Orientalmotor

5-phase stepping motor unit

CRK Series

Built-in Controller (RS-485 communication function)

USER MANUAL

$C\mathcal{E}$

Thank you for purchasing an Oriental Motor product.

This manual describes product handling procedures and safety precautions.

• Please read it thoroughly to ensure safe operation.

• Always keep the manual where it is readily available.

Table of contents

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 or injury.
- The motor will lose its holding torque when the power supply or motor excitation is turned off. If this product is used in an vertical application, be sure to provide a measure for the position retention of moving parts. Failure to provide such a measure may cause the moving parts to fall, resulting in injury or damage to the equipment.
- Do not use the motor's built-in electromagnetic brake mechanism for stopping or for safety purposes. Using it for purposes other than holding the moving parts and motor in position may cause injury or damage to equipment.
- With certain types of alarms (protective functions), the motor may stop when the alarm generates and the holding torque will be lost as a result. This will result in injury or damage to equipment.
- When an alarm is generated, first remove the cause and then clear the alarm. 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.

Connection

- Keep the driver's input-power voltage within the specified range to avoid fire.
- For the driver's power supply, use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.
- Connect the cables securely according to the wiring diagram in order to prevent fire.
- Do not forcibly bend, pull or pinch the cable and leads. Doing so may cause fire and electric shock. This will also cause stress to the connecting section and may result in damage to equipment.

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 excitation to off while the motor is operating. The motor will stop and lose its holding ability, which may result in injury or damage to equipment.
- Configure an interlock circuit using a sequence program so that when a RS-485 communication error occurs, the entire system, including the driver, will operate safety.

Repair, disassembly and modification

- Do not disassemble or modify the motor and driver. This may cause 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, or injury or damage to equipment may result.
- Keep your fingers and objects out of the openings in the motor and driver, or fire or injury may result.
- 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 hold the motor output shaft, motor cable or leads. This may cause damage or injury.

Installation

- Install the motor and driver in an enclosure in order to prevent injury.
- Keep the area around the motor and driver free of combustible materials in order to prevent fire or a skin burn(s).
- Provide a cover over the rotating parts (output shaft) of the motor to prevent injury.

Connection

- The driver's power supply connector (CN1), I/O connector (CN2), communication connector (CN3) and RS-485 communication connector (CN6/CN7) 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 PC to short, damaging both.
- When connecting, check the silk screen of the driver and pay attention to the polarity of the power supply. Reverse-polarity connection may cause damage to the driver. The power-supply circuit and the RS-485 communication circuit are not insulated. Therefore, when controlling multiple drivers via RS-485 communication, the reverse polarity of the power supply will cause a short circuit and may result in damage to the drivers.

Operation

- Use a motor and driver only in the specified combination. An incorrect combination may cause a fire.
- Provide an emergency stop device or emergency stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Before supplying power to the driver, turn all control inputs to the driver to OFF. Otherwise, the motor may start suddenly at power ON and cause injury or damage to equipment.
- Set the speed and acceleration/deceleration rate at reasonable levels. Otherwise, the motor will misstep and the moving part may move in an unexpected direction, resulting in injury or damage to equipment.
- Do not touch the rotating part (output shaft) during operation. This may cause injury.
- Before moving the motor directly with the hands, confirm that the power supply or motor excitation is turned off and that motor current is cut off. Failure not to do so may result in 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

- Immediately when trouble has occurred, stop running and turn off the driver power. Failure to do so may result in fire or injury.
- Static electricity may cause the driver to malfunction or suffer damage. While the driver is receiving power, do not touch the driver. Use only an insulated screwdriver to adjust the driver's switches.

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. If you have any question, contact your nearest Oriental Motor branch or sales office

2 Overview of the CRK series built-in controller

The **CRK** series built-in controller is a unit product consisting of a 5-phase stepping motor driver with built-in controller function and a 5-phase stepping motor offering high torque with low vibration. The driver supports I/O control and RS-485 communication.
Set the operating data and parameters using the optional data setter **OPX-2A** (sold separately), optional data setting software **MEXE02** (sold separately) or RS-485 communication.

■ Main features

- ### Three operating patterns

  You can perform positioning operation, return-to-home operation and continuous operation.
  Up to 63 operation data points can be set, and multi-point positioning is also possible.

- ### Low vibration, low noise

  The micro-step driver with smooth drive function achieves low vibration and low noise.

- ### Supporting RS-485 communication

  You can set operation data and parameters or issue operation start/stop commands from the master station.
  Up to 31 drivers can be connected to one master.

- ### Detection of misstep

  If the deviation between the encoder counter value and driver command position reaches or exceeds the set value, a STEPOUT output signal will be output.

- ### Alarm and warning functions

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

■ Related products

You can connect the **CRK** series built-in controller via the network converter so as to use in various network.

Network converter	Supported network
NETC01-CC	CC-Link communication
NETC01-M2	MECHATROLINK-Ⅱ communication
NETC01-M3	MECHATROLINK-Ⅲ communication

3 System configuration

Programmable controller or master device
Connect either device when controlling the system via RS-485 communication.

Connect to CN6 or CN7. P.32

Data setter OPX-2A (optional)

PC in which the MEXE02 has been installed

or

The PC must be supplies by the customer.

Connect to CN3. P.31

Connect to CN2. P.28

Programmable controller

Encoder connection
Connect an encoder if used.
P.31

Connect to CN4. P.24

Motor

FG

+24 V

GND

DC power supply

Noise filter
Use a noise filter to eliminate noise.
It has the effect of reducing noise generated from the power supply and driver.
P.22

AC power supply

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 machinery, and must not be used for any other purpose. For the driver's power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.
Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

■ Structure of the manual

The **CRK** series built-in controller comes with the manuals specified below.

- **CRK** Series Built-in Controller USER MANUAL (CD-ROM)

  This manual explains the product functions as well as how to install/connect and operate the product, among others.

- **CRK** Series Built-in Controller OPERATING MANUAL

  This manual explains the safety precautions, connector pin assign and others.

- Data setter **OPX-2A** <**CRK** Series Built-in Controller (RS-485 communication function)> OPERATING MANUAL
  (packaged together with the data setter)

  This manual explains how to set data using the **OPX-2A**.

- Data setting software **MEXE02** <**CRK** Series Built-in Controller (RS-485 communication function)> OPERATING MANUAL
  (packaged together with the data setting software)

  This manual explains how to set data using the **MEXE02**.

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

■ CE Marking

Because the input power supply voltage of this product is 24 VDC, it is not subject to the Low Voltage Directive (LVD). However, install and connect this product as follows.
- The product is a type with machinery incorporated, so it should be installed within an enclosure.
- For the driver's power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.

- Installation conditions
  - Overvoltage category: I
  - Pollution degree: 2
  - Degree of protection:

Motor	• High-resolution type • High-torque type • High-torque type with encoder • **TH**, **PS**, **PN** and harmonic geared type (**CRK513P** and **CRK523P**)	IP20
	• Standard type • Standard type with encoder • Standard type with electromagnetic brake • **TH**, **PS**, **PN** and harmonic geared type (**CRK543**, **CRK544**, **CRK564** and **CRK566**)	IP30
Driver	IP20	

- EMC Directive (2004/108/EC）

  This product has received EMC measures under the conditions specified in "Example of motor and driver installation and wiring" on p.23.
  Be sure to conduct EMC measures with the product assembled in your equipment by referring to "7.6 Installing and wiring in compliance with EMC Directive" on p.22.

  Applicable standards

EMI	Emission Tests Radiated Emission Test	EN 61000-6-4 EN 55011 group 1 class A
EMS	Immunity Tests Radiation Field Immunity Test Electrostatic Discharge Immunity Test Fast Transient /Burst Immunity Test Conductive Noise Immunity Test	EN 61000-6-2 IEC 61000-4-3 IEC 61000-4-2 IEC 61000-4-4 IEC 61000-4-6

■ 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.

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

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

- **Do not apply strong impact on the motor output shaft.**

  If you are using a motor with encoder, an optical encoder is housed in the motor. To prevent damage to the encoder, handle the motor with care and avoid strong impact to the motor output shaft when transporting the motor or installing the load.

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

  Operating it under an excessive overhung load and 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.

- **Motor case temperature**
  - The motor case surface temperature may exceed 100 °C (212 °F) under certain conditions (ambient temperature, operating speed, duty cycle, etc.). Keeping the surface temperature of the motor case below 100 °C (212 °F) will also maximize the life of the motor bearings (ball bearings).
  - 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 in the gear.
  - When the motor with encoder whose frame size is □20 mm (0.79 in.) or □28 mm (1.10 in.) [PK51 or PK52] is used, make sure the temperature of the encoder case does not exceed 85° C (185 °F).
  - When the motor with encoder whose frame size is □42 mm (1.65 in.) or □60 mm (2.36 in.) [PK54 or PK56] is used, make sure the temperature of the encoder case does not exceed 80° C (176 °F).

- **Maximum static torque at excitation**

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

- **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 if used to stop the motor.
  The electromagnetic brake is a power-off activated type. This means that although it helps maintain the position of the load in the event of power outage, etc., 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.

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

  The driver's power supply connector (CN1), I/O connector (CN2), communication connector (CN3) and RS-485 communication connector (CN6/CN7) 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 PC to short, damaging both.

- **Preventing electrical noise**

  See "7.6 Installing and wiring in compliance with EMC Directive" on p.22 for measures with regard to noise.

- **Regeneration**

  The overvoltage alarm will generate depending on the operating condition. When an alarm is generated, review the operating conditions.

- **Saving data to the NV memory**

  Do not turn off the main 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 the data write and cause a EEPROM error alarm to generate.
  The NV memory can be rewritten approx. 100,000 times.

- Geared type

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)			
		Frame size [mm (in.)]			
		□20 (0.79)	□ 28 (1.10) □ 30 (1.18)	□ 42 (1.65)	□ 60 (2.36)
TH geared	3.6:1 7.2:1 10:1	–	Opposite direction	Same direction	
	20:1 30:1	–	Same direction	Opposite direction	
PS geared **PN** geared	All gear ratio	–	Same direction		
Harmonic geared	All gear ratio	Opposite direction			

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.

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.12.

- Items supplied with all unit models
  - Motor .... 1 unit
  - Driver... 1 unit
  - CN1 connector (3 pins)...................................... 1 pc.
  - CN2 connector cable [1 m (3.3 ft.), 40 pins] ...... 1 pc.
  - CN4 connector leads [0.6 m (2 ft.), 5 pins]......... 1 pc.
  - USER MANUAL (CD-ROM) .... 1 pc.
  - OPERATING MANUAL.................................... 1 copy

- Item supplied with motors with electromagnetic brake
  - Varistor.. 1 pc.

- Items supplied with connector-type motor units
  Applicable product: High-resolution type, high-torque type, high-torque type with encoder, **TH** geared type,
           PS geared type, **PN** geared type, harmonic geared type (**CRK513P**, **CRK523P**)

  - Motor connector leads [0.6 m (2 ft.), 5 pins] ...... 1 pc.

- Items supplied with motor units with encoder [□20 mm (0.79 in.), □28 mm (1.10 in.)]
  Applicable product: High-torque type with encoder (**CRK513PRKD**, **CRK52□PRKD**)

  - Encoder connector leads [0.6 m (2 ft.), 8 pins]... 1 pc.
  - CN5 connector leads [0.6 m (2 ft.), 9 pins]......... 1 pc.

- Items supplied with motor units with encoder [□42 mm (1.65 in.), □60 mm (2.36 in.)]
  Applicable product: High-torque type with encoder (**CRK54□PRKD**),
  Standard type with encoder (**CRK54□RKD**, **CRK56□RKD**)

  - CN5 connector leads [0.6 m (2 ft.), 9 pins]......... 1 pc.

6.2 Combinations of motors and drivers

■ High-resolution type

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□28 (1.10)	**CRK523PMAKD**	**CRK523PMBKD**	PK523PMA	PK523PMB	CRD503-KD
	CRK524PMAKD	**CRK524PMBKD**	PK524PMA	PK524PMB	
	CRK525PMAKD	**CRK525PMBKD**	PK525PMA	PK525PMB	
	CRK523HPMAKD	**CRK523HPMBKD**	PK523HPMA	PK523HPMB	CRD507H-KD
	CRK524HPMAKD	**CRK524HPMBKD**	PK524HPMA	PK524HPMB	
	CRK525HPMAKD	**CRK525HPMBKD**	PK525HPMA	PK525HPMB	
□42 (1.65)	**CRK544PMAKD**	**CRK544PMBKD**	PK544PMA	PK544PMB	CRD507-KD
	CRK546PMAKD	**CRK546PMBKD**	PK546PMA	PK546PMB	
□60 (2.36)	**CRK564PMAKD**	**CRK564PMBKD**	PK564PMA	PK564PMB	CRD514-KD
	CRK566PMAKD	**CRK566PMBKD**	PK566PMA	PK566PMB	
	CRK569PMAKD	**CRK569PMBKD**	PK569PMA	PK569PMB	

■ High-torque type

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□20 (0.79)	**CRK513PAKD**	**CRK513PBKD**	PK513PA	PK513PB	CRD503-KD
□28 (1.10)	**CRK523PAKD**	**CRK523PBKD**	PK523PA	PK523PB	
	CRK525PAKD	**CRK525PBKD**	PK525PA	PK525PB	
	CRK523HPAKD	**CRK523HPBKD**	PK523HPA	PK523HPB	CRD507H-KD
	CRK525HPAKD	**CRK525HPBKD**	PK525HPA	PK525HPB	
□42 (1.65)	**CRK544PAKD**	**CRK544PBKD**	PK544PA	PK544PB	CRD507-KD
	CRK546PAKD	**CRK546PBKD**	PK546PA	PK546PB	

■ High-torque type with encoder

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□20 (0.79)	**CRK513PRKD**	–	PK513PA-R23L	–	CRD503-KD
□28 (1.10)	**CRK523PRKD**	–	PK523PA-R23L	–	
	CRK525PRKD	–	PK525PA-R23L	–	
	CRK523HPRKD	–	PK523HPA-R23L	–	CRD507H-KD
	CRK525HPRKD	–	PK525HPA-R23L	–	
□42 (1.65)	**CRK544PRKD**	–	PK544PA-R23L	–	CRD507-KD
	CRK546PRKD	–	PK546PA-R23L	–	

■ Standard type with encoder

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□42 (1.65)	**CRK543RKD**	–	PK543AW-R23L	–	CRD507-KD
	CRK544RKD	–	PK544AW-R23L	–	
	CRK545RKD	–	PK545AW-R23L	–	
□60 (2.36)	**CRK564RKD**	–	PK564AW-R23L	–	CRD514-KD
	CRK566RKD	–	PK566AW-R23L	–	
	CRK569RKD	–	PK569AW-R23L	–	

■ Standard type with electromagnetic brake

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□42 (1.65)	CRK543AMKD	–	PK543AWM	–	CRD507-KD
	CRK544AMKD	–	PK544AWM	–	
	CRK545AMKD	–	PK545AWM	–	
□60 (2.36)	CRK564AMKD	–	PK564AWM	–	CRD514-KD
	CRK566AMKD	–	PK566AWM	–	
	CRK569AMKD	–	PK569AWM	–	

■ Standard type

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□42 (1.65)	CRK543AKD	CRK543BKD	PK543AW	PK543BW	CRD507-KD
	CRK544AKD	CRK544BKD	PK544AW	PK544BW	
	CRK545AKD	CRK545BKD	PK545AW	PK545BW	
□60 (2.36)	CRK564AKD	CRK564BKD	PK564AW	PK564BW	CRD514-KD
	CRK566AKD	CRK566BKD	PK566AW	PK566BW	
	CRK569AKD	CRK569BKD	PK569AW	PK569BW	

■ TH geared type

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□28 (1.10)	CRK523PAKD-T7.2	CRK523PBKD-T7.2	PK523PA-T7.2	PK523PB-T7.2	CRD503-KD
	CRK523PAKD-T10	CRK523PBKD-T10	PK523PA-T10	PK523PB-T10	
	CRK523PAKD-T20	CRK523PBKD-T20	PK523PA-T20	PK523PB-T20	
	CRK523PAKD-T30	CRK523PBKD-T30	PK523PA-T30	PK523PB-T30	
□42 (1.65)	CRK543AKD-T3.6	CRK543BKD-T3.6	PK543AW-T3.6	PK543BW-T3.6	CRD507-KD
	CRK543AKD-T7.2	CRK543BKD-T7.2	PK543AW-T7.2	PK543BW-T7.2	
	CRK543AKD-T10	CRK543BKD-T10	PK543AW-T10	PK543BW-T10	
	CRK543AKD-T20	CRK543BKD-T20	PK543AW-T20	PK543BW-T20	
	CRK543AKD-T30	CRK543BKD-T30	PK543AW-T30	PK543BW-T30	
□60 (2.36)	CRK564AKD-T3.6	CRK564BKD-T3.6	PK564AW-T3.6	PK564BW-T3.6	CRD514-KD
	CRK564AKD-T7.2	CRK564BKD-T7.2	PK564AW-T7.2	PK564BW-T7.2	
	CRK564AKD-T10	CRK564BKD-T10	PK564AW-T10	PK564BW-T10	
	CRK564AKD-T20	CRK564BKD-T20	PK564AW-T20	PK564BW-T20	
	CRK564AKD-T30	CRK564BKD-T30	PK564AW-T30	PK564BW-T30	

■ PS geared type

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□28 (1.10)	CRK523PAKD-PS5	CRK523PBKD-PS5	PK523PA-PS5	PK523PB-PS5	CRD503-KD
	CRK523PAKD-PS7	CRK523PBKD-PS7	PK523PA-PS7	PK523PB-PS7	
	CRK523PAKD-PS10	CRK523PBKD-PS10	PK523PA-PS10	PK523PB-PS10	
□42 (1.65)	CRK543AKD-PS25	CRK543BKD-PS25	PK543AW-PS25	PK543BW-PS25	CRD507-KD
	CRK543AKD-PS36	CRK543BKD-PS36	PK543AW-PS36	PK543BW-PS36	
	CRK543AKD-PS50	CRK543BKD-PS50	PK543AW-PS50	PK543BW-PS50	
	CRK545AKD-PS5	CRK545BKD-PS5	PK545AW-PS5	PK545BW-PS5	
	CRK545AKD-PS7	CRK545BKD-PS7	PK545AW-PS7	PK545BW-PS7	
	CRK545AKD-PS10	CRK545BKD-PS10	PK545AW-PS10	PK545BW-PS10	
□60 (2.36)	CRK564AKD-PS25	CRK564BKD-PS25	PK564AW-PS25	PK564BW-PS25	CRD514-KD
	CRK564AKD-PS36	CRK564BKD-PS36	PK564AW-PS36	PK564BW-PS36	
	CRK564AKD-PS50	CRK564BKD-PS50	PK564AW-PS50	PK564BW-PS50	
	CRK566AKD-PS5	CRK566BKD-PS5	PK566AW-PS5	PK566BW-PS5	
	CRK566AKD-PS7	CRK566BKD-PS7	PK566AW-PS7	PK566BW-PS7	
	CRK566AKD-PS10	CRK566BKD-PS10	PK566AW-PS10	PK566BW-PS10	

■ PN geared type

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□28 (1.10)	CRK523PAKD-N5	CRK523PBKD-N5	PK523PA-N5	PK523PB-N5	CRD503-KD
	CRK523PAKD-N7.2	CRK523PBKD-N7.2	PK523PA-N7.2	PK523PB-N7.2	
	CRK523PAKD-N10	CRK523PBKD-N10	PK523PA-N10	PK523PB-N10	
□42 (1.65)	CRK544AKD-N5	CRK544BKD-N5	PK544AW-N5	PK544BW-N5	CRD507-KD
	CRK544AKD-N7.2	CRK544BKD-N7.2	PK544AW-N7.2	PK544BW-N7.2	
	CRK544AKD-N10	CRK544BKD-N10	PK544AW-N10	PK544BW-N10	
□60 (2.36)	CRK564AKD-N25	CRK564BKD-N25	PK564AW-N25	PK564BW-N25	CRD514-KD
	CRK564AKD-N36	CRK564BKD-N36	PK564AW-N36	PK564BW-N36	
	CRK564AKD-N50	CRK564BKD-N50	PK564AW-N50	PK564BW-N50	
	CRK566AKD-N5	CRK566BKD-N5	PK566AW-N5	PK566BW-N5	
	CRK566AKD-N7.2	CRK566BKD-N7.2	PK566AW-N7.2	PK566BW-N7.2	
	CRK566AKD-N10	CRK566BKD-N10	PK566AW-N10	PK566BW-N10	

■ Harmonic geared type

Frame size [mm (in.)]	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
□20 (1.10)	CRK513PAKD-H50	CRK513PBKD-H50	PK513PA-H50S	PK513PB-H50S	CRD503-KD
	CRK513PAKD-H100	CRK513PBKD-H100	PK513PA-H100S	PK513PB-H100S	
□30 (1.18)	CRK523PAKD-H50	CRK523PBKD-H50	PK523HPA-H50S	PK523HPB-H50S	CRD507H-KD
	CRK523PAKD-H100	CRK523PBKD-H100	PK523HPA-H100S	PK523HPB-H100S	
□42 (1.65)	CRK543AKD-H50	CRK543BKD-H50	PK543AW-H50S	PK543BW-H50S	CRD507-KD
	CRK543AKD-H100	CRK543BKD-H100	PK543AW-H100S	PK543BW-H100S	
□60 (2.36)	CRK564AKD-H50	CRK564BKD-H50	PK564AW-H50S	PK564BW-H50S	CRD514-KD
	CRK564AKD-H100	CRK564BKD-H100	PK564AW-H100S	PK564BW-H100S	

6.3 Names and functions of parts

■ Motor

Illustration shows the PK56□ type.

• Standard type
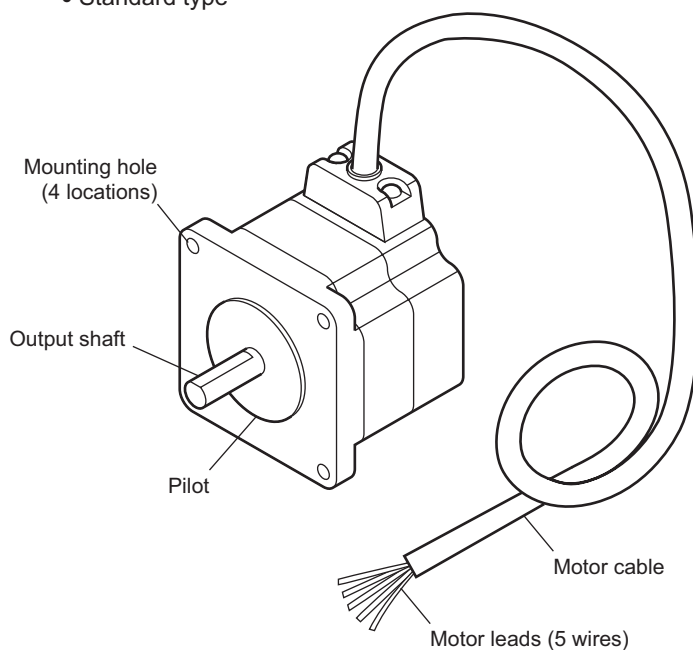
• Standard type with encoder

■ Driver

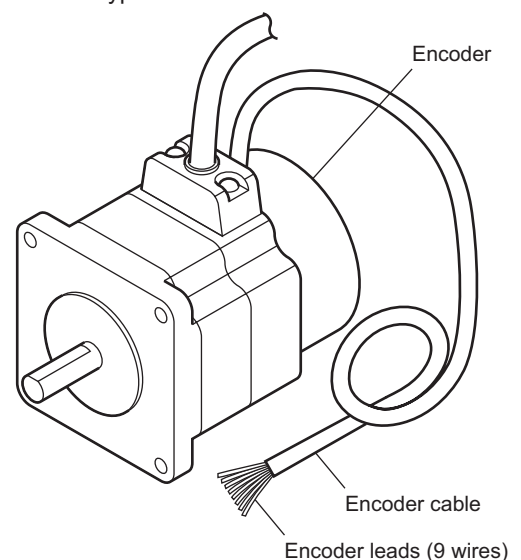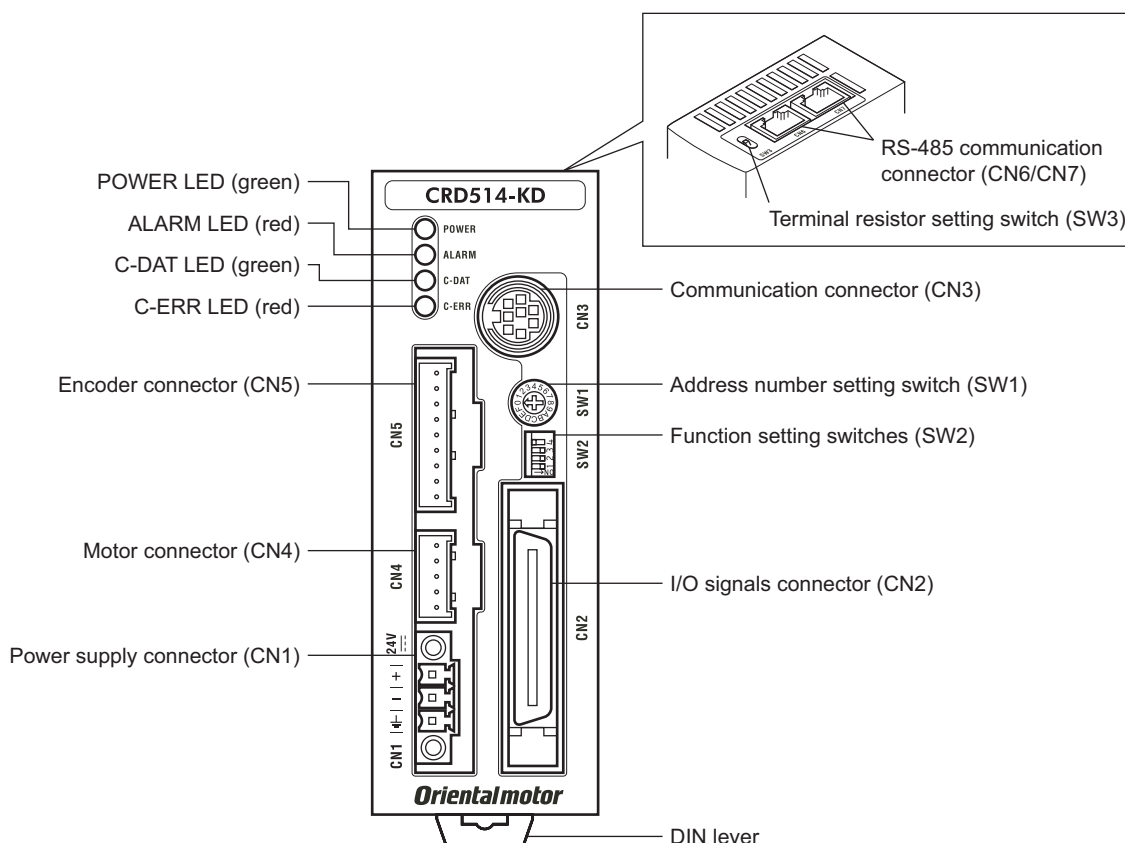| Name	Description	Reference
POWER LED (green)	This LED is lit while the main power is input.	−
ALARM LED (red)	This LED will blink when an alarm generates (a protective function is triggered). You can check the generated alarm by counting the number of times the LED blinks.	P.132
C-DAT LED (green)	This LED will blink or illuminate steadily when the driver is communicating with the master station properly via RS-485 communication.	−
C-ERR LED (red)	This LED will illuminate when a RS-485 communication error occurs with the master station.	−
Address number setting switch (SW1)	Use this switch when controlling the system via RS-485 communication. Set the address number of RS-485 communication (initial setting: 0).	P.94
Function setting switches (SW2)	Use this switches when controlling the system via RS-485 communication. No.1 to 3: Set the baud rate of RS-485 communication. 　　(initial setting: ON) No.4: Set the connection destination of RS-485 communication. 　　(initial setting: OFF)	P.94
Terminal resistor setting switch (SW3)	Use this switch when controlling the system via RS-485 communication. Set the terminal resistor (120 Ω) of RS-485 communication (initial setting: OFF).	P.95
Power supply connector (CN1)	Connect main power supply (+24 VDC) using the supplied connector.	P.25
I/O signals connector (CN2)	Connect I/O signals using the supplied connector cable.	P.28
Communication connector (CN3)	Connect a PC in which the **MEXE02** has been installed, or the **OPX-2A**.	P.31
Motor connector (CN4)	Connect the motor.	P.24
Encoder connector (CN5)	Connect the encoder.	P.31
RS-485 communication connector (CN6/CN7)	Connect the RS-485 communication cable.	P.32

7   Installation

This chapter explains the installation location and installation method of the motor and driver. Also covered in this section are the installation and wiring methods that are in compliance with the relevant EMC Directives.

7.1   Location for installation

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

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature   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 +40 °C (+32 to +104 °F) (non-freezing)
- Operating ambient humidity   85% or less (non-condensing)
- Area that is free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
- Area not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area not subject to splashing water (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

7.2   Installing the motor

The motor can be installed in any direction.
Install the motor onto an appropriate flat metal plate having excellent vibration resistance and heat conductivity.
When installing the motor, secure it with four bolts (not supplied) through the four mounting holes.
Do not leave a gap between the motor and metal plate.

Note Insert the pilot located on the motor's installation surface into the mounting plate's.

Installation method A
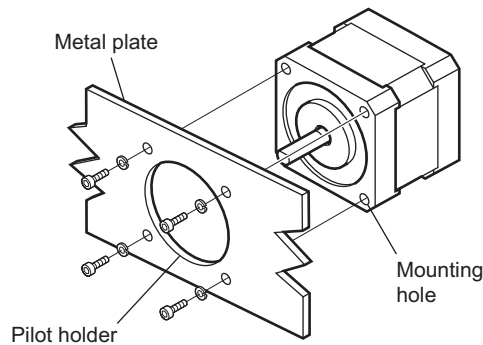
Installation method B
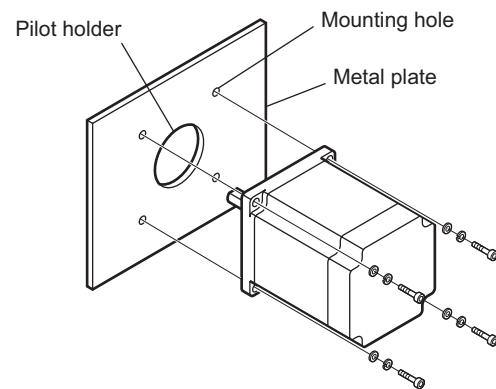
Screw size, tightening torque and installation method

Frame size [mm (in.)]	Type	Motor model*		Nominal size	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]	Installation method
		Single shaft	Double shaft				
□20 (0.79)	High-torque type	PK513PA	PK513PB	M2	0.25 (35)	2.5 (0.098)	A
	High-torque type with encoder	PK513PA-R23L	–				
	Harmonic geared type	PK513PA-H□S	PK513PB-H□S	M2	0.25 (35)	5 (0.197)	
□28 (1.10)	High-resolution type	PK523PMA PK524PMA PK525PMA PK523HPMA PK524HPMA PK525HPMA	PK523PMB PK524PMB PK525PMB PK523HPMB PK524HPMB PK525HPMB	M2.5	0.5 (71)	2.5 (0.098)	A

Frame size [mm (in.)]	Type	Motor model*		Nominal size	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]	Installation method
		Single shaft	Double shaft				
□28 (1.10)	High-torque type	PK523PA PK525PA PK523HPA PK525HPA	PK523PB PK525PB PK523HPB PK525HPB	M2.5	0.5 (71)	2.5 (0.098)	A
	High-torque type with encoder	PK523PA-R23L PK525PA-R23L PK523HPA-R23L PK525HPA-R23L	–				
	TH geared type	PK523PA-T□	PK523PB-T□	M2.5	0.5 (71)	4 (0.157)	
	PS geared type	PK523PA-PS□	PK523PB-PS□	M3	1 (142)	6 (0.236)	
	PN geared type	PK523PA-N□	PK523PB-N□				
□30 (1.18)	Harmonic geared type	PK523HPA-H□S	PK523HPB-H□S	M3	1 (142)	6 (0.236)	A
□42 (1.65)	High-resolution type	PK544PMA PK546PMA	PK544PMB PK546PMB	M3	1 (142)	4.5 (0.177)	A
	High-torque type	PK544PA PK546PA	PK544PB PK546PB				
	High-torque type with encoder	PK544PA-R23L PK546PA-R23L	–				
	Standard type with encoder	PK543AW-R23L PK544AW-R23L PK545AW-R23L	–				
	Standard type with electro-magnetic brake	PK543AWM PK544AWM PK545AWM	–				
	Standard type	PK543AW PK544AW PK545AW	PK543BW PK544BW PK545BW				
	TH geared type	PK543AW-T□	PK543BW-T□	M4	2 (280)	8 (0.315)	
	PS geared type	PK543AW-PS□ PK545AW-PS□	PK543BW-PS□ PK545BW-PS□				
	PN geared type	PK544AW-N□	PK544BW-N□				
	Harmonic geared type	PK543AW-H□S	PK543BW-H□S				
□60 (2.36)	High-resolution type	PK564PMA PK566PMA PK569PMA	PK564PMB PK566PMB PK569PMB	M4	2 (280)	–	B
	Standard type with encoder	PK564AW-R23L PK566AW-R23L PK569AW-R23L	–				
	Standard type with electro-magnetic brake	PK564AWM PK566AWM PK569AWM	–				
	Standard type	PK564AW PK566AW PK569AW	PK564BW PK566BW PK569BW				
	TH geared type	PK564AW-T□	PK564BW-T□	M4	2 (280)	8 (0.315)	
	PS geared type	PK564AW-PS□ PK566AW-PS□	PK564BW-PS□ PK566BW-PS□	M5	2.5 (350)	10 (0.394)	A
	PN geared type	PK566AW-N□ PK564AW-N□	PK566BW-N□ PK564BW-N□				
	Harmonic geared type	PK564AW-H□S	PK564BW-H□S				

∗ □ within the model name represents the gear ratio.

7.3 Installing a load

When connecting a load to the motor, align the centers of the motor's output shaft and load shaft. Also, keep the overhung load and thrust load to the permissible values or below.

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 (ball bearing) when installing a coupling or pulley to the motor's output shaft.
- Do not modify or machine the motor's output shaft. Doing so may damage the bearings and destroy the motor.
- If you are using a motor with encoder, an optical encoder is housed in the motor. To prevent damage to the encoder, handle the motor with care and avoid strong impact to the motor output shaft when transporting the motor or installing the load.

- Using a coupling

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

- Using a belt drive

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

- Using a fastening key (geared motor)

  Connect a load to the gear output shaft having a key groove, first provide a key groove on the load and fix the load with the gear output shaft using the supplied key.

- Installing on the flange surface (harmonic geared type)

  With a harmonic geared type, a load can be installed directly to the gear using the load mounting holes provided on the flange surface.
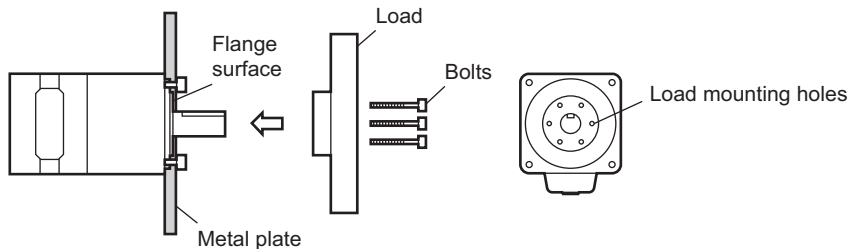
Motor model*	Nominal size	Number of bolts	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]
PK513-H□S	M2	3	0.35 (49)	3 (0.118)
PK523-H□S	M3	4	1.4 (198)	4 (0.157)
PK543-H□S	M3	6	1.4 (198)	5 (0.20)
PK564-H□S	M4	6	2.5 (350)	6 (0.236)

∗ □ within the model name represents the gear ratio.

Note
- When installing a load on the flange surface, the load cannot also be affixed using the keyway (or milled surface) 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

The overhung load and the thrust load on the motor's output shaft must be kept under the permissible values listed below.

Note Failure due to fatigue may occur when the motor bearings and output shaft are subject to repeated loading by an overhung or thrust load that is in excess of the permissible limit.

Frame size [mm (in.)]	Type	Motor model[1]		Permissible overhung load [N (lb.)] Distance from the tip of motor output shaft [mm (in.)]					Permissible thrust load [N (lb.)]
		Single shaft	Double shaft	0 (0)	5 (0.20)	10 (0.39)	15 (0.59)	20 (0.79)	
□20 (0.79)	High-torque type	PK513PA	PK513PB	12 (2.7)	15 (3.3)	–	–	–	0.05 (0.11)[2]
	High-torque type with encoder	PK513PA-R23L	–						
	Harmonic geared type	PK513PA-H□S	PK513PB-H□S	50 (11.2)	75 (16.8)	–	–	–	60 (13.5)
□28 (1.10)	High-resolution type	PK523PMA PK523HPMA	PK523PMB PK523HPMB	25 (5.6)	34 (7.6)	52 (11.7)	–	–	0.11 (0.24)[2]
		PK524PMA PK524HPMA	PK524PMB PK524HPMB						0.15 (0.33)[2]
		PK525PMA PK525HPMA	PK525PMB PK525HPMB						0.2 (0.44)[2]
	High-torque type	PK523PA PK523HPA	PK523PB PK523HPB						0.11 (0.24)[2]
		PK525PA PK525HPA	PK525PB PK525HPB						0.2 (0.44)[2]
	High-torque type with encoder	PK523PA-R23L PK523HPA-R23L	–						0.11 (0.24)[2]
		PK525PA-R23L PK525HPA-R23L	–						0.2 (0.44)[2]
	TH geared type	PK523PA-T□	PK523PB-T□	15 (3.3)	17 (3.8)	20 (4.5)	23 (18)	–	10 (2.2)
	PS geared type	PK523PA-PS□	PK523PB-PS□	45 (10.1)	60 (13.5)	80 (18)	100 (22)	–	20 (4.5)
	PN geared type	PK523PA-N□	PK523PB-N□						20 (4.5)
□30 (1.18)	Harmonic geared type	PK523HPA-H□S	PK523HPB-H□S	110 (24)	135 (30)	175 (39)	250 (56)	–	140 (31)
□42 (1.65)	High-resolution type	PK544PMA	PK544PMB	20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	–	0.3 (0.66)[2]
		PK546PMA	PK546PMB						0.5 (1.1)[2]
	High-torque type	PK544PA	PK544PB						0.3 (0.66)[2]
		PK546PA	PK546PB						0.5 (1.1)[2]
	High-torque type with encoder	PK544PA-R23L	–						0.36 (0.81)[2]
		PK546PA-R23L	–						0.56 (1.2)[2]
	Standard type with encoder	PK543AW-R23L	–						0.31 (0.69)[2]
		PK544AW-R23L	–						0.36 (0.81)[2]
		PK545AW-R23L	–						0.46 (1.0)[2]
	Standard type with electro-magnetic brake	PK543AWM	–						0.37 (0.81)[2]
		PK544AWM	–						0.42 (0.92)[2]
		PK545AWM	–						0.52 (1.14)[2]
	Standard type	PK543AW	PK543BW						0.25 (0.55)[2]
		PK544AW	PK544BW						0.3 (0.66)[2]
		PK545AW	PK545BW						0.4 (0.88)[2]
	TH geared type	PK543AW-T□	PK543BW-T□	10 (2.2)	14 (3.1)	20 (4.5)	30 (6.7)	–	15 (3.3)
	PS geared type	PK543AW-PS□	PK543BW-PS□	109 (24)	127 (28)	150 (33)	184 (41)	–	50 (11.2)
		PK545AW-PS□	PK545BW-PS□	73 (16.4)	84 (18.9)	100 (22)	123 (27)	–	
	PN geared type	PK544AW-N□	PK544BW-N□	100 (22)	120 (27)	150 (33)	190 (42)	–	100 (22)
	Harmonic geared type	PK543AW-H□S	PK543BW-H□S	180 (40)	220 (49)	270 (60)	360 (81)	510 (114)	220 (49)

∗1 □ within the model name represents the gear ratio.
∗2 indicated the motor's mass [kg (lb.)]. The thrust load should not exceed the motor's mass.

Frame size [mm (in.)]	Type	Motor model[1]		Permissible overhung load [N (lb.)]					Permissible thrust load [N (lb.)]
				Distance from the tip of motor output shaft [mm (in.)]					
		Single shaft	Double shaft	0 (0)	5 (0.20)	10 (0.39)	15 (0.59)	20 (0.79)	
□60 (2.36)	High-resolution type	PK564PMA	PK564PMB	90 (20)	100 (22)	130 (29)	180 (40)	270 (60)	0.65 (1.43)[2]
		PK566PMA	PK566PMB						0.87 (1.91)[2]
		PK569PMA	PK569PMB						1.5 (3.3)[2]
	Standard type with encoder	PK564AW-R23L	–	63 (14.1)	75 (16.8)	95 (21)	130 (29)	190 (42)	0.7 (1.57)[2]
		PK566AW-R23L	–						0.9 (2.02)[2]
		PK569AW-R23L	–						1.4 (3.1)[2]
	Standard type with electro-magnetic brake	PK564AWM	–						0.9 (2)[2]
		PK566AWM	–						1.1 (2.4)[2]
		PK569AWM	–						1.6 (3.5)[2]
	Standard type	PK564AW	PK564BW						0.6 (1.3)[2]
		PK566AW	PK566BW						0.8 (1.76)[2]
		PK569AW	PK569BW						1.3 (2.9)[2]
	TH geared type	PK564AW-T□	PK564BW-T□	70 (15.7)	80 (18)	100 (22)	120 (27)	150 (33)	40 (9)
	PS geared type	PK564AW-PS25 PK564AW-PS36 PK564AW-PS50	PK564BW-PS25 PK564BW-PS36 PK564BW-PS50	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	100 (22)
		PK566AW-PS5	PK566BW-PS5	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	
		PK566AW-PS7 PK566AW-PS10	PK566BW-PS7 PK566BW-PS10	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
	PN geared type	PK566AW-N5	PK566BW-N5	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	
		PK566AW-N7.2 PK566AW-N10	PK566BW-N7.2 PK566BW-N10	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
		PK564AW-N25 PK564AW-N36 PK564AW-N50	PK564BW-N25 PK564BW-N36 PK564BW-N50	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	
	Harmonic geared type	PK564AW-H□S	PK564BW-H□S	320 (72)	370 (83)	440 (99)	550 (123)	720 (162)	450 (101)

[1] □ within the model name represents the gear ratio.
[2] indicated the motor's mass [kg (lb.)]. The thrust load should not exceed the motor's mass.

■ 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 below.

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

Motor model*	Permissible moment load [N·m (oz-in)]
PK513-H□S	0.7 (99)
PK523-H□S	2.9 (410)
PK543-H□S	5.6 (790)
PK564-H□S	11.6 (1640)

* □ within the model name represents the gear ratio.
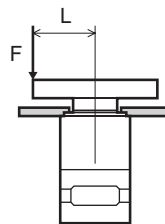
7.5   Installing the driver

■ Installation direction

Use a DIN rail 35 mm (1.38 in.) wide to mount the driver. Provide 50 mm (1.97 in.) clearances in the horizontal and vertical directions between the driver and enclosure or other equipment within the enclosure.
Refer to the figure below for the required distances between adjacent drivers when two or more drivers are installed in parallel.

- CRD503-KD, CRD507-KD, CRD507H-KD
  Horizontal direction: Can be placed in contact with each other.
  Vertical direction: Provide a clearance of 50 mm (1.97 in.) or more.
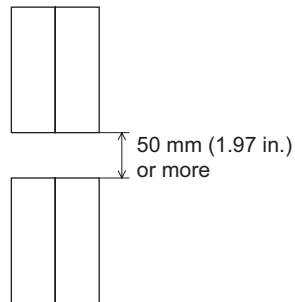
- CRD514-KD
  Horizontal direction: Provide a clearance of 20 mm (0.79 in.) or more.
  Vertical direction: Provide a clearance of 50 mm (1.97 in.) or more.
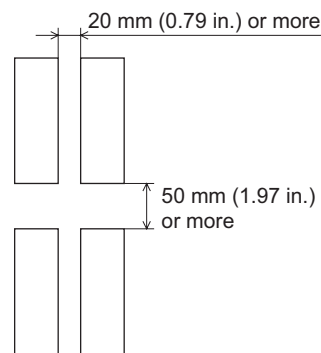
- When using the CRD514-KD in parallel with another driver
  Another unit can be placed in contact with the right side of CRD514-KD.
  Provide a clearance of 20 mm (0.79 in.) or more on the left side of CRD514-KD where a heat sink is located.
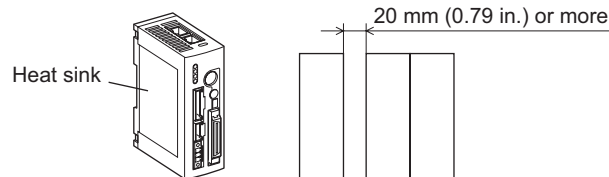
| Note | Be sure to install (position) the driver vertically. When the driver is installed in any position other than vertical, the heat radiation effect of the driver will drop. |

■ Installation method

Push up the driver's DIN lever until it locks. Hang the hook at the rear to the DIN rail, and push in the driver. After installation, fix the both sides of the driver with the end plate.
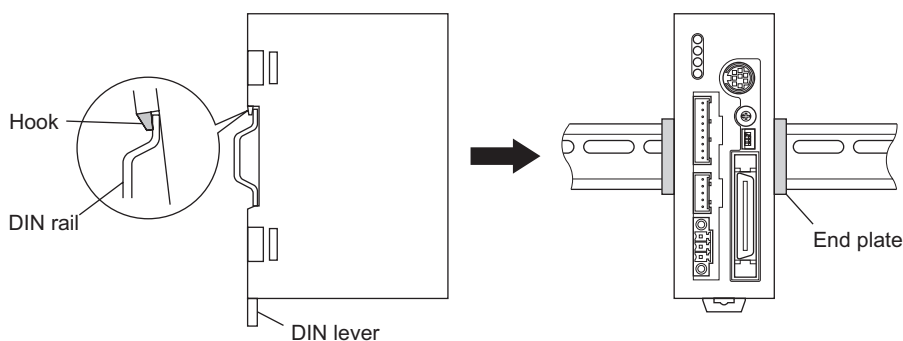
Removing from DIN rail

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

Use a force of about 10 to 20 N (2.2 to 4.5 lb.) to pull the DIN lever down to lock it. Excessive force may damage the DIN lever.
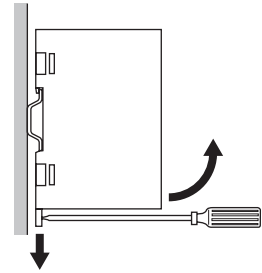
7.6 Installing and wiring in compliance with EMC Directive

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 "CE Marking" on p.7 for the applicable standards.
Oriental Motor conducts EMC measurements its motors and drivers in accordance with "Example of motor and driver installation and wiring" on p.23.
The user is responsible for ensuring the machine's compliance with the EMC Directive, based on the installation and wiring explained below.

■ Power supply

This products are specifically designed for DC power supply input.
Use a DC power supply (such as a switching power supply) compliant with the EMC Directive.

■ Connecting noise filter for power supply line

- Connect a noise filter in the DC power supply input part to prevent the noise generated in the driver from propagating externally through the power supply line.
- When using a power supply transformer, be sure to connect a noise filter to the AC input side of the power supply transformer.
- For a noise filter, use MC1210 (TDK-Lambda Corporation) or equivalent product.
- Install the noise filter as close to the AC input terminal of DC power supply as possible. Use cable clamps and other means to secure the input and output cables (AWG18: 0.75 mm^2 or more) firmly to the surface of the enclosure.
- Connect the ground terminal of the noise 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 noise filter output cable (AWG18: 0.75 mm^2 or more). Parallel placement will reduce noise filter effectiveness if the enclosure's internal noise is directly coupled to the power supply cable by means of stray capacitance.

■ Ferrite core

If the **OPX-2A** is used, install ferrite cores. Ferrite cores have the effect of reducing external noise. For a ferrite core, use ZCAT3035-1330 (TDK Corporation) or equivalent product.
Install ferrite cores as close to the **OPX-2A** as possible.

■ How to ground

The cable used to ground the 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.
Install the motor onto a grounded metal surface.

■ Wiring the power supply cable and signal cable

- Use a shielded cable of AWG22 (0.3 mm^2) or more for the power supply cable, and keep it as short as possible.
- Use a supplied cable for the I/O signals cable, and keep it as short as possible.
- To ground a power supply cable, use a metal 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.

Cable — Cable clamp
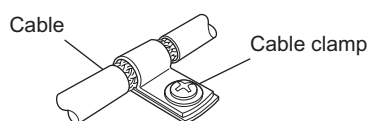
■ Notes about installation and wiring

- 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 [100 to 200 mm (3.94 to 7.87 in.)] as possible from the signal cables. If they have to cross, cross them at a right angle. Place the AC input cable and output cable of a noise filter separately from each other.

■ Example of motor and driver installation and wiring
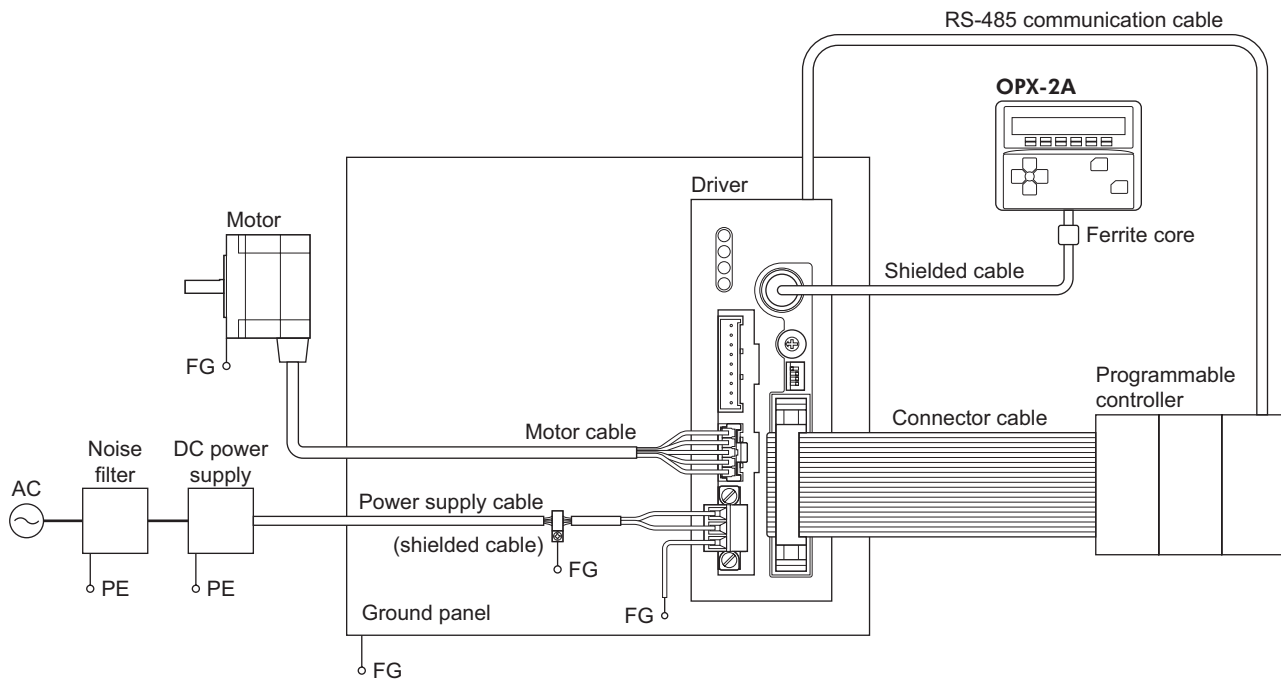
■ Precautions about static electricity

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 the driver, motor, I/O signals, how to connect the power supply, and grounding method.

Note	• Have the connector plugged in securely. Insecure connector connection may cause malfunction or damage to the motor or driver.
	• The CN2/CN4/CN5 connector have a lock mechanism. When removing these connectors, release the connector lock first. Forcibly pulling out the connector without releasing the connector lock may damage the connector.
	• To cycle the power or plugging/unplugging the connector, turn off the power and then wait for at least 5 seconds.
	• If the motor cable or power supply cable generates an undesirable amount of noise, shield the cable or install a ferrite core.

8.1 Connecting the motor

• Applicable product

Standard type with encoder, Standard type with electromagnetic brake, Standard type
TH geared type, **PS** geared type, **PN** geared type, Harmonic geared type (**CRK543**, **CRK544**, **CRK564** and **CRK566**)

• Connecting method

1. Connect the CN4 connector leads (5 pins) to the motor connector (CN4) on the driver.

2. Connect the motor leads and CN4 connector leads.
   The customer must provide the terminal block, connectors and other items needed to interconnect the leads.

Motor connector (CN4)

Blue	⟷	Blue
Red	⟷	Red
Orange	⟷	Orange
Green	⟷	Green
Black	⟷	Black

Motor lead wires   CN4 connector
                             lead wires (supplied)
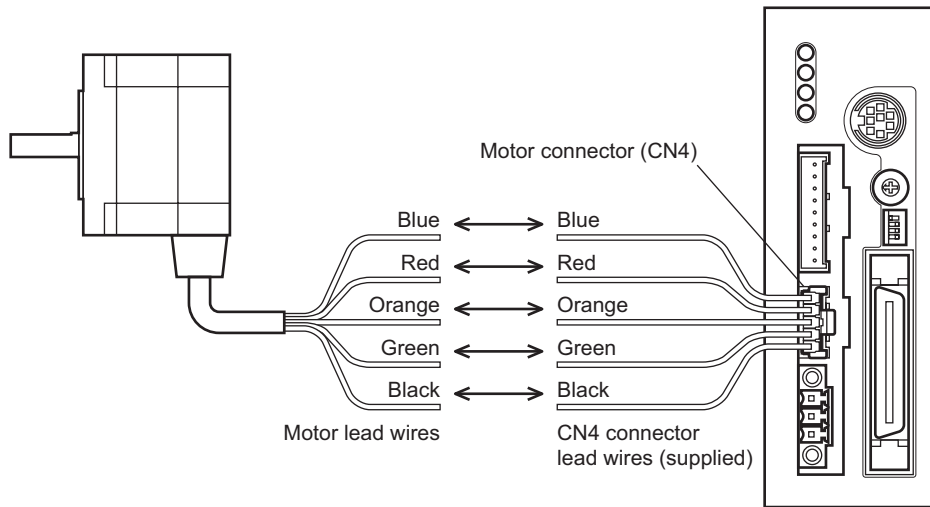
• CN4 pin assignments

Pin No.	Connection destination
1	Blue motor lead
2	Red motor lead
3	Orange motor lead
4	Green motor lead
5	Black motor lead
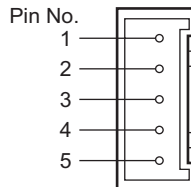
• Composition of CN4 connector with leads

Connector housing	51103-0500 (Molex)
Contact	50351-8000 (Molex)
Crimping tool	57295-5000 (Molex)
Applicable lead size	AWG22 (0.3 mm^2)

■ Connector-type motor

- Applicable product

  High-resolution type, High-torque type, High-torque type with encoder
  TH geared type, **PS** geared type, **PN** geared type, Harmonic geared type (**CRK513P**, **CRK523P**)

- Connecting method

  1. Connect the CN4 connector leads (5 pins) to the motor connector (CN4) on the driver.

  2. Connect the motor connector leads (5 pins) to the motor.

  3. Connect the motor connector leads and CN4 connector leads.
     The customer must provide the terminal block, connectors and other items needed to interconnect the leads.

Connector-type motor

Motor connector (CN4)

Blue	⟷	Blue
Red	⟷	Red
Orange	⟷	Orange
Green	⟷	Green
Black	⟷	Black

Motor connector leads (supplied) CN4 connector leads (supplied)
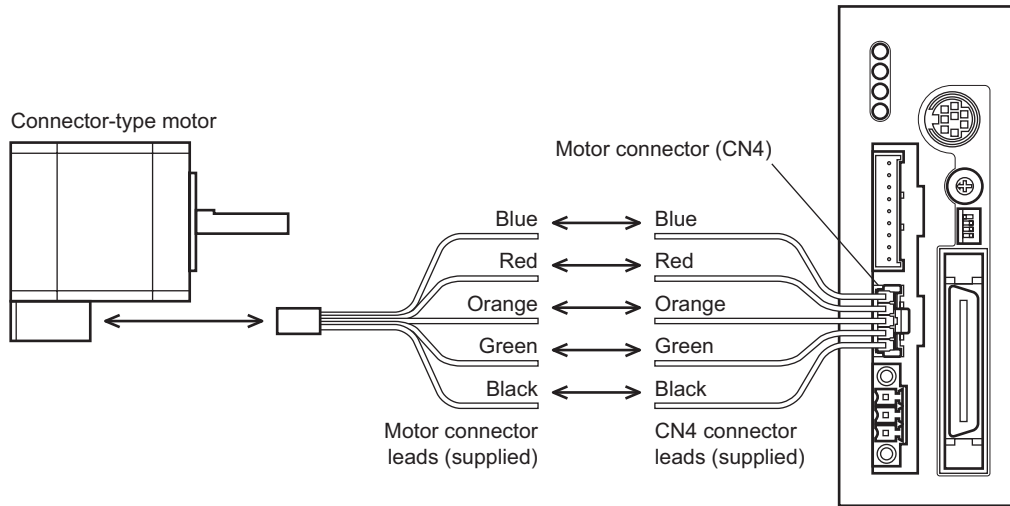
- Composition of motor connector with leads

Frame size [mm (in.)]	□20 (0.79) for **CRK51** □28 (1.10) for **CRK52**	□42 (1.65) for **CRK54**	□60 (2.36) for **CRK56**
Connector housing	51065-0500 (Molex)	51103-0500 (Molex)	51144-0500 (Molex)
Contact	50212-8100 (Molex)	50351-8100 (Molex)	50539-8100 (Molex)
Crimping tool	57176-5000 (Molex)	57295-5000 (Molex)	57189-5000 (Molex)
Applicable lead size	AWG24 (0.2 mm^2)	AWG22 (0.3 mm^2)	AWG22 (0.3 mm^2)

- Connector assignments of connector-type unit

Pin No.	Description
1	Blue motor lead
2	Red motor lead
3	Orange motor lead
4	Green motor lead
5	Black motor lead
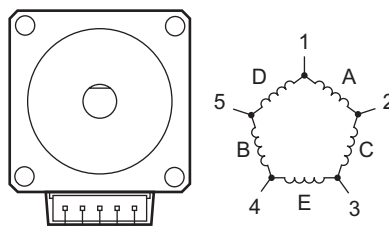
Pin No. 5 4 3 2 1

Note

- When connecting a motor, attach the cable in such a way as to prevent the connection point from receiving stress due to flexing of the cable. Make the cable's radius of curvature as large as possible.

- When disconnecting the connector type connector leads, pull the connector leads horizontally along the output shaft to remove. The motor may be damaged if force is applied in any other direction.

- The motor cables that come with the **CRK54□P**, **CRK54□PM** and **CRK56□PM** have a connector with a lock mechanism. When removing these types of cables, release the connector lock first. Forcibly pulling out the cable without releasing the connector lock may damage the motor and connector.

⇨ 2. Pull out the cable horizontally.

1. Release the lock.*
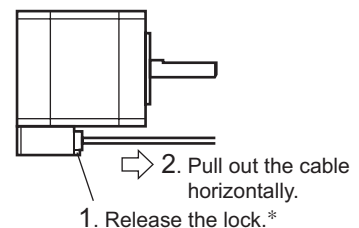
∗ **CRK54□P**, **CRK54□PM** and **CRK56□PM** only.

8.2 Connecting the electromagnetic brake

■ Connecting the power supply for electromagnetic brake

The electromagnetic brake operates via the ON/OFF status of the DC power supply. Provide a DC power supply of 24 VDC±5% 0.11 A or more for the **CRK54**, or 24 VDC±5% 0.33 A or more for the **CRK56**, for use exclusively for the electromagnetic brake.
Use a shielded cable of AWG24 (0.2 mm^2) or more to connect the electromagnetic brake to the DC power supply, keeping the length as short as possible.

■ Connecting method

Connect two leads [600 mm (23.6 in.)] from the motor to the DC power supply.

1. Connect the red/white lead to the +24 VDC terminal of the DC power supply, and connect the black/white lead to the GND terminal.

2. Connect the varistor (supplied) in parallel between the +24 VDC terminal and the GND terminal.
   The varistor does not have polarity.
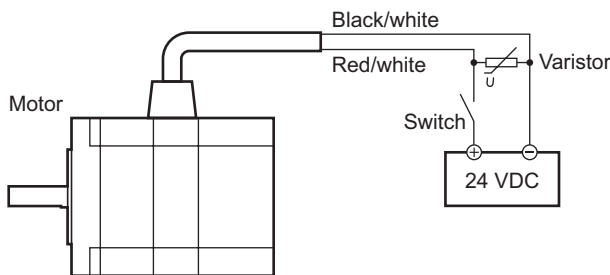
Note	• Applying a voltage over the specification will increase the temperature rise in the electromagnetic brake and may damage the motor. Conversely, insufficient voltage may prevent the brake from releasing.

- Applying a voltage over the specification will increase the temperature rise in the electromagnetic brake and may damage the motor. Conversely, insufficient voltage may prevent the brake from releasing.
- Be sure to connect the varistor to protect the switch contacts and prevent noise.
- The leads for the electromagnetic brake are polarized. Connecting the leads in reverse polarity will not properly operate the electromagnetic brake.
- Provide separate power supplies for the I/O signals and the electromagnetic brake.

■ Operating the electromagnetic brake

Operate the electromagnetic brake as follows:

1. Turn on the driver power and switch ON the excitation to excite the motor.

2. Before inputting operation commands, turn on the electromagnetic brake power and release the electromagnetic brake.
   The motor is now ready to run.

3. When holding the load in position using the electromagnetic brake following motor operation, turn off the electromagnetic brake power after confirming that the motor has stopped.

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

8.3 Connecting the power supply and grounding the driver

■ Connecting the power supply

Use the CN1 connector (3 pins) to connect the power supply cable (AWG22: 0.3 mm^2) to the power supply connector (CN1) on the driver.
Use a power supply capable of supplying the current capacity as shown below.

Driver model	CRD503-KD	CRD507-KD CRD507H-KD	CRD514-KD
Input power supply voltage	+24 VDC±10%		
Current capacity	0.7 A or more	1.4 A or more	2.5 A or more

■ Grounding the driver

Ground the driver's Frame Ground Terminal (FG) as necessary.
Ground using a wire of AWG24 to 16 (0.2 to 1.25 mm^2), and do not share the protective earth terminal with a welder or any other power equipment.

CN1 pin assignments

Pin No.	Name	Description
1	+24 VDC	+24 VDC power supply input
2	GND	Power supply GND
3	FG	Frame Ground
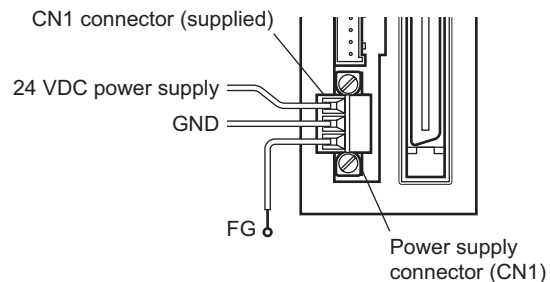
■ Connecting method

1. Strip the insulation cover of the lead wire by 7 mm (0.28 in.)
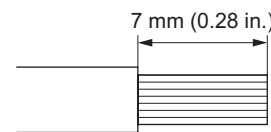
2. Insert each lead wire into the CN1 connector and tighten the screw using a screwdriver (connector screw size: M2).
    Tightening torque: 0.22 to 0.25 N·m (31 to 35 oz-in)
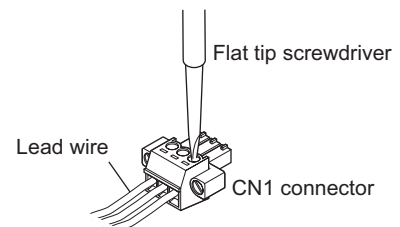
3. Insert the CN1 connector into power supply connector (CN1) and tighten the screws using a screwdriver (connector screw size: M2.5).
    Tightening torque: 0.4 N·m (56 oz-in)
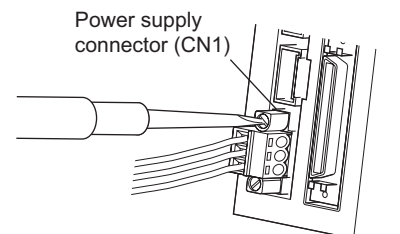
Note
- When connecting, check the silk screen of the driver and pay attention to the polarity of the power supply. Reverse-polarity connection may cause damage to the driver. The power-supply circuit and the RS-485 communication circuit are not insulated. Therefore, when controlling multiple drivers via RS-485 communication, the reverse polarity of the power supply will cause a short circuit and may result in damage to the drivers.
- Do not wire the power supply cable of the driver in the same cable duct with other power line or motor cable. Doing so may cause malfunction due to noise.

8.4 Connecting the I/O signals

Connect the CN2 connector cable (40 pins) to the I/O signals connector (CN2) on the driver.
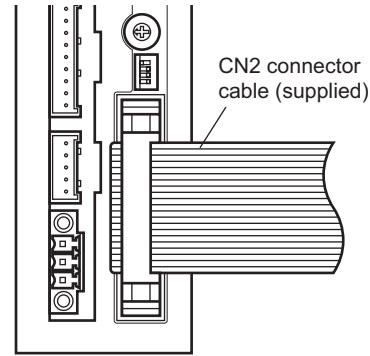
CN2 pin assignments
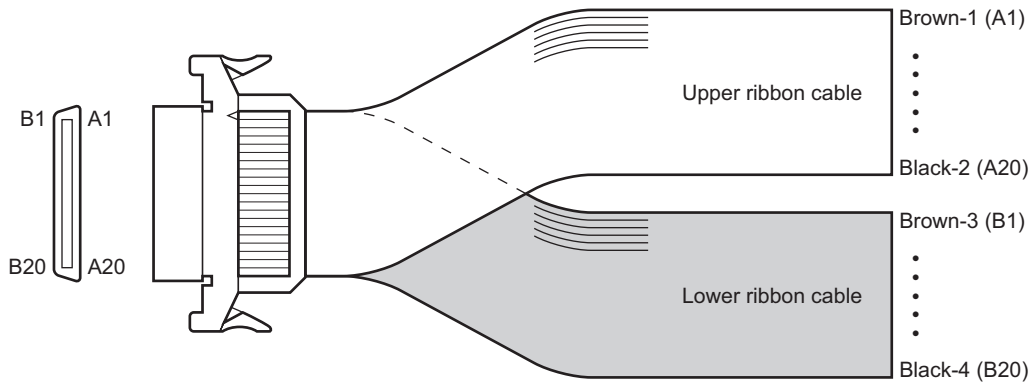
Lead wire color	Upper ribbon cable			Lead wire color	Lower ribbon cable		
	Pin No.	Signal name	Description		Pin No.	Signal name	Description
Brown-1	A1	IN-COM0	Input common	Brown-3	B1	MOVE+	Motor moving output
Red-1	A2	START	Start input	Red-3	B2	MOVE−	
Orange-1	A3	ALM-RST	Alarm reset input	Orange-3	B3	ALM+	Alarm output
Yellow-1	A4	AWO	All windings off input	Yellow-3	B4	ALM−	
Green-1	A5	STOP	Stop input	Green-3	B5	OUT1+	Control output 1 (initial value: AREA)*
Blue-1	A6	M0		Blue-3	B6	OUT1−	
Purple-1	A7	M1		Purple-3	B7	OUT2+	Control output 2 (initial value: READY)*
Gray-1	A8	M2	Data selection input	Gray-3	B8	OUT2−	
White-1	A9	M3		White-3	B9	OUT3+	Control output 3 (initial value: WNG)*
Black-1	A10	M4		Black-3	B10	OUT3−	
Brown-2	A11	M5		Brown-4	B11	OUT4+	Control output 4 (initial value: HOME-P)*
Red-2	A12	HOME/ P-PRESET	Return-to-home/ Position preset input	Red-4	B12	OUT4−	
Orange-2	A13	FWD	Forward input	Orange-4	B13	N.C.	Not used
Yellow-2	A14	RVS	Reverse input	Yellow-4	B14	N.C.	Not used
Green-2	A15	+LS	+ limit sensor input	Green-4	B15	PLS-OUT+	Pulse output (Line driver output)
Blue-2	A16	−LS	− limit sensor input	Blue-4	B16	PLS-OUT−	
Purple-2	A17	HOMES	Mechanical home sensor input	Purple-4	B17	DIR-OUT+	Direction output (Line driver output)
Gray-2	A18	SLIT	Slit sensor input	Gray-4	B18	DIR-OUT−	
White-2	A19	N.C.	Not used	White-4	B19	GND	GND
Black-2	A20	IN-COM1	Sensor input common	Black-4	B20	N.C.	Not used

∗ These settings can be changed using the "OUT1 signal mode selection" to "OUT4 signal mode selection" parameters.

■ Connecting to a current sink output circuit

* The GND line is used in common with CN1 (not insulated).

| Note | • Use input signals at 24 VDC.
| | • Use output signals at 24 VDC 20 mA or less. If the current exceeds 20 mA, connect an external resistor R_0.
| | • The PLS-OUT output and DIR-OUT output are line driver outputs. When connecting a line receiver, be sure to connect pin No.B19 on the driver to the GND on the line receiver, and connect a terminal resistor of 100 Ω or more between the driver and the input of the line receiver.

■ Connecting to a current source output circuit
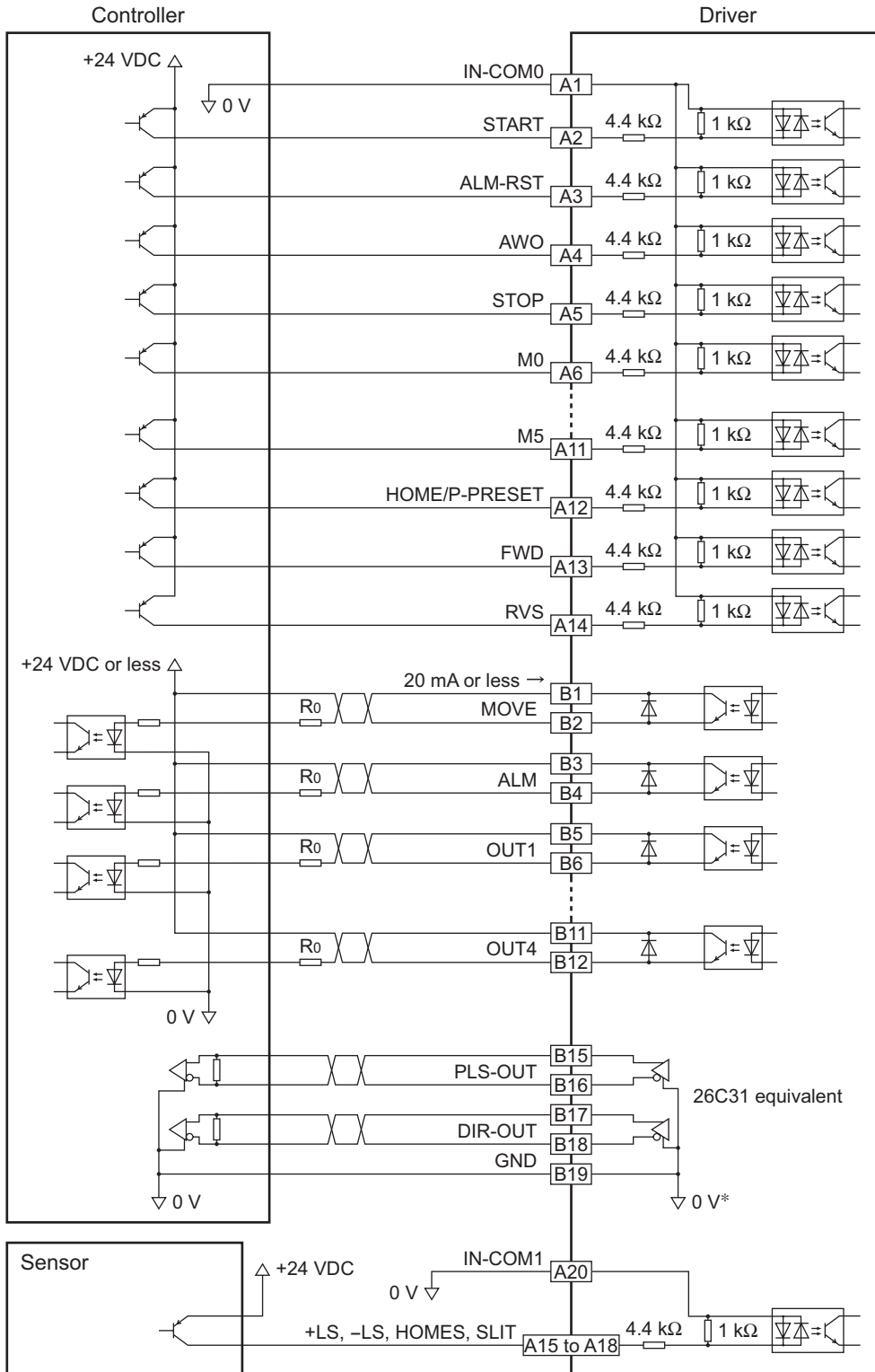
* The GND line is used in common with CN1 (not insulated).

Note	• Use input signals at 24 VDC.

• Use output signals at 24 VDC 20 mA or less. If the current exceeds 20 mA, connect an external resistor R0.

• The PLS-OUT output and DIR-OUT output are line driver outputs. When connecting a line receiver, be sure to connect pin No.B19 on the driver to the GND on the line receiver, and connect a terminal resistor of 100 Ω or more between the driver and the input of the line receiver.

8.5 Connecting the communication cable

Connect the **OPX-2A** cable or cable that comes with the **MEXE02** to the communication connector (CN3) on the driver.

OPX-2A cable or cable that comes with the **MEXE02**

Communication connector (CN3)
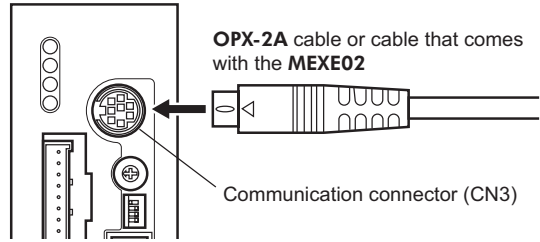
⚠ **Caution** | The driver's power supply connector (CN1), I/O connector (CN2), communication connector (CN3) and RS-485 communication connector (CN6/CN7) are not electrically insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and PC to short, damaging both.

8.6 Connecting the encoder

If an encoder is to be used, connect the encoder.
Use the CN5 connector leads (9 pins), connect the encoder to the encoder connector (CN5) on the driver.
The CN5 connector leads (9 pins) are supplied with the motor unit with encoder.
When extending the leads, use shielded cable of AWG24 to 22 (0.2 to 0.3 mm^2).
Refer to p.129 for the detailed specification of this encoder.

Encoder connector (CN5)

Encoder leads		CN5 connector leads (supplied)
Red	⟷	Red
Pink	⟷	Brown
Green	⟷	Green
Blue	⟷	Blue
Yellow	⟷	Yellow
Orange	⟷	Orange
White	⟷	White
Black	⟷	Black
Shield	⟷	Purple
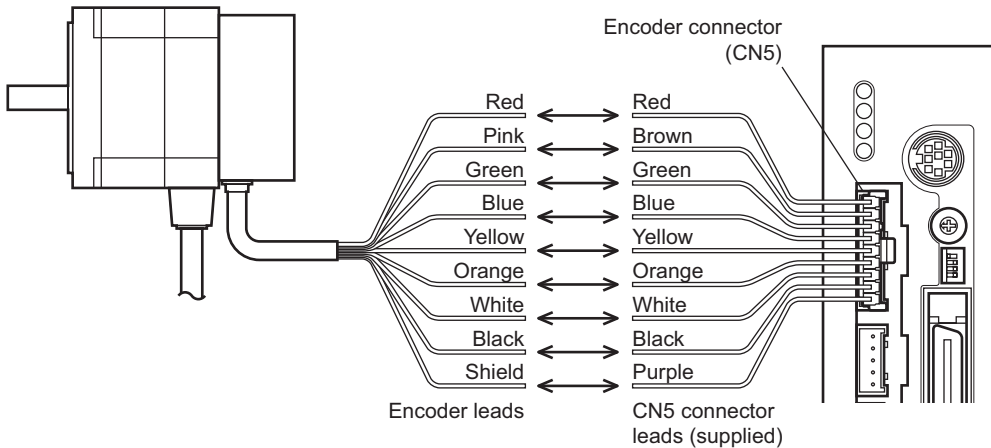
- CN5 pin assignments
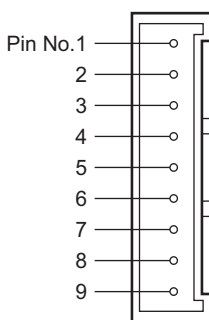
Pin No.	Signal name	Description	Connection destination
1	ENC-A+	Encoder input A-phase (Line receiver)	Red encoder lead
2	ENC-A−		Pink encoder lead
3	ENC-B+	Encoder input B-phase (Line receiver)	Green encoder lead
4	ENC-B−		Blue encoder lead
5	ENC-Z+	Encoder input Z-phase (Line receiver)	Yellow encoder lead
6	ENC-Z−		Orange encoder lead
7	+5 VDC OUT	+5 VDC power supply output for encoder	White encoder lead
8	GND	GND	Black encoder lead
9	SHIELD	Shield (Connect to GND)	Shield lead

- Composition of CN5 connector with leads

Connector housing	51103-0900 (Molex)
Contact	50351-8000 (Molex)
Crimping tool	57295-5000 (Molex)
Applicable lead size	AWG22 (0.3 mm^2)

• Internal circuit diagram
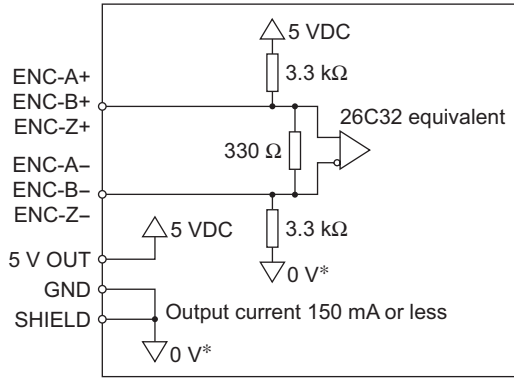
∗ The GND line is used in common with CN1 (not insulated).

| Note | The current consumption of the encoder power supply should be kept to 150 mA or less. When you are providing the encoder on your own, take note that if the encoder power consumption exceeds 150 mA, an encoder power supply must be provided externally to the system. In this case, be sure to use a common GND line for the encoder power supply and encoder connector (CN5). |

■ When connecting the connector-type motor

• Applicable product

High-torque type with encoder (**CRK513PRKD**, **CRK52□PRKD**)

• Connecting method

Connect with supplied encoder connector leads. When extending the leads, use shielded cable of AWG24 to 22 (0.2 to 0.3 mm^2).
Refer to p.129 for the detailed specification of this encoder.

1. Insert the supplied CN5 connector leads (9 pins) into the driver's encoder connector (CN5).

2. Connect the supplied encoder connector leads (8 pins) to the encoder.

3. Interconnect the CN5 connector leads and encoder connector leads.
   The customer must provide the terminal block, connectors and other items needed to interconnect the leads.
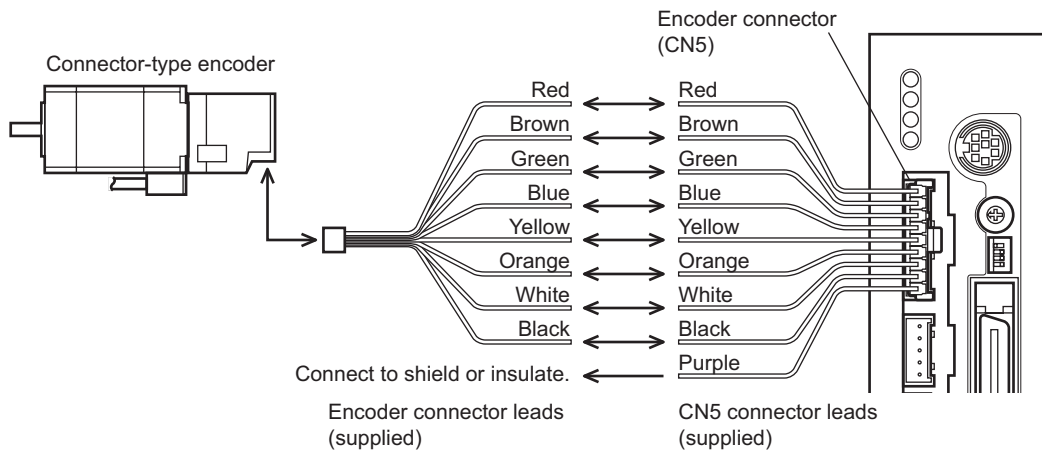
• Composition of encoder connector leads

Connector housing	51021-0800 (Molex)
Contact	50079-8000 (Molex)
Crimping tool	63819-0300 (Molex)
Applicable lead size	AWG26 (0.14 mm^2)

• Composition of CN5 pin assignments and CN5 connector with leads

Refer to p.31.

8.7 Connecting the RS-485 communication cable

Connect this cable if you want to control your product via RS-485 communication.
Connect RS-485 communication cable to CN6 or CN7 on the driver.
You can use the vacant connectors to connect a different driver. An optional driver link cable (sold separately) is available. See p.139.
You can also use a commercial LAN cable to link drivers.

Drivers can be linked.

RS-485 communication connector (CN6/CN7)

Terminal resistor setting switch (SW3)
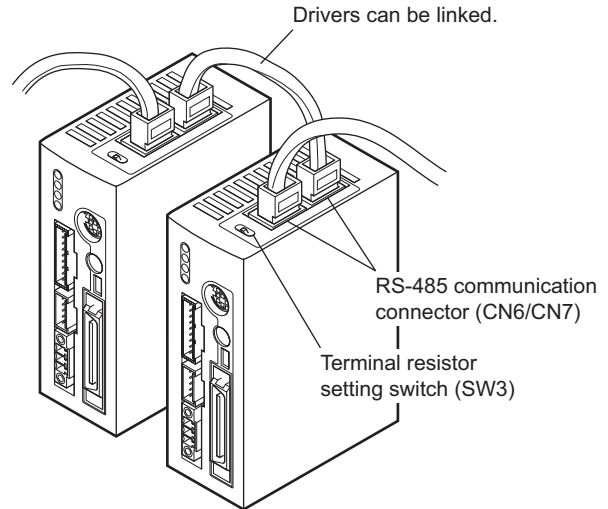
CN6/CN7 pin assignments

Pin No.	Signal name	Description
1	N.C.	Not used
2	GND	GND
3	TR+	RS-485 communication signal (+)
4	N.C.	Not used
5	N.C.	Not used
6	TR−	RS-485 communication signal (−)
7	N.C.	Not used
8	N.C.	Not used

1 N.C.
2 GND
3 TR+
4 N.C.
5 N.C.
6 TR−
7 N.C.
8 N.C.

1 N.C.
2 GND
3 TR+
4 N.C.
5 N.C.
6 TR−
7 N.C.
8 N.C.

SW3

120 Ω

0 V*
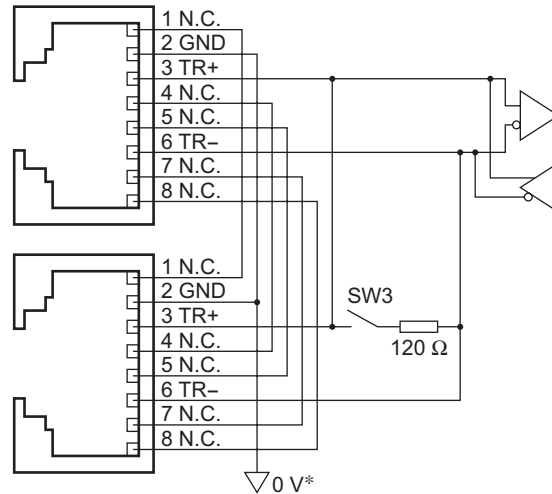
∗ The GND line is used in common with CN1 (not insulated).

9 Explanation of I/O signals

9.1 Input signals

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.

IN-COM0, START, ALM-RST, AWO, STOP
M0 to M5, HOME/P-PRESET, FWD, RVS

Driver internal circuit

A1
4.4 kΩ   1 kΩ
A2 to A14

IN-COM1, +LS, –LS, HOMES, SLIT

Driver internal circuit

A20
4.4 kΩ   1 kΩ
A15 to A18
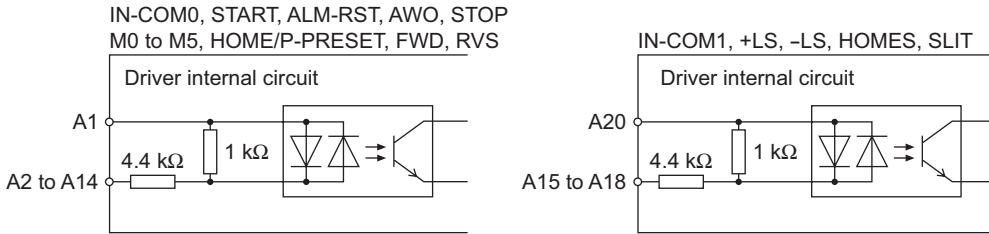
■ AWO input

This signal is used to cut off the motor current (factory setting: normally open).
When the AWO input is turned ON, the motor current will be cut off and the motor will lose its holding torque.
When the AWO input is turned OFF, current will be supplied to the motor and holding torque will be restored.
You can change the input logic using the "AWO contact configuration" parameter (p.57).

AWO input[*1]   ON
                     OFF
                          6 ms or less   6 ms or less[*2]

READY output   ON
                     OFF
                          6 ms or less   6 ms or less

Motor excitation   Excitation   Not excitation   Excitation
command
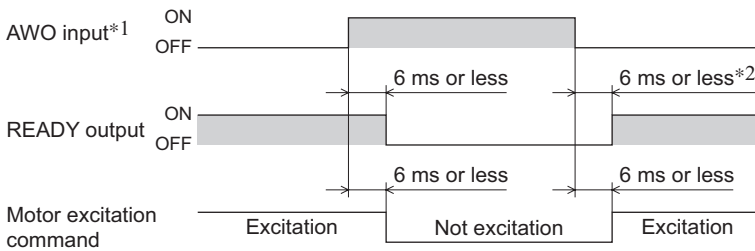
[*1] When the AWO input logic is normally open.
[*2] If the "stepout detection" parameter is set to "enable," this period becomes 500 ms or less. If the parameter is set to "disable," the period becomes 6 ms or less.

■ START input

Turn the START input from OFF to ON to start positioning operation.

                          4 ms or more   4 ms or more

START input   ON
                     OFF
                     4 ms   4 ms
                     or more   or more   4 ms or more

M0 to M5 input   ON
                     OFF
                     0 ms or more   6 ms or less   6 ms or less

READY output   ON
                     OFF
                                          6 ms or less   6 ms or less

MOVE output   ON
                     OFF

Motor operation
command
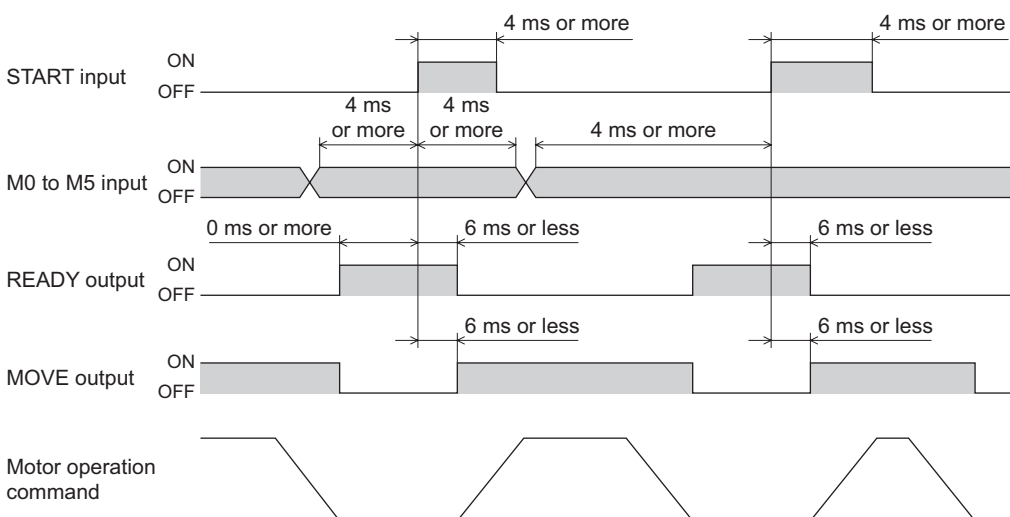
■ STOP input

The STOP input is used to stop the operating motor (factory setting: normally closed).
The STOP input turns OFF, the motor will stop. This input is normally closed, meaning that it is OFF when the power is turned on. You can set a desired stopping operation using the "STOP action" parameter.

- Immediate stop..The motor will stop immediately regardless of the specified deceleration rate.
- Deceleration stop ....The motor will stop according to the specified deceleration rate (initial value).
- Immediate stop+Motor is not excited ....The motor will stop immediately regardless of the specified deceleration rate, after which the motor excitation will be turned off.
- Deceleration stop+Motor is not excited........The motor will stop according to the specified deceleration rate, after which the motor excitation will be turned off.

The deceleration rate that applies when the motor decelerates to a stop in positioning operation or continuous operation can be set as follows using the "acceleration (deceleration) rate type" parameter:
Separate: The deceleration rate set under the applicable operation data number will be followed.
Common: The setting of the "common deceleration rate" parameter will be followed.

Note If the STOP input is normally closed, be sure to turn this input ON when operating the motor.

- When the STOP stopping method is immediate stop or deceleration stop.
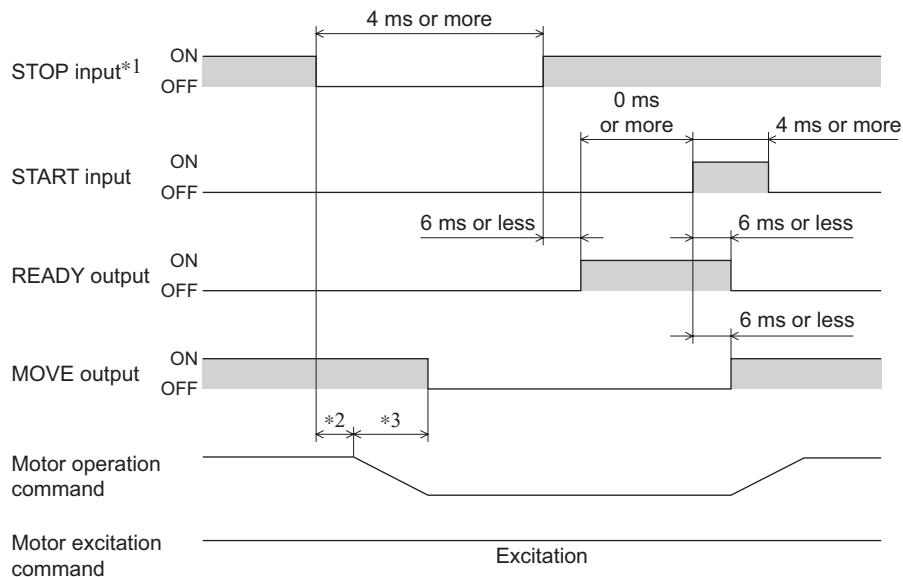
*1   When the STOP input logic is normally closed.
*2   The specific time varies depending on the command speed.
*3   The specific period varies depending on the setting of the "STOP action" parameter.

- When the STOP stopping method is immediate stop+motor is not excited or deceleration stop+ motor is not excited.
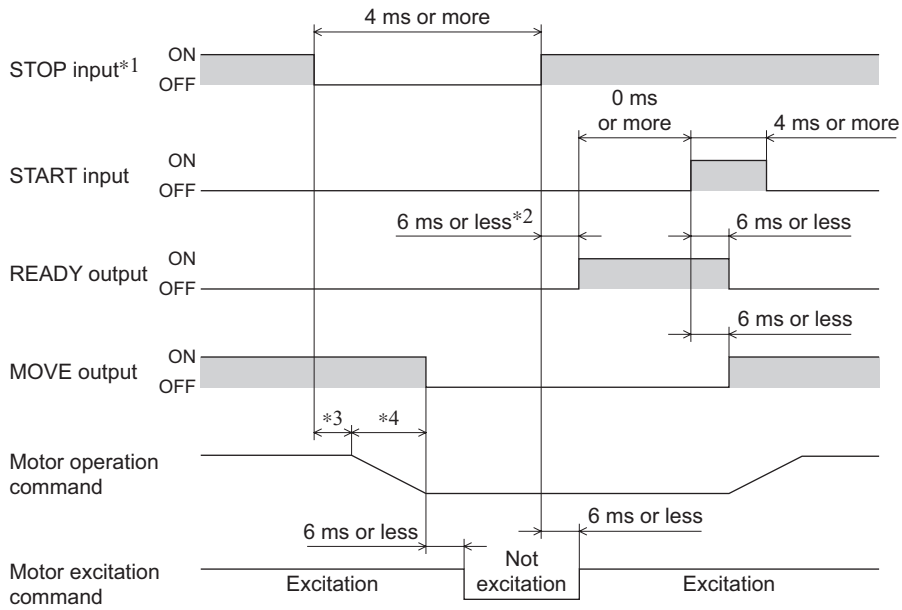
∗1 When the STOP input logic is normally closed.
∗2 If the "stepout detection" parameter is set to "enable", this period becomes 500 ms or less. If the parameter is set to "disable", the period becomes 6 ms or less.
∗3 The specific time varies depending on the command speed.
∗4 The specific period varies depending on the setting of the "STOP action" parameter.

■ M0 to M5 input

Select a desired operation data number for positioning operation or continuous operation based on a combination of ON/OFF states of M0 to M5 inputs.
The ON/OFF status should be held until an operation based on the selected operation data No. is executed.

Operation data No.	M5	M4	M3	M2	M1	M0
Sequential operation	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	**ON**
2	OFF	OFF	OFF	OFF	**ON**	OFF
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
61	**ON**	**ON**	**ON**	**ON**	OFF	**ON**
62	**ON**	**ON**	**ON**	**ON**	**ON**	OFF
63	**ON**	**ON**	**ON**	**ON**	**ON**	**ON**

■ FWD input, RVS input

When the FWD input turns ON, the motor will perform continuous operation in the + direction.
When the RVS input turns ON, the motor will perform continuous operation in the − direction.
The FWD input and RVS input are operated at the operating speed of the selected operation No.
If the FWD input and RVS input are both ON simultaneously, the motor decelerates to a stop.
When the operation data number is changed during continuous operation, the speed will change to the one specified for the new operation data number.
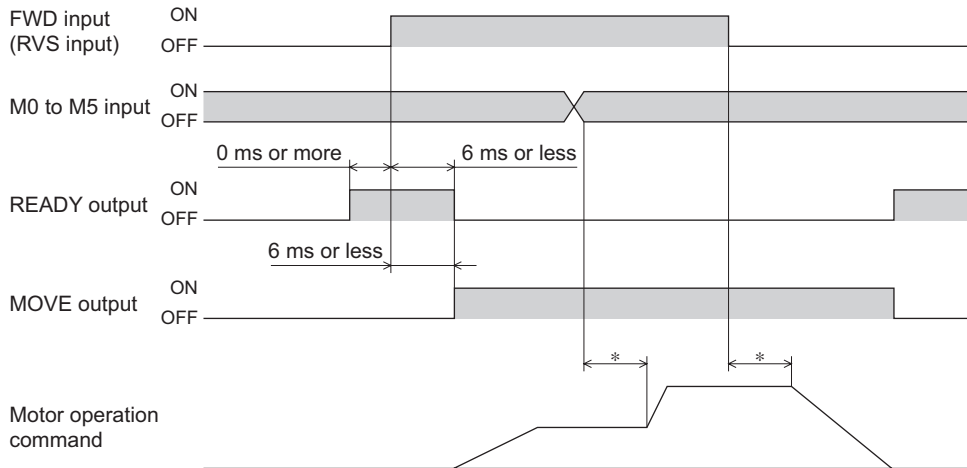
∗ The specific time varies depending on the command speed.

■ HOME/P-PRESET input

Factory setting is HOME input. Switch between HOME input and P-PRESET input using the "HOME/P-PRESET input switching" parameter.

• HOME input

The return-to-home operation starts when the HOME input turns ON.

Example: Return-to-home operation in the 3-sensor mode
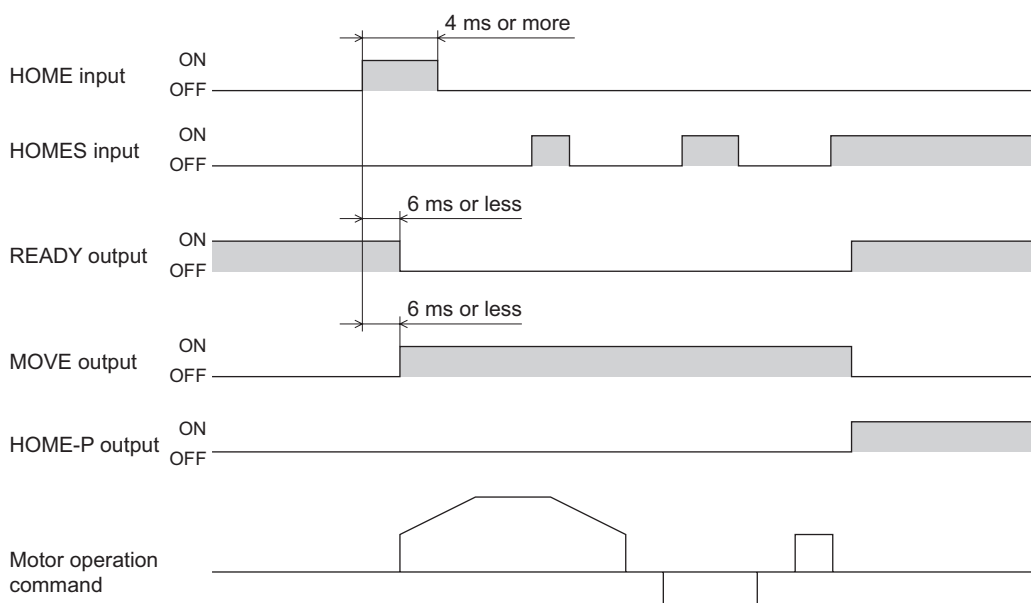
- P-PRESET input

When the P-PRESET input is turned ON, the value in the "preset position" parameter will be overwritten by the command position.

Note Perform the preset operation while the motor is stopped.
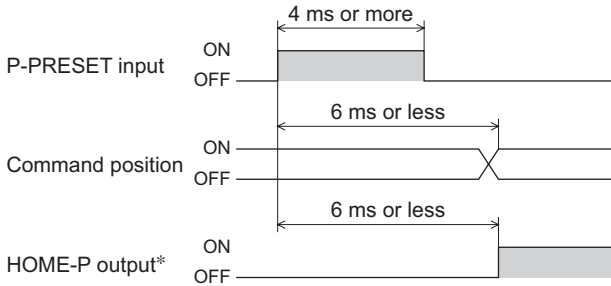
∗ When the "preset position" parameter is set to "0".

■ ALM-RST input

When an alarm generates, the ALM output will turn OFF and motor will stop. 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.) Always reset an alarm after removing the cause of the alarm and after ensuring safety. For details, refer to "ALM output" on p.40, and "15.1 Alarms" on p.132.

Note Some alarms cannot be reset with the ALM-RST input. To reset these alarms, the power must be cycled.

- Resetting the alarm
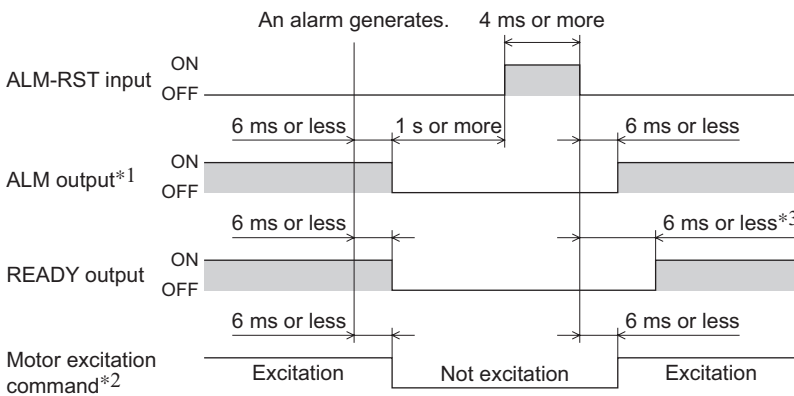
∗1 The ALM output normally closed. This output remains ON in a normal state, and will turn OFF if an alarm generates.
∗2 Assuming generation of an alarm that stops motor excitation.
∗3 If the "stepout detection" parameter is set to "enable," this period becomes 500 ms or less. If the parameter is set to "disable," the period becomes 6 ms or less.

- Limit sensor input (when the limit sensor is normally open)
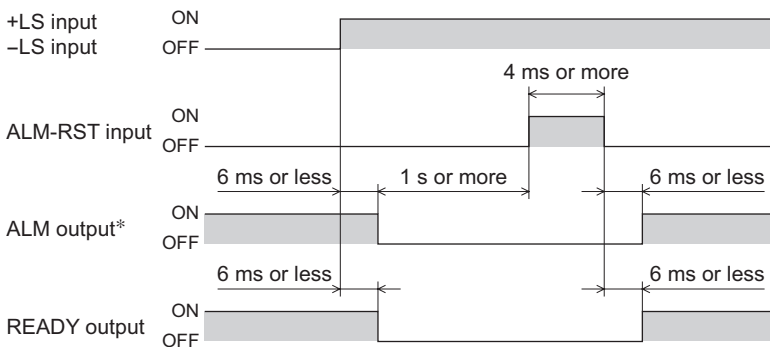
∗ The ALM output is normally closed. This output remains ON in a normal state, and will turn OFF if an alarm generates.

■ +LS input, −LS input

These signals are input from the applicable limit sensors. They are used to detect the home during return-to-home operation. In any other operation, these signals are used to stop the motor.
You can switch the input logics for +LS input and –LS input using the "LS contact configuration" parameter. Take note, however, that only the same input logics can be set for both signals.
See p.50 for details on the return-to-home operation.

> **Note** If the +LS and −LS inputs are to be used in an operation other than return-to-home, set the "hardware overtravel detection" parameter to "enable".

■ HOMES input

These signals are input from the applicable HOME sensors.
This input detects the mechanical home position when a return-to-home operation is executed in the 3-sensor mode.
You can switch the input logic for HOMES input using the "HOMES contact configuration" parameter.
See p.50 for details on the return-to-home operation.

■ SLIT input

This signal is used to detect the home using a slit disc, etc.
When detecting the home, use of the SLIT input in addition to the HOMES input and ±LS inputs will increase the accuracy of home detection.
You can switch the input logic for SLIT input using the "SLIT contact configuration" parameter.

> **Note** If the SLIT input is used, set the "SLIT detection with home-seeking" parameter to "enable".

■ IN-COM0 input

This is a common terminal for input signals.

■ IN-COM1 input

This is a common terminal for the sensors.

> **Note** Use sensor input signals at 24 VDC±10%.

9.2 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.

MOVE, ALM, OUT1 to OUT4

| Driver internal circuit |
| 20 mA or less |

B1, B3, B5, B7, B9, B11

B2, B4, B6, B8, B10, B12

PLS-OUT, DIR-OUT, GND

| Driver internal circuit |

B15, B17
B16, B18   26C31 equivalent
B19
0 V*
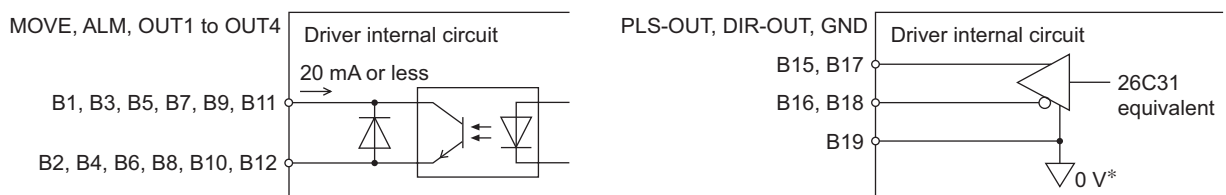
∗ The GND line is used in common with CN1 (not insulated).

■ MOVE output

The MOVE output becomes ON while operating the motor or return-to-home operation. Even when the current operation has completed, the next operation cannot be started while the MOVE output is ON.

4 ms or more

START input ON / OFF

6 ms or less   6 ms or less   6 ms or less

MOVE output ON / OFF

Motor operation command
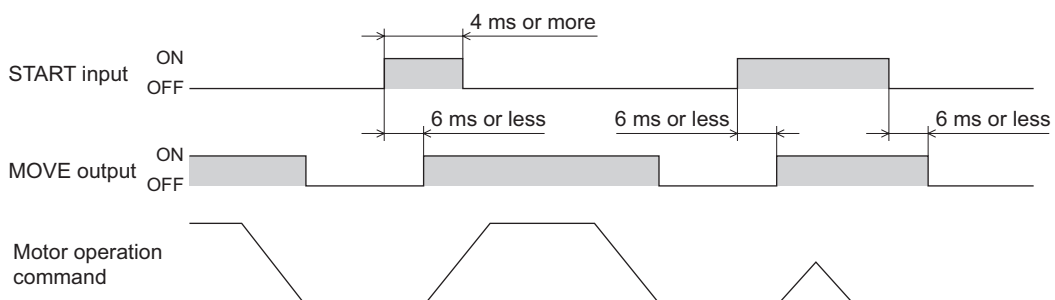
> **Note** Even when positioning operation ends, the MOVE output will not turn OFF as long as the START input remains ON.

■ ALM output

The ALM output is normally closed.
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 will stop.
Set the host controller so that it will stop motor operation commands upon detection of an OFF status of the ALM output. You can check the cause of the alarm by counting the number of times the ALARM LED blinks.
For details, refer to p.132.

■ OUT1 to OUT4 output

The "OUT1 signal mode selection" to "OUT4 signal mode selection" parameters are used to set the desired functions to be assigned to the OUT1 to OUT4 outputs, respectively. The following output signals can be assigned:

- AREA output (area output): Default for OUT1 output
- TIM output (timing output)
- READY output (operation ready complete output): Default for OUT2 output
- WNG output (warning output): Default for OUT3 output
- HOME-P output (return-to-home ready complete output): Default for OUT4 output
- ZSG output (Z-phase pulse output)
- R-OUT1 output (remote output 1)
- R-OUT2 output (remote output 2)
- R-OUT3 output (remote output 3)
- R-OUT4 output (remote output 4)
- O.H. output (overheat output)
- STEPOUT output (misstep detection output)

■ AREA output

The AREA output can be assigned to a control output.
This signal will be output when the motor output shaft is inside the area set by the "area 1" and "area 2" parameters. This signal is also output while the motor is stopped.

> **Note** If the AREA output is to be used during operation, set the width of the area so that the AREA output will remain ON for at least 1 ms. If the AREA output remains ON for less than 1 ms, the AREA output may not actually turn ON.
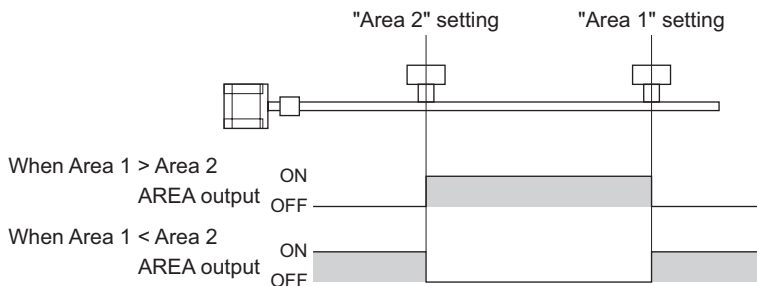
- When the area 1 boundary is greater in position coordinate than the area 2 boundary:
  The AREA output turns ON when the output shaft is positioned at or after the area 2 boundary or at or before the area 1 boundary.
- When the area 1 boundary is smaller in position coordinate than the area 2 boundary:
  The AREA output turns ON when the output shaft is positioned at or before the area 1 boundary or at or after the area 2 boundary.
- The area 1 is the same as the area 2 boundary:
  The AREA output turns ON only when the output shaft is at the specified position.

When the area 1 boundary is greater in position coordinate than the area 2 boundary
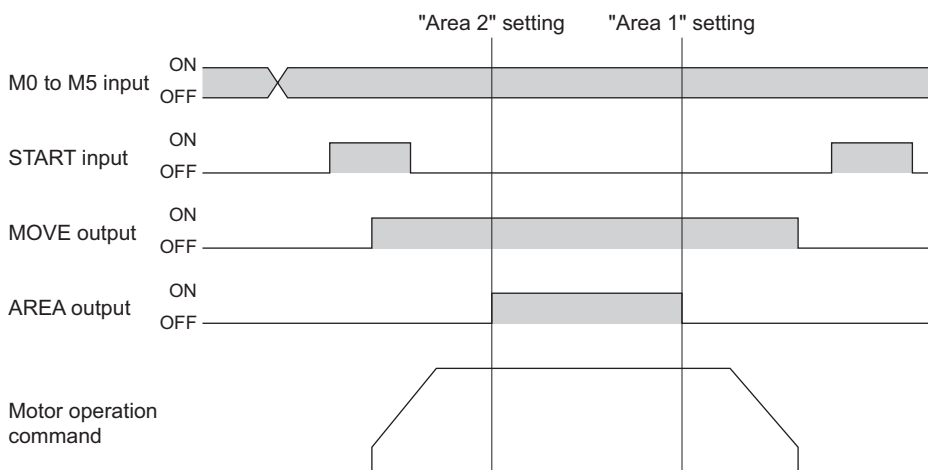
■ TIM output

The TIM output can be assigned to a control output.

This signal turns ON when the motor is at its excitation home.

If the base step angle of the motor is 0.72°, the TIM output will turn ON every time the motor moves by 7.2° from its excitation home in synchronization with the internal oscillation pulse.
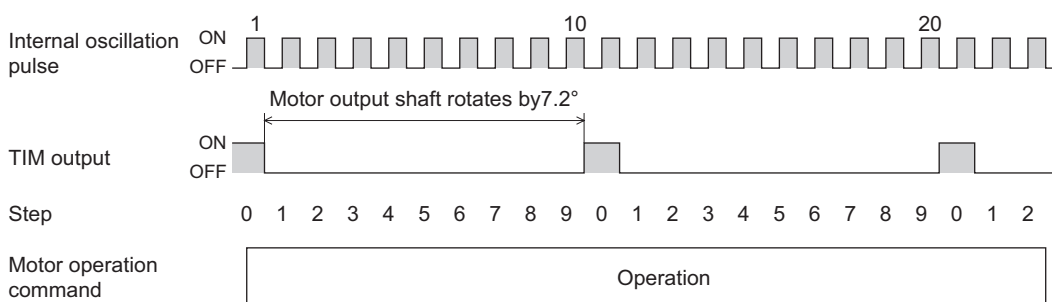
Motor type	Number of divisions		TIM output
	1	10	
Motor with 0.72°/step base step angle	0.72°	0.072°	every 7.2°
Motor with 0.36°/step base step angle	0.36°	0.036°	every 3.6°
Geared motor with 7.2 :1 gear ratio	0.1°	0.01°	every 1°

Note
- The TIM output delays behind motor movement by up to 3 ms. The output may be used to verify the stop position of the motor.
- If the TIM output is to be used during operation, set the motor operating speed to 500 Hz or below. If the motor is operated at speeds faster than 500 Hz, this signal will not be output correctly.

■ READY output

The READY output can be assigned to a control output.

This signal will be output when the driver becomes ready. Start operation after the READY output has turned ON.

The READY output remains OFF in the following conditions:
- The motor is operating.
- An alarm is present.
- Any one of the FWD input, RVS input, HOME input and START input is ON.
- The AWO input is ON (normally open).
- The STOP input is OFF (normally closed).
- The system is operating in the test mode or copy mode via the **OPX-2A**.
- The system is performing test operation, downloading data or being initialized via the **MEXE02**.
- The motor is not excited.
- Immediately after the power was turned on.

■ WNG output

The WNG output can be assigned to control output.
This signal is output when a warning generates. However, the operation will continue.
The WNG output will turn OFF automatically once the cause of the warning is removed.
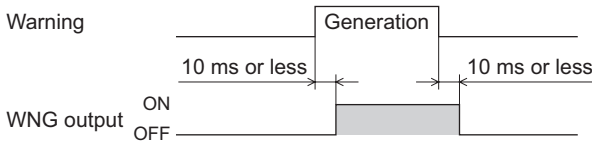
■ HOME-P output

The HOME-P output can be assigned to a control output.
This signal is output upon completion of return-to-home. It will turn ON when all of the following conditions are satisfied:
- The home is already set
- The command position has become 0
- The motor is stopped

The home can be set by the following methods:
- Successful completion of return-to-home operation
- Effecting the preset position
- Clearing the counter via RS-485 communication

The home will be cancelled when either of the following operations is performed:
- Cycle the power.
- Stop the motor excitation (when the "stepout detection" parameter is set to "disable")

■ ZSG output

The ZSG output can be assigned to a control output.
This signal is used when an encoder is connected. The ZSG output signal is output when the ENC-Z input signal is input to the CN5 from the encoder.
Normally the ENC-Z input signal is input every time the motor output shaft turns one revolution.

Note	• The ZSG output signal will not be output correctly unless the ENC-Z input remains ON for at least 1 ms.
	• The ZSG output delays behind motor movement by up to 3 ms. The output may be used to verify the stop position of the motor.

■ R-OUT1 to R-OUT4 output

These signals are general outputs. These signals are used when the system is controlled via RS-485 communication.
Shown below is a timing chart that assumes controls according to GW Protocol Version 1.
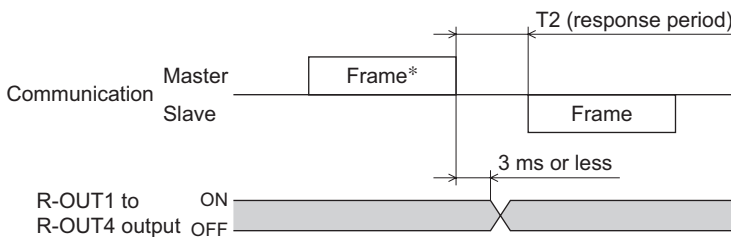
∗ Frame containing the "remote output" command

■ O.H. output

The O.H. output can be assigned to a control output.
If an overheat warning generates, the O.H. output turns ON. The O.H. output will automatically turn OFF upon recovery from the warning condition.
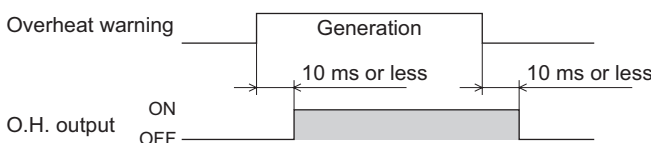
■ STEPOUT output

The STEPOUT output can be assigned to a control output.
This signal becomes effective when an encoder is connected, and a deviation error occurs.
This signal will be output when the deviation between the encoder counter value and driver command position reaches the value set in the "stepout detection band" parameter. If the STEPOUT output is to be used, set the "stepout detection" parameter to "enable". For misstep, refer to p.130.

Deviation condition	Deviation normal	Deviation abnormal

6 ms or less

STEPOUT output ON / OFF
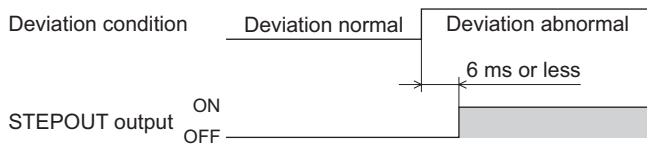
Note
- While the motor is not excited, the STEPOUT output is always OFF. The signal will become effective once the motor has remained excited for at least 500 ms.
- The STEPOUT output remains OFF during return-to-home operation.

■ PLS-OUT output, DIR-OUT output

The PLS-OUT output is used to output the driver's internal oscillation pulses. The number of pulses to be output corresponds to the commanded travel. The pulse frequency corresponds to the operating speed. The maximum output frequency is 500 kHz.
The DIR-OUT output is used to output the driver's internal direction command.

10μs or more | 10μs or more | 10μs or more

PLS-OUT+ output

10μs or more

PLS-OUT− output

DIR-OUT+ output

DIR-OUT− output

Motor operation command — CW / CCW
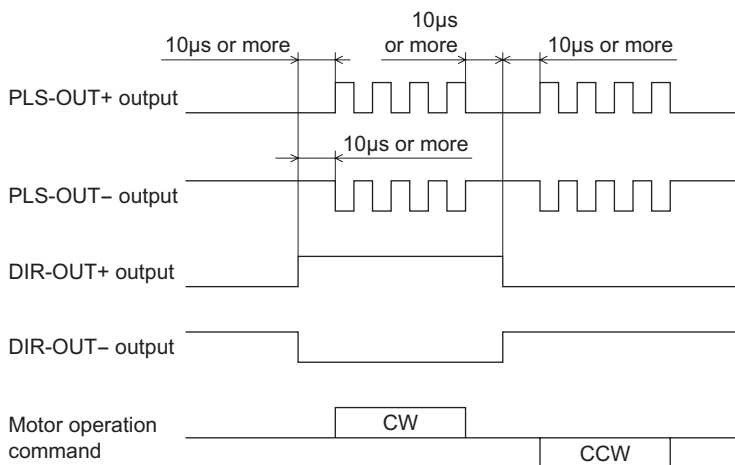
Note
The PLS-OUT output and DIR-OUT output are line driver outputs. When connecting to a line receiver, be sure to connect pin No. B19 of CN2 with the GND line of the line receiver. Also connect a terminal resistor of 100 Ω or more between the line receiver inputs.

- Connect to line receiver

Receiving side / Driver

26C31 equivalent

PLS-OUT+ B15
PLS-OUT− B16
DIR-OUT+ B17
DIR-OUT− B18
B19

0 V / 0 V*
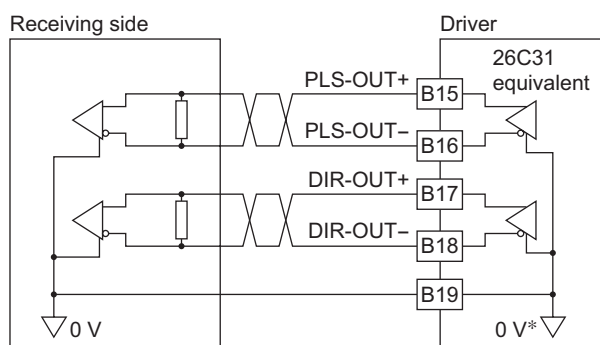
∗ The GND line is used in common with CN1 (not insulated).

- Connect to photocoupler

Receiving side / Driver

26C31 equivalent

PLS-OUT+ B15
PLS-OUT− B16
DIR-OUT+ B17
DIR-OUT− B18
B19

0 V*
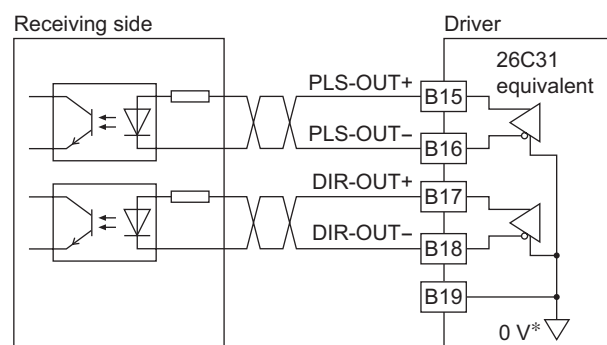
∗ The GND line is used in common with CN1 (not insulated).

10 Method of control via I/O

This chapter explains the I/O operation control to be performed based on operation data and parameters set by the optional **OPX-2A** or **MEXE02**. For the specific setting methods, refer to each OPERATING MANUAL.

10.1 Guidance

If you are new to the **CRK** series built-in controller, read this section to understand the operating methods along with the operation flow.

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

STEP 1   Check the installation and connection

Or

Check
Data setter **OPX-2A** or data setting software **MEXE02** connection
P.31

Check
Motor connection
P.24

Programmable controller

Check
Motor and driver installation
P.16, 21

Check
Power supply connection
P.27

Check
START input, STOP input, M0 input connection
P.28

FG
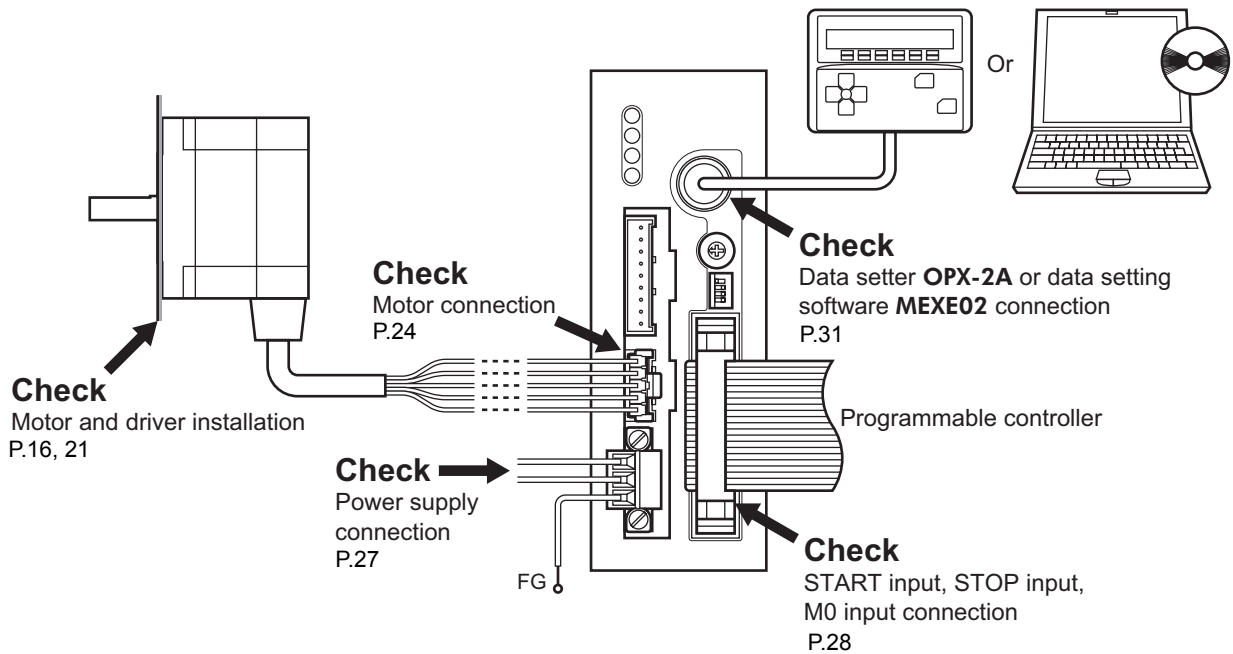
STEP 2   Turn on the power and set the operation data

Or

Turn power supply on.

Set the operation data corresponding to one motor revolution under operation data No.1.

• Position: 500 step
• Operating speed: 5000 Hz

FG

STEP 3   Operate the motor

4. Confirm that the motor rotates without problem.

Or

1. Turn the STOP input ON.

2. Turn the M0 input ON to select operation data No.1.

3. Turn the START input ON.

FG
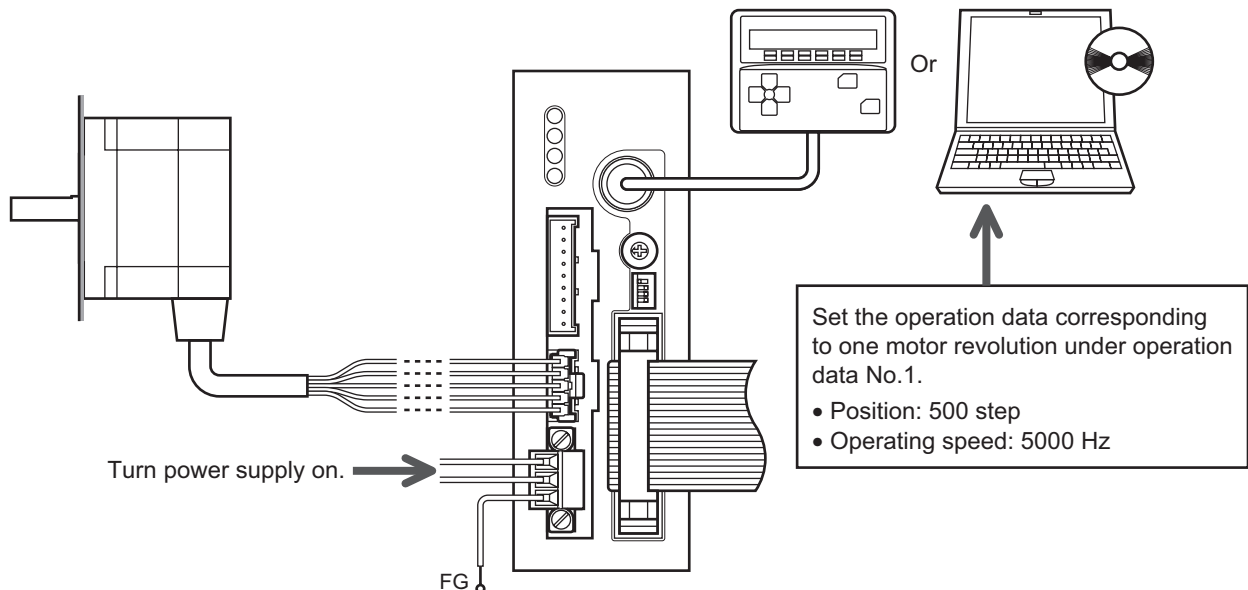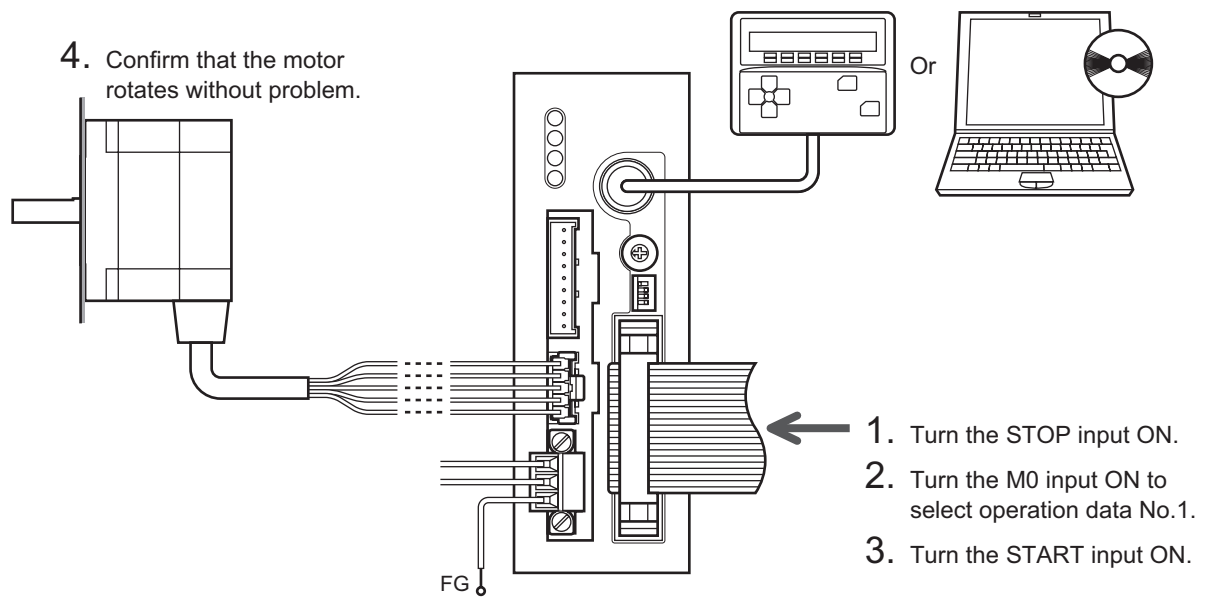
STEP 4   Were you able to operate the motor properly?

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

- Is the STOP input ON? (factory setting: normally closed)
- Is any alarm present?
- Are the power supply and motor connected securely?

For more detailed settings and functions, refer to "10.5 Setting the parameters" on p.56.

10.2 Types of operation

■ Positioning operation

Positioning operation is one in which motor operating speed, position (distance) and other items are set as operating data and then executed.

When the positioning operation is executed, the motor begins at the starting speed and accelerates until the operating speed is reached. Then, once the operating speed is reached, that speed is maintained. The motor decelerates when the stopping position approaches, and finally comes to a stop.

The deceleration rate that applies when the motor decelerates to a stop in positioning operation or continuous operation can be set as follows using the "acceleration (deceleration) rate type" parameter:

Separate: The deceleration rate set under the applicable operation data number will be followed.

Common: The setting of the "common acceleration rate" and "common deceleration rate" parameters will be followed.
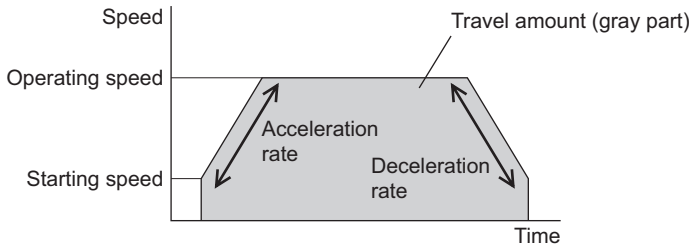
• Positioning modes

The following two operation modes are available:
- Absolute mode .... The position (distance) from home is set.
- Incremental mode .... Each motor destination becomes the starting point for the next movement. This mode is suitable when the same position (distance) is repeatedly used.
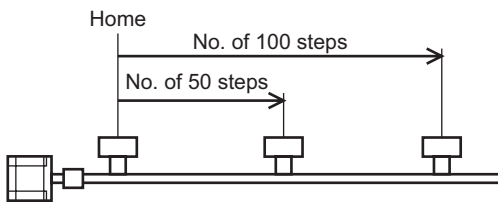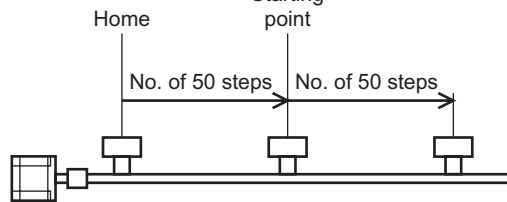
• Positioning pattern

Positioning operation can be performed in the following three patterns:
- Single-motion operation ...... Performed for single operation data.
- Linked-motion operation ..... Multiple sets of operation data are linked to perform continuous positioning operation.
- Linked-motion operation 2 .. Linked-motion operation is performed with the dwell time function. Dwell time refers to a wait time before the next positioning operation is performed. Operation data whose rotating direction is different can also be linked.
- Sequential operation .... Positioning operation is performed to the next operation data number every time a START input signal is input.

• Selecting the operation data No.

Select a operation data based on a combination of ON/OFF statuses of M0 to M5 inputs.

If all M0 to M5 inputs are turned OFF, sequential operation will be selected.

Operation data No.	M5	M4	M3	M2	M1	M0
Sequential positioning	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
61	ON	ON	ON	ON	OFF	ON
62	ON	ON	ON	ON	ON	OFF
63	ON	ON	ON	ON	ON	ON

● Single-motion operation

The positioning operation is performed only once using the single operation data.
To perform single-motion operation, set "operating mode" to "single" using operation data.
Data Nos.03 and 04 shows the operation profile when motion profiles are set as "single".
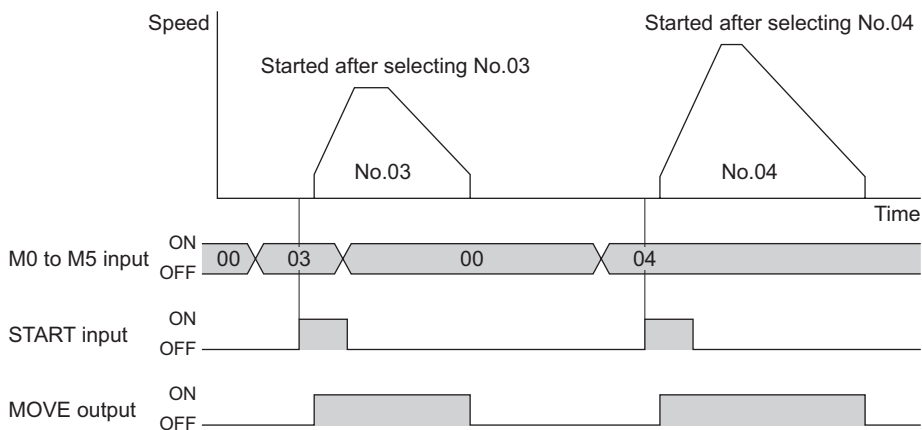
● Linked-motion operation

When set "operating mode" to "link", using operation data, positioning operation is performed continuously over successive "link" data, without stopping the motor.
A maximum of 4 operation data can be linked. If operation data includes data for which "single" is set, the motor will stop after the positioning with respect to the "single" operation data is completed.
The position achieved by a single linked-motion operation is the sum of positions set in the successive "link" operation data. The speed can be changed during the positioning operation.
Note that only operation data of the same direction can be linked.

Example of linked-motion operation

Data No.	Operating mode
01	Link
02	Link
03	Single

● If data No.01 is selected, positioning will be performed continuously for Nos.01 to 03.
● If data No.03 is selected, single-motion operation will be performed only for No.03.
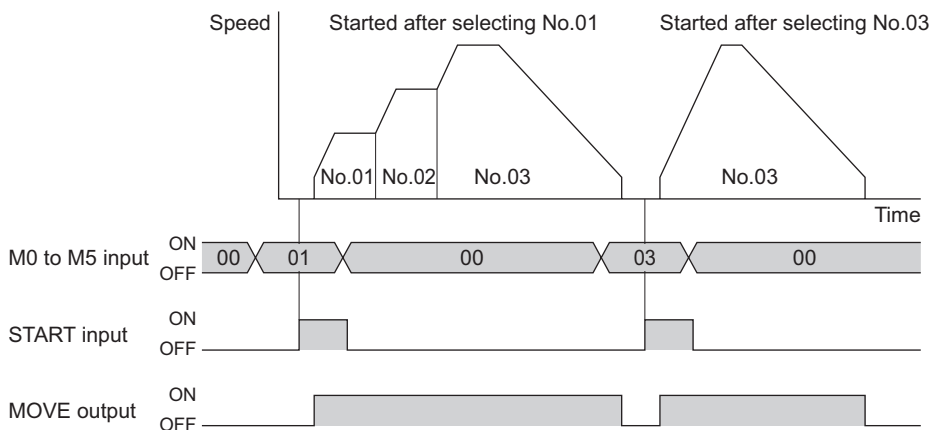
Note
● Multiple operation data of different directions cannot be linked. An operation data error alarm will generate during operation.
● Up to four sets of operation data can be linked. When combining the linked-motion operation and the linked-motion operation 2, make sure the total number of linked operation data sets does not exceed four. When linked-motion operation is performed with five or more sets of operation data linked together, an operation data error alarm will generate upon start of operation.
● No.01 will not be linked even when "link" is set for data No. 63, because the operation pertaining to No. 63 will be processed independently.
● The acceleration/deceleration in linked-motion operation corresponds to the acceleration/deceleration specified for the operation data number with which the linked-motion operation is started.

- Linked-motion operation 2

By setting the "operation mode" of operation data to "Link2," an operation data whose rotating direction is different can be linked. In this case, the system stops for the dwell time after each positioning operation, and then performs operation according to the next operation data.

If operation data includes data for which "single" is set, the motor will stop after the positioning with respect to the "single" operation data is completed.

Example of linked-motion operation 2

Data No.	Operating mode	Dwell time
01	Link2	0.5 s
02	Link2	1.0 s
03	Single	0 s

- If data No.01 is selected, positioning will be performed continuously for Nos.01 to 03.
- If data No.03 is selected, single-motion operation will be performed only for No.03.
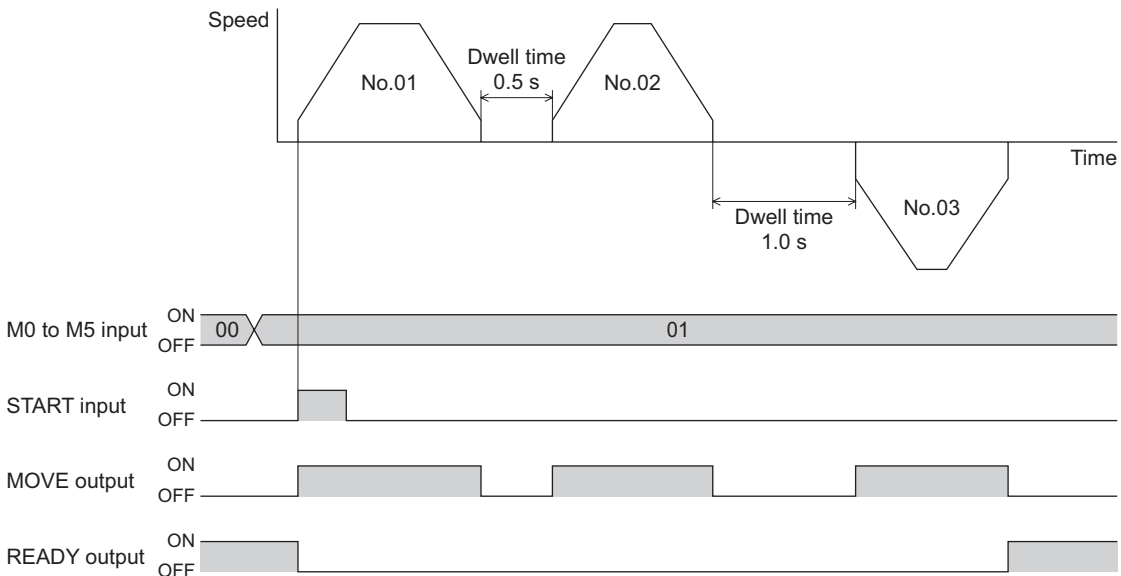
> **Note**
> - Up to four sets of operation data can be linked. When combining the linked-motion operation and the linked-motion operation 2, make sure the total number of linked operation data sets does not exceed four. When linked-motion operation is performed with five or more sets of operation data linked together, an operation data error alarm will generate upon start of operation.
> - No.01 will not be linked even when "Link2" is set for data No. 63, because the operation pertaining to No. 63 will be processed independently.

- Sequential operation

When "sequential positioning" of operation data is set to "enable", positioning operation is performed to the next operation every time a START input signal is input. This function is useful when multiple positioning operations must be performed sequentially, because there is no need to select each data number using the M0 to M5 inputs.

Upon reaching the data number for which "sequential positioning" of operation data is set to "disable", the flow will return to operation data No. 01 and sequential operation will resume from that data.

> **Note**
> Since sequential operation starts from operation data No. 01, be sure to set "sequential operation" to "enable" for data No. 01.

Example of sequential operation

An example of sequential operation based on the following operation data is given.

Data No.	Operating mode	Sequential positioning
00	–	–
01	Single	Enable
02	Link	Enable
03	Link	Enable
04	Single	Enable
05	Single	Disable
11	Single	Enable
12	Single	Enable
13	Single	Disable

Selecting data No.00 for the first operation

When a START input is turned ON with No.00 selected, a single-motion operation is performed based on data No.01.
When a START input is turned ON again, a linked-motion operation is performed based on data Nos.02, 03 and 04, in that order.
Then, when the START input is turned ON again, the driver will return to No. 01 and perform a single-motion operation based on data No. 01 because "sequential positioning" is set to "disable" for data No.05.
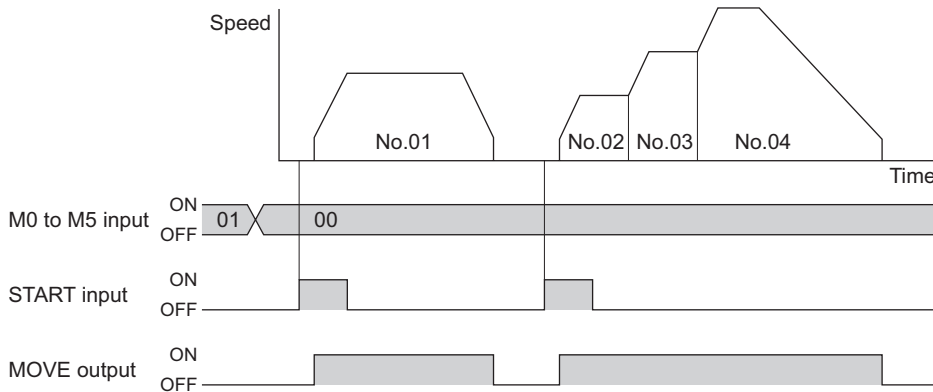
Selecting data No.00 after executing data No.11

When a START input is turned ON with No.11 selected, a single-motion operation is performed based on data No.11.
When a START input is turned ON with No.00 selected, a single-motion operation is performed based on data No.12.
Then, when a START input is turned ON again with No.00 selected, the driver returns to No.01 and performs a single-motion operation based on data No.01 because "sequential positioning" is set to "disable" for data No.13.

When "sequential positioning" is set to "disable" for of operation data No.01.

When "sequential positioning" is set to "disable" for of operation data No.01, turn a START input ON with No.00 selected, a operation data error alarm will generate.

Run data Nos. 11 and 12 and then run data No. 00 when "sequential positioning" is set to "disable" for of operation data No. 01.

A operation data error alarm will generate.

Note	The operation data is reset to No.01 under the following conditions: · Performing the return-to-home operation. · The preset command position is applied · STOP input is turned OFF (factory setting: normally closed). · Performing the continuous operation. · AWO input is turned ON (factory setting: normally open). · An alarm generated and was subsequently reset · Teaching or JOG operation (p.52) was performed using the **OPX-2A** or **MEXE02**.

- **Stop the positioning operation**

  When a STOP input is turned OFF, the current positioning operation stops (factory setting: normally closed).

In absolute mode

In the absolute mode, positions are set with reference to the home. If operation is stopped in the middle and then resumed subsequently, the equipment will move to the specified position.

In incremental mode

In the incremental mode, the achieved position becomes the starting point of the next operation. If operation is stopped in the middle, the position at which the motor has stopped becomes the starting point of the next operation.

■ Continuous operation

The motor operates continuously while the FWD or RVS input is ON. If the driver's protective function is actuated, turn the FWD or RVS input OFF.
If the FWD input is turned ON, the motor will operate in the + direction.
If the RVS input is turned ON, the motor will operate in the – direction.
Operation is performed based on the FWD input or RVS input and the operating speed corresponding to the selected operation data number.
When the input is turned OFF, the motor will decelerate to a stop. If the signal of the same direction is turned ON again during deceleration, the motor will accelerate and continue operating.
If the FWD and RVS inputs are turned ON simultaneously, the motor will decelerate to a stop.
The deceleration rate that applies when the motor decelerates to a stop in positioning operation or continuous operation can be set as follows using the "acceleration (deceleration) rate type" parameter:
Separate: The deceleration rate set under the applicable operation data number will be followed.
Common: The setting of the "common acceleration rate" and "common deceleration rate" parameter will be followed.
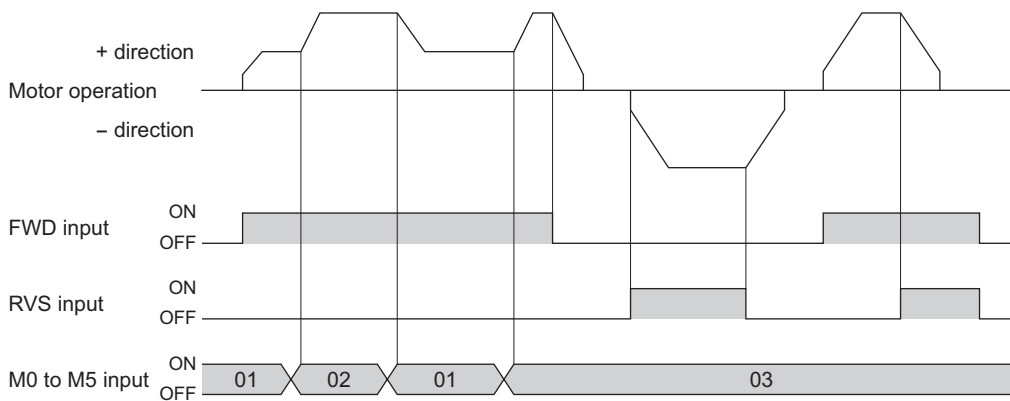
■ Return-to-home operation

Return-to-home is an operation in which the reference point of positioning (mechanical home position) is detected automatically.
When a HOME input is turned ON, a return-to-home operation is started in the preset direction.
When an offset from the mechanical home is set in the "position offset of home-seeking" parameter, the offset position becomes the home.
This home is called the electrical home. If the "position offset of home-seeking" parameter is set to "0", the mechanical home and electrical home will become the same.
When the mechanical home or electrical home is achieved by return-to-home operation, the position coordinate (command position and encoder counter value) will be reset to 0 upon reaching the mechanical home or electrical home.
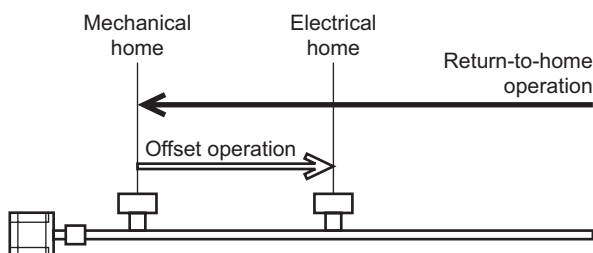
Two home detection modes are available: 3-sensor mode (high-speed operation) and 2-sensor mode (constant-speed operation). A desired mode can be set using the "home-seeking mode" parameter.
The operation sequence varies depending on the starting direction and position of home detection.

- Operation sequence of the 3-sensor mode

The home is detected using the three sensors of +LS, -LS and HOMES. The ON edge of HOMES defines the home. If the "SLIT detection with home-seeking" or "TIM signal detection with home-seeking" parameter is set, an AND gate will be applied to the ON edge of HOMES and the specified signal, thereby enabling more accurate home detection.

Also note that by setting the "TIM signal detection with home-seeking" parameter to "enable," an AND gate can be applied to TIM or encoder Z-phase.

- - - indicates when home offset has been set.

Starting position of return-to-home operation	Starting direction of return-to-home operation: + (FWD)	Starting direction of return-to-home operation: − (RVS)
−LS		
+LS		
HOMES		
Between HOMES and −LS		
Between HOMES and +LS		

- Operation sequence of the 2-sensor mode

The home is detected using +LS and –LS. When the motor pulls off of the limit sensor and both +LS and –LS turn OFF, the applicable position will be used to define the home.

If the "SLIT detection with home-seeking" or "TIM signal detection with home-seeking" parameter is set, an AND gate will be applied to the OFF edge of +LS (or –LS) signal and the specified signal, thereby enabling more accurate home detection.

Also note that by setting the "TIM signal detection with home-seeking" parameter to "enable," an AND gate can be applied to TIM or encoder Z-phase.

- - - indicates when home offset has been set.

Starting position of return-to-home operation	Starting direction of return-to-home operation: + (FWD)	Starting direction of return-to-home operation: – (RVS)
–LS		
+LS		
Between –LS and +LS		

∗ After pulling off of the limit sensor, the equipment will move by the value set in the "backward steps in 2-sensor mode home-seeking" parameter (initial value: 200 steps).

■ JOG operation

JOG operation is performed using the **OPX-2A** or **MEXE02**. Perform this operation if you want to check the wiring condition or operating condition of the motor and driver.

Use the following parameters to set the conditions needed to perform JOG operation:

- JOG operating speed
- JOG acceleration (deceleration) rate
- JOG starting speed

■ Teaching

Teaching is a function whereby the motor is moved using the **OPX-2A** or **MEXE02**, and set the current position as the position (travel amount) among operation data.

When a position (travel amount) is set by teaching, the corresponding "positioning mode" will always become one of the absolute mode.

The operating speed, acceleration/deceleration rate and starting speed of teaching are the same as the corresponding settings applicable to JOG operation.

10.3 Timing charts

■ Positioning operation

When the power is turned on and the STOP input is turned ON (normally closed), the READY output will turn ON and input of the START input signal will become possible.
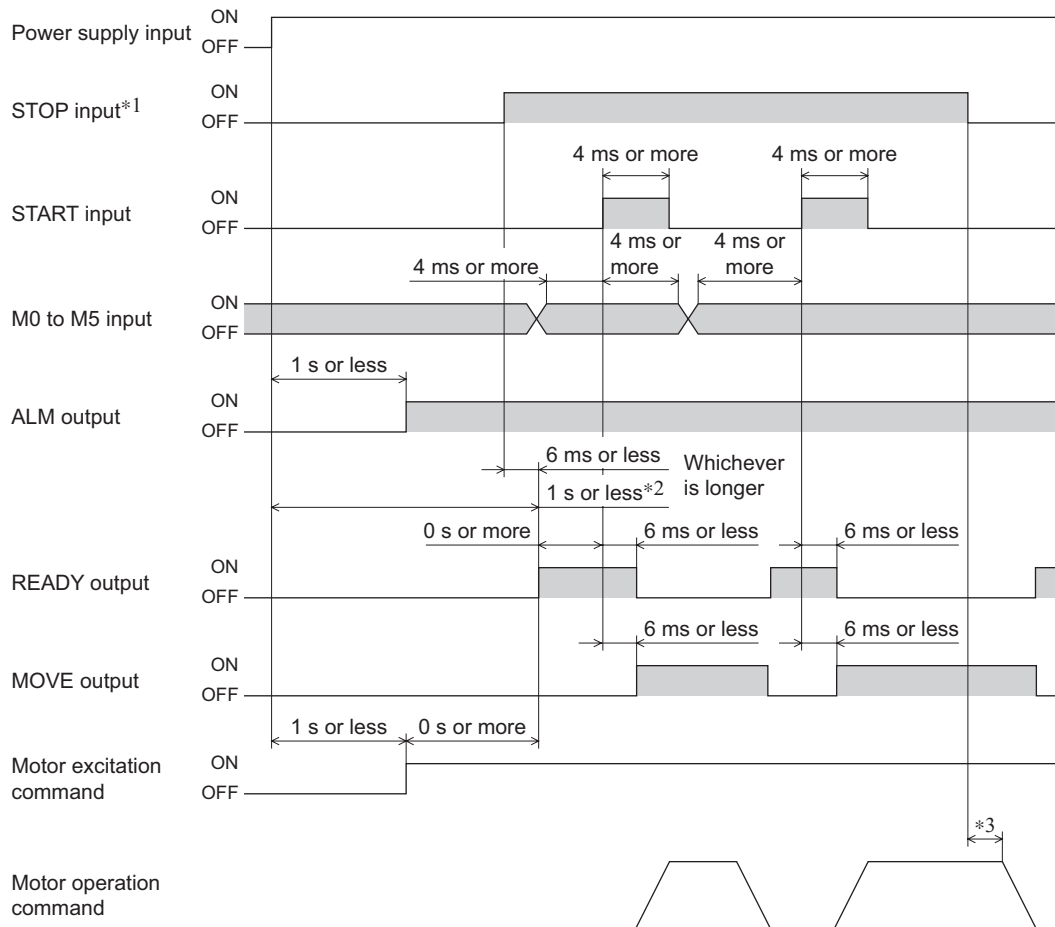
∗1   When the STOP input logic is normally closed (factory setting).
∗2   If the "stepout detection" parameter is set to "enable," this period becomes 1.5 s or less.
∗3   The specific time varies depending on the command speed.

■ Continuous operation

When the power is turned on and the STOP input is turned ON (normally closed), the READY output will turn ON and input of the FWD (RVS) input signal will become possible.
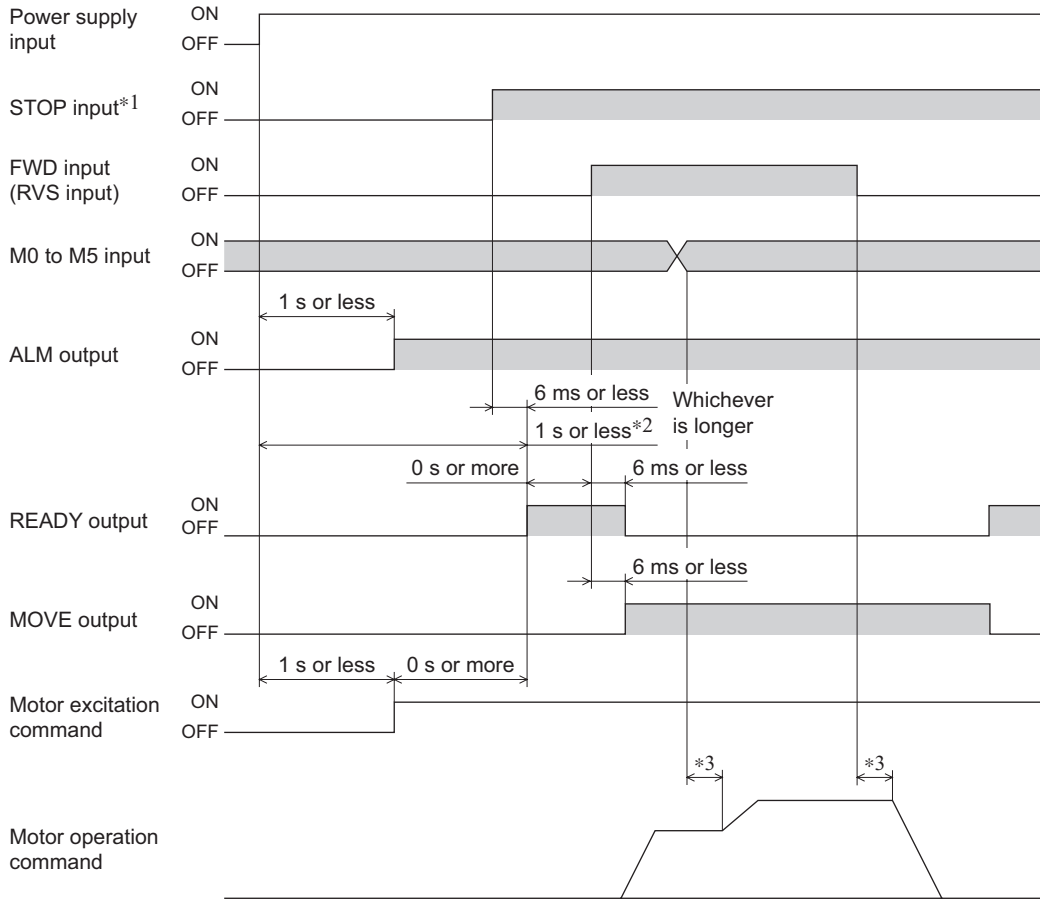
∗1 When the STOP input logic is normally closed (factory setting).
∗2 If the "stepout detection" parameter is set to "enable," this period becomes 1.5 s or less.
∗3 The specific time varies depending on the command speed.

10.4 Setting the operation data

To perform operation, operation data is needed that sets the motor operating speed, position (travel amount), and so on. Operation data is set via using the **OPX-2A** or **MEXE02**. For details on how to set operation data, refer to each OPERATING MANUAL.

This section explains the description of setting operation data.

■ Setting items of operation data

Up to 63 operation data can be set (data Nos. 01 to 63). Set the following items for each operation data.

Setting item	Setting range	Initial value	Description
Position	−8,388,608 to +8,388,607 steps	0	Sets the position (distance) for positioning operation.
Operating speed	1 to 500,000 Hz	1000	Sets the operating speed in positioning operation and continuous operation.
Positioning mode	0: INC 1: ABS	0	Selects how to specify the position (travel amount) in positioning operation (absolute mode or incremental mode).
Operating mode	0: Single 1: Link 2: Link2	0	Sets perform positioning operation as single-motion or linked-motion operation.
Sequential positioning	0: Disable 1: Enable	0	Sets enable or disable sequential positioning operation.
Acceleration rate	0.001 to 1000.000 ms/kHz	30.000	Sets the acceleration rate in positioning operation and continuous operation.∗
Deceleration rate	0.001 to 1000.000 ms/kHz	30.000	Sets the deceleration rate in positioning operation and continuous operation.∗
Dwell time	0 to 50.000 s	0	Set the dwell time to be used in linked-motion operation 2.

∗ This item is effective when the "acceleration (deceleration) rate type" parameter is set to "separate".
  If this parameter is set to "common", the values of the "common acceleration rate" and "common deceleration rate" parameters will be used (initial value: common).

10.5 Setting the parameters

In order to operate the motor, it is necessary to set not only the operation data, but also parameters that define the motor operation or control. Parameters are set via using the **OPX-2A** or **MEXE02**. For details on how to set parameters, refer to each OPERATING MANUAL.

This section explains the description of setting parameters.

■ List of parameters

The setting items of parameters are as follows.

Application parameters	I/O	• START input mode • I/O STOP input • STOP action • STOP contact configuration • C-ON logic configuration • OUT1 signal mode selection • OUT2 signal mode selection • OUT3 signal mode selection • OUT4 signal mode selection • HOME/P-PRESET input switching • Motor excitation mode	• HOME/FWD/RVS input mode • Data No. input mode • AWO contact configuration • Hardware overtravel detection • LS contact configuration • HOMES contact configuration • SLIT contact configuration • Overtravel action • Preset position • Area 1 • Area 2 • Encoder counter preset value
	Motor	• Operating current • Standstill current	
	Speed	• Common acceleration rate • Common deceleration rate • Starting speed	• Jog operating speed • Jog acceleration (deceleration) rate • Jog starting speed • Acceleration (deceleration) rate type
	Return-to-home	• Home-seeking mode • Operating speed of home-seeking • Acceleration (deceleration) rate of home-seeking • Starting speed of home-seeking	• Position offset of home-seeking • Starting direction of home-seeking • SLIT detection with home-seeking • TIM signal detection with home-seeking • Backward steps in 2-sensor mode home-seeking
	Alarm/warning	• Stepout detection band • Overvoltage warning • Overheat warning	
	Common	• Software overtravel • Positive software limit • Negative software limit • Display mode of the data setter speed • The data setter editing mode	• Communication timeout action • Receive period • Response interval • Receive monitoring • Stepout detection action
System parameters	Operation setting	• Motor rotation direction • Stepout detection • Motor step angle	• Encoder electronic gear A • Encoder electronic gear B
	Communication	• Communication axis number • Communication protocol • Communication parity • Communication stop bit	• Transmission waiting time • Communication timeout • Communication error alarm

Note When a system parameter has been changed, the new parameter will become effective after the power is cycled.

■ I/O parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
START input mode[*1]	0: RS-485 communication 1: I/O	1	Sets whether to input the START input signal via I/O or RS-485 communication.	APP-0-00
I/O STOP input[*1][*2]	0: Disable 1: Enable	1	Changes the setting to enable/disable STOP input of I/O.	APP-0-01
STOP action	0: Immediate stop 1: Decelerate stop 2: Immediate stop & Current OFF 3: Decelerate stop & Current OFF	1	Sets how the motor should stop when a STOP input is turned ON.	APP-0-02
STOP contact configuration	0: Make (N.O.) 1: Break (N.C.)	1	Sets the STOP input logic.	APP-0-03
C-ON logic configuration[*3]	0: 0=Not excited, 1=Excited 1: 0=Excited, 1=Not excited	0	Sets the C-ON logic for RS-485 communication.	APP-0-04
OUT1 signal mode selection	5: AREA 11: R-OUT1 6: TIM 12: R-OUT2 7: READY 13: STEPOUT[*5] 8: WNG 14: O.H. 9: HOME-P 15: R-OUT3 10: ZSG[*5] 16: R-OUT4	5	Sets the function assigned to the OUT1 output.	APP-0-06
OUT2 signal mode selection		7	Sets the function assigned to the OUT2 output.	APP-0-07
OUT3 signal mode selection		8	Sets the function assigned to the OUT3 output.	APP-0-08
OUT4 signal mode selection		9	Sets the function assigned to the OUT4 output.	APP-0-09
HOME/P-PRESET input switching	0: HOME 1: P-PRESET	0	Sets whether to use HOME or P-PRESET input.	APP-0-10
Motor excitation mode[*1]	0: RS-485 communication 1: I/O	1	Sets whether to control the motor excitation via I/O or RS-485 communication.	APP-0-11
HOME/FWD/RVS input mode[*1]	0: RS-485 communication 1: I/O	1	Sets whether to input the HOME, FWD and RVS input signals via I/O or RS-485 communication.	APP-0-12
Data No. input mode[*1]	0: RS-485 communication 1: I/O	1	Sets whether to input the M0 to M5 input signals via I/O or RS-485 communication.	APP-0-13
AWO contact configuration	0: Make (N.O.) 1: Break (N.C.)	0	Sets the AWO input logic.	APP-0-14
Hardware overtravel detection[*4]	0: Disable 1: Enable	1	Sets whether to enable or disable hardware overtravel detection using LS inputs.	APP-0-16
LS contact configuration	0: Make (N.O.) 1: Break (N.C.)	0	Sets the ±LS input logics.	APP-0-17
HOMES contact configuration	0: Make (N.O.) 1: Break (N.C.)	0	Sets the HOMES input logic.	APP-0-18
SLIT contact configuration	0: Make (N.O.) 1: Break (N.C.)	0	Sets the SLIT input logic.	APP-0-19
Overtravel action	0: Immediate stop 1: Decelerate stop	0	Sets the motor action to take place upon the occurrence of overtravel.	APP-0-20
Preset position	−8,388,608 to +8,388,607 step	0	Sets the preset position.	APP-0-21
Area 1	−8,388,608 to +8,388,607 step	0	Sets the range for AREA output. The AREA output will be ON when the motor is inside the area set by the area 1 and area 2.	APP-0-22
Area 2	−8,388,608 to +8,388,607 step	0		APP-0-23
Encoder counter preset value[*5]	−8,388,608 to +8,388,607 step	0	Sets the encoder counter preset value.	APP-0-26

*1 Set the parameter when controlling the system via RS-485 communication.

*2 If this parameter is disabled, the I/O STOP input will become ineffective and only the stop input received via RS-485 communication will become effective.

*3 When "Motor excitation mode" paramete is set to "RS-485 communication", the excitation condition of the motor at the power ON varies depending on the "C-ON logic configuration" parameter. The motor is not excited if the "C-ON logic configuration" parameter is set to "0," and excited if the parameter is set to "1."

*4 Even when this parameter is disabled, the ±LS will still become effective during a return-to-home operation.

*5 This parameter is used when an encoder is connected.

■ Motor parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
Operating current	5 to 100%	100	Sets the motor operating current based on the rated current being 100%.	APP-1-00
Standstill current	5 to 50%	50	Sets the motor standstill current as a percentage of the rated current, based on the rated current being 100%.	APP-1-01

Note
- Decrease the operating current and standstill current when there is an allowance in the motor torque and you wish to reduce vibration during operation or suppress heat generation from the motor. However, be careful of an excessive decrease in current, since the motor torque and holding brake force will drop in rough proportion to the operating current.
- The standstill current is the rated current (100%) multiplied by the standstill current ratio.

■ Speed parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
Common acceleration rate	0.001 to 1000.000 ms/kHz	30.000	Sets the common acceleration rate in positioning operation and continuous operation.	APP-2-00
Common deceleration rate	0.001 to 1000.000 ms/kHz	30.000	Sets the common deceleration rate in positioning operation and continuous operation.	APP-2-01
Starting speed	1 to 500,000 Hz	100	Sets the starting speed in positioning operation and continuous operation. The motor will operate at the starting speed if the operating speed is below the starting speed.	APP-2-02
Jog operating speed	1 to 500,000 Hz	1000	Sets the operating speed for JOG operation.	APP-2-06
Jog acceleration (deceleration) rate	0.001 to 1000.000 ms/kHz	30.000	Sets the acceleration/deceleration rate for JOG operation.	APP-2-07
Jog starting speed	1 to 500,000 Hz	100	Sets the starting speed for JOG operation.	APP-2-08
Acceleration (deceleration) rate type	0: Common 1: Separate	0	Sets whether to use the common acceleration/deceleration rate or the acceleration/deceleration rate specified for the operation data.	APP-2-09

■ Return-to-home parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
Home-seeking mode	0: 2 sensors 1: 3 sensors	1	Set the mode for return-to-home operation.	APP-3-00
Operating speed of home-seeking	1 to 500,000 Hz	1000	Sets the operating speed for return-to-home operation.	APP-3-02
Acceleration (deceleration) rate of home-seeking	0.001 to 1000.000 ms/kHz	30.000	Sets the acceleration/deceleration rate for return-to-home operation.	APP-3-03
Starting speed of home-seeking	1 to 500,000 Hz	100	Sets the starting speed for return-to-home operation.	APP-3-04
Position offset of home-seeking	−8,388,608 to +8,388,607 step	0	Sets the amount of offset from mechanical home.	APP-3-05
Starting direction of home-seeking	0: Negative direction 1: Positive direction	1	Sets the starting direction for home detection.	APP-3-06
SLIT detection with home-seeking	0: Disable 1: Enable	0	Sets whether or not to concurrently use the SLIT input for return-to-home operation.	APP-3-07
TIM signal detection with home-seeking	0: Disable 1: Enable (TIM) 2: Enable (ZSG)*	0	Sets whether or not to concurrently use the TIM (ZSG) output for return-to-home operation.	APP-3-08
Backward steps in 2-sensor mode home-seeking	0 to 32767 step	200	Sets the travel amount after the motor pulls out from the LS sensor in 2-sensor return-to-home operation.	APP-3-09

∗ This signal is used when an encoder is connected.

■ Alarm/warning parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
Stepout detection band*	0.1 to 360.0 deg	7.2	Sets the judgment condition for misstep detection using the deviation (angle) between the command position and encoder counter value.	APP-4-00
Overvoltage warning	25.0 to 35.0 V	31.0	Sets the voltage at which an overvoltage warning generates.	APP-4-17
Overheat warning	40 to 85 °C (104 to 185 °F)	85	Sets the temperature at which an overheat warning generates.	APP-4-19

* This parameter is used when an encoder is connected.

■ Common parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
Software overtravel	0: Disable 1: Enable	1	Sets whether to enable or disable software overtravel detection using soft limits.	APP-6-00
Positive software limit	−8,388,608 to +8,388,607 steps	8,388,607	Sets the value of soft limit in + direction.	APP-6-01
Negative software limit	−8,388,608 to +8,388,607 steps	−8,388,608	Sets the value of soft limit in − direction.	APP-6-02
Display mode of the data setter speed	0: Signed 1: Absolute	0	Sets the display method of monitored speed in the **OPX-2A**.	APP-6-03
The data setter editing mode	0: Disable 1: Enable	1	Sets whether to enable editing by the **OPX-2A** when the power is turned on.	*2
Communication timeout action	0: Immediate stop 1: Decelerate stop	1	Sets how to stop the motor when a communication timeout occurs.	APP-6-06
Receive period*1	0: Function disabled 0.01 to 9.99 sec.	0	Sets the receive period for RS-485 communication (T1). See p.96 for details.	APP-6-07
Response interval*1	0 to 1000 ms	50	Sets the response period for RS-485 communication (T2). See p.96 for details.	APP-6-08
Receive monitoring*1	0.01 to 9.99 sec.	0.10	Sets the receive monitor period for RS-485 communication (T3). See p.96 for details.	APP-6-09
Stepout detection action*3	0: No operation 1: Warning 2: Alarm	0	Sets the operation to be performed when the deviation between the command position and encoder counter value reaches the stepout detection band.	APP-6-10

*1 Set this parameter when GW Protocol Version 1 is used.
*2 The edit lock function can be activated/cancelled using the **OPX-2A**.
*3 This parameter is used when an encoder is connected.
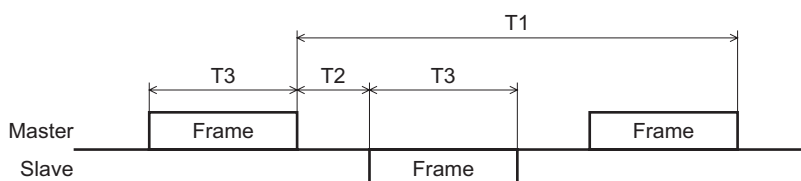
■ Operation setting parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
Motor rotation direction	0: + direction=CCW 1: + direction=CW	1	Sets the rotation direction of motor output shaft.	SYS-0-10
Stepout detection*	0: Disable 1: Enable	0	Sets whether to enable or disable the misstep detection function.	SYS-0-12
Motor step angle	See table below.	0	Sets the motor step angle.	SYS-0-13
Encoder electronic gear A*	1 to 250,000	500	Sets the encoder electronic gear A. This parameter is used in the misstep detection function. It does not affect the encoder counter value.	SYS-0-14
Encoder electronic gear B*	1 to 250,000	500	Sets the encoder electronic gear B. This parameter is used in the misstep detection function. It does not affect the encoder counter value.	SYS-0-15

∗ When an encoder is connected, this parameter is used in the misstep detection function. It does not affect the encoder counter value.

- "Motor step angle" parameter: If the base step angle of the motor is 0.72°

Setting	Step angle	Number of divisions	Setting	Step angle	Number of divisions
0	0.72°	1	8	0.0288°	25
1	0.36°	2	9	0.018°	40
2	0.288°	2.5	10	0.0144°	50
3	0.18°	4	11	0.009°	80
4	0.144°	5	12	0.0072°	100
5	0.09°	8	13	0.00576°	125
6	0.072°	10	14	0.0036°	200
7	0.036°	20	15	0.00288°	250

- "Motor step angle" parameter: If the base step angle of the motor is 0.36°

Setting	Step angle	Number of divisions	Setting	Step angle	Number of divisions
0	0.36°	1	8	0.0144°	25
1	0.18°	2	9	0.009°	40
2	0.144°	2.5	10	0.0072°	50
3	0.09°	4	11	0.0045°	80
4	0.072°	5	12	0.0036°	100
5	0.045°	8	13	0.0028°	125
6	0.036°	10	14	0.0018°	200
7	0.018°	20	15	0.00144°	250

Note
- Step angles are theoretical values.
- With the geared type, the value of "step angle/gear ratio" becomes the actual step angle.
- The base step angle is 0.36° for high-resolution type motors.

■ Communication parameters

Name	Setting range	Initial value	Description	OPX-2A screen display
Communication axis number	0 to 31	15	Sets the axis number for RS-485 communication.	SYS-1-00
Communication protocol	0: Modbus RTU 1: GW Ver.1	0	Sets the protocol for RS-485 communication.	SYS-1-01
Communication parity*	0: None 1: Even number 2: Odd number	1	Sets the parity for RS-485 communication.	SYS-1-02
Communication stop bit*	0: 1 bit 1: 2 bits	0	Sets the stop bit for RS-485 communication.	SYS-1-03
Transmission waiting time*	0 to 1000.0 ms	10.0	Sets the transmission waiting time for RS-485 communication.	SYS-1-04
Communication timeout*	0: Not monitored 1 to 10000 ms	0	Sets the condition in which a communication timeout occurs in RS-485 communication.	SYS-1-05
Communication error alarm	1 to 10 times	3	Sets the condition in which a RS-485 communication error alarm generates. A communication error alarm generates after a RS-485 communication error has occurred by the number of times set here.	SYS-1-06

∗ Set this parameter when Modbus RTU Protocol is used.

11 Overview of the RS-485 communication

The two types of protocols explained below can be used to implement controls via RS-485 communication.

- Modbus protocol (p.63)

  The Modbus protocol is simple and its specification is open to public, so this protocol is used widely in industrial applications.
  Modbus communication is based on the single-master/multiple-slave method. Only the master can issue a command. Each slave executes the requested process and returns a response message.

- GW protocol Ver.1 (p.91)

  GW protocol Version 1 is Oriental Motor's proprietary protocol at a fixed length of 9 bytes.
  Various functions such as motor operation, parameter read/write, monitoring and maintenance are available under this protocol.

12 Method of control via Modbus protocol

The following explains how to implement control from a programmable controller using the Modbus protocol via RS-485 communication.

12.1 Guidance

If you are new to the **CRK** series built-in controller, read this section to understand the operating methods along with the operation flow.

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

STEP 1   Check the installation and connection

Check
RS-485 communication
cable connection
P.32

Programmable controller
or master device

Or

Check
Motor connection
P.24

Check
Data setter **OPX-2A** or data setting
software **MEXE02** connection
P.31

Check
Motor and driver
installation
P.16, 21

Check
Power supply
connection
P.27

FG

STEP 2   Set the switches

Set terminal resistor
as necessary.

ON

Programmable controller
or master device

Or

Set baud rate, connection destination
and slave address.

Set slave address

Set the connection destination
(ON: General-purpose master device)

Set baud rate
(example: 9600 bps)

STEP 3 Turn on the power and set the parameters

Programmable controller
or master device

Or

Turn power supply on →

Set the following system parameters via **OPX-2A** or **MEXE02**.

- Communication protocol : 0 (Modbus RTU)
- Communication parity
- Communication stop bit
- Transmission waiting time

Set the following parameters via **OPX-2A**, **MEXE02** or RS-485 communication.

- START input mode : 0 (RS-485 communication)
- HOME/FWD/RVS input mode : 0 (RS-485 communication)
- Data No. input mode : 0 (RS-485 communication)
- Motor excitation mode : 0 (RS-485 communication)
- I/O STOP input : 0 (Disable)

STEP 4 Cycle the power

System parameters will become effective only after the power is cycled. If you have changed any of the system parameters, be sure to cycle the power.

STEP 5 Operate the motor

Programmable controller
or master device

3. Confirm that the motor rotates without problem.

1. Send operation data from the programmable controller.
2. Send an operation command.
 P.74

STEP 6 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 any alarm present?
- Are the power supply, motor and RS-485 communication cable connected securely?
- Are the slave address, baud rate and terminal resistor set correctly?
- Is the C-ERR LED lit?
- Is the C-DAT LED lit?

For more detailed settings and functions, refer to the following pages.

12.2 Communication specifications

Electrical characteristics	In conformance with EIA-485 Use a twisted pair cable (TIA/EIA-568B CAT5e or higher is recommended) and keep the total wiring distance including extension to 50 m (164 ft.) or less.
Transmission mode	Half duplex
Baud rate	Selectable from 9600 bps, 19200 bps, 38400 bps, 57600 bps and 115200 bps.
Physical layer	Asynchronous mode (data: 8 bits, stop bit: 1 bit/2 bits, parity: none/even number/odd number)
Protocol	Modbus RTU mode
Connection pattern	Up to 31 drivers can be connected to one programmable controller (master device).

■ Connection example
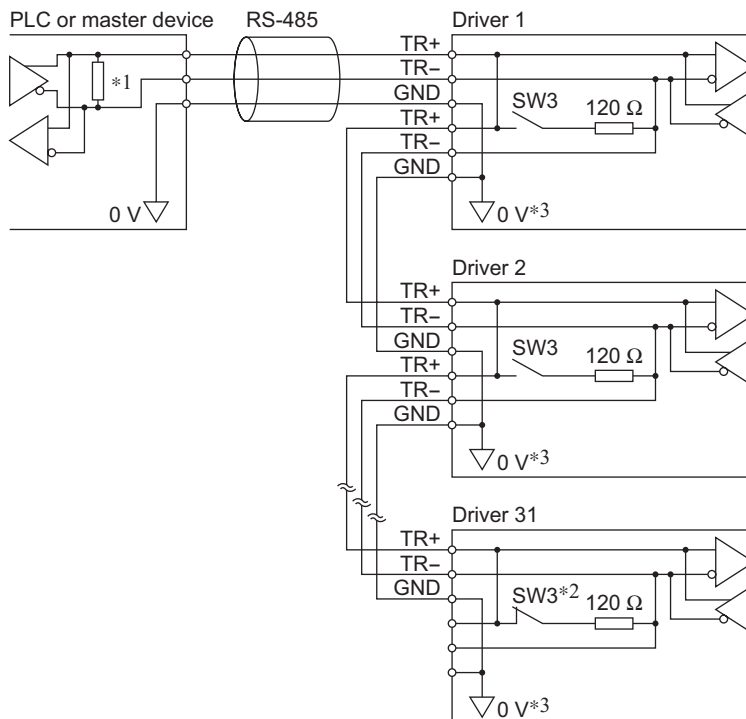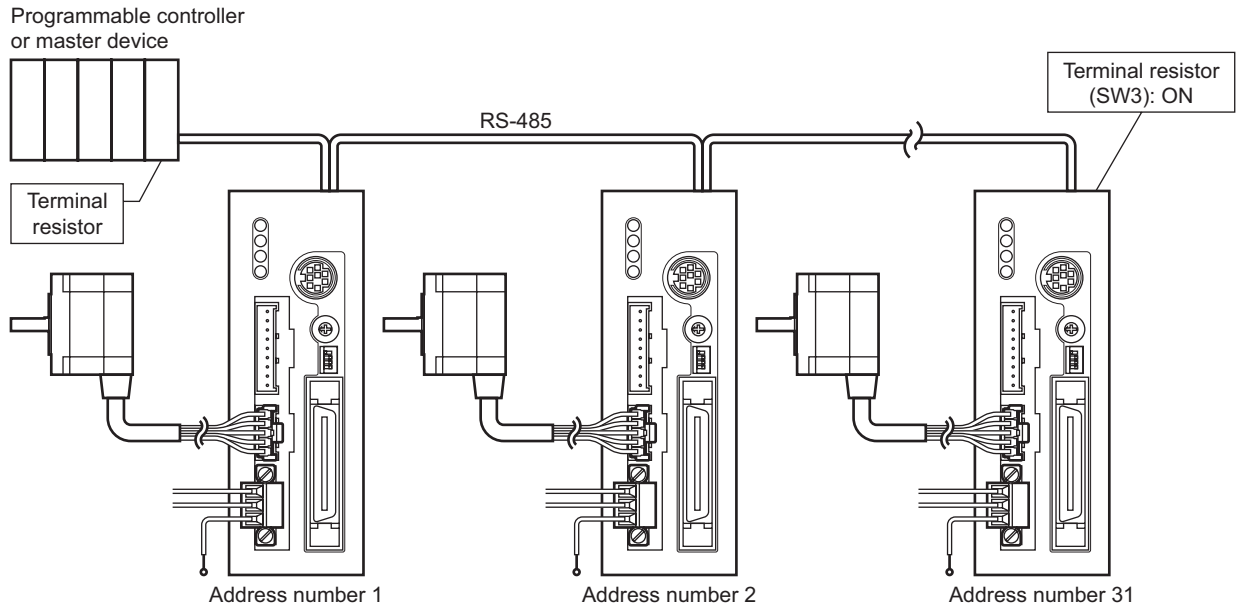
*1 Terminal resistor 120 Ω
*2 Turn the terminal resistor (SW3) to ON.
*3 The GND line is used in common with CN1 (not insulated).

12.3 Setting the switches

| Note | Be sure to turn off the driver power before setting the switches. If the switches are set while the power is still on, the new switch settings will not become effective until the driver power is cycled. |
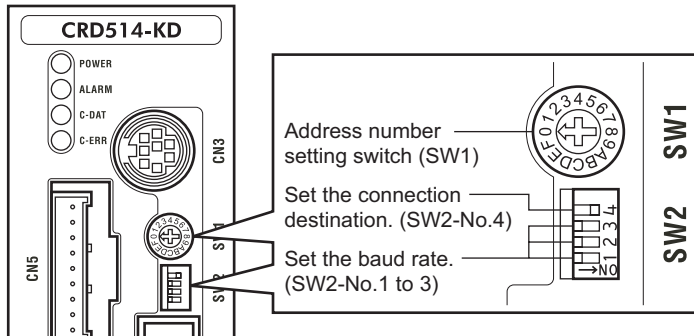
■ Slave address

Set the slave address using the address setting switch (SW1) and "communication axis number" parameter.
If SW1 is set to "F," the slave address set in the "communication axis number" parameter is selected (initial value: 15).
Make sure each slave address you set for each driver is unique.
Slave address 0 is reserved for broadcasting, so do not use this address.
Factory setting   0 (broadcast)

SW1	Slave address	SW1	Slave address
0	Broadcast	8	8
1	1	9	9
2	2	A	10
3	3	B	11
4	4	C	12
5	5	D	13
6	6	E	14
7	7	F	Setting value of "communication axis number" parameter*

* The default value of the "communication axis number" parameter is "15." Set the "communication axis number" parameter using the **OPX-2A** or **MEXE02**.

■ Setting the connection destination

Set the connection destination of RS-485 communication using position No.4 of the function setting switch (SW2).
Set this position to the ON side when controlling using the Modbus protocol.
Factory setting   OFF (network converter)

SW2-No.4	Connection destination
ON	General master device
OFF	Network converter

■ Baud rate

Set the baud rate using Nos. 1 to 3 of the function setting switch (SW2) to.
The baud rate to be set should be the same as the baud rate of the master device.
Factory setting   All ON (625,000 bps)

Baud rate (bps)	SW2-No.3	SW2-No.2	SW2-No.1
9600	OFF	OFF	OFF
19200	OFF	OFF	ON
38400	OFF	ON	OFF
57600	OFF	ON	ON
115,200	ON	OFF	OFF

| Note | Make sure the baud rate does not exceed 115,200 bps. Also note that although switch combinations other than those specified above are also available, such other switch combinations cannot be used to communicate with the master device. Accordingly, do not set the switches other than as specified above. |

■ **Terminal resistor**

Use a terminal resistor for the driver located farthest away (positioned at the end) from the programmable controller (master device).
Turn the terminal resistor setting switch (SW3) ON to set the terminal resistor for RS-485 communication (120 Ω).
Factory setting　　OFF (terminal resistor disabled)
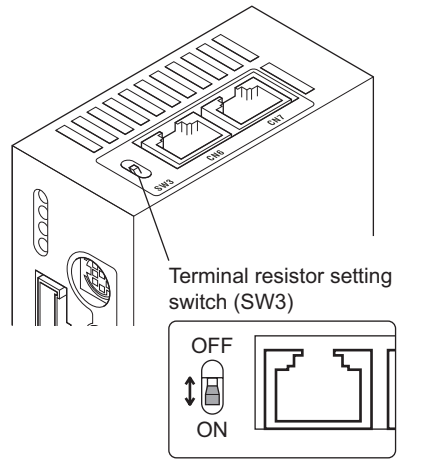
SW3	Terminal resistor (120 Ω)
OFF	Disabled
ON	Enabled
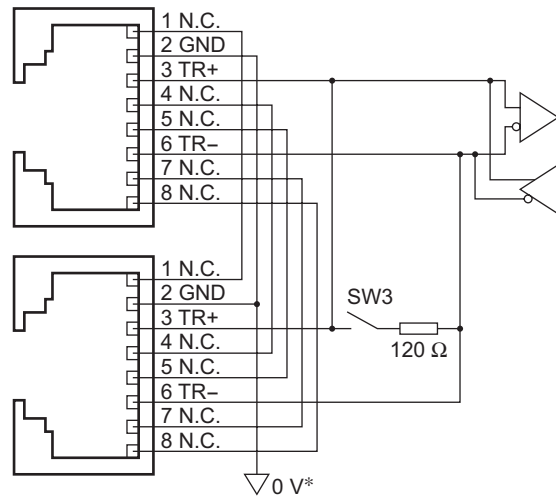
∗ The GND line is used in common with CN1 (not insulated).

12.4 Communication mode

Modbus protocol communication is based on the single-master/multiple-slave method. Under this protocol, messages are sent in one of two methods.

• Unicast mode

The master sends a command to only one slave. The slave executes the process and returns a response.
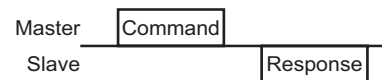
• Broadcast mode

If slave address 0 is specified on the master, the master can send a command to all slaves. Each slave executes the process, but does not return a response.
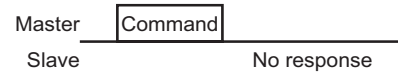
12.5 Communication timing
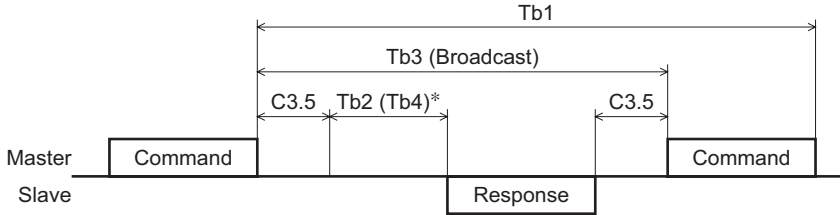
∗ If Tb2 (transmission waiting time) < Tb4 (processing time), a response is returned after Tb4+C3.5.

Communication timeout (Tb1)	Intervals between received messages are monitored. If no message could be received after the time set in the "communication timeout" parameter, a communication timeout alarm generates.
Transmission waiting time (Tb2)	The time after the slave switches its communication line to the transmission mode upon receiving a command from the master, until it starts sending a response. The transmission waiting time is set by the "transmission waiting time" parameter. The actual transmission waiting time corresponds to the silent interval (C3.5) plus the transmission waiting time (Tb2).
Broadcasting interval (Tb3)	The time until the next command is sent in broadcasting. A time equivalent to or longer than the silent interval (C3.5) plus 5 ms is required.
Silent interval (C3.5)	Be sure to provide a waiting time of 3.5 characters. If this waiting time is less than 3.5 characters long, the driver cannot respond. The silent interval should be 4 ms when the baud rate is 9600 bps, or 2.5 ms when the baud rate is 19200 bps or more.
Processing time (Tb4)	The time to process a received message. The specific time varies depending on the length of the received message. The maximum processing time is 1.5 ms.

12.6 Message

The message format is shown below.
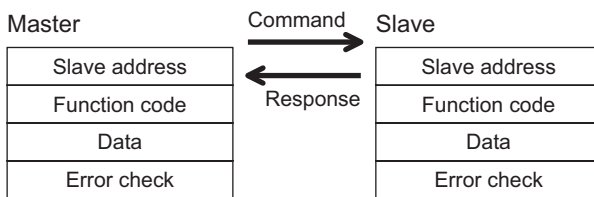
■ Command

The command message structure is shown below.

Slave address	Function code	Data	Error check
8 bits	8 bits	N×8 bits	16 bits

- Slave address

Specify the slave address (unicast mode).
If the slave address is set to 0, the master can send a command to all slaves (broadcast mode).

- Function code

The function codes and message lengths supported by the **CRK** series built-in controller are as follows.

Function code	Description	Message lengths		Broadcast
		Command	Response	
03h	Read from a holding register(s).	8	7 to 25	Impossible
06h	Write to a holding register.	8	8	Possible
08h	Perform diagnosis.	8	8	Impossible
10h	Write to multiple holding registers.	11 to 29	8	Possible

- Data

Set data associated with the selected function code. The specific data length varies depending on the function code.

- Error check

  In the Modbus RTU mode, error checks are based on the CRC-16 method. The slave calculates a CRC-16 of each received message and compares the result against the error check value included in the message. If the calculated CRC-16 value matches the error check value, the slave determines that the message is normal. See below for the CRC-16 calculation method.

CRC-16 calculation method

1. Calculate an exclusive-OR (XOR) value of the default value of FFFFh and slave address (8 bits).

2. Shift the result of step 1 to the right by 1 bit. Repeat this shift until the overflow bit becomes "1."

3. Upon obtaining "1" as the overflow bit, calculate an XOR of the result of step 2 and A001h.

4. Repeat steps 2 and 3 until a shift is performed eight times.

5. Calculate an XOR of the result of step 4 and function code (8 bits).
   Repeat steps 2 to 4 for all bytes.
   The final result gives the result of CRC-16 calculation.

Example of CRC-16 calculation (slave address: 02h, function code: 07h)

Description	Result	Overflow digit
Default value in CRC register FFFFh	1111 1111 1111 1111	–
First byte 02h	0000 0000 0000 0010	–
XOR with default value FFFFh	1111 1111 1111 1101	–
First shift to right	0111 1111 1111 1110	1
XOR with A001h	1010 0000 0000 0001 1101 1111 1111 1111	–
Second shift to right	0110 1111 1111 1111	1
XOR with A001h	1010 0000 0000 0001 1100 1111 1111 1110	–
Third shift to right	0110 0111 1111 1111	0
Fourth shift to right	0011 0011 1111 1111	1
XOR with A001h	1010 0000 0000 0001 1001 0011 1111 1110	–
Fifth shift to right	0100 1001 1111 1111	0
Sixth shift to right	0010 0100 1111 1111	1
XOR with A001h	1010 0000 0000 0001 1000 0100 1111 1110	–
Seventh shift to right	0100 0010 0111 1111	0
Eighth shift to right	0010 0001 0011 1111	1
XOR with A001h	1010 0000 0000 0001 1000 0001 0011 1110	–
XOR with next byte 07h	0000 0000 0000 0111 1000 0001 0011 1001	–
First shift to right	0100 0000 1001 1100	1
XOR with A001h	1010 0000 0000 0001 1110 0000 1001 1101	–
Second shift to right	0111 0000 0100 1110	1
XOR with A001h	1010 0000 0000 0001 1101 0000 0100 1111	–
Third shift to right	0110 1000 0010 0111	1
XOR with A001h	1010 0000 0000 0001 1100 1000 0010 0110	–
Fourth shift to right	0110 0100 0001 0011	0
Fifth shift to right	0011 0010 0000 1001	1
XOR with A001h	1010 0000 0000 0001 1001 0010 0000 1000	–
Sixth shift to right	0100 1001 0000 0100	0
Seventh shift to right	0010 0100 1000 0010	0
Eighth shift to right	0001 0010 0100 0001	0
Result of CRC-16	0001 0010 0100 0001	–

■ Response

Slave-returned responses are classified into three types: normal response, no response, and exception response.
The response message structure is the same as the command message structure.

Slave address	Function code	Data	Error check
8 bits	8 bits	N×8 bits	16 bits

- Normal response

Upon receiving a command from the master, the slave executes the requested process and returns a response.

- No response

The slave may not return a response to a command sent by the master. This condition is referred to as "No response."
The causes of no response are explained below.

Transmission error

The slave destroys the command and does not return a response if any of the following transmission errors is detected.

Cause of transmission error	Description
Framing error	Stop bit 0 was detected.
Parity error	A mismatch with the specified parity was detected.
Mismatched CRC	The calculated value of CRC-16 was found not matching the error check value.
Invalid message length	The message length exceeded 256 bytes.

Other than transmission error

A response may not be returned without any transmission error being detected.

Cause	Description
Broadcast	If the command was broadcast, the slave executes the requested process but does not return a response.
Mismatched slave address	The slave address in the command was found not matching the slave address of the driver.

- Exception response

An exception response is returned if the slave cannot execute the process requested by the command. Appended to this response is an exception code indicating why the process cannot be executed. The message structure of exception response is as follows.

Slave address	Function code	Exception code	Error check
8 bits	8 bits	8 bits	16 bits

Function code

The function code in the exception response is a sum of the function code in the command and 80h.
Example) command: 03h → Exception response: 83h

Exception code

This code indicates why the process cannot be executed.

Exception code	Cause	Description
01h	Invalid function	The process could not be executed because the function code was invalid. · The function code is not supported. · The sub-function code for diagnosis (08h) is other than 00h.
02h	Invalid data address	The process could not be executed because the data address was invalid. · The address is not supported.
03h	Invalid data	The process could not be executed because the data was invalid. · The number of registers is 0. · The number of bytes is other than twice the number of registers. · The data is outside the specified range. · The data length is outside the specified range.
04h	Slave error	The process could not be executed because an error occurred at the slave. • User interface communication in progress · The **OPX-2A** is currently connected in a mode other than the monitor mode. · Downloading or initialization is currently in progress via the **MEXE02**. • NV memory processing in progress · Internal processing was in progress. (S-BSY is ON.) · An EEPROM error alarm was present.

Example of exception response

Master			Slave	
Slave address	01h		Slave address	01h
Function code	06h		Function code	86h
Register address (upper)	02h		Data	03h
Register address (lower)	1Eh		Error check (lower)	02h
Value written (upper)	FFh		Error check (upper)	61h
Value written (lower)	FFh			
Error check (lower)	E9h			
Error check (upper)	C4h			

Command → / ← Response
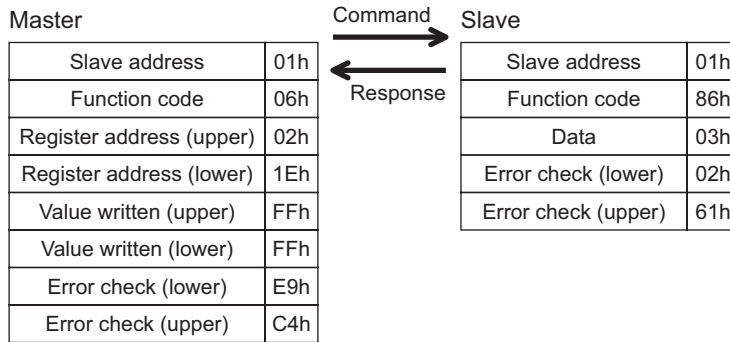
12.7 Function code

■ Reading from a holding register(s) (03h)

This function code is used to read a register (16 bits). Up to 10 successive registers (10×16 bits) can be read.
If two registers specifying the upper byte and lower byte (32 bits), respectively, constitute one value, then the two registers must be read simultaneously (example: position, operating speed). If not, an invalid value may be read.
If multiple holding registers are read, they are read in the order of register addresses.

Example of read

Read operation data for positions Nos. 1 and 2 of slave address 1.

Description	Resistor address	Value read	Corresponding decimal
Operation data position No.1 (upper)	0402h	0000h	10000
Operation data position No.1 (lower)	0403h	2710h	
Operation data position No.2 (upper)	0404h	FFFFh	−10000
Operation data position No.2 (lower)	0405h	D8F0h	

Master — Command → / ← Response — Slave

Master	
Slave address	01h
Function code	03h
Register address (upper)	04h
Register address (lower)	02h
Number of registers (upper)	00h
Number of registers (lower)	04h
Error check (lower)	E4h
Error check (upper)	F9h

Register address to start reading from (0402h)

Number of registers to be read from the starting register address (4 registers=0004h)

Slave		
Slave address	01h	
Function code	03h	
Number of data bytes	08h	Twice the number of registers in the command
Value read from register address (upper)	00h	Value read from register address 0402h
Value read from register address (lower)	00h	
Value read from register address+1 (upper)	27h	Value read from register address 0403h
Value read from register address+1 (lower)	10h	
Value read from register address+2 (upper)	FFh	Value read from register address 0404h
Value read from register address+2 (lower)	FFh	
Value read from register address+3 (upper)	D8h	Value read from register address 0405h
Value read from register address+3 (lower)	F0h	
Error check (lower)	08h	
Error check (upper)	A3h	

■ Writing to a holding register (06h)

This function code is used to write data to a specified register address.
If two registers specifying the upper byte and lower byte (32 bits), respectively, constitute one value, refer to "Writing to multiple holding registers (10h)."

Example of write

Write 80 (50h) as operating current to slave address 2.

Description	Resistor address	Value written	Corresponding decimal
Operating current	021Eh	50h	80

Master   Command →   Slave
   ← Response

Master			Slave	
Slave address	02h		Slave address	02h
Function code	06h		Function code	06h
Register address (upper)	02h		Register address (upper)	02h
Register address (lower)	1Eh		Register address (lower)	1Eh
Value write (upper)	00h		Value write (upper)	00h
Value write (lower)	50h		Value write (lower)	50h
Error check (lower)	E8h		Error check (lower)	E8h
Error check (upper)	7Bh		Error check (upper)	7Bh

Writing to a holding register (021Eh) — (Master, rows: Value write upper/lower)
Value written to the register address (021Eh) — (Slave, rows: Value write upper/lower)

■ Diagnosis (08h)

This function code is used to diagnose the communication between the master and slave. Arbitrary data is sent and the returned data is used to determine whether the communication is normal. 00h (reply to command) is the only sub-function supported by this function code.

Example of diagnosis

Send arbitrary data (1234h) to the slave.

Master   Command →   Slave
   ← Response

Master			Slave	
Slave address	03h		Slave address	03h
Function code	08h		Function code	08h
Sub function code (upper)	00h		Sub function code (upper)	00h
Sub function code (lower)	00h		Sub function code (lower)	00h
Data value (upper)	12h		Data value (upper)	12h
Data value (lower)	34h		Data value (lower)	34h
Error check (lower)	ECh		Error check (lower)	ECh
Error check (upper)	9Eh		Error check (upper)	9Eh

■ Writing to multiple holding registers (10h)

This function code is used to write data to multiple successive registers. Up to 10 registers can be written.
If two registers specifying the upper byte and lower byte (32 bits), respectively, constitute one value, then the two registers must be written simultaneously (example: position, operating speed). If not, an invalid value may be written. Registers are written in the order of register addresses. Note that even when an exception response is returned because some data is invalid as being outside the specified range, etc., other data may have been written properly.

Example of write

Set the following data as acceleration rate Nos.2 to 4 as part of operation data at slave address 4.

Description	Resistor address	Value written	Corresponding decimal
Operation data acceleration rate No.2 (upper)	0904h	0000h	10000
Operation data acceleration rate No.2 (lower)	0905h	2710h	
Operation data acceleration rate No.3 (upper)	0906h	0000h	20000
Operation data acceleration rate No.3 (lower)	0907h	4E20h	
Operation data acceleration rate No.4 (upper)	0908h	0007h	500,000
Operation data acceleration rate No.4 (lower)	0909h	A120h	

Master			Command	Slave		
Slave address	04h		Response ←	Slave address	04h
Function code	10h			Function code	10h
Register address (upper)	09h			Register address (upper)	09h
Register address (lower)	04h			Register address (lower)	04h
Number of registers (upper)	00h			Number of registers (upper)	00h
Number of registers (lower)	06h			Number of registers (lower)	06h
Number of data bytes	0Ch			Error check (lower)	02h
Value written to register address (upper)	00h			Error check (upper)	03h
Value written to register address (lower)	00h				
Value written to register address+1 (upper)	27h				
Value written to register address+1 (lower)	10h				
Value written to register address+2 (upper)	00h				
Value written to register address+2 (lower)	00h				
Value written to register address+3 (upper)	4Eh				
Value written to register address+3 (lower)	20h				
Value written to register address+4 (upper)	00h				
Value written to register address+4 (lower)	07h				
Value written to register address+5 (upper)	A1h				
Value written to register address+5 (lower)	20h				
Error check (lower)	28h				
Error check (upper)	5Ah				

Register address to start writing from (0904h)

Number of registers to be written from the starting register address (6 registers=0006h)

Twice the number of registers in the command

Value written to register address 0904h

Value written to register address 0905h

Value written to register address 0906h

Value written to register address 0907h

Value written to register address 0908h

Value written to register address 0909h

12.8 Control method selection

■ Communication setting

Set the following parameters using the **OPX-2A** or **MEXE02**.

Parameter	Setting range	Initial value	Description
Communication protocol	0: Modbus RTU 1: GW Ver.1.0	0	Sets the protocol for RS-485 communication. Set "0: Modbus RTU".
Communication parity	0: None 1: Even number 2: Odd number	1	Sets the parity for RS-485 communication.
Communication stop bit	0: 1 bit 1: 2 bits	0	Sets the stop bit for RS-485 communication.
Transmission waiting time	0 to 1000.0 ms	10.0	Sets the transmission waiting time for RS-485 communication.

■ Selection from I/O control and RS-485 communication control

Prior to shipment, I/O control is set as the method to select the operation command input method or operation data number. To change this control method to RS-485 communication, change the applicable settings using the **OPX-2A**, **MEXE02** or via RS-485 communication.

The table below lists the items whose control can be switched between I/O and RS-485 communication. You can use both methods simultaneously, such as controlling the operation via RS-485 communication and inputting a stop signal via I/O.

Item	Method of control via I/O	Method of control via RS-485 communication	This command is used to change the control method.
Positioning operation	START input	START for command 1 (001Eh)	START input mode
Excitation control	AWO input	C-ON for command 1 (001Eh)	Motor excitation mode
Stop	STOP input	STOP for command 1 (001Eh) *	I/O STOP input
Select data No.	M0 to M5 input	M0 to M5 for command 1 (001Eh)	Data number input mode
Return-to-home operation	HOME input	HOME for command 1 (001Eh)	HOME/FWD/RVS input mode
Continuous operation (forward)	FWD input	FWD for command 1 (001Eh)	HOME/FWD/RVS input mode
Continuous operation (reverse)	RVS input	RVS for command 1 (001Eh)	HOME/FWD/RVS input mode
Reset alarm	ALM-RST input	Alarm reset (0040h)	None (both are always effective)
Position preset	P-PRESET input	Position preset (0048h)	None (both are always effective)

∗ STOP for command 1 (001Eh) is always effective. Even if the "I/O STOP input" parameter is set to "enable," operation still stop when STOP is input for command 1 (001Eh).

12.9 Example of communication setting

The data required for each operation is set using the **OPX-2A**, **MEXE02** or via RS-485 communication.

■ Positioning operation

See p.46 for details on the positioning operation. How to perform the following positioning operation is explained as an example.

- Slave address: 1
- Position (distance): 1000 step
- Operating speed: 5000 Hz

1. Send the following command to turn ON the motor excitation.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to a holding register
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	20h	Turn ON C-ON=2000h
Value written (lower)	00h	
Error check (lower)	F0h	Result of CRC-16=0CF0h
Error check (upper)	0Ch	

2. Send the following command to set the position (travel amount) for operation data No.01 to 1000 steps.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	10h	Write to multiple holding registers.
Register address (upper)	04h	Position No.1=0402h
Register address (lower)	02h	
Number of registers (upper)	00h	Number of successive registers=2
Number of registers (lower)	02h	
Number of data bytes	04h	Total number of data bytes=4
Value written to register address (upper)	00h	1000 step=0000 03E8h
Value written to register address (lower)	00h	
Value written to register address+1 (upper)	03h	
Value written to register address+1 (lower)	E8h	
Error check (lower)	40h	Result of CRC-16=0840h
Error check (upper)	08h	

3. Send the following command to set the operating speed for operation data No.01 to 5000 Hz.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	10h	Write to multiple holding registers.
Register address (upper)	05h	Operating speed No.1=0502h
Register address (lower)	02h	
Number of registers (upper)	00h	Number of successive registers=2
Number of registers (lower)	02h	
Number of data bytes	04h	Total number of data bytes=4
Value written to register address (upper)	00h	5000 Hz=0000 1388h
Value written to register address (lower)	00h	
Value written to register address+1 (upper)	13h	
Value written to register address+1 (lower)	88h	
Error check (lower)	40h	Result of CRC-16=7040h
Error check (upper)	70h	

4. Send the following command to select operation data No.01 and turn the START input ON (start operation).
Position operation starts.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to holding register.
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	21h	C-ON, START and M0→ON=2101h
Value written (lower)	01h	
Error check (lower)	30h	Result of CRC-16=5C30h
Error check (upper)	5Ch	

5. Once the positioning operation has started, send the following command to turn the START input OFF again (no operation).

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to holding register.
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	20h	Turn OFF START, Turn ON M0 and C-ON=2001h
Value written (lower)	01h	
Error check (lower)	31h	Result of CRC-16=CC31h
Error check (upper)	CCh	

■ Continuous operation

See p.50 for details on the continuous operation. How to perform the following continuous operation is explained as an example.
- Slave address: 1
- Rotation direction: Forward
- Operating speed: 5000 Hz

1. Send the following command to turn ON the motor excitation.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to a holding register
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	20h	Turn ON C-ON =2000h
Value written (lower)	00h	
Error check (lower)	F0h	Result of CRC-16=0CF0h
Error check (upper)	0Ch	

2. Send the following command to set the operating speed for operation data No.01 to 5000 Hz.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	10h	Write to multiple holding registers.
Register address (upper)	05h	Operating speed No.1=0502h
Register address (lower)	02h	
Number of registers (upper)	00h	Number of successive registers=2
Number of registers (lower)	02h	
Number of data bytes	04h	Total number of data bytes=4
Value written to register address (upper)	00h	5000 Hz=0000 1388h
Value written to register address (lower)	00h	
Value written to register address+1 (upper)	13h	
Value written to register address+1 (lower)	88h	
Error check (lower)	40h	Result of CRC-16=7040h
Error check (upper)	70h	

3. Send the following command to select operation data No.01 and turn the FWD input ON (operation).
Continuous operation starts.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to holding register.
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	22h	Turn ON C-ON, FWD and M0=2201h
Value written (lower)	01h	
Error check (lower)	30h	Result of CRC-16=AC30h
Error check (upper)	ACh	

4. To stop the continuous operation, send the following command to turn the FWD input OFF again (deceleration stop).

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to holding register.
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	20h	Turn OFF FWD, Turn ON M0 and C-ON=2001h
Value written (lower)	01h	
Error check (lower)	31h	Result of CRC-16=CC31h
Error check (upper)	CCh	

■ Return-to-home operation

See p.50 for details on the return-to-home operation. How to perform the following return-to-home operation is explained as an example.
- Slave address: 1

1. Send the following command to turn ON the motor excitation.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to a holding register
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	20h	Turn ON C-ON=2000h
Value written (lower)	00h	
Error check (lower)	F0h	Result of CRC-16=0CF0h
Error check (upper)	0Ch	

2. Send the following command to turn the HOME input ON (start operation).
Return-to-home operation starts.

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to a holding register
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	28h	Turn ON C-ON and HOME=2800h
Value written (lower)	00h	
Error check (lower)	F7h	Result of CRC-16=CCF7h
Error check (upper)	CCh	

3. Once the return-to-home operation has started, send the following command to turn the HOME input OFF again (no operation).

Field name	Data	Description
Slave address	01h	Slave address 1
Function code	06h	Write to holding register.
Register address (upper)	00h	Command 1=001Eh
Register address (lower)	1Eh	
Value written (upper)	20h	Turn OFF HOME, Turn ON
Value written (lower)	00h	C-ON=2000h
Error check (lower)	F0h	Result of CRC-16=0CF0h
Error check (upper)	0Ch	

12.10 Register address list

Note   Data set via RS-485 communication is written to the driver's RAM, but data in the RAM will be cleared once the power is turned off. To save the data set via RS-485 communication to the NV memory, execute "Batch NV memory write." Note that only operation data and parameters are saved to the NV memory.

■ Register address types

- An attempt to read from an unused address or write-only register address in the following address range will return an invalid value.
- A value written to an unused address or read-only register address in the following address range will be ignored.

Address	Type	WRITE/ READ	Saving to NV memory	Description
0000h to 003Fh	Operation	W/R*	Possible	Specify operations.
0040h to 007Fh	Maintenance	W/R	Impossible	Clear alarm or warning records or perform batch processing of the NV memory.
0100h to 013Fh	Monitor	R	Impossible	Monitor the command speed, command position, I/O status, etc.
0200h to 027Fh 0300h to 033Fh	Parameter	W/R	Possible	WRITE/READ parameter.
0400h to 047Fh 0500h to 057Fh 0600h to 063Fh 0700h to 073Fh 0800h to 083Fh 0900h to 097Fh 0A00h to 0A7Fh 0C00h to 0C3Fh	Operation data	W/R	Possible	WRITE/READ operation data.

∗ Including read-only areas.

Note   • An attempt to write operation data or parameters in the following condition may fail. Also, invalid values may be read if operation data or parameters are read in this condition:
See "12.12 Detection of communication errors" on p.89 for details
· User interface communication in progress
· NV memory processing in progress
- An attempt to clear the history or process the NV memory in the following condition may fail. Note, however, that the NV memory can still be initialized even when an EEPROM error alarm is present:
See "12.12 Detection of communication errors" on p.89 for details
· User interface communication in progress
· NV memory processing in progress

■ Operation area

Address	WRITE/READ	Name	Initial value
0012h	W/R	Dwell time for the selected data number	−
0013h	W/R	Sequential positioning for the selected data number	−
0014h	W/R	Operating mode for the selected data number	−
0015h	W/R	Positioning mode for the selected data number	−
0016h	W/R	Deceleration rate for the selected data number (upper)	−
0017h	W/R	Deceleration rate for the selected data number (lower)	−
0018h	W/R	Acceleration rate for the selected data number (upper)	−
0019h	W/R	Acceleration rate for the selected data number (lower)	−
001Ah	W/R	Operating speed for the selected data number (upper)	−
001Bh	W/R	Operating speed for the selected data number (lower)	−
001Ch	W/R	Position for the selected data number (upper)	−
001Dh	W/R	Position for the selected data number (lower)	−
001Eh	W/R	Command 1	−
001Fh	W/R	Command 2	−
0020h	R	Status 1	−
0021h	R	Status 2	−
0030h	W/R	Group	−1

- Operation data for the selected data number (0012h to 001Dh)

Operation data is read or written from/to the selected data number indirectly.
The actual area to be read or written in this operation is the area where the operation data is stored.

Example) Operation data No.2 is selected

001Ch is written (read) in the exact same manner as 0404h is written (read).
001Dh is written (read) in the exact same manner as 0405h is written (read).

Address	WRITE/READ	Name
001Ch	W/R	Position for the operation data No.2 (upper)=0404h
001Dh	W/R	Position for the operation data No.2 (lower)=0405h

Example) Operation data No.3 is started after changing the original operating speed and position

By "writing to multiple holding registers" at 001Ah to 001Fh, you can change the operating speed and position for operation data No.3 and start the operation with a single command. Select operation data No.3 and then send the following command.

Address	WRITE/READ	Name
001Ah	W/R	Operating speed for the operation data No.3 (upper)
001Bh	W/R	Operating speed for the operation data No.3 (lower)
001Ch	W/R	Position for the operation data No.3 (upper)
001Dh	W/R	Position for the operation data No.3 (lower)
001Eh	W/R	Command 1

- ## Command 1 (001Eh)

Commands the slave to perform an operation.

byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Upper	–	–	C-ON	STOP	HOME	RVS	FWD	START
Lower	–	–	M5	M4	M3	M2	M1	M0

Signal name	Description	Setting range	Initial value
M0 to M5	Specify the operation data number using six bits.	0 to 63: Operating data No.	0
START	Perform positioning operation.	0: No action 1: Start operation[*1]	0
FWD	Perform continuous operation in the forward direction.	0: Deceleration stop 1: Operation	0
RVS	Perform continuous operation in the reverse direction.	0: Deceleration stop 1: Operation	0
HOME	Perform return-to-home operation.	0: No action 1: Start operation[*1]	0
STOP	Stop the motor.	0: No action 1: Stop	0
C-ON	Switch the motor excitation setting (excited/not excited).	0: Motor is not excited[*2] 1: Motor is excited[*2]	0

∗1 Operation starts at the ON edge from 0 to 1. Return the bit to "0" once the operation has started.
∗2 When the "C-ON logic configuration" parameter is set to "0."

- ## Command 2 (001Fh)

Commands the slave to perform an operation.

byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Upper	–	–	–	–	–	–	–	–
Lower	–	–	–	–	R-OUT4	R-OUT3	R-OUT2	R-OUT1

Signal name	Description	Setting range	Initial value
R-OUT1 to R-OUT4	These signals set ON/OFF of R-OUT1 to R-OUT4 outputs.	0: OFF (photocoupler un-energized) 1: ON (photocoupler energized)	0

- ## Status 1 (0020h)

Indicates the slave condition.

byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Upper	AREA	–	READY	–	HOME-P	MOVE	STEPOUT	START_R
Lower	ALM	WNG	M5_R	M4_R	M3_R	M2_R	M1_R	M0_R

Signal name	Description	Range
M0_R to M5_R	Selected operation data number[*]	0 to 63: Selected operation data number
WNG	A warning is present.	0: Warning not present 1: Warning present
ALM	An alarm is present.	0: Alarm not present 1: Alarm present
START_R	Indicates the status of START.[*]	0: START=OFF 1: START=ON
STEPOUT	The step deviation is abnormal.	0: Deviation error not present 1: Deviation error present
MOVE	Indicates the operating condition of the motor.	0: Motor stopped 1: Motor operating
HOME-P	Indicates that the motor is at home position. It can be used as a home-seeking completion signal.	0: Motor not positioned at home 1: Motor positioned at home (home-seeking completed)
READY	Indicates that the driver is ready.	0: Not ready 1: Ready
AREA	The motor output shaft is inside the specified range.	0: Outside area 1: Inside area

∗ START and M0 to M5 can be turned ON/OFF via I/O or RS-485 communication. If these signals are controlled via I/O, the I/O-controlled ON/OFF status is returned. If the signals are controlled via RS-485 communication, the RS-485-communication-controlled ON/OFF status is returned. I/O control is selected as the default prior to shipment.

● Status 2 (0021h)

Indicates the slave condition.

byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Upper	–	–	–	–	–	–	–	–
Lower	–	–	–	ZSG	TIM	O.H.	ENABLE	S-BSY

Signal name	Description	Read range
S-BSY	Indicates the internal processing condition as a result of RS-485 communication.	0: Internal processing not in progress 1: Internal processing in progress
ENABLE	Indicates the excitation condition of the motor.	0: Motor not excited 1: Motor excited
O.H.	Indicates whether or not an overheat warning is present.	0: Overheat warning not present 1: Overheat warning present
TIM	Indicates the excitation condition of the motor. "1" is read when the motor is at its excitation home.	0: TIM not being detected 1: TIM being detected
ZSG	Indicates the Z-phase condition of the encoder input.	0: ZSG not being detected 1: ZSG being detected

● Group (0030h)

■ Maintenance area

Note
● It takes time to clear the history or read/write the NV memory. The internal processing in-progress signal (S-BSY) remains ON while the processing is being executed. Do not issue maintenance commands while the internal processing is in progress.
● Do not issue maintenance commands while the motor is operating.
● Set "1" for maintenance data. Return it to "0" after the applicable operation is finished.

Address	WRITE/READ	Name	Description	Setting range
0040h	W/R	Reset alarm	Resets the alarms that are present.	0: Do not execute 1: Execute
0041h	W/R	Clear alarm records	Clear alarm records.	
0042h	W/R	Clear warning records	Clear warning records.	
0044h	W/R	Batch NV memory read	Reads the operation data and parameters saved in the NV memory, to the RAM. All operation data and parameters previously saved in the RAM are overwritten.	
0045h	W/R	Batch NV memory write	Writes the operation data and parameters saved in the RAM to the NV memory.	
0046h	W/R	All data initialization	Resets the operation data and parameters saved in the RAM and NV memory, to their defaults. [2]	
0048h	W/R	Preset position	Presets the command position as the value of the "preset position" parameter.	
0049h	W/R	Clear communication error records	Clears the communication error records.	
004Ah	W/R	Preset encoder counter [1]	Presets the encoder counter value as the value of the "encoder counter preset value" parameter.	
004Bh	W/R	Clear counter	Clears the command position and encoder counter value to 0. Internal deviations of the driver are also cleared, so any deviation error, if present, is reset.	
004Ch	W/R	Operation data initialization	Resets the operation data saved in the RAM and NV memory, to their defaults.	
004Dh	W/R	Application parameters initialization	Resets the application parameters saved in the RAM and NV memory, to their defaults.	
004Eh	W/R	System parameters initialization	Resets the system parameters saved in the RAM and NV memory, to their defaults. [2]	

*1 This resistor address is used when an encoder is connected.
*2 The communication axis number, communication protocol, communication parity, communication stop bit and transmission waiting time are not initialized.

■ Monitor area

Address	WRITE/READ	Name	Description	Setting range
0100h	R	Present alarm	Monitors the present alarm code.	–
0101h	R	Alarm record 1	Check the alarm records 1 to 10	
0102h	R	Alarm record 2		
0103h	R	Alarm record 3		
0104h	R	Alarm record 4		
0105h	R	Alarm record 5		
0106h	R	Alarm record 6		
0107h	R	Alarm record 7		
0108h	R	Alarm record 8		
0109h	R	Alarm record 9		
010Ah	R	Alarm record 10		
010Bh	R	Present warning	Monitors the present warning code.	–
010Ch	R	Warning record 1	Check the warning records 1 to 10	
010Dh	R	Warning record 2		
010Eh	R	Warning record 3		
010Fh	R	Warning record 4		
0110h	R	Warning record 5		
0111h	R	Warning record 6		
0112h	R	Warning record 7		
0113h	R	Warning record 8		
0114h	R	Warning record 9		
0115h	R	Warning record 10		
0116h	R	Present selected operation data number	Check the operation data number currently selected.	0 to 63
0117h	R	Present operation data number	Check the operation data number corresponding to the data used in the current positioning operation. This address is used in linked-motion operation and sequential operation. While the motor is stopped, the last used operation data number is indicated.	0 to 63
0118h	R	Command position (upper)	Monitors the command position.	−2,147,483,648 to 2,147,483,647 step
0119h	R	Command position (lower)		
011Ch	R	Command speed (upper)	Monitors the current command speed.	−500,000 to +500,000 Hz +: Forward −: Reverse 0: Stop
011Dh	R	Command speed (lower)		
011Eh	R	Encoder counter (upper)[*]	Monitors the encoder counter value.	−2,147,483,648 to 2,147,483,647 step
011Fh	R	Encoder counter (lower)[*]		
0124h	R	Remaining dwell time	Indicates how much of the dwell time used in the linked-motion operation 2 remains.	0 to 50000 (1=0.001 s)
0126h	R	I/O status (upper)	Monitor the each I/O signal (CN2) of the driver. (see table on next page.)	0: OFF (photocoupler un-energized) 1: ON (photocoupler energized)
0127h	R	I/O status (lower)		
0128h	R	Communication error code	Indicates the last received communication error code.	–

* This registor address is used when an encoder is connected.

Address	WRITE/READ	Name	Description	Setting range
0129h	R	Communication error code record 1	Check the communication error records 1 to 10 that have occurred in the past.	–
012Ah	R	Communication error code record 2		
012Bh	R	Communication error code record 3		
012Ch	R	Communication error code record 4		
012Dh	R	Communication error code record 5		
012Eh	R	Communication error code record 6		
012Fh	R	Communication error code record 7		
0130h	R	Communication error code record 8		
0131h	R	Communication error code record 9		
0132h	R	Communication error code record 10		
0133h	R	Driver status (upper)	Monitors the driver status. (see table on next page.)	0: OFF 1: ON
0134h	R	Driver status (lower)		

- I/O status

byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
3 (most significant bit)	–	–	OUT4	OUT3	OUT2	OUT1	ALM	MOVE
2	–	–	–	–	SLIT	HOMES	−LS	+LS
1	–	RVS	FWD	HOME/P-PRESET	STOP	AWO	ALM-RST	START
0 (least significant bit)	–	–	M5	M4	M3	M2	M1	M0

- Driver status

byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
3 (most significant bit)	ALMCD							
2	ZSG	TIM	M5_R	M4_R	M3_R	M2_R	M1_R	M0_R
1	START_R	O.H.	HOMES	SLIT	−LS	+LS	STEPOUT	WNG
0 (least significant bit)	ENABLE	ALM	AREA	S-BSY	READY	HOME-P	0	MOVE

Signal name of driver status

Signal name	Description	Read range
MOVE	Indicates the operating condition of the motor.	0: Motor stopped 1: Motor operating
HOME-P	Indicates that the motor is at home position. It can be used as a home-seeking completion signal.	0: Motor not positioned at home 1: Motor positioned at home (home-seeking completed)
READY	Indicates that the driver is ready.	0: Not ready 1: Ready
S-BSY	Indicates the internal processing condition as a result of RS-485 communication.	0: Internal processing not in progress 1: Internal processing in progress
AREA	The motor output shaft is inside the specified range.	0: Outside area 1: Inside area
ALM	An alarm is present.	0: Alarm not present 1: Alarm present
ENABLE	Indicates the excitation condition of the motor.	0: Motor not excited 1: Motor excited
WNG	A warning is present.	0: Warning not present 1: Warning present
STEPOUT	The deviation is abnormal.	0: Deviation error not present 1: Deviation error present

Signal name	Description	Read range
+LS	Indicates the condition of the I/O +LS input.	0: OFF (photocoupler un-energized) 1: ON (photocoupler energized)
−LS	Indicates the condition of the I/O −LS input.	
SLIT	Indicates the condition of the I/O SLIT input.	
HOMES	Indicates the condition of the I/O HOMES input.	
O.H.	Indicates whether or not an overheat warning is present.	0: Overheat warning not present 1: Overheat warning present
START_R	Indicates the status of START.*	0: START=OFF 1: START=ON
TIM	Indicates the excitation condition of the motor. "1" is read when the motor is at its excitation home.	0: TIM not being detected 1: TIM being detected
ZSG	Indicates the Z-phase condition of the encoder input.	0: ZSG not being detected 1: ZSG being detected
M0_R to M5_R	Selected operation data number *	0 to 63: Operation data number
ALMCD	Indicates the alarm code of the present alarm.	Alarm code

* START and M0 to M5 can be turned ON/OFF via I/O or RS-485 communication. If these signals are controlled via I/O, the I/O-controlled ON/OFF status is returned. If the signals are controlled via RS-485 communication, the RS-485-communication-controlled ON/OFF status is returned. I/O control is selected as the default prior to shipment.

■ Parameter area

● Application parameters

Address	WRITE/ READ	Name	Setting range		Initial value
0200h	W/R	START input mode	0: RS-485 communication 1: I/O		1: I/O
0201h	W/R	I/O STOP input	0: Disable 1: Enable		1: Enable
0202h	W/R	STOP action	0: Immediate stop 1: Decelerate stop 2: Immediate stop & Current OFF 3: Decelerate stop & Current OFF		1: Decelerate stop
0203h	W/R	STOP contact configuration	0: Make (N.O.) 1: Brake (N.C.)		1: Brake (N.C.)
0204h	W/R	C-ON logic configuration	0: 0=Not excited, 1=Excited 1: 0=Excited, 1=Not excited		0: 0=Not excited, 1=Excited
0206h	W/R	OUT1 signal mode selection	5: AREA 11: R-OUT1		5: AREA
0207h	W/R	OUT2 signal mode selection	6: TIM 12: R-OUT2		7: READY
0208h	W/R	OUT3 signal mode selection	7: READY 13: STEPOUT*		8: WNG
0209h	W/R	OUT4 signal mode selection	8: WNG 14: O.H. 9: HOME-P 15: R-OUT3 10: ZSG* 16: R-OUT4		9: HOME-P
020Ah	W/R	HOME/P-PRESET input switching	0: HOME 1: P-PRESET		0: HOME
020Bh	W/R	Motor excitation mode	0: RS-485 communication 1: I/O		1: I/O
020Ch	W/R	HOME/FWD/RVS input mode	0: RS-485 communication 1: I/O		1: I/O
020Dh	W/R	Data No. input mode	0: RS-485 communication 1: I/O		1: I/O
020Eh	W/R	AWO contact configuration	0: Make (N.O.) 1: Brake (N.C.)		0: Make (N.O.)
020Fh	W/R	Hardware overtravel detection	0: Disable 1: Enable		1: Enable
0210h	W/R	LS contact configuration	0: Make (N.O.) 1: Brake (N.C.)		0: Make (N.O.)
0211h	W/R	HOMES contact configuration	0: Make (N.O.) 1: Brake (N.C.)		0: Make (N.O.)
0212h	W/R	SLIT contact configuration	0: Make (N.O.) 1: Brake (N.C.)		0: Make (N.O.)
0213h	W/R	Overtravel action	0: Immediate stop 1: Decelerate stop		0: Immediate stop

* This parameter is used when an encoder is connected.

Address	WRITE/READ	Name	Setting range	Initial value
0214h	W/R	Preset position (upper)	−8,388,608 to +8,388,607 step	0
0215h		Preset position (lower)		
0216h	W/R	Area 1 (upper)	−8,388,608 to +8,388,607 step	0
0217h		Area 1 (lower)		
0218h	W/R	Area 2 (upper)	−8,388,608 to +8,388,607 step	0
0219h		Area 2 (lower)		
021Ch	W/R	Encoder counter preset value (upper)	−8,388,608 to +8,388,607 step	0
021Dh		Encoder counter preset value (lower)		
021Eh	W/R	Operating current	5 to 100%	100
021Fh	W/R	Standstill current	5 to 50%	50
0224h	W/R	Common acceleration rate (upper)	1 to 1,000,000 (1=0.001 ms/kHz)	30000
0225h		Common acceleration rate (lower)		
0226h	W/R	Common deceleration rate (upper)	1 to 1,000,000 (1=0.001 ms/kHz)	30000
0227h		Common deceleration rate (lower)		
0228h	W/R	Starting speed (upper)	1 to 500,000 Hz	100
0229h		Starting speed (lower)		
0230h	W/R	Jog operating speed (upper)	1 to 500,000 Hz	1000
0231h		Jog operating speed (lower)		
0232h	W/R	Jog acceleration (deceleration) rate (upper)	1 to 1,000,000 (1=0.001 ms/kHz)	30000
0233h		Jog acceleration (deceleration) rate (lower)		
0234h	W/R	Jog starting speed (upper)	1 to 500,000 Hz	100
0235h		Jog starting speed (lower)		
0236h	W/R	Acceleration (deceleration) rate type	0: Common 1: Separate	0: Common
0237h	W/R	Home-seeking mode	0: 2 sensors 1: 3 sensors	1: 3 sensors
023Ah	W/R	Operating speed of home-seeking (upper)	1 to 500,000 Hz	1000
023Bh		Operating speed of home-seeking (lower)		
023Ch	W/R	Acceleration (deceleration) rate of home-seeking (upper)	1 to 1,000,000 (1=0.001 ms/kHz)	30000
023Dh		Acceleration (deceleration) rate of home-seeking (lower)		
023Eh	W/R	Starting speed of home-seeking (upper)	1 to 500,000 Hz	100
023Fh		Starting speed of home-seeking (lower)		
0240h	W/R	Position offset of home-seeking (upper)	−8,388,608 to +8,388,607 step	0
0241h		Position offset of home-seeking (lower)		
0242h	W/R	Starting direction of home-seeking	0: Negative direction 1: Positive direction	1: Positive direction
0243h	W/R	SLIT detection with home-seeking	0: Disable 1: Enable	0: Disable
0244h	W/R	TIM signal detection with home-seeking	0: Disable 1: Enable (TIM) 2: Enable (ZSG)*	0: Disable
0245h	W/R	Backward steps in 2 sensor mode home-seeking	0 to 32767 step	200
0246h	W/R	Stepout detection band*	1 to 3600 (1=0.1 deg)	72
024Ah	W/R	Overvoltage warning	250 to 350 (1=0.1 V)	310
024Ch	W/R	Overheat warning	40 to 85 °C (104 to 185 °F)	85 °C (185 °F)
0252h	W/R	Software overtravel	0: Disable 1: Enable	1: Enable
0254h	W/R	Positive software limit (upper)	−8,388,608 to +8,388,607 step	+8,388,607
0255h		Positive software limit (lower)		
0256h	W/R	Negative software limit (upper)	−8,388,608 to +8,388,607 step	−8,388,608
0257h		Negative software limit (lower)		
0258h	W/R	Display mode of the data setter speed	0: Signed 1: Absolute	0: Signed

∗ This parameter is used when an encoder is connected.

Address	WRITE/READ	Name	Setting range	Initial value
0259h	W/R	The data setter editing mode	0: Disable 1: Enable	1: Enable
025Bh	W/R	Communication timeout action	0: Immediate stop 1: Decelerate stop	1: Decelerate stop
025Ch	W/R	Stepout detection action*	0: No operation (alarm/warning not present) 1: Warning 2: Alarm	0: No operation

∗ This parameter is used when an encoder is connected.

- System parameters

Note	• To make the new system parameter settings effective, execute "Batch NV memory write" and then cycle the power.
	• The communication axis number, communication parity, communication stop bit and transmission waiting time parameters relate to sending/receiving of data through communication. If these parameters are changed and the new settings become effective, communication may be disabled. Exercise due caution.

Address	WRITE/READ	Name	Setting range	Initial value
030Eh	W/R	Motor rotation direction	0: + direction=CCW 1: + direction=CW	1: + direction=CW
0310h	W/R	Stepout detection*	0: Disable 1: Enable	0: Disable
0311h	W/R	Motor step angle	See table below.	0
0312h	W/R	Encoder electronic gear A (upper)*	1 to 250,000	500
0313h		Encoder electronic gear A (lower)*		
0314h	W/R	Encoder electronic gear B (upper)*	1 to 250,000	500
0315h		Encoder electronic gear B (lower)*		
0316h	W/R	Communication axis number	0 to 31	15
0318h	W/R	Communication parity	0: None 1: Even number 2: Odd number	1: Even number
0319h	W/R	Communication stop bit	0: 1 bit 1: 2 bits	0: 1 bit
031Ah	W/R	Transmission waiting time	1 to 10000 (1=0.1 ms)	100
031Bh	W/R	Communication timeout	0: Not monitored 1 to 10000 ms	0: Not monitored
031Ch	W/R	Communication error alarm	1 to 10 times	3

∗ This parameter is used when an encoder is connected.

- "Motor step angle" parameters: If the base step angle of the motor is 0.72°

Setting	Step angle	Number of divisions	Setting	Step angle	Number of divisions
0	0.72°	1	8	0.0288°	25
1	0.36°	2	9	0.018°	40
2	0.288°	2.5	10	0.0144°	50
3	0.18°	4	11	0.009°	80
4	0.144°	5	12	0.0072°	100
5	0.09°	8	13	0.00576°	125
6	0.072°	10	14	0.0036°	200
7	0.036°	20	15	0.00288°	250

• "Motor step angle" parameters: If the base step angle of the motor is 0.36°

Setting	Step angle	Number of divisions	Setting	Step angle	Number of divisions
0	0.36°	1	8	0.0144°	25
1	0.18°	2	9	0.009°	40
2	0.144°	2.5	10	0.0072°	50
3	0.09°	4	11	0.0045°	80
4	0.072°	5	12	0.0036°	100
5	0.045°	8	13	0.0028°	125
6	0.036°	10	14	0.0018°	200
7	0.018°	20	15	0.00144°	250

Note
- Step angles are theoretical values.
- With the geared type, the value of "step angle/gear ratio" becomes the actual step angle.
- The base step angle is 0.36° for high-resolution type motors.

■ Operation data area

Address	WRITE/READ	Name	Setting range	Initial value
0402h		Position No.1 (upper)		
0403h		Position No.1 (lower)		
to	W/R	to	−8,388,608 to 8,388,607 step	0
047Eh		Position No.63 (upper)		
047Fh		Position No.63 (lower)		
0502h		Operating speed No.1 (upper)		
0503h		Operating speed No.1 (lower)		
to	W/R	to	1 to 500,000 Hz	1000
057Eh		Operating speed No.63 (upper)		
057Fh		Operating speed No.63 (lower)		
0601h to 063Fh	W/R	Positioning mode No.1 to Positioning mode No.63	0: Incremental 1: Absolute	0: Incremental
0701h to 073Fh	W/R	Operating mode No.1 to Operating mode No.63	0: Single-motion 1: Linked-motion 2: Linked-motion 2	0: Single-motion
0801h to 083Fh	W/R	Sequential positioning No.1 to Sequential positioning No.63	0: Disable 1: Enable	0: Disable
0902h		Acceleration rate No.1 (upper)		
0903h		Acceleration rate No.1 (lower)		
to	W/R	to	1 to 1,000,000 (1=0.001 ms/kHz)	30000
097Eh		Acceleration rate No.63 (upper)		
097Fh		Acceleration rate No.63 (lower)		
0A02h		Deceleration rate No.1 (upper)		
0A03h		Deceleration rate No.1 (lower)		
to	W/R	to	1 to 1,000,000 (1=0.001 ms/kHz)	30000
0A7Eh		Deceleration rate No.63 (upper)		
0A7Fh		Deceleration rate No.63 (lower)		
0C01h to 0C3Fh	W/R	Dwell time No.1 to Dwell time No.63	0 to 50000 (1=0.001 s)	0

12.11 Group send

Multiple slaves are made into a group and a command is sent to all slaves in the group at once.

- Group composition

A group consists of one parent slave and child slaves and only the parent slave returns a response.

- Group address

To perform a group send, set a group address to the child slaves to be included in the group.
The child slaves to which the group address has been set can receive a command sent to the parent slave.
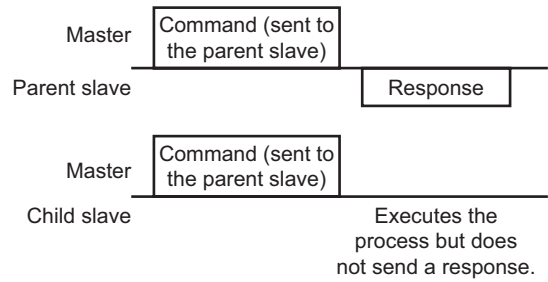
- Parent slave

No special setting is required on the parent slave to perform a group send. The address of the parent slave becomes the group address. When a command is sent to the parent slave from the master, the parent slave executes the requested process and then returns a response (same with the unicast mode).

- Child slave

Use a "group" command to set a group address to each child slave.
Change the group in the unicast mode.

Address	Setting range	Initial value
0030h	−1: No group specification (Group send is not performed) 1 to 31: Sets a group address.	−1

- Function code supporting the group send

Function code	Description
10h	Write to multiple holding registers.
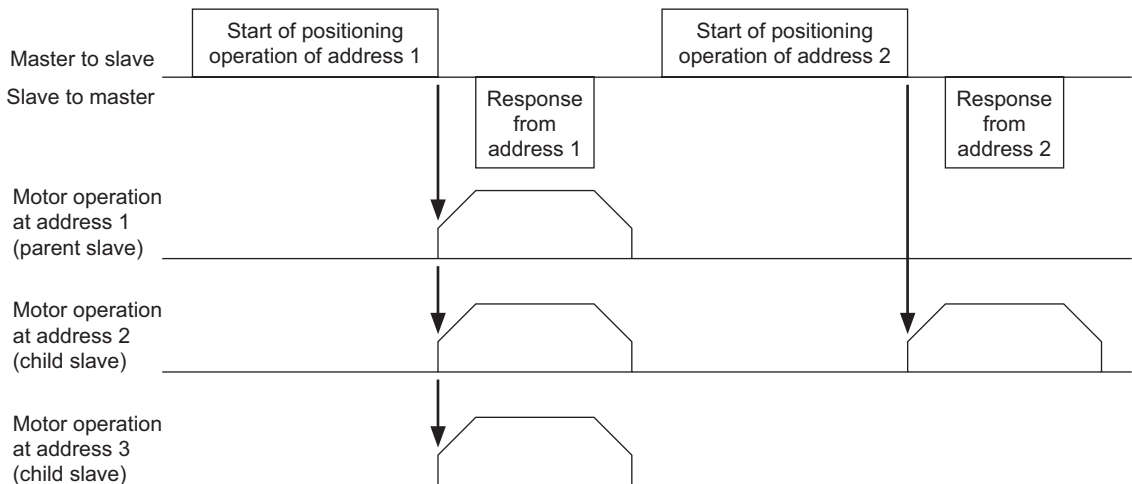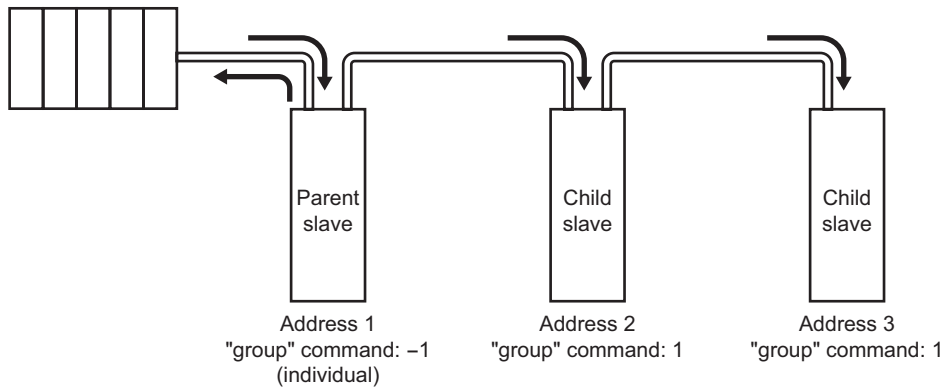
12.12 Detection of communication errors

This function detects abnormalities that may occur during RS-485 communication. The abnormalities that can be detected include alarms, warnings and communication errors.

■ Communication errors

A communication error record will be saved in the RAM. You can check the communication errors using the **MEXE02** or "communication error record" command via RS-485 communication.

Note | The communication error record will be cleared once the driver power is turned off.

Type of communication error	Error code	Cause
RS-485 communication error	84h	A transmission error was detected. See "Transmission error" on p.70.
Command not yet defined	88h	An exception response (exception code 01h, 02h) was detected. See p.70.
User interface communication in progress	89h	An exception response (exception code 04h) was detected. See p.70.
NV memory processing in progress	8Ah	
Outside setting range	8Ch	An exception response (exception code 03h) was detected. See p.70.

■ Alarms and warnings

When an alarm generates, the ALM output will turn OFF and the motor will stop. At the same time, the ALARM LED will start blinking.
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.

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

• RS-485 communication error (84h)

The table below shows the relationship between alarms and warnings when an RS-485 communication error occurs.

Description of error	Description
Warning	A warning generates when one RS-485 communication error (84h) has been detected. If normal reception occurs while the warning is present, the warning will be reset automatically.
Alarm	An alarm generates when a RS-485 communication error (84h) has been detected consecutively by the number of times set in the "communication error alarm" parameter. While the alarm is present, RS-485 communication is cut off and the motor becomes unexcited.

• RS-485 communication timeout (85h)

If communication is not established with the master after an elapse of the time set by the "communication timeout" parameter, a RS-485 communication timeout alarm will generate. The motor stopping method can be set using the "communication timeout action" parameter.

12.13 Timing charts

■ Communication start
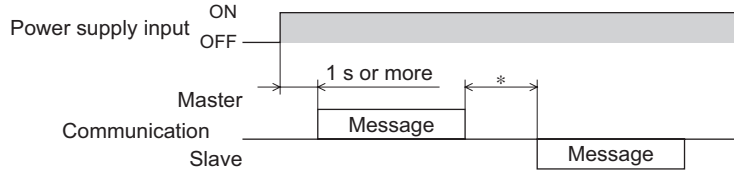
Power supply input
ON / OFF

Master Communication / Slave

Message

1 s or more

*

Message

* Tb2 (transmission waiting time)+C3.5 (silent interval)
  Tb4 (processing time)+C3.5 (silent interval) if Tb2 < Tb4

■ Operation start

Master Communication Slave

Message*1

*2

Message

MOVE output
ON / OFF

*3

*1 A message including a command to start operation via RS-485 communication.
*2 Tb2 (transmission waiting time)+C3.5 (silent interval)
   Tb4 (processing time)+C3.5 (silent interval) if Tb2 < Tb4
*3 C3.5 (silent interval)+4 ms or less

■ Operation stop, speed change

Master Communication Slave

Message*1

*2

Message

Motor speed command

*3 *4
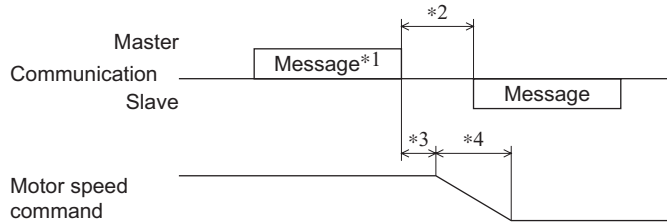
*1 A message including a command to start operation via RS-485 communication and another to change the speed.
*2 Tb2 (transmission waiting time)+C3.5 (silent interval)
   Tb4 (processing time)+C3.5 (silent interval) if Tb2 < Tb4
*3 The specific time varies depending on the command speed.
*4 The deceleration method to be applied at the time of stopping varies according to the value set by the "STOP action" parameter.

■ Excitation control

Master Communication Slave

Message*1

*2

Message

Message*1

*2

Message

Motor excitation command

Excitation   *3   Not excitation   *3   Excitation
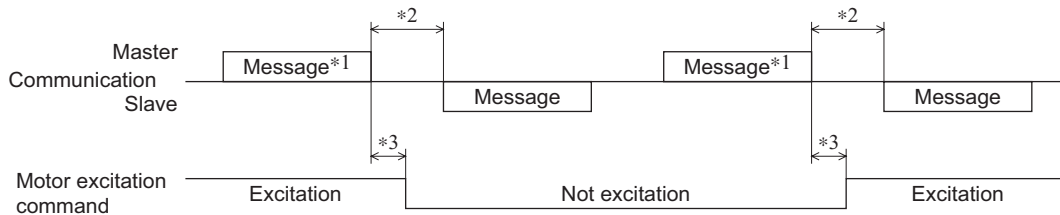
*1 A message including a command for excitation control via RS-485 communication.
*2 Tb2 (transmission waiting time)+C3.5 (silent interval)
   Tb4 (processing time)+C3.5 (silent interval) if Tb2 < Tb4
*3 C3.5 (silent interval)+4 ms or less

■ Remote output

Master Communication Slave

Message*1

*2

Message

R-OUT1 output
R-OUT2 output
ON / OFF

*3
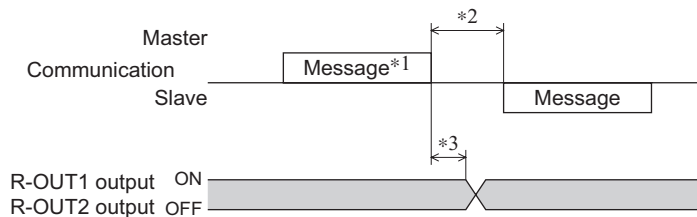
*1 A message including a command for remote output via RS-485 communication.
*2 Tb2 (transmission waiting time)+C3.5 (silent interval)
   Tb4 (processing time)+C3.5 (silent interval) if Tb2 < Tb4
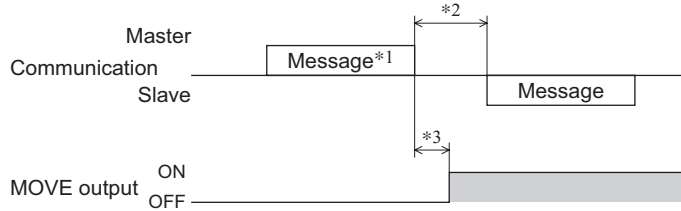*3 C3.5 (silent interval)+4 ms or less

13 Method of control via GW protocol Version 1

The following explains how to implement controls using GW protocol Version 1 via RS-485 communication.

13.1 Guidance

If you are new to the **CRK** series built-in controller, read this section to understand the operating methods along the operation flow.

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

STEP 1   Check the installation and connection

Check
RS-485 communication
cable connection
P.32

Programmable controller
or master device

Or

Check
Motor connection
P.24

Check
Data setter **OPX-2A** or data setting
software **MEXE02** connection
P.31

Check
Motor and driver
installation
P.16, 21

Check
Power supply
connection
P.27

FG

STEP 2   Set the switches

Set terminal resistor
as necessary.

ON

Programmable controller
or master device

Or

Set baud rate, connection destination and
slave address.

Set slave address

Set the connection destination
(ON: General-purpose master device)

Set baud rate
(example: 9600 bps)

STEP 3   Turn on the power and set the parameters

Programmable controller
or master device

Or

Turn power supply on

Set the following system parameters
via **OPX-2A** or **MEXE02**.
- Communication protocol   : 1 (GW Ver.1)

Set the following parameters via **OPX-2A**,
MEXE02 or RS-485 communication.
- START input mode   : 0 (RS-485 communication)
- HOME/FWD/RVS input mode : 0 (RS-485 communication)
- Data No. input mode   : 0 (RS-485 communication)
- Motor excitation mode   : 0 (RS-485 communication)
- I/O STOP input   : 0 (Disable)

STEP 4   Cycle the power

System parameters will become effective only after the power is cycled. If you have changed any of the system parameters, be sure to cycle the power.

STEP 5   Operate the motor

Programmable controller
or master device

1. Send operation data from the programmable controller.
2. Send an operation command.
   P.98
3. Confirm that the motor rotates without problem.

STEP 5   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 any alarm present?
- Are the power supply, motor and RS-485 communication cable connected securely?
- Are the address number, baud rate and terminal resistor set correctly?
- Is the C-ERR LED lit?
- Is the C-DAT LED lit?

For more detailed settings and functions, refer to the following pages.

13.2 Communication specifications

Electrical characteristics	In conformance with EIA-485 Use a twisted pair cable (TIA/EIA-568B CAT5e or higher is recommended) and keep the total wiring distance including extension to 50 m (164 ft.) or less.
Transmission mode	Half duplex
Baud rate	Selectable from 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 250000 bps, 312500 bps and 625000 bps.
Physical layer	Asynchronous mode (8 bits, 1 stop bit, no parity)
Protocol	9-byte fixed frame length, binary transfer
Connection pattern	Up to 31 drivers can be connected to one programmable controller (master device).

■ Connection example
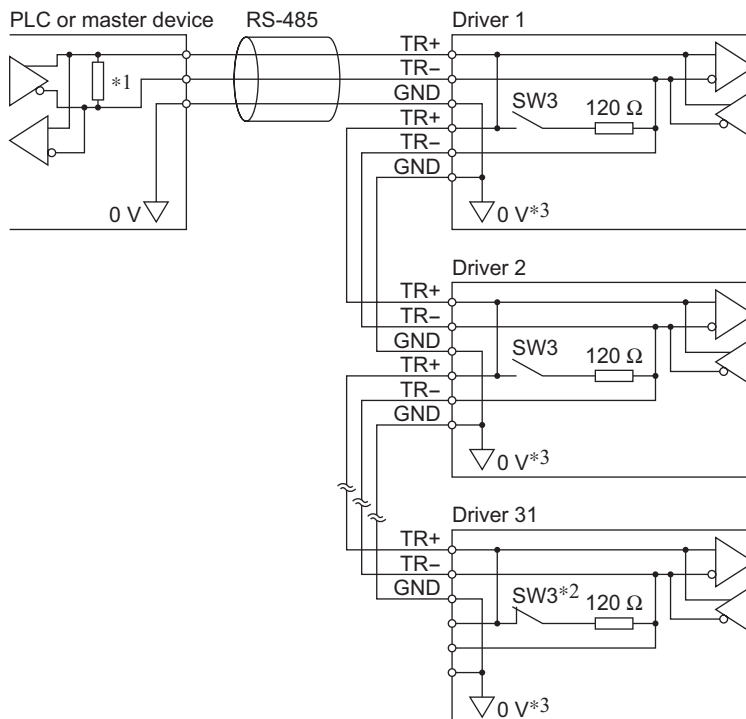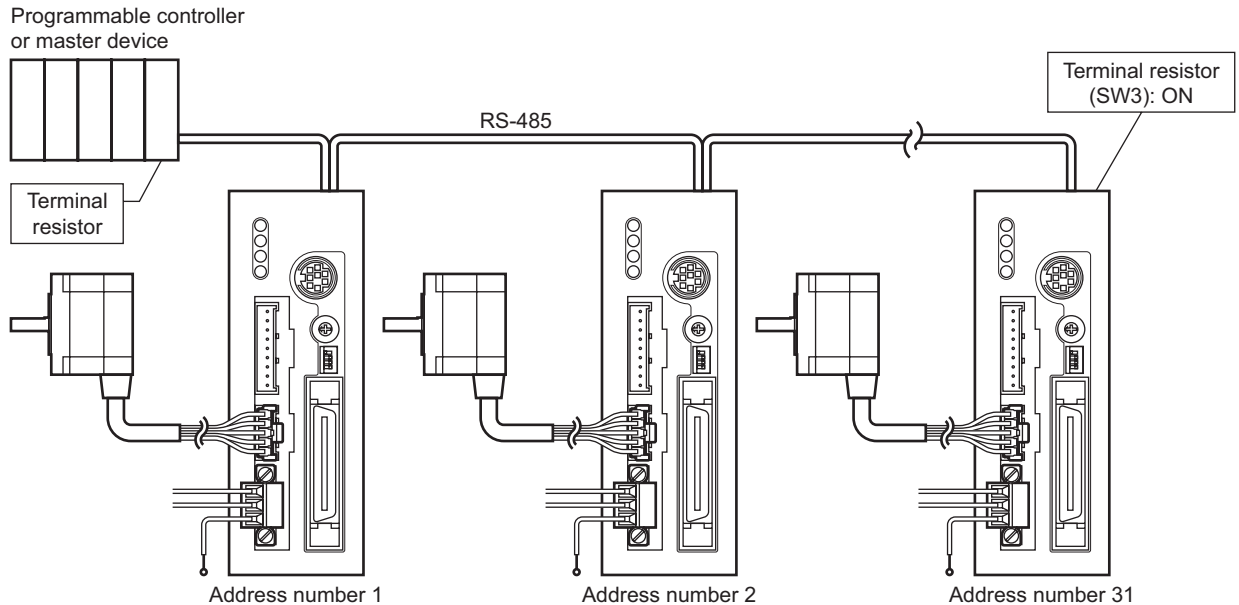
*1 Terminal resistor 120 Ω
*2 Turn the terminal resistor (SW3) to ON.
*3 The GND line is used in common with CN1 (not insulated).

13.3 Setting the switches

| Note | Be sure to turn off the driver power before setting the switches. If the switches are set while the power is still on, the new switch settings will not become effective until the driver power is cycled. |
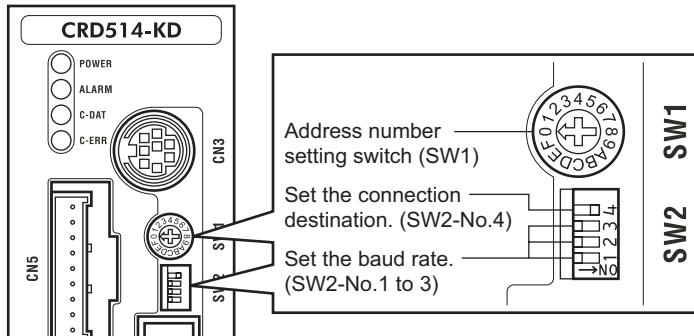
■ Address number

Set the address number using the address setting switch (SW1) and "communication axis number" parameter.
If SW1 is set to "F," the address number set in the "communication axis number" parameter is selected. (initial value: 15).
Make sure each address number you set for each driver is unique.
Factory setting   0 (address number 0)

SW1	Address number		SW1	Address number
0	0		8	8
1	1		9	9
2	2		A	10
3	3		B	11
4	4		C	12
5	5		D	13
6	6		E	14
7	7		F	Setting value of "communication axis number" parameter∗

∗ The default value of the "communication axis number" parameter is "15." Set the "communication axis number" parameter using the **OPX-2A** or **MEXE02**.

■ Setting the connection destination

Set the connection destination of RS-485 communication using position No.4 of the function setting switch (SW2).
Set this position to the ON side when controlling using the GW protocol Version 1.
Factory setting   OFF (network converter)

SW2-No.4	Connection destination
ON	General master device
OFF	Network converter

■ Baud rate

Set the baud rate using Nos. 1 to 3 of the function setting switch (SW2) to.
The baud rate to be set should be the same as the baud rate of the master device.
Factory setting   All ON (625,000 bps)

Baud rate (bps)	SW2-No.3	SW2-No.2	SW2-No.1
9600	OFF	OFF	OFF
19200	OFF	OFF	ON
38400	OFF	ON	OFF
57600	OFF	ON	ON
115,200	ON	OFF	OFF
250,000	ON	OFF	ON
312,500	ON	ON	OFF
625,000	ON	ON	ON

■ Terminal resistor

Use a terminal resistor for the driver located farthest away (positioned at the end) from the programmable controller (master device).
Turn the terminal resistor setting switch (SW3) ON to set the terminal resistor for RS-485 communication (120 Ω).
Factory setting   OFF (terminal resistor disabled)

Terminal resistor setting switch (SW3)

OFF
ON

SW3	Terminal resistor (120 Ω)
OFF	Disabled
ON	Enabled

1 N.C.
2 GND
3 TR+
4 N.C.
5 N.C.
6 TR−
7 N.C.
8 N.C.

1 N.C.
2 GND
3 TR+
4 N.C.
5 N.C.
6 TR−
7 N.C.
8 N.C.

SW3
120 Ω

0 V*
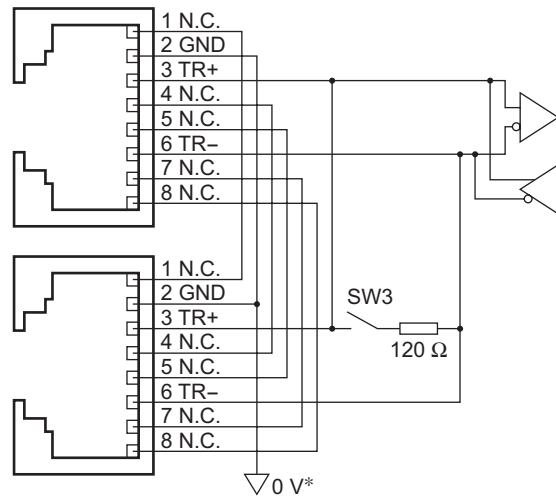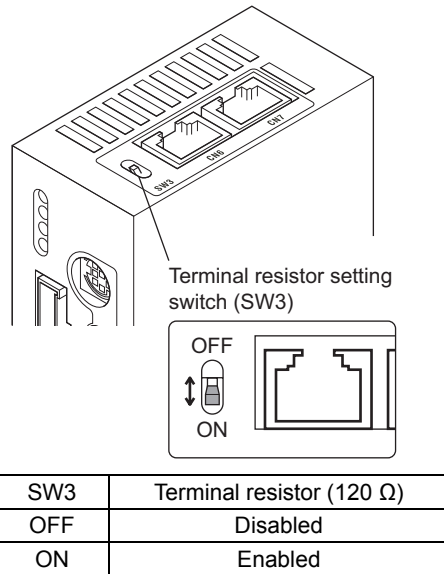
∗ The GND line is used in common with CN1 (not insulated).

13.4 Communication mode

This products uses the communication mode where one programmable controller acts as master and this driver serves as the slave, and the slave returns one frame in response to each frame received from the master.
Frames are sent in one of three methods.

• Individual send

Send a frame to each slave.

Master   Frame
Slave   Frame
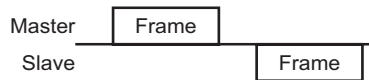
• Simultaneous send

Send a frame to all slaves simultaneously. In simultaneous send, no response is returned from the slaves. The operation specifications and commands that can be sent via simultaneous send are limited.

Master   Frame
Slave   No response
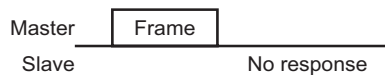
• Group send

A frame is sent simultaneously to all of the slaves comprising one group. Each group consists of one master axis and one or more slave axes, and only the master axis returns a response. The commands that can be sent via group send are limited.

Master axis
Master   Frame (sent to the master axis)
Slave   Frame

Slave axis
Master   Frame (sent to the master axis)
Slave   Executes the process but does not send a response.

13.5 Communication timing

Receive period (T1)	The period of the received frame is monitored. If no frame is received after an elapse of the time set by the "receive period" command, a communication timeout alarm will generate. Even when a frame is not sent to the applicable unit, once a BCC-matching frame is received the receive period counter will be cleared and counting will start fresh.
Response interval (T2)	The interval after the master receives a frame until the slave starts sending. This interval can be set using the "response interval" command.
Receive monitor period (T3)	The time needed for the master or slave to send one entire frame from the header to BCC is monitored. If no BCC is received after an elapse of the time set by the "receive monitoring" command, the slave will discard the frame and wait for the header.
Send interval (T4)	The interval after the slave receives a frame until the master sends the next frame. This interval must be 0.5 ms or longer in the case of individual send or group send, or 5 ms or longer in the case of simultaneous send.

13.6 Frame structures

The frame structure used for sending data from the master to the slave is shown below.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC

The frame structure used for sending data from the slave to the master is shown below.

Header	Action entry	Mode/NACK	Command	Data 1	Data 2	Data 3	Data 4	BCC

■ Header

Master: Specify the receiving slave.
Slave: Change the sender to "slave" and send a response.

bit	Function	Description	Behavior
7	"0" specification	System-reserved bit	–
6	Sender	Specify the sender.[1]	0: Slave 1: Master
5	Send specification	Specify the send mode from the master.[2]	0: Individual send 1: Simultaneous send
4 3 2 1 0	Address number	Specify the address number of the slave using five bits.	00h (address number 0) to 1Fh (address number 31)

[1]   Send the frame after setting the programmable controller (master device) to "1: Master".
[2]   Simultaneous send can be specified only for the master. If simultaneous send is specified, send the frame after setting the address number to "0".

■ Action entry

Master:　Specify the operation to be performed by the slave.

Slave:　　Sends directly the action entry data received from the master.

bit	Function	Description	Behavior
7	"0" specification	System-reserved bit [*1]	–
6	WRITE/READ	Write or read data. [*2]	0: WRITE 1: READ
5	STOP	Stop the motor. [*3][*4]	0: No action 1: Stop
4	Not used	–	–
3	HOME	Perform return-to-home operation. [*4][*5]	0: No action 1: Start operation
2	RVS	Perform continuous operation in the reverse direction. [*4][*6][*7]	0: Deceleration stop 1: Operation
1	FWD	Perform continuous operation in the forward direction. [*4][*6][*7]	
0	START	Perform positioning operation. [*4][*5][*7]	0: No action 1: Start operation

[*1]　When "1" is specified, a reception failure will be recognized. Accordingly, the frame will be discarded and NACK will be returned.

[*2]　Specify whether it is a WRITE or READ command. Other operation command bits are executed regardless of the WRITE/READ specification.

[*3]　The stopping method can be set using the "STOP action (13h)" command.

[*4]　The operation command bits have priorities. Specifically, "1" is detected in the order of STOP > FWD/RVS > HOME > START.

[*5]　Operation is started at the ON edge of this bit (when the bit changes from 0 to 1). Once the operation has started, return this bit to "0".

[*6]　Operation continues while this bit remains "1". Returning it to "0" will cause the motor to decelerate to a stop.

[*7]　Select the operation data number using the "data number selection" command and specify it using the mode command.

Note　Commands (WRITE/READ) and operation commands (STOP, HOME, RVS, FWD, START) can be sent simultaneously. Since the operation is started after writing, data setting and operation can be performed simultaneously.

■ Mode

Master:　Specify the data number. If any out-of-range mode is specified, a reception failure will be recognized. Accordingly, the frame will be discarded and NACK will be returned.

Mode	Description
00h to 3Fh	If the command requires a data number, specify an applicable data number. If the command does not require any data number, specify "00h".

Slave:　If the communication is performed successfully, the master mode will be returned directly.

Mode	Description
00h to 3Fh	The master mode will be returned directly (successful reception).
FFh	This indicates a reception failure (NACK).

If any of the following conditions are met, the frame will be discarded and NACK will be returned. The reason for NACK can be checked by the applicable communication error record.

- The system reservation bit of the operation specification is "1".
- An undefined mode is specified.
- An undefined command is specified.
- A command that cannot WRITE is specified.
- A command that cannot READ is specified.
- The value in the data area was outside the specified range.
- The command was specified in one of the following conditions:
  · An EEPROM error alarm was present.
  · The **OPX-2A** is currently connected in a mode other than the monitor mode.
  · Downloading or initialization is currently in progress via the **MEXE02**.
  · Internal processing was in progress.

■ Command

Master: Specify the command.
Slave: Sends directly the command received from the master.

The commands are classified into the following six types:
- Operation data... WRITE/READ operation data. (These commands can also be set using the **OPX-2A** or **MEXE02**.)
- Parameter .... WRITE/READ parameter. (These commands can also be set using the **OPX-2A** or **MEXE02**.)
- Operation .... Specify operations.
- Monitor .... Monitor the current speed, position, I/O status, etc.
- Maintenance...... Used in maintenance processes.
- Special .... Set group send.

See p.106 for command details.

■ Data area

Specify the value to be set in the command. Specify data in the signed four-byte binary format.
The four-byte data is expressed in the little endian order.
Master: With a WRITE command, specify the data to be written.
Slave: With a WRITE command, the master data will be returned directly. With a READ command, the data that
         has been read will be returned. If the reception failed (NACK), the master data will be returned directly. Any
         numerical value included in the master data will be ignored.

Example) When the "01234567h" is set in the data area

The data is sent from the lower byte, so the following values will be stored in the data area:

Data 1	Data 2	Data 3	Data 4
67h	45h	23h	01h

Note | If the value set in a WRITE command is outside the setting range for the applicable command, the frame will be discarded and NACK will be returned. If a function is assigned to any bit in the data area of the command [Example: I/O status (39h)], "0" will always be returned whenever a bit to which no function is assigned is read.

■ BCC

A horizontal parity used to detect errors in the frame data.
The CRC is a logical sum of all bytes from the header to data 4, calculated by the exclusive-OR gate.

■ Example of frame transmission/reception

An example of setting the position (travel amount) for operation data No. 1 to 500 pulses is given.

Sent from the master:

Header 40h	Action entry 00h	Mode 01h	Command A0h	Data 1 F4h	Data 2 01h	Data 3 00h	Data 4 00h	BCC 14h

- Sender: Master, Address number: 0
- WRITE
- Operation data No.1
- Position
- Travel amount corresponding to 500 pulses: 01F4h (sent from the lower byte)

Returned from the slave:

Header 00h	Action entry 00h	Mode 01h	Command A0h	Data 1 F4h	Data 2 01h	Data 3 00h	Data 4 00h	BCC 54h

- Sender: Slave, Address number: 0
- WRITE
- Operation data No.1
- Position
- Travel amount corresponding to 500 pulses: 01F4h (sent from the lower byte)

13.7 Control method selection

■ Setting the communication protocol

To implement controls using GW Protocol Version 1, set the "communication protocol" parameter to "1: GW Ver. 1" using the **OPX-2A** or **MEXE02**.

Note | The "communication protocol" parameter cannot be set via RS-485 communication.

■ Selection from I/O control and RS-485 communication control

Prior to shipment, I/O control is set as the method to select the operation command input method or operation data number. To change this control method to RS-485 communication, change the applicable settings using the **OPX-2A**, **MEXE02** or via RS-485 communication.

The table below lists the items whose control can be switched between I/O and RS-485 communication. You can use both methods simultaneously, such as controlling the operation via RS-485 communication and inputting a stop signal via I/O.

Item	Method of control via I/O	Method of control via RS-485 communication	This command is used to change the control method.
Positioning operation	START input	START (bit 0) of action entry	START input mode
Excitation control	AWO input	"Excitation control" command	Motor excitation mode
Stop	STOP input	STOP (bit5) of action entry*	I/O STOP input
Select data No.	M0 to M5 input	"Data number selection" command	Data number input mode
Return-to-home operation	HOME input	HOME (bit3) of action entry	
Continuous operation (forward)	FWD input	FWD (bit1) of action entry	HOME/FWD/RVS input mode
Continuous operation (reverse)	RVS input	RVS (bit2) of action entry	
Reset alarm	ALM-RST input	"Alarm reset" command	None (Both are always effective)
Position preset	P-PRESET input	"Position preset" command	

∗ The operation specification STOP is always effective. Even when the "I/O STOP input" parameter is set to "Enable", the motor will stop when the operation specification STOP is executed.

13.8 Example of communication setting

The data required for each operation is set using the **OPX-2A**, **MEXE02** or via RS-485 communication.

■ Positioning operation

See p.46 for details on the positioning operation.

Command	Name	Setting range	Initial value	Reference
0Eh	Dwell time	0 to 50000 (1=0.001 s)	0	P.108
0Fh	Sequential positioning	0: Disable 1: Enable	0	P.108
10h	Positioning mode	0: INC 1: ABS	0	P.109
11h	Operating mode	0: Single 1: Link 2: Link2	0	P.109
80h	Starting speed[1]	1 to 500,000 (Hz)	100	P.116
82h	Acceleration rate[2]	1 to 1,000,000 (1=0.001 ms/kHz)	30000	P.116
83h	Deceleration rate[2]	1 to 1,000,000 (1=0.001 ms/kHz)	30000	P.116
88h	Operating speed	1 to 500,000 (Hz)	1000	P.116
A0h	Position	−8,388,608 to +8,388,607 (step)	0	P.119

∗1 The starting speed is common to all operation data used in a positioning operation and continuous operation. Other commands can be set for each operation data.

∗2 This command is effective when the "acceleration (deceleration) rate type" parameter is set to "separate". If this parameter is set to "common", the values of common acceleration rate and common deceleration rate become effective (initial value: common).

Note	•	The excitation condition of the motor at the power ON varies depending on the "C-ON logic configuration" parameter. The motor is not excited if the "C-ON logic configuration" parameter is set to "0," and excited if the parameter is set to "1."
	•	The factory setting of the STOP input is normally closed. Accordingly, turn the I/O STOP input ON before commencing the operation if the "I/O STOP input" parameter is set to "enable". The operation cannot be performed if the STOP input remains OFF. For your information, the STOP input logic can be changed using the "STOP contact configuration" command.
	•	The motor will operate at the starting speed if the operating speed is below the starting speed.

- Setting example

  How to perform the following positioning operation is explained as an example.
  - Address number: 0
  - Position (distance): 1000 step
  - Operating speed: 5000 Hz

  1. Set the respective parameters as follows using the **OPX-2A**, **MEXE02** or via RS-485 communication:

Parameter name	Setting
START input mode	0: RS-485 communication
I/O STOP input	0: Disable
Motor excitation mode	0: RS-485 communication
Data No. input mode	0: RS-485 communication

  2. Send the following frame to turn ON the motor excitation.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	00h	22h	01h	00h	00h	00h	63h

  3. Send the following frame to set the position (travel amount) for operation number No. 1 to 1000 steps.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	01h	A0h	E8h	03h	00h	00h	0Ah

  4. Send the following frame to set the operating speed for operation data No. 1 to 5000 Hz.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	01h	88h	88h	13h	00h	00h	52h

  5. Send the following frame to select operation data No. 1 and change the START bit to 1 (operation start).
     Positioning operation will start at the ON edge of the bit (when the bit changes from 0 to 1).

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	01h	01h	00h	00h	00h	00h	00h	40h

  6. Once the positioning operation has started, send the following frame to return the START bit to 0 (no operation).

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	01h	00h	00h	00h	00h	00h	41h

■ Continuous operation

See p.50 for details on the continuous operation.

Command	Name	Setting range	Initial value	Reference
80h	Starting speed[*1]	1 to 500,000 (Hz)	100	P.116
82h	Acceleration rate[*2]	1 to 1,000,000 (1=0.001 ms/kHz)	30000	P.116
83h	Deceleration rate[*2]	1 to 1,000,000 (1=0.001 ms/kHz)	30000	P.116
88h	Operating speed	1 to 500,000 (Hz)	1000	P.116

*1 The starting speed is common to all operation data used in a positioning operation and continuous operation. Other commands can be set for each operation data.

*2 This command is effective when the "acceleration (deceleration) rate type" parameter is set to "separate". If this parameter is set to "common", the values of common acceleration rate and common deceleration rate become effective. (initial value: common)

> **Note**
> - The excitation condition of the motor at the power ON varies depending on the "C-ON logic configuration" parameter. The motor is not excited if the "C-ON logic configuration" parameter is set to "0," and excited if the parameter is set to "1."
> - The factory setting of the STOP input is normally open. Accordingly, turn the I/O STOP input ON before commencing the operation if the "I/O STOP input" parameter is set to "enable". The operation cannot be performed if the STOP input remains OFF. For your information, the STOP input logic can be changed using the "STOP contact configuration" command.
> - The motor will operate at the starting speed if the operating speed is below the starting speed.

- Setting example

  How to perform the following continuous operation is explained as an example.
  - Access number: 0
  - Rotation direction: Forward
  - Operating speed: 5000 Hz

  1. Set the respective parameters as follows using the **OPX-2A**, **MEXE02** or via RS-485 communication:

Parameter name	Setting
I/O STOP input	0: Disable
Motor excitation mode	0: RS-485 communication
HOME/FWD/RVS input mode	0: RS-485 communication
Data No. input mode	0: RS-485 communication

  2. Send the following frame to turn ON the motor excitation.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	00h	22h	01h	00h	00h	00h	63h

  3. Send the following frame to set the operating speed for operation number No. 1 to 5000 Hz.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	01h	88h	88h	13h	00h	00h	52h

  4. Send the following frame to select operation data No. 1 and change the FWD bit to 1 (operation start). Continuous operation will start.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	02h	01h	00h	00h	00h	00h	00h	43h

  5. To stop the continuous operation, send the following frame to return the FWD bit to 0 (deceleration stop).

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	01h	00h	00h	00h	00h	00h	41h

■ Return-to-home operation

See p.50 for details on the return-to-home operation.

Command	Name	Setting range	Initial value	Reference
12h	Home-seeking mode	0: 2 sensors 1: 3 sensors	1	P.109
93h	Starting speed of home-seeking	1 to 500,000 (Hz)	100	P.118
94h	Acceleration (deceleration) rate of home-seeking	1 to 1,000,000 (1=0.001 ms/kHz)	30000	P.118
95h	Operating speed of home-seeking	1 to 500,000 (Hz)	1000	P.118
A8h	Position offset of home-seeking	−8,388,608 to +8,388,607 (step)	0	P.120
A9h	Starting direction of home-seeking	0: − direction 1: + direction	1	P.120
AAh	SLIT detection with home-seeking	0: Disable 1: Enable	0	P.120
ABh	TIM signal detection with home-seeking	0: Disable 1: Enable (TIM) 2: Enable (ZSG)*	0	P.120
ACh	Backward steps in 2-sensor mode home-seeking	0 to 32767 (step)	200	P.120

∗ This signal is used when an encoder is connected.

Note
- The excitation condition of the motor at the power ON varies depending on the "C-ON logic configuration" parameter. The motor is not excited if the "C-ON logic configuration" parameter is set to "0," and excited if the parameter is set to "1."
- The factory setting of the STOP input is normally open. Accordingly, turn the I/O STOP input ON before commencing the operation if the "I/O STOP input" parameter is set to "enable". The operation cannot be performed if the STOP input remains OFF. For your information, the STOP input logic can be changed using the "STOP contact configuration" command.
- The motor will operate at the starting speed if the operating speed is below the starting speed.

- Setting example

How to perform the following return-to-home operation is explained as an example.
- Address number: 0

1. Set the respective parameters as follows using the **OPX-2A**, **MEXE02** or via RS-485 communication:

Parameter name	Setting
I/O STOP input	0: Disable
Motor excitation mode	0: RS-485 communication
HOME/FWD/RVS input mode	0: RS-485 communication
Data No. input mode	0: RS-485 communication

2. Send the following frame to turn ON the motor excitation.

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	00h	22h	01h	00h	00h	00h	63h

3. Send the following frame to change the HOME bit to 1 (operation start).
Return-to-home operation will start at the ON edge of the bit (when the bit changes from 0 to 1).

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	08h	00h	00h	00h	00h	00h	00h	48h

4. Once the return-to-home operation has started, send the following frame to return the HOME bit to 0 (no operation).

Header	Action entry	Mode	Command	Data 1	Data 2	Data 3	Data 4	BCC
40h	00h	00h	00h	00h	00h	00h	00h	40h

13.9 Command list

∗ : This command is used when an encoder is connected.

Command No.	Command name	WRITE/ READ	Mode	Data area	Initial value	Type	Reference
00h	No action	R	0	−	−	Operation	
	Data number selection	W	0 to 63	−	−	Operation	
01h	Receive period	W/R	0	0: Not monitored 1 to 999: 0.01 to 9.99 sec (1=0.01 sec)	0	Parameter	107
02h	Response interval	W/R	0	0 to 1000（ms）	50	Parameter	
03h	Receive monitoring	W/R	0	1 to 999: 0.01 to 9.99 sec (1=0.01 sec)	10	Parameter	
04h	OUT1 signal mode selection	W/R	0	5: AREA 11：R-OUT1 6: TIM 12：R-OUT2 7: READY 13：STEPOUT∗ 8: WNG 14：O.H. 9: HOME-P 15：R-OUT3 10: ZSG∗ 16：R-OUT4	5	Parameter	
05h	OUT2 signal mode selection	W/R	0		7	Parameter	
06h	OUT3 signal mode selection	W/R	0		8	Parameter	
07h	OUT4 signal mode selection	W/R	0		9	Parameter	
08h	HOME/P-PRESET input switching	W/R	0	0: HOME 1: P-PRESET	0	Parameter	108
0Bh	Group operation	W/R	0	0: Disable 1: Enable	1	Special	
0Ch	Group	W/R	0	−1: Individual send 0 to 31: Specify a group.	−1	Special	
0Dh	Communication timeout action	W/R	0	0: Immediate stop 1: Decelerate stop	1	Parameter	
0Eh	Dwell time	W/R	1 to 63	0 to 50000 (1=0.001 s)	0	Operation data	109
0Fh	Sequential positioning	W/R	1 to 63	0: Disable 1: Enable	0	Operation data	
10h	Positioning mode	W/R	1 to 63	0: INC (incremental) 1: ABS (absolute)	0	Operation data	
11h	Operating mode	W/R	1 to 63	0: Single 1: Link 2: Link2	0	Operation data	
12h	Home-seeking mode	W/R	0	0: 2 sensors 1: 3 sensors	1	Parameter	
13h	STOP action	W/R	0	0: Immediate stop 1: Decelerate stop 2: Immediate stop & Current OFF 3: Decelerate stop & Current OFF	1	Parameter	
14h	Overtravel action	W/R	0	0: Immediate stop 1: Decelerate stop	0	Parameter	
1Ah	LS contact configuration	W/R	0	0: Make (N.O.) 1: Brake (N.C.)	0	Parameter	110
1Bh	HOMES contact configuration	W/R	0	0: Make (N.O.) 1: Brake (N.C.)	0	Parameter	
1Ch	SLIT contact configuration	W/R	0	0: Make (N.O.) 1: Brake (N.C.)	0	Parameter	
1Dh	STOP contact configuration	W/R	0	0: Make (N.O.) 1: Brake (N.C.)	1	Parameter	
1Eh	AWO contact configuration	W/R	0	0: Make (N.O.) 1: Brake (N.C.)	0	Parameter	
1Fh	C-ON logic configuration	W/R	0	0: 0=Not excited, 1=Excited 1: 0=Excited, 1=Not excited	0	Parameter	
20h	Clear counter	W	0	−	−	Operation	

Command No.	Command name	WRITE/ READ	Mode	Data area	Initial value	Type	Reference
21h	Reset alarms	W	0	–	–	Operation	
22h	Excitation control	W	0	0: 0=Not excited, 1=Excited if the "C-ON logic configuration" parameter is 0 1: 0=Excited, 1=Not excited if the "C-ON logic configuration" parameter is 1	–	Operation	111
23h	Preset position	W	0	–	–	Operation	
24h	Preset encoder counter*	W	0	–	–	Operation	
25h	Clear alarm records	W	0	1: Execute	–	Maintenance	
26h	Clear warning records	W	0	1: Execute	–	Maintenance	
27h	Clear communication error records	W	0	1: Execute	–	Maintenance	
32h	Remote output	W/R	0	0: OFF (photocoupler un-energized) 1: ON (photocoupler energized)	0	Operation	112
35h	Remaining dwell time	R	0	0 to 50000 (1=0.001 s)	–	Monitor	
36h	Display selection data number	R	0	00h to 3Fh (0 to 63)	–	Monitor	
37h	Display operation data number	R	0	00h to 3Fh (0 to 63)	–	Monitor	
39h	I/O status	R	0	0: OFF (photocoupler un-energized) 1: ON (photocoupler energized)	–	Monitor	
3Ch	Driver status	R	0	–	–	Monitor	
3Dh	Communication error record	R	0 to 10	–	–	Monitor	113
3Eh	Alarm record	R	0 to 10	–	–	Monitor	
3Fh	Warning record	R	0 to 10	–	–	Monitor	
40h	Operating current	W/R	0	5 to 100 (%)	100	Parameter	114
41h	Standstill current	W/R	0	5 to 50 (%)	50	Parameter	
43h	Motor rotation direction	W/R	0	0: + direction=CCW 1: + direction=CW	1	Parameter	
44h	Motor step angle	W/R	0	0 to 15	0	Parameter	
48h	Batch NV memory write	W	0	1: Execute	–	Maintenance	115
49h	Batch all data initialization	W	0	1: Execute	–	Maintenance	
4Ah	Batch NV memory read	W	0	1: Execute	–	Maintenance	
4Bh	Encoder electronic gear A*	W/R	0	1 to 250,000	500	Parameter	116
4Ch	Encoder electronic gear B*	W/R	0	1 to 250,000	500	Parameter	
80h	Starting speed	W/R	0	1 to 500,000 (Hz)	100	Parameter	
82h	Acceleration rate	W/R	1 to 63	1 to 1,000,000 (1=0.001 ms/kHz)	30000	Operation data	
83h	Deceleration rate	W/R	1 to 63	1 to 1,000,000 (1=0.001 ms/kHz)	30000	Operation data	
88h	Operating speed	W/R	1 to 63	1 to 500,000 (Hz)	1000	Operation data	
8Bh	Command speed	R	0	−500,000 to 500,000 (Hz)	–	Monitor	117
8Dh	Acceleration (deceleration) rate type	W/R	0	0: Common 1: Separate	0	Parameter	
8Eh	Common acceleration rate	W/R	0	1 to 1,000,000 (1=0.001 ms/kHz)	30000	Parameter	
8Fh	Common deceleration rate	W/R	0	1 to 1,000,000 (1=0.001 ms/kHz)	30000	Parameter	
90h	Jog starting speed	W/R	0	1 to 500,000 Hz	100	Parameter	
91h	Jog acceleration (deceleration) rate	W/R	0	1 to 1,000,000 (1=0.001 ms/kHz)	30000	Parameter	
92h	Jog operating speed	W/R	0	1 to 500,000 Hz	1000	Parameter	

Command No.	Command name	WRITE/READ	Mode	Data area	Initial value	Type	Reference
93h	Starting speed of home-seeking	W/R	0	1 to 500,000 Hz	100	Parameter	
94h	Acceleration (deceleration) rate of home-seeking	W/R	0	1 to 1,000,000 (1=0.001 ms/kHz)	30000	Parameter	
95h	Operating speed of home-seeking	W/R	0	1 to 500,000 Hz	1000	Parameter	
98h	HOME/FWD/RVS input mode	W/R	0	0: RS-485 communication 1: I/O	1	Parameter	118
99h	START input mode	W/R	0	0: RS-485 communication 1: I/O	1	Parameter	
9Ah	I/O STOP input	W/R	0	0: RS-485 communication 1: I/O	1	Parameter	
9Bh	Motor excitation mode	W/R	0	0: RS-485 communication 1: I/O	1	Parameter	
9Ch	Data No. input mode	W/R	0	0: RS-485 communication 1: I/O	1	Parameter	
A0h	Position	W/R	1 to 63	−8,388,608 to +8,388,607 (step)	0	Operation data	
A1h	Command position	R	0	−2,147,483,648 to +2,147,483,647 (step)	−	Monitor	
A2h	Encoder counter*	R	0	−2,147,483,648 to +2,147,483,647 (step)	−	Monitor	119
A3h	Encoder counter preset value*	W/R	0	−8,388,608 to +8,388,607 (step)	0	Parameter	
A4h	Preset position	W/R	0	−8,388,608 to +8,388,607 (step)	0	Parameter	
A5h	Area 1	W/R	0	−8,388,608 to +8,388,607 (step)	0	Parameter	
A6h	Area 2	W/R	0	−8,388,608 to +8,388,607 (step)	0	Parameter	
A8h	Position offset of home-seeking	W/R	0	−8,388,608 to +8,388,607 (step)	0	Parameter	
A9h	Starting direction of home-seeking	W/R	0	0: Negative direction 1: Positive direction	1	Parameter	
AAh	SLIT detection with home-seeking	W/R	0	0: Disable 1: Enable	0	Parameter	120
ABh	TIM signal detection with home-seeking	W/R	0	0: Disable 1: Enable (TIM) 2: Enable (ZSG)*	0	Parameter	
ACh	Backward steps in 2-sensor mode home-seeking	W/R	0	0 to 32767 (step)	200	Parameter	
B1h	Overvoltage warning	W/R	0	250 to 350 (1=0.1 V)	310	Parameter	
B2h	Overheat warning	W/R	0	40 to 85 (°C)	85	Parameter	
B7h	Software overtravel	W/R	0	0: Disable 1: Enable	1	Parameter	
B8h	Positive software limit	W/R	0	−8,388,608 to +8,388,607 step	8,388,607	Parameter	121
B9h	Negative software limit	W/R	0	−8,388,608 to +8,388,607 step	−8,388,608	Parameter	
BAh	Hardware overtravel detection	W/R	0	0: Disable 1: Enable	1	Parameter	
BBh	Stepout detection band*	W/R	0	1 to 3600 (1=0.1 deg)	72	Parameter	
BCh	Stepout detection action*	W/R	0	0: No action (alarm/warning not present) 1: Warning 2: Alarm	0	Parameter	
BDh	Stepout detection*	W/R	0	0: Disable 1: Enable	0	Parameter	122
CAh	Display mode of the data setter speed	W/R	0	0: Signed 1: Absolute	0	Parameter	
CBh	The data setter editing mode	W/R	0	0: Disable 1: Enable	1	Parameter	

13.10 Command details

| Note | Data set via RS-485 communication is stored in the driver's RAM. The data saved in the RAM will be erased once the power is turned off. To retain the data in the RAM, write it to the NV memory. For details, refer to the "NV memory batch write" command (p.115). |

■ Command types

• Operation data

These commands are used to WRITE/READ operation data. They can also be set using the **OPX-2A** or **MEXE02**.
If the value set in a WRITE command is outside the setting range for the applicable command, the frame will be discarded and NACK will be returned.
If data is written under any of the following conditions, the command execution will fail. Accordingly, the frame will be discarded and NACK will be returned. If data is read under any of these conditions, an incorrect value may be read. For these reasons, do not write or read data under these conditions.
  • An EEPROM error alarm was present.
  • The **OPX-2A** is currently connected in a mode other than the monitor mode.
  • Downloading or initialization is currently in progress via the **MEXE02**.
  • Internal processing was in progress. (S-BSY is ON.)

• Parameter

These commands are used to WRITE/READ parameter. They can also be set using the **OPX-2A** or **MEXE02**.
If the value set in a WRITE command is outside the setting range for the applicable command, the frame will be discarded and NACK will be returned.
If data is written under any of the following conditions, the command execution will fail. Accordingly, the frame will be discarded and NACK will be returned. If data is read under any of these conditions, an incorrect value may be read. For these reasons, do not write or read data under these conditions.
  • An EEPROM error alarm was present.
  • The **OPX-2A** is currently connected in a mode other than the monitor mode.
  • Downloading or initialization is currently in progress via the **MEXE02**.
  • Internal processing was in progress. (S-BSY is ON.)

• Maintenance

These commands are used to clear alarm or warning records or perform batch processing of the NV memory. When a maintenance command is executed, the internal process in-progress bit (S-BSY) will turn ON.
If data is written under any of the following conditions, the command execution will fail. Accordingly, the frame will be discarded and NACK will be returned. (However, this does not apply to the "communication error record clear" command.)
  • An EEPROM error alarm was present. (The "NV memory batch initialization" command can be executed in this condition.)
  • The **OPX-2A** is currently connected in a mode other than the monitor mode.
  • Downloading or initialization is currently in progress via the **MEXE02**.
  • Internal processing was in progress. (S-BSY is ON.)

• Operation

These commands specify operations. The setting will be reflected immediately after the reception analysis.

• Monitor

These commands are used to monitor the current speed, position, I/O status, etc. After the reception analysis, the applicable status will be returned.

• Special

Set group send. The setting will be reflected immediately after the reception analysis.

■ No action (00h)

Description	Use this command if you don't want to process any command.
Action entry	READ (If WRITE is specified, the "Data number selection" command will be executed.)
Mode	00h
Data area	The data area values will be ignored. The same value as the data sent from the master will be returned.
Type	Operation command

■ Data number selection (00h)

Description	Selects operation data No. for positioning operation or continuous operation.
Action entry	WRITE (If READ is specified, the "No action" command will be executed.)
Mode	00h to 3Fh (0 to 63) Specifies the operation data number. Since the operation data number is refreshed by the "data number selection" command, it will be retained until the next "data number selection" command is set.
Data area	The data area values will be ignored.
Type	Operation command

■ Receive period (01h)

Description	Set the receive period for RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Not monitored 1 to 999: 0.01: 9.99 sec. (1 = 0.01 sec.)	Initial value	0

Note Set the receive period to "receive monitoring (T3) × 2 + response interval (T2) + send interval (T4)" or more. If this formula is not satisfied, a communication timeout error may occur during communication.

■ Response interval (02h)

Description	Sets the response period for RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0 to 1000 (ms) If 0 ms is set, sending will start immediately.	Initial value	50

■ Receive monitor period (03h)

Description	Sets the receive monitor period for RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 999: 0.01: 9.99 sec. (1 = 0.01 sec.)	Initial value	10

■ OUT1 to 4 signal mode selection (04h to 07h)

Description	Sets the function assigned to the OUT1 to OUT4 output.					
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ					
Type	Parameter command				Mode	00h
Data area	5：AREA 6：TIM 7：READY	8：WNG 9：HOME-P 10：ZSG*	11：R-OUT1 12：R-OUT2 13：STEPOUT*	14：O.H. 15：R-OUT3 16：R-OUT4	Initial value	OUT1: 5 OUT2: 7 OUT3: 8 OUT4: 9

∗ These signals are used when an encoder is connected.

■ HOME/P-PRESET input mode (08h)

Description	Sets whether to use HOME or P-PRESET input.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: HOME 1: P-PRESET	Initial value	0

■ Group operation (0Bh)

Description	Use this command for group send. This command sets whether to enable or disable operation specifications and operation commands sent to each unit.		
Action entry	WRITE/READ		
Type	Special command	Mode	00h

Data area	0: Disable 1: Enable		Initial value	1

Setting	Command to individual unit		Command to group	
	Action entry	Operation command	Action entry	Operation command
0 (disable)	×	×	○	○
1 (enable)	○	○	○	○

> **Note** The specified group operation is not saved in the NV memory, and therefore the initial value will be restored once the power is cut off.

■ Group (0Ch)

Description	Specifies the group to be used in group send.		
Action entry	WRITE/READ		
Type	Special command	Mode	00h
Data area	−1: Individual send (Do not perform group send) 0 to 31: Specify a group.	Initial value	−1

> **Note** The specified group operation is not saved in the NV memory, and therefore the initial value will be restored once the power is cut off.

■ Communication timeout action (0Dh)

Description	Sets how to stop the motor when a communication timeout occurs.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Immediate stop 1: Decelerate stop	Initial value	1

■ Dwell time (0Eh)

Description	Set the dwell time to be used in linked-motion operation 2.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	0 to 50000 (1=0.001 s)	Initial value	0

■ Sequential positioning (0Fh)

Description	Sets enable or disable sequential positioning operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	0: Disable 1: Enable	Initial value	0

■ Positioning mode (10h)

Description	Selects how to specify the position (travel amount) in positioning operation (absolute mode or incremental mode).		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	0: INC 1: ABS	Initial value	0

■ Operating mode (11h)

Description	Sets perform positioning operation as single-motion or linked-motion operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	0: Single 1: Link 2: Link2	Initial value	0

■ Home-seeking mode (12h)

Description	Set the mode for return-to-home operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: 2 sensors 1: 3 sensors	Initial value	1

■ STOP action (13h)

Description	Sets how the motor should stop when a STOP input is turned ON.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Immediate stop 1: Decelerate stop 2: Immediate stop & Current OFF 3: Decelerate stop & Current OFF	Initial value	1

■ Overtravel action (14h)

Description	Sets the motor action to take place upon the occurrence of overtravel.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Immediate stop 1: Decelerate stop	Initial value	0

■ LS contact configuration (1Ah)

Description	Sets the ±LS input logics.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Make (N.O.) 1: Brake (N.C.)	Initial value	0

■ HOMES contact configuration (1Bh)

Description	Sets the HOMES input logic.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Make (N.O.) 1: Brake (N.C.)	Initial value	0

■ SLIT contact configuration (1Ch)

Description	Sets the SLIT input logic.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Make (N.O.) 1: Brake (N.C.)	Initial value	0

■ STOP contact configuration (1Dh)

Description	Sets the STOP input logic.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Make (N.O.) 1: Brake (N.C.)	Initial value	1

■ AWO contact configuration (1Eh)

Description	Sets the AWO input logic.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Make (N.O.) 1: Brake (N.C.)	Initial value	0

■ C-ON logic configuration (1Fh)

Description	Sets the "excitation control" command logic for RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: 0=Not excited, 1=Excited 1: 0=Excited, 1=Not excited	Initial value	0

■ Clear counter (20h)

Description	Clears the command position and encoder counter to 0. This command also clears the internal deviation of the driver. You can recover from a deviation error by executing the clear counter command.		
Action entry	WRITE		
Type	Operation command	Mode	00h
Data area	The data area values will be ignored.		

| Note | Perform a counter clear while the motor is stopped.

■ Reset alarms (21h)

Description	Resets the alarms that are present.		
Action entry	WRITE		
Type	Operation command	Mode	00h
Data area	The data area values will be ignored.		

■ Excitation control (22h)

Description	Switches the motor excitation condition between excitation and non-excitation.		
Action entry	WRITE		
Type	Operation command	Mode	00h

Data area	The excitation condition of the motor at the power ON varies depending on the "C-ON logic configuration" parameter.		

"C-ON logic configuration" parameter	"Excitation control" command	
	0	1
0	Not excitation	Excitation
1	Excitation	Not excitation

■ Preset position (23h)

Description	Presets the command position as the value of the "preset position" parameter.		
Action entry	WRITE		
Type	Operation command	Mode	00h
Data area	The data area values will be ignored.		

Note Perform a preset position while the motor is stopped.

■ Preset encoder counter (24h)

Description	Presets the encoder counter value as the value of the "encoder counter preset value" parameter.		
Action entry	WRITE		
Type	Operation command	Mode	00h
Data area	The data area values will be ignored.		

Note
- Perform a preset encoder counter while the motor is stopped.
- This parameter is used when an encoder is connected.

■ Clear alarm records (25h)

Description	Clears alarm records.		
Action entry	WRITE		
Type	Maintenance command	Mode	00h
Data area	1: Execute		

■ Clear warning records (26h)

Description	Clears warning records.		
Action entry	WRITE		
Type	Maintenance command	Mode	00h
Data area	1: Execute		

■ Clear communication error records (27h)

Description	Clears the communication error records.		
Action entry	WRITE		
Type	Maintenance command	Mode	00h
Data area	1: Execute		

■ Remote output (32h)

Description	Sets ON/OFF of the R-OUT1 to R-OUT4 output. Data 1 in the data area is assigned as shown in the table below.							

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
	0	0	0	0	R-OUT4	R-OUT3	R-OUT2	R-OUT1

Action entry	WRITE/READ		
Type	Operation command	Mode	00h
Data area	0: OFF (photocoupler un-energized) 1: ON (photocoupler energized)	Initial value	0

■ Remaining dwell time (35h)

Description	Indicates how much of the dwell time used in the linked-motion operation 2 remains.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	0 to 50000 (1=0.001 s)		

■ Display selection data number (36h)

Description	You can use this command to check the operation data number currently selected. If the system is run in the test mode using the **OPX-2A**, "0" will be read.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	00h to 3Fh (0 to 63)		

■ Display operation data number (37h)

Description	The operation data number used in the positioning operation currently in progress is indicated. This command can be used in a linked-motion operation and sequential positioning operation. While the motor is stopped, the last used operation data number is indicated.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	00h to 3Fh (0 to 63) While the motor is stopped, the last executed data number will be read.		

■ I/O status (39h)

Description	Monitor the each I/O signal (CN2) of the driver. Data 1 to 4 in the data area is assigned as shown in the table below.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	0: OFF (photocoupler un-energized) 1: ON (photocoupler energized)		

Assignment table for data 1 to 4

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Data 1	0	0	M5	M4	M3	M2	M1	M0
Data 2	0	RVS	FWD	HOME	STOP	AWO	ALM-RST	START
Data 3	0	0	0	0	SLIT	HOMES	−LS	+LS
Data 4	0	0	OUT4	OUT3	OUT2	OUT1	ALM	MOVE

■ Driver status (3Ch)

Description	Monitors the driver status. Data 1 to 4 in the data area is assigned as shown in the table below.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	See table below.		

Assignment table for data 1 to 4

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Data 1	ENABLE	ALM	AREA	S-BSY	READY	HOME-P	0	MOVE
Data 2	START_R	O.H.	HOMES	SLIT	−LS	+LS	STEPOUT	WNG
Data 3	ZSG	TIM	M5_R	M4_R	M3_R	M2_R	M1_R	M0_R
Data 4	ALMCD							

Details of data being read

Signal	Data	Description
MOVE	1: Motor operating	The motor is operating.
HOME-P	1: Return-to-home complete	Return-to-home has completed. It can be used as a home-seeking completion signal.
READY	1: Ready	The motor can be operated.
S-BSY	1: Internal processing in progress	Internal processing is in progress via RS-485 communication.
AREA	1: Inside area	The motor output shaft is inside the specified range.
ALM	1: Alarm present	An alarm is present.
ENABLE	1: Motor excited	The motor excitation command is effective.
WNG	1: Warning present	A warning is present
STEPOUT	1: Deviation error present	The step deviation is abnormal.
+LS	1: +Limit sensor signal being detected	The I/O +LS signal is being input.
−LS	1: −Limit sensor signal being detected	The I/O -LS signal is being input.
SLIT	1: Slit sensor signal being detected	The I/O SLIT signal is being input.
HOMES	1: Mechanical home sensor signal being detected	The I/O HOMES signal is being input.
O.H.	1: Overheat warning present	An overheat warning is present
START_R	1: START=ON	Indicates the status of START.*
M0_R to M5_R	Operation data number (00h to 3Fh)	Selected data number
TIM	1:TIM being detected	The motor is excited. "1" will be read if the motor is at its excitation home.
ZSG	1: ZSG being detected	The encoder input corresponds to Z-phase.
ALMCD	Alarm code	The alarm code corresponding to the alarm currently present.

* START and M0 to M5 can be turned ON/OFF via I/O or RS-485 communication. If these signals are controlled via I/O, the I/O-controlled ON/OFF status is returned. If the signals are controlled via RS-485 communication, the RS-485-communication-controlled ON/OFF status is returned. I/O control is selected as the default prior to shipment.

■ Communication error record (3Dh)

Description	You can use this command to check the communication errors that have occurred in the past.
Action entry	READ
Type	Monitor command
Mode	0: Specify the communication error pertaining to the last received frame. 1 to 10: Specify communication error records 1 to 10. Specify 1 for the latest record.
Data area	The communication error code is stored under data 1 in the data area.

■ Alarm record (3Eh)

Description	You can use this command to check the alarms that are present and alarms that have occurred in the past.
Action entry	READ
Type	Monitor command
Mode	0: Specify the alarm currently present. 1 to 10: Specify alarm records 1 to 10. Specify 1 for the latest record.
Data area	The alarm code is stored under data 1 in the data area.

■ Warning record (3Fh)

Description	You can use this command to check the warnings that are present and warnings that have occurred in the past.
Action entry	READ
Type	Monitor command
Mode	0: Specify the warning currently present. 1 to 10: Specify warning records 1 to 10. Specify 1 for the latest record.
Data area	The warning code is stored under data 1 in the data area.

■ Operating current (40h)

Description	Sets the motor operating current based on the rated current being 100%.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	5 to 100 (%)	Initial value	100

Note Decrease the operating current and standstill current when there is excess margin in the motor torque and you wish to reduce vibration during operation or suppress heat generation from the motor. However, be careful of an excessive decrease in current, since the motor torque and holding brake force will drop in rough proportion to the operating current.

■ Standstill current (41h)

Description	Sets the motor standstill current as a percentage of the rated current, based on the rated current being 100%.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	5 to 50 (%)	Initial value	50

Note
- Decrease the operating current and standstill current when there is excess margin in the motor torque and you wish to reduce vibration during operation or suppress heat generation from the motor. However, be careful of an excessive decrease in current, since the motor torque and holding brake force will drop in rough proportion to the operating current.
- The standstill current is the rated current (100%) multiplied by the standstill current ratio.

■ Motor rotation direction (43h)

Description	Sets the rotation direction of motor output shaft.		
Action entry	WRITE: This setting will become effective after the "NV memory batch write" command is executed and the power is cycled. READ		
Type	Parameter command	Mode	00h
Data area	0: + direction=CCW 1: + direction=CW	Initial value	1

■ Motor step angle (44h)

Description	Sets the motor step angle.		
Action entry	WRITE: This setting will become effective after the "NV memory batch write" command is executed and the power is cycled. READ		
Type	Parameter command	Mode	00h
Data area	See table below.	Initial value	0

- Motor step angle: If the base step angle of the motor is 0.72°

Setting	Step angle	Number of divisions	Setting	Step angle	Number of divisions
0	0.72°	1	8	0.0288°	25
1	0.36°	2	9	0.018°	40
2	0.288°	2.5	10	0.0144°	50
3	0.18°	4	11	0.009°	80
4	0.144°	5	12	0.0072°	100
5	0.09°	8	13	0.00576°	125
6	0.072°	10	14	0.0036°	200
7	0.036°	20	15	0.00288°	250

Motor step angle: If the base step angle of the motor is 0.36°

Setting	Step angle	Number of divisions	Setting	Step angle	Number of divisions
0	0.36°	1	8	0.0144°	25
1	0.18°	2	9	0.009°	40
2	0.144°	2.5	10	0.0072°	50
3	0.09°	4	11	0.0045°	80
4	0.072°	5	12	0.0036°	100
5	0.045°	8	13	0.0028°	125
6	0.036°	10	14	0.0018°	200
7	0.018°	20	15	0.00144°	250

Note
- Step angles are theoretical values.
- With the geared type, the value of "step angle/gear ratio" becomes the actual step angle.
- The base step angle is 0.36° for high-resolution type motors.

■ Batch NV memory write (48h)

Description	Writes the operation data and parameters saved in the RAM, to the NV memory.		
Action entry	WRITE		
Type	Maintenance command	Mode	00h
Data area	1: Execute		

Note
- Perform the batch NV memory write while the motor is stopped.
- The NV memory can be rewritten 100,000 times.

■ Batch all data initialization (49h)

Description	Resets the operation data and parameters saved in the RAM and NV memory, to their defaults. Note that the following parameters are not initialized; Communication axis number, communication protocol, communication parity, communication stop bit and transmission waiting time		
Action entry	WRITE		
Type	Maintenance command	Mode	00h
Data area	1: Execute		

Note
- Perform the batch NV memory initialization while the motor is stopped.
- The NV memory can be rewritten 100,000 times.

■ Batch NV memory read (4Ah)

Description	Reads the operation data and parameters saved in the RAM, to the NV memory. All operation data and parameters currently saved in the RAM will be overwritten by the corresponding data and parameters read from the NV memory.		
Action entry	WRITE		
Type	Maintenance command	Mode	00h
Data area	1: Execute		

Note Perform the batch NV memory read while the motor is stopped.

■ Encoder electronic gear A (4Bh)

Description	Sets the encoder electronic gear A. This parameter is used in the misstep detection function. It does not affect the encoder counter value. See p.130 for details.		
Action entry	WRITE: This setting will become effective after the "NV memory batch write" command is executed and the power is cycled. READ		
Type	Parameter command	Mode	00h
Data area	1 to 250,000	Initial value	500

Note This command is used when an encoder is connected.

■ Encoder electronic gear B (4Ch)

Description	Sets the encoder electronic gear B. This parameter is used in the misstep detection function. It does not affect the encoder counter value. See p.130 for details.		
Action entry	WRITE: This setting will become effective after the "NV memory batch write" command is executed and the power is cycled. READ		
Type	Parameter command	Mode	00h
Data area	1 to 250,000	Initial value	500

Note This command is used when an encoder is connected.

■ Starting speed (80h)

Description	Sets the starting speed in positioning operation and continuous operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 500,000 (Hz)	Initial value	100

■ Acceleration rate (82h)

Description	Sets the acceleration rate in positioning operation and continuous operation. The acceleration rate can be set as follows using the "acceleration (deceleration) rate type" parameter: Separate: The acceleration rate set under the applicable operation data number will be followed. Common: The setting of the "common acceleration rate" parameter will be followed.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	1 to 1,000,000 (1=0.001 ms/kHz)	Initial value	30000

■ Deceleration rate (83h)

Description	Sets the deceleration rate in positioning operation and continuous operation. The deceleration rate can be set as follows using the "acceleration (deceleration) rate type" parameter: Separate: The deceleration rate set under the applicable operation data number will be followed. Common: The setting of the "common deceleration rate" parameter will be followed.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	1 to 1,000,000 (1=0.001 ms/kHz)	Initial value	30000

■ Operating speed (88h)

Description	Sets the operating speed in positioning operation and continuous operation.		
Action entry	WRITE: In positioning operation, set this before the operation is started. The setting will become effective immediately after valid data has been received. In continuous operation, the setting will become effective immediately after valid data has been received. The speed will change while continuous operation is being performed. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	1 to 500,000 (Hz)	Initial value	1000

■ Command speed (8Bh)

Description	Monitors the current command speed.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	−500,000 to 500,000 (Hz) A positive value indicates the forward direction, while a negative value indicates a reverse direction.		

■ Acceleration (deceleration) rate type (8Dh)

Description	Sets whether to use the common acceleration/ deceleration rate or the acceleration/deceleration rate specified for the operation data.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Common 1: Separate	Initial value	0

■ Common acceleration rate (8Eh)

Description	Sets the common acceleration rate in positioning operation and continuous operation. The acceleration rate can be set as follows using the "acceleration (deceleration) rate type" parameter: Separate: The acceleration rate set under the applicable operation data number will be followed. Common: The setting of the "common acceleration rate" parameter will be followed.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 1,000,000 (1=0.001 ms/kHz)	Initial value	30000

■ Common deceleration rate (8Fh)

Description	Sets the common deceleration rate in positioning operation and continuous operation. The deceleration rate can be set as follows using the "acceleration (deceleration) rate type" parameter: Separate: The deceleration rate set under the applicable operation data number will be followed. Common: The setting of the "common deceleration rate" parameter will be followed.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 1,000,000 (1=0.001 ms/kHz)	Initial value	30000

■ Jog starting speed (90h)

Description	Sets the starting speed for JOG operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 500,000 Hz	Initial value	100

■ Jog acceleration (deceleration) rate (91h)

Description	Sets the acceleration/deceleration rate for JOG operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 1,000,000 (1=0.001 ms/kHz)	Initial value	30000

■ Jog operating speed (92h)

Description	Sets the operating speed for JOG operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 500,000 Hz	Initial value	1000

■ Starting speed of home-seeking (93h)

Description	Sets the starting speed for return- to-home operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 500,000 Hz	Initial value	100

■ Acceleration (deceleration) rate of home-seeking (94h)

Description	Sets the acceleration/ deceleration rate for return-to-home operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 1,000,000 (1=0.001 ms/kHz)	Initial value	30000

■ Operating speed of home-seeking (95h)

Description	Sets the operating speed for return- to-home operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 500,000 Hz	Initial value	1000

■ HOME/FWD/RVS input mode (98h)

Description	Sets whether to input the HOME, FWD and RVS input signals via I/O or RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: RS-485 communication 1: I/O	Initial value	1

■ START input mode (99h)

Description	Sets whether to input the START input signal via I/O or RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: RS-485 communication 1: I/O	Initial value	1

■ I/O STOP input (9Ah)

Description	Sets enable or disable STOP input of I/O.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Disable 1: Enable	Initial value	1

■ Motor excitation mode (9Bh)

Description	Sets whether to control the motor excitation via I/O or RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: RS-485 communication 1: I/O	Initial value	1

■ Data No. input mode (9Ch)

Description	Sets whether to input the M0 to M5 input signals via I/O or RS-485 communication.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: RS-485 communication 1: I/O	Initial value	1

■ Position (A0h)

Description	Sets the position (distance) for positioning operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Operation data command	Mode	01h to 3Fh (1 to 63)
Data area	−8,388,608 to +8,388,607 (step)	Initial value	0

■ Command position (A1h)

Description	Monitors the command position of the driver.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	−2,147,483,648 to +2,147,483,647 (step)		

■ Encoder counter (A2h)

Description	Monitors the encoder counter value.		
Action entry	READ		
Type	Monitor command	Mode	00h
Data area	−2,147,483,648 to +2,147,483,647 (step)		

Note This command is used when an encoder is connected.

■ Encoder counter preset value (A3h)

Description	Sets the encoder counter preset value.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	−8,388,608 to +8,388,607 (step)	Initial value	0

Note This command is used when an encoder is connected.

■ Preset position (A4h)

Description	Sets the preset position.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	−8,388,608 to +8,388,607 (step)	Initial value	0

■ Area 1 (A5h)

Description	Sets the range for AREA output. The AREA output will be ON when the motor is inside the area set by the Area 1 and Area 2.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	−8,388,608 to +8,388,607 (step)	Initial value	0

■ Area 2 (A6h)

Description	Sets the range for AREA output. The AREA output will be ON when the motor is inside the area set by the Area 1 and Area 2.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	−8,388,608 to +8,388,607 (step)	Initial value	0

■ Position offset of home-seeking (A8h)

Description	Sets the amount of offset from mechanical home.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	−8,388,608 to +8,388,607 (step)	Initial value	0

■ Starting direction of home-seeking (A9h)

Description	Sets the starting direction for home detection.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Negative direction 1: Positive direction	Initial value	1

■ SLIT detection with home-seeking (AAh)

Description	Sets whether or not to concurrently use the SLIT input for return-to-home operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Disable 1: Enable	Initial value	0

■ TIM signal detection with home-seeking (ABh)

Description	Sets whether or not to concurrently use the TIM (ZSG) output for return-to-home operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Disable 1: Enable (TIM) 2: Enable (ZSG)*	Initial value	0

∗ This signal is used when an encoder is connected.

■ Backward steps in 2-sensor mode home-seeking (ACh)

Description	Sets the travel amount after the motor pulls off of the LS sensor in 2-sensor return-to-home operation.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0 to 32767 (step)	Initial value	200

■ Overvoltage warning (B1h)

Description	Sets the voltage at which an overvoltage warning generates.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	250 to 350 (1=0.1 V)	Initial value	310

■ Overheat warning (B2h)

Description	Sets the temperature at which an overheat warning generates.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	40 to 85 (°C)	Initial value	85

■ Software overtravel (B7h)

Description	Sets whether to enable or disable software overtravel detection using soft limits.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Disable 1: Enable	Initial value	1

■ Positive software limit (B8h)

Description	Sets the value of the soft limit in + direction.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	−8,388,608 to +8,388,607 step	Initial value	8,388,607

■ Negative software limit   (B9h)

Description	Sets the value of the soft limit in − direction.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	−8,388,608 to +8,388,607 step	Initial value	−8,388,608

■ Hardware overtravel detection (BAh)

Description	Sets whether to enable or disable hardware overtravel detection using LS inputs.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Disable 1: Enable	Initial value	1

■ Stepout detection band (BBh)

Description	Sets the judgment condition for misstep detection using the deviation (angle) between the command position and encoder counter value. See p.130 for misstep detection.		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	1 to 3600 (1=0.1 deg)	Initial value	72

Note
- This command is used when an encoder is connected.
- To use misstep detection, set the "stepout detection" parameter to "enable".

■ Stepout detection action (BCh)

Description	Sets the operation to be performed when the deviation between the command position and encoder counter value reaches the stepout detection band. See p.130 for misstep detection.		
Action entry	WRITE: Set this before the operation is started. The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: No action (alarm/warning not present) 1: Warning 2: Alarm	Initial value	0

Note
- This command is used when an encoder is connected.
- To use misstep detection, set the "stepout detection" parameter to "enable".

■ Stepout detection (BDh)

Description	Sets whether to enable or disable the misstep detection function. See p.130 for misstep detection.		
Action entry	WRITE: This setting will become effective after the "NV memory batch write" command is executed and the power is cycled. READ		
Mode	00h		
Data area	0: Disable 1: Enable	Initial value	0
Type	Parameter command		

Note This command is used when an encoder is connected.

■ Display mode of the data setter speed (CAh)

Description	Sets the display method of monitored speed in the data setter..		
Action entry	WRITE: The setting will become effective immediately after valid data has been received. READ		
Type	Parameter command	Mode	00h
Data area	0: Signed 1: Absolute	Initial value	0

■ The data setter editing mode (CBh)

Description	Sets whether to enable editing by the data setter when the power is turned on.		
Action entry	WRITE/READ		
Type	Parameter command	Mode	00h
Data area	0: Disable 1: Enable	Initial value	1

13.11 Simultaneous send

One frame can be sent to all slaves connected to the master. The slaves do not respond in the case of simultaneous send.

Operation specifications/commands that can be sent simultaneously

The operation specifications and commands that can be sent via simultaneous send are limited. The invalid operation specifications and commands are ignored.

- Operation specifications that can be executed via simultaneous send

Operation specifications	Description
STOP	Stop command
RVS	Continuous operation in reverse direction
FWD	Continuous operation in forward direction
START	Positioning operation

- Commands that can be executed via simultaneous send

Command No.	Command execution		Description
	READ	WRITE	
00h	Impossible	Possible	Data number selection
20h	Impossible	Possible	Clear counter
21h	Impossible	Possible	Reset alarms
22h	Impossible	Possible	Excitation control
23h	Impossible	Possible	Preset position
24h	Impossible	Possible	Preset encoder counter
32h	Impossible	Possible	Remote output

13.12 Group send

A frame is sent simultaneously to all of the slaves comprising one group.

- Group composition

Each group consists of one master axis and one or more slave axes, and only the master axis returns a response.

- Group axis number

To perform a group send, set a group axis number to the slave axes to be included in the group.
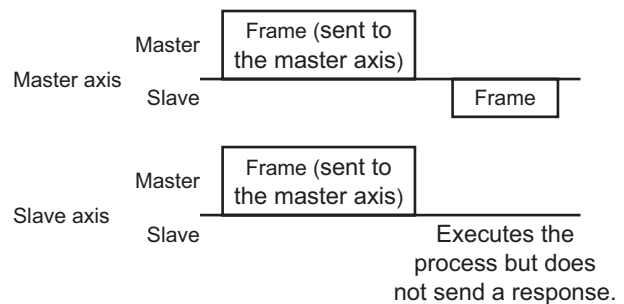
The slave axes to which the group axis number has been set can receive a frame sent to the master axis. Accordingly, you can send a frame to all of the master and slave axes in the group by sending it to the master axis only.

- Master axis

No special setting is required on the master axis to perform a group send. The axis number of the master axis becomes the group axis number. When a command is sent to the master axis from the master, the master axis executes the requested process and then returns a response.

- Slave axis

Use a "group" command to set a group axis number to each slave axis.
The master axis is not always required, and a group may consist only of slave axes if no response is required. In this case, set an available axis number for the group. When a frame is sent from the master to this axis number, the frame is sent to all members of the group simultaneously.

- Operation specifications that can be executed via group send

Operation specifications	Description
STOP	Stop command
HOME	Return-to-home operation
RVS	Continuous operation in reverse direction
FWD	Continuous operation in forward direction
START	Positioning operation

- Commands that can be executed via group send

Command No.	Command execution		Description
	READ	WRITE	
00h	Impossible	Possible	Data number selection
20h	Impossible	Possible	Clear counter
21h	Impossible	Possible	Reset alarms
22h	Impossible	Possible	Excitation control
23h	Impossible	Possible	Preset position
24h	Impossible	Possible	Preset encoder counter
32h	Impossible	Possible	Remote output

Example of group send
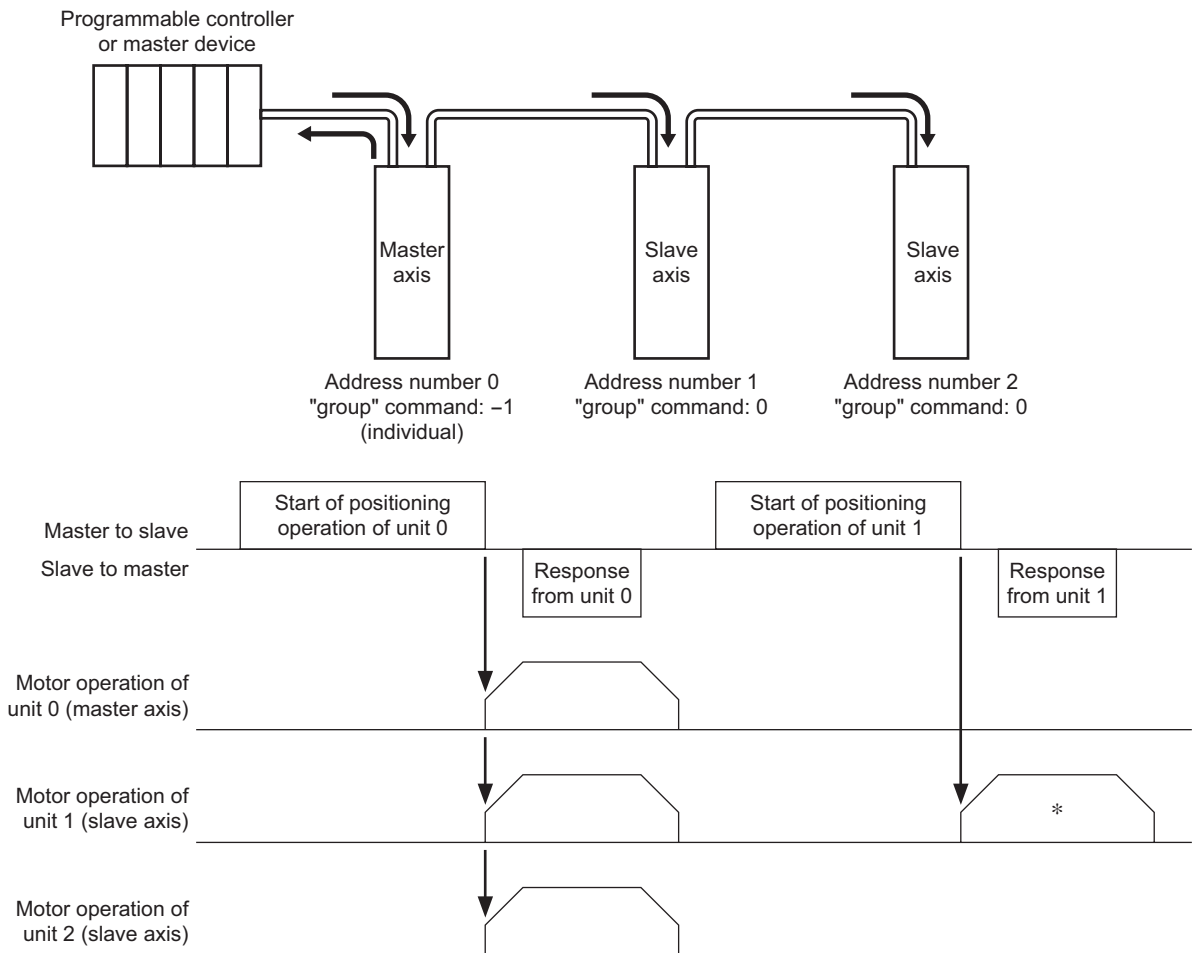
∗ This operation assumes that the "group operation" parameter is set to "enable" (initial value). If this parameter is set to "disable", the slave axes will receive frames only via group send and thus the operation specifications and commands sent individually to a given unit will not be executed.

13.13 Detection of communication errors

This function detects abnormalities that may occur during RS-485 communication. The abnormalities that can be detected include alarms, warnings and communication errors.

■ Communication errors

If the frame is discarded due to a reception failure (NACK) or RS-485 communication error (84h), a communication error record will be saved in the RAM. You can check the communication errors using the "communication error record" command.

Note | The communication error record will be cleared once the driver power is turned off.

Type of communication error	Error code	Cause
RS-485 communication error	84h	One of the following errors was detected. A single error will generate a warning. If the error generates three times consecutively, an alarm will generate. · Framing error · Elapse of receive monitor period · Mismatched BCC · Invalid header
Command not yet defined	88h	The command could not be executed for the following reasons: · Insufficient operation specification (A system-reserved bit was set to 1.) · Unknown mode (An undefined mode was specified.) · Unknown command (An undefined command was specified.) · WRITE failure (An invalid write command was specified.) · READ failure (An invalid read command was specified.)
User interface communication in progress	89h	The command could not be executed because the user interface communication was in progress. · The **OPX-2A** is currently connected in a mode other than the monitor mode. · Downloading or initialization is currently in progress via the **MEXE02**.
Internal processing in progress	8Ah	The command could not be executed because the driver was processing the NV memory. · Internal processing was in progress. (S-BSY is ON.) · An EEPROM error alarm was present.
Outside setting range	8Ch	The command could not be executed because the data was outside the specified range.

■ Alarms and warnings

When an alarm generates, the ALM output will turn OFF and the motor will stop. At the same time, the ALARM LED will start blinking.
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.

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

● RS-485 communication error (84h)

The table below shows the relationship between alarms and warnings when an RS-485 communication error occurs.

Type of error	Description
Warning	If a RS-485 communication error (84h) generates only once, a warning will generate. The warning will be reset automatically following a successful data reception.
Alarm	An alarm generates when a RS-485 communication error (84h) has been detected consecutively by the number of times set in the "communication error alarm" parameter. While the alarm is present, RS-485 communication is cut off and the motor becomes unexcited.

The causes of RS-485 communication error (84h) and remedial action taken by the slave are shown below.

Error	Cause	Remedial action
Framing error	The stop bit is "0".	The received frame will be destroyed and the slave wait for the next frame to be received.
Elapse of receive monitor period	Receive monitor period elapsed before the frame reception was completed.	
Mismatched BCC	The BCC did not match the calculated value.	
Invalid header	An address number other than 0 was specified for simultaneous send.	

Note Even when a RS-485 communication error (84h) occurs, the slave does not send a reply. Accordingly, the master should perform an appropriate action such as resending the command. Before resending the command from the master, wait for at least T2 (response time)+T3 (receive monitoring). If the command is resent before the receive monitoring period elapses, the next frame may not be received properly.

- RS-485 communication timeout (85h)

  If communication is not established with the master device after an elapse of the time set by the "receive period" parameter, a RS-485 communication timeout alarm will generate.
  The motor stopping method can be set using the "communication timeout action" parameter.

13.14 Timing charts

■ Communication start
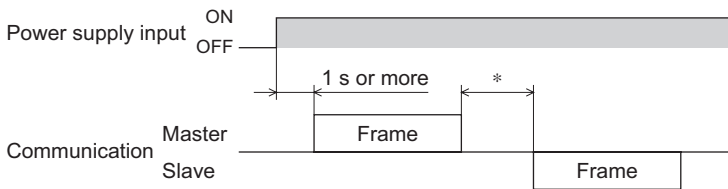
∗ T2 (response interval)

■ Operation start
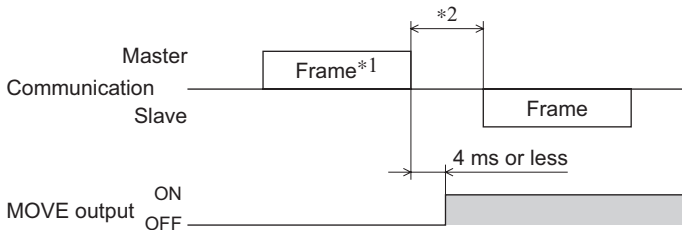
∗1 Frame containing an operation specification (HOME, RVS, FWD or START)
∗2 T2 (response interval)

■ Operation stop, speed change
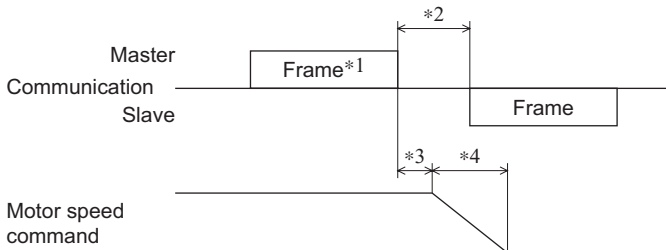
∗1 Frame containing the operation specification STOP or "data number selection" command
∗2 T2 (response interval)
∗3 The specific time varies depending on the command speed.
∗4 The deceleration method to be applied at the time of stopping varies according to the value set by the "STOP action" command.

■ Excitation control
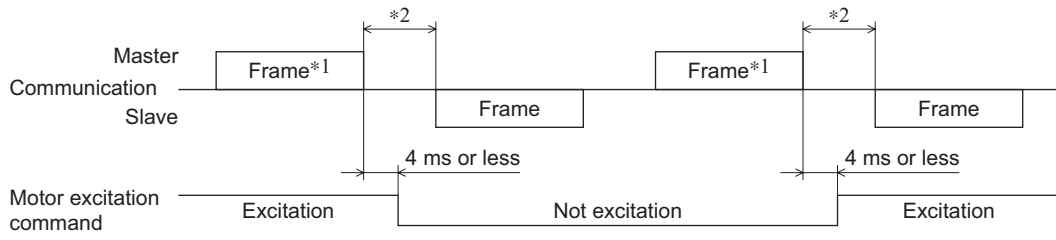
*1 Frame containing the "excitation control" command
*2 T2 (response interval)

■ Remote output
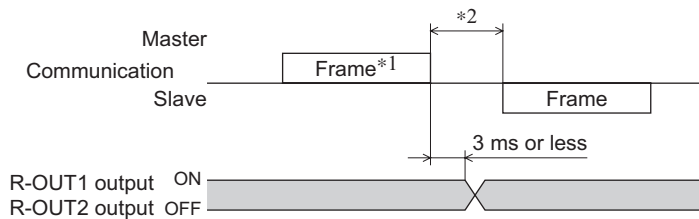
*1 Frame containing the "remote output" command
*2 T2 (response interval)

14 Related functions

This chapter explains the useful functions that facilitate operation, functions that become available when an encoder is connected, and the like.

14.1 Software overtravel

The software overtravel is a function that limits the range of movement via software settings.
When a positioning operation or continuous operation is started where the position specified by a "positive software limit" parameter or "negative software limit" parameter is to be exceeded, the motor will decelerate to a stop and a software overtravel alarm will generate.
If software overtravel is to be used, set the "software overtravel" parameter to "enable".
The operation pattern shown below applies when an operation where a soft limit is to be exceeded is started.
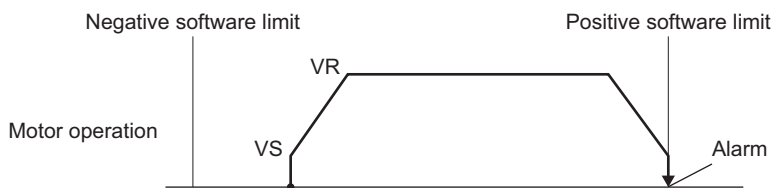
Software overtravel will become effective after the home is set. For the method to set the home, refer to p.42.

14.2 Hardware overtravel

Hardware overtravel is a function that limits the range of movement using limit sensors (±LS).
If the +LS or –LS signal is input during positioning operation or continuous operation, the motor will stop and a hardware overtravel alarm will generate.
When the +LS or −LS input is turned ON during positioning operation or continuous operation, the motor will stop and hardware overtravel alarm will generate.
You can change the input logic for ±LS sensors using the "LS contact configuration" parameter. The stopping method to be applied upon detection of a limit sensor signal can be set using the "overtravel action" parameter.
If the limit sensor input is turned ON, issuing a positioning operation start command will only generate an alarm and the operation will not be started.
Continuous operation can be performed in − direction while the +LS input is ON, or in + direction while the −LS input is ON. The motor operates at the starting speed within range between the limit sensors. Once the motor deviates from the limit sensor range, it will operate at the operating speed.

14.3 Position control

The driver has an internal oscillating-pulse counter. The command position can be read from this counter using the **OPX-2A**, **MEXE02** or RS-485 communication. You can also check the command position by counting the number of times a PLS-OUT or DIR-OUT output signal has been output.
The control range of command positions is –2,147,483,648 to 2,147,483,647.
The command position will be cleared to 0 once the return-to-home operation ends successfully. If a preset is performed using the P-PRESET input, the command position will change to the value set in the "preset position" parameter.
If an encoder is connected and the "stepout detection" parameter is set to "enable", the command position will be refreshed by the encoder counter value while the motor is not excited.

14.4 Encoder input

- You can use the **OPX-2A**, **MEXE02** or RS-485 communication command's "encoder counter" to read the 90° phase difference signal that is input from the encoder. The read value has been multiplied by 1.
- The encoder counter can be cleared to 0 by executing the RS-485 communication command's "clear counter". Also, a successful completion of return-to-home operation resets the encoder counter to 0.
- Executing the **OPX-2A**, **MEXE02** or RS-485 communication command's "preset encoder counter" changes the encoder counter value to the one set as the "encoder counter preset value".
- When an encoder is connected, the misstep detection function becomes available. Take note that the encoder input is counted even when the misstep detection function is not used.

| **Note** | Perform a counter clear or encoder counter preset while the motor is stopped.

Encoder input specifications

A-phase B-phase	Input frequency	100 kHz max.
	Counting range	−2,147,483,648 to +2,147,483,647 pulse
	Counting mode	90° phase difference input, multiplied by 1
	Interface	Differential line receiver (26C32 or equivalent)
Z-phase	Input width	1 ms or more
	Interface	Differential line receiver (26C32 or equivalent)
Encoder cable length		10 m (32.8 ft.) max.*

∗ If you want to extend the leads between the encoder and driver, use wires of AWG24 to 22 (0.2 to 0.3 mm^2).
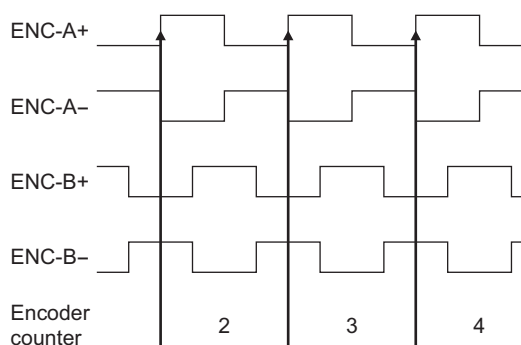
- Increment   • Decrement
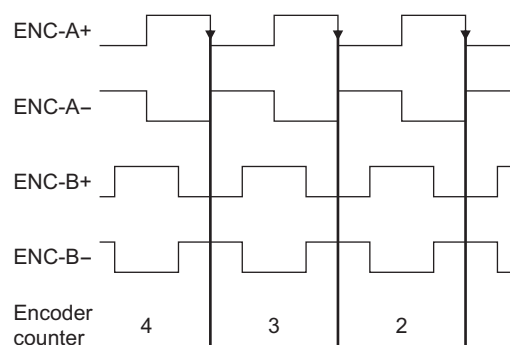
This example assumes that the "motor rotation direction" parameter is set to "+ direction=CW". If this parameter is set to "+ direction=CCW", the counter value will decrease with each increment, and increase with each decrement.

14.5 Misstep detection function

This function becomes effective when an encoder is connected. Specifically, the deviation between the command position and encoder counter is monitored.

The sub-functions specified below become available when the "stepout detection" parameter is set to "enable".

- Deviation error detection

When the deviation reaches the value set in the "stepout detection band" parameter (initial value: 7.2°), a deviation error will be recognized.

If the base step angle of the motor is 0.72°, set the value of the "stepout detection band" parameter to 7.2°.

If the base step angle of the motor is 0.36°, set the value of the "stepout detection band" parameter to 3.6°.

Deviation error detection will start after the motor has remained excited for 500 ms. This function is disabled during return to mechanical home operation.

- STEPOUT output

This signal notifies a deviation error. Assign the STEPOUT output to one of the OUT0 to OUT4 outputs.

- Alarm/warning

You can cause an alarm or warning to be generated upon detection of a deviation error.
- Generate an excessive position deviation alarm: Set the "stepout detection action" parameter to "alarm".
- Generate an excessive position deviation warning: Set the "stepout detection action" parameter to "warning".
- Do not generate an alarm or warning: Set the "stepout detection action" parameter to "no operation".

- Command position update

The command position is corrected by the encoder counter while the motor is not excited. The command position will still be refreshed even when the motor output shaft is turned by an external force while the motor excitation is stopped.

■ How to recover from deviation error

Perform one of the following operations to recover from the deviation error:
- Stop the motor excitation.
- Perform return to mechanical home.
- Clear the counter.

When the "stepout detection action" parameter is set to "alarm"

When a deviation error is detected, an excessive position deviation alarm will generate. In this case, reset the alarm by following the procedure below:

1. Stop the motor excitation or clear the counter to recover from the deviation error.

2. Turn the ALM-RST input ON to reset the alarm.

3. Perform return-to-home operation, if necessary.

| Note | If an excessive position deviation alarm generates, turning the ALM-RST input ON alone will not reset the alarm. Be sure to recover from the deviation error first, and then reset the alarm. |

■ Encoder electronic gear settings

Even when the motor resolution is different from the encoder resolution, you can still detect a deviation error by setting the encoder electronic gears. The encoder electronic gears are used to determine a deviation error and will not affect the encoder counter value.

Parameter	Description
Encoder electronic gear A	Set the encoder resolution. Set to 500 if the encoder pulse count per motor revolution is 500 P/R. Note that the resolution is 500 P/R for motors with encoder.
Encoder electronic gear B	Set the motor resolution. Set to 1000 if the pulse count required for one motor revolution is 1000 P/R.

- Setting example 1

A setting example where the base step angle is 0.72° and encoder resolution is 500 P/R is given below.

Motor step angle	Number of divisions	"Encoder electronic gear A " parameter	"Encoder electronic gear B" parameter
0.72°	1	500	500
0.36°	2	500	1000
0.288°	2.5	500	1250
0.18°	4	500	2000
0.144°	5	500	2500
0.09°	8	500	4000
0.072°	10	500	5000
0.036°	20	500	10000
0.0288°	25	500	12500
0.018°	40	500	20000
0.0144°	50	500	25000
0.009°	80	500	40000
0.0072°	100	500	50000
0.00576°	125	500	62500
0.0036°	200	500	100,000
0.00288°	250	500	125,000

- Setting example 2

A setting example where the base step angle is 0.36° and encoder resolution is 500 P/R is given below.

Motor step angle	Number of divisions	"Encoder electronic gear A " parameter	"Encoder electronic gear B" parameter
0.36°	1	500	1000
0.18°	2	500	2000
0.144°	2.5	500	2500
0.09°	4	500	4000
0.072°	5	500	5000
0.045°	8	500	8000
0.036°	10	500	10000
0.018°	20	500	20000
0.0144°	25	500	25000
0.009°	40	500	40000
0.0072°	50	500	50000
0.0045°	80	500	80000
0.0036°	100	500	100,000
0.00288°	125	500	125,000
0.0018°	200	500	200,000
0.00144°	250	500	250,000

Note	• The accuracy of deviation varies depending on the operating speed and load. Be sure to check the deviation on the actual system.

- If you are providing the encoder on your own and installing it to the motor, take note that the accuracy of deviation error detection is also affected by the encoder resolution and assembly accuracy. Be sure to check the deviation on the actual system.
- If misstep occurs, the home position on the equipment side deviates from the home position recognized by the driver. If the operation is continued in this condition, the equipment may be damaged. Accordingly, take prompt actions if misstep is detected.
- If the motor step angle has been changed, be sure to change the value of the "encoder electronic gear B" parameter accordingly. Similarly if the encoder resolution has changed, be sure to change the value of the "encoder electronic gear A" parameter accordingly. If the gears are not set properly, the command position will not be updated correctly and a deviation error will be detected.

■ Resolution

If the misstep function is used, use of an encoder with a resolution of 500 P/R.

| Note	If you are providing the encoder on your own, use the one that meets the specifications on p.129.

15 Alarms and warnings

The driver provides alarms that are designed to protect the driver from overheating, poor connection, misoperation, 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. When an alarm generates, the ALARM LED will blink. The cause of the alarm can be checked by counting the number of times the ALARM LED blinks.
Present alarms can be checked using the **OPX-2A**, **MEXE02** or RS-485 communication. You can also check the records of up to ten most recent alarms starting from the latest one, or clear the alarm records.

Example: Overvoltage alarm (number of blinks: 3)
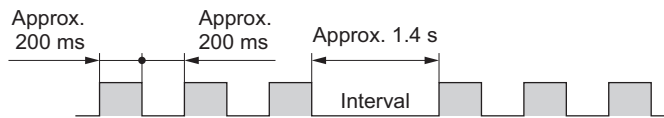
■ Alarm reset

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.53 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**, **MEXE02** or RS-485 communication.
- Cycle the power.

| Note | Some alarms cannot be reset with the ALM-RST input, **OPX-2A**, **MEXE02** or RS-485 communication. Check the following table to identify which alarms meet this condition. To reset these alarms, you must cycle the power. |

Alarm type	No. of ALARM LED blinks	Alarm code	Motor operation	Alarm reset*	Cause	Remedial action
Overheat	2	21	The motor current is cut off.	Possible	The internal temperature of the driver exceeded 85 °C (185 °F).	Review the ventilation condition in the enclosure.
Overvoltage	3	22	The motor current is cut off.	Not possible	• The internal voltage exceeded the permissible value due to regeneration, etc. • The power supply voltage exceeded the allowable value.	• If this alarm generates during operation, reduce the load or increase the acceleration/ deceleration rate. • Check the power supply voltage.
Overflow	4	10	The motor stops.	Possible	The deviation between the encoder counter value and command position reached the stepout detection band when the "stepout detection action" parameter was set to "alarm".	• Reduce the load, or increase the acceleration/deceleration rate. • Check the setting of "stepout detection band" parameter. • Check the setting of "encoder electronic gear" parameter.
±LS both sides active		60	The motor stops.	Possible	Both the +LS and −LS signals were detected when LS detection was enabled.	Check the sensor logic and setting of "LS contact configuration" parameter.
Reverse limit sensor connection		61	The motor stops.	Possible	The LS opposite to the operating direction has detected during a return-to-home operation.	Check the ±LS wiring.
Home seeking error	7	62	The motor stops.	Possible	Return-to-home operation did not complete normally.	• An unanticipated load may have been applied during the return-to-home operation. Check the load. • If the installation positions of ±LS and HOMES are close to one another, the return-to-home sequence may not end properly, depending on the starting direction of return-to-home operation. Review the sensor installation positions and the starting direction of return-to-home operation. • Return-to-home operation may have been performed in a condition where both +LS and −LS were detected. Check the sensor logic and the setting of "LS contact configuration" parameter.
No HOMES		63	The motor stops.	Possible	The HOMES is not detected at a position between +LS and −LS during return-to-home operation in 3-sensor mode.	• Set a HOMES between +LS and −LS. • Check the HOMES wiring.

* Reset alarm using the ALM-RST input/**OPX-2A**/**MEXE02**/RS-485 communication.

Alarm type	No. of ALARM LED blinks	Alarm code	Motor operation	Alarm reset*	Cause	Remedial action
TIM, Z, SLIT input error	7	64	The motor stops.	Possible	None of the SLIT input, TIM output and ZSG output could be detected during return-to-home operation.	• Adjust the connection condition of the motor output shaft and load as well as the HOMES position so that at least one of the SLIT input, TIM output and ZSG output will turn ON while HOMES is ON. • If the SLIT input, TIM output and ZSG output are not used with HOMES, set the "TIM signal detection with home-seeking" parameter and "SLIT detection with home-seeking" parameter to "disable."
Overtravel		66	The motor stops.	Possible	A +LS or −LS signal was detected when hardware overtravel was enabled.	Reset alarm using the ALM-RST input, and then pull out from the LS sensor via continuous operation or return-to-home operation.
Software overtravel		67	The motor stops.	Possible	A software limit was reached when software overtravel was enabled.	Perform the operation within the range between the software limits. In single-motion operation, check to see if the position exceeds the softlimit. In linked-motion operation, check to see if the result of linked position exceeds the softlimit.
Home seeking offset error		6A	The motor stops.	Possible	A limit sensor signal was detected during offset movement as part of return-to-home operation.	Check the setting of "position offset of home-seeking" parameter.
Invalid operation data		70	The motor stops.	Possible	• Five or more data may be linked. • Data of different directions may be linked • In a sequential positioning operation, "sequential positioning" was not set to "enable" for operation data No.01.	• Keep the number of operation data to be linked to 4 or less. • Link operation data having the same direction. • In a sequential positioning operation, set "sequential positioning" to "enable" for operation data No.01.
RS-485 communication error		84	The motor current is cut off.	Not possible	The number of consecutive RS-485 communication errors reached the value set in the "communication error alarm" parameter.	See "13.13 Detection of communication errors" on p.125.
RS-485 communication timeout		85	The motor stops.	Possible	The time set in the applicable parameter has elapsed, and yet the communication could not be established with the host system.	See "13.13 Detection of communication errors" on p.125.
Network bus error*2		81	The motor stops.	Possible	The bus of host network of the network converter turned off while the motor was operating.	Check the condition of the network converter.
Network converter error*2		8E	The motor stops.	Possible	The network converter generated an alarm.	
EEPROM error	9	41	The motor current is cut off.	Not possible	The stored data was damaged.	Initialize the parameters using the **OPX-2A**, **MEXE02** or RS-485 communication.

∗1 Reset alarm using the ALM-RST input/**OPX-2A**/**MEXE02**/RS-485 communication.
∗2 This error is detected when a network converter is used in combination.

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**, **MEXE02** or RS-485 communication.

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

Warning type	Warning code	Cause	Remedial action
Overflow	10	The deviation between the encoder counter value and command position reached the stepout detection band when the "stepout detection action" parameter was set to "warning".	• Reduce the load, or increase the acceleration/deceleration rate. • Check the setting of "stepout detection band" parameter. • Check the setting of "encoder electronic gear" parameter.
Overheat	21	The temperature inside the driver exceeded the value set in the "overheat warning" parameter.	Review the ventilation condition in the enclosure.
Overvoltage	22	• The internal voltage exceeded the value set in the "overvoltage warning" parameter due to regeneration, etc. • The power supply voltage exceeded the value set in the "overvoltage warning" parameter.	• If this alarm generates during operation, reduce the load or increase the acceleration/deceleration rate. • Check the power supply voltage.
RS-485 communication error	84	A RS-485 communication error was detected.	See "13.13 Detection of communication errors" on p.125.

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 output shaft can be moved by hand.	The AWO input is turned ON (normally open).	• Turn the AWO input OFF and confirm that the motor will be excited. • Check the setting of the "AWO contact configuration" parameter.
	Connection error in the motor leads or power supply cable.	Check the connections between the driver, motor and power supply.
	The "operating current" or "standstill current" parameter is set wrong. If the current is too low, the motor torque will also be too low and operation will be unstable.	Return the "operating current" or "standstill current" to its initial setting and check.
The motor does not operate.	The STOP input is turned OFF (normally closed).	• Turn the STOP input ON. • Check the setting of the "STOP contact configuration" parameter.
	The position (distance) is not set in the operation data while positioning operation.	Check the operation data.
	The FWD input and RVS input are turned ON simultaneously in the continuous operation.	Check the status of FWD input and RVS input.
	Electromagnetic brake is holding (electromagnetic brake motor only).	Release the electromagnetic brake by turning the power on.
The motor rotates in the direction opposite to the specified direction.	The "motor rotation direction" parameter is set wrong.	Check the setting of the "motor rotation direction" parameter.
The gear output shaft rotates in the direction opposite to the motor.	The **TH** geared type whose gear ratio is 20:1 or 30:1 is used.	• With **TH** geared motors, the gear rotates in the direction opposite to the motor when the gear ratio is 20:1 or 30:1. • All harmonic geared types rotate in the direction opposite motor rotation.
Motor operation is unstable.	Connection error in the motor leads or power supply cable.	Check the connections between the driver, motor and power supply.
	The "operating current" or "standstill current" parameter is set wrong. If the current is too low, the motor torque will also be too low and operation will be unstable.	Return the "operating current" or "standstill current" to its initial setting and check.
Loss of synchronization during acceleration or running.	The centers of the motor output shaft and load shaft are not aligned.	Check the connection condition of the motor output shaft and load shaft.
	The load or load fluctuation is too high.	Check for large load fluctuations during operation. If adjusting the operating speed to low and high torque eliminates the problem, it is necessary to review the load conditions.
	The starting speed is too high.	Lower the starting speed and set it again to a speed at which stable starting is possible.
	The acceleration/deceleration rate is too short.	Lengthen the acceleration/deceleration rate in order to reset it to a time at which stable starting is possible.
With the electromagnetic brake type, the electromagnetic brake does not hold the load.	DC power is supplied to the electromagnetic brake.	To hold the load with the electromagnetic brake while motor is stopped, turn OFF the power supply for electromagnetic brake.
Motor does not move the set amount.	Wrong step angle settings.	Check the "motor step angle" parameter.

Note   I/O signals can be monitored using the **OPX-2A**, **MEXE02** or RS-485 communication. Use these options to check the wiring conditions of I/O signals.

17 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 office.

■ During inspection

- Are any of motor mounting screws loose?
- Check for any unusual noises in the motor's bearings (ball bearings) or other moving parts.
- Are there any scratches, signs of stress or loose driver connection in the motor lead wires?
- Are the motor's output shaft (or gear output shaft) and load shaft out of alignment?
- Is there any looseness at the driver mounting points on the DIN rail?
- Is there any loose driver connector?
- Is there attachment of dust, etc., on the driver?
- Are there any strange smells or appearances within the driver?

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

18 General specifications

	Motor		Driver
Degree of protection	• High-resolution type • High-torque type • High-torque type with encoder • **TH**, **PS**, **PN** and harmonic geared type (**CRK513P**, **CRK523P**)	IP20	IP20
	• Standard type • Standard type with electromagnetic brake • Standard type with encoder • **TH**, **PS**, **PN** and harmonic geared type (**CRK543**, **CRK544**, **CRK564**, **CRK566**)	IP30	
Operation environment	Ambient temperature	−10 to +50 °C (+14 to +122 °F) (non-freezing)	0 to +40 °C (+32 to +104 °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)	−25 to +70 °C (−13 to +158 °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)	−25 to +70 °C (−13 to +158 °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		Applied 500 VDC 100 MΩ or more · Between coil and case	Applied 500 VDC 100 MΩ or more · Between FG terminal and power supply terminal
Withstand voltage		Applied 1.5 kVAC (1 kVAC for PK54□) 50/60 Hz for 1 minute. · Between coil and case	Applied 500 VAC 50/60 Hz for 1 minute, leak current 10 mA or less · Between FG terminal and power supply terminal

19 Options (sold separately)

■ Data setter

The data setter lets you set data and parameters for your **CRK** series built-in controller with ease and also functions as a monitor.

Model: **OPX-2A**

■ Data setting software

The data setting software lets you set operation data and parameters for your **CRK** series built-in controller 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**

■ Extension cable

This cable is used to extend the wiring distance between the driver and motor.

Model	Length [m (ft.)]	Number of cores
CC05PK5	5 (16.4)	5
CC10PK5	10 (32.8)	

■ Connector lead wire

The lead wires come preassembled with a crimped connector for easy connection of a encoder and driver.

Model: **LC09A-006** [0.6 m (2 ft.)]

■ RS-485 communication cable

You can link drivers using this cable connected to the RS-485 communication connectors (CN6, CN7).

Model: **CC001-RS4** [0.1 m (0.3 ft.)]

20 Related products (sold separately)

■ **Network converter**
   NETC01-CC; supporting CC-Link communication
   NETC01-M2; supporting MECHATROLINK-Ⅱ communication
   NETC01-M3; supporting MECHATROLINK-Ⅲ communication

If you are using your **CRK** series built-in controller in a CC-Link system or MECHATROLINK system, you can connect the **CRK** series built-in controller via the network converter so as to convert data from the each communication protocol to the RS-485 communication protocol and send the converted data to the driver. Alarms and other data output from the driver, which normally conform to the RS-485 communication protocol, can also be converted to the each communication protocol and sent to the master station accordingly.

Example: Connecting to the network converter **NETC01-CC**

Driver   **NETC01-CC**
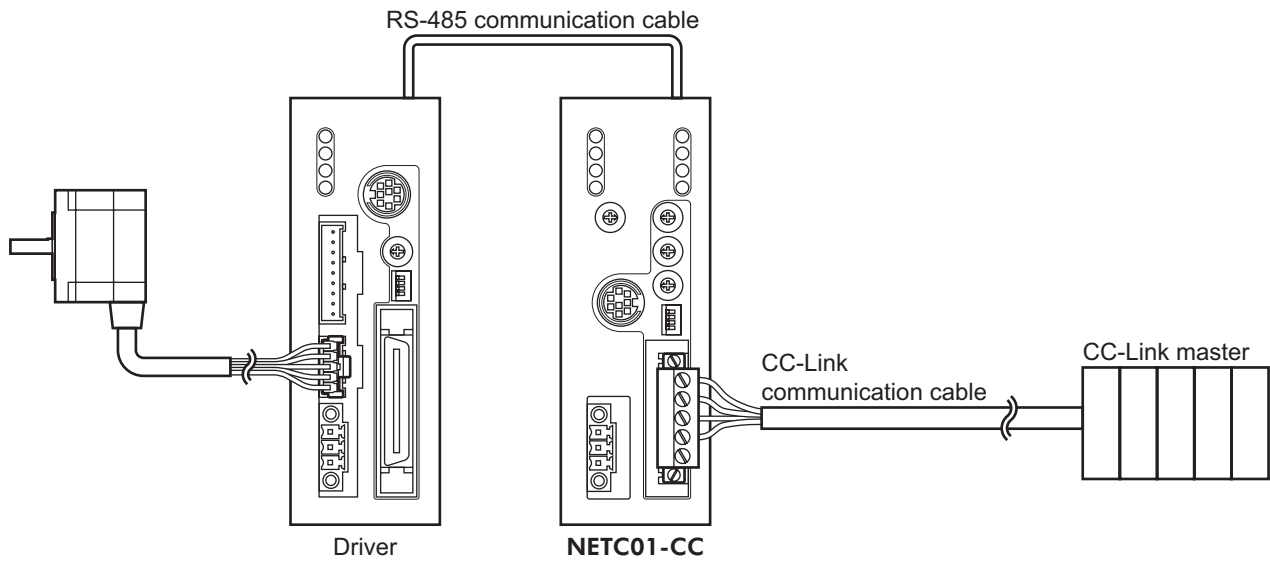
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