The Best Choice for the Most Benefit!

LSIS always tries its best to bring the greatest benefit to its customers.

AC SERVO DRIVE

XGT Servo

XDL-L7NHF Series

EtherCAT Conformance tested

Safety Precautions

- Read all safety precautions before using this product.
- After reading this manual, store it in a readily accessible location for future reference.

LSIS

www.lsis.com

Introduction

Hello. Thank you for choosing the LSIS XDL-L7NHF series products.

This user manual describes how to use this product safely and efficiently.

Failure to comply with the guidelines outlined in this manual may cause personal injury or damage to the product. Be sure to read this manual carefully before using this product and follow all guidelines contained therein.

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Safety precautions are categorized as either Warnings or Cautions, depending on the severity of the precaution.

Precautions	Meaning
Warning	Failure to comply with these guidelines may cause serious injury or death.
Caution	Failure to comply with these guidelines may cause personal injury or property damage.

- Certain cases classified as Caution may also cause serious consequences depending on the situation. Therefore, a close attention should be given to this category.

Electric Safety Precautions

Warning
▪ Before wiring or inspection tasks, turn off the power. Wait 15 minutes until the charge lamp goes off, and then check the voltage. ▪ Ground the servo drive and the servo motor. ▪ Only specially trained technicians may perform wiring on this product. ▪ Install both the servo drive and servo motor before performing any wiring. ▪ Do not operate the device with wet hands. ▪ Do not open the servo drive cover during operation. ▪ Do not operate the device with the servo drive cover removed. ▪ Even if the power is off, do not remove the servo drive cover.

Fire Safety Precautions

Caution
▪ Install the servo drive, the servo motor, and the regenerative resistor on non-combustible materials. ▪ Disconnect the input power if the servo drive malfunctions.

■ Installation Precautions

Store and operate this product under the following environmental conditions.

<table>
<tr><th rowspan="2">Environment</th><th colspan="2">Conditions</th></tr>
<tr><th>Servo Drive</th><th>Servo Motor</th></tr>
<tr><td>Operating temperature</td><td>0 ~ 50 ℃</td><td>0 ~ 40 ℃</td></tr>
<tr><td>Storage temperature</td><td>-20 ~ 65 ℃</td><td>-10 ~ 60 ℃</td></tr>
<tr><td>Operating humidity</td><td rowspan="2">Below 90% RH (no condensation)</td><td rowspan="2">20 - 80% RH (no condensation)</td></tr>
<tr><td>Storage humidity</td></tr>
<tr><td>Altitude</td><td colspan="2">1000 m or lower</td></tr>
<tr><td>Spacing</td><td>▪ When installing 1 unit:
• More than 40 mm at the top and bottom of the control panel
• More than 10 mm on the left and right sides of the control panel
▪ When installing 2 or more units:
• More than 100 mm at the top of the control panel
• More than 40 mm at the bottom of the control panel
• More than 30 mm on the left and right sides of the control panel
• More than 2 mm between units
• Refer to Section 2.2.2, "Wiring the Control Panel."</td><td></td></tr>
<tr><td>Others</td><td colspan="2">▪ Ensure the installation location is free from dust, iron, corrosive gas or combustible gas.
▪ Ensure the installation location is free from vibrations or hard impact.</td></tr>
</table>

⚠ Caution

- Install the product in the correct orientation.
- Do not drop the product or expose it to hard impact.
- Install this product in a location that is free from water, corrosive gas, combustible gas or flammable materials.
- Install this product in a location capable of supporting the weight of this product.
- Do not stand on the product or place heavy objects on top of it.
- Always maintain the specified spacing when installing the servo drive.
- Ensure that there are no conductive or flammable debris inside the servo drive or the servo motor.
- Firmly attach the servo motor to the machine.
- Install the servo motor with a correctly oriented decelerator.
- Do not touch the rotating unit of the servo motor during operation.
- Do not apply excessive force when connecting the couplings to the servo motor shaft.
- Do not place loads on the servo motor shaft that exceed the specified amount.

■ Wiring Precautions

⚠ Caution
▪ Always use an AC 200-230 V power input for the servo drive. ▪ Always connect the servo drive to a ground terminal. ▪ Do not connect commercial power directly to the servo motor. ▪ Do not connect commercial power directly to the U, V, W output terminals of the servo drive. ▪ Connect the U, V, W output terminals of the servo drive directly to the U, V, W input terminals of the servo motor, but do not install magnetic contactors between the wires. ▪ Always use pressurized terminals with insulation tubes when connecting the servo drive power terminal. ▪ When wiring, be sure to separate the U, V, and W cables for the servo motor power and encoder cable. ▪ Always use the robot cable if the motor moves. ▪ Before you perform power line wiring, turn off the input power of the servo drive, and then wait until the charge lamp goes off completely.

■ Startup Precautions

⚠ Caution
▪ Check the input voltage (AC 200-230 V) and power unit wiring before supplying power to the device. ▪ The servo must be in the OFF mode when you turn on the power. ▪ For XDL-L7NHFA □□□, check the motor ID, encoder type and encoder pulse to be used before turning on the power. ▪ For XDL-L7NHFA □□□, first set the motor ID [0x2000], encoder type [0x2001] and encoder pulse [0x2002] after turning on the power. ▪ After you complete the above settings, set the drive mode for the servo drive that is connected to the upper level controller in [0x6060]. ▪ Refer to Chapter 2.5 “Wiring for Input/Output Signals” to perform I/O wiring for the servo drive. ▪ You can check the on/off status of each I/O contact point from the digital input of [0x60FD].

■ Handling and Operating Precautions

⚠ Caution
▪ Check and adjust each parameter before operation. ▪ Do not touch the rotating unit of the motor during operation. ▪ Do not touch the heat sink during operation. ▪ Be sure to attach or remove the I/O and ENC connectors when the power is off. ▪ Extreme changes in parameter values may cause system instability.

Usage Precautions

⚠ Caution
▪ Install an emergency cut-off switch, which immediately stops operation in an emergency. ▪ Reset the alarm when the servo is off. Be warned that the system restarts immediately if the alarm is reset while the servo is on. ▪ Use a noise filter or DC reactor to minimize electromagnetic interference. This prevents nearby electrical devices from malfunctioning due to electromagnetic interference. ▪ Only use approved servo drive and servo motor combinations. ▪ The electric brake on the servo motor stops operation. Do not use it for ordinary braking. ▪ Brake failure may occur if the electric brake is degraded or the mechanical structure is improper (e.g. if the ball screw and servo motor are combined via the timing belt). Install an emergency stop device to ensure mechanical safety.

Malfunction Precautions

⚠ Caution
▪ Install a servo motor with an electric brake or separate the brake system for use during emergencies or device malfunctions. ▪ If an alarm occurs, solve the underlying cause of the problem. After ensuring safe operation, deactivate the alarm and resume operation. ▪ Do not approach the machine until the problem is solved.

Repair/Inspection Precautions

⚠ Caution
▪ Before performing servicing tasks, turn off the power. Wait 15 minutes until the charge lamp goes off, and then check the voltage. Enough voltage may remain in the condenser after the power is off to cause an electric shock. ▪ Only authorized personnel may repair and inspect the device or replace parts. ▪ Do not modify this device in any way.

General Precautions

⚠ Caution
▪ This user manual is subject to change due to product modifications or changes in standards. If such changes occur, we issue a new user manual with a new product number.

■ Product Application

⚠ Caution
▪ This product is not designed or manufactured for machines or systems intended to sustain human life. ▪ This product is manufactured under strict quality control conditions. Nevertheless, install safety devices if installing the product in a facility where product malfunctions may result in a major accident or a significant loss.

■ EEPROM Lifespan

⚠ Caution
▪ The EEPROM is rewritable up to 4 million times for the purpose of recording parameter settings and other information. The servo drive may malfunction if the total number of the following tasks exceeds 4 million, depending on the lifespan of the EEPROM. • EEPROM record as a result of parameter changes • EEPROM record as a result of an alarm

Table of Contents

1. Product Configuration

1.1 Product Verification

1. Check the nameplate to verify it matches the model ordered.
   - Does the servo drive nameplate match?
   - Does the servo motor's name plate match?
2. Check the product components and options.
   - Are the type and length of cables correct?
   - Does the regenerative resistor conform to the required standard?
     - Is the shape of the shaft correct?
     - Are there any abnormalities after mounting the oil seal or brake?
     - Are the reducer and the reducer ratios correct?
     - Is the encoder format correct?
3. Check the exterior of the device.
   - Are there any foreign substances or moisture?
   - Is there any discoloration, contaminant, damage or disconnected wire?
   - Are the bolts tightly fastened to the joints?
   - Is there any abnormal sound or excessive friction during operation?

1.2 Product Specifications

■ XDL-L7NHF Series Product Type

XDL - L7 NHF A 004 U AA

Servo Drive

Series Name	Communication/Drive Type	Input voltage	Capacity	Encoder	Option
L7 Series	NH: Network type All In One Type NHF: Network type All In One Type + Full-closed Type	A : 200Vac B : 400Vac	010 : 1kW 035 : 3.5kW 050 : 5kW 075 : 7.5kW	U : Universal (integrated type)	Blank: Standard Marking: Exclusive

■ Servo Motor Product Type

XML – S B 04 A N K 1 G1 03

Servo Motor

Motor Shape
- S:Solid shaft type
- H:Hollow shaft type
- B:Assembly type
- F:Flat type
- L:L7-exclusive

Flange Size
- A: 40 Flange
- B: 60 Flange
- C: 80 Flange
- D: 100 Flange
- E: 130 Flange
- F: 180 Flange
- G: 220 Flange

Motor Capacity
- R3: 30[W]
- R5: 50[W]
- 01: 100[W]
- 02: 200[W]
- 03: 300[W]
- 04: 400[W]
- 07: 700[W]
- 10: 1.0[kW]
- 15: 1.5[kW]
- 20: 2.0[kW]
- 35: 3.5[kW]

Rated RPM
- A: 3000[rpm]
- D: 2000[rpm]
- G: 1500[rpm]
- M: 1000[rpm]

Encoder type

Quadrature (pulse Type)
- A: Inc. 1024[ppr]
- B: Inc. 2000[ppr]
- C: Inc. 2048[ppr]
- D: Inc. 2500[ppr]
- E: Inc. 3000[ppr]
- F: Inc. 5000[ppr]
- G: Inc. 6000[ppr]

Serial BiSS (Communication type)
- N : 19bit SingleTurn
- M : 19bit MultiTurn

Shaft Shape
- N: Straight
- K: One-sided round key (standard)
- C: C Cut
- D: D Cut
- T: Taper Shape
- R: Both-side round key
- H: Hollow Shaft

Oil Seal and Brake
- Non-existent:Not included
- 1:Oil seal included
- 2:Brake included
- 3:Oil seal and brake included

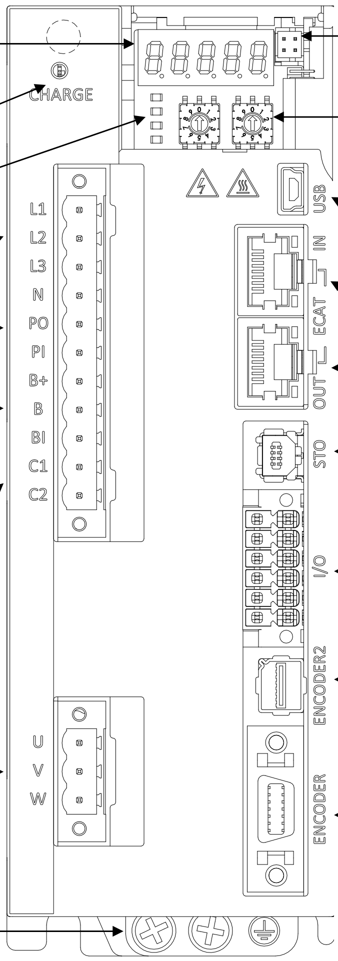
Gearbox Specifications
- Non-existent:No gearbox
- G1:General industrial purpose (Foot Mount)
- G2:General industrial purpose (Flange Mount)
- G3:Precision Gearbox

Gearbox Classification
- 03: 1/3
- 10: 1/10

1.3 Component Names

1.3.1 Servo Drive Components

■ XDL-L7NHF Drive (1 kW)



Display
Shows drive status, alarms, etc.

CHARGE lamp
Lights on when the main circuit power is on.

Status LED
It indicates the current state of EtherCAT communication.

Main power connectors(L1,L2,L3)
Terminals to input the main circuit power.

DC reactor connectors (PO,PI)
Terminals to connect the DC reactor that suppresses high-frequency power.

Regenerative resistor connectors(B+,B,BI)
Terminals to connect external regenerative resistors
-When using an internal resistor:Short-circuit B and BI terminals
-For an external resistor:Install it to B+ and B terminals.

Control power terminals (C1,C2)
Terminals to input the control power.

Servo motor connection terminals (U,V,W)
Terminals to connect the main circuit cable (power cable) of the servo motor.

Ground terminal
Ground terminal to prevent electric shock

Analog monitor connector
Connector to check analog output signals.

Node address setting switch
Switch to set the node address of the drive.
You can set the node addresses from 0 to 99.

USB connector (USB)
This connector is used to communicate with a PC.

EtherCAT communication input port (ECAT IN)

EtherCAT communication output port (ECAT OUT)

Safety connector (STO)
This connector connects safety devices.
- If a safety device is not used, be sure to install the safety jump connector before use.

Input/output signal connectors (I/O)
This connector is for sequence input/output signals.

Encoder connector 2 (ENCODER2)
Connector used to connect the encoder (sensor) installed in the external equipment.

Encoder connector (ENCODER)
This connector connects to the encoder installed in the servo motor.

■ XDL-L7NHF Drive (3.5 kW)

Display
Shows drive status, alarms, etc.

CHARGE lamp
Lights on when the main circuit power is on.

Status LED
It indicates the current state of EtherCAT communication.

Main power connectors(L1,L2,L3)
Terminals to input the main circuit power.

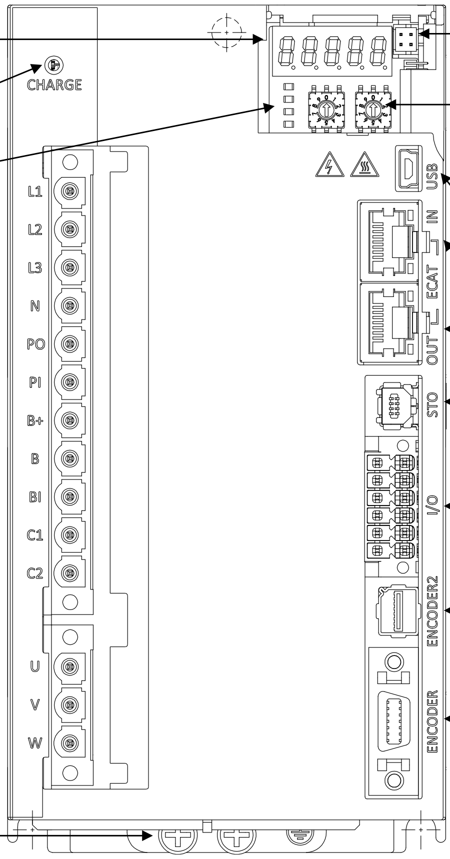
DC reactor connectors (PO,PI)
Terminals to connect the DC reactor that suppresses high-frequency power.

Regenerative resistor connectors(B+,B,BI)
Terminals to connect external regenerative resistors
-When using an internal resistor:Short-circuit B and BI terminals
-For an external resistor:Install it to B+ and B terminals.

Control power terminals (C1,C2)
Terminals to input the control power.

Servo motor connection terminals (U,V,W)
Terminals to connect the main circuit cable (power cable) of the servo motor.

Ground terminal
Ground terminal to prevent electric shock



Analog monitor connector
Connector to check analog output signals.

Node address setting switch
Switch to set the node address of the drive.
You can set the node addresses from 0 to 99.

USB connector (USB)
This connector is used to communicate with a PC.

EtherCAT communication input port (ECAT IN)

EtherCAT communication output port (ECAT OUT)

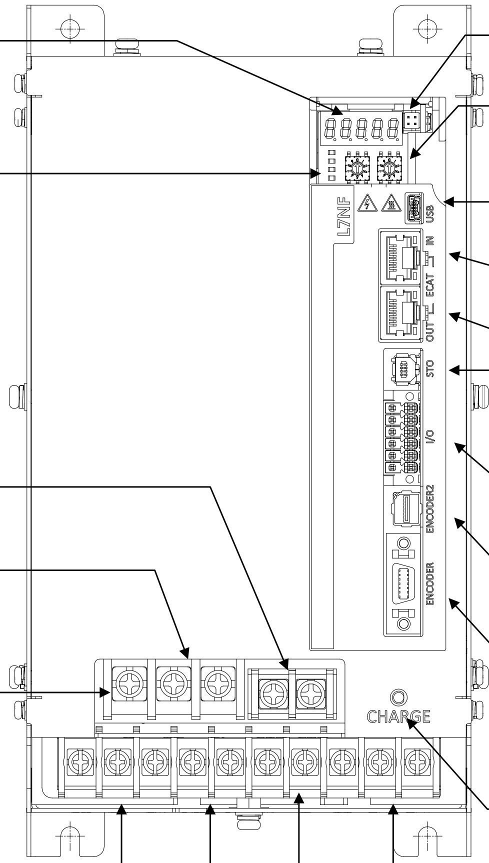
Safety connector (STO)
This connector connects safety devices.
- If a safety device is not used, be sure to install the safety jump connector before use.

Input/output signal connectors (I/O)
This connector is for sequence input/output signals.

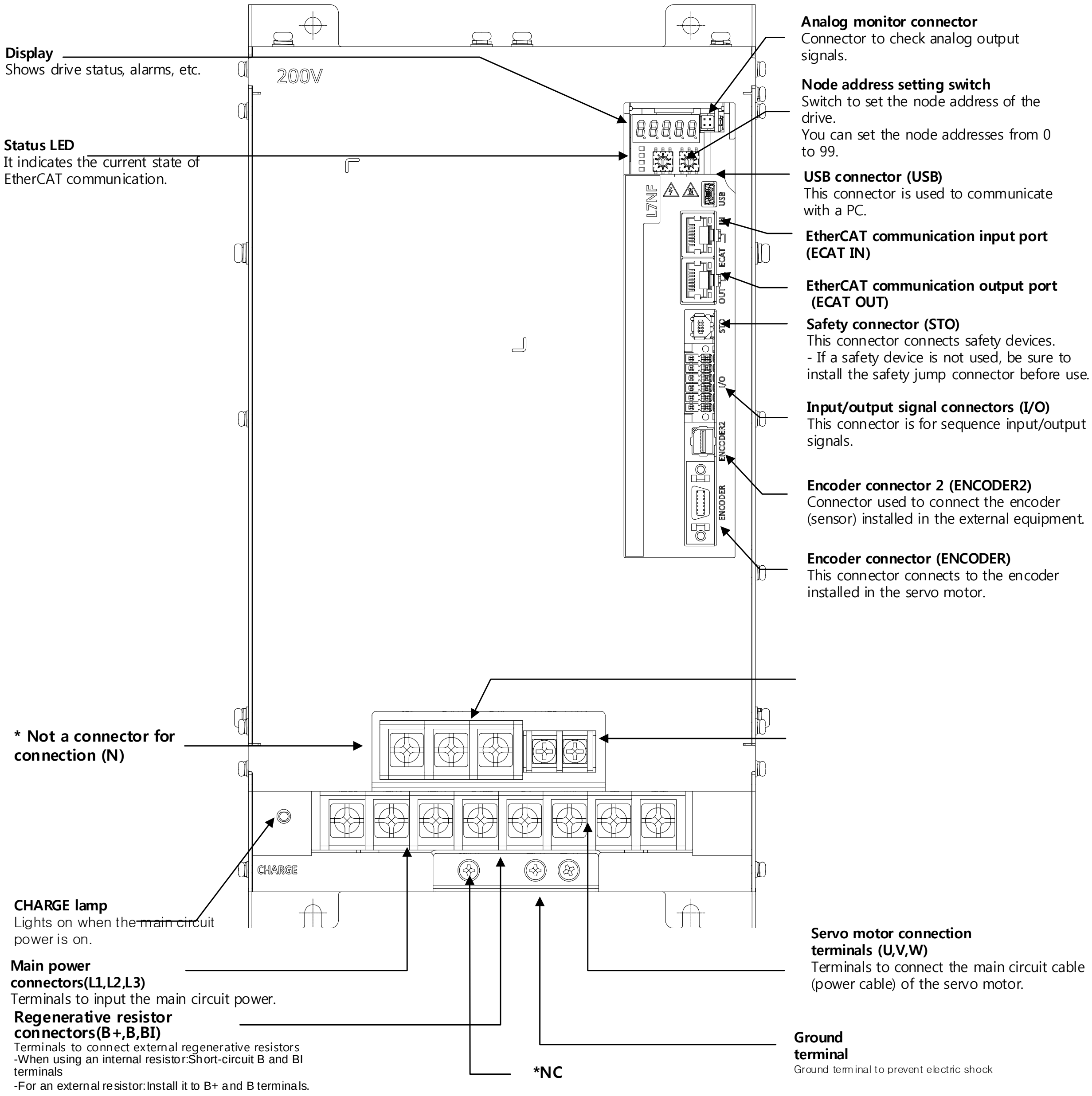
Encoder connector 2 (ENCODER2)
Connector used to connect the encoder (sensor) installed in the external equipment.

Encoder connector (ENCODER)
This connector connects to the encoder installed in the servo motor.

■ XDL-L7NHF Drive (5 kW)

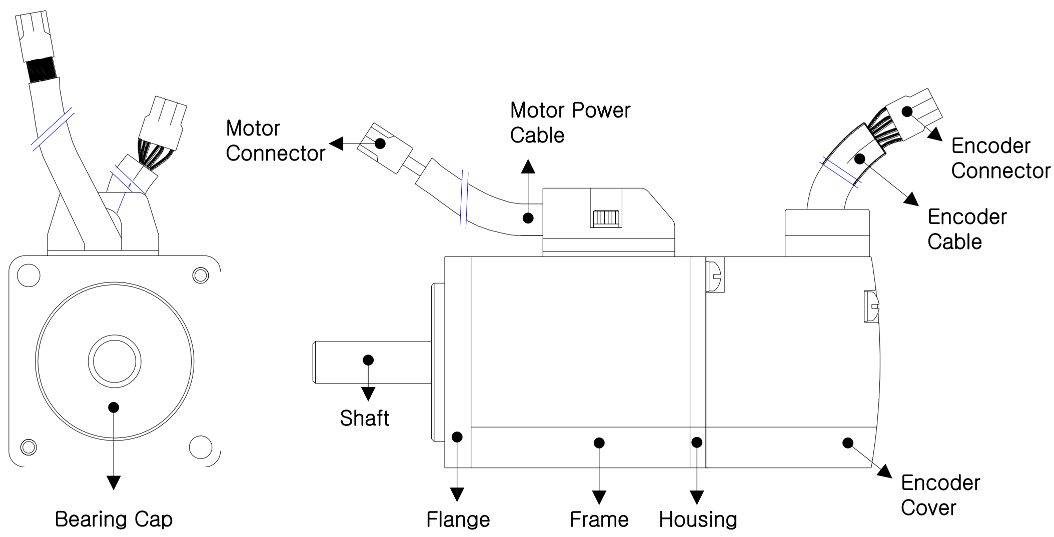


■ XDL-L7NHF Drive (7.5 kW)

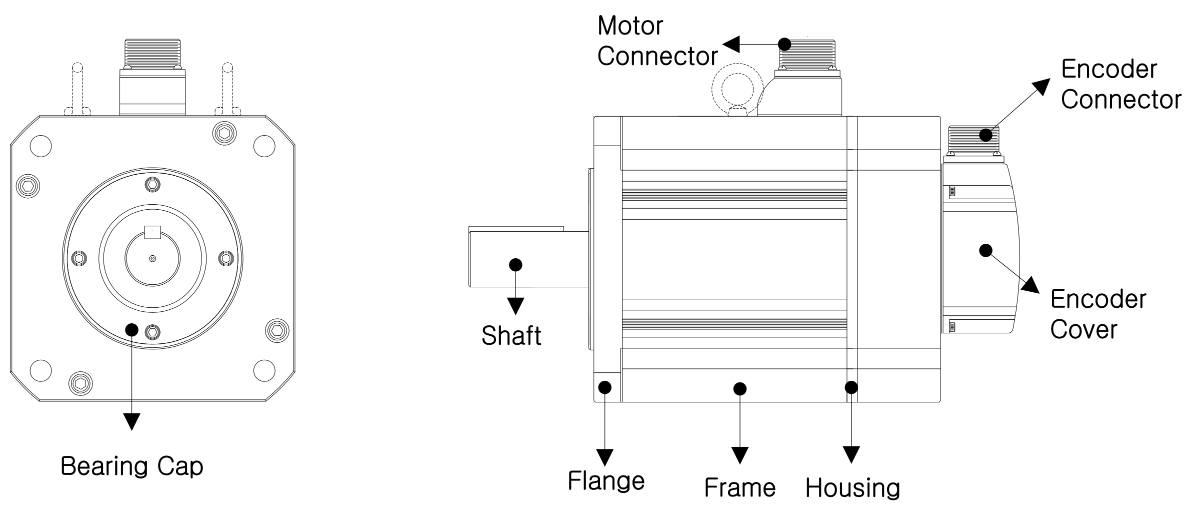


1.3.2 Servo Motor Parts

■ 80 Flange or below

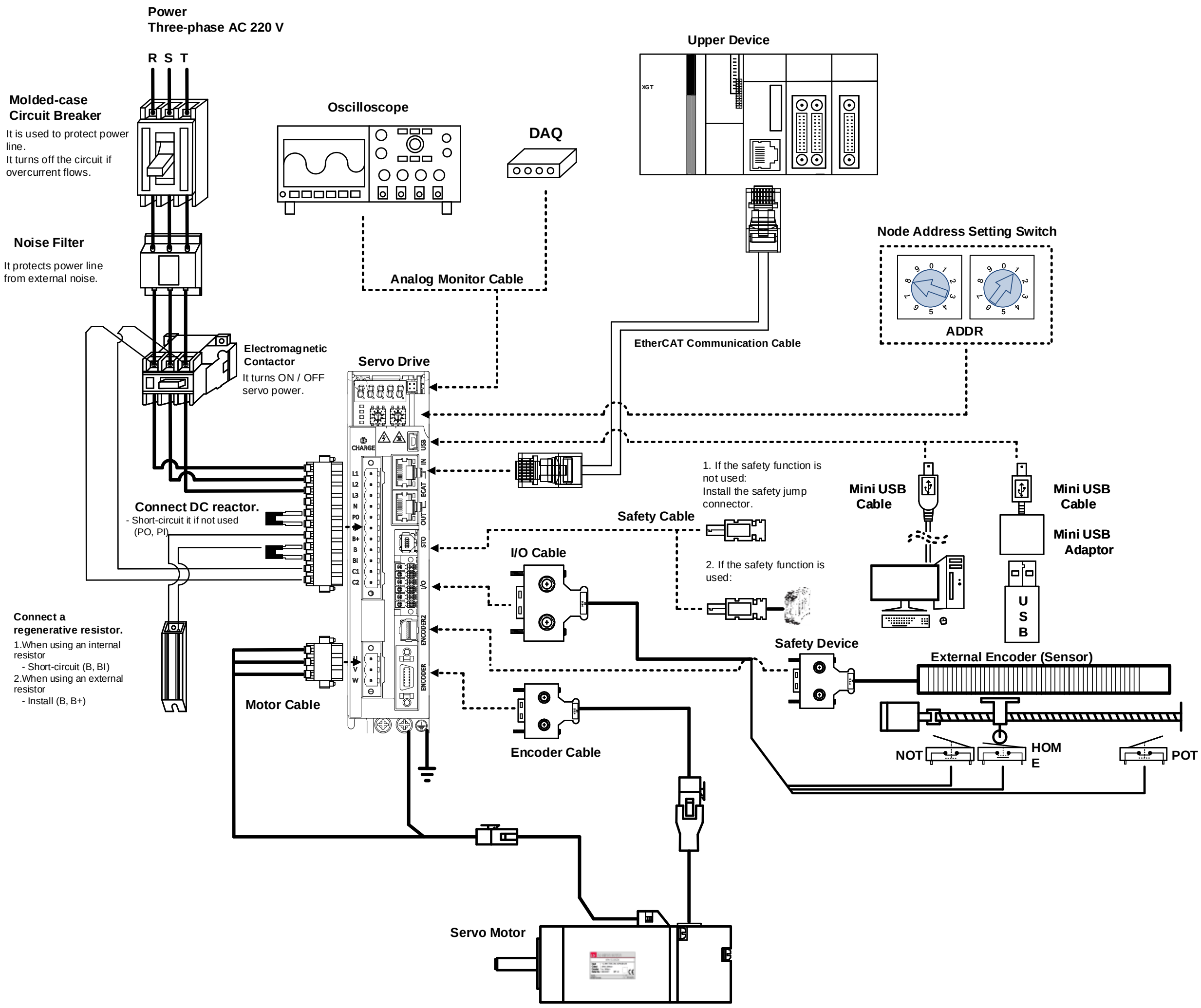


■ 130 Flange or higher



1.4 Example of System Configuration

The figure below shows an example of system configuration using this drive.



2. Wiring and Connection

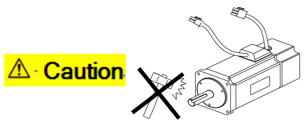
2.1 Installation of Servo Motor

2.1.1 Operating Environment

Item	Requirements	Precautions
Ambient temperature	0 ~ 40[℃]	Consult with our technical support team to customize the product if temperatures in the installation environment are outside this range.
Ambient humidity	80% RH or lower	Do not operate this device in an environment with steam.
External vibration	Vibration acceleration 19.6 ㎨ or below on both the X and Y axis.	Excessive vibrations reduce the lifespan of the bearings.

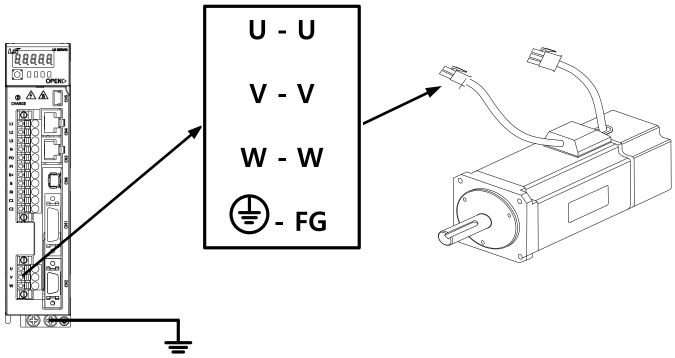
2.1.2 Preventing Impact

Impact to the motor during installation or handling may damage the encoder.



2.1.3 Motor Connection

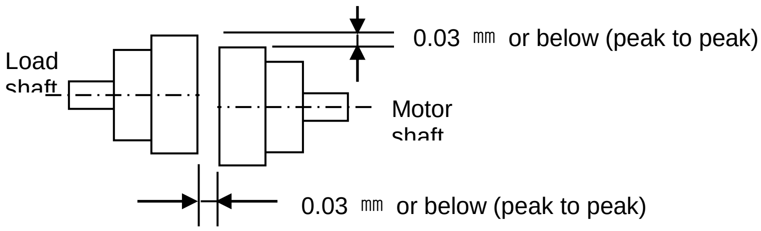
- If the motor is directly connected to commercial power, it may be burned. Be sure to connect with the specified drive before using it.
- Connect the ground terminals of the motor to either of the two ground terminals inside the drive, and attach the remaining terminal to the type-3 ground.



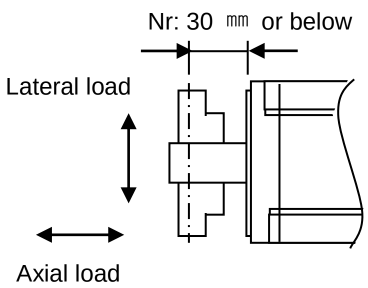
- Connect the U, V, and W terminals of the motor in the same way as the U, V, and W terminals of the drive.
- Ensure that the pins on the motor connector are securely attached.
- In order to protect against moisture or condensation in the motor, make sure that insulation resistance is 10 MΩ (500 V) or higher before installation.

2.1.4 The Load Device Connection

For coupling connections: Ensure that the motor shaft and load shaft are aligned within the tolerance range.

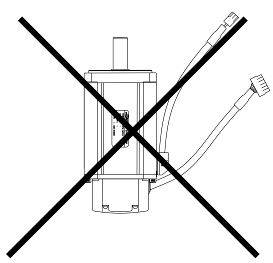


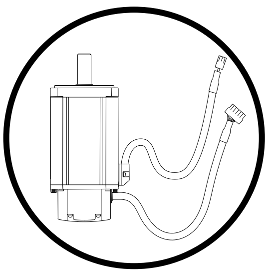
■ For pulley connections:

Flange	Lateral Load		Axial Load		Notes
	N	kgf	N	kgf	
40	148	15	39	4	
60	206	21	69	7	
80	255	26	98	10	
130	725	74	362	37	
180	1548	158	519	53	
220	1850	189	781	90	

2.1.5 Cable Installation

- For vertical installations, make sure that no oil or water flows into the connecting parts.





- Do not apply pressure to or damage the cables.
- Use robot cables to prevent swaying when the motor moves.

2.2 Installation of Servo Drive

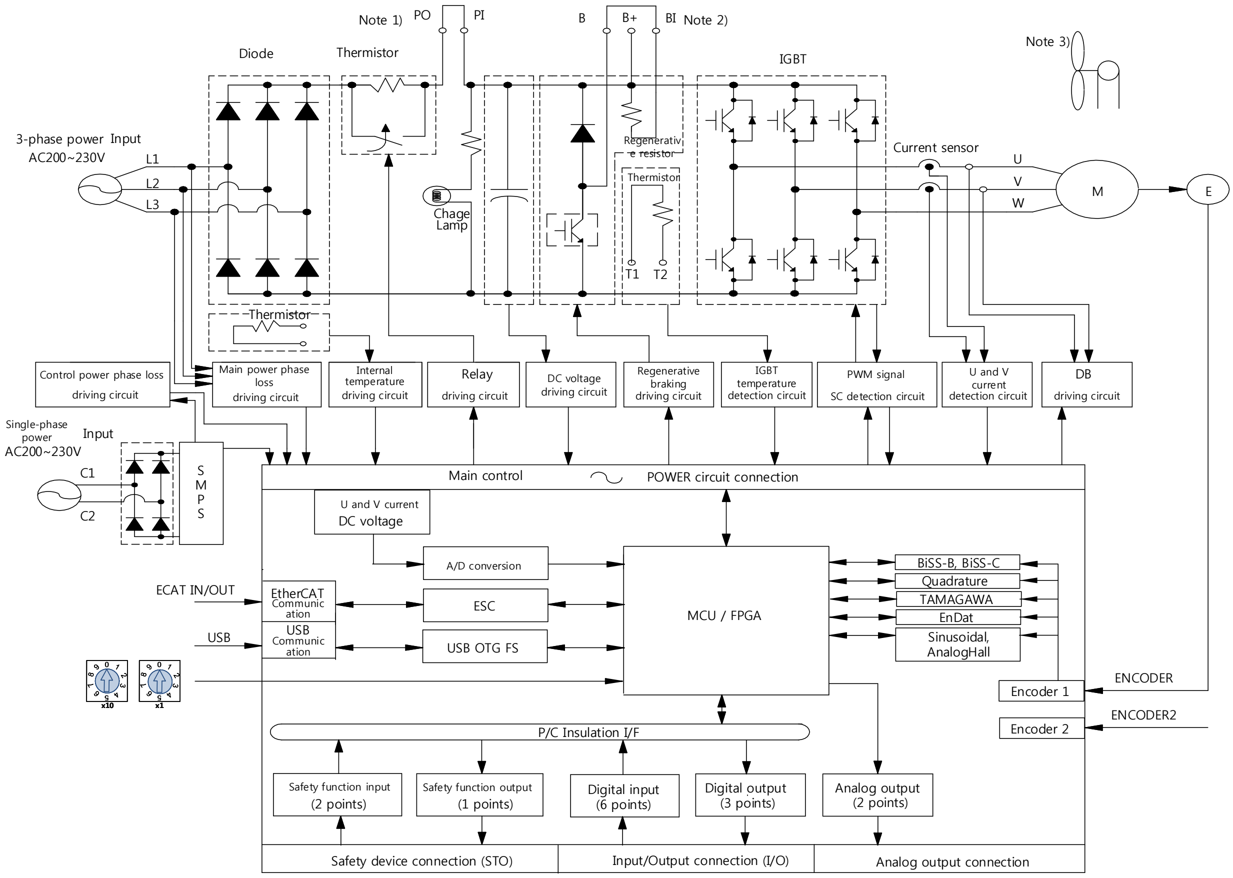
2.2.1 Installation and Usage Environment

Item	Environmental conditions	Precautions
Ambient temperature	0~50[℃]	⚠ **Caution** Install a cooling fan on the control panel to maintain an appropriate temperature.
Ambient humidity	90% RH or lower	⚠ **Caution** During prolonged periods of inactivity, moisture from condensation or frost may develop inside the drive and damage it. Remove all moisture before operating the drive after a prolonged period of inactivity.
External vibration	Vibration acceleration 4.9 ㎨ or lower	Excessive vibration reduces the lifespan of the machine and may cause malfunctions.
Ambient conditions	▪ Do not expose the device to direct sunlight. ▪ Do not expose the device to corrosive or combustible gases. ▪ Do not expose the device to oil or dust. ▪ Ensure that the device receives sufficient ventilation.	

2.3 Internal Block Diagram of Drive

2.3.1 XDL-L7NHF Drive Block Diagram

(XDL-L7NHFA010U, XDL-L7NHFA035U)



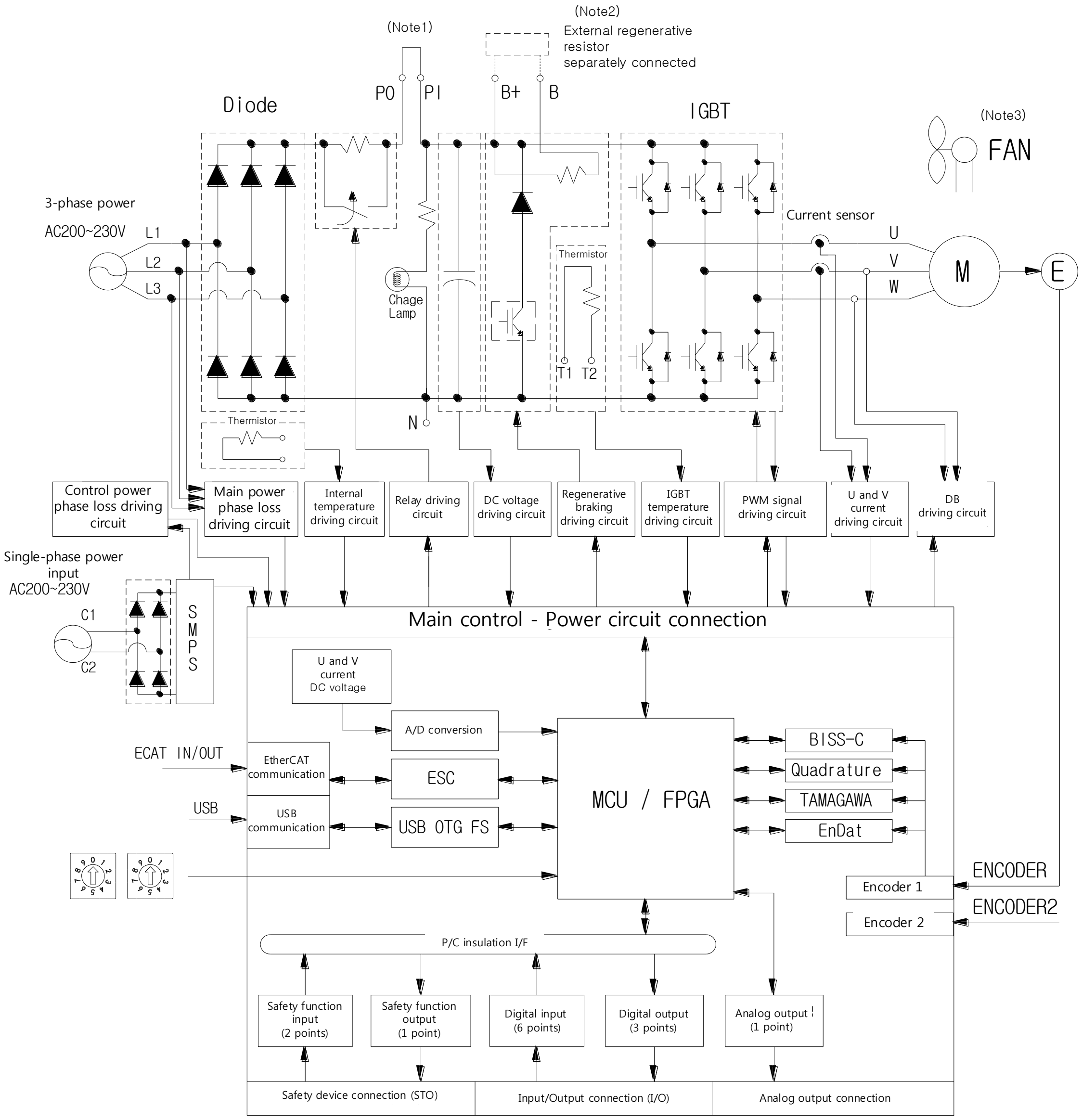
Note 1) **To use a DC reactor, connect it to the PO and PI pins.**

Note 2) **To use an external regenerative resistor, remove the B and BI short-circuit pins and connect the resistor to the B+ and B pins.**

Note 3) **XDL-L7NHFA010U and XDL-L7NHFA035U models are cooled by a DC 24 V cooling fan.**

2.3.2 XDL-L7NHF Drive Block Diagram

(XDL-L7NHFA050U, XDL-L7NHFA075U)



Note 1) To use a DC reactor, connect it to the PO and PI pins.

Note 2) If using an external regenerative resistor, attach the wiring of internal resistance to mounting hole "NC" for internal resistance of the case. Then, connect external regenerative resistance to B+ and B terminals.

Note 3) XDL-L7NHFA050U and XDL-L7NHFA075U models are cooled by a DC 24 V cooling fan.

2.4 Power Supply Wiring

- Ensure that the input power voltage is within the acceptable range.

⚠ Caution
Overvoltages can damage the drive.

- If commercial power is connected to the U, V, W terminals of the drive, they may be damaged. Be sure to connect power to L1, L2, L3 terminals.
- Connect short-circuit pins to the B and BI terminals. For external regenerative resistors, remove the short-circuit pins and use standard resistors for the B+ and B terminals.

Model	Resistance	Standard Capacity	* Notes
XDL-L7NHFA010U	40[Ω]	Built-in 100 W	⚠ **Caution** For information about resistance during regenerative capacity expansion, refer to Section 2.4.4, "Regenerative Resistor Options."
XDL-L7NHFA035U	13[Ω]	Built-in 150 W	
XDL-L7NHFA050U	6.8[Ω]	Built-in 120 W	
XDL-L7NHFA075U	6.8[Ω]	Built-in 240 W	

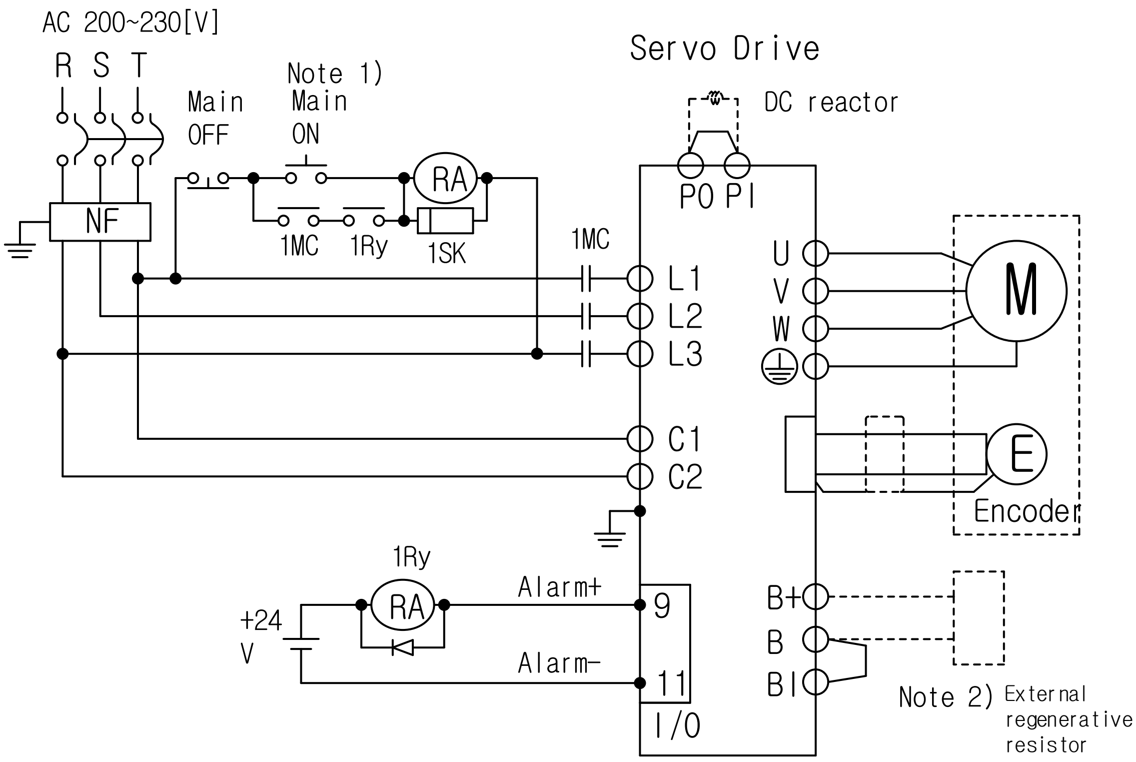
- Configure the system so that the main power (L1, L2, L3) is supplied after the control power (C1, C2). (Refer to section 2.4.1, "Power Supply Wiring Diagram.")
- High voltages may remain in the device for some time even after the main power is disconnected. Please be careful.

Warning
After disconnecting the main power, ensure that the charge lamp is off before you start wiring. Failure to do so may result in electric shock.

- Always ground the device over the shortest possible distance. Long ground wires are susceptible to noise, which may cause the device to malfunction.

2.4.1 Power Supply Wiring Diagram

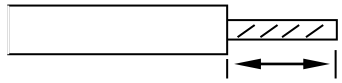
■ Power Supply Wiring Diagram (XDL-L7NHFA010U and XDL-L7NHFA035U)



Note 1) It takes approximately one to two seconds to output an alarm signal after turning on the main power. Accordingly, press and hold the main power ON switch for at least two seconds.

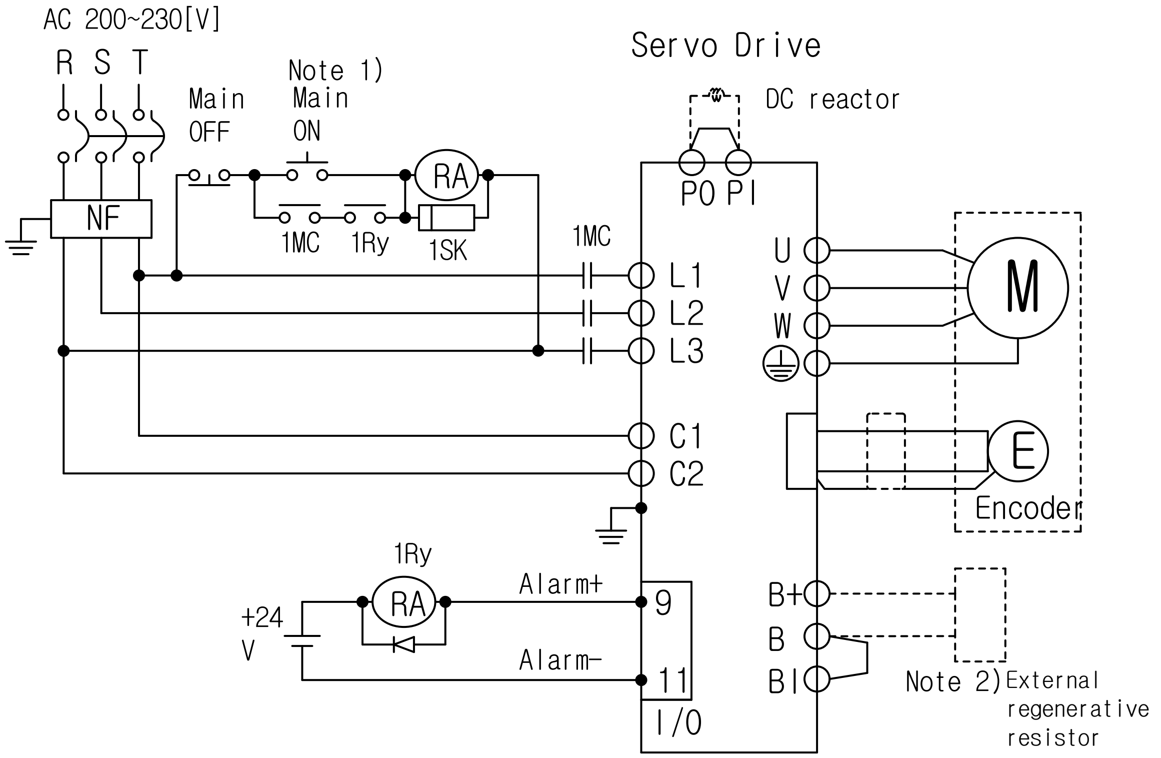
Note 2) 1 kW and 3.5 kW drives have built-in regenerative resistors of (100 W, 40 Ω) and (150 W, 13 Ω), respectively. Short-circuit B and BI terminals before using them. If the regenerative capacity is high because of frequent acceleration and deceleration, open the short-circuit pins (B and BI) and connect an external regenerative resistor to B and B+.

Note 3) Remove approximately 7 to 10 [㎜] of the sheathing from the cables for the main circuit power and attach crimp terminals. (Refer to Section 2.4.3, "Power Circuit Electrical Components.")



Note 4) For the [1 kW] drive, press the button on the drive terminal to attach or remove wires to the main circuit power unit. For the [3.5 kW] drive, use a (-) flathead screwdriver to attach or remove the wires.

■ Power Supply Wiring Diagram (XDL-L7NHFA050U to XDL-L7NHFA075U)



Note 1) It takes approximately 1 to 2 seconds until an alarm signal is output after you turn on the main power. Press and hold the main power ON switch for at least 2 seconds.

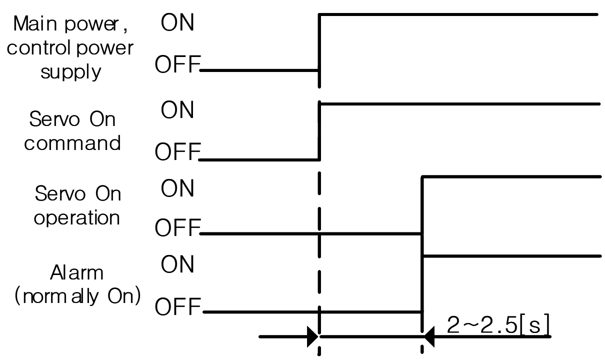
Note 2) 5 [kW] and 7.5 [kW] drives have built-in regenerative resistors of (120 W, 6.8 Ω) and (240 W, 6.8 Ω), respectively. Check the connection of internal regenerative resistor to the B+ and B terminals before using them. If the regenerative capacity is large due to frequent acceleration/deceleration, connect the internal regenerative resistor wire to the internal resistor fixing hole “NC” of the case and connect the external regenerative resistor to the B+ and B terminals.

2.4.2 Power Input Sequence

■ Power Input Sequence

- Use the magnetic contactor for main circuit power supply as shown in "2.4.1, Power Supply Wiring Diagram". Configure the external sequence to turn off the magnetic contactor at the same time as an alarm occurs.
- The control power (C1 and C2) should be applied simultaneously with or before the main power (L1, L2, and L3). Also, when the power is off, shut off the control power simultaneously or after the main power is cut off.
- 2 - 2.5 seconds after the power input, the alarm signal turns on (normal), and the Servo On command signal is recognized. Therefore, when the Servo On command signal is on at the same time as the power is input, the actual Servo On is activated 2 - 2.5 seconds later. Please keep this in mind when designing the power input sequence.

■ Timing Chart



2.4.3 Power Circuit Electrical Components

■ XDL-L7NHFA010U to XDL-L7NHFA075U

Model Name		XDL-L7NHFA010U	XDL-L7NHFA035U	XDL-L7NHFA050U	XDL-L7NHFA075U
MCCB (NFB)		30A Frame 15A (ABE33b/15)	30A Frame 30A (ABE33b/30)	50A Frame 40A (ABE53b/40)	50A Frame 50A (ABE53b/50)
Noise Filter (NF)		TB6-B010LBEI(10A)	TB6-B030NBDC(30A)	TB6-B040A (40A)	TB6-B060LA (60A)
DC reactor		HFN-15(15A)	HFN-30(30A)	HFN-40(40A)	HFN-50(50A)
MC		18A / 240V (GM□-18)	32A / 240V (GM□-32)	50A / 240V (GM□-50)	50A / 240V (GM□-50)
Wire Note 1)	L1 ,L2, L3 PO, PI, N B+, B U, V, W	AWG14(2.5 ㎟)	AWG12(4.0 ㎟)	AWG10 (6.0 ㎟)	AWG8 (8.0 ㎟)
	C1 C2	AWG16(1.5 ㎟)	AWG16(1.5 ㎟)	AWG16 (1.5 ㎟)	AWG16 (1.5 ㎟)
Crimp terminal		UA-F2010, SEOIL (10mm Strip & Twist)	UA-F4010, SEOIL (10mm Strip & Twist)	GP110028 KET	GP110732 KET
Regenerative resistor (Default)		100[W] 40Ω	150[W] 13Ω	120[W] 6.8Ω	240[W] 6.8Ω
Connector		• BLF 5.08/03/180F SN BK BX • BLF 5.08/11/180F SN BK BX	•BLZ7.62HP/03/180LR SN BK BX SO •BLZ7.62HP/11/180LR SN BK BX SO		

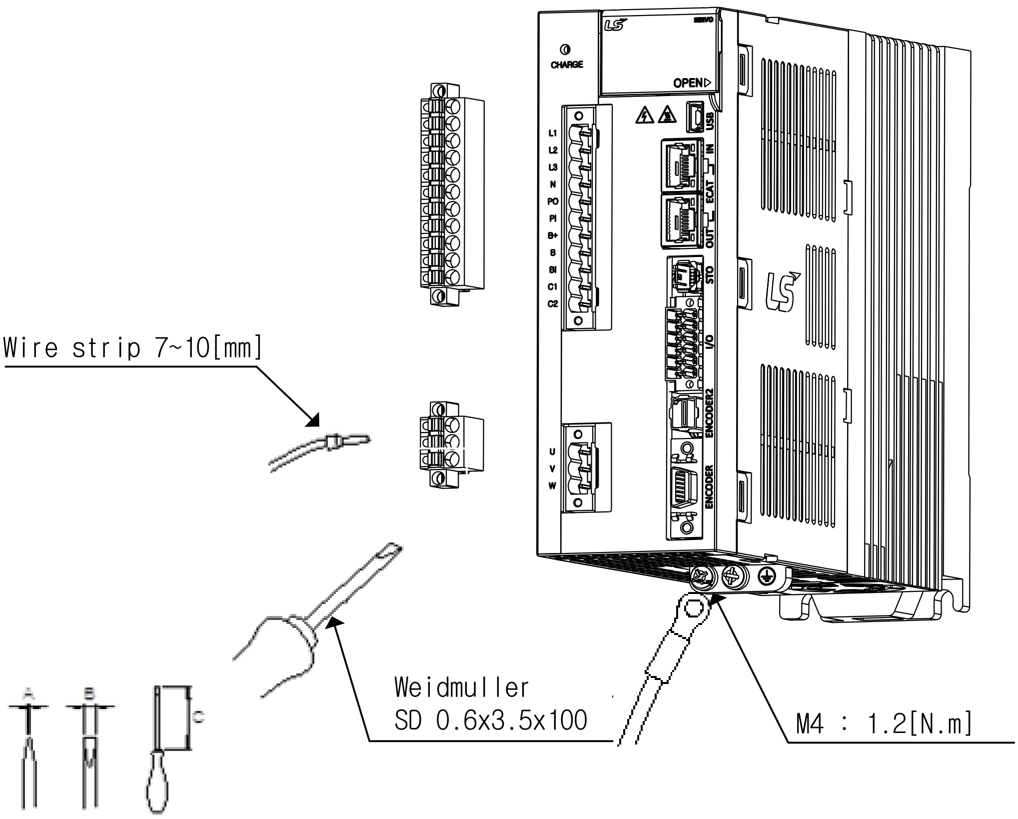
Note 1) When you select a wire, please use 600V, PVC-insulated wire.

To comply with UL(CSA) standards, use UL-certified wire (heat resistant temperature 75℃ or above).

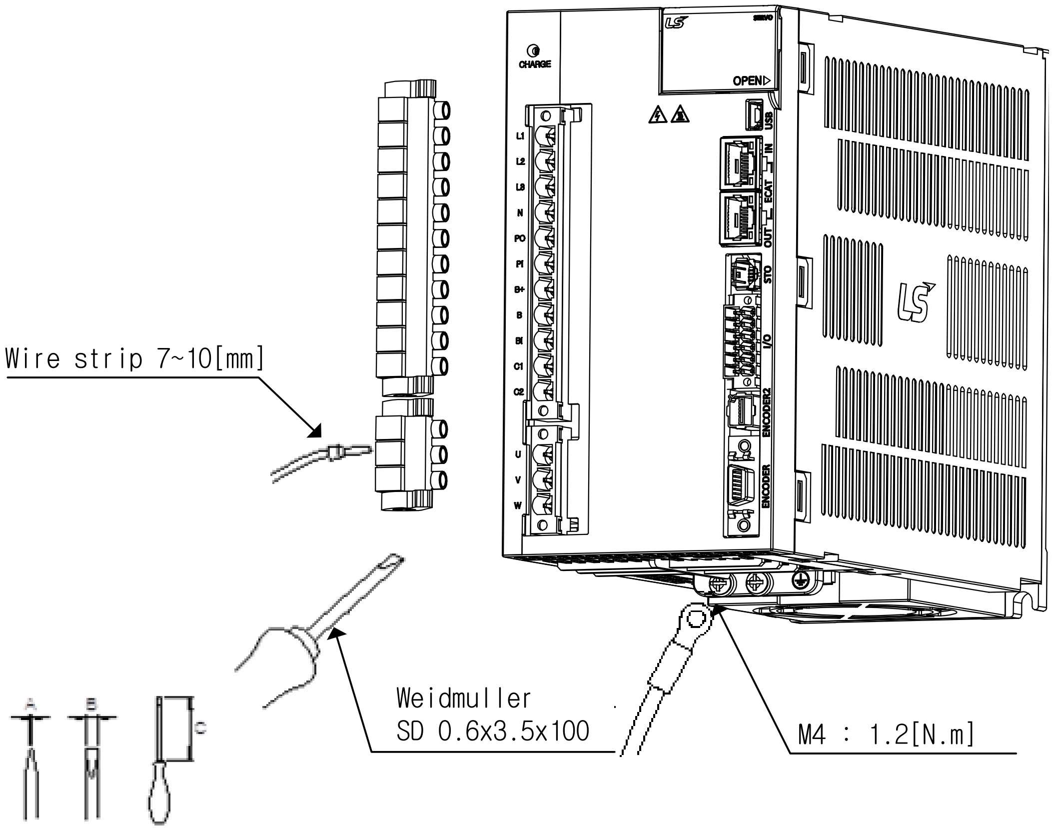
To comply with other standards, use proper wires that meet applicable standards.

For other special specifications, use wires equivalent or superior to those in this section.

■ XDL-L7NHFA010U

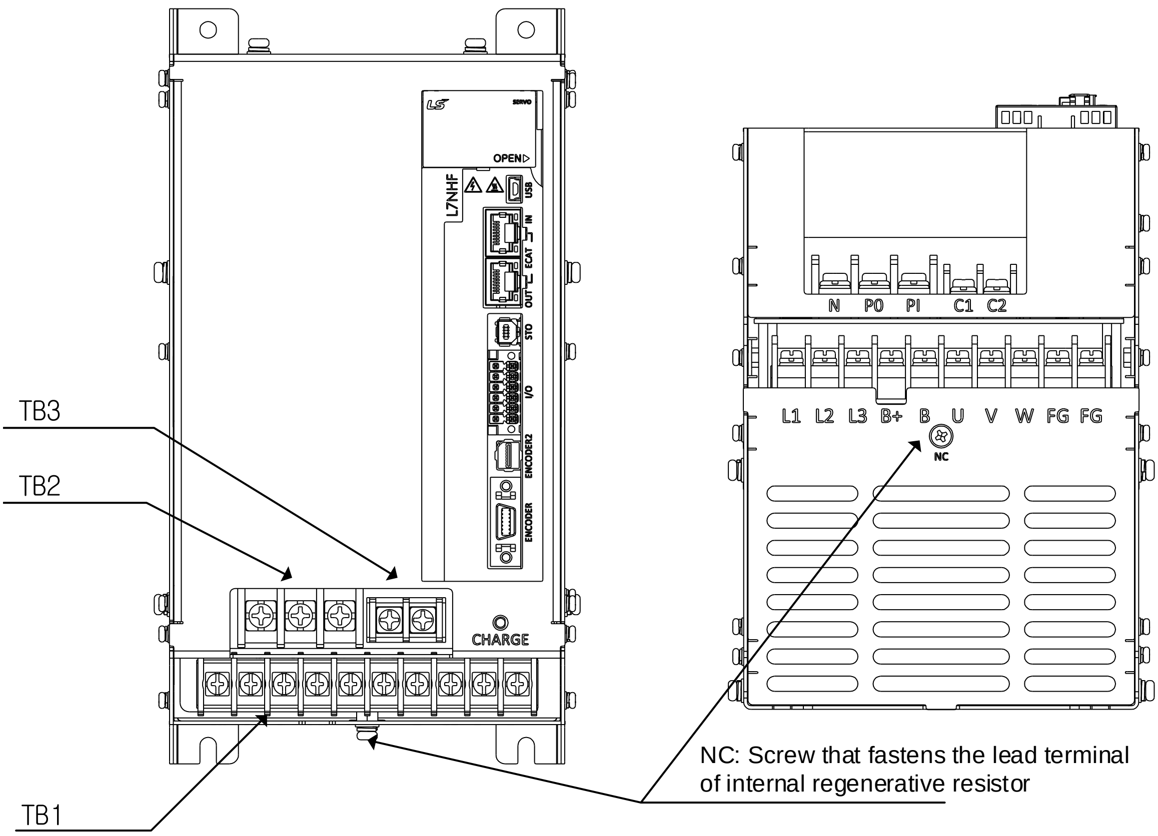


■ XDL-L7NHFA035U



1) For information on wiring to BLF 5.08 and BLZ7.62HP Series connectors, refer to the above procedures.
2) Insert electric wire into insert hole with upper locking screw loosened, and use applicable flathead (-) driver for each model to fully tighten screw to 0.4-0.5 N·m.
3) Otherwise, insufficient torque of locking screw may cause vibration-induced disconnection, system malfunction and contact-induced fire accident.
4) After you connect a wire to connector, place the connector as closely to servo drive as possible and use both locking hooks to fully lock it.
5) Use PE (Protective Earth) locking screw of M4 size (shown at the bottom of product) to tighten it to 1.2 N·m.
6) Insufficient torque of locking screw may cause PE (Protective Earth) contact failure and even malfunctioning drive.
7) We recommend that you use a Weidmüller SD 0.6 x 3.5 x 100 product for a flat-head (-) screwdriver.

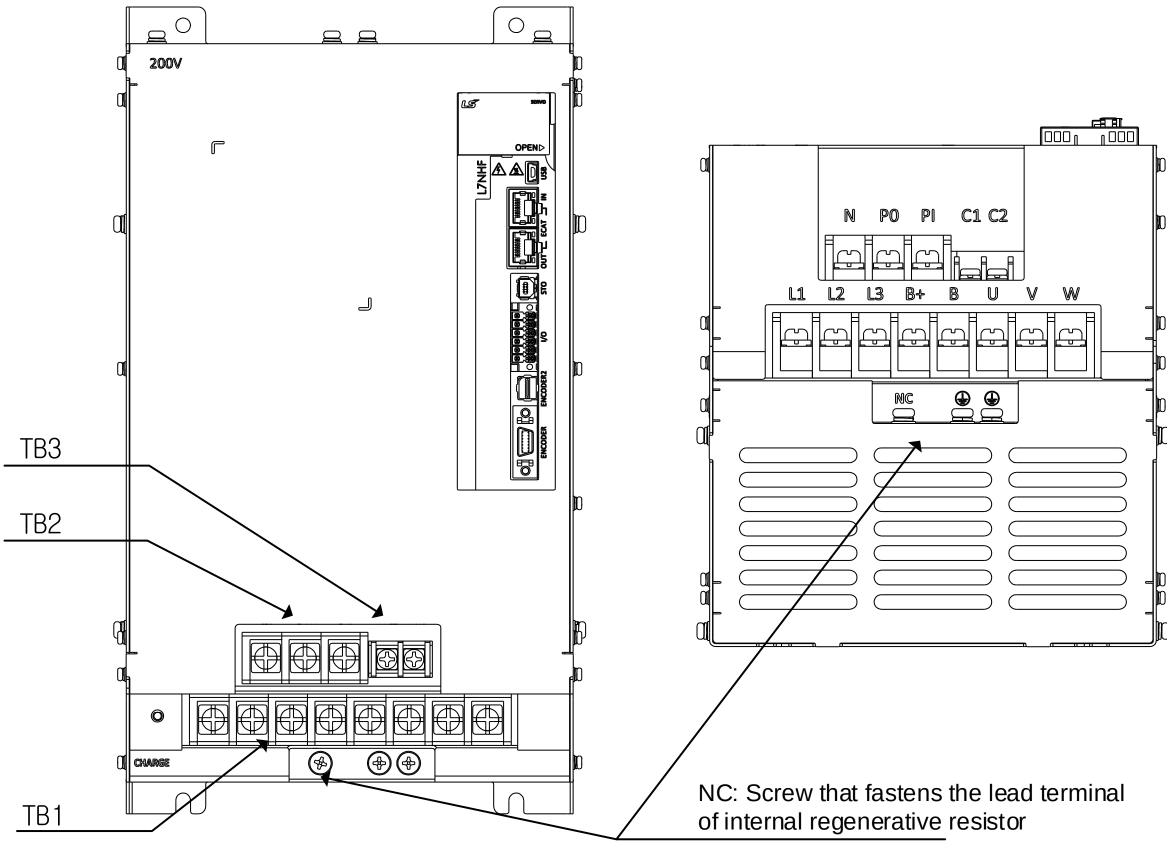
■ XDL-L7NHFA050U



1) Otherwise, insufficient torque of locking screw may cause vibration-induced disconnection, system malfunction and contact-induced fire accident.

2) Use PE (Protective Earth) locking screw of M4 size (shown at the bottom of product) to tighten it to 1.2 N·m.

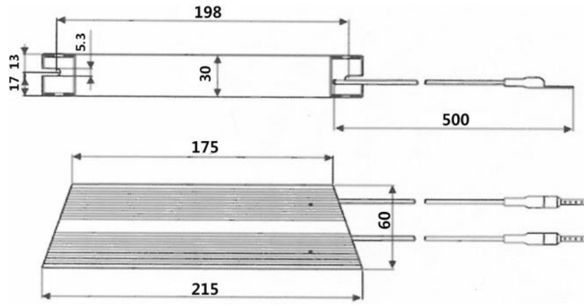
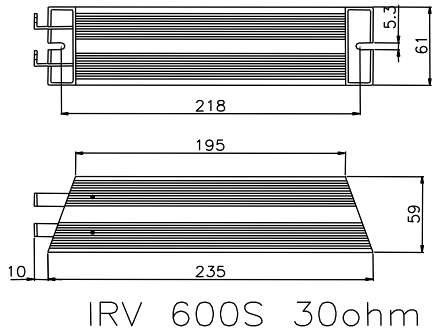
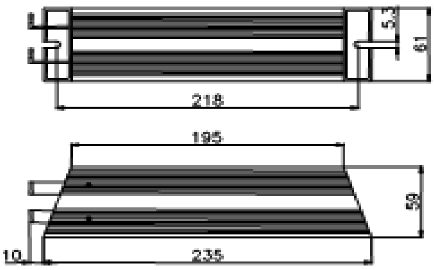
■ XDL-L7NHFA075U



1) Otherwise, insufficient torque of locking screw may cause vibration-induced disconnection, system malfunction and contact-induced fire accident.

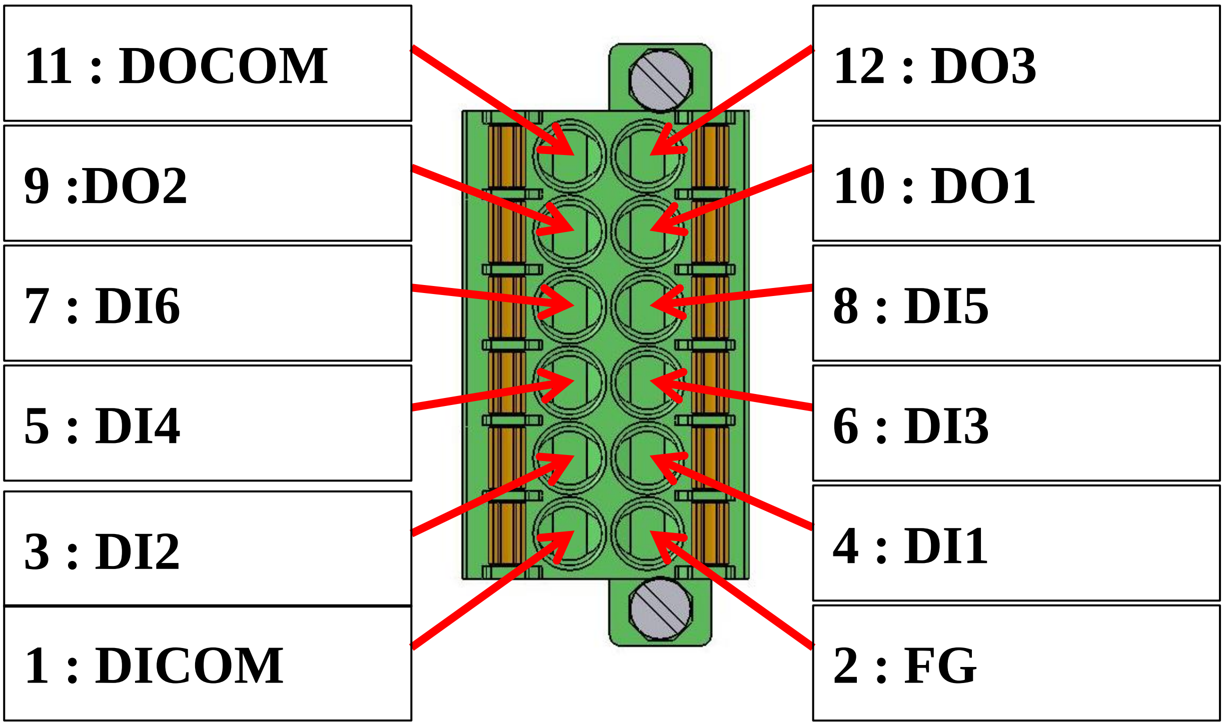
2) Use PE (Protective Earth) locking screw of M4 size (shown at the bottom of product) to tighten it to 1.2 N·m.

2.4.4 Regenerative Resistor Options

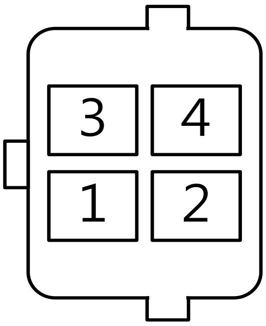
Type	Product Name	Model Name	Applicable Drive	Specifications
Resistance	Regenerative resistor	XLC-300R30	XDL-L7NHFA010U	
Resistance	Regenerative resistor	XLC-600R30	XDL-L7NHFA035U	
Resistance	Regenerative resistor	XLC-600R28	XDL-L7NHFA050U (4P) XDL-L7NHFA075U (4P)	

2.5 Wiring for Input/Output Signals

■ **I/O Connector Specifications: DFMC 1.5/6-STF-3.5 (PHOENIX)**



■ **Analog Monitoring Connector Specifications: DF-11-4DS-2C (HIROSE)**



2.5.1 Names and Functions of Digital Input/Output Signals

■ Names and Functions of Digital Input Signals (I/O Connector)

Pin Number	Name	Assignment	Description	Function
1	DICOM	DC 24V	DC 24V INPUT	COMMON
4	DI1	POT	Forward (CCW) rotation prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in the forward direction.
3	DI2	NOT	Reverse (CW) rotation prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in the reverse direction.
6	DI3	HOME	Origin sensor	Connects the origin sensor to return to the origin.
5	DI4	STOP	Servo stop	Stops the servo motor when the contact is on.
8	DI5	PCON	P control action	When the contact is on, it converts the mode from PI control to P control.
7	DI6	GAIN2	Switch from Gain 1 to 2	When the contact is on, it switches the speed control from Gain 1 to Gain 2→
** PCL			Forward Torque Limit	When the contact is on, the forward torque limit function is activated.
** BNCL			Reverse Torque Limit	When the contact is on, the reverse torque limit function is activated.
** PROBE1			Touch probe 1	The probe signal to rapidly store the position value (1)
** PROBE2			Touch probe 2	The probe signal to rapidly store the position value (2)
** EMG			Emergency stop	Emergency stop when the contact is on.
** ARST			Alarm reset	Resets the servo alarm.
** LVSF1			Vibration control filter 1	Signal to use the vibration control filter 1 according to vibration control filter function setting (0x2515)
** LVSF2			Vibration control filter 2	Signal to use the vibration control filter 2 according to vibration control filter function setting (0x2515)
** SVON			Servo ON	Servo ON

Note 1) **Signals not assigned as factory default settings. The assignment may be changed by the parameter setting. For more information, refer to 5.2 Input/Output Signals Setting.

Note 2) Wiring can be also done by using COMMON (DC 24 V) of the input signal as the GND.

■ Names and Functions of Digital Output Signals

Pin Number	Name	Assignment	Description	Function
10	DO1	BRAKE	Brake	Outputs brake control signal.
9	DO2	ALARM	Servo alarm	Outputs signal when alarm occurs.
12	DO3	RDY	Servo ready	This signal is output when the main power is established and the preparations for servo operation are complete.
11	DOCOM	GND24	GND24	COMMON
** ZSPD			Zero speed achieved	Outputs a signal when the current speed drops below the zero speed.
** INPOS1			Position reached 1	Outputs signal when having reached the command position (1)
** TLMT			Torque limit	Outputs signal when the torque is limited.
** VLMT			Speed limit	Outputs signal when the speed is limited.
** INSPD			Speed reached	Outputs signal upon reaching the command speed.
** WARN			Servo warning	Outputs signal when a warning occurs.
** TGON			Rotation detection	Outputs signal when the servo motor is rotating above the set value.
** INPOS2			Position reached 2	Outputs signal when having reached the command position (2)

** Unassigned signals. The assignment may be changed by the parameter setting. For more information, refer to 5.2 Input/Output Signals Setting.

2.5.2 Names and Functions of Analog Input/Output Signals

■ Names and Functions of Analog Output Signals (Analog Monitoring Connector)

Pin Number	Name	Description	Function
1	AMON1	Analog Monitor 1	Analog monitor output (-10V ~ +10 Signal Surface AT NC Axis 10V)
2	AMON2	Analog Monitor 2	Analog monitor output (-10V ~ +10 Signal Surface AT NC Axis 10V)
3	AGND	AGND(0V)	Analog ground
4	AGND	AGND(0V)	Analog ground

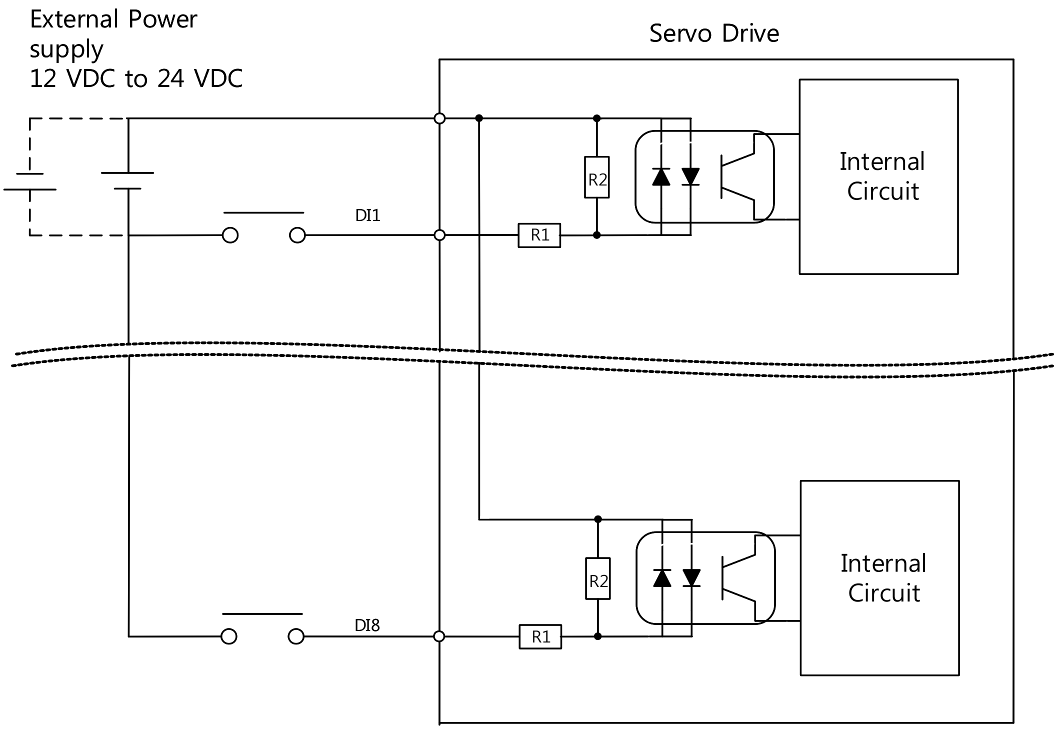
Note 1) You can change the output variables to be monitored with analog monitor output through parameter settings. For more information, refer to "5.2.3 Assignment of Analog Output Signals".

2.5.3 Examples of Connecting Input/Output Signals

■ Examples of Connecting Digital Input Signals

⚠ Caution

1. The input contact can be set to contact A or contact B based on the characteristics of individual signal.
2. Each input contact can be assigned to 15 functions.
3. For more information on signal assignment and contact change of the input contact, refer to 5.2 Input/Output Signals Setting.
4. The rated voltage is DC 12 V to DC 24 V.

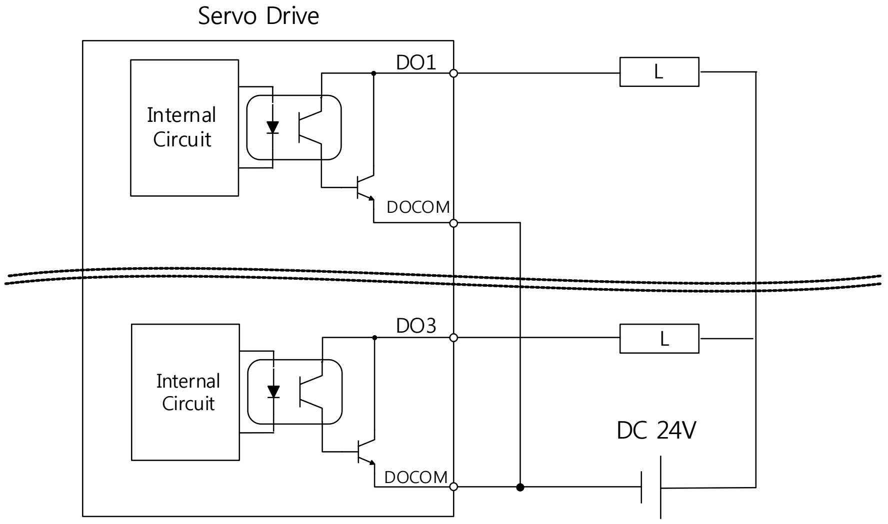


R1 : 3.3KΩ, R2 : 680Ω

■ Example of Connecting Digital Output Signals

⚠ Caution

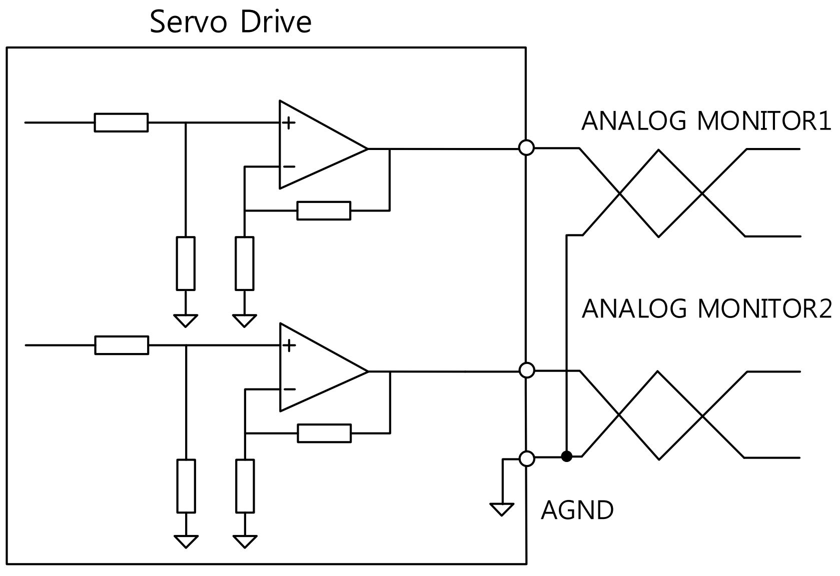
1. The output contact can be set to contact A or contact B based on the characteristics of individual signal.
2. Each output contact can be assigned to 11 output functions.
3. For more information on signal assignment and contact change of the output contact, refer to 5.2 Input/Output Signals Setting.
4. Overvoltages or overcurrents may damage the device because it uses an internal transistor switch.
5. The rated voltage and current are DC 24 V ± 10% and 120 [㎃].



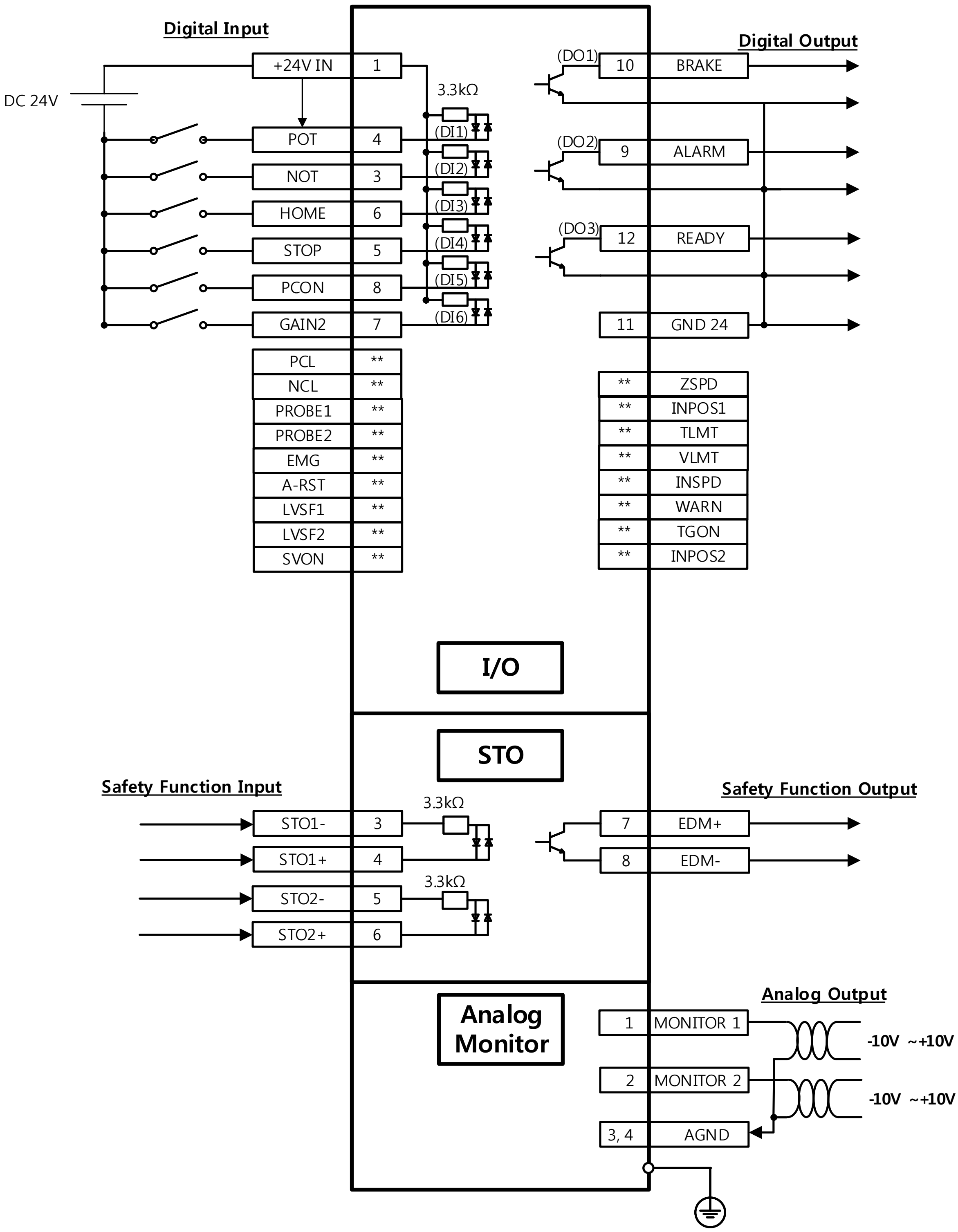
■ Examples of Connecting Analog Output Signals

⚠ Caution

1. Refer to "5.2.3 Assignment of Analog Output Signals" for signal settings and scale adjustment.
2. The range of analog output signals is -10V to 10V.
3. The resolution of analog output signal is 12 bits.
4. The maximum load current allowed is 2.5 mA.
5. The stabilization time is 15 us.



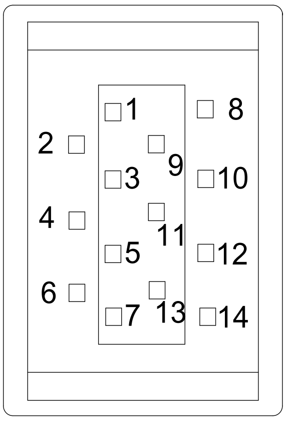
2.5.4 Input/Output Signal Wiring Diagram



Note 1) Input signals DI1 - DI6 and output signals DO1 - DO3 are factory default signals.

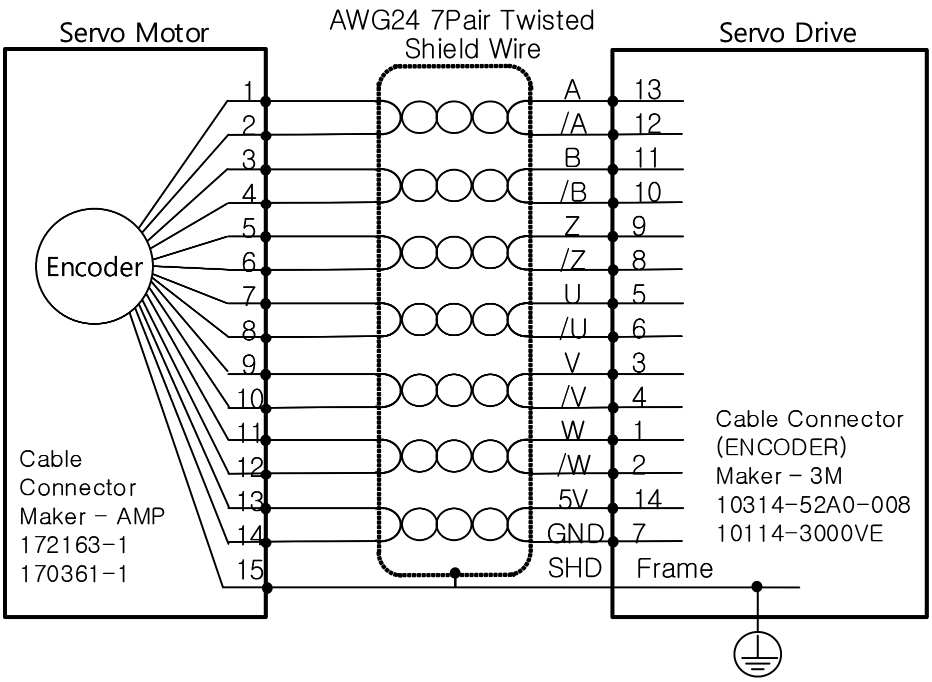
2.6 Wiring of Encoder Signal (Encoder)

■ **Encoder Connector Specification: 10114-3000VE (3M)**

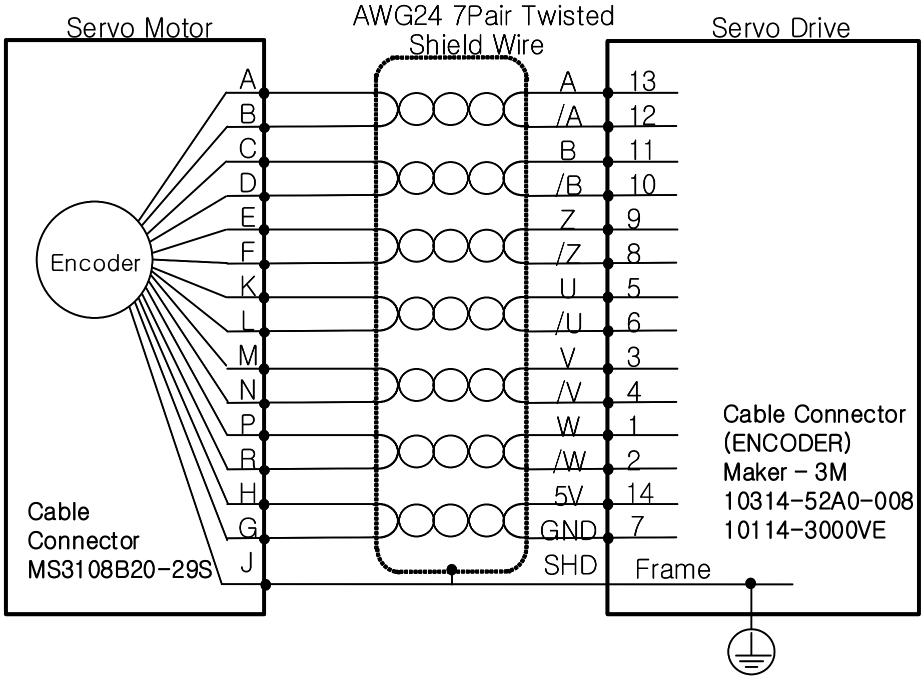


2.6.1 Quadrature Encoder Signaling Unit Wiring

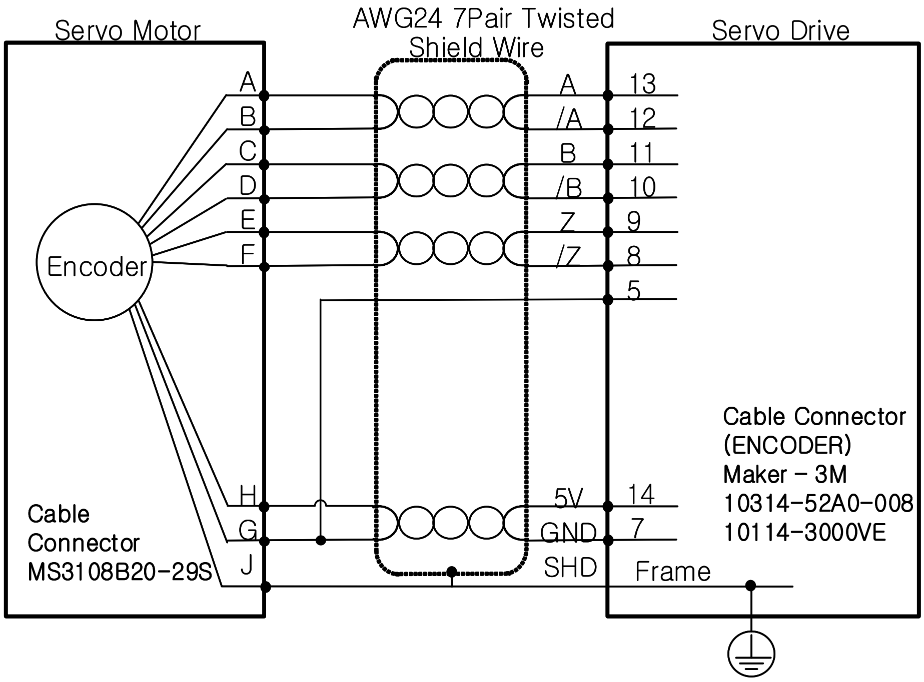
■ **XLCS-E□□□AS Cable**



■ XLCS-E□□□BS Cable

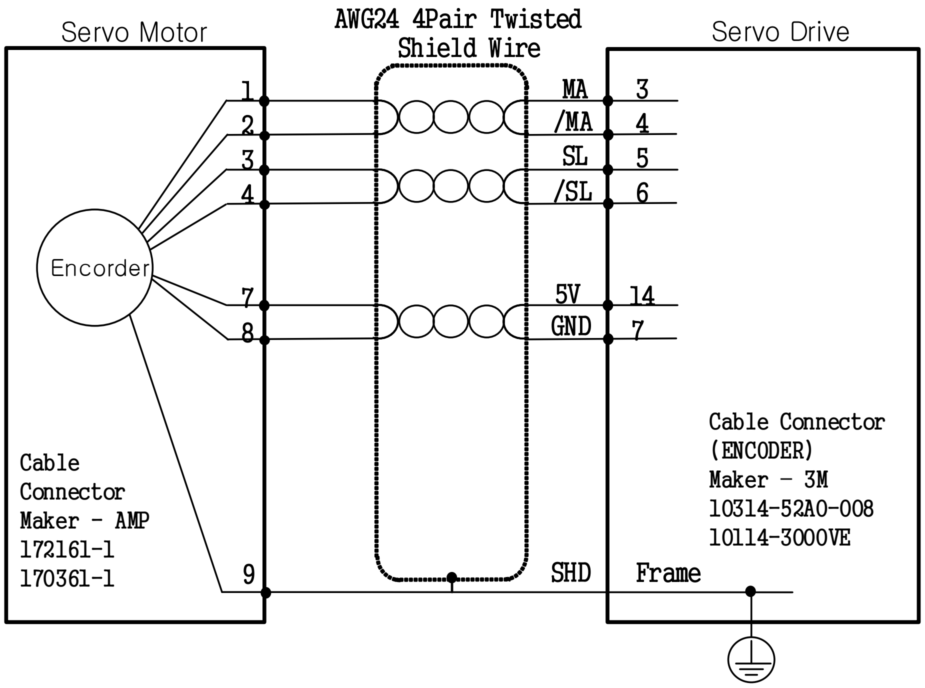


■ Without Quadrature Type Hall Sensor

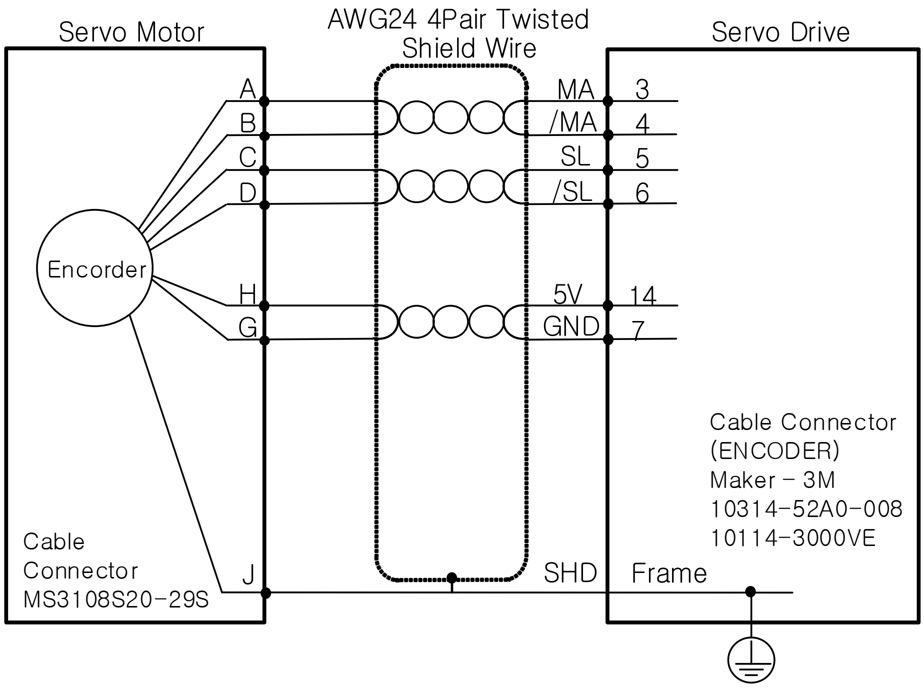


2.6.2 Serial Encoder Signaling Unit Wiring

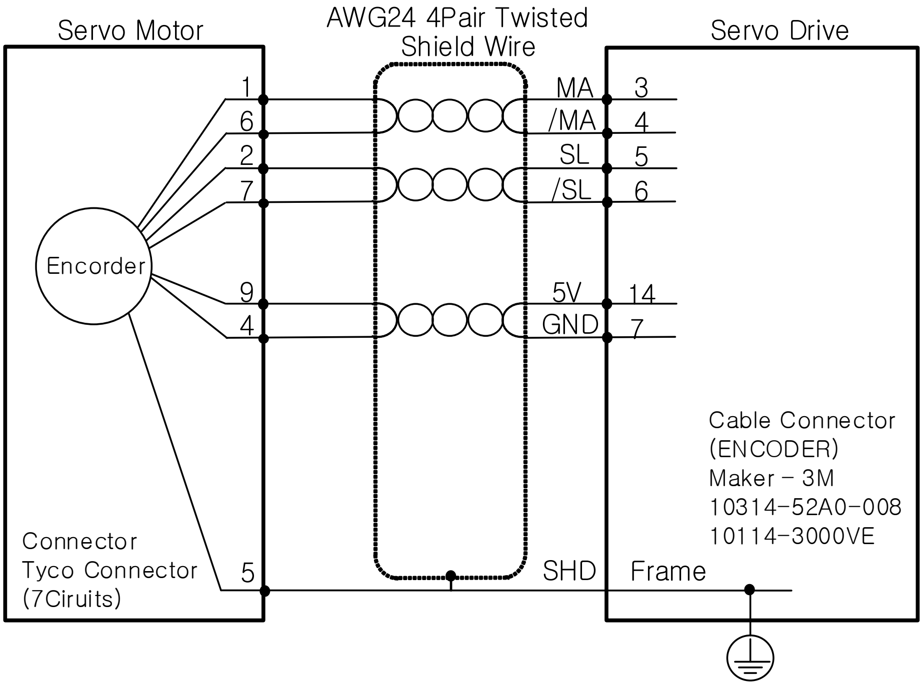
■ **XLCS-E□□□CS Cable**



■ **XLCS-E□□□DS Cable**

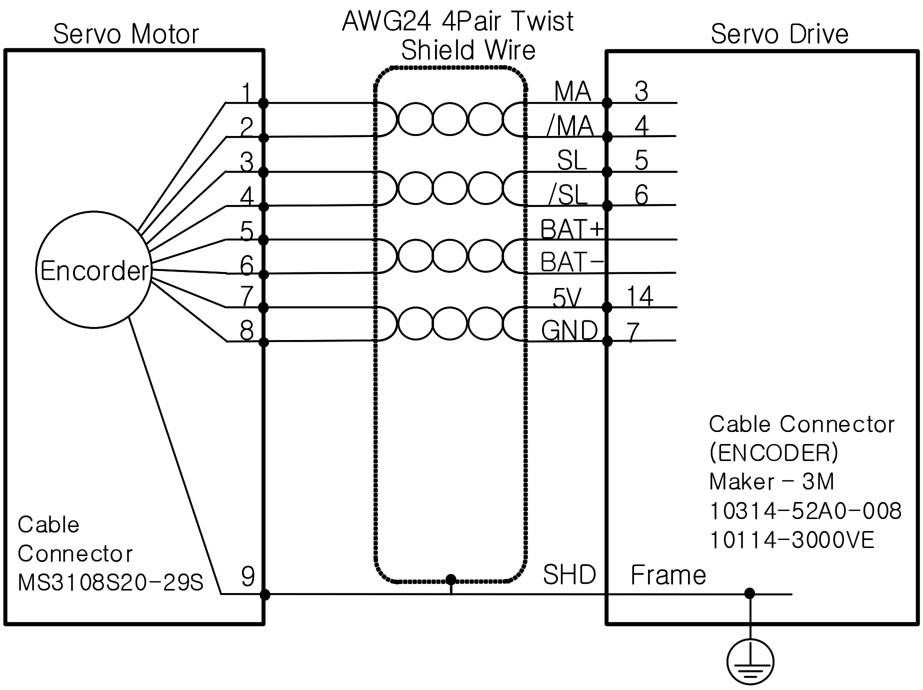


■ **XLCS-E□□□ES Cable**

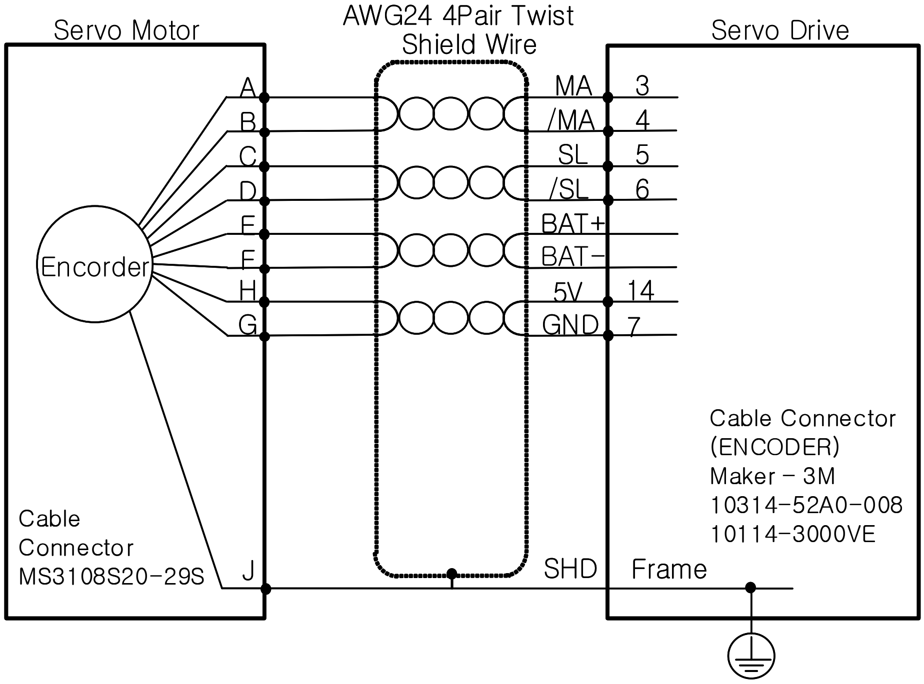


2.6.3 Multi-Turn Encoder Signaling Unit Wiring

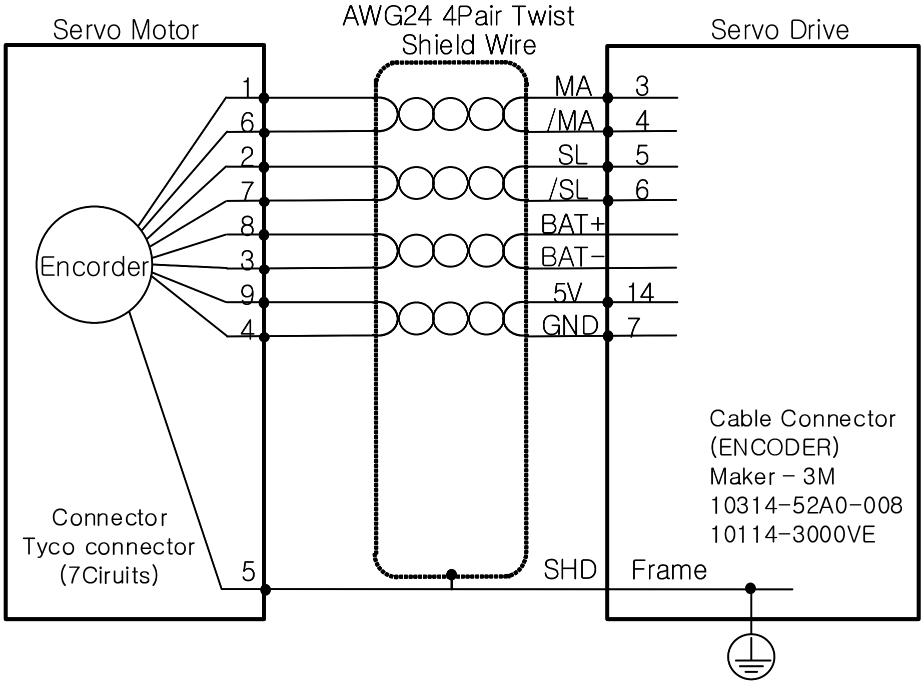
■ **XLCS-E□□□CS 1 Cable**



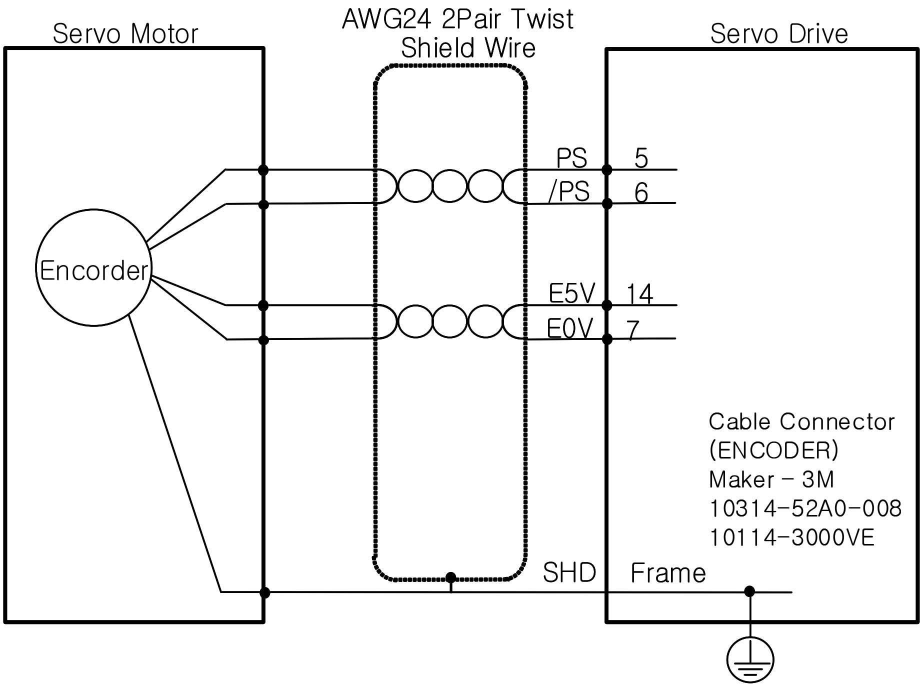
■ **XLCS-E□□□DS 1 Cable**



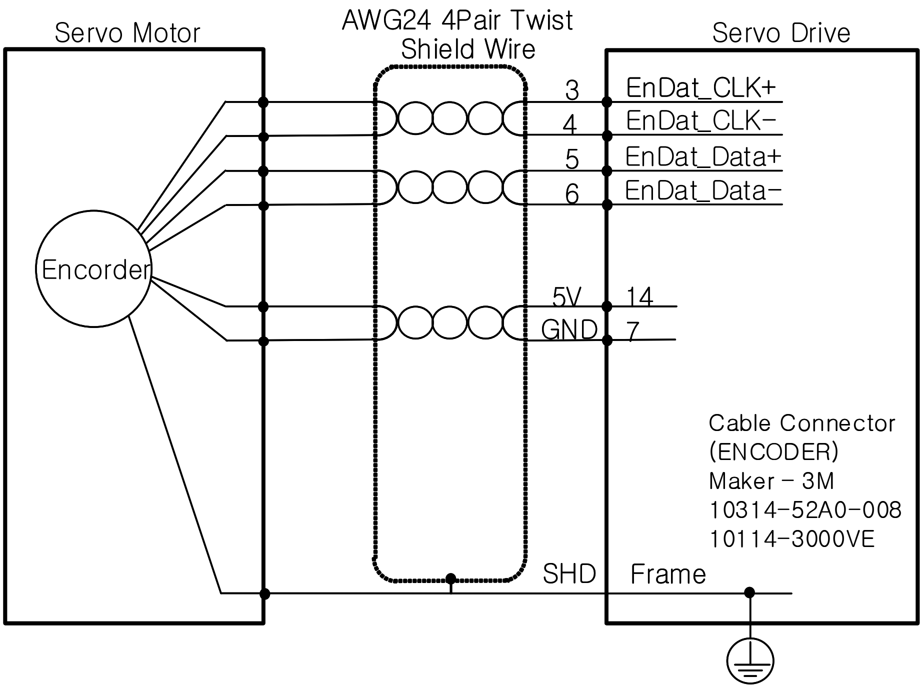
■ **XLCS-E□□□ES 1 Cable**



2.6.4 Tamagawa Encoder Signaling Unit Wiring



2.6.5 EnDat 2.2 Encoder Signaling Unit Wiring

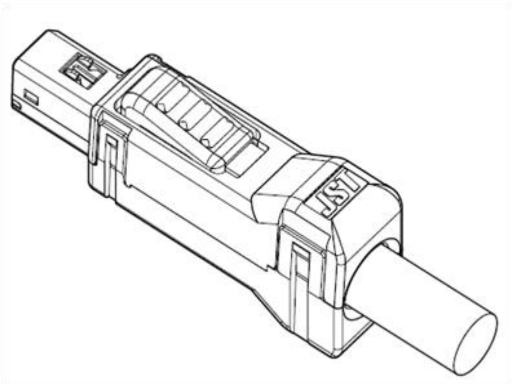


2.7 Second Encoder (Encoder 2)

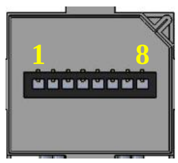
■ **Connector specifications**

- **Connector : MUF-PK8K-X**

- **Recommended wiring standards: AWG28 - AWG24**



External ENCODER2 connector to
which the drive is installed



ENCODER2 connector viewed
from the front of the drive

■ **Wiring and signal name**

Pin No	Signal name (Quadrature)	Signal name (SSI)
1	5V	5V
2	GND	GND
3	A	DATA
4	/A	/DTAT
5	B	CLK
6	/B	/CLK
7	Z	Z
8	/Z	/Z

2.8 Wiring for Safety Function Signals (STO)

■ **2069577-1(Tyco Electronics)**

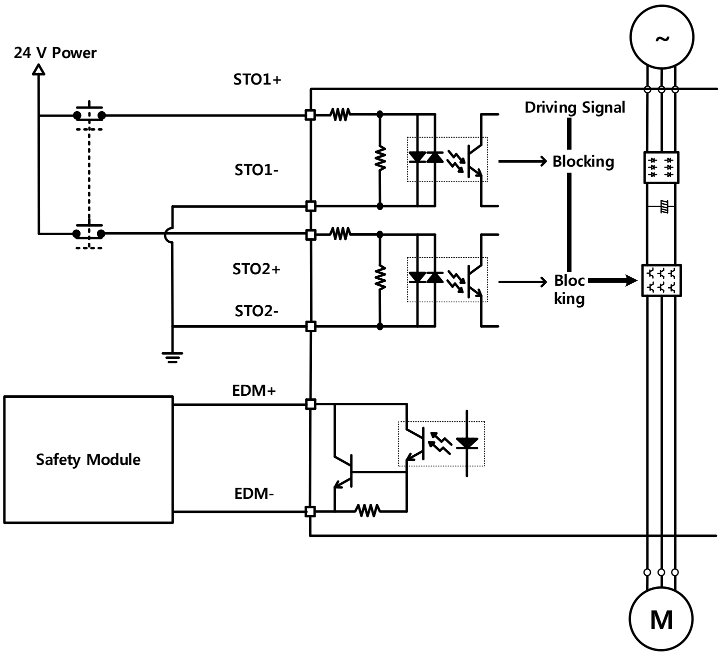
2.8.1 Names and Functions of Safety Function Signals

Pin Number	name	Function
1	+12V	For bypass wiring
2	-12V	
3	STO1-	DC 24V GND
4	STO1+	Blocks the current (torque) applied to the motor when the signal is off.
5	STO2-	DC 24V GND
6	STO2+	Blocks the current (torque) applied to the motor when the signal is off.
7	EDM+	Monitor output signal for checking the status of safety function input signal
8	EDM-	

2.8.2 Example of Connecting Safety Function Signals

⚠ **Caution**

1. The rated voltage is DC 12 V to DC 24 V.
2. With the contacts of STO1 and STO2 off, the motor output current is blocked.

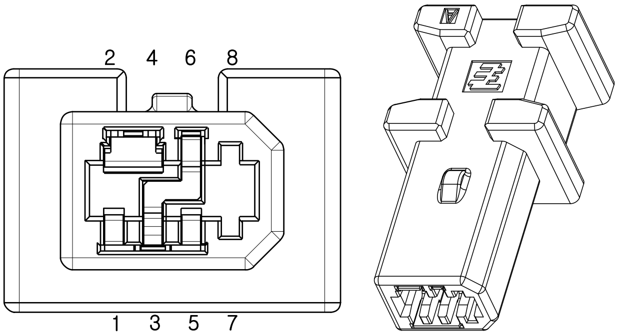


2.8.3 Bypass Wiring of Safety Function Signals

This drive provides the Mini I/O Bypass connector which has Bypass wiring to be used for the convenience of the user when the STO function is not used. To use the Bypass function, connect the Mini I/O Plug connector as follows.

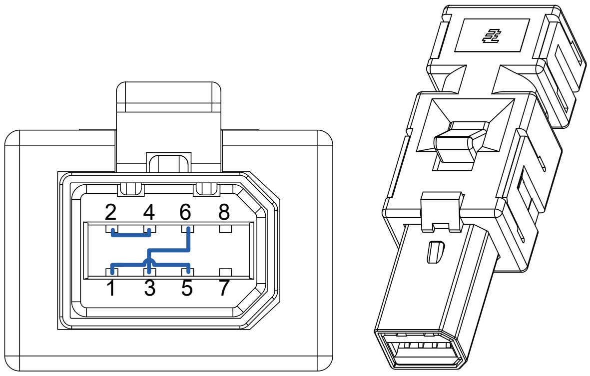
If you connect +12V to STO2-, -12V to STO1+ and STO1- to STO2+ for wiring of the Mini I/O Plug connector, you can bypass the safety function signal. Never use this power (+12 V and -12 V) except for this purpose.

■ Mini I/O By-pass Connector



1971153-1(Tyco Electronics)

■ Mini I/O Plug Connector



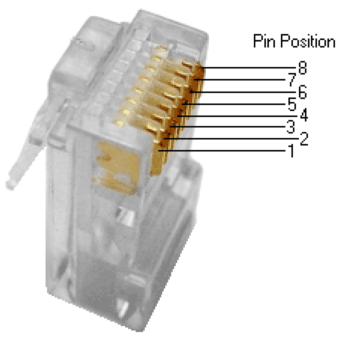
2069577-1(Tyco Electronics)

2.9 Wiring for EtherCAT Communication Signals

2.9.1 Names and Functions of EtherCAT Communication Signals

■ EtherCAT IN and EtherCAT OUT Connector

Pin Number	Signal Name	Line color
1	TX/RX0 +	White/Orange
2	TX/RX0 -	Orange
3	TX/RX1+	White/Green
4	TX/RX2 -	Blue
5	TX/RX2 +	White/Blue
6	TX/RX1 -	Green
7	TX/RX3 +	White/Brown
8	TX/RX3 -	Brown
Plate		Shield

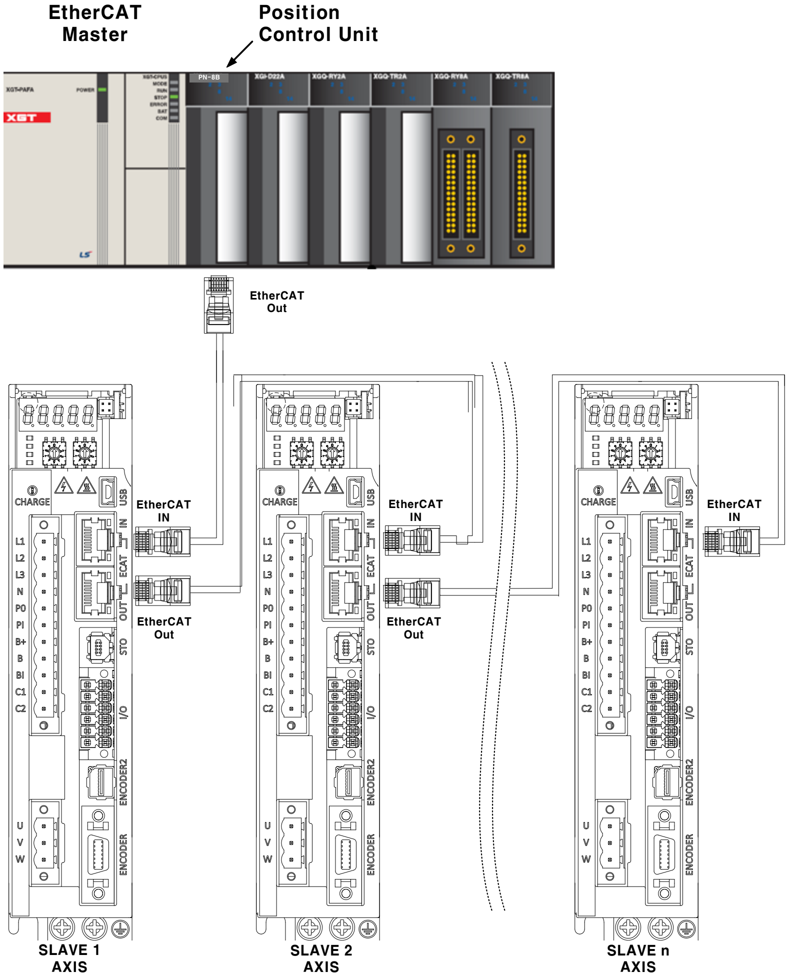


Note 1) EtherCAT only uses signals from No. 1, 2, 3, and 6.

2.9.2 Example of Drive Connection

The following figure shows the connection between a master and slave using EtherCAT communication. This is an example of a connection by topology of the basic line type.

⚠ For an environment with much noise, install ferrite core at both ends of the EtherCAT cable.



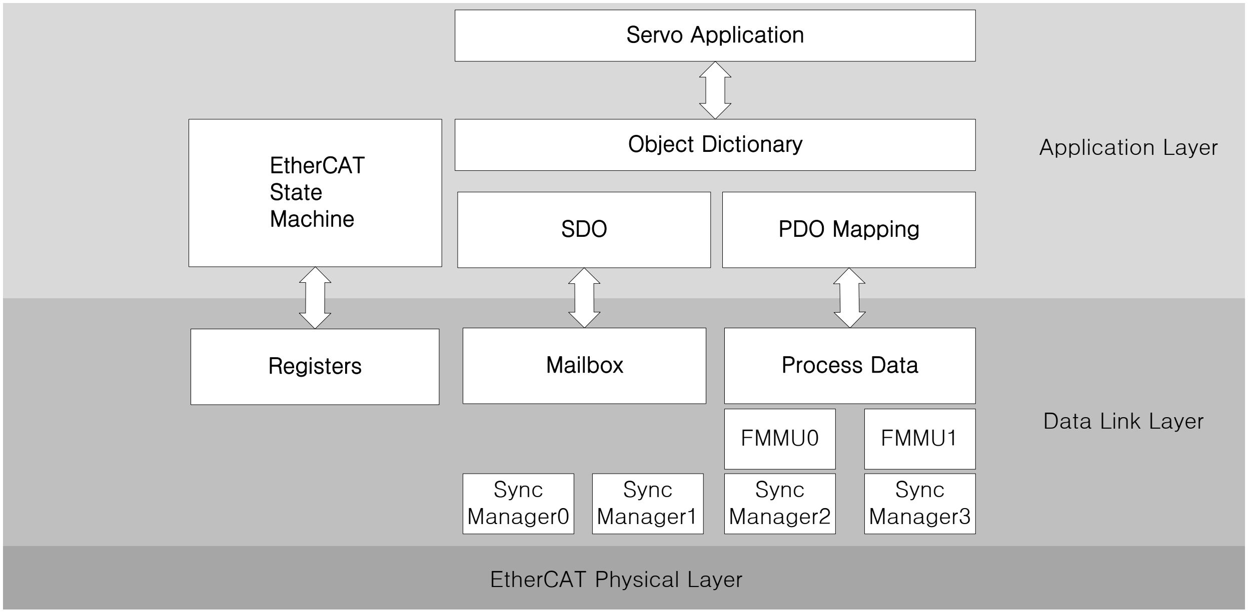
3. EtherCAT Communication

EtherCAT stands for Ethernet for Control Automation Technology. It is a communication method for masters and slaves that uses Real-Time Ethernet, developed by the German company BECKHOFF and managed by the EtherCAT Technology Group (ETG).

The basic concept of EtherCAT communication is that, when a DataFrame sent from a master passes through a slave, the slave inputs the received data to the DataFrame as soon as it receives the data.

EtherCAT uses a standard Ethernet frame compliant with IEEE802.3. Therefore, based on the Ethernet 100BASE-TX, the cable can be extended up to 100 m, and up to 65,535 nodes can be connected. In addition to this, when using a separate Ethernet switch, you can interconnect with the commonly used TCP/IP.

3.1 Structure of CANopen over EtherCAT

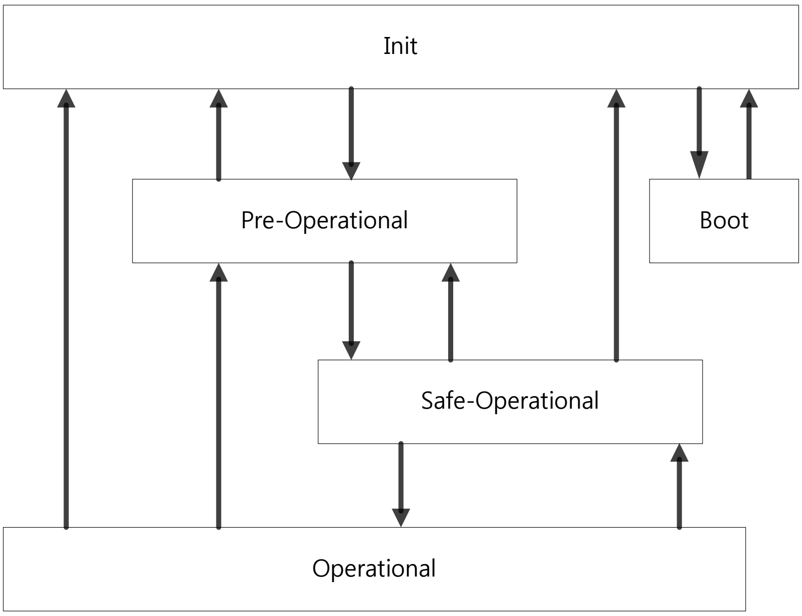


This drive supports a CiA 402 drive profile. The Object Dictionary in the application layer includes the application data and PDO (Process Data Object) mapping information from the process data interface and application data.

The PDO can be freely mapped, and the content of the process data is defined by PDO mapping.

The data mapped to the PDO is periodically exchanged (read and written) between an upper level controller and a slave by process data communication; the mailbox communication is performed aperiodically; and all of the parameters defined in the Object Dictionary are accessible.

3.1.1 EtherCAT State Machine

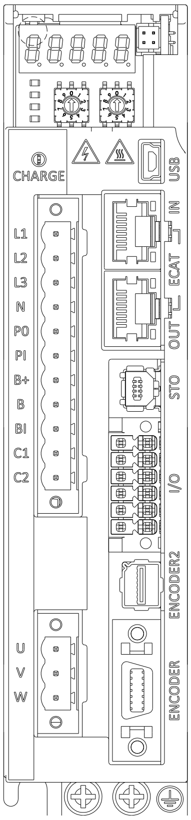


The EtherCAT drive has 5 states as shown above, and a state transition is achieved by an upper level controller (master).

State	Description
Boot	A state for firmware updates. Only mailbox communication using the FoE (File access over EtherCAT) protocol is available. The drive can transit to the Boot state only when in the Init state.
Init	Initializes the communication state. Unable to perform mailbox or process data communication.
Pre-Operational	Mailbox communication is possible.
Safe-Operational	Mailbox communication is possible and PDO can be transmitted. PDO cannot be received. The process data of the drive can be passed to an upper level controller.
Operational	Mailbox communication is possible and PDO can be transmitted and received. The process data can be properly exchanged between the drive and the upper level controller, so the drive can be normally operated.

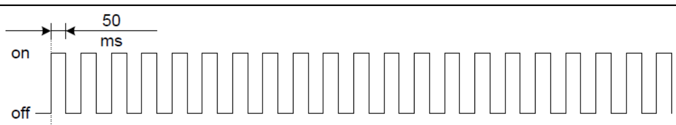
3.2 Status LED

The LEDs on the EtherCAT ports of this drive indicate the states of the EtherCAT communications and errors, as shown in the following figure. There are 3 green LEDs, L/A0, L/A1, and RUN, and 1 red LED, ERR.



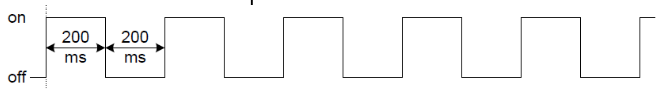
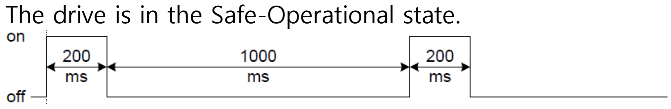
■ L/A0, L/A1 (Link Activity) LED

The L/A0 LED and L/A1 LED indicate the status of the EtherCAT IN and EtherCAT OUT communication ports, respectively. The following table outlines what each LED state indicates.

LED status	Description
OFF	Not connected for communication.
Flickering	 Connected, and communication is enabled.
ON	Connected, but communication is disabled.

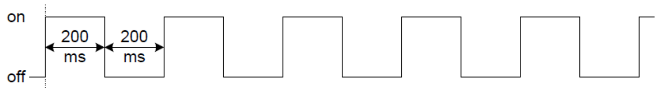
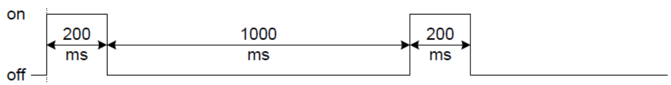
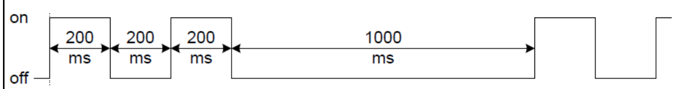
■ RUN LED

The RUN LED indicates in which state the drive is in the EtherCAT State Machine.

LED status	Description
OFF	The drive is in the Init state.
Blinking	The drive is in the Pre-Operational state. 
Single Flash	The drive is in the Safe-Operational state. 
ON	The drive is in the Operational state.

■ ERR LED

The ERR LED indicates the error status of the EtherCAT communication. The following table outlines what each LED state indicates.

LED status	Description
OFF	Indicates the EtherCAT communication is in a normal state without any error.
Blinking	Indicates that the drive has received a command from the EtherCAT master instructing it to perform a setting, which is not feasible in its present state, or to perform an impossible state transition. 
Single Flash	A DC PLL Sync error occurred. 
Double Flash	A Sync Manager Watchdog error occurred. 
ON	A servo alarm of the drive occurred.

3.3 Data Type

The following table outlines the type and range of the data types used in this manual.

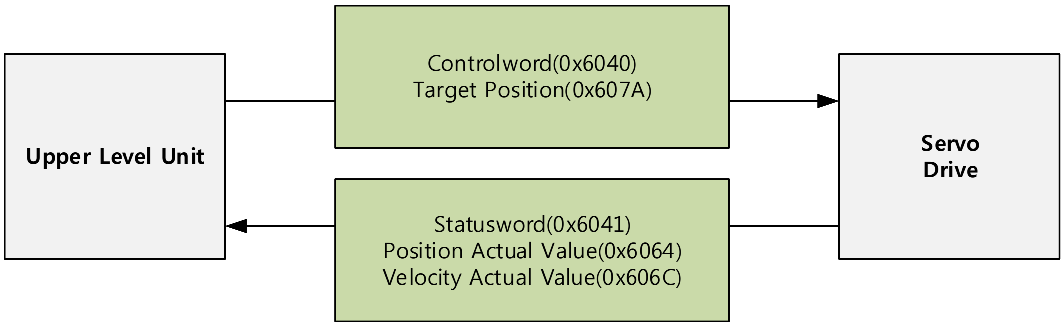
Code	Description	Range
SINT	Signed 8-bit	-128 ~127
USINT	Unsigned 8-bit	0 ~ 255
INT	Signed 16-bit	-32768 ~ 32767
UINT	Unsigned 16-bit	0 ~ 65535
DINT	Signed 32-bit	-2147483648 ~ 2147483647
UDINT	Unsigned 32-bit	0 ~ 4294967295
FP32	Float 32-bit	Single precision floating point
STRING	String Value	

3.4 PDO-Mapping

The EtherCAT uses the Process Data Object (PDO) to perform real-time data transfers. There are two types of PDOs: RxPDO receives data transferred from the upper level controller, and TxPDO sends the data from the drive to the upper level controller.

This drive uses the objects of 0x1600 to 0x1603 and 0x1A00 to 0x1A03 to assign the RxPDO and the TxPDO, respectively. Up to 10 objects can be assigned to each PDO. You can check the PDO assignment attribute of each object to see if it can be assigned to the PDO.

The diagram below shows the PDO assignment:



This is an example when assigning the Controlword and the Target Position with the RxPDO (0x1600).

Index	SubIndex	Name	Data Type
0x6040	0x00	Controlword	UINT
0x607A	0x00	Target Position	DINT

The setting values of the RxPDO (0x1600) are as follows:

SubIndex	Settings		
0	0x02 (2 values assigned)		
	Bit 31~16(Index)	Bit 15~8(Sub index)	Bit 7~0(Bit size)
1	0x6040	0x00	0x10
2	0x607A	0x00	0x20

This is an example when assigning the Statusword, the Actual Position Value, and the Actual Velocity Value with the TxPDO (0x1A00).

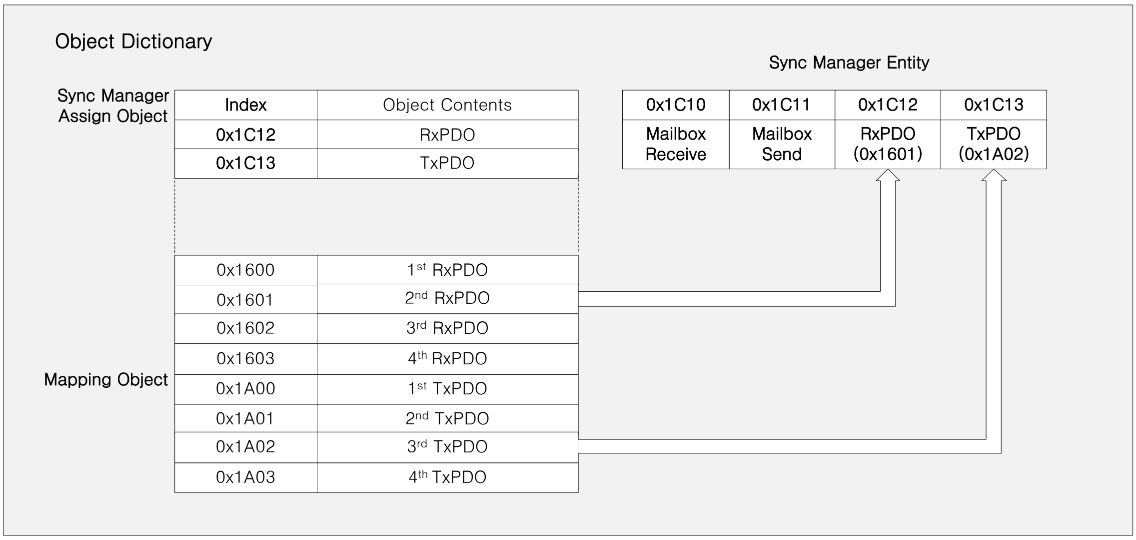
Index	SubIndex	Name	Data Type
0x6041	0x00	Statusword	UINT
0x6064	0x00	Actual Position Value	DINT
0x606C	0x00	Velocity Actual Value	DINT

The TxPDO (0x1A00) settings are as follows:

SubIndex	Settings		
0	0x03 (3 values assigned)		
	Bit 31~16(Index)	Bit 15~8(Sub index)	Bit 7~0(Bit size)
1	0x6041	0x00	0x10
2	0x6064	0x00	0x20
3	0x606C	0x00	0x20

The Sync Manager can be composed of multiple PDOs. The Sync Manager PDO Assign Object (RxPDO:0x1C12, TxPDO:0x1C13) indicates the relationship between the SyncManager and the PDO.

The following figure shows an example of SyncManager PDO mapping:



■ PDO Mapping

The following tables list the PDO mappings set by default. These settings are defined in the EtherCAT Slave Information file (XML file).

1st PDO Mapping:

RxPDO (0x1600)	Controlword (0x6040)	Target Torque (0x6071)	Target Position (0x607A)	Operation Mode (0x6060)	Touch Probe Function (0x60B8)					
TxPDO (0x1A00)	Statusword (0x6041)	Actual Torque Value (0x6077)	Actual Position Value (0x6064)	Actual Positional Error (0x60F4)	Digital Input (0x60FD)	Operation Mode Display (0x6061)	Command Speed (0x2601)	Operation Speed (0x2600)	Touch Probe Status (0x60B9)	Touch Probe 1 Forward Position Value (0x60BA)

2nd PDO Mapping:

RxPDO (0x1601)	Controlword (0x6040)	Target Position (0x607A)	Touch Probe Function (0x60B8)	Digital Output (0x60FE)		
TxPDO (0x1A01)	Statusword (0x6041)	Actual Position Value (0x6064)	Actual Positional Error (0x60F4)	Touch Probe Status (0x60B9)	Touch Probe 1 Forward Position Value (0x60BA)	Digital Input (0x60FD)

3rd PDO Mapping:

RxPDO (0x1602)	Controlword (0x6040)	Target Velocity (0x60FF)	Touch Probe Function (0x60B8)	Digital Output (0x60FE)	
TxPDO (0x1A02)	Statusword (0x6041)	Actual Position Value (0x6064)	Touch Probe Status (0x60B9)	Touch Probe 1 Forward Position Value (0x60BA)	Digital Input (0x60FD)

4th PDO Mapping:

RxPDO (0x1603)	Controlword (0x6040)	Target Torque (0x6071)	Touch Probe Function (0x60B8)	Digital Output (0x60FE)	
TxPDO (0x1A03)	Statusword (0x6041)	Actual Position Value (0x6064)	Touch Probe Status (0x60B9)	Touch Probe 1 Forward Position Value (0x60BA)	Digital Input (0x60FD)

3.5 Synchronization Using the DC (Distributed Clock)

The Distributed Clock (DC) synchronizes EtherCAT communication. The master and slave share a reference clock (system time) for synchronization, and the slave synchronizes its applications with the Sync0 event generated by the reference clock.

The following synchronization modes exist in this drive. You can change the mode with the sync control register.

(1) Free-run Mode:

In Free-run mode, it operates each cycle independent of the communication cycle and master cycle.

(2) DC Synchronous Mode:

In DC Synchronous mode, the Sync0 event from the EtherCAT master synchronizes the drive. Please use this mode for more precise synchronous control.

3.6 Emergency Messages

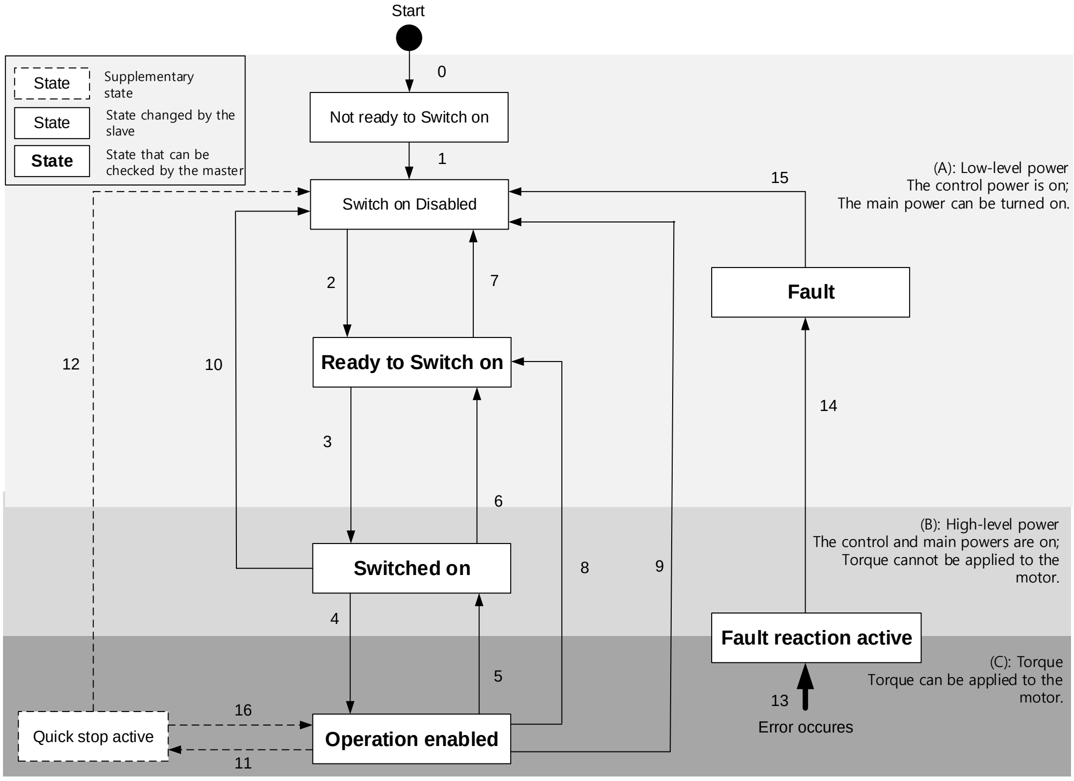
Emergency messages are passed to the master via mailbox communication when a servo alarm occurs in the drive. Emergency messages may not be sent in the event of communication failure.

Emergency messages consist of 8-byte data.

<table>
<tr><th>Byte</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td rowspan="2">Details</td><td colspan="2" rowspan="2">Emergency error code (0xFF00)</td><td rowspan="2">Error register (0x1001)</td><td rowspan="2">Reserved</td><td colspan="4">Unique field for each manufacturer</td></tr>
<tr><td colspan="2">Servo alarm code</td><td colspan="2">Reserved</td></tr>
</table>

4. CiA402 Drive Profile

4.1 State machine



State	Description
Not ready to switch on	Reset is in progress by control power on.
Switch on disabled	Initialization completed, but the main power cannot be turned on.
Ready to switch on	The main power can be turned on and the drive function is disabled.
Switched on	The main power is turned on and the drive function is disabled.
Operation enabled	The drive function is enabled, and the servo is on.
Quick Stop active	Quick stop function is in operation.
Fault reaction active	A servo alarm occurred causing a relevant sequence to be processed.
Fault	Servo alarm is activated.

■ State Machine Control Commands

The state of the State Machine can be switched by bit setting combinations of the Controlword (0x6040), as described in the table below:

Command	bits of the Controlword (0x6040)					State Machine switching
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	x	x	1	1	0	2, 6, 8
Switch on	x	0	1	1	1	3
Switch on + Enable operation	x	1	1	1	1	3 + 4
Disable voltage	x	x	x	0	x	7, 9, 10,12
Quick stop	x	x	0	1	x	7, 10,11
Disable operation	x	0	1	1	1	5
Enable operation	x	1	1	1	1	4, 16
Fault reset	0 → 1	x	x	x	x	15

■ Statusword Bit Names (0x6041)

You can check the state of the State Machine by bit combinations of the Statusword (0x6041), as described in the table below:

Command	**bits of the Statusword (0x6041)**						
	Bit 6	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Not ready to switch on	0	0	x	0	0	0	0
Switch on disabled	1	1	x	0	0	0	0
Ready to switch on	0	1	x	0	0	0	1
Switched on	0	1	x	0	0	1	1
Operation enabled	0	1	x	0	1	1	1
Fault reaction active	0	1	x	1	1	1	1
Fault	0	1	x	1	0	0	0

Bit No.	Data Description	Note
0	Ready to switch on	For more information, refer to 9.3 CiA402 Objects.
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switched on disabled	
7	Warning	
8	-	
9	Remote	
10	Target reached	
11	Internal limit active	
12	Operation mode specific	
13		
14	ABS position valid	
15	Procedure busy	

4.2 Operation Modes

This drive supports the following operation modes (0x6060):

- Profile Position Mode(PP)
- Homing Mode(HM)
- Profile Velocity Mode(PV)
- Profile Torque Mode(PT)
- Cyclic Synchronous Position Mode(CSP)
- Cyclic Synchronous Velocity Mode(CSV)
- Cyclic Synchronous Torque Mode(CST)

Drive functions supported for each mode are listed in the table below:

Function	Operation Modes			
	CSP PP	CSV PV	CST PT	HM
When the electric gear	O	O	O	O
Speed feedforward	O	X	X	OX
Torque feedforward	O	O	X	O
Position command filter	O	X	X	OX
Real-time gain adjustment	O	O	O	O
Notch filter	O	O	O	O
Disturbance observer	O	O	X	O

Note 1) For HM mode, the control mode is internally switched; thus, the function of speed feedforward and/or position command filter may or may not be applied, depending on the operation condition.

Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6060	-	Operation Mode	SNIT	RW	Yes	-
0x6061	-	Operation Mode Display	SNIT	RO	Yes	-
0x6502	-	Supported Drive Modes	UDINT	RO	No	-

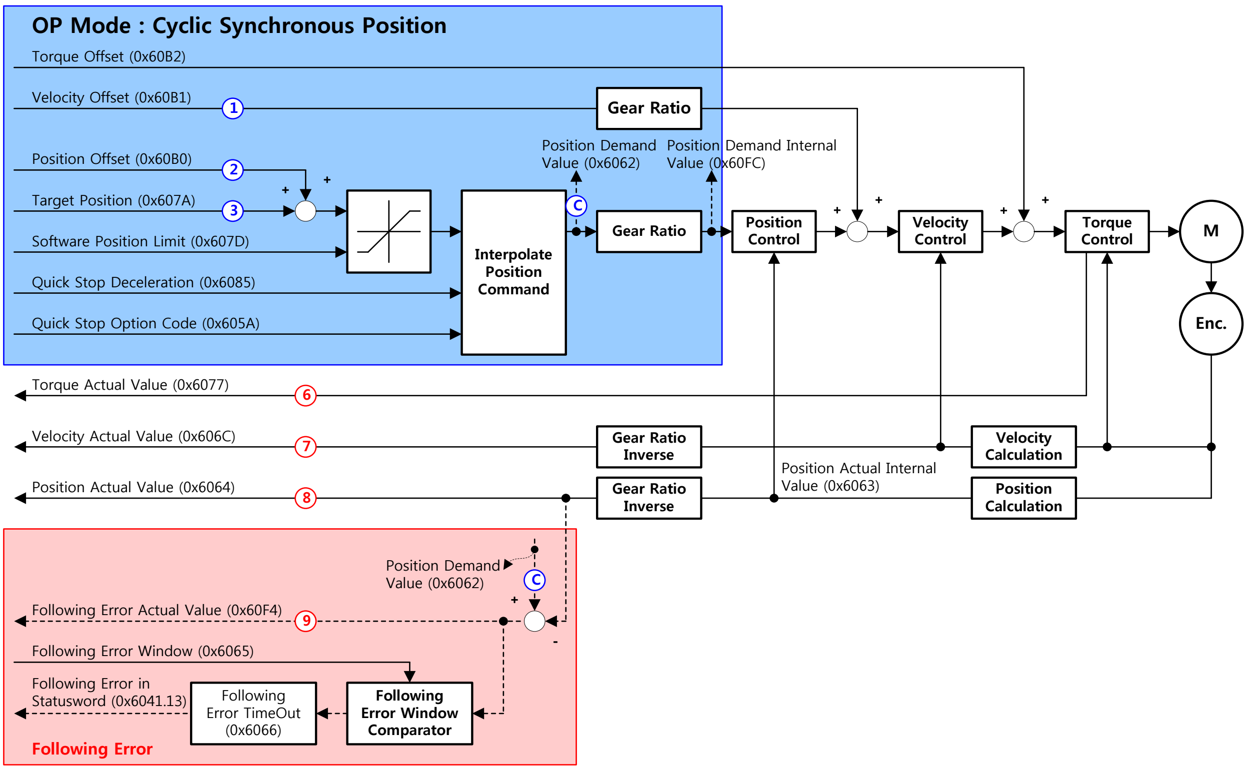
4.3 Position Control Modes

4.3.1 Cyclic Synchronous Position Mode

Cyclic Synchronous Position (CSP) mode receives the target position (0x607A) that is renewed at every PDO update cycle from the upper level controller to control the position.

In this mode, the controller is able to calculate the velocity offset (0x60B1) and the torque offset (0x60B2) that corresponds to the speed and torque feedforwards respectively, and pass them to the drive.

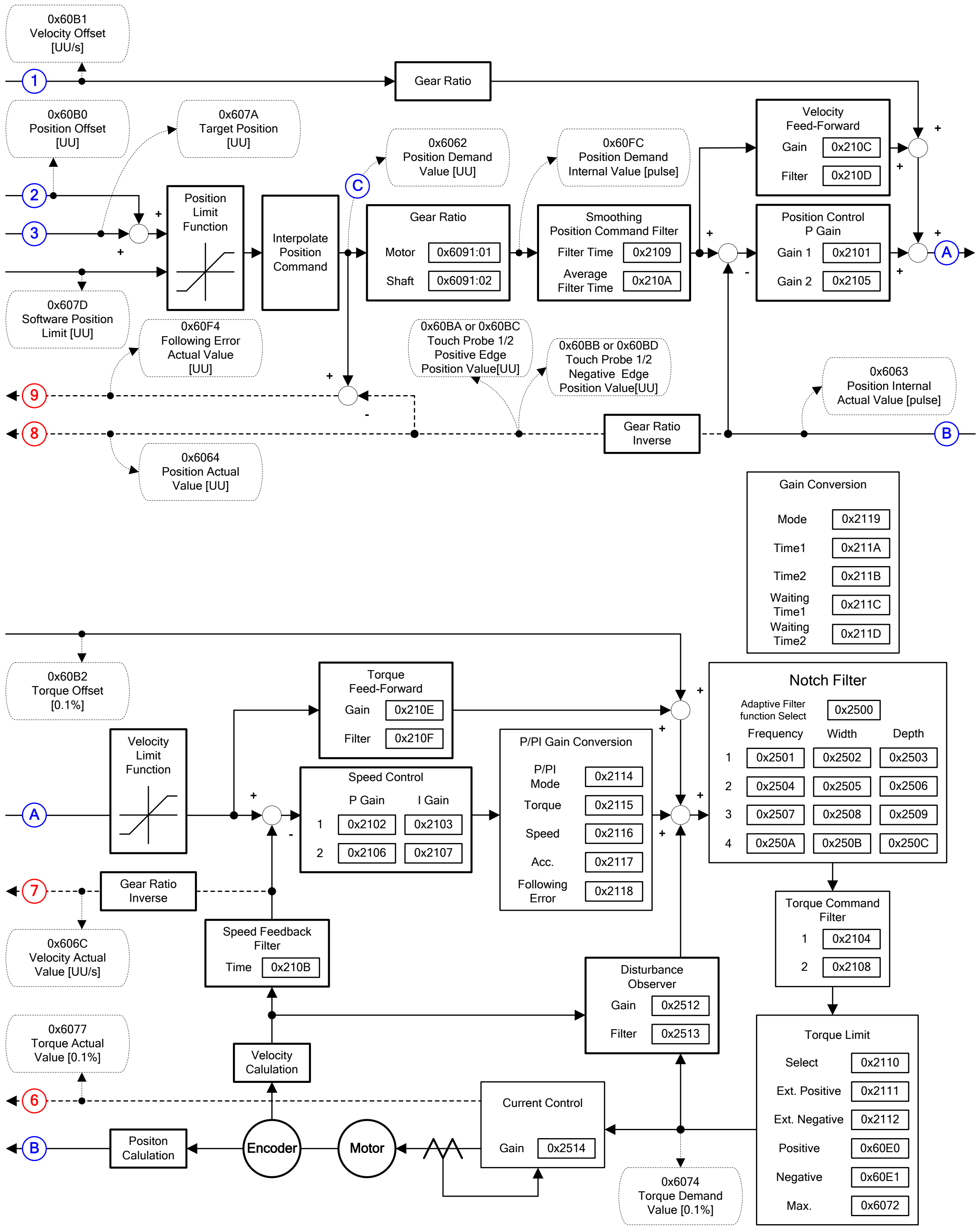
The block diagram of CSP mode is as follows:



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x607A	-	Target Position	DINT	RW	Yes	UU
0x607D	-	Software position limit	-	-	-	-
	0	Number of entries	USINT	RO	No	-
	1	Min position limit	DINT	RW	No	UU
	2	Max position limit	DINT	RW	No	UU
0x6084	-	Profile Deceleration	UDINT	RW	No	UU/s^2
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s^2
0x60B0	-	Position Offset	DINT	RW	Yes	UU
0x60B1	-	Velocity Offset	DINT	RW	Yes	UU/s
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x6062	-	Position Demand Value	DINT	RO	Yes	UU
0x60FC	-	Position Demand Internal Value	DINT	RO	Yes	pulse
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	pulse

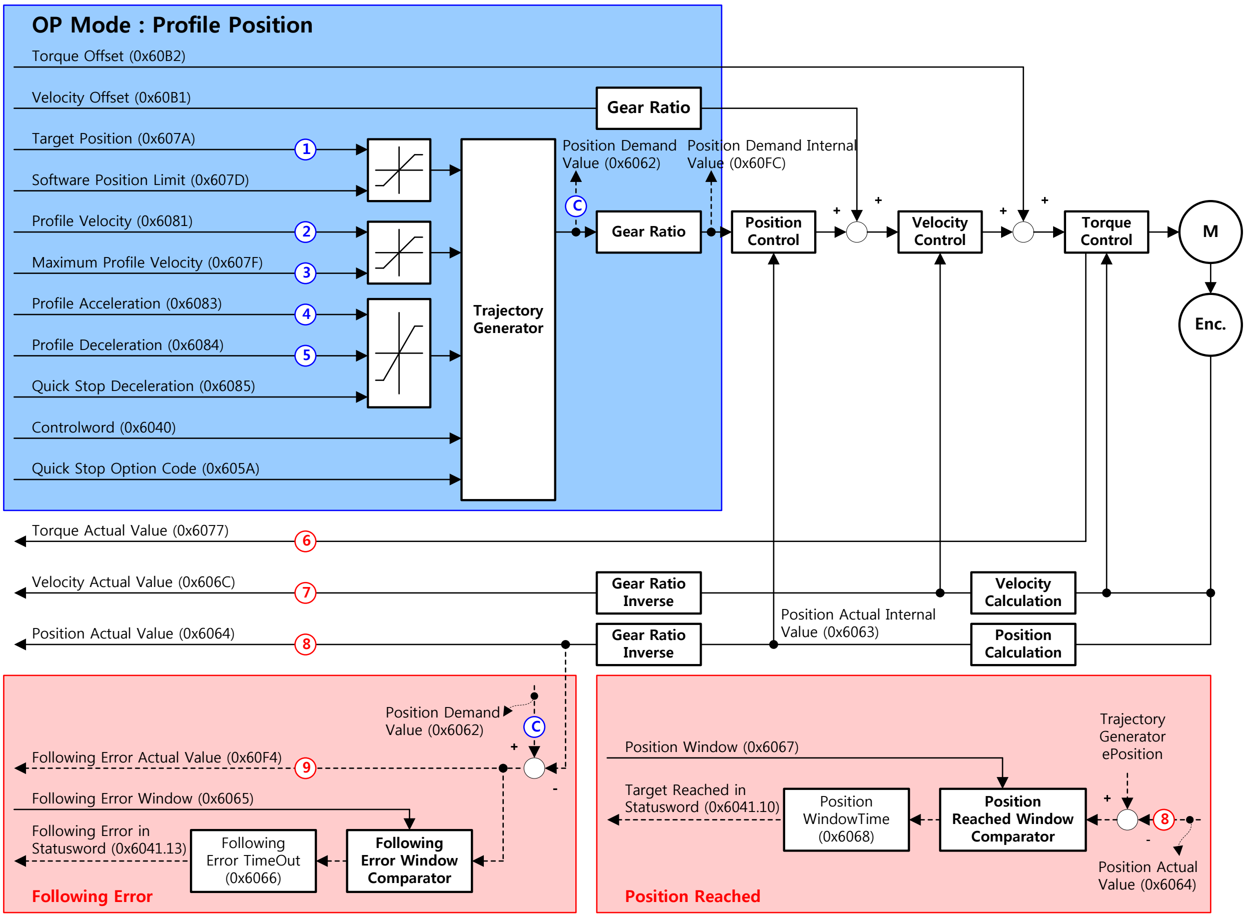
■ Internal Block Diagram of CSP Mode



4.3.2 Profile Position Mode

Unlike CSP mode, which receives the target position that is renewed at every PDO update cycle from the upper level controller, in Profile Position (PP) mode, the drive generates a position profile internally to operate up to the target position (0x607A) using the profile velocity (0x6081), acceleration (0x6083), and deceleration (0x6084).

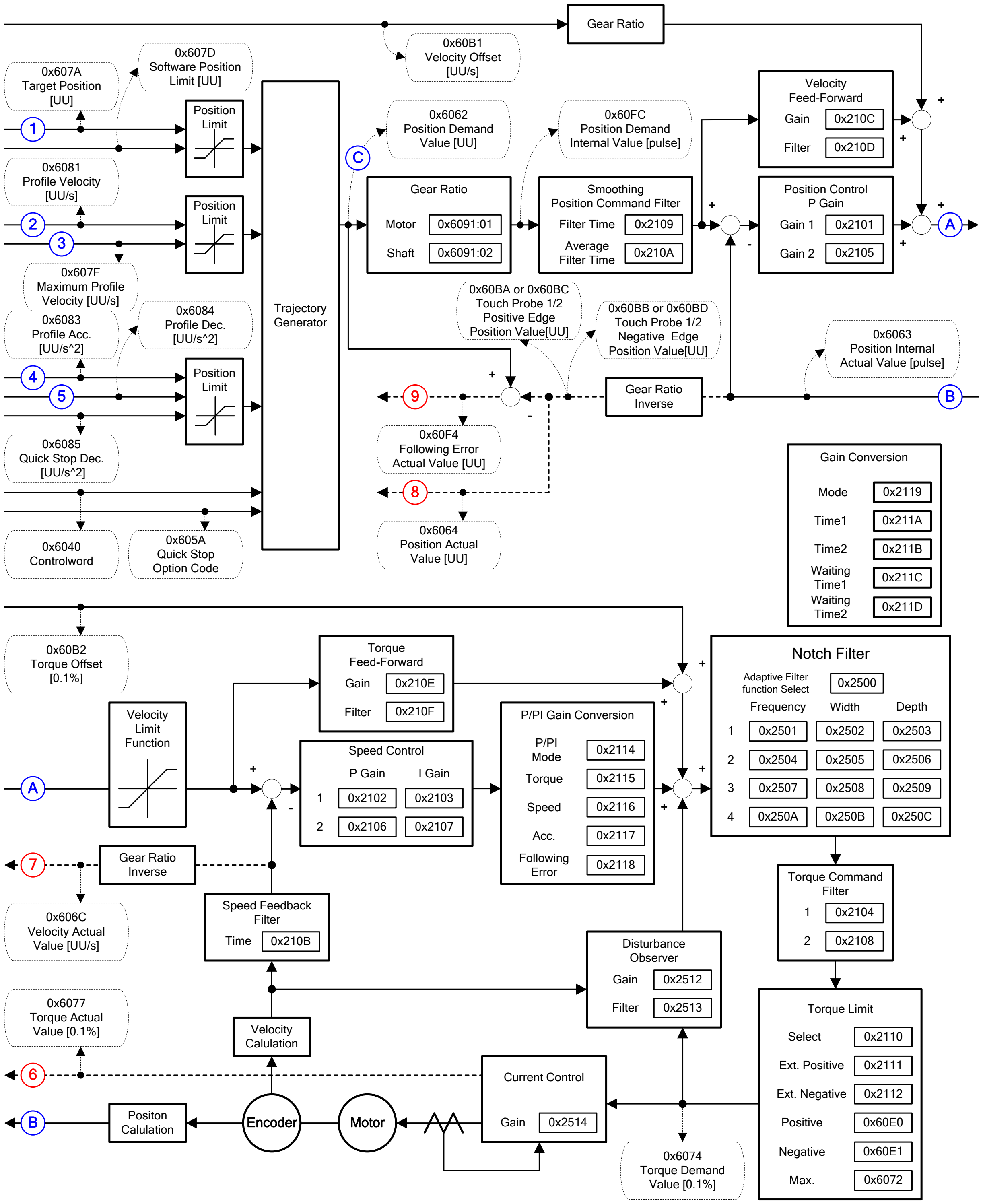
The block diagram of PP mode is as follows:



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x607A	-	Target Position	DINT	RW	Yes	UU
0x607D	-	Software position limit	-	-	-	-
	0	Number of entries	USINT	RO	No	-
	1	Min position limit	DINT	RW	No	UU
	2	Max position limit	DINT	RW	No	UU
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6081	-	Profile Velocity	UDINT	RW	No	UU/s
0x6083	-	Profile Acceleration	UDINT	RW	No	UU/s²
0x6084	-	Profile Deceleration	UDINT	RW	No	UU/s²
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s²
0x60B1	-	Velocity Offset	DINT	RW	Yes	UU/s
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x6062	-	Position Demand Value	DINT	RO	Yes	UU
0x60FC	-	Position Demand Internal Value	DINT	RO	Yes	pulse
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of PP Mode



You can use the following three position commands in Profile Position Mode:

- Single set point

  After reaching the target position, the drive sends a completion signal to the upper level controller and receives a new command.

- Change immediately

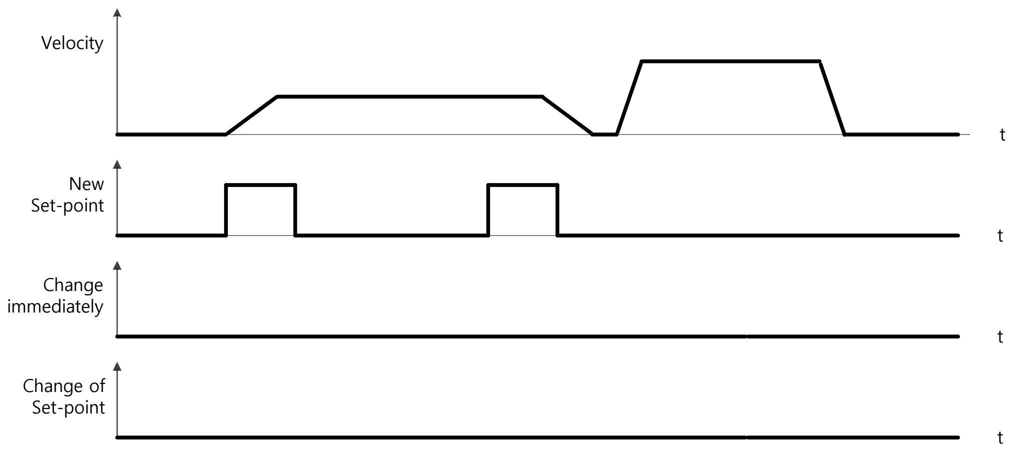
  When it receives a new position command while driving to the target position, it drives to the new position regardless of the existing target position.

- Set of Set point

  When it receives a new position command while driving to the target position, it subsequently drives to the new target position after driving to the existing target position.

The three methods mentioned above can be set by the combination of the New set point bit (Controlword, 0x6040.4), the Change set immediately bit (Controlword, 0x6040.5), and the Change set point bit (Controlword, 0x6040.9).

■ Single Set Point Driving Procedure

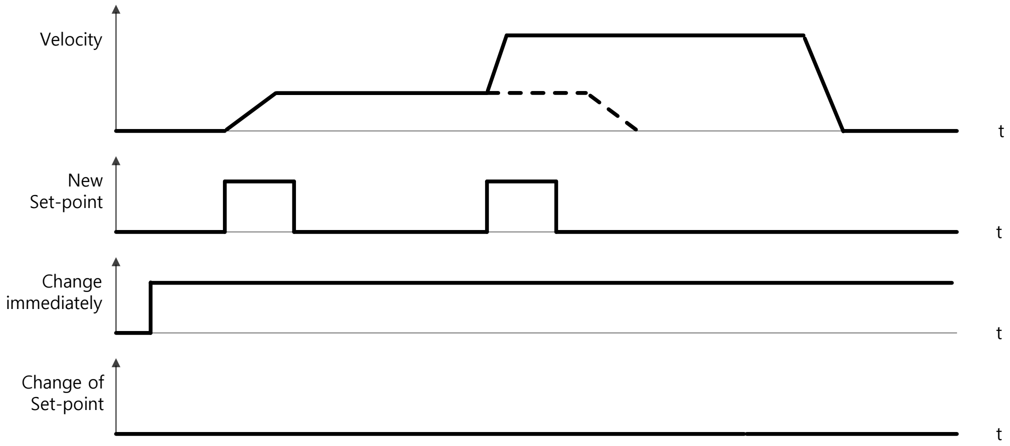


(1) Specify the target position (0x607A).

(2) Set the New set point bit to 1 and the Change set immediately bit to 0 to request the position operation.

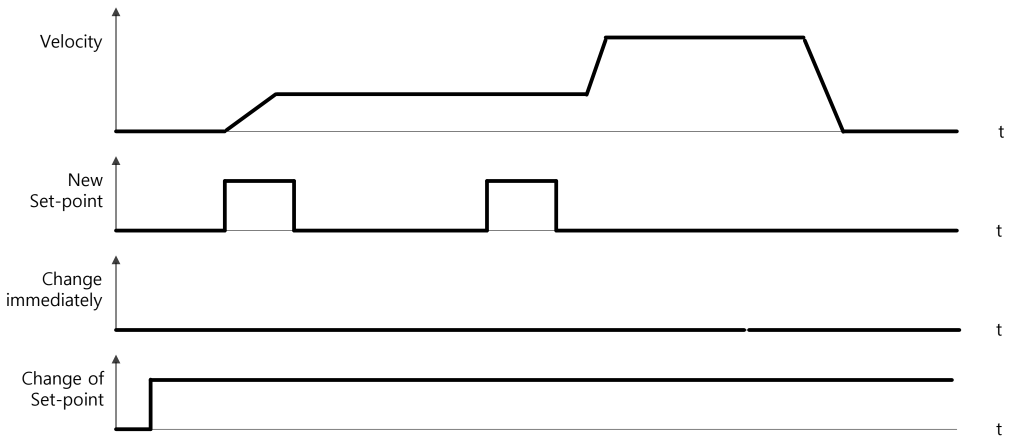
(3) The drive notifies the operator of its arrival at the target position with the Target reached bit (Statusword, 0x6041.10). The drive can suspend where it is or perform a new position operation if it receives the New set point bit.

■ Change Immediately Driving Procedure



1. Specify the target position (0x607A).
2. Set the New set point bit to 1 and the Change set immediately bit to 1 to request the position operation.
3. You can begin a new position operation (New set point) regardless of the previous target position. The drive immediately moves to the new position.
4. The drive notifies the operator of its arrival at the target position with the Target reached bit (Statusword, 0x6041.10).

■ Set of Set Point Driving Procedure



1. Specify the target position (0x607A).
2. Set the New set point bit to 1 and the Change of set point bit to 1 to request the position operation.
3. After reaching the previous target position, the drive begins to move to the new position (New set point).

4. The drive notifies the operator of its arrival at the target position with the Target reached bit (Statusword, 0x6041.10).

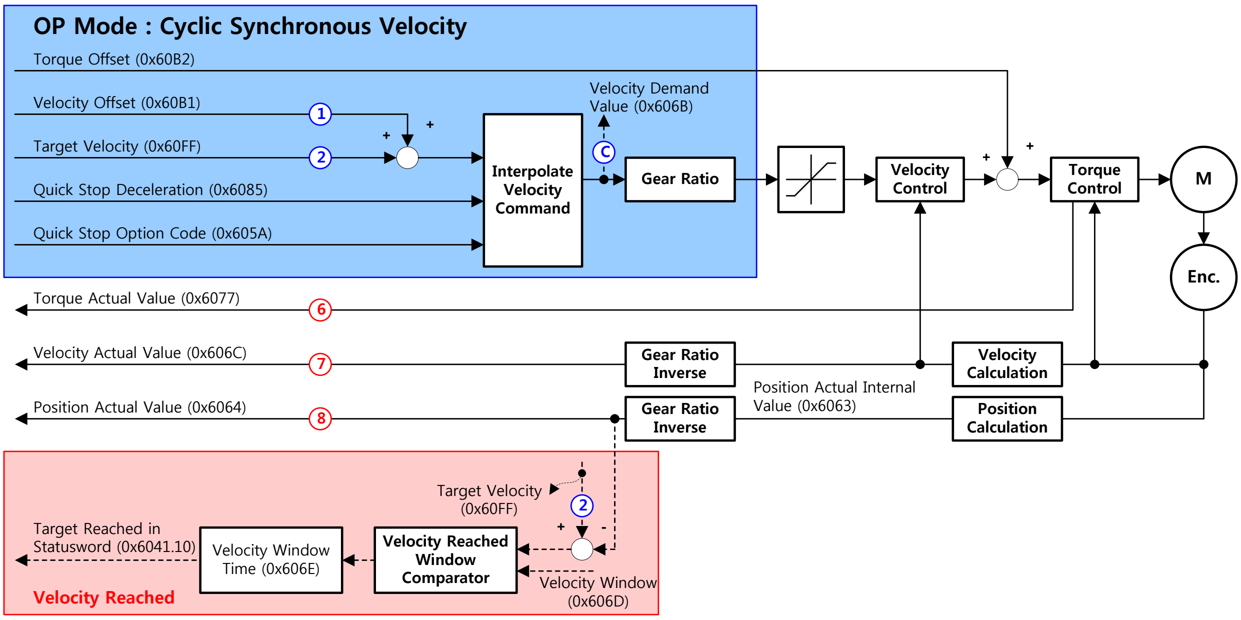
4.4 Velocity Control Modes

4.4.1 Cyclic Synchronous Velocity Mode

Cyclic Synchronous Velocity (CSV) mode receives the target velocity (0x60FF) that is renewed at every PDO update cycle from the upper level controller to control the velocity.

This mode allows the upper level controller to calculate the torque offset (0x60B2) that corresponds to the torque feedforward and pass it to the drive.

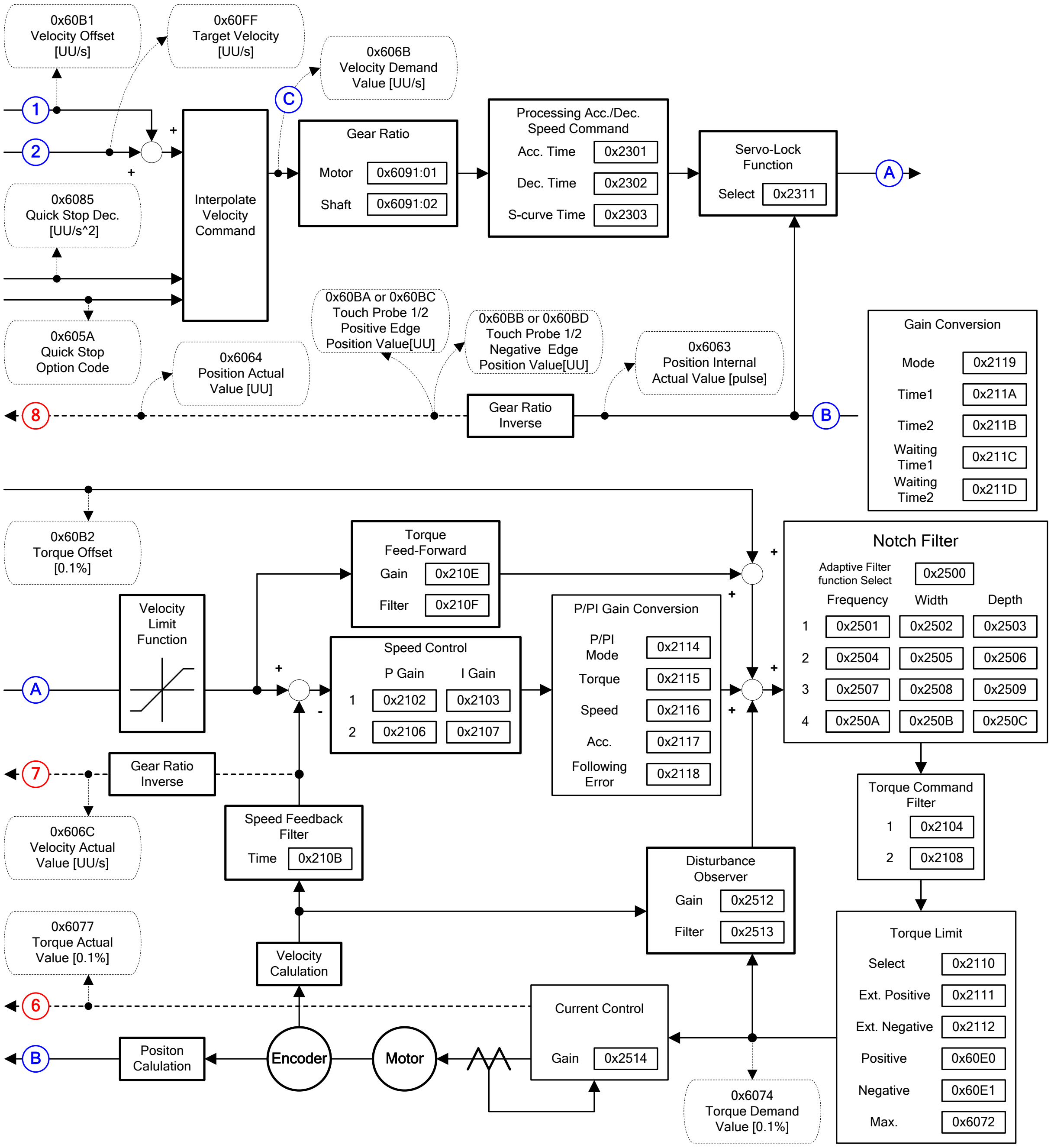
The block diagram of the CSV mode is shown below.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x60FF	-	Target Velocity	DINT	RW	Yes	UU/s
0x6084	-	Profile Deceleration	UDINT	RW	No	UU/s^2
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s^2
0x60B1	-	Velocity Offset	DINT	RW	Yes	UU/s
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x606B	-	Velocity Demand Value	DINT	RO	Yes	UU
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of CSV Mode

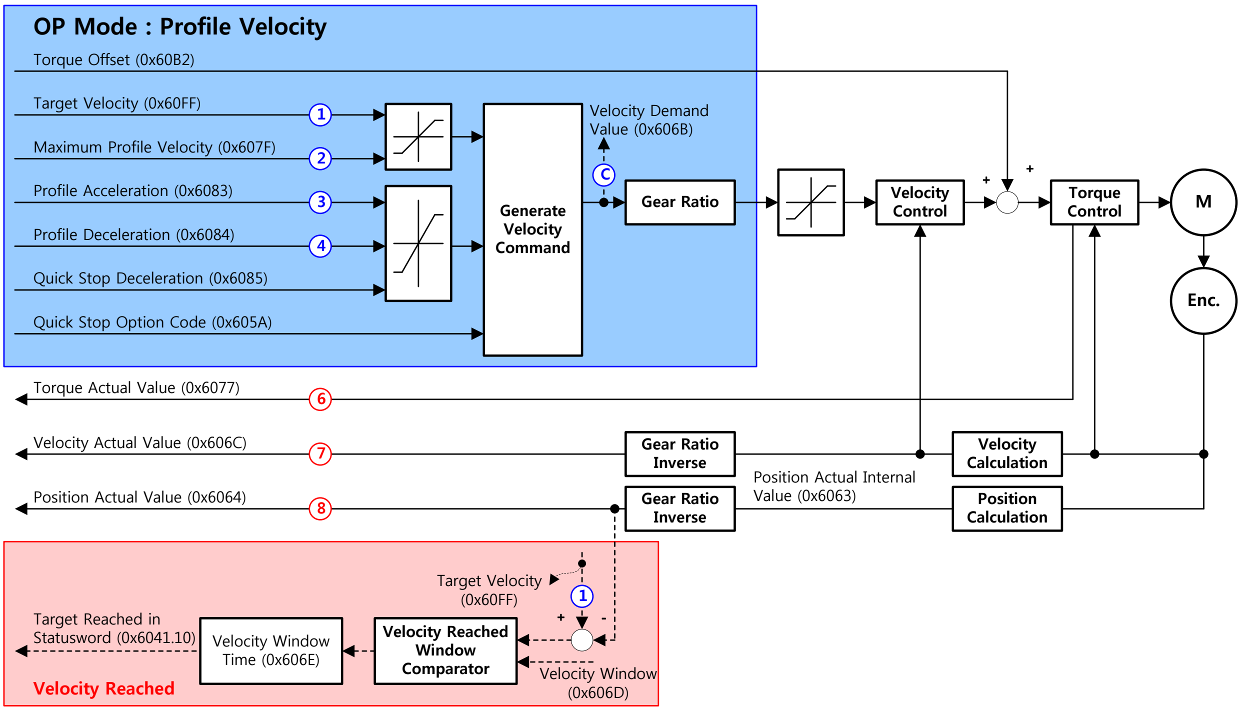


4.4.2 Profile Velocity Mode

Unlike CSV mode, which receives the target velocity that is renewed at every PDO update cycle from the upper level controller, in Profile Velocity (PV) mode, the drive generates a velocity profile internally up to the target velocity (0x60FF) using the profile acceleration (0x6083) and deceleration (0x6084) in order to control its velocity.

At this time, the max. profile velocity (0x607F) limits the maximum velocity.

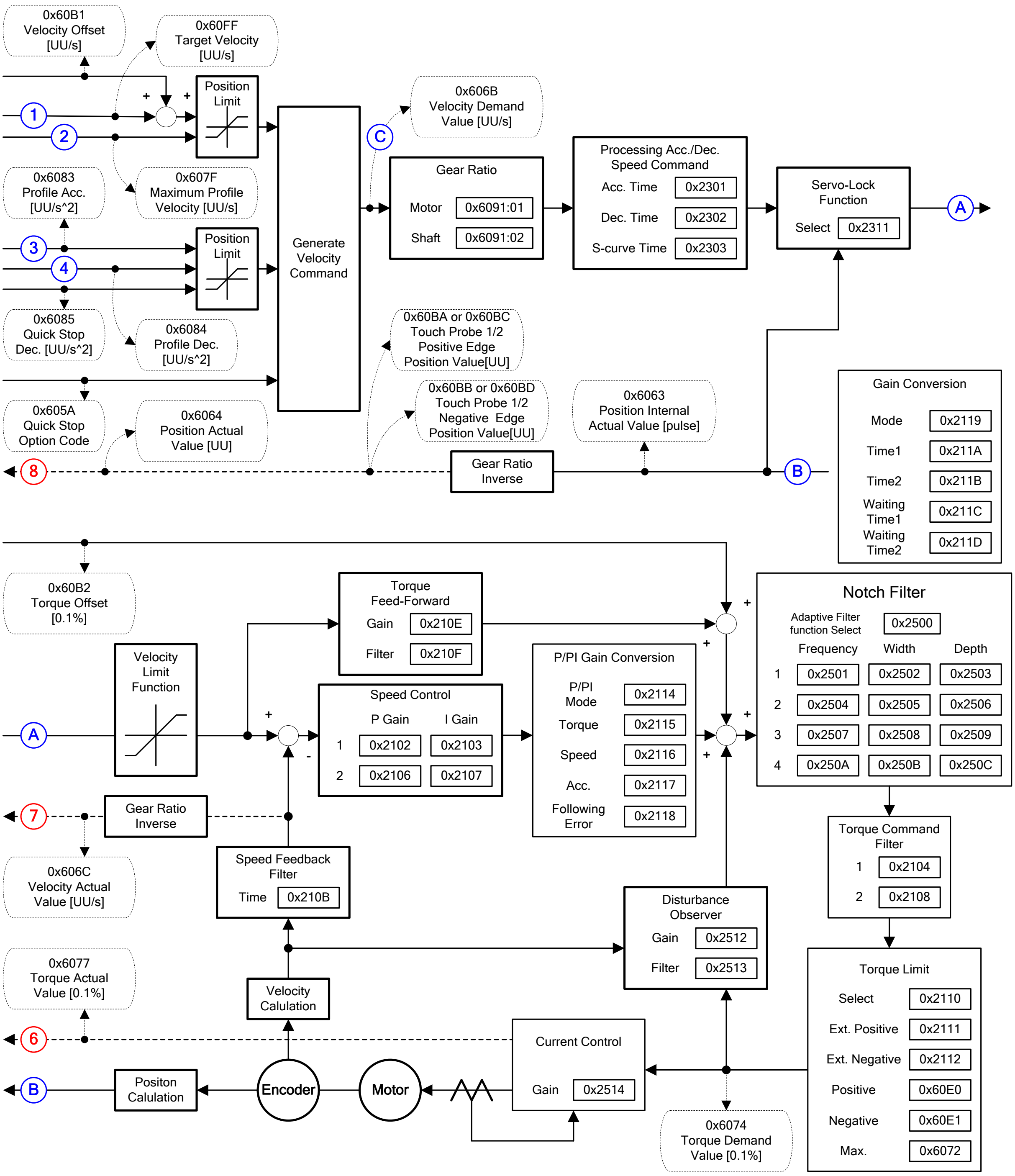
The block diagram of the PV mode is shown below.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x60FF	-	Target Velocity	DINT	RW	Yes	UU/s
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6083	-	Profile Acceleration	UDINT	RW	No	UU/s²
0x6084	-	Profile Deceleration	UDINT	RW	No	UU/s²
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s²
0x605A	-	Quick Stop Option Code	INT	RW	No	-
0x60B1	-	Velocity Offset	DINT	RW	Yes	UU/s
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x606B	-	Velocity Demand Value	DINT	RO	Yes	UU/s
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of PV Mode



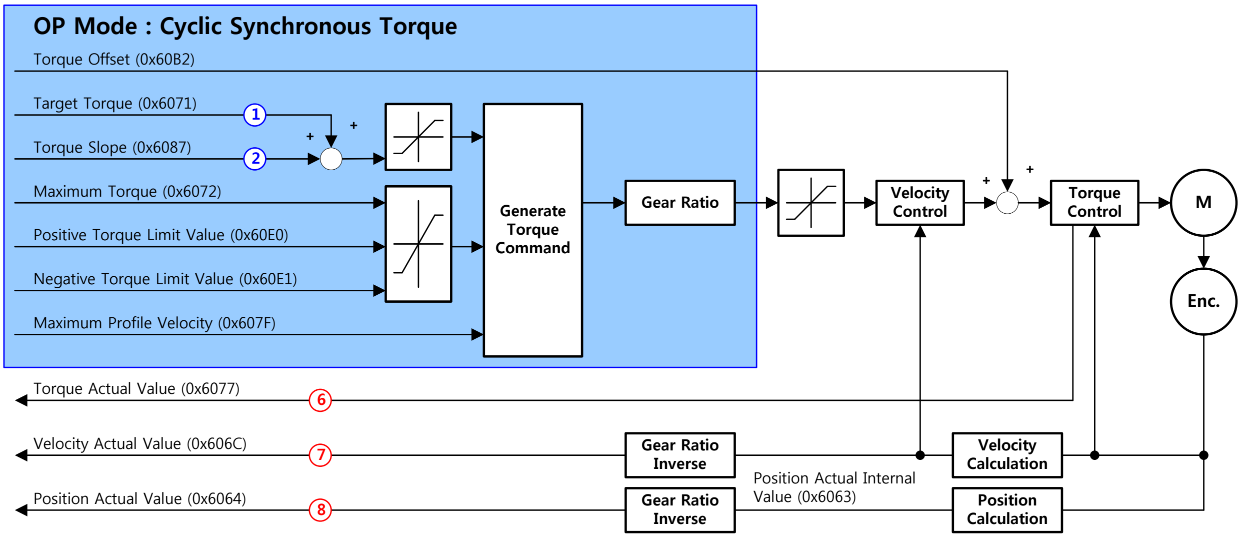
4.5 Torque Control Modes

4.5.1 Cyclic Synchronous Torque Mode

Cyclic Synchronous Torque (CST) mode receives the target torque (0x6071) that is renewed at every PDO update cycle from the upper level controller to control the torque.

This mode allows the upper level controller to calculate the torque offset (0x60B2) that corresponds to the torque feedforward and pass it to the drive.

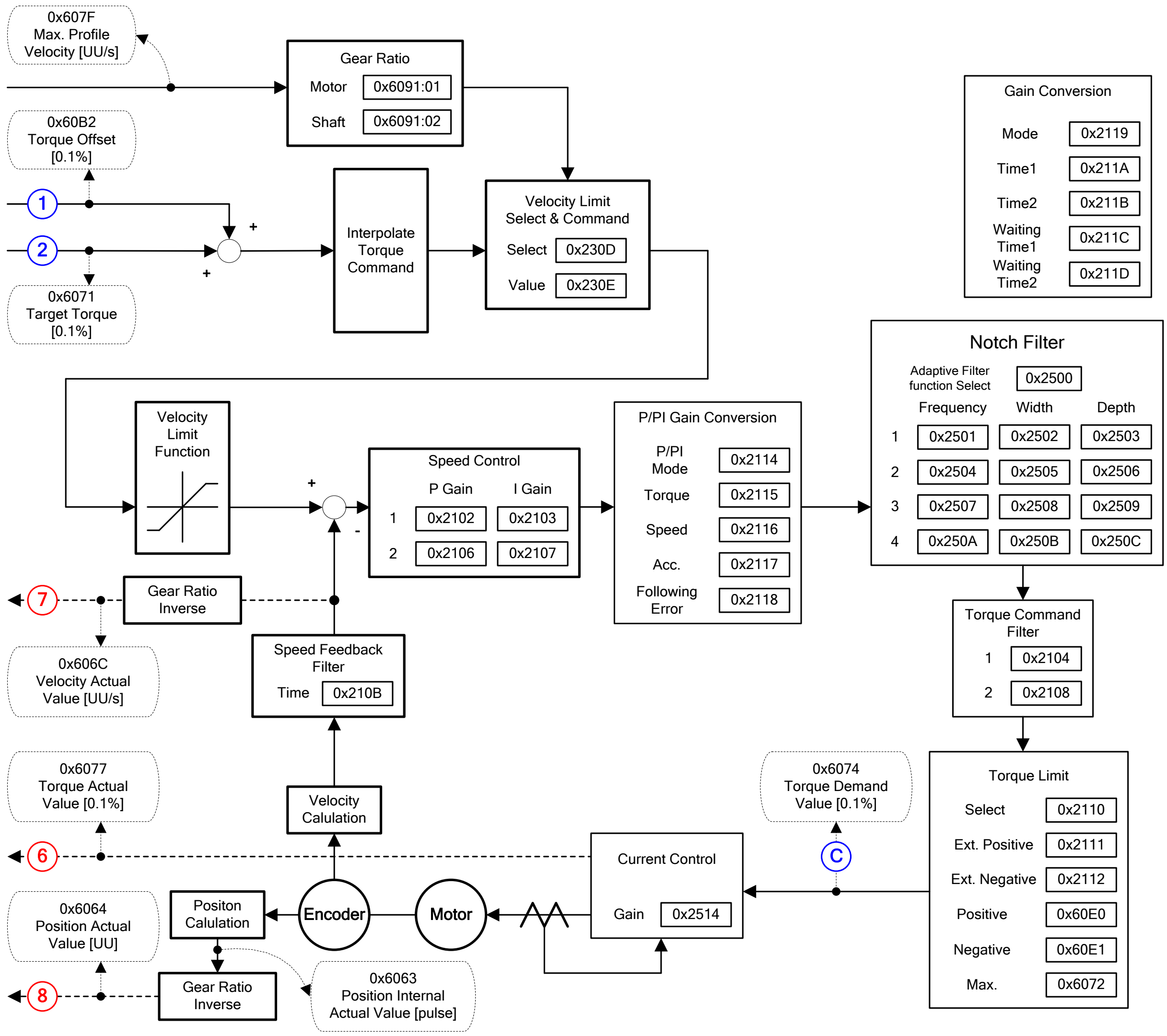
The block diagram of the CST mode is shown below.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Torque	INT	RW	Yes	0.1%
0x6072	-	Maximum Torque	UINT	RW	Yes	0.1%
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x60E0	-	Positive Torque Limit Value	UINT	RW	Yes	0.1%
0x60E1	-	Negative Torque Limit Value	UINT	RW	Yes	0.1%
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x6074	-	Torque Demand Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of CST Mode

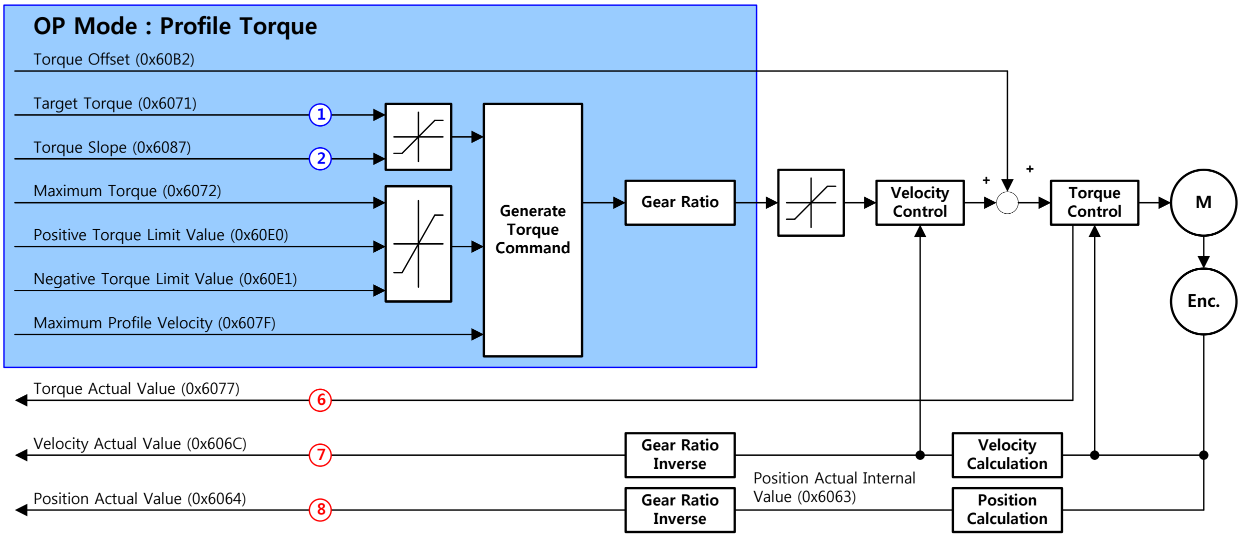


4.5.2 Profile Torque Mode

Unlike CST mode, which receives the target torque that is renewed at every PDO update cycle from the upper level controller, in Profile Torque (PT) mode, the drive generates a torque profile internally up to the target torque (0x6071) by the torque slope (0x6087) in order to control its torque.

At this moment, the torque applied to the motor is limited depending on the Forward/Reverse Torque Limit Value (0x60E0 and 0x60E1) and the Maximum Torque (0x6072) based on its driving direction.

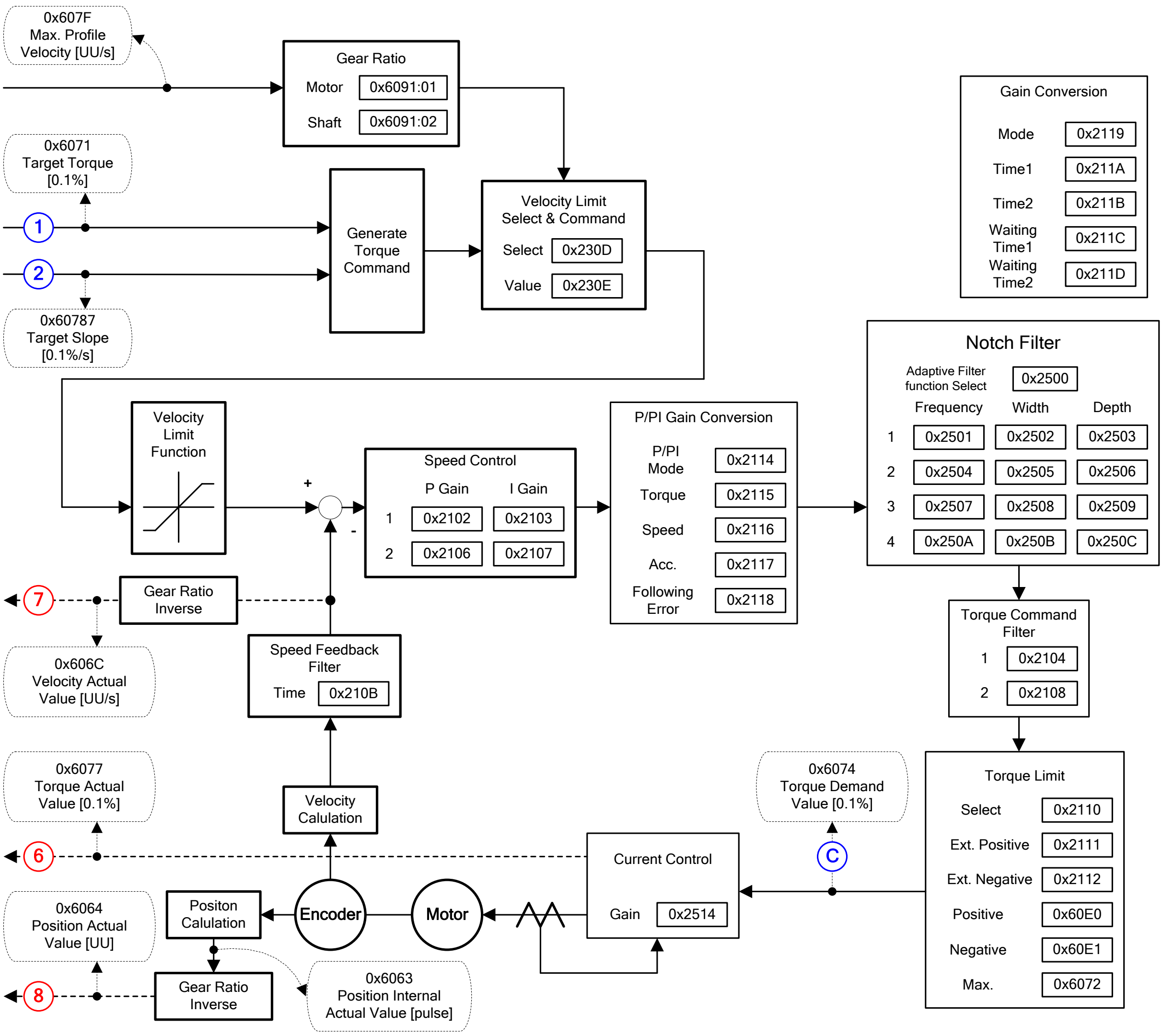
The block diagram of the PT mode is shown below.



■ Related Objects

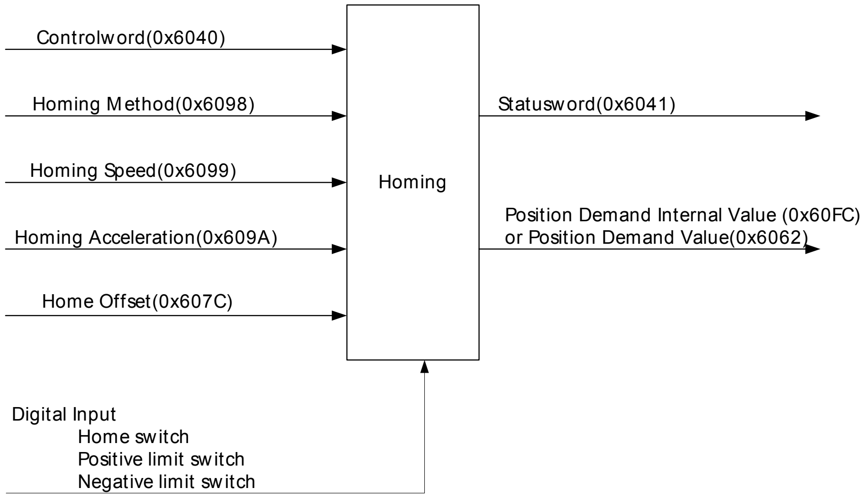
Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Torque	INT	RW	Yes	0.1%
0x6072	-	Maximum Torque	UINT	RW	Yes	0.1%
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6087	-	Torque Slope	UDINT	RW	Yes	0.1%/s
0x60E0	-	Positive Torque Limit Value	UINT	RW	Yes	0.1%
0x60E1	-	Negative Torque Limit Value	UINT	RW	Yes	0.1%
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x6074	-	Torque Demand Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of PT Mode

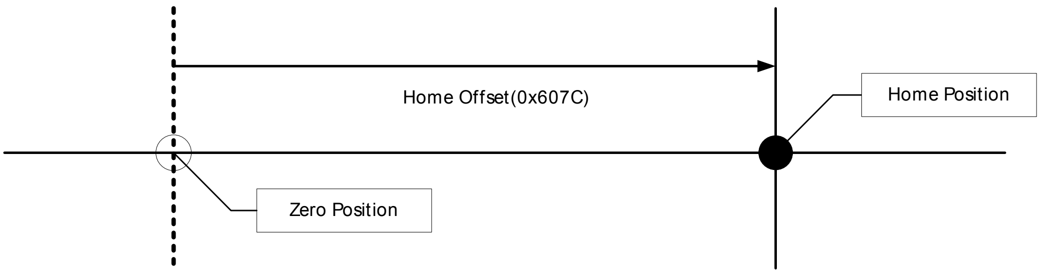


4.6 Homing

This drive provides its own homing function. The figure below represents the relationship between the input and output parameters for the homing mode. You can specify the speed, acceleration, offset, and homing method.



As shown in the figure below, you can set the offset between the home position and the zero position of the machine using the home offset. The zero position indicates a point whose Actual Position Value (0x6064) is zero (0).



4.6.1 Homing Method

The drive supports the following homing methods (0x6098):

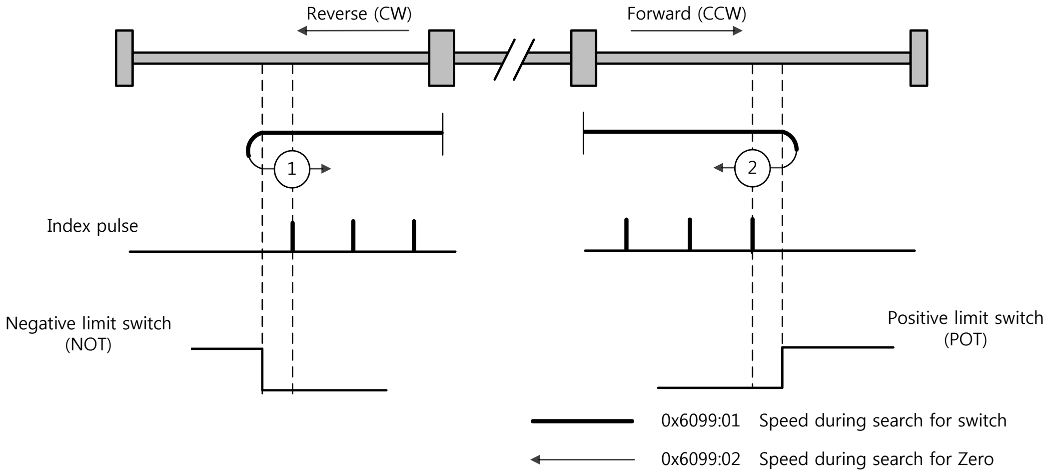
Homing Method (0x6098)	Details
1	The drive returns to the home position with the negative limit switch (NOT) and the Index (Z) pulse while driving in the reverse direction.
2	The drive returns to the home position with the positive limit switch (POT) and the Index (Z) pulse while driving in the forward direction.
7,8,9,10	The drive returns to the home position with the home switch (HOME) and the Index (Z) pulse while driving in the forward direction. When the positive limit switch (POT) is input during homing, the drive will switch its driving direction.

Homing Method (0x6098)	Details
11,12,13,14	The drive returns to the home position with the home switch (HOME) and the Index (Z) pulse while driving in the reverse direction. When the negative limit switch (NOT) is input during homing, the drive will switch its driving direction.
24	The drive returns to the home position with the home switch (HOME) while driving in the forward direction. When the positive limit switch (POT) is input during homing, the drive will switch its driving direction.
28	The drive returns to the home position with the home switch (HOME) while driving in the reverse direction. When the negative limit switch (NOT) is input during homing, the drive will switch its driving direction.
33	The drive returns to the home position with the Index (Z) pulse while driving in the reverse direction.
34	The drive returns to the home position with the Index (Z) pulse while driving in the forward direction.
35	Sets the current position as the origin.
-1	The drive returns to the home position with the negative stopper and the Index (Z) pulse while driving in the reverse direction.
-2	The drive returns to the home position with the positive stopper and the Index (Z) pulse while driving in the forward direction.
-3	The drive returns to the home position with the negative stopper while driving in the reverse direction.
-4	The drive returns to the home position with the positive stopper while driving in the forward direction.

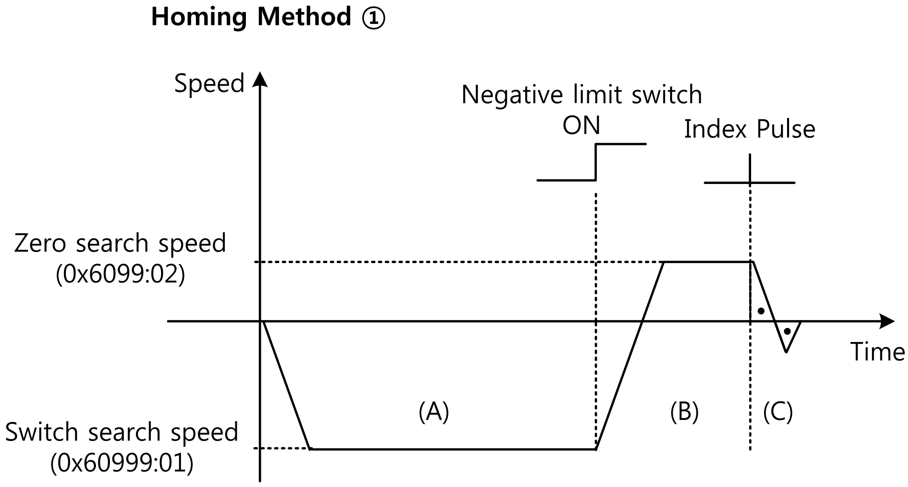
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UNIT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x607C	-	Home Offset	DINT	RW	No	UU
0x6098	-	Homing Method	SINT	RW	Yes	-
0x6099	-	Homing Speed	-	-	-	-
	0	Number of entries	USINT	RO	No	-
	1	Switch Search Speed	UDINT	RW	Yes	UU/s
	2	Zero Search Speed	UDINT	RW	Yes	UU/s
0x609A	-	Homing Acceleration	UDINT	RW	Yes	UU/s^2

■ Homing Methods 1 and 2



For homing using the Homing Method 1, the velocity profile according to the sequence is as follows. See the details below:

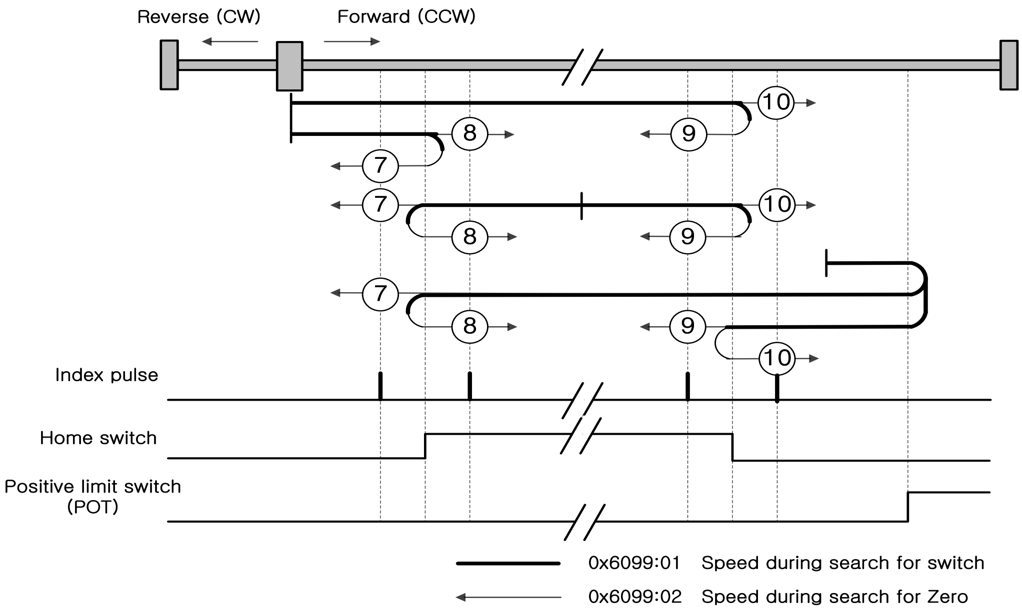


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

(B) When the negative limit switch (NOT) is turned on, the drive switches its direction to the forward direction (CCW), decelerating to the Zero Search Speed.

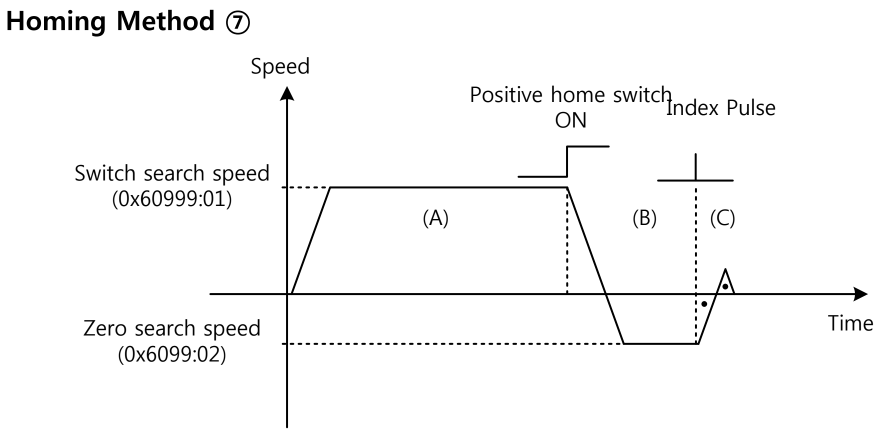
(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

■ Methods 7, 8, 9, and 10



For homing using the Homing Method 7, the velocity profile according to the sequence is as follows. The sequence depends on the relationship between the location of load and the Home switch at homing, which is categorized into three cases as below. For more information, see the details below:

(1) When the Home switch is OFF at startup, and does not meet the limit, during the operation:

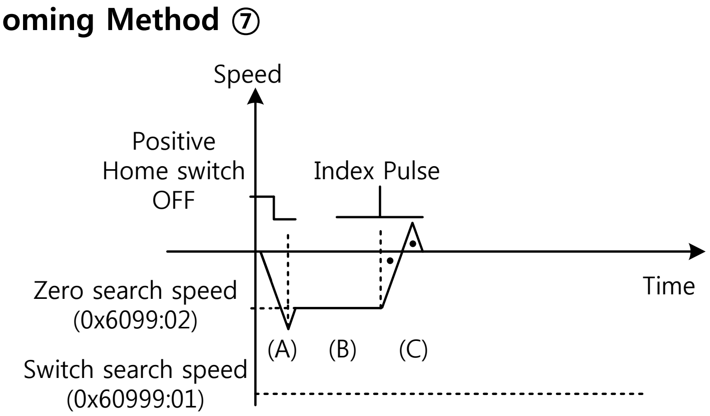


(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

(B) When the Positive Home Switch is turned on, the drive will decelerate to the Zero Search Speed, and then switches its direction to the reverse direction (CW).

(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

(2) When the Home switch is ON at startup:

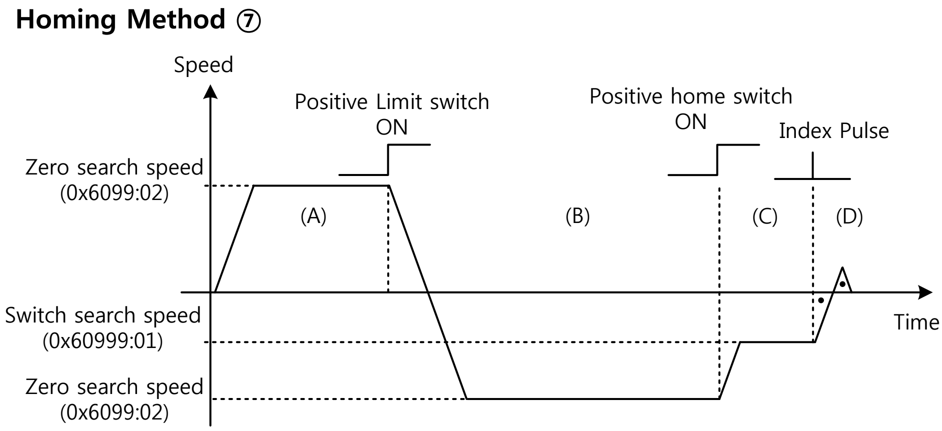


(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Positive Home Switch (CCW). It might not reach the Switch Search Speed depending on the start position of homing.

(B) When the Home switch is turned off, the drive will decelerate to Zero Search Speed, and then continue to operate.

(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

(3) When the Home switch is OFF at startup, and meets the limit during the operation:



(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

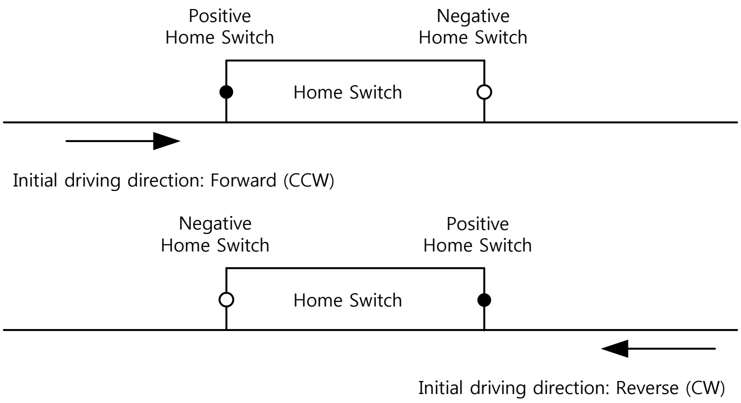
(B) When the positive limit switch (POT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the reverse direction (CW).

(C) When the Positive Home Switch is turned off, the drive will decelerate to Zero Search Speed, and then continue to operate.

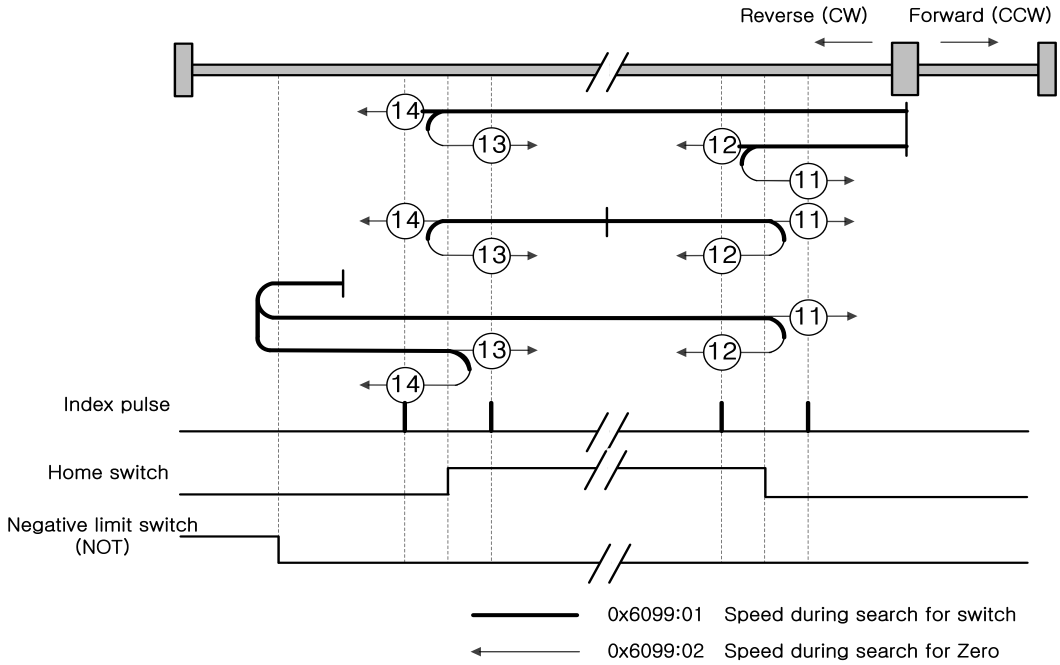
(D) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

The methods from 8 to 10 are nearly identical to the method 7 in terms of the homing sequence. The only differences are the initial driving direction and Home switch polarity.

The Positive Home Switch is determined by the initial driving direction. A Home switch which is encountered in the initial driving direction becomes the Positive Home Switch.

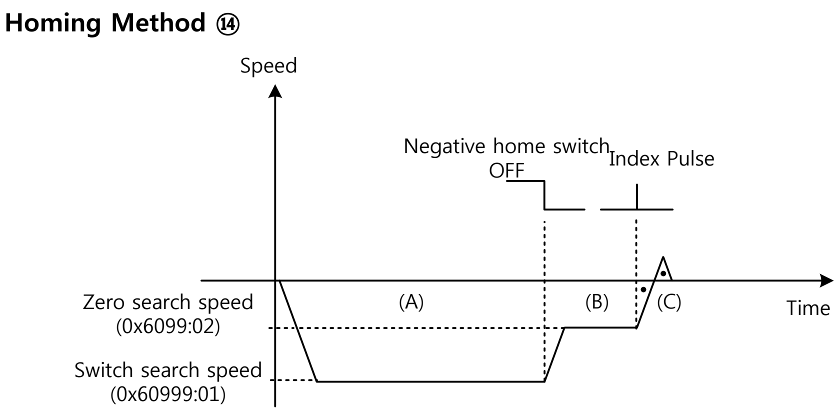


■ Methods 11, 12, 13, and 14



For homing using the Homing Method 14, the velocity profile according to the sequence is as follows. The sequence depends on the relationship between the location of load and the Home switch at homing, which is categorized into three cases as below. For more information, see the details below:

(1) When the Home switch is OFF at startup, and does not meet the limit during the operation:

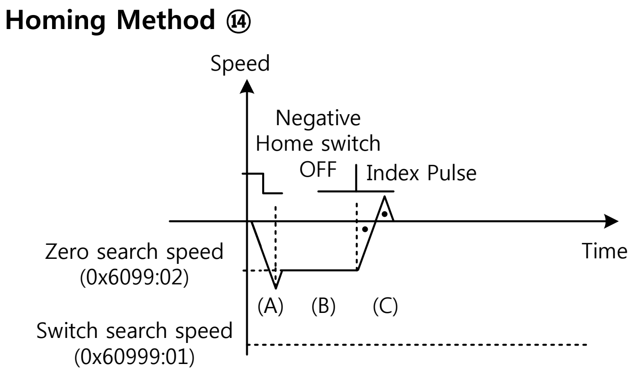


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

(B) When the Negative Home Switch is turned off, the drive will decelerate to Zero Search Speed, and then continue to operate.

(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

(2) When the switch is ON at startup:

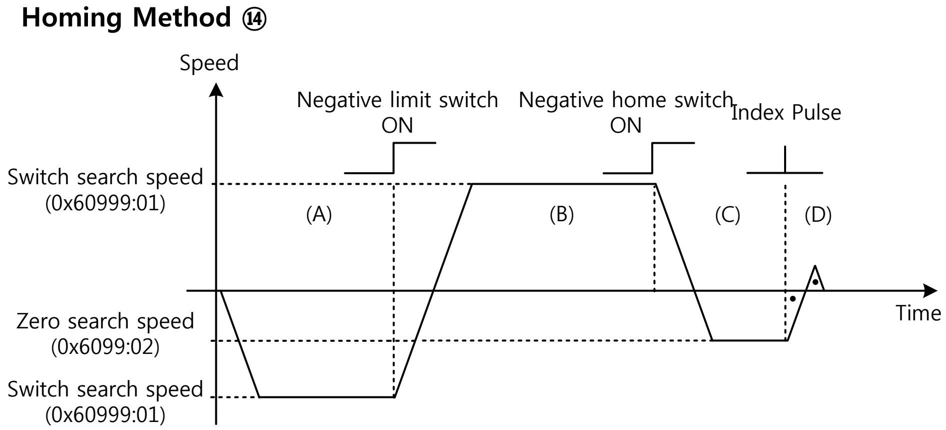


(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Negative Home Switch (CW). It might not reach the Switch Search Speed depending on the start position of homing.

(B) When the Home switch is turned off, the drive will decelerate to Zero Search Speed, and then continue to operate.

(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

(3) When the switch is OFF at startup, and meets the limit during the operation:



(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

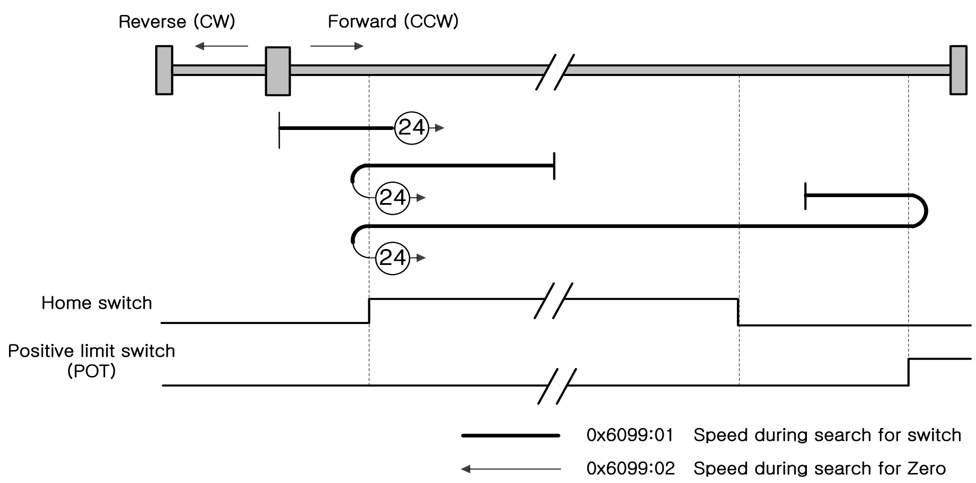
(B) When the negative limit switch (NOT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the forward direction (CCW).

(C) When the Negative Home Switch is turned on, the drive will decelerate to the Zero Search Speed, and then switches its direction to the reverse direction (CW).

(D) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

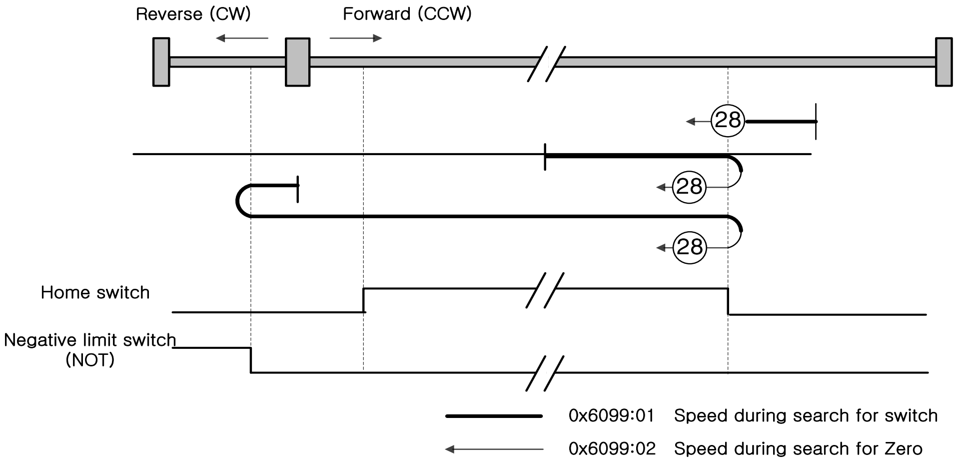
The methods from 11 to 13 are nearly identical to the method 14 in terms of the homing sequence. The only differences are the initial driving direction and Home switch polarity.

■ Method 24



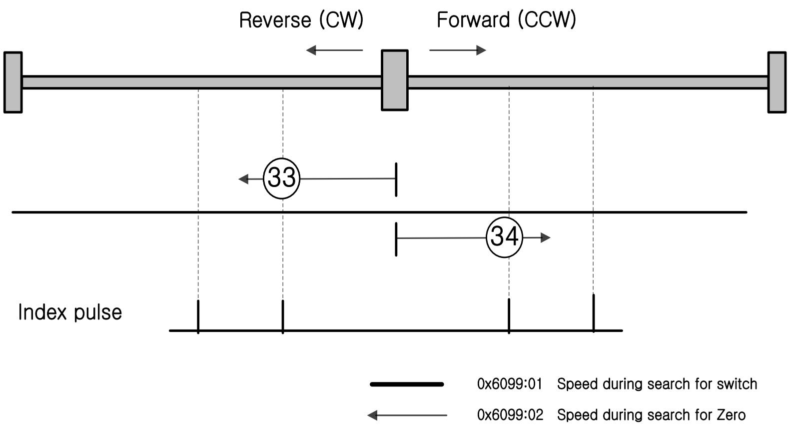
The initial driving direction is forward (CCW), and a point where the Positive Home Switch is turned on becomes the Home position.

■ Method 28



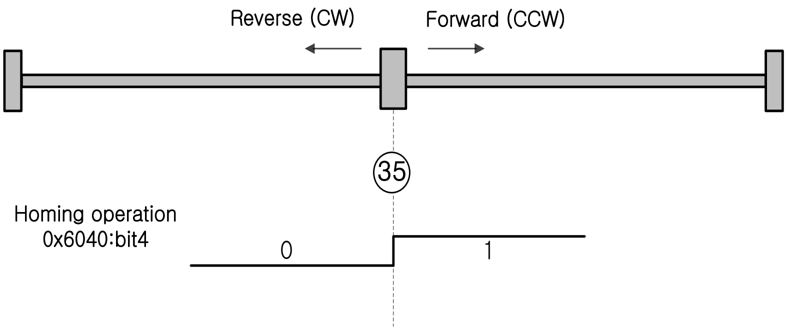
The initial driving direction is reverse (CW), and a point where the Positive Home Switch is turned on becomes the Home position.

■ Method 33 and 34



The initial driving direction is reverse (CW) for the method 33, and forward (CCW) for the method 34. The drive detects the index pulse at the Zero Search Speed.

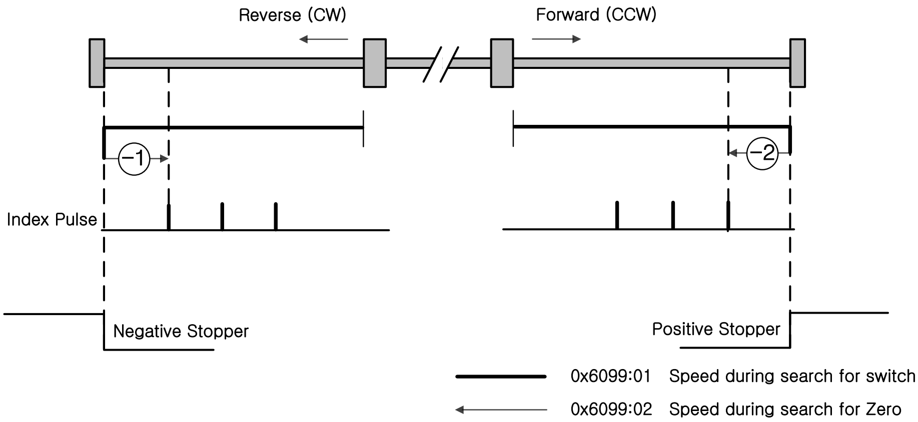
■ Method 35



The current position at startup of homing operation becomes the Home position. This method is used to change the current position to the origin depending on demand of the upper level controller.

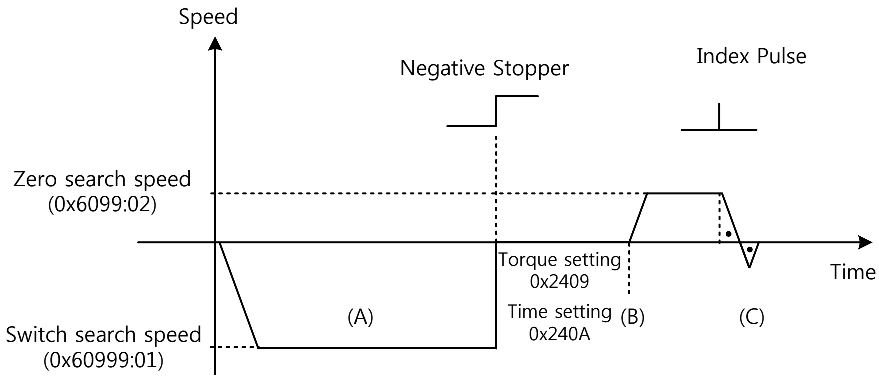
Homing method -1, -2, -3, -4 are other way of homing method different from the standard. It is available when other Home switch is not used,

■ Method -1 and -2



Homing methods -1 and -2 are using Stopper and Index (Z) pulse to home. The velocity profiles depending on the sequence are shown below. For more information, see the details below:

Homing Method -1

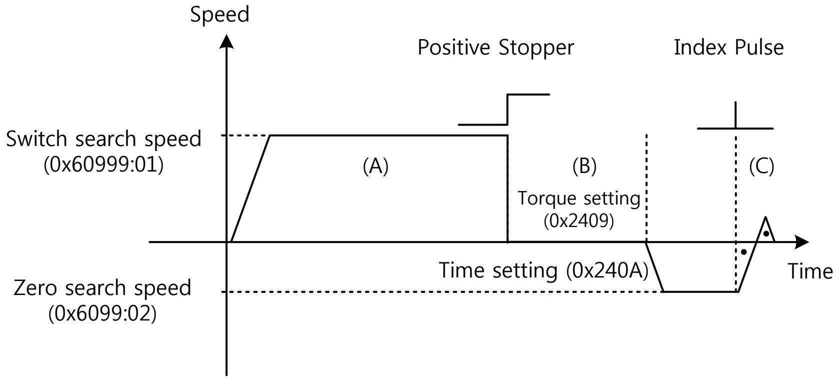


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

(B) When the drive hits the negative stopper, it will stand by according to the torque limit value (0x2409), and the time setting value (0x240A) at the time of homing using stopper before direction switch.

(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

Homing Method -2

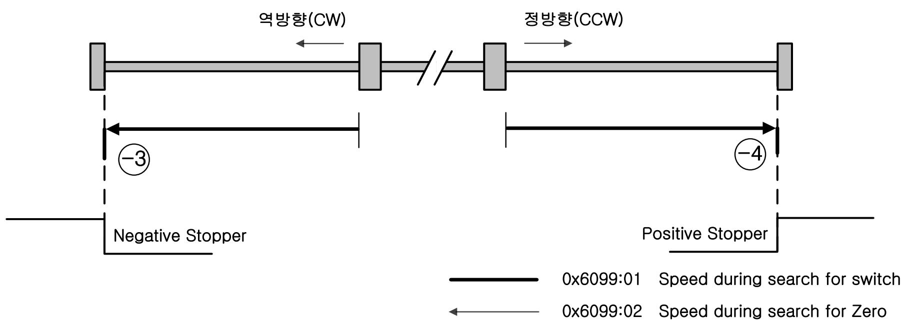


(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

(B) When the drive hits the positive stopper, it will stand by according to the torque limit value (0x2409) and the time setting value (0x240A) at the time of homing using stopper before direction switch.

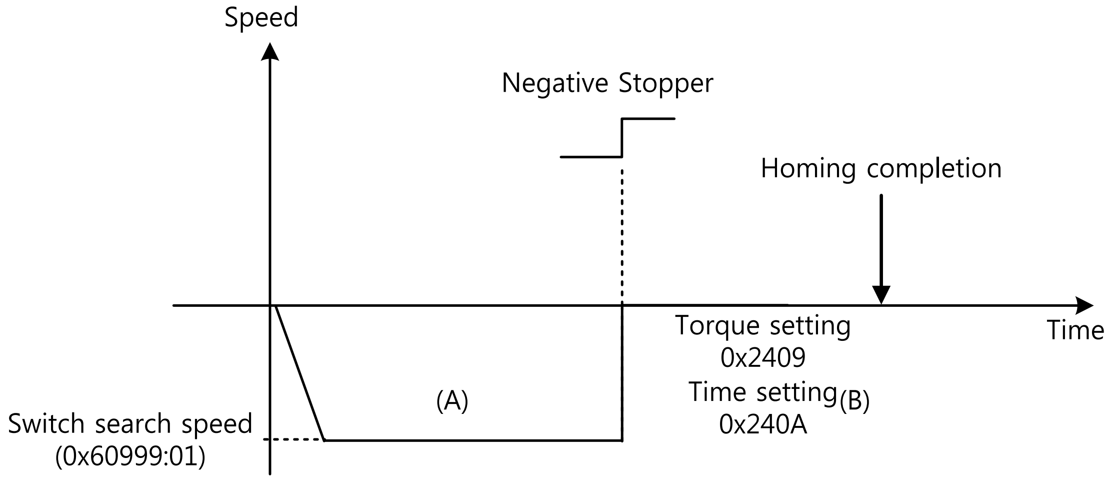
(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

■ Method -3 and -4



Homing method -3 and -4 are using Stopper to home. The velocity profiles depending on the sequence are shown below. For more information see the details below.

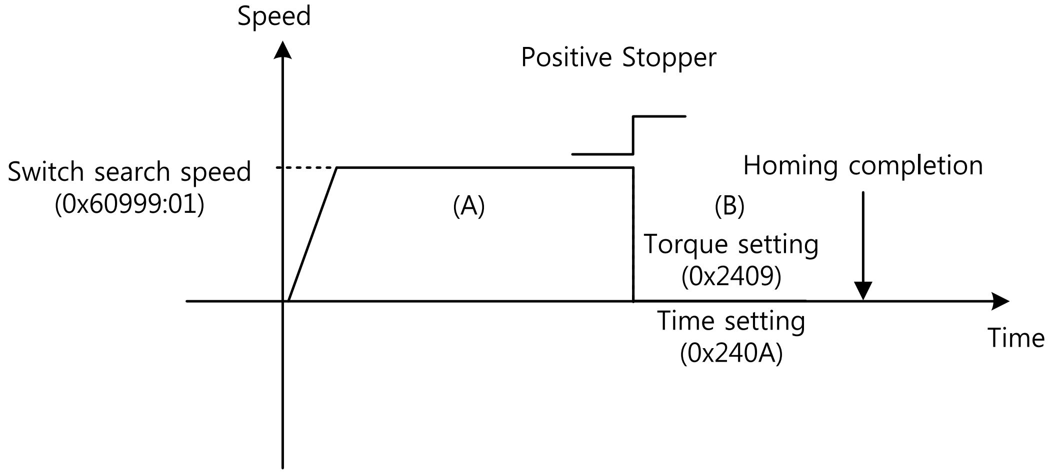
Homing Method ㊂



(A) The initioal driving direction is counter forward (CW), and the drive operates at the Switch Search Speed.

(B) When the drive hits the negative Stopper, it will stand by according to the torque limit value (0x2409), and the time setting value (0x240A) at the time of homing using stopper before direction switch.

Homing Method ㊃



(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

(B) When the drive hits the positive Stopper, it will stand by according to the torque limit value (0x2409), and the time setting value (0x240A) at the time of homing using stopper before direction switch.

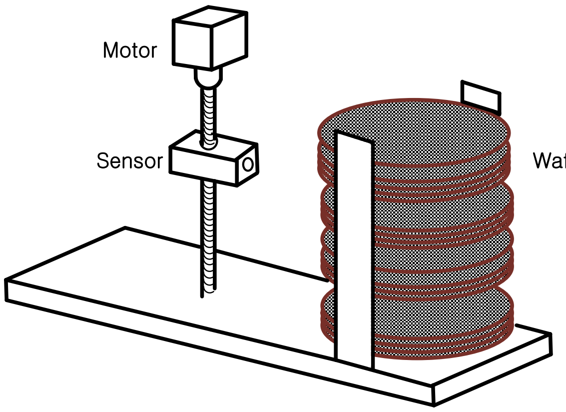
4.7 Touch Probe Function

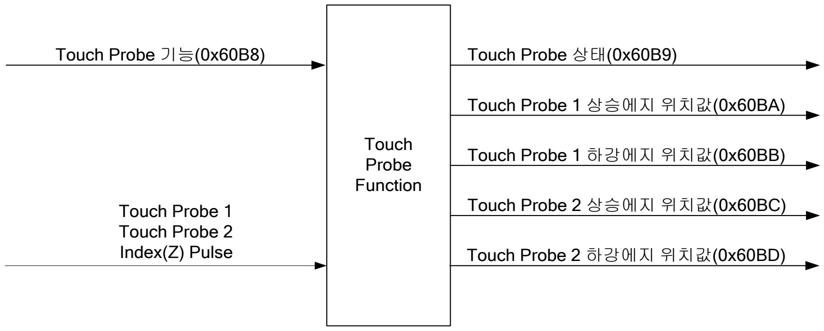
The touch probe is a function that rapidly captures the position value of the encoder with external input (PROBE 1 and 2) signals or the index (Z) pulse of the encoder.

- Example of Touch Probe

Wafer mapper system of wafer transfer robot (WTR)

When wafers are piled up on a wafer stack, the presence of wafers can be determined by scanning the stack once using a mapping sensor. At this time, any unnecessary movement by the robot can be prevented using the value of the wafer loading position, which has been captured rapidly.





The position value of the encoder (Actual Position Value, 0x6064) is latched by the following trigger events according to the setting value. At the same time, 2 channel inputs can be latched independently at the positive/negative edges.

- Triggered by touch probe 1 (I/O, PROBE1)
- Triggered by touch probe 2 (I/O, PROBE2)
- Triggered by the encoder index (Z) pulse

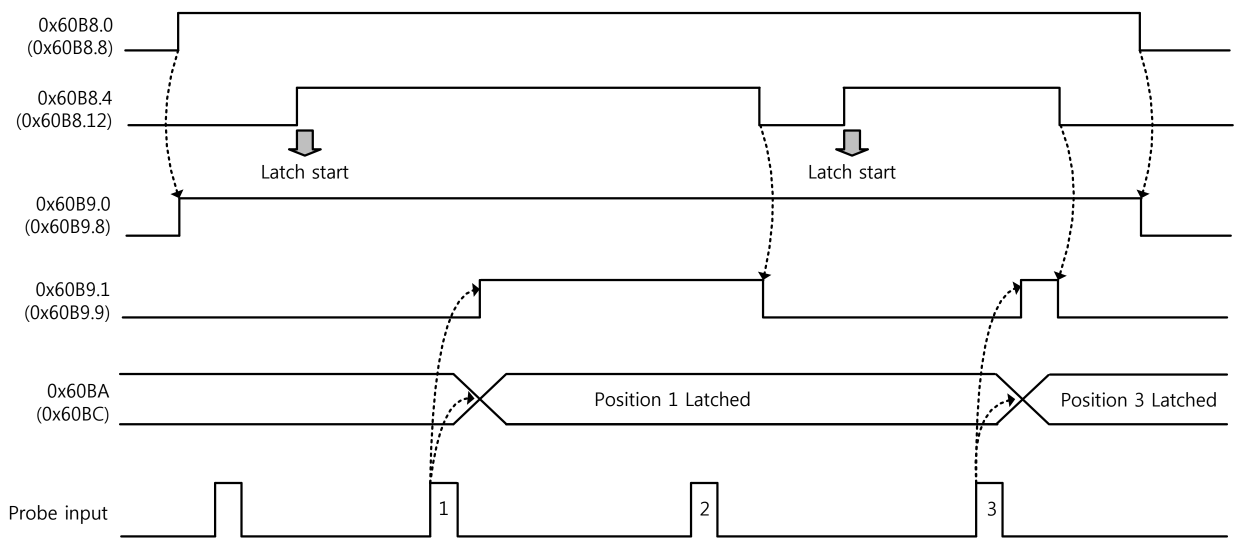
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x60B8	-	Touch Probe Function	UINT	RW	Yes	-
0x60B9	-	Touch Probe Status	UINT	RO	Yes	-
0x60BA	-	Touch Probe 1 Rising Edge Position Value	DINT	RO	Yes	UU
0x60BB	-	Touch Probe 1 Falling Edge Position Value	DINT	RO	Yes	UU
0x60BC	-	Touch Probe 2 Rising Edge Position Value	DINT	RO	Yes	UU
0x60BD	-	Touch Probe 2 Falling Edge Position Value	DINT	RO	Yes	UU

■ Touch Probe Timing Diagram

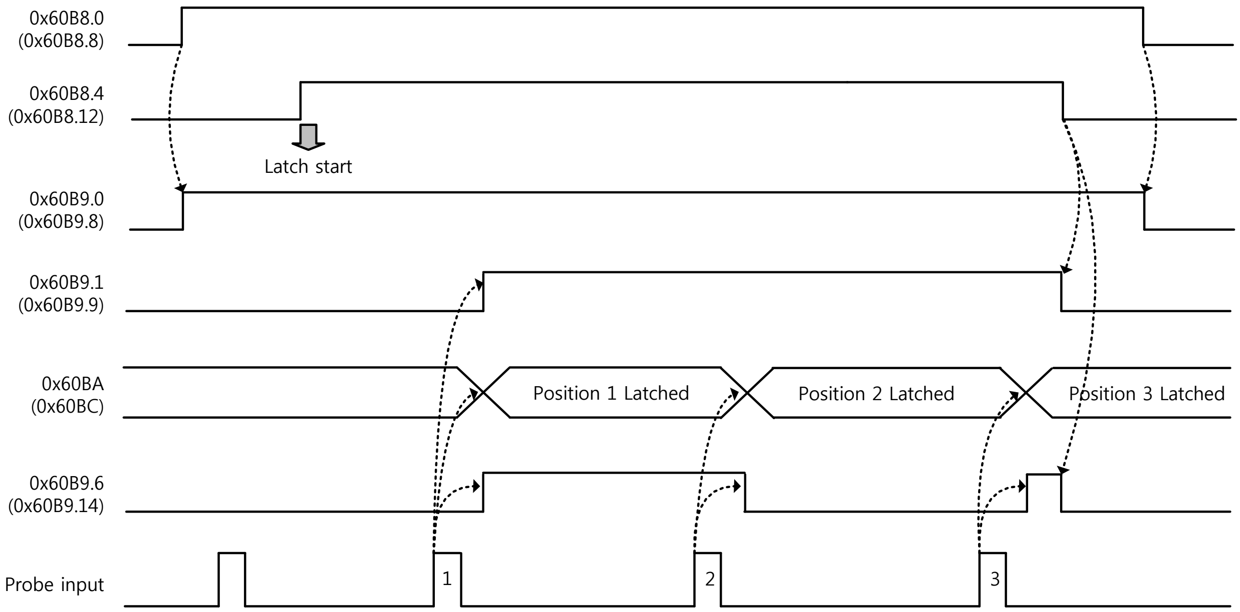
- Single Trigger Mode (0x60B8.1=0, 0x60B8.9=0):

To reset bits 1, 2, 9, and 10 of the touch probe status (0x60B9) in single trigger mode, set the corresponding bits (4, 5, 12, and 13) of the touch probe function (0x60B8) to 0.

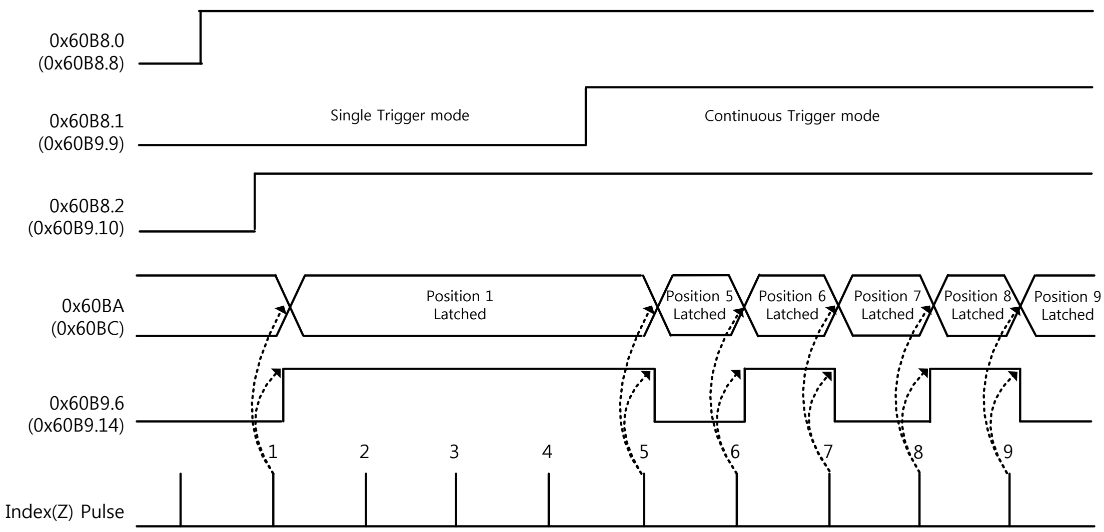


- **Continuous Trigger Mode (0x60B8.1=1, 0x60B8.9=1):**

In continuous trigger mode, bits 6, 7, 14, and 15 of the touch probe status (0x60B9) toggle (0 → 1 or 1 → 0) every time the corresponding input/edge is input.

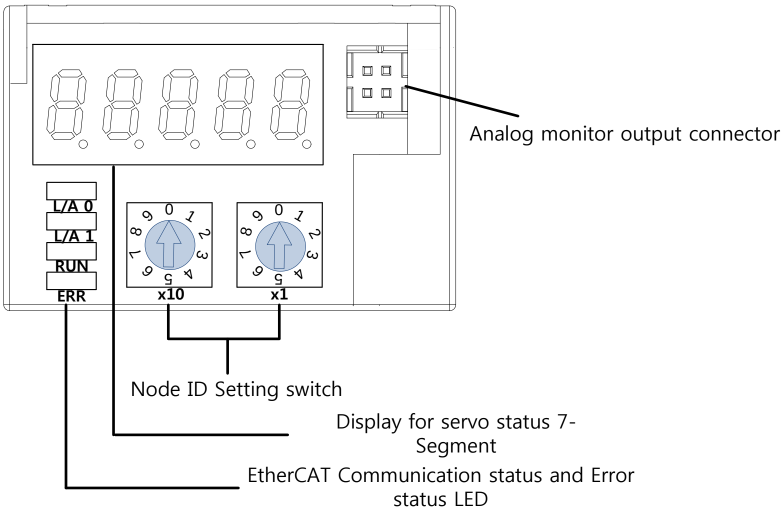


- **Index Pulse Trigger Mode (0x60B8.2=1, 0x60B8.10=1):**



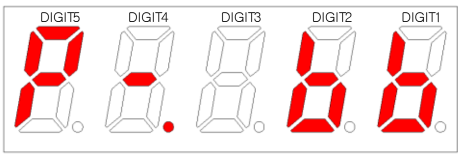
5. Drive Application Functions

5.1 Drive Front Panel

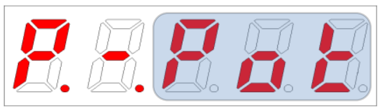


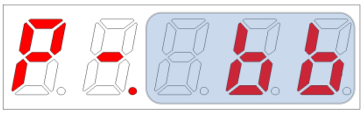
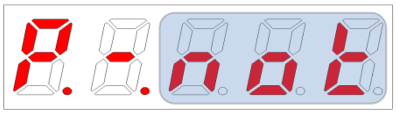
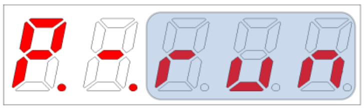
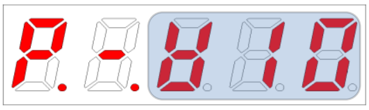
5.1.1 7-Segment for indicating servo status

7-Segment for indicating the servo status consists of 5 digits as shown below, in the order of Digit1→Digit5 from right to left:

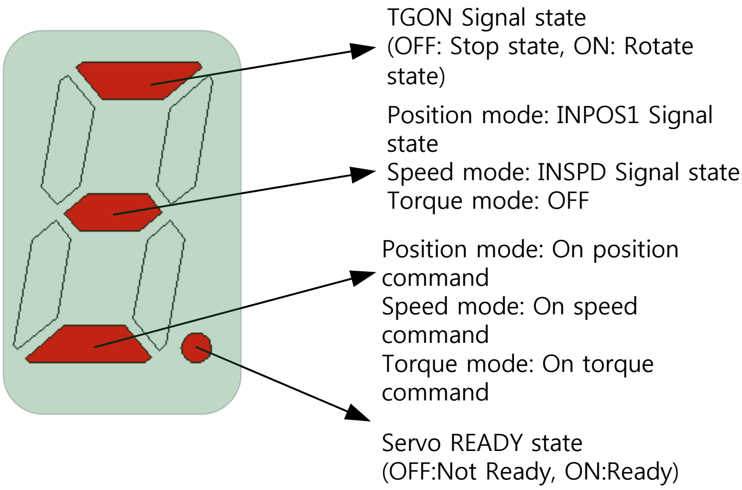


Three digits from Digits 3 to 1 of the 7-Segment represents the drive status as described below if no servo alarm occurs. In case of servo warning, they will indicate the warning status first, rather than other ones.

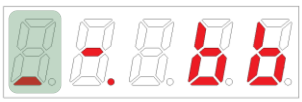
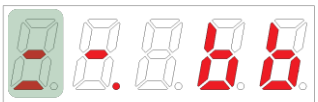
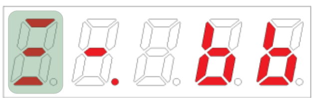
Display of Digit 3 - Digit 1	Status details
 STO connector not connected	 Positive limit sensor input

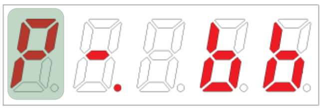
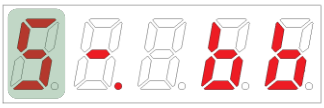
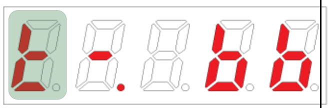
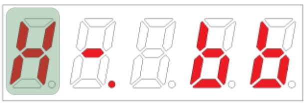
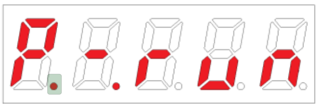
 Servo OFF	 Negative limit sensor input
 Servo ON	 Servo warning W10 occurred (code: 10)

Digit4 indicates the current operation status and servo ready status.

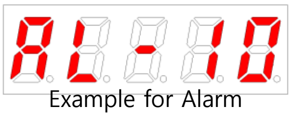


Digit5 indicates state of EtherCAT State Machine, current control mode or state of servo on.

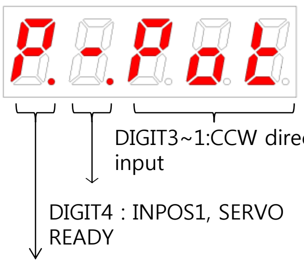
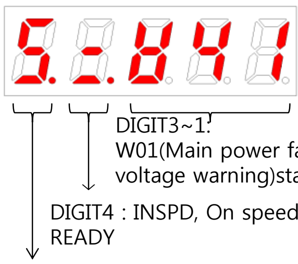
<table>
<tr><td colspan="3">If the status of the EtherCAT State Machine is prior to the operation state (communication setup process):
➔ A preparation status, where a servo operation is not available, indicating that the EtherCAT communication is in progress.</td></tr>
<tr><td>
Init state</td><td>
Pre-Operational state</td><td>
Safe-Operational state</td></tr>
</table>

If the status of the EtherCAT State Machine is the operation state (operation ready): ➔ A status, where a servo operation is available, indicating the operation mode and status.		
 Position control modes: CSP and PP	 Speed control modes: CSV and PV	 Torque control modes: CST and PT
 Homing mode	 (ON: Servo ON, OFF: Servo OFF)	

In case of servo alarm, the Digits 5 to 1 blink and are displayed as below. The Digit 2 and the Digit 1 represent the alarm code. The servo alarm is displayed first, rather than other states.



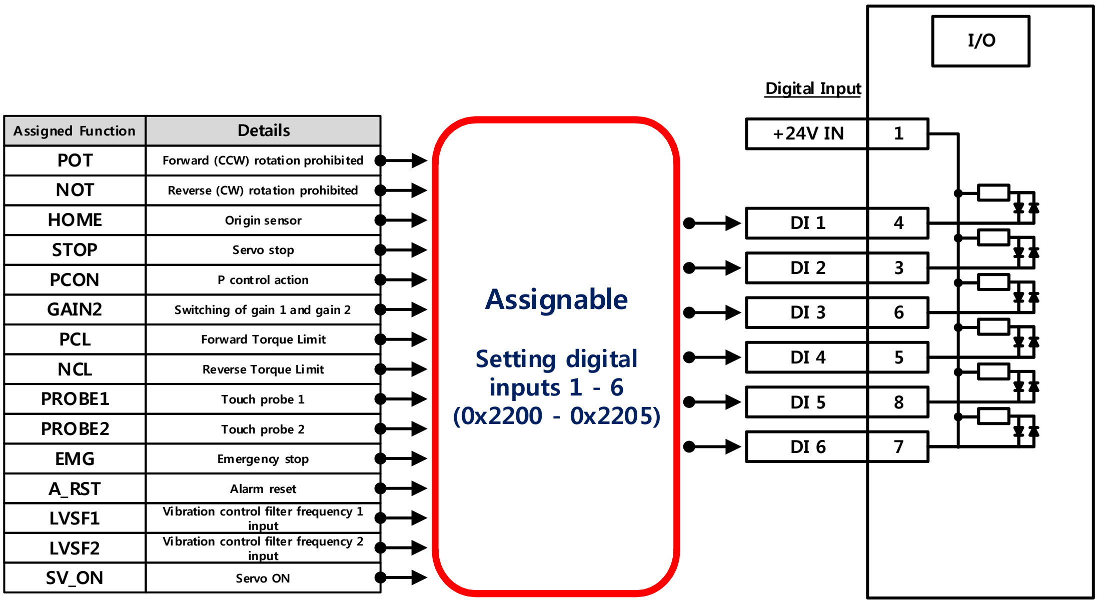
Example for Alarm state
AL-10 (IPM Fault)

Ex. 1) Limit signal input	Ex. 2) Servo warning triggered
 DIGIT3~1:CCW direction Limit input DIGIT4 : INPOS1, SERVO READY DIGIT5 : Position mode, SERVO ON	 DIGIT3~1: W01(Main power failure)+W40(Low voltage warning)state DIGIT4 : INSPD, On speed command, SERVO READY DIGIT5 : SPEED CONTROL MODE, SERVO ON

5.2 Settings for Input/Output Signals

5.2.1 Assignments for Digital Input Signals

You can set the digital input signal function and input signal level of the I/O connector. As shown in the figure below, you can arbitrarily assign up to 6 input functions, out of 15 functions, to digital input signals 1 - 6 for use:



■ **Related Objects**

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2200	-	Digital Input Signal 1 Configuration	UINT	RW		-
0x2201	-	Digital Input Signal 2 Configuration	UINT	RW		-
0x2202	-	Digital Input Signal 3 Configuration	UINT	RW		-
0x2203	-	Digital Input Signal 4 Configuration	UINT	RW		-
0x2204	-	Digital Input Signal 5 Configuration	UINT	RW		-
0x2205	-	Digital Input Signal 6 Configuration	UINT	RW		-

Set the digital input signal function and input signal level of the I/O connector. Select signals to assign with bits 7 - 0, and set the signal level to bit 15.

Bit	Setting details
15	Signal input level settings (0: contact A, 1: contact B)
14~8	Reserved
7~0	Input signal assignments

Settings	Assignable input signals
0x00	Not assigned
0x01	POT
0x02	NOT
0x03	HOME
0x04	STOP
0x05	PCON
0x06	GAIN2
0x07	PCL
0x08	NCL
0x09	PROBE1
0x0A	PROBE2
0x0B	EMG
0x0C	ARST
0x0D	LVSF1
0x0E	LVSF2
0x0F	SVON

■ Example of Assigning Digital Input Signals

The following table shows an example of assigning input signals. Verify the settings from 0x2200 to 0x2205.

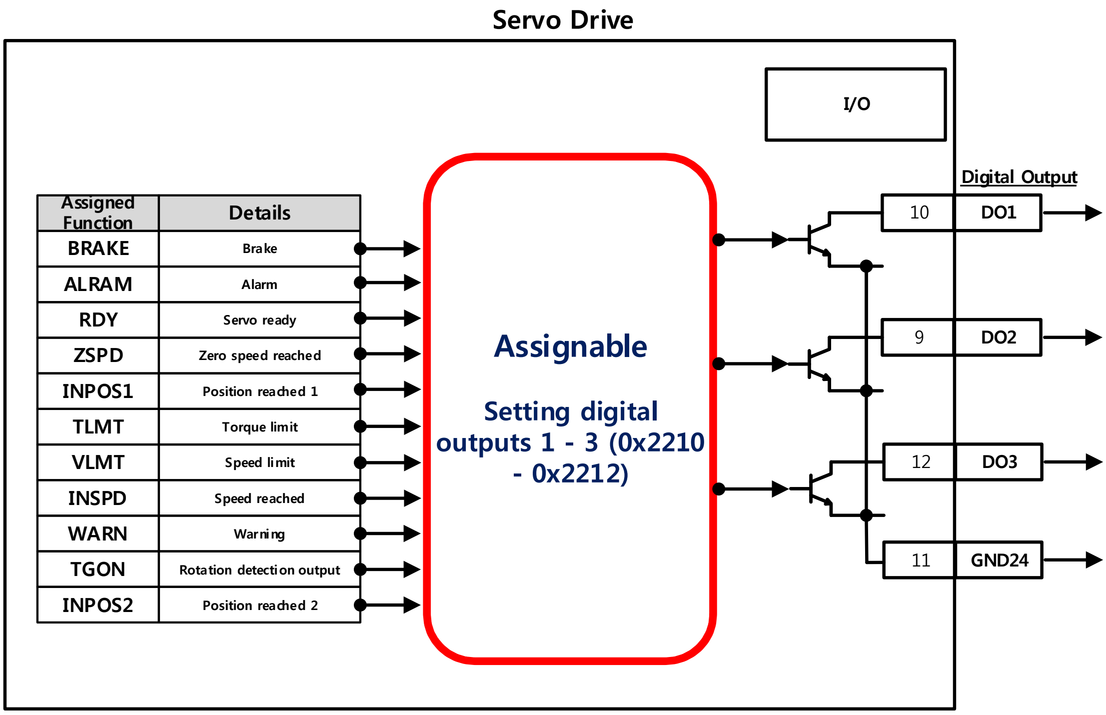
DI#1	DI#2	DI#3	DI#4	DI#5	DI#6
POT (Contact B)	NOT (Contact B)	HOME (Contact A)	STOP (Contact A)	PCON (Contact A)	GAIN2 (Contact A)

Assigned Function		Contact	Details
0x01	POT	B	Forward (CCW) rotation prohibited
0x02	NOT	B	Reverse (CW) rotation prohibited
0x03	HOME	A	Origin sensor
0x04	STOP	A	Servo stop
0x05	PCON	A	P control action
0x06	GAIN2	A	Switching of gain 1 and gain 2
0x07	PCL	-	Forward Torque Limit
0x08	NCL	-	Reverse Torque Limit
0x09	PROBE1	A	Touch probe 1
0x0A	PROBE2	-	Touch probe 2
0x0B	EMG	-	Emergency stop
0x0C	ARST	A	Alarm reset
0x0D	LVSF1	-	Vibration control filter 1
0x0E	LVSF2	-	Vibration control filter 2
0x0F	SVON		Servo ON

I/O (pin number)	Parameter	Bit		Settings	Details
		15	7~0		
DI # 1 (11)	0x2200	1	0x01	0x8001	POT (Contact B)
DI # 2 (12)	0x2201	1	0x02	0x8002	NOT (Contact B)
DI # 3 (7)	0x2202	0	0x03	0x0003	HOME (Contact A)
DI # 4 (8)	0x2203	0	0x04	0x0004	STOP (Contact A)
DI # 5 (13)	0x2204	0	0x05	0x0005	PCON (Contact A)
DI # 6 (14)	0x2205	0	0x06	0x0006	GAIN2 (Contact A)

5.2.2 Assignment of Digital Output Signals

You can set the digital output signal function and output signal level of the I/O connector. As shown in the figure below, you can arbitrarily assign up to 3 output functions, out of 11 functions, to the digital output signals 1 - 3 for use:



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2210	-	Digital Output Signal 1 Setting	UINT	RW		-
0x2211	-	Digital Output Signal 2 Setting	UINT	RW		-
0x2212	-	Digital Output Signal 3 Setting	UINT	RW		-
0x2213	-	Digital Output Signal 4 Setting	UINT	RW		-

Assign the functions of digital output signal 1 of I/O and set the output signal level. Select signals to assign with bits 7 - 0, and set the signal level to the bit 15.

Bit	Setting details
15	Set signal output level (0: contact A, 1: contact B).
14~8	Reserved
7~0	Assign output signal.

Setting values	Assignable output signal
0x00	Not assigned
0x01	BRAKE
0x02	ALARM
0x03	RDY
0x04	ZSPD
0x05	INPOS1
0x06	TLMT
0x07	VLMT
0x08	INSPD
0x09	WARN
0x0A	TGON
0x0B	INPOS2

■ Examples of Assigning Digital Output Signals

The following table shows examples of assigning output signals. Verify the settings from 0x2210 to 0x2212.

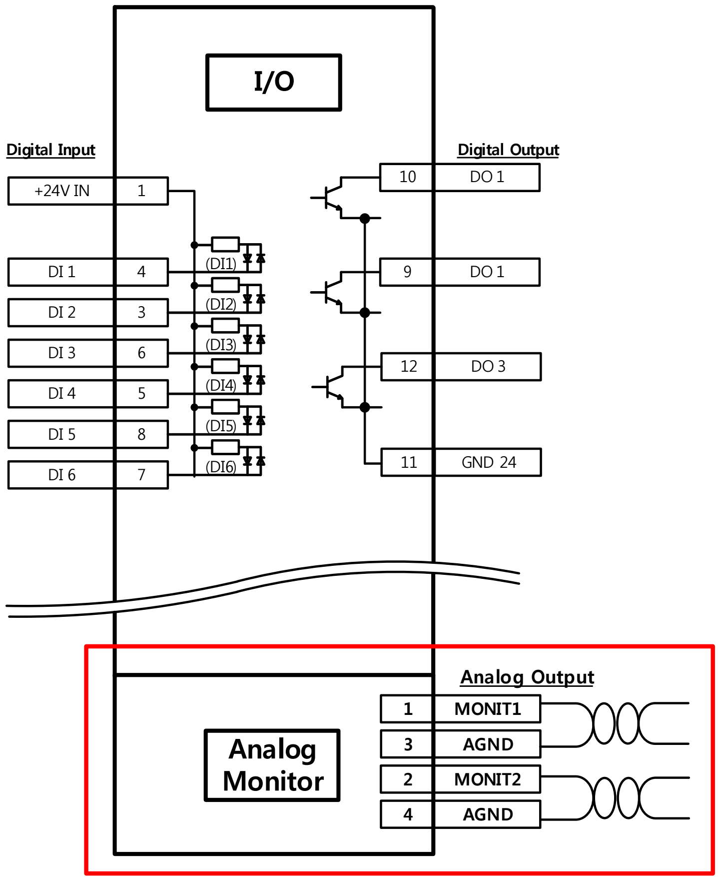
DO#1	DO#2	DO#3
BRAKE (Contact B)	ALARM (Contact B)	RDY (Contact A)

Assigned Function		Contact	Details
0x01	BRAKE	B	Brake
0x02	ALARM	B	Alarm
0x03	RDY	A	Servo ready
0x04	ZSPD	-	Zero speed reached
0x05	INPOS1	A	Position reached 1
0x06	TLMT	-	torque limit
0x07	VLMT	-	Speed limit
0x08	INSPD	-	Speed reached
0x09	WARN	-	Warning
0x0A	TGON	-	Rotation detection output
0x0B	INPOS2	-	Position reached 2

CN1 (pin number)	Parameter	Bit		Settings	Details
		15	7~0		
DO # 1 (10)	0x2210	1	0x01	0x8001	BRAKE (Contact B)
DO # 2 (9)	0x2211	1	0x02	0x8002	ALARM (Contact A)
DO # 3 (12)	0x2212	0	0x03	0x0003	RDY (Contact A)

5.2.3 Assignment of Analog Output Signals

Two channels of analog monitor outputs are provided to adjust drive gain or monitor internal status variables.

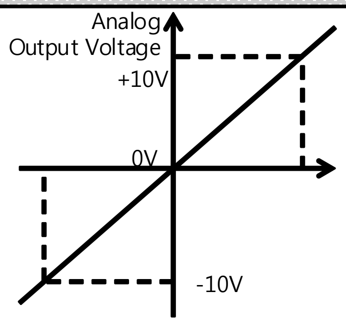
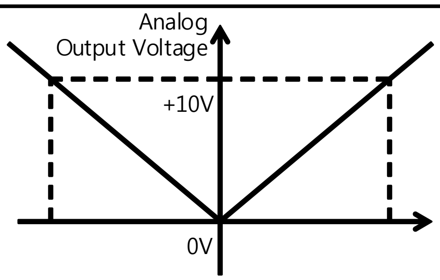


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2220	-	Analog Monitor Output Mode	UINT	RW	No	-
0x2221	-	Analog Monitor Channel 1 Configuration	UINT	RW	No	-
0x2222	-	Analog Monitor Channel 2 Configuration	UINT	RW	No	-
0x2223	-	Analog Monitor Channel 1 Offset	DINT	RW	No	-
0x2224	-	Analog Monitor Channel 2 Offset	DINT	RW	No	-
0x2225	-	Analog Monitor Channel 1 Scale	UDINT	RW	No	-
0x2226	-	Analog Monitor Channel 2 Scale	UDINT	RW	No	-

- Analog monitor output mode settings (0x2220)

The output range of the analog monitor is from -10 V to +10 V. If the setting is 1, take the absolute value of the output so the output values is only positive.

Settings	Details	Description
0	Output as negative/ positive values	
1	Output only positive values	

- Analog monitor channel 1 setting (0x2221)

This configures the monitoring variables to be output to analog monitor output channel 1.

Settings	Displayed item	Unit
0x00	Speed feedback	rpm
0x01	Speed command	rpm
0x02	Speed error	rpm
0x03	Torque feedback	%
0x04	Torque command	%
0x05	Position error	pulse
0x06	Accumulated operation overload	%
0x07	DC link voltage	V
0x08	Accumulated Regeneration Overload	%
0x09	Encoder single-turn data	pulse
0x0A	Inertia ratio	%
0x0B	Full-Closed Positional Error	UU
0x0C	Drive temperature 1	℃
0x0D	Drive temperature 2	℃
0x0E	Encoder temperature 1	℃
0x0F	Hall signal	-
0x10	U-phase current	A

0x11	V-phase current	A
0x12	W-phase current	A
0x13	Actual position value	UU
0x14	Target position value	UU
0x15	Position command speed	rpm, mm/s
0x16	Hall U signal	-
0x17	Hall V signal	-
0x18	Hall W signal	-

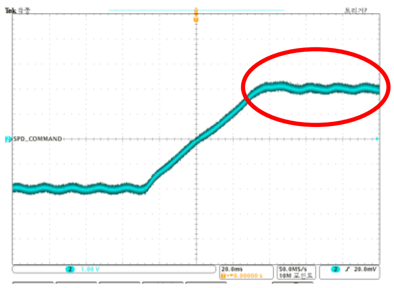
The voltage is calculated as shown below during the analog monitor output:

Output voltage for channel 1 (V) = [Monitoring signal value (0x2221) – Offset (0x2203)] / Scale (0x2205)

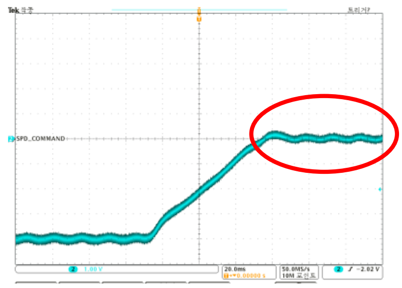
Output voltage for channel 2 (V) = [Monitoring signal value (0x2222) – Offset (0x2204)] / Scale (0x2206)

■ Setting Example

The following shows an example of monitoring ripples during the 1000 rpm operation of a speed feedback signal:

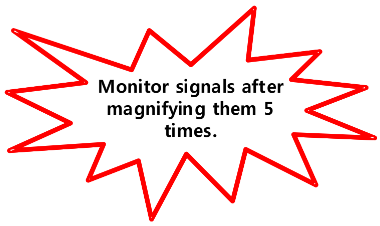


Output offset: 0 rpm
Output scale: 500rpm/V



Output offset: 1000 rpm
Output scale: 500rpm/V

Output offset: 1000 rpm
Output scale: 100rpm/V



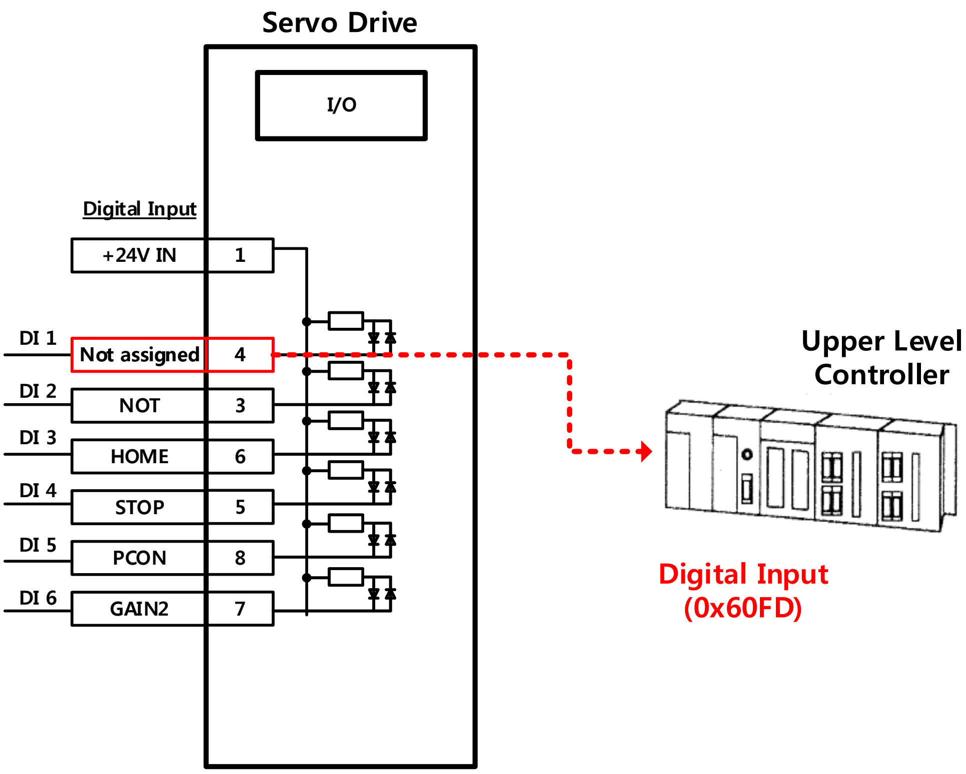
5.2.4 Use of User I/O

User I/O means some of the I/Os provided by the drive are used for controlling the drive itself and for the user's individual purposes. All contacts provided by the input/output connector (I/O) can be used as the User I/O.

If only a few user I/Os are needed, you can wire the drive with the I/O connector rather than a separate I/O module, reducing the cost.

This drive can use up to 8 points for input signals and 4 points for output signals as the user I/O.

■ How to Set the User Input



1) Set the function of the digital input port to be used as the user input to "Not assigned (setting 0)." (Refer to Input Signal Assignments.)

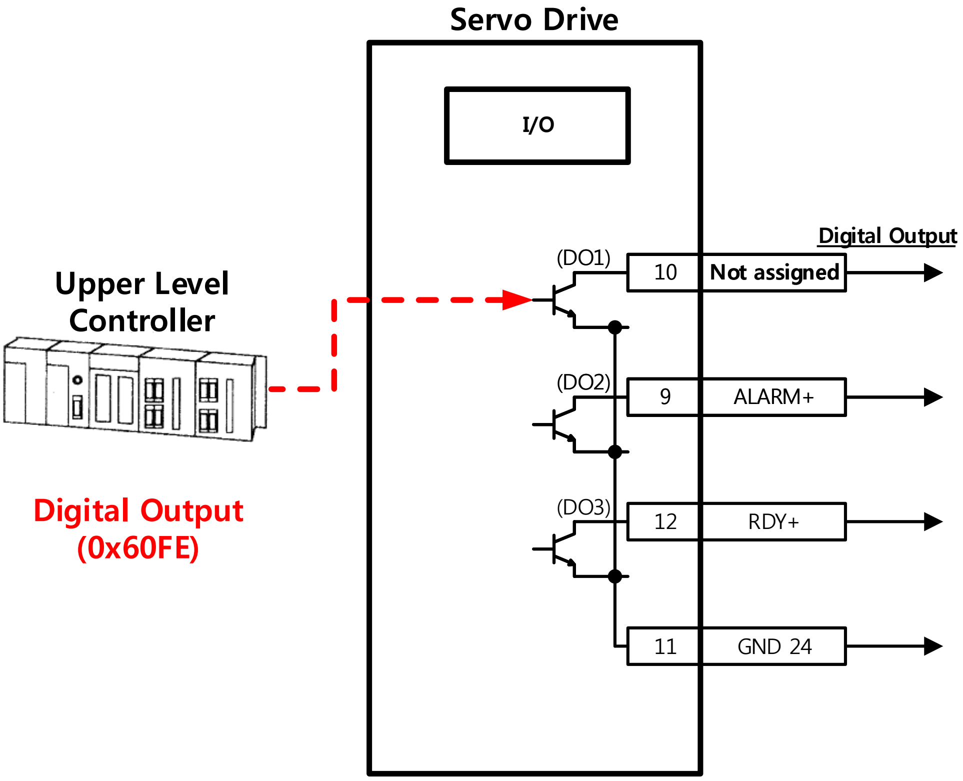
2) Read the values of the corresponding bits (0x60FD.16 - 23) from the digital input (0x60FD) to use them as the user input.

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x60FD	-	Digital Input	UDINT	RO	Yes	-

Bit	Description
0	NOT (negative limit switch)
1	POT (positive limit switch)
2	HOME (origin sensor input)
3 to 15	Reserved
16	DI #1(I/O pin 11), 0:Open, 1:Close
17	DI #2(I/O pin 12), 0:Open, 1:Close
18	DI #3(I/O pin 7), 0:Open, 1:Close
19	DI #4(I/O pin 8), 0:Open, 1:Close
20	DI #5(I/O pin 13), 0:Open, 1:Close
21	DI #6(I/O pin 14), 0:Open, 1:Close
22	Reserved
23	Reserved
24~30	Reserved
31	STO(Safe Torque Off), 0:Close, 1:Open

■ How to Set the User Output



1) Set the function of the digital output port to be used as the user output to "Not assigned (setting 0)." (Refer to Output Signal Assignments.)

2) Set the bits (bits 16 - 19) corresponding to the port used as the user output for the bit mask (0x60FE:02) to Forced Output Enabled (setting 1).

3) Using physical outputs (0x60FE:01), set the value corresponding to the user output for the relevant port (bits 16 - 19) to 0 or 1.

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x60FE	-	Digital Output	-	-	-	-
	0	Number of entries	USINT	RO	No	
	1	Physical outputs	UDINT	RW	Yes	-
	2	Bit mask	UDINT	RW	No	-

They indicate the status of digital outputs.

- **Description of physical outputs**

Bit	Description
0 to 15	Reserved
16	Forced output (0: OFF, 1: ON) of DO #1 (I/O pins 1 and 2) Provided that the relevant bit mask (0x60FE:02.16) is set to 1.
17	Forced output (0: OFF, 1: ON) of DO #2 (I/O pins 17 and 18) Provided that the relevant bit mask (0x60FE:02.17) is set to 1.
18	Forced output (0: OFF, 1: ON) of DO #3 (I/O pins 3 and 4) Provided that the relevant bit mask (0x60FE:02.18) is set to 1.
19	Reserved
20 to 23	Reserved
24	Output status of DO #1 (0: OFF, 1: ON)
25	Output status of DO #2 (0: OFF, 1: ON)
26	Output status of DO #3 (0: OFF, 1: ON)
27	Reserved
28 to 31	Reserved

- **Description of bit mask**

Bit	Description
0 to 15	Reserved
16	Forced output setting (0: Disable, 1: Enable) of DO #1 (I/O pins 1 and 2)
17	Forced output setting (0: Disable, 1: Enable) of DO #2 (I/O pins 17 and 18)
18	Forced output setting (0: Disable, 1: Enable) of DO #3 (I/O pins 3 and 4)
19	Reserved
20 to 31	Reserved

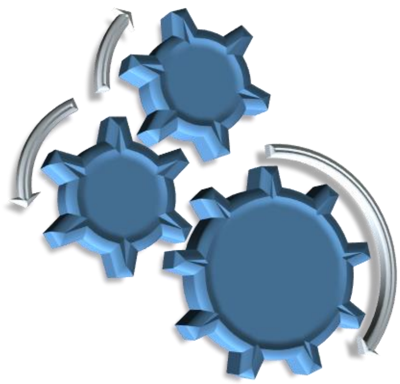
5.3 Electric Gear Setup

5.3.1 When the electric gear

This function sets the electric gear when you want to drive a motor with a user unit, the minimum unit in which the user intends to give a command.

When using the electric gear function of the drive, you cannot utilize the highest resolution of the encoder; thus, if the upper level controller has the function, please use it.

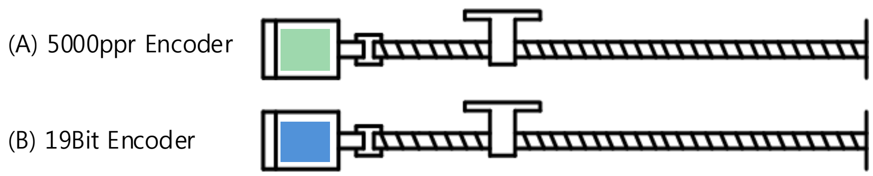
Set the gear ratio within the range of 1000 to 1/1000.



Typically, electric gears are used in the following situations:

(1) When Driving Loads Based on User Unit

You can command the driving based on the user unit, regardless of the encoder (motor) type. For the ball screw type of encoder with a 10 mm pitch, a comparison is given below for 12 mm of movement:



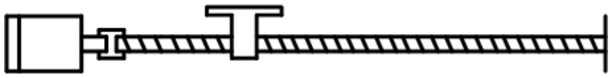
	(A) 5000 ppr encoder	(B) 19-bit (524288 ppr) encoder
When not using the electric gear	5000*12/10 = 6000	524288*12/10=629145.6
	Different command should be given depending on the encoder (motor) used for the same distance movement.	
For a command given in the minimum user unit of 1 um (0.001 mm)		
Electric gear settings	Motor Revolutions = 5000 Shaft Revolutions = 10000	Motor Revolutions = 524288 Shaft Revolutions = 10000
When using the electric gear	Can move through the same command of 12000 (12 mm= 12000 * 1 um), regardless of the encoder (motor) used.	

(2) When Driving High-Resolution Encoder at High Speed but Output Frequency of Upper Level Controller or Input Frequency of Drive is Limited

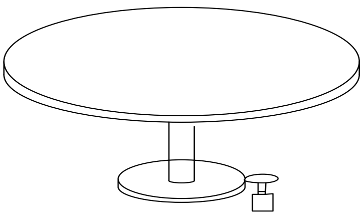
The output frequency of a general high-speed line drive pulse output unit is approximately 500 Kpps, while the allowed input frequency of the drive is approximately 1 - 4 Mpps. For this reason, when driving a high-resolution encoder at high speeds, be sure to use an electric gear for proper driving due to the limitations of the output frequency of the upper level controller and the input frequency of the drive. However, *because there is no such limitations for a communication-type drive (EtherCAT)* like this drive, you do not have to use an electric gear.

5.3.2 Example of Electric Gear Setup

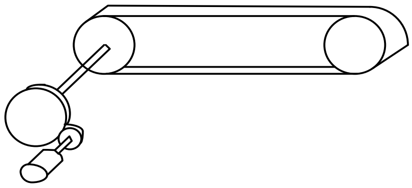
■ Ball Screw Load

Apparatus specifications	 **Pitch: 10 mm, Reduction gear ratio: 1/1**
User Unit	1um(0.001mm)
Encoder specifications	19-bit (524288 PPR)
Amount of load movement/revolution	10[mm] = 10000[User Unit]
Electric gear settings	Motor Revolutions : 524288 Shaft Revolutions : 10000

■ Turntable Load

Apparatus specifications	 **Reduction gear ratio: 100/1**
User Unit	0.001°
Encoder specifications	19-bit (524288 PPR)
Amount of load movement/revolution	360/100/0.001=3600
Electric gear settings	Motor Revolutions : 524288 Shaft Revolutions : 3600

■ Belt + Pulley System

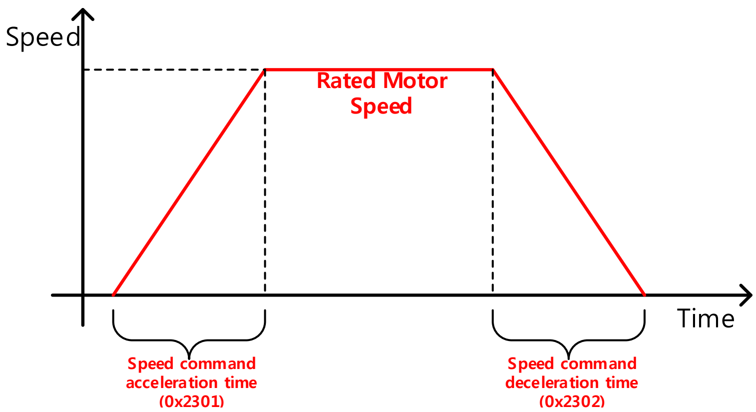
Apparatus specifications	 **Reduction gear ratio: 10/1, Pulley diameter: 100 mm**
User Unit	1um(0.001mm)
Encoder specifications	19-bit (524288 PPR)
Amount of load movement/revolution	PI*100/10/0.001=31416
Electric gear settings	Motor Revolutions : 524288 Shaft Revolutions : 31416

5.4 Settings Related to Speed Control

5.4.1 Smooth Acceleration and Deceleration

For smoother acceleration and deceleration during speed control, you can generate an acceleration/deceleration profile with trapezoidal and S-curved shapes for driving. In this case, the S-curve operation is enabled by setting the speed command S-curve time to a value of 1 ms or more.

The speed command acceleration/deceleration time (0x2301 and 0x2302) is the time needed to accelerate the drive from zero speed to the rated speed or to decelerate it from the rated speed to zero speed.

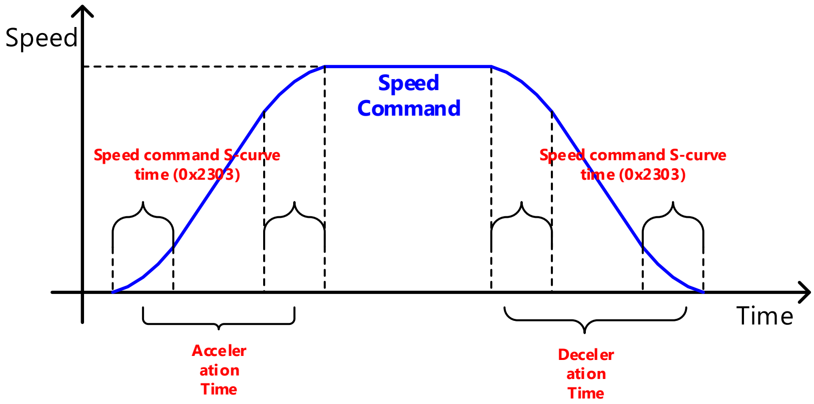


You can calculate the actual acceleration/deceleration time as shown below:

Acceleration time = speed command / rated speed x speed command acceleration time (0x2301)

Deceleration time = speed command / rated speed x speed command deceleration time (0x2302)

As shown in the figure below, you can generate an S-curve shaped acceleration/deceleration profile for driving by setting the speed command S-curve time (0x2303) to a value of 1 or more. Make sure to verify the relationship between the acceleration/deceleration time and the S-curve time.



5.4.2 Servo-lock Function

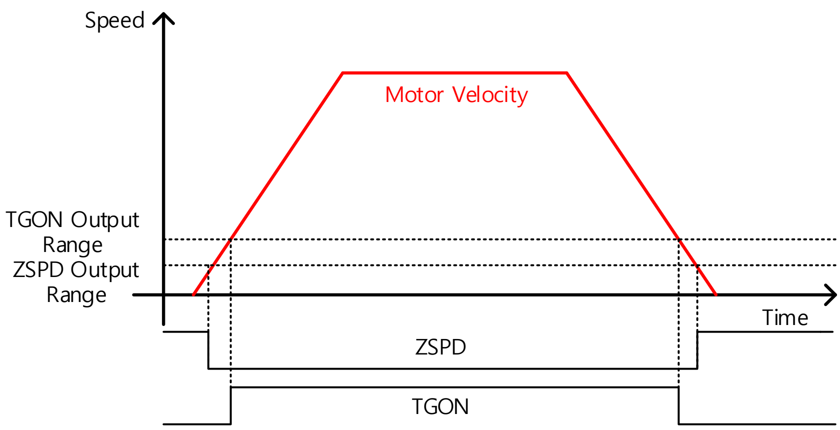
During speed control operation, the servo position will not be locked even when 0 is entered for the speed command. This is due to the characteristic of speed control; at this time, you can lock the servo position by enabling the servo-lock function (0x2311).

Setting values	Setting details
0	Servo-lock function disabled
1	Servo-lock function enabled

Using the servo-lock function, the position is internally controlled relative to the position at the time 0 is input as the speed command. If you input a speed command other than 0, the speed control will switch to normal mode.

5.4.3 Signals Related to Speed Control

As shown in the figure below, when the value of speed feedback is not more than the ZSPD output range (0x2404), a ZSPD (zero speed) signal will output; and when it is not less than the TGON output range (0x2405), a TGON (motor rotation) signal will output.



In addition, if the difference between the command and the speed feedback (i.e., speed error) is not more than the INSPD output range (0x2406), an INSPD (speed match) signal will output.

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2404	-	ZSPD Output Range	UINT	RW	Yes	rpm
0x2405	-	TGON Output Range	UINT	RW	Yes	rpm
0x2406	-	INSPD Output Range	UINT	RW	Yes	rpm

5.5 Settings Related to Position Control

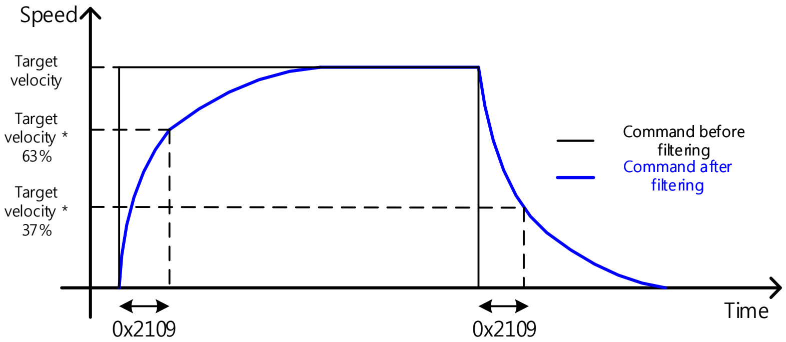
5.5.1 Position Command Filter

This section describes how to operate the drive more smoothly by applying a filter to the position command. For the purpose of filtering, you can set the position command filter time constant (0x2109) using the primary low pass filter and the position command average filter time constant (0x210A) using the moving average.

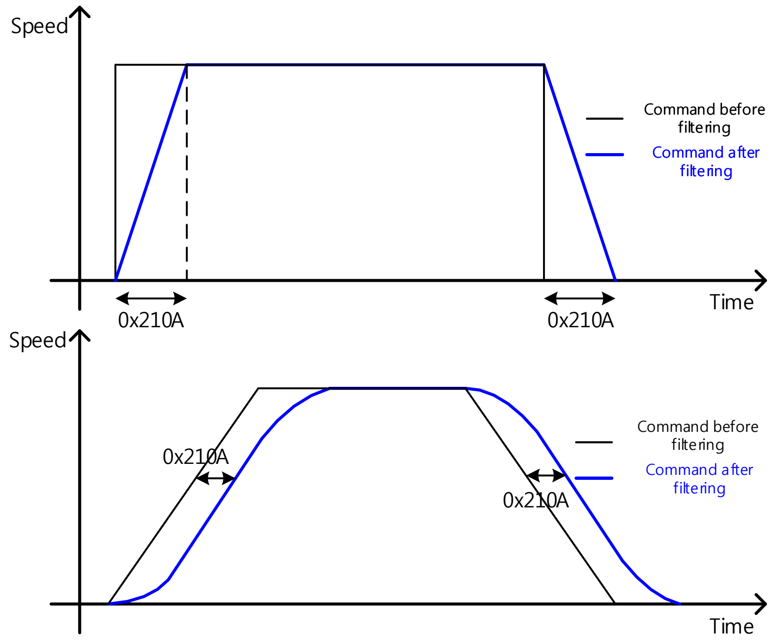
You can use a position command filter in the following cases:

(1) If the electric gear ratio is 10 times or above

(2) If the acceleration/deceleration profile cannot be generated from the upper level controller



Position command filter using the position command filter time constant (0x2109)



Position command filter using the position command average filter time constant (0x210A)

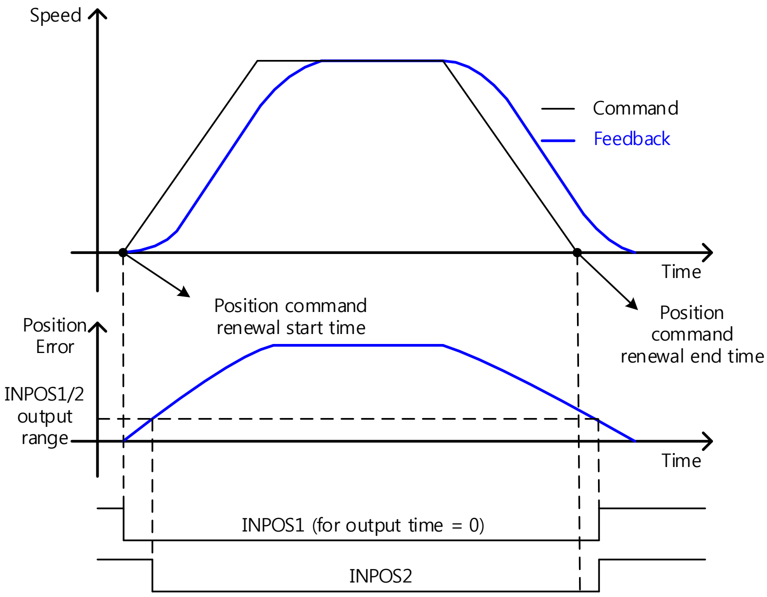
■ Related Objects

Index	Sub Index	Name	Variable type	Acces sibility	PDO assign ment	Unit
0x2109	-	Position Command Filter Time Constant	UINT	RW	Yes	0.1 ms
0x210A	-	Position Command Average Filter Time Constant	UINT	RW	Yes	0.1 ms

5.5.2 Signals Related to Position Control

As shown in the figure below, if the value of position error (i.e., the difference between the position command value input by the upper level controller and the position feedback value) is not more than the INPOS1 output range (0x2401), and is maintained for the INPOS1 output time (0x2402), the INPOS1 (position completed 1) signal will be output, provided that the position command is not renewed.

At this moment, if the position error value is not more than the INPOS2 output range (0x2403), the INPOS2 (position completed 2) signal will be output, regardless of whether the position command has been renewed or not.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2401	-	INPOS1 Output Range	UINT	RW	Yes	UU
0x2402	-	INPOS1 Output Time	UINT	RW	Yes	ms
0x2403	-	INPOS2 Output Range	UINT	RW	Yes	UU

5.6 Settings Related to Torque Control

5.6.1 Speed Limit Function

In torque control mode, the torque command input from the upper level controller controls the torque, but does not control the speed; thus, the apparatus might be damaged due to the exceedingly increased speed by an excessive torque command. To address this problem, this drive provides a function that limits motor speed based on the parameters set during torque control.

You can limit the speed using the maximum speed or the speed limit value (0x230E) according to the value of the speed limit function setting (0x230D), as described below. With the VLMT (speed limit) output value, you can verify whether the speed is limited.

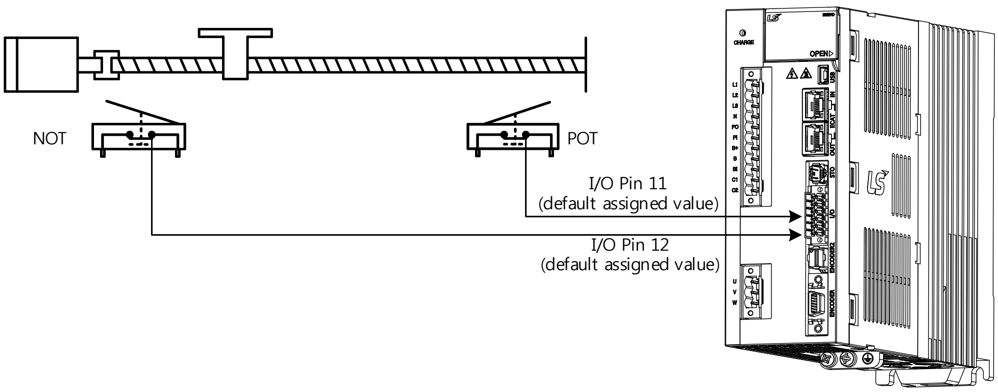
Setting values	Setting details
0	Limited by speed limit value (0x230E)
1	Limited by the maximum motor speed

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x230D	-	Speed Limit Function Configuration	UINT	RW	No	-
0x230E	-	Speed Limit Value	UINT	RW	Yes	rpm

5.7 Positive/Negative Limit Settings

This function is to safely operate the drive within the movable range of the apparatus using the positive/negative limit signals of the drive. Be sure to connect and set the limit switch for safe operation. For more information about the settings, refer to 5.2.1 Assignment of Digital Input Signals.



If the positive/negative limit signals are input, the motor will stop according to the emergency stop setting (0x2013).

Setting values	Details
0	The motor will stop according to the method set in the dynamic brake control mode (0x2012). It will stop using the dynamic brake, and then maintain the torque command at 0.
1	Using the emergency stop torque (0x2113) to decelerate and stop.

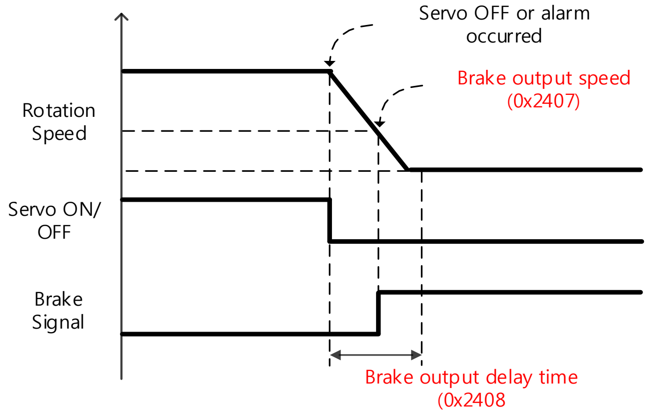
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2012	-	Dynamic Brake Control Mode	UINT	RW	No	-
0x2013	-	Emergency Stop Configuration	UINT	RW	No	-
0x2113	-	Emergency Stop Torque	UINT	RW	Yes	-

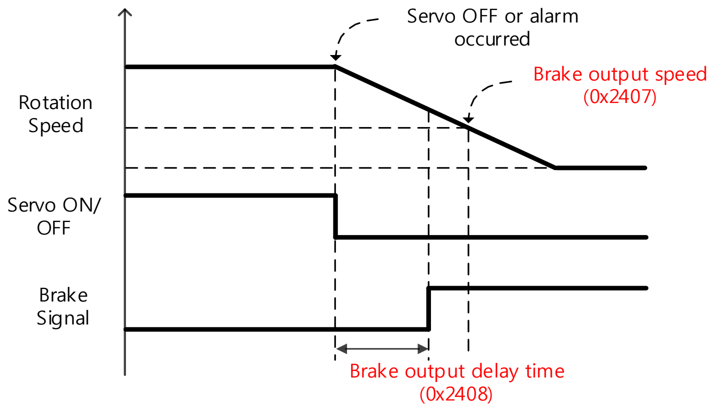
5.8 Setting the Brake Output Signal Function

If the motor stops because the servo turns off or a servo alarm occurs during rotation, you can set the speed (0x2407) and delay time (0x2408) for the brake signal output to configure the output timing.

The brake signal will be output if the motor rotation speed goes below the set speed (0x2407) or the output delay time (0x2408) has elapsed after the servo OFF command.



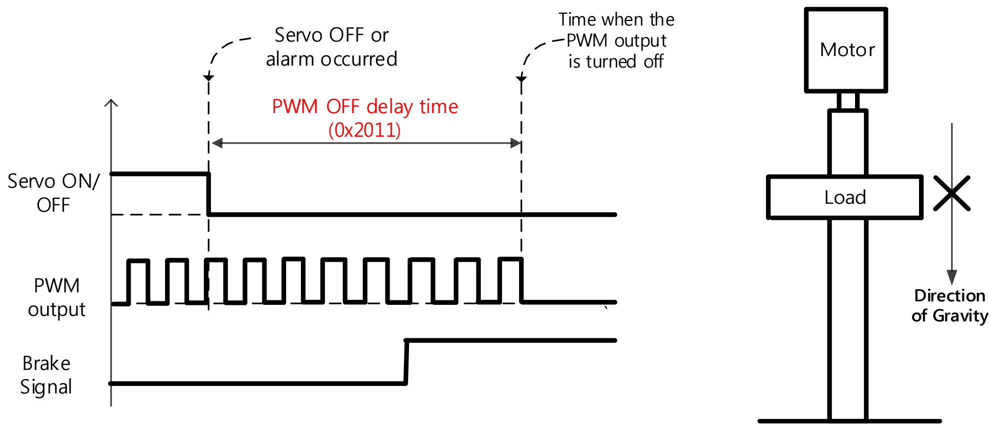
Timing diagram for signal output by the brake output speed (0x2407)



Timing diagram for signal output by the brake output delay time (0x2408)

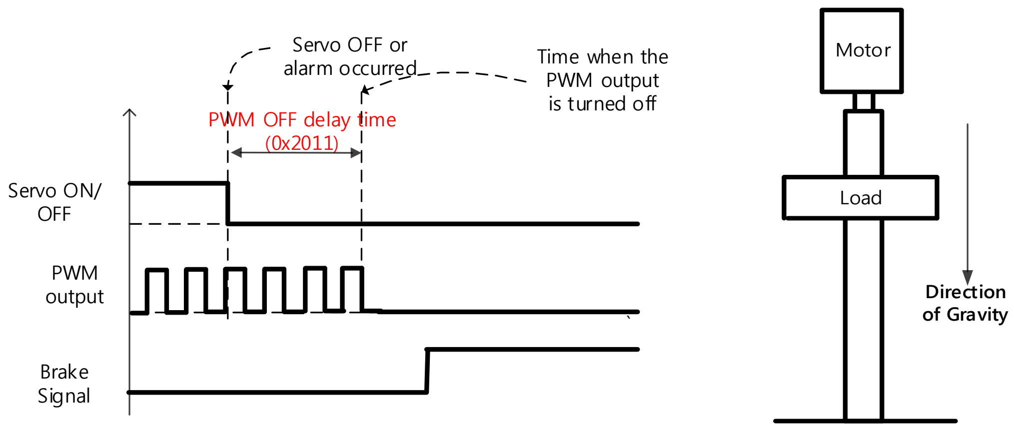
When the servo is turned off or a servo alarm occurs, set the delay time until the actual PWM output turns off.

When using a motor with a brake installed on the vertical axis, you can output the brake signal first, and then turn off the PWM after this set time, to prevent it from running down along the axis.



(1) If Brake Signal Outputs First Before PWM Output Turns off

You can output the brake signal first before the PWM output is turned off, preventing the drop along the vertical axis due to gravity.



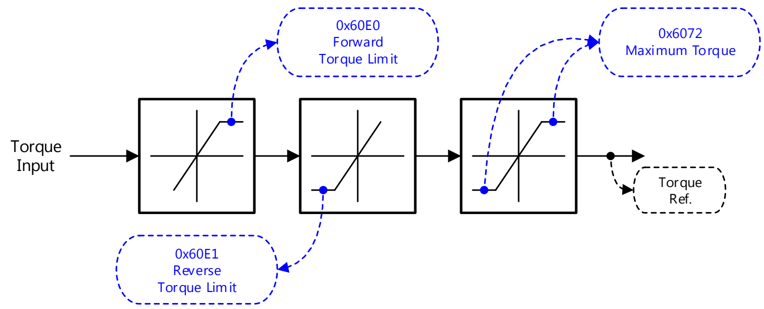
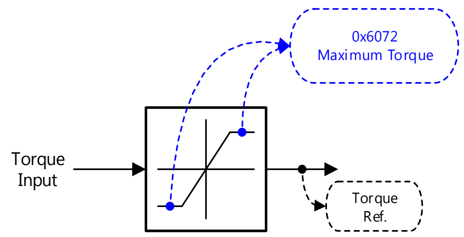
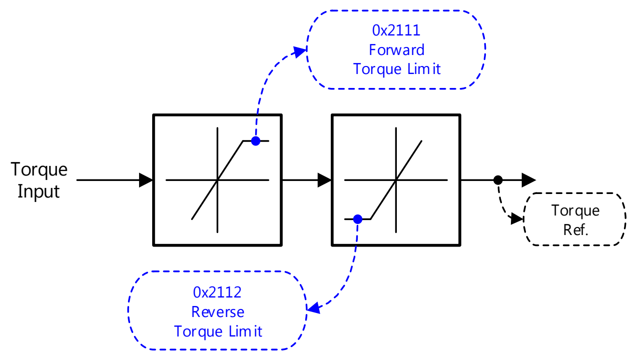
(2) If PWM Output Turns off First Before Brake Signal Outputs

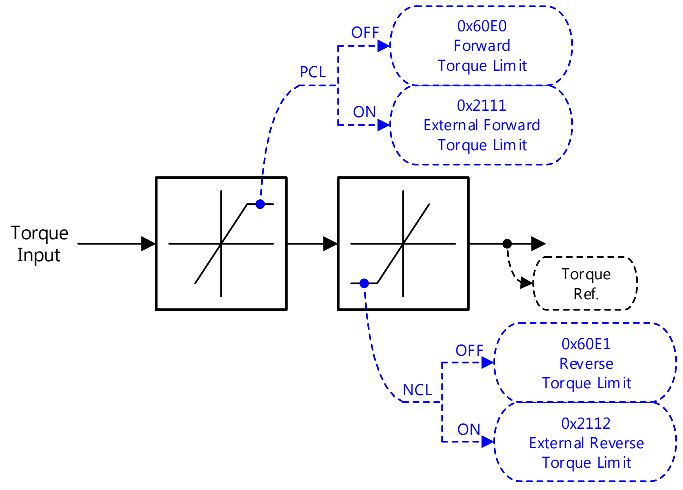
The PWM output is turned off first before the brake signal outputs, allowing the drop along the vertical axis due to gravity.

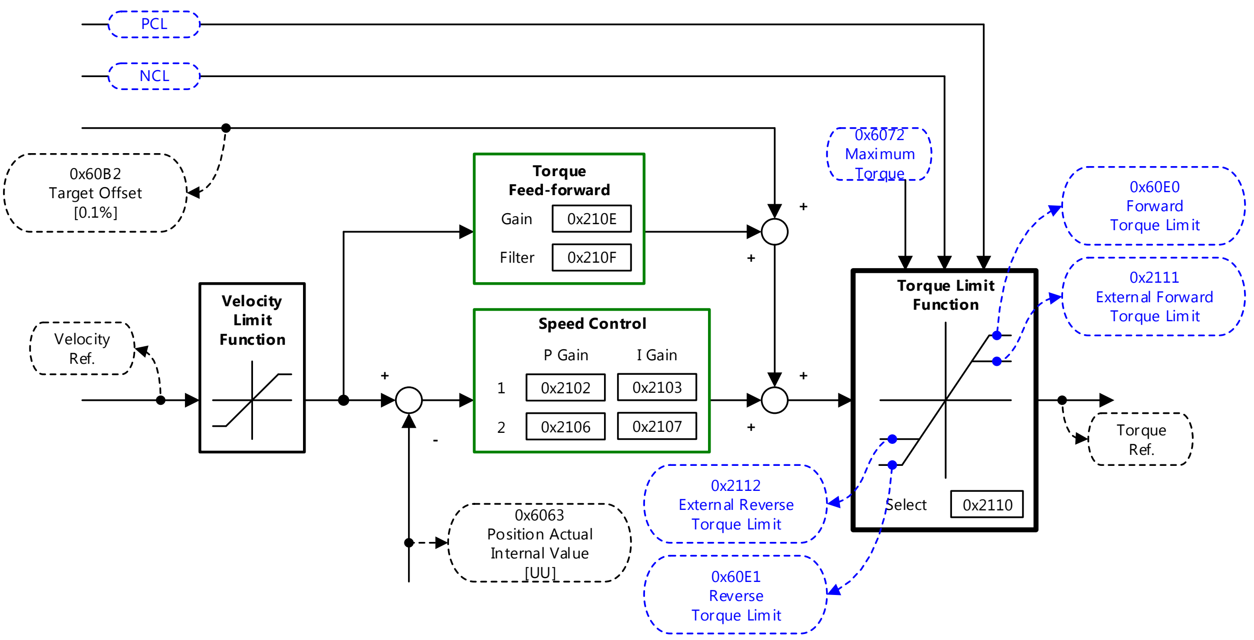
5.9 Torque Limit Function

You can limit the drive output torque to protect the machine. It can be set by the torque limit function (0x2110). The setting unit of the torque limit value is 0.1%.

■ Description of Torque Limit Function Setting (0x2110)

Limit function	Description
Internal torque limit 1 (setting 0)	 Limits the torque using forward/reverse torque limit values according to the driving direction; the maximum value is limited by the maximum torque (0x6072). - Forward: 0x60E0, Reverse: 0x60E1
Internal torque limit 2 (setting 1)	 Limits the torque by the maximum torque (0x6072) only regardless of the driving direction.
External torque limit (setting 2)	 Limits the torque using external forward/reverse torque limit values according to the driving direction. - Forward: 0x2111, Reverse: 0x2112

Internal and external torque limits (setting 3)	 Limits the torque using internal and external torque limit values according to the driving direction and the torque limit signal. - Forward: 0x60E0 (if PCL signal is not input), 0x2111 (if PCL signal is input) - Reverse: 0x60E1 (if NCL signal is not input), 0x2112 (if NCL signal is input)
Analog torque limit (setting 4)	Reserved

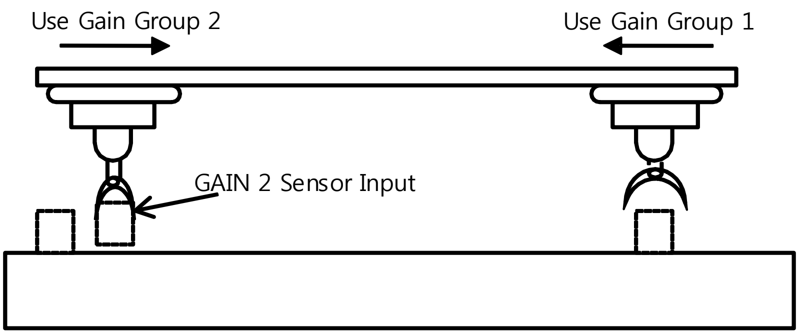


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2110	-	Torque Limit Function Configuration	UINT	RW	Yes	-
0x2111	-	External Positive Torque Limit Value	UINT	RW	Yes	0.1%
0x2112	-	External Negative Torque Limit Value	UINT	RW	Yes	0.1%
0x6072	-	Maximum Torque	UINT	RW	Yes	0.1%
0x60E0	-	Positive Torque Limit Value	UNIT	RW	Yes	0.1%
0x60E1	-	Negative Torque Limit Value	UINT	RW	Yes	0.1%

5.10 Gain Switching Function

5.10.1 Gain Group Switching



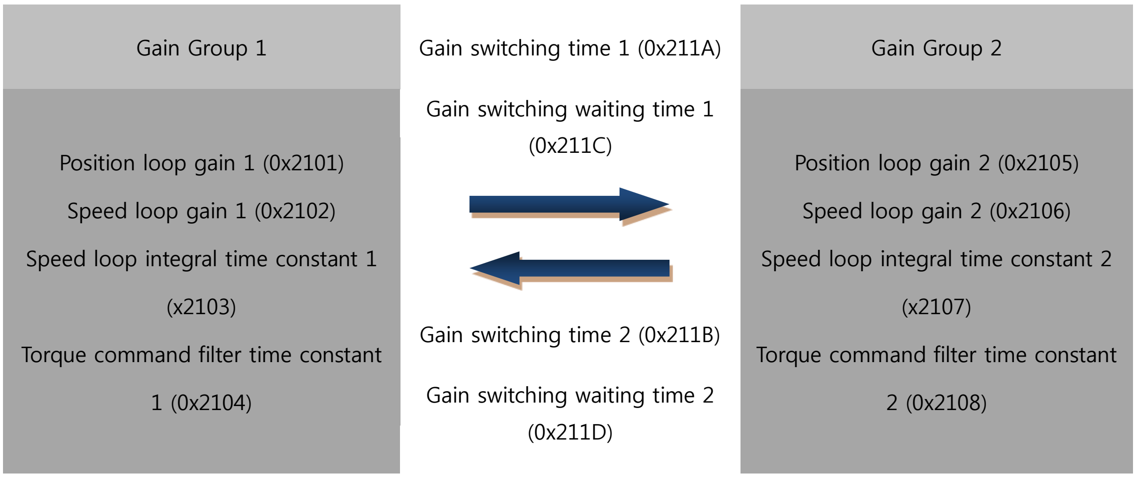
As one of the gain adjustment methods, this function is to switch between gain groups 1 and 2. You can reduce the time required for positioning through switching gains.

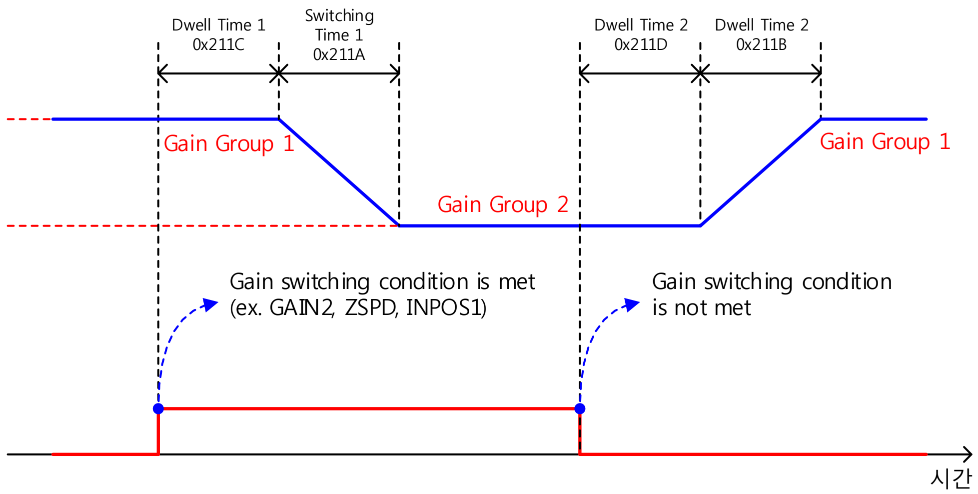
A gain group consists of the position loop gain, speed loop gain, speed loop integral time constant, and torque command filter time constant. The gain switching function (0x2119) can be set as follows:

■ Description of Gain Switching Function (0x2119)

Settings	Setting details
0	Only gain group 1 is used.
1	Only gain group 2 is used.
2	Gain is switched according to the GAIN2 input status. - 0: Use gain group 1 - 1: Use gain group 2
3	Reserved
4	Reserved
5	Reserved
6	Gain is switched according to the ZSPD output status. - 0: Use gain group 1 - 1: Use gain group 2
7	Gain is switched according to the INPOS1 output status. - 0: Use gain group 1 - 1: Use gain group 2

The waiting time and switching time for gain switching is as follows:





■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2119	-	Gain switching mode	UINT	RW	Yes	-
0x211A	-	Gain Switching Time 1	UINT	RW	Yes	ms
0x211B	-	Gain Switching Time 2	UINT	RW	Yes	ms
0x211C	-	Gain Switching Waiting Time 1	UINT	RW	Yes	ms
0x211D	-	Gain Switching Waiting Time 2	UINT	RW	Yes	ms

5.10.1 P/PI Control Switching

PI control uses both proportional (P) and integral (I) gains of the speed controller, while P control uses only the proportional gain.

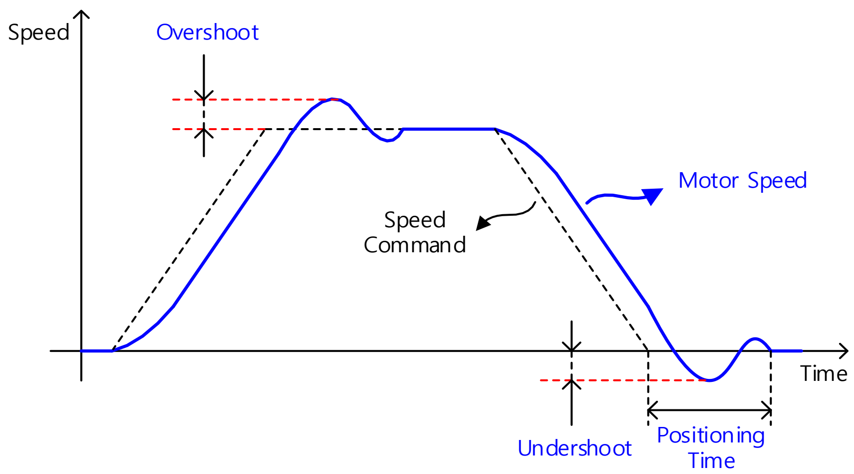
The proportional gain determines the responsiveness of the entire controller, and the integral gain is used to eliminate an error in the steady state. Too high of an integral gain will result in an overshoot during acceleration or deceleration.

The PI/P control switching functions are used to switch between the PI and P controls under parametric conditions within the servo (such as torque, speed, acceleration, and position deviation); specifically, they are used in the following situations:

Speed control: To suppress any overshoot or undershoot during acceleration/deceleration.

Position control: To suppress undershoot during positioning, resulting in a reduced positioning time.

You can accomplish a similar effect by setting the acceleration/deceleration of the upper level controller, the soft start of the servo drive, the position command filter, etc.



You can configure these settings in the P/PI control switching mode (0x2114). Please see the details below: Switching to P control by PCON input takes precedence over this setting.

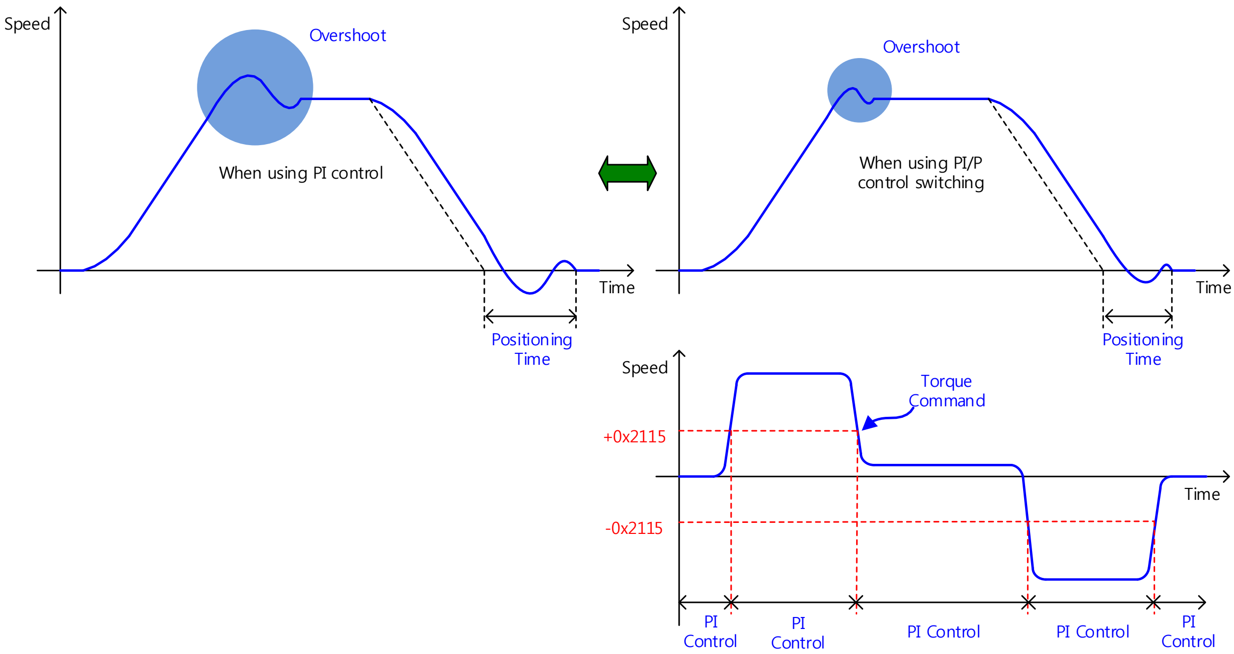
Settings	Setting details
0	Always uses PI control.
1	Switches to P control if the command torque is larger than the P control switching torque (0x2115).
2	Switches to P control if the command speed is larger than the P control switching speed (0x2116).
3	Switches to P control if the acceleration command is larger than the P control switching acceleration (0x2117).
4	Switches to P control if the position error is larger than the P control switching position error (0x2118).

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2114	-	P/PI Control Switching Mode	UINT	RW	Yes	-
0x2115	-	P Control Switching Torque	UINT	RW	Yes	0.1%
0x2116	-	P Control Switching Speed	UINT	RW	Yes	rpm
0x2117	-	P Control Switching Acceleration	UINT	RW	Yes	rpm/s
0x2118	-	P Control Switching Position Error	UINT	RW	Yes	pulse

■ Example of P/PI Switching by Torque Command

When PI control is always used rather than P/PI control switching for speed control, the integral term of the acceleration/deceleration error is accumulated, resulting in an overshoot and an extended positioning time. At this time, you can reduce the overshoot and the positioning time using an appropriate P/PI switching mode. The figure below shows an example of switching mode by torque command:



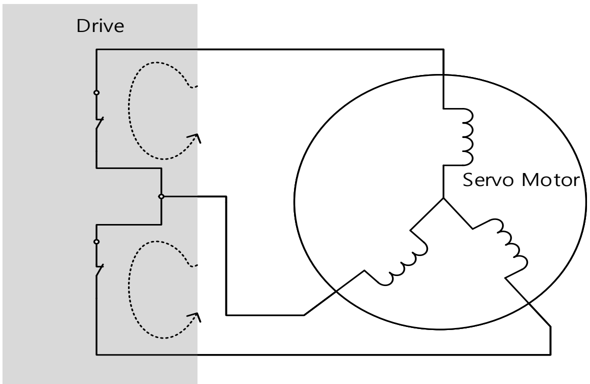
5.11 Dynamic Brake

What is Dynamic Brake?

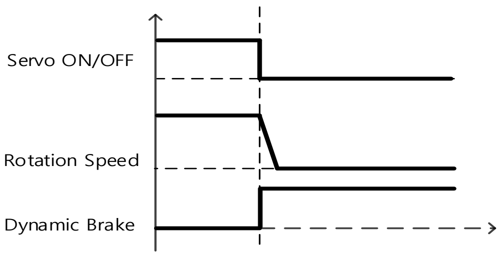
: Dynamic brake electrically short-circuits the phase of the servo motor to stop it rapidly.

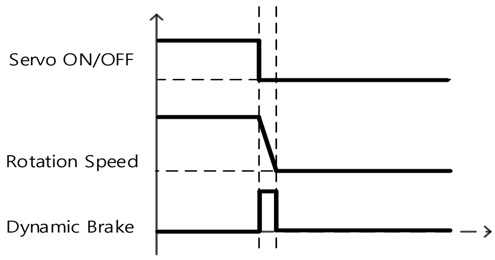
Circuits related to the dynamic brake are integrated into the drive.

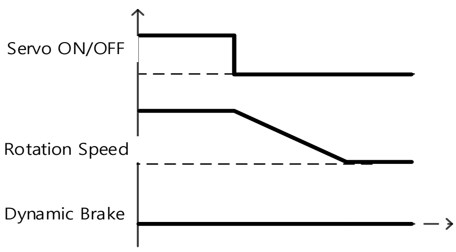
The drive short-circuits only two phases or all of three phases depending on the model type.

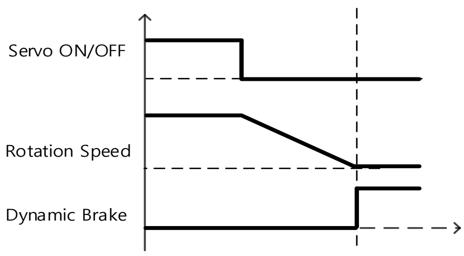


You can set various stop modes, as shown below, in dynamic brake control mode settings [0x2012]:

<table>
<tr>
<td>

Setting value: 0
Hold the dynamic brake after stopping the motor using the brake </td>
<td>

Setting value: 1
Release the dynamic brake after stopping the motor using the brake </td>
</tr>
<tr>
<td>

Setting value: 2
Release the dynamic brake after free-run stop </td>
<td>

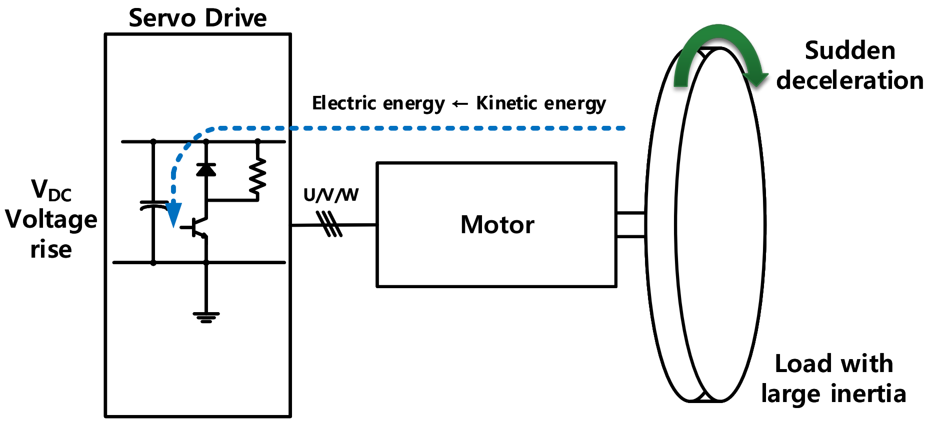
Setting value: 3
Hold the dynamic brake after free-run stop </td>
</tr>
</table>

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2012	-	Dynamic Brake Control Mode Configuration	UINT	RW	No	-
0x2013	-	Emergency Stop Configuration	UINT	RW	No	-

5.12 Regenerative Resistance Setting

Regeneration refers to a phenomenon where the kinetic energy of the motor is converted to electric energy and input into the drive because of driving a load with large inertia or sudden deceleration. At this moment, regenerative resistor is used to suppress the rise of the drive's internal voltage (V_{DC}) due to the regeneration and prevent the drive burnout.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2009	-	Regenerative resistance setting	UINT	RW	No	-
0x200A	-	Regenerative Resistor Derating Factor setting	UINT	RW	No	%
0x200B	-	Regenerative resistance value setting	UINT	RW	No	Ω
0x200C	-	Regenerative resistance capacity setting	UINT	RW	No	Watt

5.12.1 Use of Internal Regenerative Resistor

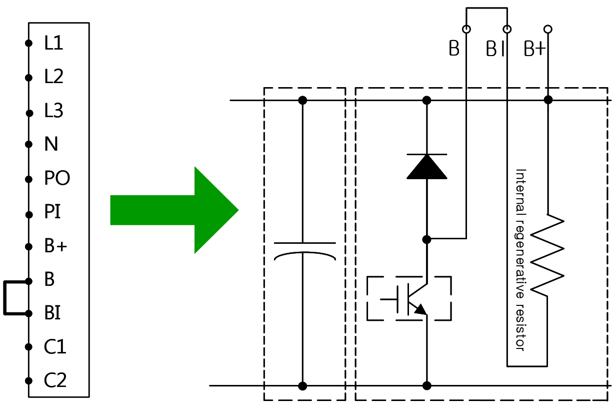
This drive essentially has internal regenerative resistor depending on its capacity. The integrated regenerative resistors depending on the drive capacity are as follows:

Drive Capacity	Internal resistance value	Internal resistor capacity
1kW	40Ω	100W
3.5kW	12.6Ω	150W
5kW	6.8Ω	120W
7.5kW	6.8Ω	240W

When using the regenerative resistor installed in the drive, make sure to observe the order below for configuration:

1. Wire the regenerative resistor.

   - Check to see if the terminals B and BI are short-circuited (short-circuited at factory setup, 1 kW or less).



Wiring method when using internal regenerative resistor

2. Set regenerative resistance (0x2009)

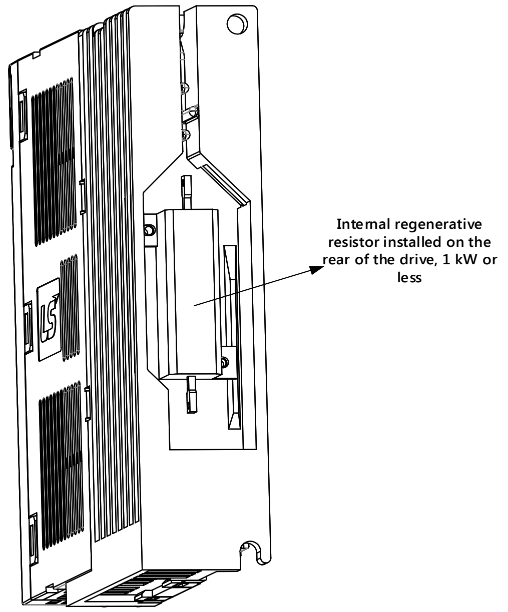
   - Configure to use the regenerative resistor integrated into the drive (0x2009 = 0).

   - Basically, the resistor is attached on the rear of the drive heat sink.

   - Initial value: 0

3. Check internal regenerative resistance value and capacity

   - Check the internal regenerative resistance value (0x200B).
   - Check the regenerative resistor capacity (0x200C).
   - 1 KW or less: Basically, the resistor is installed on the rear of the drive heat sink (see the figure below).
   - 3.5 kW - 7.5 kW: It is basically installed inside the drive.

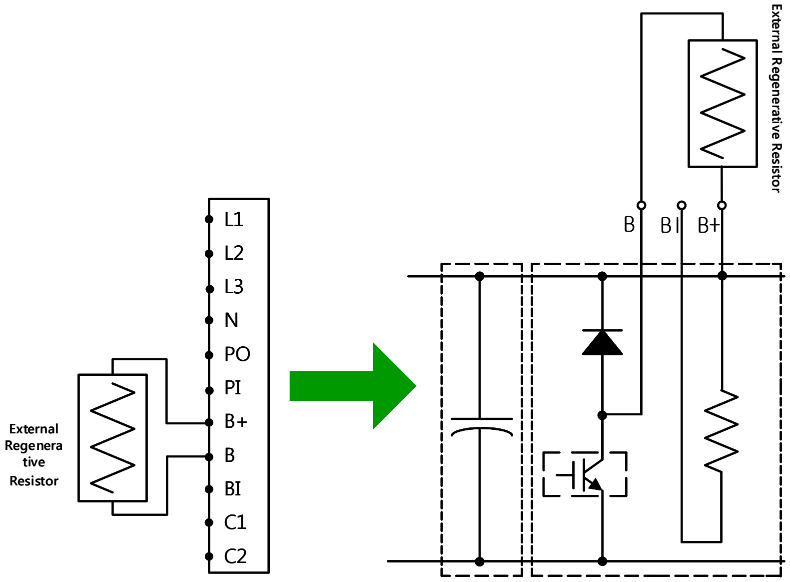


5.12.2 Use of External Regenerative Resistor

When using the external regenerative resistor considering the driving condition, make sure to observe the order below for configuration:

1. Wire the external regenerative resistor.

   - Connect the external regenerative resistor to the terminals B and B+.
   - Remove the short-circuits of the terminals B and BI (short-circuited at factory setup, 1 kW or less).



Wiring method when using external regenerative resistor

2. Set regenerative resistance (0x2009)

   - Configure to use the regenerative resistor installed separately outside the drive (0x2009=1).
   - Set if a regenerative resistance is connected of a capacity which is larger than that of the internal regenerative resistance.

3. Set regenerative resistance value (0x200B)

   - Configure the regenerative resistance of a resistor installed separately outside the drive in the unit of [Ω].
   - Be sure to configure it when you have set the regenerative resistor (0x2009) to 1.
   - Initial value: 0

4. Set the regenerative resistor capacity (0x200C).

- Configure the capacity of a regenerative resistor installed separately outside the drive in the unit of [W].
- Be sure to configure it when you have set the regenerative resistor (0x2009) to 1.
- Initial value: 0

5. Set the maximum capacity and allowed time of the regenerative resistance (0x200D, 0x200E)
   - Set the maximum capacity and use time at the capacity by using the data sheet of the externally installed regenerative resistance
   - If there are no specific values, set the maximum capacity and allowed time to 5 times the regenerative resistance capacity setting (0x200C) and 5000[ms], respectively (It may differ according to general regenerative resistance specification or individual resistors).
   - Be sure to configure it when you have set the regenerative resistor (0x2009) to 1.

LSIS provides the following regenerative resistors as options for the purpose of external regenerative resistor (see the specifications as well):

Drive Capacity	Resistance	Resistor capacity	Model Name
1kW	30Ω	300W	XLCS-300R30
3.5kW	30Ω	600W	XLC-600R30
5kW	28Ω	600W	XLC-600R28 (4P)
7.5kW	28Ω	600W	XLC-600R28 (4P)

5.12.3 Other Considerations

With the considerations of the ambient environment and heat radiation condition for installing the drive, you can configure the regenerative resistor derating factor (0x200A). In case that the heat radiation condition is poor, please use a derated resistor (less than the capacity).

When it is derated for use (setting the value not larger than 100), the less the set value, the earlier the regeneration overload alarm (AL-23) is triggered.

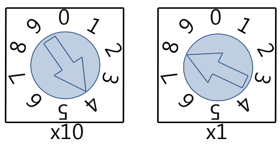
When you intend to set the derating factor to 100% or higher, be sure to fully consider the heat radiation condition of the drive installed.

5.13 Configuration of the Drive Node Address (ADDR)

Configure the drive node address. You can verify the set address in the node ID (0x2003). The value of the node setting switch is read just once when the power is turned on. Any subsequently modified settings will only take effect when the power is turned off and then turned on again.

As this drive consists of two rotary switches configurable to 0~9 as below, 0~99 node addresses can be set. The following example shows an address set to 48:

⚠ Perform the rotary switch operation for the node ID setting only when drive power is not applied.



Note: For more information about how the master reads the node address of the EtherCAT drive, refer to 18.4.1 Requesting ID in the document titled "ETG.1020 EtherCAT Protocol Enhancements.

6. Safety Functions

This servo drive has a built-in safe torque off (STO) function to reduce the risks associated with using the machine by protecting people from the dangerous operation of moveable parts. In particular, this function can be used to prevent the dangerous operation of the machine's moveable parts when you need to perform tasks such as maintenance in a danger zone.

6.1 Safe Torque Off (STO) Function

The safe torque off function blocks motor current according to the input signal transferred from a safety device connected to the connector (STO), such as safety controller and safety sensor, to stop the motor.

■ Safe Torque Off Operation State According to STO Input Contact

Signal Name	Function			
STO1	ON	ON	OFF	OFF
STO2	ON	OFF	ON	OFF
Operation state	Normal State	STO State	STO State	STO State

■ Electric Characteristics

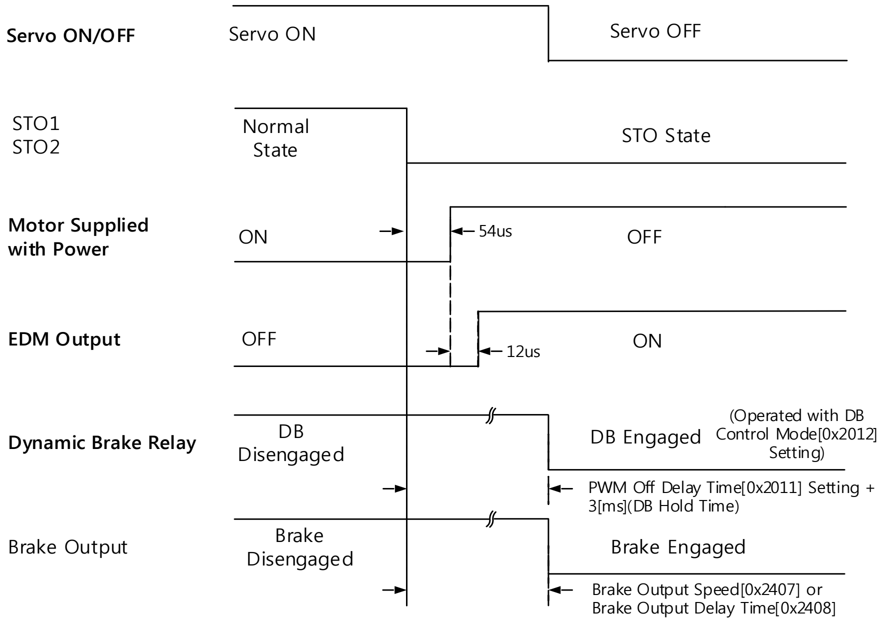
- **STO1, STO2**

Item	Characteristic value
Internal impedance	3.3 kΩ
Voltage input range	DC 12V ~ DC 24V
Maximum delay time	1 ms or less

- **EDM**

Item	Characteristic value
Maximum allowed voltage	DC 30V
Maximum current	DC 120mA
Maximum delay time	1 ms or less

■ Timing diagram for STO operation

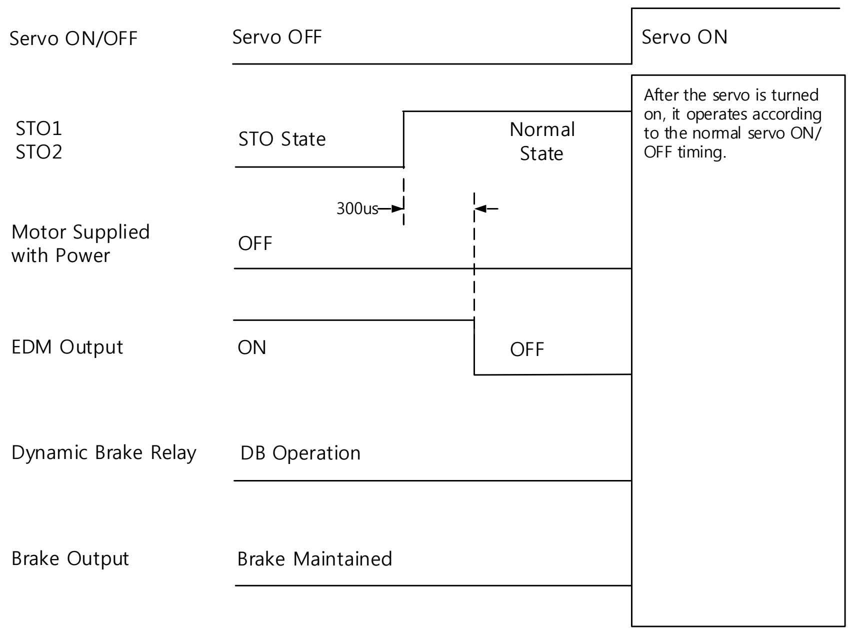


Note 1) If either STO1 or STO2 is turned off, the drive state is switched to the STO state.

Note 2) The dynamic brake operates according to the dynamic brake control mode setting (0x2012).

Note 3) Whichever is the earlier time, out of the points of time until the value becomes less than the setting value of the brake output delay time (0x2408) or less than the brake output speed (0x2407), will be applied.

■ Timing diagram for STO recovery



Note 1) Be sure to recover the STO1 and STO 2 input signals to On in the Servo Off state. It is not necessary to reset the alarm separately since the "STO state" is not an alarm state.

Note 2) The dynamic brake operates according to the dynamic brake control mode setting (0x2012) for the STO state, the alarming state, and the servo OFF state.

6.2 External Device Monitor (EDM)

Monitor output signal is to monitor the state of safety input signal with an external device.

Connect it to the terminal for external device monitor of safety device such as safety controller or safety sensor.

■ Failure detection through EDM signal

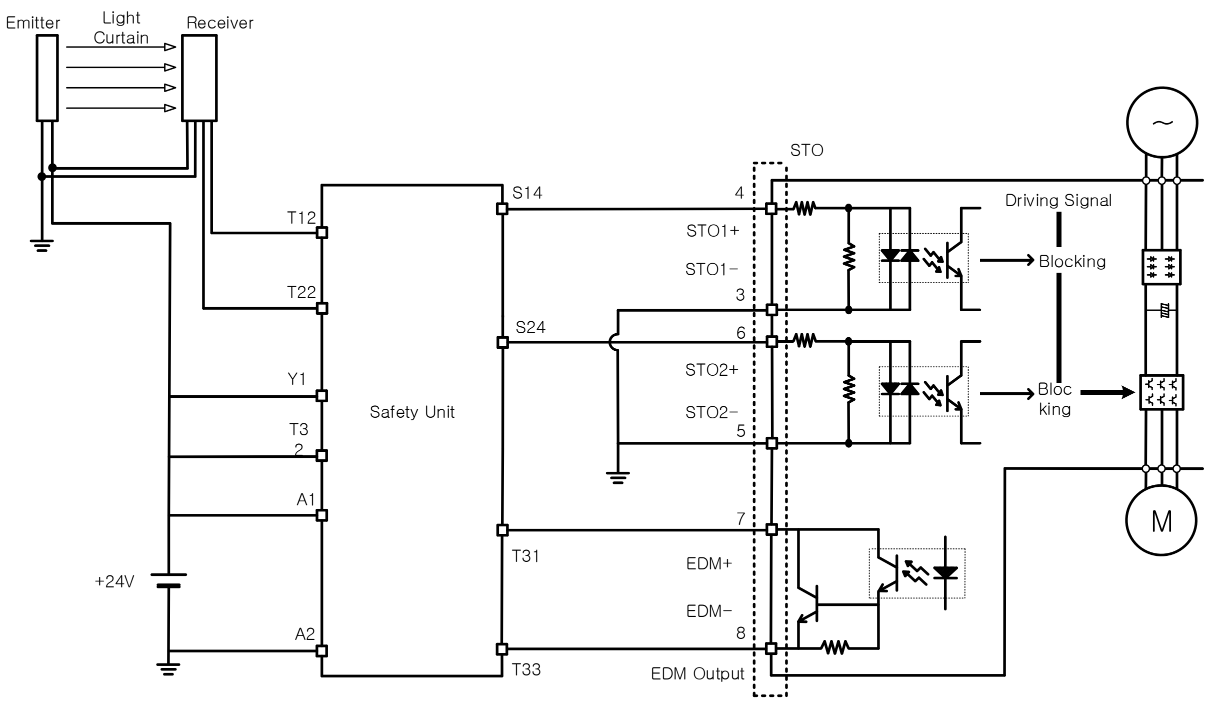
You can detect failure of the safety input circuit and the EDM output circuit by monitoring the following 4 signal states from the external device.

In case of failure, there are two possible cases:

- The EDM output signal is not turned on even when both the STO1 and 2 are off.
- The EDM output signal is turned on even when one or both of the STO1 and 2 are on.

Signal Name	Function			
STO1	ON	ON	OFF	OFF
STO2	ON	OFF	ON	OFF
EDM	OFF	OFF	OFF	ON

6.3 Example of Using the Safety Function



6.4 How to Verify the Safety Function

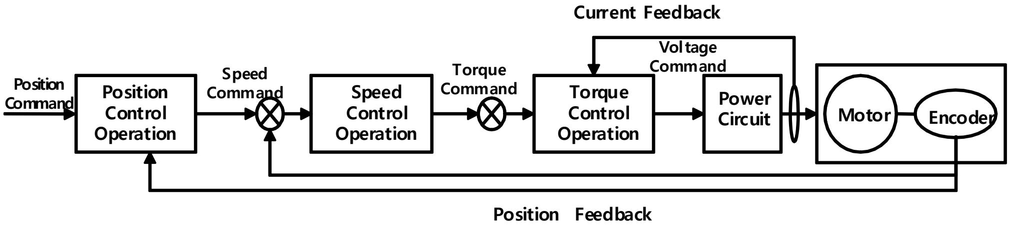
In case the servo drive was replaced prior to starting up the device or during maintenance, make sure to check the details below:

- When the STO1 and STO2 signals are turned off, check if the drive is in STO status (Bit 31 for digital input (0x60FD) is 1).
- Make sure that the EDM signal is off during general operation by checking the input indicator for feedback circuit of the connected device.

6.5 Precautions for Using the Safety Function

- When using the STO function, be sure to carry out risk assessments for the device to check if the system safety requirements are met.
- There may be risks even if the STO function works.
- In the STO state, the motor is operated by an external force; thus, if the load needs to be maintained, arrange a separate measure such as an external mechanical brake. The brake of the servo system is dedicated for maintaining the load; thus, be careful not to use it to brake the motor.
- If no external force exists and free-run stop is configured in the dynamic brake control mode setting (0x2012), note that the braking distance of load will be extended.
- The purpose of the STO function is not to block the servo drive power or electrically insulate the drive. That is why you have to disconnect the servo drive power before carrying out maintenance of any sub-drive.

7. Tuning



The drive is set to torque control, speed control, or position control mode for use, depending on the method used to connect with the upper level controller. This drive is structured so that the position control is located at the outer position while the current control at the inner position, forming a cascade-type control structure. Depending on the operation mode of the drive, you can tune the operation by setting the gain-related parameters of the torque controller, the speed controller, and the position controller to satisfy your purpose.

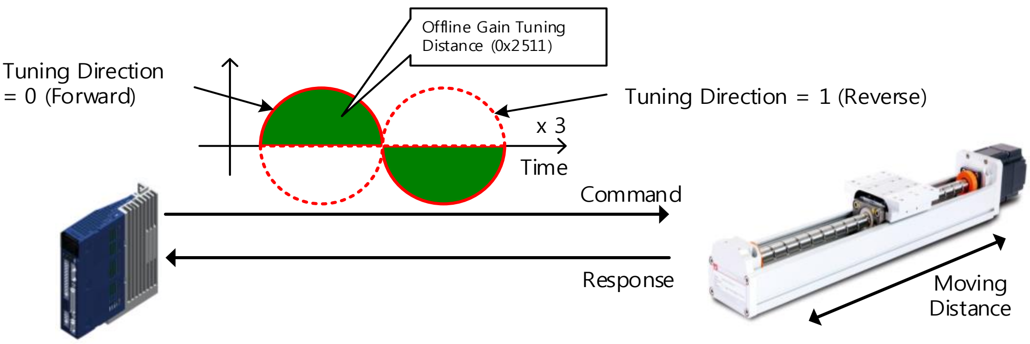
7.1 Auto Gain Tuning (Offline Auto Tuning)

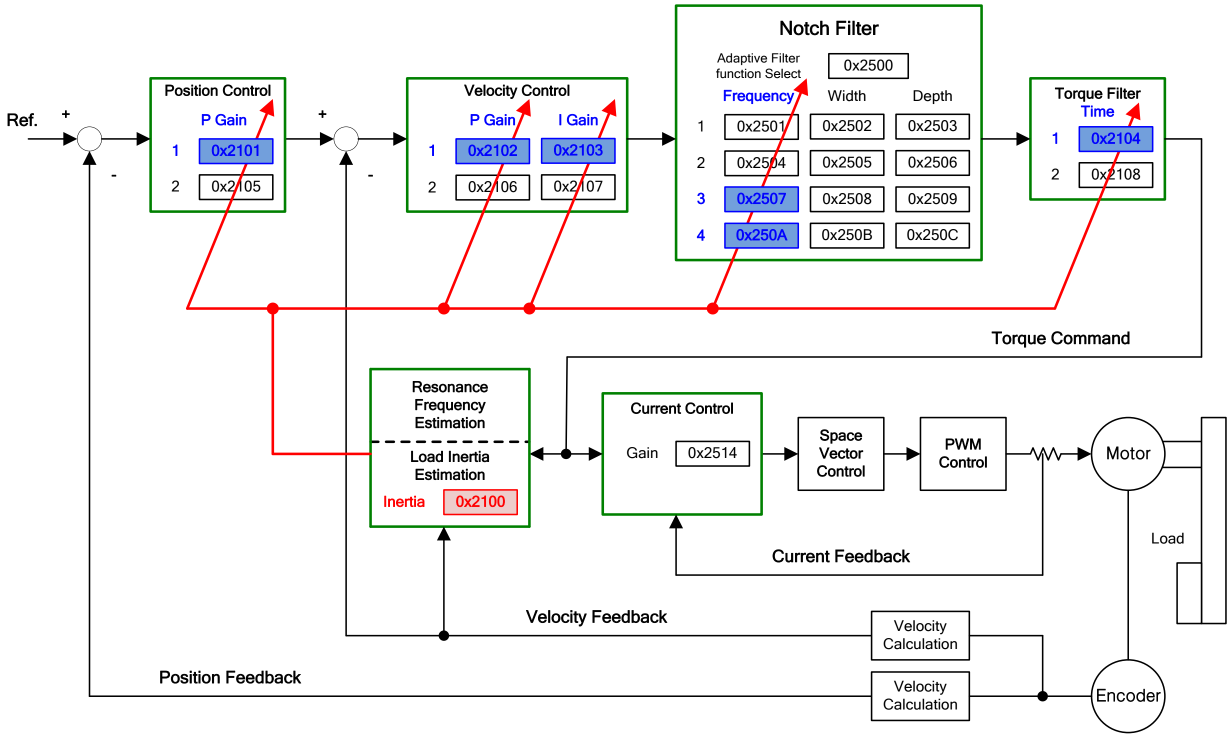
Use the command generated by the drive itself to automatically set the gain according to the load condition. The following gain-related parameters will be changed:

- Inertia ratio, position loop gain, speed loop gain, speed integral time constant, torque command filter time constant, notch filter 3 frequency, and notch filter 4 frequency

The overall gain is set higher or lower depending on the system rigidity setting (0x250E) during gain tuning. Set the appropriate value depending on the rigidity of the driven load.

As shown in the figure below, the sinusoidal-type command is generated in the forward or reverse direction according to the offline gain tuning direction (0x2510) setting. You can set the moving distance for tuning with the offline gain tuning distance (0x2511). The larger the setting value is, the longer the moving distance becomes. Set the distance appropriately for the case. Make sure to secure enough distance (one or more motor revolutions) prior to gain tuning.





■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x250E		System Rigidity for Gain Tuning	UINT	RW	No	-
0x2510	-	Off-line Gain Tuning Direction	UINT	RW	No	-
0x2511		Off-line Gain Tuning Distance	UINT	RW	No	-

7.2 Auto Gain Tuning (Online Auto Tuning)

It does not use offline auto tuning that is generated by the drive, but receives a command from an upper level unit to automatically set the parameters related to gains based on system inertia, the rigidity set by the user, and other general rules.

- Inertia ratio, position loop gain, speed loop gain, speed integral time constant, torque command filter time constant

Online tuning is carried out based on the gain table values that are divided into 20 levels based on the rigidity. The tuning results are regularly applied and the changed gains are saved on EEPROM every 2 minutes.

When estimating the inertia, the estimated results are applied quickly or slowly depending on the adaptation speed setting. The responsiveness of the overall system can be determined with the rigidity parameter.

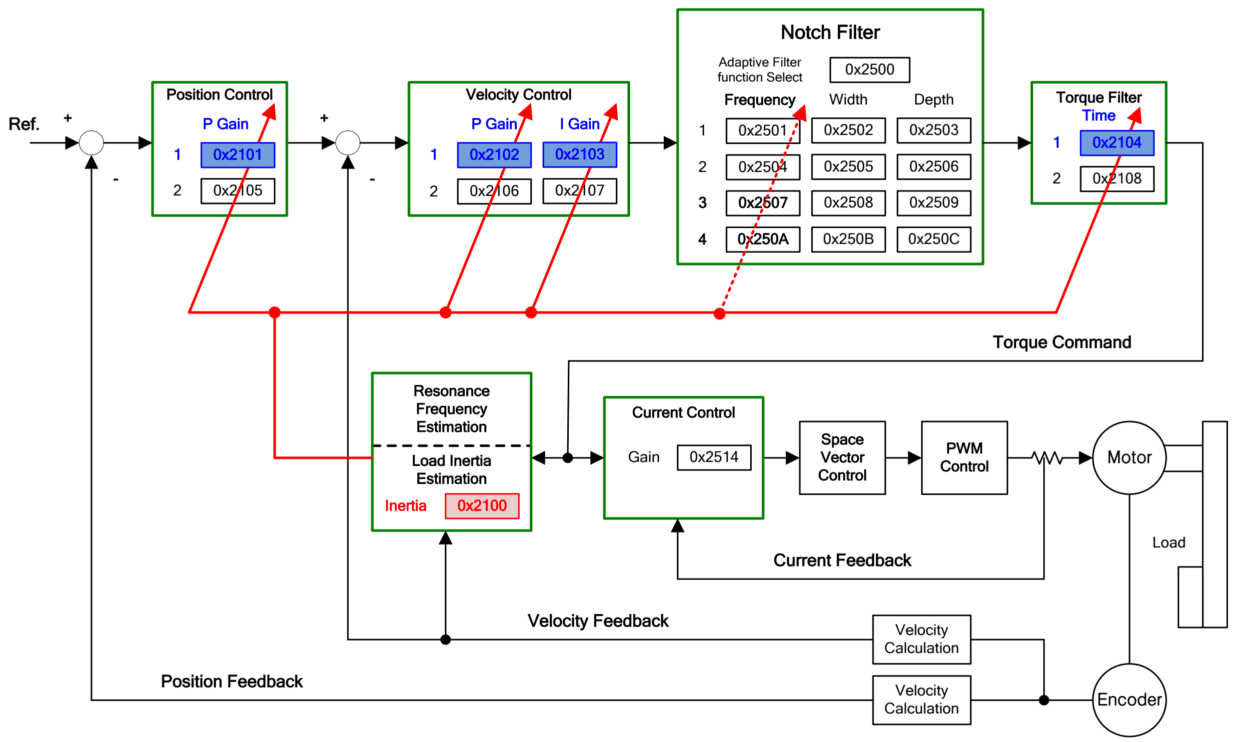
In the following cases, incorrect inertia ratio may be estimated during online auto tuning.

- When the load change is excessive
- In the case of a system with too much backlash or excessively low rigidity of the load
- When the load is too small (3 times or below) or too large (20 times or above)
- When the acceleration/deceleration torque is not sufficient as acceleration and deceleration are too small (10% of the rating or less)
- When rotation speed is low (10% of the rating or less)
- When friction torque is high

If normal inertia is not estimated due to the above conditions or during online auto tuning, carry out offline gain tuning.

■ Parameters that Change after Tuning

- Inertia ratio (0x2100), position loop gain 1 (0x2101), speed loop gain 1 (0x2102), speed integral time constant 1 (0x2103), torque command filter time constant 1 (0x2104)
- Notch filter 3, 4 frequency (0x2507, 0x250A) → Refer to the auto notch setting function



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x250D		On-line Gain Tuning Mode	UINT	RW	No	-
0x250E		System Rigidity for Gain Tuning	UINT	RW	No	-
0x250F		On-line Gain Tuning Adaptation Rate	UINT	RW	No	-

7.3 Manual Gain Tuning

7.3.1 Gain Tuning Sequence

For a cascade-type controller, tune the speed controller gain located at the inner position first, and then tune the position controller gain located at the outer position.

In other words, tune the gains in the following order: proportional gain → integral gain → feedforward gain.

The role of each individual gain is as follows:

- Proportional gain: Determines the controller BW.
- Integral gain: Determines the steady-state error, and generates an overshoot.
- Feedforward gain: Enhances the system lag characteristic.
- Differential gain: Plays the role of damper for the system (not provided)

■ Speed Controller Tuning

(1) Inertia ratio setting

- Use the automatic inertia estimation function or carry out manual setting.

(2) Proportional gain setting

- Monitor torque and noise before any vibration occurs.

(3) Integral gain setting

- Monitor the speed overshoot and the steady-state error.
- You can use the P/PI switching mode if you want to increase the integral gain but overshoot occurs.
- For this drive, the integral gain is set to the integral time constant.

(4) Speed command filter and speed feedback filter setting

■ Position Controller Tuning

(1) Proportional gain setting

- Monitor torque, position error, and noise before any vibration occurs.

(2) Feedforward setting

- Position error monitoring
- Able to set the feedforward filter.
- Set the filter if you want to increase the feedforward value but noise occurs.
- You can set the feedforward value from 0% to 100%, which is the ratio of the position command value currently being entered and the deviation.

(3) Able to set the position command filter

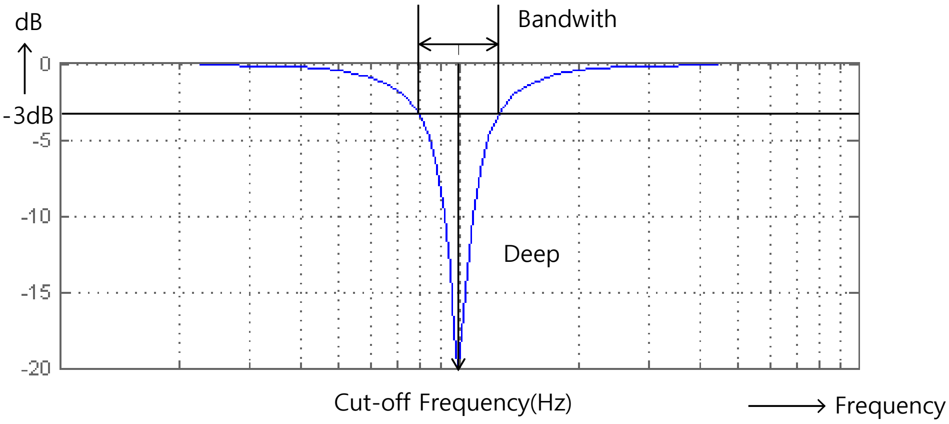
- You can smooth out the position command.

7.4 Vibration Control

7.4.1 Notch Filter

A notch filter is a band-stop filter to eliminate specific frequency component. You can use a notch filter to eliminate the resonant frequency component of an apparatus, thereby avoiding vibrations while setting a higher gain.

This drive provides notch filters with 4 steps in total. You can set the frequency, width, and depth for each filter. You can use one or two notch filters as an adaptive filter, setting the frequency and the width automatically through real-time frequency analysis (FFT).



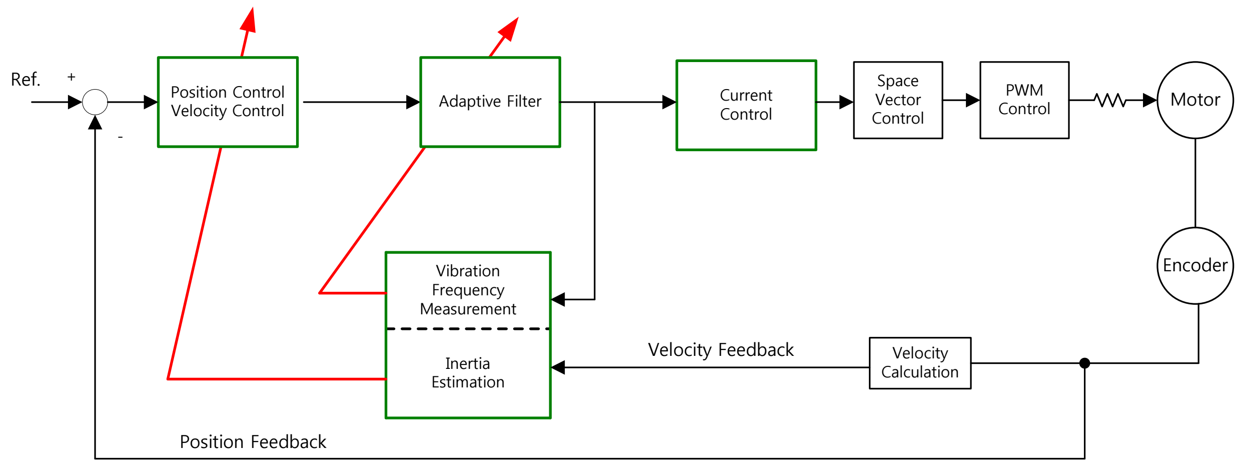
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2501	-	Notch Filter 1 Frequency	UINT	RW	No	Hz
0x2502	-	Notch Filter 1	UINT	RW	No	-
0x2503	-	Notch Filter 1 Depth	UINT	RW	No	-
0x2504	-	Notch Filter 2 Frequency	UINT	RW	No	Hz
0x2505	-	Notch Filter 2 Width	UINT	RW	No	-
0x2506	-	Notch Filter 2 Depth	UINT	RW	No	-
0x2507	-	Notch Filter 3 Frequency	UINT	RW	No	Hz
0x2508	-	Notch Filter 3 Width	UINT	RW	No	-
0x2509	-	Notch Filter 3 Depth	UINT	RW	No	-
0x250A	-	Notch Filter 4 Frequency	UINT	RW	No	Hz
0x250B	-	Notch Filter 4 Width	UINT	RW	No	-
0x250C	-	Notch Filter 4 Depth	UINT	RW	No	-

7.4.2 Adaptive Filter

An adaptive filter analyzes the real-time frequency of the vibration frequency, generated from the load during drive operation, through the speed feedback signal and automatically configures a notch filter to reduce vibrations.

It can detect the vibration frequency through frequency analysis to automatically configure one or two notch filters. At this time, the frequency and width are automatically set and the depth setting value is used as it is.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2500	-	Adaptive Filter Function Setting	UINT	RW	No	-

- Adaptive filter function setting (0x2500)

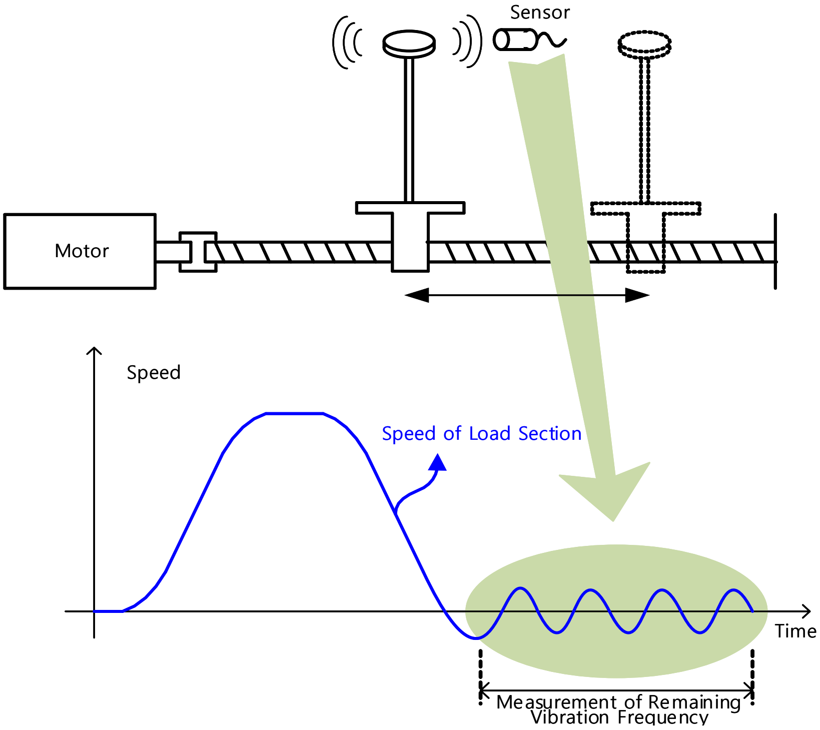
Settings	Setting details
0	Adaptive filter is not used.
1	Only one adaptive filter is used. You can check the settings configured automatically in the notch filter 3 settings (0x2507, 0x2508, 0x2509). If an arbitrary value is set in notch filter 3, auto setting is not available. If you wish to use auto setting, you should initialize notch filter 3 first.
2	Two adaptive filters are used. You can check the settings configured automatically in the notch filter 3 (0x2507, 0x2508, 0x2509) and filter 4 settings (0x250A, 0x250B, 0x250C). If an arbitrary value is set for notch filter 3 (or 4), auto setting is applied to notch filter 4 (or 3). If arbitrary values are set for notch filter 3 and 4, the original settings remain unchanged. If notch filter 3 and 4 are initialized, auto setting is available.
3	Reserved
4	Resets the notch filter 3 (0x2507, 0x2508) and notch filter 4 (0x250A, 0x250B, 0x250C) settings.
5	Reserved

7.4.3 Vibration Control (Damping) Filter

A vibration control (damping) filter can reduce the vibrations that occur in the load.

It measures the vibration frequency generated for the load using an external sensor. It uses the measurement as data for the objects related to the vibration control (damping) filter. This drive provides vibration control filters with 2 steps in total. You can set the frequency and damping amount for each filter.

It controls the low frequency range (1Hz -100 Hz) that is generated from the top of the device or the overall system. It can only operate in position control mode.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2515	-	Vibration control (damping) filter function setting	UINT	RW	No	-
0x2516	-	Vibration control (damping) filter 1 frequency	UINT	RW	No	0.1[Hz]
0x2517	-	Vibration control (damping) filter 1 coefficient	UINT	RW	No	-
0x2518	-	Vibration control (damping) filter 2 frequency	UINT	RW	No	0.1[Hz]
0x2519	-	Vibration control (damping) filter 2 coefficient	UINT	RW	No	-

- Vibration control filter function setting (0x2515)

Settings	Setting details
0	Vibration control (damping) filter is not used.
1	Vibration control (damping) filters 1 and 2 are used.
2	Vibration control (damping) filters 1 and 2 are used according to LVSF1 and LVSF2 inputs.

8. Procedure Function

The procedure function is an auxiliary function provided by the drive as described below. It can be executed by the procedure command code (0x2700) and procedure command factor (0x2701). It can be activated using the servo setting tool.

Procedure command	Code	Details
Manual JOG	0x0001	Manual jog operation
Program JOG	0x0002	Programmed jog operation
Alarm History Reset	0x0003	Deleting alarm history
Off-Line Auto-Tuning	0x0004	Offline auto-tuning
Index Pulse Search	0x0005	Phase Z position search
Absolute Encoder Reset	0x0006	Absolute encoder reset
Max. Load Torque Clear	0x0007	Instantaneous maximum operation overload value reset (0x2604)
Calibrate Phase Current Offset	0x0008	Phase current offset tuning
Software Reset	0x0009	Software reset
Commutation	0x000A	Commutation

8.1 Manual Jog Operation

A jog operation is a function that verifies the servo motor operation by speed control without an upper level controller.

Before starting the jog operation, make sure of the following:

- The main power is turned on;
- The STO (Safe Torque Off) connector is connected;
- no alarms go off;
- the servo is turned off;
- the operation speed is set with consideration to the apparatus state.

■ Related Objects

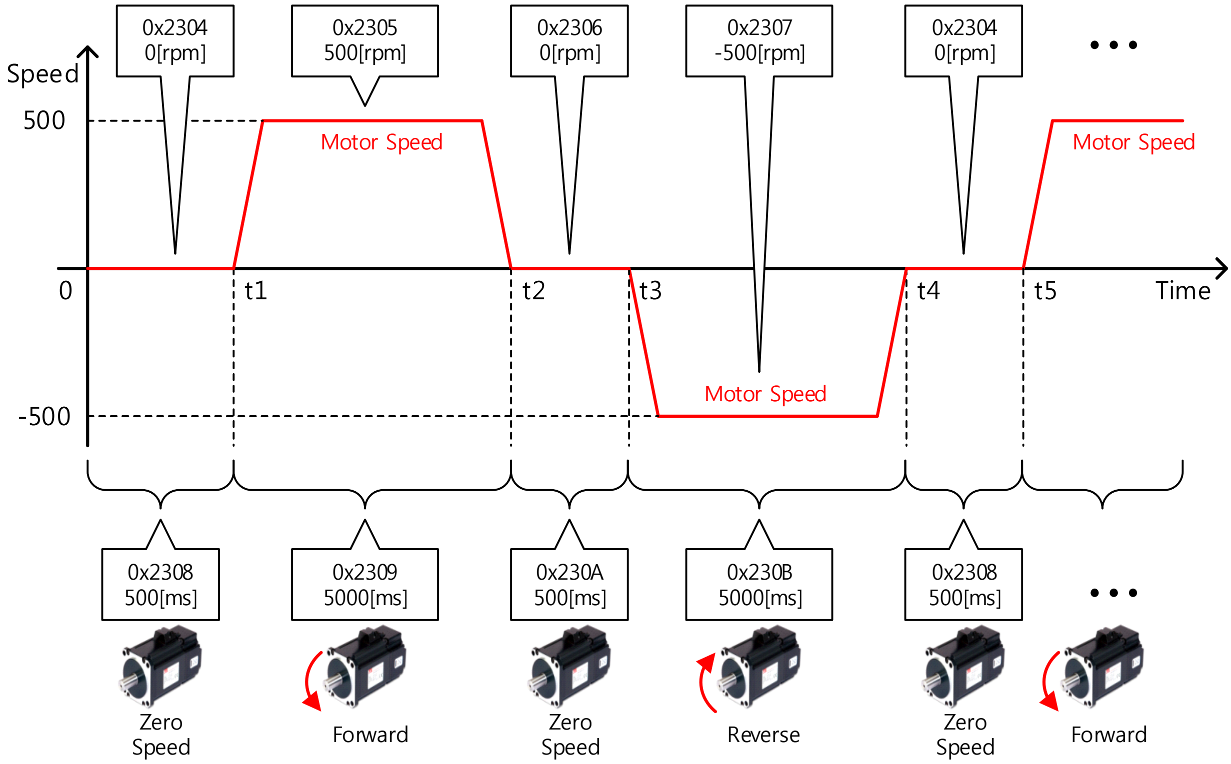
Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2300	-	Jog Operation Speed	INT	RW	No	rpm
0x2301	-	Speed Command Acceleration Time	UINT	RW	No	ms
0x2302	-	Speed Command Deceleration Time	UINT	RW	No	ms
0x2303	-	Speed Command S-curve Time	UINT	RW	No	ms

8.2 Programmed Jog Operation

A programmed jog operation is a function that verifies the servo motor operation by speed control at the preset operation speed and time without an upper level controller.

Before starting the jog operation, make sure of the following:

- The main power is turned on;
- The STO (Safe Torque Off) connector is connected;
- no alarms go off;
- the servo is turned off;
- the speed and time settings are set with consideration to the state and operation range of the apparatus.



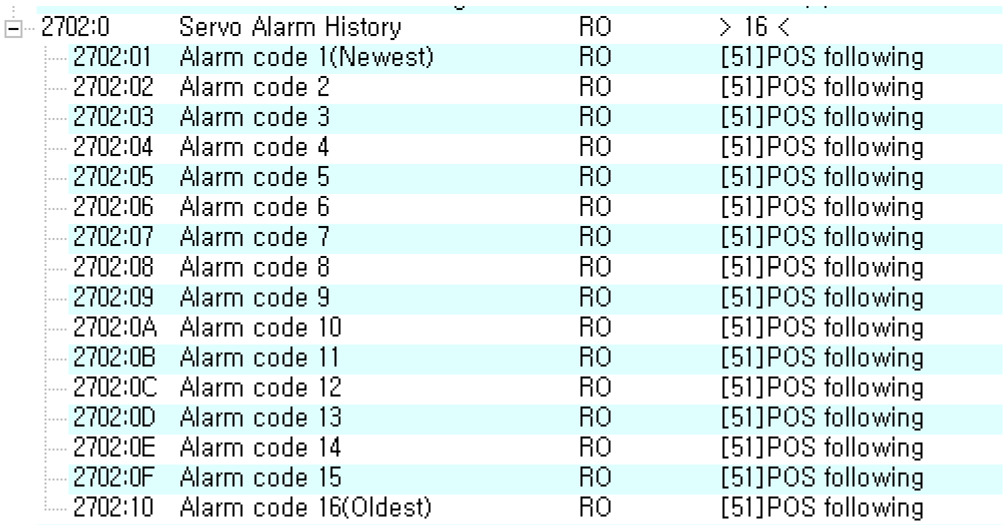
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2304	-	Programmed Jog Operation Speed 1	INT	RW	No	rpm
0x2305	-	Programmed Jog Operation Speed 2	INT	RW	No	rpm
0x2306	-	Programmed Jog Operation Speed 3	INT	RW	No	rpm
0x2307	-	Programmed Jog Operation Speed 4	INT	RW	No	rpm
0x2308	-	Programmed Jog Operation Time 1	UINT	RW	No	ms
0x2309	-	Programmed Jog Operation Time 2	UINT	RW	No	ms
0x230A	-	Programmed Jog Operation Time 3	UINT	RW	No	ms
0x230B	-	Programmed Jog Operation Time 4	UINT	RW	No	ms

8.3 Deleting Alarm History

This function deletes all of the alarm code history stored in the drive. Alarm history items are stored chronologically starting with the latest alarm up to 16 recent alarms.

You can check them below (0x2702:01 - 16). The newest alarm is listed in 0x2702:01.



2702:0	Servo Alarm History	RO	> 16 <
2702:01	Alarm code 1(Newest)	RO	[51]POS following
2702:02	Alarm code 2	RO	[51]POS following
2702:03	Alarm code 3	RO	[51]POS following
2702:04	Alarm code 4	RO	[51]POS following
2702:05	Alarm code 5	RO	[51]POS following
2702:06	Alarm code 6	RO	[51]POS following
2702:07	Alarm code 7	RO	[51]POS following
2702:08	Alarm code 8	RO	[51]POS following
2702:09	Alarm code 9	RO	[51]POS following
2702:0A	Alarm code 10	RO	[51]POS following
2702:0B	Alarm code 11	RO	[51]POS following
2702:0C	Alarm code 12	RO	[51]POS following
2702:0D	Alarm code 13	RO	[51]POS following
2702:0E	Alarm code 14	RO	[51]POS following
2702:0F	Alarm code 15	RO	[51]POS following
2702:10	Alarm code 16(Oldest)	RO	[51]POS following

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2702	-	Servo Alarm History	-	-	-	-
	1	Alarm code 1 (Newest)	STRING	RO	No	-
	2	Alarm code 2	STRING	RO	No	-
	3	Alarm code 3	STRING	RO	No	-
	4	Alarm code 4	STRING	RO	No	-
	5	Alarm code 5	STRING	RO	No	-
	6	Alarm code 6	STRING	RO	No	-
	7	Alarm code 7	STRING	RO	No	-
	8	Alarm code 8	STRING	RO	No	-
	9	Alarm code 9	STRING	RO	No	-
	10	Alarm code 10	STRING	RO	No	-
	11	Alarm code 11	STRING	RO	No	-
	12	Alarm code 12	STRING	RO	No	-
	13	Alarm code 13	STRING	RO	No	-
	14	Alarm code 14	STRING	RO	No	-
	15	Alarm code 15	STRING	RO	No	-
	16	Alarm code 16	STRING	RO	No	-

8.4 Auto Gain Tuning

For more information, refer to Section 7.1 Auto Gain Tuning.

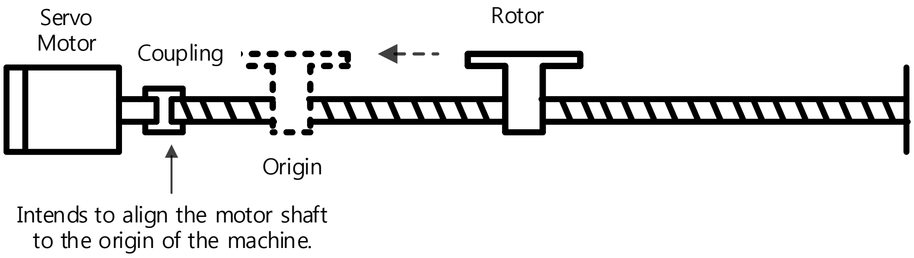
8.5 Index Pulse Search

Index pulse search function is to find the Index (Z) pulse position of the encoder and stop. You can use this function to locate a position roughly since it searches for a position using the speed operation mode. You can locate the exact position of the index pulse using the homing operation.

The speed to search for the index pulse is set in 0x230C [rpm].

Before starting the index pulse search, make sure that:

- the main power is turned on;
- no alarms go off;
- the servo is turned off;
- the Safety Torque Off (STO) connector is installed
- the operation speed is set with the consideration of the operation range of the machine.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x230C	-	Index Pulse Search Speed	INT	RW	No	rpm

8.6 Absolute Encoder Reset

This function resets the absolute encoder. You need to reset the absolute encoder in the following cases:

- When you set up the apparatus for the first time
- an alarm for low encoder voltage occurs; or
- When you want to set the multi-turn data of the absolute encoder to 0

When the absolute encoder reset is complete, the multi-turn data (0x260A) is reset to 0.

After turning on the power again, the actual position value (0x6064) is displayed by reading the position of the absolute encoder and applying the home offset (0x607C).
At the time, even if you change the home offset (0x607C) while driving, the actual position value (0x6064) does not change.

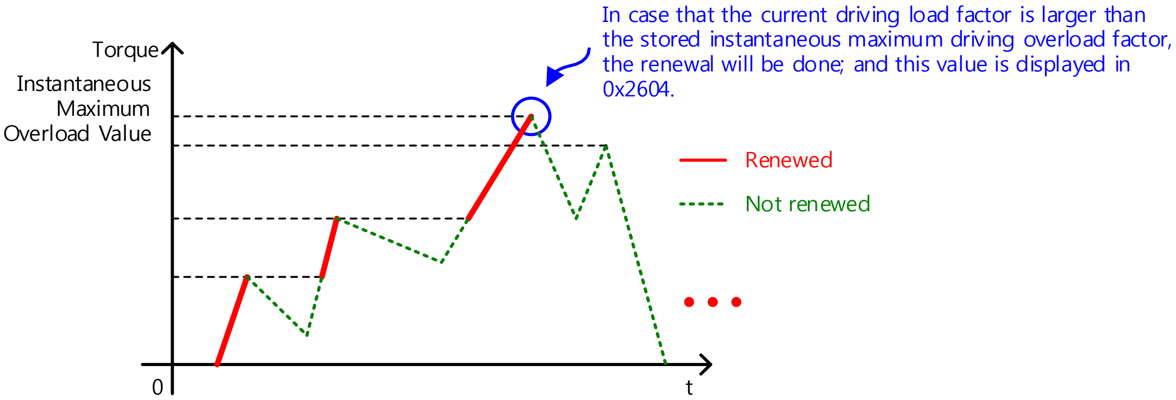
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2005	-	Absolute Encoder Configuration	UINT	RW	No	-
0x260A		Multi-Turn Data	DINT	RO	Yes	rev

8.7 Instantaneous Maximum Torque Initialization

This function initializes the instantaneous maximum overload rate (0x2604) to 0. The instantaneous maximum operation overload rate represents the maximum value of the operation overload rate output instantaneously from the drive for the last 15 seconds.

It displays the peak load for the last 15 seconds as a percentage of the rated output. The unit is 0.1%. Power cycling will reset it to 0.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2604	-	Instantaneous Maximum Operation Overload	INT	RO	Yes	0.1%

8.8 Phase Current Offset Tuning

This function is to automatically tune the current offset of the U, V, W phases. Depending on the environmental conditions, you can tune the phase current offset for use. The offset is tuned by the factory default settings.

Measured U-/V-/W-phase offsets are individually stored in 0x2015, 0x2016, and 0x2017. If an offset is too large, an AL-15 will be generated.

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2015	-	Phase U Current Offset	INT	RW	No	0.1%
0x2016	-	Phase V Current Offset	INT	RW	No	0.1%
0x2017	-	Phase W Current Offset	INT	RW	No	0.1%

8.9 Software Reset

This function is to reset the servo drive by means of software. Software reset means restarting the drive program, resulting in an effect similar to power cycling.

You can use this function in the following cases:

- When changing the parameter settings that require power cycling
- When you have to restart the drive due to an alarm that cannot be reset

8.10 Commutation

The commutation function gets information about the initial angle of the motor. When using a motor that is not equipped with a hall sensor, you have to get information about the initial angle through commutation prior to operation, in order to carry out normal operations.

■ Related Objects

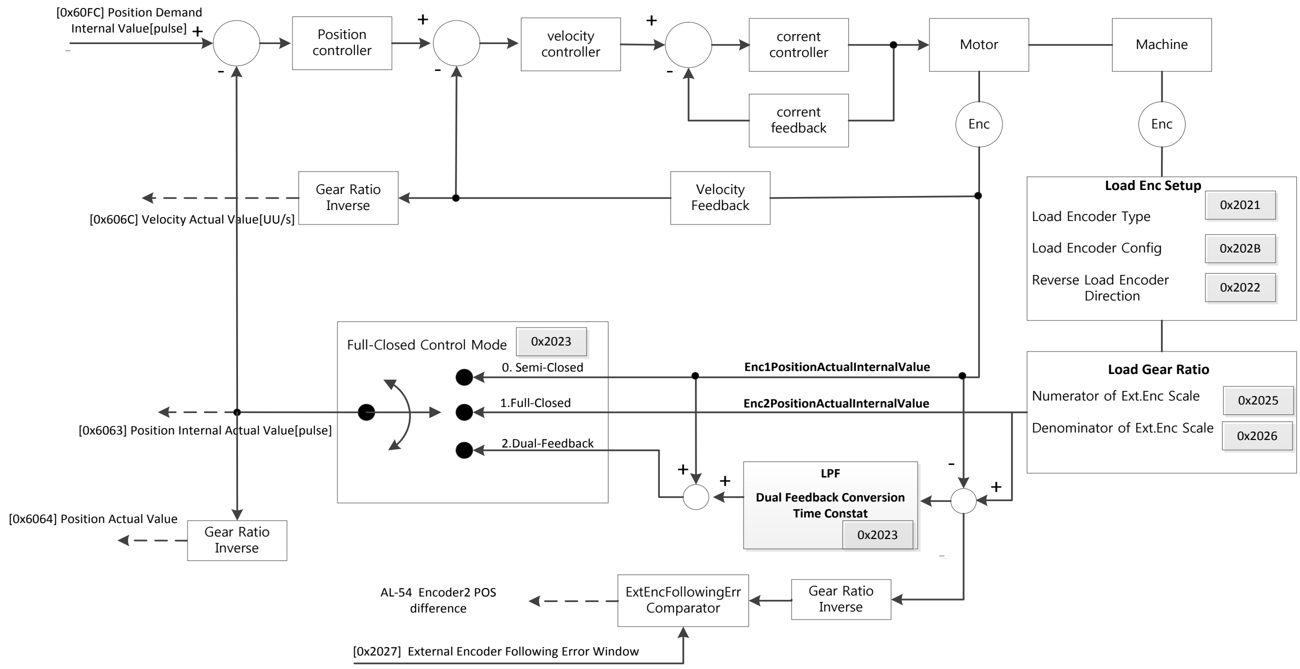
Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2019	-	Linear Scale Resolution	UINT	RW	No	nm
0x201A	-	Commutation Method	UINT	RW	No	-
0x201B	-	Commutation Current	UINT	RW	No	0.1%
0x201C	-	Commutation Time	UINT	RW	No	ms

9. Full-Closed Control

The full-closed control function is used to read the position feedback signals from a linear encoder and various encoders on the load side. You can configure the desired system and carry out precision position control without being affected by mechanical system errors. Basically, the full-closed control system uses the external position sensor on the load side to carry out position control. The motor-side encoder is used for speed control. A dual feedback control system, which combines the full-closed control and semi-closed control, can provide a faster response by using the position data of the high-speed rotating motor encoder and the load-side external encoder.

9.1 Full-Closed Control Internal Configuration

The internal configuration of full-closed control is shown below.



Function	Details	
Semi-Closed Control	It carries out position control based on the encoder information from the motor.	
	Advantages	Since it is rarely affected by the vibrations of the machine, you can raise the servo gain to shorten the adjustment time.
	Disadvantages	The machine's accuracy can be lowered due to the vibrations of the machine even when the motor is not running.

<table>
<tr><td rowspan="3">Full-Closed Control</td><td colspan="2">It carries out position control based on information from the position sensor that is separately mounted on the machine.</td></tr>
<tr><td>Advantages</td><td>The machine's accuracy can be controlled regardless of whether the motor is running or is stationary.</td></tr>
<tr><td>Disadvantages</td><td>Since it is easily affected by the vibrations of the machine, it cannot raise the servo gain too much and the adjustment time may take longer.</td></tr>
<tr><td rowspan="3">Dual-Feedback Control</td><td colspan="2">It carries out position control using the position sensor information from either the motor or the machine.
It has advantages when the sampling rate is low in the external encoder.</td></tr>
<tr><td>Advantages</td><td>It operates based on the position information from the motor while the motor is running and from the machine while the motor is stationary to raise the gain and shorten the adjustment time. It can stop the motor with the accuracy of the machine to improve control performance.</td></tr>
<tr><td>Disadvantages</td><td></td></tr>
</table>

9.2 Full-Closed Control Parameter Settings

You can set the full-closed control parameters in the following order.

A. Setting the full-closed control mode

0x2023	Setting the full-closed control mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2	0	-	RW	No	Power cycling	Yes

This sets the full-closed control mode.

Settings	Setting details
0	Semi-Closed Control (controls using only the motor-side encoder, default value)
1	Full-Closed Control (controls using the load-side position sensor)
2	Dual-Feedback Control (controls using the motor-side encoder and load-side position sensor)

B. Setting the load encoder-type

0x2021	Setting the load encoder type						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

This sets the second encoder type on the load side.

Settings	Setting details
0	Incremental encoder: Pulse type incremental encoder
1	SSI encoder: Serial communication type incremental encoder

C. Entering load encoder information

0x202B	Setting the load encoder						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	13	-	RW	No	Power cycling	Yes

This sets the second encoder, which is attached to the load side.

The settings below change depending on the setting of the encoder type 1. Do not set the reserved bit.

<table>
<tr><th>Bit</th><th>Description (if encoder type is quadrature)</th></tr>
<tr><td>3~0</td><td>Debounce filter settings
<table>
<tr><td>Settings</td><td>Cutoff Frequency</td></tr>
<tr><td>0</td><td>No Filter</td></tr>
<tr><td>1</td><td>5.000MHz</td></tr>
<tr><td>2</td><td>3.330MHz</td></tr>
<tr><td>3</td><td>2.500MHz</td></tr>
<tr><td>4</td><td>2.000MHz</td></tr>
<tr><td>5</td><td>1.667MHz</td></tr>
<tr><td>6</td><td>1.429MHz</td></tr>
<tr><td>7</td><td>1.250MHz</td></tr>
</table></td></tr>
</table>

	8	1.000MHz
	9	0.833MHz
	10	0.714MHz
31~4	Reserved	

Bit	Description (if encoder type is SSI)
0-7	Number of data bits
8-15	Number of bits for rotary multi-turn data (For a linear encoder, the setting value is irrelevant.)
16	Whether to ignore the first bit (0: one start bit, 1: two start bits)
17	Coding(0:binary, 1:gray)
20-23	Number of align bits
24-27	Clock rate (0:10Mhz, 1:5Mhz, 2:2.5Mhz, 3:1.25Mhz, 4:625Khz, 5:312.5Khz, 6:156.25Khz, 7:78.125Khz)
28	Whether error bit exists (0: No, 1: Yes)
29	Error bit logic(0:active high, 1:active low)
31~30	reserved

Setting example:

Bit	Description (if encoder type is SSI)
5~0	13
12~8	10
16	0(one start bit)
17	0
18	0
19	-
22~20	2 align bit
23	0
27-24	2
28	0
29	0
31~30	-

D. Setting the load encoder direction

0x2022	Setting the load encoder direction						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

This sets the rotation direction based on the installation direction of the load-side encoder.

Settings	Setting details
0	Forward (CCW)
1	Reverse (CW)

E. Motor encoder - setting the load encoder scale

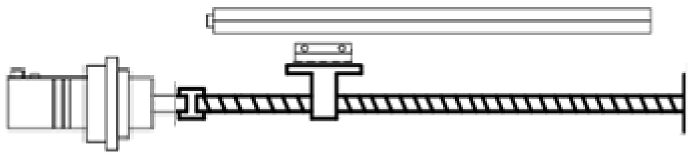
0x2025	Setting the external encoder scale (numerator)						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2147483647	0	-	RW	No	Power cycling	Yes

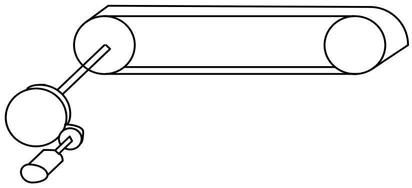
0x2026	Setting the external encoder scale (denominator)						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2147483647	0	-	RW	No	Power cycling	Yes

This sets the numerator/denominator scale for the external encoder to ensure the same scale as the motor encoder,

Examples of scale setting methods

1. Direct connection structure	This sets the scale so the number of external encoder pulses can be calculated based on the number of encoder pulses per motor rotation.
Motor encoder specifications	524288[pulse/rev]
Amount of load movement/revolution	12000[pulse/rev]
Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses $12000(\text{Number of external encoder pulses}) \times \frac{524288(\text{Numerator})}{12000(\text{Denominator})}$ $= 524288\ (\text{Number of motor encoder pulses})$

2. Reducer structure	 - Reduction ratio: 1/10 - Ball screw lead: 20 mm - Linear encoder (external encoder): 4 um If the 1/10-ratio reducer is installed on the motor, the reducer shaft rotates 1/10 turns per motor rotation. So, the scale is calculated by multiplying the deceleration ratio with the number of external encoder pulses.
Motor encoder specifications	524288[pulse/rev]
Amount of load movement/revolution	The movement of the table per rotation of the servo motor equipped with a 1/10 reducer is (1/10) * 20 mm = 2 mm. The number of external encoder pulses is calculated as 2 mm / 4 um = 500 pulses.
Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses $500(\text{Number of external encoder pulses}) \times \frac{524288(\text{Numerator})}{500(\text{Denominator})}$ $= 524288(\text{Number of motor encoder pulses})$

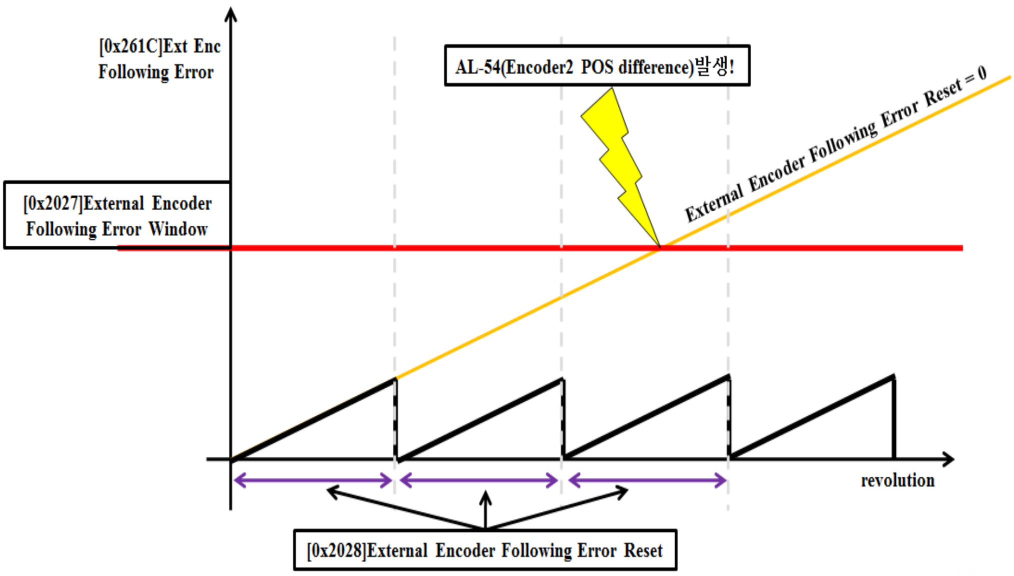
3. Belt-pulley structure	 - Motor-side pulley diameter: 30 mm - Rotary-side pulley diameter: 20 mm - External encoder resolution: 20000 pulse/rev In the case of a gear and belt-pulley system, the final gear ratio is calculated and the gear ratio is multiplied by the number of external encoder pulses to produce the scale.
Motor encoder specifications	524288[pulse/rev]
Amount of load movement/revolution	The external encoder rotates at a ratio of 30 / 20 per servo motor rotation. The number of pulses for the external encoder is calculated as 20000 x (3/2) = 30000 pulses.
Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses $30000(\text{Number of external encoder pulses}) \times \frac{524288(\text{Numerator})}{30000(\text{Denominator})}$ $= 524288(\text{Number of motor encoder pulses})$

F. Setting the load encoder position error level and initialization

0x2027	Setting the excessive external encoder position error						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 2147483647	100000	pulse	RW	No	Power cycling	Yes

0x2028	Setting the reset unit of the external encoder position error						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 10000	10	Revolution	RW	No	Power cycling	Yes

This sets the position error level for the external encoder and the reset range for the error position value.



Based on the 0x2027 (External Encoder Following Error Window) settings, the AL-54 (Encoder2 POS difference) level can be adjusted.

For a system where a slip occurs, the 0x2028 (External Encoder Following Error Reset) settings can be used to set the normal slip range for the following error value.

G. Setting the dual-feedback filter time constant

0x2024	Setting the dual-feedback filter time constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	0.1ms	RW	No	Always	Yes

In the case of dual-feedback control that refers to an external encoder, the filter time constant is set to 0.1 ms at the time when the mode switches between semi-closed control and full-closed control.

As the setting value gets close to 0 ms, it refers to the external encoder more. As it gets close to 100 ms, it refers to the motor-side encoder more. It minimizes the vibrations that are generated due to mechanical characteristics or external factors to shorten the adjustment time.

Example of setting the dual-feedback filter time constant

H. Setting the dual-feedback filter time constant

0x2029	Setting the external encoder Z phase						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

This setting determines whether to detect the Z phase signal when the external encoder is Quadrature.

10. Object Dictionary

Object is a data structure including parameters, state variables, run commands (procedures), etc. within a drive.

Object can be mainly divided into general object (from 0x1000) for EtherCAT communication, CiA402 object (from 0x6000) for CAN application over EtherCAT (CoE), and manufacturer specific object (from 0x2000) exclusively provided by this drive.

10.1 General Objects

0x1000	Device Type						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0x00020192	-	RO	No	-	No

The following table lists device types and their functions.

MSB 16 15 LSB

Additional information	Device profile number
→ 0x0002 : □□□□□□	→ 0x0192 : DS402

0x1001	Error register						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	0x00	-	RO	No	-	No

The following table shows the error register values for each device. This value is stored in the emergency message.

Bit	Setting details
0	0: No error
	1: Error occurs
1 to 7	Reserved

0x1008	Device Name						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

Represents the device name.

0x1009	Hardware Version						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

Represents the hardware version of the device.

0x100A	Software Version						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

Represents the software version of the device.

0x1010	Store Parameters						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	4	-	RO	No	-	No
SubIndex 1		Store all parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 2		Store communication parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 3		Store CiA402 parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 4		Store drive-specific parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No

Store the drive's parameters in the memory. To avoid any mistakes, store the parameters if the ASCII code value corresponding to "save" is written to the relevant SubIndex value.

	MSB		16 15	LSB
	e	v	a	s
ASCII Code	0x65	0x76	0x61	0x73

All parameters within the drive are stored when "save" is written to SubIndex 1.

Only communication parameters (from 0x1000) are stored when "save" is written to SubIndex 2.

Only CiA402 parameters (from 0x6000) are stored when "save" is written to SubIndex 3.

Only drive-specific parameters (from 0x2000) are stored when "save" is written to SubIndex 4.

0x1011	Restore Default Parameters						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	4	-	RO	No	-	No
SubIndex 1		Restore all parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 2		Restore communication parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 3		Restore CiA402 parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 4		Restore drive-specific parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No

Initialize the drive's parameters. To avoid any mistake, initialize the parameters if the ASCII code value corresponding to "load" is written to the relevant SubIndex value.

	MSB	16	15	LSB
	d	a	o	l
ASCII Code	0x64	0x61	0x6F	0x6C

All parameters within the drive are initialized when "load" is written to SubIndex 1.

Only communication parameters (from 0x1000) are initialized when "load" is written to SubIndex 2.

Only CiA402 parameters (from 0x6000) are initialized when "load" is written to SubIndex 3.

Only drive-specific parameters (from 0x2000) are initialized when "load" is written to SubIndex 4.

To apply the initialized value, you need to cycle the power of the drive.

0x1018	Object Information						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	4	-	RO	No	-	No
SubIndex 1		Vendor ID					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0x00007595	-	RO	No	-	No
SubIndex 2		Product code					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0x00010001	-	RO	No	-	No
SubIndex 3		Revision number					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	-	RO	No	-	No
SubIndex 4		Serial number					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	-	RO	No	-	No

Represents the device information.

0x1600	1st Receiving PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60710010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x607A0020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60600008	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		**Mapping entry 10**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

PDO Mapping :

Configure the Process Data Objects (PDO) to perform real-time data transfer through the CANopen over EtherCAT protocol. This drive can freely map up to 10 objects of PDOs for transmission/reception, respectively.

Use 0x1600 - 0x1603 to set the receiving PDO mapping, and 0x1A00 - 0x1A03 to set the transmitting PDO mapping. Configure information about the objects below that you want to assign to items 1 to 10 (SubIndex 1 - 10). You have to set the number of the objects to be assigned for the number of items (SubIndex 0).

31 16	15 8	7 0
Object index	Sub-Index	Length

Bits 0-7: Bit lengths of objects to be mapped (e.g. displayed as 0x20 for 32-bit data)

Bits 8-15: SubIndex of objects to be mapped

Bits 16-31: Index of objects to be mapped

0x1601	2nd Receiving PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x607A0020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1602	3rd Receiving PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FF0020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1603	4th Receiving PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60710010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A00	1st Transmitting PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	10	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60770010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60F40020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60610008	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x26010010	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x26000010	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A01	2nd Transmitting PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	6	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60F40020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A02	3rd Transmitting PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A03	4th Transmitting PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1C00	Sync Manager Communication Type						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	4	-	RO	No	-	No
SubIndex 1		Communication Type SM0					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	1	-	RO	No	-	No
SubIndex 2		Communication Type SM1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	2	-	RO	No	-	No
SubIndex 3		Communication Type SM2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	3	-	RO	No	-	No
SubIndex 4		Communication Type SM3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	4	-	RO	No	-	No

It represents the Sync Manager Communication Type assigned by default.

0x1C10	Sync Manager 0 PDO Assignment						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	0	-	RO	No	-	No

0x1C11	Sync Manager 1 PDO Assignment						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	0	-	RO	No	-	No

0x1C12	Sync Manager 2 PDO Assignment						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of objects assigned to PDO					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0x1600 to 0x1603	0x1601	-	RW	No	PREOP	No

0x1C13	Sync Manager 3 PDO Assignment						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of objects assigned to PDO					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0x1A00 to 0x1A03	0x1A01	-	RW	No	PREOP	No

0x1C32	Output Sync Manager Parameter						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No

SubIndex 11		Cycle exceeded counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	-	RO	No	-	No
SubIndex 12		**SM event missed counter**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	-	RO	No	-	No
SubIndex 13		**Shift too short counter**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	-	RO	No	-	No
SubIndex 32		**Sync error**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
BOOL	-	0	-	RO	No	-	No

0x1C33	Input Sync Manager Parameter						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	ns	RO	No	-	No

Subindex 11		Cycle exceeded counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	-	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
BOOL	-	0	-	RO	No	-	No

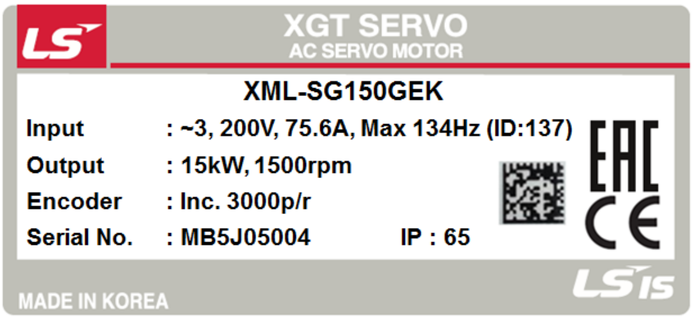
10.2 Manufacturer Specific Objects

- **Basic Setting (from 0x2000)**

0x2000	Motor ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 9999	13	-	RW	No	Power cycling	Yes

Set the motor ID. This is automatically set for the multi-turn encoders provided by LSIS. You can check the automatically set IDs. You can check the motor ID on the motor nameplate.

E.g. The motor ID is 137 on the nameplate attached to the motor shown in the figure below:



0x2001	Encoder Type						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 99	2	-	RW	No	Power cycling	Yes

Set the encoder type. You have to set it correctly by referencing the table below. However, the multi-turn encoder provided by LSIS (4 in the table below) is automatically recognized and configured regardless of these settings. Then, you can check the type of the encoder automatically recognized.

Settings	Encoder type
0	Quadrature (incremental, A lead B)
1	Quadrature (incremental, B lead A)
2	BiSS Serial (single-turn only)
3	Reserved
4	BiSS Serial Absolute (multi-turn 16-bit)
5~6	Reserved
7	Sinusoidal(1Vpp)
8	Analog Hall
9~10	Reserved
11	Tamagawa Serial (single-turn only)
12	Tamagawa Serial Absolute (multi-turn 16-bit)
13	EnDat 2.2 Serial

You can check the encoder type on the nameplate attached to the motor. Please refer to the product type of the servo motor in "1.2 Product Specifications".

0x2002	Encoder Pulse per Revolution						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 1073741824	524288	pulse	RW	No	Power cycling	Yes

Set the encoder resolution in pulse (count) based on a multiple of 4. Generally, you can check the encoder resolution on the nameplate (refer to the description of 0x2000). However, the multi-turn encoder supplied by LSIS is automatically recognized and configured regardless of these settings. Then, you can check the resolution of the encoder automatically recognized.

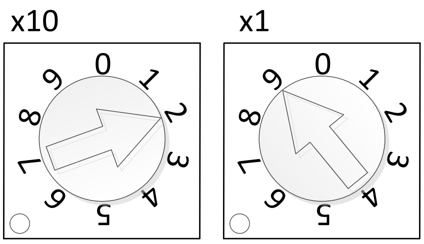
E.g. Setting for each encoder marking on the motor product nameplate

1) Inc. 3000p/r: 12000 2) Serial 20bit: 1048576 3) Serial 16/19bit: 524288

0x2003	Node ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 99	-	-	RO	No	-	No

Display the node ID configured for the node setting switch of the drive. The value of the node setting switch is read just once when the power is turned on. Any set value modified subsequently will be in effect only when the power is turned on again.

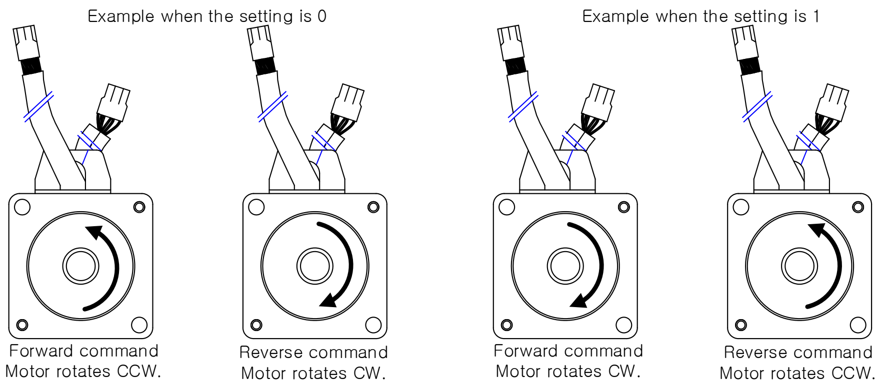
E.g. When the node ID is set to 29



0x2004	Rotation Direction Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

Set the rotation direction of the motor. You can change the rotation direction with this setting when the direction is changed between positive and negative relative to the user at the final apparatus section.

Settings	Description
0	With a positive command, the motor rotates counterclockwise. Then, the position feedback value increases.
1	With a positive command, the motor rotates clockwise. Then, the position feedback value increases.



0x2005	Absolute Encoder Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	1	-	RW	No	Power cycling	Yes

Set the usage of the absolute encoder.

Settings	Description
0	Uses the absolute encoder as the absolute encoder. Uses the multi-turn data.
1	Uses the absolute encoder as the incremental encoder. Does not use the multi-turn data. Does not display any battery-related alarm/warning.

0x2006	Main Power Input Mode Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 255	0	-	RW	No	Always	Yes

Specifies the main power input mode and the processing method if phase loss occurs.

Bit	Function	Value	Setting details
3~0	Sets the main power input.	0	Single-phase Power Input
		1	3-phase Power Input
		2	DC Power Input
7~4	Processing method in case of main power phase loss	0	Processes the phase loss as alarm (AL-42) in case of main power phase loss.
		1	Processes the phase loss as warning (W-01) in case of main power phase loss.

0x2007	Main Power Fail Check Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	20	ms	RW	No	Always	Yes

This specifies the checking interval for main power phase loss. This function detects instantaneous voltage drop or voltage sag, which may occur in a short period of time depending on the condition of external power input, to check the main power phase loss. Set this function properly according to the condition of external power input.

0x2008	7SEG Display Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 100	0	-	RW	Yes	Always	Yes

This specifies items to display in the 7SEG window.

Settings	Displayed item	Unit	Description
0	Operation status	-	
1	Speed feedback	rpm, mm/s	
2	Speed command	rpm, mm/s	
3	Torque feedback	0.1%	
4	Torque command	0.1%	
5	Accumulated operation overload	0.1%	
6	DC link voltage	V	
7	Accumulated Regeneration Overload	0.1%	
8	Mechanical angle	0.1deg	
9	Electrical angle	0.1deg	
10	Inertia ratio	%	
11	Drive temperature 1	℃	Temperature near the drive power element
12	Drive temperature 2	℃	Internal temperature of drive
13	Encoder temperature 1	℃	Internal temperature of encoder
14	Node ID	-	
15	Instantaneous maximum load factor	0.1%	Instantaneous maximum load factor for 15 seconds
16	Root Mean Square (RMS) load factor	0.1%	Root Mean Square (RMS) load factor for 15 seconds

0x2009	Regenerative resistance setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Always	Yes

Perform regenerative resistance-related setting.

Settings	Description
0	Use the regenerative resistance installed in the drive.
1	Uses regenerative resistor separately installed outside the drive. Ensure that the value (0x200B) and capacity (0x200C) of the regenerative resistor are set correctly. * Notes Power supply wiring (2.4)

0x200A	Regenerative Resistor Derating Factor setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 200	100	%	RW	No	Always	Yes

This specifies the derating factor which checks for regenerative resistance overloads. When the derating is set to a value no more than 100%, regeneration overload alarm (AL-23) will be triggered quickly. On the other hand, when it is set to a value more than 100%, the alarm will be triggered slowly. Change the setting values according to the heat radiation condition of the regenerative resistor used. Especially, when you set the derating to a value more than 100%, you have to consider the heat radiation condition.

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0x200B	Regenerative resistance value setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	ohm	RW	No	Always	Yes

When using an external regenerative resistor (0x2009=1), set the regenerative resistance in ohm. When using an internal regenerative resistor (0x2009= 0), no setting values will be applied.

0x200C	Regenerative resistance capacity setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 30000	0	watt	RW	No	Always	Yes

When using an external regenerative resistor (0x2009=1), set the regenerative resistance capacity in watt. When using an internal regenerative resistor (0x2009= 0), no setting values will be applied.

0x200D	Maximum regenerative resistance capacity setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 50000	100	watt	RW	No	Always	Yes

When using an external regenerative resistor (0x2009=1), set the maximum allowable capacity of the regenerative resistance in watt. When using an internal regenerative resistor (0x2009= 0), no setting values will be applied.

0x200E	Allowed time at maximum regenerative resistance capacity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 50000	5000	ms	RW	No	Always	Yes

When using an external regenerative resistor (0x2009=1), set the allowed time at the maximum regenerative resistance capacity (0x200D) in watt. When using an internal regenerative resistor (0x2009= 0), no setting values will be applied.

0x200F	Overload Detection Base Load Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	10 to 120	100	%	RW	No	Always	Yes

This indicates the load factor at which operation overload starts to accumulate. When this is set to a value that is 100 or less, operation overload will start to accumulate earlier at the set load factor resulting in the operation overload alarm (AL-21) being triggered early. If the heat radiation condition of the drive is poor, configure the setting to no more than 100% to trigger an overload alarm earlier.

0x2010	Overload Warning Level Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	10 to 100	50	%	RW	No	Always	Yes

This specifies the output level of the accumulated operation overload warning (W10). When the accumulated operation overload rate (0x2603) reaches the set value, a warning will be output. With this setting, you can identify the time when you need to take an appropriate action before an accumulated operation overload alarm occurs.

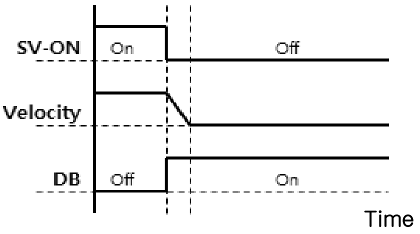
0x2011	PWM Off Delay Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	10	ms	RW	No	Always	Yes

This specifies the delay time until the PWM actually turns off after running the servo off command. When using a motor with a brake installed on the vertical axis, you can output the brake signal first, and then turn off the PWM after this set time, in order to prevent it from running down along the axis.

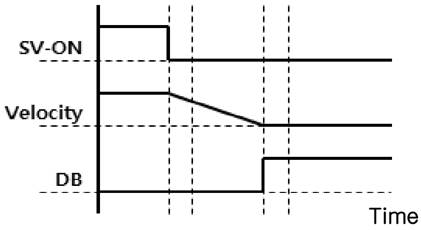
0x2012	Dynamic Brake Control Mode Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 3	0	-	RW	No	Always	Yes

This specifies the control mode of the dynamic brake upon servo off.

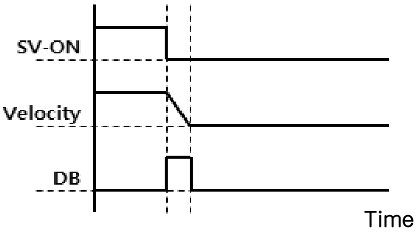
Settings	Description
0	Hold the dynamic brake after stopping the motor using the brake
1	Release the dynamic brake after stopping the motor using the brake
2	Release the dynamic brake after free-run stop
3	Hold the dynamic brake after free-run stop



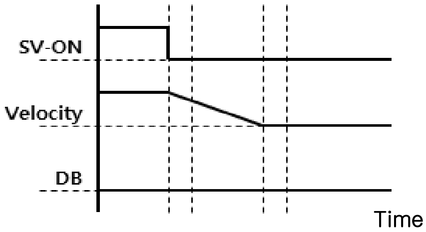
Hold after a DB stop



Hold after a free run stop



Release after a DB stop



Release after a free run stop

0x2013	Emergency Stop Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Storage
UINT	0 to 1	1	-	RW	No	Always	Yes

This specifies the method to stop the drive on emergency stop (when entering POT, NOT, or ESTOP). In torque control mode, the decelerating to stop mode using emergency stop torque is not applied.

Setting values	Details
0	The motor will stop according to the method set in the dynamic brake control mode (0x2012). It will stop using the dynamic brake, and then maintain the torque command at 0.
1	Decelerates to stop using the emergency stop torque (0x2113).

0x2014	Warning Mask Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to FFFFhex	0	-	RW	Yes	Always	Yes

When a warning occurs, the warning masked by this setting will not be triggered.

Bit	Warning Code	Warning Name
0	W01	Main power phase loss
1	W02	Low voltage of encoder battery
2	W04	Software position limit
3	-	-
4	W10	Operation overload

Bit	Warning Code	Warning Name
5	W20	Abnormal combination of drive and motor, I/O Configuration
6	W40	Low voltage
7	W80	Emergency signal input
8~14	-	-
15	STO	When STO is not connected, Statusword fault bit set

0x2015	U Phase Current Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-1000 to 1000	0	0.1%	RW	No	Always	Yes

Manually set the U phase current offset. The configured offset value is subtracted from the measured current value, and then applied as an actual current value. Do not manually set the offset if you do not know the exact setting value. You can check the automatically-tuned value if you tune the current offset with the procedure function (refer to the description of 0x2700).

0x2016	Phase V Current Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-1000 to 1000	0	0.1%	RW	No	Always	Yes

Manually set the V-phase current offset. The configured offset value is subtracted from the measured current value, and then applied as the actual current value. Do not manually set the offset if you do not know the exact setting value. You can check the automatically-tuned value if you tune the current offset with the procedure function (refer to the description of 0x2700).

0x2017	Phase W Current Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-1000 to 1000	0	0.1%	RW	No	Always	Yes

Manually set the W phase current offset. The configured offset value is subtracted from the measured current value, and then applied as the actual current value. Do not manually set the offset if you do not know the exact setting value. You can check the automatically-tuned value if you tune the current offset with the procedure function (refer to the description of 0x2700).

For a drive with small to medium capacity (7.5 KW or less), this parameter is not used since the W phase current is not separately measured.

0x2018	Magnetic Pole Pitch						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 65535	2400	.01mm	RW	No	Power cycling	Yes

This specifies the pitch between the magnetic poles of the linear motor. The pole pitch refers to the distance between the north poles or between the south poles of magnet, corresponding to 360˚ of electrical angle.

0x2019	Linear Scale Resolution						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 65535	1000	nm	RW	No	Power cycling	Yes

Set Linear Scale Resolution in nm. For a linear scale with a resolution of 1 um, set it to 1000 (= 1 um / 1 nm).

0x201A	Commutation Method						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2	0	-	RW	No	Power cycling	Yes

This specifies the commutation method to get information on the initial angle of the motor.

Settings	Description
0	Not necessary for separate commutation. Or, carry out commutation using a hall sensor.
1	Carry out commutation when the servo is turned on for the first time.
2	Reserved

0x201B	Commutation Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	500	0.1%	RW	No	Always	Yes

Select the commutation current to get information on the initial angle of the motor.

0x201C	Commutation Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	500 to 5000	1000	ms	RW	No	Always	Yes

Select the commutation time to get information on the initial angle of the motor.

0x201D	The grid size of the sinusoidal encoder.						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 65535	40	um	RW	No	Power cycling	Yes

Specify the grid size of the sine wave encoder.

0x201E	Move after homing is completed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Always	Yes

This specifies whether to move to the zero position by Home Offset[0x607C] after homing is completed.

Settings	Description
0	After homing with Homing Method [0x6098] is completed, the motor does not rotate, and the Home Offset [0x607C] value changes to the zero position.
1	After homing with Homing Method [0x6098] is completed, the motor rotates as much as the amount of Home Offset [0x607C] and the zero position becomes 0.

0x201F	Selection of the feedback speed calculation function						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2	0	-	RW	No	Always	Yes

If the encoder type is Quadrature, select the method to calculate the feedback speed.

Settings	Description
0	MT Method + Speed Observer
1	MT Method
2	M Method

0x2020	Phase settings for motor and hall sensor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	0	-	RW	No	Power cycling	Yes

For a third-party motor, check the motor wiring and hall sensor wiring and configure the motor rotation direction, hall sensor polarity, and hall sensor UVW sequence.

Bit	Description
0	Motor rotation direction setting (Exclusive OR is applied between this value and the 0x2004 setting)
1~7	Reserved
8	Reversal of hall U polarity
9	Reversal of hall V polarity
10	Reversal of hall W polarity

11	Reserved
12	Replace hall U and hall V
13	Replace hall V and hall W
14	Replace hall W and hall U
15	Reserved

0x2021	Load Encoder Type						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 100	0	-	RW	No	Power cycling	Yes

This sets the type of the second encoder, which is attached to the load side. The same setting applies to the motor-side encoder type.

Settings	Encoder type
0	Not selected
1	Quadrature, Port A
2	Quadrature, Port B

0x2022	Setting the load encoder direction						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

Set the direction of the 2nd encoder on the load side.

Settings	Setting details
0	Increase position value in the CCW direction.
1	Increase position value in the CW direction.

0x2023	Setting the full-closed control mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2	0	-	RW	No	Power cycling	Yes

Set the full-closed control mode.

Settings	Setting details
0	Semi-Closed Control (controls using only the motor-side encoder, default value)
1	Full-Closed Control (controls using the load-side encoder)
2	Dual-Feedback Control (controls using both the motor-side and load-side encoders)

0x2024	Dual Feedback Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	0.1ms	RW	No	Servo OFF	Yes

In the case of dual-feedback control that refers to an external encoder, the filter time constant is set to 0.1 ms at the time when the mode switches between semi-closed control and full-closed control.

As the setting value gets close to 0 ms, it refers to the external encoder more. As it gets close to 100 ms, it refers to the motor-side encoder more. It minimizes the vibrations that are generated due to mechanical characteristics or external factors to shorten the adjustment time.

1). Example of setting the dual-feedback filter time constant

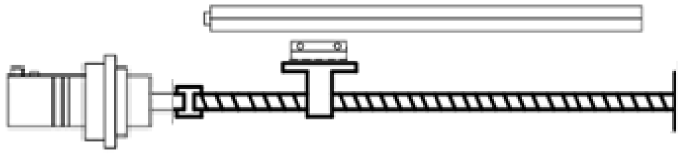
0x2025	Load encoder scale numerator						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2147483647	1	-	RW	No	Power cycling	Yes

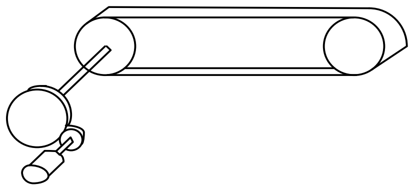
0x2026	Load encoder scale denominator						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2147483647	1	-	RW	No	Power cycling	Yes

Set the numerator/denominator scale for the load encoder to ensure the same scale with the motor encoder,

Examples of scale setting methods

1. Direct connection structure	This sets the scale so the number of external encoder pulses can be calculated based on the number of encoder pulses per motor rotation.
Motor encoder specifications	524288[pulse/rev]
Amount of load movement/revolution	12000[pulse/rev]
Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses $12000(\text{Number of external encoder pulses}) \times \frac{524288(\text{Numerator})}{12000(\text{Denominator})}$ $= 524288\ (\text{Number of motor encoder pulses})$

2. Reducer structure	 - Reduction ratio: 1/10 - Ball screw lead: 20 mm - Linear encoder (external encoder): 4 um If the 1/10-ratio reducer is installed on the motor, the reducer shaft rotates 1/10 turns per motor rotation. So, the scale is calculated by multiplying the deceleration ratio with the number of external encoder pulses.
Motor encoder specifications	524288[pulse/rev]
Amount of load movement/revolution	The movement of the table per rotation of the servo motor equipped with a 1/10 reducer is (1/10) * 20 mm = 2 mm. The number of external encoder pulses is calculated as 2 mm / 4 um = 500 pulses.
Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses $500(\text{Number of external encoder pulses}) \times \frac{524288(\text{Numerator})}{500(\text{Denominator})}$ $= 524288(\text{Number of motor encoder pulses})$

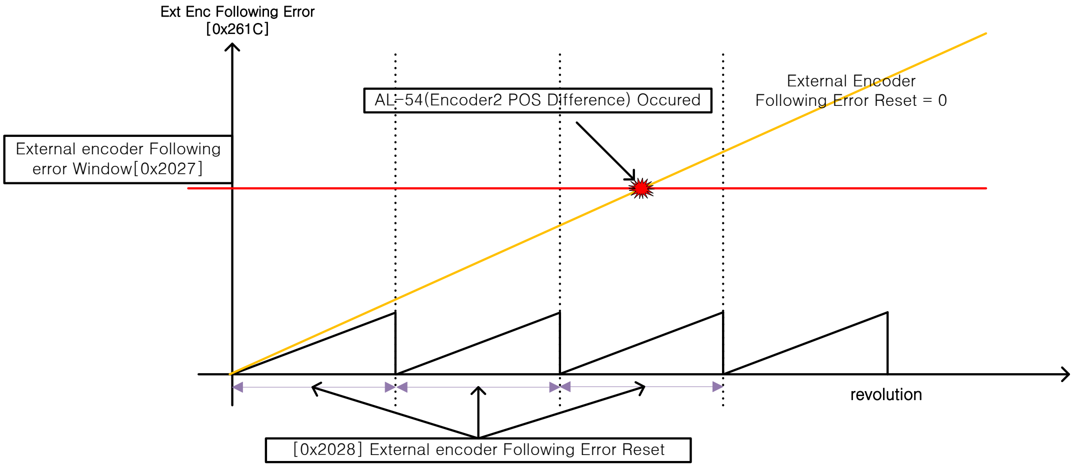
3. Belt-pulley structure	 - Motor-side pulley diameter: 30 mm - Rotary-side pulley diameter: 20 mm - External encoder resolution: 20000 pulse/rev In the case of a gear and belt-pulley system, the final gear ratio is calculated and the gear ratio is multiplied by the number of external encoder pulses to produce the scale.
Motor encoder specifications	524288[pulse/rev]
Amount of load movement/revolution	The external encoder rotates at a ratio of 30 / 20 per servo motor rotation. The number of pulses for the external encoder is calculated as 20000 x (3/2) = 30000 pulses.

Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses $30000(\text{Number of external encoder pulses}) \times \frac{524288(\text{Numerator})}{30000(\text{Denominator})}$ $= 524288(\text{Number of motor encoder pulses})$

0x2027	Excessive level of external encoder position error						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 2147483647	100000	pulse	RW	No	Always	Yes

0x2028	Load encoder position error initialization						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 10000	10	Rev	RW	No	Always	Yes

This sets the position error level for the external encoder and the reset range for the error position value.



Based on the 0x2027 (External Encoder Following Error Window) settings, the AL-54 (Encoder2 POS difference) level can be adjusted. For a system where a slip occurs, the 0x2028 (External Encoder Following Error Reset) settings can be used to set the normal slip range for the following error value.

0x2029	Setting the external encoder Z phase						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

This setting determines whether to detect the Z phase signal when the external encoder is Quadrature.

0x202B	Setting the load encoder						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0x0 to 0xFFFFFFFF	0	-	RW	No	Power cycling	Yes

This sets the second encoder, which is attached to the load side. The settings below change depending on the setting of the encoder type 2. Do not set the reserved bit.

Bit	Description (if encoder type is quadrature)
3~0	Debounce filter settings,
31~4	Reserved

* Debounce filter settings

Settings	Cutoff frequency
0	No Filter
1	5 MHz
2	3 MHz
3	2.5 MHz
4	2 MHz
5	1.6 MHz
6	1.4 MHz
7	1.25 MHz
8	1 MHz
9	0.8 MHz
10	0.7 MHz

Bit	Description (if encoder type is SSI)
0-7	Number of data bits
8-15	Number of bits for rotary multi-turn data (For a linear encoder, the setting value is irrelevant.)
16	Whether to ignore the first bit (0: one start bit, 1: two start bits)
17	Coding(0:binary, 1:gray)
20-23	Number of align bits
24-27	Clock rate (0:10Mhz, 1:5Mhz, 2:2.5Mhz, 3:1.25Mhz, 4:625Khz, 5:312.5Khz, 6:156.25Khz, 7:78.125Khz)
28	Whether error bit exists (0: No, 1: Yes)
29	Error bit logic(0:active high, 1:active low)
31~30	reserved

Setting example:

Bit	Description (if encoder type is SSI)
5~0	13
12~8	10
16	0(one start bit)
17	0
18	0
19	-
22~20	2 align bit
23	0
27-24	2
28	0
29	0
31~30	-

0x202C	Set the number of grids per revolution on a sinusoidal encoder						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0-65535	1000	-	RW	No	Power cycling	Yes

This sets the CPR or line count (number of grids per revolution) on a sine wave encoder.

0x202D	Speed feedback FIR filter setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 8	0	-	RW	No	Power cycling	Yes

This sets the degree of FIR filter for speed feedback.

In order to apply a FIR filter on a speed feedback signal, set the value to 2 or more. In this case, the speed feedback filter time constant [0x201B] does not apply. In order to use the speed feedback filter time constant, set the value to 0.

- ## Gain Adjustment (from 0x2100)

0x2100	Inertia ratio						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 3000	100	%	RW	No	Always	Yes

This specifies the ratio of the load inertia to the motor's rotor inertia as a percentage (%).

Inertia ratio = Load inertia / Motor's rotor inertia x 100

The inertia/load ratio is an important control parameter for the operation of the servo. It is crucial to set the correct inertia ratio for optimal servo operation. You can estimate the inertia ratio by auto gain tuning. The ratio will be continuously estimated during operation if you carry out real-time gain tuning.

0x2101	Position loop gain 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 500	50	1/s	RW	Yes	Always	Yes

This specifies the overall responsiveness of the position controller. The larger the setting, the responsiveness increases. Too large setting value may cause vibration depending on the load.

0x2102	Speed Loop Gain 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 2000	75	Hz	RW	Yes	Always	Yes

This specifies the overall responsiveness of the speed controller. To make the overall response of the system higher, you have to set the speed loop gain, as well as the position loop gain, large. Too large setting value may cause vibration depending on the load.

0x2103	Speed Loop Integral Time Constant 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 1000	50	ms	RW	Yes	Always	Yes

This specifies the integral time constant of the speed controller. If you set it larger, error will be reduced at the steady state (stopped or driving at constant speed), but vibration may occur at a transient state (while accelerating or decelerating).

0x2104	Torque Command Filter Time Constant 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	5	0.1ms	RW	Yes	Always	Yes

This applies a low pass filter for the torque command. You can improve the stability of the system by setting an appropriate value to smooth out the torque command. If you set it too large, the delay for the torque command will be longer, reducing the system responsiveness.

0x2105	Position Loop Gain 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 500	30	/s	RW	Yes	Always	Yes

This specifies the position loop gain used as gain group 2 for gain switching. For more information, refer to the description of the Position Loop Gain 1 (0x2101).

0x2106	Speed Loop Gain 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 2000	50	Hz	RW	Yes	Always	Yes

This specifies the speed loop gain used as gain group 2 for gain switching. For more information, refer to the description of the Speed Loop Gain 1 (0x2102).

0x2107	Speed Loop Integral Time Constant 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 1000	50	ms	RW	Yes	Always	Yes

This specifies the integral time constant of the speed loop used as gain group 2 for gain switching. For more information, refer to the description of the Speed Loop Integral Time Constant 1 (0x2103).

0x2108	Torque Command Filter Time Constant 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	0.1 ms	RW	Yes	Always	Yes

This specifies the time constant of the torque command filter used as gain group 2 for gain switching. For more information, refer to the description of the Torque Command Filter Time Constant 1 (0x2104).

0x2109	Position Command Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	0	0.1ms	RW	Yes	Always	Yes

This applies a low pass filter for the position command to smooth out the position command. This can be used for setting a higher gear ratio in particular.

0x210A	Position Command Average Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	0	0.1 ms	RW	Yes	Always	Yes

This applies a moving average filter for the position command to smooth out the position command. The value of Position Command Filter Time Constant (0x2109) is first applied. Position Command Average Filter Time Constant (0x210A) is only applied if the value is 0.

0x210B	Speed Feedback Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	5	0.1 ms	RW	Yes	Always	Yes

This applies a low pass filter to the speed feedback signal calculated from the encoder. In case system vibrations occur or vibrations occur when a gain load with too large of an inertia is applied, you can suppress the vibrations by setting the appropriate value.

0x210C	Velocity Feed-forward Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 100	0	%	RW	Yes	Always	Yes

This specifies the feedforward gain for the speed command during position control. The larger the setting is, the less the positional error is. If you set a value that is too large depending on the load, vibrations or overshoot may occur. For gain tuning, increase the setting value gradually.

0x210D	Velocity Feed-forward Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	10	0.1 ms	RW	Yes	Always	Yes

This applies a low pass filter to the compensated amount added to the speed command by the speed feedforward gain. You can enhance the system stability by using it when you set a large speed feedforward gain or when there is excessive change in position command.

0x210E	Torque Feed-forward Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 100	0	%	RW	Yes	Always	Yes

This specifies the feedforward gain for the torque command during speed control.

0x210F	Torque Feed-forward Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	10	0.1 ms	RW	Yes	Always	Yes

This applies a low pass filter to the compensated amount added to the torque command by the torque feed-forward gain.

0x2110	Torque Limit Function Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 4	2	-	RW	Yes	Always	Yes

This specifies the function to limit the output torque of the drive.

Settings	Description
0	Limits the torque using forward/reverse torque limit values according to the driving direction; the maximum value is limited by the maximum torque (0x6072). - Forward: 0x60E0, Reverse: 0x60E1
1	Limits the torque by the maximum torque (0x6072) only regardless of the driving direction.
2	Limits the torque using external forward/reverse torque limit values according to the driving direction. - Forward: 0x2111, Reverse: 0x2112
3	Limits the torque using internal and external torque limit values according to the driving direction and the torque limit signal. - Forward: 0x60E0 (if P_CL signal is not input), 0x2111 (if P_CL signal is input) - Reverse: 0x60E1 (if N_CL signal is not input), 0x2112 (if N_CL signal is input)

0x2111	External Positive Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

This specifies the external forward torque limit value according to the torque limit function setting (0x2110).

0x2112	External Negative Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

This specifies the external reverse torque limit value according to the torque limit function setting (0x2110).

0x2113	Emergency Stop Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	1000	0.1%	RW	Yes	Always	Yes

This specifies the stop torque on an emergency stop (when entering POT, NOT, or ESTOP).

0x2114	P/PI Control Switching Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 4	0	-	RW	Yes	Always	Yes

This specifies the switch mode between PI control and P control. Using this function, you can improve the speed control characteristic to reduce the overshoot during speed operation and the positioning time during position operation.

Settings	Setting details
0	Always uses PI control.
1	Switches to P control if the command torque is larger than the P control switching torque (0x2115).
2	Switches to P control if the command speed is larger than the P control switching speed (0x2116).
3	Switches to P control if the acceleration command is larger than the P control switching acceleration (0x2117).
4	Switches to P control if the position error is larger than the P control switching position error (0x2118).

0x2115	P Control Switching Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	500	0.1%	RW	Yes	Always	Yes

Refer to the description of the P/PI control switching mode (0x2114).

0x2116	P Control Switching Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

Refer to the description of the P/PI control switching mode (0x2114).

0x2117	P Control Switching Acceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 60000	1000	rpm/s	RW	Yes	Always	Yes

Refer to the description of the P/PI control switching mode (0x2114).

0x2118	P Control Switching Position Error						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 60000	100	pulse	RW	Yes	Always	Yes

Refer to the description of the P/PI control switching mode (0x2114).

0x2119	Gain switching mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 7	0	-	RW	Yes	Always	Yes

You can enhance the performance of the entire system by switching between two gain groups. According to the switching mode, manual switch or automatic switch can be done depending on the external input or output signal, respectively.

Gain Group 1		Gain Group 2
Position loop gain 1 (0x2101) Speed loop gain 1 (0x2102) Speed loop integral time constant 1 (x2103) Torque command filter time constant 1 (0x2104)		Position loop gain 2 (0x2105) Speed loop gain 2 (0x2106) Speed loop integral time constant 2 (x2107) Torque command filter time constant 2(0x2108)

Settings	Setting details
0	Only gain group 1 is used.
1	Only gain group 2 is used.
2	Gain is switched according to the GAIN2 input status. - 0: Use gain group 1 - 1: Use gain group 2
3	Reserved
4	Reserved
5	Reserved
6	Gain is switched according to the ZSPD output status. - 0: Use gain group 1 - 1: Use gain group 2
7	Gain is switched according to the INPOS1 output status. - 0: Use gain group 1 - 1: Use gain group 2

0x211A	Gain Switching Time 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	2	ms	RW	Yes	Always	Yes

This specifies the time to switch from gain group 1 to gain group 2.

0x211B	Gain Switching Time 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	2	ms	RW	Yes	Always	Yes

This specifies the time to switch from gain group 2 to gain group 1.

0x211C	Gain Switching Waiting Time 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	ms	RW	Yes	Always	Yes

This specifies the waiting time before switching from gain group 1 to gain group 2.

0x211D	Gain Switching Waiting Time 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	ms	RW	Yes	Always	Yes

This specifies the waiting time before switching from gain group 2 to gain group 1.

0x211E	Dead Band for Position Control						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	UU	RW	Yes	Always	Yes

The position controller output is 0 if the positional error for position control is below the setting.

0x211F	Drive Control Input 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to $FFFF_{hex}$	0	-	RW	Yes	Always	No

You can input the signal required for drive control via the I/O. Using a remote I/O, you can indirectly input the control input signal, inputted to the upper level controller, to the drive through this setting.

An applicable function will be performed by logical OR operation of the signal received through the I/O and the bit value of this setting.

Bit	Setting details
0	POT
1	NOT
2	HOME
3	STOP
4	PCON
5	GAIN2
6	P_CL
7	N_CL
8	PROBE1
9	PROBE2
10	EMG
11	A_RST
12	SV_ON
13	LVSF1
14	LVSF2
15	Reserved

0x211F	Drive Control Input 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to $FFFF_{hex}$	0	-	RW	Yes	Always	No

Bit	Setting details
15-0	Reserved

0x2121	Drive Status Output 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to $FFFF_{hex}$	0	-	RW	Yes	Always	No

You can assign the state of the drive output signal to the output signal of the I/O in order to verify the applicable bit of this output value, in addition to the actual output.

Bit	Setting details
0	BRAKE
1	ALARM
2	READY
3	ZSPD
4	INPOS1
5	TLMT
6	VLMT
7	INSPD
8	WARN
9	TGON
10	INPOS2
15-11	Reserved

0x2122	Drive Status Output 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to $FFFF_{hex}$	0	-	RO	Yes	-	No

Bit	Setting details
15-0	Reserved

• I/O Configuration (from 0x2200)

0x2200	Digital Input Signal 1 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0001	-	RW	No	Always	Yes

This specifies the functions of digital input signal 1 of the I/O and the input signal level.

Setting example) If the setting value is 0x006:

0	0	0	6
Contact A		GAIN2 is assigned.	

Bit	Setting details
15	Signal input level settings (0: contact A, 1: contact B)
14~8	Reserved
7~0	Input signal assignments

Settings	Assigned signal
0x00	Not assigned
0x01	POT
0x02	NOT
0x03	HOME
0x04	STOP
0x05	PCON
0x06	GAIN2
0x07	P_CL
0x08	N_CL
0x09	PROBE1
0x0A	PROBE2
0x0B	EMG
0x0C	A_RST
0x0D	LVSF1
0x0E	LVSF2
0x0F	SVON

0x2201	Digital Input Signal 2 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0002	-	RW	No	Always	Yes

This specifies the functions of digital input signal 2 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2202	Digital Input Signal 3 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0003	-	RW	No	Always	Yes

This specifies the functions of digital input signal 3 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2203	Digital Input Signal 4 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0004	-	RW	No	Always	Yes

This specifies the functions of digital input signal 4 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2204	Digital Input Signal 5 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0005	-	RW	No	Always	Yes

This specifies the functions of digital input signal 5 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2205	Digital Input Signal 6 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0006	-	RW	No	Always	Yes

This specifies the functions of digital input signal 6 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2210	Digital Output Signal 1 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x8001	-	RW	No	Always	Yes

This assigns the digital output signal 1 function and sets the output signal level of the I/O.

Setting example: If the setting is 0x8001

8	0	0	1
Contact B		Brake assigned	

Bit	Setting details
15	Signal output level settings (0: contact A, 1: contact B)
14~8	Reserved
7~0	Output signal assignments

Settings	Assigned signal
0x00	Not assigned
0x01	BRAKE
0x02	ALARM
0x03	READY
0x04	ZSPD
0x05	INPOS1
0x06	TLMT
0x07	VLMT
0x08	INSPD
0x09	WARN
0x0A	TGON
0x0B	INPOS2

0x2211	Digital Output Signal 2 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x8002	-	RW	No	Always	Yes

This sets the digital output signal 2 function and output signal level of the I/O. For more information, refer to the description of 0x2210.

0x2212	Digital Output Signal 3 Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0003	-	RW	No	Always	Yes

This sets the digital output signal 3 function and output signal level of the I/O. For more information, refer to the description of 0x2210.

0x2220	Analog Monitor Output Mode						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Always	Yes

The output range of the analog monitor is from -10 V to +10 V. If the setting is 1, take the absolute value of the output so the output values is only positive.

Settings	Setting details
0	Output as negative/positive values
1	Output as positive values only

0x2221	Analog Monitor Channel 1 Configuration						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	0	-	RW	No	Always	Yes

This configures the monitoring variables to be output to analog monitor output channel 1.

Settings	Displayed item	Unit
0x00	Speed feedback	rpm
0x01	Speed command	rpm
0x02	Speed error	rpm
0x03	Torque feedback	%
0x04	Torque command	%
0x05	Position error	pulse
0x06	Accumulated operation overload	%
0x07	DC link voltage	V

0x08	Accumulated Regeneration Overload	%
0x09	Encoder single-turn data	pulse
0x0A	Inertia ratio	%
0x0B	Full-Closed Positional Error	UU
0x0C	Drive temperature 1	℃
0x0D	Drive temperature 2	℃
0x0E	Encoder temperature 1	℃
0x0F	Hall signal	-
0x10	U-phase current	A
0x11	V-phase current	A
0x12	W-phase current	A
0x13	Current position value	UU
0x14	Target position value	UU
0x15	Position command speed	rpm, mm/s
0x16	Hall U signal	-
0x17	Hall V signal	-
0x18	Hall W signal	-

0x2222	Analog Monitor Channel 2 Configuration						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	1	-	RW	No	Always	Yes

This configures the monitoring variables to be output to analog monitor output channel 2.

0x2223	Analog Monitor Channel 1 Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	0 to 0x40000000	0	-	RW	No	Always	Yes

Subtract the offset value from the monitoring variable of analog monitor output channel 1 to determine the final output. The unit will be that of the variable configured in the Analog Monitor Channel 1 Setting (0x2221).

0x2224	Analog Monitor Channel 2 Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	0 to 0x40000000	0	-	RW	No	Always	Yes

Subtract the offset value from the monitoring variable of analog monitor output channel 2 to determine the final output. The unit will be that of the variable configured in the Analog Monitor Channel 2 Setting (0x2222).

0x2225	Analog Monitor Channel 1 Scale						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x40000000	500	-	RW	No	Always	Yes

This specifies the scaling of the variable to be output per 1 V when outputting the monitoring variable configured as analog output channel 1. The unit will be that of the variable configured in the Analog Monitor Channel 1 Setting (0x2221) per 1 V.

For example, if you set the speed feedback to channel 1 and the scale to 500, up to ±5000 rpm can be output as ±10 V.

0x2226	Analog Monitor Channel 2 Scale						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x40000000	500	-	RW	No	Always	Yes

This specifies the scaling of the variable to be output per 1 V when outputting the monitoring variable configured as analog output channel 2. The unit will be that of the variable configured in the Analog Monitor Channel 2 Setting (0x2222) per 1 V.

• Velocity Control (from 0x2300)

0x2300	Jog Operation Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-6000 to 6000	500	rpm	RW	No	Always	Yes

This specifies the jog operation speed.

0x2301	Speed Command Acceleration Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	200	ms	RW	No	Always	Yes

This specifies the time, in ms, required for the motor to reach the rated motor speed from zero speed.

0x2302	Speed Command Deceleration Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	200	ms	RW	No	Always	Yes

This specifies the time, in ms, required for the motor to decelerate from the rated motor speed to a stop.

0x2303	Speed Command S-curve Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	ms	RW	No	Always	Yes

You can configure the speed command in an S-curve pattern for smooth acceleration/deceleration. If it is set to 0, the drive will be operated in a trapezoidal pattern by default.

0x2304	Programmed Jog Operation Speed 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-6000 to 6000	0	rpm	RW	No	Always	Yes

For programmed jog operation, you can set operation speed 1 to 4 and operation time 1 to 4 as follows:

0x2305	Programmed Jog Operation Speed 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-6000 to 6000	500	rpm	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2306	Programmed Jog Operation Speed 3						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-6000 to 6000	0	rpm	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2307	Programmed Jog Operation Speed 4						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-6000 to 6000	-500	rpm	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2308	Programmed Jog Operation Time 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	500	ms	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2309	Programmed Jog Operation Time 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	5000	ms	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x230A	Programmed Jog Operation Time 3						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	500	ms	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x230B	Programmed Jog Operation Time 4						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	5000	ms	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x230C	Index Pulse Search Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-1000 to 1000	20	rpm	RW	No	Always	Yes

This specifies the speed for index pulse search.

0x230D	Speed Limit Function Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 3	0	-	RW	No	Always	Yes

This specifies the speed limit function for torque control.

Settings	Setting details
0	Limited by the speed limit value (0x230E)
1	Limited by the maximum motor speed

0x230E	Speed Limit Value at Torque Control Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 6000	1000	rpm	RW	Yes	Always	Yes

This specifies the speed limit value for torque control. This setting is applied only when the Speed Limit Function Setting (0x230D) is set to 0.

0x230F	Over Speed Detection Level						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	6000	rpm	RW	No	Always	Yes

This specifies the level to detect overspeed alarms (AL-50). If the setting is larger than the maximum motor speed, the detection level will be set by the maximum motor speed.

0x2310	Excessive Speed Error Detection Level						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 10000	5000	rpm	RW	No	Always	Yes

This specifies the level to detect excessive speed error alarms (AL-53). If the difference between the speed command and the speed feedback exceeds the setting value, an excessive speed error alarm is generated.

0x2311	Servo-Lock Function Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Always	Yes

This specifies the servo-lock function to fix the motor position with a position value when the speed command is input as 0 for speed control.

Settings	Setting details
0	Servo-lock function disabled
1	Servo-lock function enabled

• Miscellaneous Setting (from 0x2400)

0x2400	Software Position Limit Function Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 3	0	-	RW	No	Always	Yes

This specifies the software position limit function for position control. When using the position limit function, the upper and the lower limit values will be limited to the values configured in (0x607D:02) and (0x607D:01), respectively. The software position limit function will not be activated prior to the homing operation. In addition, when the upper limit value is less than the lower limit value, this function will not be activated.

Settings	Setting details
0	None of positive and negative software position limits are used.
1	Only the positive software position limit value is used. It is not limited for the reverse direction.
2	Only the negative software position limit value is used. It is not limited for the forward direction.
3	Both the positive and the negative software position limits are used.

0x2401	INPOS1 Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

With the position command not newly updated, if the position error is retained within the INPOS1 output range for the INPOS1 output time, the INPOS1 signal is output.

0x2402	INPOS1 Output Time						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	ms	RW	Yes	Always	Yes

Refer to the description of 0x2401.

0x2403	INPOS2 Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

This outputs the INPOS2 signal where the position error is less than the setting value. Unlike the INPOS1, the INPOS2 signal is output by calculating only the position error value.

0x2404	ZSPD Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 6000	10	rpm	RW	Yes	Always	Yes

When the current speed is less than the setting value, the ZSPD signal is output.

0x2405	TGON Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

When the current speed is more than the setting value, the TGON signal is output.

0x2406	INSPD Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

When the speed error is less than the setting value, the INSPD signal is output.

0x2407	BRAKE Output Speed						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 6000	100	rpm	RW	No	Always	Yes

If the motor stops because the servo turns off or a servo alarm occurs during rotation, you can set the speed (0x2407) and delay time (0x2408) for the brake signal output to configure the output timing. The brake signal will be output if the motor rotation speed goes below the set speed (0x2407) or the output delay time (0x2408) has elapsed after the servo OFF command.

0x2408	BRAKE Output Delay Time						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	100	ms	RW	No	Always	Yes

Refer to the description of 0x2407.

0x2409	Torque Limit at Homing Using Stopper						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2000	250	0.1%	RW	No	Always	Yes

This specifies the torque limit value for homing using a stopper. With too large of a value configured, the machine may collide with the stopper. So be careful.

0x240A	Duration Time at Homing Using Stopper						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	50	ms	RW	No	Always	Yes

This specifies the time to detect the stopper for homing using a stopper. Set an appropriate value, depending on the machine.

0x240B	Modulo Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5	0	-	RW	No	Power cycling	Yes

This specifies whether to use the Modulo function.

Settings	Setting details
0	Does not use the modulo function.
1	Uses the modulo function to move forward.
2	Uses the modulo function to move backward.
3	Uses the modulo function to move via the possible shortest distance.
4	Uses the Modulo function to move to the absolute position.
5	Uses the Modulo function to move to the relative position.

0x240C	Modulo Factor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	1 to 0x3FFFFFFF	3600	UU	RW	No	Power cycling	Yes

This specifies the factor for using the modulo function.

0x240D	User Drive Name						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	'Drive'	UU	RW	No	Always	Yes

The user can customize the drive name. Up to 16 characters can be used to define the name.

0x240E	Individual Parameter Save						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	0 to 1	0	-	RW	No	Always	No

This specifies whether to save parameters individually. This parameter is not saved and is initialized to 0 during power ON.

Settings	Setting details
0	Parameters are not saved individually. For details on storing parameters, refer to Storing Parameters (0x1010).
1	Save the parameters individually. When a parameter is written, it is immediately stored in the memory.

- ## Enhanced Control (from 0x2500)

0x2500	Adaptive Filter Function Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5	0	-	RW	No	Always	Yes

This specifies the adaptive filter function.

Settings	Setting details
0	Adaptive filter is not used.
1	Only one adaptive filter is used. You can check the settings configured automatically in the notch filter 3 settings (0x2507, 0x2508, 0x2509). If an arbitrary value is set in notch filter 3, auto setting is not available. If you wish to use auto setting, you should initialize notch filter 3 first.
2	Two adaptive filters are used. You can check the settings configured automatically in the notch filter 3 (0x2507, 0x2508, 0x2509) and filter 4 settings (0x250A, 0x250B, 0x250C). If an arbitrary value is set for notch filter 3 (or 4), auto setting is applied to notch filter 4 (or 3). If arbitrary values are set for notch filter 3 and 4, the original settings remain unchanged. If notch filter 3 and 4 are initialized, auto setting is available.
3	Reserved
4	Resets the notch filter 3 (0x2507, 0x2508, and 0x2509) and notch filter 4 (0x250A, 0x250B, and 0x250C) settings.
5	Reserved

0x2501	Notch Filter 1 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

This specifies the frequency of notch filter 1.

0x2502	Notch Filter 1 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 100	1	-	RW	No	Always	Yes

This specifies the width of notch filter 1.

0x2503	Notch Filter 1 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 5	1	-	RW	No	Always	Yes

This specifies the depth of notch filter 1.

0x2504	Notch Filter 2 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

This specifies the frequency of notch filter 2.

0x2505	Notch Filter 2 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 100	1	-	RW	No	Always	Yes

This specifies the width of notch filter 2.

0x2506	Notch Filter 2 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 5	1	-	RW	No	Always	Yes

This specifies the depth of notch filter 2.

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0x2507	Notch Filter 3 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

This specifies the frequency of notch filter 3.

0x2508	Notch Filter 3 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 100	1	-	RW	No	Always	Yes

This specifies the width of notch filter 3.

0x2509	Notch Filter 3 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 5	1	-	RW	No	Always	Yes

This specifies the depth of notch filter 3.

0x250A	Notch Filter 4 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

This specifies the frequency of notch filter 4.

0x250B	Notch Filter 4 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 100	1	-	RW	No	Always	Yes

This specifies the width of notch filter 4.

0x250C	Notch Filter 4 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 5	1	-	RW	No	Always	Yes

This specifies the depth of notch filter 4.

0x250D	On-line Gain Tuning Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Always	Yes

It determines whether real-time gain is adjusted during operation. The factory setting is 0 (Do not use). The estimated gain at online tuning is reflected every 64 ms, and the changed gain is stored in EEPROM about every 2 minutes.

Settings	Setting details
0	Online gain tuning is not used.
1	Online gain tuning is used.

0x250E	System Rigidity for Gain Tuning						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 20	5	-	RW	No	Always	Yes

This specifies the system rigidity applied for gain tuning. After gain tuning according to the setting, the overall gain will be set higher or lower. If the gain of the maximum setting value is not enough, carry out the tuning manually.

Increasing the system rigidity setting will increase the gain and shorten the positioning time. However, if the setting is too high, vibration may occur depending on the machine configuration. Adjust the system rigidity setting from low to high values within a range that does not cause vibration.

After the gain tuning, the following gains will be automatically changed:

Inertia ratio (0x2100), position loop gain 1 (0x2001), speed loop gain 1 (0x2102), speed integral time constant 1 (0x2103), torque command filter time constant 1 (0x2104), notch filter 3 frequency (0x2507, TBD), and notch filter 4 frequency (0x250A, TBD).

The gain values (position loop gain, speed loop gain, speed integration time constant and torque command filter time constant) according to the system rigidity settingsare determined by the values in the table below.

System Rigidity	1	2	3	4	5	6	7	8	9	10
Position loop gain 1	2	5	10	15	22	30	40	50	60	73
Speed loop gain 1	3	8	15	23	33	45	60	75	90	110
Speed integral time constant 1	190	70	50	40	30	22	15	13	10	9
Torque command filter time constant 1	80	30	20	10	8	6	4	3	3	2
System Rigidity	11	12	13	14	15	16	17	18	19	20
Position loop gain 1	87	100	117	133	160	173	200	220	240	267
Speed loop gain 1	130	150	175	200	240	260	300	330	360	400
Speed integral time constant 1	8	7	6	6	5	5	4	4	3	3
Torque command filter time constant 1	2	2	2	2	1	1	1	1	1	1

0x250F	On-line Gain Tuning Adaptation Rate						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 5	1	-	RW	No	Always	Yes

This specifies the speed reflecting the change of gain when performing online gain tuning. The larger the setting value is, the faster the change of gain is reflected. Depending on the condition of the load, the system may become unstable if it is reflected too quickly.

0x2510	Off-line Gain Tuning Direction						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Always	Yes

This specifies the movement direction when performing offline gain tuning. Set the function properly according to the condition of the apparatus section.

Settings	Setting details
0	Drive in the forward direction
1	Drive in the reverse direction

0x2511	Off-line Gain Tuning Distance						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 10	5	-	RW	No	Always	Yes

This specifies the distance when performing offline gain tuning. The larger the setting value is, the longer the moving distance becomes. Set the distance properly according to the condition of the apparatus section. Make sure to secure enough distance (one or more revolutions of motor) prior to gain tuning.

0x2512	Disturbance Observer Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 100	0	%	RW	No	Always	Yes

This function suppresses torque disturbance by compensating torque through load model. If the disturbance observer gain setting is large, the disturbance suppression works well. However, since noise occurs during operation, it is necessary to set the gain and filter time constant appropriately.

0x2513	Disturbance Observer Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	10	0.1 ms	RW	No	Always	Yes

This applies a low pass filter for the disturbance observer reference. By setting the disturbance observer gain and filter time constant appropriately, disturbance can be suppressed.

0x2514	Current Controller Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 150	100	%	RW	No	Always	Yes

This specifies the current controller gain. Lowering the setting value will reduce the noise, but the drive's responsiveness decreases as well.

0x2515	Vibration control (damping) filter setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 2	0	-	RW	No	Always	Yes

Set whether to use a filter to suppress vibration generated at the load end.

Settings	Setting details
0	Vibration control (damping) filter is not used.
1	Vibration control (damping) filter 1 and 2 are used.
2	Vibration control (damping) filters 1 and 2 are used according to LVSF1 and LVSF2 inputs.

0x2516	Vibration control (damping) filter 1 frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	0.1Hz	RW	No	Always	Yes

Set the vibration control (damping) filter 1 frequency.

0x2517	Vibration control (damping) filter 1 coefficient						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5	0	-	RW	No	Always	Yes

Set the coefficient of vibration control (damping) filter 1. The larger the set value, the bigger the damping coefficient becomes, leading to a higher damping level.

0x2518	Vibration control (damping) filter 2 frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1000	0	0.1Hz	RW	No	Always	Yes

Set the vibration control (damping) filter 2 frequency.

0x2519	Vibration control (damping) filter 2 coefficient						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5	0	-	RW	No	Always	Yes

Set the coefficient of vibration control (damping) filter 2. The larger the set value, the bigger the damping coefficient becomes, leading to a higher damping level.

• Monitoring (from 0x2600)

0x2600	Feedback Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	rpm	RO	Yes	-	No

This represents the current rotation speed of the motor.

0x2601	Command Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	rpm	RO	Yes	-	No

This represents the speed command that is input to the speed control loop of the drive.

0x2602	Position error						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	pulse	RO	Yes	-	No

This represents the position error of position control.

0x2603	Accumulated operation overload						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1%	RO	No	-	No

This represents the accumulated operation overload rate. When the value of the accumulated operation overload rate reaches the overload warning level setting (0x2010), the operation overload warning (W10) will occur; when it reaches 100%, the operation overload alarm (AL-21) will occur.

0x2604	Instantaneous Maximum Operation Overload						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1%	RO	Yes	-	No

This represents the maximum value of the operation overload rate output instantaneously from the drive for the last 15 seconds. This value can be initialized by the initialization of the instantaneous maximum operation overload.

0x2605	DC-Link Voltage						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	Volt	RO	Yes	-	No

This represents the DC link voltage by the main power input.

0x2606	Accumulated Regeneration Overload						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1%	RO	No	-	No

This represents the accumulated overload rate of the regenerative resistor due to regenerative operation. In case that the value of the accumulated regenerative overload rate reaches 100%, a regenerative overload alarm (AL-23) will be generated.

0x2607	SingleTurn Data						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	pulse	RO	Yes	-	No

This represents the single-turn data of the motor. Values ranging from 0 to (encoder resolution-1) are displayed.

0x2608	Motor Mechanical Angle						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	0.1 deg	RO	Yes	-	No

This represents the single-turn data of the motor, ranging from 0.0 to 359.9.

0x2609	Motor Electrical Angle						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1 deg	RO	Yes	-	No

This represents the electrical angle of the motor, ranging from -180.0 to 180.0.

0x260A	Multi-Turn Data						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	rev.	RO	Yes	-	No

This represents the multi-turn data of the multi-turn encoder.

0x260B	Drive Internal Temperature 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	℃	RO	No	-	No

This is the temperature measured by the temperature sensor integrated with the drive power board. If the measurement is higher than 95℃, the drive overheat alarm 1 (AL-22) will be generated.

0x260C	Drive Internal Temperature 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	℃	RO	No	-	No

This represents the temperature measured by the temperature sensor integrated with the drive control board. If the measured temperature is higher than 90℃, the drive overheat alarm 2 (AL-25) will be generated.

0x260D	Encoder Temperature						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	ºC	RO	No	-	No

This represents the temperature measured by the temperature sensor integrated into serial encoder provided by LSIS (if the setting values of the encoder type (0x2001) are 3, 4, 5, and 6). If the measured temperature is higher than 90℃, the encoder overheat alarm (AL-26) will be generated.

0x260E	Motor Rated Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	rpm	RO	No	-	No

This represents the rated speed of the driving motor.

0x260F	Motor Maximum Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	rpm	RO	No	-	No

This represents the maximum speed of the driving motor.

0x2610	Drive Rated Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	0.1A	RO	No	-	No

This represents the rated current of the drive.

0x2611	FPGA Version						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

This represents the FPGA version within the drive.

0x2612	Hall Signal Display						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	-	RO	No	-	No

This represents the signal of the hall sensor installed in the encoder (or motor). This can be used to verify the connection status of the hall sensor signal or compare the U-/V-/W-phases of the motor with the direction of the hall sensor signal.

The signal value is repeated in the order of 5→4→6→2→3→1 for a forward movement, while it is repeated in the order of 1→3→2→6→4→5 for a reverse movement.

Bit	Setting details
0	W-phase hall sensor signal
1	V-phase hall sensor signal
2	U-phase hall sensor signal

0x2613	Bootloader Version						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

This represents the bootloader version of the drive.

0x2614	Warning code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	-	RO	Yes	-	No

This represents a warning code which has occurred in the drive.

0x2615	Analog Input Channel 1 Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	mV	RO	No	-	No

This indicates the voltage in mV which is inputted to the analog input channel 1.

0x2619	Root Mean Square (RMS) load factor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1%	RO	No	-	No

This displays the Root Mean Square (RMS) load factor for the last 15 seconds in 0.1% increments.

Compare the RMS load factor with the rated torque in a 15-second driving cycle to ensure that the RMS load factor is within the drive rated torque. If the RMS load ratio is higher than the rated torque, check the drive and motor selection again.

0x261E	Load encoder position value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	pulse	RO	No	-	-

This displays the position value of the load-side encoder in pulse units of the load encoder.

0x261F	Actual position value inside the load encoder						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	No	-	-

This displays the position value of the load-side encoder in pulse units of the motor-side encoder considering the electronic gear ratio.

0x2620	Load encoder position deviation						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	pulse	RO	No	-	-

This displays the position difference between the load-side encoder and motor-side encoder in UU units.

0x2621	Encoder 2 speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU/s	RO	Yes	Always	No

This displays the speed of encoder 2 attached to the load side.

- ## Procedure and Alarm History (from 0x2700)

0x2700	Procedure Command Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0	-	RW	No	-	No

You can run various procedures with the following procedure command codes and command arguments. Make sure to enter correct value of command argument prior to entering command code because the drive refers to the command argument at the moment of entering the command code.

Command code	Command argument	Run procedure
Manual Jog (0x0001)	1	Servo ON
	2	Servo OFF
	3	Positive (+) driving (0x2300)
	4	Negative (-) driving (0x2300)
	5	Stop to zero speed
Programmed Jog (0x0002)	1	Servo ON
	2	Servo OFF
	3	Start operation
	4	Stop to zero speed (server on maintained)
Servo Alarm History Reset (0x0003)	1	
Offline Auto Tuning (0x0004)	1	Start auto tuning
Index Pulse Search (0x0005)	1	Servo ON
	2	Servo OFF
	3	Positive (+) search (0x230C)
	4	Negative (-) search (0x230C)
	5	Stop to zero speed
Absolute encoder reset (0x0006)	1	Absolute encoder reset
Instantaneous Maximum Operation Overload Reset (0x0007)	1	Instantaneous maximum operation overload value reset (0x2604)
Phase current offset tuning (0x0008)	1	Phase current offset tuning (The U, V, W phase offsets are stored in 0x2015 to 0x2017, respectively. If the offset is abnormally large, AL-15 will be generated.)
Software reset (0x0009)	1	Software reset
Commutation (0x000A)	1	Commutation is performed

0x2701	Procedure Command Argument						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to $FFFF_{hex}$	0	-	RW	No	-	No

0x2702	Servo Alarm History						ALL
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	16	-	RO	No	-	No
SubIndex 1		Alarm code 1 (Newest)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 2		Alarm code 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 3		Alarm code 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 4		Alarm code 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

SubIndex 5		Alarm code 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 6		Alarm code 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 7		Alarm code 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 8		Alarm code 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 9		Alarm code 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 10		Alarm code 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 11		Alarm code 11					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

SubIndex 12		Alarm code 12					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 13		Alarm code 13					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 14		Alarm code 14					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 15		Alarm code 15					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No
SubIndex 16		Alarm code 16 (Oldest)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
STRING	-	-	-	RO	No	-	No

This represents the history of the servo alarms generated from the drive. Up to 16 recently generated servo alarms are stored. SubIndex 1 is the newest alarm while the SubIndex 16 is the oldest one out of the recently generated alarms. The servo alarm history can be reset by the procedure command.

• Third Party Motor Support (from 0x2800)

The following motor parameters are provided to drive a motor manufactured by a third party in addition to our motor. To drive a third party's motor through our drive, you have to enter the correct parameters. In this case, however, our company has neither performed any tests for the combination of our drive and the third party motor nor gives any guarantees for the motor's characteristics.

0x2800	[Third Party Motor] Type						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

This specifies the motor type.

Settings	Setting details
0	Rotary motor
1	Linear motor

0x2801	[Third Party Motor] Number of Poles						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	2 to 1000	8	-	RW	No	Power cycling	Yes

This specifies the number of motor poles. For linear motor, set it to 2.

0x2802	[Third Party Motor] Rated Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
FP32	-	2.89	Arms	RW	No	Power cycling	Yes

This specifies the rated current of the motor.

0x2803	[Third Party Motor] Maximum Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
FP32	-	8.67	Arms	RW	No	Power cycling	Yes

This specifies the maximum current of the motor.

0x2804	[Third Party Motor] Rated Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 60000	3000	rpm	RW	No	Power cycling	Yes

This specifies the rated speed of the motor. For a linear motor, the unit is mm/s.

0x2805	[Third Party Motor] Maximum Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 60000	5000	rpm	RW	No	Power cycling	Yes

This specifies the maximum speed of the motor. For a linear motor, the unit is mm/s.

0x2806	[Third Party Motor] Inertia						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
FP32	-	0.321	Kg.m^2.10^{-4}	RW	No	Power cycling	Yes

This specifies the motor inertia. For a linear motor, set the weight of rotor. The unit is kg.

0x2807	[Third Party Motor] Torque Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
FP32	-	0.46	Nm/A	RW	No	Power cycling	Yes

This specifies the torque constant of a motor. For a linear motor, set the force constant. The unit is N/A.

0x2808	[Third Party Motor] Phase Resistance						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
FP32	-	0.82	ohm	RW	No	Power cycling	Yes

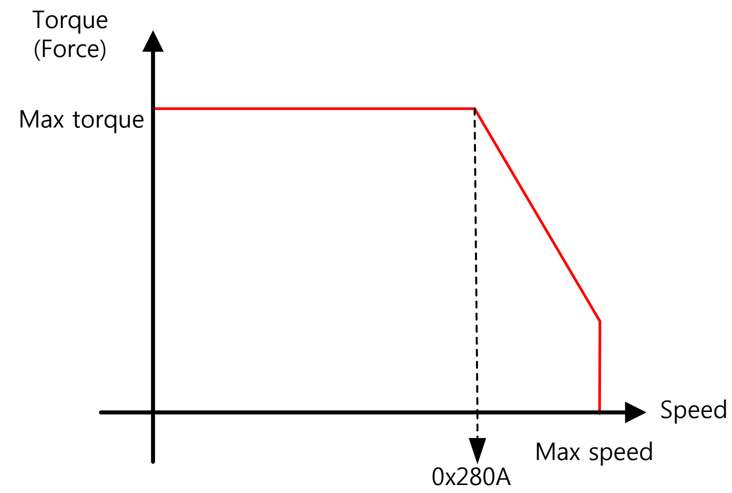
This specifies the phase resistance (= resistance between lines ÷ 2) of the motor.

0x2809	[Third Party Motor] Phase Inductance						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
FP32	0 to 1000	3.66	mH	RW	No	Power cycling	Yes

This specifies the phase inductance (= inductance between lines ÷ 2) of the motor.

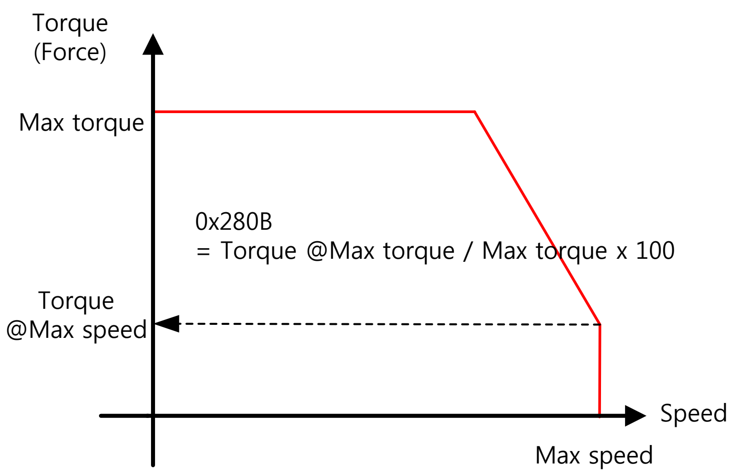
0x280A	[Third Party Motor] TN Curve Data 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	1 to 60000	3000	rpm	RW	No	Power cycling	Yes

This specifies the data of the motor speed/torque curve. Enter the maximum speed at the time when the maximum torque (the maximum thrust for a linear motor) is output. For a linear motor, the unit is mm/s.



0x280B	[Third Party Motor] TN Curve Data 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
FP32	-	100.0	%	RW	No	Power cycling	Yes

This specifies the data of the motor speed/torque curve. Enter the torque (thrust for a linear motor) which can be output at the maximum speed in percentage (%) relative to the maximum torque.



0x280C	[Third Party Motor] Hall Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 360	0	deg	RW	No	Power cycling	Yes

The offset of the hall sensor attached for the initial angle of a third party motor may vary depending on manufacturer. For this case, the hall sensor offset must be checked and correctly set.

10.3 CiA402 Objects

0x603F	Error Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	0	-	RO	Yes	-	No

The last alarm code (HEX value) that occurred in the servo drive is displayed.

0x6040	Controlword						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0	-	RW	Yes	Always	No

This is composed of bits that control the drive state, the operation mode, and manufacturer-specific options.

Bit	Function	Description
0	Switch on	Refer to the description below of bits 0 to 3.
1	Enable Voltage	
2	Quick stop	
3	Enable operation	
4 to 6	Settings by operation mode	Refer to the description below of bits 4 to 9.
7	Fault reset	0→1: Alarm/warning reset
8	Halt	Refer to the description below of bits 4 to 9.
9	Settings by operation mode	
10	–	-
11 to 15	–	-

Description of bits 0 to 3

• Bits 0 to 3: Drive state control

Command	Controlword bit			
	Bit 3	Bit 2	Bit 1	Bit 0
Shutdown	–	1	1	0
Switch on	0	1	1	1
Switch on + Enable operation	1	1	1	1
Disable voltage	–	–	0	–
Quick stop	–	0	1	–
Disable operation	0	1	1	1
Enable operation	1	1	1	1

Description of bits 4 to 9

• Bits 4, 5, 6, 8 and 9: For CSP, CSV, or CST mode operation

Bit	Function	Value	Description
4	–	0	-
5	–	0	-
6	–	0	-
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	-

• Bits 4, 5 and 9: For PP mode operation

Bit 9	Bit 5	Bit 4	Description
0	0	0 → 1	Proceeds to the next position when the operation at the current position is complete.
–	1	0 → 1	Drives to the next position immediately.
1	0	0 → 1	Drives from the current position to the profile position at the profile speed before it applies the next position.

• Bits 6 and 8: For PP mode operation

Bit	Function	Value	Description
6	Abs/rel	0	Sets the target position to an absolute value.
		1	Sets the target position to a relative value.
8	Halt	0	Runs an operation or continues an operation.
		1	Halts the operation according to the Halt Option code (0x605D).

• Bits 4, 5, 6, 8 and 9: For PV and PT mode operation

Bit	Function	Value	Description
4	–	0	Reserved
5	–	0	Reserved
6	–	0	Reserved
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

• Bits 4, 5, 6, 8 and 9: For HM mode operation

Bit	Function	Value	Description
4	Homing Start	0	Does not perform the homing operation.
		1	Performs or is performing the homing operation.
5	–	0	-
6	–	0	-
8	Halt	0	Runs the bit 4 command.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

0x6041	Statusword						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	-	RO	Yes	-	No

Statusword indicates the current state of the drive. It consists of bits that indicate the state according to the drive and operation mode.

Bit	Function	Description
0	Ready to switch on	Refer to the description below of bits 0 to 7.
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	–	Reserved
9	Remote	Processed as a Controlword (0x6040)
10	Operation mode specific	Refer to the description below of bits 10, 12 and 13.
11	Internal limit active	Refer to the description below of bit 11.
12 to 13	Operation mode specific	Refer to the description below of bits 10, 12 and 13.
14	ABS position valid	Refer to the description below of bit 14.
15	-	Reserved

Description of bits 0 to 7

• Bits 0 to 7: For the current state of the drive

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Drive State
–	0	–	–	0	0	0	0	Not ready to switch on
–	1	–	–	0	0	0	0	Switch on disabled
–	0	1	–	0	0	0	1	Ready to switch on
–	0	1	–	0	0	1	1	Switched on
–	0	1	–	0	1	1	1	Operation enabled
–	0	0	–	0	1	1	1	Quick stop active
–	0	–	–	1	1	1	1	Fault reaction active
–	0	–	–	1	0	0	0	Fault
–	–	–	1	–	–	–	–	Main Power On
1	–	–	–	–	–	–	–	Warning is occurred

• Bits 10, 12 and 13: For CSP and CSV mode operation

Bit	State	Value	Description
10	Target reached	0	Unable to reach the target (position/velocity)
		1	Reached the target (position/velocity)
12	-	0	-
13	Following error	0	No position error (always 0 in Csv/Torque mode)
		1	Positional error

• Bits 10, 12 and 13: For PP mode operation

Bit	State	Value	Description
10	Target reached	0	Halt (0x6040.8) = 0: Unable to reach the target position Halt (0x6040.8) = 1: Deceleration
		1	Halt (0x6040.8) = 0: Reached the target position Halt (0x6040.8) = 1: Speed: 0
12	Set-point acknowledge	0	Prepares the previous set point and waits for a new set point.
		1	Changed from the previous set point to the new set point.
13	Following error	0	No positional error
		1	Positional error

• Bits 10, 12 and 13: For PV mode operation

Bit	State	Value	Description
10	Target reached	0	Halt (0x6040.8) = 0: Unable to reach the target speed Halt (0x6040.8) = 1: Deceleration
		1	Halt (0x6040.8) = 0: Reached the target speed Halt (0x6040.8) = 1: Speed: 0
12	ZeroSpeed	0	Not in a zero speed state
		1	In a zero speed state
13	–	0	-

• Bits 10, 12 and 13: For homing mode operation

Bit 13 Homing error	Bit 12 Homing attained	Bit 10 Target reached	Description
0	0	0	Homing in progress
0	0	1	Homing stopped or not started
0	1	0	Performed homing operation, but did not reach the target
0	1	1	Homing completed
1	0	0	Homing error; speed not equal to 0
1	0	1	Homing error; speed equal to 0

Description of bit 11

• Bit 11: Indicates whether to use an internal limit

Bit	State	Value	Description
11	Internal Limit Active	0	Not in software position limit status or does not use the software position limit function (0x2400).
		1	Software position limit status

Description of bit 14

• Bit 14: Absolute position valid

Bit	State	Value	Description
14	ABS Position Valid	0	Homing is not complete or an alarm related to the encoder has occurred.
		1	Homing is complete (applied when the drive is connected to EtherCAT communication).

0x605A	Quick Stop Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	0 to 4	2	-	RW	No	Always	Yes

This sets the quick stop option code.

Settings	Description
0	Not used (transits into Switch On Disabled).
1	Slowly decelerates and then stops the drive according to the quick stop deceleration (0x6085) setting (Switch On Disabled).
2	Slowly decelerates and then stops the drive according to the quick stop deceleration (0x6085) setting (Switch On Disabled).
3	Stops using the torque limit value (Switch On Disabled)

0x605B	Shutdown Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	0 to 1	0	-	RW	No	Always	Yes

This specifies the operation to shut down the servo drive (Operation Enabled state -> Ready to Switch On state).

Settings	Description
0	Not used
1	Decelerates to a stop; enters the Switch On Disabled state; enters the Ready state

0x605C	Disable Operation Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	0 to 1	1	-	RW	No	Always	Yes

This specifies the Disable Operation state (Operation Enabled state → Switched On state) option code.

Settings	Description
0	Does not use the drive function.
1	Decelerates to a stop; moves to the Switch On Disabled state; moves to the Not Ready state

0x605D	Halt Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	0 to 4	0	-	RW	No	Always	Yes

The Halt option code sets the operation method used to move from the Operation Enabled state to the Switched On state.

Settings	Description
1	Decelerates to a stop; moves to the Operation Enabled state
2	Decelerates to a stop based on the quick stop deceleration time; move to the Operation Enabled state
3	Decelerates to a stop based on the torque limit; moves to the Operation Enabled state

0x605E	Fault Reaction Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	0	0	-	RW	No	Always	Yes

This sets the operation method that protects the drive system during fault reactions.

Settings	Description
0	Does not use the servo drive function. The motor will retain the free-run state.

0x6060	Operation Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
SINT	0 to 10	0	-	RW	Yes	Always	No

This sets the servo drive operation mode. The master sets the operation mode when the power is turned on.

This drive provides the following operation modes:

Settings	name	Description
0	-	Mode not assigned
1	PP	Profile Position mode
2	-	Reserved
3	PV	Profile Velocity mode
4	PT	Profile Torque mode
6	HM	Homing mode
7	-	Reserved
8	CSP	Cyclic Synchronous Position mode
9	CSV	Cyclic Synchronous Velocity mode
10	CST	Cyclic Synchronous Torque mode
Other	-	Reserved

0x6061	Operation Mode Display						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
SINT	-	-	-	RO	Yes	-	No

This displays the operation mode of the current drive.

0x6062	Position Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	Yes	-	No

This displays the position demand value in the position units (UU) specified by the user.

0x6063	Actual Internal Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	pulse	RO	Yes	-	No

This displays the actual internal position value in encoder pulses.

0x6064	Actual Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	Yes	-	No

This displays the actual position value in user-defined position units (UU).

0x6065	Positional error range						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x3FFFFFFF	600000	UU	RW	No	Always	Yes

This specifies the positional error range to check the Positional Error (Statusword, 0x6041.13).

0x6066	Positional error timeout						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This specifies the timeout for when checking the Positional Error (Statusword, 0x6041.13).

0x6067	Position Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x3FFFFFFF	100	UU	RW	No	Always	Yes

This specifies the position window for the target. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x6068	Position Window Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This sets the time it takes to reach the target position. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x606B	Velocity Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU/s	RO	Yes	-	No

This displays the output speed of the position controller or the command speed input to the speed controller.

0x606C	Actual Velocity Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU/s	RO	Yes	-	No

This displays the actual velocity value in user-defined position units.

0x606D	Velocity Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	20000	UU/s	RW	No	Always	Yes

This specifies the velocity window. If the difference between the target speed and the actual speed remains within the velocity window (0x606D) for the velocity window time (0x606E), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x606E	Velocity Window Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This specifies the velocity window time. If the difference between the target speed and the actual speed remains within the velocity window (0x606D) for the velocity window time (0x606E), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x6071	Target Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

This specifies the target torque for the motor in 0.1% increments of the rated torque during torque control.

0x6072	Maximum Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	No

This sets the maximum torque that the motor can output in 0.1% increments of the rated torque.

0x6074	Torque Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1%	RO	Yes	-	No

This displays the current torque demand value in 0.1% increments of the rated torque.

0x6076	Motor rated torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	mNm	RO	No	-	No

This displays the rated torque of the motor in mNm.

0x6077	Torque Actual Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1%	RO	Yes	-	No

This displays the actual torque value generated by the drive in 0.1% increments of the rated torque.

0x6078	Torque Actual Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-	-	0.1%	RO	Yes	-	No

This displays the actual torque value generated by the drive in 0.1% increments of the rated torque. A value that is the same as the actual torque value [0x6077] is displayed.

0x6079	DC-Link Voltage						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	0.1V	RO	Yes	-	No

This displays the DC-link voltage supplied by the main power in 0.1 V units.

0x607A	Target Position						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-2147483648 to 2147483647	0	UU	RW	Yes	Always	No

This specifies the target position in Profile Position (PP) mode and Cyclic Synchronous Position (CSP) mode.

It is used as the absolute coordinate or relative coordinate depending on the 4-bit (0x6040.4) setting of the Controlword in PP mode, and is always used as the absolute value in CSP mode.

0x607C	Home Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-536870912 to 536870911	0	UU	RW	No	Always	Yes

This sets the offset value for the origin of the absolute encoder or absolute external scale and the zero position of the actual position value (0x6064).

• Incremental Encoder

If it finds the home position or it is at the home position, then the position moved by the home offset value becomes the zero position.

• Absolute Encoder

If the absolute encoder is connected, then the home offset value is added to the absolute position (the actual position value).

0x607D	Software position limit						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	2	-	RO	No	-	No
SubIndex 1		Min. position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-1073741824 to 1073741823	-2000000000	UU	RW	No	Always	Yes
SubIndex 2		Max. position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-1073741824 to 1073741823	2000000000	UU	RW	No	Always	Yes

This specifies the software position limit value. It limits the range of the position demand value (0x6062) and actual position value (0x6064) and checks the new target positions for the setting value at every cycle.

The minimum software limit value is the reverse rotation limit. The maximum software limit value is the forward rotation limit.

0x607F	Maximum Profile Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x7FFFFFFF	0x7FFFFFFF	UU/s	RW	Yes	Always	Yes

This specifies the maximum profile speed for the PP mode operation.

0x6080	Maximum motor speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	RPM	RO	Yes	Always	Yes

This represents the maximum speed of the motor.

0x6081	Profile Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x7FFFFFFF	200000	UU/s	RW	Yes	Always	Yes

This specifies the profile speed for the PP mode operation.

0x6083	Profile Acceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x7FFFFFFF	200000	UU/s^2	RW	No	Always	Yes

This specifies the profile acceleration for the PP mode operation.

0x6084	Profile Deceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x7FFFFFFF	200000	UU/s^2	RW	No	Always	Yes

This specifies the profile deceleration for the PP mode operation.

0x6085	Quick Stop Deceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x7FFFFFFF	2000	UU/s^2	RW	No	Always	Yes

The system uses quick stop deceleration if the quick stop option code (0x605A) is set to 2.

0x6087	Torque Slope						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x7FFFFFFF	1000	0.1%/s	RW	Yes	Always	Yes

This specifies the torque slope for the PT mode operation.

0x6091	Gear ratio						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	2	-	RO	No	-	No
SubIndex 1		Motor revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	0 to 0x40000000	1	-	RW	No	Power cycling	Yes
SubIndex 2		Shaft revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	0 to 0x40000000	1	-	RW	No	Power cycling	Yes

For more information, refer to Section 5.3 Electric Gear Setup.

0x6098	Homing Methods						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
SINT	-128 to 127	34	-	RW	No	Always	Yes

This sets the homing method. For more information, refer to 4.6 Homing.

Settings	Description
0	Disabled
1	Homing using the index pulse and reverse limit contact
2	Homing using the index pulse and forward limit contact
7 to 14	Homing using the index pulse and home contact
24	Same as method 8 (does not use the index pulse)
28	Same as method 12 (does not use the index pulse)
33, 34	Homing to the index pulse
35	Homing to the current position
-1	Homing using the negative stopper and index pulse
-2	Homing using the positive stopper and index pulse
-3	Homing using the negative stopper only
-4	Homing using the positive stopper only
-5	The drive returns to the home position only with the home switch (HOME) while driving in the reverse direction.
-6	The drive returns to the home position only with the home switch (HOME) while driving in the forward direction.

0x6099	Homing Speeds						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	2	-	RO	No	-	No
SubIndex 1		Switch search speed					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	0 to 0x40000000	500000	UU/s	RW	No	Always	Yes
SubIndex 2		Zero search speed					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	0 to 0x40000000	100000	UU/s	RW	No	Always	Yes

This specifies the operation speed for homing.

0x609A	Homing Acceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0x40000000	200000	UU/s^2	RW	No	Always	Yes

This specifies the operation acceleration for homing.

0x60B0	Position Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-2147483648 to 2147483647	0	UU	RW	Yes	Always	No

In CSP mode, this specifies the offset value added to the position command.

0x60B1	Velocity Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

In CSP mode, this corresponds to the speed feed-forward value.

In CSV mode, this specifies the offset value added to the speed command value.

0x60B2	Torque Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

In CSP and CSV modes, this corresponds to the torque feed-forward value.

In CST mode, this specifies the offset value added to the torque command value.

0x60B8	Touch Probe Function						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 0xFFFF	0x0033	-	RW	Yes	Always	No

This specifies the touch probe function.

Bit	Value	Description
0	0	Does not use touch probe 1.
	1	Uses touch probe 1.
1	0	Single trigger mode
	1	Continuous trigger mode
2	0	Triggered by the input of touch probe 1.
	1	Triggered by the index pulse signal.
3	–	Reserved
4	0	Does not capture the rising edge position value of touch probe 1.
	1	Captures the rising edge position value of touch probe 1.
5	0	Does not capture the falling edge position value of touch probe 1.
	1	Captures the falling edge position value of touch probe 1.
6 to 7	–	Reserved
8	0	Does not use touch probe 2.
	1	Uses touch probe 2.
9	0	Single trigger mode
	1	Continuous trigger mode
10	0	Triggered by the input of touch probe 2.
	1	Triggered by the index pulse signal.
11	–	Reserved
12	0	Does not capture the rising edge position value of touch probe 2.
	1	Captures the rising edge position value of touch probe 2.
13	0	Does not capture the falling edge position value of touch probe 2.
	1	Captures the falling edge position value of touch probe 2.
14 to 15	–	Reserved

0x60B9	Touch Probe Status						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	-	-	-	RO	Yes	-	No

This displays the status of the touch probe.

Bit	Value	Description
0	0	Does not use touch probe 1.
	1	Uses touch probe 1.
1	0	Does not store the rising edge position value of touch probe 1.
	1	Stores the rising edge position value of touch probe 1.
2	0	Does not store the falling edge position value of touch probe 1.
	1	Stores the falling edge position value of touch probe 1.
3 to 5	–	Reserved
6	0, 1	Toggles when the rising edge position value of touch probe 1 is updated.
7	0, 1	Toggles when the falling edge position value of touch probe 1 is updated.
8	0	Does not use touch probe 2.
	1	Uses touch probe 2.
9	0	Does not store the rising edge position value of touch probe 2.
	1	Stores the rising edge position value of touch probe 2.
10	0	Does not store the falling edge position value of touch probe 2.
	1	Stores the falling edge position value of touch probe 2.
11 to 13	–	Reserved
14	0, 1	Toggles when the rising edge position value of touch probe 2 is updated.
15	0, 1	Toggles when the falling edge position value of touch probe 2 is updated.

In continuous trigger mode, you can toggle to save all update values for 6, 7, 14 and 15 bits on the rising/falling edge of the touch probe.

To disable bits 1, 2, 9 and 10 (saving the position values on the rising/falling edges of touch probes 1 and 2) of the touch probe state (0x60B9), disable bits 4, 5, 12 and 13 (using sampling on the rising/falling edges of touch probes 1 and 2) of the touch probe function (0x60B8) and enable them.

0x60BA	Touch Probe 1 Rising Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	Yes	-	No

This represents the rising edge position value of touch probe 1.

0x60BB	Touch Probe 1 Falling Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	Yes	-	No

This represents the falling edge position value of touch probe 1.

0x60BC	Touch Probe 2 Rising Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	Yes	-	No

This represents the rising edge position value of touch probe 2.

0x60BD	Touch Probe 2 Falling Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	Yes	-	No

This represents the falling edge position value of touch probe 2.

0x60E0	Positive Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

This sets the limit for the forward torque values.

0x60E1	Negative Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

This sets the limit for the reverse torque values.

0x60F4	Actual position error value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	UU	RO	Yes	-	No

This displays the actual position error during position control.

0x60FC	Position Demand Internal Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-	-	pulse	RO	Yes	-	No

This represents the value entered as the command during position control.

0x60FD	Digital Input						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	-	-	RO	Yes	-	No

They indicate the status of digital inputs.

Bit	Description
0	NOT (negative limit switch)
1	POT (positive limit switch)
2	HOME (origin sensor input)
3 to 15	Reserved
16	DI #1(I/O pin 11), 0:Open, 1:Close
17	DI #2(I/O pin 12), 0:Open, 1:Close
18	DI #3(I/O pin 7), 0:Open, 1:Close
19	DI #4(I/O pin 8), 0:Open, 1:Close
20	DI #5(I/O pin 13), 0:Open, 1:Close
21	DI #6(I/O pin 14), 0:Open, 1:Close
22	DI #7(I/O pin 9), 0:Open, 1:Close
23	DI #8(I/O pin 10), 0:Open, 1:Close
24~30	Reserved
31	STO(Safe Torque Off), 0:Close, 1:Open

0x60FE	Digital Output						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
USINT	-	2	-	RO	No	-	No
SubIndex 1		Physical outputs					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	No
SubIndex 2		Bit mask					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	Yes

- Description of physical outputs

Bit	Description
0 to 15	Reserved
16	Forced output (0: OFF, 1: ON) of DO #1 (I/O pins 3 and 4) Provided that the relevant bit mask (0x60FE:02.16) is set to 1.
17	Forced output (0: OFF, 1: ON) of DO #2 (I/O pins 23 and 24) Provided that the relevant bit mask (0x60FE:02.17) is set to 1.
18	Forced output (0: OFF, 1: ON) of DO #3 (I/O pins 25 and 26) Provided that the relevant bit mask (0x60FE:02.18) is set to 1.
19	Forced output (0: OFF, 1: ON) of DO #4 (I/O pins 1 and 2) Provided that the relevant bit mask (0x60FE:02.19) is set to 1.
20 to 23	Reserved
24	Output status of DO #1 (0: OFF, 1: ON)
25	Output status of DO #2 (0: OFF, 1: ON)
26	Output status of DO #3 (0: OFF, 1: ON)
27	Output status of DO #4 (0: OFF, 1: ON)
28 to 31	Reserved

- Description of bit mask

Bit	Description
0 to 15	Reserved
16	Forced output setting (0: Disable, 1: Enable) of DO #1 (I/O pins 3 and 4)
17	Forced output setting (0: Disable, 1: Enable) of DO #2 (I/O pins 23 and 24)
18	Forced output setting (0: Disable, 1: Enable) of DO #3 (I/O pins 25 and 26)
19	Forced output setting (0: Disable, 1: Enable) of DO #4 (I/O pins 1 and 2)
20 to 31	Reserved

0x60FF	Target Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
DINT	-2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

This specifies the target velocity in PV mode and CSV mode.

0x6502	Supported Drive Modes						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Retentive
UDINT	-	0x000003AD	-	RO	No	-	No

This displays the mode(s) supported by the drive.

Bit	Supported modes	Description
0	PP (Profile Position)	1: Supported
1	Vl (Velocity)	0: Not supported
2	PV (Profile Velocity)	1: Supported
3	PT (Torque Profile)	1: Supported
4	Reserved	0
5	HM (Homing)	1: Supported
6	IP (Interpolated Position)	0: Not Supported
7	CSP (Cyclic Synchronous Position)	1: Supported
8	CSV (Cyclic Synchronous Velocity)	1: Supported
9	CST (Cyclic Synchronous Torque)	1: Supported
10 to 31	Reserved	0

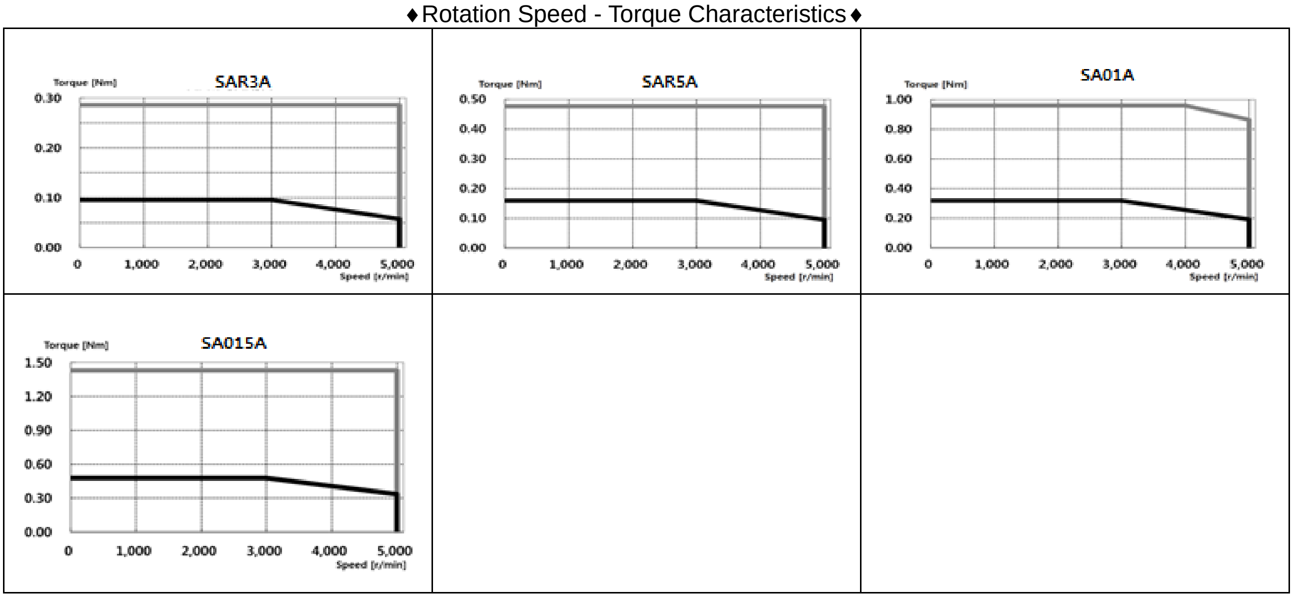
11. Product Specifications

11.1 Servo Motor

■ Product Features

Servo Motor Type (XML-□□□□□)		SAR3A	SAR5A	SA01A	SA015A
Applicable drive (XDL-L7□A□□)		L7□A001			L7□A002
Rated output	[kW]	0.03	0.05	0.10	0.15
Rated torque	[N·m]	0.10	0.16	0.32	0.48
	[kgf·cm]	0.97	1.62	3.25	4.87
Maximum instantaneous torque	[N·m]	0.29	0.48	0.96	1.43
	[kgf·cm]	2.92	4.87	9.74	14.62
Rated current	[A]	1.07	1.20	1.38	1.73
Peak current	[A]	3.21	3.60	4.14	5.19
Rated rotation speed	[r/min]	3000			
Maximum rotation speed	[r/min]	5000			
Inertia moment	[kg·m^{2}x10^{-4}]	0.0164	0.02	0.05	0.06
	[gf·cm·s^2]	0.0167	0.02	0.05	0.07
Permitted load inertia		30 times of motor inertia			20 times
Rated power rate	[kW/s]	5.56	10.55	23.78	35.34
Speed and Position Detector	Standard	Quad. Type Incremental 2048[P/R]			
	Option	Serial M-turn Type 18[Bit]			
Specifications and features	Protection method	Fully enclosedself-cooling IP55 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No exposure to direct sunlight, no corrosive or flammable gases.			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	0.3	0.4	0.5	0.7

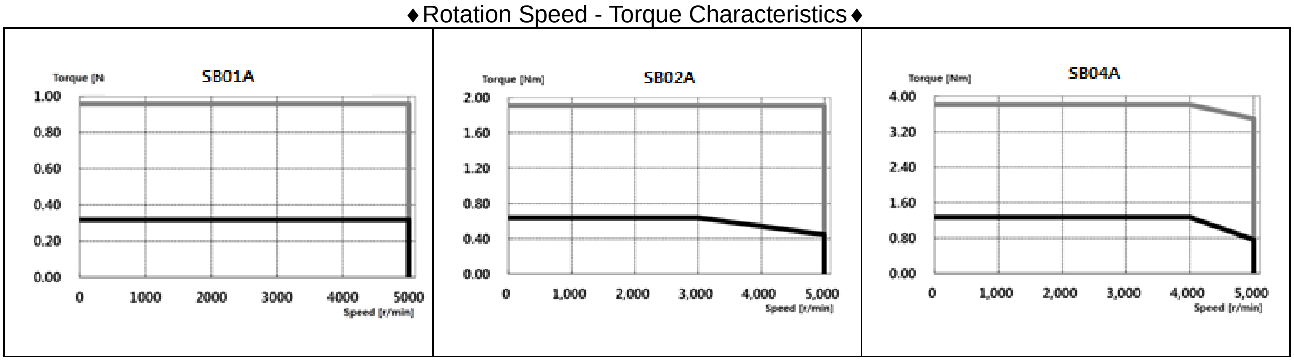
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		SB01A	SB02A	SB04A
Applicable drive (XDL-L7□A□□)		**L7□A002**		**L7□A004**
Rated output	[kW]	0.10	0.20	0.40
Rated torque	[N·m]	0.32	0.64	1.27
	[kgf·cm]	3.25	6.49	12.99
Maximum instantaneous torque	[N·m]	0.96	1.91	3.82
	[kgf·cm]	9.74	19.48	38.96
Rated current	[A]	1.65	1.63	2.89
Peak current	[A]	4.95	4.89	8.67
Rated rotation speed	[r/min]	3000		
Maximum rotation speed	[r/min]	5000		
Inertia moment	[kg·m^{2}x10^{-4}]	0.11	0.18	0.32
	[gf·cm·s^2]	0.12	0.19	0.33
Permitted load inertia		20 times of motor inertia		
Rated power rate	[kW/s]	8.89	22.26	50.49
Speed and Position Detector	Standard	Quad. Type Incremental 3000[P/R]		
	Option	Serial Type 19[Bit]		
Specifications and features	Protection method	Fully enclosedself-cooling IP55 (excluding axis penetration)·		
	Time rating	Continuous		
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C		
	Ambient humidity	20 - 80% RH (no condensation)		
	Atmosphere	No exposure to direct sunlight, no corrosive or flammable gases.		
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)		
Weight	[kg]	0.8	1.1	1.6

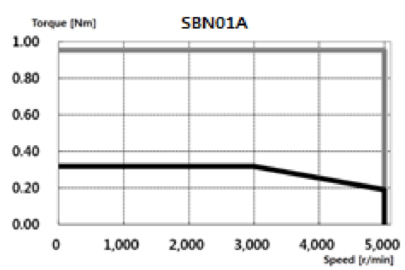
♦Rotation Speed - Torque Characteristics♦

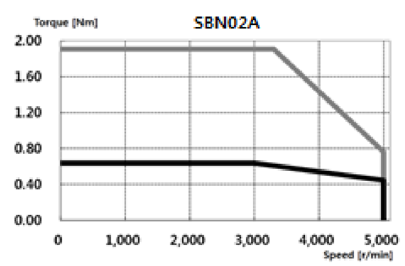


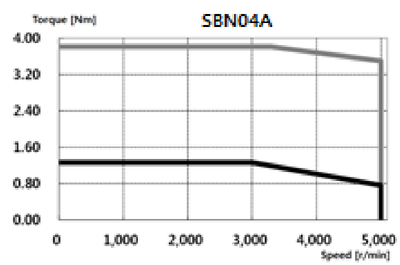
■ Product Features

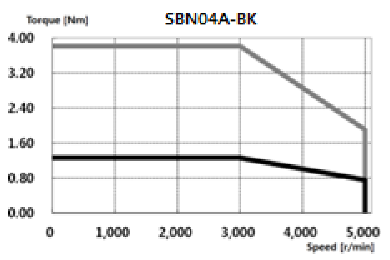
Servo Motor Type (XML-□□□□□)		SBN01A	SBN02A	SBN04A	SBN04A-BK
Applicable drive (XDL-L7□A□□)		L7□A002		L7□A004	
Rated output	[kW]	0.1	0.2	0.4	0.4
Rated torque	[N·m]	0.32	0.64	1.27	1.27
	[kgf·cm]	3.25	6.49	12.99	12.99
Maximum instantaneous torque	[N·m]	0.95	1.91	3.82	3.82
	[kgf·cm]	9.74	19.48	38.96	38.96
Rated current	[A]	1.58	1.50	3.00	2.73
Peak current	[A]	4.74	4.50	9.00	8.19
Rated rotation speed	[r/min]	3000			
Maximum rotation	[r/min]	5000			
Inertia moment	[kg·m²x10⁻⁴]	0.11	0.18	0.32	0.25
	[gf·cm·s²]	0.12	0.19	0.33	0.26
Permitted load inertia		20 times of motor inertia			
Rated power rate	[kW/s]	8.91	22.22	50.41	63.84
Speed and Position Detector	Standard	Quad. Type Incremental 3000[P/R]			
	Option	Serial Type 19[Bit]			
Specifications and features	Protection	Fully enclosedself-cooling IP55 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	0.8	1.1	1.6	1.6

♦Rotation Speed - Torque Characteristics♦





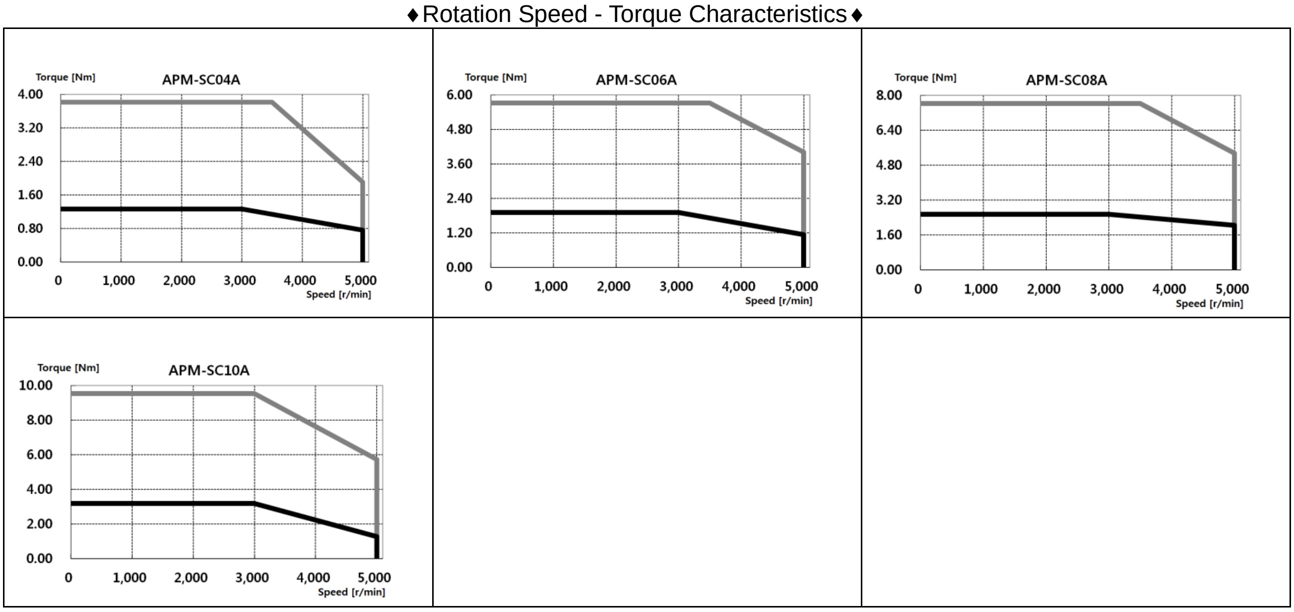




■ Product Features

Servo Motor Type (XML-□□□□□)		SC04A	SC06A	SC08A	SC10A
Applicable drive (XDL-L7□A□□)		**L7□A004**	**L7□A008**		**L7□A010**
Rated output	[kW]	0.4	0.6	0.8	1.0
Rated torque	[N·m]	1.27	1.91	2.55	3.19
	[kgf·cm]	12.99	19.49	25.98	32.48
Maximum instantaneous torque	[N·m]	3.82	5.73	7.64	9.56
	[kgf·cm]	38.96	58.47	77.95	97.43
Rated current	[A]	2.82	3.58	4.83	5.37
Peak current	[A]	8.46	10.74	14.49	16.11
Rated rotation speed	[r/min]	3000			
Maximum rotation	[r/min]	5000			
Inertia moment	[kg·m²x10^{-4}]	0.67	1.09	1.51	1.93
	[gf·cm·s²]	0.69	1.11	1.54	1.97
Permitted load inertia		15 times of motor inertia			
Rated power rate	[kW/s]	24.05	33.39	43.02	52.57
Speed and Position Detector	Standard	Quad. Type Incremental 3000[P/R]			
	Option	Serial Type 19[Bit]			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	1.9	2.5	3.2	3.8

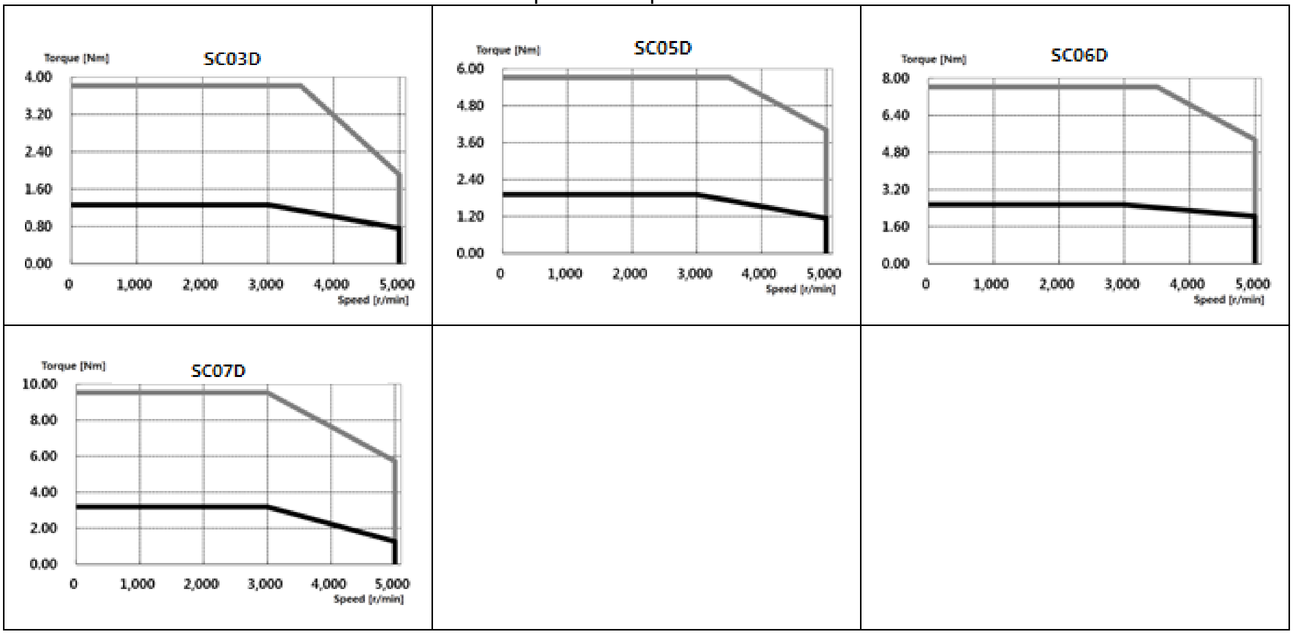
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		SC03D	SC05D	SC06D	SC07D
Applicable drive (XDL-L7□A□□)		**L7□A004**	**L7□A008**		
Rated output	[kW]	0.30	0.45	0.55	0.65
Rated torque	[N·m]	1.43	2.15	2.63	3.10
	[kgf·cm]	14.61	21.92	26.79	31.66
Maximum instantaneous torque	[N·m]	4.30	6.45	7.88	9.31
	[kgf·cm]	43.84	65.77	80.38	94.99
Rated current	[A]	2.59	3.23	3.82	4.42
Peak current	[A]	7.77	9.69	11.46	13.26
Rated rotation speed	[r/min]	2000			
Maximum rotation speed	[r/min]	3000			
Inertia moment	[kg·m²x10^{-4}]	0.67	1.09	1.51	1.93
	[gf·cm·s²]	0.69	1.11	1.54	1.97
Permitted load inertia		15 times of motor inertia			
Rated power rate	[kW/s]	30.43	42.27	45.69	49.97
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]			
	Option	Serial type 19-bit			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	1.9	2.5	3.2	3.9

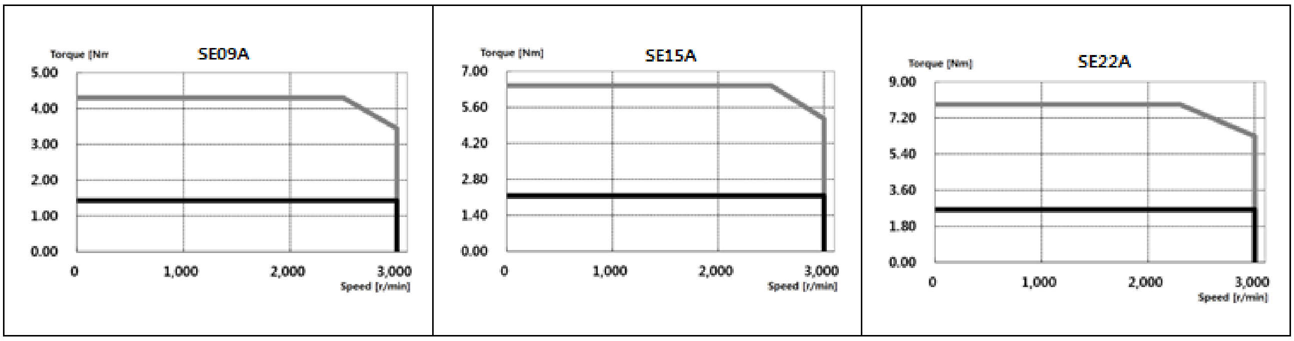
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		SE09A	SE15A	SE22A
Applicable drive (XDL-L7□A□□)		**L7□A008**	**L7□A020**	
Rated output	[kW]	0.9	1.5	2.2
Rated torque	[N·m]	2.86	4.77	7.00
	[kgf·cm]	29.23	48.72	71.45
Maximum instantaneous torque	[N·m]	8.59	14.32	21.01
	[kgf·cm]	87.69	146.15	214.35
Rated current	[A]	4.95	8.23	11.98
Peak current	[A]	14.85	24.69	35.94
Rated rotation speed	[r/min]	3000		
Maximum rotation speed	[r/min]	5000		
Inertia moment	[kg·m²x10⁻⁴]	6.66	12.00	17.34
	[gf·cm·s²]	6.80	12.24	17.69
Permitted load inertia		10 times of motor inertia		
Rated power rate	[kW/s]	12.32	18.99	28.28
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]		
	Option	Serial type 19-bit		
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·		
	Time rating	Continuous		
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C		
	Ambient humidity	20 - 80% RH (no condensation)		
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas		
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)		
Weight	[kg]	5.5	7.5	9.7

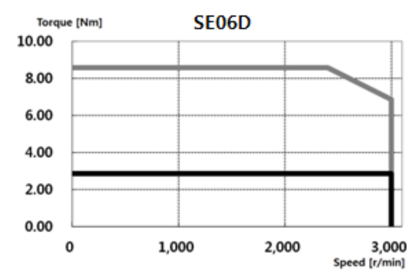
♦Rotation Speed - Torque Characteristics♦

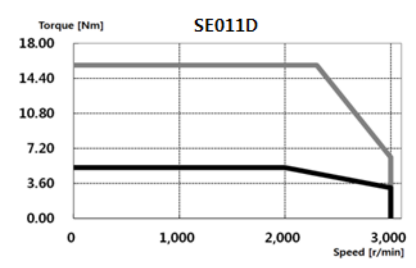


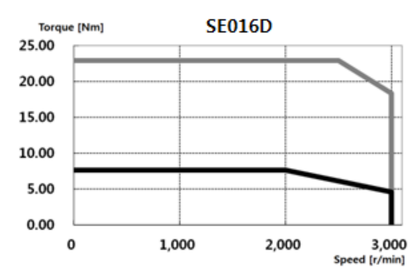
■ Product Features

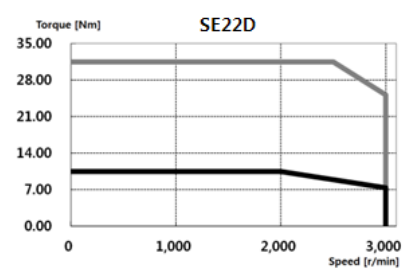
Servo Motor Type (XML-□□□□□)		SE06D	SE11D	SE16D	SE22D
Applicable drive (XDL-L7□A□□)		**L7□A008**	**L7□A010**	**L7□A020**	
Rated output	[kW]	0.6	1.1	1.6	2.2
Rated torque	[N·m]	2.86	5.25	7.64	10.50
	[kgf·cm]	29.23	53.59	77.94	107.17
Maximum instantaneous torque	[N·m]	8.59	15.75	22.92	31.51
	[kgf·cm]	87.69	160.76	233.83	321.52
Rated current	[A]	3.97	6.28	9.23	12.37
Peak current	[A]	11.91	18.84	27.69	37.11
Rated rotation speed	[r/min]	2000			
Maximum rotation speed	[r/min]	3000			
Inertia moment	[kg·m²x10⁻⁴]	6.66	12.00	17.34	22.68
	[gf·cm·s²]	6.80	12.24	17.69	23.14
Permitted load inertia		10 times of motor inertia			
Rated power rate	[kW/s]	12.32	22.98	33.65	48.64
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]			
	Option	Serial type 19-bit			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	5.5	7.5	9.7	11.8

♦Rotation Speed - Torque Characteristics♦





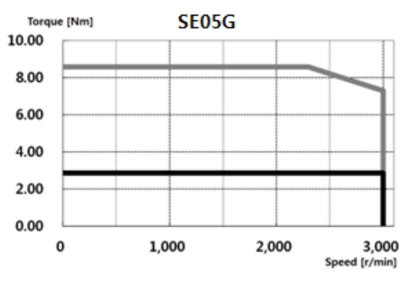


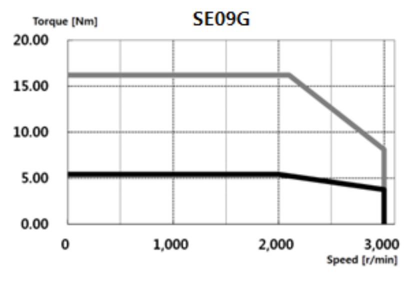


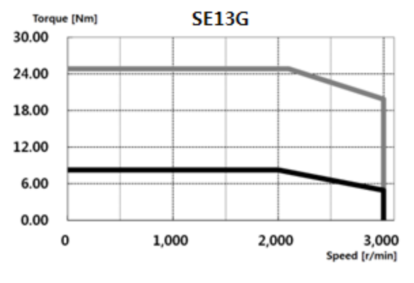
■ Product Features

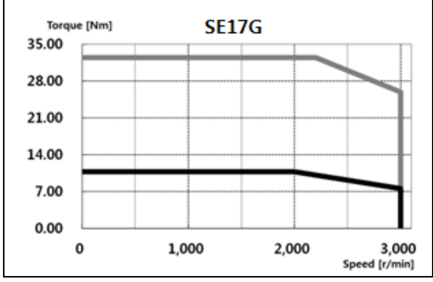
Servo Motor Type (XML-□□□□□)		SE05G	SE09G	SE13G	SE17G
Applicable drive (XDL-L7□A□□)		**L7□A008**	**L7□A010**	**L7□A020**	
Rated output	[kW]	0.45	0.85	1.3	1.7
Rated torque	[N·m]	2.86	5.41	8.28	10.82
	[kgf·cm]	29.23	55.21	84.44	110.42
Maximum instantaneous torque	[N·m]	8.59	16.23	24.83	32.46
	[kgf·cm]	87.69	165.63	253.32	331.26
Rated current	[A]	3.97	6.47	10.00	12.75
Peak current	[A]	11.91	19.41	30.00	38.25
Rated rotation speed	[r/min]	1500			
Maximum rotation speed	[r/min]	3000			
Inertia moment	[kg·m²x10^{-4}]	6.66	12.00	17.34	22.68
	[gf·cm·s²]	6.80	12.24	17.69	23.14
Permitted load inertia		10 times of motor inertia			
Rated power rate	[kW/s]	12.32	24.40	39.49	51.63
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]			
	Option	Serial type 19-bit			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	5.5	7.5	9.7	11.8

♦Rotation Speed - Torque Characteristics♦





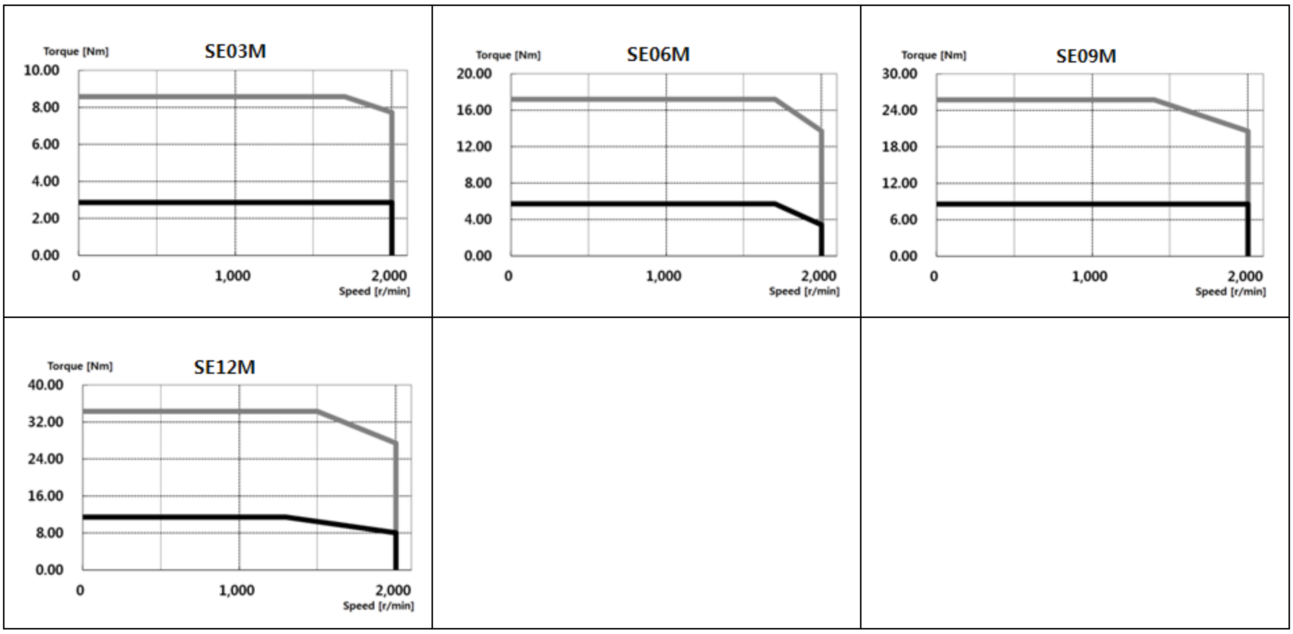




■ Product Features

Servo Motor Type (XML-□□□□□)		SE03M	SE06M	SE09M	SE12M
Applicable drive (XDL-L7□A□□)		**L7□A004**	**L7□A008**	**L7□A010**	**L7□A020**
Rated output	[kW]	0.3	0.6	0.9	1.2
Rated torque	[N·m]	2.86	5.73	8.59	11.46
	[kgf·cm]	29.23	58.46	87.69	116.92
Maximum instantaneous torque	[N·m]	8.59	17.19	25.78	34.37
	[kgf·cm]	87.69	175.30	263.06	350.75
Rated current	[A]	2.51	4.15	5.78	7.63
Peak current	[A]	7.53	12.45	17.34	22.89
Rated rotation speed	[r/min]	1000			
Maximum rotation speed	[r/min]	2000			
Inertia moment	[kg·m²x10^{-4}]	6.66	12.00	17.34	22.68
	[gf·cm·s²]	6.80	12.24	17.69	23.14
Permitted load inertia		10 times of motor inertia			
Rated power rate	[kW/s]	12.32	27.35	42.59	57.89
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]			
	Option	Serial type 19-bit			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	5.5	7.5	9.7	11.8

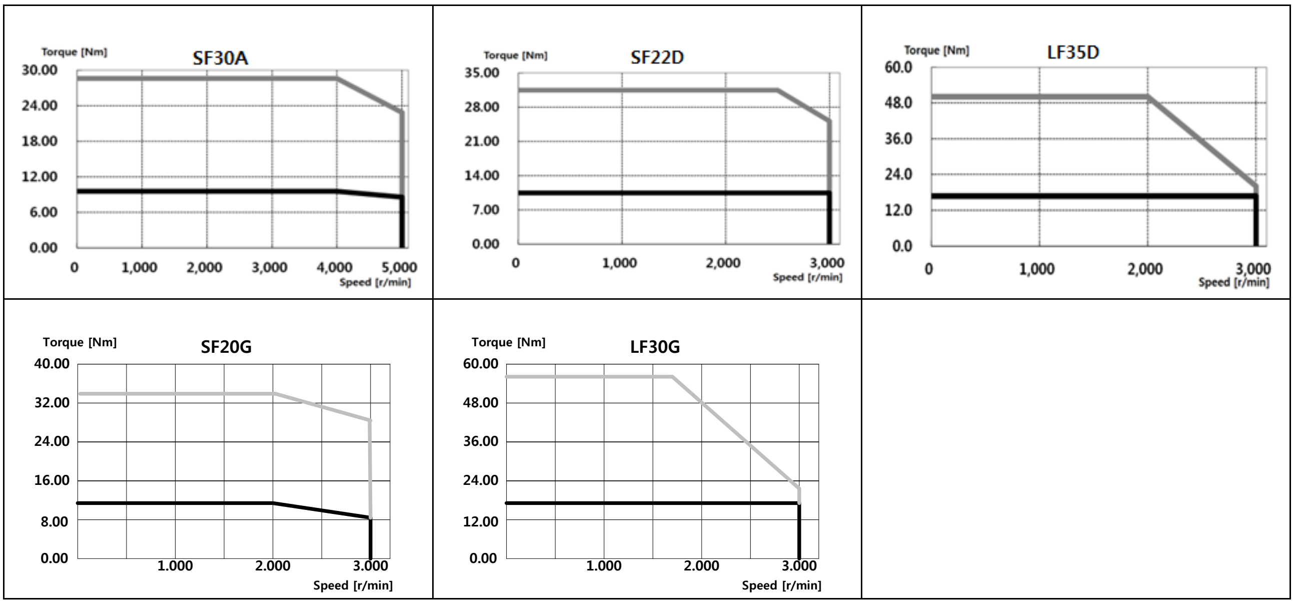
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		SF30A	SF22D	LF35D	SF20G	LF30G
Applicable drive (XDL-L7□A□□)		L7□A035	L7□A020	L7□A035		
Rated output	[kW]	3.0	2.2	3.5	1.8	2.9
Rated torque	[N·m]	9.55	10.50	16.71	11.46	18.46
	[kgf·cm]	97.43	107.17	170.50	116.92	188.37
Maximum instantaneous torque	[N·m]	28.64	31.51	50.13	34.37	55.38
	[kgf·cm]	292.29	321.52	511.51	350.75	565.10
Rated current	[A]	16.70	13.50	15.85	14.7	15.92
Peak current	[A]	50.1	40.50	47.55	44.1	47.64
Rated rotation speed	[r/min]	3000	2000		1500	
Maximum rotation speed	[r/min]	5000	3000		3000	2700
Inertia moment	[kg·m²x10^{-4}]	30.74	30.74	52.13	30.74	52.13
	[gf·cm·s²]	31.37	31.35	53.16	31.37	53.19
Permitted load inertia		5 times of motor inertia				
Rated power rate	[kW/s]	29.66	35.88	53.56	42.71	65.37
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]				
	Option	Serial type 19-bit				
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·				
	Time rating	Continuous				
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C				
	Ambient humidity	20 - 80% RH (no condensation)				
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas				
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)				
Weight	[kg]	12.4	12.4	17.7	12.4	17.7

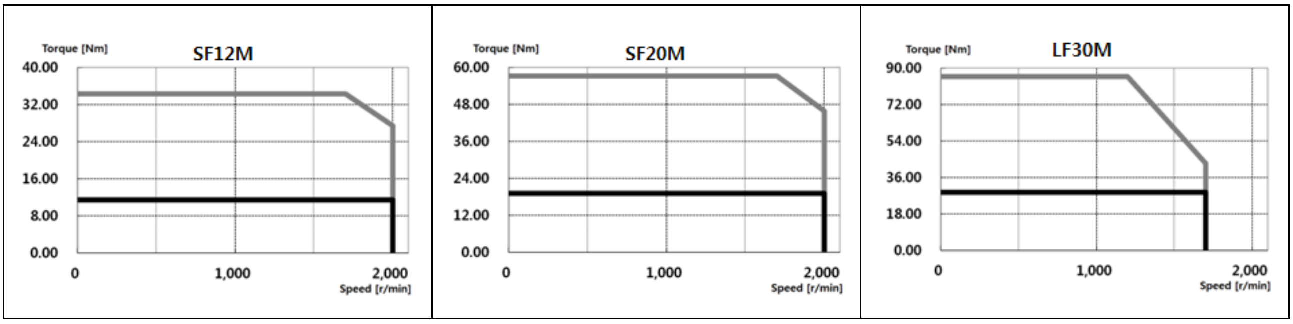
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		SF12M	SF20M	LF30M
Applicable drive (XDL-L7□A□□)		**L7□A020**	**L7□A035**	
Rated output	[kW]	1.2	2.0	3.0
Rated torque	[N·m]	11.46	19.10	28.64
	[kgf·cm]	116.92	194.86	292.29
Maximum instantaneous torque	[N·m]	34.37	57.29	85.93
	[kgf·cm]	350.75	584.58	876.88
Rated current	[A]	8.40	14.40	15.99
Peak current	[A]	25.2	43.2	47.97
Rated rotation speed	[r/min]	1000		
Maximum rotation speed	[r/min]	2000		1700
Inertia moment	[kg·m²x10⁻⁴]	30.74	52.13	83.60
	[gf·cm·s²]	31.37	53.19	85.31
Permitted load inertia		5 times of motor inertia		
Rated power rate	[kW/s]	42.71	69.95	98.15
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]		
	Option	Serial type 19-bit		
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·		
	Time rating	Continuous		
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C		
	Ambient humidity	20 - 80% RH (no condensation)		
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas		
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)		
Weight	[kg]	12.4	17.7	26.3

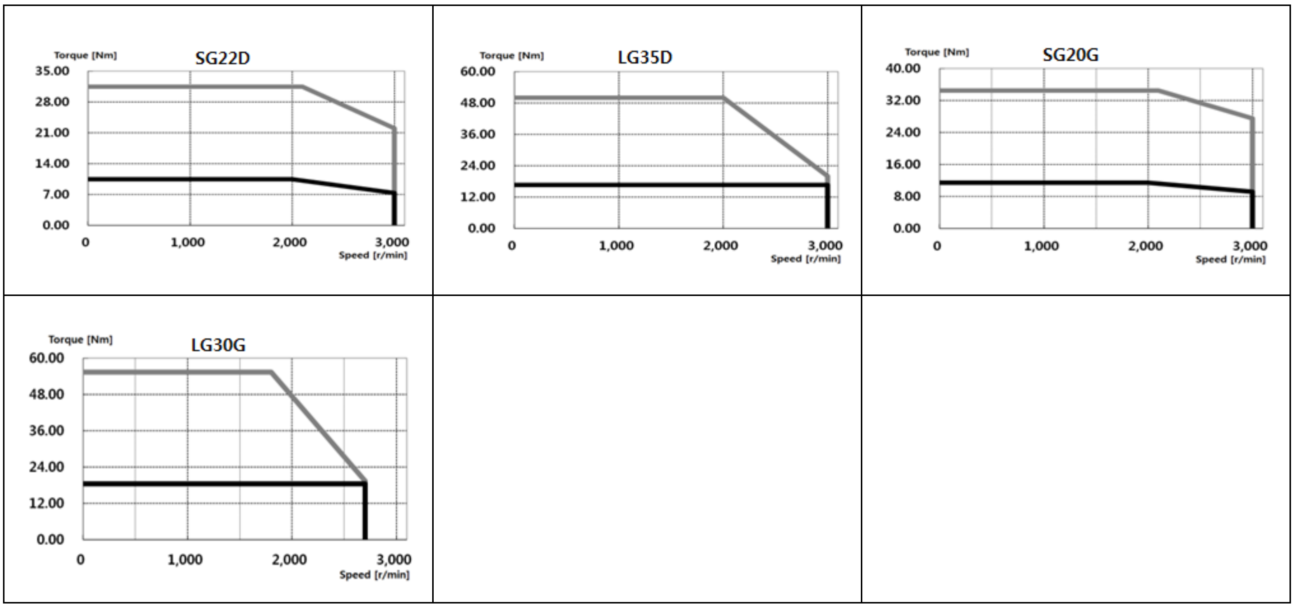
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		SG22D	LG35D	SG20G	LG30G
Applicable drive (XDL-L7□A□□)		**L7□A020**	**L7□A035**	**L7□A020**	**L7□A035**
Rated output	[kW]	2.2	3.5	1.8	2.9
Rated torque	[N·m]	10.50	16.71	11.46	18.46
	[kgf·cm]	107.20	170.52	116.92	188.37
Maximum instantaneous torque	[N·m]	31.51	50.13	34.47	55.38
	[kgf·cm]	321.52	511.51	350.80	565.10
Rated current	[A]	12.30	16.05	13.10	16.19
Peak current	[A]	36.9	48.15	39.3	48.57
Rated rotation speed	[r/min]	2000		1500	
Maximum rotation speed	[r/min]	3000		3000	2700
Inertia moment	[kg·m²x10⁻⁴]	51.42	80.35	51.42	80.35
	[gf·cm·s²]	52.47	81.99	52.47	81.99
Permitted load inertia		5 times of motor inertia			
Rated power rate	[kW/s]	21.45	34.75	25.53	42.41
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]			
	Option	Serial type 19-bit			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	17.0	22.0	17.0	22.0

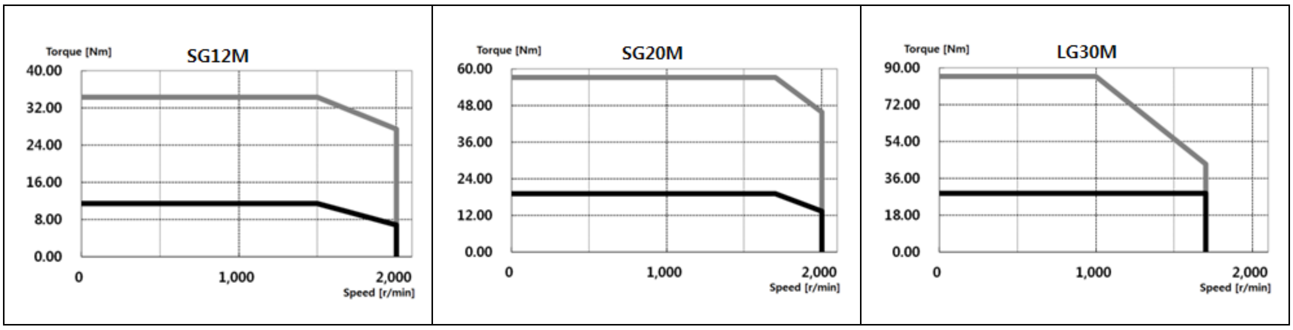
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		SG12M	SG20M	LG30M
Applicable drive (XDL-L7□A□□)		**L7□A020**	**L7□A035**	
Rated output	[kW]	1.2	2.0	3.0
Rated torque	[N·m]	11.46	19.10	28.64
	[kgf·cm]	116.92	194.86	292.29
Maximum instantaneous torque	[N·m]	34.37	57.29	85.93
	[kgf·cm]	350.75	584.58	876.88
Rated current	[A]	8.87	15.02	16.04
Peak current	[A]	26.61	45.06	48.12
Rated rotation speed	[r/min]	1000		
Maximum rotation speed	[r/min]	2000		1700
Inertia moment	[kg·m²x10^{-4}]	51.42	80.35	132.41
	[gf·cm·s²]	52.47	81.99	135.11
Permitted load inertia		5 times of motor inertia		
Rated power rate	[kW/s]	25.53	45.39	61.97
Speed and Position Detector	Standard	Quadrature Type Incremental 3000[P/R]		
	Option	Serial type 19-bit		
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·		
	Time rating	Continuous		
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C		
	Ambient humidity	20 - 80% RH (no condensation)		
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas		
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)		
Weight	[kg]	17.0	22.0	30.8

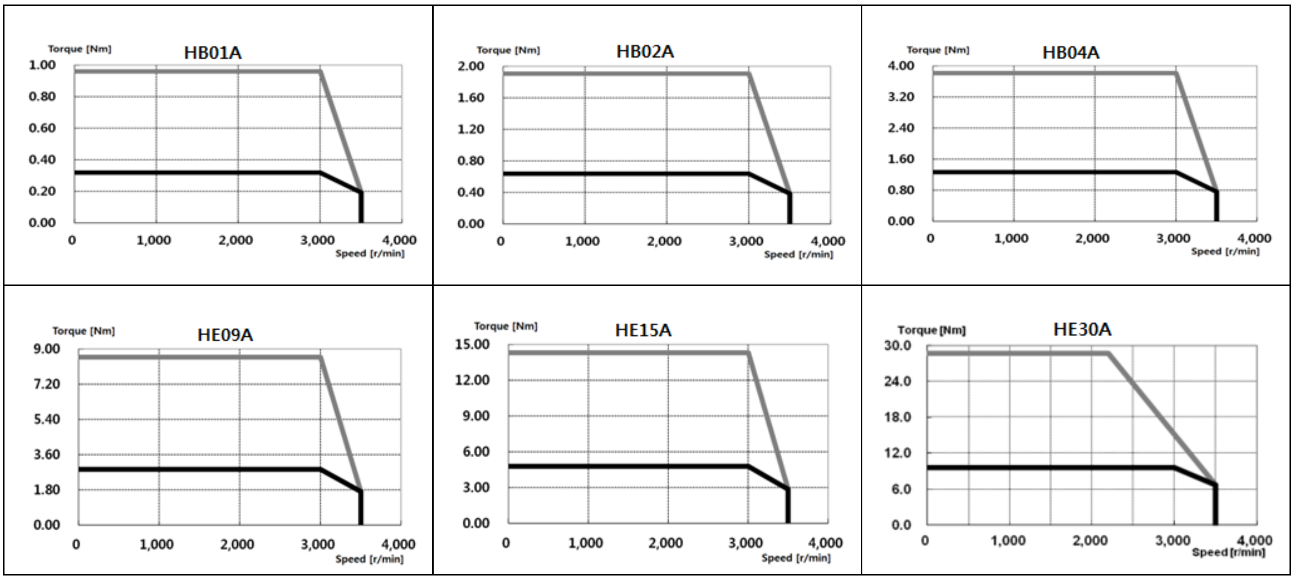
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		HB01A	HB02A	HB04A	HE09A	HE15A	HE30A
Applicable drive (XDL-L7□A□□)		L7□A002		L7□A004	L7□A008	L7□A020	L7□A035
Rated output	[kW]	0.1	0.2	0.4	0.9	1.5	3.0
Rated torque	[N·m]	0.32	0.64	1.27	2.86	4.77	9.55
	[kgf·cm]	3.25	6.49	12.99	29.23	48.72	97.43
Maximum instantaneous torque	[N·m]	0.96	1.91	3.82	8.59	14.32	28.64
	[kgf·cm]	9.74	19.48	38.96	87.69	146.15	292.29
Rated current	[A]	1.65	1.63	2.89	4.95	8.23	17.16
Peak current	[A]	4.95	4.89	8.67	14.85	24.69	51.48
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	3500					
Inertia moment	[kg·m²x10⁻⁴]	0.27	0.33	0.46	19.56	22.27	31.81
	[gf·cm·s²]	0.27	0.34	0.47	19.96	22.72	32.46
Permitted load inertia		20 times of motor inertia			10 times of motor inertia		
Rated power rate	[kW/s]	3.34	11.98	34.47	4.10	10.01	22.03
Speed and Position Detector	Standard	Quadrature Type Incremental 1024P/R			Quadrature Type Incremental 2048 P/R		
	Option	x					
Specifications and features	Protection method	Fully enclosedself-cooling IP55 (excluding axis penetration)·					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient humidity	20 - 80% RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)					
Weight	[kg]	0.9	1.2	1.7	5.8	7.4	

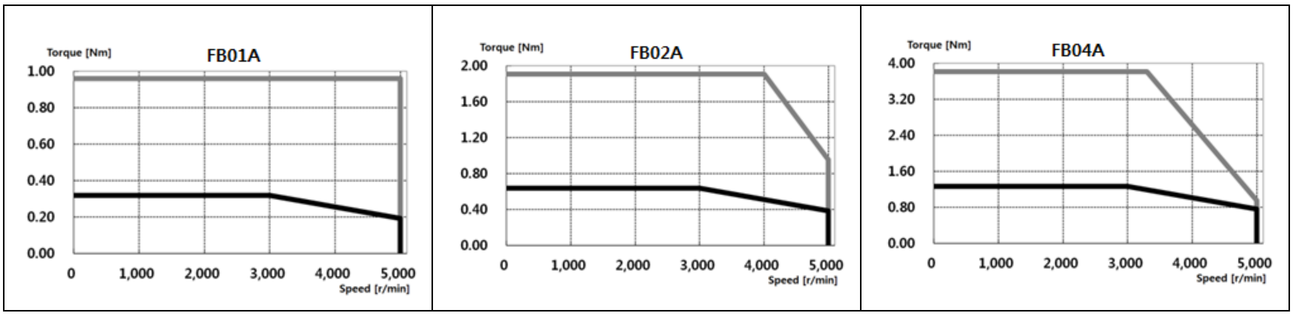
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FB01A	FB02A	FB04A
Applicable drive (XDL-L7□A□□)		**L7□A001**	**L7□A002**	**L7□A004**
Rated output	[kW]	0.10	0.20	0.40
Rated torque	[N·m]	0.32	0.64	1.27
	[kgf·cm]	3.25	6.50	12.99
Maximum instantaneous torque	[N·m]	0.96	1.91	3.82
	[kgf·cm]	9.74	19.49	38.98
Rated current	[A]	0.95	1.45	2.60
Peak current	[A]	2.86	4.35	7.79
Rated rotation speed	[r/min]	3000		
Maximum rotation speed	[r/min]	5000		
Inertia moment	[kg·m²x10^{-4}]	0.09	0.15	0.25
	[gf·cm·s²]	0.09	0.15	0.25
Permitted load inertia		20 times of motor inertia		
Rated power rate	[kW/s]	11.38	27.95	65.90
Speed and Position Detector	Standard	Serial type 19-bit		
	Option	X		
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·		
	Time rating	Continuous		
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C		
	Ambient humidity	20 - 80% RH (no condensation)		
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas		
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)		
Weight	[kg]	0.7	0.9	1.3

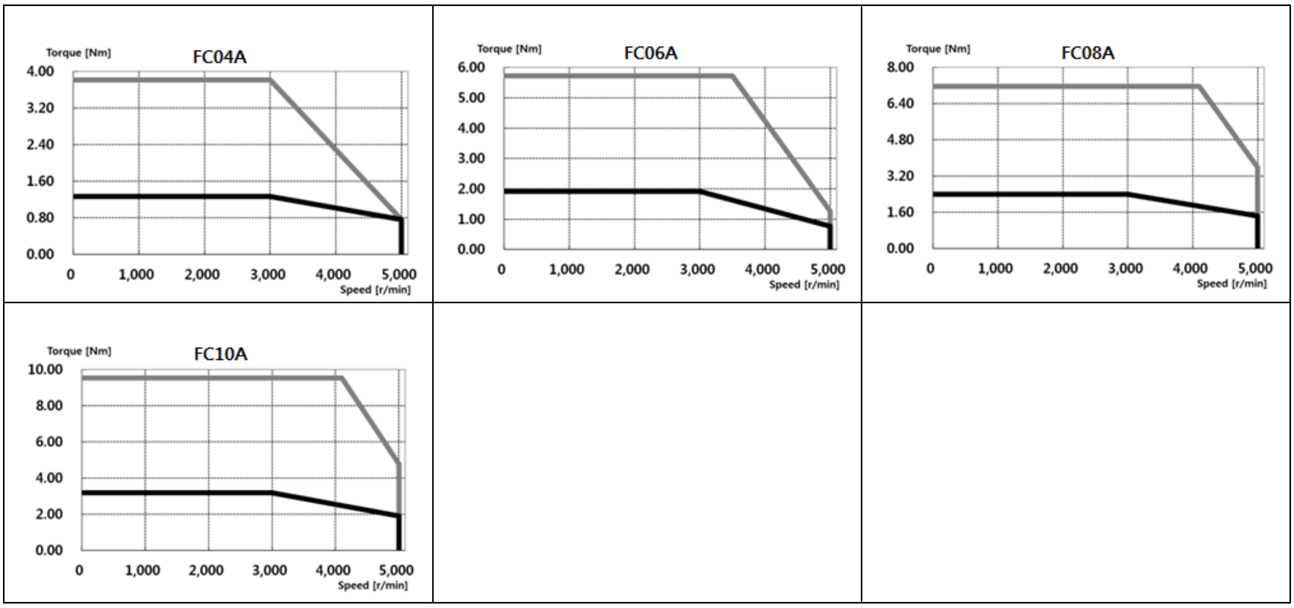
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FC04A	FC06A	FC08A	FC10A
Applicable drive (XDL-L7□A□□)		**L7□A004**	**L7□A008**		**L7□A010**
Rated output	[kW]	0.40	0.60	0.75	1.00
Rated torque	[N·m]	1.27	1.91	2.39	3.18
	[kgf·cm]	13.00	19.50	24.36	32.50
Maximum instantaneous torque	[N·m]	3.82	5.73	7.16	9.55
	[kgf·cm]	38.98	58.47	73.08	97.44
Rated current	[A]	2.58	3.81	5.02	6.70
Peak current	[A]	7.75	11.42	15.07	20.09
Rated rotation speed	[r/min]	3000			
Maximum rotation speed	[r/min]	5000			
Inertia moment	[kg·m²x10^{-4}]	0.50	0.88	1.25	1.62
	[gf·cm·s²]	0.51	0.89	1.27	1.65
Permitted load inertia		15 times of motor inertia			
Rated power rate	[kW/s]	32.62	41.69	45.78	62.74
Speed and Position Detector	Standard	Serial type 19-bit			
	Option	X			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	1.6	2.2	2.7	3.8

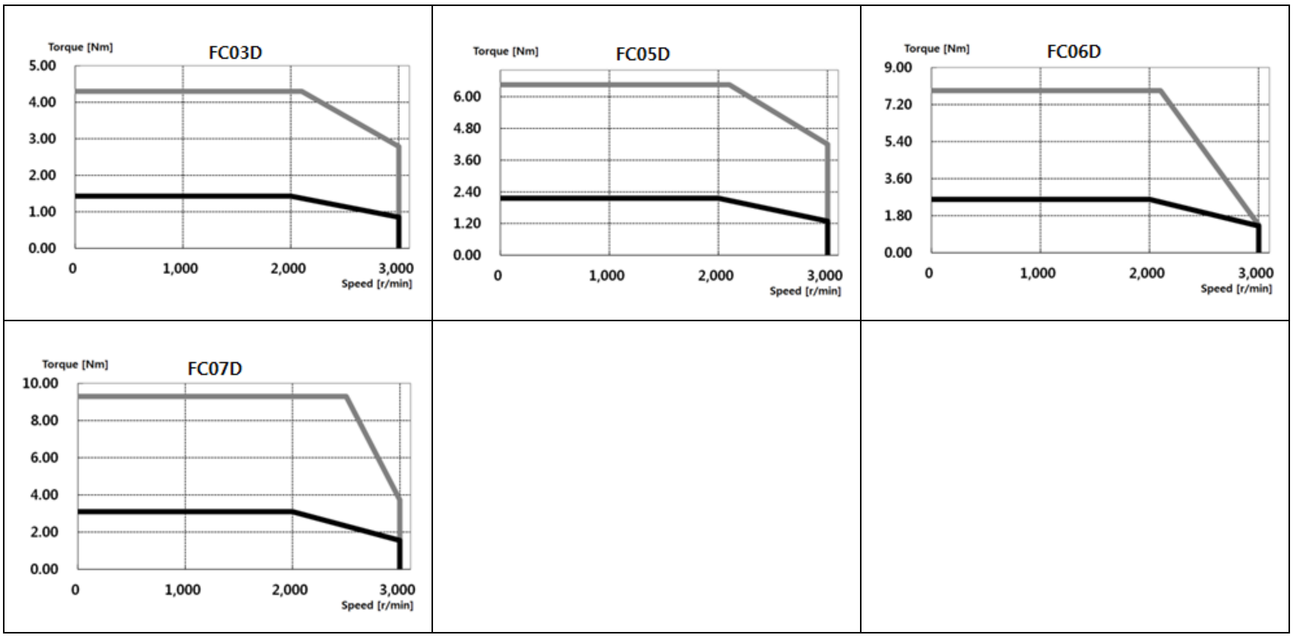
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FC03D	FC05D	FC06D	FC07D
Applicable drive (XDL-L7□A□□)		**L7□A004**	**L7□A008**		
Rated output	[kW]	0.30	0.45	0.55	0.65
Rated torque	[N·m]	1.43	2.15	2.60	3.10
	[kgf·cm]	14.60	21.90	26.80	31.70
Maximum instantaneous torque	[N·m]	4.30	6.45	7.88	9.31
	[kgf·cm]	43.80	65.80	80.40	95.00
Rated current	[A]	2.50	3.05	3.06	3.83
Peak current	[A]	7.51	9.16	9.18	11.50
Rated rotation speed	[r/min]	2000			
Maximum rotation speed	[r/min]	3000			
Inertia moment	[kg·m^{2}x10^{-4}]	0.50	0.88	1.25	1.62
	[gf·cm·s^2]	0.51	0.89	1.27	1.65
Permitted load inertia		15 times of motor inertia			
Rated power rate	[kW/s]	41.28	52.76	55.39	59.64
Speed and Position Detector	Standard	Serial type 19-bit			
	Option	X			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	1.6	2.2	2.7	3.8

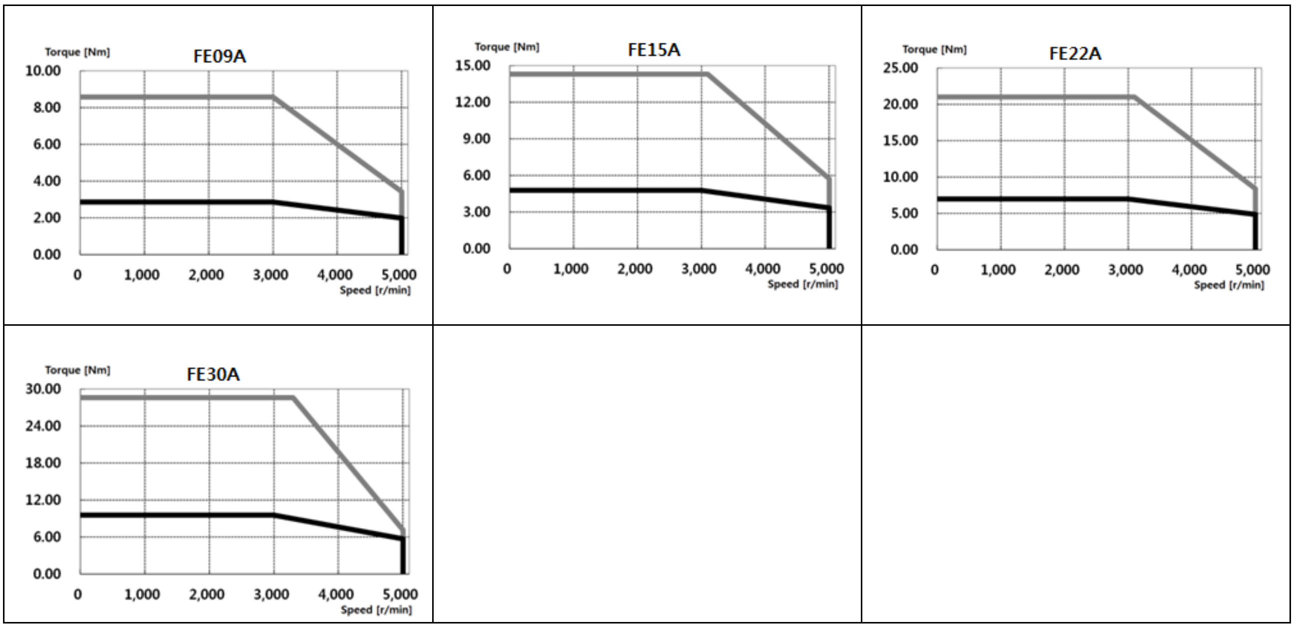
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FE09A	FE15A	FE22A	FE30A
Applicable drive (XDL-L7□A□□)		L7□A010	L7□A020		L7□A035
Rated output	[kW]	0.9	1.5	2.2	3.0
Rated torque	[N·m]	2.86	4.77	7.00	9.55
	[kgf·cm]	29.20	48.70	71.40	97.40
Maximum instantaneous torque	[N·m]	8.59	14.32	21.01	28.65
	[kgf·cm]	87.70	146.10	214.30	292.20
Rated current	[A]	6.45	9.15	13.24	16.09
Peak current	[A]	19.35	27.45	39.72	48.27
Rated rotation speed	[r/min]	3000			
Maximum rotation speed	[r/min]	5000			
Inertia moment	[kg·m²x10⁻⁴]	5.66	10.18	14.62	19.04
	[gf·cm·s²]	5.77	10.39	14.92	19.43
Permitted load inertia		10 times of motor inertia			
Rated power rate	[kW/s]	14.47	22.38	33.59	47.85
Speed and Position Detector	Standard	Serial type 19-bit			
	Option	X			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	5.0	6.7	8.5	10.1

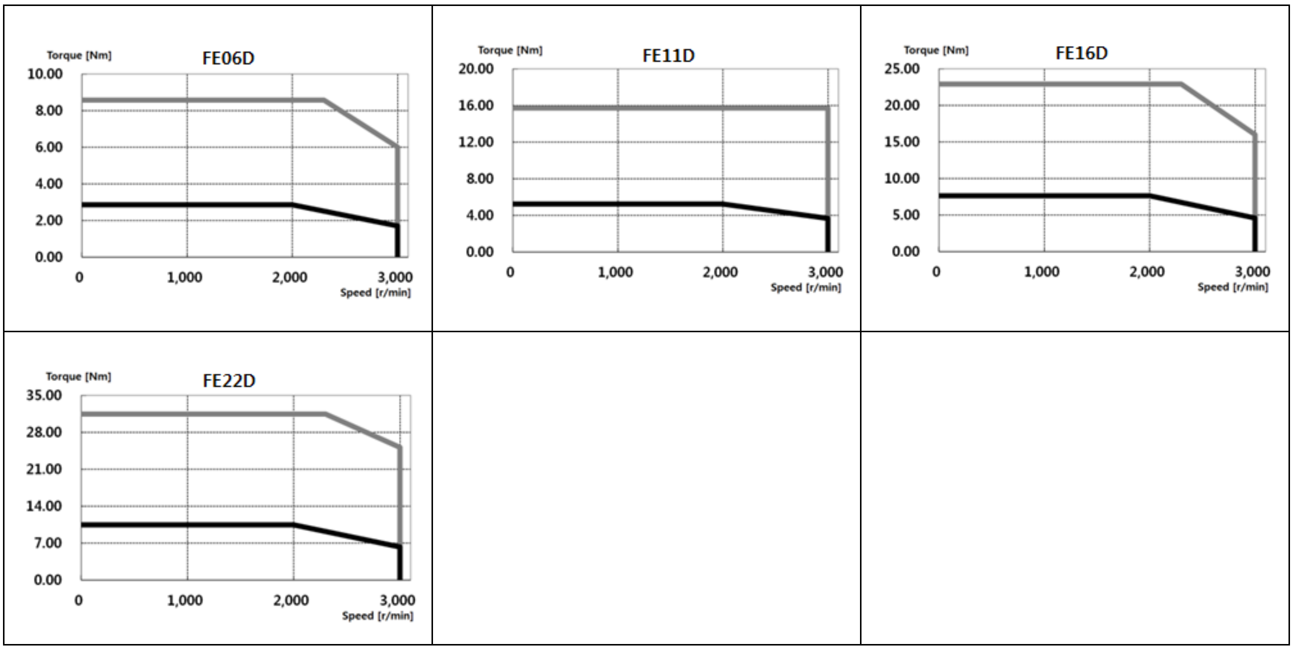
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FE06D	FE11D	FE16D	FE22D
Applicable drive (XDL-L7□A□□)		**L7□A008**	**L7□A010**	**L7□A020**	
Rated output	[kW]	0.6	1.1	1.6	2.2
Rated torque	[N·m]	2.86	5.25	7.63	10.5
	[kgf·cm]	29.2 0	53.60	77.90	107.10
Maximum instantaneous torque	[N·m]	8.59	15.75	22.92	31.51
	[kgf·cm]	87.70	160.70	233.80	321.40
Rated current	[A]	4.56	6.47	10.98	12.97
Peak current	[A]	13.68	19.41	32.94	38.91
Rated rotation speed	[r/min]	2000			
Maximum rotation speed	[r/min]	3000			
Inertia moment	[kg·m²x10^{-4}]	5.66	10.18	14.62	19.04
	[gf·cm·s²]	5.77	10.39	14.92	19.43
Permitted load inertia		10 times of motor inertia			
Rated power rate	[kW/s]	14.49	27.08	39.89	57.90
Speed and Position Detector	Standard	Serial type 19-bit			
	Option	X			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	5.0	6.7	8.5	10.1

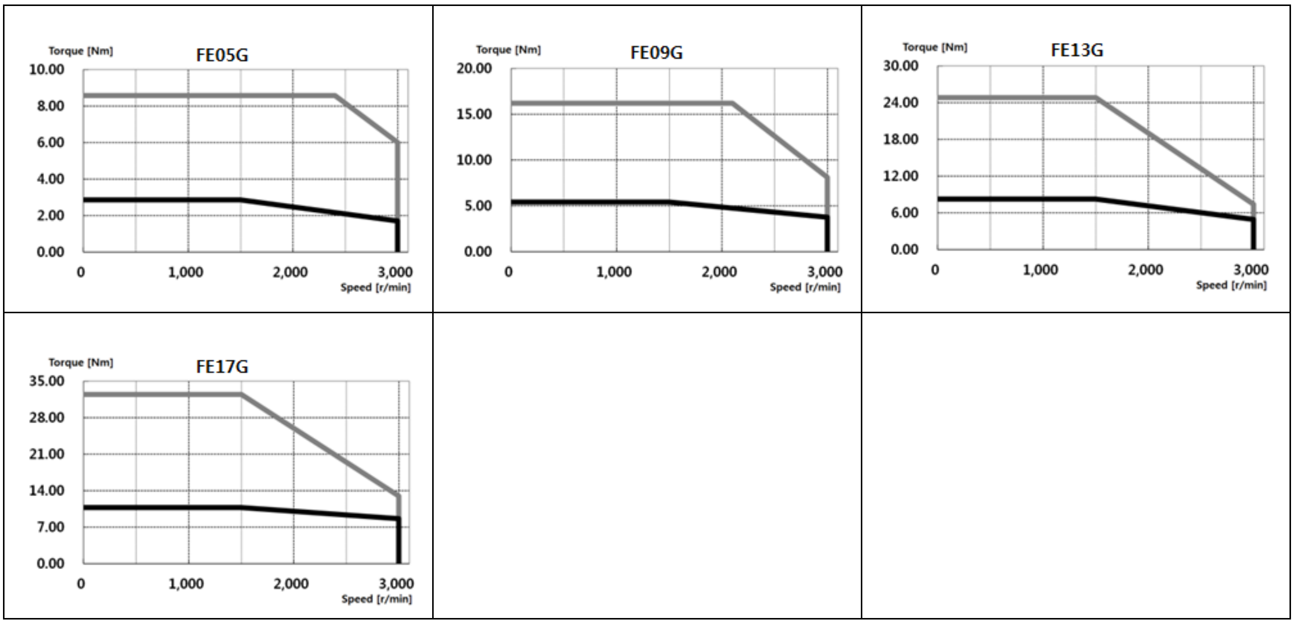
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FE05G	FE09G	FE13G	FE17G		
Applicable drive (XDL-L7□A□□)		**L7□A008**	**L7□A010**	**L7□A020**			
Rated output	[kW]	0.45	0.85	1.3	1.7		
Rated torque	[N·m]	2.86	5.41	8.27	10.82		
	[kgf·cm]	29.22	55.19	84.41	110.38		
Maximum instantaneous torque	[N·m]	8.59	16.23	24.82	32.46		
	[kgf·cm]	87.66	165.57	253.23	331.14		
Rated current	[A]	4.56	6.67	11.90	13.36		
Peak current	[A]	13.68	20.01	35.7	40.08		
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000					
Inertia moment	[kg·m^{2}x10^{-4}]	5.66	10.18	14.62	19.04		
	[gf·cm·s^2]	5.77	10.39	14.92	19.43		
Permitted load inertia		10 times of motor inertia					
Rated power rate	[kW/s]	14.49	28.74	46.81	61.46		
Speed and Position Detector	Standard	Serial type 19-bit					
	Option	X					
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient humidity	20 - 80% RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)					
Weight	[kg]	5.0	6.7	8.5	10.1		

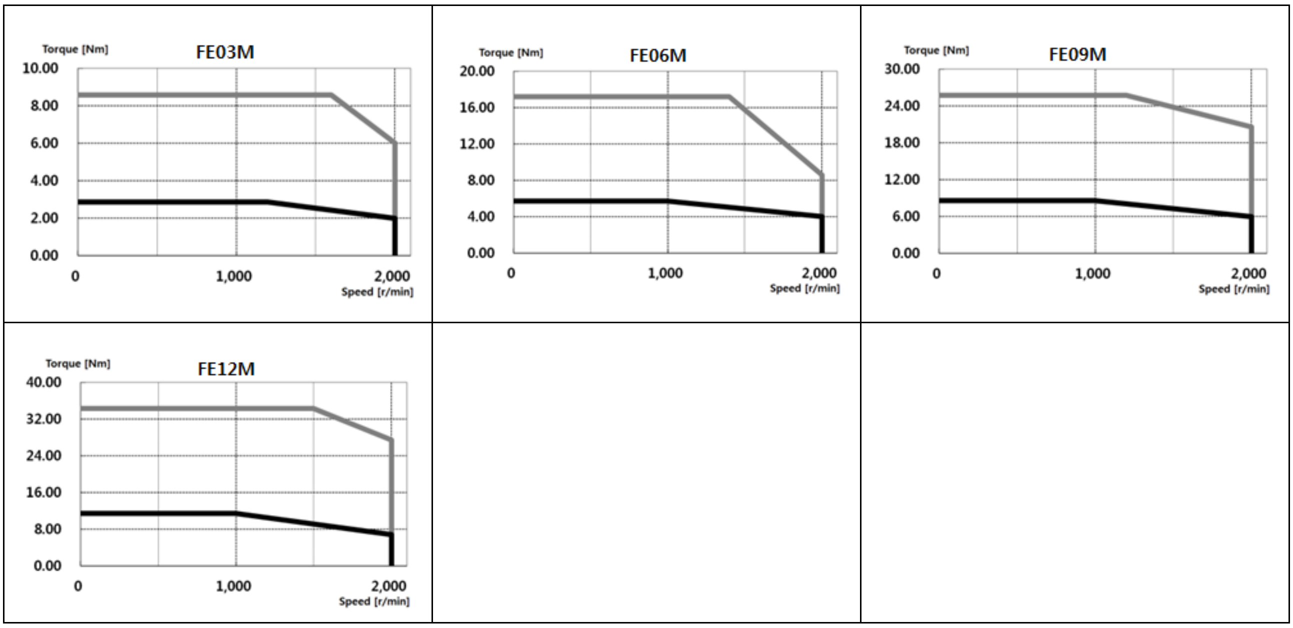
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FE03M	FE06M	FE09M	FE12M
Applicable drive (XDL-L7□A□□)		**L7□A004**	**L7□A008**	**L7□A010**	**L7□A020**
Rated output	[kW]	0.3	0.6	0.9	1.2
Rated torque	[N·m]	2.86	5.72	8.59	11.46
	[kgf·cm]	29.22	58.4	87.7	116.9
Maximum instantaneous torque	[N·m]	8.59	17.18	25.77	34.22
	[kgf·cm]	87.66	175.3	262.9	349.1
Rated current	[A]	2.73	4.56	6.18	10.67
Peak current	[A]	8.19	13.68	18.54	32.01
Rated rotation speed	[r/min]	1000			
Maximum rotation speed	[r/min]	2000			
Inertia moment	[kg·m^{2}x10^{-4}]	5.66	10.18	14.62	19.04
	[gf·cm·s^2]	5.77	10.39	14.92	19.43
Permitted load inertia		10 times of motor inertia			
Rated power rate	[kW/s]	14.49	32.22	50.48	68.91
Speed and Position Detector	Standard	Serial type 19-bit			
	Option	X			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	5.0	6.7	8.5	10.1

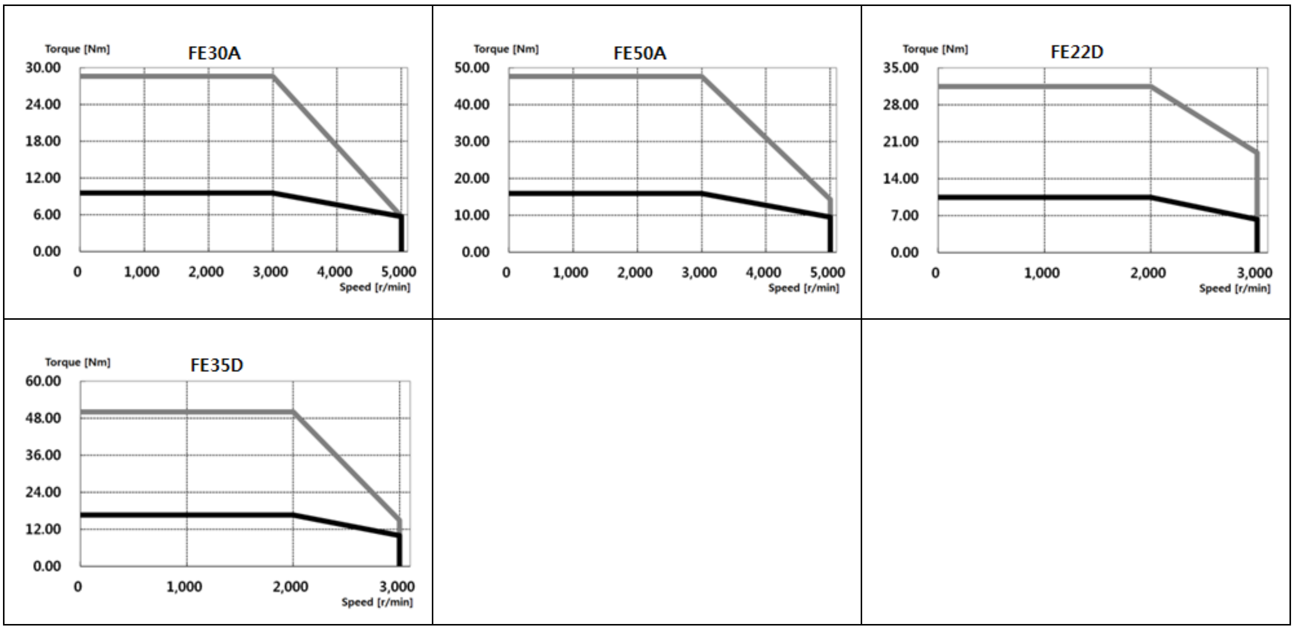
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FF30A	FF50A	FF22D	FF35D
Applicable drive (XDL-L7□A□□)		**L7□A035**	**L7□A050**	**L7□A020**	**L7□A035**
Rated output	[kW]	3.0	5.0	2.2	3.5
Rated torque	[N·m]	9.55	15.91	10.50	16.70
	[kgf·cm]	97.40	162.30	107.1	170.4
Maximum instantaneous torque	[N·m]	28.65	47.74	31.50	50.10
	[kgf·cm]	292.2	487.00	321.30	511.40
Rated current	[A]	15.26	26.47	13.07	16.48
Peak current	[A]	45.78	79.41	39.21	49.44
Rated rotation speed	[r/min]	3000		2000	
Maximum rotation speed	[r/min]	5000		3000	
Inertia moment	[kg·m²x10^{-4}]	27.96	46.56	27.96	46.56
	[gf·cm·s²]	28.53	47.51	28.53	47.51
Permitted load inertia		5 times of motor inertia			
Rated power rate	[kW/s]	32.59	54.33	39.43	59.89
Speed and Position Detector	Standard	Serial type 19-bit			
	Option	X			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	12.5	17.4	12.5	17.4

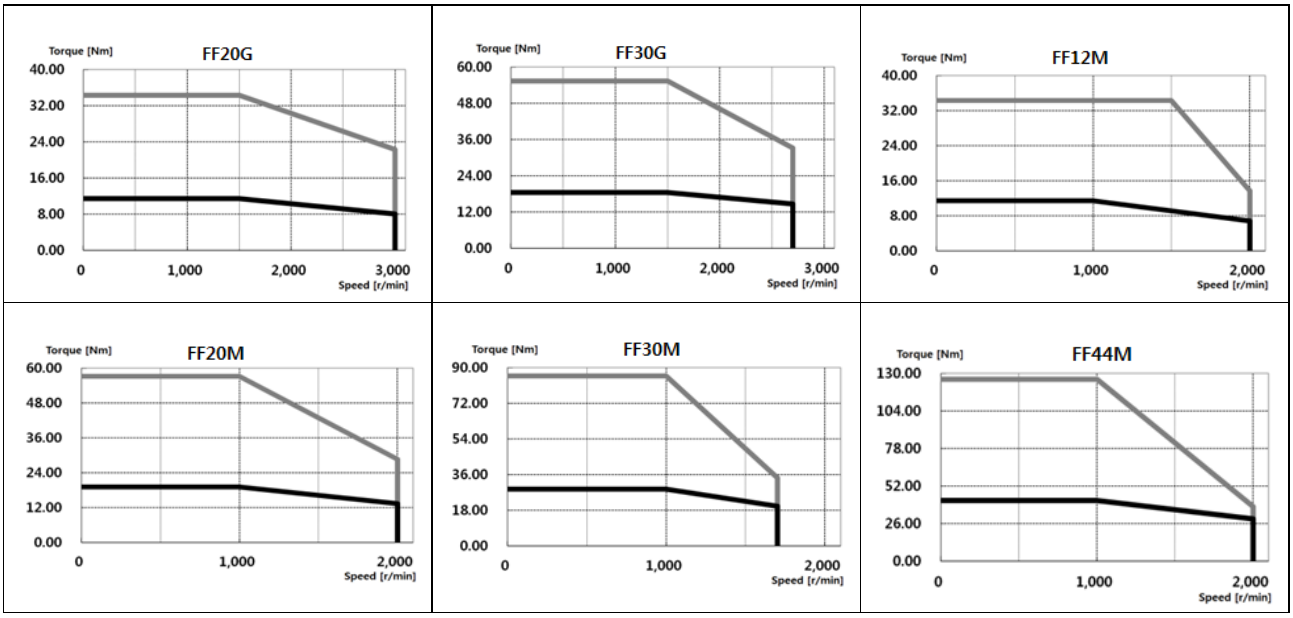
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FF20G	FF30G	FF12M	FF20M	FF30M	FF44M
Applicable drive (XDL-L7□A□□)		**L7□A020**	**L7□A035**	**L7□A020**		**L7□A035**	**L7□A050**
Rated output	[kW]	1.8	2.9	1.2	2.0	3.0	4.4
Rated torque	[N·m]	11.45	18.46	11.46	19.09	28.64	42.02
	[kgf·cm]	116.9	188.3	116.9	194.8	292.2	428.7
Maximum instantaneous torque	[N·m]	34.35	55.38	34.38	57.29	85.94	126.1
	[kgf·cm]	350.60	564.90	350.70	584.40	876.60	128.60
Rated current	[A]	12.16	15.98	11.01	12.96	16.58	30.60
Peak current	[A]	36.48	47.94	33.03	38.88	49.74	91.8
Rated rotation speed	[r/min]	1500		1000			
Maximum rotation speed	[r/min]	3000	2700	2000		1700	2000
Inertia moment	[kg·m²x10⁻⁴]	27.96	46.56	27.96	46.56	73.85	106.7
	[gf·cm·s²]	28.53	47.51	28.53	47.51	75.36	108.9
Permitted load inertia		5 times of motor inertia					
Rated power rate	[kW/s]	46.92	73.14	46.94	78.27	111.04	165.38
Speed and Position Detector	Standard	Serial type 19-bit					
	Option	X					
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient humidity	20 - 80% RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)					
Weight	[kg]	12.5	17.4	12.5	17.4	25.2	33.8

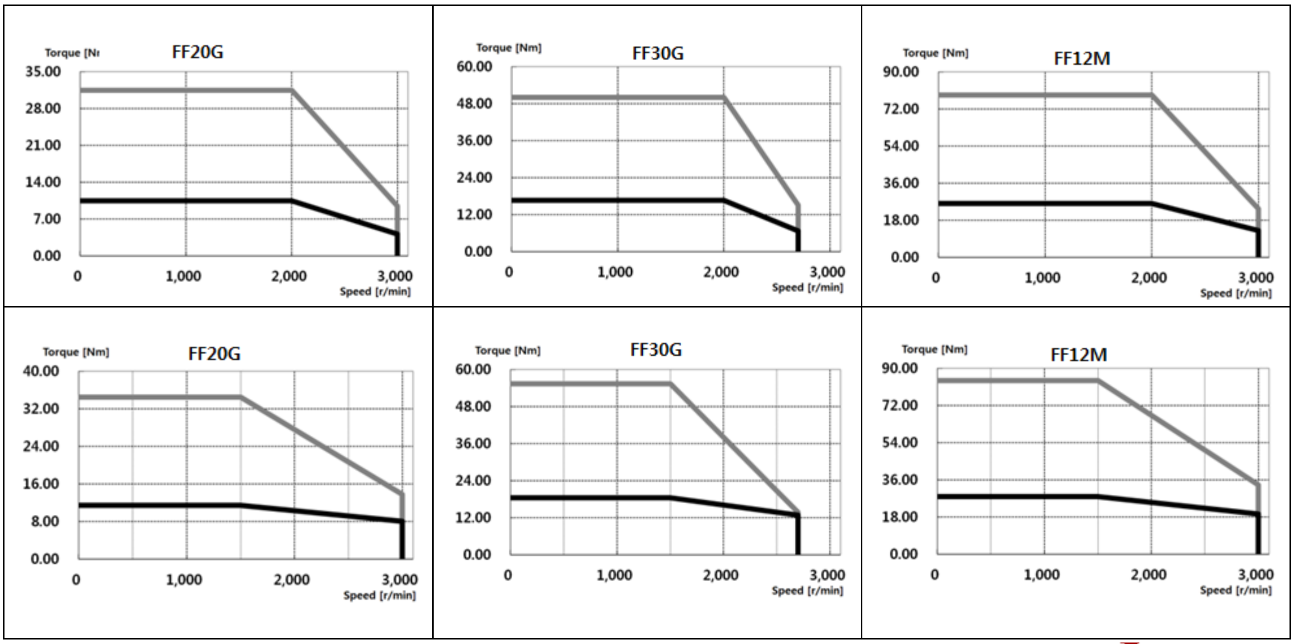
♦Rotation Speed - Torque Characteristics♦



■ Product Features

Servo Motor Type (XML-□□□□□)		FG22D	FG35D	FG55D	FG20G	FG30G	FG44G
Applicable drive (XDL-L7□A□□)		L7□A020	L7□A035	L7□A050	L7□A020	L7□A035	L7□A050
Rated output	[kW]	2.2	3.5	5.5	1.8	4.4	4.4
Rated torque	[N·m]	10.50	16.71	26.25	11.50	28	28
	[kgf·cm]	107.1	170.4	267.8	116.9	285.8	285.8
Maximum instantaneous torque	[N·m]	31.51	50.12	78.76	34.40	84	84
	[kgf·cm]	321.30	511.30	803.4	350.80	857.4	857.4
Rated current	[A]	10.25	14.67	29.74	11.18	31.72	31.72
Peak current	[A]	30.75	44.01	89.22	33.54	95.16	95.16
Rated rotation speed	[r/min]	2000			1500		
Maximum rotation speed	[r/min]	3000	2700	3000	3000	2700	3000
Inertia moment	[kg·m²x10⁻⁴]	41.13	71.53	117.72	14.13	71.53	117.72
	[gf·cm·s²]	41.97	72.99	120.12	41.97	72.99	120.12
Permitted load inertia		5 times of motor inertia					
Rated power rate	[kW/s]	26.78	38.99	58.51	31.91	47.66	66.64
Speed and Position Detector	Standard	Serial type 19-bit					
	Option	Quadrature type incremental 3000 [P/R]					
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient humidity	20 - 80% RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)					
Weight	[kg]	15.4	20.2	28.12	15.4	20.2	28

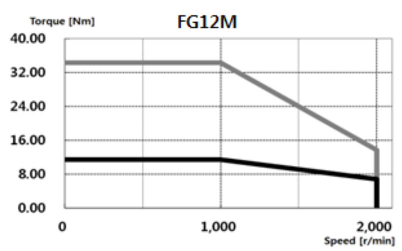
♦Rotation Speed - Torque Characteristics♦

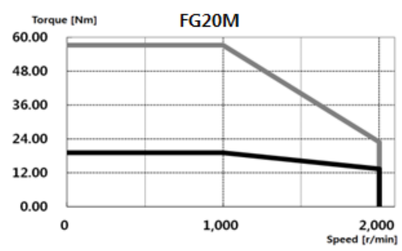


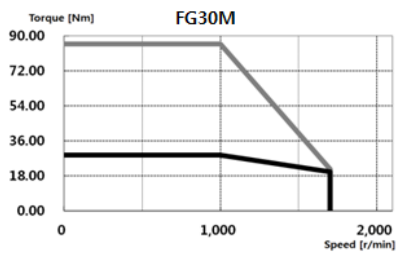
■ Product Features

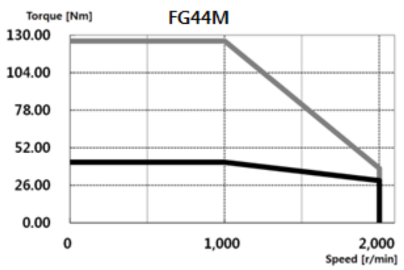
Servo Motor Type (XML-□□□□□)		FG12M	FG20M	FG30M	FG44M
Applicable drive (XDL-L7□A□□)		L7□A020		L7□A035	L7□A050
Rated output	[kW]	1.2	2.0	3.0	4.4
Rated torque	[N·m]	11.50	19.10	28.60	42.00
	[kgf·cm]	116.9	194.9	292.3	428.7
Maximum instantaneous torque	[N·m]	34.40	57.30	85.90	126.00
	[kgf·cm]	350.8	584.6	876.9	128.61
Rated current	[A]	11.28	13.10	15.52	27.26
Peak current	[A]	33.84	39.3	46.56	81.78
Rated rotation speed	[r/min]	1000			
Maximum rotation speed	[r/min]	2000		1700	2000
Inertia moment	[kg·m²x10⁻⁴]	41.13	71.53	117.72	149.40
	[gf·cm·s²]	41.97	72.99	120.12	152.45
Permitted load inertia		5 times of motor inertia			
Rated power rate	[kW/s]	31.91	51.00	69.70	118.14
Speed and Position Detector	Standard	Serial type 19-bit			
	Option	X			
Specifications and features	Protection method	Fully enclosedself-cooling IP65 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	15.4	20.2	28.0	33.5

♦Rotation Speed - Torque Characteristics♦





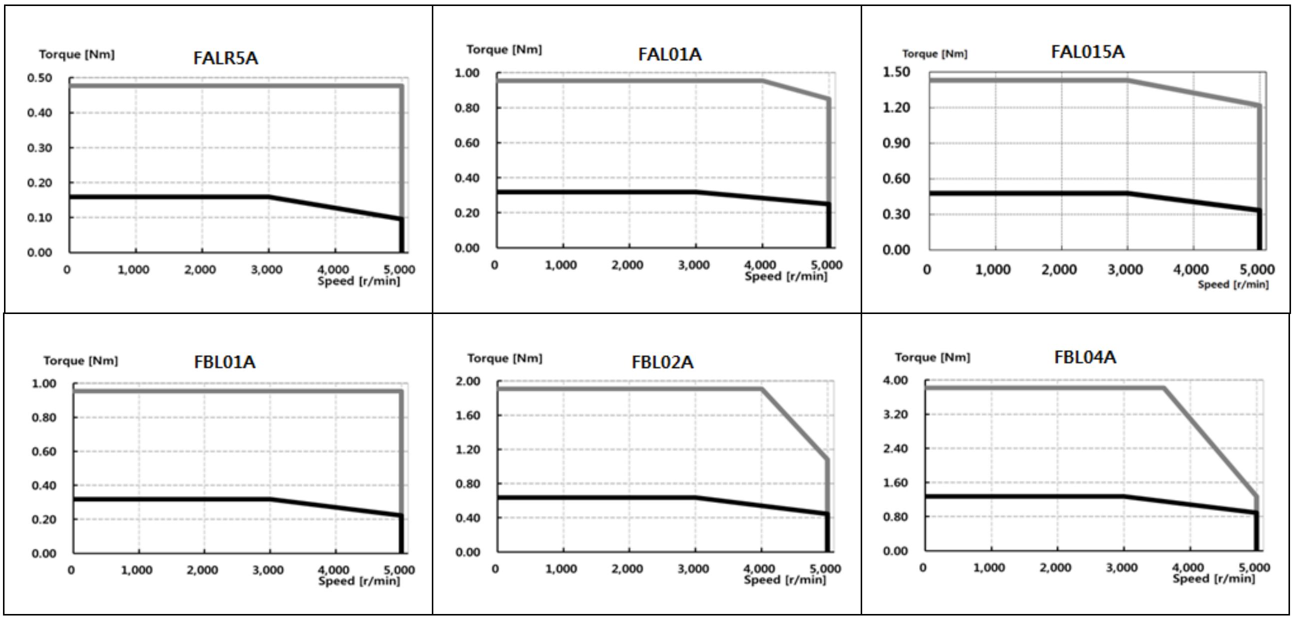




■ Product Features

Servo Motor Type (XML-□□□□□)		FALR5A	FAL01A	FAL015A	FBL01A	FBL02A	FBL04A
Applicable drive (XDL-L7□A□□)		**L7□A001**		**L7□A002**	**L7□A001**	**L7□A002**	**L7□A004**
Rated output	[kW]	0.05	0.10	0.15	0.10	0.20	0.40
Rated torque	[N·m]	0.16	0.32	0.48	0.32	0.64	1.27
	[kgf·cm]	1.62	3.25	4.87	3.25	6.49	12.99
Maximum instantaneous torque	[N·m]	0.48	0.96	1.43	0.96	1.91	3.82
	[kgf·cm]	4.87	9.74	14.62	9.74	19.48	38.96
Rated current	[A]$_{\Phi.ac.rms}$	0.95	1.25	1.76	0.95	1.45	2.60
Peak current	[A]$_{\Phi.ac.rms}$	2.85	3.75	5.28	2.85	4.35	7.80
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m^{2}x10^{-4}]	0.023	0.042	0.063	0.091	0.147	0.248
	[gf·cm·s^2]	0.024	0.043	0.065	0.093	0.150	0.253
Permitted load inertia		30 times of motor inertia		20 times of motor inertia			
Rated power rate	[kW/s]	10.55	23.78	35.34	11.09	27.60	27.07
Speed and Position Detector	Standard	Serial Multi-Turn Built-in Type(18bit)			Serial Multi-Turn Built-in Type(19bit)		
	Option	x					
Specifications and features	Protection method	Fully enclosedself-cooling IP67 (excluding axis penetration)·					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient humidity	20 - 80% RH (no condensation)					
	Atmosphere	No exposure to direct sunlight, no corrosive or flammable gases					
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)					
Weight	[kg]	0.31	0.45	0.61	0.56	0.74	1.06

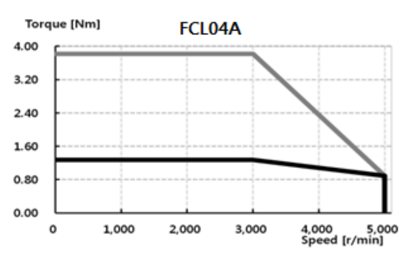
♦Rotation Speed - Torque Characteristics♦

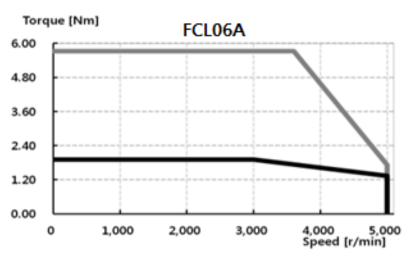


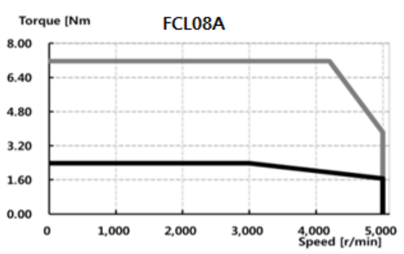
■ Product Features

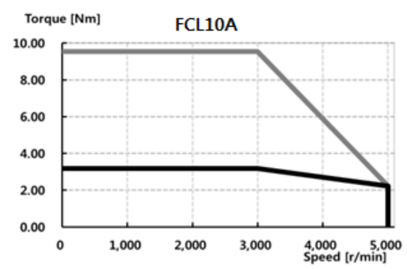
Servo Motor Type (XML-□□□□□)		FCL04A	FCL06A	FCL08A	FCL10A
Applicable drive (XDL-L7□A□□)		L7□A004	L7□A008		L7□A010
Rated output	[kW]	0.40	0.60	0.75	1.00
Rated torque	[N·m]	1.27	1.91	2.39	3.18
	[kgf·cm]	12.99	19.49	24.36	32.48
Maximum instantaneous torque	[N·m]	3.82	5.73	7.16	9.55
	[kgf·cm]	38.98	58.47	73.08	97.44
Rated current	$[A]_{\Phi.ac.rms}$	2.58	3.81	5.02	5.83
Peak current	$[A]_{\Phi.ac.rms}$	7.75	11.42	15.07	17.50
Rated rotation speed	[r/min]	3000			
Maximum rotation speed	[r/min]	5000			
Inertia moment	$[kg·m^2x10^{-4}]$	0.530	0.897	1.264	1.632
	$[gf·cm·s^2]$	0.541	0.915	1.290	1.665
Permitted load inertia		15 times of motor inertia			
Rated power rate	[kW/s]	30.60	40.66	45.09	62.08
Speed and Position Detector	Standard	Serial Multi-Turn Built-in Type(19bit)			
	Option	x			
Specifications and features	Protection method	Fully enclosedself-cooling IP67 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No exposure to direct sunlight, no corrosive or flammable gases			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	1.52	2.14	2.68	3.30

♦Rotation Speed - Torque Characteristics♦





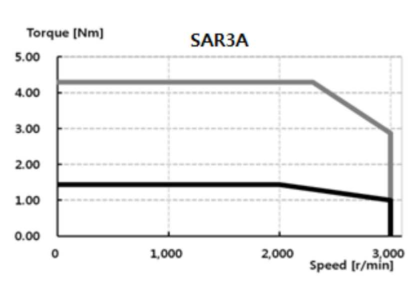


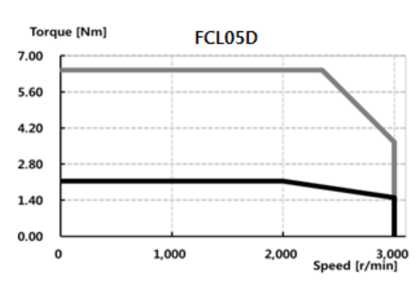


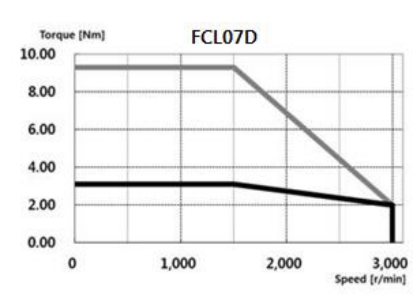
■ Product Features

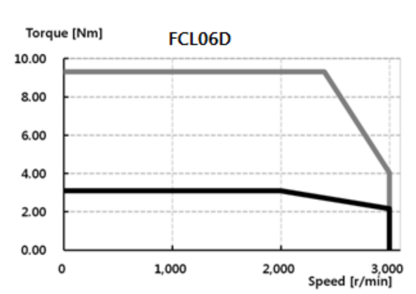
Servo Motor Type (XML-□□□□□)		FCL03D	FCL05D	FCL06D	FCL07D
Applicable drive (XDL-L7□A□□)		L7□A004	L7□A008		
Rated output	[kW]	0.30	0.45	0.55	0.65
Rated torque	[N·m]	1.43	2.15	2.63	3.10
	[kgf·cm]	14.62	21.92	26.80	31.67
Maximum instantaneous torque	[N·m]	4.30	6.45	7.88	9.31
	[kgf·cm]	43.85	65.77	80.39	95.01
Rated current	[A]$_{\Phi.ac.rms}$	2.50	3.05	3.06	3.83
Peak current	[A]$_{\Phi.ac.rms}$	7.51	9.16	9.18	11.50
Rated rotation speed	[r/min]	2000			
Maximum rotation speed	[r/min]	3000			
Inertia moment	[kg·m^{2}x10^{-4}]	0.530	0.897	1.264	1.63
	[gf·cm·s^2]	0.541	0.915	1.290	1.66
Permitted load inertia		15 times of motor inertia			
Rated power rate	[kW/s]	38.73	51.47	54.56	59.03
Speed and Position Detector	Standard	Serial Multi-Turn Built-in Type(19bit)			
	Option	x			
Specifications and features	Protection method	Fully enclosedself-cooling IP67 (excluding axis penetration)·			
	Time rating	Continuous			
	Ambient temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C			
	Ambient humidity	20 - 80% RH (no condensation)			
	Atmosphere	No exposure to direct sunlight, no corrosive or flammable gases			
	Anti-vibration	Vibration acceleration of 49 [m/s2] (5G)			
Weight	[kg]	1.26	2.12	2.66	2.78

♦Rotation Speed - Torque Characteristics♦

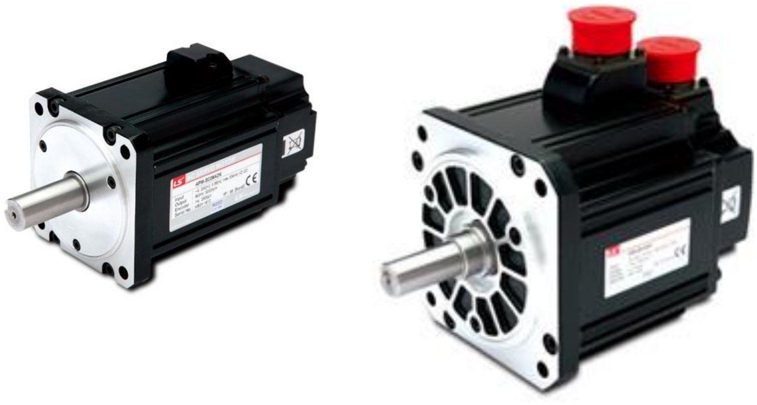








Electric Brake Specifications



Applicable motor series	SA/FAL	SB/FB/FBL	SC/FC/FCL	SE/FE	SF/FF	SG/FG
Purpose	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance
Input voltage [V]	DC 24V	DC 24V	DC 24V	DC 24V	DC 24V	DC 90V
Static friction torque [N•m]	0.32	1.47	3.23	10.4	40	74
Capacity [W]	6	6.5	9	19.4	25	32
Coil resistance [Ω]	96	89	64	29.6	23	327
Rated current [A]	0.25	0.27	0.38	0.81	1.04	0.28
Braking method	Spring brake	Spring brake	Spring brake	Spring brake	Spring brake	Spring brake
Insulation grade	Grade F	Grade F	Grade F	Grade F	Grade F	Grade F

* The same specifications apply to all electric brakes installed in our servo motors.

* Electronic brakes are designed to maintain a stop. Never use them for absolute braking.

* The characteristics of the electric brakes were measured at 20°C.

* These brake specifications are subject to change. Check the voltage specifications on your specific motor.

Heat Sink Specifications

Type	Dimension (mm)	Type
AP04	250x250x6	Aluminum
AP06	250x250x6	
AP08	250x250x12	
AP13	350x350x20	
AP18	550x550x30	
AP22	650x650x35	

Note 1. The product specifications are based on the data measured after the heat sink is mounted.

* The IP grade does not apply to the axis penetration.

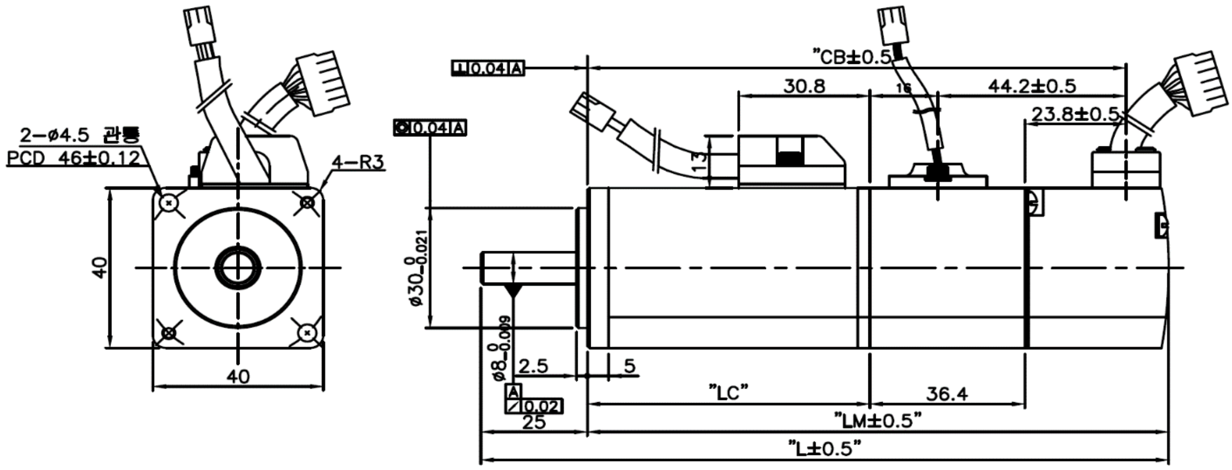
* The IP grade is not guaranteed for any decelerator.

* When a cable is bent more than the specified bending rate, it may not satisfy the specified IP grade.

* Use only the specified heat sink cables to satisfy the specified IP grade.

11.1.1 Outline Diagram

■ SA Series : SAR3A, SAR5A, SA01A, SA015A



<Power Connector>

Pin No.	Color	Phase
1	Red	U
2	White	V
3	Black	W
4	Green	FG

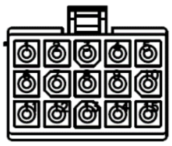
Plug : 172167−1(AMP)

<Brake Connector>

Pin No.	Phase
1	+
2	−

Plug : 172165−1(AMP)

<Encoder Connector>



Pin No.	Phase	Pin No.	Phase
1	A	9	V
2	$\overline{A}$	10	$\overline{V}$
3	B	11	W
4	$\overline{B}$	12	$\overline{W}$
5	Z	13	DC +5V
6	$\overline{Z}$	14	0V
7	U	15	SHIELD
8	$\overline{U}$		

Plug : 172171−1(AMP)

Model	External dimensions				Weight (kg)
	L	LM	LC	CB	
SAR3A	101.3(137.6)	76.3(112.6)	42.5(42.4)	66.3(102.6)	0.32(0.67)
SAR5A	108.3(144.6)	83.3(119.6)	49.5(49.4)	73.3(109.6)	0.38(0.73)
SA01A	125.3(161.6)	100.3(136.6)	66.5(66.4)	90.3(126.6)	0.5(0.85)
SA015A	145.3	120.3	86.5	110.3	0.7

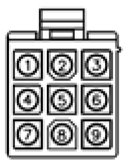
Note 1) The standard shaft end of the 40 flange is straight.

Note 2) Use DC power (24 V) to operate the brake.

Note 3) The sizes in parentheses apply when attached to the brakes. (Except SA015A)

Note 4) Option: Serial M-turn Encoder PinMap (18 Bit)

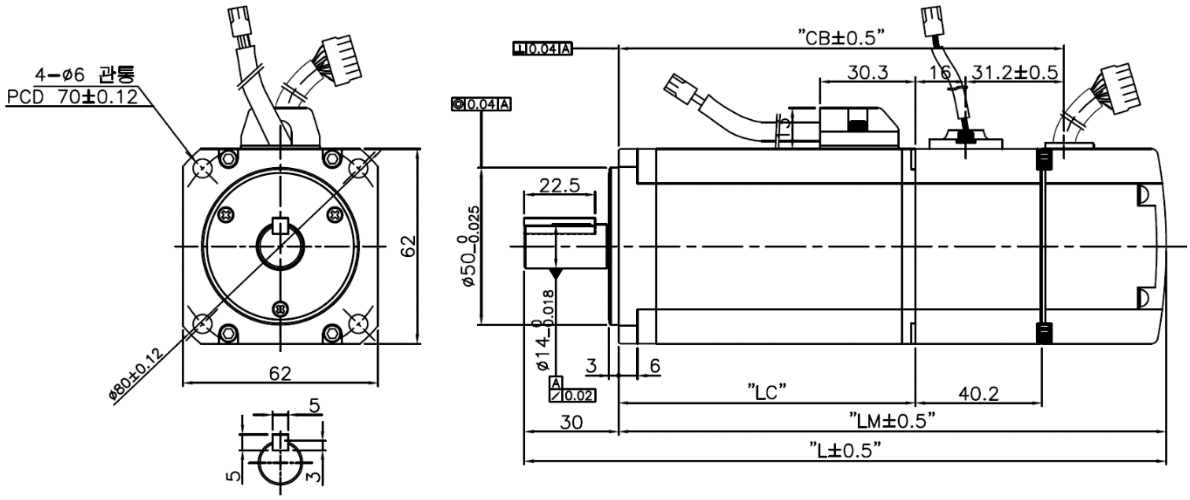
<Serial M−turn Encoder Connector>



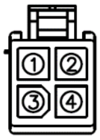
Pin No.	Phase	Pin No.	Phase
1	MA	6	GND_B
2	$\overline{MA}$	7	+5V
3	SL	8	0V
4	$\overline{SL}$	9	SHIELD
5	VDD_B		

Plug : 172169−1(AMP)

■ SB Series : SB01A, SB02A, SB04A`



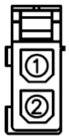
<Power Connector>



Pin No.	Color	Phase
1	Red	U
2	White	V
3	Black	W
4	Green	FG

Plug : 172167−1(AMP)

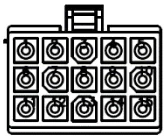
<Brake Connector>



Pin No.	Phase
1	+
2	−

Plug : 172165−1(AMP)

<Encoder Connector>



Pin No.	Phase	Pin No.	Phase
1	A	9	V
2	$\overline{A}$	10	$\overline{V}$
3	B	11	W
4	$\overline{B}$	12	$\overline{W}$
5	Z	13	DC +5V
6	$\overline{Z}$	14	0V
7	U	15	SHIELD
8	$\overline{U}$		

Plug : 172171−1(AMP)

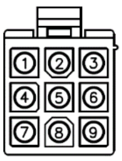
Model	External dimensions				Weight (kg)
	L	LM	LC	CB	
SB01A	122(162)	92(132)	52.5(52.3)	59.5(99.5)	0.82(1.4)
SB02A	136(176)	106(146)	66.5(66.3)	73.5(113.5)	1.08(1.66)
SB04A	164(204)	134(174)	94.5(94.3)	101.5(141.5)	1.58(2.16)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

Note 3) Option: Serial Type PinMap

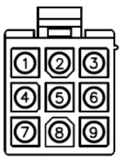
<Serial S−turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
1	MA	6	−
2	$\overline{MA}$	7	+5V
3	SL	8	0V
4	$\overline{SL}$	9	SHIELD
5	−		

Plug : 172169−1(AMP)

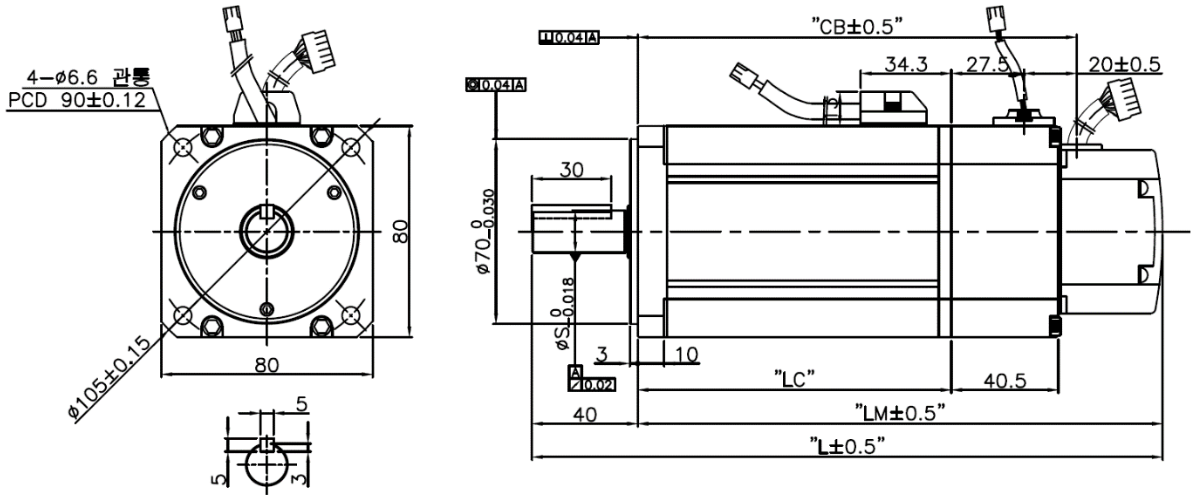
<Serial M−turn Encoder Connector>



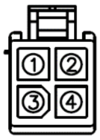
Pin No.	Phase	Pin No.	Phase
1	MA	6	GND_B
2	$\overline{MA}$	7	+5V
3	SL	8	0V
4	$\overline{SL}$	9	SHIELD
5	VDD_B		

Plug : 172169−1(AMP)

■ SC Series : SC04A,SC03D, SC06A, SC05D, SC08A, SC06D, SC10A, SC07D



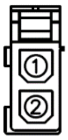
<Power Connector>



Pin No.	Color	Phase
1	Red	U
2	White	V
3	Black	W
4	Green	FG

Plug : 172167−1(AMP)

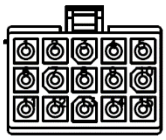
<Brake Connector>



Pin No.	Phase
1	+
2	−

Plug : 172165−1(AMP)

<Encoder Connector>



Pin No.	Phase	Pin No.	Phase
1	A	9	V
2	A	10	V
3	B	11	W
4	B	12	W
5	Z	13	DC +5V
6	Z	14	0V
7	U	15	SHIELD
8	U		

Plug : 172171−1(AMP)

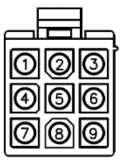
Model	External dimensions					Weight (kg)
	L	LM	LC	CB	S	
SC04A,SC03D	158.5(199.8)	118.5(158.8)	79(78.8)	86(126.3)	14	1.88(2.92)
SC06A,SC05D	178.5(218.8)	138.5(178.8)	99(98.8)	106(146.3)	16	2.52(3.56)
SC08A,SC06D	198.5(238.8)	158.5(198.8)	119(118.8)	126(166.3)	16	3.15(4.22)
SC10A,SC07D	218.5(258.8)	178.5(218.8)	139(138.8)	146(186.3)	16	3.80(4.94)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

Note 3) Option: Serial Type PinMap

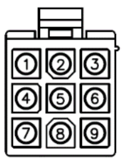
<Serial S−turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
1	MA	6	−
2	$\overline{MA}$	7	+5V
3	SL	8	0V
4	$\overline{SL}$	9	SHIELD
5	−		

Plug : 172169−1(AMP)

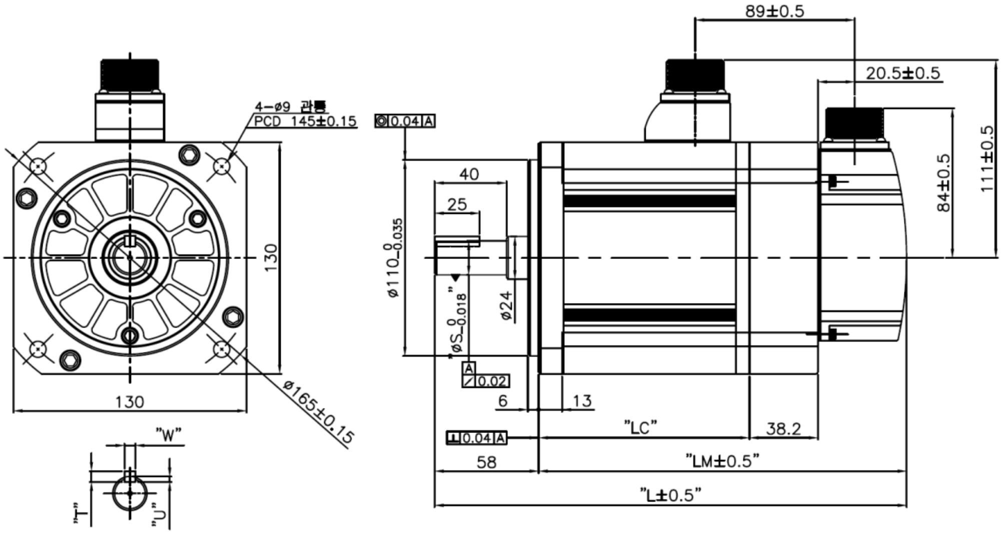
<Serial M−turn Encoder Connector>



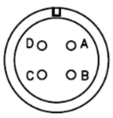
Pin No.	Phase	Pin No.	Phase
1	MA	6	GND_B
2	$\overline{MA}$	7	+5V
3	SL	8	0V
4	$\overline{SL}$	9	SHIELD
5	VDD_B		

Plug : 172169−1(AMP)

■ SE Series : SE09A, SE06D, SE05G, SE03M, SE15A, SE11D, SE09G, SE06M, SE22A, SE16D, SE13G,SE09M, SE30A, SE22D, SE17G, SE12M



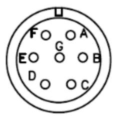
<Power Connector>



Pin No.	Color	Phase
A	Red	U
B	White	V
C	Black	W
D	Green	FG

Plug : MS3102A20-4P

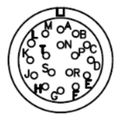
<Brake Type Connector>



Pin No.	Phase	Pin No.	Phase
A	U	D	F/G
B	V	E	BK+
C	W	F	BK−

Plug : MS3102A20-15P

<Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	A	M	V
B	A	N	V
C	B	P	W
D	B	R	W
E	Z	H	DC +5V
F	Z	G	0V
K	U	J	SHIELD
L	U		

Plug : MS3102A20-29P

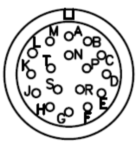
Model	External dimensions				Key dimensions			Weight (kg)
	L	LM	LC	S	T	W	U	
SE09A,SE06D,SE05G,SE03M	201.3(239.3)	143.3(181.3)	93.8(93.6)	19	5	5	3	5.5(7.04)
SE15A,SE11D,SE09G,SE06M	225.3(263.3)	167.3(205.3)	117.8(117.6)	19	5	5	3	7.54(9.08)
SE22A,SE16D,SE13G,SE09M	249.3(287.3)	191.3(229.3)	141.8(141.6)	22	6	6	3.5	9.68(11.22)
SE30A,SE22D,SE17G,SE12M	273.3(311.3)	215.3(253.3)	165.8(165.6)	22	6	6	3.5	11.78(13.32)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

Note 3) Option: Serial Type PinMap

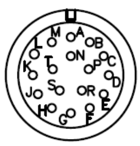
<Serial S-turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	MA	N	−
C	SL	P	−
D	SL	R	−
E	−	H	+5V
F	−	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20-29P

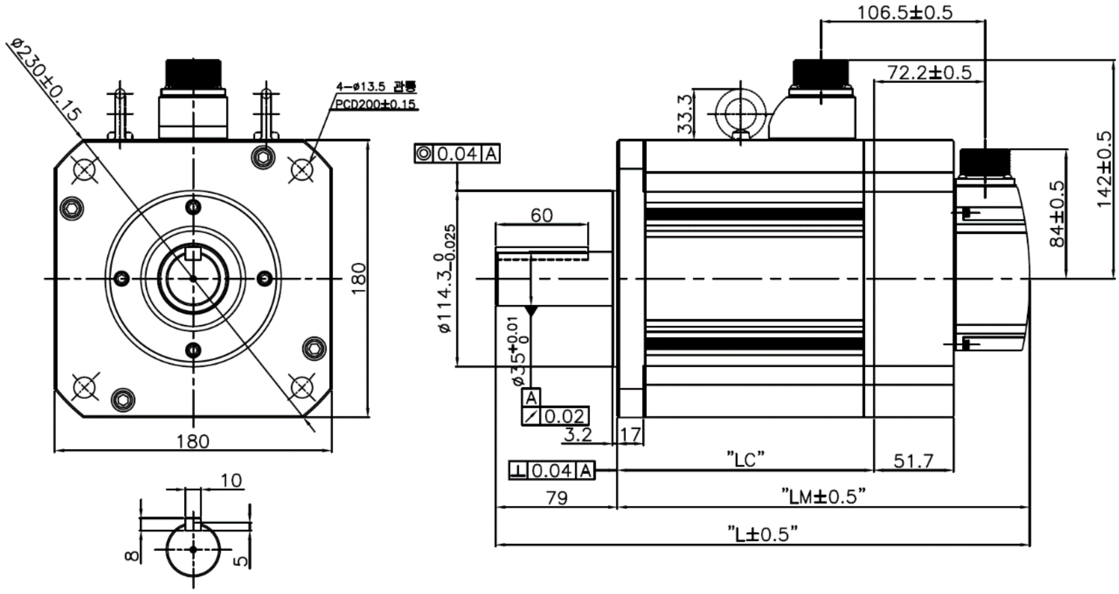
<Serial M-turn Encoder Connector>



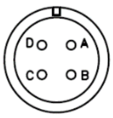
Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	MA	N	−
C	SL	P	−
D	SL	R	−
E	VOD_B	H	+5V
F	GND_B	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20-29P

■ SF Series : SF30A, SF22D, SF20G, SF12M, SF20M, LF35D, LF30G, LF30M



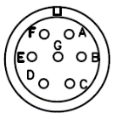
<Power Connector>



Pin No.	Color	Phase
A	Red	U
B	White	V
C	Black	W
D	Green	FG

Plug : MS3102A22-22P

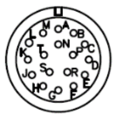
<Brake Type Connector>



Pin No.	Phase	Pin No.	Phase
A	U	D	F/G
B	V	E	BK+
C	W	F	BK−

Plug : MS3102A24-10P

<Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	A	M	V
B	A	N	V
C	B	P	W
D	B	R	W
E	Z	H	DC +5V
F	Z	G	0V
K	U	J	SHIELD
L	U		

Plug : MS3102A20-29P

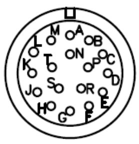
Model	External dimensions			Eye bolt	Weight (kg)
	L	LM	LC		
SF30A, SF22D, SF20G, SF12M	261.5(312.9)	182.5(233.9)	133(132.7)	No	12.4(19.2)
LF35D, LF30G, SF20M	295.5(346.9)	216.5(267.9)	167(166.7)		17.7(24.9)
LF30M	345.5(396.9)	266.5(317.9)	217(216.7)	Yes	26.3(33.4)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

Note 3) Option: Serial Type PinMap

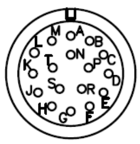
<Serial S-turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	MA	N	−
C	SL	P	−
D	SL	R	−
E	−	H	+5V
F	−	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20-29P

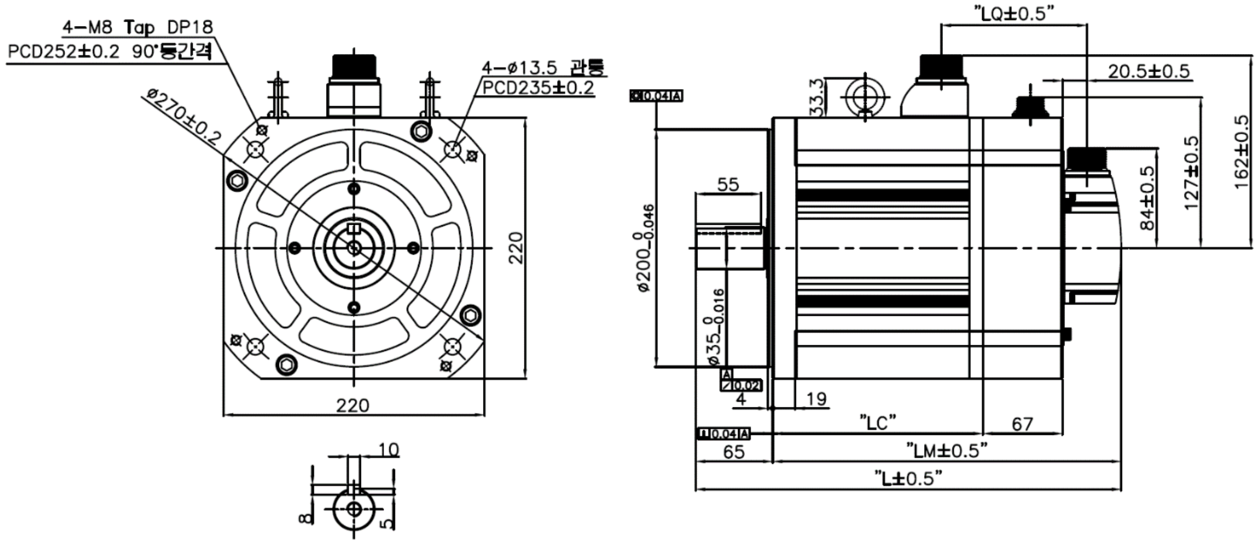
<Serial M-turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	MA	N	−
C	SL	P	−
D	SL	R	−
E	VOD_B	H	+5V
F	GND_B	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20-29P

■ SG Series : SG22D, SG20G, SG12M, LG35D, LG30G, SG20M, LG30M

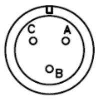


<Power Connector>

Pin No.	Color	Phase
A	Red	U
B	White	V
C	Black	W
D	Green	FG

Plug : MS3102A22-22P

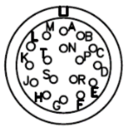
<Brake Connector>



Pin No.	Phase
A	BK+
B	BK−
C	−

Plug : MS3102A14S-7P

<Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	A	M	V
B	A	N	V
C	B	P	W
D	B	R	W
E	Z	H	DC +5V
F	Z	G	0V
K	U	J	SHIELD
L	U		

Plug : MS3102A20-29P

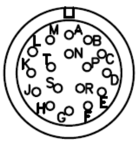
Model	External dimensions				Weight (kg)
	L	LM	LC	LQ	
SG22D, SG20G,SG12M	236.5(302.7)	171.5(237.7)	122(121.2)	56.4(122.6)	16.95(30.76)
LG35D,LG30G,SG20M	256.5(322.7)	191.5(257.7)	142(142.2)		21.95(35.7)
LG30M	292.5(358.7)	227.5(293.7)	178(177.2)		30.8(44.94)

Note 1) Use DC power 90 V to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

Note 3) Option: Serial Type PinMap

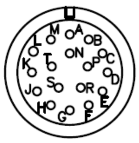
<Serial S-turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	MA	N	−
C	SL	P	−
D	SL	R	−
E	−	H	+5V
F	−	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20-29P

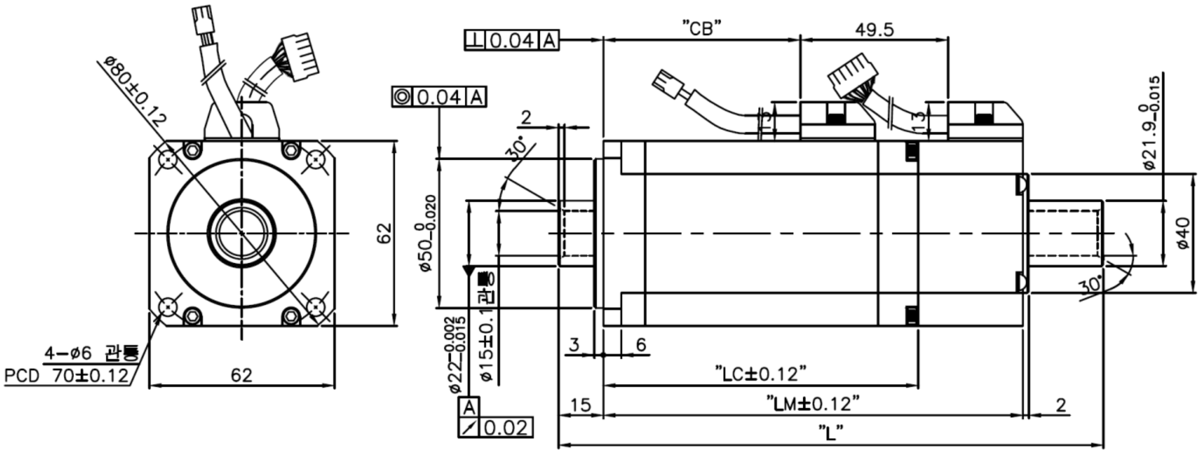
<Serial M-turn Encoder Connector>



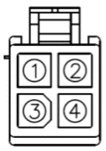
Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	MA	N	−
C	SL	P	−
D	SL	R	−
E	VOD_B	H	+5V
F	GND_B	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20-29P

■ HB01A(Hollow Shaft), HB02A(Hollow Shaft), HB04A(Hollow Shaft)



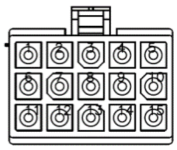
<Power Connector>



Pin No.	Color	Phase
1	Red	U
2	White	V
3	Black	W
4	Green	FG

Plug : 172167-1(AMP)

<Encoder Connector>

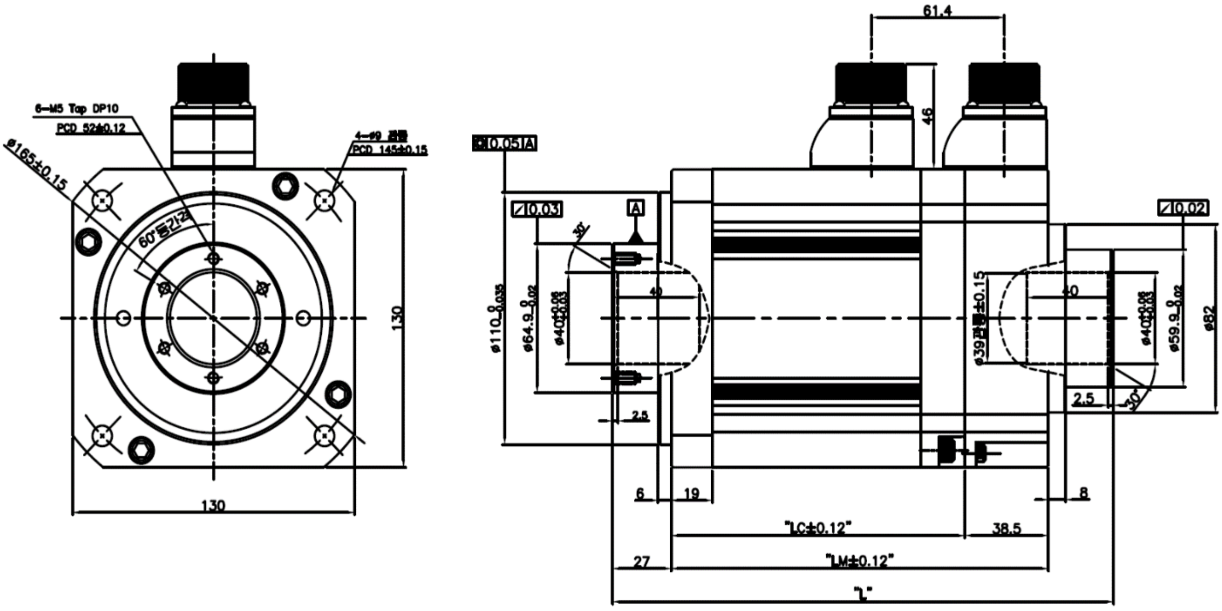


Pin No.	Phase	Pin No.	Phase
1	A	9	V
2	$\overline{A}$	10	$\overline{V}$
3	B	11	W
4	$\overline{B}$	12	$\overline{W}$
5	Z	13	DC +5V
6	$\overline{Z}$	14	0V
7	U	15	SHIELD
8	$\overline{U}$		

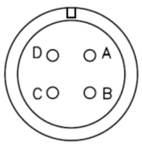
Plug : 172171-1(AMP)

Model	External dimensions				Hollow Shaft Diameter	Weight (kg)
	L	LM	LC	CB		
HB01A	140.5	98.5	68.5	24	15	0.89
HB02A	154.5	112.5	82.5	38	15	1.16
HB04A	182.5	140.5	105.5	66	15	1.69

■ HE09A(Hollow Shaft), HE15A(Hollow Shaft)



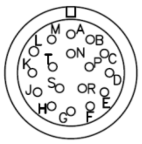
<Power Connector>



Pin No.	Color	Phase
A	Red	U
B	White	V
C	Black	W
D	Green	FG

Plug : MS3102A20-4P

<Encoder Connector>



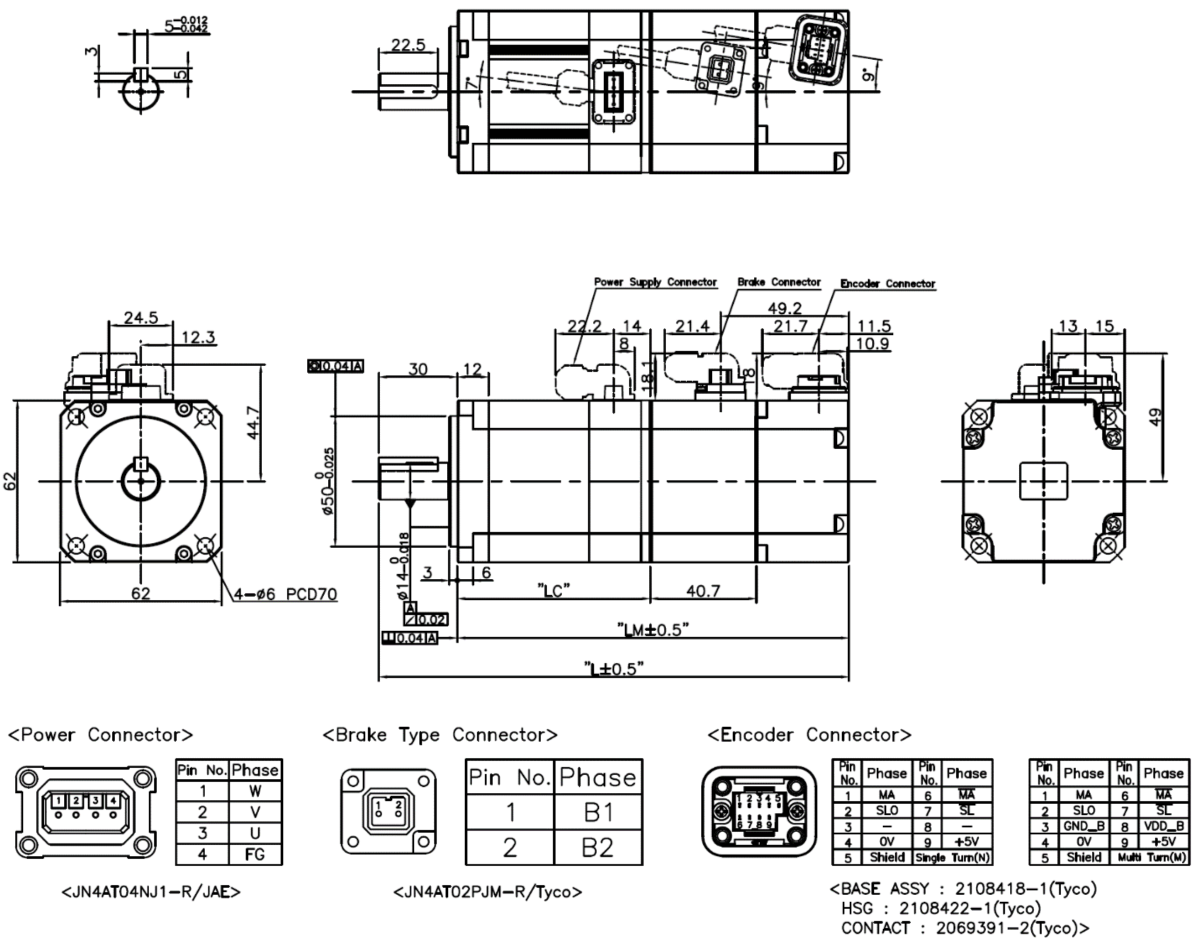
Pin No.	Phase	Pin No.	Phase
1	A	9	V
2	$\overline{A}$	10	$\overline{V}$
3	B	11	W
4	$\overline{B}$	12	$\overline{W}$
5	Z	13	DC +5V
6	$\overline{Z}$	14	0V
7	U	15	SHIELD
8	$\overline{U}$		

Plug : MS3102A20-15P

Model	External dimensions				Hollow Shaft Diameter	Weight (kg)
	L	LM	LC	CB		
HE09A	207	150	111.5	40	40	5.82
HE15A	231	174	135.5	40	40	7.43
HE30A	279	222	183.5	40	40	

■ FB Series : FB01A, FB02A, FB04A

(The rear type cable drawing is provided if requested.)



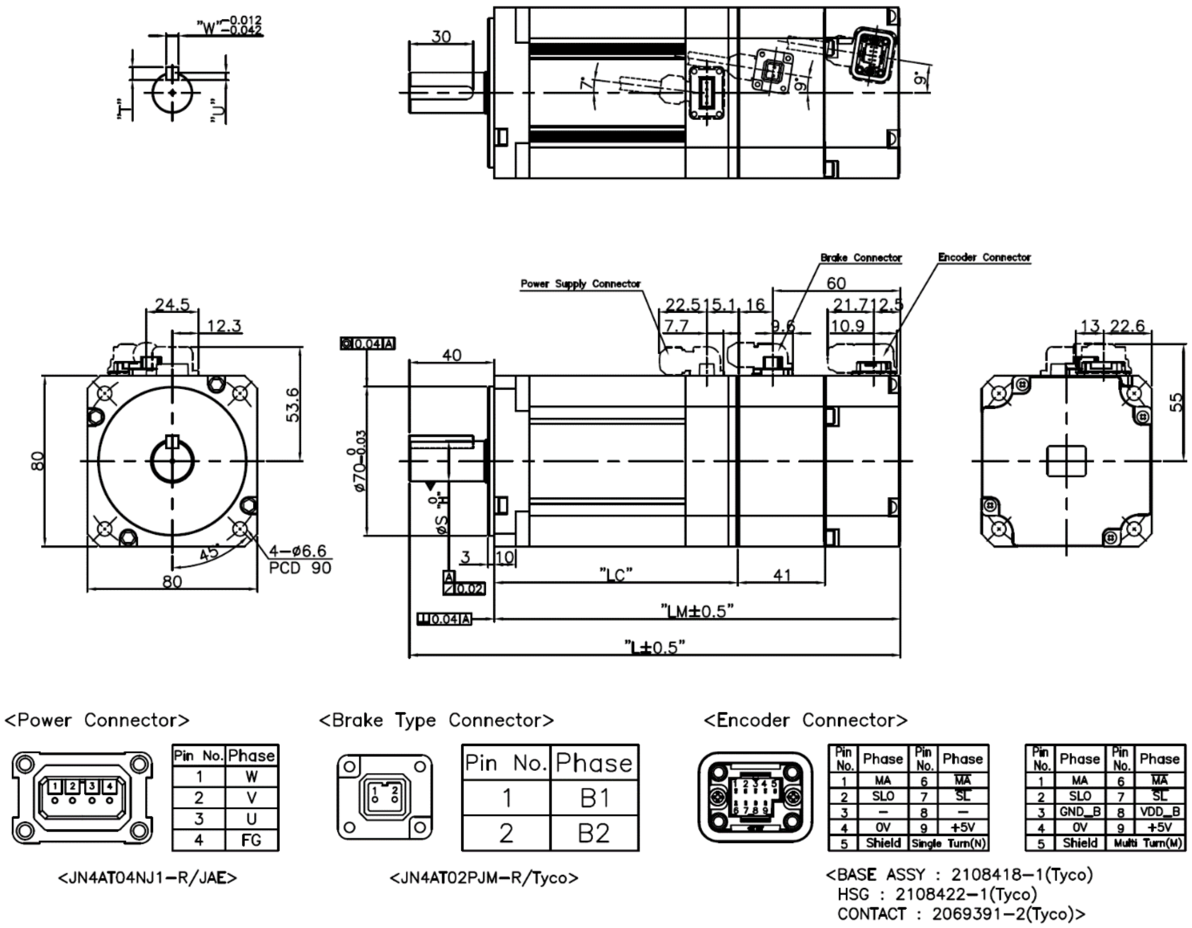
Model	External dimensions			Weight (kg)
	L	LM	LC	
FB01A	109(149.2)	79(119.2)	43.5(43)	0.72(1.3)
FB02A	120(160.2)	90(130.2)	54.5(54)	0.94(1.49)
FB04A	140(180.2)	110(150.2)	74.5(74)	1.32(1.87)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

■ SC Series : FC04A, FC03D, FC06A, FC05D, FC08A, FC06D, FC10A, FC07D

(The rear type cable drawing is provided if requested.)

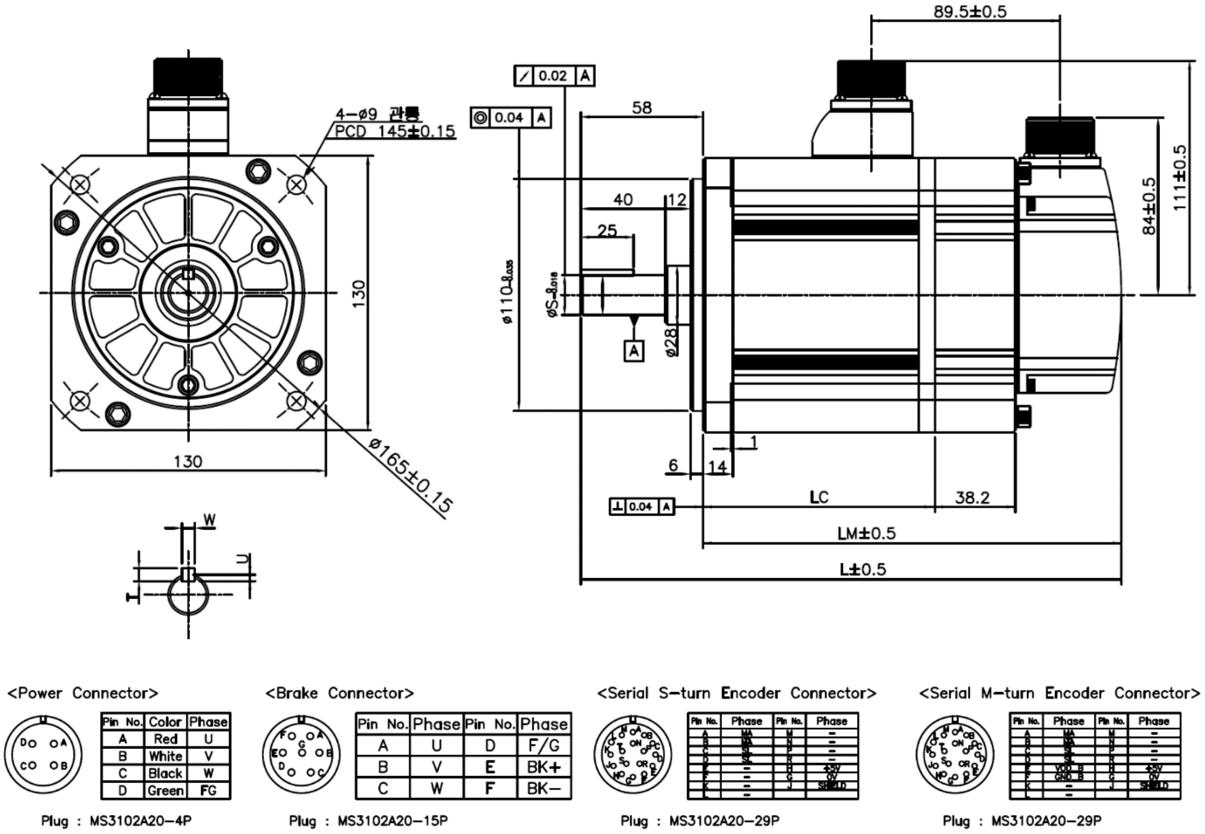


Model	External dimensions					Key dimensions			Weight (kg)
	L	LM	LC	S	H	T	W	U	
FC04A,FC03D	136.5(177)	96.5(137)	61(60.5)	14	-0.018	5	5	3	1.56(2.6)
FC06A,FC05D	154.5(195)	114.5(155)	79(78.5)	19	-0.021	6	6	3.5	2.18(3.22)
FC08A,FC06D	172.5(213)	132.5(173)	97(96.5)	19	-0.021	6	6	3.5	2.72(3.76)
FC10A,FC07D	190.5(231)	150.5(191)	115(114.5)	19	-0.021	6	6	3.5	3.30(4.34)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

■ FE Series : FE09A, FE06D, FE05G, FE03M, FE15A, FE11D, FE09G, FE06M, FE22A, FE16D, FE13G, FE09M FE30A, FE22D, FE17G, FE12M

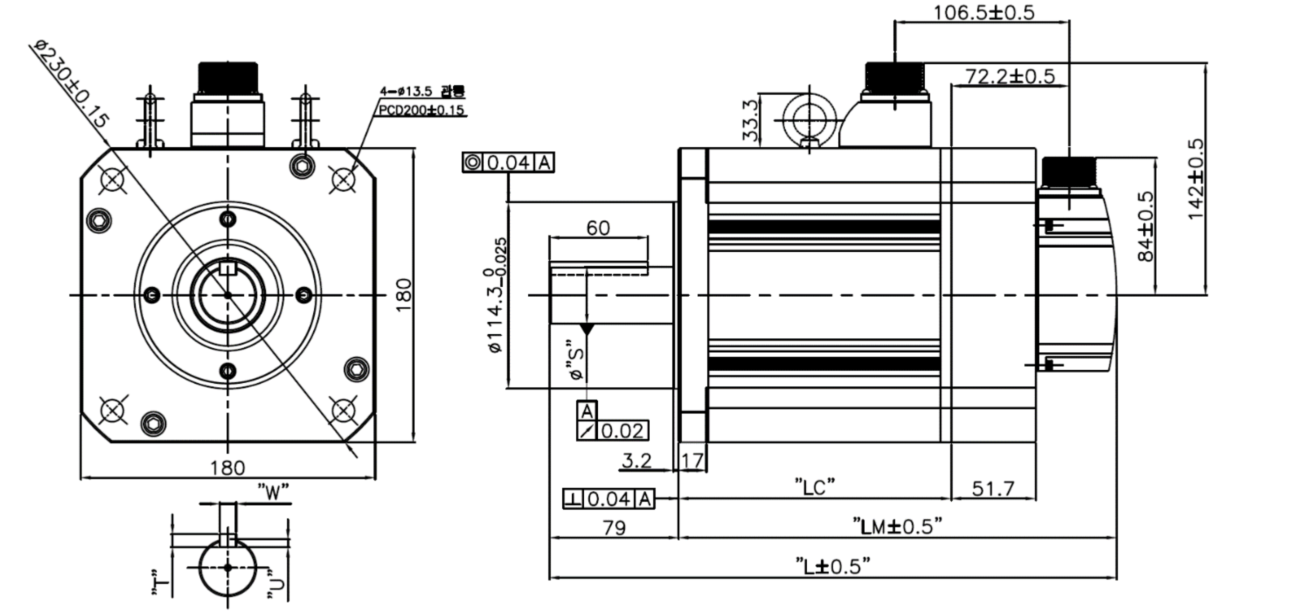


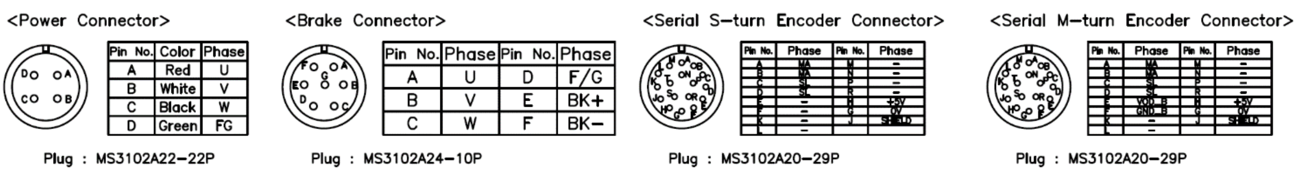
Model	External dimensions				Key dimensions			Weight (kg)
	L	LM	LC	S	T	W	U	
FE09A,FE06D, FE05G,FE03M	197.3(235.3)	139.3(177.3)	89.8(89.6)	19	5	5	3	5.04(6.58)
FE15A,FE11D, FE09G,FE06M	217.3(255.3)	159.3(197.3)	109.8(109.6)	19	5	5	3	6.74(8.28)
FE22A,FE16D, FE13G,FE09M	237.3(275.3)	179.3(217.3)	129.8(129.6)	22	6	6	3.5	8.48(10.02)
FE30A,FE22D, FE17G,FE12M	255.3(293.3)	197.3(235.3)	147.8(147.6)	24	7	8	4	10.05(11.59)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

■ FF Series : FF30A, FF22D, FF20G, FF12M, FF35D, FF30G, FF20M, FF30M





Pin No.	Color	Phase
A	Red	U
B	White	V
C	Black	W
D	Green	FG

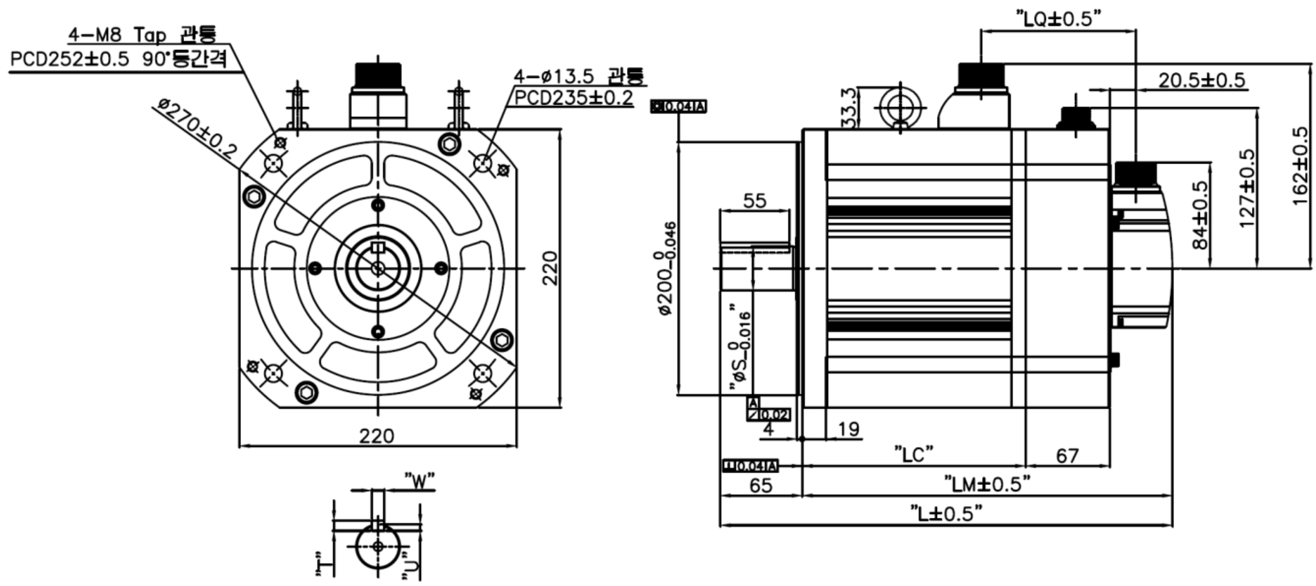
Pin No.	Phase	Pin No.	Phase
A	U	D	F/G
B	V	E	BK+
C	W	F	BK−

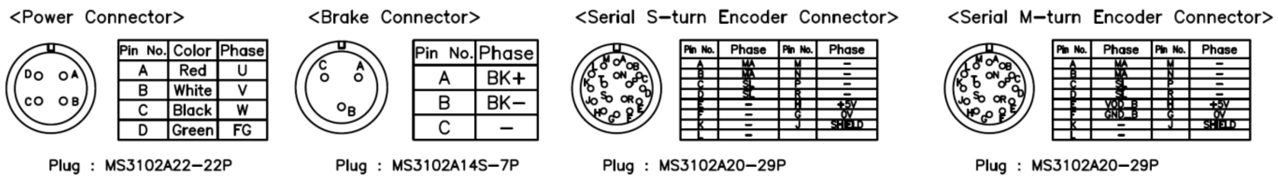
Model	External dimensions				Key dimensions			Eye bolt	Weight (kg)
	L	LM	LC	S	T	W	U		
FF30A,FF22D, FF20G,FF12M	257.5(308.9)	178.5(229.9)	129(128.7)	35 (0~+0.01)	8	10	5	No	12.5(19.7)
FF35D, FF30G,FF20M	287.5(338.9)	208.5(259.9)	159(158.7)						17.4(24.6)
FF30M	331.5(382.9)	252.5(303.9)	203(202.7)					Yes	25.2(32.4)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

■ FG Series : FG22D, FG20G, FG12M, FG35D, FG30G, FG20M, FG30M



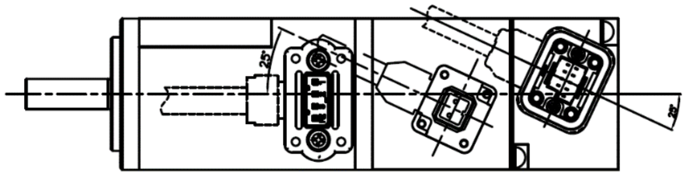


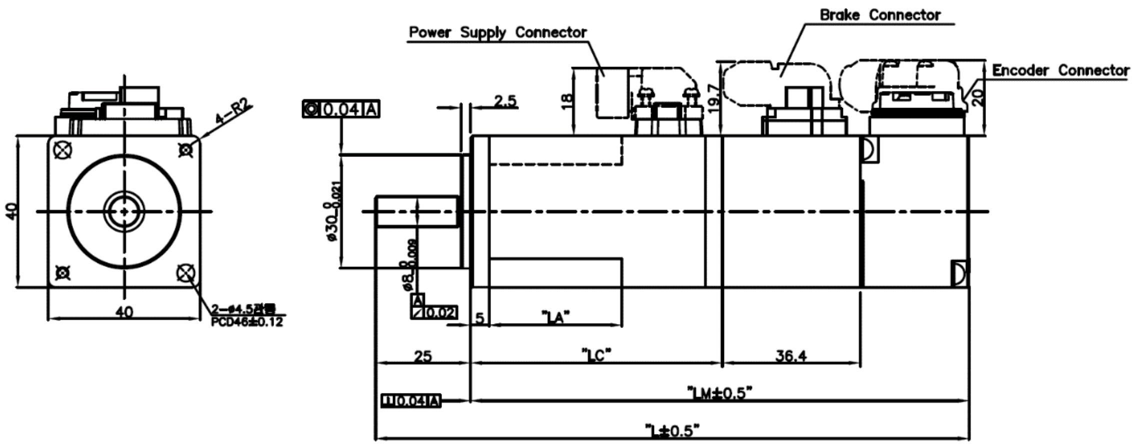
Model	External dimensions				Key dimensions			Weight (kg)
	L	LM	LC	S	T	W	U	
FG22D,FG20G, FG12M	229.5(295.7)	164.5(230.7)	115(114.2)	35 (0~+0.01)	8	10	5	15.42(29.23)
FG35D,FG30G, FG20M	250.5(316.7)	185.5(251.7)	136(135.2)					20.22(34.03)
FG30M	282.5(348.7)	217.5(283.7)	168(167.2)					28.02(41.83)

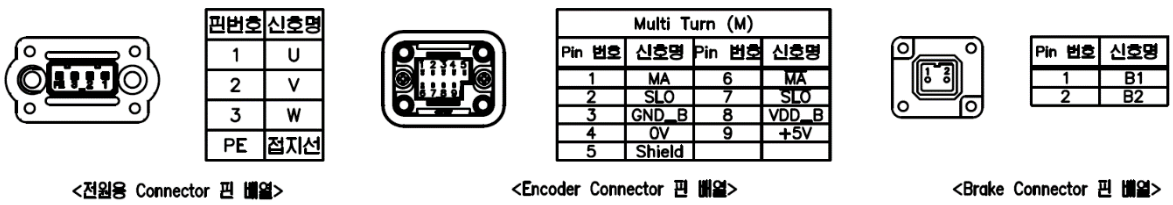
Note 1) Use DC power 90 V to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

■ FAL Series : FALR5A, FAL01A, FAL015A







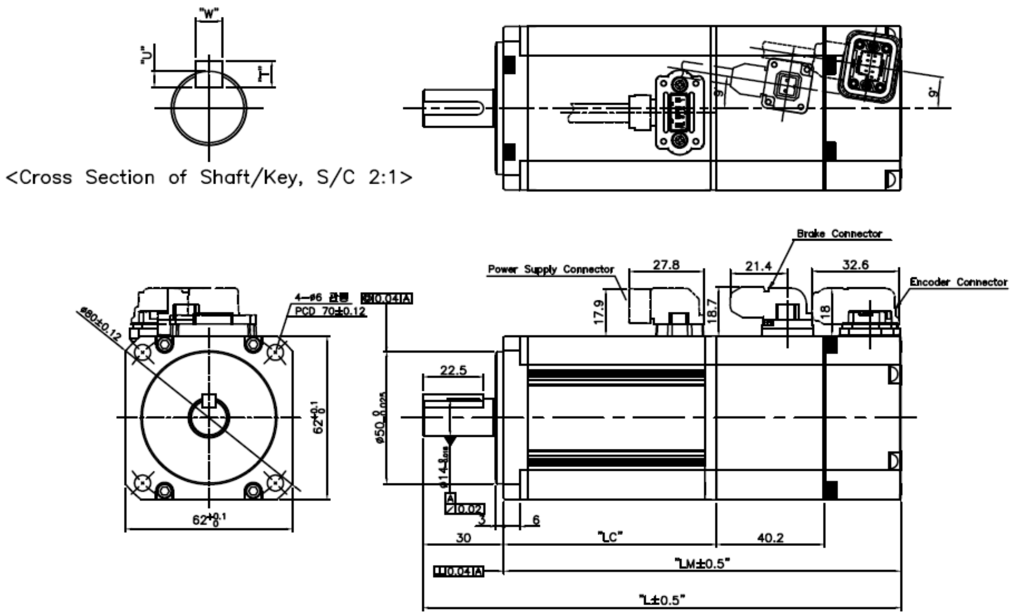
Model Name	External dimensions				Weight (kg)
	L	LM	LC	LA	
FALR5A	103.2(139.6)	78.2(114.6)	49.5	23	0.31(0.66)
FAL01A	120.2(156.6)	95.2(131.6)	66.5	35	0.45(0.80)
FAL015A	140.2	115.2	86.5	35	0.61

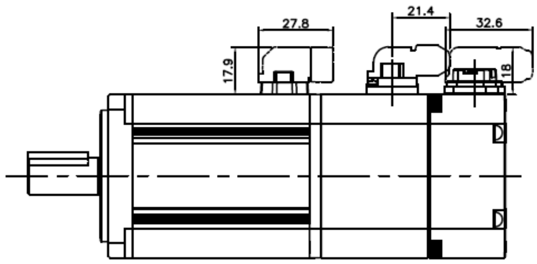
Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

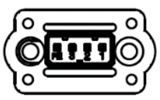
Note 3) When connecting the FAL product, connect the power cable first.

■ FBL Series : FBL01A, FBL02A, FBL04A



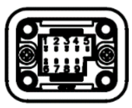


<Cable 인출 방향이, 축 반대 방향일 경우>



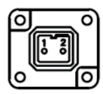
핀번호	신호명
1	U
2	V
3	W
PE	접지선

<전원용 Connector 핀 배열>



Multi Turn (M)			
Pin 번호	신호명	Pin 번호	신호명
1	MA	6	$\overline{\text{MA}}$
2	SLO	7	$\overline{\text{SLO}}$
3	GND_B	8	VDD_B
4	0V	9	+5V
5	Shield		

<Encoder Connector 핀 배열>



Pin 번호	신호명
1	B1
2	B2

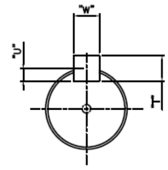
<Brake Connector 핀 배열>

Model Name	External dimensions					Key dimensions			Weight (kg)
	L	LM	LC	S	H	T	W	U	
FBL01A	107.2(147.2)	77.2(117.2)	48.5(48.3)	14	-0.018	5	5	3	0.56(1.3)
FBL02A	118.2(158.2)	88.2(128.2)	59.5(59.3)	14	-0.018	5	5	3	0.74(1.48)
FBL04A	138.2(178.2)	108.2(148.2)	79.5(79.3)	14	-0.018	5	5	3	1.06(1.8)

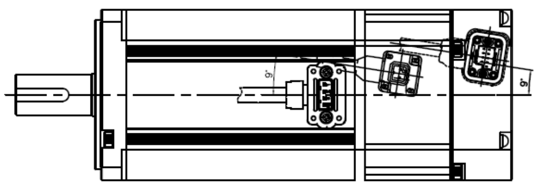
Note 1) Use DC power (24 V) to operate the brake.

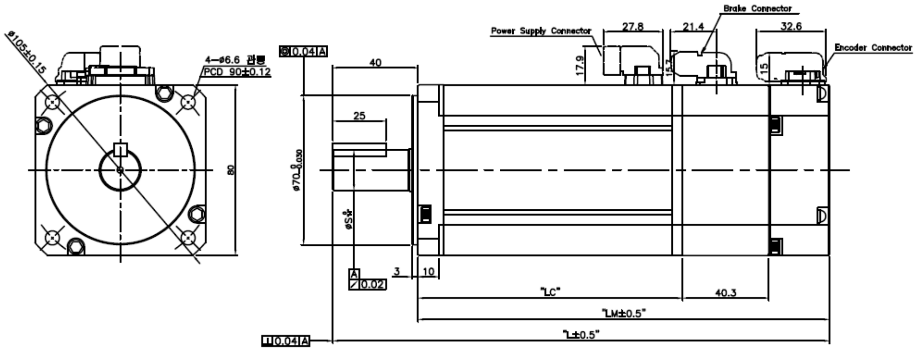
Note 2) The sizes in parentheses apply when attached to the brakes.

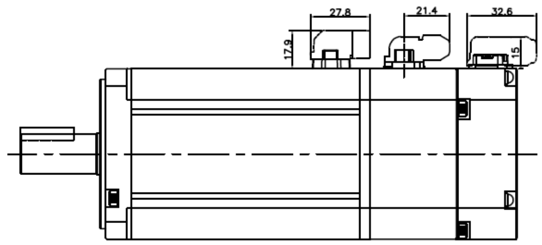
■ FCL Series : FCL04A, FCL03D, FCL06A, FCL05D, FCL08A, FCL06D, FCL10A, FCL07D



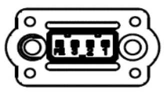
<Cross Section of Shaft/Key, S/C 2:1>





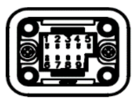


<Cable 인출 방향이, 축 반대 방향일 경우>



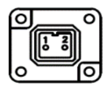
핀번호	신호명
1	U
2	V
3	W
PE	접지선

<전원용 Connector 핀 배열>



Multi Turn (M)			
Pin 번호	신호명	Pin 번호	신호명
1	MA	6	$\overline{\text{MA}}$
2	SLO	7	$\overline{\text{SLO}}$
3	GND_B	8	VDD_B
4	0V	9	+5V
5	Shield		

<Encoder Connector 핀 배열>



Pin 번호	신호명
1	B1
2	B2

<Brake Connector 핀 배열>

Model Name	External dimensions					Key dimensions			Weight (kg)
	L	LM	LC	S	H	T	W	U	
FCL04A,FCL03D	138.7(179.5)	98.7(139.5)	70(69.8)	14	-0.018	5	5	3	1.52(2.32)/1.26(2.06)
FCL06A,FCL05D	156.7(197.5)	116.7(157.5)	88(87.8)	19	-0.021	6	6	3.5	2.14(2.94)/2.12(2.92)
FCL08A,FCL06D	174.7(215.5)	134.7(175.5)	106(105.8)	19	-0.021	6	6	3.5	2.68(3.48)/2.66(3.46)
FCL10A,FCL07D	192.7(233.5)	152.7(193.5)	124(123.8)	19	-0.021	6	6	3.5	3.30(4.10)/2.78(3.58)

Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

11.2 Servo Drive

11.2.1 Product Features

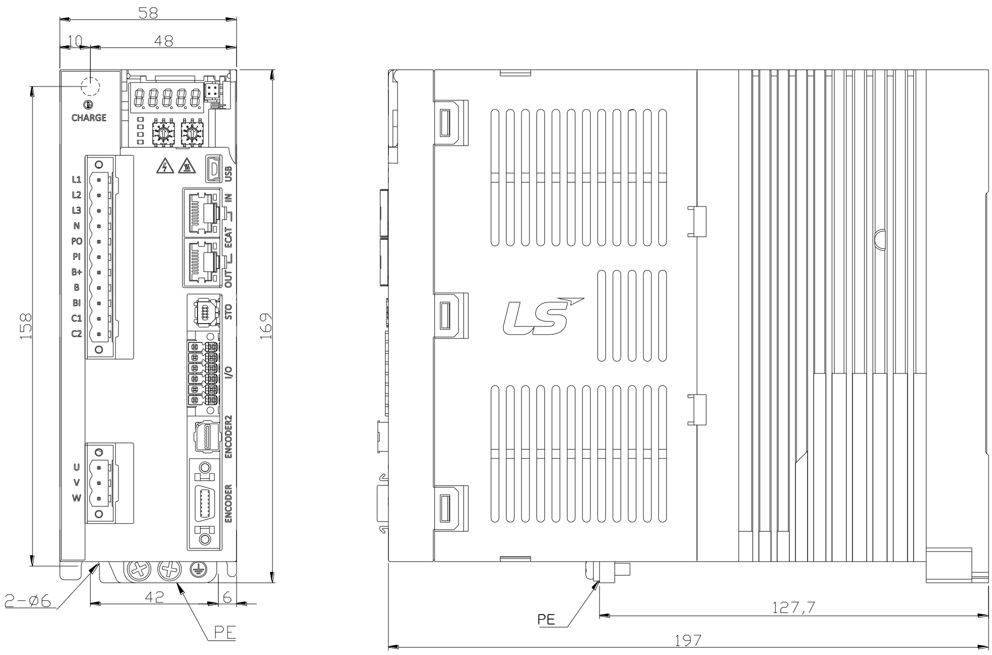
Item		L7NHFA010U	L7NHFA035U	L7NHFA050U	L7NHFA075U	
Input power	Main power	3-phase AC 200 - 230 V (-15 - +10%), 50 - 60 Hz				
	Control power	Single Phase AC 200 - 230 V (-15 - +10%), 50 - 60 Hz				
Rated current (A)		6.75	16.7	32	39.4	
Peak current (A)		20.25	50.1	90.88	98.5	
1st encoder type		Quadrture(Incremental) BiSS-B, BiSS-C(Absolute, Incremental) Tamagawa Serial(Absolute, Incremental) EnDat 2.2 Sinusoidal, Analog Hall				
2nd encoder type		Quadrture(Incremental), SSI Sinusoidal, Analog Hall (using an analog-to-BiSS converter)				
Control performance	Speed control range	Up to 1 : 5000				
	Frequency response	Maximum 1 kHz or above (when the 19-bit serial encoder is applied)				
	Speed change rate	±0.01% or lower (when the load changes between 0 and 100%) ±0.1% or less (temperature of 25±10 ℃)				
	Torque control repeat accuracy	Within ±1%				
EtherCAT Communication specifications	Communication specifications	FoE (Firmware download) EoE (Parameter settings, adjustment and auxiliary functions, and parameter copy through UDP) CoE (IEC 61158 Type12, IEC 61800-7 CIA 402 drive profile)				
	Physical layer	100BASE-TX(IEEE802.3)				
	Connector	RJ45 x 2				
	Distance	Within 100 m between nodes				
	DC (Distributed clock)	Synchronization by DC (Distributed Clock) mode Minimum DC cycle: 250 us				
	LED display	LinkAct IN, LinkAct OUT, RUN, ERR				

Item		L7NHFA010U	L7NHFA035U	L7NHFA050U	L7NHFA075U	
EtherCAT Communication specifications	Cia402 drive profile	Profile Position Mode Profile Velocity Mode Profile Torque Mode Cyclic Synchronous Position Mode Cyclic Synchronous Velocity Mode Cyclic Synchronous Torque Mode Homing Mode				
Digital input/output	Digital Input	Input voltage range: DC 12 V to DC 24 V A total of 6 input channels (allocable) Possible to allocate a total of 15 input functions (*POT, *NOT, *HOME, *STOP, *PCON, *GAIN2, P_CL, N_CL, PROBE1, PROBE2, EMG, A_RST, SV_ON, LVSF1, LVSF2) Note: The signals marked with * are allocated by default.				
	Digital Output	Rated voltage and current: DC 24 V ± 10%, 120 ㎃ A total of 3 output channels (allocable) Possible to allocate a total of 11 outputs (*BRAKE±, *ALARM±, *READY±, ZSPD±, INPOS±, TLMT±, ,VLMT±, INSPD±, WARN±, TGON±, INPOS2±) Note: The signals marked with * are allocated by default.				
Analog Output		A total of 2 channels (allocable) Possible to allocate a total of 25 outputs				
Safety Functions		2 input channels (STO1 and STO2) and 1 output channel (EDM±)				
USB Communication	Function	Firmware download, parameter settings, adjustment and auxiliary functions, and parameter copy function				
	Communication standard	Compliant with the USB 2.0 Full Speed Standard				
	Connecting device	PC or USB storage medium				

Item		L7NHFA010U	L7NHFA035U	L7NHFA050U	L7NHFA075U	
Built-in Function	Dynamic braking	Standard built-in (activated when the servo alarm goes off or when the servo is off)				
	Regenerative braking	Both the default built-in brake and an externally installed brake are possible.				
	Display function	7-segment Display (5 DIGIT)				
	Self setting function	Possible to set the drive node address by using the rotary switch				
	Add-on functions	Gain adjustment, alarm history, JOG operation, and home search				
	Protection functions	Overcurrent, overload, current limit over, overheat, overvoltage, undervoltage, encoder error, position follow error, current sensing error				
Service Environment	Operating temperature /Storage temperature	0 ~ +50[℃] / -20~ +65[℃]				
	Operating humidity /Storage humidity	Below 90% RH (no condensation)				
	Others	Indoors, areas free from corrosive or combustible gases, liquids, or dust.				

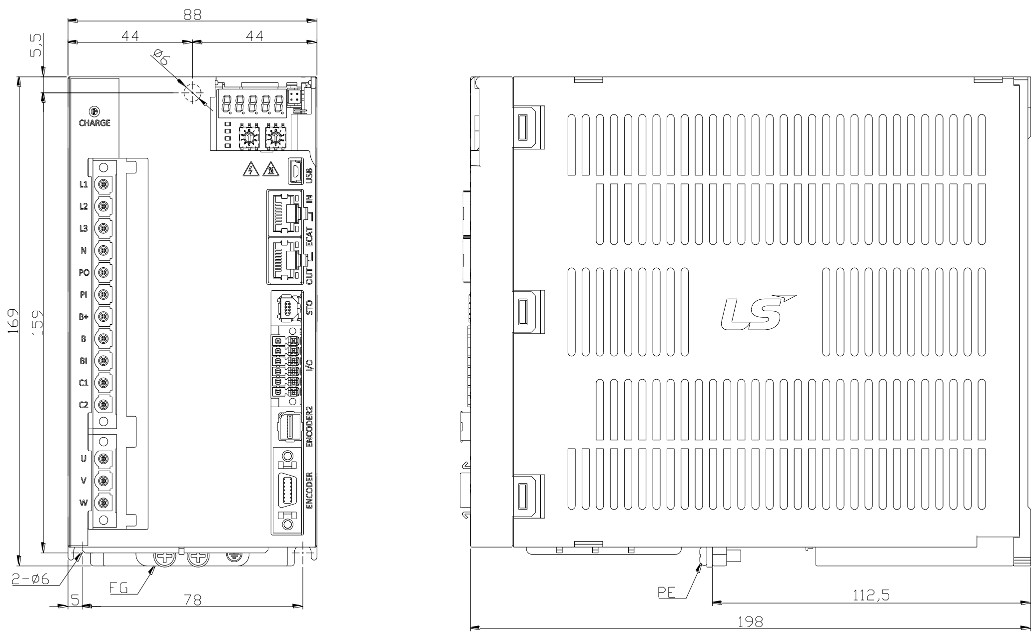
11.2.2 Outline Diagram

■ XDL-L7NHFA010U



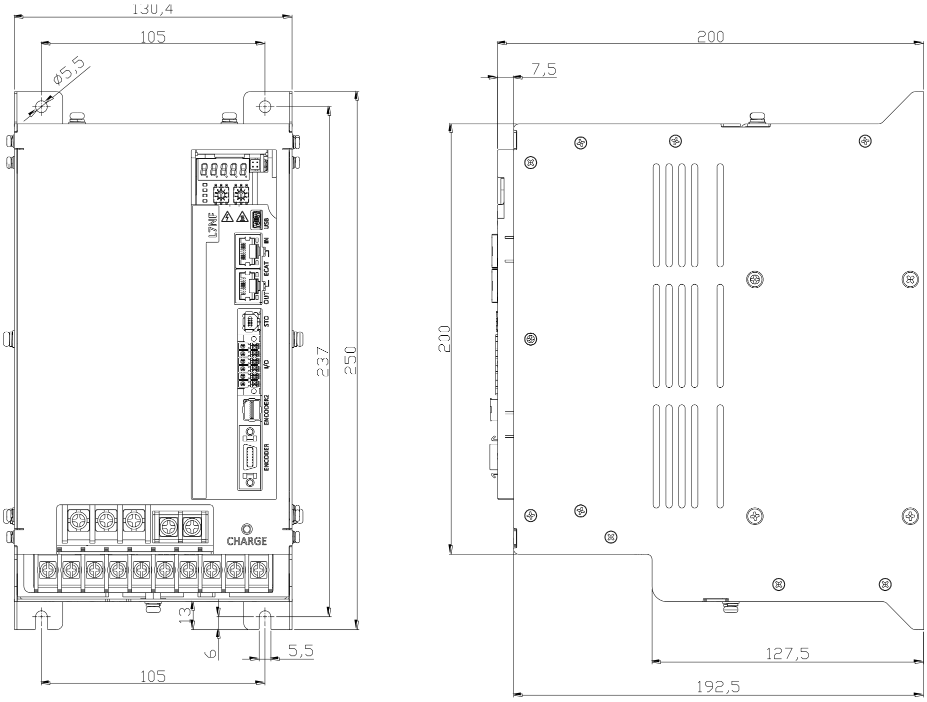
* Weight: 1.5 kg (including the cooling fan)

■ XDL-L7NHFA035U



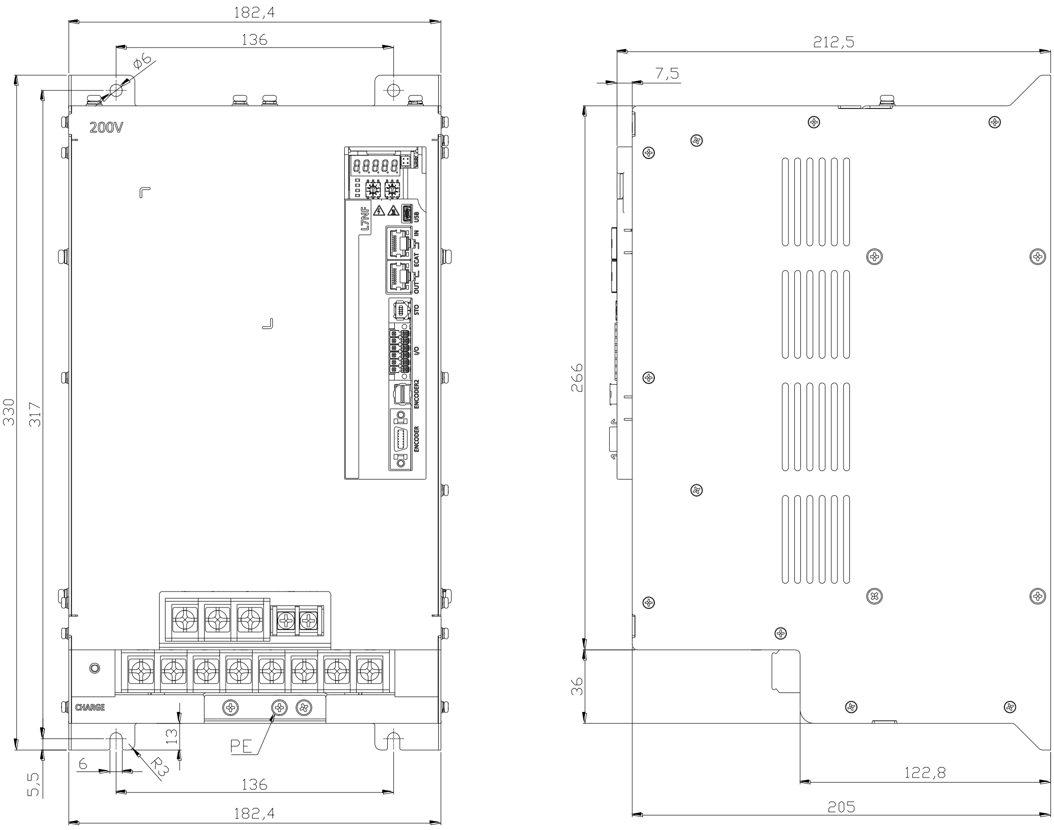
* Weight: 2.5 kg (including the cooling fan)

■ XDL-L7NHFA050U



* Weight: 5.5 kg (including the cooling fan)

■ XDL-L7NHFA075U



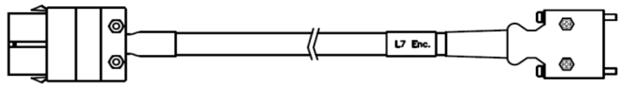
* Weight: 9.7 kg (including the cooling fan)

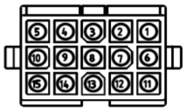
11.3 Options and Peripheral Devices

■ Option (incremental **encoder cable)**

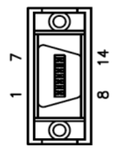
Classification	Signal	Product Name	Small Capacity AMP Type INC Encoder Cable
Name [1)]	XLCS- E□□□AS	Motors	All models of XML-SA/SB/SC/HB Series INC

Specifications





PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	A	6	$\overline{Z}$	11	W
2	$\overline{A}$	7	U	12	$\overline{W}$
3	B	8	$\overline{U}$	13	+5V
4	$\overline{B}$	9	V	14	0V
5	Z	10	$\overline{V}$	15	SHIELD

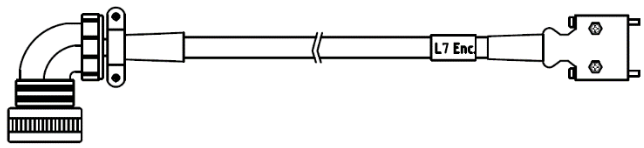


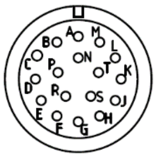
PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	W	6	$\overline{U}$	11	B
2	$\overline{W}$	7	0V	12	$\overline{A}$
3	V	8	$\overline{Z}$	13	A
4	$\overline{V}$	9	Z	14	+5V
5	U	10	$\overline{B}$	Plate	SHIELD

1. Motor connection
   a. Cap specifications (15 Positions): 172163-1 (AMP)
   b. Socket specifications: 170361-1 (AMP)
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 7Px0.2SQ or 7Px24AWG

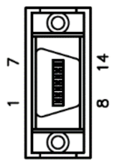
Classification	Signal	Product Name	Medium and Large Capacity MS Type INC Encoder Cable
Name [1)]	XLCS- E□□□BS	Motors	All models of XML-SE/SF/SG/LF/LG/HE Series INC

Specifications





PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
A	A	F	$\overline{Z}$	P	W
B	$\overline{A}$	K	U	R	$\overline{W}$
C	B	L	$\overline{U}$	H	+5V
D	$\overline{B}$	M	V	G	0V
E	Z	N	$\overline{V}$	J	SHIELD



PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	W	6	$\overline{U}$	11	B
2	$\overline{W}$	7	0V	12	$\overline{A}$
3	V	8	$\overline{Z}$	13	A
4	$\overline{V}$	9	Z	14	+5V
5	U	10	$\overline{B}$	Plate	SHIELD

1. Motor connection (MS: Military Standard)
   a. Plug specifications: MS3108B 20-29S
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 7Px0.2SQ or 7Px24AWG

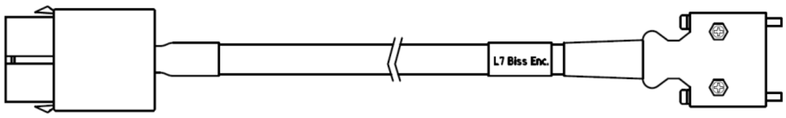
Note 1) The □□□ in the Model Name indicates the type and length of each cable. Refer to the following table for the marking information.

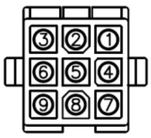
Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ Option (serial encoder cable)

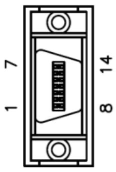
Classification	Signal	Product Name	Small Capacity AMP Type Serial Encoder Cable (Single Turn)
Name [1]	XLCS- E□□□CS	Motors	All models of XML-SB/SC Series S-turn

Specifications





PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	MA	6	–
2	$\overline{MA}$	7	+5V
3	SLO	8	0V
4	$\overline{SLO}$	9	SHIELD
5	–		

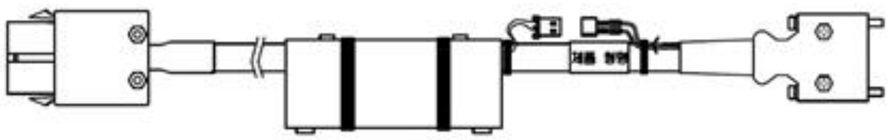


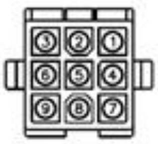
PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	–	6	$\overline{SLO}$	11	–
2	–	7	0V	12	–
3	MA	8	–	13	–
4	$\overline{MA}$	9	–	14	+5V
5	SLO	10	–	Plate	SHIELD

1. Motor connection
   a. Cap specifications (9 Positions): 172161-1 (AMP)
   b. Socket specifications: 170361-1 (AMP)
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 3Px0.2SQ or 3Px24AWG

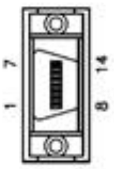
Classification	Signal	Product Name	Small Capacity AMP Type Serial Encoder Cable (Multi-turn)
Name [1]	XLCS- E□□□CS1	Motors	All models of XML-SA/SB/SC Series M-turn

Specifications



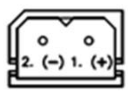


Pin No	Encoder Signal	Pin No	Encoder Signal
1	MA	1	GND_B
2	/MA	2	+5[V]
3	SLO	3	0[V]
4	/SLO	4	Shield
5	VDD_B		



Pin No	Encoder Signal	Pin No	Encoder Signal	Pin No	Encoder Signal
1	–	6	/SLO	11	–
2	–	7	0[V]	12	–
3	MA	8	–	13	–
4	/MA	9	–	14	5[V]
5	SLO	10	–	Plate	Shield

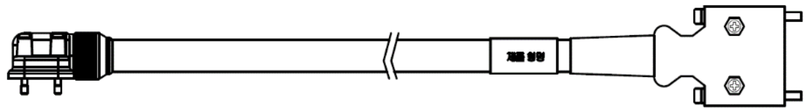
1. Motor connection
   a. Cap specifications (9 Positions): 172161-1 (AMP)
   b. Socket specifications: 170361-1 (AMP)
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 4Px0.2SQ or 4Px24AWG
4. Battery connection
   a. Connector specifications: 5267-02A (Molex)
   b. Battery specifications: ER6V (TOSHIBA, AA, 3.6V, 2000 mAh)

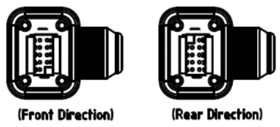


Pin No	Encoder Signal	Line color
1	BATTERY(ADD_B)	Red
2	BATTERY 0[V](GND_B)	Black

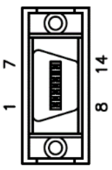
Classification	Signal	Product Name	Serial Encoder Cable for Small Capacity Flat Motor (Single Turn)
Name 1)	XLCS- E□□□ES(Front Direction)/ XLCS- E□□□ES-R(Rear Direction)	Motors	All models of XML-FB/FC Series S-turn

Specifications



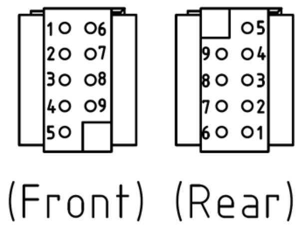


PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	MA	6	$\overline{\text{MA}}$
2	SLO	7	$\overline{\text{SLO}}$
3	-	8	-
4	0V	9	+5V
5	SHIELD		



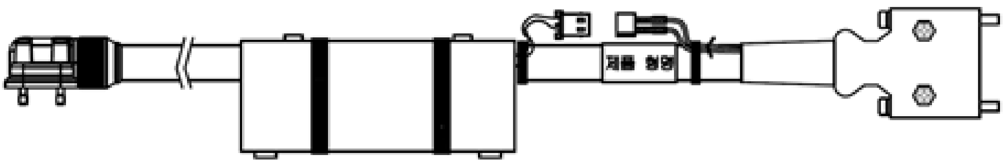
PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	-	6	$\overline{\text{SLO}}$	11	-
2	-	7	0V	12	-
3	MA	8	-	13	-
4	$\overline{\text{MA}}$	9	-	14	+5V
5	SLO	10	-	Plate	SHIELD

1. Motor connection
   a. Cap specifications: 2201825-1 (Tyco)
   b. Socket specifications: 2174065-4 (Tyco)
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 3Px0.2SQ or 3Px24AWG

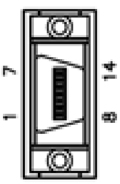


Classification	Signal	Product Name	Serial Encoder Cable for Small Capacity Flat Motor (Multi-turn)
Name 1)	XLCS- E□□□ES1(Front Direction)/ XLCS- E□□□ES1-R(Rear Direction)	Motors	All models of XML-FAL/FB(L)/FC(L) Series M-turn

Specifications

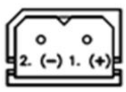


Pin No	Encoder Signal	Pin No	Encoder Signal
1	MA	1	/MA
2	SLO	2	/SLO
3	GND_E	3	VDD_B
4	0[V]	4	+5[V]
5	Shield		



Pin No	Encoder Signal	Pin No	Encoder Signal	Pin No	Encoder Signal
1	–	6	/SLO	11	–
2	–	7	0[V]	12	–
3	MA	8	–	13	–
4	/MA	9	–	14	5[V]
5	SLO	10	–	Plate	Shield

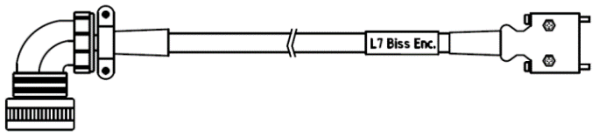
1. Motor connection
   a. Cap specifications (9 Positions): 2201825-1 (Tyco)
   b. Socket specifications: 2174065-4 (Tyco)
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 4Px0.2SQ or 4Px24AWG Battery connection
4. Battery connection
   a. Connector specifications: 5267-02A (Molex)
   b. Battery specifications: ER6V (TOSHIBA, AA, 3.6V, 2000 mAh)

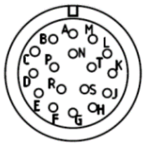


Pin No	Encoder Signal	Line color
1	BATTERY(ADD_B)	Red
2	BATTERY 0[V](GND_B)	Black

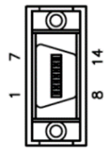
Classification	Signal	Product Name	Medium and Large Capacity MS Type Serial Encoder Cable (Single Turn)
Name 1)	XLCS- E□□□DS	Motors	All models of XML-SE/SF/SG/LF/LG/FE/FF/FG Series S-turn

Specifications





PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
A	MA	F	-	P	-
B	$\overline{MA}$	K	-	R	-
C	SLO	L	-	H	+5V
D	$\overline{SLO}$	M	-	G	0V
E	-	N	-	J	SHIELD

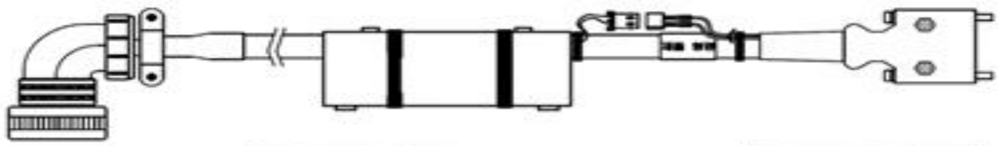


PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	-	6	$\overline{SLO}$	11	-
2	-	7	0V	12	-
3	MA	8	-	13	-
4	$\overline{MA}$	9	-	14	+5V
5	SLO	10	-	Plate	SHIELD

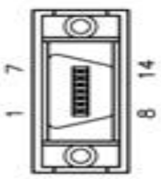
1. Motor connection (MS: Military Standard)
   a. Plug specifications: MS3108B 20-29S
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 3Px0.2SQ or 3Px24AWG

Classification	Signal	Product Name	Medium and Large Capacity MS Type Serial Encoder Cable (Multi-turn)
Name 1)	XLCS- E□□□DS1	Motors	All models of XML-SE/SF/SG/LF/LG/FE/FF/FG Series S-turn

Specifications

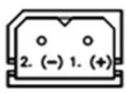


Pin No	Encoder Signal	Pin No	Encoder Signal
A	MA	M	-
B	/MA	N	-
C	SLO	P	-
D	/SLO	R	-
E	VDD_B	H	+5[V]
F	GND_B	G	0[V]
K	-	J	Shield
L	-		



Pin No	Encoder Signal	Pin No	Encoder Signal
1	-	8	-
2	-	9	-
3	MA	10	-
4	/MA	11	-
5	SLO	12	-
6	/SLO	13	-
7	0[V]	14	+5[V]
Plate		Shield	

1. Motor connection (MS: Military Standard)
   a. Plug specifications: MS3108B 20-29S
2. Drive connection (CN2)
   a. Case specifications: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. Connector specifications: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 4Px0.2SQ or 4Px24AWG
4. Battery connection
   a. Connector specifications: 5267-02A (Molex)
   b. Battery specifications: ER6V (TOSHIBA, AA, 3.6V, 2000 mAh)



Pin No	Encoder Signal	Line color
1	BATTERY(ADD_B)	Red
2	BATTERY 0[V](GND_B)	Black

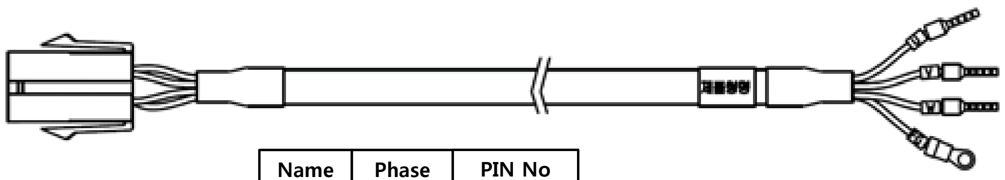
Note 1) The □□□ in the Model Name indicates the type and length of each cable. Refer to the following table for the marking information.

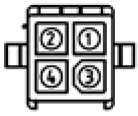
Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ Option (standard power cable)

Classification	Power supply	Product Name	Small Capacity AMP Type Power Cable
Name [1]	XLCS- P□□□GS	Motors	All models of XML-SA/SB/SC/HB Series

Specifications





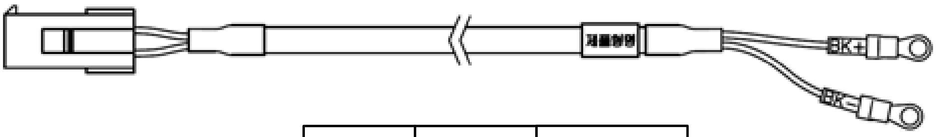
Name	Phase	PIN No
LEAD WIRE	U	1
	V	2
	W	3
FG	FG	4

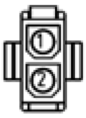
1.

Motor connection
 a. Cap specifications (4 Positions): 172159-1 (AMP)
 b. Socket specifications: 170362-1 (AMP)
2. Drive connection (U, V, W, and PE)
 a. U, V and W pin specifications: 1512
 b. PE pin specifications: 1.5x4 (ring terminal)
3. Cable specifications: 4Cx0.75SQ or 4Cx18AWG

Classification	Brake release	Product Name	Small Capacity AMP Type Brake Cable
Name [1]	XLCS- P□□□KB	Motors	All models of XML-SA/SB/SC Series

Specifications





Name	Phase	PIN No
LEAD WIRE	+	1
	-	2

1. Motor connection
 a. Cap specifications (2 Positions): 172157-1 (AMP)
 b. Socket specifications: 170362-1 (AMP)
2. For braking power
 a. Connection terminal specifications: 1.5x3 (ring terminal)
3. Cable specifications: 2Cx0.75SQ or 2Cx19AWG

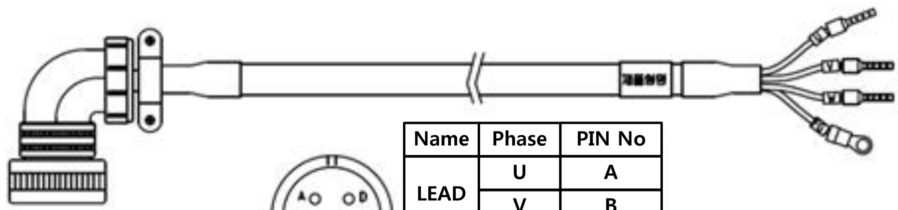
Note 1) The □□□ in the Model Name indicates the type and length of each cable. Refer to the following table for the marking information.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ Option (standard power cable)

Classification	Power supply	Product Name	Medium Capacity MS Type Power Cable (for 130 Flange)
Name 1)	XLCS- P□□□HS	Motors	All models of XML-SE/FE/HE Series

Specifications

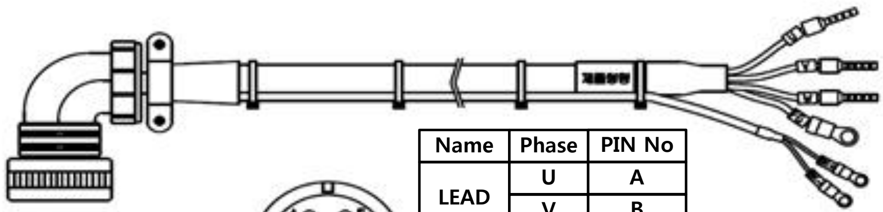


Name	Phase	PIN No
LEAD WIRE	U	A
	V	B
	W	C
FG	FG	D

1. Motor connection (MS: Military Standard)
   a. Plug specifications: MS3108B 20-4S
2. Drive connection (U, V, W, and PE)
   a. U, V and W pin specifications: 2512
   b. PE pin specifications: 2.5x4 (ring terminal)
3. Cable specifications: 4Cx2.5SQ or 4Cx14AWG

Classification	Power and brake	Product Name	Medium Capacity MS Type Power/Brake Cable (for 130 Flange)
Name 1)	XLCS- P□□□NB	Motors	All models of XML-SE/FE Series

Specifications



Name	Phase	PIN No
LEAD WIRE	U	A
	V	B
	W	C
FG	FG	D
FG	+	E
	-	F

1. Motor connection
   a. PLUG specifications: MS3108B 20-15S (MS)
2. Drive connection
   a. U, V and W pin specifications: 2512
   b. PE pin specifications: 2.5 x 4 (ring terminal)
3. Power cable specifications: 4Cx2.5SQ or 4Cx14AWG
4. Brake power connection
   a. Connection terminal specifications: 1.5 x 3 (ring terminal)
5. Brake cable specifications: 2Cx0.75SQ or 2Cx19AWG

Note 1) The □□□ in the Model Name indicates the type and length of each cable. Refer to the following table for the marking information.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ Option (standard power cable)

<table>
<tr><td>Classification</td><td>Power supply</td><td>Product Name</td><td>Medium Capacity MS Type Power Cable (for 180/220 Flange)</td></tr>
<tr><td>Name [1)]</td><td>XLCS- P□□□IS</td><td>Motors</td><td>SF30A, SF22D, LF35D, SF20G, LF30G, SF12M, SF20M LF30M
SG22D, LG35D, SG20G, LG30G, SG12M, SG20M, LG30M
FF30A, FF22D, FF35D, FF20G, FF30G, FF12M, FF20M, FF30M
FG22D, FG35D, FG20G, FG12M, FG20M, FG30M</td></tr>
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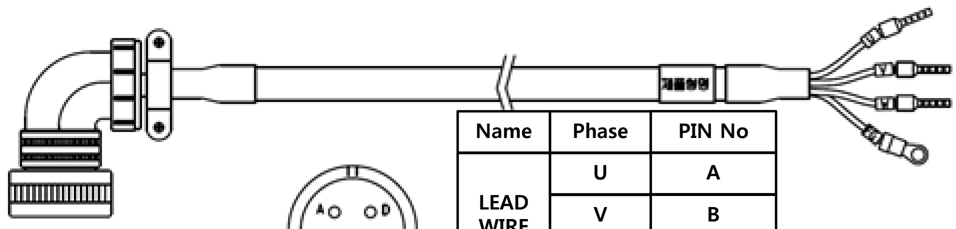
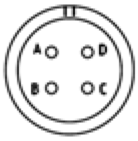
<table>
<tr><th>Name</th><th>Phase</th><th>PIN No</th></tr>
<tr><td rowspan="3">LEAD WIRE</td><td>U</td><td>A</td></tr>
<tr><td>V</td><td>B</td></tr>
<tr><td>W</td><td>C</td></tr>
<tr><td>FG</td><td>FG</td><td>D</td></tr>
</table>
1. Motor connection (MS: Military Standard)
a. Plug specifications: MS3108B 22-22S
2. Drive connection (U, V, W, and PE)
a. U, V and W pin specifications: 2512
b. PE pin specifications: 2.5x4 (ring terminal)
3. Cable specifications: 4Cx2.5SQ or 4Cx14AWG
</td></tr>
<tr><td>Classification</td><td>Power and brake</td><td>Product Name</td><td>Medium Capacity MS Type Power/Brake Cable (for 180 Flange)</td></tr>
<tr><td>Name [1)]</td><td>XLCS- P□□□PB</td><td>Motors</td><td>SF30A, SF22D, LF35D, SF20G, LF30G, SF12M, SF20M LF30M
FF30A, FF22D, FF35D, FF20G, FF30G, FF12M, FF20M, FF30M</td></tr>
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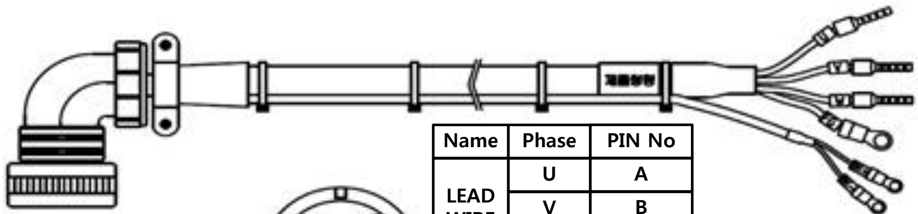

<table>
<tr><th>Name</th><th>Phase</th><th>PIN No</th></tr>
<tr><td rowspan="3">LEAD WIRE</td><td>U</td><td>A</td></tr>
<tr><td>V</td><td>B</td></tr>
<tr><td>W</td><td>C</td></tr>
<tr><td>FG</td><td>FG</td><td>D</td></tr>
<tr><td rowspan="2">Brake Wire</td><td>+</td><td>E</td></tr>
<tr><td>-</td><td>F</td></tr>
</table>
1. Motor connection
a. PLUG specifications: MS3108B 24-10S (MS)
2. Drive connection
a. U, V and W pin specifications: 2512
b. PE pin specifications: 2.5 x 4 (ring terminal)
3. Power cable specifications: 4Cx2.5SQ or 4Cx14AWG
4. Brake power connection
a. Connection terminal specifications: 1.5 x 3 (ring terminal)
5. Brake cable specifications: 2Cx0.75SQ or 2Cx19AWG
</td></tr>
</table>

<table>
<tr><td>Classification</td><td>Power supply</td><td>Product Name</td><td>Medium Capacity MS Type Brake Cable (for 220 Flange)</td></tr>
<tr><td>Name [1)]</td><td>XLCS- P□□□SB</td><td>Motors</td><td>All models of XML-SG/LG/FG</td></tr>
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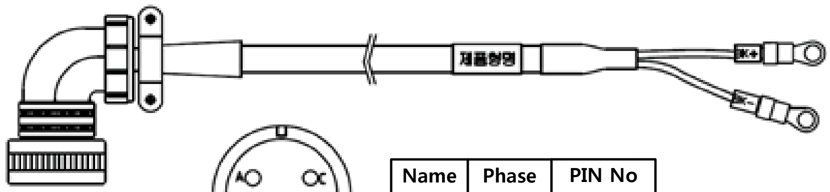
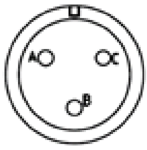



Name	Phase	PIN No
Brake Wire	+	A
	-	B

1. Motor connection
a. PLUG specifications: MS3108B 14-7S (MS)
2. For braking power
a. Connection terminal specifications: 1.5x3 (ring terminal)
3. Cable specifications: 2Cx0.75SQ or 2Cx19AWG
</td></tr>
</table>

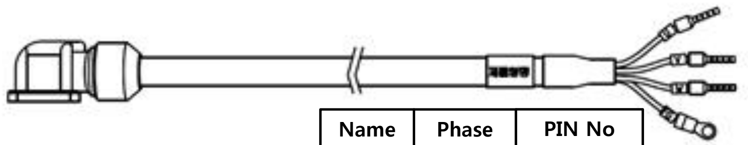
Note 1) The □□□ in the Model Name indicates the type and length of each cable. Refer to the following table for the marking information.

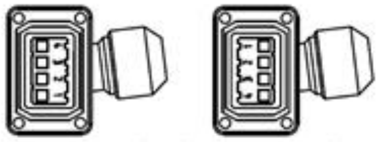
Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ Option (small capacity Flat/L series power cable)

Classification	Power supply	Product Name	Small Capacity Flat Type Power Cable
Name 1)	XLCS- P□□□FS(Front Direction)/ XLCS- P□□□FS-R(Rear Direction)	Motors	All models of XML-FB/FC Series

Specifications

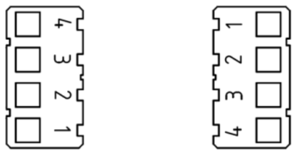




(Front Direction) (Rear Direction)

Name	Phase	PIN No
LEAD WIRE	U	3
	V	2
	W	1
FG	FG	4

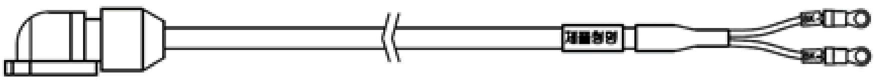
1. Motor connection
   a. PLUG specifications: KN5FT04SJ1 (JAE)
   b. Socket specifications: ST-KN-S-C1B-3500 (JAE)
2. Drive connection (U, V, W, and PE)
   a. U, V and W pin specifications: 1512
   b. PE pin specifications: 1.5x4 (ring terminal)
3. Cable specifications: 4Cx0.75SQ or 4Cx18AWG

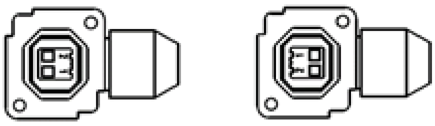


(Front Direction) (Rear Direction)

Classification	Brake	Product Name	Small Capacity Flat Type Brake Cable
Name 1)	XLCS- B□□□QS(Front Direction)/ XLCS- B□□□QS-R(Rear Direction)	Motors	All models of XML-FAL/FB(L)/FC(L) Series

Specifications





(Front Direction) (Rear Direction)

Name	Phase	PIN No
Brake Wire	+	1
	-	2

1. Motor connection
   a. PLUG specifications: KN5FT02SJ1 (JAE)
   b. Socket specifications: ST-KN-S-C1B-3500 (JAE)
2. For braking power
   a. Connection terminal specifications: 1.5x3 (ring terminal)
3. Cable specifications: 2Cx0.5SQ or 2Cx20AWG

(Front Direction) (Rear Direction)

<table>
<tr><td>Classification</td><td>Power supply</td><td>Product Name</td><td>Small Capacity L Series Power Cable</td></tr>
<tr><td>Name [1)]</td><td>XLCS- P□□□LS(Front Direction)/
XLCS- P□□□LS-R(Rear Direction)</td><td>Motors</td><td>All models of XML-FAL/FBL/FCL Series</td></tr>
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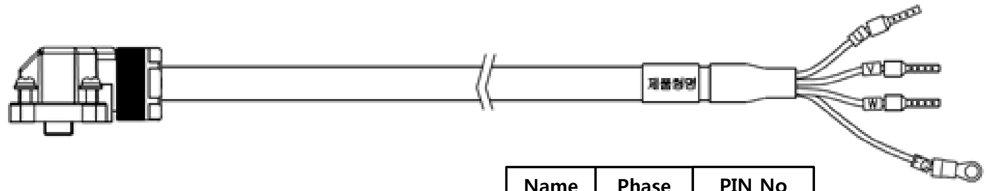
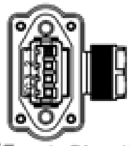
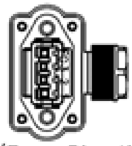
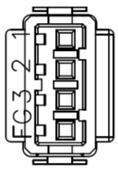
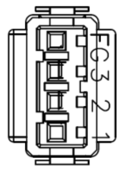
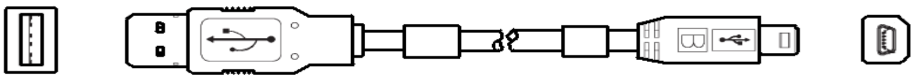
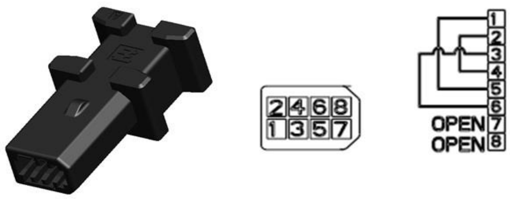


 (Front Direction)  (Rear Direction)
<table>
<tr><th>Name</th><th>Phase</th><th>PIN No</th></tr>
<tr><td rowspan="3">LEAD WIRE</td><td>U</td><td>1</td></tr>
<tr><td>V</td><td>2</td></tr>
<tr><td>W</td><td>3</td></tr>
<tr><td>FG</td><td>FG</td><td>4</td></tr>
</table>
1. Motor connection
a. Plug specifications: SM-JN8FT04 (Suntone)
b. Socket specifications: SMS-201 (Suntone)
2. Drive connection (U, V, W, and PE)
a. U, V and W pin specifications: 1512
b. PE pin specifications: 1.5x4 (ring terminal)
3. Cable specifications: 4Cx0.75SQ or 4Cx18AWG
4. Others: For FAL products, the encoder cable should be connected after installing the power cable.
 (Front Direction)  (Rear Direction)
</td></tr>
</table>

Note 1) The □□□ in the Model Name indicates the type and length of each cable. Refer to the following table for the marking information.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ Option (drive cable)

Classification	Signal	Product Name	Communication Cable (CN5)
Name [1)]	XLCS-CN5XDL-L7U	Drive	XDL-L7NH Series
Specifications	 1. PC connection: USB A plug 2. Drive connection (CN5): Mini USB 5P Plug 3. Electrical requirements: Double shielded, twisted pair, EMI filter installation (Reference product: SANWA KU-AMB518)		
Classification	CN	Product Name	STO Connector
Name [1)]	XLCS-CN6K	Drive	XDL-L7NH SERIES
Specifications	 1. MINI I/O By-Pass Connector: 1971153 (TE)		

Classification	CN	Product Name	CN6 Connector
Name 1)	XLCS-STO□□A	Drive	XDL-L7N Series

Specifications

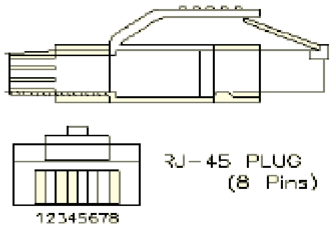
1. Plug Connector Kit
   a. 2069577-1 (TE)
2. Cable
   a. 4P x 26AWG
3. Product Marking
   a. XLCS - STO03A (0.3m)
   b. XLCS - STO10A (1m)
   c. XLCS - STO30A (3m)

-Pin Map -

PIN 번호	IO신호	Color
1	NC	–
2	NC	–
3	HWBB1 Minus	Orange
4	HWBB1 Plus	Orange/Stripe
5	HWBB2 Minus	Yellow
6	HWBB2 Plus	Yellow/Stripe
7	EDM Plus	White
8	EDM Minus	White/Stripe

Classification	CN	Product Name	CN6 Cable
Name 1)	XLCS-CN4NNA	Drive	XDL-L7N Series

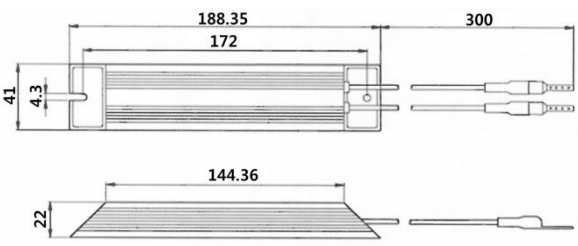
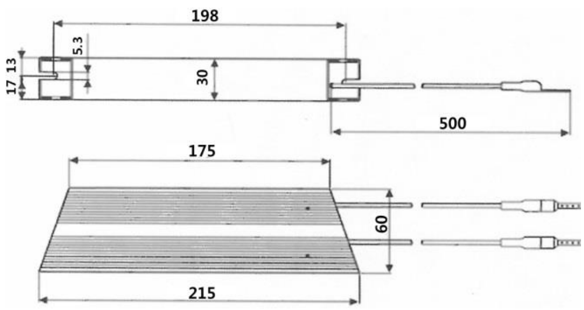
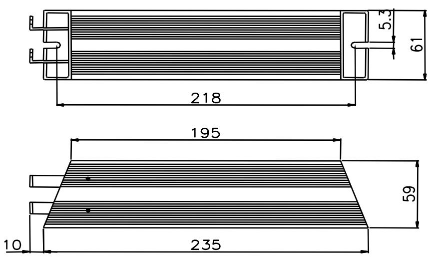
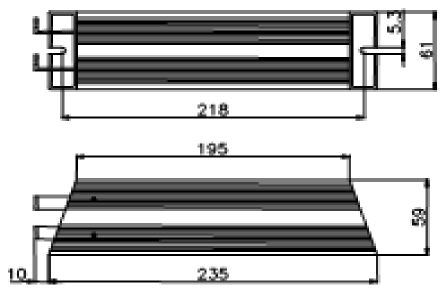
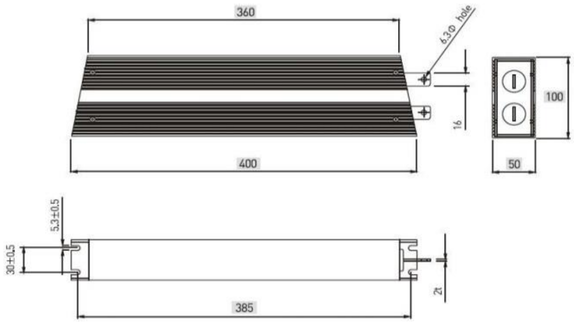
Specifications



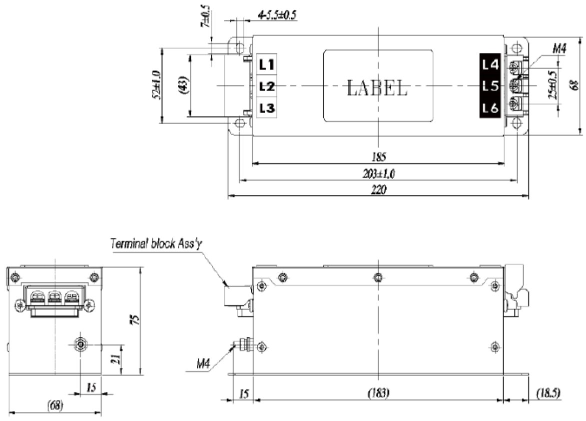
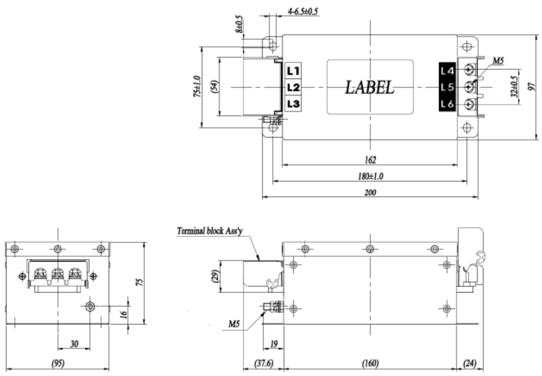
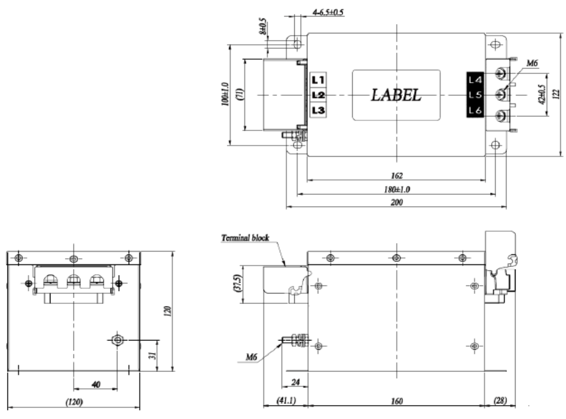
1. Connector: 44915-0021 (MOLEX)
2. Plug Housing: WRJ-45 (Wlztek)

PIN 번호	신호명	선 색상
1	Tx/Rx0+	White/Orange
2	Tx/Rx0–	Orange
3	Tx/Rx1+	White/Green
4	Tx/Rx2+	Blue
5	Tx/Rx2–	White/Blue
6	Tx/Rx1–	Green
7	Tx/Rx3+	White/Brown
8	Tx/Rx3–	Brown
Plate		Shield

■ Optional Braking Resistance

Type	Name	Model Name	Drive	Specifications
Resistance	Braking Resistance	XLC-140R50	L7NHFA001U L7NHFA002U L7NHFA004U	
Resistance	Braking Resistance	XLC-300R30	L7NHFA008U L7NHFA010U	
Resistance	Braking Resistance	XLC-600R30	L7NHFA020U (2P) L7NHFA035U (3P)	 IRV 600S 30ohm
Resistance	Braking Resistance	XLC-600R28	L7NHFA050U (4P) L7NHFA075U (4P)	
Resistance	Braking Resistance	IRM2000-3.3Ω 3.3[Ω] (2000W)	L7NHFA150U	

■ Option (Noise Filter)

Type	Name	Model Name	Drive	Specifications
Resistance	Noise Filter	XLCS-TB6-B010LBEI	L7□A 001□ L7□A 002□ L7□A 004□ L7□A 008□ L7□A 010□ L7□B 010□	
		XLCS-TB6-B020NBDC	L7□B 020□ L7□B 035□	
		XLCS-TB6-B030NBDC	L7□A 020□ L7□A 035□ L7□B 050□	
		XLCS-TB6-B040AS	L7□A 050□ L7□B 075□	
		XLCS-TB6-B060LAS	L7□B 150□	

12. Maintenance and Inspection

This chapter explains how to perform basic maintenance and inspection tasks as well as diagnose and troubleshoot the servo motor and drive.

12.1 Maintenance and Inspection

12.1.1 Precautions

1. Measuring the motor voltage: The PWM controls the voltage output from the servo amp to the motor. Because of this, the waves take the form of pulses. Use a rectifier voltmeter for accurate measurements because different meters may produce different results.

2. Measuring the motor current: Use a moving iron ammeter and wait for the motor's reactance to smooth the pulse waveform into sine waves.

3. Measuring the electric power: Use an electrodynamometer based on the 3 power meter method.

4. Other gauges: When using an oscilloscope or digital voltmeter, do not allow them to touch the ground. Use a 1 mA or less input current gauge.

12.1.2 What to Inspect

Wait at least 10 minutes after turning off the power before beginning the inspection because the condenser can hold enough voltage to cause an electrical accident.

(1) Inspecting the Servo Motor

⚠ Caution
Wait at least 10 minutes after turning off the power before beginning the inspection because the condenser can hold enough voltage to cause an electrical accident.

Checklist	Inspection Period	Inspection and Handling	Notes
Vibration and sound check	Monthly	Touch the motor and listen for sounds.	The feel and sounds should be the same as usual.
Inspect the exterior of the motor	Depends on the amount of contamination or damage.	Clean the motor with a cloth or air pressure.	-
Measure the insulation resistance	At least once a year	Disconnect the motor from the drive and measure the insulation resistance. A normal resistance level is 10 ㏁ or higher. Note 1)	Contact our service center if the resistance is lower than 10 ㏁.
Replace the oil seal	At least once every 5,000 hours	Remove the oil seal from the motor and replace it.	This only applies to motors with an oil seal.
General inspection	At least once every 20,000 hours or after 5 years.	Contact our service center.	Do not disassemble the servo motor yourself.

Note 1) Measure the resistance between the PE and one of the U, V, and W power lines on the servo motor.

(2) Inspecting the Servo Drive

Checklist	Inspection Period	Inspection process	What to do if you find an abnormality
Clean the main body and control board	At least once a year	Check if there is any dust or oil on the components.	Clean it with air pressure or cloth.
Check for loose screws	At least once a year	Check whether the screws are loose on the terminals and connectors.	Tighten the screws.
Check for defective parts on the main body or the control board	At least once a year	Check for discoloration, damage, or disconnection caused by heat.	Contact our company.

12.1.3 Replacing Parts

Mechanical friction and aging may deteriorate the following parts or even cause them to malfunction. This is why it is important to conduct regular maintenance checks and replace worn parts.

1. Smoothing condensers: Ripple currents and other factors can cause this part to wear. The lifespan of this part depends on the operating temperature and environment. It normally lasts for 10 years if used continuously in a normal, air-conditioned environment. Inspect the condenser at least once each year because it can rapidly age over a short period of time once it starts to deteriorate (inspect it more frequently as it approaches obsolescence).

   * Visual inspection criteria:

   a. The condition of the case: Check for deformations on the sides and bottom.

   b. The condition of the lid: Check for notable expansion, severe cracks, or broken parts.

   c. The relief valve: Check for notable valve expansion and operation.

   d. Also regularly check whether the exterior is cracked, discolored, or leaking and whether there are any broken parts. The condenser is obsolete when its capacity degrades to less than 85% of the rated capacity.

2. The relays: Check for bad connection and wear and tear on the contacts caused by switching currents. A relay is obsolete when its accumulated number of switches reaches 100,000, depending on the power capacity.

3. Motor bearings: Replace the bearings after 20,000 to 30,000 hours of operation at the rated speed under the rated load. Replace the bearings if abnormal sounds or vibrations are detected during inspection, depending on the operating conditions.

Standard Parts Replacement Cycle

Part Name	Standard Replacement Cycle	Method
Smoothing condenser	7-8 years	Replace (determine after inspection).
Relay	-	Determine after inspection
Fuse	10 years	Replace
Aluminum electrolytic condensers on printed boards	5 years	Replace with new boards (determined after inspection)
Cooling fan	4-5 years	Replace
Motor bearing	-	Determine after inspection
Motor oil seal	5,000 hours	Replace

12.2 Diagnosing and Troubleshooting Abnormalities

Alarms or warnings are generated if a problem occurs during operation. If this happens, check the applicable code and take appropriate action. If the problem persists, contact our service center.

12.2.1 Servo Motor

[Cause of abnormalities, inspection procedure, and troubleshooting methods]

Symptoms	Cause	Inspection process	Remedies
The motor does not move.	The P-OT and N-OT inputs are off.	Refer to "2. Wiring and Connection" or "2.5. Wiring for Input/Output Signals."	Turn on the P-OT and N-OT inputs.
	The motor is defective.	Use a resistance tester to measure the resistance to the motor lead terminal (resistance between phases: several ohms).	Replace the motor.
	The locking screws are loose.	Check the locking screws.	Tighten any loose screws.
	The external wiring is incorrect or the cables are disconnected.	Check the wires to the motor and the encoder.	Redo the wiring. Replace the cables.
	Encoder failure	Check the output waves.	Replace the encoder. (Contact our service center.)
Motor rotation is unstable.	The connection is bad.	Check the connection of the motor lead terminal.	Fix any bad connections.
	The input voltage is low.	Check the input voltage of the drive.	Change the power source.
	Overloads occur.	Check the condition of the machine.	Remove any foreign substances from the rotating unit and grease or lubricate it.
The motor overheats.	The ambient temperature is too high.	Check the temperature around the motor. (40℃ or lower)	Change heat transfer structure. Install a cooling fan.
	The surface of the motor is contaminated.	Check whether there are any foreign substances on the surface of the motor.	Clean the surface of the motor.
	Overloads occur.	Check the load on the drive. Check the acceleration/deceleration time.	Reduce the load. Increase the acceleration/deceleration time. Replace with a motor with a greater capacity.
	The magnetic power of the magnets is reduced.	Check the counter voltage and voltage waveforms.	Replace the motor.

Symptoms	Cause	Inspection process	Remedies
The device is making a strange sound.	Coupling is bad.	Tighten the coupling screws and measure the concentricity of the connection.	Readjust the coupling.
	The bearings are abnormal.	Check the bearings for vibrations and sounds.	Contact us.
	The parameters are set incorrectly (the inertia, gain, and time constants).	Check the parameters.	Refer to Chapter 9 Object Dictionary.

12.2.2 Servo Drive

■ Servo Alarm

If the drive detects a problem, it will trigger a servo alarm and transition to the servo off state to stop. In this case, the value of the emergency stop setting (0x2013) is used to stop the drive.

Alarm code name	Cause	Checklist	Troubleshooting
AL-10 IPM fault (Overcurrent (Hardware)) AL-14 Over current (Overcurrent (Software)) AL-16 Current limit exceeded (Overcurrent (Hardware))	Motor cable failure	Check for wiring failure and short-circuits.	Replace the motor cable.
	Encoder cable failure	Check for wiring failure and short-circuits.	Replace the encoder cable.
	Parameter setting failure	Motor ID [0x2000], encoder type [0x2001], and encoder type [0x2002] settings should be the same as the motor label information.	Modify the parameters so they match the motor label information.
	Motor phase resistance failure	Inspect resistance between motor lines (U-V, V-W, W-U below several Ω)	Replace the motor.
	Apparatus status failure	Determine whether there is any conflict or restraint in the equipment.	Inspect the apparatus.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
	Failure due to noise	Find a way to resolve the Noise problem by checking the wiring and installation.	Check the wiring of the PE. Adjust the PE wiring size so that it matches the size of the drive main circuit wiring.

Alarm code name	Cause	Checklist	Troubleshooting
AL-11 IPM temperature (IPM Overheat)	Ambient temperature	Check whether the ambient temperature is over 50 ℃.	Lower the temperature around the drive.
	Continuous overload alarm	Check whether the load is below 100% in the accumulated drive overload rate [0x2603].	Change the capacity of the drive and motor. Adjust the gain.
	High-frequency regenerative operation or continuous regenerative operation	Check the accumulated regenerative overload rate [0x2606].	Adjust the regenerative resistance setting [0x2009]. Use the external regenerative resistance.
	Drive installation direction	Check the drive installation status.	Refer to "2. Wiring and Connection."
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-15 Current offset (Abnormal Current Offset)	Excessive current offset in motor U-phase and V-phase	Check whether the U, V, W phase current offsets [0x2015] - [0x2017] are 5% of the rated current or higher.	Adjust the phase current offset again.
	Drive failure		If an alarm occurs continuously after adjusting the phase current offset, there may be a problem with the drive. Replace the drive.
AL-21 Continuous overload (Continuous Overload)	The drive operates continuously, exceeding the rated load.	Continuous operation in the constant speed area or in the stopped state Check whether the load is below 100% with the load rate [0x2603].	Change the capacity of the drive and motor. Adjust the gain.
	Motor brake failure	Check whether the motor brake is open at SVON.	Supply power to the motor brake.
	Parameter setting failure	Check motor ID [0x2000], encoder type [0x2001], encoder type [0x2002] setting and applicable motor label information	Modify the parameters so they match the motor label information.
		Check the overload detection default load rate setting [0x200F].	Set it to an appropriate value.
	Apparatus status failure	Operation should be normal.	Inspect the apparatus.

Alarm code name	Cause	Checklist	Troubleshooting
	Motor cable failure	Check for wiring failure and short-circuits.	Replace the motor cable.
	Encoder cable failure	Check for wiring failure and short-circuits.	Replace the encoder cable.
AL-22 Drive temperature 1 (Drive Overheat 1)	Ambient temperature	Check whether the ambient temperature is over 50 ℃.	Lower the temperature around the drive.
	Drive failure	In normal conditions, check if the drive temperature 1 [0x260B] is significantly different from the ambient temperature.	Replace the drive.
AL-23 Regeneration overload (Regenerative overload)	Capacity exceeded due to high frequency operation or continuous regenerative operation	Check the accumulated regenerative overload rate [0x2606] setting.	Adjust the regenerative resistor setting [0x2009] after connecting the external regenerative resistor and use the external regenerative resistor.
	Parameter setting failure	Check the regenerative resistance-related parameters [0x2009] - [0x200E] settings.	Set it to an appropriate value.
	Main power input voltage failure	Check whether the main power voltage is 385 Vdc or higher.	Inspect the power again.
	Drive failure	Check if the regenerative resistor generates any heat when not in operation.	Replace the drive.
AL-24 Motor cable open (Motor Disconnection)	Parameter setting failure	Check the settings [0x2015], [0x2015] and [0x2015] for U, V and W-phase current offsets.	Execute the command for the current offset adjustment procedure.
	Motor cable failure	Check the cable disconnection.	Replace the motor cable.
	Motor failure	Check for a U, V, or W short-circuit in the motor. (U-V, V-W, W-U)	Replace the motor.
	Drive failure		If an alarm occurs continuously after SV-ON, there may be a problem with the drive. Replace the drive.
AL-25 Drive temperature 2 (Drive Overheat 2)	Ambient temperature	Check whether the ambient temperature is over 50 ℃.	Lower the temperature around the drive.
	Drive failure	In normal conditions, check if the drive temperature 2 [0x260C] is significantly different from the ambient temperature.	Replace the drive.
AL-26	Reserved		

Alarm code name	Cause	Checklist	Troubleshooting
Encoder temperature (Encoder Overheat)			
AL-30 Encoder communication (Serial Encoder Communication Error) AL-31 Encoder cable open (Encoder Cable Disconnection) AL-32 Encoder data (Encoder Data Error)	Encoder cable failure	Check for disconnection, wiring failure, or short-circuits.	Replace the encoder cable.
	Parameter setting failure	Encoder type [0x2001] and encoder resolution [0x2002] settings should be the same as the motor label information.	Modify the parameter so it matches the motor label information. If the modified values are not applied after saving the parameters, replace the motor because there may be a problem with the motor.
	Encoder failure		If an alarm occurs continuously after power cycling, there may be a failure in the motor. Replace the motor.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-33 Motor setting (Motor ID Setting Error)	Motor ID setting	Motor ID [0x2000] setting should be the same as the motor label information.	Modify the parameter so it matches the motor label information. The alarm can be deactivated by turning off and on the power after modifying the parameter.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-34 Z Phase open (Encoder Z-phase loss)	Parameter setting failure	Check the setting of the warning mask [0x2014].	If the motor does not use the Z phase (e.g. step motor), set the 14th bit in the warning mask settings to mask the AL-34.
	Encoder cable failure	Check for wiring failure and short-circuits.	Replace the encoder cable.
	Encoder failure		If an alarm occurs continuously after power cycling, there may be a

Alarm code name	Cause	Checklist	Troubleshooting
			failure in the motor. Replace the motor.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-35 Low battery (Low Voltage of Encoder Battery)	Parameter setting failure	Check the absolute encoder setting [0x2005].	If you want to use an absolute encoder as an incremental encoder, set it to 1 so the alarm does not occur.
	Battery connection failure or no connection	Check the battery connection status.	Properly connect the battery.
	The battery voltage is low	Check whether the battery voltage is 3.3 V or higher.	Replace the battery.
AL-36 Sinusoidal ENC amplitude (Encoder Sine Wave Amplitude Error) AL-37 Sinusoidal ENC frequncy (Encoder Sine Wave Frequency Error)	Encoder cable failure	Check for disconnection, wiring failure, or short-circuits. Check for shield and PE disconnection.	Replace the encoder cable.
	Parameter setting failure	Check the encoder type setting [0x2001].	Check the encoder type setting. Check the speed command. (Maximum: 250kHz)
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
	Converter failure		If an alarm occurs continuously after power cycling, there may be a problem with the converter. Replace the converter.
	Encoder failure		If an alarm occurs continuously after power cycling, there may be a problem with the encoder. Replace the encoder.
AL-38	Abnormal combination of drive and motor	Check the brand label codes of the drive and motor.	Please use drives and motors with the same brand label.

Alarm code name	Cause	Checklist	Troubleshooting
Encoder setting error (Encoder Setting Error)	Encoder cable failure	Check for wiring failure or short-circuits.	Replace the encoder cable.
	Encoder failure		If an alarm occurs continuously after power cycling, there may be a failure in the motor. Replace the motor.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-40 Under voltage (Low Voltage)	Main power input voltage failure	Check whether the main power voltage is about 134 Vac or higher.	Inspect the power again.
		Check whether the DC link voltage [0x2605] is above 190 Vdc while the main power is being supplied.	Replace the drive.
	Power voltage drops during operation	Check the wiring status of the main power.	Use the 3-phase supply voltage.
AL-41 Over voltage (Overvoltage)	Main power input voltage failure	Check whether the main power voltage is about 286 Vac or lower.	Inspect the power again.
		Check whether the DC link voltage [0x2605] is below 405 Vdc while the main power is being supplied.	Replace the drive.
	When the external regenerative resistor value is large	Check the operation condition and regenerative resistance value.	Please recheck the regenerative resistance value considering the operation condition and load.
	Acceleration/Deceleration settings	Check whether a rapid increase/decrease occurs frequently.	Set a long acceleration/deceleration time.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-42	Main power input voltage failure	Check the voltage range of 200-230 Vac between L1, L2 and L3	Inspect the power again.

Alarm code name	Cause	Checklist	Troubleshooting
Main power fail (Main power failure)		phases.	
	Parameter setting failure	Check the main power input mode setting [0x2006] according to the main power input status.	Make parameter settings and wiring with a 3-phase input power if possible.
	Momentary power failure	Check the monitoring interval of the main power phase loss [0x2007].	Increase the monitoring interval of the main power phase loss [0x2007] or check the power supply.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-43 Control power fail (Control power failure)	A voltage failure between C1 and C2 phases.	The voltage between C1 and C2 phases should be within 200-230 Vac.	Inspect the control power again.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-50 Over speed limit (Overspeed)	Motor cable failure	Check for wiring failure and short-circuits.	Replace the motor cable.
	Encoder cable failure	Check for wiring failure and short-circuits.	Replace the encoder cable.
	Parameter setting failure	Motor ID [0x2000], encoder type [0x2001], and encoder resolution [0x2002] settings should be the same as the motor label information.	Modify the parameters so that they match the motor label information.
		Check the gear ratio [0x6091] setting.	Set the electronic gear ratio low.
		Check the gain control parameter settings [0x2100] - [0x211F].	Readjust the gain according to the operation condition.
	Encoder failure		If an alarm occurs continuously after power cycling, there may be a failure in the motor. Replace the motor.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-51	Parameter setting	Check the gear ratio [0x6091] setting.	Set the electronic gear ratio low accordingly.

Alarm code name	Cause	Checklist	Troubleshooting
POS following (Excessive Position Error)	failure	Check the settings for position error range [0x6065] and position error overtime [0x6066].	Readjust the parameter according to the operation condition.
	Apparatus status failure	Check whether there is any restraint on the driving part.	Inspect the apparatus.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-53 Excessive SPD deviation (Excessive Speed Error)	Motor cable failure	Check for disconnection, wiring failure, and short-circuits.	Replace the motor cable.
	Encoder cable failure	Check for disconnection, wiring failure, and short-circuits.	Replace the encoder cable.
	Parameter setting failure	Motor ID [0x2000], encoder type [0x2001], and encoder resolution [0x2002] settings should be the same as the motor label information.	Modify the parameters so that they match the motor label information.
		Check the gear ratio [0x6091] setting.	Set the electronic gear ratio low.
	Apparatus status failure	Check whether there is any restraint on the driving part. Check the operation status of the limit contact sensor.	Inspect the apparatus.
	Encoder failure		If an alarm occurs continuously after power cycling, there may be a failure in the motor. Replace the motor.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-54 Encoder2 POS difference (Excessive Position Error of External Encoder)	Parameter setting failure	Check the external encoder gear ratio settings [0x2025] and [0x2026].	Set the electronic gear ratio accordingly.
		Check the position error range setting [0x2027].	Readjust the parameter according to the operation condition.
	Apparatus status failure	Check whether there is any restraint on the driving part.	Inspect the apparatus.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.

Alarm code name	Cause	Checklist	Troubleshooting
AL-63 Parameter checksum (Parameter Error)	When changing O/S	Check the parameter whose setting is set to the maximum value of the variable type.	Restore the initial parameter (0x1011). If you carry out the restoration, the parameter value changes to the initial value. Set the parameter before operation.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-71 Factory setting (Invalid Factory Settings)	Parameter setting failure	Contact our service center. Check the drive capacity with the device name setting [0x1008].	Reset the drive capacity and download the OS again. If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
AL-80 Enc2 communication (Load Encoder Communication Error) AL-81 Enc2 cable open (Load Encoder Cable Disconnection) AL-83 Enc2 Z phase open (Load Encoder Z-phase Disconnection)	Load encoder cable failure	Check for disconnection, wiring failure, and short-circuits.	Replace the encoder cable.
	Parameter setting failure	The load encoder type [0x2021] and load encoder setting [0x202B] parameter settings should be the same as the encoder information.	Modify the parameters so they match the motor information.
	Load encoder failure		If an alarm occurs continuously after power cycling, there may be a problem with the motor. Replace the motor.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.

■ Servo Warning

If the drive detects an error that is classified as a servo warning, it will trigger a warning. In this case, the drive will maintain normal operating conditions. After the cause of the warning is eliminated, the warning will be cleared automatically. In case of a warning, take an appropriate action. You can specify if each warning is checked with a warning mask configuration (0x2014).

※ When two or more warnings occur, they are displayed as the sum of warning codes.

E.g. It is displayed as follows: "W10 (operation overload) + W40 (low voltage) = W50".

Bit	Warning code	Warning name
0	W01	Main power phase loss
1	W02	Low voltage of encoder battery
2	W04	Software position limit
3	-	-
4	W10	Operation overload
5	W20	An abnormal combination of drive and motor, or an I/O setting error.
6	W40	Low voltage
7	W80	Emergency signal input

Warning state (code) name	Cause	Checklist	Troubleshooting
 PWR_FAIL (Main power phase loss)	Main power input voltage failure	Check the voltage range of 200-230 Vac between L1, L2 and L3 phases.	Inspect the power again.
	Parameter setting failure	Check the main power input mode setting [0x2006] according to the main power input status.	Make parameter settings and wiring with a 3-phase input power if possible.
	Momentary power failure	Check the monitoring interval of the main power phase loss [0x2007].	Increase the monitoring interval of the main power phase loss [0x2007] or check the power supply.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.
 LOW_BATT (Low Voltage of	Parameter setting failure	Check the absolute encoder setting [0x2005].	If you want to use an absolute encoder as an incremental encoder, set it to 1 so the alarm does not occur.

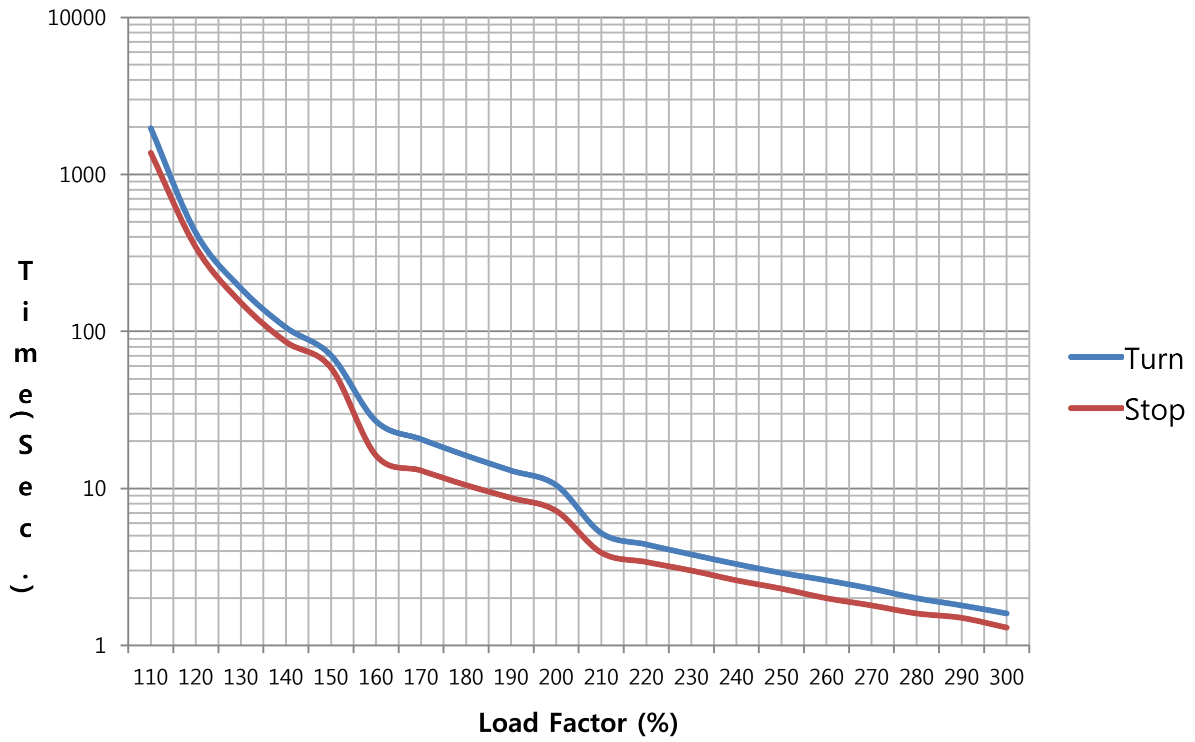
Warning state (code) name	Cause	Checklist	Troubleshooting
Encoder Battery)	Battery connection failure or no connection	Check the battery connection status.	Properly connect the battery.
	The battery voltage is low	Check whether the battery voltage is 3.3 V or higher.	Replace the battery.
 SW_POS_LMT (Software position limit)	Parameter setting failure	Check the function [0x2400] and setting [0x607D] of the software position limit.	Change the settings of the software position limit function [0x2400] or change the minimum and maximum setting values of the software position limit [0x607D].
 OV_LOAD (Operation Overload)	The drive operates continuously, exceeding the rated load.	Check the accumulated operation overload rate [0x2603] and overload warning level setting [0x2010] in the constant speed area or in the stopped state.	Change the capacity of the drive and motor. Adjust the gain. Adjust the overload warning level setting [0x2010].
	Motor brake failure	Check whether the motor brake is open at SVON.	Supply power to the motor brake.
	Parameter setting failure	Motor ID [0x2000], encoder type [0x2001], and encoder type [0x2002] settings should be the same as the motor label information.	Modify the parameters so they match the motor label information.
		Check the overload detection default load rate setting [0x200F].	Set it to an appropriate value.
	Apparatus status failure	Operation should be normal.	Inspect the apparatus.
	Motor cable failure	Check for wiring failure and short-circuits.	Replace the motor cable.
	Encoder cable failure	Check for wiring failure and short-circuits.	Replace the encoder cable.
 SETUP (Setting Failure)	Abnormal combination of drive and motor	Check whether the current capacity of the motor is larger than the drive's current capacity.	Lower the torque limit value or replace the motor to one that has a lower current capacity than the drive.
	IO setting failure	Check whether the signal allocation has overlapped in the digital input signal settings [0x2200] - [0x2208] and the digital output signal settings [0x2210] - [0x2213].	Set the parameters properly according to the operation status.

Warning state (code) name	Cause	Checklist	Troubleshooting
 UD_VTG (Low Voltage)	Main power input voltage failure	Check whether the main power voltage is 134 Vac or higher.	Inspect the power again.
		Check whether the DC link voltage [0x2605] is between 190 - 405 Vdc while the main power is being supplied.	Replace the drive.
	Power voltage drops during operation	Check the wiring status of the main power.	Use the 3-phase supply voltage.
 EMG (Emergency Signal Input)	EMG contact failure	Emergency stop occurred by an EMG contact. Check the settings of the wiring and drive parameters (drive control input 1 [0x211F], digital input signal 1 setting [0x2200] - digital input signal 16 setting [0x220F]).	Set the wiring and parameters properly according to the operation status.
	Drive failure		If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.

12.3 Servo Drive Overload Graph

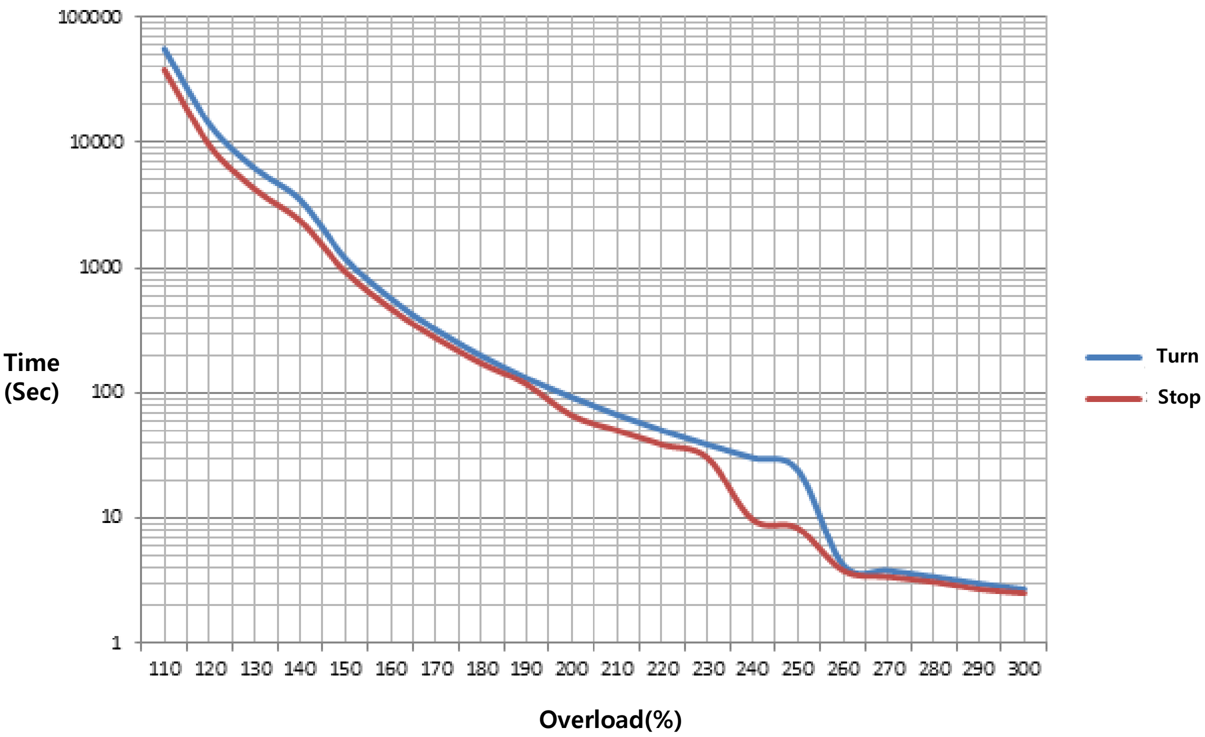
■ Servo Drive Overload Graph (SA Type 100 W or less)

Load factor (%)	AL-21 duration (sec)		Load factor (%)	AL-21 duration (sec)	
	Turn	Stop		Turn	Stop
100 or less	Infinite	Infinite			
110	1969.0	1372.0	210	5.2	3.9
120	424.0	343.2	220	4.4	3.4
130	188.4	152.5	230	3.8	3.0
140	106.0	85.8	240	3.3	2.6
150	70.4	58.6	250	2.9	2.3
160	26.8	16.2	260	2.6	2.0
170	20.6	13.0	270	2.3	1.8
180	16.2	10.5	280	2.0	1.6
190	13.0	8.7	290	1.8	1.5
200	10.5	7.2	300	1.6	1.3



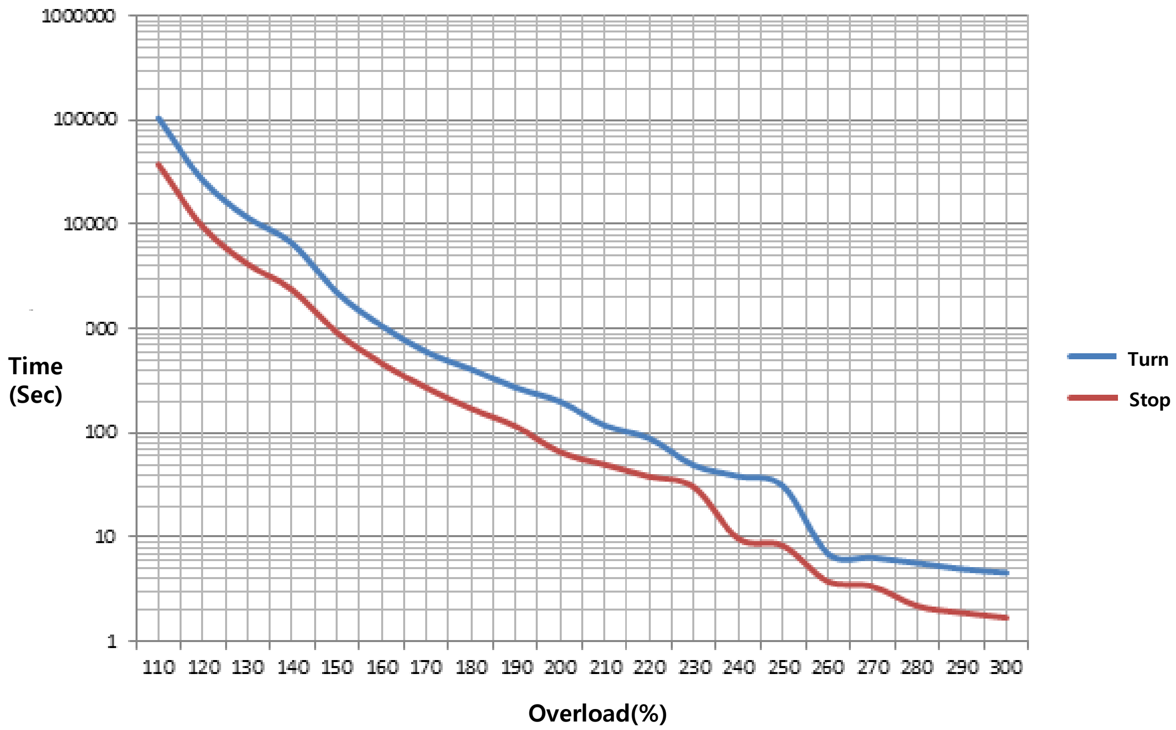
■ Servo Drive Overload Graph (400W)

Load factor (%)	AL-21 duration (sec) Turn	AL-21 duration (sec) Stop	Load factor (%)	AL-21 duration (sec) Turn	AL-21 duration (sec) Stop
100 or less	Infinite	Infinite			
110	55776.0	37935.0	210	66.8	50.1
120	13944.0	9483.0	220	50.1	38.5
130	6197.0	4215.0	230	38.5	30.3
140	3486.0	2371.0	240	30.3	9.7
150	1183.0	926.0	250	24.2	8.3
160	566.0	470.0	260	4.2	3.8
170	318.0	273.0	270	3.8	3.4
180	198.0	173.0	280	3.4	3.1
190	131.0	117.0	290	3.0	2.7
200	92.0	66.0	300	2.7	2.5



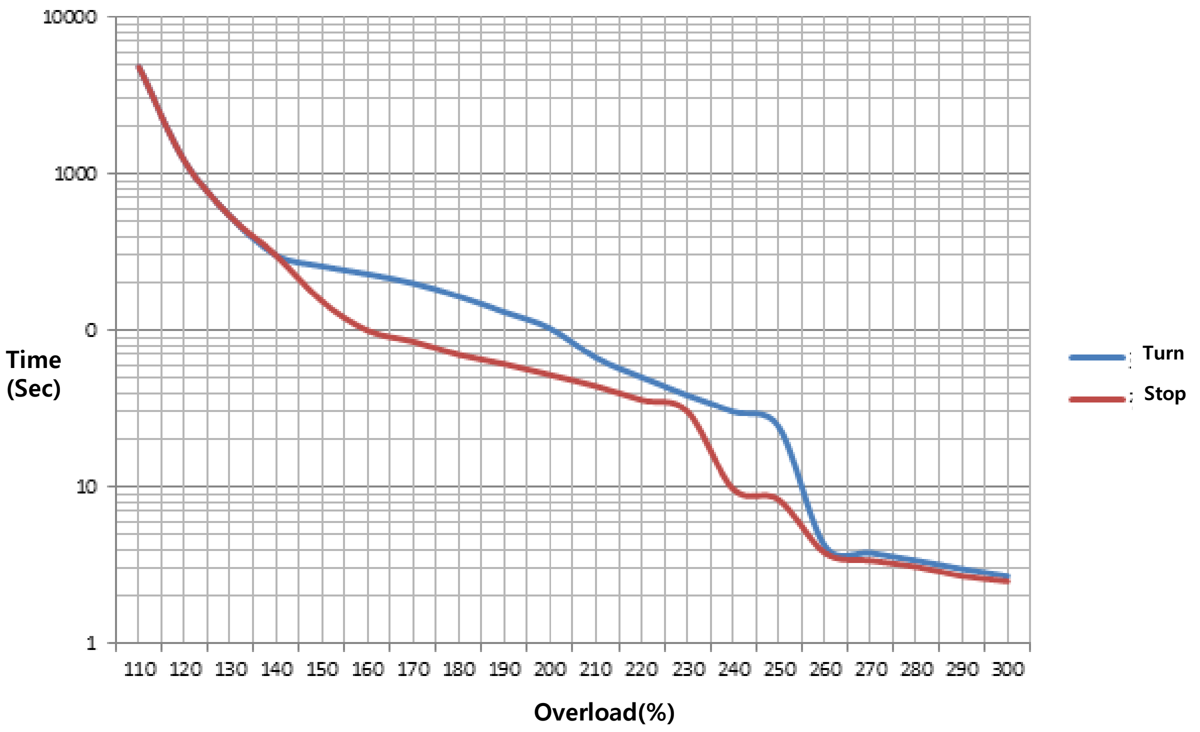
■ Servo Drive Overload Graph (750 W and 1 kW)

Load factor (%)	AL-21 duration (sec)		Load factor (%)	AL-21 duration (sec)	
	Turn	Stop		Turn	Stop
100 or less	Infinite	Infinite			
110	105800.0	37935.0	210	119.0	50.1
120	26450.0	9483.0	220	89.2	38.5
130	11755.5	4215.0	230	49.3	30.3
140	6612.5	2371.0	240	38.8	9.7
150	2244.0	926.0	250	31.0	8.3
160	1073.6	470.0	260	7.0	3.8
170	603.2	273.0	270	6.4	3.4
180	413.6	173.0	280	5.7	2.2
190	273.6	117.0	290	5.0	1.9
200	201.0	66.0	300	4.6	1.7



■ Servo Drive Overload Graph (2kW and 3.5kW)

Load factor (%)	AL-21 duration (sec) Turn	AL-21 duration (sec) Stop	Load factor (%)	AL-21 duration (sec) Turn	AL-21 duration (sec) Stop
100 or less	Infinite	Infinite			
110	4832	4832	210	66.8	44
120	1208	1208	220	50.1	36
130	536	536	230	38.5	30.3
140	302	302	240	30.3	9.7
150	257	154	250	24.2	8.3
160	229	100	260	4.2	3.8
170	200	85	270	3.8	3.4
180	165	70	280	3.4	3.1
190	131	61	290	3.0	2.7
200	103	52	300	2.7	2.5



13. Test Drive

For a safe and proper test drive, make sure to check the following prior to the test drive. If there is a problem, take an appropriate measure before the test drive.

■ Servo Motor State

Is the motor correctly installed and wired?

Is each connecting part secured tightly?

For a motor with oil seals fittings, is there any damage to the oil seal?

Has oil been properly applied?

If you perform test drive of a servo motor having been stored for an extended period, make sure to check the motor according to the maintenance and inspection method for servo motor. For more information on maintenance and inspection, refer to 11. **11. Maintenance and Inspection**.

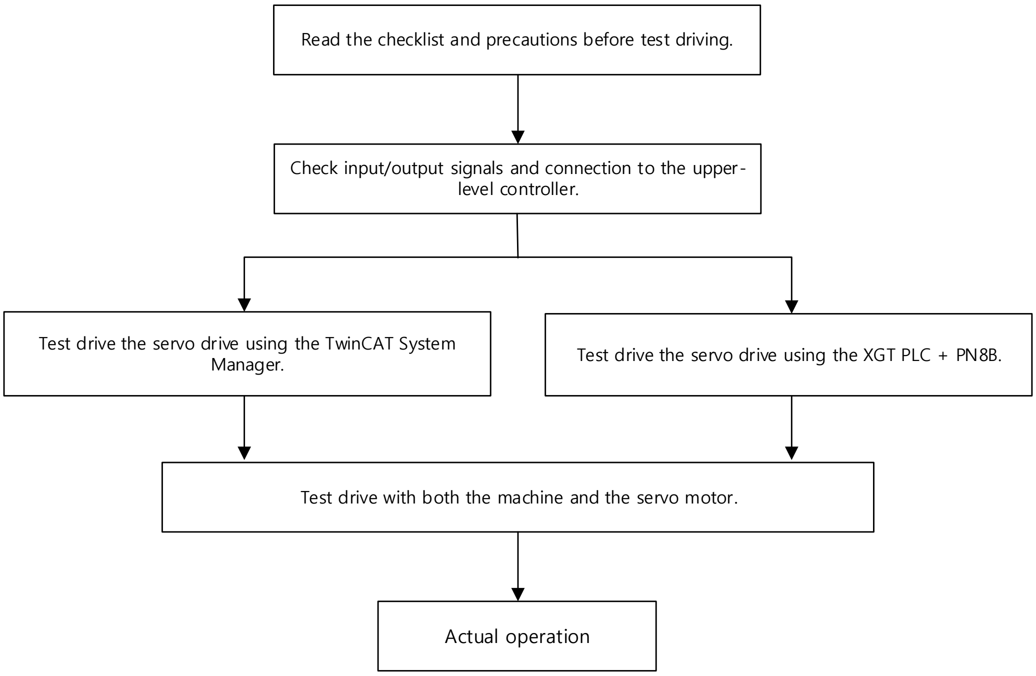
■ Servo Drive State

Is the drive correctly installed, wired, and connected?

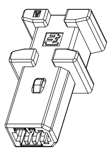
Is the supply voltage for the servo drive correct?

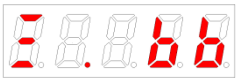
13.1 Preparation for Operation

Perform the test drive in the following order:



Before the test drive, check that the upper level controller and the servo drive are correctly wired, and the objects of the servo drive are correctly configured.

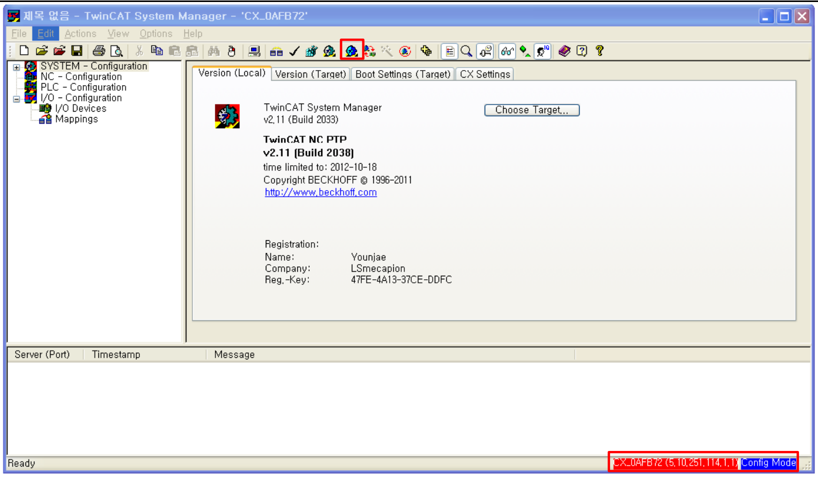
Order	Handling	Notes
1	Connect the power connector and safety function connector of Servo Drive.	Refer to Section 2.5 Wiring for Input/Output Signals.
2	Connect motor and encoder cables to the servo drive.	Refer to Section 2.5 Wiring for Input/Output Signals.
3	If you use the safety function, connect the STO safety device connector.  (Note) If you do not use the safety function, insert safety jumper connector, an accessory of the servo drive, into the STO. If you do not install the connector, motor current will be not supplied and the torque will not output from the motor. In this case, the panel monitor state at the power ON will be "Sto." (Note) When removing the safety jumper connector attached to the STO,	Refer to Section 2.5 Wiring for Input/Output Signals.

	pull out the motor main circuit connector first, and then the connector body while pressing the lock ejector on the jumper connector side towards the servo drive side. The connector may be damaged if you pull it out when the lock has not been released. Please be careful.	
4	Connect ECAT IN and OUT of the EtherCAT communication connector between the upper level device and Servo Drive. (Note) Please use the CAT5 and SFTP cables.	Refer to Section 2.5 Wiring for Input/Output Signals.
5	Turn on the servo drive. The servo drive communication is in the Safe OP state. Make sure that the state of the servo drive panel monitor is as the figure below:  The Link/Activity LED is flickering. The RUN LED is in "Single Flash." (Note) If the Error LED is flickering or on, and the monitor panel state is AL-xx, refer to Manual Maintenance and Inspection. (Note) If the Link/Activity LED is not flickering, the communication is not established.	Refer to Section 11 Maintenance and Inspection.
6	Now, we have finished checking the connection and state of input signal circuits to prepare for the test drive.	Refer to Section 11 Maintenance and Inspection.

13.2 Test Drive Using TwinCAT System Manager

■ Test Drive Procedure

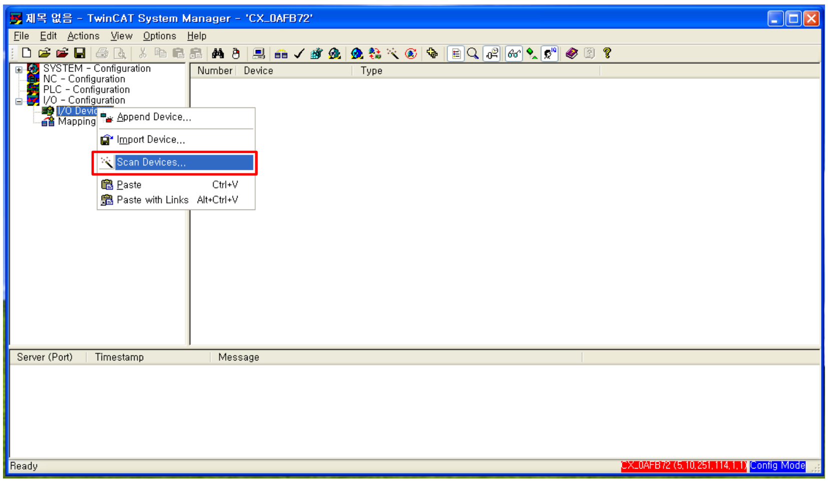
Order	Handling	Notes
1	Before launching the TwinCAT System Manager, copy the servo drive XML file into the schema folder (C:₩TwinCAT₩Io₩EtherCAT).	
2	Launch the TwinCAT System Manager.	
3	Select a Target System. When performing the test drive using a remote system, select the device.	
4	Restart the TwinCAT System with Config Mode. ▪ Using the Set/Reset TwinCAT to Config Mode icon under the TwinCat System Manager, you can restart the system with Config Mode.	



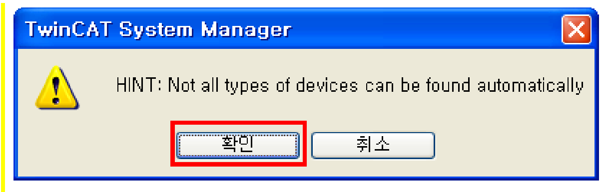
5

Search for EtherCAT communication-based devices connected to the system.

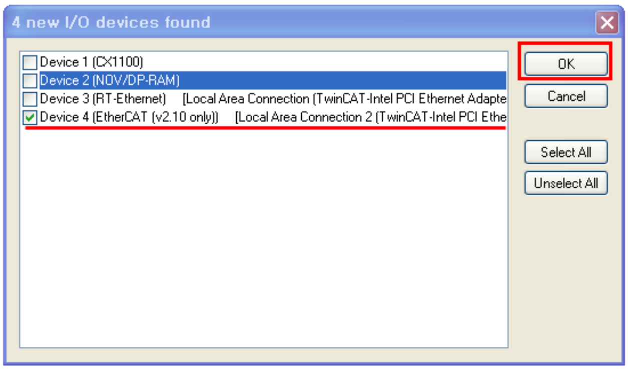
- Right-click I/O Devices in the Work Space pane of the TwinCAT system, and then click Scan Devices.

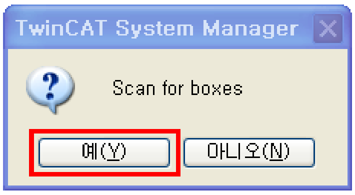
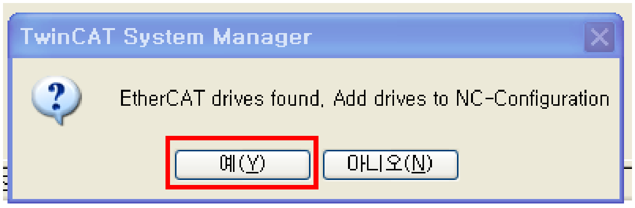


- If the dialog window below appears in the TwinCAT System Manager, click OK.

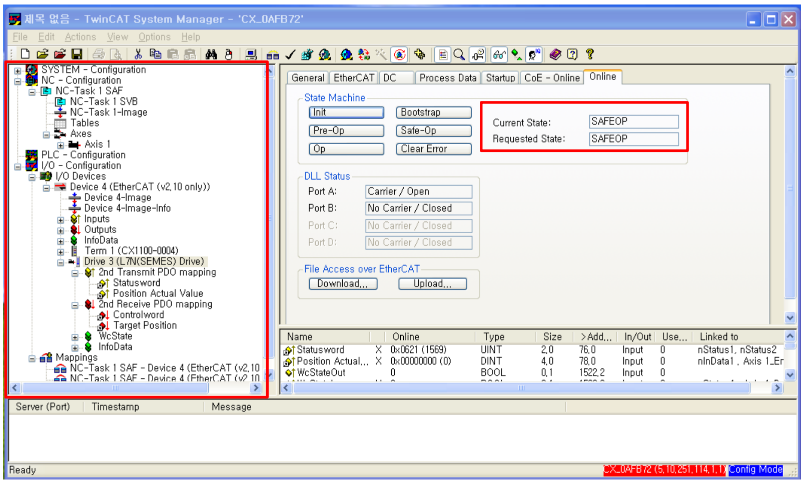


- If the New I/O devices found dialog window appears, select the device or servo drive that needs to be test driven and click OK.

<table>
<tr><td></td><td>

If the dialog window below appears, click Yes.

</td><td></td></tr>
<tr><td>6</td><td>Add the servo drive's NC Task to the NC-Configuration.
If the dialog window below appears, click Yes.

</td><td></td></tr>
<tr><td>7</td><td>Switch the TwinCAT System Manager to a free run state to allow it to control devices independently of the TwinCAT PLC and so on.
If the dialog window below appears, click Yes.

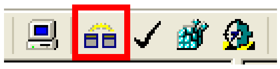
</td><td></td></tr>
<tr><td>8</td><td>Make sure NC Task is added to the NC-Configuration tree in the workspace on the left, and the servo drive is registered to the I/O-Configuration tree.
If the connected servo drive is registered, select it.
Click the Online tab on the right side to verify that Current State and Requested State are in the SAFEOP state.</td><td></td></tr>
</table>



9 Switch the EtherCAT communication state from SafeOP to OP, enabling MailBox Communication and Process Data Communication.

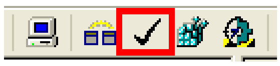
- Click the Generate Mappings icon on the menu bar.

  Map the images defined in NC Task and I/O Device.



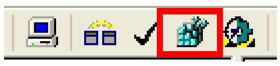
- Click the Check Configuration icon on the menu bar.

  Check if the currently set configuration is valid.



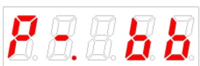
- Click the Activate Configuration icon on the menu bar.

  Save Project Configuration in Windows Registry.



10 Verify if the EtherCAT communication state has switched from SafeOP to OP.

- Verify if the states of the servo drive panel monitor and the I/O device (servo drive) of the TwinCAT system are in the online state as shown in the figure below.
- Check the panel monitor status.



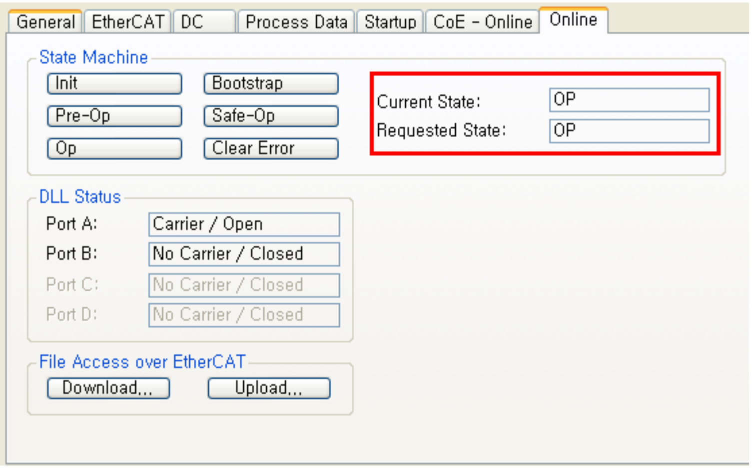
- Check the communication LED.

  The Link/Activity LED is flickering.

  The RUN LED is on.

- Check the online state of the I/O device of the TwinCAT system.

  In the I/O-Configuration tree of the workspace, click the servo drive, and then click the Online tab to check if Current State and Requested State are in the OP state.

<table>
<tr><td></td><td>

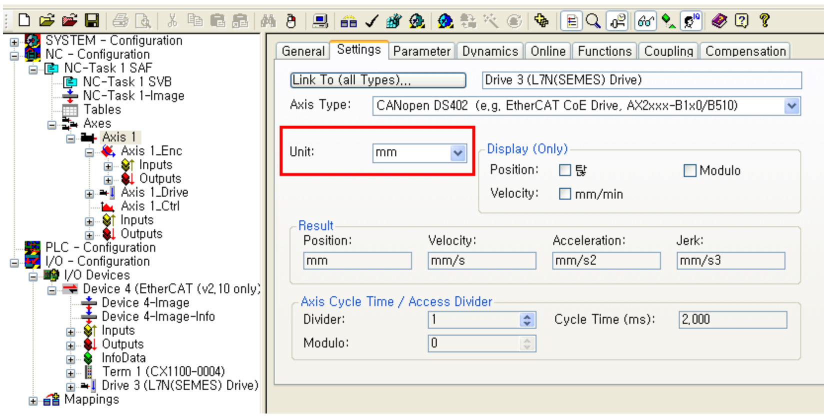
- Verify if the state displayed at the bottom-right of the TwinCAT System Manager menu window is in the Run state.


</td><td></td></tr>
<tr><td>11</td><td>We have finished adding NC-Task and I/O Devices (servo drive) to the TwinCAT System Manager.</td><td></td></tr>
</table>

■ Setting NC-Task Axis Parameters

<table>
<tr><th>Order</th><th>Handling</th><th>Notes</th></tr>
<tr><td>1</td><td>Set the display units for the relevant axis.

- Select Axis1.
- Click the Settings tab.
- Click the display units for position and speed.

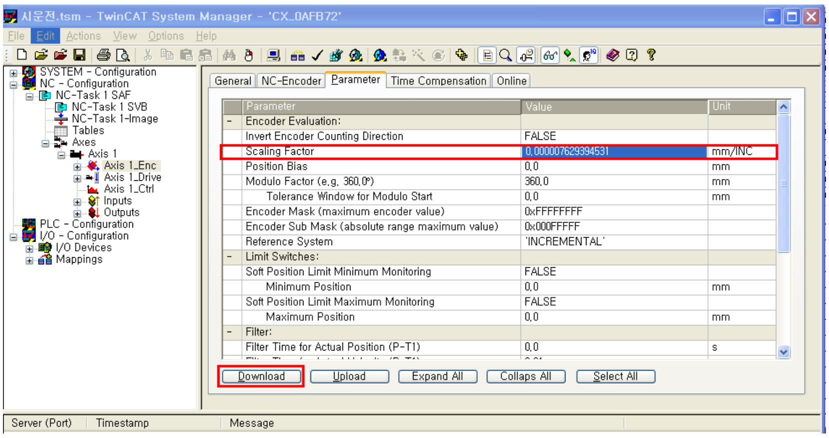


Note: Remember the actual units will not be converted even if the units shown in the figure above was converted to mm or degrees.

Note: Change the units and tune the Axis Scaling Factor below.</td><td></td></tr>
<tr><td>2</td><td>Set the Axis Scaling Factor. The Axis Scaling Factor determines the distance of the axial load movement while the motor shaft makes one revolution.</td><td></td></tr>
</table>

<table>
<tr>
<td></td>
<td>

- Select Axis1.
- Click the Parameter tab.
- Set the Scaling Factor.
- Then, download the settings.



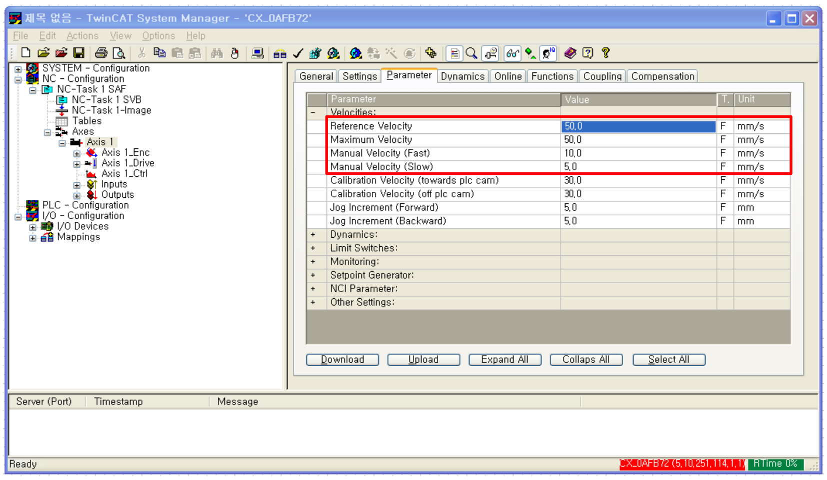
Note: The default is 0.0001 if the scaling factor is not set.

Note: After configuring the settings, download them.

</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>

Set the speed parameter of the test drive axis.

- Select Axis 1.
- Click the Parameter tab.
- Set Maximum Velocity, Manual Velocity (Fast), and Manual Velocity (Slow). Then, download the settings.



</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>

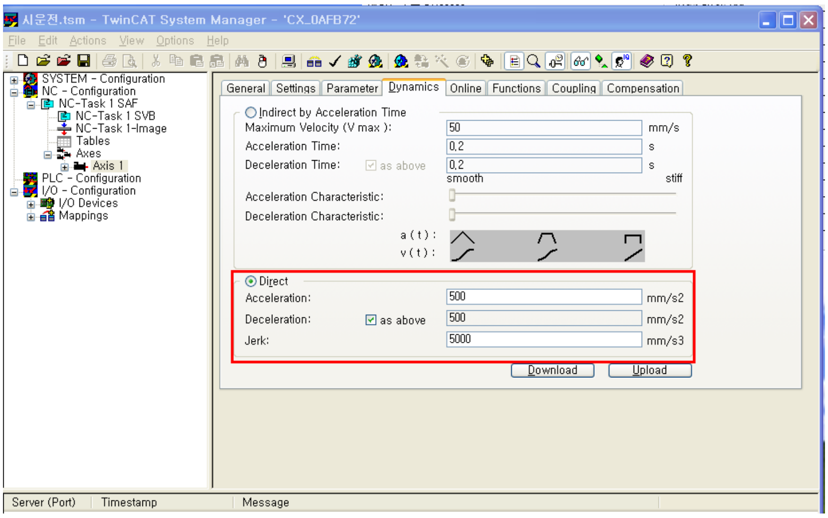
Set the speed, acceleration, and jerk of the test drive axis.

Set the acceleration, deceleration, and jerk directly for the test drive axis; the TwinCAT NC can calculate the acceleration based on the configured profile timing.

- Select Axis 1.
- Click the Dynamics tab.
- Set the acceleration, deceleration, and jerk directly.

</td>
<td></td>
</tr>
</table>

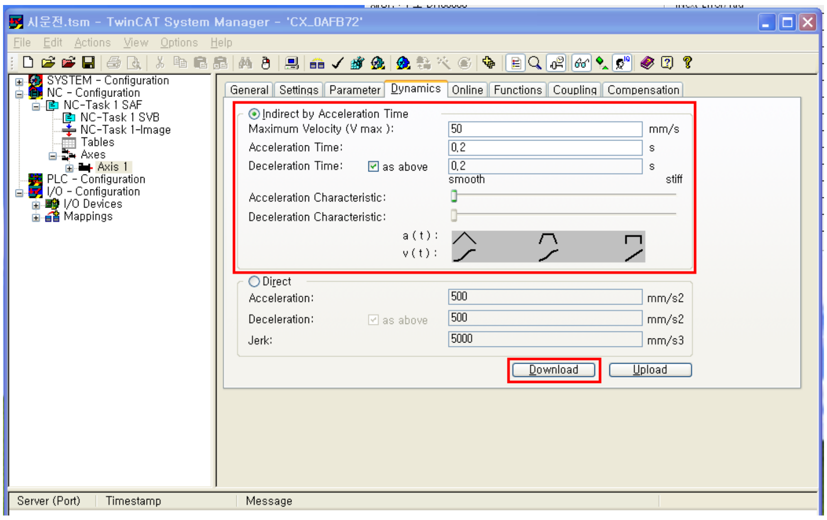
- Select the Direct button.
- Set the acceleration, deceleration, and jerk.
- Download the settings.



- Set the acceleration, deceleration, and jerk indirectly.

Set the acceleration, deceleration, and jerk indirectly by setting the acceleration time. If you change the acceleration time, the acceleration value will be automatically changed.

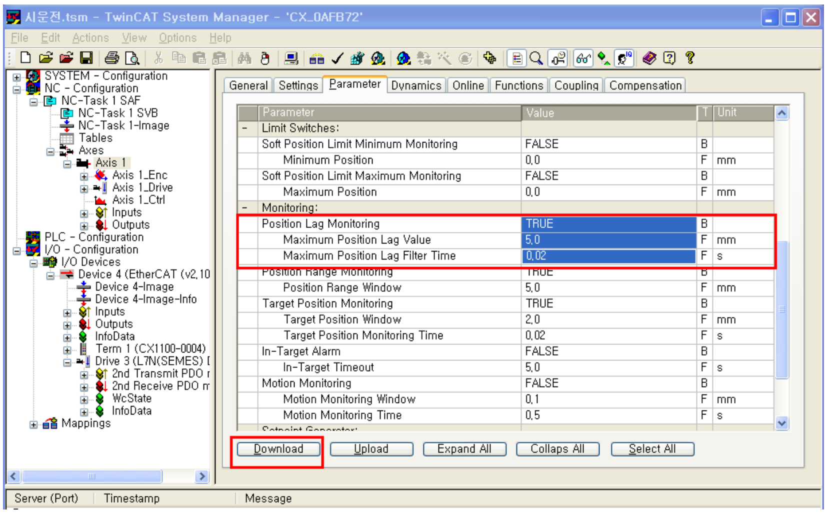
- Select the Indirect by Acceleration Time button.
- Set the acceleration, deceleration, and jerk.
- Download the settings.



5

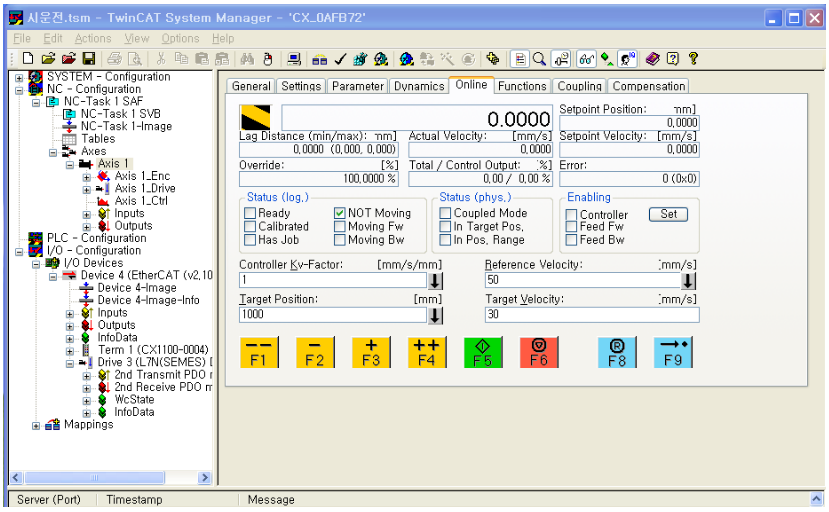
Set the Position Lag Monitoring (Following Error).

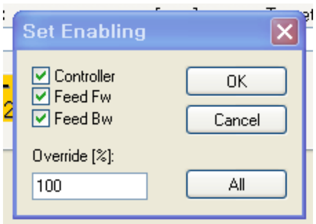
- Select Axis 1.
- Click the Parameter tab.
- Set the Position Lag Monitoring.
- Set the Position Lag Filter Time.
- Download the settings.

<table>
<tr><td></td><td>


Note: The Position Lag Monitoring is the difference between the position reference and the actual position at a given cycle time. When the Position Lag Monitoring is enabled, the TwinCAT NC generates an alarm if the positional error exceeds the settings.
</td><td></td></tr>
</table>

■ Test Drive the Servo Drive Using TwinCAT NC Axis

<table>
<tr><th>Order</th><th>Handling</th><th>Notes</th></tr>
<tr><td>1</td><td>
Make sure that TwinCAT NC axis is "Servo On."
Select Axis 1.
Click the Online tab.


Click the Set button.


</td><td></td></tr>
</table>

<table>
<tr><td></td><td>

- Select Controller, Feed Fw, and Feed Bw in the Set Enabling pop-up.
- Set the Override to 100%.
- Click OK.
- Make sure that the state of the servo drive panel monitor is as the figure below:

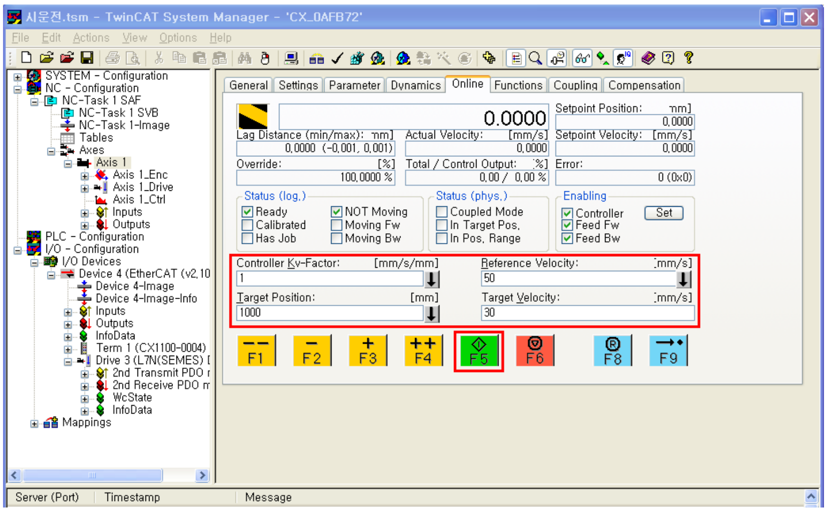

</td><td></td></tr>
<tr><td>2</td><td>

Use the buttons shown below to manually perform the test drive (JOG).

<table>
<tr><td></td><td>Perform a reverse rotation at the specified Manual Velocity (Fast).</td></tr>
<tr><td></td><td>Perform a reverse rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Perform a forward rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Perform a forward rotation at the specified Manual Velocity (Fast).</td></tr>
</table>
</td><td></td></tr>
<tr><td>3</td><td>

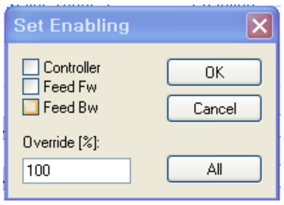
Perform the test drive with relative coordinates.

- Set the Target Position.
- Set the Target Velocity.
- Click the F5 button.



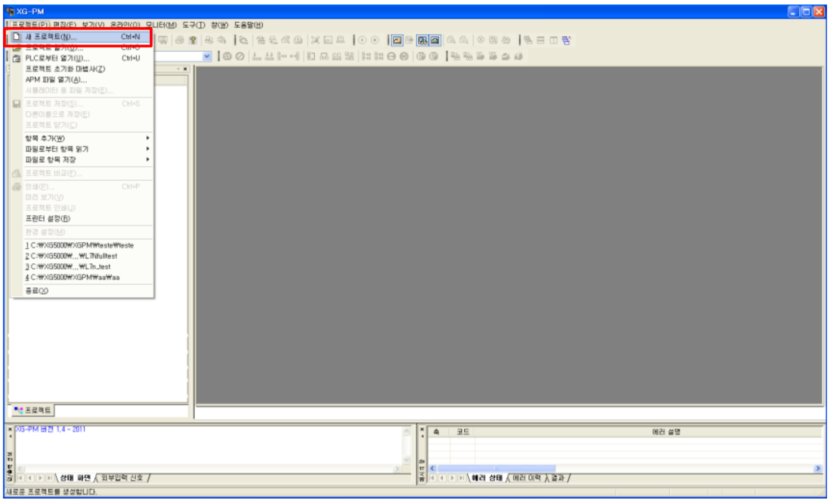
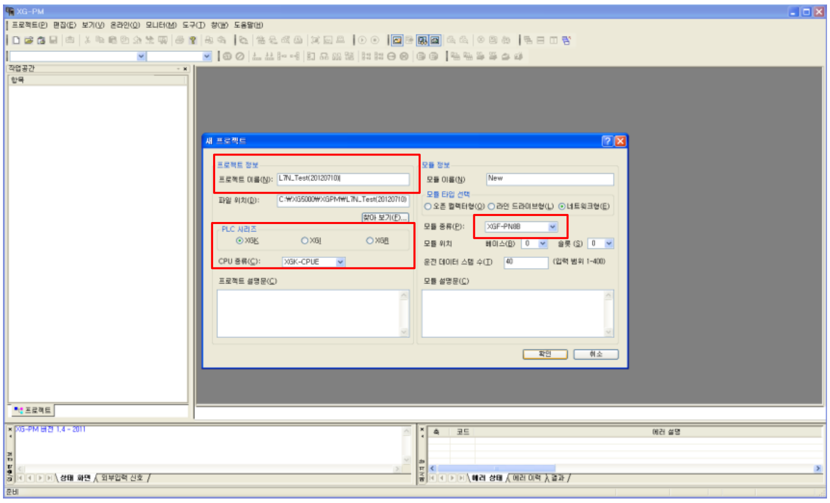
- Move it to the Target Position from the current position, decelerating to a stop.
- After moving it to the Target Position, verify if the Set Position is the same as the Target Position.
- Click the F6 button to stop driving with relative coordinates.
- When the alarm goes off, click the F8 button to reset the alarm.

Note: If the position limit is enabled, set the Target Position within the limit.
</td><td></td></tr>
</table>

4	Make sure the TwinCAT NC axis is "Servo Off." ▪ Click Set. ▪ Click to clear Controller, Feed Fw, and Feed Bw in Enabling. ▪ Click OK. 	
5	Test driving the drive using the TwinCAT NC axis is completed.	

13.3 Test Drive Using LSIS PLC (XGT + PN8B)

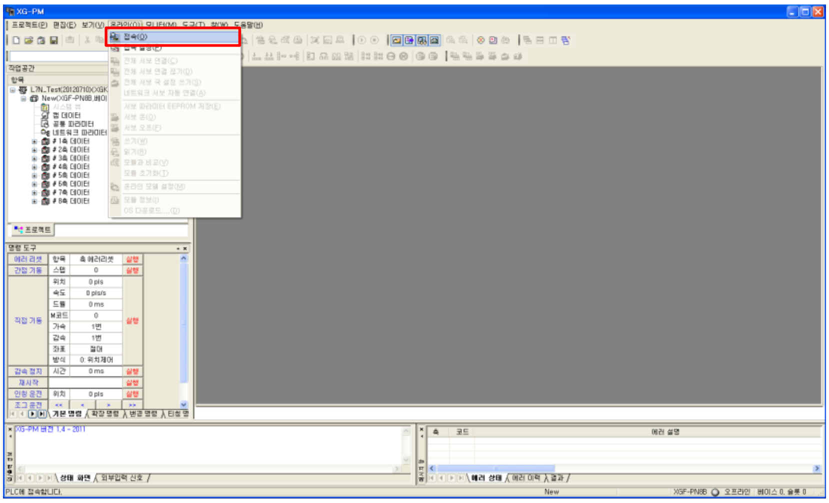
■ Test Drive Procedure

Order	Handling	Notes
1	Launch the XG-PM.	
2	Create a new project. ▪ On the menu bar, click Project → New Project. 	
3	Name the new project. ▪ Select the PLC series and the CPU type. ▪ Select the module type (XGF-PN8B), and click OK. 	

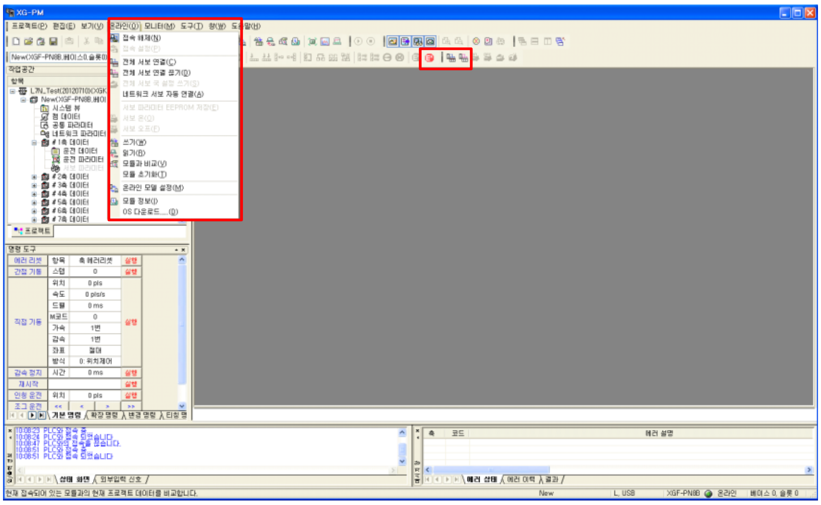
4

The PC and the PLC are connected for communication.

- On the menu bar, click Online → Connection.



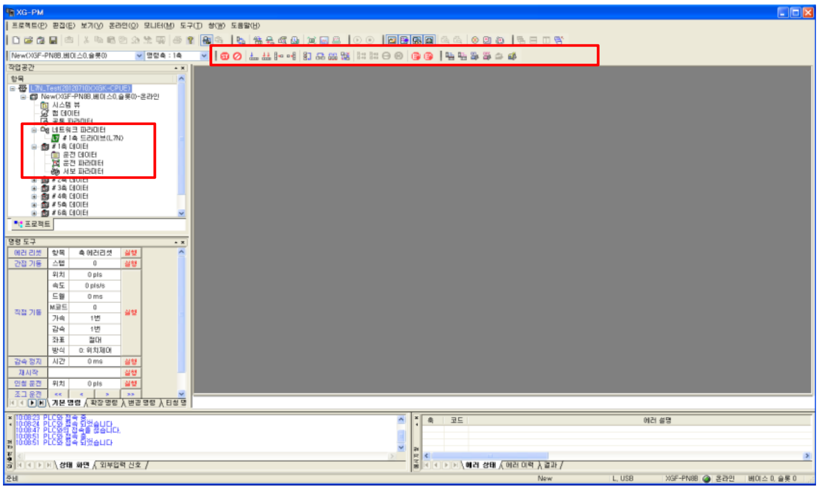
- When the PC and the PLC are connected, the connection between the PLC and the servo drive will be enabled as shown in the figure below.



5

Connect the PLC with the servo drive.

- For the first connection, enable the network parameters and servo parameters in the workspace on the left through Connect Network Servo Automatically.
- After the servo drive and the PLC are connected, the servo parameters and the motor test drive function will be enabled.
- Connecting multiple shafts enables as many servo parameters as the number of connected shafts.



- Make sure that the state of the servo drive panel monitor is as the figure below:

- Check the status LED.

The Link/Activity LED is flickering.

The RUN LED is on.

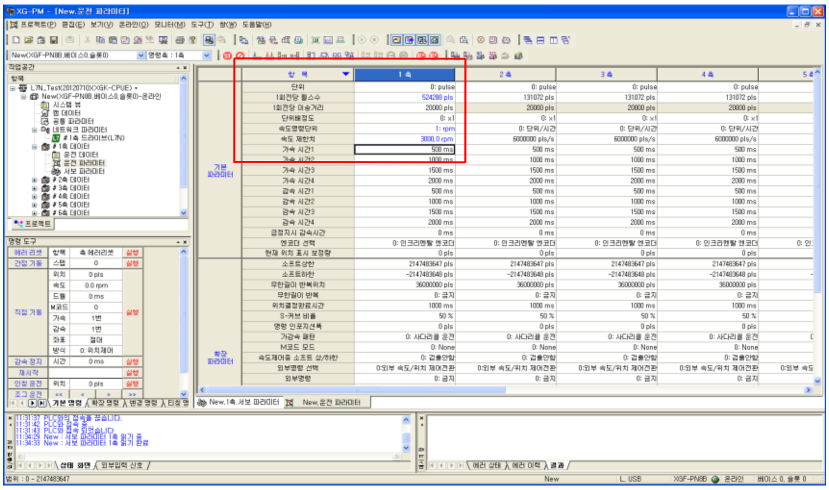
Note: Automatic connection of the network servo registers the device connected to the XGT, and initializes the parameters of the connected device.

Note: For subsequent connections, connect or disconnect the XGT and the servo drive by connecting the entire servo or disconnecting them respectively, since the device has been registered and its parameters initialized through automatic servo connection.

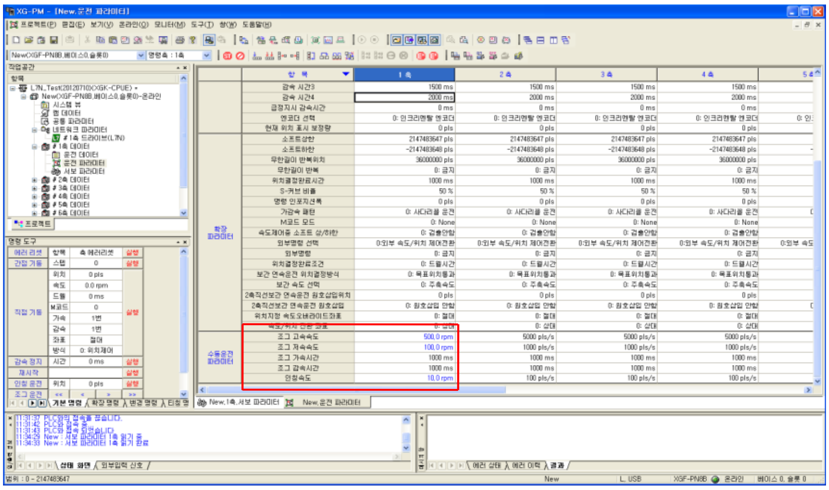
Note: In case there is any change in the XGT-connected device, initialize the parameters of the device connected by the automatic servo connection.

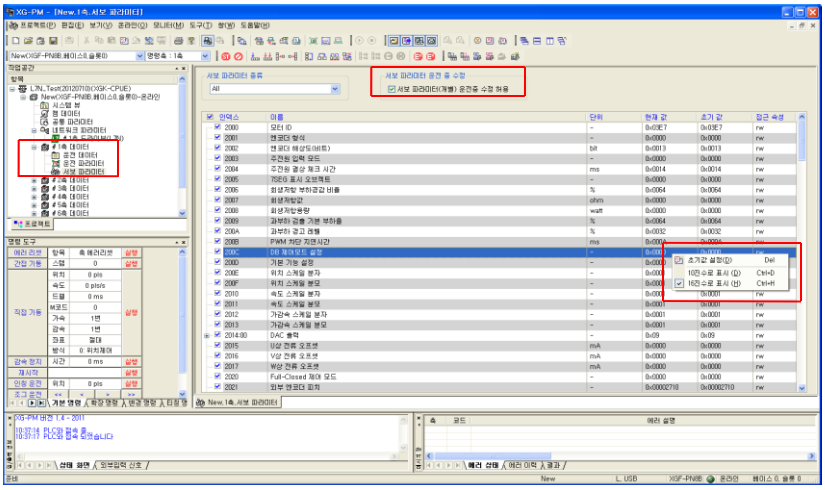
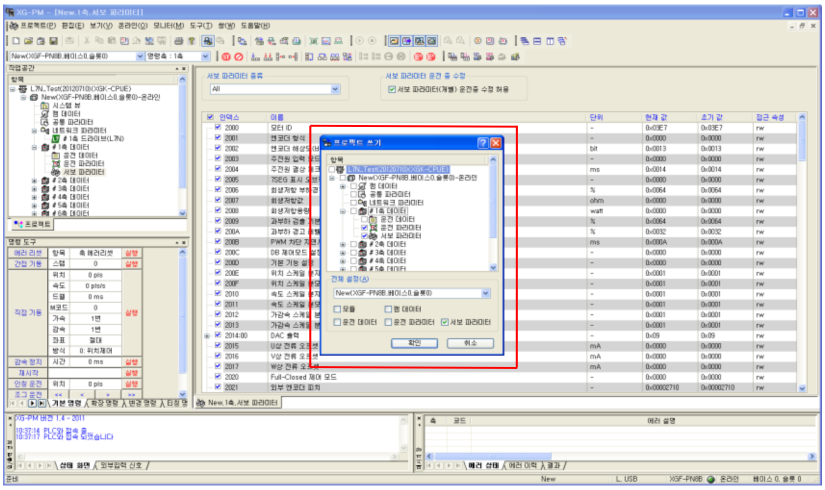
6 Set the Driving Parameters of Test Drive Axis → Basic Parameters.

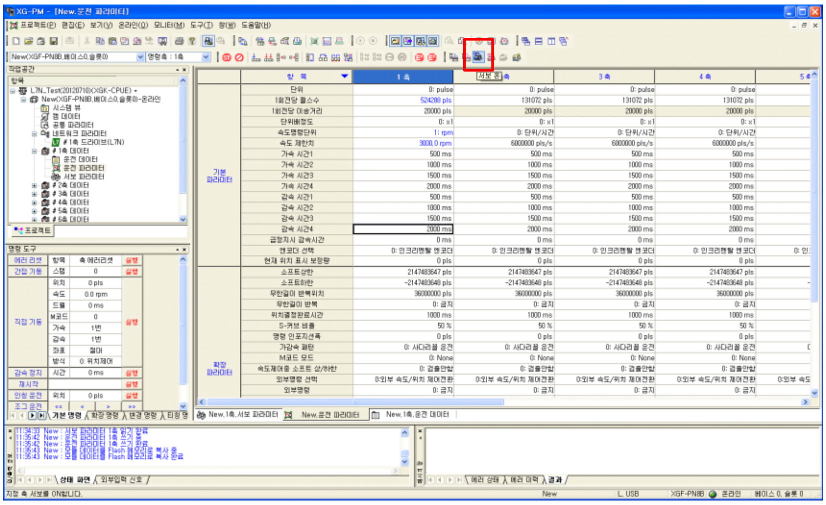
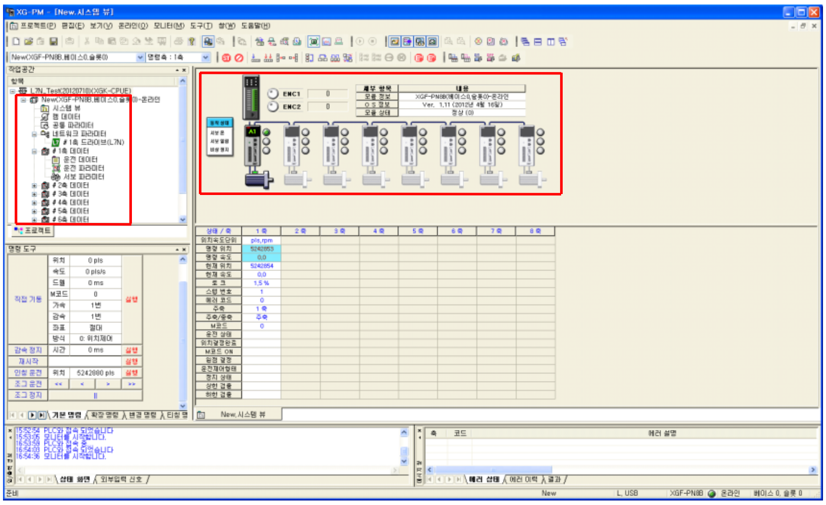
- Enter the number of encoder pulses per motor revolution.
  - Encoder resolution of 19 bits = 524288
  - Check the motor specifications, and then configure the appropriate settings.
- Set the units for the speed command.
  - It can be set as rpm or mm/s.
  - Set the speed limit.
  - Check the motor specifications, and then configure the appropriate settings.

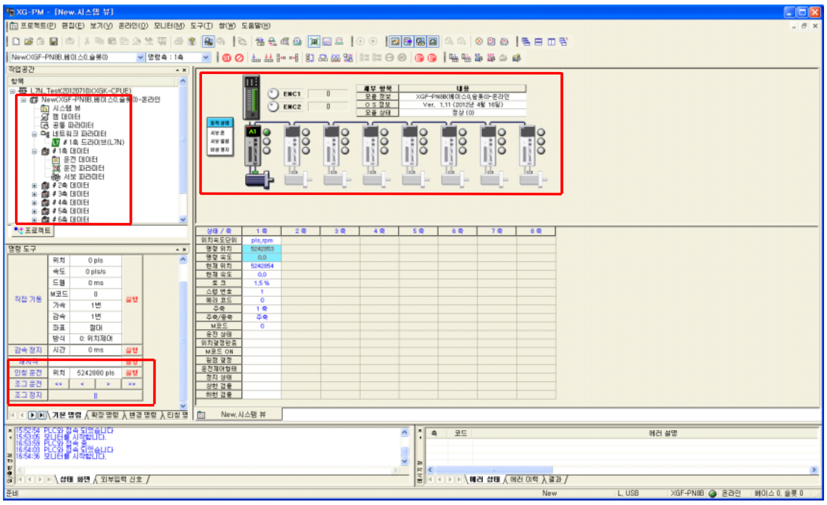
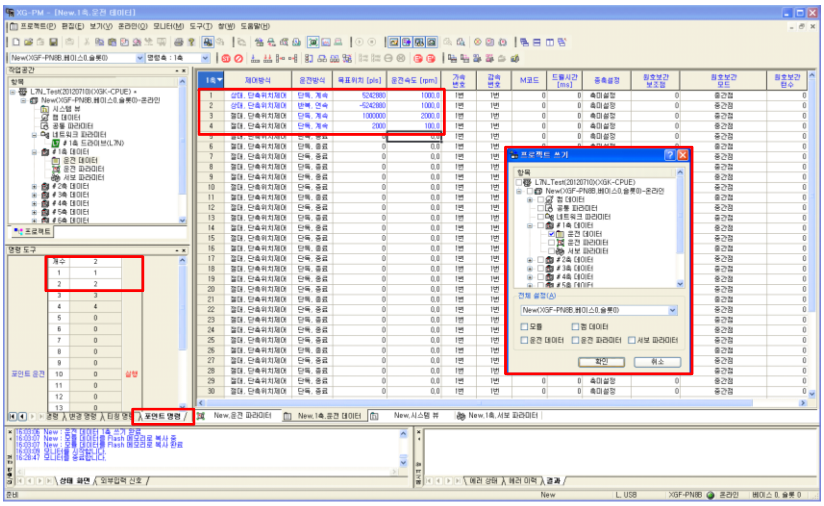


8 Set the Driving Parameters of Test Drive Axis → Manual Operation (Jog) Parameters.



Step	Description	
9	Set the servo parameters of the test drive axis.  ▪ Select parameters that you want to change, and then change them. ▪ To change the parameters during operation, click to select the Allow to Modify Servo Parameters During Operation checkbox at the top of the pane. ▪ You can display parameter values as decimals or hexadecimals.	
11	Save the configured parameters. ▪ On the menu bar, click Online → Write. ▪ With the Write Project dialog window enabled, click to select the Operation Data of Test Drive Axis, the Operation Parameters, and the Servo Parameters checkboxes, and then click OK to save the configured parameters. 	

Step	Description	
12	Turn on the servo. ▪ On the menu bar, click the Servo ON icon to turn on the servo of the servo drive of the test drive axis. 	
13	Save the configured parameters. ▪ Click the System View tab and the Basic Command tab in the workspace to check the state of the servo drive as shown in the figure below.  ▪ Make sure that the state of the servo drive panel monitor is as the figure below:  ▪ Check the status LED. The Link/Activity LED is flickering. The RUN LED is on.	

14	Test drive using jog operation and inching operation  ▪ For the jog operation, the motor is driven with the settings of the operation parameters. ▪ For the inching operation, the motor moves to the entered position. ▪ After entering the position value, click the Run button to perform the test drive.	
15	Point to Point Test Drive ▪ Select Workspace → Command Tool → Point Command tab. ▪ Set the operation data. ▪ On the Point Command tab in the workspace, specify the number of point operations and the order. ▪ On the menu bar, click Online → Write to store the operation data. ▪ On the Point Command tab, click the Run button to perform the test drive. 	
16	Test driving the drive using the XGT is completed.	

14. Appendix

14.1 Firmware Update

14.1.1 Use of USB OTG

The drive performs a USB host function to search for firmware files in the USB memory and download them to the flash memory inside the drive. You can easily update the firmware using the USB memory and OTG cable without a PC. The update procedure is as follows:

(1) Prepare a download cable (USB OTG cable) and a USB memory.

Use a USB OTG cable, consisting of a USB Female Plug Type A and USB Mini B 5 pins, as the download cable.

(2) Copy the firmware file (XDL-L7NHF_FW.bin) to the USB memory.

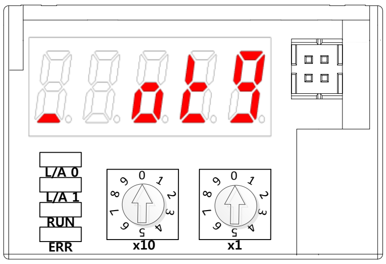
***Caution**

1. The XDL-L7NH_FW.bin file should be placed in the root directory of the USB memory, and the full file name including the extension should match.

2. The formatting type of the USB memory has to be set to FAT32 (default).

(3) After connecting the USB memory to the USB OTG cable, connect it to the USB terminal and power on the drive.

(4) If 7-Segment for servo status display shows "boot" and then "otg", it indicates that update is in progress. If three horizontal bars of FND Digit5 are sequentially turned on from bottom to top, it indicates that download is complete. At the time, turn the power off and remove the USB OTG cable and USB memory.

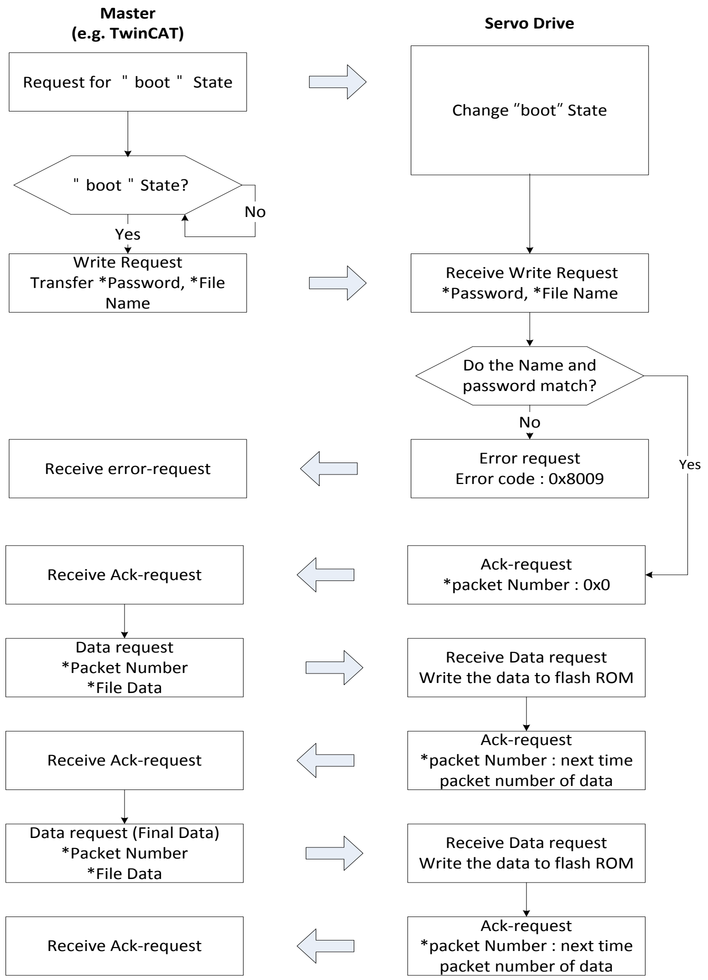


(7-Segment displays a message when downloading the firmware using the OTG)

(5) Turn on the power again, and verify if the firmware is updated.

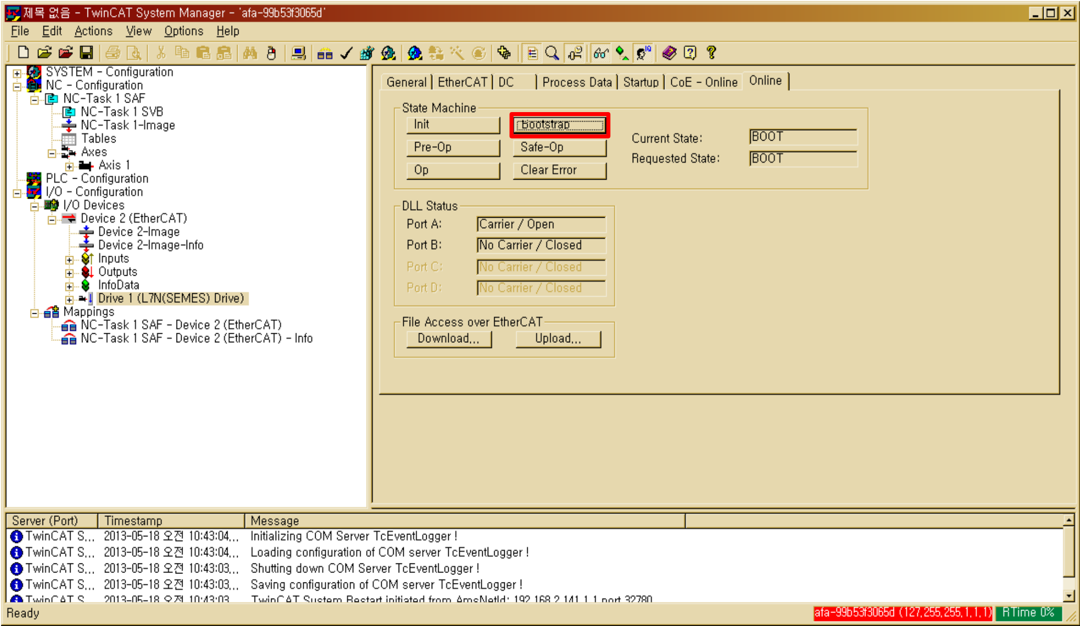
14.1.2 Use of FoE (File access over EtherCAT)

FoE is a simple file transfer protocol using the EtherCAT, enabling firmware update. When the drive and the upper level controller (e.g.: TwinCAT) are connected, you can simply update the firmware remotely via FoE. The update procedure is as follows:

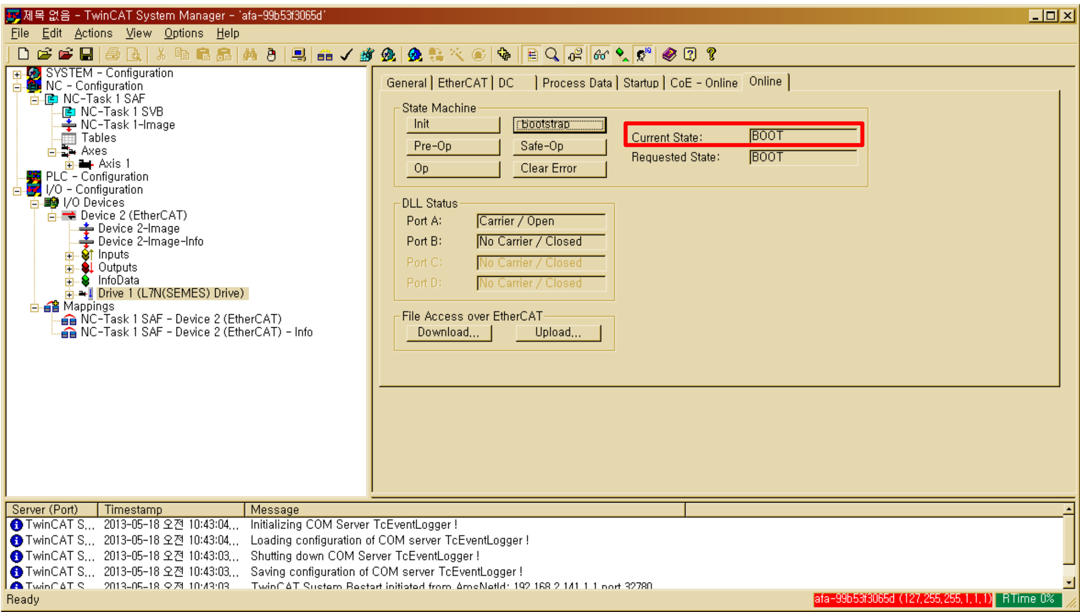


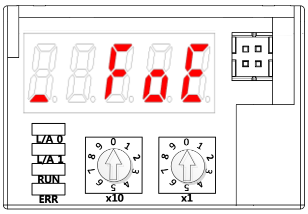
(1) Establish communication between the drive and the TwinCAT.

(2) I/O Configuration of TwinCAT - On the Online tab of the drive connected to the I/O, click Bootstrap in the State Machine menu.

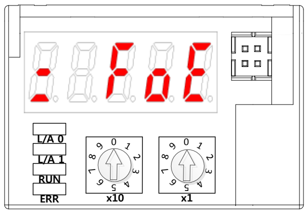


(3) After the current state is changed to BOOT and you check the drive status (7-segment displays boot), wait for approx. 10 seconds until the internal flash memory of the drive is cleared.





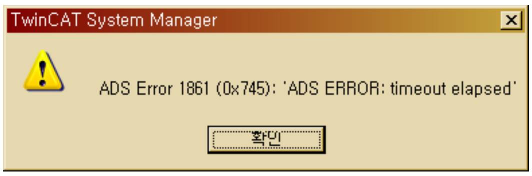
(7-Segment display appears at the start of firmware download using FoE)

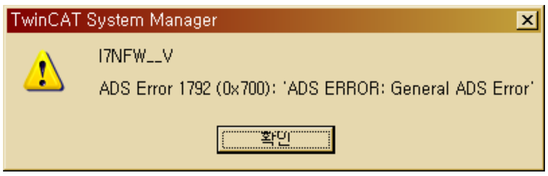


(7-Segment display appears when flash deletion is completed during the firmware download using FoE)

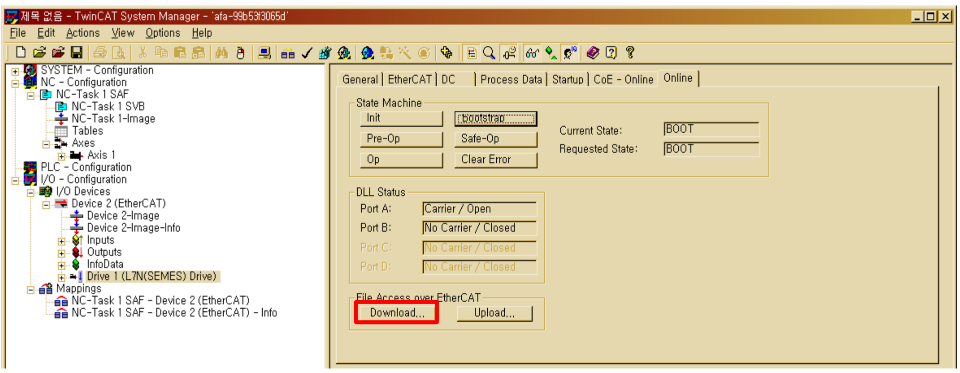
*Caution

The following error occurs if you try to download before the required 10 seconds pass for the flash memory to be cleared. Two error windows shown below may indicate that the flash memory is not deleted completely, or the file name does not match. Check the file name, wait for 10 seconds until the flash memory is cleared, and then try it again.

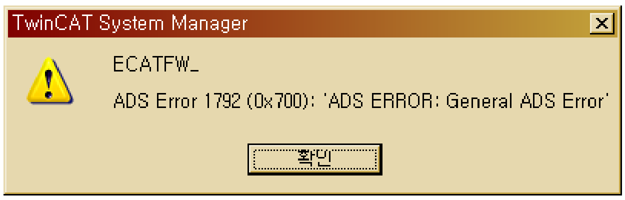




(4) Click Download in the File Access over EtherCAT menu at the bottom of the Online tab.

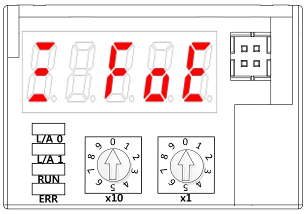


(5) Select the path of the file to be downloaded (XDL-L7NH_FW.efw or XDL-L7NH_FW.bin) and the file. If the file name does not match, download will not start and the following error will occur:



(6) Enter the password for file download and click OK to start the download. (Password: 00000000)

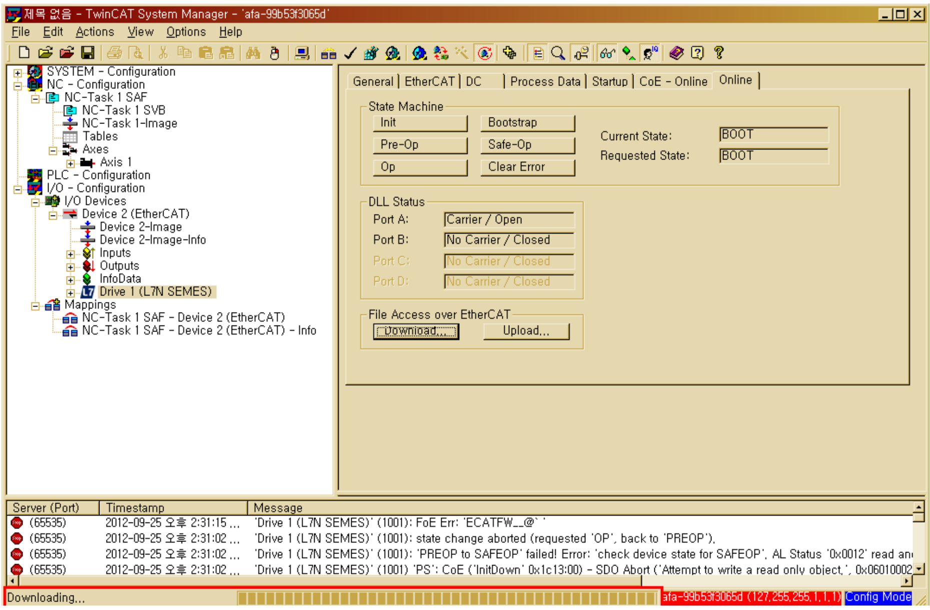
(7) If "Downloading..." is displayed as shown in the following figure, the download is in progress. If the progress bar at the bottom is full, it indicates the download is completed. After completing the download, be sure to click Init in the State Machine menu to switch it to the Init status.



(7-Segment display appears at the completion of firmware download using FoE)

*Caution

If you do not change the communication state to Init and turn on the power again according to the upper level controller, the state will be automatically changed to BOOT and the flash memory may be cleared. In this case, you have to download the firmware again according to this procedure.



(8) After the download is completed, turn on the power again and verify if the firmware is updated.

14.1.3 How to use DriveCM

Drive CM allows the OS upgrade for the drive through the PC's USB port. The transmission time depends on the PC performance, but it usually takes several seconds to several minutes.

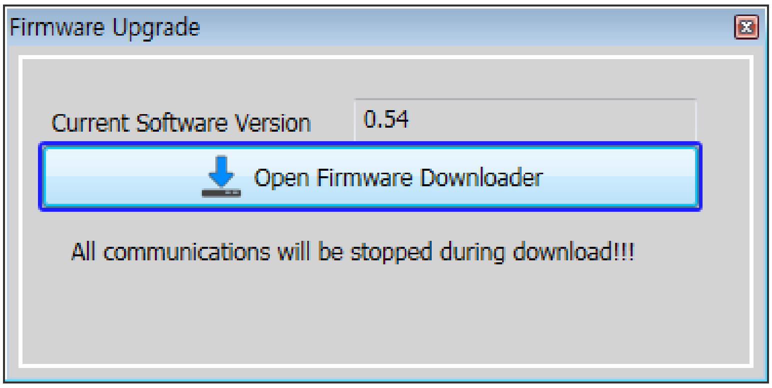
Click "Setup" and "Firmware Update" from the top menu of DriveCM.

■ Precautions for Firmware Upgrade

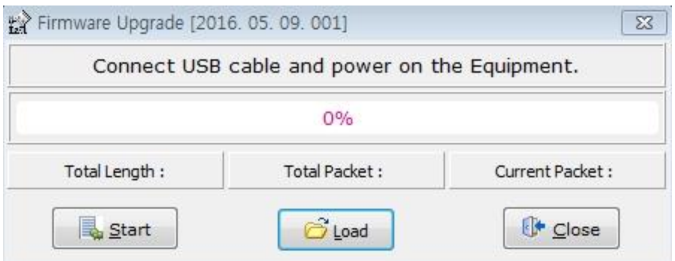
- Do not turn off the PC or drive during transmission.
- Do not unplug the USB cable or close the firmware program during transmission.
- Do not run other applications on the PC during transmission.
- The parameter (object) settings in the drive can be initialized. Be sure to save the settings for the drive parameters (objects) before upgrading.

■ OS Download

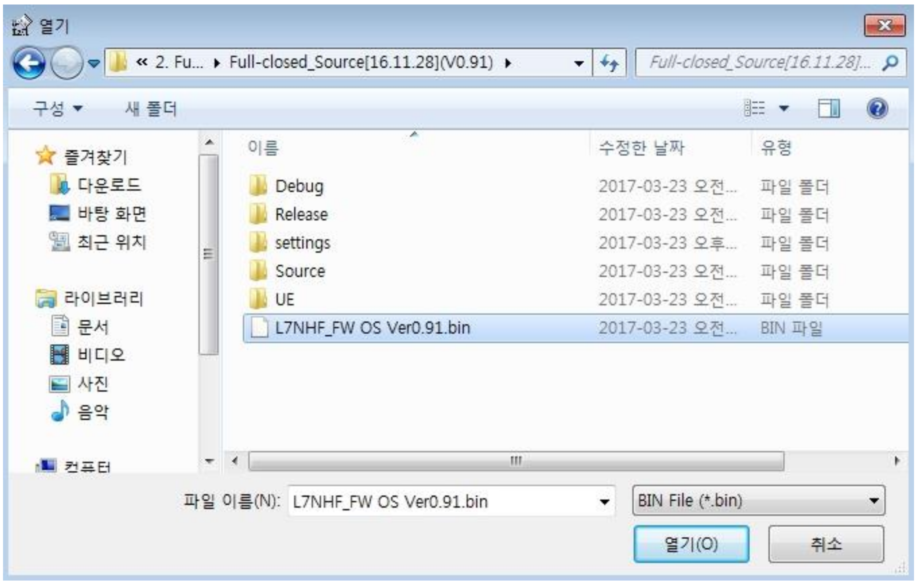
1) Press the "Open Firmware Downloader" button.



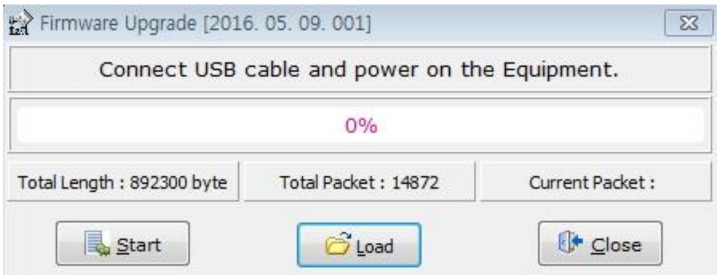
1) To load the appropriate OS file, click the "Load" button.



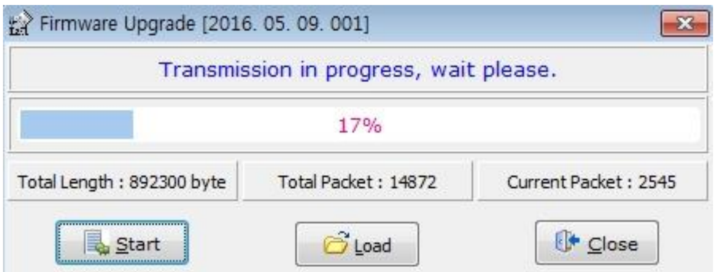
2) Select the OS file to transfer and click the Open button.



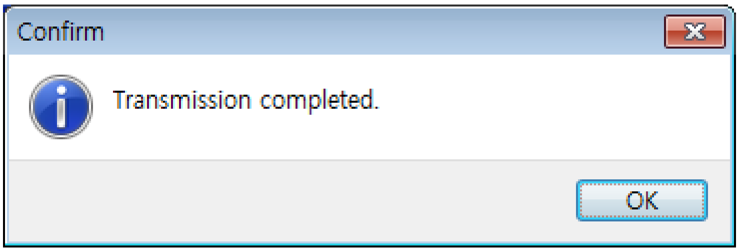
3) "Total Length" and "Total Packet" of the loaded OS are displayed.



4) Click Start to begin transmission. 10 seconds are counted down to clear the internal memory in the drive. (For XDL-L7NH and XDL-L7P, the segment 7 should display "USB". For PEGASUS, a red "ERR" LED should be illuminated.)

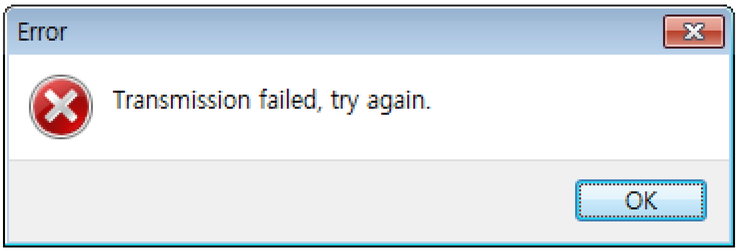


5) After clearing, the OS is transmitted automatically and the progress bar and "Current Packet" display the current transmission status. (The transmission time depends on the PC performance, but it usually takes several seconds to several minutes.)

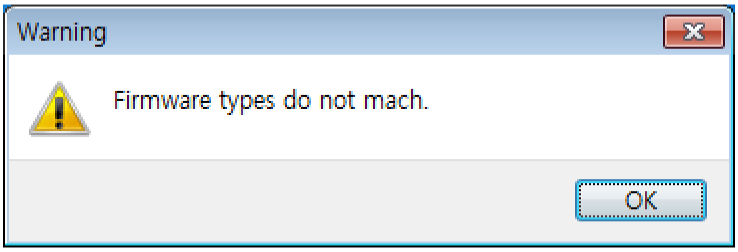


6) When transmission is completed, a popup saying "Transmission completed" is displayed. (When transmission to the PC is completed, turn the drive off and on to restart.)

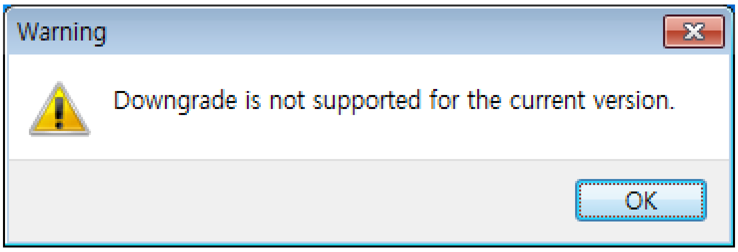
■ An Error Occurs During Transmission



■ Turn off and on the drive and repeat the above process from (2) to (7).



■ Check the drive type and capacity of the firmware you wish to transmit.



■ Check the firmware version. You cannot download a version that is lower than the current

Warranty

1. Warranty Period

The product you purchased will be guaranteed for 18 months from the date of manufacturing.

2. Scope of Warranty

Any trouble or defect occurring for the above-mentioned period will be partially replaced or repaired. However, please note the following cases will be excluded from the scope of warranty.

(1) Any trouble attributable to unreasonable condition, environment or handling otherwise specified in the manual,
(2) Any trouble attributable to others' products,
(3) If the product is modified or repaired in any other place not designated by the company,
(4) Due to unintended purposes
(5) Owing to the reasons unexpected at the level of the contemporary science and technology when delivered.
(6) Not attributable to the company; for instance, natural disasters or fire

3. Since the above warranty is limited to servo product unit only, make sure to use the product considering the safety for system configuration or applications.

Environmental Policy

LSIS Co., Ltd supports and observes the environmental policy as below.

Environmental Management	About Disposal
LSIS considers the environmental preservation as the preferential management subject and every staff of LSIS use the reasonable endeavors for the pleasurably environmental preservation of the earth.	LSIS' servo product is designed to protect the environment. For the disposal, separate aluminum, iron and synthetic resin (cover) from the product as they are reusable.

User Manual Revision History

Number	Date issued	Revised content	Version number	Notes
1	2017.10.13	Newly created.	1.0	
2				
3				
4				
5				
6				
7				

LS values every single customers.

Quality and service come first at LSIS.

Always at your service, standing for our customers.

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※ LSIS constantly endeavors to improve its product so that information in this manual is subject to change without notice.

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