Oriental motor

HM-40073-3

Tuning-free AC servo motor unit

NX Series

USER MANUAL

CE

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.

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1 Safety precautions

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

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

⚠ Warning

General

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire, electric shock or injury.
- Assign qualified personnel the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Failure to do so may result in fire, electric shock or injury.
- Do not transport, install the product, perform connections or inspections when the power is on. Always turn the power off before carrying out these operations. Failure to do so may result in electric shock.
- Provide a means to hold the moving parts in place for applications involving vertical travel. In the position control mode, the motor will lose its holding torque when the power is turned off. In all other modes, the holding torque will be lost when the motor stops. Loss of holding torque may cause the moving part to drop, resulting in injury or damage to the equipment.
- The terminals on the driver's front panel marked with ⚠ ⚠ symbol indicate the presence of high voltage. Do not touch these terminals while the power is on to avoid the risk of fire or electric shock.
- When the driver generates an alarm (=any of the driver's protective functions is triggered), the motor will stop and lose its holding torque. Accordingly, provide measures to hold the moving part in place in the event of an alarm. Failure to do so may result in injury or equipment damage.
- When the driver's protection function is triggered, first remove the cause and then clear the protection function. Continuing the operation without removing the cause of the problem may cause malfunction of the motor and driver, leading to injury or damage to equipment.

Installation

- The motor and driver are Class I equipment. When installing the motor and driver, do not touch them or ground the motor and driver first. Failure to do so may cause electric shock.
- Install the motor and driver in an enclosure in order to prevent electric shock or injury.

Connection

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

Operation

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

Maintenance and inspection

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

Repair, disassembly and modification

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

⚠ Caution

General

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

Transportation

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

Installation

- Provide a cover over the rotating parts (output shaft) of the motor to prevent injury.
- To prevent the risk of damage to equipment, leave nothing around the motor and driver that would obstruct ventilation.

Connection

- The driver’s data edit connector (CN4) and analog I/O signals connector (CN6) are not insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and these equipment to short, damaging both.

Operation

- Use a motor and driver only in the specified combination. An incorrect combination may cause a fire.
- Provide an emergency-stop device or emergency-stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Before supplying power to the driver, turn all input signals to the driver to OFF. Otherwise, the motor may start suddenly and cause injury or damage to equipment.
- Do not touch the rotating parts (output shaft) of the motor during operation. This may cause injury.
- When moving the motor output shaft by hand while the motor is at standstill, confirm first that the FREE input of the driver is turned ON. If the FREE input is not ON, an attempt to move the motor output shaft by hand may result in injury.
- Use a 24 VDC power supply that has been given reinforced insulation between the primary side and secondary side. Failure to do so may cause electric shock.
- Immediately when trouble has occurred, stop running and turn off the driver power. Failure to do so may result in fire, electric shock or injury.
- To prevent electric shock, use only an insulated screwdriver to adjust the driver’s switches.
- The motor’s surface temperature may exceed 70 °C (158 °F), even under normal operating conditions. If a motor is accessible during operation, post a warning label shown in the figure in a conspicuous position to prevent the risk of skin burn(s).

Warning label

Maintenance and inspection

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

Disposal

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

■ Precautions when using lithium thionyl chloride batteries

The built-in battery is a lithium thionyl chloride battery with hermetically sealed construction by glass sealing and laser welding. Always observe the following items when using the battery. If the battery is improperly used, heat, explosion, fire, etc. may happen. Doing so may result in equipment damage.

⚠ Warning

Do not recharge

- Never try to recharge the battery. If it is recharged, the electrolyte of the battery heats, gas is generated, the pressure in the battery may increase, and the battery may leak, heat, explode or catch on fire.
- Only use these battery for the specified use. Contact failure or dissatisfication with specification and performance may occur if the terminal construction or the like does not fit the apparatus. The battery may leak, heat, explode or catch on fire.
- Do not incinerate, heat, disassemble or remodel the battery. The glass seal part or the vent part (the vent for gas to escape) may be damaged, and the battery may leak, heat, explode or catch on fire.
- If the liquid of the battery touches the eyes, the eyes may be injured. Do not rub the eyes, but flush the eyes amply with clean water such as city water and then receive medical treatment immediately.
- If the liquid of the battery gets into the mouth, rinse out the mouth and consult a doctor immediately.
- Do not short the + − terminals of the battery with a wire and do not carry or keep a metallic necklace, hairpin, etc. together with batteries. The battery may be short-circuited, causing over-current and may leak, heat, explode or catch on fire.
- If leakage or a strong odor comes from the battery, the leaked electrolyte may corrode any metal parts; so, dispose of the battery immediately.
- Do not peel off or damage the outer label (heat-shrinkable tube) of the battery. The battery may be short-circuited and may leak, heat, explode or catch on fire.
- Do not expose battery to strong impact by dropping or throwing the battery. The battery may leak, heat, explode or catch on fire.
- Do not deform the battery. The glass seal part or the vent part (the vent for gas to escape), etc, may be damaged and the battery may leak, heat, explode or catch on fire.
- At storage or disposal of the battery, insulate the terminal part with tape or the like. If the battery is mixed with other battery or metallic object, the battery may be short-circuited and may heat, explode or catch on fire.

⚠ Caution

- Do not use or keep the battery in places exposed to strong direct sunlight or in cars under hot sun, etc. The battery may leak, heat or explode.
- Keep the battery away from water. The battery may heat.
- At the storage of battery, avoid direct sunlight, high temperature and high humidity places. The battery may leak, heat or explode. In addition, the performance and the life of the battery may decrease.
- This battery is allowed to be disposed as general incombustible refuse. However, if rules for battery disposal exist, such as regulations of local government, dispose of the battery in accordance with the rules.
- Do not give ultrasonic vibration to the battery. By ultrasonic vibration, the contents of battery will be finely powdered, which may cause internal short-circuit resulting in leakage, heat or explosion of the battery.

■ Precautions against transport and storage

Store the battery in a place that satisfies the following conditions: Storage of the battery at high temperature or high humidity may decrease the performance or cause leakage.

- Avoid high temperature and high humidity
- Well ventilated dry place where the temperature in not so high
- A place having a normal temperature [+5 to +35 °C (+41 to +95 °F)], little temperature fluctuation
- A relative humidity of 70% and less
- Avoid direct sunlight
- Keep away from rain water

Avoid rough handling during transport. Rough handling may cause dents or deformation, which can bring a decrease of performance or leakage. Moreover, the battery compartment may be damaged, causing the battery to be deformed; if the + − terminals are short-circuited the battery may be damaged by heating, and moreover leakage, explosion, fire, etc. may happen.

As for the distribution, such as transport, display and others, observe strictly the first-in, first-out method and pay attention to avoid long-term stock. The battery have a long storage property at normal temperature and humidity conditions [normal temperature: +5 to +35 °C (+41 to +95 °F), relative humidity: 70% or less]; however since the long-term stock may deteriorate their performance, observe strictly the appropriate volume of inventories and the first-in, first-out method.

2 Overview of the NX series

The **NX** Series tuning-free AC servo motor unit is a product consisting of a high-performance motor equipped with 20-bit absolute encoder, and a driver supporting four control modes based on position, speed, torque and tension.
When used with the optional data-setter **OPX-2A** or the data setting software **MEXE02** (both are sold separately), you can set parameters and data using the switches on the driver and also access extended functions.

■ Main features

- Stable operation without tuning
  - The automatic tuning function ensures stable operation of the equipment regardless of its mechanism. If the present response is insufficient, all you need is to adjust the mechanical rigidity setting switch and the motor will operate with higher response.
  - With an internal potentiometer, setting of damping control frequency is easy. Even if the motor is assembled into a machine of low rigidity, you can suppress residual vibration during positioning, in order to improve compliance.
  - Automatic tuning supports an adjustment range of up to 50 times the rotor inertial moment, while manual tuning supports an adjustment range of up to 100 times.
- Selection from four control modes

  You can set one of four control modes using the control mode setting switches on the driver.
  - Position control mode..... Positioning operation is performed based on input pulses.
  - Speed control mode ..... The operating speed is controlled via I/O signals.
  - Torque control mode ..... The motor is operated at a constant torque.
  - Tension control mode ..... The generated torque and speed of the motor are adjusted to maintain a constant tension during winding and unwinding operations.
- Separate main power supply and control power supply

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

  The driver supports both the current sink output circuit and the current source output circuit. (Line driver output is not supported).
- Automatically controlled electromagnetic brake

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

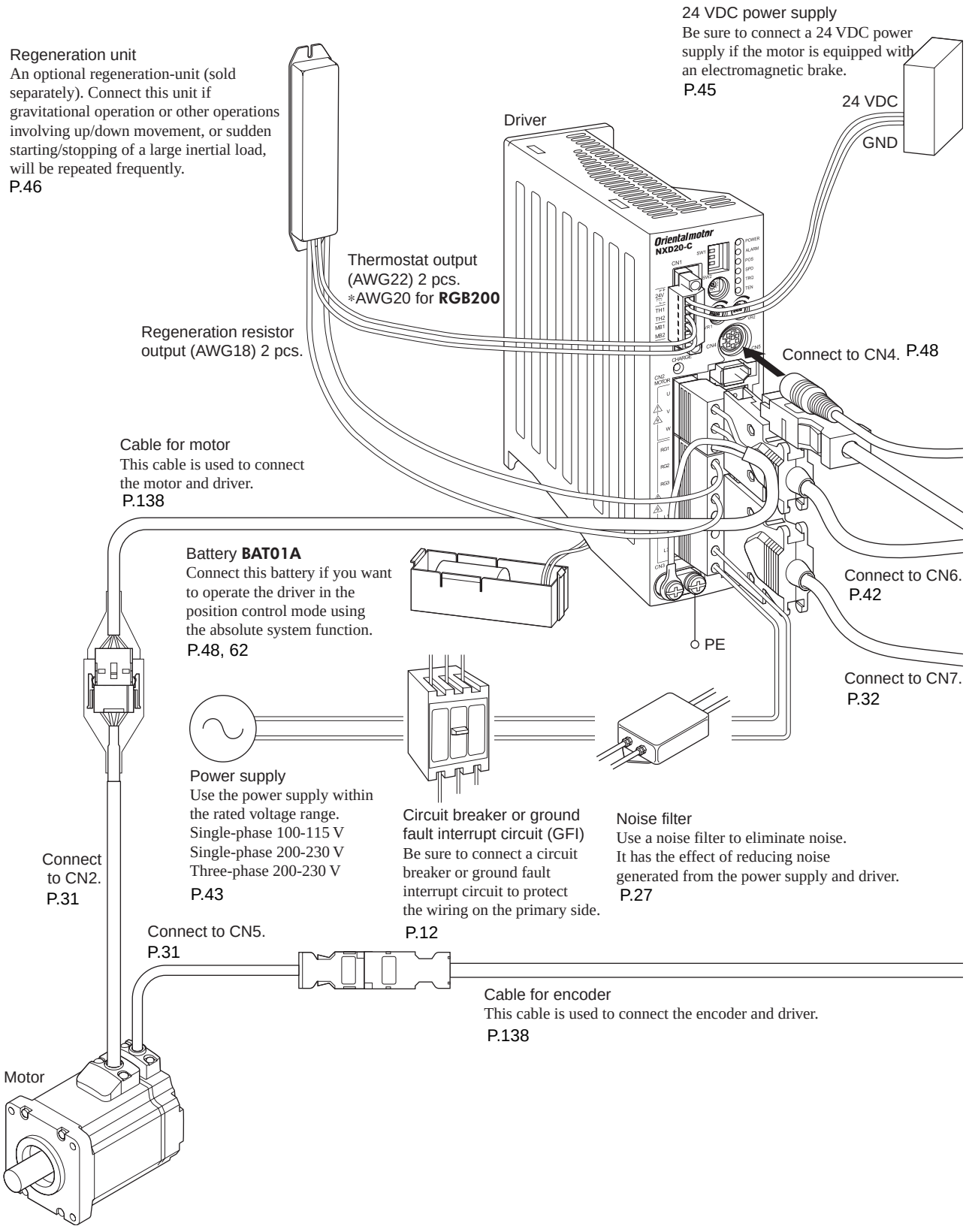
  The driver provides alarms that are designed to protect the driver from overheating, poor connection, misoperation, etc. (protective functions), as well as warnings that are output before the corresponding alarms generate (warning functions).
- Absolute system

  Connect the optional battery **BAT01A** (sold separately) and use the driver in the position control mode, and your **NX** series will effectively comprise an absolute system.

■ Extended functions

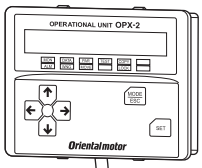
When used with the optional data-setter **OPX-2A** or the data setting software **MEXE02** (both are sold separately), the **NX** series driver lets you set desired parameters, operation mode, resolution and other items according to the needs of your equipment.

3 System configuration

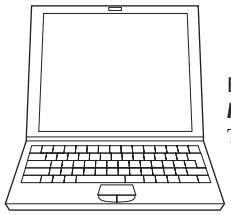


Extend functions are made available through use of options (sold separately)!

Data setter **OPX-2A**

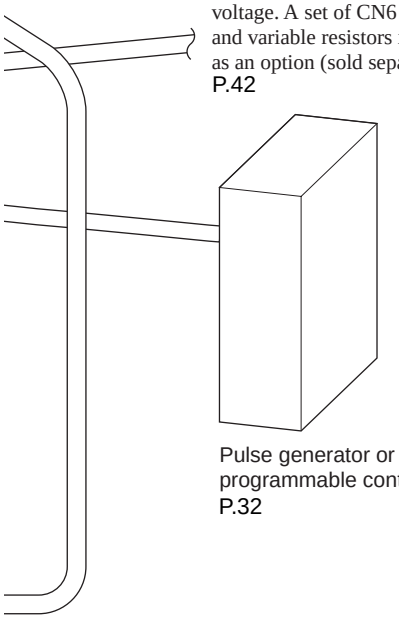


Or



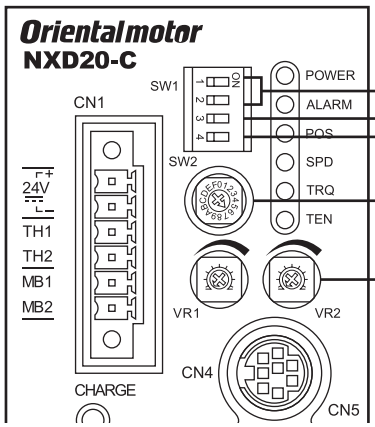
PC in which the data setting software **MEXE02** has been installed
The customer must provide a PC.

Analog I/Os
Connect an external potentiometer or external DC voltage. A set of CN6 connector and variable resistors is available as an option (sold separately).
P.42



Pulse generator or programmable controller
P.32

Easy setting using switches!



Control mode setting switches (SW1-1, 1-2)
Use these switches to set the control mode of the driver.

Absolute system setting switch (SW1-3)
Set this switch when the absolute function of the driver is used by connecting a battery. P.56, 62

Pulse input mode selector switch (SW1-4)
Use this switch to set the pulse input mode. P.52

Mechanical rigidity setting switch
What is set with this switch varies depending on the control mode.

Internal potentiometers (VR1, VR2)
What is set with each switch varies depending on the control mode.

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. Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

■ Structure of the manual

The **NX** series comes with the manuals specified below.

- **NX** Series Motor OPERATING MANUAL

  This manual explains the motor functions and how to install the motor, among others.

- **NX** Series Driver OPERATING MANUAL

  This manual explains the driver functions and how to install the driver, among others.

- **NX** Series USER MANUAL (CD-ROM)

  This manual explains the motor and driver functions, how to install/connect and troubleshooting, among others.

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

■ Standards and CE Marking

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

- Applicable standards

	Applicable standards	Certification Body	Standards File No.
Motor	UL 104*1 CSA C22.2 No.100*1	UL	E62327
	EN 60034-1*1	TÜV	R 50124202
	EN 60034-5	Conforming to the respective standards.	
Driver	UL 508C*2 CSA C22.2 No.14*2	UL	E171462
	EN 50178	Conforming to the respective standards.	
	EN 61800-5-1*2	TÜV	R 50124205

∗1 NXM620, NXM810, NXM820 and NXM920 only.
∗2 Excluding NXD75-S.

- For UL standard (UL 508C), the product is recognized for the condition of Maximum Surrounding Air Temperature 50 °C (122 °F).
- Connect a Class 2 power supply (UL-certified) to the 24 VDC power supply.
- The short-circuit testing has been conducted by UL with the effective current value of 5000 A at 240 V.

- Installation conditions (EN Standard)

Motor	Driver
Motor is to be used as a component within other equipment.	Driver is to be used as a component within other equipment.
Overvoltage category: II	Overvoltage category: II
Pollution degree: 3	Pollution degree: 2
Protection against electric shock: Class I	Protection against electric shock: Class I

- For Low Voltage Directive
  - The product is a type with machinery incorporated, so it should be installed within an enclosure.
  - This product cannot be used with cables normally used for IT equipment.
  - Install the product within the enclosure in order to avoid contact with hands.
  - Be sure to maintain a protective ground in case hands should make contact with the product.
    Be sure to connect the protective earth lead of the cable for motor to the protective earth terminal on the driver, and ground the driver's protective earth terminal.
  - To protect against electric shock using an earth leakage breaker (RCD), connect a type B earth leakage breaker to the primary side of the driver.
  - When using a circuit breaker (MCCB), use a unit conforming to the EN or IEC standard.
  - Isolate the motor cable, power-supply cable and other drive cables from the signal cables (CN1, CN4 to CN7) by means of double insulation.
- EMC Directive

EMC of this product has been measured according to the configuration illustrated in "Example of installation and wiring" on p.28. The compliance of the final machinery with the EMC Directive will depend on such factors as the configuration, wiring, layout and risk involved in the control-system equipment and electrical parts. It therefore must be verified through EMC measures by the customer of the machinery.

Applicable standards

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

■ WARNING FOR UL MARKING ON DRIVER

Solid state motor overload protection is provided in each model.

■ Hazardous substances

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

5 Precautions for use

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

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

  Always use the supplied cable to connect the motor and driver.
  If a flexible cable or cable longer than 3 m (9.8 ft.) is to be used, an appropriate cable must be purchased separately. Refer to “18 Options (sold separately)” on p.138.

- 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 an overhung load and thrust load in excess of the specified permissible limit.

  Operating the motor 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.

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

  The electromagnetic brake is of non-excitation type. 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. Always stop the motor first, and then use the electromagnetic brake to maintain the position of the load.

- Preventing leakage current

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

- Preventing electrical noise

  See “7.7 Installing and wiring in compliance with EMC Directive” on p.27 for measures with regard to noise.

- Do not apply impact to the encoder.

  If the encoder receives strong impact, the encoder may be damaged or the motor may malfunction.

- About grease of geared motor

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

- Saving data to the NV memory

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

- Motor excitation at power ON

  When the driver has been set to lock the servo after the motor stops in the position control mode or speed control mode: Turning on the power supply will not excite the motor. To excite the motor, you must turn the S-ON input ON.
  You can set the motor to be excited automatically after the power has been turned on, by changing the applicable driver parameter using the data setter **OPX-2A** or the data setting software **MEXE02**.

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

  The factory setting is to use the internal regeneration resistor. Note, however, that the internal regeneration resistor does not support continuous regenerative operation, gravitational operation or other operations involving up/down movements, or frequent repeating of sudden starting/stopping of a large inertial load. If any of these operations must be performed, use the optional regeneration unit (sold separately).

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

  The data edit connector (CN4) and analog I/O signals connector (CN6) are not insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and these equipment to short, damaging both. Use the data setter **OPX-2A** to set data, etc.

6 Preparation

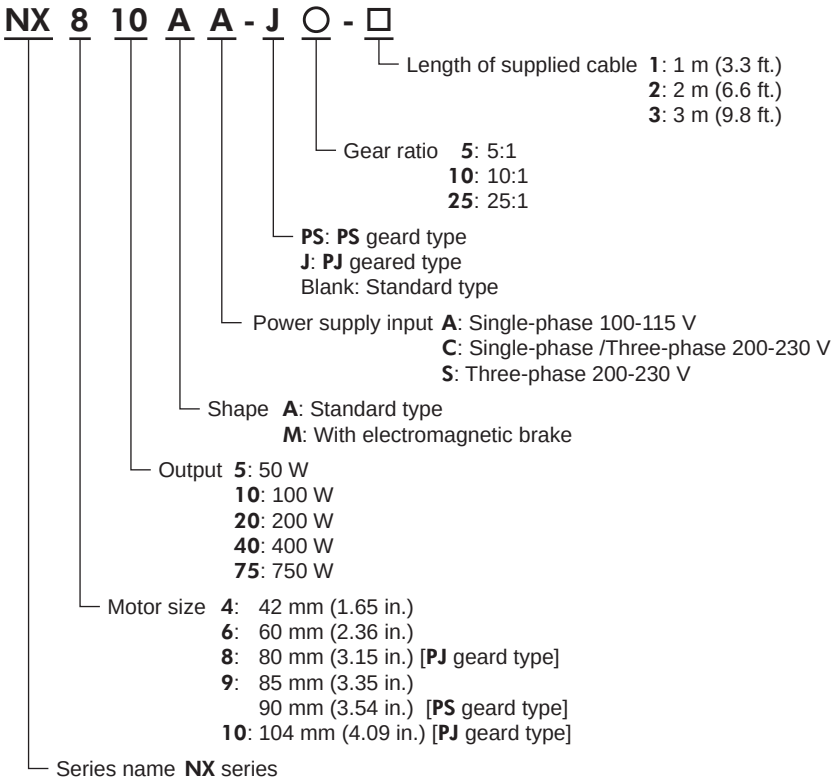
This chapter explains the items you should check, as well as the name and function of each part.

6.1 Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the branch or sales office from which you purchased the product.
Verify the model number of the purchased unit against the number shown on the package label.
Check the model number of the motor and driver against the number shown on the nameplate.
The unit models and corresponding motor/driver combinations are listed on p.15.

- Motor.....1 unit
- Driver .....1 unit
- CN1 connector (6 pins) .....1 pc.
- CN2 connector (3 pins) .....1 pc.
- CN3 connector (7 pins) .....1 pc.
- CN7 connector (36 pins) .....1 pc.
- Connector wiring lever (for CN2, CN3).....1 pc.
- Cable for motor (supplied with the unit) .....1 pc.
- Cable for encoder (supplied with the unit) .....1 pc.
- Cable for electromagnetic brake.....1 pc.
  (supplied with the unit having an electromagnetic brake)
- Parallel key (supplied with geared types).....1 pc.
- **NX** Series Motor OPERATING MANUAL .....1 copy
- **NX** Series Driver OPERATING MANUAL.....1 copy
- **NX** Series USER MANUAL (CD-ROM).....1 pc.

6.2 How to identify the product model



6.3 Combinations of motors and drivers

□ indicates the cable length. ○ indicates the gear ratio.

■ Standard type

Unit model	Motor model	Driver model
NX45AA-□	NXM45A	NXD20-A
NX45AC-□		NXD20-C
NX410AA-□	NXM410A	NXD20-A
NX410AC-□		NXD20-C
NX620AA-□	NXM620A	NXD20-A
NX620AC-□		NXD20-C
NX640AS-□	NXM640A	NXD75-S
NX975AS-□	NXM975A	

■ Standard type with electromagnetic brake

Unit model	Motor model	Driver model
NX45MA-□	NXM45M	NXD20-A
NX45MC-□		NXD20-C
NX410MA-□	NXM410M	NXD20-A
NX410MC-□		NXD20-C
NX620MA-□	NXM620M	NXD20-A
NX620MC-□		NXD20-C
NX640MS-□	NXM640M	NXD75-S
NX975MS-□	NXM975M	

■ PS geared type

Unit model	Motor model	Driver model
NX65AA-PS○-□	NXM65A-PS○	NXD20-A
NX65AC-PS○-□		NXD20-C
NX610AA-PS○-□	NXM610A-PS○	NXD20-A
NX610AC-PS○-□		NXD20-C
NX920AA-PS○-□	NXM920A-PS○	NXD20-A
NX920AC-PS○-□		NXD20-C
NX940AS-PS○-□	NXM940A-PS○	NXD75-S

■ PS geared type with electromagnetic brake

Unit model	Motor model	Driver model
NX65MA-PS○-□	NXM65M-PS○	NXD20-A
NX65MC-PS○-□		NXD20-C
NX610MA-PS○-□	NXM610M-PS○	NXD20-A
NX610MC-PS○-□		NXD20-C
NX920MA-PS○-□	NXM920M-PS○	NXD20-A
NX920MC-PS○-□		NXD20-C
NX940MS-PS○-□	NXM940M-PS○	NXD75-S

■ PJ geared type

Unit model	Motor model	Driver model
NX810AA-J○-□	NXM810A-J○	NXD20-A
NX810AC-J○-□		NXD20-C
NX820AA-J○-□	NXM820A-J○	NXD20-A
NX820AC-J○-□		NXD20-C
NX1040AS-J○-□	NXM1040A-J○	NXD75-S
NX1075AS-J○-□	NXM1075A-J○	

■ PJ geared type with electromagnetic brake

Unit model	Motor model	Driver model
NX810MA-J○-□	NXM810M-J○	NXD20-A
NX810MC-J○-□		NXD20-C
NX820MA-J○-□	NXM820M-J○	NXD20-A
NX820MC-J○-□		NXD20-C
NX1040MS-J○-□	NXM1040M-J○	NXD75-S
NX1075MS-J○-□	NXM1075M-J○	

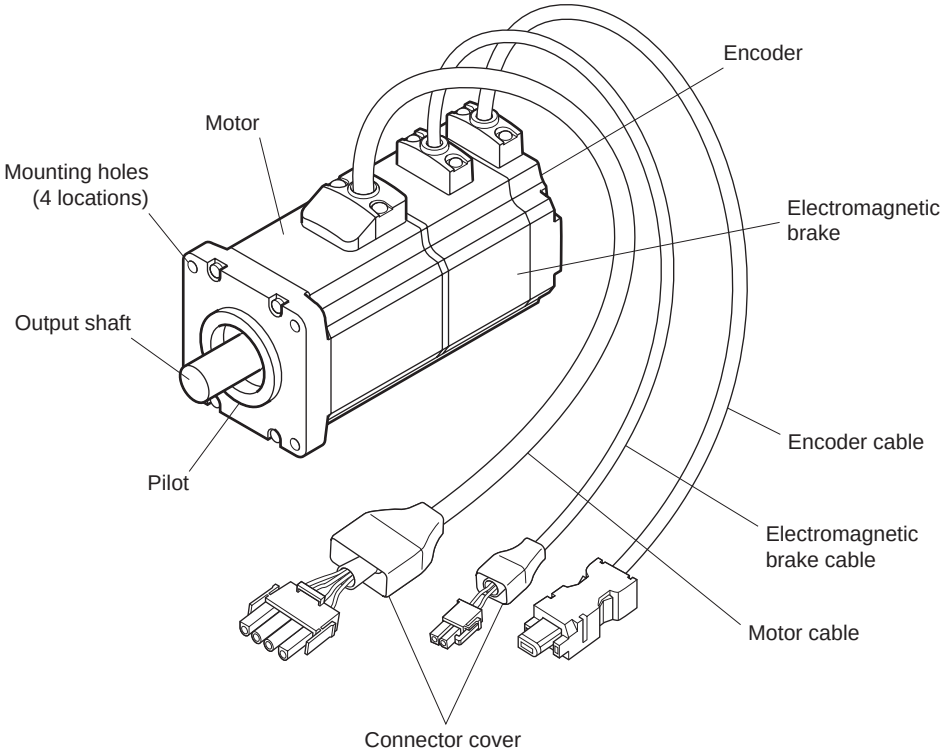
6.4 I/O ratings

- ■ indicates **A** (single shaft) or **M** (with electromagnetic brake).
- □ indicates the cable length.
- ○ indicates the gear ratio.
- The model names of motors (UL recognized) apply to the condition before a gearhead is assembled.

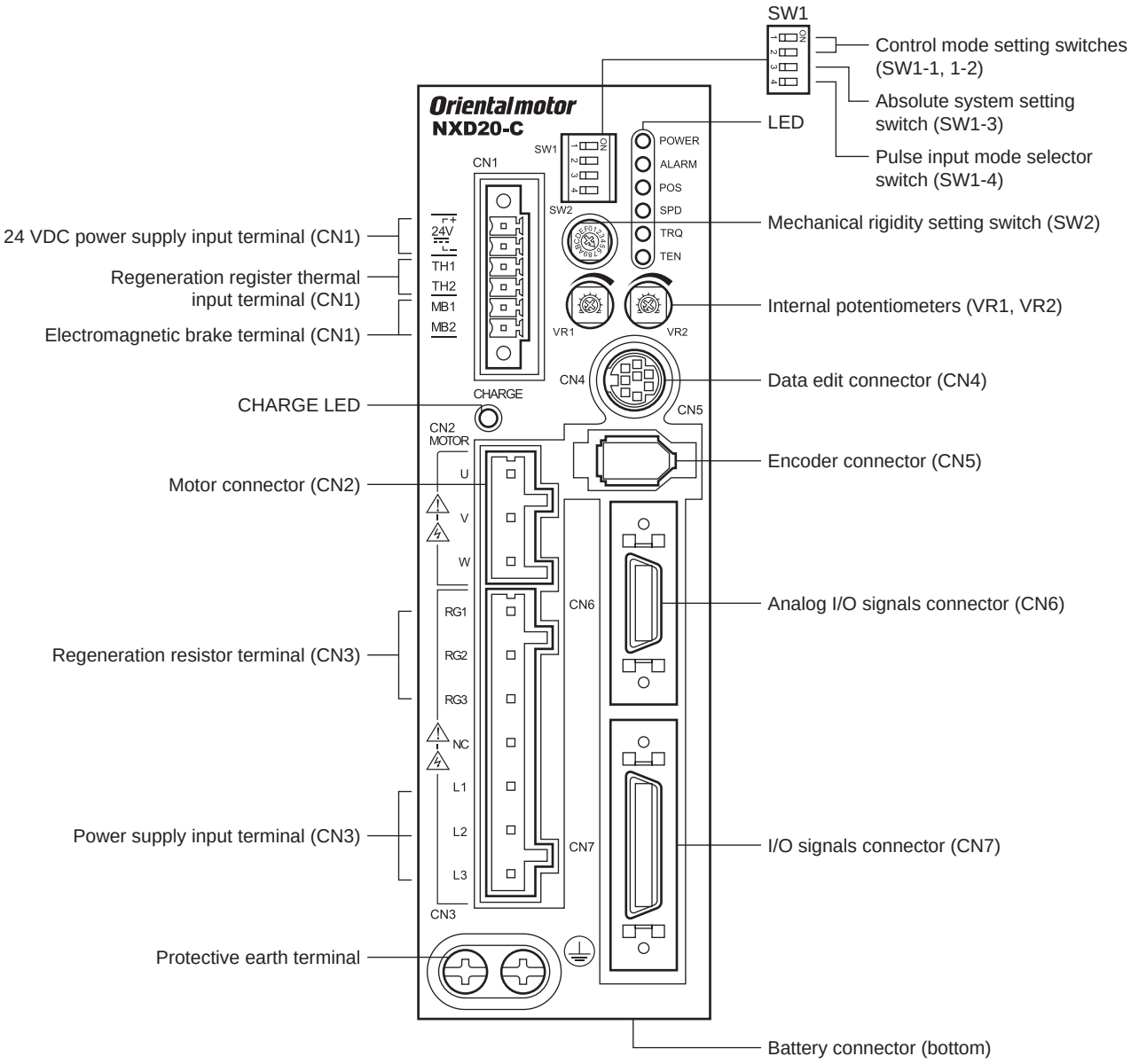
Unit model	Motor model	Motor model (UL recognized)	Driver model	Input			Output			
				Voltage	Frequency	Current	Voltage	Frequency	Current	Output
NX45■A-□	NXM45■	–	NXD20-A	Single-phase 100-115 V	50/60 Hz	1.9 A	Three-phase 0-119 V	0-150 Hz	0.91 A	50 W
NX45■C-□			NXD20-C	Single-phase/ Three-phase 200-230 V		1.2 A/ 0.7 A				
NX410■A-□	NXM410■	–	NXD20-A	Single-phase 100-115 V		2.9 A	Three-phase 0-144 V		1.12 A	100 W
NX410■C-□			NXD20-C	Single-phase/ Three-phase 200-230 V		1.8 A/ 1.0 A				
NX65■A-PS○-□	NXM65■-PS○	–	NXD20-A	Single-phase 100-115 V		1.9 A	Three-phase 0-119 V		0.91 A	50 W
NX65■C-PS○-□			NXD20-C	Single-phase/ Three-phase 200-230 V		1.2 A/ 0.7 A				
NX610■A-PS○-□	NXM610■-PS○	–	NXD20-A	Single-phase 100-115 V		2.9 A	Three-phase 0-144 V		1.12 A	100 W
NX610■C-PS○-□			NXD20-C	Single-phase/ Three-phase 200-230 V		1.8 A/ 1.0 A				
NX620■A-□	NXM620■	NXM620■	NXD20-A	Single-phase 100-115 V		4.6 A	Three-phase 0-152 V	0-300 Hz	1.8 A	200 W
NX620■C-□			NXD20-C	Single-phase/ Three-phase 200-230 V		2.8 A/ 1.6 A				
NX640■S-□	NXM640■	–	NXD75-S	Three-phase 200-230 V		2.8 A	Three-phase 0-162 V		3.2 A	400 W
NX810■A-J○-□	NXM810■-J○	NXM610■-J	NXD20-A	Single-phase 100-115 V		2.8 A	Three-phase 0-141 V		1.1 A	100 W
NX810■C-J○-□			NXD20-C	Single-phase/ Three-phase 200-230 V		1.8 A/ 1.0 A				
NX820■A-J○-□	NXM820■-J○	NXM620■-J	NXD20-A	Single-phase 100-115 V		4.6 A	Three-phase 0-152 V		1.8 A	200 W
NX820■C-J○-□			NXD20-C	Single-phase/ Three-phase 200-230 V		2.8 A/ 1.6 A				
NX920■A-PS○-□	NXM920■-PS○	NXM620■	NXD20-A	Single-phase 100-115 V		4.6 A				
NX920■C-PS○-□			NXD20-C	Single-phase/ Three-phase 200-230 V		2.8 A/ 1.6 A				
NX940■S-PS○-□	NXM940■-PS○	–	NXD75-S	Three-phase 200-230 V		2.8 A	Three-phase 0-162 V		3.2 A	400 W
NX975■S-□	NXM975■	–				4.7 A	Three-phase 0-160 V		5.9 A	750 W
NX1040■S-J○-□	NXM1040■-J○	–				2.9 A	Three-phase 0-127 V		5.1 A	400 W
NX1075■S-J○-□	NXM1075■-J○	–				4.7 A	Three-phase 0-160 V		5.9 A	750 W

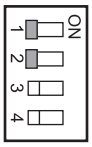
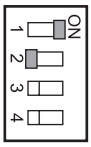
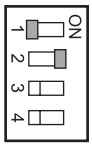
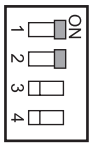
6.5 Names and functions of parts

■ Motor (Example: NXM620M)



■ Driver (Example: NXD20-C)



Name	Description	Reference
Control mode setting switches (SW1-1, 1-2)	These switches are used to set the control mode of the driver (position control, speed control, torque control or tension control). Position control mode  Speed control mode  Torque control mode  Tension control mode 	–
Absolute system setting switch (SW1-3)	This switch is effective in the position control mode. Set the switch when the absolute function of the driver is used by connecting the optional battery **BAT01A** (sold separately). ON: Enable the absolute function OFF: Disable the absolute function The factory setting is “OFF.”	p.56 p.62
Pulse input mode selector switch (SW1-4)	In the position control mode, this switch toggles the driver between the 1-pulse input mode and 2-pulse input mode according to the pulse output mode of the controller. ON: 1-pulse input mode, negative logic OFF: 2-pulse input mode, negative logic The factory setting depends on the destination country.	p.52
LED	These LED indicate the status of the driver. POWER (green): This LED is lit while the main power or 24 VDC is input. ALARM (red): This LED will blink when an alarm generates (a protective function is triggered). You can check the generated alarm (triggered protective function) by counting the number of times the LED blinks. POS (green): This LED is lit in the position control mode. SPD (green): This LED is lit in the speed control mode. TRQ (green): This LED is lit in the torque control mode. TEN (green): This LED is lit in the tension control mode.	–
Mechanical rigidity setting switch (SW2)	What is set with this switch varies depending on the control mode. • Position control mode or speed control mode The switch sets the gain adjustment level according to the mechanical rigidity. The factory setting is “6.” • Torque control mode Not used. • Tension control mode The switch sets the minimum speed in the simple mode. The factory setting is “6.” The switch is not used in high function mode I or high function mode II.	–
Internal potentiometers (VR1, VR2)	What is set with each switch varies depending on the control mode. • Position control mode VR1: This switch sets the damping control frequency. VR2: Not used. • Speed control mode VR1: This switch sets the speed command value. VR2: This switch sets the acceleration/deceleration time. • Torque control mode VR1: This switch sets the torque command value. VR2: This switch sets the speed limit. • Tension control mode VR1: This switch sets the tension command value. VR2: This switch sets the speed limit.	–
Data edit connector (CN4)	Connect a PC in which the data setting software **MEXE02** has been installed, or the data setter **OPX-2A**.	p.48
Encoder connector (CN5)	Connect the motor encoder via a cable for encoder.	p.31
Analog I/O signals connector (CN6)	Connect the analog I/O signals.	p.42
I/O signals connector (CN7)	Connect the I/O signals of the controller.	p.32

Name	Description	Reference
24 VDC power supply input terminal (CN1) [24V]	Connect 24 VDC. Once a 24 VDC power supply is connected, you can check the contents of alarms that have generated even when the main power is cut off. If a motor with an electromagnetic brake is used, be sure to connect a 24 VDC power supply for the electromagnetic brake power.	p.45
Regeneration resistor thermal input terminal (CN1) [TH1, TH2]	Connect the optional regeneration unit (sold separately). If no regeneration unit is connected, plug in the CN1 connector to short the TH1 and TH2 terminals. The driver is shipped with a jumper wire preassembled in the CN1 connector, so you can short the terminals by simply plugging the connector.	p.45
Electromagnetic brake terminal (CN1) [MB1, MB2]	Connect the lead wires from the cable for electromagnetic brake (24 VDC). MB1: Electromagnetic brake − (black) MB2: Electromagnetic brake + (white)	p.45
CHARGE LED (red)	This LED is lit while the main power is input. After the main power has been turned off, the LED will turn off once the residual voltage in the driver drops to a safe level.	−
Motor connector (CN2)	Connect the cable for motor or cable for flexible motor to connect the motor. Phase U: Red Phase V: White Phase W: Black	p.31
Regeneration resistor terminal (CN3) [RG1, RG3]	When using the internal regeneration resistor, short the RG2 and RG3 terminals using a jumper wire supplied with the CN3 connector. If the optional regeneration unit (sold separately) is used, remove the jumper wire which has shorted the RG2 and RG3 terminals, and connect the lead wires to the RG1 and RG3 terminals.	p.45
Power supply input terminal (CN3)	• Single-phase 100-115 VAC L, N: Connect single-phase 100-115 VAC. • Single-phase 200-230 VAC L1, L2: Connect single-phase 200-230 VAC. L3: Not used. • Three-phase 200-230 VAC L1, L2, L3: Connect a three-phase 200-230 VAC. • NC: Not used.	p.43
Protective earth terminal	Ground this terminal using a grounding wire of AWG16 (1.25 mm^2) or larger.	p.45
Battery connector	Connect the optional battery **BAT01A** (sold separately) when using the absolute function of the driver in the position control mode.	p.48

7 Installation

This chapter explains the installation location of the driver, installation method, and how to install the regeneration resistor unit.
Also covered in this section are the installation and wiring methods that are in compliance with the relevant EMC Directive.

7.1 Location for installation

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

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

7.2 Installing the motor

■ Installation direction

The motor can be installed in any direction. There is an exception, however, in humid places, areas subject to mist and other environments where water accumulates easily. In such environments, the motor should be installed in the direction whereby the motor cable extends downward.

■ Installation method

To allow for prevent vibration, install the motor on a metal surface of sufficient strength. Install the motor in a location where heat dissipation capacity equivalent to a level achieved with a heat sink (made of aluminum) is ensured. Refer to the table below for the heak sink.

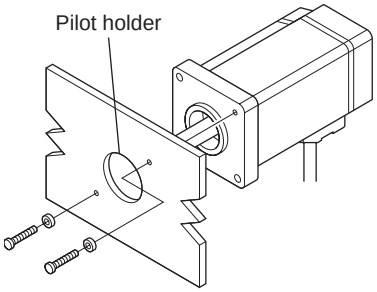
Motor model	Heat sink size [mm (in.)]
NXM45, NXM410, NXM620, NXM65-PS□, NXM610-PS□, NXM920-PS□, NXM810-J□, NXM820-J□	250×250×6 (9.84×9.84×0.24)
NXM640, NXM940-PS□, NXM1040-J□	300×300×10 (11.81×11.81×0.39)
NXM975, NXM1075-J□	350×350×10 (13.78×13.78×0.39)

∗ □ within the model name represents the gear ratio.

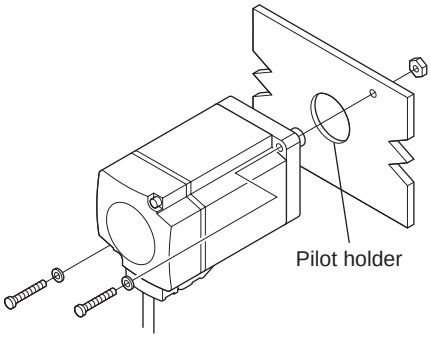
- Motor frame size: 42 mm (1.65 in.)

Secure at the two mounting holes according to the installation method appropriate for your specific method of use.

Installation method A



Installation method B

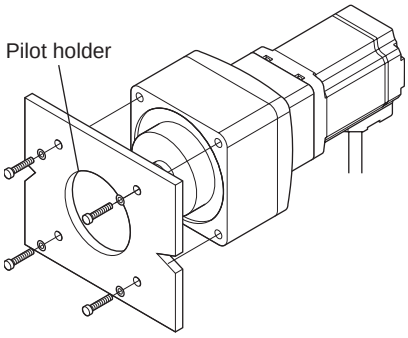


Motor type	Frame size [mm (in.)]	Bolt size	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]	Installation method
Standard	42 (1.65)	M3	1 (142)	6 (0.24)	A
				–	B

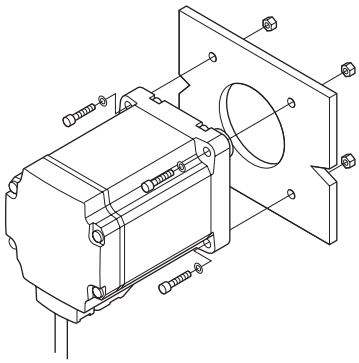
- Motor frame size: 60 to 104 mm (2.36 to 4.09 in.)

Secure at the four mounting holes according to the installation method appropriate for your specific method of use.

Installation method C



Installation method D



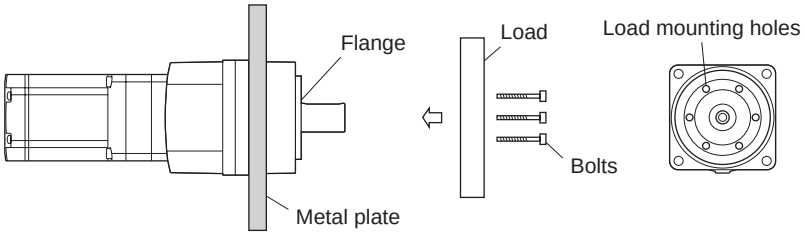
Motor type	Frame size [mm (in.)]	Bolt size	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]	Installation method
Standard	60 (2.36)	M4	2 (280)	–	D
	85 (3.35)	M6	3 (420)		
PS geared	60 (2.36)	M5	2.5 (350)	10 (0.39)	C
	90 (3.54)	M8	4 (560)	15 (0.59)	
PJ geared	80 (3.15)	M6	9 (1270)	–	D
	104 (4.09)	M8	15 (2100)		

7.3 Installing a load

When connecting a load to the motor, align the centers of the motor's output shaft and load shaft. Be careful not to damage the output shaft or the bearings (ball bearings) when installing a coupling or pulley to the motor's output shaft.

■ Installing on the flange surface

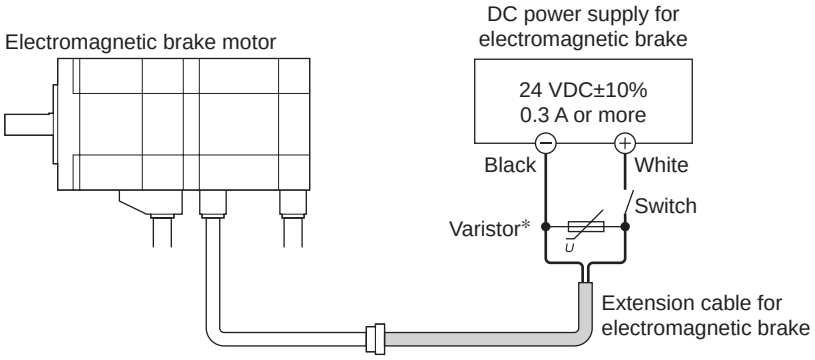
With a **PJ** geared type, a load can be installed directly to the gear using the load mounting holes provided on the flange surface.



Motor model	Bolt size	Number of bolts	Tightening torque [N·m (oz-in)]	Effective depth of bolt [mm (in.)]
NXM810 NXM820	M6	6	9 (1270)	12 (0.47)
NXM1040 NXM1075	M8	6	15 (2100)	15 (0.59)

■ Electromagnetic brake motor

To release the electromagnetic brake and install the load, a DC power supply is needed to power the electromagnetic brake. Use an extension cable for electromagnetic brake to connect a DC power supply of 24 VDC±10% to the motor.
Unit models come with an extension cable for electromagnetic brake.



∗ To protect the switch contacts and prevent noise, the customer is advised to provide a varistor [recommended varistor: Z15D121 (Ishizuka Electronics Corporation)].

7.4 Permissible overhung load and permissible thrust load

Type	Unit model*	Permissible overhung load [N (lb.)]								Permissible thrust load [N (lb.)]
		Distance from the tip of motors output shaft [mm (in.)]								
		0 (0)	5 (0.2)	10 (0.39)	15 (0.59)	20 (0.79)	25 (0.98)	30 (1.18)	35 (1.38)	
Standard	**NX45** **NX410**	81 (18.2)	88 (19.8)	95 (21)	104 (23)	–	–	–	–	59 (13.2)
	NX620 **NX640**	230 (51)	245 (55)	262 (58)	281 (63)	304 (68)	–	–	–	98 (22)
	NX975	376 (84)	392 (88)	408 (91)	426 (95)	446 (100)	467 (105)	491 (110)	–	147 (33)
PS geared	**NX6□-PS5**	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	–	–	–	100 (22)
	NX6□-PS10	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	–	–	–	
	NX6□-PS25	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	–	–	–	
	NX9□-PS5 **NX9□-PS10**	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)	–	–	–	300 (67)
	NX9□-PS25	850 (191)	940 (210)	1050 (230)	1190 (260)	1380 (310)	–	–	–	
PJ geared	**NX8□-J5**	300 (67)	330 (74)	350 (78)	380 (85)	400 (90)	430 (96)	460 (103)	500 (112)	300 (67)
	NX8□-J10	450 (101)	480 (108)	510 (114)	540 (121)	570 (128)	610 (137)	650 (146)	700 (157)	400 (90)
	NX8□-J25	680 (153)	710 (159)	750 (168)	780 (175)	840 (189)	900 (200)	950 (210)	1000 (220)	600 (135)
	NX10□-J5	650 (146)	700 (157)	730 (164)	750 (168)	800 (180)	830 (186)	880 (198)	920 (200)	500 (112)
	NX10□-J10	900 (200)	950 (210)	1000 (220)	1050 (230)	1100 (240)	1180 (260)	1230 (270)	1300 (290)	650 (146)
	NX10□-J25	1350 (300)	1400 (310)	1480 (330)	1550 (340)	1600 (360)	1650 (370)	1750 (390)	1850 (410)	1000 (220)

∗ □ within the model name represents the output.

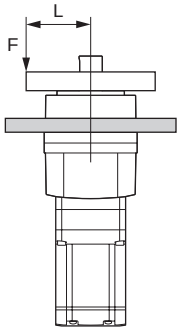
■ Permissible moment load of the PJ geared type

When installing an arm or table on the flange surface, calculate the moment load using the formula below if the flange surface receives any eccentric load. The moment load should not exceed the permissible value specified in the table.

Moment load: M [N·m (lb-in)] = F × L

Unit model	Permissible moment load [N·m (lb-in)]
NX8□-J5	16 (140)
NX8□-J10	33 (290)
NX8□-J25	60 (530)
NX10□-J5	30 (260)
NX10□-J10	66 (580)
NX10□-J25	120 (1060)

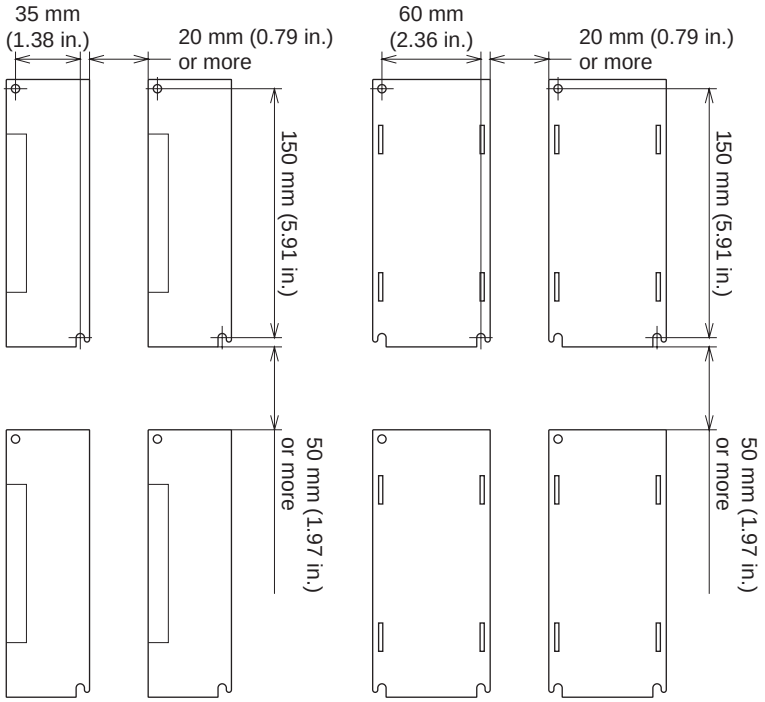
∗ □ within the model name represents the output.



7.5 Installing the driver

The driver is designed so that heat is dissipated via air convection and conduction through the enclosure. When two or more drivers are to be installed side by side, provide 20 mm (0.79 in.) and 50 mm (1.97 in.) clearances in the horizontal and vertical directions, respectively. When installing the driver in an enclosure, use two screws (three screws for NXD75-S) to secure the driver through the mounting holes.
Screws (M4) are not supplied. Please provide separately.

- NXD20-A, NXD20-C
- NXD75-S



Note

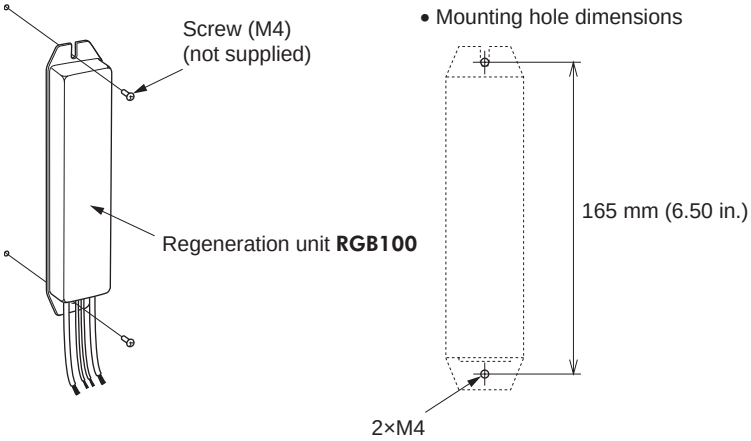
- Install the driver in an enclosure whose pollution degree is 2 or above or protection class is IP54 or better.
- Do not install any equipment that generates a large amount of heat or noise near the driver.
- Do not install the driver underneath the controller or other equipment vulnerable to heat.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

7.6 Installing the regeneration unit

Regeneration units (options: sold separately) vary based upon the model of the driver used.

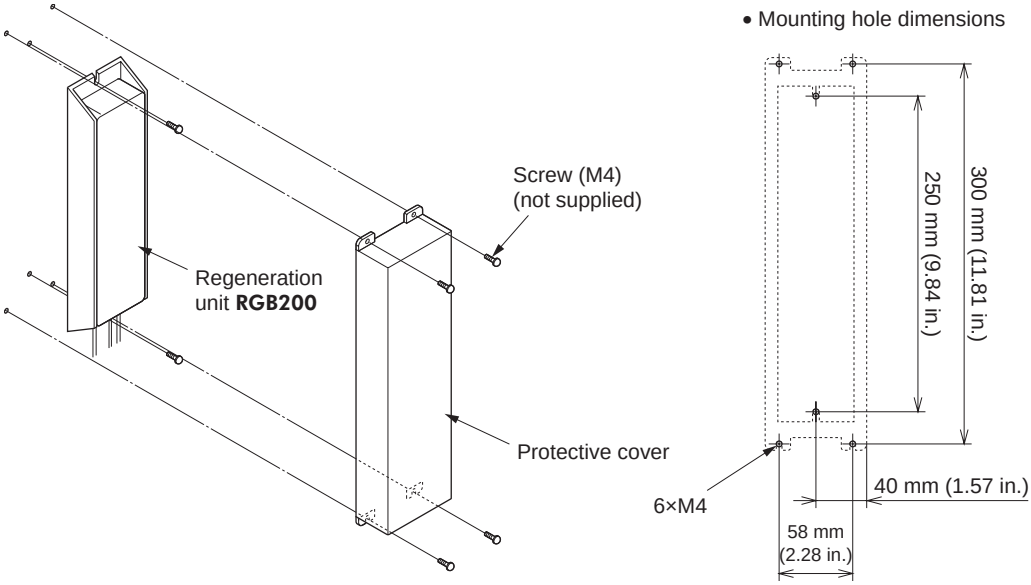
■ NXD20-A and NXD20-C

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



■ NXD75-S

Use a regeneration unit **RGB200**.
Install the **RGB200** in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 350 × 350 × 3 mm (13.78 × 13.78 × 0.12 in.)] is ensured. Secure the **RGB200** main unit on a smooth metal plate offering high heat conductivity, using two screws (M4, not supplied).
Then, put the protective cover on the **RGB200** main unit using 4 screws (M4, not supplied).



⚠ Caution Use the regeneration unit with the protective cover and do not touch during operation or immediately after stopping. The surface is hot and may cause skin burn(s).

7.7 Installing and wiring in compliance with EMC Directive

Effective measures must be taken against the EMI that the motor and driver may give to adjacent control-system equipment, as well as the EMS of the motor and driver itself, in order to prevent a serious functional impediment in the machinery. The use of the following installation and wiring methods will enable the driver to be compliant with the EMC directive.
EMI emitting noise changes according to the layout of the product or the wiring of the cables. If the noise generated by the cable causes a problem, insert ferrite cores in the cable.
Refer to "Standards and CE Marking" on p.10 for the applicable standards.

■ Connecting mains filter for power supply line

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

Driver model	Manufacturer	Single-phase 100-115 V	Single-phase 200-230 V	Three-phase 200-230 V
NXD20-A NXD20-C	TDK Corporation	ZRCS-2010-00S	−	−
	TDK-Lambda Corporation	−	MC1210	MC1310
NXD75-S	TDK-Lambda Corporation	−	−	RTHN-5010

- Install the mains filter as close to the driver as possible.
- Use cable clamps and other means to secure the input and output cables firmly to the surface of the enclosure.
- Connect the ground terminal of the mains filter to the grounding point, using as thick and short a wire as possible.
- Do not place the AC input cable (AWG16 to 14: 1.25 to 2.0 mm^2) parallel with the mains-filter output cable (AWG16 to 14: 1.25 to 2.0 mm^2). Parallel placement will reduce mains-filter effectiveness if the enclosure's internal noise is directly coupled to the power supply cable by means of stray capacitance.

■ Connecting a surge arrester

Use a surge arrester as below table.

Manufacturer	Single-phase 100-115 V, 200-230 V	Three-phase 200-230 V
OKAYA ELECTRIC INDUSTRIES CO., LTD.	R·C·M-601BQZ-4	R·C·M-601BUZ-4

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

■ Connecting the 24 VDC power supply

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

■ How to ground

The cable used to ground the driver, motor and mains 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.

How to ground the driver

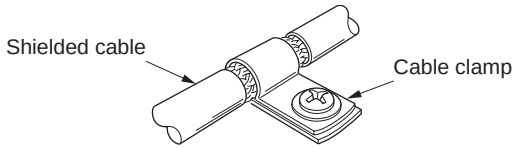
Refer to p.45 for how to ground the driver.

How to ground the motor

Connect the protective earth lead of the cable for motor, to the protective earth terminal on the driver.

■ Wiring the power supply cable and signal cable

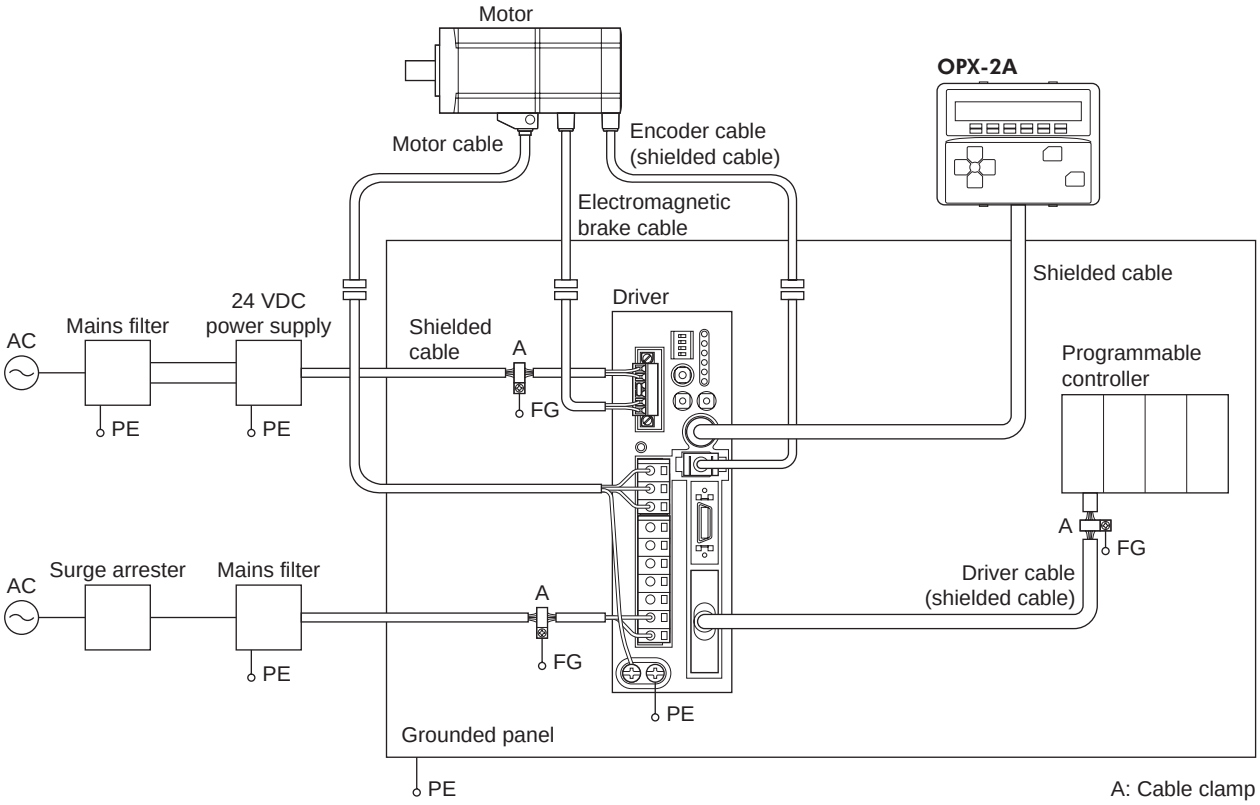
Use a shielded cable of AWG16 to 14 (1.25 to 2.0 mm^2) or larger for the main power supply, and wire the power supply cable over the shortest possible distance.
Use a shielded cable of AWG28 to 16 (0.08 to 1.25 mm^2) for the 24 VDC power supply, and wire the power supply cable over the shortest possible distance.
Use a shielded cable of AWG28 (0.08 mm^2) or more for the I/O signals, and wire the signal cable over the shortest possible distance. An optional driver cable (sold separately) is available. Refer to p.138.
To ground a shielded cable, use a metal clamp or similar device that will maintain contact with the entire circumference of the shielded cable. Attach a cable clamp as close to the end of the cable as possible, and connect it as shown in the figure.



■ Notes about installation and wiring

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

■ Example of 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 electrostatic charge is impressed on the driver, the driver may be damaged.

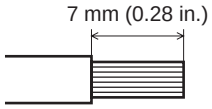
8 Connection

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

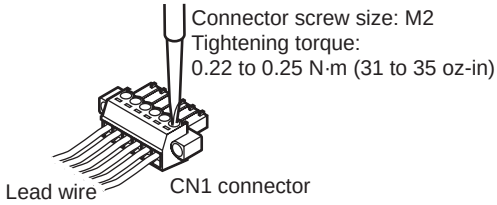
8.1 Connection method for connectors

■ Wiring the CN1 connector

1. Strip the insulation cover of the lead wire by 7 mm (0.28 in.)



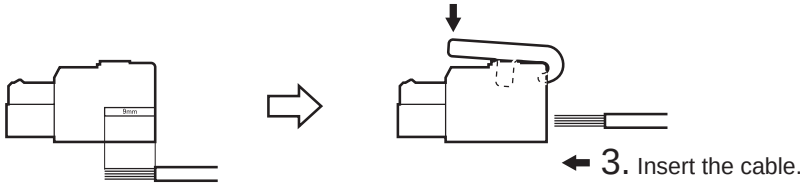
2. Insert each lead wire into the CN1 connector and tighten the screw using a screwdriver.



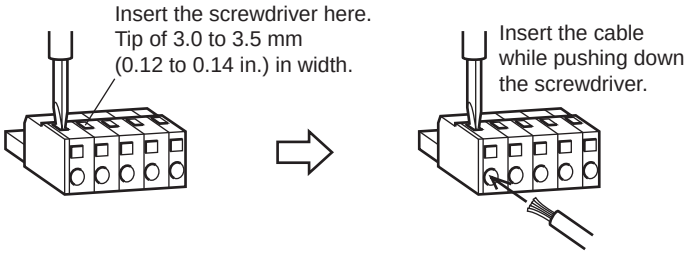
■ Wiring the CN2/CN3 connectors

1. Strip off the cable sheath based on the strip gauge.

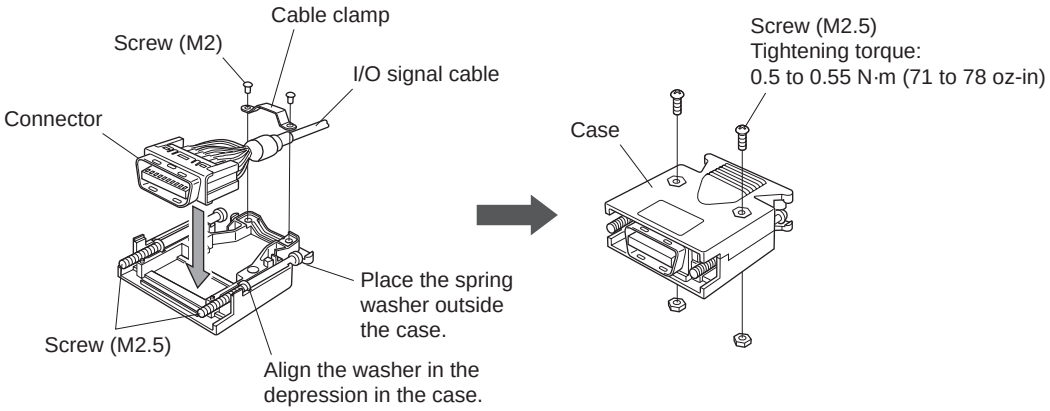
2. Push the connector wiring lever in the direction of the arrow.



You can also use a flat-tip screwdriver.



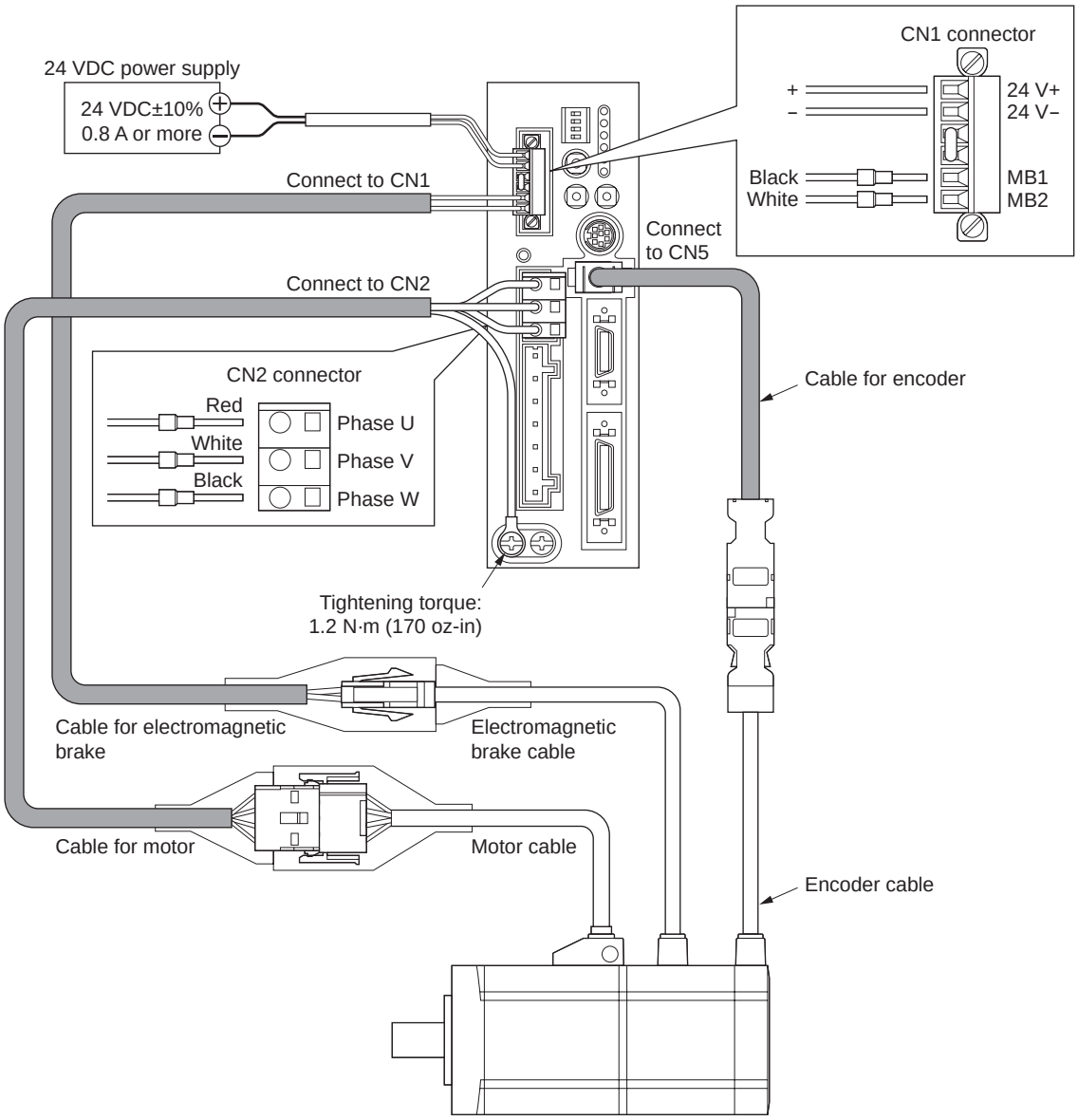
■ Wiring the CN6/CN7 connectors



8.2 Connecting the motor

■ Example: electromagnetic brake motor

Refer to p.45 for the connection method of 24 VDC power supply.

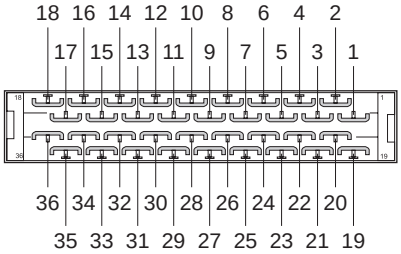


Note

- The lead wires of the cable for electromagnetic brake have polarities, so connect them in the correct polarity. If the lead wires are connected with their polarities reversed, the electromagnetic brake will not operate properly.
- Have the connector plugged in securely. Insecure connector connection may cause malfunction or damage to the motor or driver.
- When plugging/unplugging the connector of the motor cable, turn off the power and wait for the CHARGE LED to turn off. The residual voltage may cause electric shock.
- When installing the motor to a moving part, use an optional flexible cable offering excellent flexibility. For the flexible cable, refer to “18 Options (sold separately)” on p.138.

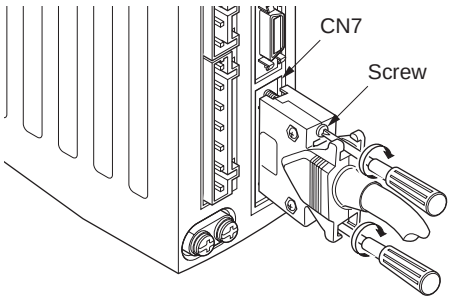
8.3 Connecting the I/O signals

Solder the I/O signal cable (AWG28 to 26: 0.08 to 0.14 mm^2) to the CN7 connector (36 pins) by checking the pin numbers in “Connector function tables” provided on p.33 and pages that follow. Use a shielded cable for I/O signals.
Refer to p.30 for wiring the connectors.
We provide an optional driver cable allowing easy connection with a driver, as well as a connector-terminal block conversion unit. Refer to p.138 for details.



■ Connecting the connector (CN7)

Tightening torque: 0.3 to 0.35 N·m (42 to 49 oz-in)



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

■ Connector function table – Position control mode

Pin No.	Signal name	Name
1	−	−
2	GND	Ground connection
3	ASG+	A-phase pulse line-driver output
4	ASG−	
5	BSG+	B-phase pulse line-driver output
6	BSG−	
7	ZSG1+	Z-phase pulse line-driver output
8	ZSG1−	
9	ALM+	Alarm output
10	ALM−	
11	WNG+/MOVE+*/MBC+*	Warning output/ Motor moving output */ Electromagnetic brake control signal output *
12	WNG−/MOVE−*/MBC−*	
13	END+	Positioning complete output
14	END−	
15	READY+/AL0+*/P-OUTR+	Operation ready complete output/Alarm code output bit 0*/Position data output ready output
16	READY−/AL0−*/P-OUTR−	
17	TLC+/AL1+*/P-OUT0+	Torque limit output /Alarm code output bit 1*/ Position data output bit 0
18	TLC−/AL1−*/P-OUT0−	
19	ZSG2+/NEAR+*/AL2+*/P-OUT1+	Z-phase pulse open-collector output/Near position output */Alarm code output bit 2*/Position data output bit 1
20	ZSG2−/NEAR−*/AL2−*/P-OUT1−	
21	GND	Ground connection
22	IN-COM	Input common
23	S-ON	Servo on input
24	CLR/ALM-RST/P-CK	Deviation clear input/Alarm reset input/ Position data transmission clock input
25	P-REQ	Position data request input
26	TL	Torque limit enable input
27	M0	Data selection input
28	M1	
29	P-PRESET	Position preset input
30	FREE	Shaft free input
31	CW+/PLS+	CW pulse input/Pulse input
32	CW−/PLS−	
33	CW+24 V/PLS+24 V	CW pulse/pulse input for 24 V
34	CCW+24 V/DIR+24 V	CCW pulse input/direction input for 24 V
35	CCW+/DIR+	CCW pulse input/Direction input
36	CCW−/DIR−	

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

■ Connector function table – Speed control mode

Pin No.	Signal name	Name
1	–	–
2	GND	Ground connection
3	ASG+	A-phase pulse line-driver output
4	ASG−	
5	BSG+	B-phase pulse line-driver output
6	BSG−	
7	ZSG1+	Z-phase pulse line-driver output
8	ZSG1−	
9	ALM+	Alarm output
10	ALM−	
11	WNG+/MOVE+*/MBC+*	Warning output/ Motor moving output */ Electromagnetic brake control signal output *
12	WNG−/MOVE−*/MBC−*	
13	VA+	Speed attainment output
14	VA−	
15	READY+/AL0+*	Operation ready complete output/Alarm code output bit 0*
16	READY−/AL0−*	
17	TLC+/AL1+*	Torque limit output /Alarm code output bit 1*
18	TLC−/AL1−*	
19	ZSG2+/ZV+*/AL2+*	Z-phase pulse open-collector output/ Motor zero speed output */ Alarm code output bit 2*
20	ZSG2−/ZV−*/AL2−*	
21	GND	Ground connection
22	IN-COM	Input common
23	S-ON	Servo on input
24	ALM-RST	Alarm reset input
25	BRAKE	Instantaneous stop input
26	TL	Torque limit enable input
27	M0	Data selection input
28	M1	
29	M2	
30	FREE	Shaft free input
31	CW+	CW input
32	CW−	
33	CW+24 V	CW input for 24 V
34	CCW+24 V	CCW input for 24 V
35	CCW+	CCW input
36	CCW−	

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

■ Connector function table – Torque control mode

Pin No.	Signal name	Name
1	−	−
2	GND	Ground connection
3	ASG+	A-phase pulse line-driver output
4	ASG−	
5	BSG+	B-phase pulse line-driver output
6	BSG−	
7	ZSG1+	Z-phase pulse line-driver output
8	ZSG1−	
9	ALM+	Alarm output
10	ALM−	
11	WNG+/MOVE+*/MBC+*	Warning output/ Motor moving output */ Electromagnetic brake control signal output *
12	WNG−/MOVE−*/MBC−*	
13	−	−
14	−	−
15	READY+/AL0+*	Operation ready complete output/Alarm code output bit 0*
16	READY−/AL0−*	
17	VLC+/AL1+*	Speed limit output/Alarm code output bit 1*
18	VLC−/AL1−*	
19	ZSG2+/ZV+*/AL2+*	Z-phase pulse open-collector output/ Motor zero speed output */ Alarm code output bit 2*
20	ZSG2−/ZV−*/AL2−*	
21	GND	Ground connection
22	IN-COM	Input common
23	−	−
24	ALM-RST	Alarm reset input
25	−	−
26	−	−
27	M0	Data selection input
28	M1	
29	M2	
30	FREE	Shaft free input
31	CW+	CW input
32	CW−	
33	CW+24 V	CW input for 24 V
34	CCW+24 V	CCW input for 24 V
35	CCW+	CCW input
36	CCW−	

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

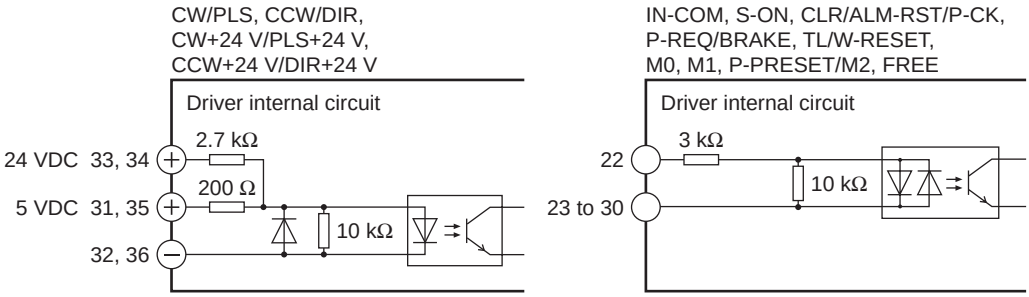
■ Connector function table – Tension control mode

Pin No.	Signal name	Name
1	−	−
2	GND	Ground connection
3	ASG+	A-phase pulse line-driver output
4	ASG−	
5	BSG+	B-phase pulse line-driver output
6	BSG−	
7	ZSG1+	Z-phase pulse line-driver output
8	ZSG1−	
9	ALM+	Alarm output
10	ALM−	
11	WNG+/MOVE+*/MBC+*	Warning output/ Motor moving output */ Electromagnetic brake control signal output *
12	WNG−/MOVE−*/MBC−*	
13	−	−
14	−	−
15	READY+/AL0+*	Operation ready complete output/Alarm code output bit 0*
16	READY−/AL0−*	
17	VLC+/AL1+*	Speed limit output/Alarm code output bit 1*
18	VLC−/AL1−*	
19	ZSG2+/ZV+*/AL2+*	Z-phase pulse open-collector output/ Motor zero speed output */ Alarm code output bit 2*
20	ZSG2−/ZV−*/AL2−*	
21	GND	Ground connection
22	IN-COM	Input common
23	−	−
24	ALM-RST	Alarm reset input
25	−	−
26	W-RESET	Roll diameter reset input
27	M0	Data selection input
28	M1	
29	M2	
30	FREE	Shaft free input
31	CW+	CW input
32	CW−	
33	CW+24 V	CW input for 24 V
34	CCW+24 V	CCW input for 24 V
35	CCW+	CCW input
36	CCW−	

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

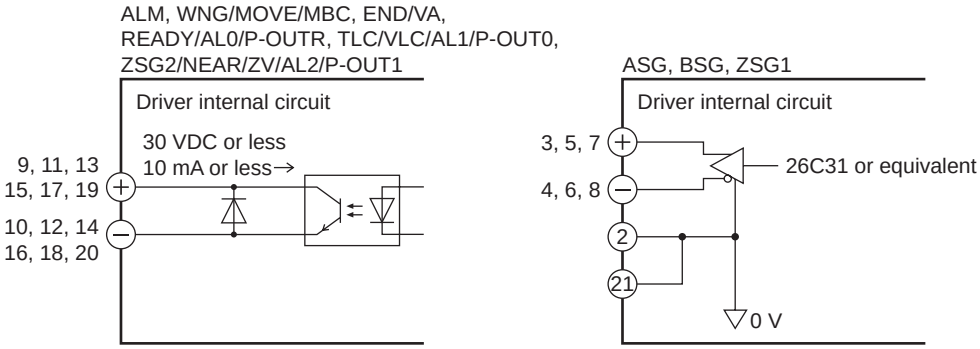
■ Internal input circuit

All 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.

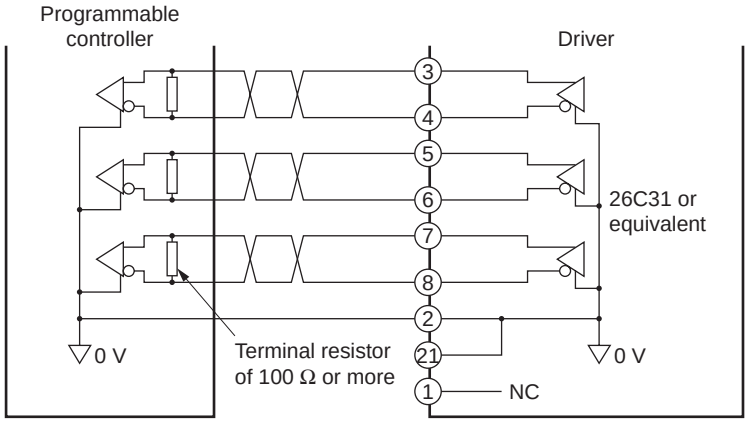


■ Internal output circuit

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

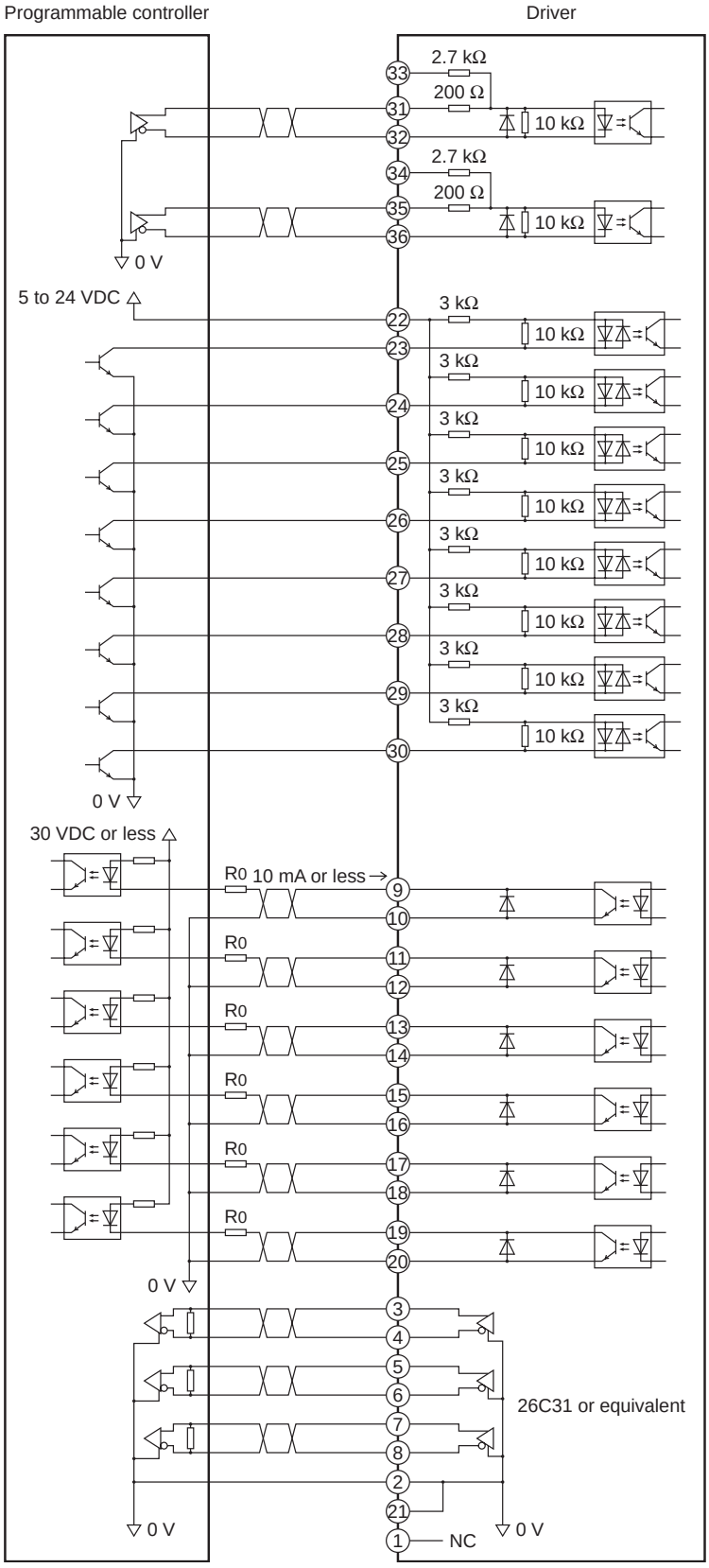


Note The ASG output, BSG output and ZSG1 output are line driver outputs. When connecting a line driver output, receive it with a line receiver. Also, be sure to connect pin 2 or 21 on the driver to the GND on the line receiver, and connect a terminal resistor of 100 Ω or more between the driver and the input of the line receiver.



■ Connecting to a current sink output circuit

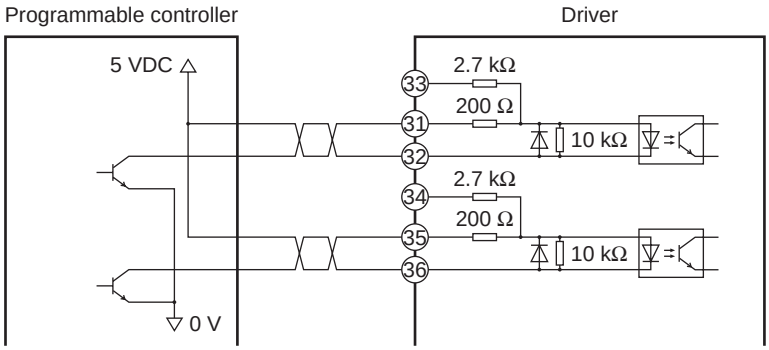
- When pulse input is of line driver type



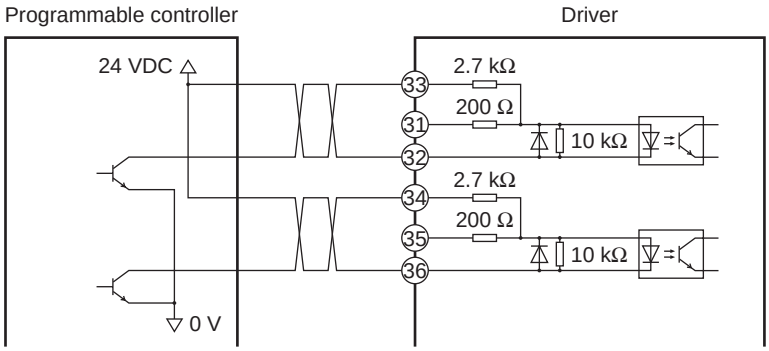
Note

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

- When the input voltage is 5 V

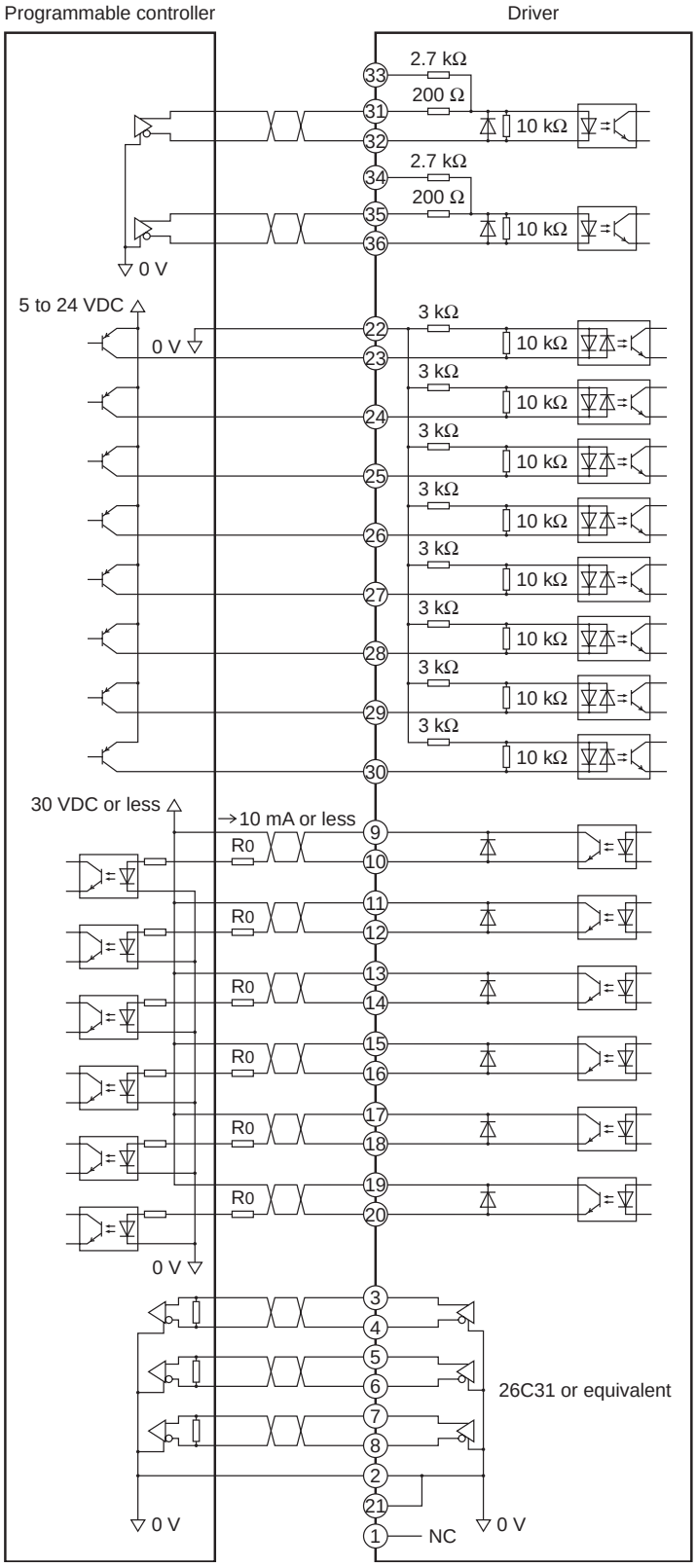


- When the input voltage is 24 V



■ Connecting to a current source output circuit

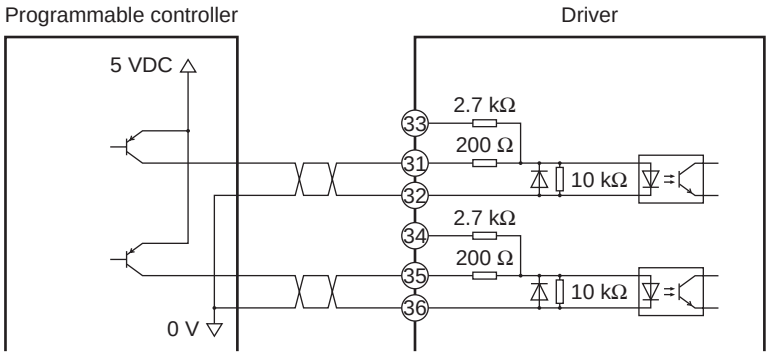
- When pulse input is of line driver type



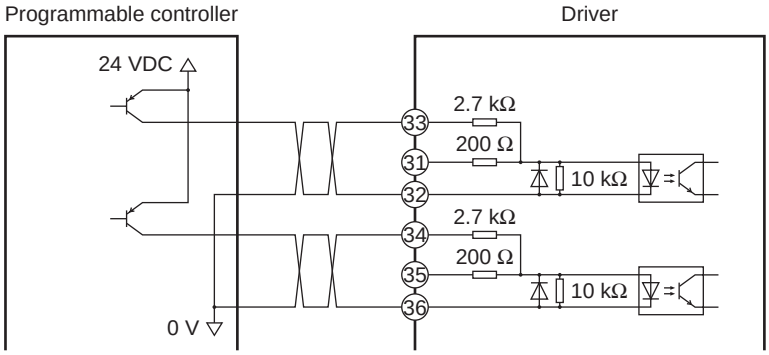
Note

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

- When the input voltage is 5 V

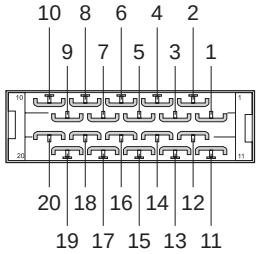


- When the input voltage is 24 V



8.4 Connecting the analog I/O signals

Use the connector (20 pins) included in the optional accessory set **AS-SV2** or **AS-SD1** (sold separately) as the analog I/O connector (CN6).
Solder the analog I/O cable (AWG28 to 26: 0.08 to 0.14 mm^2) to the CN6 connector by checking the pin numbers in "Connector function table" provided below. Use a shielded cable for analog I/O signals.
Refer to p.30 for wiring the connectors.
An optional connector-terminal block conversion unit (sold separately) is available for easy connection with the driver. Refer to p.138 for details.

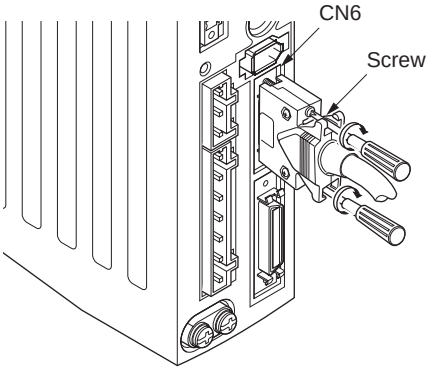


■ Connector function table

Pin No.	I/O	Signal name	Name	Description
1	Input	V-REF	Analog speed (command / limit) input	Terminal used to input an analog speed (command/limit).
2	GND	SG	Signal ground	Ground for analog I/Os.
3	Output	P-VREF	Reference voltage output for analog speed (command/limit) input	A power supply output used to connect a variable resistor to the analog speed (command/limit) input.
4	Output	P-TREF	Reference voltage output for analog torque (command/limit) input	Power supply output used to connect a variable resistor to the analog torque (command/limit) input.
5	Input	T-REF	Analog torque (command / limit) input	Terminal used to input an analog torque (command/limit).
6	GND	SG	Signal ground	Ground for analog I/Os.
7	Output	V-MON	Analog speed monitor output	Voltage corresponding to the monitored analog speed is output from here.
8	GND	SG	Signal ground	Ground for analog I/Os.
9	Output	T-MON	Analog torque monitor output	Voltage corresponding to the monitored analog torque is output from here.
10	GND	SG	Signal ground	Ground for analog I/Os.
11	–	–	–	–
12	–	–	–	–
13	–	–	–	–
14	–	–	–	–
15	–	–	–	–
16	–	–	–	–
17	–	–	–	–
18	–	–	–	–
19	–	–	–	–
20	–	–	–	–

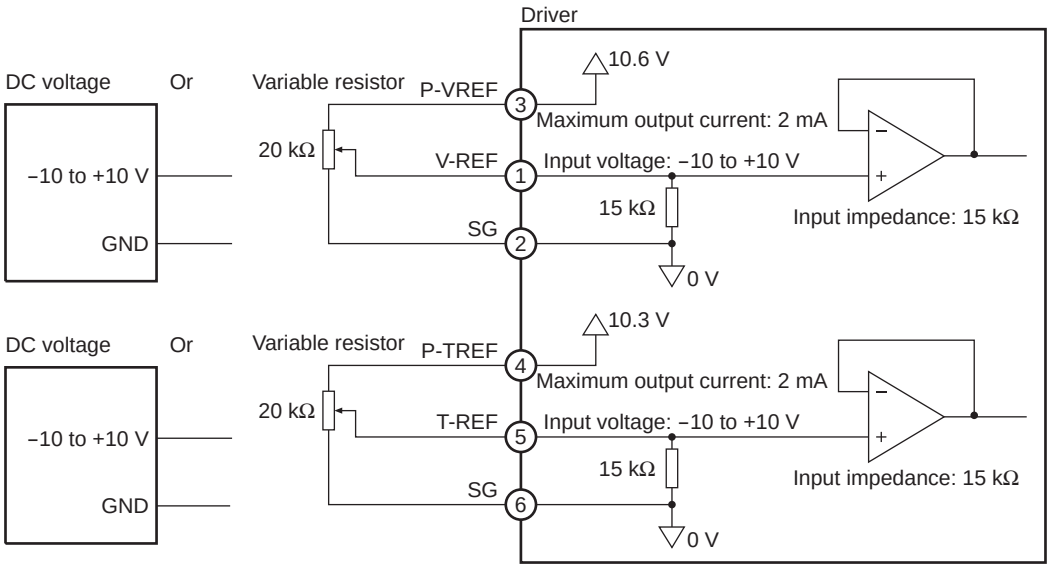
■ Connecting the connector

Tightening torque: 0.3 to 0.35 N·m (42 to 49 oz-in)

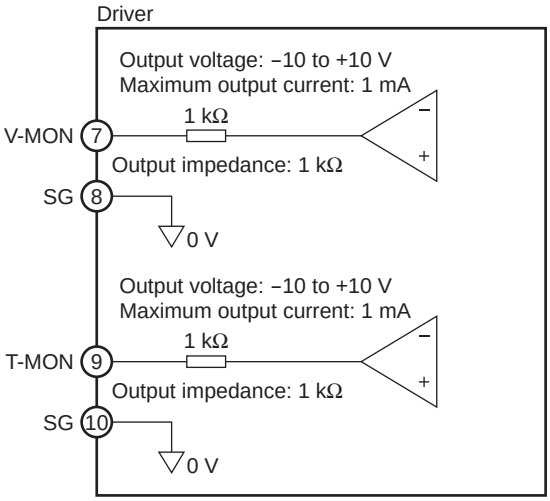


■ Connection example

- Input circuit



- Output circuit



Note The output impedance is 1 kΩ. Check the input impedance of the measuring instrument or external circuit to be connected.

8.5 Connecting the power supply

Use the CN3 connector (7 pins) to connect the power supply cable (AWG16 to 14: 1.25 to 2.0 mm^2) to the main power supply connector (CN3) on the driver. Refer to p.30 for details on the connector wiring method. Use a power supply capable of supplying the current capacity as below table.

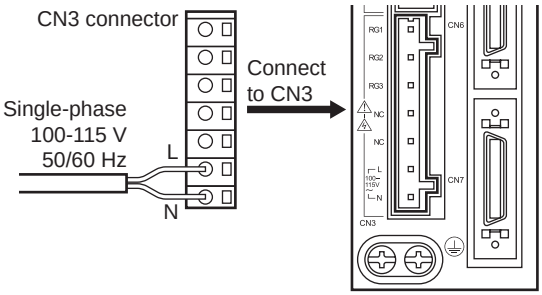
Note

- 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.
- Before plugging/unplugging the CN3 connector, turn off the power and wait for the CHARGE LED to turn off. Failure to do so may cause electric shock due to residual voltage.
- The current capacity for the power supply as shown below is the value when operating the motor in the continuous duty region. When operating in the limited duty region, the current will flow maximum three times as much as the continuous region. Refer to p.159 for the continuous duty region and limited duty region.

■ Single-phase 100-115 V

Connect the live side of the power cable to the L terminal and the neutral side to the N terminal.
Use a power supply capable of supplying the current capacity as shown below.

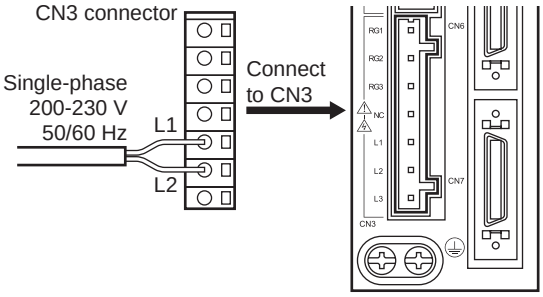
Unit model	Current capacity
NX45	1.9 A or more
NX410	2.9 A or more
NX65	1.9 A or more
NX610	2.9 A or more
NX620	4.6 A or more
NX810	2.8 A or more
NX820 **NX920**	4.6 A or more



■ Single -phase 200-230 V

Connect the live side of the power cable to the L1 terminal and the neutral side to the L2 terminal.
Use a power supply capable of supplying the current capacity as shown below.

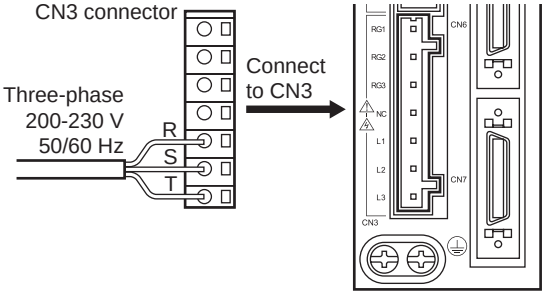
Unit model	Current capacity
NX45	1.2 A or more
NX410	1.8 A or more
NX65	1.2 A or more
NX610	1.8 A or more
NX620	2.8 A or more
NX810	1.8 A or more
NX820 **NX920**	2.8 A or more



■ Three-phase 200-230 V

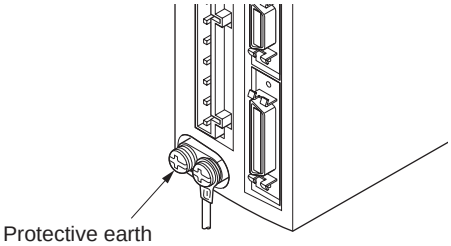
Connect the R, S and T phase lines of the power cable to the L1, L2 and L3 terminals, respectively.
Use a power supply capable of supplying the current capacity as shown below.

Unit model	Current capacity
NX45	0.7 A or more
NX410	1.0 A or more
NX65	0.7 A or more
NX610	1.0 A or more
NX620	1.6 A or more
NX640	2.8 A or more
NX810	1.0 A or more
NX820 **NX920**	1.6 A or more
NX940	2.8 A or more
NX975	4.7 A or more
NX1040	2.9 A or more
NX1075	4.7 A or more



8.6 Grounding the driver

Be sure to ground the protective earth terminal (screw size: M4) of the driver.
Tightening torque: 1.2 N·m (170 oz-in)
You can ground either of the two protective earth terminals. The terminal not grounded should be connected to the protective earth lead of the motor cable.
Use a grounding wire (AWG16 to 14: 1.25 to 2.0 mm^2), and do not share the protective earth terminal with a welder or any other power equipment.
When grounding the protective earth terminal, use a round terminal and affix the grounding point near the driver.



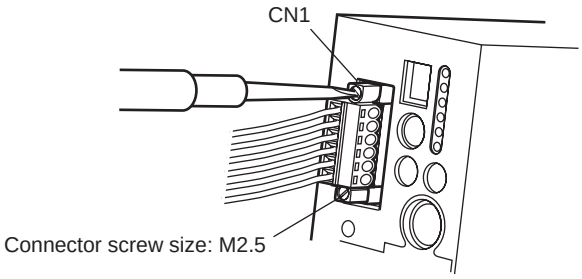
8.7 Connecting the 24 VDC power supply input, regeneration resistor and electromagnetic brake

Use the CN1 connector (6 pins) to connect the 24 VDC power supply input, regeneration resistor thermal input and electromagnetic brake. Connect the lead wire (AWG28 to 16: 0.08 to 1.25 mm^2).

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

■ Connecting method

Tightening torque: 0.4 N·m (56 oz-in)



■ Connecting the 24 VDC power supply input

Connect a power supply of 24±10% VDC, 0.8 A or more.
Once a 24 VDC power supply is connected, you can check the contents of alarms that have generated even when the main power is cut off. If a motor with electromagnetic brake is used, be sure to connect a 24 VDC power supply as the electromagnetic brake power.
The 24 VDC power supply will not be used to drive the motor. Connect a 24 VDC power supply as necessary.

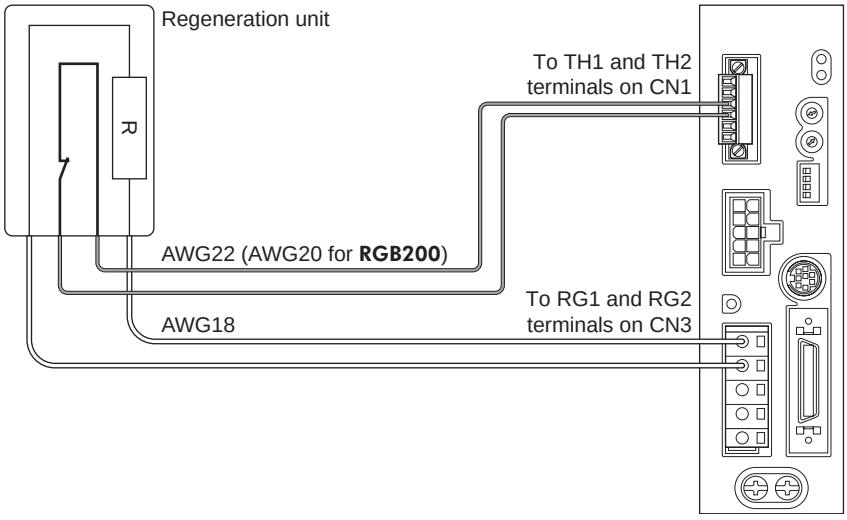
■ Connecting the regeneration unit

- When the internal regeneration resistor is used

  The driver has an internal regeneration resistor. The driver is shipped with the TH1 and TH2 terminals of CN1, and RG2 and RG3 terminals of CN3, shorted respectively to enable the internal regeneration resistor. The internal regeneration resistor does not support continuous regenerative operation, gravitational operation or other operations involving up/down movements, or frequent repeating of sudden starting/stopping of a large inertial load. If any of these operations must be performed, use the optional regeneration unit (sold separately).

- When the optional regeneration unit (sold separately) is used

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



- The two thin lead wires [AWG22 (0.3 mm^2) for **RGB100**, AWG20 (0.5 mm^2) for **RGB200**] of the regeneration unit are thermostat outputs. Connect them to the TH1 and TH2 terminals using the CN1 connector.
- Regenerative current flows through the two thick lead wires (AWG18: 0.75 mm^2) of the regeneration unit. Remove from the CN3 connector the jumper wire which has shorted the RG2 and RG3 terminals, and connect the lead wires to the RG1 and RG3 terminals.

Note

- When connecting the optional regeneration unit (sold separatery), be sure to remove the jumper wires from the CN1 connector and CN3 connector.
- If the current consumption of the regeneration unit exceeds the allowable level, the thermostat will be triggered and a regeneration unit overheat alarm will generate. If a regeneration unit overheat alarm generates, turn off the power and check the content of the error.

■ Regeneration unit specifications

Driver model		NXD20-A, NXD20-C		NXD75-S	
Regeneration unit type		Internal regeneration resistor	**RGB100***	Internal regeneration resistor	**RGB200***
Allowable current consumption	Continuous regenerative power	–	50 W	–	200 W
	Instantaneous regenerative power	600 W	600 W	2250 W	2250 W
Resistance		150 Ω	150 Ω	50 Ω	50 Ω
Operating temperature of thermostat		Operation: 95±5 °C (203±41 °F)	Operation: Opens at 150±7 °C (302±45 °F) Reset: Closes at 145±12 °C (293±54 °F) (normally closed)	Operation: 75±5 °C (167±41 °F)	Operation: Opens at 175±5 °C (347±41 °F) Reset: Closes at 115±15 °C (239±59 °F) (normally closed)
Electrical rating of thermostat		–	120 VAC 4A, 30 VDC 4 A (minimum current: 5 mA)	–	227 VAC 8 A 115 VAC 22 A

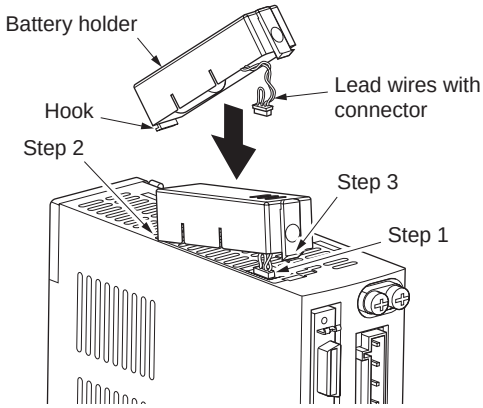
* Install the regeneration unit in a location where heat dissipation capacity equivalent to a level achieved with a heat sink [made of aluminum, 350 × 350 × 3 mm (13.78 × 13.78 × 0.12 in.)] is ensured.

■ Connecting the electromagnetic brake

Refer to “8.2 Connecting the motor” on p.31.

8.8 Connecting the battery

1. Hold the driver with its bottom facing up and plug the connector attached at the end of the battery lead wires into the battery connector.
2. Hook the tabs on the battery connector onto the mating parts on the driver.
3. Push in the battery holder carefully by ensuring that the lead wires are not pinched.



Note

- Installing or removing the battery must be performed by qualified personnel with expert knowledge of the handling of the driver and battery.
- Remove the battery if the driver is not turned on for an extended period exceeding the data retention period. Failure to do so may cause the battery fluid to leak or battery performance to drop.
- When installing or removing the battery, cut off the main power supply and 24 VDC power supply of the driver.
- Once the battery is disconnected, the absolute motor position stored in the driver will be lost. After the battery has been installed, be sure to set the absolute motor position again.

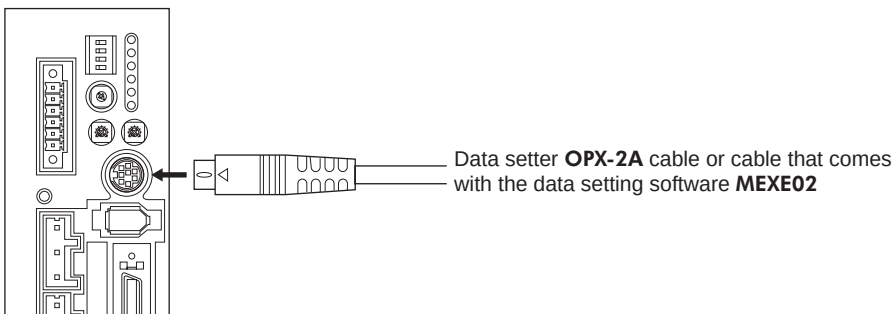
■ Specifications

Battery type	Lithium thionyl chloride batteries
Nominal voltage (V)	3.6
Rated capacity (mAh)	1700
Weight [kg (oz.)]	0.025 (0.882)
Life	Approx. 4 years*
Data retention period	2 years*
Ambient temperature	0 to +50 °C (+32 to +122 °F) (non-freezing)
Ambient humidity	85% or below (non-condensing)
Storage/Transporting temperature	+5 to +35 °C (+41 to +95 °F) (non-freezing)
Storage/Transporting humidity	70% or below (non-condensing)

* At an ambient temperature of 20 °C (68 °F)

8.9 Connecting the data setter

Connect the cable of the data setter **OPX-2A** or cable supplied with the data setting software **MEXE02**, to CN4 on the driver.



⚠ Caution

The driver's data edit connector (CN4) and analog I/O signals connector (CN6) are not insulated. When grounding the positive terminal of the power supply, do not connect any equipment (PC, etc.) whose negative terminal is grounded. Doing so may cause the driver and these equipment to short, damaging both.

9 Functions and operations in the position control mode

The following functions are available in the position control mode:

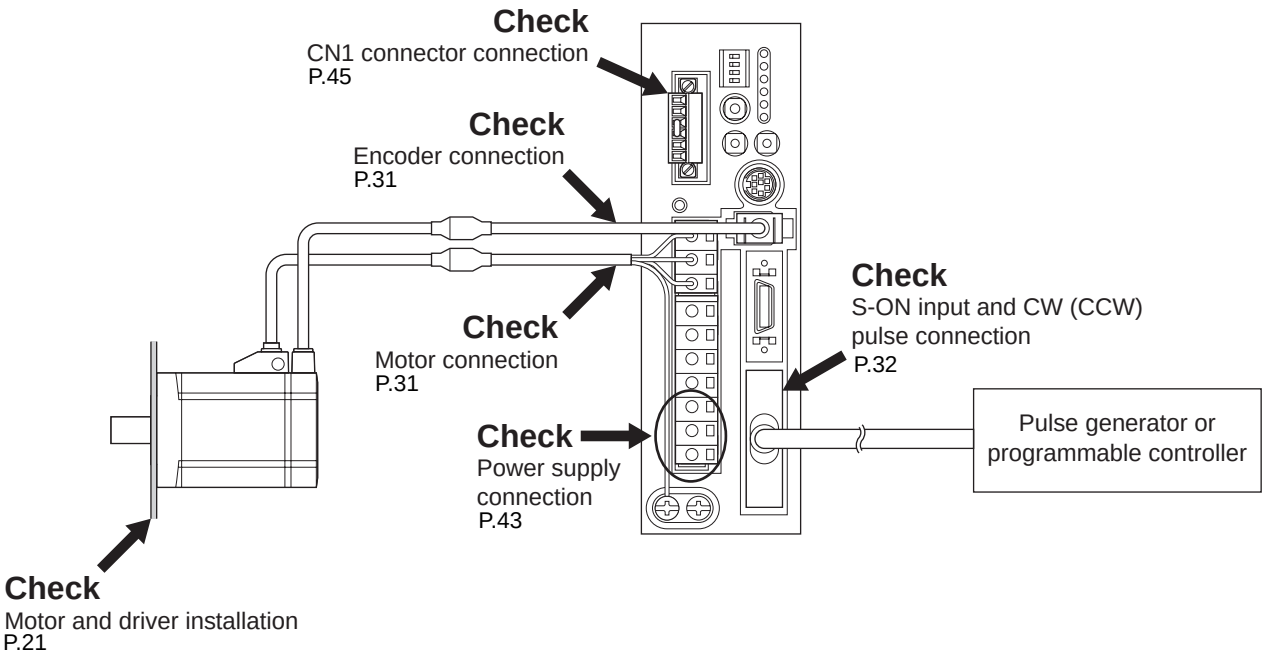
- Positioning operation based on pulse input
  Positioning operation is performed based on input pulses.
- Torque limit ..... The maximum output torque of the motor is limited.
- Absolute system ..... When a battery is connected, the absolute function of the driver can be used.
- Current position output..... The current position data recognized by the driver is output.
- Tuning ..... Operations are performed via automatic tuning. Gain adjustment is also possible according to the load inertia or mechanical rigidity.
- Damping control..... Residual vibration can be suppressed during positioning, in order to shorten the positioning time.

9.1 Quick operations

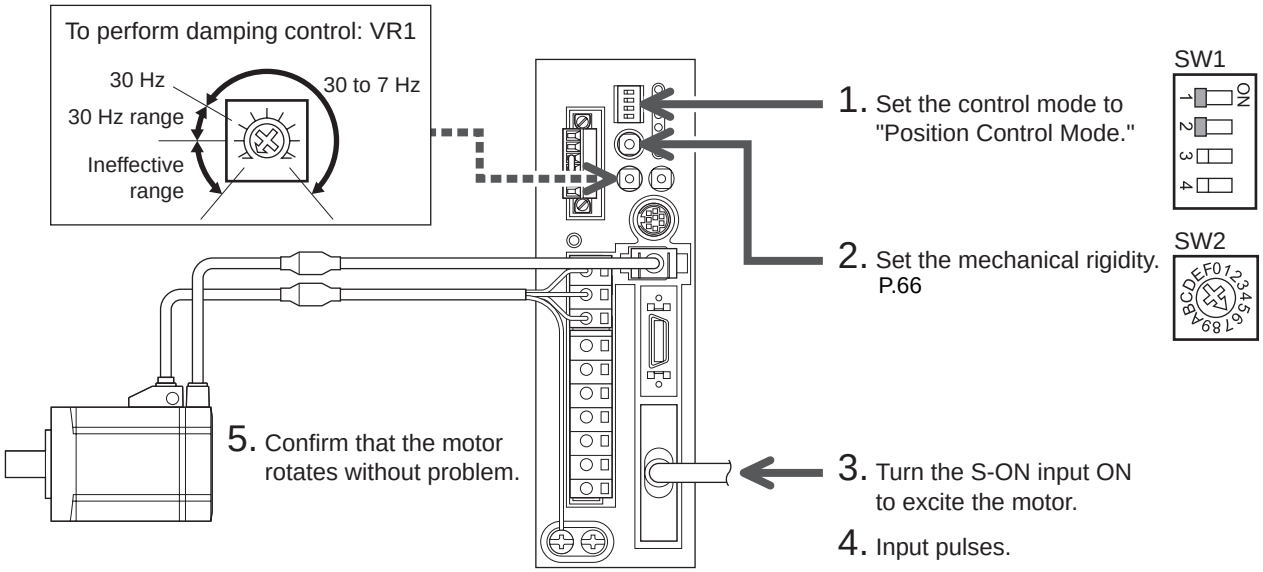
If you are new to the **NX** series driver, read this chapter and you will be able to perform basic motor operations.

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

STEP 1 Check the installation and connection



STEP 2 Operate the motor



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

STEP 3 Were you able to operate the motor properly?

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

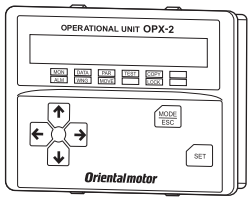
- Is the S-ON input ON?
- Are the thermal terminals for regeneration resistor (TH1 and TH2) on the CN1 (shorted)?
- Is any alarm present?
- Are the power supply and motor connected securely?
- Is the POS LED (green) lit?

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

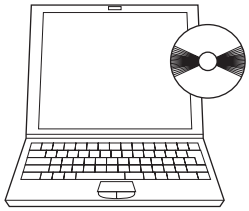
9.2 List of setting items

The items that can be set in the position control mode are listed below.
You can use the data setter **OPX-2A** or the data setting software **MEXE02** to set operation data or change the internal parameters of the driver.
Parameter codes displayed on the **OPX-2A** screen are shown in brackets. These codes are also referenced in the main text herein. Use these codes as keywords.

OPX-2A



MEXE02



For the method to set parameters with the **OPX-2A** or **MEXE02**, refer to the operating manual for each option.

■ Operation data

Item	Description	**OPX-2A** screen display	Reference
Torque limit	Sets the torque limit value.	trq	p.59
Damping frequency	Sets the damping control frequency.	vib	p.69

■ Application parameters

Item	Description	**OPX-2A** screen display	Reference
Gain tuning mode selection	Selects the gain tuning mode.	[APP-0-00]	p.66
Load inertial moment ratio	Sets the ratio of load inertial moment and motor inertial moment	[APP-0-01]	
Mechanical rigidity setting	Selects the rigidity applicable to automatic, semi-auto or manual tuning.	[APP-0-02]	
Position loop gain	Sets the position loop gain. When this value is increased, the response will increase.	[APP-0-03]	
Speed loop gain	Sets the speed loop gain. When this value is increased, the response will increase.	[APP-0-04]	
Speed loop integral time constant	Sets the speed loop integral time constant. When this value is decreased, the response will increase.	[APP-0-05]	
Speed feed-forward rate	Sets the speed feed-forward rate. This parameter can be used to shorten the positioning time.	[APP-0-06]	
S-ON signal logic	Changes the S-ON input logic.	[APP-1-00]	p.56
Output signal selection 1	Selects the output signal.	[APP-1-02]	–
Output signal selection 2	Selects the output signal.	[APP-1-03]	
Positioning complete output band	Sets the output condition for END output.	[APP-1-04]	p.57
Positioning near output band	Sets the output condition for NEAR output.	[APP-1-05]	p.57
Minimum ON time for MOVE signal	Sets the minimum ON time for MOVE output.	[APP-1-08]	p.57
Preset value	Sets the preset position.	[APP-1-09]	p.58
Alarm code output	Changes the setting to enable/disable alarm code output.	[APP-1-10]	p.126
Analog torque limit gain	Sets the torque limit per 1 V of analog input voltage.	[APP-2-03]	p.60
Analog torque limit offset voltage	Sets the offset voltage for analog torque limit input.	[APP-2-05]	
Analog input signal automatic offset	Changes the setting to enable/disable automatic offset for analog input signals.	[APP-2-06]	
Analog speed monitor maximum value	Sets the maximum value of monitored analog speed. This setting determines the slope of output of monitored analog speed.	[APP-2-07]	p.124
Analog speed monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog speed.	[APP-2-08]	
Analog speed monitor offset voltage	Sets the offset voltage for monitored analog speed.	[APP-2-09]	

Item	Description	**OPX-2A** screen display	Reference
Analog torque monitor maximum value	Sets the maximum value of monitored analog torque. This setting determines the slope of output of monitored analog torque.	[APP-2-10]	p.125
Analog torque monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog torque.	[APP-2-11]	
Analog torque monitor offset voltage	Sets the offset voltage for monitored analog torque.	[APP-2-12]	
Mechanical rigidity setting switch	Changes the setting to enable/disable the mechanical rigidity setting switch (SW2) on the driver.	[APP-4-00]	p.66
Command filter	Sets the time constant for command filter.	[APP-4-01]	p.68
Damping control	Changes the setting to enable/disable damping control.	[APP-4-02]	p.69

■ System parameter

Item	Description	**OPX-2A** screen display	Reference
Electronic gear A	Set the denominator of electronic gear.	[SyS-0-00]	p.55
Electronic gear B	Set the numerator of electronic gear.	[SyS-0-01]	
Encoder output electronic gear A	Sets the denominator of the electronic gear for encoder output.	[SyS-0-02]	p.123
Encoder output electronic gear B	Sets the numerator of the electronic gear for encoder output.	[SyS-0-03]	
Pulse input mode	Select the pulse input mode.	[SyS-1-00]	p.52
Operation after absolute position loss alarm reset	Selects how the motor should operate after an absolute position loss alarm is reset.	[SyS-1-01]	p.62
Analog input signals	Changes the setting to enable/disable the analog input signals.	[SyS-1-05]	p.59
Motor rotation direction	Select rotation direction of the motor.	[SyS-1-06]	p.55

9.3 Positioning operation based on pulse input

Positioning operation is performed according to the operation data set with the programmable controller. Follow the steps below to perform positioning operation:

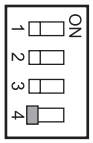
Step 1 Setting the pulse input mode
Step 2 Setting the resolution
Step 3 Setting the motor rotation direction
Step 4 Confirming the absolute system function
Step 5 Performing the positioning operation

Step 1 Setting the pulse input mode

Set a desired pulse input mode of the driver according to the pulse output mode of the controller (pulse oscillator) used with the driver. The pulse input mode can be set using the pulse input mode selector switch (SW1-4) on the driver or applicable parameter.

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

■ Using the switch



Use the pulse input mode selector switch (SW1-4) to set a desired mode.
1P: 1-pulse input mode, negative logic
2P: 2-pulse input mode, negative logic

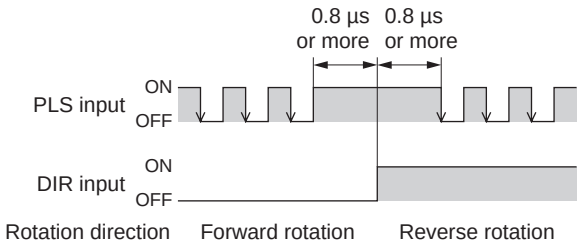
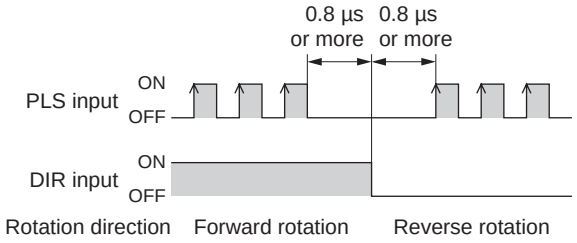
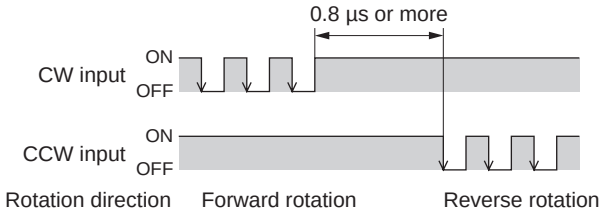
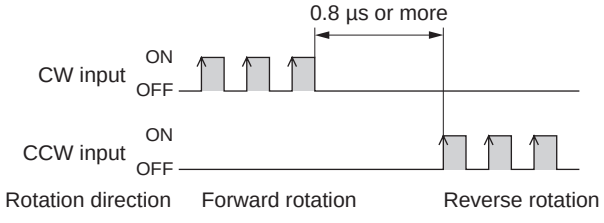
Each mode can only be set with a negative logic using the pulse input mode selector switch.
To select a positive logic, set the applicable parameter using the **OPX-2A** or **MEXE02**.

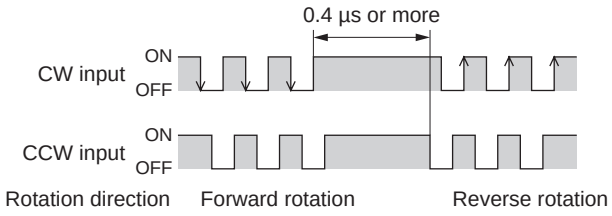
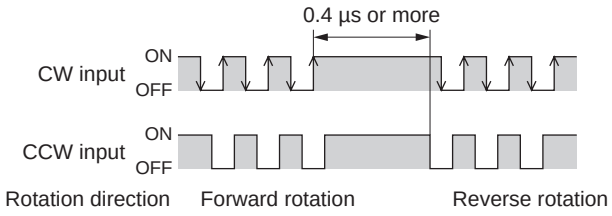
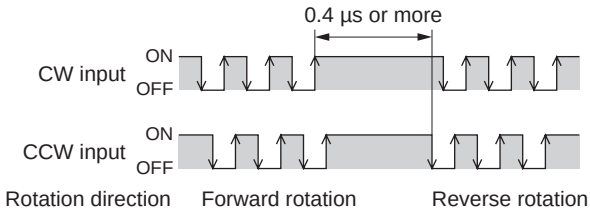
Note

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

■ Using the parameter

The system parameter for pulse input mode [SyS-1-00] is used to set the input mode.

Pulse input mode	Input pattern	Timing chart
1-pulse input mode	Positive logic	
	Negative logic	
2-pulse input mode	Positive logic	
	Negative logic	

Pulse input mode	Input pattern	Timing chart
Phase difference input mode	× 1	
	× 2	
	× 4	

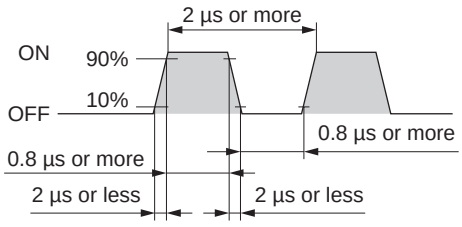
Whether to cause the motor to rotate in CW direction or CCW direction when a forward direction pulse is input can be set using the system parameter for motor rotation direction [SyS-1-06]. Refer to p.55.

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

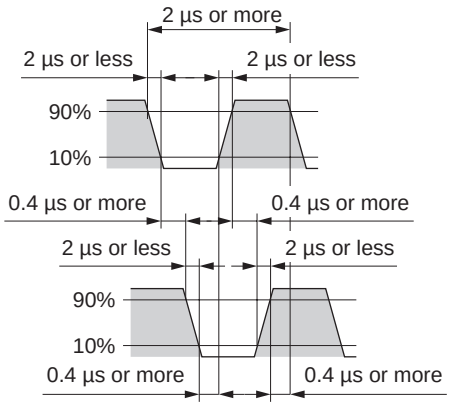
■ Pulse signal

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

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



• Phase difference input mode



Step 2 Setting the resolution

Set the resolution using the system parameters for electronic gear A [SyS-0-00] and electronic gear B [SyS-0-01]. Note that the calculated value must fall within the setting range specified below:

Resolution setting range: 100 to 100,000 P/R

Factory setting: 1000 P/R

$$\text{Resolution [P/R]} = 1000 \times \frac{\text{Electronic gear B [SyS-0-01]}}{\text{Electronic gear A [SyS-0-00]}}$$

• Setting example

Resolution (P/R)	Electronic gear A	Electronic gear B
1000	1 (initial value)	1 (initial value)
100	10	1
360	100	36

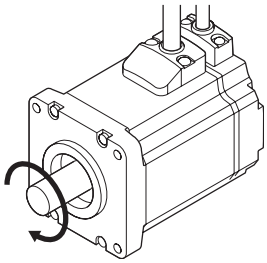
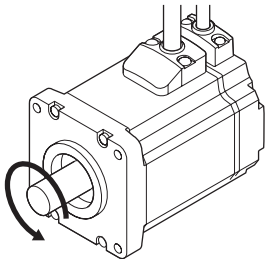
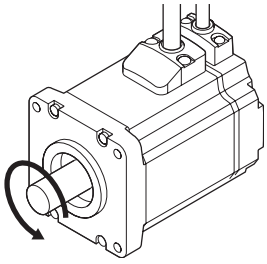
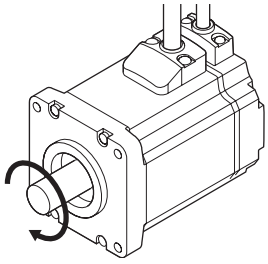
Note

- When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.
- If the calculated resolution exceeds the setting range, an electronic gear setting error warning will generate. Refer to “15.2 Warnings” on p.132.
- If the power is cycled while an electronic gear setting error warning is present, an electronic gear setting error alarm will generate. Refer to “15.1 Alarms” on p.126.

Step 3 Setting the motor rotation direction

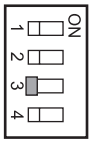
Set a desired motor rotation direction using the system parameter for motor rotation direction [SyS-1-06].

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

Setting of motor rotation direction parameter [SyS-1-06]	CW pulse is input	CCW pulse is input
When “+ = CW” is set	• The command position increases. • The motor rotates in CW direction. 	• The command position decreases. • The motor rotates in CCW direction. 
When “+ = CCW” is set	• The command position increases. • The motor rotates in CCW direction. 	• The command position decreases. • The motor rotates in CW direction. 

Step 4 Confirming the absolute system function

Install the optional battery **BAT01A** (sold separately). When the battery is connected, the current position will be retained even in the event of power outage or after the driver power is cut off.
Set the absolute system function using the absolute system setting switch (SW1-3).
ON: Enable the absolute function
OFF: Disable the absolute function (factory setting)

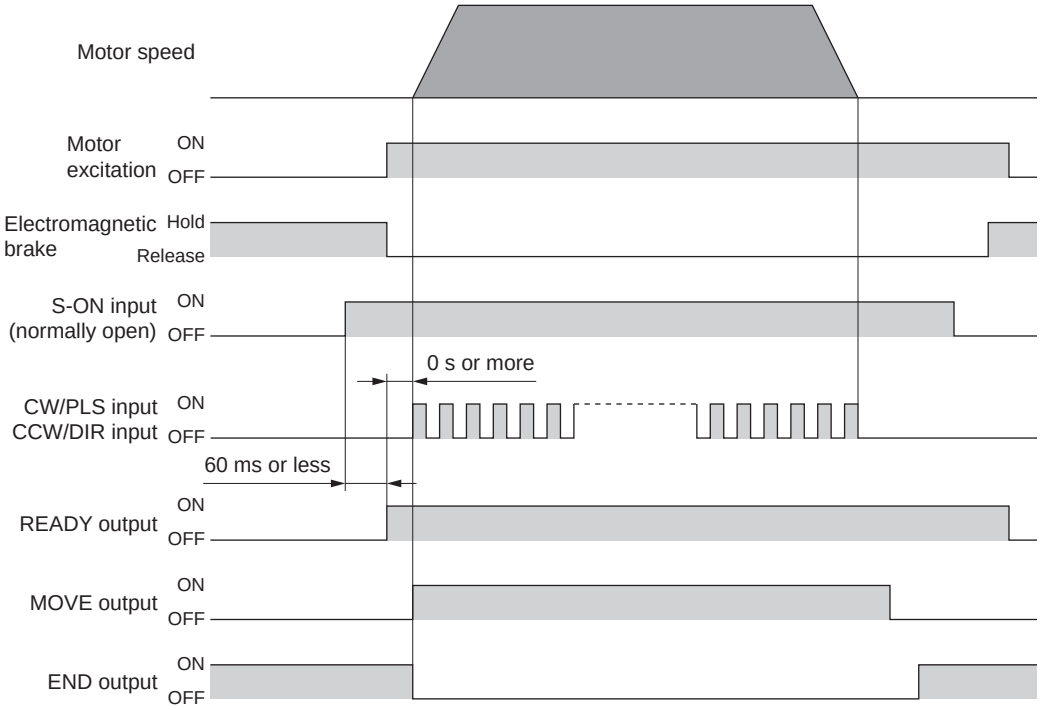


For details, refer to “9.5 Absolute system” on p.62.

Step 5 Performing the positioning operation

1. Turn the S-ON input ON.
   The motor is excited.
   When the motor becomes ready, the READY output will turn ON.

2. Confirm that the READY output is ON, and input pulses.
   The motor starts operating. The MOVE output remains ON while operation is in progress.
   Once the motor operation ends and the rotor enters the positioning complete output band, the END output will turn ON.



■ Exciting the motor: S-ON input

Turning the S-ON input ON will excite the motor.
In the case of an electromagnetic brake motor, the electromagnetic brake will be released after the motor is excited.
When the S-ON input is OFF, the deviation counter will be cleared and input pulses will be ignored.
You can set the S-ON input to function in the contact A (normally open) or B (normally closed) logic using the application parameter for S-ON signal logic [APP-1-00] (the initial value is to use the contact A (normally open) logic). If the S-ON input is set to use the contact B (normally closed) logic, the motor will be excited automatically after the power is turned on and turning the S-ON input ON will cause the motor to lose its holding torque.

Note If the S-ON input is turned ON when only the 24 VDC power is input, a main power supply warning will generate. If a pulse signal is input while a main power supply warning is present, a main power supply error will generate.

■ Notifying that the motor is ready: READY output

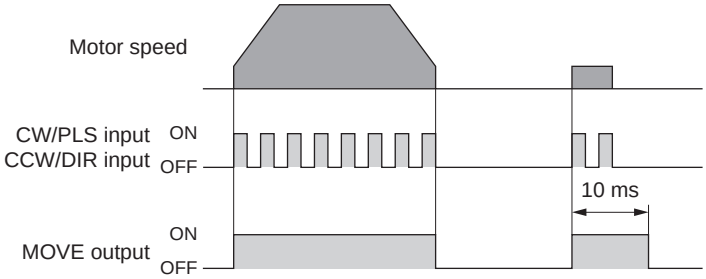
When the motor becomes ready, the READY output will turn ON. Confirm that the READY output is ON before inputting pulses. The READY output remains ON while pulses are input.
The READY output is OFF under the following conditions. Motor operation is disabled while the READY output is OFF:

- The main power supply is cut off.
- An alarm is present.
- The S-ON input is OFF (the S-ON input logic is “Contact A (normally open)”)
- The FREE input or CLR input is ON.
- An operation is performed on the **OPX-2A** in the test mode or copy mode.
- A test operation is performed using **MEXE02**.

■ Notifying that operation is in progress: MOVE output

The MOVE output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MOVE output remains ON while the motor is operating. You can set the minimum time during which the MOVE output remains ON using the application parameter for minimum ON time for MOVE signal [APP-1-08]. Even in a short operation, the MOVE output will remain ON for the time set in this parameter.

Example: When 10 ms is set in the parameter for minimum ON time for MOVE signal [APP-1-08]

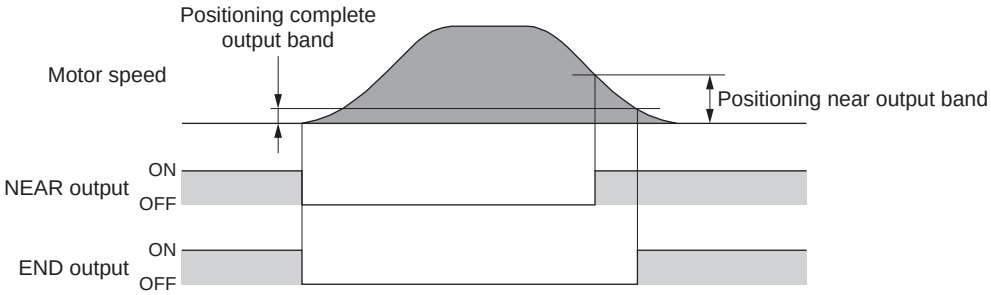


■ Notifying the completion of operation: END output

Once the motor operation ends and the position deviation falls within the positioning complete output band, the END output will turn ON. How long it takes for the END output to turn ON after the operation command completes varies depending on the operating conditions, etc.
You can set the band within which the END output turns ON, using the application parameter for positioning complete output band [APP-1-04].

■ Notifying that the positioning target is near: NEAR output

The NEAR output can be enabled by selecting the output using the application parameter for output signal selection 2 [APP-1-03].
Once the motor operation ends and the position deviation falls within the positioning near output band, the NEAR output will turn ON.
You can set the band within which the NEAR output turns ON, using the application parameter for positioning near output band [APP-1-05].
If the positioning near output band parameter [APP-1-05] is set to a value greater than the value in the positioning complete output band parameter [APP-1-04], the NEAR output will turn ON before the END output does. This way, you can be informed that the positioning target is near.



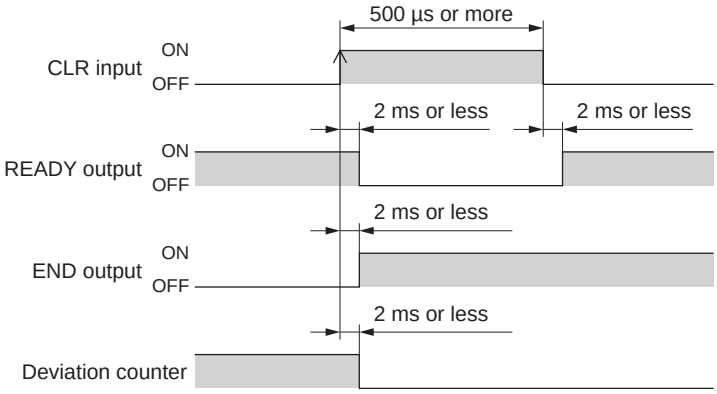
Note These outputs cannot be used in conjunction with the ZSG2 output.

■ Notifying the timing of electromagnetic brake control: MBC output

Use the MBC output to control the electromagnetic brake using a programmable controller, etc.
The MBC output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MBC output will turn ON when the electromagnetic brake is released, and turn OFF when the electromagnetic brake is actuated (= to hold the load in position). Set the programmable controller to control the electromagnetic brake by detecting the ON/OFF status of the MBC output.

■ Clear the accumulated pulses (deviation) to zero: CLR input

When the CLR input is turned ON, the pulses accumulated in the deviation counter (= deviation) will be cleared to zero.
Input pulses are ignored while the CLR input is ON.

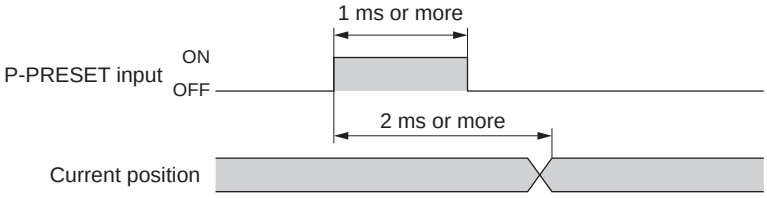


Note

- The CLR input functions as the P-CK input when the P-REQ input is ON. Accordingly, turning the CLR input ON while the P-REQ input is ON will not clear the deviation counter.
- When an alarm generates, the CLR input changes to ALM-RST input. Take note that when the P-REQ input is ON, the function of the P-CK input is given priority and therefore turning ON the ALM-RST input will not reset the alarm.

■ Presetting the current position: P-PRESET input

When the P-PRESET input is turned ON, the value in the application parameter for preset value [APP-1-09] will be overwritten by the current position and the current position will become the home position.
If the absolute function is enabled, turning the P-PRESET input ON will set the home position. The preset value will be written to the EEPROM.
If the absolute function is disabled, the preset value is not written to the EEPROM. Accordingly, cycling the power will reset the current position to zero.
If a current position loss alarm has generated, perform a return-to-home operation after resetting the alarm, and then set the home position using the P-PRESET input.

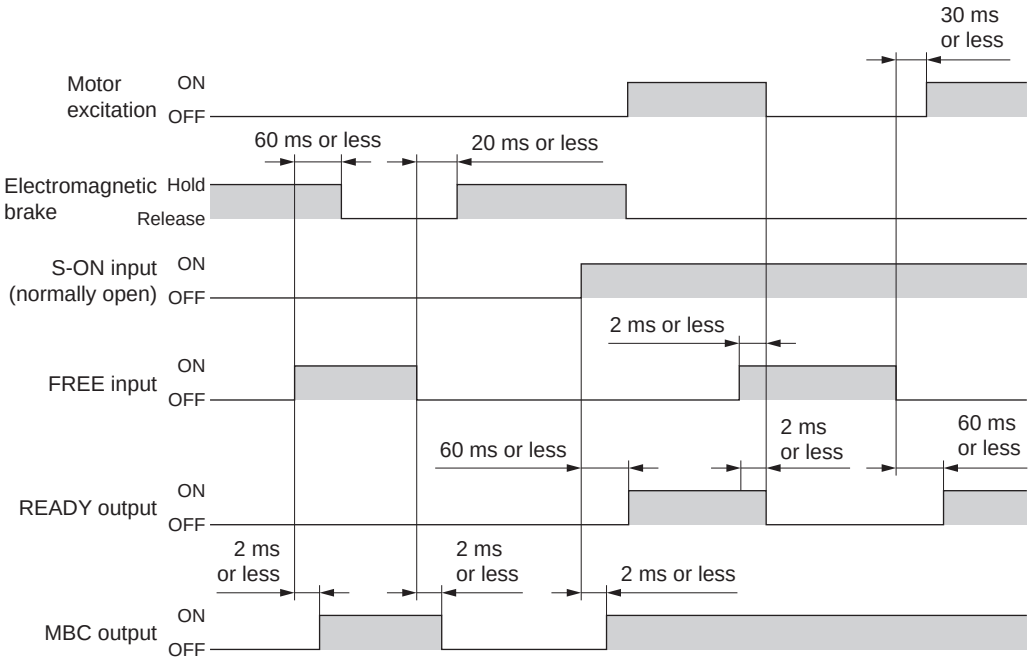


Note

- The EEPROM can be rewritten approx. 100,000 times.
- Do not turn off the main power and 24 VDC power for at least 5 seconds after the P-PRESET input has turned ON. If the power is turned off within 5 seconds, the preset value may not be reflected properly.

■ Freeing the motor output shaft: FREE input

When the FREE input is turned ON, the motor current will be cut off. The motor will lose its holding torque, and the output shaft can be turned with an external force. The deviation counter will also be cleared.
If the FREE input is turned ON while the position is held with the electromagnetic brake, the electromagnetic brake will be released. Accordingly, the position can no longer be held.



9.4 Torque limit

The maximum output torque of the motor can be limited by turning the TL input ON. Use this input to suppress motor torque, for your safety.
Follow the steps below to limit the maximum output torque of the motor during positioning operation:
Step 1 Setting the torque limit value
Step 2 Limiting the torque

Step 1 Setting the torque limit value

Set the torque limit value as an integer percentage of the rated torque being 100%, under each of four operation data numbers from 0 to 3.
When the system parameter for analog input signals [SyS-1-05] is set to “Enable,” one analog point as well as three digital points are available to assign settings. If the parameter is set to “Disable,” four digital points are available to assign settings.

	Analog input signals [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No.0	Analog setting (External potentiometer or external DC voltage)	Digital setting
No.1	Digital setting	
No.2	Digital setting	
No.3	Digital setting	

Note If operation data No. 0 is selected as the torque limit, the damping control frequency (p.69) set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for the two parameters.

Select a desired torque limit value from among the predefined settings, based on a combination of ON/OFF statuses of M0 and M1 inputs.

Operation data	M1 input	M0 input
No.0	OFF	OFF
No.1	OFF	**ON**
No.2	**ON**	OFF
No.3	**ON**	**ON**

■ Analog setting

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 and M1 inputs OFF and select operation data No. 0.
3. Connect an external potentiometer or external DC voltage to pins 4 to 6 of the analog I/O connector (CN6).
Refer to p.42 for details on the connection method.
4. Set the gain.
Set the torque limit value per 1 V of voltage command in the application parameter for analog torque limit gain [APP-2-03].
Setting range: 0 to 300%
Initial value: 30%
5. Adjust the offset.
If there is even a slight margin of error in the voltage value, the torque limit value may not become 0% even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

Automatic adjustment

1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Enable.”
2. Input 0 V to the analog input terminal (pin 5 of CN6).
3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

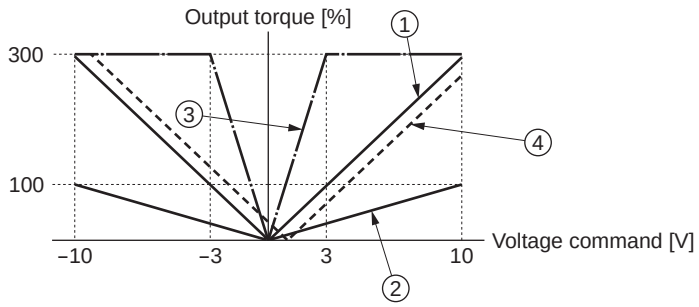
Adjustment using a parameter

1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Disable.”
2. Set the offset voltage in the application parameter for analog torque limit offset voltage [APP-2-05].

6. Use an external potentiometer or external DC voltage to set the torque limit value.

Setting example

Setting example	Analog torque limit gain [APP-2-03]	Analog torque limit offset voltage [APP-2-05]	Description
①	30%	0 V	The torque limit value per 1 V of voltage command becomes 30%.
②	10%	0 V	The torque limit value per 1 V of voltage command becomes 10%.
③	100%	0 V	The torque limit value per 1 V of voltage command becomes 100%.
④	30%	1 V	The home position of voltage command becomes 1 V. The gain of torque limit value is the same as in example①.



■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 1 to 3 as the torque limit value.
3. Select one of operation data Nos. 1 to 3 based on a combination of ON/OFF statuses of M0 and M1 inputs.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

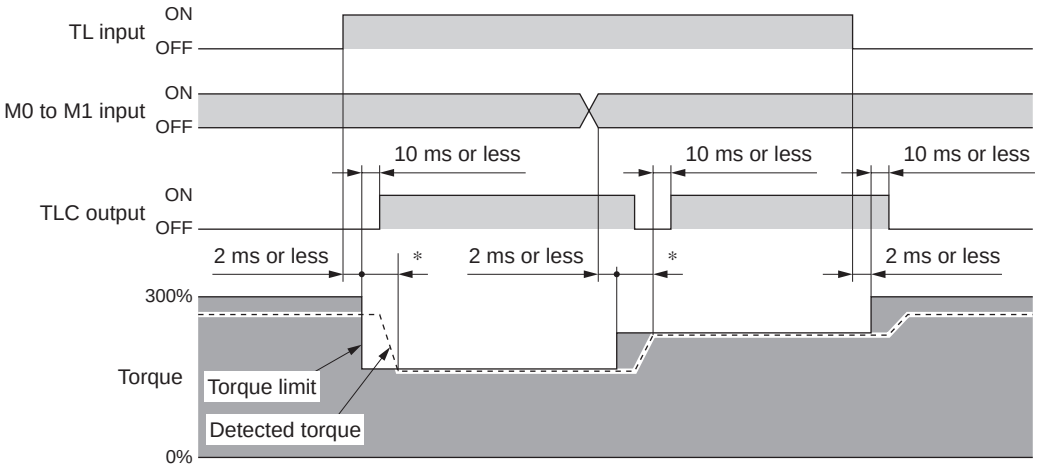
1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 3 as the torque limit value.
3. Select one of operation data Nos. 0 to 3 based on a combination of ON/OFF statuses of M0 and M1 inputs.

Step 2 Limiting the torque

Turning the TL input ON while positioning operation is in progress will limit the maximum output torque by the torque limit value you have set.



* The specific time varies depending on the load condition and gain.

Note If the TL input is turned ON when the torque limit value is set to 0%, the motor will lose its holding torque. Even if a pulse is input in this condition, the motor will not operate, but the command position will still be refreshed. Turning the TL input OFF in this condition will disable the torque limit function and the motor may move to the command position at the maximum torque. Exercise caution when no external potentiometer or external DC voltage is connected or when the digital torque setting is 0%.

■ Enabling the torque limit function: TL input

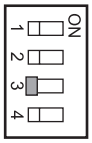
When the TL input is turned ON, the torque limit function will be enabled and the maximum output torque of the motor will be adjusted to the specified torque limit value.
While the TL input is OFF, the torque limit function is disabled and the maximum output torque of the motor remains 300% (the rated torque corresponds to 100%).

■ Notifying that the torque is being limited: TLC output

When the specified torque limit value is reached, the TLC output will turn ON.

9.5 Absolute system

Install the optional battery **BAT01A** (sold separately). When the battery is connected, the current position will be retained even in the event of power outage or after the driver power is cut off.
Set the absolute system function using the absolute system setting switch (SW1-3).
ON: Enable the absolute function
OFF: Disable the absolute function (factory setting)



Note

- If an absolute position loss alarm generates when the absolute function is enabled, the following causes are suspected. Reset the alarm by referring to “Resetting the absolute position loss alarm” on p.63.
  · The power was turned on for the first time after connecting the battery.
  · The battery was disconnected while the main power supply and 24 VDC power supply were cut off.
  · The battery voltage became low while the main power supply and 24 VDC power supply were cut off.
  · The encoder cable was disconnected.
  · The coordinate control range was exceeded. (In this condition, a position range error is output first. When the motor is operated again, an absolute position loss alarm will generate.)
- If the absolute function is set to “Enable” but no battery is connected, a “no battery” alarm will generate.
- If a battery is connected when the absolute function is set to “Disable,” an “ABS not supported” alarm will generate.
- The new setting of the absolute system setting switch will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.
- The factory setting of the absolute function is “OFF” (Disable). Accordingly, position information will be lost once the power is turned off.

■ Coordinate control range

The range of motor positions that can be controlled using the absolute system function corresponds to the smaller of the two ranges specified below. Which range is used varies depending on the motor resolution:

- Current position : −2,147,483,648 to +2,147,483,647 pulses
- Amount of rotation : −32,768 to +32,767 revolutions

Note When the current position exceeds the coordinate control range, a position range error alarm will generate. Resetting the position range error alarm will cause an absolute position loss alarm to generate.

■ Loss of absolute position

If, when the absolute function is enabled, the position information stored in the driver is lost due to low battery voltage, etc., an absolute position loss alarm will generate. Reset the alarm by referring to “Resetting the absolute position loss alarm” on p.63.
You can set how to enable pulse input after an absolute position loss alarm has been reset. Set the method in the system parameter for operation after absolute position loss alarm reset [SyS-1-01].

Parameter for operation after absolute position loss alarm reset [SyS-1-01]	Description
Enable pulse input at the ON edge of the P-REQ input (initial value)	Even after resetting the alarm with the ALM-RST input, pulse input will remain disabled until the P-REQ input is turned ON. If a pulse is input before the P-REQ input turns ON, an absolute position loss alarm will generate again.
Enable pulse input	Pulse input will be enabled once the alarm is reset with the ALM-RST input.

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

■ Resetting the absolute position loss alarm

Be sure to set the home position again after resetting the absolute position loss alarm.

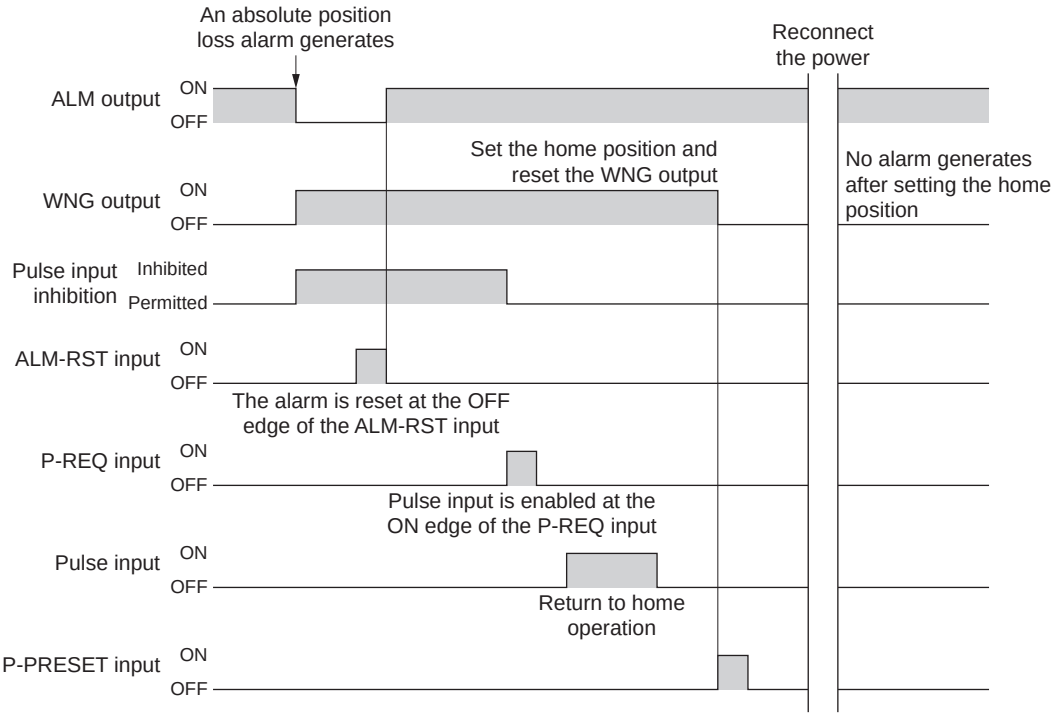
- How to reset

1. Turn the ALM-RST input to ON and then OFF to reset the alarm.
2. Perform a return-to-home operation using an external controller.
3. Set the home position again with the P-PRESET input.

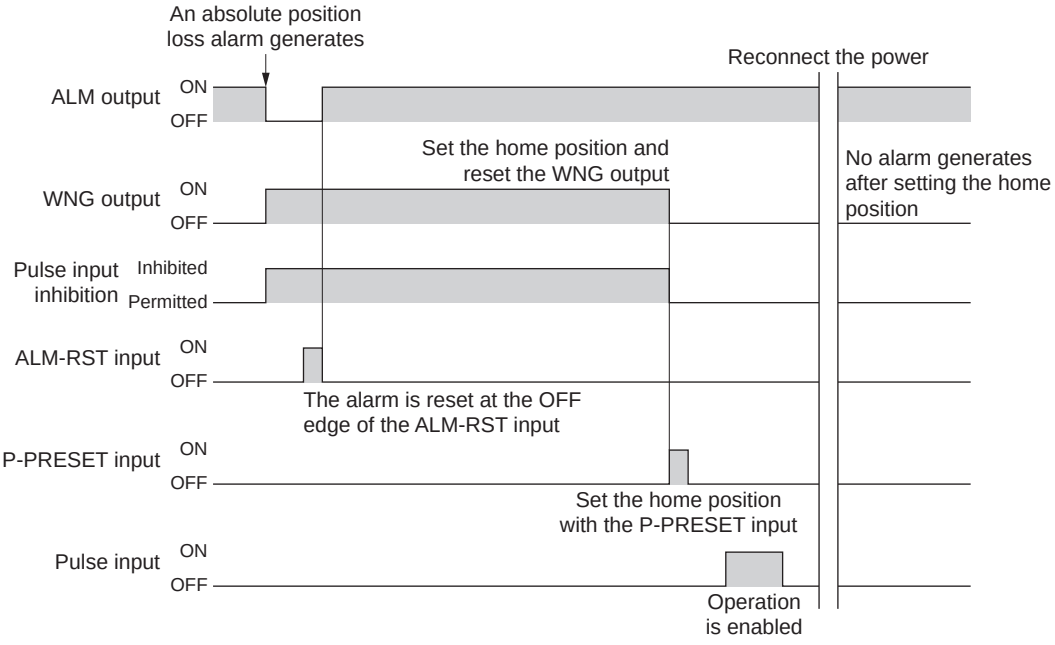
Note

- Even after resetting the alarm, the alarm status will continue until the home position is set again.
- Resetting the absolute position loss alarm will reset the current position to zero. As a result, performing a positioning operation before the home position is set may cause the motor to move the equipment abruptly. Always set the home position first.

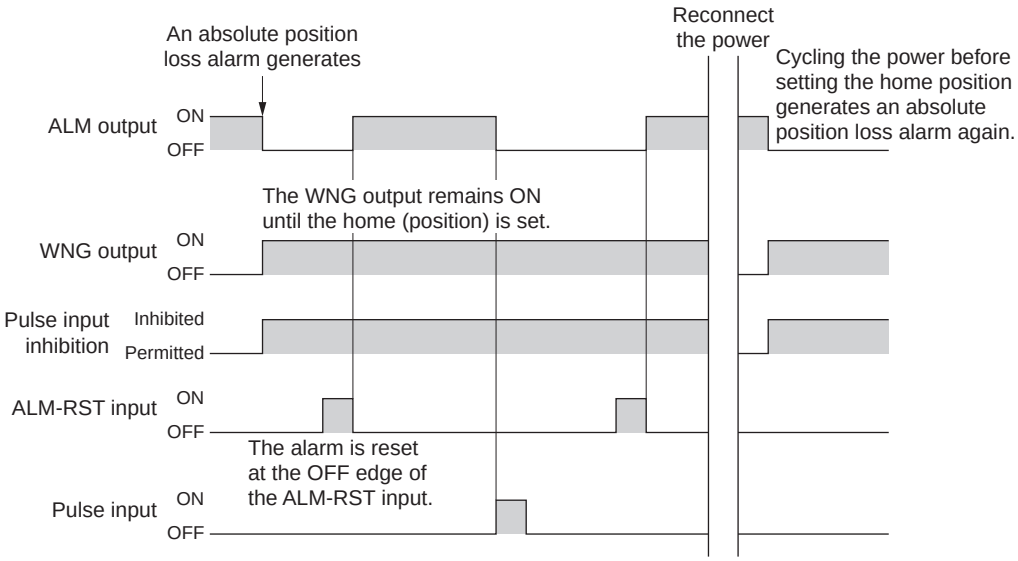
- Setting the home position after the motor has returned to its home position



- Setting the home position before the motor has returned to its home position



- Not setting the home position



9.6 Current position output

This function can be used when the absolute system function is enabled. current position data recognized by the driver is output. It takes 0.5 to 1 second to read the data.
The data is output as a 56 bit data signal consisting of the current position, status, alarm code and checksum. The data format is shown below.
The last 8 bits of the transmission data provide the checksum. They represent the last 8 bits of the result of adding the 48 bits consisting of the absolute data, status, and alarm code in one-byte units a total of six times.

■ Information that can be read

The information listed below can be read from the driver using this function.
The driver outputs all information as binary values.

Current position 32 bit	+	Status 8 bit	+	Alarm code 8 bit	+	Checksum 8 bit

- Current position (32 bit)

The first 32 bits are sent in binary mode, which is two's complement.

- Status (8 bit)

These numbers indicate the driver status.
Different information is assigned to each bit.

Status = 000 0 0 0 0 0

- bit 0: overflow
- bit 1: Loss of absolute data due to overspeed
- bit 2: Loss of absolute data due to low battery voltage
- bit 3: Low battery voltage
- bit 4: No battery
- bits 5 to 7: Not defined (always 0)

Example: When an overflow alarm has generated

Status = 0000 0001

- Alarm code (8 bit)

8 bits are sent in binary mode.

Example: When an overload alarm has generated

Alarm code = 0011 0000 = 48 (decimal) = 30 (hexadecimal)

- Checksum (8 bit)

The 48 bits of current position and status information are divided into bytes, and all bytes are added up.
The checksum represents the last 8 bits in the result obtained by a total of six additions (addition of six bytes).
This information is used to check if the data has been read correctly.

Example: Data output from the driver when the current position corresponds to 12345 steps and an overload alarm is present

0000 0000 0000 0000 0011 0000 0011 1001	0000 0000	0011 0000	1001 1001
Current position	Status	Alarm	Checksum

After the data has been read, all bytes constituting the current position (32 bits), status (8 bits) and alarm code (8 bits) read into the programmable controller are added up.

0000 0000 + 0000 0000 + 0011 0000 + 0011 1001 + 0000 0000 + 0011 0000

Result = 0000 0000 1001 1001

Last 8 bits (1 byte)

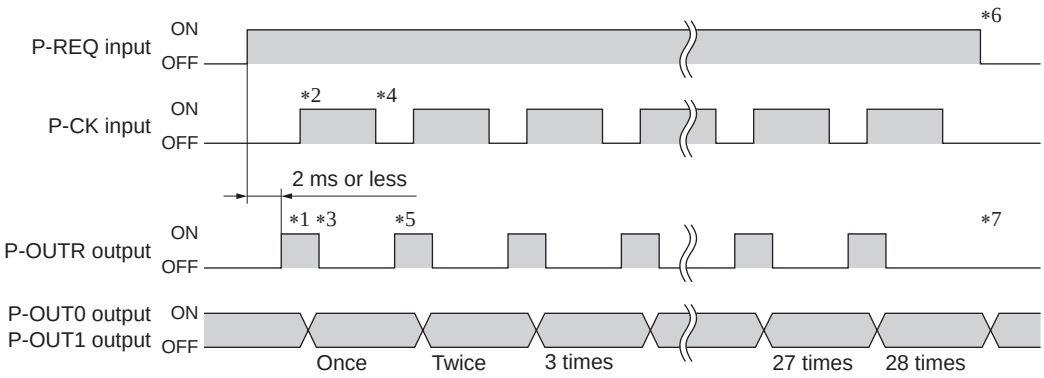
The checksum represents the last 8 bits, or “1101 0001” in the above example.
If the calculated result matches the checksum value read from the driver, the data have been read correctly.

■ I/O signals used

The signals used in the current position output mode are indicated. This information is sent by input pin 2 and output pin 3.
Normally other signals are assigned to the P-CK input, P-OUTR output, P-OUT0 output and P-OUT1 output. When the P-REQ input turns ON, these signals function as the P-CK input, P-OUTR output, P-OUT0 output and P-OUT1 output.
Note, however, that when the P-REQ input is ON, the current position output function is given priority. Accordingly, the CLR/ALM-RST input, READY/AL0 output, TLC/AL1 output and ZSG2/NEAR/AL2 output will not function.

Signal name	Description
P-REQ input	The programmable controller uses this signal to request the transmission of data.
P-CK input (normal: CLR/ALM-RST input)	This signal is used to request data (clock).
P-OUTR output (normal: READY output)	This signal indicates that data is ready for transmission.
P-OUT0 output (normal: TLC output) P-OUT1 output (normal: ZSG2/NEAR output)	These signals indicate two bits of data. The P-OUT0 output represents the low-order bit, while the P-OUT1 output represents the high-order bit.

The P-REQ input is always enabled. When the P-REQ input is ON during operation, the current position, status and alarm code are transmitted.



∗1 The driver turns the P-OUTR output ON within 2 ms of the ON edge of the P-REQ input.
∗2 The programmable controller turns the P-CK input ON after confirming that the P-OUTR output has turned ON.
∗3 After confirming that the P-CK input has turned ON, the driver sets upper 2 bits of the data to be sent in the P-OUT0 output and P-OUT1 output, and then turns the P-OUTR output OFF.
∗4 After confirming that the P-OUTR output has turned OFF, the programmable controller receives the P-OUT0 output and P-OUT1 output and then turns the P-CK input OFF.
∗5 The driver turns the P-OUTR output ON after confirming that the P-CK input has turned OFF. Steps ∗2 to ∗5 are repeated 28 times hereafter.
∗6 Once 56 bits of data have been received, the programmable controller turns the P-REQ input OFF.
∗7 The driver assigns the P-OUTR output to the READY output after confirming that the P-REQ input has turned OFF.
If the P-REQ input turns OFF before the transmission is complete, the driver interrupts the transmission, assigns the signal again, and then turns the P-OUTR output OFF.

9.7 Gain tuning

The motor compliance with respect to commands can be adjusted according to the load inertia and mechanical rigidity.
You can also tune the motor in the semi-auto or manual mode in situations where the positioning time must be shortened, or when automatic tuning is difficult due to a large or fluctuating load inertial moment.

■ Selecting the tuning mode

Gain tuning can be performed in three modes. Select a desired tuning mode using the application parameter for gain tuning mode selection [APP-0-00]. Automatic tuning supports an adjustment range of up to 50 times the rotor inertia moment, while manual tuning supports an adjustment range of up to 100 times.
Automatic: The load inertial moment is estimated internally by the driver. Simply set the mechanical rigidity and the gain will be adjusted automatically.
Semi-auto: Set the mechanical rigidity and load inertial moment ratio, and the gain will be adjusted automatically.
Manual: The customer must set the gain directly. Select this mode when the load inertia is large or the response needs to be increased above the level achievable by automatic tuning.

Related parameters

The parameters that can be set vary depending on the tuning mode.

Parameter name	Automatic	Semi-auto	Manual
Load inertial moment ratio [APP-0-01]	−	○	○
Mechanical rigidity setting [APP-0-02]	○	○	○
Position loop gain [APP-0-03]	−	−	○
Speed loop gain [APP-0-04]	−	−	○
Speed loop integral time constant [APP-0-05]	−	−	○
Speed feed-forward rate [APP-0-06]	−	−	○

■ Gain tuning mode

- Automatic

Set the mechanical rigidity using the mechanical rigidity setting switch (SW2) on the driver or the application parameter for mechanical rigidity setting [APP-0-02].
Which value should be made effective is selected using the application parameter for mechanical rigidity setting switch [APP-4-00].
Once the mechanical rigidity is set, the gain will be adjusted automatically.
Refer to p.68 for details on the range of gains that can be set with automatic tuning.

SW2 dial setting	Value of mechanical rigidity setting switch parameter	Reference mechanical rigidity
0 to 3	0 to 3	Low rigidity (belt pulley, etc.)
4 to 9	4 to 9	Medium rigidity (chain, etc.)
A to F	10 to 15	High rigidity (ball screw, directly coupled load, etc.)

Note

- The higher the value of mechanical rigidity, the higher the motor response becomes. Note, however, that an excessively high value may cause vibration or noise.
- The estimated value of load inertial moment is saved in the driver's EEPROM every 20 minutes.

- Semi-auto

1. Set the application parameter for load inertial moment ratio [APP-0-01].
   The load inertial moment ratio refers to the percentage of the inertial moment of the load to the rotor inertial moment of the motor. If the rotor inertial moment is equal to the load inertial moment, the load inertial moment ratio becomes 100%. Refer to the catalog for the rotor inertial moment of your motor.
   If the equipment is complex and estimating the load is difficult, you can use the **OPX-2A** or **MEXE02** to monitor the load inertial moment ratio estimated by the driver.
2. Set the mechanical rigidity in the same manner as in the "automatic" mode.
   Once the mechanical rigidity and load inertial moment ratio are set, the gain will be adjusted automatically.
   Refer to p.68 for details on the range of gains that can be set with semi-auto tuning.

- Manual

Follow the procedure below to adjust the gain with a sufficient margin.

1. Set the application parameter for load inertial moment ratio [APP-0-01].
   The load inertial moment ratio refers to the percentage of the inertial moment of the load to the rotor inertial moment of the motor. If the rotor inertial moment is equal to the load inertial moment, the load inertial moment ratio becomes 100%. Refer to the catalog for the rotor inertial moment of your motor.
   If the equipment is complex and estimating the load is difficult, you can use the **OPX-2A** or **MEXE02** to monitor the load inertial moment ratio estimated by the driver.
2. Set the mechanical rigidity in the same manner as in the "automatic" mode.
3. Adjust the compliance with respect to speed deviation. Set the application parameter for speed loop gain [APP-0-04].
   Increasing the speed loop gain will decrease the deviation between the command speed and actual speed. Note, however, that an excessively high value may increase the motor overshoot or cause hunting.
4. Decrease the deviation that cannot be adjusted with the speed loop gain. Set the application parameter for speed loop integral time constant [APP-0-05].
   If the integral time constant is too high, motor operation will become slow. If the constant is too low, on the other hand, hunting may occur.
5. Adjust the compliance with respect to position deviation. Set the application parameter for position loop gain [APP-0-03].
   Increasing the position loop gain will decrease the deviation between the command position and actual position. Note, however, that an excessively high value may increase the motor overshoot or cause hunting.
6. Repeat steps 2 to 5 to set an optimal gain.

- Speed feed-forward rate

If the speed is constant, the deviation between the command position and actual position can be reduced to shorten the settling time.
Setting the speed feed-forward rate to 100% will bring the deviation down to nearly 0. Note, however, that an excessively high value may increase the motor overshoot or undershoot.

■ Gains that can be set with automatic tuning/semi-auto tuning

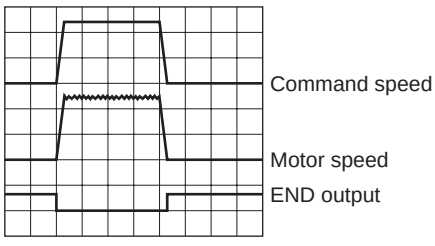
In automatic tuning and semi-auto tuning, the gain is set automatically.
The table below summarizes different conditions and corresponding gains.

SW2 dial setting	Value of mechanical rigidity setting switch parameter	Position loop gain [Hz]	Speed loop gain [Hz]	Speed loop integral time constant [ms]	Speed feed-forward rate [%]
0	0	3	14	51.0	80
1	1	4	22	51.0	80
2	2	6	32	48.2	80
3	3	9	46	33.8	80
4	4	11	56	28.4	80
5	5	14	68	23.4	80
6	6	16	82	19.4	80
7	7	20	100	15.8	80
8	8	20	120	13.2	80
9	9	20	150	10.6	80
A	10	20	180	8.8	80
B	11	20	220	7.2	80
C	12	20	270	5.8	80
D	13	20	330	4.8	80
E	14	20	390	4.0	80
F	15	20	470	3.4	80

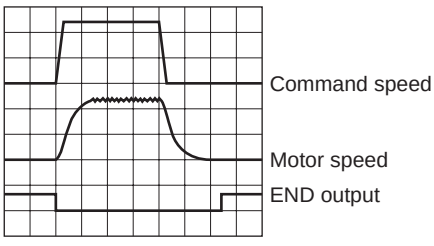
9.8 Command filter

You can apply a filter to the command position in order to make the acceleration/deceleration more gradual. Decreasing the value of command filter will shorten the settling time. However, an excessively low value may cause vibration.
Set an appropriate value in the application parameter for command filter parameter [APP-4-01].
Initial value: 3 ms

- Command filter = 0 ms



- Command filter = 100 ms



9.9 Damping control

Even if the motor is assembled into a machine of low rigidity, residual vibration can be reduced during positioning, in order to shorten the positioning time. (An optimal value varies depending on the equipment and its operating conditions.)
Set a damping control frequency under each of four operation data numbers from 0 to 3.
When the system parameter for analog input signals [SyS-1-05] is set to "Enable," one analog point as well as three digital points are available to assign settings. If the parameter is set to "Disable," four digital points are available to assign settings.

	Analog input signal parameter [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No.0	Analog setting (internal potentiometer VR1)	Digital setting
No.1	Digital setting	
No.2	Digital setting	
No.3	Digital setting	

Note If operation data No. 0 is selected for damping control, the torque limit value (p.59) set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for the two parameters.

Select a desired damping control frequency from among the predefined settings, based on a combination of ON/OFF statuses of M0 and M1 inputs.

Operation data	M1 input	M0 input
No.0	OFF	OFF
No.1	OFF	**ON**
No.2	**ON**	OFF
No.3	**ON**	**ON**

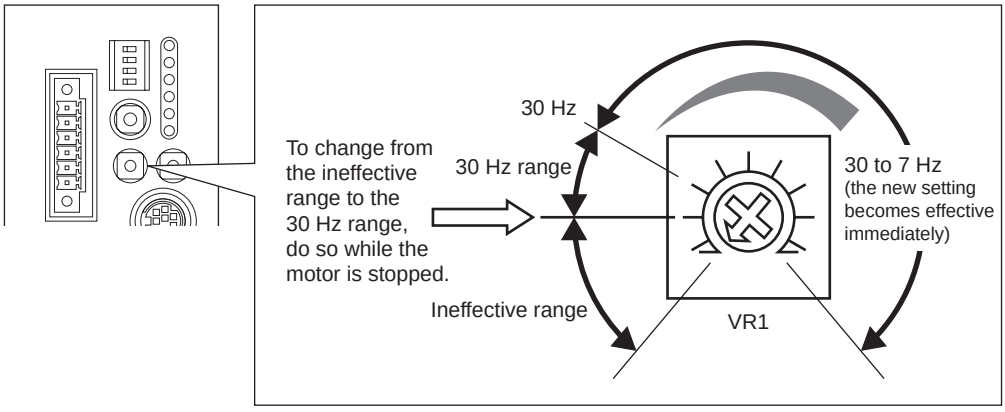
■ Analog setting

1. Set the system parameter for analog input signals [SyS-1-05] to "Enable."

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

2. Turn the M0 and M1 inputs OFF and select operation data No. 0.

3. Use the internal potentiometer VR1 to set the damping control frequency.
   The new damping control frequency becomes effective immediately, even when operation is in progress.
   Setting range: 7.00 to 30.00 Hz
   Factory setting: Disable
   The damping control frequency set by the VR1 can be monitored in **MEXE02**.



Note To change the damping control frequency from the ineffective range to the 30 Hz range, stop the motor before turning the VR1. Changing the setting while the motor is operating may cause the motor to move the equipment abruptly.

■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 1 to 3 as the damping control frequency.
   Setting range: 7.00 to 100.00 Hz
   Initial value: 30.00 Hz
3. Set the application parameter for damping control [APP-4-02] to “Enable.”
4. Select one of operation data Nos. 1 to 3 based on a combination of ON/OFF statuses of M0 and M1 inputs.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”
2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 3 as the damping control frequency.
   Setting range: 7.00 to 100.00 Hz
   Initial value: 30.00 Hz
3. Set the application parameter for damping control [APP-4-02] to “Enable.”
4. Select one of operation data Nos. 0 to 3 based on a combination of ON/OFF statuses of M0 and M1 inputs.

10 Functions and operations in the speed control mode

The following functions are available in the speed control mode:

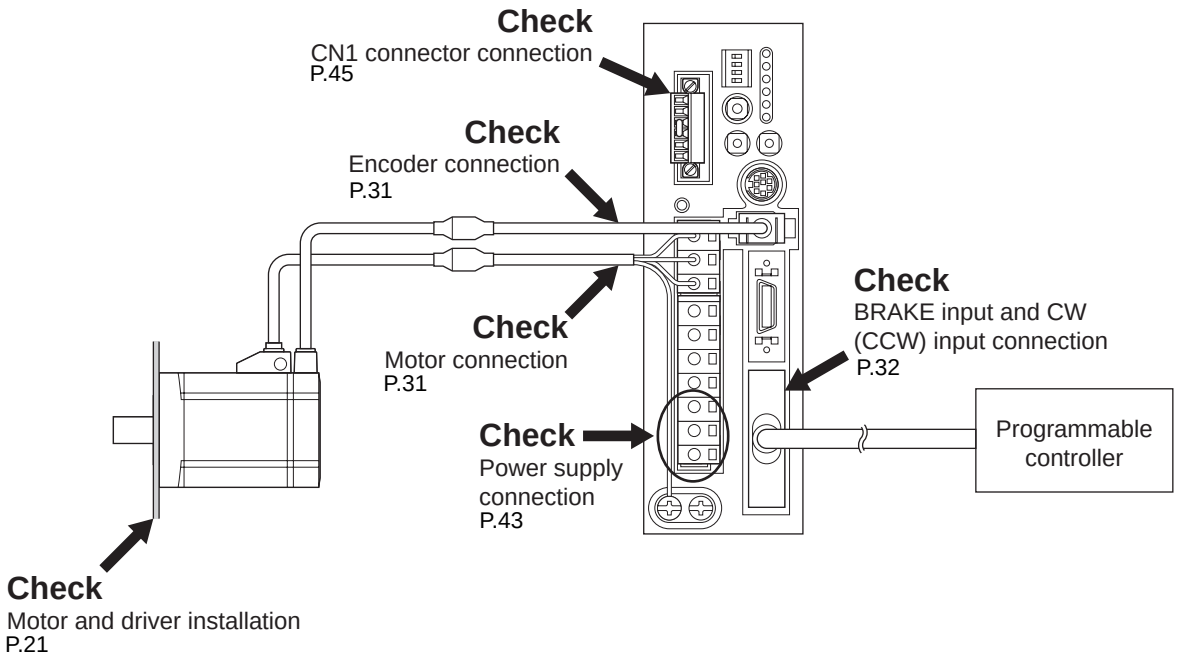
- Speed controlled operation.....The motor speed is controlled.
- Torque limit.....The maximum output torque of the motor is limited.
- Tuning .....Operations are performed via automatic tuning. Gain adjustment is also possible according to the load inertia or mechanical rigidity.

10.1 Quick operations

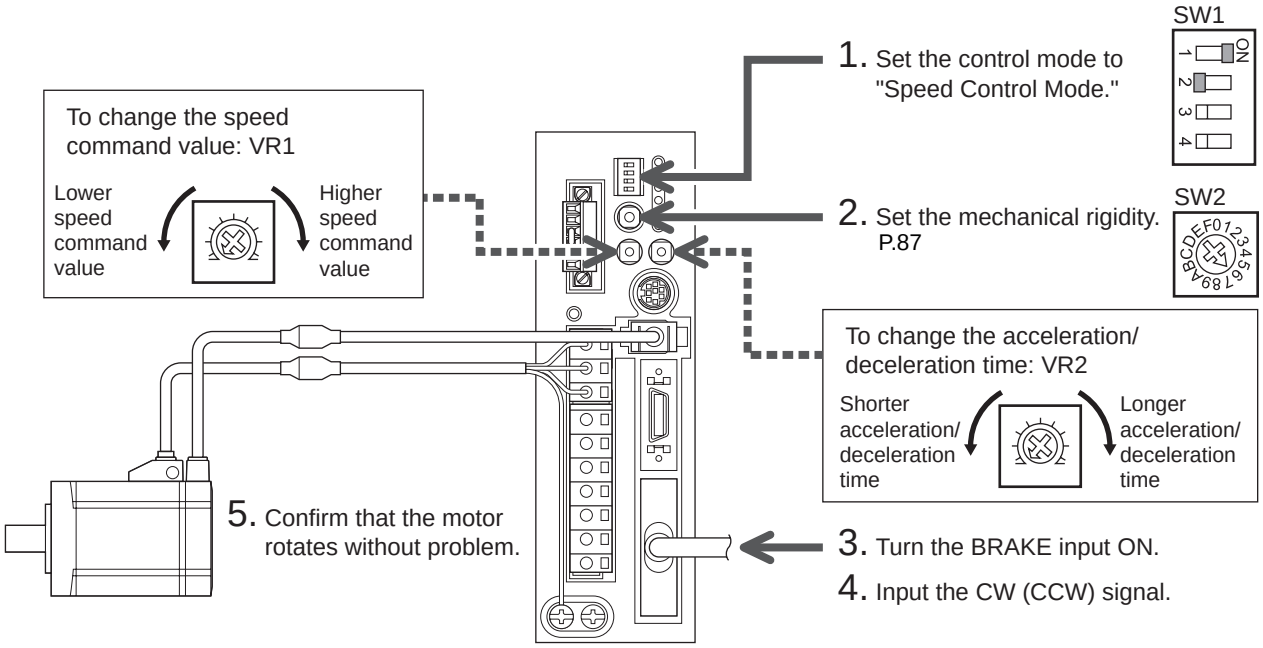
If you are new to the **NX** series driver, read this chapter and you will be able to perform basic motor operations.

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

STEP 1 Check the installation and connection



STEP 2 Operate the motor



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

STEP 3 Were you able to operate the motor properly?

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

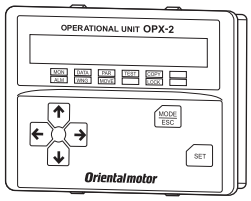
- Is the BRAKE input ON?
- Are the thermal terminals for regeneration resistor (TH1 and TH2) on the CN1 (shorted)?
- Is any alarm present?
- Are the power supply and motor connected securely?
- Is the SPD LED (green) lit?
- Isn't the VR1 set to 0 r/min?

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

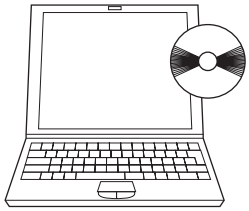
10.2 List of setting items

The items that can be set in the speed control mode are listed below.
You can use the data setter **OPX-2A** or the data setting software **MEXE02** to set operation data or change the internal parameters of the driver.
Parameter codes displayed on the **OPX-2A** screen are shown in brackets. These codes are also referenced in the main text herein. Use these codes as keywords.

OPX-2A



MEXE02



For the method to set parameters with the **OPX-2A** or **MEXE02**, refer to the operating manual for each option.

■ Operation data

Item	Description	**OPX-2A** screen display	Reference
Operating speed	Sets the operating speed.	rEv	p.75
Torque limit	Sets the torque limit value.	trq	p.84
Acceleration time	Sets the acceleration time per 1000 r/min.	tA	p.75
Deceleration time	Sets the deceleration time per 1000 r/min.	td	p.75

■ Application parameters

Item	Description	**OPX-2A** screen display	Reference
Gain tuning mode selection	Selects the gain tuning mode.	[APP-0-00]	p.87
Load inertial moment ratio	Sets the ratio of load inertial moment and motor inertial moment.	[APP-0-01]	
Mechanical rigidity setting	Selects the rigidity applicable to automatic, semi-auto or manual tuning.	[APP-0-02]	
Position loop gain	Sets the position loop gain. When this value is increased, the response will increase.	[APP-0-03]	
Speed loop gain	Sets the speed loop gain. When this value is increased, the response will increase.	[APP-0-04]	
Speed loop integral time constant	Sets the speed loop integral time constant. When this value is decreased, the response will increase.	[APP-0-05]	
Speed feed-forward rate	Sets the speed feed-forward rate. This parameter can be used to shorten the positioning time.	[APP-0-06]	
S-ON signal logic	Changes the S-ON input logic.	[APP-1-00]	p.81
BRAKE signal logic	Changes the BRAKE input logic.	[APP-1-01]	p.81
Output signal selection 1	Selects the output signal.	[APP-1-02]	–
Output signal selection 2	Selects the output signal.	[APP-1-03]	
Zero speed output band	Sets the output condition for ZV output.	[APP-1-06]	p.82
Attained speed output band	Sets the output condition for VA output.	[APP-1-07]	p.83
Minimum ON time for MOVE signal	Sets the minimum ON time for MOVE output.	[APP-1-08]	p.82
Alarm code output	Changes the setting to enable/disable alarm code output.	[APP-1-10]	p.126
Analog speed command gain	Sets the speed command per 1 V of analog input voltage.	[APP-2-00]	p.76
Analog speed command clamp	Sets the speed at which to clamp the analog speed command to zero.	[APP-2-01]	
Analog speed command offset voltage	Sets the offset voltage for analog speed command input.	[APP-2-02]	
Analog torque limit gain	Sets the torque limit per 1 V of analog input voltage.	[APP-2-03]	p.85
Analog torque limit offset voltage	Sets the offset voltage for analog torque limit input.	[APP-2-05]	
Analog input signal automatic offset	Changes the setting to enable/disable automatic offset for analog input signals.	[APP-2-06]	p.85

Item	Description	**OPX-2A** screen display	Reference
Analog speed monitor maximum value	Sets the maximum value of monitored analog speed. This setting determines the slope of output of monitored analog speed.	[APP-2-07]	p.124
Analog speed monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog speed.	[APP-2-08]	
Analog speed monitor offset voltage	Sets the offset voltage for monitored analog speed.	[APP-2-09]	
Analog torque monitor maximum value	Sets the maximum value of monitored analog torque. This setting determines the slope of output of monitored analog torque.	[APP-2-10]	p.125
Analog torque monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog torque.	[APP-2-11]	
Analog torque monitor offset voltage	Sets the offset voltage for monitored analog torque.	[APP-2-12]	
Mechanical rigidity setting switch	Changes the setting to enable/disable the mechanical rigidity setting switch (SW2) on the driver.	[APP-4-00]	p.87

■ System parameters

Item	Description	**OPX-2A** screen display	Reference
Encoder output electronic gear A	Sets the denominator of the electronic gear for encoder output.	[SyS-0-02]	p.123
Encoder output electronic gear B	Sets the numerator of the electronic gear for encoder output.	[SyS-0-03]	
Operation selection after stopping in speed control mode	Sets how the motor should operate after stopping in the speed control mode.	[SyS-1-02]	p.78
Analog input signals	Changes the setting to enable/disable the analog input signals.	[SyS-1-05]	p.75
Motor rotation direction	Select rotation direction of the motor.	[SyS-1-06]	p.79

10.3 Speed control operation

The motor operates continuously while the CW input or CCW input is ON.
Follow the steps below to perform speed controlled operation:
Step 1 Setting the speed command value and acceleration/deceleration time
Step 2 Setting the operation after stopping
Step 3 Setting the motor rotation direction
Step 4 Performing the speed controlled operation

Step 1 Setting the speed command value and acceleration/deceleration time

Set a speed command value and acceleration/deceleration time under each of eight operation data numbers from 0 to 7.
When the system parameter for analog input signals [SyS-1-05] is set to "Enable," two analog points and six digital points are available to assign settings. If the parameter is set to "Disable," eight digital points are available to assign settings.

	Analog input signals [SyS-1-05]		
Operation data	Enable (initial value)		Disable
	Speed command	Acceleration/ deceleration time	Speed command and acceleration/deceleration time
No.0	Analog setting (internal potentiometer VR1)	Analog setting (internal potentiometer VR2*)	Digital setting
No.1	Analog setting (External potentiometer or external DC voltage)	Analog setting (internal potentiometer VR2*)	Digital setting
No.2 to 7	Digital setting		

* The acceleration time and deceleration time are the same.

Note If operation data No. 0 is selected for speed controlled operation, the torque limit value (p.84) set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for the two parameters.

Select a desired speed command value and acceleration/deceleration time from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

Operation data	M2 input	M1 input	M0 input
No.0	OFF	OFF	OFF
No.1	OFF	OFF	**ON**
No.2	OFF	**ON**	OFF
No.3	OFF	**ON**	**ON**
No.4	**ON**	OFF	OFF
No.5	**ON**	OFF	**ON**
No.6	**ON**	**ON**	OFF
No.7	**ON**	**ON**	**ON**

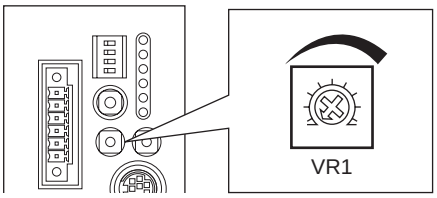
■ Using the internal potentiometer VR1

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

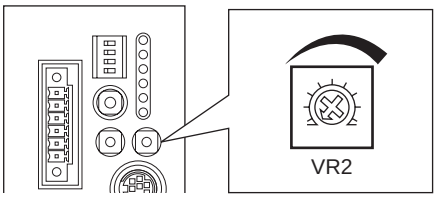
   Note When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

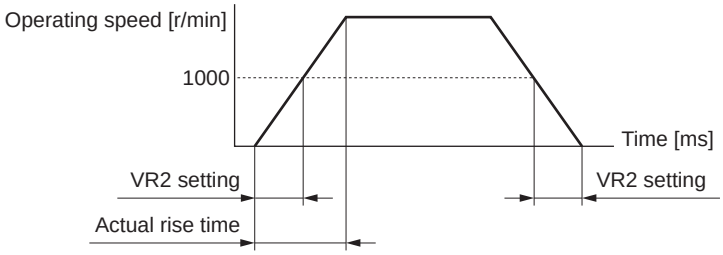
2. Turn the M0 to M2 inputs OFF and select operation data No. 0.

3. Set the speed command using the internal potentiometer VR1.
   Setting range: 0 to 5500 r/min
   Factory setting: 0 r/min



4. Set the acceleration/deceleration time using the internal potentiometer VR2.
   The acceleration time and deceleration time are the same.
   Setting range: 5 to 10000 ms / (1000 r/min)
   Factory setting: 5 ms / (1000 r/min)





■ Using an external potentiometer or external DC voltage

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 input ON and M1 and M2 inputs OFF, and select operation data No. 1.

3. Connect an external potentiometer or external DC voltage to pins 1 to 3 of the analog I/O connector (CN6).
   Refer to p.42 for details on the connection method.

4. Set the gain.
   Set the speed command value per 1 V of voltage command in the application parameter for analog speed command gain [APP-2-00].
   Setting range: 0 to 5500 r/min
   Initial value: 550 r/min

5. Set the minimum speed.
   To clamp all speed command values below a certain speed at 0 r/min, set the application parameter for analog speed command clamp [APP-2-01].

6. Set the offset.
If there is even a slight margin of error in the voltage value, the speed command value may not become 0 r/min even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

Automatic adjustment

1. Set the application parameter for analog input signal automatic offset [APP-2-06] to "Enable."

2. Input 0 V to the analog input terminal (pin 5 of CN6).

3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

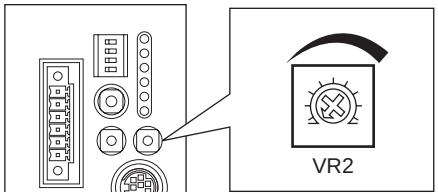
Adjustment using a parameter

1. Set the application parameter for analog input signal automatic offset [APP-2-06] to "Disable."

2. Set the offset voltage in the application parameter for analog speed command offset voltage [APP-2-02].

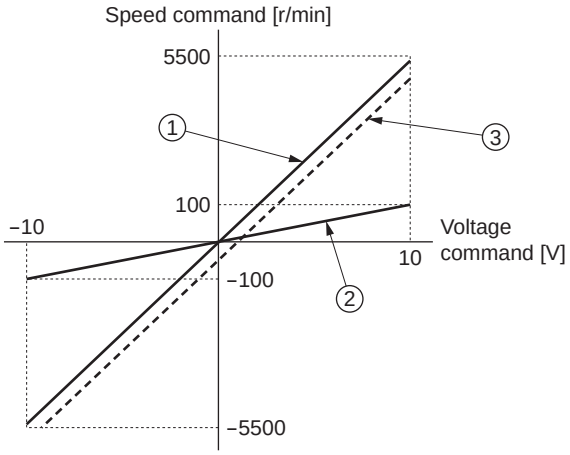
7. Set the speed command value using an external potentiometer or external DC voltage.

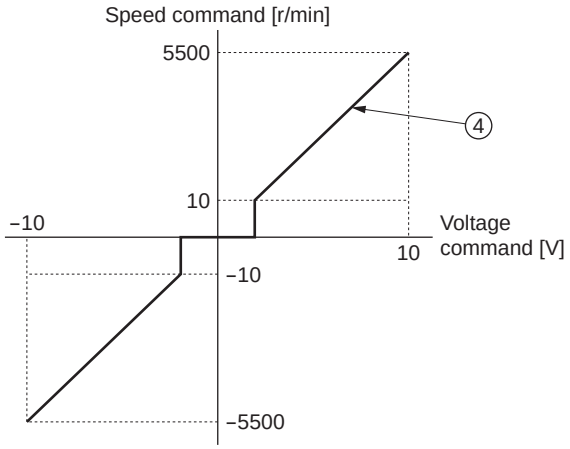
8. Set the acceleration/deceleration time using the internal potentiometer VR2.
The acceleration time and deceleration time are the same.
Setting range: 5 to 10000 ms / (1000 r/min)
Factory setting: 5 ms / (1000 r/min)



Setting example

Setting example	Analog speed command gain [APP-2-00]	Analog speed command clamp [APP-2-01]	Analog speed command offset voltage [APP-2-02]	Description
①	550 r/min	0 r/min	0 V	The speed command value per 1 V of voltage command becomes 550 r/min.
②	10 r/min	0 r/min	0 V	The speed command value per 1 V of voltage command becomes 10 r/min.
③	550 r/min	0 r/min	1 V	The home position of voltage command becomes 1 V. The gain of speed command value is the same as in example①.
④	550 r/min	10 r/min	0 V	If the speed command value is set less than 10 r/min of the voltage command (less than 1 V), the speed command value will be 0 r/min.





■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 2 to 7 as the speed command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 2 to 7.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

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

2. the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 7 as the speed command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 0 to 7.

Step 2 Setting the operation after stopping

In the speed control mode, you can set how the motor should operate after stopping, in the system parameter for operation selection after stopping in speed control mode [SyS-1-02].

When the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Free” (initial value)

Starting/stopping of the motor is interlocked with motor excitation. While the motor is stopped, the motor excitation turns off and the output shaft becomes free. The motor will be excited the moment it is started.
In the case of an electromagnetic brake motor, actuation/release of the electromagnetic brake is controlled in interlock with motor excitation.

When the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Servo lock”

Motor excitation is controlled by the S-ON input. Even when it is not operating, the motor remains excited and the position is being held as long as the S-ON input is ON.
In the case of an electromagnetic brake motor, actuation/release of the electromagnetic brake is controlled in interlock with motor excitation.

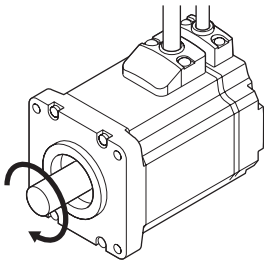
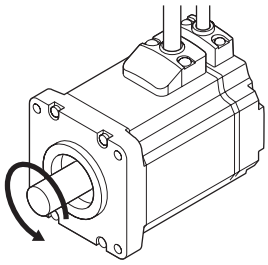
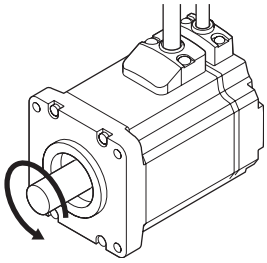
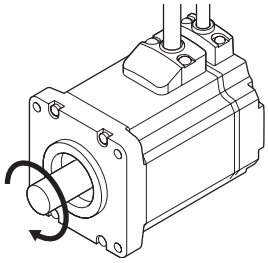
Note When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

Step 3 Setting the motor rotation direction

Set a desired motor rotation direction using the system parameter for motor rotation direction [SyS-1-06].

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

When the speed command is a positive value

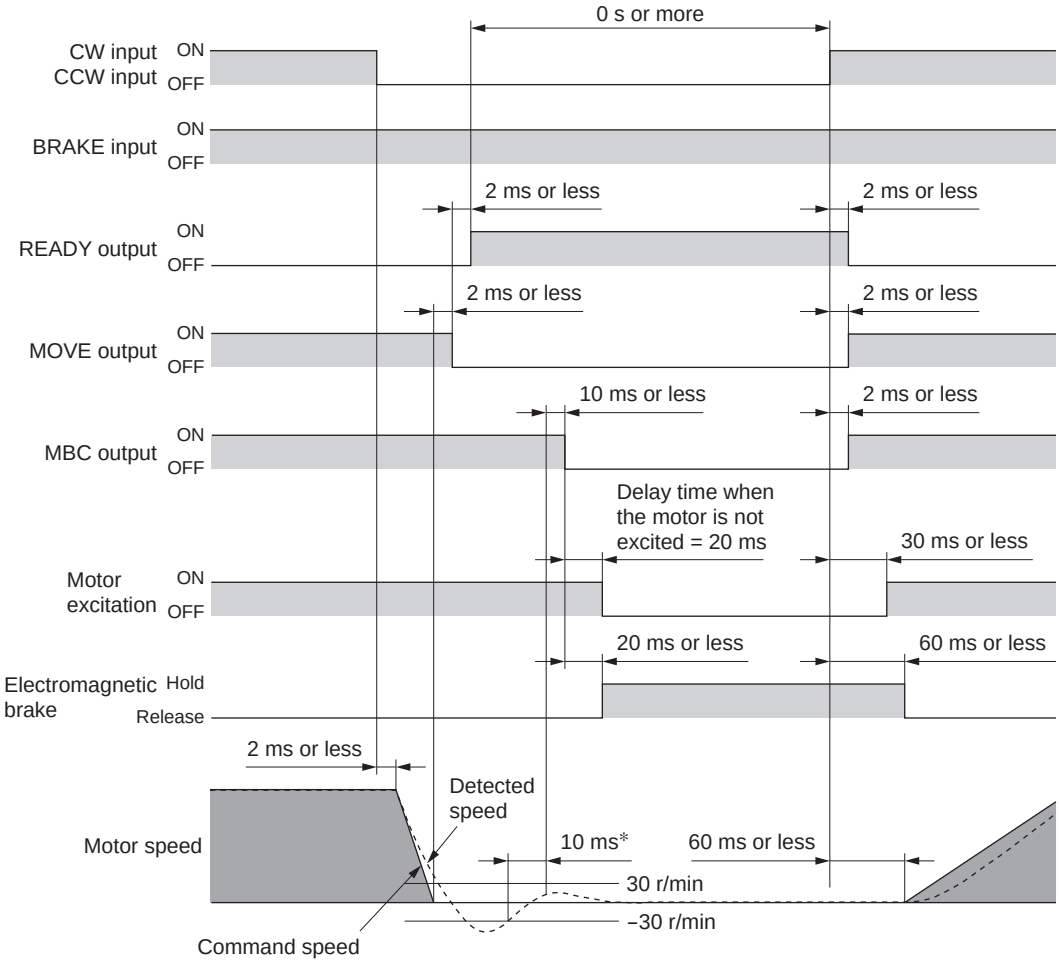
Setting of motor rotation direction parameter [SyS-1-06]	CW input ON	CCW input ON
When "+ = CW" is set	The motor rotates in CW direction. 	The motor rotates in CCW direction. 
When "+ = CCW" is set	The motor rotates in CCW direction. 	The motor rotates in CW direction. 

If the speed command is a negative value, the rotation direction is reversed.

Step 4 Performing the speed controlled operation

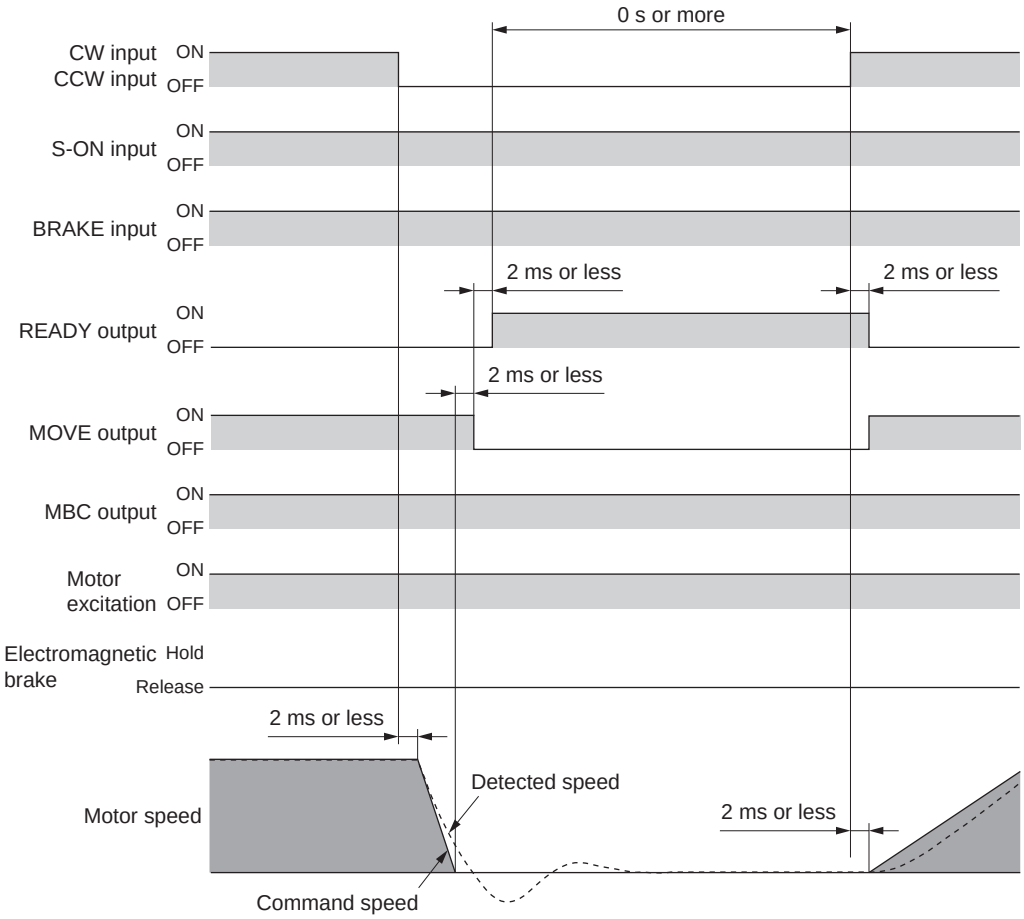
1. Turn the BRAKE input ON.
   If the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to "Servo lock," also turn the S-ON input ON.
   When the motor becomes ready, the READY output will turn ON.
2. Set the speed command value.
   Analog setting: Set a desired value using the internal/external potentiometer or external DC voltage.
   Digital setting: Set a desired operation data number based on a combination of ON/OFF statuses of M0 to M2 inputs.
3. Turn the CW input or CCW input ON.
   A speed controlled operation starts according to the speed command value set in step 2.
4. Turn the CW input or CCW input OFF.
   The motor decelerates to a stop.
   Even if the CW input and CCW input are turned ON simultaneously, the motor will still decelerate until it stops.
   Once the motor operation ends and the rotor enters the zero speed output band, the ZV output will turn ON.

When the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Free”



∗ If the detected speed remains at or below ±30 r/min for 10 ms or more, the MBC output will turn OFF.

When the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Servo lock”



■ Exciting the motor: S-ON input

This input is effective when the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Servo lock.”

Turning the S-ON input ON will excite the motor. In the case of an electromagnetic brake motor, the electromagnetic brake will be released after the motor is excited.

When the S-ON input is OFF, the deviation counter will be cleared and input operation commands will be ignored.

You can set the S-ON input to function in the contact A (normally open) or B (normally closed) logic using the application parameter for S-ON signal logic [APP-1-00] (the initial value is to use the contact A logic (normally open)). If the S-ON input is set to use the contact B (normally closed) logic, the motor will be excited automatically after the power is turned on and turning the S-ON input ON will cause the motor to lose its holding torque.

Note If the S-ON input is turned ON when only the 24 VDC power is input, a main power supply warning will generate. If a pulse signal is input while a main power supply warning is present, a main power supply error will generate.

■ Stopping the motor instantaneously: BRAKE input

The motor can be stopped instantaneously by turning the BRAKE input OFF. To operate the motor, turn the BRAKE input ON.

If the application parameter for BRAKE signal logic [APP-1-01] is set to “Contact A (normally open),” the motor will stop instantaneously when the BRAKE input turns ON.

■ Notifying that the motor is ready: READY output

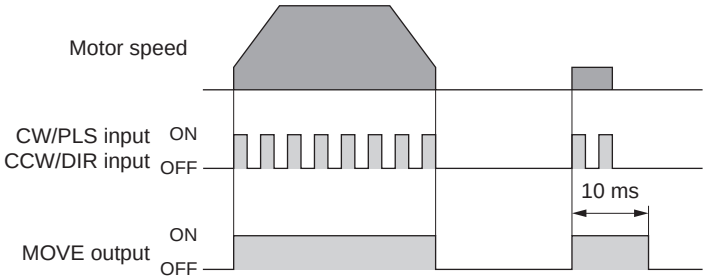
When the motor becomes ready, the READY output will turn ON. Start the operation after confirming that the READY output has turned ON. The READY output remains OFF while the motor is operating.
The READY output is OFF under the following conditions. Motor operation is disabled while the READY output is OFF:

- The main power supply is cut off.
- An alarm is present.
- The S-ON input is OFF (the S-ON input logic is “Contact A (normally open),” and the operation after stopping is “Servo lock”).
- The FREE input, CW input or CCW input is ON.
- The BRAKE input is OFF (the BRAKE input logic is “Contact B (normally closed)”).
- An operation is performed on the **OPX-2A** in the test mode or copy mode.
- A test operation is performed using **MEXE02**.

■ Notifying that operation is in progress: MOVE output

The MOVE output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MOVE output remains ON while the motor is operating. You can set the minimum time during which the MOVE output remains ON using the application parameter for minimum ON time for MOVE signal [APP-1-08]. Even in a short operation, the MOVE output will remain ON for the time set in this parameter.

Example: When 10 ms is set in the parameter for minimum ON time for MOVE signal [APP-1-08]

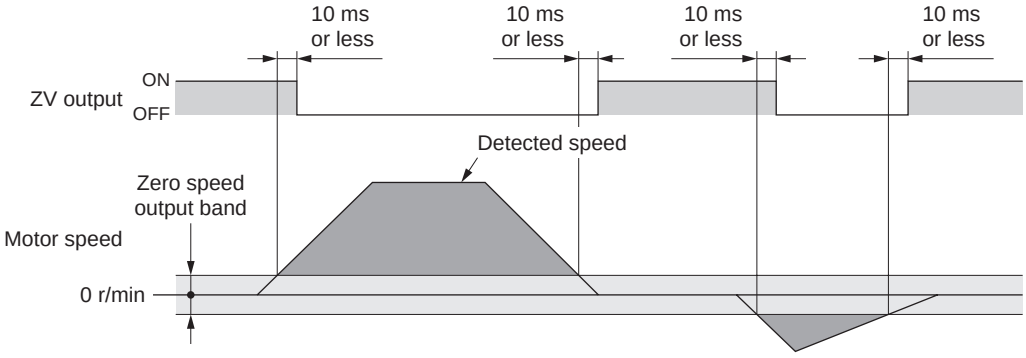


■ Notifying the timing of electromagnetic brake control: MBC output

Use the MBC output to control the electromagnetic brake using a programmable controller, etc.
The MBC output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MBC output will turn ON when the electromagnetic brake is released, and turn OFF when the electromagnetic brake is actuated (= to hold the load in position). Set the programmable controller to control the electromagnetic brake by detecting the ON/OFF status of the MBC output.

■ Notifying that the detected speed has become zero: ZV output

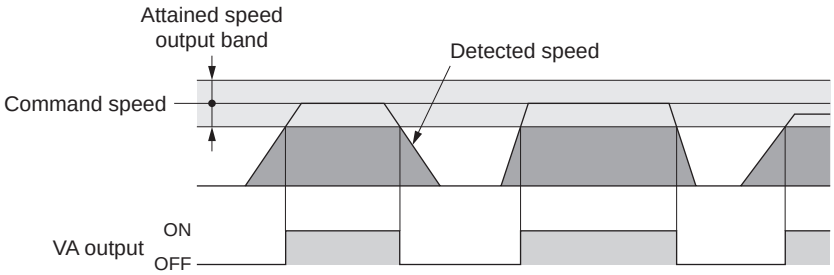
The ZV output can be enabled by selecting the output using the application parameter for output signal selection 2 [APP-1-03]. When the detected speed drops into the zero speed output band, the ZV output will turn ON.
You can set the band within which the ZV output turns ON, using the application parameter for zero speed output band [APP-1-06].



■ Notifying that the command speed has been reached: VA output

When the detected speed enters the range of “command speed ± attained speed output band,” the VA output will turn ON.

You can set the band within which the VA output turns ON, using the application parameter for attained speed output band [APP-1-07].

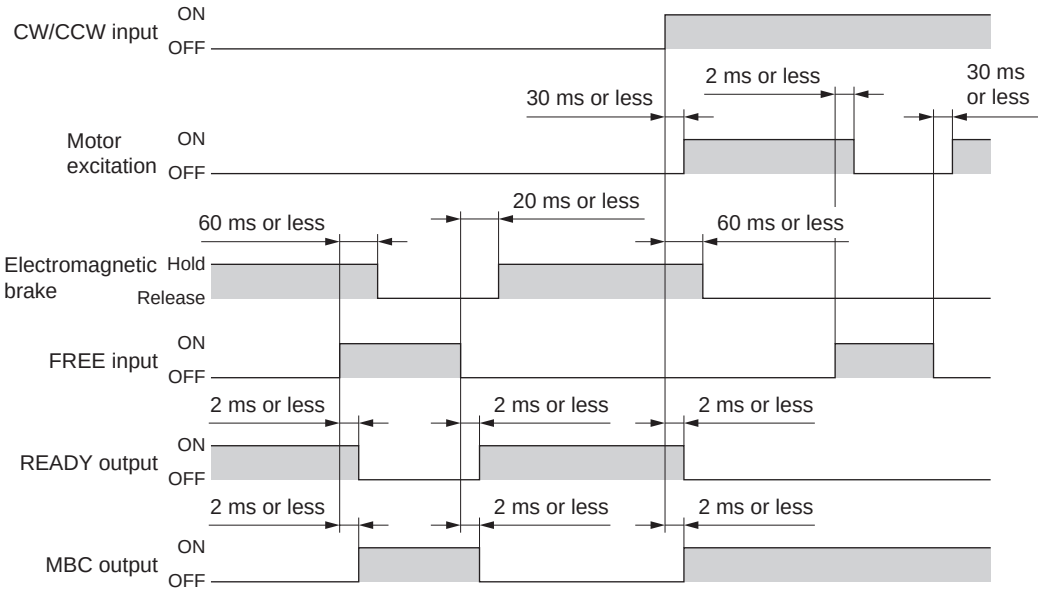


■ Freeing the motor output shaft: FREE input

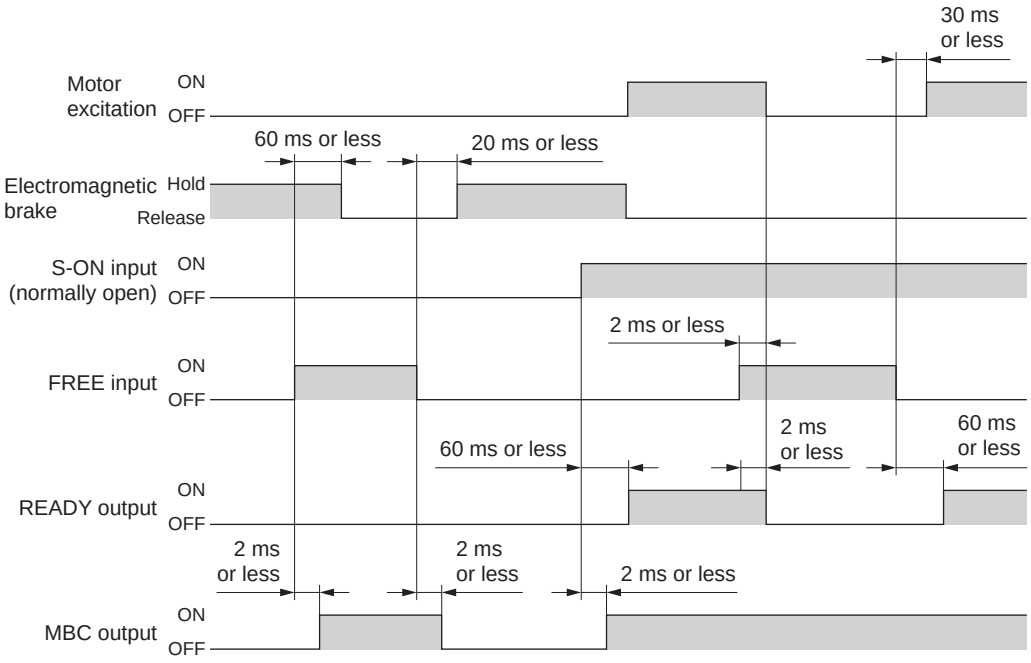
When the FREE input is turned ON, the motor current will be cut off. The motor will lose its holding torque, and the output shaft can be turned with an external force.

If the FREE input is turned ON while the position is held with the electromagnetic brake, the electromagnetic brake will be released. Accordingly, the position can no longer be held.

When the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Free”



When the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Servo lock”



10.4 Torque limit

The maximum output torque of the motor can be limited by turning the TL input ON. Use this input to suppress motor torque, for your safety.
Follow the steps below to limit the maximum output torque of the motor during positioning operation:
Step 1 Setting the torque limit value
Step 2 Limiting the torque

Step 1 Setting the torque limit value

Set a torque limit value under each of eight operation data numbers from 0 to 7.
When the system parameter for analog input signals [SyS-1-05] is set to “Enable,” two analog points as well as six digital points are available to assign settings. If the parameter is set to “Disable,” eight digital points are available to assign settings.
Set the torque limit value as an integer percentage of the rated torque being 100%, in a range of 0 to 300%.

	Analog input signals [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No. 0 or 1	Analog setting (External potentiometer or external DC voltage)	Digital setting
No.2 to 7	Digital setting	

Note If operation data No. 0 is selected as the torque limit, the speed command and acceleration/deceleration time (p.75) set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for the two parameters.

Select a desired torque limit value from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

Operation data	M2 input	M1 input	M0 input
No.0	OFF	OFF	OFF
No.1	OFF	OFF	**ON**
No.2	OFF	**ON**	OFF
No.3	OFF	**ON**	**ON**
No.4	**ON**	OFF	OFF
No.5	**ON**	OFF	**ON**
No.6	**ON**	**ON**	OFF
No.7	**ON**	**ON**	**ON**

■ Analog setting

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Combine the ON/OFF statuses of M0 to M2 inputs to select operation data No. 0 or 1.
3. Connect an external potentiometer or external DC voltage to pins 4 to 6 of the analog I/O connector (CN6).
   Refer to p.42 for details on the connection method.
4. Set the gain.
   Set the torque limit value per 1 V of voltage command in the application parameter for analog torque limit gain [APP-2-03].
   Setting range: 0 to 300%
   Initial value: 30%
5. Adjust the offset.
   If there is even a slight margin of error in the voltage value, the torque limit value may not become 0% even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

   ### Automatic adjustment

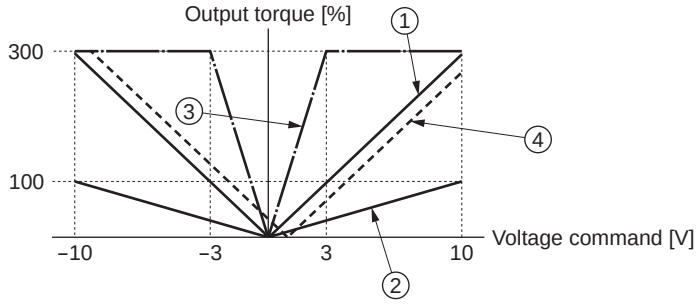
   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Enable.”
   2. Input 0 V to the analog input terminal (pin 5 of CN6).
   3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

   ### Adjustment using a parameter

   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Disable.”
   2. Set the offset voltage in the application parameter for analog torque limit offset voltage [APP-2-05].
6. Use an external potentiometer or external DC voltage to set the torque limit value.

Setting example

Setting example	Analog torque limit gain [APP-2-03]	Analog torque limit offset voltage [APP-2-05]	Description
①	30%	0 V	The torque limit value per 1 V of voltage command becomes 30%.
②	10%	0 V	The torque limit value per 1 V of voltage command becomes 10%.
③	100%	0 V	The torque limit value per 1 V of voltage command becomes 100%.
④	30%	1 V	The home position of voltage command becomes 1 V. The gain of torque limit value is the same as in example①.



■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 2 to 7 as the torque limit value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 2 to 7.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

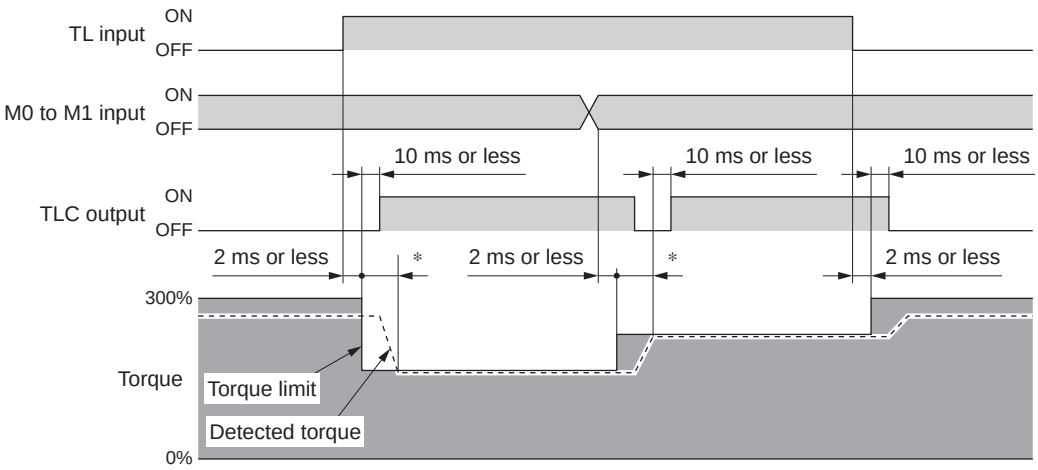
Note When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 7 as the torque limit value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 0 to 7.

Step 2 Limiting the torque

Turning the TL input ON while positioning operation is in progress will limit the maximum output torque by the torque limit value you have set.

Example of limiting the torque using operation data Nos. 1 and 2



* The specific time varies depending on the load condition and gain.

Note If the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to "Free," take note of the following point:
If the TL input is turned ON when the torque limit value is set to 0%, the motor will lose its holding torque. Even if an operation command is input in this condition, the motor will not operate, but the command position will still be refreshed. Turning the TL input OFF in this condition will disable the torque limit function and the motor may move to the command position at the maximum torque. Exercise caution when no external potentiometer or external DC voltage is connected or when the digital setting is 0%.

■ Enabling the torque limit function: TL input

When the TL input is turned ON, the torque limit function will be enabled and the maximum output torque of the motor will be adjusted to the specified torque limit value.
While the TL input is OFF, the torque limit function is disabled and the maximum output torque of the motor remains 300% (the rated torque corresponds to 100%).

■ Notifying that the torque is being limited: TLC output

When the specified torque limit value is reached, the TLC output will turn ON.

10.5 Gain tuning

The motor compliance with respect to commands can be adjusted according to the load inertial and mechanical rigidity.
You can also tune the motor in the semi-auto or manual mode in situations where the positioning time must be shortened, or when automatic tuning is difficult due to a large or fluctuating load inertial moment.

■ Selecting the tuning mode

Gain tuning can be performed in three modes. Select a desired tuning mode using the application parameter for gain tuning mode selection [APP-0-00]. Automatic tuning supports an adjustment range of up to 50 times the rotor inertial moment, while manual tuning supports an adjustment range of up to 100 times.

Automatic: The load inertial moment is estimated internally by the driver. Simply set the mechanical rigidity and the gain will be adjusted automatically.

Semi-auto: Set the mechanical rigidity and load inertial moment ratio, and the gain will be adjusted automatically.

Manual: The customer must set the gain directly. Select this mode when the load inertia is large or the response needs to be increased above the level achievable by automatic tuning.

Related parameters

The parameters that can be set vary depending on the tuning mode.

Parameter name	Automatic	Semi-auto	Manual
Load inertial moment ratio [APP-0-01]	−	○	○
Mechanical rigidity setting [APP-0-02]	○	○	○
Position loop gain [APP-0-03] *	−	−	○
Speed loop gain [APP-0-04]	−	−	○
Speed loop integral time constant [APP-0-05]	−	−	○
Speed feed-forward rate [APP-0-06] *	−	−	○

* This parameter is used when the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Servo lock.”

■ Gain tuning mode

- Automatic

Set the mechanical rigidity using the mechanical rigidity setting switch (SW2) on the driver or the application parameter for mechanical rigidity setting [APP-0-02].
Which value should be made effective is selected using the application parameter for mechanical rigidity setting switch [APP-4-00].
Once the mechanical rigidity is set, the gain will be adjusted automatically.
Refer to p.89 for details on the range of gains that can be set with automatic tuning.

SW2 dial setting	Value of mechanical rigidity setting switch parameter	Reference mechanical rigidity
0 to 3	0 to 3	Low rigidity (belt pulley, etc.)
4 to 9	4 to 9	Medium rigidity (chain, etc.)
A to F	10 to 15	High rigidity (ball screw, directly coupled load, etc.)

Note
- The higher the value of mechanical rigidity, the higher the motor response becomes. Note, however, that an excessively high value may cause vibration or noise.
- The estimated value of load inertial moment is saved in the driver’s EEPROM every 20 minutes.

- Semi-auto

1. Set the application parameter for load inertial moment ratio [APP-0-01].
   The load inertial moment ratio refers to the percentage of the inertial moment of the load to the rotor inertial moment of the motor. If the rotor inertial moment is equal to the load inertial moment, the load inertial moment ratio becomes 100%. Refer to the catalog for the rotor inertial moment of your motor. If the equipment is complex and estimating the load is difficult, you can use the **OPX-2A** or **MEXE02** to monitor the load inertial moment ratio estimated by the driver.
2. Set the mechanical rigidity in the same manner as in the “automatic” mode.
   Once the mechanical rigidity and load inertial moment ratio are set, the gain will be adjusted automatically. Refer to p. 89 for details on the range of gains that can be set with semi-auto tuning.

- Manual

Follow the procedure below to adjust the gain with a sufficient margin.

1. Set the application parameter for load inertial moment ratio [APP-0-01].
   The load inertial moment ratio refers to the percentage of the inertial moment of the load to the rotor inertial moment of the motor. If the rotor inertial moment is equal to the load inertial moment, the load inertial moment ratio becomes 100%. Refer to the catalog for the rotor inertial moment of your motor. If the equipment is complex and estimating the load is difficult, you can use the **OPX-2A** or **MEXE02** to monitor the load inertial moment ratio estimated by the driver.
2. Set the mechanical rigidity in the same manner as in the “automatic” mode.
3. Adjust the compliance with respect to speed deviation. Set the application parameter for speed loop gain [APP-0-04].
   Increasing the speed loop gain will decrease the deviation between the command speed and actual speed. Note, however, that an excessively high value may increase the motor overshoot or cause hunting.

4. Decrease the deviation that cannot be adjusted with the speed loop gain. Set the application parameter for speed loop integral time constant [APP-0-05].
   If the integral time constant is too high, motor operation will become slow. If the constant is too low, on the other hand, hunting may occur.
5. When the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Servo lock,” adjust the compliance with respect to position deviation. Set the application parameter for position loop gain [APP-0-03].
   Increasing the position loop gain will decrease the deviation between the command position and actual position. Note, however, that an excessively high value may increase the motor overshoot or cause hunting.
6. Repeat steps 2 to 5 to set an optimal gain.

- Speed feed-forward rate

This parameter can be set when the parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to “Servo lock.”
If the speed is constant, the deviation between the command position and actual position can be reduced to shorten the settling time.
Setting the speed feed-forward rate to 100% will bring the deviation down to nearly 0. Note, however, that an excessively high value may increase the motor overshoot or undershoot.

■ Gains that can be set with automatic tuning/semi-auto tuning

In automatic tuning and semi-auto tuning, the gain is set automatically.
The table below summarizes different conditions and corresponding gains.

SW2 dial setting	Value of mechanical rigidity setting switch parameter	Position loop gain [Hz]	Speed loop gain [Hz]	Speed loop integral time constant [ms]	Speed feed-forward rate [%]
0	0	3	14	51.0	80
1	1	4	22	51.0	80
2	2	6	32	48.2	80
3	3	9	46	33.8	80
4	4	11	56	28.4	80
5	5	14	68	23.4	80
6	6	16	82	19.4	80
7	7	20	100	15.8	80
8	8	20	120	13.2	80
9	9	20	150	10.6	80
A	10	20	180	8.8	80
B	11	20	220	7.2	80
C	12	20	270	5.8	80
D	13	20	330	4.8	80
E	14	20	390	4.0	80
F	15	20	470	3.4	80

11 Functions and operations in the torque control mode

The following functions are available in the torque control mode:

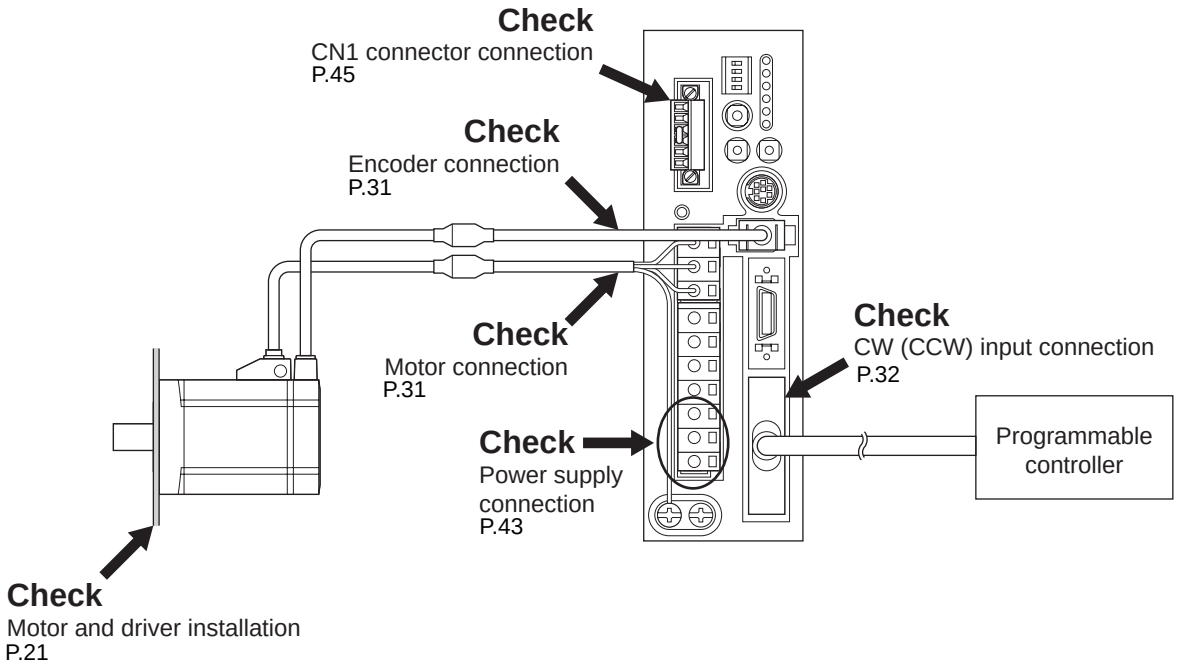
- Torque controlled operation ..... The motor is operated in a manner controlling its output torque at a specified level.
- Speed limit ..... The speed of the motor operating under torque control is limited.

11.1 Quick operations

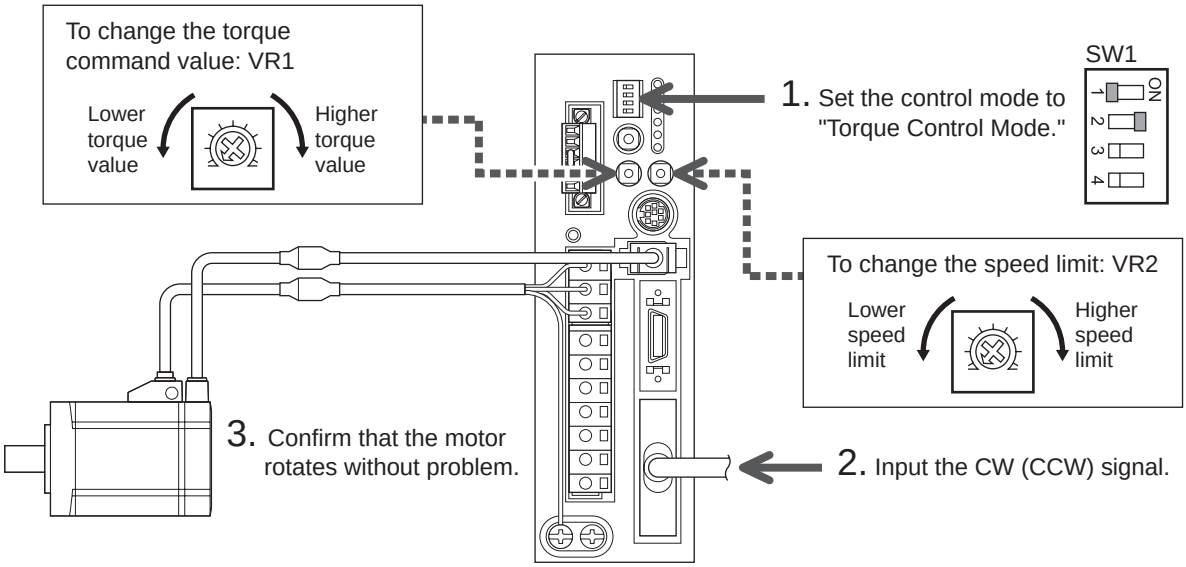
If you are new to the **NX** series driver, read this chapter and you will be able to perform basic motor operations.

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

STEP 1 Check the installation and connection



STEP 2 Operate the motor



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

STEP 3 Were you able to operate the motor properly?

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

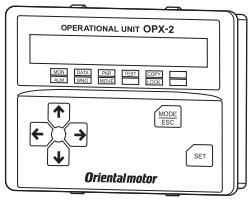
- Are the thermal terminals for regeneration resistor (TH1 and TH2) on the CN1 (shorted)?
- Is any alarm present?
- Are the power supply and motor connected securely?
- Is the TRQ LED (green) lit?
- Isn't the VR2 set to 0 r/min?

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

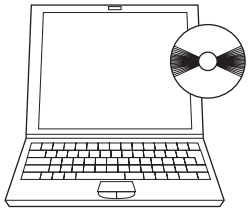
11.2 List of setting items

The items that can be set in the torque control mode are listed below.
You can use the data setter **OPX-2A** or the data setting software **MEXE02** to set operation data or change the internal parameters of the driver.
Parameter codes displayed on the **OPX-2A** screen are shown in brackets. These codes are also referenced in the main text herein. Use these codes as keywords.

OPX-2A



MEXE02



For the method to set parameters with the **OPX-2A** or **MEXE02**, refer to the operating manual for each option.

■ Operation data

Item	Description	**OPX-2A** screen display	Reference
Torque command	Sets the torque command value. The rated torque corresponds to 100%.	trq	p.93
Speed limit	Sets the speed limit value.	rEv	p.99

■ Application parameters

Item	Description	**OPX-2A** screen display	Reference
Output signal selection 1	Selects the output signal.	[APP-1-02]	–
Output signal selection 2	Selects the output signal.	[APP-1-03]	
Zero speed output band	Sets the output condition for ZV output.	[APP-1-06]	p.98
Minimum ON time for MOVE signal	Sets the minimum ON time for MOVE output.	[APP-1-08]	p.98
Alarm code output	Changes the setting to enable/disable alarm code output.	[APP-1-10]	p.126
Analog speed command gain	Sets the speed command per 1 V of analog input voltage.	[APP-2-00]	p.100
Analog speed command clamp	Sets the speed at which to clamp the analog speed command to zero.	[APP-2-01]	
Analog speed command offset voltage	Sets the offset voltage for analog speed command input.	[APP-2-02]	
Analog torque limit gain	Sets the torque limit per 1 V of analog input voltage.	[APP-2-03]	p.94
Analog torque limit offset voltage	Sets the offset voltage for analog torque limit input.	[APP-2-05]	
Analog input signal automatic offset	Changes the setting to enable/disable automatic offset for analog input signals.	[APP-2-06]	
Analog speed monitor maximum value	Sets the maximum value of monitored analog speed. This setting determines the slope of output of monitored analog speed.	[APP-2-07]	p.124
Analog speed monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog speed.	[APP-2-08]	
Analog speed monitor offset voltage	Sets the offset voltage for monitored analog speed.	[APP-2-09]	
Analog torque monitor maximum value	Sets the maximum value of monitored analog torque. This setting determines the slope of output of monitored analog torque.	[APP-2-10]	p.125
Analog torque monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog torque.	[APP-2-11]	
Analog torque monitor offset voltage	Sets the offset voltage for monitored analog torque.	[APP-2-12]	

■ System parameters

Item	Description	**OPX-2A** screen display	Reference
Encoder output electronic gear A	Sets the denominator of the electronic gear for encoder output.	[SyS-0-02]	p.123
Encoder output electronic gear B	Sets the numerator of the electronic gear for encoder output.	[SyS-0-03]	
Analog input signals	Changes the setting to enable/disable the analog input signals.	[SyS-1-05]	p.93
Motor rotation direction	Set the direction in which motor torque generates.	[SyS-1-06]	p.96

11.3 Torque control operation

The motor is operated in a manner controlling its output torque at a specified level.
Follow the steps below to perform a torque controlled operation:
Step 1 Setting the torque command value
Step 2 Setting the motor rotation direction
Step 3 Performing the torque controlled operation

Step 1 Setting the torque command value

Set a torque command value under each of eight operation data numbers from 0 to 7.
When the system parameter for analog input signals [SyS-1-05] is set to “Enable,” two analog points and six digital points are available to assign settings. If the parameter is set to “Disable,” eight digital points are available to assign settings.
Set the torque limit as an integer percentage of the rated torque being 100%, in a range of 0 to 300%.

	Analog input signals [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No.0	Analog setting (internal potentiometer VR1)	Digital setting
No.1	Analog setting (External potentiometer or external DC voltage)	Digital setting
No.2 to 7	Digital setting	

Note If operation data No. 0 is selected for torque controlled operation, the speed limit value (p.99) set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for the two parameters.

Select a desired torque command value from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

Operation data	M2 input	M1 input	M0 input
No.0	OFF	OFF	OFF
No.1	OFF	OFF	**ON**
No.2	OFF	**ON**	OFF
No.3	OFF	**ON**	**ON**
No.4	**ON**	OFF	OFF
No.5	**ON**	OFF	**ON**
No.6	**ON**	**ON**	OFF
No.7	**ON**	**ON**	**ON**

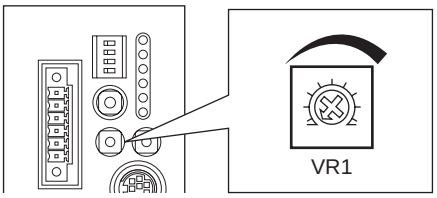
■ Using the internal potentiometer VR1

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 to M2 inputs OFF and select operation data No. 0.

3. Use the internal potentiometer VR1 to set the torque command value.
   Setting range: 0 to 300%
   Factory setting: 0%



■ Using an external potentiometer or external DC voltage

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 input ON and M1 and M2 inputs OFF, and select operation data No. 1.

3. Connect an external potentiometer or external DC voltage to pins 4 to 6 of the analog I/O connector (CN6).
   Refer to p.42 for details on the connection method.

4. Set the gain.
   Set the torque command value per 1 V of voltage command in the application parameter for analog torque command gain [APP-2-03].
   Setting range: 0 to 300%
   Initial value: 30%

5. Set the offset.
   If there is even a slight margin of error in the voltage value, the torque command value may not become 0% even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

   Automatic adjustment

   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Enable.”
   2. Input 0 V to the analog torque input terminal (pin 5 of CN6).
   3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

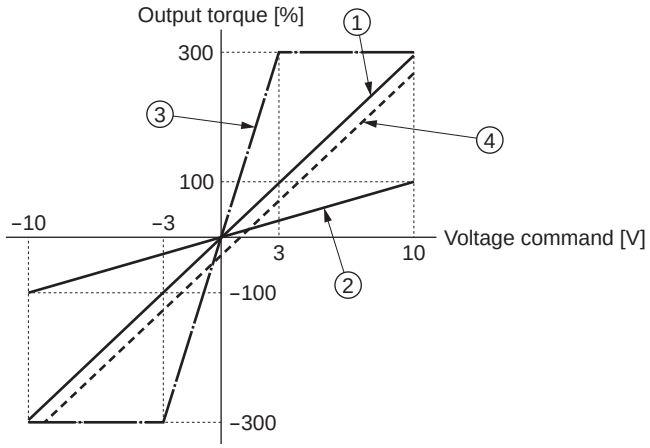
   Adjustment using a parameter

   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Disable.”
   2. Set the offset voltage in the application parameter for analog torque command offset voltage [APP-2-05].

6. Set the torque command value using an external potentiometer or external DC voltage.

Setting example

Setting example	Analog torque command gain [APP-2-03]	Analog torque command offset voltage [APP-2-05]	Description
①	30%	0 V	The torque command value per 1 V of voltage command becomes 30%.
②	10%	0 V	The torque command value per 1 V of voltage command becomes 10%.
③	100%	0 V	The torque command value per 1 V of voltage command becomes 100%.
④	30%	1 V	The home position of voltage command becomes 1 V. The gain on torque command value is the same as in example①.



■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 2 to 7 as the torque command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 2 to 7.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

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

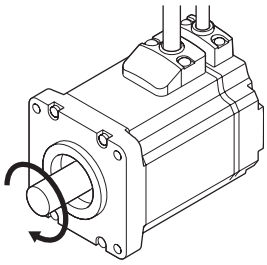
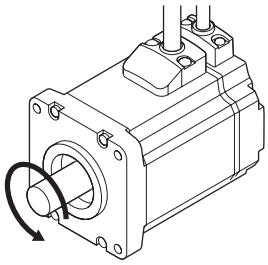
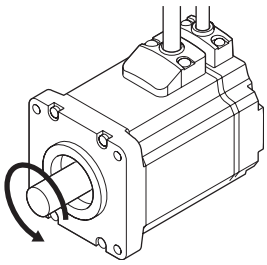
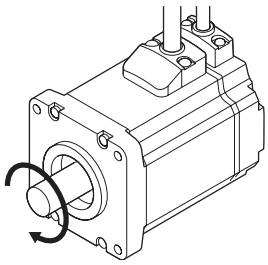
2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 7 as the torque command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 0 to 7.

Step 2 Setting the motor rotation direction

Set a desired motor rotation direction using the system parameter for motor rotation direction [SyS-1-06].

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

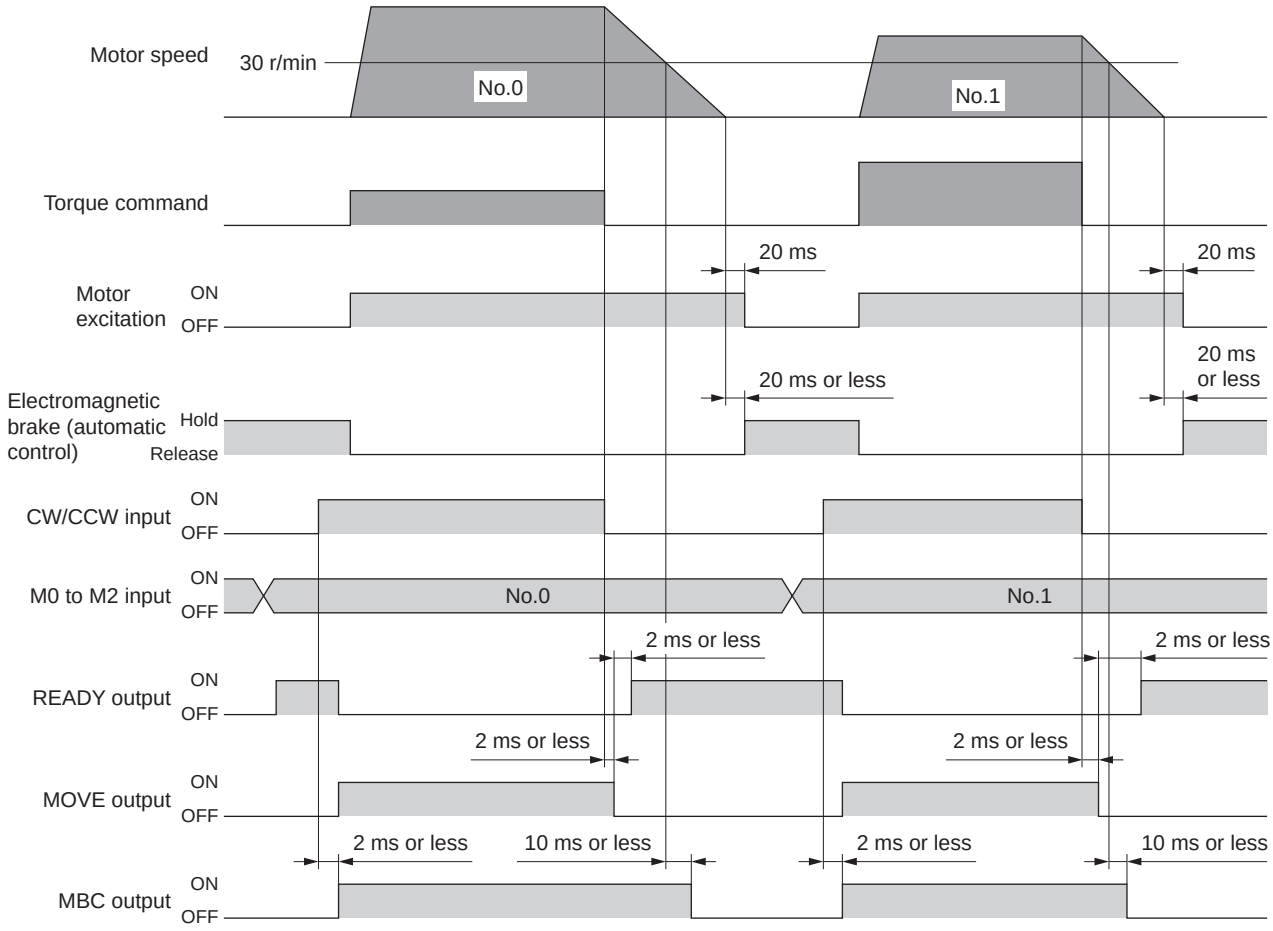
When the torque command is a positive value

Setting of motor rotation direction parameter [SyS-1-06]	CW input ON	CCW input ON
When "+ = CW" is set	The motor rotates in CW direction. 	The motor rotates in CCW direction. 
When "+ = CCW" is set	The motor rotates in CCW direction. 	The motor rotates in CW direction. 

If the torque command is a negative value, the rotation direction is reversed.

Step 3 Performing the torque controlled operation

1. Set the torque command value.
   Analog setting: Set a desired value using the internal/external potentiometer or external DC voltage.
   Digital setting: Set a desired operation data number based on a combination of ON/OFF statuses of M0 to M2 inputs.
2. Turn the CW input or CCW input ON.
   Torque controlled operation starts according to the torque command value set in step 1.
3. Turn the CW input or CCW input OFF.
   The motor torque drops to zero and the motor stops immediately.
   Even if the CW input and CCW input are turned ON simultaneously, the torque will still drop to zero and the motor will stop immediately.



∗ When the CW (or CCW) input is turned OFF, the motor will remain excited for approx. 20 ms after the torque command is completed.

Note Since the operating speed cannot be set in the torque control mode, the motor may operate at high speed if the load is too small for the command torque.

■ Notifying that the motor is ready: READY output

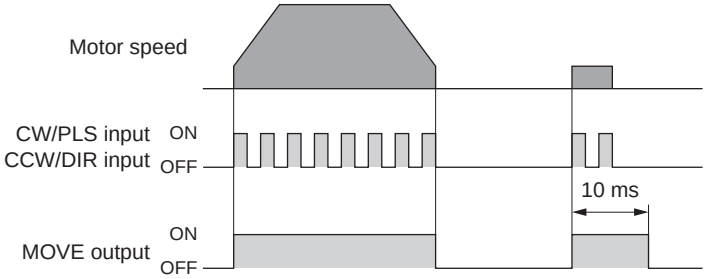
When the motor becomes ready, the READY output will turn ON. Start the operation after confirming that the READY output has turned ON. The READY output remains OFF while the motor is operating.
The READY output is OFF under the following conditions. Motor operation is disabled while the READY output is OFF:

- The main power supply is cut off.
- An alarm is present.
- The FREE input, CW input or CCW input is ON.
- An operation is performed on the **OPX-2A** in the test mode or copy mode.
- A test operation is performed using **MEXE02**.

■ Notifying that operation is in progress: MOVE output

The MOVE output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MOVE output remains ON while the motor is operating. You can set the minimum time during which the MOVE output remains ON using the application parameter for minimum ON time for MOVE signal [APP-1-08]. Even in a short operation, the MOVE output will remain ON for the time set in this parameter.

Example: When 10 ms is set in the parameter for minimum ON time for MOVE signal [APP-1-08]

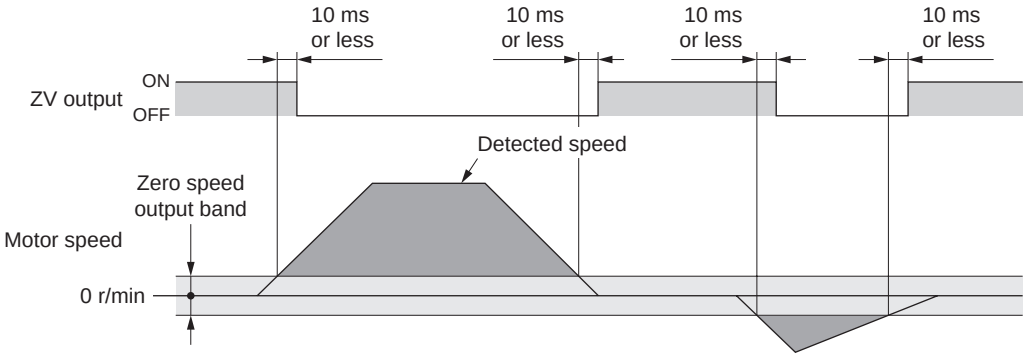


■ Notifying the timing of electromagnetic brake control: MBC output

Use the MBC output to control the electromagnetic brake using a programmable controller, etc.
The MBC output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MBC output will turn ON when the electromagnetic brake is released, and turn OFF when the electromagnetic brake is actuated (= to hold the load in position). Set the programmable controller to control the electromagnetic brake by detecting the ON/OFF status of the MBC output.

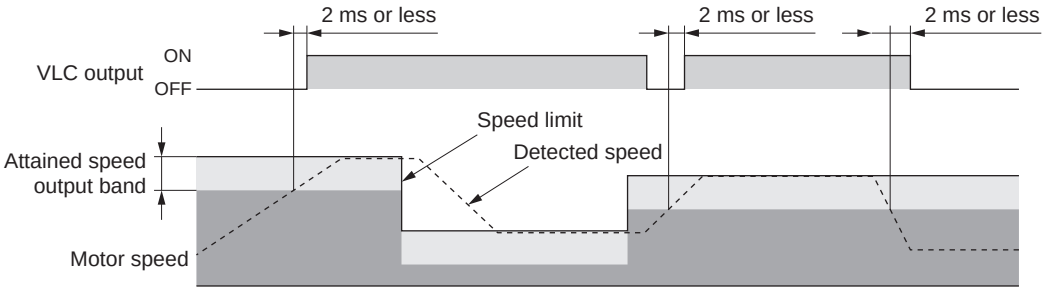
■ Notifying that the detected speed has become zero: ZV output

The ZV output can be enabled by selecting the output using the application parameter for output signal selection 2 [APP-1-03]. When the detected speed drops into the zero speed output band, the ZV output will turn ON.
You can set the band within which the ZV output turns ON, using the application parameter for zero speed output band [APP-1-06].



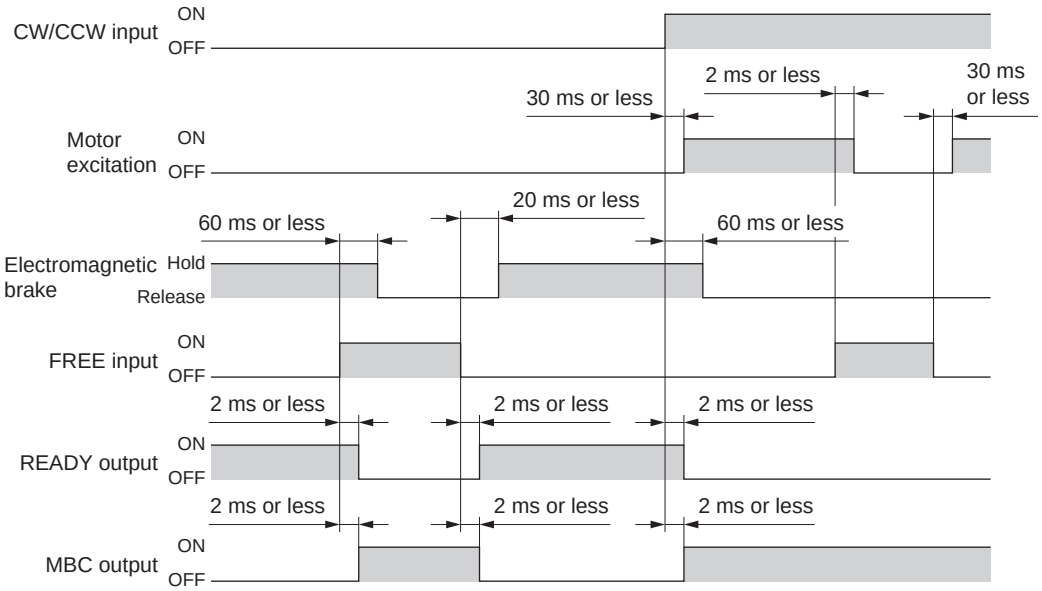
■ Notifying that the speed is being limited: VLC output

When the detected speed reaches the speed limit, the VLC output will turn ON.



■ Freeing the motor output shaft: FREE input

When the FREE input is turned ON, the motor current will be cut off. The motor will lose its holding torque, and the output shaft can be turned with an external force.
If the FREE input is turned ON while the position is held with the electromagnetic brake, the electromagnetic brake will be released. Accordingly, the position can no longer be held.



11.4 Speed limit

Since speed control is not performed during torque controlled operation, the motor may operate at high speed if the load is too small. To prevent this from happening, you can limit the speed of the motor operating under torque control.

Set a speed limit value under each of eight operation data numbers from 0 to 7.
When the system parameter for analog input signals [SyS-1-05] is set to “Enable,” two analog points and six digital points are available to assign settings. If the parameter is set to “Disable,” eight digital points are available to assign settings.

	Analog input signals [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No.0	Analog setting (internal potentiometer VR2)	Digital setting
No.1	Analog setting (External potentiometer or external DC voltage)	Digital setting
No.2 to 7	Digital setting	

Note If operation data No. 0 is selected as the speed limit, the torque command value (p.93) set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for the two parameters.

Select a desired speed limit value from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

Operation data	M2 input	M1 input	M0 input
No.0	OFF	OFF	OFF
No.1	OFF	OFF	**ON**
No.2	OFF	**ON**	OFF
No.3	OFF	**ON**	**ON**
No.4	**ON**	OFF	OFF
No.5	**ON**	OFF	**ON**
No.6	**ON**	**ON**	OFF
No.7	**ON**	**ON**	**ON**

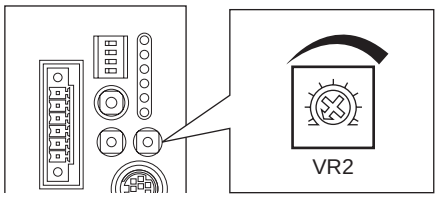
■ Using the internal potentiometer VR2

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 to M2 inputs OFF and select operation data No. 0.

3. Set the speed limit value using the internal potentiometer VR2.
   Setting range: 0 to 5500 r/min
   Factory setting: 0 r/min



■ Using an external potentiometer or external DC voltage

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 input ON and M1 and M2 inputs OFF, and select operation data No. 1.

3. Connect an external potentiometer or external DC voltage to pins 1 to 3 of the analog I/O connector (CN6).
   Refer to p.42 for details on the connection method.

4. Set the gain.
   Set the speed command value per 1 V of voltage command in the application parameter for analog speed limit gain [APP-2-00].
   Setting range: 0 to 5500 r/min
   Initial value: 550 r/min

5. Set the minimum speed.
   To clamp all speed command values below a certain speed at 0 r/min, set the application parameter for analog speed limit clamp [APP-2-01].

6. Set the offset.
   If there is even a slight margin of error in the voltage value, the speed limit value may not become 0 r/min even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

   Automatic adjustment

   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Enable.”

   2. Input 0 V to the analog speed input terminal (pin 1 of CN6).

   3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

Adjustment using a parameter

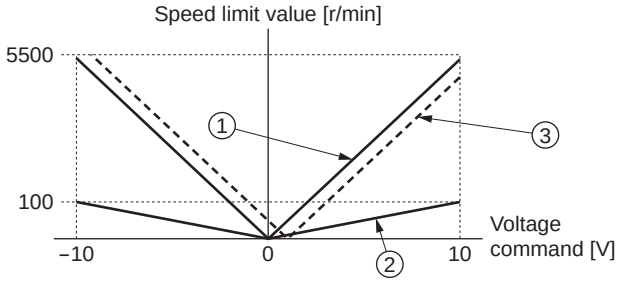
1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Disable.”

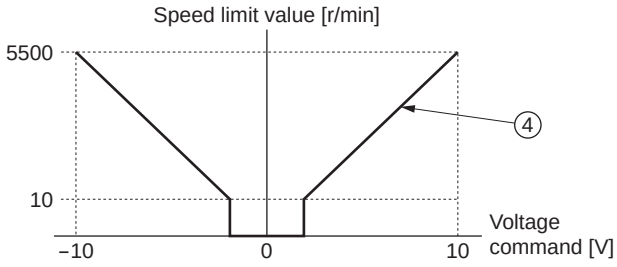
2. Set the offset voltage in the application parameter for analog speed limit offset voltage [APP-2-02].

7. Set the speed limit value using an external potentiometer or external DC voltage.

Setting example

Setting example	Analog speed limit gain [APP-2-00]	Analog speed limit clamp [APP-2-01]	Analog speed limit offset voltage [APP-2-02]	Description
①	550 r/min	0 r/min	0 V	The speed limit value per 1 V of voltage command becomes 550 r/min.
②	10 r/min	0 r/min	0 V	The speed limit value per 1 V of voltage command becomes 10 r/min.
③	550 r/min	0 r/min	1 V	The home position of voltage command becomes 1 V. The gain of speed limit value is the same as in example①.
④	550 r/min	10 r/min	0 V	If the speed limit value is set less than 10 r/min of the voltage command (less than 1 V), the speed limit value will be 0 r/min.





■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 2 to 7 as the speed command value.

3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 2 to 7.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 7 as the speed command value.

3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 0 to 7.

12 Functions and operations in the tension control mode

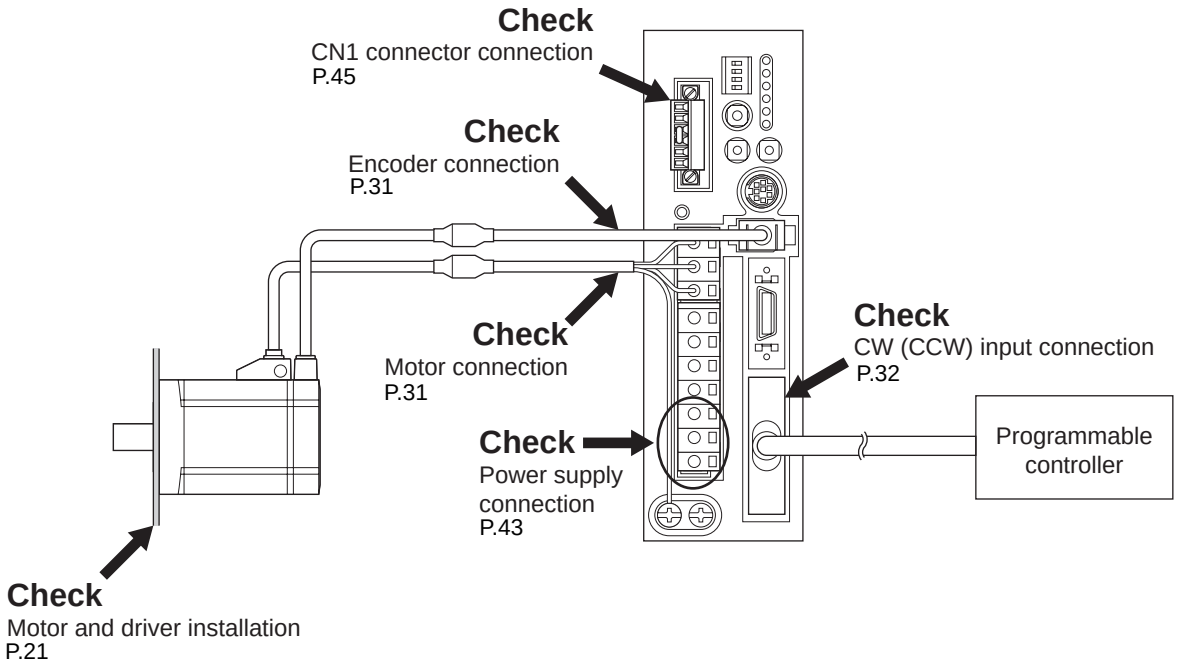
When winding a roll of film, paper, etc., the diameter of material is different between the start and end of winding. Therefore, the torque must be changed according to the changing diameter to keep the tension at a constant level. This type of control is possible in the tension control mode.

12.1 Quick operations

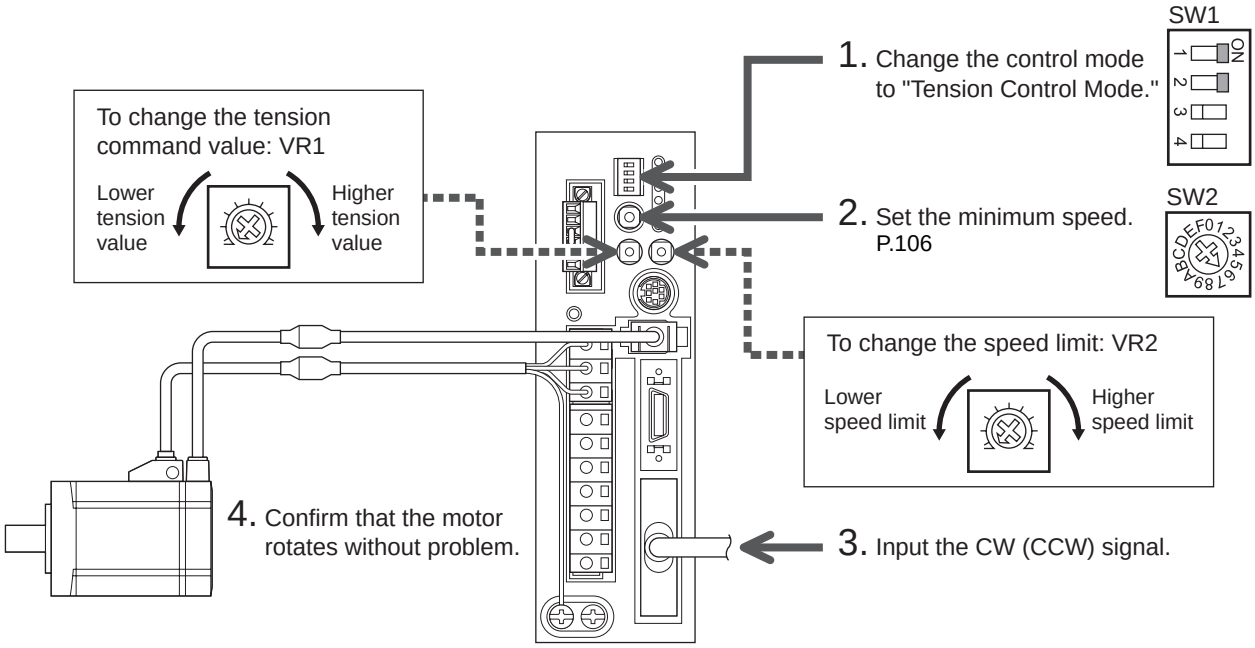
If you are new to the **NX** series driver, read this chapter and you will be able to perform basic motor operations.

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

STEP 1 Check the installation and connection



STEP 2 Operate the motor



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

STEP 3 Were you able to operate the motor properly?

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

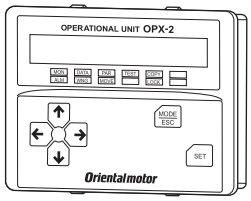
- Are the thermal terminals for regeneration resistor (TH1 and TH2) on the CN1 (shorted)?
- Is any alarm present?
- Are the power supply and motor connected securely?
- Is the TEN LED (green) lit?
- Isn't the VR2 set to 0 r/min?

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

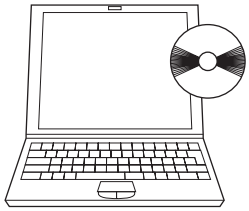
12.2 List of setting items

The items that can be set in the tension control mode are listed below.
You can use the data setter **OPX-2A** or the data setting software **MEXE02** to set operation data or change the internal parameters of the driver.
Parameter codes displayed on the **OPX-2A** screen are shown in brackets. These codes are also referenced in the main text herein. Use these codes as keywords.

OPX-2A



MEXE02



For the method to set parameters with the **OPX-2A** or **MEXE02**, refer to the operating manual for each option.

■ Operation data

Item	Description	**OPX-2A** screen display	Reference
Tension command	Sets the tension command. The rated torque corresponds to 100%.	tEn	p.107 p.111
Material thickness*1*2	Sets the thickness of material.	dt	p.113
Initial diameter*1*2	Sets the initial diameter when winding or unwinding.	din	
Final diameter*1*2	Sets the final diameter when winding or unwinding.	dPk	
Taper setting*1*2	This function prevents excessively tight winding. As the roll diameter increases, the tension is lowered. The tension becomes constant when the taper setting is 100%.	tEP	p.114
Core inertial moment*2	Sets the inertial moment of the core.	Jc	p.114
Material inertial moment*2	Sets the inertial moment of the material at the maximum material thickness.	JL	
Speed limit	Sets the speed limit value.	rEv	p.120

∗1 This parameter is set in high function mode I.
∗2 This parameter is set in high function mode II.

■ Application parameters

Item	Description	**OPX-2A** screen display	Reference
Output signal selection 1	Selects the output signal.	[APP-1-02]	–
Output signal selection 2	Selects the output signal.	[APP-1-03]	
Zero speed output band	Sets the output condition for ZV output.	[APP-1-06]	p.119
Minimum ON time for MOVE signal	Sets the minimum ON time for MOVE output.	[APP-1-08]	p.118
Alarm code output	Changes the setting to enable/disable alarm code output.	[APP-1-10]	p.126
Analog speed limit gain	Sets the speed limit per 1 V of analog input voltage.	[APP-2-00]	p.121
Analog speed limit clamp	Sets the speed at which to clamp the analog speed limit to zero.	[APP-2-01]	
Analog speed limit offset voltage	Sets the offset voltage for analog speed limit input.	[APP-2-02]	
Analog tension command gain	Sets the tension command per 1 V of analog input voltage.	[APP-2-04]	p.107 p.111
Analog tension command offset voltage	Sets the offset voltage for analog tension command input.	[APP-2-05]	
Analog input signal automatic offset	Changes the setting to enable/disable automatic offset for analog input signals.	[APP-2-06]	
Analog speed monitor maximum value	Sets the maximum value of monitored analog speed. This setting determines the slope of output of monitored analog speed.	[APP-2-07]	p.124
Analog speed monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog speed.	[APP-2-08]	
Analog speed monitor offset voltage	Sets the offset voltage for monitored analog speed.	[APP-2-09]	

Item	Description	**OPX-2A** screen display	Reference
Analog torque monitor maximum value	Sets the maximum value of monitored analog torque. This setting determines the slope of output of monitored analog torque.	[APP-2-10]	p.125
Analog torque monitor maximum voltage	Sets the monitored output voltage corresponding to the maximum value of monitored analog torque.	[APP-2-11]	
Analog torque monitor offset voltage	Sets the offset voltage for monitored analog torque.	[APP-2-12]	
Acceleration/deceleration correction filter	Sets the correction filter time constant for acceleration/ deceleration. Increase the value if vibration occurs when the motor accelerates/decelerates during winding operation.	[APP-4-03]	p.115
Friction torque correction	Sets the friction torque correction. This parameter corrects the torque load based on the friction of mechanical parts. The value is based on the torque detected during idle operation.	[APP-4-04]	p.115

■ System parameters

Item	Description	**OPX-2A** screen display	Reference
Encoder output electronic gear A	Sets the denominator of the electronic gear for encoder output.	[SyS-0-02]	p.123
Encoder output electronic gear B	Sets the numerator of the electronic gear for encoder output.	[SyS-0-03]	
Tension control mode selection	Sets the operation mode.	[SyS-1-03]	p.105
Tension control gear ratio	Sets the gear ratio between the motor shaft and winding shaft.	[SyS-1-04]	p.115
Analog input signals	Changes the setting to enable/disable the analog input signals.	[SyS-1-05]	p.107 p.111
Motor rotation direction	Set the direction in which motor torque generates.	[SyS-1-06]	p.109

12.3 Selecting the operation mode

Three operation modes are available in the tension control mode. Set a desired operation mode in the system parameter for tension control mode [SyS-1-03].

Mode type	Description
Simple (initial value)	The tension is controlled at a constant level when the feed rate is constant during winding operation, etc. The motor speed is inversely proportional to the torque.
High function I	The current winding (unwinding) diameter is calculated automatically based on the initial diameter, material thickness and final diameter. The tension is controlled at a constant level regardless of the operating speed.
High function II	In addition to the control in high function mode I, the load inertial moment is calculated internally by the driver based on the material inertial moment and core inertial moment. The tension is controlled at a constant level even during acceleration/deceleration.

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

The operation data items that can be set vary depending on the selected mode.

Setting item	Tension mode		
	Simple	High function I	High function II
Tension command value	Available	Available	Available
Material thickness	Not available	Available	Available
Initial diameter	Not available	Available	Available
Final diameter	Not available	Available	Available
Material inertial moment	Not available	Not available	Available
Core inertial moment	Not available	Not available	Available
Taper setting	Not available	Available	Available
Speed limit	Available	Available	Available

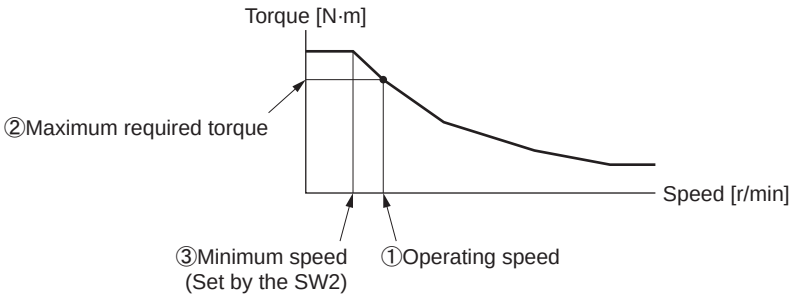
12.4 Tension controlled operation (simple mode)

Follow the steps below to perform a tension controlled operation:
Step 1 Calculating the tension command value
Step 2 Setting the tension command value
Step 3 Setting the motor rotation direction
Step 4 Performing the tension controlled operation

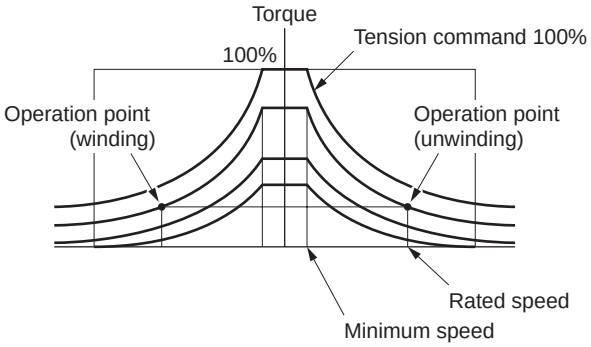
Step 1 Calculating the tension command value

In the simple mode, the operating speed of the motor is inversely proportional to the generated torque. Calculate the tension command value based on the operating speed and torque, by using the formula below:

$$\text{Tension command value [\%]} = \frac{\text{②Maximum required torque [N·m]} \times 100}{\text{Rated motor torque [N·m]}} \times \frac{\text{①Operating speed [r/min]}}{\text{③Minimum speed [r/min]}}$$

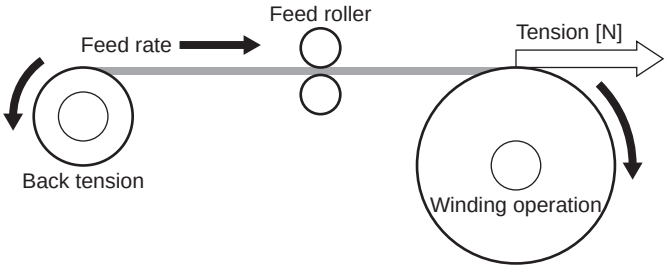


①Operating speed.....The lowest winding speed (corresponding to the maximum roll diameter)
②Maximum required torque.....Calculate an appropriate value according to the mechanism of your equipment.
③Minimum speed.....Set by the SW2. Find an approximate value of operating speed (①) from the table below. Note that the minimum speed must be smaller than the operating speed.
Example: If the operating speed is 24 r/min, the minimum speed should be the value corresponding to dial setting 2 (22 r/min).



SW2 dial setting	Minimum speed [r/min]	SW2 dial setting	Minimum speed [r/min]
0	10	8	220
1	15	9	330
2	22	A	470
3	33	B	680
4	47	C	1000
5	68	D	1500
6	100	E	2200
7	150	F	3000

Note In the simple mode, keep constant the rate of material feed set by the feed roller, etc. If the feed rate changes, the tension cannot be kept constant.



Step 2 Setting the tension command value

Set a tension command value calculated per Step 1 under each of eight operation data numbers from 0 to 7. When the system parameter for analog input signals [SyS-1-05] is set to "Enable," two analog points and six digital points are available to assign settings. If the parameter is set to "Disable," eight digital points are available to assign settings.

	Analog input signals [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No.0	Analog setting (internal potentiometer VR1)	Digital setting
No.1	Analog setting (External potentiometer or external DC voltage)	Digital setting
No.2 to 7	Digital setting	

Note If operation data No. 0 is selected for tension controlled operation, the speed limit value (p.120) set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for the two parameters.

Select a desired tension command value from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

Operation data	M2 input	M1 input	M0 input
No.0	OFF	OFF	OFF
No.1	OFF	OFF	**ON**
No.2	OFF	**ON**	OFF
No.3	OFF	**ON**	**ON**
No.4	**ON**	OFF	OFF
No.5	**ON**	OFF	**ON**
No.6	**ON**	**ON**	OFF
No.7	**ON**	**ON**	**ON**

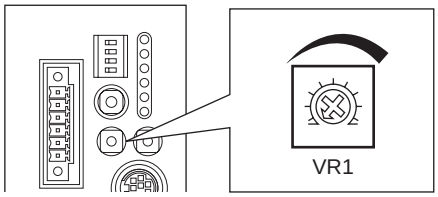
■ Using the internal potentiometer VR1

1. Set the system parameter for analog input signals [SyS-1-05] to "Enable."

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

2. Turn the M0 to M2 inputs OFF and select operation data No. 0.

3. Set the tension command value using the internal potentiometer VR1.
   Setting range: 0 to 100%
   Factory setting: 0%



■ Using an external potentiometer or external DC voltage

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 input ON and M1 and M2 inputs OFF, and select operation data No. 1.
3. Connect an external potentiometer or external DC voltage to pins 4 to 6 of the analog I/O connector (CN6).
   Refer to p.42 for details on the connection method.
4. Set the gain.
   Set the tension command value per 1 V of voltage command in the application parameter for analog tension command gain [APP-2-04].
   Setting range: 0 to 100%
   Initial value: 10%
5. Set the offset.
   If there is even a slight margin of error in the voltage value, the tension command value may not become 0% even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

   ### Automatic adjustment

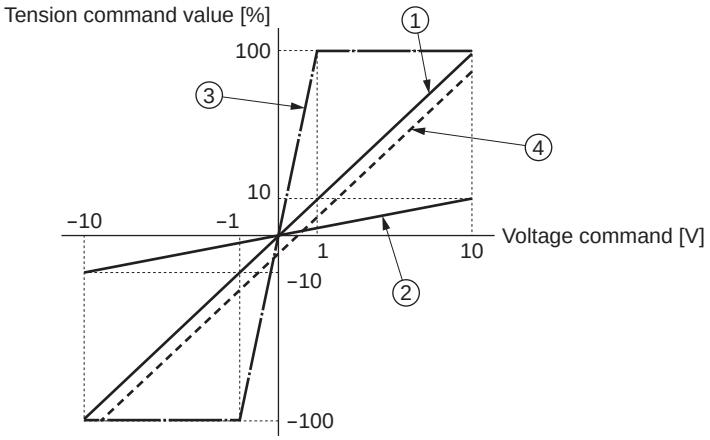
   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Enable.”
   2. Input 0 V to the analog torque input terminal (pin 5 of CN6).
   3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

   ### Adjustment using a parameter

   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Disable.”
   2. Set the offset voltage in the application parameter for analog tension command offset voltage [APP-2-05].
6. Set the tension command value using an external potentiometer or external DC voltage.

Setting example

Setting example	Analog tension command gain [APP-2-04].	Analog tension command offset voltage [APP-2-05].	Description
①	10%	0 V	The tension command value per 1 V of voltage command becomes 10%.
②	1%	0 V	The tension command value per 1 V of voltage command becomes 1%.
③	100%	0 V	The tension command value per 1 V of voltage command becomes 100%.
④	10%	1 V	The home position of voltage command becomes 1 V. The gain on tension command value is the same as in example①.



■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 2 to 7 as the tension command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 2 to 7.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

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

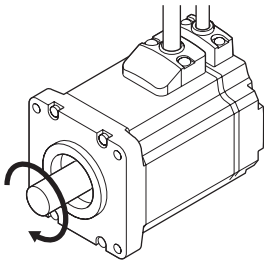
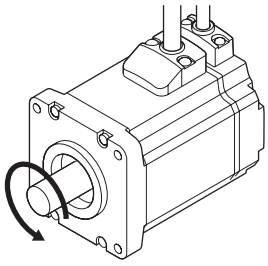
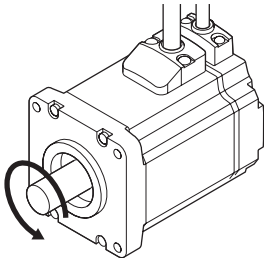
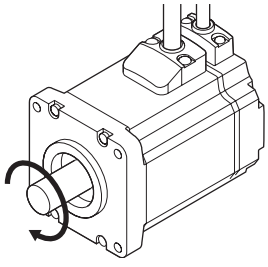
2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 7 as the tension command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 0 to 7.

Step 3 Setting the motor rotation direction

Set a desired motor rotation direction using the system parameter for motor rotation direction [SyS-1-06].

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

When the tension command is a positive value

Setting of motor rotation direction parameter [SyS-1-06]	CW input ON	CCW input ON*
When “+ = CW” is set	The motor rotates in CW direction. 	The motor rotates in CCW direction. 
When “+ = CCW” is set	The motor rotates in CCW direction. 	The motor rotates in CW direction. 

* The CCW input is not used in high function mode I and high function mode II.

If the tension command is a negative value, the rotation direction is reversed.

Step 4 Performing the tension controlled operation

1. Set the tension command value.
   Analog setting: Set a desired value using the internal/external potentiometer or external DC voltage.
   Digital setting: Set a desired operation data number based on a combination of ON/OFF statuses of M0 to M2 inputs.
2. Turn the CW input or CCW input ON.
   Tension controlled operation starts according to the speed command value set in step 1.

   Note Operation data numbers cannot be changed when the CW input or CCW input is ON.
3. Turn the CW input or CCW input OFF.
   Motor excitation turns off and the motor performs the free-run stop.
   Refer to p.116 for details on the timing chart.

12.5 Tension control operation (high function mode I, high function mode II)

Follow the steps below to perform a tension controlled operation:
Step 1 Calculating the tension command value
Step 2 Setting the tension command value
Step 3 Setting the initial diameter, material thickness and final diameter
Step 4 Setting the material inertial moment and core inertial moment (high function mode II only)
Step 5 Setting the taper
Step 6 Performing the tension controlled operation
Step 7 Setting the parameters

Step 1 Calculating the tension command value

Calculate the required motor torque based on the tension and maximum diameter needed for your equipment, by using the formula below:

Required motor torque [N·m] = Tension [N] × Maximum diameter [m] / 2

Based on the calculated required motor torque, calculate the tension command value by using the formula below:

$$\text{Tension command value [\%]} = \frac{\text{Required motor torque [N·m]}}{\text{Rated motor torque [N·m]}} \times 100$$

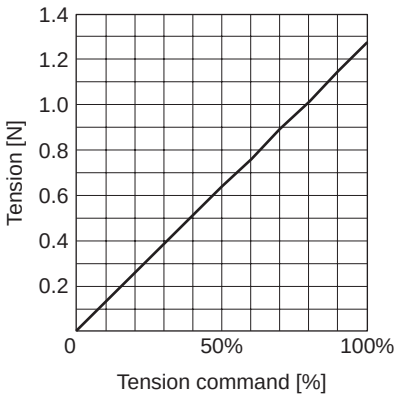
Example: When the tension is 0.32 N, maximum diameter is 1 m (3.3 ft.) and applicable motor is NX620AA-1 (rated torque: 0.64 N·m)

$$\text{Required motor torque [N·m]} = 0.32\ \text{[N]} \times \frac{1\ \text{[m]}}{2} = 0.16\ \text{[N·m]}$$

$$\text{Tension command value [\%]} = \frac{0.16\ \text{[N·m]}}{0.64\ \text{[N·m]}} \times 100 = 25\ \text{[\%]}$$

Example: When the winding diameter is 1000 mm (39.37 in.)

Tension command value [%]	Motor output	
	Torque [N·m]	Tension [N]
100	0.64	1.27
80	0.51	1.02
60	0.38	0.76
40	0.25	0.51
20	0.13	0.25
0	0	0



Step 2 Setting the tension command value

Set a tension command value under each of eight operation data numbers from 0 to 7.
When the system parameter for analog input signals [SyS-1-05] is set to "Enable," two analog points and six digital points are available to assign settings. If the parameter is set to "Disable," eight digital points are available to assign settings.
available to assign settings.

	Analog input signals [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No.0	Analog setting (internal potentiometer VR1)	Digital setting
No.1	Analog setting (External potentiometer or external DC voltage)	Digital setting
No.2 to 7	Digital setting	

Note If operation data No. 0 is selected as the tension command, other data* set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for individual parameters.

∗ High function mode I: Initial diameter, material thickness, final diameter (p.113), taper (p.114), speed limit value (p.120)
High function mode II: Initial diameter, material thickness, final diameter (p.113), material inertial moment, core inertial moment (p.114), taper (p.114), speed limit value (p.120)

Select a desired tension command value from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

Operation data	M2 input	M1 input	M0 input
No.0	OFF	OFF	OFF
No.1	OFF	OFF	**ON**
No.2	OFF	**ON**	OFF
No.3	OFF	**ON**	**ON**
No.4	**ON**	OFF	OFF
No.5	**ON**	OFF	**ON**
No.6	**ON**	**ON**	OFF
No.7	**ON**	**ON**	**ON**

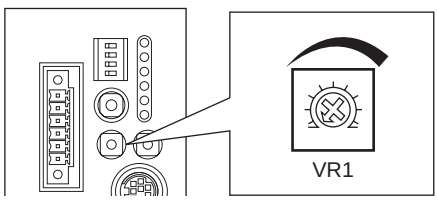
■ Using the internal potentiometer VR1

1. Set the system parameter for analog input signals [SyS-1-05] to "Enable."

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

2. Turn the M0 to M2 inputs OFF and select operation data No. 0.

3. Set the tension command value using the internal potentiometer VR1.
   Setting range: 0 to 100%
   Factory setting: 0%



■ Using an external potentiometer or external DC voltage

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 input ON and M1 and M2 inputs OFF, and select operation data No. 1.
3. Connect an external potentiometer or external DC voltage to pins 4 to 6 of the analog I/O connector (CN6).
   Refer to p.42 for details on the connection method.
4. Set the gain.
   Set the tension command value per 1 V of voltage command in the application parameter for analog tension command gain [APP-2-04].
   Setting range: 0 to 100%
   Initial value: 10%
5. Set the offset.
   If there is even a slight margin of error in the voltage value, the tension command value may not become 0% even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

   ### Automatic adjustment

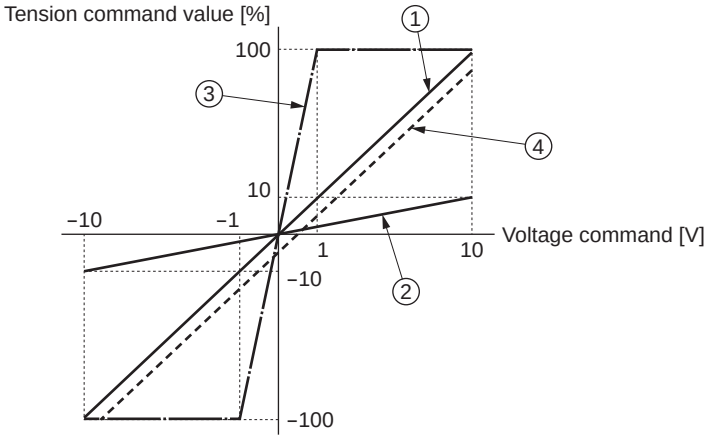
   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Enable.”
   2. Input 0 V to the analog torque input terminal (pin 5 of CN6).
   3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

   ### Adjustment using a parameter

   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Disable.”
   2. Set the offset voltage in the application parameter for analog tension command offset voltage [APP-2-05].
6. Set the tension command value using an external potentiometer or external DC voltage.

Setting example

Setting example	Analog tension command gain [APP-2-04].	Analog tension command offset voltage [APP-2-05].	Description
①	10%	0 V	The tension command value per 1 V of voltage command becomes 10%.
②	1%	0 V	The tension command value per 1 V of voltage command becomes 1%.
③	100%	0 V	The tension command value per 1 V of voltage command becomes 100%.
④	10%	1 V	The home position of voltage command becomes 1 V. The gain on tension command value is the same as in example①.



■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 2 to 7 as the tension command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 2 to 7.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

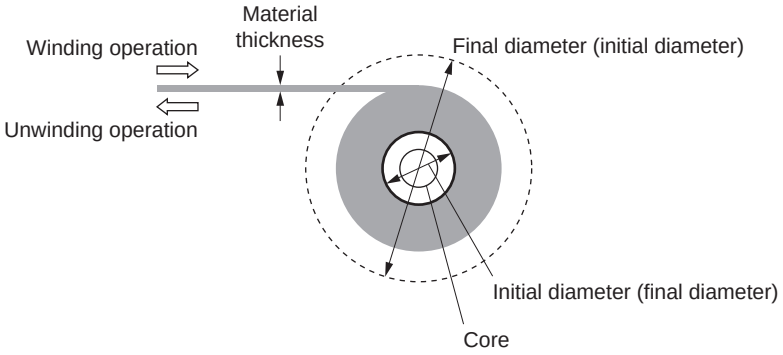
Note When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 7 as the tension command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 0 to 7.

Step 3 Setting the initial diameter, material thickness and final diameter

In high function mode I or high function mode II, set an initial diameter, material thickness and final diameter under each of operation data numbers from 0 to 7.
Select desired data from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

When the initial diameter is smaller than the final diameter, winding operation is performed.
When the initial diameter is greater than the final diameter, unwinding operation is performed.



Item	Initial value	Setting range	Description
Material thickness	50	1 to 5000 [µm]	Sets the thickness of material.
Initial diameter	500	1 to 1000 [mm]	Sets the initial diameter when winding or unwinding.
Final diameter	1000	1 to 1000 [mm]	Sets the final diameter when winding or unwinding.

Step 4 Setting the material inertial moment and core inertial moment (high function mode II only)

In high function mode II, set a material inertial moment and core inertial moment under each of operation data numbers from 0 to 7.
Select desired data from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

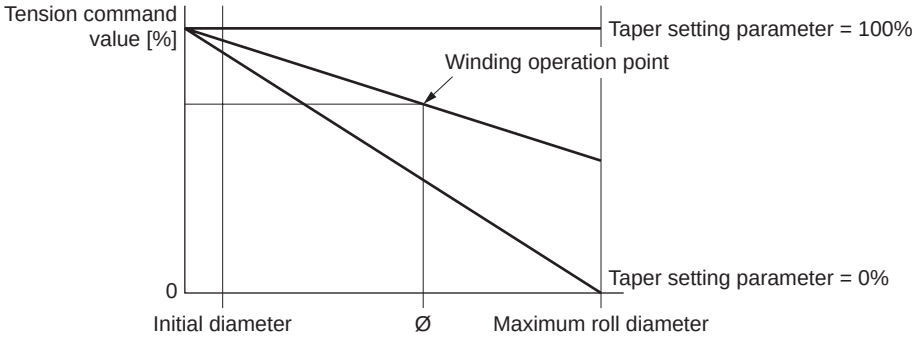
As the material inertial moment, set the value of inertial moment corresponding to the maximum diameter. (The maximum diameter is the final diameter in the case of winding operation, or initial diameter in the case of unwinding operation.)
Do not include the core inertial moment in the material inertial moment.

Item	Initial value	Setting range	Description
Core inertial moment	0	0.00to 99999.99 [$\times 10^{-4}$ kgm^2]	Sets the inertial moment of the core.
Material inertial moment	0	0.00 to 99999.99 [$\times 10^{-4}$ kgm^2]	Sets the inertial moment of the material at the maximum material thickness.

Step 5 Setting the taper

The taper setting lowers the tension as the roll diameter increases, in order to prevent excessively tight winding.
Set a tension (%) at the maximum diameter under each of operation data numbers from 0 to 7.
Select desired data from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

When the taper is 100%, the tension remains constant during the operation.
Setting range: 0 to 100%
Initial value: 100%



When the roll diameter is “0,” the tension command value is used. Once the roll diameter reaches the maximum diameter, the taper setting will be applied to the tension command value.

Example: When the tension command value is set to 80% and taper setting to 50%

When the roll diameter is “0,” the tension command value is 80%.
Once the roll diameter reaches the maximum diameter, the tension command value will be adjusted to 40% (80% × 50%). The tension command value traces a straight line connecting these two values between the point where the roll diameter is “0” and the point where it corresponds to the maximum diameter.
The roll diameter never becomes zero because the core diameter is always included as part of the roll diameter. The tension controlled operation, practically, starts from the "initial diameter" position as shown in the graph above.
If the taper setting is a value other than 100%, the taper is applied to the tension command value from the beginning when the roll diameter is equal to the initial diameter.
If the taper setting is 100%, the tension command value remains the specified value throughout the operation.

Step 6 Performing the tension controlled operation

1. Set the tension command value.
   Analog setting: Set a desired value using the internal/external potentiometer or external DC voltage.
   Digital setting: Set a desired operation data number based on a combination of ON/OFF statuses of M0 to M2 inputs.
2. Set the direction in which tension generates in the system parameter for motor rotation direction [SyS-1-06].
3. Turn the CW input ON.
   Tension controlled operation starts at the tension command value set in step 1.

   Note
   - The CCW input is not accepted in high function mode I or high function mode II.
   - Operation data numbers cannot be changed when the CW input is ON.
4. Turn the CW input OFF.
   Motor excitation turns off and the motor performs the free-run stop.
   Refer to p.116 for details on the timing chart.

Step 7 Setting the parameters

Set the following parameters as necessary.

■ Friction torque correction

Correct the torque load based on the friction of mechanical parts. Set the output torque during idle operation of the equipment in the application parameter for friction torque correction [APP-4-04]. The value based on the output torque during idle operation can be monitored by the **OPX-2A** or **MEXE02**.
Setting range: 0 to 50%
Initial value: 0%

■ Tension control gear ratio

When a deceleration mechanism is used between the motor output shaft and winding (or unwinding) shaft, set a gear ratio in the system parameter for tension control gear ratio [SyS-1-04]. When using the geared motor, include the gear ratio of such geared-motor as well.
Setting range: 1.0 to 1,000.0
Initial value: 1.0

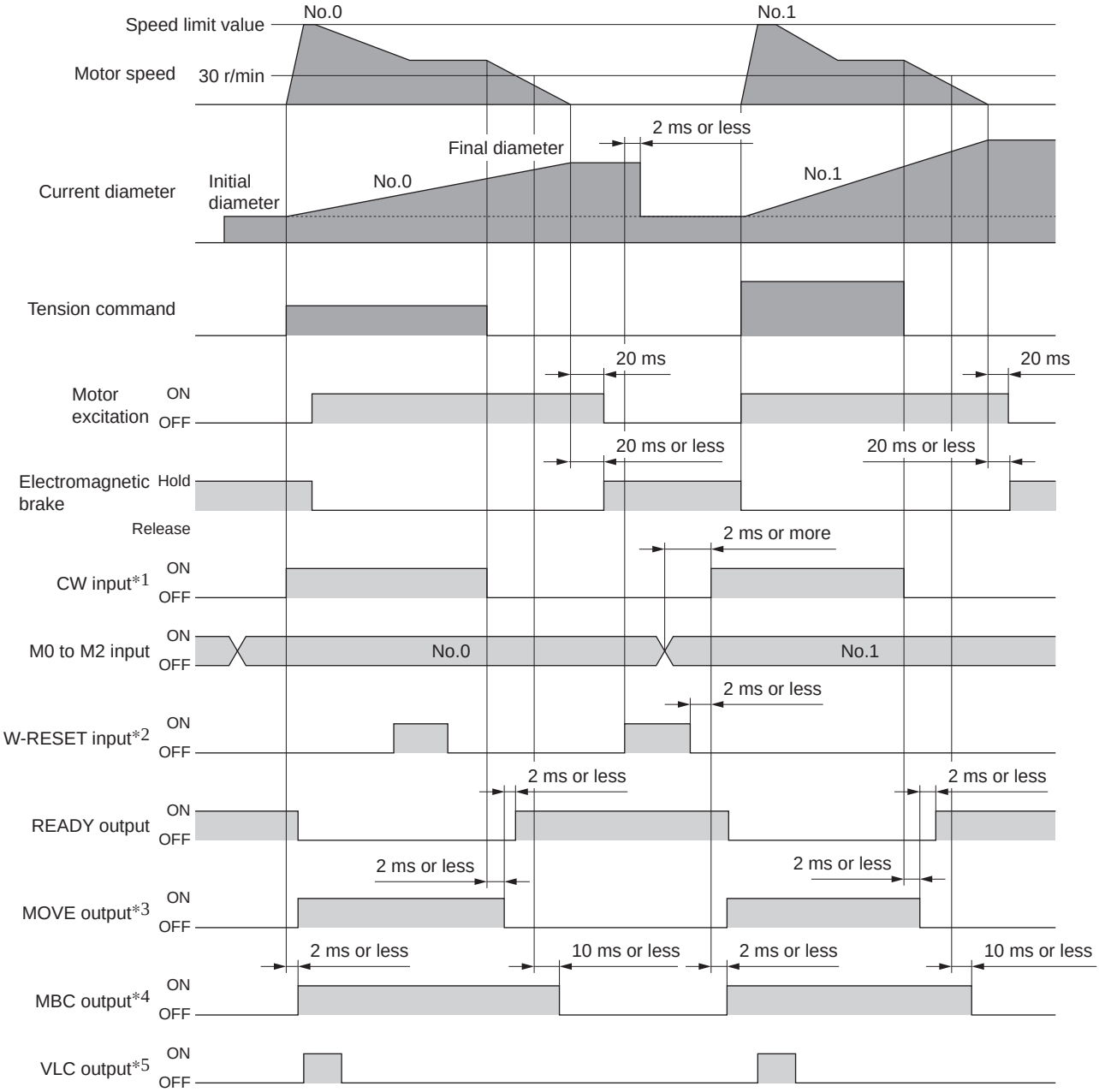
Note
When a system parameter has been changed, the new parameter will become effective after the power is cycled. If a 24 VDC power supply is used, also cycle the 24 VDC power supply.

■ Acceleration/deceleration correction filter (high function mode II only)

Set the correction filter time constant for acceleration/deceleration in the application parameter for acceleration/deceleration correction filter [APP-4-03]. Increase the value if vibration occurs when the motor is operating.
Setting range: 10 to 500 ms
Initial value: 100 ms

12.6 Timing chart

■ Winding operation



∗1 The direction in which the motor rotates when the CW input turns ON can be set in the system parameter for motor rotation direction [SyS-1-06].
The CCW input is not used in high function mode I or high function mode II. In these modes, set the direction in the motor rotation direction parameter [SyS-1-06].

∗2 Turning the W-RESET input ON during operation will not trigger a reset.

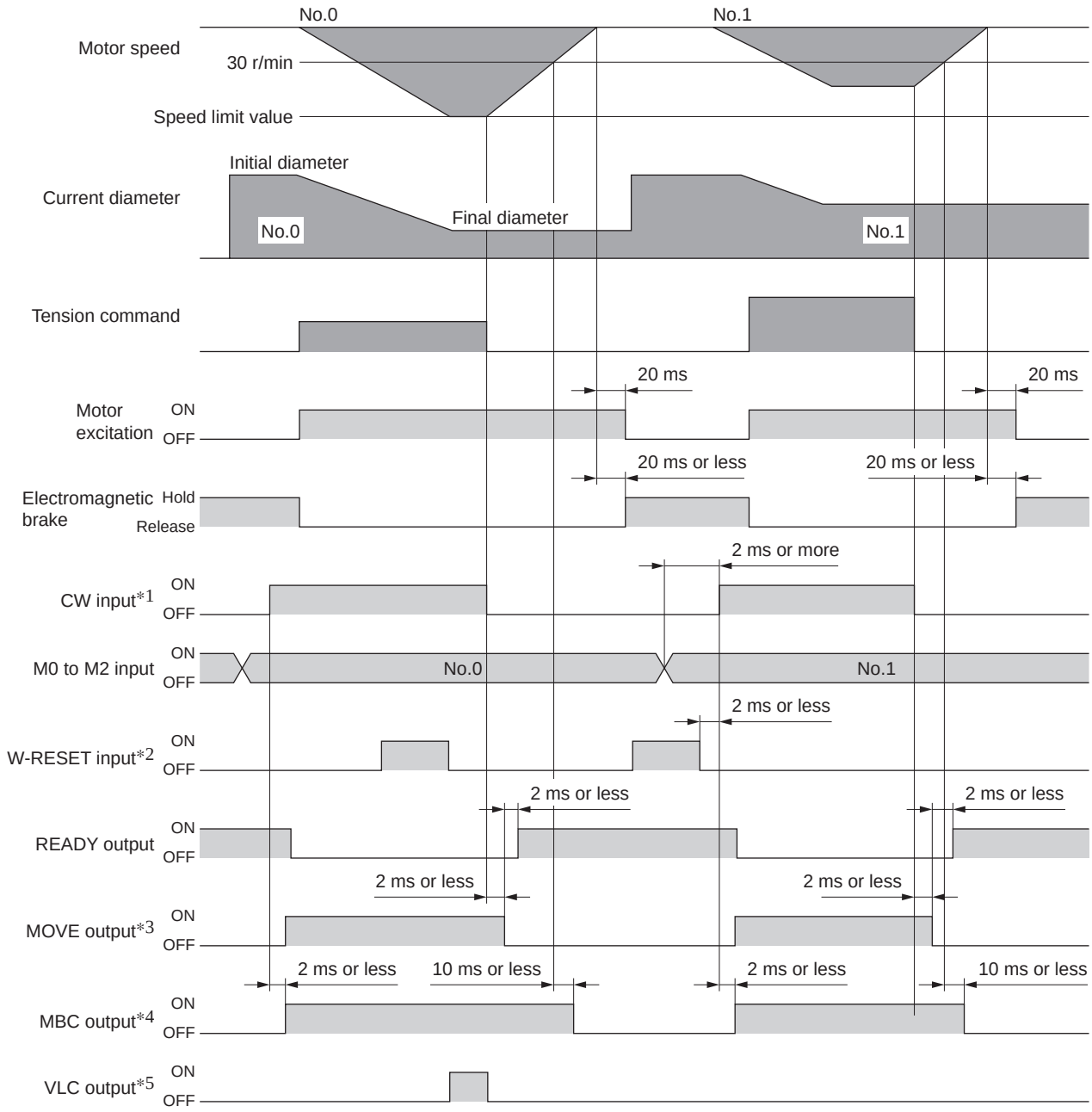
∗3 If the MOVE output is to be used, select the output in the application parameter for output signal selection 1 [APP-1-02]. You can also set the minimum time during which the MOVE output turns ON, using the application parameter for minimum ON time for MOVE signal [APP-1-08].

∗4 If the MBC output is to be used, select the output in the application parameter for output signal selection 1 [APP-1-02].

∗5 Since the operating speed cannot be set in the tension control mode, the motor may operate at high speed at the end of winding if the load is too small. For your reference, the speed limit value can be set in operation data. Once the specified speed limit is reached, the VLC output will turn ON.

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

■ Unwinding operation



∗1 The direction in which the motor rotates when the CW input turns ON can be set in the system parameter for motor rotation direction [SyS-1-06].
The CCW input is not used in high function mode I or high function mode II. In these modes, set the direction in the motor rotation direction parameter [SyS-1-06].

∗2 Turning the W-RESET input ON during operation will not trigger a reset.

∗3 If the MOVE output is to be used, select the output in the application parameter for output signal selection 1 [APP-1-02]. You can also set the minimum time during which the MOVE output turns ON, using the application parameter for minimum ON time for MOVE signal [APP-1-08].

∗4 If the MBC output is to be used, select the output in the application parameter for output signal selection 1 [APP-1-02].

∗5 Since the operating speed cannot be set in the tension control mode, the motor may operate at high speed at the end of winding if the load is too small. For your reference, the speed limit value can be set in operation data. Once the specified speed limit is reached, the VLC output will turn ON.

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

■ Resetting the roll diameter: W-RESET input

In high function mode I and high function mode II, the current winding (unwinding) diameter is calculated. If the W-RESET is turned ON while the motor is stopped, the winding (unwinding) diameter will be reset to the initial diameter at the ON edge of the W-RESET input.
Nothing will happen if the W-RESET input is turned ON while the motor is operating.

■ Notifying that the motor is ready: READY output

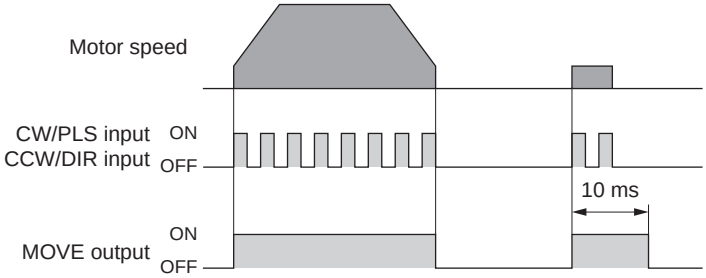
When the motor becomes ready, the READY output will turn ON. Confirm that the READY output is ON before inputting pulses. The READY output remains ON while pulses are input.
The READY output is OFF under the following conditions. Motor operation is disabled while the READY output is OFF:

- The main power supply is cut off.
- An alarm is present.
- The FREE input, CW input or CCW input is ON.
- An operation is performed on the **OPX-2A** in the test mode or copy mode.
- A test operation is performed using **MEXE02**.

■ Notifying that operation is in progress: MOVE output

The MOVE output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MOVE output remains ON while the motor is operating. You can set the minimum time during which the MOVE output remains ON using the application parameter for minimum ON time for MOVE signal [APP-1-08]. Even in a short operation, the MOVE output will remain ON for the time set in this parameter.

Example: When 10 ms is set in the parameter for minimum ON time for MOVE signal [APP-1-08]

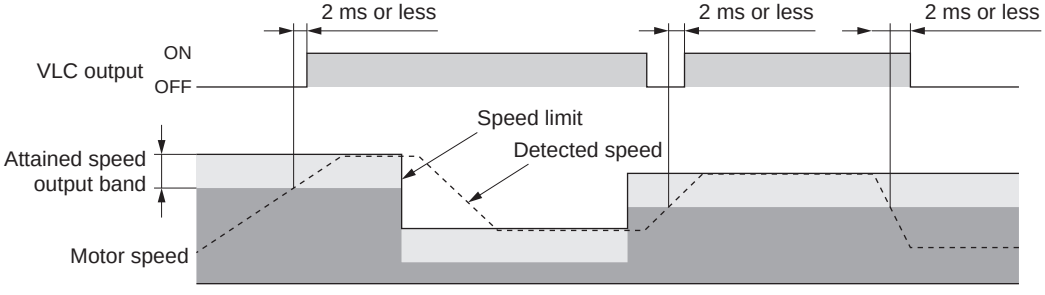


■ Notifying the timing of electromagnetic brake control: MBC output

Use the MBC output to control the electromagnetic brake using a programmable controller, etc.
The MBC output can be enabled by selecting the output using the application parameter for output signal selection 1 [APP-1-02].
The MBC output will turn ON when the electromagnetic brake is released, and turn OFF when the electromagnetic brake is actuated (= to hold the load in position). Set the programmable controller to control the electromagnetic brake by detecting the ON/OFF status of the MBC output.

■ Notifying that the speed is being limited: VLC output

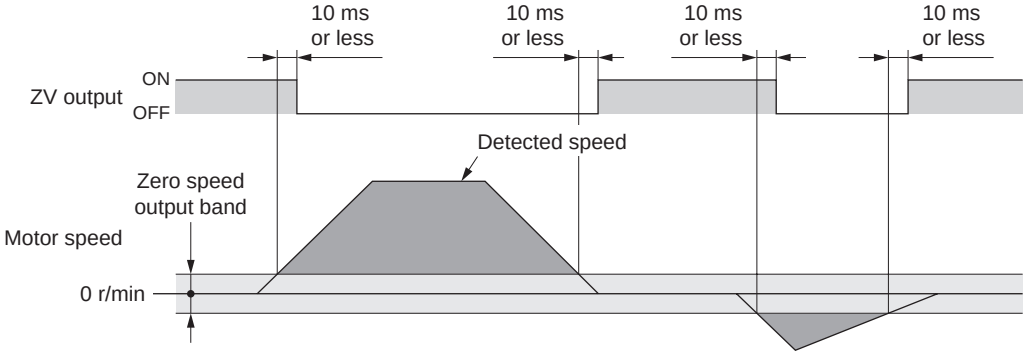
When the detected speed reaches the speed limit, the VLC output will turn ON.



■ Notifying that the detected speed has become zero: ZV output

The ZV output can be enabled by selecting the output using the application parameter for output signal selection 2 [APP-1-03]. When the detected speed drops into the zero speed output band, the ZV output will turn ON.

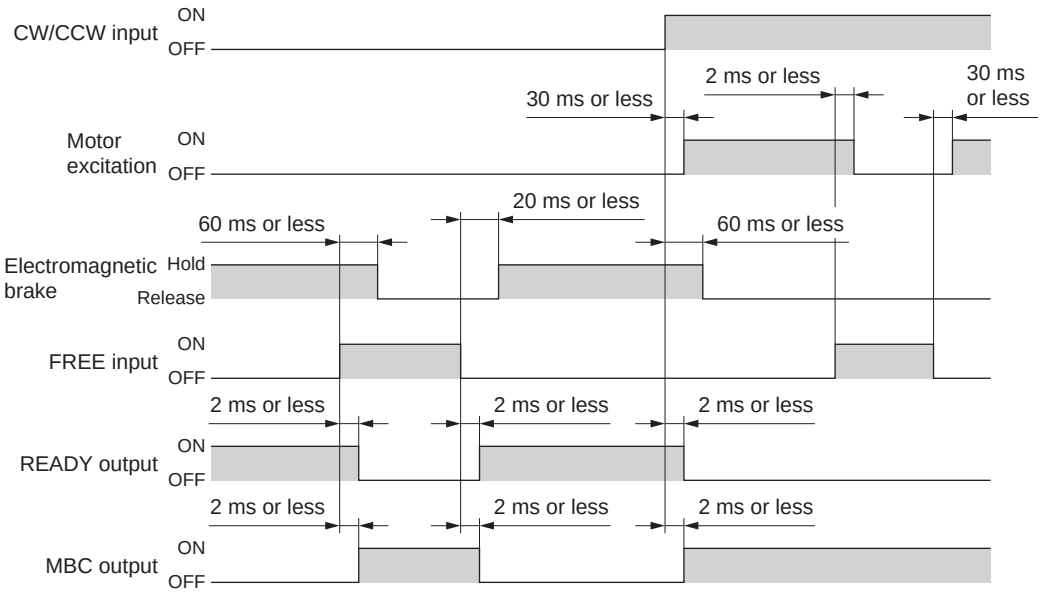
You can set the band within which the ZV output turns ON, using the application parameter for zero speed output band [APP-1-06].



■ Freeing the motor output shaft: FREE input

When the FREE input is turned ON, the motor current will be cut off. The motor will lose its holding torque, and the output shaft can be turned with an external force. The deviation counter will also be cleared.

If the FREE input is turned ON while the position is held with the electromagnetic brake, the electromagnetic brake will be released. Accordingly, the position can no longer be held.



12.7 Speed limit

Since speed control is not performed during tension controlled operation, the motor may operate at high speed if the load is too small. To prevent this from happening, you can limit the speed of the motor operating under tension control.

Set a speed limit value under each of eight operation data numbers from 0 to 7.
When the system parameter for analog input signals [SyS-1-05] is set to "Enable," two analog points and six digital points are available to assign settings. If the parameter is set to "Disable," eight digital points are available to assign settings.

	Analog input signals [SyS-1-05]	
Operation data	Enable (initial value)	Disable
No.0	Analog setting (internal potentiometer VR2)	Digital setting
No.1	Analog setting (External potentiometer or external DC voltage)	Digital setting
No.2 to 7	Digital setting	

Note

If operation data No. 0 is selected as the speed limit, other data* set under operation data No. 0 will also be selected. Different operation data numbers cannot be selected for individual parameters.

* Simple mode: Tension command value (p.107)
  High function mode I: Tension command value (p.111), initial diameter, material thickness, final diameter (p.113), taper (p.114)
  High function mode II: Tension command value (p.111), initial diameter, material thickness, final diameter (p.113), material inertial moment, core inertial moment (p.114), taper (p.114)

Select a desired speed limit value from among the predefined settings, based on a combination of ON/OFF statuses of M0 to M2 inputs.

Operation data	M2 input	M1 input	M0 input
No.0	OFF	OFF	OFF
No.1	OFF	OFF	**ON**
No.2	OFF	**ON**	OFF
No.3	OFF	**ON**	**ON**
No.4	**ON**	OFF	OFF
No.5	**ON**	OFF	**ON**
No.6	**ON**	**ON**	OFF
No.7	**ON**	**ON**	**ON**

■ Using the internal potentiometer VR2

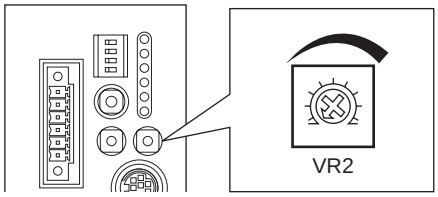
1. Set the system parameter for analog input signals [SyS-1-05] to "Enable."

   Note

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

2. Turn the M0 to M2 inputs OFF and select operation data No. 0.

3. Set the speed limit value using the internal potentiometer VR2.
   Setting range: 0 to 5500 r/min
   Factory setting: 0 r/min



■ Using an external potentiometer or external DC voltage

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Turn the M0 input ON and M1 and M2 inputs OFF, and select operation data No. 1.

3. Connect an external potentiometer or external DC voltage to pins 1 to 3 of the analog I/O connector (CN6).
   Refer to p.42 for details on the connection method.

4. Set the gain.
   Set the speed command value per 1 V of voltage command in the application parameter for analog speed limit gain [APP-2-00].
   Setting range: 0 to 5500 r/min
   Initial value: 550 r/min

5. Set the minimum speed.
   To clamp all speed command values below a certain speed at 0 r/min, set the application parameter for analog speed limit clamp [APP-2-01].

6. Set the offset.
   If there is even a slight margin of error in the voltage value, the speed limit value may not become 0 r/min even when the voltage command specifies 0 V (minimum value). In this case, adjust the offset using one of the two methods described below.

   ### Automatic adjustment

   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Enable.”

   2. Input 0 V to the analog speed input terminal (pin 1 of CN6).

   3. Apply the offset for analog torque input using the **OPX-2A** or **MEXE02**.

   ### Adjustment using a parameter

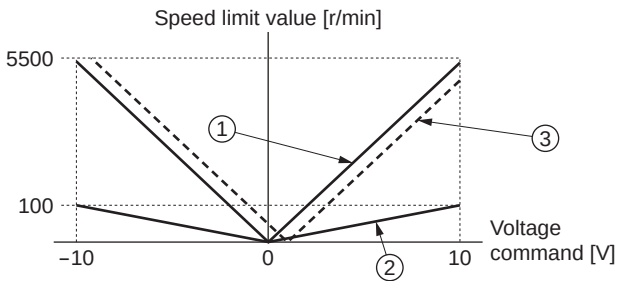
   1. Set the application parameter for analog input signal automatic offset [APP-2-06] to “Disable.”

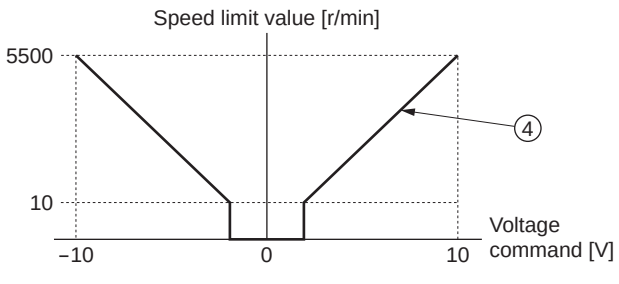
   2. Set the offset voltage in the application parameter for analog speed limit offset voltage [APP-2-02].

7. Set the speed limit value using an external potentiometer or external DC voltage.

Setting example

Setting example	Analog speed limit gain [APP-2-00]	Analog speed limit clamp [APP-2-01]	Analog speed limit offset voltage [APP-2-02]	Description
①	550 r/min	0 r/min	0 V	The speed limit value per 1 V of voltage command becomes 550 r/min.
②	10 r/min	0 r/min	0 V	The speed limit value per 1 V of voltage command becomes 10 r/min.
③	550 r/min	0 r/min	1 V	The home position of voltage command becomes 1 V. The gain of speed limit value is the same as in example①.
④	550 r/min	10 r/min	0 V	If the speed limit value is set less than 10 r/min of the voltage command (less than 1 V), the speed limit value will be 0 r/min.





■ Digital setting

- When the analog input signal parameter [SyS-1-05] is set to “Enable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Enable.”

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

2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 2 to 7 as the speed command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 2 to 7.

- When the analog input signal parameter [SyS-1-05] is set to “Disable”

1. Set the system parameter for analog input signals [SyS-1-05] to “Disable.”

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

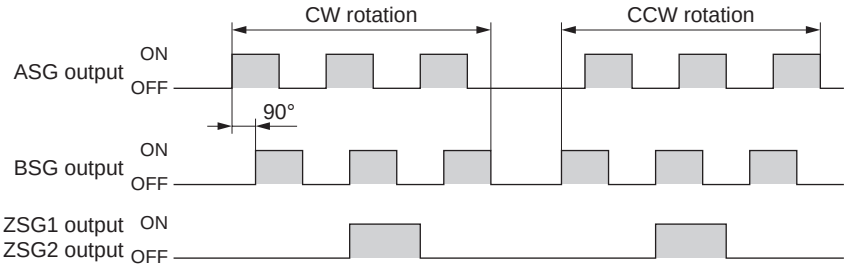
2. Use the **OPX-2A** or **MEXE02** to set one of operation data Nos. 0 to 7 as the speed command value.
3. Combine the ON/OFF statuses of M0 to M2 inputs to select one of operation data Nos. 0 to 7.

13 Monitor functions

This chapter explains the functions to check the motor conditions, such as motor position, detected speed and detected torque. The monitor functions described herein are available in all control modes.

13.1 Encoder output

The motor position can be checked by counting the numbers of ASG output and BSG output pulses.
The BSG output has a 90° phase difference with respect to the ASG output.
The ZSG1 output and ZSG2 output will turn ON every time the motor rotates by one revolution.



Note

- There is a maximum delay of 0.1 ms between pulse output and motor movement. Accordingly, use the ASG output and BSG output for checking the position where the motor is stopped.
- The minimum output band is approx. 400 µs for both the ZSG1 output and ZSG2 output.
- If the ZSG1 output and ZSG2 output are used, keep the frequencies of the ASG output and BSG output to below 1 kHz. If the ASG and BSG frequencies are 1 kHz or higher, the ZSG1 and ZSG2 signals may not be output properly.

■ Resolution of encoder output

You can set a desired resolution of encoder output using the system parameters for encoder output electronic gear A [SyS-0-02] and encoder output electronic gear B [SyS-0-03].
However, the calculated value must fall within the setting range specified below:
Resolution setting range: 100 to 10000 P/R
Initial value: 1000 P/R

$$\text{Encoder output resolution [P/R]} = 1000 \times \frac{\text{Encoder output electronic gear B [SyS-0-03]}}{\text{Encoder output electronic gear A [SyS-0-02]}}$$

Setting example

Resolution (P/R)	Encoder output electronic gear A	Encoder output electronic gear B
1000	1 (initial value)	1 (initial value)
100	10	1
360	100	36

13.2 Analog monitor

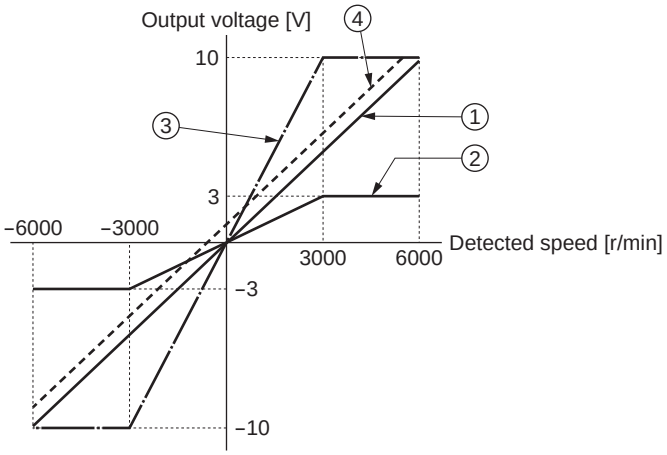
The detected speed and detected torque can be output as voltages from pin 7 (V-MON output) and pin 9 (T-MON output) of the analog I/O connector (CN6), respectively.
Use this function if you want the output voltage to be monitored by a programmable controller, etc.
Output voltage: ±10 VDC

■ Analog speed monitor

Set the analog speed monitor using the following application parameters:

- Analog speed monitor maximum value [APP-2-07]
  Sets the maximum value of detected speed to be monitored.
- Analog speed monitor maximum voltage [APP-2-08]
  Sets the voltage at which to detect the maximum speed.
- Analog speed monitor offset voltage [APP-2-09]
  This parameter is set when the home position of output voltage is to be offset.

Setting example	Analog speed monitor maximum value [APP-2-07]	Analog speed monitor maximum voltage [APP-2-08]	Analog speed monitor offset voltage [APP-2-09]	Description
①	6000 r/min	10 V	0 V	When the detected speed is 6000 r/min, 10 V is output.
②	3000 r/min	3 V	0 V	When the detected speed is 3000 r/min, 3 V is output. The voltage does not rise above 3 V even when the detected speed exceeds 3000 r/min.
③	3000 r/min	10 V	0 V	When the detected speed is 3000 r/min, 10 V is output.
④	6000 r/min	10 V	1 V	The home position of output voltage becomes 1 V.



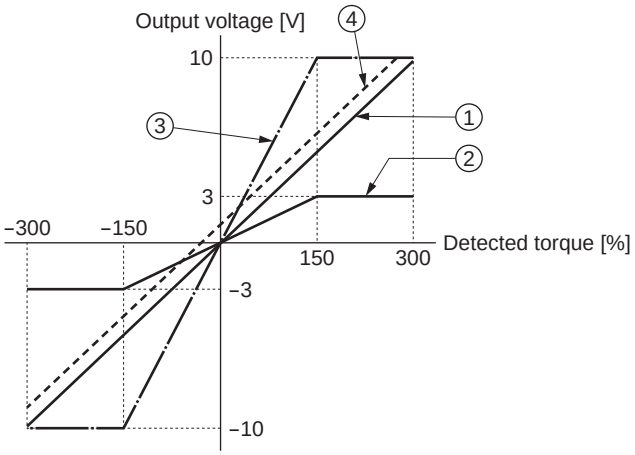
Note Even when a speed above the maximum voltage is detected, the output will not exceed the maximum voltage.

■ Analog torque monitor

Set the analog torque monitor using the following application parameters:

- Analog torque monitor maximum value [APP-2-10]
  Sets the maximum value of detected torque to be monitored.
- Analog torque monitor maximum voltage [APP-2-11]
  Sets the voltage at which to detect the maximum torque.
- Analog torque monitor offset voltage [APP-2-12]
  This parameter is set when the home position of output voltage is to be offset.

Setting example	Analog torque monitor maximum value [APP-2-10]	Analog torque monitor maximum voltage [APP-2-11]	Analog torque monitor offset voltage [APP-2-12]	Description
①	300%	10 V	0 V	When the detected torque is 300%, 10 V is output.
②	150%	3 V	0 V	When the detected torque is 150%, 3 V is output. The voltage does not rise above 3 V even when the detected torque exceeds 150%.
③	150%	10 V	0 V	When the detected torque is 150%, 10 V is output.
④	300%	10 V	1 V	The home position of output voltage becomes 1 V.



Note Even when a torque above the maximum voltage is detected, the output will not exceed the maximum voltage.

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

Note The driver uses semiconductor elements, so be extremely careful when handling them. Static electricity may damage the driver.

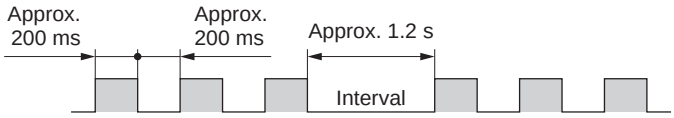
15 Alarms and warnings

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 the application parameter for alarm code output [APP-1-10] is set to "Enable," the READY output, TLC/VLC output and ZSG2/NEAR/ZV output will automatically switch to the AL0 output, AL1 output and AL2 output, respectively. However, the current position output function is given priority when the P-REQ input is ON in the position control mode. In this case, alarm codes are not output. Also, the ALM-RST input cannot be used because the CLR/ALM-RST/P-CK input functions as the P-CK input.
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 data setter **OPX-2A** or the data setting software **MEXE02**.
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)



Note Some alarms cause the motor current to be cut off, resulting in the motor losing its holding torque. In the case of an electromagnetic brake motor, the electromagnetic brake will actuate to hold the load in position.

■ Alarm reset

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

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

Note

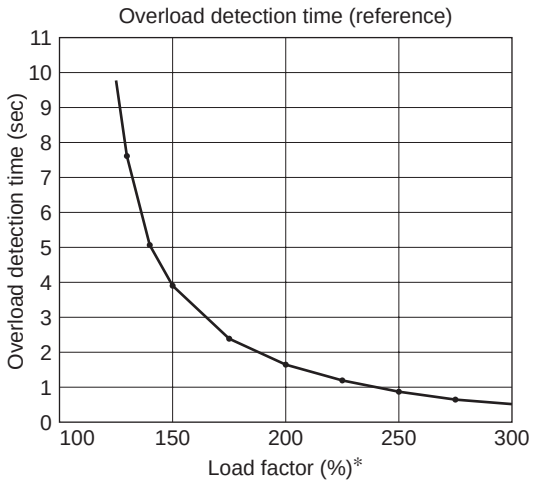
- Some alarms cannot be reset with the ALM-RST input or alarm reset functions provided by the **OPX-2A** and **MEXE02**. Check which alarms fall under this category in the tables provided on the following pages. To reset these alarms, the power must be cycled. If a 24 VDC power supply is connected, also cycle the 24 VDC power supply.
- The absolute position loss alarm cannot be reset with the ALM-RST input alone. Refer to p.63 for details on the method to reset this alarm.

■ Characteristics of the overload alarm

How long it takes to detect an overload alarm varies depending on the torque.

Reference overload detection time

Continuous output torque	Overload detection time
100%	Continuous
125%	Approx. 10 sec
150%	Approx. 4 sec
250%	Approx. 1 sec
300%	Approx. 0.5 sec



* The load factor is 100% when the rated torque is output.

■ Descriptions of alarms

Alarm type	Number of times the ALARM LED blinks	Alarm code output			Alarm code	Motor operation upon alarm*	Reset using the ALM-RST input/ **OPX-2A/MEXE02**
		AL2	AL1	AL0			
Overheat protection	2	OFF	ON	OFF	21	×	Possible
Motor overheat protection					26	×	Not possible
Overload					30	×	Possible
Overspeed					31	×	Possible
Command pulse error					34	×	Possible
Regeneration unit overheat					51	×	Not possible
Overvoltage protection	3	OFF	ON	ON	22	×	Not possible
Main power supply error					23	×	Possible
Undervoltage					25	×	Possible
Excessive position deviation	4	ON	OFF	OFF	10	×	Possible
Overcurrent protection	5	ON	OFF	ON	20	×	Not possible

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

Cause	Action
The internal temperature of the driver exceeded approx. 85°C (185 °F).	Review the ventilation condition in the enclosure.
The motor temperature reached approx. 85°C (185 °F).	• Check the heat dissipation condition of the motor. • Review the ventilation condition of the surroundings.
A torque exceeding the rated torque was applied.	• Reduce the load or increase the acceleration/deceleration time. • Check the cable connection. • Check if the electromagnetic brake is released during operation.
The detected motor speed exceeded 6000 r/min.	• Keep the speed of the motor output shaft to not more than 5500 r/min. • If the speed is overshooting due to insufficient gain adjustment, readjust the gain.
The command pulse frequency exceeded the specified value.	• Set the command pulse frequency to 500 kHz or less. • Check the electronic gear setting and reduce the speed of the motor output shaft to 5500 r/min or less.
• The regeneration unit is not connected correctly. • The regeneration unit is overheating. • The heat sink is overheating.	• If an external regeneration unit is connected, connect the thermostat outputs of the regeneration unit correctly to the regeneration resistor thermal input terminals (TH1 and TH2 terminals of CN1). • If the internal regeneration resistor is used, short the regeneration resistor thermal input terminals (TH1 and TH2 terminals of CN1). • The current consumption of the regeneration unit/resistor exceeds the allowable level. Review the load condition and operating conditions. • Check if the built-in cooling fan operates (for the NXD75-S only).
• 200-230 VAC was applied to a product specified for 100-115 VAC. • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit. • The regeneration unit is not connected correctly. • The DC voltage of the main power supply became approx. 400 V or higher.	• Check the input voltage of the main power supply. • If this alarm generates during acceleration/deceleration, the current consumption of the regeneration unit/resistor may have exceeded the allowable level. Review the load condition and operating conditions. • If the internal regeneration resistor is used, switch to an external regeneration unit.
The motor was started when the main power was cut off.	Check if the main power is input properly.
The main power was cut off momentarily or the voltage became low.	Check the input voltage of the main power supply.
• The deviation between the command position and actual position at the motor output shaft exceeded the value set in the excessive position deviation alarm parameter [APP-3-00]. (Initial value: 10 rev) • The load is large or the acceleration/deceleration time is short.	• Reduce the load or increase the acceleration/deceleration time. • If the torque limit function is used, increase the torque limit value.
The motor, cable or driver output circuit was shorted.	Turn off the power and check the motor, cable and driver output circuit for shorting, and then turn the power back on.

Alarm type	Number of times the ALARM LED blinks	Alarm code output			Alarm code	Motor operation upon alarm*	Reset using the ALM-RST input/ **OPX-2A/MEXE02**
		AL2	AL1	AL0			
Position range error	7	ON	ON	ON	32	○	Possible
Absolute position loss					33	○	Possible
ABS not supported					47	○	Possible
No battery					48	○	Possible
Electronic gear setting error					71	×	Not possible
Sensor error during operation	8	OFF	OFF	OFF	28	×	Not possible
Encoder communication error					2A	×	Not possible
Sensor error during initialization					42	×	Not possible
Rotor rotation during initialization					43	×	Not possible
Encoder EEPROM error					44	×	Not possible
Motor combination error					45	×	Not possible
EEPROM error	9	OFF	OFF	ON	41	×	Not possible

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

Cause	Action
• The command position exceeded the coordinate control range (−2,147,483,648 to 2,147,483,647). • The multi-rotation data for internal encoder coordinates exceeded the coordinate control range (−32,768 to 32,767). (This alarm generates when the absolute system function is used in the position control mode.)	• Set the command position so that the moving range will remain inside the coordinate control range. • If this alarm generates inside the coordinate control range, the multi-rotation data for internal encoder coordinates exceeds the coordinate control range. Turn off the power, disconnect the encoder cable, connect it again after approx. 30 seconds, and then turn the power back on.
• The power was turned on for the first time after connecting the battery. • No battery is connected, the battery cable is disconnected, or the battery has been consumed. • The encoder cable came off. • The position range error alarm was reset. (This alarm generates when the absolute system function is used in the position control mode.)	• Perform position preset. • Check the battery connection, or replace the battery.
The battery was detected when the absolute function was disabled in the position control mode.	If the absolute system function is used, enable the absolute function. If the absolute system function is not used, disconnect the battery.
No battery was detected or the battery cable was disconnected when the absolute function was enabled.	Check the connection condition of the battery.
The power was turned on when the resolution set by the electronic gear and encoder output electronic gear was outside the specified range.	Set the electronic gear and encoder output electronic gear correctly, then turn the power back on.
An encoder error was detected during operation.	Turn off the power, check the connection between the encoder and driver, then turn the power back on.
A communication error occurred between the driver and encoder.	Turn off the power, check the connection between the encoder and driver, then turn the power back on.
An encoder error was detected when the power was turned on.	Turn off the power, check the connection between the encoder and driver, then turn the power back on.
The motor output shaft rotated by 1/40th of a revolution during the initialization following a power on.	Prevent the motor output shaft from rotating due to an external force when the power is turned on.
Data stored in the encoder communication circuit was damaged.	Turn off the power, check the connection between the encoder and driver, then turn the power back on.
A motor not supported by the driver is connected.	Check the driver model and motor model, and use the driver and motor in the correct combination.
Data stored in the driver was damaged.	Initialize the parameters and operation data using the data setter **OPX-2A** or the data setting software **MEXE02**.

15.2 Warnings

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

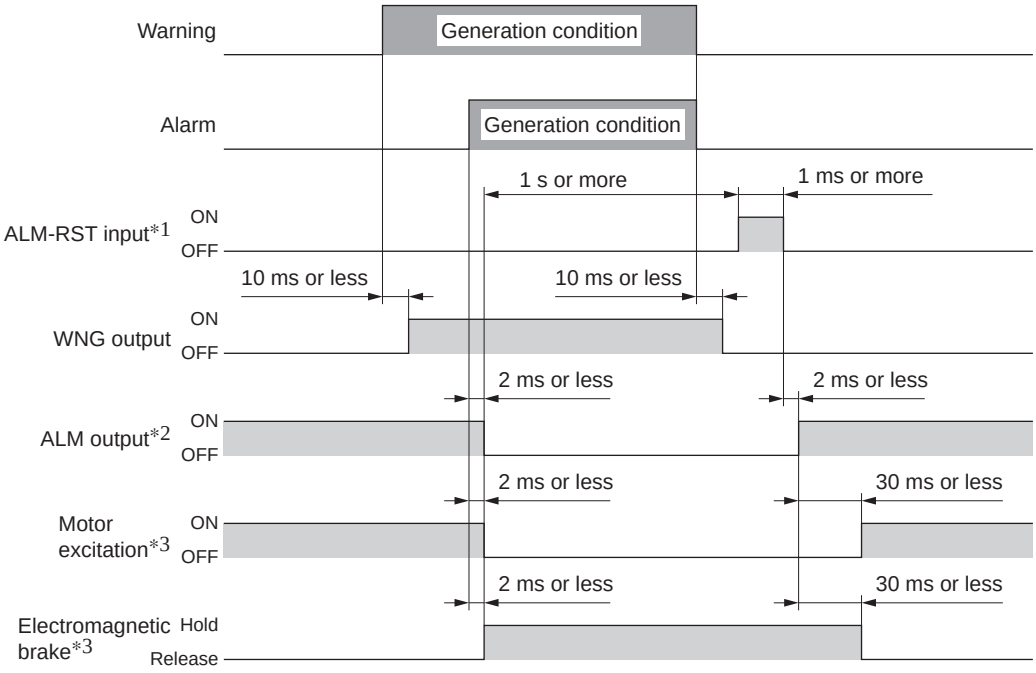
Note You can also clear the warning records by turning off the driver power.

■ Descriptions of warnings

Warning type	Warning code	Cause	Action
Excessive position deviation	10	• The deviation between the command position and actual position at the motor output shaft exceeded the value set in the excessive position deviation warning parameter [APP-3-01].(Initial value: 9 rev) • The load is large or the acceleration/deceleration time is short.	• Reduce the load or increase the acceleration/deceleration time. • If the torque limit function is used, increase the torque limit value.
Overheat	21	The internal temperature of the driver exceeded the value set in the overheat warning parameter [APP-3-04]. [Initial value: 80°C (176 °F)]	Review the ventilation condition in the enclosure.
Overvoltage	22	• The DC voltage of the main power supply exceeded the value set in the overvoltage warning parameter [APP-3-02]. (Initial value: 390 V) • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit.	• Check the input voltage of the main power supply. • If this warning generates during operation, reduce the load or increase the acceleration/deceleration time. • If the internal regeneration resistor is used, switch to an external regeneration unit.
Main power supply	23	The S-ON input was turned ON when the main power was cut off.	• Do not turn the S-ON input ON while the main power is cut off. • Check the S-ON signal logic.
Undervoltage	25	• The DC voltage of the main power supply became lower than the value set in the undervoltage warning parameter [APP-3-03]. (Initial value: 125 V) • The main power was cut off momentarily or the voltage became low.	Check the input voltage of the main power supply.
Low battery voltage	27	The battery discharged and its voltage dropped to 3.2 V or below.	Replace the battery.
Overload	30	• The generated torque exceeded the value set in the overload warning parameter [APP-3-05]. (Initial value: 90%) • The load is large or the acceleration/deceleration time is short.	• Reduce the load, or increase the acceleration/deceleration time. • Check the cable connection. • Check if the electromagnetic brake is released during operation.
Overspeed	31	The detected motor speed exceeded the value set in the overspeed warning parameter [APP-3-06].(Initial value: 5800 r/min)	• Check the electronic gear setting and reduce the speed of the motor output shaft to the value set in the parameter or less. • If the speed is overshooting due to insufficient gain adjustment, readjust the gain.
Absolute position loss	33	The battery or encoder was disconnected.	Perform position preset.
Electronic gear setting error	71	The resolution set by the electronic gear and encoder output electronic gear became outside the specified range.	Set the electronic gear and encoder output electronic gear correctly, then turn the power back on.

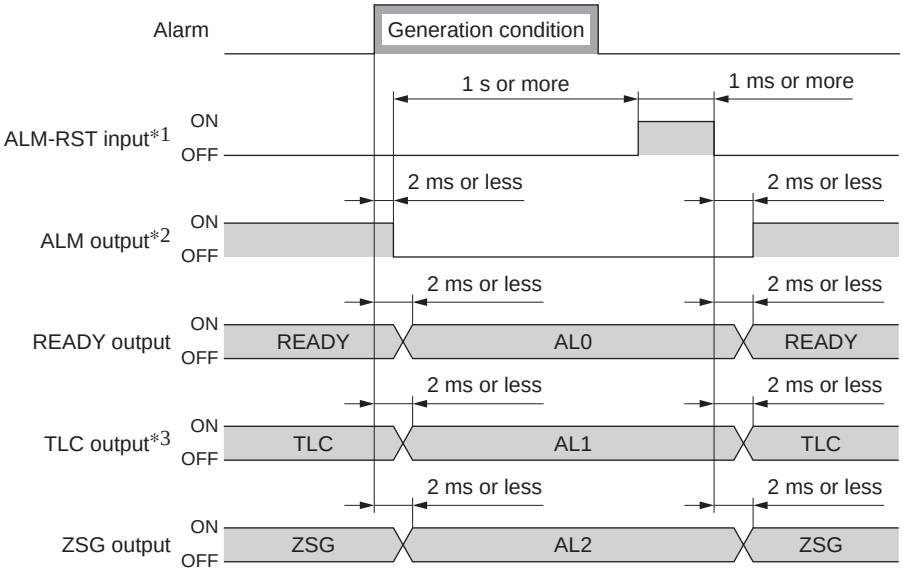
15.3 Timing charts

■ ALM output/WNG output



∗1 An alarm is reset at the ON→OFF edge. Before resetting an alarm, be sure to remove the cause of the alarm, and then input the signal only once.
∗2 The signal logic is contact B (normally closed). This output remains ON in a normal state, and will turn OFF if an alarm generates.
∗3 Assuming generation of an alarm that stops motor excitation.

■ AL0 output /AL1 output/AL2 output



∗1 An alarm is reset at the ON→OFF edge. Before resetting an alarm, be sure to remove the cause of the alarm, and then input the signal only once.
∗2 The signal logic is contact B (normally closed). This output remains ON in a normal state, and will turn OFF if an alarm generates.
∗3 In the position control mode and speed control mode, the TLC output becomes effective. In the torque control mode and tension control mode, the VLC output becomes effective.

■ Notifying the generation of an alarm: ALM output

When an alarm generates, the ALM output will turn OFF. At the same time, the ALARM LED on the driver will start blinking and the motor current will be cut off, causing the motor to stop*. In the case of an electromagnetic brake motor, the electromagnetic brake will actuate to hold the load in position.
Set the programmable controller to stop the motor operation command upon detection of an OFF status of the ALM output.
The cause of the generated alarm can be checked by counting the number of times the ALARM LED blinks.
* Some alarms do not cut off the current.

■ Notifying the generation of a warning: WNG output

When a warning generates, the WNG output will turn ON. You can cause a warning to generate prior to a corresponding alarm. The generation conditions of warnings can be changed using the **OPX-2A** or **MEXE02**.

■ Notifying the content of an alarm using an alarm code: AL0/AL1/AL2 outputs

When the application parameter for alarm code output [APP-1-10] is set to “Enable,” the READY output, TLC/VLC output and ZSG2/NEAR/ZV output will automatically switch to the AL0 output, AL1 output and AL2 output, respectively, upon generation of an alarm. The generated alarm can be checked by the ON/OFF statuses of these signals.

16 Troubleshooting and remedial actions

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

Phenomenon	Possible cause	Remedial action
• The motor is not excited. • The motor can be moved by hand.	The S-ON input is turned OFF. *1*2	• Turn the S-ON input ON and confirm that the motor will be excited. • Check the setting of the application parameter for S-ON signal logic [APP-1-00].
	The TL input was turned ON when the torque limit value was set to 0%.	• Set an appropriate torque limit value. • Keep the TL input OFF when the torque limit value is set to 0%.
	The FREE input is turned ON.	Turn the FREE input OFF.
The motor does not operate.	The BRAKE input is turned OFF. *3	• Turn the BRAKE input ON. • Check the setting of the application parameter for BRAKE signal logic [APP-1-01].
	The CLR input is turned ON. *1	Turn the CLR input OFF.
	The CW input or CCW input is not connected properly.	• Check the connection between the controller and driver. • Check the pulse signal specifications (voltage, width). *1
	The CW input and CCW input are turned ON simultaneously in the 2-pulse input mode. *1	Each pulse signal input should specify either the CW input or CCW input, but not both. Make sure the terminal not receiving the signal input remains OFF.
	The pulse signal is connected to DIR input in the 1-pulse input mode. *1	Connect the pulse signal to the PLS input.
	The VL input was turned ON when the speed limit value was set to 0 r/min. *4	Set an appropriate speed limit value.
	An electromagnetic brake motor is used and the electromagnetic brake is not released.	Connect a 24 VDC power supply to the CN1 input terminal for 24 VDC power supply.
The motor rotates in the direction opposite to the specified direction.	The CW input and CCW input are connected in reverse in the 2-pulse input mode. *1	Connect CW pulse signals via the CW input, and connect CCW pulse signals via the CCW input.
	The DIR input is set in reverse in the 1-pulse input mode. *1	Turn the DIR input ON to cause the motor to rotate in CW direction, and turn the input OFF to cause the motor to rotate in CCW direction.
	The system parameter for motor rotation direction [SyS-1-06] is set wrongly.	Check the setting of the motor rotation direction parameter [SyS-1-06].
Motor operation is unstable.	Pulse signals are not connected properly. *1	• Check the connection between the controller and driver. • Check the pulse signal specifications (voltage, width).
The electromagnetic brake does not hold the load.	The FREE input is turned ON.	Turn the FREE input OFF.
The electromagnetic brake is not released.	24 VDC power is not input.	Connect a 24 VDC power supply to the CN1 input terminal for 24 VDC power supply.

∗1 In the position control mode.
∗2 In the speed control mode when the system parameter for operation selection after stopping in speed control mode [SyS-1-02] is set to "Servo lock."
∗3 In the speed control mode.
∗4 In the torque control mode or tension control mode.

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

17 General specifications

■ Motor specifications

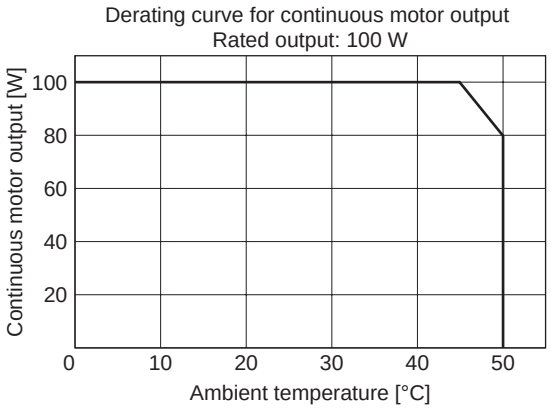
Degree of protection		IP65*
Operation environment	Ambient temperature	0 to +40 °C (+32 to +104 °F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 1000 m (3300 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, liquids, or oil (oil droplets)
Storage environment	Ambient temperature	−20 to +60 °C (−4 to +140 °F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 3000 m (10000 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, liquids, or oil (oil droplets)
Shipping environment	Ambient temperature	−20 to +60 °C (−4 to +140 °F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 3000 m (10000 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, liquids, or oil (oil droplets)

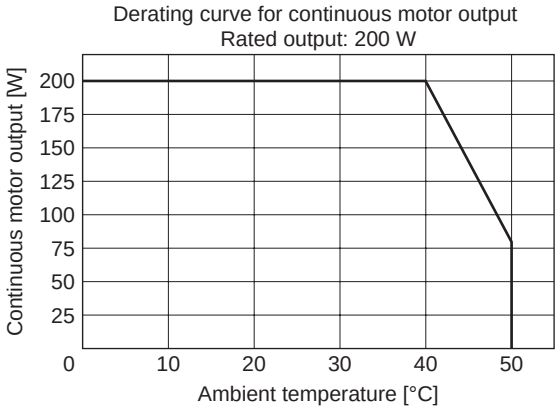
* With the standard type, excluding the through part of the shaft and connectors. With the geared type, excluding the connectors.

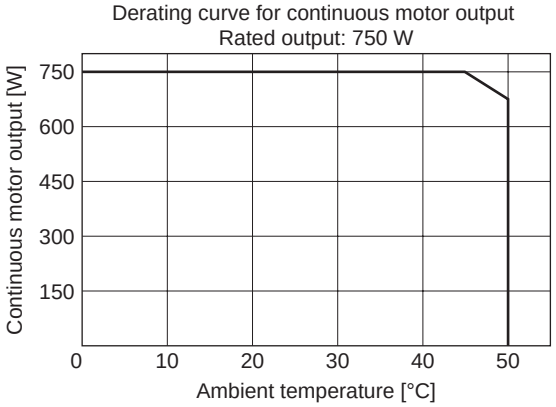
■ Driver specifications

Operation environment	Degree of protection	IP20
	Ambient temperature	0 to +50 °C (+32 to +122 °F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 1000 m (3300 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil
Storage environment	Ambient temperature	−20 to +60 °C (−4 to +140 °F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 3000 m (10,000 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil
Shipping environment	Ambient temperature	−20 to +60 °C (−4 to +140 °F) (non-freezing)
	Humidity	85% or less (non-condensing)
	Altitude	Up to 3000 m (10000 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil

Note If the ambient temperature of the driver exceeds 40 °C (104 °F) while the driver is in use, keep the continuous output of the motor to or below the derating curve shown below. For your information, there is no need for derating for the models whose rated output is 50 W or 400 W.







■ Battery specifications

Battery type	Lithium thionyl chloride batteries
Life	Approx. 4 years*
Data retention period	2 years*
Ambient temperature	0 to +50 °C (+32 to +122 °F) (non-freezing)
Ambient humidity	85% or below (non-condensing)
Storage/Transporting temperature	+5 to +35 °C (+41 to +95 °F) (non-freezing)
Storage/Transporting humidity	70% or below (non-condensing)

* At an ambient temperature of 20 °C (68 °F)

18 Options (sold separately)

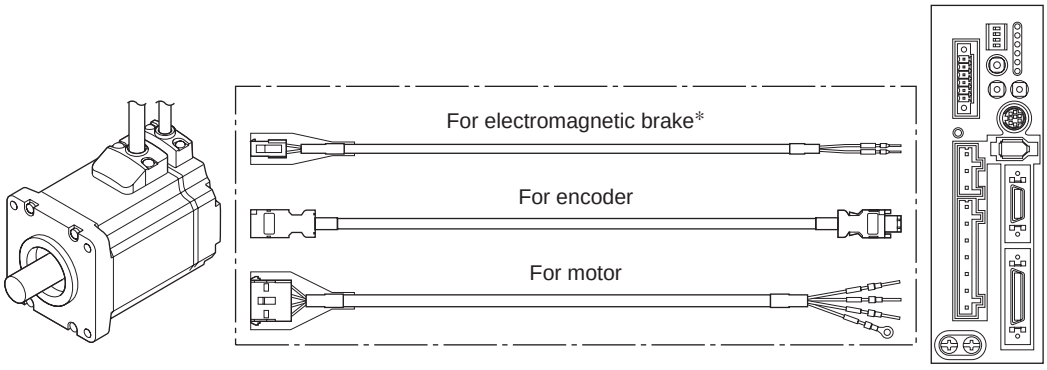
■ Motor cable set

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

- System configuration

Extending the wiring length using a connection cable set

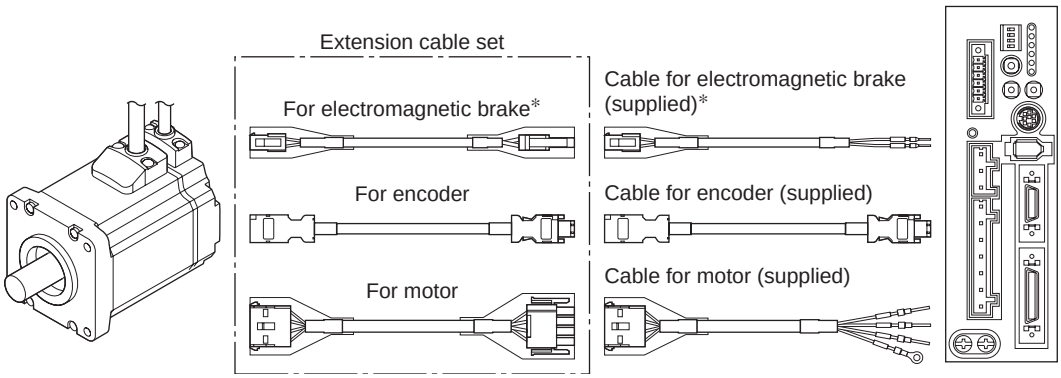
Do not use the supplied cable.



* Only when the motor is of electromagnetic brake type.

Extending the wiring length using an extension cable set

Connect an extension cable to the supplied cable.



* Only when the motor is of electromagnetic brake type.

Note When extending the wiring length by connecting an extension cable to the supplied cable, keep the total cable length to 20 m (65.6 ft.) or less.

- Connection cable set

A cable set is needed to connect the motor and driver.
Each set consists of two cables, one for motor and the other for encoder.
The cable set for electromagnetic brake motor consists of three cables, one each for motor, encoder and electromagnetic brake.

• For standard motors

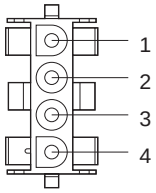
Model	Length [m (ft.)]
CC050VNF	5 (16.4)
CC070VNF	7 (23)
CC100VNF	10 (32.8)
CC150VNF	15 (49.2)
CC200VNF	20 (65.6)

• For electromagnetic brake motors

Model	Length [m (ft.)]
CC050VNFB	5 (16.4)
CC070VNFB	7 (23)
CC100VNFB	10 (32.8)
CC150VNFB	15 (49.2)
CC200VNFB	20 (65.6)

Pin assignments of cable for motor connector

Pin No.	Color	Lead size
1	Red	AWG16 (1.25 mm^2)
2	White	
3	Black	
4	Green/ yellow	

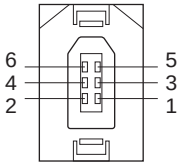


Model: 350780-1 (Tyco Electronics AMP)

Pin assignments of cable for encoder connector

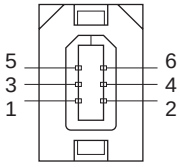
Pin No.	Color	Lead size
1	Green	AWG18 (0.75 mm^2)
2	Black	AWG18 (0.75 mm^2)
3	Red	AWG24 (0.2 mm^2)
4	White	AWG18 (0.75 mm^2)
5	Yellow	AWG24 (0.2 mm^2)
6	Brown	AWG24 (0.2 mm^2)

• Motor side



Model: 54280-0609
(Molex)

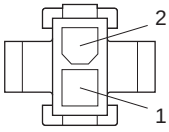
• Driver side



Model: 55100-0670
(Molex)

Pin assignments of cable for electromagnetic brake connector

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



Model: 5559-02P-210 (Molex)

• Flexible connection cable set

A cable set offering excellent flexibility used to connect the motor and driver.
Each set consists of two cables, one for motor and the other for encoder.
The cable set for electromagnetic brake motor consists of three cables, one each for motor, encoder and electromagnetic brake.

• For standard motors

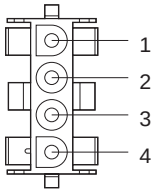
Model	Length [m (ft.)]
CC010VNR	1 (3.3)
CC020VNR	2 (6.6)
CC030VNR	3 (9.8)
CC050VNR	5 (16.4)
CC070VNR	7 (23)
CC100VNR	10 (32.8)
CC150VNR	15 (49.2)
CC200VNR	20 (65.6)

• For electromagnetic brake motors

Model	Length [m (ft.)]
CC010VNRB	1 (3.3)
CC020VNRB	2 (6.6)
CC030VNRB	3 (9.8)
CC050VNRB	5 (16.4)
CC070VNRB	7 (23)
CC100VNRB	10 (32.8)
CC150VNRB	15 (49.2)
CC200VNRB	20 (65.6)

Pin assignments of cable for motor connector

Pin No.	Color	Lead size
1	Red	AWG17 (1.25 mm^2)
2	White	
3	Black	
4	Green/ yellow	

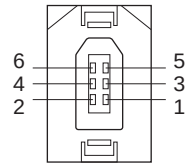


Model: 350780-1 (Tyco Electronics AMP)

Pin assignments of cable for encoder connector

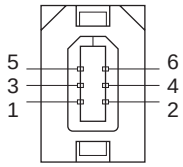
Pin No.	Color	Lead size
1	Green	AWG19 (0.75 mm^2)
2	Black	AWG19 (0.75 mm^2)
3	Red	AWG25 (0.2 mm^2)
4	White	AWG19 (0.75 mm^2)
5	Yellow	AWG25 (0.2 mm^2)
6	Brown	AWG25 (0.2 mm^2)

• Motor side



Model: 54280-0609 (Molex)

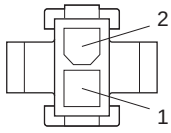
• Driver side



Model: 55100-0670 (Molex)

Pin assignments of cable for electromagnetic brake connector

Pin No.	Color	Lead size
1	White	AWG21 (0.5 mm^2)
2	Black	



Model: 5559-02P-210 (Molex)

- Extension cable set

This cable set is needed to extend the wiring length between the motor and driver.
Each set consists of two cables, one for motor and the other for encoder.
The cable set for electromagnetic brake motor consists of three cables, one each for motor, encoder and electromagnetic brake.

• For standard motors

Model	Length [m (ft.)]
CC010VNFT	1 (3.3)
CC020VNFT	2 (6.6)
CC030VNFT	3 (9.8)
CC050VNFT	5 (16.4)
CC070VNFT	7 (23)
CC100VNFT	10 (32.8)
CC150VNFT	15 (49.2)

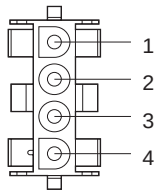
• For electromagnetic brake motors

Model	Length [m (ft.)]
CC010VNFBT	1 (3.3)
CC020VNFBT	2 (6.6)
CC030VNFBT	3 (9.8)
CC050VNFBT	5 (16.4)
CC070VNFBT	7 (23)
CC100VNFBT	10 (32.8)
CC150VNFBT	15 (49.2)

Pin assignments of cable for motor connector

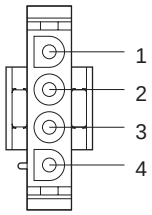
Pin No.	Color	Lead size
1	Red	AWG16 (1.25 mm^2)
2	White	
3	Black	
4	Green/ yellow	

• Motor side



Model: 350780-1
(Tyco Electronics AMP)

• Driver side

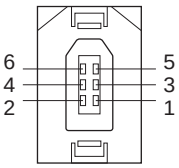


Model: 350779-1
(Tyco Electronics AMP)

Pin assignments of cable for encoder connector

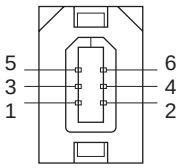
Pin No.	Color	Lead size
1	Green	AWG18 (0.75 mm^2)
2	Black	AWG18 (0.75 mm^2)
3	Red	AWG24 (0.2 mm^2)
4	White	AWG18 (0.75 mm^2)
5	Yellow	AWG24 (0.2 mm^2)
6	Brown	AWG24 (0.2 mm^2)

• Motor side



Model: 54280-0609
(Molex)

• Driver side

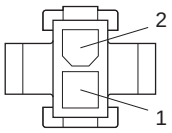


Model: 55100-0670
(Molex)

Pin assignments of cable for electromagnetic brake connector

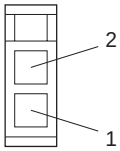
Pin No.	Color	Lead size
1	White	AWG20 (0.5 mm^2)
2	Black	

• Motor side



Model: 5559-02P-210
(Molex)

• Driver side



Model: 5557-02R-210
(Molex)

- Flexible extension cable set

This cable set offering excellent flexibility is needed to extend the wiring length between the motor and driver. Each set consists of two cables, one for motor and the other for encoder.
The cable set for electromagnetic brake motor consists of three cables, one each for motor, encoder and electromagnetic brake.

• For standard motors

Model	Length [m (ft.)]
CC010VNRT	1 (3.3)
CC020VNRT	2 (6.6)
CC030VNRT	3 (9.8)
CC050VNRT	5 (16.4)
CC070VNRT	7 (23)
CC100VNRT	10 (32.8)
CC150VNRT	15 (49.2)

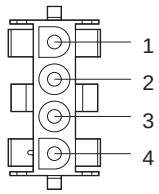
• For electromagnetic brake motors

Model	Length [m (ft.)]
CC010VNRBT	1 (3.3)
CC020VNRBT	2 (6.6)
CC030VNRBT	3 (9.8)
CC050VNRBT	5 (16.4)
CC070VNRBT	7 (23)
CC100VNRBT	10 (32.8)
CC150VNRBT	15 (49.2)

Pin assignments of cable for motor connector

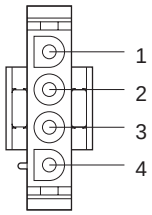
Pin No.	Color	Lead size
1	Red	AWG17 (1.25 mm^2)
2	White	
3	Black	
4	Green/ yellow	

• Motor side



Model: 350780-1
(Tyco Electronics AMP)

• Driver side

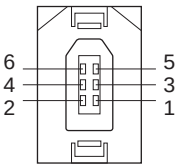


Model: 350779-1
(Tyco Electronics AMP)

Pin assignments of cable for encoder connector

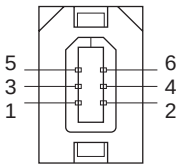
Pin No.	Color	Lead size
1	Green	AWG19 (0.75 mm^2)
2	Black	AWG19 (0.75 mm^2)
3	Red	AWG25 (0.2 mm^2)
4	White	AWG19 (0.75 mm^2)
5	Yellow	AWG25 (0.2 mm^2)
6	Brown	AWG25 (0.2 mm^2)

• Motor side



Model: 54280-0609
(Molex)

• Driver side

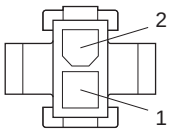


Model: 55100-0670
(Molex)

Pin assignments of cable for electromagnetic brake connector

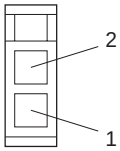
Pin No.	Color	Lead size
1	White	AWG21 (0.5 mm^2)
2	Black	

• Motor side



Model: 5559-02P-210
(Molex)

• Driver side



Model: 5557-02R-210
(Molex)

■ Accessory set

Use an accessory set if the analog I/O functions are to be used.

Model: **AS-SV2**
A set of one CN6 connector and two variable resistors.

Model: **AS-SD1**
This is a CN6 connector.

■ Data setter

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

Model: **OPX-2A**

■ Data setting software

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

Model: **MEXE02**

■ Regeneration unit

Connect the regeneration unit if gravitational operation or other operations involving up/down movement, or sudden starting/stopping of a large inertial load, will be repeated frequently.

Model	Applicable product
RGB100	NXD20-A, NXD20-C
RGB200	NXD75-S

■ Battery

A battery needed when the absolute function is to be used in the position control mode.

Model: **BAT01A**

■ Driver cable

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

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

■ Connector-terminal block conversion unit

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

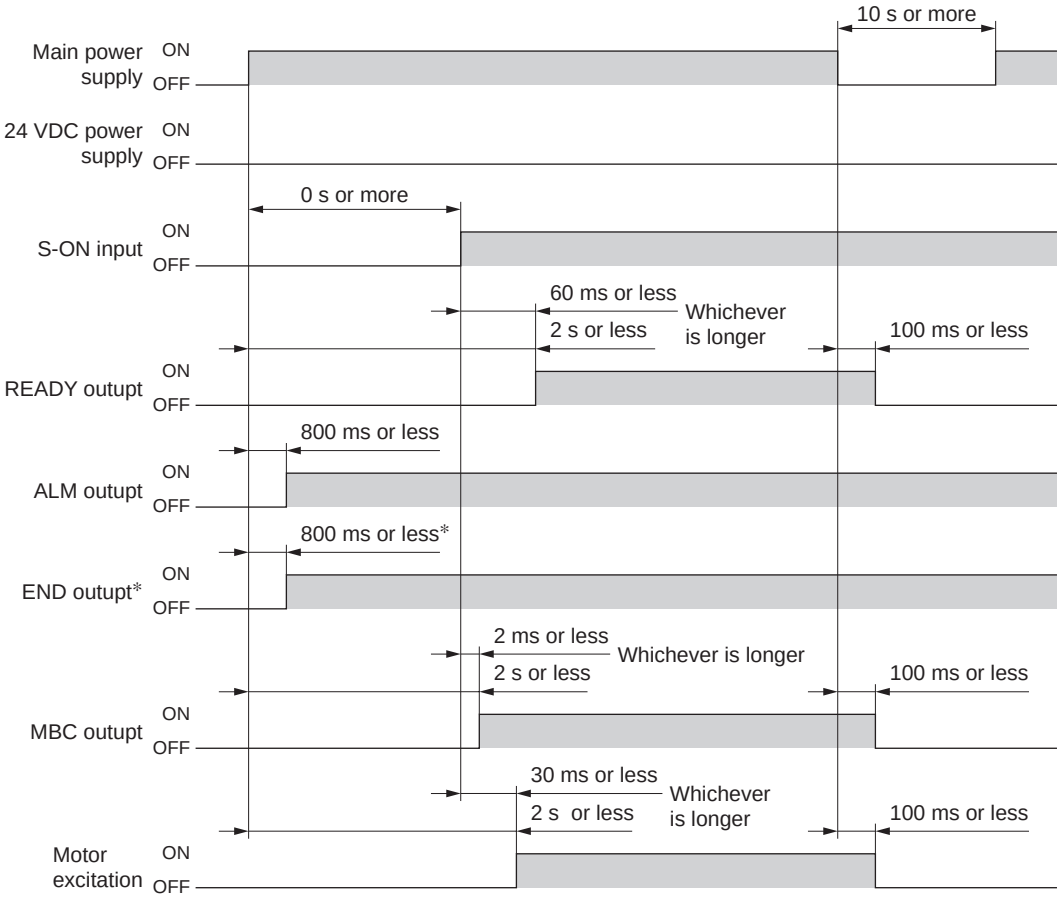
Model	Connect to
CC20T1	CN6 (analog I/O signals connector: 20 pins)
CC36T1	CN7 (I/O signals connector: 36 pins)

19 References

19.1 Timing charts

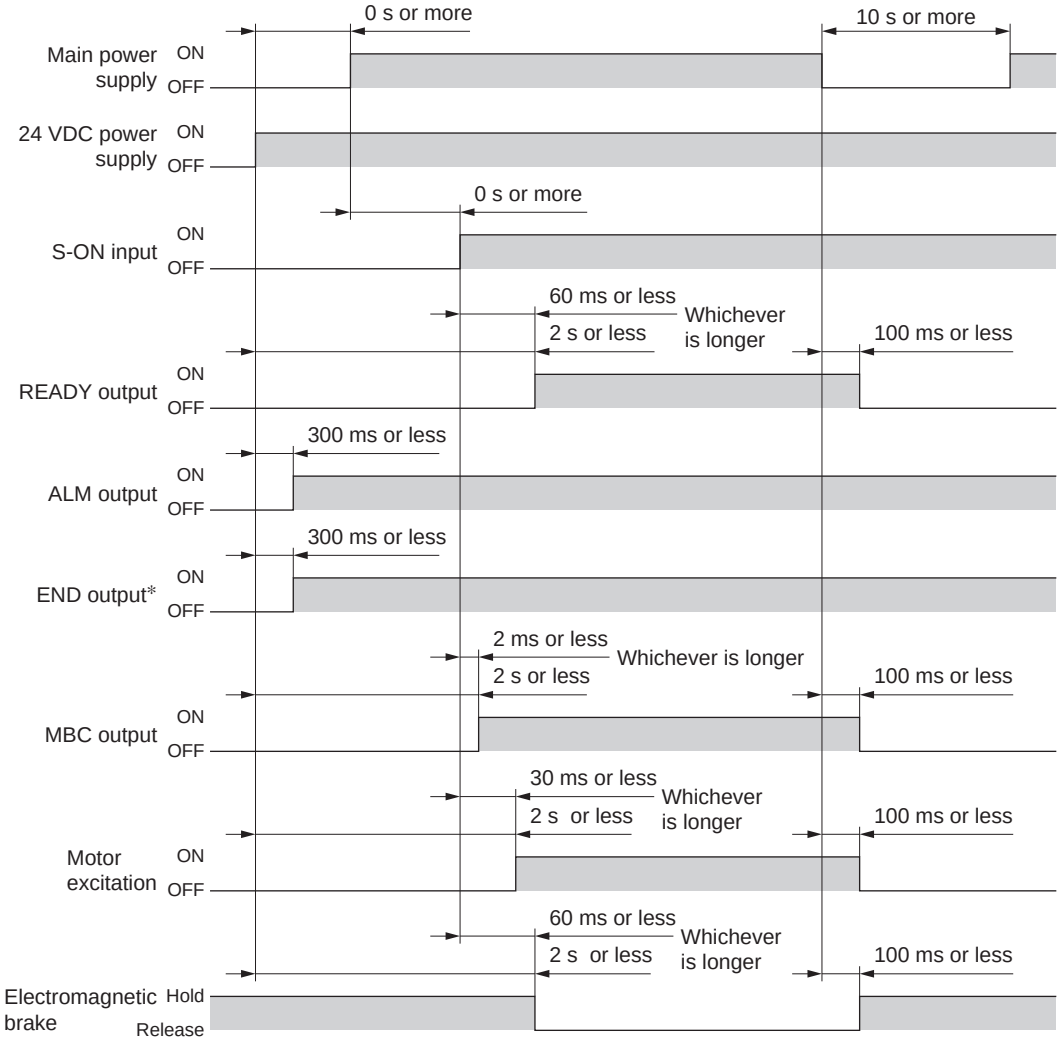
■ Power supply input [position control mode, speed control mode (servo locked after stopping)]

- When no 24 VDC power supply is used



* Position control mode only.

- When a 24 VDC power supply is used

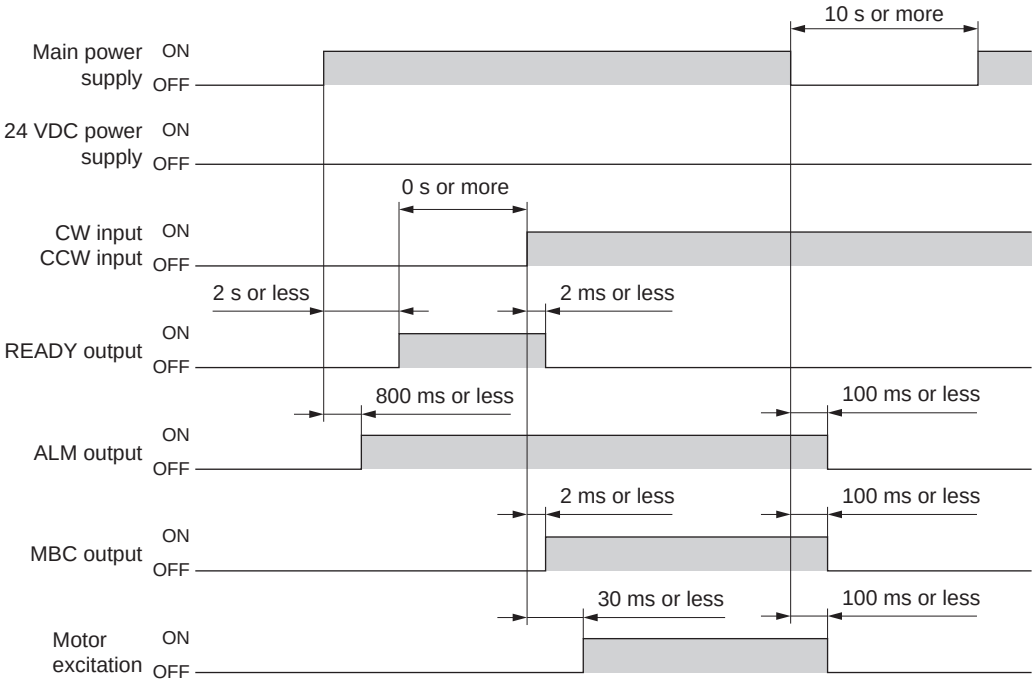


* Position control mode only.

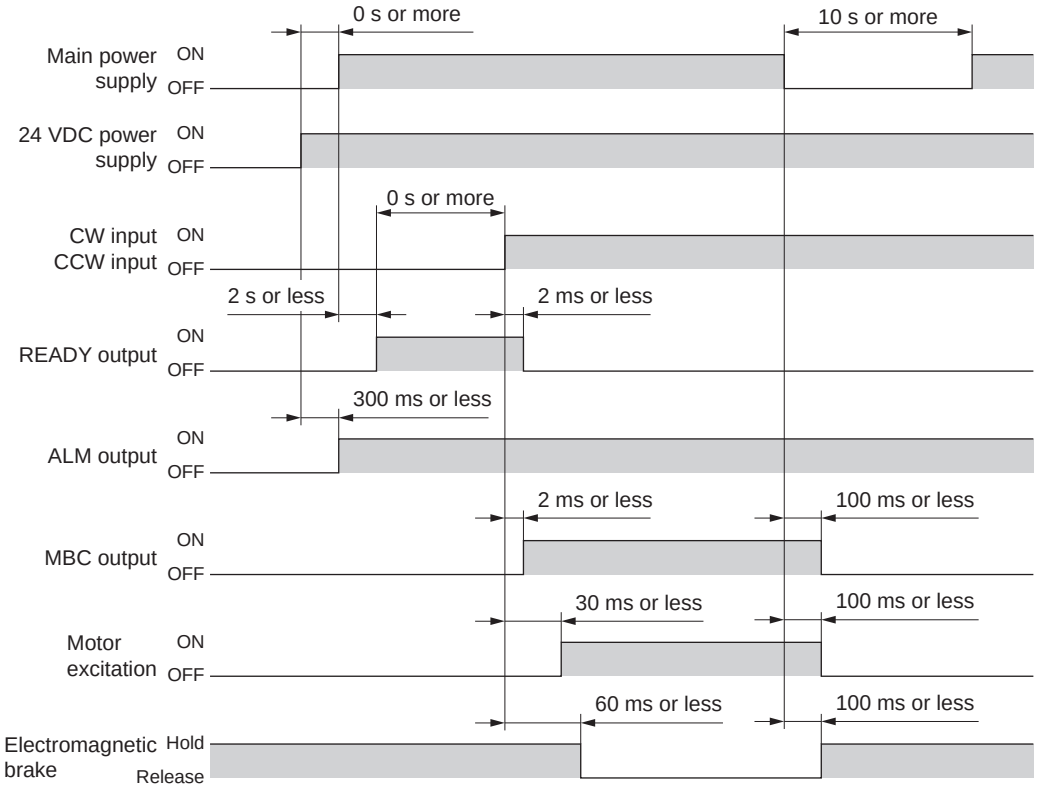
- When to turn on the main power and 24 VDC power is not specified.

■ Power supply input [speed control mode (free after stopping), torque control mode, tension control mode]

- When no 24 VDC power supply is used

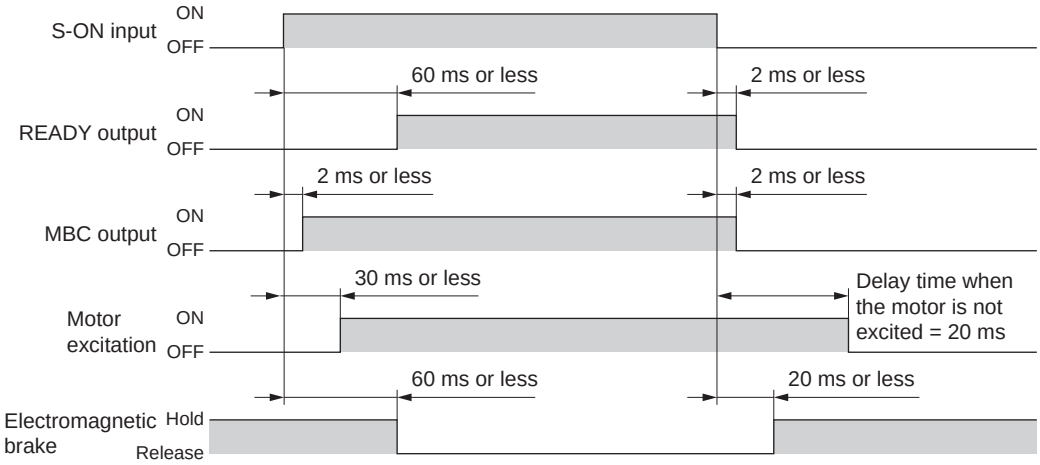


- When a 24 VDC power supply is used



- When to turn on the main power and 24 VDC power is not specified.

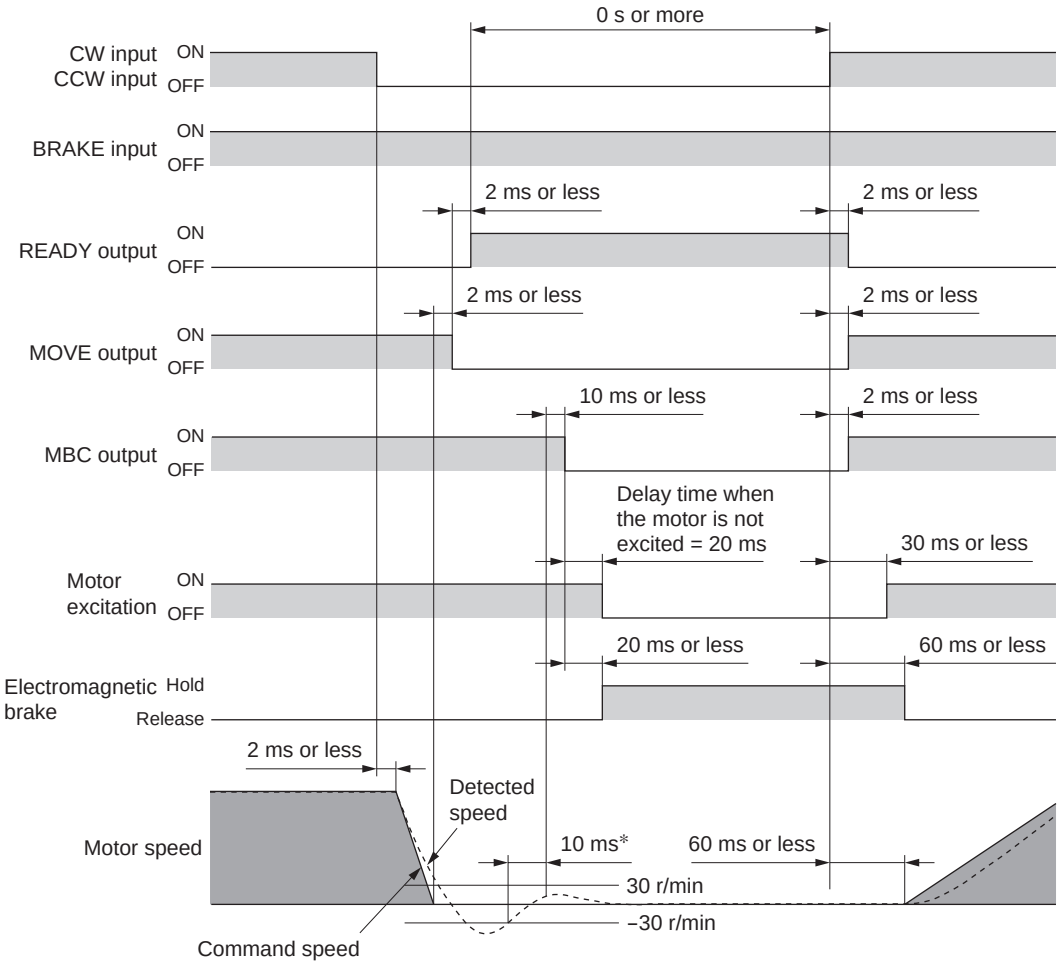
■ S-ON input [position control mode, speed control mode (servo locked after stopping)]



- The electromagnetic brake does not operate if no 24 VDC power is input.
- If the S-ON input is OFF, motor excitation will turn off after the electromagnetic brake is actuated.

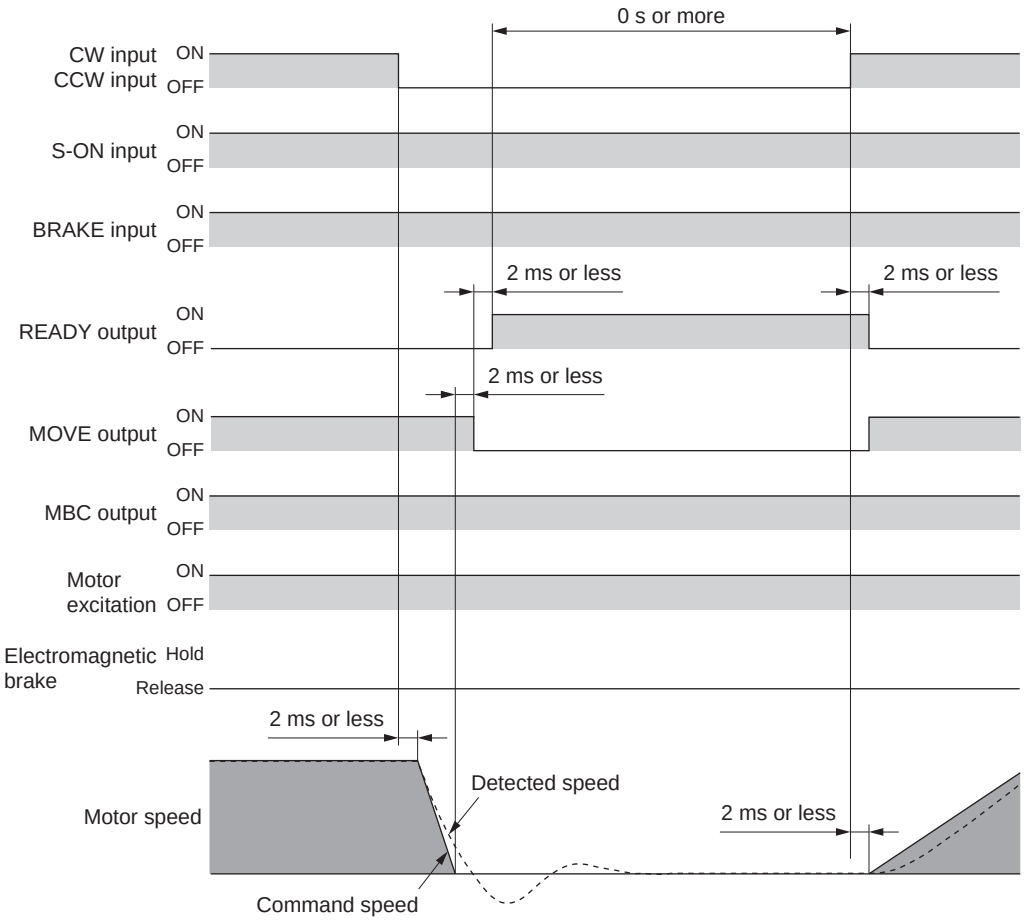
■ CW input/CCW input [speed control mode]

- Free after stopping

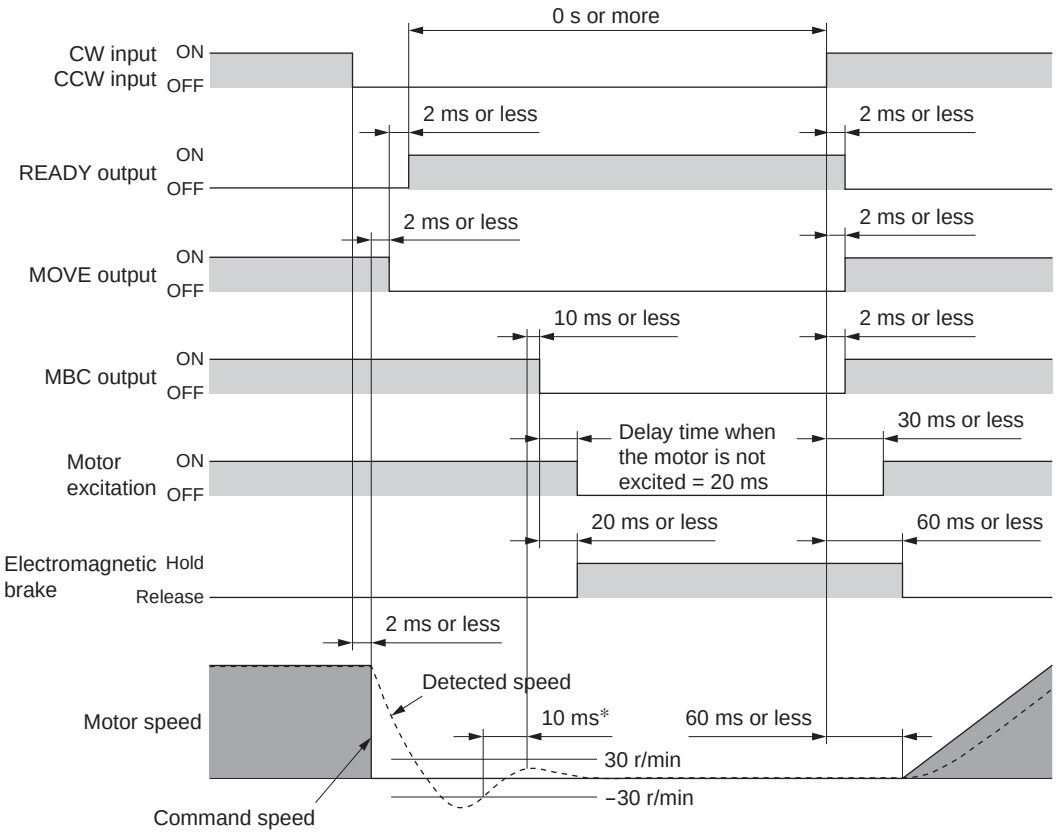


∗ If the detected speed remains at or below ±30 r/min for 10 ms or more, the MBC output will turn OFF.

- Servo locked after stopping

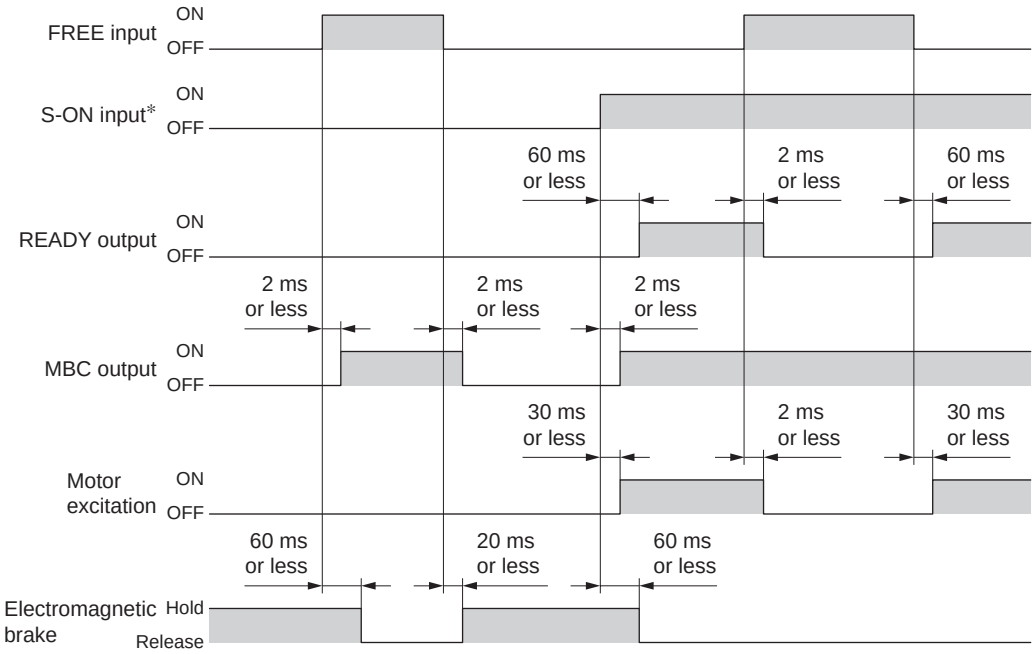


■ CW input/CCW input [torque control mode, tension control mode]



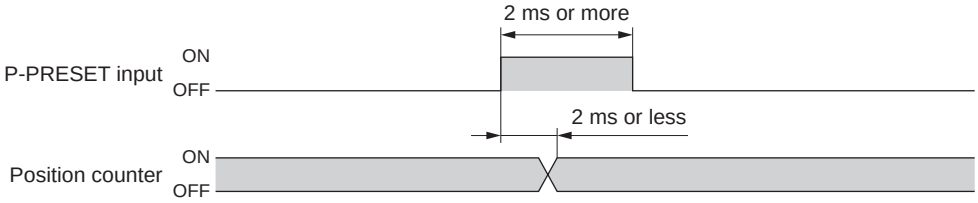
∗ If the detected speed remains at or below ±30 r/min for 10 ms or more, the MBC output will turn OFF.

■ FREE input

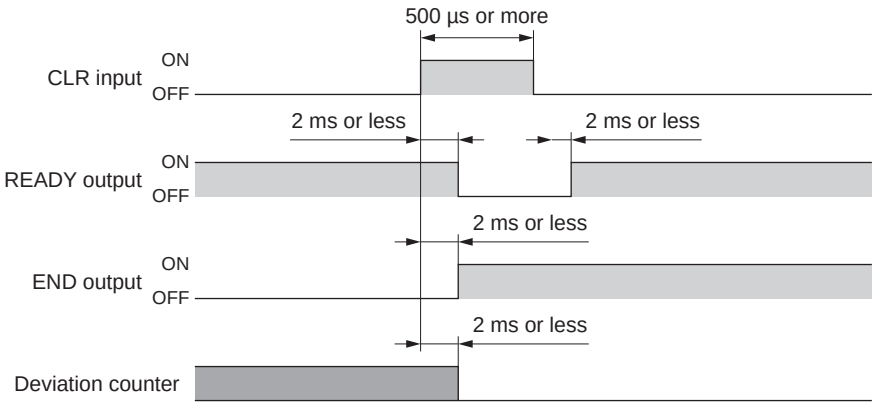


* Position control mode and speed control mode only.

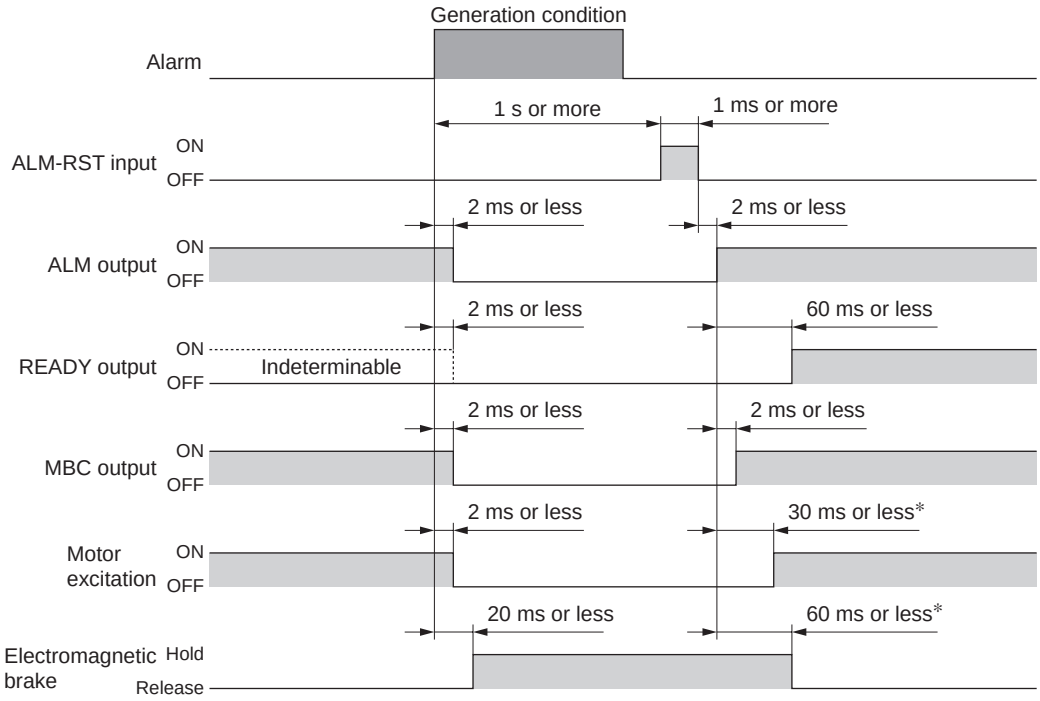
■ P-PRESET input [position control mode]



■ CLR input [position control mode]



■ ALM-RST input

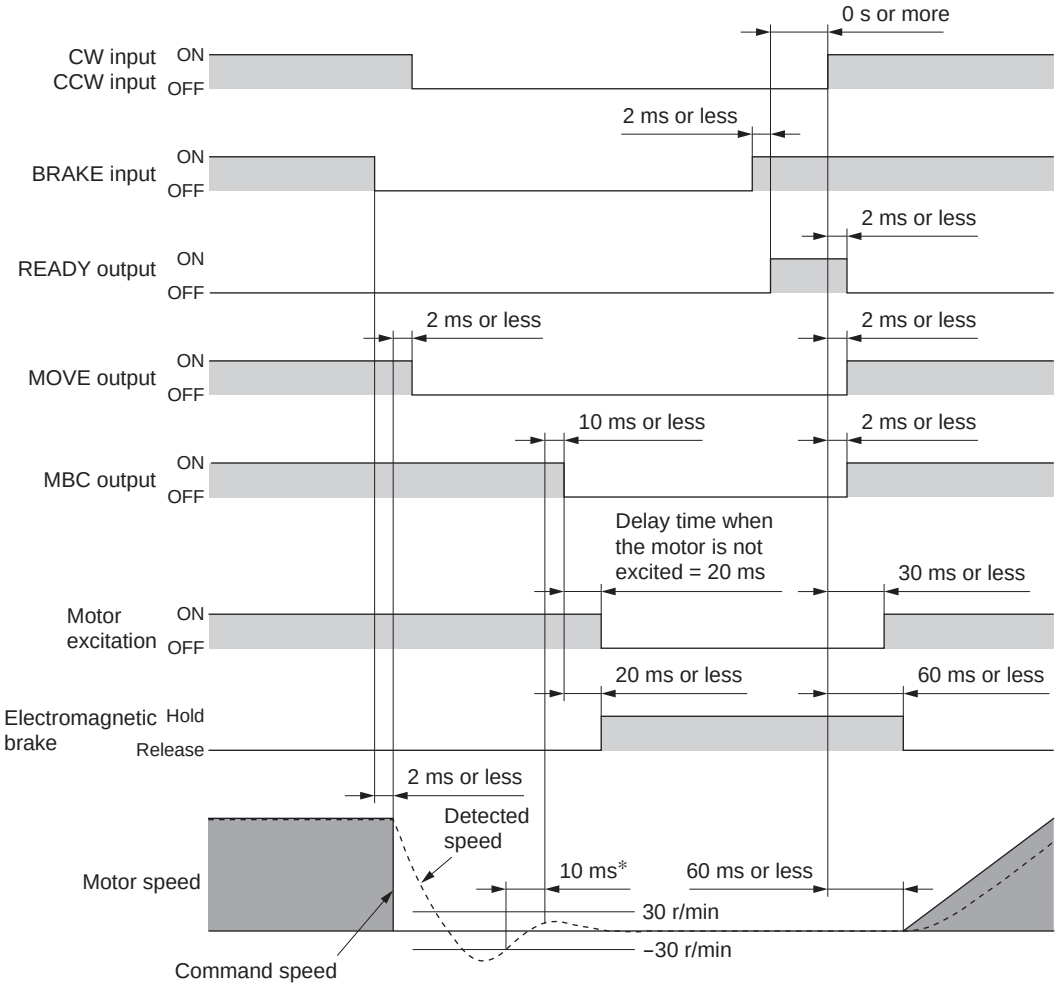


* In the position control mode or speed control mode (servo locked upon stopping) when the S-ON input is ON. In the torque control mode and tension control mode, the motor will remain unexcited and the electromagnetic brake will continue to hold the load in position until a start signal is input.

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

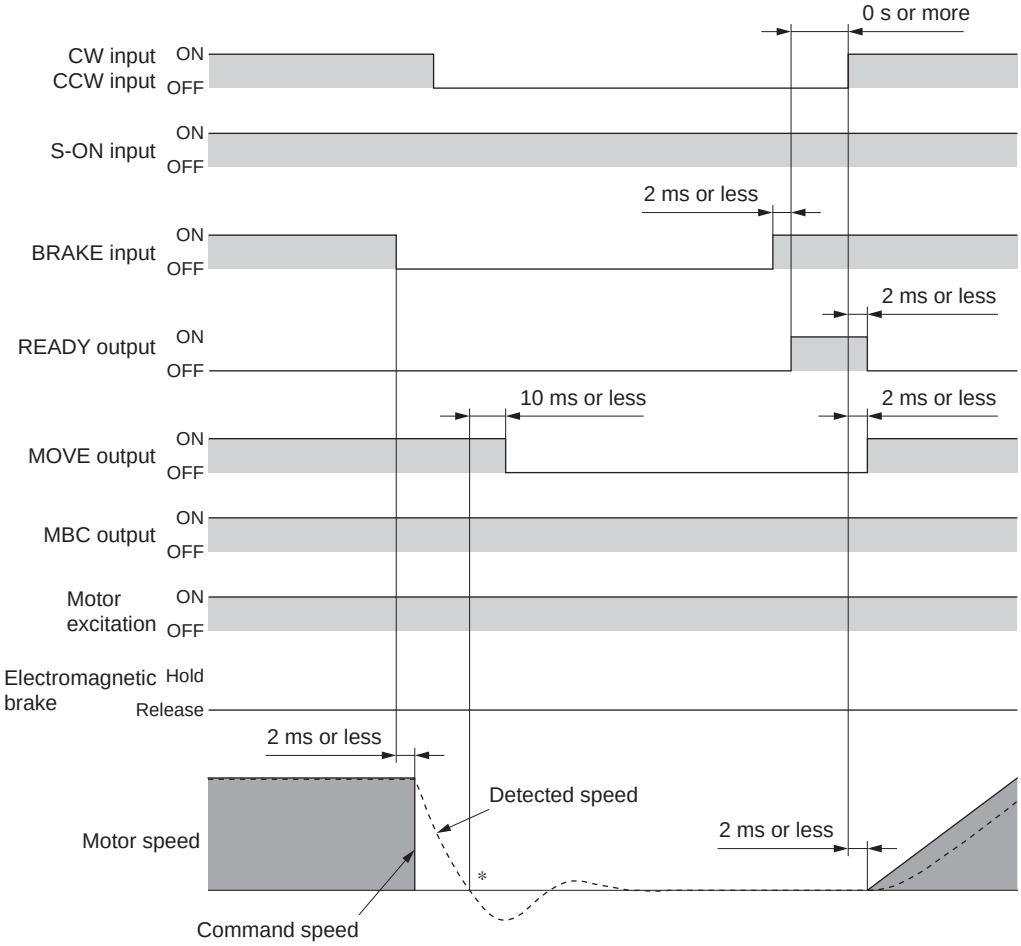
■ BRAKE input [speed control mode]

- Free after stopping



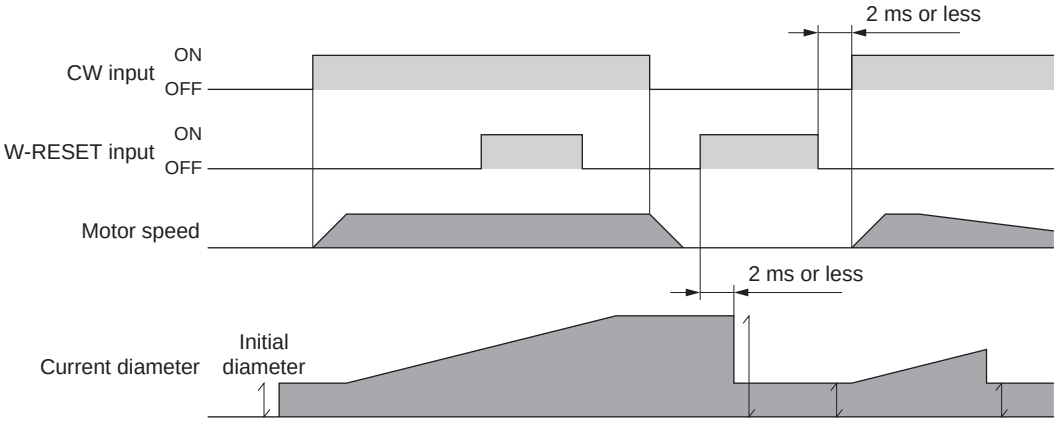
* If the detected speed remains at or below ±30 r/min for 10 ms or more, the MBC output will turn OFF.

- Servo locked after stopping

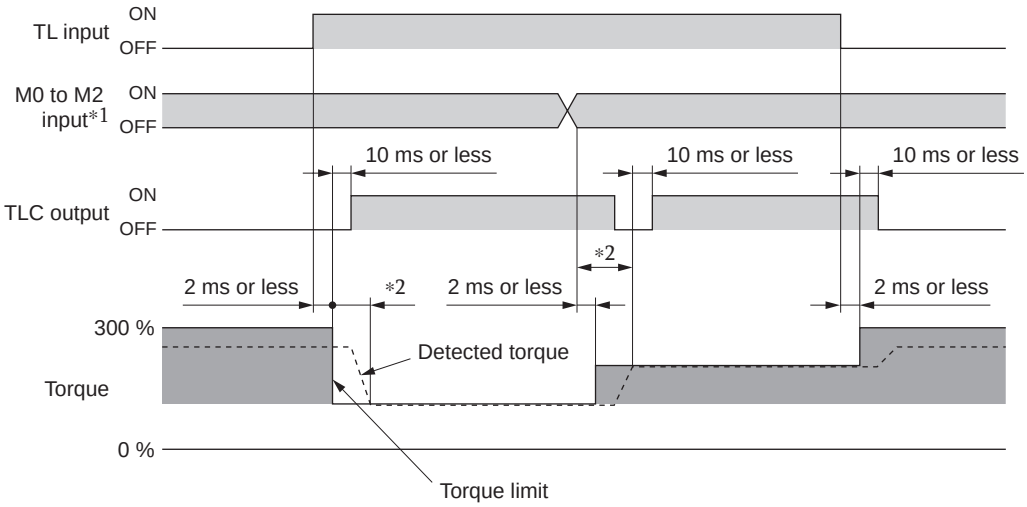


* The MOVE output will turn OFF when the detected speed becomes zero.

■ W-RST input [tension control mode]

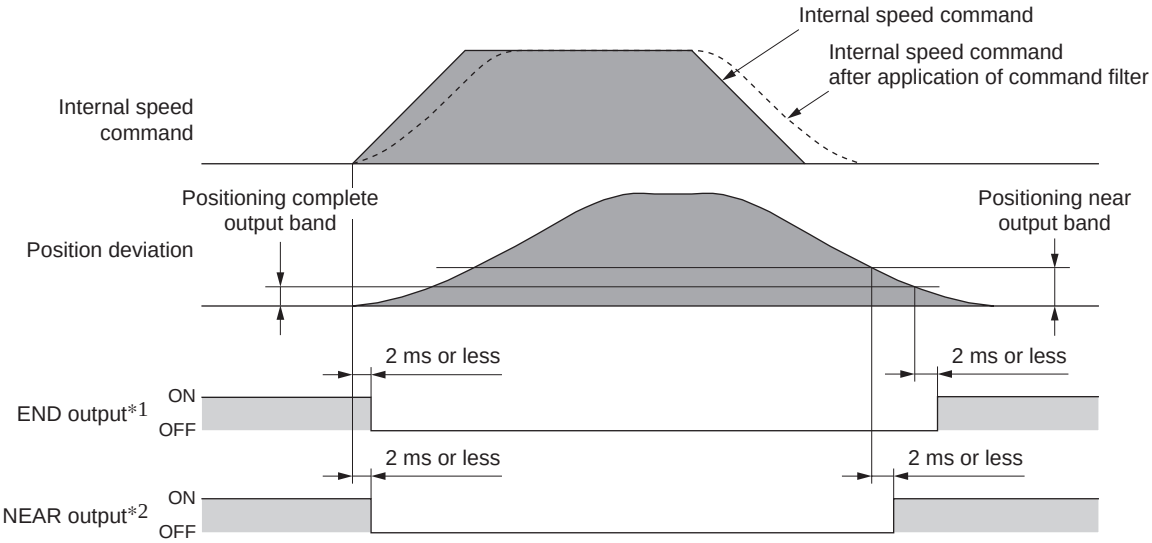


■ TL input [position control mode, speed control mode]



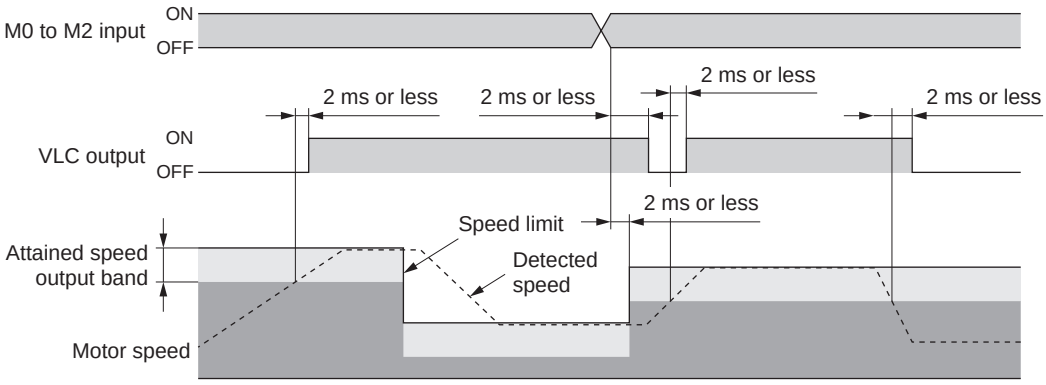
*1 In the position control mode, the M0 and M1 inputs are used instead.
*2 The specific time varies depending on the load condition and gain.

■ END output/NEAR output [position control mode]

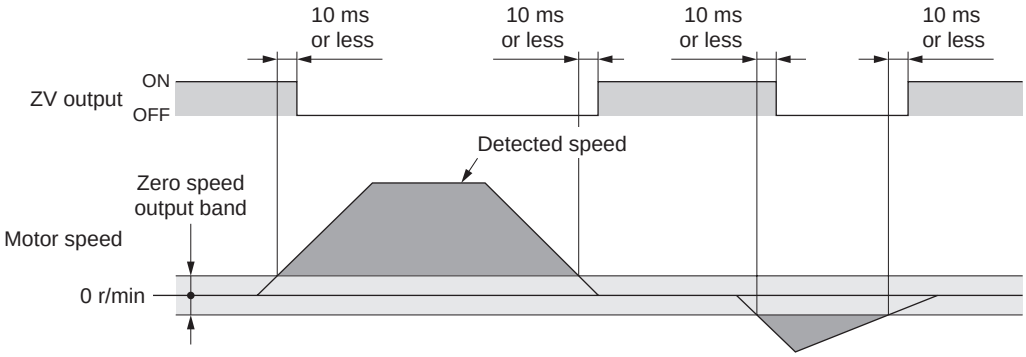


*1 The END output will turn ON when the internal speed command becomes “0” while the position deviation remains within the range set in the application parameter for positioning complete output band [APP-1-04].
*2 The NEAR output will turn ON when the internal speed command becomes “0” while the position deviation remains within the range set in the application parameter for positioning near output band [APP-1-05].

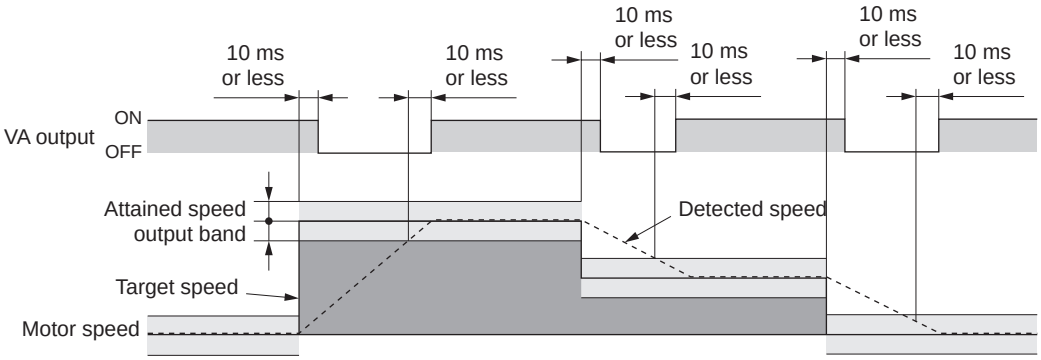
■ VLC output [torque control mode, tension control mode]



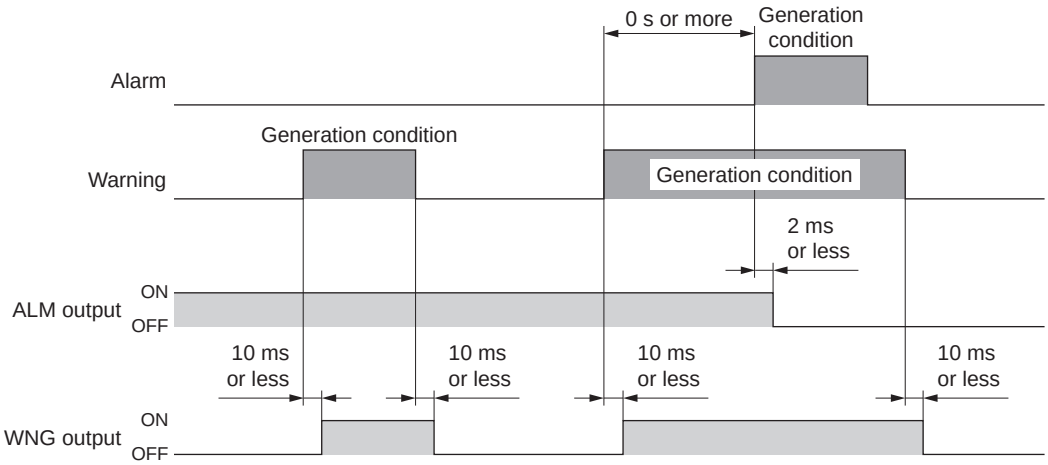
■ ZV output [speed control mode, torque control mode, tension control mode]



■ VA output [speed control mode]

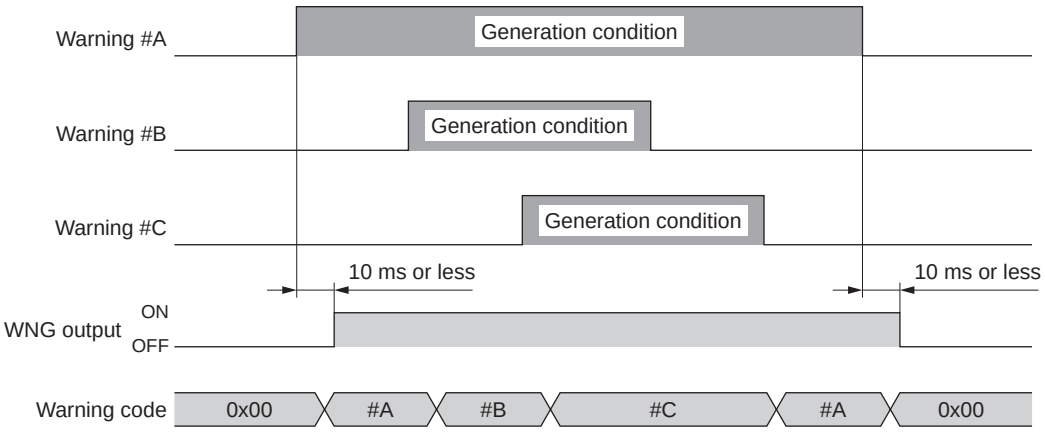


■ ALM output/WNG output

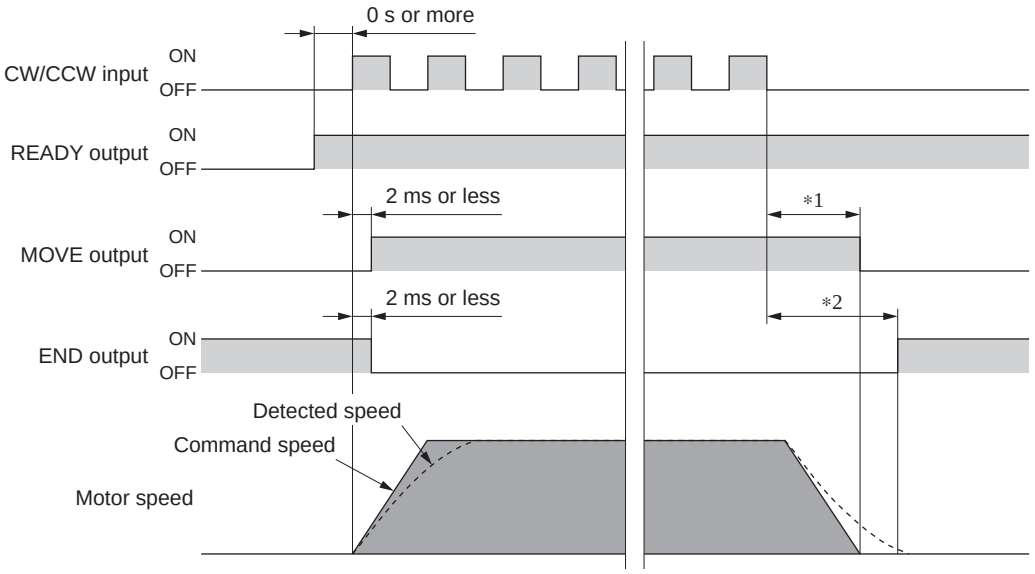


- Some alarms are not preceded by a warning.

■ WNG output

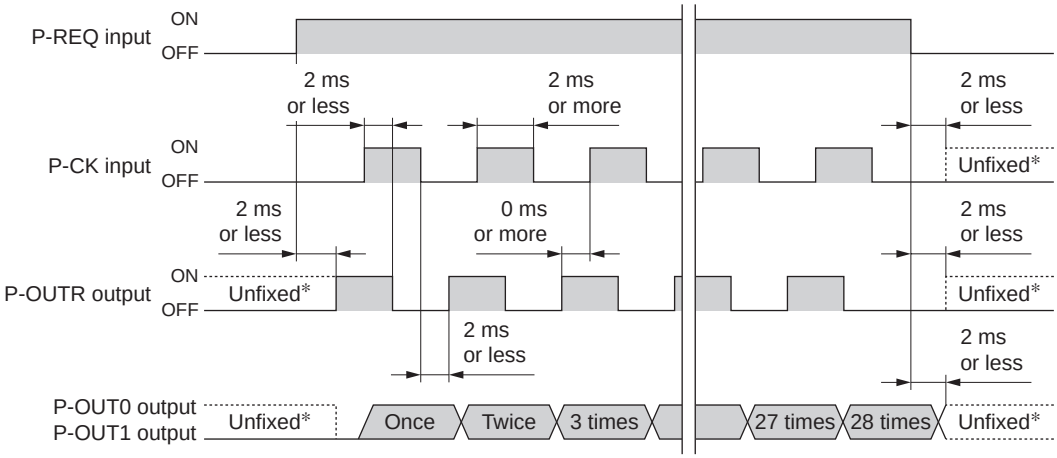


■ Operation based on pulse input [position control mode]

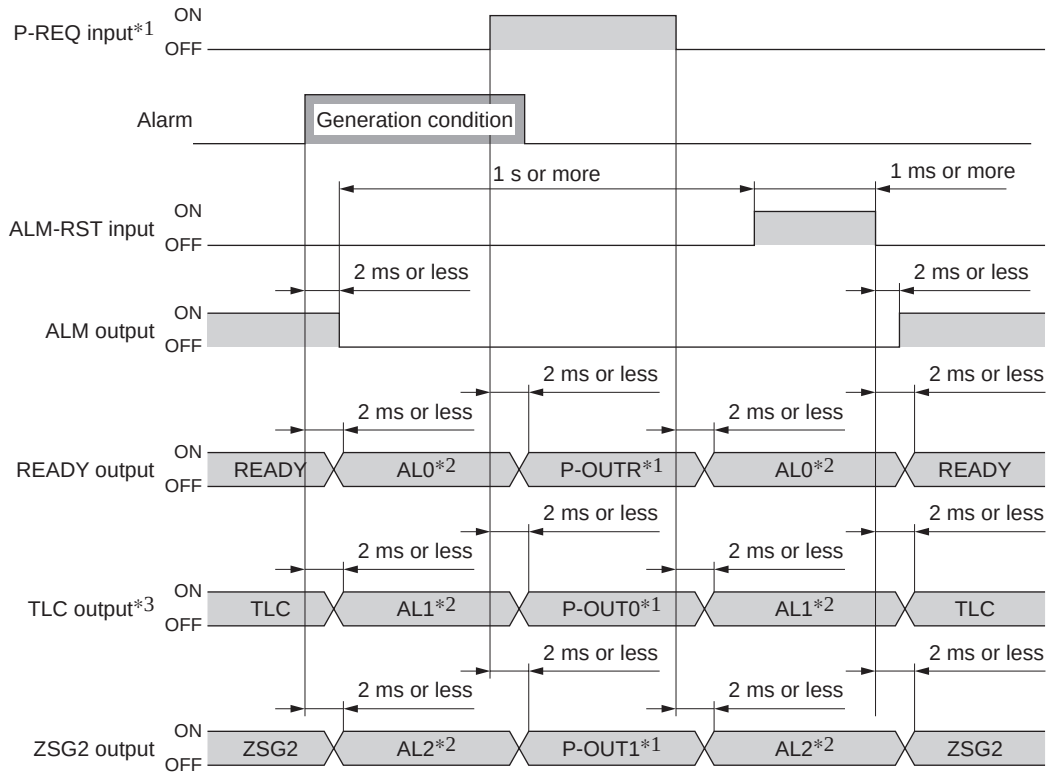


∗1 The specific time varies depending on the setting of the application parameter for command filter [APP-4-01].
∗2 The specific time varies depending on the gain, positioning complete band and load condition.

■ Current position output [position control mode]

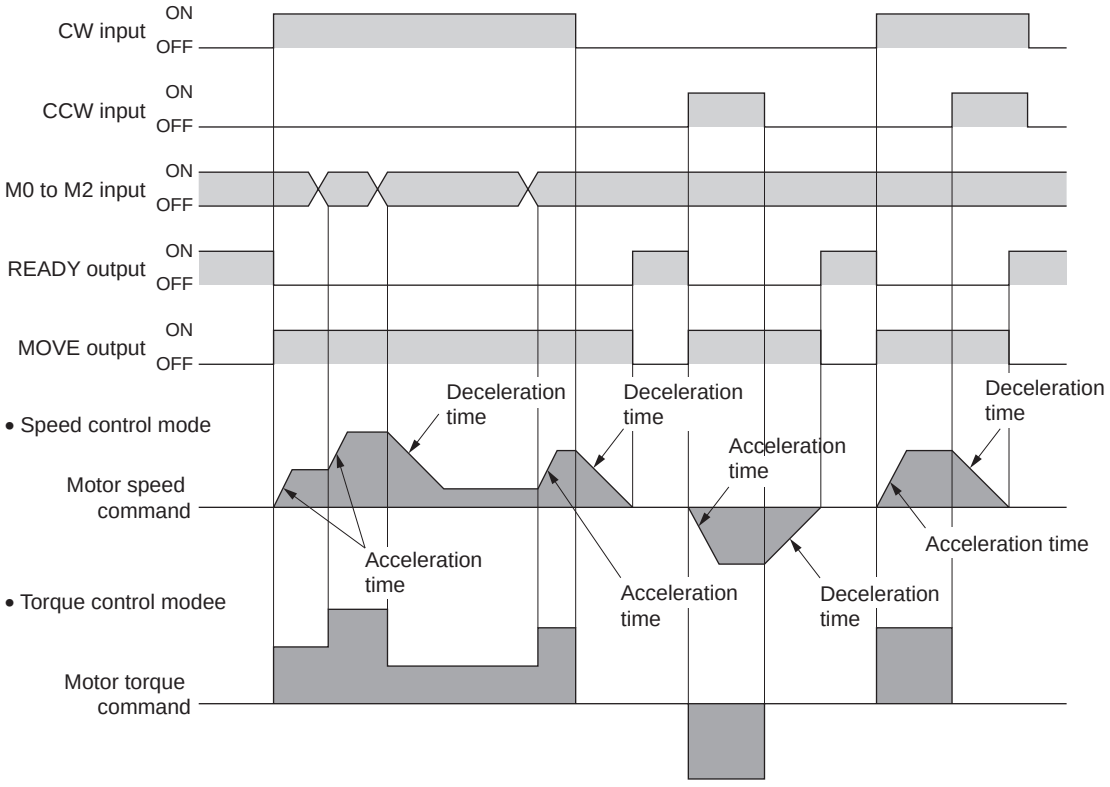


■ Output selection

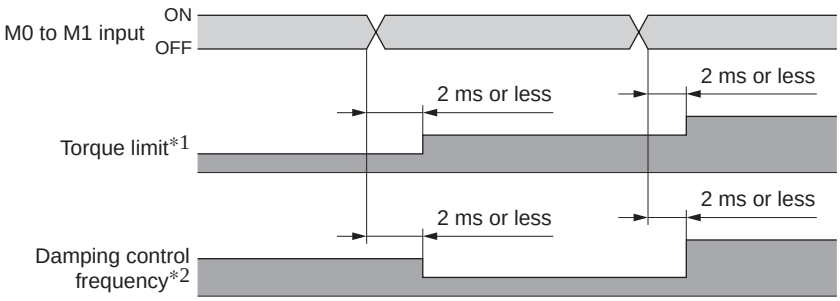


∗1 In the position control mode.
∗2 When the application parameter for alarm code output [APP-1-10] is set to “Enable.”
∗3 In the position control mode or speed control mode. The VLC output becomes effective in the torque control mode and tension control mode.

■ Multi-stage command operation [speed control mode, torque control mode]

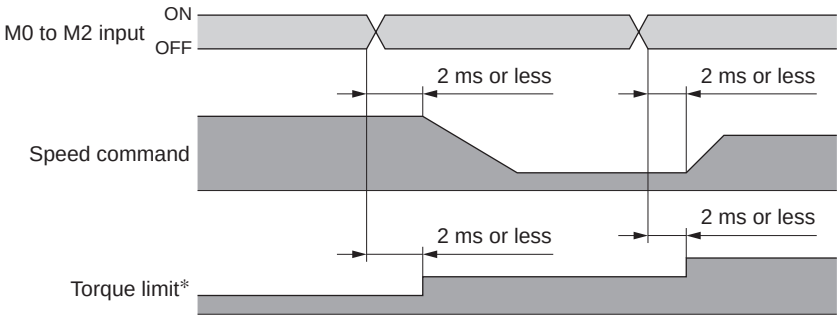


■ M0 to M1 input [position control mode]



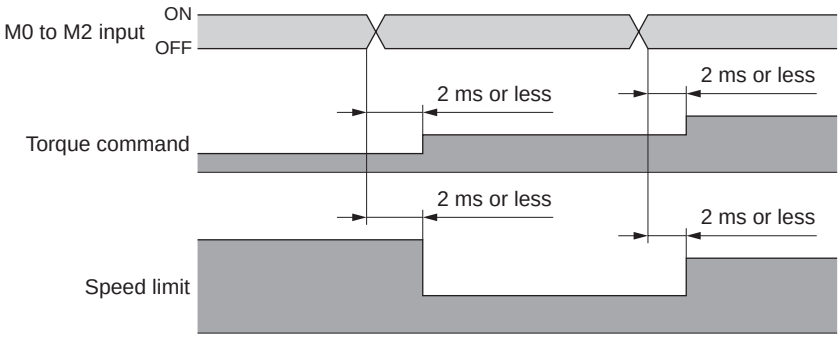
∗1 The TL input is ON.
∗2 Damping control is enabled.

■ M0 to M2 input [speed control mode]



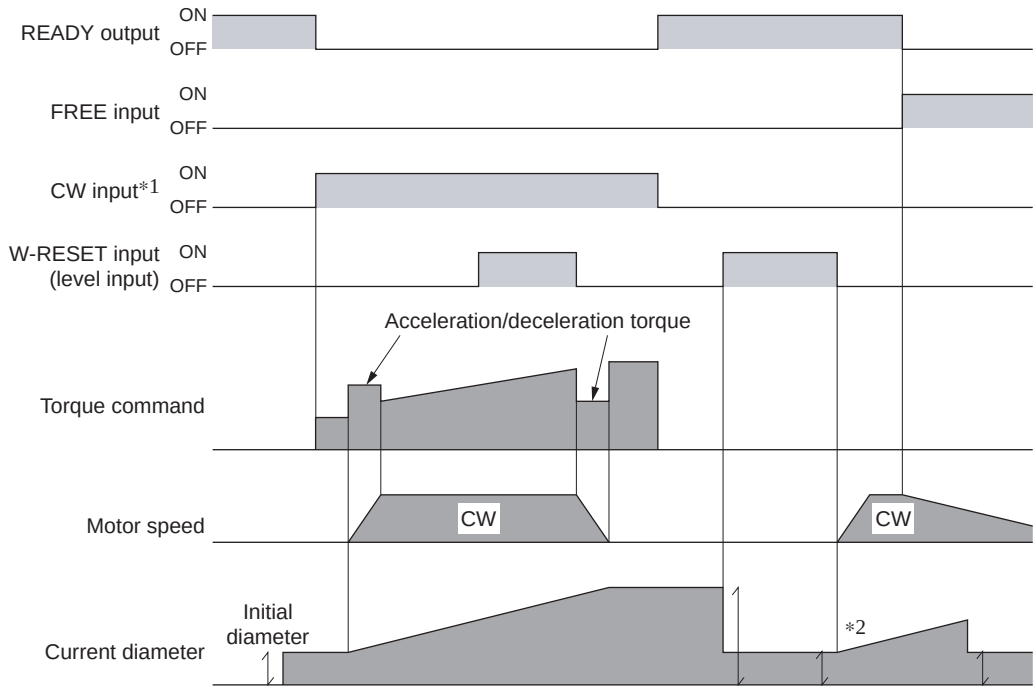
∗ The TL input is ON.

■ M0 to M2 input [torque control mod]



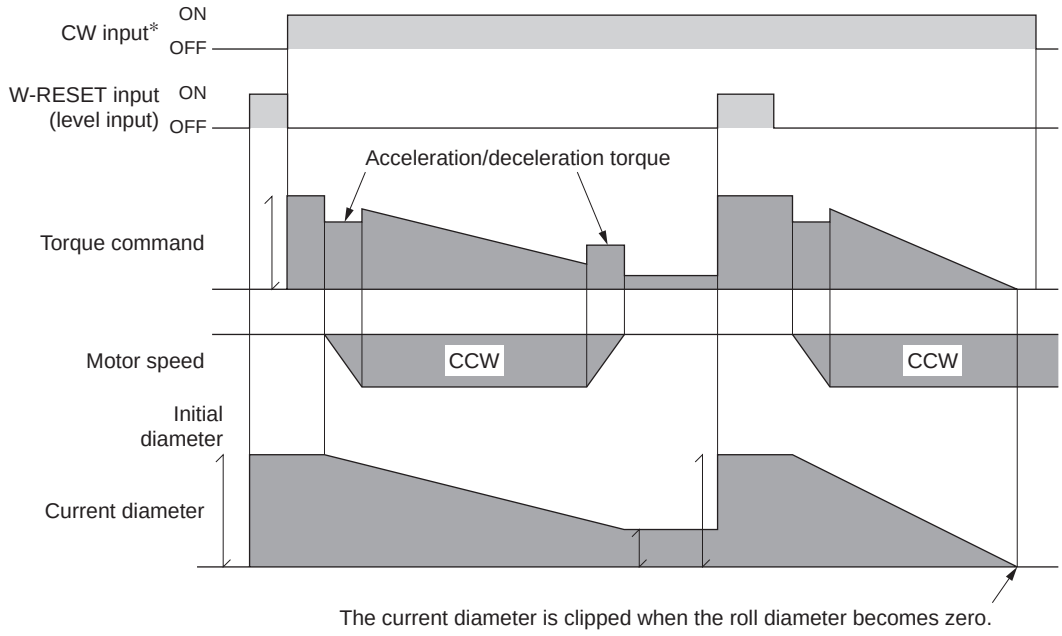
■ Tension controlled operation

- Winding operation (CW input ON)



∗1 In high function mode I and high function mode II, the CCW input is disabled.
∗2 Even when the CW input is OFF and FREE input is ON, the driver will continue to calculate the current diameter if the motor is rotated externally.

- Unwinding operation (CW input ON)



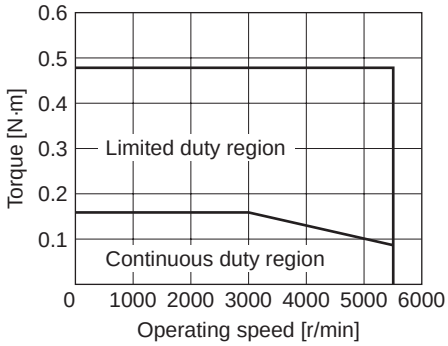
∗ In high function mode I and high function mode II, the CCW input is disabled.

19.2 Speed - Torque Characteristics

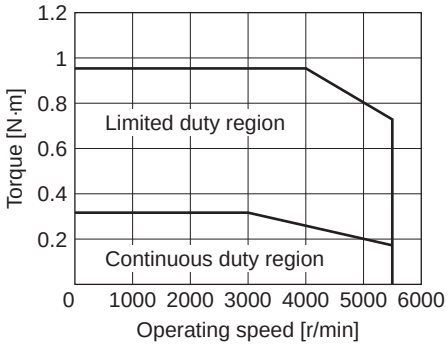
Continuous duty region: Continuous operation is possible in this region.
Limited duty region: This region is used primarily when accelerating and decelerating.

■ Standard type

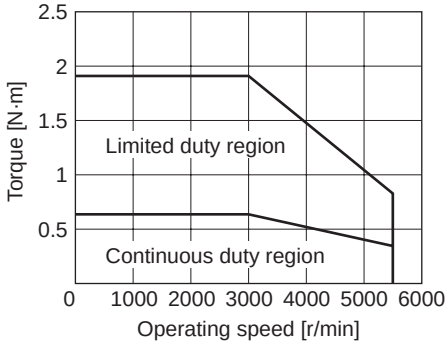
NX45



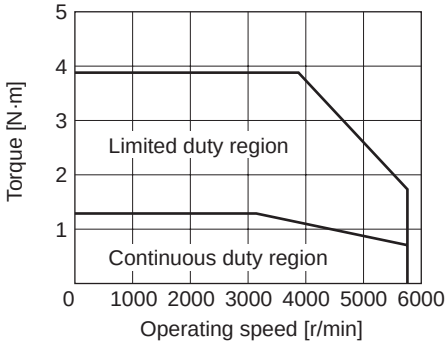
NX410



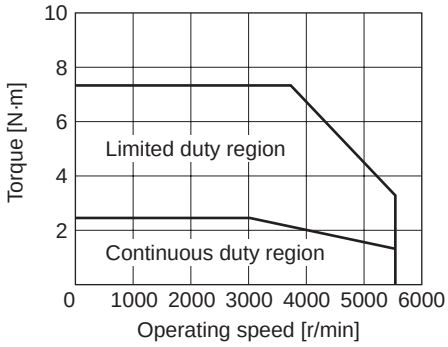
NX620



NX640



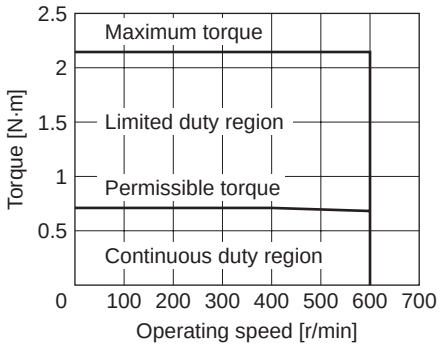
NX975



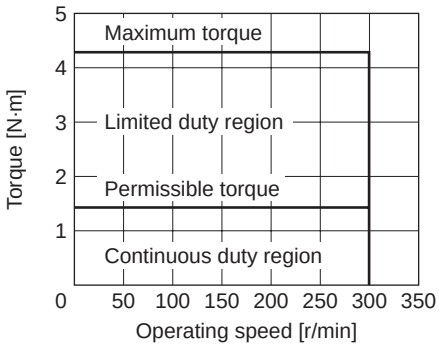
■ PS geared type

• NX65

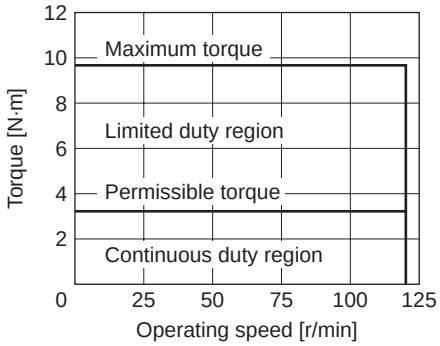
Gear ratio: 5



Gear ratio: 10

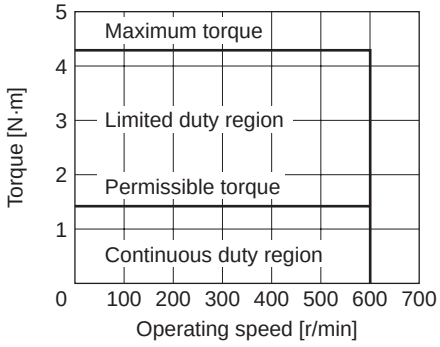


Gear ratio: 25

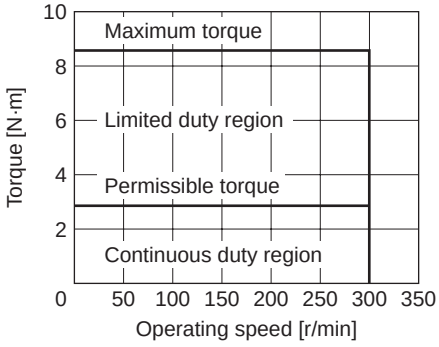


• NX610

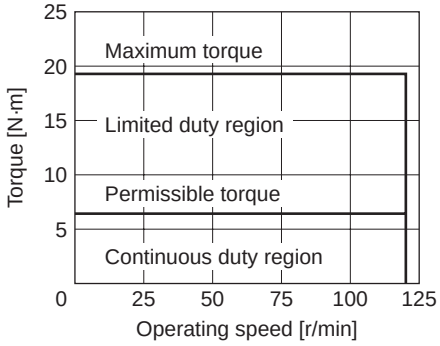
Gear ratio: 5



Gear ratio: 10

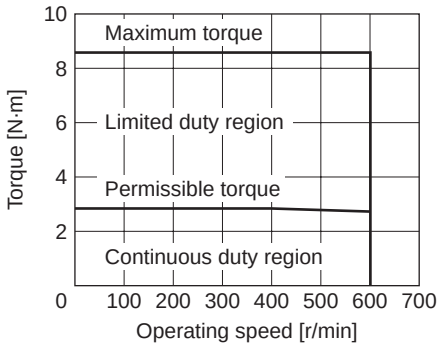


Gear ratio: 25

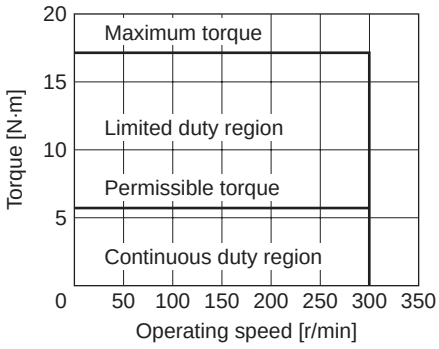


- **NX920**

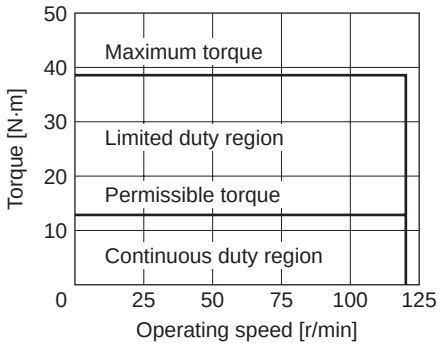
Gear ratio: 5



Gear ratio: 10

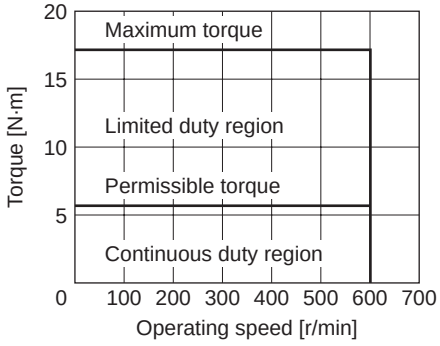


Gear ratio: 25

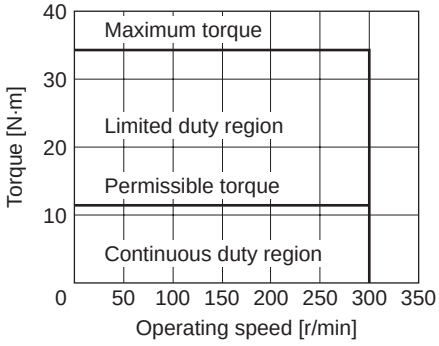


- **NX940**

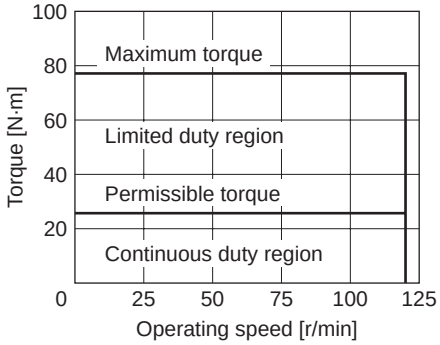
Gear ratio: 5



Gear ratio: 10



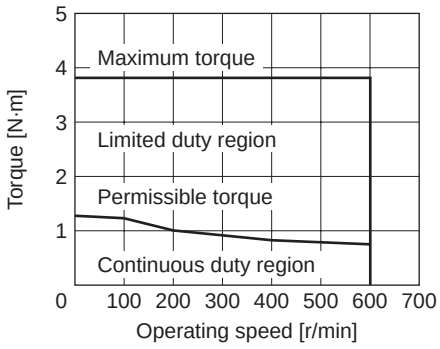
Gear ratio: 25



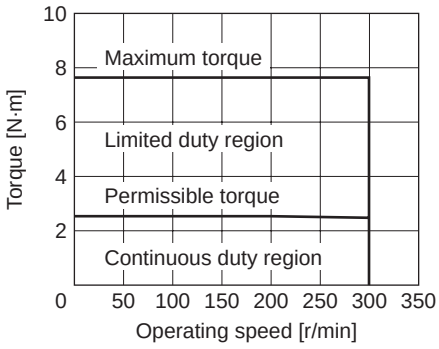
■ PJ geared type

• NX810

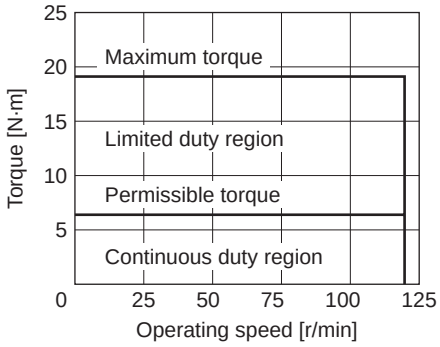
Gear ratio: 5



Gear ratio: 10

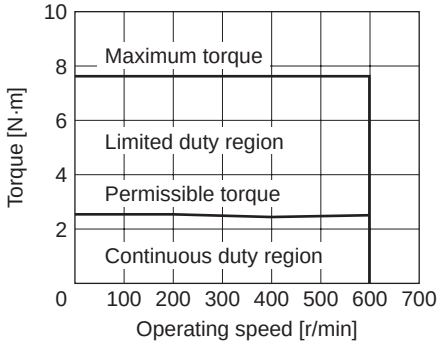


Gear ratio: 25

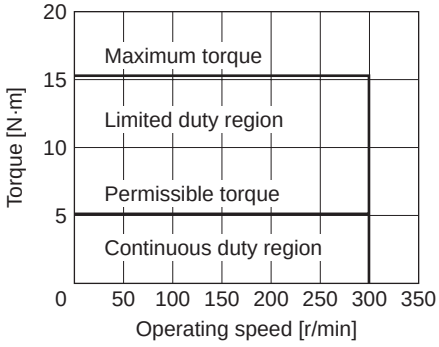


• NX820

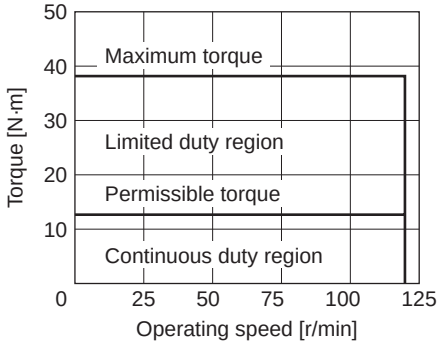
Gear ratio: 5



Gear ratio: 10

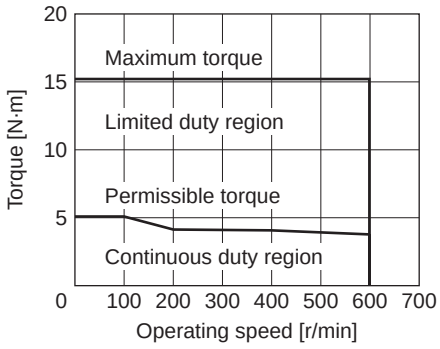


Gear ratio: 25

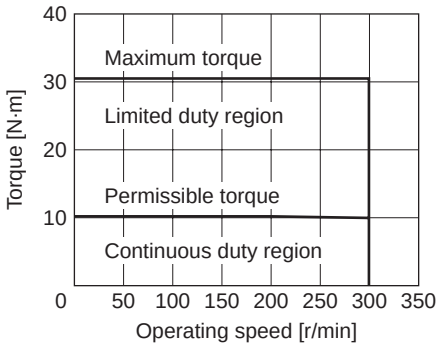


- **NX1040**

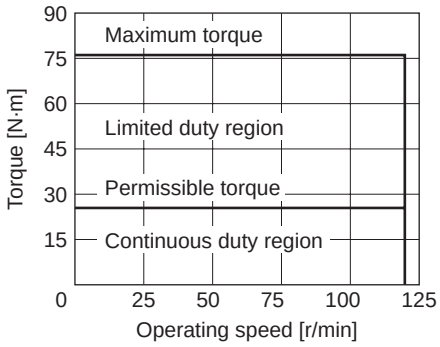
Gear ratio: 5



Gear ratio: 10

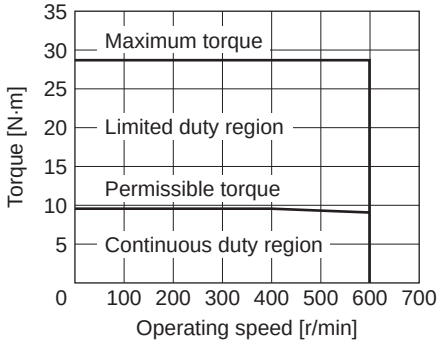


Gear ratio: 25

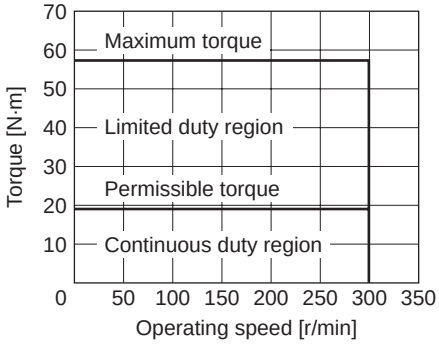


- **NX1075**

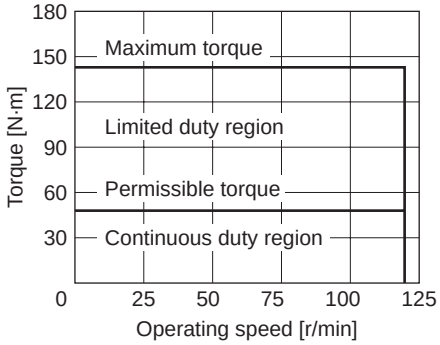
Gear ratio: 5



Gear ratio: 10



Gear ratio: 25



19.3 Function/parameter list (position control mode)

Item	Overview	Standard specification	Extended function
Control mode	Set the control mode.	Available	Available
Torque limit	Set the torque limit value as an analog setting (external potentiometer or external DC voltage).	Available	Available
	Set the torque limit value per 1 V of analog input voltage.	Not available	Available
	Set the offset voltage for analog input.	Not available	Available
	Set whether or not to enable automatic offset for analog input signals.	Not available	Available
	Set the torque limit value via one of operation data Nos. 0 to 3 as a digital setting.	Not available	Available
Damping control frequency	Set the damping control frequency as an analog setting (internal potentiometer VR1). Residual vibration can be suppressed during positioning operation, in order to shorten the positioning time.	Available	Available
	Set the damping control frequency via one of operation data Nos. 0 to 3 as a digital setting.	Not available	Available
	Enable damping control.	Available	Available
Operation data selection	Select one of operation data Nos. 0 to 3 using the M0 and M1 inputs.	Available	Available
Analog/digital selection	Toggle operation data No. 0 between analog setting and digital setting. When the parameter is set to “Enable,” operation data No. 0 becomes an analog setting, while operation data Nos. 1 to 3 provide digital settings. When the parameter is set to “Disable,” all operation data numbers provide digital settings.	Not available	Available
Resolution setting	Set the resolution per pulse. The resolution is calculated by the formula below: Resolution = 1000 × (Electronic gear B / Electronic gear A) The calculated value should fall within the setting range specified below: Setting range: 100 to 100,000 P/R	Not available	Available
Motor rotation direction	Set the rotation direction of the motor relative to the input pulse.	Not available	Available
Absolute system	The current position can be stored in the driver. Use the optional battery (sold separately) if the absolute function is to be enabled.	Available	Available
Operation after absolute position loss alarm reset	Set how the motor should operate after an absolute position loss alarm has been reset, when the absolute system function is used.	Not available	Available
Pulse input	Perform a positioning operation based on pulses input from a pulse generator.	Available	Available
Pulse input mode selection	Set the pulse input mode.	Available	Available
S-ON input	Excite the motor to be ready for operation.	Available	Available
	Set the S-ON input logic.	Not available	Available
READY output	When the motor becomes ready, the READY output will turn ON.	Available	Available
Positioning complete output	When the current position enters the positioning complete output band, the END output will turn ON.	Available	Available
	Set the output band for positioning complete output.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
–	–	–	–
APP-2-03	Analog torque limit gain	0 to 300 [%]	30
APP-2-05	Analog torque limit offset voltage	−1.00 to 1.00 [V]	0
APP-2-06	Analog input signal automatic offset	0: Disable 1: Enable	0
trq	Torque limit	0 to 300 [%]	0
–	–	–	–
vib	Damping frequency	7.00 to 100.00 [Hz]	30.00
APP-4-02	Damping control	0: Disable 1: Enable	1
–	–	–	–
SyS-1-05	Analog input signals	0: Disable 1: Enable	1
SyS-0-00	Electronic gear A	1 to 1000	1
SyS-0-01	Electronic gear B	1 to 1000	1
SyS-1-06	Motor rotation direction	0: + = CCW 1: + = CW	1
–	–	–	–
SyS-1-01	Operation after absolute position loss alarm reset	0: Enable pulse input at the ON edge of the P-REQ input 1: Enable pulse input	0
–	–	–	–
SyS-1-00	Pulse input mode	0: Setting by the pulse input mode selector switch 1: 2-pulse input mode, negative logic 2: 2-pules input mode, positive logic 3: 1-pulse input mode, negative logic 4: 1-pules input mode, positive logic 5: Phase difference mode, × 1 6: Phase difference mode, × 2 7: Phase difference mode, × 4	0
–	–	–	–
APP-1-00	S-ON input logic	0: Contact A (normally open) 1: Contact B (normally closed)	0
–	–	–	–
–	–	–	–
APP-1-04	Positioning complete output band	0.01 to 36.00 [°]	0.36

Item	Overview	Standard specification	Extended function
Positioning near output	When the current position enters the positioning near output band, the NEAR output will turn ON.	Not available	Available
	Enable the positioning near output.	Not available	Available
	Set the output band for positioning near output.	Not available	Available
MOVE output	The MOVE output remains ON while the motor is operating.	Not available	Available
	Select the MOVE output.	Not available	Available
	Set the minimum ON time for the MOVE output.	Not available	Available
Torque limit enable input	Set the torque limit value in operation data. Use the M0 and M1 inputs to select a desired torque limit value from among the predefined settings.	Available	Available
TLC output	The TLC output will turn ON when the torque limit value is reached.	Available	Available
Deviation counter clear	The internal deviation counter of the driver is reset at the ON edge.	Available	Available
FREE input	Release the electromagnetic brake and stop the motor excitation. The motor output shaft becomes free. The deviation counter continues to be reset while the FREE input is ON.	Available	Available
MBC output	Output the timing at which to release the electromagnetic brake.	Not available	Available
Position preset	Rewrite the preset value with the current position.	Available	Available
	Set the preset value.	Not available	Available
Current position output	Output the current position. 56 bits of data are output, include the current position, encoder status, alarm code and checksum.	Available	Available
Encoder feedback output	Output the ASG/BSG/ZSG1 (ZSG2) signals based on encoder feedback pulses.	Available	Available
	Set the encoder feedback pulses per motor evolution. The resolution of encoder feedback pulses is calculated by the formula below: Resolution = 1000 × (Encoder output electronic gear B / Encoder output electronic gear A) The calculated value should fall within the setting range specified below: Setting range: 100 to 10,000 P/R	Not available	Available
	Select the ZSG2 output.	Not available	Available
Alarm code	When an alarm generates, a corresponding alarm code will be output based on the READY/P-OUTR output, TLC/P-OUT0 output and ZSG2/NEAR/P-OUT1 output.	Not available	Available
Analog speed monitor	Output a voltage according to the detected speed.	Available	Available
	Set the maximum analog speed to be monitored	Not available	Available
	Set the maximum voltage for monitored analog speed.	Not available	Available
	Set the offset value for monitored analog speed.	Not available	Available
Analog torque monitor	Output a voltage according to the detected torque.	Available	Available
	Set the maximum analog torque to be monitored.	Not available	Available
	Set the maximum voltage for monitored analog torque.	Not available	Available
	Set the offset value for monitored analog torque.	Not available	Available
Tuning mode selection	Set the gain tuning mode. Automatic: The load inertial moment is estimated internally by the driver. Simply set the mechanical rigidity, and the gain will be adjusted automatically. Semi-auto: Set the mechanical rigidity and load inertial moment ratio, and the gain will be adjusted automatically. Manual: The customer must set the gain directly.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
APP-1-03	Output signal selection 2	0: ZSG2 output 1: NEAR output	0
APP-1-05	Positioning near output band	0.01 to 36.00 [°]	1.80
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
APP-1-08	Minimum ON time for MOVE signal	0 to 255 [ms]	5
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
–	–	–	–
APP-1-09	Preset value	−2,147,483,648 to 2,147,483,647 [step]	0
–	–	–	–
–	–	–	–
SyS-0-02	Encoder output electronic gear A	1 to 1000	1
SyS-0-03	Encoder output electronic gear B	1 to 1000	1
APP-1-03	Output signal selection 2	0: ZSG2 output 1: NEAR output	0
APP-1-10	Alarm code output	0: Disable 1: Enable	0
–	–	–	–
APP-2-07	Analog speed monitor maximum value	1 to 6000 [r/min]	5500
APP-2-08	Analog speed monitor maximum voltage	1 to 10 [V]	10
APP-2-09	Analog speed monitor offset voltage	−1.00 to 1.00 [V]	0
–	–	–	–
APP-2-10	Analog torque monitor maximum value	1 to 300 [%]	300
APP-2-11	Analog torque monitor maximum voltage	1 to 10 [V]	10
APP-2-12	Analog torque monitor offset voltage	−1.00 to 1.00 [V]	0
APP-0-00	Gain tuning mode selection	0: Automatic 1: Semi-auto 2: Manual	0

Item	Overview	Standard specification	Extended function
Load inertial ratio setting	Set the percentage of the load inertial moment to the rotor inertial moment of the motor. This ratio is set in semi-auto tuning or manual turning. If the load inertial moment is equal to the rotor inertial moment, the load inertial ratio become 100%.	Not available	Available
Mechanical rigidity setting switch	Set the gain adjustment level according to the mechanical rigidity.	Available	Available
Mechanical rigidity selection	Set whether or not to enable the mechanical rigidity setting switch.	Not available	Available
	Set the mechanical rigidity as a digital setting.	Not available	Available
Position loop proportional gain	Set the position loop proportional gain when manual tuning is performed. When the value is increased, the response will increase.	Not available	Available
Speed loop proportional gain	Set the speed loop proportional gain when manual tuning is performed. When the value is increased, the response will increase.	Not available	Available
Speed loop integral time constant	Set the speed loop integral time constant when manual tuning is performed. When the value is decreased, the response will increase.	Not available	Available
Speed feed-forward rate	Set the speed feed-forward rate when manual tuning is performed. This setting allows the settling time to be shortened.	Not available	Available
Command filter	Apply a filter to the pulse input command to make the operation smooth.	Available	Available
Damping control	Suppress residual vibration during positioning, in order to shorten the positioning time.	Available	Available
Data-setter initial display	Set the initial screen on the **OPX-2A**. In the position control mode, the top screen of the monitor mode will become the initial display if the selected item cannot be displayed.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
APP-0-01	Load inertial moment ratio	0 to 10,000 [%]	500
–	–	–	–
APP-4-00	Mechanical rigidity setting switch	0: Disable 1: Enable	1
APP-0-02	Mechanical rigidity setting	0 to 15	6
APP-0-03	Position loop gain	1 to 200 [Hz]	10
APP-0-04	Speed loop gain	1 to 1000 [Hz]	50
APP-0-05	Speed loop integral time constant	1.0 to 500.0 [ms]	31.8
APP-0-06	Speed feed-forward rate	0 to 100 [%]	0
APP-4-01	Command filter	0 to 100 [ms]	3
APP-4-02	Damping control	0: Disable 1: Enable	1
SyS-1-07	Data-setter initial display	0: Operating speed [r/min] 1: Position [steps] 2: Torque [%] 3: Estimated inertial moment ratio [%] 4: Operation number 5. Selected number 6: Tension [%] 7: Revolution counter [rev] 8: Roll diameter [mm] 9: Top screen of monitor mode	0

19.4 Function/parameter list (speed control mode)

Item	Overview	Standard specification	Extended function
Control mode	Set the control mode.	Available	Available
Speed command	Set the speed command value via operation data No. 0 or 1 as an analog setting (internal potentiometer VR1, external potentiometer or external DC voltage). Operation data Nos. 2 to 7 provide digital settings.	Available	Available
	Set the speed command value per 1 V of analog input voltage.	Not available	Available
	Set the speed at which to clamp the analog input to zero.	Not available	Available
	Set the offset voltage for analog input.	Not available	Available
	Set whether or not to enable automatic offset for analog input signals.	Not available	Available
	Set the speed command value via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
Torque limit	Set the torque limit value via operation data No. 0 or 1 as an analog setting (internal potentiometer VR1, external potentiometer or external DC voltage). Operation data Nos. 2 to 7 provide digital settings.	Available	Available
	Set the torque limit value per 1 V of analog input voltage.	Not available	Available
	Set the offset voltage for analog input.	Not available	Available
	Set whether or not to enable automatic offset for analog input signals.	Not available	Available
	Set the torque limit value via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
Acceleration/ deceleration time.	Set the acceleration/deceleration time via operation data No. 0 or 1 as an analog setting (internal potentiometer VR2). The acceleration time and deceleration time are the same.	Available	Available
	Set the acceleration time via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
	Set the deceleration time via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
Operation data selection	Select one of operation data Nos. 0 to 7 using the M0 to M2 inputs.	Available	Available
Analog/digital selection	Toggle operation data No. 0 and No. 1 between analog setting and digital setting. When this parameter is set to “Enable,” operation data Nos. 0 and 1 become analog settings, while Nos. 2 to 7 provide digital settings. When the parameter is set to “Disable,” all operation data numbers provide digital	Not available	Available
Motor rotation direction	Set the rotation direction of the motor.	Not available	Available
Operation after stopping	Set how the motor should operate after stopping.	Not available	Available
S-ON input	Excite the motor to be ready for operation.	Not available	Available
	Set the S-ON input logic.	Not available	Available
READY output	When the motor becomes ready, the READY output will turn ON.	Available	Available
Forward/reverse	Start operating in forward or reverse direction.	Available	Available
Instantaneous stop	Stop the motor instantaneously.	Available	Available
	Set the BRAKE input logic.	Not available	Available
ZV output	The ZV output will turn ON when the detected speed drops into the speed range set by the zero speed output band.	Not available	Available
	Set the band within which the ZV output turns ON.	Not available	Available
VA output	The VA output will turn ON when the operating speed reaches the speed range set by the attained speed output band.	Available	Available
	Set the band within which the VA output turns ON.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
–	–	–	–
APP-2-00	Analog speed command gain	0 to 5500 [r/min]	550
APP-2-01	Analog speed command clamp	0 to 500 [r/min]	10
APP-2-02	Analog speed command offset voltage	−1.00 to 1.00 [V]	0
APP-2-06	Analog input signal automatic offset	0: Disable 1: Enable	0
rEv	Operating speed	0 to 5500 [r/min]	0
–	–	–	–
APP-2-03	Analog torque limit gain	0 to 300 [%]	30
APP-2-05	Analog torque limit offset voltage	−1.00 to 1.00 [V]	0
APP-2-06	Analog input signal automatic offset	0: Disable 1: Enable	0
trq	Torque limit	0 to 300 [%]	0
–	–	–	–
tA	Acceleration time	5 to 10,000 [ms / 1000 r/min]	100
td	Deceleration time	5 to 10,000 [ms / 1000 r/min]	100
–	–	–	–
SyS-1-05	Analog input signals	0: Disable 1: Enable	1
SyS-1-07	Motor rotation direction	0: + = CCW 1: + = CW	1
SyS-1-02	Operation selection after stopping in speed control mode	0: Free 1: Servo lock	0
–	–	–	–
APP-1-00	S-ON signal logic	0: Contact A (normally open) 1: Contact B (normally closed)	0
–	–	–	–
–	–	–	–
–	–	–	–
APP-1-01	BRAKE signal logic	0: Contact A (normally open) 1: Contact B (normally closed)	1
APP-1-03	Output signal selection 2	0: ZSG2 output 1: ZV output	0
APP-1-06	Zero speed output band	1 to 5500 [r/min]	10
–	–	–	–
APP-1-07	Attained speed output band	1 to 5500 [r/min]	30

Item	Overview	Standard specification	Extended function
MOVE output	The MOVE output remains ON while the motor is operating.	Available	Available
	Select the MOVE output.	Not available	Available
	Set the minimum ON time for the MOVE output.	Not available	Available
FREE input	Release the electromagnetic brake and stop the motor excitation. The motor output shaft becomes free. The deviation counter continues to be reset while the FREE input is ON.	Available	Available
MBC output	Output the timing at which to release the electromagnetic brake.	Not available	Available
Torque limit enable input	Set the torque limit value in operation data. Use the M0 to M2 inputs to select a desired torque limit value from among the predefined settings.	Available	Available
TLC output	The TLC output will turn ON when the detected torque reaches the torque limit value.	Available	Available
Encoder feedback output	Output the ASG/BSG/ZSG1 (ZSG2) signals based on encoder feedback pulses.	Available	Available
	Set the encoder feedback pulses per motor evolution. The resolution of encoder feedback pulses is calculated by the formula below: Resolution = 1000 × (Encoder output electronic gear B / Encoder output electronic gear A) The calculated value should fall within the setting range specified below: Setting range: 100 to 10,000 P/R	Not available	Available
	Select the ZSG2 output.	Not available	Available
Alarm code	When an alarm generates, a corresponding alarm code will be output based on the READY output, TLC output and ZSG2/ZV output.	Not available	Available
Analog speed monitor	Output a voltage according to the detected speed.	Available	Available
	Set the maximum analog speed to be monitored.	Not available	Available
	Set the maximum voltage for monitored analog speed.	Not available	Available
	Set the offset value for monitored analog speed.	Not available	Available
Analog torque monitor	Output a voltage according to the detected torque.	Available	Available
	Set the maximum analog torque to be monitored.	Not available	Available
	Set the maximum voltage for monitored analog torque.	Not available	Available
	Set the offset value for monitored analog torque.	Not available	Available
Tuning mode selection	Set the gain tuning mode. Automatic: The load inertial moment is estimated internally by the driver. Simply set the mechanical rigidity, and the gain will be adjusted automatically. Semi-auto: Set the mechanical rigidity and load inertial moment ratio, and the gain will be adjusted automatically. Manual: The customer must set the gain directly.	Not available	Available
Load inertial ratio setting	Set the percentage of the load inertial moment to the rotor inertial moment of the motor. This ratio is set in semi-auto tuning or manual turning. If the load inertial moment is equal to the rotor inertial moment, the load inertial ratio becomes 100%.	Not available	Available
Mechanical rigidity setting switch	Set the gain adjustment level according to the mechanical rigidity.	Available	Available
Mechanical rigidity selection	Set whether or not to enable the mechanical rigidity setting switch.	Not available	Available
	Set the mechanical rigidity as a digital setting.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
APP-1-08	Minimum ON time for MOVE signal	0 to 255 [ms]	5
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
–	–	–	–
–	–	–	–
–	–	–	–
SyS-0-02	Encoder output electronic gear A	1 to 1000	1
SyS-0-03	Encoder output electronic gear B	1 to 1000	1
APP-1-03	Output signal selection 2	0: ZSG2 output 1: NEAR output	0
APP-1-10	Alarm code output	0: Disable 1: Enable	0
–	–	–	–
APP-2-07	Analog speed monitor maximum value	1 to 6000 [r/min]	5500
APP-2-08	Analog speed monitor maximum voltage	1 to 10 [V]	10
APP-2-09	Analog speed monitor offset voltage	−1.00 to 1.00 [V]	0
–	–	–	–
APP-2-10	Analog torque monitor maximum value	1 to 300 [%]	300
APP-2-11	Analog torque monitor maximum voltage	1 to 10 [V]	10
APP-2-12	Analog torque monitor offset voltage	−1.00 to 1.00 [V]	0
APP-0-00	Gain tuning mode selection	0: Automatic 1: Semi-auto 2: Manual	0
APP-0-01	Load inertial moment ratio	0 to 10,000 [%]	500
–	–	–	–
APP-4-00	Mechanical rigidity setting switch	0: Disable 1: Enable	1
APP-0-02	Mechanical rigidity setting	0 to 15	6

Item	Overview	Standard specification	Extended function
Position loop proportional gain	Set the position loop proportional gain when manual tuning is performed. When the value is increased, the response will increase.	Not available	Available
Speed loop proportional gain	Set the speed loop proportional gain when manual tuning is performed. When the value is increased, the response will increase.	Not available	Available
Speed loop integral time constant	Set the speed loop integral time constant when manual tuning is performed. When the value is decreased, the response will increase.	Not available	Available
Speed feed-forward rate	Set the speed feed-forward rate when manual tuning is performed. This setting allows the settling time to be shortened.	Not available	Available
Data-setter initial display	Set the initial screen on the **OPX-2A**. In the position control mode, the top screen of the monitor mode will become the initial display if the selected item cannot be displayed.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
APP-0-03	Position loop gain	1 to 200 [Hz]	10
APP-0-04	Speed loop gain	1 to 1000 [Hz]	50
APP-0-05	Speed loop integral time constant	1.0 to 500.0 [ms]	31.8
APP-0-06	Speed feed-forward rate	0 to 100 [%]	0
SyS-1-07	Data-setter initial display	0: Operating speed [r/min] 1: Position [steps] 2: Torque [%] 3: Estimated inertial moment ratio [%] 4: Operation number 5. Selected number 6: Tension [%] 7: Revolution counter [rev] 8: Roll diameter [mm] 9: Top screen of monitor mode	0

19.5 Function/parameter list (torque control mode)

Item	Overview	Standard specification	Extended function
Control mode	Set the control mode.	Available	Available
Torque command	Set the torque command value via operation data No. 0 or 1 as an analog setting (internal potentiometer VR1, external potentiometer or external DC voltage). Operation data Nos. 2 to 7 provide digital settings.	Available	Available
	Set the torque command value per 1 V of analog input voltage.	Not available	Available
	Set the offset voltage for analog input.	Not available	Available
	Set whether or not to enable automatic offset for analog input signals.	Not available	Available
	Set the torque command value via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
Speed limit	Set the speed limit value via operation data No. 0 or 1 as an analog setting (internal potentiometer VR2, external potentiometer or external DC voltage). Operation data Nos. 2 to 7 provide digital settings.	Available	Available
	Set the speed limit value per 1 V of analog input voltage.	Not available	Available
	Set the speed at which to clamp the analog input to zero.	Not available	Available
	Set the offset voltage for analog input.	Not available	Available
	Set whether or not to enable automatic offset for analog input signals.	Not available	Available
	Set the speed limit value via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
Operation data selection	Select one of operation data Nos. 0 to 7 using the M0 to M2 inputs.	Available	Available
Analog/digital selection	Toggle operation data No. 0 and No. 1 between analog setting and digital setting. When this parameter is set to “Enable,” operation data Nos. 0 and 1 become analog settings, while Nos. 2 to 7 provide digital settings. When the parameter is set to “Disable,” all operation data numbers provide digital	Not available	Available
Motor rotation direction	Set the direction in which motor torque generates.	Not available	Available
READY output	When the motor becomes ready, the READY output will turn ON.	Available	Available
Forward/reverse	Start operating in forward or reverse direction. With an analog setting, the rotation direction changes depending on the voltage.	Available	Available
MOVE output	The MOVE output remains ON while the motor is operating.	Available	Available
	Select the MOVE output.	Not available	Available
	Set the minimum ON time for the MOVE output.	Not available	Available
FREE input	Release the electromagnetic brake and stop the motor excitation. The motor output shaft becomes free.	Available	Available
MBC output	Output the timing at which to release the electromagnetic brake.	Not available	Available
Encoder feedback output	Output the ASG/BSG/ZSG1 (ZSG2) signals based on encoder feedback pulses.	Available	Available
	Set the encoder feedback pulses per motor evolution. The resolution of encoder feedback pulses is calculated by the formula below: Resolution = 1000 × (Encoder output electronic gear B / Encoder output electronic gear A) The calculated value should fall within the setting range specified below: Setting range: 100 to 10,000 P/R	Not available	Available
	Select the ZSG2 output.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
–	–	–	–
APP-2-03	Analog torque command gain	0 to 300 [%]	30
APP-2-05	Analog torque command offset voltage	−1.00 to 1.00 [V]	0
APP-2-06	Analog input signal automatic offset	0: Disable 1: Enable	0
trq	Torque command	0 to 300 [%]	0
–	–	–	–
APP-2-00	Analog speed limit gain	0 to 5500 [r/min]	550
APP-2-01	Analog speed limit clamp	0 to 500 [r/min]	10
APP-2-02	Analog speed limit offset voltage	−1.00 to 1.00 [V]	0
APP-2-06	Analog input signal automatic offset	0: Disable 1: Enable	0
rEv	Analog input signal automatic offset	0 to 5500 [r/min]	0
–	–	–	–
SyS-1-05	Analog input signals	0: Disable 1: Enable	1
SyS-1-06	Motor rotation direction	0: + = CCW 1: + = CW	1
–	–	–	–
–	–	–	–
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
APP-1-08	Minimum ON time for MOVE signal	0 to 255 [ms]	5
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
–	–	–	–
SyS-0-02	Encoder output electronic gear A	1 to 1000	1
SyS-0-03	Encoder output electronic gear B	1 to 1000	1
APP-1-03	Output signal selection 2	0: ZSG2 output 1: NEAR output	0

Item	Overview	Standard specification	Extended function
ZV output	The ZV output will turn ON when the detected speed drops into the speed range set by the zero speed output band.	Not available	Available
	Set the band within which the ZV output turns ON.	Not available	Available
Alarm code	When an alarm generates, a corresponding alarm code will be output based on the READY output, VLC output and ZSG2/ZV output.	Not available	Available
Analog speed monitor	Output a voltage according to the detected speed.	Available	Available
	Set the maximum analog speed to be monitored.	Not available	Available
	Set the maximum voltage for monitored analog speed.	Not available	Available
	Set the offset value for monitored analog speed.	Not available	Available
Analog torque monitor	Output a voltage according to the detected torque.	Available	Available
	Set the maximum analog torque to be monitored.	Not available	Available
	Set the maximum voltage for monitored analog torque.	Not available	Available
	Set the offset value for monitored analog torque.	Not available	Available
Data-setter initial display	Set the initial screen on the **OPX-2A**. In the torque control mode, the top screen of the monitor mode will become the initial display if the selected item cannot be displayed.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
APP-1-03	Output signal selection 2	0: ZSG2 output 1: ZV output	0
APP-1-06	Zero speed output band	1 to 5500 [r/min]	10
APP-1-10	Alarm code output	0: Disable 1: Enable	0
–	–	–	–
APP-2-07	Analog speed monitor maximum value	1 to 6000 [r/min]	5500
APP-2-08	Analog speed monitor maximum voltage	1 to 10 [V]	10
APP-2-09	Analog speed monitor offset voltage	−1.00 to 1.00 [V]	0
–	–	–	–
APP-2-10	Analog torque monitor maximum value	1 to 300 [%]	300
APP-2-11	Analog torque monitor maximum voltage	1 to 10 [V]	10
APP-2-12	Analog torque monitor offset voltage	−1.00 to 1.00 [V]	0
SyS-1-07	Data-setter initial display	0: Operating speed [r/min] 1: Position [steps] 2: Torque [%] 3: Estimated inertial moment ratio [%] 4: Operation number 5. Selected number 6: Tension [%] 7: Revolution counter [rev] 8: Roll diameter [mm] 9: Top screen of monitor mode	0

19.6 Function/parameter list (tension control mode)

Item	Overview	Standard specification	Extended function
Control mode	Set the control mode.	Available	Available
Tension control mode	Select the tension control mode. Simple: The tension is controlled at a constant level when the feed rate is constant during winding operation, etc. High function I: The current winding (unwinding) diameter is calculated automatically based on the initial diameter, material thickness and final diameter. The tension is controlled at a constant level regardless of the operating speed. High function II: In addition to the control in high function mode I, the load inertial moment is calculated internally by the driver based on the material inertial moment and core inertial moment. The tension is controlled at a constant level even during acceleration/deceleration.	Not available	Available
Tension command	Set the tension command value via operation data No. 0 or 1 as an analog setting (internal potentiometer VR1, external potentiometer or external DC voltage). Operation data Nos. 2 to 7 provide digital settings.	Available	Available
	Set the tension command value per 1 V of analog input voltage.	Not available	Available
	Set the offset voltage for analog input.	Not available	Available
	Set whether or not to enable automatic offset for analog input signals.	Not available	Available
	Set the tension command value via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
Speed limit	Set the speed limit value via operation data No. 0 or 1 as an analog setting (internal potentiometer VR2, external potentiometer or external DC voltage). Operation data Nos. 2 to 7 provide digital settings.	Available	Available
	Set the speed limit value per 1 V of analog input voltage.	Not available	Available
	Set the speed at which to clamp the analog input to zero.	Not available	Available
	Set the offset voltage for analog input.	Not available	Available
	Set whether or not to enable automatic offset for analog input signals.	Not available	Available
	Set the speed limit value via one of operation data Nos. 0 to 7 as a digital setting.	Not available	Available
Material thickness	Set the change in radius (material thickness) per one revolution of the winding (unwinding) shaft in high function mode I or high function mode II.	Not available	Available
Initial diameter	Set the material diameter at the start of winding or unwinding in high function mode I or high function mode II.	Not available	Available
Maximum diameter	Set the material diameter at the end of winding or unwinding in high function mode I or high function mode II.	Not available	Available
Material inertial moment	Set the inertial moment corresponding to the maximum material diameter in high function mode I or high function mode II.	Not available	Available
Core inertial moment	Set the inertial moment of the core around which material is set, in high function mode II.	Not available	Available
Taper setting	Reduce the tension according to the change in the roll diameter to prevent excessively tight winding, in high function mode II.	Not available	Available
Tension control gear ratio	Set the ratio of the motor shaft speed and the winding shaft speed.	Not available	Available
Operation data selection	Select one of operation data Nos. 0 to 7 using the M0 to M2 inputs.	Available	Available
Analog/digital selection	Toggle operation data No. 0 and No. 1 between analog setting and digital setting. When this parameter is set to “Enable,” operation data Nos. 0 and 1 become analog settings, while Nos. 2 to 7 provide digital settings. When the parameter is set to “Disable,” all operation data numbers provide digital	Not available	Available
READY output	When the motor becomes ready, the READY output will turn ON.	Available	Available
Forward/reverse	Start operating in forward or reverse direction.	Available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
–	–	–	–
SyS-1-03	Tension control mode selection	0: Simple 1: High function I 2: High function II	0
–	–	–	–
APP-2-04	Analog tension command gain	0 to 100 [%]	10
APP-2-05	Analog tension command offset voltage	−1.00 to 1.00 [V]	0
APP-2-06	Analog input signal automatic offset	0: Disable 1: Enable	0
tEn	Tension command	0 to 100 [%]	0
–	–	–	–
APP-2-00	Analog speed limit gain	0 to 5500 [r/min]	550
APP-2-01	Analog speed limit clamp	0 to 500 [r/min]	10
APP-2-02	Analog speed limit offset voltage	−1.00 to 1.00 [V]	0
APP-2-06	Analog input signal automatic offset	0: Disable 1: Enable	0
rEv	Speed limit	0 to 5500 [r/min]	0
dt	Material thickness	1 to 5000 [µm]	50
din	Initial diameter	1 to 1000 [mm]	500
dPK	Final diameter	1 to 1000 [mm]	1000
JL	Material inertial moment	0 to 99999.99 [$\times 10^{-4}$ kgm^2]	0
Jc	Core inertial moment	0 to 99999.99 [$\times 10^{-4}$ kgm^2]	0
tEP	Taper setting	0 to 100 [%]	100
SyS-1-04	Tension control gear ratio	1.0 to 1000.0	1.0
–	–	–	–
SyS-1-05	Analog input signals	0: Disable 1: Enable	1
–	–	–	–
–	–	–	–

Item	Overview	Standard specification	Extended function
ZV output	The ZV output will turn ON when the detected speed drops into the speed range set by the zero speed output band.	Not available	Available
	Set the band within which the ZV output turns ON.	Not available	Available
Acceleration/deceleration correction filter	Set the correction filter time constant for acceleration/deceleration in high function mode II. Increase the value if vibration occurs when the motor accelerates/decelerates during winding operation.	Not available	Available
Friction torque correction	Correct the torque load based on the friction of mechanical parts in high function mode I or high function mode II. The value is based on the torque detected during idle operation.	Not available	Available
W-RESET input	Reset the roll diameter of the winding shaft to the initial value.	Available	Available
Encoder feedback output	Output the ASG/BSG/ZSG1 (ZSG2) signals based on encoder feedback pulses.	Available	Available
	Set the encoder feedback pulses per motor evolution. The resolution of encoder feedback pulses is calculated by the formula below: Resolution = 1000 × (Encoder output electronic gear B / Encoder output electronic gear A) The calculated value should fall within the setting range specified below: Setting range: 100 to 10,000 P/R	Not available	Available
	Select the ZSG2 output.	Not available	Available
Alarm code	When an alarm generates, a corresponding alarm code will be output based on the READY output, VLC output and ZSG2/ZV output.	Not available	Available
Analog speed monitor	Output a voltage according to the detected speed.	Available	Available
	Set the maximum analog speed to be monitored.	Not available	Available
	Set the maximum voltage for monitored analog speed.	Not available	Available
	Set the offset value for monitored analog speed.	Not available	Available
Analog torque monitor	Output a voltage according to the detected torque.	Available	Available
	Set the maximum analog torque to be monitored.	Not available	Available
	Set the maximum voltage for monitored analog torque.	Not available	Available
	Set the offset value for monitored analog torque.	Not available	Available
MOVE output	The MOVE output remains ON while the motor is operating.	Available	Available
	Select the MOVE output.	Not available	Available
	Set the minimum ON time for the MOVE output.	Not available	Available
FREE input	Release the electromagnetic brake and stop the motor excitation. The motor output shaft becomes free.	Available	Available
MBC output	Output the timing at which to release the electromagnetic brake.	Not available	Available
Motor rotation direction	Set the direction in which motor torque generates.	Not available	Available
Data-setter initial display	Set the initial screen on the **OPX-2A**. In the torque control mode, the top screen of the monitor mode will become the initial display if the selected item cannot be displayed.	Not available	Available

Parameter/operation data			
OPX-2A screen display	Name	Setting range	Initial value
APP-1-03	Output signal selection 2	0: ZSG2 output 1: ZV output	0
APP-1-06	Zero speed output band	1 to 5500 [r/min]	10
APP-4-03	Acceleration/deceleration correction filter	10 to 500 [ms]	100
APP-4-04	Friction torque correction	0 to 50 [%]	0
–	–	–	–
–	–	–	–
SyS-0-02	Encoder output electronic gear A	1 to 1000	1
SyS-0-03	Encoder output electronic gear B	1 to 1000	1
APP-1-03	Output signal selection 2	0: ZSG2 output 1: NEAR output	0
APP-1-10	Alarm code output	0: Disable 1: Enable	0
–	–	–	–
APP-2-07	Analog speed monitor maximum value	1 to 6000[r/min]	5500
APP-2-08	Analog speed monitor maximum voltage	1 to 10 [V]	10
APP-2-09	Analog speed monitor offset voltage	−1.00 to 1.00 [V]	0
–	–	–	–
APP-2-10	Analog torque monitor maximum value	1 to 300 [%]	300
APP-2-11	Analog torque monitor maximum voltage	1 to 10 [V]	10
APP-2-12	Analog torque monitor offset voltage	−1.00 to 1.00 [V]	0
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
APP-1-08	Minimum ON time for MOVE signal	0 to 255 [ms]	5
–	–	–	–
APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
SyS-1-06	Motor rotation direction	0: + = CCW 1: + = CW	1
SyS-1-07	Data-setter initial display	0: Operating speed [r/min] 1: Position [steps] 2: Torque [%] 3: Estimated inertial moment ratio [%] 4: Operation number 5. Selected number 6: Tension [%] 7: Revolution counter [rev] 8: Roll diameter [mm] 9: Top screen of monitor mode	0

19.7 Warning/alarm lists

■ Alarms (protective functions)

Item		Overview/condition
Alarm check function	LED indicator	When an alarm generates, the ALARM LED on the front face of the driver will blink. The number of times the LED blinks varies depending on the content of the alarm.
ALM output	ALM output	This signal will be output when an alarm generates.
Alarm code output	Alarm code output (AL0 to AL2 output)	This alarm is used to allow the programmable controller to detect the content of each alarm that has generated.
	Alarm code output enable/disable setting	Enable alarm code output if you want alarm codes to be output.
Alarm reset	Power cycle/reconnection	Cycle the power to reset alarms.
	ALM-RST input	Input the ALM-RST signal to reset alarms.
Alarm detection condition setting	Excessive position deviation alarm	Set the condition under which an excessive position deviation alarm generates, as an amount of rotation of the motor shaft.
Descriptions of alarms	Overheat protection	The internal temperature of the driver exceeded approx. 85 °C (185 °F).
	Motor overheat generation	The motor temperature reached approx. 85 °C (185 °F).
	Overload	A load exceeding the rated torque was applied.
	Overspeed	The detected motor speed exceeded 6000 r/min.
	Command pulse error	The command pulse frequency exceeded the specified value.
	Regeneration unit overheat	• The regeneration unit is not connected correctly. • The regeneration unit is overheating.
	Overvoltage protection	• 200-230 VAC was applied to a product specified for 100-150 VAC. • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit. • The regeneration unit is not connected correctly. • The DC voltage of the main power supply became approx. 400 V or higher.
	Main power supply error	The motor was started when the main power was cut off.
	Undervoltage	The main power was cut off momentarily or the voltage became low.
	Excessive position deviation	• The deviation between the command position and actual position at the motor output shaft exceeded the value set in the excessive position deviation alarm parameter [APP-3-00]. (Initial value: 10 rev) • The load is large or the acceleration/deceleration time is short.
	Overcurrent protection	The motor, cable or driver output circuit was shorted.
	Position range error	• The command position exceeded the coordinate control range (−2,147,483,648 to 2,147,483,647). • The multi-rotation data for internal encoder coordinates exceeded the coordinate control range (−32,768 to 32,767).(This alarm generates when the absolute system function is used in the position control mode.)
	Absolute position loss	• The power was turned on for the first time after connecting the battery. • No battery is connected, the battery cable is disconnected, or the battery has been consumed. • The encoder cable came off. • The position range error alarm was reset. (This alarm generates when the absolute system function is used in the position control mode.)
	ABS not supported	The battery was detected when the absolute function was disabled in the position control mode.
	No battery	No battery was detected or the battery cable was disconnected when the absolute function was enabled.

Standard specification	Extended function	Parameter/operation data			
		OPX-2A screen display	Name	Setting range	Initial value
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Not available	Available	−	−	−	−
Not available	Available	APP-1-10	Alarm code output	0: Disable 1: Enable	0: Disable
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Not available	Available	APP-3-00	Excessive position deviation alarm	1 to 1000 [rev]	10
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−
Available	Available	−	−	−	−

Item		Overview/condition
Descriptions of alarms	Electronic gear setting error	The power was turned on when the resolution set by the electronic gear and encoder output electronic gear was outside the specified range.
	Sensor error during operation	An encoder error was detected during operation.
	Encoder communication error	A communication error occurred between the driver and encoder.
	Sensor error during initialization	An encoder error was detected when the power was turned on.
	Rotor rotation during initialization	The motor output shaft rotated by 1/40th of a revolution during the initialization following a power on.
	Encoder EEPROM error	Data stored in the encoder communication circuit was damaged.
	Motor combination error	A motor not supported by the driver is connected.
	EEPROM error	Data stored in the driver was damaged.

Standard specification	Extended function	Parameter/operation data			
		OPX-2A screen display	Name	Setting range	Initial value
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–

■ Warnings (warning functions)

Item		Overview/condition
Warning check function	WNG output	When a warning generates, the WNG output will turn ON.
Warning detection condition setting	Excessive position deviation warning	Set the condition under which an excessive position deviation warning generates, as an amount of rotation of the motor shaft.
	Overvoltage warning	Set the voltage at which an overvoltage warning generates.
	Undervoltage warning	Set the voltage at which an undervoltage warning generates.
	Overheat warning	Set the temperature at which an overheat warning generates.
	Overload warning	Set the condition under which an overload warning generates.
	Overspeed warning	Set the speed at which an overspeed warning generates.
Descriptions of warnings	Excessive position deviation	• The deviation between the command position and actual position at the motor output shaft exceeded the value set in the excessive position deviation warning parameter [APP-3-01]. (Initial value: 9 rev) • The load is large or the acceleration/deceleration time is short.
	Overheat	The internal temperature of the driver exceeded the value set in the overheat warning parameter [APP-3-04]. [Initial value: 80 °C (176 °F)]
	Overvoltage	• The voltage of the main power supply exceeded the value set in the overvoltage warning parameter [APP-3-02]. (Initial value: 390 V) • A large inertial load was stopped abruptly, or up/down operation was performed without connecting a regeneration unit.
	Main power supply	The S-ON input was turned ON when the main power was cut off.
	Undervoltage	• The DC voltage of the main power supply became lower than the value set in the undervoltage warning parameter [APP-3-03]. (Initial value: 125 V) • The main power was cut off momentarily or the voltage became low.
	Low battery voltage	The battery discharged and its voltage dropped to 3.2 V or below.
	Overload	• The generated torque exceeded the value set in the overload warning parameter [APP-3-05]. (Initial value: 90%) • The load is large or the acceleration/deceleration time is short.
	Overspeed	The detected motor speed exceeded the value set in the overspeed warning parameter [APP-3-06]. (Initial value: 5800 r/min)
	Absolute position loss	The battery or encoder was disconnected.
	Electronic gear setting error	The resolution set by the electronic gear and encoder output electronic gear became outside the specified range.

Standard specification	Extended function	Parameter/operation data			
		OPX-2A screen display	Name	Setting range	Initial value
Available	Available	APP-1-02	Output signal selection 1	0: WNG output 1: MOVE output 2: MBC output	0
Not available	Available	APP-3-01	Excessive position deviation warning	1 to 1000 [rev]	9
Not available	Available	APP-3-02	Overvoltage warning	320 to 400 [V]	390
Not available	Available	APP-3-03	Undervoltage warning	120 to 280 [V]	125
Not available	Available	APP-3-04	Overheat warning	40 to 85 [°C] (104 to 185 °F)	80
Not available	Available	APP-3-05	Overload warning	1 to 100 [%]	90
Not available	Available	APP-3-06	Overspeed warning	1 to 6000 [r/min]	5800
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–
Available	Available	–	–	–	–

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