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Oriental motor

HM-5069-4

Brushless DC motor and driver package

BX Series

OPERATING MANUAL

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

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

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1 Introduction

1.1 Before use

Only qualified personnel should work with the product.
Use the product correctly after thoroughly reading the section “Safety precautions.”
The product described in this manual has been designed and manufactured for use in general industrial machinery, and must not be used for any other purpose. Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

1.2 Overview of the product

The **BX** series is a brushless DC motor adopting a thin, high torque motor with encoder and high-precision driver. This product is available in two types; a combination type equipped with a special-purpose gearhead, which is best, suited to high-torque operation by gear speed reduction and a round shaft type which is the optimum for high speed requirements.
You can extend the performance using the optional system upgrade tool (data setter **OPX-1A**).

1.3 Standards and CE Marking

This product conforms with the EC’s Low Voltage Directive and EMC Directive under the following conditions. Take the following measures to ensure conformance with the EC’s Low Voltage Directive and EMC Directive.

■ For Low Voltage Directive

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

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

	Motor	Driver
Applicable Standards	EN 60034-1, EN 60034-5, EN 60664-1	EN 50178
Installation conditions	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
Protective range	IP54 (except for the shaft of the round shaft motor)	IP10
Insulation class	E	–

■ EMC Directive

This product has received EMC measures under the conditions specified in “Example of motor and driver installation and wiring” on page 26.
Be sure to conduct EMC measures with the product assembled in your equipment by referring to 5.11, “Installing and wiring in compliance with EMC Directive” on page 24.

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■ UL/CSA Standards

		Certification Body	Applicable Standards	Standards File No.
Motor*	30 W 60 W 120 W	UL	UL 60950-1 CSA C22.2 No.60950-1	E208200
	200 W 400 W		UL 1004-1 CSA C22.2 No.100	E335369
Driver		UL	UL 508C CSA C22.2 No.14	E171462

* Insulation class of this motor is A.

■ UL RECOGNITION OF DRIVER

Drivers are recognized by UL at following condition.

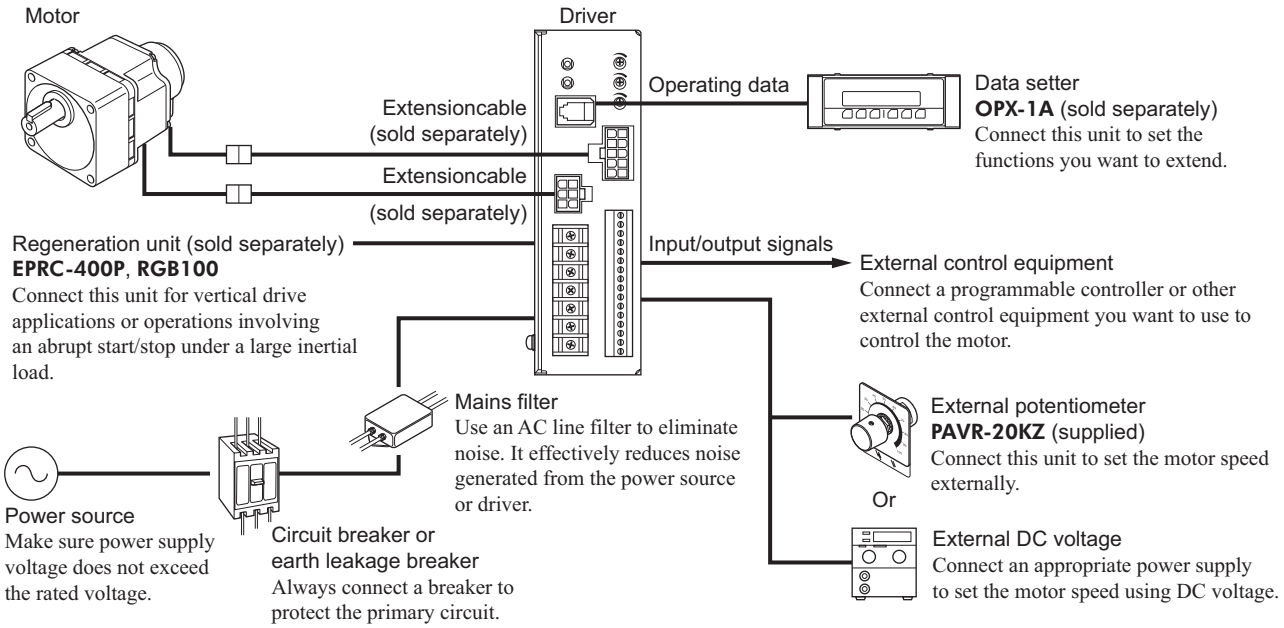
- Maximum Surrounding Air Temperature 50 °C.
- Solid state motor overload protection is provided in each model.
- Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 Arms Symmetrical Amperes, 120 or 240 VAC Maximum Voltage.
- Integral solid state short circuit protection does not provide 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.

■ Hazardous substances

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

1.4 System configuration

A sample system configuration using the **BX** series is provided below.



- Three types of input power sources can be used: single-phase 100-115 V, single-phase 200-230 V and three-phase 200-230 V.
- The mechanical home seeking function requires home-position detection sensors.

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2 Safety precautions

The precautions described below are intended to prevent danger or injury to the user and other personnel through safe, correct use of the product. Use the product only after carefully reading and fully understanding these instructions.

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

⚠ Warning

General

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire, electric shock or injury.
- Assign qualified personnel the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Failure to do so may result in fire, electric shock or injury.
- Do not transport, install the product, perform connections or inspections when the power is on. Always turn the power off before carrying out these operations. Failure to do so may result in electric shock.
- The terminals on the driver's front panel marked with ⚠ ⚠ symbol indicate the presence of high voltage. Do not touch these terminals while the power is on to avoid the risk of fire or electric shock.
- The equipment provided with electromagnetic brake should be used when you want to utilize it for vertical application. If the motor has no electromagnetic brake, the holding force of the motor is insufficient when power is off, the movable parts may fall and cause injuries or damage of the equipment.
- Do not use the brake mechanism of the motor with electromagnetic brake as a safety brake. It is intended to hold the movable parts and motor position. This caution is to avoid personal injury or damage to the equipment.
- When the driver's protection function is triggered, first remove the cause and then clear the protection function. Continuing the operation without removing the cause of the problem may cause malfunction of the motor, leading to injury or damage to equipment.

Installation

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

Connection

- Keep the driver's input-power voltage within the specified range to avoid fire and electric shock.
- Connect the cables securely according to the wiring diagram in order to prevent fire and electric shock.
- Do not forcibly bend, pull or pinch the cable. Doing so may fire and electric shock.
- To prevent electric shock, be sure to install the terminal cover (supplied) over the driver's power supply terminals after making connections.

Operation

- Turn off the driver power in the event of a power failure, or the motor may suddenly start when the power is restored and may cause injury or damage to equipment.
- Do not turn ON the FREE input when the position is held in the vertical direction. Otherwise, the holding force of the motor and electromagnetic brake will be lost, causing personal injury and equipment damage.

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Maintenance and inspection

- Do not touch the connection terminals of the driver immediately after the power is turned off (for a period of 30 seconds). The residual voltage may cause electric shock.

Repair, disassembly and modification

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

⚠ Caution

General

- Do not use the motor (gearhead), driver and the regeneration unit beyond their specifications, or electric shock, injury or damage to equipment may result.
- Keep your fingers and objects out of the openings in the motor and driver. Failure to do so may result in fire, electric shock or injury.
- During running and for some time after stopping the equipment, do not touch the motor, driver and the regeneration unit. You may be burnt by high temperature on the surfaces of the motor, driver and the regeneration unit.

Transportation

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

Installation

- Keep the area around the motor and driver free of combustible materials in order to prevent fire or a skin burn(s).
- To prevent the risk of damage to equipment, leave nothing around the motor and driver that would obstruct ventilation.
- The motor and driver should be firmly secured on the metallic plate in order to prevent personal injury and damage to the equipment.
- The rotating part (output shaft) of the motor (gearhead) should be provided with a cover. Otherwise, injury may occur.
- Do not allow your finger to be caught between the equipment and motor or gearhead when installing the motor with or without gearhead on the equipment. Otherwise, injury may occur.

Operation

- Use the motor and driver in it‘s specified combination. This is to prevent fire.
- Provide an emergency-stop device or emergency-stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- To prevent bodily injury, do not touch the rotating parts (output shaft) of the motor during operation.
- 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.
- To prevent electric shock, use only an insulated screwdriver to adjust the internal switches.
- The motor’s surface temperature may exceed 70 °C (158 °F), even under normal operating conditions. If a motor is accessible during operation, post a warning label shown in the figure in a conspicuous position to prevent the risk of skin burn(s).



Warning label

Maintenance and inspection

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

Disposal

- 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.

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3 Precautions for use

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

■ Connect protective devices to the power line

Connect a circuit breaker or earth leakage breaker to the driver's power line to protect the primary circuit. If an earth leakage breaker is to be installed, use one incorporating high-frequency noise elimination measures. Refer to 10.2, "Recommended peripherals" on page 46 for the selection of appropriate protective devices.

■ Use an electromagnetic brake motor for an application involving up/down travel.

When the motor is used in an application involving up/down travel, use an electromagnetic brake motor to hold the load in position. To hold the load in position, apply the electromagnetic brake only after the motor has stopped. Do not use the brake to bring the moving motor to a halt. Repeated braking for such a purpose will wear the brake hub excessively, causing its holding ability to drop.
Since the electromagnetic brake is of the non-excitation type, it can also be used to hold the load in position upon the occurrence of a power failure. However, this is not a secure means of holding the load. Do not use the electromagnetic brake as a safety brake.

■ Use a regeneration unit (sold separately) for vertical drive applications and those involving high inertial loads.

The driver may be damaged if the energy that is regenerated during a vertical (gravitational) operation or due to an abrupt start/stop involving a large inertial load exceeds the maximum level that can be absorbed by the driver. The optional regeneration unit (sold separately) is designed to discharge the regenerated energy, thereby protecting the driver.

■ Do not use a solid-state relay (SSR) to turn on/off the power

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

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

Conducting the insulation resistance measurement or withstand voltage test with the motor and driver connected may result in injury or damage to equipment.

■ Do not conduct insulation resistance test or withstand voltage test on the encoder.

These tests may damage the encoder.

■ Grease measures

On rare occasions, a small amount of grease may ooze out from the geared motor. If there is concern over possible environmental damage resulting from the leakage of grease, check for grease stains during regular inspections. Alternatively, install an oil pen 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 on the hollow-shaft flat gearhead output shaft

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.

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■ Measures against noise

To prevent possible driver and motor operation errors due to external noise, take the following measures against noise:

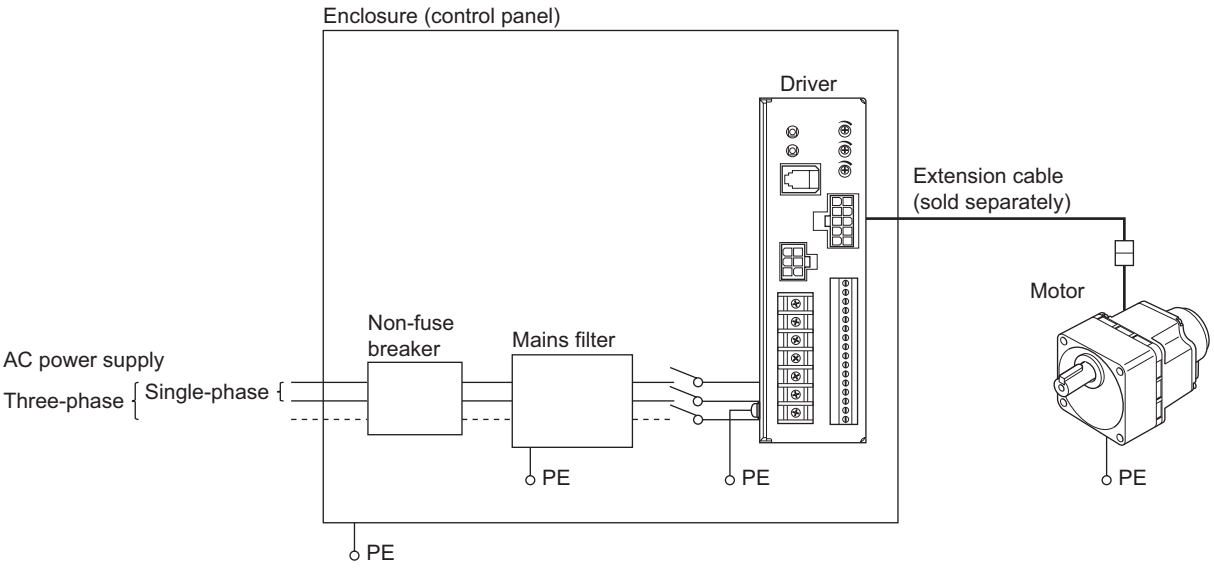
- Electrical connection of the motor

  For electrical connection of the driver and motor, use an optional extension cable.

- Electrical connection of input/output signal cable
  - Connect the input/output signal cable in the shortest possible distance.
  - Connect the input/output signal cable 100 mm (4 in.) or more away from the induction load such as electromagnetic relay and current carrying cables (for power supply, motor, etc.). Do not connect it together with the current carrying cable, for example, by routing them together through the same duct or conduit.
  - Furthermore, use the braided-screen cable as the input/output signal cable. When the braided-screen cable cannot be used, it will be effective to install a Ferrite core on each of the controller and driver sides.

- Connection of mains filter for power supply line

  To prevent external noise from being transferred through the power line, connect a mains filter to the driver AC power supply line input section. Ground the mains filter ground terminal using a cable with a diameter of equivalent to AWG18 (0.75 mm^2) or greater.



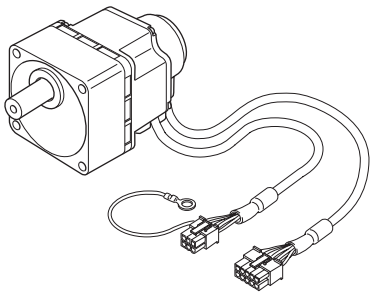
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4 Preparation

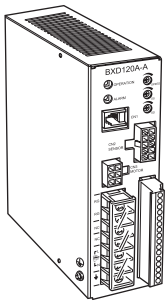
This section covers the points to be checked along with the names and functions of respective parts.

4.1 Checking the product

Verify that the items listed below are included.
Report any missing or damaged items to the branch or sales office from which you purchased the product.
Verify the model number of the purchased unit against the number shown on the package label.
Check the model number of the motor and driver against the number shown on the nameplate.
The unit models and corresponding motor/gearhead/driver combinations are listed on page 9.



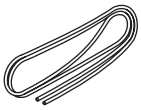
• Motor *1 1 unit
The figure shows a combination type.



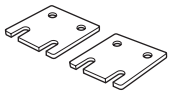
• Driver *2 1 unit



• One external potentiometer *3
1 piece



• One signal cable for connecting external potentiometer [1 m (3.3 ft.)]
1 piece



• Driver mounting brackets
2 pieces



• Screws for driver mounting brackets (M3) 4 pieces

• Operating manual 1 copy

Accessories for combination-type parallel-shaft gearhead *5

• Hexagonal socket head screw set
(Screw, flat washer, spring washer and hexagonal nut, 4 pieces each)



• Parallel key
1 piece *4

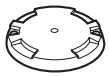


Accessories for combination-type hollow-shaft flat gearhead *5

• Hexagonal socket head screw set *6
(Screw, flat washer, spring washer and hexagonal nut, 4 pieces each)



• Safety cover
1 piece



• Parallel key
1 piece



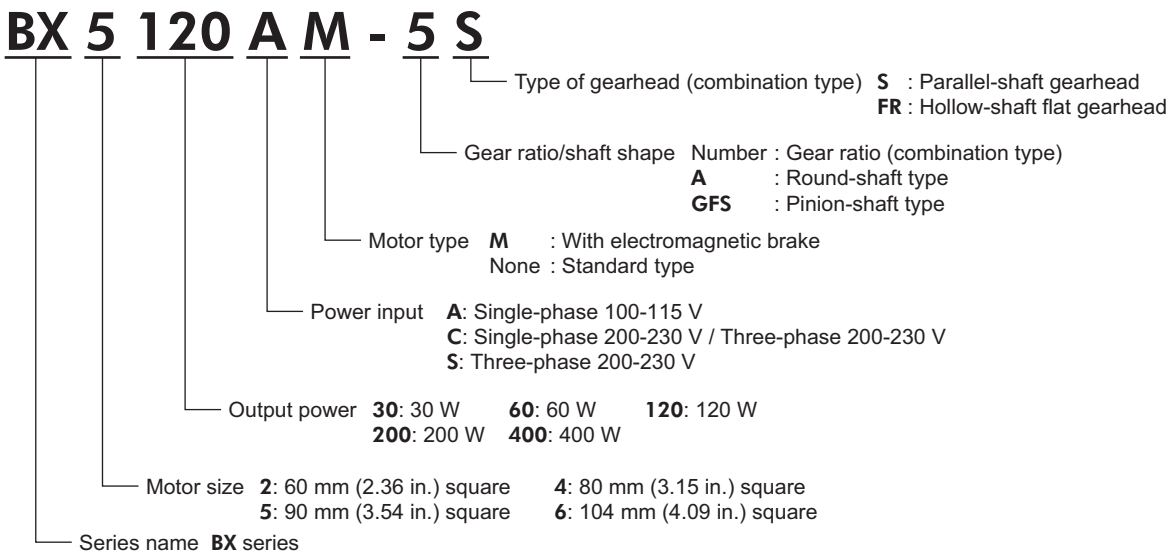
• Safety-cover mounting screw (M3)
2 pieces



*1 One shaft key is supplied for the combination type.
*2 One combination type connector is supplied.
*3 The external potentiometer in the illustration indicates the setter in the assembled state.
*4 On the GFS6G□, the parallel key is affixed to the gearhead output shaft.
*5 Supplied for the motor/gearhead combination type only
*6 The GFS6G□FR does not come with hexagonal nuts.

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4.2 How to identify the product model



4.3 Combination list

■ Combination-type parallel-shaft gearhead

The motor comes preassembled with a parallel-shaft gearhead.

- Standard
- With electromagnetic brake

Unit model	Motor model	Gearhead model	Driver model	Unit model	Motor model	Gearhead model	Driver model
BX230A-☐S	BXM230-GFS	GFS2G☐	BXD30A-A	**BX230AM-☐S**	BXM230M-GFS	GFS2G☐	BXD30A-A
BX230C-☐S			BXD30A-C	**BX230CM-☐S**			BXD30A-C
BX460A-☐S	BXM460-GFS	GFS4G☐	BXD60A-A	**BX460AM-☐S**	BXM460M-GFS	GFS4G☐	BXD60A-A
BX460C-☐S			BXD60A-C	**BX460CM-☐S**			BXD60A-C
BX5120A-☐S	BXM5120-GFS	GFS5G☐	BXD120A-A	**BX5120AM-☐S**	BXM5120M-GFS	GFS5G☐	BXD120A-A
BX5120C-☐S			BXD120A-C	**BX5120CM-☐S**			BXD120A-C
BX6200A-☐S	BXM6200-GFS	GFS6G☐	BXD200A-A	**BX6200AM-☐S**	BXM6200M-GFS	GFS6G☐	BXD200A-A
BX6200C-☐S			BXD200A-C	**BX6200CM-☐S**			BXD200A-C
BX6400S-☐S	BXM6400-GFS	GFS6G☐	BXD400A-S	**BX6400SM-☐S**	BXM6400M-GFS	GFS6G☐	BXD400A-S

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

■ Combination-type hollow-shaft flat gearhead

The motor comes preassembled with a hollow-shaft flat gearhead.

- Standard
- With electromagnetic brake

Unit model	Motor model	Gearhead model	Driver model	Unit model	Motor model	Gearhead model	Driver model
BX230A-☐FR	BXM230-GFS	GFS2G☐FR	BXD30A-A	**BX230AM-☐FR**	BXM230M-GFS	GFS2G☐FR	BXD30A-A
BX230C-☐FR			BXD30A-C	**BX230CM-☐FR**			BXD30A-C
BX460A-☐FR	BXM460-GFS	GFS4G☐FR	BXD60A-A	**BX460AM-☐FR**	BXM460M-GFS	GFS4G☐FR	BXD60A-A
BX460C-☐FR			BXD60A-C	**BX460CM-☐FR**			BXD60A-C
BX5120A-☐FR	BXM5120-GFS	GFS5G☐FR	BXD120A-A	**BX5120AM-☐FR**	BXM5120M-GFS	GFS5G☐FR	BXD120A-A
BX5120C-☐FR			BXD120A-C	**BX5120CM-☐FR**			BXD120A-C
BX6200A-☐FR	BXM6200-GFS	GFS6G☐FR	BXD200A-A	**BX6200AM-☐FR**	BXM6200M-GFS	GFS6G☐FR	BXD200A-A
BX6200C-☐FR			BXD200A-C	**BX6200CM-☐FR**			BXD200A-C
BX6400S-☐FR	BXM6400-GFS	GFS6G☐FR	BXD400A-S	**BX6400SM-☐FR**	BXM6400M-GFS	GFS6G☐FR	BXD400A-S

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

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■ Round-shaft type

- Standard
- With electromagnetic brake

Unit model	Motor model	Driver model	Unit model	Motor model	Driver model
BX230A-A	BXM230-A2	BXD30A-A	**BX230AM-A**	BXM230M-A2	BXD30A-A
BX230C-A		BXD30A-C	**BX230CM-A**		BXD30A-C
BX460A-A	BXM460-A2	BXD60A-A	**BX460AM-A**	BXM460M-A2	BXD60A-A
BX460C-A		BXD60A-C	**BX460CM-A**		BXD60A-C
BX5120A-A	BXM5120-A2	BXD120A-A	**BX5120AM-A**	BXM5120M-A2	BXD120A-A
BX5120C-A		BXD120A-C	**BX5120CM-A**		BXD120A-C
BX6200A-A	BXM6200-A	BXD200A-A	**BX6200AM-A**	BXM6200M-A	BXD200A-A
BX6200C-A		BXD200A-C	**BX6200CM-A**		BXD200A-C
BX6400S-A	BXM6400-A	BXD400A-S	**BX6400SM-A**	BXM6400M-A	BXD400A-S

■ Pinion-shaft type

- Standard
- With electromagnetic brake

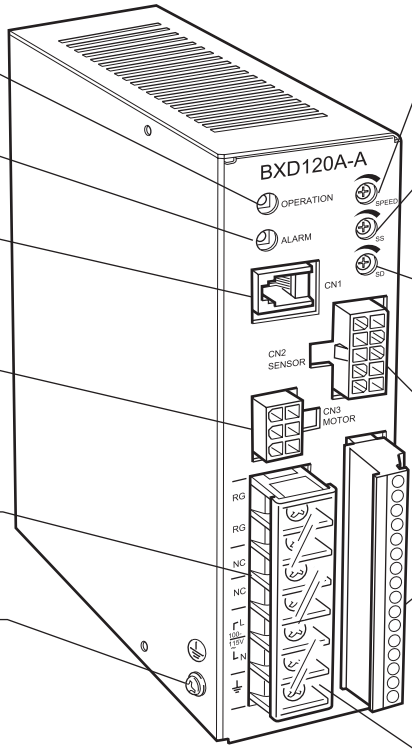
Unit model	Motor model	Driver model	Unit model	Motor model	Driver model
BX230A-GFS	BXM230-GFS	BXD30A-A	**BX230AM-GFS**	BXM230M-GFS	BXD30A-A
BX230C-GFS		BXD30A-C	**BX230CM-GFS**		BXD30A-C
BX460A-GFS	BXM460-GFS	BXD60A-A	**BX460AM-GFS**	BXM460M-GFS	BXD60A-A
BX460C-GFS		BXD60A-C	**BX460CM-GFS**		BXD60A-C
BX5120A-GFS	BXM5120-GFS	BXD120A-A	**BX5120AM-GFS**	BXM5120M-GFS	BXD120A-A
BX5120C-GFS		BXD120A-C	**BX5120CM-GFS**		BXD120A-C
BX6200A-GFS	BXM6200-GFS	BXD200A-A	**BX6200AM-GFS**	BXM6200M-GFS	BXD200A-A
BX6200C-GFS		BXD200A-C	**BX6200CM-GFS**		BXD200A-C
BX6400S-GFS	BXM6400-GFS	BXD400A-S	**BX6400SM-GFS**	BXM6400M-GFS	BXD400A-S

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4.4 Name and function of each part

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

■ Driver (common to round shaft type and combination type)



Power input indication LED (green)
Lights up when current is applied.

Alarm output indication LED (red) P.44
When the protection function has activated, the LED flashes.

Data setter connector
Connect it to the **OPX-1A**.

Motor connector P.29
Connect the motor cable.

Power connection terminal P.27
Connect the AC power and regeneration unit to this terminal.

Protective earth terminal P.29
Install the ground cable with a diameter equivalent to AWG18 (0.75 mm^2) or greater, and connect it to the ground.

Internal potentiometer P.39
Set the motor speed. The speed is set to "0" at the time of shipment.

Acceleration time potentiometer P.40
Set the acceleration time for motor operation. It is set to "0" at the time of shipment.

Deceleration time potentiometer P.40
Set the deceleration time when the motor is stopped. It is set to "0" at the time of shipment.

Encoder connector P.29
Connect the encoder cable.

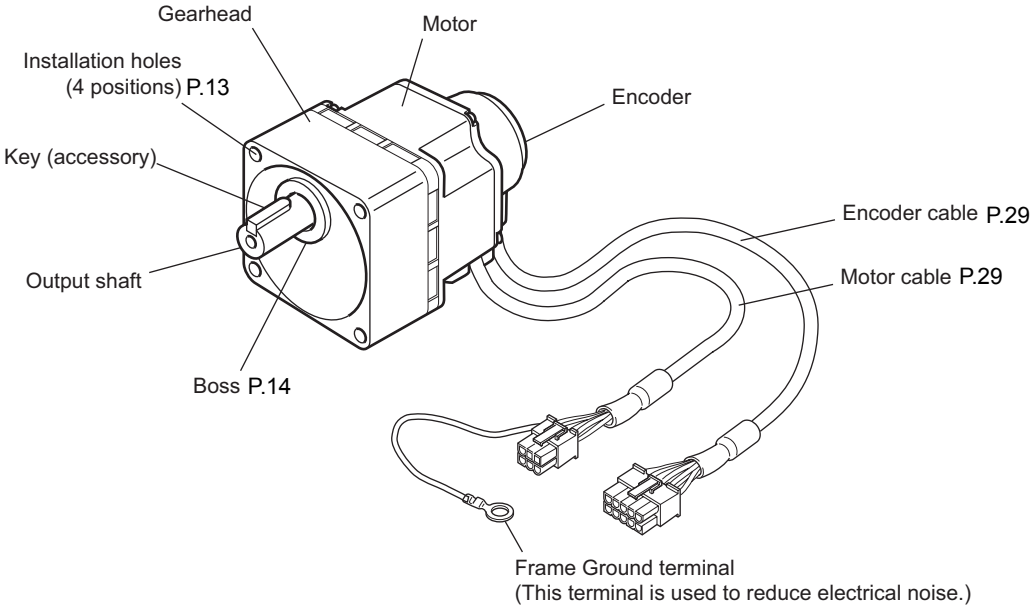
Input/output signal connector P.30
Connect it to the external control equipment such as the programmable controller.

Power supply connection terminal cover
This is a cover to protect the power supply connection terminal.
Be sure to install this cover before turning on power.

■ Motor

- **BX230**, **BX460**, **BX5120**

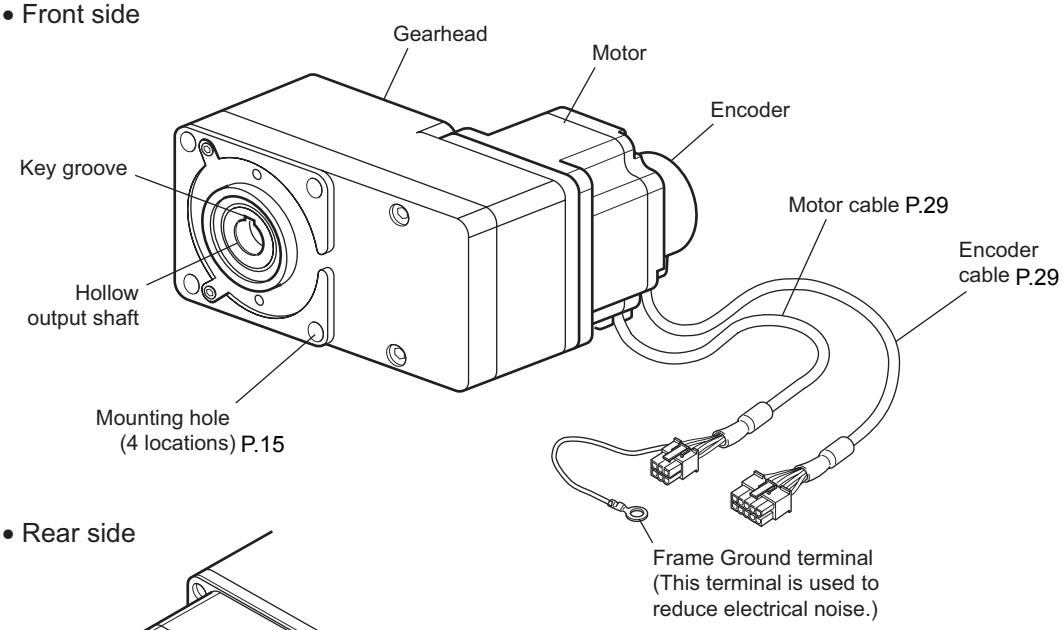
The figure shows a combination-type parallel-shaft gearhead, standard type motor.



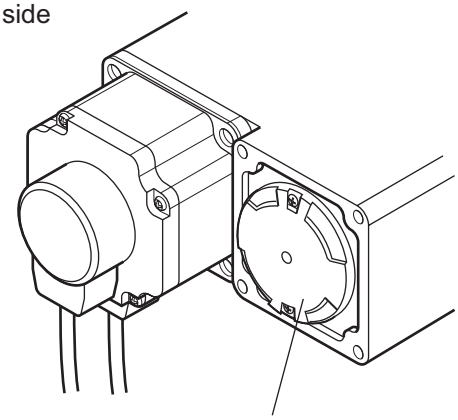
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The figure shows a combination-type hollow-shaft flat gearhead, standard type motor.

• Front side

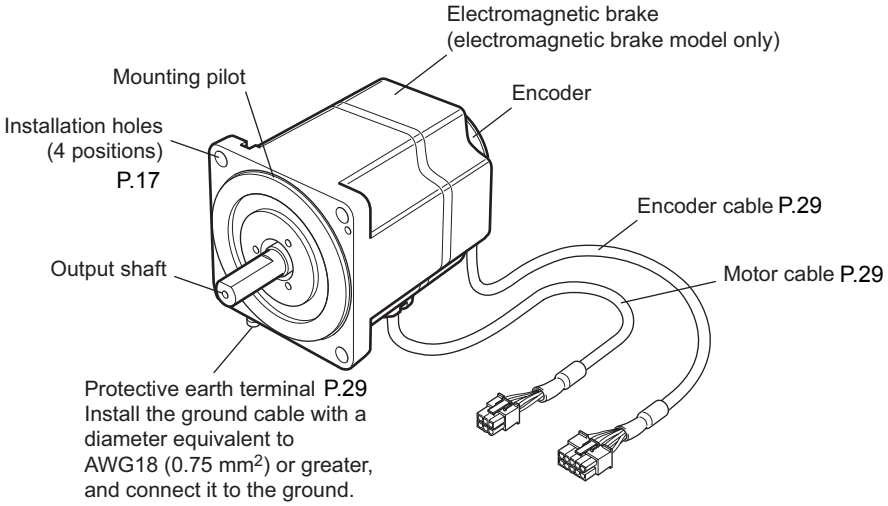


• Rear side



- **BX6200、BX6400**

The figure shows a round-shaft motor with electromagnetic brake.



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5 Installation

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

Combination-type parallel-shaft gearhead	See page 13, 18
Combination-type hollow-shaft flat gearhead	See page 15, 19
Round-shaft type	See page 17, 18
Pinion-shaft type	Parallel-shaft gearhead: See page 13, 18 Hollow-shaft flat gearhead: See page 15, 19

5.1 Location for installation

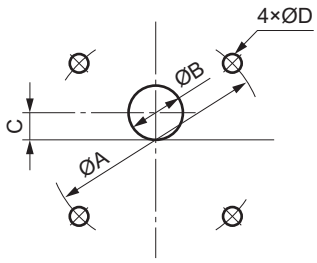
The motor and driver are designed and manufactured for installation in equipment.
Install them in a well-ventilated location that provides easy access for inspection. The location must also satisfy the following conditions:

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

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

5.2 Installing the combination-type parallel-shaft gearhead

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



Unit model	ØA	ØB	C	ØD
BX230	70 (2.76)	24 (0.94)	10 (0.39)	4.5 (0.177)
BX460	94 (3.70)	34 (1.34)	13 (0.51)	6.5 (0.256)
BX5120	104 (4.09)	40 (1.57)	18 (0.71)	8.5 (0.335)
BX6200 **BX6400**	120 (4.72)	42 (1.65)	20 (0.79)	8.5 (0.335)

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

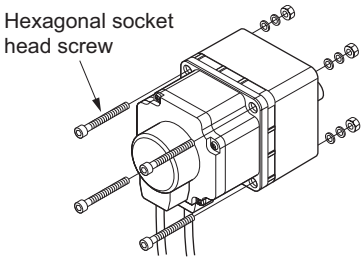
Maximum applicable plate thickness

Unit model	Maximum applicable plate thickness*
BX230	5 mm (0.20 in.)
BX460	8 mm (0.31 in.)
BX5120, **BX6200**, **BX6400**	12 mm (0.47 in.)

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

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



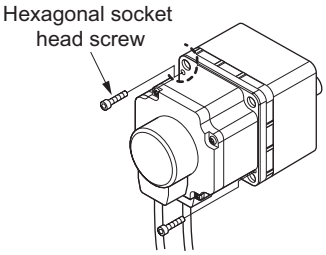
Unit model	Nominal thread size	Tightening torque
BX230	M4	1.8 N·m (15.9 lb-in)
BX460	M6	6.4 N·m (56 lb-in)
BX5120 **BX6200** **BX6400**	M8	15.5 N·m (137 lb-in)

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

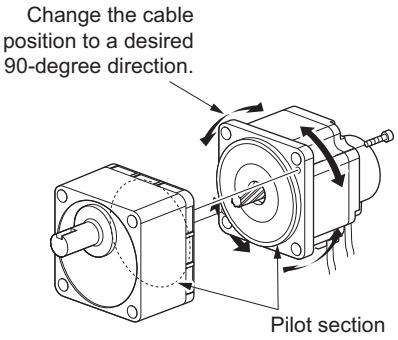
■ Changing the motor cable output direction

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

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



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



Unit model	Nominal thread size	Tightening torque
BX230 **BX460**	M2.6	0.4 N-m (3.5 lb-in)
BX5120 **BX6200** **BX6400**	M3	0.6 N-m (5.3 lb-in)

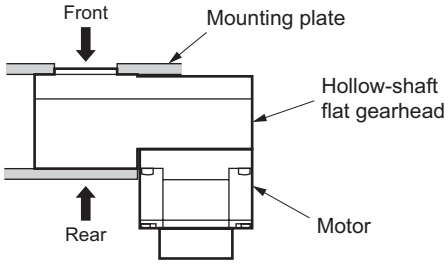
Note

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

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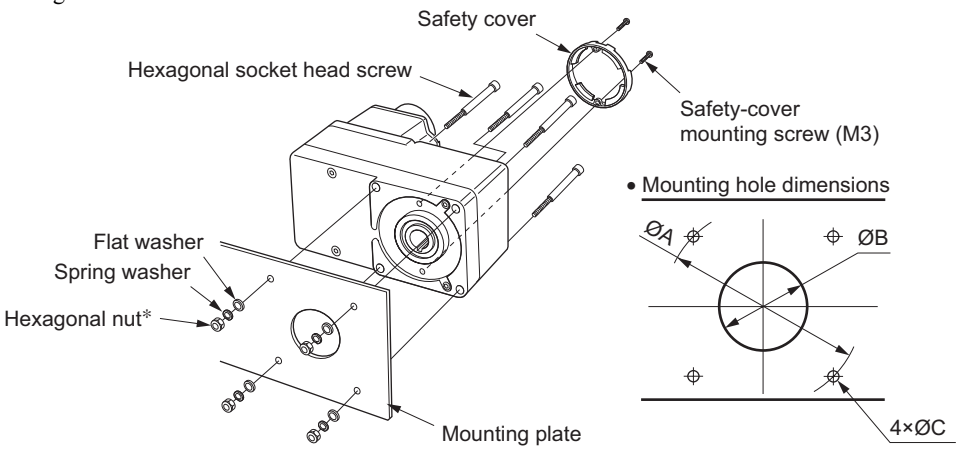
5.3 Installing the combination-type hollow-shaft flat gearhead

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



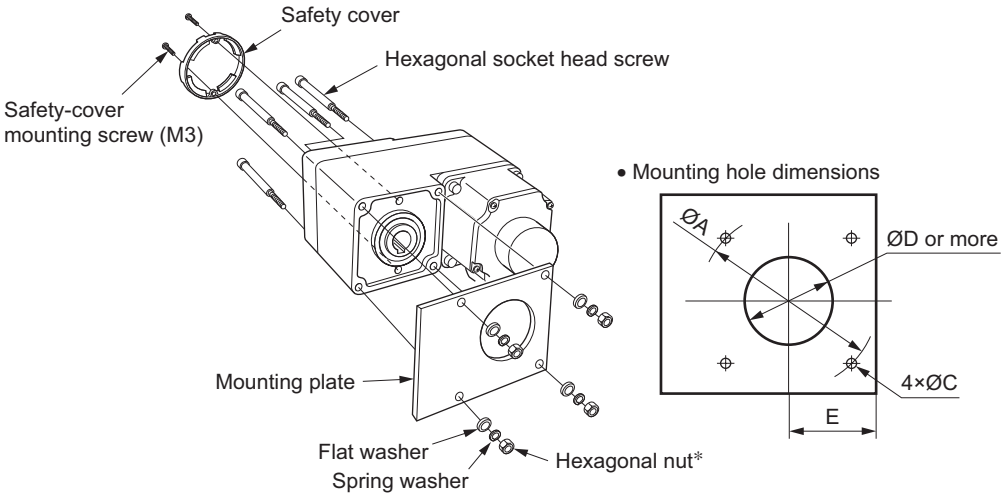
- Using the front side as the mounting surface

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



∗ The **BX6200** and **BX6400** do not come with hexagonal nuts. Provide hexagonal nuts separately or drill tapped holes in the mounting plate.

- Using the rear side as the mounting surface



∗ The **BX6200** and **BX6400** do not come with hexagonal nuts. Provide hexagonal nuts separately or drill tapped holes in the mounting plate.

Unit model	Nominal thread size	Tightening torque	ØA [mm (in.)]	ØB [mm (in.)]	ØC [mm (in.)]	ØD [mm (in.)]	E [mm (in.)]
BX230	M5	3.8 N·m (33 lb-in)	70 (2.76)	$34^{+0.039}_{0}$ ($1.34^{+0.0015}_{0}$)	5.5 (0.217)	25 (0.98)	29 (1.14)
BX460	M6	6.4 N·m (56 lb-in)	94 (3.70)	$38^{+0.039}_{0}$ ($1.50^{+0.0015}_{0}$)	6.5 (0.256)	30 (1.18)	39 (1.54)
BX5120	M8	15.5 N·m (137 lb-in)	104 (4.09)	$50^{+0.039}_{0}$ ($1.97^{+0.0015}_{0}$)	8.5 (0.335)	35 (1.38)	44 (1.73)
BX6200 **BX6400**			120 (4.72)	$58^{+0.046}_{0}$ ($2.28^{+0.0018}_{0}$)	–	42 (1.65)	57 (2.24)

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.

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Maximum applicable plate thickness

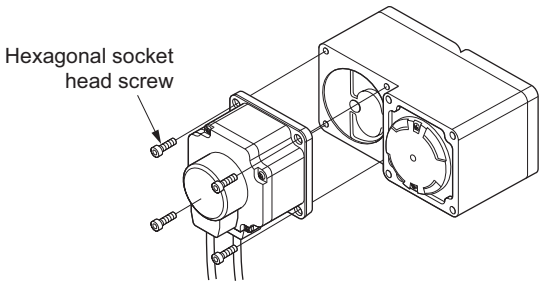
Unit model	Maximum applicable plate thickness*
BX230	5 mm (0.20 in.)
BX460	8 mm (0.31 in.)
BX5120 **BX6200** **BX6400**	12 mm (0.47 in.)

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

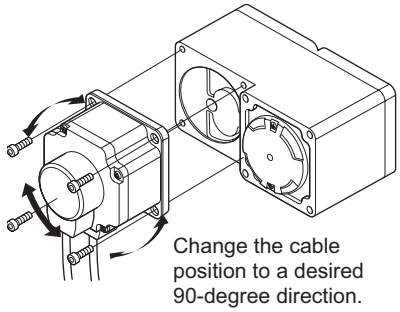
■ Changing the motor cable output direction

The gearhead can be removed and the motor cable position changed to one of three 90-degree 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-degree directions.
Install the motor carefully to prevent the pinion of the motor output shaft from contacting the casing or gear of the gearhead.
Also confirm that no gaps remain between the motor flange surface and the end face of the gearhead's pilot section.



Unit model	Nominal thread size	Tightening torque
BX230	M4	1.8 N·m (15.9 lb-in)
BX460	M6	6.4 N·m (56 lb-in)
BX5120 **BX6200** **BX6400**	M8	15.5 N·m (137 lb-in)

Note

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

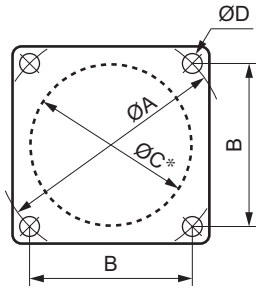
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5.4 Installing the round-shaft type

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

Unit model	Size of radiation plate	Material/thickness
BX230	115 mm × 115 mm (4.53 in. × 4.53 in.)	Thickness: 5 mm (0.20 in.) Material: Aluminum
BX460	135 mm × 135 mm (5.31 in. × 5.31 in.)	
BX5120	165 mm × 165 mm (6.50 in. × 6.50 in.)	
BX6200	200 mm × 200 mm (7.87 in. × 7.87 in.)	
BX6400	250 mm × 250 mm (9.84 in. × 9.84 in.)	Thickness: 6 mm (0.24 in.) Material: Aluminum

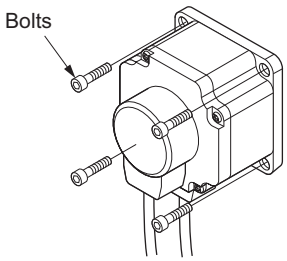
1. Open mounting holes in the mounting plate [unit: mm (in.)].



Unit model	ØA	B	ØC*	ØD
BX230	70 (2.76)	49.5 (1.949)	$54^{+0.030}_{0}$ ($2.1260^{+0.0012}_{0}$)	4.5 (0.177)
BX460	94 (3.70)	66.47 (2.616)	$73^{+0.030}_{0}$ ($2.8740^{+0.0012}_{0}$)	6.5 (0.256)
BX5120	104 (4.09)	73.54 (2.895)	$83^{+0.035}_{0}$ ($3.2677^{+0.0014}_{0}$)	8.5 (0.335)
BX6200 **BX6400**	120 (4.72)	84.85 (3.341)	$94^{+0.035}_{0}$ ($3.7008^{+0.0014}_{0}$)	8.5 (0.335)

* ØC indicates the pilot diameter on the flange.

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



Unit model	Nominal thread size	Tightening torque
BX230	M4	1.8 N-m (15.9 lb-in)
BX460	M6	6.4 N-m (56 lb-in)
BX5120 **BX6200** **BX6400**	M8	15.5 N-m (137 lb-in)

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

5.5 Installing the pinion-shaft type

A pinion-shaft motor is used with a parallel-shaft gearhead or hollow-shaft flat gearhead assembled to it.
Installing a parallel-shaft gearhead: See page 13
Installing a hollow-shaft flat gearhead: See page 15

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5.6 Installing a load on the combination-type parallel gearhead or round-shaft type

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

Note

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

■ Output shaft shape

- Combination-type parallel-shaft gearhead

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

Unit model	Parallel key dimension
BX230	4 mm (0.1575 in.)
BX460	5 mm (0.1969 in.)
BX5120、BX6200、BX6400	6 mm (0.2362 in.)

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

- Round-shaft type

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

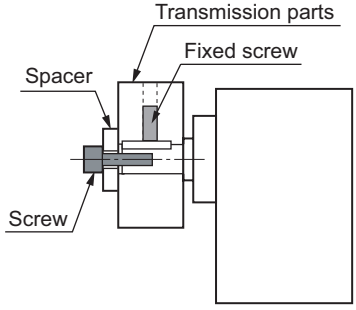
- Using a gear

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.

- Using the output axis tip screw hole of a gearhead

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

The example of output axis tip screw hole use



Gearhead model name *	Output shaft tip screw hole
GFS4G□	M5 Effective depth 10 mm (0.39 in.)
GFS5G□ GFS6G□	M6 Effective depth 12 mm (0.47 in.)

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

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

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

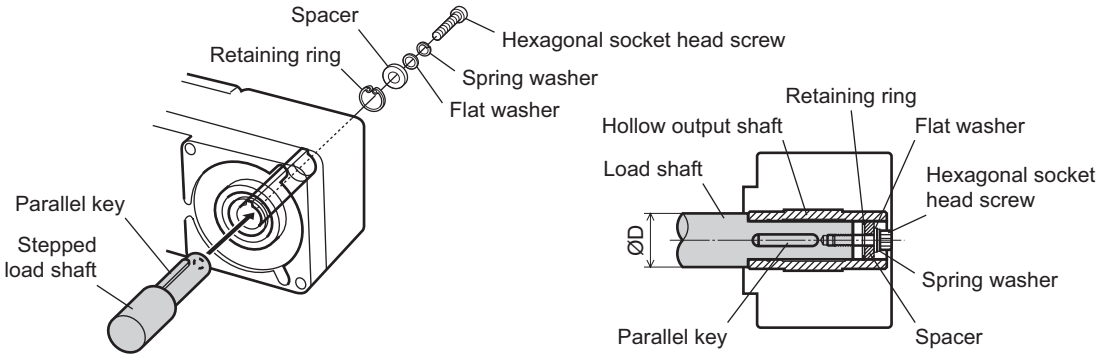
Note

- Apply grease (molybdenum disulfide grease, etc.) on the surface of the load shaft and inner walls of the hollow output shaft to prevent seizure.
- When installing the load shaft using an end plate, the safety cover (supplied) cannot be attached due to contact between the safety cover and hexagonal socket head screw. Take safety measures against rotating part.

■ Stepped load shaft

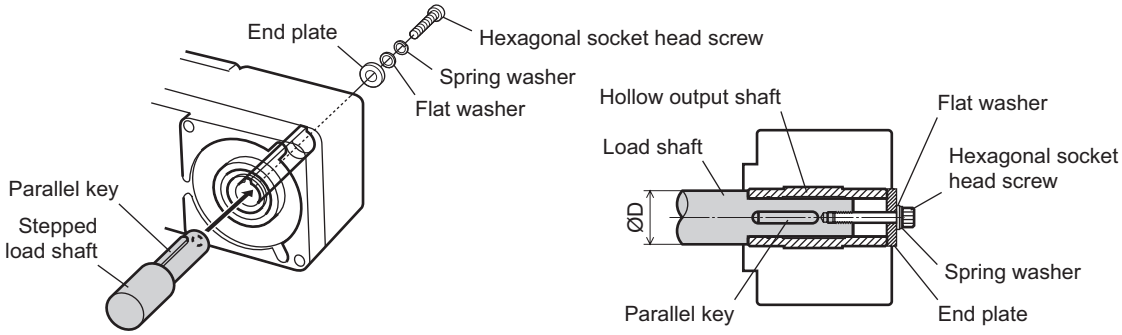
- Affixing method using retaining ring

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



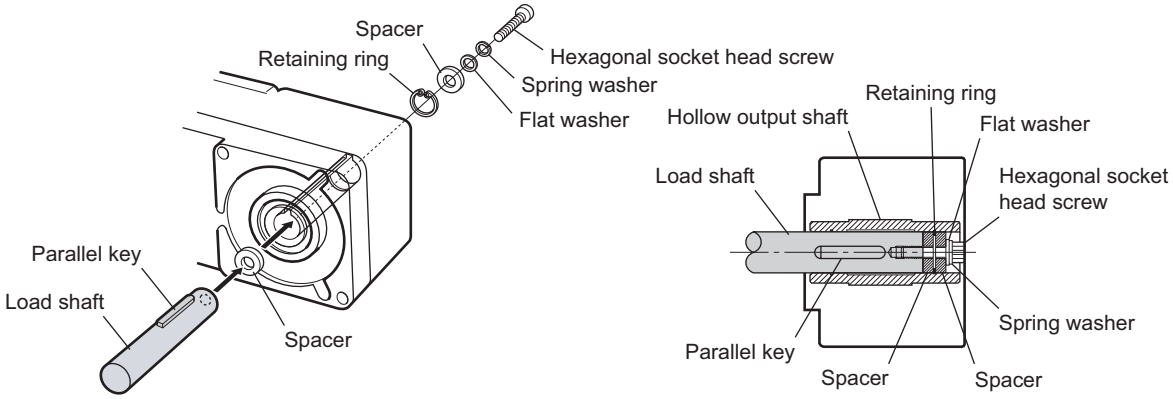
- Affixing method using end plate

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



■ Non-stepped load shaft

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



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

Unit model	Inner diameter of hollow shaft	Recommended diameter of load shaft	Nominal diameter of retaining ring	Applicable screw	Spacer thickness	Outer diameter of stepped shaft (ØD)
BX230	$Ø12^{+0.027}_{0}$ ($Ø0.4724^{+0.0011}_{0}$)	$Ø12^{0}_{-0.018}$ ($Ø0.4724^{0}_{-0.0007}$)	Ø12 (Ø0.47)	M4	3 (0.12)	20 (0.79)
BX460	$Ø15^{+0.027}_{0}$ ($Ø0.5906^{+0.0011}_{0}$)	$Ø15^{0}_{-0.018}$ ($Ø0.5906^{0}_{-0.0007}$)	Ø15 (Ø0.59)	M5	4 (0.16)	25 (0.98)
BX5120	$Ø20^{+0.033}_{0}$ ($Ø0.7874^{+0.0013}_{0}$)	$Ø20^{0}_{-0.021}$ ($Ø0.7874^{0}_{-0.0008}$)	Ø20 (Ø0.79)	M6	5 (0.20)	30 (1.18)
BX6200 BX6400	$Ø25^{+0.033}_{0}$ ($0.9843^{+0.0013}_{0}$)	$Ø25^{0}_{-0.021}$ ($0.9843^{0}_{-0.0008}$)	Ø25 (Ø0.98)	M10	6 (0.24)	40 (1.57)

5.8 Permissible overhung load and thrust load

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

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

Combination-type parallel-shaft gearhead

Unit model	Gear ratio	Distance from tip of gearhead output shaft and permissible overhung load [N (lb.)]		Permissible thrust load [N (lb.)]
		10 mm (0.39 in.)	20 mm (0.79 in.)	
BX230	5	100 (22)	150 (33)	40 (9)
	10 to 20	150 (33)	200 (45)	
	30 to 200	200 (45)	300 (67)	
BX460	5	200 (45)	250 (56)	100 (22)
	10 to 20	300 (67)	350 (78)	
	30 to 200	450 (101)	550 (123)	
BX5120	5	300 (67)	400 (90)	150 (33)
	10 to 20	400 (90)	500 (112)	
	30 to 200	500 (112)	650 (146)	
BX6200 BX6400	5 to 20	550 (123)	800 (180)	200 (45)
	30, 50	1000 (220)	1250 (280)	300 (67)
	100, 200	1400 (310)	1700 (380)	400 (90)

Combination-type hollow-shaft flat gearhead

Unit model	Gear ratio	Distance from gearhead mounting surface and permissible overhung load [N (lb.)]		Permissible thrust load [N (lb.)]
		10 mm (0.39 in.)	20 mm (0.79 in.)	
BX230	5, 10	450 (101)	370 (83)	200 (45)
	15 to 200	500 (112)	400 (90)	
BX460	5, 10	800 (180)	660 (148)	400 (90)
	15 to 200	1200 (270)	1000 (220)	
BX5120	5, 10	900 (200)	770 (173)	500 (112)
	15, 20	1300 (290)	1110 (240)	
	30 to 200	1500 (330)	1280 (280)	
BX6200 BX6400	5 (**BX6400** only)	1230 (270)	1070 (240)	800 (180)
	10			
	15, 20	1680 (370)	1470 (330)	
	30 to 100	2040 (450)	1780 (400)	

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Round-shaft type

Unit model	Distance from tip of motor output shaft and overhung load [N (lb.)]		Permissible thrust load [N (lb.)]
	10 mm (0.39 in.)	20 mm (0.79 in.)	
BX230	87.2 (19.6)	107 (24)	Not to exceed one-half the motor's dead weight *
BX460	117 (26)	137 (30)	
BX5120	156 (35)	176 (39)	
BX6200 **BX6400**	197 (44)	221 (49)	

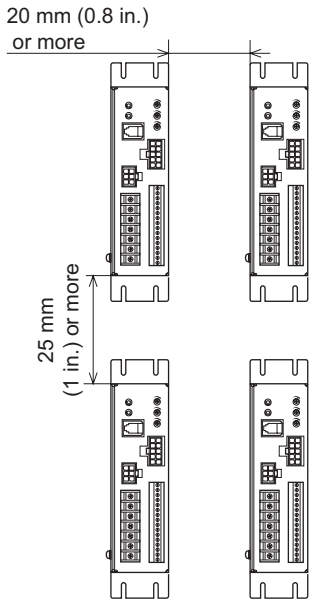
* Minimize the thrust load. If a thrust load must be applied, do not let it exceed one-half the motor's dead weight.

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5.9 Installing the driver

■ Orientation

The driver is designed on the basis of heat radiation by air convection and heat conduction to the housing.
When installing the driver in the housing, be sure to mount it in a vertical orientation using the mounting holes provided on the driver. There must be a clearance of at least 25 mm (1 in.) in the horizontal and vertical directions, respectively, between the driver and enclosure or other equipment within the enclosure. When two or more drivers are to be installed side by side, provide 20 mm (0.8 in.) and 25 mm (1 in.) clearances in the horizontal and vertical directions, respectively.



Note

- Install the driver vertically inside the enclosure.
- Do not install any equipment that generates a large amount of heat near the driver.
- Check ventilation if the ambient temperature of the driver exceeds 50 °C (122 °F).

■ How to install the driver

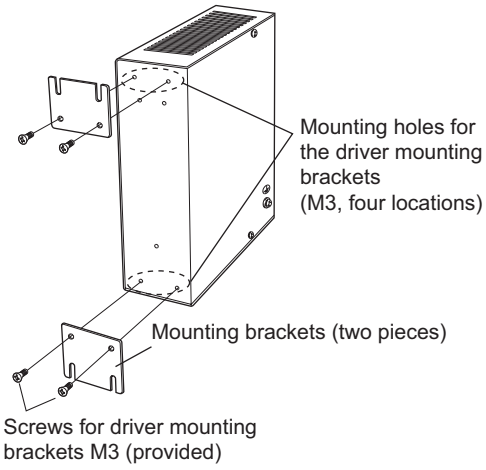
Install the driver on a flat metal plate having excellent vibration resistance and heat conductivity.

- Using driver mounting brackets

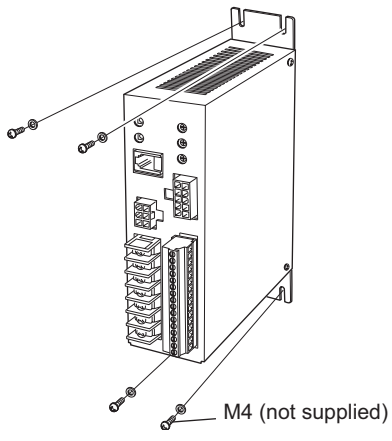
1. Attach the driver mounting brackets to the four mounting holes provided in the back of the driver, using optional screws for the driver mounting brackets (M3, four pieces).
   Tightening torque: 0.5 to 0.6 N·m (4.4 to 5.3 lb-in)

Note

- Do not use the mounting holes (M3, four locations) for the driver mounting brackets provided on the back of the driver for any purpose other than securing the driver mounting brackets.
- Be sure to use the supplied screws when securing the driver mounting brackets.



2. Install the driver by securing it with four bolts (M4, not supplied) through the four mounting holes provided. Leave no gap between the driver and plate.

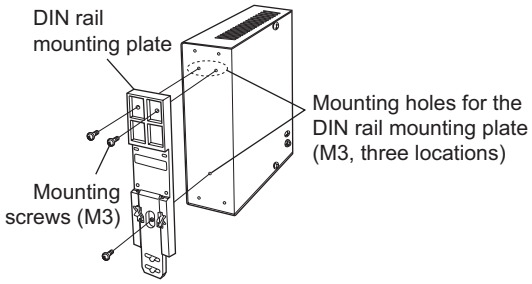


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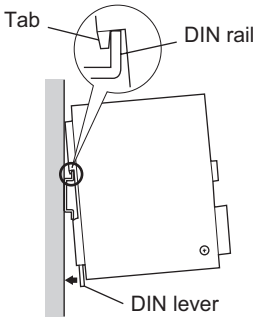
- Mounting to DIN rail

When mounting the driver to a DIN rail, use a separately sold DIN rail mounting plate (model number: **PADP01**) and attach it to a 35 mm (1.38 in.) wide DIN rail.

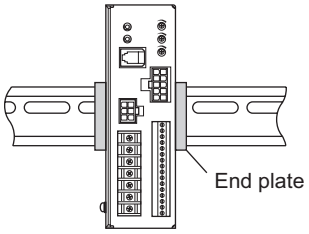
1. Attach the DIN rail mounting plate (model number: **PADP01**) to the back of the driver using the screws supplied with the plate.
   Tightening torque: 0.3 to 0.4 N·m
   (2.6 to 3.5 lb-in)



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

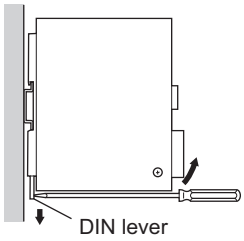


3. Secure the driver using end plates (not supplied).



- Removing from DIN rail

Pull the DIN lever down until it locks using a flat blade-parallel tip type 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.



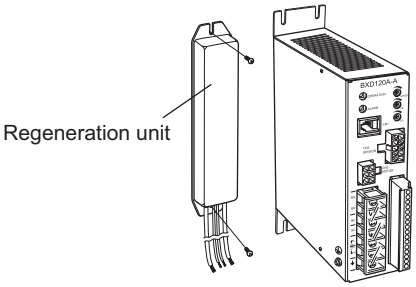
Note

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

5.10 Installing the regeneration unit

- **EPRC-400P**, **RGB100** (sold separately)

Using two screws (not attached), secure the regeneration unit on a flat metal plate [corresponding to an aluminum plate of 350 × 350 × 3 mm (13.78 × 13.78 × 0.12 in.)] having excellent heat conductivity.



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5.11 Installing and wiring in compliance with EMC Directive

■ General

- EMC Directive

The **BX** series has been designed and manufactured for incorporation in general industrial machinery. The EMC Directive requires that the equipment incorporating this product comply with these directives.
The installation and wiring method for the motor and driver are the basic methods that would effectively allow the customer's equipment to be compliant with the EMC Directive.
The compliance of the final machinery with the EMC Directive will depend on such factors as the configuration, wiring, layout and risk involved in the control-system equipment and electrical parts. It therefore must be verified through EMC measures by the customer of the machinery.

- Applicable standards

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

■ Installing and wiring in compliance with EMC Directive

Effective measures must be taken against the EMI that the **BX** series may give to adjacent control-system equipment, as well as the EMS of the **BX** series itself, in order to prevent a serious functional impediment in the machinery.
The use of the following installation and wiring methods will enable the **BX** series to be compliant with the EMC Directive (the aforementioned compliance standards).

- Connecting mains filter for power source line

Connect a mains filter in the AC input line to prevent the noise generated in the driver from propagating externally through the power-source line.
Use a mains filter or equivalent as below table.

Manufacturer	Single-phase 100 V	Single-phase 200 V	Three-phase 200 V
Schaffner EMC AG	FN2070-10-06	−	FN251-8-07
EPCOS AG	B84113-C-B110	−	−
TDK Corporation	−	ZAG2210-11S	−
TDK-Lambda Corporation	MC1210	MC1210	MC1310

- 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: 0.75 mm^2 or more) parallel with the mains-filter output cable (AWG18: 0.75 mm^2 or more). 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.

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■ How to ground

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

- How to ground the driver

Use the Protective Earth Terminal located on the side of the driver. Refer to page 29 for the way to ground the driver.

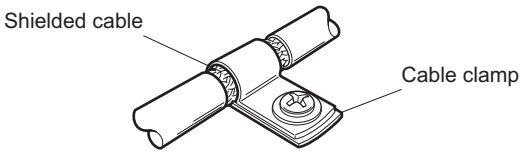
- How to ground the motor

BX230, **BX460**, **BX5120**	Ground the Frame Ground terminal of the motor cable. Or, ground the motor using one of its four mounting holes. At this time, insulate the Frame Ground terminal extending from the motor cable without connecting it to ground.
BX6200, **BX6400**	Ground the motor's Protective Earth Terminal.

Refer to page 29 for the way to ground the motor.

■ Wiring the signal cable

Use a braided screen cable with a wire of a size ranging between AWG24 to 22 (0.2 to 0.3 mm^2) for the driver signal cable, and keep it as short as possible.
To ground a shielded cable, use a metal clamp or similar device that will maintain contact with the entire circumference of the shielded cable. Attach a cable clamp as close to the end of the cable as possible, and connect it as shown in the figure.

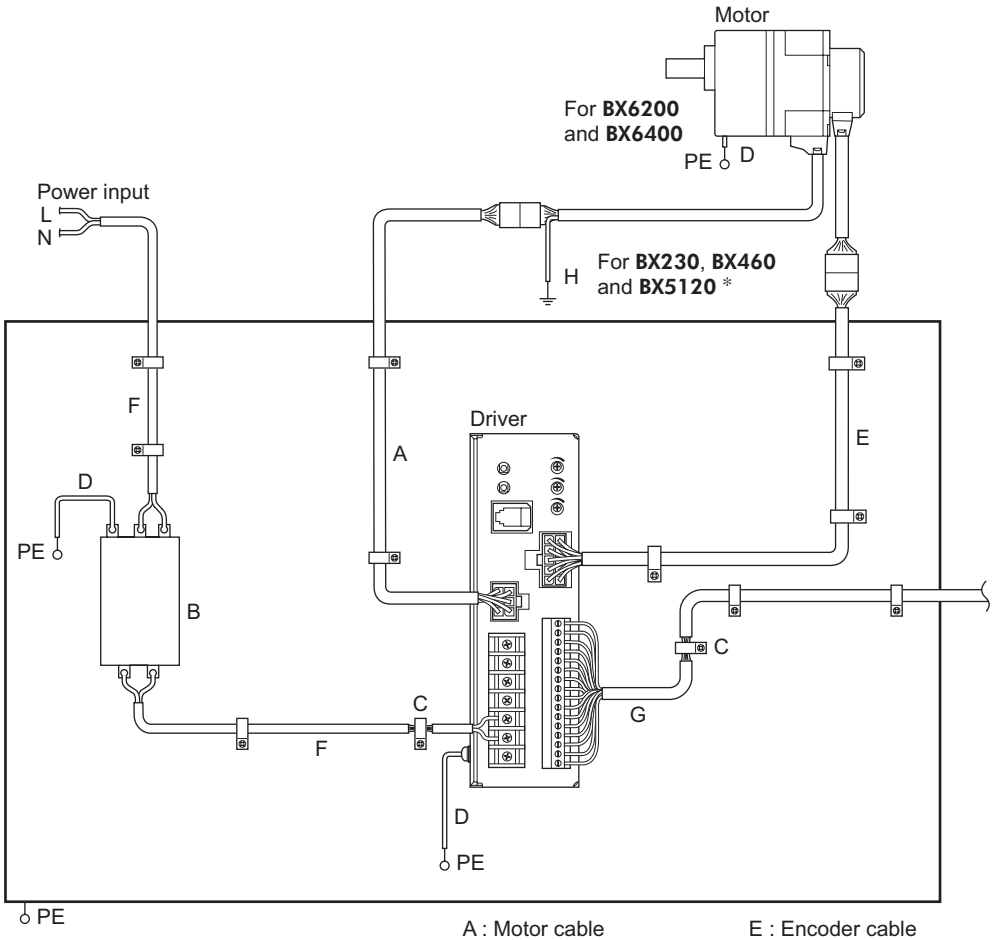


■ Notes about installation and wiring

- Connect the motor, driver and 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.
- Place the power cables such as the motor and power supply cables as far apart [100 to 200 mm (4 to 8 in.)] as possible from the signal cables. If they have to cross, cross them at a right angle. Place the AC input cable and output cable of a mains filter separately from each other.
- If an extension cable is required between the motor and driver, it is recommended that an optional extension cable (sold separately) be used, since the EMC measures are conducted using the Oriental Motor extension cable.

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■ Example of motor and driver installation and wiring



A : Motor cable
B : Mains filter
C : Cable clamp
D : Protective earth terminal
E : Encoder cable
F : Power cable
G : Signal cable
H : Frame Ground terminal

* To provide protective grounding using a mounting hole provided on the motor mounting surface, insulate the Frame Ground terminal without connecting it to ground.

■ Precautions about static electricity

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

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

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6 Connection

The section covers the method of connecting the driver and power source/regeneration unit/motor/external control equipment, earth connection method, an example of connection and input/output signals.

6.1 Connecting to the power supply

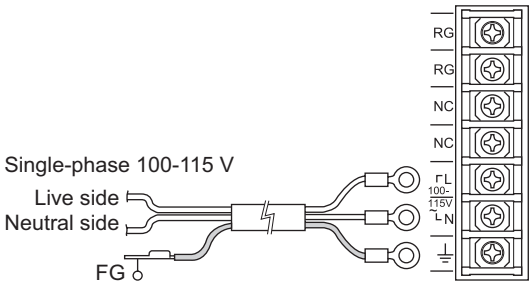
Connect the power cable to the L and N terminals or the L1, L2 and L3 terminals of the power supply terminals located on the driver.

Note

- Do not run the driver's power cable through a conduit containing other power lines or motor cables.
- Furnish a power supply capable of supplying adequate driver input current. If the current capacity is insufficient, the transformer may be damaged, or the motor may run erratically due to a drop in torque.

■ For single-phase 100 V unit

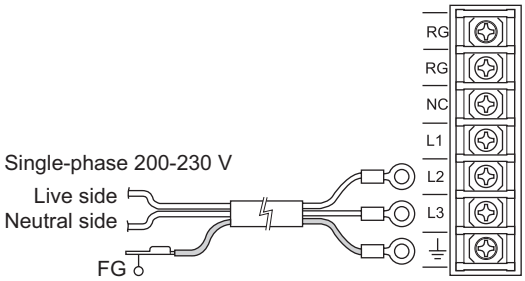
Connect the live side (phase wire side) of the single-phase 100-115 V power supply to the terminal L, and the neutral side (neutral line) to the terminal N. Connect the frame ground terminal to the ground point on the power supply side.



Unit name	Rated current capacity	Maximum current capacity
BX230	1.4 A	2.4 A
BX460	2.2 A	3.5 A
BX5120	3.7 A	6.7 A
BX6200	4.7 A	9 A

■ For single-phase 200 V unit

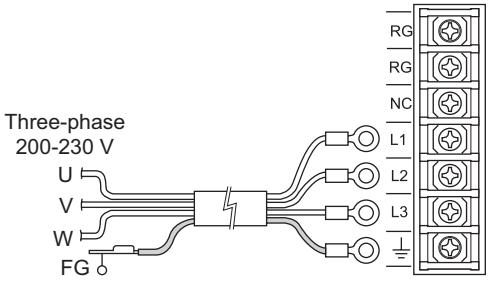
Connect the live side (phase wire side) of the single-phase 200-230 V power supply to the terminal L2, and the neutral side (neutral line) to the terminal L3. Connect the frame ground terminal to the ground point on the power supply side.



Unit name	Rated current capacity	Maximum current capacity
BX230	0.8 A	1.6 A
BX460	1.4 A	2.2 A
BX5120	2.3 A	4.1 A
BX6200	2.8 A	5.3 A

■ For three-phase 200 V unit

Connect the U, V and W phases of the three-phase 200-230 V power supply to terminals L1, L2 and L3, respectively. Connect the frame ground terminal to the ground point on the power supply side.



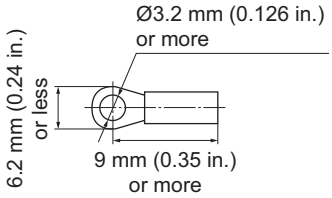
Unit name	Rated current capacity	Maximum current capacity
BX230	0.5 A	0.8 A
BX460	0.7 A	1.2 A
BX5120	1.1 A	2 A
BX6200	1.7 A	3.2 A
BX6400	2.8 A	4.4 A

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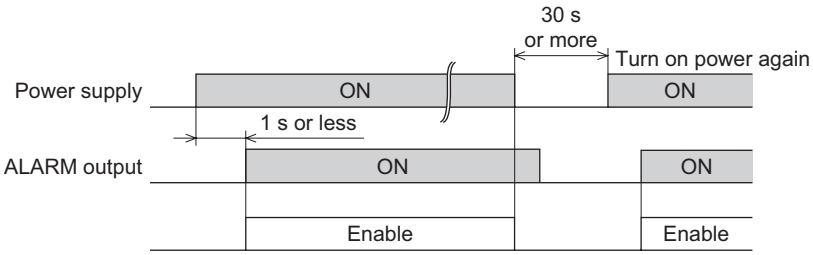
■ Terminal screw size and applicable lead wire size for power connection

For connection, use an insulated round crimp terminal.

- Terminal screw size: M3
- Tightening torque: 0.8 N·m (7.0 lb-in)
- Applicable lead wire size: AWG16 to 18 (1.25 to 0.75 mm^2)



6.2 Turning on the power



Note After shutting down the power, wait at least 30 seconds before turning it back on.

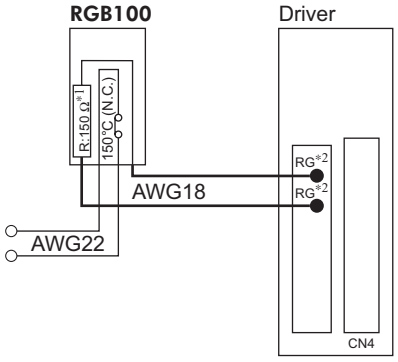
6.3 Connecting the regeneration unit

- Connect the two thick lead wires (AWG18) of the regeneration unit to the driver's RG terminals.
- The thin lead wires (AWG22) of the regeneration unit are thermal protector output.
  Provide a measure on the thermal protector contact to shut off the power supply in the event an error is detected.

■ Regeneration unit specifications

Applicable product *1	**BX230□, BX460□, BX5120□**	**BX6200□, BX6400S**
Model	**EPRC-400P**	**RGB100**
Continuous regenerative power *2	100 W	100 W
Resistance	400 Ω	150 Ω
Thermostat operation temperature	Operation: Open at 150±7 °C (302±45 °F) Reset: Close at 145±12 °C (293±54 °F) (Normally closed)	Operation: Open at 150±7 °C (302±45 °F) Reset: Close 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 at 12 VDC)	120 VAC, 4 A 30 VDC, 4 A (minimum current: 5 mA)

∗1 □ in the model names indicates the power source specification (**A** or **C**).
∗2 Install the regeneration unit in a location where a radiation capacity equivalent to a heat sink [material: aluminum, 350 × 350 × 3 mm (13.78 × 13.78 × 0.12 in.)] is provided.



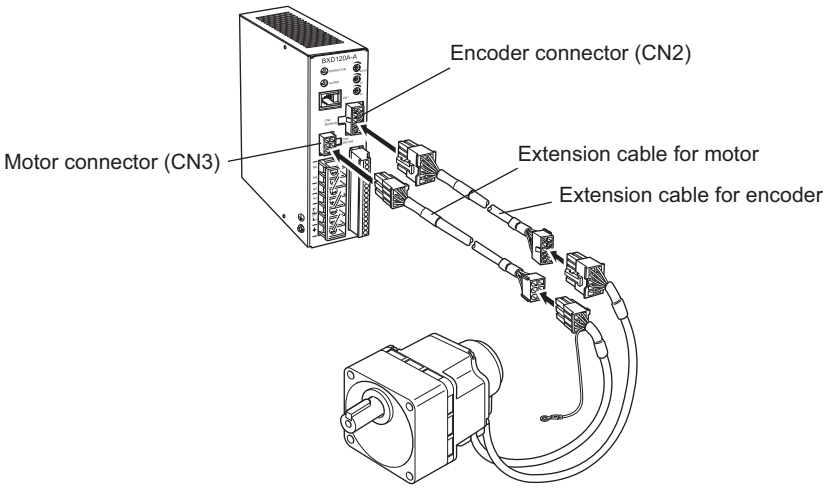
∗1 Using the **EPRC-400P** R: 400 Ω
∗2 The RG has no polarity.

⚠ Warning In the event the thermal protector is triggered, shut off the power.

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6.4 Connecting the motor

Insert the motor cable connector into the driver motor connector (CN3).
Insert the encoder connector cable into the driver encoder connector (CN2).
To increase the distance between the motor and driver, use the optional extension cable. For the details of this cable, see page 45.



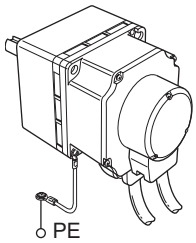
Note Firmly insert the connector in position. Incomplete connection of the connector may cause operation failure, or may damage the motor or driver.

6.5 Grounding the motor and driver

■ Grounding the motor

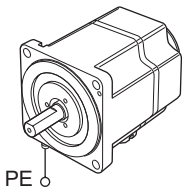
- **BX230**, **BX460**, **BX5120**

Ground the motor using one of its four mounting holes.
At this time, insulate the frame ground terminal extending from the motor cable without connecting it to ground.
Use a grounding cable of AWG18 (0.75 mm^2) or more in diameter.
Use a round, insulated crimp terminal in combination with an inner-clip washer and bolt it in place to secure the grounding connection.



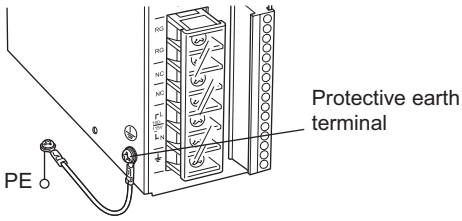
- **BX6200**, **BX6400**

Be sure to ground the motor's Protective Earth Terminal (screw size: M4).
Use a grounding cable of AWG18 (0.75 mm^2) or more in diameter.
Use a round, insulated crimp terminal in combination with an inner-clip washer and bolt it in place to secure the grounding connection.



■ Grounding the driver

Be sure to ground the Protective Earth Terminal (screw size: M4) located on the driver side.
Use a grounding cable of AWG18 (0.75 mm^2) or more in diameter. Do not share the grounding cable with a welder or power equipment. Use a round, insulated crimp terminal to ground the cable near the driver.
Tightening torque: 1.2 N·m (10.6 lb-in)

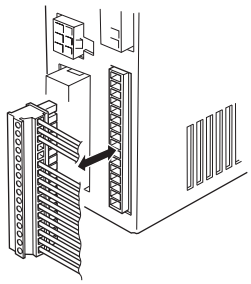


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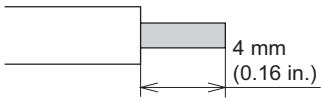
6.6 Connecting input/output signal

■ Connecting the input/output signal connector

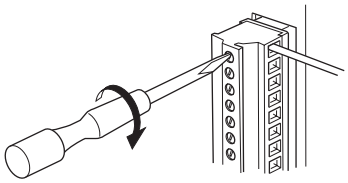
The combination type connector is used for the input/output signal connection (CN4). The combination connector may be installed and removed with the lead wire connected, as shown figure, thereby offering better work efficiency for driver installation and maintenance.



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.)

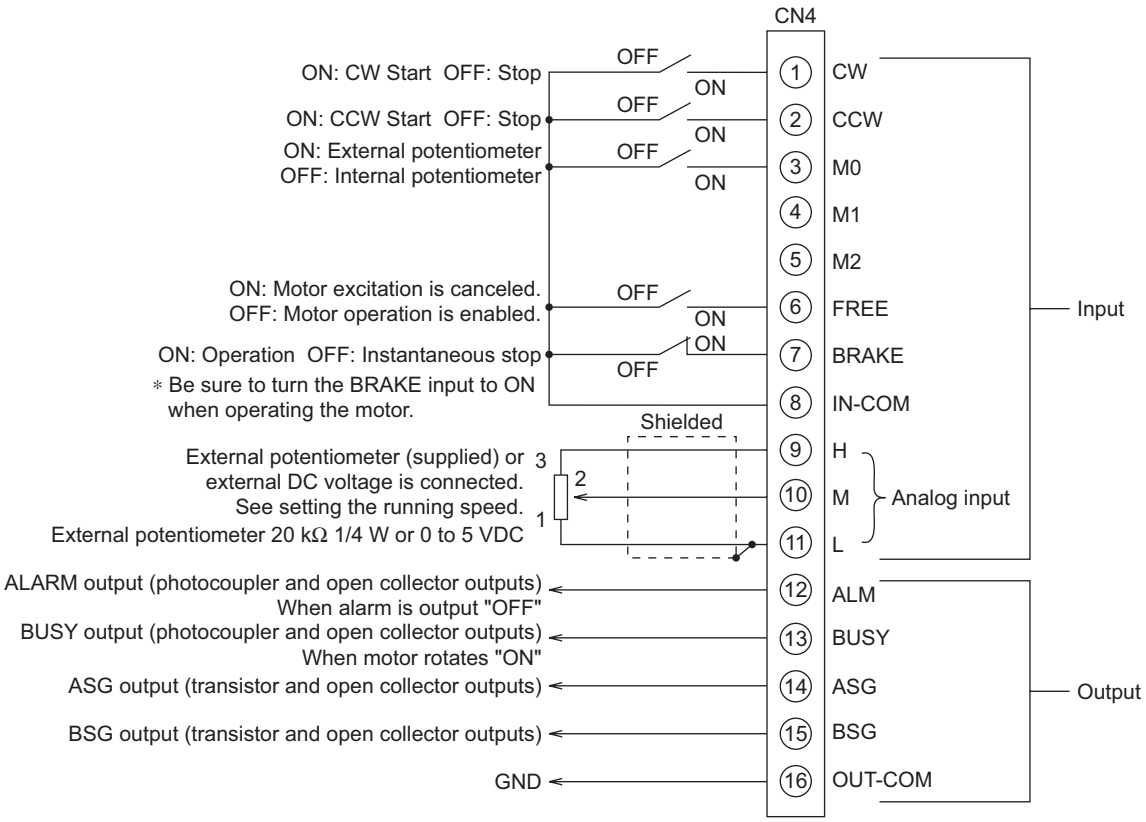


2. Loosen the combination connector screw.
3. Insert the peeled cable conductor into the combination connector, and tighten the screw.
   Use a 3 mm (0.12 in.) wide slotted head screwdriver.
   Tightening torque: 0.5 to 0.8 N·m (4.4 to 7.0 lb-in)



■ Connection diagram

Using the driver input/output signal connector (CN4), make a connection as illustrated below:



Note

The output signal voltage must be no less than 4.5 VDC and no greater than 26.4 VDC. Since output signals are open collector outputs, be sure to connect an external resistance and limit the output current as follows:
ALARM output, BUSY output: 40 mA or less
ASG output, BSG output: 20 mA or less

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- Input signal

The CW, CCW, M0, M1, M2, FREE and BRAKE inputs are photocoupler inputs.
Internal resistor: 2.3 kΩ
Internal voltage: +15 V
The M1 and M2 inputs are connected when using the system upgrading tool (**OPX-1A**).

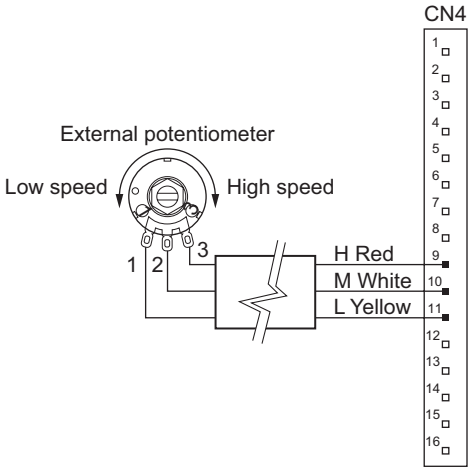
- Output signal

ALARM and BUSY outputs are photocoupler and open collector outputs.
ASG and BSG output are transistor and open collector outputs.
External operating conditions: ALARM and BUSY outputs: 4.5 to 26.4 VDC without exceeding 40 mA
ASG and BSG outputs: 4.5 to 26.4 VDC without exceeding 20 mA

■ Connecting the external potentiometer

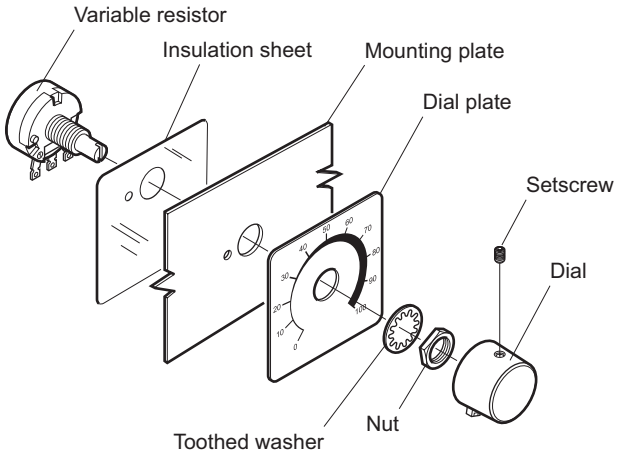
Optional external potentiometer is connected as below.
To connect the external potentiometer, use the attached external potentiometer and the signal cable [1 m (3.3 ft.)] for connection of the external potentiometer.

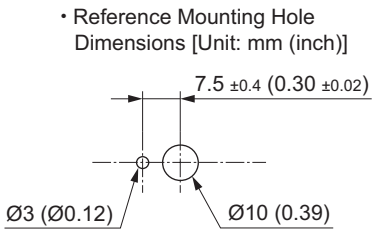
1. Connect the red lead wire of the signal cable for connection of the external potentiometer (hereinafter referred to as “signal cable”) to the terminal 3 of the external potentiometer and input terminal H.
2. Connect the white lead wire of the signal cable to the terminal 2 of the external potentiometer and input terminal M.
3. Connect the yellow lead wire of the signal cable to the terminal 1 of the external potentiometer and input terminal L.
4. Connect the shielded cable of the signal cable to the input terminal L. (Make sure that the shielded cable of the signal cable does not touch other terminals).



- How to Install the external potentiometer

1. Insert the variable resistor over the insulation sheet into the hole provided in the mounting plate, as illustrated below.
2. Set the dial plate and toothed washer, and tighten with the nut.
   Tightening torque: 0.45 N·m (3.9 lb-in)
3. Install the dial and secure it with the setscrew (M4).
   Tightening torque: 0.4 N·m (3.5 lb-in)

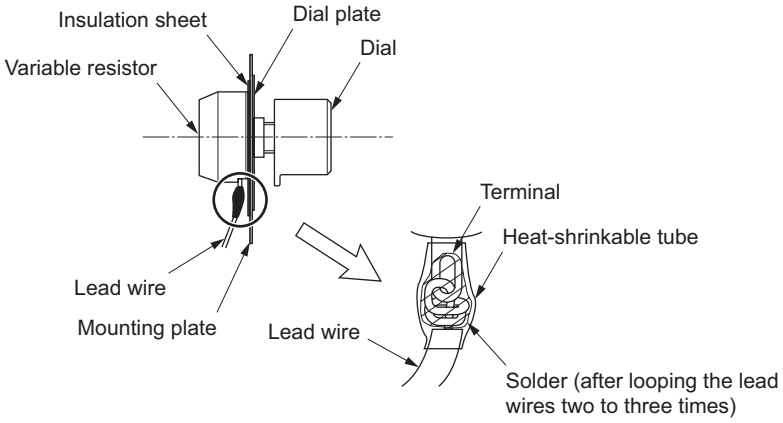




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- Soldering the external potentiometer terminal

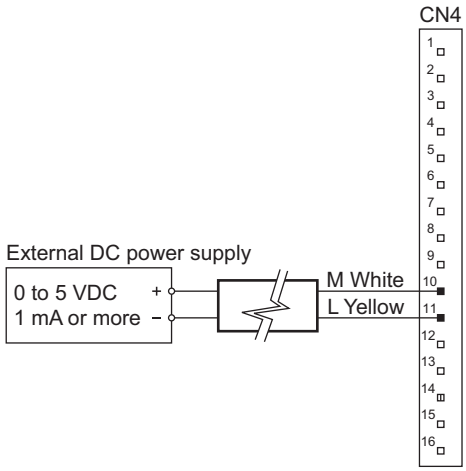
1. Guide the lead wires through the terminal hole and loop them two to three times.
2. Solder the lead wires to the terminal.
   Soldering condition: 235 °C (455 °F), less than 5 sec.
3. Cover a heat-shrinkable tube over the soldered part to insulate.



■ Connecting to the external DC power supply

For external DC voltage, use the DC power supply (0 to 5 VDC) having the primary and secondary sides provided with reinforced insulation.

1. Connect the lead wire of the signal cable for connection of the external potentiometer (hereinafter referred to as “signal cable”) to the positive terminal of the external DC power supply and input terminal M.
2. Connect the lead wire of the signal cable to the negative terminal of the external DC power supply and input terminal L.
3. Connect the shielded cable of the signal cable to the input terminal L. (Make sure that the shielded cable on the external potentiometer side does not touch other terminals.)
   Input impedance between input M and input L is about 15 kΩ. Input L is connected with the IN-COM inside the driver.



Note

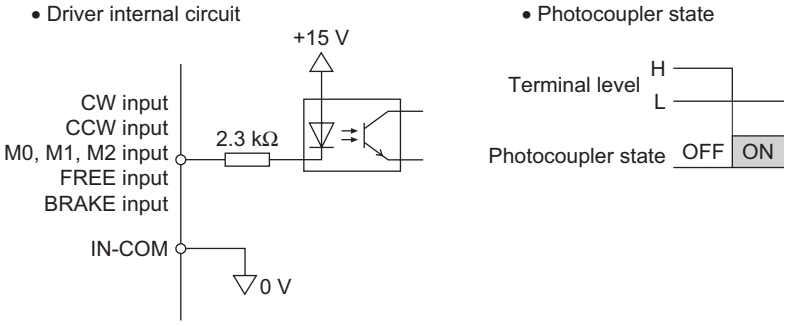
- The external DC power supply voltage must not exceed 5 VDC. Otherwise, the driver may be damaged.
- When connecting the external DC power supply, sufficient care must be taken not to mistake power polarity. Connection with incorrect polarity may damage the driver.

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6.7 About input signal and output signal

■ Input signals

All input signals of the driver are photocoupler inputs.
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.



- CW input

When the brake input is ON, motor operation is enabled (See the description of brake input).
If the CW input is turned ON, acceleration and operation are performed in the clockwise direction for the time set on the acceleration time potentiometer. If it is turned OFF, deceleration takes place and the operation stops at the time set on the acceleration time potentiometer.

- CCW input

When the brake input is ON, motor operation is enabled (See the description of brake input).
If the CCW input is turned ON, acceleration and operation are performed in the counterclockwise direction for the time set on the acceleration time potentiometer. If it is turned OFF, deceleration takes place and the operation stops at the time set on the acceleration time potentiometer.
Check the motor direction by referring to 7.1, “Rotating direction of the motor output shaft” on page 38.

Note

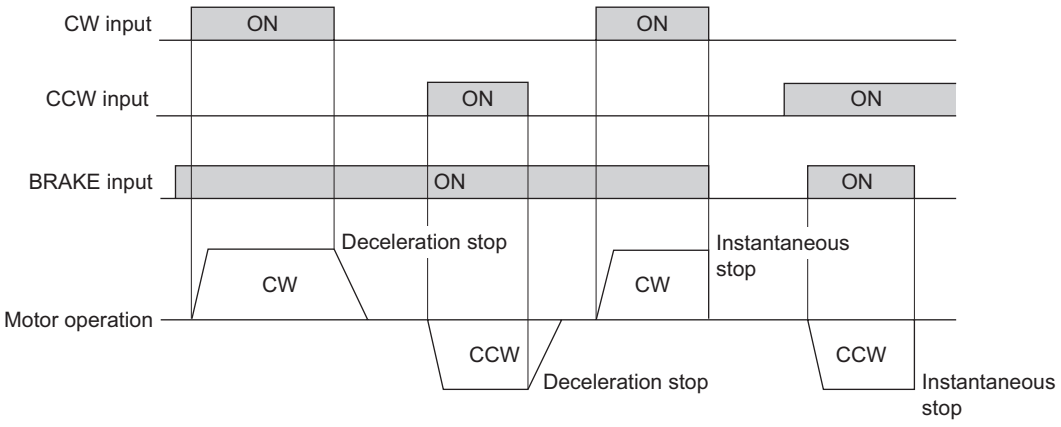
- If both CW and CCW inputs are turned ON simultaneously, the motor stops after deceleration.
- If the BRAKE input is turned OFF concurrently as the CW or CCW input is turned OFF, brake is applied to stop the operation.

- BRAKE input and ALARM-RESET input

If the BRAKE input and driver protection functions have activated during normal times, they will work as ALARM-RESET input.

Normal times (BRAKE input)

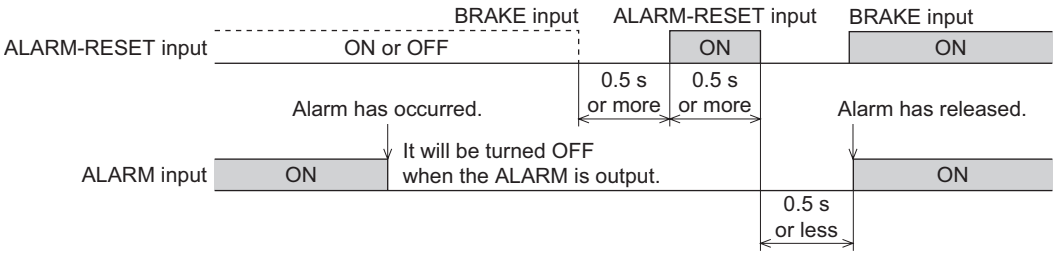
Function will be activated as BRAKE input function (Signal name “BRAKE” is indicated on the right of the driver). When the brake input is ON, the motor is enabled.
If it is OFF, brake is applied to the running motor to instantaneous stop it.
To start motor operation, be sure to set the brake input to ON.



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Activation of protection function (ALARM-RESET input)

The function is performed as ALARM-RESET (alarm reset) input. The protection function is reset and the driver restarts.
This is used to reset the protection function when power is applied.
However, if protection functions for overcurrent, EEPROM error and encoder failure have activated, resetting will be disabled. Turn on the power again to perform resetting.
If one shot (0.5 s) is input to ALARM-RESET input, the driver will be restarted.
You can reset the protection function by cycling on the power supply.



Be sure to turn on power again after removing the cause for the operation of protection function; then reset ALARM output.
For the output conditions of the protection function, see the description on page 35.

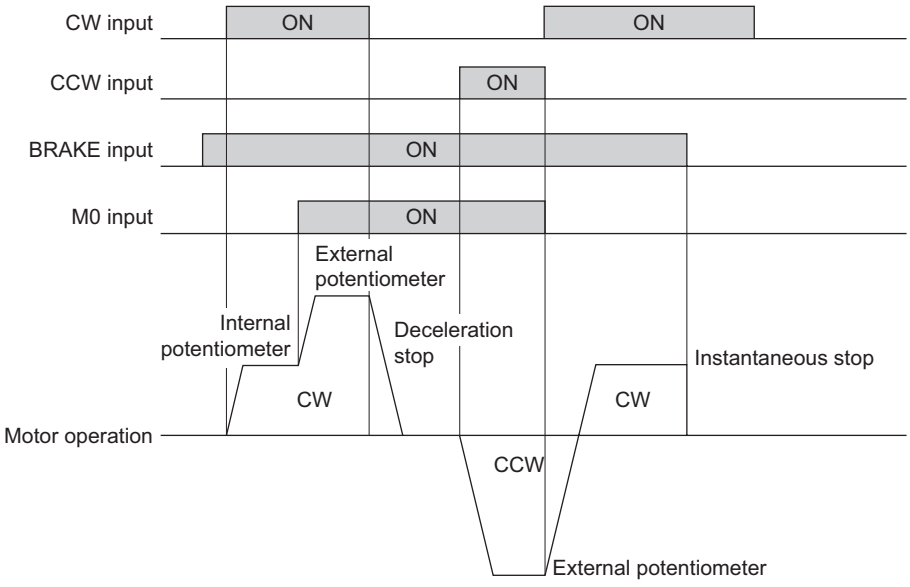
- FREE input

> ⚠ Warning
> Do not turn ON the FREE input when the position is held in the vertical direction. Otherwise, the holding force of the motor and electromagnetic brake will be lost, causing personal injury and equipment damage.

If FREE input is turned ON, motor excitation will be canceled, and the electromagnetic brake* will be released.
When FREE input is turned OFF, the driver excites the motor and activates the electromagnetic brake*.
The FREE input function takes precedence, independently of other inputs.
Even if a protection function activates, the FREE input function works.
* The electromagnetic brake refers to the case where the motor equipped with an electromagnetic brake.

- M0 input

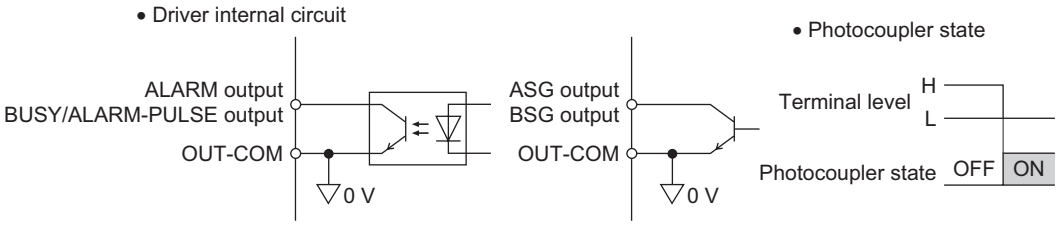
Switch the speed setting in motor startup to the external or internal potentiometer.
Turning ON of the M0 input enables the external potentiometer or external DC voltage setting speed.
Turning OFF of the M0 input enables the setting speed of the internal potentiometer.
Switching of the M0 input allows two-speed switching operation according to the external potentiometer or a combined use of external potentiometer.
The M1 and M2 inputs are connected when using the system upgrade tool (**OPX-1A**).
Do not make a connection if you do not use the external potentiometer.



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■ 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.

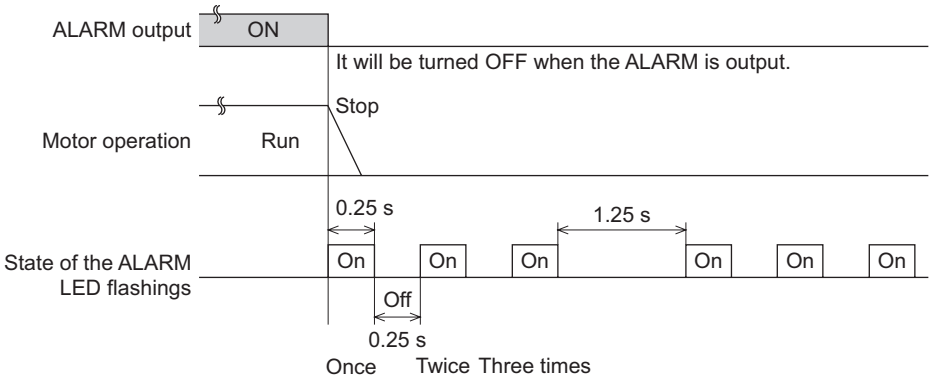


- ALARM output: photocoupler and open collector outputs

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

When the protection function has activated, the ALARM output is turned off to stop the motor. If the electromagnetic brake is not supplied, stop is provided by inertia.
When the electromagnetic brake is supplied, stop is provided by application of the electromagnetic brake.
In this case, you can confirm the type of the activated protection function by counting the ALARM LED flashings [After flashing by the specified number of times (LED is on for 0.25 s and off for 0.25 s), the LED repeats flashing at intervals of 1.25 s].

E.g.: three flashings (overvoltage protection)



Protection function	Number of ALARM LED blinks	Assumed causes
Overload protection	2	Load in excess of the rated torque is applied to the motor for about five seconds or more.
Overvoltage protection	3	• The power-supply voltage applied to the driver has exceeded 115 VAC or 230 VAC by 20% or more. • A load exceeding the motor’s allowable load inertia or gravitational capacity is driven.
Excessive displacement	4	The motor is unable to follow the command during operation in the position control mode or when the “servo lock function at motor standstill” is used in the speed control mode using the system upgrade tool.
Overcurrent protection	5	Excessive current has flown through the driver due to ground fault, etc. (The ALARM-RESET input cannot be used.)
Overspeed protection	6	The speed has exceeded 4000 r/min on the motor shaft.
EEPROM error	7	Set data cannot be written or read. (The ALARM-RESET input cannot be used.)
Encoder failure	8	An encoder signal error has occurred due to poor connection, wire breakage or other problem with the signal cable. (The ALARM-RESET input cannot be used.)
Insufficient voltage protection	9	The power-supply voltage applied to the driver has dropped below 100 VAC or 200 VAC by 40% or more.

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Resetting the protection function

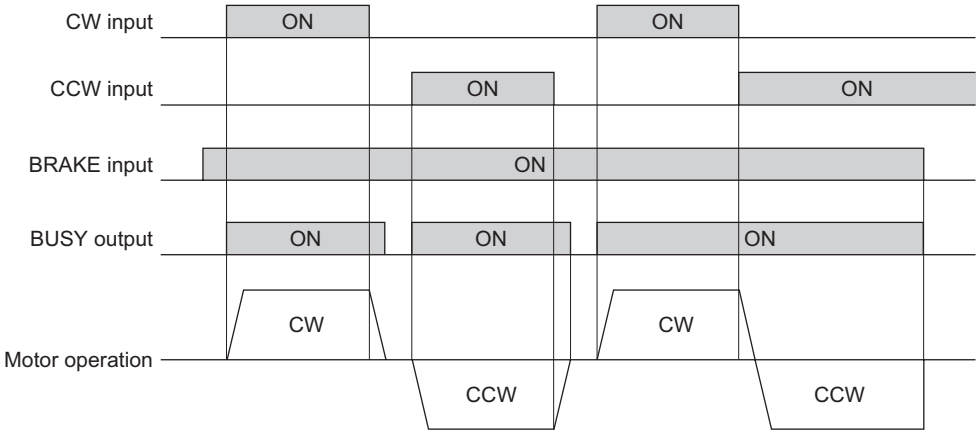
Reset any of the protection functions via the ALARM-RESET input or by turning the power off and back on again only after removing the cause of the problem and ensuring safety.
One-shot ALARM-RESET input (0.5 s) will restart the driver.
However, if protection functions for overcurrent, EEPROM error and encoder failure have activated, resetting will be disabled. Turn on the power again to perform resetting.
Wait at least 30 seconds after turning off the power before turning it back on again.

- BUSY output and ALARM-PULSE output: photocoupler and open collector outputs

If the BUSY output and driver protection functions have activated during normal times, they will work as ALARM-PULSE output.

Normal times (BUSY output)

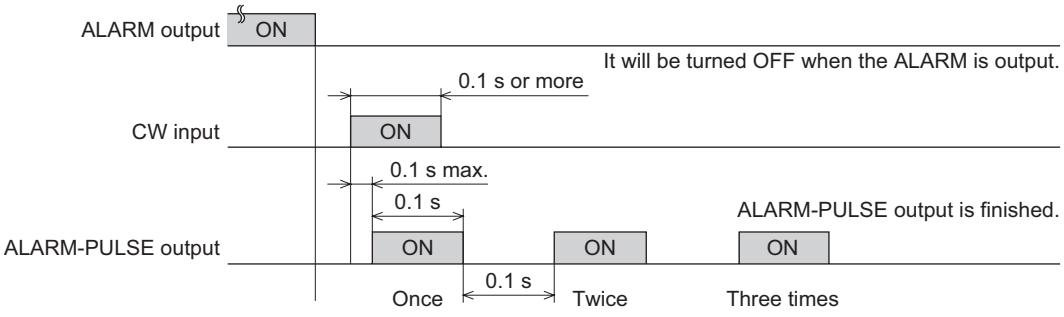
Function will be activated as BUSY output.
When the motor is running, the following output will be given:
If CW or CCW input and BRAKE input are turned ON simultaneously, the BUSY output will be turned ON.
It will be turned OFF when the motor has stopped by deceleration.



Activation of protection function (ALARM-PULSE output)

The function is performed as ALARM-PULSE output, and the causes for the protection function having been activated are conveyed to the external control equipment in terms of the number of pulses.
If one shot (0.1 s or more) is given to the CW input, the number of ALARM LED flashings in response to the activation of the protection function and the pulses (5 Hz) corresponding to the number of ALARM LED flashings are output. The causes for the protection function having been activated is identified by the external control equipment counting the output pulses.

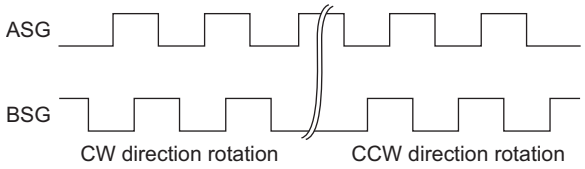
E.g.: three outputs (overvoltage protection)



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- ASG output and BSG output: Transistor and open collector outputs

  Outputs feedback pulses from the encoder (500 p/r).



Note When you want to the encoder feedback pulses, count both the ASG output and BSG output in the phase difference mode of the up/down counter.

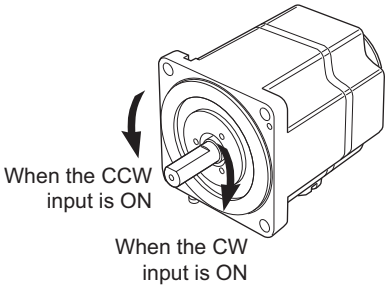
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7 Running

Setting the motor running speed and running operation are as follows.

7.1 Rotating direction of the motor output shaft

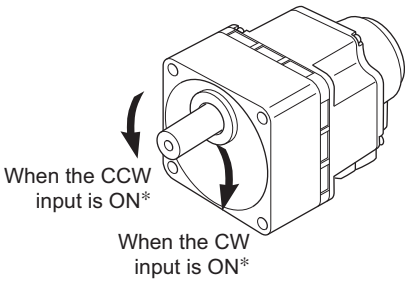
The rotating direction of the motor output shaft is defined as clockwise (CW) or counterclockwise (CCW) as viewed from the motor output shaft. However, the rotating direction of the motor output shaft may vary from that of the gearhead output shaft depending on the gear ratio of the gearhead.



■ Rotating direction of the gearhead output shaft

- Combination-type parallel-shaft gearhead

Gear ratios 5, 10, 15, 20, 200 : Same direction as the motor
Gear ratios 30, 50, 100 : Opposite direction to the motor

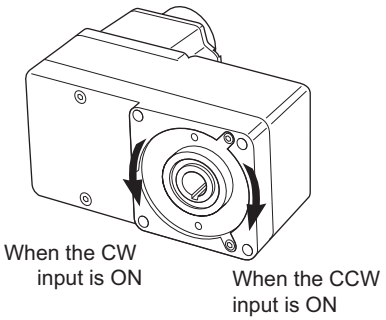


* The rotating direction when the CW input or CCW input is ON varies depending on the gear ratio.

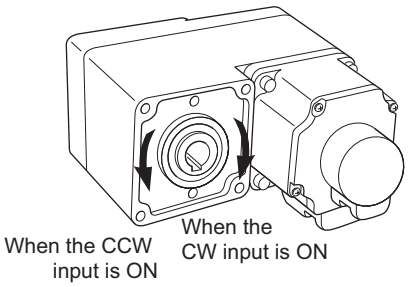
- Combination-type hollow-shaft flat gearhead

At all gear ratios, the rotating direction is opposite to that of the motor as viewed from the front.
With a combination-type hollow-shaft flat gearhead, the rotating direction will vary depending on whether the motor unit is viewed from the front or rear.

• Viewed from Front



• Viewed from Rear



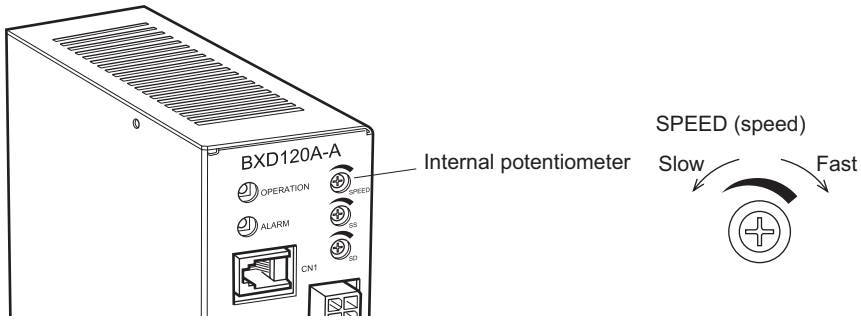
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7.2 Setting the running speed

The motor's running speed can be set using the driver's internal potentiometer, external potentiometer or an external DC voltage. The motor speed range is from 30 to 3000 r/min.
Two running speeds can be set by combining the internal potentiometer and external potentiometer, or the internal potentiometer and external DC voltage.

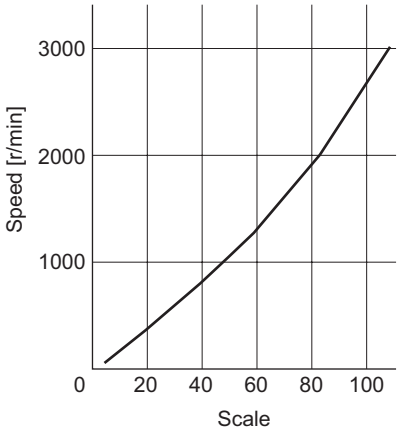
■ Setting by internal potentiometer

Use a precision screw-driver for this adjustment. Clockwise rotation will increase the set speed.
The speed is set to 0 r/min at time of shipment.



■ Setting by external potentiometer

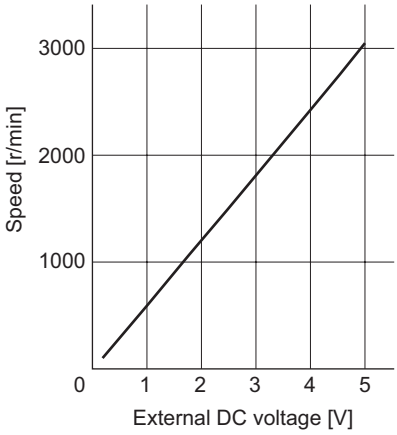
To drive the motor at the speed set on the external potentiometer, turn on the M0 input.
Clockwise rotation will increase the set speed.



External potentiometer scale-speed characteristics
(typical value)

■ Setting by external DC voltage

To drive the motor set at the external DC voltage, turn on the M0 input.

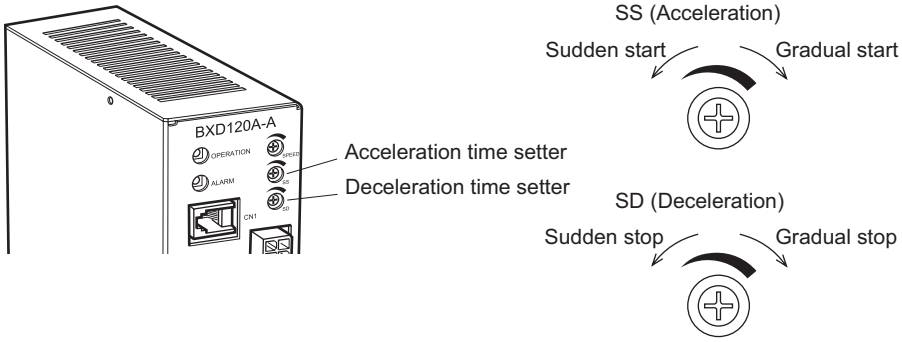


External DC voltage-speed characteristics
(typical value)

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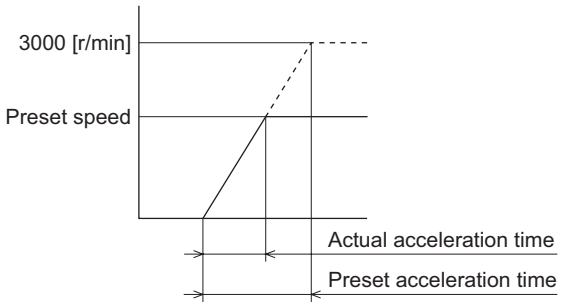
■ How to set the acceleration and deceleration time

You can set the acceleration time and deceleration time separately when you want to start and stop the motor. When the acceleration and deceleration time has been set, it is valid to any of the setting speeds by the internal potentiometer, external potentiometer and external DC voltage.
Use a precision screw-driver for this adjustment.



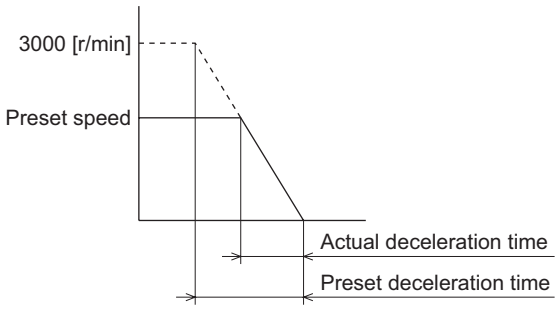
- How to set the acceleration time

The acceleration time potentiometer (SS) is used to set the time required from the start of motor operation to attainment of the set speed. Turn the setter in the clockwise direction, and the time will be prolonged. Time setting range is from 0.1 to 15 s (Time is set to 0.1 s at the time of shipment).

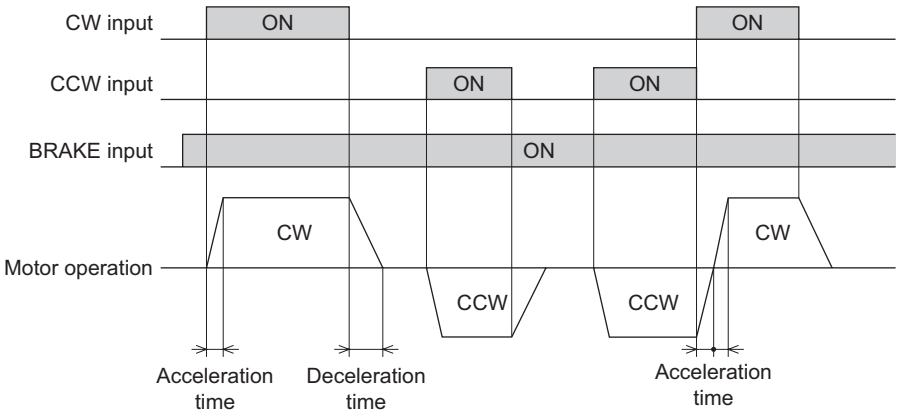


- How to set the deceleration time

The deceleration time potentiometer (SD) is used to set the time required from the set speed to the stop of motor operation. Turn the setter in the clockwise direction, and the time will be prolonged. Time setting range is from 0.1 to 15 s (Time is set to 0.1 s at the time of shipment).



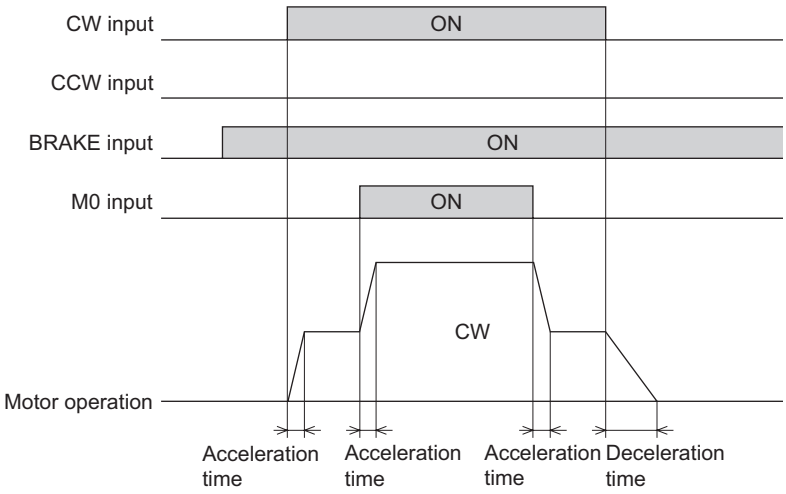
- Example of forward/reverse operation



Note When you have changed the rotation direction, the speed is decelerated and accelerated in conformity to the acceleration setting time.

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- Changing the speed



Note When the speed of rotation is changed over to the low speed by the M0 input, the speed is reduced according to acceleration setting time, not according to deceleration setting time.

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8 Inspection

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

8.1 Inspection items

- Check if the motor and gearhead installation screws are loosened or not.
- Check if abnormal noise is produced from the motor bearing section (ball bearing).
- Check if abnormal noise is produced from the gearhead bearing (ball bearing) and gear meshing section.
- Check if the motor/gearhead output shaft and load shaft are misaligned or not.
- Check if the motor cable or encoder cable are damaged or stressed. Also check if the connections with the driver are loosened.
- Check if the driver opening is clogged or not.
- Check if the driver mounting screws and power connection terminal screws are loosened or not.
- Check if the driver internal power element smoothing capacitor have abnormal smell or other failures.

Note

- To prevent the encoder from being damaged, never measure the insulation resistance or dielectric strength of the encoder as an independent unit.
- Semiconducting elements are used for the driver. Carefully handle the driver, because the driver may be damaged by static electricity.

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9 Troubleshooting and remedial actions

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

9.1 Troubleshooting

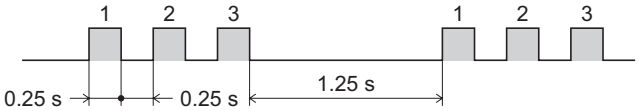
Phenomenon	Possible cause	Remedial action
The motor fails to turn.	BRAKE input turned OFF.	Turn on the BRAKE input.
	FREE input turned ON.	Turn off the FREE input.
	Both of CW input and CCW input turned OFF.	Turn on the CW input or CCW input.
	Both of CW input and CCW input turned ON.	Turn on either of the CW input or CCW input.
	The internal potentiometer is not adjusted.	Turn the internal potentiometer slightly in the clockwise direction. The speed is set to 0 r/min at time of shipment.
	M0 input is not turned OFF.	When the M0 input is off, the internal potentiometer is selected.
	The external potentiometer contact is faulty.	Check for connection of the external potentiometer.
	M0 input is not turned ON.	When the M0 input is on, the external potentiometer is selected.
	M1 input and M2 input is turned ON.	Turn off the M1 input and M2 input.
	The external DC voltage contact is faulty.	Check for connection of the external DC voltage.
The motor rotates in the direction opposite that which is specified.	Incorrect CW/CCW input or faulty connection.	The motors driven in the CW direction when the CW input is turned on and CCW direction when the CCW input is turned on.
	The combination-type parallel-shaft gearhead is using a gear with a gear ratio of 30, 50 or 100.	If the gear ratio is 30, 50 or 100, the gearhead output shaft will turn in the opposite direction to the motor output shaft. Reverse the CW and CCW input operations.
	A combination-type hollow-shaft flat gearhead is used.	With a combination-type hollow-shaft flat gearhead, the rotating direction is different depending on whether the gearhead is viewed from the front or rear.
Motor operation is unstable. Vibration is great.	The center of the motor (gearhead) output shaft is not aligned with the center of the load shaft.	Check the coupling condition of the motor (gearhead) output shaft and load shaft.
	Effect of noise.	Check for running only with the motor, driver and external control equipment required for running. If noise influence has been confirmed, take the appropriate measures such as separation from noise generating source, re-connection of wiring, replacement of the signal cable by a shielded cable, and installation of a Ferrite core.
The motor fails to stop instantaneously.	Turn OFF the set CW input or CCW input to stop the motor.	To stop the motor instantaneously, turn off the BRAKE input. If the motor does not stop instantaneously after that, load inertia may be excessive. Increase friction load or reduce load inertia, and check the result.

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9.2 Actions to be taken when the driver's protection functions have activated

When the driver's ALARM LED is flashing, check the number of flashes and take an appropriate measure according to the table below.
The ALARM LED's flashing pattern is as shown in the figure below:

Flashing pattern example: Overvoltage protection function (three flashes)



Number of ALARM LED blinks	Protective function	Possible cause	Remedial action
2	Overload protection	Load in excess of the rated torque is applied to the motor for about five seconds or more.	Re-examine the load.
3	Overvoltage protection	• The power-supply voltage applied to the driver has exceeded 115 VAC or 230 VAC by 20% or more. • A load exceeding the motor's allowable load inertia or gravitational capacity is driven.	When it has occurred to acceleration/deceleration of the motor, reduce the load inertia or prolong acceleration/deceleration time. Or connect the optional regeneration unit (sold separately). If this trouble has occurred in the gravitational application, reduce the load or speed. Or connect the optional regeneration unit (sold separately).
4	Excessive displacement	The motor is unable to follow the command during operation in the position control mode or when the "servo lock function at motor standstill" is used in the speed control mode using the system upgrade tool.	Reduce load inertia and load torque or prolong the acceleration and deceleration time.
5	Overcurrent protection	Excessive current has flown through the driver due to ground fault, etc. (The ALARM-RESET input cannot be used.)	Any one of motor cable, motor winding and driver output element is short circuited. Turn on the driver power supply again. If the problem cannot be solved by it, contact your local sales office.
6	Overspeed protection	The speed has exceeded 4000 r/min on the motor shaft.	Reduce the motor speed below 3000 r/min.
7	EEPROM error	Set data cannot be written or read. (The ALARM-RESET input cannot be used.)	Turn on the driver power supply again. If the problem cannot be solved by it, contact your local sales office.
8	Encoder failure	An encoder signal error has occurred due to poor connection, wire breakage or other problem with the signal cable. (The ALARM-RESET input cannot be used.)	Check the encoder cable for connection.
9	Insufficient voltage protection	The power-supply voltage applied to the driver has dropped below 100 VAC or 200 VAC by 40% or more.	Check the power voltage.

Note Turn on the driver power supply again. If the problem cannot be solved by it, contact your local sales office.

■ Resetting the protection function

Reset any of the protection functions via the ALARM-RESET input or by turning the power off and back on again only after removing the cause of the problem and ensuring safety.
One-shot ALARM-RESET input (0.5 s) will restart the driver.
However, if protection functions for overcurrent, EEPROM error and encoder failure have activated, resetting will be disabled. Turn on the power again to perform resetting.
Wait at least 30 seconds after turning off the power before turning it back on again.

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10 Appendix

10.1 Optional (Sold separately)

■ System upgrade tool Data setter OPX-1A (Supplied with modular cable)

This data setter provides a substantial extension of the **BX** series functions.
It allows digital setting of the speed in eight steps, positioning operation (setting of movements at 6 points) and mechanical home position resetting. It also has a great variety of additional functions including driver data copying function and operation monitoring function.

■ Regeneration unit

EPRC-400P (for **BX230**, **BX460**, **BX5120**)
RGB100 (for **BX6200**, **BX6400**)
This regeneration unit consumes and discharges regeneration energy generated during gravitational operation or sudden stop of large load inertial, thereby protecting the driver.

■ Extension cable and flexible cable

We have available the extension cable and flexible cable required to extend the distance between the motor and driver.
These cables for motor cable and encoder cable are available as one set.

Length [m (ft.)]	Model	
	Extension cable	Flexible cable
1 (3.3)	**CC01SBF**	**CC01SBR**
2 (6.6)	**CC02SBF**	**CC02SBR**
3 (9.8)	**CC03SBF**	**CC03SBR**
5 (16.4)	**CC05SBF**	**CC05SBR**
7 (23.0)	**CC07SBF**	**CC07SBR**
10 (32.8)	**CC10SBF**	**CC10SBR**
15 (49.2)	**CC15SBF**	**CC15SBR**
20 (65.6)	**CC20SBF**	**CC20SBR**

■ DIN rail mounting plate (Supplied with three mounting screws)

Plate for mounting the driver to a DIN rail [35 mm (1.38 in.)].
Model: **PADP01**

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10.2 Recommended peripherals

Circuit breaker or earth leakage breaker

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

Model*	**BX230□** **BX460□**	**BX5120□** **BX6200C** **BX6400S**	**BX6200A**
Rated current of protective device	5 A	10 A	15 A
Circuit breaker	Mitsubishi Electric Corporation NF30		
Earth leakage breaker	To prevent malfunction, use an earth leakage breaker with a current sensitivity of 200 mA or more and operating time of 0.1 second or more, or use one incorporating high-frequency noise elimination measures. Mitsubishi Electric Corporation NV series Fuji Electric FA Components&Systems Co., Ltd. EG series, SG series		

* □ in the model names indicates the power source specification (**A** or **C**).

Mains filter

Manufacturer	Single-phase 100−115 V	Single-phase 200−230 V	Three-phase 200−230 V
Schaffner EMC AG	FN2070-10-06	—	FN251-8-07
EPCOS AG	B84113-C-B110	—	—
TDK Corporation	—	ZAG2210-11S	—
TDK-Lambda Corporation	MC1210	MC1210	MC1310

Overvoltage category II applies to mains filters.

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