Oriental motor

HP-7447-3

2-Phase Stepping Motor Driver

RBD200A-V

OPERATING MANUAL

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

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

Table of contents

1 Introduction

■ Before use

Only qualified personnel should work with the product.
Use the product correctly after thoroughly reading the section 2 “Safety precautions.” on page 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. For the driver’s power supply, use a DC power supply with reinforced insulation on its primary and secondary sides. Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

■ Overview of the product

The **RBD200A-V** is an encased microstep driver with built-in smooth drive function.

■ Standards and CE Marking

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

- Applicable Standards

Applicable Standards	Certification Body	Standard File No.	CE Marking
UL 508C* CSA C22.2 No.14	UL	E171462	Low Voltage Directive, EMC Directive
EN 50178	–	–	

∗ For UL Standard (UL 508C), the product is recognized for the condition of Maximum Surrounding Air Temperature 40 °C (104 °F).

- The temperature-rise test, as required by the UL Standards, is conducted with the aluminum heat sink attached. The size and thickness of the heat sink are as described below.

Size [mm (in.)]	Thickness [mm (in.)]
200 × 100 (7.87 × 3.94)	2 (0.08)

- Installation conditions (EN Standard)

Motor 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

■ Compliance with the EC Directives

- For Low Voltage Directive

  This product is designed for use as a built-in component.
  - Install the product within an enclosure in order to avoid contact with the hands.
  - Be sure to maintain a Protective Earth in case the hands should make contact with the product. Securely ground the Protective Earth Terminals of the motor and driver.

- For EMC Directive (89/336/EEC, 92/31/EEC)

  This product has received EMC measures under the conditions specified in “Example of motor and driver installation and wiring” on page 16.
  Be sure to conduct EMC measures with the product assembled in your equipment by referring to 5.4 “Installing and wiring in compliance with EMC Directive” on page 14.

■ Hazardous substances

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

2 Safety precautions

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

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

⚠Warning

General

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire, electric shock or injury.
- Assign qualified personnel the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Failure to do so may result in fire, electric shock or injury.
- Do not transport, install the product, perform connections or inspections when the power is on. Always turn the power off before carrying out these operations. Failure to do so may result in electric shock.
- The terminals on the driver’s front panel marked with ⚠ ⚠ symbol indicate the presence of high voltage. Do not touch these terminals while the power is on to avoid the risk of fire or electric shock.
- Provide a means to hold the moving parts in place for applications involving vertical travel. The motor loses holding torque when the power is shut off, allowing the moving parts to fall and possibly cause injury or damage to equipment.
- When the driver’s protective function is triggered, shut off the power immediately. Turn the power back on only after determining the cause. Continuing the operation without determining the cause of the problem may cause malfunction of the motor, leading to injury or damage to equipment.

Installation

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

Connection

- Keep the driver's input power voltage within the specified range to avoid electric shock or fire.
- For the driver's power supply use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.
- Connect the cables securely according to the wiring diagram in order to prevent electric shock or fire.
- Do not forcibly bend, pull or pinch the power cable and motor cable. Doing so may result in electric shock or fire.
- Do not touch the connection terminals of the driver immediately after the power is turned off. To avoid electric shock of the residual voltage, wait more than 5 seconds after Power LED is off.

Operation

- Turn off the driver power in the event of a power failure, or the motor may suddenly start when the power is restored and may cause injury or damage to equipment.
- Do not turn the AWO (all windings off) input to "ON" while the motor is operating. The motor will stop and lose its holding ability, which may result in injury or damage to equipment.

Repair, disassembly and modification

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

⚠Caution

General

- Do not use the motor 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 motor and driver, or fire, electric shock or injury may result.
- Do not touch the motor or driver during operation or immediately after stopping. The surfaces are hot and may cause a burn.

Transportation

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

Installation

- Keep the area around the motor and driver free of combustible materials in order to prevent fire or a burn.
- To prevent the risk of damage to equipment, leave nothing around the motor and driver that would obstruct ventilation.
- Provide a cover over the rotating parts (output shaft) of the motor to prevent injury.

Operation

- Use a motor 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 motor may start suddenly and cause injury or damage to equipment.
- To prevent bodily injury, do not touch the rotating parts (output shaft) of the motor during operation.
- Before moving the motor directly (as in the case of manual positioning), confirm that the driver AWO (all windings off) input is "ON" to prevent injury.
- Immediately when trouble has occurred, stop running and turn off the driver power. Failure to do so may result in fire or injury.
- To prevent electric shock, use only an insulated precision screwdriver to adjust the driver switches.
- The motor's surface temperature may exceed 70 °C (158 °F), even under normal operating conditions. If a motor is accessible during operation, post the warning label shown in the figure in a conspicuous position to prevent the risk of burns.


Warning label

Maintenance and inspection

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

Disposal

- To dispose of the motor 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 **RBD200A-V**.

- Do not operate the driver internal switches other than the SW1, SW2, RUN and DATA.

  Changing the switch settings may cause a product malfunction or cause damage to the product. See page 29 for details on the switches.

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

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

- Operate the motor with a surface temperature not exceeding 100 °C (212 °F).

  The motor casing's surface temperature may exceed 100 °C (212 °F) under certain conditions (ambient temperature, operating speed, duty cycle, etc.). Keeping the surface temperature of the motor casing below 100 °C (212 °F) will also maximize the life of the motor bearings (ball bearings).

- About maximum static torque at excitation

  Maximum static torque at excitation represents a value obtained when the motor is excited using the rated current. When the motor is combined with a **RBD200A-V**, the maximum static torque at excitation drops to approximately 50% (factory setting) due to the current cutback function that suppresses the rise in motor temperature in a standstill state. Acceleration and operation at the maximum static torque at excitation is possible in start-up, but it only has approximately 50% holding power after it has stopped. When selecting a motor for your application, consider the fact that the holding power will be reduced to approximately 50% after the motor has stopped.

- Preventing electrical noise

  See 5.4 "Installing and wiring in compliance with EMC Directive" on page 14 for measures with regard to noise.

- Connect the motor and driver correctly and securely.

  Wrong connection of leads or poor contact may damage the driver.

- Regeneration

  When a large inertial load is operated at high speed, regenerative energy will generate and increase the power supply voltage, causing the protective function to be triggered. Review the operating condition and make sure an excessive regenerative voltage will not be generated.

4 Preparation

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

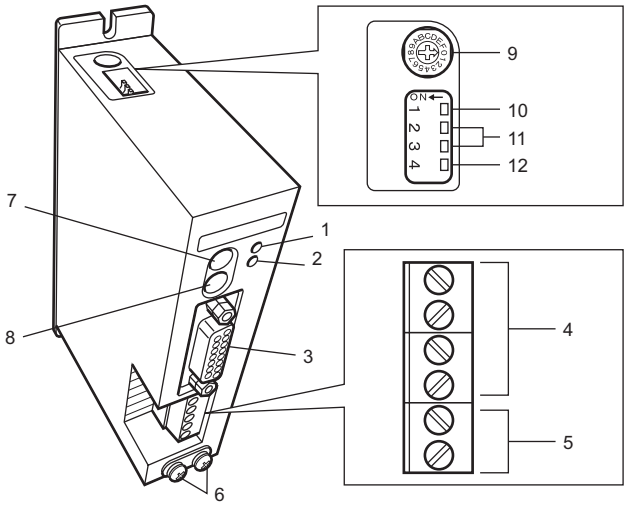
- Driver ..... 1 unit
- Operating manual (this manual) ..... 1 copy

Note When removing the driver from the conductive protection bag, make sure your hands are not charged with static electricity. This is to prevent damage to the driver due to static electricity.

4.2 Applicable motors

This driver can be used with 2-phase stepping motors.

4.3 Names and functions of parts



No.	Name	Description
1	POWER LED (green)	Lit when the power is on.
2	ALARM LED (red)	This LED blinks when the protective function was triggered and the ALARM output has turned OFF as a result. The triggered protective function can be checked by counting the number of times the LED blinks.
3	I/O signals connector (CN1)	Connect to I/O signals.
4	Motor terminal	Connect to motor.
5	Power supply terminal	Connect to power supply.
6	Protective Earth Terminal	Make ground connection by installing a grounding wire of AWG18 (0.75 mm^2) or larger.
7	Motor operating current setting switch (RUN)	Set the operating current of the motor.
8	Step angle setting switch (DATA)	Select a desired motor step angle from among the 16 preset levels.
9	Third harmonic waveform correction function (SW1)	This function sets a correction value to be applied to motor drive current waveforms.
10	Smooth drive function switch (SW2-1)	This function lets you reduce vibration and noise during low-speed operation.
11	Anti-resonance function (SW2-2, SW2-3)	This function reduces vibration during medium-speed operation.
12	Motor standstill current setting switch (SW2-4)	Set the current when the motor is at a standstill.

5 Installation

This chapter explains the installation location and installation methods of the driver. The installation and wiring methods in compliance with the EMC Directive are also explained.

5.1 Location for installation

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

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature 0 to +40 °C (+32 to +104 °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 (rains, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibration or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum

5.2 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 a perpendicular (vertical) orientation.
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 or noise 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 40 °C (104 °F).

5.3 Installation method

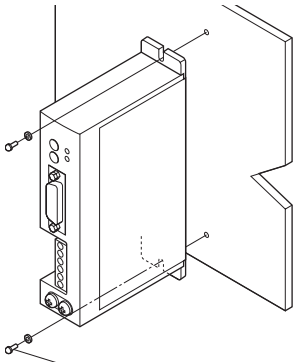
Install the driver on a flat metal plate having excellent vibration resistance and heat conductivity.
If the driver's input power-supply voltage is 48 V or below, the driver can be installed onto a DIN rail using an optional DIN rail mounting plate (sold separately). If vibration is noticeable, however, do not install the driver onto a DIN rail, but install it directly onto a metal plate using the mounting holes provided in the driver.
The temperature-rise test, as required by the UL Standards, is conducted with the aluminum heat sink attached. The size and thickness of the heat sink are as described below.

Size [mm (in.)]	Thickness [mm (in.)]
200 × 100 (7.87 × 3.94)	2 (0.08)

Note If the driver's input power-supply voltage exceeds 48 V, do not install the driver onto a DIN rail. Sufficient heat dissipation cannot be achieved and the driver's overheat protection function may be triggered as a result. In such a case, install the driver onto a metal plate directly.

- Using driver mounting holes

Install the driver by securing it with two screws (M3, not supplied) through the mounting holes provided. Leave no gap between the driver and metal plate.

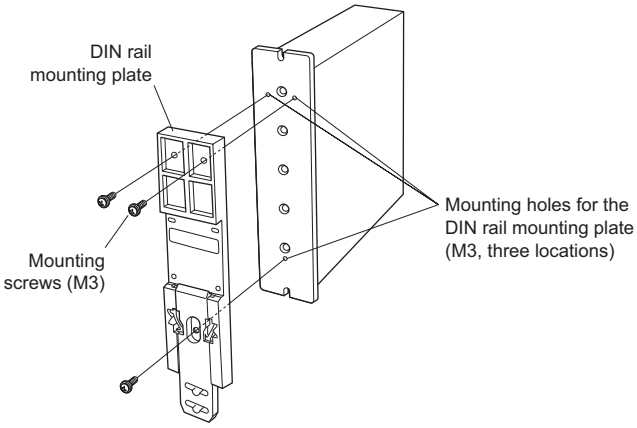


- Mounting to DIN rail

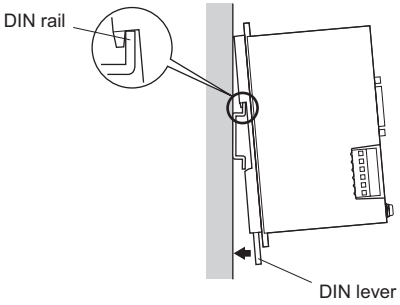
  Use a DIN rail 35 mm (1.38 in.) wide to mount the driver.

Note If the driver's input power-supply voltage exceeds 48 V, do not install the driver onto a DIN rail. Sufficient heat dissipation cannot be achieved and the driver's overheat protection function may be triggered as a result. In such a case, install the driver onto a metal plate directly.

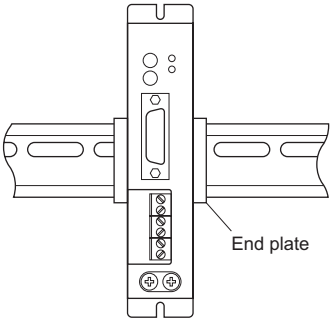
1. Attach the DIN rail mounting plate (model number: **PADP01**) to the back of the driver using the screws supplied with the plate.
   Tightening torque: 0.3 to 0.4 N·m (42 to 56 oz-in)



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.



3. Secure the driver with end plate.

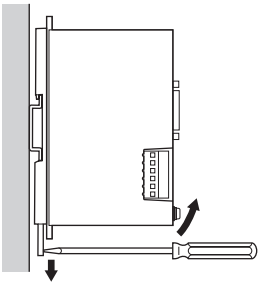


Note

- 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.

- 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.

5.4 Installing and wiring in compliance with EMC Directive

Effective measures must be taken with regard to EMI (electromagnetic interference) caused by the **RBD200A-V** in the control system equipment operating nearby and EMS (electromagnetic susceptibility) of the **RBD200A-V**. Failure to do so may result in serious impairment of the machine's functionality.
The use of the following installation and wiring methods will enable the **RBD200A-V** to be compliant with the EMC Directive.
Oriental Motor conducts EMC measurements its **RBD200A-V** in accordance with "Example of motor and driver installation and wiring" on page 16.
The user is responsible for ensuring the machine's compliance with the EMC Directive, based on the installation and wiring explained below.

Applicable Standards

EMI	Emission Tests Radiated Emission Test	EN 61000-6-4 EN 55011
EMS	Immunity Tests Radiation Field Immunity Test Electrostatic Discharge Immunity Test Fast Transient/Burst Immunity Test Conductive Noise Immunity Test	EN 61000-6-2 IEC 61000-4-3 IEC 61000-4-2 IEC 61000-4-4 IEC 61000-4-6

■ About power supply

The **RBD200A-V** is specifically designed for DC power supply input.
Use a DC power supply (such as a switching power supply) compliant with the EMC Directive.

■ Mains filter

Connect a mains filter on the input side of the DC power supply so as to prevent the noise generated in the driver from being transmitted externally via the power supply line. When a power supply transformer is used, be sure to connect a mains filter on the AC input side of the power supply transformer. For mains filters, use FN2070 (Schaffner EMC), or an equivalent.

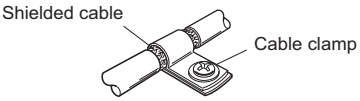
- Install the mains filter as close to the AC input terminal of DC power supply as possible. Also, secure the I/O cables (AWG18: 0.75 mm^2 or more) using cable clamps or the like so that the cables won't lift from the surface of the enclosure panel.
- The cable used to ground the mains filter must be as thick and short to the grounding point as possible.
- Do not wire the AC input cable (AWG18: 0.75 mm^2 or more) and the output cable of the mains filter (AWG18: 0.75 mm^2 or more) in parallel. If these two cables are wired in parallel, noise inside the enclosure will be connected to the power supply cable via stray capacitance, reducing the effect of the mains filter.

■ Grounding method

When grounding the driver and mains filter, use a cable of the largest possible size and connect to the ground point over the shortest distance so that no potential difference will be generated at the grounded position. The ground point must be a large, thick and uniform conductive surface. Install the motor onto a grounded metal surface.

■ Wiring the power supply cable and I/O signals cable

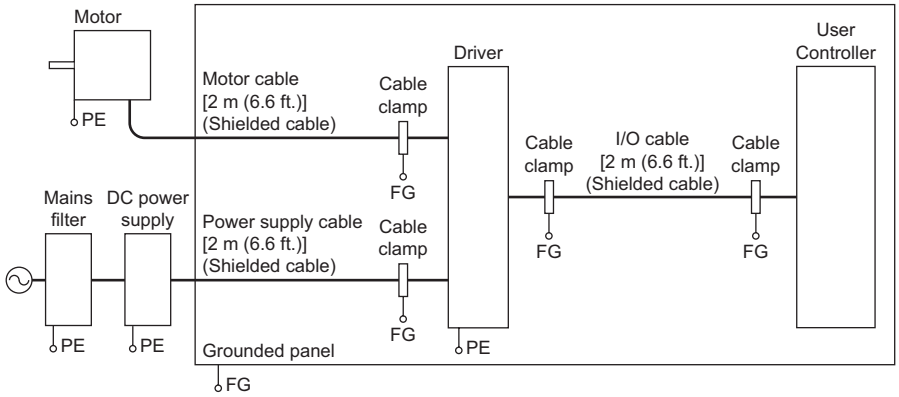
Use a shielded cable of AWG18 (0.75 mm^2) or more in diameter for the driver power supply cable. Use a shielded cable of AWG26 (0.14 mm^2) or more in diameter for the driver I/O signals cable, and keep it as short as possible.
Use a metal cable clamp that contacts the shielded cable along its entire circumference to secure/ground the power supply cable or I/O signals cable. Attach a cable clamp as close to the end of the cable as possible, and connect it as shown in the figure.



■ Notes about installation and wiring

- Connect the motor, driver and any surrounding control system equipment directly to the grounding point so as to prevent a potential difference from generating 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 the cable lengths as short as possible. Do not wind or bundle extra lengths.
- Separate the power source cables such as motor cable and power supply cable from the signal cables, and wire them apart by around 100 to 200 mm (3.94 to 7.87 in.). If a power source cable must cross over a signal cable, wire them at right angles. Keep an appropriate distance between the AC input cable and output cable of the mains filter.

■ Example of motor and driver installation and wiring



■ Example of motor and driver installation and wiring

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 precision screwdriver when adjusting the motor current using the control on the driver.

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, motor, power and controller, as well as the input/output signals.

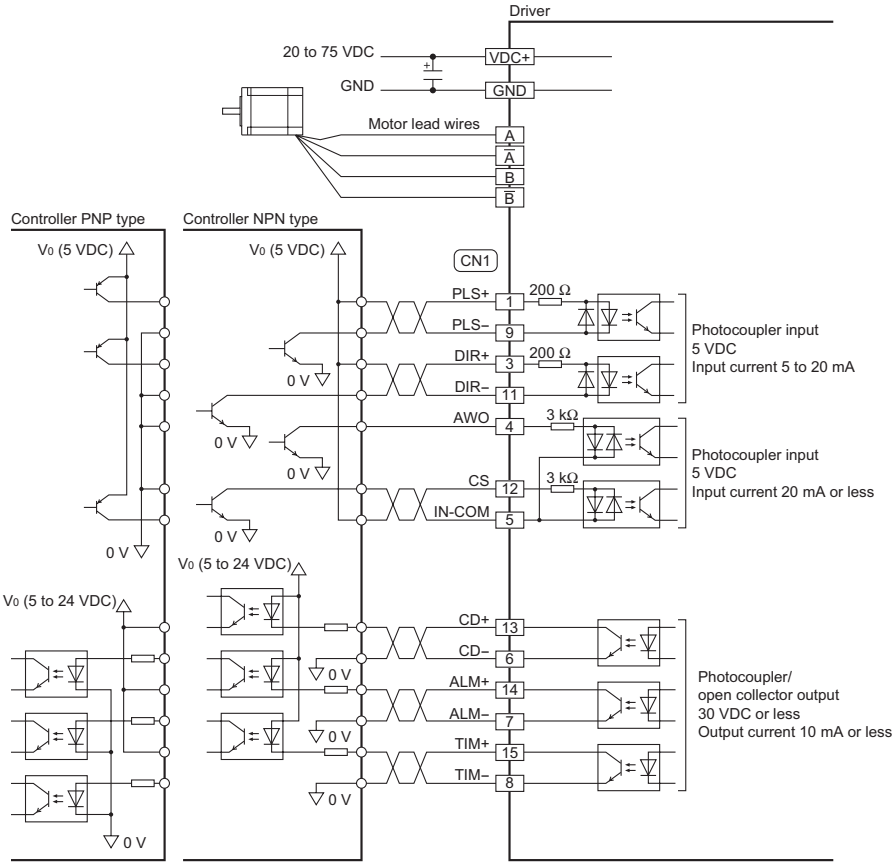
6.1 Connection example

Either 5 or 24 VDC can be used as the signal voltage for the PLS input, and DIR input.
Line driver input is also supported.

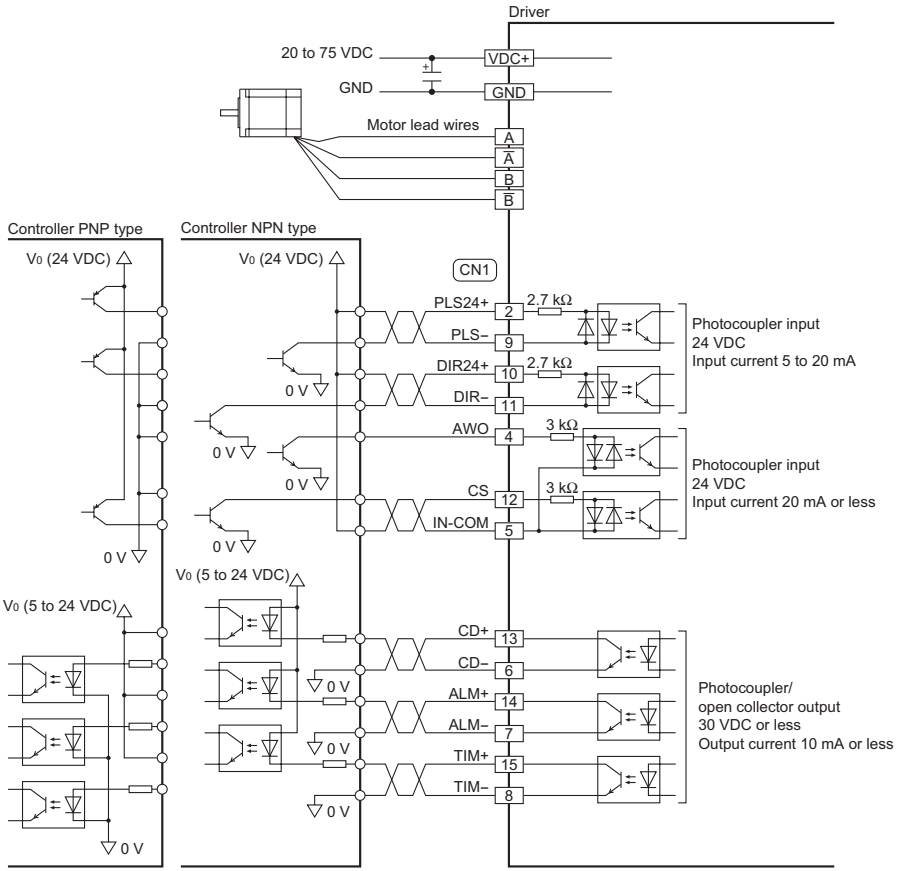
Note

- The pin numbers corresponding to the PLS input and DIR input change in accordance with the signal voltage.
  5 VDC or line driver input:
  PLS input pin 1 and pin 9
  DIR input pin 3 and pin 11
  24 VDC:
  PLS input pin 2 and pin 9
  DIR input pin 10 and pin 11
- Be certain the I/O signals cable that connects the driver and controller is as short as possible. The maximum input frequency will decrease as the cable length increases.
- Connect the motor and driver correctly and securely. Wrong connection of leads or poor contact may damage the driver.

■ 5 VDC or line driver input:



■ 24 VDC:


Driver
20 to 75 VDC
VDC+
GND
GND
Motor lead wires
A
Ā
B
B̄
Controller PNP type
Controller NPN type
V0 (24 VDC)
V0 (24 VDC)
CN1
PLS24+
2
2.7 kΩ
PLS–
9
DIR24+
10
2.7 kΩ
DIR–
11
AWO
4
3 kΩ
CS
12
3 kΩ
IN-COM
5
0 V
0 V
0 V
0 V
0 V
Photocoupler input
24 VDC
Input current 5 to 20 mA
Photocoupler input
24 VDC
Input current 20 mA or less
V0 (5 to 24 VDC)
V0 (5 to 24 VDC)
CD+
13
CD–
6
ALM+
14
ALM–
7
TIM+
15
TIM–
8
0 V
0 V
0 V
0 V
Photocoupler/
open collector output
30 VDC or less
Output current 10 mA or less

6.2 Connecting the power supply

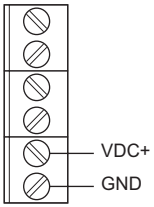
⚠Warning For the driver's power supply use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.

Connecting the power supply to the driver's power supply terminal.

Provide a power supply of 20 to 75 VDC and 5.2 A or more.
Use a cable of AWG18 (0.75 mm^2). Keep the wiring distance as short as possible [less than 2 m (6.6 ft.)] to suppress the effect of noise.
The power supply terminals are provided on a terminal block. Strip the cable sheath by 8 mm (0.31 in.), then insert the lead wire into the terminal and tighten with terminal screws.
Tightening torque: 0.5 to 0.6 N·m (71 to 85 oz-in)

Pin assignments of power supply terminal

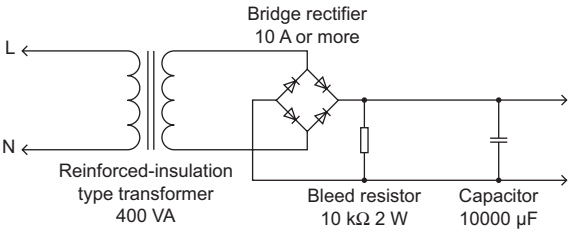
Signal name	Description
VDC+	DC power supply input
GND	GND



Note

- Pay attention to polarity when connecting the power supply. Connecting the power supply in reverse polarity may damage the driver.
- Do not wire the driver's power supply cable in the same conduit in which another power line or the motor cable is wired.
- If the motor cable or power supply cable generates an undesirable amount of noise, shield the cable or install a ferrite core.

Recommended driver power supply circuit



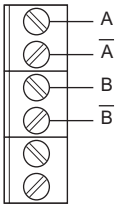
6.3 Connecting and grounding the motor

■ Connecting method

Connecting the motor leads to the driver's motor terminal.
The power supply terminals are provided on a terminal block. Strip the cable sheath by 8 mm (0.31 in.), then insert the lead wire into the terminal and tighten with terminal screws.
Tightening torque: 0.5 to 0.6 N·m (71 to 85 oz-in)

Pin assignments of motor terminal

Signal name	Description
A	A-phase output
$\overline{A}$	$\overline{A}$-phase output
B	B-phase output
$\overline{B}$	$\overline{B}$-phase output

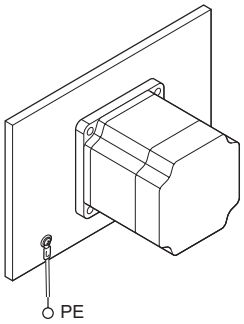


Note

- Connect the motor and driver correctly and securely. Wrong connection of leads or poor contact may damage the driver.
- If the motor cable or power supply cable generates an undesirable amount of noise, shield the cable or install a ferrite core.

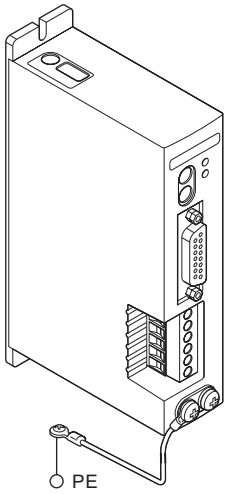
■ Grounding method

Install the motor to the grounded metal plate.
Use a grounding wire thicker than AWG18 (0.75 mm^2).
When grounding, use a round terminal and affix it with a mounting screw over a crow washer.



6.4 Grounding the driver

Be sure to ground the Protective Earth Terminal (screw size: M4) of the driver.
Use a grounding wire of AWG18 (0.75 mm^2) or more in diameter, and ground the cable near the driver with a round terminal.
Do not share the grounding wire with a welder or power machinery.

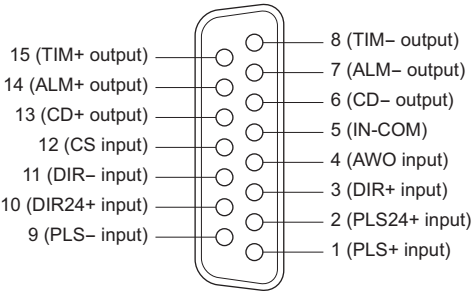


6.5 Connecting the I/O signals

Connecting the I/O signals to the driver's CN1.
Keep the wiring distance as short as possible [less than 2 m (6.6 ft.)] to suppress the effect of noise.

Note Separate I/O signals cable at least 100 mm (3.94 in.) from electromagnetic relays and other than inductance loads. Additionally, route I/O signals cable perpendicular to power supply cables and motor cables, rather than in a parallel fashion.

CN1 pin assignments



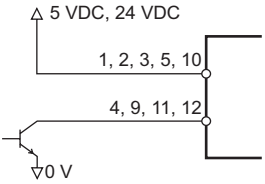
Pin No.	Signal name	Description
1	PLS+ input	Pulse input
2	PLS24+ input	Pulse input (24 VDC)
3	DIR+ input	Rotation direction input
4	AWO input	All windings off input
5	IN-COM	Common input
6	CD− output	Current-cutback output
7	ALM− output	Alarm output
8	TIM− output	Excitation timing output
9	PLS− input	Pulse input
10	DIR24+ input	Rotation direction input (24 VDC)
11	DIR− input	Rotation direction input
12	CS input	Step angle switching input
13	CD+ output	Current-cutback output
14	ALM+ output	Alarm output
15	TIM+ output	Excitation timing output

6.6 About input/output signals

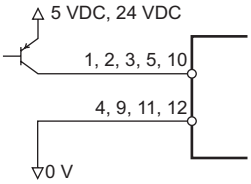
■ Input signals

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

• Example of connection with a current sink output circuit



• Example of connection with a current source output circuit



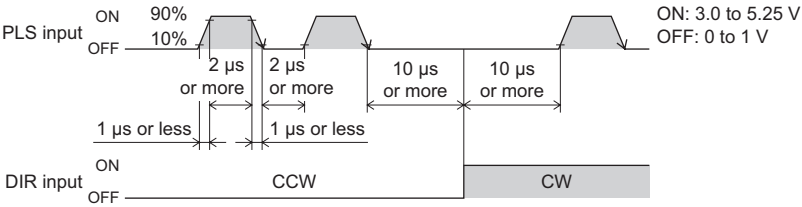
- PLS (pulse) input, DIR (rotating direction) input

Either 5 or 24 VDC can be used as the signal voltage for the PLS input, and DIR input.
Line driver input is also supported.

5 VDC

The controller pulses are connected to the PLS+ input (pin No.1) or the PLS− input (pin No.9), and the rotation direction is connected to the DIR+ input (pin No.3) or the DIR− input (pin No.11).

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

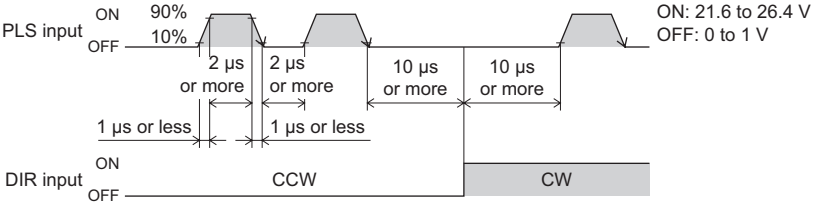


Note The interval for switching the motor direction represents the response time of the circuit. Set this interval to an appropriate time after which the motor will respond.

24 VDC

The controller pulses are connected to the PLS24+ input (pin No.2) or the PLS− input (pin No.9), and the rotation direction is connected to the DIR24+ input (pin No.10) or DIR− input (pin No.11).

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

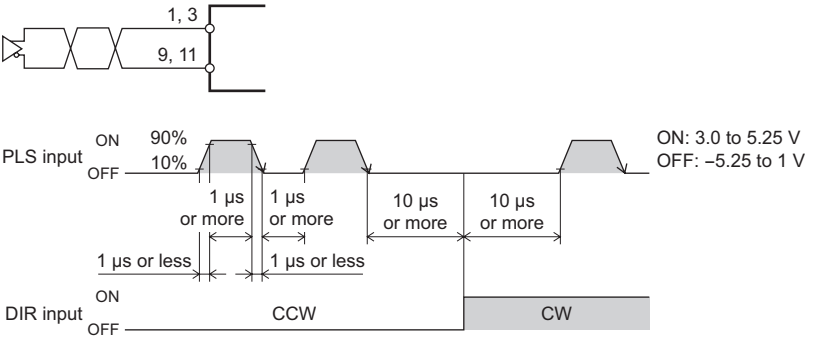


Note The interval for switching the motor direction represents the response time of the circuit. Set this interval to an appropriate time after which the motor will respond.

Line driver input

The controller pulses are connected to the PLS+ input (pin No.1) or the PLS− input (pin No.9), and the rotation direction is connected to the DIR+ input (pin No.3) or DIR− input (pin No.11).

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



Note The interval for switching the motor direction represents the response time of the circuit. Set this interval to an appropriate time after which the motor will respond.

- AWO (all windings off) input

  Use the signal only when the motor's output shaft must be rotated manually for position adjustment (ON: 4.5 to 26.4 V, OFF: 0 to 1 V.)
  - When the AWO input is turned ON, the driver stops supplying current to the motor and the motor's holding torque is lost. You to adjust the load position manually.
  - When the AWO input is turned OFF, the current supply to the motor resumes, thereby restoring the motor's holding torque.

- CS (step angle switching) input

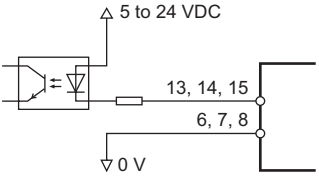
  (ON: 4.5 to 26.4 V, OFF: 0 to 1 V)
  - When the CS input is turned ON, the motor will operate at the base step angle regardless of the settings of the step angle setting switches.
  - When the CS input is turned OFF, the motor will operate at the step angle set by the step angle setting switches.

Note Do not switch the CS input while the motor is operating, or the motor may misstep and stall.

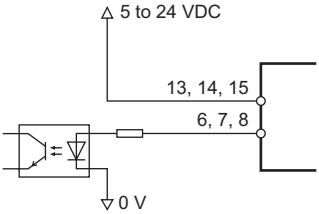
■ Output signals

Driver output signals are photocoupler/open-collector output. The signal state represents the "ON: Carrying current" or "OFF: Not carrying current" state of the internal photocoupler.

• Example of connection with a current source input circuit



• Example of connection with a current sink input circuit



- CD (current-cutback) output

  The CD output remains ON while the automatic current cutback function is active.

- ALM (alarm) output

  ALM output remains ON when the driver is operating normally, then turns OFF when a protective function is triggered.
  Error detection by the driver, such as overheat, overvoltage and overcurrent during motor operation, turns the ALM output OFF, blinks the ALARM LED on the driver, and simultaneously shuts off the motor current to stop motor operation.
  Count the number of the ALARM LED blinks to identify the particular protective function that has been triggered. For details, refer to page 34.

- TIM (excitation timing) output

  When the motor-excitation state (combined phases of current flowing) is in the excitation home position (step [0]), the driver turns ON the TIM output. The motor-excitation state is reset to the excitation home position when the power supply is switched on.

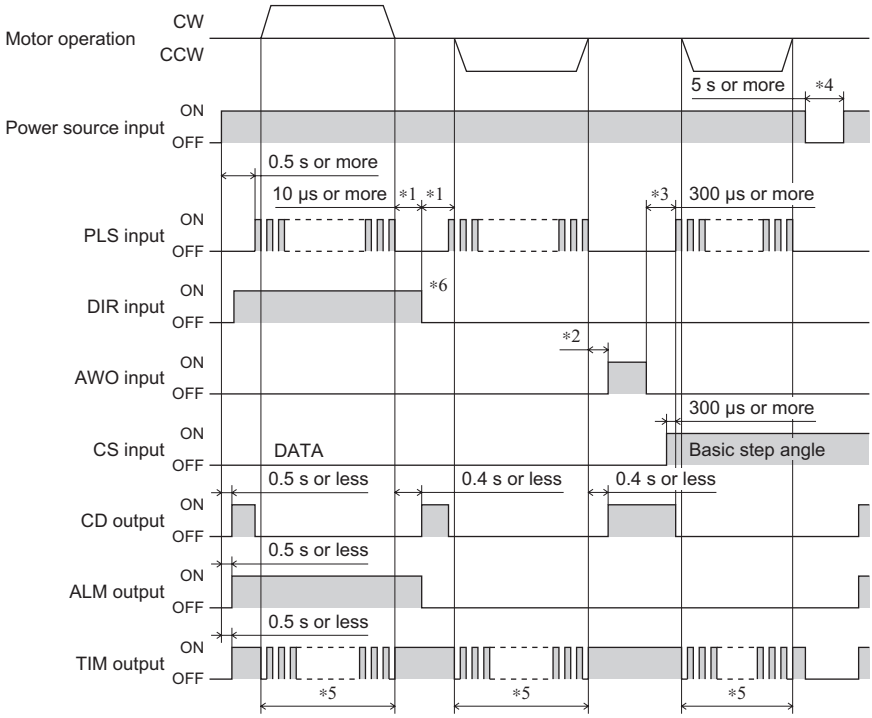
  When the motor has a base step angle of 1.8°/step, the TIM output turns ON with a rotation of every 7.2° from the excitation home position in synchronization with a pulse input. The TIM output behaves differently depending on the combined motor and the microstep resolution.

  Also, when detecting the mechanical home position for a mechanical device, by making an AND circuit for the mechanical home position sensor and the TIM output, the variation in the motor stop position within the mechanical home position sensor can be reduced and the mechanical home position made more precise.

Note

- When using the TIM output, stop the motor's output shaft at an integer multiple of 7.2°.
- When switching the step angle, do this with the motor stopped and the TIM output ON.

6.7 Timing chart



The section indicates that the photocoupler diode is emitting light.

∗1 "10 µs or more" indicated in connection with the DIR input select time indicates a circuit response time. Set it to the time required for the motor to respond to the applicable pulse input.

∗2 The specific duration varies depending on the load inertial moment, load torque, self-starting frequency, etc.

∗3 Do not input pulse signals immediately after switching the AWO input to OFF, given that it will affect the motor's starting characteristics.

∗4 To cycle the power, turn off the power and then wait for at least 5 seconds after the POWER LED has turned off.

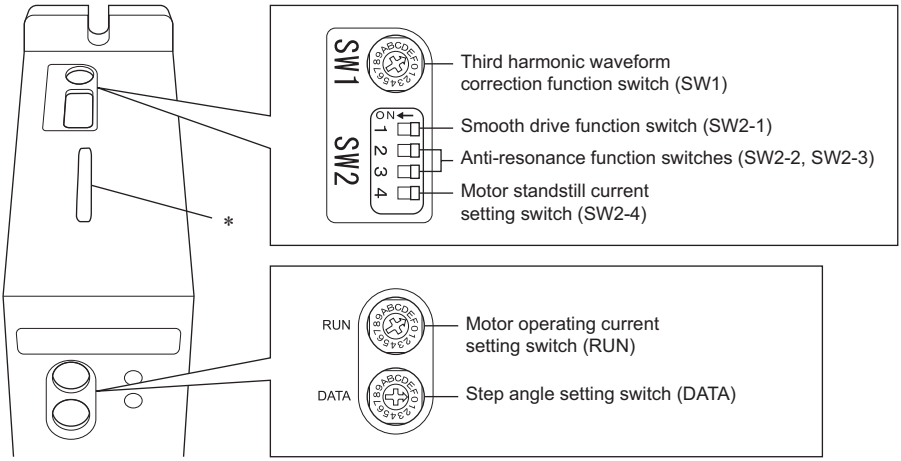
∗5 TIM output is output once every 7.2° rotation of the motor output shaft.

∗6 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.

Note The maximum response frequency is 250 kHz at a pulse duty of 50%. Response can be obtained up to 500 kHz in the line driver input mode.

7 Settings

This chapter explains how to set the driver functions.



Note Do not operate the driver internal switches other than the SW1, SW2, RUN and DATA. Changing the switch settings may cause a product malfunction or cause damage to the product.

Setting of the switches indicated by *

7.1 Smooth drive function

This function lets you reduce vibration and noise during low-speed operation without having to change the step angle setting. This is achieved by automatically dividing the step angle in accordance with the input pulses. This function makes it not necessary to change the pulse speed or pulse count from the controller.
Use an insulated precision screwdriver to change the ON/OFF position of the smooth drive function switch (SW2-1).

Factory setting OFF (used)

- When the smooth drive function is not used, set the smooth drive function switch to “ON.”
- When the smooth drive function is used, set the smooth drive function switch to “OFF.”

7.2 Anti-resonance function

This function reduces vibration during medium-speed operation.
Use an insulated precision screwdriver to change the ON/OFF position of the anti-resonance function switch (SW2-2, SW2-3).
Use the SW2-2 to turn the anti-resonance function ON or OFF.
Use the SW2-3 to set the base step angle of the motor used with the driver.

Factory setting SW2-2: OFF (used)
SW2-3: OFF (1.8°/step)

- When the anti-resonance function is not used, set the SW2-2 to "ON."
- When the anti-resonance function is used, set the SW2-2 to "OFF."
  When the base step angle of the motor is 0.9°/step, set the SW2-3 to "ON."
  When the base step angle of the motor is 1.8°/step, set the SW2-3 to "OFF."

7.3 Step angle

Select a desired motor step angle from among the 16 preset levels.
Use an insulated precision screwdriver to change the dial of the step angle setting switch (DATA).
The step angle is calculated by dividing the base step angle of the motor by the number of divisions.

Factory setting 0 (Number of divisions 1)

Sample settings with a motor whose base step angle is 1.8°/step

Dial setting	Number of divisions	Resolution	Step angle
0	1	200	1.8°
1	2	400	0.9°
2	4	800	0.45°
3	5	1000	0.36°
4	8	1600	0.225°
5	9	1800	0.2°
6	10	2000	0.18°
7	16	3200	0.1125°
8	18	3600	0.1°
9	20	4000	0.09°
A	32	6400	0.05625°
B	36	7200	0.05°
C	40	8000	0.045°
D	64	12800	0.028125°
E	80	16000	0.0225°
F	128	25600	0.0140625°

Note

- Step angles are theoretical values.
- The step angle set by the step angle setting switches becomes effective when the CS input is OFF.
- Do not switch the CS input or the step angle setting switch while the motor is operating, or the motor may misstep and stall. Set the step angle setting switches when the TIM output is ON.

7.4 Motor current and third harmonic waveform correction function

When the load is light and there is a margin for motor torque, the motor's operating vibration and the temperature increase of the motor and driver can be held down by lowering the motor's operating current.
Third harmonic waveform correction function sets a correction value to be applied to motor drive current waveforms.
Use an insulated precision screwdriver to change the dial of the motor operating current setting switch (RUN) and the third harmonic waveform correction function switch (SW1).

Factory setting RUN: 0, SW1: 0 (0.08 A/phase, no correction)

■ Setting method

Refer to the table of "Representative values of operating current (A/phase) and third harmonic waveform correction function" on page 32 to find the value of operating current you want to set, and then set the RUN switch and SW1 to the corresponding dials.
If the third harmonic waveform correction function is not used, set the SW1 to "0," "4," "8" or "C" so that the correction value becomes 0%.
If the third harmonic waveform correction function is used, select a desired correction value in the range of −2 to −6%.

Setting example

To set the operating current to 1.00 A/phase and third harmonic waveform correction value to −4%, set the RUN switch to "7" and the SW1 to "6."

Note

- There are four setting groups (0 to 3, 4 to 7, 8 to B, and C to F) for the third harmonic waveform correction function switch (SW1). If the SW1 is set to the dial in a wrong setting group, the operating current to be applied will change significantly. Set the SW1 correctly by checking the table of "Representative values of operating current (A/phase) and third harmonic waveform correction function."
- Set the motor's operating current to a value not exceeding the rated current of the motor.
- The actual operating current may vary from the applicable value in the table depending on the motor used.

■ Representative values of operating current (A/phase) and third harmonic waveform correction function

	Third harmonic waveform correction function								
	SW1	0	1	2	3	4	5	6	7
	Correction value	0%	−2%	−4%	−6%	0%	−2%	−4%	−6%
Motor operating current setting switch (RUN)	0	0.08				0.13			
	1	0.15				0.25			
	2	0.22				0.38			
	3	0.30				0.50			
	4	0.37				0.63			
	5	0.45				0.75			
	6	0.52				0.88			
	7	0.60				1.00			
	8	0.67				1.13			
	9	0.75				1.25			
	A	0.83				1.40			
	B	0.90				1.50			
	C	0.97				1.60			
	D	1.05				1.75			
	E	1.12				1.90			
	F	1.20				2.00			

	Third harmonic waveform correction function								
	SW1	8	9	A	B	C	D	E	F
	Correction value	0%	−2%	−4%	−6%	0%	−2%	−4%	−6%
Motor operating current setting switch (RUN)	0	0.19				0.28			
	1	0.38				0.56			
	2	0.56				0.84			
	3	0.75				1.13			
	4	0.94				1.40			
	5	1.13				1.70			
	6	1.30				2.00			
	7	1.50				2.25			
	8	1.70				2.50			
	9	1.90				2.80			
	A	2.05				3.10			
	B	2.25				3.40			
	C	2.45				3.65			
	D	2.60				3.95			
	E	2.80				4.20			
	F	3.00				4.50			

7.5 Standstill current

Set a rate of reduction with respect to the set operating current. The standstill current is calculated by multiplying the operating current with the specified rate of reduction.
Use an insulated precision screwdriver to change the ON/OFF position of the motor standstill current setting switch (SW2-4).

Factory setting OFF (50% of the rated current)

- When this switch is set to “ON,” the rate of reduction becomes 25%.
- When this switch is set to “OFF,” the rate of reduction becomes 50%.

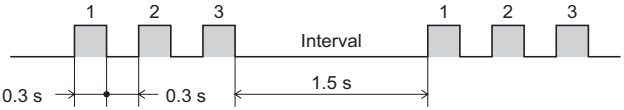
When pulse output is stopped, the motor current will automatically drop to the standstill current within approx. 0.3 second.

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 overheat, overvoltage and overcurrent. When a protective function is triggered, the ALM output turns OFF, blinks the ALARM LED on the driver, and simultaneously shuts off the motor current to stop motor operation.



The number of ALARM LED blinks varies according to the nature of the triggered protective function, and you can check the cause that triggered the protective function by counting the number of blinks.
The table below gives descriptions of protective functions and their corresponding numbers of blinks.

No. of blinks	Protective function	Conditions
2	Overheat protection	When the driver temperature exceeds a specified value.
3	Overvoltage protection	When the driver inverter's primary voltage exceeds a permissible value.
5	Overcurrent protection	When an excessive current flows through the driver inverter's power element.

8.2 How to clear a protective function

If the ALM output turned OFF as a result of actuation of any of the driver's protective functions, reset the ALM output (turn the signal ON) by cycling the driver power.

Note To clear the ALM output, be sure to remove the cause of the problem that has triggered the protective function before turning the power back on. To cycle the power, turn off the power and then wait for at least 5 seconds after the POWER LED has turned off.

9 Inspection

It is recommended that periodic inspections be conducted for the items listed below after each operation of the motor.
If an abnormal condition is noted, stop the use and contact your nearest office.

Inspection items

- Are the motor installation screws loose?
- Are there any abnormal sounds from the motor's bearing section (ball bearings) or elsewhere?
- Do any of the motor leads have damage or stress, or is there any play at the section for connection with the driver?
- Is there any deviation between the centers of the motor's output shaft and load shaft?
- Are the driver installation screws or connector sections loose?
- Is there any dust or dirt on the driver?
- Are there any strange smells or other abnormalities at the driver?

Note The driver uses semiconductor elements. Handle the driver carefully. There is a danger of the driver being damaged by static electricity, etc.

10 Troubleshooting and remedial actions

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

Phenomenon	Possible cause	Remedial action
• The motor is not energized. • The motor's output shaft can be turned easily by hand.	Connection error in the motor or power supply.	Check that the connections between the driver, motor and power supply.
	Operating current potentiometer incorrectly set. If the setting is too low, the motor torque will also be too low and operation will be unstable.	Check the operating current.
	The AWO input is set to ON.	Switch the AWO input to OFF and confirm that the motor is excited.
The motor does not run.	Pulse input line connection error.	• Check the controller and driver. • Check the pulse input specifications (voltage and width).
Motor operation is unstable.	Motor connection error.	Check that the driver and motor connections.
	Operating current potentiometer incorrectly set. If the setting is too low, the motor torque will also be too low and operation will be unstable.	Check the operating current.

Phenomenon	Possible cause	Remedial action
Loss of synchronization during acceleration or running.	The centers of the motor's output shaft and load shaft are not aligned.	Check the connection condition of the motor output shaft and load shaft.
	The load or load fluctuation is too high.	Check for large load fluctuations during motor operation. If adjusting the motor's operating speed to low and high torque eliminates the problem, it is necessary to review the load conditions.
	The speed of the starting pulse is too high.	Lower the speed of the starting pulse.
	The acceleration (deceleration) time is too short.	Lengthen the acceleration (deceleration) time.
	Electrical noise	Check running with only the motor, driver and required controller. If the impact of noise is recognized, take countermeasures, such as rewiring for greater distance from the noise source, changing the signal cables to shielded wire, or mounting a ferrite core.
Motor does not move the set amount.	Mistake in switching CS input.	Check the CS input state.
	Wrong step angle settings.	Check the settings of the step angle setting switches.
	Pulse output count is too low or too high.	Check whether or not the number of pulses required for operation at the set step angle are being output.

Phenomenon	Possible cause	Remedial action
Motor vibration too great.	The centers of the motor's output shaft and load shaft are not aligned.	Check the connection condition of the motor output shaft and load shaft.
	Motor resonating	If the vibration decreases when the operating pulse speed is changed, it means the motor is resonating. Vibration can be suppressed by taking the following measures: • Change the operating pulse speed setting. • Change the third harmonic waveform correction value. • Install a clean damper (sold separately).
	Load too small.	Lower the operating current. Vibration will increase if the motor's output torque is too large for the load.
Motor too hot.	Long continuous operation time of the motor.	Decrease the operation time of the motor per session or increase the standstill time. Make sure that the motor case temperature will not exceed 100 °C (212 °F).
	Motor standstill current adjustment too high.	Lower the motor standstill current.
TIM output not output.	CS input switched to ON when TIM output is not being output.	Switch the CS input to ON when TIM output is being output.

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