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.

<table>
<thead>
<tr>
<th>Applicable Standards</th>
<th>Certification Body</th>
<th>Standards File No.</th>
<th>CE Marking</th>
</tr>
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<tbody>
<tr>
<td>UL 1004-1</td>
<td>UL</td>
<td>E335369</td>
<td>Low Voltage Directives</td>
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<tr>
<td>EN 60950-1</td>
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<td>Motor</td>
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<td>E171462</td>
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<tr>
<td></td>
<td>CSA C222.2 No.14</td>
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<td>EMC Directives</td>
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<td>Driver</td>
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</tr>
<tr>
<td></td>
<td>EN 50178</td>
<td></td>
<td></td>
</tr>
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</table>

* Insulation class UL/CSA Standards: class A, EN Standards: class E

Installation conditions

<table>
<thead>
<tr>
<th>Motor</th>
<th>Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor is to be used as a component within other equipment.</td>
<td>Driver is to be used as a component within other equipment.</td>
</tr>
<tr>
<td>Overvoltage category: III*</td>
<td>Overvoltage category: III*</td>
</tr>
<tr>
<td>Pollution degree: 3</td>
<td>Pollution degree: 2</td>
</tr>
<tr>
<td>Protection against electric shock: Class I equipment</td>
<td>Protection against electric shock: Class I equipment</td>
</tr>
</tbody>
</table>

* Overvoltage category II when EN 60950-1 is applicable.

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” 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.

<table>
<thead>
<tr>
<th>Location</th>
<th>Tightening torque</th>
<th>Wire range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power connection terminal and cable</td>
<td>1.0 N·m</td>
<td>AWG18 to 14</td>
</tr>
<tr>
<td>Motor connection terminal and cable</td>
<td>0.8 to 1.0 N·m</td>
<td>AWG14</td>
</tr>
</tbody>
</table>

* Wire range of BLFD200A2 type is AWG14.

Hazardous substances

**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.

- **Power supply**
  Make sure power supply voltage does not exceed the rated voltage.

- **Circuit breaker or earth leakage breaker**
  Always connect a breaker to protect the primary circuit.
  p.86

- **Mains filter**
  Use a mains filter to eliminate noise. It effectively reduces noise generated from the power supply or driver.
  p.29, 86

- **External control equipment**
  Connect a programmable controller or other external control equipment you want to use to control the motor.
  p.37, 55

- **Remote-control kit (sold separately)**
  Use this kit to remove the digital operator from the driver and install it on a panel surface.
  p.27, 84

- **Digital operator**

- **Driver**

- **External potentiometer**
  PAVR-20KZ (sold separately)
  Connect this unit to set the motor speed externally.
  p.52, 84

- **External DC voltage**
  Connect an appropriate power supply to set the motor speed using DC voltage.
  p.52

- **Connection cables (sold separately)**
  These dedicated cables are used for connecting the motor and driver. They are not supplied with the product.
  p.33, 84

- **Motor**

- **Connection cables (sold separately)**
  These dedicated cables are used for connecting the motor and driver. They are not supplied with the product.
  p.86

- **Remote-control kit (sold separately)**
  Use this kit to remove the digital operator from the driver and install it on a panel surface.
  p.27, 84

- **Digital operator**

- **Driver**

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  p.52

- **Connection cables (sold separately)**
  These dedicated cables are used for connecting the motor and driver. They are not supplied with the product.
  p.33, 84

- **Motor**
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.
- Be sure to 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.

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.

⚠️ **WARNING**
- Risk of electric shock.
  - Read manual before installing.
  - Wait 1 minute for capacitor discharge after disconnecting power supply.
- Hot Surface
  - Do not touch the heatsink, Risk of burn.

⚠️ **AVERTISSEMENT**
- Risque de décharge électrique.
  - Lisez le manuel avant l’installation.
  - Attendez 1 minute après la coupure de l’alimentation, pour permettre la décharge des condensateurs.
- Surface chaude
  - Ne pas toucher le dissipateur thermique, Risque de brûlure.
3 Precautions for use

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 mm²).\(^*\)
    \* BLFD200A2 type is AWG14 (2.0 mm²).
  - Be sure to ground both ends of the shielded cable used for the mains filter.
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
- Operating manual (this manual) 1 copy

The figure shows a combination type.

Accessories for combination type parallel shaft gearhead *

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

- Parallel key 1 pc.
(For GFS6G□FR 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 hexagonal 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.

* The GFS6G□FR does not come with hexagonal nuts.

**Note** Optional connection cables (sold separately) are needed to connect the driver and motor (p.84).
### 4.2 How to read the unit model

![Diagram of unit model]

**Type of gearhead (combination type)**
- **FR**: Hollow shaft flat gearhead
- **Blank**: Parallel shaft gearhead

**Gear ratio/shaft shape**
- **A**: Round shaft type
- **GFS**: Pinion shaft type

**Number**: Gear ratio (combination type)
- **5**: 5
- **10**: 10
- **15**: 15
- **20**: 20
- **30**: 30
- **50**: 50
- **100**: 100
- **200**: 200

**BLF series**

### 4.3 Combination tables

**Combination type parallel shaft gearhead**

The motor comes preassembled with a parallel shaft gearhead.

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Components</th>
<th>Motor model</th>
<th>Gearhead model</th>
<th>Driver model</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230A-□</td>
<td>BLFM230-GFS</td>
<td>GFS2G□</td>
<td>BLFD30C2</td>
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<tr>
<td>BLF230C-□</td>
<td>BLFM230-GFS</td>
<td>GFS2G□</td>
<td>BLFD30A2</td>
<td></td>
</tr>
<tr>
<td>BLF230S-□</td>
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<td>BLFD30S2</td>
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</tr>
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<td>BLF460C-□</td>
<td>BLFM460-GFS</td>
<td>GFS4G□</td>
<td>BLFD60C2</td>
<td></td>
</tr>
<tr>
<td>BLF460S-□</td>
<td>BLFM460-GFS</td>
<td>GFS4G□</td>
<td>BLFD60S2</td>
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</tr>
<tr>
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</tr>
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<td>BLF5120C-□</td>
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<td>GFS6G□</td>
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</tbody>
</table>

* □ 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.

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Components</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230A-□FR</td>
<td>BLFM230-GFS</td>
<td>BLF30A2</td>
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<td>BLF400S2</td>
</tr>
</tbody>
</table>

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

Round shaft type

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Components</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230A-A</td>
<td>BLFM230-A</td>
<td>BLF30A2</td>
</tr>
<tr>
<td>BLF230C-A</td>
<td>BLFM230-A</td>
<td>BLF30C2</td>
</tr>
<tr>
<td>BLF230S-A</td>
<td>BLFM230-A</td>
<td>BLF30S2</td>
</tr>
<tr>
<td>BLF460A-A</td>
<td>BLFM460-A</td>
<td>BLF60A2</td>
</tr>
<tr>
<td>BLF460C-A</td>
<td>BLFM460-A</td>
<td>BLF60C2</td>
</tr>
<tr>
<td>BLF460S-A</td>
<td>BLFM460-A</td>
<td>BLF60S2</td>
</tr>
<tr>
<td>BLF5120A-A</td>
<td>BLFM5120-A</td>
<td>BLF120A2</td>
</tr>
<tr>
<td>BLF5120C-A</td>
<td>BLFM5120-A</td>
<td>BLF120C2</td>
</tr>
<tr>
<td>BLF5120S-A</td>
<td>BLFM5120-A</td>
<td>BLF120S2</td>
</tr>
<tr>
<td>BLF6200A-A</td>
<td>BLFM6200-A</td>
<td>BLF200A2</td>
</tr>
<tr>
<td>BLF6200C-A</td>
<td>BLFM6200-A</td>
<td>BLF200C2</td>
</tr>
<tr>
<td>BLF6200S-A</td>
<td>BLFM6200-A</td>
<td>BLF200S2</td>
</tr>
<tr>
<td>BLF6400S-A</td>
<td>BLFM6400-A</td>
<td>BLF400S2</td>
</tr>
</tbody>
</table>

Pinion shaft type

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Components</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230A-GFS</td>
<td>BLFM230-GFS</td>
<td>GFS2G□FR</td>
</tr>
<tr>
<td>BLF230C-GFS</td>
<td>BLFM230-GFS</td>
<td>GFS2G□FR</td>
</tr>
<tr>
<td>BLF230S-GFS</td>
<td>BLFM230-GFS</td>
<td>GFS2G□FR</td>
</tr>
<tr>
<td>BLF460A-GFS</td>
<td>BLFM460-GFS</td>
<td>GFS4G□FR</td>
</tr>
<tr>
<td>BLF460C-GFS</td>
<td>BLFM460-GFS</td>
<td>GFS4G□FR</td>
</tr>
<tr>
<td>BLF460S-GFS</td>
<td>BLFM460-GFS</td>
<td>GFS4G□FR</td>
</tr>
<tr>
<td>BLF5120A-GFS</td>
<td>BLFM5120-GFS</td>
<td>GFS5G□FR</td>
</tr>
<tr>
<td>BLF5120C-GFS</td>
<td>BLFM5120-GFS</td>
<td>GFS5G□FR</td>
</tr>
<tr>
<td>BLF5120S-GFS</td>
<td>BLFM5120-GFS</td>
<td>GFS5G□FR</td>
</tr>
<tr>
<td>BLF6200A-GFS</td>
<td>BLFM6200-GFS</td>
<td>GFS6G□FR</td>
</tr>
<tr>
<td>BLF6200C-GFS</td>
<td>BLFM6200-GFS</td>
<td>GFS6G□FR</td>
</tr>
<tr>
<td>BLF6200S-GFS</td>
<td>BLFM6200-GFS</td>
<td>GFS6G□FR</td>
</tr>
<tr>
<td>BLF6400S-GFS</td>
<td>BLFM6400-GFS</td>
<td>GFS6G□FR</td>
</tr>
</tbody>
</table>

* 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.
### 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
    - 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

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Explanation</th>
<th>Reference page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mode indicator LEDs</td>
<td>The illuminating LED indicates the current operation mode. MNTR: Monitor mode</td>
<td>−</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F/R: Direction setting mode LO/RE: Digital operator/external input signal setting mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRGM: Data setting mode</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RUN LED</td>
<td>A green light stays on during operation.</td>
<td>−</td>
</tr>
<tr>
<td>3</td>
<td>ALARM LED</td>
<td>A red light will come on when an alarm is generated.</td>
<td>−</td>
</tr>
<tr>
<td>4</td>
<td>Display</td>
<td></td>
<td>−</td>
</tr>
<tr>
<td>5</td>
<td>Operation keys</td>
<td>Use these keys to switch the mode or set data.</td>
<td>p.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="mode.png" alt="Mode" /> : Switch the operation mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="next.png" alt="Next" /> : Move to the next item or increase the value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="previous.png" alt="Previous" /> : Move to the previous item or decrease the value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="confirm.png" alt="Confirm" /> : Confirm the data</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>STOP</td>
<td>Stop the motor.</td>
<td>−</td>
</tr>
<tr>
<td>7</td>
<td>RUN</td>
<td>Start the motor operation.</td>
<td>−</td>
</tr>
<tr>
<td>8</td>
<td>Unit display LEDs</td>
<td>The illuminating LED indicates the current display unit. r/min: Speed of motor or gearhead output shaft m/min: Conveyor transfer speed %: Load factor</td>
<td>p.66, 71</td>
</tr>
<tr>
<td>9</td>
<td>Driver connector (CN3)</td>
<td>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.</td>
<td>p.27</td>
</tr>
<tr>
<td>10</td>
<td>Mounting hole (4 locations)</td>
<td>Use these holes to install the digital operator to a mounting plate using the remote-control kit.</td>
<td>p.27</td>
</tr>
</tbody>
</table>
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.)].

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

Open holes with a minimum diameter of ØB +1 mm (0.04 in.).

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Maximum applicable plate thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>5 mm (0.20 in.)</td>
</tr>
<tr>
<td>BLF460</td>
<td>8 mm (0.31 in.)</td>
</tr>
<tr>
<td>BLF5120</td>
<td>12 mm (0.47 in.)</td>
</tr>
<tr>
<td>BLF6200</td>
<td>12 mm (0.47 in.)</td>
</tr>
<tr>
<td>BLF6400</td>
<td>12 mm (0.47 in.)</td>
</tr>
</tbody>
</table>

* 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.

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

**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.

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

**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

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.

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Nominal thread size</th>
<th>Tightening torque</th>
<th>ØA [mm (in.)]</th>
<th>ØB [mm (in.)]</th>
<th>ØC [mm (in.)]</th>
<th>ØD [mm (in.)]</th>
<th>E [mm (in.)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>M5</td>
<td>3.8 N·m (33 lb-in)</td>
<td>70 (2.76)</td>
<td>34⁻²⁵⁰₁⁰ / ₂ (1.34⁻²⁵⁰₁⁰ / ₂)</td>
<td>5.5 (0.217)</td>
<td>25 (0.98)</td>
<td>29 (1.14)</td>
</tr>
<tr>
<td>BLF460</td>
<td>M6</td>
<td>6.4 N·m (56 lb-in)</td>
<td>94 (3.70)</td>
<td>38⁻²⁵⁰₁⁰ / ₂ (1.50⁻²⁵⁰₁⁰ / ₂)</td>
<td>6.5 (0.256)</td>
<td>30 (1.18)</td>
<td>39 (1.54)</td>
</tr>
<tr>
<td>BLF5120</td>
<td>M8</td>
<td>10.4 N·m (137 lb-in)</td>
<td>104 (4.09)</td>
<td>50⁻²⁵⁰₁⁰ / ₂ (1.97⁻²⁵⁰₁⁰ / ₂)</td>
<td>8.5 (0.335)</td>
<td>35 (1.38)</td>
<td>44 (1.73)</td>
</tr>
<tr>
<td>BLF6200</td>
<td>M8</td>
<td>15.5 N·m (137 lb-in)</td>
<td>120 (4.72)</td>
<td>58⁻²⁵⁰₁⁰ / ₂ (2.28⁻²⁵⁰₁⁰ / ₂)</td>
<td>–</td>
<td>42 (1.65)</td>
<td>57 (2.24)</td>
</tr>
</tbody>
</table>

Note: The BLF6200 and BLF6400 do not come with hexagonal nuts. Provide hexagonal nuts separately or drill tapped holes in the mounting plate.
## Maximum applicable plate thickness

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Maximum applicable plate thickness *</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>5 mm (0.20 in.)</td>
</tr>
<tr>
<td>BLF460</td>
<td>8 mm (0.31 in.)</td>
</tr>
<tr>
<td>BLF5120</td>
<td></td>
</tr>
<tr>
<td>BLF6200</td>
<td>12 mm (0.47 in.)</td>
</tr>
<tr>
<td>BLF6400</td>
<td></td>
</tr>
</tbody>
</table>

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

## 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.

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

### 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).

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

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

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.

<table>
<thead>
<tr>
<th>Unit model</th>
<th>ØA</th>
<th>B</th>
<th>ØCH7*</th>
<th>ØD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>70 (2.76)</td>
<td>49.5 (1.949)</td>
<td>54 (2.126)</td>
<td>4.5 (0.177)</td>
</tr>
<tr>
<td>BLF460</td>
<td>94 (3.70)</td>
<td>66.47 (2.616)</td>
<td>73 (2.874)</td>
<td>6.5 (0.256)</td>
</tr>
<tr>
<td>BLF5120</td>
<td>104 (4.09)</td>
<td>73.54 (2.895)</td>
<td>83 (3.267)</td>
<td>8.5 (0.335)</td>
</tr>
<tr>
<td>BLF6200</td>
<td>120 (4.72)</td>
<td>84.85 (3.341)</td>
<td>94 (3.700)</td>
<td>8.5 (0.335)</td>
</tr>
<tr>
<td>BLF6400</td>
<td>(4.72)</td>
<td>(3.341)</td>
<td>(3.700)</td>
<td>(0.335)</td>
</tr>
</tbody>
</table>

* ØC indicates the pilot diameter on the flange.

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.

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Parallel key dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>4 mm (0.16 in.)</td>
</tr>
<tr>
<td>BLF460</td>
<td>5 mm (0.20 in.)</td>
</tr>
<tr>
<td>BLF5120, BLF6200, BLF6400</td>
<td>6 mm (0.24 in.)</td>
</tr>
</tbody>
</table>

* 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 provided at the tip of the output shaft as an auxiliary means for preventing the transfer mechanism from disengaging. (GFS2G type have no output shaft tip screw hole.)

**The example of output axis tip screw hole use**

**Gearhead model name**

<table>
<thead>
<tr>
<th>Gearhead model name</th>
<th>Output shaft tip screw hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFS4G</td>
<td>M5, Effective depth 10 mm (0.39 in.)</td>
</tr>
<tr>
<td>GFS5G</td>
<td>M6, Effective depth 12 mm (0.47 in.)</td>
</tr>
<tr>
<td>GFS6G</td>
<td></td>
</tr>
</tbody>
</table>

* The square box in the gearhead model will contain a value representing the gear ratio.
### 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

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Gear ratio</th>
<th>Distance from tip of gearhead output shaft and permissible overhung load * [N (lb.)]</th>
<th>Permissible thrust load [N (lb.)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>5</td>
<td>100 (22) [90 (20)] 150 (33) [110 (24)]</td>
<td>40 (9)</td>
</tr>
<tr>
<td></td>
<td>10 to 20</td>
<td>150 (33) [130 (29)] 200 (45) [170 (38)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 to 200</td>
<td>200 (45) [180 (40)] 300 (67) [230 (51)]</td>
<td></td>
</tr>
<tr>
<td>BLF460</td>
<td>5</td>
<td>200 (45) [180 (40)] 250 (56) [220 (49)]</td>
<td>100 (22)</td>
</tr>
<tr>
<td></td>
<td>10 to 20</td>
<td>300 (67) [270 (60)] 350 (78) [330 (74)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 to 200</td>
<td>450 (101) [420 (94)] 550 (123) [500 (112)]</td>
<td></td>
</tr>
<tr>
<td>BLF5120</td>
<td>5</td>
<td>300 (67) [230 (51)] 400 (90) [300 (67)]</td>
<td>150 (33)</td>
</tr>
<tr>
<td></td>
<td>10 to 20</td>
<td>400 (90) [370 (83)] 500 (112) [430 (96)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 to 200</td>
<td>500 (112) [450 (101)] 650 (146) [550 (123)]</td>
<td></td>
</tr>
<tr>
<td>BLF6200</td>
<td>5 to 20</td>
<td>550 (123) [500 (112)] 800 (180) [700 (157)]</td>
<td>200 (45)</td>
</tr>
<tr>
<td>BLF6400</td>
<td></td>
<td>550 (123) [500 (112)] 800 (180) [700 (157)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30, 50</td>
<td>1000 (220) [900 (202)] 1250 (280) [1100 (247)]</td>
<td>300 (67)</td>
</tr>
<tr>
<td></td>
<td>100, 200</td>
<td>1400 (310) [1200 (270)] 1700 (380) [1400 (315)]</td>
<td>400 (90)</td>
</tr>
</tbody>
</table>

* 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

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Distance from tip of gearhead output shaft and permissible overhung load [N (lb.)]</th>
<th>Permissible thrust load [N (lb.)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>80 (18) 100 (22)</td>
<td>Not to exceed one-half the motor's dead weight *</td>
</tr>
<tr>
<td>BLF460</td>
<td>110 (24) 130 (29)</td>
<td></td>
</tr>
<tr>
<td>BLF5120</td>
<td>150 (33) 170 (38)</td>
<td></td>
</tr>
<tr>
<td>BLF6200</td>
<td>197 (44) 221 (49)</td>
<td></td>
</tr>
</tbody>
</table>

* 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.
- When installing the load shaft using an end plate, the safety cover (supplied) cannot be attached due to contact between the safety cover and hexagonal socket head screw. Take safety measures against rotating part.

### Stepped load shaft

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

- **Affixing method using end plate**
  Affix the load shaft by tightening the hexagonal socket head screw over an end plate, flat washer and spring washer.

### 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.)]

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Inner diameter of hollow shaft (H8)</th>
<th>Recommended diameter of load shaft (h7)</th>
<th>Nominal diameter of retaining ring</th>
<th>Applicable screw</th>
<th>Spacer thickness</th>
<th>Outer diameter of stepped shaft (ØD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLF230</td>
<td>Ø12 (Ø0.4724)</td>
<td>Ø12 (Ø0.4724)</td>
<td>Ø12 (Ø0.47)</td>
<td>M4</td>
<td>3 (0.12)</td>
<td>20 (0.79)</td>
</tr>
<tr>
<td></td>
<td>(Ø0.4724 +0.0001)</td>
<td>(Ø0.4724 +0.0001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLF460</td>
<td>Ø15 (Ø0.5906)</td>
<td>Ø15 (Ø0.5906)</td>
<td>Ø15 (Ø0.59)</td>
<td>M5</td>
<td>4 (0.16)</td>
<td>25 (0.98)</td>
</tr>
<tr>
<td></td>
<td>(Ø0.5906 +0.0001)</td>
<td>(Ø0.5906 +0.0001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLF5120</td>
<td>Ø20 (Ø0.7874)</td>
<td>Ø20 (Ø0.7874)</td>
<td>Ø20 (Ø0.79)</td>
<td>M6</td>
<td>5 (0.20)</td>
<td>30 (1.18)</td>
</tr>
<tr>
<td></td>
<td>(Ø0.7874 +0.0001)</td>
<td>(Ø0.7874 +0.0001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLF6200</td>
<td>Ø25 (Ø0.9843)</td>
<td>Ø25 (Ø0.9843)</td>
<td>Ø25 (Ø0.98)</td>
<td>M10</td>
<td>6 (0.24)</td>
<td>40 (1.57)</td>
</tr>
<tr>
<td>BLF6400</td>
<td>Ø25 (Ø0.9843)</td>
<td>Ø25 (Ø0.9843)</td>
<td>Ø25 (Ø0.98)</td>
<td>M10</td>
<td>6 (0.24)</td>
<td>40 (1.57)</td>
</tr>
</tbody>
</table>

### 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**

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Gear ratio</th>
<th>Distance from gearhead mounting surface and permissible overhung load * [N (lb.)]</th>
<th>Permissible thrust load [N (lb.)]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10 mm (0.39 in.) 20 mm (0.79 in.)</td>
<td></td>
</tr>
<tr>
<td>BLF230</td>
<td>5, 10</td>
<td>450 (101) [410 (92)] 370 (83) [330 (74)]</td>
<td>200 (45)</td>
</tr>
<tr>
<td></td>
<td>15 to 200</td>
<td>500 (112) [460 (103)] 400 (90) [370 (83)]</td>
<td></td>
</tr>
<tr>
<td>BLF460</td>
<td>5, 10</td>
<td>800 (180) [730 (164)] 660 (148) [600 (135)]</td>
<td>400 (90)</td>
</tr>
<tr>
<td></td>
<td>15 to 200</td>
<td>1200 (270) [1100 (240)] 1000 (220) [910 (200)]</td>
<td></td>
</tr>
<tr>
<td>BLF5120</td>
<td>5, 10</td>
<td>900 (200) [820 (184)] 770 (173) [700 (157)]</td>
<td>500 (112)</td>
</tr>
<tr>
<td></td>
<td>15, 20</td>
<td>1300 (290) [1200 (270)] 1110 (240) [1020 (220)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 to 200</td>
<td>1500 (330) [1400 (310)] 1280 (280) [1200 (270)]</td>
<td></td>
</tr>
<tr>
<td>BLF6200</td>
<td>5 (BLF6400 only)</td>
<td>1230 (270) [1130 (250)] 1070 (240) [990 (220)]</td>
<td>800 (180)</td>
</tr>
<tr>
<td>BLF6400</td>
<td>10</td>
<td>1680 (370) [1550 (340)] 1470 (330) [1360 (300)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15, 20</td>
<td>2040 (450) [1900 (420)] 1780 (400) [1660 (370)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 to 100</td>
<td>2040 (450) [1900 (420)] 1780 (400) [1660 (370)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 mm (3.94 in.) or more 20 mm (0.79 in.) or more 25 mm (0.98 in.) or more 100 mm (3.94 in.) or more 100 mm (3.94 in.) or more</td>
<td></td>
</tr>
</tbody>
</table>

* 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.
Installation

**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)

   - Mounting hole dimensions [Unit: mm (in.)]

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

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**

<table>
<thead>
<tr>
<th></th>
<th>Emission Tests</th>
<th>EN 61000-6-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS</td>
<td>Immunity Tests</td>
<td>EN 61000-6-2</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TDK Corporation</td>
<td>ZAG2210-11S</td>
<td>ZAG2210-11S</td>
<td>–</td>
</tr>
<tr>
<td>TDK-Lambda Corporation</td>
<td>MC1210</td>
<td>MC1210</td>
<td>MC1310</td>
</tr>
<tr>
<td>OKAYA ELECTRIC INDUSTRIES CO., LTD.</td>
<td>SUP-EW10-ER-6</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Schaffner EMC</td>
<td>FN2070-10-06</td>
<td>FN2070-10-06</td>
<td>FN251-8-07</td>
</tr>
<tr>
<td>Tyco Electronics CORCOM</td>
<td>–</td>
<td>10ESK1</td>
<td>–</td>
</tr>
</tbody>
</table>

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 mm²) and the mains filter’s output cable AWG 18 to 14 (0.75 to 2.0 mm²) 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 mm²).

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 mm²) 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 mm²).

Wiring the external I/O signal cable

Use a shielded cable of AWG26 to 22 (0.14 to 0.3 mm²) 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.

1. Remove the front cover and terminal block cover.
2. Connect the power supply. (p.32)
3. Connect the motor connection cable. (p.33)
4. Install the terminal block cover.
5. Connect the signal connection cable. (p.34)
6. Make ground connections. (p.35)
7. Connect external I/O signals, if necessary. (p.37)
8. Install the front cover.

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.

Connecting the power supply p.32
Connect an appropriate power supply that matches the power specification of the product you are using.

Connecting the motor p.33
Connect the motor connection cable and signal connection cable.

Protective Earlthing p.35
Provide ground connections from the driver and motor.

Connecting external I/O signals p.37
- Connect external I/O signals when the motor is controlled by a programmable controller or other external control equipment.
- Make the necessary connection when the speed is set using an external potentiometer (sold separately) or external DC voltage.
- Make the necessary connection when a speed output signal or alarm output signal is used.

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.

![Single-phase connection diagram](image)

### Three-phase 200–240 V

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

![Three-phase connection diagram](image)

### 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 mm²)
  - BLFD200A2 type is AWG14 (2.0 mm²).
- **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.

![Diagram of connection](image)

| Crimp terminals on the motor connection cable | NICHIFU Co., Ltd. TMEN2-3.5S (3 pcs.) |
| 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)

<table>
<thead>
<tr>
<th>Driver terminal name</th>
<th>U</th>
<th>V</th>
<th>W</th>
<th>Protective Earth Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead color</td>
<td>Red</td>
<td>White</td>
<td>Black</td>
<td>Green/Yellow</td>
</tr>
<tr>
<td>Signal name</td>
<td>Motor phase U</td>
<td>Motor phase V</td>
<td>Motor phase W</td>
<td>PE</td>
</tr>
<tr>
<td>Connector pin No.</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Driver terminal name</th>
<th>VCC</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>GND</th>
<th>GND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead color</td>
<td>Yellow</td>
<td>Brown</td>
<td>Red</td>
<td>Orange</td>
<td>Green</td>
<td>-</td>
</tr>
<tr>
<td>Signal name</td>
<td>Sensor power</td>
<td>Signal input A</td>
<td>Signal input B</td>
<td>Signal input C</td>
<td>GND</td>
<td>Drain</td>
</tr>
<tr>
<td>Connector pin No.</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

- Section view of the signal connection cable
- Connector on the signal connection cable
- Connector on the signal cable

<table>
<thead>
<tr>
<th>A: Brown (AWG22)</th>
<th>VCC: Yellow (AWG22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braided shield</td>
<td>Drain: AWG22 or equivalent</td>
</tr>
<tr>
<td>B: Red (AWG22)</td>
<td>GND: Green (AWG22)</td>
</tr>
<tr>
<td>C: Orange (AWG22)</td>
<td></td>
</tr>
</tbody>
</table>

![Signal connection cable diagram]
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 mm²) and securely affix the cable using a round crimp terminal with insulation cover.

* BLFD200A2 type is AWG14 (2.0 mm²).

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

![Protective Earth Terminal](image)

- **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 mm²)
    * BLFD200A2 type is AWG14 (2.0 mm²).

**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 N·m (113.6 to 142 oz-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.

![Diagram of Protective Earth Terminal connection](image)

- **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 mm²)

**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.

![Diagram of Protective Earth Terminal connection](image)

- **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 mm²)
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.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Applicable cable size</th>
<th>Crimp terminal (bar terminal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHOENIX CONTACT GmbH &amp; Co. KG</td>
<td>AI 0.25-6</td>
<td>AWG26 to 24 (0.14 to 0.2 mm²)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AI 0.34-6</td>
<td>AWG22 (0.3 mm²)</td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Application</th>
<th>Necessary settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use input signals connected to terminals X1, X2 and X3</td>
<td>Switch the operation-signal input method to &quot;external input signals&quot; on the digital operator (p.68)</td>
</tr>
</tbody>
</table>
| Use an external potentiometer Use external DC voltage | • Select "external potentiometer" for operation data No.2 (p.52).  
• Short terminals M0 and C0.                      |

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.
### Input signal connection terminals

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

<table>
<thead>
<tr>
<th>Terminal position</th>
<th>Terminal name</th>
<th>Signal name</th>
<th>Description</th>
<th>Necessary settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower stage</td>
<td>X0</td>
<td>EXT-ERROR input *1</td>
<td>External alarm input (normally closed)</td>
<td>Remove the short bar and connect an external control equipment.</td>
</tr>
<tr>
<td></td>
<td>C0</td>
<td>IN-COM0</td>
<td>Input signal common</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>IN-COM0</td>
<td>Input signal common</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>X1</td>
<td>CW input *2</td>
<td>Clockwise rotation</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>X2</td>
<td>CCW input *2</td>
<td>Counterclockwise rotation</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>X3</td>
<td>STOP-MODE input *2</td>
<td>Selection of motor stop action</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>X4</td>
<td>NC</td>
<td>Not connected.</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>X5</td>
<td>ALARM-RESET input</td>
<td>Alarm reset</td>
<td>–</td>
</tr>
<tr>
<td>Upper stage</td>
<td>TH</td>
<td>NC</td>
<td>Not connected.</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>M0</td>
<td>M0 input</td>
<td>Operation data selection for multi-speed operation</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>M1</td>
<td>M1 input</td>
<td>Eight types of operation data can be selected by a combination of ON/OFF statuses of M0, M1 and M2 inputs.</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>M2</td>
<td>M2 input</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>VH</td>
<td>VH input</td>
<td>Speed setting using an external potentiometer or external DC voltage</td>
<td>• Select &quot;external potentiometer&quot; for operation data No.2.</td>
</tr>
<tr>
<td></td>
<td>VM</td>
<td>VM input</td>
<td>–</td>
<td>• Short M0 and C0.</td>
</tr>
<tr>
<td></td>
<td>VL</td>
<td>VL input</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>C3</td>
<td>IN-COM1</td>
<td>Input signal common (0 V)</td>
<td>–</td>
</tr>
</tbody>
</table>

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

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

---

![Diagram of input signal connection terminals](image-url)

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.

Output signal connection terminals

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

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

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.
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: MODE, ↑, ↓, SET, STOP, RUN

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 MODE . 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.

Monitor mode
The display starts in this mode when the power is turned on. The motor can be operated in this mode. The speed or load condition is displayed while the motor is operating. The operating speed can be changed and stored as data.

Direction setting mode
The motor direction that applies when the motor is operated from the digital operator is set.

Digital operator/external input signal setting mode
The input method of motor operation signals is selected from between the digital operator or external input signals.

Data setting mode
The data necessary for operating the motor are set.
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

<table>
<thead>
<tr>
<th>Unit model</th>
<th>Ratio</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Same direction as the motor</td>
<td>Opposite direction to the motor</td>
</tr>
<tr>
<td>BLF230</td>
<td>5 to 20, 200</td>
<td>30 to 100</td>
</tr>
<tr>
<td>BLF460</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLF5120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLF6200</td>
<td>5 to 20, 100, 200</td>
<td>30, 50</td>
</tr>
<tr>
<td>BLF6400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 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.
7.3 Operation mode transition

Monitor mode

- Speed display
- Load factor display

Direction setting mode

- Clockwise
- Counterclockwise

Data setting mode

- Operation data setting
- Operation data No.1
- Operation data No.2
- Operation data No.3

* Initial setting: 9.13 “Initializing data” (p.77)
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.

a) Operation using [RUN], [STOP] 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.

<table>
<thead>
<tr>
<th>Operation method</th>
<th>Speed setting method</th>
<th>① Internal potentiometer</th>
<th>② Digital setting</th>
<th>③ External potentiometer</th>
<th>④ External DC voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Digital operator</td>
<td>p.47</td>
<td>p.49</td>
<td>p.52</td>
<td>p.52</td>
<td></td>
</tr>
<tr>
<td>b) External input signals</td>
<td>*</td>
<td>p.55</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

### 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.”

![Initial display after power on](image)

### 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.
      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.
      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.
   \textbf{Note} Once the motor stops, the output shaft will become free.

\textbf{Timing chart}

\begin{itemize}
  \item The actual acceleration/deceleration time will vary depending on the specified speed and load condition (p.69).
\end{itemize}

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).
   \begin{itemize}
     \item 1. Press [MODE] to switch to the direction setting mode.
        The F/R LED will illuminate.
     \item 2. Press [\textbf{1}] or [\textbf{1}] to select a desired direction.
        For: Clockwise
        rEv: Counterclockwise
     \item 3. Press [SET] to confirm the selection.
        The display will blink.
   \end{itemize}

3. Set the operation method to “digital operator.”
   The initial setting is “Lo” (digital operator).
   \begin{itemize}
     \item 1. Press [MODE] to switch to the digital operator/external input
        signal setting mode.
        The LO/RE LED will illuminate.
     \item 2. Press [\textbf{1}] or [\textbf{1}] to select “Lo” (digital operator).
   \end{itemize}
3. Press [SET] to confirm the selection. The display will blink.

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.

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 \( \uparrow \) or \( \downarrow \) 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 \( \text{SET} \) to confirm the new setting.
   The display will blink and show “P.no1.”

5. Press \( \text{MODE} \) to switch to the monitor mode.

6. Operate the motor and adjust the speed.
   Press \( \text{RUN} \) on the digital operator.
   The motor will start operating and the RUN LED will illuminate.

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 \( \text{MODE} \) with the display showing the speed (e.g., 2000 r/min).
      The MNTR LED will blink.

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

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

8. Stop the motor.
   Press \( \text{STOP} \) on the digital operator. The motor will stop in the specified deceleration time.

   \[
   \text{Note:} \quad \text{Once the motor stops, the output shaft will become free and the load will no longer be held.}
   \]

**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.

<table>
<thead>
<tr>
<th>External potentiometer terminal</th>
<th>Driver terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>VH</td>
</tr>
<tr>
<td>2</td>
<td>VM</td>
</tr>
<tr>
<td>1</td>
<td>VL</td>
</tr>
</tbody>
</table>

- **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 k\(\Omega\) at both 5 V and 10 V. Connect the external DC power supply according to the table below.

<table>
<thead>
<tr>
<th>Signal wire</th>
<th>Driver terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>VM</td>
</tr>
<tr>
<td>-</td>
<td>VL</td>
</tr>
</tbody>
</table>

- **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 \textbf{MODE} to switch to the direction setting mode.
      The F/R LED will illuminate.
   2. Press \textup{↑} or \textup{↓} to select a desired direction.
      For: Clockwise
      \textit{rEv}: Counterclockwise
   3. Press \textbf{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 \textbf{MODE} to switch to the digital operator/external input
      signal setting mode.
      The LO/RE LED will illuminate.
   2. Press \textup{↑} or \textup{↓} to select “Lo” (digital operator).
   3. Press \textbf{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 \textbf{MODE} to switch to the data setting mode.
      The PRGM LED will illuminate and “SPd” will be displayed.
   2. Press \textbf{SET}.
      “P.no1” will be displayed.
   3. Press \textup{↑}.
      “P.no2” will be displayed.
   4. Press \textbf{SET}.
      The speed setting method will be displayed.
   5. Press \textup{↑} or \textup{↓} to select “E-vr” (external potentiometer).
6. Press \[\text{SET}\] 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/specifed time and the  
actual time. Check in 9.8 “Setting the acceleration time and deceleration time” on p.69.

1. Press \[\text{↑}\] or \[\text{↓}\] 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 \[\text{SET}\] to  
   confirm the new setting.  
The display will blink and show “dEc2”, after which the  
deceleration time will be displayed.

3. Press \[\text{↑}\] or \[\text{↓}\] 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 \[\text{SET}\] to  
   confirm the new setting.  
The display will blink and show “P.no2.”

5. Press \[\text{MODE}\] to switch to the monitor mode.

8. Operate the motor and adjust the speed.

1. Press \[\text{RUN}\] on the digital operator.  
The motor will start operating and the RUN LED will illuminate.

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

   ![External potentiometer vs. speed characteristics](image)

   ![External DC voltage vs. speed characteristics](image)

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

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

### Timing chart

- **Motor operation pattern**
- **Power**
- **Digital operator operation**

* 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.

   - **Motor operation pattern**
   - **EXT-ERROR**
     ON (Run) OFF (Stop)
   - **ALARM-OUT1**
     ON OFF (Alarm)

* 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
8  Basic operations

• 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.

Motor operation pattern

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.

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

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

2.5 ms

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.

<table>
<thead>
<tr>
<th>Type of protection function</th>
<th>ALARM-OUT1 output</th>
<th>ALARM-OUT2 output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal operation</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Overload protection function</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Other protection function</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Overload warning function</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

| 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. |
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.

### Motor operation pattern

<table>
<thead>
<tr>
<th>Motor Operation Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ALARM-RESET</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ALARM-OUT1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ALARM-OUT2</td>
</tr>
</tbody>
</table>

**Protection function**

- Overload protection/alarm reset
- Protection function other than overload protection/alarm reset

**Overload warning**

- 10 ms or more
- OFF

**Spontaneous stop**

- CW

**Enabling overload warning**

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 \[ \text{↑} \] or \[ \text{↓} \] to select “SPd1” (digital setting).

5. Press \[ \text{SET} \].

The current speed setting will be displayed.

6. Press \[ \text{↑} \] or \[ \text{↓} \] 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 \[ \text{SET} \] to confirm the new setting.

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

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 \[ \text{↑} \] or \[ \text{↓} \] 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 \[ \text{SET} \] to confirm the new setting.

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

3. Press \[ \text{↑} \] or \[ \text{↓} \] 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 \[ \text{SET} \] to confirm the new setting.

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

5. Press \[ \text{MODE} \] to switch to the monitor mode.

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

<table>
<thead>
<tr>
<th>Operation data</th>
<th>M0 input</th>
<th>M1 input</th>
<th>M2 input</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

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.

2. Press [↑] or [↓] to change the motor speed.
   (e.g., 1000 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 display will blink and the new speed will be set digitally as the speed in operation No.1.

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.

<table>
<thead>
<tr>
<th>Operation data</th>
<th>M0 input</th>
<th>M1 input</th>
<th>M2 input</th>
<th>Speed setting method</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Internal potentiometer/digital setting</td>
</tr>
<tr>
<td>No.2</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>External potentiometer/digital setting</td>
</tr>
<tr>
<td>No.3</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>Digital setting</td>
</tr>
<tr>
<td>No.4</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>Digital setting</td>
</tr>
<tr>
<td>No.5</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>Digital setting</td>
</tr>
<tr>
<td>No.6</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>Digital setting</td>
</tr>
<tr>
<td>No.7</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>Digital setting</td>
</tr>
<tr>
<td>No.8</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>Digital setting</td>
</tr>
</tbody>
</table>

**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.

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.

<table>
<thead>
<tr>
<th>Operation data</th>
<th>M0 input</th>
<th>M1 input</th>
<th>M2 input</th>
<th>Speed setting method</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Internal potentiometer</td>
</tr>
<tr>
<td>No.2</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>External potentiometer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor operation pattern</th>
<th>Internal/external speed switching</th>
<th>Direction change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internally set speed</td>
<td>CW</td>
<td>CCW</td>
</tr>
<tr>
<td>Externally set speed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power</th>
<th>Digital operator operation</th>
<th>M0 input</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>RUN</td>
<td>ON</td>
</tr>
<tr>
<td>OFF</td>
<td>STOP</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Note that the power can be turned on or off when the motor is stopped. The direction setting can be changed after pressing [RUN] and the motor is stopped for 2 seconds.
**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).

![Motor operation pattern diagram]

**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.

![Power input and driver layout diagram]

**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 VRx of the external potentiometer using the formula below:
Resistance VRx = 20/n (kΩ), n/4 (W)
Example: If two drivers are used, resistance VRx is calculated as 10 kΩ, 1/2 W (20/2 (kΩ), 2/4 (W)).
If the speed will vary among the respective motors, make adjustments by connecting a resistor of 1.5 kΩ, 1/4 W to terminal M on driver 1 and connecting a variable resistor of 5 kΩ, 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:
Current capacity I = 1 × n (mA)
Example: If two drivers are used, current capacity I is calculated as 2 mA or more (1 × 2 (mA)).
If the speed will vary among the respective motors, make adjustments by connecting a resistor of 1.5 kΩ, 1/4 W to terminal M on driver 1 and connecting a variable resistor of 5 kΩ, 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 ↑ or ↓ 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.

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

*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 \textbf{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.

2. To cancel the key lock, press \textbf{SET} for 3 seconds or more. “L.oFF” will blink and the key operation will be enabled.

Even when the key lock is active, \textbf{STOP} remains enabled if the motor is in the digital operator mode. In the external input signal mode, \textbf{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.

\textbf{Internal potentiometer, external potentiometer or external DC voltage}

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

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 \textbf{SET}.

   “SPd1” will be displayed.

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

5. Press \textbf{SET}.

   The new speed will be set to the operation data digitally.
### 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.

   ![Image of the display showing speed](image)

   Press **MNTR**

2. Press **↑** or **↓** to change the motor speed.
   (e.g., 2000 r/min)
   The speed will change while **↑** or **↓** is being pressed.

   ![Image of speed change](image)

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.

   ![Image of confirmation](image)

### 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.

   ![Image of direction LED](image)

2. Press **↑** or **↓** to select a desired direction.
   For: Clockwise
   rEv: Counterclockwise

   ![Image of direction selection](image)

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

   ![Image of confirmation](image)

### 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.

   ![Image of input method LED](image)

2. Press **↑** or **↓** to select the operation method.
   Lo: Operation using the digital operator
   rE: Operation using external input signals

   ![Image of input method selection](image)

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

   ![Image of confirmation](image)
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).

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:

\[
\text{Acceleration time set in operation data} = \frac{3000 \text{ r/min}}{2000 \text{ r/min}} \times 2 \text{ seconds} = 3 \text{ seconds}
\]

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:

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

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

\[
\text{Conveyor transfer speed (m/min) = Motor shaft speed (r/min)} / \text{Conveyor gear ratio}
\]
Example: When the pulley diameter is 0.1 m and gearhead gear ratio is 20

\[
\text{Conveyor gear ratio} = \frac{\text{Gearhead gear ratio}}{\text{Pulley diameter (m) } \times \frac{\pi}{2}} = \frac{20}{0.1 \times \frac{\pi}{2}} \approx 63.7
\]

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:

\[
\text{Conveyor transfer speed} = \frac{1300}{63.7} \approx 20.4 \text{ (m/min)}
\]

### 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.

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

### 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.

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

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

1. Press [MODE] to switch to the data setting mode.
   The PRGM LED will illuminate and “SPd” will be displayed.

2. Press [↑] twice to select “inP” (input mode), and then press [SET].

3. Press [↑] or [↓] to select a desired input mode.
   (e.g., 2wir)
   - 2wir: 2-wire input mode
   - 3wir: 3-wire input mode

4. Press [SET] to confirm the selection.

5. Press [MODE] to switch to the monitor mode.
■ Timing chart in the 2-wire mode

- Motor operation pattern
- CW
  - ON
  - OFF
- CCW
  - ON
  - OFF
- STOP-
  - ON
  - OFF

■ Timing chart in the 3-wire mode

- Motor operation pattern
- CW
  - ON
  - OFF
- START/
  - ON
  - OFF
- STOP
- RUN/
  - ON
  - OFF
- BRAKE
- CW/
  - ON
  - OFF

* 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 \textbf{STOP} on the digital operator.
Pressing \textbf{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).

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

1. Press \textbf{MODE} to switch to the data setting mode.
The PRGM LED will illuminate and “SPd” will be displayed.

2. Press \textbf{↑} three times to select “StoP” (STOP key setting), and then press \textbf{SET}.

3. Press \textbf{↑} or \textbf{↓} to enable/disable the STOP key (e.g., on).
on: Enable the STOP key
off: Disable the STOP key

4. Press \textbf{SET} to confirm the selection.

5. Press \textbf{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 diagram with relays and contact switches]

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

![Input circuit diagram with transistors]

- **Output circuit**

![Output circuit diagram with transistors and current limiting resistor]

* 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.
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.
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.

<table>
<thead>
<tr>
<th>Alarm code</th>
<th>Alarm description</th>
<th>Action</th>
<th>ALARM-RESET input</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL20</td>
<td>Overcurrent</td>
<td>Excessive current flowed through the driver due to a ground fault, etc.</td>
<td>Check the cables between the driver and motor for breakage.</td>
</tr>
<tr>
<td>AL22</td>
<td>Overvoltage</td>
<td>- The voltage impressed on the driver exceeded 120 or 240 V by approx. 20%. - A load exceeding the allowable load inertia was driven.</td>
<td>Check the power supply voltage. - Reduce the load inertia.</td>
</tr>
<tr>
<td>AL25</td>
<td>Insufficient voltage protection</td>
<td>The voltage impressed on the driver dropped below approx. 40% of 100 or 200 V.</td>
<td>Check the power supply voltage. Check the wiring of the power cable.</td>
</tr>
<tr>
<td>AL29</td>
<td>CPU error</td>
<td>Improper connection between the driver and digital operator.</td>
<td>Check the connection with the digital operator.</td>
</tr>
<tr>
<td>AL30</td>
<td>Overload protection</td>
<td>A load exceeding the rated torque was applied to the motor for approx. 5 seconds or more.</td>
<td>• Reduce the load. • Change the operation pattern including the acceleration/deceleration time.</td>
</tr>
<tr>
<td>AL31</td>
<td>Overspeed protection</td>
<td>The speed of the motor output shaft exceeded approx. 4800 r/min.</td>
<td>Reduce the speed to 4000 r/min or below.</td>
</tr>
<tr>
<td>AL41</td>
<td>EEPROM error</td>
<td>Operation data set in the digital operator cannot be rewritten or read.</td>
<td>If the alarm doesn’t reset after reconnecting the power, contact your nearest Oriental Motor branch or sales office.</td>
</tr>
<tr>
<td>AL42</td>
<td>Motor sensor error</td>
<td>Improper signal cable connection or wire breakage.</td>
<td>Check the cable for breakage or improper connection.</td>
</tr>
<tr>
<td>AL46</td>
<td>Operation error</td>
<td>The power was reconnected while the motor was operating in the external input signal mode.</td>
<td>Turn the operation signals OFF and then turn on the power.</td>
</tr>
<tr>
<td>AL6E</td>
<td>External error</td>
<td>The motor stopped due to the EXT-ERROR input.</td>
<td>Remove the cause that triggered the EXT-ERROR input.</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Problem</th>
<th>Likely cause</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing is displayed after the power is turned on.</td>
<td>The digital operator was not connected properly when the power was turned on.</td>
<td>Check the connection of the digital operator and then turn on the power again.</td>
</tr>
<tr>
<td>Digital operator mode</td>
<td>The motor is not set to the digital operator mode.</td>
<td>Select “Lo” (digital operator) in the digital operator/external input signal setting mode.</td>
</tr>
<tr>
<td>External input signal mode</td>
<td>The motor is not set to the external input signal mode.</td>
<td>Select “rE” (external input signals) in the digital operator/external input signal setting mode.</td>
</tr>
<tr>
<td>Both the CW and CCW inputs are ON.</td>
<td></td>
<td>Turn On either the CW or CCW input at a time.</td>
</tr>
<tr>
<td>Both the CW and CCW inputs are OFF.</td>
<td></td>
<td>Turn On either the CW or CCW input at a time.</td>
</tr>
<tr>
<td>Internal potentiometer mode</td>
<td>The internal potentiometer is set to 0 r/min.</td>
<td>Turn the internal potentiometer clockwise. The factory setting is 0 r/min.</td>
</tr>
<tr>
<td>The M0, M1 and M2 inputs are not OFF.</td>
<td></td>
<td>Set the M0, M1 and M2 inputs to OFF, or do not connect anything.</td>
</tr>
<tr>
<td>External potentiometer (external DC voltage) mode</td>
<td>The external potentiometer is not connected properly.</td>
<td>Check the connection with the external potentiometer.</td>
</tr>
<tr>
<td>The external DC power supply is not connected properly.</td>
<td></td>
<td>Check the connection with the external DC power supply.</td>
</tr>
<tr>
<td>The M0 input is not ON while the M1 and M2 inputs are not OFF.</td>
<td></td>
<td>Set the M0 input to ON and the M1 and M2 inputs to OFF when using an external potentiometer or external DC voltage.</td>
</tr>
<tr>
<td>Digital setting mode</td>
<td>Speed is not set.</td>
<td>Set the speed digitally. The factory setting is 0 r/min.</td>
</tr>
<tr>
<td>The correct operation data is not selected by the M0, M1 and M2 inputs.</td>
<td></td>
<td>Select the operation data in which the desired speed is set, by combining the ON/OFF statuses of M0, M1 and M2 inputs correctly.</td>
</tr>
<tr>
<td>An alarm code is displayed on the digital operator.</td>
<td></td>
<td>Reset the alarm by referring to 10.2 “Protection functions of the driver” on p.80.</td>
</tr>
</tbody>
</table>
| 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:  
• The correct input mode is selected.  
• I/O signal connection terminals X1 (CW input) and X2 (CCW input) are connected correctly. |
<p>| 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). |</p>
<table>
<thead>
<tr>
<th>Problem</th>
<th>Likely cause</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unstable motor operation&lt;br&gt;• Large vibration or speed fluctuation</td>
<td>The center of the motor (gearhead) output shaft is not aligned with the center of the load shaft.</td>
<td>Check the coupling condition of the motor (gearhead) output shaft and load shaft.</td>
</tr>
<tr>
<td></td>
<td>Effect of noise.</td>
<td>Implement noise elimination measures by referring to Chapter 3 &quot;Precautions for use&quot; on p.9, 5.10 &quot;Installing and wiring in compliance with EMC Directives&quot; on p.28. Provide ample clearances between the cables.</td>
</tr>
<tr>
<td>The motor doesn’t stop instantaneously.</td>
<td>The load exceeds the allowable inertia.</td>
<td>Check the allowable inertia of the motor and change the load inertia.</td>
</tr>
<tr>
<td></td>
<td>The deceleration time is too long.</td>
<td>Check the deceleration time set in the operation data.</td>
</tr>
<tr>
<td>The motor speed doesn’t rise quickly at start.</td>
<td>The load exceeds the allowable inertia.</td>
<td>Check the allowable inertia of the motor and change the load inertia.</td>
</tr>
<tr>
<td>Pressing [MODE] will not switch to the monitor mode (the MNTR LED does not illuminate).</td>
<td>An operation signal or signals have been input.</td>
<td>Turn all operation signal inputs OFF.</td>
</tr>
<tr>
<td></td>
<td>The RUN LED illuminates.</td>
<td>Turn all operation signal inputs OFF, or press [STOP] .</td>
</tr>
</tbody>
</table>
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).

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

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.

<table>
<thead>
<tr>
<th>Cable length</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 m (6.56 ft.) type</td>
<td>BLFHS-02</td>
</tr>
<tr>
<td>5 m (16.4 ft.) type</td>
<td>BLFHS-05</td>
</tr>
</tbody>
</table>

- **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 variable resistor 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)

• Reference Mounting Hole Dimensions [Unit: mm (in.)]

   - Ø3 (Ø0.12)
   - Ø10 (Ø0.39)

<table>
<thead>
<tr>
<th>Variable resistor</th>
<th>Insulation sheet</th>
<th>Mounting plate</th>
<th>Dial plate</th>
<th>Setscrew</th>
<th>Toothed washer</th>
<th>Nut</th>
</tr>
</thead>
</table>

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

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.

<table>
<thead>
<tr>
<th>Model</th>
<th>BLF230 BLF460C, BLF460S BLF5120S</th>
<th>BLF460A, BLF5120A BLF5120C, BLF6200C BLF6200S, BLF6400S</th>
<th>BLF6200A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current of protective device</td>
<td>5 A</td>
<td>10 A</td>
<td>15 A</td>
</tr>
<tr>
<td>Circuit breaker</td>
<td>Mitsubishi Electric Corporation NF30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TDK Corporation</td>
<td>ZAG2210-11S</td>
<td>ZAG2210-11S</td>
<td>–</td>
</tr>
<tr>
<td>TDK-Lambda Corporation</td>
<td>MC1210</td>
<td>MC1210</td>
<td>MC1310</td>
</tr>
<tr>
<td>OKAYA ELECTRIC INDUSTRIES CO., LTD.</td>
<td>SUP-EW10-ER-6</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Schaffner EMC</td>
<td>FN2070-10-06</td>
<td>FN2070-10-06</td>
<td>FN251-8-07</td>
</tr>
<tr>
<td>Tyco Electronics CORCOM</td>
<td>–</td>
<td>10ESK1</td>
<td>–</td>
</tr>
</tbody>
</table>

Overvoltage category II applies to mains filters.
### 13.4 Initial settings

#### Driver

**Selector switch**

<table>
<thead>
<tr>
<th>Name</th>
<th>Initial setting</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>External voltage selection switch</td>
<td>5 VDC</td>
<td>5 VDC, 10 VDC</td>
</tr>
<tr>
<td>Sink/Source selector switch</td>
<td>Sink logic</td>
<td>Source logic</td>
</tr>
</tbody>
</table>

#### Digital operator

**Direction setting mode**

<table>
<thead>
<tr>
<th>Name</th>
<th>Initial setting</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction</td>
<td>For</td>
<td>For: Clockwise, rEv: Counterclockwise</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Initial setting</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital operator/external input signal setting</td>
<td>Lo</td>
<td>Lo: Operation using the digital operator, rE: Operation using external input signals</td>
</tr>
</tbody>
</table>

**Speed selection mode**

<table>
<thead>
<tr>
<th>Name</th>
<th>Initial setting</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation data</td>
<td>P.no1</td>
<td>P.no1 to 8</td>
</tr>
<tr>
<td>Speed</td>
<td>0 r/min</td>
<td>80 to 4000 r/min</td>
</tr>
<tr>
<td>Acceleration time</td>
<td>0.5 s</td>
<td>0.2 to 15 s</td>
</tr>
<tr>
<td>Deceleration time</td>
<td>0.5 s</td>
<td>0.2 to 15 s</td>
</tr>
<tr>
<td>Speed setting method for operation data No.1</td>
<td>i-vr</td>
<td>i-vr: Internal potentiometer, SPD1: Digital setting</td>
</tr>
<tr>
<td>Speed setting method for operation data No.2</td>
<td>E-vr</td>
<td>E-vr: External potentiometer or external DC voltage, SPD2: Digital setting</td>
</tr>
<tr>
<td>Gear ratio</td>
<td>1.00 r/min</td>
<td>r/min: Gearhead output shaft speed, m/min: Conveyor transfer speed</td>
</tr>
<tr>
<td>Input mode</td>
<td>2wir</td>
<td>2wir: 2-wire input mode, 3wir: 3-wire input mode</td>
</tr>
<tr>
<td>STOP key enable/disable</td>
<td>on</td>
<td>on: Enable, oFF: Disable</td>
</tr>
</tbody>
</table>

**Overload warning function**

<table>
<thead>
<tr>
<th>Name</th>
<th>Initial setting</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload warning function</td>
<td>oFF</td>
<td>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%)</td>
</tr>
</tbody>
</table>