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AC Servo User Manual

L7NH Series (400V)

Ver1.4

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.

LS Mecapion

Introduction

Hello. Thank you for choosing LS Mecapion L7NH Series.

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.

- The contents of this manual are subject to change without notice.
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Safety precautions are categorized as either Warnings or Cautions, depending on the severity of the precaution.

Precautions	Definition
Danger	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.

- Precautions listed as Cautions may also result in serious injury .

Electric Safety Precautions

Danger
▪ Before wiring or inspection tasks, turn off the power. Wait 15 minutes until the charge lamp goes off, and then check the voltage. ▪ Ground both 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.

Environment	Conditions	
	Servo drive	**Servo motor**
Operating temp.	0 ~ 50 ℃	0 ~ 40 ℃
Storage temp.	-20 ~ 65 ℃	-10 ~ 60 ℃
Operating humidity	Below 90% RH (no condensation)	20~80% RH(no condensation)
Storage humidity		
Altitude	1000 m or lower	
Spacing	▪ 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 2.2.1, "Wiring the Control Panel."	
Other	▪ Ensure the installation location is free from dust, iron, corrosive gas, and combustible gas. ▪ Ensure the installation location is free from vibrations or the potential for hard impacts.	

⚠ Caution

- Install the product with 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 380-480 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 380-480 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.
- Before you turn on the power, check the motor's ID and the encoder pulse for L7NHB □□□.
- Set the motor ID[0x2000], encoder type[0x2001] and the encoder pulse [0x2002] for L7NHB□□□ first after you turn 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 1.4 "System Configuration" to perform I/O wiring for the servo drive according to each drive mode.
- You can check the ON/OFF state for each input terminal of I/O at [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 ENCODER connectors when the power is off.
- Extreme change of parameters 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 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. ▪ The electric brake may malfunction if the brake degrades or if the mechanical structure is improper (for example, 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 solving the problem and 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 its parts. ▪ Do not modify this device in any way.

■ General Precautions

⚠ Caution
▪ This user manual is subject to change due to product modification 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 device 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 recording as a result of parameter changes • EEPROM recording as a result of an alarm

Table of Contents

1. Product Configuration

1.1 Product Verification

1. Check the name tag to verify that the product received matches the model ordered
    - Does the servo drive's name plate 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 gearbox and the gear ratios correct?
        - Is the encoder format correct?
3. Check the exterior of the device.
    - Are there any foreign substances or humidity in the device?
    - 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

■ L7NH Series Product Type

L7 NH B 010 U AA

Series Name	Communication/ Drive Type	Input voltage	Capacity	Encoder	Option
L7 Series	NH : Network type All-in-One Type	A: 200Vac B: 400Vac	001 : 100W 002 : 200W 004 : 400W 008 : 750W 010 : 1kW 020 : 2kW 035 : 3.5kW 050 : 5.0kW 075 : 7.5kW 110 : 11.0kW 150 : 15kW	U: Universal	Blank: Standard Marked: Dedicated use

■ Servo Motor Product Format

APM – S E P 10 D E K 1 G1 03

Servo Motor: APM

Motor Shape
- S: Real Axis
- H: Hollow Shaft
- B: Assembly

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

Input
- Blank: 200[Vac]
- P: 400[Vac

Motor
- R3: 30[W]
- R5: 50[W]
- 01: 100[W]
- 02: 200[W]
- 03: 300[W]
- 04: 400[W]
- 06: 550/600[W]
- 07: 650[W]
- 08: 750/800[W]
- 10: 1[kW]
- 15: 1.5[kW]
- 20: 2[kW]
- 35: 3.5[kW]
- 50: 5[kW]
- 75: 7.5[kW]
- 150: 15[kW]
- 220: 22[kW]
- 300: 30[kW]
- 370: 37[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: Double-sided
- H: Hollow Shaft

Oil Seal, Brake Existence
- Non-existent: None included ed
- 1: Oil Seal attached
- 2: Brake attached
- 3: Oil Seal and Brake

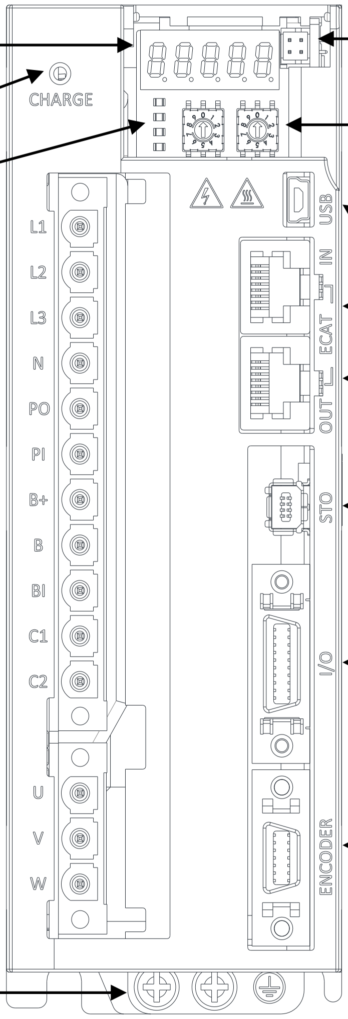
Gearbox Spec.
- Non-existent: No gearbox
- G1: For general industrial purposes
- G2: For general industrial purposes
- G3: Precise Gearbox

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

1.3 Part Names

1.3.1 Servo Drive Parts

■ L7NH Drive (1KW)



Display
It shows drive status, alarms, etc.

CHARGE lamp
This turns on when the main circuit power is on.

Status LED
It indicates the current state of EtherCAT communication.

Main power connectors (L1, L2, and L3)
These terminals connect to the main circuit power input.

DC reactor connector (PO, PI)
These terminals connect to the DC reactor to suppress high-frequency power.
-If the DC reactor is not used, be sure to short-circuit this connector.

Regenerative resistance connector (B+ , B, BI)
These terminals connect to the external regenerative resistor.
-For basic installations : Short-circuit B and BI terminals.
-For external resistor installations : Install to B+ and B terminals.

Control power terminals (C1 and C2)
These terminals connect to the control power input.

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

Ground terminal
It is a ground terminal to prevent electric shock.

Connector for analog monitors
It is a connector for checking the analog output signal.

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

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

EtherCAT communication input port (ECAT IN)

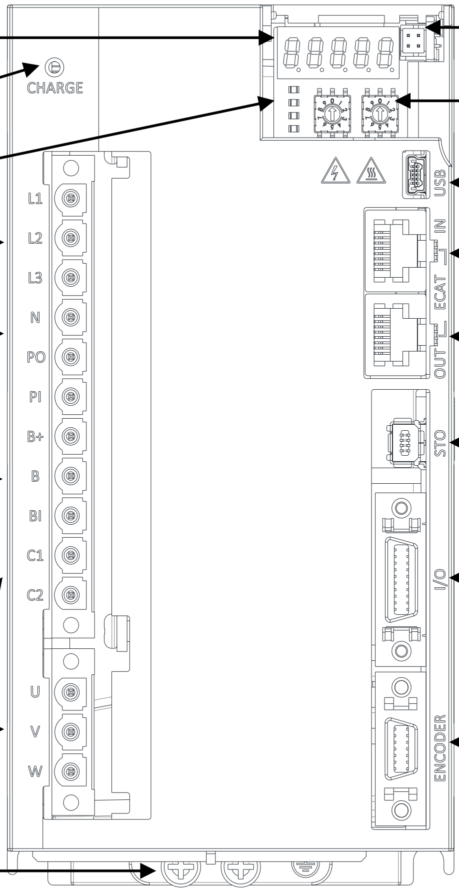
EtherCAT communication output port (ECAT OUT)

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.

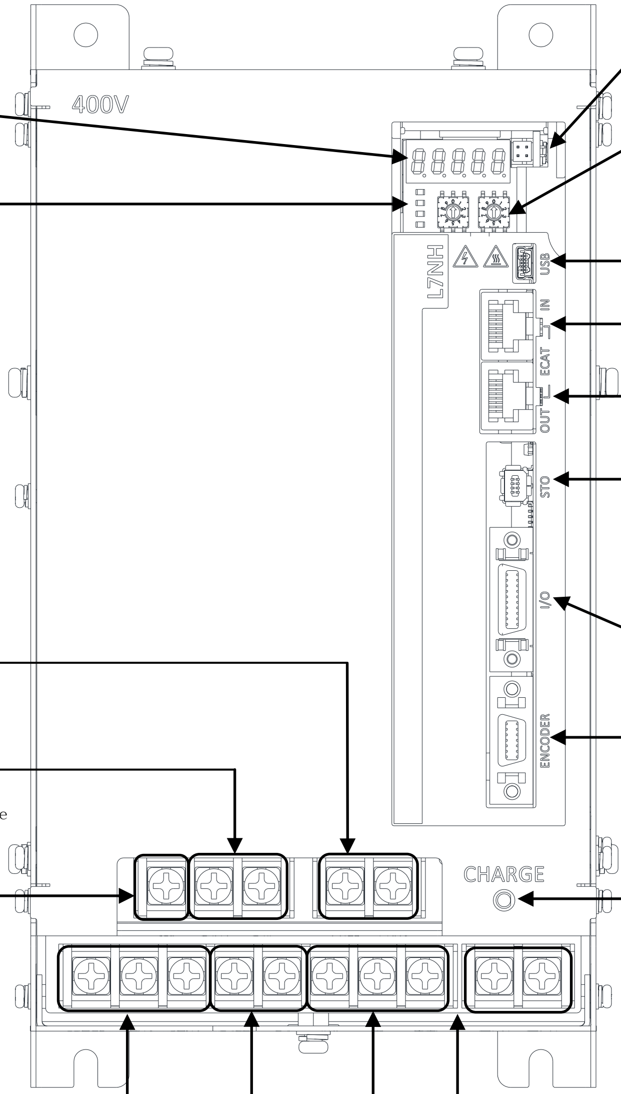
Input/output signal connector (I/O)
This connector is for sequence input/output signals.

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

■ L7NH Drive (2KW, 3.5KW)



■ L7NH Drive (5KW)



Display
It shows drive status, alarms, etc.

Status LED
It indicates the current state of EtherCAT communication.

Control power terminals (C1 and C2)
These terminals connect to the control power input.

DC reactor connector (PO, PI)
These terminals connect to the DC reactor to suppress high-frequency power.
-If the DC reactor is not used, be sure to short-circuit this connector.

* It is not a connector for connection (N)

Main power connectors (L1, L2, and L3)
These terminals connect to the main circuit power input.

Regenerative resistance connector (B+ , B)
These terminals connect to the external regenerative resistor.
-For basic installations : Short-circuit B+ and B terminals.
-For external resistor installations : After attaching internal resistor wiring to the internal resistor fixing hole “NC” of the case, connect the external resistor to B+ and B terminals.

Connector for analog monitors
It is a connector for checking the analog output signal.

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

USB connector (USB)
This connector is 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 connector (I/O)
This connector is for sequence input/output signals.

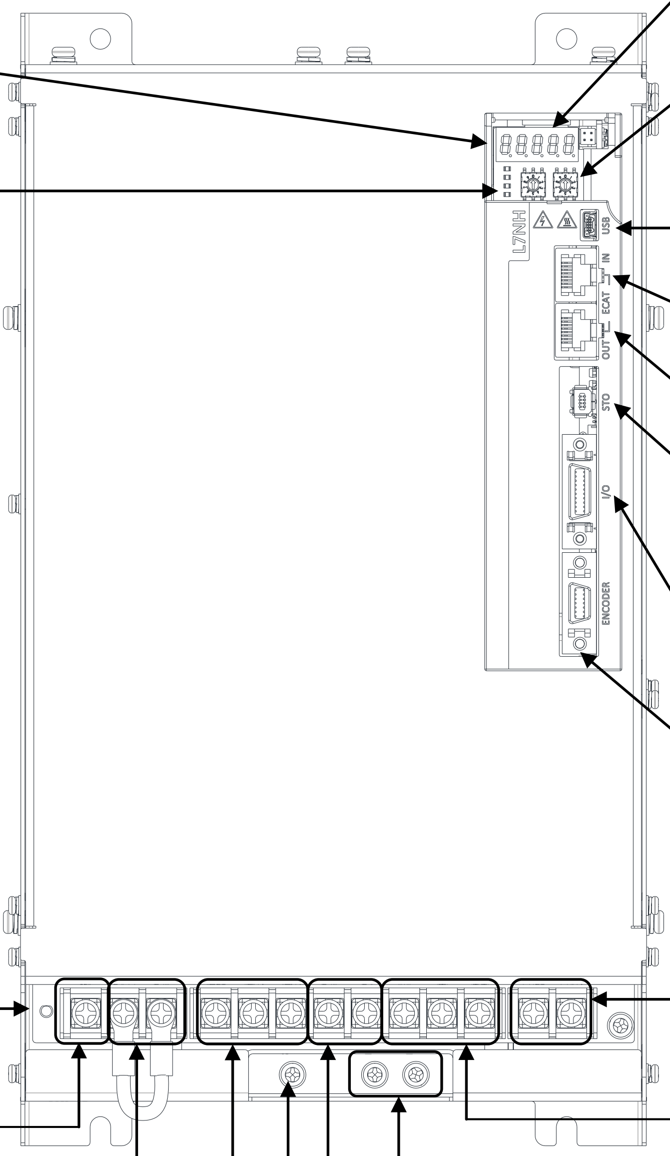
Encoder connector (ENCODER)
This connector connects to the encoder installed in the servo motor.

CHARGE lamp
This turns on when the main circuit power is on.

Ground terminal
It is a ground terminal to prevent electric shock.

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

■ L7NH Drive (7.5KW)



Display
It shows drive status, alarms, etc.

Status LED
It indicates the current state of EtherCAT communication.

CHARGE lamp
This turns on when the main circuit power is on.

*** It is not a connector for connection (N)**

DC reactor connector (PO, PI)
These terminals connect to the DC reactor to suppress high-frequency power.
-If the DC reactor is not used, be sure to short-circuit this connector.

Main power connectors (L1, L2, and L3)
These terminals connect to the main circuit power input.

*** NC**

Connector for analog monitors
It is a connector for checking the analog output signal.

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

USB connector (USB)
This connector is 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 connector (I/O)
This connector is for sequence input/output signals.

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

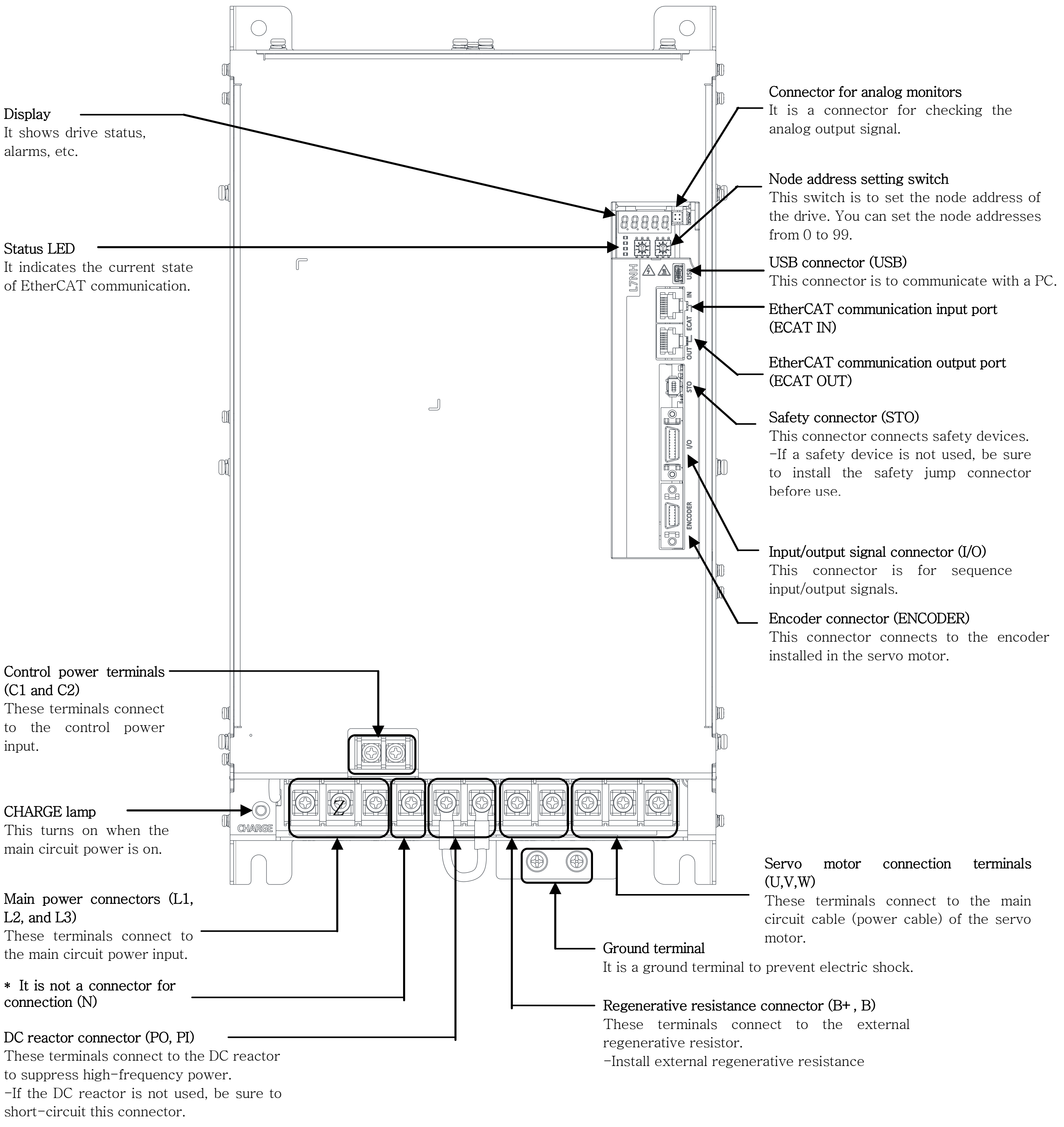
Control power terminals (C1 and C2)
These terminals connect to the control power input.

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

Ground terminal
It is a ground terminal to prevent electric shock.

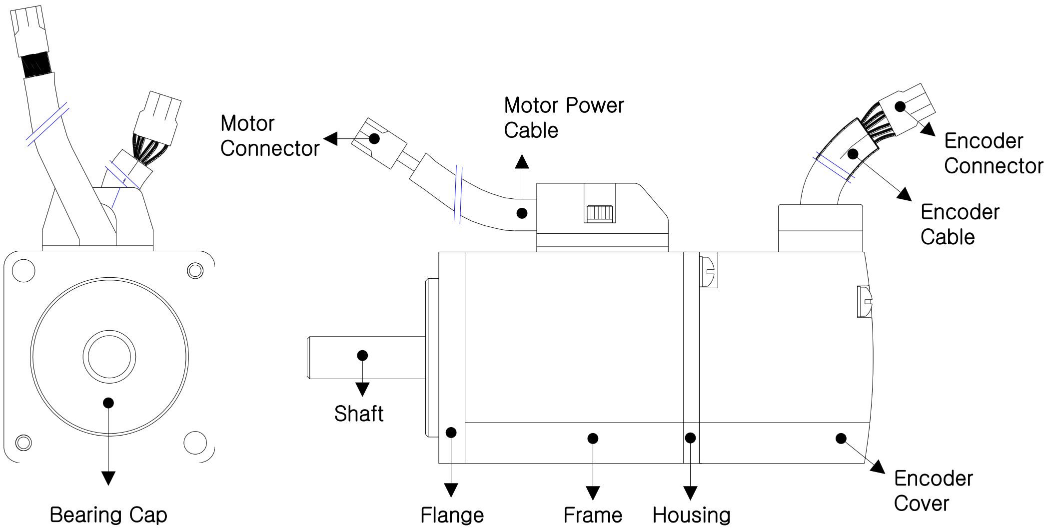
Regenerative resistance connector (B+ , B)
These terminals connect to the external regenerative resistor.
-For basic installations : Short-circuit B+ and B terminals.
-For external resistor installations : After attaching internal resistor wiring to the internal resistor fixing hole “NC” of the case, connect the external resistor to B+ and B terminals.

■ L7NH Drive (15KW)

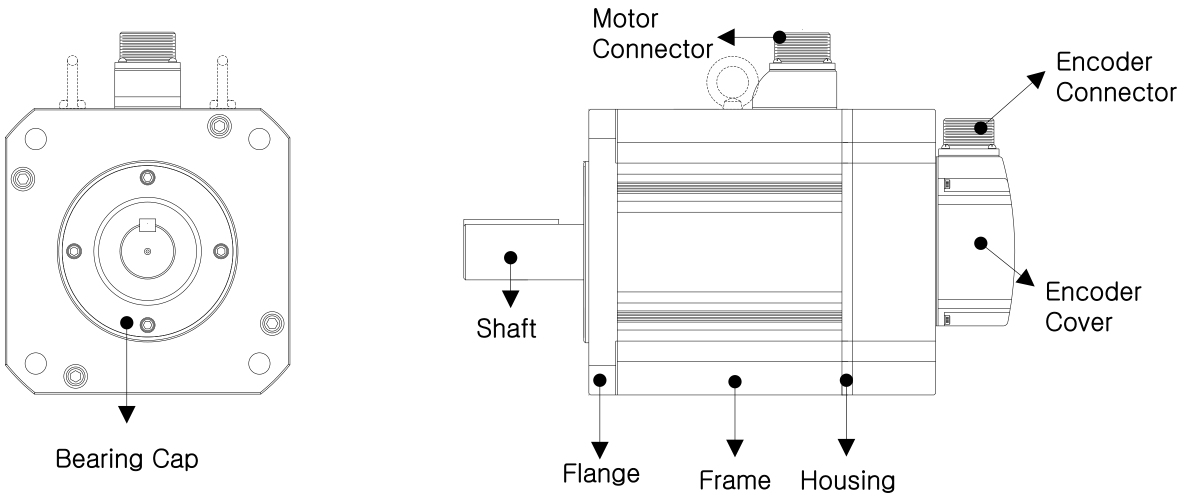


1.3.2 Servo Motor Parts

■ 80 Flange or below

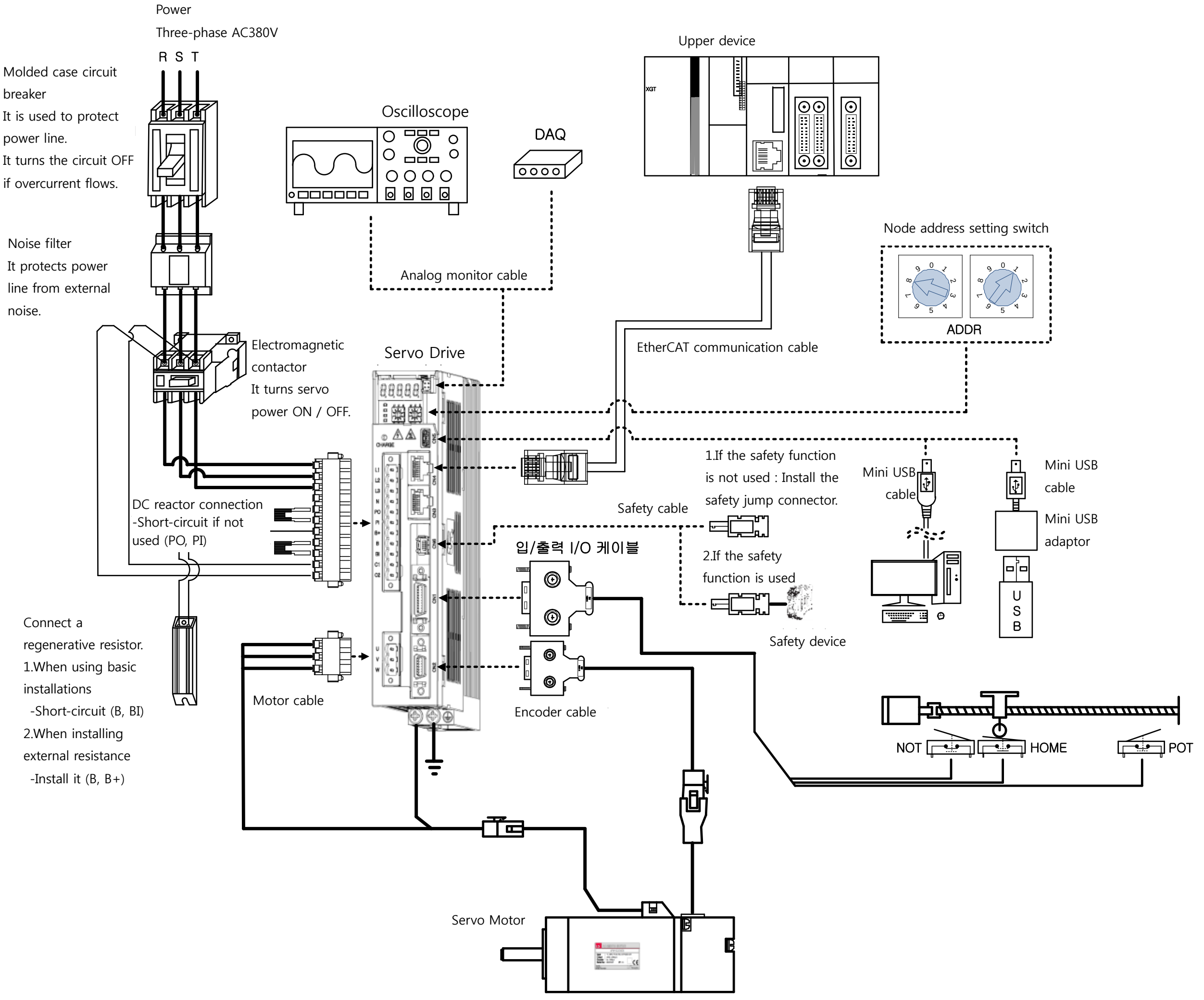


■ 130 Flange or higher



1.4 System Configuration Example

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



2. Wiring and Connection

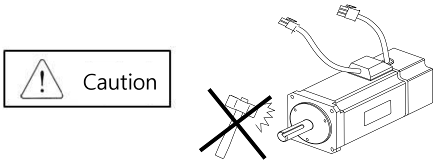
2.1 Installation of Servo Motor

2.1.1 Operating Environment

Item	Requirements	Notes
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.

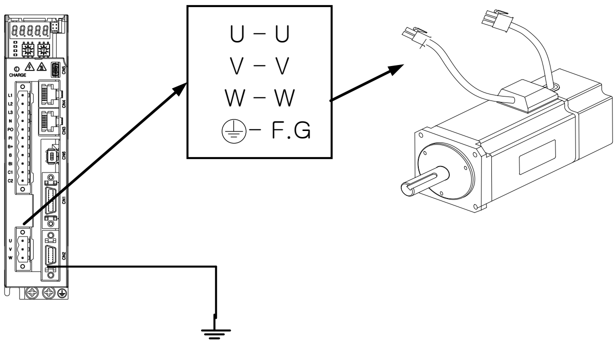
2.1.2 Preventing Impact

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



2.1.3 Motor Connection

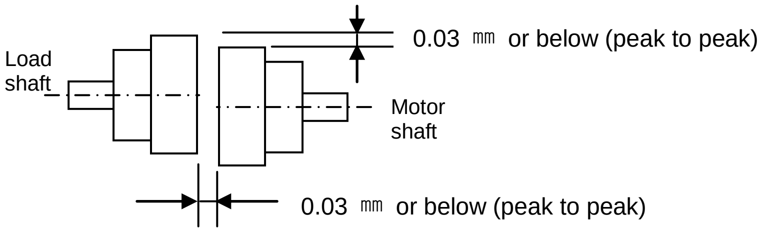
- If the motor is directly connected to commercial power, it may be burned. Be sure to connect with the specified drive before using it.
- Connect the ground terminals of the motor to either of the two ground terminals inside the drive, and attach the remaining terminal to the type-3 ground.



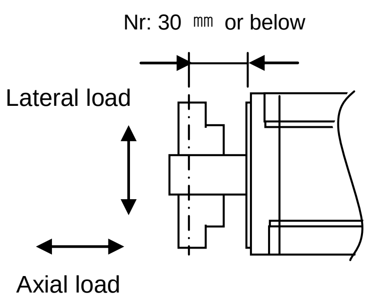
- Connect the U, V, and W terminals of the motor in the same way as the U, V, and W terminals of the drive.
- Ensure that the pins on the motor connector are securely attached.
- In order to protect against moisture or condensation in the motor, make sure that insulation resistance is 10 ㏁ (500 V) or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

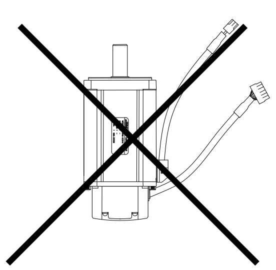


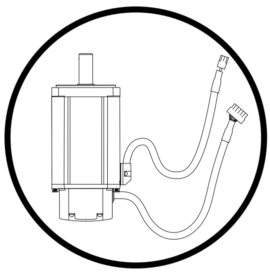
■ For pulley connections:

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.

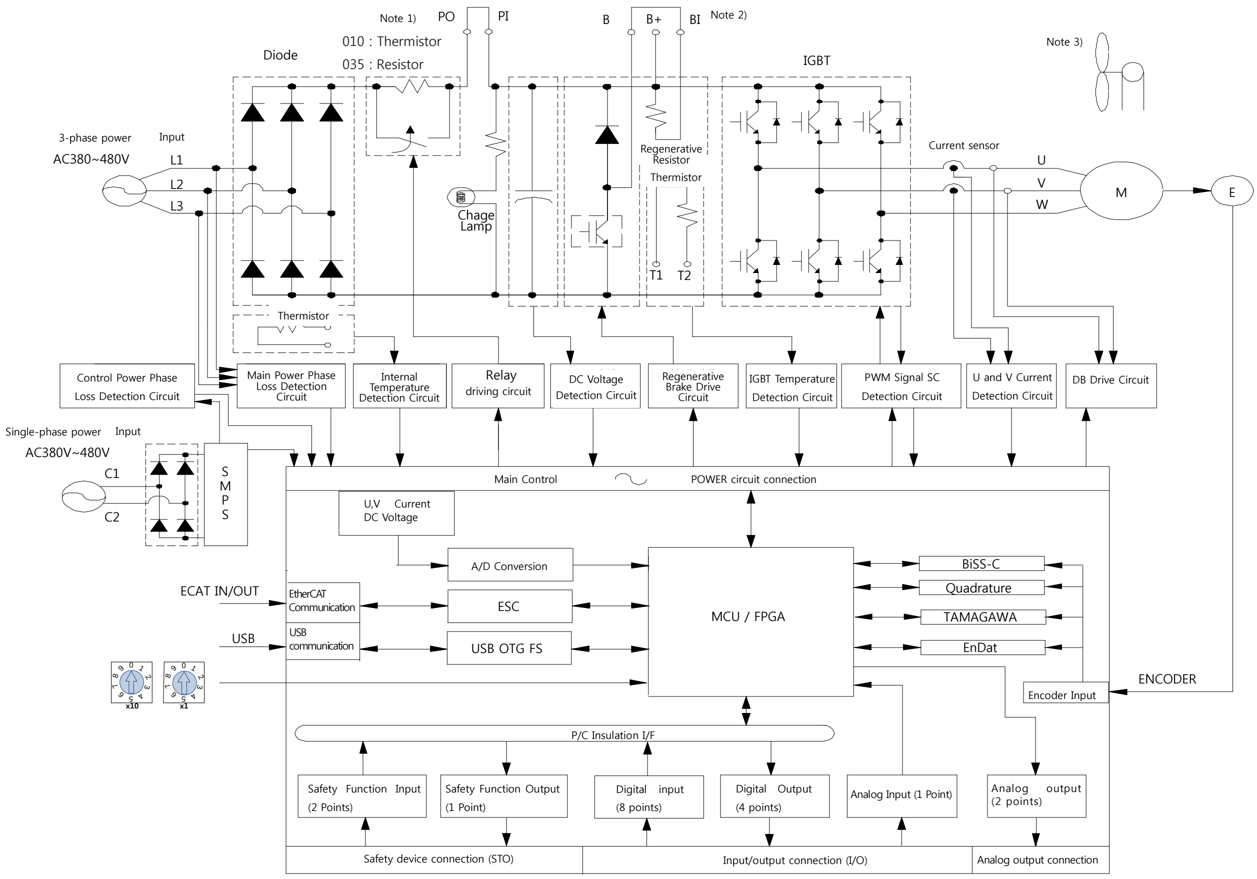
2.2 Installation of Servo Drive

2.2.1 Installation and Usage Environment

Item	Environmental conditions	Notes
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** Condensation or moisture may develop inside the drive during prolonged periods of inactivity 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 L7NH Drive Block Diagram (L7NHB010U~L7NHB035U)

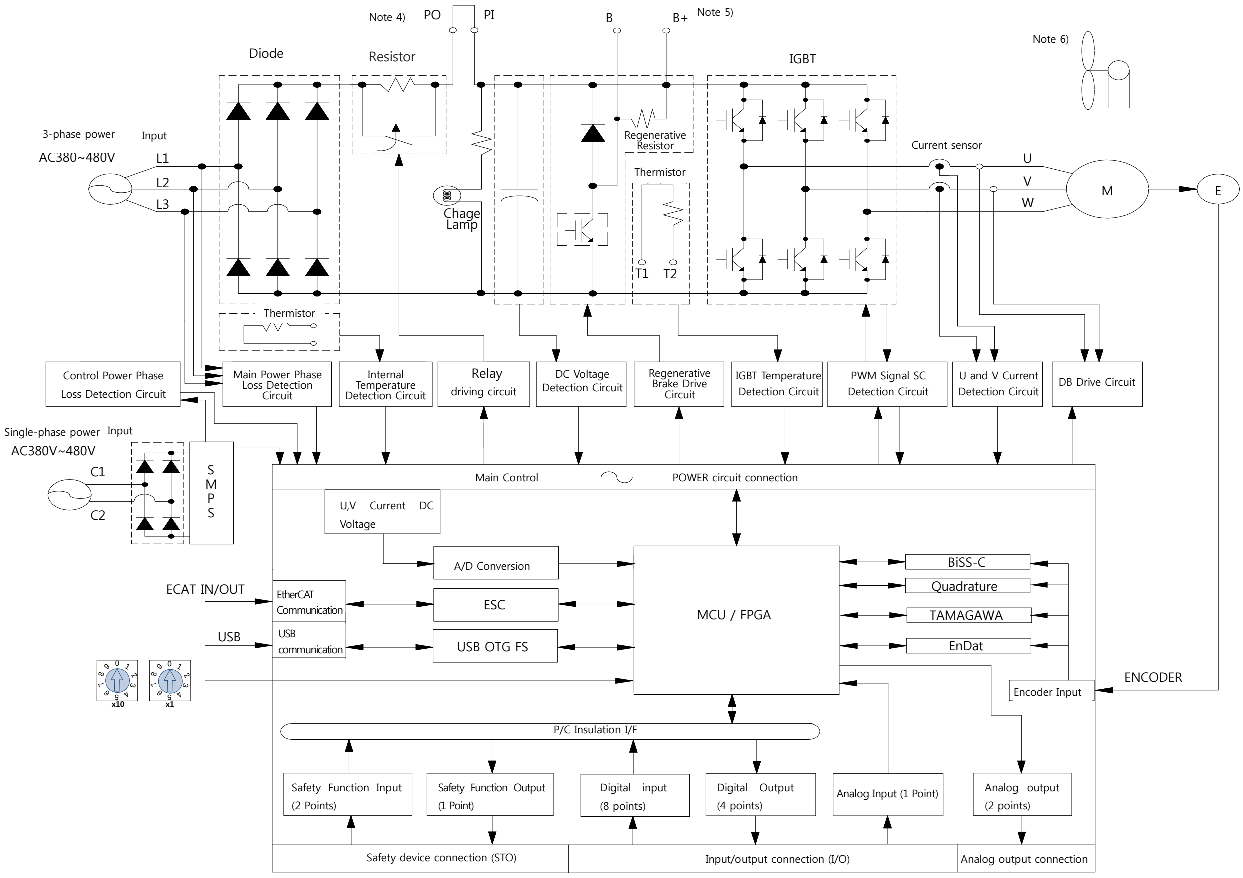


Note 1) If using a DC reactor, connect the PO and PI pins.

Note 2) If using an external regenerative resistor, remove the B and BI short-circuit pins and connect the B+ and B pins.

Note 3) L7NHB010U~L7NHB035U Model is cooled by a DC 24 V cooling fan.

2.3.2 L7NH Drive Block Diagram (L7NHB050U~L7NHB075U)

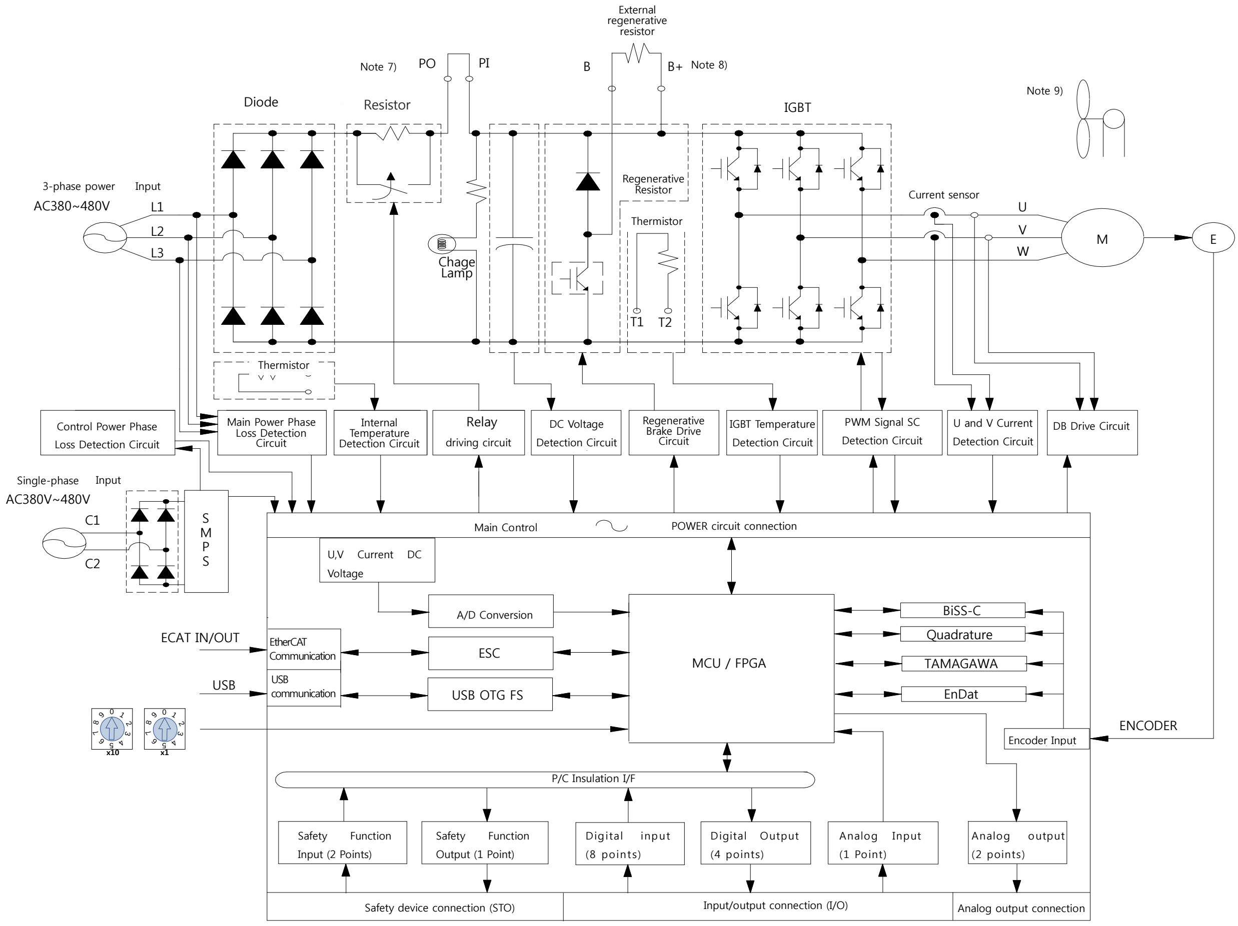


Note 4) If using a DC reactor, connect the PO and PI pins.

Note 5) If the external regenerative resistor is used, after attaching internal resistor wiring to the internal resistor fixing hole “NC” of the case, connect the external regenerative resistor to B+ and B terminals.

Note 6) L7NHB050U ~ L7NHB075U models are cooled by a DC 24 V cooling fan.

2.3.3 L7NH Drive Block Diagram (L7NHB150U)



Note 7) If using a DC reactor, connect the PO and PI pins.

Note 8) L7NHB150U model has no internal regenerative resistance. The external regenerative resistance is used. When attaching the resistance, connect it to B+ and B terminals.

Note 9) L7NHB150U Model is 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 U, V, W terminals of 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
L7NHB010U	100[Ω]	Built-in 100 W	⚠ **Caution** For information about resistance during regenerative capacity expansion, refer to Section 2.4.3, "Regenerative Resistor Options."
L7NHB020U	40[Ω]	Built-in 150 W	
L7NHB035U			
L7NHB050U	27[Ω]	Built-in 120 W	
L7NHB075U	27[Ω]	Built-in 240 W	
L7NHB150U	13.4[Ω]	External 2000 W	

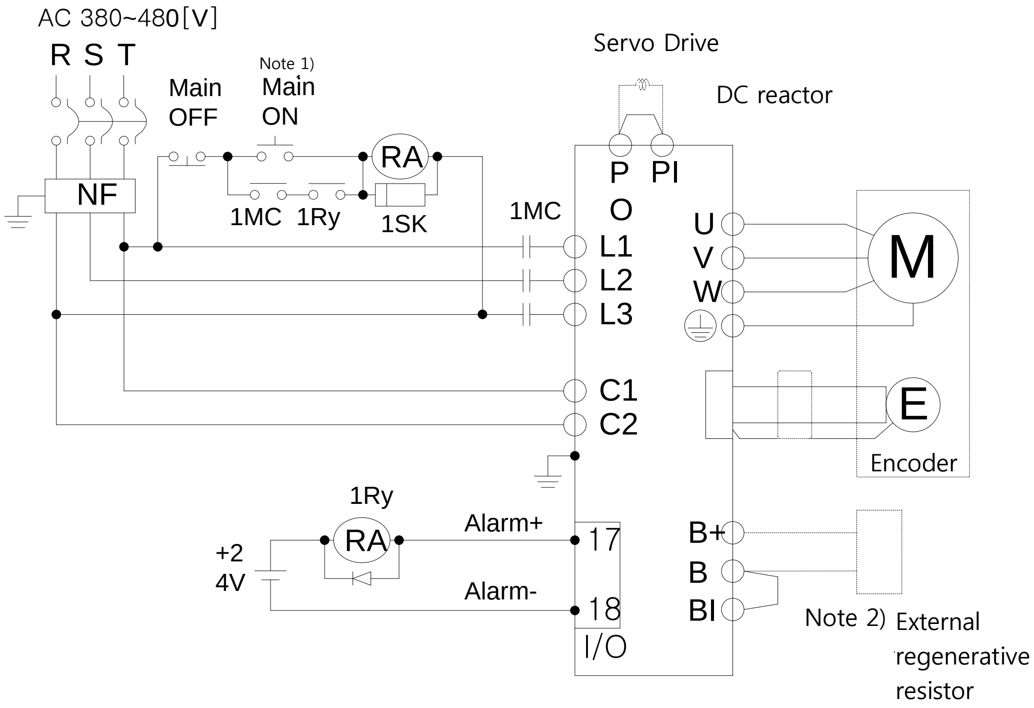
- Configure the system so that the main power (L1, L2, L3) is supplied after the control power (C1, C2). (Refer to section 2.4.1, "Power Supply Wiring Diagram.")
- High voltages may remain in the device for sometime even after the main power is disconnected. Please be careful.

Warnings
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

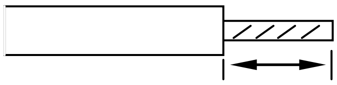
■ **Power Supply Wiring Diagram(L7NHB010U~L7NHB035U)**



Note 1) It takes approximately one to two seconds until alarm signal is output after you turn on the main power. Accordingly, push and hold the main power ON switch for at least two seconds.

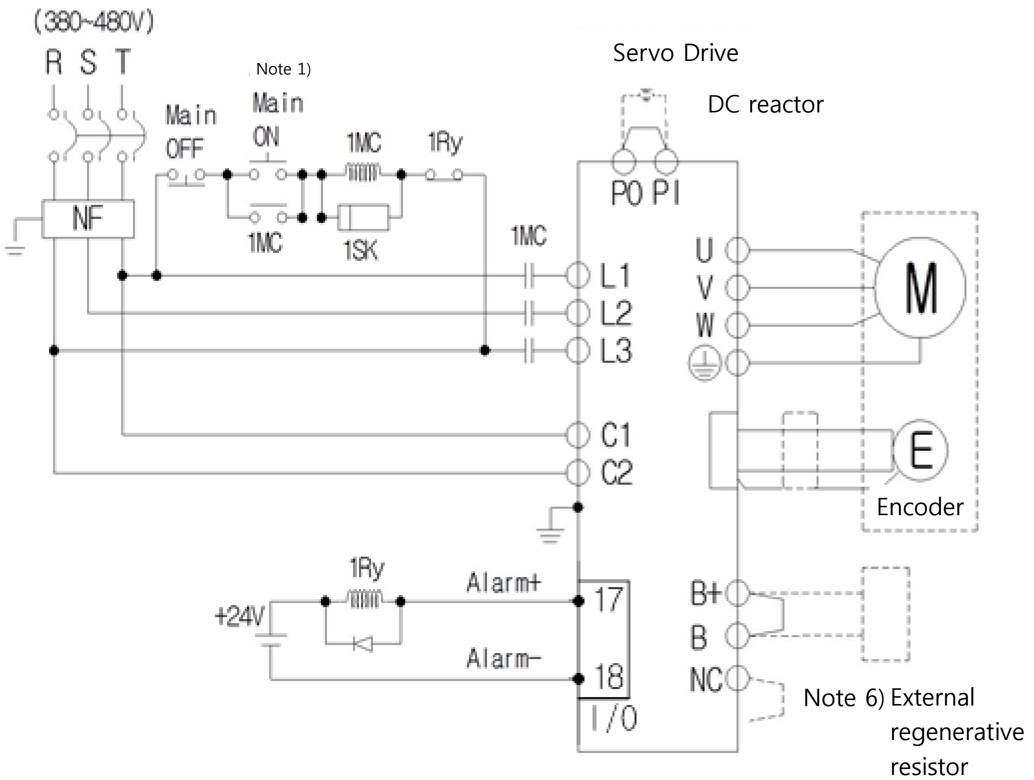
Note 2) Short-circuit B and BI terminals before use, because L7NHB010U(100[W], 100[Ω]) and L7NHB020U~ L7NHB035U(150[W], 40[Ω]) have internal regenerative resistance. If the regenerative capacity is high because of frequent acceleration and deceleration, open the short-circuit pins (B , BI) and connect an external regenerative resistor to B and B+.

Note 3) Remove approximately 7-10 ㎜ of the sheathing from the cables for the main circuit power and attach crimp terminals. (Refer to Section 2.4.2, "Power Circuit Electrical Components.")

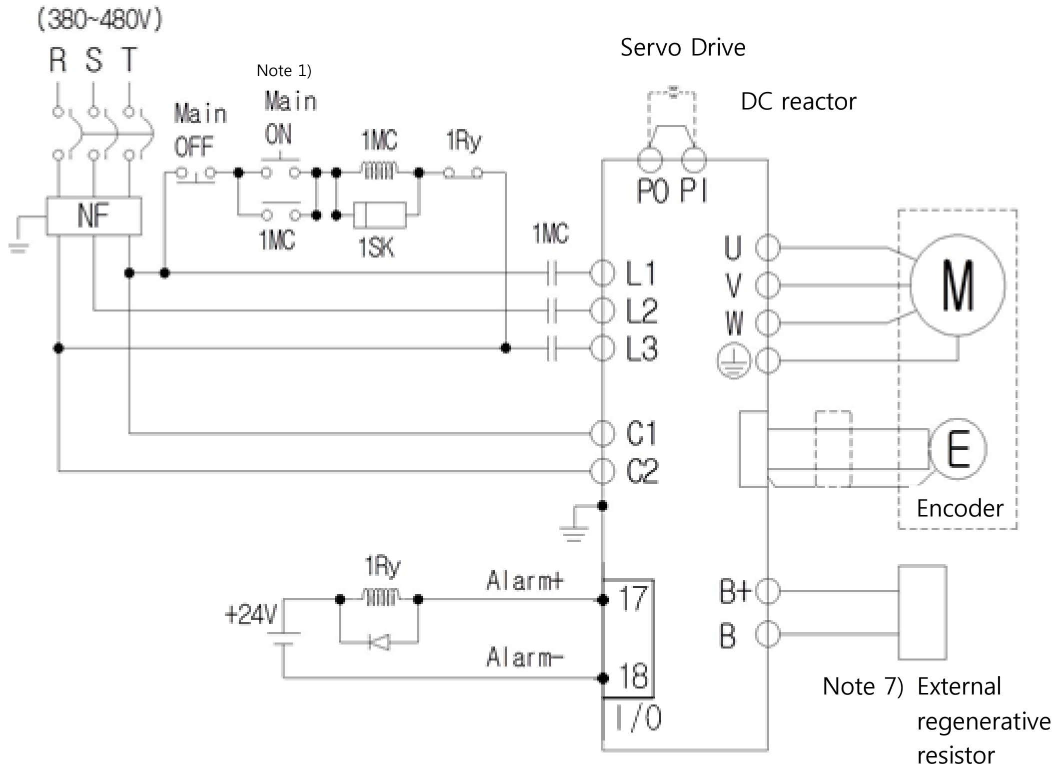


Note 4) Use a (-) flathead screwdriver to connect or remove the main circuit power unit wiring.

■ **Power Supply Wiring Diagram(L7NHB050U~L7NHB075U)**



■ **Power Supply Wiring Diagram(L7NHB150U)**



Note 5) It takes approximately one to two seconds until alarm signal is output after you turn on the main power. Accordingly, push and hold the main power ON switch for at least two seconds.

Note 6) Short-circuit B and BI terminals before use, because L7NHB050U(120[W], 27[Ω]), L7NHB075U(240[W], 27[Ω]) have internal regenerative resistance. If the regenerative capacity is high because of frequent acceleration and deceleration, attach the short-circuit pins (B+, B) to NC terminal and connect an external regenerative resistor to B+ and B before use.

Note 7) By default, use external regenerative resistance for L7NHB150U(2000[W], 13.4[Ω]), and connect the resistance to B+ and B terminals before use.

Note 8) For the cables for the main circuit and control power unit, you must use crimp terminals (L7NHB050U, L7NHB075U : GP110028_KET, L7NHB150U : GP110732_KET) compliant with electrical components.
(Refer to Section 2.4.2, "Power Circuit Electrical Components.")
L7NHB050U, L7NHB075U and L7NHB150U use terminal block, so use (+) and (-) screwdrivers to connect or remove the terminals.

2.4.2 Power Circuit Electrical Components

Name		L7NHB010U	L7NHB020U	L7NHB035U	L7NHB050U	L7NHB075U	L7NHB150U
MCCB		30A Frame 10A (ABE33b/10)	30A Frame 20A (ABE33b/20)		30A Frame 30A (ABE33b/30)	30A Frame 30A (ABE33b/30)	50A Frame 50A (ABE53b/50)
Noise Filter (NF)		TB6-B010LBEI (10A)	TB6-B020NBDC (20A)		TB6-B030NBDC (30A)	TB6-B040A (40A)	TB6-B060LA (60A)
DC reactor		10[A]	20[A]		30[A]	30[A]	50[A]
MC		9A / 550V (GM□-12)	18A / 550V (GM□-22)		26A / 550V (GM□-40)	26A / 550V (GM□-40)	38A / 550V (GM□-50)
Wire Note 1)	L1, L2 ,L3, PO, PI, N B+, B, U, V, W	AWG14 (2.08 ㎟)			AWG10 (5.5 ㎟)	AWG10 (5.5 ㎟)	AWG8 (8.0 ㎟)
	C1, C2	AWG14 (2.08 ㎟)					
Crimp terminal		UA-F4010, SEOIL (10mm Strip & Twist)			GP110028 KET	GP110028 KET	GP110732 KET
Regenerative Resistor (Default)		100[W] 100Ω	150[W] 40Ω		120[W] 27Ω	240[W] 27Ω	
Connector (Default)		BLZ 7.62HP/3/180LR SN OR BX SO BLZ 7.62HP/11/180LR SN OR BX SO					

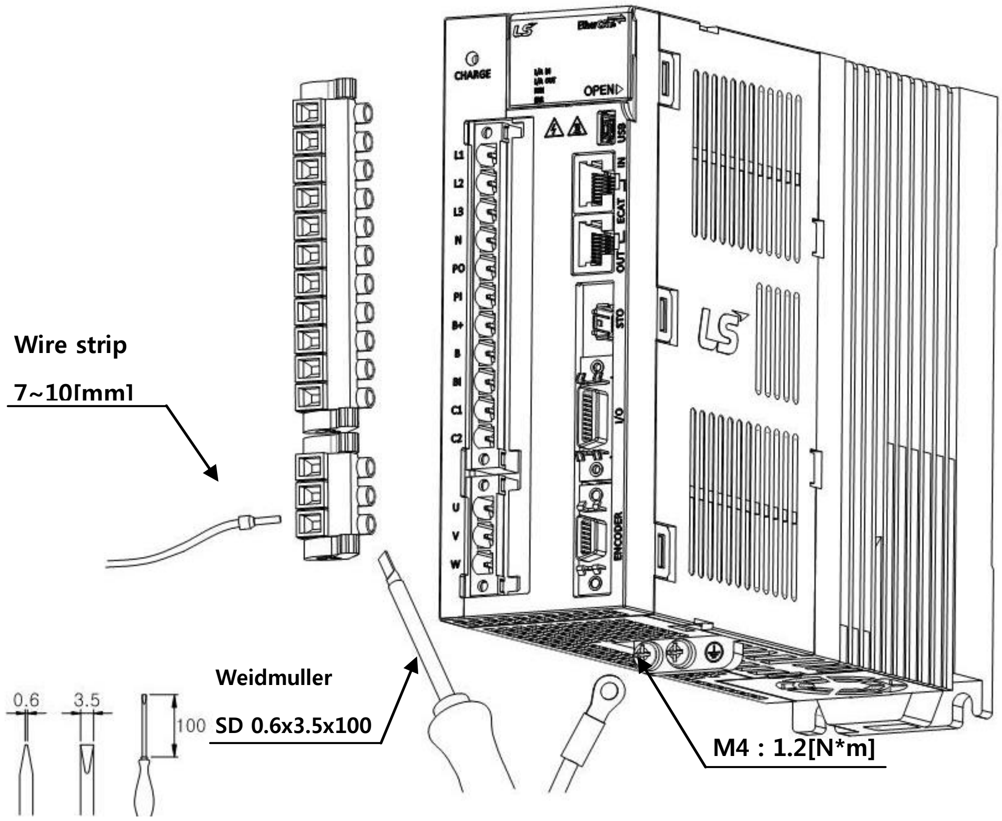
Note 1) When you select a wire, please use 600V, PVC-insulated wire.

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

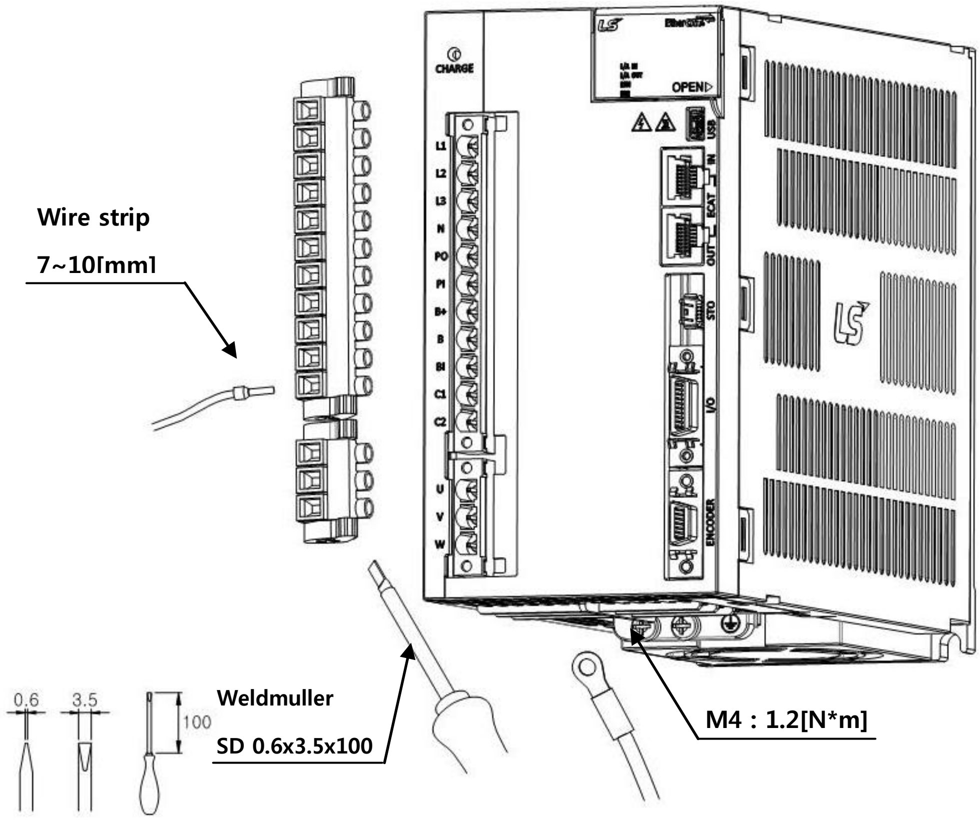
To comply with other standards, use proper wires that meet applicable standards.

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

■ L7NHB010U



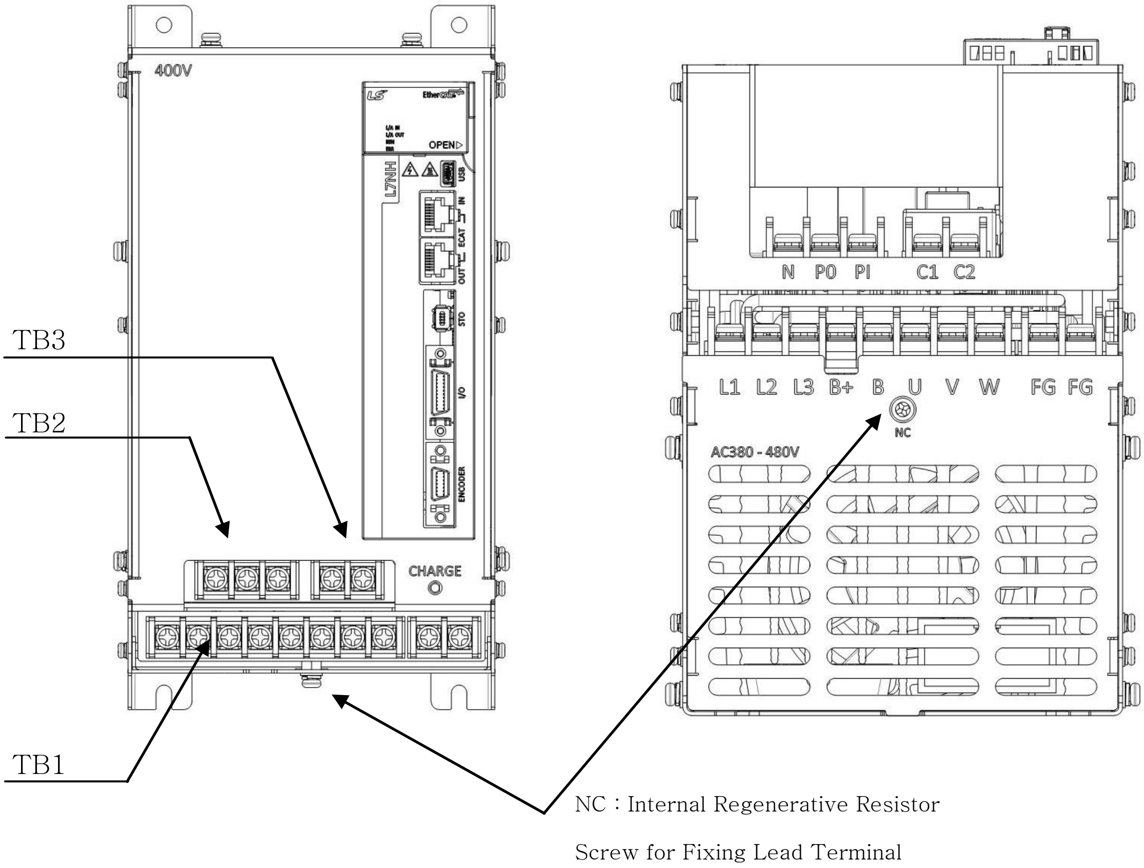
■ L7NHB020U / L7NHB035U



For information on wiring to BLZ 7.62HP Series connector, refer to the above procedures.

1) 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.
2) Otherwise, insufficient torque of locking screw may cause vibration-induced disconnection, system malfunction and contact-induced fire accident.
3) 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.
4) Use FG locking screw of M4 size (shown in bottom of product) to tighten it to 1.2 N·m.
5) Insufficient torque of locking screw may cause FG contact failure and even malfunctioning drive.
6) Recommended (-) driver: Use Weidmuller flathead driver (SD 0.6×3.5×100).

■ L7NHB050U



Terminal signal

TB1

L1	L2	L3	B+	B	U	V	W	FG	FG

Terminal screw: M4
Tightening torque: 1.2 N·m

TB2

N	PO	P1

Terminal screw: M4
Tightening torque: 1.2 N·m

TB3

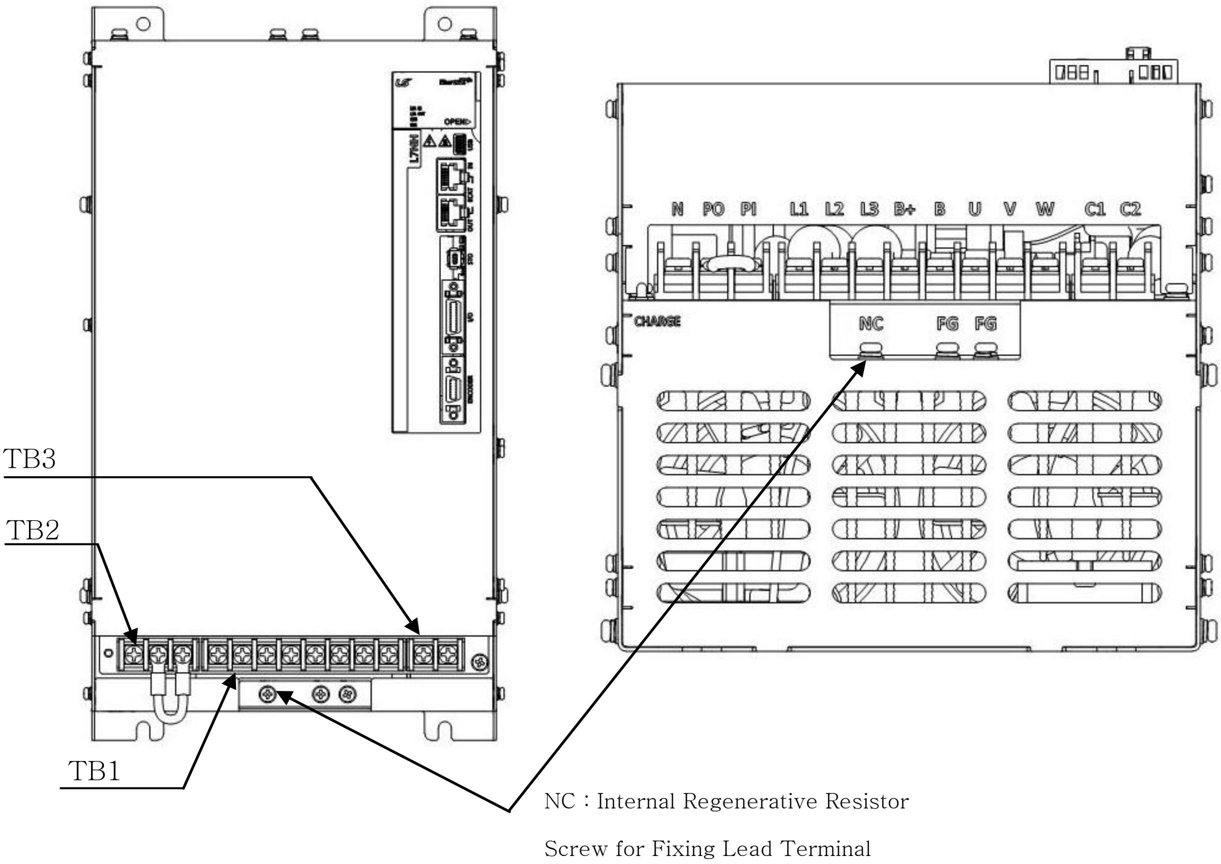
C1	C2

Terminal screw: M4
Tightening torque: 1.2 N·m

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

2) Use FG locking screw of M4 size (shown in bottom of product) to tighten it to 1.2 N·m.

■ L7NHB075U



Terminal signal

TB1

L1	L2	L3	B+	B	U	V	W

Terminal screw : M4
Tightening torque : 1.2[N·m]

TB2

N	PO	PI

Terminal screw : M4
Tightening torque : 1.2[N·m]

TB3

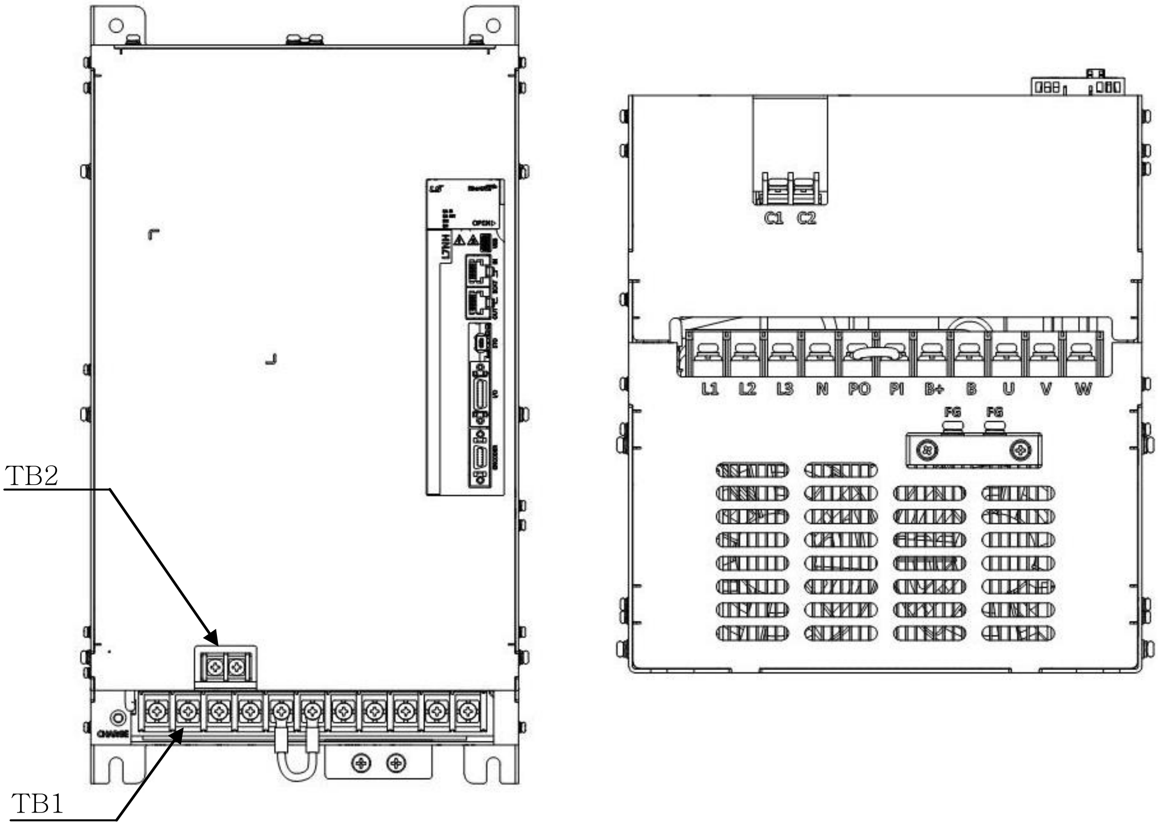
C1	C2

Terminal screw : M4
Tightening torque : 1.2[N·m]

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

2) Use FG locking screw of M4 size (shown in bottom of product) to tighten it to 1.2 N·m.

■ L7NHB150U



Terminal signal

TB1

L1	L2	L3	N	PO	PI	B+	B	U	V	W

Terminal screw: M5

Tightening torque: 3.24 N·m

TB2

C1	C2

Terminal screw: M4

Tightening torque: 1.2 N·m

FG

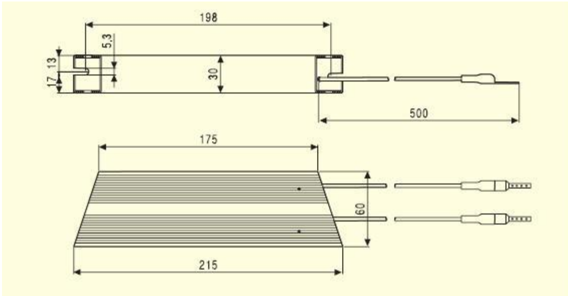
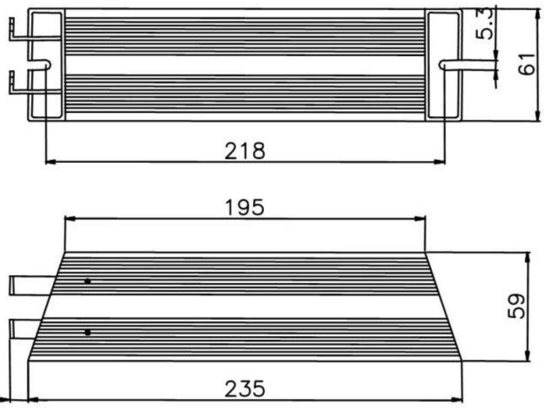
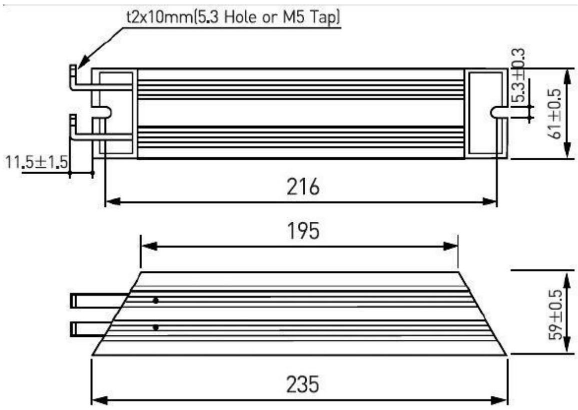
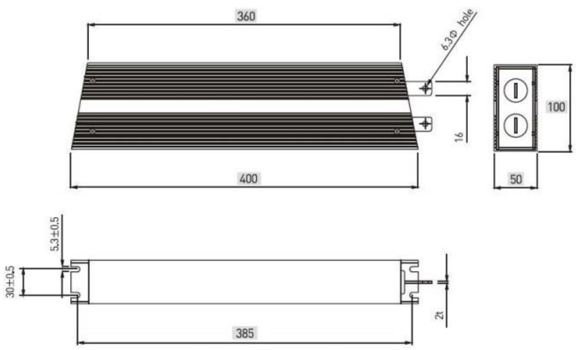
Terminal screw: M5

Tightening torque: 3.24 N·m

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

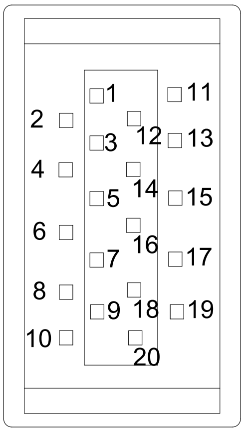
2) Use FG locking screw of M4 size (shown in bottom of product) to tighten it to 1.2 N·m.

2.4.3 Regenerative Resistor Options

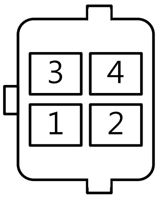
Category	Product Name	Name	Applicable Drive	Specifications
Resistance	Braking resistance	IRV300-82Ω 82[Ω] (300W)	L7NHB010U	
Resistance	Braking resistance	IRV600-140Ω 70Ω] (600W *2P) - Making under review	L7NHB020U /L7NHB035U (2P)	
Resistance	Braking resistance	IRV600-75Ω 25[Ω] (600W *3P)	L7NHB050U /L7NHB075U (3P)	
Resistance	Braking resistance	IRM2000-13.4Ω 13.4[Ω] (2000W)	L7NHB150U	

2.5 Wiring for Input/Output Signals

■ **I/O Connector Specification : 10120-3000PE (3M)**



■ **Analog Monitoring Connector Specification : 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	Details	Function
6	+24V	DC 24V	DC 24V INPUT	COMMON
11	DI1	POT	Forward (CCW) prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in forward direction.
12	DI2	NOT	Reverse (CW) prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in reverse direction.
7	DI3	HOME	Origin sensor	Connects the origin sensor to return to the origin.
8	DI4	STOP	Servo stop	Stops the servo motor when the contact is on.

13	DI5	PCON	P control action	When the contact is on, it converts the mode from PI control to P control.
14	DI6	GAIN2	Switch from Gain 1 to 2	When the contact is on, it switches the speed control gain 1 → the gain 2
9	DI7	PCL	Forward torque limit	When the contact is on, the forward torque limit function is activated.
10	DI8	NCL	Negative torque limit	When the contact is on, the negative 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 Suppression Filter 1	Depending on the Vibration Suppression Filter function setting(0x2515), using filter 1 signal
** LVSF2			Vibration Suppression Filter 2	Depending on the Vibration Suppression Filter function setting(0x2515), using filter 2 signal
** SVON			Servo On	Servo On

Note 1) **Signals not assigned by default as factory setting. The assignment may be changed by 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	Details	Function
1	DO1+	BRAKE+	Brake	Outputs brake control signal.
2	DO1-	BRAKE-		
17	DO2+	ALARM+	Servo alarm	Outputs signal when alarm occurs.
18	DO2-	ALARM-		
3	DO3+	RDY+	Servo ready	This signal is output when the main power is established and the preparations for servo operation are complete.
4	DO3-	RDY-		
19	DO4+	ZSPD+	Zero speed reached	Outputs a signal when the current speed drops below the zero speed.
20	DO4-	ZSPD-		
** 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 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 Input Signals (I/O Connector)

Pin Number	Name	Details	Function
15	A-TLMT	Analog torque limit	It applies -10~+10V between A-TMLT(AI1) and AGND to limit motor output torque. Relationship between input voltage and limit torque depends on the value of [0x221C].
5	AGND	AGND (0V)	Analog ground

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

Pin Number	Name	Details	Function
1	AMON1	Analog Monitor 1	Analog monitor output (-10V ~ +10)
2	AMON2	Analog Monitor 2	Analog monitor output (-10V ~ +10)
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 by parameter setting.

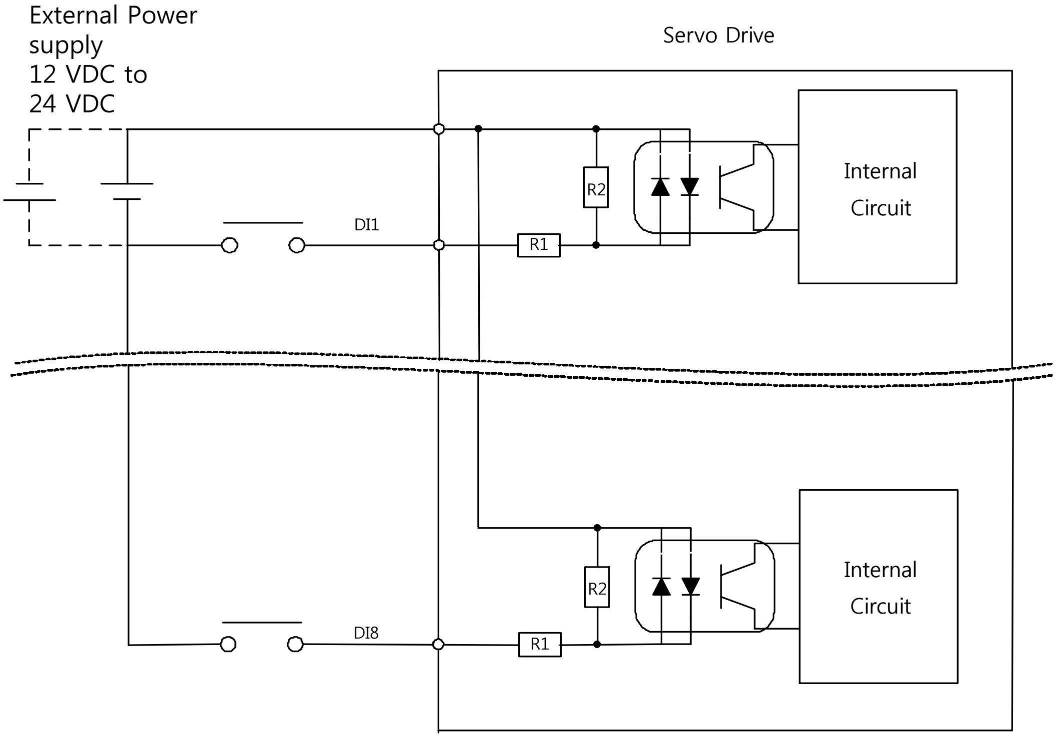
For more information, refer to「5.2.3 Analog Monitor.」

2.5.3 Examples of Connecting Input/Output Signals

■ Examples of Connecting Digital Input Signals

⚠ Caution

1. The input contact can be set to the contact A or the 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.

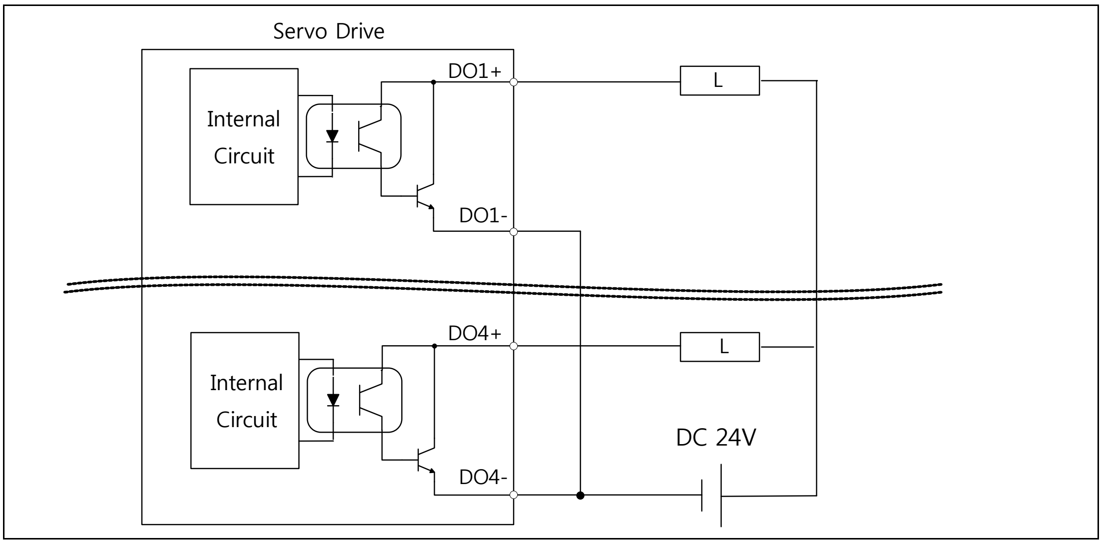


R1 : 3.3KΩ, R2 : 680Ω

■ Example of Connecting Digital Output Signals

⚠ Caution

1. The output contact can be set to the contact A or the 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 [㎃].

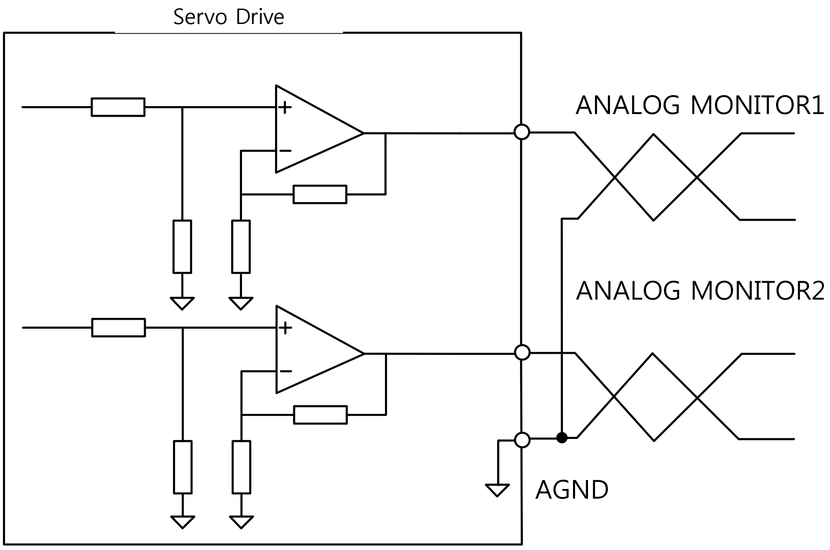


Note 1) For DO1~ DO4 output signals, the GND24 terminal is separated.

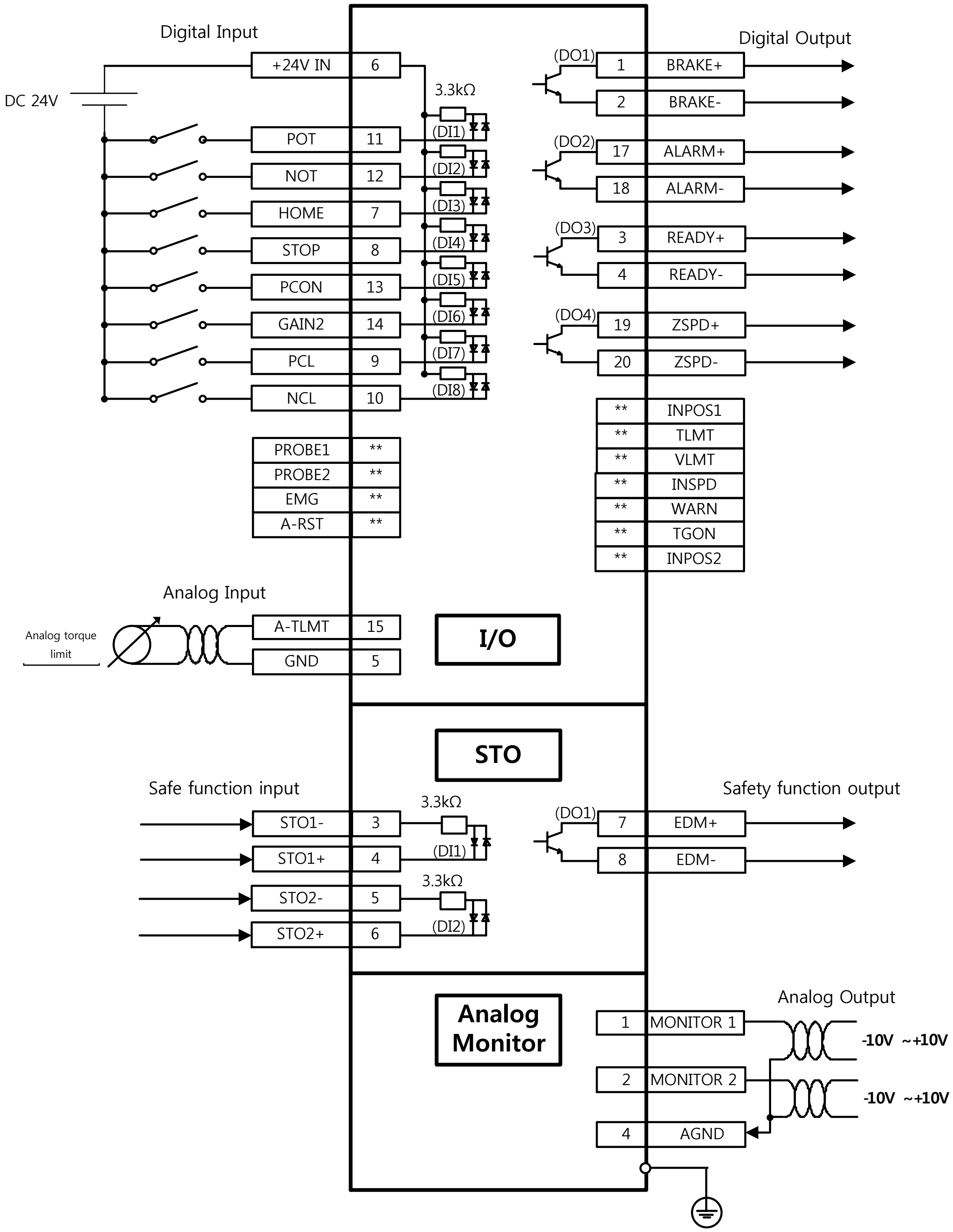
■ Example of Connecting Analog Output Signals

⚠ Caution

1. For more information on settings and scale adjustment of monitoring signals, refer to 5.2.3 Assignment of Analog output signals.
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].



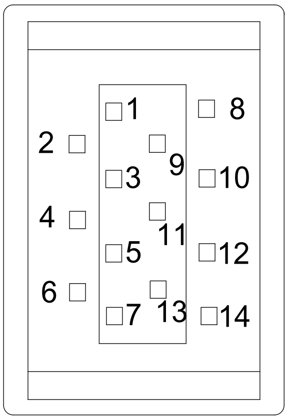
2.5.4 Examples of Connecting Input/Output Signals



Note 1) The input signals DI1 - DI8 and output signals DO1 - DO4 are the factory default signals.

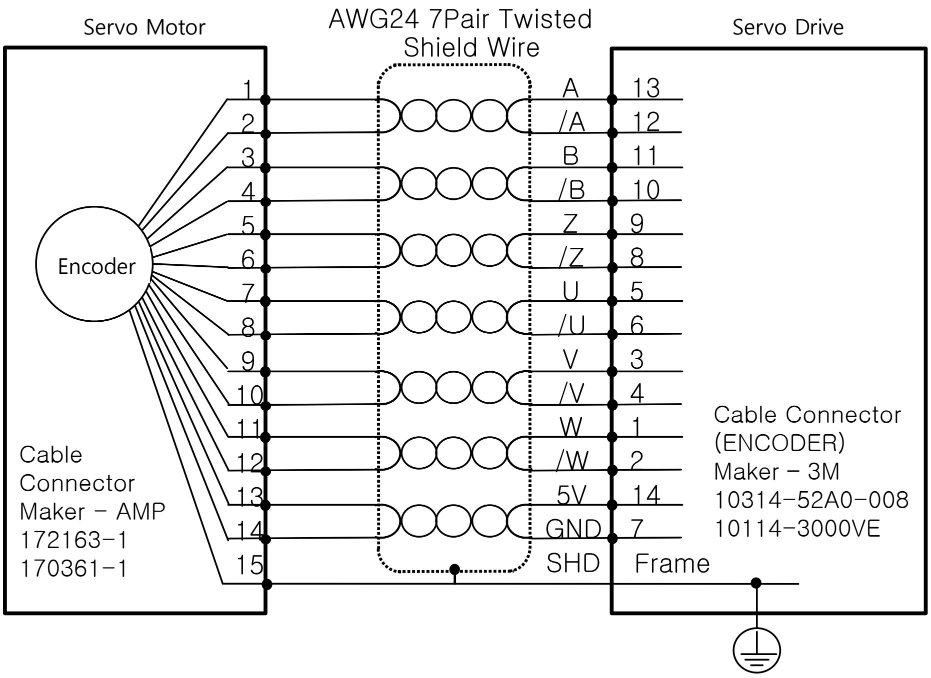
2.6 Wiring of Encoder Signal (ENCODER)

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

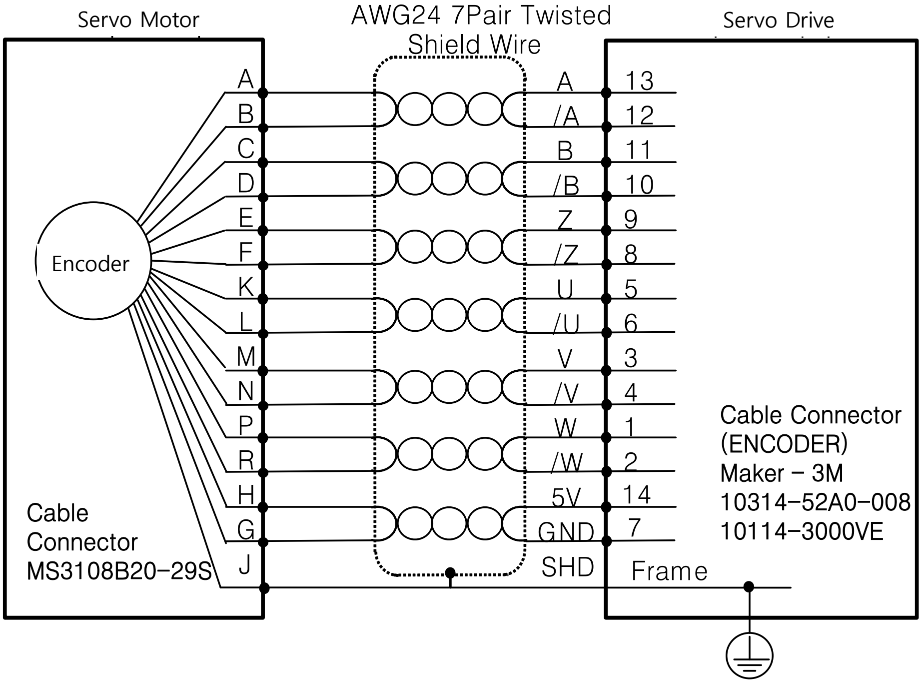


2.6.1 Quadrature Encoder Signaling Unit Wiring

■ **APCS-E□□□AS Cable**

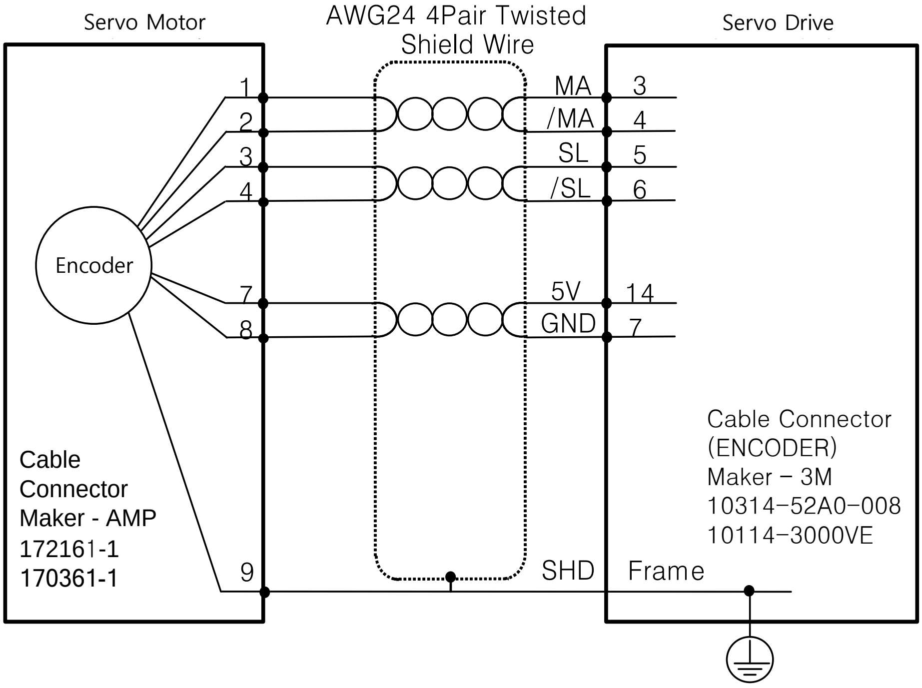


■ **APCS-E□□□BS Cable**

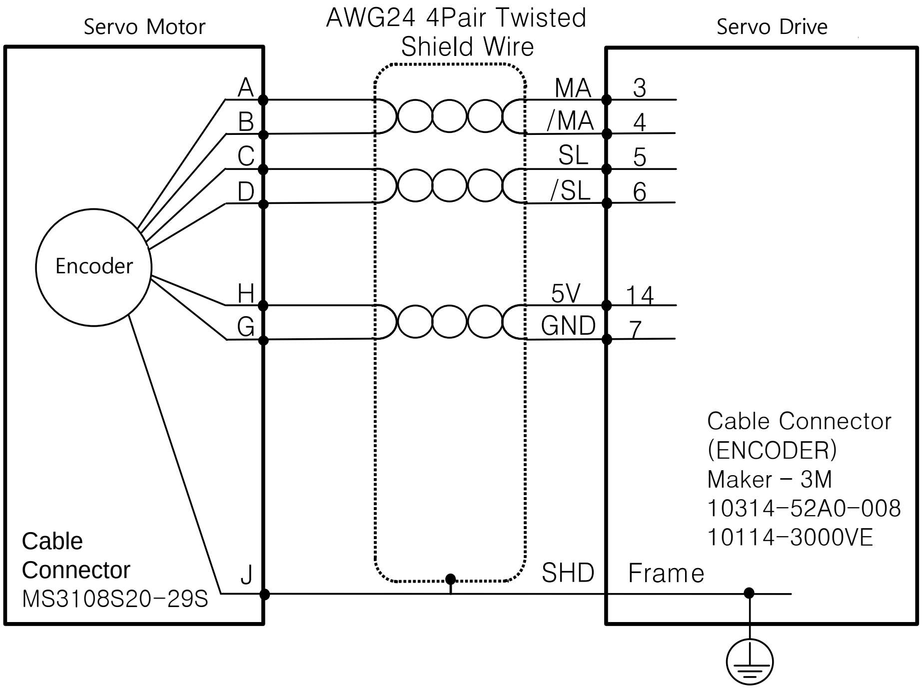


2.6.2 Serial Encoder Signaling Unit Wiring

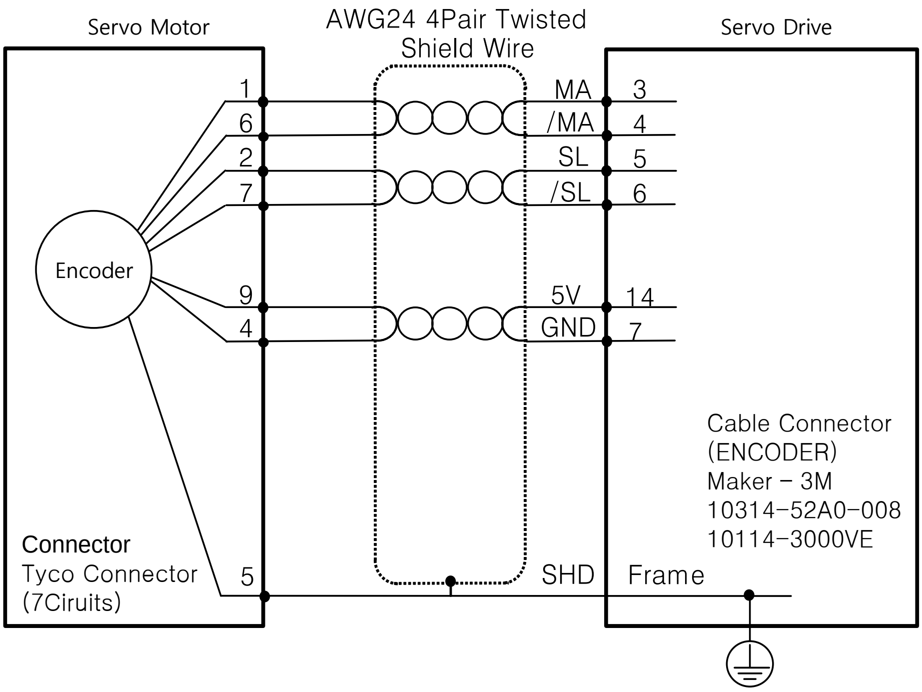
■ **APCS-E□□□CS Cable**



■ **APCS-E□□□DS Cable**

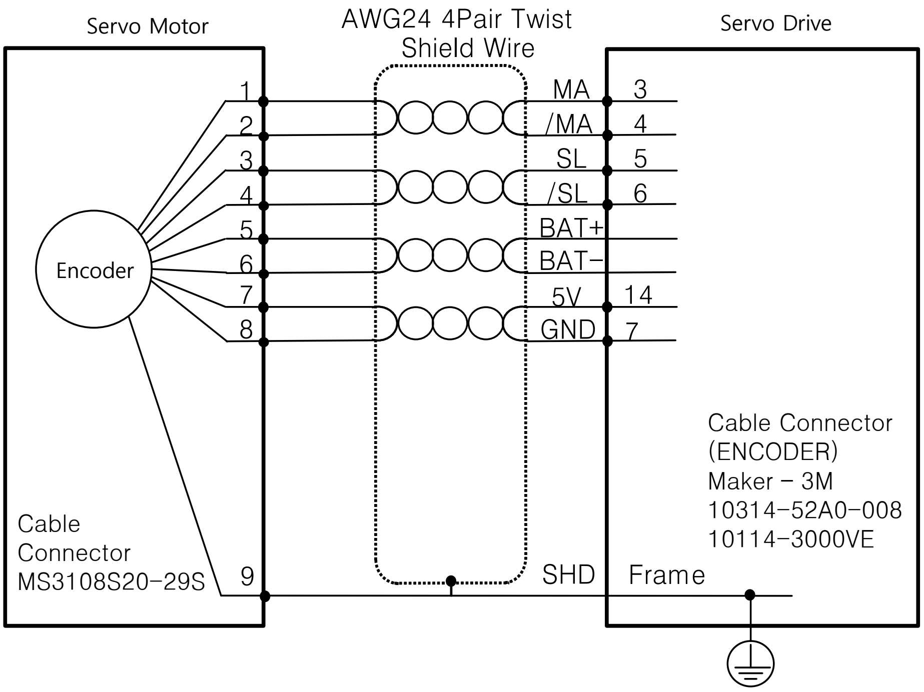


■ **APCS-E□□□ES Cable**

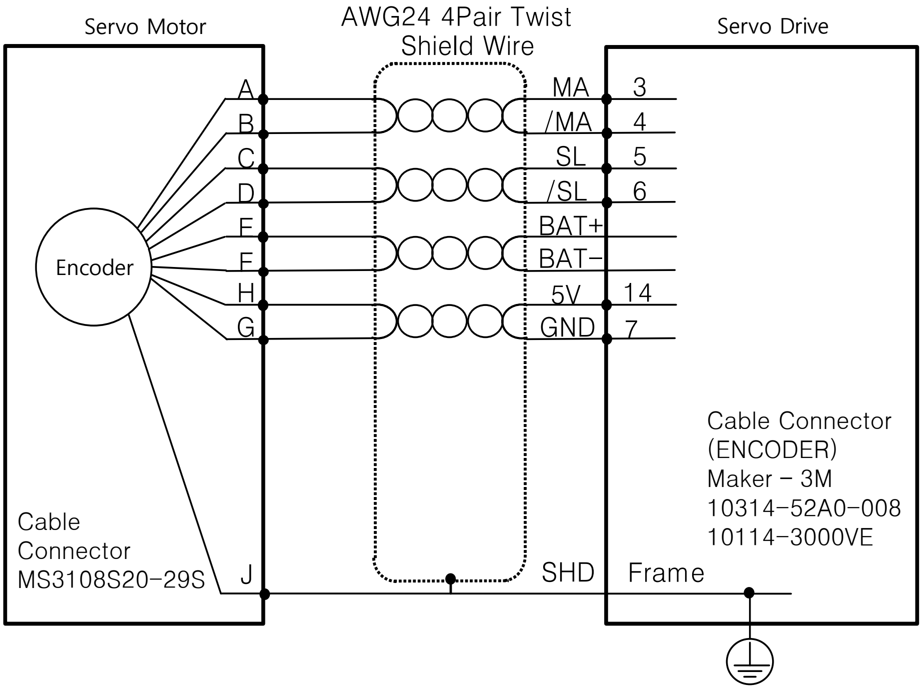


2.6.3 Multi-Turn Encoder Signaling Unit Wiring

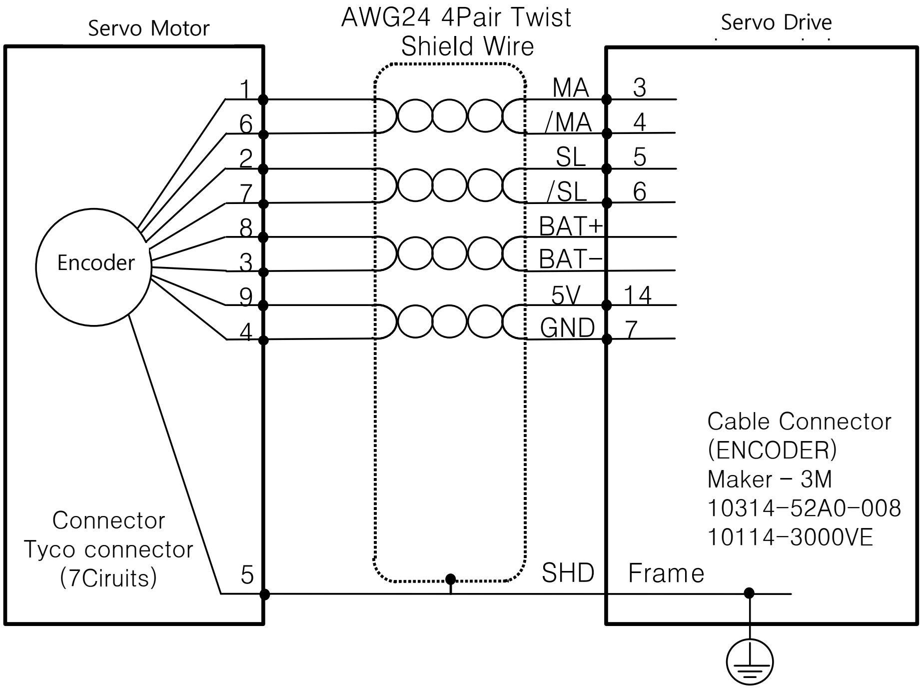
■ APCS-E□□□CS1 Cable



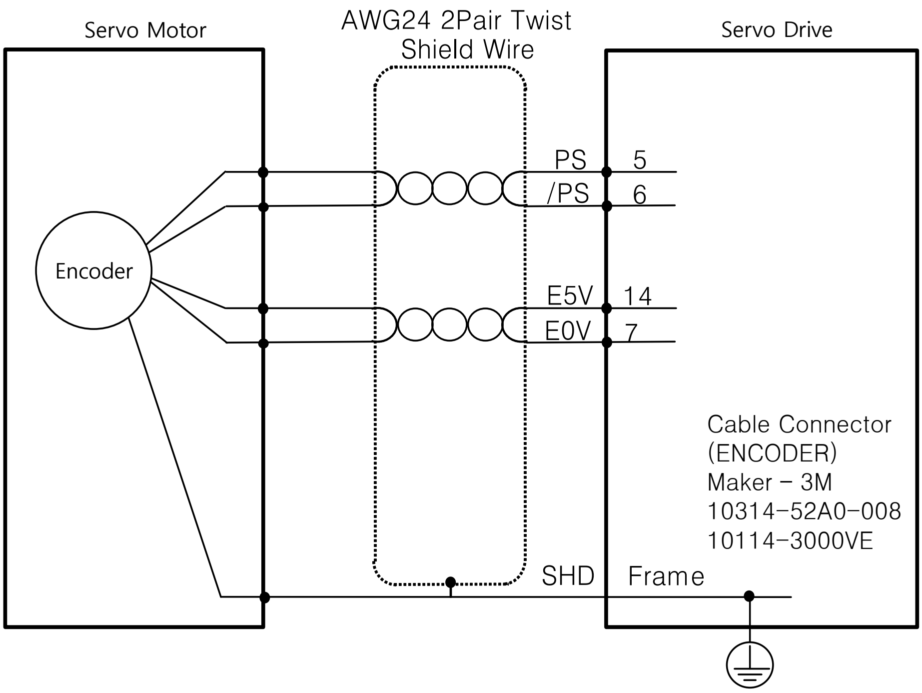
■ APCS-E□□□DS1 Cable



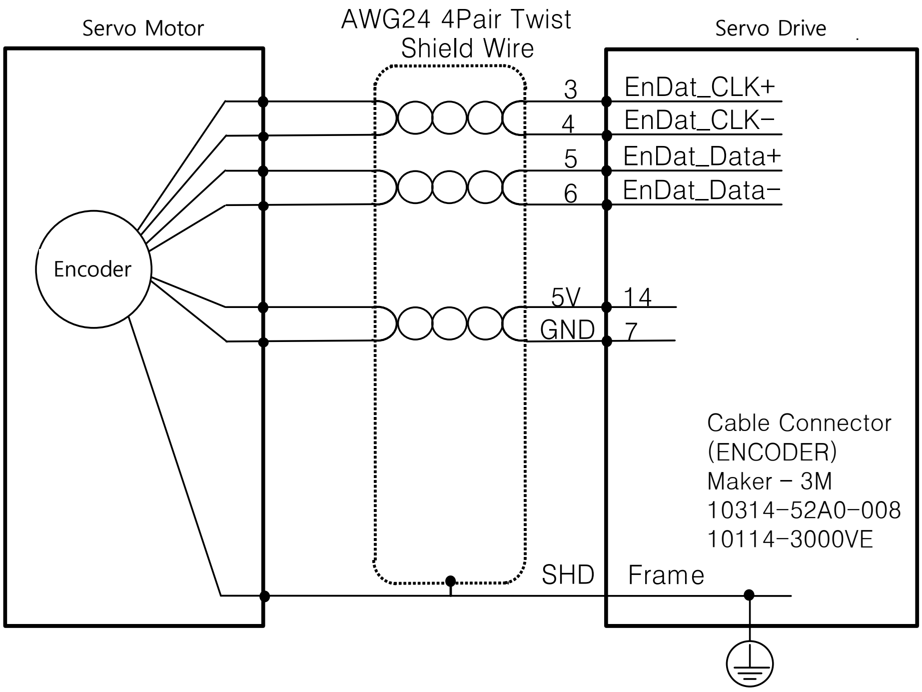
■ **APCS-E□□□ES1 Cable**



2.6.4 Tamagawa Encoder Signaling Unit Wiring

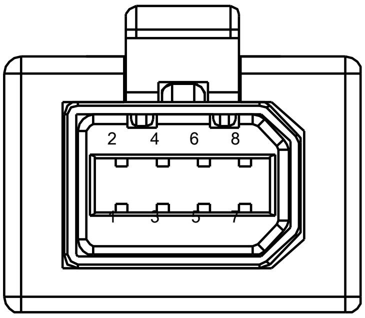


2.6.5 EnDat 2.2 Encoder Signaling Unit Wiring



2.7 Wiring for Safety Function Signals (STO)

■ **2069577-1(Tyco Electronics)**



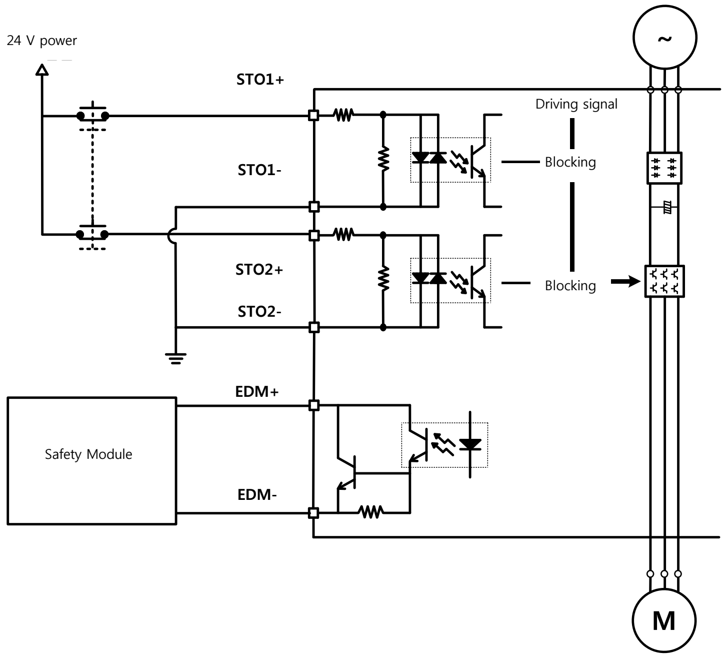
2.7.1 Names and Functions of Safety Function Signals

Pin Number	name	Function
1	+12V	For bypass wiring
2	-12V	
3	STO1-	DC 24 V GND
4	STO1+	Blocks the current (torque) applied to the motor when the signal is off.
5	STO2-	DC 24 V 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-	

2.7.2 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.

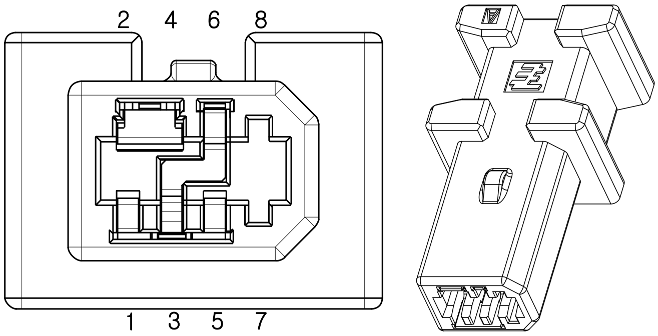


2.7.3 Bypass Wiring of Safety Function Signal

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.

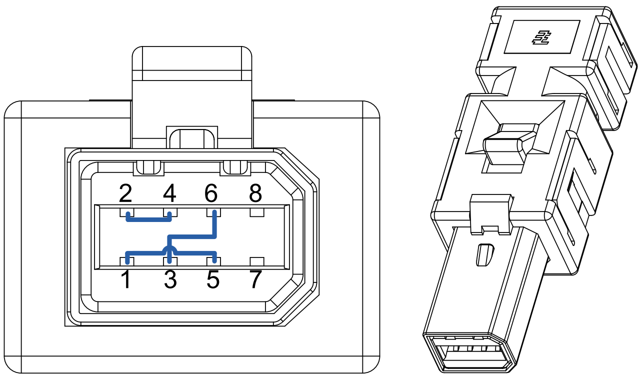
If you connect +12V to STO2-, -12V to STO1+ and STO1- to STO2+ for wiring of the Mini I/O Plug connector, you can bypass the safety function signal. Never use this power (+12V,-12V) except for this purpose.

■ Mini I/O By-pass Connector



1971153-1(Tyco Electronics)

■ Mini I/O Plug Connector



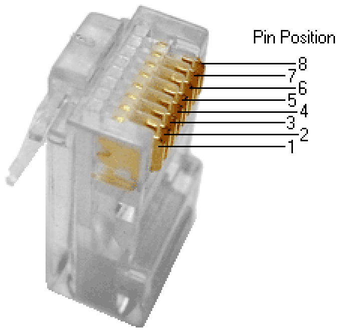
2069577-1(Tyco Electronics)

2.8 Wiring for EtherCAT Communication Signals

2.8.1 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

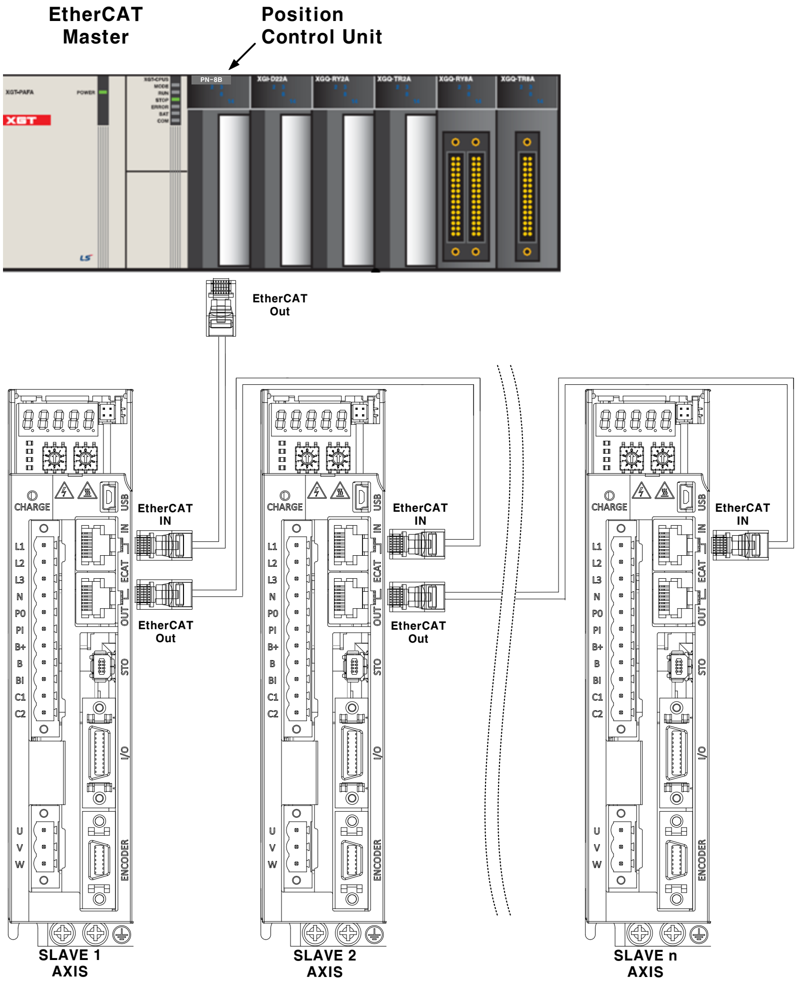


Note 1) EtherCAT only uses signals from No. 1, 2, 3, and 6.

2.8.2 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 basic line type.

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



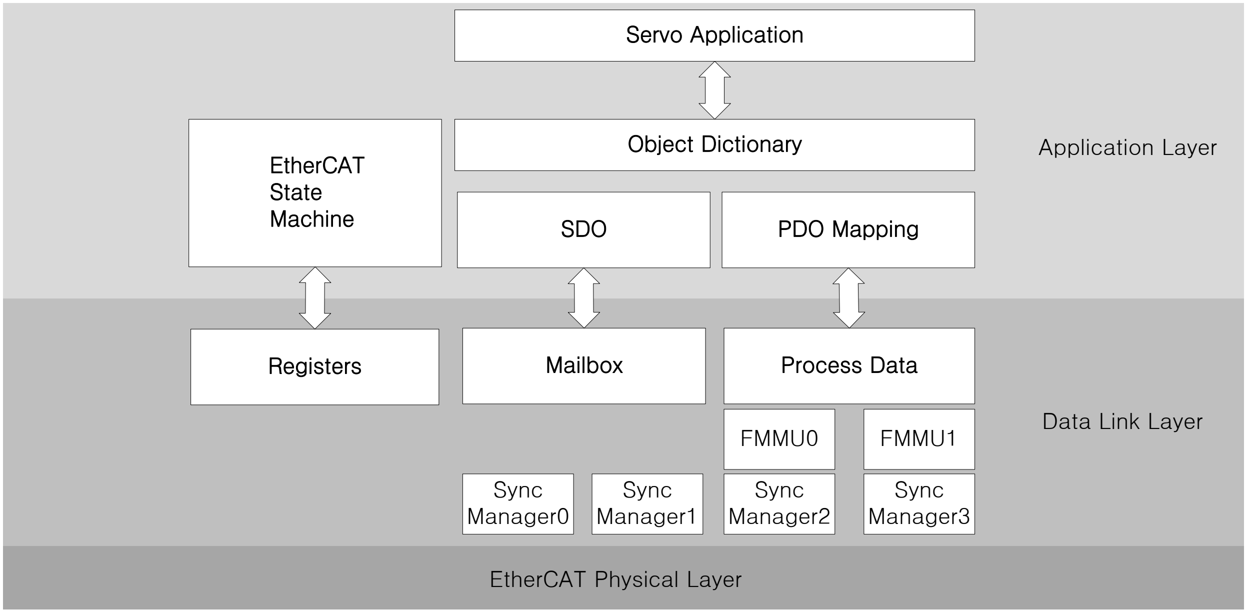
3. EtherCAT Communication

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

The basic concept of the 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. Based on the Ethernet of 100BASE-TX, therefore, 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 it to common TCP/IP.

3.1 Structure of CANopen over EtherCAT

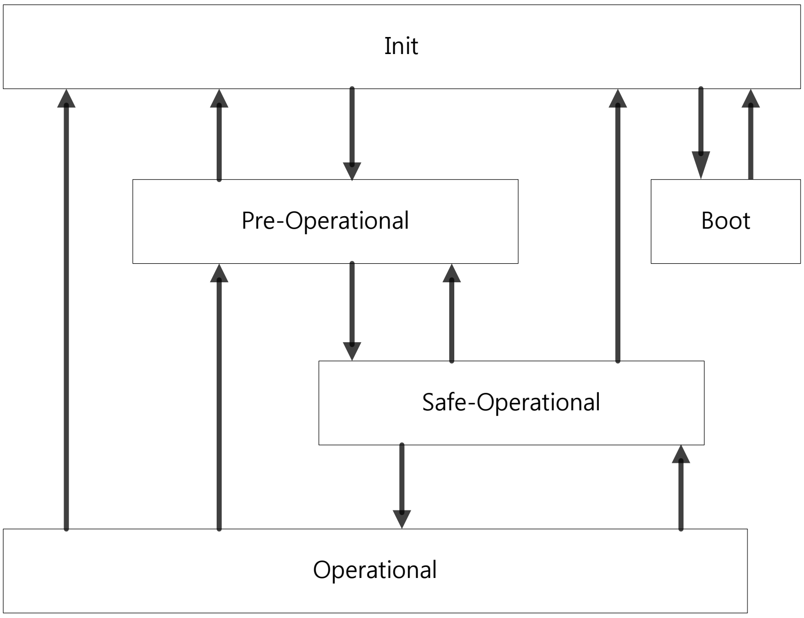


This drive supports a CiA 402 drive profile. The Object Dictionary in the application layer includes application data and PDO (Process Data Object) mapping information from the process data interface and application data.

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 not performed periodically; and all of the parameters defined in the Object Dictionary are accessible.

3.1.1 EtherCAT State Machine

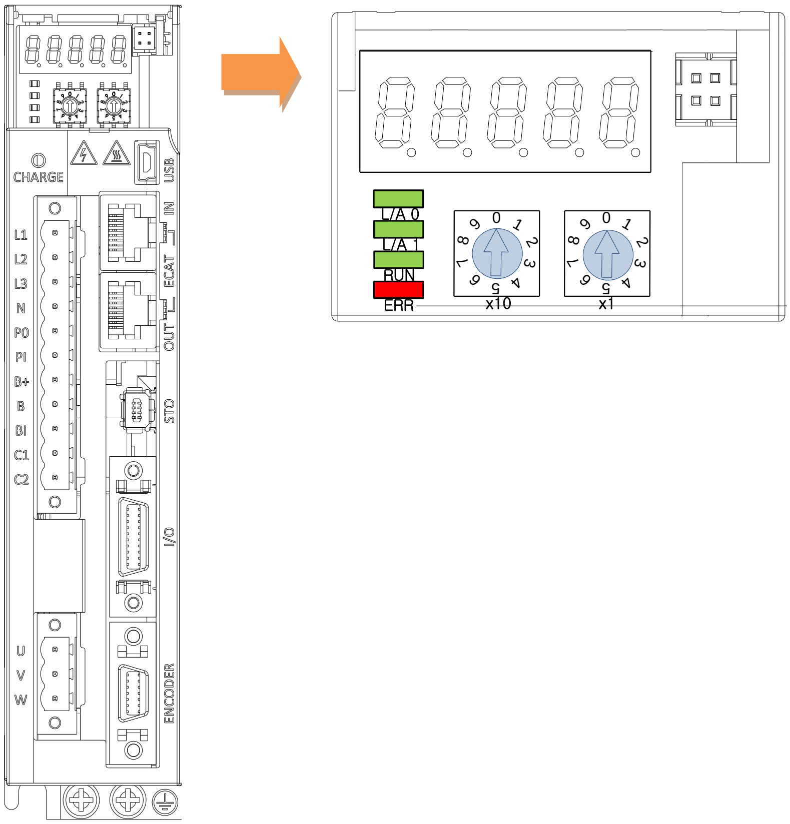


The EtherCAT drive has 5 states as above, and a state transition is done by an upper level controller (master).

State	Details
Boot	A state for firmware update. 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 can not 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.

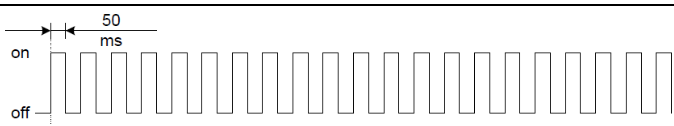
3.2 Status LED

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, which are L/A0, L/A1, and RUN, and 1 red ERR LED.



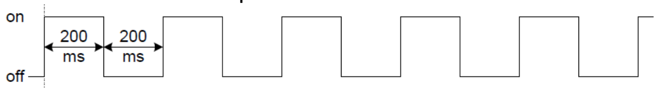
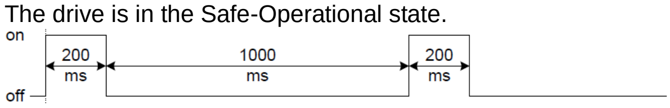
■ L/A0, L/A1 (Link Activity) LED

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.

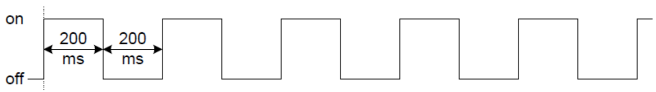
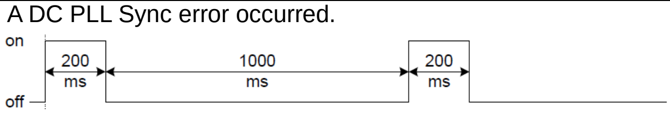
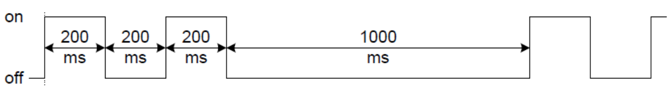
■ RUN LED

The RUN LED indicates in which status 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 normal state of the EtherCAT communication 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 the 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.

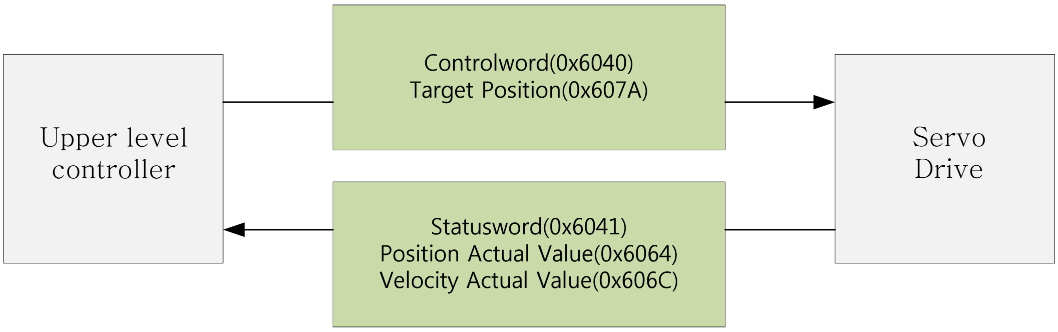
Codes	Description	Range
SINT	Signed 8bit	-128 ~127
USINT	Unsigned 8bit	0 ~ 255
INT	Signed 16bit	-32768 ~ 32767
UINT	Unsigned 16bit	0 ~ 65535
DINT	Signed 32bit	-2147483648 ~ 2147483647
UDINT	Unsigned 32bit	0 ~ 4294967295
FP32	Float 32bit	Single precision floating point
STRING	String Value	

3.4 PDO assignment

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	Setting values		
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 to assign the Statusword, the Actual Position Value, and the Actual Velocity Value with the TxPDO (0x1A00).

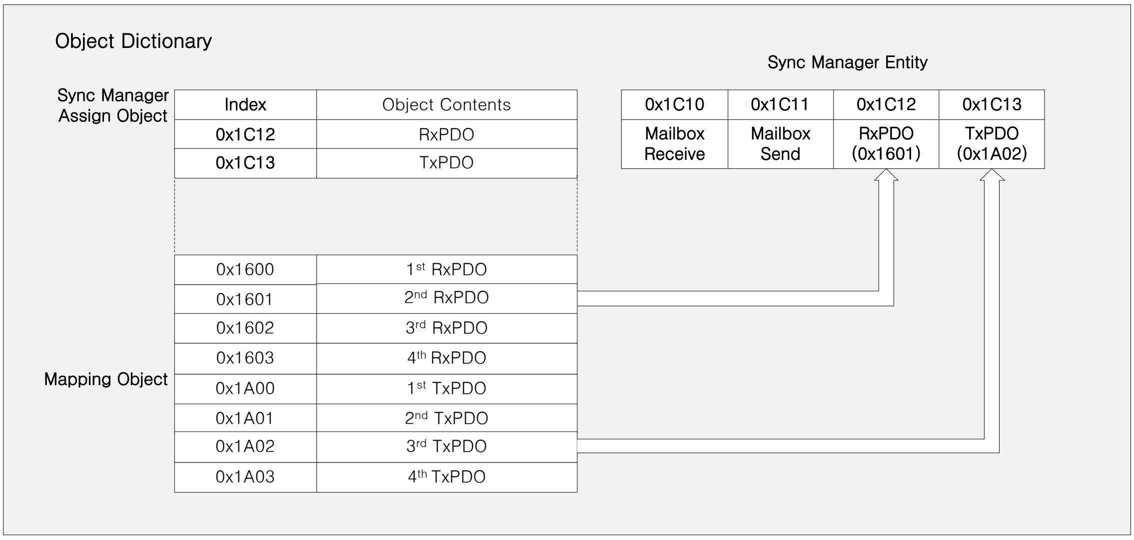
Index	SubIndex	Name	Data Type
0x6041	0x00	Statusword	UINT
0x6064	0x00	Actual Position Value	DINT
0x606C	0x00	Velocity Actual Value	DINT

The setting values of the TxPDO (0x1A00) are as follows:

SubIndex	Setting values		
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 the 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)	Modes of Operation (0x6060)	Touch Probe Function (0x60B8)					
TxPDO (0x1A00)	Statusword (0x6041)	Actual code value (0x6077)	Position actual value (0x6064)	Following error actual value (0x60F4)	Digital input (0x60FD)	Operation Mode Display (0x6061)	Command Speed (0x2601)	Drive speed (0x2600)	Touch probe status (0x60B9)	Touch probe 1 positive position value (0x60BA)

2nd PDO Mapping:

RxPDO (0x1601)	Controlword (0x6040)	Target (0x607A)	Touch Probe Function (0x60B8)	Digital output (0x60FE)		
TxPDO (0x1A01)	Statusword (0x6041)	Position actual value (0x6064)	Following error actual value (0x60F4)	Touch probe status (0x60B9)	Touch probe 1 positive 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)	Position actual value (0x6064)	Touch probe status (0x60B9)	Touch probe 1 positive 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)	Position actual value (0x6064)	Touch probe status (0x60B9)	Touch probe 1 positive 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.

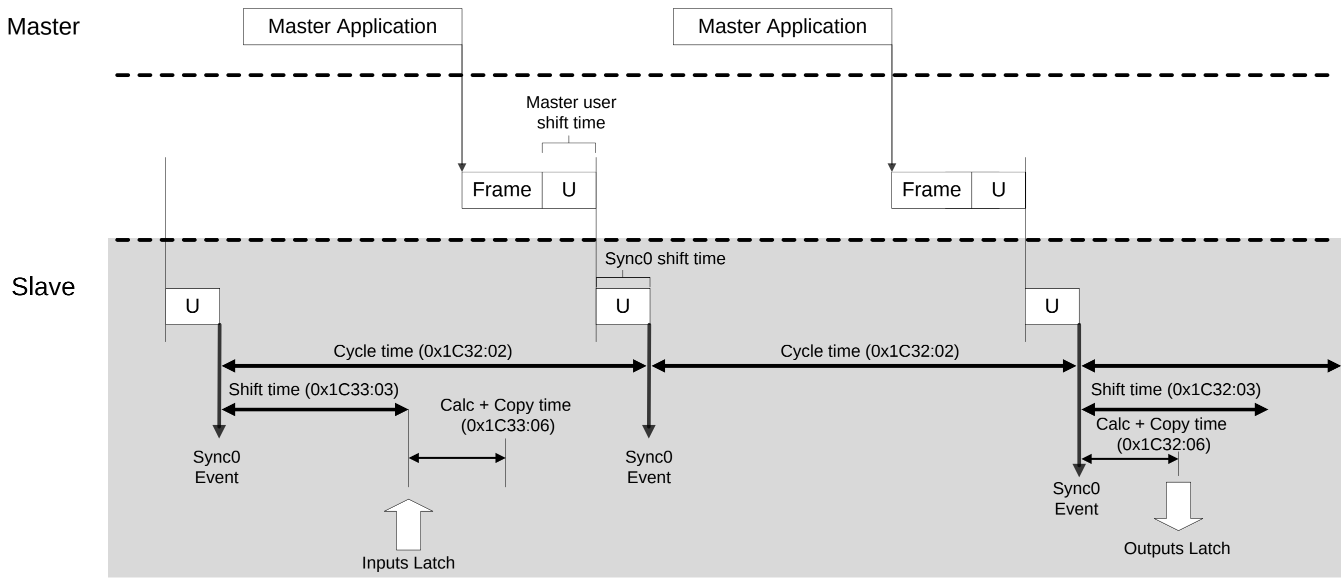
The following synchronization modes exist in this drive. You can change the mode with the sync control register.

(1) Free-run Mode:

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

(2) DC Synchronous Mode:

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

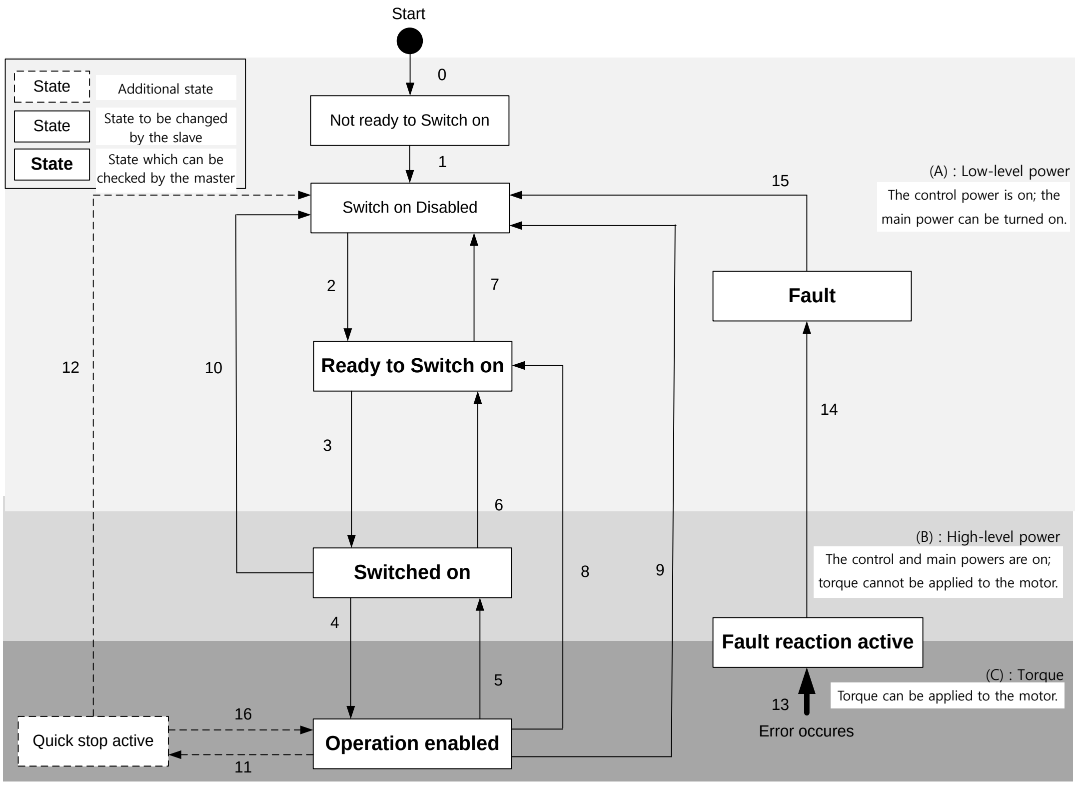
Emergency messages are passed to the master via mailbox communication when a servo alarm occurs in the drive. Emergency messages may not be sent in the event of communication failure.

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

Switching states of the State Machine can be done through combinations of Controlword (0x6040) bits setting, 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 through 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	Torque limit active	
15	Drive specific	

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

■ Related Objects

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

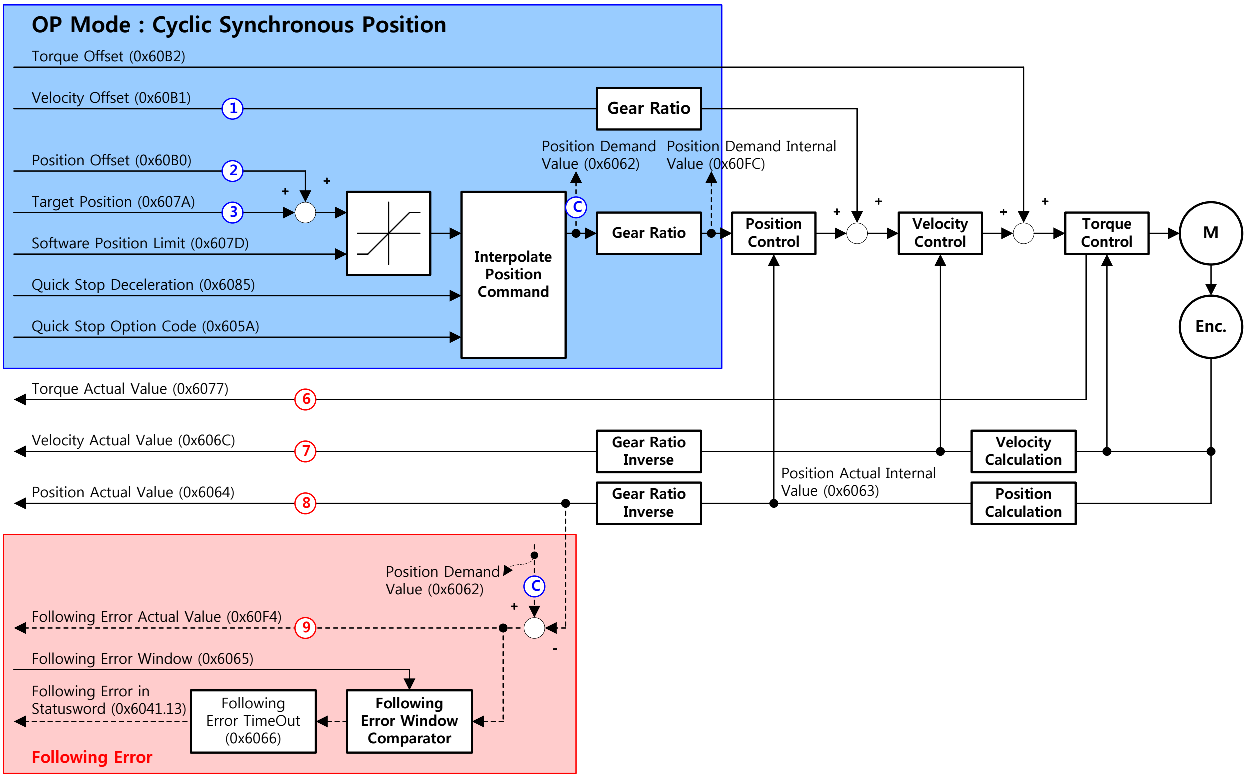
4.3 Position Control Modes

4.3.1 Cyclic Synchronous Position Mode

The Cyclic Synchronous Position (CSP) mode receives the target position (0x607A), 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) corresponding the speed and torque feedforwards respectively, and pass them to the drive.

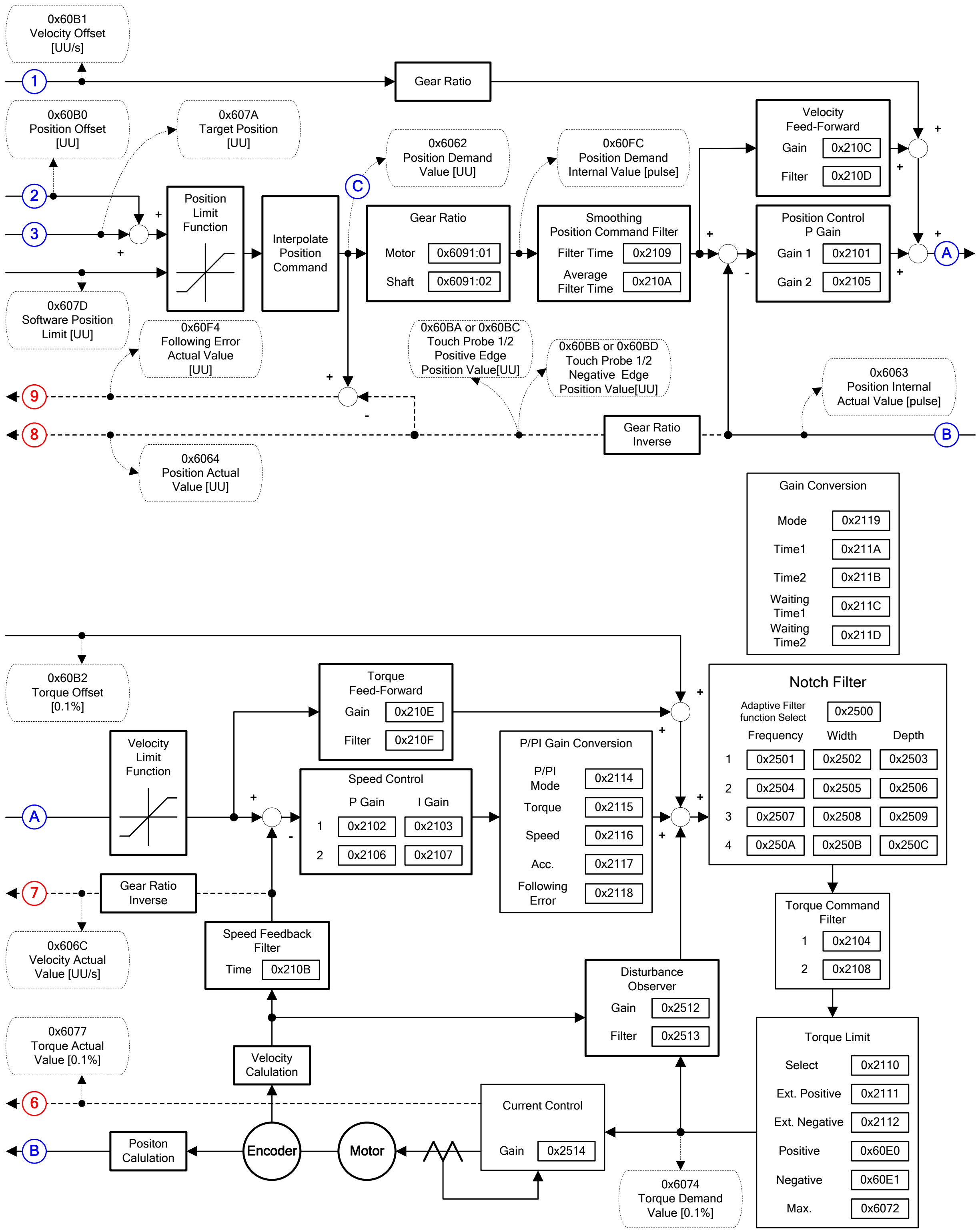
The block diagram of the CSP mode is as follows:



■ 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	-	Velocity Actual 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	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

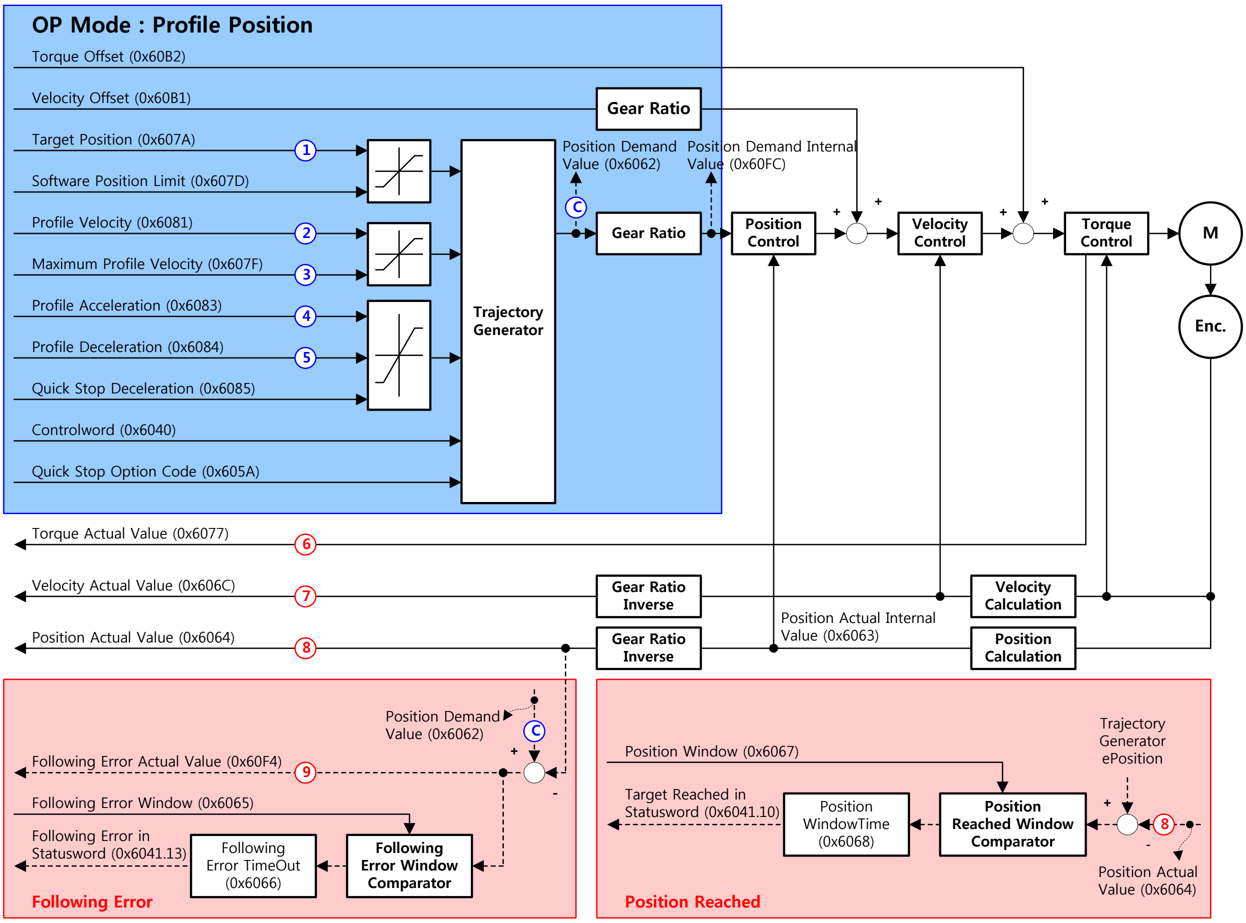
■ Internal Block Diagram of CSP Mode



4.3.2 Profile Position Mode

Unlike the CSP mode receiving the target position, renewed at every PDO update cycle, from the upper level controller, in the 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 the PP mode is as follows:

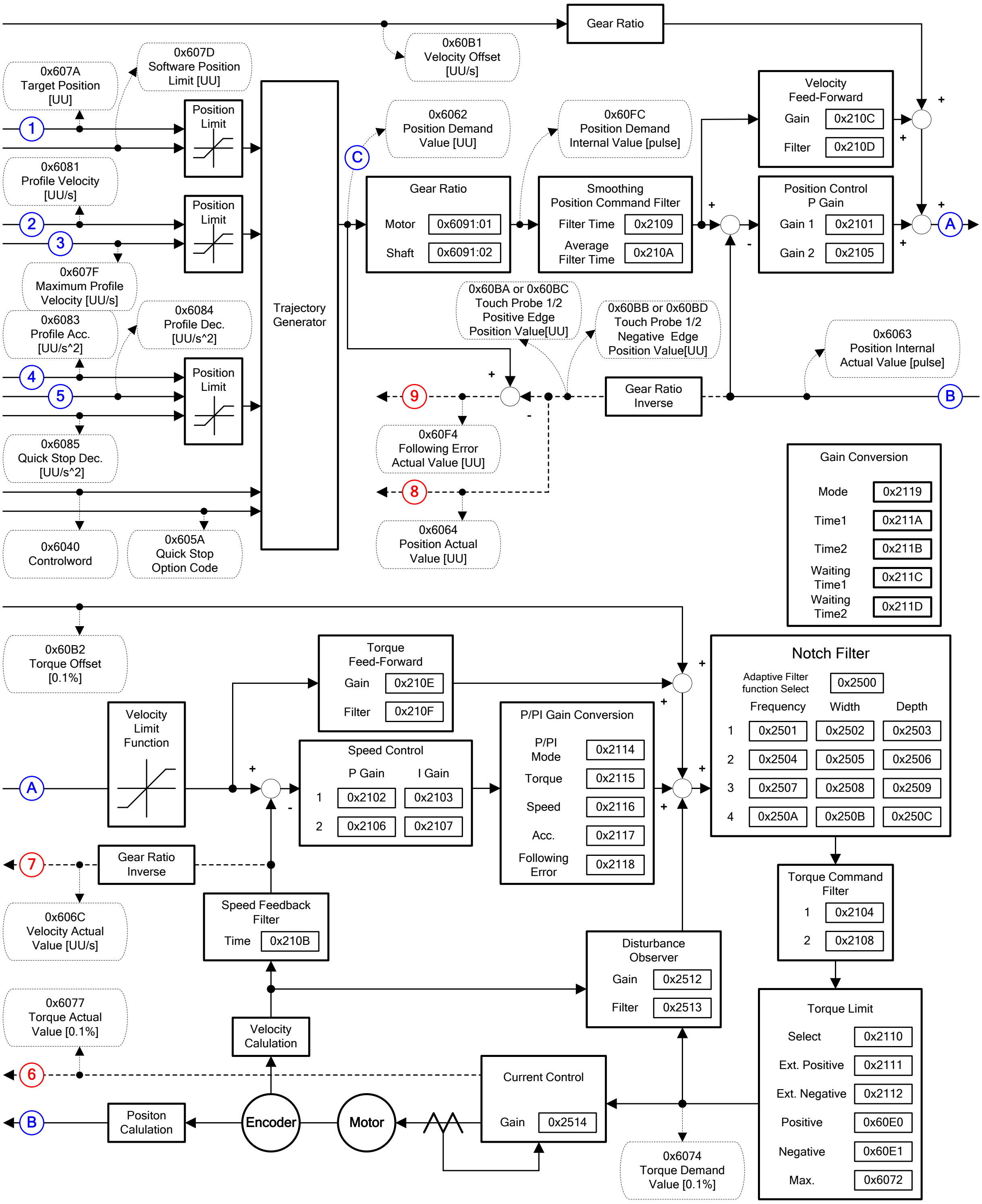


■ Related Objects

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/s^2
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%
0x6062	-	Position Demand Value	DINT	RO	Yes	UU
0x60FC	-	Position Demand Internal Value	DINT	RO	Yes	pulse
0x606C	-	Velocity Actual 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	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal 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

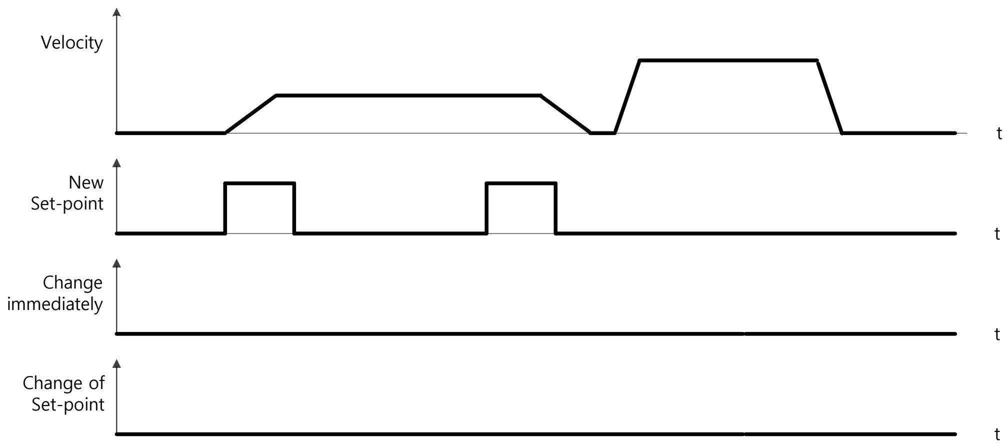
  After receiving a new position command while driving to the target position, it drives to the new position regardless of the existing target position.

- Set of Set point

  After receiving 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 a combination of the New setpoint bit (Controlword, 0x6040.4), the Change set immediately bit (Controlword, 0x6040.5), and the Change setpoint bit (Controlword, 0x6040.9).

Single Set Point Driving Procedure

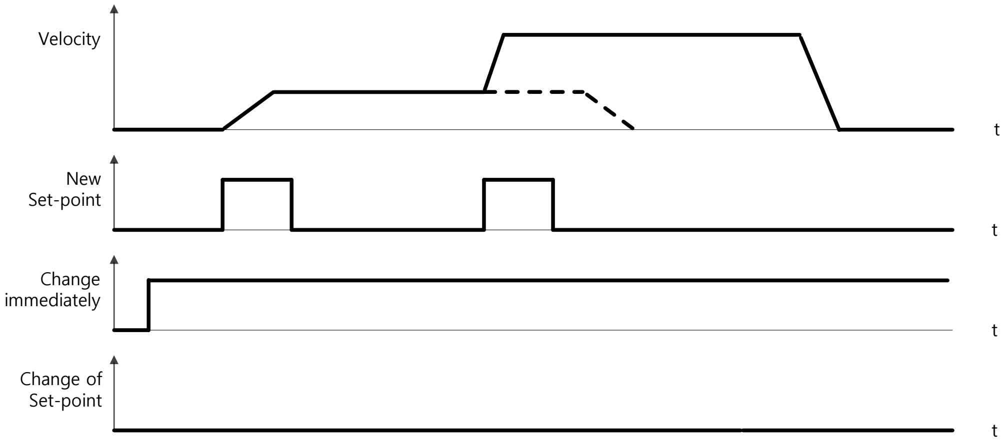


(1) Specify the target position (0x607A).

(2) Set the New setpoint 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



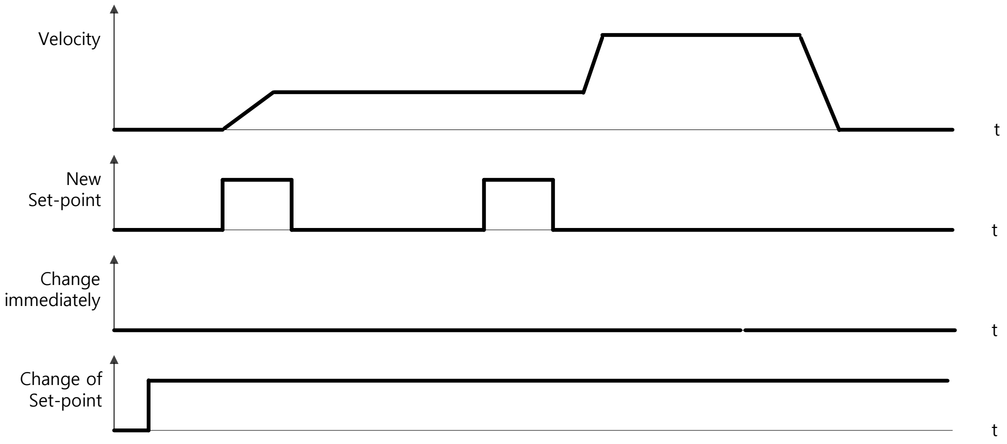
(1) Specify the target position (0x607A).

(2) Set the New setpoint 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 setpoint) 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 setpoint 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 setpoint).

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

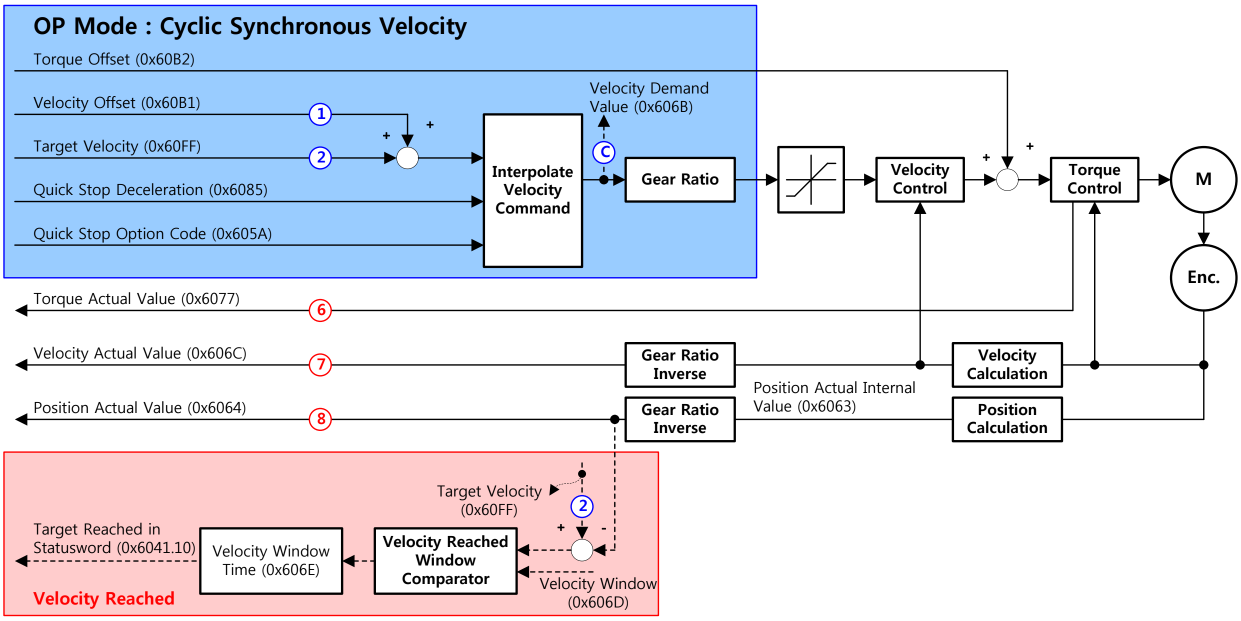
4.4 Velocity Control Mode

4.4.1 Cyclic Synchronous Velocity Mode

The Cyclic Synchronous Velocity (CSV) mode receives the target velocity (0x60FF), 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) corresponding the torque feedforward and pass it to the drive.

The block diagram of the CSV mode is as follows:

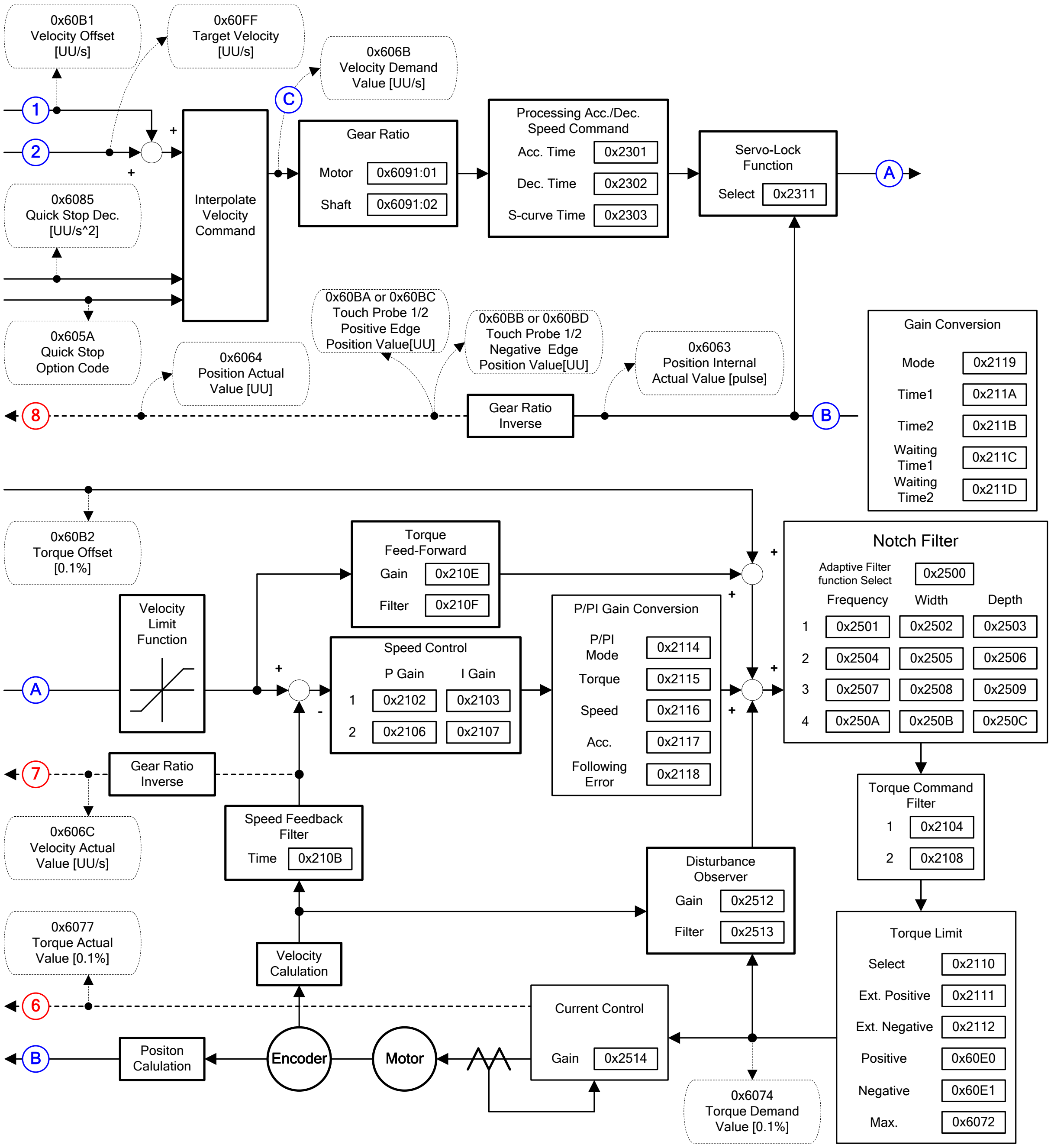


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
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	-	Velocity Actual 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	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of CSV Mode

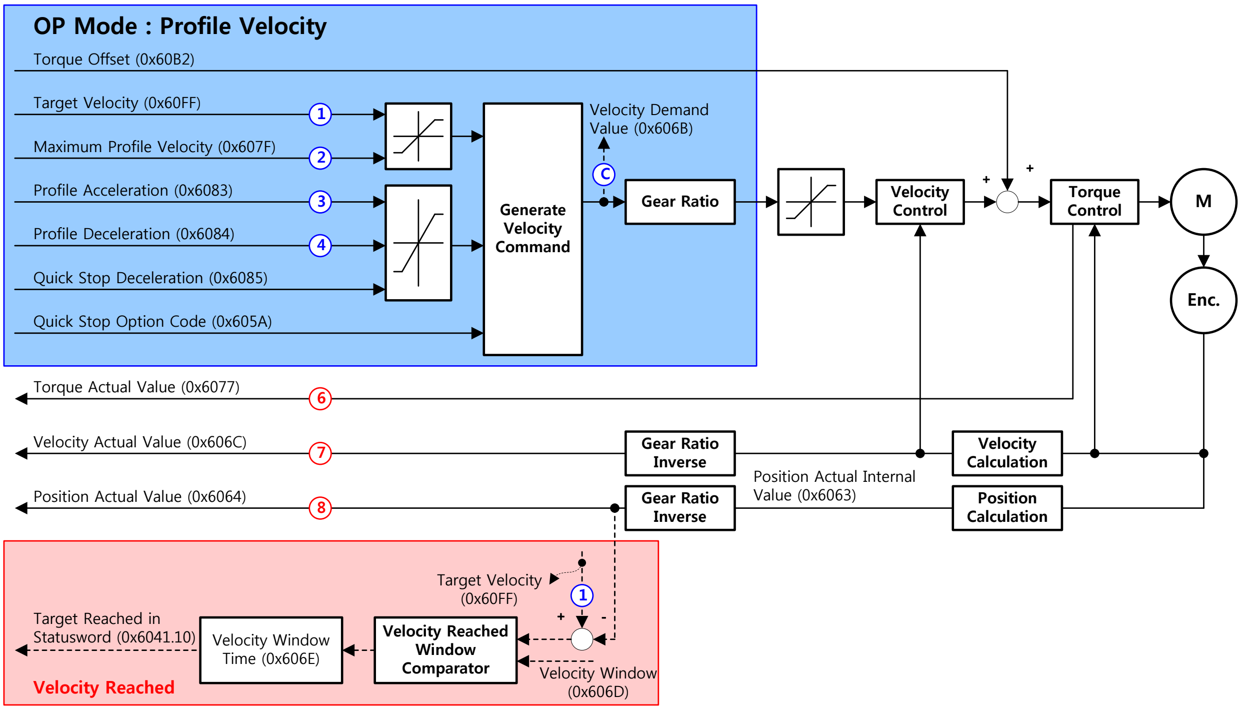


4.4.2 Profile Velocity Mode

Unlike the CSV mode receiving the target velocity, renewed at every PDO update cycle, from the upper level controller, in the 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 moment, the max. profile velocity (0x607F) limits the maximum velocity.

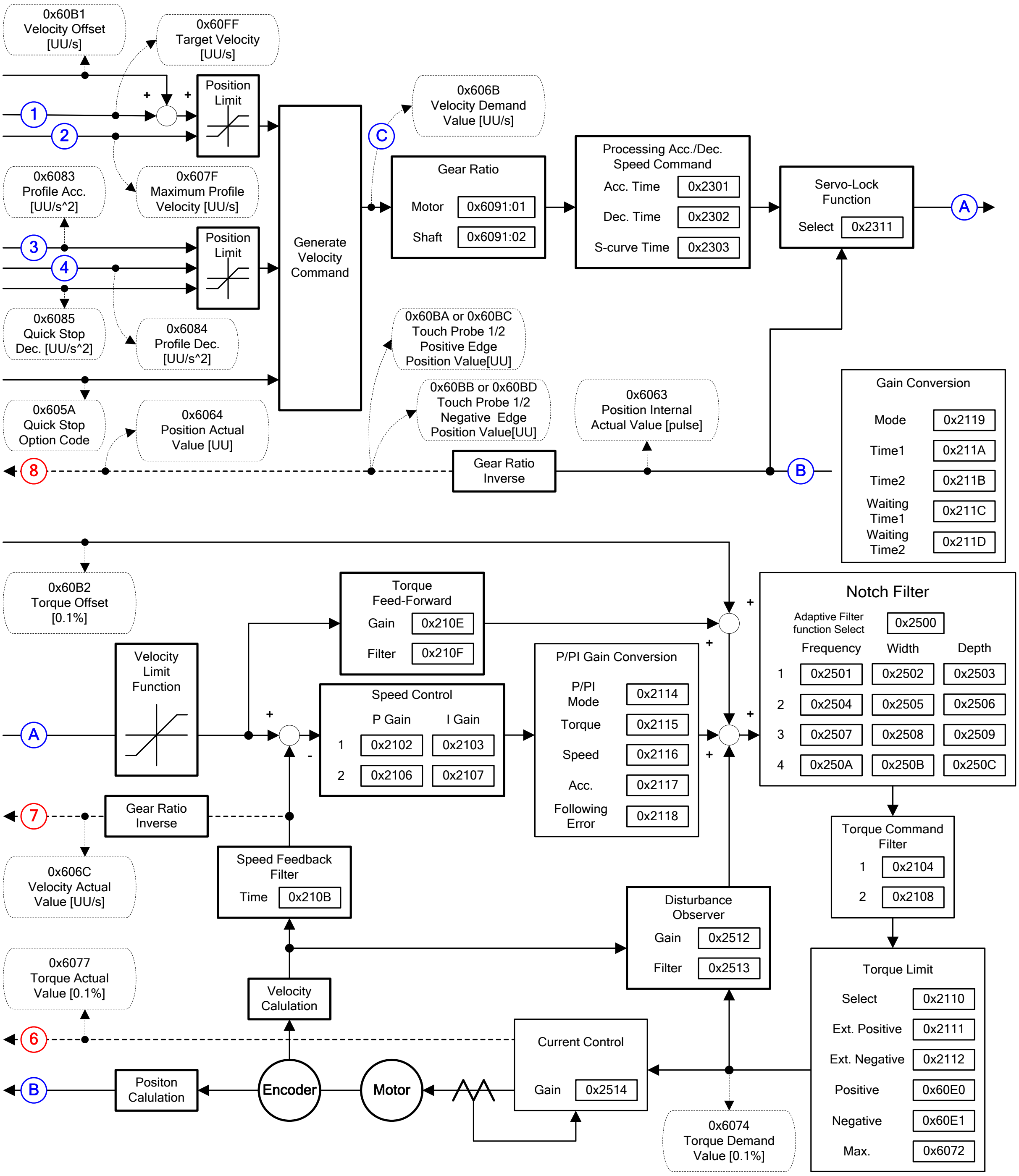
The block diagram of the PV mode is as follows:



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x60FF	-	Target Velocity	DINT	RW	Yes	UU/s
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6083	-	Profile Acceleration	UDINT	RW	No	UU/s^2
0x6084	-	Profile Deceleration	UDINT	RW	No	UU/s^2
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s^2
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	-	Velocity Actual 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	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of PV Mode



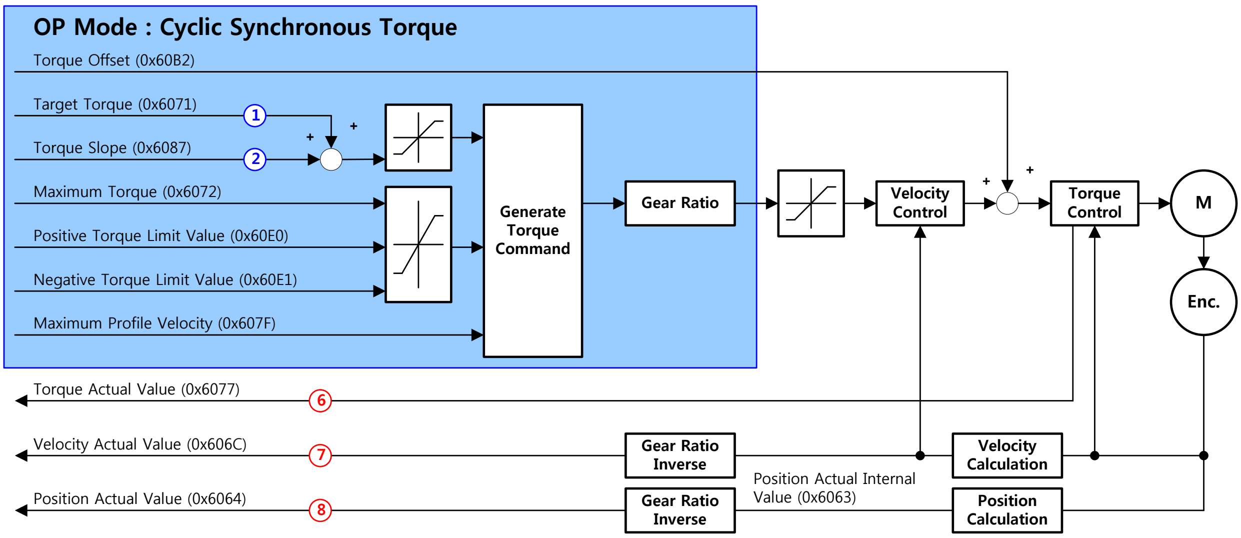
4.5 Torque Control Modes

4.5.1 Cyclic Synchronous Torque Mode

The Cyclic Synchronous Torque (CST) mode receives the target torque (0x6071), 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) corresponding the torque feedforward and pass it to the drive.

The block diagram of the CST mode is as follows:

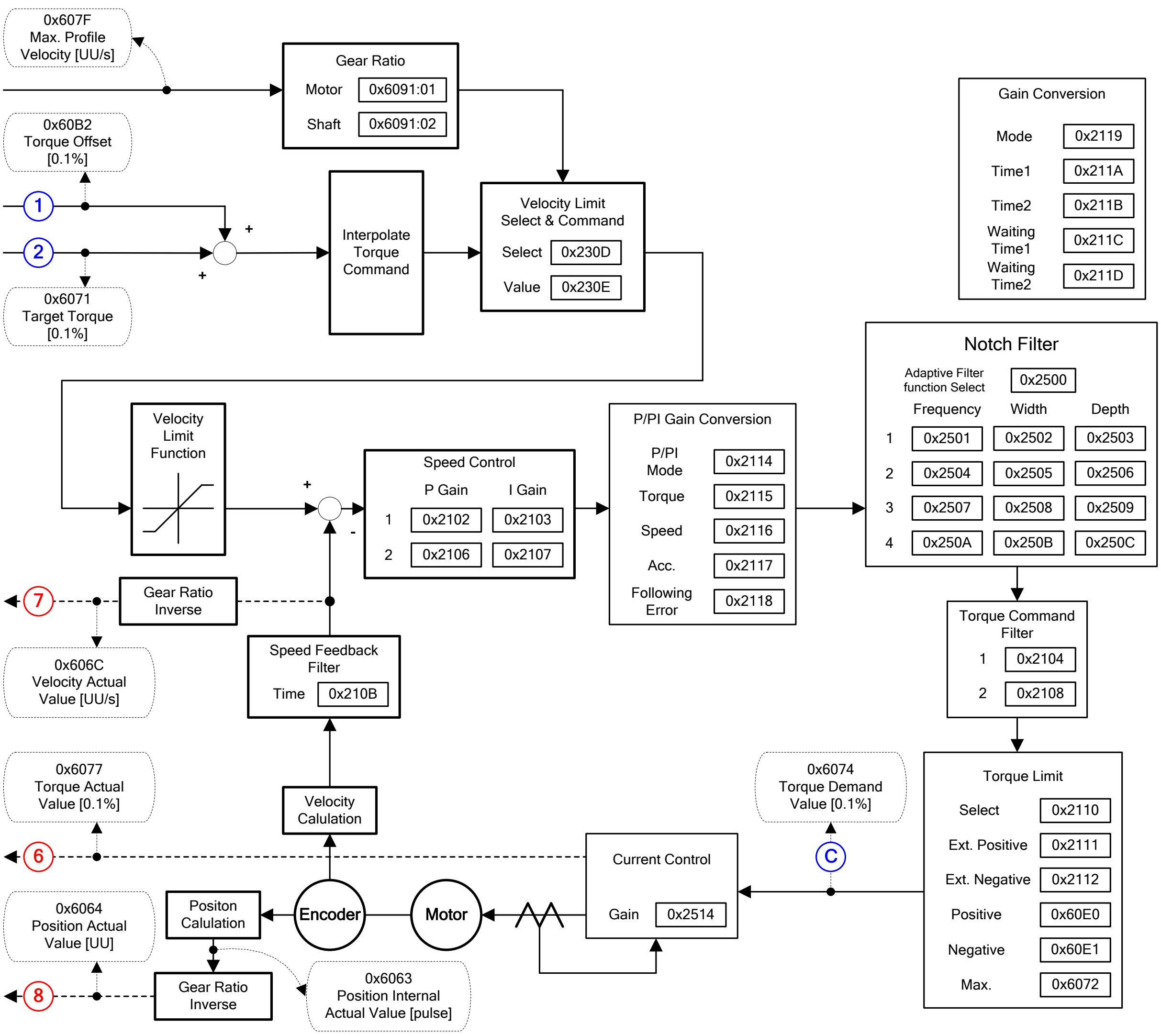


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Velocity	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	-	Velocity Actual 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	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of CST Mode

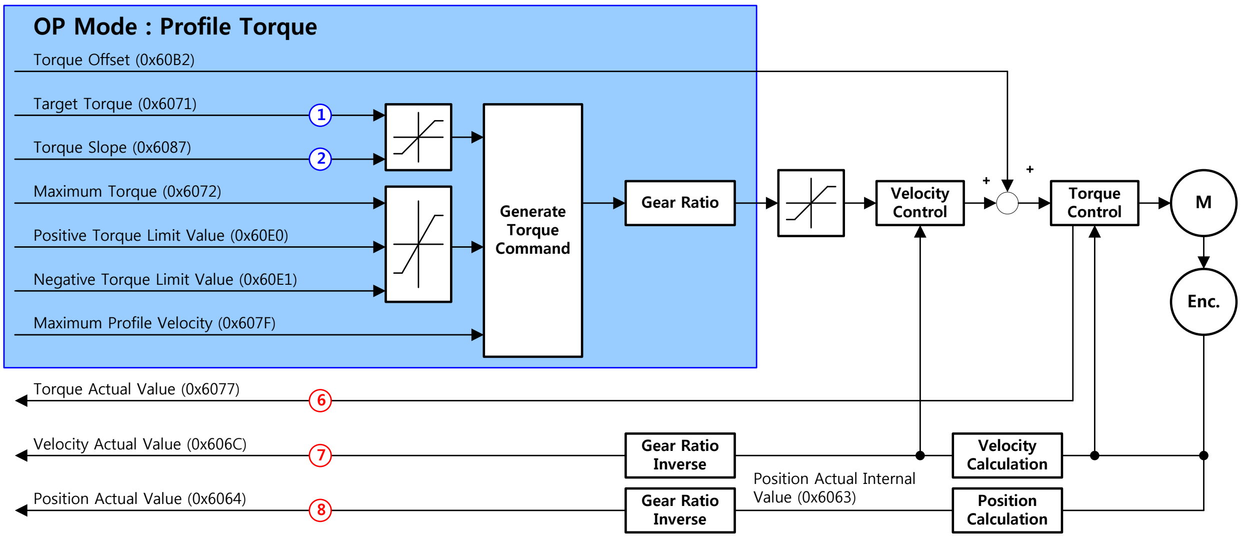


4.5.2 Profile Torque Mode

Unlike the CST mode receiving the target torque, renewed at every PDO update cycle, from the upper level controller, in the 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 Positive/Negative Torque Limit Value (0x60E0 and 0x60E1) and the Maximum Torque (0x6072) based on its driving direction.

The block diagram of the PT mode is as follows:

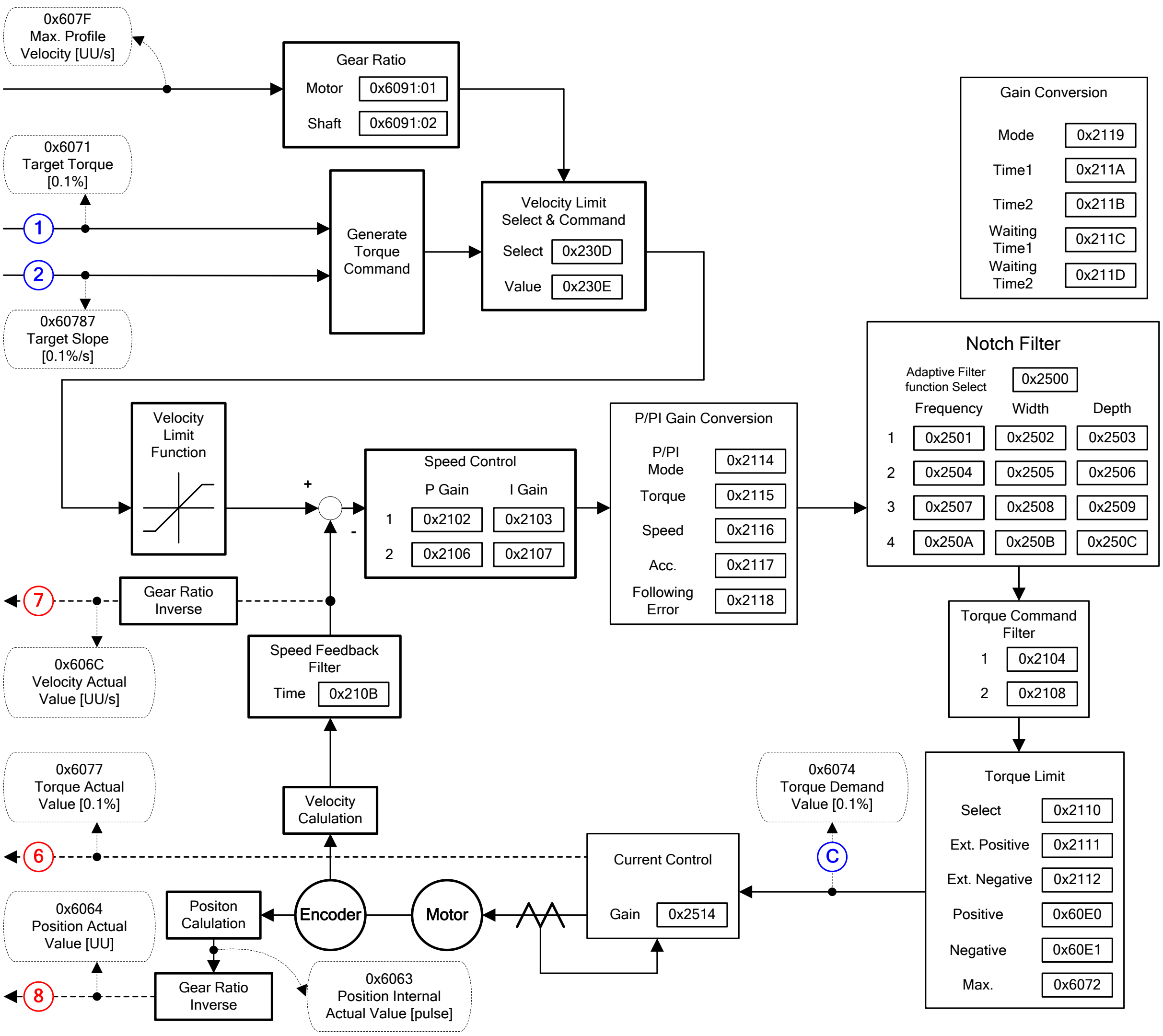


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Velocity	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	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s

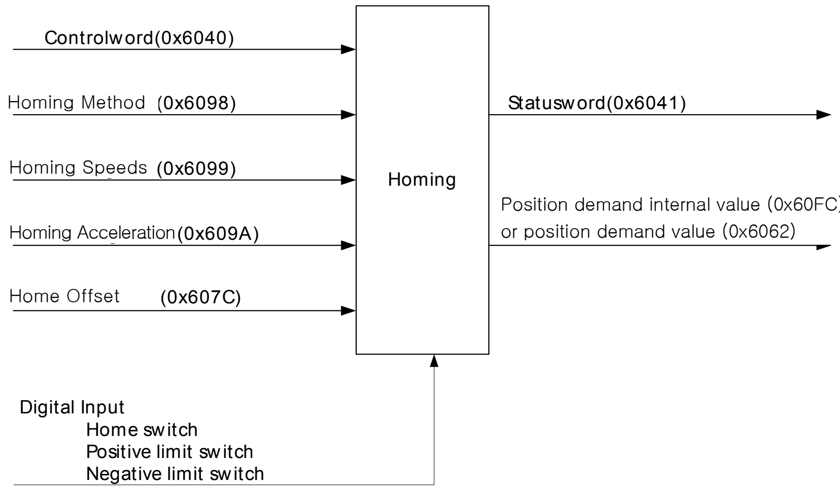
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of PT Mode

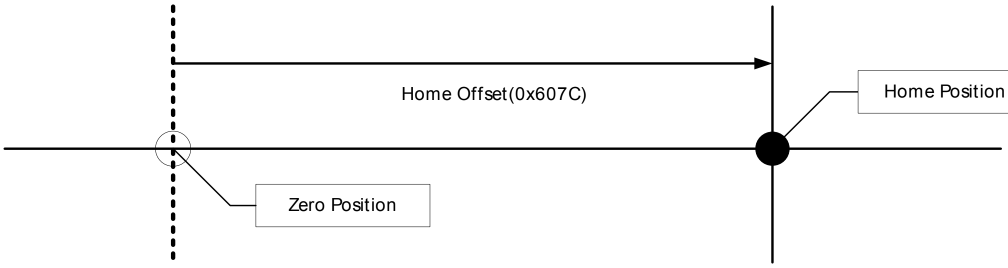


4.6 Homing

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

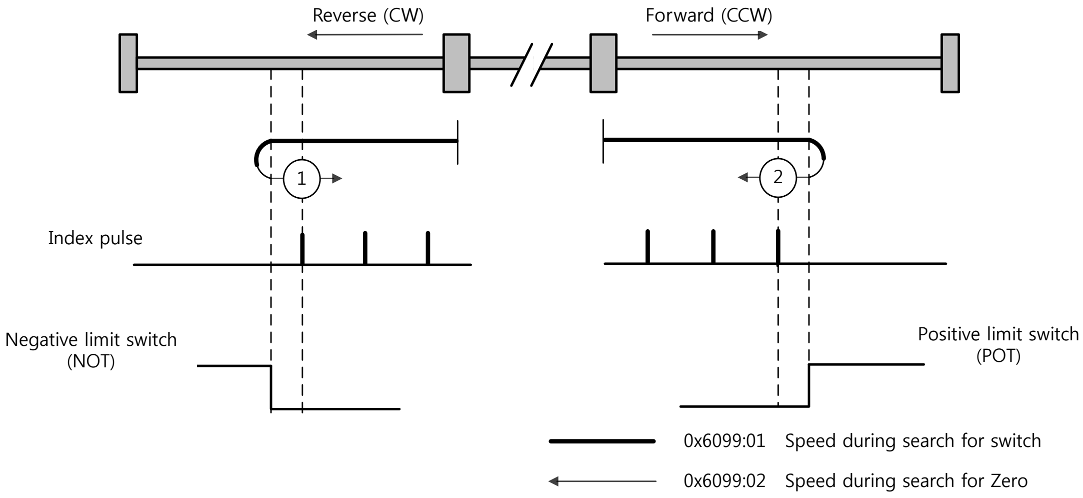
The drive supports the following homing methods (0x6098):

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.
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 only returns to the home position with the negative stopper while driving in the reverse direction.
-4	The drive only returns to the home position with the positive stopper while driving in the forward direction.
-5	During reverse operation, the motor is returned to the orign by Home switch
-6	During foward operation, the motor is returned to the orign by Home switch

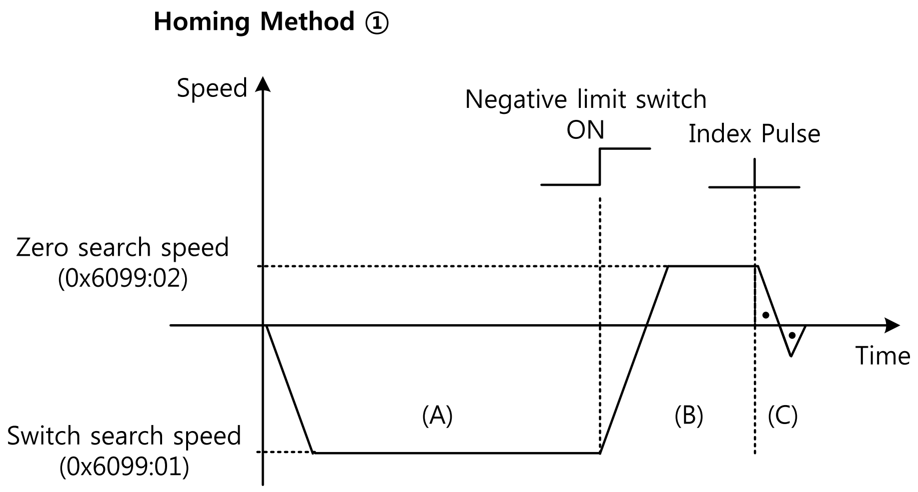
■ Related Objects

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	Speed during search for switch	UDINT	RW	Yes	UU/s
	2	Speed during search for zero	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:

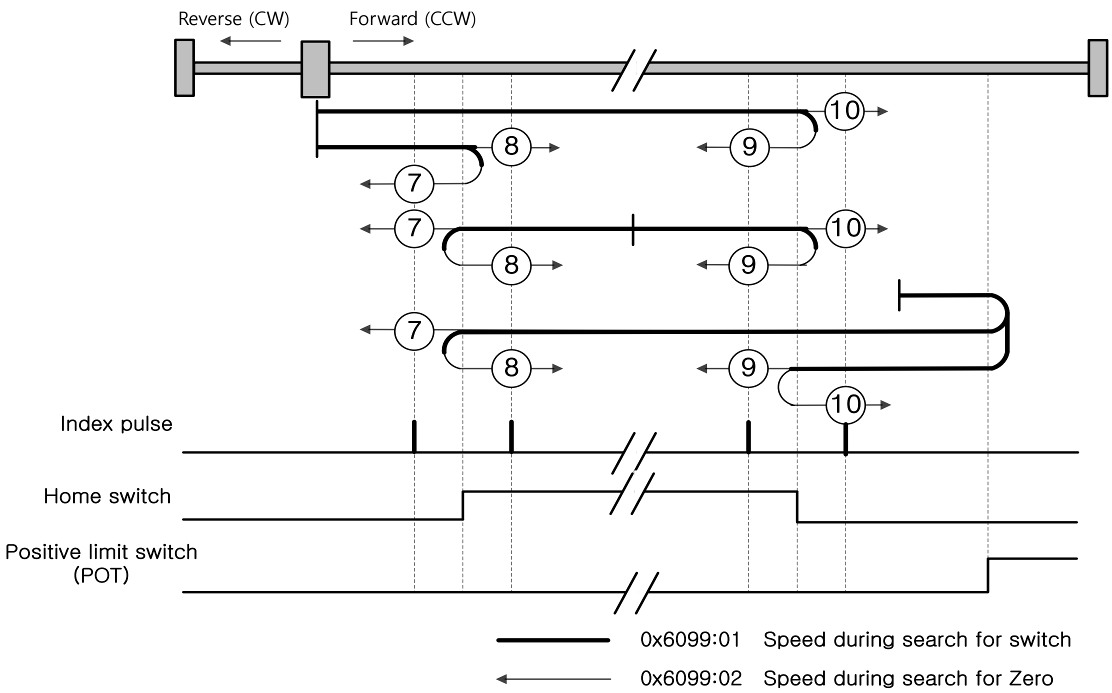


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

(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).

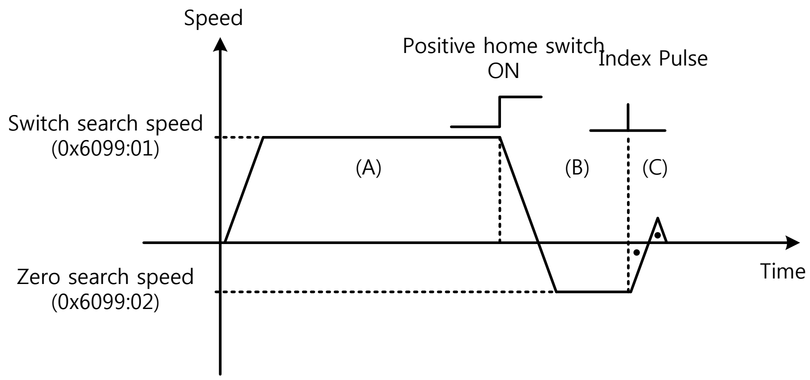
■ Methods 7, 8, 9, and 10



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 load position and the Home switch at homing, which is categorized into three cases as below. For more information, see the details below:

(1) At the start of homing, when the Home switch is OFF and the limit is not met during operation

Homing Method ⑦



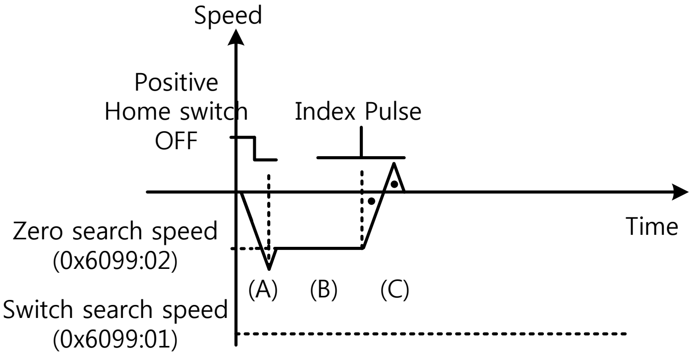
(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

(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) At the start of homing, when the Home switch is ON

Homing Method ⑦



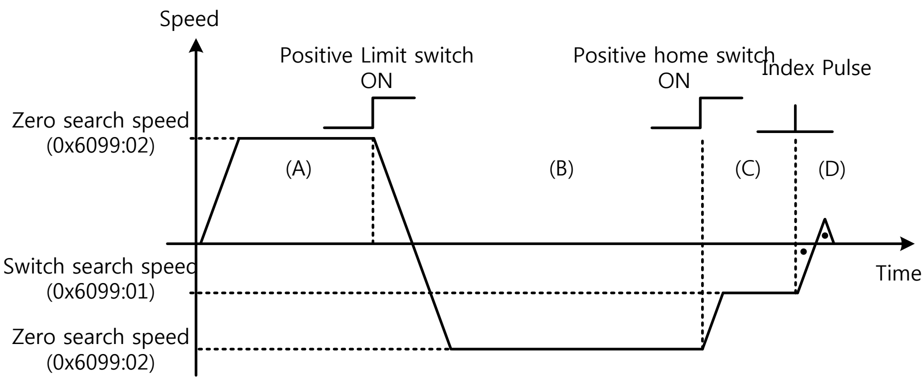
(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Positive Home Switch (CCW). It might not reach the Switch Search Speed depending on the start position of homing.

(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) At the start of homing, when the Home switch is OFF and the limit is met during operation

Homing Method ⑦



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

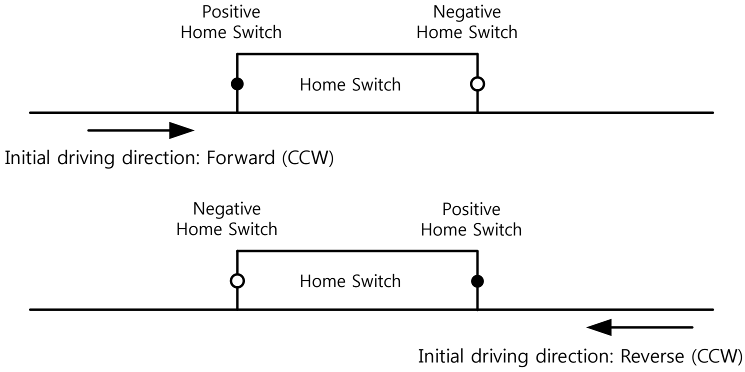
(B) When the positive limit switch (POT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the reverse direction (CW).

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

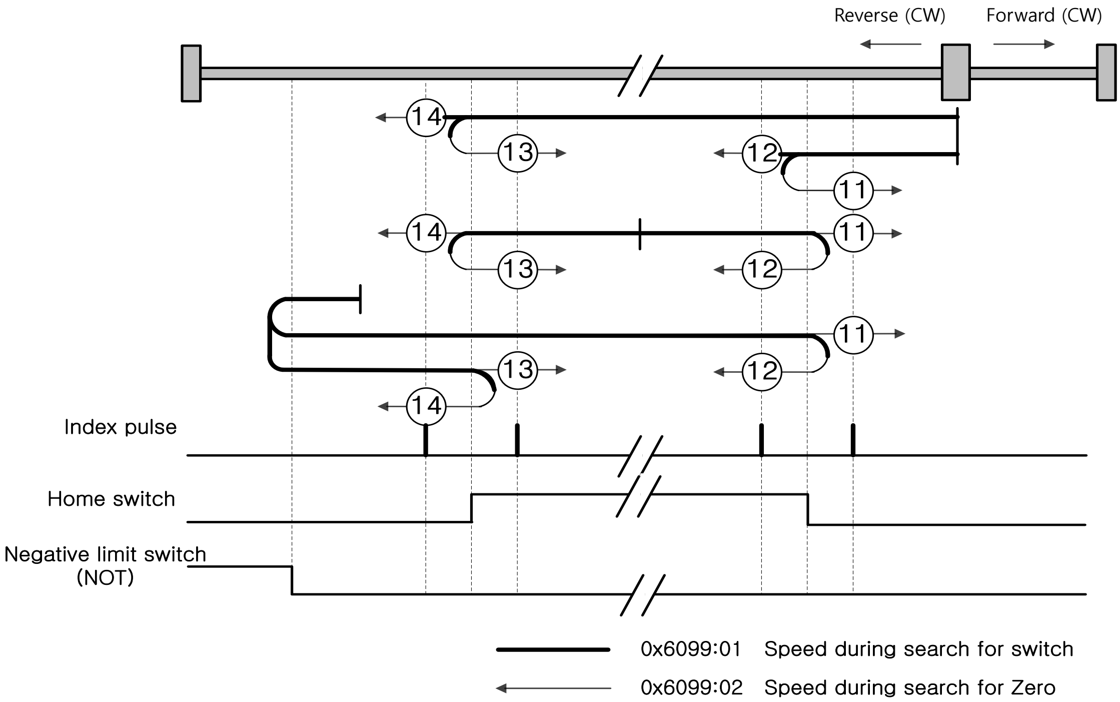
(D) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

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.



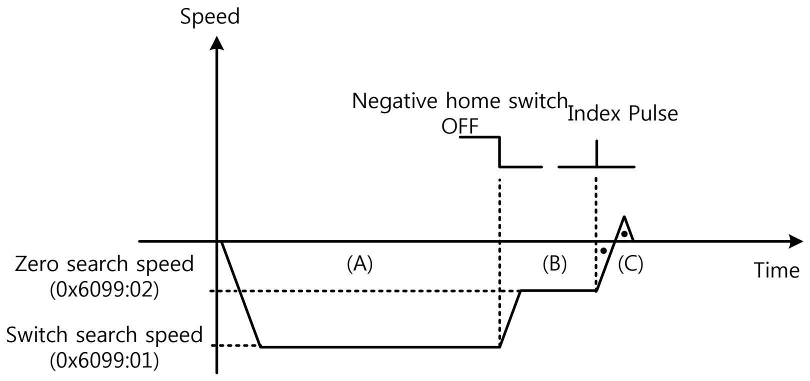
■ Methods 11, 12, 13, and 14



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 load position and the Home switch at homing, which is categorized into three cases as below. For more information, see the details below:

(1) At the start of homing, when the Home switch is OFF and the limit is not met during operation

Homing Method ⑭



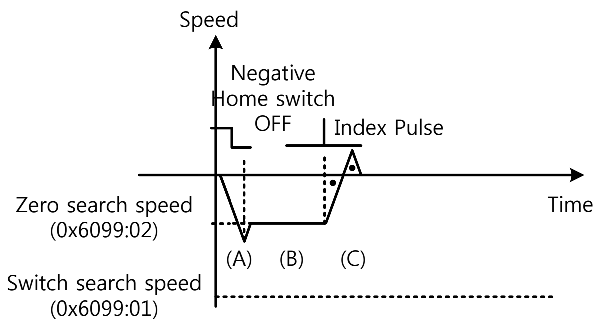
(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

(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) At the start of homing, when the Home switch is ON

Homing Method ⑭



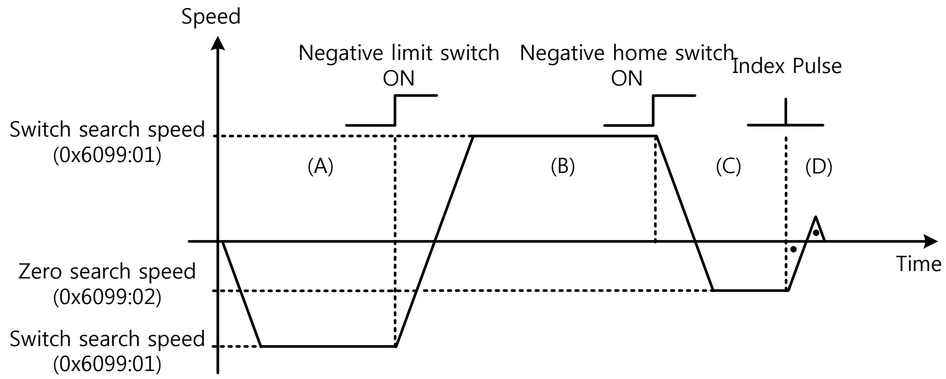
(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Negative Home Switch (CW). It might not reach the Switch Search Speed depending on the start position of homing.

(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) At the start of homing, when the Home switch is OFF and the limit is met during operation

Homing Method ⑭



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

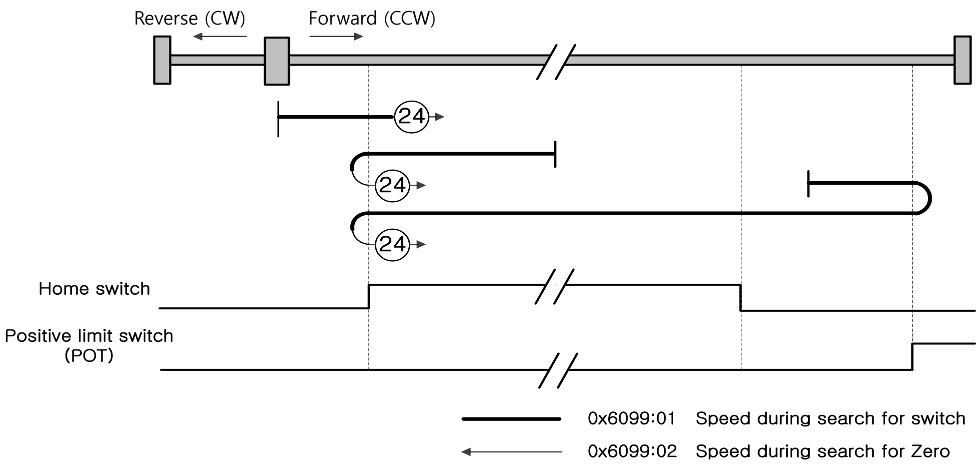
(B) When the negative limit switch (NOT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the forward direction (CCW).

(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).

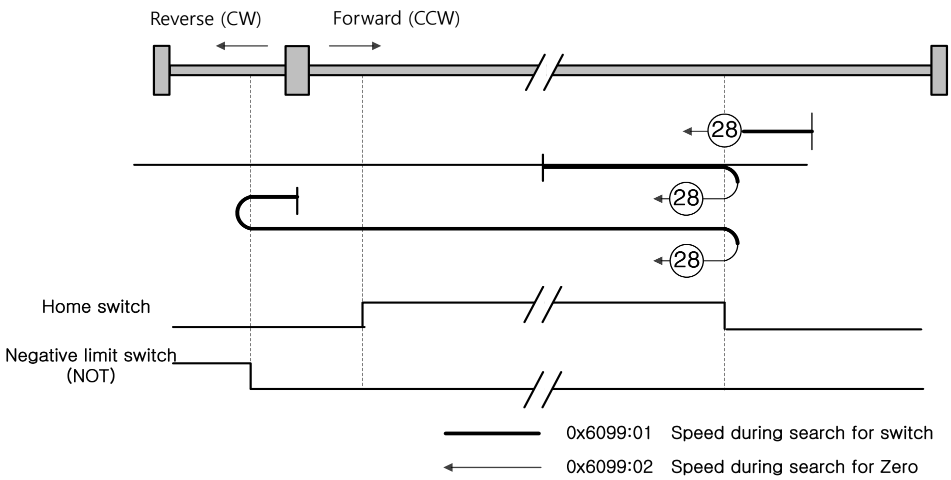
The methods from 11 to 13 are nearly identical to the method 14 in terms of the homing sequence. The only differences are the initial driving direction and Home switch polarity.

■ Method 24



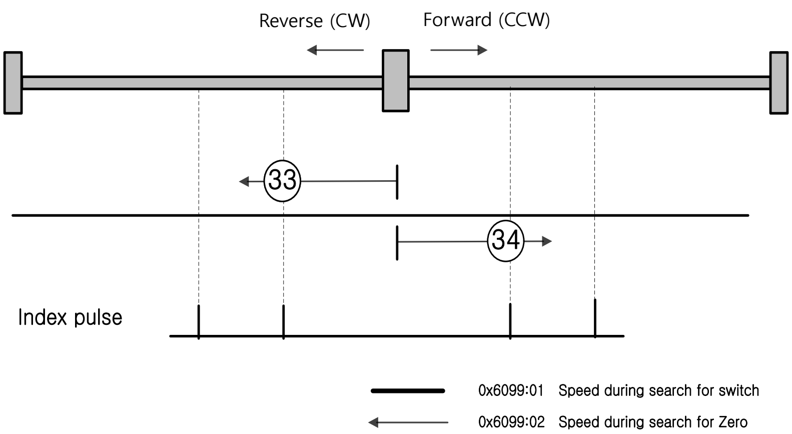
The initial driving direction is forward (CCW), and a point where the Positive Home Switch is turned on becomes the Home position.

■ Method 28



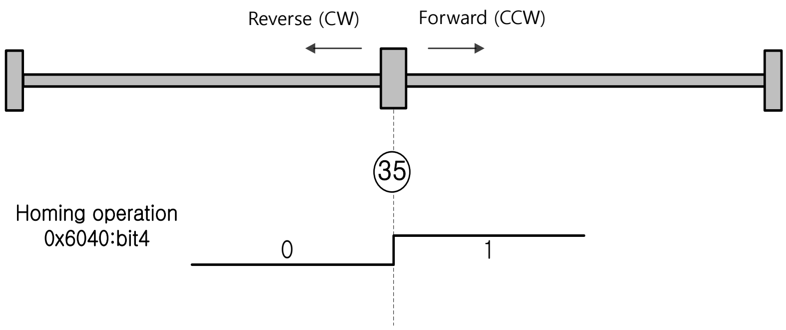
The initial driving direction is reverse (CW), and a point where the Positive Home Switch is turned on becomes the Home position.

■ 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.

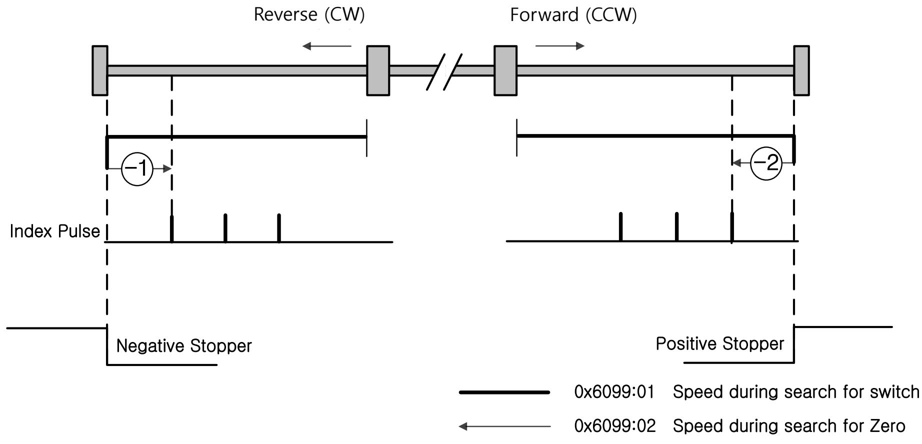
■ Method 35



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.

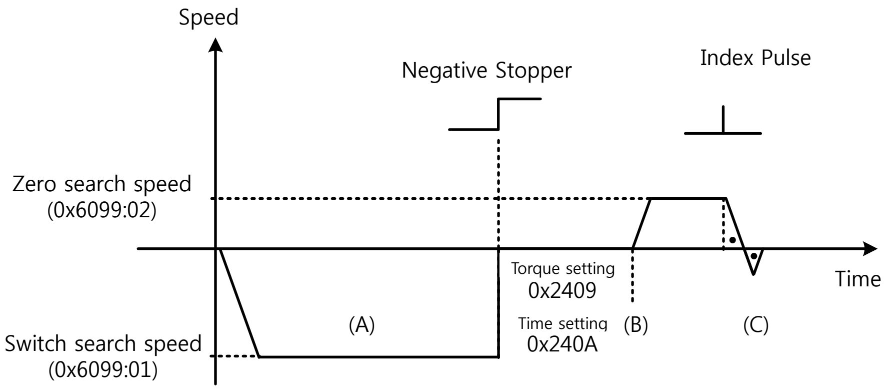
Homing methods -1, -2, -3 and -4 are supported by this drive besides the standard ones. They can be used if the Home switch is not used separately.

■ Method -1 and -2



Homing method -1 and -2 perform homing by using the Stopper and Index (Z) Pulse. The velocity profile according to sequence is as follows. For more information, see the details below:

Homing Method -1

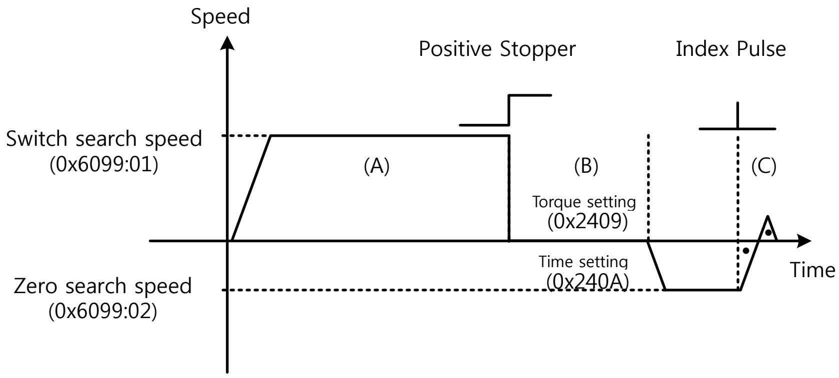


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

(B) (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

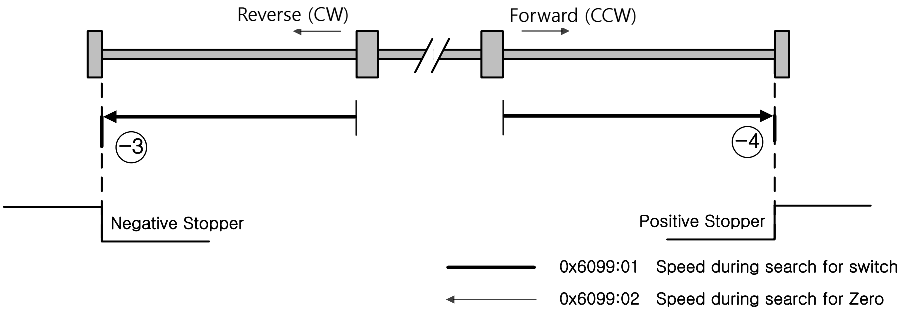


(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

(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.

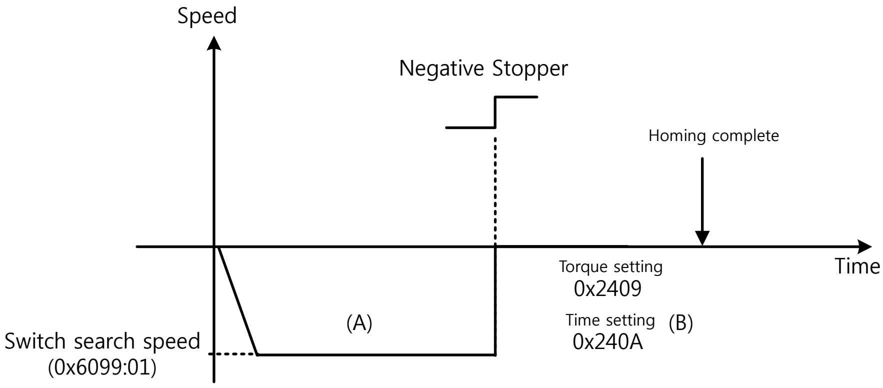
(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

■ Method -3 and -4



Homing method -3 and -4 only perform homing by using the Stopper. The velocity profile according to sequence is as follows. For more information, see the details below:

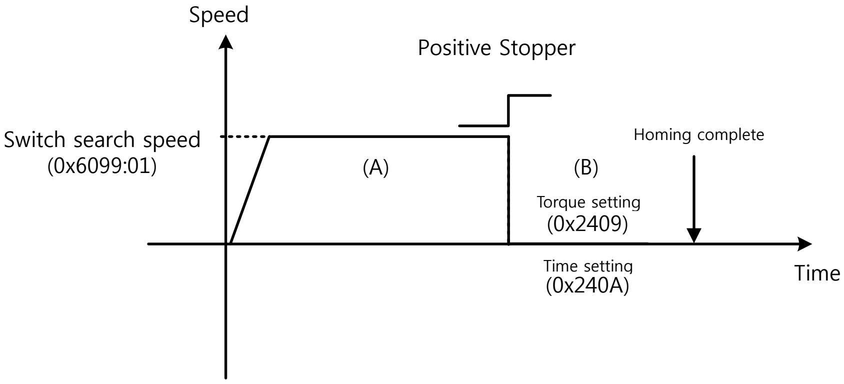
Homing Method -3



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

(B) (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 homing is complete.

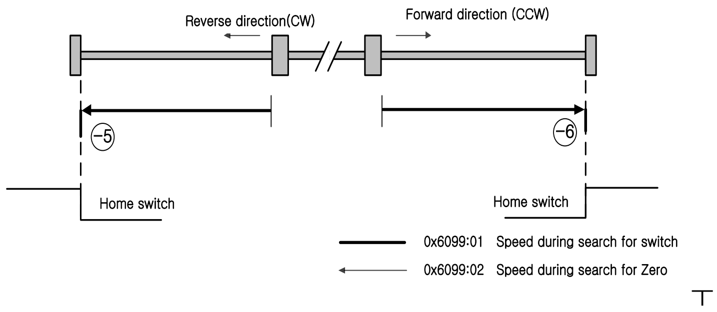
Homing Method -4



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

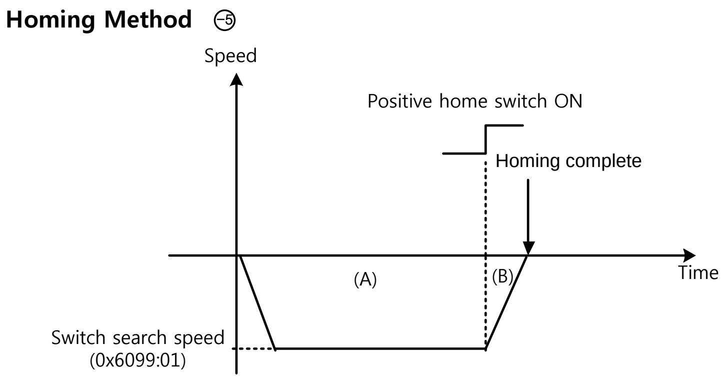
(B) When the drive hits the positive stopper, it will stand by according to the torque limit value (0x2409) and the time setting value (0x240A) at the time of homing using stopper before homing is complete.

■ Methods -5, -6



Homing Methods -5, -6 uses only Home switch to return to origin. The speed profile of each sequence is as follows. When limit switch is detected, Homing is stopped. Please see the explanations below for further details.

(1) Cases where the home witch is off when homing begins, and the limit is not met in the process

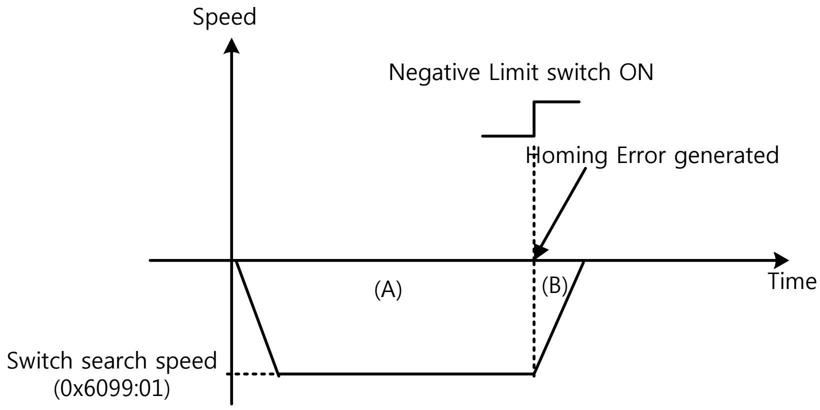


(A) The initial direction is reverse (CW). The motor operates at the switch search speed.

(B) When the positive home switch is on, the motor decelerates and stops. Then, home is Completed

(2) Cases where the home witch is off when homing begins, and the limit is met in the process

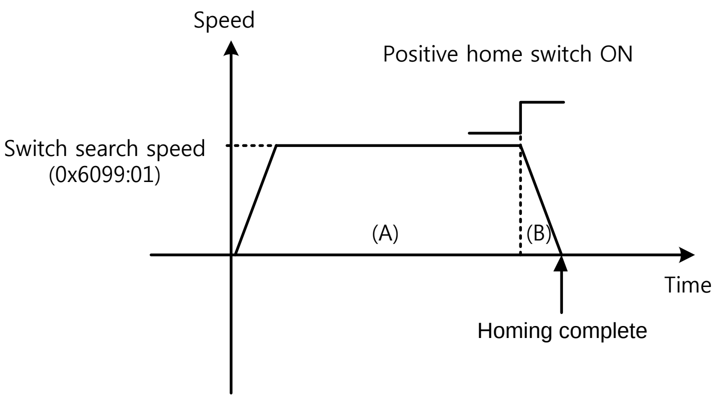
Homing Method ⊖5



(A) The initial direction is reverse (CW). The motor operates at the switch search speed.

(B) When the negative limit switch is on, Homing Error is generated. And then the motor decelerated and stops

Homing Method ⊖6



(A) The initial direction is forward (CCW). The motor operates at the switch search speed.

(B) When the positive home switch is on, the motor decelerates and stops. Then, home is Completed

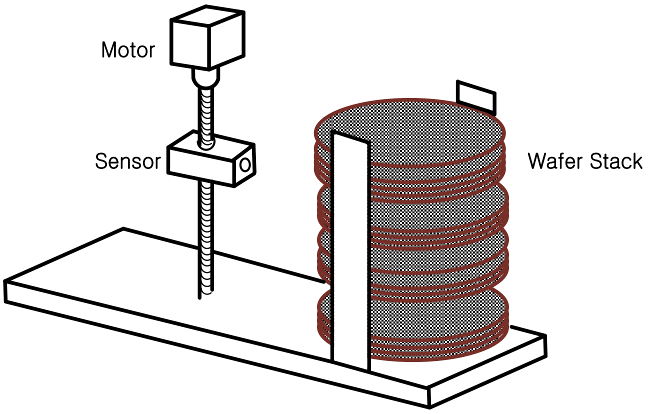
4.7 Touch Probe Function

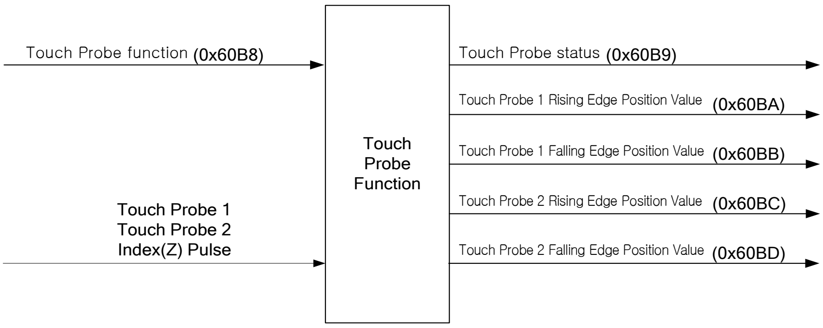
Touch probe is a function to rapidly capture the position value of the encoder with external input (PROBE 1 and 2) signals or the Index (Z) pulse of the encoder.

- Example of Touch Probe

Wafer mapper system of wafer transfer robot (WTR)

In the case that wafers are piled up on a wafer stack, the presence of wafer can be determined by scanning the stack once using mapping sensor. At this moment, any unnecessary movement of robot can be prevented by use of the value of wafer loading position 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 the touch probe 1 (I/O, PROBE1)
- Triggered by the touch probe 2 (I/O, PROBE2)
- Triggered by the encoder Index (Z) pulse

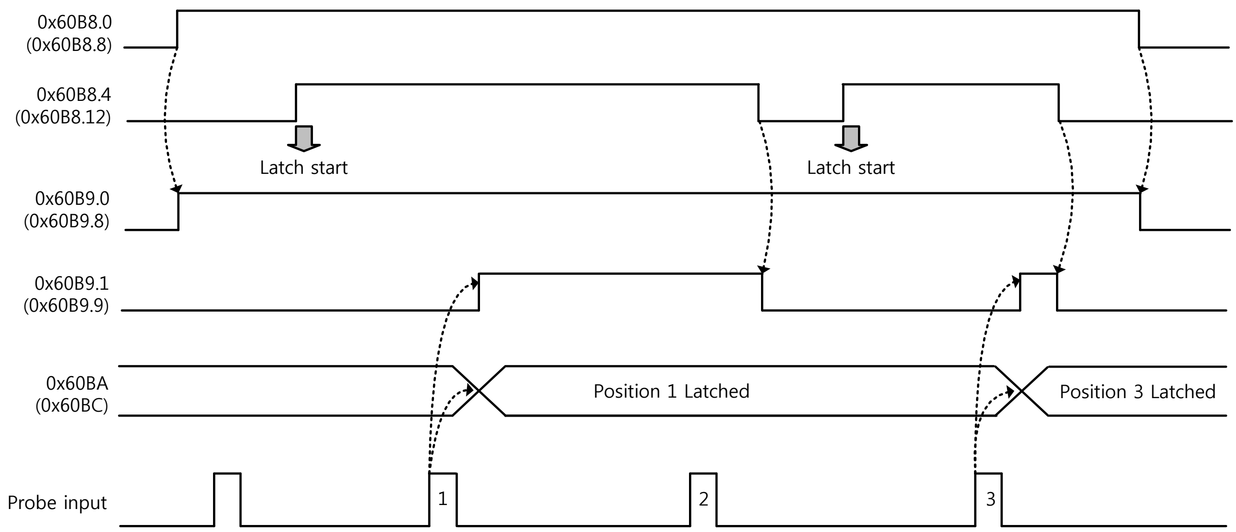
■ Related Objects

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 Positive Edge Position Value	DINT	RO	Yes	UU
0x60BB	-	Touch Probe 1 Negative Edge Position Value	DINT	RO	Yes	UU
0x60BC	-	Touch Probe 2 Positive Edge Position Value	DINT	RO	Yes	UU
0x60BD	-	Touch Probe 2 Negative Edge Position Value	DINT	RO	Yes	UU

■ Touch Probe Timing Diagram

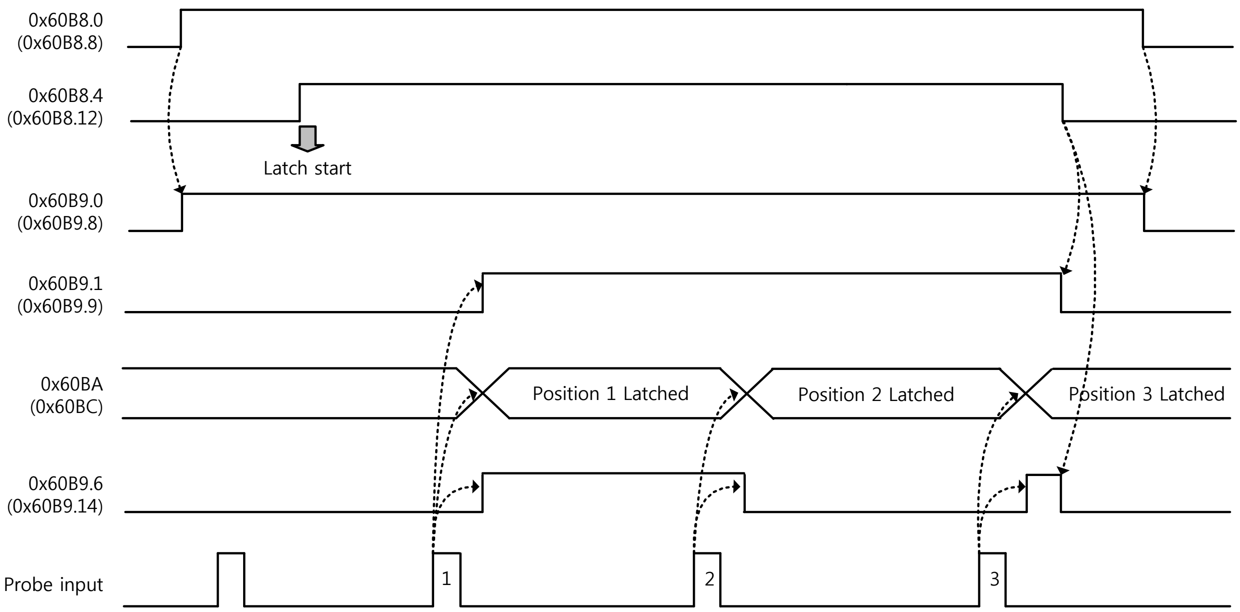
- Single Trigger Mode (0x60B8.1=0, 0x60B8.9=0):

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

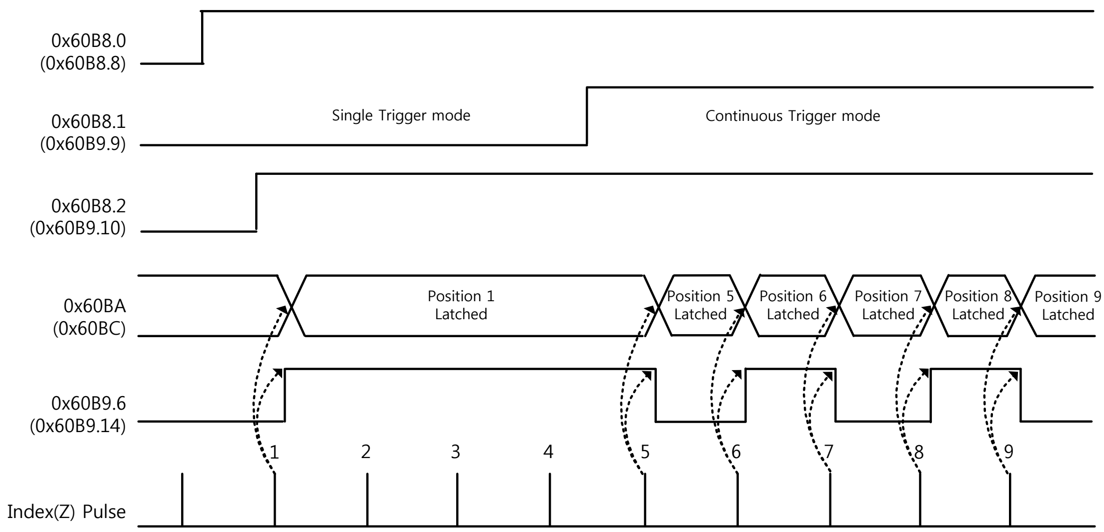


- **Continuous Trigger Mode (0x60B8.1=1, 0x60B8.9=1):**

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

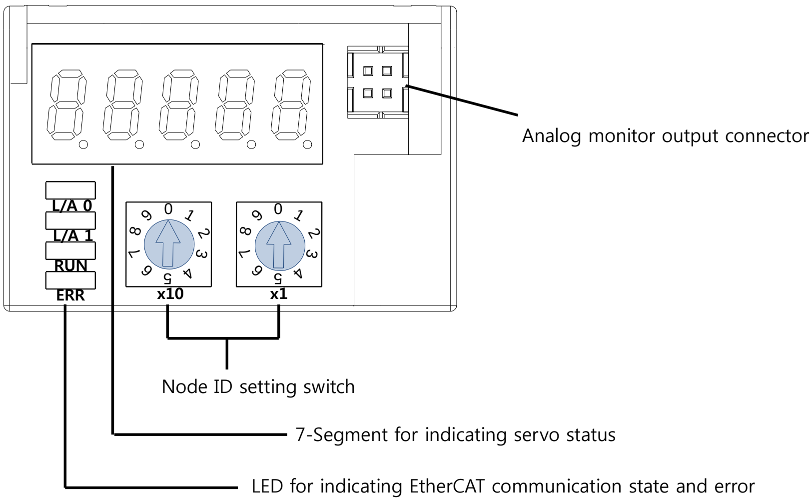


- **Index Pulse Trigger Mode (0x60B8.2=1, 0x60B8.10=1):**



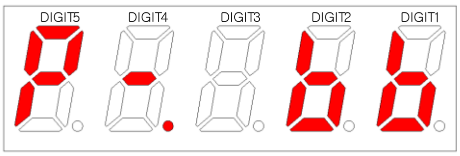
5. Drive Application Functions

5.1 Drive Front Panel

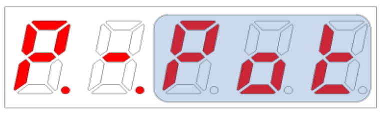
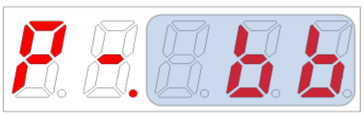
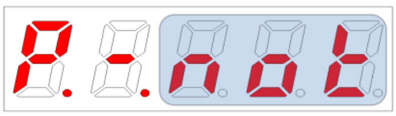


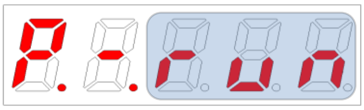
5.1.1 7-Segment for indicating servo status

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

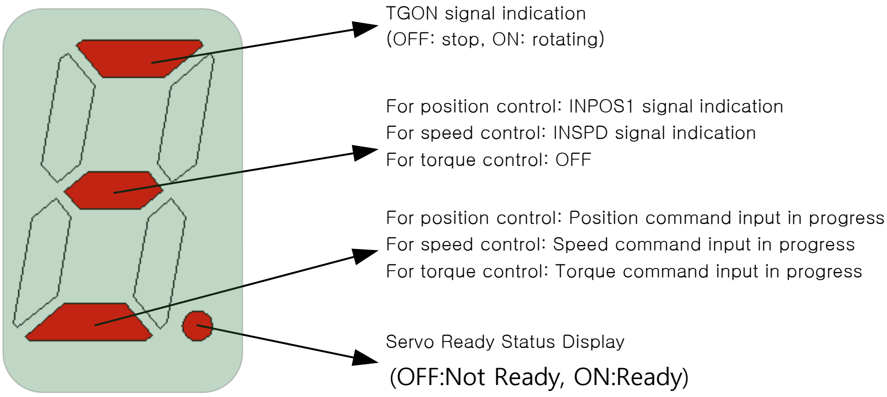


Three digits from Digits 3 to 1 of the 7 -Segment represents the drive status as described below if no servo alarm occurs. In case of servo warning, they will indicate the warning status first, rather than other ones.

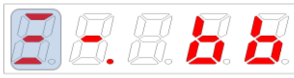
Display of Digit 3 - Digit 1	Status details
 STO connector not connected	 Positive limit sensor input
 Servo OFF	 Negative limit sensor input

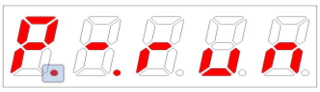
 Servo ON	 Servo warning W10 occurred (code: 10)

Digit4 indicates the current operation status and servo ready status.

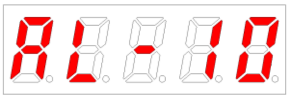


Digit5 indicates the status of the *EtherCAT* State Machine or of the current control mode and servo ON.

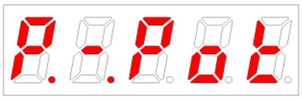
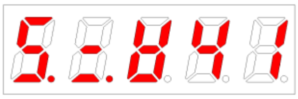
If the status of the EtherCAT State Machine is prior to the operation state (communication setup process): ➔ A preparation status, where a servo operation is not available, indicating that the EtherCAT communication is in progress.		
 Init state	 Pre-Operational state	 Safe-Operational state

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, PP, and IP	 Speed control modes: CSV and PV	 Torque control modes: CST and PT
 Homing mode	 (ON: Servo OFF, ON: Servo ON)	

In case of servo alarm, the Digits 5-1 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.



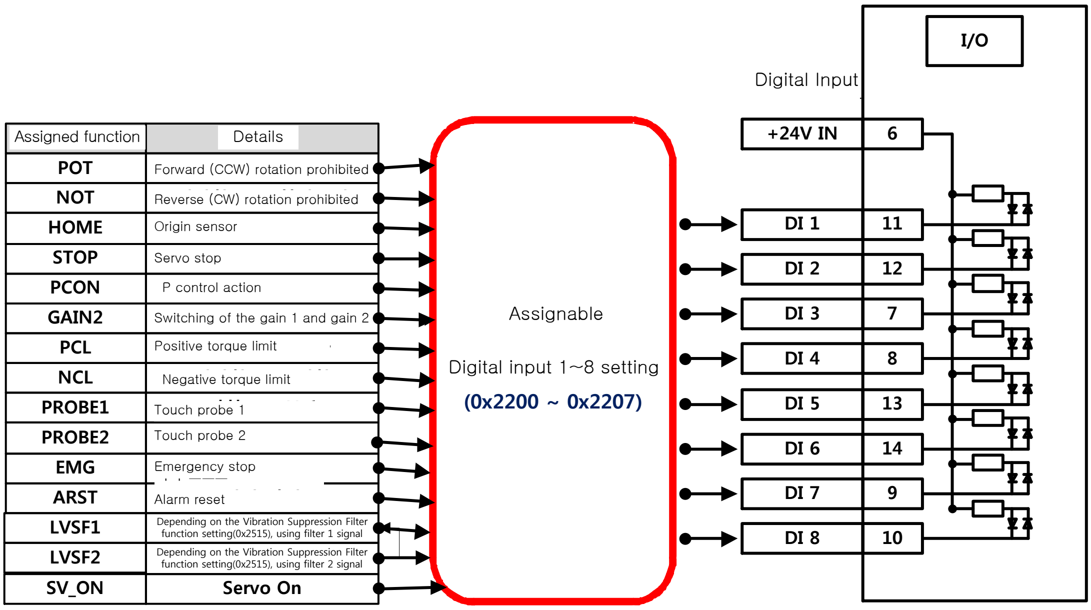
An example of alarm status output
AL-10 (IPM Fault)

Ex. 1) Limit signal input	Ex. 2) Servo warning triggered
 DIGIT3~1: Positive limit input DIGIT4 : INPOS1, servo ready DIGIT5 : Position control mode, servo ON	 DIGIT3~1: W01 (main power phase loss) + W40 (low voltage warning) occurred DIGIT4 : INSPD, speed command input in progress, servo ready DIGIT5 : Speed control mode, servo ON

5.2 Input/Output Signals Setting

5.2.1 Assignment of Digital Input Signals

You can set the digital input signal function and input signal level of the I/O connector. You can arbitrarily assign up to 8 input functions out of 12 functions, as shown in the figure below, to the digital input signals 1-8 for use:



■ **Related Objects**

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2200	-	Digital Input Signal 1 Selection	UINT	RW		-
0x2201	-	Digital Input Signal 2 Selection	UINT	RW		-
0x2202	-	Digital Input Signal 3 Selection	UINT	RW		-
0x2203	-	Digital Input Signal 4 Selection	UINT	RW		-
0x2204	-	Digital Input Signal 5 Selection	UINT	RW		-
0x2205	-	Digital Input Signal 6 Selection	UINT	RW		-
0x2206	-	Digital Input Signal 7 Selection	UINT	RW		-
0x2207	-	Digital Input Signal 8 Selection	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 the bit 15.

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

Contact A: The default status is 0 (Low). Input 1 (High) to actuate it (Active High).

Contact B: The default status is 1 (High). Input 0 (Low) to actuate it (Active Low).

Setting values	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

■ Example of Assigning Digital Input Signals

The following table shows an example of assigning input signals. Verify the setting values from 0x2200 to 0x2207.

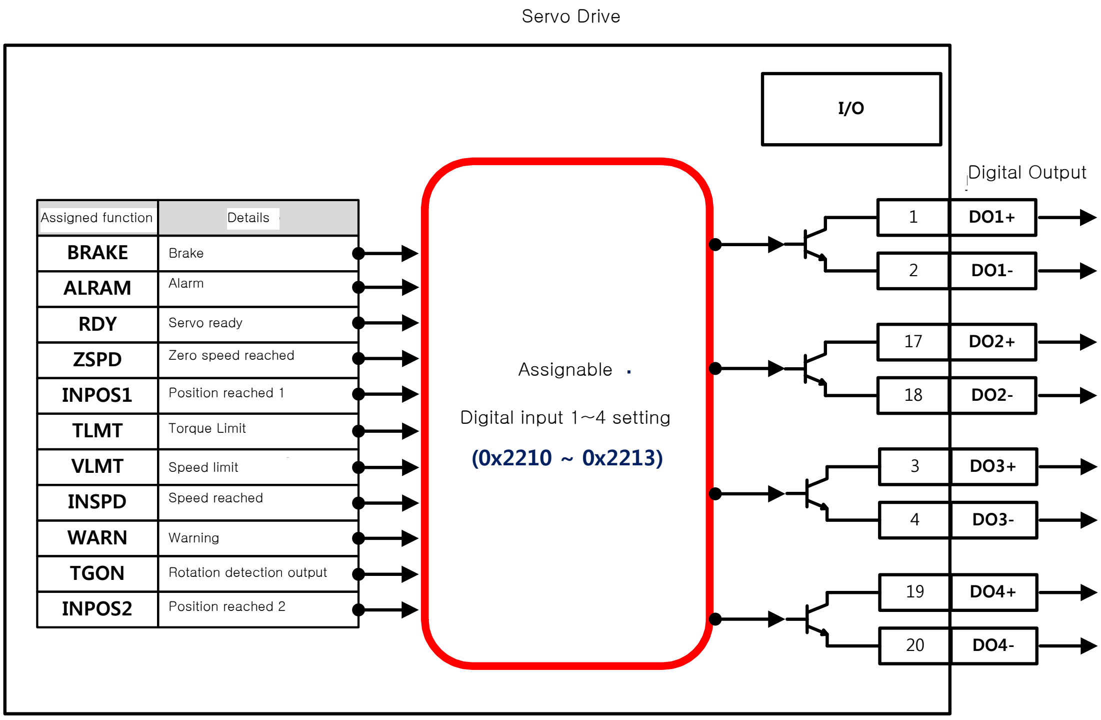
DI#1	DI#2	DI#3	DI#4	DI#5	DI#6	DI#7	DI#8
POT (Contact A)	NOT (Contact A)	HOME (Contact A)	STOP (Contact A)	PCON (Contact A)	GAIN2 (Contact A)	PROBE1 (Contact A)	ARST (Contact A)

Assignable		Contact	Details
0x01	POT	A	Forward (CCW) rotation prohibited
0x02	NOT	A	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 the gain 1 and gain 2
0x07	PCL	-	Positive torque limit
0x08	NCL	-	Negative torque limit
0x09	PROBE1	A	Touch probe 1
0x0A	PROBE2	-	Touch probe 2
0x0B	EMG	-	Emergency stop
0x0C	ARST	A	Alarm reset

CN1 (Pin Number)	Setting parameter	Bit		Setting values	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)
DI # 7 (9)	0x2206	0	0x09	0x0009	PROBE1(Contact A)
DI # 8 (10)	0x2207	0	0x0C	0x000C	ARST(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. You can arbitrarily assign up to 4 output functions out of 11 functions, as shown in the figure below, to the digital output signals 1-4 for use:



■ **Related Objects**

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

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

Bit	Setting details
15	Signal output level settings (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 setting values from 0x2210 to 0x2213.

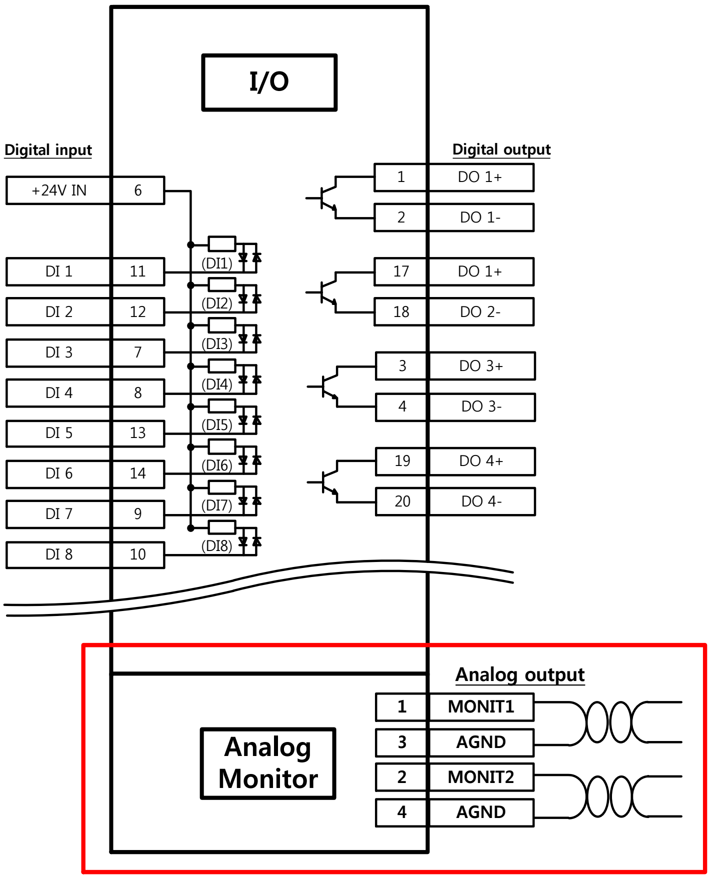
DO#1	DO#2	DO#3	DO#4
BRAKE (Contact B)	ALARM (Contact B)	RDY (Contact A)	INPOS1 (Contact A)

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)	Setting parameter	Bit		Setting values	Details
		15	7~0		
DO # 1 (1,2)	0x2210	1	0x01	0x8001	BRAKE(Contact B)
DO # 2 (17,18)	0x2211	1	0x02	0x8002	ALARM(Contact B)
DO # 3 (3,4)	0x2212	0	0x03	0x0003	RDY(Contact A)
DO # 4 (19,20)	0x2213	0	0x05	0x0005	INPOS1(Contact A)

5.2.3 Assignment of Analog Output Signals

Providing 2 channels of Analog monitor to adjust drive gains or to monintor state parameter

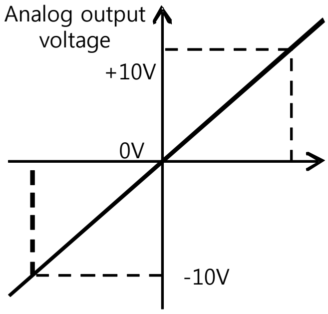
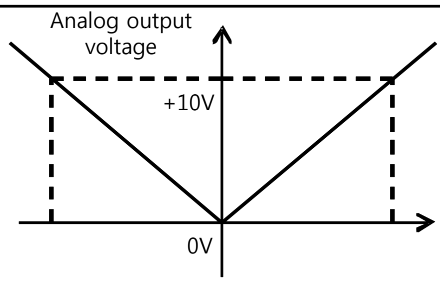


■ Retated objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2220	-	Analog Monitor Output Mode)	UINT	RW	No	-
0x2221	-	Analog Monitor Channel 1 Select	UINT	RW	No	-
0x2222	-	Analog Monitor Channel 2 Select	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 (0x2220)

Analog monitor output range is -10~+10V. If setting value is 1, output value is positive value only.

Set value	Setting details	Details
0	Positive(or negative) value output value	
1	Positive value output value only	

ut

- Analog monitor channel 1 setting (0x2221)

Setting the parmeters to monitor through Analog monitor output channel 1

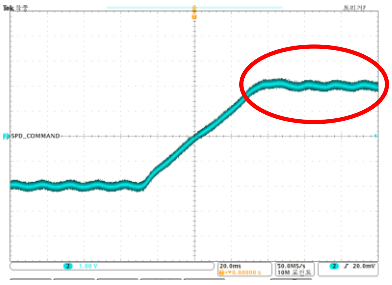
Th voltage is calculated as follow when analog monitor is output

Channel 1 output voltage [V] = [Monitoring signal value(0x2221) – Offset(0x2203)] / Scale(0x2205)

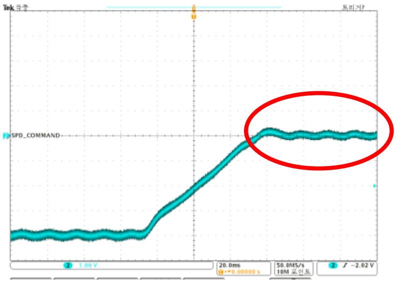
Channel 1 output voltage [V] = [Monitoring signal value (0x2222) – Offset(0x2204)] / Scale(0x2206)

■ Setting example

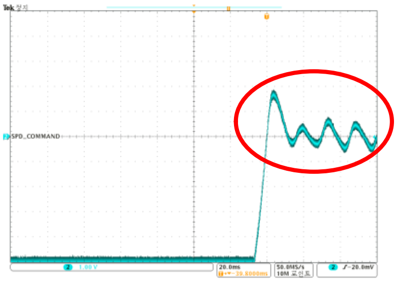
The following shows an example of monitoring ripple during 1000 rpm operation of speed feedback signal



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



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



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

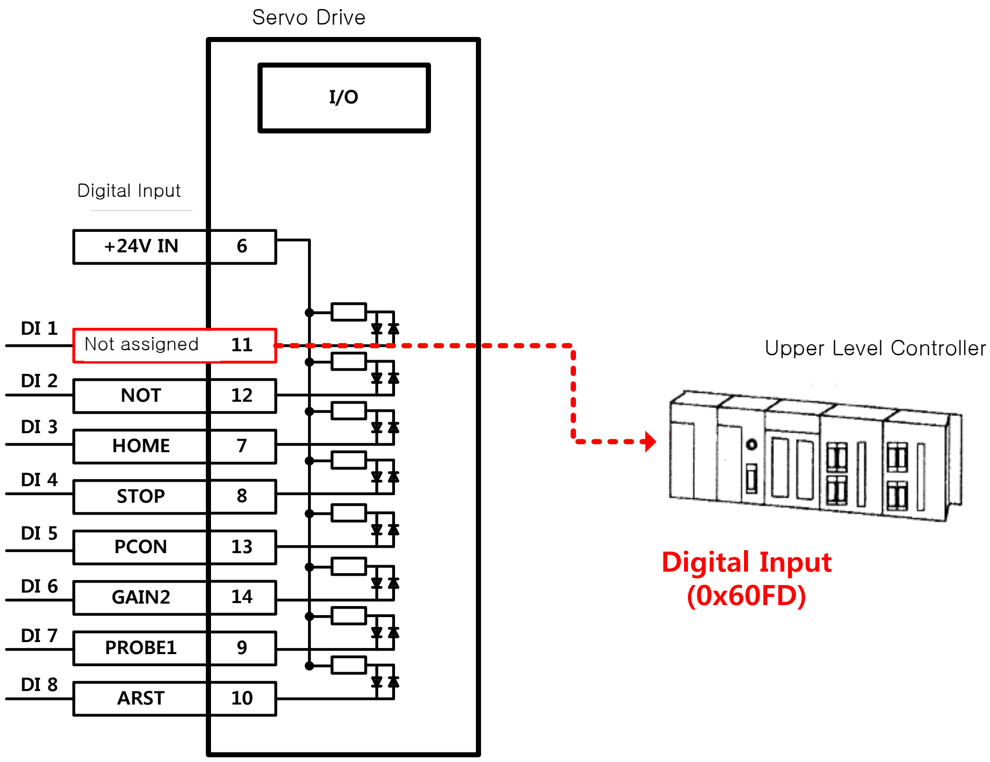
5.2.4 Use of User I/O

User I/O means that some of I/Os provided by the drive are used for individual purpose of the user, in addition to the purpose of controlling the drive itself. All contacts provided by the input/output connector(I/O) can be used as 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 is available with up to 8 points for input signals and 4 points for output signals as the user I/O.

■ How to Set User Input



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

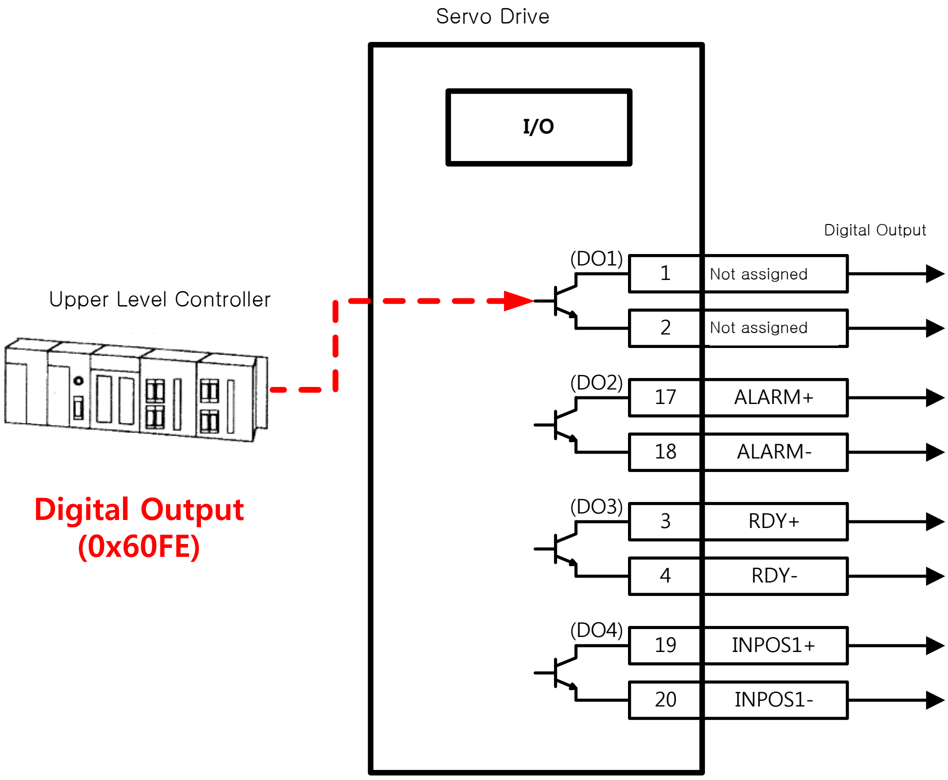
2) Read the values of the corresponding bits (0x60FD.16-23) from the digital input (0x60FD), in order to use them as the user input.

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x60FD	-	Digital Inputs	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	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

■ How to Set User Output



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

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 value: 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 Outputs	-	-	-	-
	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	Forced output (0: OFF, 1: ON) of DO #4 (I/O pins 19 and 20) 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 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	Forced output setting (0:Disable, 1:Enable) of DO #4 (I/O pins 19 and 20)
20 to 31	Reserved

5.2.5

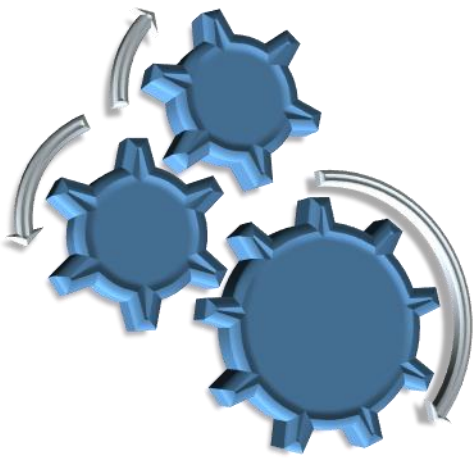
5.3 Electric Gear Setup

5.3.1 Electric Gear

This function sets the electric gear when you want to drive a motor by so-called 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, in case the upper level controller has the function, please use it if possible.

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

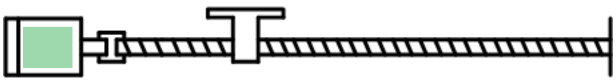


Typically, electric gears are used in the following situations:

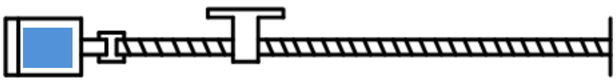
(1) When Driving Loads Based on User Unit

- 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 pitch of 10 mm, the comparison is given below for 12 mm of movement:

(A) 5000 ppr encoder



(B) 19-bit encoder



	(A) 5000 ppr encoder	(B) 19-bit (524288 ppr) encoder
If the electric gear is not used	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
If the electric gear is used	Can move through the same command of 12000 (12 mm= 12000 * 1 um), regardless of the encoder (motor) used.	

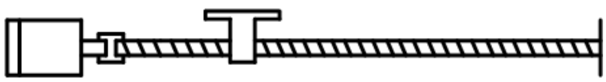
(2) When Driving High-Resolution Encoder at High Speed but Output Frequency of Upper Level Controller or Input Frequency of Drive is Limited

- 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 speed, 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.

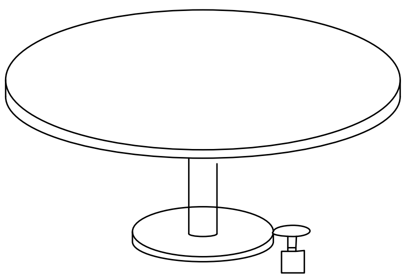
-

5.3.2 Example of Electric Gear Setup

■ Ball Screw Load

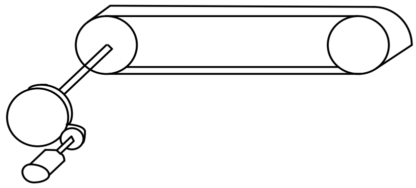
Apparatus specification	 **Pitch: 10 mm, Reduction gear ratio: 1/1**
User Unit	1um(0.001mm)
Encoder specification	19-bit (524288 PPR)
Amount of load movement/revolution	10[mm] = 10000[User Unit]
Electric gear settings	Motor Revolutions : 524288 Shaft Revolutions : 10000

■ Turntable Load

Apparatus specification	 **Reduction gear ratio: 100/1**
User Unit	0.001°

Encoder specification	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

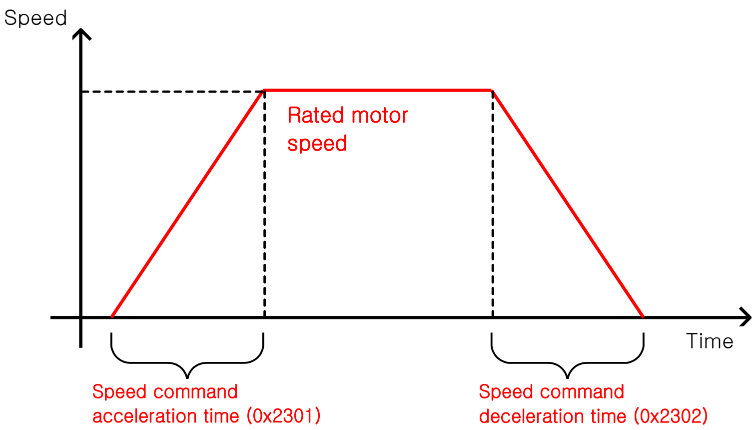
Apparatus specification	 **Reduction gear ratio: 10/1, Pulley diameter: 100 mm**
User Unit	1um(0.001mm)
Encoder specification	19-bit (524288 PPR)
Amount of load movement/revolution	PI*100/10/0.001=31416
Electric gear settings	Motor Revolutions : 524288 Shaft Revolutions : 31416

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. At this moment, 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.

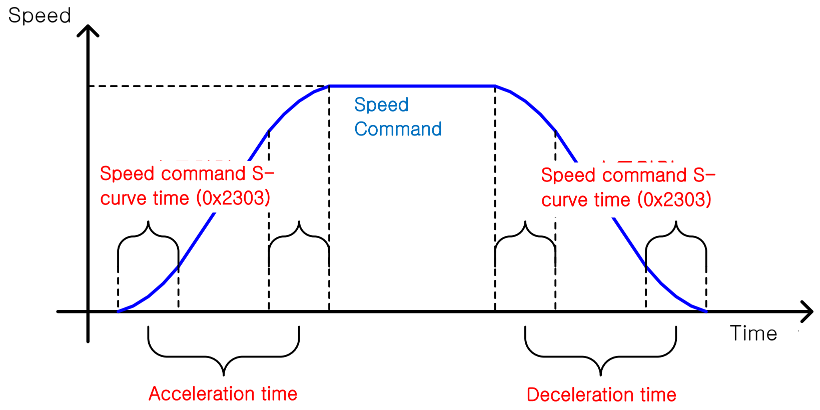


You can calculate the actual acceleration/deceleration time as below:

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) at a value of 1 or more. Make sure to verify the relationship between the acceleration/deceleration time and S-curve time.



5.4.2 Servo-lock Function

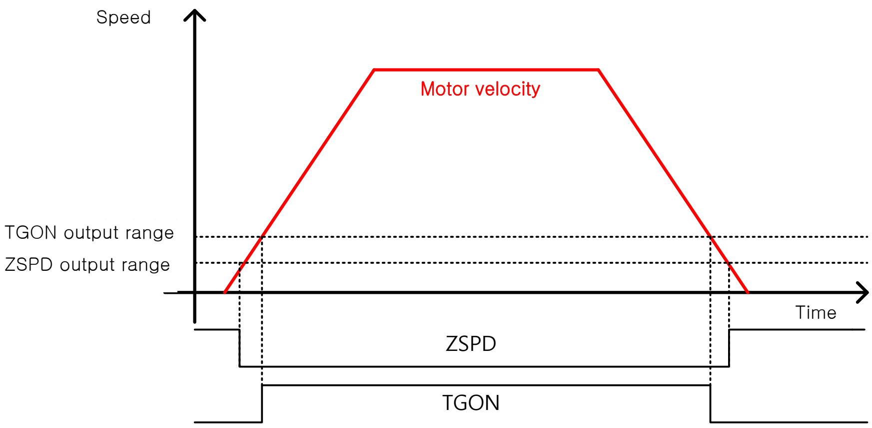
During the speed control operation, the servo position will not be locked even when 0 is entered for a speed command. This is due to the characteristic of speed control; at this moment, you can lock the servo position by enabling the servo-lock function (0x2311).

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 of inputting 0 as a speed command. If you input a speed command other than 0, the speed control will be switched to the 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 be output; and when it is not less than the TGON output range (0x2405), a TGON (motor rotation) signal will be 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 be 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

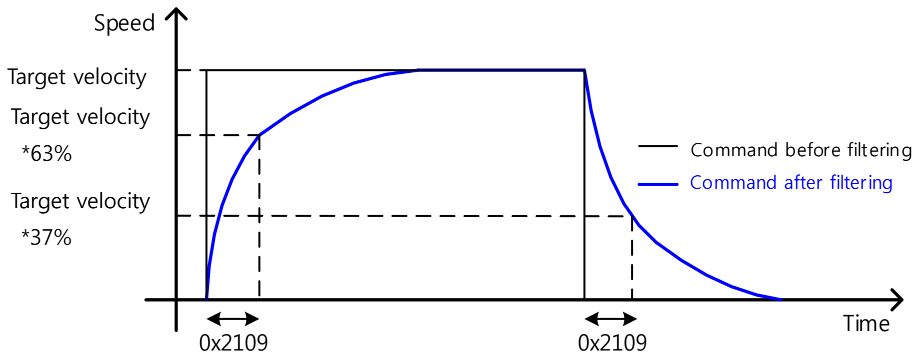
5.5.1 Position Command Filter

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

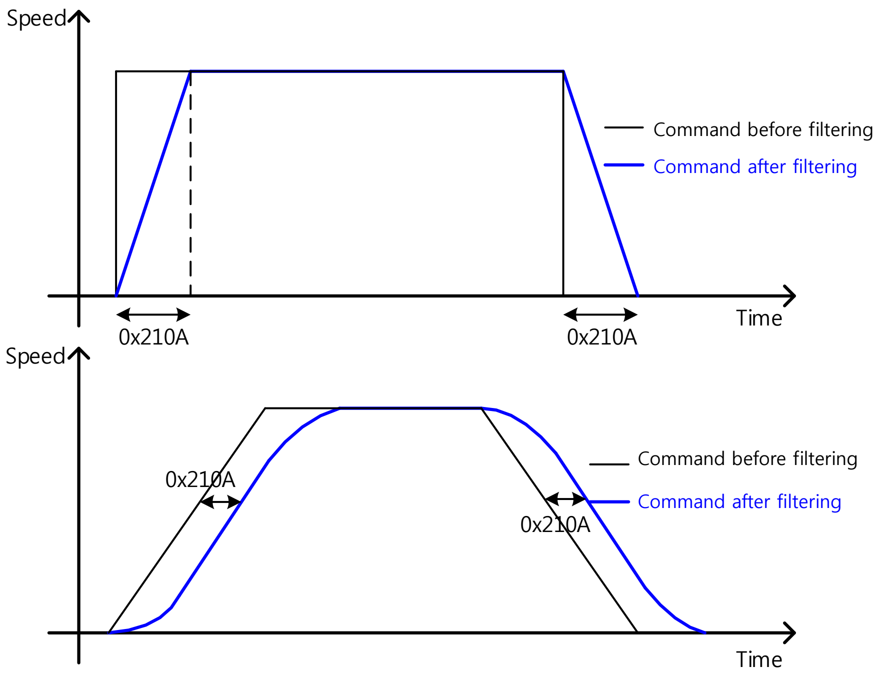
You can use a position command filter if:

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

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



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



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

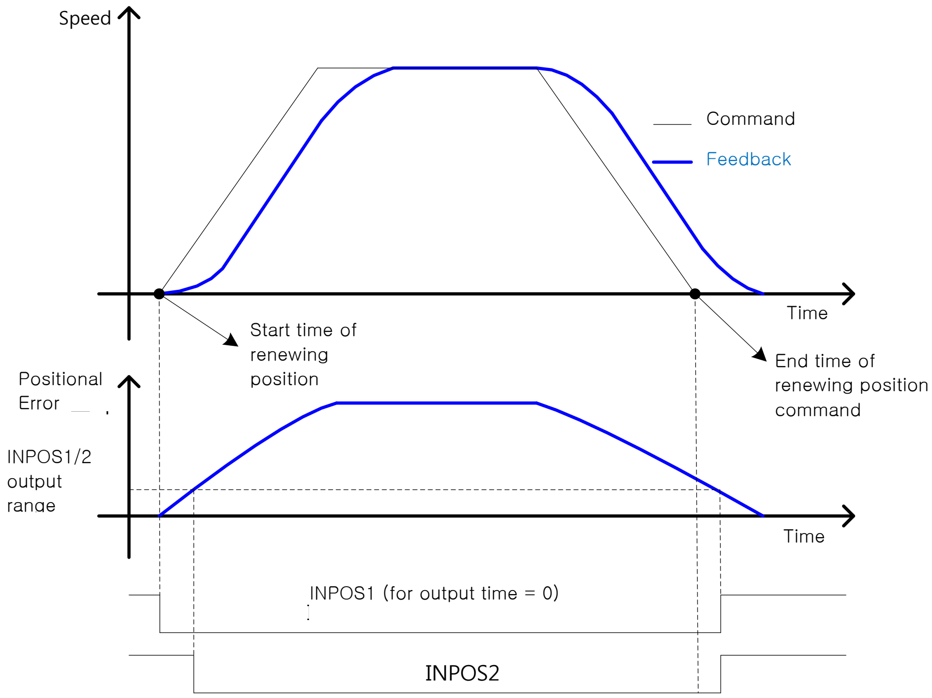
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2109	-	Position Command Filter Time Constant	UINT	RW	Yes	0.1ms
0x210A	-	Position Command Average Filter Time Constant	UINT	RW	Yes	0.1ms

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 the 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 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 output value of VLMT (speed limit), you can verify if the speed is limited.

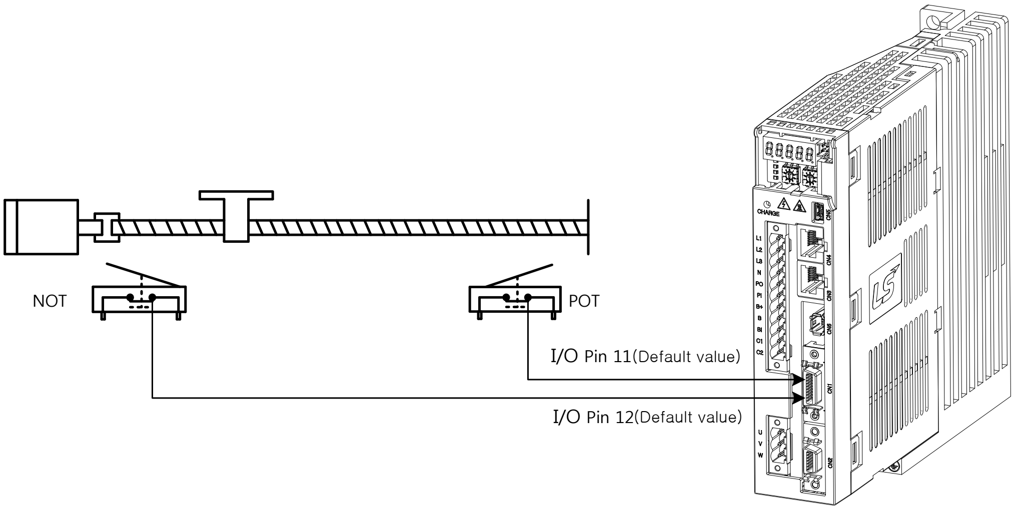
Setting values	Setting details
0	Limited by speed limit value (0x230E)
1	Limited by the maximum motor speed

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x230D	-	Speed Limit Function Select	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	Description
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).

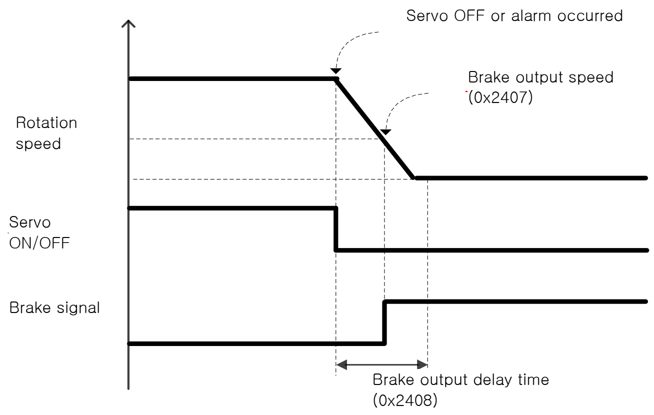
■ Related Objects

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	-

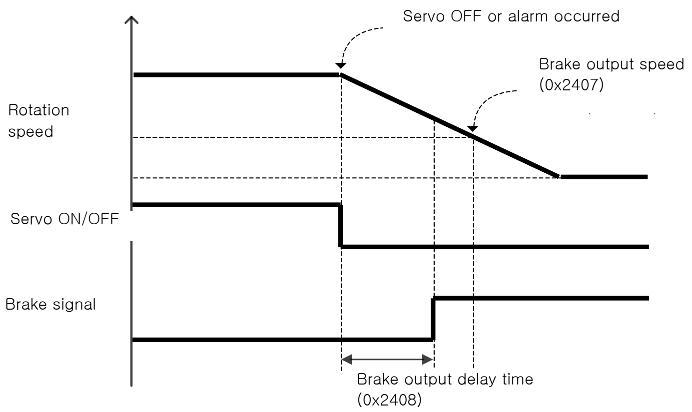
5.8 Setting the Brake Output Signal Function

If the motor stops due to servo OFF or servo alarm during rotation, you can set the speed (0x2407) and delay time (0x2408) for brake signal output, in order 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.



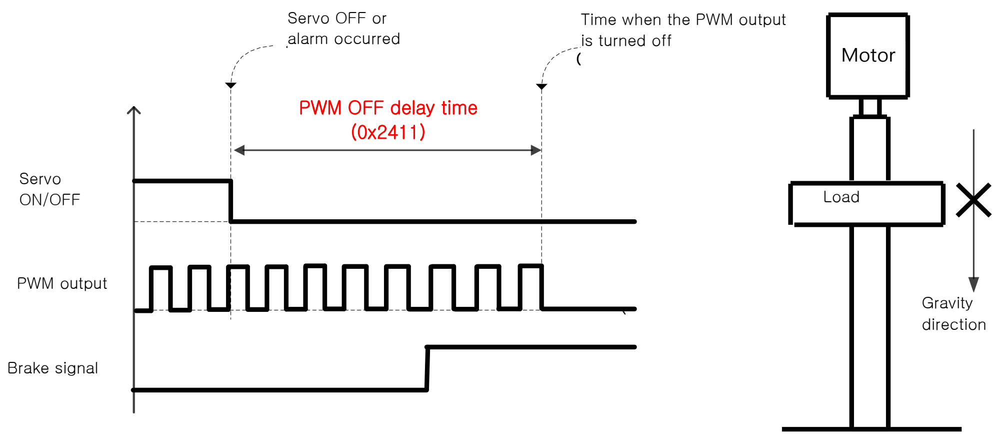
Timing diagram for signal output by the brake output speed (0x2407)



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

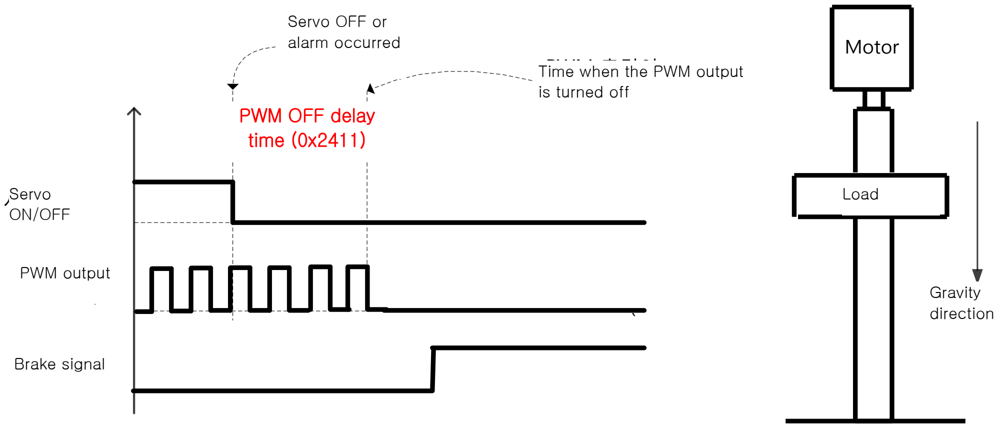
Set the time to delay until the actual PWM output goes off when the servo is turned off or a servo alarm occurs.

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.



(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 the gravity.



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

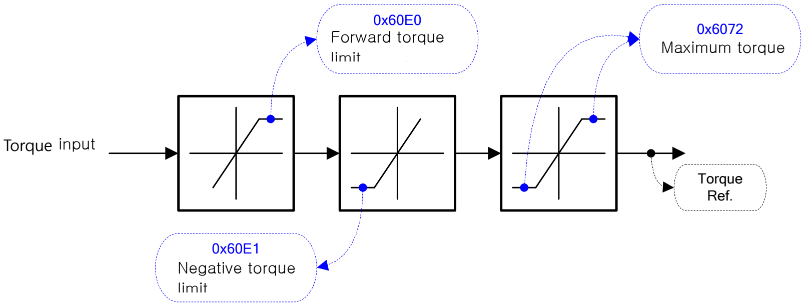
The PWM output is turned off first before the brake signal output, allowing the drop along the vertical axis due to the gravity.

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 torque limit value is 0.1%.

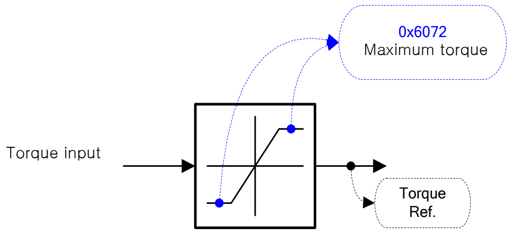
- Description of Torque Limit Function Setting (0x2110)

<table>
<tr><th>Limit function</th><th>Description</th></tr>
<tr><td>Internal torque limit 1

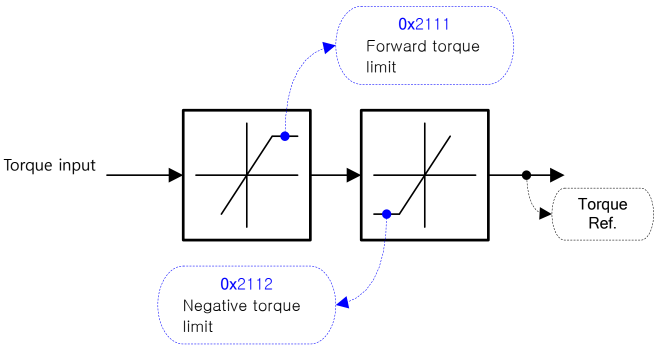
(set value 0)</td><td>


Limits the torque using positive/negative torque limit value according to the driving direction; the maximum value is limited by the maximum torque (0x6072).

- Forward: 0x60E0, Reverse: 0x60E1
</td></tr>
<tr><td>Internal torque limit 2

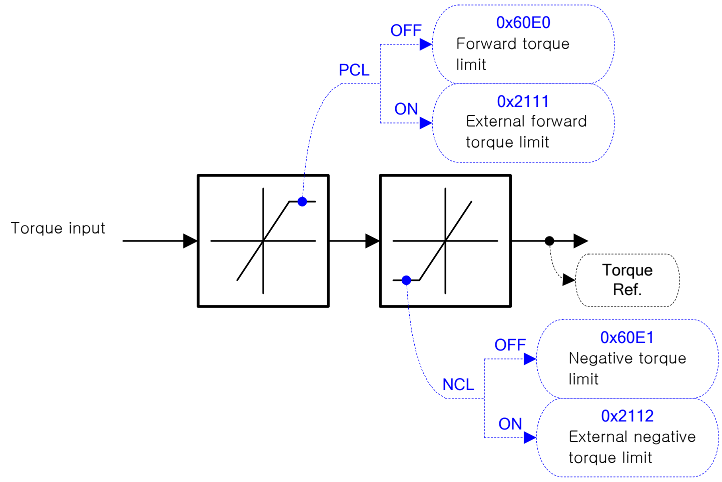
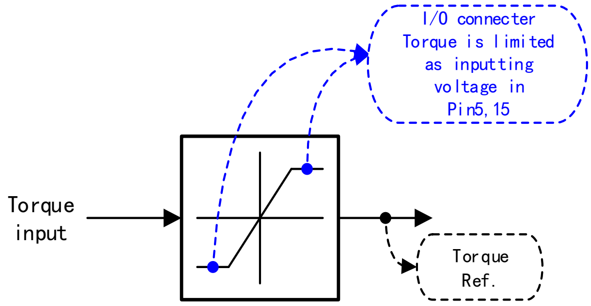
(set value 1)</td><td>


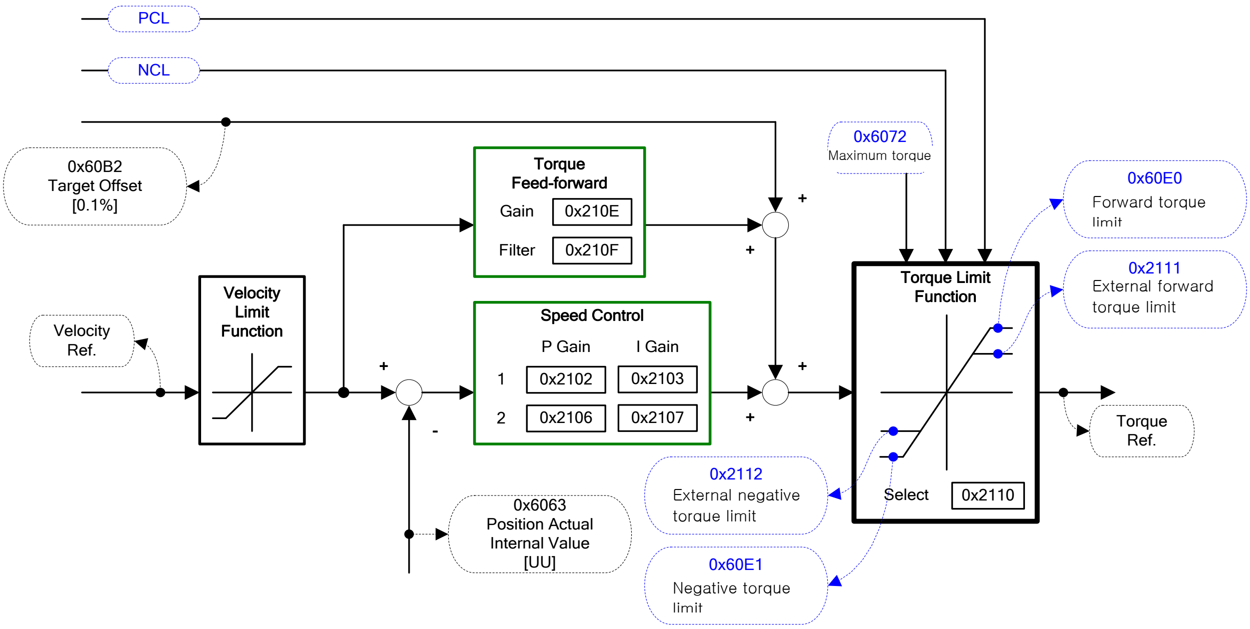
Limits the torque only by the maximum torque (0x6072) regardless of the driving direction.
</td></tr>
<tr><td>External torque limit

(set value 2)</td><td>


Limits the torque using external positive/negative torque limit value according to the driving direction.

- Forward: 0x2111, Reverse: 0x2112
</td></tr>
</table>

Internal and external torque limits (set value 3)	 Limits the torque using internal and external torque limit value 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 (set value 4)	 - Restricted by torque limited value which in put as analog. - Restriced normal direction / reverse direction torque regardless of +/ - of analog voltage. - Refer offset(0x221C) and then scale(0x221C) of analog torque limitation.

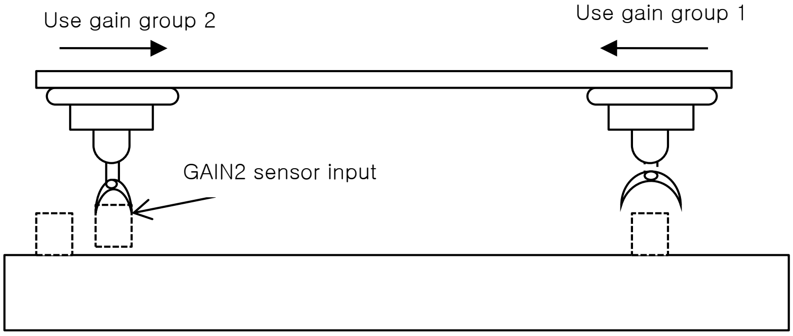


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2110	-	Torque Limit Function Select	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



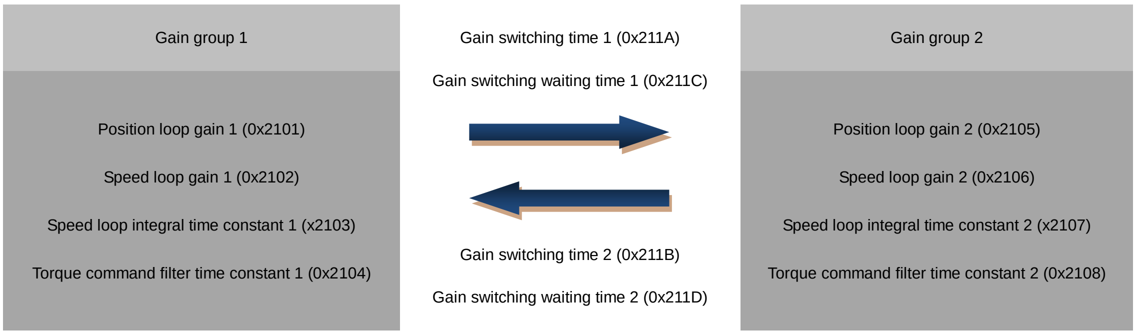
This function is to switch between the gain groups 1 and 2, as one of gain adjustment methods. You can reduce the time required for positioning through switching gains.

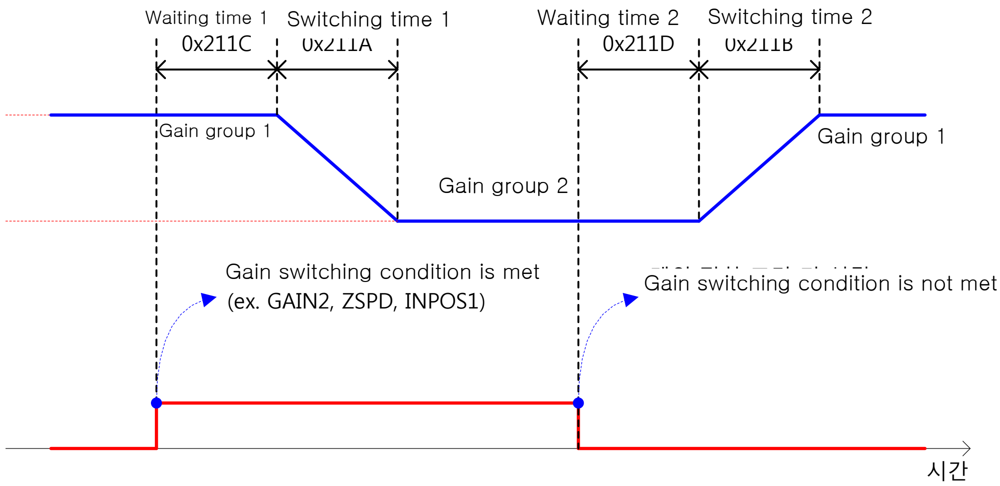
A gain group consists of position loop gain, speed loop gain, speed loop integral time constant, and torque command filter time constant. The gain switching function (0x2119) can be set as follows:

- Description of Gain Switching Function (0x2119)

Setting values	Setting details
0	Only the gain group 1 is used.
1	Only the 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

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 Conversion Mode	UINT	RW	Yes	-
0x211A	-	Gain Conversion Time 1	UINT	RW	Yes	ms
0x211B	-	Gain Conversion Time 2	UINT	RW	Yes	ms
0x211C	-	Gain Conversion Waiting Time 1	UINT	RW	Yes	ms
0x211D	-	Gain Conversion Waiting Time 2	UINT	RW	Yes	ms

5.10.2 P/PI Control Switching

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

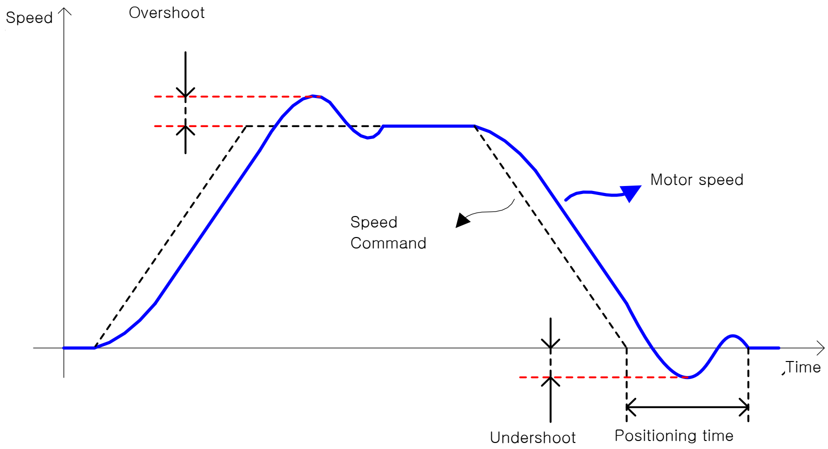
The proportional gain determines the responsiveness of the entire controller, and the integral gain is used to eliminate an error in the steady state. Too high of an integral gain will result in an overshoot during acceleration or deceleration.

The PI/P control switching functions are used to switch between the PI and P controls under the condition of the parameters within the servo (such as torque, speed, acceleration, and position deviation); specifically, they are used under 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 similar effect by setting the acceleration/deceleration of the upper level controller, the soft start of the servo drive, the position command filter, or 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.

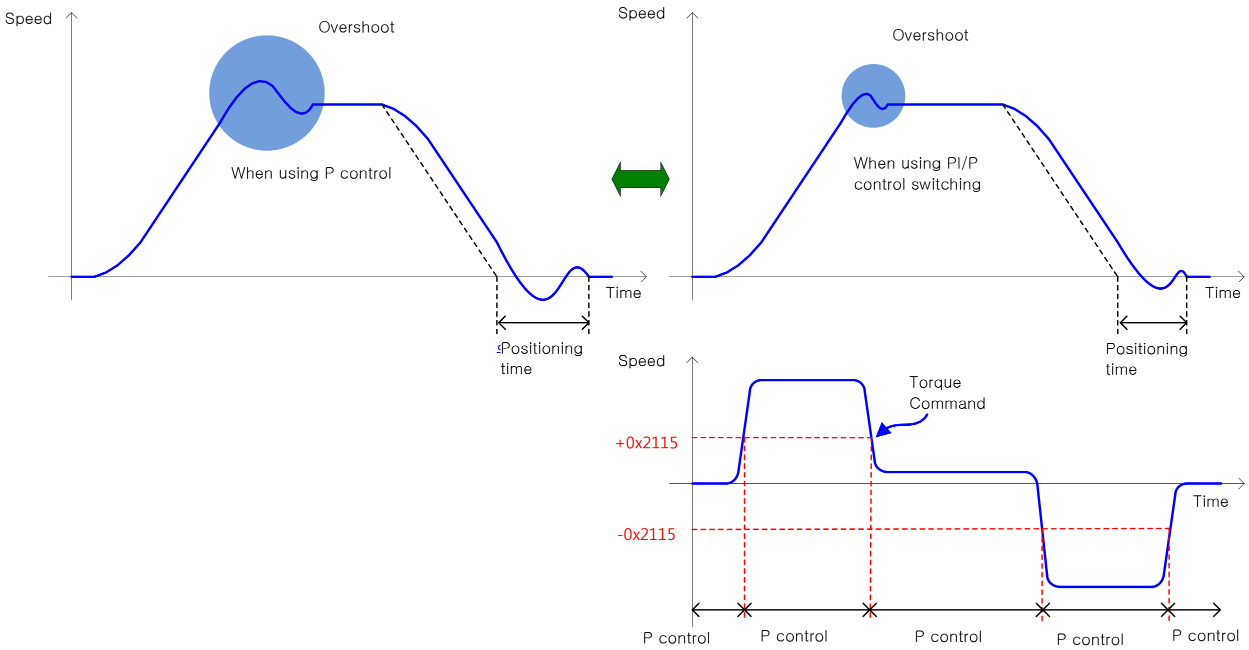
Setting values	Setting details
0	Always uses the PI control.
1	Switches to the P control if the command torque is larger than the P control switching torque (0x2115).
2	Switches to the P control if the command speed is larger than the P control switching speed (0x2116).
3	Switches to the P control if the acceleration command is larger than the P control switching acceleration (0x2117).
4	Switches to the 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 Conversion Mode	UINT	RW	Yes	-
0x2115	-	P Control Switch Torque	UINT	RW	Yes	0.1%
0x2116	-	P Control Switch Speed	UINT	RW	Yes	rpm
0x2117	-	P Control Switch Acceleration	UINT	RW	Yes	rpm/s
0x2118	-	P Control Switch Following Error	UINT	RW	Yes	pulse

Example of P/PI Switching by Torque Command

When always using the PI Control rather than P/PI control switching for speed control, the integral term of acceleration/deceleration error is accumulated, resulting in an overshoot and an extended positioning time. At this moment, 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:



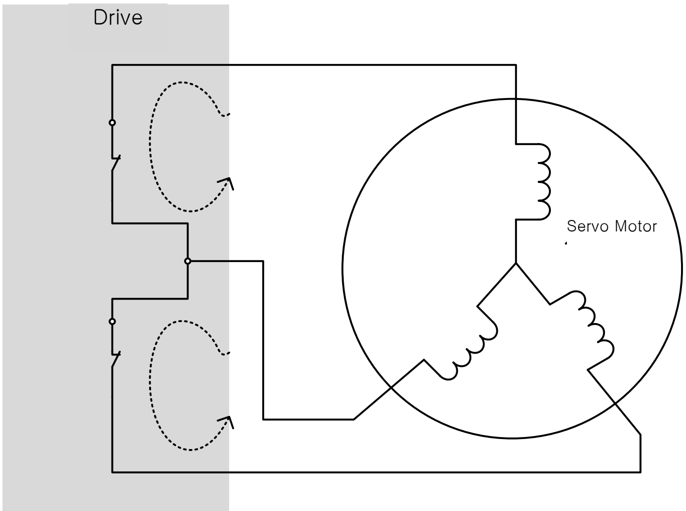
5.11 Dynamic brake

What is Dynamic Brake?

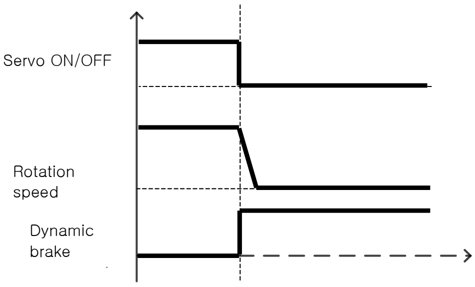
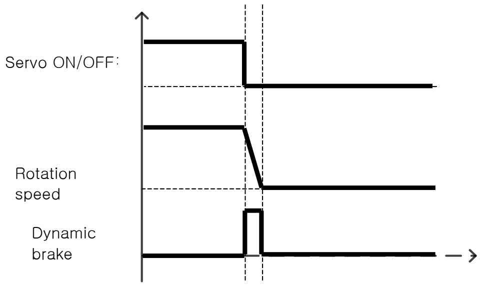
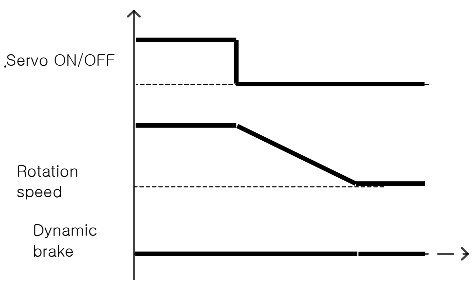
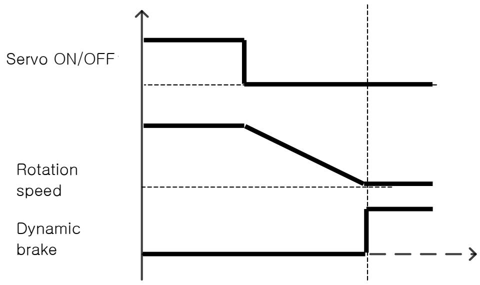
Dynamic brake electrically short-circuits the phase of the servo motor to stop it rapidly.

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]:

 Setting value: 0 Hold the dynamic brake after stopping the motor using the brake	 Setting value: 1 Release the dynamic brake after stopping the motor using the brake
	

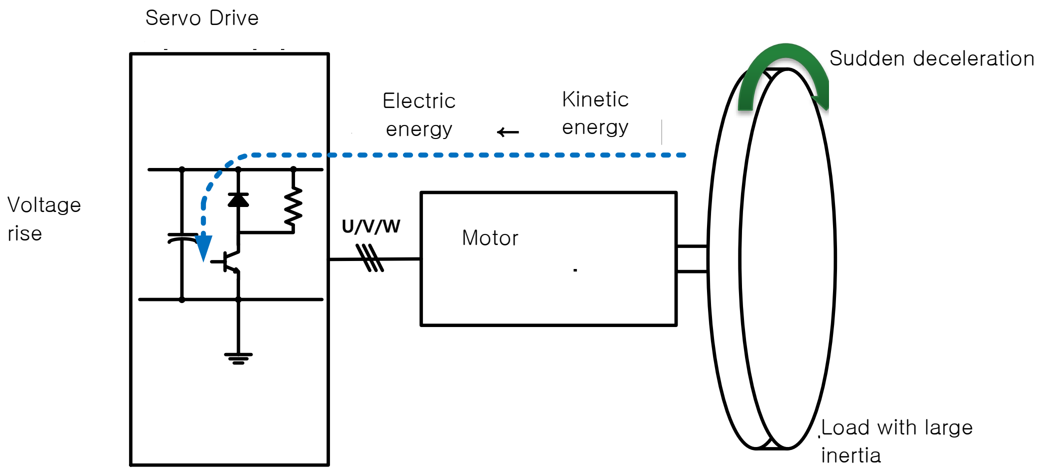
Setting value: 2 Release the dynamic brake after free-run stop	Setting value: 3 Hold the dynamic brake after free-run stop

■ 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	-

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	-	Regeneration Brake Resistor Configuration	UINT	RW	No	-
0x200A	-	Regeneration Brake Resistor Derating Factor	UINT	RW	No	%
0x200B	-	Regeneration Brake Resistor Value	UINT	RW	No	Ω
0x200C	-	Regeneration Brake Resistor Capacity	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	100[Ω]	100[W]
2kW/3.5kW	40[Ω]	150[W]
5kW	27[Ω]	120[W]
7.5KW	27[Ω]	240[W]

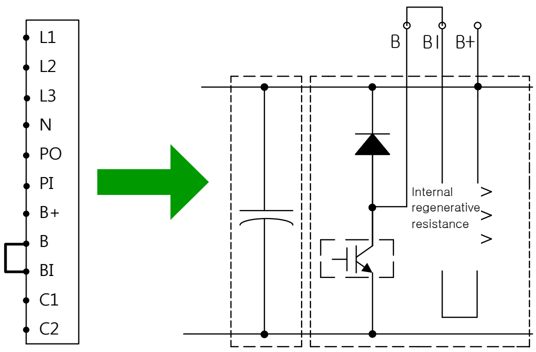
Note) By default, 15KW uses external resistance (13.4[Ω], 2000[W])

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, 3.5 kW or less).

   Note) For 5KW and 7.5KW, check if B+ and B terminals are short-circuited. They are shorted before shipped.



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

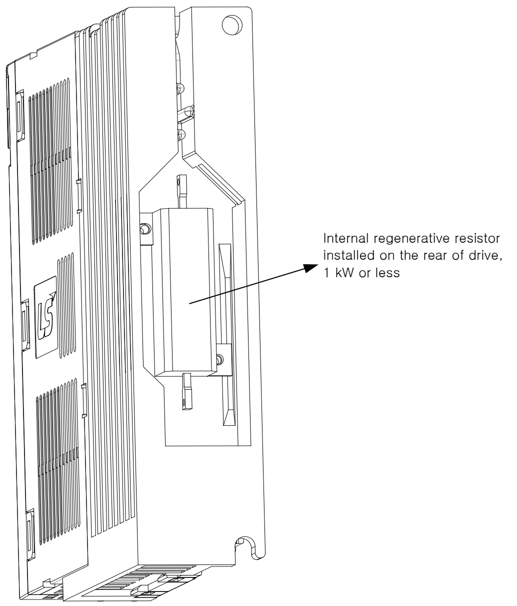
   - Check the internal regenerative resistance value (0x200B).

   - 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).

   - 7.5 KW or less: It is basically installed inside the drive.

   - 15 KW or more: Internal regenerative resistance is not installed



5.12.2 Use of External Regenerative Resistor

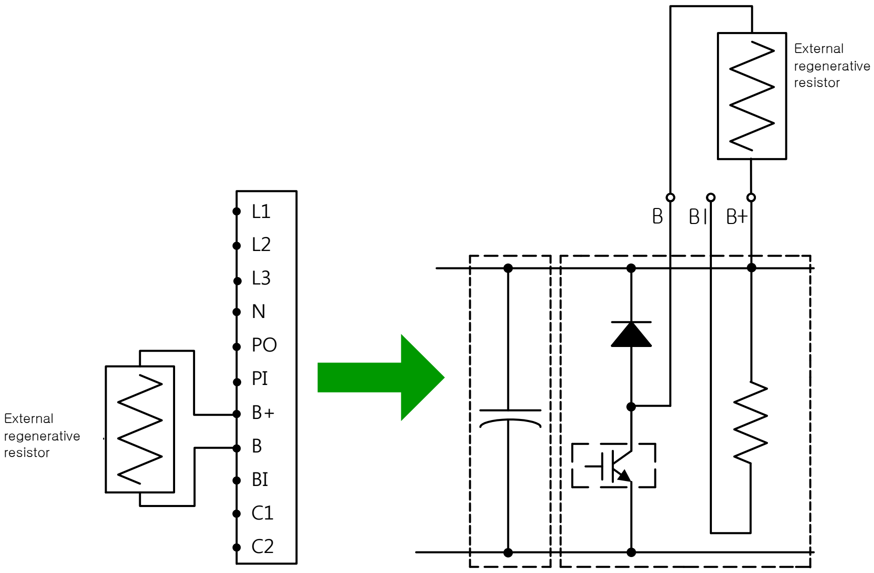
When using the external regenerative resistor considering the driving condition, make sure to observe the order below for configuration:

1. Wire the external regenerative resistor.

   - Remove the short circuit at B and BI terminals and connect the external regenerative resistance to B and B+ terminals (for 3.5KW or less)

   - Remove the internal regenerative resistance at B+ and B terminals and connect the external regenerative resistance to B+ and B terminals (for 5KW and 7.5KW)

   - Connect the standard external regenerative resistance to B+ and B terminals (for 15KW)



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.

LS Mecapion 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	82[Ω]	300[W]	IRV300-82Ω
2KW/3.5KW	70[Ω]	600[W]*2P	IRV600-140Ω
5KW	25[Ω]	600[W]*3P	IRV600-75Ω
7.5KW	25[Ω]	600[W]*3P	IRV600-75Ω
15KW	13.4[Ω]	2000[W]	IRM2000-13.4Ω

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.

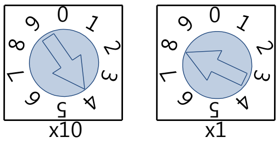
When you intend to set the derating factor to 100% or higher, be sure to fully consider the heat radiation condition of the drive installed.

5.13 Configuration of 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 set value modified subsequently will be in effect only when the power is 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 rotary switch operation for 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 built-in safe torque off (STO) function to reduce the risk while using the machine by protecting people around the machine against dangerous operation of its movable parts. Especially, this function can be used to prevent dangerous operation of the machine's movable 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

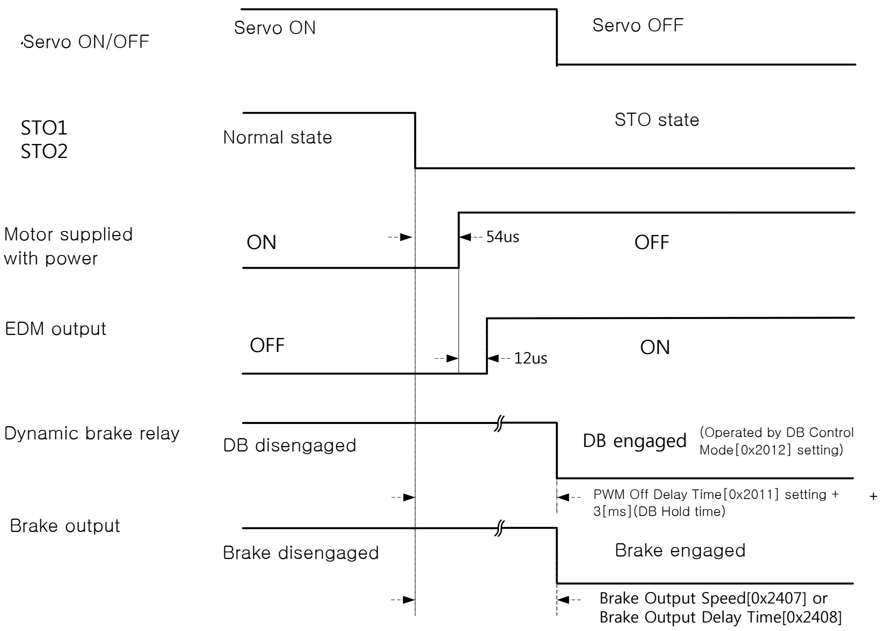
- STO1 and STO2

Item	Characteristic value
Internal impedance	3.3 ㏀
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**

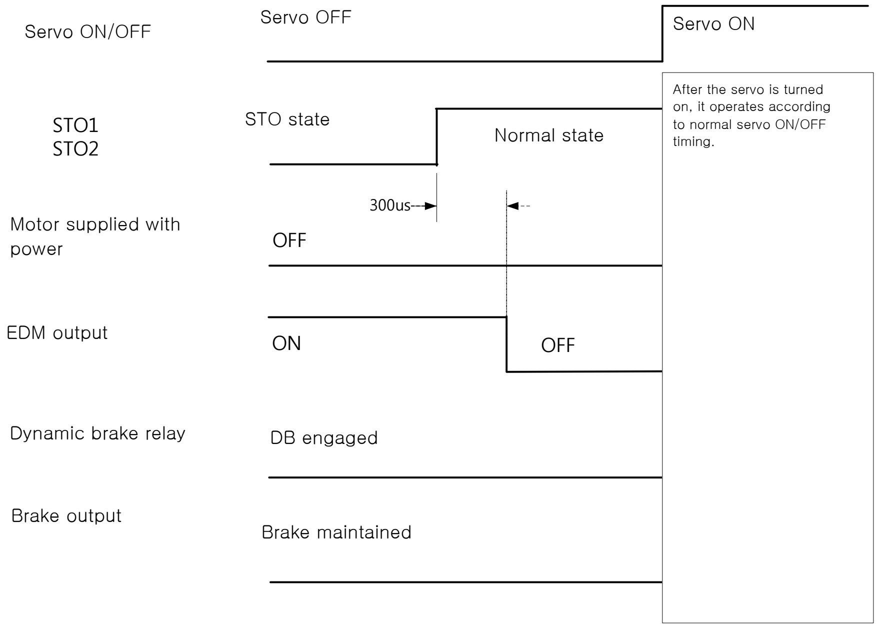


Note 1) If at least one of STO1 and 2 is turned off, the drive state is switched to the STO state.

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

Note3) Whichever the earlier time, out of points of time until the value becomes less than the set value of the brake output delay time (0x2408) or that of the brake output speed (0x2407) , will be applied.

■ Timing diagram for STO recovery



Note 1) Be sure to recover the input signals of STO1 and 2 to ON at the servo OFF state. It is not necessary to reset 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

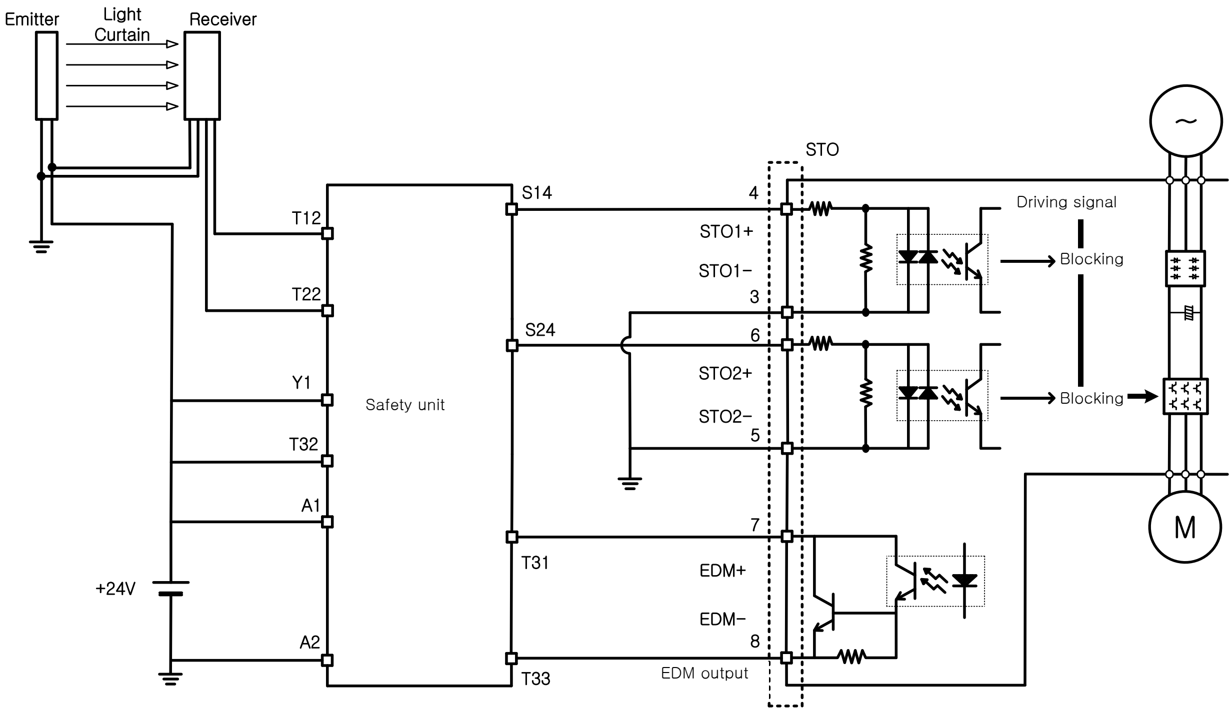
You can detect failure of the safety input circuit and the EDM output circuit by monitoring the following 4 signal states from the external device.

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 Safety Function



6.4 How to Verify Safety Function

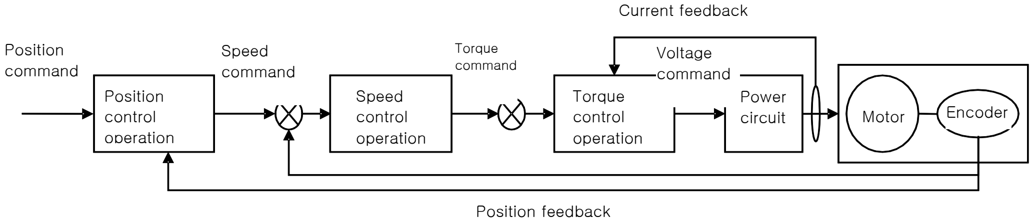
In case that the servo drive was replaced prior to the device startup or during maintenance, make sure to check the details below:

- When STO1 and STO2 signals are turned OFF, check if the drive is in STO status (Bit 31 of 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 Safety Function

- When using the STO function, be sure to carry out risk assessment for the device to check if the safety requirements of the system are met.
- There may be risks even if the STO function works.
- At 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 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 the maintenance of any sub-drive.

7. Tuning



The drive is set to the torque control, the speed control, or the position control mode for use, depending on the method to connect with the upper level controller. This drive is structured so that the position control is located at the outermost while the current control at the innermost, forming a cascade style 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.

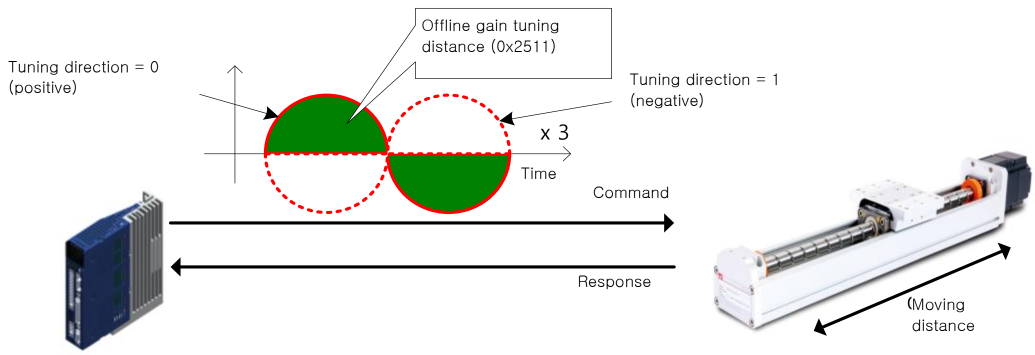
7.1 Off-line Auto Gain Tuning

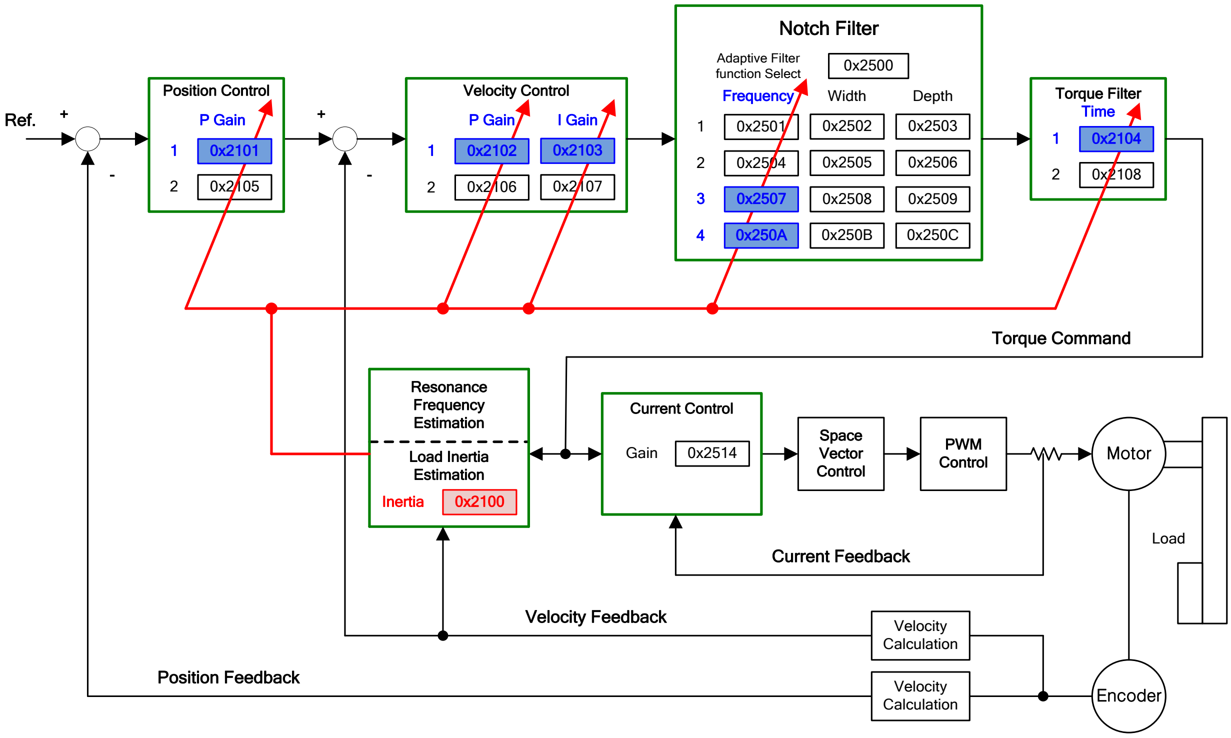
Use the command generated by the drive itself to automatically set the gain according to the load condition. The following gain-related parameters will be changed:

- 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 entire 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 load.

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

Does not use the off-line auto gain tuning command generated by itself(L7NH Drive) and While operating under the command form host device, it sets parameters related gain automatically base on general rule and the rigidity set by user.

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

During online tuning, it refers 20 steps of value of gain table by rigidity. The result of tuning is reflected regulary and changed gain is stored in EEPROM every two minutes.

When intertia estimating, estimated result reflected quickly or slowly by set adaption speed value. The setting rigidity parameters can determine the overall responsiveness of system.

In the following cases, it may be inaccurate to estimate the inertia when online auto tuning.

- When a change of the load is too heavy
- When rigidity of load is too weak or too heavy backlash system.
- When the load is too small(less than 3 times) or too heavy (more than 20 times)
- When acceleration and deceleration is too small for sufficient acceleration and deceleration torque(less than 10% of the rated).
- When the speed of revolution is too slow(less than 10% of the rated).
- When friction torque is too large.

If the above conditions or on-line auto tuning system doesn’t operate well, please run an off-line gain tuning.

7.3 Manual Gain Tuning

7.3.1 Gain Tuning Sequence

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

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

The role of each individual gain is as follows:

– Proportional gain: Determines the controller BW.

– Integral gain: Determines error of steady-state, and generates an overshoot.

– Feedforward gain: Enhances the system lag characteristic.

– Differential gain: Plays a role of damper for the system (not provided)

■ Speed Controller Tuning

(1) Inertia ratio setting

– Use 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, positional error, and noise before any vibration occurs.

(2) Feedforward setting

- Positional 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 being entered currently and the deviation.

(3) Able to set the position command filter

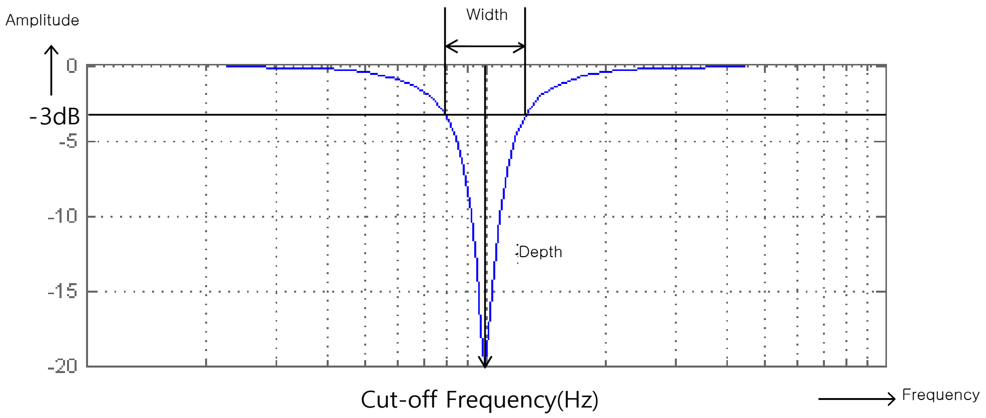
- You can smooth a position command.

7.4 Vibration Control

7.4.1 Notch Filter

Notch filter is a sort of band stop filter to eliminate specific frequency component. You can use a notch filter to eliminate the resonant frequency component of an apparatus, resulting in avoiding vibration while setting a higher gain.

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



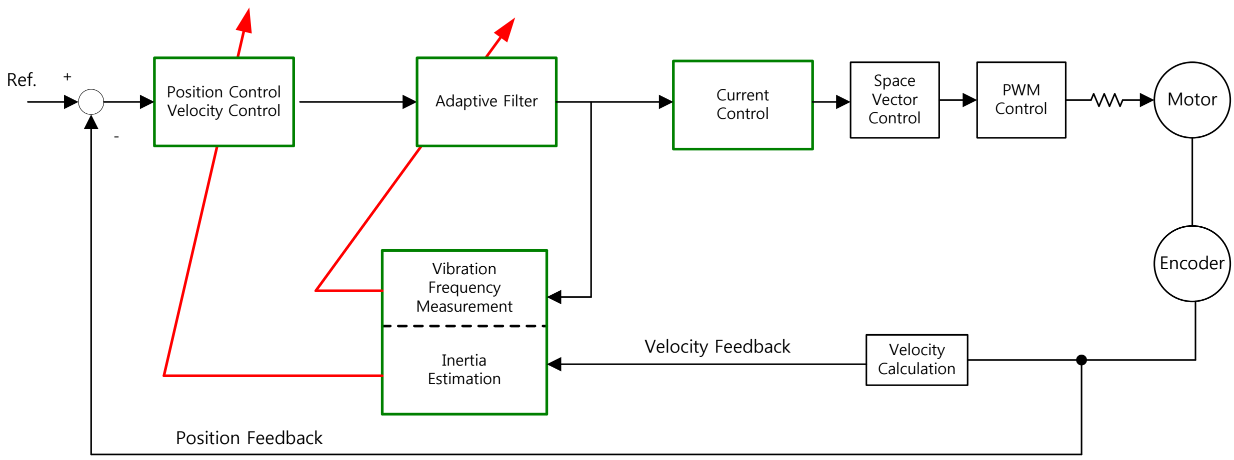
■ **Related Objects**

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2501	-	Notch Filter 1 Frequency	UINT	RW	No	Hz
0x2502	-	Notch Filter 1 Width	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

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

It can detect the vibration frequency through frequency analysis to automatically configure one or two notch filters. On this occasion, the frequency and its width are automatically set and the setting value for the depth 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)

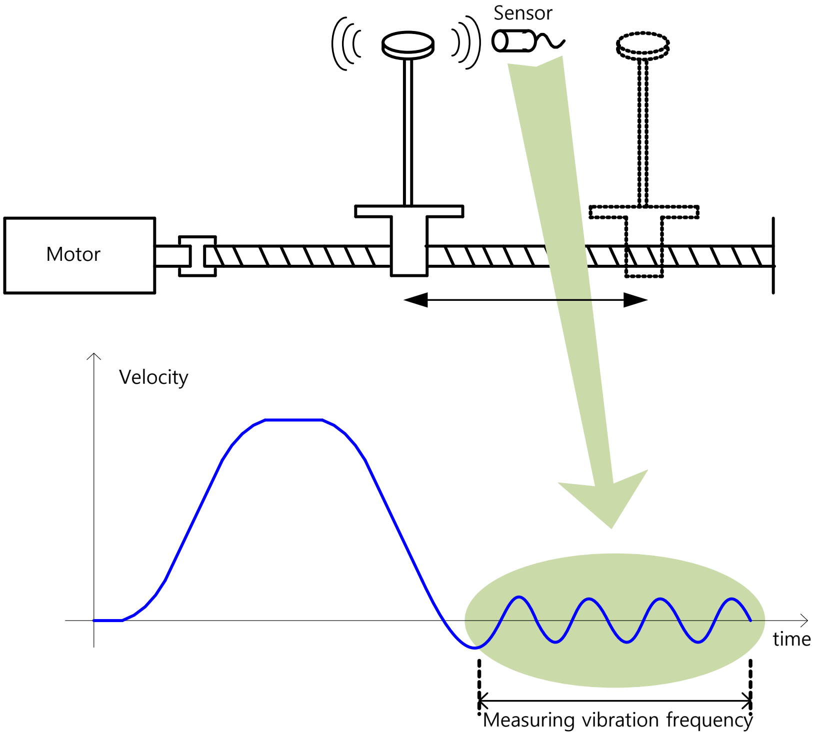
Setting values	Setting details
0	Adaptive filter is not used.
1	Only one adaptive filter is used. You can check the settings configured automatically in the Notch Filter 4 Settings (0x250A and 0x250B).
2	Only two adaptive filters are used. You can check the settings configured automatically in the Notch Filter 3 (0x2507 and 0x2508) and 4 Settings (0x250A and 0x250B).
3~5	Reserved

7.4.3 Vibration Control (Damping) Filter

Vibration control (damping) filter is to decrease vibration occurring in the load.

Measuring vibration frequency occurring in the load throuth the external sensor, and using measured value as the object data for vibration control (damping) filter. L7NH has two vibration control (damping) filter in total. Reagarding each filter, It's available to set up the frequency and volume of decreasing vibration.

L7NH controls frequency from 1[Hz] to 100[Hz] coming from load or total system. This function is only available on position control mode.



■ Rerated object

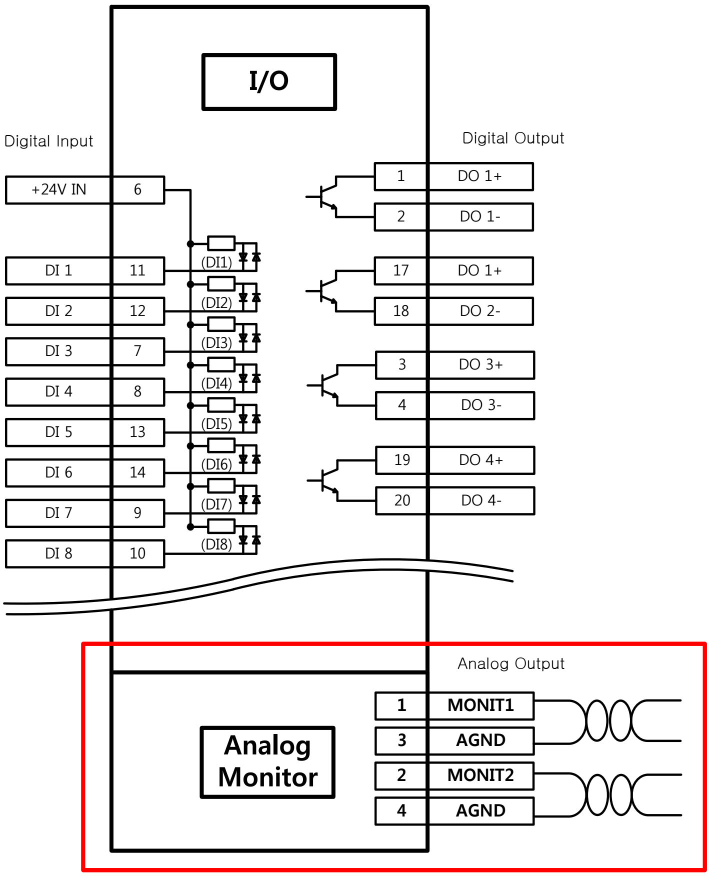
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2515	-	Vibration Suppression Filter Configuration	UINT	RW	No	-
0x2516	-	Vibration Suppression Filter 1 Frequency	UINT	RW	No	0.1[Hz]
0x2517	-	Vibration Suppression Filter 1 Damping	UINT	RW	No	-
0x2518	-	Vibration Suppression Filter 2 Frequency	UINT	RW	No	0.1[Hz]
0x2519	-	Vibration Suppression Filter 2 Damping	UINT	RW	No	-

Vibration Suppression Filter Configuration (0x2515)

Setting Value	Setting Details
0	Not using Vibration control (damping) filter
1	Applying Vibration control (damping) filter 1,2
2	Applying Vibration control (damping) filter 1,2 according to LVSF1, LVSF2 digital input.

7.5 Analog Monitor

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



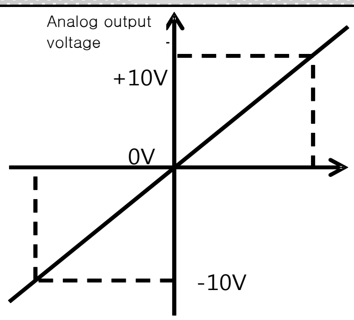
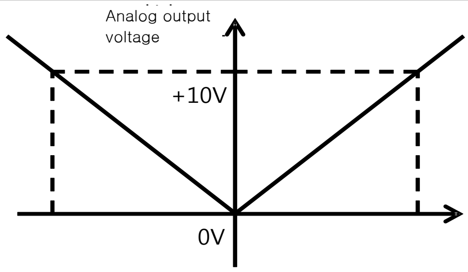
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2220	-	Analog Monitor Output Mode	UINT	RW	No	-

0x2221	-	Analog Monitor Channel 1 Setting	UINT	RW	No	-
0x2222	-	Analog Monitor Channel 2 Setting	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 (0x2220) Setting

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

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

- Analog Monitor Channel 1 Setting (0x2221)

Configure the monitoring variables to be output to the analog monitor output channel 1.

Setting values	Displayed item	Unit
0	Speed feedback	rpm
1	Speed command	rpm
2	Speed error	rpm
3	Torque feedback	%
4	Torque command	%
5	Positional Error	pulse
6	Accumulated Operation Overload	%

7	DC link voltage	V
8	Accumulated Regeneration Overload	%
9	Encoder single-turn data	pulse
10	Inertia ratio	%
11	Full-Closed positional error	UU
12	Drive temperature 1	°C
13	Drive temperature 2	°C
14	Encoder temperature 1	°C

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

Channel 1 output voltage [V] = [Monitoring signal value (0x2221) – Offset (0x2203)] / Scale (0x2205)

Channel 2 output voltage [V] = [Monitoring signal value (0x2222) – Offset (0x2204)] / Scale (0x2206)

■ Setting Example

The following shows an example of monitoring ripple during 1000 rpm operation of speed feedback signal:

8. Procedure Function

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

Procedure command	Codes	Details
Manual JOG	0x0001	Manual JOG operation
Program JOG	0x0002	Programs JOG operation
Alarm History Reset	0x0003	Alarm history reset
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	Resets instantaneous maximum operation overload (0x2604) value
Calibrate Phase Current Offset	0x0008	Phase current offset tuning
Software Reset	0x0009	Software reset
Commutation	0x000A	Commutation

8.1 Manual JOG Operation

Jog operation is a function to verify the servo motor operation by the speed control, without an upper level controller.

Before starting the jog operation, make sure that:

- 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 the consideration of the apparatus state.

■ Related Objects

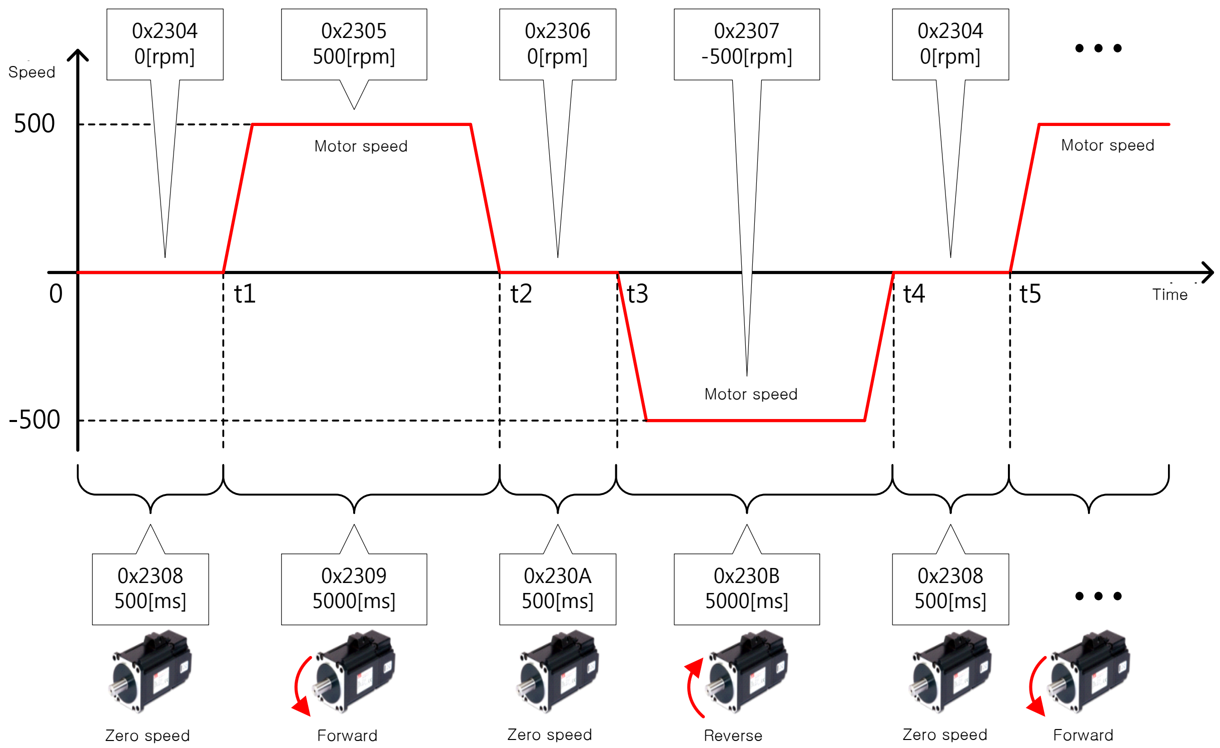
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2300	-	Jog Operation Speed	INT	RW	No	rpm
0x2301	-	Speed Command Acceleration Time	UINT	RW	No	ms
0x2302	-	Speed Command Deceleration Time	UINT	RW	No	ms
0x2303	-	Speed Command S-curve Time	UINT	RW	No	ms

8.2 Programmed Jog Operation

Programmed jog operation is a function to verify the servo motor operation by the speed control at preset operation speed and time, without an upper level controller.

Before starting the jog operation, make sure that:

- 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 the consideration of 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 (Program Jog Operation Speed 1)	INT	RW	No	rpm
0x2305	-	Programmed Jog Operation Speed 2 (Program Jog Operation Speed 2)	INT	RW	No	rpm
0x2306	-	Programmed Jog Operation Speed 3 (Program Jog Operation Speed 3)	INT	RW	No	rpm
0x2307	-	Programmed Jog Operation Speed 4 (Program Jog Operation Speed 4)	INT	RW	No	rpm
0x2308	-	Programmed Jog Operation Time 1 (Program Jog Operation Time 1)	UINT	RW	No	ms
0x2309	-	Programmed Jog Operation Time 2 (Program Jog Operation Time 2)	UINT	RW	No	ms
0x230A	-	Programmed Jog Operation Time 3 (Program Jog Operation Time 3)	UINT	RW	No	ms
0x230B	-	Programmed Jog Operation Time 4 (Program 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 as below (0x2702:01 - 16). The latest 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 (Servo Alarm History)	-	-	-	-
	1	Alarm code 1 (Newest) (Alarm code 1(Newest))	STRING	RO	No	-
	2	Alarm code 2 (Alarm code 2)	STRING	RO	No	-
	3	Alarm code 3 (Alarm code 3)	STRING	RO	No	-
	4	Alarm code 4 (Alarm code 4)	STRING	RO	No	-
	5	Alarm code 5 (Alarm code 5)	STRING	RO	No	-
	6	Alarm code 6 (Alarm code 6)	STRING	RO	No	-
	7	Alarm code 7 (Alarm code 7)	STRING	RO	No	-
	8	Alarm code 8 (Alarm code 8)	STRING	RO	No	-
	9	Alarm code 9 (Alarm code 9)	STRING	RO	No	-
	10	Alarm code 10 (Alarm code 10)	STRING	RO	No	-
	11	Alarm code 11 (Alarm code 11)	STRING	RO	No	-
	12	Alarm code 12 (Alarm code 12)	STRING	RO	No	-
	13	Alarm code 13 (Alarm code 13)	STRING	RO	No	-
	14	Alarm code 14 (Alarm code 14)	STRING	RO	No	-
	15	Alarm code 15 (Alarm code 15)	STRING	RO	No	-
	16	Alarm code 16 (Alarm code 16(Oldest))	STRING	RO	No	-

8.4 Auto Gain Tuning

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

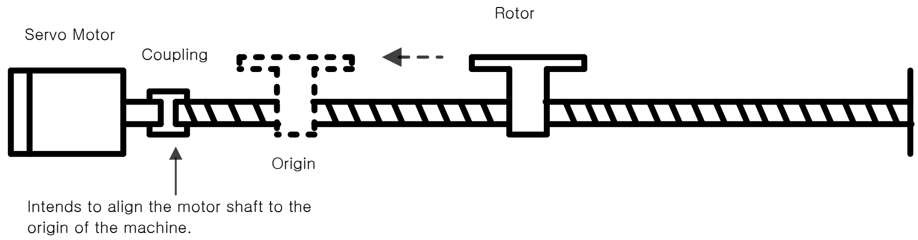
8.5 Index Pulse Search

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 Safet Torque Off (STO) connector is installed; and
- the operation speed is set with consideration to the operation range of the machine.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x230C	-	Index Pulse Search Speed (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 if:

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

When the absolute encoder reset is completed, the multi-turn data (0x260A) and the single-turn data (0x2607) are reset to 0. After the reset, turn on the power again to change the actual position value (0x6064) to the reset position value.

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).
Then, the actual position value (0x6064) will not be changed even if you change the home offset (0x607C) during operation.

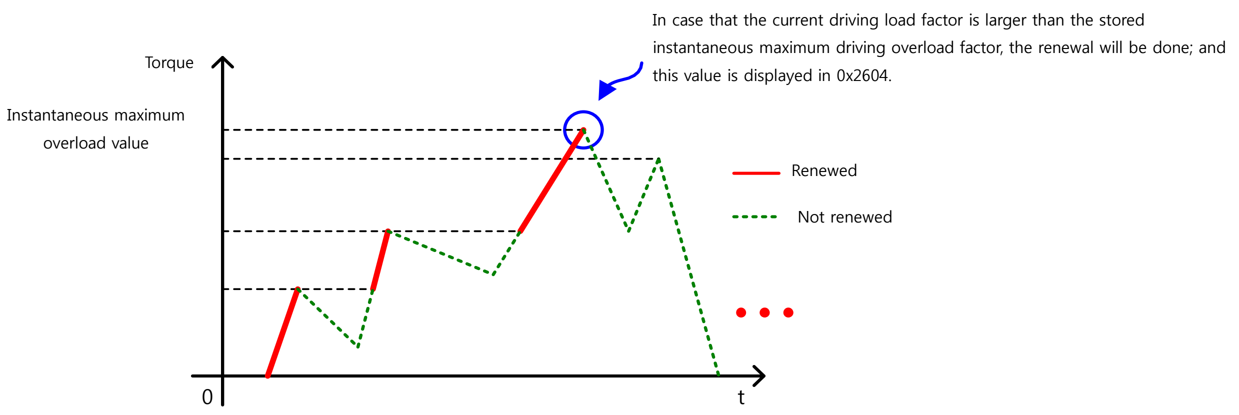
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2005	-	Absolute Encoder Configuration (Absolute Encoder Configuration)	UINT	RW	No	-
0x260A		Multi-Turn Data (MultiTurn 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 during the 15 seconds.

It displays the maximum (peak) load, during the 15 secconds, as a percentage of the rated output. The unit is [0.1%]. Turning on the power again will reset it to 0.



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2604	-	Instantaneous Maximum Operation Overload (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 U/V/W phases. Depending on the environmental condition, you can tune the phase current offset for use. The offset is tuned by factory default setting.

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

■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2015	-	Phase U Current Offset (U Phase Current Offset)	INT	RW	No	0.1%
0x2016	-	Phase V Current Offset (V Phase Current Offset)	INT	RW	No	0.1%
0x2017	-	Phase W Current Offset (W Phase 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 a restart of the drive program, resulting in an effect similar to recycling the power.

You can use this function if:

- you changed parameter settings which require the power to be recycled; or
- you have to restart the drive due to an alarm which cannot be reset.

8.10 Commutation

Commutation function is to get the information on the initial angle of motor. In case of using a motor with hall sensor not installed, you have to get the information on the initial angle through commutation prior to operation, in order to carry out normal operation.

■ Related Objects

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

9. Object Dictionary

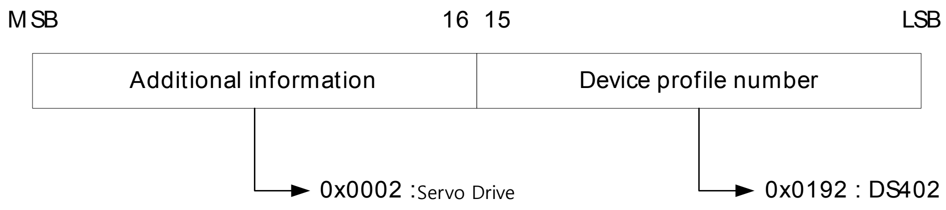
Object is a data structure including parameters, state variables, run commands (procedures), and etc. within a drive.

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.

9.1 General Objects

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

The following table lists device types and their functions.



0x1001	Error Register						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
STRING	-	-	-	RO	No	-	No

Represents the device name.

0x1009	Hardware Version						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
USINT	-	4	-	RO	No	-	No
SubIndex 1		Store all parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No

Store the drive's parameters into the memory. To avoid any mistake, 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
ASC11 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	Storage
USINT	-	4	-	RO	No	-	No
SubIndex 1		Restore all parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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 'save' is written to the relevant SubIndex value.

	MSB		16 15	LSB
	d	a	o	l
ASC11 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 recycle the power of the drive.

0x1018	Identity Object						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	4	-	RO	No	-	No
SubIndex 1		Vendor ID					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage

UDINT	-	0x00007595	-	RO	No	-	No
SubIndex 2		Product code					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0x00010001	-	RO	No	-	No
SubIndex 3		Revision number					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	-	RO	No	-	No
SubIndex 4		Serial number					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	-	RO	No	-	No

Represents the device information.

0x1600	1st Receive PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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 on 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

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

Bit 8-15: SubIndex of objects to be mapped

Bit 16-31: Index of objects to be mapped

0x1601	2nd Receive PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1602	3rd Receive PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1603	4th Receive PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A00	1st Transmit PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage

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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A01	2nd Transmit PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable	Setting range	Initial value	Unit	Accessibility	PDO	Change	Storage

type					assignment	attribute	
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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A02	3rd Transmit PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable	Setting range	Initial value	Unit	Accessibility	PDO	Change	Storage

type					assignment	attribute	
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	Storage
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	Storage
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	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A03	4th Transmit PDO Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
USINT	-	4	-	RO	No	-	No
SubIndex 1		Communication Type SM0					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	1	-	RO	No	-	No
SubIndex 2		Communication Type SM1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 3		Communication Type SM2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	3	-	RO	No	-	No
SubIndex 4		Communication Type SM3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
USINT	-	0	-	RO	No	-	No

0x1C11	Sync Manager 1 PDO Assignment						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of object assigned to PDO					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of object assigned to PDO					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					

Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					

Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
BOOL	-	0	-	RO	No	-	No

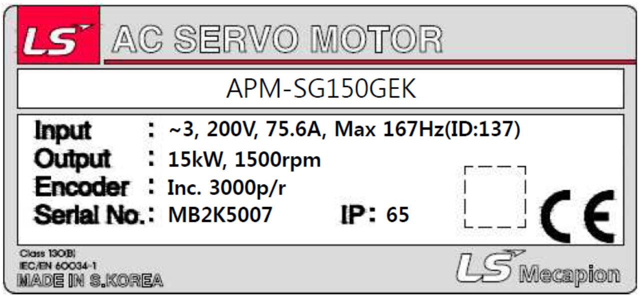
9.2 Manufacturer Specific Objects

● Basic Setting(0x2000~)

0x2000	Motor ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 9999	998	-	RW	No	Power recycling	Yes

Set the motor ID. For the serial encoder provided by LS Mecapion, it is automatically set. You can check the automatically set IDs. You can check the motor ID on the motor nameplate.

Ex) 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	Storage
UINT	0 to 99	2	-	RW	No	Power recycling	Yes

Set the encoder type. You have to set it correctly by referencing the table below. However, the serial encoder provided by LS Mecapion (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.

Setting values	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

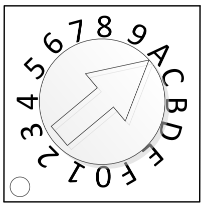
0x2002	Encoder Pulse per Revolution						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 1073741824	524288	pulse	RW	No	Power recycling	Yes

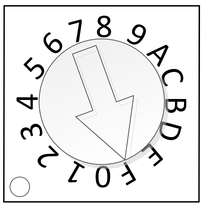
Set the encoder resolution in the unit of pulse (count) based on a multiple of 4. Generally, you can check the encoder resolution on the nameplate (refer to the description of 0x2000). However, the serial encoder provided by LS Mecapion is automatically recognized and configured regardless of these settings. Then, you can check the resolution of the encoder automatically recognized.

0x2003	Node ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	-	-	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.

Ex) Example of setting the node ID to 10 (0x0A) and 15 (0x0F)


ADDR

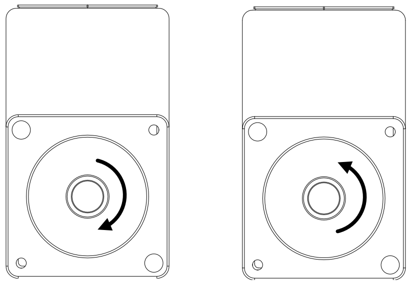

ADDR

0x2004	Rotation Direction Select						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Power recycling	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.

Setting values	**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	Storage
UINT	0 to 1	1	-	RW	No	Power recycling	Yes

Set the usage of the absolute encoder.

Setting values	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 Fail Check Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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 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	Storage
UINT	0 to 100	0	-	RW	Yes	Always	Yes

This specifies items to display in the 7SEG window.

Setting values	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	°C	Temperature near the drive power element
12	Drive Temperature 2	°C	Internal temperature of drive
13	Encoder temperature 1	°C	Internal temperature of encoder
14	Node ID	-	

0x2009	Regeneration Brake Resistor Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Always	Yes

Perform regenerative resistance-related setting.

Setting values	**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. For the wiring of the external regenerative resistor, refer to the wiring diagram of the power supply (2.3).

0x200A	Regeneration Brake Resistor Derating Factor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 fast. 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.

0x200B	Regeneration Brake Resistor Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Regeneration Brake Resistor Power						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Peak Power of Regeneration Brake Resistor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Duration Time @ Peak Power of Regeneration Brake Resistor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 in watt. When using an internal regenerative resistor (0x2009= 0), no setting values will be applied.

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

This indicates the load factor at which operation overload starts to be accumulated. When this is set to a value no more than 100, operation overload will start to be accumulated earlier at the set load factor to result in early trigger of operation overload alarm (AL-21). 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						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	10 to 100	50	%	RW	No	Always	Yes

This specifies the output level of 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.

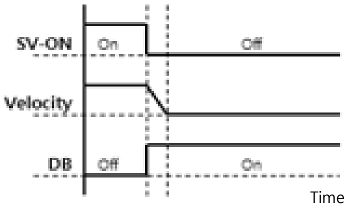
0x2011	PWM Off Delay Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	10	ms	RW	No	Always	Yes

This specifies the delay time until the PWM actually turns off after running 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.

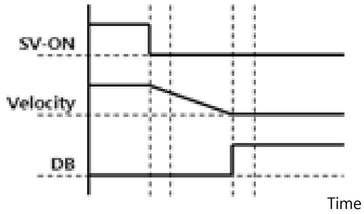
0x2012	Dynamic Brake Control Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 3	0	-	RW	No	Always	Yes

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

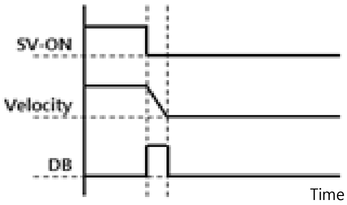
Setting values	Description
0	Hold the dynamic brake after stopping the motor using the brake
1	Release the dynamic brake after stopping the motor using the brake
2	Release the dynamic brake after free-run stop
3	Hold the dynamic brake after free-run stop



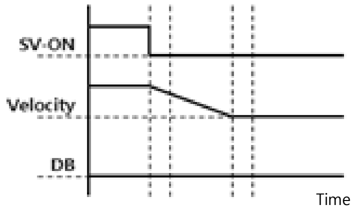
Hold after a DB stop



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	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	1	-	RW	No	Always	Yes

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

Setting values	Description
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 $FFFF_{hex}$	0	-	RW	Yes	Always	Yes

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

Bit	Warning code	Warning name/ Description
0	W01	Main power phase loss
1	W02	Low voltage of encoder battery

2	W04	Software Position Limit
3	W08	-
4	W10	Operation overload
5	W20	Abnormal combination of drive and motor, abnormal I/O setting
6	W40	Low voltage
7	W80	Emergency signal input
8~14	-	-
15	STO	STO 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	V 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 V 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).

0x2017	W 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 W 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).

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	Storage
UINT	1 to 65535	2400	.01mm	RW	No	Power recycling	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	Storage
UINT	1 to 65535	1000	nm	RW	No	Power recycling	Yes

Set Linear Scale Resolution in nm. For a linear scale with the 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	Storage
UINT	0 to 2	0	-	RW	No	Power recycling	Yes

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

Setting values	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	Storage
UINT	0 to 1000	500	0.1%	RW	No	Always	Yes

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

0x201D	Grating Period of Sinusoidal Encoder						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 65535	40	um	RW	No	Power recycling	Yes

Set grid of sinusoidal encoder

0x201E	Homing Done Behaviour						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Always	Yes

Set movement towards Zero position according to home offset [0x607C].

Setting values	Description
0	Motor will not move and home offset [0x607C] value will be zero position after homing by homing method [0x6098]
1	Motor will be rotate as much as home offset and zero offset will be 0, after homming by homing method [0x6098]

0x201F	Velocity Function Select						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 2	0	-	RW	No	Always	Yes

Select the method to calculate feedback speed when encoder type is Quadrature.

Setting values	Description
0	MT Method + Speed Observer
1	MT Method
2	M Method

0x2020	Motor Hall Phase Config						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Power recycling	Yes

Checking the motor wiring and hall sensor wiring in case of 3rd party motor and Setting the sequence of hall sensor UVW, polarity of hall sensor signal and motor rotation direction.

Setting values	Description
0	Setting direction of rotation of motor (0x2004's setting values and Exclusive OR operation.)
1~7	Reserved
8	Hall U polarity reversal
9	Hall V polarity reversal
10	Hall W polarity reversal
11	Reserved
12	Hall U, Hall V replace
13	Hall V, Hall W replace
14	Hall W, Hall U replace
15	Reserved

Gain Adjustment(0x2100~)

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

This specifies the ratio of the load inertia to the motor's rotor inertia in %.

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	Storage
UINT	1 to 500	50	1/s	RW	Yes	Always	Yes

This specifies the whole responsiveness of the position controller. The larger the setting is configured, the higher the responsiveness is. 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	Storage
UINT	1 to 2000	75	Hz	RW	Yes	Always	Yes

This specifies the whole responsiveness of the speed controller. To make the whole responsiveness of the system higher, you have to set the speed loop gain large as well, along with the position loop gain. 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	Storage
UINT	1 to 1000	50	ms	RW	Yes	Always	Yes

This specifies the integral time constant of the speed controller. If you set a large value, error will be reduced at a steady state (while stopped or driving at a 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	Storage
UINT	0 to 1000	5	0.1ms	RW	Yes	Always	Yes

This applies a low pass filter for torque command. You can improve the system stability by setting an appropriate value to smoothen 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	Storage
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	Storage
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	Storage
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	Storage
UINT	0 to 1000	0	0.1ms	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	Storage
UINT	0 to 10000	0	0.1ms	RW	Yes	Always	Yes

This applies a low pass filter for position command to smoothen the position command. Especially, this can be used for setting a higher gear ratio.

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

This applies a moving average filter for position command to smoothen 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	Storage
UINT	0 to 1000	5	0.1ms	RW	Yes	Always	Yes

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

0x210C	Velocity Feed-forward Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 too large value depending on the load, vibration 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	Storage
UINT	0 to 1000	10	0.1 ms	RW	Yes	Always	Yes

This applies 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	Storage
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	Storage
UINT	0 to 1000	10	0.1 ms	RW	Yes	Always	Yes

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

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

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

Setting values	Description
0	Limits the torque using positive/negative torque limit value according to the driving direction; the maximum value is limited by the maximum torque (0x6072). - Forward: 0x60E0, Reverse: 0x60E1
1	Limits the torque only by the maximum torque (0x6072) regardless of the driving direction.
2	Limits the torque using external positive/negative torque limit value according to the driving direction. - Forward: 0x2111, Reverse: 0x2112
3	Limits the torque using internal and external torque limit value 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)
4	Limited by the analog input torque limit. - Refer to analog torque limit scale (0x221C) and offset (0x221D)

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

This specifies the external positive 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	Storage
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

This specifies the external negative 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	Storage
UINT	0 to 5000	1000	0.1%	RW	Yes	Always	Yes

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

0x2114	P/PI Control Conversion Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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.

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

0x2115	P Control Switch Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Switch Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Switch Acceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Switch Following Error						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 60000	100	pulse	RW	Yes	Always	Yes

Refer to the description of the P/PI control switching mode (0X2114).

0x2119	Gain Conversion Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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)

Setting values	Setting details
0	Only the gain group 1 is used.
1	Only the 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 Conversion Time 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Conversion Time 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Conversion Waiting Time 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Conversion Waiting Time 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
UINT	0 to 1000	0	UU	RW	Yes	Always	Yes

The position controller output is 0 if 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	Storage
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 input through 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

0x2120	Drive Control Input 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to $FFFF_{hex}$	0	-	RW	Yes	-	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	Storage
UINT	0 to $FFFF_{hex}$	0	-	RW	Yes	Always	No

You can assign the state of the drive output signal to the I/O output signal, in order to verify the applicable bit of this output value, in addition to 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	Storage
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 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 assigned	

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

Setting values	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

0x2201	Digital Input Signal 2 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0002	-	RW	No	Power recycling	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 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0003	-	RW	No	Power recycling	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 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0004	-	RW	No	Power recycling	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 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0005	-	RW	No	Power recycling	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 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0006	-	RW	No	Power recycling	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.

0x2206	Digital Input Signal 7 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0007	-	RW	No	Power recycling	Yes

This specifies the functions of digital input signal 7 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2207	Digital Input Signal 8 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0008	-	RW	No	Power recycling	Yes

This specifies the functions of digital input signal 8 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2210	Digital Output Signal 1 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x8001	-	RW	No	Power recycling	Yes

Assign the functions of digital output signal 1 of I/O and set the output signal level.

Setting example) If the setting value 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	Assign output signal

Setting values	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 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x8002	-	RW	No	Power recycling	Yes

Assign the functions of digital output signal 2 of I/O and set the output signal level. For more information, refer to the description of 0x2210.

0x2212	Digital Output Signal 3 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0003x	-	RW	No	Power recycling	Yes

Assign the functions of digital output signal 3 of I/O and set the output signal level. For more information, refer to the description of 0x2210.

0x2213	Digital Output Signal 4 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0004	-	RW	No	Power recycling	Yes

Assign the functions of digital output signal 4 of I/O and set the output signal level. For more information, refer to the description of 0x2210.

0x221C	Analog Torque Limit Scale						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	300	0.1%/V	RW	No	Always	Yes

If the value of torque limit function setting (0x2110) is 4 (analog torque limit), torque is limited by the analog input torque limit. Set the scale of the analog input value at this time.

0x221D	Analog Torque Limit Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-1000 to 1000	0	mV	RW	No	Always	Yes

This specifies the analogue voltage offset controlled by the analogue torque limit

0x2220	Analog Monitor Output Mode						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Always	Yes

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

Setting values	Setting details
0	Output as negative/positive values
1	Output only as positive values

0x2221	Analog Monitor Channel 1 Select						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	0	-	RW	No	Always	Yes

Configure the monitoring variables to be output to the analog monitor output channel 1.

Setting values	Displayed item	Unit
0	Speed feedback	rpm
1	Speed command	rpm
2	Speed error	rpm

3	Torque feedback	%
4	Torque command	%
5	Positional Error	pulse
6	Accumulated Operation Overload	%
7	DC link voltage	V
8	Accumulated Regeneration Overload	%
9	Encoder single-turn data	pulse
10	Inertia Ratio	%
11	Full-Closed positional error	UU
12	Drive Temperature 1	°C
13	Drive Temperature 2	°C
14	Encoder temperature 1	°C

0x2222	Analog Monitor Channel 2 Select						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	1	-	RW	No	Always	Yes

Configure the monitoring variables to be output to the analog monitor output channel 2.

0x2223	Analog Monitor Channel 1 Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	0	-	RW	No	Always	Yes

Subtract the offset value from the monitoring variable of the 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	Storage
DINT	0 to 0x40000000	0	-	RW	No	Always	Yes

Subtract the offset value from the monitoring variable of the 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	Storage
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 the 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 the 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	Storage
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 the 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(0x2300~)

0x2300	Jog Operation Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
UINT	0 to 10000	200	ms	RW	No	Always	Yes

Specifies the time required, in ms, 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	Storage
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 the stop.

0x2303	Speed Command S-curve Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Program Jog Operation Speed 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-6000 to 6000	0	rpm	RW	No	Always	Yes

For programmed jog operation, you can set the operation speed 1 to 4 and the operation time 1 to 4 as follows:

0x2305	Program Jog Operation Speed 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-6000 to 6000	500	rpm	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2306	Program Jog Operation Speed 3						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-6000 to 6000	0	rpm	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2307	Program Jog Operation Speed 4						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-6000 to 6000	-500	rpm	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2308	Program Jog Operation Time 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	500	ms	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x2309	Program Jog Operation Time 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	5000	ms	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x230A	Program Jog Operation Time 3						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	500	ms	RW	No	Always	Yes

Refer to the description of Programmed Jog Operation Speed 1 (0x2304).

0x230B	Program Jog Operation Time 4						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
INT	-1000 to 1000	20	rpm	RW	No	Always	Yes

This specifies the speed for index pulse search.

0x230D	Speed Limit Function Select						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 3	0	-	RW	No	Always	Yes

This specifies the speed limit function for torque control.

Setting values	Setting details
0	Limited by 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	Storage
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	Storage
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	Storage
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 Select						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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.

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

• Miscellaneous Setting(0x2400~)

0x2400	Software Position Limit Function Select						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 (0x670D:02) and (0x670D: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.

Setting values	Setting details
0	None of positive and negative software position limits are used.
1	Only positive software position limit value is used. It is not limited for the reverse direction.
2	Only negative software position limit value is used. It is not limited for the forward direction.
3	Both of 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	Storage
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

With the position command not newly updated, if the positional 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	Storage
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	Storage
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

This outputs the INPOS2 signal where the positional error is less than the setting value. Unlike the INPOS1, the INPOS2 signal is output by calculating only the positional error value.

0x2404	ZSPD Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
UINT	0 to 6000	100	rpm	RW	No	Always	Yes

If the motor stops due to servo OFF or servo alarm during rotation, you can set the speed (0x2407) and delay time (0x2408) for brake signal output, in order 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	Storage
UINT	0 to 1000	100	ms	RW	No	Always	Yes

Refer to the description of 0x2407.

0x2409	Torque Limit for Homing Using Stopper						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 for Homing Using Stopper						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
UINT	0 to 3	0	-	RW	No	Power recycling	Yes

This specifies whether to use the Modulo function.

Setting values	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	Storage
DINT	1 to 0x3FFFFFFF	3600	UU	RW	No	Power recycling	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	Storage
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 Storage						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 1	0	-	RW	No	Always	No

This specifies whether to save parameters individually. This parameter is not saved and initialized to 0 during power ON.

Setting values	Setting details
0	Parameters are not saved individually. For details on storing a parameter, refer to Storing Parameters (0x1010).
1	Save the parameters individually. When a parameter is written, it is immediately stored in the memory.

• Enhanced Control(0x2500~)

0x2500	Adaptive Filter Function Select						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5	0	-	RW	No	Always	Yes

This specifies the adaptive filter function.

Setting values	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 4 Settings (0x250A and 0x250B).
2	Only two adaptive filters are used. You can check the settings configured automatically in the Notch Filter 3 (0x2507 and 0x2508) and 4 Settings (0x250A and 0x250B).
3~5	Reserved

0x2501	Notch Filter 1 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	50 to 5000	5000	Hz	RW	No	Servo off	Yes

This specifies the frequency of the notch filter 1.

0x2502	Notch Filter 1 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 100	1	Hz	RW	No	Servo off	Yes

This specifies the width of the notch filter 1.

0x2503	Notch Filter 1 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 5	1	-	RW	No	Servo off	Yes

This specifies the depth of the notch filter 1.

0x2504	Notch Filter 2 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	50 to 5000	5000	Hz	RW	No	Servo off	Yes

0x2505	Notch Filter 2 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 100	1	Hz	RW	No	Servo off	Yes

0x2506	Notch Filter 2 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 5	1	-	RW	No	Servo off	Yes

0x2507	Notch Filter 3 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	50 to 5000	5000	Hz	RW	No	Servo off	Yes

0x2508	Notch Filter 3 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 100	1	Hz	RW	No	Servo off	Yes

0x2509	Notch Filter 3 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 5	1	-	RW	No	Servo off	Yes

0x250A	Notch Filter 4 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	50 to 5000	5000	Hz	RW	No	Servo off	Yes

0x250B	Notch Filter 4 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 100	1	Hz	RW	No	Servo off	Yes

0x250C	Notch Filter 4 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 5	1	-	RW	No	Servo off	Yes

0x250D	On-line Gain Tuning Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Servo off	Yes

This specifies the On-line Gain Tuning Mode.

Setting values	Setting details
0	On-line Gain Tuning not used
1	On-line Gain Tuning used

0x250E	System Rigidity for Gain Tuning						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 20	5	-	RW	No	Servo off	Yes

This specifies the system rigidity applied for gain tuning. After the 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. 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).

0x250F	On-line Gain Tuning Adaptation Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 5	1	-	RW	No	Servo off	Yes

This specifies the speed reflecting the change of gain when performing on-line gain tuning. The larger the setting value is, the faster the change of gain is reflected.

0x2510	Off-line Gain Tuning Direction						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Servo off	Yes

This specifies the movement direction when performing the Off-line Gain Tuning. Set the function properly according to the condition of the apparatus section.

Setting values	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	Storage
UINT	1 to 10	5	-	RW	No	Servo off	Yes

It specifies the distance when performing the off-line gain tuning. The larger the setting value is, the longer the movement distance becomes. Set the distance properly according to the condition of the apparatus section. Make sure to secure enough distance (more than one revolution of motor) prior to gain tuning.

0x2512	Disturbance Observer Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 100	50	%	RW	No	Servo off	Yes

(It will be supported later)

0x2513	Disturbance Observer Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	10	0.1 ms	RW	No	Servo off	Yes

(It will be supported later)

0x2514	Current Controller Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 150	100	%	RW	No	Servo off	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 Suppression Filter Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5	0	-	RW	No	Servo off	Yes

(Description will be added later)

0x2516	Vibration Suppression Filter 1 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 2000	0	0.1Hz	RW	No	Servo off	Yes

0x2517	Vibration Suppression Filter 1 Damping						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5	0	-	RW	No	Servo off	Yes

0x2518	Vibration Suppression Filter 2 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 2000	0	0.1Hz	RW	No	Servo off	Yes

0x2519	Vibration Suppression Filter 2 Damping						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5	0	-	RW	No	Servo off	Yes

Monitoring (from 0x2600)

0x2600	Feedback Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
INT	-	-	rpm	RO	Yes	-	No

This represents the speed command input to the speed control loop of the drive.

0x2602	Following Error						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	pulse	RO	Yes	-	No

This represents the positional error of position control.

0x2603	Accumulated Operation Overload						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
INT	-	-	0.1%	RO	Yes	-	No

This represents the maximum value of the operation overload rate output instantaneously from the drive. 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	Storage
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	Storage
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	Storage
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	Mechanical Angle						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	0.1deg	RO	Yes	-	No

This represents the single-turn data of the motor, ranging from 0.0 to 359.9.

0x2609	Electrical Angle						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	0.1deg	RO	Yes	-	No

This represents the electrical angle of the motor, ranging from -180.0 to 180.0.

0x260A	MultiTurn Data						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	rev.	RO	Yes	-	No

This represents the multi-turn data of multi-turn encoder.

0x260B	Drive Temperature 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	^{o}C	RO	No	-	No

It is the temperature measured by the temperature sensor integrated onto the drive power board. If the measurement is higher than 95℃, the drive overheat alarm 1 (AL-22) will be generated.

0x260C	Drive Temperature 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	^{o}C	RO	No	-	No

This represents the temperature measured by the temperature sensor integrated onto 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	Storage
INT	-	-	^{o}C	RO	No	-	No

This represents the temperature measured by the temperature sensor integrated into serial encoder provided by LS Mecapion (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	Storage
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	Storage
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	Storage
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	Storage
STRING	-	-	-	RO	No	-	No

This represents the version of the FPGA within the drive.

0x2612	Hall Signal Display						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
INT	-	-	mV	RO	No	-	No

This indicates the voltage in mV, which is inputted to the analogue input channel 1.

- **Procedure and Alarm history(0x2700~)**

0x2700	Procedure Command Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Operation start
	4	Stop to zero speed (server on maintained)
Servo Alarm History Initialization(0x0003)	1	
Off-line 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	Resets instantaneous maximum operation overload (0x2604) value
Phase current offset tuning (0x0008)	1	Phase current offset tuning (The U-/V-/W-phase offsets are stored in 0x2015 - 7, 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	Storage
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	Storage
STRING	-	16	-	RO	No	-	No
SubIndex 1		Alarm code 1 (Newest)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 2		Alarm code 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 3		Alarm code 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 4		Alarm code 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 5		Alarm code 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 6		Alarm code 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 7		Alarm code 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 8		Alarm code 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No

<table>
<tr><td colspan="2">SubIndex 9</td><td colspan="6">Alarm code 9</td></tr>
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<tr><td>STRING</td><td>-</td><td>-</td><td>-</td><td>RO</td><td>No</td><td>-</td><td>No</td></tr>
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<tr><td>STRING</td><td>-</td><td>-</td><td>-</td><td>RO</td><td>No</td><td>-</td><td>No</td></tr>
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<tr><td colspan="2">SubIndex 15</td><td colspan="6">Alarm code 15</td></tr>
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<tr><td>STRING</td><td>-</td><td>-</td><td>-</td><td>RO</td><td>No</td><td>-</td><td>No</td></tr>
</table>

This represents the history of servo alarm generated from the drive. Up to 16 servo alarms recently generated are stored. The SubIndex 1 is the latest alarm while the SubIndex 16 is the oldest one out of the recently generated alarms. The servo alarm history can be reset by procedure command.

• Third Party Motor Support(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 correct parameters. In this case, however, our company neither has performed any test for the combination of our drive and the third party motor, nor gives any warranty for the motor characteristic.

0x2800	[Third Party Motor] Type						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Power recycling	Yes

This specifies the motor type.

Setting values	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	Storage
UINT	2 to 1000	8	-	RW	No	Power recycling	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	Storage
FP32	-	2.89	Arms	RW	No	Power recycling	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	Storage
FP32	-	8.67	Arms	RW	No	Power recycling	Yes

This specifies the maximum current of the motor.

0x2804	[Third Party Motor] Rated Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 60000	3000	rpm	RW	No	Power recycling	Yes

This specifies the rated speed of the motor. For a linear motor, the unit is mm/s.

0x2805	[Third Party Motor] Maximum Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 60000	5000	rpm	RW	No	Power recycling	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	Storage
FP32	-	0.321	$Kg.m^2.10^{-4}$	RW	No	Power recycling	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	Storage
FP32	-	0.46	Nm/A	RW	No	Power recycling	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	Storage
FP32	-	0.82	ohm	RW	No	Power recycling	Yes

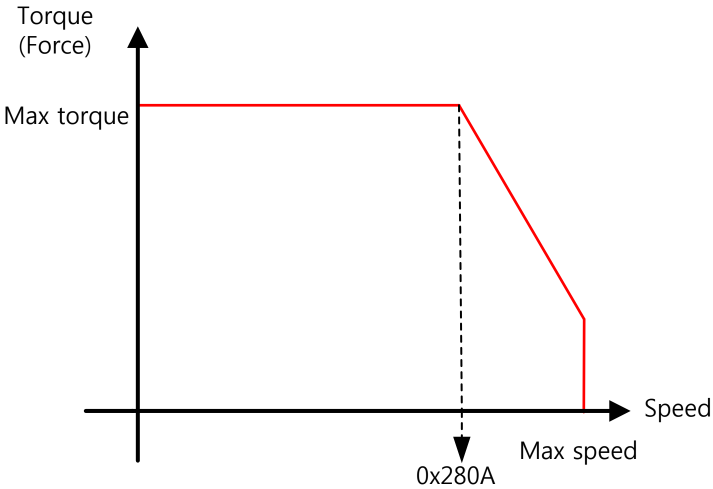
This specifies the phase resistance (= resistance between lines ÷ 2) of the motor.

0x2809	[Third Party Motor] Phase Inductance						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
FP32	0 to 1000	3.66	mH	RW	No	Power recycling	Yes

This specifies the phase inductance (= inductance between lines ÷ 2) of the motor.

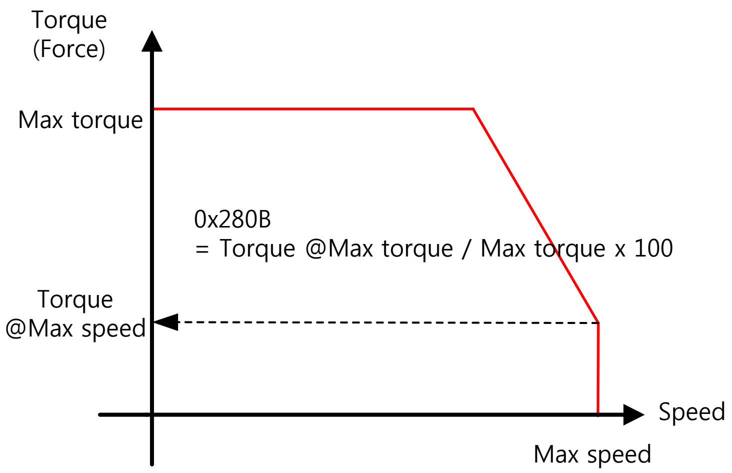
0x280A	[Third Party Motor] TN Curve Data 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 60000	3000	rpm	RW	No	Power recycling	Yes

This specifies the data of the motor speed/torque curve. Enter the maximum speed at the time when the maximum torque (for a linear motor, the maximum thrust) 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	Storage
FP32	-	100.0	%	RW	No	Power recycling	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	Storage
UINT	0 to 360	0	deg	RW	No	Power recycling	Yes

The offset of the hall sensor attached for initial angle of a 3rd party motor may vary depending on manufacturer. For this case, the hall sensor offset must be checked and correctly set.

9.3 CiA402 Objects

0x603F	Error Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	0	-	RO	Yes	-	No

The alarm code which has last occurred in Servo Drive is displayed.

0x6040	Controlword						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0	-	RW	Yes	Always	No

This is composed of bits which control the drive state, the operation mode, and manufacturer-specific options.

Bit	Function	Description
0	Switch on	Refer to the section concerning Bits 0 to 3.
1	Enable Voltage	
2	Quick stop	
3	Enable operation	
4 to 6	Settings by operation mode	Refer to the section concerning bits 4 to 9.
7	Fault reset	0→1: Alarm/warning reset
8	Halt	Refer to the section concerning Bits 4 to 9.
9	Settings by operation mode	
10	–	-
11 to 15	–	-

<Description on Bits 0 to 3>

• Bits 0 to 3: Drive state control

Command	Controlword Bit				
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0
Shutdown	0	–	1	1	0
Switch on	0	0	1	1	1
Switch on + Enable operation	0	1	1	1	1
Disable voltage	0	–	–	0	–
Quick stop	0	–	0	1	–
Disable operation	0	0	1	1	1

Enable operation	0	1	1	1	1

<Description on Bits 4 to 9>

• Bits 4, 5 and 9: For PP mode operation

Bit 9	Bit 5	Bit 4	Details
0	0	0 → 1	It proceeds to the next position when the operation at the current position is complete.
–	1	0 → 1	It drives to the next position immediately.
1	0	0 → 1	It 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	Details
6	Abs/rel	0	This sets the target position to an absolute value.
		1	This 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 HM mode operation

Bit	Function	Value	Details
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

• Bits 4, 5, 6, 8 and 9: For CSP, CSV, or CST mode operation

Bit	Function	Value	Details
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, 6, 8 and 9: For IP mode operation

Bit	Function	Value	Details
4	Use of Interpolation	0	Interpolation disabled
		1	Interpolation enabled
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

• Bits 4, 5, 6, 8 and 9: For PV and PT mode operation

Bit	Function	Value	Details
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

0x6041	Statusword						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	Yes	-	No

The 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 section concerning 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 sections concerning bits 10, 12 and 13.
11	Internal limit active	Refer to the section concerning bit 11.
12 to 13	Operation mode specific	Refer to the sections concerning bits 10, 12 and 13.
14	Torque limit active	0: no torque limit active 1: torque limit active
15	–	Reserved

<Description on 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

<Description on Bit 11>

• Bit 11: Indicates whether to use an internal limit

Use of an internal limit: Both the software position limit and internal limit are applied to the target position.

Use N-OT/P-OT contacts

Interpolation speed exceeded (used only in the IP or CSP mode)

<Description on Bits 10, 12 and 13>

• Bits 10, 12 and 13: For PP mode operation

Bit	State	Value	Details
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 is 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 homing mode operation

Bit 13	Bit 12	Bit 10	Details
Homing error	Homing attained	Target reached	
0	0	0	Homing in progress
0	0	1	Homing stopped or not started
0	1	0	Performed homing operation, but the 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

• Bits 10, 12 and 13: For CSP, CSV, or CST mode operation

Bit	State	Value	Details
10	Target reached	0	Unable to reach the target (position/velocity/torque)
		1	Reached the target (position/velocity/torque)
12	Target value ignored	0	Ignores the target value (position/velocity/torque)
		1	Uses the target value as the position control input
13	Following error	0	No positional error (always 0 in Csv/Torque Mode)
		1	Positional error

• Bits 10, 12 and 13: For IP mode operation

Bit	State	Value	Details
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 is 0
12	IP mode active	0	Interpolation deactivated
		1	Interpolation activated
13	–	0	-
10	Target reached	0	Halt (0x6040.8) = 0: Unable to reach the target position Halt (0x6040.8) = 1: deceleration

• Bits 10, 12 and 13: For PV mode operation

Bit	State	Value	Details
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 is 0
12	Speed	0	Not in a zero speed state
		1	In zero a speed state
13	–	0	-

• Bits 10, 12 and 13: For PT mode operation

Bit	State	Value	Details
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 is 0
12	–	0	Reserved
13	–	0	Reserved

0x605A	Quick Stop Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	0 to 4	2	-	RW	No	Always	Yes

This sets the Quick Stop option code.

Setting values	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).

Setting values	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	Storage
INT	0 to 1	1	-	RW	No	Always	Yes

This specifies the Disable Operation state (Operation Enabled state → Switched On state) option code.

Setting values	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	Storage
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.

Setting values	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	Storage
INT	0	0	-	RW	No	Always	Yes

This sets the operation method which protects the drive system during fault reactions.

Setting values	Description
0	Does not use the servo drive function. The motor will retain the free-run state.

0x6060	Modes of Operation						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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:

Setting values	name	Details
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	Modes of Operation Display						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
DINT	-	-	UU	RO	Yes	-	No

This displays the position demand value in the position units (UU) specified by the user.

0x6063	Position Actual Internal Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage

DINT	-	-	pulse	RO	Yes	-	No

This displays the actual internal position value in encoder pulses.

0x6064	Position Actual Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU	RO	Yes	-	No

This displays the actual position value in user-defined position units (UU).

0x6065	Following Error Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Following Error Timeout						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Velocity Actual Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU/s	RO	Yes	-	No

This displays the actual velocity value in user-defined position unit.

0x606D	Velocity Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Velocity Window Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
INT	-	-	0.1%	RO	Yes	-	No

This displays the current torque demand value in 0.1% increments of the rated torque.

0x6077	Torque Actual Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	0.1%	RO	Yes	-	No

This displays the actual torque value generated by the drive in 0.1% increments of the rated torque.

0x607A	Target Position						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 absolute coordinate or relative coordinate depending on the Bit 4 (0x6040.4) setting of the Controlword in the PP mode, and is always used as absolute value in the CSP mode.

0x607C	Home Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Min. position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Max Profile Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0x7FFFFFFF	0x7FFFFFFF	UU/s	RW	Yes	Always	Yes

This specifies the maximum profile speed for the PP mode operation.

0x6081	Profile Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
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	Storage
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	Storage
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	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Motor revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	1	-	RW	No	Power	Yes

						recycling	
SubIndex 2		Shaft revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	1	-	RW	No	Power recycling	Yes

For more information, refer to Section 5.3 Electric Gear Setup.

0x6098	Homing Method						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
SINT	-128 to 127	34	-	RW	No	Always	Yes

This sets the homing method. For more information, refer to 4.6 Homing.

Setting values	Details
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

0x6099	Homing Speeds						
SubIndex 0		Number of entries(Number of entries)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Switch search speed(Speed during search for switch)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	500000	UU/s	RW	No	Always	Yes
SubIndex 2		Zero search speed(Speed during search for zero)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
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	Storage
DINT	-2147483648 to 2147483647	0	UU	RW	Yes	Always	No

In the 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	Storage
DINT	-2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

In the CSP mode, this corresponds to the speed feedforward value.

In the 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	Storage
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

In the CSP and CSV modes, this corresponds to the torque feedforward value.

In the 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	Storage
UINT	0 to 0xFFFF	0x0033	-	RW	Yes	Always	Yes

This sets the touch probe function.

Bit	Value	Description
0	0	Does not use the touch probe 1.
	1	Uses the touch probe 1.
1	0	Single trigger mode
	1	Continuous trigger mode
2	0	Triggered by the input of the touch probe 1.
	1	Triggered by the Index pulse signal.
3	–	Reserved
4	0	Does not capture the rising edge position value of the touch probe 1.
	1	Captures the rising edge position value of the touch probe 1.
5	0	Does not capture the falling edge position value of the touch probe 1.
	1	Captures the falling edge position value of the touch probe 1.
6 to 7	–	Reserved
8	0	Does not use the touch probe 2.
	1	Uses the touch probe 2.
9	0	Single trigger mode
	1	Continuous trigger mode
10	0	Triggered by the input of the touch probe 2.
	1	Triggered by the Index pulse signal.
11	–	Reserved
12	0	Does not capture the rising edge position value of the touch probe 2.
	1	Captures the rising edge position value of the touch probe 2.
13	0	Does not capture the falling edge position value of the touch probe 2.

	1	Captures the falling edge position value of the touch probe 2.
14 to 15	–	Reserved

0x60B9	Touch Probe Status						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	Yes	-	No

This displays the status of the touch probe.

Bit	Value	Description
0	0	Does not use the touch probe 1.
	1	Uses the touch probe 1.
1	0	Does not store the rising edge position value of the touch probe 1.
	1	Stores the rising edge position value of the touch probe 1.
2	0	Does not store the falling edge position value of the touch probe 1.
	1	Stores the falling edge position value of the touch probe 1.
3 to 5	–	Reserved
6	0, 1	Toggles when the rising edge position value of the touch probe 1 is updated.
7	0, 1	Toggles when the falling edge position value of the touch probe 1 is updated.
8	0	Does not use the touch probe 2.
	1	Uses the touch probe 2.
9	0	Does not store the rising edge position value of the touch probe 2.
	1	Stores the rising edge position value of the touch probe 2.
10	0	Does not store the falling edge position value of the touch probe 2.
	1	Stores the falling edge position value of the touch probe 2.
11 to 13	–	Reserved
14	0, 1	Toggles when the rising edge position value of the touch probe 2 is updated.
15	0, 1	Toggles when the falling edge position value of the touch probe 2 is updated.

In continuous trigger mode, you can toggle whether 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 Positive Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU	RO	Yes	-	No

This represents the rising edge position value of the touch probe 1.

0x60BB	Touch Probe 1 Negative Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU	RO	Yes	-	No

This represents the falling edge position value of the touch probe 1.

0x60BC	Touch Probe 2 Positive Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU	RO	Yes	-	No

This represents the rising edge position value of the touch probe 2.

0x60BD	Touch Probe 2 Negative Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU	RO	Yes	-	No

This represents the falling edge position value of the touch probe 2.

0x60E0	Positive Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

This sets the limit of positive torque values.

0x60E1	Negative Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

This sets the limit of negative torque values.

0x60F4	Following Error Actual Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
DINT	-	-	pulse	RO	Yes	-	No

This represents the value entered as the command during the position control.

0x60FD	Digital Inputs						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Outputs						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Physical outputs					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Storage
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	Yes

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 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	Stora ge
DINT	–2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

This specifies the target velocity in the PV mode and the CSV mode.

0x6502	Supported Drive Modes						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0x000003AD	-	RO	No	-	No

This displays the mode(s) supported by the drive.

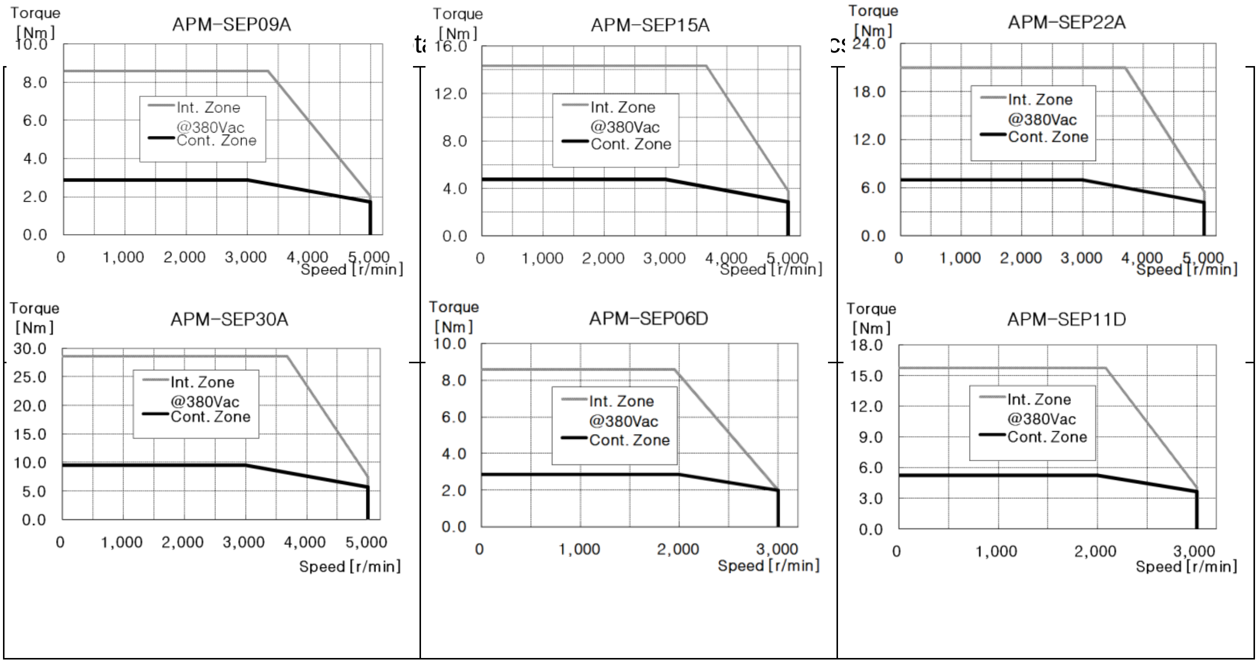
Bit	Supported modes	Details
0	PP (Profile Position)	1: Supported
1	Vl (Velocity)	0: Not supported
2	PV (Profile Velocity)	1: Supported
3	PT (Torque Profile)	1: Supported
4	Reserved	0
5	HM (Homing)	1: Supported
6	IP (Interpolated Position)	0: Not Supported
7	CSP (Cyclic Synchronous Position)	1: Supported
8	CSV (Cyclic Synchronous Velocity)	1: Supported
9	CST (Cyclic Synchronous Torque)	1: Supported
10 to 31	Reserved	0

10. Product Specifications

10.1 Servo Motor

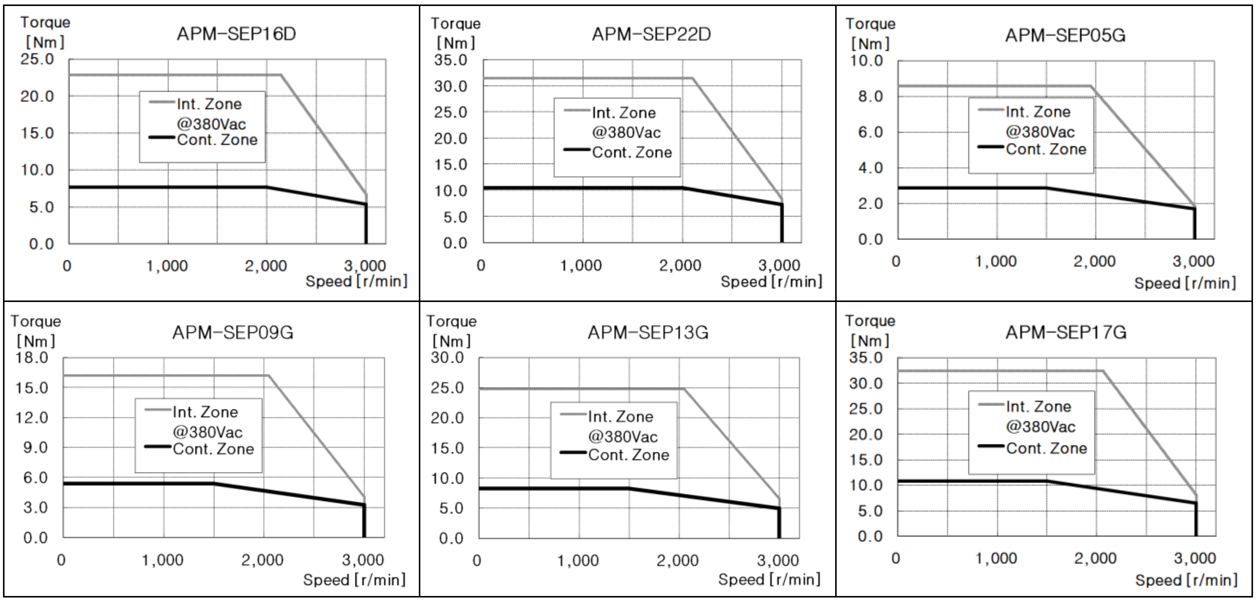
10.1.1 Product Characteristcs

Servo Motor Type (APM-□)		SEP09A	SEP15A	SEP22A	SEP30A	SEP06D	SEP11D
Applicable Drive (L7□B□)		**L7□B010□**	**L7□B020□**	**L7□B035□**		**L7□B010□**	
Rated Output	[kW]	0.9	1.5	2.2	3.0	0.6	1.1
Rated torque	[N·m]	2.86	4.77	7.0	9.55	2.86	5.25
	[kgf·cm]	29.23	48.72	71.46	97.44	29.23	53.59
Maximum instantaneous torque	[N·m]	8.59	14.32	21.01	28.65	8.59	15.76
	[kgf·cm]	87.7	146.16	214.37	292.33	87.7	160.78
Rated Current	[A]	2.97	4.89	7.17	9.78	3.57	3.27
Max. Current	[A]	8.91	14.67	21.51	29.34	10.71	9.81
Rated rotation speed	[r/min]	3000				2000	
Maximum rotation speed	[r/min]	5000				3000	
Inertia moment	[kg·m2x10-4]	6.659	11.999	17.339	22.679	6.659	11.999
	[gf·cm·s2]	6.795	12.244	17.693	23.142	6.795	12.244
Permitted load inertia		Motor inertia x10					
Rated power rate	[kW/s]	12.32	19.00	28.28	40.21	12.32	22.99
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					


APM-SEP09A
Torque [Nm]
10.0
8.0
6.0
4.0
2.0
0.0
0
1,000
2,000
3,000
4,000
5,000
Speed [r/min]
Int. Zone
@380Vac
Cont. Zone
APM-SEP15A
Torque [Nm]
16.0
12.0
8.0
4.0
0.0
Int. Zone
@380Vac
Cont. Zone
APM-SEP22A
Torque [Nm]
24.0
18.0
12.0
6.0
0.0
Int. Zone
@380Vac
Cont. Zone
APM-SEP30A
Torque [Nm]
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Int. Zone
@380Vac
Cont. Zone
APM-SEP06D
Torque [Nm]
10.0
8.0
6.0
4.0
2.0
0.0
0
1,000
2,000
3,000
Speed [r/min]
Int. Zone
@380Vac
Cont. Zone
APM-SEP11D
Torque [Nm]
18.0
15.0
12.0
9.0
6.0
3.0
0.0
Int. Zone
@380Vac
Cont. Zone

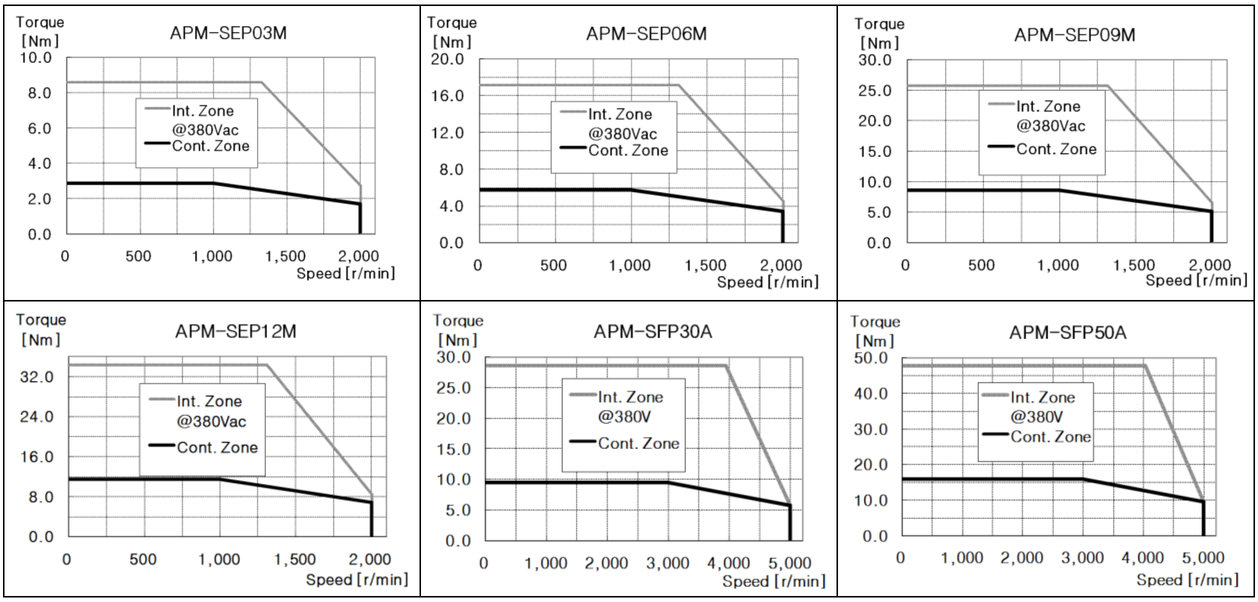
Servo Motor Type (APM-□)		SEP16D	SEP22D	SEP05G	SEP09G	SEP13G	SEP17G
Applicable Drive (L7□B□)		**L7□B020□**		**L7□B010□**		**L7□B020□**	
Rated Output	[kW]	1.6	2.2	0.45	0.85	1.3	1.7
Rated torque	[N·m]	7.64	10.5	2.86	5.41	8.28	10.82
	[kgf·cm]	77.95	107.19	29.23	55.22	84.45	110.43
Maximum instantaneous torque	[N·m]	22.92	31.51	8.59	16.23	24.83	32.47
	[kgf·cm]	233.86	321.56	87.70	165.65	253.35	331.30
Rated Current	[A]	4.79	6.54	3.57	3.37	5.19	6.74
Max. Current	[A]	14.37	19.62	10.71	10.11	15.57	20.22
Rated rotation speed	[r/min]	2000		1500			
Maximum rotation speed	[r/min]	3000		3000			
Inertia moment	[kg·m2x10-4]	17.339	22.679	6.659	11.999	17.339	22.679
	[gf·cm·s2]	17.693	23.142	6.795	12.244	17.693	23.142
Permitted load inertia		Motor inertia x10					
Rated power rate	[kW/s]	48.64	91.96	12.32	24.4	57.08	97.61
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



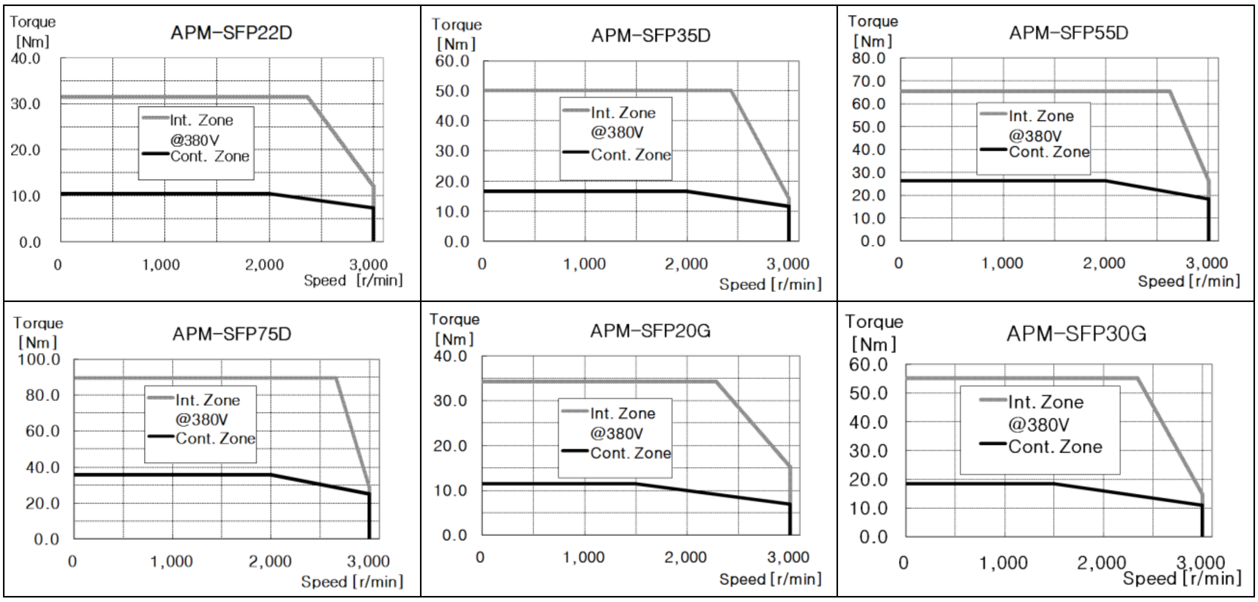
Servo Motor Type (APM-□)		SEP03M	SEP06M	SEP09M	SEP12M	SFP30A	SFP50A
Applicable Drive (L7□B□)		**L7□B010□**			**L7□B020□**	**L7□B035□**	**L7□B050□**
Rated Output	[kW]	0.3	0.6	0.9	1.2	3.0	5.0
Rated torque	[N·m]	2.86	5.73	8.59	11.46	9.55	15.92
	[kgf·cm]	29.23	58.47	87.70	116.93	97.44	162.40
Maximum instantaneous torque	[N·m]	8.59	17.19	25.78	34.38	28.65	39.79
	[kgf·cm]	87.70	175.40	263.09	350.79	292.33	406.01
Rated Current	[A]	2.52	2.42	3.62	4.80	9.37	15.49
Max. Current	[A]	7.56	7.26	10.86	14.40	28.11	38.73
Rated rotation speed	[r/min]	1000				3000	
Maximum rotation speed	[r/min]	2000				5000	
Inertia moment	[kg·m2x10-4]	6.659	11.999	17.339	22.679	30.740	52.130
	[gf·cm·s2]	6.795	12.244	17.693	23.142	31.367	53.194
Permitted load inertia		Motor inertia x10				Motor inertia x5	
Rated power rate	[kW/s]	12.32	27.36	42.60	57.90	29.66	48.59
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



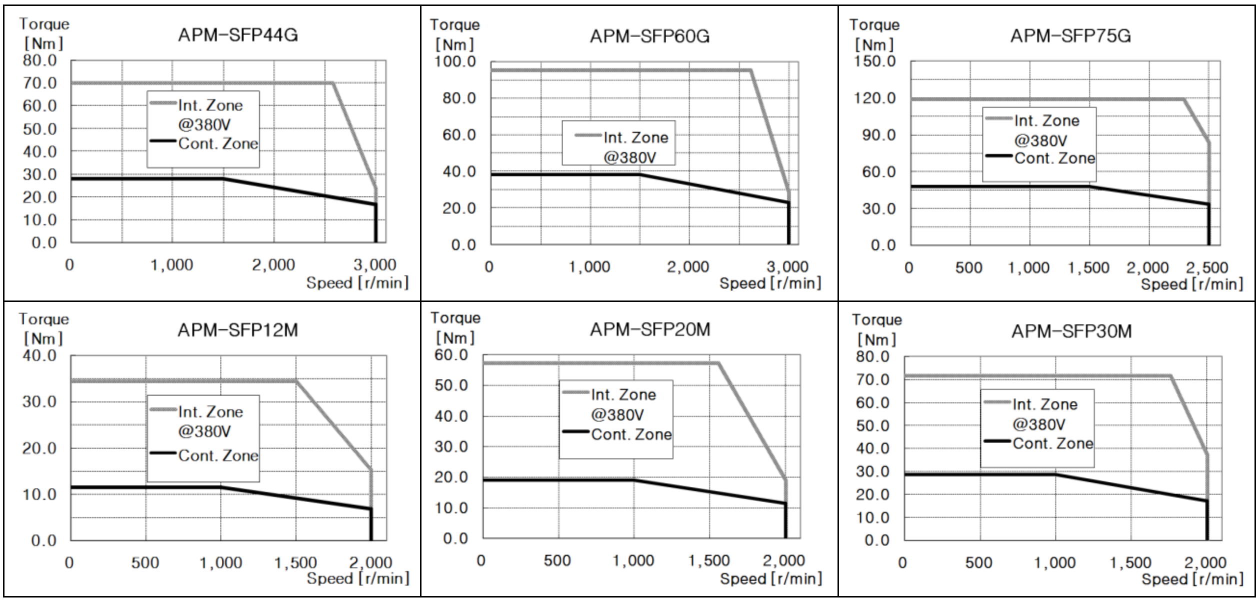
Servo Motor Type (APM-□)		SFP22D	SFP35D	SFP55D	SFP75D	SFP20G	SFP30G
Applicable Drive (L7□B□)		**L7□B020□**	**L7□B035□**	**L7□B050□**	**L7□B075□**	**L7□B020□**	**L7□B050□**
Rated Output	[kW]	2.2	3.5	5.5	7.5	1.8	2.9
Rated torque	[N·m]	10.50	16.71	26.26	35.81	11.46	18.46
	[kgf·cm]	107.19	170.52	267.96	365.41	116.93	188.39
Maximum instantaneous torque	[N·m]	31.51	50.13	65.65	89.52	34.38	55.39
	[kgf·cm]	321.56	511.57	669.91	913.52	350.79	565.16
Rated Current	[A]	6.56	10.07	15.82	21.36	7.15	11.12
Max. Current	[A]	19.68	30.21	39.55	53.4	21.45	33.36
Rated rotation speed	[r/min]	2000				1500	
Maximum rotation speed	[r/min]	3000				3000	
Inertia moment	[kg·m2x10-4]	30.740	52.130	83.600	121.350	30.740	52.130
	[gf·cm·s2]	31.367	53.194	85.306	123.827	31.367	53.194
Permitted load inertia		Motor inertia x5					
Rated power rate	[kW/s]	35.89	53.57	82.49	105.67	42.72	65.38
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



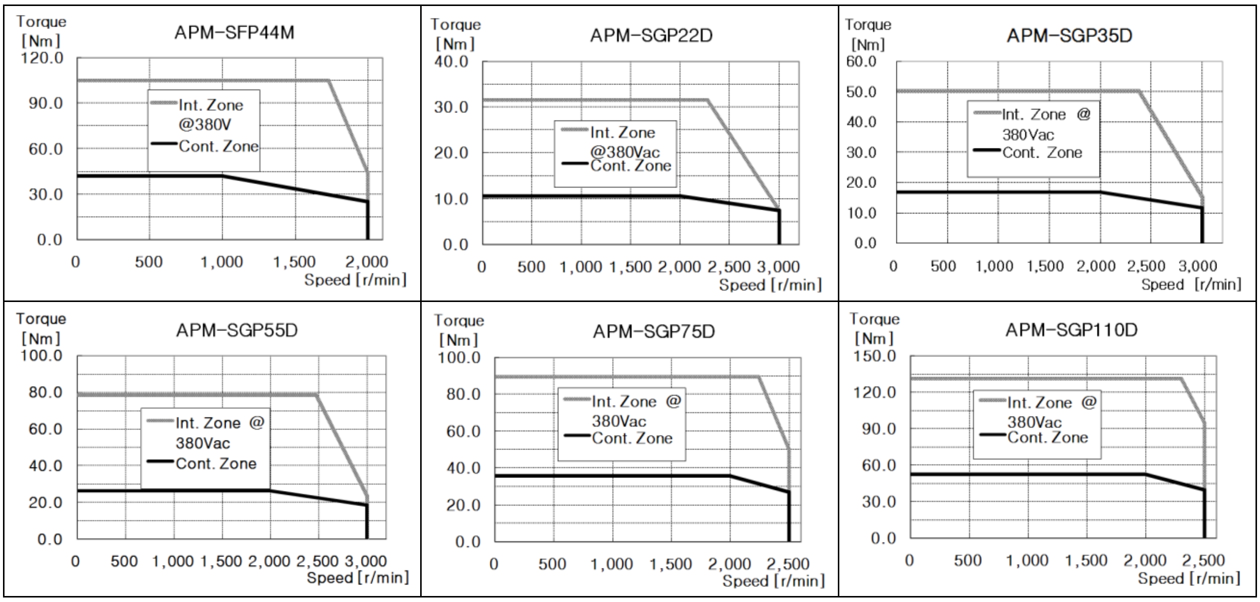
Servo Motor Type (APM-□)		SFP44G	SFP60G	SFP75G	SFP12M	SFP20M	SFP30M
Applicable Drive (L7□B□)		L7□B050□	L7□B075□	L7□B150□	L7□B020□		L7□B050□
Rated Output	[kW]	4.4	6.0	7.5	1.2	2.0	3.0
Rated torque	[N·m]	28.01	38.20	47.75	11.46	19.10	28.65
	[kgf·cm]	285.83	389.77	487.21	116.93	194.88	292.33
Maximum instantaneous torque	[N·m]	70.03	95.49	119.37	34.38	57.30	71.62
	[kgf·cm]	714.57	974.42	1,218.02	350.79	584.65	730.81
Rated Current	[A]	16.87	22.78	25.96	4.77	7.88	11.92
Max. Current	[A]	42.18	56.95	64.90	14.31	23.64	29.80
Rated rotation speed	[r/min]	1500			1000		
Maximum rotation speed	[r/min]	3000		2500	2000		
Inertia moment	[kg·m2x10-4]	83.600	121.350	143.820	30.740	52.130	83.600
	[gf·cm·s2]	85.306	123.827	146.755	31.367	53.194	85.306
Permitted load inertia		Motor inertia x5					
Rated power rate	[kW/s]	93.86	120.23	158.51	42.72	69.97	98.17
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



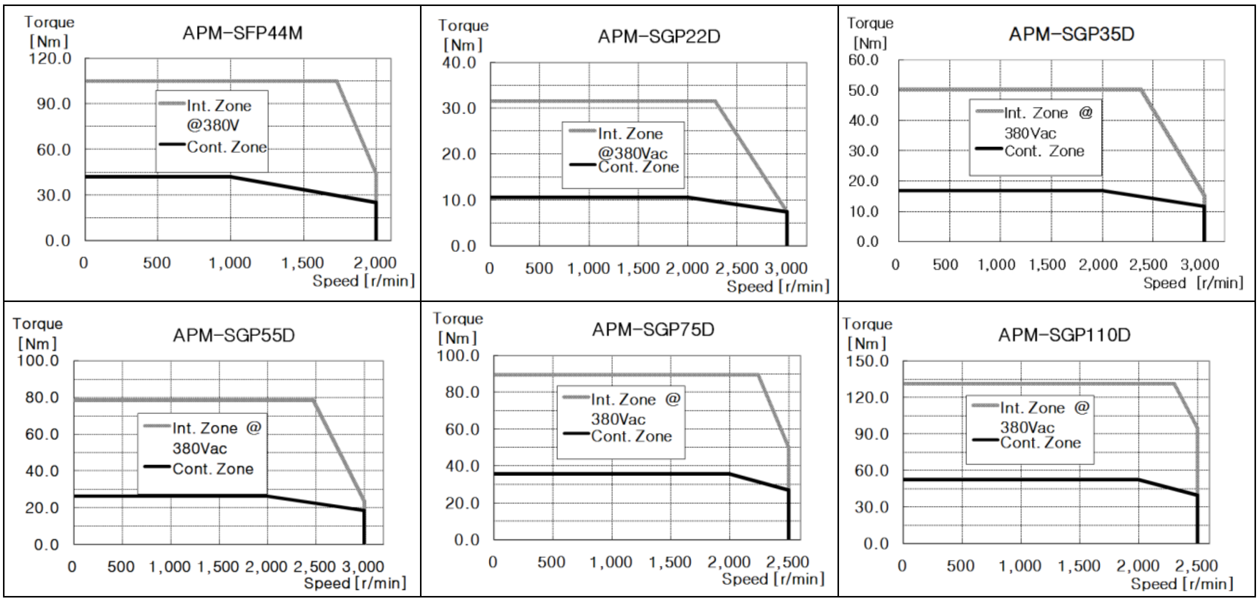
Servo Motor Type (APM-□)		SF44M	SGP22D	SGP35D	SGP55D	SGP75D	SGP110D
Applicable Drive (L7□B□)		**L7□B050□**	**L7□B020□**	**L7□B035□**	**L7□B050□**	**L7□B075□**	**L7□B150□**
Rated Output	[kW]	4.4	2.2	3.5	5.5	7.5	11.0
Rated torque	[N·m]	42.02	10.50	16.71	26.26	35.81	52.52
	[kgf·cm]	428.74	107.19	170.52	267.96	365.41	535.93
Maximum instantaneous torque	[N·m]	105.04	31.51	50.13	78.78	89.52	131.30
	[kgf·cm]	1,071.86	321.56	511.57	803.89	913.52	1,339.82
Rated Current	[A]	17.15	6.27	10.03	15.66	18.42	27.41
Max. Current	[A]	42.88	18.81	30.09	46.98	46.05	68.53
Rated rotation speed	[r/min]	1,000	2000				
Maximum rotation speed	[r/min]	2,000	3000			2500	
Inertia moment	[kg·m2x10-4]	121.350	51.42	80.35	132.41	172.91	291.36
	[gf·cm·s2]	123.827	52.47	81.99	135.11	176.44	297.31
Permitted load inertia		Motor inertia x5					
Rated power rate	[kW/s]	145.48	21.46	34.76	52.08	74.16	94.65
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



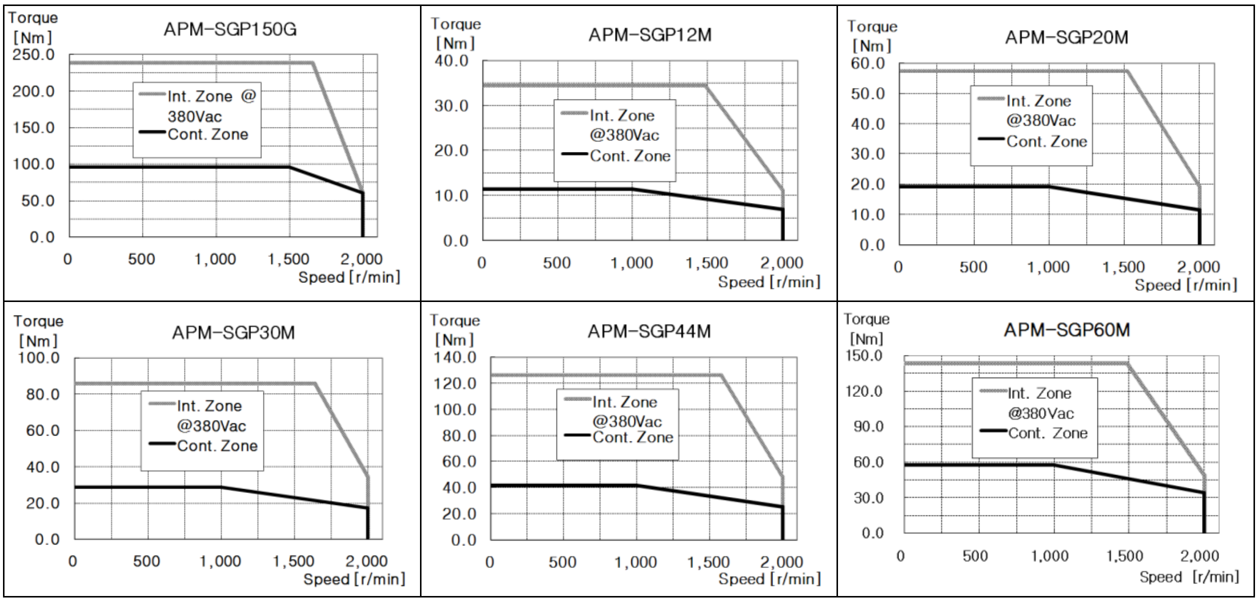
Servo Motor Type (APM-□)		SGP20G	SGP30G	SGP44G	SGP60G	SGP85G	SGP110G
Applicable Drive (L7□B□)		L7□B020□	L7□B050□	L7□B050□	L7□B075□	L7□B150□	
Rated Output	[kW]	1.8	2.9	4.4	6.0	8.5	11.0
Rated torque	[N·m]	11.46	18.46	28.01	38.20	54.11	70.03
	[kgf·cm]	116.93	188.39	285.83	389.77	552.17	714.57
Maximum instantaneous torque	[N·m]	34.38	55.39	70.03	95.49	135.28	175.07
	[kgf·cm]	350.79	565.16	714.57	974.42	1,380.43	1,786.43
Rated Current	[A]	6.83	11.08	16.71	19.65	28.24	28.02
Max. Current	[A]	20.49	33.24	41.78	49.13	70.60	70.05
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000			2500		2000
Inertia moment	[kg·m2x10-4]	51.42	80.35	132.41	172.91	291.36	291.36
	[gf·cm·s2]	52.47	81.99	135.11	176.44	297.31	297.31
Permitted load inertia		Motor inertia x5					
Rated power rate	[kW/s]	25.531	42.41	59.25	84.36	100.5	168.3
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



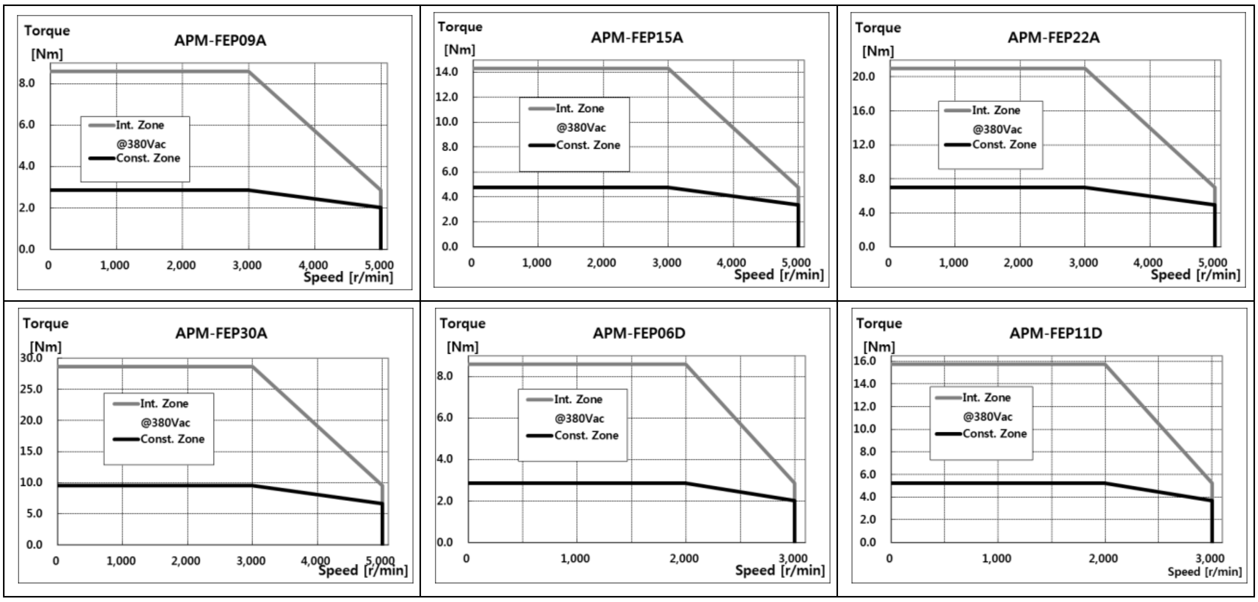
Servo Motor Type (APM-□)		SGP150G	SGP12M	SGP20M	SGP30M	SGP44M	SGP60M
Applicable Drive (L7□B□)		L7□B150□	L7□B020□		L7□B050□		L7□B150□
Rated Output	[kW]	15.0	1.2	2.0	3.0	4.4	6.0
Rated torque	[N·m]	95.49	11.46	19.10	28.65	42.02	57.30
	[kgf·cm]	974.42	116.93	194.88	292.33	428.74	584.65
Maximum instantaneous torque	[N·m]	238.73	34.38	57.30	85.94	105.04	143.24
	[kgf·cm]	2,436.05	350.79	584.65	876.98	1,071.86	1,461.63
Rated Current	[A]	35.70	4.72	7.84	11.73	17.29	22.93
Max. Current	[A]	89.25	11.80	23.52	35.19	43.23	57.33
Rated rotation speed	[r/min]	1,500	1000				
Maximum rotation speed	[r/min]	2,000	2000				
Inertia moment	[kg·m2x10-4]	424.5	51.42	80.35	132.41	172.91	291.36
	[gf·cm·s2]	433.2	52.47	81.99	135.11	176.44	297.31
Permitted load inertia		Motor inertia x5					
Rated power rate	[kW/s]	214.8	25.53	45.39	61.97	102.08	112.64
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



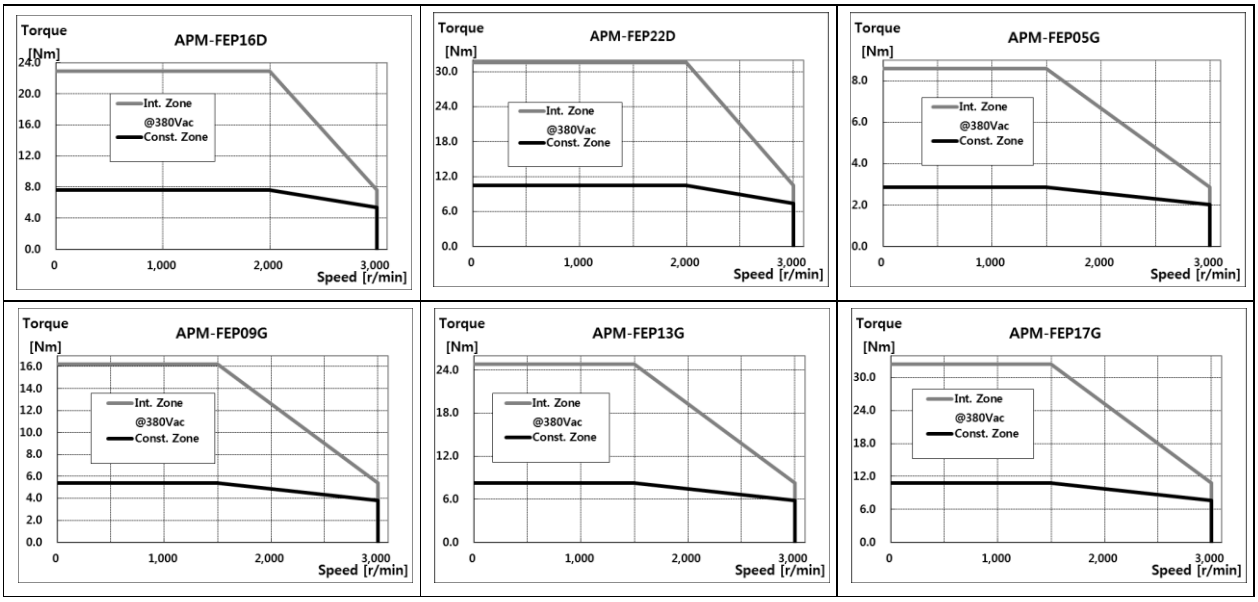
Servo Motor Type (APM-□)		FEP09A	FEP15A	FEP22A	FEP30A	FEP06D	FEP11D
Applicable Drive (L7□B□)		L7□B010□	L7□B020□	L7□B035□		L7□B010□	
Rated Output	[kW]	0.9	1.5	2.2	3.0	0.6	1.1
Rated torque	[N·m]	2.86	4.77	7.00	9.55	2.86	5.25
	[kgf·cm]	29.23	48.72	71.46	97.44	29.23	53.59
Maximum instantaneous torque	[N·m]	8.59	14.32	21.01	28.65	8.59	15.76
	[kgf·cm]	87.7	146.16	214.37	292.33	87.7	160.78
Rated Current	[A]	3.47	6.68	9.12	9.94	3.28	3.40
Max. Current	[A]	10.40	20.03	27.35	29.81	9.83	10.19
Rated rotation speed	[r/min]	3000				2000	
Maximum rotation speed	[r/min]	5000				3000	
Inertia moment	[kg·m2x10-4]	6.659	11.999	17.339	22.679	6.659	11.999
	[gf·cm·s2]	6.795	12.244	17.693	23.142	6.795	12.244
Permitted load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	12.32	19.00	28.28	40.21	12.32	22.99
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



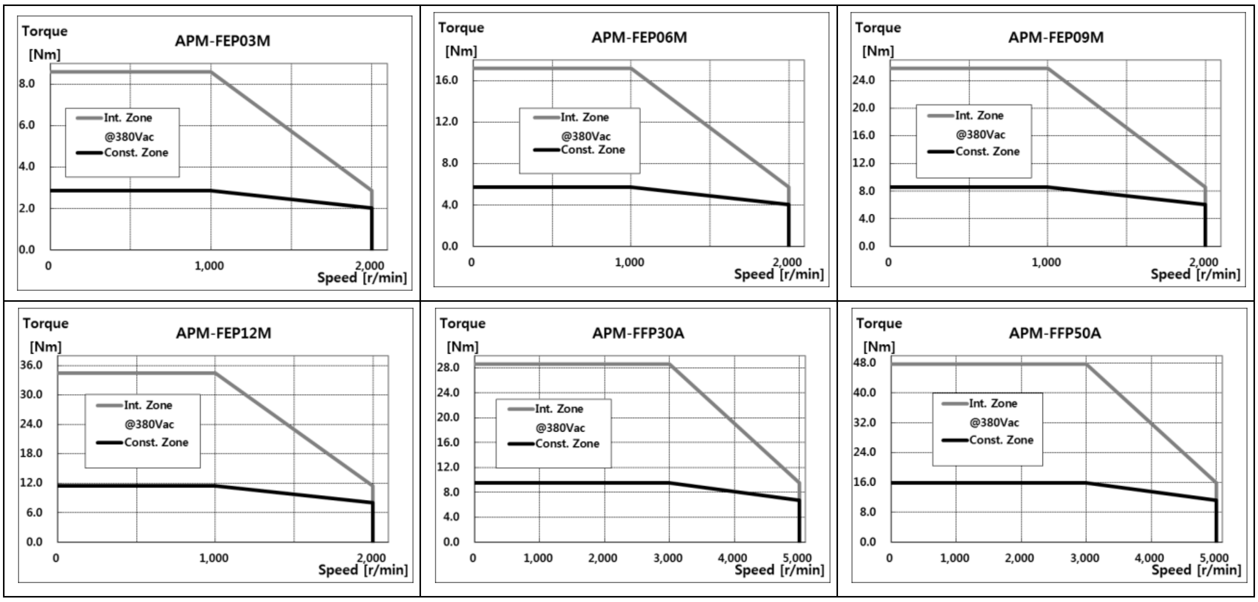
Servo Motor Type (APM-□)		FEP16D	FEP22D	FEP05G	FEP09G	FEP13G	FEP17G
Applicable Drive (L7□B□)		L7□B020□		L7□B010□		L7□B020□	
Rated Output	[kW]	1.6	2.2	0.45	0.85	1.3	1.7
Rated torque	[N·m]	7.64	10.5	2.86	5.41	8.28	10.82
	[kgf·cm]	77.95	107.19	29.23	55.22	84.45	110.43
Maximum instantaneous torque	[N·m]	22.92	31.51	8.59	16.23	24.83	32.47
	[kgf·cm]	233.86	321.56	87.70	165.65	253.35	331.30
Rated Current	[A]	4.97	6.80	3.28	3.50	5.39	7.01
Max. Current	[A]	14.92	20.04	9.83	10.50	16.16	21.02
Rated rotation speed	[r/min]	2000		1500			
Maximum rotation speed	[r/min]	3000		3000			
Inertia moment	[kg·m2x10-4]	14.619	19.040	5.659	10.179	14.619	19.040
	[gf·cm·s2]	14.917	19.429	5.774	10.387	14.917	19.429
Permitted load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	39.92	57.95	14.50	28.77	46.85	61.52
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



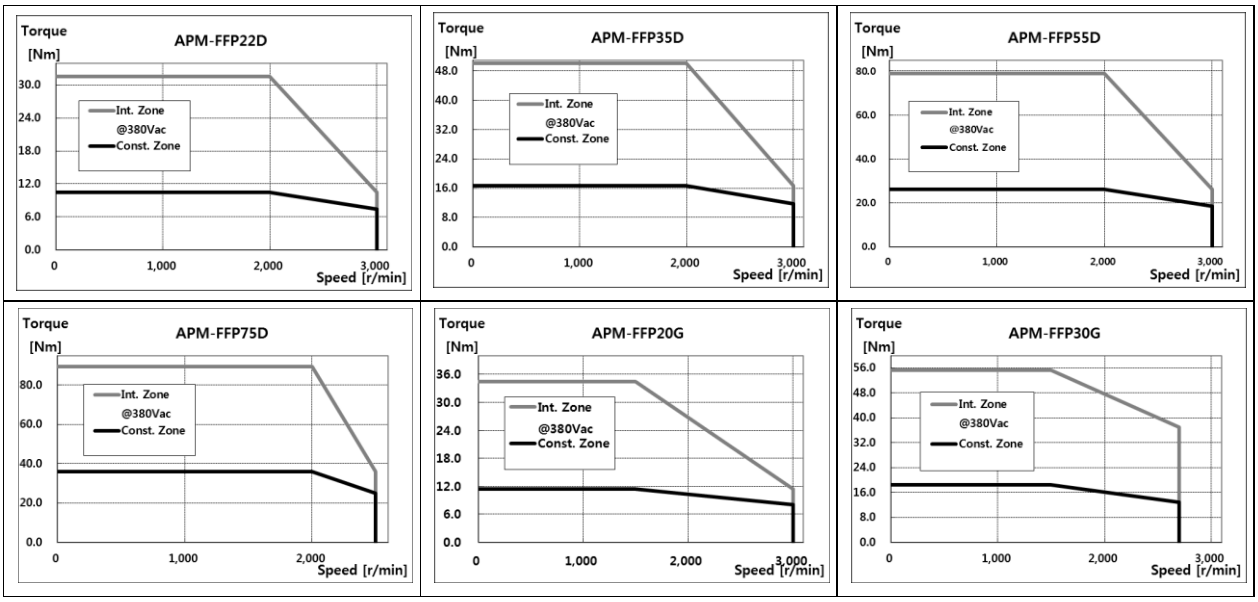
Servo Motor Type (APM-□)		FEP03M	FEP06M	FEP09M	FEP12M	FFP30A	FFP50A
Applicable Drive (L7□B□)		L7□B010□			L7□B035□		L7□B075□
Rated Output	[kW]	0.3	0.6	0.9	1.2	3.0	5.0
Rated torque	[N·m]	2.86	5.73	8.59	11.46	9.55	15.92
	[kgf·cm]	29.23	58.47	87.70	116.93	97.44	162.40
Maximum instantaneous torque	[N·m]	8.59	17.19	25.78	34.38	28.65	39.79
	[kgf·cm]	87.70	175.40	263.09	350.79	292.33	406.01
Rated Current	[A]	3.28	3.28	3.33	4.87	9.79	16.07
Max. Current	[A]	9.83	9.83	9.99	14.60	29.38	48.22
Rated rotation speed	[r/min]	1000				3000	
Maximum rotation speed	[r/min]	2000				5000	
Inertia moment	[kg·m2x10-4]	5.659	10.179	14.619	19.040	27.960	46.560
	[gf·cm·s2]	5.774	10.387	14.917	19.429	28.531	47.510
Permitted load inertia		Motor inertia x 10				Motor inertia x 5	
Rated power rate	[kW/s]	14.50	32.25	50.53	68.97	32.61	54.40
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



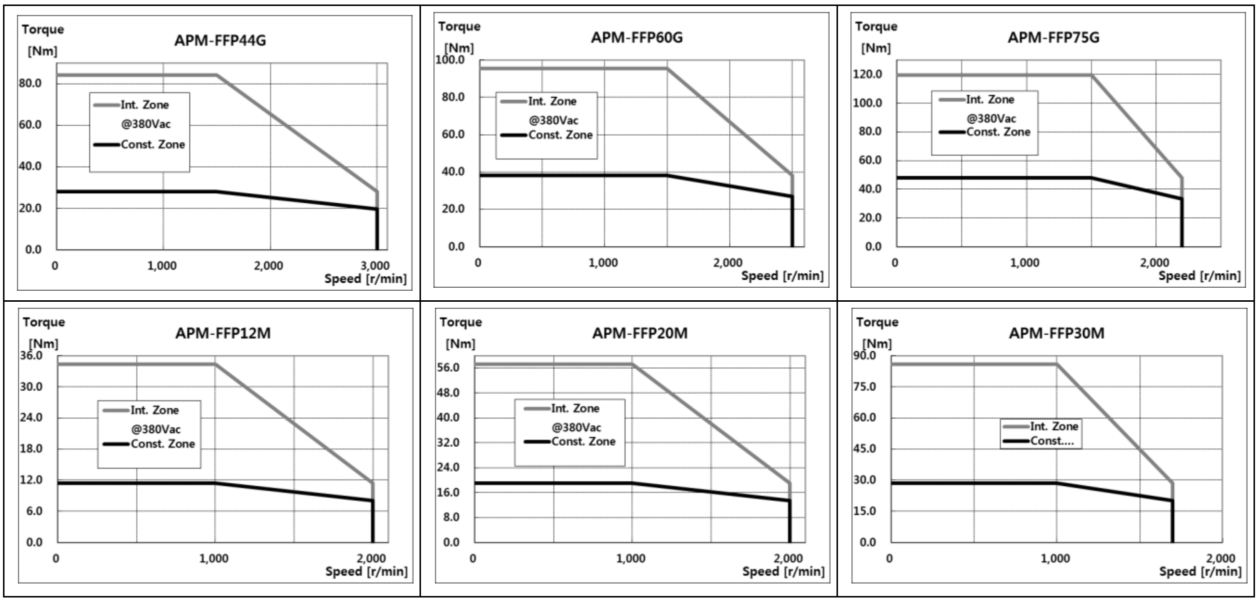
Servo Motor Type (APM-□)		FFP22D	FFP35D	FFP55D	FFP75D	FFP20G	FFP30G
Applicable Drive (L7□B□)		**L7□B020□**	**L7□B035□**	**L7□B050□**	**L7□B075□**	**L7□B020□**	**L7□B035□**
Rated Output	[kW]	2.2	3.5	5.5	7.5	1.8	2.9
Rated torque	[N·m]	10.50	16.71	26.26	35.81	11.46	18.46
	[kgf·cm]	107.19	170.52	267.96	365.41	116.93	188.39
Maximum instantaneous torque	[N·m]	31.51	50.13	78.78	89.52	34.38	55.39
	[kgf·cm]	321.56	511.57	803.89	913.52	350.79	565.16
Rated Current	[A]	6.93	9.09	14.70	18.97	7.56	10.04
Max. Current	[A]	20.80	27.26	44.10	47.42	22.69	30.12
Rated rotation speed	[r/min]	2000				1500	
Maximum rotation speed	[r/min]	3000			2500	3000	2700
Inertia moment	[kg·m2x10-4]	27.960	46.560	73.850	106.730	27.960	46.560
	[gf·cm·s2]	28.531	47.510	75.357	108.908	28.531	47.510
Permitted load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	39.46	59.98	93.38	120.15	46.96	73.21
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



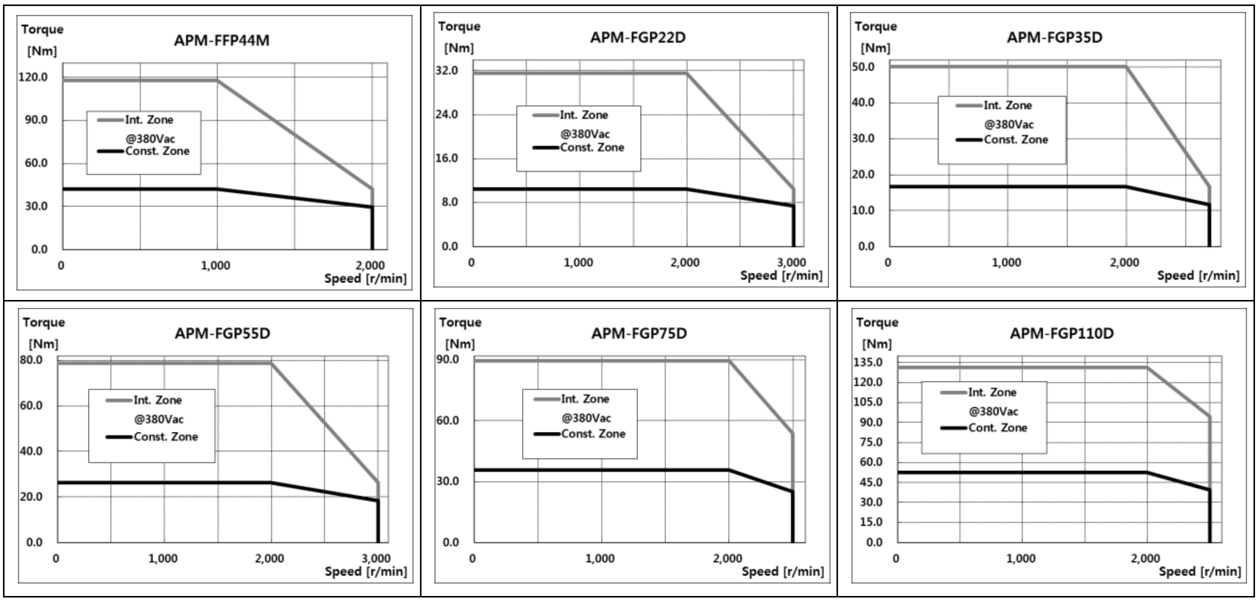
Servo Motor Type (APM-□)		FFP44G	FFP60G	FFP75G	FFP12M	FFP20M	FFP30M
Applicable Drive (L7□B□)		L7□B050□	L7□B075□		L7□B020□		L7□B050□
Rated Output	[kW]	4.4	6.0	7.5	1.2	2.0	3.0
Rated torque	[N·m]	28.01	38.20	47.75	11.46	19.10	28.65
	[kgf·cm]	285.83	389.77	487.21	116.93	194.88	292.33
Maximum instantaneous torque	[N·m]	84.034	95.49	119.37	34.38	57.30	71.62
	[kgf·cm]	857.48	974.42	1,218.02	350.79	584.65	730.81
Rated Current	[A]	15.68	20.23	20.01	4.83	7.94	11.90
Max. Current	[A]	47.04	50.58	50.03	14.50	23.83	35.70
Rated rotation speed	[r/min]	1500			1000		
Maximum rotation speed	[r/min]	3000	2500	2200	2000		1700
Inertia moment	[kg·m2x10-4]	73.850	106.730	131.290	27.960	46.560	73.850
	[gf·cm·s2]	85.306	108.908	133.969	28.531	47.510	75.357
Permitted load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	106.25	136.70	173.64	46.96	78.34	111.13
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



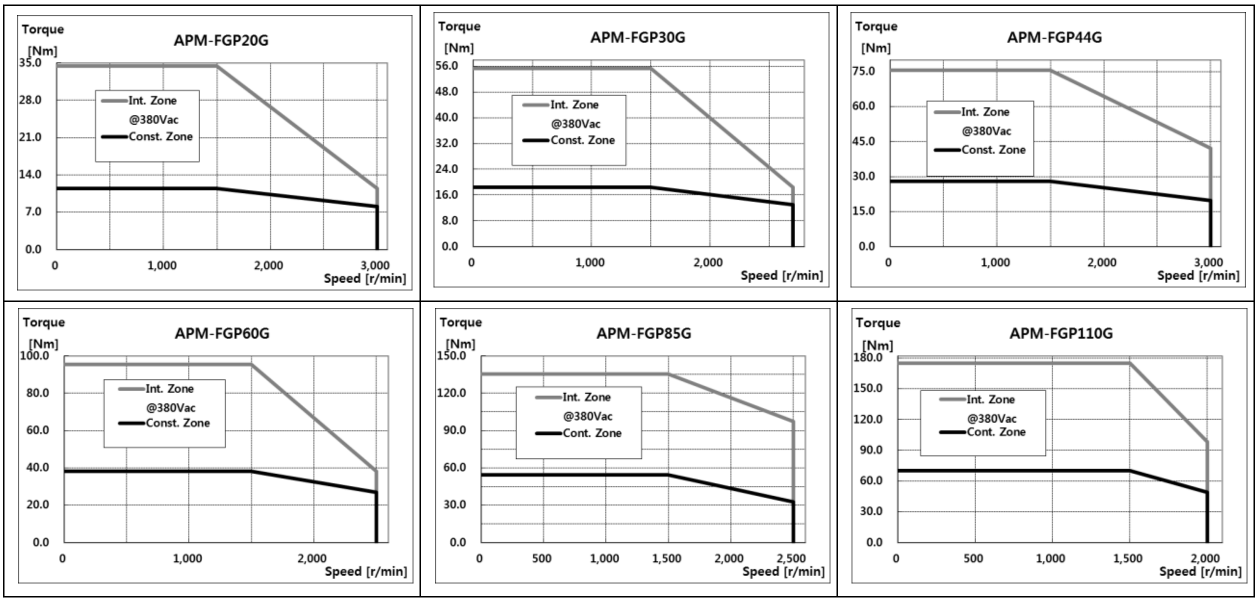
Servo Motor Type (APM-□)		FFP44M	FGP22D	FGP35D	FGP55D	FGP75D	FGP110D
Applicable Drive (L7□B□)		L7□B050□	L7□B020□	L7□B035□	L7□B050□	L7□B075□	L7□B150□
Rated Output	[kW]	4.4	2.2	3.5	5.5	7.5	11.0
Rated torque	[N·m]	42.02	10.50	16.71	26.26	35.81	16.71
	[kgf·cm]	428.74	107.19	170.52	267.96	365.41	170.52
Maximum instantaneous torque	[N·m]	117.65	31.51	50.13	78.78	89.52	50.13
	[kgf·cm]	1200.47	321.56	511.57	803.89	913.52	511.57
Rated Current	[A]	16.69	7.12	8.73	16.04	19.10	27.41
Max. Current	[A]	46.73	21.35	26.20	48.11	47.76	68.52
Rated rotation speed	[r/min]	1,000	2000				
Maximum rotation speed	[r/min]	2,000	3000	2700	3000	2500	
Inertia moment	[kg·m2x10-4]	106.730	41.130	71.530	117.720	149.400	291.36
	[gf·cm·s2]	108.908	41.969	72.990	120.122	152.449	297.31
Permitted load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	145.48	26.83	39.04	58.58	85.83	94.68
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



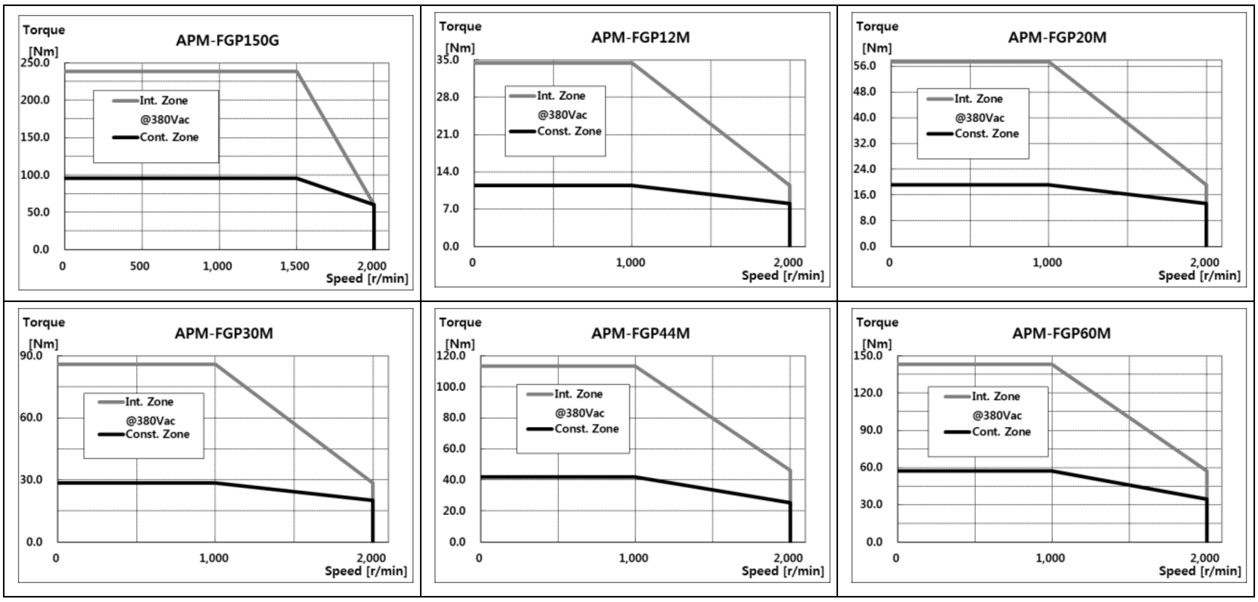
Servo Motor Type (APM-□)		FGP20G	FGP30G	FGP44G	FGP60G	FGP85G	FGP110G
Applicable Drive (L7□B□)		L7□B020□	L7□B035□	L7□B050□	L7□B075□	L7□B150□	
Rated Output	[kW]	1.8	2.9	4.4	6.0	8.5	11.0
Rated torque	[N·m]	11.46	18.46	28.01	38.20	54.11	70.03
	[kgf·cm]	116.93	188.39	285.83	389.77	552.17	714.57
Maximum instantaneous torque	[N·m]	34.38	55.39	84.03	95.49	135.28	175.07
	[kgf·cm]	350.79	565.16	857.49	974.42	1,380.43	1,786.43
Rated Current	[A]	7.76	9.65	17.11	20.38	28.24	28.02
Max. Current	[A]	23.29	28.95	46.19	50.95	70.60	70.05
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000	2700	3000	2500	2500	2000
Inertia moment	[kg·m2x10-4]	41.130	71.530	117.720	149.400	291.36	291.36
	[gf·cm·s2]	41.969	72.990	120.122	152.449	297.31	297.31
Permitted load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	25.531	42.41	59.25	84.36	100.5	168.3
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



Servo Motor Type (APM-□)		FGP150G	FGP12M	FGP20M	FGP30M	FGP44M	FGP60M
Applicable Drive (L7□B□)		L7□B150□	L7□B020□		L7□B075□		L7□B150□
Rated Output	[kW]	15.0	1.2	2.0	3.0	4.4	6.0
Rated torque	[N·m]	95.49	11.46	19.10	28.65	42.02	57.30
	[kgf·cm]	974.42	116.93	194.88	292.33	428.74	584.65
Maximum instantaneous torque	[N·m]	238.73	34.38	57.30	85.94	113.45	143.24
	[kgf·cm]	2,436.05	350.79	584.65	876.98	1157.59	1,461.63
Rated Current	[A]	35.70	4.75	7.88	11.74	17.39	22.93
Max. Current	[A]	89.25	14.24	23.64	35.22	46.95	57.32
Rated rotation speed	[r/min]	1,500	1000				
Maximum rotation speed	[r/min]	2,000	2000				
Inertia moment	[kg·m2x10-4]	385.05	41.130	71.530	117.720	149.400	291.36
	[gf·cm·s2]	392.90	41.969	72.990	120.122	152.449	297.31
Permitted load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	236.82	31.93	50.99	54.93	118.17	112.64
Speed and position detector	Standard	Serial type 19[Bit]					
Specifications and features	Protection method	Fully enclosed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 °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)					

♦Rotational speed-Torque Characteristics♦



Electric Brake Specifications

Applicable Motor Series	SEP/FEP	SFP/FFP	SGP/FGP
Purpose	Maintenance	Maintenance	Maintenance
Input voltage (V)	DC 24V	DC 24V	DC 90V
Static friction torque (N•m)	10.4	40	74
Capacity (W)	19.4	25	32
Coil resistance (Ω)	29.6	23	327
Rated current (A)	0.81	1.04	0.28
Braking mechanism	Spring brake	Spring brake	Spring brake
Insulation class	Grade F	Grade F	Grade F

Note 1) DO NOT apply DC24V power (for interface only) to electronic brake.
You MUST use power source only for electronic brake.

Note 2) Electronic brake installed in our servo motor applies same specifications for each series.

Note 3) Electric brakes are designed to maintain a stop. Never use them for absolute braking.

Note 4) The characteristics of the electric brakes were measured at 20°C.

Note 5) These brake specifications are subject to change. Check the voltage specifications on your specific motor.

Heat Sink

Classification	Standard (mm)	Classification
AP13	350x350x20	
AP18	550x550x30	
AP22	650x650x35	

Note 1) The data on the product features is measured when those heat sinks were applied.

※ Exculding axis penetration in the IP grade

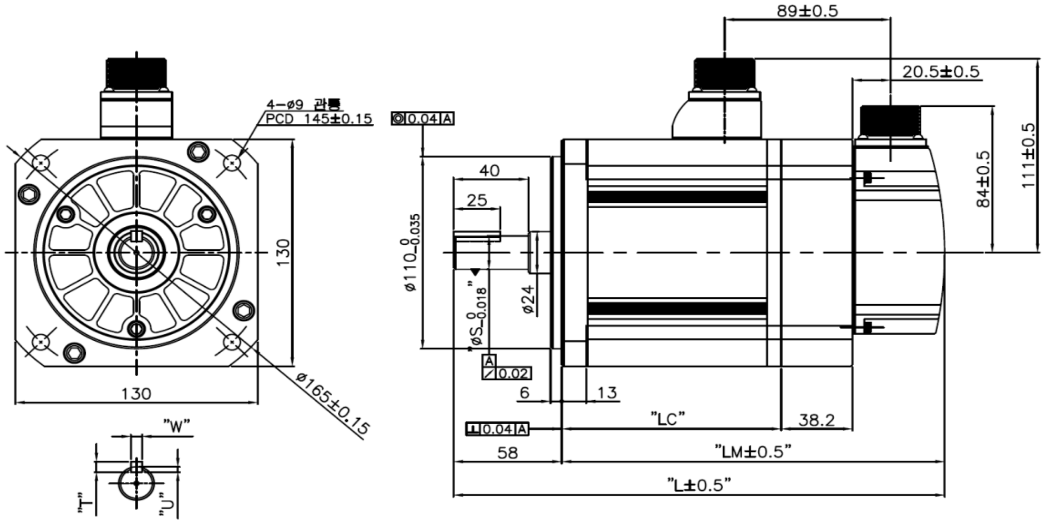
※ When you attach reducer to the motor, we don't guarantee IP for reducer.

※ If you bend over specification designated in cable standard, it is difficult to guarantee IP marked

※ It can be satisfied Prtotection grade when you use private cable only.

10.1.2 Outline Diagram

■ **SEP Series | APM-SEP09A,SEP06D,SEP05G,SEP03M, SEP15A,SEP11D,SEP09G,SEP06M,SEP22A,SEP16D, SEP13G,SEP09M, SEP30A,SEP22D,SEP17G,SEP12M**



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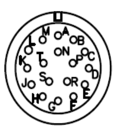


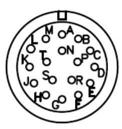
Pin No.	Phase	Pin No.	Phase
A	A	M	V
B	$\overline{A}$	N	$\overline{V}$
C	B	P	W
D	$\overline{B}$	R	$\overline{W}$
E	Z	H	DC +5V
F	$\overline{Z}$	G	0V
K	U	J	SHIELD
L	$\overline{U}$		

Plug : MS3102A20-29P

Pha
U
V
W
FG

.P

<Serial S-turn Encoder Connector>

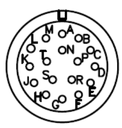


Pin No.	Phase	Pin No.	Phase
A	MA	M	–
B	$\overline{MA}$	N	–
C	SL	P	–
D	$\overline{SL}$	R	–
E	–	H	+5V
F	–	G	0V
K	–	J	SHIELD
L	–		

Plug : MS3102A20-29P

Plug : MS3102A20-15P

<Serial M-turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	MA	M	–
B	$\overline{MA}$	N	–
C	SL	P	–
D	$\overline{SL}$	R	–
E	VDD_B	H	+5V
F	GND_B	G	0V
K	–	J	SHIELD
L	–		

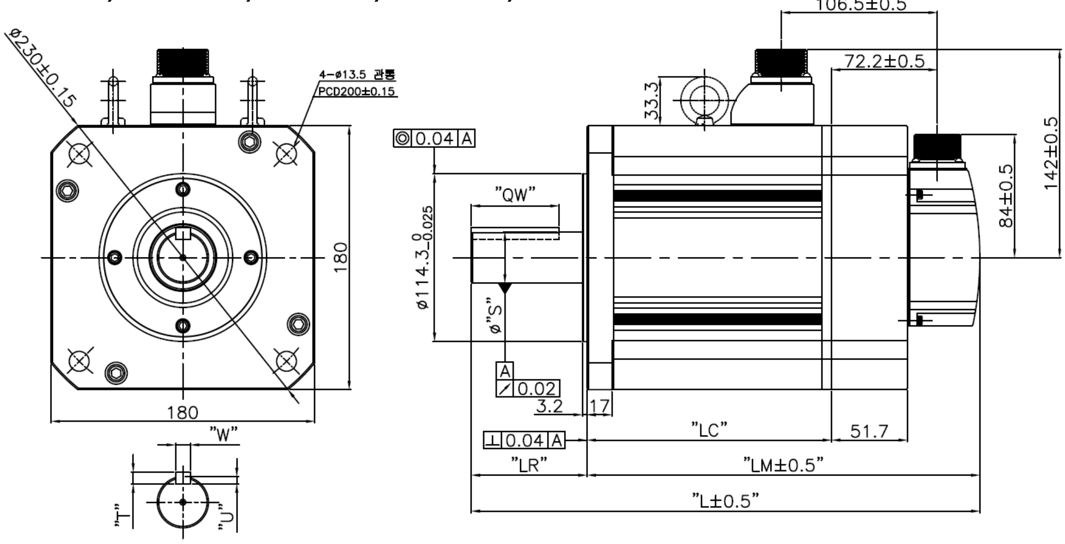
Plug : MS3102A20-29P

	External Dimensions				Key Dimensions			Weight (Kg)
	L	LM	LC	S	T	W	U	
SEP09A,SEP06D,SEP05G,SEP03M	201.3(239.3)	143.3(181.3)	93.8(93.6)	19	5	5	3	5.5(7.04)
SEP15A,SEP11D,SEP09G,SEP06M	225.3(263.3)	167.3(205.3)	117.8(117.6)	19	5	5	3	7.54(9.08)
SEP22A,SEP16D,SEP13G,SEP09M	249.3(287.3)	191.3(229.3)	141.8(141.6)	22	6	6	3.5	9.68(11.22)
SEP30A,SEP22D,SEP17G,SEP12M	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.

■ SFP Series | APM-SFP30A,SFP22D,SFP20G,SFP12M, SFP50A,SFP35D,SFP30G,SFP20M, SFP55D,SFP44G, SFP30M, SFP75D,SFP60G,SFP44M,SFP75G



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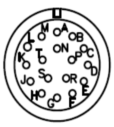


Pin No.	Phase	Pin No.	Phase
A	A	M	V
B	A	N	V
C	B	P	W
D	B	R	W
E	Z	H	DC +5V
F	Z	G	0V
K	U	J	SHIELD
L	U		

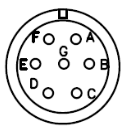
Plug : MS3102A20-29P

<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

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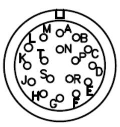
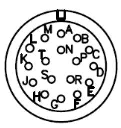


Pin No.	Phase	Pin No.	Phase
A	MA	M	-
B	MA	N	-
C	SL	P	-
D	SL	R	-
E	-	H	+5V
F	-	G	0V
K	-	J	SHIELD
L	-		

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

Model	External Dimensions					Key Dimensions				Eye Bolt	Weight (Kg)
	L	LM	LC	LR	S	QW	T	W	U		

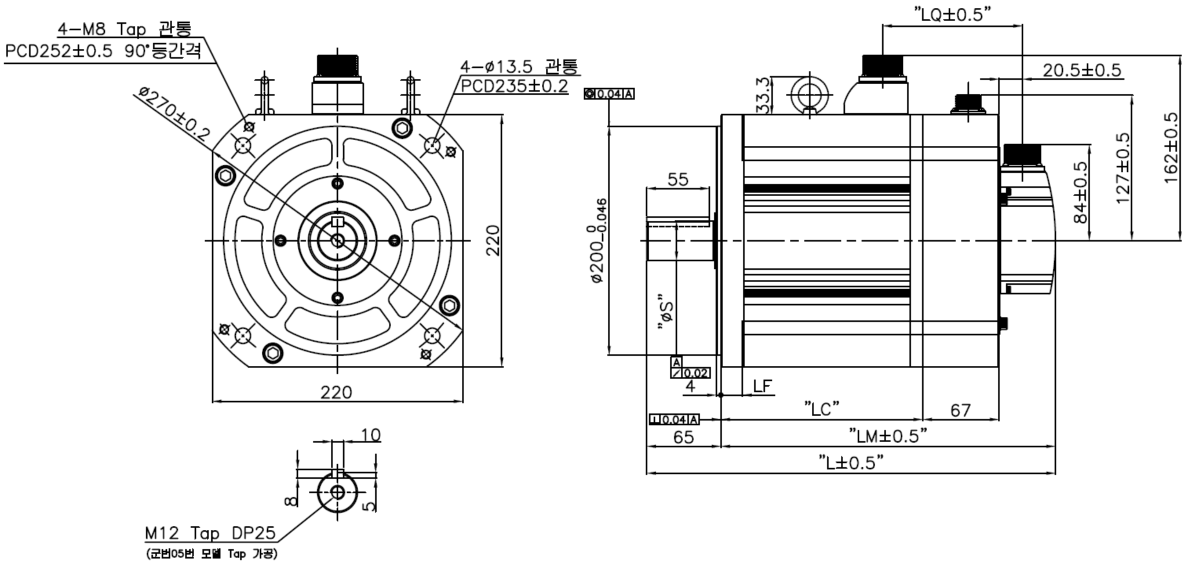
SFP30A, SFP22D, SFP20G, SFP12M	261.5(312.9)	182.5(233.9)	133(132.7)	79	$35^{+0.01}_{0}$	60	8	10	5	X	12.4(19.2)
SFP50A, SFP35D, SFP30G, SFP20M	295.5(346.9)	216.5(267.9)	167(166.7)								17.7(24.9)
SFP55D, SFP44G SFP30M	345.5(396.9)	266.5(317.9)	217(216.7)							O	26.3(33.4)
SFP75D, SFP60G, SFP44M	405.5(456.9)	326.5(377.9)	277(276.7)								35.6(42.8)
SFP75G**(주 3)**	457.5	344.5	295	113	$42^{0}_{-0.016}$	96	8	12	5		39.4

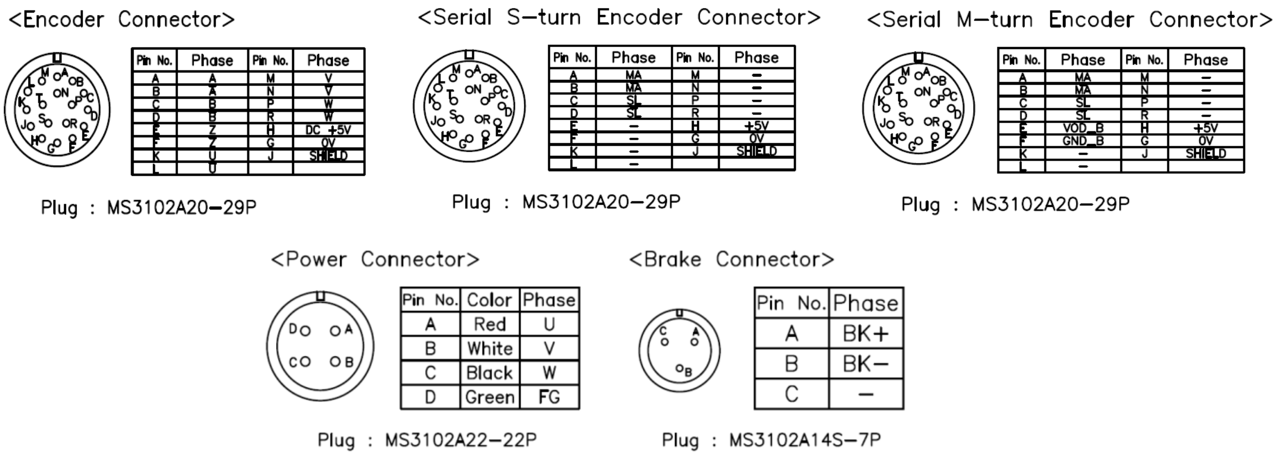
Note 1) LF30M or higher-end models have eye bolts.

Note 2) Use DC power (24 V) to operate the brake.

Note 3) The sizes in parentheses apply when attached to the brakes.

■ SGP Series | APM-SGP22D,SGP20G,SGP12M,SGP35D, SGP30G,SGP20M, SGP55D,SGP44G,SGP30M,SGP75D, SGP60G,SGP44M,SGP110D,SG85G,SG60M



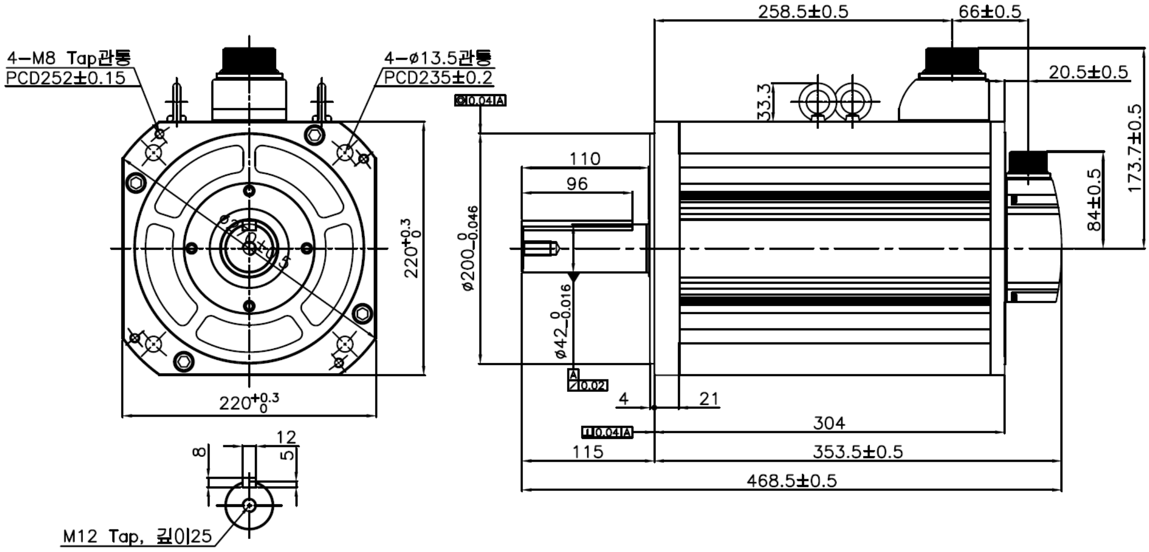


Model	External Dimensions						Power Connector	Weight (Kg)
	L	LM	LC	LF	LQ	S		
SGP22D, SGP20G, SGP12M	236.5(302.7)	171.5(237.7)	122(121.2)	19	56.4(122.6)	$35_{-0.016}^{0}$	MS3102A 22-22P	16.95(30.76)
SGP35D,SGP30G, SGP20M	256.5(322.7)	191.5(257.7)	142(142.2)					21.95(35.7)
SGP55D, SGP44G, SGP30M	292.5(358.7)	227.5(293.7)	178(177.2)					30.8(44.94)
SGP75D, SGP60G, SGP44M,	320.5(386.7)	255.5(321.7)	206(205.2)					37.52(50.94)
SGP110D, SGP85G, SG60M	418.5(484.7)	353.5(419.7)	304(303.2)	21	66(132.2)	$45_{-0.016}^{0}$	MS3102A 32-17P	66.2(82.6)

Note 4) Use DC power (90 V) to operate the brake.

Note 5) The sizes in parentheses apply when attached to the brakes.

■ SGP Series | APM - SGP110G

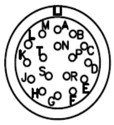


<Power Connector>

Plug : MS3102A32−17P

핀번호	신호명
A	U
B	V
C	W
D	접지

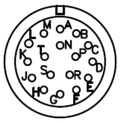
<Encoder Connector>



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

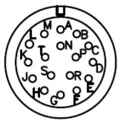
<Serial S−turn Encoder Connector>



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

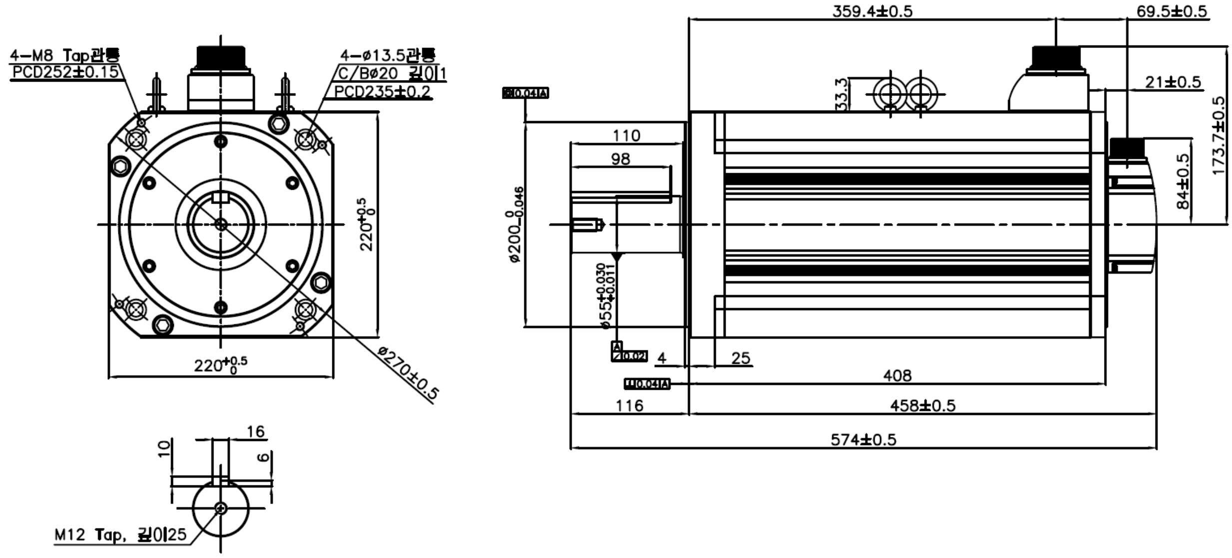
<Serial M−turn Encoder Connector>



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

■ SGP Series | APM-SGP150G

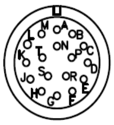


<Power Connector>

Plug : MS3102A32−17P

핀번호	신호명
A	U
B	V
C	W
D	접지

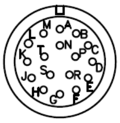
<Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	A	M	V
B	$\overline{A}$	N	$\overline{V}$
C	B	P	W
D	$\overline{B}$	R	$\overline{W}$
E	Z	H	DC +5V
F	$\overline{Z}$	G	0V
K	U	J	SHIELD
L	$\overline{U}$		

Plug : MS3102A20−29P

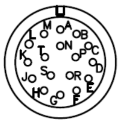
<Serial S−turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	$\overline{MA}$	N	−
C	SL	P	−
D	$\overline{SL}$	R	−
E	−	H	+5V
F	−	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20−29P

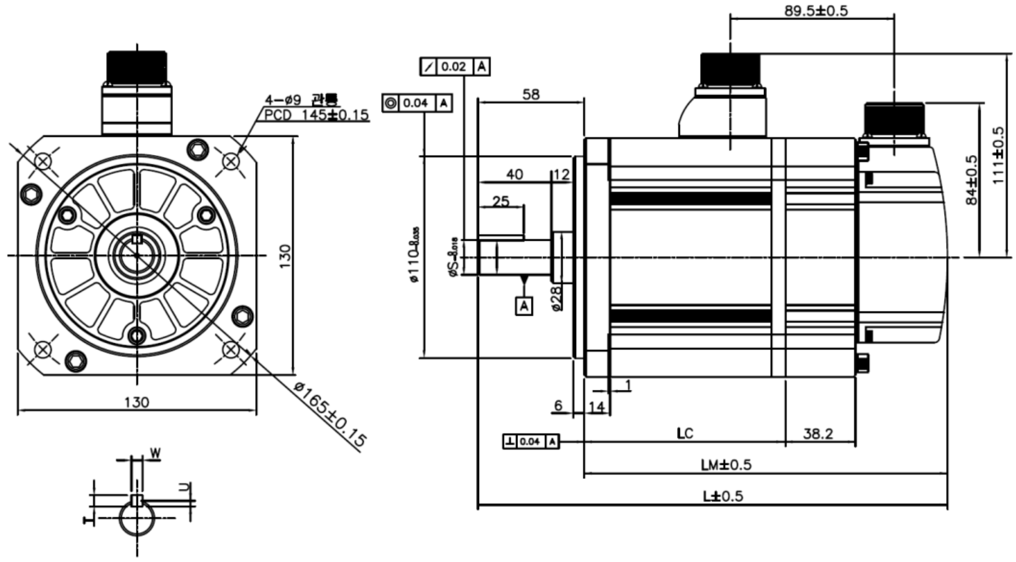
<Serial M−turn Encoder Connector>



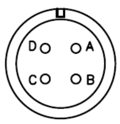
Pin No.	Phase	Pin No.	Phase
A	MA	M	−
B	$\overline{MA}$	N	−
C	SL	P	−
D	$\overline{SL}$	R	−
E	VOD_B	H	+5V
F	GND_B	G	0V
K	−	J	SHIELD
L	−		

Plug : MS3102A20−29P

■FEP Series | APM-FEP09A, FEP06D, FEP05G, FEP03M
APM-FEP15A, FEP11D, FEP09G, FEP06M
APM-FEP22A, FEP16D, FEP13G, FEP09M
APM-FEP30A, FEP22D, FEP17G, FEP12M



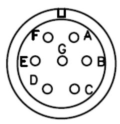
<Power Connector>



Pin No.	Color	Phase
A	Red	U
B	White	V
C	Black	W
D	Green	FG

Plug : MS3102A20−4P

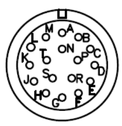
<Brake Type Connector>



Pin No.	Phase	Pin No.	Phase
A	U	D	F/G
B	V	E	BK+
C	W	F	BK−

Plug : MS3102A20−15P

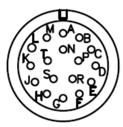
<Serial S−turn Encoder Connector>



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	−		

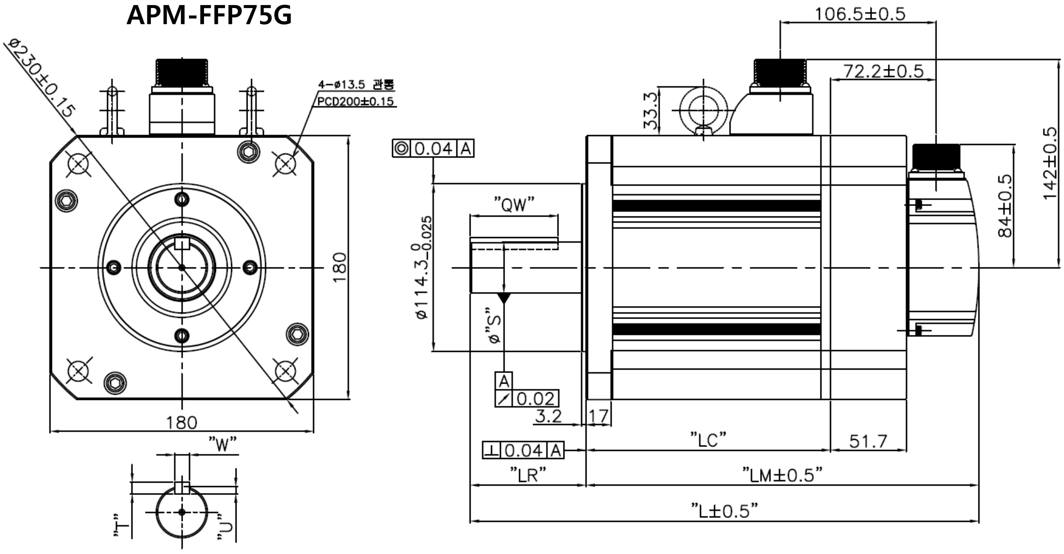
Plug : MS3102A20−29P

Model	External Dimensions				Key Dimensions			Weight (Kg)
	L	LM	LC	S	T	W	U	
FEP09A,FEP06D,FEP05G,FEP03M	197.3(235.3)	139.3(177.3)	89.8(89.6)	19	5	5	3	5.04(6.58)
FEP15A,FEP11D,FEP09G,FEP06M	217.3(255.3)	159.3(197.3)	109.8(109.6)	19	5	5	3	6.74(8.28)
FEP22A,FEP16D,FEP13G,FEP09M	237.3(275.3)	179.3(217.3)	129.8(129.6)	22	6	6	3.5	8.48(10.02)
FEP30A,FEP22D,FEP17G,FEP12M	255.3(293.3)	197.3(235.3)	147.8(147.6)	24	7	8	4	10.05(11.59)

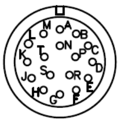
Note 1) Use DC power (24 V) to operate the brake.

Note 2) The sizes in parentheses apply when attached to the brakes.

■ **FFP Series | APM-FFP30A, FFP22D, FFP20G, FFP12M**
APM-FFP50A, FFP35D, FFP30G, FFP20M
APM-FFP55D, FFP44G, FFP30M
APM-FPF75D, FPF60G, FFP44M
APM-FFP75G



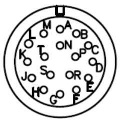
<Serial S-turn Encoder Connector>



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

<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

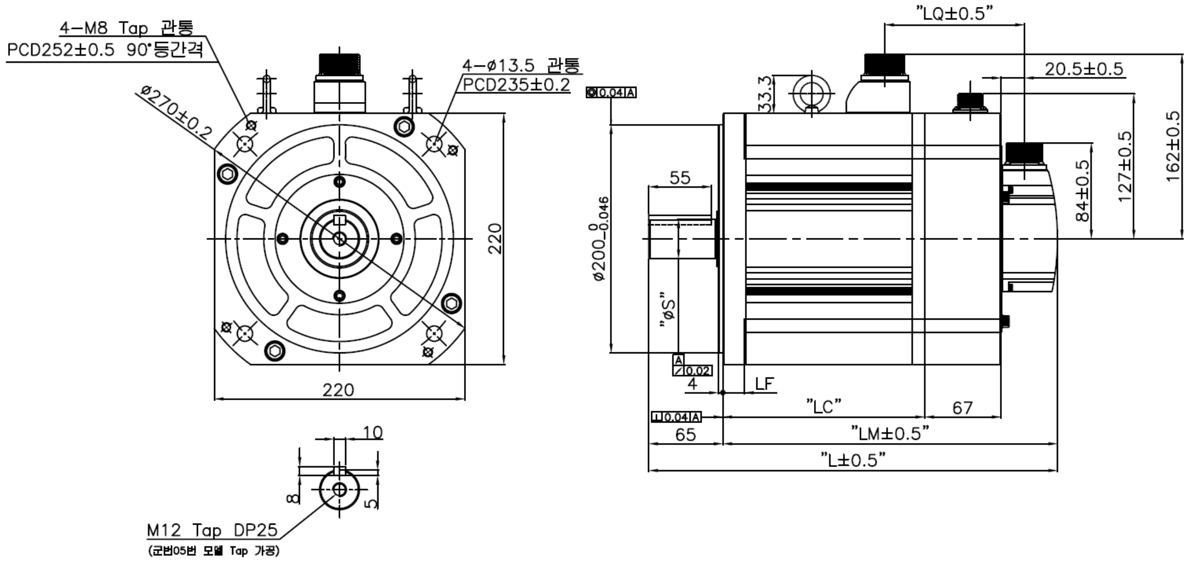
Model	External Dimensions					Key Dimensions				Eye Bolt	Weight (Kg)
	L	LM	LC	LR	S	QW	T	W	U		
FFP30A, FFP22D, FFP20G, FFP12M	257.5(308.9)	178.5(229.9)	129(128.7)	79	$35^{+0.01}_{0}$	60	8	10	5	X	12.5(19.7)
FFP50A, FFP35D, FFP30G, FFP20M	287.5(338.9)	208.5(259.9)	159(158.7)								17.4(24.6)
FFP55D, FFP44G FFP30M	331.5(382.9)	252.5(303.9)	203(202.7)							O	25.2(32.4)
FFP75D, FFP60G, FFP44M	384.5(435.9)	305.5(356.9)	256(255.7)		$42^{0}_{-0.016}$			12			33.8(41.0)
FFP75G(주 3)	439.5	326.5	277	113		96					38.5

Note 3) Use DC power (24 V) to operate the brake.

Note 4) The sizes in parentheses apply when attached to the brakes.

Note 5) Using MS3102A 32-17P Connector for SFP75G

■ **FGP Series | APM-FGP22D, FGP20G, FGP12M**
APM-FGP35D, FGP30G, FGP20M
APM-FGP55D, FGP44G, FGP30M
APM-FGP75D, FGP60G, FGP44M
APM-FGP110D, FGP85G, FGP60M

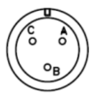


<Power Connector>

Pin No.	Color	Phase
A	Red	U
B	White	V
C	Black	W
D	Green	FG

Plug : MS3102A22-22P

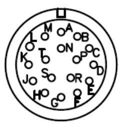
<Brake Connector>



Pin No.	Phase
A	BK+
B	BK−
C	−

Plug : MS3102A14S-7P

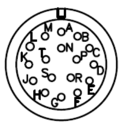
<Serial S-turn Encoder Connector>



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	−		

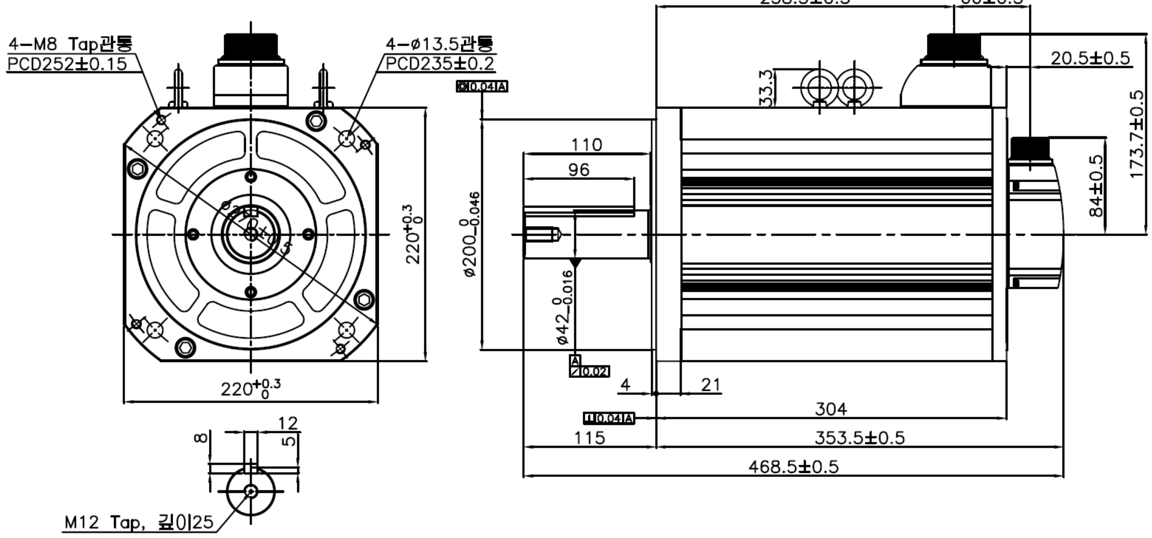
Plug : MS3102A20-29P

Model	External Dimensions						Power Connector	Weight (Kg)
	L	LM	LC	LF	LQ	S		
FGP22D, FGP20G, FGP12M	229.5(295.7)	164.5(230.7)	115(114.2)	19	56.4(122.6)	$35_{-0.016}^{0}$	MS3102A 22-22P	15.42(29.23)
FGP35D, FGP30G, FGP20M	250.5(316.7)	185.5(251.7)	136(135.2)					20.22(34.03)
FGP55D, FGP44G, FGP30M	282.5(348.7)	217.5(283.7)	168(167.2)					28.02(41.83)
FGP75D, FGP60G, FGP44M,	304.5(370.7)	239.5(305.7)	190(189.2)					33.45(47.26)
FGP110D, FGP85G, FG60M	418.5(484.7)	353.5(419.7)	304(303.2)	21	66(132.2)	$45_{-0.016}^{0}$	MS3102A 32-17P	66.2(82.6)

Note 6) Use DC power (90 V) to operate the brake.

Note 7) The sizes in parentheses apply when attached to the brakes.

■ FGP Series | APM-FGP110G

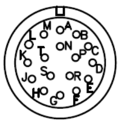


<Power Connector>

Plug : MS3102A32-17P

핀번호	신호명
A	U
B	V
C	W
D	접지

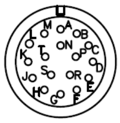
<Serial S-turn Encoder Connector>



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

10.2 Servo Drive

10.2.1 Product Characteristics

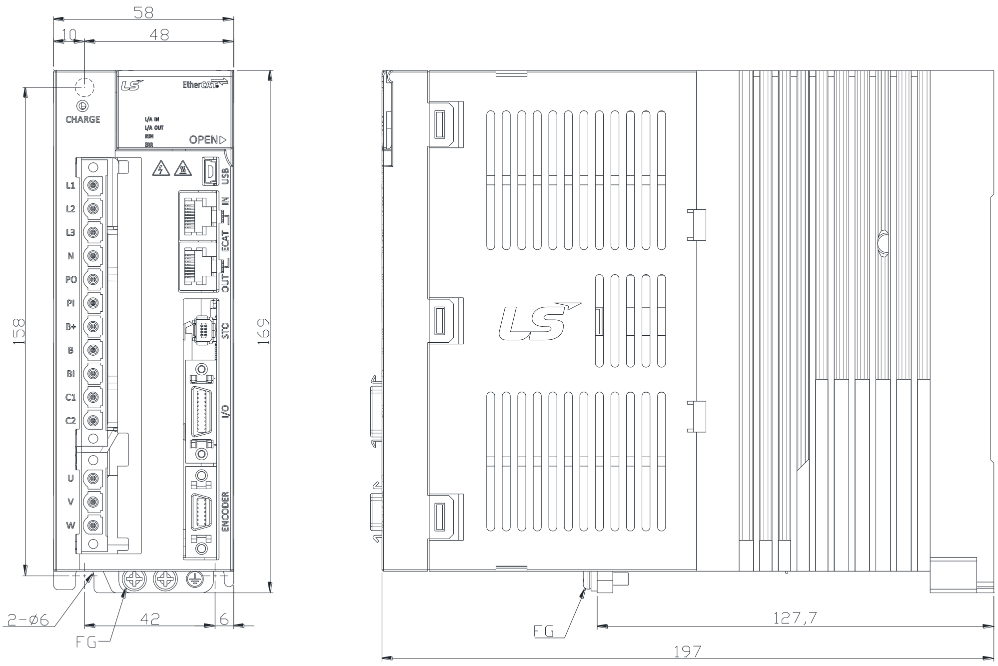
Item \ Name		L7NHB 010U	L7NHB 020U	L7NHB 035U	L7NHB 050U	L7NHB 075U	L7NHB 150U
Input Power	Main power	Three-phase AC 380-480 V (-15-10%), 50-60 Hz					
	Control power	Single-phase AC 380-480 V (-15-10%), 50-60 Hz					
Rated current (A)		3.7	8	10.1	17.5	22.8	39
Peak current (A)		11.1	24	30.3	47.25	57	97.5
Encoder Type		Quadrature(Incremental) BiSS-B, BiSS-C(Absolute, Incremental) Tamagawa Serial(Absolute, Incremental) EnDat 2.2					
Control performance	Speed control range	Maximum 1 : 5000					
	Frequency response	Maximum 1 kHz or above (when the 19-bit serial encoder is applied).					
	Speed regulation	±0.01% or lower (when the load changes between 0 and 100%) ±0.1% or less (temperature of 25℃ (±10))					
	Torque control repeatability	Within ±1%					
EtherCAT Communication Specification	Communication Specification	FoE (Firmware download) EoE (Parameter setting, adjustment, 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)	Sync by DC mode Minimum DC cycle: 250[us]					
	LED display	LinkAct IN, LinkAct OUT, RUN, ERR					
	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] ~ DC 24[V] A total of 8 input channels (allocable) You can selectively allocate a total of 12 functions. (*POT, *NOT, *HOME, *STOP, *PCON, *GAIN2, *P_CL, *N_CL, PROBE1, PROBE2, EMG, A_RST) 주) * Default allocation signal.
	Digital Output	Rated voltage and current: DC 24 V ± 10%, 120 ㎃ A total of 4 input channels (allocable) You can selectively allocate a total of 11 kinds of output. (*BRAKE±, *ALARM±, *READY±, *ZSPD±, INPOS±, TLMT±, VLMT±, INSPD±, WARN±, TGON±, INPOS2±) 주) * Default allocation signal.
Analog Monitor		A total of 2 input channels (allocable) You can selectively allocate a total of 15 kinds of output.
Safety Functions		2 input channels (STO1, STO2), 1 output channel (EDM±)
USB communication	Function	Firmware download, parameter setting, adjustment, auxiliary functions, and parameter copy function.
	Communication standard	Conform to the USB 2.0 Full Speed Standard.
	Connecting device	PC or USB storage medium
Built-in functions	Dynamic braking	Standard built-in (activated when the servo alarm goes off or when the servo is off) Note) If excessive DB(Dynamic Brake) or more than allowable inertia is used, the DB resistor may be burnt.
	Regenerative braking	Both the default built-in brake and an externally installed brake are possible. Note) For L7□B150U, regenerative braking is installed externally as standard.
	Display function	Seven segments (5 DIGIT)
	Self-Setting Function	Possible to set the drive node address by using Rotary Switch
	Add-on functions	Gain adjustment, alarm history, JOG operation, origin search
	Protection	Overcurrent, overload, excessive current limit, overheat, overvoltage,

	functions	undervoltage, overspeed, encoder error, position following error, current sensing error, etc.
Use environment	Use temperature /Storage temperature	0 ~ 50[℃], -20 ~ 65[℃]
	Use humidity /Storage humidity	90% RH or less (no condensation)
	Other	Indoors in an area free from corrosive or combustible gases, liquids, or dust.

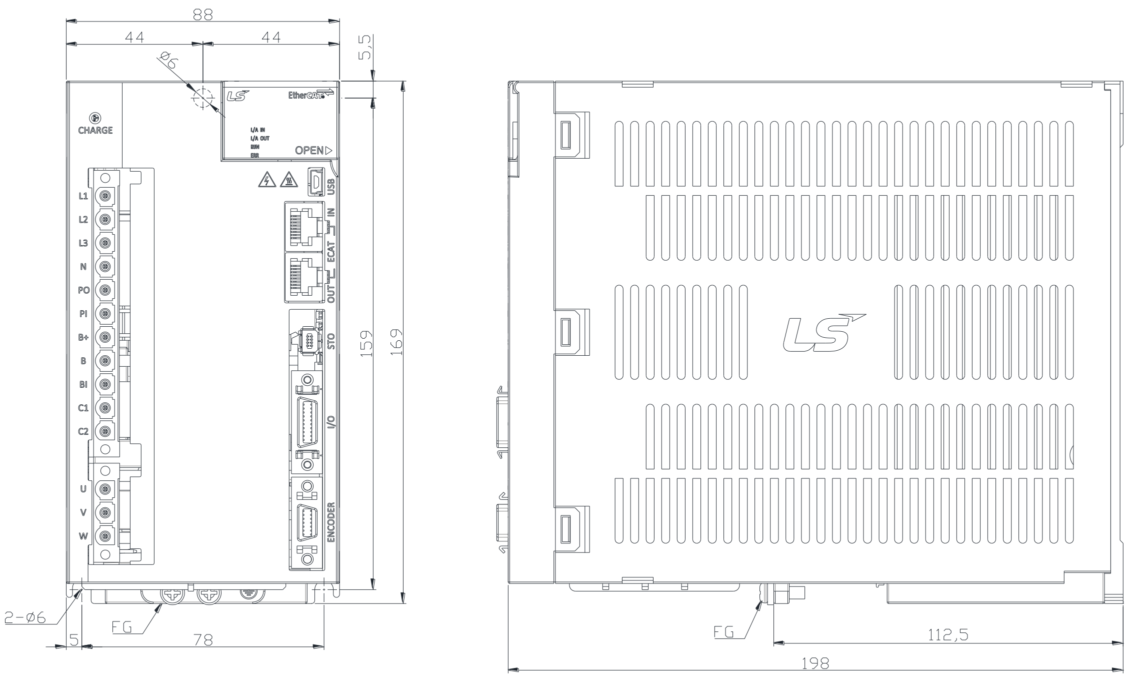
10.2.2 Outline Diagram

■ L7NHB010U



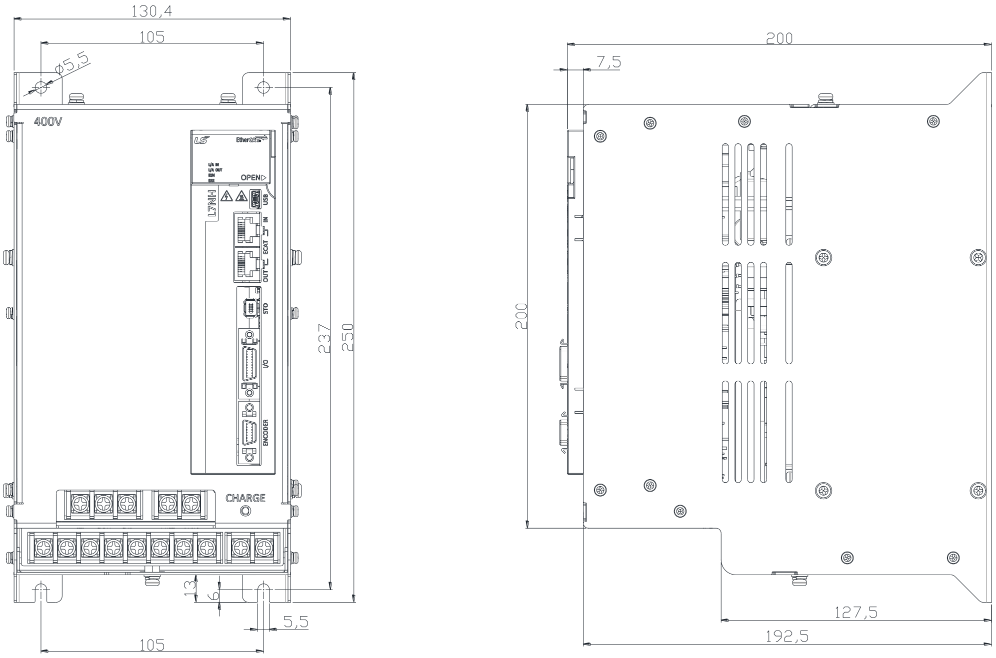
*Weight : 1.5 kg (including the cooling fan)

■ L7NHB020U / L7NHB035U



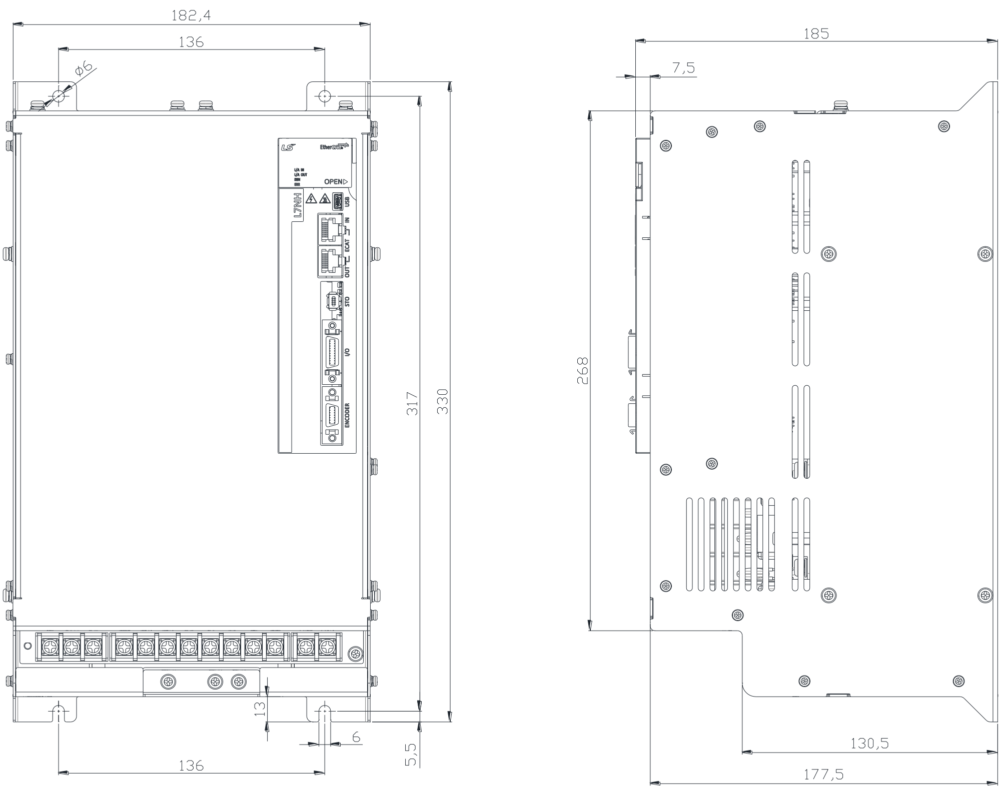
*Weight : 2.5 kg (including the cooling fan)

■ L7NHB050U



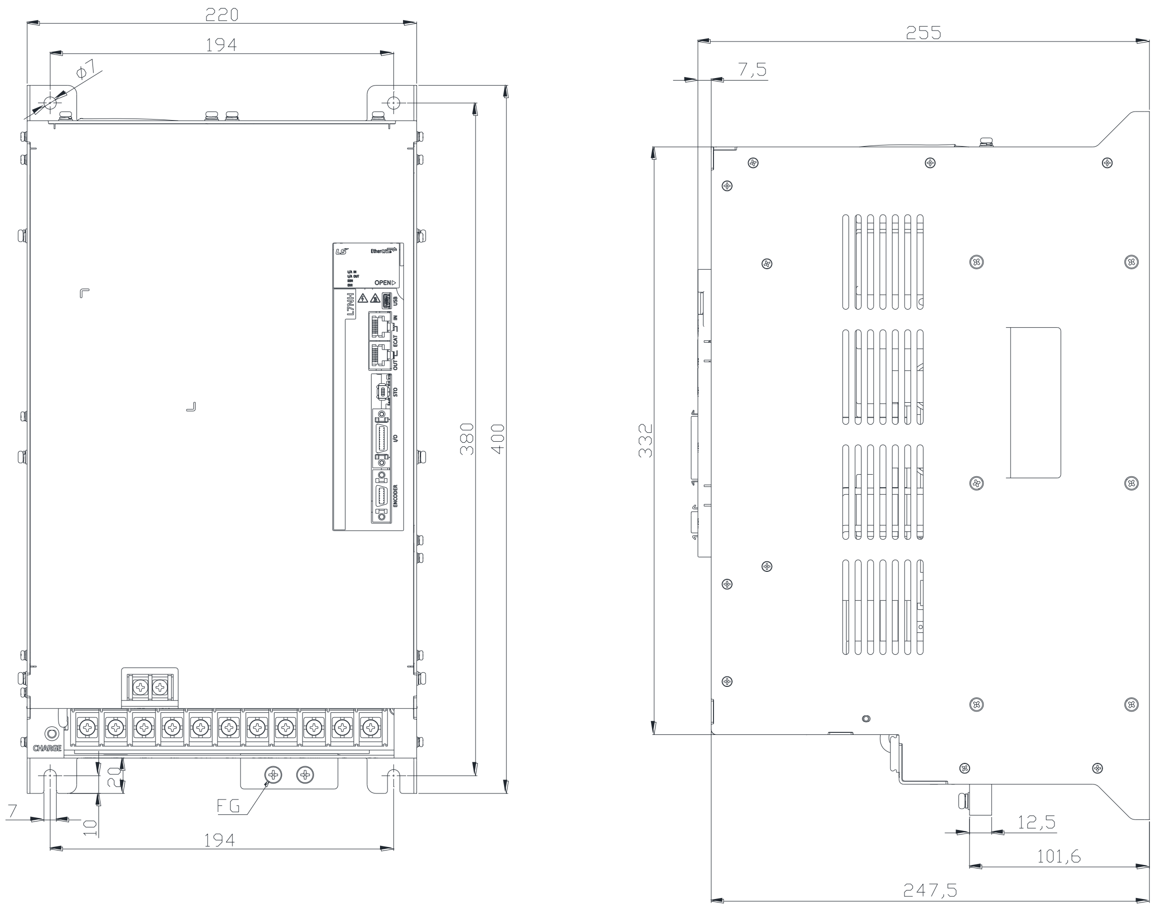
*Weight : 5.5 kg (including the cooling fan)

■ L7NHB075U



*Weight : 8.5 kg (including the cooling fan)

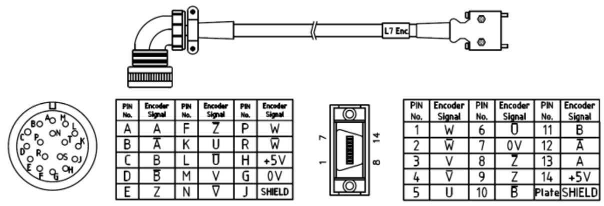
■ L7NHB150U



*Weight : 15.5 kg (including the cooling fan)

10.3 Options and Peripheral Devices

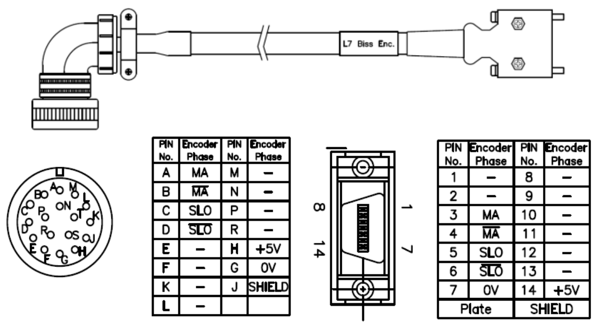
■ **Option (Incremental encoder cable)**

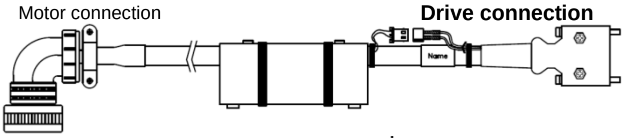
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For signaling	S Series Motor INC. Encoder cable (Midium capacity)	APCS-E□□□BS	APM-SEP APM-SFP APM-SGP SERIES All model	Motor connection Drive connection (ENCODER)  **1. Motor connection (MS:Military Standard)** **a. PLUG specifications : MS3108B 20-29S** **2. Drive connection (CN2)** **a. Case specifications: 10314-52A0-008(3M) or SM-14J(Suntone 사)** **b. CONNECTOR specifications : 10114-3000VE(3M) or SM-14J(Suntone)** **3. Cable specifications: 7Px0.2SQ or 7Px24AWG**

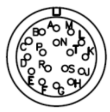
Note 1) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information.

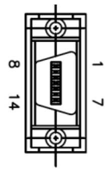
Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ **Option (serial encoder cable)**

Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For signaling	S/Flat Series motor S-turn Encoder cable (medium capacity)	APCS-E□□□DS	APM-SEP APM-SFP APM-SGP APM-FEP APM-FFP APM-FGP SERIES All models	Motor connection Drive connection (ENCODER)  **1. Motor connection** a. PLUG specifications : MS3108A 20-29S **2. Drive connection (CN2)** a. CASE specifications : 10314-52A0-008(3M) or SM-14J(Suntone)

<table>
<tr><td></td><td></td><td></td><td></td><td>b. CONNECTOR specifications :
10114-3000VE(3M) or SM-14J(Suntone)
3. Cable specifications: 3Px0.2SQ or 3Px24AWG</td></tr>
<tr><td>For signaling</td><td>S/Flat Series motor M-turn Encoder cable (medium capacity)</td><td>APCS-E□□□DS1</td><td>APM-SEP
APM-SFP
APM-SGP
APM-FEP
APM-FFP
APM-FGP
SERIES
All models</td><td>




<table>
<tr><td>PIN No.</td><td>Encoder Phase</td><td>PIN No.</td><td>Encoder Phase</td></tr>
<tr><td>A</td><td>MA</td><td>M</td><td>–</td></tr>
<tr><td>B</td><td>$\overline{MA}$</td><td>N</td><td>–</td></tr>
<tr><td>C</td><td>SLO</td><td>P</td><td>–</td></tr>
<tr><td>D</td><td>$\overline{SLO}$</td><td>R</td><td>–</td></tr>
<tr><td>E</td><td>VDD_B</td><td>H</td><td>+5V</td></tr>
<tr><td>F</td><td>GND_B</td><td>G</td><td>0V</td></tr>
<tr><td>K</td><td>–</td><td>J</td><td>SHIELD</td></tr>
<tr><td>L</td><td>–</td><td></td><td></td></tr>
</table>


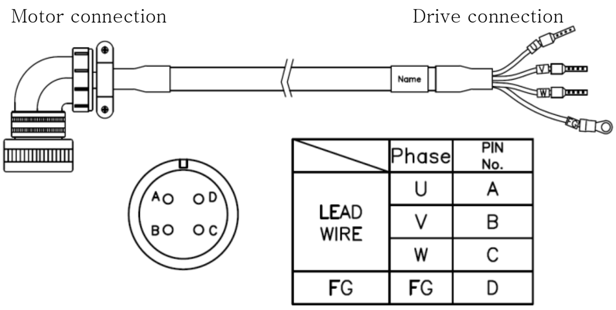
<table>
<tr><td>PIN No.</td><td>Encoder Phase</td><td>PIN No.</td><td>Encoder Phase</td></tr>
<tr><td>1</td><td>–</td><td>8</td><td>–</td></tr>
<tr><td>2</td><td>–</td><td>9</td><td>–</td></tr>
<tr><td>3</td><td>MA</td><td>10</td><td>–</td></tr>
<tr><td>4</td><td>$\overline{MA}$</td><td>11</td><td>–</td></tr>
<tr><td>5</td><td>SLO</td><td>12</td><td>–</td></tr>
<tr><td>6</td><td>$\overline{SLO}$</td><td>13</td><td>–</td></tr>
<tr><td>7</td><td>0V</td><td>14</td><td>+5V</td></tr>
<tr><td colspan="2">Plate</td><td colspan="2">SHIELD</td></tr>
</table>
1. Motor connection
a. PLUGspecifications: MS3108A 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 specification : 5267-02A(Molex)
b. Battery specification : ER6V(TOSHIBA, 3.6V, 2000mAh)</td></tr>
</table>

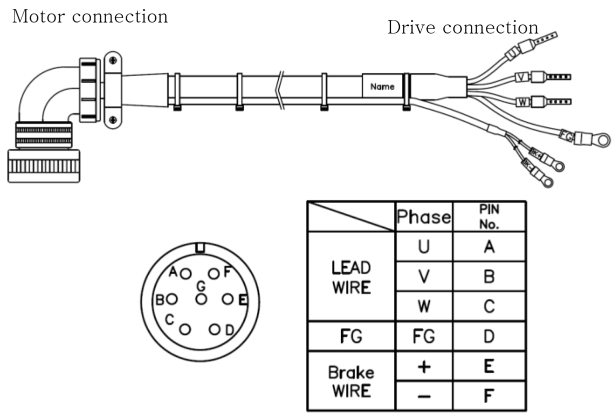
Note 1) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ **Option [Medium capacity power cable]**

Category	Product Name	Name (Note 1)	Applicable Motors	Specifications

<table>
<tr>
<td>For power</td>
<td>Power cable
(400V/Medium capacity
130Flange)</td>
<td>APCF-P□□□HS</td>
<td>APM-SEP
APM-FEP
SERIES
All models</td>
<td>


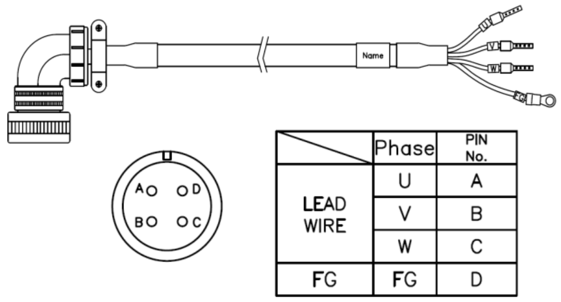
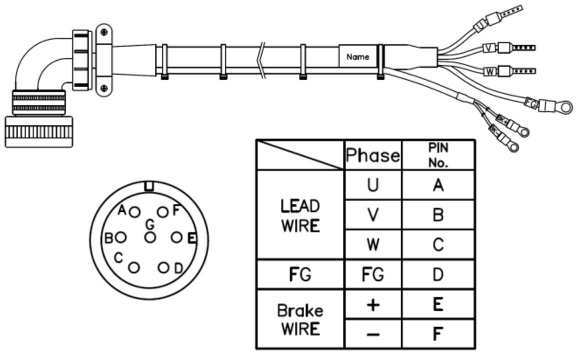
<Motor side Connector>
1. Motor connection
a. PLUG specifications : MS3108A 20-4S
2. Drive connection (U,V,W,FG)
a. U,V,W pin specifications: 1512(Ferrule)
b. FG pin specifications: 1.5x4(Ring Terminal)
3. Cable specifications: 4Cx1.5SQ or 4Cx15AWG
</td>
</tr>
<tr>
<td>For power</td>
<td>Power cable
(Brake type)
(400V//Medium capacity
130Flange)</td>
<td>APCF-P□□□NB</td>
<td>APM-SEP
APM-FEP
SERIES
All models</td>
<td>


<Motor side Connector>
1. Motor connection
a. PLUGspecifications : MS3108A 20-15S
2. Drive connection
a. U, V, W pin specifications: 1512(Ferrule)
b. FG pin specifications: 1.5 x 4(Ring Terminal)
3. Power cable specifications : 4Cx1.5SQ or 4Cx15AWG
4. Brake power cable connection
a. Connection terminal specifications: 1.5 x 3(Ring Terminal)
5. Brake cable specifications : 2Cx0.75SQ or 2Cx19AWG
</td>
</tr>
</table>

Note 1) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

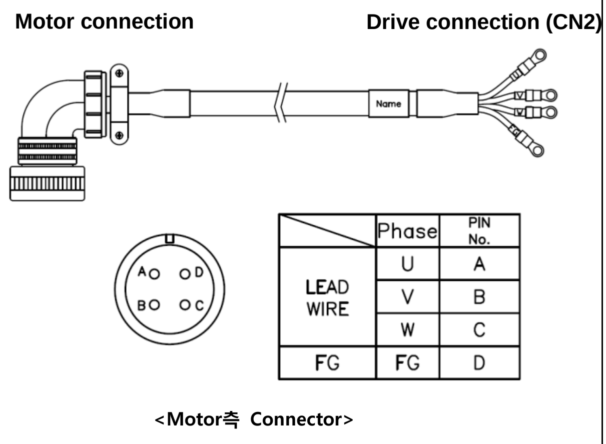
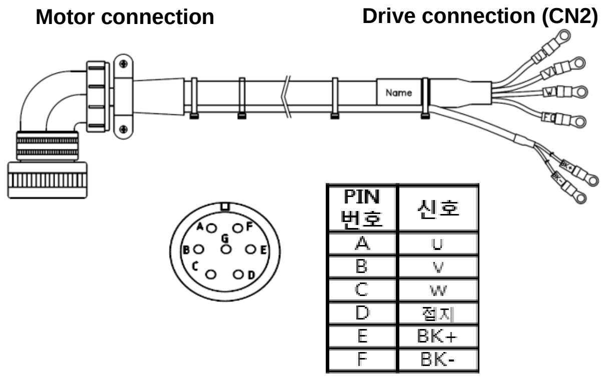
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications

For power	Power cable (400V/Medium capacity below3.5kW 180Flange)	APCF-P□□□IS	SFP30A SFP22D SFP35D SFP20G SFP12M SFP20M SGP22D SGP35D SGP20G SGP12M SGP20M FFP30A FFP22D FFP35D FFP20G FFP30G FFP12M FFP20M FGP22D FGP35D FGP20G FGP30G FGP12M FGP20M	**Motor connection** **Drive connection(CN2)**  <Motor side Connector> **1. Motor connection** a. PLUG specification : MS3108A 22-22S **2. Drive connection (U,V,W,FG)** a. U,V,W pin specification: 2512(Ferrule) b. FG pin specification : 2.5x4 (Ring Terminal) **3. Cable specifications:** 4Cx1.5SQ or 4Cx15AWG
For power	Power cable (For brake) (400V/Medium capacity below3.5kW 180Flange)	APCF-P□□□PB	SFP30A SFP22D SFP35D SFP20G SFP12M SFP20M FFP30A FFP22D FFP35D FFP20G FFP30G FFP12M FFP20M	Motor connection Drive connection  <Motor side Connector> **1. Motor connection** a. PLUG specification : MS3108A 24-10S **2. Drive connection** a. U, V, W pin specification: 2512(Ferrule) b. FG pin specification: 2.5 x 4(Ring Terminal) **3. Power Cable specifications::** 4Cx1.5SQ or 4Cx15AWG **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 name indicates the type and length of each cable. Refer to the following table for this information.

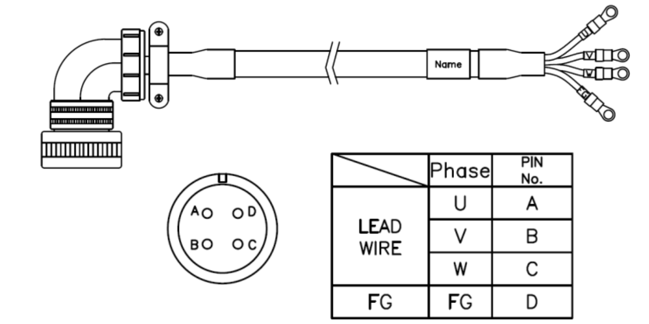
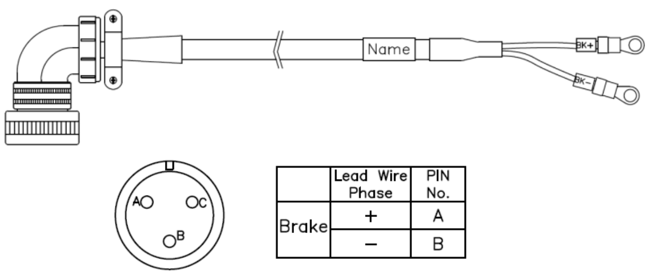
Cable length (m)	3	5	10	20

Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For power	Power cable (400V/Medium capacity below7.5kW 180/220Flange)	APCF-P□□□JS	SFP50A, SFP55D, SFP75D, SFP30G SFP44G, SFP60G, SFP30M, SFP44M SGP55D, SGP75D, SGP30G, SGP44G, SGP60G, SGP30M, SGP44M FFP50A, FFP55D, FFP75D, FFP44G, FFP60G, FFP30M, FFP44M FGP55D, FGP75D, FGP44G, FGP60G, FGP30M, FGP44M	 **1. Motor connection (MS : Military Standard)** a. PLUG specification : MS3108A 22-22S **2. Drive connection (U,V,W,FG)** a. U,V,W,FG 핀 specification : 4.0x 5(Ring Terminal) **3. Cable specification:** 4Cx4.0SQ or 4Cx11AWG
For power	Power cable (400V/Medium capacity below7.5kW 180/Flange)	APCF-P□□□LB	SFP50A, SFP55D, SFP75D, SFP44G, SFP60G, SFP30M, SFP44M FFP50A, FFP55D, FFP75D, FFP44G, FFP60G, FFP75G FFP30M, FFP44M	 **1. Motor connection** a. PLUGspecification : MS3108A 24-10S **2. Drive connection** a. U, V, W,FG pin specification : 4.0X5 (Ring Terminal) **3. Power cable specification :** 4Cx4.0SQ or 4Cx11AWG **4. Brake power cable connection** a. Connection terminal specifications: 1.5 x 3(Ring Terminal) **5. Brake cable specification :** 2Cx0.75SQ or 2Cx19AWG

Note 1) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information.

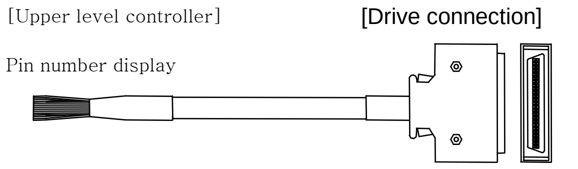
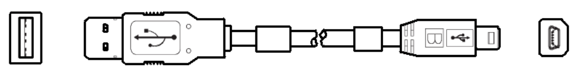
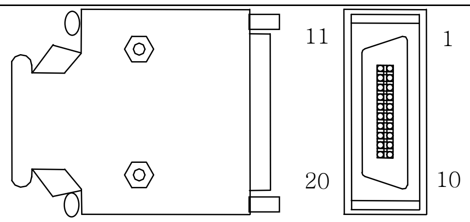
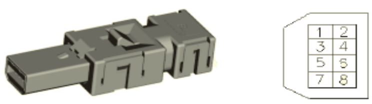
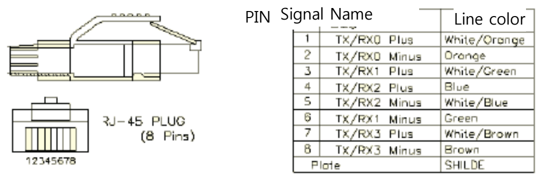
Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20

Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For power	Power cable (400V/Medium capacity below15kW 180/220 Flange)	APCF-P□□□MS	SFP75G, SGP110D, SGP85G, SGP110G, SGP150G, SGP60M FGP110D, FGP85G, FGP110G, FGP150G, FGP60M	**Motor connection** **Drive connection(CN2)**  **1. Motor connection** a. PLUG specification : MS3108A 32-17S **2. Drive connection (U,V,W,FG)** a. U,V,W,FG pin specification: 10x5 (Ring Termianl) **3. Cable specification:** 4Cx10SQ or 4Cx7AWG
For power	Brake cable (200/400V 220 Flange)	APCS-P□□□SB	SGP22D SGP35D SGP55D SGP75D SGP12M SGP20M SGP30M SGP44M SGP20G SGP30G SGP44G SGP60G FGP22D FGP35D FGP55D FGP75D FGP20G FGP30G FGP30G FGP44G FGP60G FGP12M FGP20M FGP30M FGP44M	**Motor connection** **Power connection**  **1. Motor connection** a. PLUG specifications : MS3108B 14-7S(MS) **2. For Brake power** a. Connection terminal specifications : 1.5x3(Ring Terminal) **3. cable specification :** 2Cx0.75SQ or 2Cx19AWG

Note 1) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information.

Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20

■ **Optional cables**

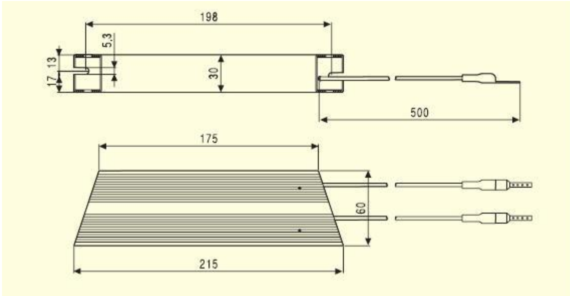
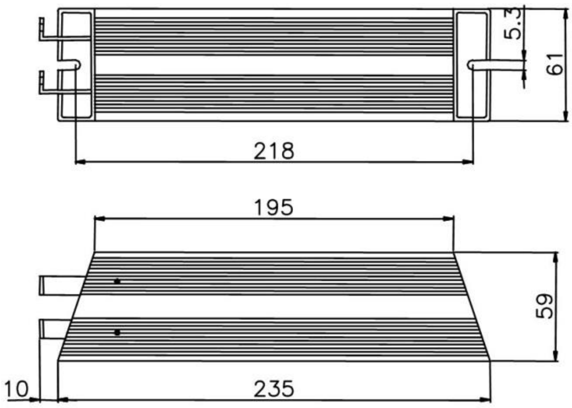
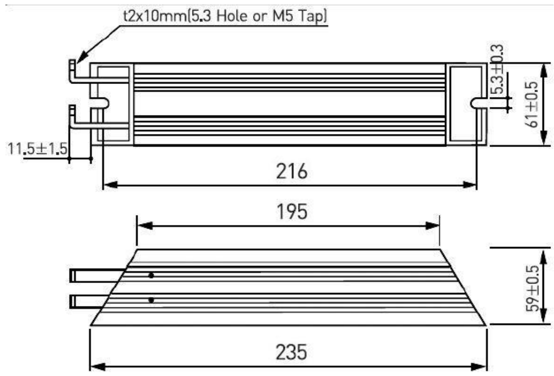
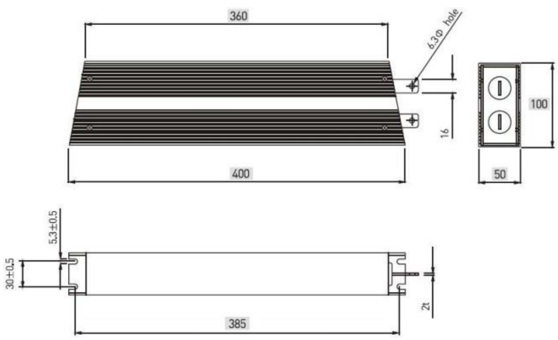
Category	Product Name	Name (Note 1)	Applicable Drive	Specifications
For signaling	I/O cable	APCS-CN1□□A	L7NH SERIES	 1. Drive connection (I/O) a. Case specifications: 10320-52A0-008 (3M) b. Connector specifications: 10120-3000VE (3M) c. Cable specifications: ROW-SB0.1Cx20C(AWG 28)
For signaling	Communication cable	APCS-CM5L7U	L7NH SERIES	[PC - USB port] [Servo drive – USB]  1. PC connection: USB A Plug 2. Drive connection (USB): Mini USB 5P plug 3. Electrical requirements: Double shielded, twisted pair, EMI filter installation (similar product: SANWA 사 KU-AMB518)
CN	I/O Connector	APC-CN2NNA	L7N SERIES	 1. Case specifications: 10320-52A0-008 (3M) 2. Connector specifications: 10120-3000VE (3M)
CN	STO Connector	APCS-CN6J	L7N SERIES	 1. Case specifications: 2069577-1 (Tyco)
CN	ECAT In/Out Connector	APCS-CN4NNA	L7N SERIES	 1. Case specifications: 10320-52A0-008 (3M)

Note 1) The □ in the name indicates the length of each cable. Refer to the following table for this information.

Cable length (m)	1	2	3	5
Written as	01	02	03	05

■ **Optional braking resistance**

Category	Product Name	Name	Applicable Drive	Specifications

Resist ance	Braking resistance	IRV300-82Ω 82[Ω] (300W)	L7□B010U	
Resist ance	Braking resistance	IRV600-140Ω 70Ω] (600W*2P) - Making under review	L7□B020U /L7□B035U (2P)	
Resist ance	Braking resistance	IRV600-75Ω 25[Ω] (600W*3P)	L7□B050U /L7□B075U (3P)	
Resist ance	Braking resistance	IRM2000- 13.4Ω 13.4[Ω] (2000W)	L7□B150U	

11. Maintenance and Inspection

11.1 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.

11.1.1 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.

11.1.2 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.

Inspection Item	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 6) Measure the resistance between the FG and one of the U, V, and W power lines on the servo motor.

(2) Inspecting the Servo Drive

Inspection Item	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	Clean it with air pressure or cloth.
Check for loose screws	At least once a year	Check if terminal block or connector tightening screws, etc. are not loose.	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.

11.1.3 Replacing Parts

Mechanical friction and aging may deteriorate the following parts or even cause them to malfunction. This makes it important to conduct regular maintenance checks and replace worn parts.

5. 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.

6. The relays: Check for bad connections 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.

7. 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.

[The Standard Part Replacement Cycle]

Part Name	Standard Replacement Cycle	Method
Smoothing condenser	7-8 years	Replace (determine after inspection).
Relays	-	Determine after inspection
Fuses	10 years	Replace
Aluminium electrolytic condensers on PCB	5 years	Replace with new boards (determined after inspection)
Cooling fans	4-5 years	Replace
Motor bearings	-	Determine after inspection
Motor oil seal	5,000 hours	Replace

11.2 Diagnosing and Troubleshooting Abnormalities

Alarm or warning will be generated if a problem occurs during operation. If this happens, check the applicable code and take a proper action. If the problem persists, contact our service center.

11.2.1 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 section 3.6, "Signals."	Turn on the P-OT and N-OT inputs.
	The motor has defects.	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.
	The encoder has defects.	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 less	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. Use a motor with a greater capacity.
	The magnetic power of the magnets is reduced.	Check the counter voltage and voltage waveforms.	Replace the motor.
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."

11.2.2 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	Causes	Details	What to check
AL-10 IPM fault AL-14 Over current AL-16 Current limit exceeded	Motor cable error	Wiring is incorrect and check short	Replace motor cable
	Encoder cable error	Wiring is incorrect and check short	Replace encoder cable
	Parameter cable error	Motor ID [0x2000], encoder type[0x2001], encoder form[0x2002] setting vaule should be same with applied to motor label.	Modifty motor label and parameter concordantly
	Check motor phase resistor	Check if U/V/W phase currentffset(0x2015~0x2017) is 5% or above of the rated current, Replace drive	Replace motor
	Machine part has problem	Determine whether there is a conflict or binding in the equipment.	Check machine part
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Error by noize	Check method to improve noise of wiring, install.	Please check condition of wiring for FG. Match wire size of FG with wire size of drive main circuit.
AL-11 IPM temperature	surroundings temperature	Check wherther surrounding temperature is over 50 [℃]	Lower surrounding temperature
	Continuous Overload alram	Accumulated operate overload percentage [0x2603] Checking the load percentage is under 100%	Change drive and motor capacitiy, Please tune gain.
	Motor cable open	Check accumulated regenerative overload[0x2606]	Adjust regeneration resistor setting[0x2009] Use external regenerarion resistor.
	Drive setting direction	Check drive setting status	Refer “2. Wiring and Joint
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-15 Current offset	Motor U/V/W phase current offset oversetting	Check whether the U/V/W phase current offset [0x2015~0x2017] are 5% of the rated current or highter.	Rerun adjusting phase current offset
	Drive error		If alarm occurs continually after adjusting offset of phase current, please replace new drive because drive has problem.
AL-21 Continuous overload	In case of sequent operating that exceed rated load	Check if load which is accumulating driving load rate[0x2603] is below 100% when it is in constant speed section and stop	Change drive and motor capacitiy, Please tune gain.

Alarm Code	Causes	Details	What to check
	Motor brake error	Checking whether the motor brake is not holding	Provide power to motor brake
	Parameter setting error	Motor ID[0x2000], Encoder type[0x2001], Check the label of application motor and Encoder form[0x2002] setting value.	Modify the parameter as same as motor label information.
		Over load detected standard load rate setting [0x200F] Value checking	Set as proper value
	Machine part has problem	there is no problem for running	Check machine part.
	Motor cable error	Wiring is incorrect and check short	Replace motor cable.
	Encoder cable error	Wiring is incorrect and check short	Replace encoer cable.
AL-22 Drive temperature 1	surrounding temerature	Check wherther surrounding temperature is over 50 [℃]	Lower surrounding temperature of drive.
	Drive error	Check if displayed value 1 [0x260B] of drive temperature is much different with surrounding temperature when it is normal condition.	Replace the drive
AL-23 Regeneration overload	Capacity excess by high frequency operationg or continue regenerative operating	Checking overload rate accumulated regeneration on 0x2606	Adjust value on 0x2009. Use braking resistor
	Parameter setting error	Check setting value[0x2009] ~ [0x200E]	Set as proper value
	Main power input voltage error	Check whether Main power (544[Vac]) has problem or not.	Recheck the power supply
	Drive error	Checking the temperature of regenerative resistance on Servo-off status	Replace the drive
AL-24 Motor cable open	Parameter setting error	Check [0x2015], [0x2015], [0x2015] Check value offset current	Process the Phase current offset control procedure command
	Motor cable error	Check whether cable is disconnected.	Replace the motor cable.
	Motor error	Check short circuit of U,V,W in Motor (U-V, V-W, W-U)	Replace the motor
	Drive error		If specific alarm signal is persistently occurred, It is highly possible to have fault, so Kindly recommend you to change the servo drive.
AL-25	Surrounding temperature	Check whether surrounding temperature is over 50[℃]	Lower the surrondng termpertaure of drive

Alarm Code	Causes	Details	What to check
Drive temperature 2	Drive error	Comparing displayed drive temperature 2 [0x260C] in normal status and the surrounding temperature.	Replace the drive
AL-26 Encoder temperature	Reserved		
AL-30 Encoder communication AL-31 Encoder cable open AL-32 Encoder data	Encoder cable error	Disconnect, wiring is incorrect and check Short.	Replace encoder cable.
	Parameter setting error	Value of [0x2001], [0x2002] is same with application motor label.	Modify the parameter as same as motor label information. If modified value is not applied to parameter, it is highly possible to have fault, So Kindly recommend you to change the servo motor.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-33 Motor setting	Setting Motor ID	Value of [0x2000] is same with application motor label.	Revise it with motor label information equally. It is possible to release alarm when power off/on after adjusting parameter.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-34 Z Phase open	Encoder cable error	Wiring is incorrect and check Short.	Replace encoder cable.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-35 Low battery	Parameter setting error	Check setting value [0x2005]	It will be no alarm to set as 1 when you use absolute encoder as the incremental encoder.
	Bad connection of battery No connected.	Check status of battery access	Connect battery rightly.
	When battery voltage is low	Check whether voltage is over 3.3v.	Replace bettery
AL-36 Sinusoidal ENC amplitude AL-37	Encoder cable error	Wiring is incorrect and check short Check shield and FG disconnect	Replace encoder cable.
	Parameter setting error	Check setting valud of encoder type [0x2001]	Check setting encoder type. Check speed command.(Maximum:250kHz)

Alarm Code	Causes	Details	What to check
Sinusoidal ENC frequncy	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	resolver error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-38 Encoder setting error	Drive / Motor combination error	Check brand label code of motor and drive.	Use motor and drive of same brand label.
	Encoder cable error	Wiring is incorrect and check Short	Replace encoder cable.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-40 Under voltage	Main power input voltage error	Check the main power voltage is over 3phase 219[Vac]	Recheck the power supply.
		Check [0x2605] value is over 310 [Vdc] when main power is accordingly input	Replace the drive.
	running when power voltage is low	Check wiring of main power supply	Use 3 phase as supply voltage.
AL-41 Over voltage	Main power input voltage error	Check whether the main power voltage is below 572[Vac]	Recheck the power supply.
		Check [0x2605] value is below 810[Vdc] when main power is accordingly input.	Replace the drive.
	When braking resistor is high	Check operating condition regenerative resistance.	Review the regenerative resistance consider the operating condition and load.
	Setting value of acceleration/ deceleration	In case of many time for acceleration / deceleration	Set longer acceleration / deceleration time

Alarm Code	Causes	Details	What to check
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-42 Main power fail	Main power input voltage error	check voltage between phase 380- 480[Vac] of L1, L2, L3.	Recheck power supply.
	Parameter setting error	Check setting value arroding to state of main power [0x2006]	Wire or set parameter as input power on (possible 3 phase)
	momentary power failure	Check setting value [0x2007]	check main power source or reduce value of [0x2007]
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-43 Control power fail	Voltage between phase of C1, C2 error	Voltage between phase of C1, C2 is within 380-480[Vac].	Recheck power supply of drive
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-50 Over speed limit	Motor Encoder error	Wiring is incorrect and check Short.	Replace motor cable.
	Encoder cable error	Wiring is incorrect and check Short.	Replace encoder cable.
	Parameter setting error	Value of [0x2000], [0x2001], [0x2002] is same with application motor label.	Modify the parameter as sams as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low.
		Check setting value[0x2100] ~ [0x211F]	Readjust gain according to operating condtion.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-51 POS following	Parameter setting error	Check setting value [0x3000], [0x3003], [0x3004].	Set up correct parameter according to operating method.
		Check [0x6091] Setting value	Set Electronic gear ratio low.
		Check setting value on 0x6066 of position error excess time, 0x6065 of position error range	Set up correct parameter according to operating method.
	Machine part has problem	Checking it was forced by drive part	Check Machine part has problem
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-53 Excessive SPD deviation	Motor cable error	Disconnect, wiring is incorrect and check Short.	Replace motor cable
	Encoder cable error	Disconnect, wiring is incorrect and check Short.	Replace encoder cable
	Parameter setting	Value of [0x2000], [0x2001], [0x2002] is same with application motor label.	Modify the parameter as sams as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low..

Alarm Code	Causes	Details	What to check
	Machine part has problem	Checking it was forced by drive part operating condition of limit contact point sensor	Check Machine part.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-63 Parameter checksum	When O/S is changed	Check parameter that parameter setting value was set as maximum value of variable form	Restore initial parameter (0x1011). If you restore it, setting up parameter would be changed into initial value. So set up parameter before operating
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-71 Factory setting	Parameter setting error	Contact our service center Check [0x1008] DeviceName	Please download OS or set capacity of drive again. If alarm continue after servo on again, Replace drive. Because drive may have problem.

■ Servo Warning

If the drive detects an error classified as a servo warning, it will trigger a warning. In this case, the drive will maintain normal operation condition. After the cause of the warning is eliminated, the warning will be automatically cleared. In case of a warning, take an appropriate action. You can specify if each warning is checked with warning mask configuration (0x2014).

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	Abnormal combination of Drive and Motor, abnormal I/O setting
6	W40	Low voltage
7	W80	Emergency signal input

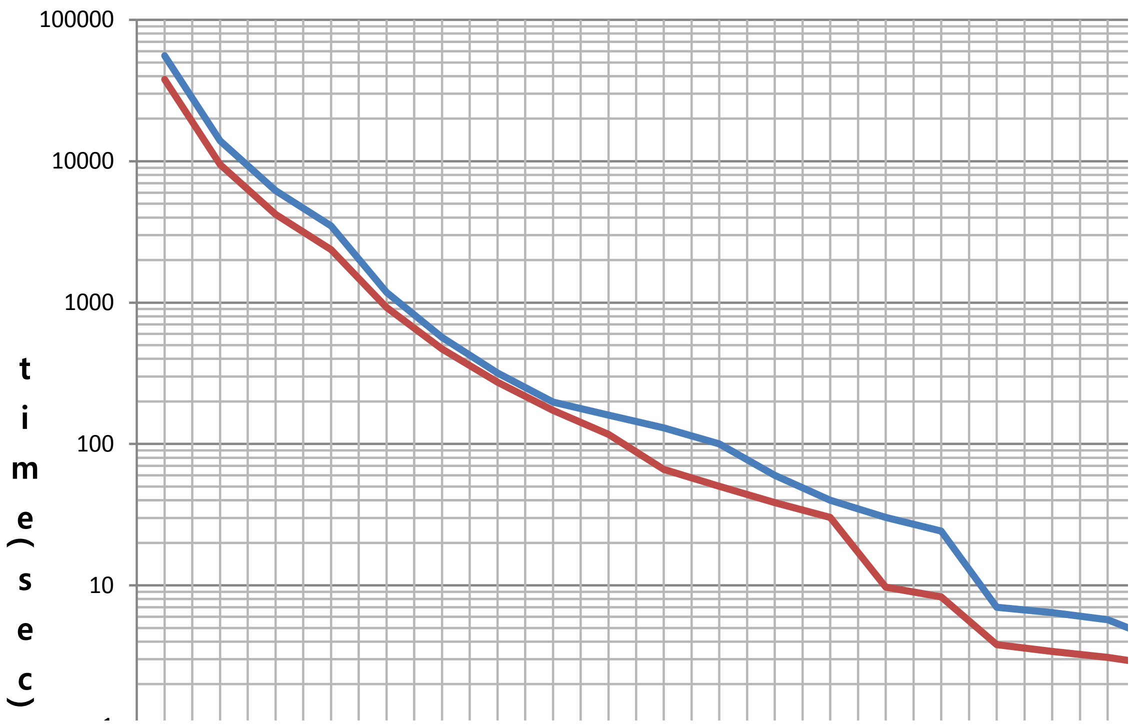
Alarm Code	Causes	Detail	What to check
 PWR_FAIL	Main power input voltage error	Check voltage between phase 380-480[Vac] of L1, L2, L3	Recheck power supply.
	Parameter setting error	Check value of main power input mode set[0x2006] arroding to state of main power input.	Wire or set parameter as input power on(possible 3 phase)
	Momentary power failure	Check value of main power input mode set[0x2006] arroding to state of main power input.	Check actual main power or increase value of checking time of loss of main power.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
 LOW_BATT	Parameter setting error	Check setting value of absolute encoder [0x2005]	Alarm will be disappeared if you set “1” when using ABS encoder as incremental encoder.
	Bad conection of battery, No connected.	Check the status of battery	Connect battery rightly.
	When battery voltage is low.	Check whether battery voltage is over 3.3V	Replace battery.
 SW_POS_LMT	Parameter setting error	Setting function of software restriction on location [0x2400], Check value of software restriction on location[0x607D]	Change value of software position limit function[0x2400] or change the set of limit value of maximum postion and minimum position of software position limit[0x607D]
 OV_LOAD	In case of sequent	Check overload warning level setting[0x2010] and constant speed section or accumulated operation	Change drive and motor capacitiy, Please tune gain.

Alarm Code	Causes	Detail	What to check
	operating that exceed rated load	overload rate[0x2603]	Adjust the setting value overload warning level[0x2010].
	Motor brake error	Checking the motor brake is not holding	Provide supply power to motor brake.
	Parameter setting error	Motor ID[0x2000], Encoder type[0x2001], Encoder form [0x2002] vaule is same with motor label.	Modify the parameter as sams as motor label information.
		Check value of set of overload detecting basic load rate[0x200F]	Set as proper value.
	Machine part has problem	There is no problem for running	Check machine part has problem
	Motor cable error	Wiring is incorrect and check Short.	Replace motor cable
	Emcoder cable error	Wiring is incorrect and check Short.	Replace encoder cable
 SETUP	Drive / Motor Combination error	Check whether capacity of current of motor is bigger than capacity of current of drive or not.	reduce value of torque limit or use the motor which capacity is lower than capacity of current of drive
	IO setting error	Check whether one signal is assigned more than 2 in digital input signal assignment[0x2200] ~ [0x2208] and digital output signal assignment[0x2210]~[0x2213].	Set up correct parameter according to operating method.
 UD_VTG	Main power input voltage error	Check if main power has problem or not	Recheck the power supply.
		Check that DC link voltage [0X2605] is between 190~405 [Vdc] when main power is supplied correctly.	Replace the drive
	Running when power voltage is low	Check wiring status of main power	Use 3 phase as supply voltage
 EMG	EMG contact error	It is state of EMG Wiring or drive parameter(drivecontrol input1[0x211F], digital input signal1 set[0x2200]~digital input Check sinal 16 setting[0x220F]	Set up correct parameter according to operating method.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.

11.3 Overload Operating Characteristic Curve

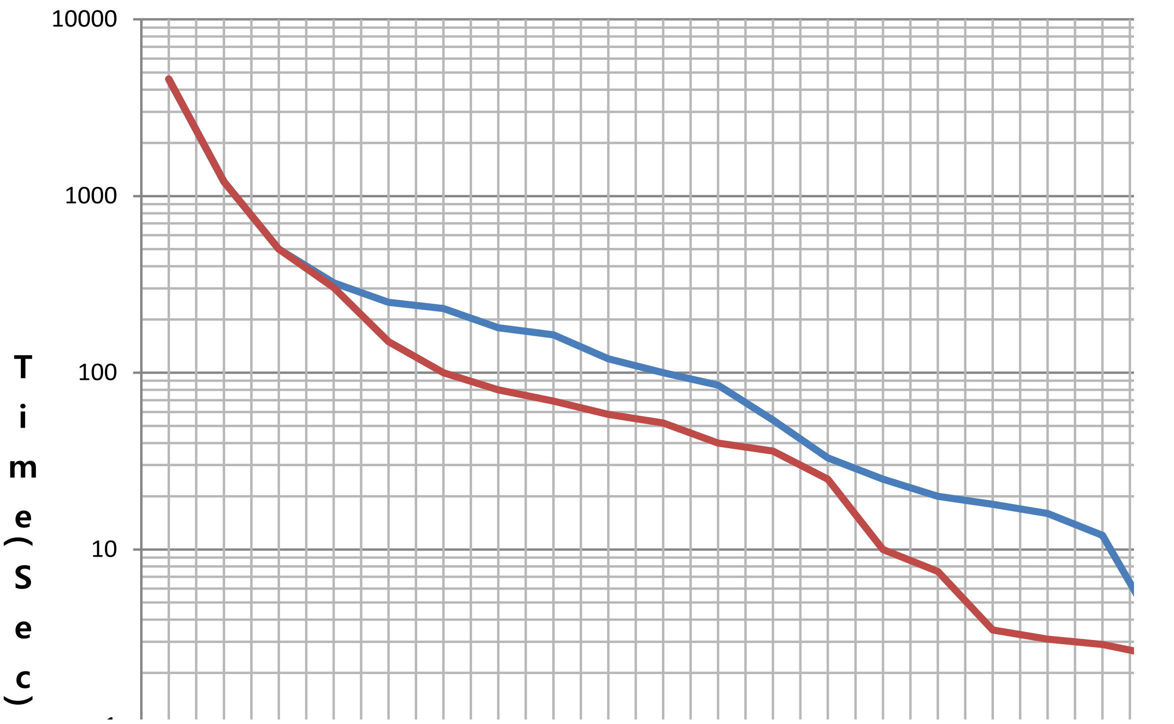
■ Overload Operating Characteristic Curve (1kW)

Overload(%)	AL-21 occurred time (sec)		Overload(%)	AL-21 occurred time (sec)	
	Operation	Stop		Operation	Stop
Below 100	Infinite	Infinite			
110	55776.0	37937.7	210	100.0	50.1
120	13944.0	9483.9	220	60.0	38.5
130	6197.3	4215.1	230	40.0	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	7.0	3.8
170	318.0	273.0	270	6.4	3.4
180	198.0	173.0	280	5.7	3.1
190	160.0	117.0	290	4.0	2.7
200	130.0	66.0	300	3.0	2.0



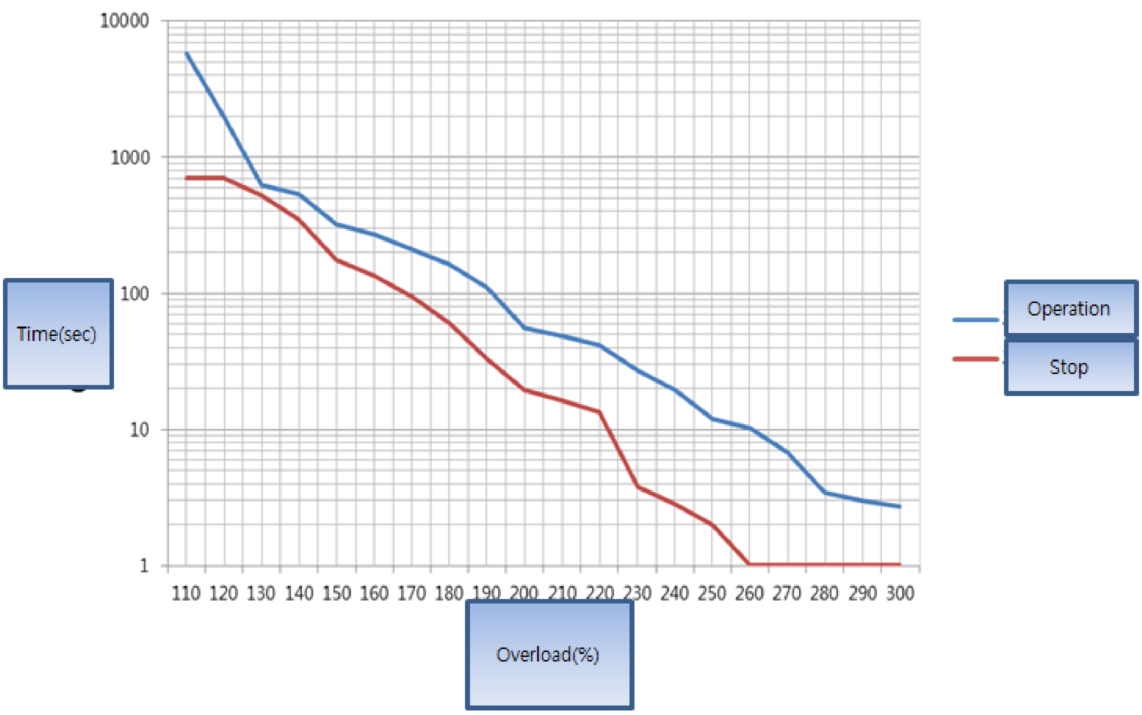
■ Overload Operating Characteristic Curve (2kW, 3.5kW)

Overload(%)	AL-21 occurred time (sec)		Overload(%)	AL-21 occurred time (sec)	
	Operation	Stop		Operation	Stop
Below 100	Infinite	Infinite			
110	4602.0	4600.0	210	85.0	40.0
120	1208.0	1208.0	220	54.0	36.0
130	500.0	500.0	230	33.0	25.0
140	323.0	303.0	240	25.0	10.0
150	250.0	150.0	250	20.0	7.5
160	231.0	100.0	260	18.0	3.5
170	180.0	80.0	270	16.0	3.1
180	164.0	69.0	280	12.0	2.9
190	120.0	58.0	290	3.5	2.5
200	100.0	52.0	300	2.5	2.3



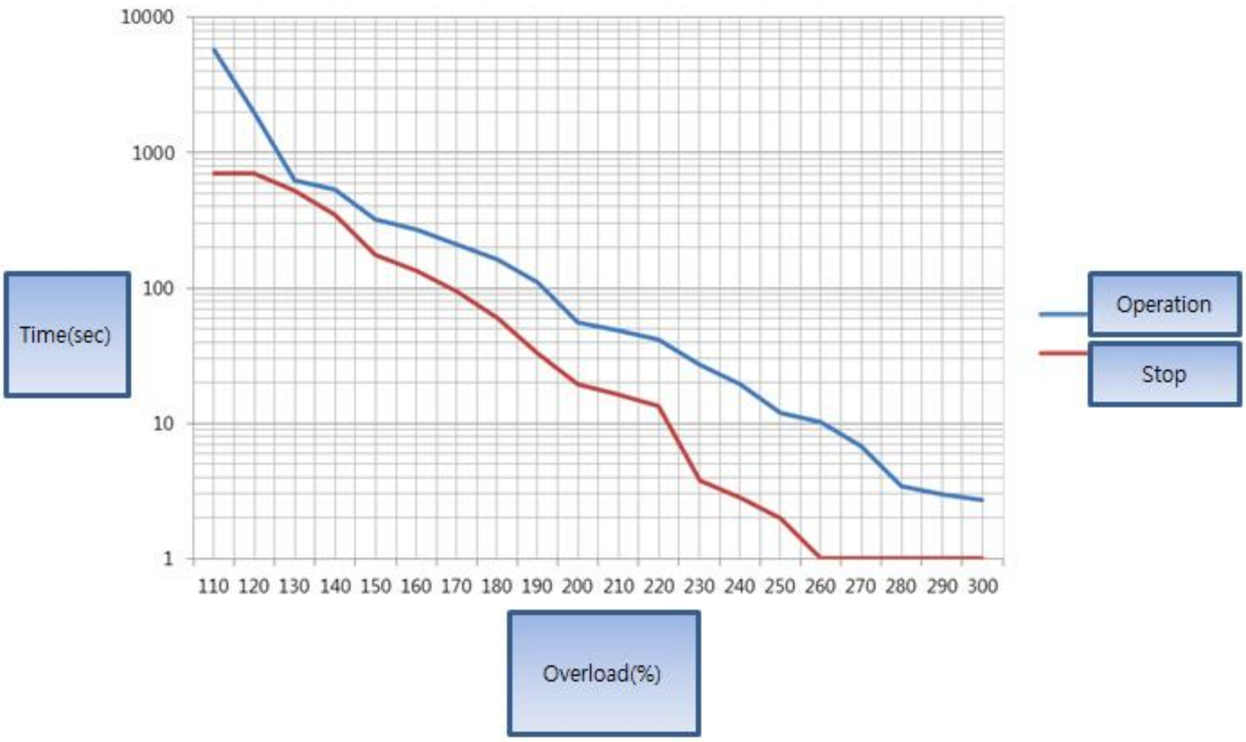
■ Overload Operating Characteristic Curve (5kW, 7.5kW)

Overload(%)	AL-21 occurred time (sec)		Overload(%)	AL-21 occurred time (sec)	
	Operation	Stop		Operation	Stop
Below 100	Infinite	Infinite			
110	5760.0	420.0	210	120.0	16.0
120	550.0	300.0	220	60.0	8.0
130	440.0	250.0	230	40.0	4.0
140	360.0	200.0	240	30.0	1.8
150	300.0	150.0	250	20.0	1.2
160	270.0	120.0	260	18.0	1.0
170	240.0	100.0	270	16.0	1.0
180	210.0	60.0	280	14.0	1.0
190	180.0	45.0	290	6.0	1.0
200	150.0	35.0	300	5.0	1.0



■ Overload Operating Characteristic Curve (15kW)

Overload(%)	AL-21 occurred time (sec)		Overload(%)	AL-21 occurred time (sec)	
	Operation	Stop		Operation	Stop
Below 100	Infinite	Infinite			
110	5760.0	704.0	210	49.0	16.4
120	1998.0	698.4	220	42.0	13.5
130	630.0	524.2	230	27.0	3.8
140	540.0	350.1	240	19.6	2.8
150	324.0	176.0	250	12.0	2.0
160	271.8	135.0	260	10.2	1.0
170	210.6	94.0	270	6.8	1.0
180	162.9	60.0	280	3.4	1.0
190	111.0	32.8	290	3.0	1.0
200	56.0	19.3	300	2.7	1.0



12. Test Drive

For safe and proper test drive, make sure to check the following prior to 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 correctly tightened without loosening?

For a motor with oil seal fitted, is there any damage on the oil seal?

Is oil 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. Maintenance and Inspection.

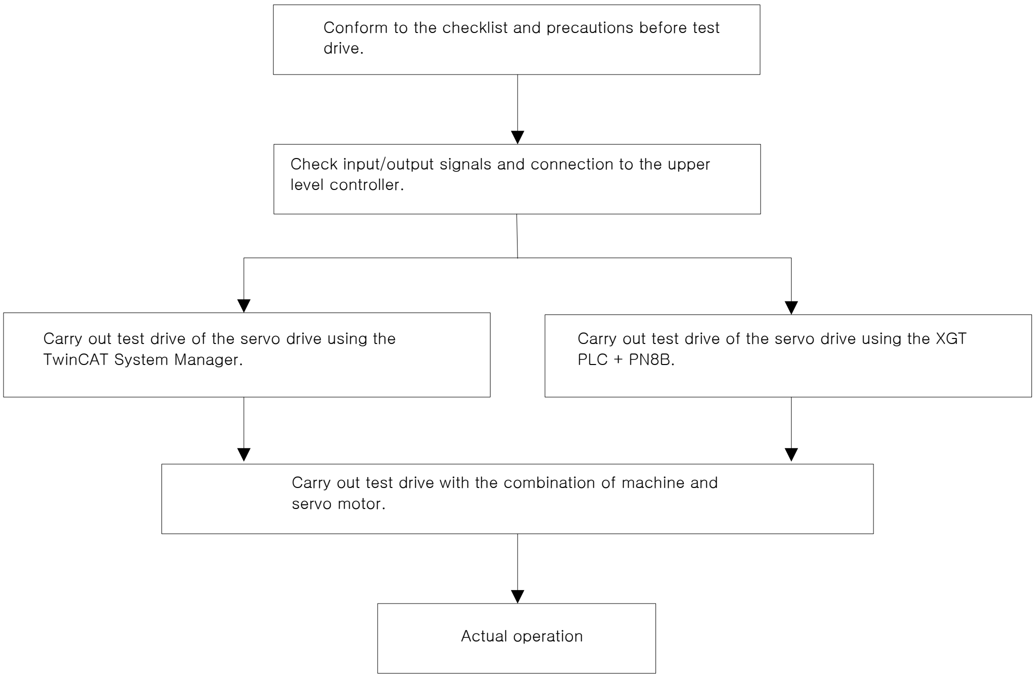
■ Servo Drive State

Is the drive correctly installed, wired, and connected?

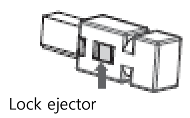
Is the supply voltage for the servo drive correct?

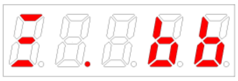
12.1 Preparation for Operation

Carry out test drive in the following order:



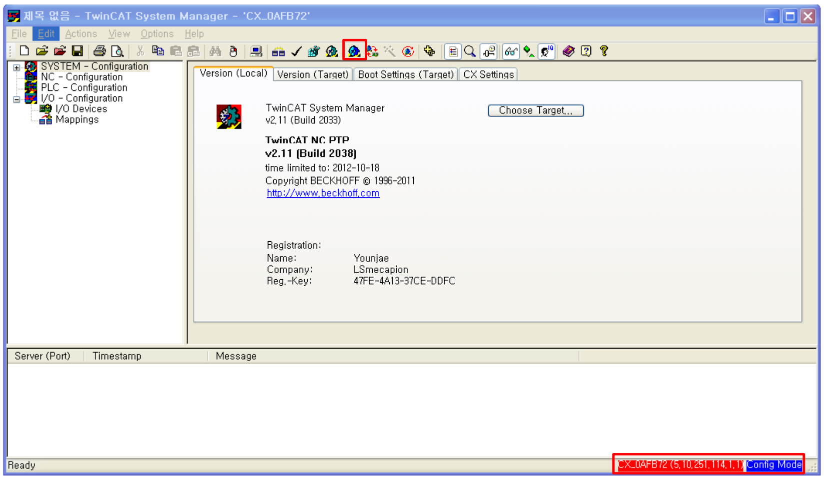
Verify that, before the test drive, the upper level controller and the servo drive are correctly wired, and the objects of the servo drive are correctly configured.

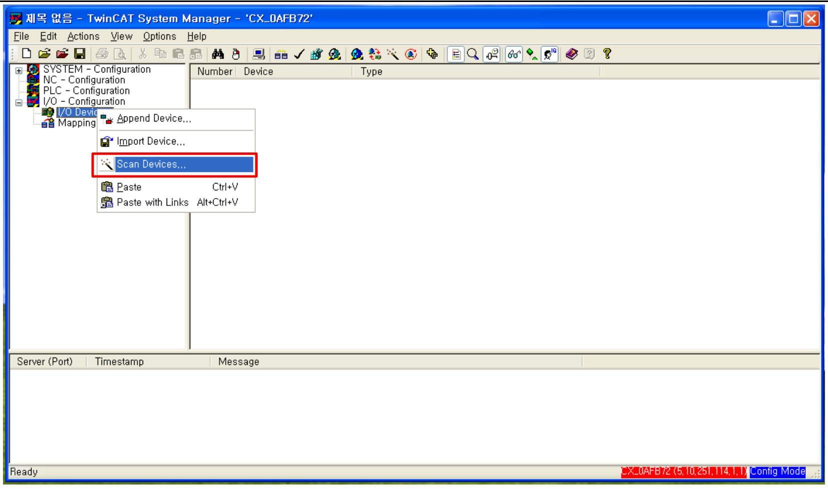
Order	Handling	Notes
1	Connect the power connector and safety function connector of Servo Drive.	Refer to Section 2.5 Wiring for Input/Output Signals.
2	Connect motor and encoder cables to the servo drive.	Refer to Section 2.5 Wiring for Input/Output Signals.
3	If you use the safety function, connect 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, neither motor current will be supplied nor torque 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, 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 without the lock released. Please be careful.	Refer to Section 2.5 Wiring for Input/Output Signals.
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 finished checking the connection and state of input signal circuits to prepare for test drive.	Refer to Section 11 Maintenance and Inspection.

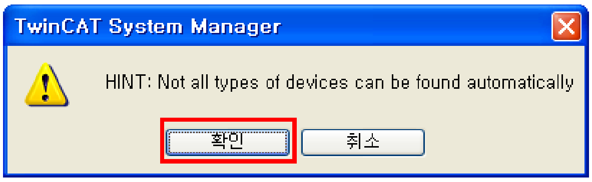
12.2 Test Drive Using TwinCAT System Manager

■ Test Drive Procedure

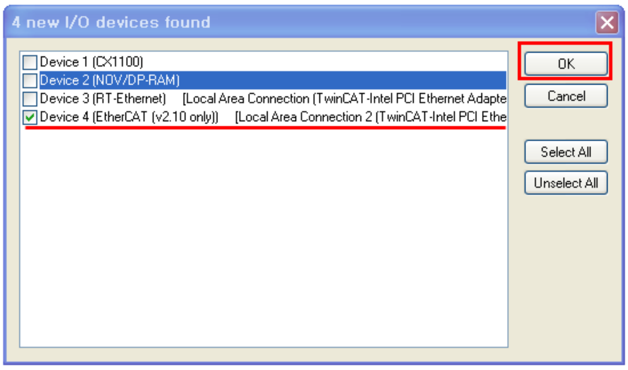
Order	Handling	Notes
1	Before launching the TwinCAT System Manager, copy the servo drive XML file into the schema folder (C:\TwinCAT\Io\EtherCAT).	
2	Launch the TwinCAT System Manager.	
3	Select the target system. When carrying out the test drive using a remote system, select its device.	
4	Restart the TwinCAT System with the "Config Mode." ▪ Using the "Set/Reset TwinCAT to Config Mode" icon under the TwinCat System Manager, you can restart the system with the Config Mode. 	
5	Search for the EtherCAT communication based devices connected to the system. ▪ Right-click the I/O Devices in the Work Space pane of the TwinCAT system to select "Scan Devices."	



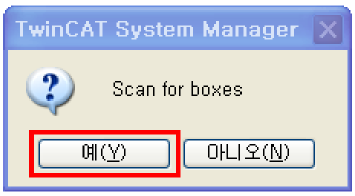
- If the dialog window below pops up in the TwinCAT System Manager, select "OK".



- If the "new I/O devices found" dialog window pops up, select any device or servo drive required to be driven for test and select the "OK" button.



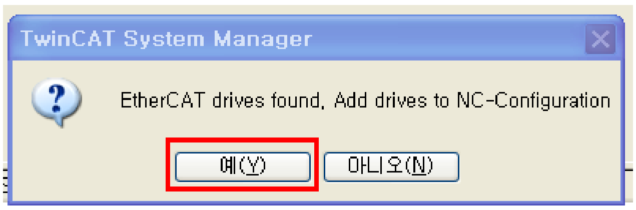
- If the dialog window below pops up, select the "Yes" button.



6

Add the NC Task of the servo drive to the NC-Configuration.

- If the dialog window below pops up, select "Yes."

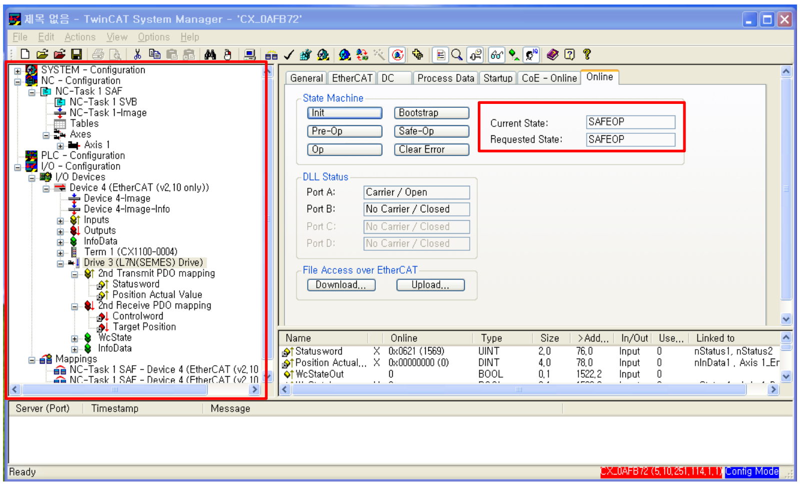


<table>
<tr><td>7</td><td>
Switch the TwinCAT System Manager to Free Run state, allowing it to control devices independently of the TwinCAT PLC and so on.

- If the dialog window below pops up, select "Yes."

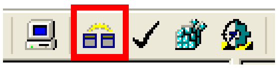
</td><td></td></tr>
<tr><td>8</td><td>
Make sure that the NC Task is added to the NC-Configuration tree in the workspace on the left, and the servo drive is registered to the "I/O-Configuration" tree.

- If the connected servo drive is registered, select it.
- Click the "Online" tab on the right side to verify that the "Current State" and the "Requested State" are in the "SAFEOP" state.

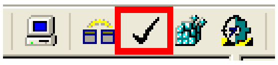


</td><td></td></tr>
<tr><td>9</td><td>
Switch the EtherCAT communication state from the SafeOP state to the OP state, enabling the MailBox Communication and the Process Data Communication.

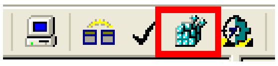
- Click the Generate Mappings icon on the menu bar.
Map the images defined in the NC Task and the I/O Device.



- Click the Check Configuration icon on the menu bar.
Check if the configuration currently set is valid.



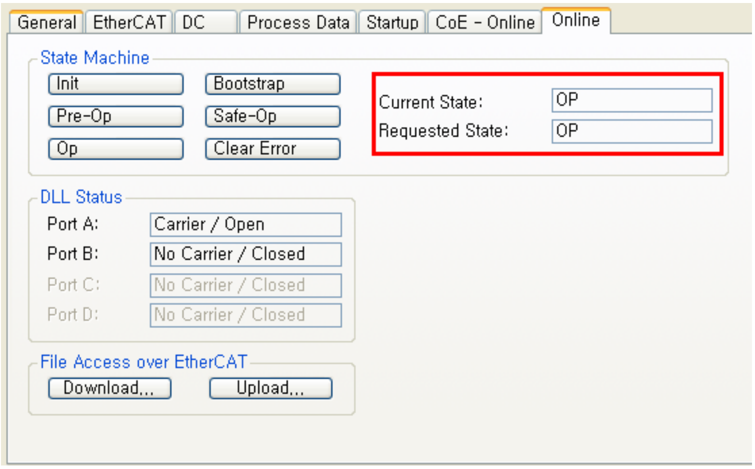
- Click the Activate Configuration icon on the menu bar.
Save the Project Configuration in the Windows Registry.


</td><td></td></tr>
<tr><td>10</td><td>
Verify if the EtherCAT communication state is switched from the SafeOP state to the OP state.

- Verify if the states of the servo drive panel monitor and the I/O device (servo drive) of the TwinCAT system are in online state as shown in the figure below.
- Check the panel monitor status.
</td><td></td></tr>
</table>

<table>
<tr><td></td><td>


▪ 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, select the servo drive under the test drive, and then the "Online" tab, to check to see if the "Current State" and the "Requested State" are in the OP state.

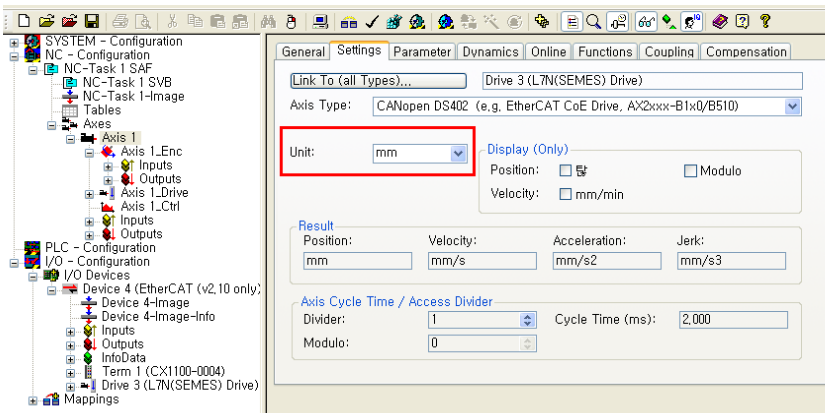


▪ Verify if the state displayed on the bottom right of the TwinCAT System Manager menu window is in the Run state.

</td><td></td></tr>
<tr><td>11</td><td>We finished adding the 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 unit of display of the relevant axis.
▪ Select the "Axis1."
▪ Select the "Settings" tab.
▪ Select the unit of display for position and speed.



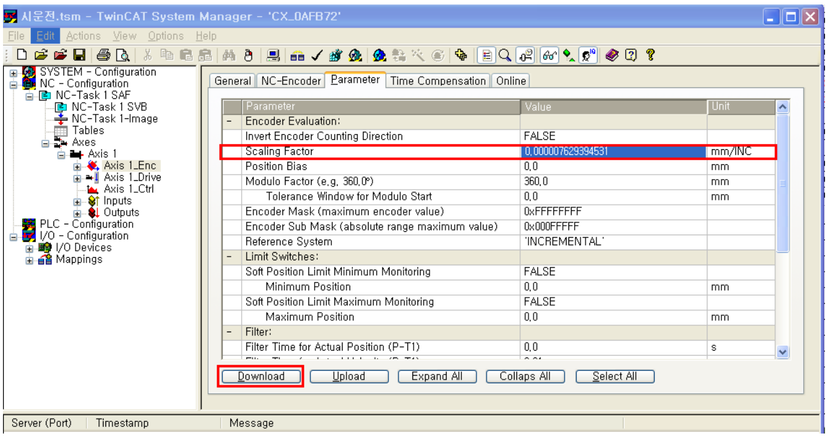
</td><td></td></tr>
</table>

(Note) Note that the actual unit will not be converted even when the unit shown in the figure above was converted to mm or degree.
(Note) Change the unit and tune the Axis Scaling Factor below.

2

Set the Axis Scaling Factor. The Axis Scaling Factor determines the distance of the axial load movement while the motor shaft makes one revolution.

- Select the "Axis1."
- Select the "Parameter" tab.
- Set "Scale Factor."
- Then, download the settings.

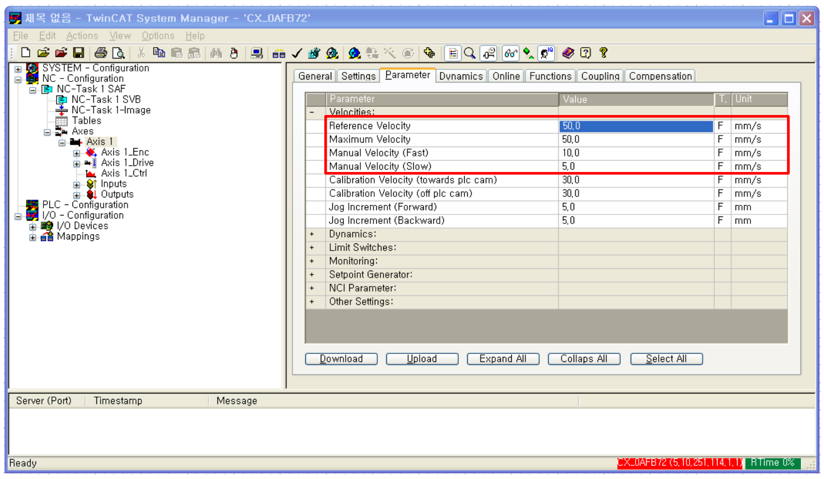


(Note) The default is 0.0001 if the scaling factor is not set.
(Note) After the setting, download the settings.

3

Set the speed parameter of the test drive axis.

- Select "Axis 1."
- Select the "Parameter" tab.
- Set the "Maximum Velocity", the "Manual Velocity (Fast)", and the "Manual Velocity (Slow)." Then, download the settings.

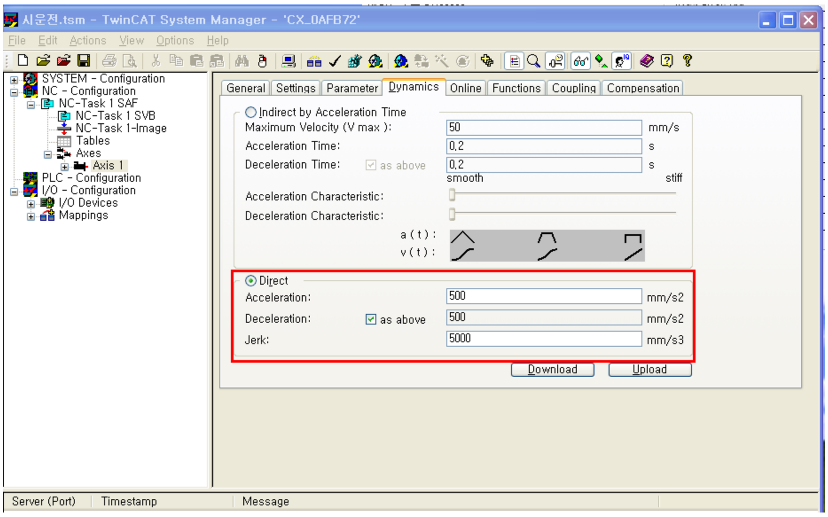


4

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 the Axis 1.
- Select the "Dynamics" tab.
- Set the acceleration, deceleration, and jerk directly.
  - Select the "Direct" radio button.

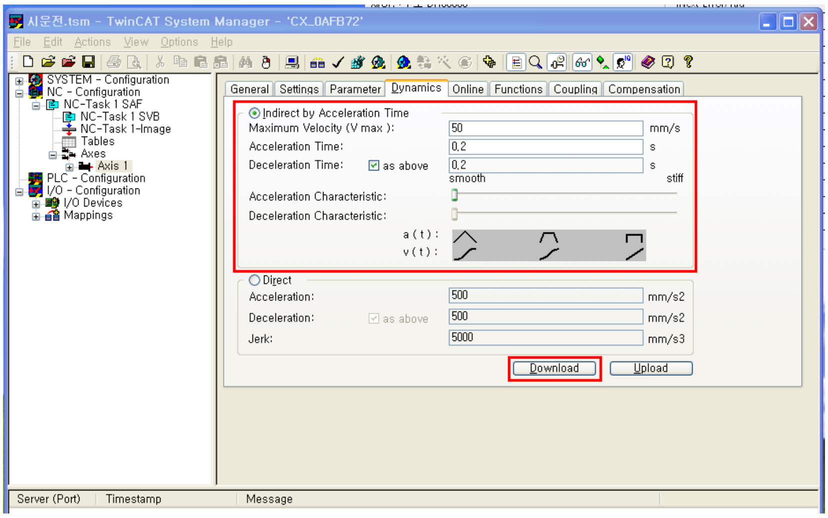
- Set the acceleration, deceleration, and jerk.
- Download the settings.



- 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.

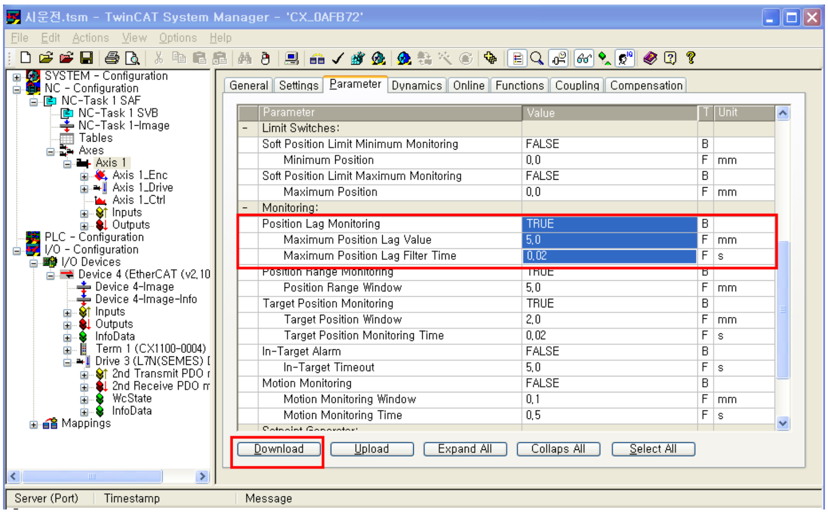
- Select the "Indirect by Acceleration Time" radio button.
- Set the acceleration, deceleration, and jerk.
- Download the settings.



5

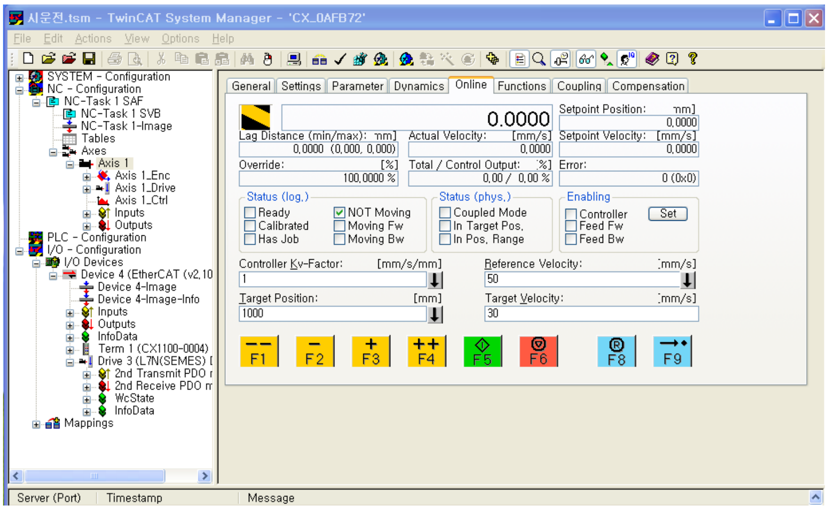
Set the Position Lag Monitoring (Positional Error).

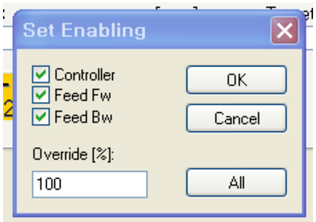
- Select "Axis 1."
- Select the "Parameter" tab.
- Set the Position Lag Monitoring.
- Set the Position Lag Filter Time.
- Download the settings.

<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 of 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 the TwinCAT NC axis is "Servo On."
Select "Axis 1."
Select the "Online" tab.


Click the "Set" button.


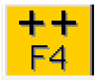
Select "Controller", "Feed Fw", and "Feed Bw."
Set the Override to 100%.</td><td></td></tr>
</table>

<table>
<tr><td></td><td>

- Click the "OK" button.
- 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>

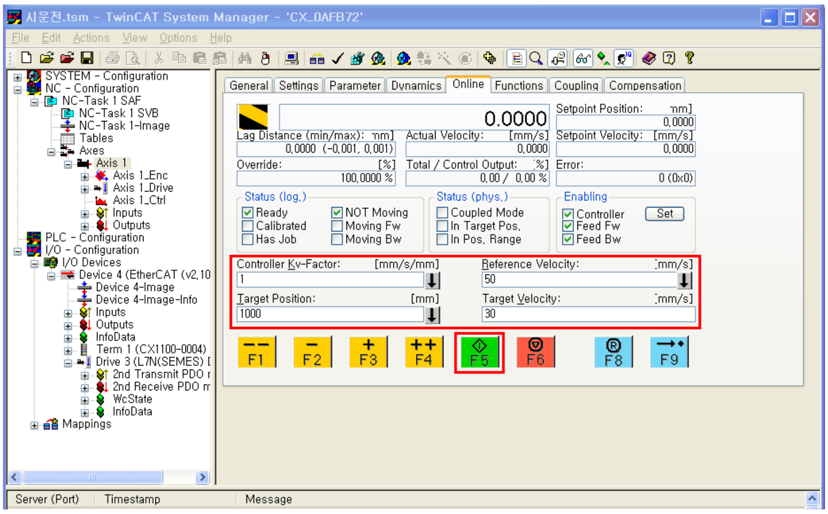
Use the buttons shown below to manually perform the drive test (JOG).

<table>
<tr><td></td><td>Make a reverse rotation at the specified Manual Velocity (Fast).</td></tr>
<tr><td></td><td>Make a reverse rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Make a forward rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Make a forward rotation at the specified Manual Velocity (Fast).</td></tr>
</table>

</td><td></td></tr>
<tr><td>3</td><td>

Carry out the test drive with a relative coordinate.

- Set the "Target Position."
- Set the “Target Velocity.”
- Click “F5.”



- Move it to the Target Position from the current position, decelerating to stop.
- After moving it to the Target Position, verify if the Set Position is identical to the Target Position.
- Click "F6" to stop during the relative coordinate driving.
- When the alarm goes off, click "F8" to reset the alarm.

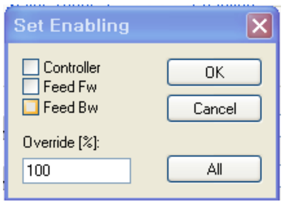
(Note) If the position limit is enabled, set the Target Position within the limit.

</td><td></td></tr>
<tr><td>4</td><td>

Make sure that the TwinCAT NC axis is "Servo Off."

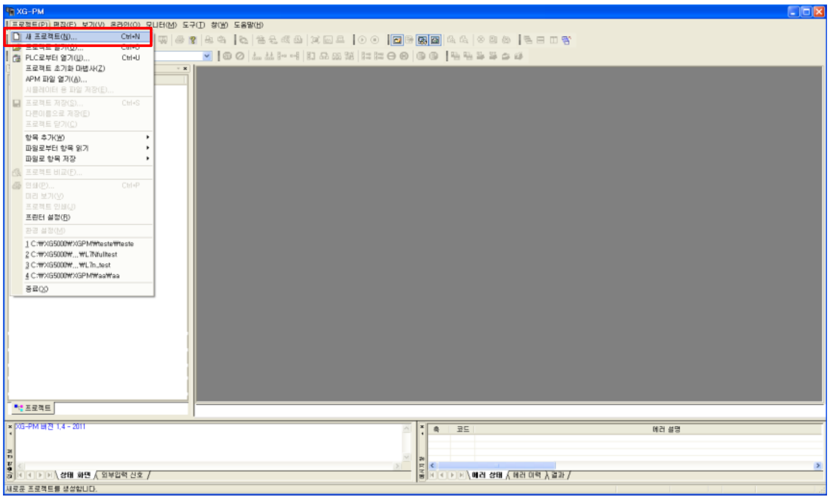
- Click "Set."
- Deselect "Controller", "Feed Fw", and "Feed Bw."
- Click "OK".

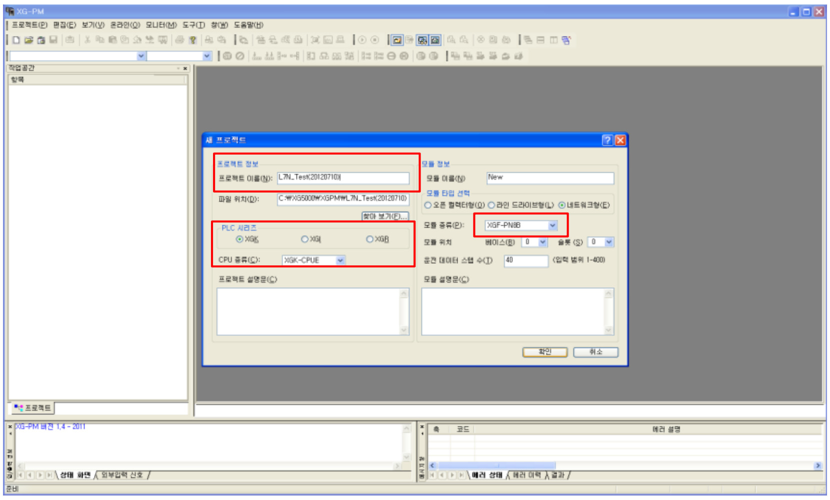
</td><td></td></tr>
</table>

		
5	The test drive of servo drive using the TwinCAT NC axis is completed.	

12.3 Test Drive Using LSIS PLC (XGT + PN8B)

■ Test Drive Procedure

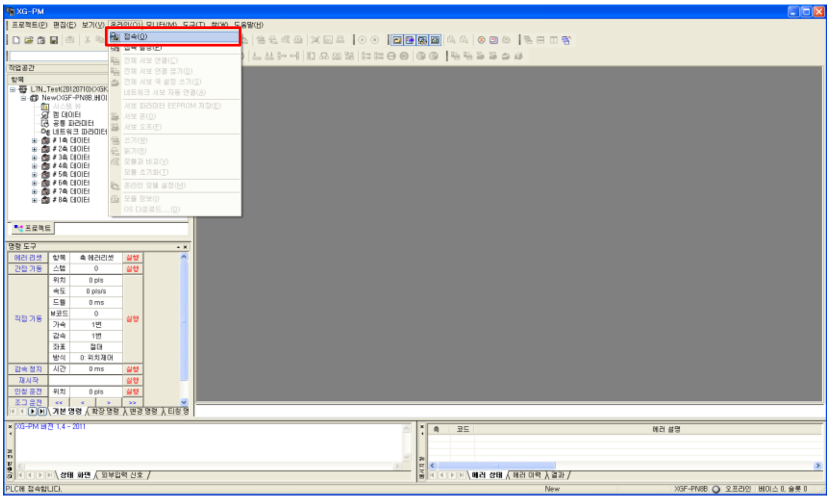
Order	Handling	Notes
1	Launch the XG-PM.	
2	Create a new project. ▪ On the menu bar, click Project → New Project. 	
3	Name the new project. ▪ Select the PLC series and the CPU type. ▪ Select the module type (XGF-PN8B), and click OK.	



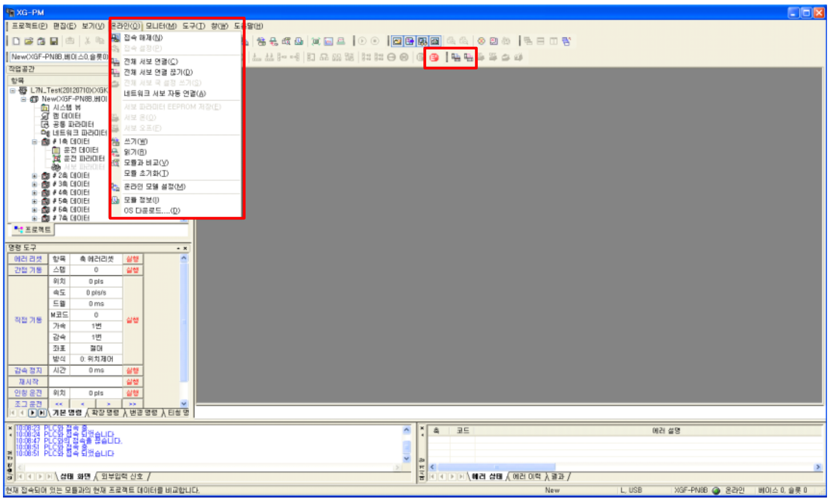
4

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:

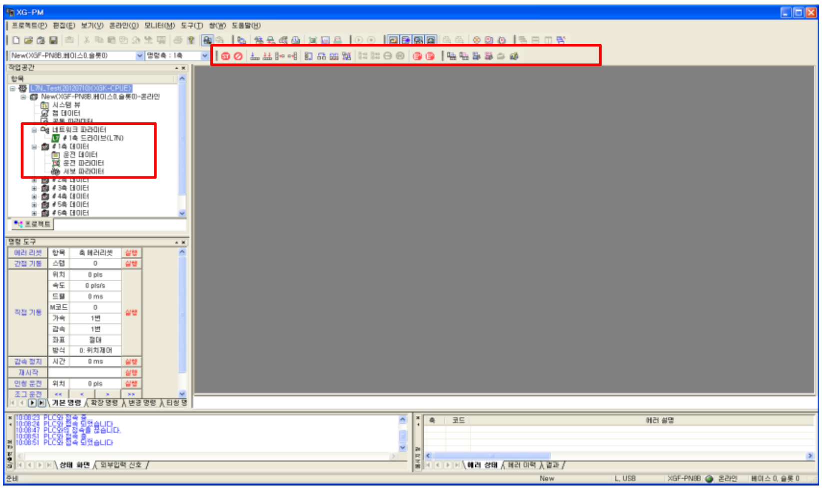


5

Connect PLC with Servo Drive.

- For the first connection, enable the network parameters and the 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 the servo parameters as many as the number of the connected shafts.



- Make sure that the state of the servo drive panel monitor is as the figure below:

- Check the state of the status LEDs.

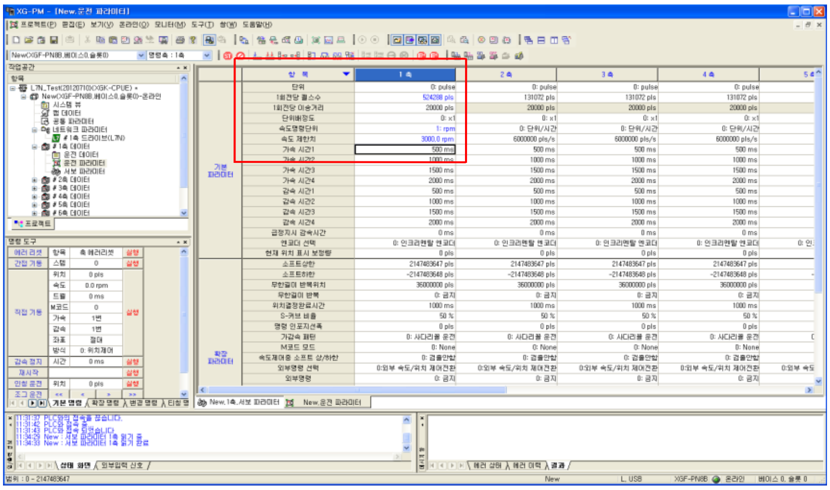
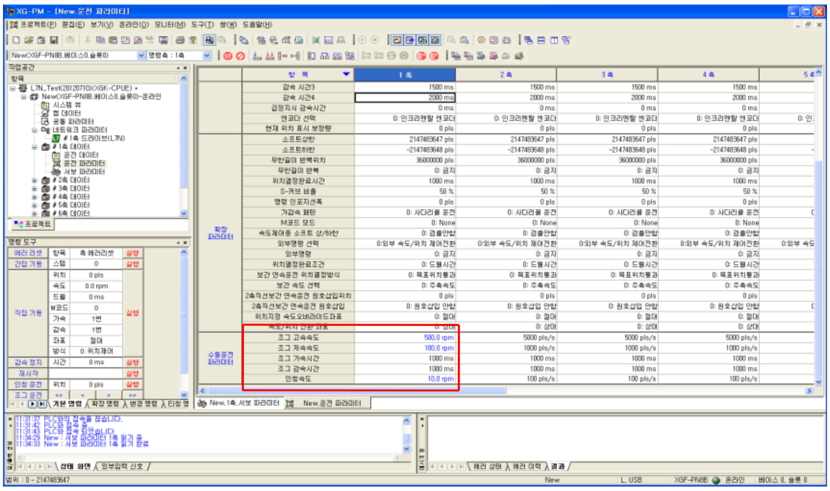
The Link/Activity LED is flickering.

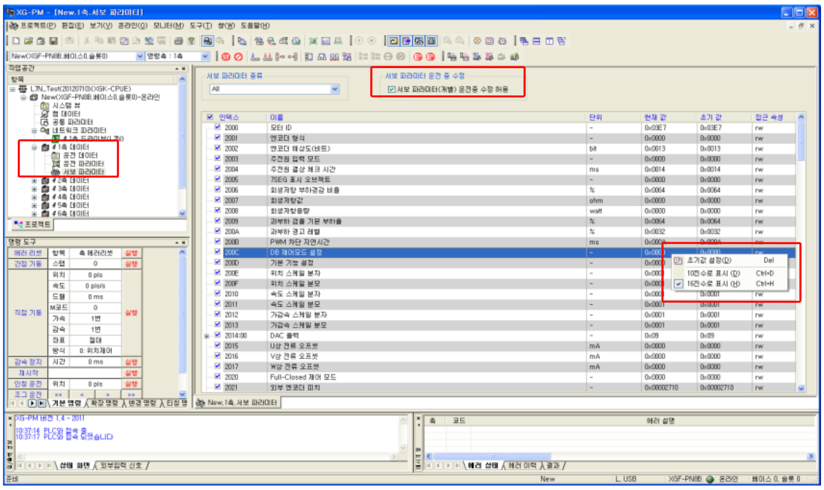
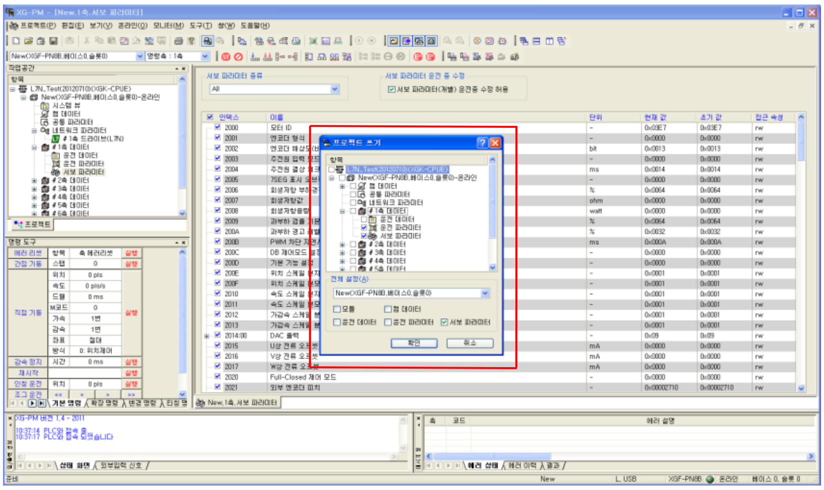
The RUN LED is on.

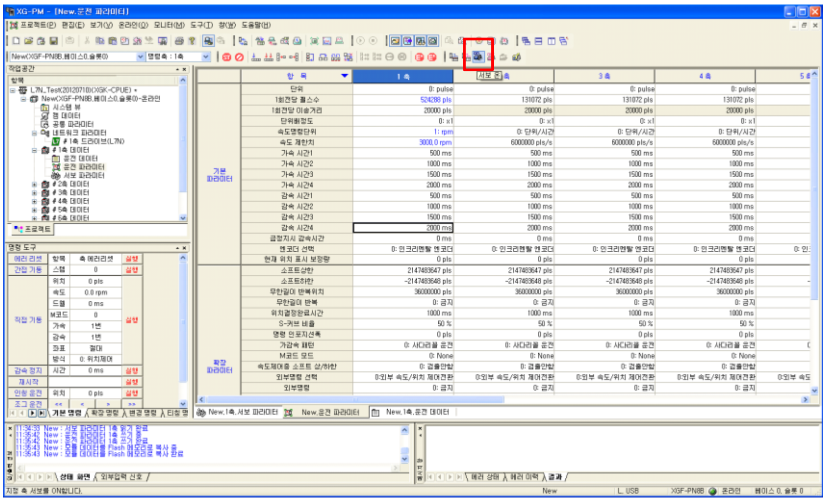
(Note) The automatic connection of network servo registers the device connected to the XGT, and initializes the parameters of the connected device.

(Note) For subsequent connections, connect or disconnect the XGT and the servo drive by connecting the entire servos or disconnecting them respectively, since the device has been registered and its parameters initialized through automatic servo connection.

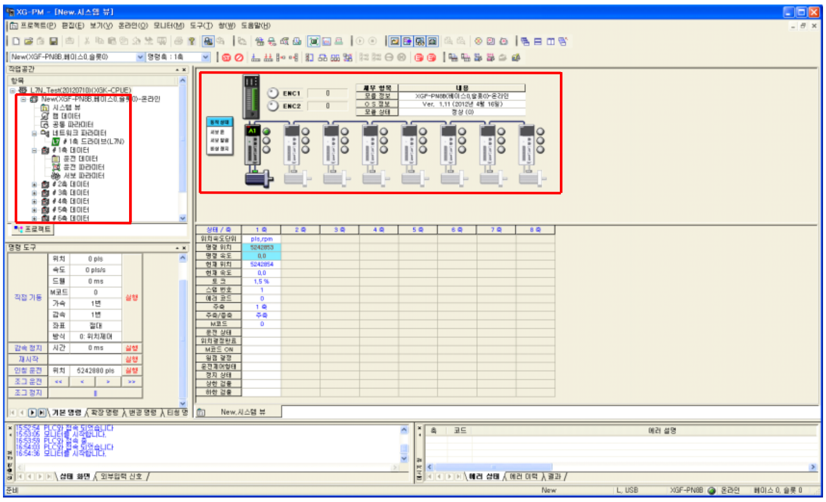
(Note) In case that there is any change in the connected device of the XGT, initialize the parameters of the device connected by the automatic servo connection.

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 appropriate settings. ▪ Set the unit of the speed command. • It can be set as rpm or mm/s. • Set the speed limit. • Check the motor specifications, and then configure appropriate settings. 	
7	Set the Driving Parameters of Test Drive Axis → Manual Operation (Jog) Parameters. 	
8	Set the servo parameters of the test drive axis.	

	 ▪ Select parameters that you want to change, and then change them. ▪ To change any parameter during operation, check the "Allow to Modify Servo Parameters During Operation" checkbox at the top center. ▪ You can display a parameter value as a decimal or hexadecimal.	
9	Save the configured parameters. ▪ On the menu bar, click → Online → Write. ▪ With the Write Project dialog window enabled, check the Operation Data of Test Drive Axis, the Operation Parameters, and the Servo Parameters checkboxes, and then click OK to save the configured parameters. 	
10	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.	

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td>11</td><td>Save the configured parameters.

▪ Select the "System View" and the "Basic Command" tabs in the workspace to check the state of the servo drive as shown in the figure below:

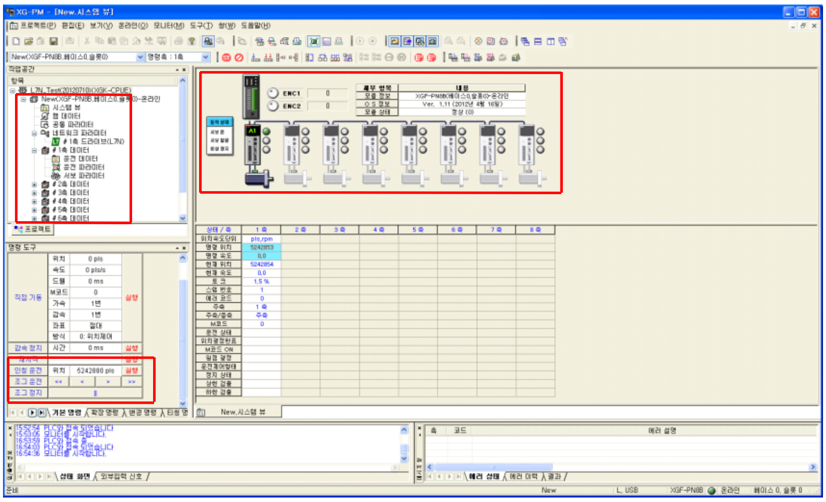


▪ Make sure that the state of the servo drive panel monitor is as the figure below:

▪ Check the state of the status LEDs.

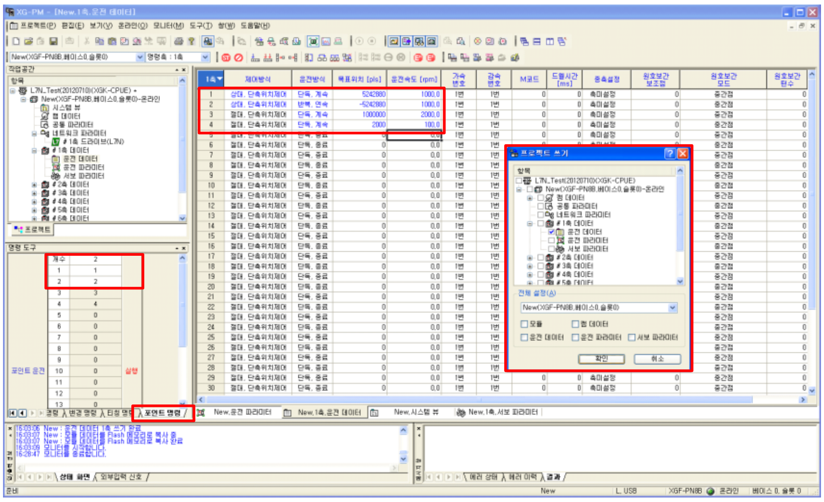
The Link/Activity LED is flickering.

The RUN LED is on.</td><td></td></tr>
<tr><td>12</td><td>Test drive using jog operation and inching operation</td><td></td></tr>
</table>

<table>
<tr>
<td></td>
<td>

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 carry out the test drive.
</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>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 and the rank of point operations.
On the menu bar, click Online → Write to store the operation data.
On the Point Command tab, click the "Run" button to carry out the test drive.

</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>The test drive of serve drive using the XGT is completed.</td>
<td></td>
</tr>
</table>

13. Appendix

13.1 Firmware Update

13.1.1 Use of USB OTG

The drive performs USB host function to search for firmware files in the USB memory and download them to 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 USB Female Plug Type A and USB Mini B 5 pins, as the download cable.

(2) Copy the firmware file (L7NH_FW.bin) to update to the USB memory.

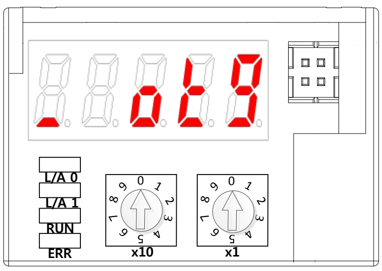
***Caution**

1. The 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) When 7-Segment for servo status display shows 'boot' and then 'otg', it indicates that update is in progress. Three horizontal bars of FND Digit5 are sequentially turned on from bottom to top, it indicates that download is complete. At the time, remove the USB OTG cable and USB memory.

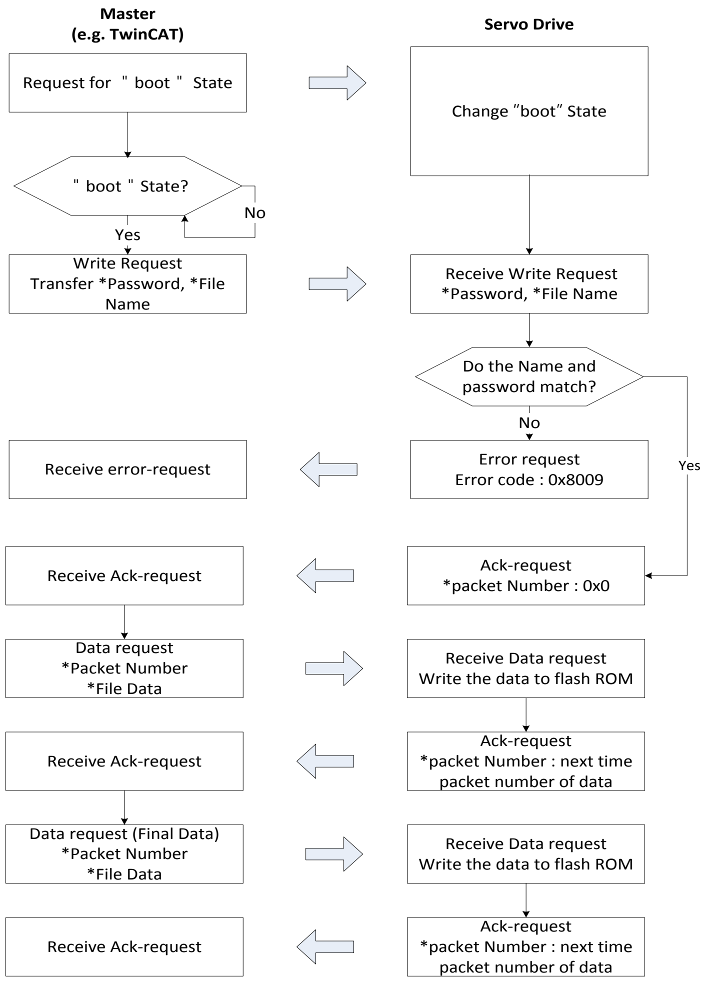


(7-segments display a message when downloading the firmware using the OTG)

(5) Turn on the power again, and verify if the firmware is updated.

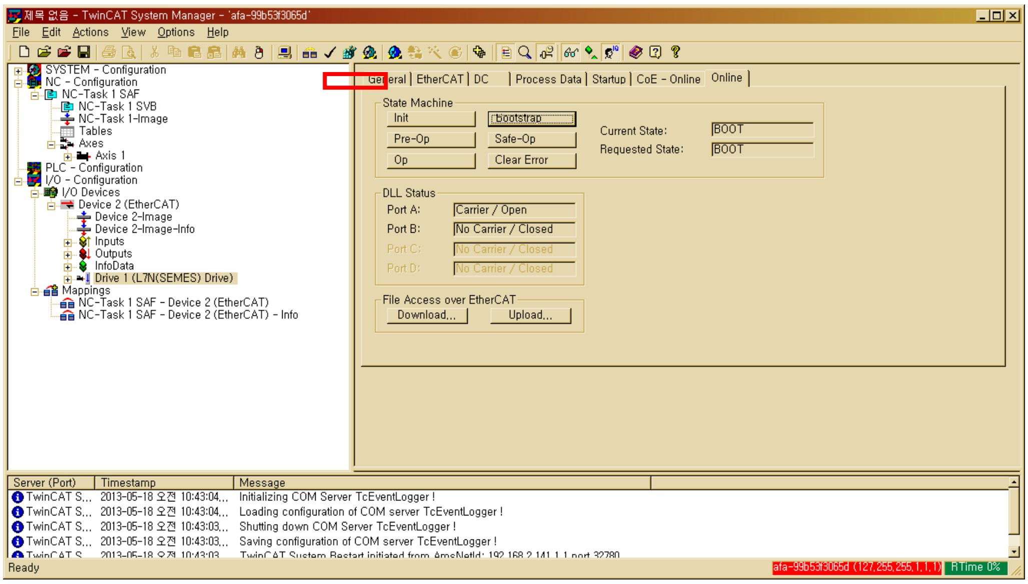
13.1.2 Use of FoE (File access over EtherCAT)

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:

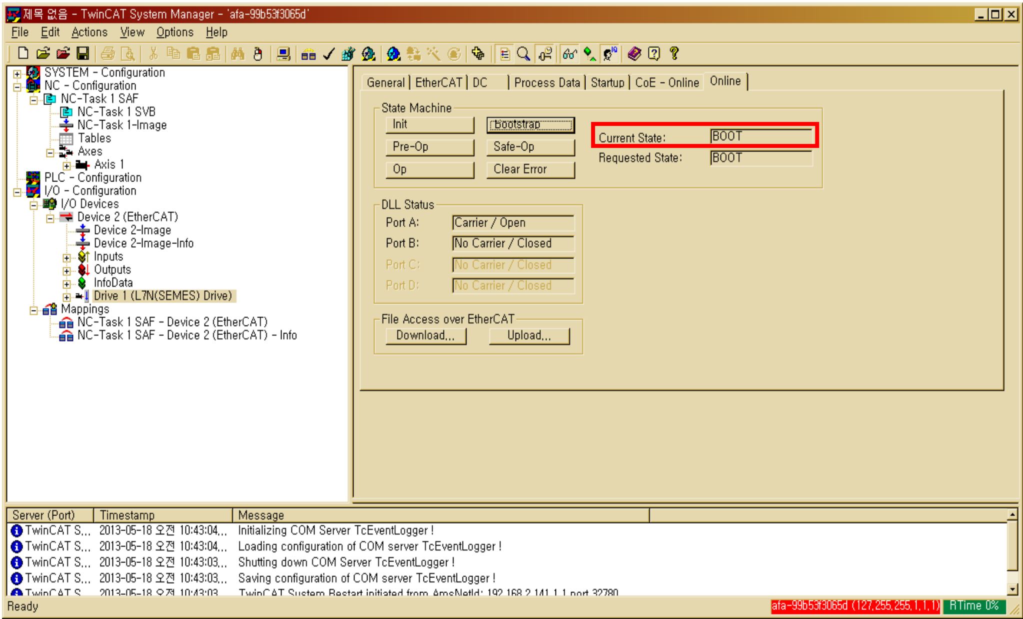


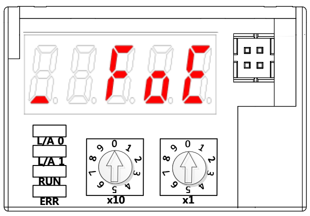
(1) Establish communication between the drive and the TwinCAT.

(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.

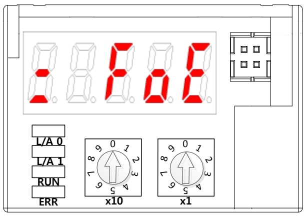


(3) After the current state is changed to BOOT and you check the drive status (7-segments display boot), wait for approx. 10 seconds until the internal flash memory of the drive is cleared.





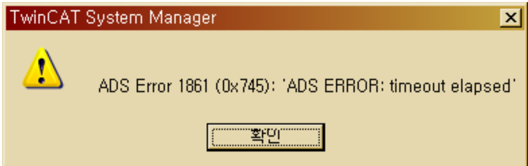
(7-segments display a message when downloading the firmware using the FoE)

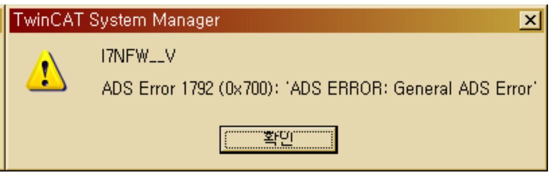


(7-segments display a message when Flash deletion is complete while downloading the firmware using the FoE)

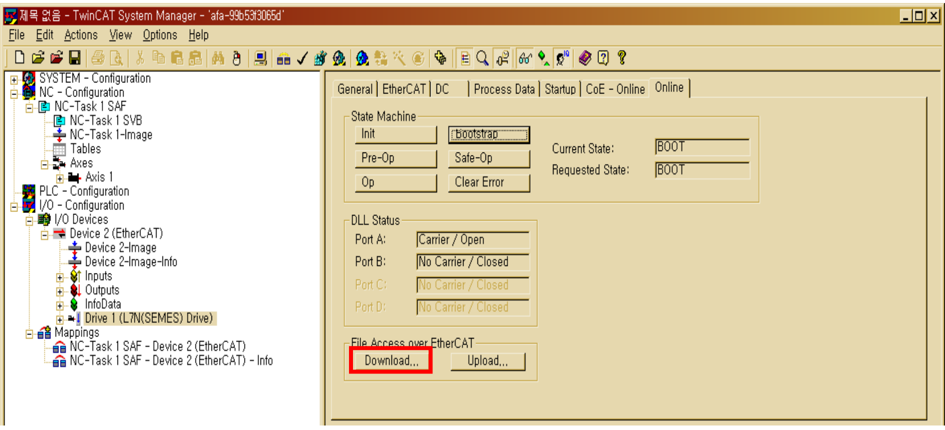
***Caution**

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.

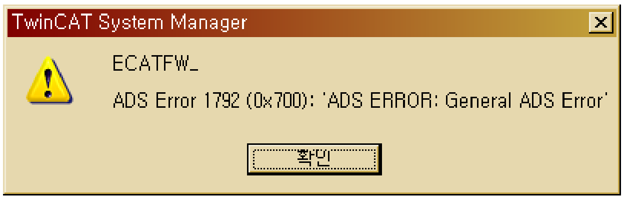




(4) Click Download in the File Access over EtherCAT menu at the bottom of the Online tab.

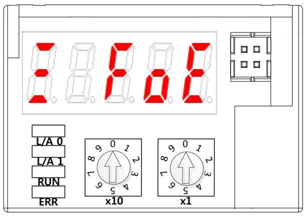


(5) Select the path of the file to be downloaded (L7NH_FW.efw or L7NH_FW.bin) and the file. If the file name does not match, download will not start and the following error will occur:



(6) Enter the password for file download and click OK to start the download. (Password: 00000000)

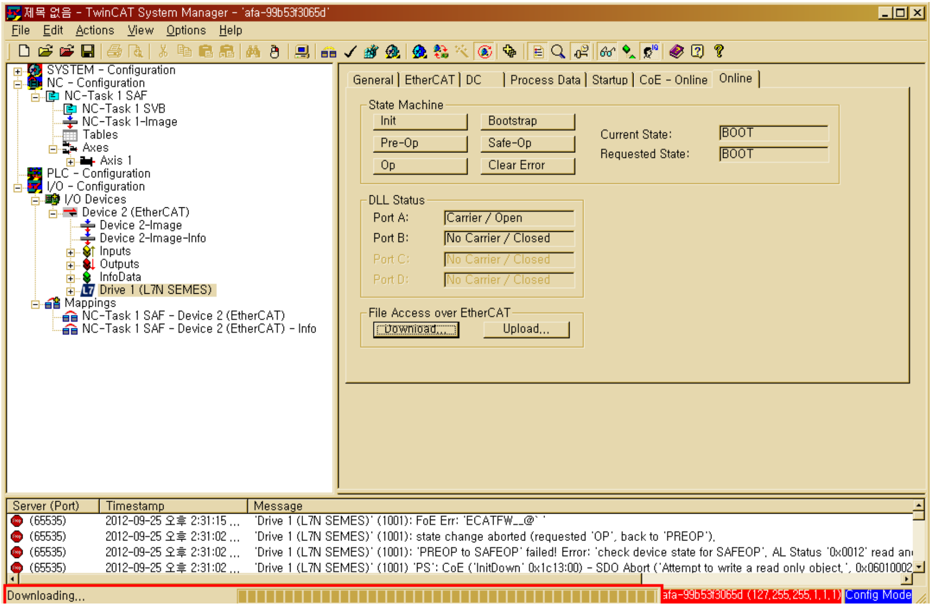
(7) If "Downloading..." is displayed as shown in the following figure, the download is in progress. If the progress bar at the bottom is full, it indicates the download is completed. After completing the download, be sure to click Init in the State Machine menu to switch it to the Init status.



(7-segments display a message when you finished downloading the firmware using the 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.

13.1.3 Use of Drive CM

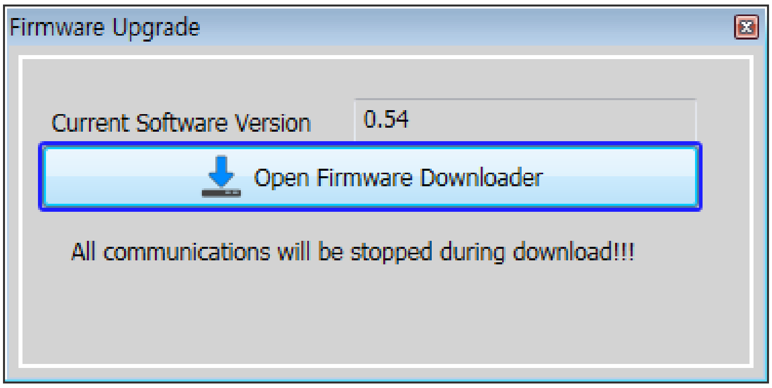
Drive CM allows the firmware upgrade through the PC's USB port. The transmission time depends on the PC performance, but it usually takes from scores of seconds to several minutes.

Select Setup→ Firmware Update from the top main menu or click on the corresponding shortcut icon.

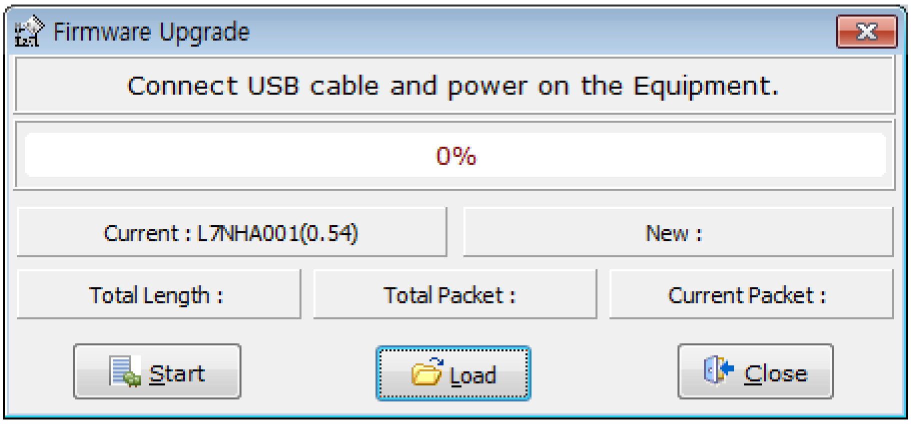
■ Precautions for Firmware Upgrade

- 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.
- Before upgrade drive’s parameter(object), Please same predetermined value since the value can be re-set.

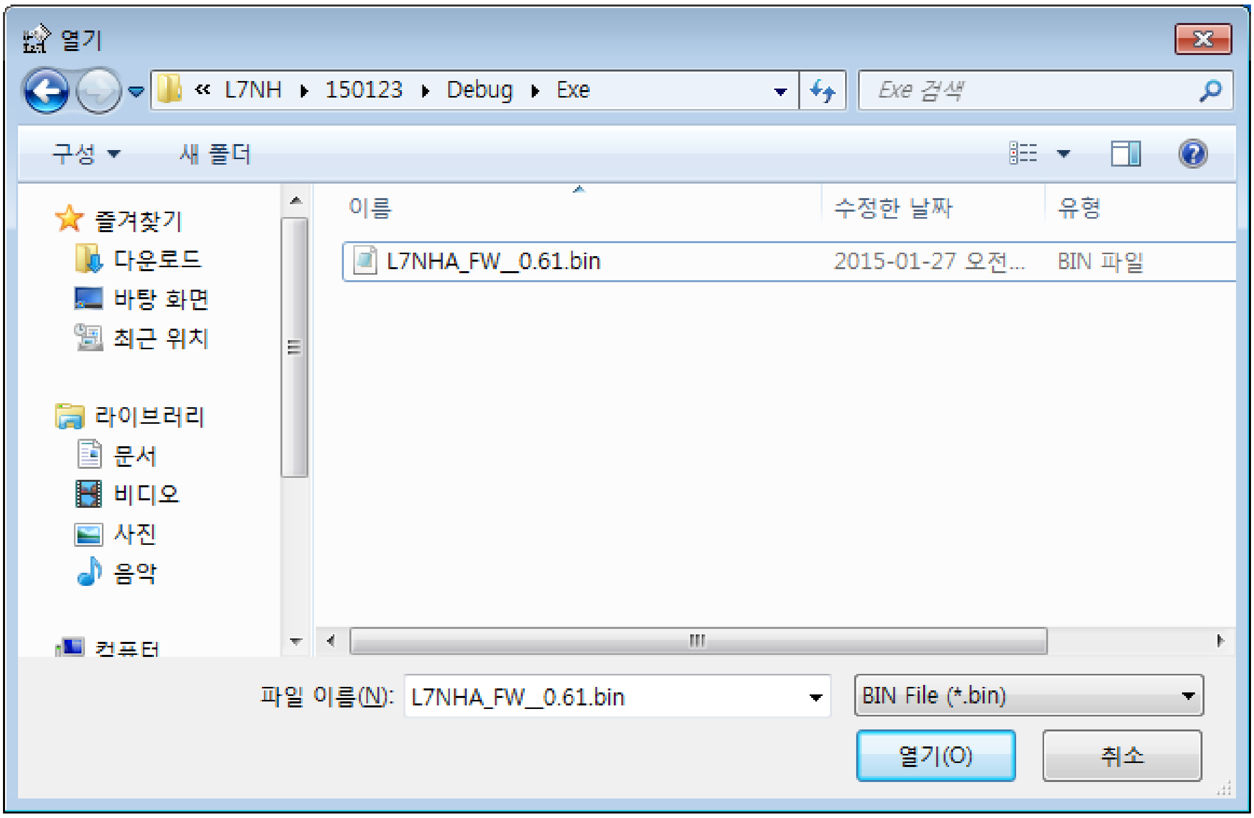
■ Operation of OS Download



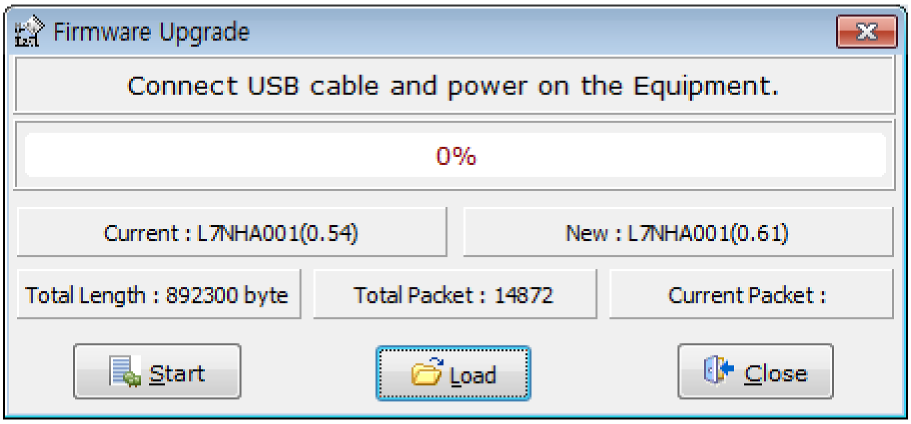
1) Click the “Open Firmware Downloader” button



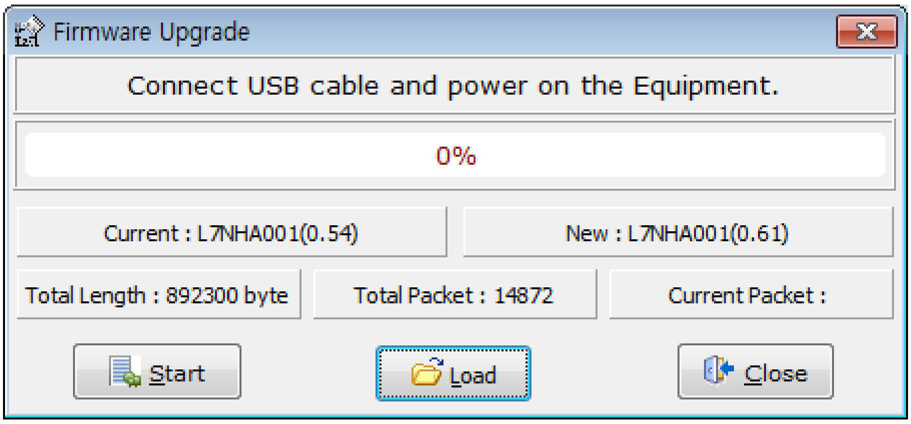
2) To load the appropriate firmware file, click the "Load" button..



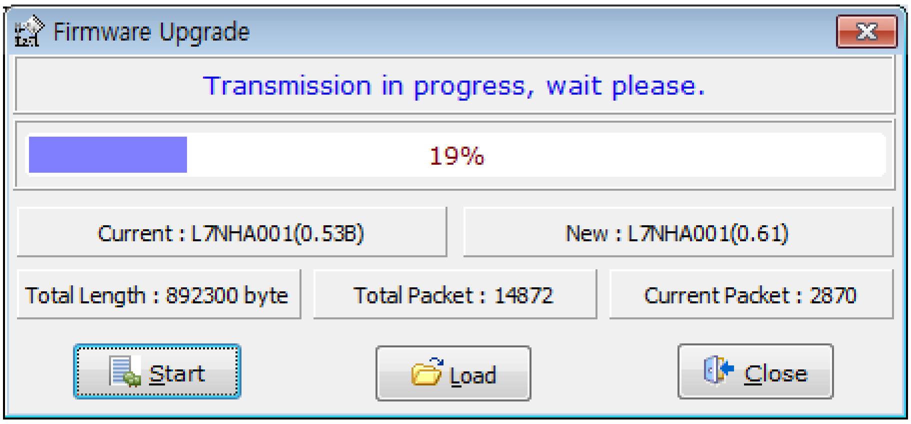
3) Select the BIN file of the firmware to transmit and press the Open button.



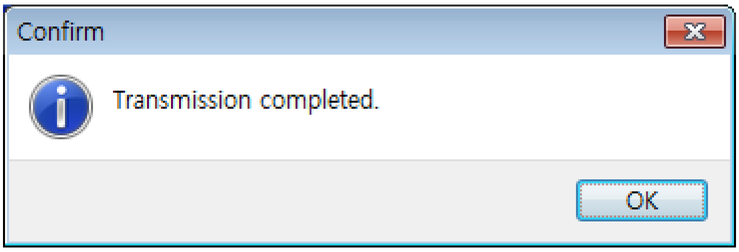
4) “Total Length" and "Total Packet" of the loaded firmware are displayed.



5) Press the "Start" button to start transmission. 10 seconds are counted down to clear the internal memory in the drive. (For L7NH and L7P, the segment 7 should display "USB". For PEGASUS, a red "ERR" LED should be illuminated.)

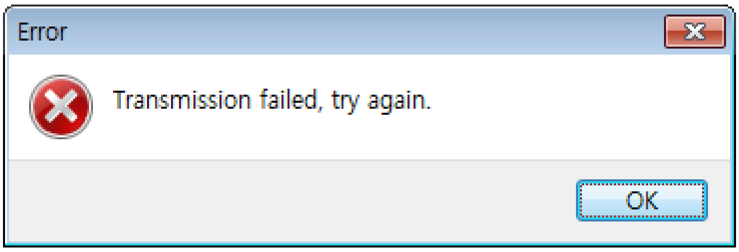


6) After clearing, the firmware is transmitted automatically and the progress bar and "Current Packet" display the current transmission status. (The transmission time depends on the PC performance, but it usually takes from scores of seconds to several minutes.)

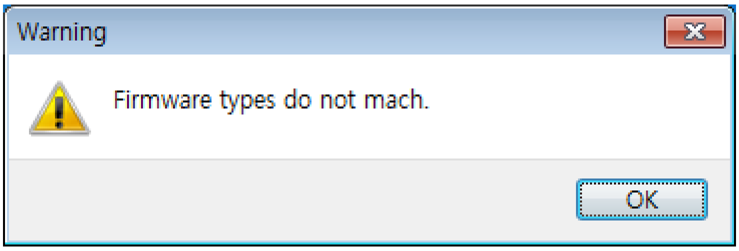


7) When transmission is completed, a popup saying "Transmission completed" is displayed. (When transmission to the PC is completed, turn off and on the drive for rebooting.)

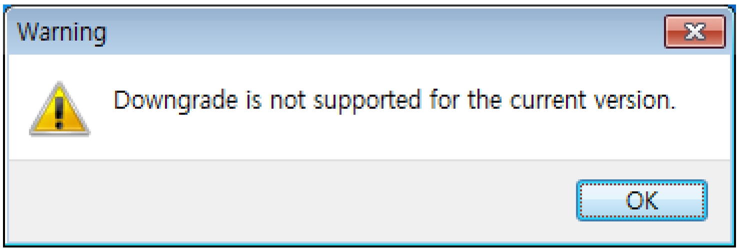
■ An Error Occurs During Transmission



■ Turn off and on the drive and repeat the above process from (2) to (7)



■ Check firmware drive type and capacity to transmit.



■ Check firmware version. The firmware version is lower than current one can't be downloaded

Quality Assurance

Product Name	LS Mecapion Servo Drive	**Date of Installation**	
Model name	***L7NHB Series***	**Warranty Period**	

Customer	**Name**	
	Address	
	Phone	
Retailer	**Name**	
	Address	
	Phone	

This product was produced using strict quality control and testing procedures developed by LS Mecapion technicians.

The warranty applies for 12 months after the date of installation. The warranty is valid for 18 months after the date of manufacture if the installation date is not filled out. However, the term of this warranty may change depending on the terms of the contract.

Free Technical Support

If the drive malfunctions under proper usage conditions and the product warranty is still valid, contact one of our agencies or designated service centers. We will repair the drive free of charge.

Paid Technical Support

The warranty does not cover technical support if:

- **The malfunction is the result of negligence on the part of the consumer.**
- **The malfunction is the result of inappropriate voltage or defects in the machines connected to the product.**
- **The malfunction is the result of an act of god (fire, flood, gas, earthquake, etc.).**
- **The product was modified or repaired by someone other than our agency or service center.**
- **The LS Mecapion name tag is not attached to the product.**
- **The warranty has expired.**

※ After installing the servo, fill out this quality assurance form and send it to our quality assurance department (technical support).

Send to: LS Mecapion Quality Assurance Service
Phone: 82.53.593.0066 (154) Fax: 82.53.591.8614

Visit the LS Mecapion homepage (***http://www. lsmecapion.com)*** for more information and services.

User Manual Revision History

Number	Date issued	Revised content	Version number	Notes
1	2014.09.24	Added functions and precautions	1.1	
2	2014.11.06	Added New Model(L7NHB050U)	1.2	
3	2015.05.15	Added functions and modified typing error	1.4	
4				
5				
6				
7				
8				
9				

Green Management

LS Mecapion considers protecting the environment a high priority. We work hard to protect the Earth.

Product Disposal

The LS Mecapion servo drive is environmentally friendly.

You can disassemble the drive and recycle the iron, aluminum, bronze, and synthetic resin (cover) components.