Oriental motor

HM-60510-2

Drivers for 2-Phase, 5-Phase Stepping Motors

CVD Series

Multi-Axis Type

EtherCAT Compatible

OPERATING MANUAL Hardware Edition

Table of contents

Thank you for purchasing an Oriental Motor product.
This 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.

1 Introduction

1-1 Before using the product

Only qualified personnel of electrical and mechanical engineering should work with the product.
Use the product properly after thoroughly reading the section "3 Safety precautions" on p.4. In addition, be sure to observe the contents described in warning, caution, and note in this document.
The product described in this document is designed and manufactured to be incorporated in general industrial equipment. Do not use it for any other purpose. Oriental Motor Co., Ltd. is not responsible for any compensation for damage caused through failure to observe this warning.

1-2 Related operating manuals

For operating manuals, download from Oriental Motor Website Download Page or contact your nearest Oriental Motor sales office.

- **CVD** Series Multi-Axis Type EtherCAT Compatible OPERATING MANUAL Hardware Edition (This document)
- **CVD** Series Multi-Axis Type EtherCAT Compatible OPERATING MANUAL Software Edition

Read the following operating manuals for a motor or a motorized actuator.

- OPERATING MANUAL Motor Edition
- OPERATING MANUAL Actuator Edition
- Motorized Actuator Function Setting Edition

1-3 How to use operating manuals

To use the product, read both the Hardware Edition (this document) and the Software Edition of the **CVD** Series multi-axis type EtherCAT compatible operating manuals.
The Hardware Edition describes installation, connection, etc.
The Software Edition describes control methods via EtherCAT, object list, troubleshooting, etc.

2 Overview of the product

The **CVD** Series multi-axis type EtherCAT compatible is a DC input driver for 2-phase and 5-phase stepping motors. Up to four motors can be connected to a single driver.

■ Product lineup

Two types of drivers are available, the connector shape is right angle and vertical.
A single driver supports both 2-phase and 5-phase stepping motors. The number of phases of the motor is set for each axis using the parameter.

■ Low vibration and low noise

A board type microstepping driver equipped with the smooth drive function achieves low-vibration and low-noise operation.

■ How to set parameters

Parameters can be set via EtherCAT or using the **MEXE02** support software.
This manual describes how to set parameters via EtherCAT.

■ Providing the ESI File

The ESI (EtherCAT SubDevice Information) file is a file that describes the specific information of the EtherCAT SubordinateDevice products in XML format. By importing the ESI file into the EtherCAT Configuration Tool of a PLC (programmable controller), the settings of EtherCAT can be configured before the driver is delivered.
The ESI file can be downloaded from Oriental Motor Website Download Page.

3 Safety precautions

The precautions described below are intended to ensure the safe and proper use of the product and to prevent the user and other personnel from exposure to the risk of injury. 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.
memo	The items under this heading contain related information and contents to gain a further understanding of the text in this manual.

⚠WARNING

General

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, in areas subjected to splashing water, or near combustible materials. Doing so may result in fire or injury.
- Assign qualified personnel to the task of installing, wiring, operating, inspecting, and troubleshooting the product. Handling by unqualified personnel may result in fire, injury, or damage to equipment.
- When an alarm of the driver is generated (any of the driver's protective functions is triggered), remove the cause before resetting the alarm (protective function). Continuing operation without correcting the cause of the problem may cause the motor and driver to malfunction, resulting in injury or damage to equipment.
- Do not use the brake mechanism of the electromagnetic brake motor for braking or as a safety brake. The electromagnetic brake is intended to hold the moving part and motor positions. This may result in injury or damage to equipment.
- Depending on the type of alarm (protection function), the motor may stop to lose holding force when an alarm is generated. This may result in injury or damage to equipment.

Installation

- Install the driver in an enclosure. Failure to do so may result in injury.

Connection

- Keep the input power voltage of the driver within the specified range. Failure to do so may result in fire.
- Connect the product securely according to the connection diagram. Failure to do so may result in fire.
- Do not forcibly bend, pull, or pinch the cable. Doing so may result in fire.

Operation

- Turn off the main power supply and the control power supply in the event of a power failure. Failure to do so may result in injury or damage to equipment.
- Do not remove the motor excitation during operation. Doing so may cause the motor to stop and lose the holding force, resulting in injury or damage to equipment.
- For the main power supply and the control 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.

Repair, disassembly, and modification

- Do not disassemble or modify the driver. Doing so may result in injury or damage to equipment.

⚠CAUTION

General

- Do not use the driver beyond the specifications. Doing so may result in injury or damage to equipment.
- Do not touch the driver during operation or immediately after stopping. The surface is hot, and this may cause a skin burn(s).
- Do not forcibly bend or pull the cable that is connected to the driver. Doing so may cause damage to the product.

Installation

- Keep the area around the driver free of combustible materials. Failure to do so may result in fire or a skin burn(s).
- Do not leave anything around the driver that would obstruct ventilation. Doing so may result in damage to equipment.

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 system will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Before turning on the main power supply and the control power supply, turn all input signals to the driver OFF. Failure to do so may result in injury or damage to equipment.
- When moving the moving part manually, put the motor in a non-excitation state. Performing work while the motor is in an excitation state may result in injury.
- If an abnormal condition has occurred, immediately stop operation to turn off the main power supply and the control power supply. Failure to do so may result in fire or injury.

4 Precautions for use

This chapter explains restrictions and requirements that the user should consider when using the product.

- **Note on connecting a main power supply and a control power supply whose positive terminals are grounded**

  The USB connector (CN3) on the driver is not electrically insulated. When grounding the positive terminals of a main power supply and a control power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and this equipment to short, damaging both. When connecting, do not ground equipment.

- **Saving data to non-volatile memory**

  Do not turn off the control power supply while writing the data to non-volatile memory, and do not turn off the control power supply for five seconds after writing has been completed. Doing so may abort writing the data and cause an alarm of EEPROM error to generate. Non-volatile memory can be rewritten approximately 100,000 times.

- **Noise elimination measures**

  Refer to p.27 for noise elimination measures.

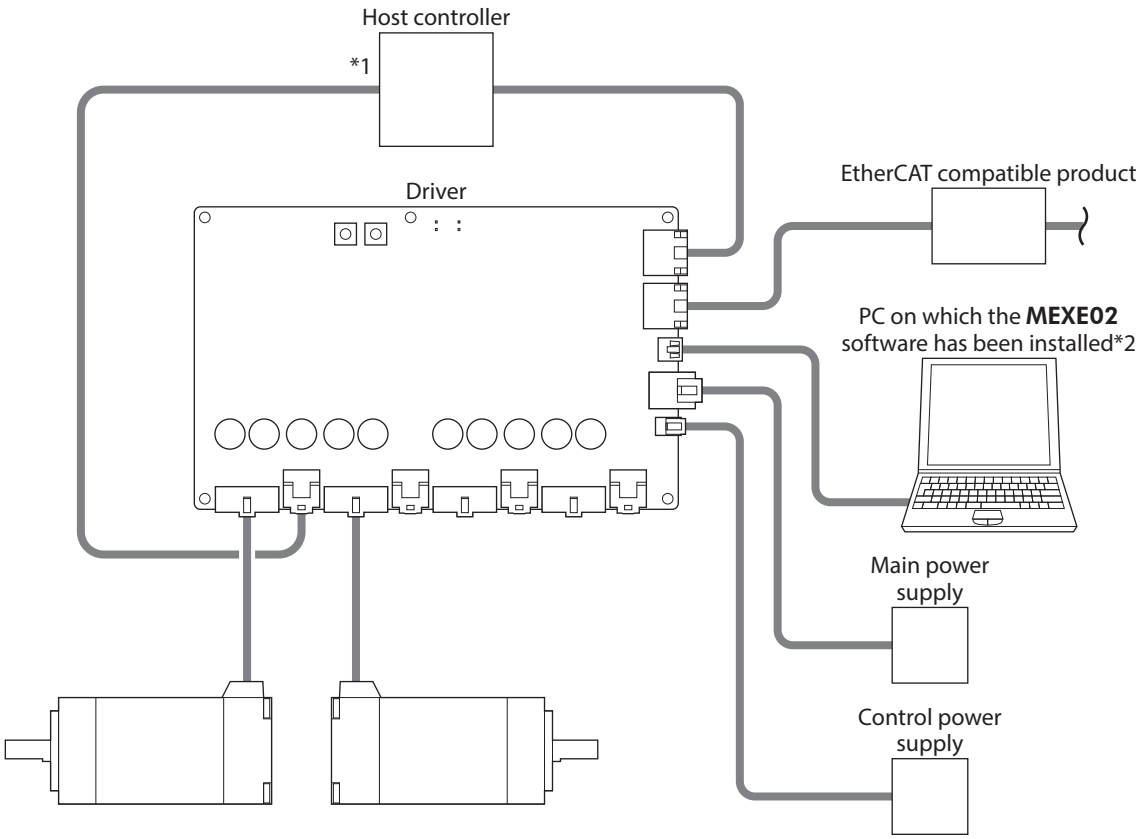
- **Regeneration**

  When operating a large load inertia at a high speed, the regenerative energy generated may increase the power supply voltage, causing an alarm of Overvoltage to generate. To prevent damage to the driver, reconsider the operating conditions so that regenerative voltage is not generated.

- **When using an electromagnetic brake motor in a vertical drive such as elevating equipment, provide a sufficient safety factor and evaluate it with the user's equipment.**

  When a stepping motor in an open-loop system is excited after the control power supply is turned on, a specific phase is excited. Therefore, a load may fall depending on the load.
  Evaluate the product in the user's environment and ensure a sufficient safety factor and use.

5 System configuration



*1 Connect when using direct I/O or sensors.

*2 The PC must be supplied by the user.

6 Preparation

6-1 Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the Oriental Motor sales office from which you purchased the product.

- Driver ..... 1 unit
- Instructions and Precautions for Safe Use..... 1 copy

Note When taking out the driver from the electrostatic discharge (ESD) protection bag, make sure your hands are not charged with static electricity. Static electricity may cause damage to the driver.

6-2 How to identify the product model

Check the driver model against the model described on the nameplate. Refer to p.9 for how to identify the nameplate.

CVD 4A B R - K ED
1 2 3 4 5 6

1	Series	**CVD**: **CVD** Series
2	Number of Axes	**4A**: 4 Axes
3	Driver shape	**B**: With mounting plate Blank: Without mounting plate
4	Connector shape	**R**: Right angle Blank: Vertical
5	Power supply input	**K**: DC power supply
6	Network type	**ED**: EtherCAT compatible

6-3 Products that can be combined

Products with which the driver can be combined are listed below. Check the product model with the nameplate.

Product type	Applicable Series	Product to be combined*1	
2-Phase stepping motors Bipolar	**PKP** Series	**PKP203D06A** **PKP213D05■** **PKP214D06■** **PKP22□D15■** **PKP22□D15■2** **PKP22□MD15■** **PKP23□D15■** **PKP23□D23■** **PKP24□D08■2** **PKP24□D15■** **PKP24□D15■2**	**PKP24□D23■** **PKP24□D23■2** **PKP24□MD15■** **PKP24□MD15■2** **PKP25□D28■A2** **PKP26□D14■2** **PKP26□D28■** **PKP26□D28■2** **PKP26□MD28■** **PKP26□MD28■2** **PKP262FD15A**
5-Phase stepping motors	**PKP** Series	**PKP52□MN03** **PKP52□MN07** **PKP52□N03** **PKP52□N07** **PKP52□N12**	**PKP54□MN** **PKP54□N18■** **PKP54□N18■2** **PKP56□FMN** **PKP56□FN24■2**
	PK Series	**PK513** **PK52□H** **PK52□P**	**PK54□** **PK56□***2

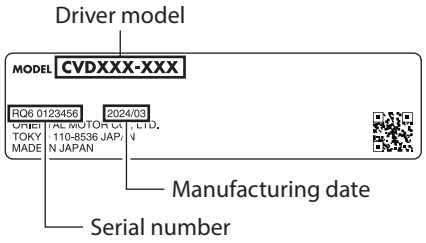
Product type	Applicable Series	Product to be combined*1	
Motorized actuators	**DH** Series	**DHM28PAK2**	**DHM42PAK**
	DRLII Series	**DRLM20** **DRLM28**	**DRLM42** **DRLM60**

*1 Product models in the table describe part of the whole name of the products. The driver can be combined with products that include the product models listed here. Note, however, that the motors with a voltage output type encoder are excluded.
The box (☐) in the product model indicates a number representing the motor length.
The box (■) in the product model indicates **A** (single shaft), **B** (double shaft), or **M** (with an electromagnetic brake) representing the motor shape.

*2 Motors with a rated current of 1.4 A/phase are covered.

6-4 Information about nameplate

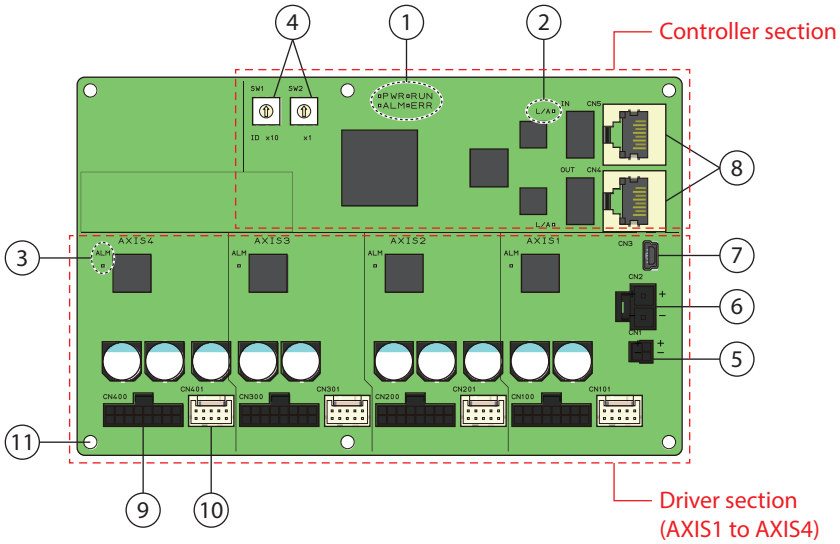
The figure shows an example.



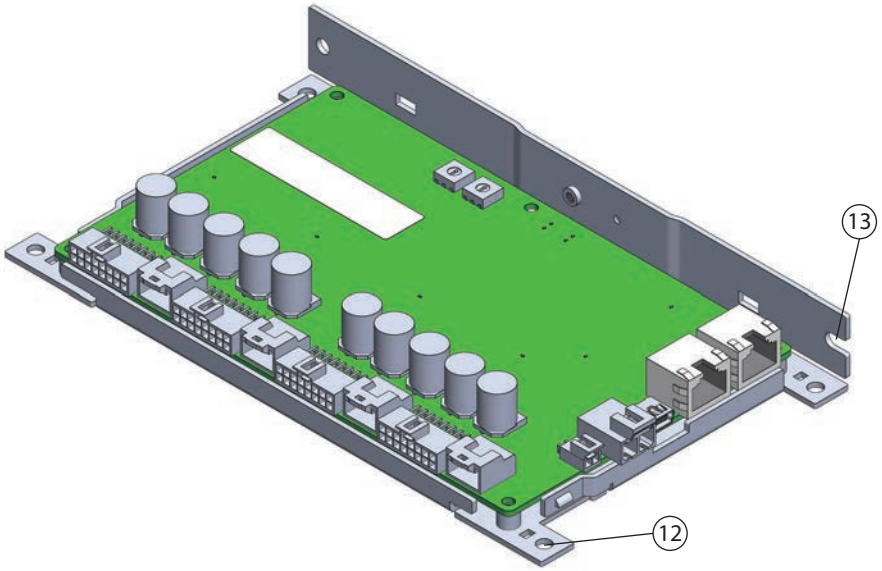
memo The position describing the information may vary depending on the product.

6-5 Names and functions of parts

The figure shows the driver whose shape is "Without mounting plate" and whose connector shape is "Vertical."



■ When the driver shape is "With mounting plate"



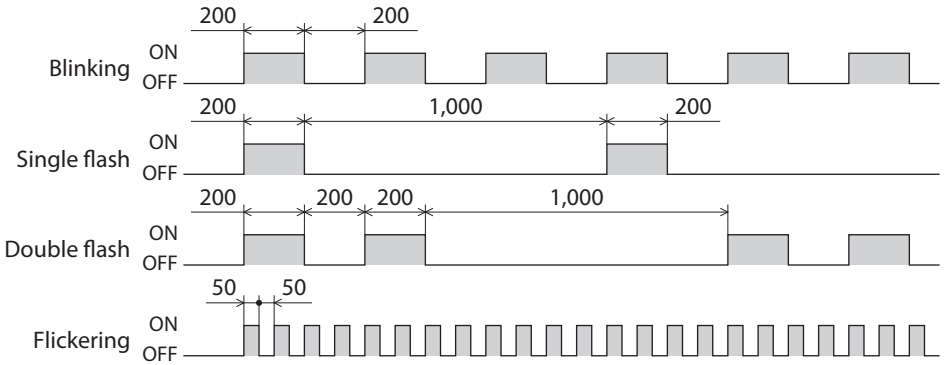
Number	Name	Description
1	PWR LED (Green)	This LED is lit while the control power supply is on.
	RUN LED (Green)	This LED indicates the communication status of EtherCAT.
	ALM LED (Red)	This LED blinks or is lit when an alarm is generated in the controller section.
	ERR LED (Red)	This LED blinks when an error has occurred in EtherCAT communication.
2	L/A LEDs (Green)	This LED indicates the LINK/ACT status of EtherCAT.
3	ALM1 to ALM4 LEDs (Red)	Each LED blinks when an alarm is generated in the corresponding driver section.
4	Node address setting switches [SW1 (×10), SW2 (×1)]	Sets the node address of the driver. Factory setting: 0 [SW1 (×10): 0, SW2 (×1): 0]
5	Control power supply connector [CN1]	Connects a control power supply. (24 VDC)
6	Main power supply connector [CN2]	Connects a main power supply. (24 VDC)
7	USB connector [CN3]	Use a USB cable to connect to a PC on which the **MEXE02** software has been installed. (USB2.0 mini-B port)
8	EtherCAT connector [CN5 IN, CN4 OUT]	• CN5 IN: Connects the EtherCAT compatible product on the host side. • CN4 OUT: Connects the EtherCAT compatible product of the next address number.
9	Motor connector [CN100, CN200, CN300, CN400]	Connects the motor, electromagnetic brake, and encoder.
10	I/O connector [CN101, CN201, CN301, CN401]	Connects the I/O signals.
11	Mounting hole	Install the driver with the screws.
12	Cutout for mounting A (4 places)	Install the driver with the screws.
13	Cutout for mounting B (2 places)	Install the driver with the screws.

memo The power ground (GND) of the CN1 and that of the CN2 are common internally.

6-6 Indication of LEDs

LED indicator	LED status*	Description
RUN (Green)	No light	Initialization state
	Blinking	Pre-Operational state
	Single flash	Safe-Operational state
	Light	Operational state (normal condition)
ERR (Red)	No light	No communication error
	Blinking	Communication setting error
	Single flash	Communication data error
	Double flash	Communication watchdog timeout
ALM (Red)	No light	No alarm in controller section
	Blinking	Alarm generated in controller section
	Light	CPU error
L/A (Green)	No light	No link
	Light	Link establishment
	Flickering	In operation after link establishment

* The blinking state of the LED is as follows. (Unit: ms)



7 Installation

7-1 Installation location

The driver is designed and manufactured to be incorporated 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 +50 °C [+32 to 122 °F] (non-freezing)
- Operating ambient humidity: 85 % or less (non-condensing)
- Area free of explosive atmosphere, 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
- Up to 1,000 m (3,000 ft.) above sea level

7-2 Installation direction

Install the driver in a vertical or horizontal position on a flat metal plate with excellent vibration resistance. If the driver is installed in a state other than vertical or horizontal position, its heat radiation effect will deteriorate.
The following items are required to install the driver. They must be provided by the user.

Items to be prepared	Driver shape is "Without mounting plate" and connector shape is "Vertical"	Driver shape is "Without mounting plate" and connector shape is "Right angle"	Driver shape is "With mounting plate"
M3 screw	6 pieces*1	4 pieces*1	4 pieces (2 pieces)*2
M3 spring washer	6 pieces*1	4 pieces*1	4 pieces (2 pieces)*2
M3 metal spacer	6 pieces*1	4 pieces*1	–

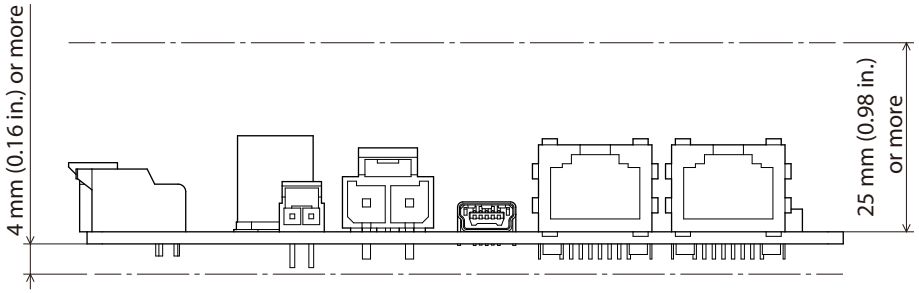
*1 Use items with a maximum outer diameter of 6 mm (0.24 in.) or less.

*2 The value in parentheses ( ) is the value when using the cutouts for mounting B.

memo

- Install the driver in an enclosure.
- Do not install any equipment that generates a large amount of heat or noise near the driver.
- Reconsider the ventilation condition if the ambient temperature of the driver exceeds 50 °C (122 °F).

Check the temperature monitor values of each axis via EtherCAT or with the **MEXE02** software under the operating conditions of the user's equipment, and check that there is sufficient margin for the "85 °C (185 °F)" threshold of the main circuit overheat alarm. The internal temperature of the driver is easily increased, especially when the Oriental Motor circuit product cover is attached.
Install the driver in a condition that provides the space from the enclosure or other equipment shown in the figure.



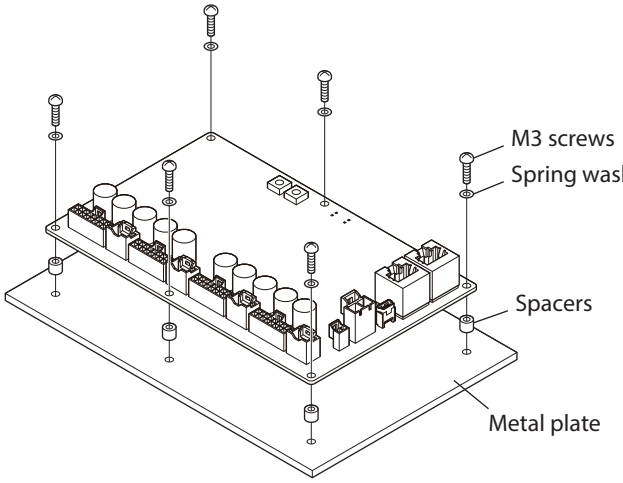
7-3 Installation method

■ When the driver shape is "Without mounting plate"

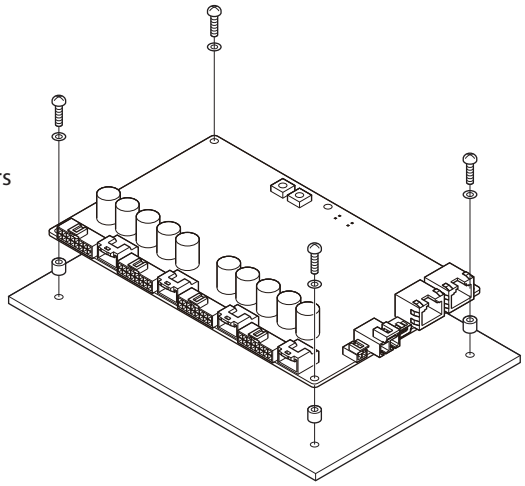
- **Horizontal installation**

  Install the driver in the direction shown in the figure. Installing the driver upside down will cause the heat radiation effect to deteriorate.

When the connector shape is "Vertical"



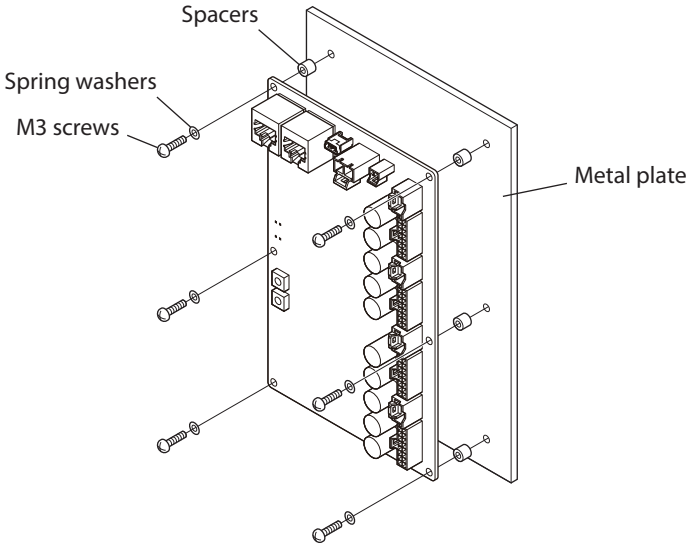
When the connector shape is "Right angle"



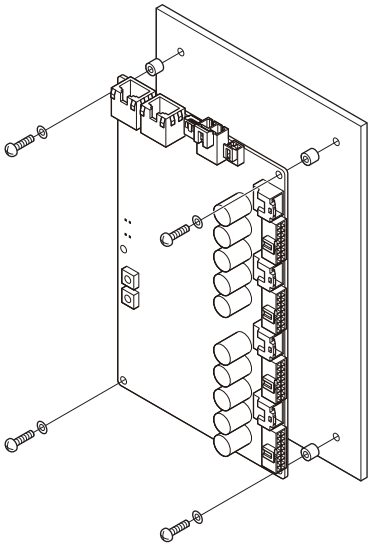
- **Vertical installation**

  The driver can be installed in any direction.

When the connector shape is "Vertical"



When the connector shape is "Right angle"



■ When the driver shape is "With mounting plate"

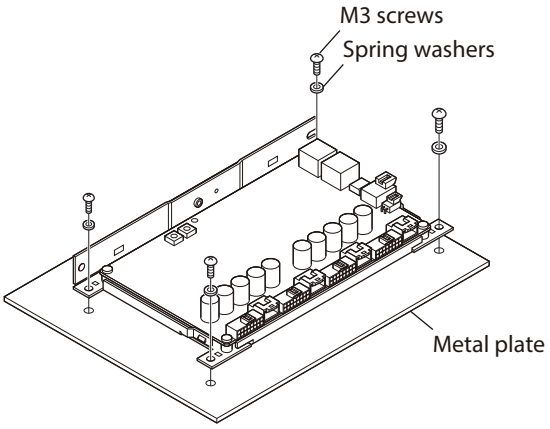
The figure shows the driver whose connector shape is "Right angle."

Note If both cutouts for mounting A and B are used for installation, the heat sink is distorted, causing stress on the board.

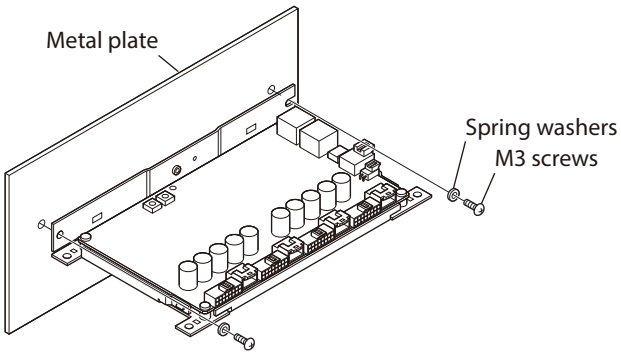
- **Horizontal installation**

  Install the driver in the direction shown in the figure. Installing the driver upside down will cause the heat radiation effect to deteriorate.

When using the cutouts for mounting A



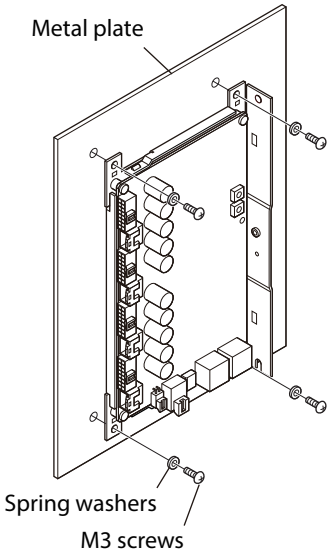
When using the cutouts for mounting B



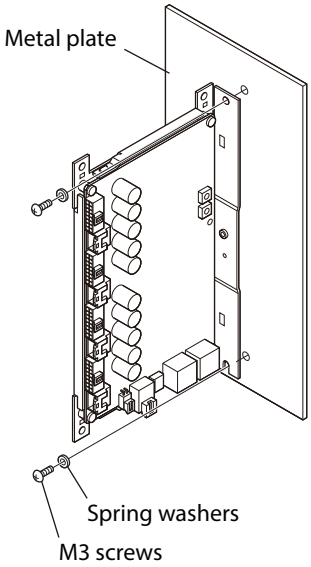
- **Vertical installation**

  The driver can be installed in any direction.

When using the cutouts for mounting A



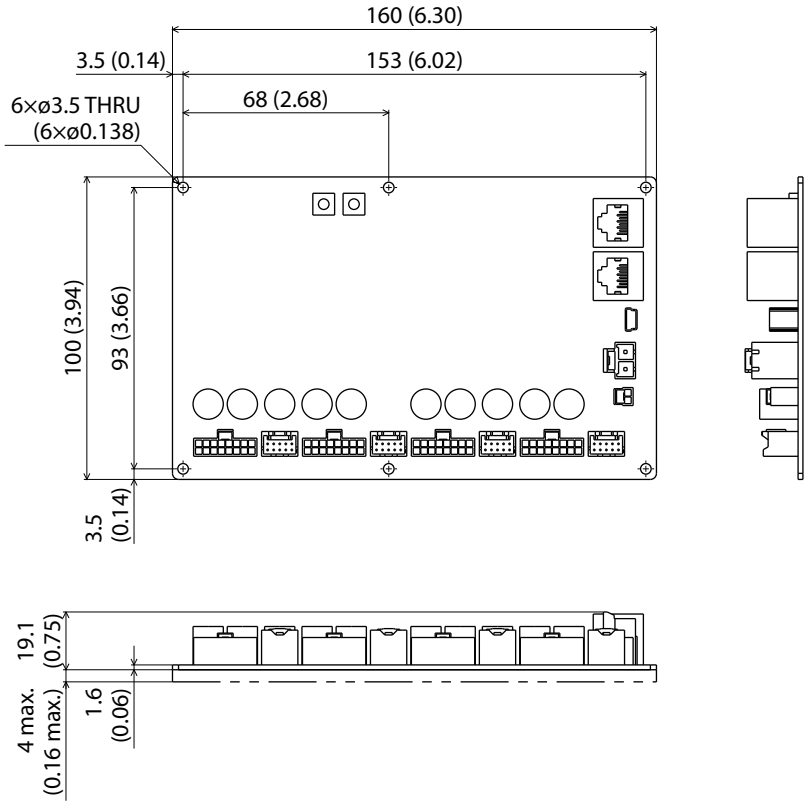
When using the cutouts for mounting B



■ Dimensions [Unit: mm (in.)]

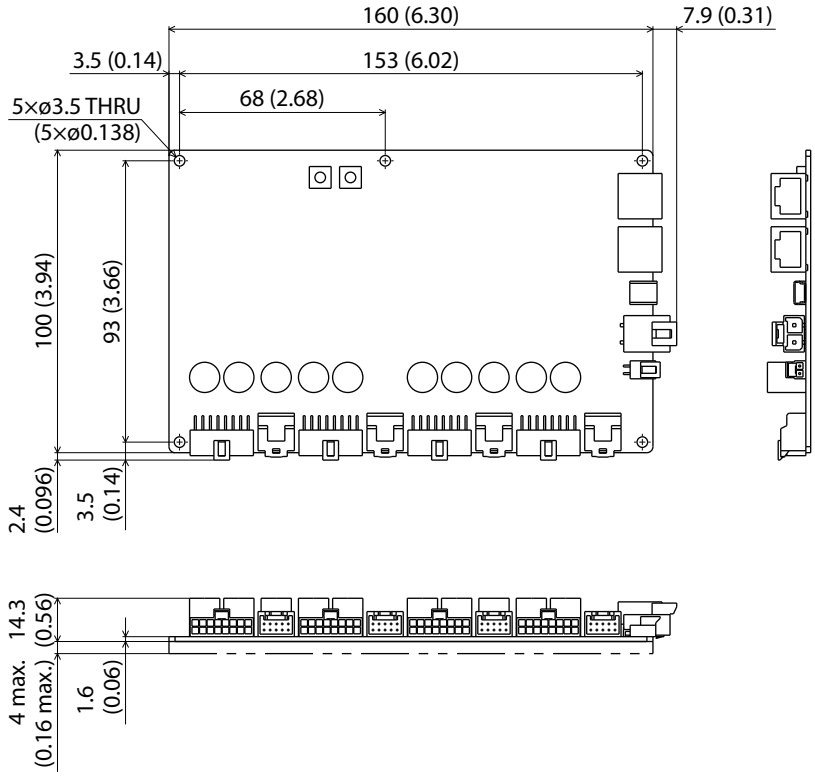
- **When the driver shape is "Without mounting plate" (Connector shape: Vertical)**

  Mass: 0.11 kg (0.24 lb.)



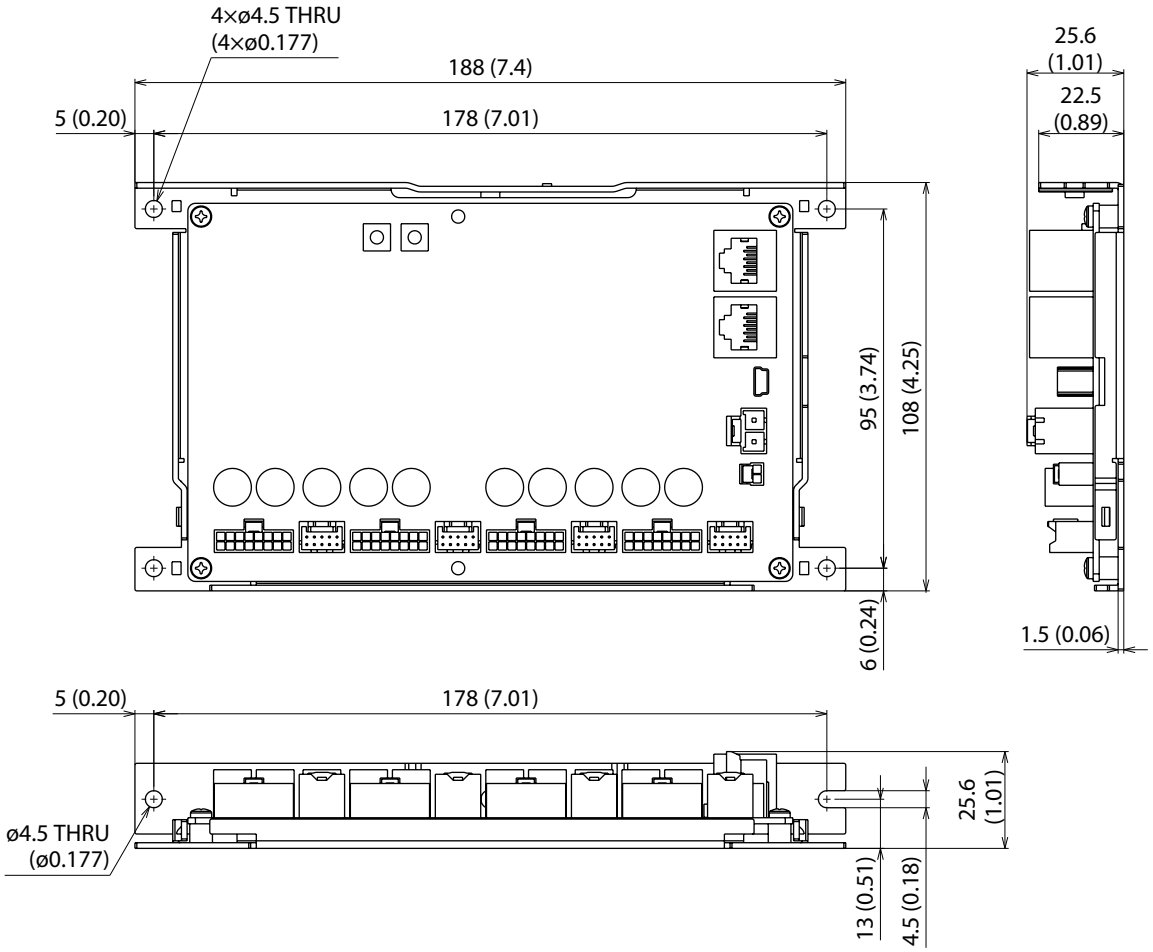
- **When the driver shape is "Without mounting plate" (Connector shape: Right angle)**

  Mass: 0.11 kg (0.24 lb.)



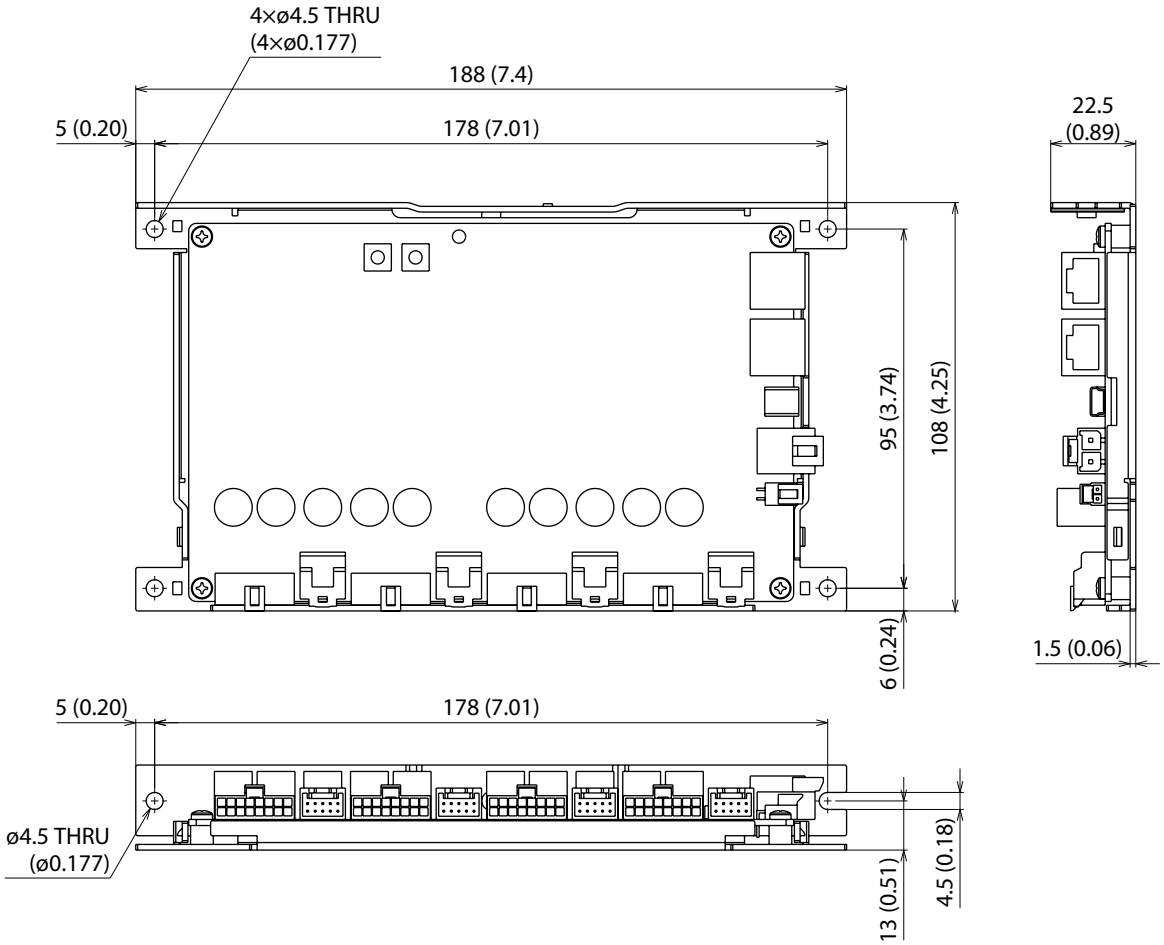
- **When the driver shape is "With mounting plate" (Connector shape: Vertical)**

  Mass: 0.21 kg (0.46 lb.)



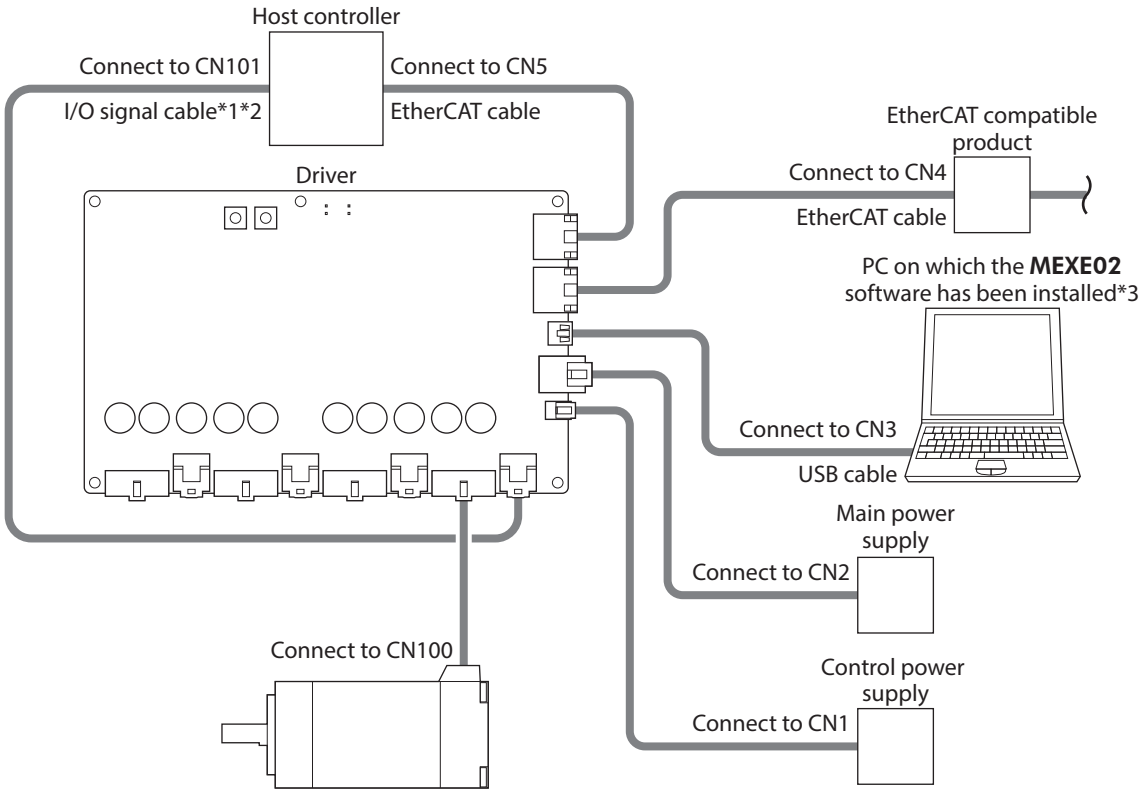
- **When the driver shape is "With mounting plate" (Connector shape: Right angle)**

  Mass: 0.21 kg (0.46 lb.)



8 Connection

8-1 Connection example



*1 It is provided in Oriental Motor products.

*2 Connect when using direct I/O or sensors.

*3 The PC must be supplied by the user.

Note

- When connecting, be sure to observe the correct polarity of the main power supply and the control power supply. The driver may be damaged if the polarity of the main power supply and the control power supply is reversed.
- Connect the connectors securely. Insecure connector connections may cause malfunction or damage to the driver.

memo

- When disconnecting the connector, pull out while pressing the latches on the connector with fingers.
- The lead wires of the "cable for electromagnetic brake" have polarities, so make sure to connect them according to the correct polarity. If the lead wires are connected with reversed polarity, the electromagnetic brake will not operate properly.
- Before connecting/disconnecting the connectors of the main power supply and control power supply, turn off the main and control power supplies and wait for the PWR LED to turn off.
- Before turning on the main power supply again, turn off the main power supply and wait at least 10 seconds. If the main power supply is turned off and then immediately on again, the voltage output may stop due to overcurrent protection caused by inrush current on the power supply side of the equipment.
- Do not wire the power supply cable in the same cable duct with other power line or connection cable.
- If the connection cable or the power supply cable generates an undesirable amount of noise due to the installation or wiring, shield the cable or install a ferrite core.
- Up to three cables can be used to connect a motor and driver. Maintain 10 m (32.8 ft.) or less for wiring distance between a motor and driver.

8-2 Connection for motor, encoder, and electromagnetic brake (CN100 to CN400)

■ Applicable connector

Manufacturer	Molex, LLC
Connector housing	1053081216
Contact	• AWG 20, AWG 22: 1053002200 • AWG 24, AWG 26: 1053001200
Designated crimp tool	• AWG 20, AWG 22: 0638275600 • AWG 24, AWG 26: 0638276000

■ Applicable lead wire

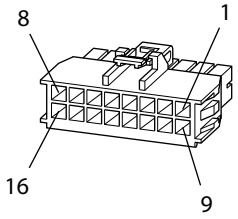
Use appropriate lead wires, taking into account the current of the motor to be connected.
Use the thickest cable possible, as longer cables may drop voltage and are more susceptible to noise.

Lead size	• AWG 22, AWG 20 (0.3 to 0.5 mm^2) • AWG 26, AWG 24 (0.14 to 0.2 mm^2)
Outer diameter of wire insulation	• AWG 22, AWG 20: ø1.60 mm (0.06 in.) • AWG 26, AWG 24: ø1.30 mm (0.05 in.)
Stripping length of wire insulation	2.50 to 3.50 mm (0.10 to 0.14 in.)

■ Pin assignment

Pin number	Signal name	Description
1	FG	Encoder shield
2	BLK	Motor lead wire Black
3	GRN	Motor lead wire Green
4	ORG	Motor lead wire Orange
5	RED	Motor lead wire Red
6	BLU	Motor lead wire Blue
7	MB–	Electromagnetic brake
8	MB+	
9	GND	Encoder ground
10	DC5V OUT	+5 V power output for encoder
11	Z–	Encoder input phase Z (differential input)
12	Z+	
13	B–	Encoder input phase B (differential input)
14	B+	
15	A–	Encoder input phase A (differential input)
16	A+	

Applicable connector
Housing insertion direction

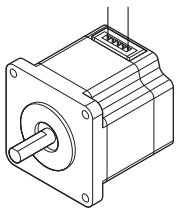


■ Connecting 2-phase stepping motors

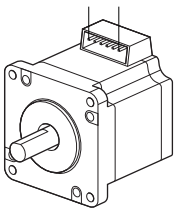
The pin assignments of the connector vary depending on the motor. Refer to the table when connecting. "Colors" in the table indicates the lead wire colors of the Oriental Motor connection cable.
Pin numbers are shown in the figures.

Note The model A and model B motors have different pin assignments. The motor does not rotate properly if the connection is wrong.

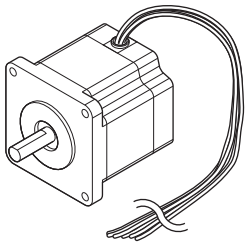
• Model A
Pin number → 5 1



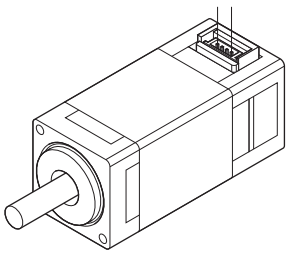
• Model B
Pin number → 1 6



• Model C



• Model D
Pin number → 4 1

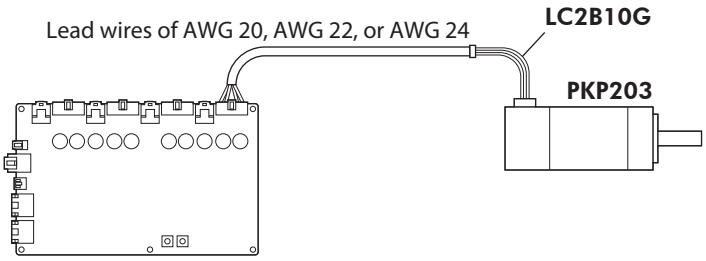


● Pin assignment

Motor		Pin number of CN100 to CN400 of driver				
		6	5	4	3	2
Model A	Pin number	4	5	–	2	1
	Color	Blue	Red	–	Green	Black
Model B	Pin number	1	3	–	6	4
	Color	Blue	Red	–	Green	Black
Model C	Color	Blue	Red	–	Green	Black
Model D	Pin number	3	4	–	2	1
	Color	Blue	Red	–	Green	Black

● Motors of frame size 13 mm (0.51 in.)

When the motor with a frame size of 13 mm (0.51 in.) [**PKP203**] is used, since the wire size of the connection cable (**LC2B10G**) is as small as AWG 28 (0.127 mm^2), connect to the driver by relaying with the lead wires of AWG 22, AWG 20 (0.3 to 0.5 mm^2), or AWG 24 (0.2 mm^2). Connection cables (without terminal processing) provided by Oriental Motor can also be used. Refer to p.32 for the models.



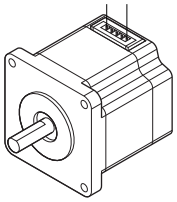
■ Connecting 5-phase stepping motors and motorized actuators

The pin assignments of the connector vary depending on the motor. Refer to the table when connecting. "Colors" in the table indicates the lead wire colors of the Oriental Motor connection cable.
Pin numbers are shown in the figures.

Note The model A and model B motors have different pin assignments. The motor does not rotate properly if the connection is wrong.

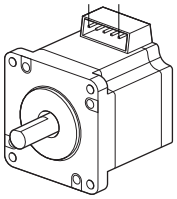
• Model A

Pin number → 5 1

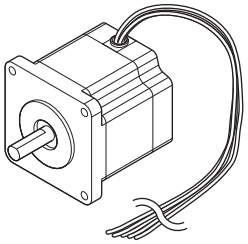


• Model B

Pin number → 1 5



• Model C



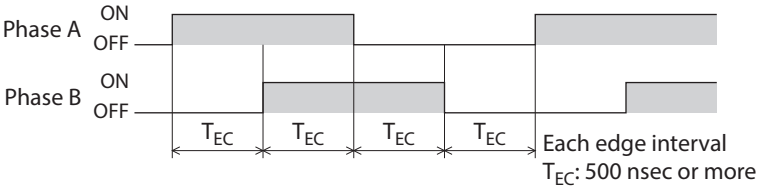
● Pin assignment

Motor		Pin number of CN100 to CN400 of driver				
		6	5	4	3	2
Model A	Pin number	5	4	3	2	1
	Color	Blue	Red	Orange	Green	Black
Model B	Pin number	1	2	3	4	5
	Color	Blue	Red	Orange	Green	Black
Model C	Color	Blue	Red	Orange	Green	Black

■ Specifications of encoder input section

Type	Item	Description
Phase A Phase B	Output type	Incremental
	Maximum frequency	500 kHz (each frequency of phase A and phase B)
	Edge interval	500 nsec or more
	Count range	−2,147,483,648 to +2,147,483,647 counts
	Count system	90-degree phase difference input
	Multiplication number	×4 multiplication
	Interface	Differential receiver*
Phase Z	Input width	1 ms or more
	Interface	Differential receiver*
5 V power output	Output voltage	5 VDC±10 %
	Output current	200 mA or less

* Use an encoder with electrical characteristics of 26C31 or equivalent.



Note Use the current consumption of a power supply for the encoder to be 200 mA or less. If it exceeds 200 mA, provide an external power supply for the encoder.

8-3 Connecting the control power supply (CN1)

■ Applicable connector

Manufacturer	Molex, LLC
Connector housing	1053071202
Contact	1053002200
Designated crimp tool	0638275600

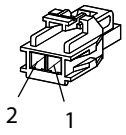
■ Applicable lead wire

Lead size	AWG 22, AWG 20 (0.3 to 0.5 mm^2)
Outer diameter of wire insulation	ø1.60 mm (0.06 in.)
Stripping length of wire insulation	2.50 to 3.50 mm (0.10 to 0.14 in.)

■ Pin assignment

Pin number	Signal name	Description
1	24 V (control power supply)	Control power supply (24 VDC)
2	GND	Power supply ground

Applicable connector
Housing insertion direction



■ Power supply current capacity

1.3 A or more (Excluding output power supply for sensor. Including current for electromagnetic brake control)
Keep the wiring distance of the cable as short as possible [2 m (6.6 ft.) or less].

8-4 Connecting the main power supply (CN2)

■ Applicable connector

Manufacturer	Molex, LLC
Connector housing	2004561212
Contact	• AWG 10: 1720630335 • AWG 12: 1720630333 • AWG 16, AWG 14: 1720630334
Designated crimp tool	• AWG 10: 2133096000 • AWG 12: 2238631300 • AWG 14: 2133091300 • AWG 16: 2133091400

■ Applicable lead wire

Lead size	• AWG 10 (6.00 mm^2) • AWG 12 (4.00 mm^2) • AWG 16, AWG 14 (1.50 to 2.50 mm^2)
Outer diameter of wire insulation	• AWG 10: ø3.607 mm (0.14 in.) • AWG 12: ø4.06 mm (0.16 in.) • AWG 16, AWG 14: ø3.15 to 3.58 mm (0.12 to 0.14 in.)

Stripping length of wire insulation	• AWG 10: 4.80 to 5.40 mm (0.19 to 0.21 in.) • AWG 12: 5.00 to 5.50 mm (0.20 to 0.22 in.) • AWG 16, AWG 14: 4.60 to 5.20 mm (0.18 to 0.20 in.)

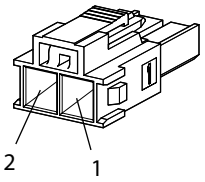
memo

- Keep the wiring distance of the cable as short as possible [2 m (6.6 ft.) or less] to suppress the effect of noise.
- Before turning on the main power supply again, turn off the main power supply and wait at least 10 seconds. If the main power supply is turned off and then immediately on again, the voltage output may stop due to overcurrent protection caused by inrush current on the power supply side of the equipment.

■ Pin assignment

Pin number	Signal name	Description
1	24 V (main power supply)	Main power supply (24 VDC)
2	GND	Power supply ground

Applicable connector
Housing insertion direction



■ Power supply current capacity

The current capacity for the main power supply varies depending on the product combined.
The current capacity of the main power supply is the sum of the power supply current capacities of the products used.

Product type	Product model*1	Input power supply voltage	Power supply current capacity
2-Phase stepping motors Bipolar	**PKP203D06A** **PKP213D05■** **PKP214D06■**	24 VDC±10 %	0.5 A or more
	PKP24□D08■2		0.8 A or more
	PKP26□D14■2		1.3 A or more
	PKP22□D15■ **PKP22□D15■2** **PKP22□MD15■** **PKP23□D15■** **PKP24□D15■** **PKP24□MD15■** **PKP262FD15A**		1.9 A or more
	PKP24□D15■2 **PKP24□MD15■2**		1.4 A or more
	PKP23□D23■ **PKP24□D23■** **PKP24□D23■2**		2.0 A or more
	PKP25□D28■A2 **PKP26□D28■** **PKP26□D28■2** **PKP26□MD28■** **PKP26□MD28■2**		3.0 A or more

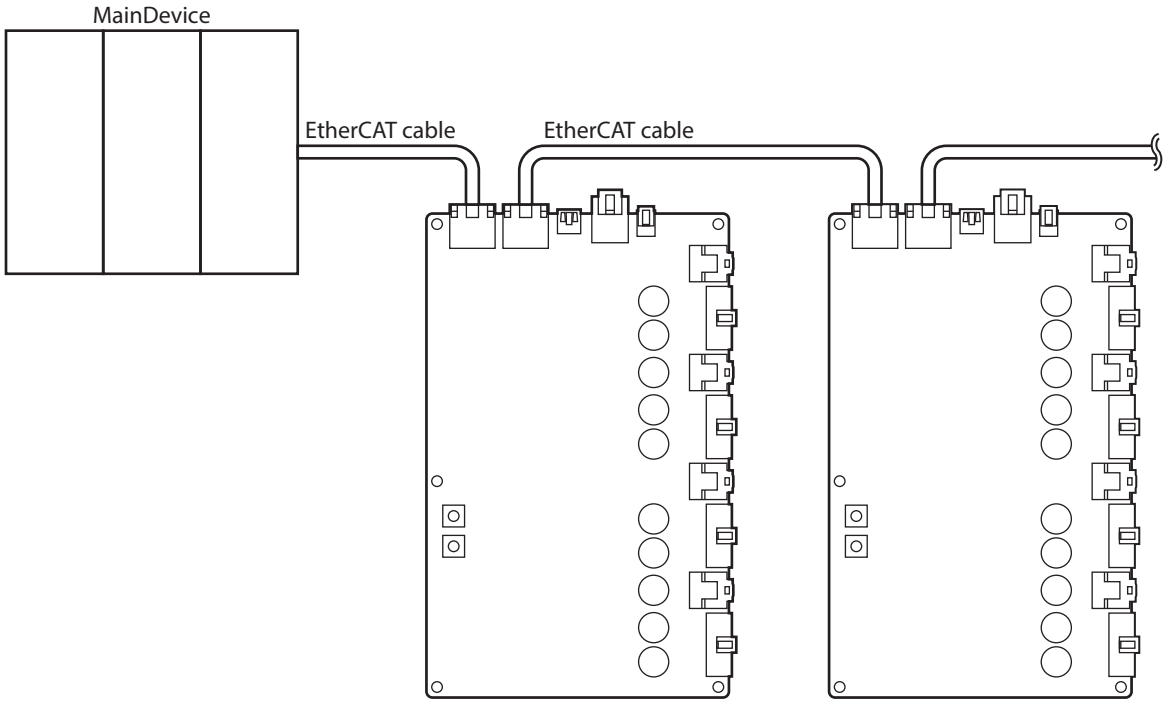
Product type	Product model*1	Input power supply voltage	Power supply current capacity
5-Phase stepping motors	**PK513** **PK52□P** **PKP52□MN03** **PKP52□N03**	24 VDC±10 %	0.6 A or more
	PK52□H **PK54□** **PKP52□MN07** **PKP52□N07**		1.4 A or more
	PKP52□N12		1.7 A or more
	PK56□*2		1.8 A or more
	PKP54□MN **PKP54□N18■** **PKP54□N18■2**		2.8 A or more
	PKP56□FMN **PKP56□FN24■2**		3.0 A or more
Motorized actuators	**DHM28PAK2** **DHM42PAK**	24 VDC±10 %	1.4 A or more
	DRLM20		0.6 A or more
	DRLM28 **DRLM42**		1.4 A or more
	DRLM60		1.8 A or more

*1 Product models in the table describe part of the whole name of the products. The driver can be combined with products that include the product models listed here. However, the motors with a voltage output type encoder are excluded.
The box (□) in the product model indicates a number representing the motor length.
The box (■) in the product model indicates **A** (single shaft), **B** (double shaft), or **M** (with an electromagnetic brake) representing the motor shape.

*2 Motors with a rated current of 1.4 A/phase are covered.

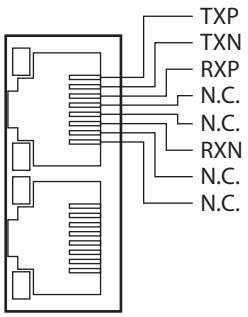
8-5 Connecting the EtherCAT cable (CN4, CN5)

Connect an EtherCAT MainDevice to the CN5 IN connector of the driver using the EtherCAT cable.
When connecting between drivers, be sure to connect from the CN4 OUT connector to the CN5 IN connector.



■ Pin assignment

Signal name	Description
TXP	Transmitted data +
TXN	Transmitted data –
RXP	Received data +
N.C.	–
N.C.	–
RXN	Received data –
N.C.	–
N.C.	–



8-6 Connecting the USB cable (CN3)

Using a USB cable with the following specifications, connect a PC on which the **MEXE02** software has been installed to the USB connector (CN3).

Specifications	USB2.0 (full speed)
Cable	Length: 3 m (9.8 ft.) or less Shape: A to mini B

memo
- Connect the driver and a PC directly using a USB cable.
- In large electrically noisy environments, use the USB cable with a ferrite core or install a ferrite core on the USB cable.

8-7 Connecting the I/O signals (CN101 to CN401)

■ Applicable connector

Manufacturer	Molex, LLC
Connector housing	5016461000
Contact	• AWG 26, AWG 24, AWG 22: 5016471100 • AWG 28, AWG 26: 5016481000
Designated crimp tool	• AWG 26, AWG 24, AWG 22: 638192300 • AWG 28, AWG 26: 638192400

■ Applicable lead wire

Lead size	• AWG 26, AWG 24, AWG 22 (0.126 to 0.34 mm^2) • AWG 28, AWG 26 (0.079 to 0.136 mm^2)
Outer diameter of wire insulation	• AWG 26, AWG 24, AWG 22: ø0.95 to 1.50 mm (0.04 to 0.06 in.) • AWG 28, AWG 26: ø0.85 to 1.40 mm (0.03 to 0.06 in.)
Stripping length of wire insulation	2.10 to 2.50 mm (0.08 to 0.10 in.)

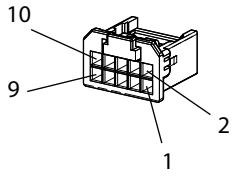
memo
- Keep the wiring distance of the cable as short as possible [2 m (6.6 ft.) or less] to suppress the effect of noise.
- Twisted-pair wires or shielded wires are recommended for the I/O signal cable.

■ Pin assignment

Pin number	Signal name	Description*
1	IN-COM	Input common
2	IN0	Control input 0 (FW-LS)
3	IN1	Control input 1 (RV-LS)
4	IN2	Control input 2 (HOMES)
5	IN3	Control input 3 (FREE)
6	GND	GND
7	OUT+	Control output (ALM-B)
8	OUT–	
9	IN-COM	Input common
10	+24 V	Output power supply for sensor

* Values in parentheses ( ) are initial values.

Applicable connector
Housing insertion direction



■ Specifications of output power supply for sensor

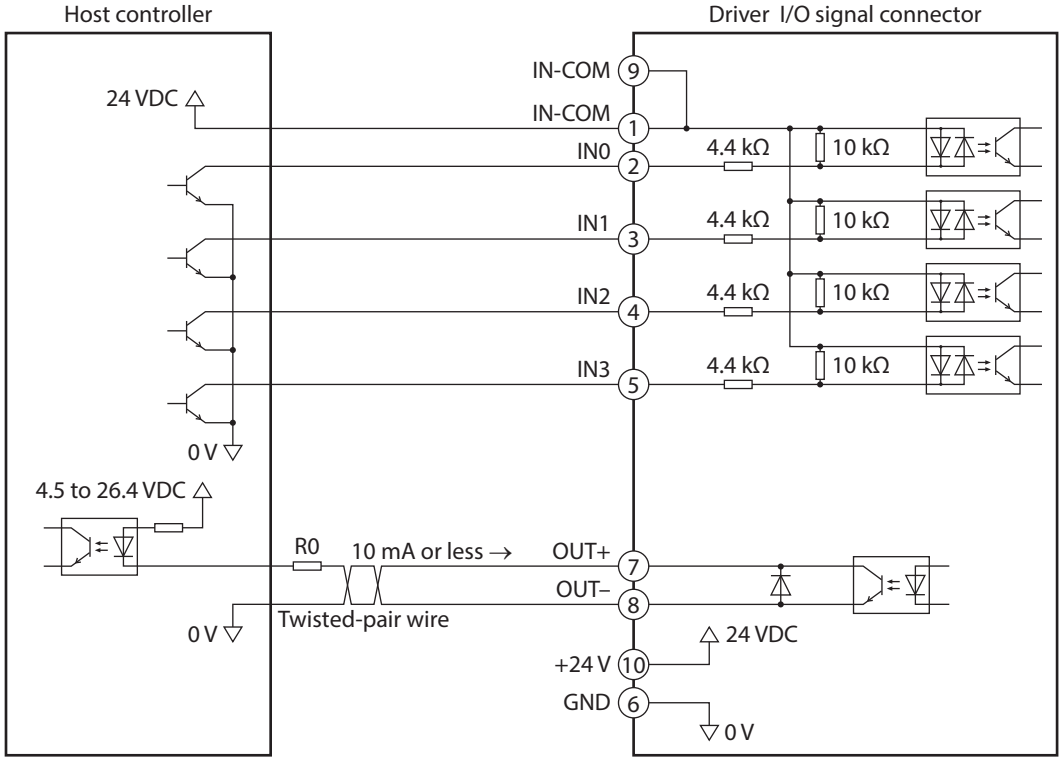
- Output voltage: 24 VDC±5 % (supplied from control power supply)
- Output current: 250 mA or less

■ Connection diagram

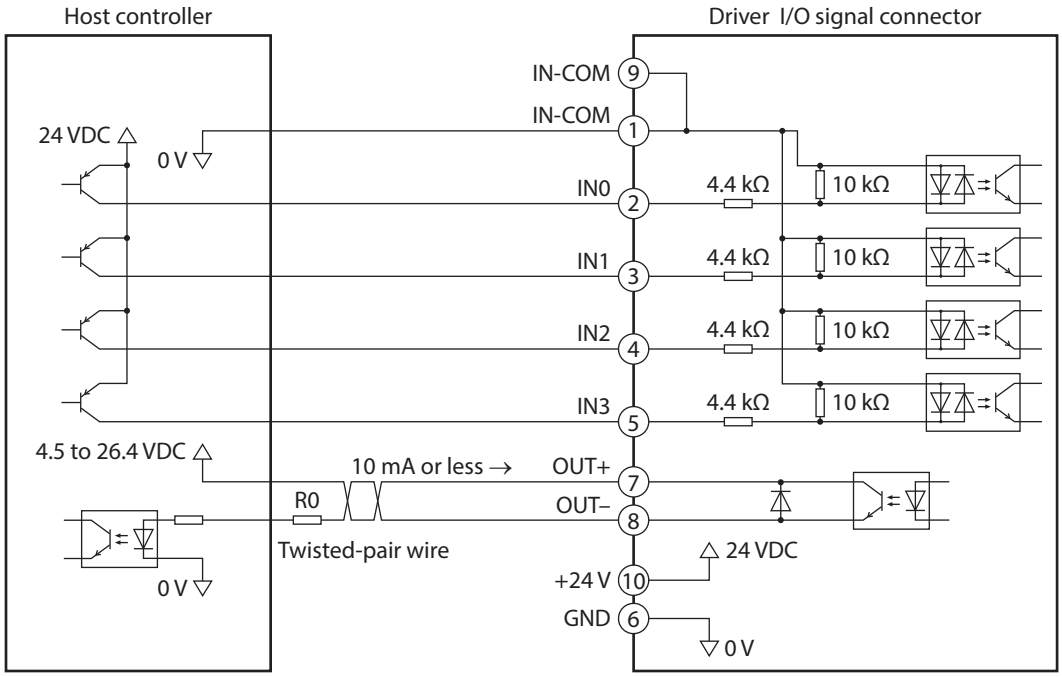
memo

- Use input signals at 24 VDC.
- Use output signals at 4.5 to 26.4 VDC, 10 mA or less. If the current exceeds 10 mA, connect an external resistor R0 to keep the current to 10 mA or less.

● Connection example with a current sink output circuit



● **Connection example with a current source output circuit**



8-8 Noise elimination measures

There are two types of electrical noises: One is a noise to invade into the driver from the outside and cause the driver malfunction, and the other is a noise to emit from the driver and cause peripheral equipment malfunction.
For the noise that is invaded from the outside, take measures to prevent the driver malfunction. It is necessary to take appropriate measures because the signal lines are very likely to be affected by the noise.
For the noise that is emitted by the driver, take measures to suppress it.

■ Measures against electrical noise

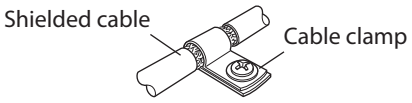
There are the following three methods mainly to take measures against the electrical noise.

● **Noise suppression**

- When relays or electromagnetic switches are used, use noise filters or CR circuits to suppress surge generated by them.
- Cover the driver by a metal plate such as aluminum. This is effective in shielding the electrical noise emitted from the driver.

● **Prevention of noise propagation**

- Use shielded cables for connection and ground both ends. If unshielded cables are used, evaluate thoroughly on customer equipment.
- Keep cables as short as possible without coiling and bundling extra lengths.
- Grounding multiple points will increase the effectiveness of blocking electrical noise because the impedance at the grounding points will be reduced. However, ground them so that a potential difference does not occur among the grounding points.
- To ground a shielded cable, use a metal cable clamp that can maintain contact with the entire circumference of the shielded cable, and ground as near the product as possible.



● **Suppression of effect by noise propagation**

- Wrap the noise propagating cable around a ferrite core. This will prevent the propagated noise from entering into the driver or from being emitted from the driver. The frequency band in which an effect of the ferrite core can be seen is generally 1 MHz or more. Check the frequency characteristics of the ferrite core used. To increase the noise attenuation effect of the ferrite core, wrap the cable several more times.

■ Oriental Motor's noise suppression products

Refer to p.34 for the model.

- **Surge suppressors**

  These are effective in suppressing the surge that occurs in a contact part of the relay. Connect when using a relay or electromagnetic switch. A CR circuit for surge suppression and a CR circuit module are provided.

8-9 Compliance with EMC Directive/Regulations

Effective measures must be taken against the EMI that the motor and driver may give to adjacent control system equipment, as well as the EMS of the motor and driver itself, to prevent the occurrence of serious malfunctions in the functions of the mechanical device. Use of the following installation and wiring methods will enable the motor and driver to comply with the EMC Directive/Regulations.
Oriental Motor conducts EMC testing on its motors and drivers in accordance with "Example of installation and wiring" on p.29.
The user is responsible for ensuring that the machine complies with EMC based on the installation and wiring described below.

⚠CAUTION

This equipment is not intended for use in residential environments nor for use on a low-voltage public network supplied in residential premises, and it may not provide adequate protection to radio reception interference in such environments.

- **Connecting the main power supply and control power supply**

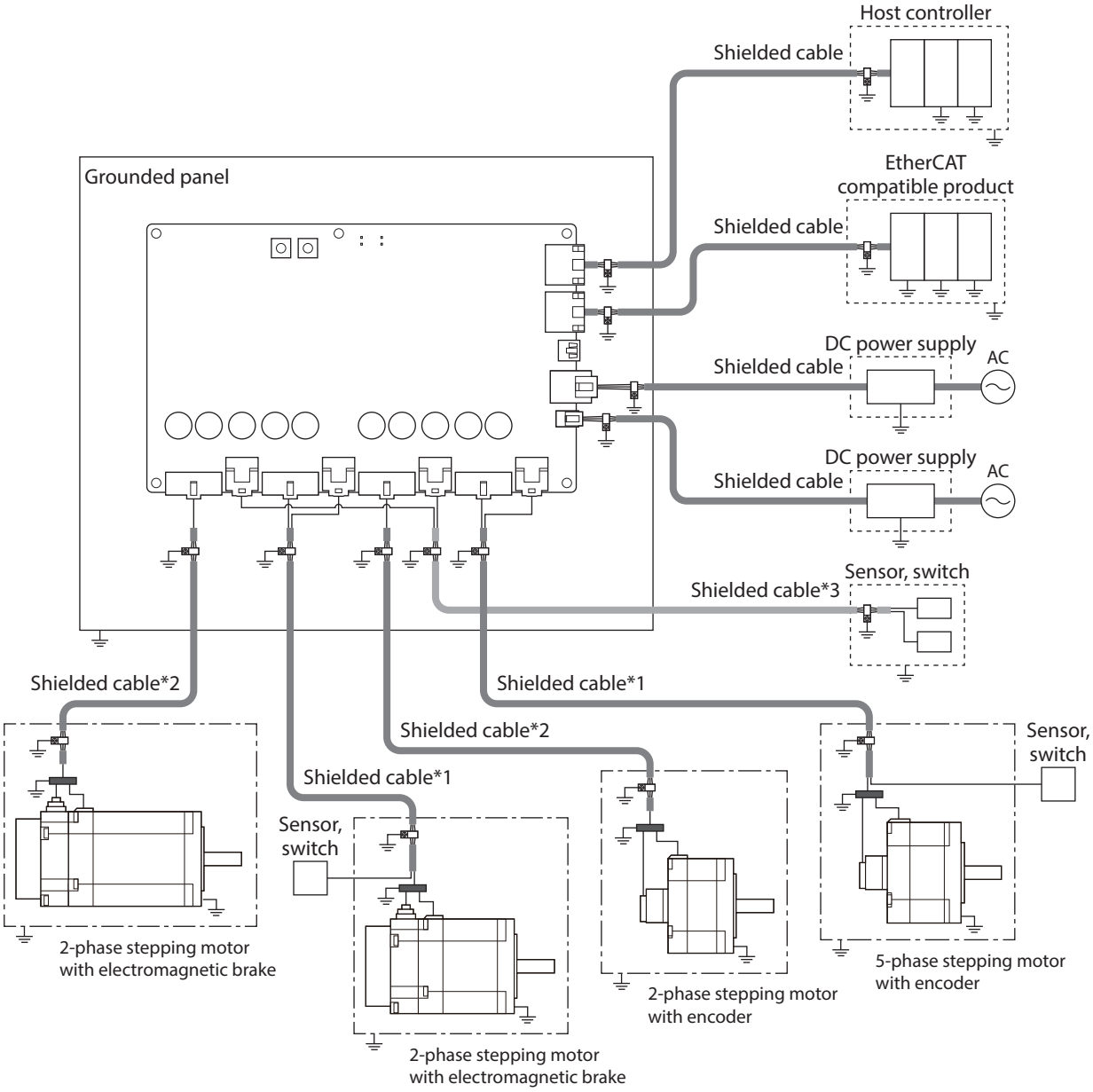
  The driver is a product of DC power input. Use a DC power supply (switched-mode power supply, etc.) that complies with the EMC Directive/Regulations.

- **Connecting the signal cables**

  Refer to "Prevention of noise propagation" on p.27.

- **Grounding method**
  - The wires used to ground the motor and the driver must be as thick and as short as possible so that there is no potential difference between the grounding points.
  - Choose a large, thick, and uniformly conductive surface for the grounding point.
  - Install the motor to a grounded metal plate.

- **Example of installation and wiring**



Notation in figure	Description
⏚	Grounding
—·—·—	Grounded panel for motor
- - - - - -	Shielding box
	Cable clamp

Notation in figure	Description
	Relay connector
	Cable
	Lead wire

- For the braided-shielded wires of the shielded cables of *1 and *2, connect them to the FG terminal of the motor connector and the grounded panel for motor.
- Refer to the table below for the shielded cables of *1 to *3.

Number	Cable part number	Length [m (ft.)]	
		EMI	EMS
*1	CF10.02.25 (igus) Number of conductors: 25 Conductor cross-sectional area: 0.25 mm^2	1 (3.3)	3 (9.8)
*2		0.5 (1.6)	
*3		3 (9.8)	

Note The driver uses components that are sensitive to static electricity. Take measures against static electricity as it may cause the driver to malfunction or be damaged.

9 Setting

9-1 Setting of node address

Set the node address of the driver using two node address setting switches (SW1, SW2).
The node address setting switch is hexadecimal. Convert the node address from decimal to hexadecimal to set.
When connecting two or more EtherCAT compatible products, set the node addresses so that they are not duplicated.

Factory setting: 0 [SW1 (×10): 0, SW2 (×1): 0]

Setting range	Description
0 (00h)	The setting of the MainDevice is enabled.
1 to 255 (1h to FFh)	The setting of the driver is enabled.

memo Be sure to turn off the control power supply of the driver before setting the switches. Setting the switches while the control power supply is on will not enable the new setting.

10 Inspection and maintenance

10-1 Inspection

It is recommended that the following items be checked periodically after each operation of the motor. If any abnormality occurs, discontinue use of the product and contact your nearest Oriental Motor sales office.

■ Inspection items

- Check to see if any of the mounting screws secured the driver are loose.
- Check to see if the connection part with the connector is loose.
- Check to see if there is no dust adhering to the driver.
- Check to see if the driver has an abnormal odor or has defects in its appearance.

Note The driver uses semiconductor components. Since static electricity may damage semiconductor components, be extremely careful when handling it.

10-2 Warranty

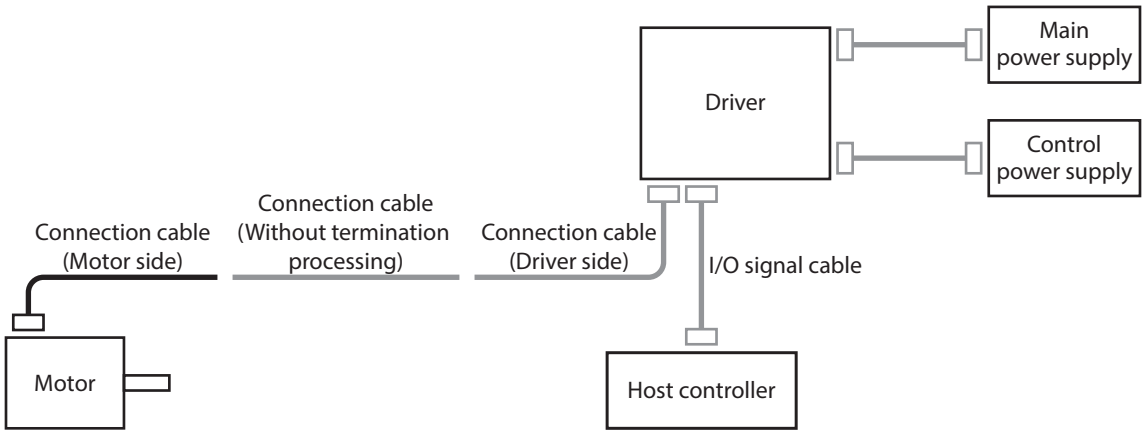
Check on the Oriental Motor Website for the product warranty.

10-3 Disposal

Dispose the product correctly in accordance with laws and regulations, or instructions of local governments.

11 Cables

This chapter describes cables shown in gray in the figure.



11-1 Connection cables (Driver side)

These are dedicated cables for multi-axis drivers. A connector is assembled on the driver side.

■ 2-Phase

Model	Length [m (ft.)]	Number of lead wire cores	Description
LCD06CA-2M	0.6 (2)	4 pieces	Motor lead wires
LCD06CA-2MB		6 pieces	Motor lead wires, electromagnetic brake lead wires
LCD06CA-2ME		13 pieces	Motor lead wires, encoder lead wires

■ 5-Phase

Model	Length [m (ft.)]	Number of lead wire cores	Description
LCD06CA-5M	0.6 (2)	5 pieces	Motor lead wires
LCD06CA-5MB		7 pieces	Motor lead wires, electromagnetic brake lead wires
LCD06CA-5ME		14 pieces	Motor lead wires, encoder lead wires

11-2 Connection cables (Without termination processing)

These cables are used to extend the wiring distance between a motor and a driver.

■ Connection cables

Model	Length [m (ft.)]	Lead wire size	Outer diameter
CC05PK5	5 (16.4)	AWG 22 (0.3 m^2)	ø7.2 mm (0.28 in)
CC10PK5	10 (32.8)		

■ Flexible connection cables

These cables are used for 5-phase stepping motors and motorized actuators. They cannot be used for 2-phase stepping motors.

Model	Length [m (ft.)]	Lead wire size	Outer diameter
CC05PK5R	5 (16.4)	AWG 22 (0.3 m^2)	ø5.8 mm (0.23 in.)
CC10PK5R	10 (32.8)		

11-3 I/O signal cables

These cables are used when connecting the I/O signals of the host controller to the driver.

■ Connector assembly type

This is a cable that allows a simple and easy connection with the driver.
A connector is assembled at the driver side.

Model	Length [m (ft.)]	Number of poles
LCD06CA-S	0.6 (2)	10

■ General-purpose type

These are shielded cables for control I/O of the driver, providing excellent noise immunity. The ground wires useful for grounding come out of both ends of the cable.
Select the cable suitable for the number of I/O signals connected.

Model list

Length [m (ft.)]	Number of lead wire cores	
	6 pieces	10 pieces
0.5 (1.6)	**CC06D005B-1**	**CC10D005B-1**
1 (3.3)	**CC06D010B-1**	**CC10D010B-1**
1.5 (4.9)	**CC06D015B-1**	**CC10D015B-1**
2 (6.6)	**CC06D020B-1**	**CC10D020B-1**

11-4 Power supply cable

These are cables with a connector for connecting a driver and a power supply.

Model	Length [m (ft.)]	Type
LC02D06C	0.6 (2)	For main power supply
LC02D06D		For control power supply

12 Accessories

12-1 Relay contact protection circuit/module

- **CR circuit for surge suppression**

  This product is effective for the suppression of the surge that occurs in a contact part of the relay. Use it to protect the contacts of the relay or switch.

  Model: **EPCR1201-2**

- **CR circuit module**

  This product is effective for the suppression of the surge that occurs in a contact part of the relay. Use it to protect the contacts of the relay or switch.
  Four pieces of CR circuit for surge suppression are mounted on the compact circuit, and this product can be installed to the DIN rail. This product can make the wiring easily and securely since it also supports terminal block connection.

  Model: **VCS02**

- **Circuit product cover**

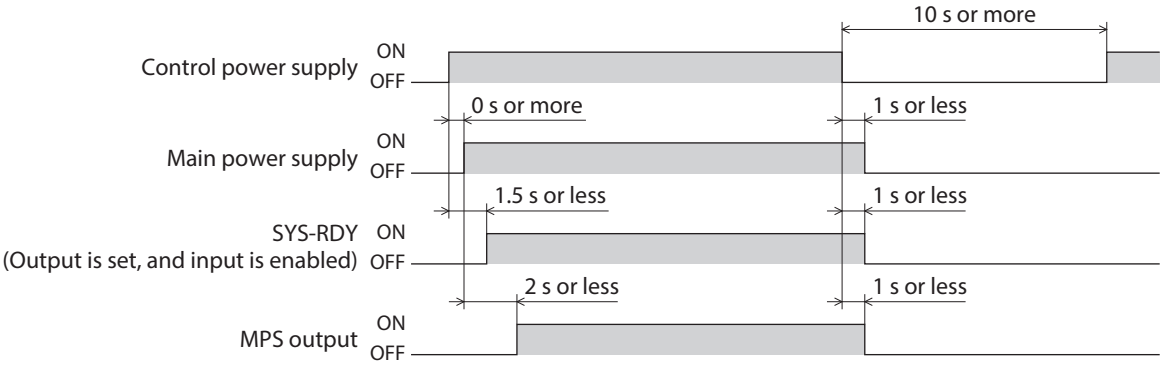
  This is a cover to prevent contact with the live parts and to protect the board.
  It can be used for the driver whose shape is "With mounting plate" and whose connector shape is "Right angle."

  Model: **PADC-CVD4ARED**

13 Appendix

13-1 Timing chart

■ Power activation



13-2 Specifications

■ Product specifications

Main power supply	Input voltage	24 VDC±10 %
	Input current	0.5 to 3.0 A per axis (12 A maximum)*1
Control power supply	Input voltage	24 VDC±5 %
	Input current	1.3 A*2
Interface	Control input	Number of input points: 4, photocoupler
	Control output	Number of output points: 1, photocoupler, open collector
	Field network	EtherCAT

*1 It varies depending on the product combined. Refer to p.23.
*2 Excluding the output power supply for sensor.

■ General specifications

Degree of protection		IP00
Operating environment	Ambient temperature	0 to +50 °C [+32 to +122 °F] (non-freezing)
	Humidity	85 % or less (non-condensing)
	Altitude	Up to 1,000 m (3,300 ft.) above sea level
	Surrounding atmosphere	No corrosive gas or dust. No exposure to water or oil.
Storage environment Shipping environment	Ambient temperature	−25 to +70 °C [−13 to +158 °F] (non-freezing)
	Humidity	85 % or less (non-condensing)
	Altitude	Up to 3,000 m (10,000 ft.) above sea level
	Surrounding atmosphere	No corrosive gas or dust. No exposure to water or oil.

13-3 Regulations and standards

■ UL Standards, CSA Standards

CVD4A-KED and **CVD4AR-KED** are recognized by UL under UL and CSA Standards.

■ CE Marking / UKCA Marking

This product is affixed with the marks under the following directive/regulations.

- **EU EMC Directive / UK EMC Regulations**
  Refer to "8-9 Compliance with EMC Directive/Regulations" on p.28 for details on compliance.
- **EU RoHS Directive / UK RoHS Regulations**
  This product does not contain the substances exceeding the restriction values.

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