

Hollow Rotary Actuators

DG Series

DG85, DG130, DG200

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

■ Before use

Only qualified personnel should work with the product.

Use the product correctly after thoroughly reading the section 2 “Safety precautions” on p.4.

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.

■ Overview of the product

The **DG** series models are the hollow rotary actuator for high precision positioning. It uses the **αSTEP** stepping motor, with a rotor position sensor, as its power unit (hereinafter referred to as actuator.)

■ Standards and CE Marking

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

• Applicable Standards

	Applicable Standards	Certification Body	Standards File No.
Motor	UL 1004-1, UL 1004-2, UL 1004-6 CSA C22.2 No.100 ^{*2} CSA C22.2 No.77 ^{*2}	UL	E64199
	EN 60950-1, EN 60034-1 EN 60034-5, IEC 60664-1	—	—
Driver	UL 508C ^{*1} CSA C22.2 No.14	UL	E171462
	EN 60950-1 EN 50178	—	—

*1 For UL standard (UL 508C), the product is recognized for the condition of Maximum Surrounding Air Temperature 50 °C (122 °F).

*2 **DG85R-ASAA** (Motor model: ASM46AA-D), **DG85R-ASBA** (Motor model: ASM46BA-D) is not recognized by CSA Standards.

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

• Installation conditions (EN Standard)

Actuator and driver are to be used as a component within other equipment.

Overvoltage category: II

Pollution degree: Class 2

Protection against electric shock: Class I

• For Low Voltage Directive

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

- Install the product within the enclosure in order to avoid contact with hands.
- Be sure to maintain a protective ground in case hands should make contact with the product. Securely ground the protective grounding terminals of the actuator and driver.

• EMC Directive

This product has received EMC measures under the conditions specified in “Example of actuator and driver installation and wiring” on p.21.

Be sure to conduct EMC measures with the product assembled in your equipment by referring to 5.7

“Installing and wiring in compliance with EMC Directive” on p.19.

■ Hazardous substances

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

■ Main features

- Direct installation of a load axis

A table, arm or other load can be mounted directly on the output table.

Thus, it reduces the need for fastening members such as couplings and friction conclusion tool, power transmission members such as belt pulleys, and assembly man-hours.

- A cross roller bearing for the output table

The high rigidity cross roller bearing is integrated with the output table to increase the permissible thrust load and permissible moment load.

- High precision positioning without backlash

The non-backlash mechanism allows for highly precise positioning with $\pm 15''$ (0.004°) repetitive positioning accuracy and $2'$ (0.033°) of lost motion.

- Hollow, large diameter structure

Hollow section of the output table:

Unit model	Bore diameter [mm (in.)]
DG85	33 (1.30)
DG130	62 (2.44)
DG200	100 (3.94)

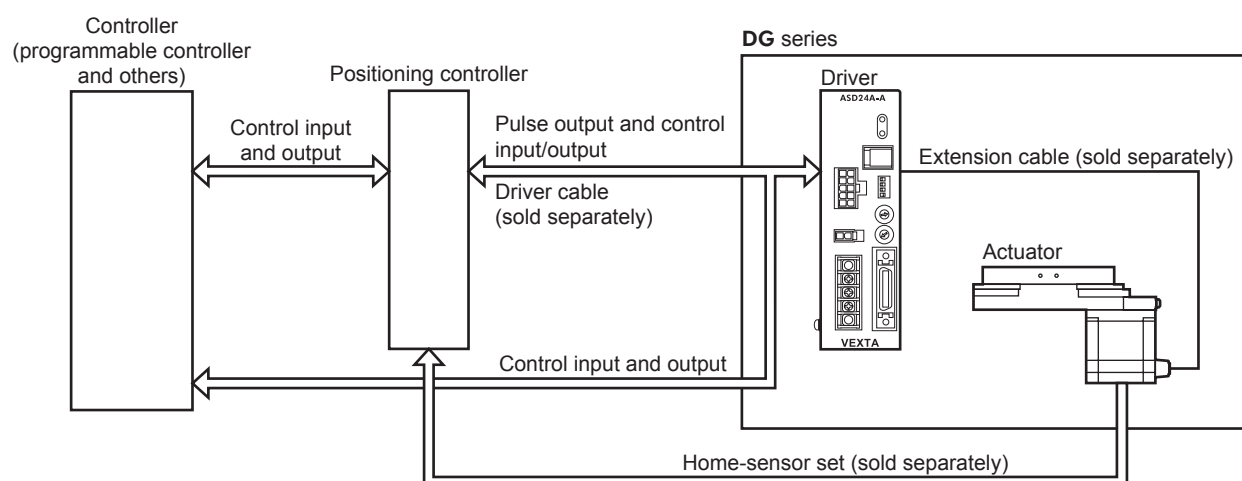
As a result your equipment design can be simplified and installation space reduced by routing tubes and wires through the hollow section. (The hollow section does not rotate.)

- Quick response, high reliability

The ***αSTEP*** used in the **DG** series does not allow missteps, even with a sudden change in load. The speed and amount of rotation are monitored during operation, and when the possibility of a misstep is detected due to an overload, etc., the response delay is corrected and operation continues within the maximum operating torque range.

■ System configuration



Controllers with pulse output functions are needed to operate the **DG** series.



- Extension cables are available in two types: the standard type and the electromagnetic brake type. If you are using an electromagnetic brake actuator, be sure to connect the actuator to the driver using an optional extension cable for the electromagnetic brake. The electromagnetic brake will not function if the motor cable is connected directly to the driver. Also, provide separate power supplies for the control input/output and the electromagnetic brake.
- The **DG** series is available in three input power supply: single-phase 100-115 V, single-phase 200-230 V and three-phase 200-230 V (**DG85**: single-phase 100-115 V only).
- Home detection sensors are required when the return to mechanical home is performed using the **EMP400** series. Home sensor set is available as an option (sold separately). Refer to p.46.


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, injury or damage to equipment.
- 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.
- Provide a means to hold the moving parts in place for applications involving vertical travel. The actuator loses holding torque when the power is shut off, allowing the moving parts to fall and possibly cause injury or damage to equipment.
- Do not use the actuator's built-in electromagnetic brake mechanism for stopping or for safety purposes. Using it for purposes other than holding the moving parts and actuator in position may cause injury or damage to equipment.
- When the driver protection function is triggered, the actuator will stop and lose its holding torque, possibly causing injury or damage to 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 actuator, leading to injury or damage to equipment.

Installation

- To prevent the risk of electric shock, use the actuator and driver for class I equipment only.
- Install the actuator and driver in their enclosures in order to prevent electric shock or injury.
- Install the actuator 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 actuator may suddenly start when the power is restored and may cause injury or damage to equipment.
- Do not turn the C.OFF (All windings off) input to ON while the actuator is operating. The actuator will stop and lose its holding ability, which may result in injury or damage to equipment.

Maintenance and inspection

- Do not touch the connection terminals of the driver immediately after the power is turned off (for a period of 10 seconds). The residual voltage may cause electric shock.

Repair, disassembly and modification

- Do not disassemble or modify the actuator 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 actuator and driver beyond their specifications, or electric shock, injury or damage to equipment may result.
- Keep your fingers and objects out of the openings in the actuator and driver, or fire, electric shock or injury may result.
- Do not touch the actuator or driver during operation or immediately after stopping. The surfaces are hot and may cause a skin burn(s).

Transportation

- Do not hold the output table or motor cable. This may cause injury.

Installation

- Keep the area around the actuator 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 actuator and driver that would obstruct ventilation.
- Provide a cover over the rotating parts of the output table to prevent injury.

Operation

- Use an actuator and driver only in the specified combination. An incorrect combination may cause a fire.
- Provide an emergency stop device or emergency stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Before supplying power to the driver, turn all control inputs to the driver to OFF. Otherwise, the actuator may start suddenly and cause injury or damage to equipment.
- To prevent bodily injury, do not touch the rotating parts (output table) of the actuator during operation.
- Before moving the actuator directly (as in the case of manual positioning), confirm that the driver C.OFF (All windings off) input is ON to prevent injury.
- The actuator'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).
- For the power supply to the control input/output, use a DC power supply with reinforced insulation on the primary side, and provide separate power supplies for the control input/output and the electromagnetic brake. Failure to do so may result in electric shock.
- 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.



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 actuator or driver, disassemble it into parts and components as much as possible and dispose of individual parts/components as industrial waste.

3 Precautions for use

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

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

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

- Operate the actuator below the permissible torque.

Operating the **DG** series at torque outside the permissible range or keeping the output table locked may damage the gear mechanism. Be sure to operate the actuator below the permissible torque.

- Do not apply moment load and thrust load in excess of the specified permissible limit.

Be sure to operate the actuator within the specified permissible limit of moment load and thrust load.

Operating it under an excessive moment load and thrust load may damage the actuator bearings (cross roller bearing). See p.14 for details.

- Do not make an impact with the actuator.

Do not drop the actuator. Also, do not strike or hammer the motor unit and mechanical unit. Doing so may cause the positioning accuracy decrease, the rotor position detection sensor damage and the actuator service life reduction.

- Set the surface temperature of the actuators as follows:

The driver has an overheat protection function, but the actuator has no such feature. When using the actuator, set its operating conditions (operating speed, operating duty, etc.) so that the following temperatures are maintained.

When the home sensor set (sold separately) is not used

Use the actuator at the ambient operating temperature of 0 to +50 °C (+32 to +122 °F) and motor surface temperature of 100 °C (212 °F) or less. If the motor surface temperature exceeds 100 °C (212 °F), the life of the bearing (ball bearing) employed in the motor will be diminished to a significant extent.

When the home sensor set (sold separately) is used

Use the actuator at the ambient operating temperature of 0 to +40 °C (+32 to +104 °F) and motor surface temperature of 90 °C (194 °F) or less. If the motor surface temperature exceeds 90 °C (194 °F), the temperatures of the photomicrosensors employed as home sensors will rise and the life of the sensor will be diminished to a significant extent.

- Use an electromagnetic brake type for an application involving up/down travel.

When the actuator is used in an application involving up/down travel, such as a lifter, use an electromagnetic brake type to hold the load in position. To hold the load in position, apply the electromagnetic brake only after the actuator has stopped. Do not use the brake to bring the moving actuator 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.

When the driver protection function is triggered, the actuator stops as the current is turned off. The user must set a controller sequence that will cut off the power to the electromagnetic brake and hold the load in position upon detecting an ALARM output turns OFF.

- Connecting an electromagnetic brake actuator

Provide separate power supplies for the control input/output and the electromagnetic brake.

Always use an optional extension cable for the electromagnetic brake type when connecting the actuator to the driver. Connect the two lead wires for the electromagnetic brake, which extend from the extension cable, to the DC power supply while ensuring the correct polarities of the leads.

Be sure to connect the supplied non-polarized varistor in order to protect the switch contacts and prevent noise.

- **M2.5 screw holes for home sensor installation**

The M2.5 screw holes provided in the gear mechanism and output table side of the actuator is used for installing the home sensor set (sold separately). Do not use these holes for any purpose other than installation of the home sensor.

- **Maximum static torque at excitation**

The maximum static torque at excitation indicates the output table's holding torque at standstill. The current cutback function, which suppresses the increase in motor temperature, maintains the maximum static torque at excitation to below permissible torque. When selecting the actuator, consider the maximum static torque at excitation in addition to the permissible torque.

Also, the holding torque of the output table becomes zero in the non-excitation state. When the load is held in position using the electromagnetic brake, the holding torque corresponds to the static friction torque of the electromagnetic brake. See p.45 for details

- **Permissible speed**

Use the actuator within the permissible speed.

The permissible speed indicates the permissible speed (r/min) of the output table. If the actuator is operated at speeds exceeding the permissible speed, the life of the actuator may be diminished to a significant extent.

- **DG series with double motor shafts**

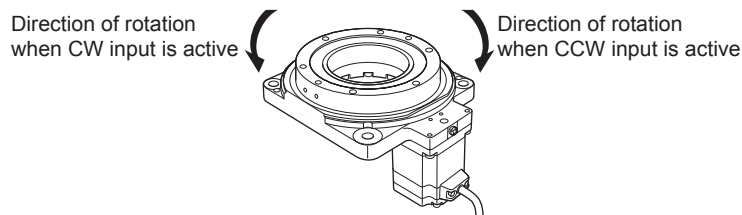
The **DG** series includes models with double motor shafts. With these models, do not apply load torque, overhung load or thrust load on the shaft opposite the motor's output shaft.

- **Actuators screws**

Do not loosen or remove the actuator screws. To do so may cause the positioning accuracy to drop or result in actuator damage.

- **Rotating direction of the actuators**

The CW and CCW inputs provided as driver input signals indicate the opposite directions to the output table's direction of rotation. When the CW input is active, the output table rotates counterclockwise. When the CCW input is active, the output table rotates clockwise.



- **Hollow section**

If the tube or wire routed through the hollow section is allowed to turn with the output table, provide a means to prevent friction, and consequential breakage, due to contact between the tube/wire and the inner walls of the hollow section.

- **Protective Earth Terminal**

The actuator come with a M4 Protective Earth Terminal. Do not use this Protective Earth Terminal for purposes other than grounding.

- **Install the driver in a vertical orientation.**

The driver's heat dissipation function is designed according to vertical orientation. Installing the driver in any other orientation may shorten the life of electronic parts due to temperature increases within the driver.

- **Preventing leakage current**

Stray capacitance exists between the driver's current carrying line and other current carrying lines, the earth and the motor, respectively. A high frequency current may leak out through such capacitance, having a detrimental effect on the surrounding equipment. The actual leakage current depends on the driver's switching frequency, the length of wiring between the driver and motor, and so on.

When providing a leakage current breaker, use the following products, for instance, which have high frequency signal protection:

Mitsubishi Electric Corporation: NV series

Fuji Electric FA Components & Systems Co., Ltd.: EG and SG series

- **Preventing electrical noise**

See 5.7 “Installing and wiring in compliance with EMC Directive” on p.19 for measures with regard to noise.

- **Grease of actuators**

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

4 Preparation

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

4.1 Checking the product

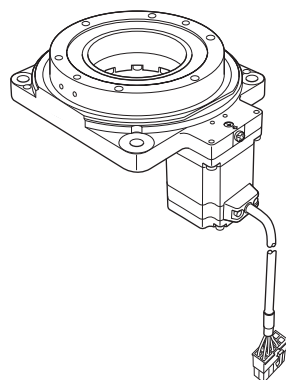
Upon opening the package, verify that the items listed below are included.

Report any missing or damaged items to the branch or sales office from which you purchased the product.

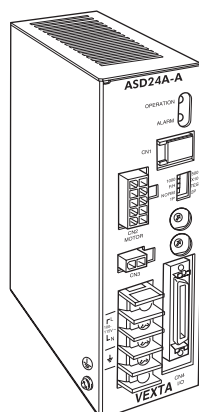
Verify the model number of the purchased unit against the number shown on the package label.

Check the model number of the actuator and driver against the number shown on the nameplate.

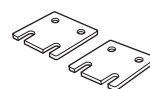
The unit models and corresponding actuator/driver combinations are listed on p.10.



- Actuator 1 unit
Illustration shows the **DG130R-ASAA**.



- Driver 1 unit



- Driver mounting brackets
2 pcs.



- Screws for driver mounting brackets
(M3) 4 pcs.

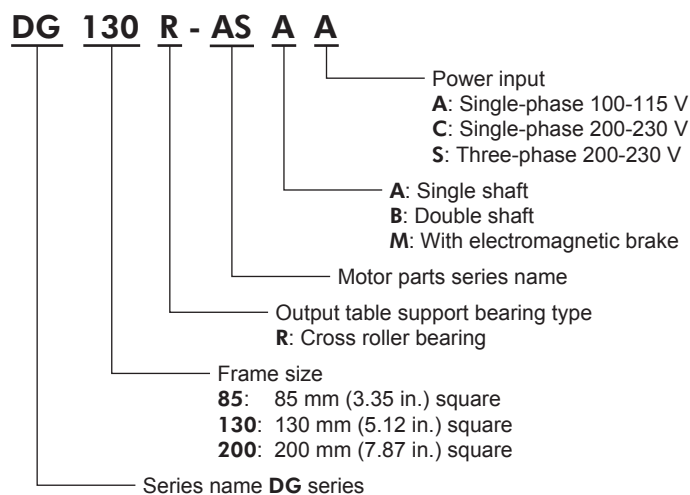


- Control input/output connector 1 set

- Operating manual
(this manual) 1 copy

- Varistor 1 pc.
(supplied with electromagnetic brake actuator)

4.2 How to identify the product model



4.3 Combinations of actuators and drivers

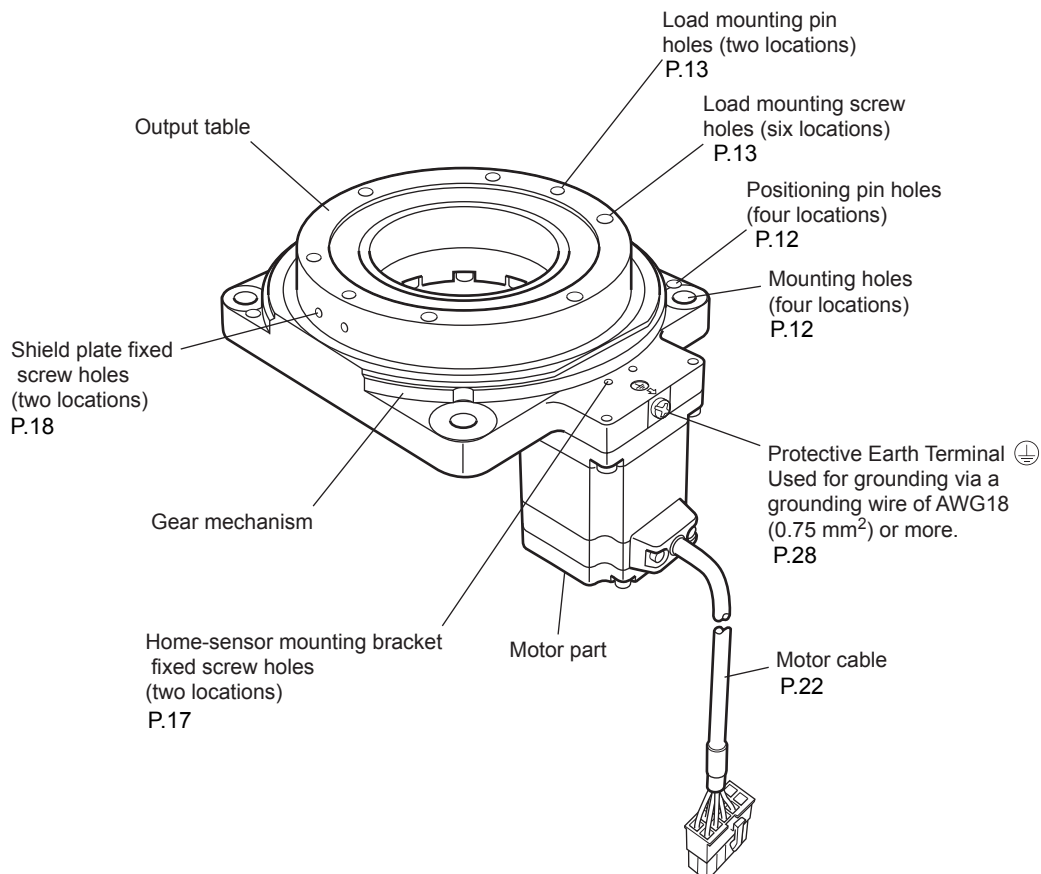
Unit model	Actuator model	Driver model
DG85R-ASAA	DGM85R-ASAA	ASD13B-A
DG85R-ASBA	DGM85R-ASBA	
DG130R-ASAA	DGM130R-ASAA	ASD24A-A
DG130R-ASBA	DGM130R-ASBA	
DG130R-ASMA	DGM130R-ASMA	
DG130R-ASAC	DGM130R-ASAC	ASD12A-C
DG130R-ASBC	DGM130R-ASBC	
DG130R-ASMC	DGM130R-ASMC	
DG130R-ASAS	DGM130R-ASAC	ASD12A-S
DG130R-ASBS	DGM130R-ASBC	
DG130R-ASMS	DGM130R-ASMC	
DG200R-ASAA	DGM200R-ASAA	ASD30E-A
DG200R-ASBA	DGM200R-ASBA	
DG200R-ASMA	DGM200R-ASMA	
DG200R-ASAC	DGM200R-ASAC	ASD20A-C
DG200R-ASBC	DGM200R-ASBC	
DG200R-ASMC	DGM200R-ASMC	
DG200R-ASAS	DGM200R-ASAC	ASD20A-S
DG200R-ASBS	DGM200R-ASBC	
DG200R-ASMS	DGM200R-ASMC	

4.4 Names and functions of parts

This section covers the names and functions of parts in the actuator and driver.

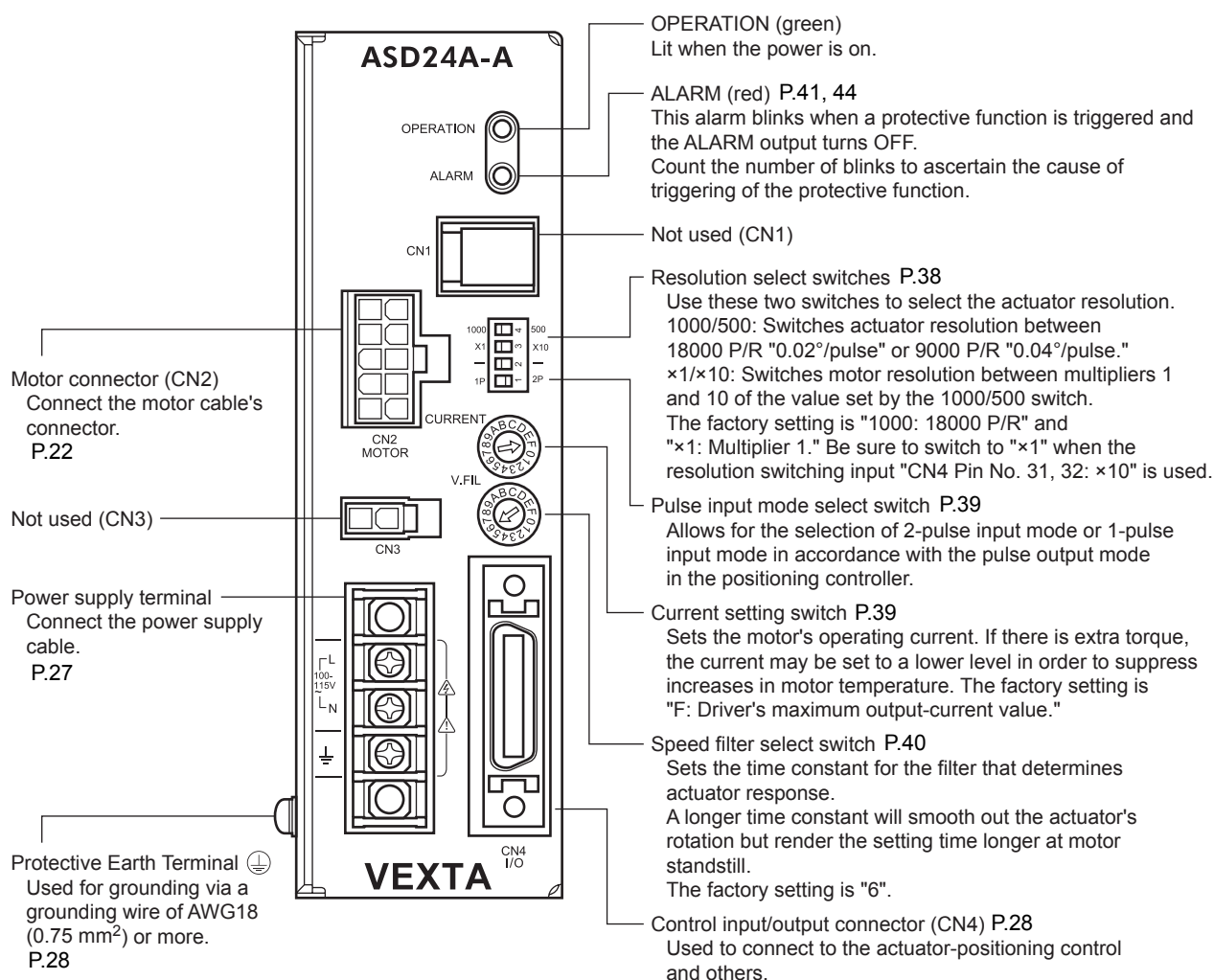
■ Actuator

Illustration shows the **DG130**.

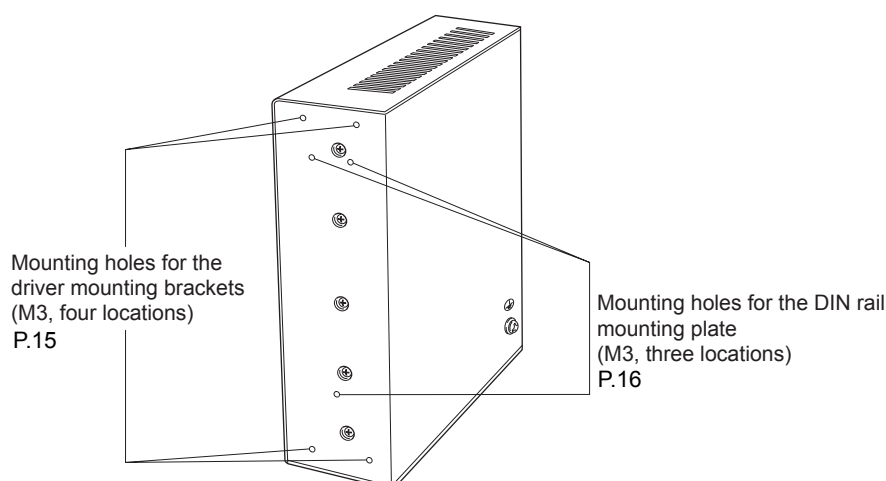


■ Driver

Front side of driver



Rear side of driver



5 Installation

This section covers the environment and method of installing the actuator and driver, along with load installation.

Also covered in this section are the installation and wiring methods that are in compliance with the relevant EMC Directive.

5.1 Location for installation

The actuator 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

When the home sensor set is not used

Actuator: 0 to +50 °C (+32 to +122 °F) (non-freezing)

Driver: 0 to +50 °C (+32 to +122 °F) (non-freezing)

When the home sensor set is used

Actuator: 0 to +40 °C (+32 to +104 °F) (non-freezing)

Driver: 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

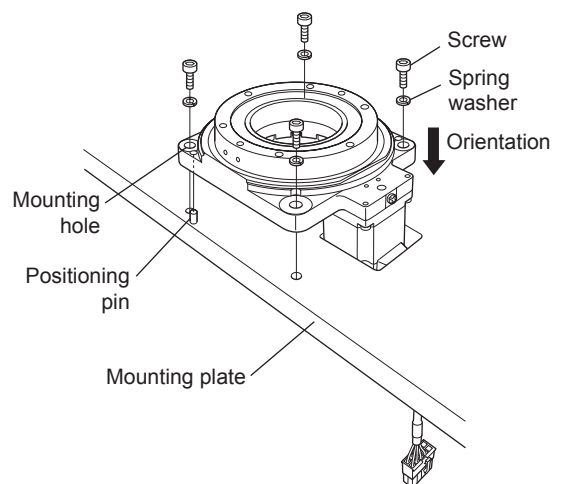
5.2 Installing the actuator

■ Installation direction

The actuator can be installed in any direction.

■ How to install the actuator

Install the actuator onto the mounting plate from the direction shown on p.13. Use the four mounting holes to affix the actuator to the mounting plate with screws. The positioning pin holes are provided in the mounting surface of the actuator. Use these positioning holes to locate the actuator with respect to the equipment. Provide a motor relief hole in the mounting plate.

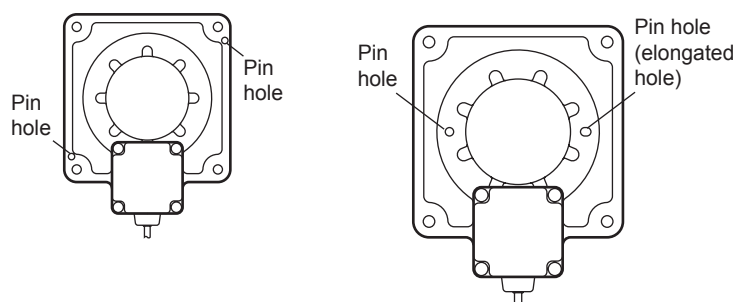


Unit model	Bolt size	Tightening torque [N·m (lb-in)]	Mounting plate thickness and material
DG85	M6	6 (53)	Iron/Aluminum plate 8 mm (0.315 in.) or thicker
DG130	M8	13 (115)	Iron/Aluminum plate 10 mm (0.394 in.) or thicker
DG200	M10	25 (220)	Iron/Aluminum plate 15 mm (0.591 in.) or thicker

Positioning pin holes (as viewed from the actuator's installation surface)

DG85, DG130

DG200



Unit model	Pin hole diameter [mm (in.)]	Pin hole depth [mm (in.)]	Number of pin hole
DG85	$\varnothing 5^{+0.012}_0$ ($\varnothing 0.1969^{+0.0005}_0$)	10.5 (0.413), through hole	2
DG130		12 (0.472), through hole	
DG200	$\varnothing 8^{+0.015}_0$ ($\varnothing 0.3150^{+0.0006}_0$)	8 (0.315), blind hole	2 [one of those is an elongated hole of $8^{+0.015}_0$ mm ($0.3150^{+0.0006}_0$ in.) wide]

Note

- Do not loosen or remove the actuator screws. To do so may cause the positioning accuracy to drop or result in actuator damage.
- Be sure the positioning pins are secured to the mounting plate. Driving the pins into the actuator may damage the actuator due to impact.
- The actuator cannot be installed from below the mounting plate.
- Do not drop the actuator. Also, do not strike or hammer the motor unit and mechanical unit. Doing so may cause the positioning accuracy decrease, the rotor position detection sensor damage and the actuator service life reduction.

5.3 Securing the load to the output table

Install the load with screws using the load mounting screw holes (six locations) in the output table.

The output table has the load mounting pin holes.

These holes can be combined with the positioning pins for accurate positioning of the load.

Unit model	Bolt size	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]	Material of load
DG85	M4	2 (280)	8 (0.315)	Iron or aluminum
DG130	M5	3.5 (490)		
DG200	M6	6 (850)	10 (0.394)	

Unit model	Pin hole diameter [mm (in.)]	Pin hole depth [mm (in.)]	Number of pin hole
DG85	$\varnothing 5^{+0.012}_0$ ($\varnothing 0.1969^{+0.0005}_0$)	6 (0.236)	2
DG130			
DG200	$\varnothing 8^{+0.015}_0$ ($\varnothing 0.3150^{+0.0006}_0$)	8 (0.315)	

Note

- Be sure the positioning pins are secured to the load. Driving the pins into the output table may damage the bearing due to impact or an excessive moment of inertia.

5.4 Permissible moment load and permissible thrust load

The moment load and thrust load must not exceed the values shown in the table below.

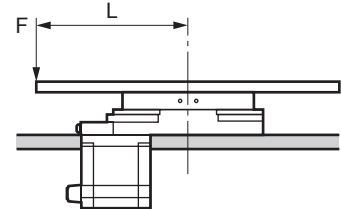
Unit model	Permissible thrust load [N (lb.)]	Permissible moment load [N·m (lb-in)]
DG85	500 (112.5)	10 (88)
DG130	2000 (450)	50 (440)
DG200	4000 (900)	100 (880)

The moment load and thrust load can be calculated using the formulas below:

Example 1: When external force F is applied at distance L from the center of the output table

Thrust load [N (lb.)] $F_s = F + \text{Mass of load} \times g$ (acceleration of gravity)

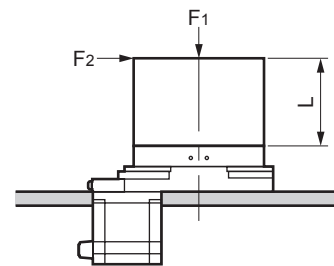
Moment load [N·m (lb-in)] $M = F \times L$



Example 2: When external forces F_1 and F_2 are applied at distance L from the mounting surface of the output table

Thrust load [N (lb.)] $F_s = F_1 + \text{Jig and mass of load} \times g$ (acceleration of gravity)

Moment load [N·m (lb-in)] $M = F_2 \times (L + a)$



Unit model	a [m (in.)]
DG85	0.02 (0.79)
DG130	0.03 (1.18)
DG200	0.04 (1.57)

5.5 Installing the driver

■ Installation direction

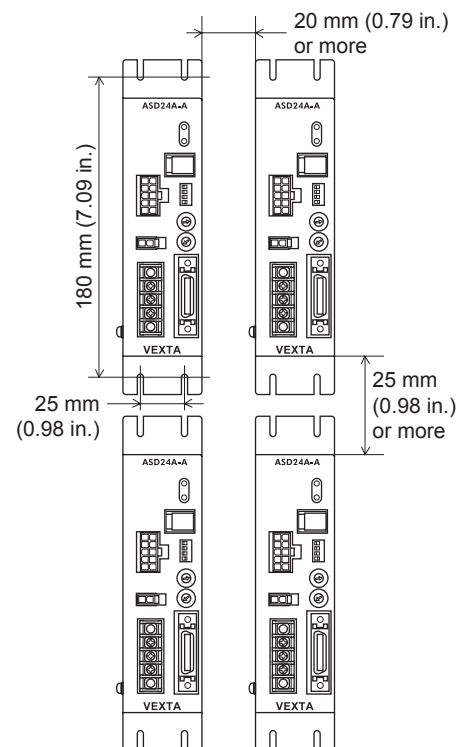
The driver is designed so that heat is dissipated via air convection and conduction through the enclosure.

When installing the driver in an enclosure, it must be placed in perpendicular (vertical) orientation using a DIN rail or driver mounting brackets.

There must be a clearance of at least 25 mm (0.98 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 (0.79 in.) and 25 mm (0.98 in.) clearances in the horizontal and vertical directions, respectively.

Note

- Install the driver in an enclosure.
- Do not install any equipment that generates a large amount of heat near the driver.
- Do not install the driver underneath the controller or other equipment vulnerable to heat.
- Check ventilation if the ambient temperature of the driver exceeds 50 °C (122 °F).



■ How to install the driver

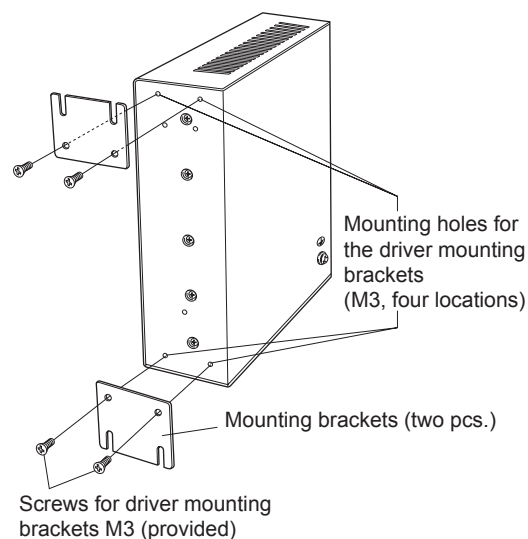
Install the driver on a flat metal plate having excellent vibration resistance and heat conductivity.

In the presence of a great amount of vibration, do not use a DIN rail. Screw down the driver directly through the use of driver mounting brackets.

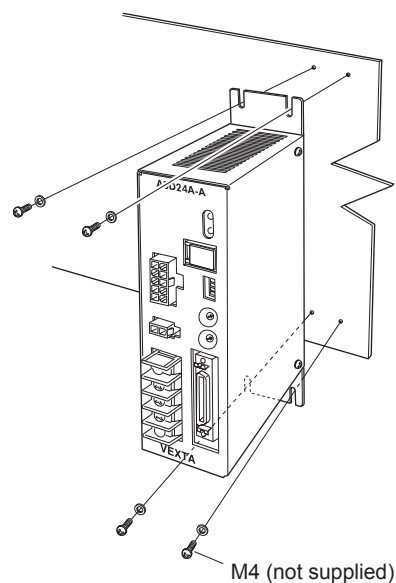
If a DIN rail is to be used, use a DIN rail mounting plate (sold separately).

● 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 pcs.).
Tightening torque: 0.5 to 0.6 N·m
(71 to 85 oz-in)



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.



Note

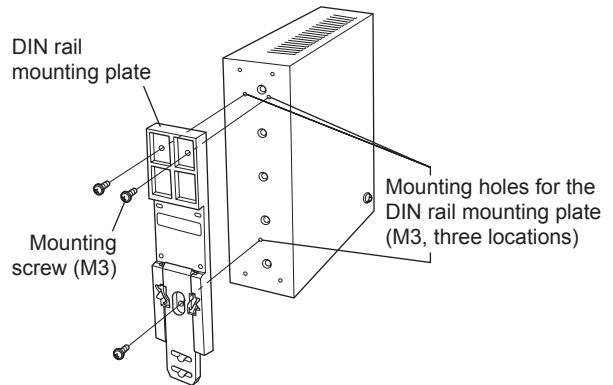
- Do not use the mounting holes (M3, four locations) for the driver mounting brackets provided on the back of the driver for any purpose other than securing the driver mounting brackets.
- Be sure to use the supplied screws when securing the driver mounting brackets.

- Mounting to DIN rail

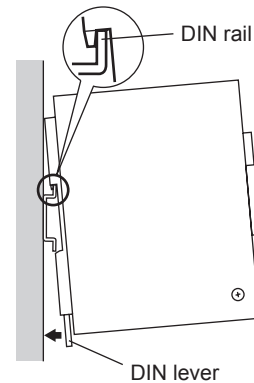
Use a DIN rail 35 mm (1.38 in.) wide to mount the driver.

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
(42 to 56 oz-in)

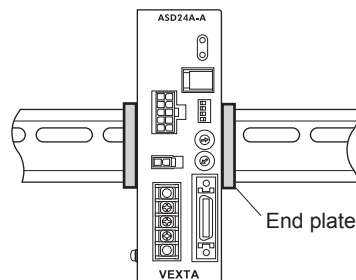


2. Pull the DIN lever down, engage the upper hooks of the DIN rail mounting plate over the DIN rail, and push the DIN lever until it locks in place.



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

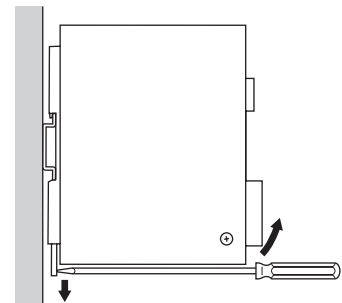


- Removing from DIN rail

Pull the DIN lever down until it locks using a flat blade parallel tip type screwdriver, and lift the bottom of the driver to remove it from the rail.

Note

- 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.



5.6 Installation of home sensor set (sold separately)

■ Home position sensor setting details

Home sensor set (**PADG-SB**: NPN output, **PADG-SBY**: PNP output) of the following parts:

- Photomicrosensor 1 pc.
EE-SX673A (Supplied with **PADG-SB**, OMRON Corporation)
EE-SX673R (Supplied with **PADG-SBY**, OMRON Corporation)
- Connector with cables 1 pc.
EE-1010-R (OMRON Corporation) length 2 m (6.6 ft.)
- Mounting bracket for sensor 1 pc.
- Shield plate 1 pc.
- Screw (M3, Spring washer, Washer) 2 pcs.
- Hexagonal socket head screw (M2.5) 4 pcs.

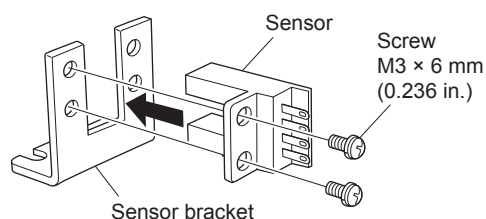
■ Installation the sensor

Install the home sensor set (**PADG-SB** or **PADG-SBY**) to the actuator by following the procedure below.

Note

- Do not install the home sensor set while the power is supplied. To do so may result in injury or equipment damage.
- Be sure to install the sensor and shield plate in the direction shown in the figure. Installing them in the wrong direction may disable sensor detection or cause the shield plate to contact the sensor and result in sensor damage.
- When installing the sensor bracket and shield plate to the actuator, be sure to use the supplied screws.

1. Affix the sensor to the sensor bracket using the supplied screws (M3 × 2).
Screw holes are provided in two locations on the right and left sides of the sensor bracket. The sensor can be installed on either side. However, ensure a line of sight between the installed sensor and the indicator lamp. Tightening torque: 0.6 N·m (85 oz-in)

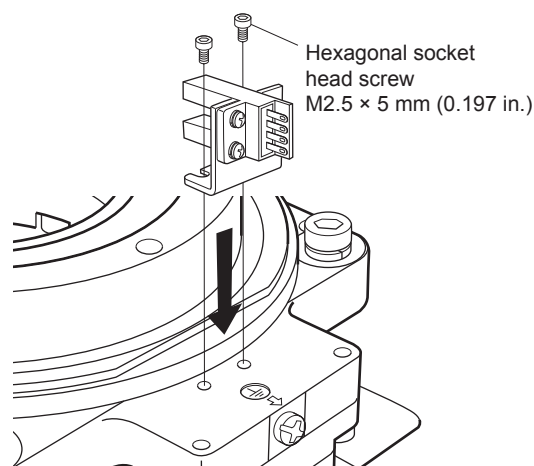


2. Affix the bracket and sensor assembly to the gear mechanism of the actuator using the supplied hexagonal socket head screws (M2.5 × 2).
Tightening torque: 0.5 N·m (71 oz-in)

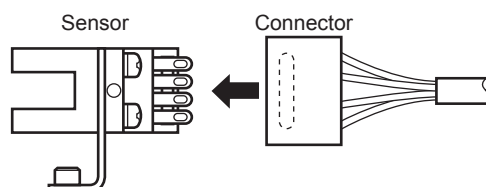
Illustration shows the **DG130**.

Note

Do not use the M2.5 screw holes to install the home sensor, as provided in the actuator, for any purpose other than installation of the home sensor set.



3. Plug the connector with cable into the sensor.
Firmly insert the sensor connector by aligning its orientation with the connector.

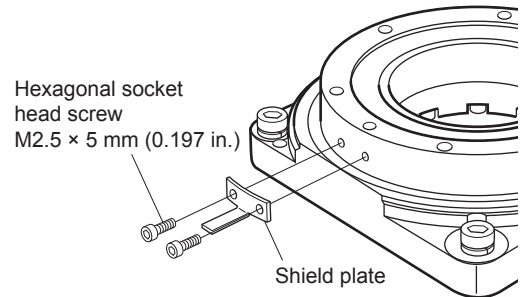


Note

- Do not install or remove the connector with cable while the power is being supplied. Doing so may damage the sensor.
- When removing the connector with a cable, do not pull it by the cables. Pull out the connector while pressing it firmly from the top and bottom.
- Wire the robot cable in such a way that it will not contact the actuator.

4. Affix the shield plate to the output table using the supplied hexagonal socket head screws (M2.5 × 2).

Tightening torque: 0.5 N·m (71 oz-in)

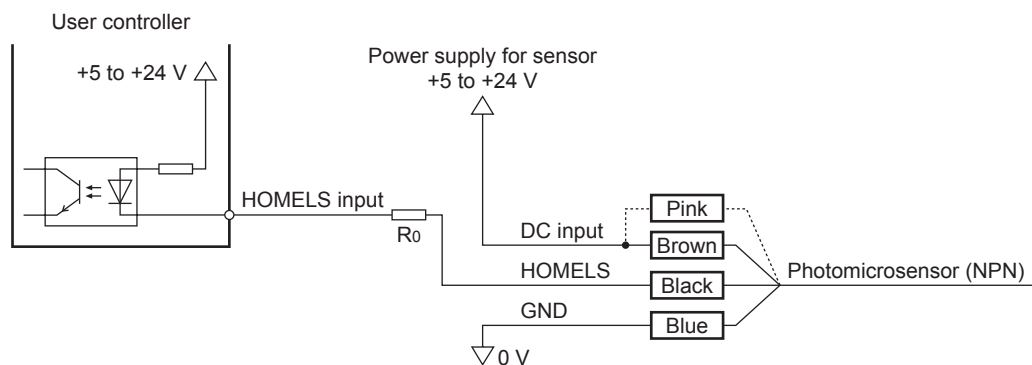
**Note**

- The photomicrosensor is designed for use within equipment and therefore has no special means of protection against disturbances from external supplies of light. If the actuator is to be used under an incandescent lamp or in conditions that are subject to disturbances from external light, provide the means to prevent such interference.
- Use the sensors after confirming that there is no looseness, play or other abnormality due to vibration, impact, etc.
- Place the power cables such as the motor and power supply cables as far apart as possible from the signal cables. If they have to cross, cross them at a right angle.
- To prevent sensor deterioration due to heat, set the operating conditions (speed and operating duty) of the actuator in such a way that the ambient operating temperature remains at 0 to +40 °C (+32 to +104 °F) and the motor surface temperature remains at 90 °C (194 °F) or less.
- To prevent malfunctioning due to the adhesion of dust on the sensors, clean and/or replace the sensors regularly.
- Use a common GND for the sensor power and user's controller power. Any difference in GND potential will result in a sensor malfunction.

■ Sensor wire connection

- Connection diagram when the home sensor set **PADG-SB** is used.

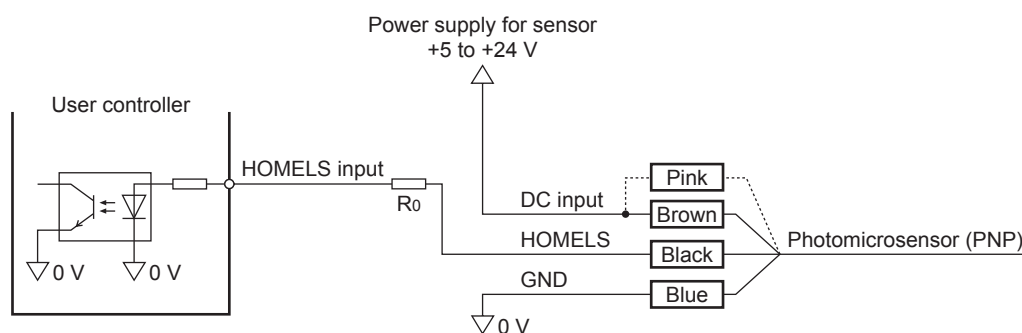
The power supply must be 5 VDC or more and 24 VDC or less. The current must be 100 mA or less.
If the current exceeds 100 mA, connect an external resistor R₀.



* The pink lead is connected to the brown lead if the sensor logic is N.C. (normally closed).
If the sensor logic is N.O. (normally open), the pink lead is not connected.

- Connection diagram when the home sensor set **PADG-SBY** is used

The power supply must be 5 VDC or more and 24 VDC or less. The current must be 50 mA or less. If the current exceeds 50 mA, connect an external resistor R_0 .



* The pink lead is connected to the brown lead if the sensor logic is N.C. (normally closed).
If the sensor logic is N.O. (normally open), the pink lead is not connected.

5.7 Installing and wiring in compliance with EMC Directive

■ General

EMC Directive

The **DG** 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 actuator 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	EN 61000-6-4 EN 61800-3 EN 55011 group 1 class A EN 61000-3-2 EN 61000-3-3
EMS	EN 61000-6-2 EN 61800-3

■ Installing and wiring in compliance with EMC Directive

Effective measures must be taken against the EMI that the **DG** series may give to adjacent control system equipment, as well as the EMS of the **DG** 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 **DG** series to be compliant with the EMC Directive (the aforementioned compliance standards).

- Connecting mains filter for power supply line

Connect a mains filter in the AC input line to prevent the noise generated in the driver from propagating externally through the power supply line.

Use a mains filter or equivalent as below table.

Manufacturer	Single-phase 100-115 V Single-phase 200-230 V	Three-phase 200-230 V
SOSHIN ELECTRIC CO.,LTD	HF2010A-UPF	HF-3010C-SZA
Schaffner EMC	FN2070-10-06	FN3025HP-10-71

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 mm² or more) parallel with the mains filter output cable (AWG18: 0.75 mm² 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.

- **Connecting surge arrester**

Use a surge arrester as below table.

Manufacturer	Single-phase 100-115 V	Single-phase 200-230 V
OKAYA ELECTRIC INDUSTRIES CO., LTD.	R-A-V-781BWZ-4, R-C-M-601BQZ-4	
PHOENIX CONTACT GmbH & Co. KG	PT2-PE/S120AC-ST	PT2-PE/S230AC-ST

Note When measuring dielectric strength of the equipment, be sure to remove the surge arrester, or the surge arrester may be damaged.

- **Power supply for electromagnetic brake (for electromagnetic brake type only)**

Use a DC power supply that complies with the EMC Directive for an external DC power supply of the electromagnetic brake. Use a shielded cable for wiring, and keep the wiring and grounding as short as possible. Refer to “Wiring the signal cable” for details on how to ground the shielded cable.

- **How to ground**

The cable used to ground the driver, actuator 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

Be sure to connect the Protective Earth Terminal located on the driver side to the ground.

Refer to p.28 for the way to ground the driver.

How to ground the actuator

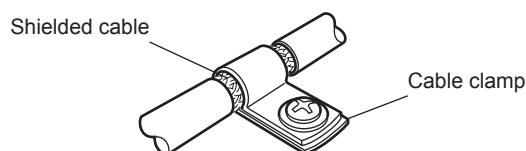
Connect to the ground the Protective Earth Terminal on the gear mechanism for the **DG85/DG130**, or on the motor for the **DG200**.

Refer to p.28 for the way to ground the actuator.

- **Wiring the signal cable**

Use a shielded cable of AWG24 (0.2 mm²) or more in diameter for the driver signal cable, and keep it as short as possible. Contact the nearest sales office for a shielded cable (sold separately).

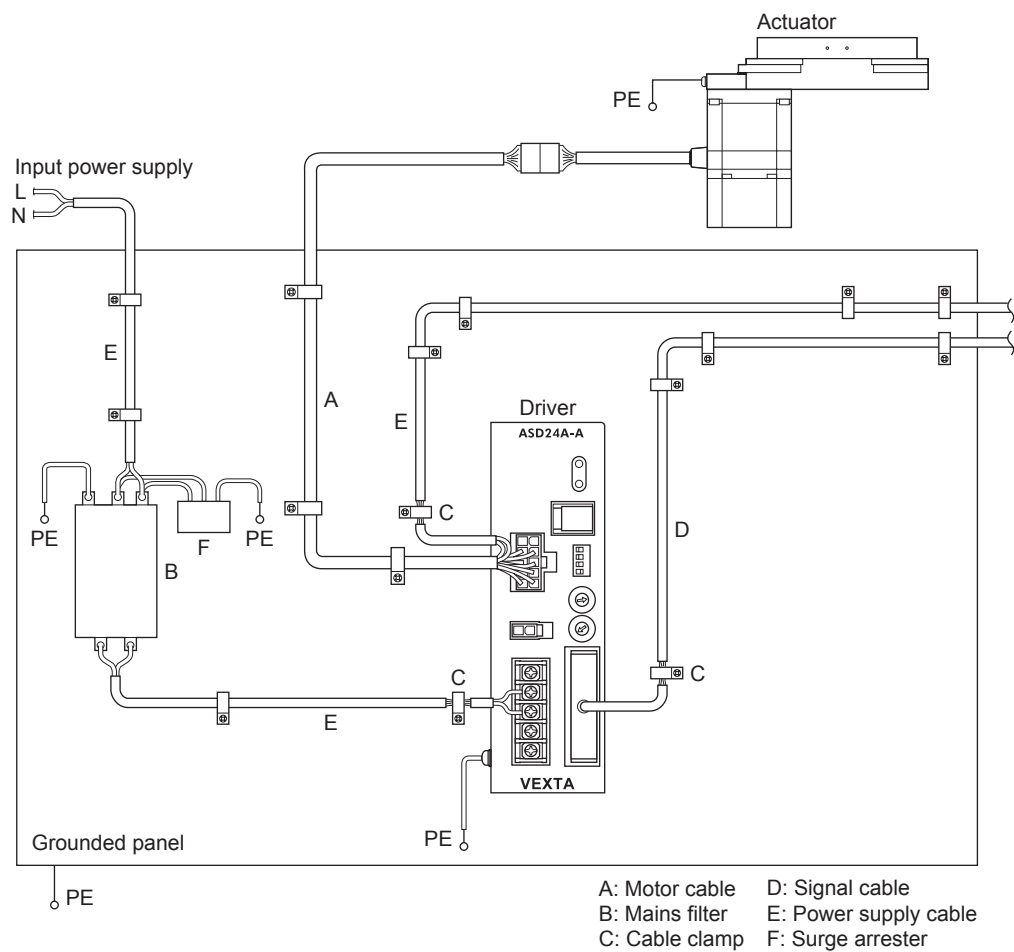
To ground a shielded cable, use a metal clamp or similar device that will maintain contact with the entire circumference of the shielded cable. Attach a cable clamp as close to the end of the cable as possible, and connect it as shown in the figure.



- **Notes about installation and wiring**

- Connect the actuator, 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 (3.94 to 7.87 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 actuator 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.

- Example of actuator and driver installation and wiring



■ 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.

Always use an insulated screwdriver to adjust the driver's built-in motor current switch.

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

6 Connection

This section covers the methods and examples of connecting and grounding the driver, actuator, power and controller, as well as the control input/output.

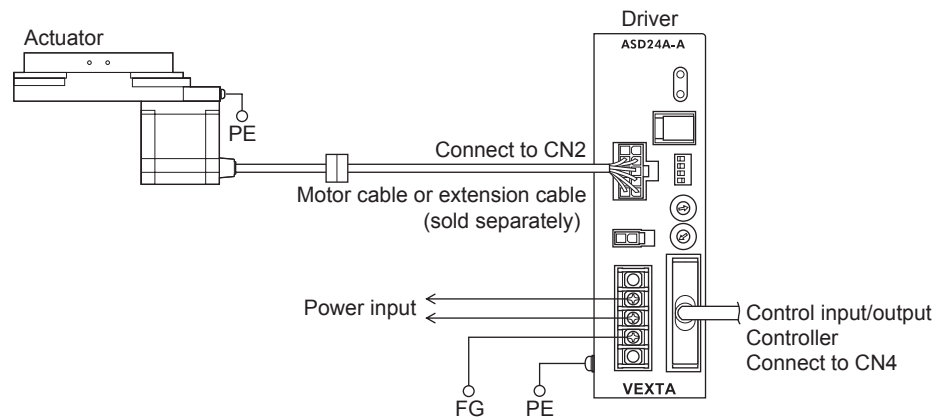
6.1 Connecting the actuator

Plug the connector of the motor cable or the extension cable into the driver's motor connector (CN2). Use an optional extension cable (sold separately) to extend the distance between the actuator and driver. Refer to 12 "Options (sold separately)" on p.46 for the extension cable.

Note

- Have the connector plugged in securely. Insecure connector connection may cause malfunction or damage to the actuator or driver.
- To disconnect the plug, pull the plug while using the fingers to press the latches on the plug.
- When the actuator is to be installed in a moving part, thereby subjecting the motor cable to repeated bending and stretching, use an optional flexible extension cable (sold separately). Refer to 12 "Options (sold separately)" on p.46 for the flexible extension cable.
- Be certain the control input/output cable that connects the driver and controller is as short as possible. The maximum input frequency will decrease as the cable length increases.

■ Connection example



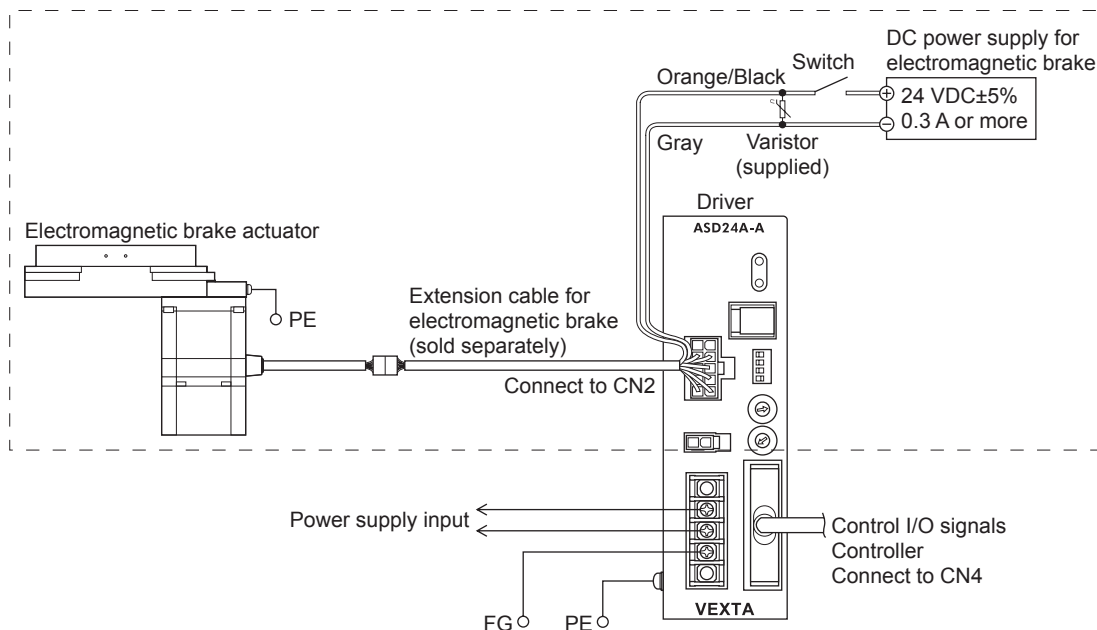
6.2 Connecting the electromagnetic brake actuator

Provide a DC power supply of 24 VDC \pm 5% at 0.3 A or more.

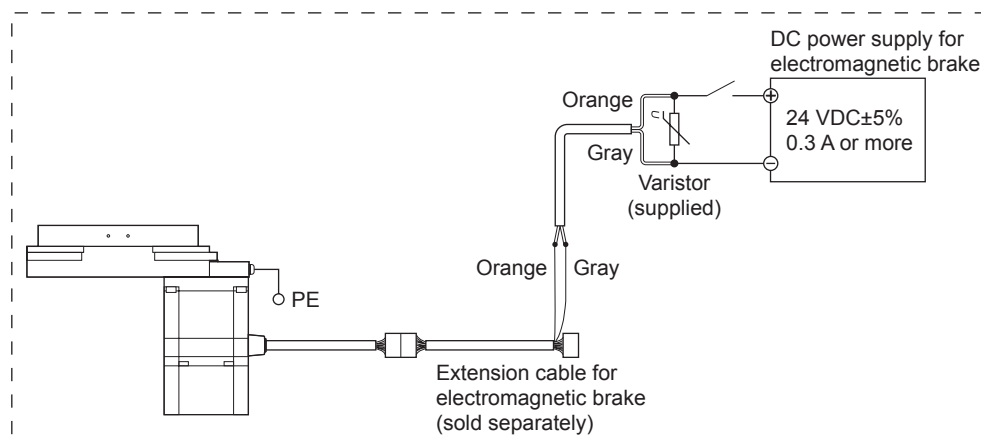
Use a shielded cable of AWG24 (0.2 mm²) or more to connect the electromagnetic brake to the DC power supply, keeping the length as short as possible.

1. Connect the orange/black lead wire ending from the driver's connector side of the extension cable for the electromagnetic brake to the +24 V terminal of the DC power supply.
 2. Connect gray lead wire to GND terminal of DC power supply.
 3. Connect the varistor in parallel across the +24 V and GND terminals.
- The varistor is non-polarized.

■ Connection example



The colors of the two lead wires extending from the driver's connector side of the flexible cable for the electromagnetic brake differ from those of the extension cable.



See p.45 for the specification of electromagnetic brake.

Note

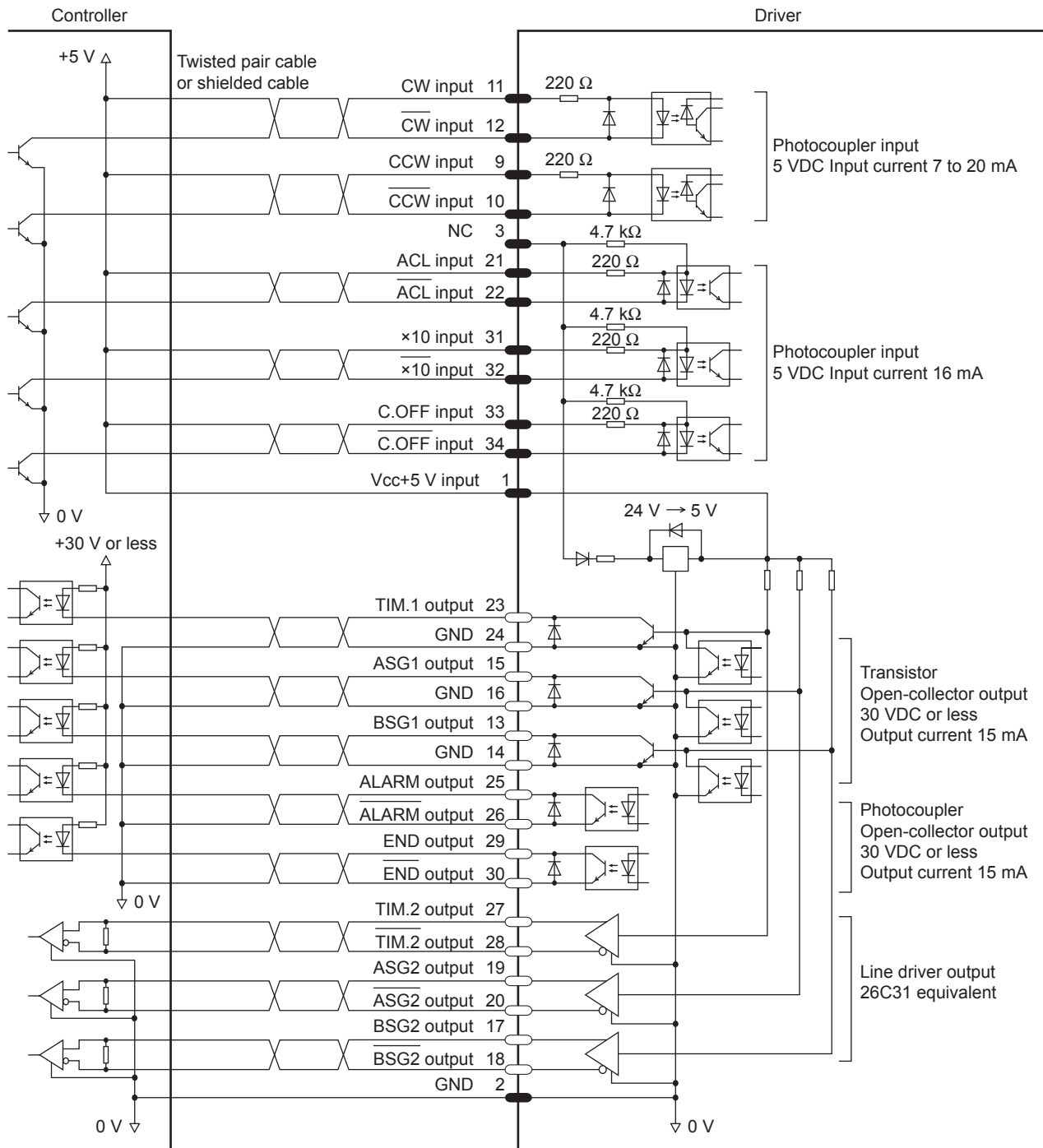
- Extension cables are available in two types: the standard type and the electromagnetic brake type. If you are using an electromagnetic brake actuator, be sure to connect the actuator to the driver using an optional extension cable for the electromagnetic brake. The electromagnetic brake will not function if the motor cable is connected directly to the driver.
- Provide separate power supplies for the control input/output and the electromagnetic brake.

6.3 Connection example for the control input/output

Either 5 or 24 VDC is selected as a signal voltage for the C.OFF input, $\times 10$ input and ACL input.

The TIM.1/TIM.2 outputs, ASG1/ASG2 outputs and BSG1/BSG2 outputs require a 5 or 24 VDC power.

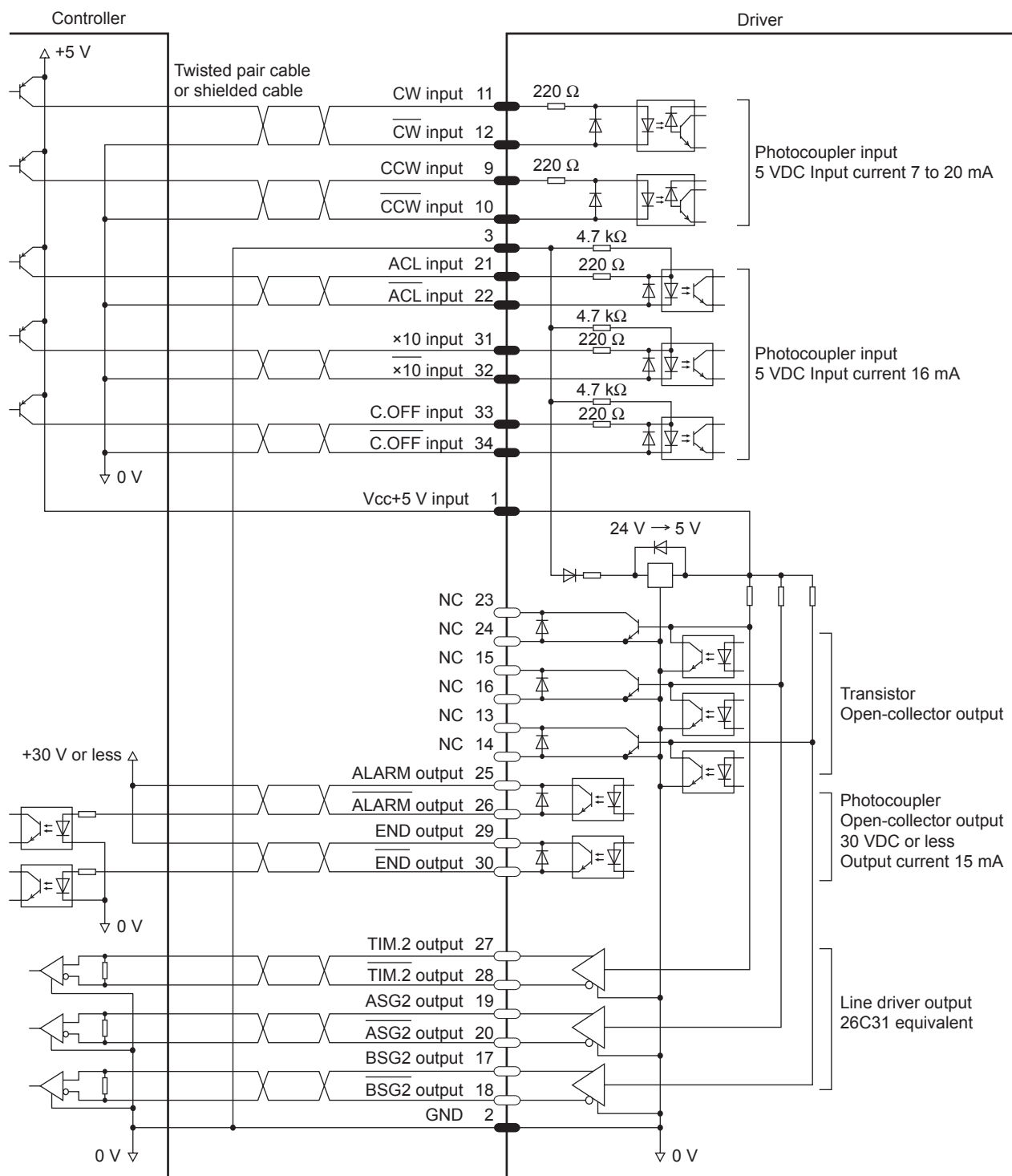
■ 5 VDC (connection example of current sink output circuit)



Note

- Make sure all signals in each of the following two power circuits are connected to the same voltage.
If a 5 VDC power supply and a 24 VDC power supply are connected together, the driver or power supplies may be damaged.
 - C.OFF input, $\times 10$ input and ACL input voltage (Pin Nos.21, 22, 31, 32, 33, 34)
 - TIM.1/TIM.2 outputs, ASG1/ASG2 outputs, BSG1/BSG2 outputs voltage (Pin Nos.1, 2)
- Use output signals with a power supply not exceeding 30 VDC and 15 mA. If these specifications are exceeded, the internal elements may be damaged. Check the specification of the connected equipment.
- Connect a terminating resistance of 100 Ω or more between the line receiver inputs.

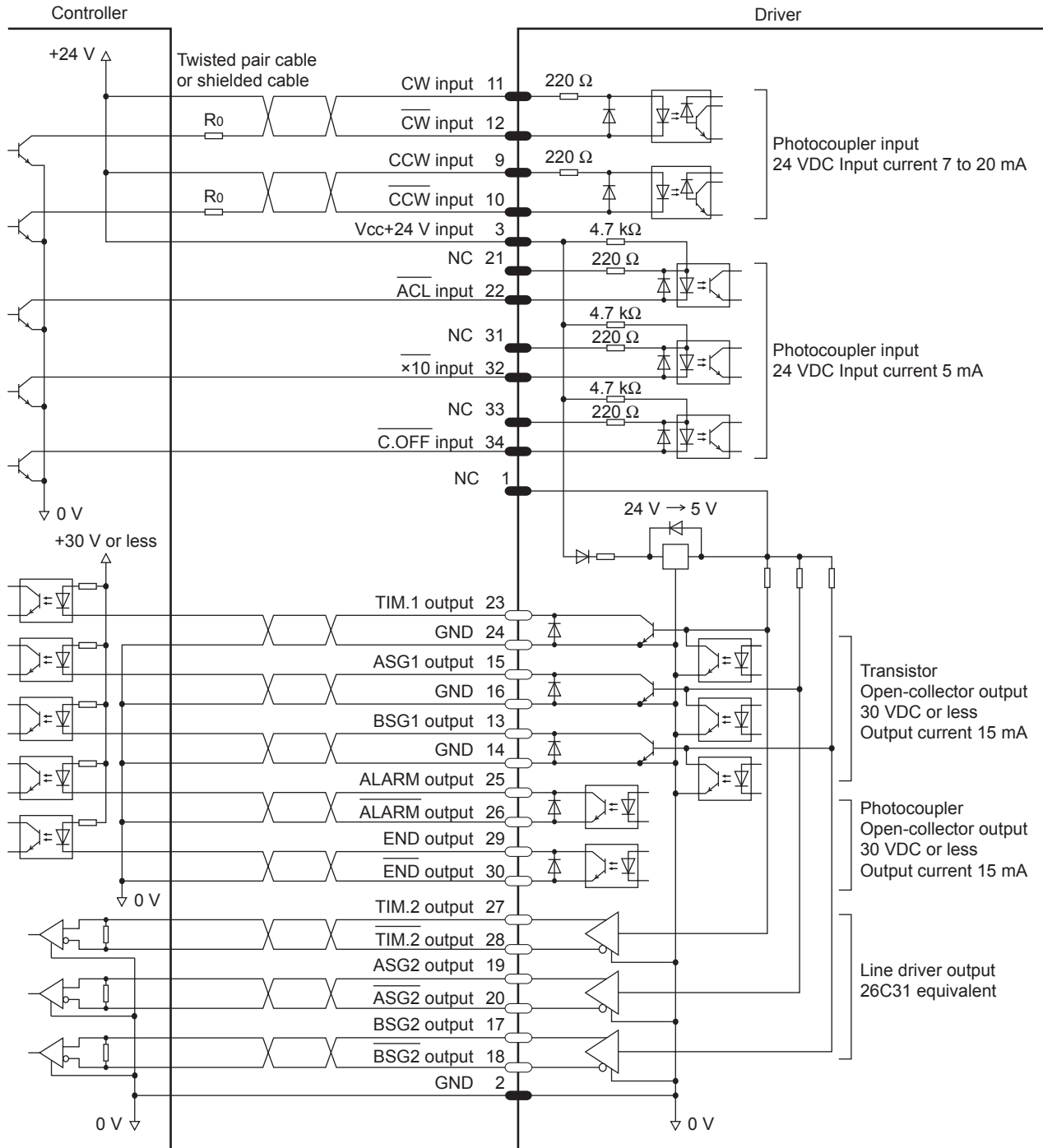
■ 5 VDC (connection example of current source output circuit)



Note

- Make sure all signals in each of the following two power circuits are connected to the same voltage. If a 5 VDC power supply and a 24 VDC power supply are connected together, the driver or power supplies may be damaged.
 - C.OFF input, x10 input and ACL input voltage (Pin Nos.21, 22, 31, 32, 33, 34)
 - TIM.2 outputs, ASG2 outputs, BSG2 outputs voltage (Pin Nos.1, 2)
- Use output signals with a power supply not exceeding 30 VDC and 15 mA. If these specifications are exceeded, the internal elements may be damaged. Check the specification of the connected equipment.
- If the current source output circuits are connected, the transistor open-collector outputs (TIM1, ASG1, BSG1) cannot be used. If any of these signals is connected, it may result in damage to the driver.
- Connect a terminating resistance of 100 Ω or more between the line receiver inputs.

■ 24 VDC



Note

- The CW and CCW inputs are of the 5 VDC input specification. If the voltage to be applied is above 5 VDC, be sure to connect an external resistor to prevent the current from exceeding 20 mA. Applying a voltage above 5 VDC without using an external resistor will damage the elements.
Example) When V_0 is 24 VDC R_0 : 1.5 to 2.2 k Ω , 0.5 W or more.
- Use output signals with a power supply not exceeding 30 VDC and 15 mA. If these specifications are exceeded, the internal elements may be damaged. Check the specification of the connected equipment.
- Connect a terminating resistance of 100 Ω or more between the line receiver inputs.

6.4 Connecting to the power supply

Connect the power supply cable to the power supply terminals on the driver.

Note

- Furnish a power supply capable of supplying adequate driver input current. If the current capacity is insufficient, the transformer may be damaged, or the actuator may run erratically due to a drop in torque.
- Do not run the driver's power cable through a conduit containing other power lines or motor cables.
- After shutting down the power, wait at least 10 seconds before turning it back on, unplugging, or plugging in the motor's cable connector.

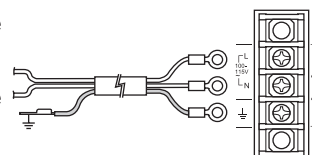
■ For single-phase 100-115 V unit, single-phase 200-230 V unit

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

Connect the \perp terminal to the grounding point of the power supply.

Use a power supply capable of supplying the current capacity as shown below.

Single-phase
100-115 V
50/60 Hz
Single-phase
200-230 V
50/60 Hz



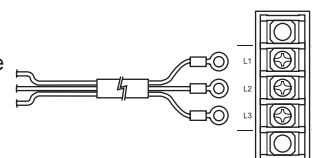
Unit model	Current capacity
DG85R-ASAA DG85R-ASBA	Single-phase 100-115 V $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ 3.3 A or more
DG130R-ASAA DG130R-ASBA DG130R-ASMA	Single-phase 100-115 V $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ 5 A or more
DG200R-ASAA DG200R-ASBA DG200R-ASMA	Single-phase 100-115 V $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ 6.5 A or more
DG130R-ASAC DG130R-ASBC DG130R-ASMC	Single-phase 200-230 V $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ 3 A or more
DG200R-ASAC DG200R-ASBC DG200R-ASMC	Single-phase 200-230 V $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ 4.5 A or more

■ For three-phase 200-230 V unit

Connect the U, V and W phase lines of the power cable to the L1, L2 and L3 terminals, respectively.

Use a power supply capable of supplying the current capacity as shown below.

Three-phase
200-230 V
50/60 Hz



Unit model	Current capacity
DG130R-ASAS DG130R-ASBS DG130R-ASMS	Three-phase 200-230 V $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ 1.5 A or more
DG200R-ASAS DG200R-ASBS DG200R-ASMS	Three-phase 200-230 V $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ 2.4 A or more

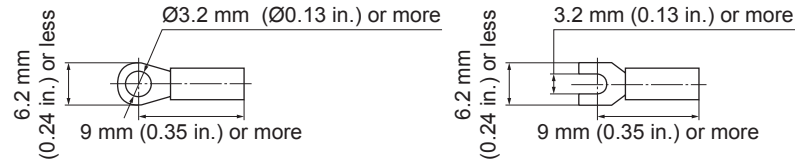
■ Terminal screw size and applicable lead wire size for power connection

Screw size: M3

Tightening torque: 0.8 N·m (113 oz-in)

Applicable minimum lead wire size: AWG18 (0.75 mm²)

■ Applicable insulated crimp terminals



6.5 Grounding the actuator and driver

■ Grounding the actuator

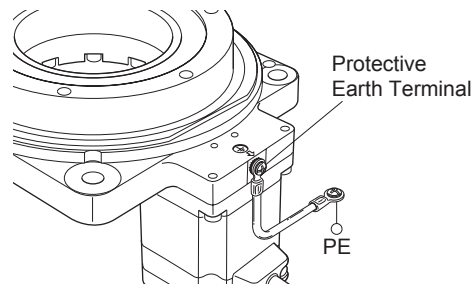
Be sure to connect to the ground the Protective Earth Terminal (thread size: M4) on the gear mechanism for the **DG85/DG130**, or on the motor for the **DG200**.

Tightening torque: 1.2 N·m (170 oz-in)

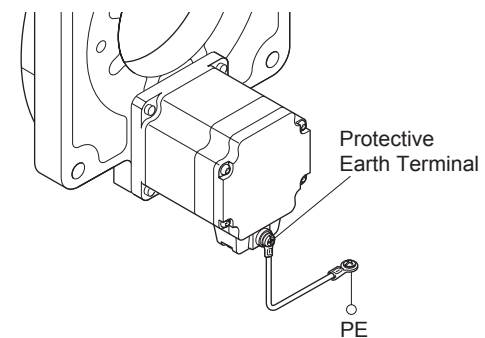
Use a grounding cable of AWG18 (0.75 mm²) or more in diameter.

Use a ground cable with round terminals and affix the terminal on each side using the supplied cross head screw with a washer.

DG85, DG130



DG200



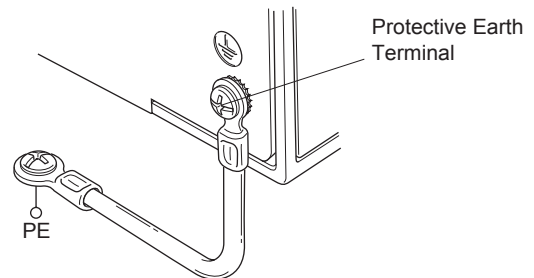
■ Grounding the driver

Be sure to ground the Protective Earth Terminal (screw size: M4) located on the driver side.

Tightening torque: 0.5 to 0.6 N·m (71 to 85 oz-in)

Use a grounding cable of AWG18 (0.75 mm²) or more in diameter.

Do not share the grounding cable with a welder or power equipment. Use a round terminal to ground the cable near the driver.

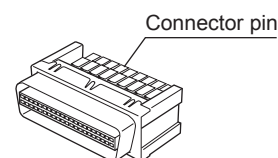


6.6 Connecting control input/output

■ Assembling the control input/output connector

Solder the control input/output cable (AWG28: 0.08 mm² or more) to the connector (36 pins). Assemble the connector and cover with the supplied screws. Use a shielded cable. For the pin assignments, refer to p.30.

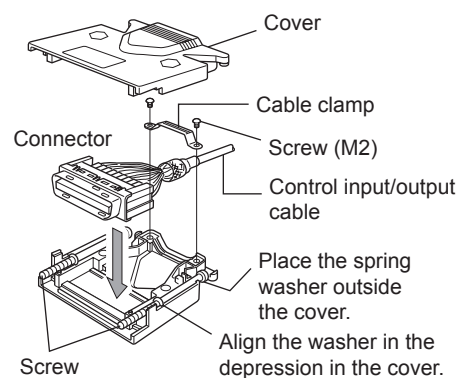
We provide optional driver cable allowing one touch connection with a driver, as well as connector-terminal block conversion unit. Refer to p.46 for details.



● Assembling the connector and the cover

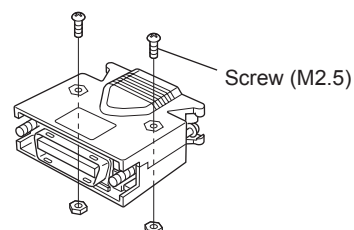
1. Attach the supplied screws (two pcs.) to the cover and insert the connector with the control input/output cable soldered to it.

Adjust the cable clamp to its correct position.



2. Attach the other cover and clamp both connector covers together with screws and nuts.

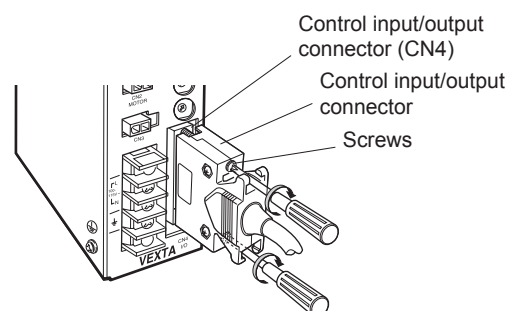
Tightening torque: 0.5 to 0.55 N·m (71 to 78 oz-in)



■ Connecting control input/output connector

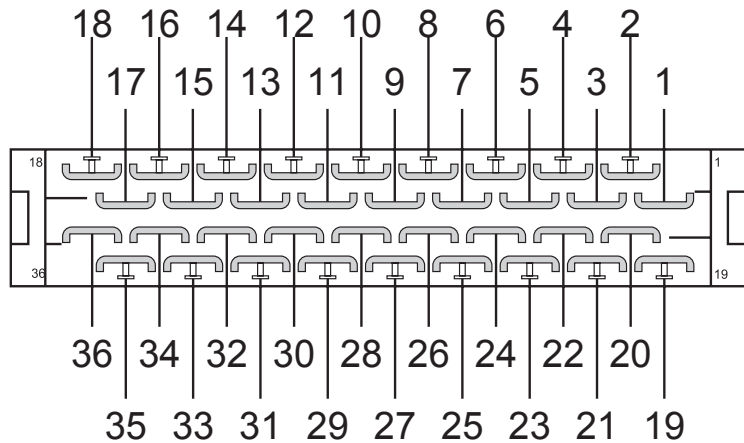
Insert the control input/output connector into the control input/output connector CN4 on the driver side, and tighten the screw with a flat blade parallel tip type screwdriver.

Tightening torque: 0.3 to 0.35 N·m (42 to 49 oz-in)



■ Connector pin functions

Connector pin assignments
(Viewed from the soldering
side)



Pin No.	Signal	Description	Direction	Pin No.	Signal	Description	Direction
1	Vcc+5 V	5 VDC	Input	19	ASG2	A-phase pulse output Line driver	Output
2	GND	GND		20	ASG2		
3	Vcc+24 V	24 VDC		21	ACL	Alarm clear	Input
4	–	Not used	–	22	ACL		
5	–	Not used	–	23	TIM.1	Timing Open-collector	Output
6	–	Not used	–	24	GND		
7	–	Not used	–	25	ALARM	Alarm	Output
8	–	Not used	–	26	ALARM		
9	CCW (DIR.)	CCW pulse (ON: CW, OFF: CCW)	Input	27	TIM.2	Timing Line driver	Output
10	CCW (DIR.)			28	TIM.2		
11	CW (PLS)	CW pulse (Pulse)	Input	29	END	Positioning complete	Output
12	CW (PLS)			30	END		
13	BSG1	B-phase pulse output Open-collector	Output	31	×10	Resolution switch	Input
14	GND			32	×10		
15	ASG1	A-phase pulse output Open-collector	Output	33	C.OFF	All Windings Off	Input
16	GND			34	C.OFF		
17	BSG2	B-phase pulse output Line driver	Output	35	–	Not used	–
18	BSG2			36	–	Not used	–

Note

- The functions shown in parentheses are enabled when “1P: 1-Pulse Input Mode” is selected through the pulse input mode select switch.
- The CW and CCW inputs provided as driver input signals indicate the opposite directions to the output table's direction of rotation. When the CW input is active, the output table rotates counterclockwise. When the CCW input is active, the output table rotates clockwise.
- Make sure all signals in each of the following two power circuits are connected to the same voltage.
If a 5 VDC power supply and a 24 VDC power supply are connected together, the driver or power supplies may be damaged.
 - C.OFF input, ×10 input and ACL input voltage (Pin Nos.21, 22, 31, 32, 33, 34)
 - TIM.1/TIM.2 outputs, ASG1/ASG2 outputs, BSG1/BSG2 outputs voltage (Pin Nos.1, 2)

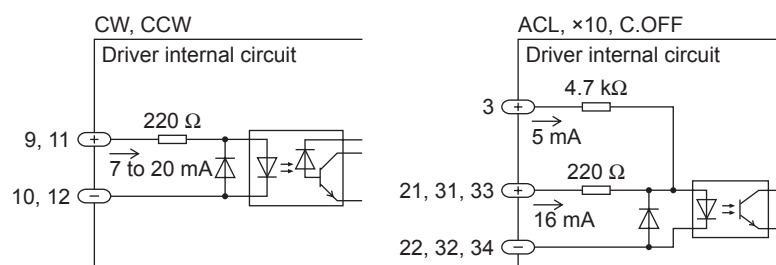
6.7 About control input/output

■ Input signals

All input signals of the driver are photocoupler inputs.

For C.OFF input, $\times 10$ input and ACL input a signal voltage of either 5 or 24 VDC can be selected. Be sure to use it with voltage of either 5 or 24 VDC.

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.



Note

Make sure all signals in each of the following two power circuits are connected to the same voltage.

If a 5 VDC power supply and a 24 VDC power supply are connected together, the driver or power supplies may be damaged.

- C.OFF input, $\times 10$ input and ACL input voltage (Pin Nos.21, 22, 31, 32, 33, 34)
- TIM.1/TIM.2 outputs, ASG1/ASG2 outputs, BSG1/BSG2 outputs voltage (Pin Nos.1, 2)

• CW input and CCW input

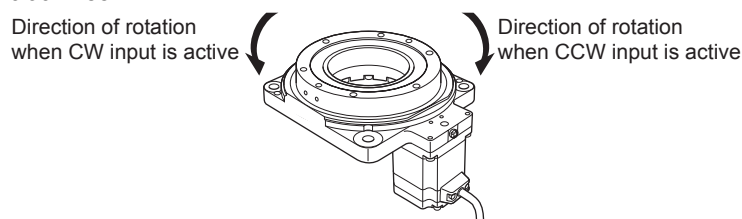
With this driver either 2-pulse input mode or 1-pulse input mode may be selected in accordance with the controller used. Refer to p.39 for details on how to set the pulse input mode.

ALARM output is in the OFF state immediately after the driver power is turned on. Check to see that ALARM output has been turned from OFF to ON before inputting pulse signals.

For the electromagnetic brake type, wait at least 0.1 second after releasing the electromagnetic brake, then input pulse signals. When an electromagnetic brake type is used, also refer to “6.8 Operating the electromagnetic brake” on p.36.

Note

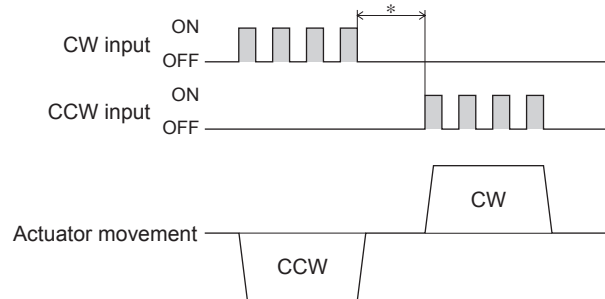
- If no pulse is to be input, be sure to keep the photocoupler in OFF state.
- The factory setting of the pulse input mode depends on the destination country. Check the pulse input mode setting in accordance with the pulse mode in the controller used.
- The CW and CCW inputs provided as driver input signals indicate the opposite directions to the output table's direction of rotation. When the CW input is active, the output table rotates counterclockwise. When the CCW input is active, the output table rotates clockwise.



2-pulse input mode

Connect the CW pulse and CCW pulse of the controller to pin No.12, $\overline{\text{CW}}$ input, and pin No.10, $\overline{\text{CCW}}$ input, respectively.

- When the CW pulse input changes from the OFF state to ON state, the actuator will rotate one step in the CCW direction.
- When the CCW pulse input changes from the OFF state to ON state, the actuator will rotate one step in the CW direction.



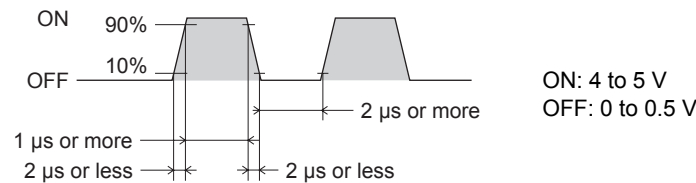
* The minimum interval time needed for switching the direction of rotation will vary, depending on the operating speed and size of the load. Do not shorten the interval time any more than is necessary.

Set the input pulse voltage to the CW and CCW pulse inputs at 5 VDC.

If the voltage exceeds 5 VDC, insert an external resistor to limit the input current to nearly 10 mA.

$$R = \frac{V - 1.5}{10 \text{ mA}} - 220 [\Omega] \quad \begin{array}{l} \text{R: External resistor} \\ \text{V: Pulse voltage} \end{array}$$

Use an input pulse signal with a waveform having a sharp rise and fall, as shown in the figure.



The figure shows the voltage levels of pulse signals.

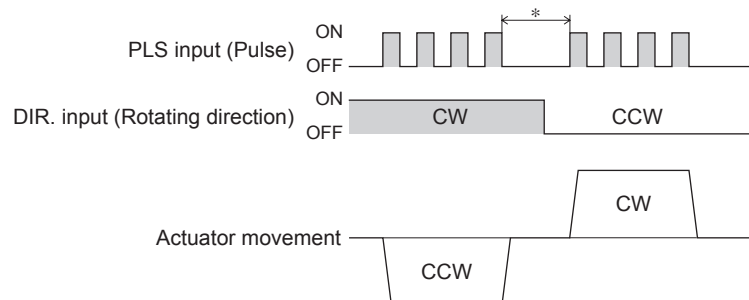
Note Do not input a CW pulse and CCW pulse simultaneously. If a pulse is input while the other photocoupler is in the ON state, the actuator will not operate properly.

1-pulse input mode

In 1-pulse input mode, the pin functions will be as follows: pin No.11, PLS input; pin No.12, $\overline{\text{PLS}}$ input; pin No.9, DIR. input; and pin No.10, $\overline{\text{DIR}}$ input.

Connect the pulse of the positioning controller to pin No.12, PLS input, and the rotating direction to pin No.10, DIR. input.

- When the DIR. input is ON, a rise of the PLS input from OFF to ON will rotate the actuator one step in the CCW direction.
- When the DIR. input is OFF, a rise of the PLS pulse input from OFF to ON will rotate the actuator one step in the CW direction.



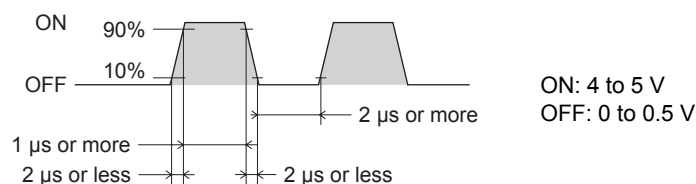
* The minimum interval time needed for switching the direction of rotation will vary, depending on the operating speed and size of the load. Do not shorten the interval time any more than is necessary.

The voltage of pulse and rotation direction input to the PLS input and DIR. input shall be 5 VDC.
If the voltage exceeds 5 VDC, connect an external resistor to limit the input current to nearly 10 mA.

$$R = \frac{V - 1.5}{10 \text{ mA}} - 220 [\Omega]$$

R: External resistor
V: Pulse voltage

Use an input pulse signal with a waveform having a sharp rise and fall, as shown in the figure.



The figure shows the voltage levels of pulse signals.

• C.OFF (All windings off) input

Use the signal only when the output table must be rotated manually for position adjustment.

Note

- Normally, keep the C.OFF input in the OFF state or leave it disconnected.
- Turning the C.OFF input to ON resets the deviation counter in the driver.

- When the C.OFF input is turned ON, the driver will shut off the output current and the actuator will lose its excitation holding torque. This, however, will allow you to adjust the load position manually.
- When the C.OFF input is turned OFF, the driver will turn the output current to ON again and the actuator's excitation holding torque will be restored. The C.OFF input must be OFF when operating the actuator.

• ×10 (Resolution selection) input

Selects and switches to 10 times either of the resolution “500: 0.04°/pulse” or “1000: 0.02°/ pulse” that has been selected with the resolution select switch.

For instance, if “1000: 0.02°/pulse” has been selected, this signal can switch between the 0.02° step rotation and 0.002° step rotation.

Refer to p.38 for the selection of the resolution select switch.

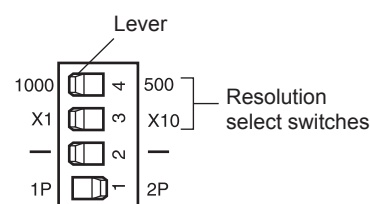
The resolution select switch [1000/500] is based on the motor resolution. The resolution of the hollow rotary actuator is 18 times the motor resolution. Refer to the table below.

Resolution select switch	Output table resolution	1 step rotation angle
500 × 1	9000	0.04°
1000 × 1	18000	0.02°
500 × 10	90000	0.004°
1000 × 10	180000	0.002°

- Turning the ×10 input to ON will select/switch to ×10 resolution.
- Turning the ×10 input to OFF will select/switch to ×1 resolution.

Note

Be sure to set the resolution select switch to “×1” when ×10 input is used. If the switch is set to “×10”, the resolution will remain at 10 times, regardless of the ON or OFF resolution selector input.

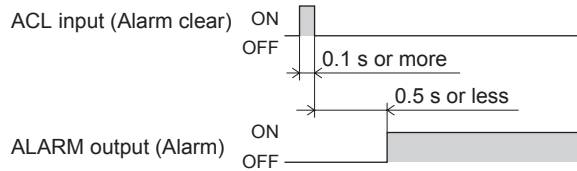


• ACL (Alarm clear) input

The input clears the ALARM output issued when a protective function has been triggered.

The ALARM output remains ON when the driver is operating normally, then turns OFF when a protective function is triggered. For details, refer to “ALARM output” on p.35 and 8 “Protective functions” on p.41. Setting the ACL input in the ON state clears the ALARM output.

To cancel the ALARM output, be sure to remove the cause of the problem that has triggered the protective function before turning the power back on.



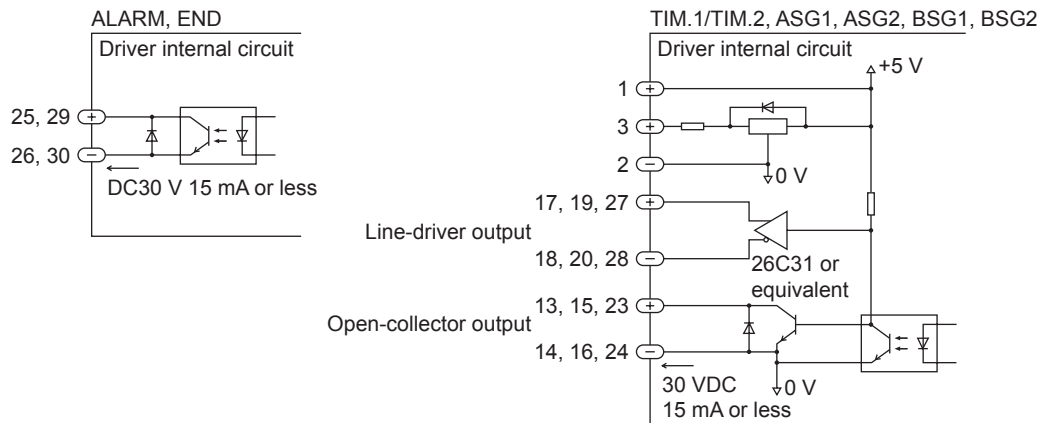
Note

- Turning the power back on will clear the ALARM output. To cancel the ALARM output, be sure to remove the cause of the problem that has triggered the protective function before turning the power back on. After the power has been shut off, wait at least 10 seconds before turning the power back on.
- The overcurrent protection, EEPROM data error and system error cannot be cleared using the ACL input. Clear these errors by cycling the power. If the problem persists, please contact the nearest office.

■ Output signals

Driver output signals are photocoupler/open collector output, transistor open collector output for the TIM.1, ASG1 and BSG1 outputs, and line-driver output for the TIM.2, ASG2 and BSG2 outputs.

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.



Note

Make sure all signals in each of the following two power circuits are connected to the same voltage.

If a 5 VDC power supply and a 24 VDC power supply are connected together, the driver or power supplies may be damaged.

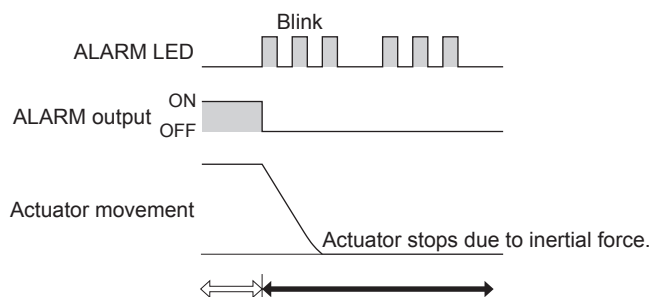
- C.OFF input, ×10 input and ACL input voltage (Pin Nos.21, 22, 31, 32, 33, 34)
- TIM.1/TIM.2 outputs, ASG1/ASG2 outputs, BSG1/BSG2 outputs voltage (Pin Nos.1, 2)

• ALARM output

ALARM output remains ON when the driver is operating normally, then turns OFF when a protective function is triggered.

Detect this ALARM output on the controller side and cancel the command to operate the actuator thereafter. Error detection by the driver, such as overload and overcurrent during actuator operation, turns the ALARM output OFF, blinks the ALARM LED on the driver, and simultaneously shuts off the actuator current to stop actuator operation.

Count the number of the ALARM LED blinks to identify the particular protective function that has been triggered. For details, refer to 8 “Protective functions” on p.41.

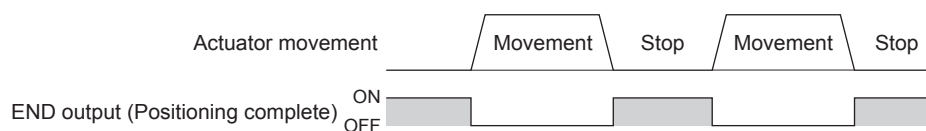


When the driver is operating normally. When a protective function is triggered.

• END (Positioning complete) output

END output turns ON when actuator movement is complete. Conditions for the issuance of END output are as follows:

END output is issued when the pulse speed is 500 Hz or less, and the rotor has positioned within $\pm 0.1^\circ$ of the commanded position.



Note

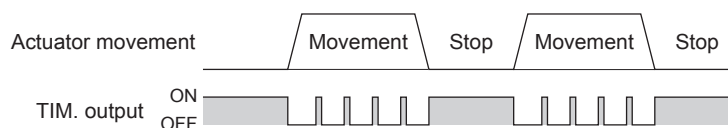
The timing of the END output turning ON after the pulse stops will vary, depending on the conditions of the load, the pulse input, and the speed filter setting.

• TIM. (Timing) output

TIM. output are available in two types: transistor open-collector output and line driver output. Use either one to suit the input system of the positioning controller.

The use of TIM. output requires separate 5 or 24 VDC power.

TIM. output turns ON whenever the output table rotates 0.4° .



Note

If TIM. output is to be detected, set the pulse speed at 500 Hz or less. Use the $\times 10$ input to switch the resolution only when TIM. output is in the ON state and the actuator stops. If the resolution is switched under any other conditions, TIM. output may not turn ON even when the output table has rotated 0.4° .

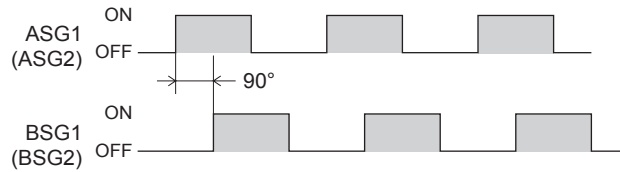
• ASG output and BSG output

ASG and BSG outputs are available in two types: transistor open-collector output and line driver output. Use either type to suit the input system of the counter unit and other functions of the controller.

The use of ASG and BSG outputs requires separate 5 or 24 VDC power.

The output pulse resolution will be the same as the motor resolution at the time power is supplied to the driver.

Counting ASG output pulses allows the actuator position to be monitored.



ASG output: Outputs pulse while the actuator operates.

BSG output: Detects the direction of actuator rotation. It has a 90° phase difference with regard to ASG output. The level of BSG output at the rise time of ASG output indicates the direction of actuator rotation.

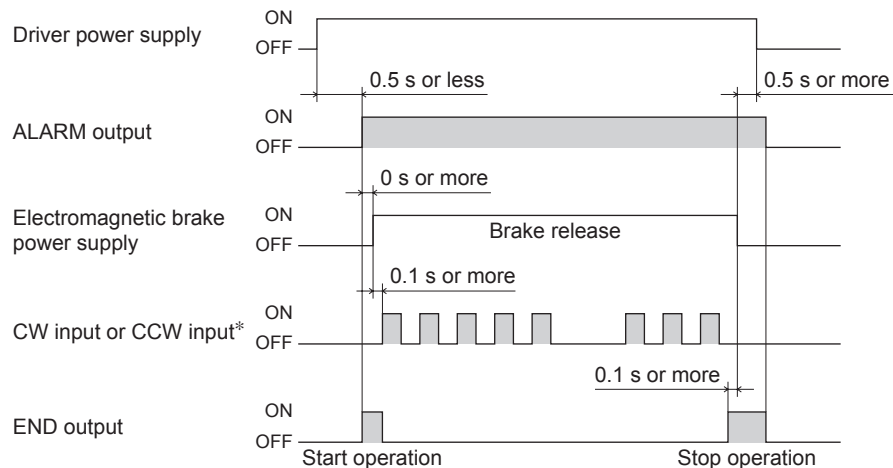
Note

The pulse output delays behind actuator rotation by up to 1 ms. The output may be used to verify the actuator's stop position.

6.8 Operating the electromagnetic brake

Operate the electromagnetic brake as follows:

1. Check that ALARM output has turned from OFF to ON.
ALARM output is in the OFF state immediately after the driver power is turned on.
2. Supply power to the electromagnetic brake to release the electromagnetic brake.
The actuator becomes operational.
3. To allow the electromagnetic brake to hold the load after the operation has completed, turn the power supply for electromagnetic brake OFF only after verifying that END output has turned from OFF to ON.



* CCW input is enabled when 2-pulse input mode is selected

Note

Apply the electromagnetic brake only after the actuator has stopped. Do not use the brake to bring the moving actuator to a halt. Repeated braking for such a purpose will wear the brake hub excessively, causing a decrease in its ability to hold.

When the driver protection function is triggered

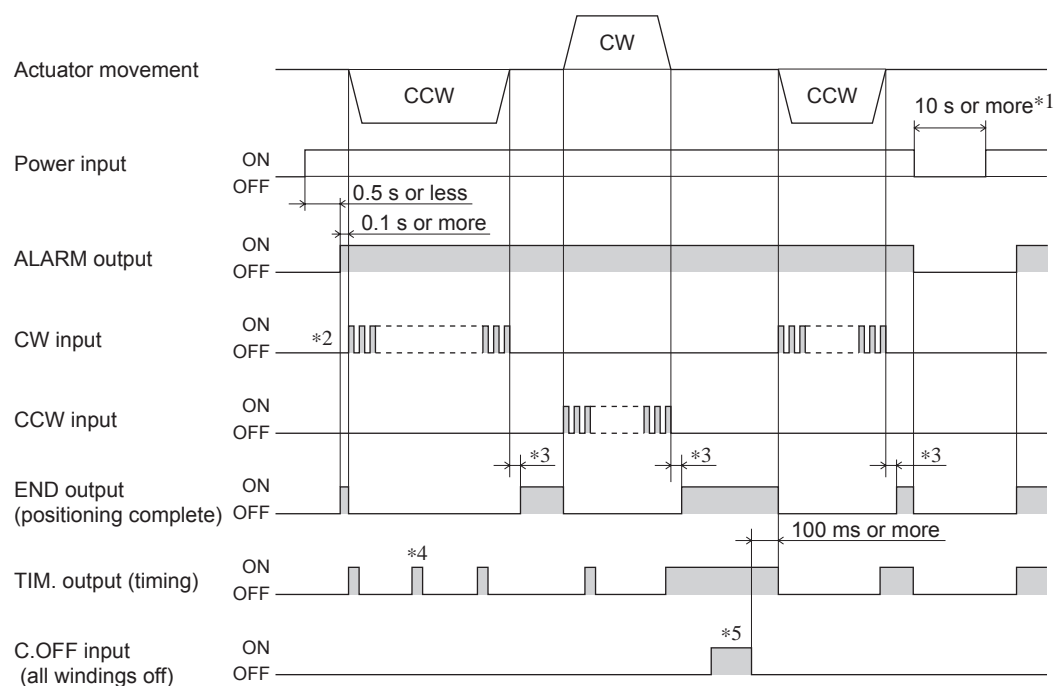
When the driver protection function is triggered, the actuator stops as the current is turned off. The actuator loses its holding ability, which in a vertical travel application may cause the load to fall.

The user must set a controller sequence that will cut off the power to the electromagnetic brake and hold the load in position upon detecting an ALARM output turns OFF.

6.9 Timing chart

Note

The CW and CCW inputs provided as driver input signals indicate the opposite directions to the output table's direction of rotation. When the CW input is active, the output table rotates counterclockwise. When the CCW input is active, the output table rotates clockwise.



- *1 After the power has been shut off, wait at least 10 seconds before turning the power back on.
- *2 To input the CW or CCW signal pulse, wait at least 0.1 second after clearing the ALARM output.
- *3 The turning of END output to ON does not necessarily mean the actuator has stopped. Provide enough of a time delay for a halt, which will vary, depending on the acceleration/deceleration rates and load condition.
The time for END output to turn ON after the pulse signal stops will vary, depending on the pulse signal input condition and speed filter setting condition.
- *4 Detect TIM. output only at a pulse speed of 500 Hz or less. No accurate detection is possible at a speed over 500 Hz.
- *5 Turning C.OFF input ON shuts off the actuator current, at which time the actuator loses its holding ability. It also clears the value on the deviation counter.

7 Setting

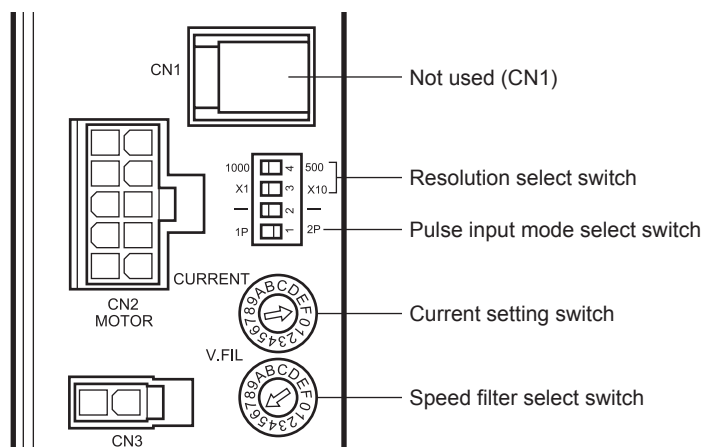
This section covers the selection and settings of driver functions.

The various switches provided on the driver's front panel allow for the setting of resolution, pulse input mode, current level and speed filter.



Warning

Before working on the system, shut off the power to the driver and wait 10 seconds. Failure to do so may result in electric shock.



7.1 Resolution

Use the resolution select switches “1000/500” and “ $\times 1/\times 10$ ” to set the actuator resolution.

The resolution of the output table is 18 times the motor resolution.

Setting of resolution select switches		Resolution of the output table
[500]	[$\times 1$]	9000 P/R (0.04°/pulse)
[1000]	[$\times 1$]	18000 P/R (0.02°/pulse)
[500]	[$\times 10$]	90000 P/R (0.004°/pulse)
[1000]	[$\times 10$]	180000 P/R (0.002°/pulse)

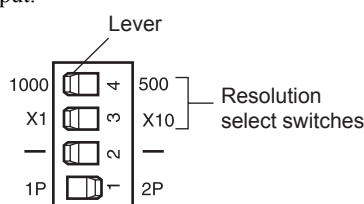
A total of four resolution levels may be selected, with $\times 10$ input “CN4 Pin Nos.31, 32” used to switch between 1000 and 10000 and between 500 and 5000.

Refer to p.33 for the use of $\times 10$ input.

Factory settings

[1000]: 18000 P/R (0.02°/pulse)

[$\times 1$]: Multiplier 1

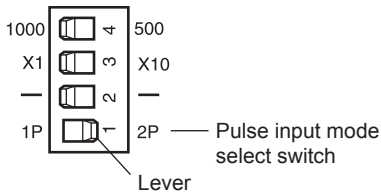


Note

- Be sure to shut off the power before using the resolution select switches. The new resolution takes effect when the power is turned on again.
- Be sure to set the resolution select switch to “ $\times 1$ ” when $\times 10$ input is used. If the switch is set to “ $\times 10$ ”, $\times 10$ input becomes invalid.

7.2 Pulse input modes

Either the 2-pulse or 1-pulse input mode may be selected in accordance with the controller used.



- Note**
- The factory setting of the pulse input mode depends on the destination country. Check the pulse input mode setting in accordance with the pulse mode in the controller used.
 - Be sure to shut off the power before using the pulse input mode select switch. The new pulse input mode takes effect when the power is turned on again.

When the actuator is to be controlled through 2-pulse signal input via the CW pulse signal and CCW pulse signal, set the pulse input mode select switch to “2P.”



When the actuator is to be controlled through the PLS (pulse) and the DIR. (rotating direction), set the pulse input mode select switch to “1P.”



7.3 Operating current

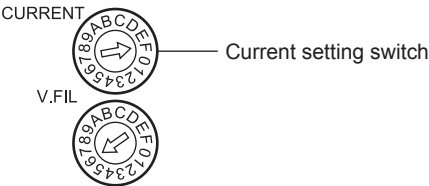
Use the operating current adjustment switch “CURRENT” to set the actuator’s operating current.

Set the operating current as a product of the maximum driver output current “F”, which is 100%, multiplied by the operating current percentage corresponding to the given dial. The switch provides a selection of 16 levels ranging between “0” and “F.”

If there is extra torque, the current may be set to a lower level in order to suppress increases in motor temperature.

Factory setting

[F]: Driver’s maximum output current value



- Note**
- An excessively low operating current level may cause a problem when starting the actuator or holding the load in position. Do not reduce the current any more than is necessary.

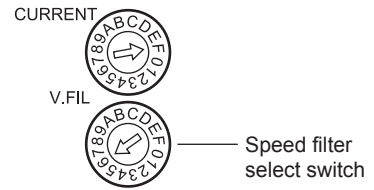
The dial settings and corresponding levels of operating current rates are as follows:

Dial setting	Operating current rate (%)	Dial setting	Operating current rate (%)
0	6	8	56
1	13	9	63
2	19	A	69
3	25	B	75
4	31	C	81
5	38	D	88
6	44	E	94
7	50	F	100

7.4 Speed filter

Use the speed filter select switch “V.FIL” to select the filter time constant that determines the actuator’s response to pulse input. The switch provides a selection of 16 levels ranging between “0” and “F”. When a larger value is selected, it will reduce shock when the actuator is started and stopped, and will minimize low speed vibration.

The greater the filter time constant, the smoother the actuator movement becomes. However, command synchronicity will decrease. Select an optimal value to fit the load and application.



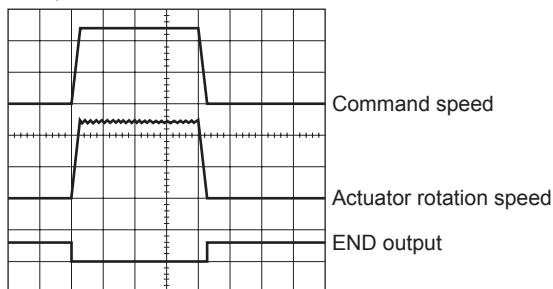
Factory setting

[6]: 1.20

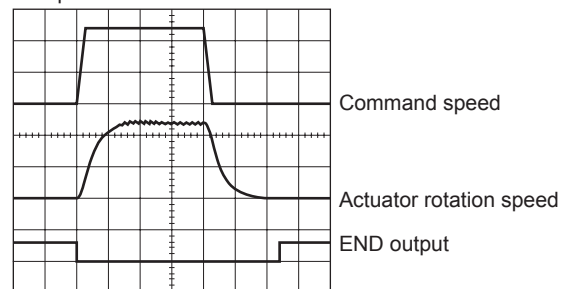
The dial settings and corresponding levels of filter time constants are as follows:

Dial setting	Filter time	Dial setting	Filter time
0	None	8	2.70
1	0.12	9	4.10
2	0.16	A	8.20
3	0.27	B	12.0
4	0.41	C	16.0
5	0.82	D	27.0
6	1.20	E	41.0
7	1.60	F	82.0

When the speed filter select switch is set to "0"



When the speed filter select switch is set to "E"



8 Protective functions

This section covers the driver protection functions and methods used to clear the triggered function.

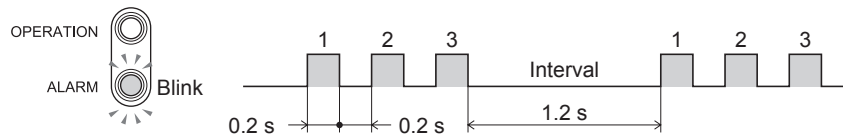
8.1 Descriptions of protective functions and numbers of LED blinks

The driver is provided with functions that protect the driver from ambient temperature increases, improper power supply or motor cable connections, and the occurrence of operating errors.

When a protective function is triggered, the ALARM LED on the front panel blinks, ALARM output turns OFF, and simultaneously the actuator current is shut off in order to stop the actuator.

ALARM output remains ON when the driver is operating normally, then turns OFF when a protective function is triggered. For details, refer to “ALARM output” on p.35.

ALARM LED blinking cycle (example: for overvoltage protection)



The number of ALARM LED blinks varies according to the nature of the triggered protective function, thereby facilitating action and recovery from the abnormal conditions causing the function to be triggered. The table below gives descriptions of protective functions and their corresponding numbers of blinks.

No. of blinks	Function	Conditions
1	Overheat protection	When a heat radiating unit within the driver reaches approx. 85 °C (185 °F).
2	Overload protection	When a load exceeding the maximum torque is applied to the motor for five seconds or more.
3	Overvoltage protection	When the voltage on the primary side of the driver inverter has exceeded the permissible value.
4	Speed error protection	When the actuator has not normally followed up on pulse input.
5	Overcurrent protection	When an excessive current flows through the driver inverter's power element.
6	Overspeed	When the output table speed exceeds 270 r/min.
7	EEPROM data error	When the motor parameter in the driver is damaged.
8	Sensor error	When power turns on without the connection of a motor cable to the driver.
ALARM LED turns on.	System error	When the driver is out of order.

8.2 How to clear a protective function

When a driver protection function is triggered, turning the ALARM output OFF by employing either of the following methods may clear ALARM output (return to ON):

- Give a one shot ACL (Alarm clear) input to clear the ALARM output.
- Turn the power back on.

Note

- To clear the ALARM output, be sure to remove the cause of the problem that has triggered the protective function before either giving a one shot ACL input or turning the power back on. After turning off the power, wait at least 10 seconds before turning the power back on.
- The overcurrent protection, EEPROM data error and system error cannot be cleared using the ACL input. Clear these errors by cycling the power. If the problem persists, please contact the nearest office.

9 Inspection

It is recommended that periodic inspections be conducted for the items listed below after each operation of the actuator.

If an abnormal condition is noted, discontinue any use and contact your nearest office.

■ During inspection

- Are any of the actuator mounting screws loose?
- Check for any unusual noises in the actuator's bearings (cross roller bearing) or other moving parts.
- In sure that the screws used to tighten the output table and load are not loose.
- Are there any scratches, signs of stress or loose driver connections in the motor cable?
- Check for a blocked opening of the driver case.
- Are any of the driver mounting screws or power connection terminal screws loose?
- Are there any strange smells or appearances in the driver?

Note

The driver uses semiconductor elements, so be extremely careful when handling them.
Static electricity may damage the driver.

10 Troubleshooting and remedial actions

During actuator operation, the actuator or driver may fail to function properly due to an improper speed setting or wiring. When the actuator cannot be operated correctly, refer to the contents provided in this section and take appropriate action. If the problem persists, contact your nearest office.

■ If the ALARM LED is not blinking

If the actuator does not operate properly even though the ALARM LED is not blinking, refer to the table below:

Phenomenon	Possible cause	Remedial action
<ul style="list-style-type: none"> The actuator is not excited. The actuator can be turned with the hands. 	C.OFF input is ON.	Turn the C.OFF input to OFF and confirm that the actuator is excited.
The actuator does not run.	Bad connection for CW or CCW input.	<ul style="list-style-type: none"> Check the connections of the controller and driver. Review the specifications (voltage and width) for the input pulse.
	In 2-pulse input mode, the CW and CCW pulse inputs are both ON at the same time.	Input the pulse signal either to the CW or CCW input. Make sure the terminal with no input is set to OFF.
	In 1-pulse input mode, the pulse signal is connected to the DIR. input.	Connect the pulse signal to the PLS input.
	Electromagnetic brake is holding (electromagnetic brake motor only).	Release the electromagnetic brake by turning the power on.
The actuator rotates in the direction opposite that which is specified (The CW and CCW inputs provided as driver input signals indicate the opposite directions to the output table's direction of rotation).	In 2-pulse input mode, the CW and CCW pulse inputs are connected in reverse.	Connect the CW pulse input to the CW pulse input and CCW pulse input to CCW pulse input.
	In 1-pulse input mode, the DIR. input is set in reverse.	Set to ON when setting the CW direction or OFF when setting the CCW direction.
Actuator operation is unstable.	Bad connection of the pulse signal line.	<ul style="list-style-type: none"> Check the connections of the controller and driver. Review the specifications (voltage and width) for input pulse.
Vibration is great.	Small load.	Reduce the current by adjusting the driver's current setting switch. If the actuator's output torque is too great for the load, vibration will increase.
The TIM. output does not turn ON.	The ×10 input is turned OFF during operation.	When the ×10 input is turned OFF, the TIM. output may not turn ON.
Positioning accuracy is poor.	The screws affixing the actuator or load are skewed.	Tighten the screws to the specified torque.
	The pulse count input is incorrect.	Check the pulse count setting.
	Bad connection of the pulse signal line.	Check the connections of the controller and driver.
	The load's friction torque is excessive.	Reduce the friction torque or perform positioning from one direction only.
The electromagnetic brake does not hold.	The electromagnetic brake is turned on.	To use an electromagnetic brake to hold the load in position after the actuator has stopped, turn off the electromagnetic brake.

■ If the ALARM LED is blinking

If the ALARM LED is blinking, count the number of blinks and refer to the table below:

Number of ALARM LED Blinks	Type of alarm and possible cause	Remedial action
1	Overheat protection. Driver ambient temperature exceeded 50 °C (122 °F).	Review actuator's operating condition and ventilation in the enclosure.
2	Overload protection. Overloading.	Reduce the actuator load.
3	Overvoltage protection. Incorrect power connection or loading beyond the regenerative ability of the driver.	<ul style="list-style-type: none"> • Check power supply connections. • Reduce load in a vertical travel application.
4	Speed error protection. Overloading or incorrect speed filter setting.	Reduce load or slightly increase the speed filter setting.
5	Overcurrent protection. Short circuited motor cable.	Shut off the driver power and check the motor cable and driver connectors. Then turn the driver power back on.
6	Excessive speed. Excessively high operating pulse speed.	Set the speed of the output table at the permissible speed or less.
7	EEPROM data error. Error in driver.	Turn on the driver power. If the error persists, contact the branch or sales office from which you purchased the product and request repair.
8	Sensor error. Bad motor cable connection or open line.	Shut off the driver power and check the motor cable and driver connectors. Then turn the driver power back on.
ALARM LED turns on.	System error. The driver is out of order.	Turn the driver power on. If the error persists, contact the branch or sales office from which you purchased the product and request repair.

11 Main specifications

This section covers the main specifications of the **DG** series.

Refer to the catalog for detailed specifications, torque characteristics and dimensions.

		Actuator	Driver
Degree of protection		IP40 (Motor cable connector: IP20)	IP10
Operation environment	Ambient temperature	0 to +50 °C (+32 to +122 °F) (non-freezing) Home sensor set attachment: 0 to +40 °C (+32 to +104 °F) (non-freezing)	0 to +50 °C (+32 to +122 °F) (non-freezing)
	Ambient humidity	85% or less (non-condensing)	
	Altitude	Up to 1000 m (3300 ft.) above sea level	
	Surrounding atmosphere	No corrosive gas, dust, water or oil	
Storage environment	Ambient temperature	-20 to +60 °C (-4 to +140 °F) (non-freezing)	-25 to +70 °C (-13 to +158 °F) (non-freezing)
	Ambient humidity	85% or less (non-condensing)	
	Altitude	Up to 3000 m (10000 ft.) above sea level	
	Surrounding atmosphere	No corrosive gas, dust, water or oil	
Shipping environment	Ambient temperature	-20 to +60 °C (-4 to +140 °F) (non-freezing)	-25 to +70 °C (-13 to +158 °F) (non-freezing)
	Ambient humidity	85% or less (non-condensing)	
	Altitude	Up to 3000 m (10000 ft.) above sea level	
	Surrounding atmosphere	No corrosive gas, dust, water or oil	

■ Specifications of electromagnetic brake

Unit model	Type	Power supply input	Consumption current	Excitation current	Static friction torque [N·m (oz-in)]
DG130	Non-excitation type	24 VDC±5%	6 W	0.25 A	12 (1704)
DG200					20 (2840)

- The electromagnetic brake is used to retain the load in position when the actuator power is cut off. Do not use the electromagnetic brake for braking purposes.
- A power supply of 24 VDC ± 5%, 0.3 A or more is required to control the electromagnetic brake.
- The static friction torques are values on the output table.

12 Options (sold separately)

■ Extension cable

Required to extend the distance between the actuator and driver.

• Extension cable		• Extension cable for electromagnetic brake	
Model	Length [m (ft.)]	Model	Length [m (ft.)]
CC01AIP	1 (3.3)	CC01AIPM	1 (3.3)
CC02AIP	2 (6.6)	CC02AIPM	2 (6.6)
CC03AIP	3 (9.8)	CC03AIPM	3 (9.8)
CC05AIP	5 (16.4)	CC05AIPM	5 (16.4)
CC07AIP	7 (23)	CC07AIPM	7 (23)
CC10AIP	10 (32.8)	CC10AIPM	10 (32.8)
CC15AIP	15 (49.2)	CC15AIPM	15 (49.2)
CC20AIP	20 (65.6)	CC20AIPM	20 (65.6)

■ Flexible extension cable

Highly flexible cable required to extend the distance between the actuator and driver.

• Flexible extension cable		• Flexible cable for electromagnetic brake	
Model	Length [m (ft.)]	Model	Length [m (ft.)]
CC01SAR	1 (3.3)	CC01SARM2	1 (3.3)
CC02SAR	2 (6.6)	CC02SARM2	2 (6.6)
CC03SAR	3 (9.8)	CC03SARM2	3 (9.8)
CC05SAR	5 (16.4)	CC05SARM2	5 (16.4)
CC07SAR	7 (23)	CC07SARM2	7 (23)
CC10SAR	10 (32.8)	CC10SARM2	10 (32.8)

■ Home sensor set

Used to perform the return to home operation.

Model: **PADG-SB** (NPN output)
PADG-SBY (PNP output)

■ DIN rail mounting plate

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

Model: **PADP01**

■ Driver cable

Cable with connectors for driver control input/output (36 pins), providing excellent noise resistance.

Model	Length [m (ft.)]
CC36D1-1	1 (3.3)
CC36D2-1	2 (6.6)

■ Connector-terminal block conversion unit

Use this cable to connect the driver to a host controller via the terminal block. [Cable length: 1 m (3.3 ft.)]

Model: **CC36T1**

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