Oriental motor

HM-5109-3

Brushless Motor and Driver Package

BLE Series

Standard type, Electromagnetic brake type

OPERATING MANUAL

Thank you for purchasing an Oriental Motor product.
This Operating Manual describes product handling procedures and safety precautions.

- Please read it thoroughly to ensure safe operation.
- Always keep the manual where it is readily available.

Table of contents

1 Introduction

■ Before use

This product must be handled by qualified personnel.
Before using motor unit, read 2 “Safety precautions” on p.4 carefully to understand its correct use.
The **BLE** 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 **BLE** Series is a line of units, each consisting of a compact, high-torque brushless motor and a high-functional box-type driver.
Each unit has a **FBL**Ⅱ compatible mode, so existing users of **FBL**Ⅱ Series units can use the **BLE** Series units with the same settings.
With the accessory data setter **OPX-2A** or data editing software **MEXE02** (both are sold separately), you can improve the performance and set operation data/ parameters and motor operations with ease.

■ Standards and CE Marking

This product is recognized by UL. The CE Marking (Low Voltage Directive and EMC Directive) is affixed to the product in accordance with EN Standards.
The name of products certified to conform with relevant standards are represented by applicable unit model motor and driver part numbers.

- Applicable Standards

	Applicable Standards	Certification Body	Standards File No.	CE Marking
Motor*	UL 1004-1 CSA C22.2 No.100	UL	E335369	Low Voltage Directive EMC Directives
	EN60034-1 EN60034-5 EN60664-1 EN60950-1	Conform to EN Standards		
Driver	UL 508C CSA C22.2 No.14	UL	E171462	
	EN 60950-1 EN 61800-5-1	Conform to EN Standards		

* Thermal class UL/CSA Standards: 105(A), EN Standards: 120(E)

A temperature test has been conducted with a radiation plate. The size, thickness and material of the radiation plates are as below table.

Model	Size [mm (in.)]	Thickness [mm (in.)]	Material
BLEM23	115×115 (4.53×4.53)*	5 (0.20)	Aluminum
BLEM46	135×135 (5.31×5.31)		
BLEM512	165×165 (6.50×6.50)		

* Electromagnetic brake type: 135×135 mm (5.31×5.31 in.)

- Installation conditions

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

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

- Low Voltage Directive

The product is a type to be incorporated into machinery, 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 “Example of motor and driver installation and wiring” on p.26.Be sure to conduct EMC measures with the product assembled in your equipment by referring to 6.11 “Installing and wiring in compliance with EMC Directive” p.25.

■ UL RECOGNITION OF DRIVER

Drivers are recognized by UL at following condition.

- Maximum Surrounding Air Temperature 50°C.
- Install device in pollution degree 2 environment.
- Solid state motor overload protection reacts at less than 160% FLA.
- Suitable For Use On A Circuit Capable Of Delivering Not More Than 5,000 Arms Symmetrical Amperes, 120 or 240 VAC Maximum Voltage.
- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes.
- Use UL Listed Inverse Time Circuit Breaker rated 120 or 240 VAC, 15 A Only.
- Drives have no provision for motor over temperature protection. Motor over temperature protection is required at end application.

■ Hazardous substances

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

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

- 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.
- The terminals on the driver’s front panel marked with ⚠ ⚠ symbol indicate the presence of high voltage. Do not touch these terminals while the power is on to avoid the risk of fire or electric shock.
- Do not use a non-electromagnetic brake type motor in a vertical application. 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.
- Do not use the brake mechanism of the electromagnetic brake motor as a safety brake. It is intended to hold the moving parts and motor position. Doing so may result in injury or damage to equipment.
- 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.
- 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.
- 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 or connection cable. Doing so may result in electric shock or fire.
- Be sure to observe the specified cable sizes. Use of unspecified cable sizes may result in fire.
- Observe the specified screw tightening torque when connecting terminals to the terminal block. Failure to do so may result in electric shock or equipment damage.
- Always keep the driver’s power supply voltage below the rating. Failure to do so may result in fire or electric shock.
- When using the electromagnetic brake motor, do not turn the MB-FREE input ON while a load is held in vertical direction. Otherwise, the holding power of the motor and electromagnetic brake will be lost, causing personal injury or damage to equipment.
- When using the electromagnetic brake motor in vertical drive (gravitational operation), be sure to operate after checking the load condition. If a load in excess of the rated torque is applied or the small torque limiting value is set using a **OPX-2A** or **MEXE02** (accessories), the load may fall. This may result in injury or damage to equipment.
- 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 30 seconds or until the CHARGE LED turns off) after the power is turned off. Residual voltage may cause electric shock.
- Regularly check the openings in the driver for accumulated dust. Accumulated 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

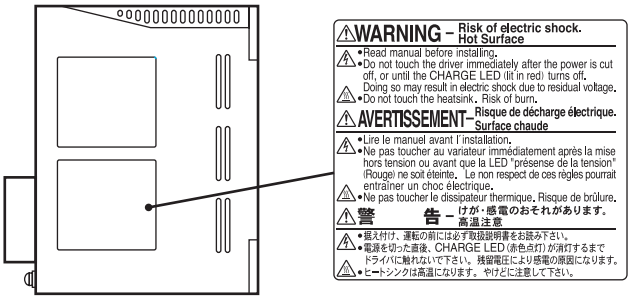
- Do not use the product in conditions exceeding the motor (gearhead) or driver specifications. Doing so may result in electric shock, fire, injury or equipment damage.
- Do not insert an object into the openings in the driver. Doing so may result in fire, electric shock or injury.
- Do not touch the motor (gearhead) or driver during the operation or immediately after the operation has stopped. Touching a hot motor (gearhead) or driver surface may cause a skin burn(s).
- Do not carry the product by the motor (gearhead) output shaft or any of the cables. Doing so may result in injury.
- Do not place around the motor and driver any object blocking the air flow. 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.
- For the I/O signals power supply, use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.
- 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 under normal operating conditions. If the operator is allowed to approach a running motor, attach a warning label as shown to the right in a conspicuous position. Failure to do so may result in skin burn(s).


Warning label

- Use an insulated screwdriver to adjust the internal speed potentiometer, acceleration time potentiometer, deceleration time potentiometer and switches in the driver. Failure to do so may result in electric shock.
- 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 driver.
Be sure to observe the instructions on the label when handling the driver.



3 Precautions for use

This chapter explains the restrictions and other items you should take heed of when using the **BLE** Series standard type.

- 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 "Preventing leakage current" below for the selection of protective devices.

- Use an electromagnetic brake type for an application involving vertical travel

  When the motor is used in an application involving vertical travel, use an electromagnetic brake type to hold the load in position.

- 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 the product.

- Grease measures

  On rare occasions, a small amount of grease may ooze out from the gearhead. If there is concern over possible environmental damage resulting from the leakage of grease, check for grease stains during regular inspections. Alternatively, install an oil pan or other device to prevent leakage from causing further damage. Oil leakage may lead to problems in the customer's equipment or products.

- Apply grease to the output shaft of a 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.

- Preventing leakage current

  Stray capacitance exists between the driver's current-carrying line and other current-carrying lines, the earth and the motor, respectively. A high-frequency current may leak out through such capacitance, having a detrimental effect on the surrounding equipment. The actual leakage current depends on the driver's switching frequency, the length of wiring between the driver and motor, and so on.
  When connecting an earth leakage breaker, use one of the following products offering resistance against high frequency current:
  Mitsubishi Electric Corporation: NV series
  Fuji Electric FA Components & Systems Co., Ltd.: EG and SG series

- Noise elimination measures

  Provide noise elimination measures to prevent a motor or driver malfunction caused by external noise.
  For more effective elimination of noise, use a shielded I/O signal cable or attach ferrite cores if a non-shielded cable is used. Refer to p.25 for the noise elimination measures.

- Note on connecting a power supply whose positive terminal is grounded

  The communication connector (CN3) and I/O signal connector (CN5) are not insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and PC to short, damaging both.

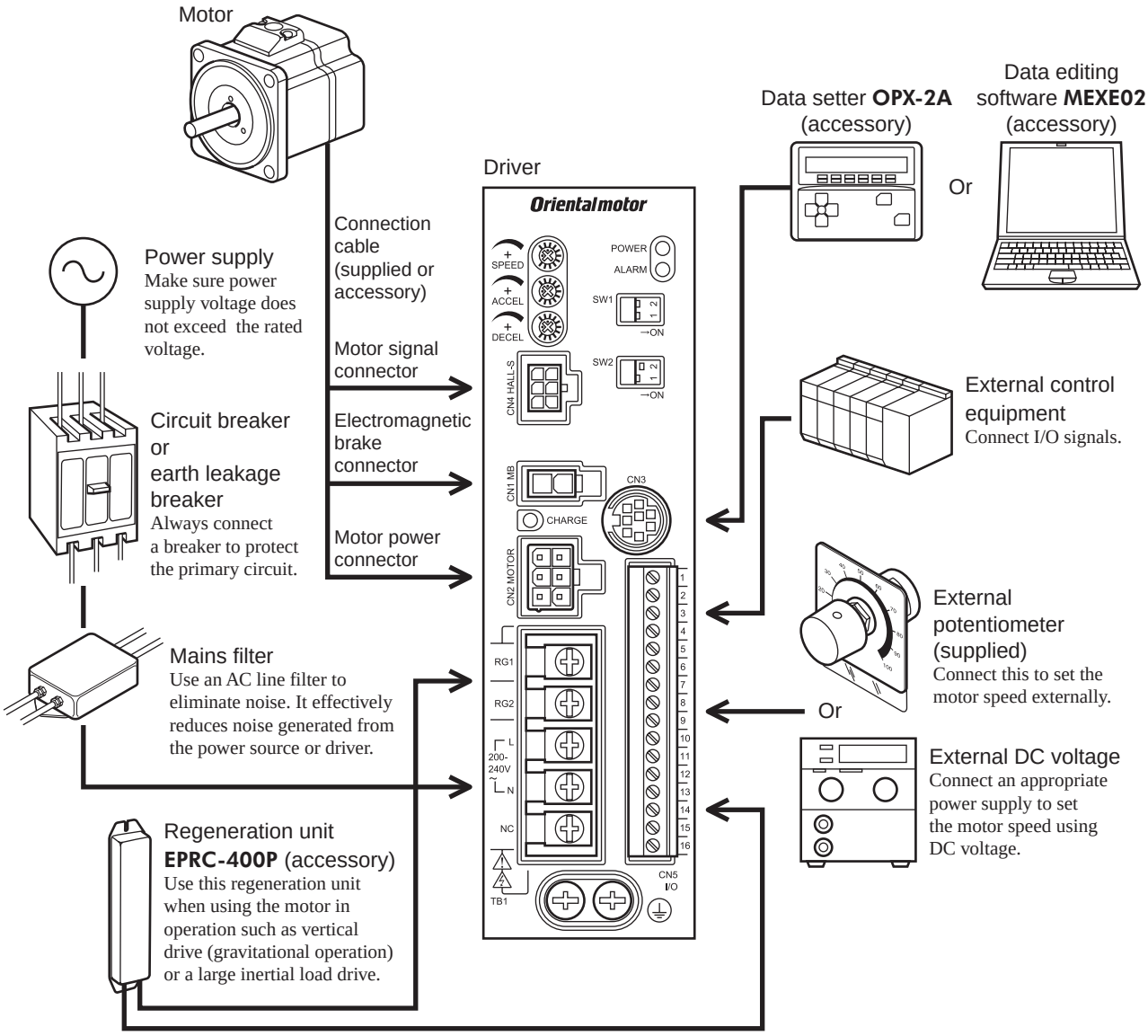
- Use a connection cable (supplied or accessory) when extending the wiring distance between the motor and driver

- When using the motor in operation such as vertical drive (gravitational operation) or a large inertial load drive, use an accessory regeneration unit (sold separately).

  The driver may be damaged if the regeneration energy generated during vertical drive (gravitational operation) or sudden starting/stopping of a large inertial load exceeds the allowable limit that can be absorbed by the driver.
  The accessory regeneration unit (sold separately) is designed to discharge the regenerated energy, thereby protecting the driver.

4 System configuration

An example of system configuration using the **BLE** Series electromagnetic brake type is shown below.



5 Preparation

This chapter explains the items you should check, as well as the names and functions of each part.

5.1 Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the branch or sales office from which you purchased the product.
Verify the model number of the purchased product against the number shown on the package label.
Check the model number of the motor and driver against the number shown on the nameplate.
Model names for motor and driver combinations are listed in section 5.3 “Combination tables.”

- Motor ..... 1 unit (with a gearhead, only for combination type)
- Driver ..... 1 unit
- Connection cable ..... 1 pc. (Only models with a supplied connection cable)
- Operating manual (this manual) ..... 1 copy
- External potentiometer ..... 1 pc.
- Signal cable for external potentiometer ... 1 pc. [1 m (3.3 ft.)]

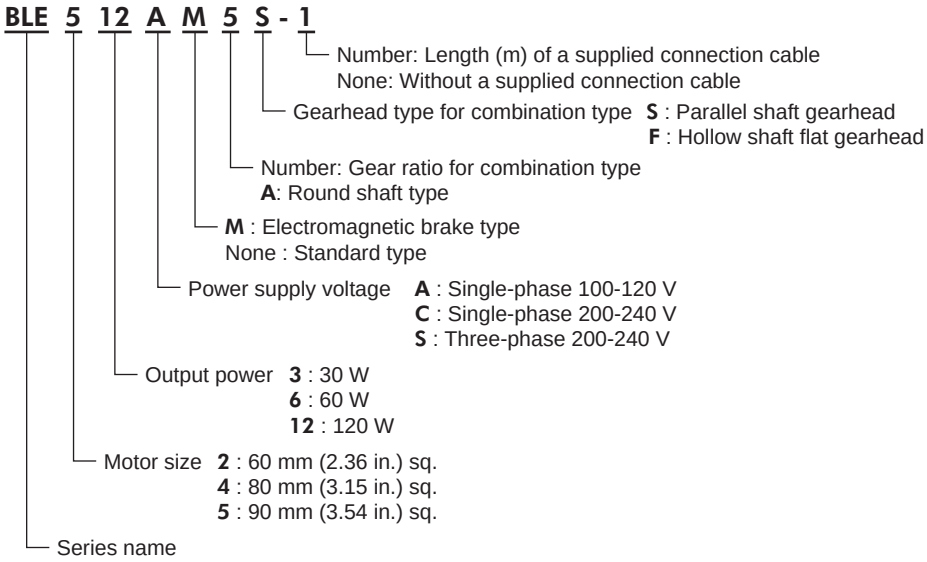
Accessories for combination type parallel shaft gearhead

- Hexagonal socket head screw set ..... 1 set (Hexagonal socket head screw, flat washer, spring washer and nut, 4 pcs. each)
- Parallel key ..... 1 pc.

Accessories for combination type hollow shaft flat gearhead

- Hexagonal socket head screw set ..... 1 set (Hexagonal socket head screw, flat washer, spring washer and nut, 4 pcs. each)
- Safety cover ..... 1 pc.
- Safety cover mounting screw ..... 2 pcs.
- Parallel key ..... 1 pc.

5.2 How to identify the product model



5.3 Combination tables

□ in the model names indicates a number representing the gear ratio.
■ indicates a number representing the length of a connection cable.
The combination types come with the motor and gearhead pre-assembled.

■ Standard type

Motor type	Model	Motor model	Gearhead model	Driver model
Combination type parallel shaft gearhead	**BLE23A□S-■**	BLEM23-GFS	GFS2G□	BLED3A
	BLE23C□S-■			BLED3C
	BLE23S□S-■			BLED3S
	BLE46A□S-■	BLEM46-GFS	GFS4G□	BLED6A
	BLE46C□S-■			BLED6C
	BLE46S□S-■			BLED6S
	BLE512A□S-■	BLEM512-GFS	GFS5G□	BLED12A
	BLE512C□S-■			BLED12C
	BLE512S□S-■			BLED12S
Combination type hollow shaft flat gearhead	**BLE23A□F-■**	BLEM23-GFS	GFS2G□FR	BLED3A
	BLE23C□F-■			BLED3C
	BLE23S□F-■			BLED3S
	BLE46A□F-■	BLEM46-GFS	GFS4G□FR	BLED6A
	BLE46C□F-■			BLED6C
	BLE46S□F-■			BLED6S
	BLE512A□F-■	BLEM512-GFS	GFS5G□FR	BLED12A
	BLE512C□F-■			BLED12C
	BLE512S□F-■			BLED12S
Round shaft type	**BLE23AA-■**	BLEM23-A	−	BLED3A
	BLE23CA-■		−	BLED3C
	BLE23SA-■		−	BLED3S
	BLE46AA-■	BLEM46-A	−	BLED6A
	BLE46CA-■		−	BLED6C
	BLE46SA-■		−	BLED6S
	BLE512AA-■	BLEM512-A	−	BLED12A
	BLE512CA-■		−	BLED12C
	BLE512SA-■		−	BLED12S

■ Electromagnetic brake type

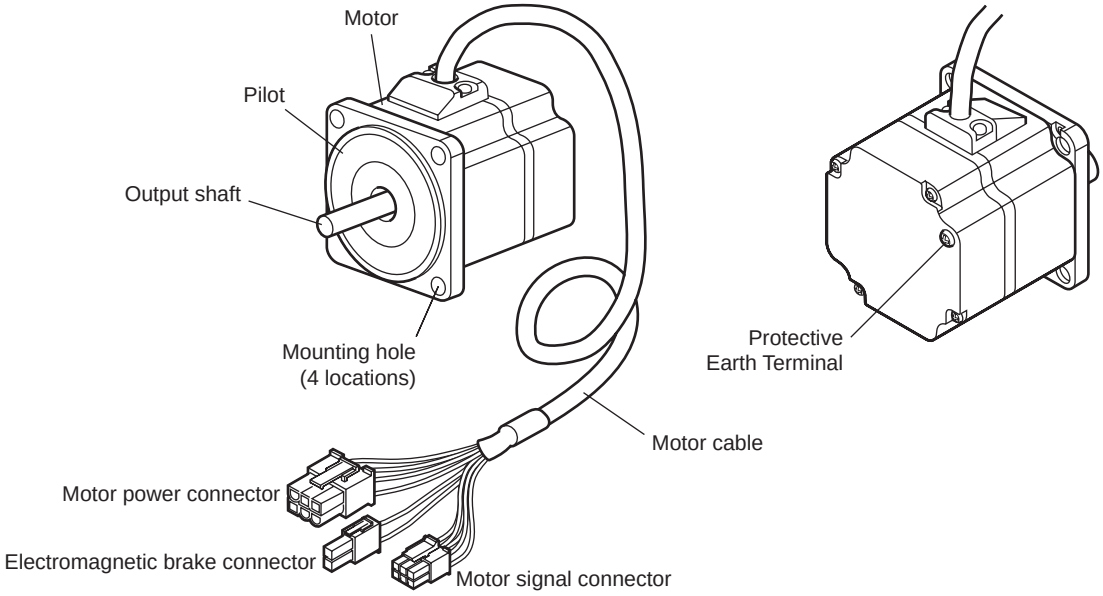
Motor type	Model	Motor model	Gearhead model	Driver model
Combination type parallel shaft gearhead	**BLE23AM□S-■**	BLEM23M2-GFS	GFS2G□	BLED3AM
	BLE23CM□S-■			BLED3CM
	BLE23SM□S-■			BLED3SM
	BLE46AM□S-■	BLEM46M2-GFS	GFS4G□	BLED6AM
	BLE46CM□S-■			BLED6CM
	BLE46SM□S-■			BLED6SM
	BLE512AM□S-■	BLEM512M2-GFS	GFS5G□	BLED12AM
	BLE512CM□S-■			BLED12CM
	BLE512SM□S-■			BLED12SM
Combination type hollow shaft flat gearhead	**BLE23AM□F-■**	BLEM23M2-GFS	GFS2G□FR	BLED3AM
	BLE23CM□F-■			BLED3CM
	BLE23SM□F-■			BLED3SM
	BLE46AM□F-■	BLEM46M2-GFS	GFS4G□FR	BLED6AM
	BLE46CM□F-■			BLED6CM
	BLE46SM□F-■			BLED6SM
	BLE512AM□F-■	BLEM512M2-GFS	GFS5G□FR	BLED12AM
	BLE512CM□F-■			BLED12CM
	BLE512SM□F-■			BLED12SM
Round shaft type	**BLE23AMA-■**	BLEM23M2-A	−	BLED3AM
	BLE23CMA-■		−	BLED3CM
	BLE23SMA-■		−	BLED3SM
	BLE46AMA-■	BLEM46M2-A	−	BLED6AM
	BLE46CMA-■		−	BLED6CM
	BLE46SMA-■		−	BLED6SM
	BLE512AMA-■	BLEM512M2-A	−	BLED12AM
	BLE512CMA-■		−	BLED12CM
	BLE512SMA-■		−	BLED12SM

5.4 Names and functions of parts

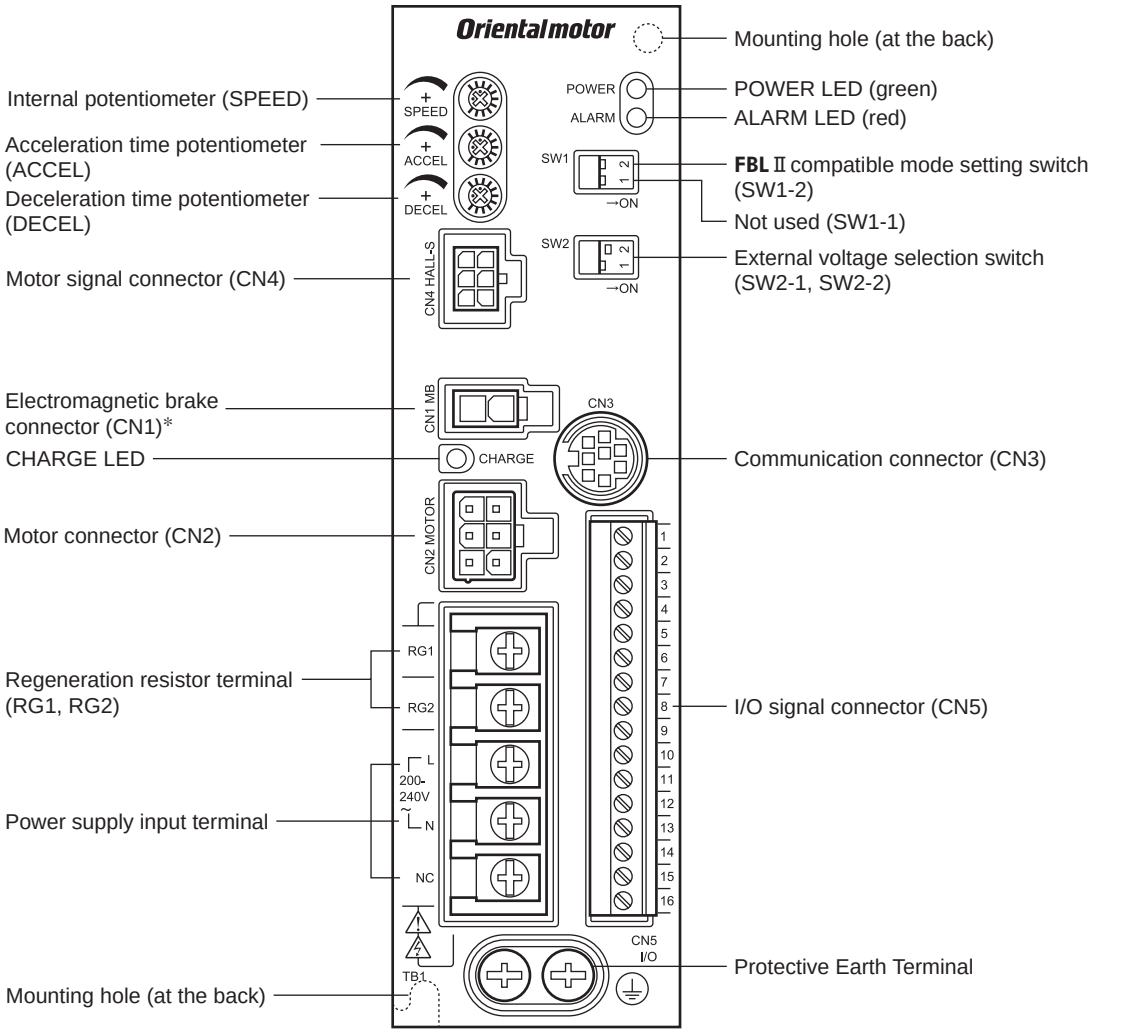
This section explains the name and function of each part of the motor and driver.

■ Motor

Illustration shows the electromagnetic brake type.



■ Driver



* Electromagnetic brake type only

Name	Explanation	Ref.
Internal potentiometer	Set the operating speed of the motor.	P.41
Acceleration time potentiometer	Set the acceleration time when starting the motor.	P.43
Deceleration time potentiometer	Set the deceleration time when stopping the motor.	P.43
POWER LED (green)	Lit while the main power is input.	−
ALARM LED (red)	Blinks when a protective function is triggered.	P.50
Motor signal connector [CN4]	Connect the motor signal connector on the motor cable or connection cable.	P.29
FBLⅡ compatible mode setting switch (SW1)	SW1-1: Not used. Keep this switch OFF.	−
	SW1-2: Set the **FBL**Ⅱ compatible mode. ON: The **FBL**Ⅱ compatible mode is enabled. OFF: The **FBL**Ⅱ compatible mode is disabled (factory setting).	P.46
External voltage selection switch (SW2)	SW2-1: Select whether to use an external power supply or the driver's built-in power supply. When controlling the operation using relays, switches, etc., select the driver's built-in power supply. ON: Driver's built-in power supply OFF: External power supply (factory setting)	P.31
	SW2-2: When setting the speed via external DC voltage, change the setting according to the external DC voltage. ON: 5 VDC (factory setting) OFF: 10 VDC	P.41
Electromagnetic brake connector [CN1]	Connect the electromagnetic brake connector on the motor cable or connection cable.	P.29
CHARGE LED (red)	Lit while the main power is input. After the main power has been turned off, the LED will turn off once the residual voltage in the driver drops to a safe level.	−
Motor connector [CN2]	Connect the motor power connector on the motor cable or connection cable.	P.29
Regeneration resistor terminal (TB1) [RG1, RG2]	Connect the accessory regeneration unit **EPRC-400P** (sold separately).	P.30
Power supply input terminal (TB1) [L, N] [L1, L2, L3]	Connect to the main power supply. • Single-phase 100-120 V L, N: Connect a single-phase 100-120 VAC NC: Not used. • Single-phase 200-240 V L, N: Connect a single-phase 200-240 VAC NC: Not used. • Three-phase 200-240 V L1, L2, L3: Connect a three-phase 200-240 VAC	P.28
Communication connector [CN3]	Connect the **OPX-2A** or **MEXE02** (accessories).	P.36
I/O signal connector [CN5]	• Use this connector when using an external power supply for I/O signals. (24 VDC −15% to +20%) • Connect the I/O signals from the programmable controller. • Connect the thermostat output of the accessory regeneration unit **EPRC-400P** (sold separately). • Connect the external potentiometer (supplied).	P.31
Protective Earth Terminal	Ground this terminal using a grounding wire of AWG18 to 14 (0.75 to 2.0 mm^2).	P.28
Mounting holes (two locations at the back)	These mounting holes are used to install the driver with screws (M4).	P.22

6 Installation

This chapter explains the installation location and installation methods of the motor and driver, as well as how to install a load and external potentiometer. Also covered in this section are the installation and wiring methods that are in compliance with the relevant EMC Directive.

6.1 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 not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area free of excessive salt
- Area that is free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
- Area not subject to splashing water (rain, water droplets), oil (oil droplets) or other liquids
- 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

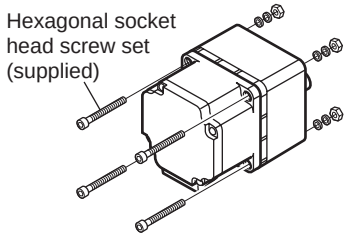
6.2 Installation overview

This section explains an overview of how to install the motor and driver. Refer to each applicable section for details.

■ Installing the combination parallel shaft gearhead or round shaft type

Install the hexagonal socket head screw in the four mounting holes you drilled and tighten the nuts until no gaps remain between the motor and mounting plate.
The combination type parallel shaft gearheads come with a set of hexagonal socket head screws. Round shaft types do not come with hexagonal socket head screws. Hexagonal socket head screws must be provided by the customer if a round shaft type is used.
Refer to p.15 for the machining dimensions of the mounting plate and how to install/remove the gearhead.

· Combination parallel shaft gearhead

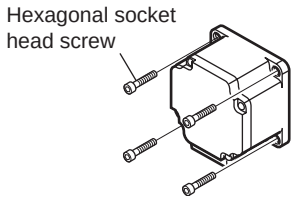


Hexagonal socket head screw set
(supplied with the combination type parallel shaft gearhead)

Model	Nominal thread size	Tightening torque	Maximum applicable plate thickness *
BLE23	M4	1.8 N·m (15.9 lb-in)	5 mm (0.20 in.)
BLE46	M6	6.4 N·m (56 lb-in)	8 mm (0.31 in.)
BLE512	M8	15.5 N·m (137 lb-in)	12 mm (0.47 in.)

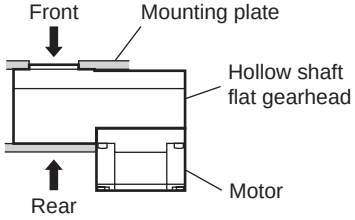
* The figures in the table apply when the supplied hexagonal socket head screw set is used.

· Round shaft type



■ 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 drilled 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.
Refer to p.16 for the installation method and how to install/remove the gearhead.



Hexagonal socket head screw set (supplied)

Model	Nominal thread size	Tightening torque	Maximum applicable plate thickness *
BLE23	M5	3.8 N·m (33 lb-in)	5 mm (0.20 in.)
BLE46	M6	6.4 N·m (56 lb-in)	8 mm (0.31 in.)
BLE512	M8	15.5 N·m (137 lb-in)	12 mm (0.47 in.)

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

■ Installing the driver

The driver can be installed in two different ways. Refer to p.22 for the specific installation methods.

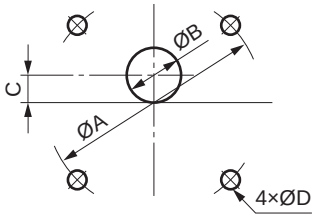
- Use screws (M4: not supplied) to affix the driver through the mounting holes (two locations) provided at the back of the driver.
- Affix the driver on a DIN rail using the accessory DIN-rail mounting plate (sold separately).

6.3 Installing the combination parallel shaft gearhead

Mounting hole dimensions [unit: mm (in.)].

Model	ØA	ØB	C	ØD
BLE23	70 (2.76)	24 (0.94)	10 (0.39)	4.5 (0.177)
BLE46	94 (3.70)	34 (1.34)	13 (0.51)	6.5 (0.256)
BLE512	104 (4.09)	40 (1.57)	18 (0.71)	8.5 (0.335)

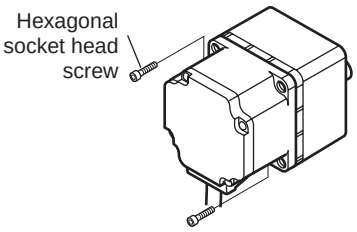
ØB indicates the external dimensions of the product.
Drill holes with a minimum diameter of ØB +1 mm (0.04 in.).



■ Removing/Installing the gearhead

To replace the gearhead or change the cable outlet direction, remove the screws assembling the gearhead. The gearhead can be removed and the motor cable position changed to a desired 90° direction.

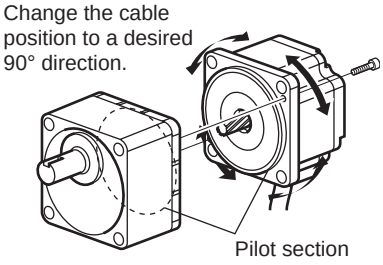
1. Remove the hexagonal socket head screws (2 pcs.) assembling the motor and gearhead and detach the motor from the gearhead.



Assembly screws

Model	Nominal thread size	Tightening torque
BLE23 **BLE46**	M2.6	0.4 N·m (3.5 lb-in)
BLE512	M3	0.6 N·m (5.3 lb-in)

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.



Note

- Do not forcibly assemble the motor and gearhead. Also, do not let metal objects or other foreign matter 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 hexagonal socket head screws (4 pcs.).

6.4 Installing the round shaft type

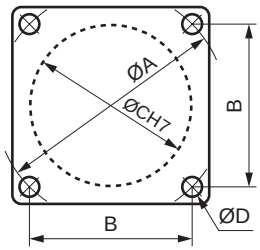
Install the motor to a mounting plate of the following size or larger, so that the motor case temperature will not exceed 90 °C (194 °F).

Model	Size of mounting plate	Thickness	Material
BLE23	115×115 mm (4.53×4.53 in.)*	5 mm (0.20 in.)	Aluminum
BLE46	135×135 mm (5.31×5.31 in.)		
BLE512	165×165 mm (6.50×6.50 in.)		

* Electromagnetic brake type: 135×135 mm (5.31×5.31 in.)

Mounting hole dimensions [unit: mm (in.)]

Model	ØA	B	ØCH7	ØD
BLE23	70 (2.76)	49.5 (1.949)	$54^{+0.030}_{0}$ ($2.1260^{+0.0012}_{0}$)	4.5 (0.177)
BLE46	94 (3.70)	66.47 (2.616)	$73^{+0.030}_{0}$ ($2.8740^{+0.0012}_{0}$)	6.5 (0.256)
BLE512	104 (4.09)	73.54 (2.895)	$83^{+0.035}_{0}$ ($3.2677^{+0.0014}_{0}$)	8.5 (0.335)



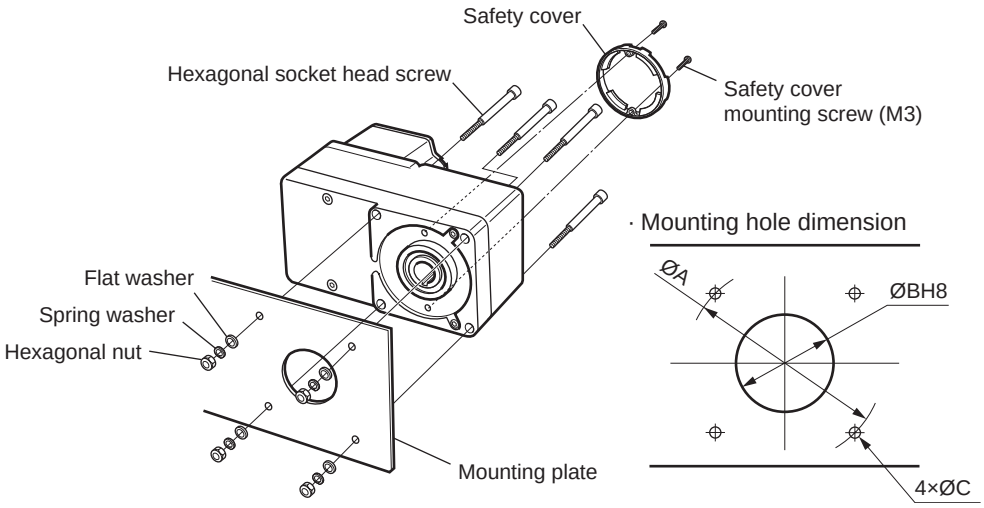
ØC indicates the pilot diameter on the flange.

Note Fit the boss on the gearhead mounting surface into a pilot receiving hole.

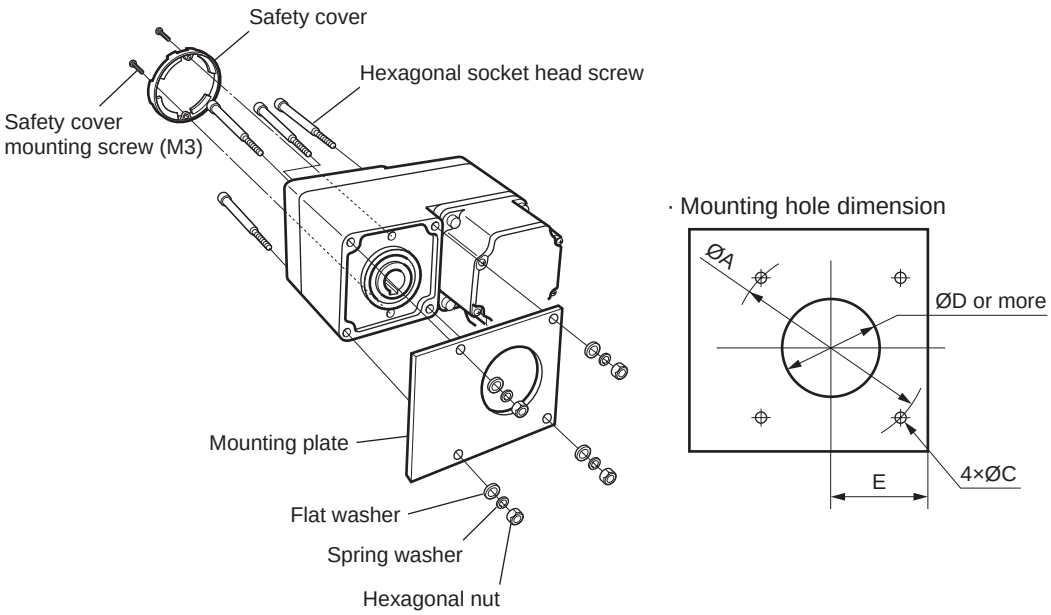
6.5 Installing the combination type hollow shaft flat gearhead

■ 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



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

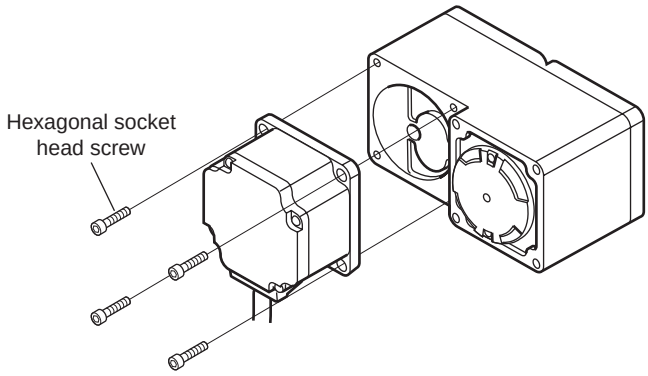
Model	ØA	ØBH8	ØC	ØD	E
BLE23	70 (2.76)	$34^{+0.039}_{0}$ ($1.34^{+0.0015}_{0}$)	5.5 (0.22)	25 (0.98)	29 (1.14)
BLE46	94 (3.70)	$38^{+0.039}_{0}$ ($1.50^{+0.0015}_{0}$)	6.5 (0.26)	30 (1.18)	39 (1.54)
BLE512	104 (4.09)	$50^{+0.039}_{0}$ ($1.97^{+0.0015}_{0}$)	8.5 (0.33)	35 (1.38)	44 (1.73)

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

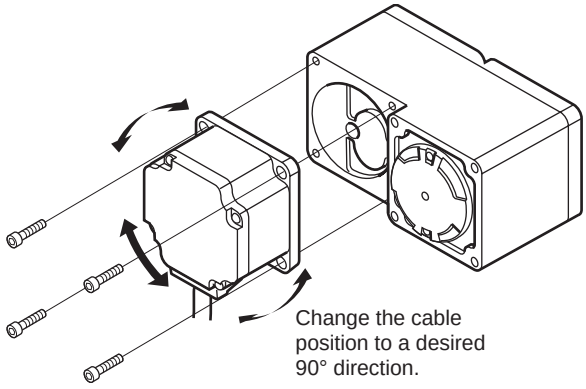
■ Removing/Installing the gearhead

To replace the gearhead or change the cable outlet direction, remove the screws assembling the 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.



Assembly screws

Model	Nominal thread size	Tightening torque
BLE23	M4	1.8 N·m (15.9 lb-in)
BLE46	M6	6.4 N·m (56 lb-in)
BLE512	M8	15.5 N·m (137 lb-in)

Note

- Do not forcibly assemble the motor and gearhead. Also, do not let metal objects or other foreign matters enter the gearhead. The pinion or gear of the motor output shaft may be damaged, resulting in noise or shorter service life.
- Do not allow dust to attach to the pilot sections of the motor and gearhead. Also, assemble the motor 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.

6.6 Installing a load

■ 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.

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.

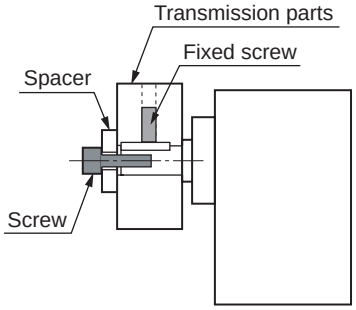
When using the output axis tip screw hole of a gearhead

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.)

Gearhead model name *	Output shaft tip screw hole
GFS4G□	M5 Effective depth 10 mm (0.39 in)
GFS5G□	M6 Effective depth 12 mm (0.47 in)

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

The example of output axis tip screw hole use



■ Combination type hollow shaft flat gearhead

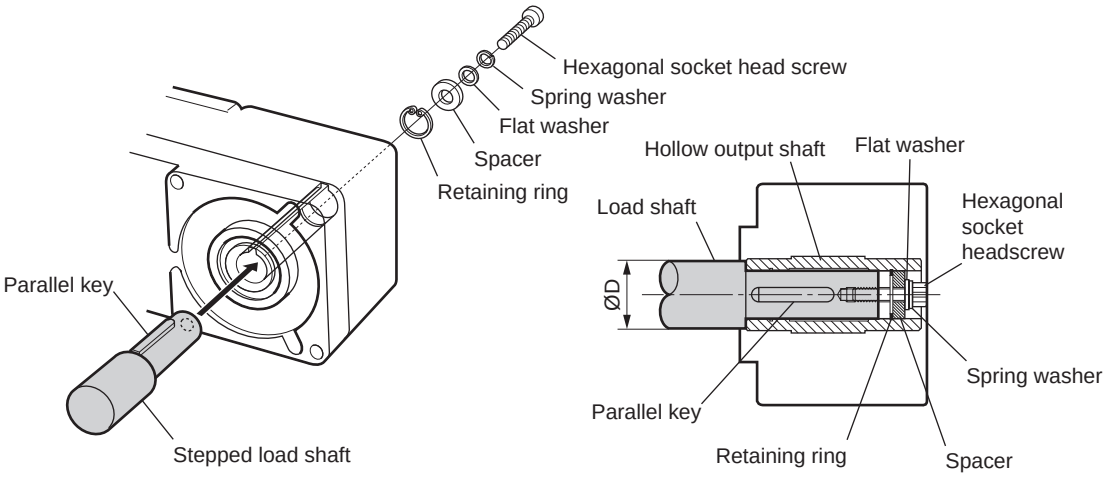
If the motor is subject to a strong impact upon instantaneous stop or receives a large overhung load, use a stepped load shaft.

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

- Stepped load shaft

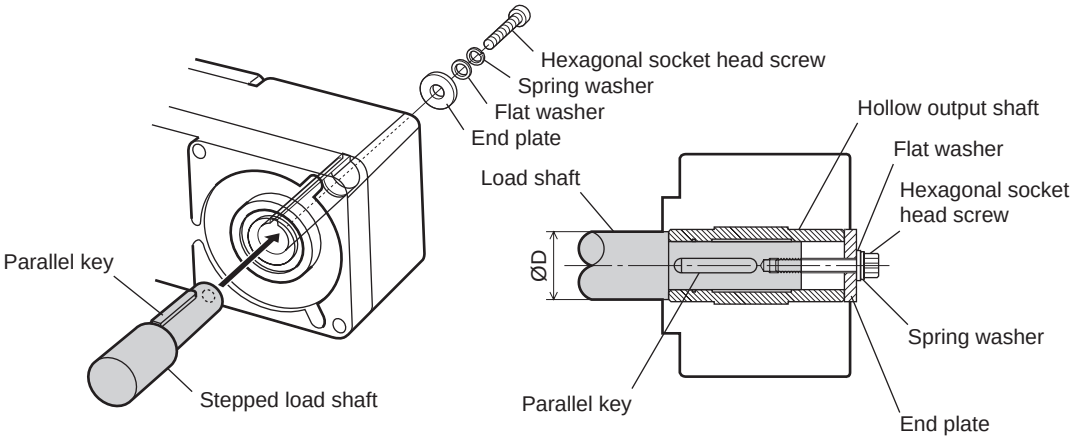
Affixing method using retaining ring

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

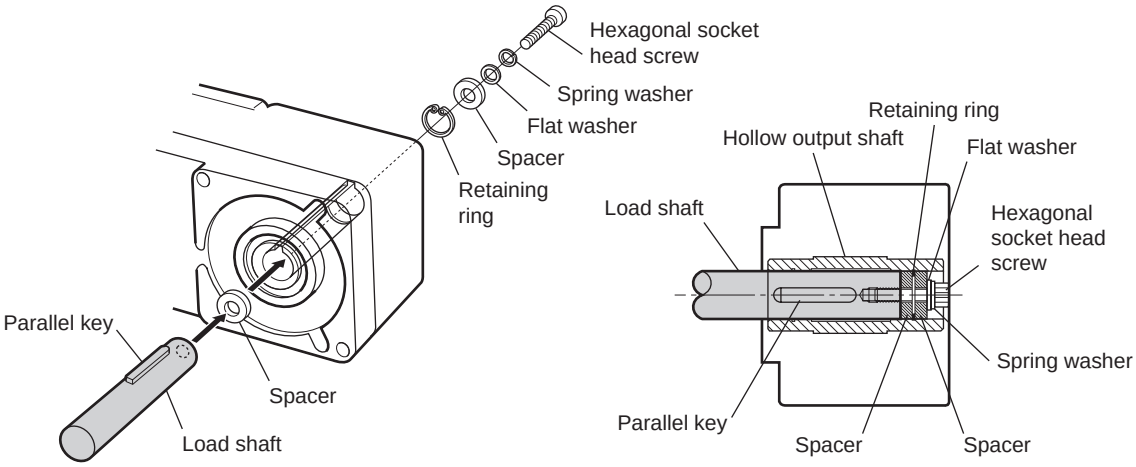
Affix the load shaft by tightening the hexagonal socket head screw over an end plate, flat washer and spring washer.



Note 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.

- 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.)]

Model	Inner diameter of hollow shaft (H8)	Recommended diameter of load shaft (h7)	Nominal diameter of retaining ring	Applicable screw	Spacer thickness	Outer diameter of stepped shaft (ØD)
BLE23	$Ø12^{+0.027}_{0}$ ($Ø0.4724^{+0.0011}_{0}$)	$Ø12^{0}_{-0.018}$ ($Ø0.4724^{0}_{-0.0007}$)	Ø12 (Ø0.47)	M4	3 (0.12)	20 (0.79)
BLE46	$Ø15^{+0.027}_{0}$ ($Ø0.5906^{+0.0011}_{0}$)	$Ø15^{0}_{-0.018}$ ($Ø0.5906^{0}_{-0.0007}$)	Ø15 (Ø0.59)	M5	4 (0.16)	25 (0.98)
BLE512	$Ø20^{+0.033}_{0}$ ($Ø0.7874^{+0.0013}_{0}$)	$Ø20^{0}_{-0.021}$ ($Ø0.7874^{0}_{-0.0008}$)	Ø20 (Ø0.79)	M6	5 (0.20)	30 (1.18)

6.7 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

Model		Distance from tip of gearhead output shaft and permissible overhung load* [N (lb.)]		Permissible thrust load [N (lb.)]
	Gear ratio	10 mm (0.39 in.)	20 mm (0.79 in.)	
BLE23	5	100 (22) [90 (20)]	150 (33) [110 (24)]	40 (9)
	10 to 20	150 (33) [130 (29)]	200 (45) [170 (38)]	
	30 to 200	200 (45) [180 (40)]	300 (67) [230 (51)]	
BLE46	5	200 (45) [180 (40)]	250 (56) [220 (49)]	100 (22)
	10 to 20	300 (67) [270 (60)]	350 (78) [330 (74)]	
	30 to 200	450 (101) [420 (94)]	550 (123) [500 (112)]	
BLE512	5	300 (67) [230 (51)]	400 (90) [300 (67)]	150 (33)
	10 to 20	400 (90) [370 (83)]	500 (112) [430 (96)]	
	30 to 200	500 (112) [450 (101)]	650 (146) [550 (123)]	

* 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.

- Combination type
  hollow shaft flat gearhead

Model		Distance from gearhead mounting surface and permissible overhung load* [N (lb.)]		Permissible thrust load [N (lb.)]
	Gear ratio	10 mm (0.39 in.)	20 mm (0.79 in.)	
BLE23	5, 10	450 (101) [410 (92)]	370 (83) [330 (74)]	200 (45)
	15 to 200	500 (112) [460 (103)]	400 (90) [370 (83)]	
BLE46	5, 10	800 (180) [730 (164)]	660 (148) [600 (135)]	400 (90)
	15 to 200	1200 (270) [1100 (240)]	1000 (220) [910 (200)]	
BLE512	5, 10	900 (200) [820 (184)]	770 (173) [700 (157)]	500 (112)
	15, 20	1300 (290) [1200 (270)]	1110 (240) [1020 (220)]	
	30 to 200	1500 (330) [1400 (310)]	1280 (280) [1200 (270)]	

∗ 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.

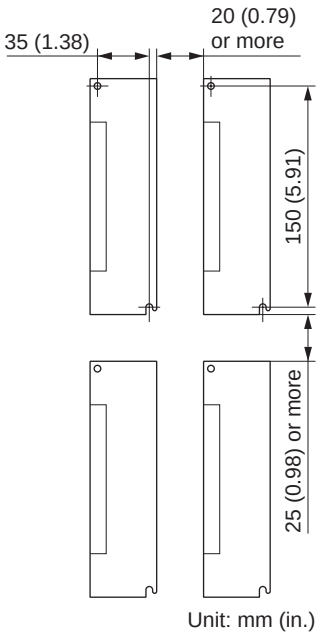
- Round shaft type

Model	Distance from tip of motor output shaft and permissible overhung load [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
BLE23	80 (18)	100 (22)	Not to exceed one-half the motor's dead weight*
BLE46	110 (24)	130 (29)	
BLE512	150 (33)	170 (38)	

∗ Minimize the thrust load. If a thrust load must be applied, do not let it exceed one-half the motor's mass.

6.8 Installing the driver

The driver is designed so that heat is dissipated via air convection and conduction through the enclosure. Install the driver to a flat metal plate offering excellent vibration resistance.
When two or more drivers are to be installed side by side, provide 20 mm (0.79 in.) and 25 mm (0.98 in.) clearances in the horizontal and vertical directions, respectively.



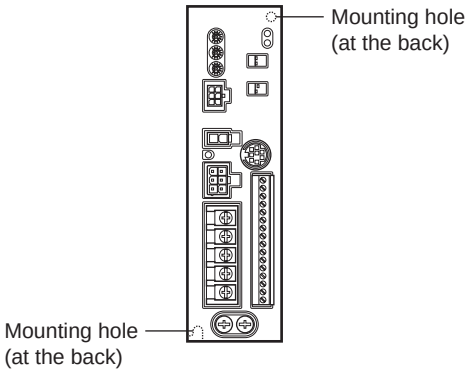
Unit: mm (in.)

Note

- Install the driver in an enclosure whose pollution degree is 2 or above or protection class is IP54 or better.
- Be sure to install (position) the driver vertically. Do not block the radiation openings.
- Do not install any equipment that generates a large amount of heat or noise near the driver.
- 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.

■ Installing with screws

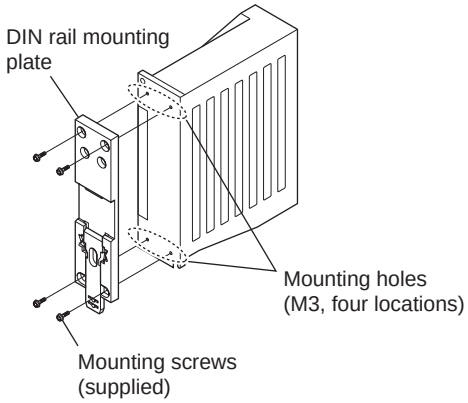
Install the driver perpendicularly (vertical position) and affix the driver through the mounting holes using two screws (M4: not supplied).



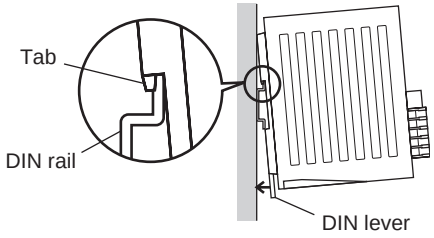
■ Mounting to DIN rail

When mounting the driver to a DIN rail, use a separately sold DIN rail mounting plate (model number: **PADP03**) and attach it to a 35 mm (1.38 in.) wide DIN rail.

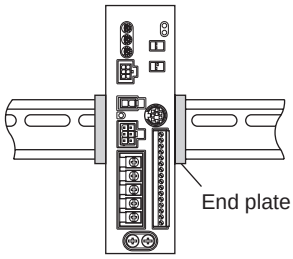
1. Attach the DIN rail mounting plate (model number: **PADP03**) to the back of the driver using the screws supplied with the plate.
   Tightening torque: 0.3 to 0.4 N·m (2.6 to 3.5 lb-in)



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

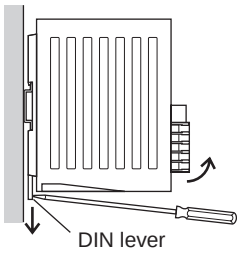


3. Use an end plate (not supplied) to secure the driver.



- Removing from DIN rail

Pull the DIN lever down until it locks using a flat tip screwdriver, and lift the bottom of the driver to remove it from the rail.
Use force of about 10 to 20 N (2.2 to 4.5 lb.) to pull the DIN lever to lock it. Excessive force may damage the DIN lever.

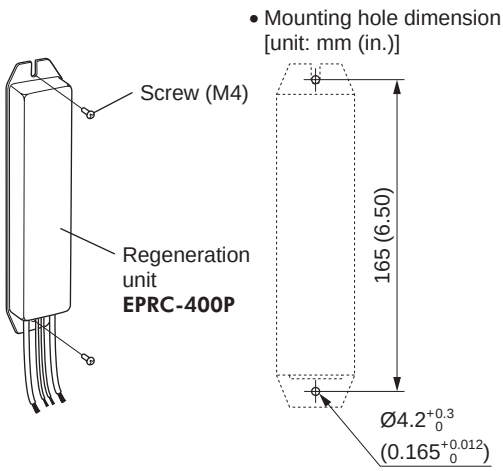


Note

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

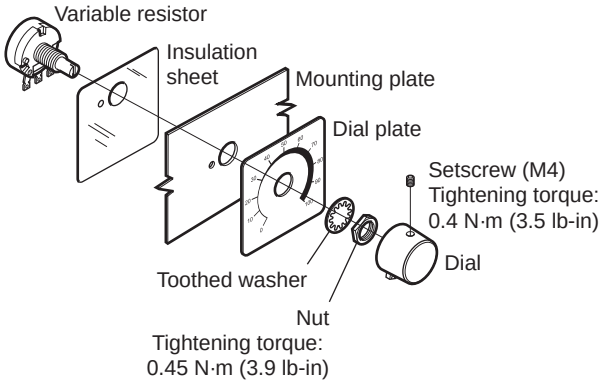
6.9 Installing the regeneration unit (accessory)

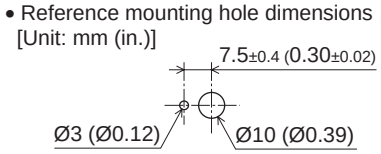
Install the accessory regeneration unit **EPRC-400P** (sold separately) in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 350×350×3 mm (13.78×13.78×0.12 in.)] is ensured.
Affix the **EPRC-400P** on a smooth metal plate offering high heat conductivity, using two screws (M4, not supplied).



6.10 Installing the external potentiometer (supplied)

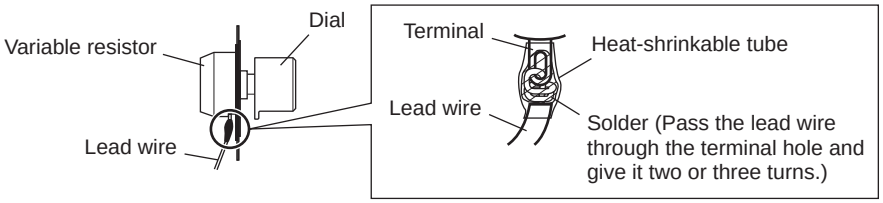
Insert the external potentiometer as shown below.





Soldering the variable resister terminal and the lead wires

Cover a heat-shrinkable tube over the soldered part to insulate.
Soldering condition: 235 °C (455 °F), less than 5 sec.



6.11 Installing and wiring in compliance with EMC Directive

The **BLE** Series is designed and manufactured for use as an internal component of equipment. The EMC Directives require that your mechanical equipment in which the **BLE** Series is installed satisfy the applicable requirements.
The installation/wiring methods of the motor and driver explained here represent the basic methods that are effective in helping your mechanical equipment conform to the EMC Directives.
The final level of conformance of your mechanical equipment to the EMC Directives will vary depending on the control system equipment used with the motor/driver, configuration of electrical parts, wiring, layout, hazard level, and the like. Therefore, you must conduct the EMC tests on your mechanical equipment to confirm compliance.

■ Applicable Standards

EMI	Emission Tests Harmonics Current Test Voltage Fluctuations Test	EN 61000-6-4, EN 61800-3 C3 EN 61000-3-2 EN 61000-3-3
EMS	Immunity Tests	EN 61000-6-2, EN 61800-3 C3

Without effective measures to suppress the electromagnetic interference (EMI) caused by the **BLE** Series in the surrounding control system equipment or the electromagnetic spectrum (EMS) generated by the **BLE** Series, the function of your mechanical equipment may be seriously affected.
The **BLE** Series will conform to the EMC Directives if installed/wired using the methods specified below.

■ Connecting a mains filter

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

Manufacturer	Single-phase 100-120 V	Single-phase 200-240 V	Three-phase 200-240 V
TDK-Lambda Corporation	MC1210	MC1210	MC1310

Overvoltage category II applies to mains filters.
Install the mains filter as close to the driver as possible, and use cable clamps and other means to secure the input and output cables firmly to the surface of the enclosure. Connect the ground terminal of the mains filter to the grounding point, using as thick and short a wire as possible.
Do not place the AC input cable (AWG18 to 14: 0.75 to 2.0 mm^2) parallel with the mains-filter output cable (AWG18 to 14: 0.75 to 2.0 mm^2). Parallel placement will reduce mains filter effectiveness if the enclosure's internal noise is directly coupled to the power supply cable by means of stray capacitance.

■ Connecting the AC power line reactor

When inputting single-phase 200-240 V, insert a reactor (5 A, 5 mH) in the AC power line to ensure compliance with EN 61000-3-2.

■ Connecting the control power supply

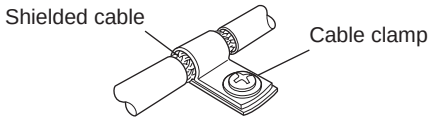
Use a control power supply conforming to the EMC Directive. Use a shielded cable for wiring and wire/ground the control power supply over the shortest possible distance. Refer to "Wiring the power supply cable" for how to ground the shielded cable.

■ Grounding procedure

The cable used to ground the motor, driver, mains filter and power supply cable (shielded cable) must be as thick and short to the grounding point as possible so that no potential difference is generated. Choose a large, thick and uniformly conductive surface for the grounding point. Refer to the p.28 for the recommended grounding method.

■ Wiring the power supply cable

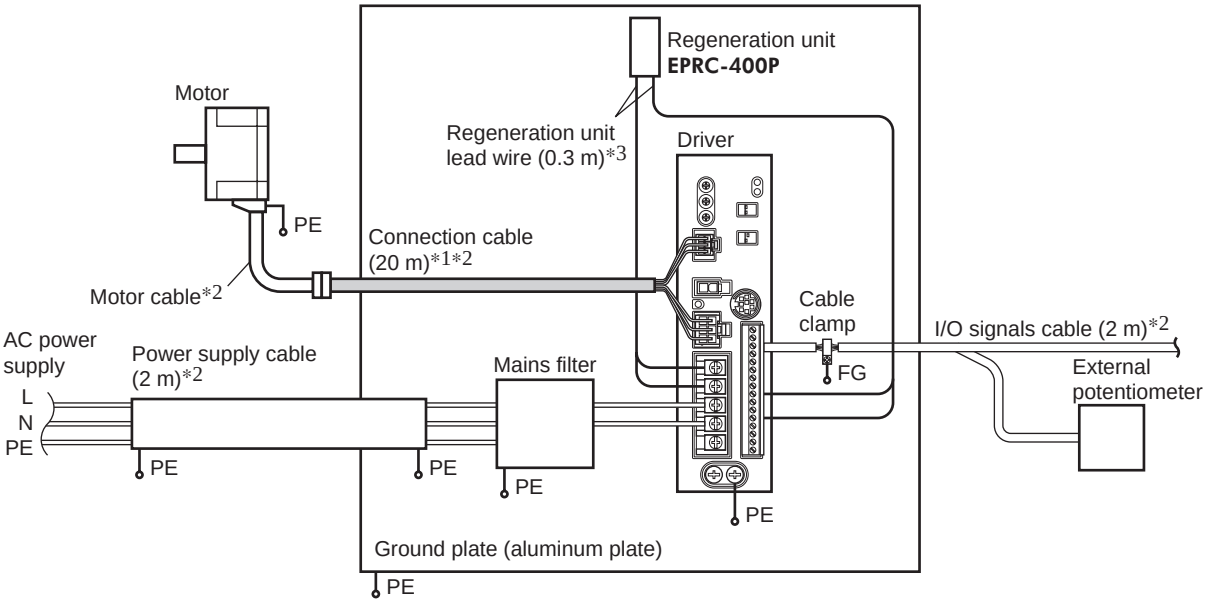
Use a shielded cable of AWG18 to 14 (0.75 to 2.0 mm^2) in diameter for the driver power supply cable and keep it as short as possible.
Strip a part of the shielded cable and ground the stripped part using a metal cable clamp that contacts the stripped cable around its entire circumference, or use a drain wire to make the ground connection.
When grounding the shielded cable, connect both ends (mains filter side and power supply side) to earth to prevent a potential difference from generating in the shielded cable.



■ Notes about installation and wiring

- Connect the motor/driver and other peripheral control equipment directly to the grounding point so as to prevent a potential difference from developing between grounds.
- When relays or electromagnetic switches are used together with the system, use mains filters and CR circuits to suppress surges generated by them.
- Keep cables as short as possible without coiling and bundling extra lengths.
- 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 they must cross, do so at a right angle. Place the AC input cable and output cable of a mains filter separately from each other.
- Use a connection cable (supplied or accessory) when extending the wiring distance between the motor and driver. The EMC measures are conducted using the Oriental Motor connection cable.

■ Example of motor and driver installation and wiring



∗1 Performance has been evaluated based on connection cable lengths of up to 20 m (65.6 ft.). You can connect up to three connection cables.
∗2 Shielded cable
∗3 Unshielded cable

■ Precautions about static electricity

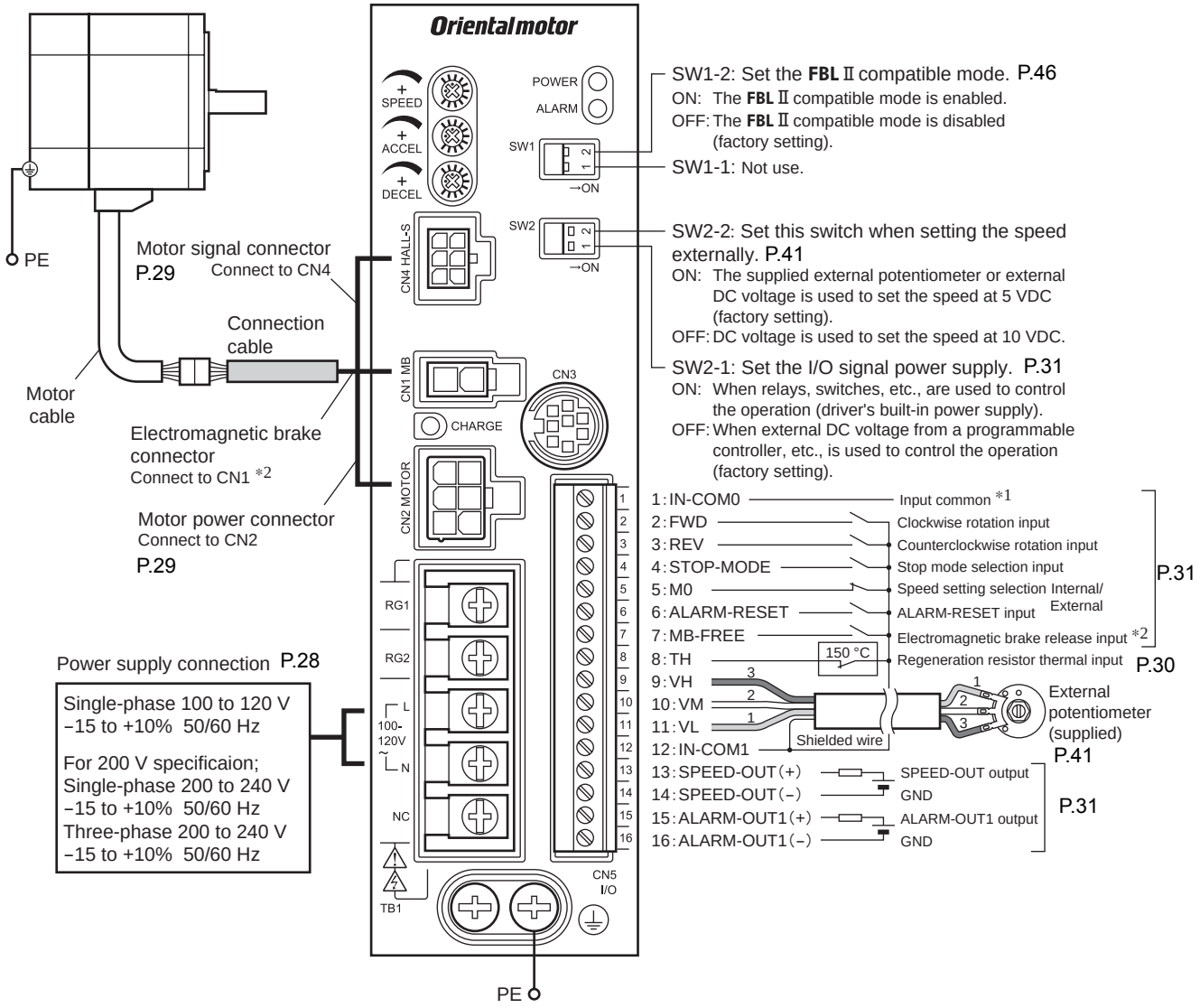
Static electricity may cause the driver to malfunction or become damaged. Do not come close to or touch the driver while the power is on except when operating the switch of the front of driver.
To change the settings of driver switches, be sure to use an insulated screwdriver.

7 Connection

This chapter explains how to connect the driver and motor, I/O signals, and power supply, as well as the grounding method.

7.1 Connection example

The connection example below shows an example of a electromagnetic brake type single-phase 100 to 120 V driver where the built-in power supply and supplied external potentiometer are used to set the speed. Refer to the applicable pages for details.



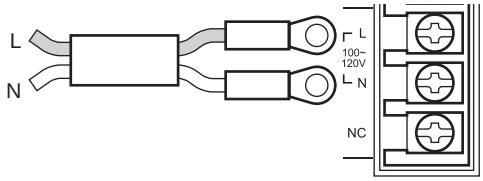
∗1 Connection is not necessary if the built-in power supply is used.
∗2 Connection is necessary only when using an electromagnetic brake motor.

7.2 Connecting the power supply

Connect the power cable to the Power supply input terminal (TB1) on the driver.
Tightening torque: 1.0 N·m (8.8 lb-in)
The product does not come with a power cable. It must be supplied by the user.

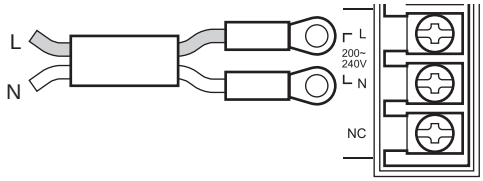
- Single-phase 100-120 V

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



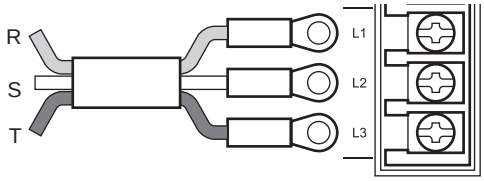
- Single-phase 200-240 V

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

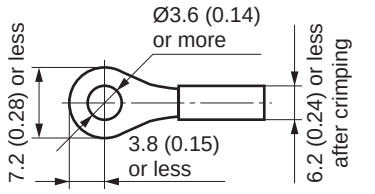


- Three-phase 200-240 V

Connect the R, S and T phase lines to the L1, L2 and L3 terminals, respectively.



- Power connection terminal and cable
  - Applicable crimp terminal: Round crimp terminal with insulation cover
  - Thread size of terminal: M3.5
  - Applicable lead wire: AWG18 to 14 (0.75 to 2.0 mm^2)
  - 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.



Unit: mm (in.)

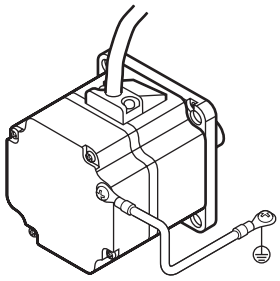
■ Circuit breaker

Be sure to connect a circuit breaker to the power line of the driver to protect the primary circuit.
Rated current of protective device: Single-phase input 10 A, three-phase input 5 A
Circuit breaker: Mitsubishi Electric Corporation NF30

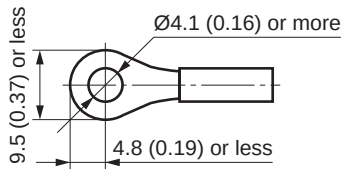
7.3 Grounding

■ Grounding 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 (7.0 to 8.8 lb-in)



- Ground terminal and cable
  - Applicable crimp terminal: Round crimp terminal with insulation cover
  - Thread size of terminal: M4
  - Applicable lead wire: AWG18 to 14 (0.75 to 2.0 mm^2)



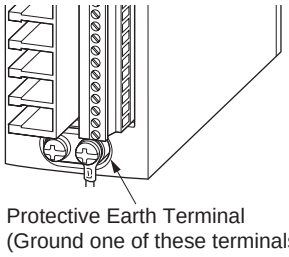
Unit: mm (in.)

■ Grounding the driver

Be sure to ground the Protective Earth Terminal (screw size: M4) of the driver.
Tightening torque: 1.2 N·m (10.6 lb-in)

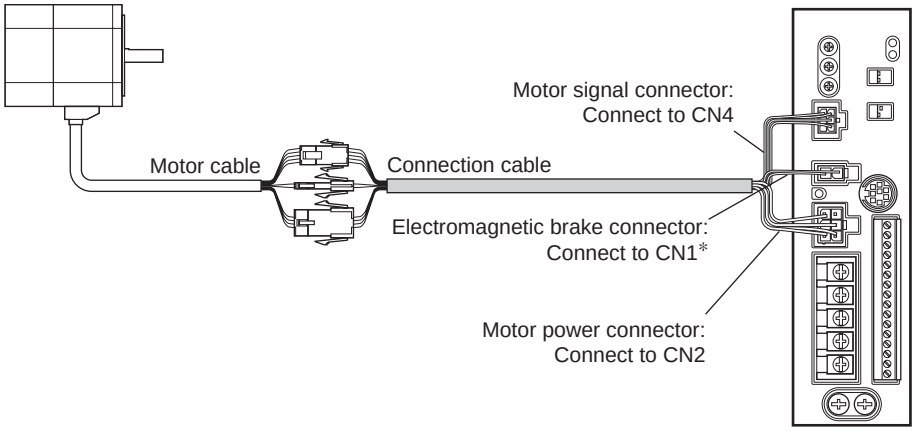
You can ground either of the two Protective Earth Terminals. The terminal that is not grounded is used as a service terminal. Use the service terminal according to your specific need, such as connecting it to the motor in order to ground the motor.

Use a grounding wire of AWG18 to 14 (0.75 to 2.0 mm^2), and do not share the Protective Earth Terminal with a welder or any other power equipment.
When grounding the Protective Earth Terminal, use a round terminal and affix the grounding point near the driver.



7.4 Connecting the motor and driver

Connect the motor cable to the motor connector (CN2) and motor signal connector (CN4) of the driver.
Insert the motor power connector into CN2, and the motor signal connector into CN4.
To expand connection between the motor and driver, use the connection cable (supplied or accessory).
Connection can be extended to a maximum of 20.4 m (66.9 ft.).



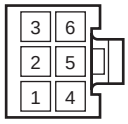
* Electromagnetic brake type only

Note Have the connector plugged in securely. Insecure connector connection may cause malfunction or damage to the motor or driver.

■ Connector of the motor cable

• Motor power connector

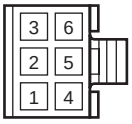
Pin No.	Color	Lead wire
1	Blue	AWG18
2	–	–
3	–	Drain AWG24 or equivalent
4	Purple	AWG18
5	Gray	AWG18
6	–	–



Housing: 5557-06R-210 (Molex)
Terminal: 5556T (Molex)

• Motor signal connector

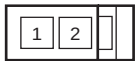
Pin No.	Color	Lead wire
1	–	–
2	Green	AWG26
3	Yellow	AWG26
4	Brown	AWG26
5	Red	AWG26
6	Orange	AWG26



Housing: 43025-0600 (Molex)
Terminal: 43030-0004 (Molex)

■ Connector of the electromagnetic brake

Pin No.	Color	Lead wire
1	Black	AWG24
2	White	AWG24



Housing: 5557-02R-210 (Molex)
Terminal: 5556T (Molex)

■ Connection cable

This cable (sold separately) is used to extend the wiring distance between the driver and motor. Flexible connection cables are also available. You can connect up to three connection cables.

• Standard type
Connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLE**
2 (6.6)	**CC02BLE**
3 (9.8)	**CC03BLE**
5 (16.4)	**CC05BLE**
7 (23)	**CC07BLE**
10 (32.8)	**CC10BLE**
15 (49.2)	**CC15BLE**
20 (65.6)	**CC20BLE**

• Standard type
Flexible connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLER**
2 (6.6)	**CC02BLER**
3 (9.8)	**CC03BLER**
5 (16.4)	**CC05BLER**
7 (23)	**CC07BLER**
10 (32.8)	**CC10BLER**
15 (49.2)	**CC15BLER**
20 (65.6)	**CC20BLER**

• Electromagnetic brake type
Connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLEM**
2 (6.6)	**CC02BLEM**
3 (9.8)	**CC03BLEM**
5 (16.4)	**CC05BLEM**
7 (23)	**CC07BLEM**
10 (32.8)	**CC10BLEM**
15 (49.2)	**CC15BLEM**
20 (65.6)	**CC20BLEM**

• Electromagnetic brake type
Flexible connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLEMR**
2 (6.6)	**CC02BLEMR**
3 (9.8)	**CC03BLEMR**
5 (16.4)	**CC05BLEMR**
7 (23)	**CC07BLEMR**
10 (32.8)	**CC10BLEMR**
15 (49.2)	**CC15BLEMR**
20 (65.6)	**CC20BLEMR**

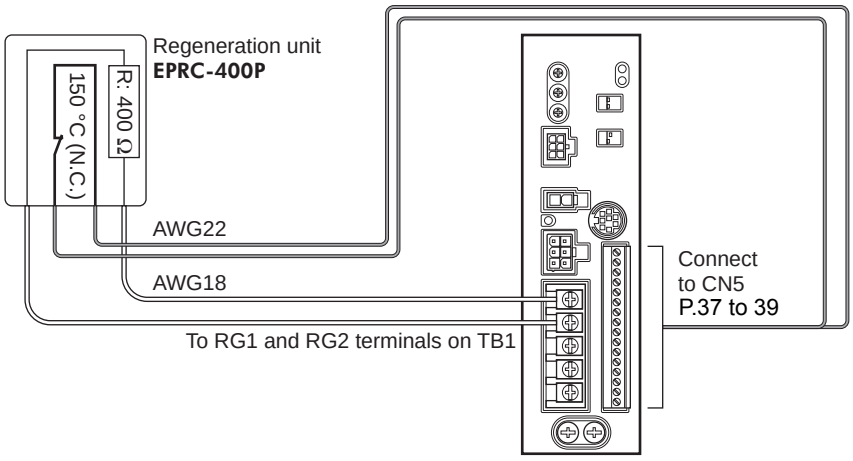
7.5 Connecting the regeneration unit

Use the accessory regeneration unit **EPRC-400P** (sold separately) if gravitational operation or sudden starting/stopping of a large inertia load, will be repeated frequently.
Install the regeneration unit in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 350×350×3 mm (13.78×13.78×0.12 in.)] is ensured.

• Connection method

Connection to the I/O terminals varies depending on the connection method. Refer to p.37.
Connect the regeneration unit before turning on the main power. The regeneration unit does not perform its control function if connected after the main power has been turned on.

- Regenerative current flows through the two thick lead wires (AWG18: 0.75 mm^2) of the regeneration unit. Connect them to the RG1 and RG2 terminals of the TB1. The applicable crimp terminal is the same as the one used to connect the power supply. Refer to p.28.
- The two thin lead wires (AWG22: 0.3 mm^2) of the regeneration unit are thermostat outputs. Refer to p.31 for the connection method.



Note If the current consumption of the regeneration unit exceeds the allowable level, the thermostat will be triggered and a regeneration unit overheat alarm will generate. If a regeneration unit overheat alarm generates, turn off the power and check the content of the error.

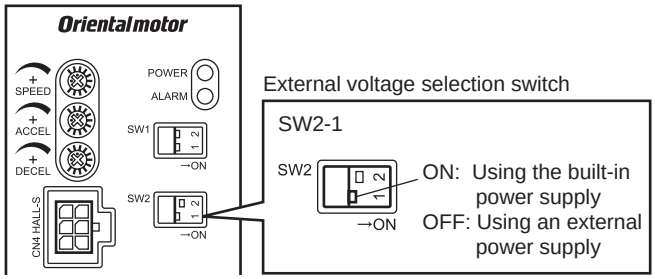
• Regeneration unit specifications

Model	**EPRC-400P**
Continuous regenerative power	100 W
Resistance	400 Ω
Operating temperature of thermostat	Operation: Opens at 150±7 °C (302±45 F°) Reset: Closes at 145±12 °C (293±54 F°) (normally closed)
Electrical rating of thermostat	120 VAC 4 A, 30 VDC 4 A (minimum current: 5 mA)

7.6 Selecting the I/O signal power supply

Select the I/O signal power supply (built-in power supply or external power supply) to be used.
The driver comes with a built-in power supply. To control the operation using relays and switches, set the external voltage selector switch SW2-1 to the ON side to select the built-in power supply.

Factory setting:
OFF (an external power supply is used)



Note

- Change the setting of the external voltage selector switch SW2-1 before turning on the power.
- The built-in power supply cannot be used with the source logic. If the source logic is used, do not turn the external voltage selector switch to the ON position.

7.7 Connecting the I/O signals

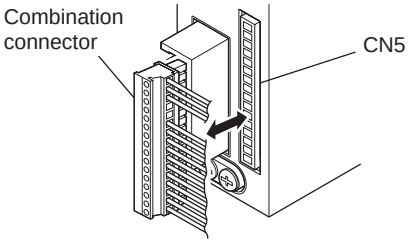
■ Connector function table

Pin No.	Terminal name	Signal name	Name	Explanation
1	C0	IN-COM0	Input signal common	−
2	X0*	FWD	Forward input	The motor turns in the clockwise direction.
3	X1*	REV	Reverse input	The motor turns in the counterclockwise direction.
4	X2*	STOP-MODE	Stop mode selection input	Select instantaneous stop or deceleration stop.
5	X3*	M0	Speed setting selection input	Select the internal potentiometer or external potentiometer (external DC voltage).
6	X4*	ALARM-RESET	Alarm reset input	Alarms are reset.
7	X5*	MB-FREE	Electromagnetic brake release input	Select the operation mode of the electromagnetic brake when the motor stops. This signal is not used for the standard type.
8	X6*	TH	Regeneration resistor thermal input	If a regeneration unit is used, connect the thermostat output of the regeneration unit (normally closed).
9	VH	VH	External speed setting input	Set the speed of the external potentiometer (external DC voltage). Refer to p.41 for details.
10	VM	VM		
11	VL	VL		
12	C1	IN-COM1	Input common (0 V)	−
13	Y0+*	SPEED-OUT (+)	SPEED-OUT output	30 pulses are output with each revolution of the motor output shaft. (To use this signal in the **FBL**Ⅱ compatible mode, refer to p.46.)
14	Y0−*	SPEED-OUT (−)		
15	Y1+*	ALARM-OUT1 (+)	ALARM-OUT1 output	This signal is output when an alarm generates (normally closed).
16	Y1−*	ALARM-OUT1 (−)		

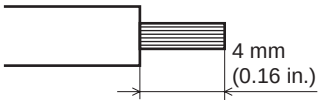
* The **OPX-2A** or **MEXE02** can be used to change the assignments of I/O signals. Refer to p.49.

■ Connecting input/output signals

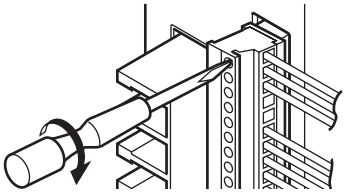
The combination type connector is used for the input/output signal connection (CN5).
The combination connector may be installed and removed with the lead wire connected, thereby offering better work efficiency for driver installation and maintenance.



1. Strip the lead wire and twist the cable conductor.
   Applicable lead wire diameter:
   AWG24 to 20 (0.2 to 0.5 mm^2)
   Length of the lead wire which can be peeled:
   4 mm (0.16 in.)

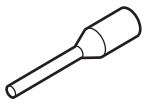


2. Loosen the combination connector screw.
3. Insert the stripped cable conductor into the combination connector, and tighten the screw.
   Use a 3 mm (0.12 in.) wide slotted head screwdriver.
   Tightening torque: 0.5 to 0.8 N·m (4.4 to 7.0 lb-in)



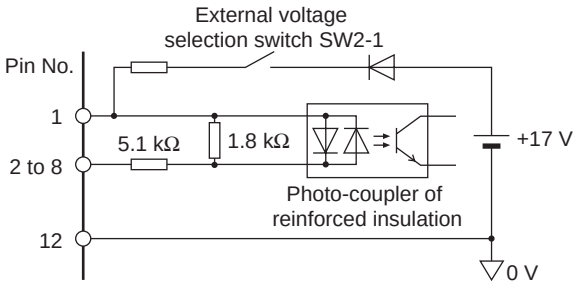
If crimp terminals are used, select the following terminals.

Manufacturer	PHOENIX CONTACT GmbH & Co. KG
Model	AI 0.25-6 [AWG24 (0.2 mm^2)] AI 0.34-6 [AWG22 (0.3 mm^2)] AI 0.5-6 [AWG20 (0.5 mm^2)]



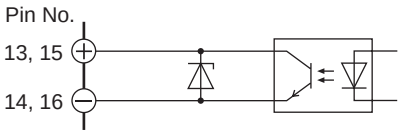
■ Input signal circuit

All input signals of the driver are photocoupler inputs.
When an external power supply is used:
24 VDC –15 to +20%, 100 mA or more



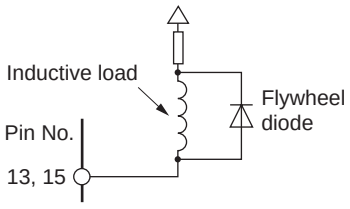
■ Output signal circuit

The driver outputs signals are photocoupler/open-collector output.
The ON voltage of the output circuit is max. 1.6 V. When driving each element using the output signal circuit, give consideration to this ON voltage.
4.5 to 30 VDC, 40 mA or less
(For the SPEED-OUT output, supply at least 5 mA of current.)



Note

- Always connect a current-limiting resistor. If the power supply voltage is connected to the output circuit directly without connecting a current-limiting resistor in between, the driver will be damaged.
- When connecting a relay (inductive load), etc., to detect alarm outputs, use a relay with built-in flywheel diode, or provide a fly-back voltage control measure based on diode, etc., for the inductive load.



■ Input signals

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

- FWD input and REV input

When the FWD input is turned ON, the motor turns in the clockwise direction according to the time set by the acceleration time potentiometer. When the FWD input is turned OFF, the motor stops.
When the REV input is turned ON, the motor turns in the counterclockwise direction according to the time set by the acceleration time potentiometer. When the REV input is turned OFF, the motor stops.
If both the FWD input and REV input are turned ON, the motor stops instantaneously.

- STOP-MODE input

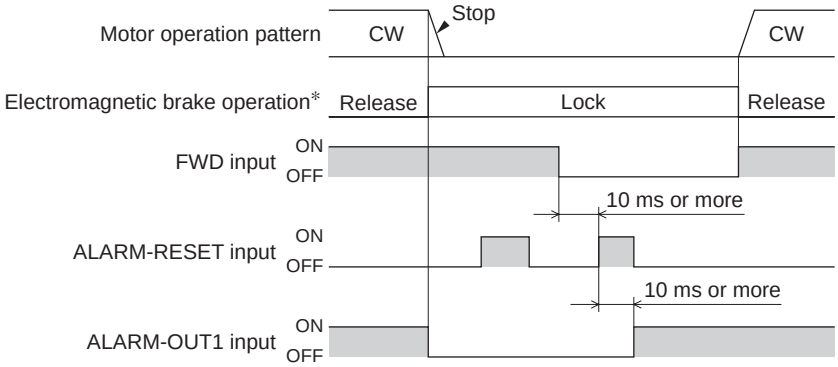
Select how the motor should stop when the FWD input or REV input is turned OFF.
When the STOP-MODE input is ON, the motor stops according to the time set by the deceleration time potentiometer.
STOP-MODE input is OFF, the motor stops instantaneously.

- M0 input

Select how the motor speed is set.
When the M0 input is ON, the motor turns at the speed set by the external potentiometer or external DC voltage.
When the M0 input is OFF, the motor turns at the speed set by the internal potentiometer.
By switching the M0 input, the motor can be operated at two speeds through use of both the external potentiometer and internal potentiometer. Refer to p.44 for details.
You can set a maximum of eight speeds by changing the assignments of M0 to M2 inputs using the **OPX-2A** or **MEXE02**.

- ALARM-RESET input

This input actuates the driver’s protective function to reset present alarms.
To reset each alarm, be sure to remove the cause of the alarm before switching the ALARM-RESET input.
To reset an alarm, turn both the FWD input and REV input OFF, remove the cause of the alarm, and then turn the ALARM-RESET input ON (and keep it ON for 10 ms or more). The ALARM-RESET input will not be received if the FWD input or REV input is ON.
If the alarm cannot be reset with the ALARM-RESET input, turn off the power, wait for at least 30 seconds, and then turn the power back on.



∗ The electromagnetic brake locks the moment an alarm generates. The electromagnetic brake can be set to lock after a free-run stop of the motor using the **OPX-2A** or **MEXE02**.

Note
- Continuing the operation of the unit without removing the cause of the alarm may result in equipment damage.
- Overcurrent and EEPROM errors cannot be reset using the ALARM-RESET input.

- MB-FREE input

This input signal is used for the electromagnetic brake type. The operation mode of the electromagnetic brake at motor standstill is selected.
When the MB-FREE input is ON, the electromagnetic brake will be released.
When the MB-FREE input is OFF, the electromagnetic brake will actuate and hold the shaft in position.

Note The MB-FREE input is disabled while an alarm is present.

- TH input

When using the regeneration unit **EPRC-400P**, connect the thermostat output of the regeneration unit (normally closed).

■ Output signals

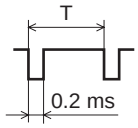
The signal state represents the “ON: Carrying current” or “OFF: Not carrying current” state of the internal photocoupler rather than the voltage level of the signal.

- SPEED-OUT output

30 pulses are output with each revolution of the motor output shaft synchronously with the motor operation.
The pulse width of output pulse signals is 0.2 ms. You can use the SPEED-OUT output to calculate the motor speed.

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

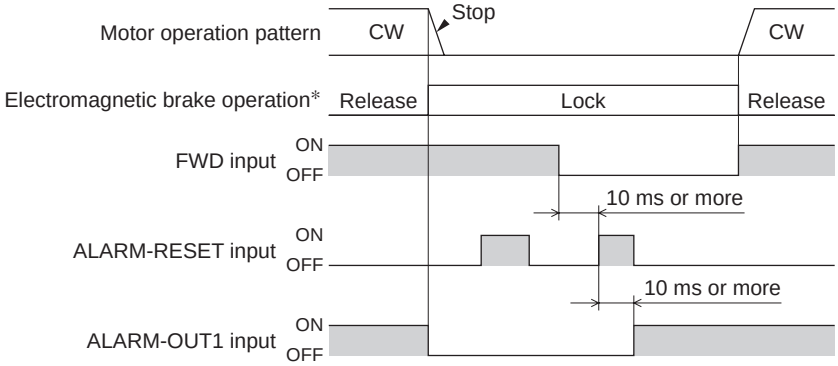
$$\text{Motor shaft speed (r/min)} = \frac{\text{SPEED-OUT output frequency}}{30} \times 60$$



To display/monitor the speed of the motor output shaft or reduced speed of the gearhead output shaft, connect the accessory digital speed indicator **SDM496** (sold separately). Refer to p.53 for details.

- ALARM-OUT1 output

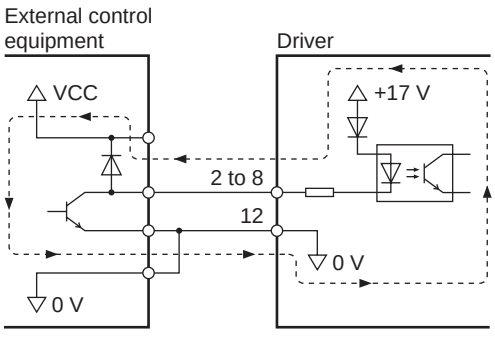
When the driver’s protective function actuates, the ALARM-OUT1 output turns OFF and the ALARM LED blinks (normally closed).
The motor coasts to a stop in the case of a standard type. When the motor is an electromagnetic brake type, the motor stops instantaneously and the electromagnetic brake is actuated to hold the shaft in position.
To reset an alarm, turn both the FWD input and REV input OFF, remove the cause of the alarm, and then turn the ALARM-RESET input ON (and keep it ON for 10 ms or more). The ALARM-RESET input will not be received if the FWD input or REV input is ON.
If the alarm cannot be reset with the ALARM-RESET input, turn off the power, wait for at least 30 seconds, and then turn the power back on.



∗ The electromagnetic brake locks the moment an alarm generates. The electromagnetic brake can be set to lock after a free-run stop of the motor using the **OPX-2A** or **MEXE02**.

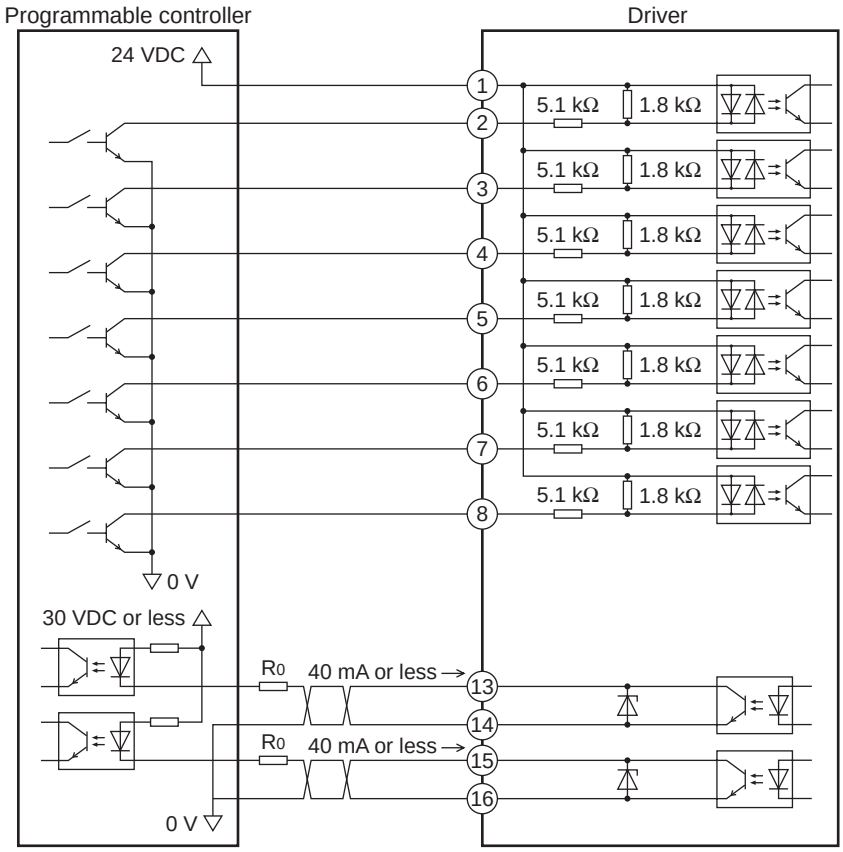
■ Using a controller with a built-in clamp diode

If a controller with a built-in clamp diode is used, a leakage 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 down, turn off the driver power first, followed by the controller power.
When powering up, turn on the controller power first, followed by the driver power.

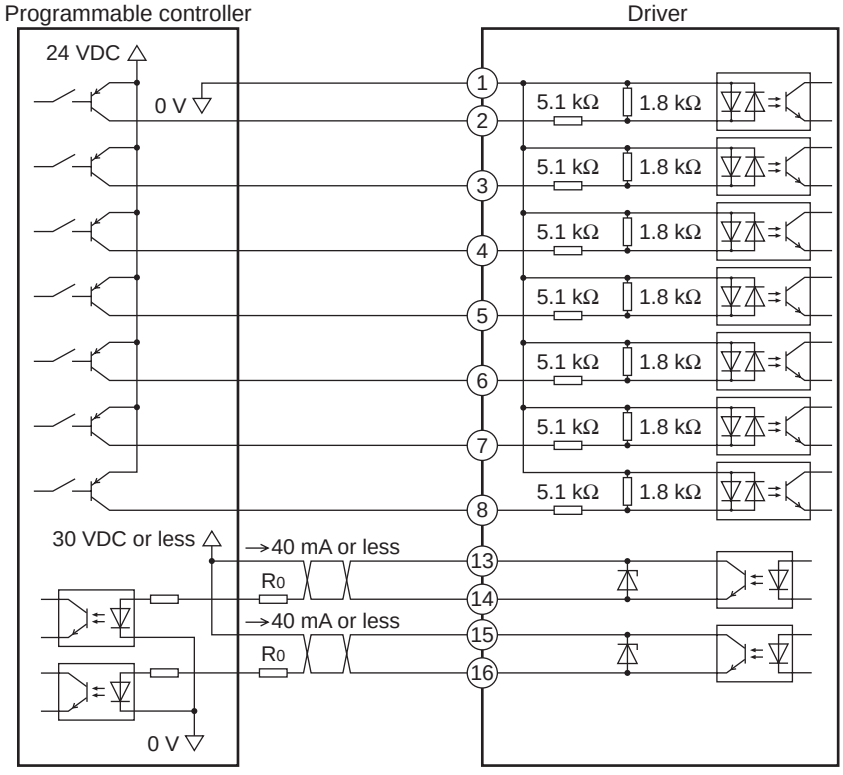


■ Example of connection with I/O signal circuit

- Sink logic circuit



- Source logic circuit

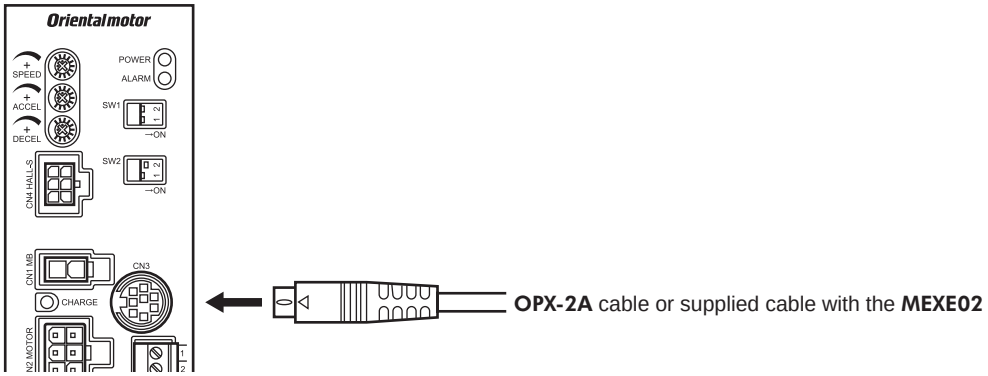


Note

- Keep the output signal to 30 VDC or less.
- Be sure to connect the current-limiting resistor R_0 and keep the current to 40 mA or less.

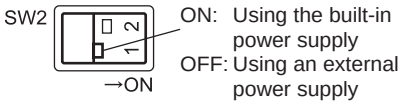
7.8 Connecting the communication cable

Connect **OPX-2A** cable or supplied cable with the **MEXE02** to the communication connector (CN3).



7.9 Connection diagram (example)

Each connection diagram (example) is for the electromagnetic brake type. In the case of the standard type, there are no connection for the electromagnetic brake and no connection/input for the MB-FREE input signal.
To use the built-in power supply, set the external voltage selector switch (SW2-1) to the ON side.
The factory setting is OFF (an external power supply is used).
To use an external power supply, the factory setting need not be changed.

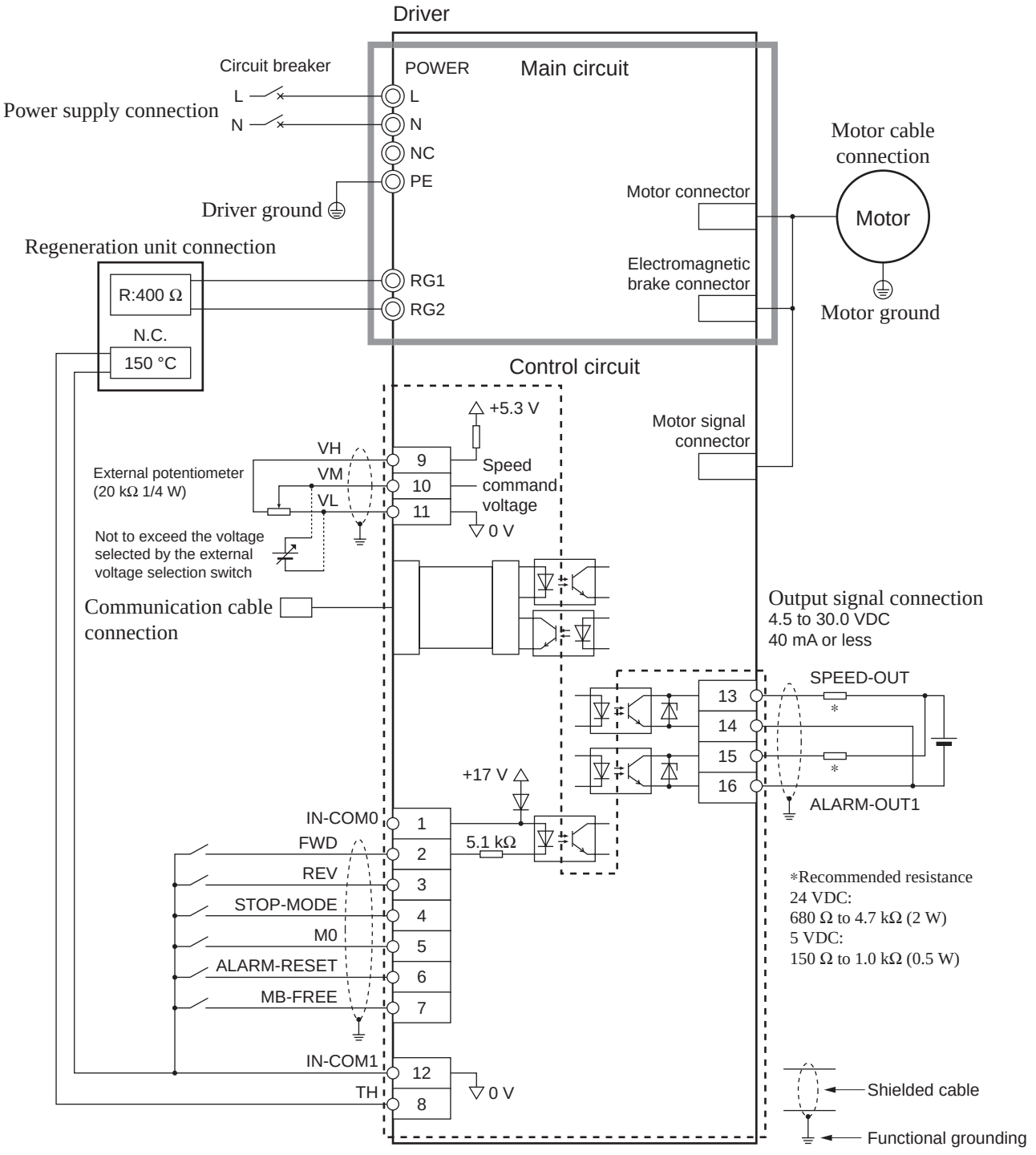


Note Change the setting of the external voltage selector switch (SW2-1) before turning on the main power supply.

■ Sink logic

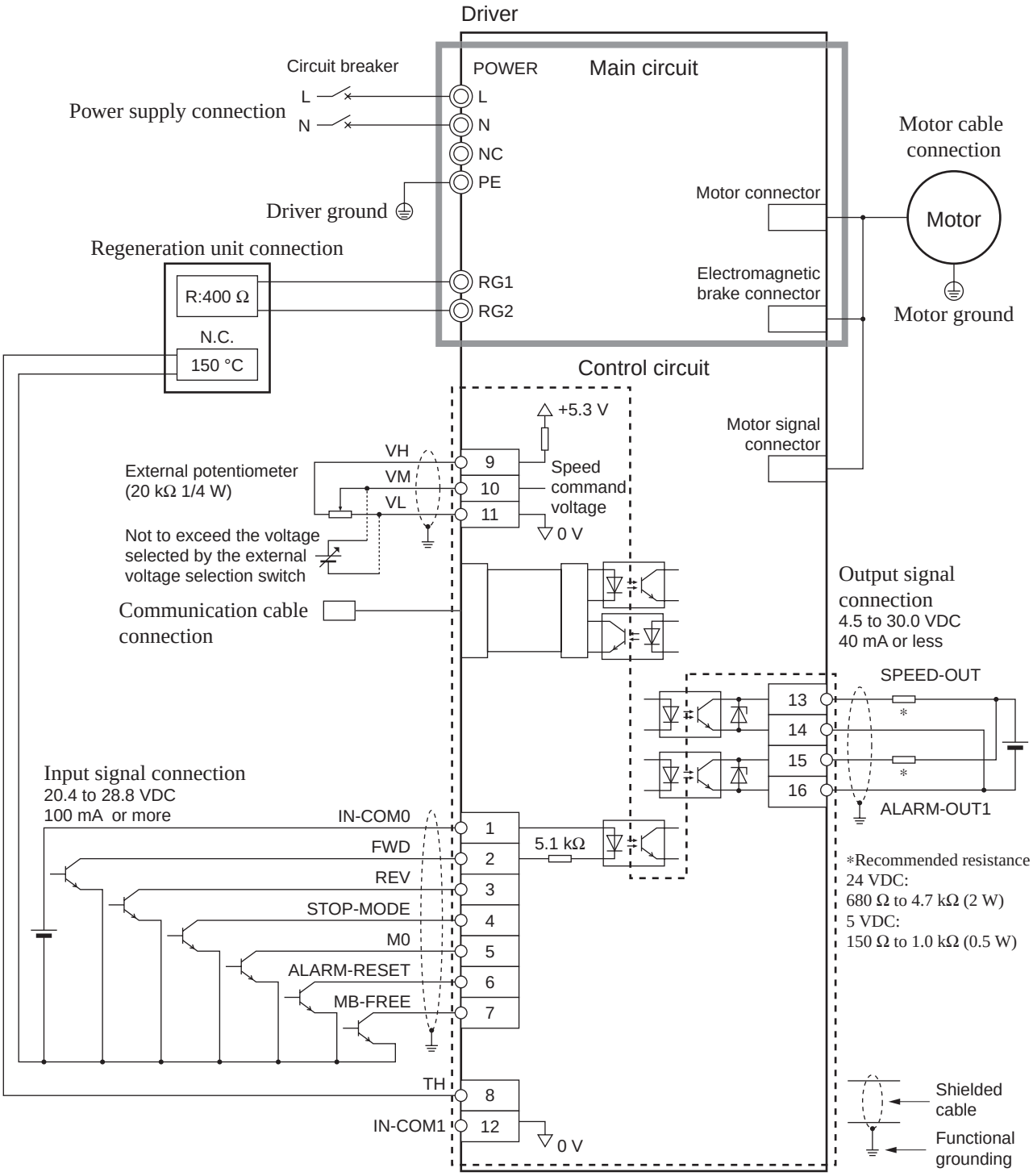
- Using the built-in power supply

In the connection example given below, the motor is operated with a single-phase 100 to 120 V power supply, relays, switches and other contact switches. For the SPEED-OUT output, supply at least 5 mA of current.



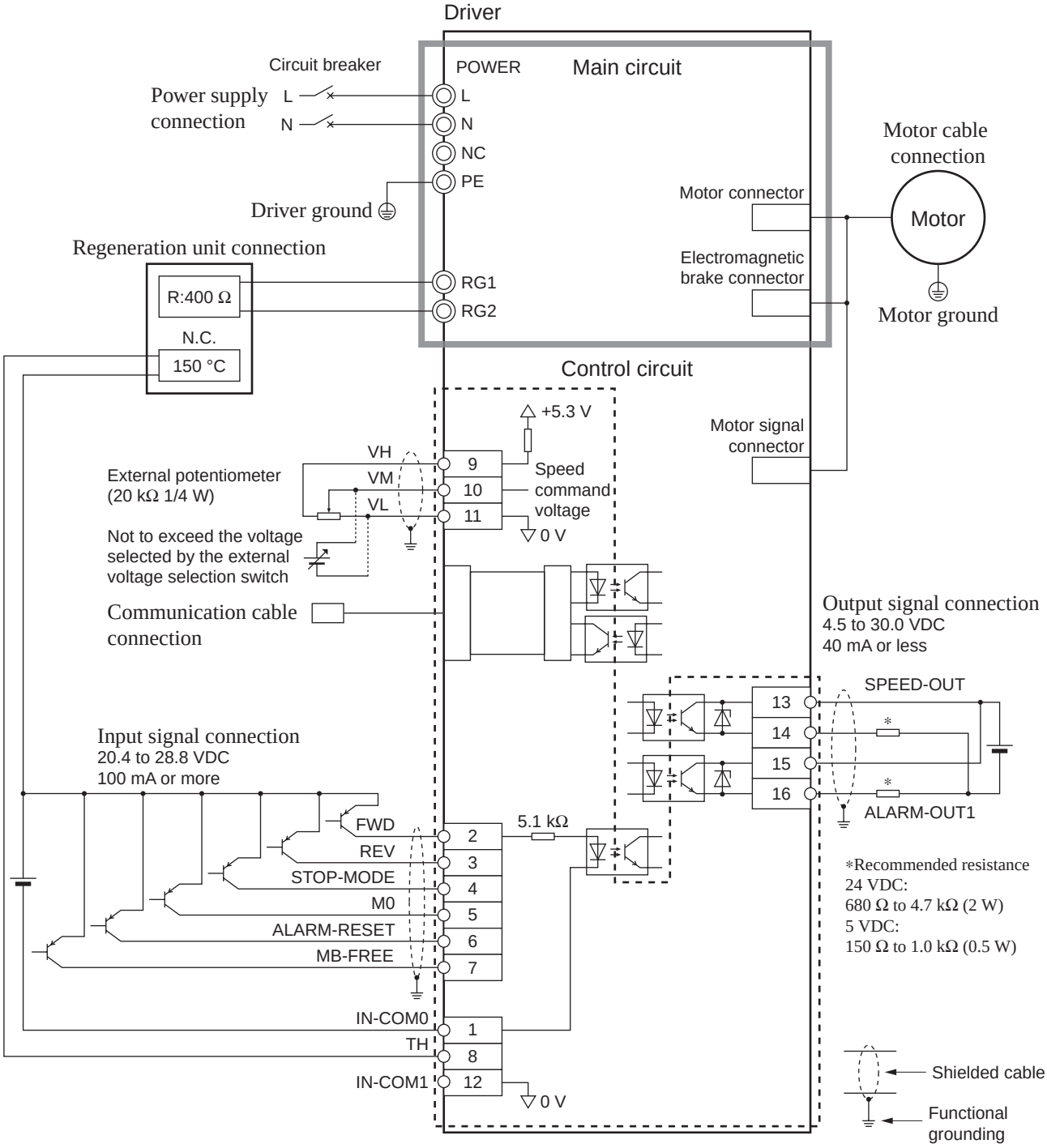
- Using an external power supply

In the connection example given below, the motor is operated with a single-phase 100 to 120 V power supply based on transistor sequence connection. For the SPEED-OUT output, supply at least 5 mA of current.



■ Source logic

In the connection example given below, the motor is operated with a single-phase 200 to 240 V power supply based on transistor sequence connection. For the SPEED-OUT output, supply at least 5 mA of current.



8 Operation

This chapter explains the operations that can be performed with the **BLE** Series.

8.1 Operation overview

With the **BLE** Series, you can perform three types of operations including basic operations, operations in the **FBL**Ⅱ compatible mode, and extended operations using the **OPX-2A** or **MEXE02**. The table below shows the details of each operation and the reference pages.

Type of operation	What you can do		Explanation	Ref.
Basic operation	Speed setting	Internal potentiometer	Set the speed using the internal potentiometer. The operating method, stopping method and direction switching method are also explained here.	P.41
		External potentiometer	Set the speed using the external potentiometer.	
		External DC voltage	Set the speed using external DC voltage.	
	Run/stop		Run/stop the motor.	P.42
	Setting the acceleration time and deceleration time		You can set the acceleration time and deceleration time separately for starting and stopping.	P.43
	Changing the speed		Operation can be performed at two speeds through use of both the external potentiometer (external DC voltage) and internal potentiometer.	P.44
	Examples of operation patterns		Examples of run/stop are explained using timing charts.	P.44
	Parallel operation		A single external potentiometer (external DC voltage) can be used to set the same speed for multiple motors.	P.45
Operations in **FBL**Ⅱ compatible mode	Settings of the following items can be changed in the same manner as with the **FBL**Ⅱ Series: • Operation that should take place when the FWD input and REV input turn ON simultaneously • Operation that should take place when the direction is switched instantaneously • SPEED-OUT output setting • Alarm output logic • Speed setting range • Acceleration/deceleration time settings			P.46
Extended operations using the **OPX-2A** or **MEXE02**	The following functions are extended when the **OPX-2A** or **MEXE02** is used. Refer to p.49 for the assignments of I/O signals as well as operation patterns when eight speeds are set: • Operating speed (maximum of 8 speeds) • Torque limit • Change of I/O signal assignments • Various displays (speed, alarm code, load factor) • I/O monitor • Warning output • Test operation • Data copy			P.49

8.2 Basic operation

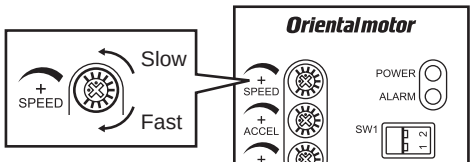
■ Speed setting

The setting range is 100 to 4000 r/min.

- Setting by internal potentiometer

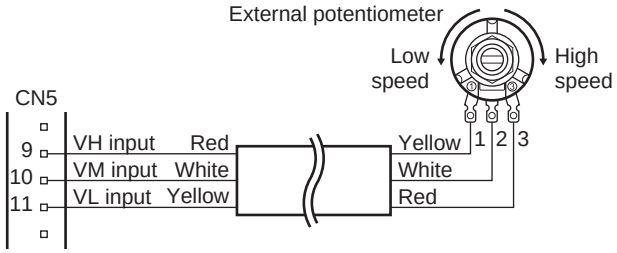
Use a precision screwdriver to turn the internal potentiometer.
Turn the potentiometer clockwise to increase the speed.

Factory setting: 0 r/min

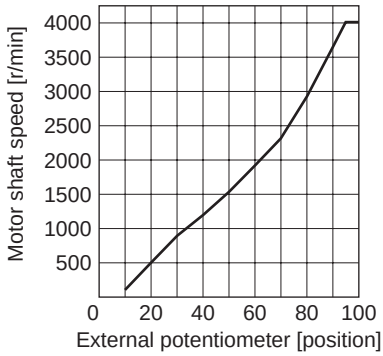


- Setting by the external potentiometer

Connect the supplied external potentiometer to the I/O signal connector (CN5) of the driver.
Use the supplied signal wire [1 m (3.3 ft.)] for this connection.
Connect the shield wire of the signal wire to the VL input terminal.
Make sure the shield wire does not contact other terminals.
When the M0 input is turned ON, the external potentiometer is enabled. Turn the potentiometer clockwise to increase the speed.



- External potentiometer position vs. speed characteristics (representative values)

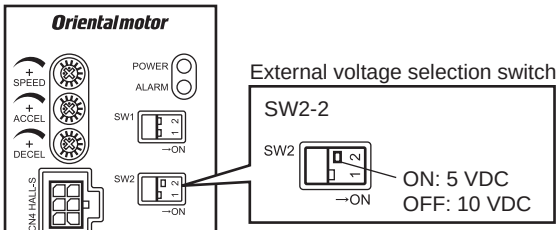


∗ Refer to p.47 for the characteristics when the **FBL**Ⅱ compatible mode is used.

- Setting with external DC voltage

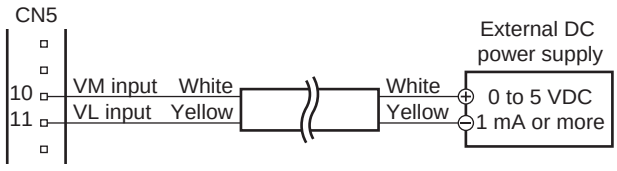
Set either 5 or 10 VDC for the external DC voltage. Use the external voltage selector switch SW2-2 to set which voltage to be used. 5 VDC is set when the switch is set to the ON position, and 10 VDC is set when the switch is set to the OFF position.

Factory setting: 5 VDC (ON)

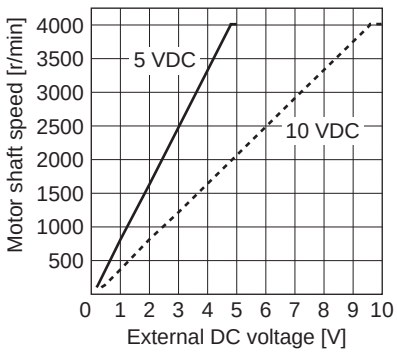


Note Change the setting of the external voltage selector switch SW2-2 before turning on the power.

For the external voltage, use a DC power supply (0 to 5 VDC or 0 to 10 VDC) with reinforced insulation on both the primary side and secondary side, and use the supplied signal wire [1 m (3.3 ft.)] to connect it to the I/O signal connector (CN5).
Connect the shield wire of the signal wire to the VL input terminal. Make sure the shield wire does not contact other terminals.
The input impedance between the VM input and VL input is approx. 15 kΩ when SW2-2 is ON, and approx. 30 kΩ when OFF. The VL input is connected to IN-COM1 inside the driver.



- External DC voltage vs. speed characteristics (representative values)



∗ Refer to p.47 for the characteristics when the **FBL**Ⅱ compatible mode is used.

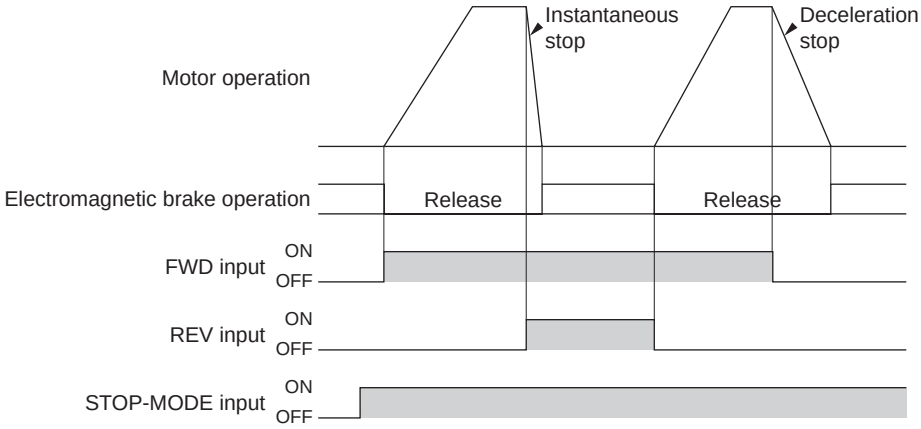
Note Be sure to set the external DC voltage to either 5 VDC or less, or 10 VDC or less. When connecting the external DC power supply, make sure the polarities are correct. If the polarities are reversed, the driver may be damaged.

■ Running/stopping the motor

Run/stop the motor by inputting operation control signals.

- Operation

When the FWD input is turned ON, the motor turns in the clockwise direction according to the time set by the acceleration time potentiometer. When the FWD input is turned OFF, the motor stops.
When the REV input is turned ON, the motor turns in the counterclockwise direction according to the time set by the acceleration time potentiometer. When the REV input is turned OFF, the motor stops.
If the FWD input and REV input are turned ON at the same time, the motor stops instantaneously.



Note

When using the motor in vertical drive (gravitational operation), although it depends on the load condition, if operation is performed with the setting below, the motor shaft may momentarily rotate in the reverse direction (about one-fourth revolution of the motor output shaft) at the time of starting/stopping the motor.
· When the set rotation speed is low
· When the acceleration time and deceleration time is long

- Stop

Select how the motor should stop when the FWD input or REV input is turned ON.
When the STOP-MODE input is ON, the motor stops according to the time set by the deceleration time potentiometer.
STOP-MODE input is OFF, the motor stops instantaneously.

FWD input	REV input	STOP-MODE input	Motor status
ON	OFF	−	Clockwise rotation
OFF	ON	−	Counterclockwise rotation
ON	ON	−	Instantaneous stop
−	−	OFF	Instantaneous stop
−	−	ON	Deceleration stop

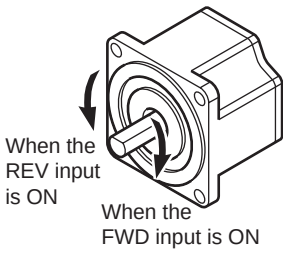
■ Rotating direction of the motor output shaft

The rotating direction of the motor output shaft represents the direction when viewed from the motor output shaft side.

- Combination type parallel shaft gearhead

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.

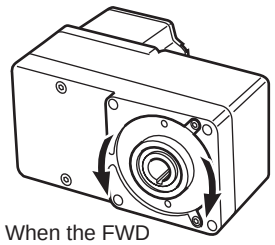
Gear ratio	Rotating direction of gearhead output shaft
5, 10, 15, 20, 200	Same as the motor output shaft
30, 50, 100	Opposite to the motor output shaft



- Combination type hollow shaft flat gearhead

For 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.

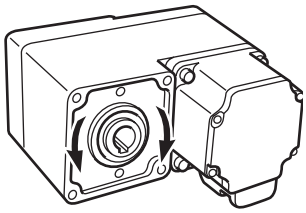
· Viewed from Front



When the FWD input is ON

When the REV input is ON

· Viewed from Rear

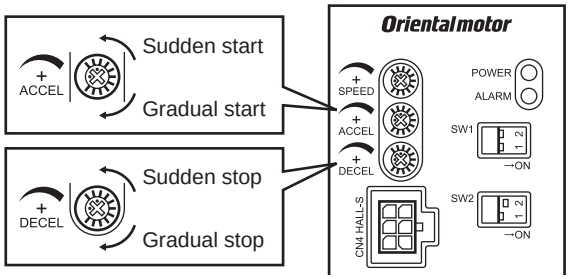


When the REV input is ON

When the FWD input is ON

8.3 Setting the acceleration time and deceleration time

You can set the acceleration time and deceleration time separately for starting and stopping.
The acceleration time and deceleration time are effective for all speed settings.



■ Setting the acceleration time

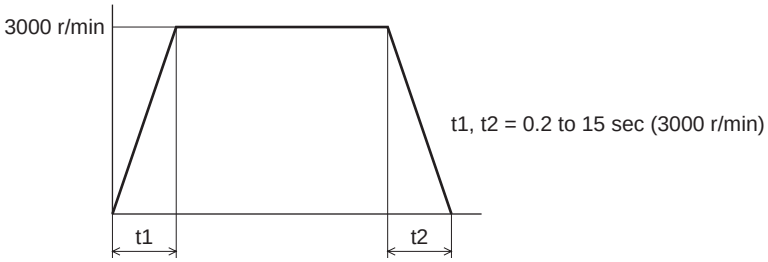
"Acceleration time" refers to the time needed to reach the rated speed (3000 r/min).
Set the acceleration time using the acceleration time potentiometer (ACCEL). Turning the potentiometer clockwise increases the time.

The setting range is 0.2 to 15 sec.
Factory setting: 0.2 sec

■ Setting the deceleration time

"Deceleration time" refers to the time needed for the motor to stop from the rated speed (3000 r/min).
Set the acceleration time using the deceleration time potentiometer (DECEL). Turning the potentiometer clockwise increases the time.

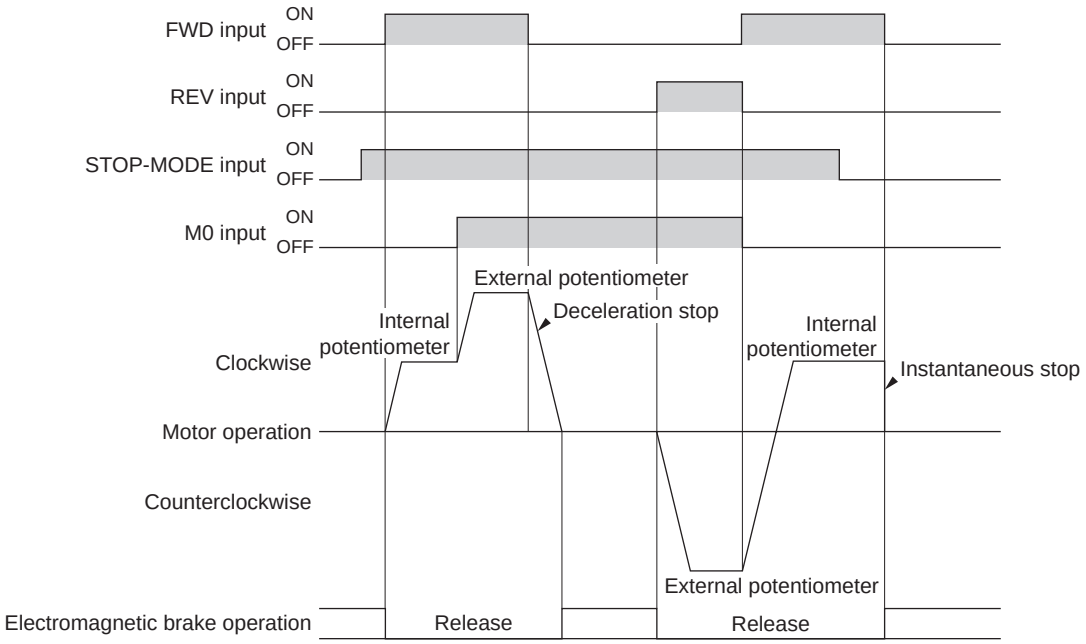
The setting range is 0.2 to 15 sec.
Factory setting: 0.2 sec



"Acceleration time (t1)" refers to the time needed for the motor to reach the rated speed (3000 r/min) from the stationary state.
"Deceleration time (t2)" refers to the time needed for the motor to stop from the rated speed (3000 r/min).
The actual acceleration time and deceleration time vary depending on the conditions of use, load inertia, load torque, etc. If smooth acceleration operation or deceleration operation is not possible, increase the acceleration time or deceleration time.

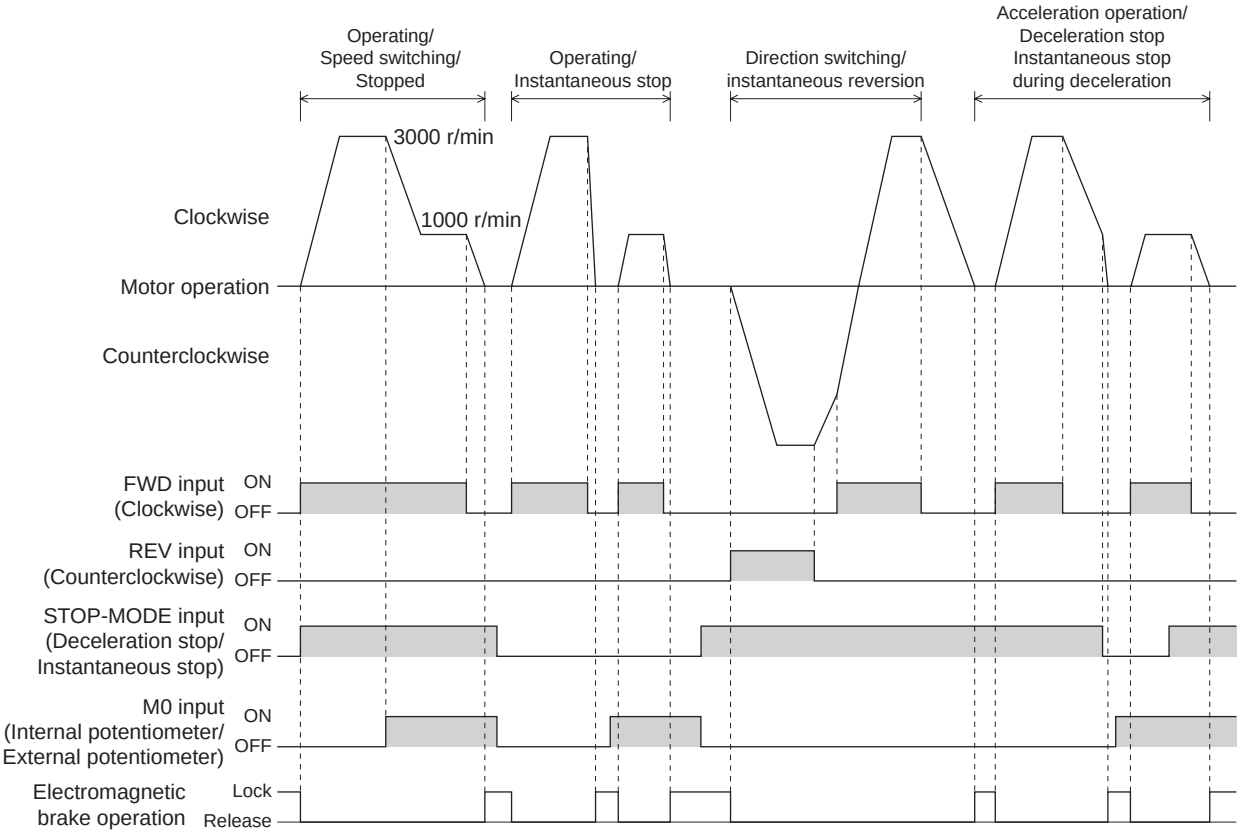
8.4 Changing the speed

Operation can be performed at two speeds through use of both the internal potentiometer and external potentiometer (external DC voltage).
When the M0 input is ON, the motor turns at the speed set by the external potentiometer or external DC voltage.
When the M0 input is OFF, the motor turns at the speed set by the internal potentiometer.



8.5 Examples of operation patterns

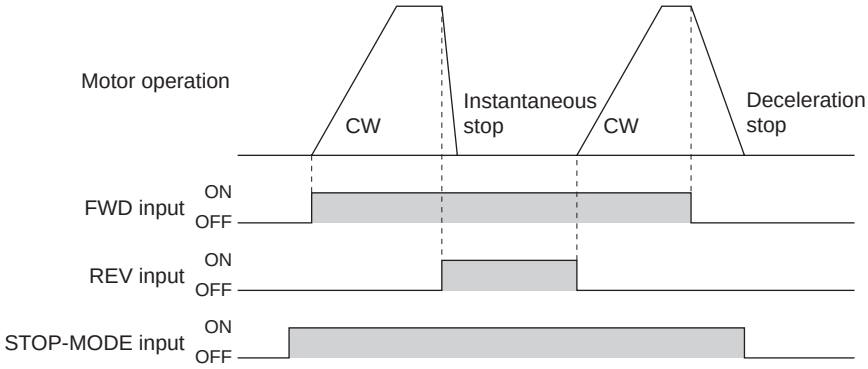
The charts below are examples of setting the internal potentiometer to 3000 r/min and external potentiometer to 1000 r/min and switching the speed between these two levels.



Note

- Make sure each signal remains ON for at least 10 ms.
- When switching the FWD input and REV input, provide an interval of at least 10 ms.

If the FWD input and REV input are turned ON at the same time, the motor stops instantaneously regardless of the status of the STOP-MODE input.



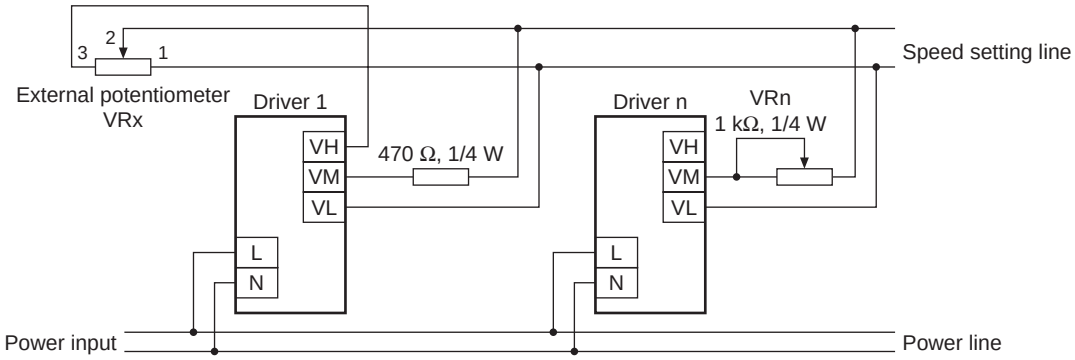
8.6 Parallel operation

If two or more motors are to be operated at the same speed by using a single external potentiometer (external DC voltage), 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.

- 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 the external potentiometer, set the external voltage selector switch (SW2-2) to 5 VDC.
- Set the external voltage selector switch (SW2-2) the same way for all the drivers.

■ Using an external potentiometer

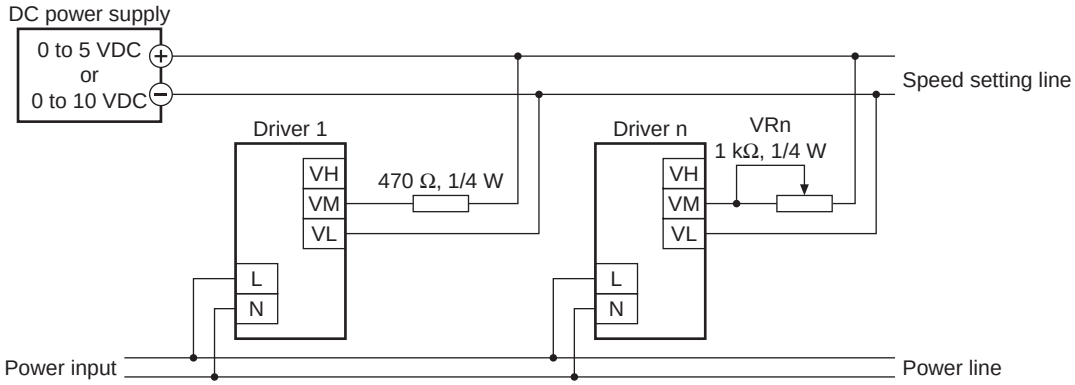
Connect the drivers as shown below.
When performing parallel operation using the external potentiometer, the number of drivers should not exceed 20 units.



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)].
(Use a resistor of the calculated wattage or more.)
If the speed will vary among the respective motors, make adjustments by connecting a resistor of 470 Ω, 1/4 W to terminal VM on driver 1 and connecting a variable resistor of 1 kΩ, 1/4 W to driver 2 and subsequent drivers.

■ Using external DC voltage

Connect the drivers as shown below.



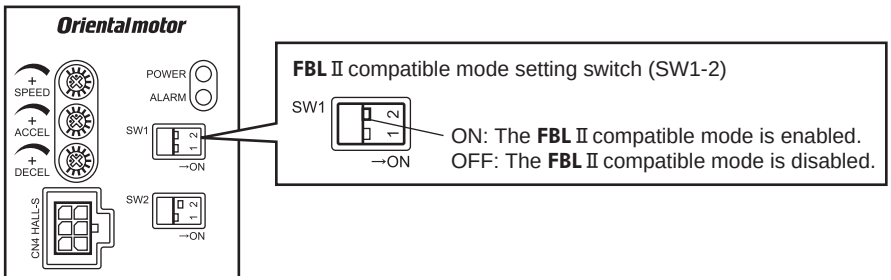
If the number of drivers used is "n," calculate the current capacity (I) of the external DC power supply using the formula below:
Current capacity (I) = 1 × n (mA)
Example: If two drivers are used, current capacity (I) is calculated as 2 mA or more [1 × 2 (mA)].
If the speed will vary among the respective motors, make adjustments by connecting a resistor of 470 Ω, 1/4 W to terminal VM on driver 1 and connecting a variable resistor of 1 kΩ, 1/4 W to driver 2 and subsequent drivers.

8.7 Setting the FBLⅡ compatible mode and operation

In this mode, the settings switch to those identical to the **FBL**Ⅱ Series.
Switch the mode using the **FBL**Ⅱ compatible mode setting switch (SW1-2).

Note Change the setting of the **FBL**Ⅱ compatible mode setting switch (SW1-2) before turning on the main power supply. If the switch setting is changed after the main power supply has been turned on, the new setting does not become effective.

ON: The **FBL**Ⅱ compatible mode is enabled.
OFF: The **FBL**Ⅱ compatible mode is disabled (factory setting).



■ Details of FBLⅡ compatible mode

The acceleration time and deceleration time vary depending on load.

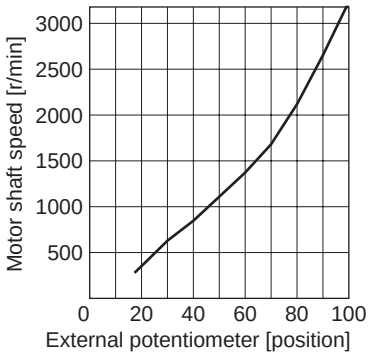
Item	**FBL**Ⅱ compatible mode	**BLE** Series (The **FBL**Ⅱ compatible mode is disabled)
Operation that should take place when the FWD input and REV input turn ON simultaneously	The FWD input is given priority and the motor turns in the clockwise direction.	The motor stops instantaneously.
Operation that should take place when the direction is switched instantaneously	The motor stops instantaneously and the direction also switches instantaneously.	The motor stops instantaneously and the direction switches according to the acceleration time set by the acceleration time potentiometer (ACCEL).
SPEED-OUT output setting	12 pulses are output with each motor revolution (pulse width: 0.5 ms).	30 pulses are output with each motor revolution (pulse width: 0.2 ms).
Alarm output logic	The alarm output turns ON when the drive's protective function triggers (normally open).	The alarm output turns OFF when the drive's protective function triggers and an alarm generates (normally closed).
Speed setting range	300 to 3000 r/min	100 to 4000 r/min
Acceleration and deceleration time setting	Setting range: 0.5 to 15 sec (at 3000 r/min)	Setting range: 0.2 to 15 sec (at 3000 r/min)

■ Control of operation in FBL Ⅱ compatible mode

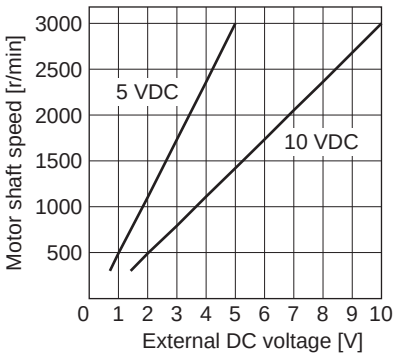
FWD input	REV input	STOP-MODE input	Motor status
ON	OFF	−	Clockwise rotation
OFF	ON	−	Counterclockwise rotation
ON	ON	−	Clockwise rotation
−	−	OFF	Instantaneous stop
−	−	ON	Deceleration stop

■ Speed characteristics

· External potentiometer position vs. speed characteristics (representative values)



· External DC voltage vs. speed characteristics (representative values)

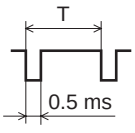


■ SPEED-OUT output

12 pulses are output with each revolution of the motor output shaft synchronously with the motor operation (pulse width of 0.5 ms).

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

$$\text{Motor shaft speed (r/min)} = \frac{\text{SPEED-OUT output frequency}}{12} \times 60$$

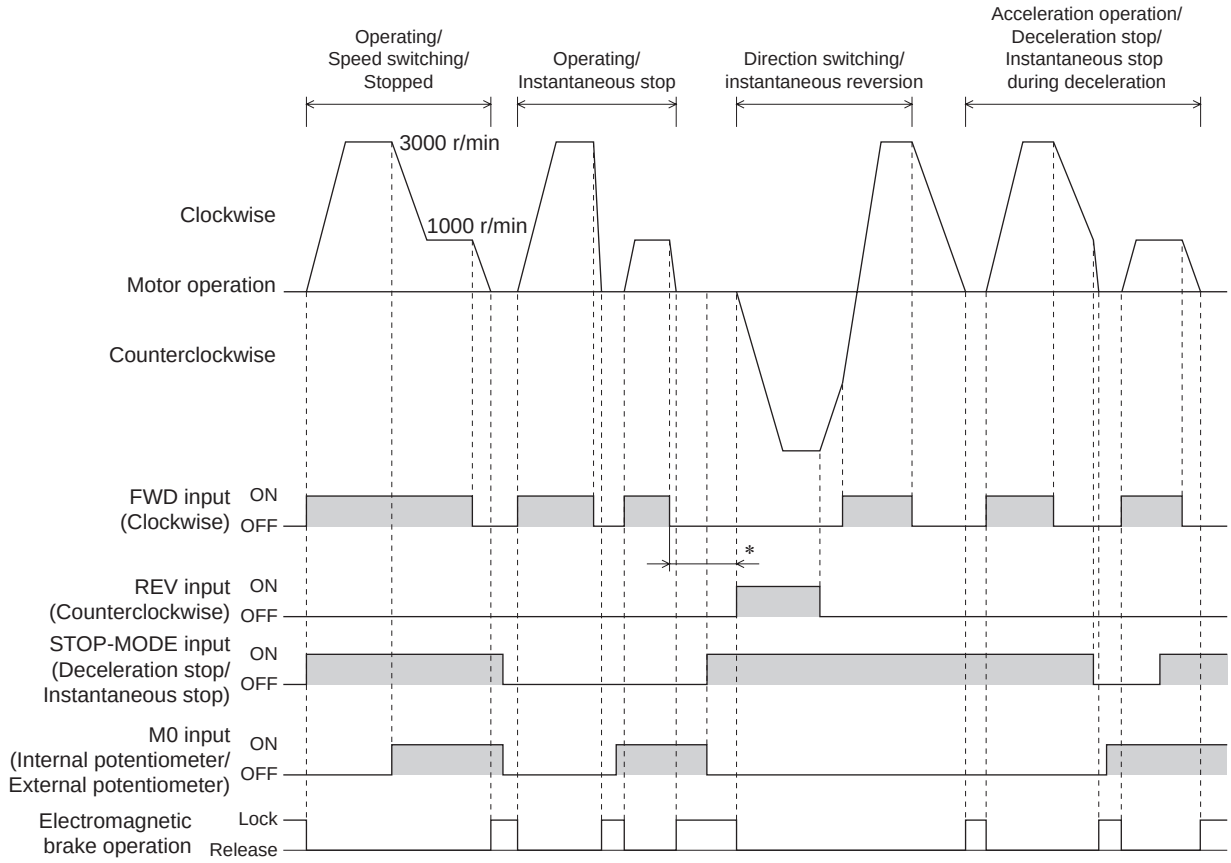


■ Setting the acceleration time and deceleration time

Both setting ranges of the acceleration time and the deceleration time are 0.5 to 15 sec (at 3000 r/min).

■ Example of operation pattern

The chart below is an example of setting the internal potentiometer to 3000 r/min and external potentiometer to 1000 r/min and operating the motor at two speeds.



∗ When switching the FWD input and REV input, provide an interval of at least 10 ms.

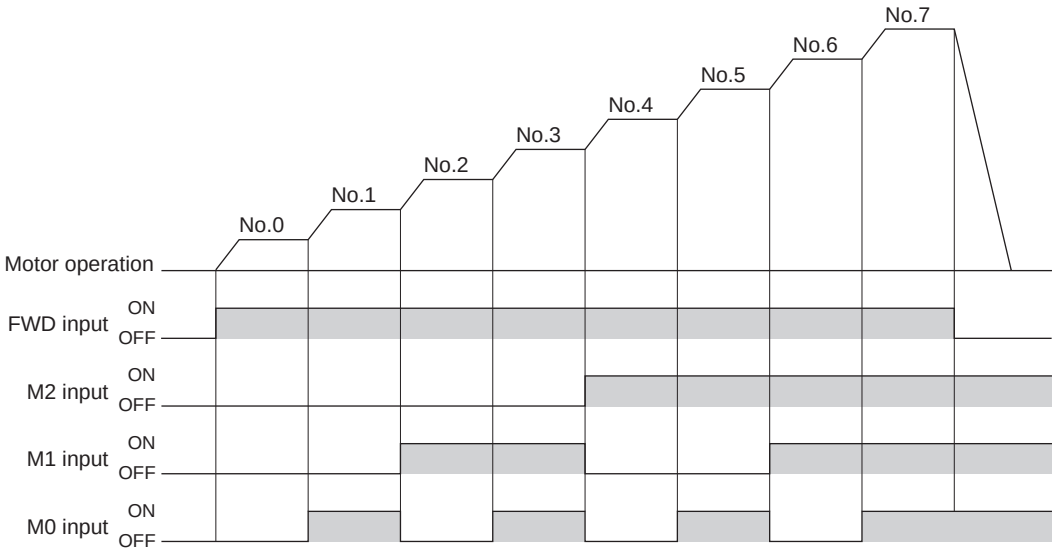
Note Make sure each signal remains ON for at least 10 ms.

9 Extended functions

The following functions can be extended using the **OPX-2A** or **MEXE02**.
For details, refer to the operating manual for each product.

- A maximum of eight speeds can be set.
- The torque can be limited.
- The assignments of I/O signals can be changed.
- The speed, alarm code and load factor can be displayed.
- I/Os can be monitored.
- Warnings can be output.
- Test operation can be performed.
- Data can be copied.

■ Example of operation pattern with maximum eight speed settings



10 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 discharge can damage the driver.

■ Inspection items

Confirm that:

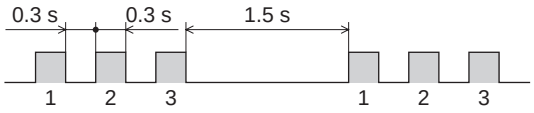
- The motor/gearhead mounting screws are not loose.
- The bearing (ball bearing) and other parts of the motor are not generating noise.
- The bearing (ball bearing) and gear meshing parts of the gearhead are not generating noise.
- The motor/gearhead output shaft is not misaligned with the load shaft.
- 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.

11 Protection function

When an alarm generates and the driver's protective function is actuated, the ALARM-OUT1 output will turn OFF.* In the case of a standard type, the motor coasts to a stop, and then the holding power of the motor output shaft is lost. When the motor is an electromagnetic brake type, the motor stops instantaneously and the electromagnetic brake is actuated to hold the shaft in position.
The ALARM LED blinks at the same time. You can check the type of the alarm by counting the number of times the ALARM LED blinks.

* ON in the **FBL Ⅱ** compatible mode

Flashing pattern example: Sensor error (three flashes)



To reset an alarm, be sure to remove the cause of the alarm and then perform one of the following operations:
- Turn the ALARM-RESET input ON for at least 10 ms. (Refer to p.33 for details.)
- Turn off the power, wait for at least 30 sec, and then cycle the power.

Note
- Alarms cannot be reset if the FWD input or REV input is ON or the motor is running. Be sure to stop the motor before resetting any alarm.
- Alarms caused by damage to the motor or driver itself cannot be reset using the method explained above. Please contact your nearest office.
- Make sure the ALARM-RESET input remains ON for at least 10 ms. If the ON period is too short, the alarm may not be reset.
- If an external stop alarm generates, the motor stops instantaneously.

■ Alarm list

No. of ALARM LED blinks	Alarm name	Cause	Remedial action	Reset using the ALARM-RESET input
2	Overload	A load exceeding the rated torque was applied to the motor for 5 seconds or more.	• Decrease the load. • Review the operation pattern settings such as the acceleration/deceleration time.	Possible
3	Sensor error	The motor sensor signal line experienced an open circuit during operation, or the signal connector came off.	Check the connection between the driver and motor.	Possible
	Initial sensor error	The motor sensor signal line broke or signal connector came off before the main power supply was turned on.		
4	Overvoltage	• The main power-supply voltage became higher than the rated voltage by approx. 20%. • A load exceeding the allowable gravitational capacity of the motor is driven or sudden starting/stopping of a large inertial load is performed.	• Check the main power supply voltage. • If this alarm occurs during operation, reduce the load or increase the acceleration/deceleration time. • Use a regeneration unit.	Possible
5	Undervoltage	The main power-supply voltage became lower than the rated voltage by approx. 40%	• Check the main power supply voltage. • Check the wiring of the power supply cable.	Possible
6	Overspeed	The rotating speed of the motor output shaft exceeded approx. 4800 r/min.	• Decrease the load. • Review the operation pattern settings such as the acceleration/deceleration time.	Possible

No. of ALARM LED blinks	Alarm name	Cause	Remedial action	Reset using the ALARM-RESET input
7	Overcurrent	Excessive current has flown through the driver due to ground fault, etc.	Check the wiring between the driver and motor for damage. If the alarm does not reset even after the power supply has been cycled, contact your nearest office.	Not possible
8	EEPROM error	• Stored data was damaged. • Data became no longer writable or readable.	Initialize the parameters if the **OPX-2A** or **MEXE02** is used. If the alarm does not reset even after the power supply has been cycled, contact your nearest office.	Not possible
9	Overheated regeneration unit	• Overheating of the regeneration unit was detected. • Lead wires of the thermostat output of the regeneration unit broke during operation.	• The power consumption of the regeneration resistor exceeds the permissible level. Review the load condition and operating conditions. • Check the connection between the lead wires of the regeneration unit/thermostat output and CN5 on the driver.	Possible
10	External stop *1	The EXT-ERROR input turned OFF.	Check the EXT-ERROR input.	Possible
11	Initial operation inhibition *2	The main power supply was cycled when the FWD input or REV input was ON.	Turn the FWD input and REV input OFF, and then cycle the main power supply.	Possible
14	Main circuit output error *3	The motor drive wire broke or motor power connector came off.	Check the connection between the driver and motor.	Possible

∗1 Only when EXT-ERROR is assigned using the **OPX-2A** or **MEXE02**.
∗2 This alarm generates when the "Initial operation inhibition" function has been enabled using the **OPX-2A** or **MEXE02**. This alarm does not generate in the **FBL** Ⅱ compatible mode.
∗3 This alarm does not generate when the torque limit is set to less than 200% using the **OPX-2A** or **MEXE02**.

Note Cycle the power to reset the overcurrent and EEPROM error alarms. To cycle the power, wait for at least 30 seconds after the power is cut off and then turn it back on. If the unit does not operate properly after the power is cycled, internal circuit damage is suspected. Please contact your nearest office.

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 contact your nearest Oriental Motor office.

Problem	Likely cause	Corrective action
The motor doesn't operate.	The power supply is not connected correctly.	Check the connection of the power supply.
	Both the FWD input and REV input are OFF.	Turn ON either the FWD input or REV input one at a time.
	Both the FWD input and REV input are ON.	Turn ON either the FWD input or REV input one at a time.
	The internal potentiometer is not adjusted.	The factory setting is 0 r/min. Turn the internal potentiometer clockwise.
	The potentiometer is not selected correctly.	Turn the M0 input OFF when using the internal potentiometer. Turn the M0 input ON when using the external potentiometer.
	The external potentiometer or external DC voltage is not connected correctly.	Check the connection of the external potentiometer or external DC voltage.
	The ALARM LED (red) is blinking.	An alarm generated due to a protective function being triggered. Refer to p.50 to reset the alarm.
	Electromagnetic brake is not released. (electromagnetic brake motor only).	Turn ON the MB-FREE input.
The motor turns in the opposite direction to the specified direction.	The FWD input and REV input are connected wrongly or otherwise not connected correctly.	Check the connection of the FWD input and REV input. The motor turns in the clockwise direction when the FWD input is ON, and in the counterclockwise direction when the REV input is ON.
	The combination type parallel shaft gearhead is using a gear with a gear ratio of 30:1, 50:1 or 100:1.	When the gear ratio of the combination type parallel shaft gearhead is 30, 50 or 100, the rotating direction of the gear output shaft is opposite the rotating direction of the motor output shaft. Accordingly, reverse the FWD input and REV input operations.
	A combination type hollow shaft flat gearhead is used.	• With a combination type hollow shaft flat gearhead, the rotating direction of the gear output shaft is opposite the rotating direction of the motor output shaft. Accordingly, reverse the FWD input and REV input operations. • Is the gearhead viewed in the correct direction? With a combination type hollow shaft flat gearhead, the rotating direction of the gearhead changes according to the direction in which the gearhead is viewed.
• Unstable motor operation • Large vibration	The motor (gearhead) output shaft is not misaligned with the load shaft.	Check the coupling condition of the motor (gearhead) output shaft and load shaft.
	Effect of noise.	Check the operation only with the motor, driver and other external equipment required for operation. If an effect of noise has been confirmed, implement the following countermeasures: • Move the unit farther away from noise generation sources. • Review the wiring. • Change the signal cables to a shielded type. • Install ferrite cores.
The motor doesn't stop instantaneously.	The STOP-MODE input is ON.	To cause the motor to stop instantaneously, turn OFF the STOP-MODE input.
	The inertial load is large.	Reduce the load inertia or connect the accessory regeneration unit (sold separately) to check the inertial load.
The electromagnetic brake does not hold.	The MB-FREE input is ON.	Turn OFF the MB-FREE input.

13 Accessories (sold separately)

■ Connection cable

This cable is used to extend the wiring distance between the driver and motor. Connection can be extended to a maximum of 20.4 m (66.9 ft.). Flexible connection cables are also available. You can connect up to three connection cables.

• Standard type
Connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLE**
2 (6.6)	**CC02BLE**
3 (9.8)	**CC03BLE**
5 (16.4)	**CC05BLE**
7 (23)	**CC07BLE**
10 (32.8)	**CC10BLE**
15 (49.2)	**CC15BLE**
20 (65.6)	**CC20BLE**

• Standard type
Flexible connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLER**
2 (6.6)	**CC02BLER**
3 (9.8)	**CC03BLER**
5 (16.4)	**CC05BLER**
7 (23)	**CC07BLER**
10 (32.8)	**CC10BLER**
15 (49.2)	**CC15BLER**
20 (65.6)	**CC20BLER**

• Electromagnetic brake type
Connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLEM**
2 (6.6)	**CC02BLEM**
3 (9.8)	**CC03BLEM**
5 (16.4)	**CC05BLEM**
7 (23)	**CC07BLEM**
10 (32.8)	**CC10BLEM**
15 (49.2)	**CC15BLEM**
20 (65.6)	**CC20BLEM**

• Electromagnetic brake type
Flexible connection cable

Length [m (ft.)]	Model
1 (3.3)	**CC01BLEMR**
2 (6.6)	**CC02BLEMR**
3 (9.8)	**CC03BLEMR**
5 (16.4)	**CC05BLEMR**
7 (23)	**CC07BLEMR**
10 (32.8)	**CC10BLEMR**
15 (49.2)	**CC15BLEMR**
20 (65.6)	**CC20BLEMR**

■ Regeneration unit

Connect the regeneration unit if gravitational operation or sudden starting/stopping of a large inertial load, will be repeated frequently.

Model: **EPRC-400P**

■ Digital speed indicator

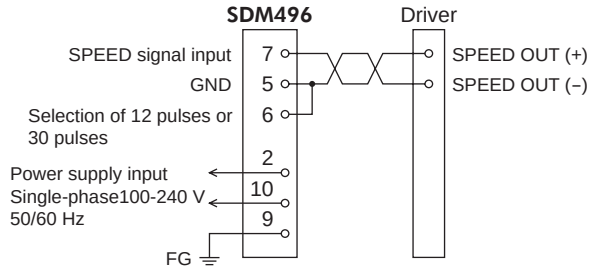
This device displays the speed of the motor output shaft and reduced speed of the gearhead output shaft.

Model: **SDM496**

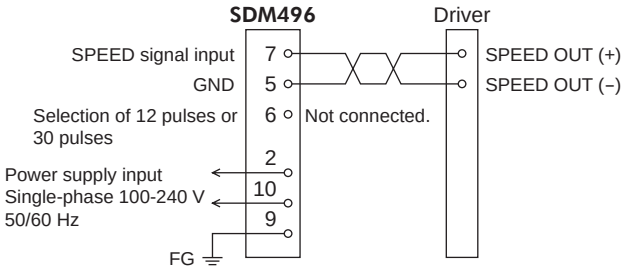
Note

- The **SDM496** is not certified under safety standards. If the **SDM496** is combined with a **BLE** Series unit, the **BLE** Series unit does not conform to safety standards, either.
- The **SDM496** cannot be used with the source logic.

• Basic connection (30 pulses/revolution)



• **FBL**Ⅱ compatible mode (12 pulses/revolution)



■ Data setter

This data setter can be used to set or monitor operation data and parameters.

Model: **OPX-2A**

■ Data editing software

The data editing software lets you set parameters for your **BLE** Series and monitor its operating condition using a PC.

Model: **MEXE02**

■ DIN rail mounting plate

When mounting the driver to a DIN rail, use a DIN rail mounting plate.
Use a DIN rail 35 mm (1.38 in.) wide.

Model: **PADP03**

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