between the driver and motor for breakage.	Cannot be used.
AL22	Overvoltage protection	<ul style="list-style-type: none"> <li>The voltage impressed on the driver exceeded 120 or 240 V by approx. 20%.</li> <li>A load exceeding the allowable load inertial was driven.</li> </ul>	<ul style="list-style-type: none"> <li>Check the power supply voltage.</li> <li>Reduce the load inertia.</li> </ul>	Can be used.
AL25	Insufficient voltage protection	The voltage impressed on the driver dropped below approx. 40% of 100 or 200 V.	<ul style="list-style-type: none"> <li>Check the power supply voltage.</li> <li>Check the wiring of the power cable.</li> </ul>	Can be used.
AL29	CPU error	Improper connection between the driver and digital operator.	Check the connection with the digital operator.	Cannot be used.
		Error in the driver's internal CPU.	If the alarm doesn't reset after reconnecting the power, contact your nearest Oriental Motor branch or sales office.	Cannot be used.
AL30	Overload protection	A load exceeding the rated torque was applied to the motor for approx. 5 seconds or more.	<ul style="list-style-type: none"> <li>Reduce the load.</li> <li>Change the operation pattern including the acceleration/ deceleration time.</li> </ul>	Can be used.
AL31	Overspeed protection	The speed of the motor output shaft exceeded approx. 4800 r/min.	Reduce the speed to 4000 r/min or below.	Can be used.
AL41	EEPROM error	Operation data set in the digital operator cannot be rewritten or read.	If the alarm doesn't reset after reconnecting the power, contact your nearest Oriental Motor branch or sales office.	Cannot be used.
AL42	Motor sensor error	Improper signal cable connection or wire breakage.	Check the cable for breakage or improper connection.	Can be used.
AL46	Operation error	The power was reconnected while the motor was operating in the external input signal mode.	Turn the operation signals OFF and then turn on the power.	Can be used.
AL6E	External error	The motor stopped due to the EXT-ERROR input.	Remove the cause that triggered the EXT-ERROR input.	Can be used.

If an overcurrent protection (AL20), CPU error (AL29) or EEPROM error (AL41) alarm occurred, turn off the power, wait for at least 1 minute, and then turn the power back on. If the motor doesn't operate properly after reconnecting the power, the internal circuitry may have been damaged. Please contact your nearest Oriental Motor branch or sales office.



# 11 Inspection

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It is recommended that the items listed below be inspected regularly after motor operation. If any abnormality is found, stop using the motor and call our Technical Support Line.

**Note**

- Never measure insulation resistance or conduct a dielectric strength test with the motor and driver connected. Doing so may damage the motor/driver.
- The driver uses semiconductor elements, so handle it with due care. Electrostatic can damage the driver.

## ■ Inspection items

Confirm that:

- The motor/gearhead mounting screws are not loose
- The bearing (ball bearing) and other parts of the motor are not generating noise
- The bearing (ball bearing) and gear meshing parts of the gearhead are not generating noise
- The motor/gearhead output shaft is not misaligned with the load shaft
- The cables are free from damage or stress and are securely connected to the driver
- The openings in the driver are not blocked
- The driver mounting screws and power connection terminal screws are not loose
- The power elements and smoothing capacitors in the driver are not generating an abnormal smell or having abnormalities

# 12 Troubleshooting and remedial actions

An erroneous speed setting or connection may prevent the motor/driver from operating properly. If proper motor operation cannot be achieved, take an appropriate action by referring to this chapter. If the information provided here does not help, please call our Tech Support Line.

Problem	Likely cause		Corrective action
Nothing is displayed after the power is turned on.	The digital operator was not connected properly when the power was turned on.		Check the connection of the digital operator and then turn on the power again.
The motor doesn't operate.	Digital operator mode	The motor is not set to the digital operator mode.	Select "Lo" (digital operator) in the digital operator/external input signal setting mode.
	External input signal mode	The motor is not set to the external input signal mode.	Select "rE" (external input signals) in the digital operator/external input signal setting mode.
		Both the CW and CCW inputs are ON.	Turn ON either the CW or CCW input at a time.
		Both the CW and CCW inputs are OFF.	Turn ON either the CW or CCW input at a time.
	Internal potentiometer mode	The internal potentiometer is set to 0 r/min.	Turn the internal potentiometer clockwise. The factory setting is 0 r/min.
		The M0, M1 and M2 inputs are not OFF.	Set the M0, M1 and M2 inputs to OFF, or do not connect anything.
	External potentiometer (external DC voltage) mode	The external potentiometer is not connected properly.	Check the connection with the external potentiometer.
		The external DC power supply is not connected properly.	Check the connection with the external DC power supply.
		The M0 input is not ON while the M1 and M2 inputs are not OFF.	Set the M0 input to ON and the M1 and M2 inputs to OFF when using an external potentiometer or external DC voltage.
	Digital setting mode	Speed is not set.	Set the speed digitally. The factory setting is 0 r/min.
		The correct operation data is not selected by the M0, M1 and M2 inputs.	Select the operation data in which the desired speed is set, by combining the ON/OFF statuses of M0, M1 and M2 inputs correctly.
Digital setting is not selected for operation data Nos.1 and 2.		Change the speed setting method for operation data Nos.1 and 2 to digital setting.	
	An alarm code is displayed on the digital operator.		Reset the alarm by referring to 10.2 "Protection functions of the driver" on p.80.
The motor turns in the opposite direction to the specified direction.	The CW or CCW input was selected incorrectly or is not connected properly.		Confirm that: <ul style="list-style-type: none"> <li>• The correct input mode is selected.</li> <li>• I/O signal connection terminals X1 (CW input) and X2 (CCW input) are connected correctly.</li> </ul>
	The combination type parallel shaft gearhead is using a gear with a gear ratio of 30, 50 or 100.		If the gear ratio is 30, 50 or 100, the gearhead output shaft will turn in the opposite direction to the motor output shaft. Reverse the CW and CCW input operations.
	A combination type hollow shaft flat 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.43).

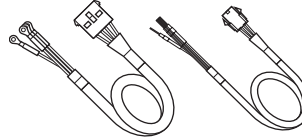
Problem	Likely cause	Corrective action
<ul style="list-style-type: none"> <li>• Unstable motor operation</li> <li>• Large vibration or speed fluctuation</li> </ul>	The center of the motor (gearhead) output shaft is not aligned with the center of the load shaft.	Check the coupling condition of the motor (gearhead) output shaft and load shaft.
	Effect of noise.	Implement noise elimination measures by referring to Chapter 3 "Precautions for use" on p.9, 5.10."Installing and wiring in compliance with EMC Directives (89/336/EEC, 92/31/EEC)" on p.28. Provide ample clearances between the cables.
The motor doesn't stop instantaneously.	The load exceeds the allowable inertia.	Check the allowable inertia of the motor and change the load inertia.
	The deceleration time is too long.	Check the deceleration time set in the operation data.
The motor speed doesn't rise quickly at start.	The load exceeds the allowable inertia.	Check the allowable inertia of the motor and change the load inertia.
Pressing <b>MODE</b> will not switch to the monitor mode (the MNTR LED does not illuminate).	An operation signal or signals have been input.	Turn all operation signal inputs OFF.
	The RUN LED illuminates.	Turn all operation signal inputs OFF, or press <b>STOP</b> .

# 13 Appendix

## 13.1 Dedicated connection cable

These cables are used to connect the motor and driver. Each set consists of a motor cable and a signal cable (sold separately).

Length	Model
1 m (3.28 ft.)	<b>CC01BLF</b>
2 m (6.56 ft.)	<b>CC02BLF</b>
3 m (9.84 ft.)	<b>CC03BLF</b>
5 m (16.4 ft.)	<b>CC05BLF</b>
7 m (23.0 ft.)	<b>CC07BLF</b>
10 m (32.8 ft.)	<b>CC10BLF</b>
15 m (49.2 ft.)	<b>CC15BLF</b>
20 m (65.6 ft.)	<b>CC20BLF</b>



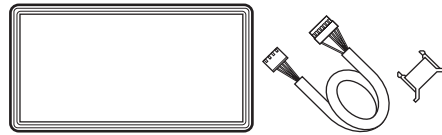
## 13.2 Optional parts and accessories

The optional parts and accessories for the **BLF** series are explained. All options are sold separately.

### ■ Remote-control kit

A set of a dedicated cable and a rubber gasket used to install the digital operator on an enclosure panel, etc., after removing it from the driver.

Cable length	Model
2 m (6.56 ft.) type	<b>BLFHS-02</b>
5 m (16.4 ft.) type	<b>BLFHS-05</b>



### ■ External potentiometer

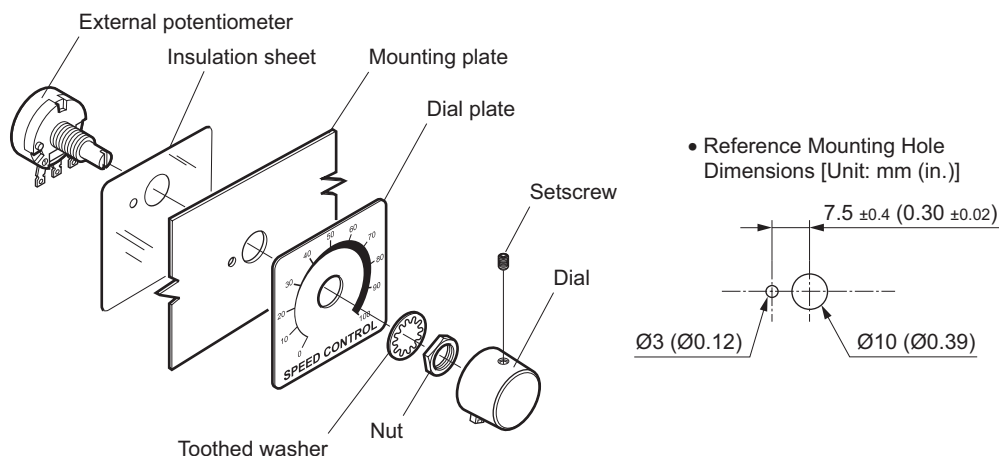
Model: **PAVR-20KZ**

This external potentiometer consists of a variable resistor, insulation sheet, dial plate and dial.



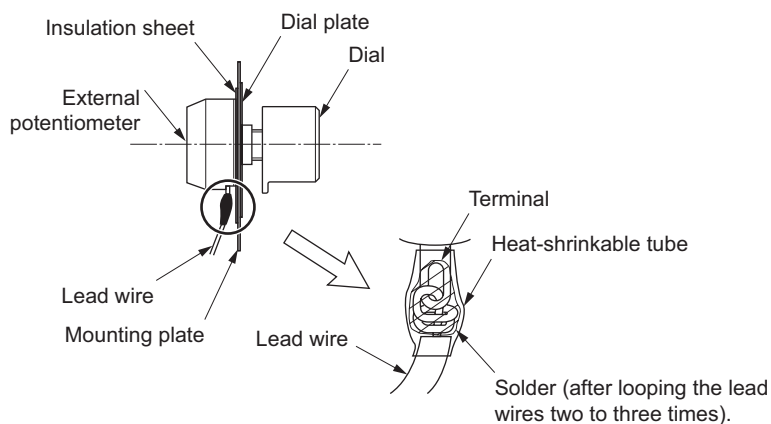
- How to Install the external potentiometer **PAVR-20KZ**

1. Insert the external potentiometer over the insulation sheet into the hole provided in the mounting plate, as illustrated below.
2. Set the dial plate and toothed washer, and tighten with the nut.  
Tightening torque: 0.45 N·m (63.9 oz-in)
3. Install the dial and secure it with the setscrew (M4).  
Tightening torque: 0.4 N·m (56.8 oz-in)



- Soldering the external potentiometer terminal

1. Guide the lead wires through the terminal hole and loop them two to three times.
2. Solder the lead wires to the terminal.
3. Cover a heat-shrinkable tube over the soldered part to insulate.



### 13.3 Recommended peripherals

#### Circuit breaker or earth leakage breaker

Be sure to connect a circuit breaker or earth leakage breaker to the power line of the driver to protect the primary circuit.

Model	<b>BLF230 BLF460C, BLF460S BLF5120S</b>	<b>BLF460A, BLF5120A BLF5120C, BLF6200C BLF6200S, BLF6400S</b>	<b>BLF6200A</b>
Rated current of protective device	5 A	10 A	15 A
Circuit breaker	Mitsubishi Electric Corporation NF30		
Earth leakage breaker	To prevent malfunction, use an earth leakage breaker with a current sensitivity of 200 mA or more and operating time of 0.1 second or more, or use one incorporating high-frequency noise elimination measures. Mitsubishi Electric Corporation NV series Fuji Electric FA Components & Systems Co., Ltd. EG series, SG series		

#### Mains filter

Manufacturer	Single-phase 100–120 V	Single-phase 200–240 V	Three-phase 200–240 V
TDK Corporation	ZAG2210-11S	ZAG2210-11S	–
DENSEI-LAMBDA K.K.	MC1210	MC1210	MC1310
OKAYA ELECTRIC INDUSTRIES CO., LTD.	SUP-EW10-ER-6	–	–
Schaffner EMC	FN2070-10-06	FN2070-10-06	FN251-8-07
Tyco Electronics CORCOM	–	10ESK1	–

Overvoltage category II applies to mains filters.

## 13.4 Initial settings

### ■ Driver

#### Selector switch

Name	Initial setting	Setting range
External voltage selection switch	5 VDC	5 VDC 10 VDC
Sink/Source selector switch	Sink logic	Sink logic Source logic

### ■ Digital operator

#### Direction setting mode

Name	Initial setting	Setting range
Direction	For	For: Clockwise rEv: Counterclockwise

#### Digital operator/external input signal setting mode

Name	Initial setting	Setting range
Digital operator/external input signal setting	Lo	Lo: Operation using the digital operator rE: Operation using external input signals

#### Speed selection mode

Name	Initial setting	Setting range
Operation data	P.no1	P.no1 to 8
Speed	0 r/min	80 to 4000 r/min
Acceleration time	0.5 s	0.2 to 15 s
Deceleration time	0.5 s	0.2 to 15 s
Speed setting method for operation data No.1	i-vr	i-vr: Internal potentiometer SPD1: Digital setting
Speed setting method for operation data No.2	E-vr	E-vr: External potentiometer or external DC voltage SPD2: Digital setting
Gear ratio	1.00 r/min	r/min: Gearhead output shaft speed m/min: Conveyor transfer speed
Input mode	2wir	2wir: 2-wire input mode 3wir: 3-wire input mode
STOP key enable/disable	on	on: Enable oFF: Disable
Overload warning function	oFF	oFF: Disable the overload warning function on: Enable the overload warning function (Initial setting: 100) 100 to 50: Load factor at which an overload warning will be output (set as a percentage of the rated torque in increments of 10%)

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ORIENTAL MOTOR U.S.A. CORP.  
Technical Support Line Tel:(800)468-3982  
Available from 7:30 AM to 5:00 PM, P.S.T.  
E-mail: techsupport@orientalmotor.com  
www.orientalmotor.com

ORIENTAL MOTOR (EUROPA) GmbH  
Headquarters and Düsseldorf Office  
Tel:0211-5206700 Fax:0211-52067099  
Munich Office  
Tel:08131-59880 Fax:08131-598888  
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ORIENTAL MOTOR (UK) LTD.  
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Tel:02-93906346 Fax:02-93906348

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Tel:(02)8228-0707 Fax:(02)8228-0708

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Tel:(6745)7344 Fax:(6745)9405

ORIENTAL MOTOR (MALAYSIA) SDN. BHD.  
Tel:(03)79545778 Fax:(03)79541528

INA ORIENTAL MOTOR CO.,LTD.  
KOREA  
Tel:(032)822-2042~3 Fax:(032)819-8745

ORIENTAL MOTOR CO.,LTD.  
Headquarters Tokyo, Japan  
Tel:(03)3835-0684 Fax:(03)3835-1890