Oriental motor

Drivers for 5-Phase Stepping Motors

CVD Series

Fully Closed-Loop Control Type

OPERATING MANUAL

Thank you for purchasing an Oriental Motor product.

This Operating Manual describes product handling procedures and safety precautions.

• Please read it thoroughly to ensure safe operation.

• Always keep the manual where it is readily available.

Table of contents

1 Introduction

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 "2 Safety precautions" on p.5. In addition, be sure to observe the contents described in warning, caution, and note in this manual.
The product described in this manual is designed and manufactured to be incorporated into 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 About operating manuals

■ Related operating manuals

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

- **CVD** Series Fully Closed-Loop Control Type OPERATING MANUAL (this document)
- **CVD** Series Fully Closed-Loop Control Type OPERATING MANUAL Function Edition

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

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

1-3 How to use operating manuals
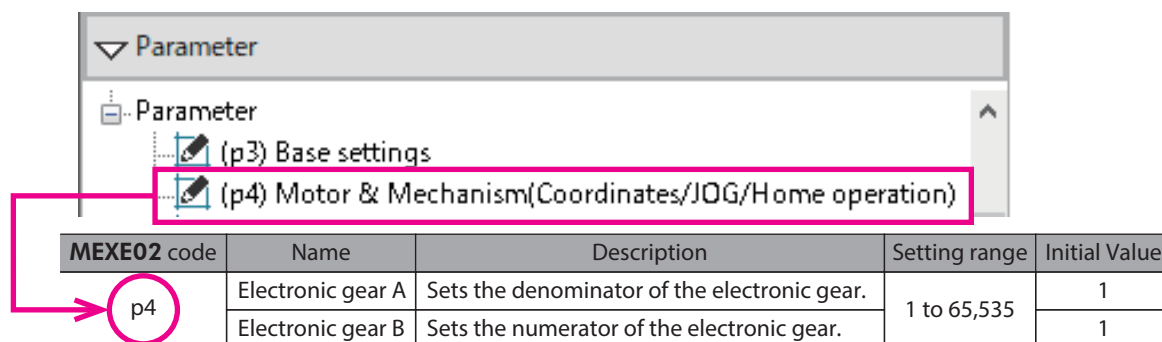
This product can be controlled by pulse input or RS-485 communication.
This manual describes the contents related to the hardware and pulse input. For how to control or monitor operation via RS-485 communication, refer to the **CVD** Series Fully Closed-Lop Control Type OPERATING MANUAL Function Edition.

■ When the screen display of the MEXE02 support software is described

When the screen display of the **MEXE02** software version 4 is described, it may be indicated using a number such as "(p10)" described in front of the parameter type.

Example of description

MEXE02 code	Name	Description	Setting range	Initial Value
p4	Electronic gear A	Sets the denominator of the electronic gear.	1 to 65,535	1
	Electronic gear B	Sets the numerator of the electronic gear.		1

1-4 Overview of the product

The **CVD** Series fully closed-loop control type driver is a DC input driver for 5-phase stepping motors.

■ Equipped with the fully closed-loop correction function

The fully closed-loop correction function is a function that corrects the positional displacement of the motor with high accuracy using the information from the externally installed encoder. This product directly reads the position of an object (load, table, machine, etc.) with an external encoder, compares it with the command position (target position) inside the driver, and corrects the motor position. Therefore, there is no need for the host controller to correct an error due to gear backlash, lead screw pitch, torsion, elongation, etc. that exists between the motor and the object.
When the difference (position deviation) between the command position and the feedback position becomes a certain value or less, the driver completes the positioning and automatically switches to open-loop mode. In open-loop mode, since position information is not fed back, operation can be performed without hunting.

■ Low vibration and low noise

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

■ Operation by pulse input

Operation is performed by inputting pulses to the driver using a host controller.

■ Compatible with network communication

The driver is compatible with Modbus RTU (RS-485 communication) and can monitor the present position information. Also, operation data and parameters can be set, and operation can be started and stopped via RS-485 communication. Operation data and parameters can also be set using the **MEXE02** software.

2   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.

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 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.
- Use a DC power supply with reinforced insulation on its primary and secondary sides for a main power supply. 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 insert a finger or an object between the board and the heat sink. Doing so may result in fire or injury.
- 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 result in 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, 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 any abnormality is observed, stop the operation immediately to turn off the main power supply. Failure to do so may result in fire or injury.

3   Precautions for use

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

● **When conducting the insulation resistance measurement or the dielectric strength test, be sure to separate the connection between the motor and the driver.**

Conducting the insulation resistance measurement or the dielectric strength test with the motor and driver connected may result in damage to the product.

● **Note when connecting a power supply whose positive terminal is grounded**

The USB connector (CN3) on the driver is not electrically insulated. When grounding the positive terminal of the main 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 main power supply while writing the data to non-volatile memory, and also do not turn off for five seconds after writing is 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.26 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.

4 Preparation

4-1 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.

4-2 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 5 B R - K F
   1   2   3   4   5   6

1	Series	**CVD**: **CVD** Series
2	Number of phases of motor	**5**: 5-phase
3	Driver shape	**B**: With mounting plate
4	Connector shape	**R**: Right-angle Blank: Vertical
5	Power supply input	**K**: DC power supply
6	Type	**F**: Fully closed-loop control type

4-3 Products that can be combined

Products with which the driver can be combined are listed below. Check the product model with the nameplate. Models in the table describe part of the entire name of models. The driver can be combined with products that include the product models listed here.
Note, however, that the motors with an encoder are excluded.

- The box (□) in the motor model indicates a number representing the motor length.
- The box (■) in the motor model indicates **A** (single shaft) or **B** (double shaft) representing the motor shaft shape.

Product type	Applicable Series	Product to be combined	
5-Phase stepping motors	**PKP** Series	**PKP52□N12** **PKP52□MN03** **PKP52□MN07** **PKP54□MN**	**PKP54□N18■** **PKP54□N18■2** **PKP56□FMN** **PKP56□FN24■2**
	PK Series	**PK513** **PK52□H** **PK52□P**	**PK54□** **PK56□***
Motorized actuators	**DH** Series	**DHM28PAK2**	**DHM42PAK**
	DRLII Series	**DRLM20** **DRLM28**	**DRLM42** **DRLM60**

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

4-4　Information about nameplate

The figure shows an example.

Driver model →
Serial number →

CVDXXXXXXX-XX
RS6 0123456　　　2024/05
ORIENTAL MOTOR CO., LTD.
TOKYO 110-8536 JAPAN
MADE IN JAPAN

Manufacturing date

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

4-5　Names and functions of parts

The figure shows the driver whose connector shape is right-angle.

Type	Name	Description
LED indicators	PWR/ALM LED (LED1: Green/Red)	• This LED is lit while the main power supply is turned on. • If an alarm (protective function) is generated, the LED will blink in red. • If information is generated, the LED will blink twice in green and red colors simultaneously. (Green and red colors may overlap and it may be visible to orange.)
	C-DAT/C-ERR LED (LED2: Green/Red)	• This LED blinks or is lit in green when the driver is communicating properly with the host controller via RS-485 communication. • It is lit in red when an error occurs in communication with the host controller via RS-485 communication.
Switches	Address number setting switch (SW1)	This is used to set the address number (server address) of RS-485 communication. Factory setting: 1
	Termination resistor setting switch (SW2)	This is used to set the termination resistor (120 Ω) of RS-485 communication. Factory setting: Both Nos. 1 and 2 are OFF (Termination resistor disabled)
Connectors	Power supply connector (CN1)	Connects a main power supply.
	Motor connector (CN2)	Connects the motor.
	USB connector (CN3)	Connects a PC on which the **MEXE02** software has been installed. (USB2.0 mini-B port)

Type	Name	Description
Connectors	RS-485 connector (CN4)	Connect a host controller.
	Encoder input connector (CN5)	Connects the encoder.
	I/O signal connector (CN6)	Connects the I/O signal cable.
	Encoder output connector (CN7)	Signals input to the CN5 connector are output.

4-6 Indication of LEDs

The status of the driver and RS-485 communication can be checked using the indication of LEDs.

■ PWR/ALM LED (LED1)

The status of the driver can be checked.

Green	Red	Description
No light	No light	The main power supply is not turned on.
Light	No light	The main power supply is in a state of being on.
–	Blinking	An alarm is being generated. The alarm item generated can be checked by counting the number of times the LED blinks. The LED is lit in green when the alarm is reset.
Blinking twice simultaneously		• Information is being generated. Green and red colors may overlap and it may be visible to orange. The LED is lit in green when the information is cleared. • Teaching, remote operation is being executed with the **MEXE02** software. Green and red colors may overlap and it may be visible to orange. The LED is lit in green when teaching, remote operation is completed.

■ C-DAT/C-ERR LED (LED2)

The status of RS-485 communication can be checked.

Green	Red	Description
Light/blinking	–	The driver communicates with the client properly via RS-485 communication.
–	Light	An error occurs in communication with the client via RS-485 communication. The LED is lit or blink in green when the communication status returns to normal.

5   Installation

5-1   Installation location

The driver is designed and manufactured to be incorporated into 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 (3,300 ft.) above sea level

5-2   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 position other than vertical or horizontal, 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	Cutouts for mounting A	Cutouts for mounting B
M3 screw	4 pieces	2 pieces
M3 spring washer	4 pieces	2 pieces
M3 nut*	4 pieces	2 pieces

* Not required if mounting screw holes are provided in enclosure.

Install the driver so that there is a clearance of 25 mm (0.98 in.) or more horizontally and 50 mm (1.97 in.) or more vertically between the driver and the enclosure or other equipment inside the enclosure. When installing two or more drivers side by side, leave a clearance in the horizontal and vertical directions as shown in the figure.
The figure shows the driver whose connector shape is right-angle.

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).

● **Horizontal installation [Unit: mm (in.)]**

● **Vertical installation [Unit: mm (in.)]**

40 (1.57) or more

50 (1.97) or more
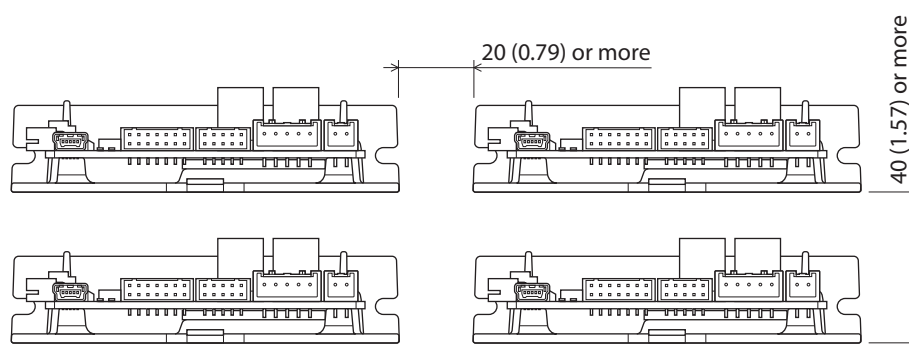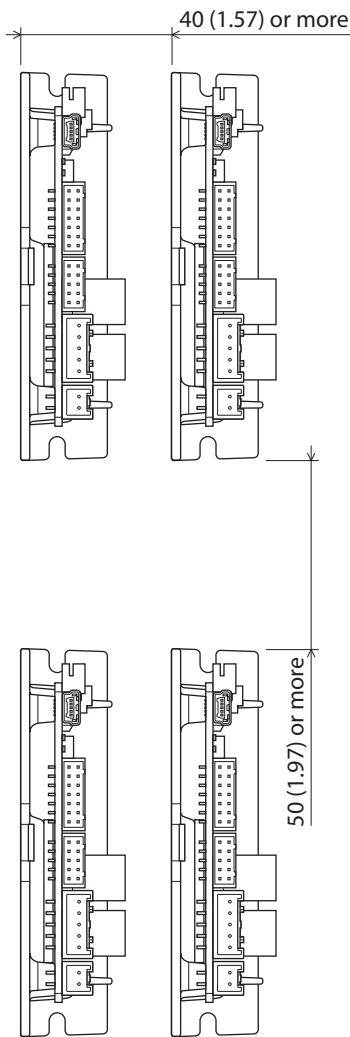
5-3   Installation method

Install the driver using either the cutouts for mounting A or B.
The tightening torque of the mounting screws should be 0.5 N·m (71 oz-in).
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.

memo When tightening the screws, make sure that the screw tightening tool does not come in contact with the encoder output connector (CN7).

● **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

M3 screws
Spring washers
Metal plate

When using the cutouts for mounting B

Metal plate
Spring washers
M3 screws
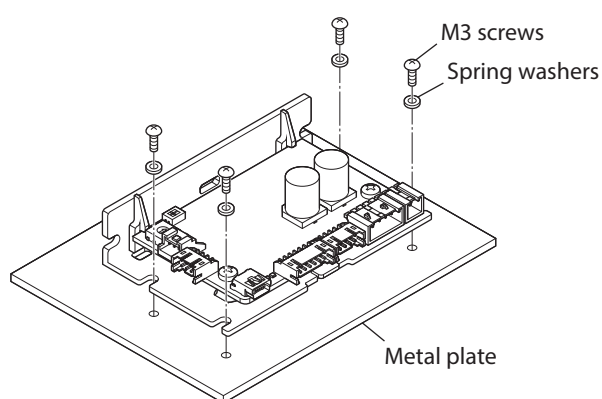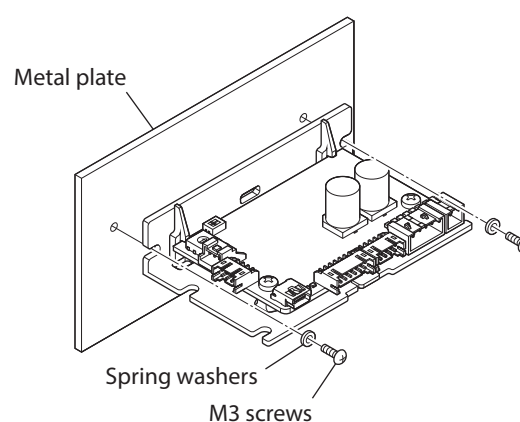
● **Vertical installation**

The driver can be installed in any direction.

When using the cutouts for mounting A

Metal plate
Spring washers
M3 screws

When using the cutouts for mounting B

Metal plate
Spring washers
M3 screws
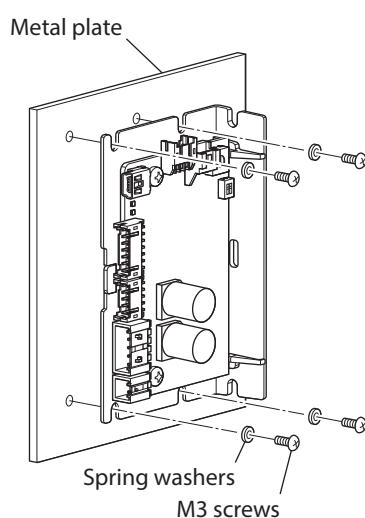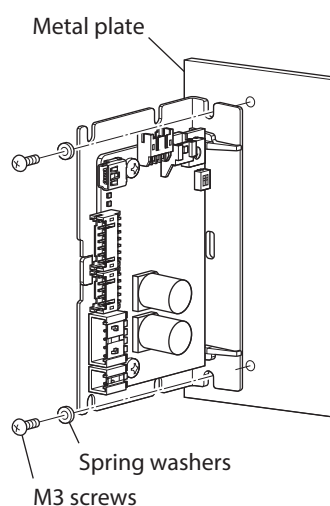
■ Dimensions [Unit: mm (in.)]

● **When the connector shape is "Right angle"**
Mass: 67 g (0.15 lb.)

24.5 max. (0.96 max.)
20 (0.79)
2.5 (0.10)
2 (0.08)

85 (3.35)
3.5 (0.14)
78 (3.07)
52.5 (2.07)
30 (1.18)
3.5 (0.14)
5 (0.20)
3.5 (0.14)
6.5 max. (0.26 max.)

3.5 (0.14)
78 (3.07)
8 (0.31)
3.5 (0.14)
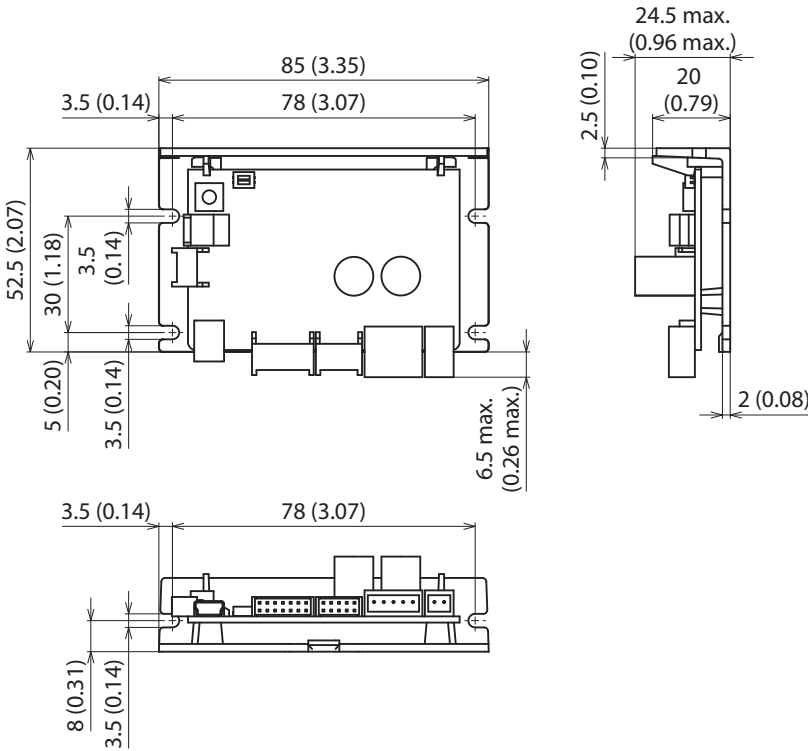
● **When the connector shape is "Vertical"**
Mass: 67 g (0.15 lb.)

24.5 max. (0.96 max.)
20 (0.79)
2.5 (0.10)
2 (0.08)

85 (3.35)
3.5 (0.14)
78 (3.07)
52.5 (2.07)
30 (1.18)
3.5 (0.14)
2 max. (0.08 max.)
5 (0.20)
3.5 (0.14)

3.5 (0.14)
78 (3.07)
8 (0.31)
3.5 (0.14)
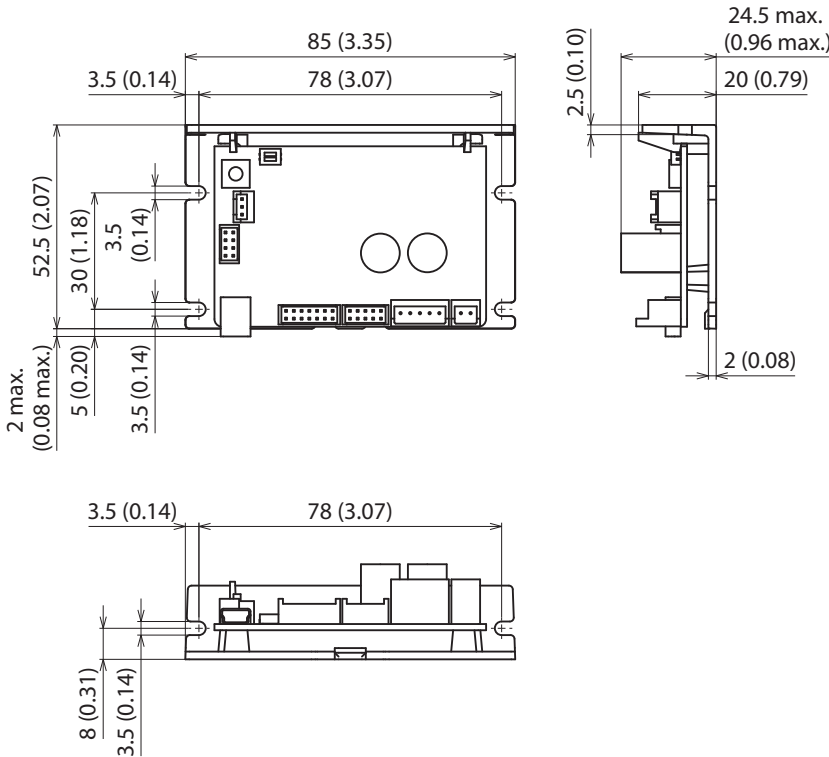
6   Connection

■ Connection example

Host controller

Connect to CN4

RS-485 cable (For connection to host controller)*1

Connect to CN7

Encoder output cable

Connect to CN6
I/O signal cable

PC on which the **MEXE02**
software has been installed*2

Connect to CN3

USB cable

Connect to CN2

Connection cable*1

Table

Motor

Connect to CN1
DC power supply cables*1

Linear encoder

AC power
supply

Noise
filter

Main power
supply

+24 V ⊕

GND ⊖

Connect to CN5
Encoder input cable

*1 It is provided in Oriental Motor products.
*2 The PC must be supplied by the user.

Note
- When connecting, pay attention to the polarity of the main power supply. Connecting the main power supply with the wrong polarity may cause damage to the driver.
- Connect the connector securely. Insecure connector connection may cause malfunction or damage to the driver.

memo
- When disconnecting the connector, pull out while pressing the latches on the connector with fingers.
- Before turning the main power supply back on or inserting/pulling out the connector, turn off the power and wait for the PWR/ALM LED to turn off.
- When wiring the I/O signal cable, keep it at least 100 mm (3.94 in.) away from inductive loads such as electromagnetic relays, and do not wire it in parallel with the power supply cable and connection cable.
- 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.
- Keep 3 m (9.8 ft.) or less for the total wiring distance of the RS-485 cable. If the distance is more than 3 m (9.8 ft.), the driver is likely to be affected by the noise.

6-1　Connecting the main power supply (CN1)

■ Power supply current capacity

- The current capacity for the main power supply varies depending on the product combined.
- Models in the table describe part of the entire name of models.
  The box (□) in the motor model indicates a number representing the motor length.
  The box (■) in the motor model indicates **A** (single shaft) or **B** (double shaft) representing the motor shaft shape.

● 5-Phase stepping motors

Model	Input power supply voltage	Power supply current capacity
PK513		0.6 A or more
PK52□H		1.4 A or more
PK52□P		0.6 A or more
PK54□		1.4 A or more
PK56□		1.8 A or more
PKP52□N12	24 VDC±10 %	1.7 A or more
PKP52□MN03		0.6 A or more
PKP52□MN07		1.4 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

Model	Input power supply voltage	Power supply current capacity
DHM28PAK2 DHM42PAK		1.4 A or more
DRLM20	24 VDC±10 %	0.6 A or more
DRLM28 DRLM42		1.4 A or more
DRLM60		1.8 A or more

■ Pin assignment
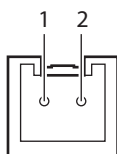
Pin number	Description
1	+24 VDC power supply input
2	Power supply ground

■ Applicable connector

Manufacturer	Molex, LLC
Connector housing	51103-0200
Contact	50351-8100
Applicable lead wire	AWG22 (0.3 mm^2)

(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.

6-2   Connecting the motor, motorized actuator (CN2)

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 or motor.
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   • Model B   • Model C
Pin number → 5 1   Pin number → 1   5
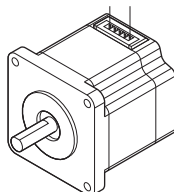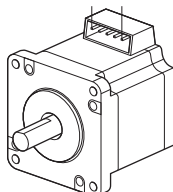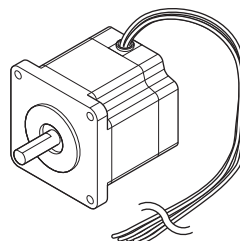
■ Pin assignment
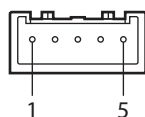
Driver CN2 pin number	Model A		Model B		Model C
	Pin number	Color	Pin number	Color	Color
1	5	Blue	1	Blue	Blue
2	4	Red	2	Red	Red
3	3	Orange	3	Orange	Orange
4	2	Green	4	Green	Green
5	1	Black	5	Black	Black

■ Applicable connector

Manufacturer	Molex, LLC
Connector housing	51103-0500
Contact	50351-8100
Applicable lead wire	AWG24 to AWG22 (0.2 to 0.3 mm^2)*

* When using a motor with an input current of 2.4 (A/phase), use AWG 22 (0.3 mm^2) lead wires.

6-3   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.

6-4　Connecting the RS-485 communication compatible product (CN4)

Connect the RS-485 cable to the RS-485 connector (CN4) on the driver.

■ Pin assignment
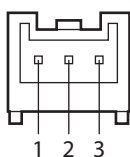
Pin number	Signal name	Description
1	TR+	RS-485 communication signal positive side
2	TR−	RS-485 communication signal negative side
3	GND	GND

■ Applicable connector

Manufacturer	J.S.T. Mfg. Co., Ltd.
Connector housing	PAP-03V-S
Contact	SPHD-001T-P0.5 or SPHD-002T-P0.5
Applicable lead wire	• When the contact is SPHD-001T-P0.5: AWG26 to AWG22 (0.13 to 0.33 mm^2) • When the contact is SPHD-002T-P0.5: AWG28 to AWG24 (0.08 to 0.21 mm^2)

(memo) For an RS-485 cable, it is recommended to use twisted-pair wires or shielded wires.

■ Internal output circuit
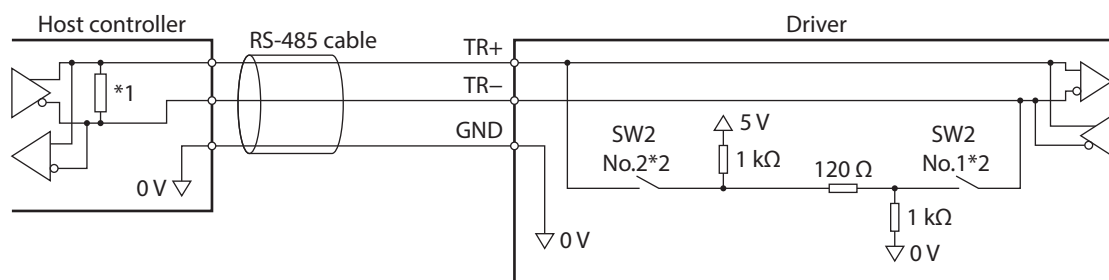
*1 Termination resistor 120 Ω
*2 Turn the termination resistor ON.

6-5 Connecting the external encoder (CN5)

Connect the external encoder to the encoder input connector (CN5).

■ Pin assignment
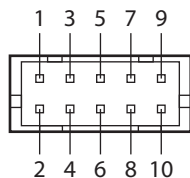
Pin number	Signal name	Description
1	ENC-A+	Encoder input phase A (Line receiver)
2	ENC-A−	
3	ENC-B+	Encoder input phase B (Line receiver)
4	ENC-B−	
5	ENC-Z+	Encoder input phase Z (Line receiver)
6	ENC-Z−	
7	+5 VDC OUT	+5 VDC power output for encoder
8	No connection	Not used
9	GND	GND
10	SHIELD	Shield (connect to frame ground)

■ Applicable connector

Manufacturer	J.S.T. Mfg. Co., Ltd.
Connector housing	PHDR-10VS
Contact	SPHD-001T-P0.5 or SPHD-002T-P0.5
Applicable lead wire	• When the contact is SPHD-001T-P0.5: AWG26 to AWG22 (0.13 to 0.33 mm^2) • When the contact is SPHD-002T-P0.5: AWG28 to AWG24 (0.08 to 0.21 mm^2)

■ Internal output circuit

■ Specifications of encoder input section

Type	Item	Description
Phase A Phase B	Input mode	Incremental
	Maximum frequency	4.0 MHz*1
	Edge interval	62.5 nsec or more
	Count range	−2,147,483,648 to +2,147,483,647 counts
	Count system	90-degree phase difference input
	Multiplication number	×1, ×2, ×4*2
	Interface	Differential line receiver (26C32 equivalent)
Phase Z	Input width	1 ms or more
	Interface	Differential line receiver (26C32 equivalent)
5 VDC power supply output	Output current	300 mA or less

*1 It is the frequency of each of phase A and phase B.
*2 It can be set using the "Multiplication number" parameter.

Phase A ON / OFF
Phase B ON / OFF

T_{EC} T_{EC} T_{EC} T_{EC} Each edge interval
T_{EC}: 62.5 nsec or more
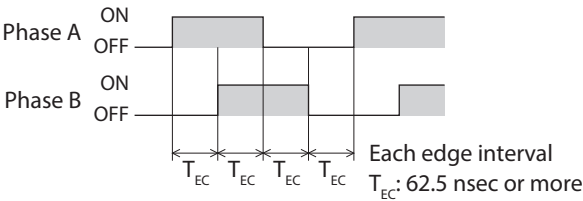
Note Use the current consumption of a power supply for the encoder to be 300 mA or less. If it exceeds 300 mA, provide an external power supply for the encoder.

6-6 Connecting the I/O signals (CN6)

■ Pin assignment
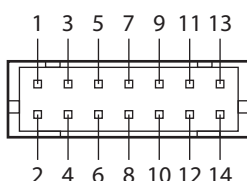
Pin number	Signal name*1	Description*1*2
1	CW+ [PLS+]	CW pulse input positive side [Pulse input positive side]
2	CW− [PLS−]	CW pulse input negative side [Pulse input negative side]
3	CCW+ [DIR+]	CCW pulse input positive side [Rotation direction input positive side]
4	CCW− [DIR−]	CCW pulse input negative side [Rotation direction input negative side]
5	IN-COM	Input common
6	IN0	Control input 0 (P-PRESET)
7	IN1	Control input 1 (FCLOOP-DIS)
8	IN2	Control input 2 (AWO)
9	OUT0+	Control output 0 (ALM-B)
10	OUT0−	
11	OUT1+	Control output 1 (ENC-IN-POS)
12	OUT1−	
13	OUT2+	Control output 2 (TIM)
14	OUT2−	

1 3 5 7 9 11 13

2 4 6 8 10 12 14

*1 Values in brackets [ ] are signals when the 1-pulse input mode is set.
*2 Values in parentheses ( ) are initial values.

■ Applicable connector

Manufacturer	J.S.T. Mfg. Co., Ltd.
Connector housing	PHDR-14VS
Contact	SPHD-001T-P0.5 or SPHD-002T-P0.5
Applicable lead wire	• When the contact is SPHD-001T-P0.5: AWG26 to AWG22 (0.13 to 0.33 mm^2) • When the contact is SPHD-002T-P0.5: AWG28 to AWG24 (0.08 to 0.21 mm^2)

(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.
- For the I/O signal cable, it is recommended to use twisted-pair wires or shielded wires.

■ When the voltage of input signals is 5 VDC

● When the pulse input circuit of the driver is line driver type
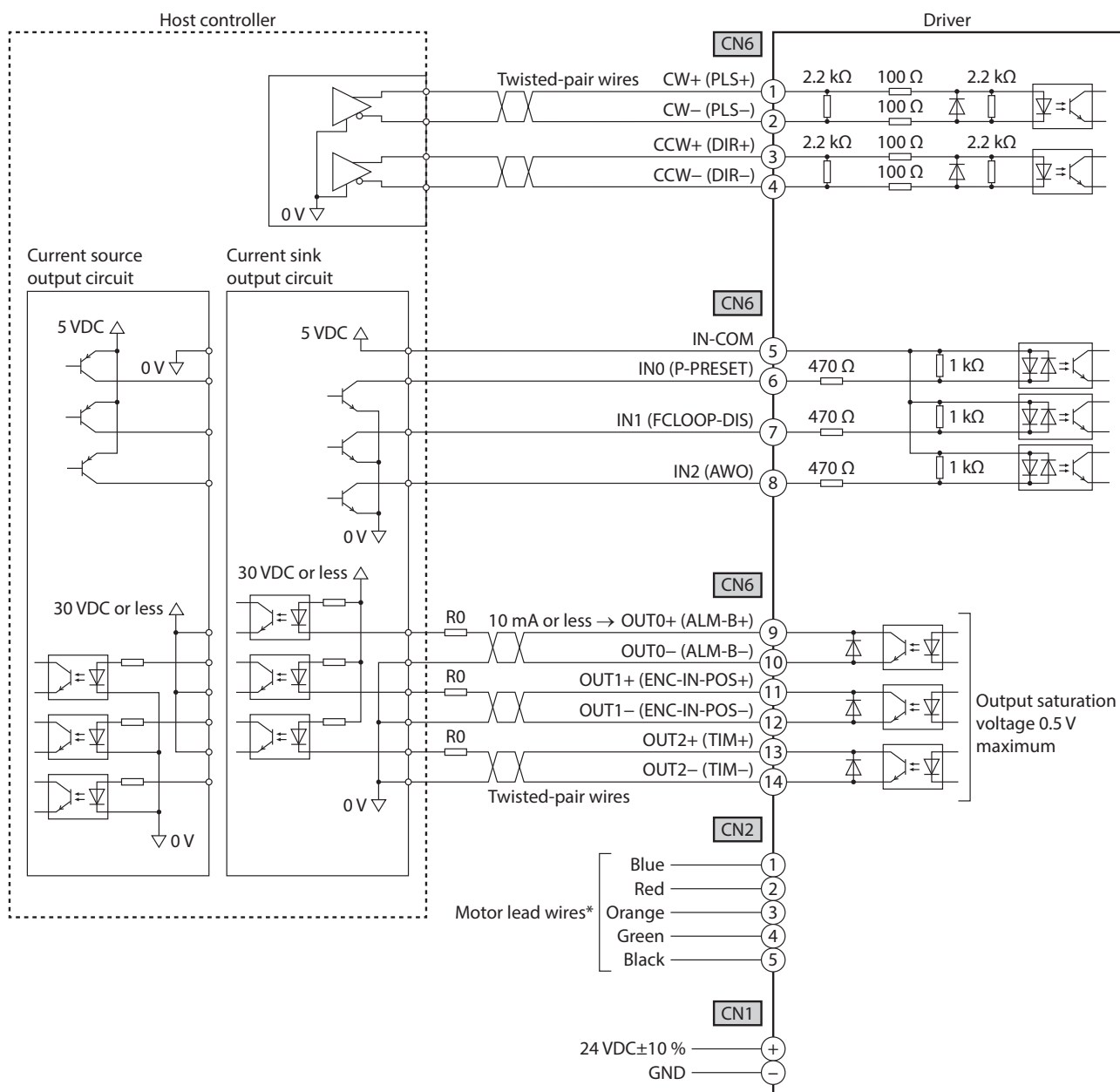
Host controller

Driver

CN6

Twisted-pair wires CW+ (PLS+) ① 2.2 kΩ 100 Ω 2.2 kΩ
CW− (PLS−) ② 100 Ω
CCW+ (DIR+) ③ 2.2 kΩ 100 Ω 2.2 kΩ
CCW− (DIR−) ④ 100 Ω
0 V

Current source output circuit

Current sink output circuit

5 VDC
0 V

5 VDC

CN6

IN-COM ⑤
IN0 (P-PRESET) ⑥ 470 Ω 1 kΩ
IN1 (FCLOOP-DIS) ⑦ 470 Ω 1 kΩ
IN2 (AWO) ⑧ 470 Ω 1 kΩ
0 V

30 VDC or less

30 VDC or less

CN6

R0 10 mA or less → OUT0+ (ALM-B+) ⑨
OUT0− (ALM-B−) ⑩
R0 OUT1+ (ENC-IN-POS+) ⑪
OUT1− (ENC-IN-POS−) ⑫
R0 OUT2+ (TIM+) ⑬
OUT2− (TIM−) ⑭
0 V Twisted-pair wires

Output saturation voltage 0.5 V maximum

0 V

CN2

Blue ①
Red ②
Motor lead wires* Orange ③
Green ④
Black ⑤

CN1

24 VDC±10 % (+)
GND (−)

* The pin assignments of the connector vary depending on the motor. Refer to p.17 for details.

memo Use output signals at 30 VDC and 10 mA or less. If the current exceeds 10 mA, connect an external resistor R0 to adjust.

● **When the pulse input circuit of the driver is open collector type**
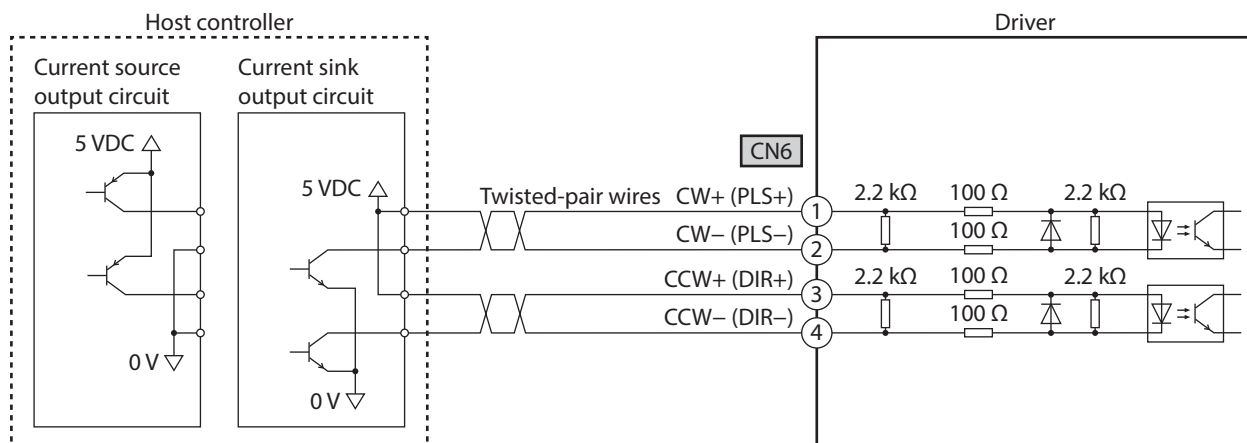
Connection

■ When the voltage of input signals is 24 VDC

● When the pulse input circuit of the driver is open collector type
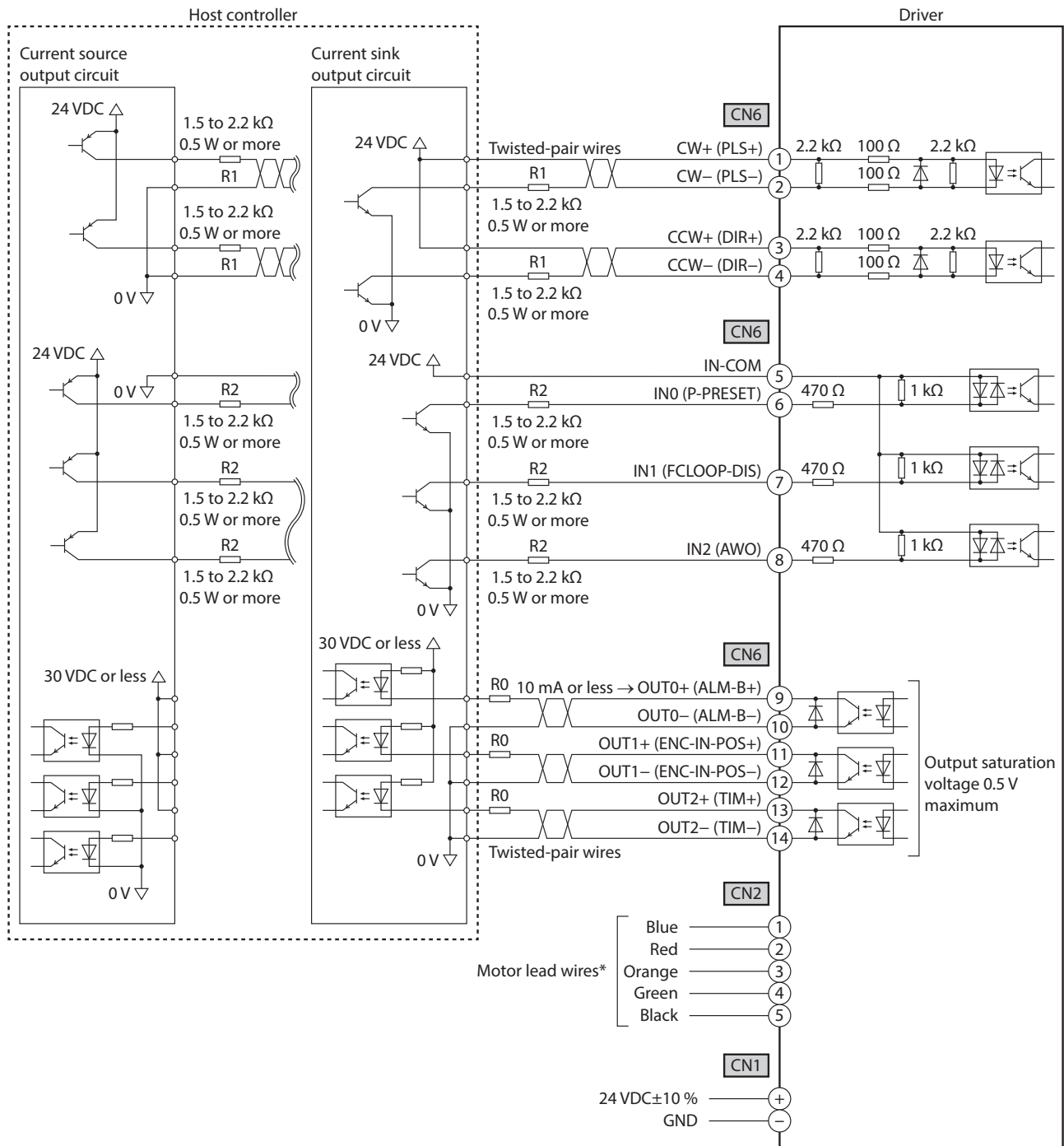
* The pin assignments of the connector vary depending on the motor. Refer to p.17 for details.

(memo)
- Specifications of the CW input and the CCW input are 5 VDC. If the voltage exceeds 5 VDC, connect an external resistor R1 to adjust the input current to 7 to 20 mA.
  Example) When 24 VDC is connected, use an external resistor R1 of 1.5 to 2.2 kΩ and 0.5 W or more.
- Specifications of the IN0, IN1, and IN2 inputs are 5 VDC. If the voltage exceeds 5 VDC, connect an external resistor R2 to adjust the input current to 5 to 15 mA.
  Example) When 24 VDC is connected, use an external resistor R2 of 1.5 to 2.2 kΩ and 0.5 W or more.
- Use output signals at 30 VDC and 10 mA or less. If the current exceeds 10 mA, connect an external resistor R0 to adjust.

6-7 Connecting the counter (CN7)

This is an output of the encoder signal connected to the encoder input connector (CN5).
When a counter dedicated to the encoder or a high-speed counter module of the PLC is connected to the encoder output connector (CN7), the feedback position can be monitored.

■ Pin assignment
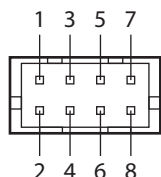
Pin number	Signal name	Description
1	ENC-A OUT+	Encoder output phase A (Line driver)
2	ENC-A OUT−	
3	ENC-B OUT+	Encoder output phase B (Line driver)
4	ENC-B OUT−	
5	ENC-Z OUT+	Encoder output phase Z (Line driver)
6	ENC-Z OUT−	
7	GND	GND
8	SHIELD	Shield (connect to frame ground)

■ Applicable connector

| Manufacturer	J.S.T. Mfg. Co., Ltd.
Connector housing	PHDR-08VS
Contact	SPHD-001T-P0.5 or SPHD-002T-P0.5
Applicable lead wire	• When the contact is SPHD-001T-P0.5: AWG26 to AWG22 (0.13 to 0.33 mm^2) • When the contact is SPHD-002T-P0.5: AWG28 to AWG24 (0.08 to 0.21 mm^2)

■ Internal output circuit

memo Connect the termination resistor to the input terminal side of the host controller.

6-8   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 effectively shields the electrical noise emitted by the driver.

● **Prevention of noise propagation**

- Keep power lines, such as the connection cables and power supply cables, at least 100 mm (3.94 in.) away from signal lines, such as the I/O signal cable and the RS-485 cable. Also, do not bundle them or wire them in parallel. If power and signal cables must cross, cross them at right angles.
- To effectively eliminate noise, use shielded cables for power and signal lines, or install ferrite cores if unshielded cables are used.
- 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.

Shielded cable   Cable clamp
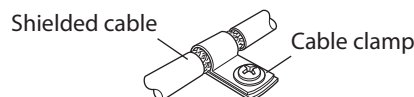
● **Suppression of effect by noise propagation**

- 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.
- Change the transmission method of pulse signals to the line driver type which is less likely to be affected by electrical noise. If the pulse signal of the host controller is open collector type, use Oriental Motor's pulse signal converter for noise immunity. Refer to p.67 for the model.

■ Noise suppression products

● **Noise filter**

- Connect a noise filter (or equivalent) as shown in the table below to the AC input side of the DC power supply. When a power supply transformer is used, be sure to connect a noise filter to the AC input side of the power supply transformer. This will prevent noise from propagating through the power supply line. Install the noise filter as close as possible to the input terminals of the DC power supply.

Manufacturer	Part number
SOSHIN ELECTRIC CO., LTD.	HF2010A-UPF
Schaffner EMC	FN2070-10-06

- Use the AWG18 (0.75 mm^2) or thicker wire for the input and output cables of the noise filter, and secure them firmly using a cable clamp or others so that the cable does not come off the enclosure.
- Place the input cable as far away from the output cable as possible and do not wire the cables in parallel. If the input and output cables are placed at a close distance or wired in parallel, the noise in the enclosure will affect the power cable through stray capacitance, and the noise suppression effect will be reduced.
- Connect the ground terminal of the noise filter to the grounding point using a wire that is as thick and short as possible.
- When connecting a noise filter in an enclosure, wire the input cable of the noise filter as short as possible. Wiring over a long distance may reduce the noise suppressing effect.

■ **Oriental Motor's noise suppression products**

Refer to p.67 for the model.

● **Pulse signal converter for noise immunity**

This product converts a pulse signal, which is output from the open collector output, to a pulse signal for good noise immunity by outputting the pulse signal again from the differential output.

● **Surge suppressor**

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.

6-9 Compliance with the 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.28.

The user is responsible for ensuring the machine's compliance 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.

● **Main 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.26.

● **Grounding method**

- Use the thickest possible wires and the shortest distance to ground the motor and driver 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 and driver to a grounded metal plate.

● **Example of installation and wiring**

Connection cable

Motor

Table

Linear encoder ⏚ *1

Shielded cable

Cable clamp

Shielded cable

Host controller*2

AC

DC power supply

Shielded cable

Shielded cable

Cable clamp

Cable clamp

Shielded cable

Encoder counter

Driver

Cable clamp

Shielded cable

Cable clamp

Host controller

Grounded panel

▨ is a ferrite core.
⏚ represents grounding.
⋯ is a shielding box.
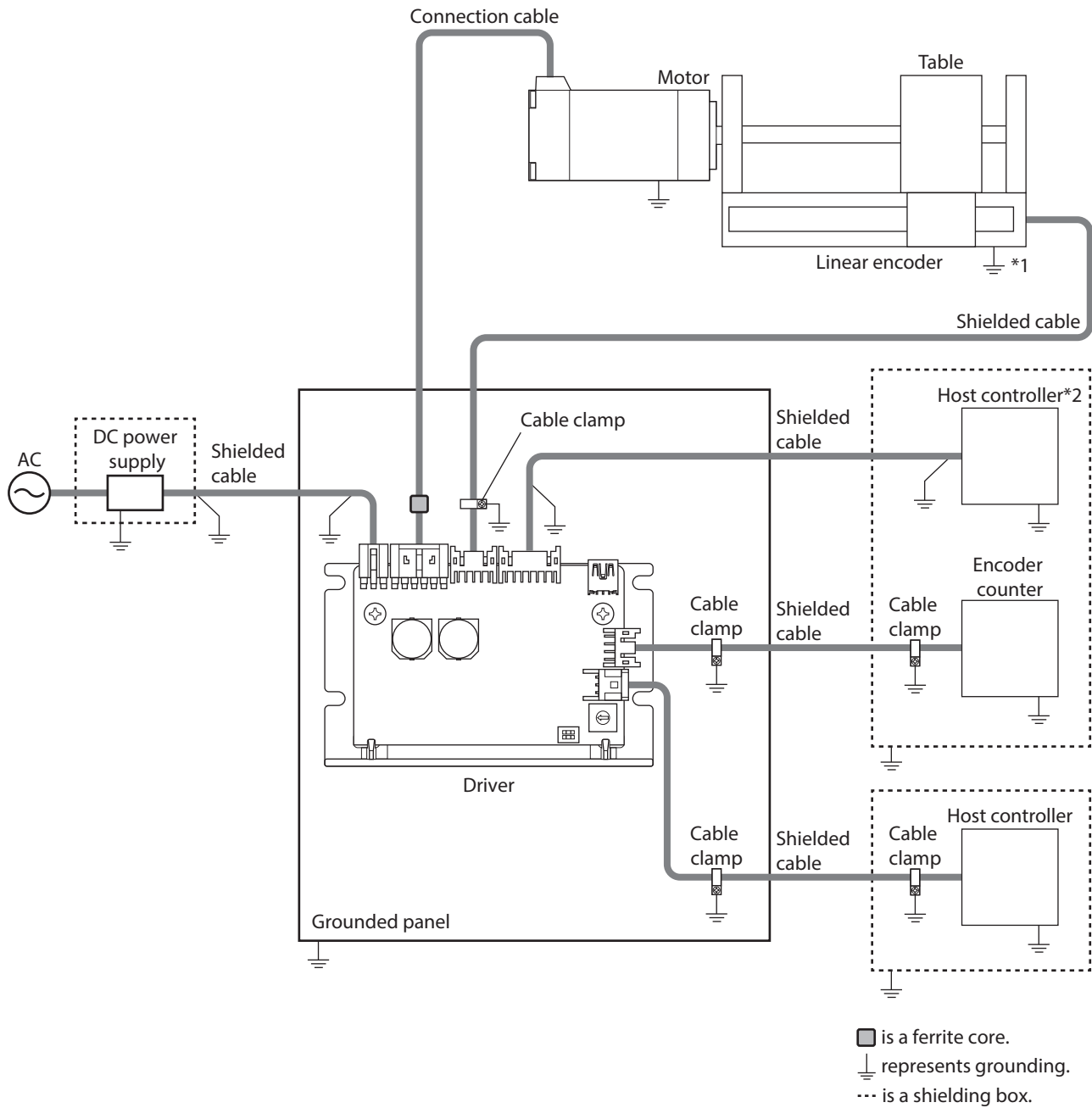
*1 Ground the machinery.
*2 The line driver system is used to drive the pulse signals.

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.

7 Explanation of I/O signals

This chapter explains the signals assigned to the I/O signal connector at the time of shipment.

7-1 Input signals

All input signals of the driver are photocoupler inputs. The signal state represents a state of "ON: Carrying current" or "OFF: Not carrying current" for the internal photocoupler rather than the voltage level of the signal.

■ CW [PLS] input, CCW [DIR] input

The CW and CCW inputs are used for the 2-pulse input mode, and the PLS and DIR inputs for the 1-pulse input mode. Set the pulse input mode of the driver according to the pulse output mode of the host controller used.

● 2-Pulse input mode (Factory setting)

When the CW input is turned from OFF to ON, the motor rotates in the clockwise direction by one step.
When the CCW input is turned from OFF to ON, the motor rotates in the counterclockwise direction by one step.
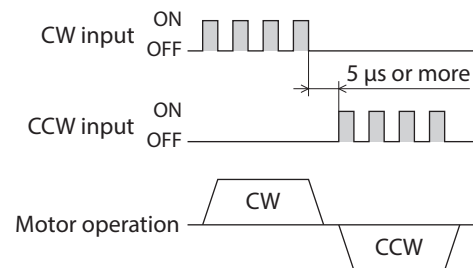
Note Do not input the CW input and the CCW input at the same time. The motor will not operate properly.

memo When the motor is stopped, be sure to stop inputting a pulse signal (pulse input OFF).

● 1-Pulse input mode

When the PLS input is turned from OFF to ON while the DIR input is ON, the motor rotates in the clockwise direction by one step.
When the PLS input is turned from OFF to ON while the DIR input is OFF, the motor rotates in the counterclockwise direction by one step.
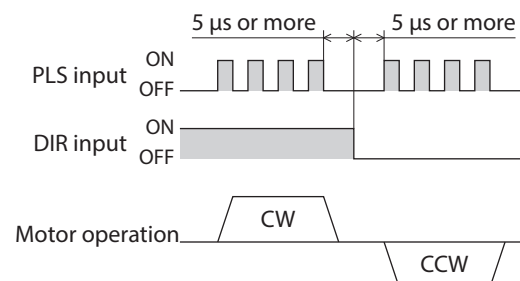
memo When the motor is stopped, be sure to stop inputting a pulse signal (pulse input OFF).

● Pulse signal

Input pulses with a sharp rise and fall as shown in the figure. The figure shows the voltage level of the pulse signal.
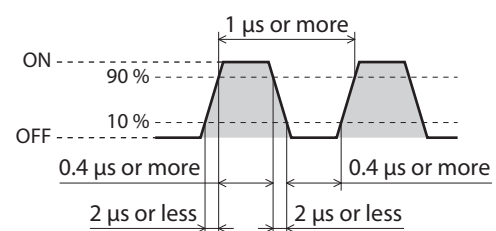
■ P-PRESET input

When the P-PRESET input is turned ON, the command position and the feedback position are preset to zero and the coordinates are set. However, preset cannot be executed while the motor is in operation.

■ FCLOOP-DIS input

If the FCLOOP-DIS input is turned ON when the "Fully closed-loop correction enable" parameter is set to "1: Enable," the correction by the fully closed-loop control is disabled. Also, the FCLOOP-RDY input is turned OFF.
To disable the FCLOOP-DIS input, set the "Fully closed-loop mode" parameter to "1: FCLOOP-DIS input disable." The correction by the fully closed-loop control is enabled regardless of whether the FCLOOP-DIS input is ON or OFF.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	Fully closed-loop correction enable	Enables the correction by the fully closed-loop control.	0: Disable 1: Enable	1
	Fully closed-loop mode	Selects whether to enable or disable the fully closed-loop correction according to the FCLOOP-DIS input when the "Fully closed-loop correction enable" parameter is set to "1: Enable."	0: Follow FCLOOP-DIS input 1: FCLOOP-DIS input disable	0

■ AWO input

When the AWO input is turned ON, the motor current is shut off to put the motor in a non-excitation state. The output shaft can be rotated manually since the holding force of the motor is lost. When the AWO input is turned OFF, the motor current is supplied to restore the holding force of the motor.

Note | When a load is installed vertically, do not turn the AWO input ON. The motor will lose its holding force and a load may fall.

7-2   Output signals

All output signals of the driver are photocoupler, open-collector outputs.
The output section is explained as a state of "ON: Carrying current" or "OFF: Not carrying current" for the internal photocoupler.

■ ALM-B output

If an alarm is generated, the ALM-B output is turned OFF. At the same time, the PWR/ALM LED on the driver will blink in red, and the motor will stop. When an alarm to put the motor in a non-excitation state is generated, the motor will be in a non-excitation state after it stops.
The ALM-B output is normally closed.

■ ENC-IN-POS output

The ENC-IN-POS output is turned ON when the following conditions are met.
- The position deviation (cnt) was equal to or less than the value set in the "In-position range" parameter.
- The time set in the "In-position delay time" parameter has elapsed.

If the ENC-IN-POS output is turned OFF while the FCLOOP-RDY output is ON, the correction by the fully closed-loop control will be performed until the ENC-IN-POS output is turned ON. When the ENC-IN-POS output is turned ON, the fully closed-loop correction is completed and the hunting-free open-loop state is entered.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	In-position delay time	Sets the time from when the position deviation enters the in-position range to when the ENC-IN-POS output is turned ON, based on the encoder position information.	0 to 1,000 ms	10
	In-position range	Sets the allowable range of the position deviation based on the feedback position.	0 to 100,000 cnt	5

memo
- If a value set in the "In-position range" parameter is too low, the ENC-IN-POS output will be unstable depending on the environmental conditions of the equipment and will be turned ON and OFF repeatedly.
- If the "In-position range" parameter is set to "0," the ENC-IN-POS output is turned ON when the position deviation (cnt) is 1 cnt or less. However, the correction by the fully closed-loop control is performed until the position deviation (cnt) is 0 cnt.

■ TIM output

Each time the motor output shaft rotates by 7.2 degrees (3.6 degrees for the high-resolution type), the motor excitation state returns to the step "0" position and the TIM output is turned ON.
If an AND circuit is configured with the home sensor and the TIM output when the home is detected, the variation for the motor stop positions within a range of the home sensor can be reduced and the home can be detected more accurately.

Note
- The TIM output is properly turned ON when the command speed is 500 Hz or less.
- When using the TIM output, set the travel amount or the resolution so that the motor output shaft stops at an integral multiple of 7.2 degrees (3.6 degrees for the high-resolution type).

7-3 Timing chart

● **Main power supply ON**
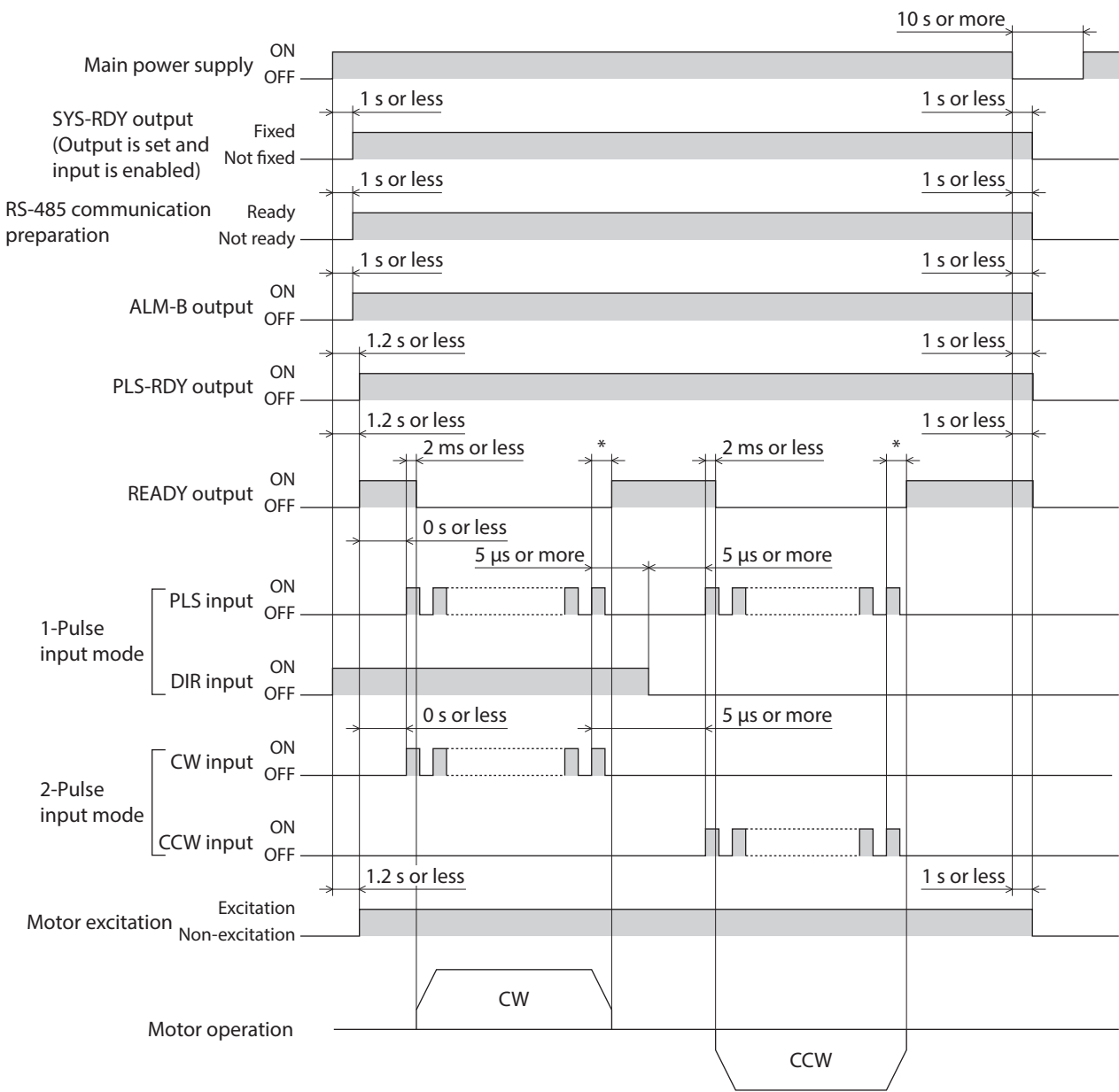
* It varies depending on the operating speed, command filter, etc.

● **Excitation**

Excitation command	ON / OFF
CRNT output	ON / OFF
PLS-RDY output	ON / OFF
READY output	ON / OFF
DCMD-RDY output	ON / OFF
Motor excitation	Excitation / Non-excitation

200 ms or less
2 ms or less
200 ms or less   2 ms or less
200 ms or less   2 ms or less
200 ms or less   2 ms or less
200 ms or less   2 ms or less
200 ms or less   220 ms or less
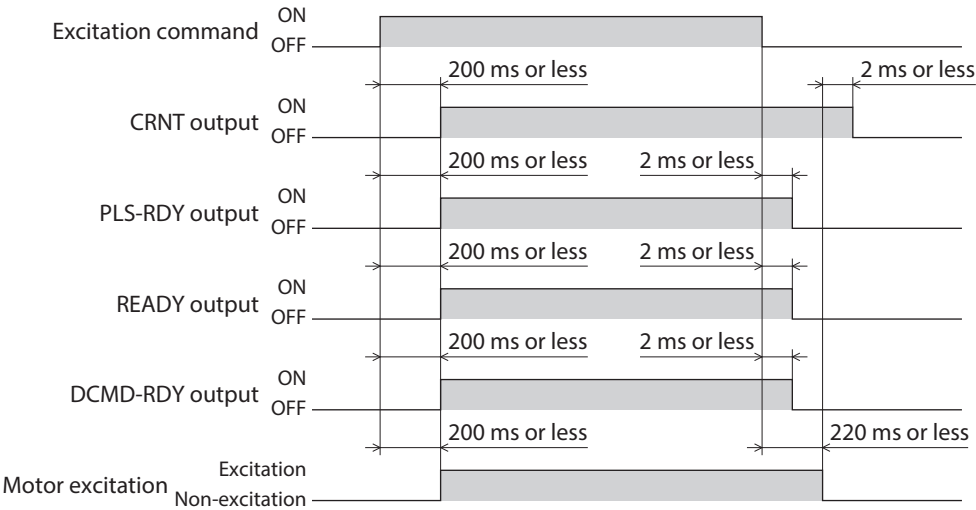
8 Setting

8-1 Setting of motor

Set the "Applicable motor setting" parameter according to the product to be combined.
If the parameter is set, the output current of the driver is automatically set.

⚠**CAUTION** Be sure to set in accordance with the product being combined. If the output current of the driver is accidentally set to a value higher than the rated current of the motor being combined, fire or a skin burn(s) may result.

(memo) • The parameter that has been set will be enabled after the main power supply is turned on again.
• If the parameter is set to a value not described in the table, the motor will remain in a non-excitation state and information of Motor setting error will be generated.

■ Parameter setting values for the combined products

Models in the table describe part of the entire name of models.
• The box (□) in the motor model indicates a number representing the motor length.
• The box (■) in the motor model indicates **A** (single shaft) or **B** (double shaft) representing the motor shaft shape.

● **When combined with a motor**

Model	Setting of parameter	Output current of driver to be set (A/phase)
PK513 PK52□P PKP52□MN03	18: 5-phase, 0.35 A/phase	0.35
PK52□H PK54□ PKP52□MN07	19: 5-phase, 0.75 A/phase	0.75
PKP52□N12	20: 5-phase, 1.2 A/phase	1.2
PK56□	21: 5-phase, 1.4 A/phase	1.4
PKP54□MN PKP54□N18■ PKP54□N18■2	22: 5-phase, 1.8 A/phase	1.8
PKP56□FMN PKP56□FN24■2	23: 5-phase, 2.4 A/phase	2.4

● **When combined with a motorized actuator**

Model	Setting of parameter	Output current of driver to be set (A/phase)
DRLM20	18: 5-phase, 0.35 A/phase	0.35
DRLM28 DHM28PAK2 DRLM42 DHM42PAK	19: 5-phase, 0.75 A/phase	0.75
DRLM60	21: 5-phase, 1.4 A/phase	1.4

● **Related parameter**

MEXE02 code	Name	Description	Setting range	Initial value
p4	Applicable motor setting	Sets the output current of the driver according to the product to be combined. Check "Parameter setting values for the combined products" on p.34 and set the parameter.	0: No setting 18: 5-phase, 0.35 A/phase 19: 5-phase, 0.75 A/phase 20: 5-phase, 1.2 A/phase 21: 5-phase, 1.4 A/phase 22: 5-phase, 1.8 A/phase 23: 5-phase, 2.4 A/phase	0

8-2 Setting of resolution

Set the "Electronic gear A" and "Electronic gear B" parameters according to a desired resolution.
If the "Electronic gear A" and "Electronic gear B" parameters are set, the resolution per revolution of the motor output shaft can be set.
Note that the calculated value must fall within the setting range specified below.

Setting range of resolution: 100 to 125,000 P/R
Initial value: 500 P/R

$$\text{Resolution (P/R)} = 500 \times \frac{\text{Electronic gear B}}{\text{Electronic gear A}}$$

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p4	Electronic gear A	Sets the denominator of the electronic gear.	1 to 65,535	1
	Electronic gear B	Sets the numerator of the electronic gear.		1

Note If a resolution out of the setting range is set, information of Electronic gear setting error will be generated. If the main power supply is turned on again or Configuration is executed in a state where information of Electronic gear setting error is generated, an alarm of Electronic gear setting error will be generated.

memo
- The step angle is a theoretical value.
- The actual step angle for the geared type is calculated using the formula: step angle divided by gear ratio.
- Compared with the standard type, the resolution and the step angle of the high-resolution type are twice and one-half, respectively.

■ Calculation method of electronic gears A and B

This section explains how to calculate the electronic gears A and B with an example of a ball screw.
- When a ball screw with a lead of 12 mm is to be moved 0.01 mm per step.
- Gear ratio: 1 (No speed reduction mechanism between the motor and ball screw.)

$$\text{Resolution on mechanism} = 500 \times \frac{\text{Electronic gear B}}{\text{Electronic gear A}} = \frac{\text{Ball screw lead}}{\text{Minimum travel amount}}$$

In this example:
$$500 \times \frac{\text{Electronic gear B}}{\text{Electronic gear A}} = \frac{12 \text{ mm}}{0.01 \text{ mm}}$$

By calculation:
$$\frac{\text{Electronic gear B}}{\text{Electronic gear A}} = \frac{12}{5}$$

Therefore, the electronic gear A is 5 and the electronic gear B is 12, and the resolution is 1,200 P/R.

8-3   Setting of pulse input mode

Set the pulse input mode of the driver according to the pulse output mode of the host controller used.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p10	PULSE-I/F mode selection	Sets the pulse input mode.	−1: Disable 1: 2-pulse input mode 2: 1-pulse input mode	1

8-4   Setting related to the fully closed-loop correction

This section describes the settings to perform the correction by the fully closed-loop control using an externally installed encoder.

■ Mechanism information

Set the related parameters according to the encoder, motor, and mechanism to be used.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	Encoder type	Selects the type of the encoder to be connected.	0: Linear 1: Rotary	0
	Encoder count action	Selects the action when ENC-A+ is turned from OFF to ON while ENC-B+ is OFF.	0: Counting down 1: Counting up	1
	Basic step angle	Sets the basic step angle of the motor to be used.	1: 0.72° (Standard type) 2: 0.36° (High resolution type)	1
	Mechanism lead	Sets the lead of the mechanism to be assembled to the motor.	1 to 500 (1=0.1 mm)	10
	Gear ratio	Sets the gear ratio when using a gear reduction mechanism.	10 to 10,000 (1=0.1)	10

memo When the "Encoder type" parameter is set to "1: Rotary," the value set in the "Mechanism lead" parameter is disabled.

● **Setting example: When using a ball screw with a linear encoder**

This section shows an example of setting the parameters when used under the following conditions.
- Motor type: **PK**/**PKP** Series standard type
- Gear ratio: 1 (No speed reduction mechanism between the motor and ball screw.)
- Ball screw lead: 6 mm
- The travel direction of the ball screw is the same as the counting direction of the pulses output from the linear encoder.

MEXE02 code	Name	Setting value
p11	Encoder type	0: Linear
	Encoder count action	1: Counting up
	Basic step angle	1: 0.72° (Standard type)
	Mechanism lead	60 (1=0.1 mm)
	Gear ratio	10 (1=0.1)

■ Encoder resolution

Set the related parameters according to the encoder to be used.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	Encoder type	Selects the type of the encoder to be connected.	0: Linear 1: Rotary	0
	Linear encoder resolution	Sets the resolution of the linear encoder.	1 to 50,000 nm	100
	Rotary encoder resolution	Sets the resolution of the rotary encoder.	100 to 16,777,215 P/R	10,000
	Multiplication number	Sets the multiplication number used as the basis for the feedback position.	0: ×1 multiplication 1: ×2 multiplication 2: ×4 multiplication	2

● Setting example: When a linear encoder is used

When using a linear encoder whose specifications are shown in the figure, the parameter settings are as follows.

Parameter name	Setting value
Encoder type	0: Linear
Linear encoder resolution	100
Multiplication number	2: ×4 multiplication
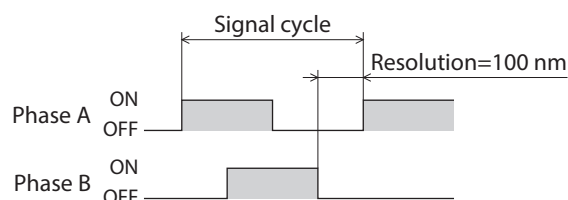
memo   When the "Encoder type" parameter is set to "0: Linear," the value set in the "Rotary encoder resolution" parameter is disabled.

■ Encoder count operation

The value obtained by multiplying the encoder input according to the setting of the "Multiplication number" parameter is the feedback position. The feedback position can be read on the status monitor of the **MEXE02** software or "Feedback position (cnt)" of RS-485 communication.
Refer to "Relationship between encoder input waveform and feedback position" on p.38 for the count action of the encoder.
The feedback position is preset to zero in the following cases.
- When position preset has been executed to set the coordinates.
- When return-to-home operation has been completed properly.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	Encoder count action	Selects the action when ENC-A+ is turned from OFF to ON while ENC-B+ is OFF.	0: Counting down 1: Counting up	1
	Multiplication number	Sets the multiplication number used as the basis for the feedback position.	0: ×1 multiplication 1: ×2 multiplication 2: ×4 multiplication	2
p4	Motor rotation direction	Sets the rotation direction of the motor output shaft.	0: Positive direction=CCW 1: Positive direction=CW	1

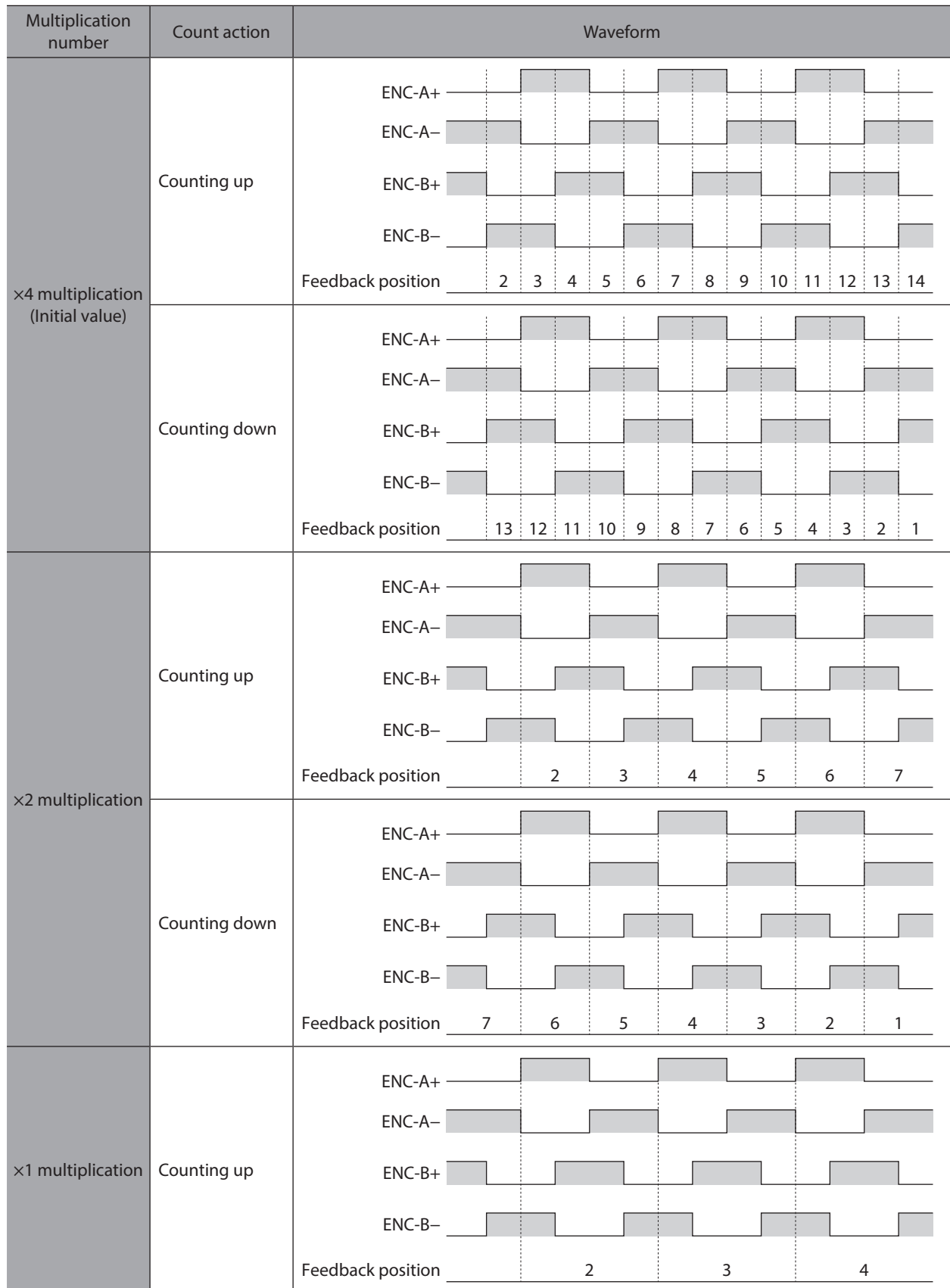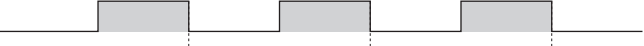memo   Set the related parameters so that the motor rotation direction and the encoder count action match.
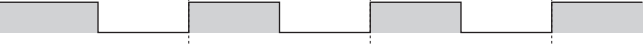
● **Relationship between encoder input waveform and feedback position**

The feedback position when the "Multiplication number" parameter and "Encoder count action" parameter are set is as follows.

The figure shows an example when the "Encoder count action" parameter is set to "1: Counting up." When the "Encoder count action" parameter is set to "0: Counting down," counting up and counting down are reversed.

Refer to p.20 for the specifications of encoder input section.

Multiplication number	Count action	Waveform
×4 multiplication (Initial value)	Counting up	ENC-A+ / ENC-A− / ENC-B+ / ENC-B− — Feedback position: 2 3 4 5 6 7 8 9 10 11 12 13 14
	Counting down	ENC-A+ / ENC-A− / ENC-B+ / ENC-B− — Feedback position: 13 12 11 10 9 8 7 6 5 4 3 2 1
×2 multiplication	Counting up	ENC-A+ / ENC-A− / ENC-B+ / ENC-B− — Feedback position: 2 3 4 5 6 7
	Counting down	ENC-A+ / ENC-A− / ENC-B+ / ENC-B− — Feedback position: 7 6 5 4 3 2 1
×1 multiplication	Counting up	ENC-A+ / ENC-A− / ENC-B+ / ENC-B− — Feedback position: 2 3 4

Multiplication number	Count action	Waveform
×1 multiplication	Counting down	ENC-A+ / ENC-A− / ENC-B+ / ENC-B− Feedback position: 4 3 2 1

■ Fully closed-loop correction function

● Adjustment of correction range

The correction range when the fully closed-loop correction is performed can be adjusted.
The deviation between the command position and the feedback position is monitored and the motor position is corrected until the deviation falls within the range set in the "In-position range" parameter after the FCLOOP-RDY output is turned ON.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	Correction operation waiting time	Sets the time from the stop at the command position to the start of the correction operation by the fully closed-loop control. Set a value that is longer than or equal to the settling time for the residual vibration to end after the stop.	0 to 10,000 ms	10
	In-position range	Sets the allowable range of the position deviation based on the feedback position.	0 to 100,000 cnt	5

memo: When a high-resolution type encoder is used, the correction operation may be unstable if the value set in the "In-position range" parameter is too low. Reconsider the setting of the "In-position range" parameter if the correction operation is unstable.

● Adjustment of the correction speed

The correction speed when the fully closed-loop correction is performed can be adjusted.
The higher the value of the "Correction speed gain" parameter, the shorter the time required to reach the command speed.

Related parameter

MEXE02 code	Name	Description	Setting range	Initial value
p11	Correction speed gain	Sets the speed when the fully closed-loop correction is performed.	1 to 1,000 (1=0.1)	10

memo: If the value set in the "Correction speed gain" parameter is too high, the overshoot during correction will be large, causing the correction operation to be unstable. Reconsider the setting of the "Correction speed gain" parameter if the correction operation is unstable.

● **Adjustment of the correction upper limit**

The upper limit of the correction amount when the fully closed-loop correction is performed can be set. Adjust according to the position deviation between the motor and the encoder caused by backlash or torsion of the mechanism. When the position deviation is large, increase the value.

memo
- If the position deviation exceeds the correction upper limit, the operation of the fully closed-loop correction cannot be completed and an alarm of Encoder timeout may be generated.
- If the "Encoder correction timeout" parameter is set to "0: Disable," a state in which the position deviation occurs will continue because an alarm of Encoder timeout will not be generated.

Related parameter

MEXE02 code	Name	Description	Setting range	Initial value
p11	Correction upper limit	Sets the upper limit of the correction amount when the fully closed-loop correction is performed.	1 to 100 (1=0.01 rev)	1

● **Signals related to the fully closed-loop correction function**

P-PRESET input

Refer to p.29 for the P-PRESET input.

FCLOOP-DIS input

Refer to p.30 for the FCLOOP-DIS input.

FCLOOP-RDY output

When all of the following conditions are met, the FCLOOP-RDY output is turned ON and the correction by the fully closed-loop control is performed.
- The main power supply of the driver is turned on.
- The AWO input is OFF.
- The STOP input is OFF.
- An alarm is not being generated.
- The motor is not operated.
- The following commands are not executed via RS-485 communication.
  – Configuration
  – Data batch initialization
  – All data batch initialization
  – Read batch NV memory
  – Write batch NV memory
- The correction by the fully closed-loop control is enabled.
- The motor coordinates are set.
- The encoder coordinates are set.
- The time set in the "Correction operation waiting time" parameter has elapsed.

Note
The conditions under which the encoder coordinates are to be set are as follows.
- When return-to-home operation has been completed.
- When position preset has been executed to set the coordinates.

If an alarm of Encoder excessive position deviation or Encoder timeout is generated after the encoder coordinates are set, the encoder coordinates will be in an unset state. To continue operation after the alarm is reset, set the encoder coordinates again.

memo
- The conditions under which the correction by the fully closed-loop control is disabled are as follows.
  – The "Fully closed-loop correction enable" parameter is set to "0: Disable."
  – The FCLOOP-DIS input is in an ON state when the "Fully closed-loop mode" parameter is "1: Follow FCLOOP-DIS input."
- Even if the FCLOOP-RDY output is ON, the correction by the fully closed-loop control will not be performed when the position deviation is less than a value set in the "In-position range" parameter.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	Fully closed-loop correction enable	Enables the correction by the fully closed-loop control.	0: Disable 1: Enable	1
	Fully closed-loop mode	Selects whether to enable or disable the fully closed-loop correction according to the FCLOOP-DIS input when the "Fully closed-loop correction enable" parameter is set to "1: Enable."	0: Follow FCLOOP-DIS input 1: FCLOOP-DIS input disable	0
	Correction operation waiting time	Sets the time from the stop at the command position to the start of the correction operation by the fully closed-loop control. Set a value that is longer than or equal to the settling time for the residual vibration to end after the stop.	0 to 10,000 ms	10

ENC-IN-POS output

Refer to p.30 for the ENC-IN-POS input.

FCLOOP-MON output

When the correction by the fully closed-loop control is performed, the FCLOOP-MON output is turned ON.
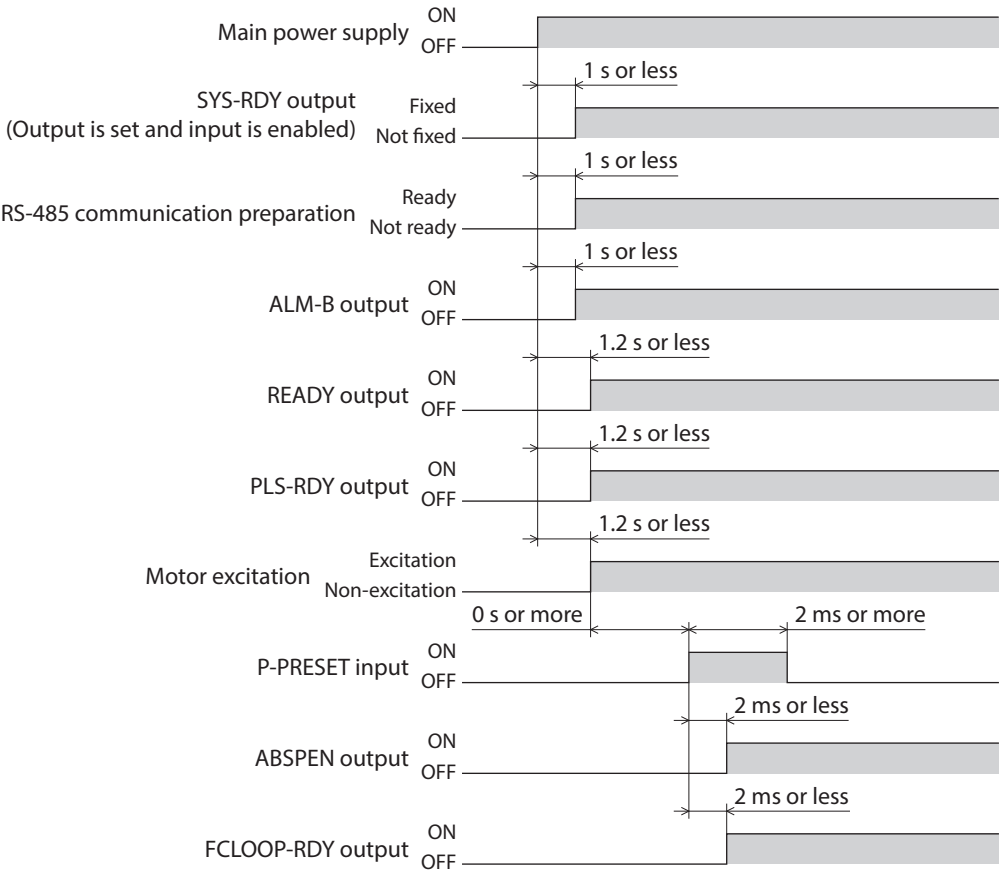
memo) Even if the FCLOOP-RDY output is ON, the correction by the fully closed-loop control will not be performed when the position deviation is less than a value set in the "In-position range" parameter. Also, the FCLOOP-MON output will not be turned ON.

● **Timing chart**

How to start the correction function

1. Check that the READY output is being ON.

2. Turn the P-PRESET input ON.
   The ABSPEN output is turned ON and the FCLOOP-RDY output is turned ON.

Main power supply	ON / OFF	
SYS-RDY output (Output is set and input is enabled)	Fixed / Not fixed	1 s or less
RS-485 communication preparation	Ready / Not ready	1 s or less
ALM-B output	ON / OFF	1 s or less
READY output	ON / OFF	1.2 s or less
PLS-RDY output	ON / OFF	1.2 s or less
Motor excitation	Excitation / Non-excitation	1.2 s or less
P-PRESET input	ON / OFF	0 s or more / 2 ms or more
ABSPEN output	ON / OFF	2 ms or less
FCLOOP-RDY output	ON / OFF	2 ms or less

Relationship between signals during correction operation

1. Check that the FCLOOP-RDY output is in an ON state.

2. Execute operation.
   During operation, the FCLOOP-RDY output and the READY output are turned OFF, and the MOVE output is turned ON. During this time, the position correction is not performed.

3. When the operation is completed, the MOVE output is turned OFF. After the time set in the "Correction operation waiting time" parameter has elapsed, the FCLOOP-RDY and FCLOOP-MON outputs are turned ON and the position correction is started.

4. When the correction of the position is started, it is performed according to the speed of the correction operation adjusted by the "Correction speed gain" parameter until the position deviation is equal to or less than the value set in the "In-position range" parameter.

5. When the time set in the "In-position delay time" parameter has elapsed, the ENC-IN-POS output is turned ON and positioning is completed.

6. When the FCLOOP-DIS input is turned ON to disable the correction by the fully closed-loop control, the FCLOOP-RDY output is turned OFF.

7. When the FCLOOP-RDY output is turned OFF, the position deviation returns to the state before the correction is performed, and the FCLOOP-MON output was turned OFF.

8. When the FCLOOP-DIS input is turned OFF to enable the correction by the fully closed-loop control, the FCLOOP-RDY and FCLOOP-MON outputs are turned ON after the time set in the "Correction operation waiting time" parameter has elapsed, and the position correction is resumed.

The slope at the position correction changes depending on the correction speed gain.
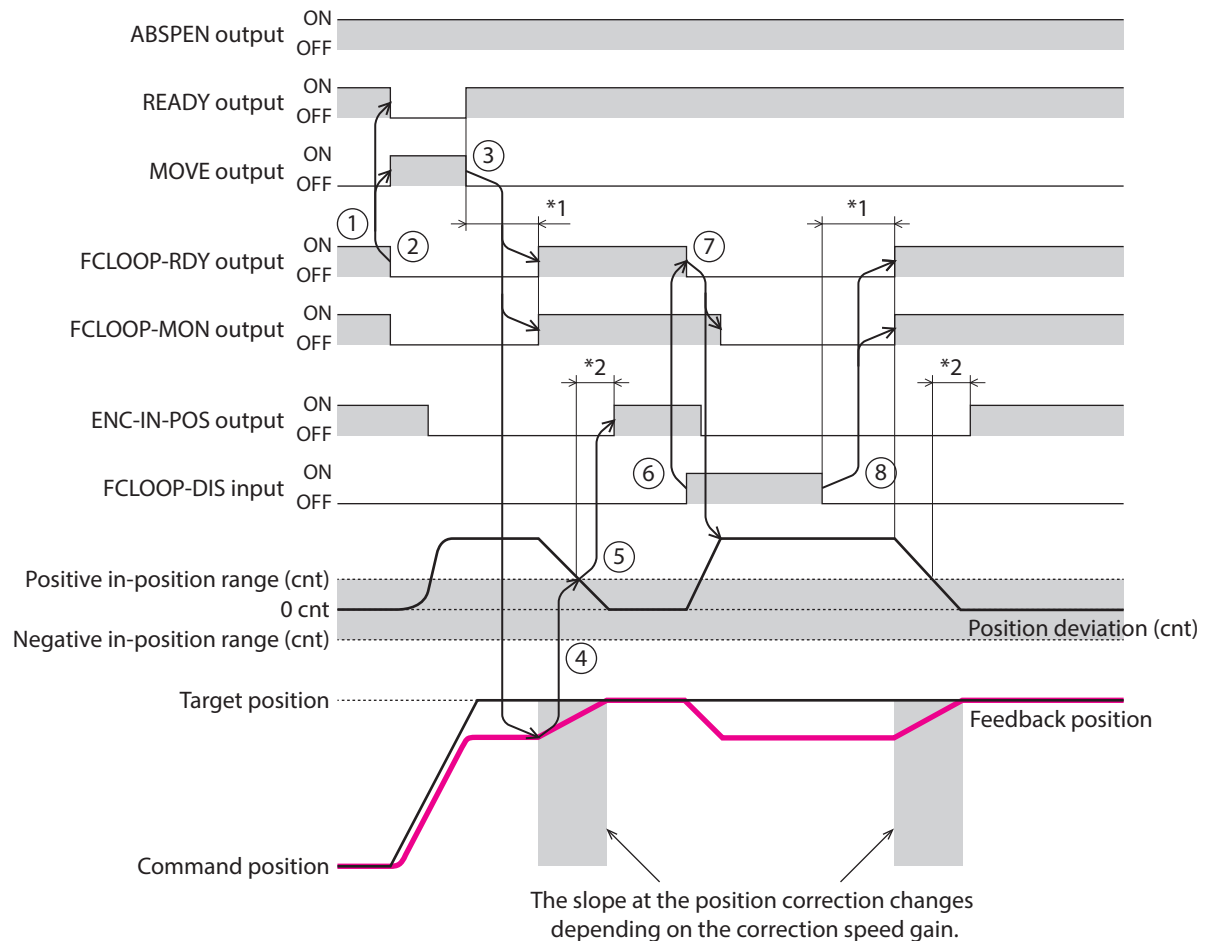
*1 Correction operation waiting time (ms)
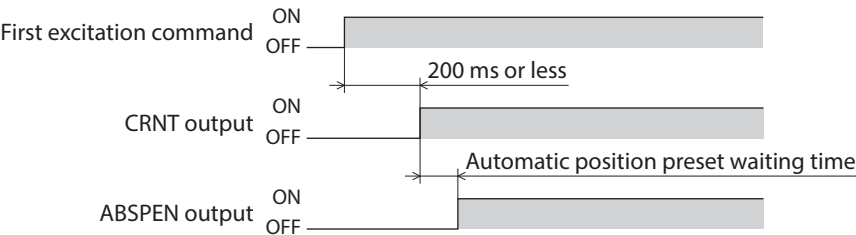*2 In-position delay time (ms)

(memo) After the correction by the fully closed-loop control has been performed, if the position deviation is outside the setting range of the "In-position range" parameter due to an external force, correction will be performed again.

■ **Automatic position preset function**

After the main power supply is turned on and the motor is excited for the first time, position preset is automatically executed to set the coordinates.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p11	Automatic position preset enable	Sets whether or not to automatically execute the position preset after the main power supply is turned on and the motor is excited for the first time.	0: Disable 1: Enable	0
	Automatic position preset waiting time	Sets the waiting time from when the main power supply is turned on and the motor is excited for the first time until the position preset is automatically executed.	100 to 1,000 ms	100

First excitation command
ON
OFF

200 ms or less

CRNT output
ON
OFF

Automatic position preset waiting time

ABSPEN output
ON
OFF

8-5 Setting of operating current and stop current

The operating current and the stop current are calculated based on the base current (%).
The base current is a current used to set the operating current and the stop current and is set as a percentage (%) of the maximum output current of the driver. If the load is small and there is sufficient allowance for torque, the motor temperature rise can be suppressed by setting a lower base current.

Note If the base current is too low, there may be a problem starting the motor or holding the load. Do not reduce the base current any more than necessary.

■ Operating current

The motor operating current is calculated as follows.
- Motor operating current = Maximum output current × "Base current" parameter setting value × "Operating current" setting value

Related operation data

MEXE02 code	Name	Description	Setting range	Initial value
p1	Operating current	Sets the motor operating current based on the base current being 100 %.	0 to 1,000 (1=0.1 %)	1,000

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p3	Base current	Sets the base current.	0 to 1,000 (1=0.1 %)	1,000

■ Stop current

When the motor stops, the automatic current cutback function is activated and the motor current is reduced to the stop current.
The motor stop current is calculated as follows.
- Motor stop current = Maximum output current × "Base current" parameter setting value × "Stop current" parameter value

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p3	Base current	Sets the base current.	0 to 1,000 (1=0.1 %)	1,000
	Stop current	Sets the motor stop current based on the base current being 100 %.	0 to 1,000 (1=0.1 %)	500

Note When the "Applicable motor setting" parameter is set to "23: 5-phase, 2.4 A/phase," set the "Stop current" parameter to 75 % or less.

8-6　Setting of command filters

Using the command filter to adjust the motor response can suppress motor vibration.
There are two types of command filters, LPF (speed filter) and moving average filter.

Related parameters

MEXE02 code	Parameter name	Description	Setting range	Initial value
p3	Command filter setting	Sets the filter function to adjust the motor response.	1: LPF (Speed filter) 2: Moving average filter	1
	Command filter time constant	Adjusts the motor response.	0 to 200 ms	1

■ LPF (Speed filter)

Select "1: LPF (speed filter)" with the "Command filter setting" parameter and set the "Command filter time constant" parameter.
Increasing the value in the "Command filter time constant" parameter can suppress motor vibration during low-speed operation and make the motor movement smoother when starting/stopping. However, setting it too high will reduce synchronization performance in response to the command. Set an appropriate value according to a load or an application.

• When the "Command filter time constant" parameter is set to 0 ms
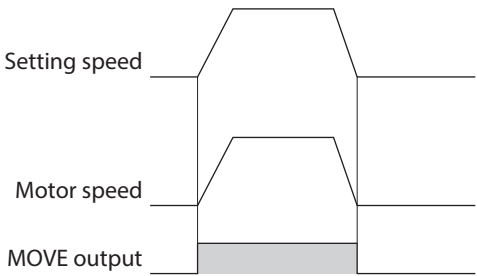
• When the "Command filter time constant" parameter is set to 200 ms
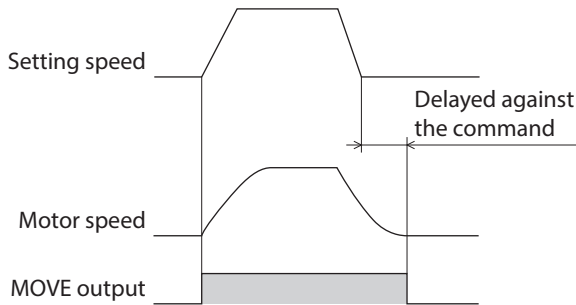
■ Moving average filter

Select "2: Moving average filter" with the "Command filter setting" parameter and set the "Command filter time constant" parameter.
The positioning time can be shortened by suppressing the residual vibration during positioning operation.
The optimal value for the "Command filter time constant" parameter varies depending on a load or operating condition. Set an appropriate value according to a load or operating condition.

	When the "Command filter time constant" parameter is set to 0 ms	When the "Command filter time constant" parameter is set to 200 ms
Self-start (rectangular) drive		
Trapezoidal drive		

9   Inspection and maintenance

9-1   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.

9-2   Warranty

Check on the Oriental Motor Website for the product warranty.

9-3   Disposal

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

10 Alarms

This driver is equipped with the alarm function to protect against temperature rise, poor connection, operation error, and the like.

If an alarm is generated, the ALM-A output is turned ON and the ALM-B output is turned OFF to stop the motor. At the same time, the PWR/ALM LED blinks in red.

The present alarm can be checked by counting the number of times the LED blinks, via RS-485 communication, or using the **MEXE02** software.

10-1 Alarm reset

Before resetting an alarm, always correct the cause of the alarm and ensure safety, and perform one of the reset operations specified below.

- Execute the alarm reset by the maintenance command via RS-485 communication.
- Execute the alarm reset using the **MEXE02** software.
- Turn the ALM-RST input ON. (It is enabled at the ON edge.) (Timing chart ⇨ p.54)
- Turn the main power supply off and on again.

memo Some alarms can not be reset by any other method than turning the main power supply back on. Refer to "10-3 Alarm list" on p.50.

10-2 Alarm history

Up to 10 generated alarm items are stored in non-volatile memory in order from most recent to oldest. The alarm history stored in non-volatile memory can be read and cleared when one of the following items is performed.

- Read the alarm history with the monitor command via RS-485 communication.
- Clear the alarm history with the maintenance command via RS-485 communication.
- Read and clear the alarm history using the **MEXE02** software.

■ Items that can be checked in the alarm history

Name	Description
Code	Indicates the alarm code.
Alarm message	Indicates the alarm type. The alarm content cannot be checked via RS-485 communication. Check with the alarm monitor of the **MEXE02** software.
Sub code	This is the code to be checked by Oriental Motor. However, when the operation data error (alarm code 70h) occurs, the cause of the alarm can be checked by a customer if the sub code is used. Refer to the next table for details of sub codes.
Driver temperature	Indicates the driver temperature when an alarm was generated.
Inverter voltage	Indicates the inverter voltage when an alarm was generated.
Physical I/O input	Indicates the status of direct I/O in hexadecimal when an alarm was generated. (Details of bits ⇨ p.49)
R-I/O output	Indicates the status of R-OUT in hexadecimal when an alarm was generated. (Details of bits ⇨ p.49)
Operation information 0	Indicates the operation data number that was being executed when an alarm was generated. (⇨ p.49)
Operation information 1	Indicates the operation in a number that was being executed when an alarm was generated. (⇨ p.49)
Command position	Indicates the command position of the motor when an alarm was generated.
Elapsed time from BOOT	Indicates the amount of time elapsed from when the main power supply was turned on to when an alarm was generated.
Elapsed time from motor move	Indicates the amount of time elapsed from when the operation was started to when an alarm was generated.

Name	Description
Power supply time	Indicates the amount of time elapsed from when the main power supply was first turned on to when an alarm was generated.

(memo) The R-I/O output is monitored internally even if RS-485 communication is not used. If an output signal to be monitored is assigned to the R-OUT output, the number of monitors when an alarm is generated can be increased.

● **Sub code of operation data error (alarm code 70h)**

Sub code	Cause of alarm
01h	Positioning operation was executed in a state where the travel amount was set to a value less than −2,147,483,647 steps or more than 2,147,483,647 steps.
03h	Positioning operation was executed with the speed of 0 Hz while the travel amount was set to a value other than 0 step.

● **Details of bits for physical I/O input**

Values in brackets [ ] are initial values.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
–	–	–	–	–	DIN2 [AWO]	DIN1 [FCLOOP-DIS]	DIN0 [P-PRESET]

● **Details of bits for R-I/O output**

Values in brackets [ ] are initial values.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
R-OUT15 [FCLOOP-MON]	R-OUT14 [ENC-IN-POS]	R-OUT13 [MOVE]	R-OUT12 [TIM]	R-OUT11 [AREA2]	R-OUT10 [AREA1]	R-OUT9 [AREA0]	R-OUT8 [SYS-BSY]

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
R-OUT7 [ALM-A]	R-OUT6 [INFO]	R-OUT5 [READY]	R-OUT4 [HOME-END]	R-OUT3 [START_R]	R-OUT2 [M2_R]	R-OUT1 [M1_R]	R-OUT0 [M0_R]

● **Information indicated in "Operation Information 0" and "Operation Information 1"**

Operation information 0	−1: Operation data not used (*1) or immediately after turning on the main power supply 0 to 255: Operation data number in operation*2
Operation information 1	0: No internal oscillation (being stopped) 1: Stored data operation 2: Direct data operation 3: Return-to-home operation 5: JOG operation 6: High-speed JOG operation 7: Combined JOG operation 8: Inching operation 9: Continuous operation 13: Teaching, remote operation

*1 Operation other than stored data operation or continuous macro operation is being executed.
*2 While the operation is stopped, the operation data number that was operated just before the stop is displayed.

10-3 Alarm list

Alarm code	Number of LED blinks	Alarm type	Cause	Remedial action	Reset using the ALM-RST input	Motor excitation*
13h	4	Encoder excessive position deviation	During the fully closed-loop correction, the deviation between the command position and the encoder feedback position exceeded the value set in the "Encoder excessive position deviation alarm" parameter.	• Check the connection of the external encoder. • Increase the acceleration/ deceleration time or slow down the acceleration/ deceleration rate, and perform operation with the time that can be started and stopped stably. • Check that the setting of the "Encoder count action" parameter matches the travel direction of the ball screw or the rotation direction of the table.	Possible	Excitation
20h	5	Overcurrent	The motor, the cable, and the driver output circuit were short-circuited.	Turn off the main power supply and check that the motor, the cable, and the driver are not damaged. After that, turn on the main power supply again. If the alarm still does not reset, the motor, the cable, or the driver may be damaged. Contact your nearest Oriental Motor sales office.	Not possible	Non-excitation
21h	2	Main circuit overheat	The board temperature of the driver exceeded 85 °C (185 °F).	Reconsider the ventilation condition.	Possible	Non-excitation
22h	3	Overvoltage	• The power supply voltage exceeded 43.1 VDC. • A large load inertia was suddenly stopped. • Vertical operation (elevating operation) was performed.	• Check the input voltage of the main power supply. • Reduce the load. • Increase the acceleration/ deceleration time or slow down the acceleration/ deceleration rate.	Possible	Non-excitation
25h	3	Undervoltage	The main power supply was momentarily shut off or the voltage was insufficient.	Check the input voltage of the main power supply.	Possible	Non-excitation
34h	2	Command pulse error	The frequency of the command pulse exceeded 9,600 r/min.	Reduce the frequency of the command pulse.	Possible	Non-excitation

Alarm code	Number of LED blinks	Alarm type	Cause	Remedial action	Reset using the ALM-RST input	Motor excitation*
36h	8	Encoder timeout	During the fully closed-loop correction, the correction was not completed even after the time set in the "Encoder correction timeout" parameter had elapsed.	• Check the connection of the external encoder. • Reconsider "In-position range" parameter. • Reconsider the setting of the "Correction speed gain" parameter. • Reconsider the "Correction operation waiting time" parameter. If the acceleration/deceleration time is too short or the acceleration/deceleration rate is too fast, residual vibration may remain for a long time after the operation is stopped.	Possible	Excitation
41h	9	EEPROM error	The data stored in the driver was damaged.	Initialize all parameters.	Not possible	Non-excitation
4Ah	7	Return-to-home incomplete	Absolute positioning operation was started in a state where the coordinates were not set.	Execute the position preset or return-to-home operation.	Possible	Excitation
60h	7	±LS both sides active	• When the "FW-LS/RV-LS input action" parameter is set to "2: Immediate stop with alarm" or "3: Deceleration stop with alarm," both the FW-LS input and the RV-LS input were detected. • Return-to-home operation was executed in a state where both the FW-LS input and the RV-LS input were detected.	Check the sensor logic installed and the "Inverting mode" parameter.	Possible	Excitation
61h	7	Reverse ±LS connection	The LS input opposite to the operating direction was detected while return-to-home operation in the 2-sensor mode or the 3-sensor mode was performed.	Check the wiring of the sensor.	Possible	Excitation
62h	7	Return-to-home operation error	• The installation positions of the FW-LS and RV-LS sensors and the HOME sensor are close to each other. • During return-to-home operation in the one-way rotation mode, the motor position exceeded the HOME sensor while the motor was decelerating to a stop.	• Reconsider the sensor installation positions and the starting direction of motor operation. • Reconsider the specifications of the HOME sensor and the "(HOME) Return-to-home acceleration/deceleration" parameter.	Possible	Excitation

Alarm code	Number of LED blinks	Alarm type	Cause	Remedial action	Reset using the ALM-RST input	Motor excitation*
63h	7	No HOMES	The HOMES input was not detected at a position between the FW-LS input and the RV-LS input while return-to-home operation in the 3-sensor mode was performed.	Install the HOME sensor at a position between the FW-LS and RV-LS sensors.	Possible	Excitation
64h	7	TIM, ZSG, SLIT signal error	None of the TIM output, the ZSG output, or the SLIT input could be detected during return-to-home operation.	• Reconsider the connection status of the load and the position of the HOME sensor so that these signals should be ON while the HOMES input is ON. • When a signal is not used, set the "(HOME) Return-to-home TIM/ZSG signal detection" parameter and the "(HOME) Return-to-home SLIT detection" parameter to "0: Disable."	Possible	Excitation
66h	7	Hardware overtravel	When the "FW-LS/RV-LS input action" parameter is set to "2: Immediate stop with alarm" or "3: Deceleration stop with alarm," the FW-LS input or the RV-LS input was detected.	Reset the alarm and then escape from the sensor by operating the motor or manually.	Possible	Excitation
67h	7	Software overtravel	When the "Software overtravel" parameter is set to "2: Immediate stop with alarm" or "3: Deceleration stop with alarm," the motor position reached the set value of the software limit.	• Reconsider the operation data. • Reset the alarm and then escape from the sensor by operating the motor or manually.	Possible	Excitation
6Ah	7	Return-to-home operation offset error	When offset movement as part of return-to-home operation was performed, the FW-LS input or the RV-LS input was detected.	Check the offset value.	Possible	Excitation
70h	7	Operation data error	Positioning SD operation was performed with data whose operating speed was 0 r/min.	Check the operation data. (Sub code of operation data error ⇨ p.49)	Possible	Excitation
71h	7	Electronic gear setting error	The resolution set with the "Electronic gear A" parameter and the "Electronic gear B" parameter was out of the specifications.	Reconsider the "Electronic gear A" and "Electronic gear B" parameters and set the resolution to a range within the specifications.	Not possible	Non-excitation
84h	7	RS-485 communication error	The number of consecutive RS-485 communication errors generated has reached the value set in the "Communication error alarm" parameter.	• Check the connection between the driver and the host controller. • Check the setting of RS-485 communication.	Possible	Excitation

Alarm code	Number of LED blinks	Alarm type	Cause	Remedial action	Reset using the ALM-RST input	Motor excitation*
85h	7	RS-485 communication timeout	The time set in the "Communication timeout" parameter has elapsed, and yet the communication could not be established with the host controller.	Check the connection between the driver and the host controller.	Possible	Excitation
F0h	Light	CPU error	CPU malfunctioned.	Turn the main power supply off and on again.	–	–

* An excitation state of the motor when an alarm is generated is as follows.
Non-excitation: If an alarm is generated, the motor current is cut off and the motor holding force is lost.
Excitation: Even if an alarm is generated, the motor current is not cut off and the motor position is held.

10-4　Timing chart

■ When the motor remains in an excitation state even if an alarm is generated

1. If an error occurs, the ALM-B output, the MOVE output, and the PLS-RDY output are turned OFF.
   At the same time, the motor stops immediately.

2. Remove the cause of the alarm before turning the ALM-RST input ON.
   The alarm is reset, and the ALM-B output, the READY output, and the PLS-RDY output are turned ON.

(memo) When resetting the alarm, stop inputting the pulse signal. If the alarm is reset while the pulse signal is input, the motor may start rotating suddenly, causing injury or damage to equipment.

3. Check that the ALM-B output has been turned ON, and then turn the ALM-RST input OFF.
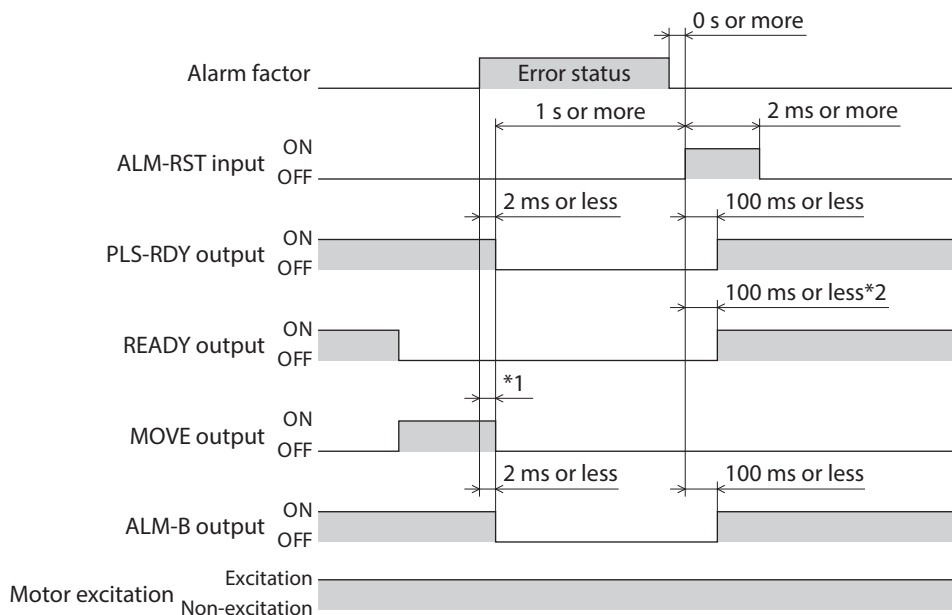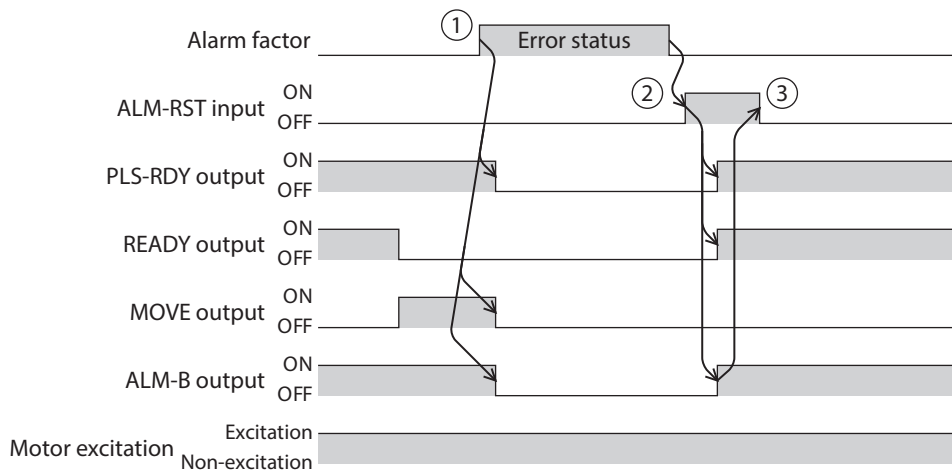
*1 It varies depending on the driving condition.
*2 It is the time when the MOVE output is OFF.

■ When the motor goes into a non-excitation state if an alarm is generated

1. If an error occurs, the ALM-B output, the MOVE output, and the PLS-RDY output are turned OFF.
   At the same time, the motor stops immediately.

2. Remove the cause of the alarm before turning the ALM-RST input ON.
   The alarm is reset, and the ALM-B output, the READY output, and the PLS-RDY output are turned ON.

   memo   When resetting the alarm, stop inputting the pulse signal. If the alarm is reset while the pulse signal
           is input, the motor may start rotating suddenly, causing injury or damage to equipment.

3. Check that the ALM-B output has been turned ON, and then turn the ALM-RST input OFF.
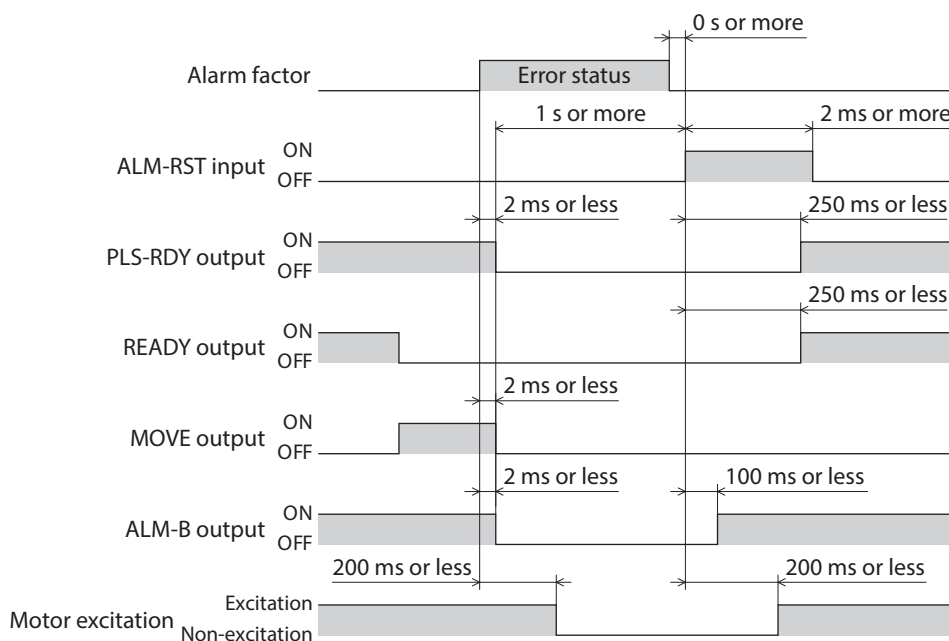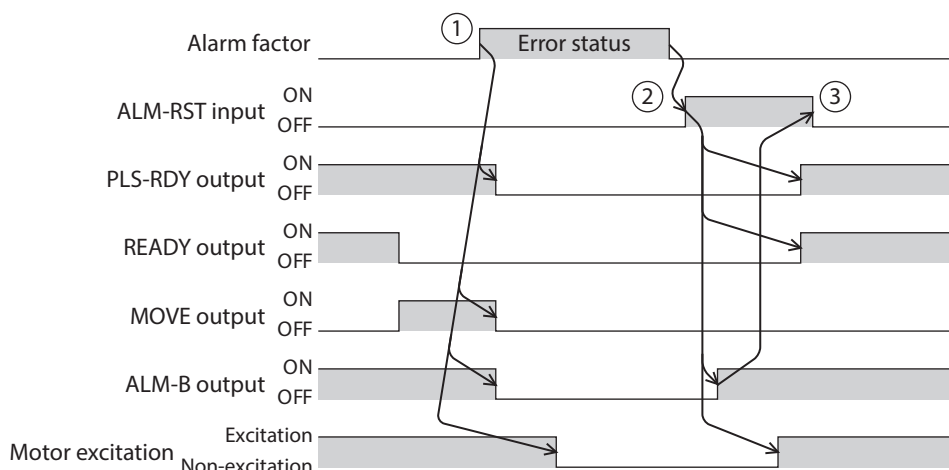
11   Information

The driver is equipped with a function to generate information output before an alarm is generated.
This function can be used for periodic maintenance of equipment by setting a appropriate value in the parameter of each information.
For example, setting the "Tripmeter information" parameter can be used as a reference to perform maintenance every time a certain rotation amount is reached.

■ Status when information is generated

● Information bit output

If information is generated, a bit output (INFO-∗∗ output) of the corresponding information is turned ON.

● INFO output

If information is generated, the INFO output is turned ON.

● LED indicator

If information is generated, the PWR/ALM LED will simultaneously blink in red and green twice.
(Red and green colors may overlap and may be visible as orange.)

● Motor operation

The motor continues to operate during information unlike in the case of an alarm.

● Parameters

Each information has a corresponding "INFO action" parameter. If the parameter is set to "0: No Info reflect," only the bit output of information is turned ON, and the INFO output and LED are not changed.

Related parameters

MEXE02 code	Name	Description	Setting range	Initial value
p5	Driver temperature information (INFO-DRVTMP)	Sets the condition under which the information (INFO-DRVTMP) is generated.	40 to 85 °C	85
	Overvoltage information (INFO-OVOLT)	Sets the condition under which the overvoltage information (INFO-OVOLT) is generated.	180 to 430 (1=0.1 V)	430
	Undervoltage information (INFO-UVOLT)	Sets the condition under which the undervoltage information (INFO-UVOLT) is generated.	180 to 430 (1=0.1 V)	180
	Tripmeter information (INFO-TRIP)	Sets the condition under which the tripmeter information (INFO-TRIP) is generated.	0: Disable 1 to 2,147,483,647 (1=0.1 kRev)	0
	Odometer information (INFO-ODO)	Sets the condition under which the odometer information (INFO-ODO) is generated.	0: Disable 1 to 2,147,483,647 (1=0.1 kRev)	0
	Information LED condition	Sets the LED status when information is generated.	0: Disable (LED does not blink) 1: Enable (LED blinks)	1
	Information auto clear	When the cause of the information is removed, the INFO output and the bit output of the corresponding information are automatically turned OFF.	0: Disable (Not turned OFF automatically) 1: Enable (Turned OFF automatically)	1
	INFO action (Driver temperature information (INFO-DRVTMP))	Sets the bit output, the INFO output, and the LED status when information is generated.	0: No info reflect (Only the bit output is ON.) 1: Info reflect (The bit output and the INFO output are ON and the LED blinks.)	1
	INFO action (Overvoltage information (INFO-OVOLT))			
	INFO action (Undervoltage information (INFO-UVOLT))			

MEXE02 code	Name	Description	Setting range	Initial value
p5	INFO action (Start operation error information (INFO-START))	Sets the bit output, the INFO output, and the LED status when information is generated.	0: No info reflect (Only the bit output is ON.) 1: Info reflect (The bit output and the INFO output are ON and the LED blinks.)	1
	INFO action (PRESET request information (INFO-PR-REQ))			
	INFO action (Motor setting error information (INFO-MSET-E))			
	INFO action (Electronic gear setting error information (INFO-EGR-E))			
	INFO action (RS-485 communication error information (INFO-NET-E))			
	INFO action (Forward operation prohibition information (INFO-FW-OT))			
	INFO action (Reverse operation prohibition information (INFO-RV-OT))			
	INFO action (Tripmeter information (INFO-TRIP))			
	INFO action (Odometer information (INFO-ODO))			
	INFO action (Encoder setting error information (INFO-ENC-E))			
	INFO action (Start operation restricted mode information (INFO-DSLMTD))			
	INFO action (I/O test mode information (INFO-IOTEST))			
	INFO action (Configuration request information (INFO-CFG))			
	INFO action (Reboot request information (INFO-RBT))			

11-1   Clearing information

How to clear the information can be set with the "Information auto clear" parameter.

● **When the "Information auto clear" parameter is set to "1: Enable" (factory setting)**

The generated information will automatically be cleared if the condition to clear information is met.

● **When the "Information auto clear" parameter is set to "0: Disable"**

Even if the condition to clear information is met, the information remains generated. The information can be cleared if one of the following is performed in a state where the condition to clear information is met.
- Execute Clear information with the maintenance command via RS-485 communication.
- Execute Clear information on the information monitor of the **MEXE02** software.
- Turn the INFO-CLR input ON.
- Turn the main power supply off and on again.

11-2   Information history

Up to 16 generated information items are stored in RAM in order from most recent to oldest. Information items stored as the information history are the information code, generation time, and contents of information.
The stored information history can be read or cleared if one of the following operations is performed.
- Read the information history by the monitor command via RS-485 communication.
- Clear the information history by the maintenance command via RS-485 communication.
- Read or clear the information history using the **MEXE02** software.

memo Information history is stored in RAM, so it is cleared when the main power supply of the driver is turned off.

■ Items that can be checked in the information history

Name	Description
Information history 1	Indicates the most recent information history. Refer to p.59 for details on information codes. When information is being generated, its code is also displayed on the information history 1 simultaneously.
Information history 2	Indicates the information history. Refer to p.59 for details on information codes.
Information history 3	
Information history 4	
Information history 5	
Information history 6	
Information history 7	
Information history 8	
Information history 9	
Information history 10	
Information history 11	
Information history 12	
Information history 13	
Information history 14	
Information history 15	
Information history 16	Indicates the oldest information history. Refer to p.59 for details on information codes.
Information time history 1	Indicates the history of the time when the most recent information was generated. When information is being generated, the time when the present information was generated is displayed.
Information time history 2	Indicates the history of the time when information was generated.
Information time history 3	
Information time history 4	
Information time history 5	
Information time history 6	
Information time history 7	
Information time history 8	
Information time history 9	
Information time history 10	
Information time history 11	
Information time history 12	
Information time history 13	
Information time history 14	
Information time history 15	
Information time history 16	Indicates the history of the time when the oldest information was generated.

● **Information codes**

Information codes are displayed in eight hexadecimal digits. They can also be read in 32 bits.
If multiple information items are generated, the logical sum (OR) of the information codes is displayed.

Example) When information items of the driver temperature and the overvoltage are generated

Information code of Driver temperature: 0000 0004h
Information code of Overvoltage: 0000 0010h
OR value of two information codes: 0000 0014h

Information code	32 bits indication	Information item
00000004h	0000 0000 0000 0000 0000 0000 0000 0100	Driver temperature
00000010h	0000 0000 0000 0000 0000 0000 0001 0000	Overvoltage
00000020h	0000 0000 0000 0000 0000 0000 0010 0000	Undervoltage
00000200h	0000 0000 0000 0000 0000 0010 0000 0000	Start operation error
00000800h	0000 0000 0000 0000 0000 1000 0000 0000	Preset request
00001000h	0000 0000 0000 0000 0001 0000 0000 0000	Motor setting error
00002000h	0000 0000 0000 0000 0010 0000 0000 0000	Electronic gear setting error
00008000h	0000 0000 0000 0000 1000 0000 0000 0000	RS-485 communication error
00010000h	0000 0000 0000 0001 0000 0000 0000 0000	Forward operation prohibition
00020000h	0000 0000 0000 0010 0000 0000 0000 0000	Reverse operation prohibition
00100000h	0000 0000 0001 0000 0000 0000 0000 0000	Tripmeter
00200000h	0000 0000 0010 0000 0000 0000 0000 0000	Odometer
01000000h	0000 0001 0000 0000 0000 0000 0000 0000	Encoder setting error
10000000h	0001 0000 0000 0000 0000 0000 0000 0000	Start operation restricted mode
20000000h	0010 0000 0000 0000 0000 0000 0000 0000	I/O test mode
40000000h	0100 0000 0000 0000 0000 0000 0000 0000	Configuration request
80000000h	1000 0000 0000 0000 0000 0000 0000 0000	Reboot request

11-3   Information list

Information item	Information bit output signal	Cause	Condition to clear
Driver temperature	INFO-DRVTMP	The internal temperature of the driver exceeded the value set in the "Driver temperature information" parameter.	The internal temperature of the driver fell below the value set in the "Driver temperature information" parameter.
Overvoltage	INFO-OVOLT	• The voltage of the main power supply exceeded the value set in the "Overvoltage information" parameter. • A large load inertia was suddenly stopped. • Vertical operation (elevating operation) was performed.	The voltage of the main power supply fell below the value set in the "Overvoltage information" parameter.
Undervoltage	INFO-UVOLT	• The voltage of the main power supply fell below the value set in the "Undervoltage information" parameter. • The main power supply was momentarily shut off or the voltage was insufficient.	The voltage of the main power supply exceeded the value set in the "Undervoltage information" parameter.

Information item	Information bit output signal	Cause	Condition to clear
Start operation error	INFO-START	• The operation start signal in the direction that was stopped by the FW-BLK input or RV-BLK input has been turned ON. • The operation start signal in the direction that was stopped by the FW-LS input or RV-LS input has been turned ON. • The operation start signal in the direction that was stopped by the software limit has been turned ON. • When operation could not be executed (example: the READY output was OFF), the operation start signal was turned ON.	Operation was started properly.
Preset request	INFO-PR-REQ	Preset was executed by the position preset or return-to-home operation.	Preset was completed.
Motor setting error	INFO-MSET-E	A value not described in the table of "Parameter setting values for the combined products" on p.34 was set.	Set the correct value for the motor setting, and turn on the main power supply again.
Electronic gear setting error	INFO-EGR-E	The resolution set with the "Electronic gear A" parameter and the "Electronic gear B" parameter was out of the specifications.	The resolution was set within the specification range.
RS-485 communication error	INFO-NET-E	An RS-485 communication error was detected.	RS-485 communication was performed properly.
Forward operation prohibition	INFO-FW-OT	• The positive software limit was exceeded. • Either the FW-LS input or the FW-BLK input was turned ON.	The position of the motor fell into the range of the positive software limit, and additionally, both the FW-LS input and the FW-BLK input were turned OFF.
Reverse operation prohibition	INFO-RV-OT	• The negative software limit was exceeded. • Either the RV-LS input or the RV-BLK input was turned ON.	The position of the motor fell into the range of the negative software limit, and additionally, both the RV-LS input and the RV-BLK input were turned OFF.
Tripmeter	INFO-TRIP	The travel distance of the motor exceeded the value set in the "Tripmeter information" parameter.	After one of the following operations was performed, the travel distance (Tripmeter) of the motor fell below the value set in the "Tripmeter information" parameter. • The "Tripmeter information" parameter was set again. • The tripmeter was cleared using the **MEXE02** software or via RS-485 communication.
Odometer	INFO-ODO	The cumulative travel distance of the motor exceeded the value set in the "Odometer information" parameter.	After the following operation was performed, the cumulative travel distance (Odometer) of the motor fell below the value set in the "Odometer information" parameter. • The "Odometer information" parameter was set again.
Encoder setting error	INFO-ENC-E	The combination of the resolution set with the encoder settings and the mechanism was outside the specification range.	The encoder settings were set within the specification range.

Information item	Information bit output signal	Cause	Condition to clear
Start operation restricted mode	INFO-DSLMTD	• "Teaching, remote operation" was executed using the **MEXE02** software. • Configuration was executed. • Data was written to the driver with the **MEXE02** software. • "Reset" was executed with the **MEXE02** software.	• Teaching, remote operation was canceled. • Configuration was completed. • Writing data was completed. • Data was restored to the factory setting.
I/O test mode	INFO-IOTEST	• "I/O test" was executed with the **MEXE02** software. • Configuration was executed.	• The I/O test mode was canceled. • Configuration was completed.
Configuration request	INFO-CFG	The parameter that required executing Configuration was changed.	Configuration was executed.
Reboot request	INFO-RBT	A parameter that requires the main power to be turned on again was changed.	The main power supply was turned on again.

12 Troubleshooting and remedial actions

In motor operation, the motor or the driver may not operate properly due to an improper setting or incorrect connection.

When the motor cannot be operated properly, refer to the contents provided in this chapter and take an appropriate remedial action.

If the problem persists, contact your nearest Oriental Motor sales office.

Phenomenon	Possible cause	Remedial action
• The motor is not excited. • The output shaft can be rotated by hand.	Connection error of the connection cable or power supply cable.	Check the connections for the driver, the motor, and the main power supply.
	The AWO input is being ON.	Turn the AWO input OFF.
	The "Applicable motor setting" parameter remains at the factory setting.	Set the "Applicable motor setting" parameter and turn on the main power supply again.
	The "Applicable motor setting" parameter was set to a value outside the specification range.	Set the correct value to the "Applicable motor setting" parameter and turn on the main power supply again.
	A value set in the "Base current" parameter or "Stop current" parameter is too low.	Check the setting of the "Base current" parameter or "Stop current" parameter. If the motor current is low, the torque will also be low and operation will be unstable.
The motor does not rotate.	The STOP input is being ON.	Turn the STOP input OFF.
	The position (travel amount) is not set in the operation data when positioning SD operation is performed.	Check the operation data.
	When JOG operation, high-speed JOG operation, or continuous macro operation is performed, input signals to operate the motor in the forward direction and the reverse direction are being ON simultaneously.	Turn both inputs in the forward direction and the reverse direction OFF, and then turn either one ON.
The motor rotates in the direction opposite to the specified direction.	The "Motor rotation direction" parameter is set wrongly.	Check the setting of the "Motor rotation direction" parameter.
The output shaft of the geared motor (gearhead output shaft) rotates in the opposite direction to the motor output shaft.	The geared motor whose output shaft rotates in the opposite direction to the motor output shaft is used.	• The output shaft of the **TS** geared type with a gear ratio of 20 or 30 rotates in the opposite direction to the motor output shaft. • In the case of the **SH** geared type with a frame size of 28 mm (1.10 in.), the output shaft rotates in the opposite direction to the motor output shaft when the gear ratio is 9, 10, or 18. • In the case of the **SH** geared type with a frame size of 42 mm (1.65 in.) and 60 mm (2.36 in.), the output shaft rotates in the opposite direction to the motor output shaft when the gear ratio is 18 or 36. • In the case of the flat type motor with harmonic gear, the output shaft always rotates in the opposite direction to the motor output shaft.
Motor operation is unstable.	Connection error of the connection cable or power supply cable.	Check the connections for the driver, the motor, and the main power supply.
	A value set in the "Base current" parameter is too low.	Check the setting of the "Base current" parameter. If the motor current is low, the torque will also be low and operation will be unstable.

| Phenomenon	Possible cause	Remedial action
The motor causes loss of synchronization during acceleration or operation.	The centers of the output shaft and the load shaft are not aligned.	Check the connection condition of the output shaft and the load shaft.
	The load fluctuation is large.	Check to see if large load fluctuations have occurred during operation.
	Torque is insufficient.	Reconsider the load condition.
	The starting speed is too high.	Set a lower starting speed so that the motor can be started stably.
	The acceleration is too fast.	Set the acceleration to be slower so that the motor can be started stably.
Motor vibration is too large.	The load is small.	Reduce the current with the "Base current" parameter. If the motor output torque is too high relative to the load, vibration will increase.
The motor position (travel amount) does not match the setting value.	The setting of resolution (step angle) is incorrect.	Check the setting values of the "Electronic gear A" and "Electronic gear B" parameters.
The fully closed-loop correction is not performed.	The home is not set.	After the main power is turned on, do one of the following. • Turn the P-PRESET input ON. • Perform return-to-home operation.
	The coordinates of the command position and the feedback position do not match.	• Check to see if the "Encoder type" parameter matches the external encoder shape. • Check to see if the "Encoder resolution" parameter matches the resolution of the external encoder. • For a linear encoder, check to see if the "Mechanism lead" parameter matches the lead width of the connected mechanism. • When connecting a gear reduction mechanism, check to see if the "Gear ratio" parameter matches the gear ratio. • When using a high-resolution type motor, make sure that the "Base step angle" parameter is set to "2: 0.36°." • Check that the value set in the "Multiplication number" parameter matches the resolution of the external encoder. • Check that the setting of the "Encoder count action" parameter matches the travel direction of the ball screw or the rotation direction of the table.
	The fully closed-loop correction is disabled.	• Make sure that the "Fully closed-loop correction enable" parameter is set to "1: Enable." • Turn the FCLOOP-DIS input OFF.
	An alarm of Encoder timeout is generated.	• Check the connection of the external encoder. • Reconsider "In-position range" parameter. • Reconsider the setting of the "Correction speed gain" parameter. • Reconsider the "Correction operation waiting time" parameter. If the acceleration/deceleration time is too short or the acceleration/deceleration rate is too fast, residual vibration may remain for a long time after the operation is stopped.

Phenomenon	Possible cause	Remedial action
The fully closed-loop correction is not performed.	An alarm of Encoder excessive position deviation is generated.	• Check the connection of the external encoder. • Increase the acceleration/deceleration time or slow down the acceleration/deceleration rate, and perform operation with the time that can be started and stopped stably. • Check that the setting of the "Encoder count action" parameter matches the travel direction of the ball screw or the rotation direction of the table.

(memo) When an alarm is being generated, check the alarm content via RS-485 communication or using the **MEXE02** software.

13 Cables

This chapter describes cables shown in gray in the figure.
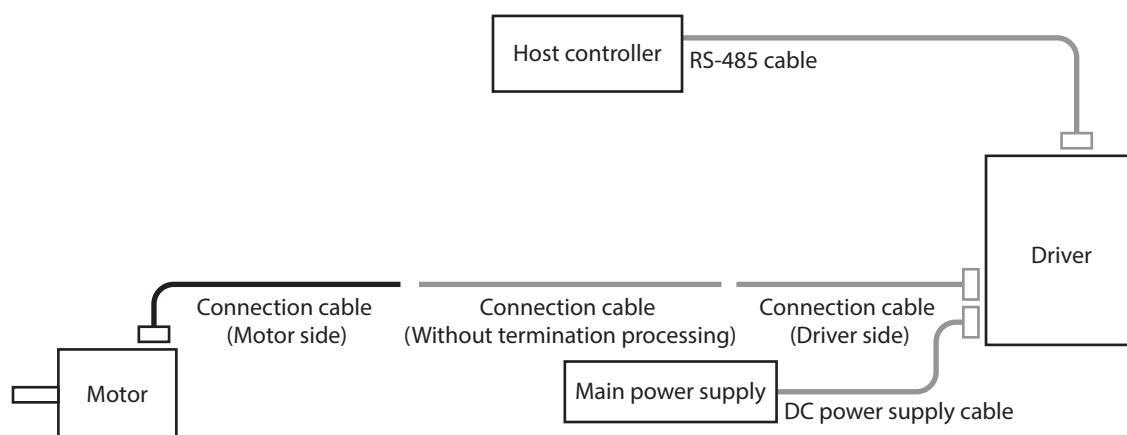
> (memo) In addition to the cables described here, there are several types of connection cables available, such as those that can be connected directly between the motor and the driver. Check on the Oriental Motor Website for cables not described here.

13-1 DC power supply cables

These are the connection cables between the main power supply and the driver. They are shielded cables with a ground wire at each end.

Model	Length [m (ft.)]
CC02D005-2	0.5 (1.6)
CC02D010-2	1 (3.3)
CC02D015-2	1.5 (4.9)
CC02D020-2	2 (6.6)

13-2 RS-485 cable

This cable is used when connecting the driver to a host controller. A connector is assembled on one end of the cable (driver side).

Model: **CC030-RS** [3 m (9.8 ft.)]

13-3 Connection cables (Driver side)

A connector is assembled on the driver side.

■ Connection cables

Model	Length [m (ft.)]
CC005N1	0.5 (1.6)
CC010N1	1 (3.3)

■ Flexible connection cables

Model	Length [m (ft.)]
CC005N1R	0.5 (1.6)
CC010N1R	1 (3.3)

13-4　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.)]	Electrical wire size	Outer diameter
CC05PK5	5 (16.4)	AWG22 (0.3 m^2)	ø7.2 mm
CC10PK5	10 (32.8)		

■ Flexible connection cables

Model	Length [m (ft.)]	Electrical wire size	Outer diameter
CC05PK5R	5 (16.4)	AWG22 (0.3 m^2)	ø5.8 mm
CC10PK5R	10 (32.8)		

14 Accessories

14-1 Relay contact protection circuit/module

■ Pulse signal converter for noise immunity

This product converts a pulse signal, which is output from the open collector output, to a pulse signal for good noise immunity by outputting the pulse signal again from the differential output.

Model: **VCS06**

■ CR circuit for surge suppression

This product is effective in suppressing 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 in suppressing 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**

15 Specifications

15-1 Product specifications

Input voltage	24 VDC±10 %
Input current	0.6 to 3.0 A*
Interface — Pulse input	• 3 to 5.25 VDC • Maximum input pulse frequency Line driver output: 1 MHz (duty cycle 50 %) Open-collector output: 250 kHz (duty cycle 50 %)
Interface — Control input	4.5 to 5.25 VDC
Interface — Control output	30 VDC or Less (output saturation voltage: maximum 0.5 V) 10 mA or less
Interface — Encoder input	• Input mode: Incremental (phase A, phase B, phase Z) • Count system: 90-degree phase difference input • Multiplication number: ×1, ×2, ×4 multiplication • Input frequency: Maximum 4.0 MHz (frequency of each of phase A and phase B) • Interface: Differential line receiver (26C32 equivalent)
Interface — 5 V power output for encoder	300 mA or less
Interface — Field network	Modbus RTU (RS-485 communication)

* It varies depending on the product combined. Refer to p.16.

15-2 General specifications

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.

15-3 Communication specifications

Electrical characteristics	EIA-485 Compliant Use a twisted pair cable and keep the total extension distance up to a maximum of 3 m (9.8 ft).
Communication mode	Half duplex Asynchronous mode (data: 8 bits, stop bit: 1 bit/2 bits, parity: none/even number/odd number)
Transmission rate	Selectable from 9,600 bps, 19,200 bps, 38,400 bps, 57,600 bps, 115,200 bps, and 230,400 bps.
Protocol	Modbus RTU mode
Type of Connection	Up to 31 drivers can be connected to a single host controller.

16 Regulations and standards

16-1 UL Standards, CSA Standards

This product is recognized by UL under UL and CSA Standards.

16-2 CE Marking / UKCA Marking

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

■ EU EMC Directive / UK EMC Regulations

For details on compliance, refer to "6-9 Compliance with the EMC Directive/Regulations" on p.27.

■ EU RoHS Directive / UK RoHS Regulations

This product does not contain the substances exceeding the restriction values.

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