Oriental motor

HM-60156

Stepping motor and driver package

αSTEP

High-efficiency **AR Series**

AC power input　Pulse input type

USER MANUAL

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

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

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1 Safety precautions

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

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

⚠ Warning

General

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire, electric shock or injury.
- Assign qualified personnel the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Failure to do so may result in fire, electric shock, injury or damage to equipment.
- Do not transport, install the product, perform connections or inspections when the power is on. Always turn the power off before carrying out these operations. Failure to do so may result in electric shock.
- The terminals on the driver's front panel marked with ⚠ ⚠ symbol indicate the presence of high voltage. Do not touch these terminals while the power is on to avoid the risk of fire or electric shock.
- Take measures to keep the moving parts in position for vertical operations such as elevator applications. The motor loses holding torque when the power is shut off, allowing the moving parts to fall and possibly cause injury or damage to equipment.
- The brake mechanism of an electromagnetic brake motor is used to keep the moving part and motor in position. Do not use it as a deceleration/safety brake. Doing so may result in injury or damage to the equipment.
- When the driver generates an alarm (any of the driver's protective functions is triggered), the motor will stop and lose its holding torque. Accordingly, provide measures to hold the moving part in place in the event of an alarm. Failure to do so may result in injury or equipment damage.
- When the driver generates an alarm (any of the driver's protective functions is triggered), first remove the cause and then clear the protection function. Continuing the operation without removing the cause of the problem may cause malfunction of the motor and driver, leading to injury or damage to equipment.

Installation

- The motor and driver are Class I equipment. When installing the motor and driver, do not touch the driver without grounding the driver first. Failure to do so may result in electric shock.
- Install the motor and driver in the enclosure in order to prevent electric shock or injury.

Connection

- Keep the driver's input power voltage within the specified range. Failure to do so may result in fire or electric shock.
- Connect the cables securely according to the wiring diagram. Failure to do so may result in fire or electric shock.
- Do not forcibly bend, pull or pinch the cable. Doing so may fire and electric shock.

Operation

- Turn off the driver power in the event of a power failure. Or the motor may suddenly start when the power is restored and may cause injury or damage to equipment.
- Do not turn the FREE input to ON while the motor is operating. The motor will stop and lose its holding power. Doing so may result in injury or damage to equipment.

Maintenance and inspection

- Do not touch the connection terminals on the driver while the power is supplied or for at least 10 minutes after turning off the power. Before making wiring connections or carrying out checks, also wait for the CHARGE LED to turn off and check the voltage with a tester, etc. Failure to do so may result in electric shock.

Repair, disassembly and modification

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

⚠ Caution

General

- Do not use the motor and driver beyond its specifications. Doing so may result in electric shock, injury or damage to equipment.
- Keep your fingers and objects out of the openings in the motor and driver. Failure to do so may result in fire, electric shock or injury.
- Do not touch the motor and driver during operation or immediately after stopping. The surface is hot and may cause a skin burn(s).

Transportation

- Do not carry the motor by holding the motor output shaft or motor cable. Doing so may cause injury.

Installation

- Provide a cover over the rotating parts (output shaft) of the motor. Failure to do so may result in injury.
- Do not leave anything around the motor and driver that would obstruct ventilation. Doing so may result in damage to equipment.

Connection

- The communication connector (CN4) and I/O signal connector (CN5) are not insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and these equipment to short, damaging both.

Operation

- Use a motor and driver only in the specified combination. An incorrect combination may cause a fire.
- Provide an emergency stop device or emergency stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Before supplying power to the driver, turn all input signals to the driver OFF. Otherwise, the motor may start suddenly at power ON and cause injury or damage to equipment.
- Do not touch the rotating part (output shaft) during operation. Doing so may cause injury.
- The motor surface temperature may exceed 70 °C (158 °F) even under normal operating conditions. If the operator is allowed to approach the running motor, attach a warning label as shown below in a conspicuous position. Failure to do so may result in skin burn(s).

Warning label

- Before moving the motor directly with the hands, confirm that the FREE input turns ON. Failure to do so may result in injury.
- Use a 24 VDC power supply that has been given reinforced insulation between the primary side and secondary side. Failure to do so may cause electric shock.
- Immediately when trouble has occurred, stop running and turn off the driver power. Failure to do so may result in fire, electric shock or injury.
- To prevent electric shock, use only an insulated screwdriver to adjust the driver's switches.

Maintenance and inspection

- To prevent the risk of electric shock, do not touch the terminals while performing the insulation resistance test or dielectric strength test.

Disposal

- To dispose of the motor and driver, disassemble it into parts and components as much as possible and dispose of individual parts/components as industrial waste.

2 Overview of the AR Series

The **AR** Series high-efficiency stepping motor and driver package is a product consisting of a stepping motor equipped with a rotor position detection sensor, and a high-performance microstep driver.
When the **AR** Series is used with an accessory data setter **OPX-2A** or data setting software **MEXE02** (both are sold separately), push-motion operation can be performed in addition to accurate positioning operation.

■ Main features

- Introducing closed loop control

The **AR** Series can continue its operation even upon encountering quick acceleration or an abrupt change in load. Monitoring the speed and amount of rotation while the motor is running, the **AR** Series performs closed-loop control under overload and similar conditions to continue its operation at the maximum torque.

- Energy-saving

Motor and driver losses have been substantially reduced to achieve low heat generation and save energy.
Since the motor and driver generate much less heat, they can now be operated for longer hours at high speed, which was not possible with conventional stepping motors/drivers.

- Easy adjustment using a speed filter

Even after the motor has been installed in the equipment, the motor response can be adjusted to suppress vibration using a digital switch with ease.

- Separate main power supply and control power supply

A separate 24 VDC power supply is connected to supply control power, independently of the main power supply. This way, the motor position can be detected and contents of alarms can be checked while the 24 VDC power is supplied, even when the main power is cut off.

- Supporting sink output and source output

The driver supports both the current sink output circuit and the current source output circuit. (Line driver output is not supported).

- Automatically controlled electromagnetic brake

Since the driver automatically controls the electromagnetic brake, all you need is to connect a 24 VDC power supply and the electromagnetic brake will operate. This saves time to adjust the timings of control signal inputs and design a ladder program.

- Alarm and warning functions

The driver provides alarms that are designed to protect the driver from overheating, poor connection, error in operation, etc. (protective functions), as well as warnings that are output before the corresponding alarms generate (warning functions).

■ Various operation modes

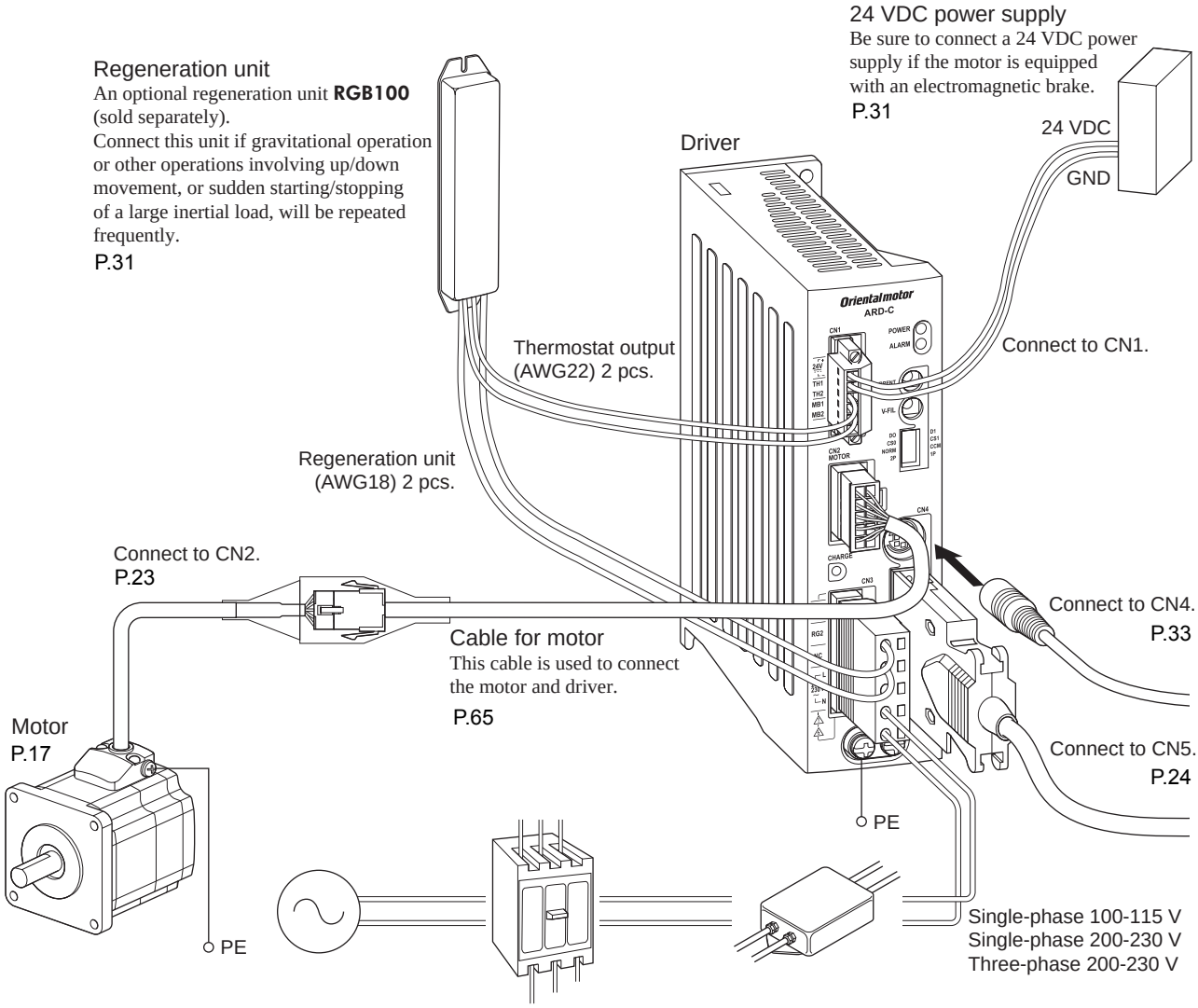
Positioning operation and return to electrical home operation can be performed.
When the **AR** Series is used with an accessory **OPX-2A** or **MEXE02** (both are sold separately), push-motion operation can also be performed.

■ Extended functions

When used with the **OPX-2A** or **MEXE02**, the desired parameters, operation mode, resolution and other items can be set according to your equipment. For details, refer to p.46

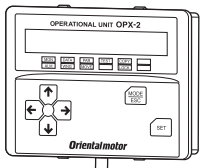
3 System configuration

All you need is to turn the C-ON input ON and input pulses!

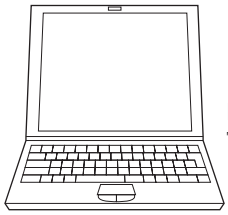


Extended functions are made available through use of accessories (sold separately)!

Data setter **OPX-2A**

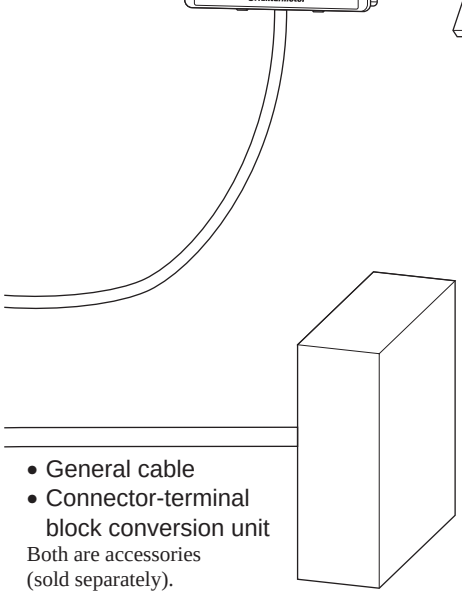


Or



PC in which the data editing software **MEXE02** has been installed

The customer must provide a PC.



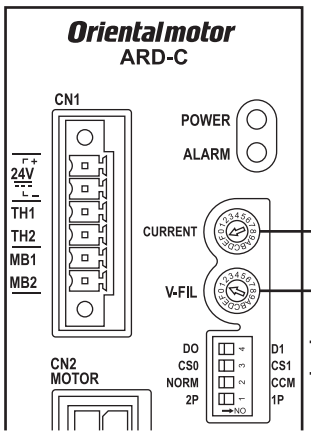
- General cable
- Connector-terminal block conversion unit

Both are accessories (sold separately).

Controller

Connect a controller that has a pulse generating function.

Easy setting using switches!



Set the operating current. P.45
(CURRENT switch)

Restrict the torque/temperature rise.

Set the speed filter. P.45
(V-FIL switch)

Suppress motor vibration or cause the motor to start/stop smoothly.

Set the resolution. P.44
(D0/D1 and CS0/CS1 switches)

Change the resolution per revolution of the motor output shaft.

4 Introduction

■ Before use

Only qualified personnel should work with the product.
Use the product correctly after thoroughly reading the section "1 Safety precautions" on p.3.
The product described in this manual has been designed and manufactured for use in general industrial equipment.
Do not use for any other purpose. Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

■ Operating Manuals for the AR Series

Operating manuals for the **AR** Series are listed below.

- **AR** Series Motor OPERATING MANUAL
  This manual explains the motor functions and how to install the motor, among others.
- **AR** Series AC power input Pulse input type Driver OPERATING MANUAL
  This manual explains the driver functions and how to install the driver, among others.
- **AR** Series AC power input Pulse input type USER MANUAL (this document)
  This manual explains the function, installation and connection of the motor and driver as well as operating method.
- Data setter **OPX-2A** OPERATING MANUAL (packaged together with the data setter)
  This manual explains how to set data using the accessory data-setter **OPX-2A** (sold separately).
- Data setting software **MEXE02** OPERATING MANUAL (packaged together with the data setting software)
  This manual explains how to set data using the accessory data setting software **MEXE02** (sold separately).

After reading the above manuals, keep them in a convenient place so that you can reference them at any time.

■ Standards and CE Marking

This product is recognized by UL and certified by CSA.
A certification by TÜV Rheinland has been obtained to confirm compliance with the EN Standards.

- Applicable Standards

	Applicable Standards	Certification Body	Standards File No.
Motor	UL 1004 UL 2111 CSA C22.2 No.100 CSA C22.2 No.77	UL	E64199
	EN 60034-1	TÜV	R 50124201
	EN 60034-5 EN 60664-1	Conforming to the respective standards.	
Driver	UL 508C CSA C22.2 No.14	UL	E171462
	EN 50178	Conforming to the respective standards.	
	EN 61800-5-1	TÜV	R 50124204

- For UL standard (UL 508C), the product is recognized for the condition of Maximum Surrounding Air Temperature 50 °C (122 °F).
- Connect a Class 2 power supply (UL-certified) to the 24 VDC power supply.

- Installation conditions (EN Standard)

Motor	Driver
Motor is to be used as a component within other equipment. Overvoltage category: Ⅱ Pollution degree: 3 (2 for the double-shaft type) Protection against electric shock: Class Ⅰ	Driver is to be used as a component within other equipment. Overvoltage category: Ⅱ Pollution degree: 2 Protection against electric shock: Class Ⅰ

- Low Voltage Directives
  - This product is designed and manufactured to be installed within another device.
  - This product cannot be used with cables normally used for IT equipment.
  - Install the product within the enclosure in order to avoid contact with hands.
  - Be sure to maintain a protective ground in case hands should make contact with the product. Securely ground the protective earth terminals of the motor and driver.
  - To protect against electric shock using an earth leakage breaker (RCD), connect a type B earth leakage breaker to the primary side of the driver.
  - When using a circuit breaker (MCCB), use a unit conforming to the EN or IEC standard.
  - Isolate the motor cable, power-supply cable and other drive cables from the signal cables (CN1, CN4, CN5) by means of double insulation.
  - The temperature of the driver's heat sink may exceed 90 °C (194 °F) depending on the driving conditions. Accordingly, take heed of the following items:
    · Do not touch the driver.
    · Do not use the driver near flammable objects.
    · Always conduct a trial operation to check the driver temperature.

- EMC Directive

This product has received EMC compliance under the conditions specified in "Example of motor and driver installation and wiring" on p.22. Since the compliance of the final machinery with the EMC Directive will depend on such factors as the configuration, wiring, layout and risk involved in the control-system equipment and electrical parts, it therefore must be verified through EMC measures by the customer of the machinery.

Applicable Standards

EMI	Emission Tests Radiated Emission Test Conducted Emission Test Harmonics Current Test Voltage Fluctuations Test	EN 61000-6-4, EN 61800-3 C3 EN 55011 group 1 class A EN 55011 group 1 class A EN 61000-3-2 EN 61000-3-3
EMS	Immunity Tests Radiation Field Immunity Test Electrostatic Discharge Immunity Test Fast Transient / Burst Immunity Test Conductive Noise Immunity Test Surge Immunity Test Voltage Dip Immunity Test Voltage Interruption Immunity Test	EN 61000-6-2, EN 61800-3 C3 IEC 61000-4-3 IEC 61000-4-2 IEC 61000-4-4 IEC 61000-4-6 IEC 61000-4-5 IEC 61000-4-11 IEC 61000-4-11

■ WARNING FOR UL MARKING ON DRIVER

These drivers have not been evaluated for motor overload protection. The motor overload protection alarm of the driver should be considered in the end use product.

■ Hazardous substances

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

5 Precautions for use

This section covers limitations and requirements the user should consider when using the product.

- **Use the supplied cable to connect the motor and driver.**

  Always use the supplied cable to connect the motor and driver.
  If a flexible cable or cable of 3 m (9.8 ft.) or longer is to be used, an appropriate cable must be purchased separately.
  Refer to p.65 for details.

- **Perform the insulation resistance test or dielectric strength test separately on the motor and the driver.**

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

- **Do not apply an overhung load and thrust load in excess of the specified permissible limit.**

  Operating the motor under an excessive overhung load or thrust load may damage the motor bearings (ball bearings).
  Be sure to operate the motor within the specified permissible limit of overhung load and thrust load.
  See p.19 for details.

- **Use the motor in conditions where its surface temperature will not exceed 100 °C (212 °F).**

  The driver has an overheat protection function, but the motor has no such feature. The motor surface temperature may exceed 100 °C (212 °F) under certain conditions (ambient temperature, operating speed, duty cycle, etc.).
  To prevent the motor bearings (ball bearings) from reaching its usable life quickly, use the motor in conditions where the surface temperature will not exceed 100 °C (212 °F).
  Use the geared type motor in a condition where the gear case temperature does not exceed 70 °C (158 °F), in order to prevent deterioration of grease and parts in the gear case.
  If the motor is to be operated continuously, install the motor in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 250×250×6 mm (9.84×9.84×0.24 in.)] is ensured.

- **Maximum static torque at excitation**

  The maximum static torque at excitation is the maximum power the stepping motor has when power (rated current) is being supplied but the motor is not rotating. When the motor is combined with a dedicated driver, the automatic current cutback function of the driver reduces the maximum static torque at excitation by approximately 50% at motor standstill. The maximum power of the motor can be used at acceleration and operation when starting the motor, but the holding power is reduced to approximately 50% after stopping the motor. When selecting a motor for your application, consider the fact that the holding power will be reduced to approximately 50% at motor standstill.

- **Do not use the electromagnetic brake to reduce speed or as a safety brake.**

  Do not use the electromagnetic brake as a means to decelerate and stop the motor. The brake hub of the electromagnetic brake will wear significantly and the braking force will drop. Since the power off activated type electromagnetic brake is equipped, it helps maintain the position of the load when the power is cut off, but this brake cannot securely hold the load in place. Accordingly, do not use the electromagnetic brake as a safety brake.
  To use the electromagnetic brake to hold the load in place, do so after the motor has stopped.

- **Double shaft type motor**

  Do not apply a load torque, overhung load or thrust load to the output shaft on the opposite side of the motor output shaft.

- **Preventing leakage current**

  Stray capacitance exists between the driver's current-carrying line and other current-carrying lines, the earth and the motor, respectively. A high-frequency current may leak out through such capacitance, having a detrimental effect on the surrounding equipment. The actual leakage current depends on the driver's switching frequency, the length of wiring between the driver and motor, and so on. When providing a leakage current breaker, use the following products, for example, which have high-frequency signal protection:
  Mitsubishi Electric Corporation: NV series
  Fuji Electric FA Components & Systems Co., Ltd.: EG and SG series

- **Preventing electrical noise**

  See "7.7 Installing and wiring in compliance with EMC Directive" on p.21 for measures with regard to noise.

- **Maximum torque of geared type motor**

  Always operate the geared type motor under a load not exceeding the maximum torque. If the load exceeds the maximum torque, the gear will be damaged.

- About grease of geared motor

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

- Rotating direction of the gear output shaft

  The relationship between the rotating direction of the motor shaft and that of the gear output shaft changes as follows, depending on the gear type and gear ratio.

Type of gear	Gear ratio	Rotating direction (relative to the motor rotating direction)
TH geared	3.6 7.2 10	Same direction
	20 30	Opposite direction
PL geared **PS** geared **PN** geared	All gear ratios	Same direction
Harmonic geared	All gear ratios	Opposite direction

- Do not perform the push-motion operation with geared types.

  Doing so may cause damage to the motor or gearhead.

- Saving data to the NV memory

  Do not turn off the main power supply or 24 VDC power supply while data is being written to the NV memory and 5 seconds after the completion of a data write. Doing so may abort writing the data and cause a EEPROM error alarm to generate. The NV memory can be rewritten approx. 100,000 times.

- Motor excitation at power ON

  Simply turning on the power will not excite the motor. To excite the motor, always turn the C-ON input ON.
  If the applicable driver parameter is changed using the **OPX-2A** or **MEXE02**, the motor can be excited automatically after the power ON.

- Use the accessory regeneration unit **RGB100** (sold separately) if gravitational operation or other operation involving up/down movement, or sudden starting/stopping of a large inertial load, will be repeated frequently.

  The overvoltage alarm will generate depending on the operating condition. If an overvoltage protection alarm is detected, adjust the driving condition or use the accessory regeneration unit **RGB100** (sold separately).

- Note on connecting a power supply whose positive terminal is grounded

  The communication connector (CN4) and I/O signal connector (CN5) are not insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and these equipment to short, damaging both. Use the data setter **OPX-2A** to set data, etc.

6 Preparation

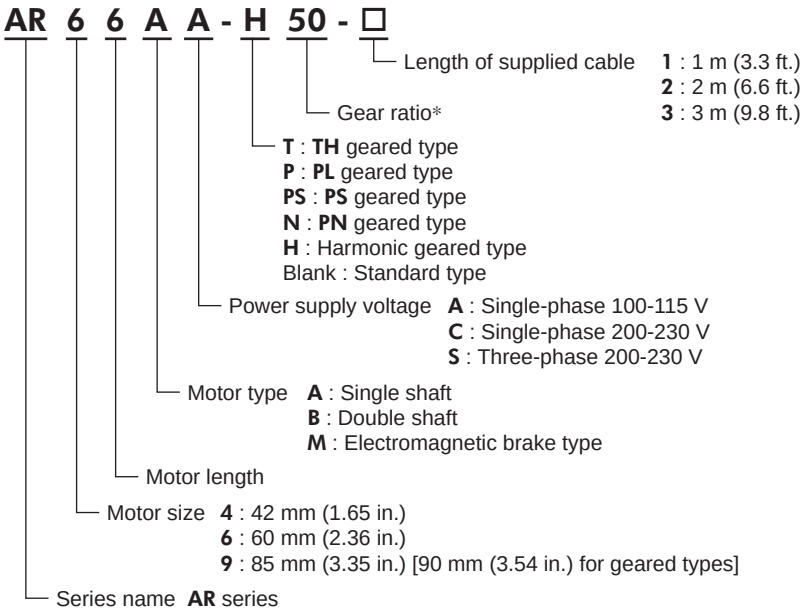
This chapter explains the items you should check, as well as the name and function of each part.

6.1 Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the branch or sales office from which you purchased the product.
Verify the model number of the purchased unit against the number shown on the package label.
Check the model number of the motor and driver against the number shown on the nameplate. The unit models and corresponding motor/driver combinations are listed on p.13.

- Motor ..... 1 unit
- Driver ..... 1 unit
- CN1 connector (6 pins) ..... 1 pc.
- CN3 connector (5 pins) ..... 1 pc.
- CN5 connector (36 pins) ..... 1 pc.
- Connector wiring lever (for CN3) ..... 1 pc.
- **AR** Series Motor OPERATING MANUAL ..... 1 copy
- **AR** Series AC power input Driver OPERATING MANUAL ..... 1 copy
- **AR** Series USER MANUAL (CD-ROM) ..... 1 pc.
- Cable for motor ..... 1 pc.
  (Included in a motor and driver package product)
- Cable for electromagnetic brake ..... 1 pc.
  (Supplied with electromagnetic brake motor package)
- Parallel key ..... 1 pc.
  (Supplied with geared types; except for the **AR46TH**, **AR46PL** and **AR66TH**)

6.2 How to identify the product model



* The model name is "**7**" for the gear ratio "7.2:1" of the **PS** geared type.

6.3 Combinations of motors and drivers

- □ indicates **A** (single shaft), **B** (double shaft) or **M** (with electromagnetic brake).
  For the **AR911**, □ indicates **A** (single shaft) or **B** (double shaft).
  For geared type, □ indicates **A** (single shaft) or **M** (with electromagnetic brake).
- ■ in the unit model represents a number indicating the gear ratio.
- ○ indicates the cable length.

■ Standard type

Model	Motor model	Driver model
AR46□A-○	ARM46□C	ARD-A
AR66□A-○	ARM66□C	
AR69□A-○	ARM69□C	
AR98□A-○	ARM98□C	
AR911□A-○	ARM911□C	
AR46□C-○	ARM46□C	ARD-C
AR66□C-○	ARM66□C	
AR69□C-○	ARM69□C	
AR98□C-○	ARM98□C	
AR911□C-○	ARM911□C	
AR46□S-○	ARM46□C	ARD-S
AR66□S-○	ARM66□C	
AR69□S-○	ARM69□C	
AR98□S-○	ARM98□C	
AR911□S-○	ARM911□C	

■ PN geared type

Model	Motor model	Driver model
AR46□A-N■-○	ARM46□C-N■	ARD-A
AR66□A-N■-○	ARM66□C-N■	
AR98□A-N■-○	ARM98□C-N■	
AR46□C-N■-○	ARM46□C-N■	ARD-C
AR66□C-N■-○	ARM66□C-N■	
AR98□C-N■-○	ARM98□C-N■	
AR46□S-N■-○	ARM46□C-N■	ARD-S
AR66□S-N■-○	ARM66□C-N■	
AR98□S-N■-○	ARM98□C-N■	

■ TH geared type

Model	Motor model	Driver model
AR46□A-T■-○	ARM46□C-T■	ARD-A
AR66□A-T■-○	ARM66□C-T■	
AR98□A-T■-○	ARM98□C-T■	
AR46□C-T■-○	ARM46□C-T■	ARD-C
AR66□C-T■-○	ARM66□C-T■	
AR98□C-T■-○	ARM98□C-T■	
AR46□S-T■-○	ARM46□C-T■	ARD-S
AR66□S-T■-○	ARM66□C-T■	
AR98□S-T■-○	ARM98□C-T■	

■ PS geared type

Model	Motor model	Driver model
AR46□A-PS■-○	ARM46□C-PS■	ARD-A
AR66□A-PS■-○	ARM66□C-PS■	
AR98□A-PS■-○	ARM98□C-PS■	
AR46□C-PS■-○	ARM46□C-PS■	ARD-C
AR66□C-PS■-○	ARM66□C-PS■	
AR98□C-PS■-○	ARM98□C-PS■	
AR46□S-PS■-○	ARM46□C-PS■	ARD-S
AR66□S-PS■-○	ARM66□C-PS■	
AR98□S-PS■-○	ARM98□C-PS■	

■ PL geared type

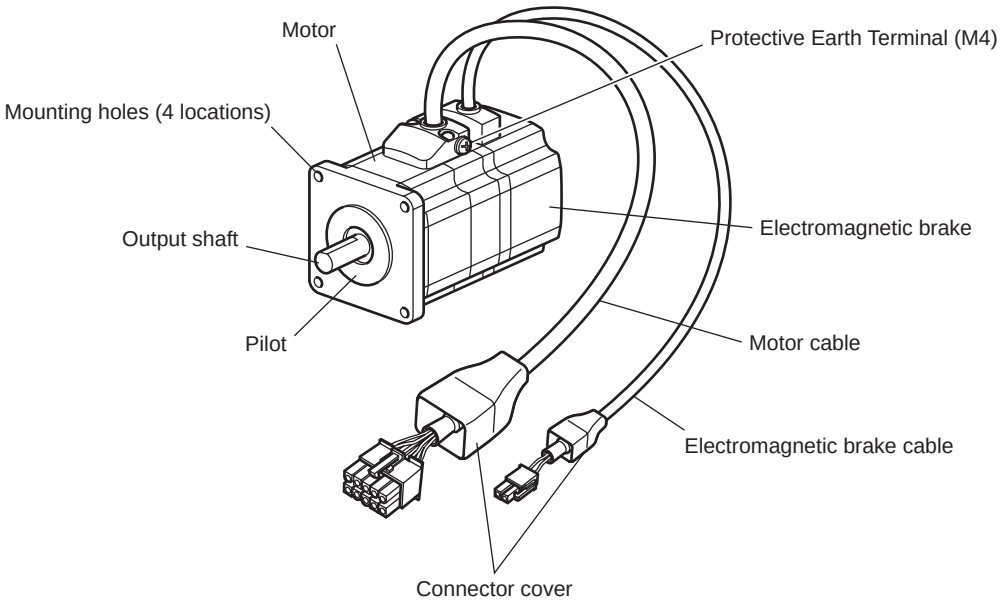
Model	Motor model	Driver model
AR46□A-P■-○	ARM46□C-P■	ARD-A
AR66□A-P■-○	ARM66□C-P■	
AR98□A-P■-○	ARM98□C-P■	
AR46□C-P■-○	ARM46□C-P■	ARD-C
AR66□C-P■-○	ARM66□C-P■	
AR98□C-P■-○	ARM98□C-P■	
AR46□S-P■-○	ARM46□C-P■	ARD-S
AR66□S-P■-○	ARM66□C-P■	
AR98□S-P■-○	ARM98□C-P■	

■ Harmonic geared type

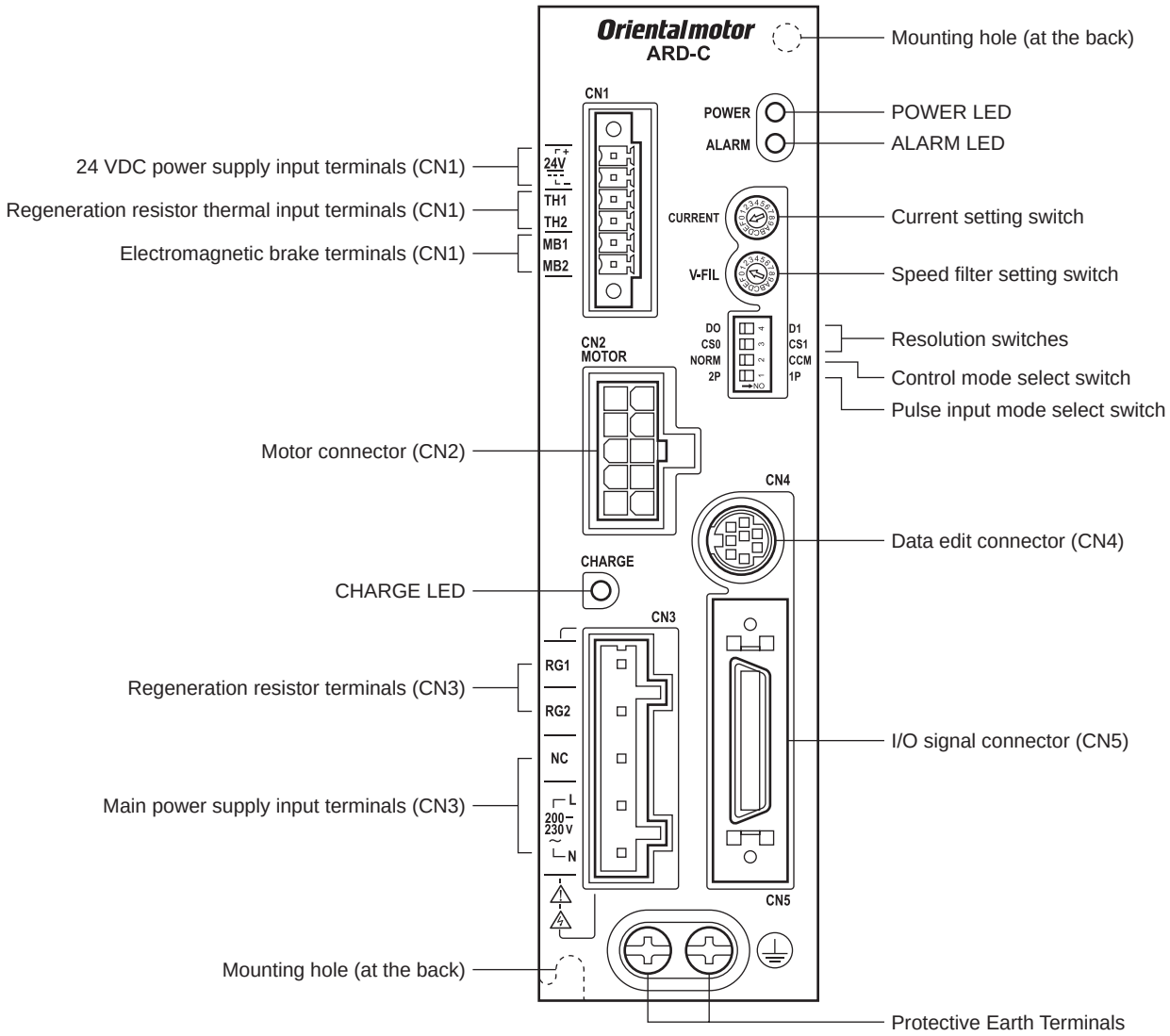
Model	Motor model	Driver model
AR46□A-H■-○	ARM46□C-H■	ARD-A
AR66□A-H■-○	ARM66□C-H■	
AR98□A-H■-○	ARM98□C-H■	
AR46□C-H■-○	ARM46□C-H■	ARD-C
AR66□C-H■-○	ARM66□C-H■	
AR98□C-H■-○	ARM98□C-H■	
AR46□S-H■-○	ARM46□C-H■	ARD-S
AR66□S-H■-○	ARM66□C-H■	
AR98□S-H■-○	ARM98□C-H■	

6.4 Names and functions of parts

■ Motor (Example: ARM66MC)



■ Driver (Example: 200-230 V input type)



Name	Description	Ref.
POWER LED (Green)	This LED is lit while the main power or 24 VDC power is input.	−
ALARM LED (Red)	This LED will blink when an alarm generates. It is possible to check the generated alarm by counting the number of times the LED blinks.	P.57
Current setting switch (CURRENT)	This switch adjusts the operating current. It is used to limit the torque and temperature rise. A desired current can be set as a percentage (%) of the rated output current. Factory setting: F	P.45
Speed filter setting switch (V-FIL)	This switch adjusts the motor response. Use this switch if you want to suppress motor vibration or cause the motor to start/stop smoothly. "0" and "F" correspond to the minimum and maximum speed filter settings, respectively. Factory setting: 1	P.45
Resolution switches (D0/D1, CS0/CS1)	These two switches are used to set the resolution per revolution of the motor output shaft. The factory settings are "D0" and "CS0" (1000 P/R).	P.44
Control mode select switch (NORM/CCM)	This switch toggles the driver between the normal mode and current control mode. NORM: Normal mode (Keep the switch in this position in normal conditions of use.) CCM: Current control mode (Set the switch to this position if you want to suppress noise or vibration.) Factory setting: NORM	P.52
Pulse input mode select switch (2P/1P)	This switch is used to toggle between the 1-pulse input mode and 2-pulse input mode according to the pulse output mode of the controller. 1P:1-pulse input mode, active low 2P:2-pulse input mode, active low The factory setting of the pulse-input mode depends on the destination country.	P.44
Data edit connector (CN4)	Connect a PC in which the **MEXE02** has been installed, or the **OPX-2A**.	P.33
I/O signal connector (CN5)	Connect the I/O signals of the controller.	P.24
Protective Earth Terminals	Used for grounding via a grounding cable of AWG16 to 14 (1.25 to 2.0 mm^2) or more.	P.31
24 VDC power supply input terminals (CN1) [24V]	Connect 24 VDC. Once a 24 VDC power supply is connected, you can check the contents of alarms that have generated even when the main power is cut off. If a motor with an electromagnetic brake is used, be sure to connect a 24 VDC power supply as the electromagnetic brake power.	P.31
Regeneration resistor thermal input terminals (CN1) [TH1, TH2]	Connect the accessory regeneration unit **RGB100** (sold separately). If no regeneration unit is connected, plug in the CN1 connector to short the TH1 and TH2 terminals. The driver is shipped with a jumper wire preassembled in the CN1 connector, so you can short the terminals by simply plugging the connector.	P.31
Electromagnetic brake terminals (CN1) [MB1, MB2]	Connect the lead wires from the electromagnetic brake (24 VDC). MB1:Electromagnetic brake − (black) MB2:Electromagnetic brake + (white)	P.31
Motor connector (CN2)	Connect the motor.	P.23
CHARGE LED (Red)	This LED is lit while the main power is input. After the main power has been turned off, the LED will turn off once the residual voltage in the driver drops to a safe level.	−
Regeneration resistor terminals (CN3) [RG1, RG2]	Connect the accessory regeneration unit **RGB100** (sold separately).	P.32
Main power supply input terminals (CN3)	• Single-phase 100-115 V, single-phase 200-230 V L, N:Connect a single-phase 100-115 VAC or 200-230 VAC. • Three-phase 200-230 V L1, L2, L3: Connect a three-phase 200-230 VAC. • NC: Not used.	P.30
Mounting holes (2 locations at the back)	These mounting holes are used to affix the driver with screws.	P.20

6.5 Input/output power ratings

- □ indicates **A** (single shaft), **B** (double shaft) or **M** (with electromagnetic brake).
  For the **AR911**, □ indicates **A** (single shaft) or **B** (double shaft).
  For geared type, □ indicates **A** (single shaft) or **M** (with electromagnetic brake).
- For geared type, ● represents the type of gear and number indicating the gear ratio.
- ○ indicates the cable length.

Model	Motor model	Driver model	Input			Output current
			Voltage	Frequency	Current	
AR46□A●-○	ARM46□C●	ARD-A	Single-phase 100-115 V	50/60 Hz	2.9 A	0.49 A
AR66□A●-○	ARM66□C●				4.4 A	0.74 A
AR69□A-○	ARM69□C				6.1 A	0.92 A
AR98□A●-○	ARM98□C●				5.5 A	1.13 A
AR911□A-○	ARM911□C				6.5 A	1.27 A
AR46□C●-○	ARM46□C●	ARD-C	Single-phase 200-230 V		1.9 A	0.49 A
AR66□C●-○	ARM66□C●				2.7 A	0.74 A
AR69□C-○	ARM69□C				3.8 A	0.92 A
AR98□C●-○	ARM98□C●				3.4 A	1.13 A
AR911□C-○	ARM911□C				4.1 A	1.27 A
AR46□S●-○	ARM46□C●	ARD-S	Three-phase 200-230 V		1.0 A	0.49 A
AR66□S●-○	ARM66□C●				1.4 A	0.74 A
AR69□S-○	ARM69□C				2.0 A	0.92 A
AR98□S●-○	ARM98□C●				1.8 A	1.13 A
AR911□S-○	ARM911□C				2.2 A	1.27 A

7 Installation

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

7.1 Location for installation

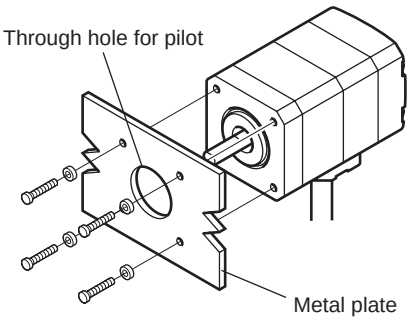
The motor and driver has been designed and manufactured to be installed within another device. Install them in a well-ventilated location that provides easy access for inspection.
The location must also satisfy the following conditions:

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature Motor: −10 to +50 °C (+14 to +122 °F) (non-freezing)
  Harmonic geared type: 0 to +40 °C (+32 to +104 °F) (non-freezing)
  Driver: 0 to +50 °C (+32 to +122 °F) (non-freezing)
- Operating ambient humidity 85% or less (non-condensing)
- Area that is free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
- Area not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area not subject to splashing water (rain, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibration or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum
- 1000 m (3300 ft.) or lower above sea level

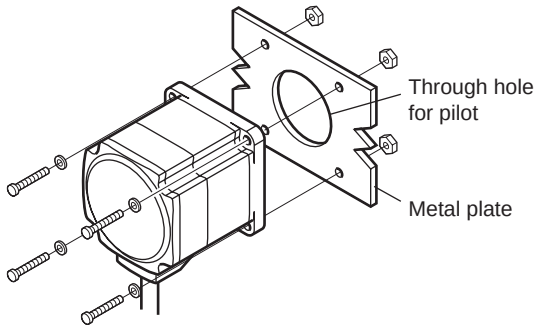
7.2 Installing the motor

The motor can be installed in any direction.
To allow for heat dissipation and prevent vibration, install the motor on a metal surface of sufficient strength.

Installation method A



Installation method B



Type	Frame size [mm (in.)]	Bolt size	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]	Installation method
Standard	42 (1.65)	M3	1 (142)	4.5 (0.177)	A
	60 (2.36)	M4	2 (280)	–	B
	85 (3.35)	M6	3 (420)		
TH geared	42 (1.65) 60 (2.36)	M4	2 (280)	8 (0.315)	A
	90 (3.54)	M8	4 (560)	15 (0.591)	
PL geared **PN** geared **PS** geared Harmonic geared*1	42 (1.65)	M4	2 (280)	8 (0.315)	
	60 (2.36)	M5	2.5 (350)	10 (0.394)	
	90 (3.54)	M8	4 (560)	15 (0.591)	
Harmonic geared *2	90 (3.54)	M8	4 (560)	–	B

∗1 **AR46** and **AR66** type.
∗2 **AR98** type.

7.3 Installing a load

When connecting a load to the motor, align the centers of the motor output shaft and load shaft. Flexible couplings are available as accessories.

Note

- When coupling the load to the motor, pay attention to the centering of the shafts, belt tension, parallelism of the pulleys, and so on. Securely tighten the coupling and pulley set screws.
- Be careful not to damage the output shaft or bearings when installing a coupling or pulley to the motor output shaft.
- Do not modify or machine the motor output shaft. Doing so may damage the bearings and destroy the motor.
- Do not apply strong force using hammer or other tools when removing the parallel key. Doing so may damage the motor output shaft and bearings (ball bearings).

- Using a coupling

Align the centers of the motor output shaft and load shaft in a straight line.

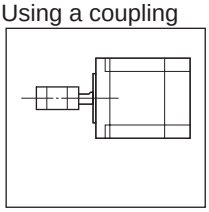
- Using a belt drive

Align the motor output shaft and load shaft in parallel with each other, and position both pulleys so that the line connecting their centers is at a right angle to the shafts.

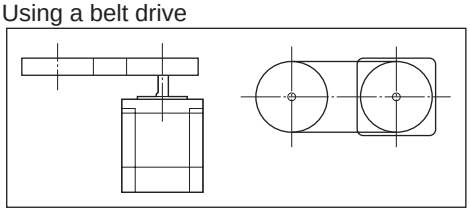
- Using a gear drive

Align the motor output shaft and gear shaft in parallel with each other, and let the gears mesh at the center of the tooth widths.

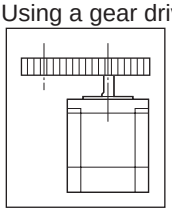
• Using a coupling



• Using a belt drive



• Using a gear drive

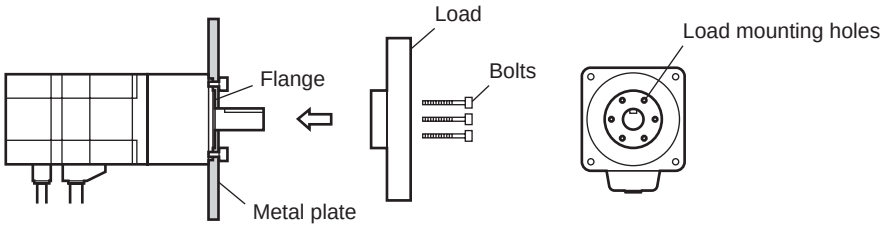


- Using a parallel key (geared motor)

When connecting the load and gear output shaft with a key slot, secure the load using the key supplied with the gear output shaft after machining the key slot on the load.

- Installing on the flange surface (Harmonic geared type)

With a Harmonic geared type (excluding **AR98**), a load can be installed directly to the gear using the load mounting holes provided on the flange surface.



Model	Bolt size	Number of bolts	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]
AR46	M3	6	1.4 (198)	5 (0.197)
AR66	M4	6	2.5 (350)	6 (0.236)

Note

- When installing a load on the flange surface, the load cannot be mounted using the key slot in the output shaft.
- Design an appropriate installation layout so that the load will not contact the metal plate or bolts used for installing the motor.

7.4 Permissible overhung load and permissible thrust load

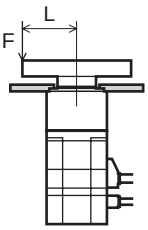
Note With a double shaft type, do not apply load torque, overhung load or thrust load to the output shaft on the opposite side of the motor output shaft.

Type	Model	Gear ratio	Permissible overhung load [N (lb.)]					Permissible thrust load [N (lb.)]
			Distance from the tip of motor output shaft [mm (in.)]					
			0 (0)	5 (0.2)	10 (0.39)	15 (0.59)	20 (0.79)	
Standard	**AR46**	–	35 (7.8)	44 (9.9)	58 (13)	85 (19.1)	–	4.6 (1.03)
	AR46M							6.1 (1.37)
	AR66		90 (20)	100 (22)	130 (29)	180 (40)	270 (60)	8.8 (1.98)
	AR66M							11.8 (2.6)
	AR69							13.7 (3)
	AR69M							16.7 (3.7)
	AR98		260 (58)	290 (65)	340 (76)	390 (87)	480 (108)	18 (4)
	AR98M							24 (5.4)
	AR911							29 (6.5)
TH geared	**AR46**	–	10 (2.2)	14 (3.1)	20 (4.5)	30 (6.7)	–	15 (3.3)
	AR66		70 (15.7)	80 (18)	100 (22)	120 (27)	150 (33)	40 (9)
	AR98		220 (49)	250 (56)	300 (67)	350 (78)	400 (90)	100 (22)
PS geared **PL** geared	**AR46**	5 7.2 10	73 (16.4)	84 (18.9)	100 (22)	123 (27)	–	50 (11.2)
		25 36 50	109 (24)	127 (28)	150 (33)	184 (41)	–	
	AR66	5	200 (54)	220 (49)	250 (56)	280 (63)	320 (72)	100 (22)
		7.2 10	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
		25 36 50	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	
	AR98	5 7.2 10	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)	300 (67)
		25	850 (191)	940 (210)	1050 (230)	1190 (260)	1380 (310)	
		36	930 (200)	1030 (230)	1150 (250)	1310 (290)	1520 (340)	
		50	1050 (230)	1160 (260)	1300 (290)	1480 (330)	1710 (380)	
PN geared	**AR46**	–	100 (22)	120 (27)	150 (33)	190 (42)	–	100 (22)
	AR66	5	200 (54)	220 (49)	250 (56)	280 (63)	320 (72)	
		7.2 10	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
		25 36 50	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	
	AR98	5	480 (108)	520 (117)	550 (123)	580 (130)	620 (139)	300 (67)
		7.2 10	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)	
		25	850 (191)	940 (210)	1050 (230)	1110 (240)	1190 (260)	
		36	930 (200)	1030 (230)	1150 (250)	1220 (270)	1300 (290)	
		50	1050 (230)	1160 (260)	1300 (290)	1380 (310)	1490 (330)	
Harmonic geared	**AR46**	–	180 (40)	220 (49)	270 (60)	360 (81)	510 (114)	220 (49)
	AR66		320 (72)	370 (83)	440 (99)	550 (123)	720 (162)	450 (101)
	AR98		1090 (240)	1150 (250)	1230 (270)	1310 (290)	1410 (310)	1300 (290)

■ Permissible moment load of the Harmonic geared type

When installing an arm or table on the flange surface, calculate the moment load using the formula below if the flange surface receives any eccentric load. The moment load should not exceed the permissible value specified in the table.
Moment load: M [N·m (oz-in)] = F × L

Model	Permissible moment load [N·m (oz-in)]
AR46	5.6 (790)
AR66	11.6 (1640)

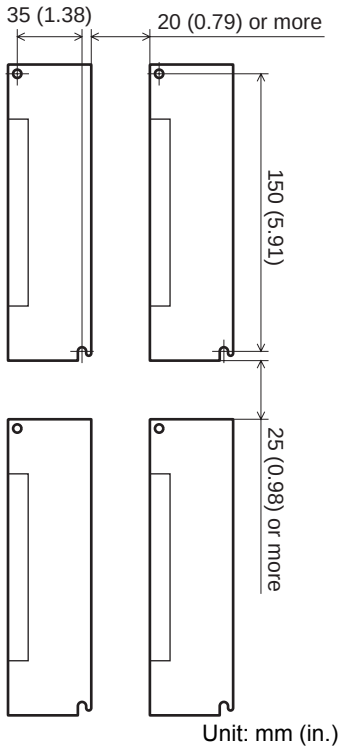


7.5 Installing the driver

The driver is designed so that heat is dissipated via air convection and conduction through the enclosure. Install the driver on a flat metal plate [material: aluminium, 200×200×2 mm (7.87×7.87×0.08 in.) equivalent] having excellent heat conductivity. When two or more drivers are to be installed side by side, provide 20 mm (0.79 in.) and 25 mm (0.98 in.) clearances in the horizontal and vertical directions, respectively.
When installing the driver in an enclosure, use two screws (M4, not supplied) to affix the driver through the mounting holes.

Note

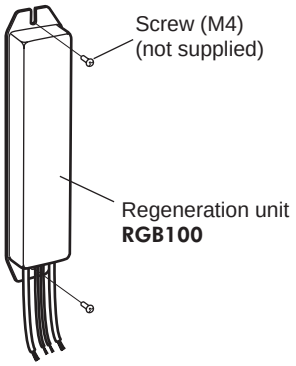
- Install the driver in an enclosure whose pollution degree is 2 or better environment, or whose degree of protection is IP54 minimum.
- Do not install any equipment that generates a large amount of heat or noise near the driver.
- Do not install the driver underneath the controller or other equipment vulnerable to heat.
- Check ventilation if the ambient temperature of the driver exceeds 50 °C (122 °F).
- Be sure to install the driver vertically (vertical position).



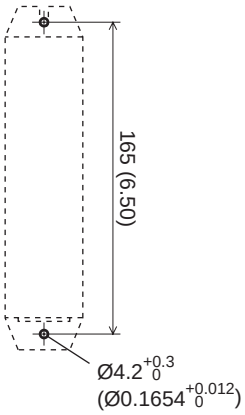
Unit: mm (in.)

7.6 Installing the regeneration unit

Install the accessory regeneration unit **RGB100** (sold separately) in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 350×350×3 mm (13.78×13.78×0.12 in.)] is ensured. Affix the **RGB100** on a smooth metal plate offering high heat conductivity, using two screws (M4, not supplied).



• Plate cutout for mounting
[unit: mm (in.)]



7.7 Installing and wiring in compliance with EMC Directive

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, in order to prevent a serious functional impediment in the machinery. The use of the following installation and wiring methods will enable the motor and driver to be compliant with the EMC directive. Refer to "Standards and CE Marking" on p.8 for the applicable standards.

■ Connecting noise filter for power supply line

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

Manufacturer	Single-phase 100-115 V Single-phase 200-230 V	Three-phase 200-230 V
TDK-Lambda Corporation	MC1210	MC1310

- Install the mains filter as close to the driver as possible.
- Use cable clamps and other means to secure the input and output cables firmly to the surface of the enclosure.
- Connect the ground terminal of the mains filter to the grounding point, using as thick and short a wire as possible.
- Do not place the AC input cable (AWG18: 0.75 mm^2 or more) parallel with the mains-filter output cable (AWG18: 0.75 mm^2 or more). Parallel placement will reduce mains-filter effectiveness if the enclosure's internal noise is directly coupled to the power supply cable by means of stray capacitance.

■ Connecting surge arrester

Use a surge arrester or equivalent as below table.

Manufacturer	Single-phase 100-115 V Single-phase 200-230 V	Three-phase 200-230 V
OKAYA ELECTRIC INDUSTRIES CO., LTD.	R·A·V-781BWZ-4	R·A·V-781BXZ-4

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

■ Connecting the AC power line reactor

When inputting single-phase 230 V, insert a reactor (5 A, 5 mH) in the AC power line to ensure compliance with EN 61000-3-2.

■ Connecting the 24 VDC power supply

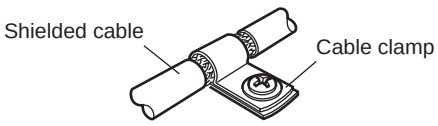
Use a 24 VDC power supply conforming to the EMC Directive.
Use a shielded cable for wiring, and wire/ground the power supply cable over the shortest possible distance.
Refer to "Wiring the power supply cable and signal cable" for how to ground the shielded cable.

■ How to ground

The cable used to ground the motor, driver and noise filter must be as thick and short as possible so that no potential difference is generated. Choose a large, thick and uniformly conductive surface for the grounding point.
See p.31 for grounding the motor and driver.

■ Wiring the power supply cable and signal cable

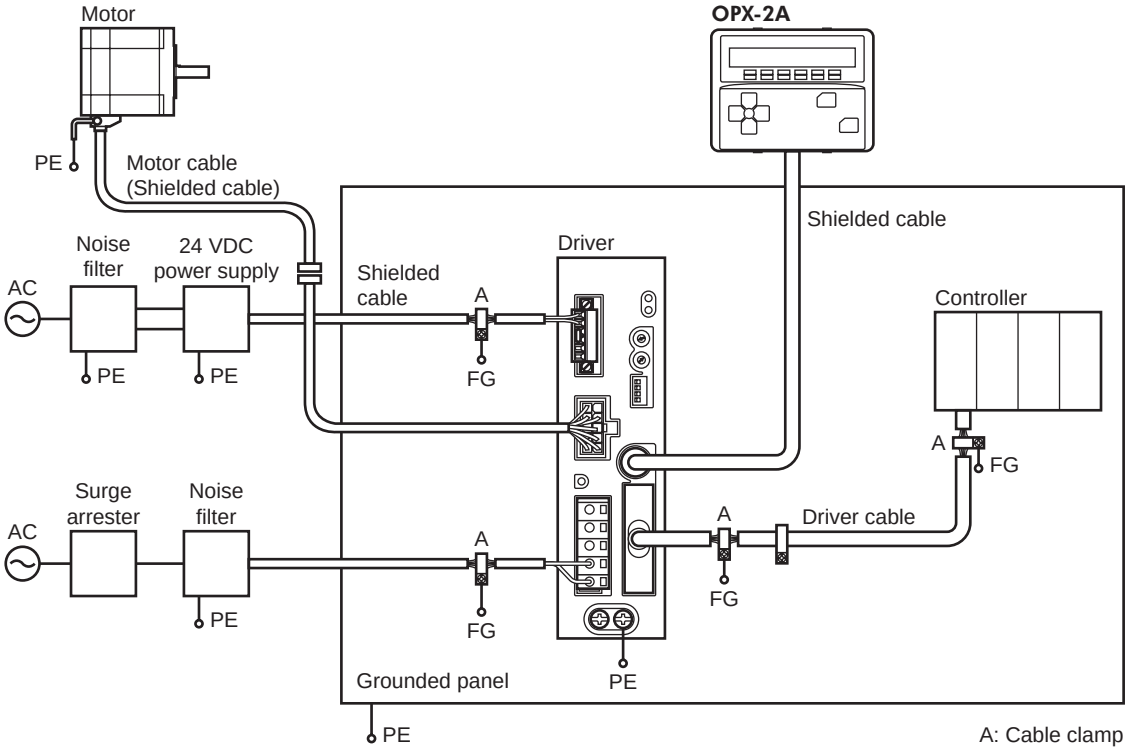
Use a shielded cable for the power supply cable and signal cable, and keep it as short as possible. An accessory driver cable is available (sold separately). Refer to p.67.
To ground a shielded cable, use a metal cable clamp or similar device that will maintain contact with the entire circumference of the cable. Attach a cable clamp as close to the end of the cable as possible, and connect it as shown in the figure.



■ Notes about installation and wiring

- Connect the motor, driver and other peripheral control equipment directly to the grounding point so as to prevent a potential difference from developing between grounds.
- When relays or electromagnetic switches are used together with the system, use noise filters and CR circuits to suppress surges generated by them.
- Keep cables as short as possible without coiling and bundling extra lengths.
- Place the power cables such as the motor and power supply cables as far apart [200 mm (7.87 in.)] as possible from the signal cables. If the power cables and signal cables have to cross, cross them at a right angle. Place the AC input cable and output cable of a noise filter separately from each other.
- When extending the distance between the motor and driver, it is recommended that an accessory motor connection cable (sold separately) should be used. The EMC measures are conducted using the Oriental Motor extension cable.

■ Example of motor and driver installation and wiring



■ Precautions about static electricity

Static electricity may cause the driver to malfunction or suffer damage. While the driver is receiving power, handle the driver with care and do not come near or touch the driver. Always use an insulated screwdriver to adjust the driver's switches.

Note The driver uses parts that are sensitive to electrostatic charge. Before touching the driver, turn off the power to prevent electrostatic charge from generating. If an electrostatic charge is impressed on the driver, the driver may be damaged.

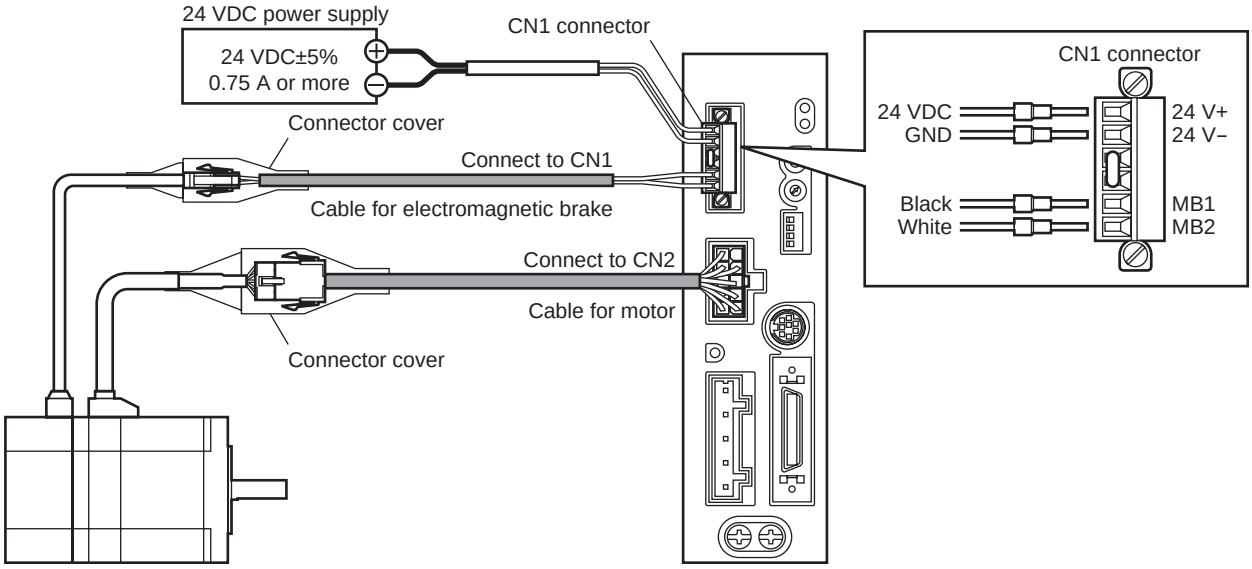
8 Connection

This chapter explains how to connect the motor, I/O signals and power supply to the driver, as well as grounding method.

8.1 Connecting the motor

■ Connection example (electromagnetic brake motor)

Refer to p.31 for the connection method of 24 VDC power supply.

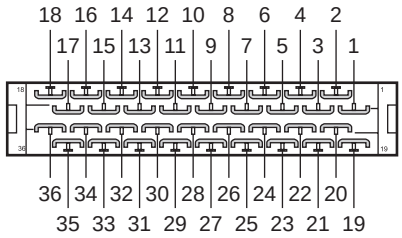


Note

- The lead wires of the "cable for electromagnetic brake" have polarities, so connect them in the correct polarities. If the lead wires are connected with their polarities reversed, the electromagnetic brake will not operate properly.
- If the distance between the motor and driver is extended to 20 m (65.6 ft.) or longer, use a power supply of 24 VDC±4%.
- Have the connector plugged in securely. Insecure connector connection may cause malfunction or damage to the motor or driver.
- When unplugging the connector, do so while pressing the latches on the connector.
- When plugging/unplugging the connector, turn off the power and wait for the CHARGE LED to turn off before doing so. The residual voltage may cause electric shock.
- When installing the motor to a moving part, use an accessory flexible cable offering excellent flexibility. Refer to p.65 for details.

8.2 Connecting the I/O signals

Solder the I/O signal cable (AWG28 to 24: 0.08 to 0.2 mm^2) to the CN5 connector (36 pins) while checking the pin numbers in the "Connector function table" provided below. Use a shielded cable for I/O signals. We provide an accessory driver cable allowing simple and easy connection with a driver, as well as connector-terminal block conversion unit. Refer to p.67 for details.



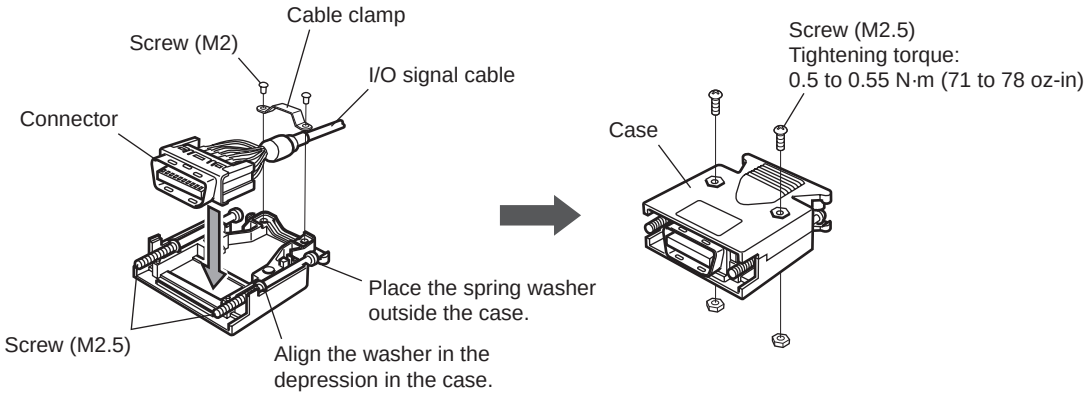
■ Connector function table

Pin No.	Operating mode		Name		Ref.
	Positioning operation	Push-motion operation*	Positioning operation	Push-motion operation*	
1	−		−		−
2	GND		Ground connection		−
3	ASG+		A-phase differential output (Line driver)		P.40
4	ASG−				
5	BSG+		B-phase differential output (Line driver)		P.40
6	BSG−				
7	TIM1+		Timing differential output (Line driver)		P.40
8	TIM1−				
9	ALM+		Alarm output		P.41
10	ALM−				
11	WNG+		Warning output		P.41
12	WNG−				
13	END+		Positioning complete output		P.40
14	END−				
15	READY+/AL0+*		Operation ready complete output/ Alarm code output 0		P.39
16	READY−/AL0−*				
17	TLC+/AL1+*		Torque limit output/Alarm code output 1		P.39
18	TLC−/AL1−*				
19	TIM2+/AL2+*		Timing output (open collector)/Alarm code output 2		P.40
20	TIM2−/AL2−*				
21	GND		Ground connection		−
22	IN-COM		Input common		−
23	**C-ON**		Current on input		P.36
24	CLR/ALM-RST		Deviation clear input/Alarm reset input		P.38
25	CCM		Current control mode ON input		P.39
26	CS	T-MODE*	Resolution selection input	Push-motion operation ON	P.37
27	−	M0*	−	Push-current setting selection input	P.39
28	RETURN	M1*	Return to electrical home operation		P.37
29	P-RESET	M2*	Position reset input		P.38
30	FREE		Excitation OFF, Release the electromagnetic brake input		P.37
31	CW+/PLS+		CW pulse input/Pulse input (+5 V or line driver)		P.36
32	CW−/PLS−				
33	CW+24 V/PLS+24 V		CW pulse input/Pulse input (+24 V)		
34	CCW+24 V/DIR+24 V		CCW pulse input/Direction input (+24 V)		
35	CCW+/DIR+		CCW pulse input/Direction input (+5 V or line driver)		
36	CCW−/ DIR−				

* The signal will become effective if the applicable setting has been changed using the **OPX-2A** or **MEXE02**.

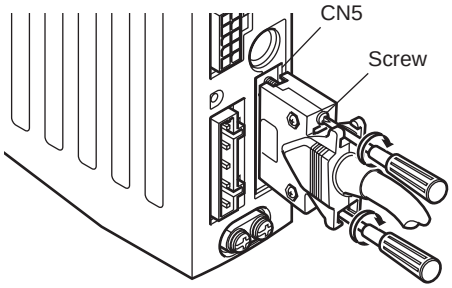
Note The factory setting of the C-ON input is normally open. Be sure to turn the C-ON input ON when operating the motor. Set the C-ON input to normally closed when the C-ON input is not used. Refer to p.36 for details.

■ Assembling the connector



■ Connecting the connector

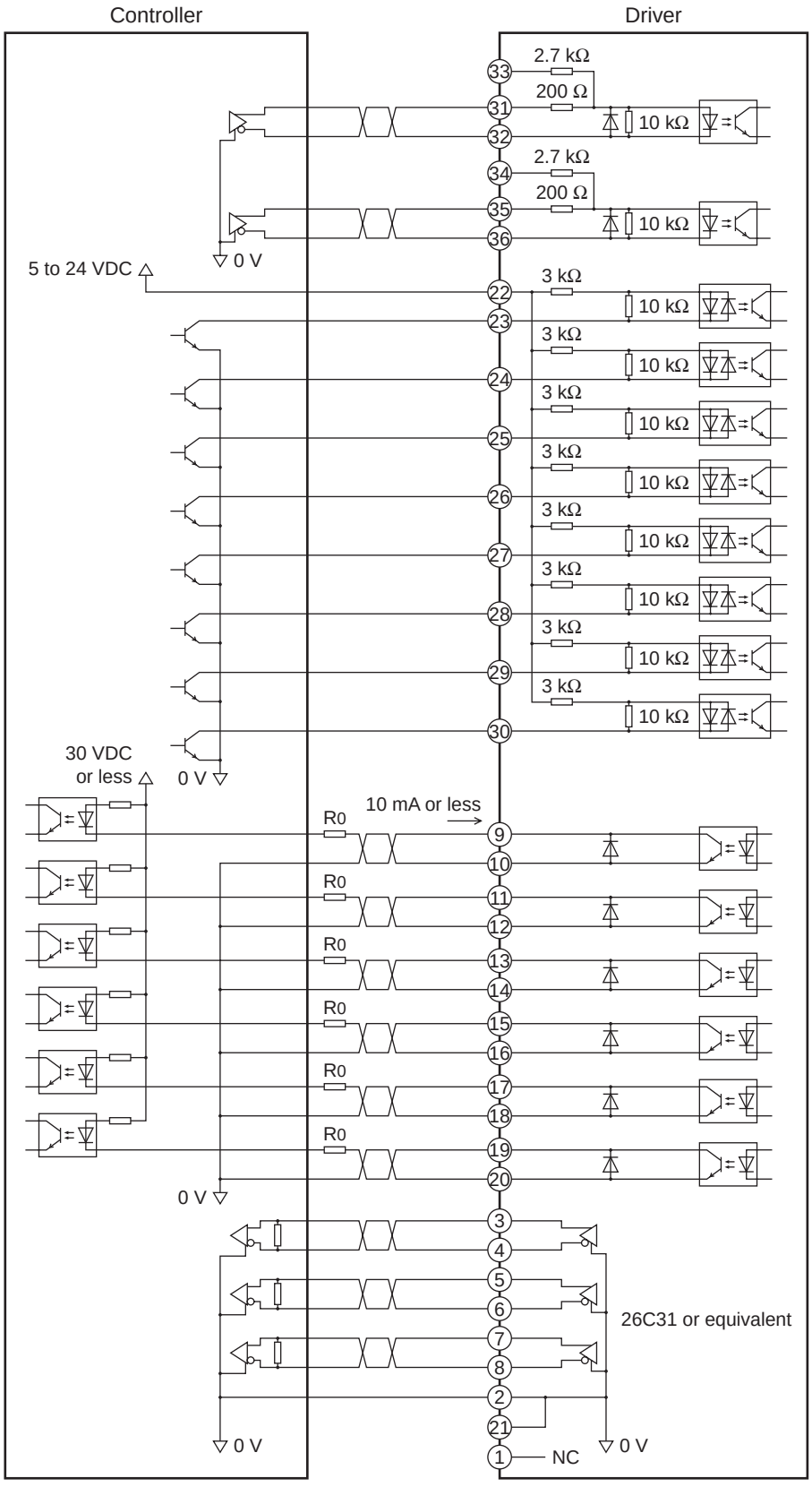
Insert the CN5 connector into the I/O signal connector (CN5) on the driver, and tighten the screw.
Tightening torque:0.3 to 0.35 N·m (42 to 49 oz-in)



Note Be certain the I/O signal cable is as short as possible. The maximum input frequency will decrease as the cable length increases.

■ Connecting to a current sink output circuit

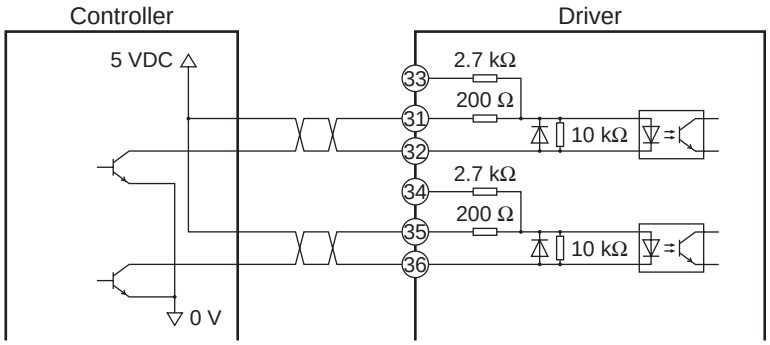
- When pulse input is of line driver type



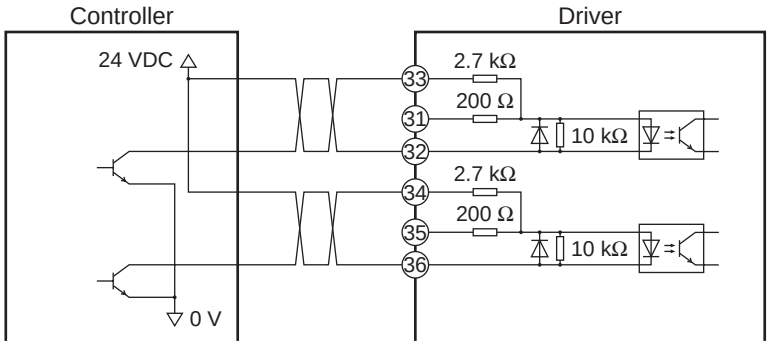
Note

- Use output signals at 30 VDC or less. If the current exceeds 10 mA, connect an external resistor R_0.
- Connect a termination resistor of 100 Ω or more between the driver and the input of the line receiver.

- When pulse input is of 5 VDC type

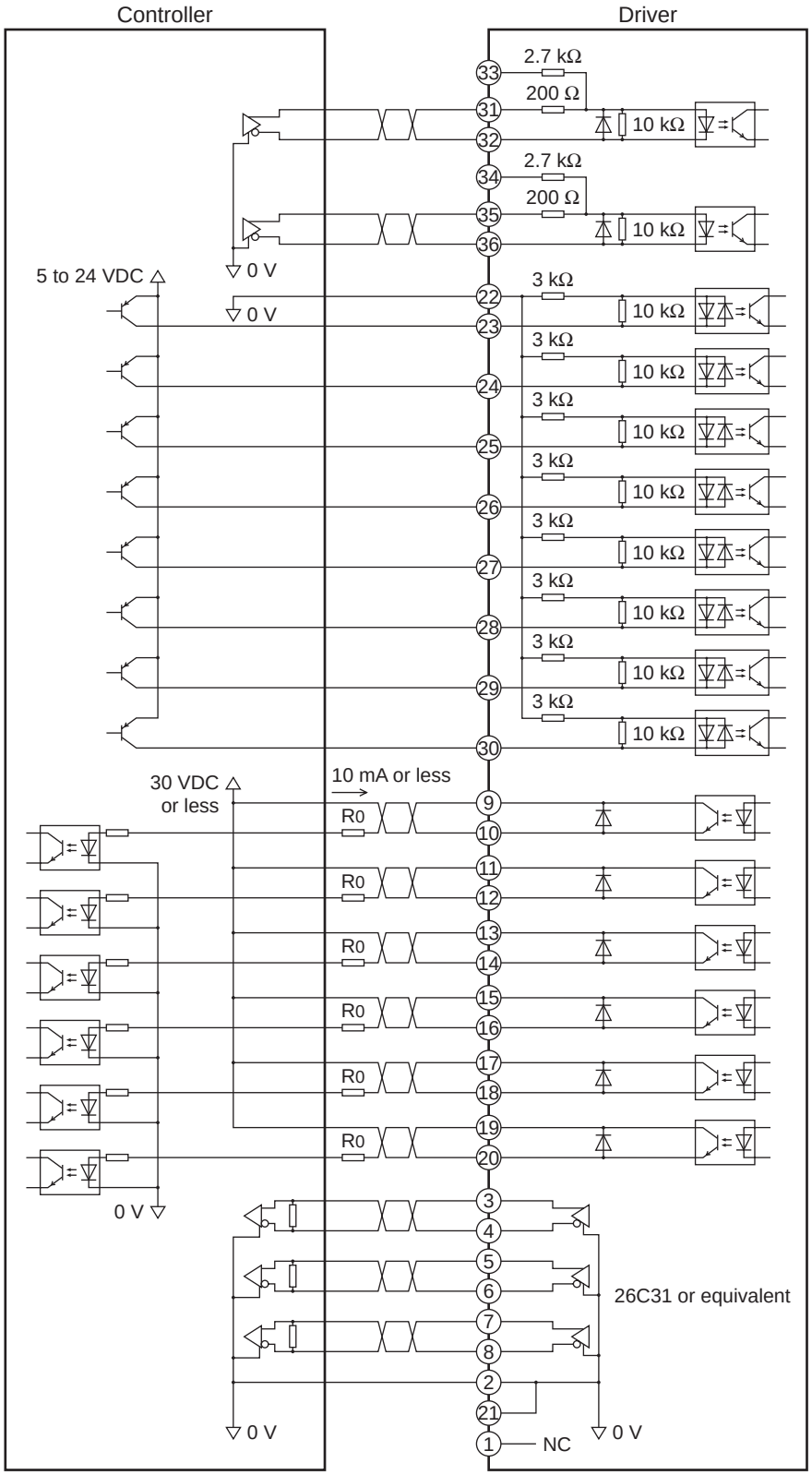


- When pulse input is of 24 VDC type



■ Connecting to a current source output circuit

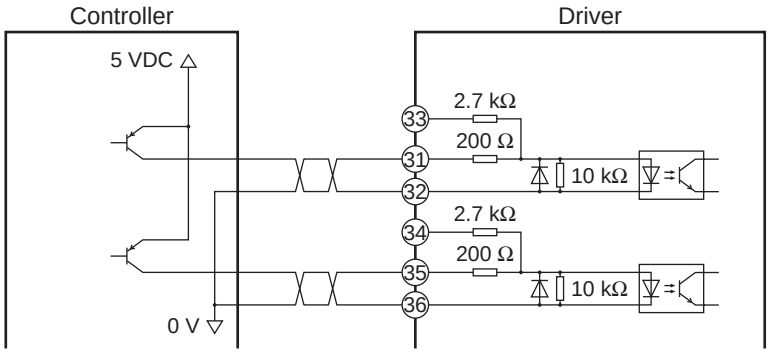
- When pulse input is of line driver type



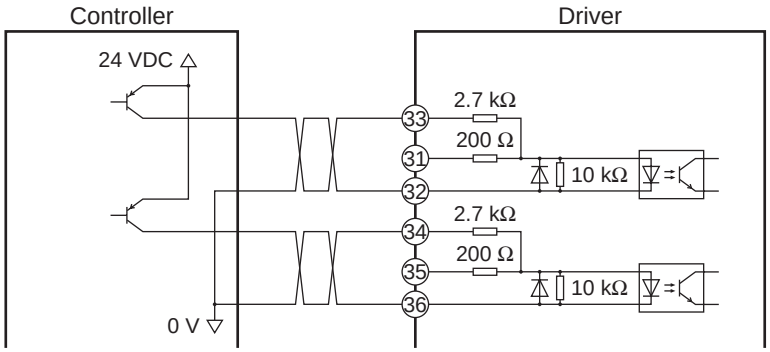
Note

- Use output signals at 30 VDC or less. If the current exceeds 10 mA, connect an external resistor R0.
- Connect a termination resistor of 100 Ω or more between the driver and the input of the line receiver.

- When pulse input is of 5 VDC type



- When pulse input is of 24 VDC type



8.3 Connecting the power supply

Use the CN3 connector (5 pins) to connect the power supply cable (AWG16 to 14: 1.25 to 2.0 mm^2) to the main power supply connector (CN3) on the driver.

■ Power supply current capacity

• Single-phase 100-115 V

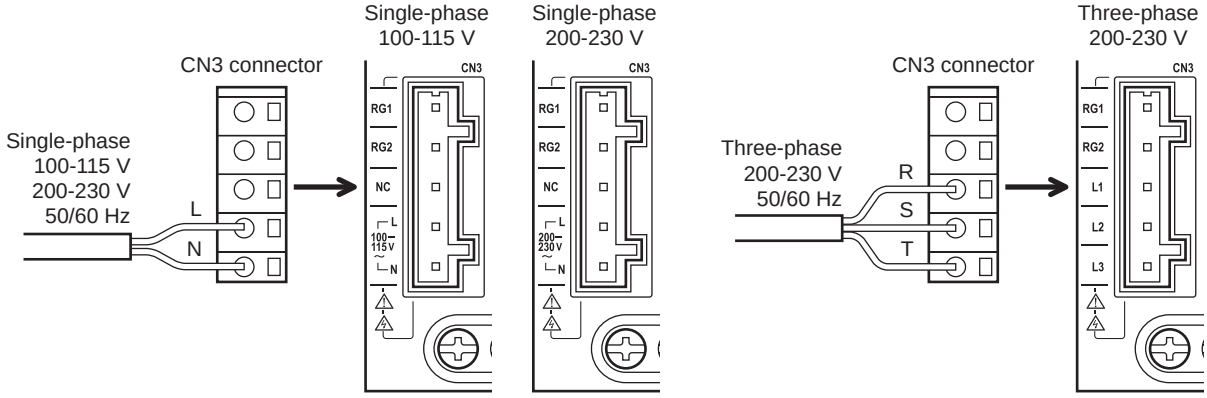
Model	Power supply current capacity
AR46	2.9 A or more
AR66	4.4 A or more
AR69	6.1 A or more
AR98	5.5 A or more
AR911	6.5 A or more

• Single-phase 200-230 V

Model	Power supply current capacity
AR46	1.9 A or more
AR66	2.7 A or more
AR69	3.8 A or more
AR98	3.4 A or more
AR911	4.1 A or more

• Three-phase 200-230 V

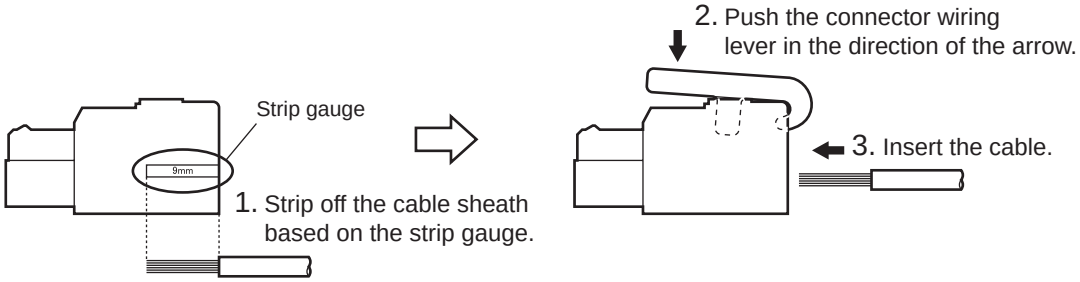
Model	Power supply current capacity
AR46	1.0 A or more
AR66	1.4 A or more
AR69	2.0 A or more
AR98	1.8 A or more
AR911	2.2 A or more



Note

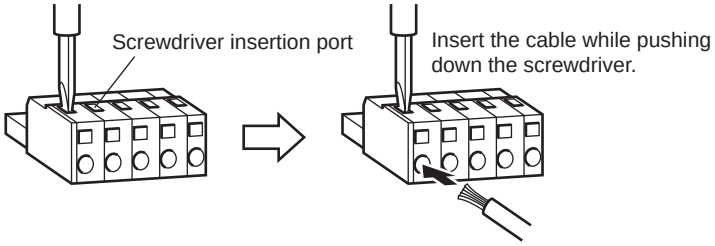
- Pay attention to the polarity of the power supply. Reverse-polarity connection may cause damage to the driver.
- Do not wire the power supply cable of the driver in the same cable duct with other power lines or motor cables. Doing so may cause malfunction due to noise.
- When cycling the power or plugging/unplugging the connector, turn off the power and wait for the CHARGE LED to turn off. The residual voltage may cause electric shock.

■ Connecting method of the power supply cable



Cable size capacity: AWG16 to 14 (1.25 to 2.0 mm^2)
Sheath length to be removed: 8 to 9 mm (0.31 to 0.35 in.)

You can also connect the power supply cable using a flat-tip screwdriver.
Insert a flat-tip screwdriver with a tip of 3.0 to 3.5 mm (0.12 to 0.14 in.) in width into the insertion port and push. In this condition, insert the cable.

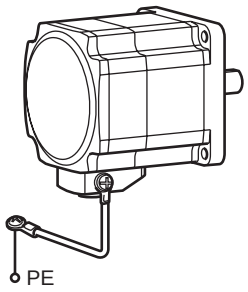


8.4 Grounding the motor and driver

■ Grounding the motor

Be sure to ground the Protective Earth Terminal of the motor.
Tightening torque: 1.2 N·m (170 oz-in)

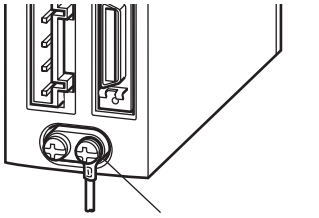
Use a grounding wire of AWG18 (0.75 mm^2) or more.
Use a round, terminal in combination with an inner-clip washer and bolt it in place to secure the grounding connection. Ground wires and crimp terminals are not supplied.



■ Grounding the driver

Be sure to ground the protective earth terminal (screw size: M4) of the driver.
Tightening torque: 1.2 N·m (170 oz-in)

You can ground either of the two protective earth terminals. The terminal not grounded should be connected to the protective earth lead of the motor cable.
Use a grounding wire (AWG16 to 14: 1.25 to 2.0 mm^2), and do not share the protective earth terminal with a welder or any other power equipment.
When grounding the protective earth terminal, use a round terminal and affix the grounding point near the driver.

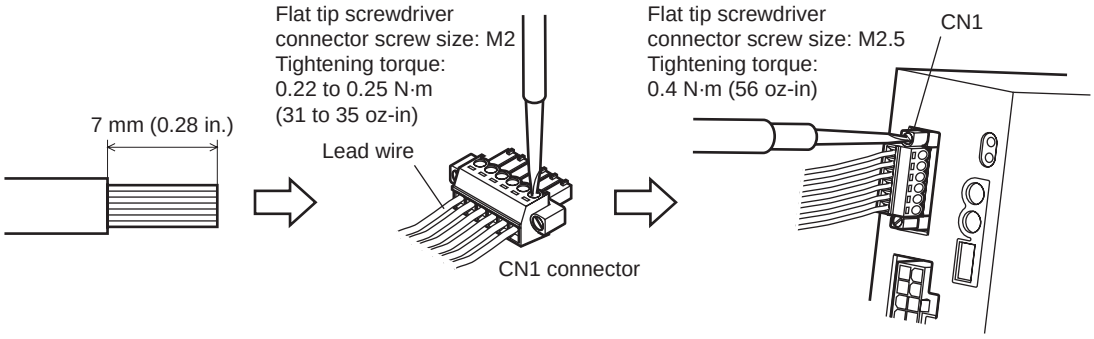


8.5 Connecting the 24 VDC power supply input, regeneration resistor/unit and electromagnetic brake

Use the CN1 connector (6 pins) to connect the 24 VDC power supply input, regeneration resistor thermal input and electromagnetic brake. Connect the lead wire (AWG24 to 16: 0.2 to 1.25 mm^2) to the connector while checking the pin numbers in below.

Display	Description
24V+	24 VDC power supply input (Be sure to connect these pins when an electromagnetic brake is used.)
24V−	
TH1	Regeneration resistor thermal input (If these pins are not used, short it using a jumper wire.)
TH2	
MB1	Electromagnetic brake − (Connect the black lead wire of the electromagnetic brake.)
MB2	Electromagnetic brake + (Connect the white lead wire of the electromagnetic brake.)

■ Connecting method



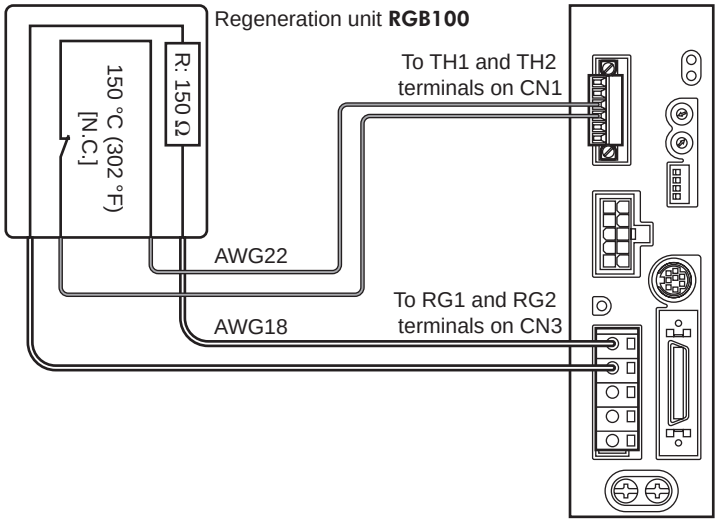
■ Connecting the 24 VDC power supply input

Connect a power supply of 24±5% VDC, 0.75 A or more.
Once a 24 VDC power supply is connected, you can check the contents of alarms that have generated even when the main power is cut off. If a motor with electromagnetic brake is used, be sure to connect a 24 VDC power supply as the electromagnetic brake power. The 24 VDC power supply will not be used to drive the motor. Connect a 24 VDC power supply as necessary.

Note If the distance between the motor and driver is extended to 20 m (65.6 ft.) or longer, use a power supply of 24±4% VDC.

■ Connecting the regeneration resistor

Use the accessory regeneration unit **RGB100** (sold separately) if gravitational operation or other operation involving up/down movement, or sudden starting/stopping of a large inertia load, will be repeated frequently.



- The two thin lead wires (AWG22: 0.3 mm^2) of the regeneration unit are the thermostat outputs. Connect them to the TH1 and TH2 terminals using the CN1 connector.
- Regenerative current flows through the two thick lead wires (AWG18: 0.75 mm^2) of the regeneration unit. Connect them to the RG1 and RG2 terminals using the CN3 connector.

Note
- Before connecting the regeneration unit, be sure to remove the jumper wire from the CN1 connector.
- If the current consumption of the regeneration unit exceeds the allowable level, the thermostat will be triggered and a regeneration unit overheat alarm will generate. If a regeneration unit overheat alarm generates, turn off the power and check the content of the error.

Regeneration unit specifications

Model	**RGB100**
Allowable current consumption	Continuous regenerative power *: 50 W
	Instantaneous regenerative power: 600 W
Resistance	150 Ω
Operating temperature of thermostat	Operation:Opens at 150±7 °C (302±45 °F) Reset:Closes at 145±12 °C (293±54 °F) (normally closed)
Electrical rating of thermostat	120 VAC 4 A, 30 VDC 4 A (minimum current: 5 mA)

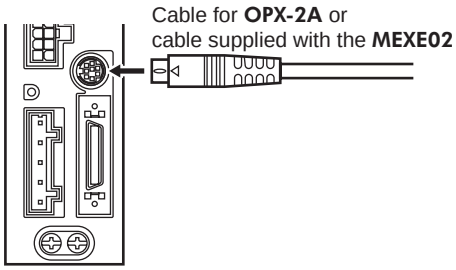
∗ Install the regeneration unit in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 350×350×3 mm (13.78×13.78×0.12 in.)] is ensured.

■ Connecting the electromagnetic brake

Refer to p.23.

8.6 Connecting the data setter

Connect **OPX-2A** cable or supplied cable with the **MEXE02** to the data edit connector (CN4) on the driver.



⚠ Caution

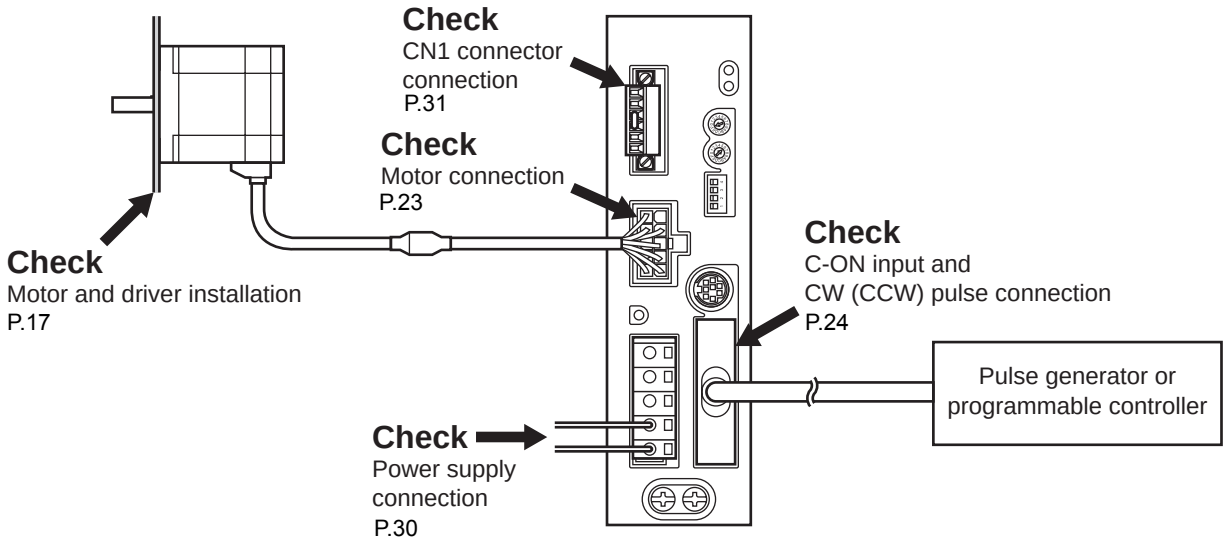
The data edit connector (CN4) and I/O signal connector (CN5) of the driver are not electrically insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and these equipment to short, damaging both.

9 Quick operations

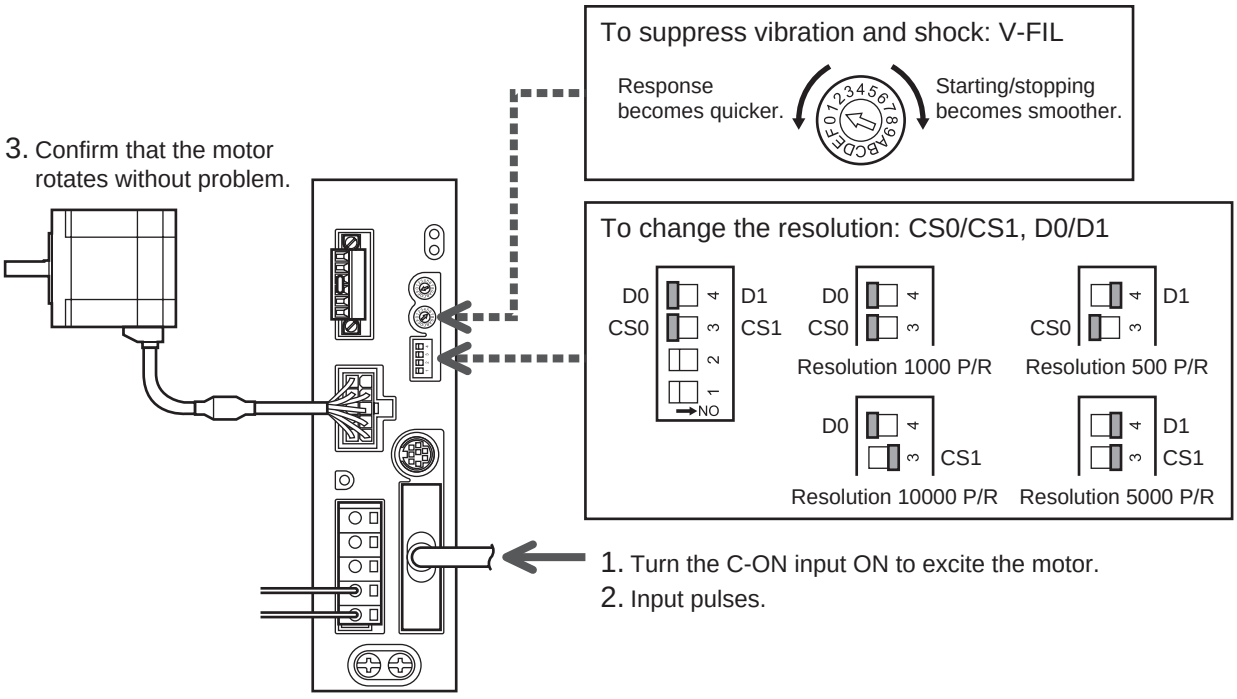
If you are new to the **AR** Series driver, read this chapter and you will be able to perform basic motor operations quickly.

Note Before operating the motor, check the condition of the surrounding area to ensure safety.

STEP 1 Check the installation and connection



STEP 2 Operate the motor



STEP 3 Were you able to operate the motor properly?

How did it go? Were you able to operate the motor properly? If the motor does not function, check the following points:

- Is the C-ON input ON?
- Are the thermal terminals for regeneration resistor (TH1 and TH2) on the CN1 shorted?
- Is any alarm present?
- Are the power supply and motor connected securely?

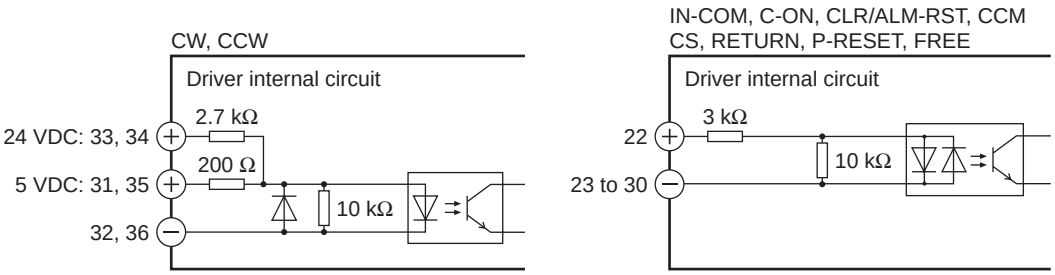
For more detailed settings and functions, refer to "12 Extended functions" on p.46.

10 Explanation of I/O signals

Check the timing charts on p.68.

10.1 Input signals

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



■ C-ON input

This signal is used to excite the motor (initial value: normally open).
When an electromagnetic brake motor is used, release the electromagnetic brake after the motor is excited.
With the **OPX-2A** or **MEXE02**, it is possible to set the C-ON input logic and the excitation position at the C-ON input ON. Refer to p.50 for details.

Note The factory setting of the C-ON input is normally open. Be sure to turn the C-ON input ON when operating the motor. Set the C-ON input to normally closed when the C-ON input is not used.

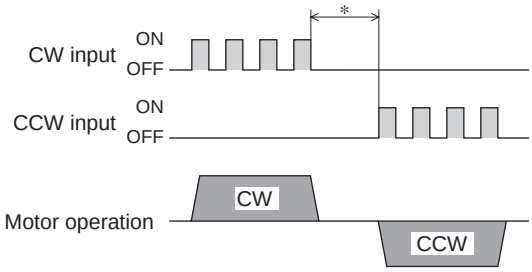
■ CW/PLS input, CCW/DIR input

These input serve as the CW and CCW inputs in the 2-pulse input mode, or PLS and DIR inputs in the 1-pulse input mode. They are common to all pulse input types including 5 VDC input, 24 VDC input and line driver input.

Note
- When no pulse is input, be sure to keep the photocoupler in the OFF state.
- The CW and CCW indicate the rotation direction of the motor, as seen from the output shaft. The output shaft of the **TH** geared typed motors with ratios of 20 and 30, as well as all ratios of the Harmonic geared type motors, rotate in the opposite direction of the motor shaft.

- 2-pulse input mode
  - When the CW input is turned ON, the motor will rotate by one step in CW direction.
  - When the CCW input is turned ON, the motor will rotate by one step in CCW direction.

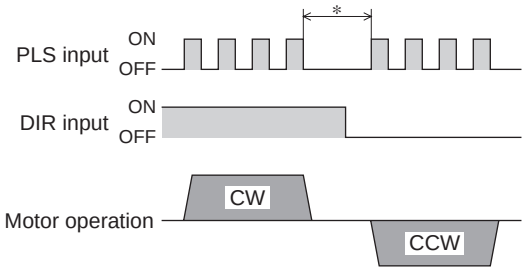
  ∗ The minimum interval time needed for switching the direction of rotation will vary, depending on the operating speed and size of the load. Do not shorten the interval time more than necessary.



Note While one pulse is input, the other pulse should always be turned OFF. If both pulses are turned ON simultaneously, no pulse will be input.

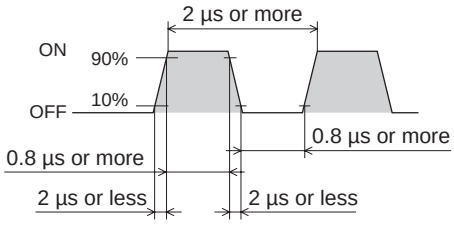
- 1-pulse input mode
  - When the PLS input is turned ON while the DIR input is ON, the motor will rotate by one step in CW direction.
  - When the PLS input is turned ON while the DIR input is OFF, the motor will rotate by one step in CCW direction.

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



- Pulse signal

Input a pulse with sharp rising and falling edges as shown in the figure. The figure shows the voltage levels of pulse signals.



■ FREE input

When the FREE input is turned ON, current supplied to the motor will be cut off, thereby allowing the motor output shaft to be turned by external force. If the motor is equipped with an electromagnetic brake, the electromagnetic brake will also be released.
When the FREE input is turned OFF, current will be supplied to excite the motor and the holding torque will be restored. The automatic return operation after turning the FREE input OFF can be set using the **OPX-2A** or **MEXE02**.
Refer to p.50.

Note When operating the motor, be sure to turn the FREE input OFF.

■ CS (T-MODE) input

The CS input is effective when positioning operation is performed.
When "push-motion operation" is selected with the **OPX-2A** or **MEXE02**, the T-MODE input will become effective.

- CS input

When the resolution switch (CS0/CS1) is set to CS0, the resolution setting can be changed according to the CS input.

Resolution switch / CS input	CS0 and D0	CS0 and D1
OFF	The CS0 setting is selected. Factory setting: 1000 P/R	The CS0 setting is selected. Factory setting: 500 P/R
ON	The CS1 setting is selected. Factory setting: 10000 P/R	The CS1 setting is selected. Factory setting: 5000 P/R

Note While the resolution switch (CS0/CS1) is set to CS1, the CS input is disabled. The CS1 setting is maintained.

- T-MODE input

When the T-MODE input is turned ON, the push-motion operation will be started.

■ RETURN (M1) input

The RETURN input is effective when positioning operation is performed.
When "push-motion operation" is selected with the **OPX-2A** or **MEXE02**, the M1 input will become effective.

- RETURN input

When the RETURN input is turned ON, the motor will start a return to electrical home operation.
Return to electrical home operation is a type of operation that moves the motor to its electrical home position (where the cumulative value of command positions becomes "0").
The electrical home position is initially at the motor position when the power is turned on and it can be changed to a desired position using the P-RESET input.

- M1 input

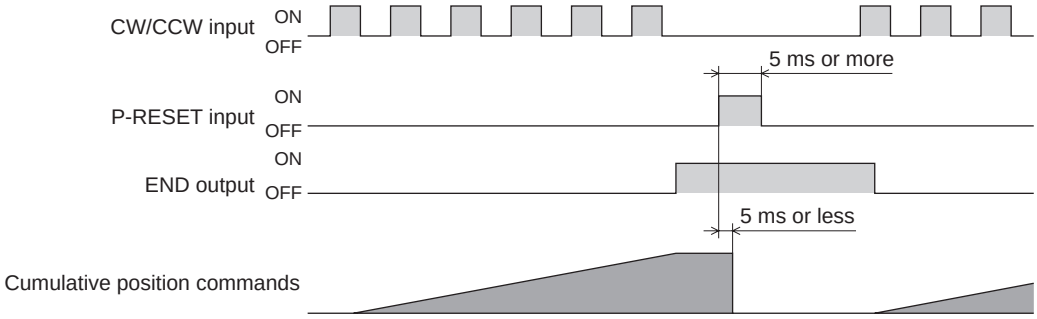
Combine this input with the M0 and M2 inputs to select a desired current setting for push-motion operation.
Refer to p.51 for details.

■ P-RESET (M2) input

The P-RESET input is effective when positioning operation is performed.
When "push-motion operation" is selected with the **OPX-2A** or **MEXE02**, the M2 input will become effective.

- P-RESET input

When the P-RESET input is turned ON, the cumulative value of command positions will become "0" and the electrical home position will be set. Input this signal while the motor is at standstill.



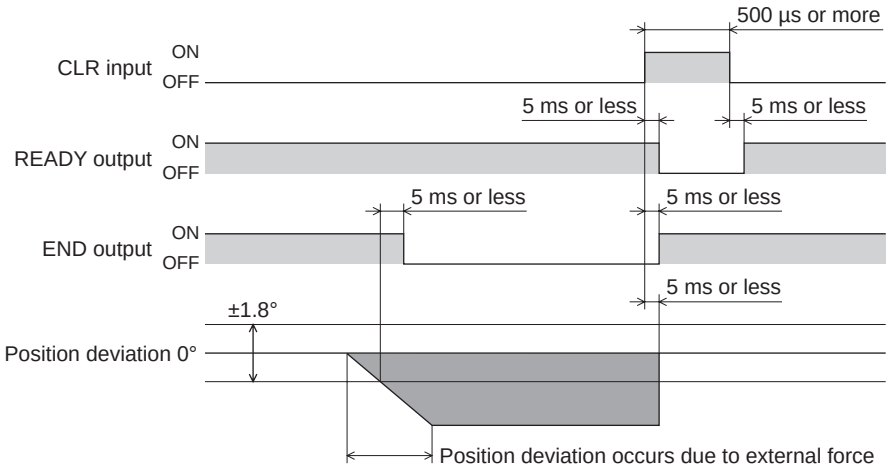
- M2 input

Combine this input with the M0 and M1 inputs to select a desired current setting for push-motion operation.
Refer to p.51 for details.

■ CLR/ALM-RST input

This input is used to clear the position deviation counter.
If an alarm generates, the CLR/ALM-RST input will function as an input signal to reset the alarm.

- CLR input

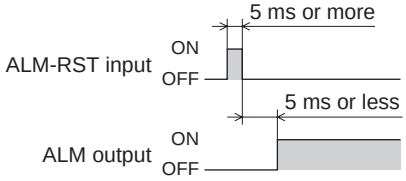


Note

- When performing a return to mechanical home operation using a stopper, etc., do not use the CLR input. If the CLR input is used, the home position may become offset.
- Pulse input is disabled while the CLR input is ON.
- When the CLR input is turned ON, the automatic return operation and return to electrical home operation will stop.

- ALM-RST input

When an alarm generates, the ALM output will turn OFF. When the ALM-RST input is turned from ON to OFF, the ALM output will turn ON and the alarm will be reset. (The alarm will be reset at the OFF edge of the ALM-RST input.) Before resetting an alarm, always remove the cause of the alarm and ensure safety.
For details, refer to "ALM output" on p.41, and "15.1 Alarms" on p.57.



Note

Alarms that cannot be reset with the ALM-RST input need to be reset by cycling the power. If a normal condition cannot be restored after cycling the power, contact your nearest Oriental Motor sales office.

■ CCM input

When the CCM input is turned ON, the control mode will change from the normal mode to the current control mode. In the current control mode, noise and vibration can be reduced although the motor synchronicity drops.
Be sure to turn the CCM input ON/OFF after confirming that the motor has stopped.

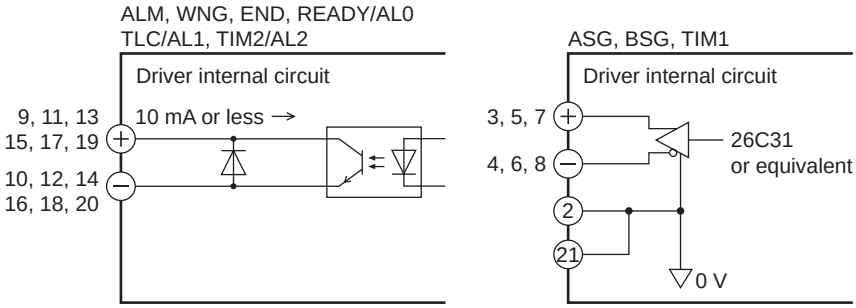
Note Keep the control mode switch in the NORM (normal mode). If the switch is in the CCM (current control mode), the CCM input will be disabled.

■ M0 input

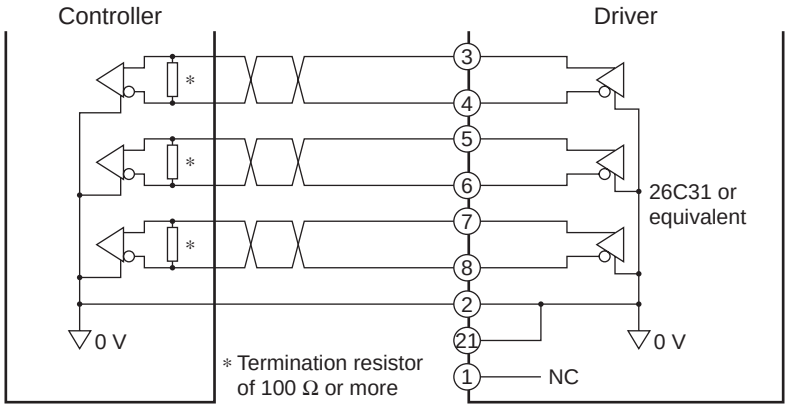
When "push-motion operation" is set with the **OPX-2A** or **MEXE02**, the M0 input will become effective. Combine this input with the M1 and M2 inputs to select a desired current setting for push-motion operation.
Refer to p.51 for details.

10.2 Output signals

The driver outputs signals in the photocoupler/open-collector output mode or line driver output mode. The signal state represents the "ON: Carrying current" or "OFF: Not carrying current" state of the internal photocoupler rather than the voltage level of the signal.



Note The ASG output, BSG output and TIM1 output are line driver outputs. When connecting a line driver output, receive the output signal using a line receiver. Also, be sure to connect pins 2 and 21 of the driver to the GND on the line receiver, and connect a termination resistor of 100 Ω or more between the driver and the input of the line receiver.



■ READY/AL0 output

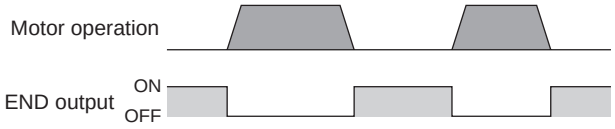
When the driver becomes ready, the READY output turns ON. Input pulse signals to driver after the READY output has turned ON.
If an alarm generates, an alarm code indicating the cause of the alarm can be output and checked via the combination of AL0, AL1 and AL2 outputs. To use alarm codes, the applicable parameter must be changed using the **OPX-2A** or **MEXE02**. For details on alarm, refer to p.57.

■ TLC/AL1 output

This signal will be output when the torque characteristic exceeds the specified range. If a push current is set using an extended function, this signal is output while pushing.
If an alarm generates, an alarm code indicating the cause of the alarm can be output and checked via the combination of AL0, AL1 and AL2 outputs. To use alarm codes, the applicable parameter must be changed using the **OPX-2A** or **MEXE02**. For details on alarm, refer to p.57.

■ END output

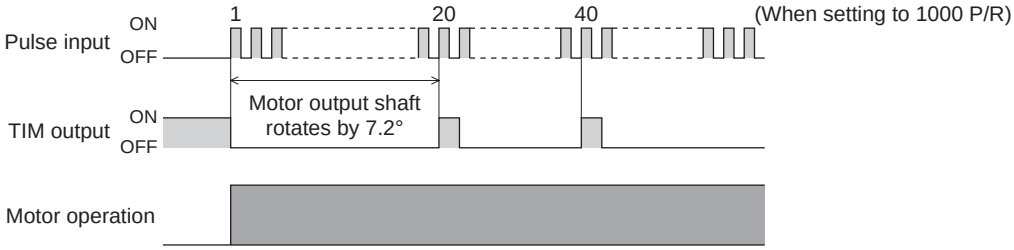
When the motor has completed its movement, the END output will turn ON. Specifically, the END output will turn ON when the rotor position falls within ±1.8° of the command position while no pulse signal is input.
A desired output condition for the END signal can be set using the **OPX-2A** or **MEXE02**.
Refer to "18.2 Function/parameter list" on p.78.



∗ The output time of the END signal varies depending on the position command filter and operating speed.

■ TIM1 output

The TIM output will turn ON every time the motor output shaft rotates by 7.2°.
Two types of TIM outputs are available: the line driver output (TIM1 output), and the open collector output (TIM2 output). Change the TIM output according to the pulse input mode of the programmable controller.



Note

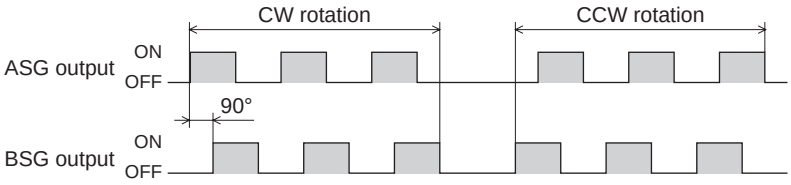
- The TIM1 output will turn ON when the pulse speed is 10 kHz or less, and the TIM2 output will turn ON when the pulse speed is 500 Hz or less.
- When changing the resolution using the CS input, do so while the TIM output is ON and the motor is at standstill. If the CS input is turned ON/OFF when one or both of these conditions are unsatisfied, the TIM output will not turn ON even after the motor output shaft rotates by 7.2°.

■ TIM2/AL2 output

Refer to "TIM1 output" for the TIM2 output.
If an alarm generates, an alarm code indicating the cause of the alarm can be output and checked via the combination of AL0, AL1 and AL2 outputs. To use alarm codes, the applicable parameter must be changed using the **OPX-2A** or **MEXE02**. For details on alarm, refer to p.57.

■ ASG output, BSG output

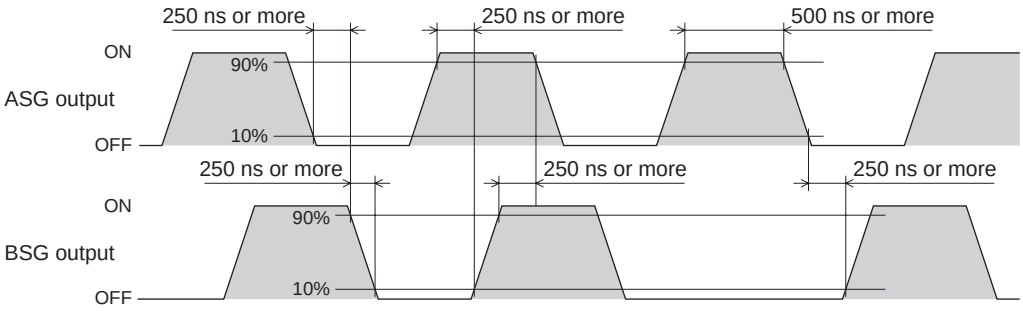
The ASG output is used to output pulses according to motor operation. The motor position can be monitored by counting the ASG output pulses. The number of output pulses per motor revolution varies depending on the resolution effective when turning the power on.
The BSG output has a 90° phase difference with respect to the ASG output. The motor rotation direction can be determined by detecting the BSG output level at the rise of the ASG output.



Note

- The ASG output and BSG output are subject to a maximum delay of 0.1 ms with respect to motor operation. Use these outputs to check the position at which the motor is stopped.
- Connect a termination resistor of 100 Ω or more between the driver and the input of the line receiver.

Electrical characteristics of ASG output and BSG output



The electrical characteristics vary depending on the IC specification of the line driver.

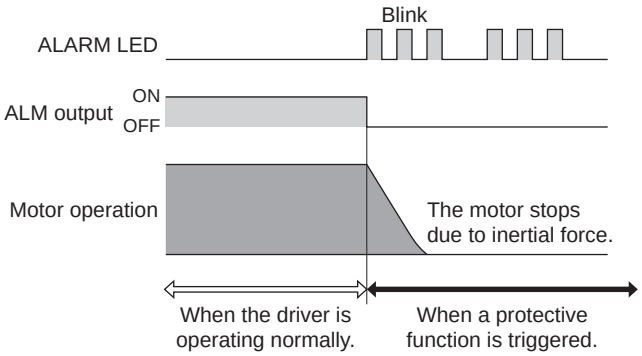
■ WNG output

When a warning generates, the WNG output turns ON. The warning can be generated before a corresponding alarm generates. To use the WNG output, the applicable parameter must be changed using the **OPX-2A** or **MEXE02**. (The initial value is to use the same conditions applicable to alarms.) For details on warning, refer to p.62.

■ ALM output

When an alarm generates, the ALM output will turn OFF. At the same time, the ALARM LED of the driver will blink and the motor current will be cut off and stop.* In the case of an electromagnetic brake motor, the electromagnetic brake will switch to the holding mode.
Set the programmable controller so that it will stop motor operation commands upon detection of an OFF status of the ALM output.
The cause of the alarm can be checked by counting the number of times the ALARM LED blinks. For details, refer to p.57.

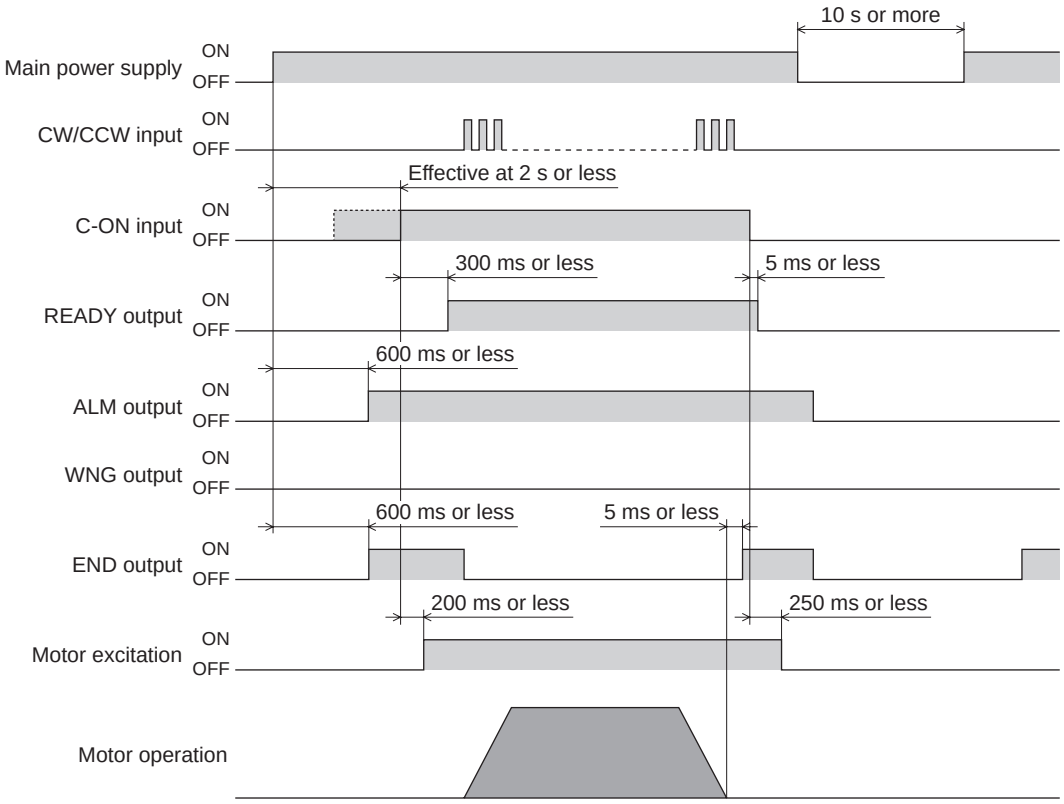
* Abnormal operation data alarm is not supported by this function (because the current will not be cut off even after these errors occur).



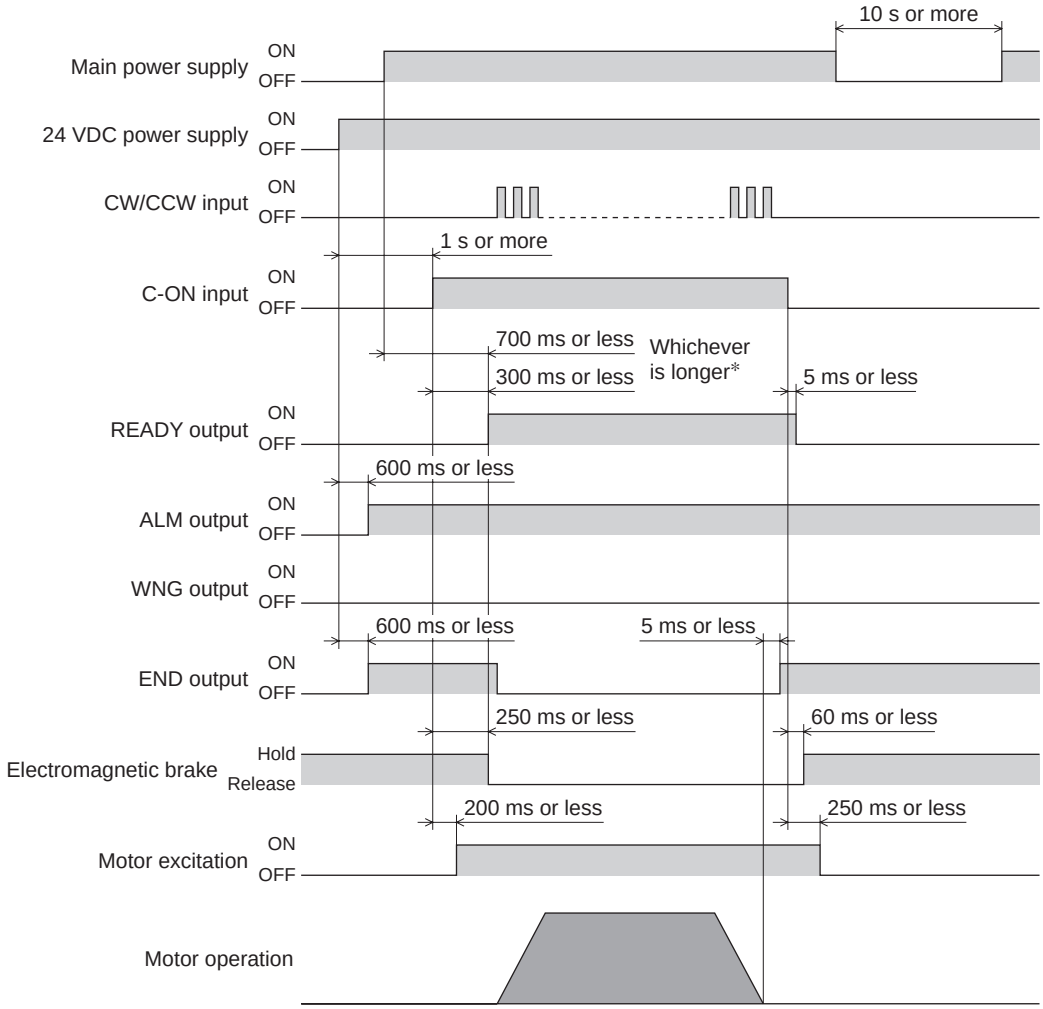
10.3 Timing chart

■ When no 24 VDC power supply is connected to CN1

When turning the main power supply on and turning the C-ON input ON, the motor will be excited.
The READY output will turn ON and pulse input will be enabled.



■ When a 24 VDC power supply is connected to CN1

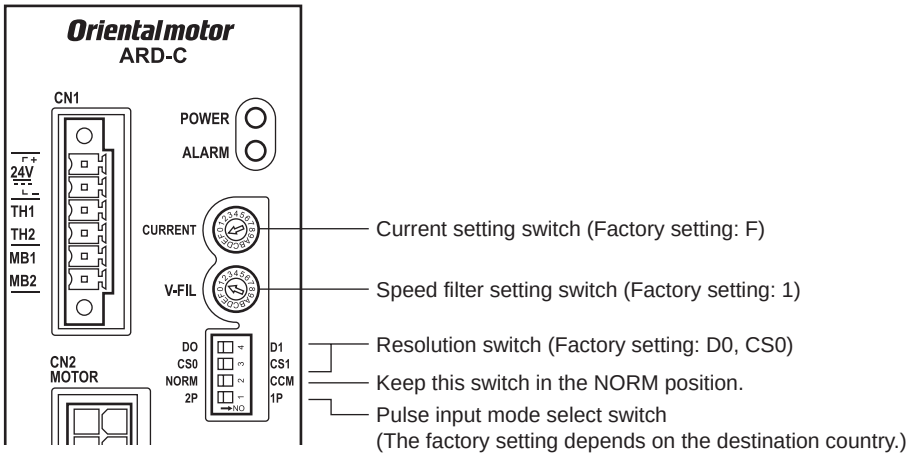


* The specific time varies depending on the timing at which the C-ON input is turned ON.

11 Setting

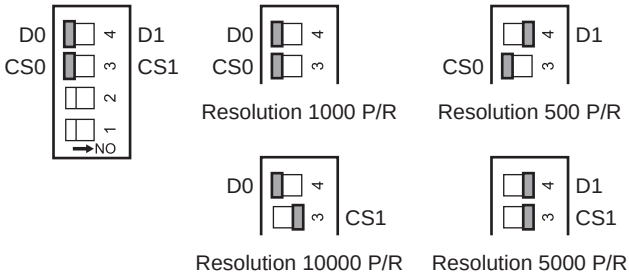
This chapter explains how to change and set the driver functions using the switches on the front face of the driver.

Note Before operating any switch, turn off the driver power and wait for the CHARGE LED to turn off. Failure to do so may cause electric shock.



11.1 Resolution

Use the resolution switches (D0/D1 and CS0/CS1) to set a desired resolution per revolution of the motor output shaft.



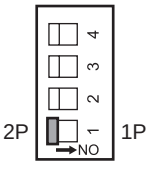
Note

- The new settings of the resolution switches will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.
- When changing the resolution using the CS input, use the switches in "CS0"/"D0" or "CS0"/"D1" combination. If the CS input is turned ON when "CS1" is selected, the resolution will not be changed.

To change the basic resolution setting: Refer to "Resolution" on p.47.

11.2 Pulse input mode

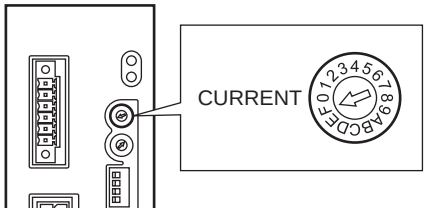
Set a desired pulse input mode of the driver according to the pulse output mode of the controller (pulse generator) used with the driver. Set a desired mode using the pulse input mode select switch (2P/1P).
1P: 1-pulse input mode (when the PLS input and DIR input are used)
2P: 2-pulse input mode (when the CW input and CCW input are used)



Note The new setting of the pulse input mode select switch will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

To change the basic setting for pulse input mode: Refer to "Pulse input mode" on p.48.

11.3 Operating current



Set a desired operating current using the current setting switch (CURRENT).
The operating current to be set is the maximum output current multiplied by the operating current rate (%) set to each dial setting of the current setting switch, where "F" corresponds to 100%.
One of 16 operating current levels from 0 to F can be set.
If the load is small and there is an ample allowance for torque, motor temperature rise can be suppressed by setting a lower operating current.
The dial settings and corresponding operating current rates are listed below.

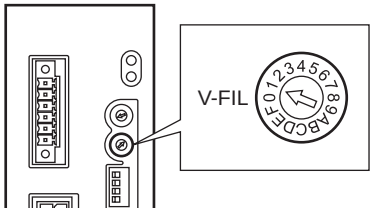
Dial setting	Operating current rate (%)
0	6.3
1	12.5
2	18.8
3	25.0
4	31.3
5	37.5
6	43.8
7	50.0

Dial setting	Operating current rate (%)
8	56.3
9	62.5
A	68.8
B	75.0
C	81.3
D	87.5
E	93.8
F	100 (factory setting)

Note Excessively low operating current may cause a problem in starting the motor or holding the load in position. Do not lower the operating current more than necessary.

To change the basic setting for operating current: Refer to "Operating current" on p.53.

11.4 Speed filter

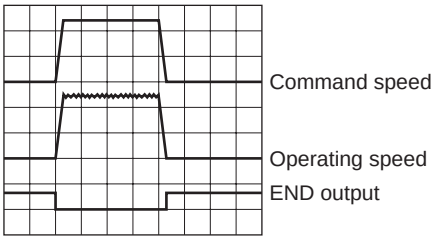


The motor response to input pulses can be adjusted with the speed filter setting switch (V-FIL).
One of 16 speed filter levels from 0 to F can be set.
When setting a higher value for the speed filter, lower vibration at low speed operation or smoother operation at starting/stopping of the motor can be achieved.
However, if this setting is too high, synchronization performance is decreased. Set a suitable value based on the load or application.

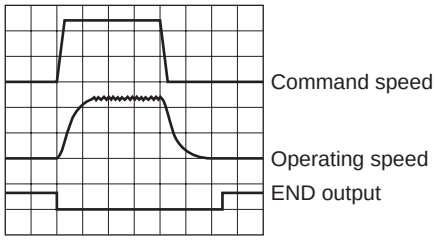
Dial setting	Speed filter time constant (ms)
0	0
1	1 (factory setting)
2	2
3	3
4	5
5	7
6	10
7	20

Dial setting	Speed filter time constant (ms)
8	30
9	50
A	70
B	100
C	120
D	150
E	170
F	200

• Speed filter setting switch=0 (minimum)



• Speed filter setting switch=F (maximum)

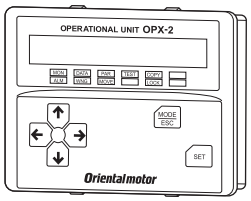


To change the basic setting for speed filter: Refer to "Speed filter" on p.53.

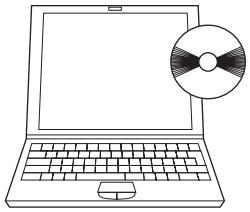
12 Extended functions

Using the **OPX-2A** or **MEXE02**, the driver parameters can be changed, and also test operation and monitoring operations can be performed. The key functions are listed below.
Parameter codes displayed on the **OPX-2A** screen are shown in brackets. Since these codes are also referenced in the main text herein, use these codes as keywords.
Parameters that can be set with the **OPX-2A** can also be set with **MEXE02**. For the method to set parameters with the **OPX-2A** or **MEXE02**, refer to the operating manual for each product.

OPX-2A



MEXE02



■ Application parameters

Item	Description	**OPX-2A** screen display	Reference
Operating current	Set each operating current rate assigned to the current setting switch.	[APP-0-00] to [APP-0-15]	P.53
Speed filter	Set each filter time constant assigned to the speed filter setting switch.	[APP-1-00] to [APP-1-15]	P.53
I/O input mode	Select the input signal mode.	[APP-2-00]	–
AL0-2 signal output	Change the setting to enable/disable alarm code output.	[APP-2-01]	P.57
C-ON input logic	Change the C-ON input logic.	[APP-2-02]	P.50
END signal range	Set the output condition for END output.	[APP-2-03]	P.40
END signal offset	If the position at which the motor stops deviates from the theoretical position due to the effect of the load, friction, etc., set an offset for the output position corresponding to the END output.	[APP-2-04]	P.50
Push-motion current	Set the operating current rate applicable to push-motion operation.	[APP-2-05] to [APP-2-12]	P.51
Standstill current	Set the standstill current as a percentage of the operating current.	[APP-3-00]	P.53
Speed error gain 1	Set the speed error gain. When this value is increased, motor vibration will decrease.	[APP-3-01]	P.53
Speed error gain 2	Set the speed error gain. When this value is increased, motor vibration at the time of speed change will decrease.	[APP-3-02]	
Position loop gain	Set the position loop gain. When this value is increased, the response will increase.	[APP-4-00]	P.54
Speed loop gain	Set the speed loop gain. When this value is increased, the response will increase.	[APP-4-01]	
Speed loop integral time constant	Set the integral time constant for speed loop. When this value is decreased, the response will increase.	[APP-4-02]	
Anti-vibration control	Change the setting to enable/disable anti-vibration control.	[APP-4-03]	P.54
Frequency of anti-vibration control	Set the frequency of anti-vibration control.	[APP-4-04]	
Operating speed of return operation	Set the operating speed of return to electrical home operation.	[APP-6-00]	P.52
Acceleration/deceleration rate of return operation	Set the acceleration and deceleration rate of return to electrical home operation.	[APP-6-01]	
Starting speed of return operation	Set the starting speed of return to electrical home operation.	[APP-6-02]	
Operating speed of JOG operation	Set the operating speed of JOG operation.	[APP-7-00]	P.51
Acceleration/deceleration rate of JOG operation	Set the acceleration and deceleration rate of JOG operation.	[APP-7-01]	
Starting speed of JOG operation	Set the starting speed of JOG operation.	[APP-7-02]	

■ System parameters

Item	Description	**OPX-2A** screen display	Reference
Electronic gear A1 to A4	Set the denominator of the electric gear.	[SyS-0-00] to [SyS-0-03]	P.47
Electronic gear B	Set the numerator of the electric gear.	[SyS-0-04]	
Pulse input mode	Select the pulse input mode.	[SyS-1-00]	P.48
Smooth drive	Change the setting to enable/disable the smooth drive.	[SyS-1-01]	P.53
Excite position at first current on	Select the position at which the motor is excited after the power has been turned on.	[SyS-1-02]	P.50
Auto return	Set whether or not to automatically return the motor, when the current is turned on, to the position where it was stopped.	[SyS-1-03]	P.50
Rotation direction	Select rotation direction of the motor.	[SyS-1-04]	P.50

Note When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

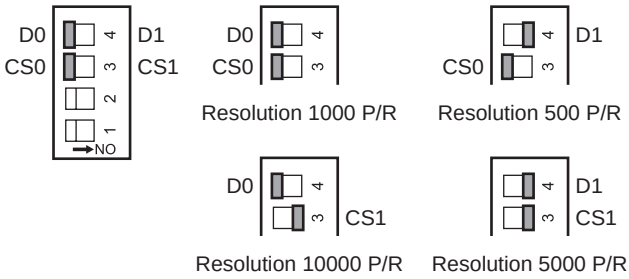
12.1 Setting

■ Resolution

The resolution can be set using the applicable driver switches or CS input.

- Using the switches

Use the resolution switches (D0/D1 and CS0/CS1) to set a desired resolution per revolution of the motor output shaft.



Note The new settings of the resolution switches will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

The values of resolution switches (CS0/CS1, D0/D1) can be changed with the system parameters for electronic gear [SyS-0-00] to [SyS-0-04] as shown in the table below. Note that the calculated value must fall within the setting range specified below:
Resolution setting range: 100 to 10000 P/R
Factory setting: 1000 P/R

Resolution switches	CS0	CS1
D0	$1000 \times \frac{\text{Electronic gear B [SyS-0-04]}}{\text{Electronic gear A1 [SyS-0-00]}}$	$1000 \times \frac{\text{Electronic gear B [SyS-0-04]}}{\text{Electronic gear A2 [SyS-0-01]}}$
D1	$1000 \times \frac{\text{Electronic gear B [SyS-0-04]}}{\text{Electronic gear A3 [SyS-0-02]}}$	$1000 \times \frac{\text{Electronic gear B [SyS-0-04]}}{\text{Electronic gear A4 [SyS-0-03]}}$

Note
- When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.
- If the calculated resolution exceeds the setting range, an electronic gear setting error warning will generate. Refer to p.62.
- If the power is cycled while an electronic gear setting error warning is present, an electronic gear setting error alarm will generate. Refer to p.57.

- Using the CS input

When the resolution switch (CS0/CS1) is set to CS0, the resolution setting can be changed according to the CS input.

CS input \ Resolution switch	CS0 and D0	CS0 and D1
OFF	The CS0 setting is selected. Factory setting: 1000 P/R	The CS0 setting is selected. Factory setting: 500 P/R
ON	The CS1 setting is selected. Factory setting: 10000 P/R	The CS1 setting is selected. Factory setting: 5000 P/R

Note

- When the resolution switch (CS0/CS1) is set to CS1, the CS input is disabled. The CS1 setting is maintained.
- When the CS input is turned ON while the application parameter for abnormal operation data warning [APP-5-00] is set to "Enable," a return to electrical home operation will be disabled and an abnormal operation data warning will generate. When performing a return to electrical home operation after the CS input is turned ON, turn the P-RESET input ON to confirm the electrical home position and then turn the RETURN input ON.

■ Pulse input mode

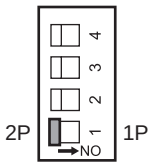
Set the desired pulse input mode of the driver according to the pulse output mode of the controller (pulse generator) used with the driver. The pulse input mode is set using the applicable driver switch or parameter.

- 1-pulse input mode
  A pulse signal is input via the PLS input and the rotation direction is selected using the DIR input.
- 2-pulse input mode
  When a pulse signal is input via the CW input, the motor will rotate in forward direction. If a pulse signal is input via the CCW input, the motor will rotate in reverse direction.
- Phase difference input mode (set by a parameter)
  The motor will rotate in forward direction when the CCW input phase is delayed by 90° relative to the CW input.
  The motor will rotate in reverse direction when the CCW input phase is advanced by 90° relative to the CW input.

- Using the switch

Set a desired mode using the pulse input mode select switch (2P/1P).
1P: 1-pulse input mode, active low
2P: 2-pulse input mode, active low

Each mode can only be set with the low active using the pulse input mode select switch. To select the high active, set the applicable parameter using the **OPX-2A** or **MEXE02**.

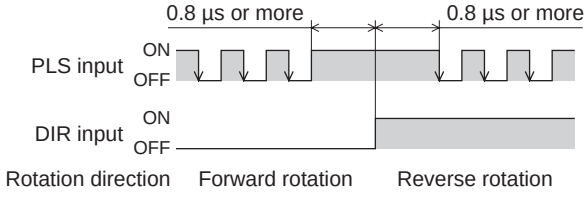
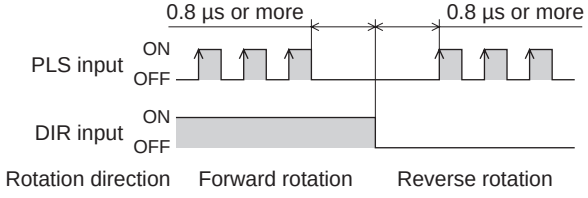


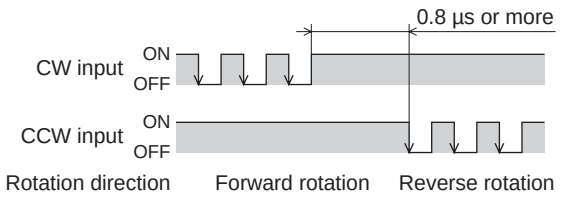
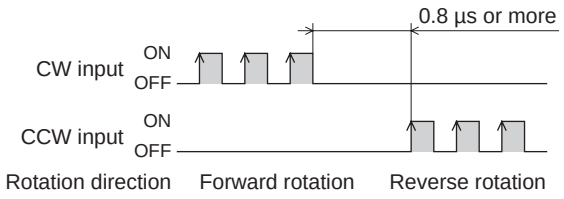
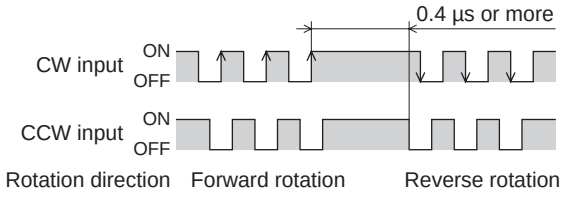
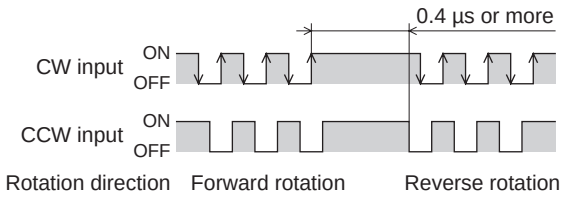
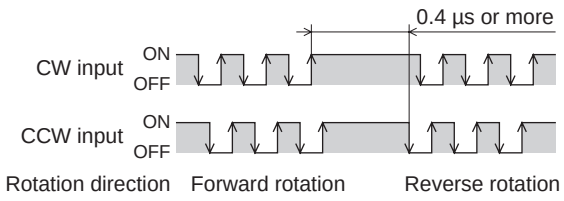
Note

- The new setting of the pulse input mode select switch will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.
- The factory setting of the pulse input mode depends on the destination country.

- Using the parameter

Set a desired mode using the system parameter for pulse input mode [SyS-1-00].

Pulse input mode	Input pattern	Timing chart
1-pulse input mode	Active high	
	Active low	

Pulse input mode	Input pattern	Timing chart
2-pulse input mode	Active high	
	Active low	
Phase difference mode	×1	
	×2	
	×4	

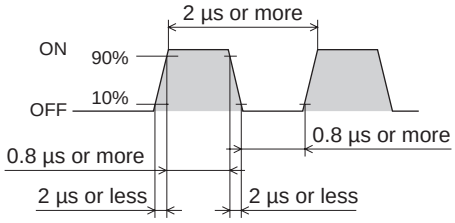
Whether to cause the motor to rotate in CW direction or CCW direction when a forward direction pulse is input can be set using the system parameter for rotation direction [SyS-1-04]. Refer to p.50.

Note When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

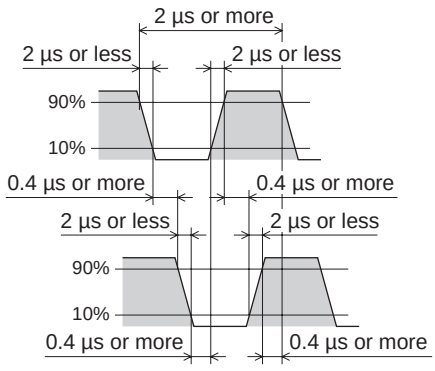
- Pulse signal

Input a pulse with sharp rising and falling edges as shown in the figures. The figure shows the voltage levels of pulse signals.

• 1-pulse input mode, 2-pulse input mode



• Phase difference mode



■ Motor excitation at power ON

When the power is turned on and the C-ON input switched ON, the motor will be excited at the current position. If the system parameter for excite position at first current on [SyS-1-02] is set to "Electrical angle 0°," the motor will be excited at the position corresponding to electrical angle 0° (where the TIM output turns ON).
If the C-ON input is set to normally closed, however, the motor will be excited automatically at the electrical angle 0° position after the power has been turned on.
The C-ON input logic can be set using the application parameter for C-ON input logic [APP-2-02].

Note

- If the parameter for excite position at first current on [SyS-1-02] is set to "Electrical angle 0°", the motor output shaft may move by a maximum of 3.6° when the C-ON input is turned ON.
- When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

■ Automatic return operation

This is a return operation when the motor is in a state of current ON.
If the system parameter for auto return [SyS-1-03] is set to "Enable," the motor can automatically return, when the C-ON input is turned ON or FREE input is turned OFF, to the position where it was stopped.

Note

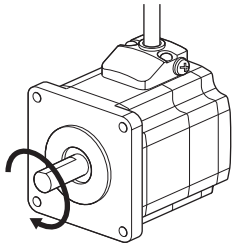
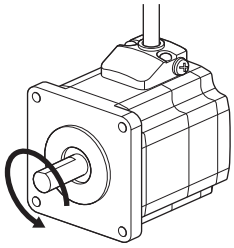
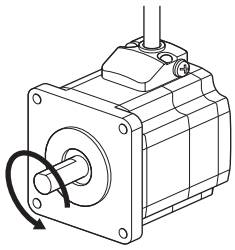
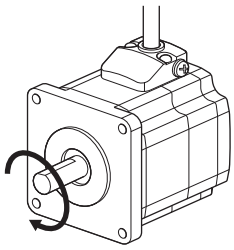
When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

■ Setting the motor rotation direction

Set a desired motor rotation direction using the system parameter for rotation direction [SyS-1-04].

Note

- When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.
- The CW and CCW indicate the rotation direction of the motor, as seen from the output shaft. The output shaft of the **TH** geared typed motors with ratios of 20 and 30, as well as all ratios of the Harmonic geared type motors, rotate in the opposite direction of the motor shaft.

Setting of rotation direction parameter [SyS-1-04]	CW pulse is input	CCW pulse is input
When “+ = CW” is set	• The command position increases. • The motor rotates in CW direction. 	• The command position decreases. • The motor rotates in CCW direction. 
When “+ = CCW” is set	• The command position increases. • The motor rotates in CCW direction. 	• The command position decreases. • The motor rotates in CW direction. 

■ Setting the positioning completion (END) signal offset

The motor stops at the theoretical stopping position as a center point or thereabout. If the motor stops at a position deviated from the theoretical stopping position due to the load, friction, etc., and the deviation band exceeds the specified END signal range, the END output will not turn ON. In this case, use the application parameter for END signal offset [APP-2-04] to compensate the deviation band.

12.2 Operation

■ Push-motion operation

Push-motion operation is a type of operation where pulses are input to pressurize the load continuously.
When selecting a push-motion operation with the application parameter for I/O input mode [APP-2-00], turning the T-MODE input ON and inputting pulses, push-motion operation will start.
Pulses will be continuously input and accumulate even when the load is balanced with the torque.

Note Do not perform push-motion operation with geared type motors. Doing so may cause damage to the motor or gearhead.

- Setting the current for push-motion operation

Set a desired current for push-motion operation using any of the application parameters for push-motion current 0 to 7 (any one of [APP-2-05] to [APP-2-12]). The current value set in the parameter will be used to limit the output torque.
You can select a desired current setting by a combination of ON/OFF statuses of M0 to M2 inputs.
Setting range: 0 to 100%

Push-motion current parameter	Initial value (%)	M2	M1	M0
0 [APP-2-05]	30.0	OFF	OFF	OFF
1 [APP-2-06]	40.0	OFF	OFF	**ON**
2 [APP-2-07]	50.0	OFF	**ON**	OFF
3 [APP-2-08]	60.0	OFF	**ON**	**ON**
4 [APP-2-09]	70.0	**ON**	OFF	OFF
5 [APP-2-10]	80.0	**ON**	OFF	**ON**
6 [APP-2-11]	90.0	**ON**	**ON**	OFF
7 [APP-2-12]	100.0	**ON**	**ON**	**ON**

- Performing the push-motion operation

1. Set the application parameter for I/O input mode [APP-2-00] to “Push-motion operation.”
2. Select a current value using the M0 to M2 inputs.
3. Turn the T-MODE input ON.
4. Input CW or CCW pulses.
   The load is pressurized continuously while the T-MODE input is ON.
   The output torque is limited at the current value selected for the parameter in step 2.
   If the output torque reaches the current value selected for the parameter in step 2, the TLC output will turn ON.
   Refer to p.70 and p.72 for the timing charts.
5. Stop the pulse input.
6. Turn the T-MODE input OFF.

Note
- During push-motion operation, the automatic current cutback function does not operate even when the pulse input is stopped. In other words, the value of push current selected for the parameter is maintained.
- If the load is removed during push-motion operation, the motor will move at high speed the number accumulated pulses.
- Since pulses are input continuously during push-motion operation, a prolonged push condition may generate an excessive position deviation alarm. If the push condition continues for a prolonged period, stop the pulse input. Whether or not the motor is pushing the load can be determined using the TLC output.

■ Test operation

Test operation is performed using the data setter **OPX-2A** or the data setting software **MEXE02**.
Conduct test operation (JOG operation) to check the levels of vibration and noise or to check how operations are performed in a push-motion operation and/or a return to electrical home operation.
Set the required conditions for JOG operation using the following parameters:
- Operating speed of JOG operation [APP-7-00]
- Acceleration and deceleration rate of JOG operation [APP-7-01]
- Starting speed of JOG operation [APP-7-02]

Note JOG operation is performed only while each applicable operation button is pressed on the **OPX-2A** or clicked in **MEXE02**. External signals cannot be used to start/stop the motor.

■ Return to electrical home operation

When the RETURN input is turned ON, the motor will start a return to electrical home operation.
The electrical home (position) refers to the motor position effective when the driver power is turned on, or the position when the P-RESET input is turned ON.
Set the required conditions for return to electrical home operation using the following parameters:

- Operating speed of return operation [APP-6-00]
- Acceleration and deceleration rate of return operation [APP-6-01]
- Starting speed of return operation [APP-6-02]

Refer to p.74 for the timing chart.

Note

- Pulses are not counted during return to electrical home operation.
- If the CS input is turned ON when the application parameter for abnormal operation data warning [APP-5-00] is set to “Enable,” a return to electrical home operation will be disabled and an abnormal operation data warning will generate. If a return to electrical home operation is to be performed after the CS input is turned ON, turn the P-RESET input ON to confirm the electrical home position and then turn the RETURN input ON.
- Turning the P-RESET input ON while a return to electrical home operation is still in progress will set the applicable position as the electrical home, and the motor will stop.

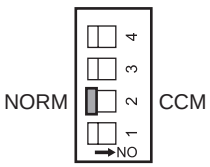
12.3 Adjustment

You can adjust the operating current, motor operation at start/stop, and compliance with the command.
The items that can be adjusted vary between the normal mode and the current control mode.

Item	Description	Normal mode	Current control mode
Operating current	Adjust the current during operation.	Can be adjusted	Can be adjusted
Standstill current	Adjust the current at standstill.		Can not be adjusted
Speed filter	Apply a filter to input pulses to make the pulses smooth.		Can be adjusted
Smooth drive	Insert interpolation pulses between input pulses.		
Speed error gain	Suppress vibration while the motor is accelerating/decelerating.		Can not be adjusted
Position loop gain Speed loop gain Speed integral time constant	Vibration that generates while the motor is accelerating/decelerating or at standstill can be adjusted to an optimal level.	Can not be adjusted	Can be adjusted
Anti-vibration control	Enclosure vibration that occurs with an equipment of low rigidity can be adjusted to an optimal level.		

■ Control mode

The driver operates in one of two control modes: the normal mode, and the current control mode. The desired mode can be set using the control mode select switch (NORM/CCM).
If noise is heard during high-speed operation or there is notable vibration, it may be effective to switch to the current control mode.
Note, however, that a slight delay may occur in the current control mode, compared to the normal mode, depending on the condition of the load.
Keep the driver in the normal mode during normal conditions of use.
NORM: Normal mode
CCM: Current control mode

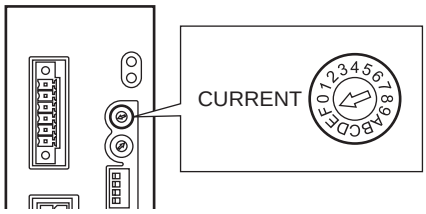


Note

- The new setting of the control mode select switch will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.
- In the normal mode, the CCM input becomes effective.

■ Operating current

Set a desired operating current using the current setting switch (CURRENT).
The operating current to be set is the maximum output current multiplied by the operating current rate (%) set to each dial setting of the current setting switch, where "F" corresponds to 100%.
One of 16 operating current levels from 0 to F can be set. If the load is small and there is an ample allowance for torque, you can suppress rise in motor temperature by setting a lower operating current.



Note If the operating current is too low, starting of the motor and its position hold function may be affected. Do not lower the operating current more than necessary.

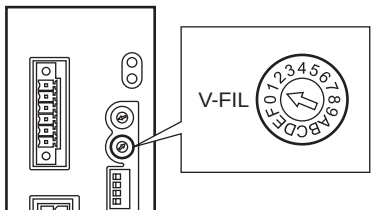
You can change the value assigned to each dial setting of the current setting switch, by using a corresponding application parameter for operating current at CURRENT (one of [APP-0-00] to [APP-0-15]).

■ Standstill current

When the motor stops, the current cutback function will be actuated to lower the motor current to the standstill current. The standstill current is calculated by multiplying the operating current (100%) by the ratio of standstill current. Even when the operating current changes, the standstill current will be calculated as a percentage of the operating current (deemed to be 100%). Set a desired standstill current using the application parameter for standstill current [APP-3-00].
The initial value is 50%.

■ Speed filter

You can use the speed filter setting switch (V-FIL) to adjust how the motor responds to input pulses.
One of 16 speed filter levels from 0 to F can be set.
When the speed filter level is raised, vibration can be suppressed during low-speed operation, and starting/stopping of the motor will become smooth.
Note, however, that an excessively high filter level will result in lower synchronicity with commands. Set an appropriate value according to the specific load and purpose.



You can change the value assigned to each dial setting of the speed filter setting switch, by using a corresponding application parameter for speed filter at V-FIL (one of [APP-1-00] to [APP-1-15]).

■ Smooth drive

When the smooth drive function is used, the driver automatically implements microstep control over input pulses. This helps suppress motor vibration.
If the smooth drive function is not used, vibration may increase in the low-speed range although starting characteristics will improve.
Set whether or not to use the smooth drive using the system parameter for smooth drive [SyS-1-01].

Note When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

■ Speed error gain

The speed error gain is used to suppress vibration while the motor is operating or accelerating/ decelerating.
Set the required conditions using the following application parameters:

- Speed error gain 1 [APP-3-01]..... Adjusts vibration during operation.
- Speed error gain 2 [APP-3-02]..... Adjusts vibration during acceleration/deceleration.

Note The initial values reflect results of adjustment. Do not change the initial values in normal conditions of use.

■ Position loop gain, speed loop gain, speed loop integral time constant

These items are effective in the current control mode.
Vibration that occurs while the motor is accelerating/decelerating or at standstill can be adjusted to an optimal value. (The optimal value varies depending on the equipment and operating conditions.)
Set the required conditions using the following application parameters:

- Position loop gain [APP-4-00]..... Adjusts the compliance with respect to position deviation. When this value is increased, the deviation between the command position and actual position will decrease. However, an excessively high value may increase the motor overshoot or cause hunting.
- Speed loop gain [APP-4-01]..... Adjusts the compliance with respect to speed deviation. When this value is increased, the deviation between the command speed and actual speed will decrease. However, an excessively high value may increase the motor overshoot or cause hunting.
- Speed loop integral time constant [APP-4-02]..... Decreases the deviation that cannot be adjusted with the speed loop gain. An excessively high value will slow the motor movement. An excessively low value, on the other hand, may cause hunting.

■ Anti-vibration control

This item is effective in the current control mode.
Even when the motor is assembled into a machine of low rigidity, residual vibration can be suppressed during positioning, in order to shorten the positioning time. (The optimal value varies depending on the equipment and operating conditions.)
Set the required conditions using the following application parameters:

- Anti-vibration control [APP-4-03]..... Sets whether or not to enable anti-vibration control.
- Frequency of anti-vibration control [APP-4-04]..... Set the frequency of anti-vibration control.

13 Inspection

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

■ During inspection

- Are any of the motor mounting screws loose?
- Check for any unusual noises in the motor bearings (ball bearings) or other moving parts.
- Are the motor output shaft and load shaft out of alignment?
- Are there any scratches, signs of stress or loose driver connections in the motor lead wires?
- Check for a blocked opening of the driver case.
- Are any of the driver mounting screws or power connection terminal screws loose?
- Are there any strange smells or appearances within the driver?

Note The driver uses semiconductor elements. Handle the driver with care since static electricity may damage semiconductor elements.

14 General specifications

		Motor	Driver
Degree of protection		IP54* (IP20 for the double-shaft type)	IP20
Operation environment	Ambient temperature	−10 to +50 °C (+14 to +122 °F) (non-freezing) Harmonic geared type: 0 to +40 °C (+32 to +104 °F) (non-freezing)	0 to +50 °C (+32 to +122 °F) (non-freezing)
	Humidity	85% or less (non-condensing)	
	Altitude	Up to 1000 m (3300 ft.) above sea level	
	Surrounding atmosphere	No corrosive gas, dust, water or oil	
Storage environment	Ambient temperature	−20 to +60 °C (−4 to +140 °F) (non-freezing)	
	Humidity	85% or less (non-condensing)	
	Altitude	Up to 3000 m (10000 ft.) above sea level	
	Surrounding atmosphere	No corrosive gas, dust, water or oil	
Shipping environment	Ambient temperature	−20 to +60 °C (−4 to +140 °F) (non-freezing)	
	Humidity	85% or less (non-condensing)	
	Altitude	Up to 3000 m (10000 ft.) above sea level	
	Surrounding atmosphere	No corrosive gas, dust, water or oil	
Insulation resistance		100 MΩ or more when 500 VDC megger is applied between the following places: Case - Motor and sensor windings Case - Electromagnetic brake windings	100 MΩ or more when 500 VDC megger is applied between the following places: Protective Earth Terminal - Power supply terminals Signal I/O terminals - Power supply terminals
Dielectric strength		Sufficient to withstand 1.5 kVAC at 50/60 Hz applied between the following places for 1 minute: Case - Motor and sensor windings Case - Electromagnetic brake windings	Sufficient to withstand the following for 1 minute. Protective Earth Terminal - Power supply terminals: 1.5 kVAC 50/60 Hz Signal I/O terminals - Power supply terminals : 1.8 kVAC 50/60 Hz

* Excluding the mounting surface and connectors.

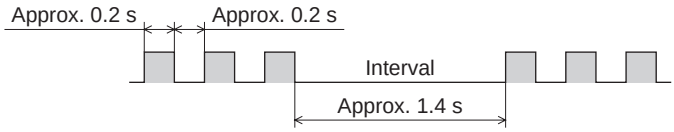
15 Alarms and warnings

The driver provides alarms that are designed to protect the driver from overheating, poor connection, error in operation, etc. (protective functions), as well as warnings that are output before the corresponding alarms generate (warning functions).

15.1 Alarms

When an alarm generates, the ALM output will turn OFF and the motor will stop. (The motor will continue to operate after generating the abnormal operation data alarm, because abnormal operation data alarm does not cut off the motor current.)
When the application parameter for AL0-2 signal output [APP-2-01] is set to "Enable", the READY output, TLC output and TIM2 output will automatically switch to the AL0 output, AL1 output and AL2 output, respectively.
When an alarm generates, the ALARM LED will blink. The present alarm can be checked by counting the number of times the ALARM LED blinks, or using the **OPX-2A** or **MEXE02**.

Example: Overvoltage alarm (number of blinks: 3)



■ Alarm reset

Perform one of the reset operations specified below. Before resetting an alarm, always remove the cause of the alarm and ensure safety. Refer to p.71 for the timing chart.

- Turn the ALM-RST input to ON and then OFF. (The alarm will be reset at the OFF edge of the input.)
- Perform an alarm reset using the **OPX-2A** or **MEXE02**.
- Cycle the power.

Note Some alarms cannot be reset with the ALM-RST input, **OPX-2A** or **MEXE02**. Check the following table to identify which alarms meet this condition. To reset these alarms, you must cycle the power. If a 24 VDC power supply is connected, also cycle the 24 VDC power supply.

■ Descriptions of alarms

See p.84 for more information about the alarm parameters.

Alarm type	Number of times the ALARM LED blinks	Alarm code output			Alarm code	Motor operation upon alarm*	Reset using the ALM-RST input/ **OPX-2A/MEXE02**
		AL2	AL1	AL0			
Overheat protection	2	OFF	ON	OFF	21	×	Possible
Overload					30		
Overspeed					31		
Command pulse error					34		
Regeneration unit overheat					51		Not possible
Overvoltage protection	3	OFF	ON	ON	22		
Main power supply error					23		Possible
Undervoltage					25		
Overflow rotation during current on	4	ON	OFF	OFF	10		
Overflow rotation during current off					12		
Overcurrent protection	5	ON	OFF	ON	20		Not possible
Drive circuit error					2D		
Abnormal operation data	7	ON	ON	ON	70	○	Possible
Electronic gear setting error					71	×	Not possible

* The symbols in the "Motor operation upon alarm" field are explained below.
×: When an alarm generates, the motor current will be cut off and the motor will lose its holding torque. In the case of an electromagnetic brake motor, the motor will become unexcited and the electromagnetic brake will hold the load automatically.
○: Even when an alarm generates, the motor current will not be cut off and the motor position will be held.

Cause	Action
The internal temperature of the driver exceeded 85 °C (185 °F).	Review the ventilation condition in the enclosure.
The cumulative value of applied loads exceeding the maximum torque reached or exceeded the value set in the overload parameter [APP-5-03].	• Reduce the load or increase the acceleration/deceleration rate. • If the driver is in the current control mode, increase the current limit value. • Check if the electromagnetic brake is released during operation.
The speed of the motor output shaft exceeded 4500 r/min (excluding geared motors).	• Check the electronic gear setting and reduce the speed of the motor output shaft to 4500 r/min or less. • If the motor is overshooting at the time of acceleration, increase the acceleration/deceleration rate.
The command pulse frequency exceeded the specified value.	• Set the command pulse to 500 kHz or less. • Check the electronic gear setting and reduce the speed of the motor output shaft to 4500 r/min or less.
• The regeneration unit is not connected correctly. • The regeneration unit is overheating.	• If no regeneration unit is used, short the TH1 and TH2 terminals of CN1. • Connect the regeneration unit correctly. • The regenerative power of the regeneration unit exceeds the allowable level. Review the load condition and operating conditions.
• 200-230 VAC was applied to a product specified for 100-115 VAC. • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit.	• Check the input voltage of the main power supply. • If this alarm generates during operation, reduce the load or increase the acceleration/deceleration rate. • Connect the accessory regeneration unit **RGB100** (sold separately).
The motor was started when the main power was cut off.	Check if the main power is input properly.
The main power was cut off momentarily or the voltage became low.	Check the input voltage of the main power supply.
• When the current was turned on, the deviation between the command position and actual position at the motor output shaft exceeded the value set in the parameter for overflow rotation during current on [APP-5-01]. • The load is large or acceleration/deceleration rate is too short.	• Reduce the load, or increase the acceleration/deceleration rate. • If the driver is in the current control mode, increase the current limit value.
The C-ON input was turned ON while an overflow rotation during current off warning was present.	• Do not turn the C-ON input ON while an overflow rotation during current off warning is present. • Set the auto return parameter [SyS-1-03] to “Disable.”
The motor, cable or driver output circuit was shorted.	Turn off the power and check the motor, cable and driver output circuit for shorting, and then cycle the power.
The motor cable was disconnected.	Turn off the power and check the connection between the motor cable and driver, and then cycle the power.
Return to electrical home operation was performed while an abnormal operation data warning was present.	Do not perform return to electrical home operation while an abnormal operation data warning is present.
The power was turned on when the resolution set by the electronic gear was outside the specified range.	Set the electronic gear correctly, and then turn the power back on.

Alarm type	Number of times the ALARM LED blinks	Alarm code output			Alarm code	Motor operation upon alarm*	Reset using the ALM-RST input/ **OPX-2A/MEXE02**
		AL2	AL1	AL0			
Sensor error during operation	8	OFF	OFF	OFF	28	×	Not possible
Initial sensor error					42		
Initial rotor rotation error					43		
Motor combination error					45		
EEPROM error	9	OFF	OFF	ON	41		

* The symbols in the "Motor operation upon alarm" field are explained below.
  ×: When an alarm generates, the motor current will be cut off and the motor will lose its holding torque. In the case of an electromagnetic brake motor, the motor will become unexcited and the electromagnetic brake will hold the load automatically.
  ○: Even when an alarm generates, the motor current will not be cut off and the motor position will be held.

Cause	Action
A sensor error occurred while the motor was operating.	Turn off the power and check the connection between the motor cable and driver, and then cycle the power.
A sensor error occurred when the power was turned on.	
The motor output shaft rotated at a speed of 15 r/min or more while the initialization was still in progress following a power on.	Adjust the load and make sure the motor output shaft does not turn due to an external force when the power is turned on.
A motor not supported by the driver is connected.	Check the driver model and motor model, and use the driver and motor in the correct combination.
Data stored in the driver was damaged.	Initialize the parameters using the **OPX-2A** or **MEXE02**.

15.2 Warnings

When a warning generates, the WNG output will turn ON. The motor will continue to operate.
Once the cause of the warning is removed, the WNG output will turn OFF automatically.
Present warnings can be checked using the **OPX-2A** or **MEXE02**.
You can also check the records of up to ten most recent warnings starting from the latest one, or clear the warning records.

Note You can also clear the warning records by turning off the driver power.

■ Descriptions of warnings

See p.84 for more information about the warning parameters.

Warning type	Warning code	Cause	Action
Overflow rotation during current on	10	• When the current was turned on, the deviation between the command position and actual position at the motor output shaft exceeded the value set in the parameter for overflow rotation during current on [APP-5-04]. • The load is large or acceleration/ deceleration rate is too short.	• Reduce the load or increase the acceleration/deceleration rate. • If a torque limit is set using an extended function, increase the setting.
Overflow rotation during current off	12	When the current was turned off, the deviation between the command position and actual position to motor output shaft exceeded the value set in the parameter for overflow rotation during current off [APP-5-02]. (This warning is output when the parameter for auto return [SyS-1-03] is set to “Enable.”)	• Reduce the amount of rotation at current off to the specified setting or less. Or, change the setting. • Turn the CLR input ON to clear the position deviation.
Overheat	21	The internal temperature of the driver exceeded the value set in the overheat warning parameter [APP-5-07].	Review the ventilation condition in the enclosure.
Overvoltage	22	• The voltage of the main power supply exceeded the value set in the overvoltage warning parameter [APP-5-05]. • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit.	• Check the input voltage of the main power supply. • If this warning generates during operation, reduce the load or increase the acceleration/deceleration rate. • Connect the accessory regeneration unit **RGB100** (sold separately).
Main power supply error	23	The C-ON input was turned ON when the main power was cut off.	• Do not turn the C-ON input ON while the main power is cut off. • Check the C-ON input logic.
Undervoltage	25	• The DC voltage of the main power supply became lower than the value set in the undervoltage warning parameter [APP-5-06]. • The main power was cut off momentarily or the voltage became low.	Check the input voltage of the main power supply.
Overload	30	• A load exceeding the maximum torque was applied for the time set in the overload warning parameter [APP-5-08] or longer. • The load is large or acceleration/ deceleration rate is too short.	• Reduce the load or increase the acceleration/deceleration rate. • If the driver is in the current control mode, increase the current limit value. • Check if the electromagnetic brake is released during operation.
Overspeed	31	The detected motor speed exceeded the value set in the overspeed warning parameter [APP-5-09].	• Check the electronic gear setting and reduce the speed of the motor output shaft to the value set in the parameter or less. • If the motor is overshooting at the time of acceleration, increase the acceleration/ deceleration rate.

Warning type	Warning code	Cause	Action
Abnormal operation data	70	The CS input was changed when the current was on.	Do not change the CS input when the current is on.
		The traveled distance from the electrical home exceeded the control range (2,147,483,648 pulses). (This alarm generates when the application parameter for abnormal operation data warning [APP-5-00] is set to “Enable.”)	Turn the P-RESET input ON and set the electrical home, again.
Electronic gear setting error	71	The resolution set by the electronic gear is outside the specified range.	Set the electronic gear correctly.

16 Troubleshooting and remedial actions

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

Phenomenon	Possible cause	Remedial action
• The motor is not excited. • The motor can be moved by hand.	The C-ON input is turned OFF.	• Turn the C-ON input ON and confirm that the motor will be excited. • Check the setting of the application parameter for C-ON input logic [APP-2-02].
	The FREE input is turned ON.	Turn the FREE input OFF.
The motor does not operate.	The CLR input is turned ON.	Turn the CLR input OFF.
	The CW input or CCW input is not connected properly.	• Check the connection between the controller and driver. • Check the pulse signal specifications (voltage, width).
	The CW input and CCW input are turned ON simultaneously in the 2-pulse input mode.	Each pulse signal input should specify either the CW input or CCW input, but not both. Make sure the terminal not receiving the signal input remains OFF.
	The pulse signal is connected to DIR input in the 1-pulse input mode.	Connect the pulse signal to the PLS input.
	An electromagnetic brake motor is used and the electromagnetic brake is not released.	Check the connection between the electromagnetic brake and driver.
The motor rotates in the direction opposite to the specified direction.	The CW input and CCW input are connected in reverse in the 2-pulse input mode.	Connect CW pulse signals via the CW input, and connect CCW pulse signals via the CCW input.
	The DIR input is set in reverse in the 1-pulse input mode.	Turn the DIR input ON to cause the motor to rotate in CW direction, and turn the input OFF to cause the motor to rotate in CCW direction.
	The system parameter for rotation direction [SyS-1-04] is set wrong.	Check the setting of the rotation direction parameter [SyS-1-04].
The gear output shaft rotates in the direction opposite to the motor.	A gear that rotates in the direction opposite to the motor shaft is used.	• With **TH** geared motors, the gear rotates in the direction opposite to the motor when the gear ratio is 20 or 30. • With Harmonic geared motors, the gear always rotates in the direction opposite to the motor.
Motor operation is unstable.	Pulse signals are not connected properly.	• Check the connection between the controller and driver. • Check the pulse signal specifications (voltage, width).
Notable vibration occurs.	The load is small.	Lower the current using the current setting switch. If the motor output torque is too large relative to the load, vibration will increase.
The electromagnetic brake does not hold the load.	The power is input to the electromagnetic brake.	Check the connection between the electromagnetic brake and driver.
	The FREE input is turned ON.	Turn the FREE input OFF.
The electromagnetic brake is not released.	The power is not supplied to the electromagnetic brake.	Check the connection between the electromagnetic brake and driver.
The TIM output does not turn ON.	The CS input was turned OFF while the motor was operating.	The TIM output may not turn ON if the CS input is switched from ON to OFF.

Note I/O signals can be monitored using the **OPX-2A** or **MEXE02**. Use these options to check the wiring conditions of I/O signals.

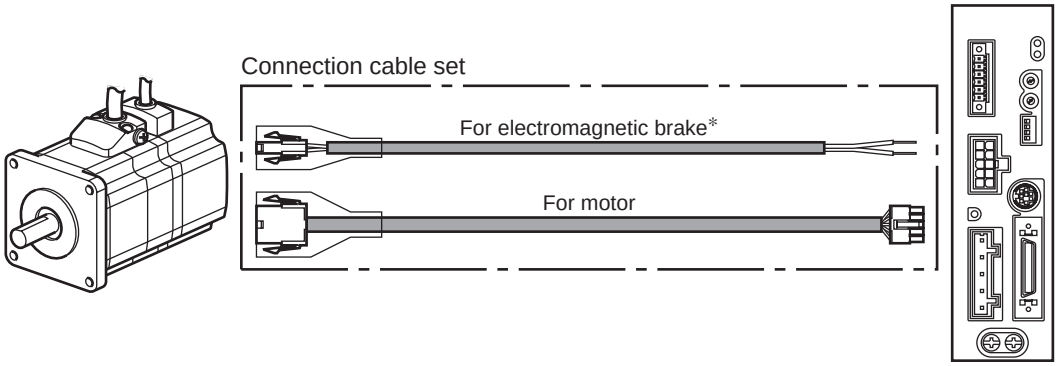
17 Accessories (sold separately)

■ Motor connection cable

The cable supplied with the **AR** Series is all you need to connect the motor and driver.
Take note, however, that if you wish to connect the motor and driver over a distance of 3 m (9.8 ft.) or more, the supplied cable is not long enough and you must use a connection cable set or extension cable set.
A cable set for the electromagnetic brake motor consists of a motor cable and an electromagnetic brake cable.
When installing the motor on a moving part, use a flexible cable offering excellent flexibility.

- Extending the wiring length using a connection cable set

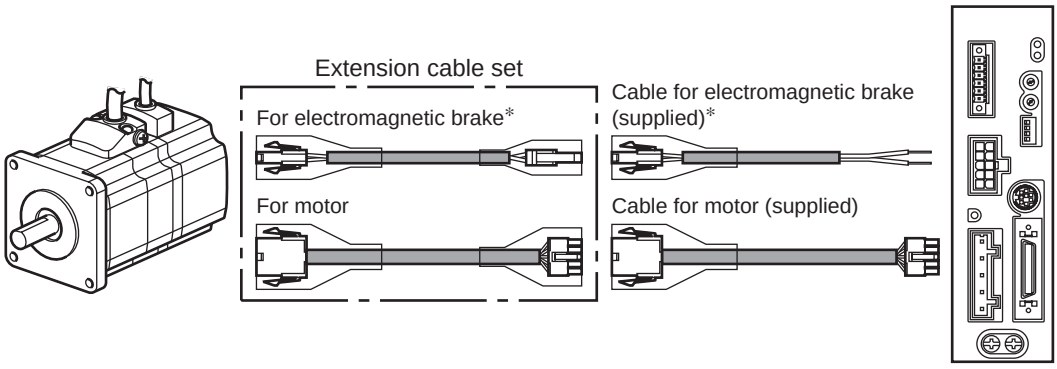
Do not use the supplied cable.



* Only when the motor is of electromagnetic brake type.

- Extending the wiring length using an extension cable set

Connect an extension cable to the supplied cable.



* Only when the motor is of electromagnetic brake type.

Note When extending the wiring length by connecting an extension cable to the supplied cable, keep the total cable length to 30 m (98.4 ft.) or less.

- Connection cable set

See p.67 for connector pin assignments of the cable.

• For motor

Model	Length [m (ft.)]
CC050VAF	5 (16.4)
CC070VAF	7 (23)
CC100VAF	10 (32.8)
CC150VAF	15 (49.2)
CC200VAF	20 (65.6)
CC300VAF	30 (98.4)

• For electromagnetic brake

Model	Length [m (ft.)]
CC050VAFB	5 (16.4)
CC070VAFB	7 (23)
CC100VAFB	10 (32.8)
CC150VAFB	15 (49.2)
CC200VAFB	20 (65.6)
CC300VAFB	30 (98.4)

- Flexible connection cable set

• For motor

Model	Length [m (ft.)]
CC010VAR	1 (3.3)
CC020VAR	2 (6.6)
CC030VAR	3 (9.8)
CC050VAR	5 (16.4)
CC070VAR	7 (23)
CC100VAR	10 (32.8)
CC150VAR	15 (49.2)
CC200VAR	20 (65.6)
CC300VAR	30 (98.4)

• For electromagnetic brake

Model	Length [m (ft.)]
CC010VARB	1 (3.3)
CC020VARB	2 (6.6)
CC030VARB	3 (9.8)
CC050VARB	5 (16.4)
CC070VARB	7 (23)
CC100VARB	10 (32.8)
CC150VARB	15 (49.2)
CC200VARB	20 (65.6)
CC300VARB	30 (98.4)

- Extension cable set

• For motor

Model	Length [m (ft.)]
CC010VAFT	1 (3.3)
CC020VAFT	2 (6.6)
CC030VAFT	3 (9.8)
CC050VAFT	5 (16.4)
CC070VAFT	7 (23)
CC100VAFT	10 (32.8)
CC150VAFT	15 (49.2)
CC200VAFT	20 (65.6)

• For electromagnetic brake

Model	Length [m (ft.)]
CC010VAFBT	1 (3.3)
CC020VAFBT	2 (6.6)
CC030VAFBT	3 (9.8)
CC050VAFBT	5 (16.4)
CC070VAFBT	7 (23)
CC100VAFBT	10 (32.8)
CC150VAFBT	15 (49.2)
CC200VAFBT	20 (65.6)

- Flexible extension cable set

• For motor

Model	Length [m (ft.)]
CC010VART	1 (3.3)
CC020VART	2 (6.6)
CC030VART	3 (9.8)
CC050VART	5 (16.4)
CC070VART	7 (23)
CC100VART	10 (32.8)
CC150VART	15 (49.2)
CC200VART	20 (65.6)

• For electromagnetic brake

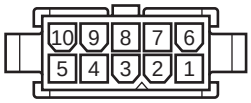
Model	Length [m (ft.)]
CC010VARBT	1 (3.3)
CC020VARBT	2 (6.6)
CC030VARBT	3 (9.8)
CC050VARBT	5 (16.4)
CC070VARBT	7 (23)
CC100VARBT	10 (32.8)
CC150VARBT	15 (49.2)
CC200VARBT	20 (65.6)

- Connector pin assignments

• Pin assignment of "cable for motor"

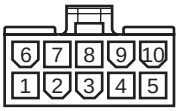
Pin No.	Color	Lead size
1	White	AWG26 (0.14 mm^2)
2	Purple	
3	Red	AWG22 (0.3 mm^2)
4	Blue	
5	Green	
6	Black	AWG26 (0.14 mm^2)
7	Brown	
8	Gray	AWG22 (0.3 mm^2)
9	Orange	
10	Drain wire	AWG26 (0.14 mm^2)

• Motor side



Model: 5559-10P-210 (Molex)

• Driver side

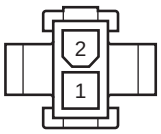


Model: 5557-10R-210 (Molex)

• Pin assignment of "cable for electromagnetic brake"

Pin No.	Color	Lead size
1	White	AWG20 (0.5 mm^2)*
2	Black	

* AWG21 (0.5 mm^2) for flexible cable



Model 5559-02P-210 (Molex)

■ Data setter

The data setter lets you set parameters for your **AR** Series with ease and also functions as a monitor.

Model: **OPX-2A**

■ Data setting software

The data setting software lets you set parameters for your **AR** Series and monitor its operating condition using a PC. The software comes with a PC interface cable [5 m (16.4 ft.)]. The cable is connected to the USB port on the PC.

Model: **MEXE02**

■ Regeneration unit

Connect the regeneration unit if gravitational operation or other operations involving up/down movement, or sudden starting/stopping of a large inertial load, will be repeated frequently. Always connect the regeneration unit if an overvoltage protection warning or alarm generates.

Model: **RGB100**

■ Driver cable

A shielded cable for driver I/O signals (36 pins) offering excellent noise resistance.

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

■ Connector-terminal block conversion unit

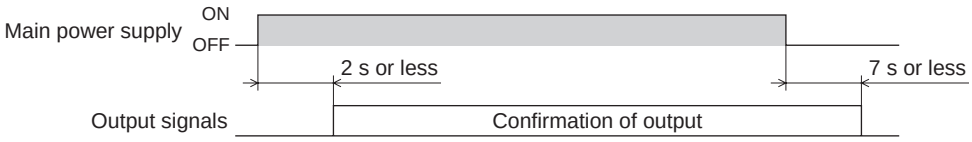
Use this cable to connect the driver to a host controller via the terminal block. [Cable length: 1 m (3.3 ft.)]

Model: **CC36T1**

18 Reference

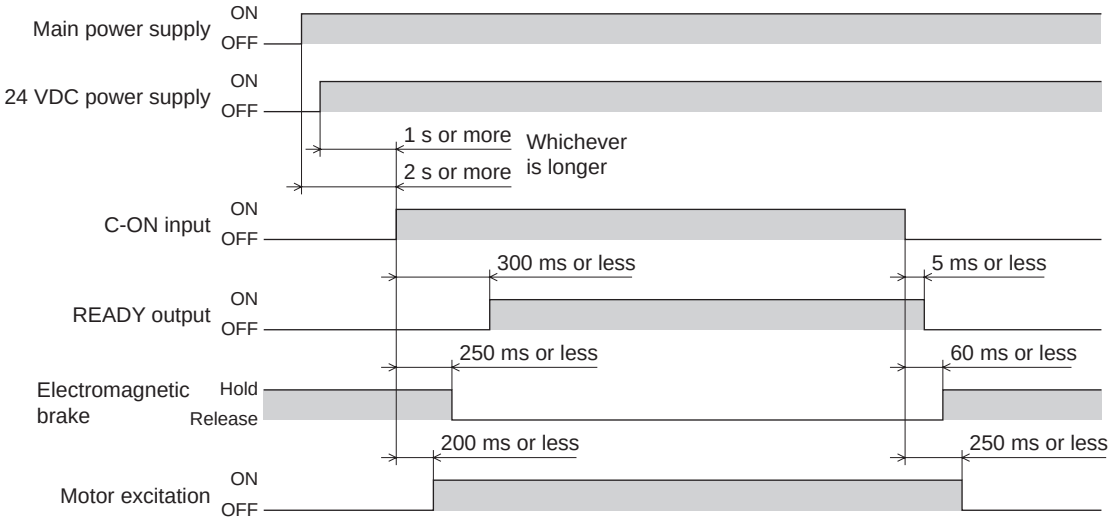
18.1 Timing charts

■ Power input



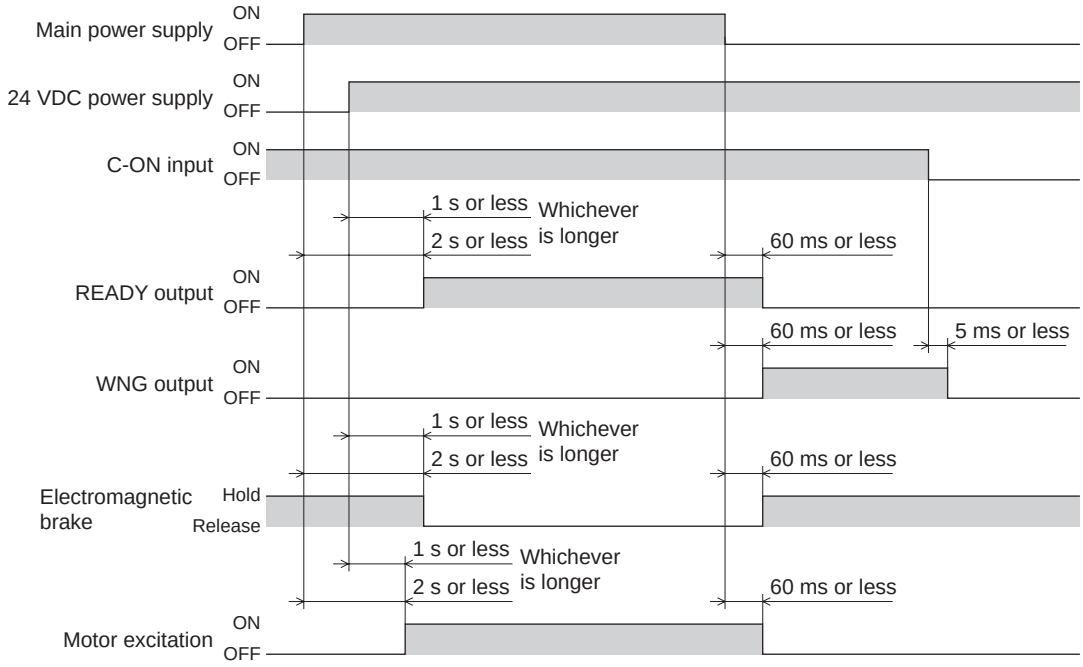
■ C-ON input

- The C-ON input is turned ON after turning on the power



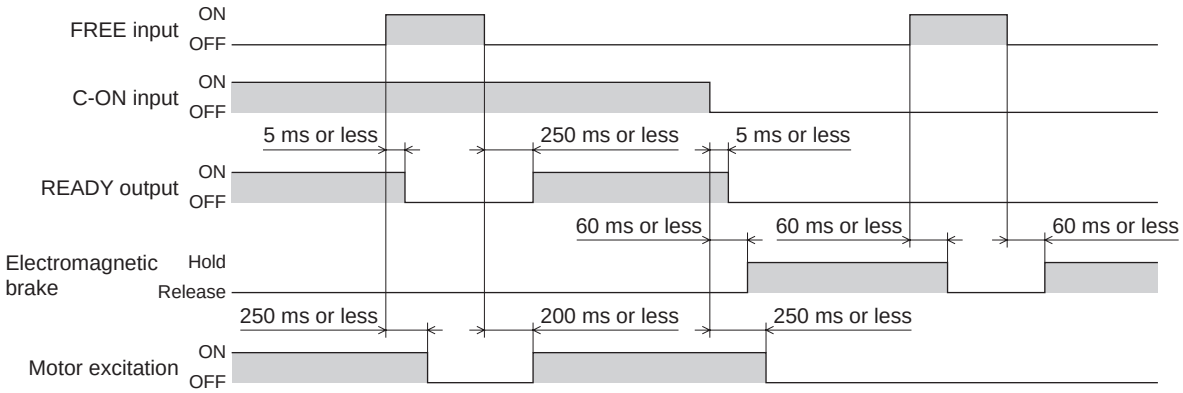
- If 24 VDC power is not input, the electromagnetic brake does not operate.
- When the C-ON input is OFF, motor excitation will turn off after the electromagnetic brake is actuated.

- The power is turned on after turning the C-ON input ON, or the main power is cut off.

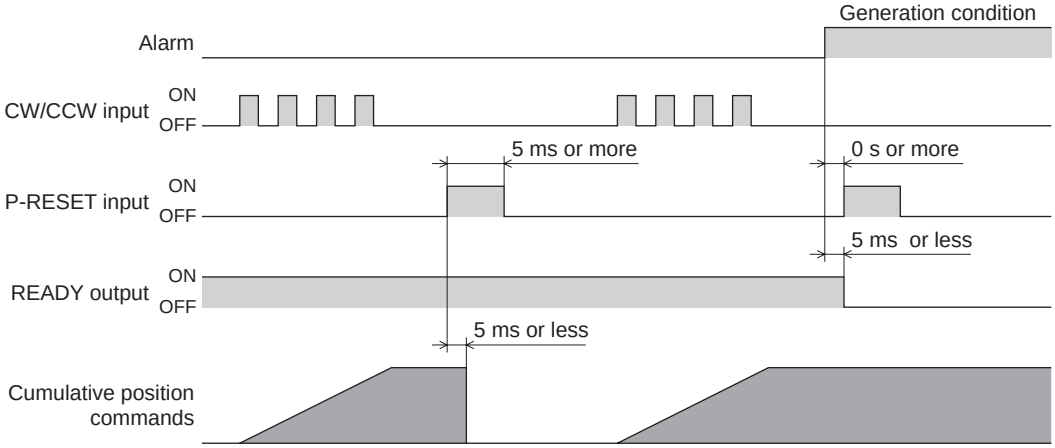


- If the main power is cut off, electromagnetic brake operation and motor excitation will turn off simultaneously.

■ FREE input

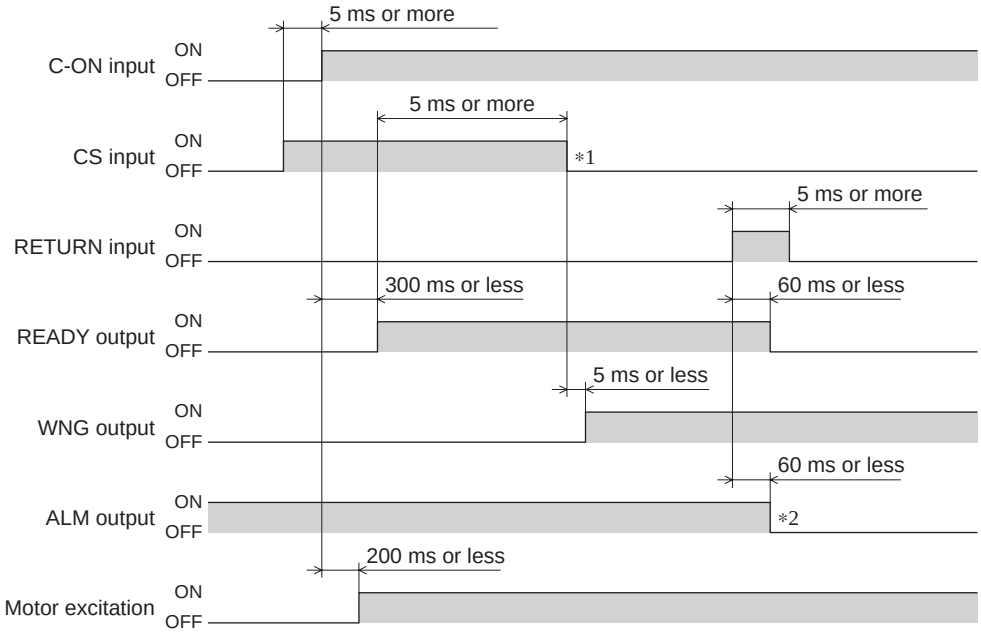


■ P-RESET input



- When the P-RESET input is turned ON, the cumulative value of position commands will be reset to "0" and the current position will be set as the electrical home.
- If an alarm generates, the P-RESET input will become invalid.
- Input the P-RESET signal while the motor is at standstill.

■ CS input

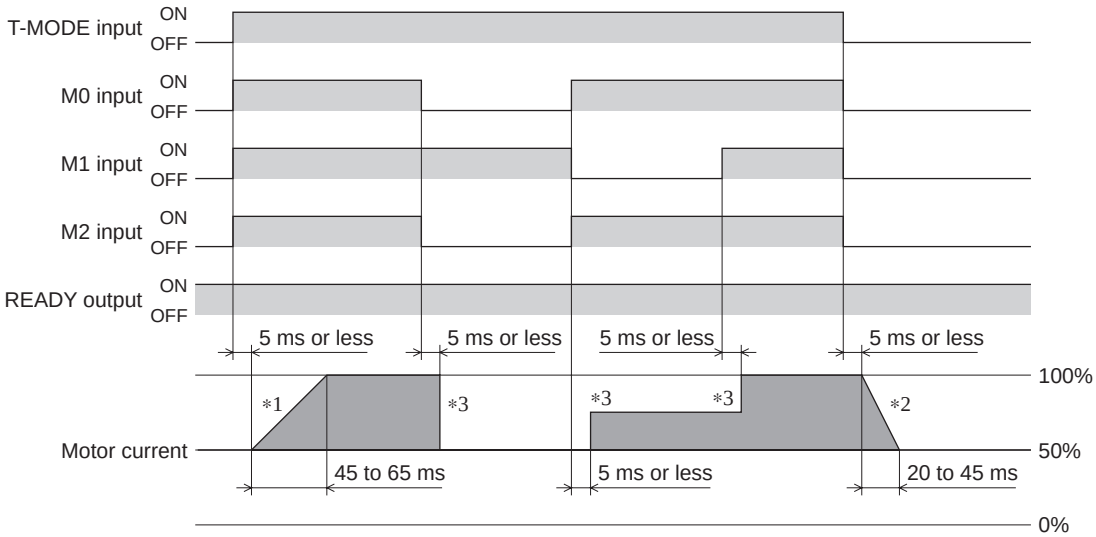


∗1 If the CS input is changed while the C-ON input is ON, an operation data error warning will generate.
∗2 If a return to electrical home operation is performed while an operation data error warning is present, an operation data error alarm will generate. Note that the motor will remain excited.

- This timing chart assumes that the application parameter for abnormal operation data warning [APP-5-00] is set to "Enable." If this parameter is set to "Disable," no warning will be output and an alarm will generate right away.
- Change the CS input when the current is turned off.

■ T-MODE input, M0 to M2 input

The motor current waveform in the above chart assumes that the standstill current is set to 50% while the push current is set to 100%.

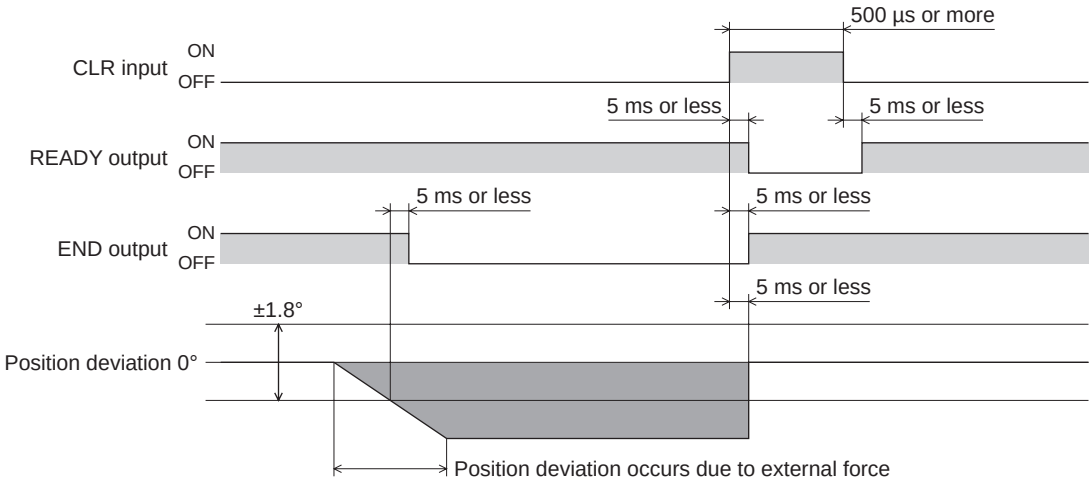


∗1 When the T-MODE is ON, the motor current rises to the push current at a rate of approx. 0.9% per millisecond.
∗2 When the T-MODE is OFF, the motor current drops to the push current at a rate of approx. 1.8% per millisecond.
∗3 When the value of push current is changed using the M0 to M2 inputs, the change is reflected immediately.

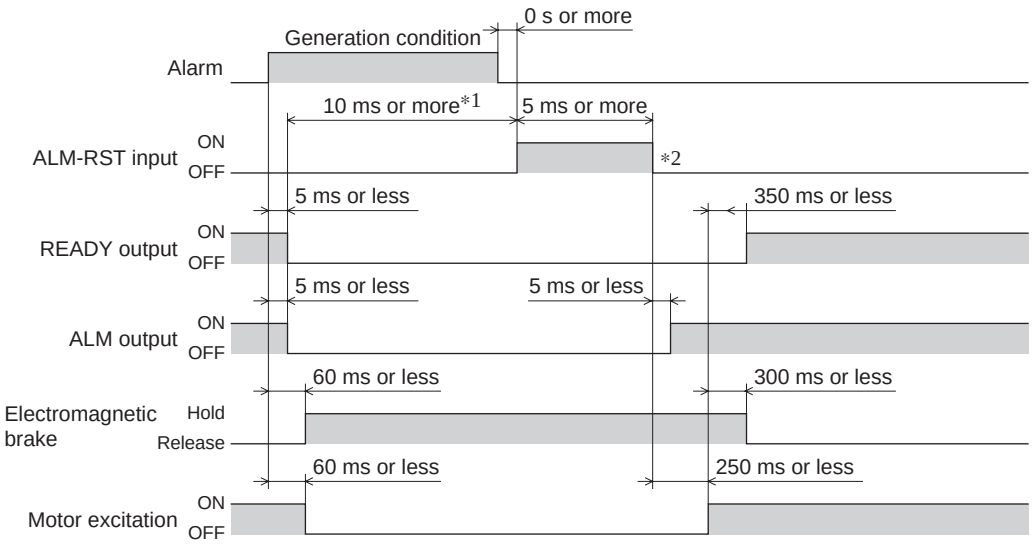
- When the T-MODE input is turned ON, the value of push current set by the M0 to M2 inputs will become effective and the overload protection alarm will become invalid.
- Input the T-MODE signal while the motor is at standstill.
- The combinations of M0 to M2 inputs and corresponding initial values of push-current percentage are shown below.

M2	M1	M0	Initial value (%)
OFF	OFF	OFF	30.0
OFF	OFF	**ON**	40.0
OFF	**ON**	OFF	50.0
OFF	**ON**	**ON**	60.0
ON	OFF	OFF	70.0
ON	OFF	**ON**	80.0
ON	**ON**	OFF	90.0
ON	**ON**	**ON**	100.0

■ CLR input



■ ALM-RST input

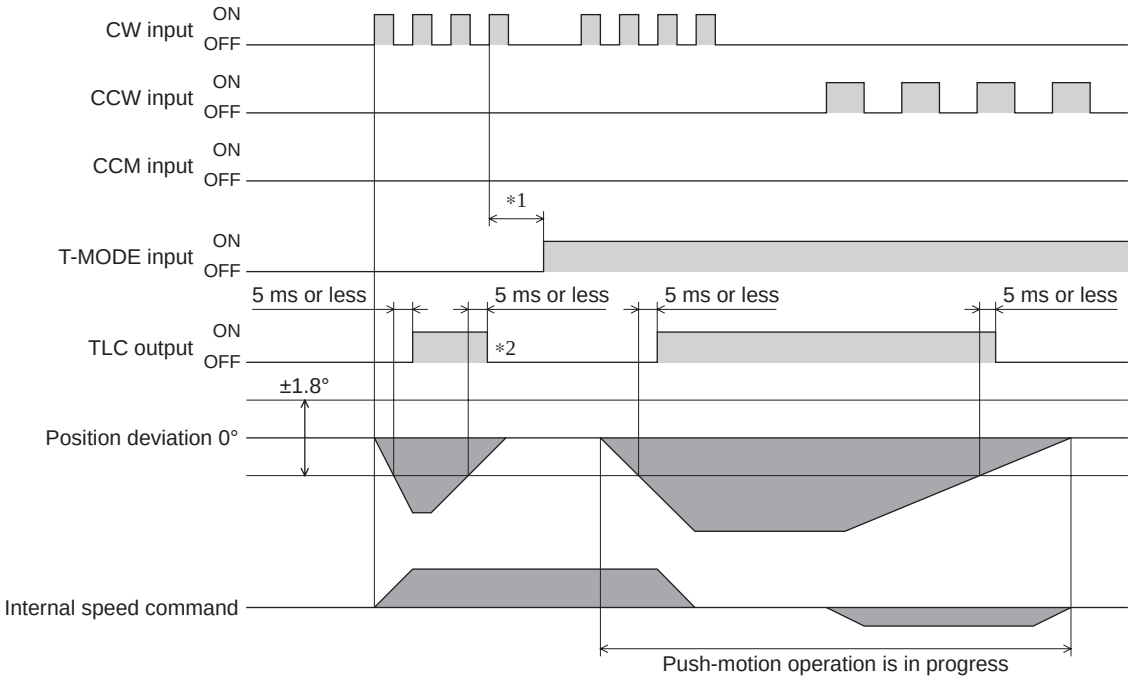


*1 The specific time varies depending on when an alarm record is saved.
*2 An alarm is reset at the OFF edge of the ALM-RST input.

- This timing chart assumes generation of an alarm that turns off motor excitation.

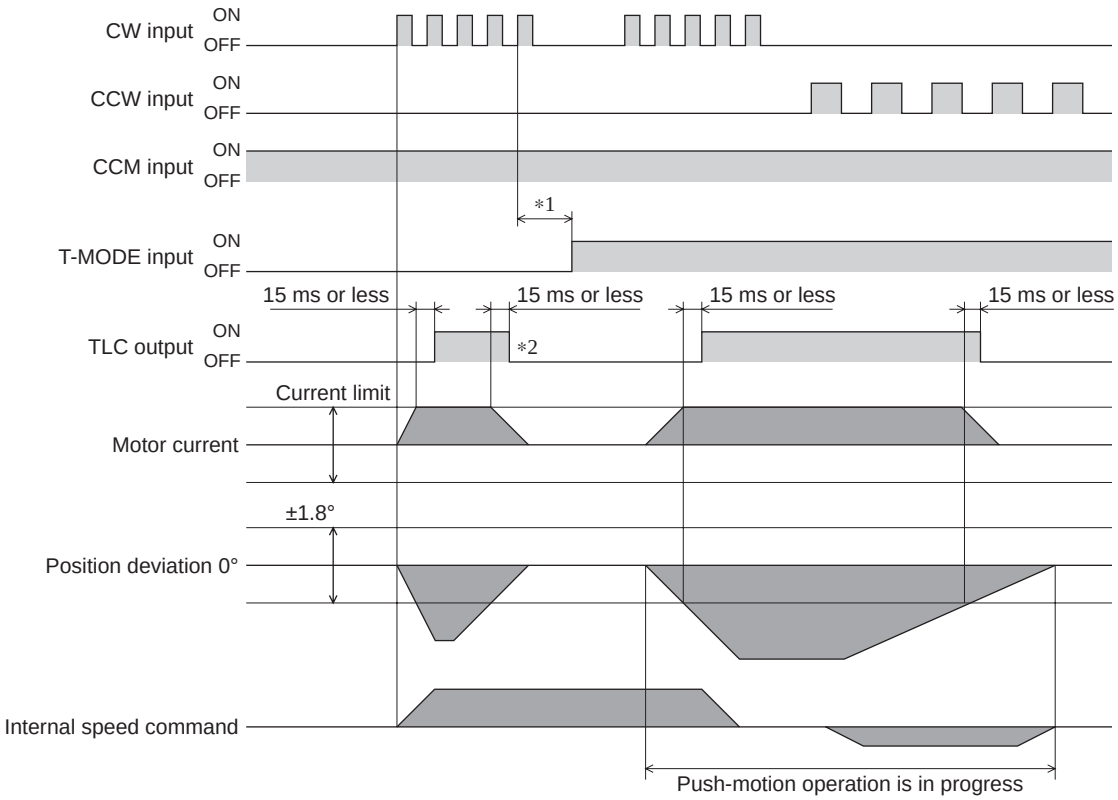
■ TLC output

- Normal mode



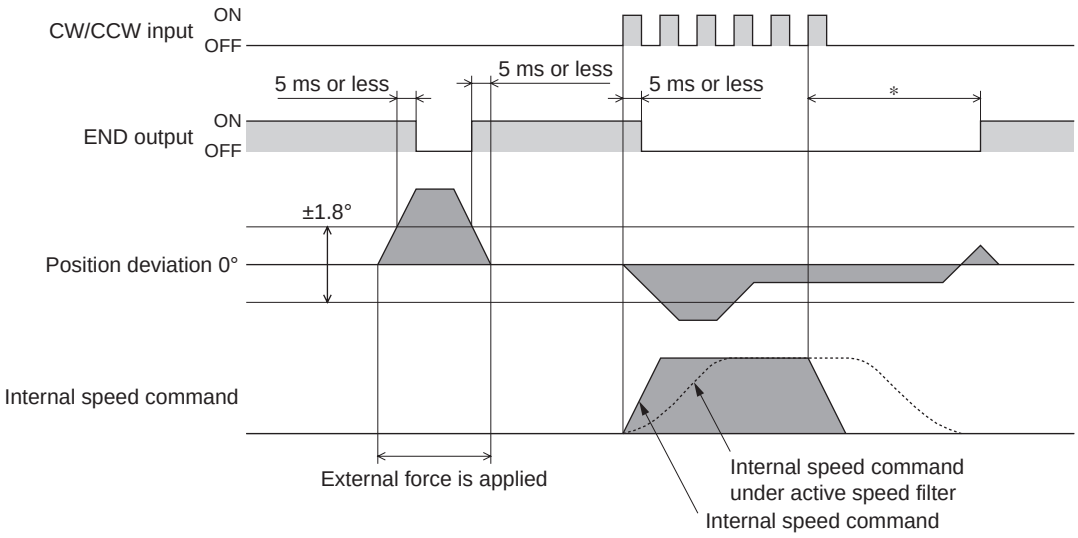
∗1 Input the T-MODE signal while the motor is at standstill.
∗2 When the position deviation exceeds ±1.8°, the TLC signal will be output even during acceleration/deceleration.

- Current control mode



∗1 Input the T-MODE signal while the motor is at standstill.
∗2 When the motor current reaches the operating current, the TLC signal will be output even during acceleration/deceleration.

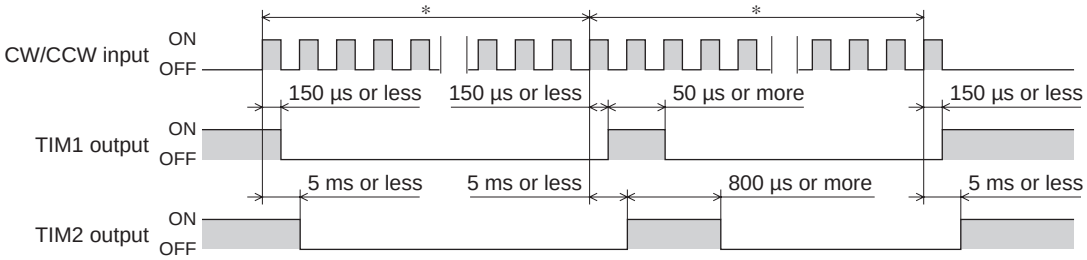
■ END output



∗ The output time of the END signal varies depending on the speed filter and operating speed.

- The END output will turn ON when the position deviation becomes ±1.8° and internal speed command is "0."

■ TIM1 output/TIM2 output

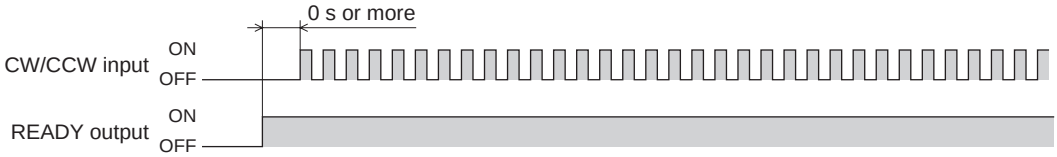


∗ When pulses corresponding to 1/50th the resolution are input (assuming that the resolution is a multiple of 50).

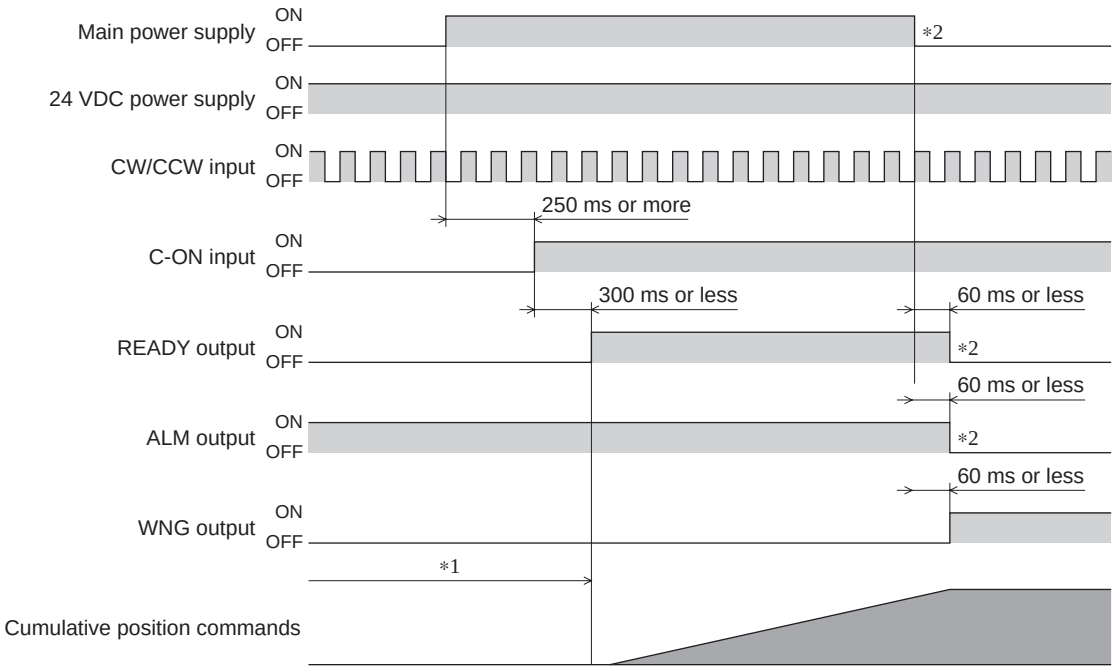
- This timing chart assumes that an operation starts from the position where the TIM output turns ON.
- The TIM1 output is a line driver output, while the TIM2 output is an open collector output.

■ Operation by pulse input

- Positioning operation



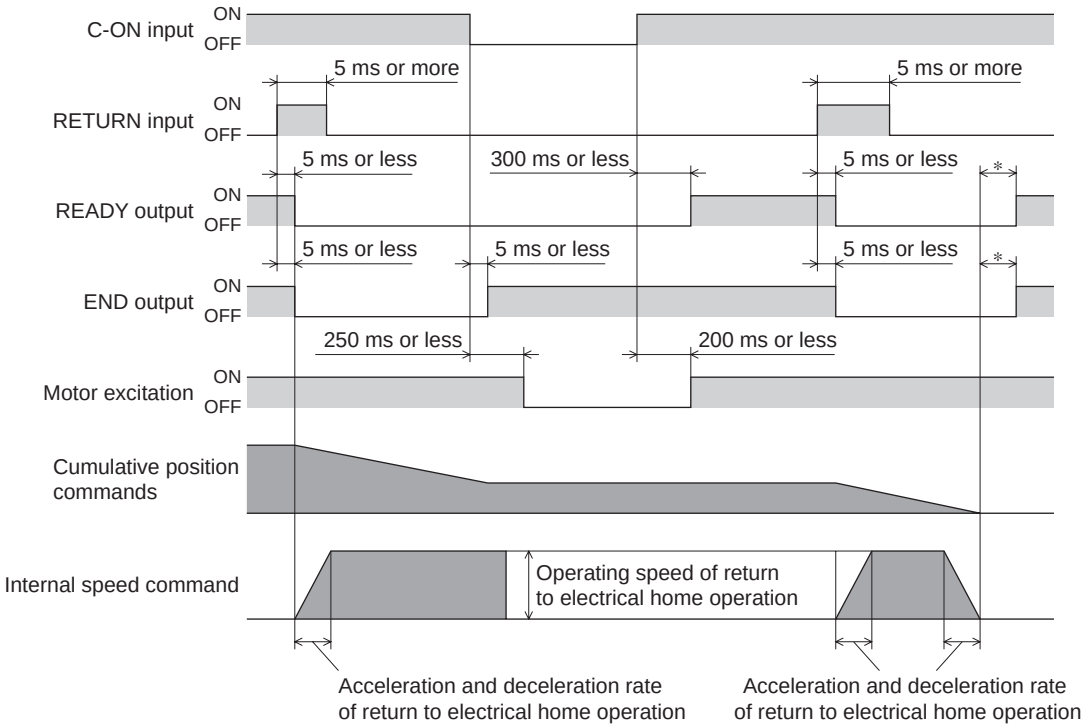
- When an error occurs



∗1 When the READY output is OFF, input pulses are ignored.
∗2 If a pulse is input while the main power is cut off, a main power supply error alarm will generate.

■ Return to electrical home operation

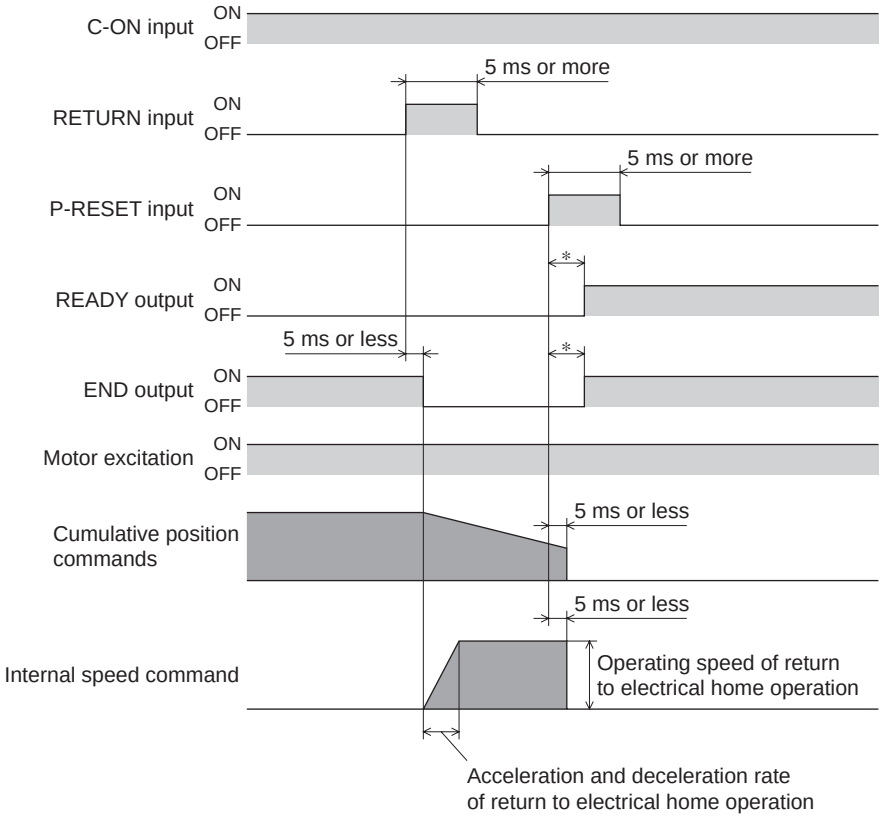
- When operation is interrupted



∗ The output time of the END signal varies depending on the speed filter and operating speed.

- If the C-ON input is turned OFF while a return to electrical home operation is still in progress, the operation will be interrupted. When the C-ON input is turned ON again and then the RETURN input is turned ON, the operation will resume from the position where it was interrupted.
- Return to electrical home operation can also be interrupted with the FREE input or CLR input. Note, however, that when a return to electrical home operation is interrupted using the CLR input, motor excitation will not turn off.

- Operation is terminated with the P-RESET input

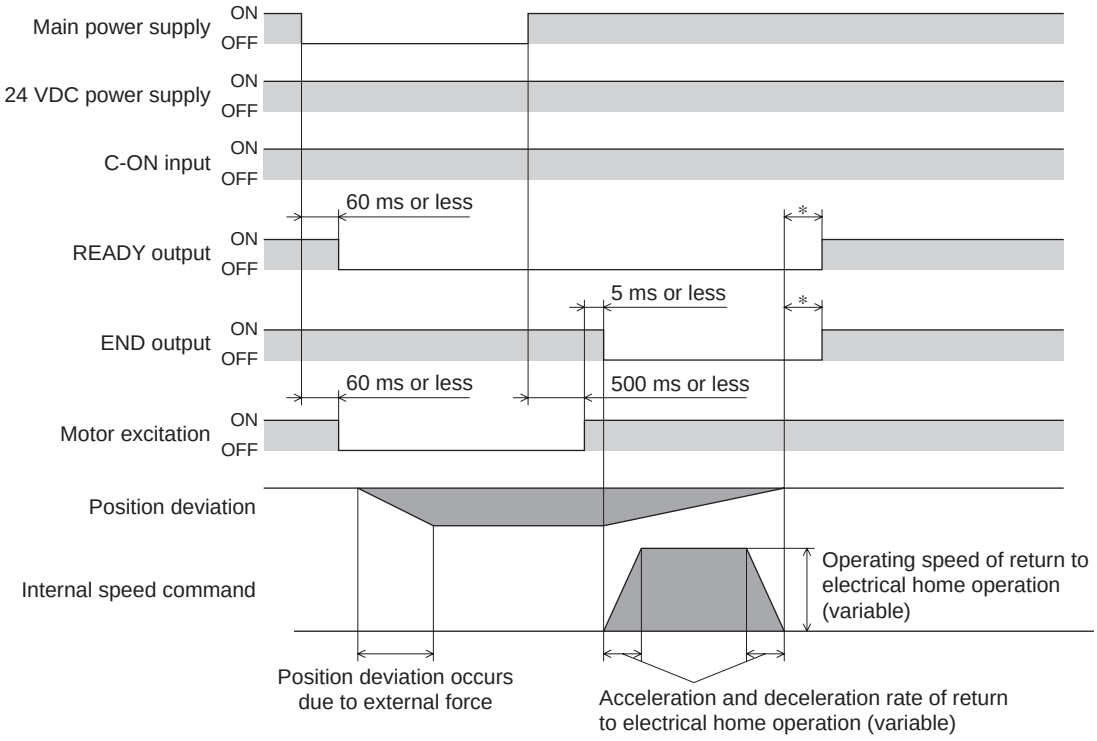


∗ The output time of the END signal varies depending on the speed filter and operating speed.

- When the P-RESET input is turned ON, the cumulative value of position commands will be reset to "0" and the current position will be set as the electrical home position. Accordingly, the return to electrical home operation will end.

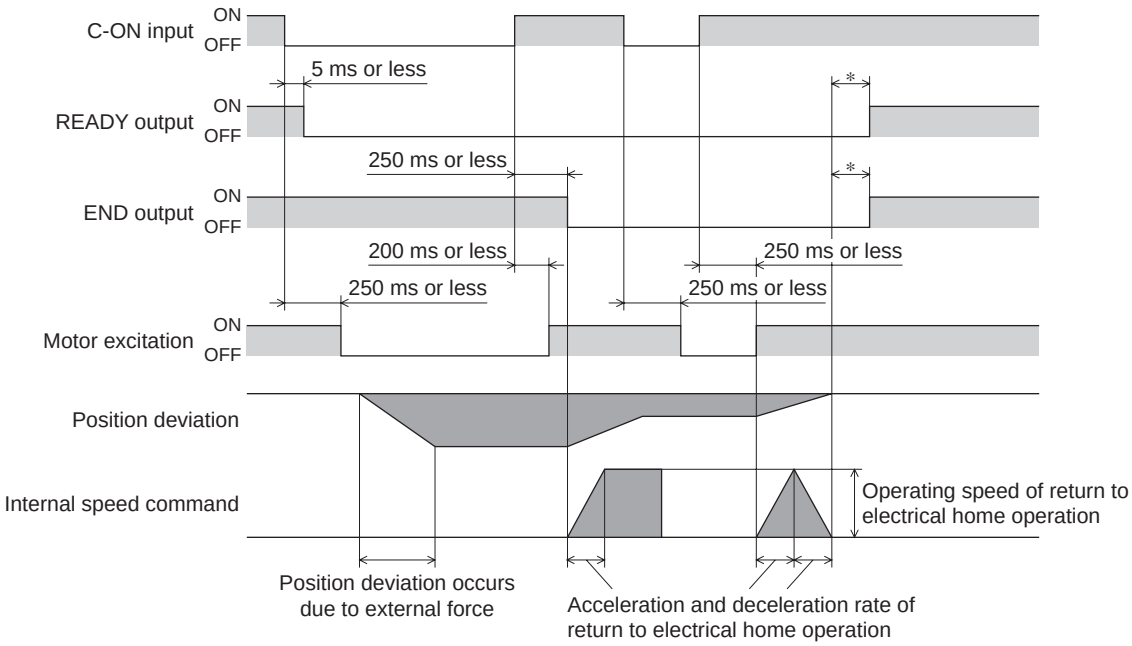
■ Automatic return operation

- Position deviation occurs due to cutoff of the main power supply



∗ The output time of the END signal varies depending on the speed filter and operating speed.

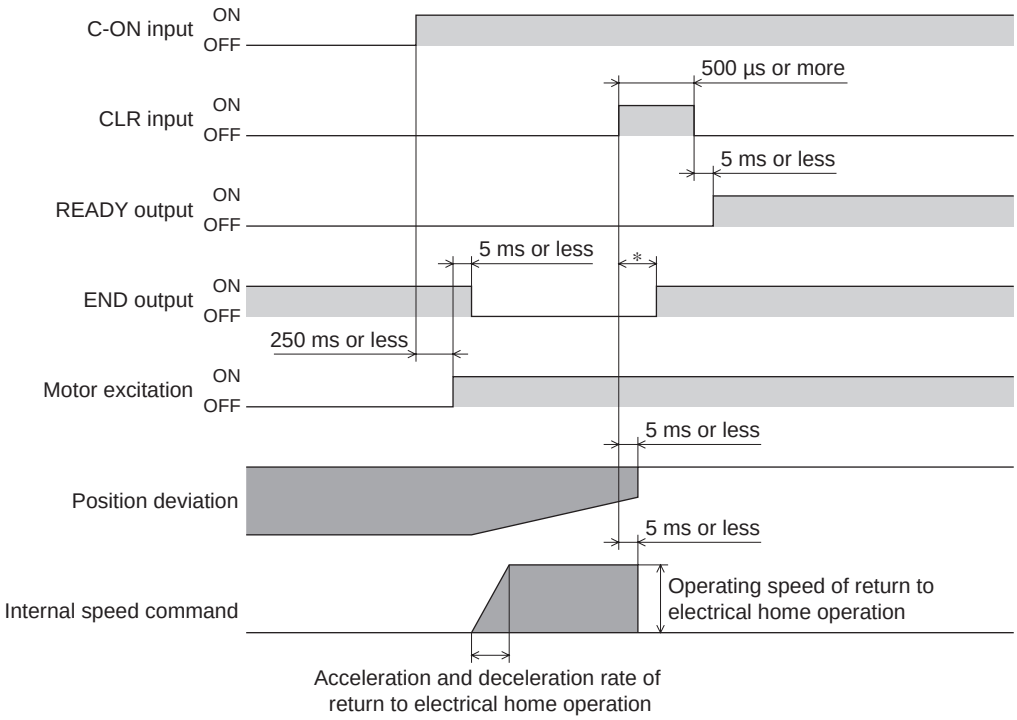
- Position deviation occurs due to turning OFF of the C-ON input



∗ The output time of the END signal varies depending on the speed filter and operating speed.

- If the C-ON input is turned OFF while automatic return operation is still in progress, the operation will be interrupted. When the C-ON input is turned ON again, the return operation will resume.
- Automatic return operation can also be interrupted using the FREE input.

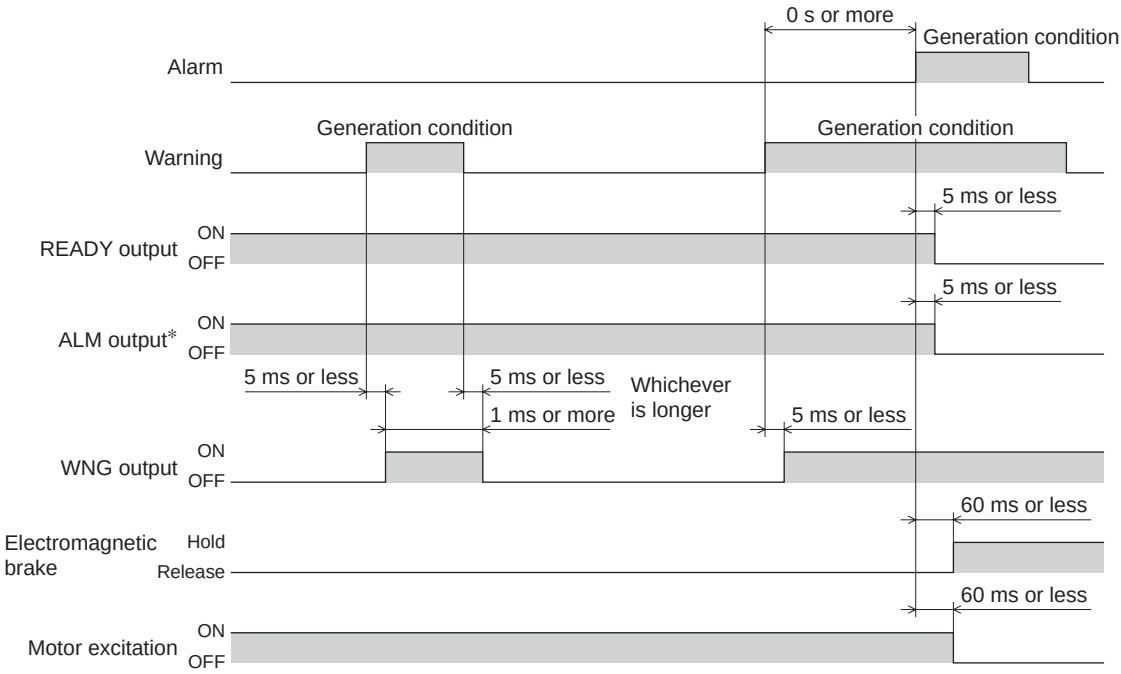
- Operation is terminated with the CLR input



∗ The output time of the END signal varies depending on the speed filter and operating speed.

- When the CLR input is turned ON, the position deviation will be cleared. Accordingly, the return operation will end.

■ ALM output/WNG output



* An alarm code is also output at the same timing.

- This timing chart assumes generation of an alarm that turns off motor excitation.
- Some alarms do not turn off motor excitation.
- Some alarms are not preceded by a warning.

18.2 Function/parameter list

Item	Overview	Standard specification	Extended function	Mode	
				Normal	Current control
Control mode	Set the control mode.	Available	Available	Available	Available
Resolution	Set the resolution using the resolution switches.				
	Change the electronic gear value assigned to each resolution switch. The calculated value should fall within the setting range specified below (the value of electronic gear B is common): Resolution setting range: 100 to 10000 P/R Resolution = 1000 × (Electronic gear B / Electronic gear A1 to A4) Four resolutions can be set using different combinations of resolution switches.	Not available			
Operating current	Set the operating current using the current setting switch. The purpose of the setting varies depending on the control mode. Normal mode: An operating current is set. Current control mode: A current limit value used for limiting the torque and temperature rise is set.	Available			
	Change the value assigned to each dial setting of the current setting switch.	Not available			
Standstill current percentage setting	Set the standstill current as a percentage of the operating current.				Not available
Pulse input mode selection	Set the pulse input mode using the select switch.	Available			Available
	Set the pulse input mode using the applicable parameter.	Not available			
Rotation direction	Set the rotation direction of the motor.				
C-ON input	Excite the motor.	Available			
	Set the logic of the C-ON input.	Not available			
Enable/disable return operation to excitation position at current ON	Set whether or not to return the motor to its excitation position (where the deviation becomes “0”) when the current is turned on.				

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
–	–	–	–
SyS-0-00	Electronic gear A1	1 to 1000	10
SyS-0-01	Electronic gear A2		1
SyS-0-02	Electronic gear A3		20
SyS-0-03	Electronic gear A4		2
SyS-0-04	Electronic gear B		10
–	–	–	–
APP-0-00	Operating current at CURRENT ‘0’	0.0 to 100.0 [%]	6.3
APP-0-01	Operating current at CURRENT ‘1’		12.5
APP-0-02	Operating current at CURRENT ‘2’		18.8
APP-0-03	Operating current at CURRENT ‘3’		25.0
APP-0-04	Operating current at CURRENT ‘4’		31.3
APP-0-05	Operating current at CURRENT ‘5’		37.5
APP-0-06	Operating current at CURRENT ‘6’		43.8
APP-0-07	Operating current at CURRENT ‘7’		50.0
APP-0-08	Operating current at CURRENT ‘8’		56.3
APP-0-09	Operating current at CURRENT ‘9’		62.5
APP-0-10	Operating current at CURRENT ‘A’		68.8
APP-0-11	Operating current at CURRENT ‘B’		75.0
APP-0-12	Operating current at CURRENT ‘C’		81.3
APP-0-13	Operating current at CURRENT ‘D’		87.5
APP-0-14	Operating current at CURRENT ‘E’		93.8
APP-0-15	Operating current at CURRENT ‘F’		100.0
APP-3-00	Standstill current	0.0 to 50 [%]	50.0
–	–	–	2P
SyS-1-00	Pulse input mode	0: Setting by the pulse input mode select switch 1: 2-pulse input mode, active low 2: 2-pules input mode, active high 3: 1-pulse input mode, active low 4: 1-pules input mode, active high 5: Phase difference mode, ×1 6: Phase difference mode, ×2 7: Phase difference mode, ×4	0
SyS-1-04	Rotation direction	0: + = CCW 1: + = CW	1: + = CW
–	–	–	–
APP-2-02	C-ON input logic	0: Contact A (normally open) 1: Contact B (normally closed)	0: Contact A (normally open)
SyS-1-03	Auto return	0: Disable 1: Enable	0: Disable

Item	Overview	Standard specification	Extended function	Mode	
				Normal	Current control
I/O input signal mode selection	Set whether or not to perform push-motion operation.	Not available	Available	Available	Available
Alarm code	Output a corresponding alarm code using the READY/AL0 output, TLC/AL1 output and TIM2/AL2 output when an alarm generates.				
END signal range	Set the output band for END output.				
END signal offset	Set the offset for END output.				
Pulse input operation	Perform operation based on input of CW/CCW pulses.	Available			
Push-motion operation	Set the current for push-motion operation.	Not available			
	Set the input signal mode.				
	Select the current for push-motion operation using the M0 to M2 inputs.				
	Output the TLC signal during push-motion operation. The output condition varies depending on the control mode: Normal mode: The TLC output will turn ON when misstepping (±1.8° or more) is detected. Current control mode: The TLC output will turn ON when the specified torque is reached.	Available			
Setting for return to electrical home operation	Set the operating speed of return to electrical home operation.	Not available			
	Set the acceleration and deceleration rate of return to electrical home operation.				
	Set the starting speed of return to electrical home operation.				
ASG/BSG output	Check the motor output.	Available			
TIM output	The TIM outputs (TIM1, TIM2) will turn ON every time the motor output shaft rotates by 7.2°.				

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
APP-2-00	I/O input mode	0: positioning operation (normal) 1: push-motion operation	0: positioning operation (normal)
APP-2-01	AL0-2 signal output	0: Disable 1: Enable	0: Disable
APP-2-03	END signal range	0.0 to 18.0 [°]	1.8
APP-2-04	END signal offset	−1.8 to 1.8 [°]	0.0
–	–	–	–
APP-2-05	Push-motion current 0	0.0 to 100.0 [%]	30.0
APP-2-06	Push-motion current 1		40.0
APP-2-07	Push-motion current 2		50.0
APP-2-08	Push-motion current 3		60.0
APP-2-09	Push-motion current 4		70.0
APP-2-10	Push-motion current 5		80.0
APP-2-11	Push-motion current 6		90.0
APP-2-12	Push-motion current 7		100.0
APP-2-00	I/O input mode	0: positioning operation (normal) 1: push-motion operation	0: positioning operation (normal)
–	–	–	–
–	–	–	–
APP-6-00	Operating speed of return operation	1 to 4000 [r/min]	30
APP-6-01	Acceleration and deceleration rate of return operation	0.01 to 1000.00 [ms/1000 r/min]	100.00
APP-6-02	Starting speed of return operation	0 to 4000 [r/min]	30
–	–	–	–
–	–	–	–

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Overview</th><th rowspan="2">Standard specification</th><th rowspan="2">Extended function</th><th colspan="2">Mode</th></tr>
<tr><th>Normal</th><th>Current control</th></tr>
<tr><td rowspan="2">Speed filter (V-FIL) setting</td><td>Apply a filter to the operation commands using the speed filter setting switch. Adjust the filter according to the load condition.</td><td>Available</td><td rowspan="15">Available</td><td rowspan="3">Available</td><td rowspan="3">Available</td></tr>
<tr><td>Change the value assigned to each dial setting of the speed filter setting switch.</td><td rowspan="14">Not available</td></tr>
<tr><td>Adjustment in normal mode</td><td>Suppress vibration during rotation.</td><td rowspan="2">Not available</td></tr>
<tr><td rowspan="6">Gain adjustment in current control mode</td><td>Suppress vibration during operation and acceleration/deceleration.</td><td rowspan="6">Not available</td><td rowspan="12">Available</td></tr>
<tr><td>Adjust the position loop gain.</td></tr>
<tr><td>Adjust the speed loop gain.</td></tr>
<tr><td>Adjust the speed loop integral time constant.</td></tr>
<tr><td>Set the frequency of anti-vibration control.</td></tr>
<tr><td>Set anti-vibration control to be enabled.</td></tr>
<tr><td>Smooth drive</td><td>Set the smooth drive.</td><td rowspan="6">Available</td></tr>
<tr><td rowspan="3">JOG operation</td><td>Set the operating speed of JOG operation.</td></tr>
<tr><td>Set the acceleration and deceleration rate of JOG operation.</td></tr>
<tr><td>Set the starting speed of JOG operation.</td></tr>
<tr><td>Motor excitation position at power on</td><td>Select the position at which the motor is excited after the power has been turned on.</td></tr>
<tr><td rowspan="2">Data setter</td><td>Show the speed on the data setter with a sign or as an absolute value.</td></tr>
<tr><td>Set the gear ratio for geared motor used for speed monitor.</td></tr>
</table>

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
APP-1-00	Speed filter at V-FIL ‘0’	0 to 200 [ms]	0
APP-1-01	Speed filter at V-FIL ‘1’		1
APP-1-02	Speed filter at V-FIL ‘2’		2
APP-1-03	Speed filter at V-FIL ‘3’		3
APP-1-04	Speed filter at V-FIL ‘4’		5
APP-1-05	Speed filter at V-FIL ‘5’		7
APP-1-06	Speed filter at V-FIL ‘6’		10
APP-1-07	Speed filter at V-FIL ‘7’		20
APP-1-08	Speed filter at V-FIL ‘8’		30
APP-1-09	Speed filter at V-FIL ‘9’		50
APP-1-10	Speed filter at V-FIL ‘A’		70
APP-1-11	Speed filter at V-FIL ‘B’		100
APP-1-12	Speed filter at V-FIL ‘C’		120
APP-1-13	Speed filter at V-FIL ‘D’		150
APP-1-14	Speed filter at V-FIL ‘E’		170
APP-1-15	Speed filter at V-FIL ‘F’		200
APP-3-01	Speed error gain 1	0 to 500	45
APP-3-02	Speed error gain 2		45
APP-4-00	Position loop gain	1 to 50	10
APP-4-01	Speed loop gain	10 to 200	180
APP-4-02	Speed loop integral time constant	10.0 to 200.0 [ms]	100.0
APP-4-04	Frequency of anti-vibration control	3.00 to 100.00 [Hz]	7.00
APP-4-03	Anti-vibration control	0: Disable 1: Enable	0: Disable
SyS-1-01	Smooth drive		1: Enable
APP-7-00	Operating speed of JOG operation	1 to 4000 [r/min]	30
APP-7-01	Acceleration and deceleration rate of JOG operation	0.01 to 1000.00 [ms/1000 r/min]	100.00
APP-7-02	Starting speed of JOG operation	0 to 4000 [r/min]	30
SyS-1-02	Excite position at first current on	0: Detected position 1: Electrical angle 0°	0: Detected position
APP-8-00	Displayed speed on OPX-2A	0: Signed 1: Absolute value	0: Signed
APP-8-01	Deceleration rate of speed monitor	1.0 to 100.0	1.0

18.3 Warning/alarm lists

■ Alarms (protective functions)

Item		Overview/condition
Alarm check function	LED indicator	When an alarm generates, the ALARM LED on the front face of the driver will blink. The number of times the LED blinks varies depending on the content of the alarm.
ALM output	ALM output	This signal will be output when an alarm generates.
Alarm code output	Alarm code output (AL0 to AL2 outputs)	These outputs are used by the host controller to detect the content of each alarm that has generated.
	Alarm code output enable/disable setting	Enable alarm code output if you want alarm codes to be output.
Alarm reset	Power cycle/ reconnection	Cycle the power to reset alarms.
	ALM-RST input	Input the ALM-RST signal to reset alarms.
Alarm detection condition setting	Excessive position deviation alarm	Set the condition under which an excessive position deviation alarm generates when the current is turned on.
	Overload alarm	Set the condition under which an overload detection alarm generates when the current is turned off. The overload condition varies depending on the control mode. Normal mode: A position deviation of 1.8° or more has occurred. Current control mode: The operating current has reached the limit.
Descriptions of alarms	Overheat protection	The internal temperature of the driver exceeded 85 °C (185 °F).
	Overload	The cumulative value of applied loads exceeding the maximum torque reached or exceeded the value set in the overload parameter [APP-5-03].
	Overspeed	The speed of the motor output shaft exceeded 4500 r/min (excluding geared motors).
	Command pulse error	The command pulse frequency exceeded the specified value.
	Regeneration unit overheat	• The regeneration unit is not connected correctly. • The regeneration unit is overheating.
	Overvoltage protection	• 200-230 VAC was applied to a product specified for 100-115 VAC. • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit.
	Main power supply error	The motor was started when the main power was cut off.
	Undervoltage	The main power was cut off momentarily or the voltage became low.
	Overflow rotation during current on	• When the current was turned on, the deviation between the command position and actual position exceeded the value set in the parameter for overflow rotation during current on [APP-5-01]. • The load is large or acceleration/deceleration rate is low.
	Overflow rotation during current off	The C-ON input was turned ON while an excessive position deviation warning at current OFF was present.
	Overcurrent protection	The motor, cable or driver output circuit was shorted.
	Drive circuit error	The motor cable was disconnected.
	Abnormal operation data	Return to electrical home operation was performed while an abnormal operation data warning was present.
	Electronic gear setting error	The power was turned on when the resolution set by the electronic gear was outside the specified range.
	Sensor error during operation	A sensor error occurred while the motor was operating.
	Initial sensor error	A sensor error occurred when the power was turned on.
	Initial rotor rotation error	The motor output shaft rotated at a speed of 15 r/min or more while the initialization was still in progress following a power on.
	Motor combination error	A motor not supported by the driver is connected.
	EEPROM error	Data stored in the driver was damaged.

Standard specification	Extended function	Mode		Parameter/operation data			
		Normal	Current control	**OPX-2A** screen display	Name	Setting range	Initial value
Available	Available	Available	Available	–	–	–	–
				–	–	–	–
Not available				–	–	–	–
				APP-2-01	AL0-2 signal output	0: Disable 1: Enable	0: Disable
Available				–	–	–	–
				–	–	–	–
Not available				APP-5-01	Overflow rotation during current on	0.01 to 300.00 [rev]	3.00
				APP-5-03	Overload	0.1 to 30.0 [s]	5.0
Available				–	–	–	–
				–	–	–	–
				–	–	–	–
				–	–	–	–
				–	–	–	–
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■ Warnings (warning functions)

Item		Overview/condition
Warning check function	WNG output	When a warning generates, the WNG output will turn ON.
	Return to electrical home operation warning output enable/disable setting	When the CS input is turned ON, a return to electrical home operation will be disabled and an operation data error warning will generate.
Warning detection condition setting	Excessive position deviation warning	Set the condition under which an excessive position deviation warning generates when the current is turned on.
		Set the condition under which an excessive position deviation warning generates when the current is turned off.
	Overvoltage warning	Set the condition under which an overvoltage warning generates.
	Undervoltage warning	Set the condition under which an undervoltage warning generates.
	Overheat warning	Set the condition under which a driver overheat warning generates.
	Overload warning	Set the condition under which an overload detection warning generates. The overload condition varies depending on the control mode. Normal mode: A position deviation of 1.8° or more has occurred. Current control mode: The operating current has reached the limit.
	Overspeed warning	Set the condition under which a motor overspeed warning generates.
Descriptions of warnings	Overflow rotation during current on	• When the current was turned on, the deviation between the command position and actual position exceeded the value set in the parameter for overflow warning rotation during current on [APP-5-04]. • The load is large or acceleration/deceleration rate is too short.
	Overflow rotation during current off	When the current was turned off, the deviation between the command position and actual position exceeded the value set in the parameter for overflow rotation during current off [APP-5-02]. (This warning is output when the parameter for auto return [SyS-1-03] is set to “Enable.”)
	Overheat	The internal temperature of the driver exceeded the value set in the overheat warning parameter [APP-5-07].
	Overvoltage	• The voltage of the main power supply exceeded the value set in the overvoltage warning parameter [APP-5-05]. • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit.
	Main power supply error	The C-ON input was turned ON when the main power was cut off.
	Undervoltage	• The DC voltage of the main power supply became lower than the value set in the undervoltage warning parameter [APP-5-06]. • The main power was cut off momentarily or the voltage became low.
	Overload	• A load exceeding the maximum torque was applied for the time set in the overload warning parameter [APP-5-08] or longer. • The load is large or acceleration/deceleration rate is too short.
	Overspeed	The detected motor speed exceeded the value set in the overspeed warning parameter [APP-5-09].
	Operation data error	• The CS input was changed when the current was on. • The traveled distance from the electrical home exceeded the control range (2,147,483,648 pulses). (This alarm generates when the application parameter for abnormal operation data warning [APP-5-00] is set to “Enable.”)
	Electronic gear setting error	The resolution set by the electronic gear is outside the specified range.

Standard specification	Extended function	Mode		Parameter/operation data			
		Normal	Current control	**OPX-2A** screen display	Name	Setting range	Initial value
Not available	Available	Available	Available	–	–	–	–
				APP-5-00	Abnormal operation data warning	0: Disable 1: Enable	0: Disable
				APP-5-04	Overflow warning rotation during current on	0.01 to 300.00 [rev]	3.00
				APP-5-02	Overflow rotation during current off	0.01 to 300.00 [rev]	100.00
				APP-5-05	Overvoltage warning	320 to 450 [V]	435
				APP-5-06	Undervoltage warning	120 to 280 [V]	120
				APP-5-07	Overheat warning	40 to 85 [°C]	85
				APP-5-08	Overload warning	0.1 to 30.0 [s]	5.0
				APP-5-09	Overspeed warning	1 to 5000 [r/min]	4500
				–	–	–	–
				–	–	–	–
				–	–	–	–
				–	–	–	–
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