The right choice for the ultimate yield!

LS ELECTRIC strives to maximize your profits in gratitude for choosing us as your partner.

Xmotion

User Manual

L7NH Series

EtherCAT Conformance tested

Safety Instructions

- Read this manual carefully before installing, wiring, operating, servicing or inspecting this equipment.
- Keep this manual within easy reach for quick reference.

LS ELECTRIC

Introduction

Hello. Thank you for choosing LS ELECTRIC 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.
- The reproduction of part or all of the contents of this manual in any form, by any means or for any purpose is strictly prohibited without the explicit written consent of LS ELECTRIC.
- LS ELECTRIC retains all patents, trademarks, copyrights and other intellectual property rights to the material in this manual. The information contained in this manual is only intended for use with LS ELECTRIC products.

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

Precautions	Meaning
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.

<table>
<tr><th rowspan="2">Environment</th><th colspan="2">Conditions</th></tr>
<tr><th>Servo Drive</th><th>Servo Motor</th></tr>
<tr><td>Ambient temperature</td><td>0 ~ 50 ℃</td><td>0 ~ 40 ℃</td></tr>
<tr><td>Storage temp.</td><td>-20 ~ 65 ℃</td><td>-10 ~ 60 ℃</td></tr>
<tr><td>Ambient humidity</td><td rowspan="2">Below 90% RH (no condensation)</td><td rowspan="2">20~80% RH(no condensation)</td></tr>
<tr><td>Storage humidity</td></tr>
<tr><td>Altitude</td><td colspan="2">Up to 1000m</td></tr>
<tr><td>Spacing</td><td>▪ When installing 1 unit:
• More than 40 mm at the top and bottom of the control panel
• More than 10 mm on the left and right sides of the control panel
▪ When installing 2 or more units:
• More than 40 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 than10 mm between units
• Refer to Section 2.2.1, "Wiring the Control Panel."</td><td></td></tr>
<tr><td>Etc</td><td colspan="2">▪ 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.</td></tr>
</table>

⚠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
▪ Be sure to use AC power for the input power of the servo drive. ▪ Always use an AC 380-480 V power input for the servo drive. ▪ 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. ▪ Note3) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

■ 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 2.5 Input/Output Signal Wiring’ and perform I/O wiring of the servo drive for each operation 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. ▪ 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 driver'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	S: Standard I/O N: network NH: Network type & All-in-One Type P: Standard I/O & Index	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: Exclusive

■ Servo Motor Product Format

APM – S E P 10 D E K 1 G1 03

Servo Motor

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: 200Vac
- P: 400Vac

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
- 1: Oil Seal attached
- 2: Brake attached
- 3: Oil Seal and Brake

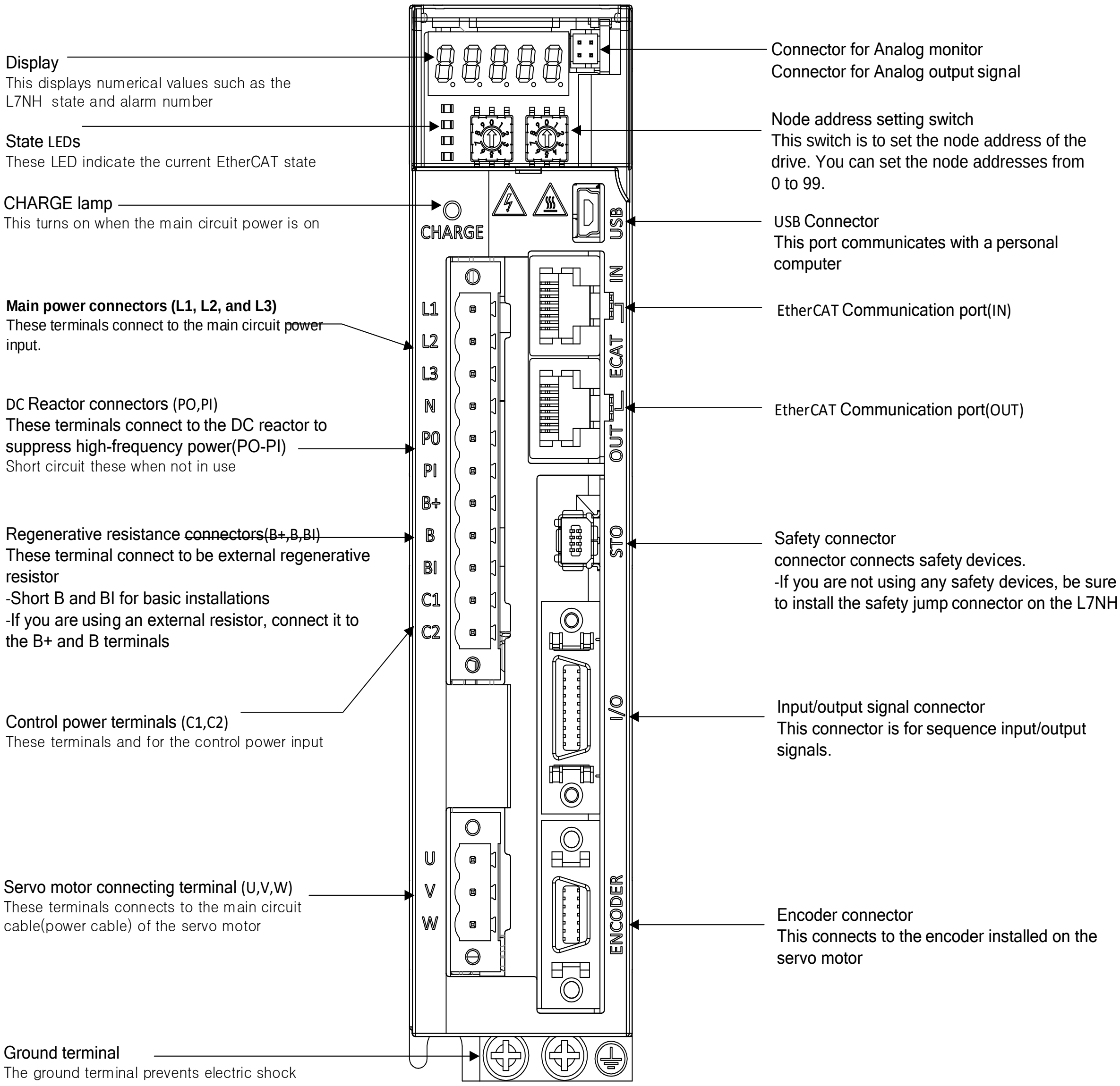
Gearbox Classification
- 03: 1/3
- 10: 1/10

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

1.3 Part Names

1.3.1 Servo Drive Parts

■ 100W, 200W, 400W (200[V])



■ 750W, 1kW (200[V])

Display
This displays numerical values such as the L7NH state and alarm number

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

State LEDs
These LED indicate the current EtherCAT state

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

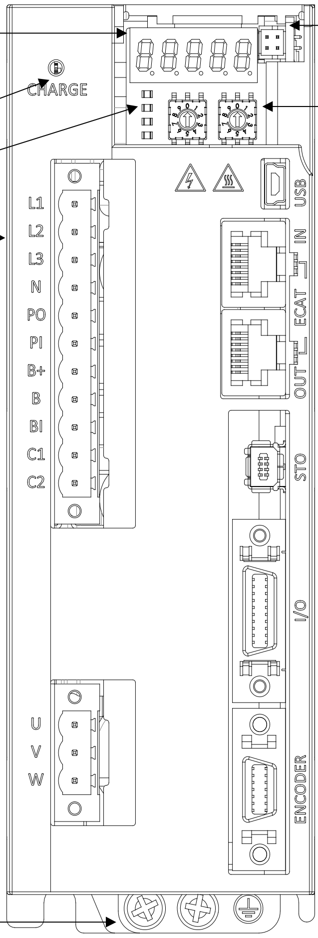
DC Reactor connectors (PO,PI)
These terminals connect to the DC reactor to suppress high-frequency power(PO-PI)
Short circuit these when not in use

Regenerative resistance connectors(B+,B,BI)
These terminal connect to be external regenerative resistor
-Short B and BI for basic installations
-If you are using an external resistor, connect it to the B+ and B terminals

Control power terminals (C1,C2)
These terminals and for the control power input

Servo motor connecting terminal (U,V,W)
These terminals connects to the main circuit cable(power cable) of the servo motor

Ground terminal
The ground terminal prevents electric shock



Connector for Analog monitor
Connector for 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
This port communicates with a personal computer

EtherCAT Communication port(IN)

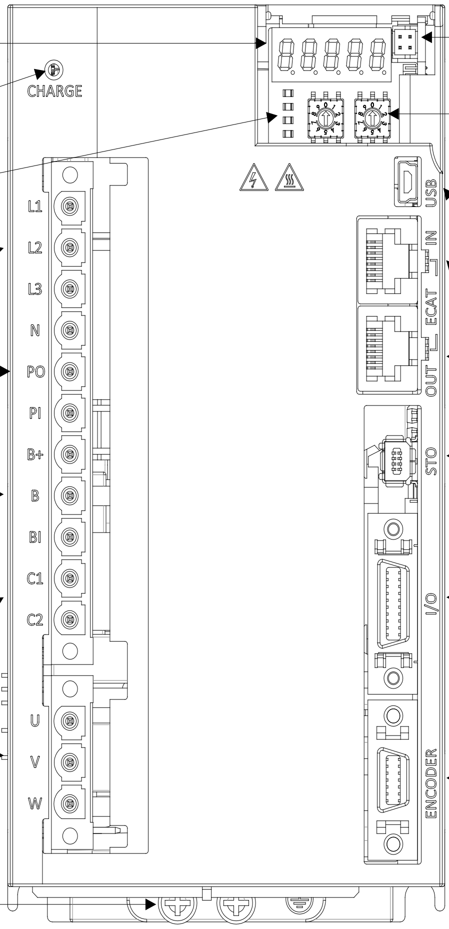
EtherCAT Communication port(OUT)

Safety connector
This connector connects safety devices.
-If you are not using any safety devices, be sure to install the safety jump connector on the L7NH

Input/output signal connector
This connector is for sequence input/output signals.

Encoder connector
This connects to the encoder installed on the servo motor

■ 2kW, 3.5kW (200[V])



Display
This displays numerical values such as the L7NH state and alarm number

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

State LEDs
These LED indicate the current EtherCAT state

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

DC Reactor connectors (PO,PI)
These terminals connect to the DC reactor to suppress high-frequency power(PO-PI)
Short circuit these when not in use

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Connector for Analog output signal

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This port communicates with a personal computer

EtherCAT Communication port(IN)

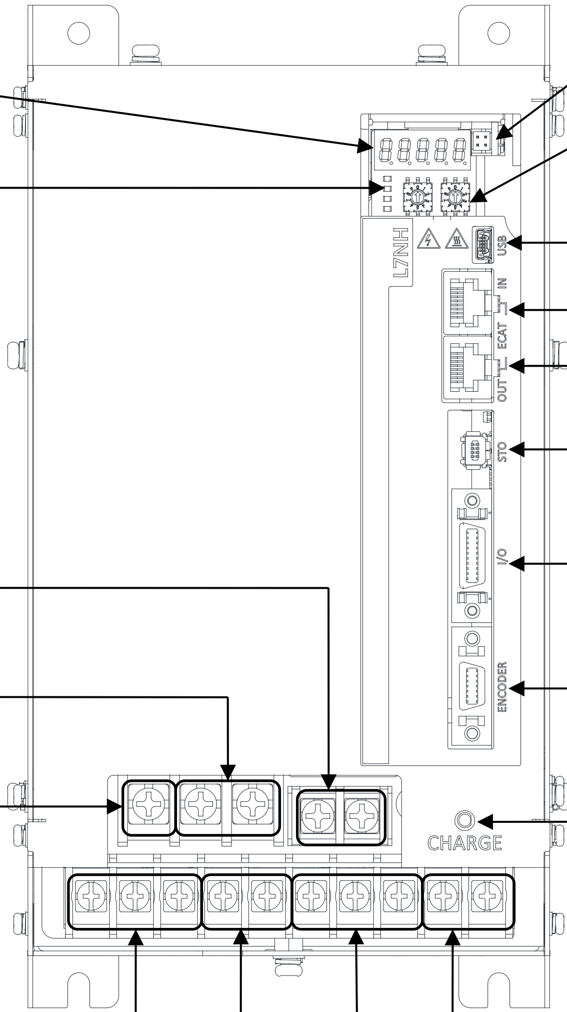
EtherCAT Communication port(OUT)

Safety connector
This connector connects safety devices.
-If you are not using any safety devices, be sure to install the safety jump connector on the L7NH

Input/output signal connector
This connector is for sequence input/output signals.

Encoder connector
This connects to the encoder installed on the servo motor

■ **5KW(200[V])**



Display
It shows drive status, alarms, etc.

Status LED
It indicates the current state of EtherCAT communication.

Control power terminals (C1 and C2)

DC reactor connector (PO, PI)
These terminals connect to the DC reactor to suppress high-frequency power.

*** 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

EtherCAT communication input 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.

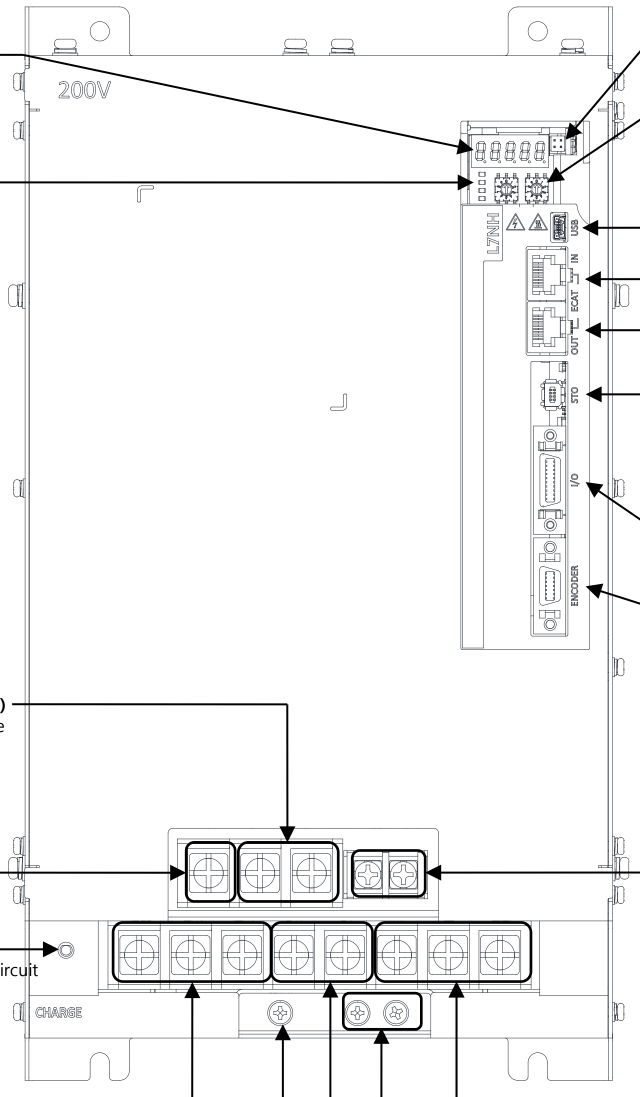
Encoder connector (ENCODER)
This connector connects to the encoder installed in the servo motor.

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.

■ 7.5KW(200[V])



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

Display
It shows drive status, alarms, etc.

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.

Status LED
It indicates the current state of EtherCAT communication.

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

EtherCAT communication input port (ECAT IN)

EtherCAT communication input 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.

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)**

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

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

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

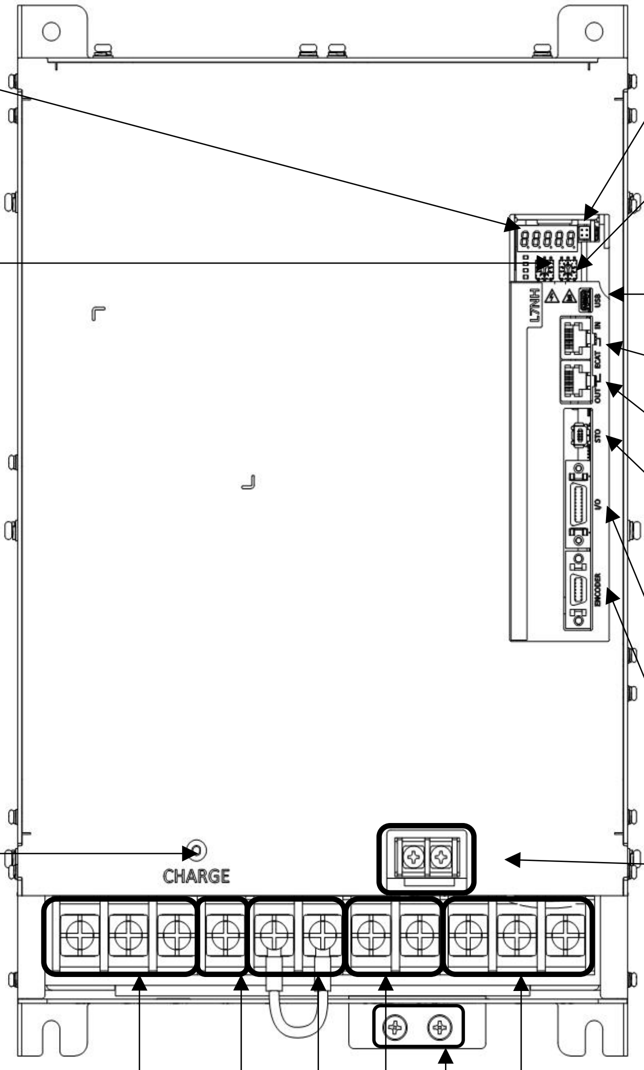
Servo motor connection terminals (U,V,W)
These terminals connect to the main circuit cable (power cable) of the servo motor.

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 : B+, B terminal short-circuit After attaching to the internal resistance fixing hole "NC" of the case, wire the external resistance to B+, B terminals.

*** NC**

■ 15KW(200[V])



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.

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

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 connectorENCODER)
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.

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

*** 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.

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.
-Install external regenerative resistance

■ 1kW (400[V])

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
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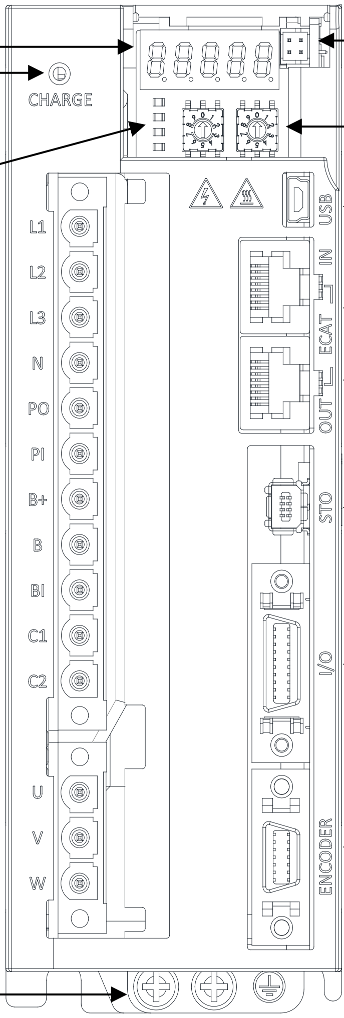

Connector for analog monitors
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Node address setting switch
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USB connector (USB)
This connector is to communicate with a PC.

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.

■ 2kW, 3.5kW (400[V])

Display
It shows drive status, alarms, etc.

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

Status LED
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Main power connectors (L1, L2, and L3)
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-If the DC reactor is not used, be sure to short-circuit this connector.

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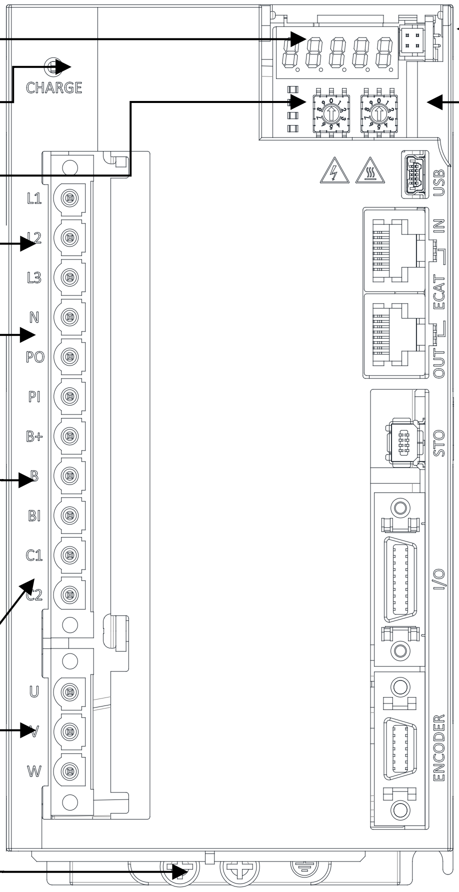

Ground terminal
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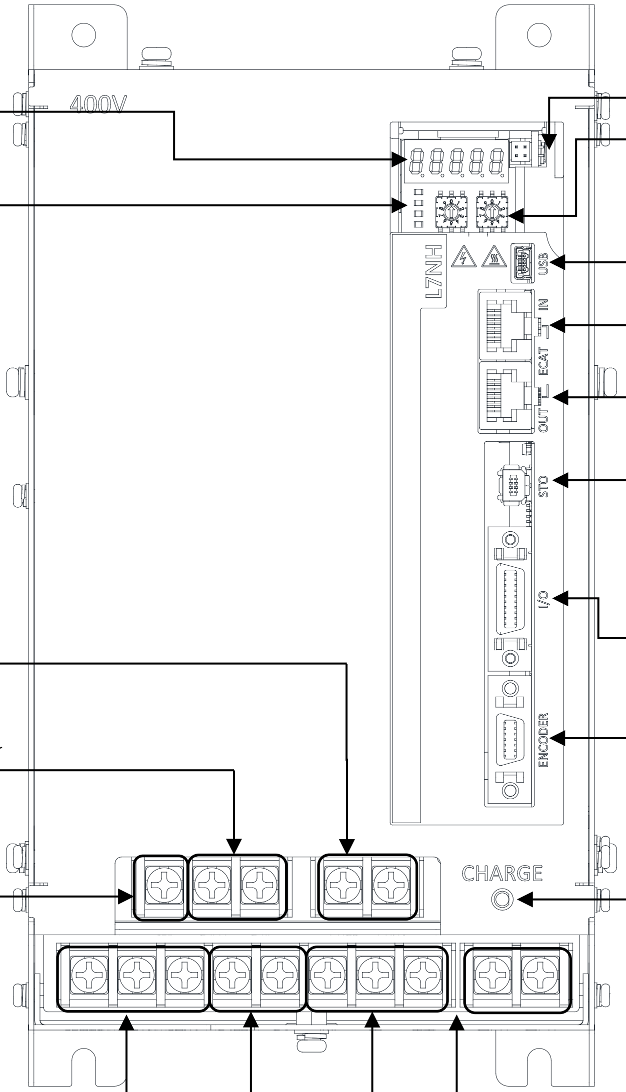
■ 5kW (400[V])



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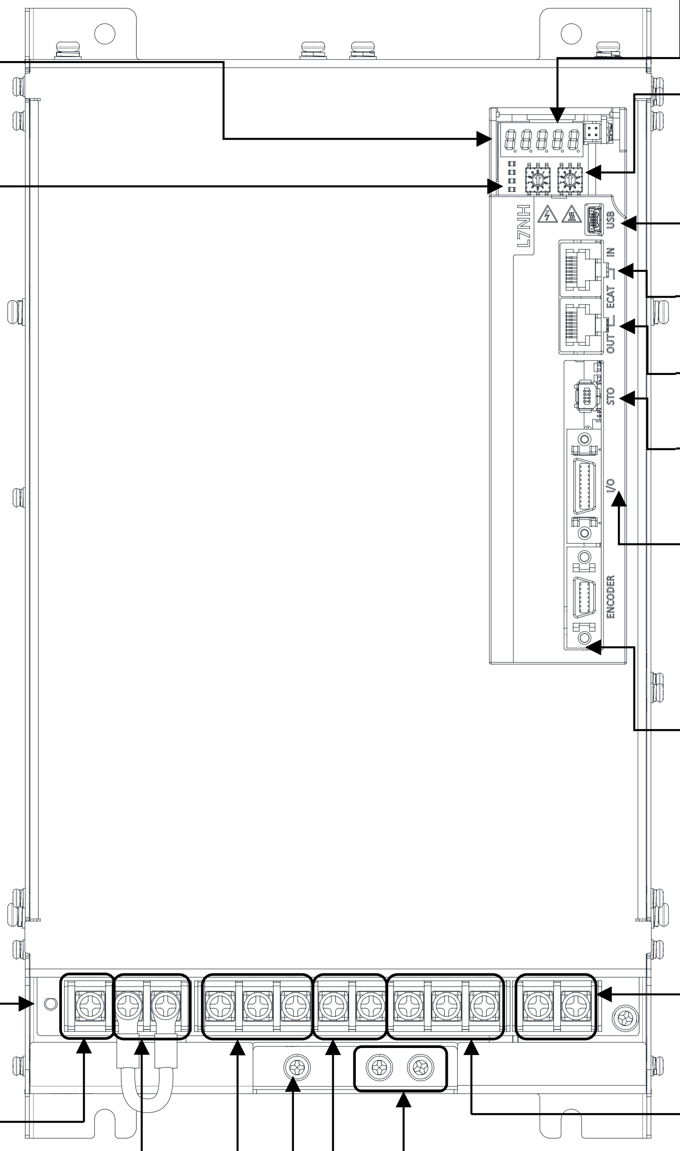
L7NH
USB
IN
ECAT
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STO
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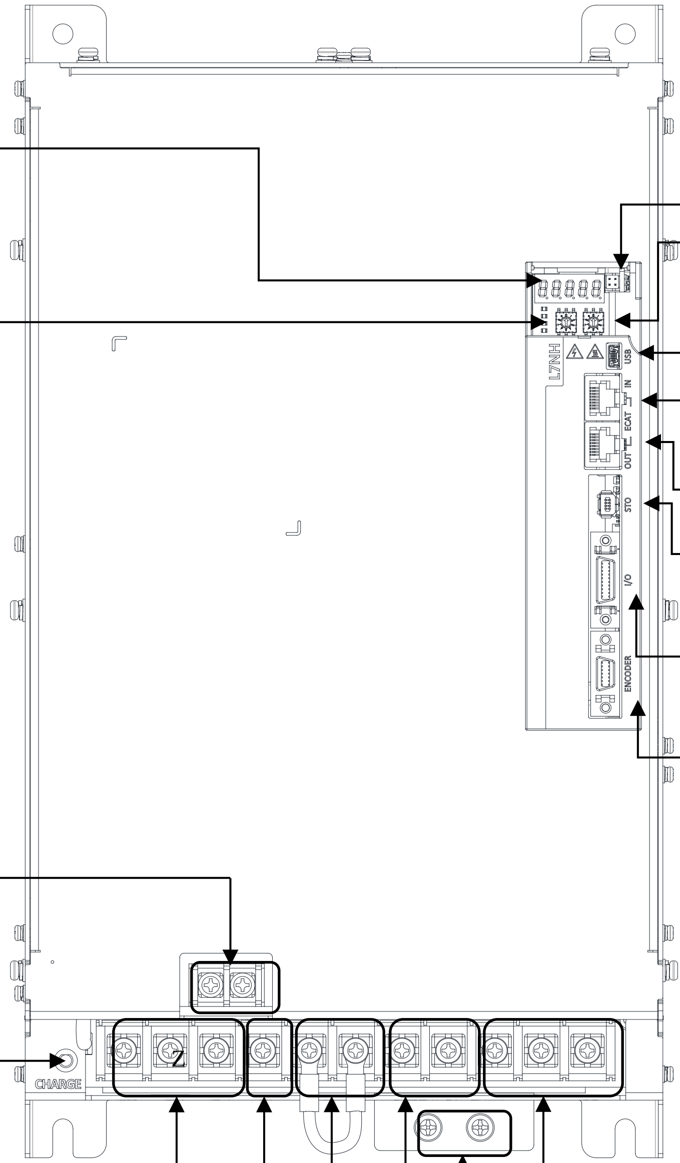
Safety connector (STO)
This connector connects safety devices.
-If a safety device is not used, be sure to install the safety jump connector before use.
Input/output signal connector (I/O)
This connector is for sequence input/output signals.
Encoder connector (ENCODER)
This connector connects to the encoder installed in the servo
CHARGE lamp
This turns on when the main circuit power is on.
Control power terminals (C1 and C2)
These terminals connect to the
Servo motor connection terminals (U,V,W)
These terminals connect to the main circuit cable (power cable) of the servo motor.
*** 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.
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.
* NC
Main power connectors (L1, L2, and ~~L3~~)
These terminals connect to the main circuit power input.

■ 15KW(400[V])



Display
It shows drive status, alarms, etc.

Status LED
It indicates the current state of EtherCAT communication.

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.

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

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

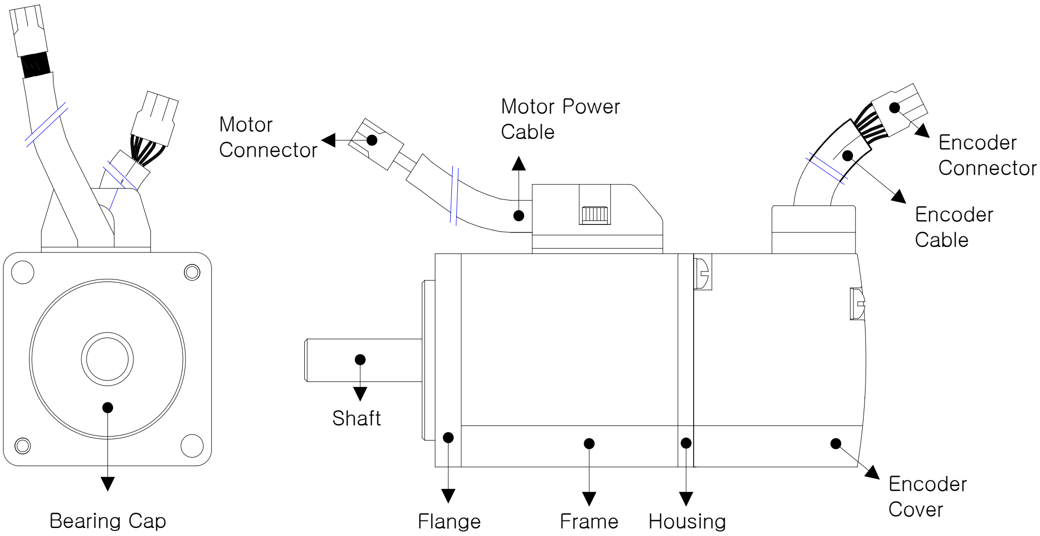
*** It is not a connector for connection (N)**

Regenerative resistance connector (B+, B)
These terminals connect to the external regenerative resistor.
-Install external regenerative resistance

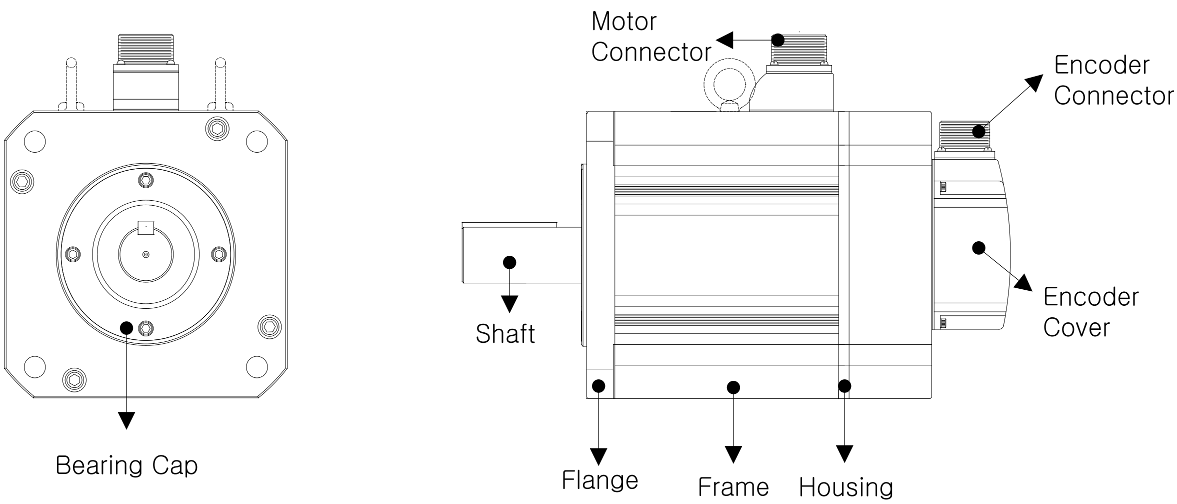
DC reactor connector (PO, PI)
These terminals connect to the DC reactor to suppress high-frequency power.
-If the DC reactor is not used, be sure to short-circuit this connector.

1.3.2 Servo Motor Parts

■ 80 Flange or below



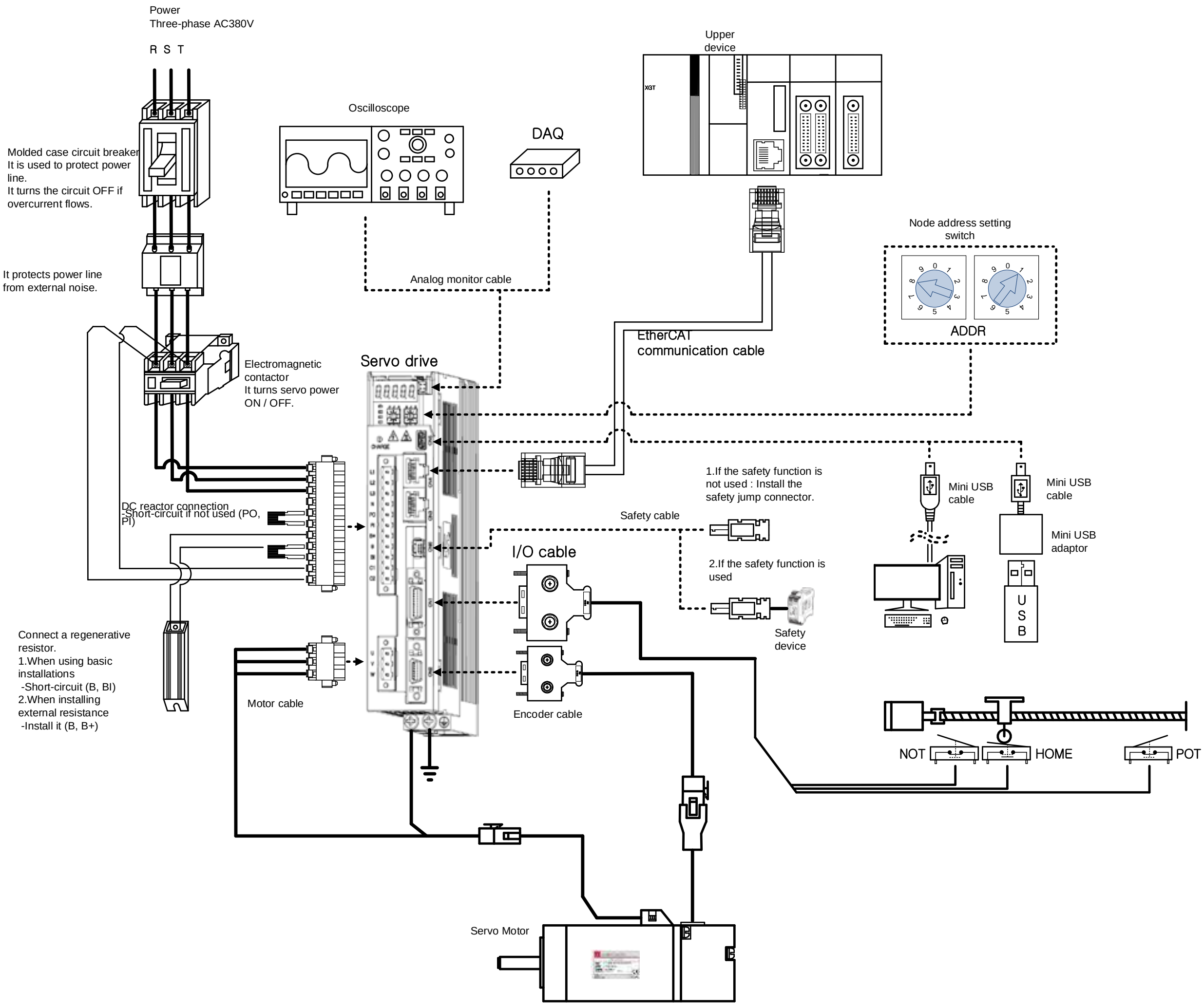
■ 130 Flange or higher



1.4 System configuration example

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

•Example of 200[V]/100[W] drive



⚠Caution

- Note3) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.
- 1.When using basic installations -Short-circuit (B, BI)

2. Encoder cable Servo Motor

2.1 Servo Motor

Heat Sink Spec.

Classification	Size(mm)	Classification
AP04	250x250x6	Aluminum
AP06	250x250x6	
AP08	250x250x12	
AP13	350x350x20	
AP18	550x550x30	
AP22	650x650x35	

※ In the case of product specifications, it is the data measured after applying the heat sink.

※ In case of IP rating, the shaft penetration part is excluded.

※ When attaching a reducer, the IP grade of the reducer part is not guaranteed.

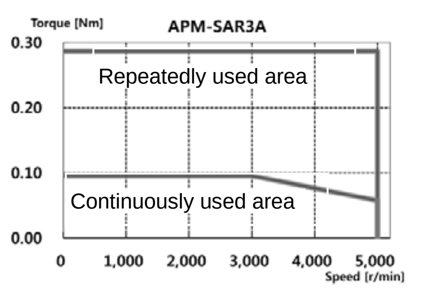
※ If bending occurs beyond the specifications specified in the cable standard, the indicated IP rating may not be satisfied.

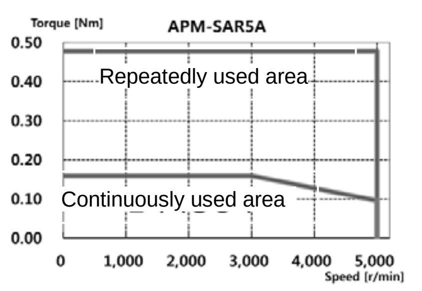
※ The corresponding protection level is satisfied only when the dedicated cable is used.

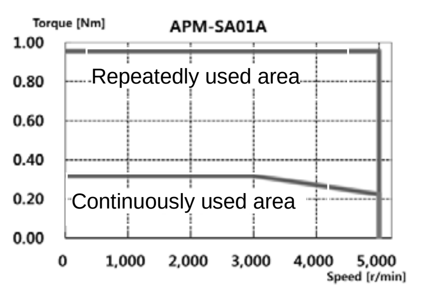
■ Procuct Features [200V]

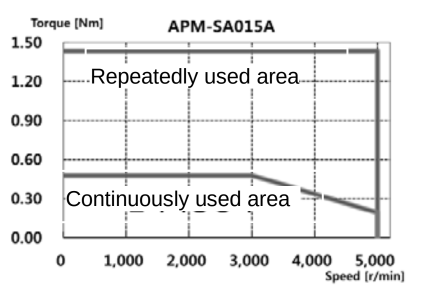
Servo Motor Name (APM-□□□□□)		SAR3A	SAR5A	SA01A	SA015A	-	-
Applicable Drive (L7□A□□)		**L7□A001**			**L7□A002**		
Rated output	[kW]	0.03	0.05	0.10	0.15		
Rated torque	[N·m]	0.10	0.16	0.32	0.48		
	[kgf·cm]	0.97	1.62	3.25	4.87		
Instantaneous maximum torque	[N·m]	0.29	0.48	0.96	1.43		
	[kgf·cm]	2.92	4.87	9.74	14.62		
Rated Current	[A]	1.07	1.20	1.38	1.61		
Maximum Current	[A]	3.21	3.60	4.14	4.83		
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m²x10¯⁴]	0.0164	0.02	0.05	0.06		
	[gf·cm·s²]	0.0167	0.02	0.05	0.07		
Allowable load inertia		Motor inertia x 30			20		
Rated power rate	[kW/s]	5.56	10.55	23.78	36.01		
Speed Position detector	Standard	Quad. Type Incremental 2048[P/R]					
	Option	Serial M-turn Type 18[Bit](to apply)					
Specifications and features	Method of protection	Fully closed·self-cooling IP55 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	0.3	0.4	0.5	0.7		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 pahse AC230V





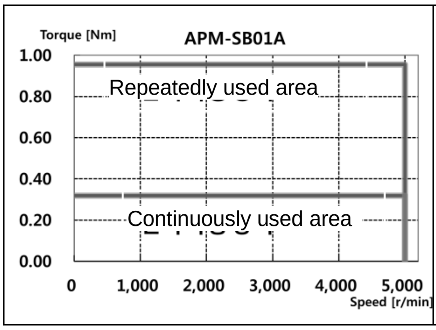


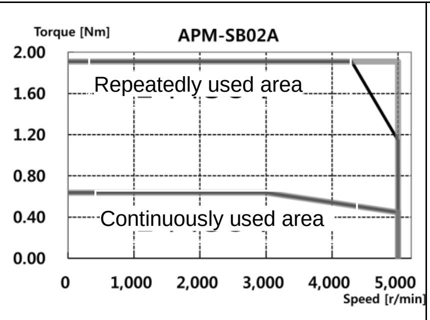


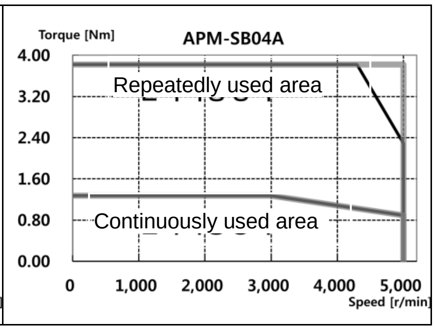
■ Procuct Features [200V]

Servo Motor Name (APM-□□□□□)		SB01A	SB02A	SB04A	-	-	-
Applicable Drive (L7□A□□)		L7□A002		L7□A004			
Rated output	[kW]	0.10	0.20	0.40			
Rated torque	[N·m]	0.32	0.64	1.27			
	[kgf·cm]	3.25	6.49	12.99			
Instantaneous maximum torque	[N·m]	0.96	1.91	3.82			
	[kgf·cm]	9.74	19.48	38.96			
Rated Current	[A]	1.65	1.63	2.89			
Maximum Current	[A]	4.95	4.89	8.67			
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m²x10¯⁴]	0.11	0.18	0.32			
	[gf·cm·s²]	0.12	0.19	0.33			
Allowable load inertia		Motor inertia x 20					
Rated power rate	[kW/s]	8.89	22.26	50.49			
Speed Position detector	Standard	Quad. Type Incremental 3000[P/R]					
	Option	Serial Type 19[Bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP55 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	0.8	1.1	1.6			

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 pahse AC230V



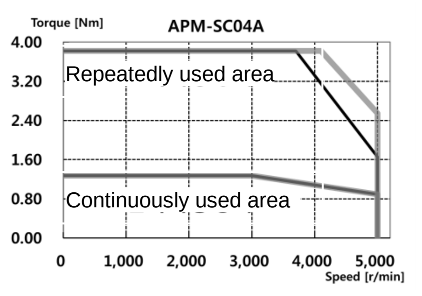


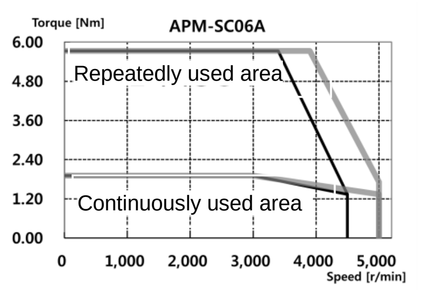


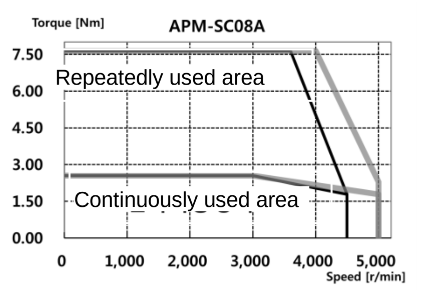
■ Procuct Features [200V]

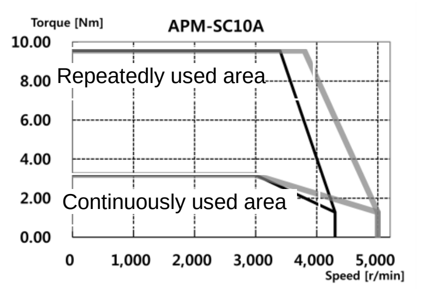
Servo Motor Name (APM-□□□□□)		SC04A	SC06A	SC08A	SC10A	-	-
Applicable Drive (L7□A□□)		L7□A004	L7□A008		L7□A010		
Rated output	[kW]	0.4	0.6	0.8	1.0		
Rated torque	[N·m]	1.27	1.91	2.55	3.19		
	[kgf·cm]	12.99	19.49	25.98	32.48		
Instantaneous maximum torque	[N·m]	3.82	5.73	7.64	9.56		
	[kgf·cm]	38.96	58.47	77.95	97.43		
Rated Current	[A]	2.82	3.58	4.83	5.37		
Maximum Current	[A]	8.46	10.74	14.49	16.11		
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m²x10¯⁴]	0.67	1.09	1.51	1.93		
	[gf·cm·s²]	0.69	1.11	1.54	1.97		
Allowable load inertia		Motor inertia x 15					
Rated power rate	[kW/s]	24.05	33.39	43.02	52.57		
Speed Position detector	Standard	Quad. Type Incremental 3000[P/R]					
	Option	Serial Type 19[Bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP55 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	1.9	2.5	3.2	3.8		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





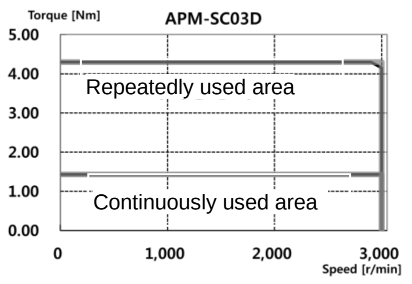


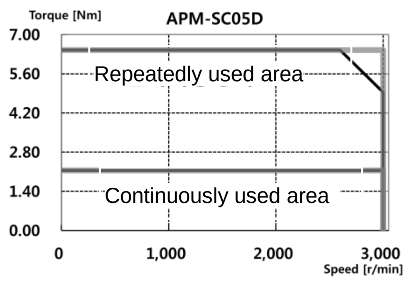


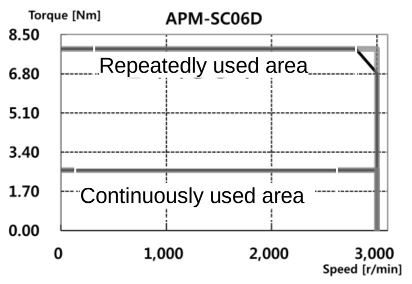
■ Product Features [200V]

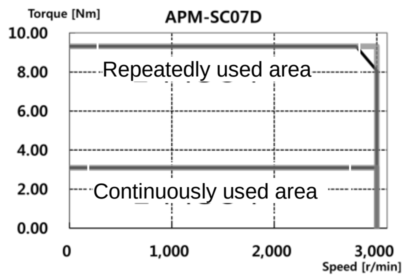
Servo Motor Name (APM-□□□□□)		SC03D	SC05D	SC06D	SC07D	-	-
Applicable Drive (L7□A□□)		L7□A004	L7□A008				
Rated output	[kW]	0.30	0.45	0.55	0.65		
Rated torque	[N·m]	1.43	2.15	2.63	3.10		
	[kgf·cm]	14.61	21.92	26.79	31.66		
Instantaneous maximum torque	[N·m]	4.30	6.45	7.88	9.31		
	[kgf·cm]	43.84	65.77	80.38	94.99		
Rated Current	[A]	2.59	3.23	3.82	4.42		
Maximum Current	[A]	7.77	9.69	11.46	13.26		
Rated rotation speed	[r/min]	2000					
Maximum rotation speed	[r/min]	3000					
Inertia moment	[kg·m²x10⁻⁴]	0.67	1.09	1.51	1.93		
	[gf·cm·s²]	0.69	1.11	1.54	1.97		
Allowable load inertia		Motor inertia x 15					
Rated power rate	[kW/s]	30.43	42.27	45.69	49.97		
Speed Position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial Type 19 [bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	1.9	2.5	3.2	3.9		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





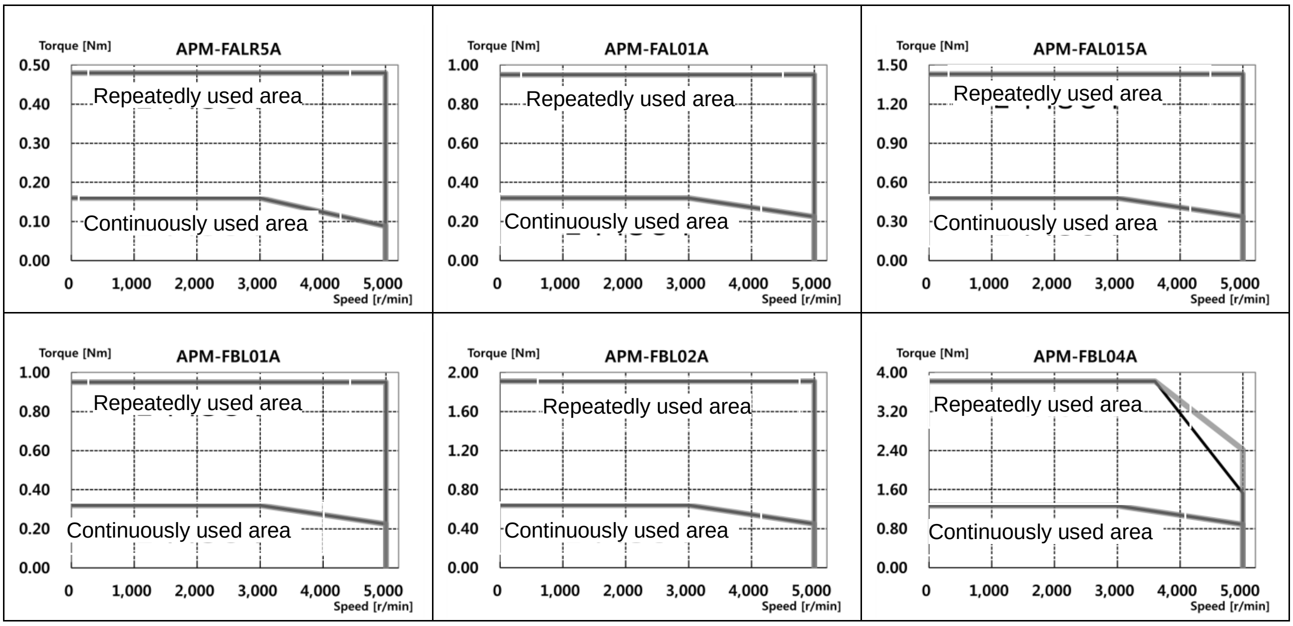




■ Product Features [200V]

Servo Motor Name (APM-□□□□□)		FALR5A	FAL01A	FAL015A	FBL01A	FBL02A	FBL04A
Applicable Drive (L7□A□□)		L7□A001		L7□A002	L7□A001	L7□A002	L7□A004
Rated output	[kW]	0.05	0.10	0.15	0.10	0.20	0.40
Rated torque	[N·m]	0.16	0.32	0.48	0.32	0.64	1.27
	[kgf·cm]	1.62	3.25	4.87	3.25	6.49	12.99
Instantaneous maximum torque	[N·m]	0.48	0.96	1.43	0.96	1.91	3.82
	[kgf·cm]	4.87	9.74	14.62	9.74	19.48	38.96
Rated Current	[A]Φ.ac.rms	0.95	1.25	1.52	0.95	1.45	2.60
Maximum Current	[A]Φ.ac.rms	2.85	3.75	4.56	2.85	4.35	7.80
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m²x10⁻⁴]	0.023	0.042	0.063	0.091	0.147	0.248
	[gf·cm·s²]	0.024	0.043	0.065	0.093	0.150	0.253
Allowable load inertia		Motor inertia x 30		Motor inertia x 20			
Rated power rate	[kW/s]	10.55	23.78	36.19	11.09	27.60	27.07
Speed Position detector	Standard	Serial Multi-Turn Built-in Type(18bit)			Serial Multi-Turn Built-in Type(19bit)		
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP67 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	0.31	0.45	0.61	0.56	0.74	1.06

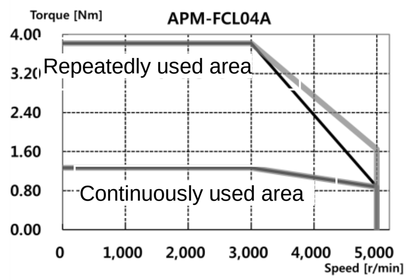
♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V

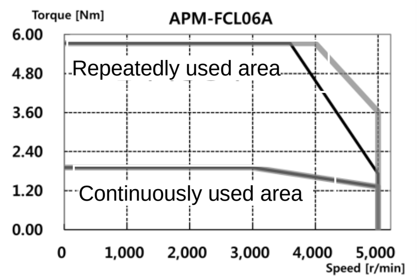


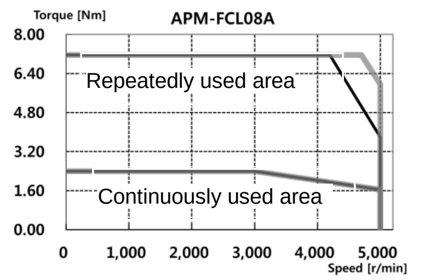
■ Product Features [200V]

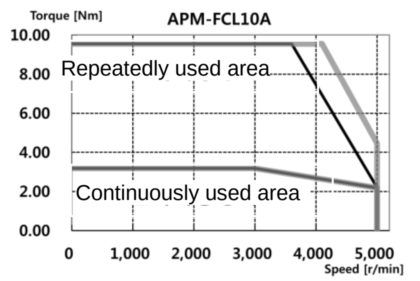
Servo Motor Name (APM-□□□□□)		FCL04A	FCL06A	FCL08A	FCL10A	-	-
Applicable Drive (L7□A□□)		L7□A004	L7□A008		L7□A010		
Rated output	[kW]	0.40	0.60	0.75	1.00		
Rated torque	[N·m]	1.27	1.91	2.39	3.18		
	[kgf·cm]	12.99	19.49	24.36	32.48		
Instantaneous maximum torque	[N·m]	3.82	5.73	7.16	9.55		
	[kgf·cm]	38.98	58.47	73.08	97.44		
Rated Current	[A]Φ.ac.rms	2.58	3.81	5.02	5.83		
Maximum Current	[A]Φ.ac.rms	7.75	11.42	15.07	17.50		
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m²x10⁻⁴]	0.530	0.897	1.264	1.632		
	[gf·cm·s²]	0.541	0.915	1.290	1.665		
Allowable load inertia		Motor inertia x 15					
Rated power rate	[kW/s]	30.60	40.66	45.09	62.08		
Speed Position detector	Standard	Serial Multi-Turn Built-in Type(19bit)					
	Option	X					
Specifications and features	Method of	Fully closed·self-cooling IP67 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	1.52	2.14	2.68	3.30		

♦ Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





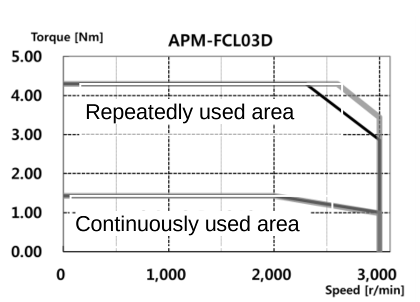


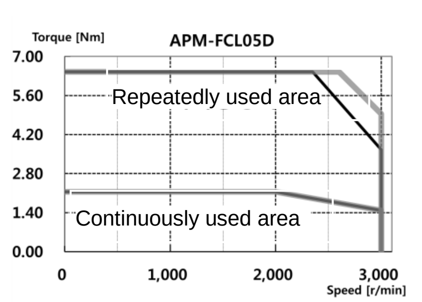


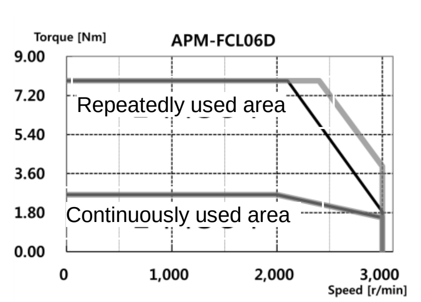
■ Product Features [200V]

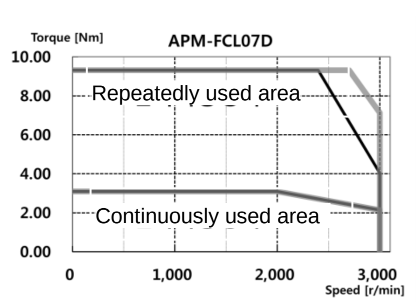
Servo Motor Name (APM-□□□□□)		FCL03D	FCL05D	FCL06D	FCL07D	-	-
Applicable Drive (L7□A□□)		L7□A004	L7□A008				
Rated output	[kW]	0.30	0.45	0.55	0.65		
Rated torque	[N·m]	1.43	2.15	2.63	3.10		
	[kgf·cm]	14.62	21.92	26.80	31.67		
Instantaneous maximum torque	[N·m]	4.30	6.45	7.88	9.31		
	[kgf·cm]	43.85	65.77	80.39	95.01		
Rated Current	[A]Φ.ac.rms	2.50	3.05	3.06	3.83		
Maximum Current	[A]Φ.ac.rms	7.51	9.16	9.18	11.50		
Rated rotation speed	[r/min]	2000					
Maximum rotation speed	[r/min]	3000					
Inertia moment	[kg·m²x10⁻⁴]	0.530	0.897	1.264	1.63		
	[gf·cm·s²]	0.541	0.915	1.290	1.66		
Allowable load inertia		Motor inertia x 15					
Rated power rate	[kW/s]	38.73	51.47	54.56	59.03		
Speed Position detector	Standard	Serial Multi-Turn Built-in Type(19bit)					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP67 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	1.26	2.12	2.66	2.78		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





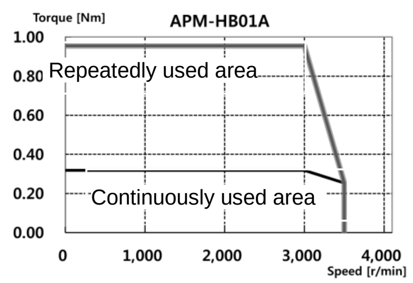


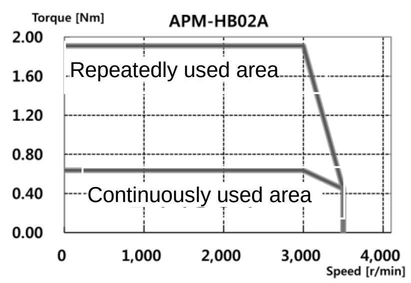


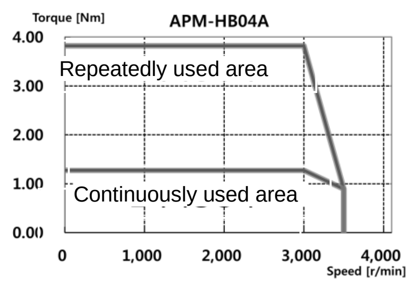
■ Product Features [200V]

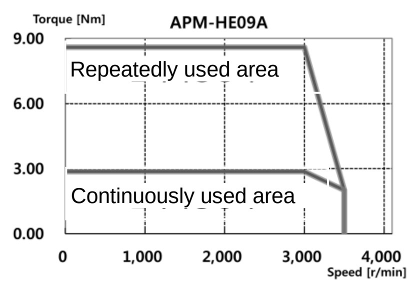
Servo Motor Name (APM-□□□□□)		HB01A	HB02A	HB04A	HE09A	HE15A	HE30A
Applicable Drive (L7□A□□)		**L7□A002**		**L7□A004**	**L7□A008**	**L7□A020**	**L7□A035**
Rated output	[kW]	0.1	0.2	0.4	0.9	1.5	3
Rated torque	[N·m]	0.32	0.64	1.27	2.86	4.77	9.55
	[kgf·cm]	3.25	6.49	12.99	29.23	48.72	97.43
Instantaneous maximum torque	[N·m]	0.96	1.91	3.82	8.59	14.32	28.64
	[kgf·cm]	9.74	19.48	38.96	87.69	146.15	292.29
Rated Current	[A]	1.65	1.63	2.89	4.95	8.23	17.16
Maximum Current	[A]	4.95	4.89	8.67	14.85	24.69	51.48
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	3500					
Inertia moment	[kg·m^{2}x10^{-4}]	0.27	0.33	0.46	19.56	22.27	31.81
	[gf·cm·s^2]	0.27	0.34	0.47	19.96	22.72	32.46
Allowable load inertia		Motor inertia x 20			Motor inertia x 10		
Rated power rate	[kW/s]	3.34	11.98	34.47	4.10	10.01	22.03
Speed Position detector	Standard	Quadrature Type Incremental 1024P/R			Quadrature Type Incremental 2048P/R		
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP55 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	0.9	1.2	1.7	5.8	7.4	10.83

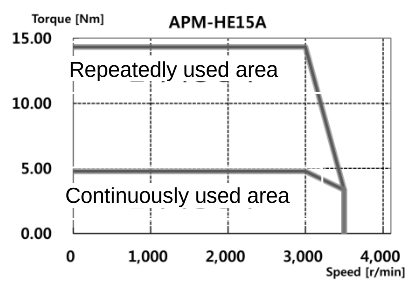
♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V

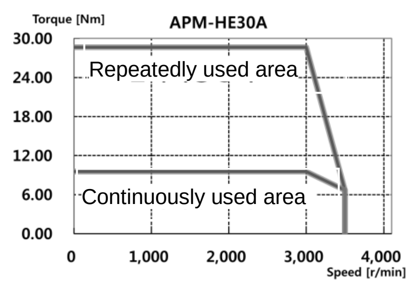








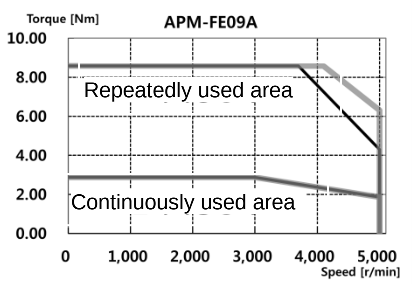


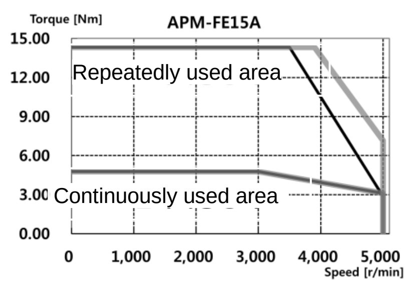


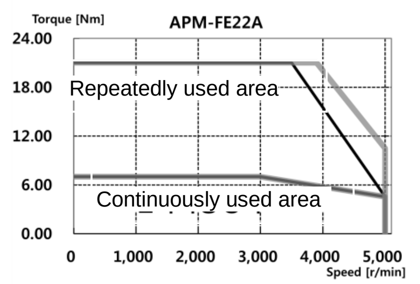
■ Product Features [200V]

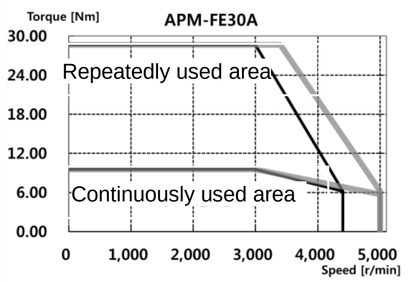
Servo Motor Name (APM-□□□□□)		FE09A	FE15A	FE22A	FE30A	-	-
Applicable Drive (L7□A□□)		L7□A010	L7□A020		L7□A035		
Rated output	[kW]	0.9	1.5	2.2	3.0		
Rated torque	[N·m]	2.86	4.77	7.00	9.55		
	[kgf·cm]	29.20	48.70	71.40	97.40		
Instantaneous maximum torque	[N·m]	8.59	14.32	21.01	28.65		
	[kgf·cm]	87.70	146.10	214.30	292.20		
Rated Current	[A]	6.45	9.15	13.24	16.09		
Maximum Current	[A]	19.35	27.45	39.72	48.27		
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m²x10⁻⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.47	22.38	33.59	47.85		
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.0	6.7	8.5	10.1		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





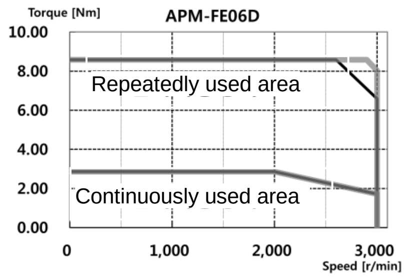


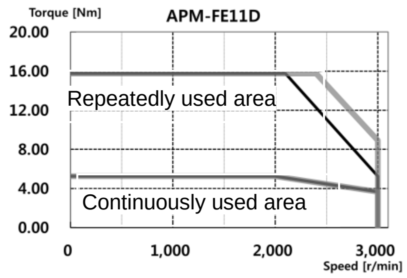


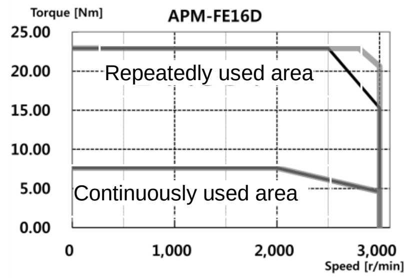
■ Product Features [200V]

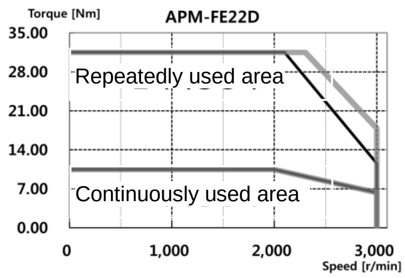
Servo Motor Name (APM-□□□□□)		FE06D	FE11D	FE16D	FE22D	-	-
Applicable Drive (L7□A□□)		L7□A008	L7□A010	L7□A020			
Rated output	[kW]	0.6	1.1	1.6	2.2		
Rated torque	[N·m]	2.86	5.25	7.63	10.5		
	[kgf·cm]	29.2/0	53.60	77.90	107.10		
Instantaneous maximum torque	[N·m]	8.59	15.75	22.92	31.51		
	[kgf·cm]	87.70	160.70	233.80	321.40		
Rated Current	[A]	4.56	6.47	10.98	12.97		
Maximum Current	[A]	13.68	19.41	32.94	38.91		
Rated rotation speed	[r/min]	2000					
Maximum rotation speed	[r/min]	3000					
Inertia moment	[kg·m²x10⁻⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.49	27.08	39.89	57.90		
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.0	6.7	8.5	10.1		

♦ Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





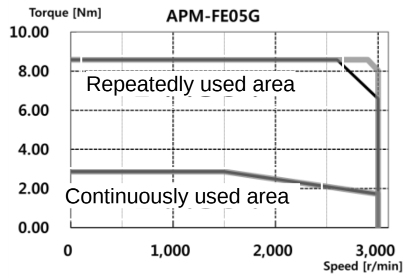


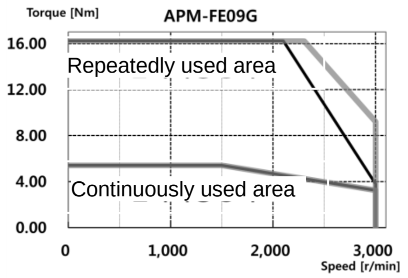


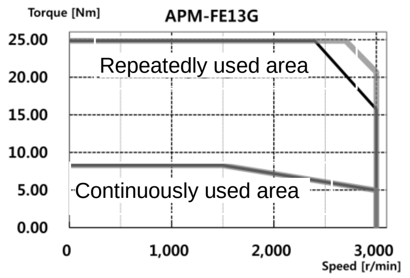
■ Product Features [200V]

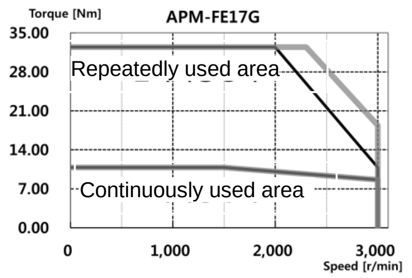
Servo Motor Name (APM-□□□□□)		FE05G	FE09G	FE13G	FE17G	-	-
Applicable Drive (L7□A□□)		L7□A008	L7□A010	L7□A020			
Rated output	[kW]	0.45	0.85	1.3	1.7		
Rated torque	[N·m]	2.86	5.41	8.27	10.82		
	[kgf·cm]	29.22	55.19	84.41	110.38		
Instantaneous maximum torque	[N·m]	8.59	16.23	24.82	32.46		
	[kgf·cm]	87.66	165.57	253.23	331.14		
Rated Current	[A]	4.56	6.67	11.90	13.36		
Maximum Current	[A]	13.68	20.01	35.7	40.08		
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000					
Inertia moment	[kg·m²x10⁻⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.49	28.74	46.81	61.46		
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.0	6.7	8.5	10.1		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





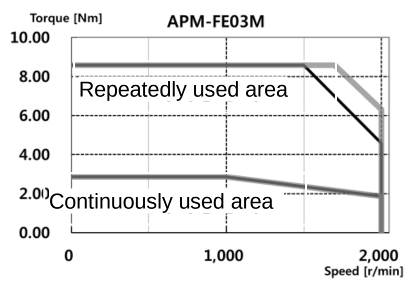


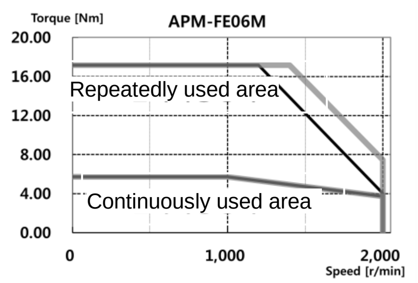


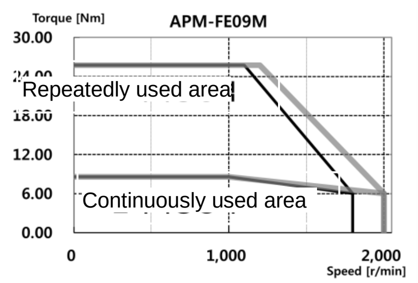
■ Product Features [200V]

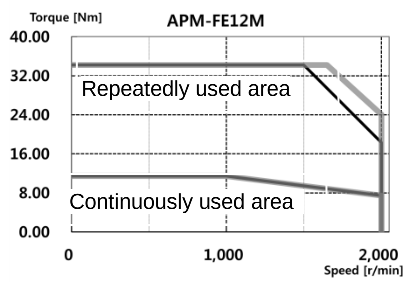
Servo Motor Name (APM-□□□□□)		FE03M	FE06M	FE09M	FE12M	-	-
Applicable Drive (L7□A□□)		L7□A004	L7□A008	L7□A010	L7□A020		
Rated output	[kW]	0.3	0.6	0.9	1.2		
Rated torque	[N·m]	2.86	5.72	8.59	11.46		
	[kgf·cm]	29.22	58.4	87.7	116.9		
Instantaneous maximum torque	[N·m]	8.59	17.18	25.77	34.22		
	[kgf·cm]	87.66	175.3	262.9	349.1		
Rated Current	[A]	2.73	4.56	6.18	10.67		
Maximum Current	[A]	8.19	13.68	18.54	32.01		
Rated rotation speed	[r/min]	1000					
Maximum rotation speed	[r/min]	2000					
Inertia moment	[kg·m²x10⁻⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.49	32.22	50.48	68.91		
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.0	6.7	8.5	10.1		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





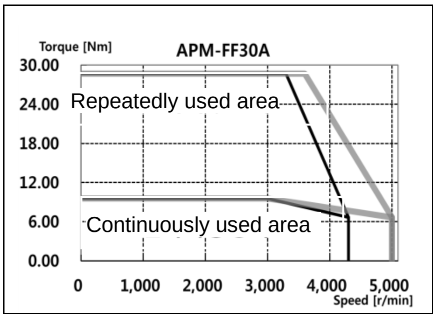


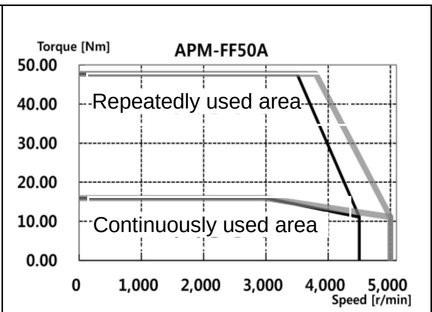


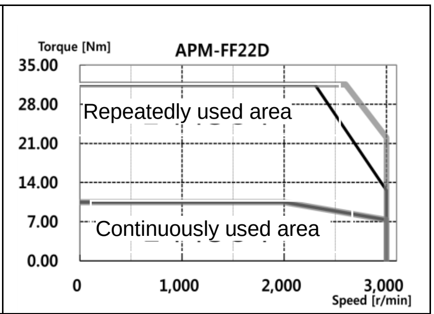
■ Product Features [200V]

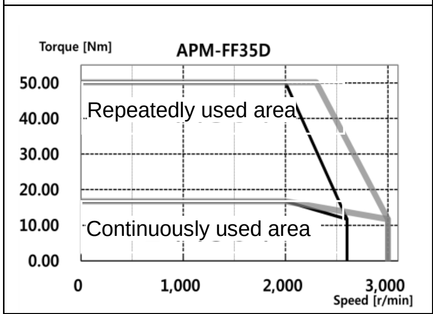
Servo Motor Name (APM-□□□□□)		FF30A	FF50A	FF22D	FF35D	FF55D	FF75D
Applicable Drive (L7□A□□)		L7□A035	L7□A050	L7□A020	L7□A035	L7□A050	L7□A075B
Rated output	[kW]	3.0	5.0	2.2	3.5	5.5	7.5
Rated torque	[N·m]	9.55	15.91	10.50	16.70	26.25	35.81
	[kgf·cm]	97.40	162.30	107.1	170.4	267.8	365.4
Instantaneous maximum torque	[N·m]	28.65	47.74	31.50	50.10	78.76	89.53
	[kgf·cm]	292.3	487.00	321.30	511.40	803.4	913.5
Rated Current	[A]	15.26	26.47	13.07	16.48	28.78	32.95
Maximum Current	[A]	45.78	79.41	39.21	49.44	86.34	82.375
Rated rotation speed	[r/min]	3000		2000			
Maximum rotation speed	[r/min]	5000		3000			2500
Inertia moment	[kg·m²x10⁻⁴]	27.96	46.56	27.96	46.56	73.85	106.7
	[gf·cm·s²]	28.53	47.51	28.53	47.51	75.36	108.9
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	32.59	54.33	39.43	59.89	93.27	120.15
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	12.5	17.4	12.5	17.4	25.12	33.8

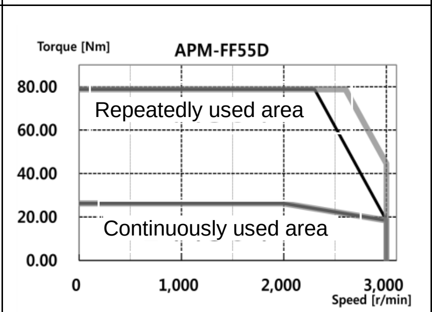
♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V

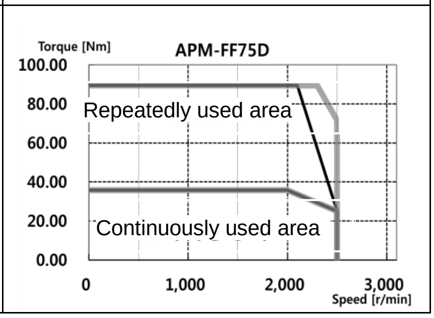








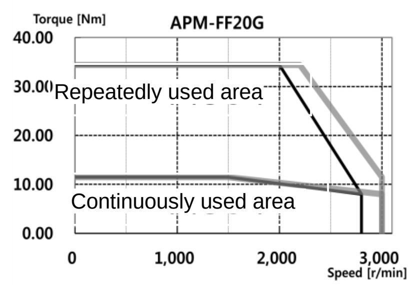


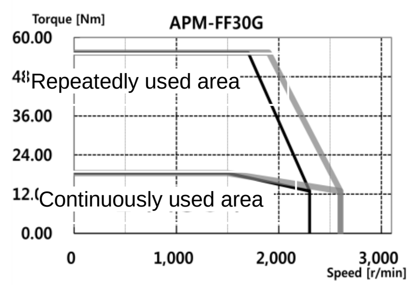


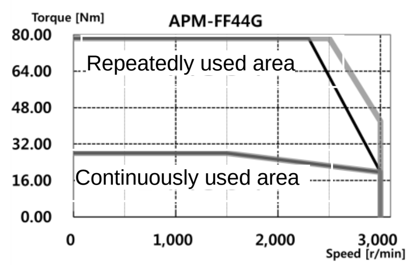
■ Product Features [200V]

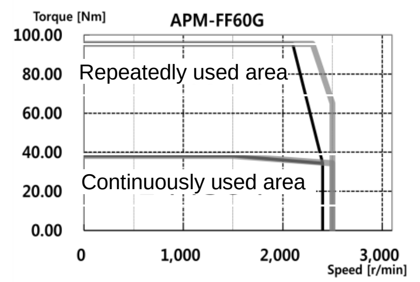
Servo Motor Name (APM-□□□□□)		FF20G	FF30G	FF44G	FF60G	FF75G	-
Applicable Drive (L7□A□□)		L7□A020	L7□A035	L7□A050	L7□A075B		
Rated output	[kW]	1.8	2.9	4.4	6.0	7.5	
Rated torque	[N·m]	11.45	18.46	28.00	38.20	47.70	
	[kgf·cm]	116.9	188.3	285.7	389.80	487.20	
Instantaneous maximum torque	[N·m]	34.35	55.38	78.4	95.50	119.3	
	[kgf·cm]	350.60	564.90	799.6	974.90	1217.3	
Rated Current	[A]	12.16	15.98	30.70	35.14	35.26	
Maximum Current	[A]	36.48	47.94	85.96	87.85	88.15	
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000	2700	3000	2500	2200	
Inertia moment	[$kg\cdot m^2x10^{-4}$]	27.96	46.56	73.85	106.70	131.30	
	[$gf\cdot cm\cdot s^2$]	28.53	47.51	75.36	108.90	134.00	
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	46.92	73.14	106.15	136.73	173.63	
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	12.5	17.4	25.2	33.8	38.5	

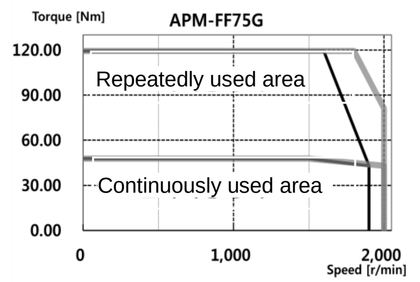
♦ Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V







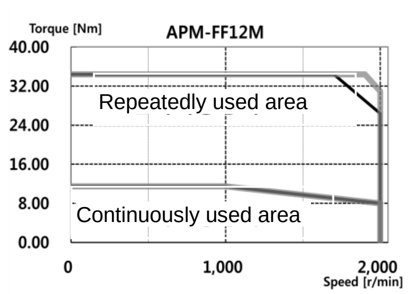


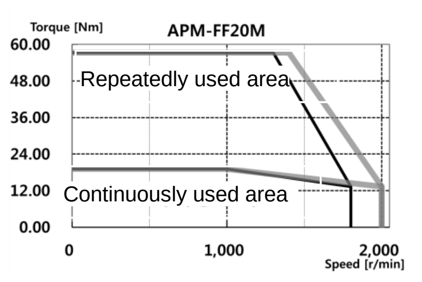


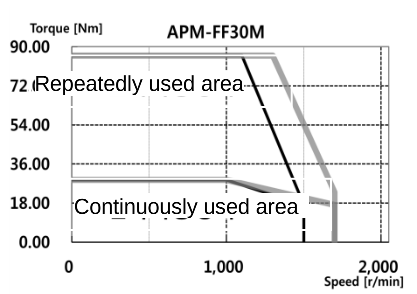
■ Product Features [200V]

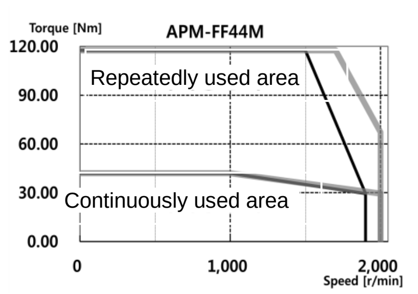
Servo Motor Name (APM-□□□□□)		FF12M	FF20M	FF30M	FF44M	-	-
Applicable Drive (L7□A□□)		L7□A020		L7□A035	L7□A050		
Rated output	[kW]	1.2	2.0	3.0	4.4		
Rated torque	[N·m]	11.46	19.09	28.64	42.02		
	[kgf·cm]	116.9	194.8	292.2	428.7		
Instantaneous maximum torque	[N·m]	34.38	57.29	85.94	105.05		
	[kgf·cm]	350.70	584.40	876.60	1071.52		
Rated Current	[A]	11.01	12.96	16.58	30.60		
Maximum Current	[A]	33.03	38.88	49.74	85.68		
Rated rotation speed	[r/min]	1000					
Maximum rotation speed	[r/min]	2000		1700	2000		
Inertia moment	[kg·m²x10⁻⁴]	27.96	46.56	73.85	106.7		
	[gf·cm·s²]	28.53	47.51	75.36	108.9		
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	46.94	78.27	111.04	165.38		
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	12.5	17.4	25.2	33.8		

♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V





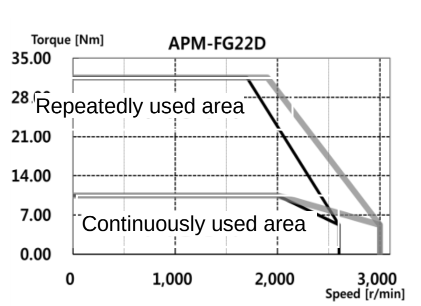


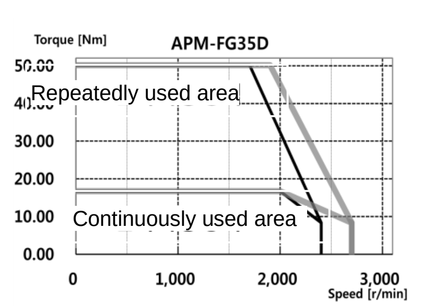


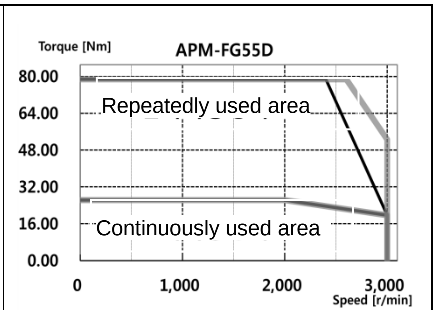
■ Product Features [200V]

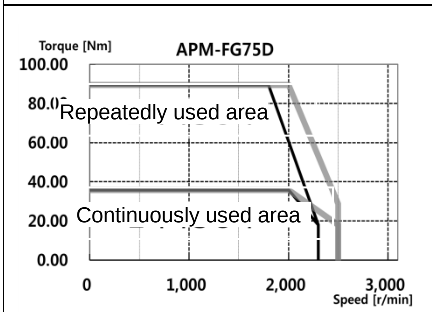
Servo Motor Name (APM-□□□□□)		FG22D	FG35D	FG55D	FG75D	FG110D	-
Applicable Drive (L7□A□□)		**L7□A020**	**L7□A035**	**L7□A050**	**L7□A075B**	**L7□A150B**	
Rated output	[kW]	2.2	3.5	5.5	7.5	11	
Rated torque	[N·m]	10.50	16.71	26.25	35.81	52.52	
	[kgf·cm]	107.1	170.4	267.8	365.4	525.9	
Instantaneous maximum torque	[N·m]	31.51	50.12	78.76	89.53	157.55	
	[kgf·cm]	321.30	511.30	803.4	913.5	1607.60	
Rated Current	[A]	10.25	14.67	29.74	30.17	51.39	
Maximum Current	[A]	30.75	44.01	89.22	75.43	154.17	
Rated rotation speed	[r/min]	2000					
Maximum rotation speed	[r/min]	3000	2700	3000	2500	2500	
Inertia moment	[kg·m²x10¯⁴]	41.13	71.53	117.72	149.4	291.36	
	[gf·cm·s²]	41.97	72.99	120.12	152.45	297.31	
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	26.78	38.99	58.51	85.83	94.65	
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	Quadrature Type Incremental 3000[P/R]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	15.4	20.2	28.12	33.45	66.2	

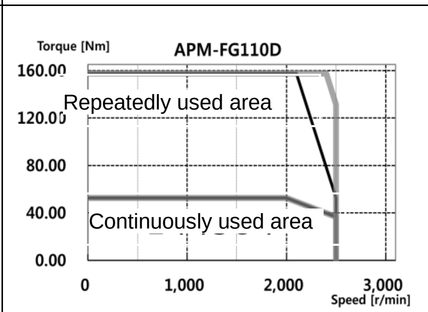
♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V







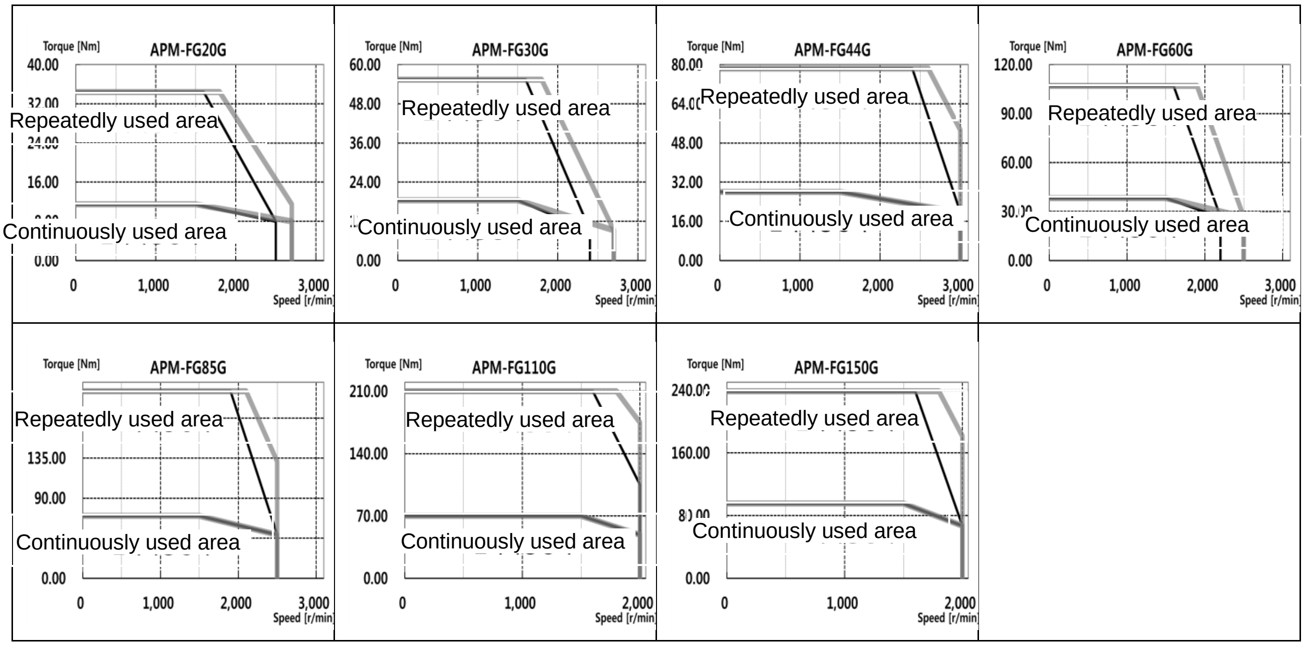




■ Product Features [200V]

Servo Motor Name (APM-□□□□□)		FG20G	FG30G	FG44G	FG60G	FG85G	FG110G	FG150G
Applicable Drive (L7□A□□)		L7□A020	L7□A035	L7□A050	L7□A075	L7□A150B		
Rated output	[kW]	1.8	2.9	4.4	6.0	8.5	11	15
Rated torque	[N·m]	11.50	18.50	28.00	38.2	54.11	69.99	95.45
	[kgf·cm]	116.9	188.4	285.8	389.7	552.1	714.2	974
Instantaneous maximum torque	[N·m]	34.40	55.40	78.4	95.5	162.32	209.97	238.63
	[kgf·cm]	350.80	565.1	800.24	974.3	1656.30	2142.60	2435
Rated Current	[A]	11.18	16.21	31.72	32.18	52.94	59.3	75.6
Maximum Current	[A]	33.54	48.63	88.82	96.54	158.82	177.9	189
Rated rotation speed	[r/min]	1500						
Maximum rotation speed	[r/min]	2700	2700	3000	2500	2500	2000	2000
Inertia moment	[kg·m^{2}x10^{-4}]	14.13	71.53	117.72	149.4	291.36	291.36	424.57
	[gf·cm·s^2]	41.97	72.99	120.12	152.45	297.31	297.31	416.08
Allowable load inertia		Motor inertia x 5						
Rated power rate	[kW/s]	31.91	47.66	66.64	97.63	100.48	168.27	223.44
Speed Position detector	Standard	Serial Type 19 [bit]						
	Option	Quadrature Type Incremental 3000[P/R]						
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)						
	Time rating	Continuous						
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]						
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)						
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas						
	Anti-vibration	Vibration acceleration 49[m/s2](5G)						
Weight	[kg]	15.4	20.2	28.0	33.45	66.2	66.3	92.2

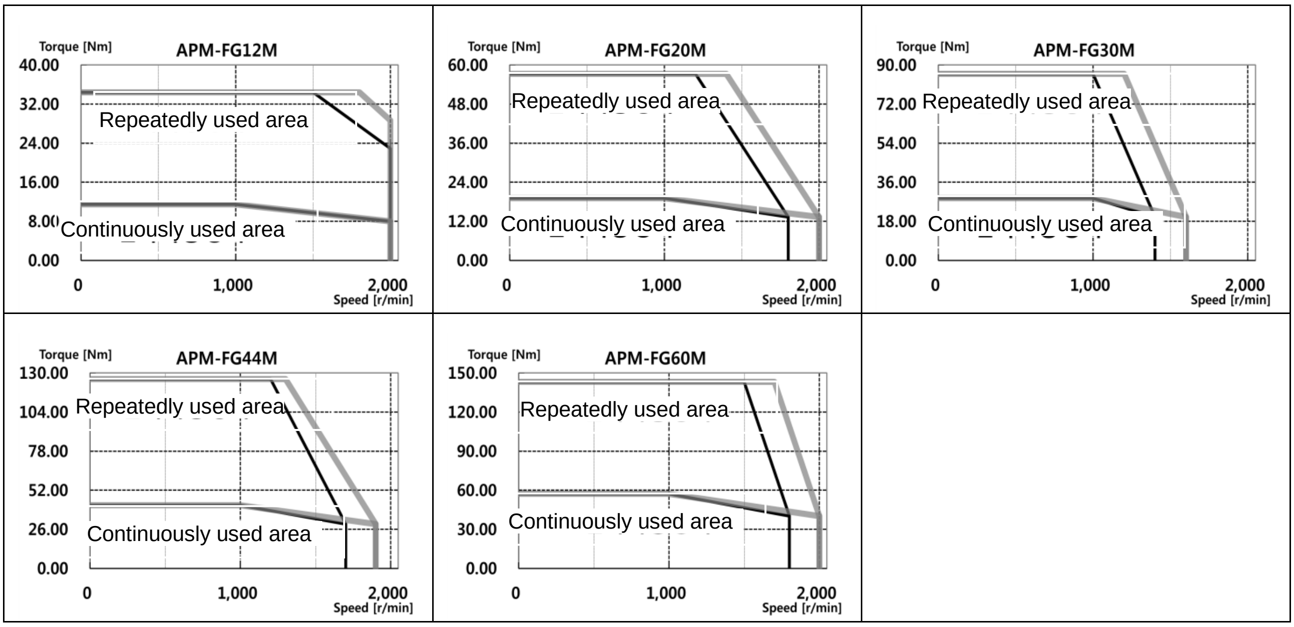
♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V



■ Product Features [200V]

Servo Motor Name (APM-□□□□□)		FG12M	FG20M	FG30M	FG44M	FG60M	-
Applicable Drive (L7□A□□)		L7□A020		L7□A035	L7□A050	-	
Rated output	[kW]	1.2	2.0	3.0	4.4	6.0	
Rated torque	[N·m]	11.50	19.10	28.60	42.00	57.29	
	[kgf·cm]	116.9	194.9	292.3	428.7	584.6	
Instantaneous maximum torque	[N·m]	34.40	57.30	85.90	126.00	143.2	
	[kgf·cm]	350.8	584.6	876.9	128.61	1432.4	
Rated Current	[A]	11.28	13.10	15.52	27.26	39.32	
Maximum Current	[A]	33.84	39.3	46.56	81.78	98.30	
Rated rotation speed	[r/min]	1000					
Maximum rotation speed	[r/min]	2000		1600	1900	2000	
Inertia moment	[kg·m²x10¯⁴]	41.13	71.53	117.72	149.40	291.36	
	[gf·cm·s²]	41.97	72.99	120.12	152.45	297.31	
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	31.91	51.00	69.70	118.14	112.65	
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	15.4	20.2	28.0	33.5	66.2	

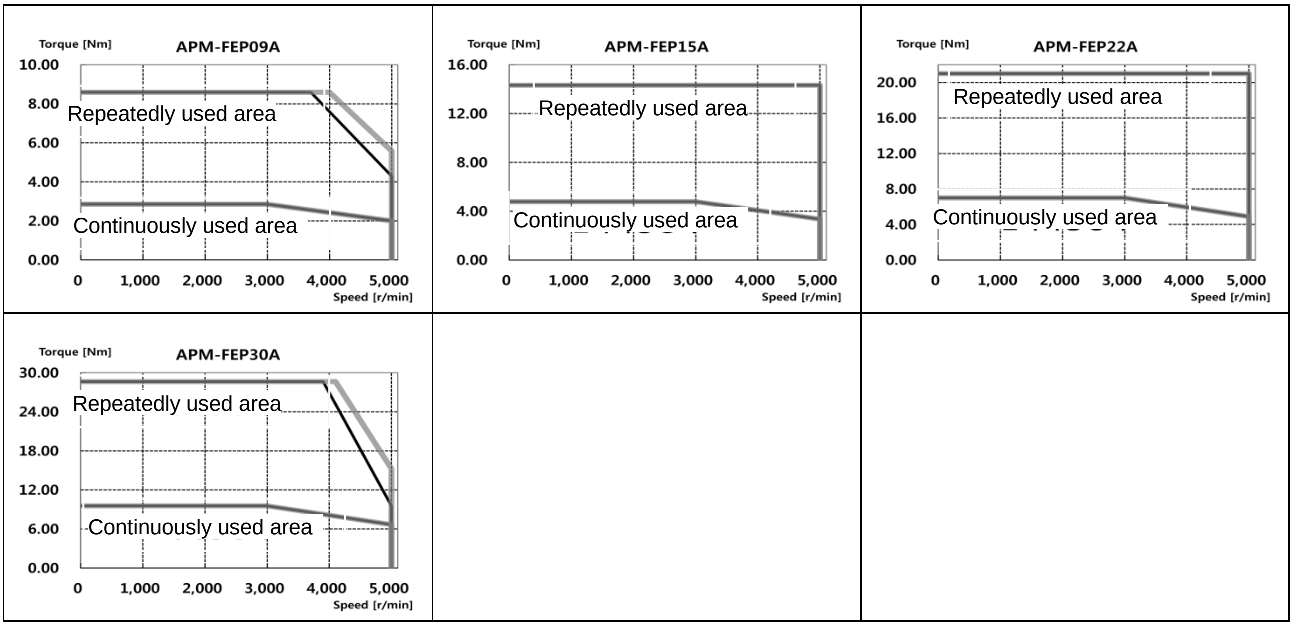
♦Rotation Speed - Torque Characteristics: 3 phase AC200V, ■ : 3 phase AC230V



■ Product Features [400V]

Servo Motor Name (APM-□□□□□□)		FEP09A	FEP15A	FEP22A	FEP30A	-	-
Applicable Drive(L7□A□□)		**L7□B010□**	**L7□B020□**		**L7□B035□**		
Rated output	[kW]	0.9	1.5	2.2	3.0		
Rated torque	[N·m]	2.86	4.77	7.00	9.55		
	[kgf·cm]	29.23	48.72	71.46	97.44		
Instantaneous maximum torque	[N·m]	8.59	14.32	21.01	28.65		
	[kgf·cm]	87.7	146.16	214.37	292.33		
Rated Current	[A]	3.47	6.68	7.64	9.94		
Maximum Current	[A]	10.40	20.03	22.92	29.81		
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m2x10-4]	5.659	10.179	14.619	19. 040		
	[gf·cm·s2]	5.774	10.387	14.917	19.429		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.50	22.40	33.55	47.89		
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.5	7.54	9.68	11.78		

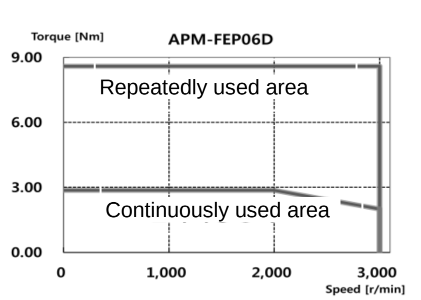
♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V

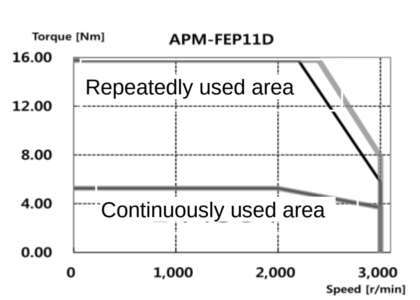


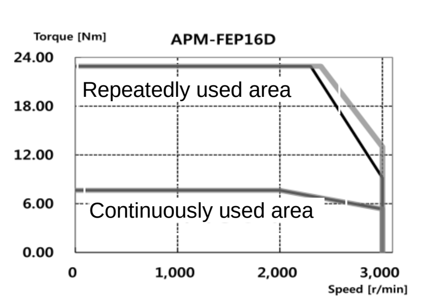
■ Product Features [400V]

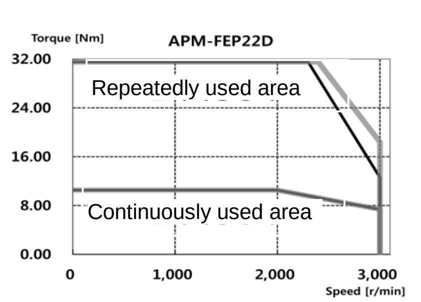
Servo Motor Name (APM-□□□□□□)		FEP06D	FEP11D	FEP16D	FEP22D	-	-
Applicable Drive(L7□A□□)		L7□B010□		L7□B020□			
Rated output	[kW]	0.6	1.1	1.6	2.2		
Rated torque	[N·m]	2.86	5.25	7.64	10.5		
	[kgf·cm]	29.23	53.59	77.95	107.19		
Instantaneous maximum torque	[N·m]	8.59	15.76	22.92	31.51		
	[kgf·cm]	87.7	160.78	233.86	321.56		
Rated Current	[A]	3.28	3.40	4.97	6.80		
Maximum Current	[A]	9.83	10.19	14.92	20.04		
Rated rotation speed	[r/min]	2000		2000			
Maximum rotation speed	[r/min]	3000		3000			
Inertia moment	[kg·m2x10-4]	5.659	10.179	14.619	19.040		
	[gf·cm·s2]	5.774	10.387	14.917	19.429		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.50	27.10	39.92	57.95		
Speed Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.5	7.54	9.68	11.78		

♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V





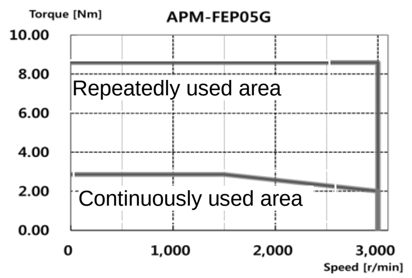


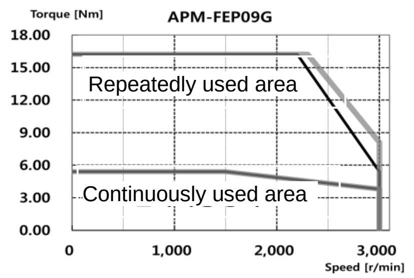


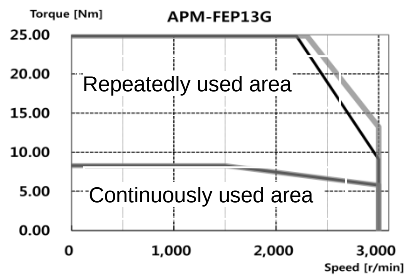
■ Product Features [400V]

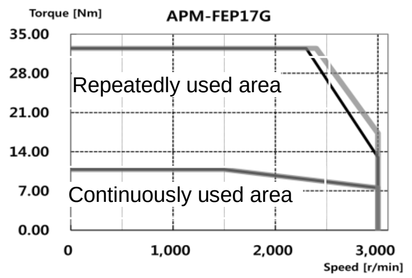
Servo Motor Name (APM-□□□□□□)		FEP05G	FEP09G	FEP13G	FEP17G	-	-
Applicable Drive(L7□A□□)		L7□B010□		L7□B020□			
Rated output	[kW]	0.45	0.85	1.3	1.7		
Rated torque	[N·m]	2.86	5.41	8.28	10.82		
	[kgf·cm]	29.23	55.22	84.45	110.43		
Instantaneous maximum torque	[N·m]	8.59	16.23	24.83	32.47		
	[kgf·cm]	87.70	165.65	253.35	331.30		
Rated Current	[A]	3.28	3.50	5.39	7.01		
Maximum Current	[A]	9.83	10.50	16.16	21.02		
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000					
Inertia moment	[kg·m2x10-4]	5.659	10.179	14.619	19.040		
	[gf·cm·s2]	5.774	10.387	14.917	19.429		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.50	28.77	46.85	61.52		
Speed, Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.5	7.54	9.68	11.78		

♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V





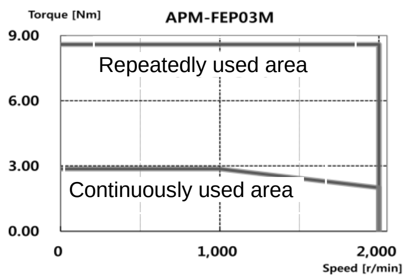


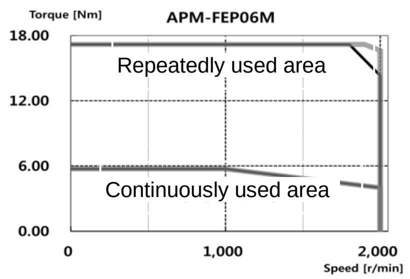


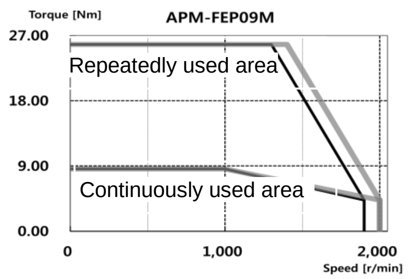
■ Product Features [400V]

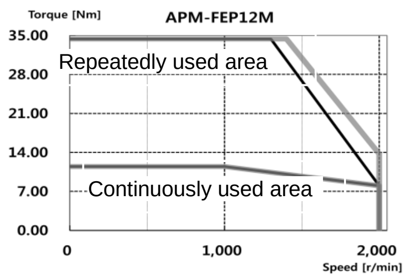
Servo Motor Name (APM-□□□□□□)		FEP03M	FEP06M	FEP09M	FEP12M	-	-
Applicable Drive(L7□A□□)		**L7□B010□**			**L7□B035□**		
Rated output	[kW]	0.3	0.6	0.9	1.2		
Rated torque	[N·m]	2.86	5.73	8.59	11.46		
	[kgf·cm]	29.23	58.47	87.70	116.93		
Instantaneous maximum torque	[N·m]	8.59	17.19	25.78	34.38		
	[kgf·cm]	87.70	175.40	263.09	350.79		
Rated Current	[A]	3.28	3.28	3.33	4.87		
Maximum Current	[A]	9.83	9.83	9.99	14.60		
Rated rotation speed	[r/min]	1000					
Maximum rotation speed	[r/min]	2000					
Inertia moment	[kg·m2x10-4]	5.659	10.179	14.619	19.040		
	[gf·cm·s2]	5.774	10.387	14.917	19.429		
Allowable load inertia		Motor inertia x 10					
Rated power rate	[kW/s]	14.50	32.25	50.53	68.97		
Speed, Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	5.5	7.54	9.68	11.78		

♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V





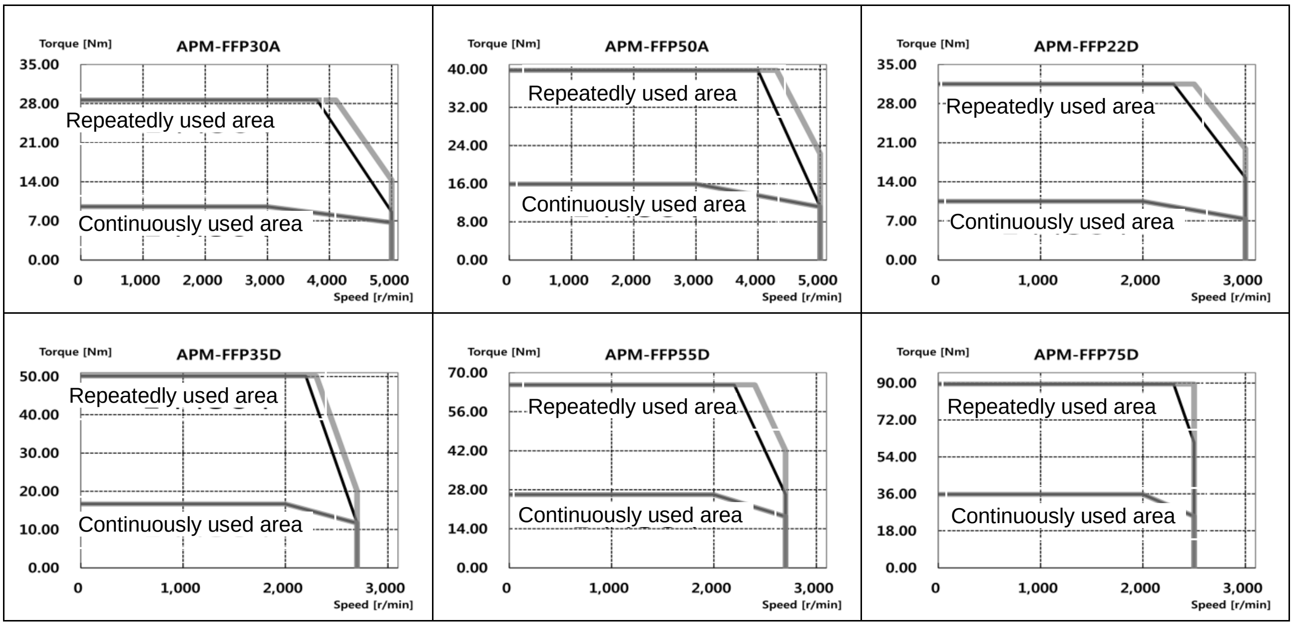




■ Product Features [400V]

Servo Motor Name (APM-□□□□□□)		FFP30A	FFP50A	FFP22D	FFP35D	FFP55D	FFP75D
Applicable Drive(L7□A□□)		L7□B035□	L7□B075□	L7□B020□	L7□B035□	L7□B050□	L7□B075□
Rated output	[kW]	3.0	5.0	2.2	3.5	5.5	7.5
Rated torque	[N·m]	9.55	15.92	10.50	16.71	26.26	35.81
	[kgf·cm]	97.44	162.40	107.19	170.52	267.96	365.41
Instantaneous maximum torque	[N·m]	28.65	39.79	31.51	50.13	65.65	89.52
	[kgf·cm]	292.33	406.01	321.56	511.57	669.84	913.52
Rated Current	[A]	9.79	16.07	6.93	9.09	14.70	18.97
Maximum Current	[A]	29.38	40.18	20.80	27.26	36.75	47.42
Rated rotation speed	[r/min]	3000		2000			
Maximum rotation speed	[r/min]	5000		3000	2800	2700	2500
Inertia moment	[kg·m2x10-4]	27.960	46.560	27.960	46.560	73.850	106.730
	[gf·cm·s2]	28.531	47.510	28.531	47.510	75.357	108.908
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	32.61	54.40	39.46	59.98	93.38	120.15
Speed, Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	12.4	17.7	12.4	17.7	26.3	35.6

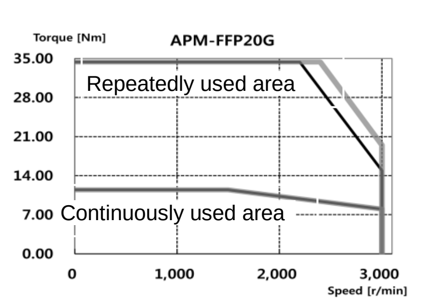
♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V

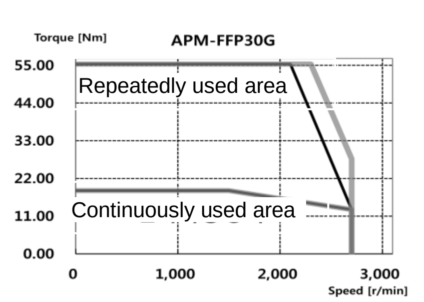


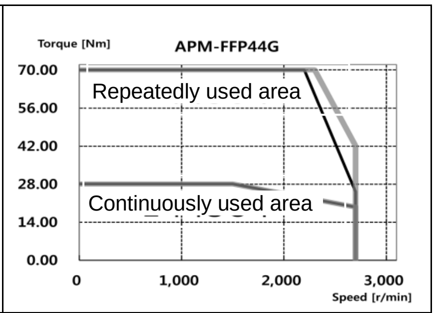
■ Product Features [400V]

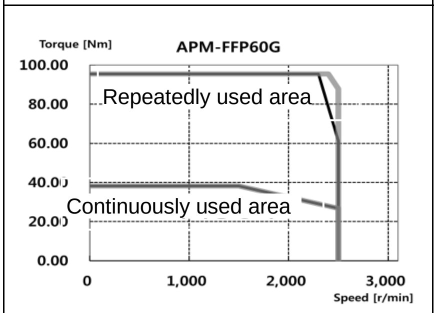
Servo Motor Name (APM-□□□□□□)		FFP20G	FFP30G	FFP44G	FFP60G	FFP75G	-
Applicable Drive(L7□A□□)		L7□B020□	L7□B035□	L7□B050□	L7□B075□		
Rated output	[kW]	1.8	2.9	4.4	6.0	7.5	
Rated torque	[N·m]	11.46	18.46	28.01	38.20	47.75	
	[kgf·cm]	116.93	188.39	285.83	389.77	487.21	
Instantaneous maximum torque	[N·m]	34.38	55.39	70.02	95.49	119.37	
	[kgf·cm]	350.79	565.16	714.48	974.42	1218.02	
Rated Current	[A]	7.56	10.04	15.68	20.23	20.01	
Maximum Current	[A]	22.69	30.12	39.20	50.58	50.03	
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000	2700	2700	2500	2200	
Inertia moment	[kg·m2x10-4]	27.960	46.560	73.850	106.730	131.290	
	[gf·cm·s2]	28.531	47.510	85.306	108.908	133.969	
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	46.96	73.21	106.25	136.70	173.64	
Speed, Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	12.4	17.7	26.3	35.6	39.4	

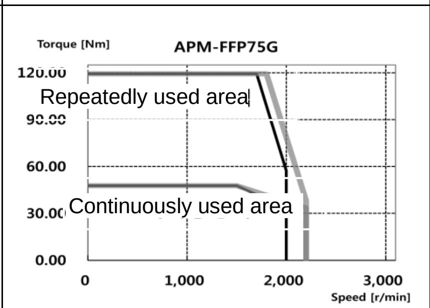
♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V







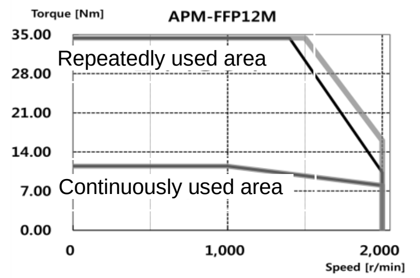


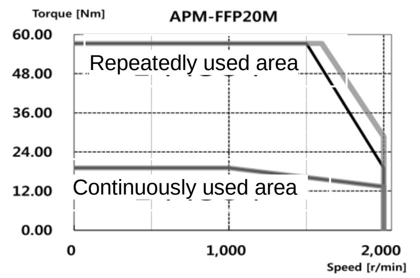


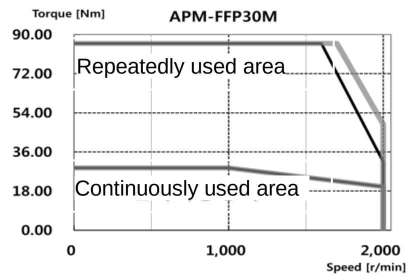
■ Product Features [400V]

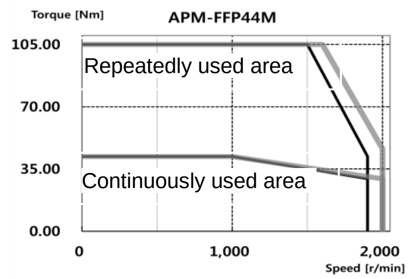
Servo Motor Name (APM-□□□□□□)		FFP12M	FFP20M	FFP30M	FFP44M	-	-
Applicable Drive(L7□A□□)		L7□B020□		L7□B050□	L7□B050□		
Rated output	[kW]	1.2	2.0	3.0	4.4		
Rated torque	[N·m]	11.46	19.10	28.65	42.02		
	[kgf·cm]	116.93	194.88	292.33	428.74		
Instantaneous maximum torque	[N·m]	34.38	57.30	71.62	105.05		
	[kgf·cm]	350.79	584.65	730.81	1071.85		
Rated Current	[A]	4.83	7.94	11.90	16.69		
Maximum Current	[A]	14.50	23.83	35.70	41.73		
Rated rotation speed	[r/min]	1000					
Maximum rotation speed	[r/min]	2000		1700	2000		
Inertia moment	[kg·m2x10-4]	27.960	46.560	73.850	106.730		
	[gf·cm·s2]	28.531	47.510	75.357	108.908		
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	46.96	78.34	111.13	145.48		
Speed, Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	12.4	17.7	26.3	35.6		

♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V





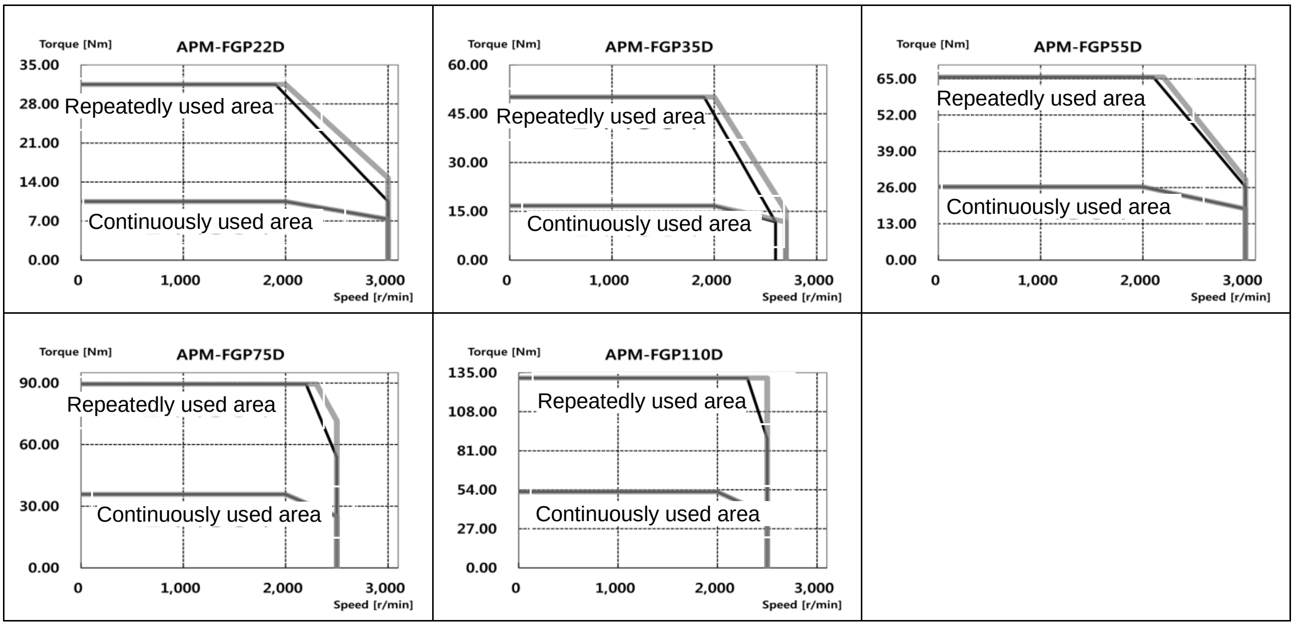




■ Product Features [400V]

Servo Motor Name (APM-□□□□□□)		FGP22D	FGP35D	FGP55D	FGP75D	FGP110D	-
Applicable Drive(L7□A□□)		L7□B020□	L7□B035□	L7□B050□	L7□B075□	L7□B150□	
Rated output	[kW]	2.2	3.5	5.5	7.5	11.0	
Rated torque	[N·m]	10.50	16.71	26.26	35.81	52.52	
	[kgf·cm]	107.19	170.52	267.96	365.41	525.9	
Instantaneous maximum torque	[N·m]	31.51	50.13	65.65	89.52	131.30	
	[kgf·cm]	321.56	511.57	669.84	913.52	1339.69	
Rated Current	[A]	7.12	8.73	16.04	19.10	27.41	
Maximum Current	[A]	21.35	26.20	40.1	47.76	68.52	
Rated rotation speed	[r/min]	2000					
Maximum rotation speed	[r/min]	3000	2700	3000	2500		
Inertia moment	[kg·m2x10-4]	41.130	71.530	117.720	149.400	291.36	
	[gf·cm·s2]	41.969	72.990	120.122	152.449	297.31	
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	26.83	39.04	58.58	85.83	94.68	
Speed, Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	16.95	21.95	30.8	37.52	66.2	

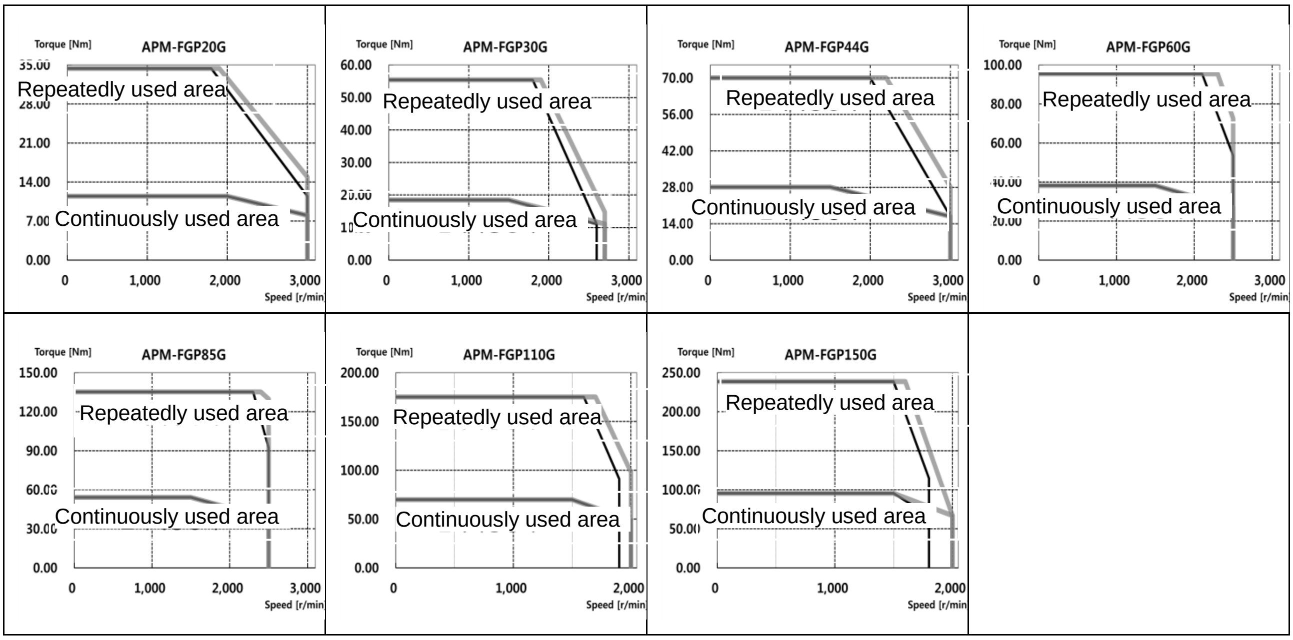
♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V



■ Product Features [400V]

Servo Motor Name (APM-□□□□□□)		FGP20G	FGP30G	FGP44G	FGP60G	FGP85G	FGP110G	FGP150G
Applicable Drive(L7□A□□)		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	15.0
Rated torque	[N·m]	11.46	18.46	28.01	38.20	54.11	70.03	95.49
	[kgf·cm]	116.93	188.39	285.83	389.77	552.17	714.57	974.42
Instantaneous maximum torque	[N·m]	34.38	55.39	84.03	95.49	135.28	175.07	238.73
	[kgf·cm]	350.79	565.16	857.49	974.42	1380.43	1786.43	2436.05
Rated Current	[A]	7.76	9.65	17.11	20.38	28.24	28.02	35.71
Maximum Current	[A]	23.29	28.95	46.19	50.95	70.60	70.05	89.25
Rated rotation speed	[r/min]	1500						
Maximum rotation speed	[r/min]	3000	2700	3000	2500	2500	2000	2000
Inertia moment	[kg·m2x10-4]	41.130	71.530	117.720	149.400	291.36	291.36	424.57
	[gf·cm·s2]	41.969	72.990	120.122	152.449	297.31	297.31	416.08
Allowable load inertia		Motor inertia x 5						
Rated power rate	[kW/s]	25.531	42.41	59.25	84.36	100.5	168.3	234.44
Speed, Position detector	Standard	Serial Type 19 [bit]						
	Option	X						
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)						
	Time rating	Continuous						
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]						
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)						
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas						
	Anti-vibration	Vibration acceleration 49[m/s2](5G)						
Weight	[kg]	16.95	21.95	30.8	37.52	66.2	66.3	92.2

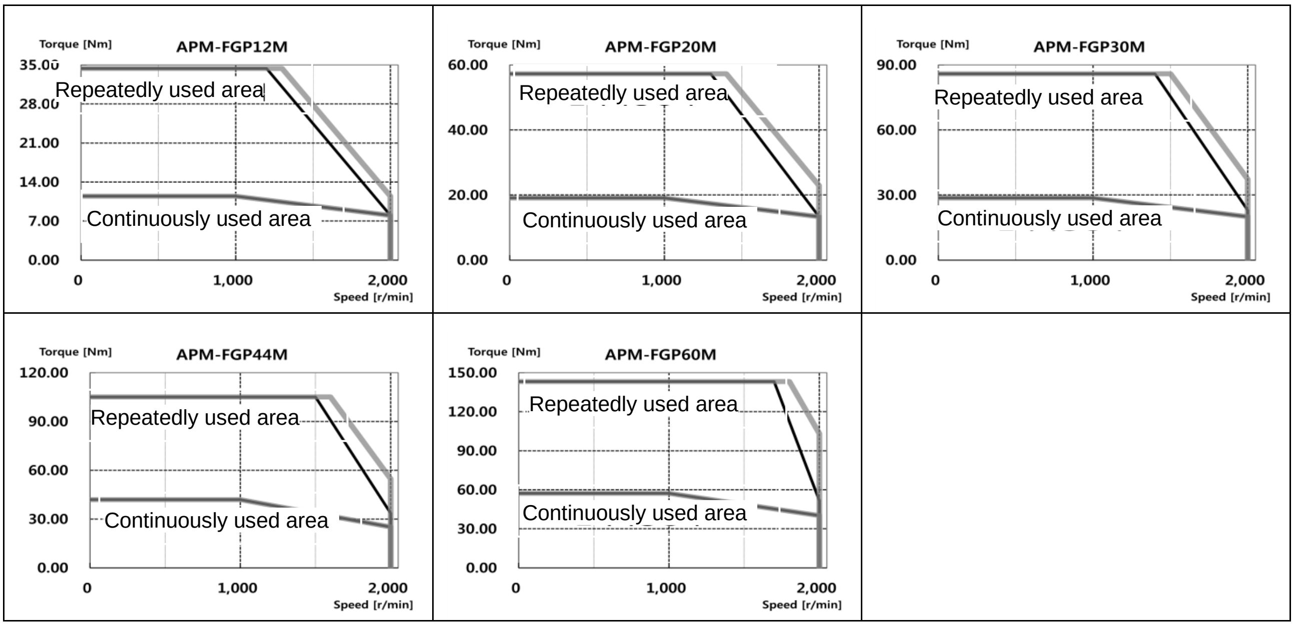
♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V



■ Product Features [400V]

Servo Motor Name (APM-□□□□□□)		FGP12M	FGP20M	FGP30M	FGP44M	FGP60M	-
Applicable Drive(L7□A□□)		L7□B020□		L7□B035□	L7□B050□	L7□B075□	
Rated output	[kW]	1.2	2.0	3.0	4.4	6.0	
Rated torque	[N·m]	11.46	19.10	28.65	42.02	57.30	
	[kgf·cm]	116.93	194.88	292.33	428.74	584.65	
Instantaneous maximum torque	[N·m]	34.38	57.30	85.94	113.45	143.24	
	[kgf·cm]	350.79	584.65	876.98	1157.59	1461.63	
Rated Current	[A]	4.75	7.88	11.74	17.39	20.23	
Maximum Current	[A]	14.24	23.64	35.22	46.95	49.69	
Rated rotation speed	[r/min]	1000					
Maximum rotation speed	[r/min]	2000					
Inertia moment	[kg·m2x10-4]	41.130	71.530	117.720	149.400	291.36	
	[gf·cm·s2]	41.969	72.990	120.122	152.449	297.31	
Allowable load inertia		Motor inertia x 5					
Rated power rate	[kW/s]	31.93	50.99	54.93	118.17	112.64	
Speed, Position detector	Standard	Serial Type 19 [bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	Operating temperature: 0~40[°C], Storage temperature : -10~60[°C]					
	Ambient humidity	Ambient humidity: 80[%]RH, Storage humidity: 90[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49[m/s2](5G)					
Weight	[kg]	16.95	21.95	30.8	37.52	66.2	

♦Rotation Speed - Torque Characteristics: 3 phase AC380V, ■ : 3 phase AC400V



■ Electric brake specification

Applicable motor series	FAL	FBL	FCL	FE(P)	FF(P)	FG(P)	FG(P)110G FG(P)150G
Usage	For retain	For retain	For retain	For retain	For retain	For retain	For retain
Input voltage(V)	DC 24V	DC 24V	DC 24V	DC 24V	DC 24V	DC 90V	DC 24V
Static friction torque [N•m]	0.32	1.47	3.23	10.4	40	74	120
Capacity[W]	6	6.5	9	19.4	25	32	26
Coil resistance[Ω]	96	89	64	29.6	23	327	22.2
Rated current [A]	0.25	0.27	0.38	0.81	1.04	0.28	1.08
Brake method	Spring brake	Spring brake	Spring brake	Spring brake	Spring brake	Spring brake	Spring brake
Insulation grade	Grade F	Grade F	Grade F	Grade F	Grade F	Grade F	Grade F

Note1) The same specifications apply to all electric brakes installed in our servo motors.

Note2) Electric brakes are designed to maintain a stop. Never use them for absolute braking.

Note3) The characteristics of the electric brakes were measured at 20°C.

Note4) These brake specifications are subject to change. Check the voltage specifications on your specific motor.

Note5) FAL, FBL, FCL, FE (P) Series brake UL standard meets Class 2.

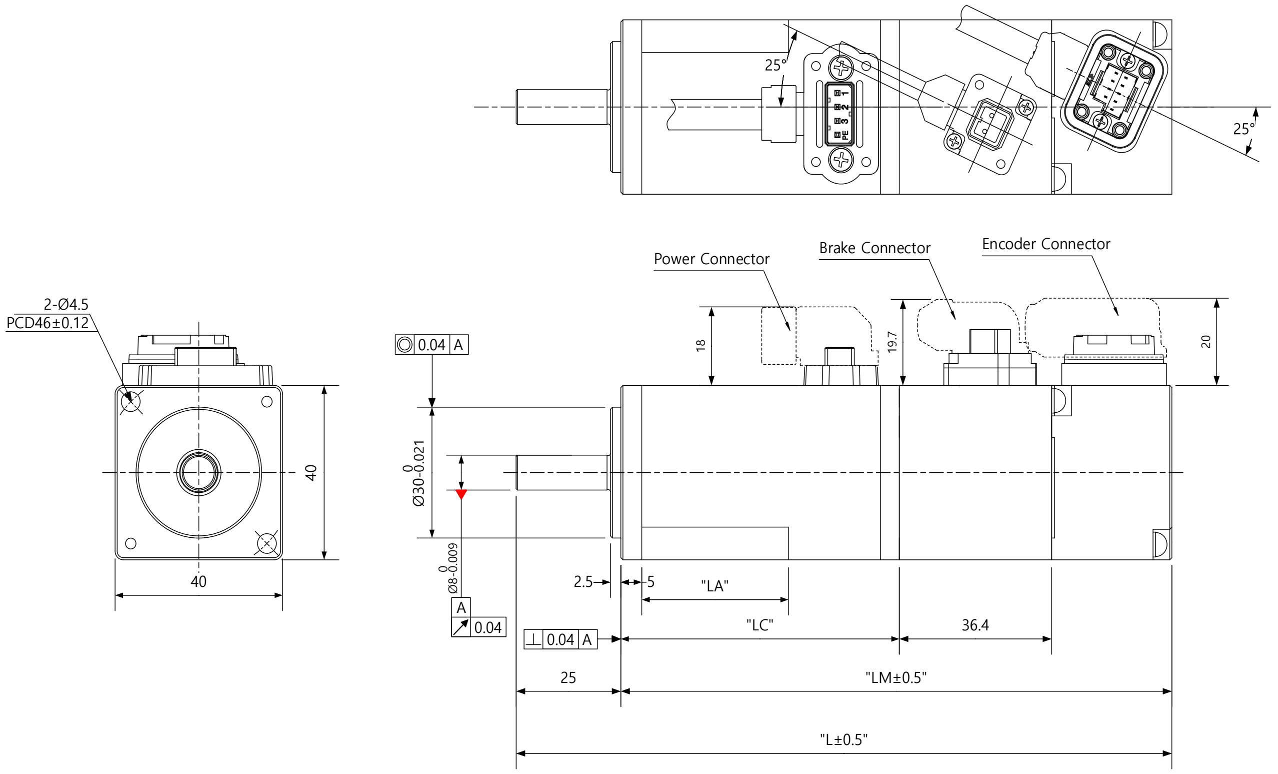
Note6) Do not share the electronic brake power supply with the interface DC24V power supply. Be sure to use a power supply exclusively for electronic brakes.

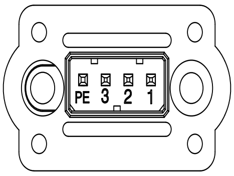
2.1.1 Outline drawing

■ **FAL Series | APM – FALR5A, FBL02A, FBL04A**

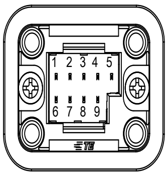
APM – FAL01A

APM – FAL015A

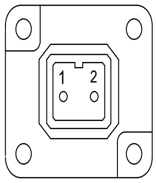




Pin No.	Signal name
1	U
2	V
3	W
PE	FG



Multi Turn (M)			
Pin No.	Signal name	Pin No.	Signal name
1	MA	6	/MA
2	SLO	7	/SLO
3	GND_B	8	VDD_B
4	0V	9	+5V
5	Shield		



Pin No.	Signal name
1	BK+
2	BK-

<Power Connector pin arrangement> <Encoder Connector pin arrangement> <Brake Connector pin arrangement>

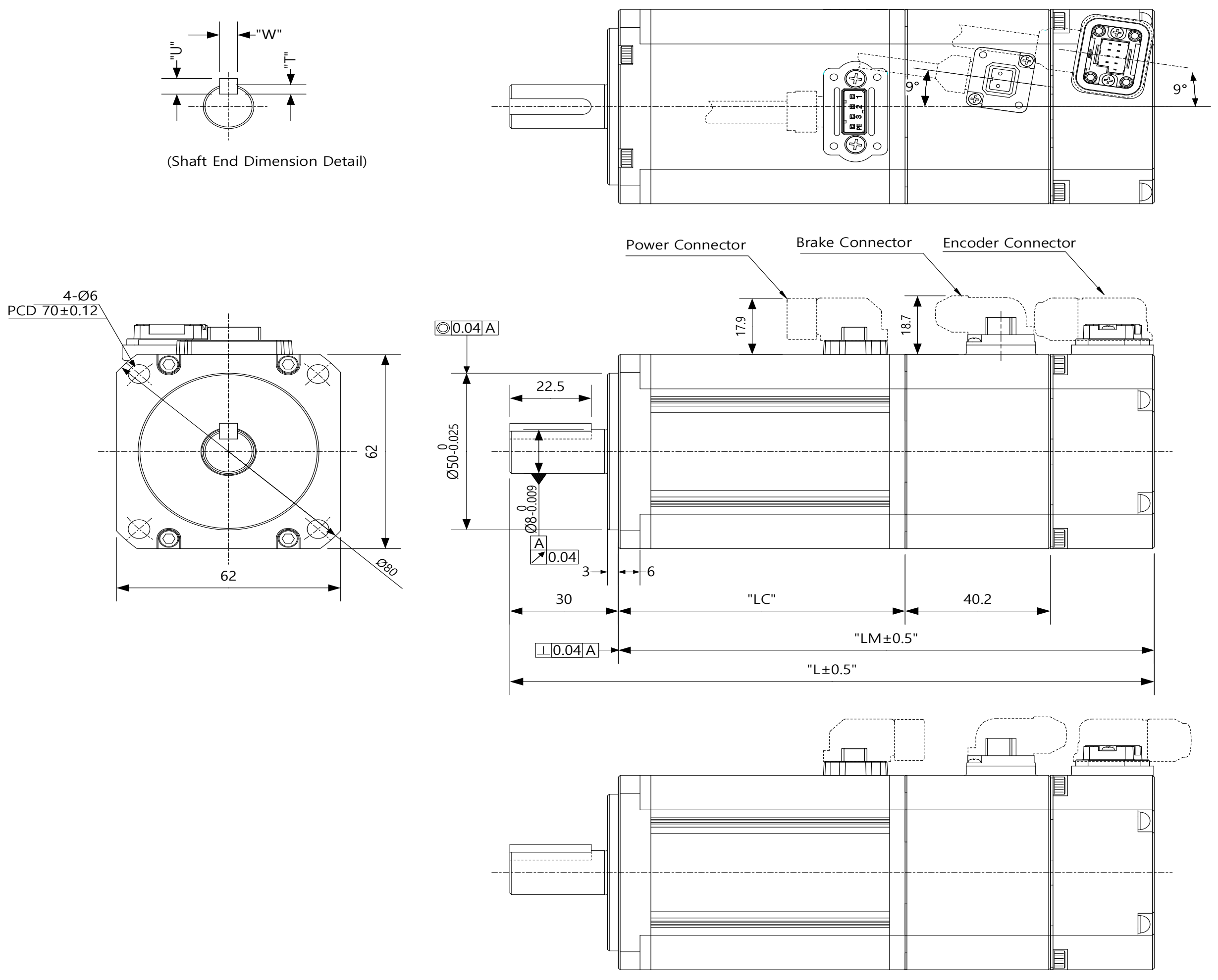
Model name	Dimension				Weight(Kg)
	L	LM	LC	LA	
FALR5A	**103.2(139.6)**	**78.2(114.6)**	**49.5**	**23**	**0.31(0.66)**
FAL01A	**120.2(156.6)**	**95.2(131.6)**	**66.5**	**35**	**0.45(0.80)**
FAL015A	**140.2**	**115.2**	**86.5**	**35**	**0.61**

Note1) Use DC power (24 V) to operate the brake

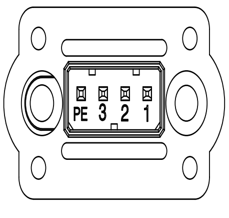
Note2) The sizes in parentheses apply when attached to the brakes.

Note3) When connecting FAL products, connect the power cable first.

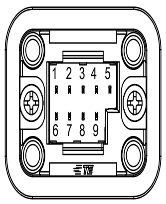
■ **FBL Series | APM – FBL01A, FBL02A, FBL04A**



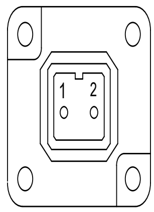
<When the cable is pulled out in the opposite direction of the axis>



Pin No.	Signal name
1	U
2	V
3	W
PE	FG



Multi Turn (M)			
Pin No.	Signal name	Pin No.	Signal name
1	MA	6	/MA
2	SLO	7	/SLO
3	GND_B	8	VDD_B
4	0V	9	+5V
5	Shield		



Pin No.	Signal name
1	BK+
2	BK-

<Power Connector pin arrangement> <Encoder Connector pin arrangement> <Brake Connector pin arrangement>

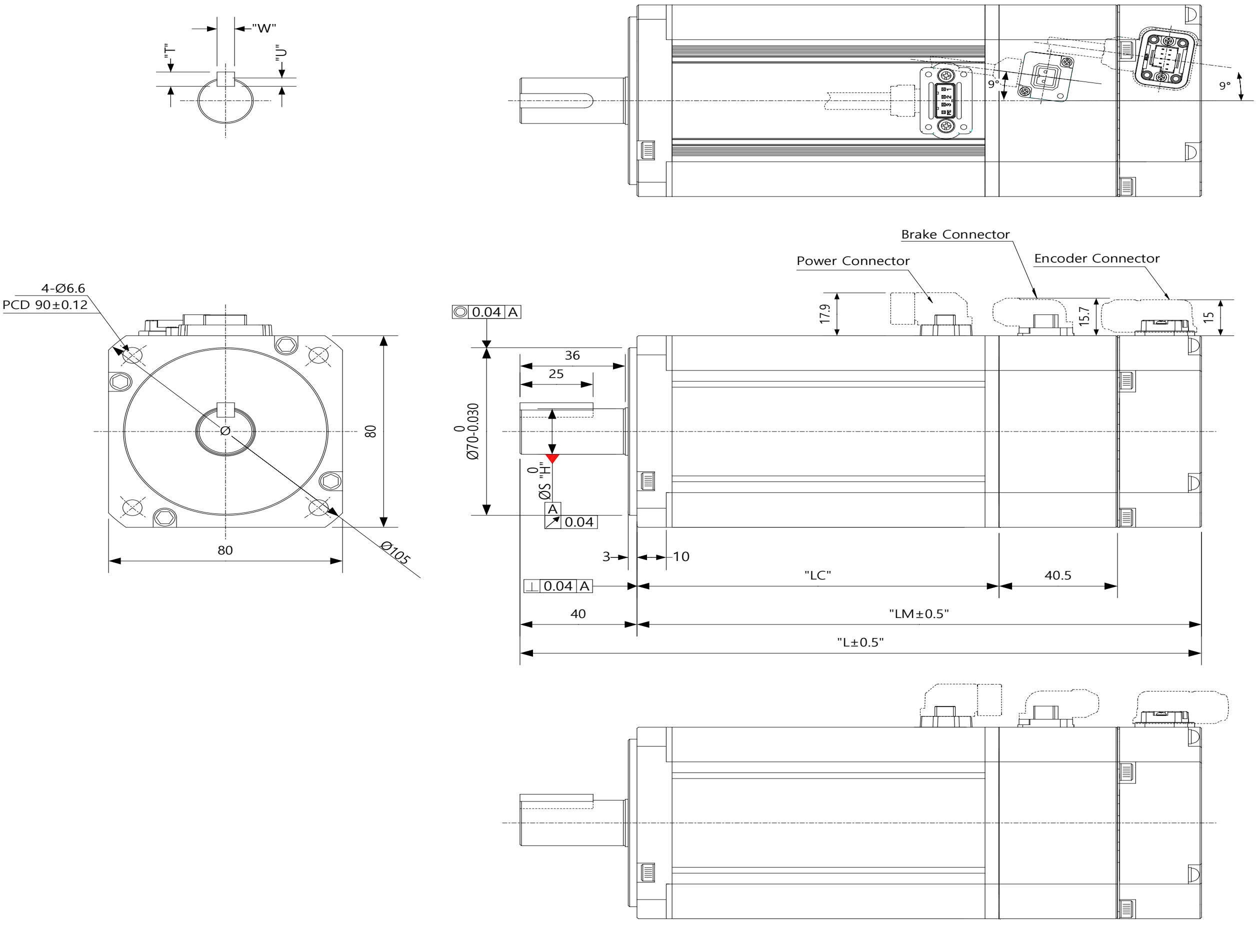
Model name	Dimension					Key dimension			Weight(Kg)
	L	LM	LC	S	H	T	W	U	
FBL01A	**107.2(147.2)**	**77.2(117.2)**	**48.5(48.3)**	**14**	**-0.018**	**5**	**5**	**3**	**0.56(1.3)**
FBL02A	**118.2(158.2)**	**88.2(128.2)**	**59.5(59.3)**	**14**	**-0.018**	**5**	**5**	**3**	**0.74(1.48)**
FBL04A	**138.2(178.2)**	**108.2(148.2)**	**79.5(79.3)**	**14**	**-0.018**	**5**	**5**	**3**	**1.06(1.8)**

Note1) Use DC power (24 V) to operate the brake

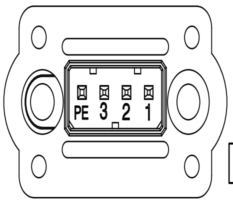
Note2) The sizes in parentheses apply when attached to the brakes.

■ **FCL Series | APM – FCL04A, FCL03D, FCL05D**

APM - FCL08A, FCL06D, FCL10A, FCL07D

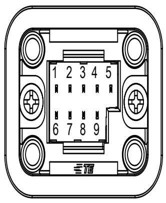


<When the cable withdrawal direction is opposite to the axis>



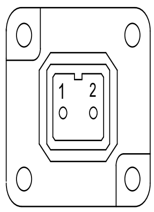
Pin No.	Signal name
1	U
2	V
3	W
PE	FG

<Power Connector pin arrangement>



Multi Turn (M)			
Pin No.	Signal name	Pin No.	Signal name
1	MA	6	/MA
2	SLO	7	/SLO
3	GND_B	8	VDD_B
4	0V	9	+5V
5	Shield		

<Encoder Connector pin arrangement>



Pin No.	Signal name
1	BK+
2	BK-

<Brake Connector pin arrangement>

Model name	Dimension					Key dimension			Weight(Kg)
	L	LM	LC	S	H	T	W	U	
FCL04A,FCL03D	138.7(179.5)	98.7(139.5)	70(69.8)	14	-0.018	5	5	3	1.52(2.32)/1.26(2.06)
FCL06A,FCL05D	156.7(197.5)	116.7(157.5)	88(87.8)	19	-0.021	6	6	3.5	2.14(2.94)/2.12(2.92)
FCL08A,FCL06D	174.7(215.5)	134.7(175.5)	106(105.8)	19	-0.021	6	6	3.5	2.68(3.48)/2.66(3.46)
FCL10A,FCL07D	192.7(233.5)	152.7(193.5)	124(123.8)	19	-0.021	6	6	3.5	3.30(4.10)/2.78(3.58)

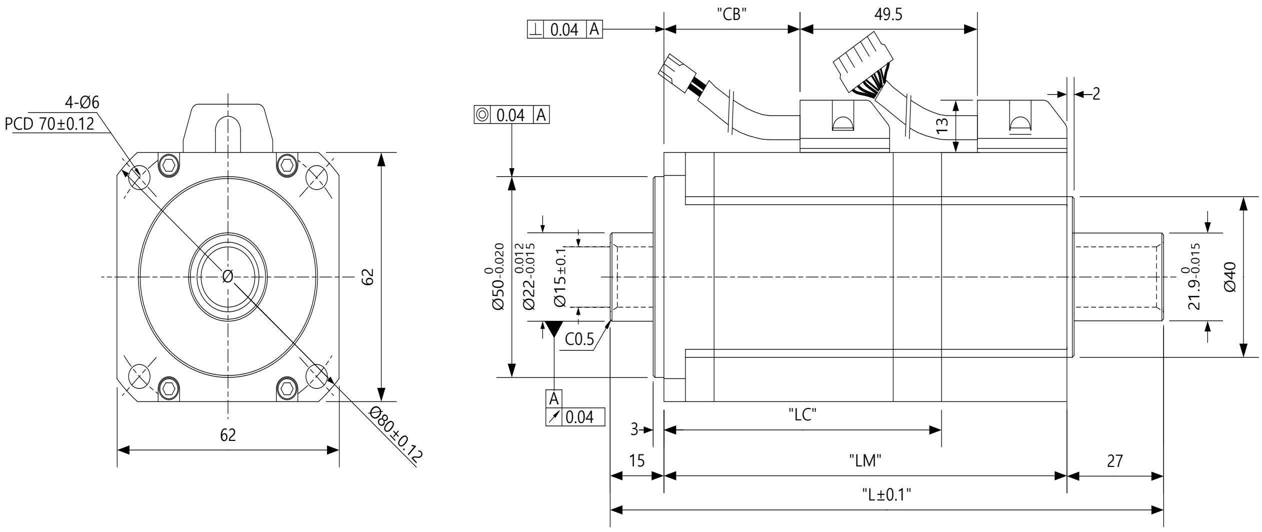
Note1) Use DC power (24 V) to operate the brake

Note2) The sizes in parentheses apply when attached to the brakes.

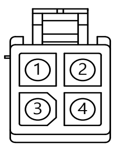
■ **HB Series | APM-HB01A (Hollow Shaft)**

APM-HB02A (Hollow Shaft)

APM-HB04A (Hollow Shaft)



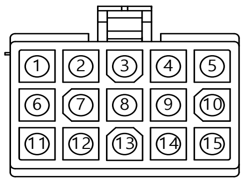
<Power Connector>



Pin No.	Signal name
1	U
2	V
3	W
4	FG

Plug : 172167-1(AMP)

<Encoder Connector>



Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
1	A	6	/Z	11	W
2	/A	7	U	12	/W
3	B	8	/U	13	+5V
4	/B	9	V	14	0V
5	Z	10	/V	15	SHIELD

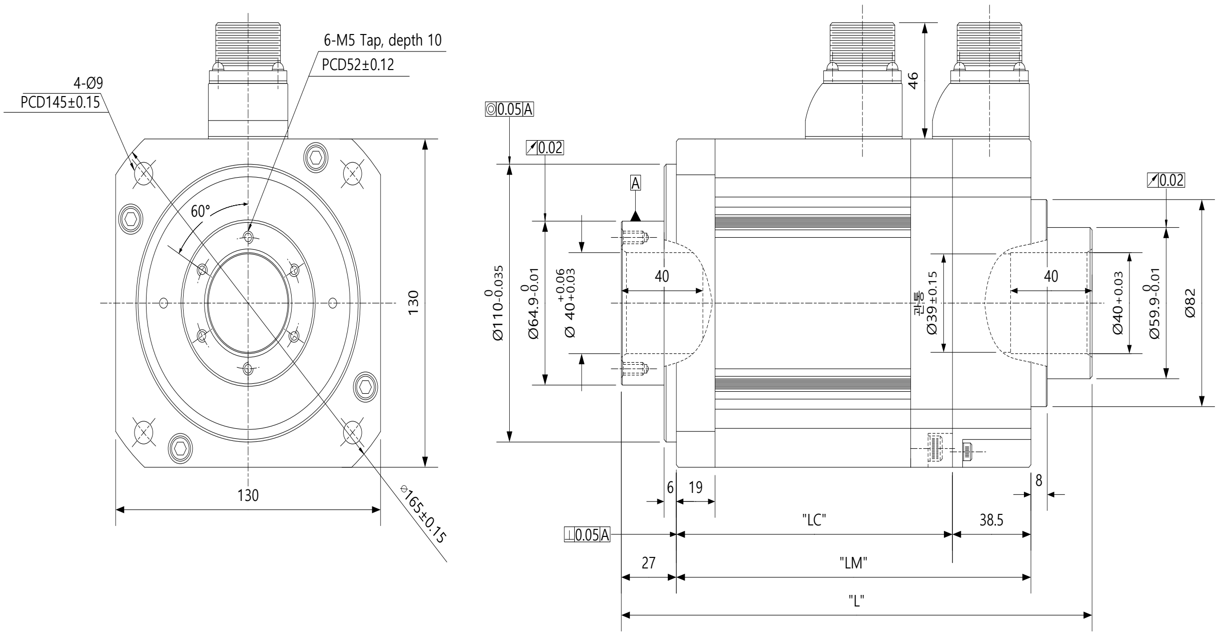
Plug : 172171-1(AMP)

Model	Dimension				Hollow Shaft	Weight(Kg)
	L	LM	LC	CB		
HB01A	140.5	98.5	68.5	24	15	0.89
HB02A	154.5	112.5	82.5	38	15	1.16
HB04A	182.5	140.5	105.5	66	15	1.69

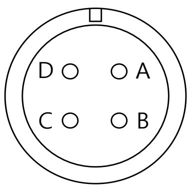
■ **HE Series | APM-HE09A (Hollow Shaft)**

APM-HE15A (Hollow Shaft)

APM-HE30A (Hollow Shaft)



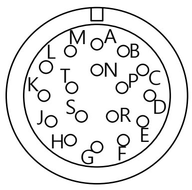
<Power Connector>



Pin No.	Signal name
A	U
B	V
C	W
D	FG

Plug : MS3102A20-4P

<Encoder Connector>

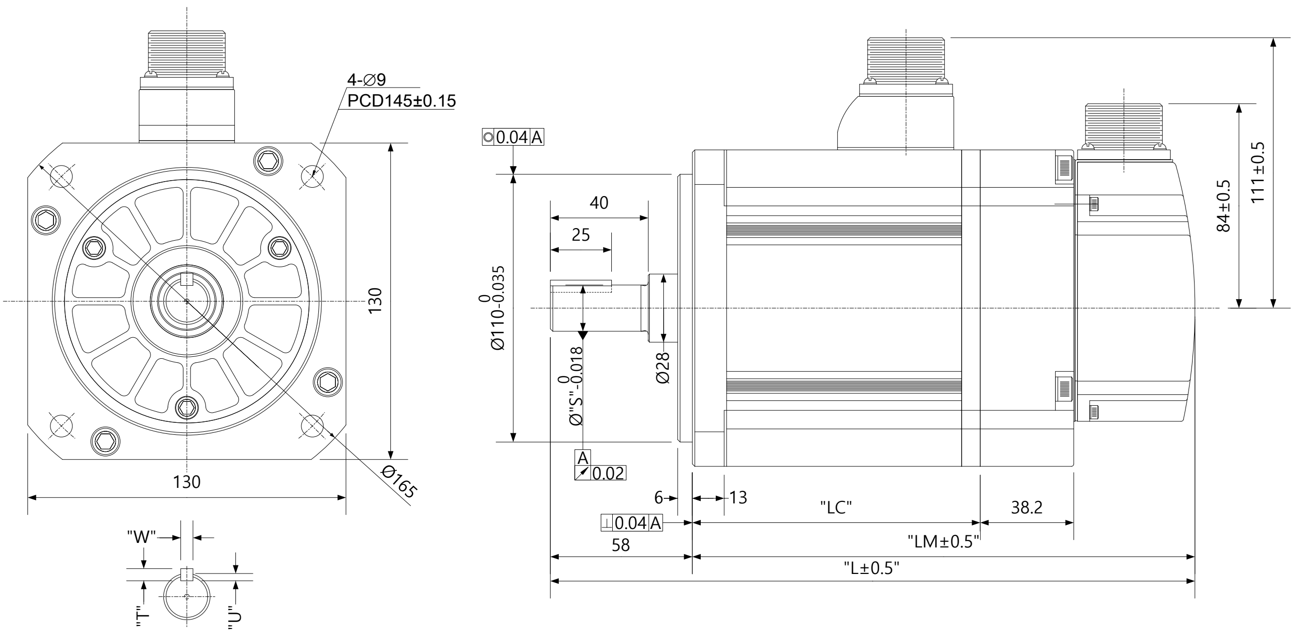


Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
A	A	F	/Z	P	W
B	/A	K	U	R	/W
C	B	L	/U	H	+5V
D	/B	M	V	G	0V
E	Z	N	/V	J	SHIELD

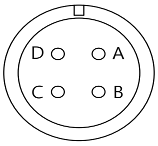
Plug : MS3102A20-15P

Model	Dimension			Hollow Shaft	Weight(Kg)
	L	LM	LC		
HE09A	207	150	111.5	40	5.8
HE15A	231	174	135.5	40	7.4
HE30A	279	222	183.5	40	10.83

■FE(P) Series | APM-FE(P)09A, FE(P)06D, FE(P)05G, FE(P)03M, FE(P)15A, FE(P)11D, FE(P)09G, FE(P)06MAPM-FE(P)22A, FE(P)16D, FE(P)13G, FE(P)09M, FE(P)30A, FE(P)22D, FE(P)17G, FE(P)12M



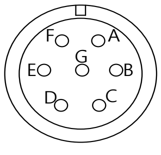
<Power Connector>



Pin No.	Signal name
A	U
B	V
C	W
D	FG

Plug : MS3102A20-4P

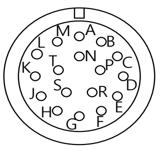
<Brake Type Connector>



Pin No.	Signal name	Pin No.	Signal name
A	U	D	FG
B	V	E	BK+
C	W	F	BK-

Plug : MS3102A20-15P

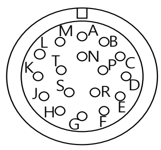
<Serial M-Turn Connector>



Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
A	MA	F	GND_B	P	-
B	/MA	K	-	R	-
C	SLO	L	-	H	+5V
D	/SLO	M	-	G	0V
E	VDD_B	N	-	J	SHIELD

Plug : MS3102A20-29P

<Serial S-Turn Connector>



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

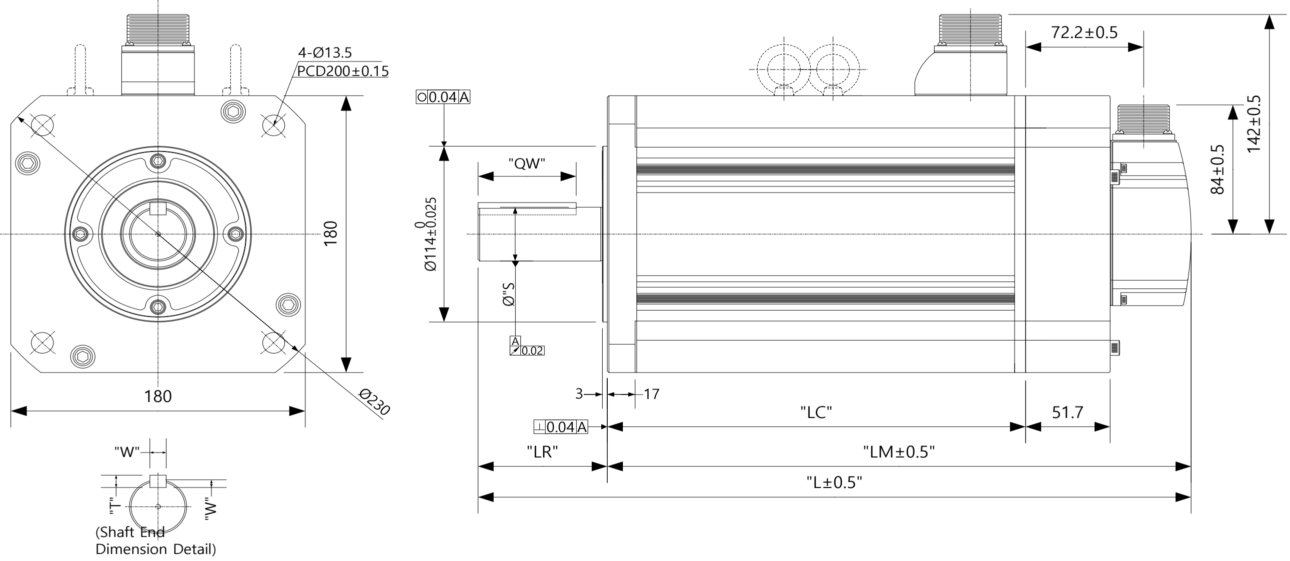
Plug : MS3102A20-29P

Model	Dimension				Key dimension			Weight(Kg)
	L	LM	LC	S	T	W	U	
FE09A,FE06D, FE05G,FE03M	197.3(235.3)	139.3(177.3)	89.8(89.6)	19	5	5	3	5.04(6.58)
FE15A,FE11D, FE09G,FE06M	217.3(255.3)	159.3(197.3)	109.8(109.6)	19	5	5	3	6.74(8.28)
FE22A,FE16D, FE13G,FE09M	237.3(275.3)	179.3(217.3)	129.8(129.6)	22	6	6	3.5	8.48(10.02)
FE30A,FE22D, FE17G,FE12M	255.3(293.3)	197.3(235.3)	147.8(147.6)	24	7	8	4	10.05(11.59)

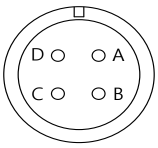
Note1) Use DC power (24 V) to operate the brake

Note2) The sizes in parentheses apply when attached to the brakes.

■ **FF(P) Series | APM-FF(P)30A, FF(P)22D, FF(P)20G, FF(P)12M, FF(P)50A, FF(P)35D, FF(P)30G, FF(P)20M, APM-FF(P)55D, FF(P)44G, FF(P)30M, FF(P)75D, FF(P)60G, FF(P)44M, FF(P)75G**



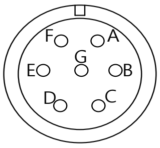
<Power Connector>



Pin No.	Signal name
A	U
B	V
C	W
D	FG

Plug : MS3102A22-22P

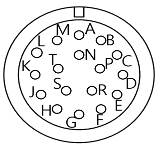
<Brake Type Connector>



Pin No.	Signal name	Pin No.	Signal name
A	U	D	FG
B	V	E	BK+
C	W	F	BK-

Plug : MS3102A24-10P

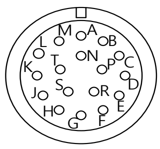
<Serial M-Turn Connector>



Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
A	MA	F	GND_B	P	-
B	/MA	K	-	R	-
C	SLO	L	-	H	+5V
D	/SLO	M	-	G	0V
E	VDD_B	N	-	J	SHIELD

Plug : MS3102A20-29P

<Serial S-Turn Connector>



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

Plug : MS3102A20-29P

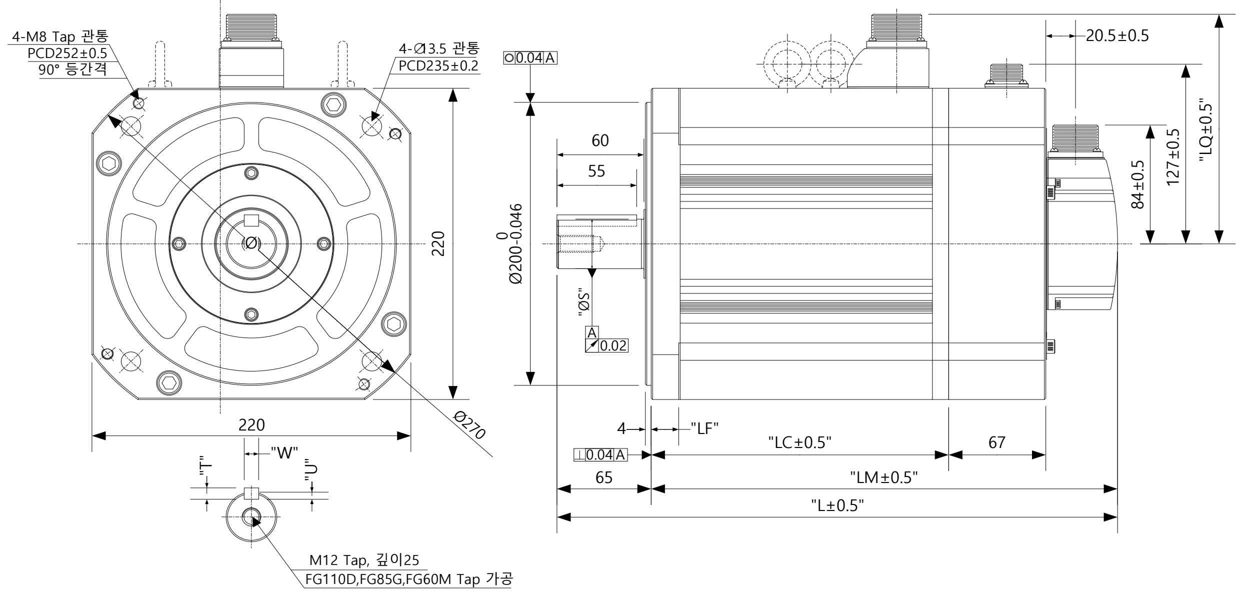
<table>
<tr><th rowspan="2">Model</th><th colspan="5">Dimension</th><th colspan="4">Key dimension</th><th rowspan="2">Eye bolt</th><th rowspan="2">Weight (Kg)</th></tr>
<tr><th>L</th><th>LM</th><th>LC</th><th>LR</th><th>S</th><th>QW</th><th>T</th><th>W</th><th>U</th></tr>
<tr><td>FF30A, FF22D
FF20G, FF12M</td><td>257.5(308.9)</td><td>178.5(229.9)</td><td>129(128.7)</td><td rowspan="4">79</td><td rowspan="3">35
(0~+0.01)</td><td rowspan="4">60</td><td rowspan="5">8</td><td rowspan="3">10</td><td rowspan="5">5</td><td rowspan="2">X</td><td>12.5
(19.7)</td></tr>
<tr><td>FF50A, FF35D
FF30G, FF20M</td><td>287.5(338.9)</td><td>208.5(259.9)</td><td>159(158.7)</td><td>17.4
(24.6)</td></tr>
<tr><td>FF55D, FF44G
FF30M</td><td>331.5(382.9)</td><td>252.5(303.9)</td><td>203(202.7)</td><td rowspan="3">O</td><td>25.2
(32.4)</td></tr>
<tr><td>FF75D, FF60G,
FF44M</td><td>384.5(435.9)</td><td>305.5(356.9)</td><td>256(255.7)</td><td rowspan="2">42
(-0.016~0)</td><td rowspan="2">12</td><td>33.8
(41.0)</td></tr>
<tr><td>FF75G(Nnote3)</td><td>439.5</td><td>326.5</td><td>277</td><td>113</td><td>96</td><td>38.5</td></tr>
</table>

Note1) Use DC power (24 V) to operate the brake

Note2) The sizes in parentheses apply when attached to the brakes.

Not3) For FF75G model, use MS connector 32-17P.

■FG(P) Series | APM-FG(P)22D, FG(P)20G, FG(P)12M, FG(P)35D, FG(P)30G, FG(P)20M, FG(P)55D, FG(P)44GAPM- FG(P)30M, FG(P)75D, FG(P)60G, FG(P)44M, FG(P)110D, FG(P)85G, FG(P)60M

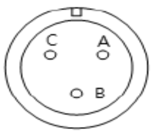


<Power Connector>

Pin No.	Signal name
A	U
B	V
C	W
D	FG

Plug : MS3102A22-22P
(주 3) Plug : MS3102A32-17P

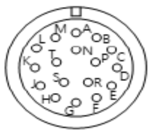
<Brake Connector>



Pin No.	Polarity
A	BK+
B	BK-
C	NC

Plug : MS3102A14-7P

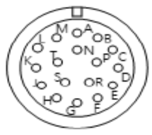
<Serial M-Turn Connector>



Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
A	MA	F	GND_B	P	-
B	/MA	K	-	R	-
C	SLO	L	-	H	+5V
D	/SLO	M	-	G	0V
E	VDD_B	N	-	J	SHIELD

Plug : MS3102A20-29P

<Serial S-Turn Connector>



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

Plug : MS3102A20-29P

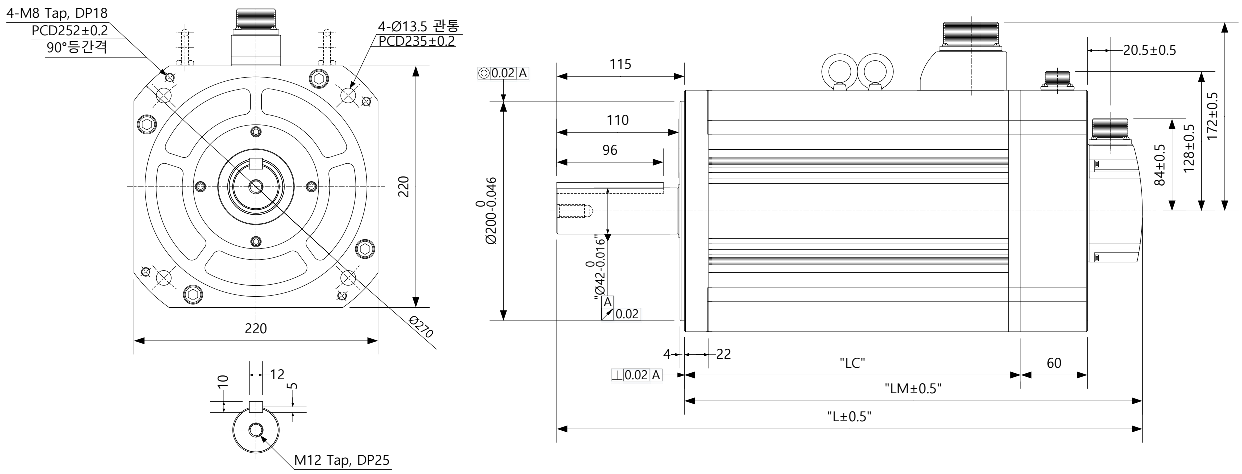
<table>
<tr><th rowspan="2">Model</th><th colspan="6">Dimension</th><th colspan="3">Key dimension</th><th rowspan="2">Power Connector</th><th rowspan="2">Weight (Kg)</th></tr>
<tr><th>L</th><th>LM</th><th>LC</th><th>LF</th><th>LQ</th><th>S</th><th>T</th><th>W</th><th>U</th></tr>
<tr><td>FG22D, FG20G
FG12M</td><td>229.5
(295.7)</td><td>164.5
(230.7)</td><td>115
(114.2)</td><td rowspan="4">19</td><td rowspan="4">162</td><td rowspan="3">35
(-0.016~0)</td><td rowspan="5">8</td><td rowspan="3">10</td><td rowspan="4">5</td><td rowspan="4">MS3102A
22-22P</td><td>15.42
(29.23)</td></tr>
<tr><td>FG35D, FG30G
FG20M</td><td>250.5
(316.7)</td><td>185.5
(251.7)</td><td>136
(135.2)</td><td>20.22
(34.03)</td></tr>
<tr><td>FG55D, FG44G
FG30M</td><td>282.5
(348.7)</td><td>217.5
(283.7)</td><td>168
(167.2)</td><td>28.02
(41.83)</td></tr>
<tr><td>FG75D, FG60G
FG44M,</td><td>304.5
(370.7)</td><td>239.5
(305.7)</td><td>190
(189.2)</td><td>42
(-0.016~0)</td><td>12</td><td>33.45
(47.26)</td></tr>
<tr><td>FG110D, FG85G
FG60M(note3)</td><td>418.5
(484.7)</td><td>353.5
(419.7)</td><td>304
(303.2)</td><td>21</td><td>173</td><td>45
(-0.016~0)</td><td>10</td><td>6</td><td>MS3102A
32-17P</td><td>66.2
(82.6)</td></tr>
</table>

Note1) Use DC power (24 V) to operate the brake

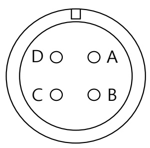
Note2) The sizes in parentheses apply when attached to the brakes.

Note3) Connector specification is MS3102A32-17P

■ **FG (P) Series | APM-FG (P) 110G**



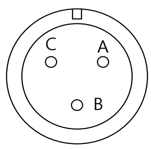
<Power Connector>



Pin No.	Signal name
A	U
B	V
C	W
D	FG

Plug : MS3102A32-17P

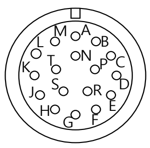
<Brake Connector>



Pin No.	Polarity
A	BK+
B	BK-
C	NC

Plug : MS3102A14-7P

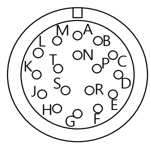
<Serial M-Turn Connector>



Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
A	MA	F	GND_B	P	-
B	/MA	K	-	R	-
C	SLO	L	-	H	+5V
D	/SLO	M	-	G	0V
E	V_{DD}_B	N	-	J	SHIELD

Plug : MS3102A20-29P

<Serial S-Turn Connector>



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

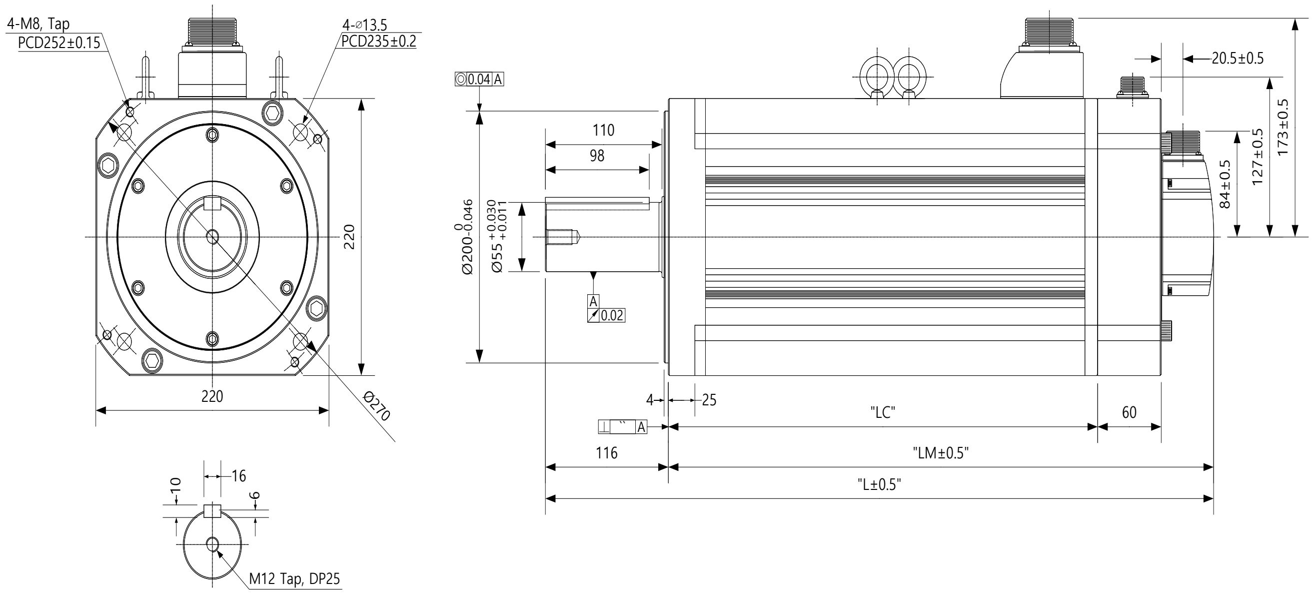
Plug : MS3102A20-29P

Model	Dimension			Power Connector	Weight (Kg)
	L	LM	LC		
FG110G	468.5(527.7)	353.5(419.7)	304(303.2)	MS3102A 32-17P	66.3(82.7)

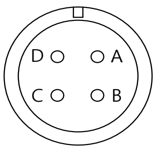
Note1) Use DC power (24 V) to operate the brake

Note2) The sizes in parentheses apply when attached to the brakes.

■ **FG (P) Series | APM-FG(P)150G**



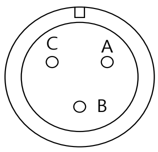
<Power Connector>



Pin No.	Signal name
A	U
B	V
C	W
D	FG

Plug : MS3102A32-17P

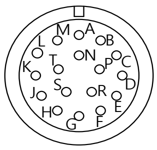
<Brake Connector>



Pin No.	Polarity
A	BK+
B	BK-
C	NC

Plug : MS3102A14-7P

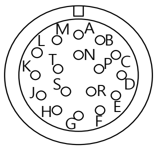
<Serial M-Turn Connector>



Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
A	MA	F	GND_B	P	-
B	/MA	K	-	R	-
C	SLO	L	-	H	+5V
D	/SLO	M	-	G	0V
E	VDD_B	N	-	J	SHIELD

Plug : MS3102A20-29P

<Serial S-Turn Connector>



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

Plug : MS3102A20-29P

Model	Dimension			Power Connector	Weight(Kg)
	L	LM	LC		
FG150G	574(630.5)	458(514.5)	408(405)	MS3102A 32-17P	92.2(108.6)

Note1) Use DC power (24 V) to operate the brake

Note2) The sizes in parentheses apply when attached to the brakes.

2.1.2 Motor type and ID

[200V]

Model name	ID	Watt	Note
SAR3A	1	30	
SAR5A	2	50	
SA01A	3	100	
***SA015A**	**6**	**150**	**Mass production after March 2018**
SB01A	11	100	
SB02A	12	200	
SB04A	13	400	
HB02A	15	200	Hollow Shaft
HB04A	16	400	Hollow Shaft
-	-	-	-
SC04A	21	400	
SC06A	22	600	
SC08A	23	800	
SC10A	24	1000	
SC03D	25	300	
SC05D	26	450	
SC06D	27	550	
SC07D	28	650	
-	-	-	-
HE09A	77	900	Hollow Shaft
HE15A	78	1500	Hollow Shaft
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Model name	ID	Watt	Note
DB03D	601	63	
DB06D	602	126	
DB09D	603	188	
DC06D	611	126	
DC12D	612	251	
DC18D	613	377	
DD12D	621	251	
DD22D	622	461	
DD34D	623	712	
DE40D	632	838	
DE60D	633	1257	
DFA1G	641	1728	
DFA6G	642	2513	
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

*** SA015A: For models produced before March 2018, use ID 5.**

Model name	ID	Watt	Note
FALR5A	702	50	
FAL01A	703	100	
***FAL015A**	**706**	**150**	**Mass production after March 2018**
-	-	-	-
FBL01A	714	100	
FBL02A	715	200	
FBL04A	716	400	
-	-	-	-
FCL04A	729	400	
FCL06A	730	600	
FCL08A	731	750	
FCL10A	732	1000	
-	-	-	-
FCL03D	733	300	
FCL05D	734	450	
FCL06D	735	550	
FCL07D	736	650	
-	-	-	-
FE09A	761	900	
FE15A	762	1500	
FE22A	763	2200	
FE30A	764	3000	
FE06D	765	600	
FE11D	766	1100	
FE16D	767	1600	
FE22D	768	2200	
FE03M	769	300	
FE06M	770	600	
FE09M	771	900	
FE12M	772	1200	
FE05G	773	450	
FE09G	774	850	
FE13G	775	1300	
FE17G	776	1700	
-	-	-	-

Model name	ID	Watt	Note
FF30A	781	3000	
FF50A	782	5000	
FF22D	785	2200	
FF35D	786	3500	
FF55D	787	5500	
FF75D	788	7500	
FF12M	789	1200	
FF20M	790	2000	
FF30M	791	3000	
FF44M	792	4000	
FF20G	793	1800	
FF30G	794	2900	
FF44G	795	4400	
FF60G	796	6000	
FF75G	804	7500	
-	-	-	-
FG22D	811	2200	
FG35D	812	3500	
FG55D	813	5500	
FG75D	814	7500	
FG12M	821	1200	
FG20M	822	2000	
FG30M	823	3000	
FG44M	824	4400	
FG60M	825	6000	
FG20G	831	1800	
FG30G	832	2900	
FG44G	833	4400	
FG60G	834	6000	
FG85G	835	8500	
FG110G	836	11000	
FG150G	837	15000	
-	-	-	-
-	-	-	-
-	-	-	-

*** FAL015A: For models produced before March 2018, use ID 704.**

[400V]

Model name	ID	Watt	Note
FEP09A	261	900	
FEP15A	262	1500	
FEP22A	263	2200	
***FEP22A**	**277**	**2200**	**Mass production after March 2018**
FEP30A	264	3000	
FEP06D	265	600	
FEP11D	266	1100	
FEP16D	267	1600	
FEP22D	268	2200	
-	-	-	-
FEP03M	269	300	
FEP06M	270	600	
FEP09M	271	900	
FEP12M	272	1200	
-	-	-	-
FEP05G	273	450	
FEP09G	274	850	
FEP13G	275	1300	
FEP17G	276	1700	
-	-	-	-
FFP30A	281	3000	
FFP50A	282	5000	
FFP22D	285	2200	
FFP35D	286	3500	
FFP55D	287	5500	
FFP75D	288	7500	
-	-	-	-
FFP12M	289	1200	
FFP20M	290	2000	
FFP30M	291	3000	
FFP44M	292	4400	
-	-	-	-
FFP20G	293	1800	
FFP30G	294	2900	

Model name	ID	Watt	Note
FFP44G	295	4400	
FFP60G	296	6000	
FFP75G	297	7500	
-	-	-	-
FGP22D	311	2200	
FGP35D	312	3500	
FGP55D	313	5500	
FGP75D	314	7500	
FGP110D	315	11000	
-	-	-	-
FGP12M	321	1200	
FGP30M	322	2000	
FGP30M	323	3000	
FGP44M	324	4400	
FGP60M	325	6000	
***FGP60M**	**326**	**6000**	**Mass production after March 2018**
FGP20G	331	1800	
FGP30G	332	2900	
FGP44G	333	4400	
FGP60G	334	6000	
FGP85G	335	8500	
FGP110G	336	11000	
FGP150G	337	15000	
-	-	-	-
SCP04A	421	400	
SCP06A	422	600	
SCP08A	423	800	
SCP10A	424	1000	
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

*** FEP22A: For models produced before March 2018, use ID 263.**

***FGP60M : For models produced before March 2018, use ID 325**

2.2 Servo Drive

2.2.1 Product feature

200[V]

Item \ Model name		L7NHA 001U	L7NHA 002U	L7NHA 004U	L7NHA 008U	L7NHA 010U	L7NHA 020U	L7NHA 035U	L7NHA 050U	L7NHA 075U	L7NHA 150U
Input power	Main power	Three-phase AC200 ~ 230[V](-15 ~ +10[%]), 50 ~ 60[Hz]									
	Control power	Single-phase AC200 ~ 230[V](-15 ~ +10[%]), 50 ~ 60[Hz]									
Rated current [A]		1.4	1.7	3.0	5.2	6.75	13.5	16.7	32	39.4	76
Maximum current [A]		4.2	5.1	9.0	15.6	20.25	40.5	50.1	90.88	98.5	190
Encoder Type		Quadrature(Incremental) , BiSS-B, BiSS-C(Absolute, Incremental) Tamagawa Serial(Absolute, Incremental), EnDat 2.2 Sinusoidal, Analog Hall									
Control performance	Speed control range	Maximum 1 : 5000									
	Frequency Response time	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 Repeat Accuracy	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 sign	Link Act IN, Link Act 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	Digital Input	Input voltage range: DC 12[V] ~ DC 24[V] A total of 8 input channels (allocable)									

Input/ output		You can selectively allocate a total of 15 functions. (*POT, *NOT, *HOME, *STOP, *PCON, *GAIN2, *P_CL, *N_CL, PROBE1, PROBE2, EMG, A_RST, SV_ON, LVSF1, LVSF2) Note) * 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±) Note) * Default allocation signal.
Analog input	Analog Input	Input voltage range: -10 ~ +10[V], Function: Analog torquelimit(1 channel, disable to allocation)
	Analog Output	A total of 2 input channels (allocable) You can selectively allocate a total of 25 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 Function	Dynamic braking	Standard built-in (activated when the servo alarm goes off or when the servo is off)
	Regenerative braking	Both the default built-in brake and an externally installed brake are possible
	Display function	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 functions	Overcurrent, overload, excessive current limit, overheat, overvoltage, undervoltage, overspeed, encoder error, position following error, current sensing error, etc.
Operating ambient environment	Operating ambient temperature /Storage temperature	0 ~ +50[℃] / -20~ +65[℃]
	Ambient humidity /Storage humidity	90% RH or less (no condensation)
	Etc	Indoors in an area free from corrosive or combustible gases, liquids, or dust.

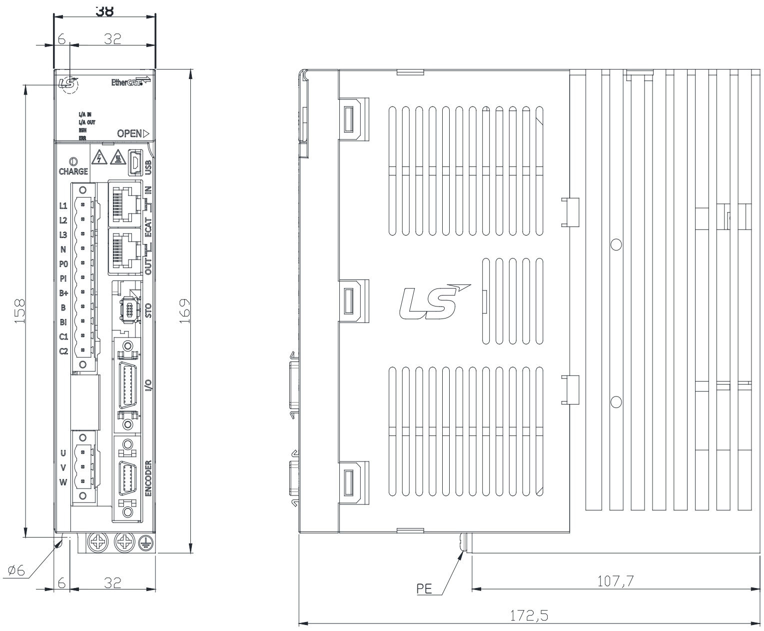
400[V]

<table>
<tr><th colspan="2">Model name / Item</th><th>L7NHB010U</th><th>L7NHB020U</th><th>L7NHB035U</th><th>L7NHB050U</th><th>L7NHB075U</th><th>L7NHB150U</th></tr>
<tr><td rowspan="2">Input power</td><td>Main power</td><td colspan="6">Three-phase AC380 ~ 480[V](-15 ~ +10[%]), 50 ~ 60[Hz]</td></tr>
<tr><td>Control power</td><td colspan="6">Single-phase AC380 ~ 480[V](-15 ~ +10[%]), 50 ~ 60[Hz]</td></tr>
<tr><td colspan="2">Rated current [A]</td><td>3.7</td><td>8</td><td>10.1</td><td>17.5</td><td>22.8</td><td>39</td></tr>
<tr><td colspan="2">Maximum current [A]</td><td>11.1</td><td>24</td><td>30.3</td><td>47.25</td><td>57</td><td>97.5</td></tr>
<tr><td colspan="2">Encoder Type</td><td colspan="6">Quadrature(Incremental)
BiSS-B, BiSS-C(Absolute, Incremental)
Tamagawa Serial(Absolute, Incremental)
EnDat 2.2</td></tr>
<tr><td rowspan="4">Control performance</td><td>Speed Control range</td><td colspan="6">Maximum 1 : 5000</td></tr>
<tr><td>Frequency Response time</td><td colspan="6">Maximum 1 kHz or above (when the 19-bit serial encoder is applied).</td></tr>
<tr><td>Speed regulation</td><td colspan="6">±0.01% or lower (when the load changes between 0 and 100%)
±0.1% or less (temperature of 25℃ (±10))</td></tr>
<tr><td>Torque control Repeat Accuracy</td><td colspan="6">Within ±1%</td></tr>
<tr><td rowspan="7">EtherCAT Communication specification</td><td>Communication Specification</td><td colspan="6">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)</td></tr>
<tr><td>Physical layer</td><td colspan="6">100BASE-TX(IEEE802.3)</td></tr>
<tr><td>Connector</td><td colspan="6">RJ45 x 2</td></tr>
<tr><td>Distance</td><td colspan="6">Within 100 m between nodes</td></tr>
<tr><td>DC (Distributed Clock)</td><td colspan="6">Sync by DC mode Minimum DC cycle: 250[us]</td></tr>
<tr><td>LED sign</td><td colspan="6">LinkAct IN, LinkAct OUT, RUN, ERR</td></tr>
<tr><td>Cia402 drive Profile</td><td colspan="6">Profile Position Mode
Profile Velocity Mode
Profile Torque Mode
Cyclic Synchronous Position Mode
Cyclic Synchronous Velocity Mode
Cyclic Synchronous Torque Mode
Homing Mode</td></tr>
<tr><td rowspan="2">Digital Input/output</td><td>Digital input</td><td colspan="6">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)
Note) * Default allocation signal.</td></tr>
<tr><td>Digital output</td><td colspan="6">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±)</td></tr>
</table>

		Note) * Default allocation signal.
Analog Input/output	Analog Input	Input voltage range: -10 ~ +10[V], Function: Analog torque limit(1 channel, disable to allocation)
	Analog Output	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 Function	Dynamic braking	Standard built-in (activated when the servo alarm goes off or when the servo is off) Note) There is a possibility of DB resistance burnout when using excessive DB (Dynamic Brake) or using more than the allowable inertia
	Regenerative braking	Both the default built-in brake and an externally installed brake are possible Note) L7□B150U is equipped with external regeneration 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 functions	Overcurrent, overload, excessive current limit, overheat, overvoltage, under voltage, overspeed, encoder error, position following error, current sensing error, etc.
Operating ambient environment	Operating ambient temperature /Storage temperature	0 ~ 50[℃], -20 ~ 65[℃]
	Ambient humidity /Storage humidity	90% RH or less (no condensation)
	Etc	Indoors in an area free from corrosive or combustible gases, liquids, or dust.

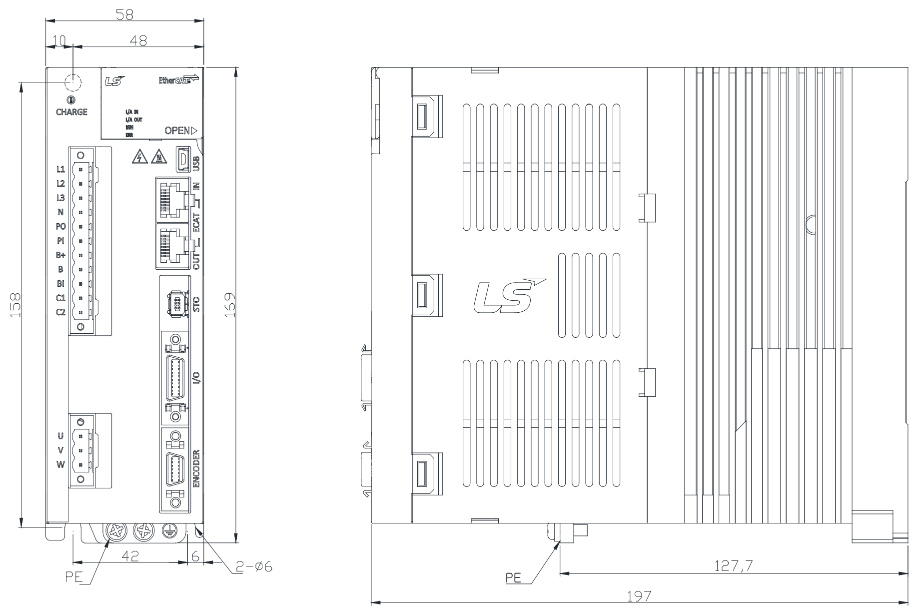
2.2.2 Outline drawing

■ **L7NHA001U ~ L7NHA004U**



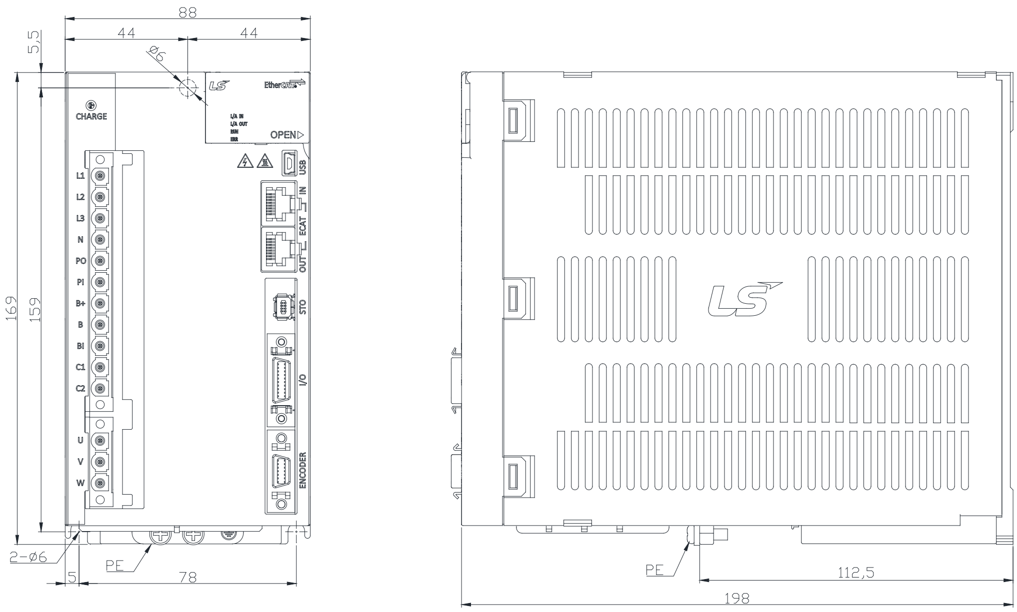
*Weight: 1.0[kg]

■ **L7NHA008U ~ L7NHA010U**



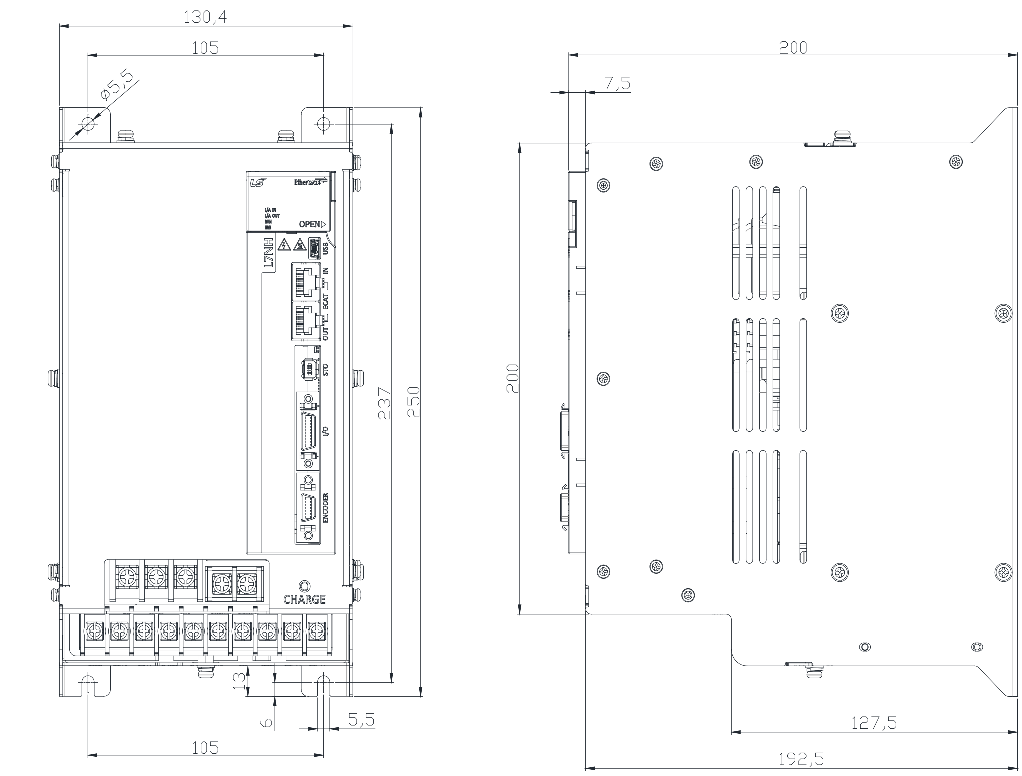
*Weight: 1.5[kg] (including cooling pan)

■ L7NHA020U / L7NHA035U



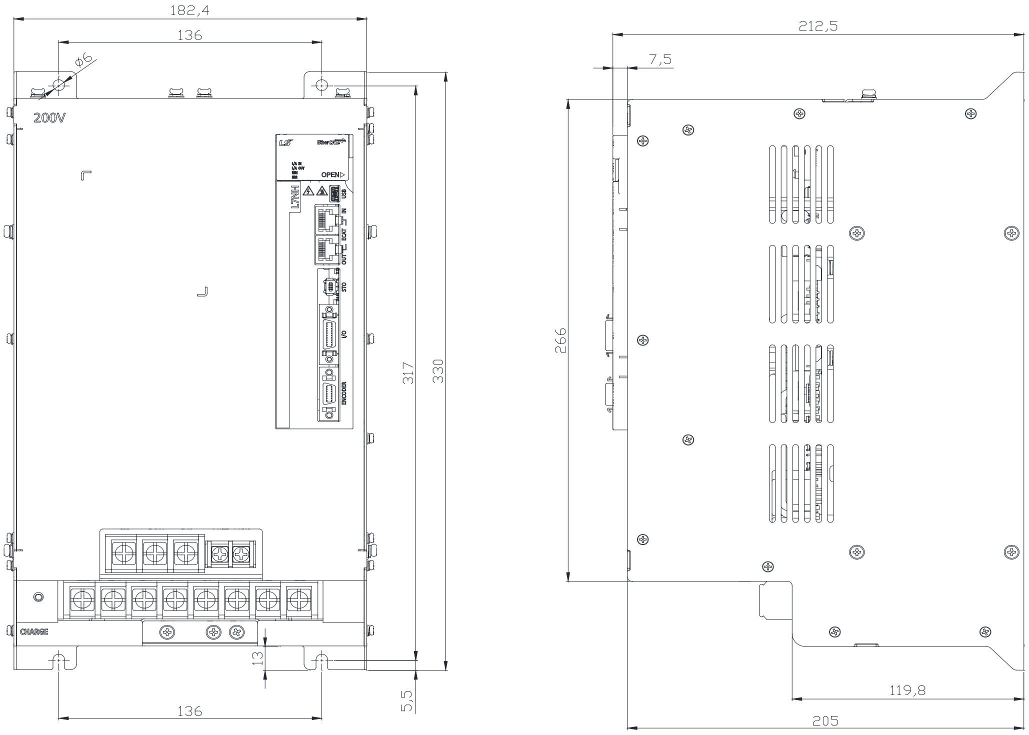
*Weight: 2.5[kg] (including cooling pan)

■ L7NHA050U



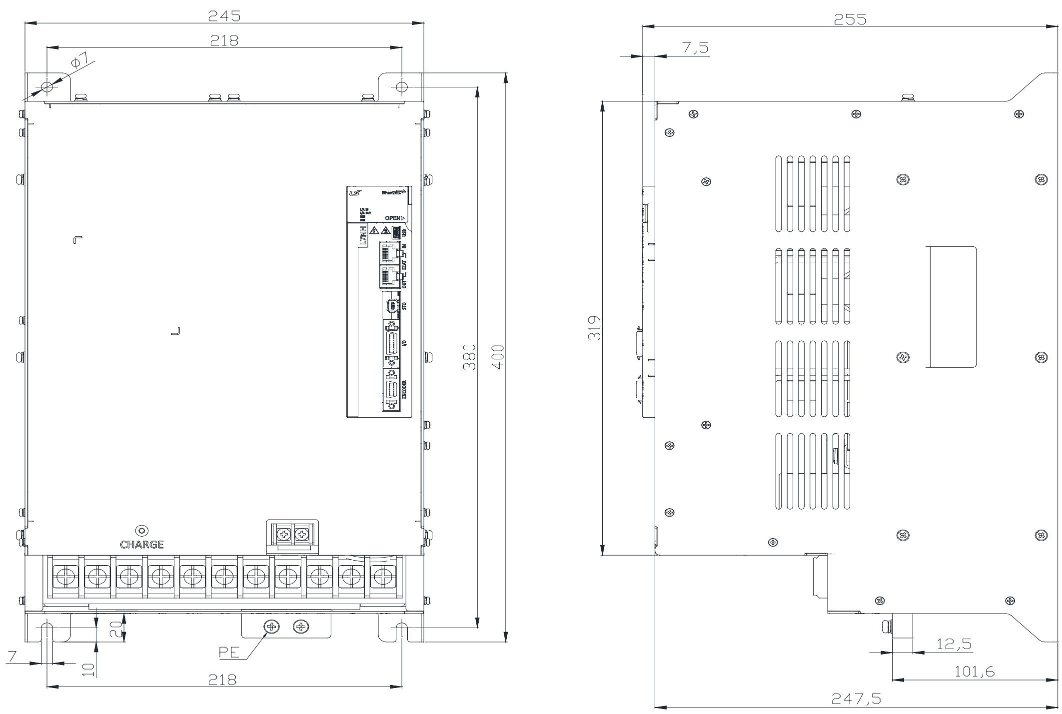
*Weight: 5.5[kg] (including cooling pan)

■ L7NHA075U



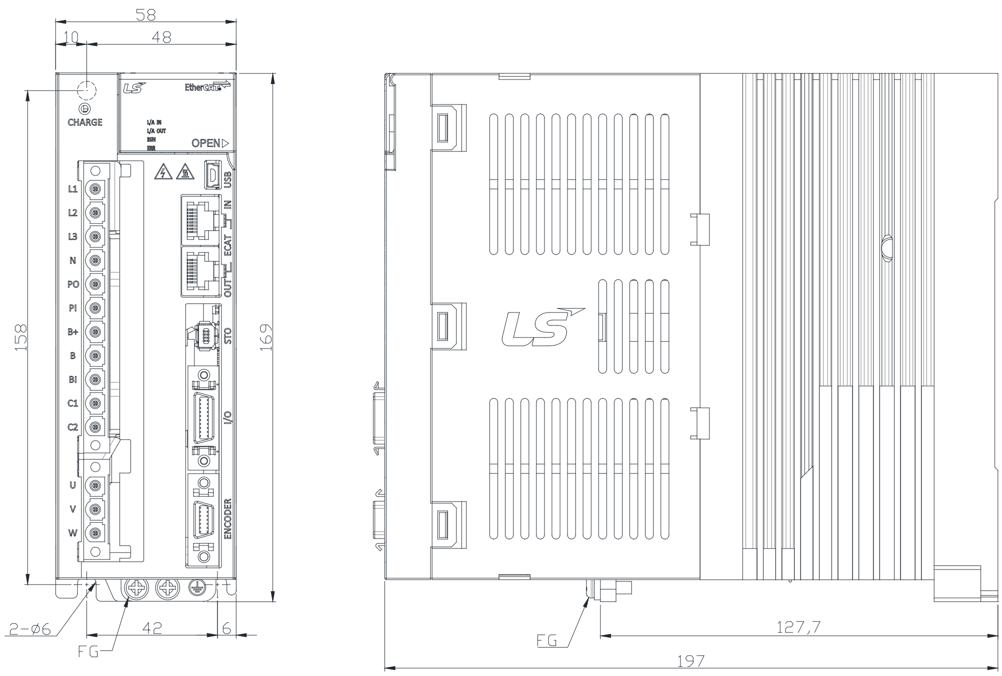
*Weight: 9.7[kg] (including cooling pan)

■ L7NHA150U



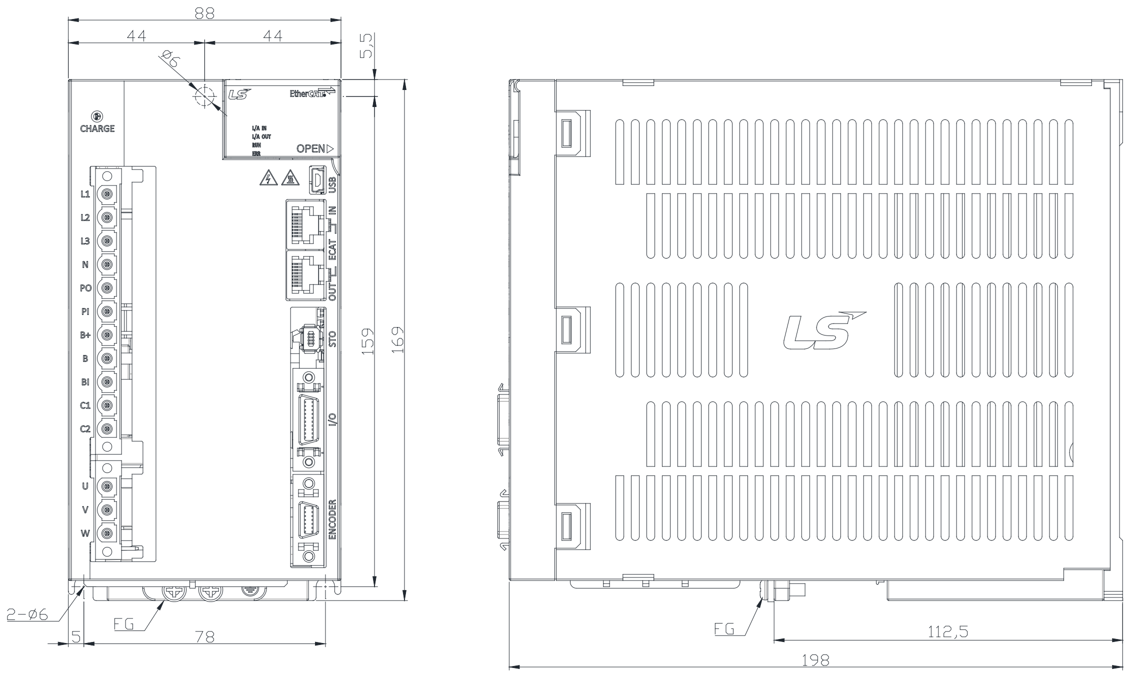
*Weight: 16.2[kg] (including cooling pan)

■ L7NHB010U



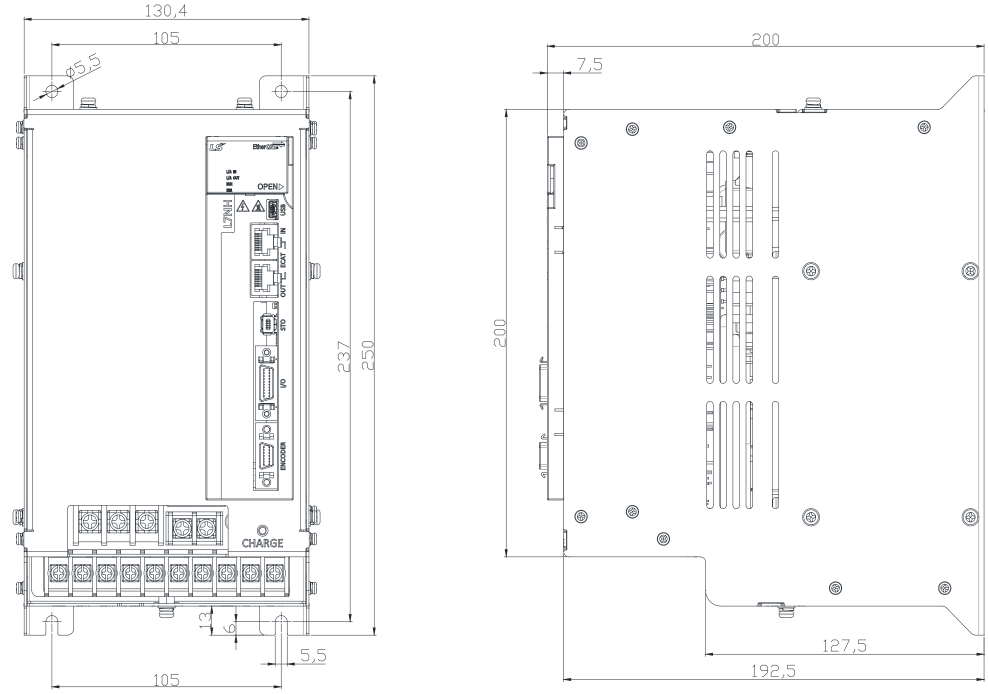
*Weight: 1.5[kg] (including cooling pan)

■ L7NHB020U / L7NHB035U



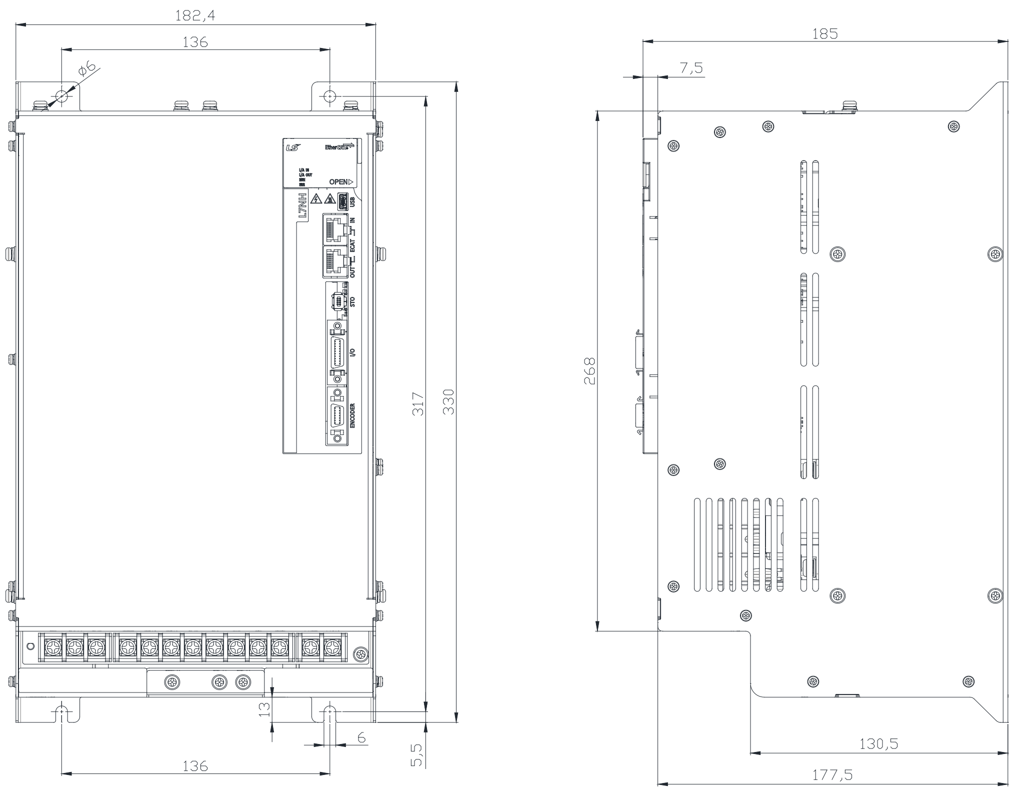
*Weight: 2.5[kg] (including cooling pan)

■ L7NHB050U



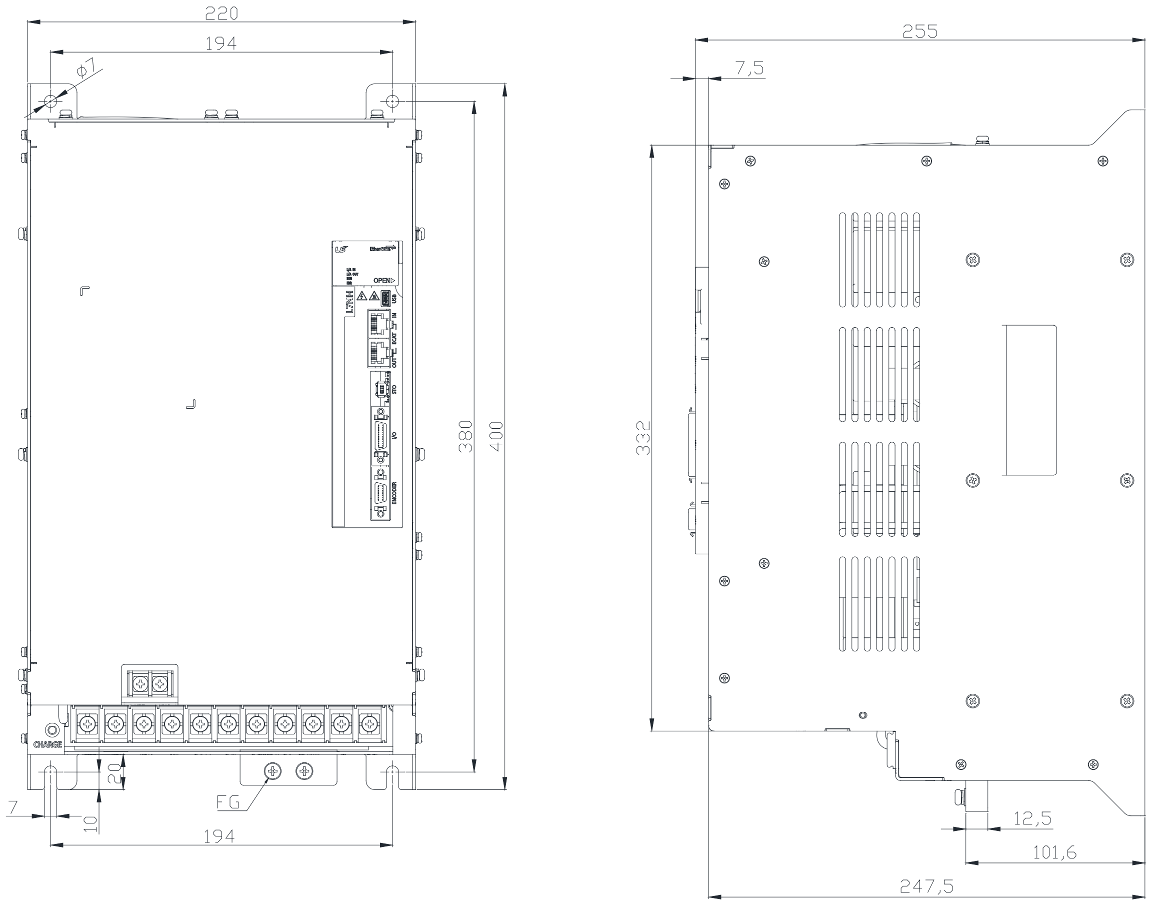
*Weight: 5.5[kg] (including cooling pan)

■ L7NHB075U



*Weight: 8.5[kg] (including cooling pan)

■ L7NHB150U



*Weight: 15.5[kg] (including cooling pan)

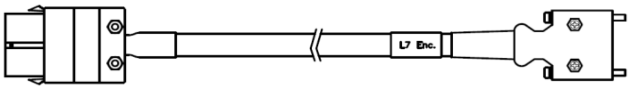
2.3 Options and Peripheral Devices

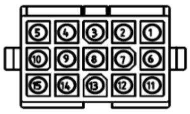
■ Option (Incremental encoder cable)

Category	For signal	Product Name	Small capacity AMP Type INC encoder cable
Name (Note 1)	APCS- E□□□AS	Applicable Motors	All model of APM-SA/SB/SC/HB SERIES INC

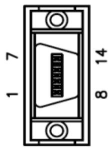
Spec.

Motor Side Connector | Drive Side Connector





PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	A	6	$\overline{Z}$	11	W
2	$\overline{A}$	7	U	12	$\overline{W}$
3	B	8	$\overline{U}$	13	+5V
4	$\overline{B}$	9	V	14	0V
5	Z	10	$\overline{V}$	15	SHIELD



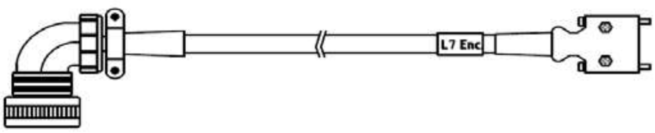
PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	W	6	$\overline{U}$	11	B
2	$\overline{W}$	7	0V	12	$\overline{A}$
3	V	8	$\overline{Z}$	13	A
4	$\overline{V}$	9	Z	14	+5V
5	U	10	$\overline{B}$	Plate	SHIELD

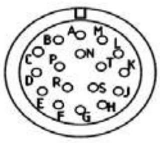
1. Motor connection
a. CAP Spec(15 Position) : 172163-1(AMP company)
b. SOCKET spec.:170361-1(AMP company)
2. Drive connection (CN2)
a. CASE Spec. : 10314-52A0-008(3M) or SM-14J(Suntone)
B CASE Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec. : 7Px0.2SQ or 7Px24AWG

Category	For signal	Product Name	Medium-large capacity MS Type INC encoder cable
Name (Note 1)	APCS- E□□□BS	Applicable Motors	All model of APM-SE/SF/SG/LF/LG/HE SERIES INC

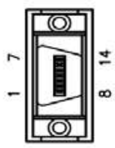
Spec.

Motor Side Connector | Drive Side Connector





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



PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	W	6	$\overline{U}$	11	B
2	$\overline{W}$	7	0V	12	$\overline{A}$
3	V	8	$\overline{Z}$	13	A
4	$\overline{V}$	9	Z	14	+5V
5	U	10	$\overline{B}$	Plate	SHIELD

1. Motor connection(MS:Military Standard)
a. PLUG spec. : MS3108B 20-29S
2. Drive connection (CN2)
a. CASE Spec. : 10314-52A0-008(3M) or SM-14J(Suntone)
B Connector Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec. : 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

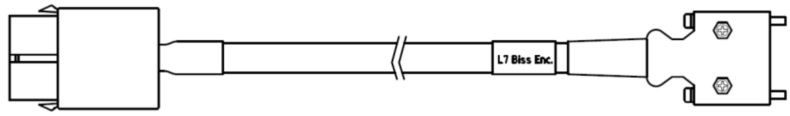
Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

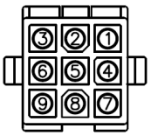
■ Option (Serial encoder cable)

Category	For signal	Product Name	Small capacity AMP Type serial encoder cable (single turn)
Name (Note 1)	APCS- E□□□CS	Applicable Motors	All model of APM-SB/SC SERIES S-turn

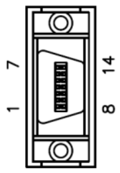
Spec.

Motor Side Connector **Drive Side Connector**





PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	MA	6	-
2	$\overline{MA}$	7	+5V
3	SLO	8	0V
4	$\overline{SLO}$	9	SHIELD
5	-		



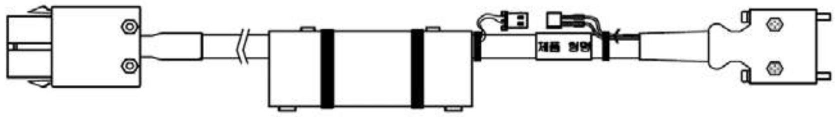
PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	-	6	$\overline{SLO}$	11	-
2	-	7	0V	12	-
3	MA	8	-	13	-
4	$\overline{MA}$	9	-	14	+5V
5	SLO	10	-	Plate	SHIELD

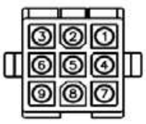
1. Motor connection
a. CAP Spec(9 Position) : 172161-1(AMP company)
b. SOCKET spec.:170361-1(AMP company)
2. Drive connection (CN2)
a. CASE Spec. : 10314-52A0-008(3M) or SM-14J(Suntone)
b. Connector Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec. : 3Px0.2SQ or 3Px24AWG

Category	For signal	Product Name	Small capacity AMP Type serial encoder cable (multi turn)
Name (Note 1)	APCS- E□□□CS1	Applicable Motors	All model of APM-SA/SB/SC SERIES M-turn

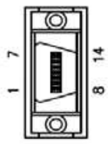
Spec.

Motor Side Connector **Drive Side Connector**





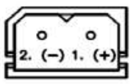
PIN 번호	Encoder 신호	PIN 번호	Encoder 신호
1	MA	6	GND_B
2	$\overline{MA}$	7	+5V
3	SLO	8	0V
4	$\overline{SLO}$	9	SHIELD
5	VDD_B		



PIN 번호	Encoder 신호	PIN 번호	Encoder 신호	PIN 번호	Encoder 신호
1	–	6	$\overline{SLO}$	11	–
2	–	7	0V	12	–
3	MA	8	–	13	–
4	$\overline{MA}$	9	–	14	+5V
5	SLO	10	–	Plate	SHIELD

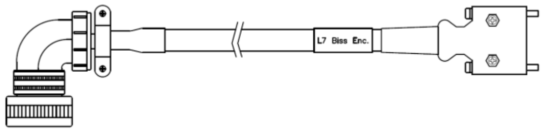
1. **Motor connection**
a. **CAP Spec(9 Position) : 172161-1(AMP company)**
b. SOCKET spec.:170361-1(AMP company)
2. Drive connection (CN2)
a. CASE Spec. : 10314-52A0-008(3M) or SM-14J(Suntone)
b. Connector Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec. : 4Px0.2SQ or 4Px24AWG
4. Battery connection
a. Connector spec.: 5267-02A(Molex)
b. Battery spec. : ER6V(TOSHIBA, AA, 3.6V, 2000mAh)

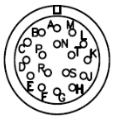
Batterv Connector



PIN 번호	Encoder 신호	선색
1	BATTERY(VDD_B)	적색
2	BATTERY 0V(GND_B)	흑색

■ **Option [serial encoder cable]**

<table>
<tr><th rowspan="2">Classification</th><th rowspan="2">Product Name</th><th rowspan="2">Product name(*Note 1)</th><th rowspan="2">Applicable Motors</th><th colspan="2">Specification</th></tr>
<tr><th>Motor</th><th>Drive connection</th></tr>
<tr><td>For signal</td><td>S/Flat Series motor S-turn Encoder cable (medium capacity)</td><td>APCS-E□□□DS</td><td>APM-SEP
APM-SFP
APM-SGP
APM-FEP
APM-FFP
APM-FGP
SERIES
All models</td><td colspan="2">




<table>
<tr><th>PIN No.</th><th>Encoder Phase</th><th>PIN No.</th><th>Encoder Phase</th></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>–</td><td>H</td><td>+5V</td></tr>
<tr><td>F</td><td>–</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>
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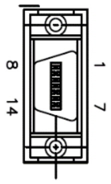
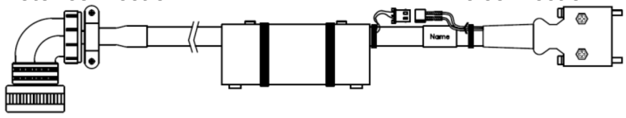
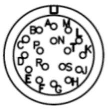


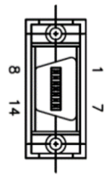
<table>
<tr><th>PIN No.</th><th>Encoder Phase</th><th>PIN No.</th><th>Encoder Phase</th></tr>
<tr><td>1</td><td>–</td><td>8</td><td>–</td></tr>
<tr><td>2</td><td>–</td><td>9</td><td>–</td></tr>
<tr><td>3</td><td>MA</td><td>10</td><td>–</td></tr>
<tr><td>4</td><td>$\overline{MA}$</td><td>11</td><td>–</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. PLUG spec. : MS3108A 20-29S
2. Drive connection (CN2)
a. CASE Spec. : 10314-52A0-008(3M) or SM-14J(Suntone)
b. Connector Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec. : 3Px0.2SQ or 3Px24AWG
</td></tr>
<tr><td>For signal</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 colspan="2">
Motor connection **Drive connection**





<table>
<tr><th>PIN No.</th><th>Encoder Phase</th><th>PIN No.</th><th>Encoder Phase</th></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><th>PIN No.</th><th>Encoder Phase</th><th>PIN No.</th><th>Encoder Phase</th></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. PLUG spec. : MS3108A 20-29S
2. Drive connection (CN2)
a. CASE Spec. : 10314-52A0-008(3M) or SM-14J(Suntone)
b. Connector Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec. : 4Px0.2SQ or 4Px24AWG
4. Battery connection
a. Connector spec.: 5267-02A(Molex)
b. Battery spec. : 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

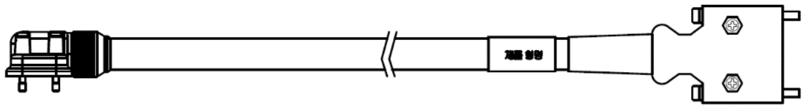
Cable length (m)	3	5	10	20
For robot	F03	F05	F10	F20
General	N03	N05	N10	N20

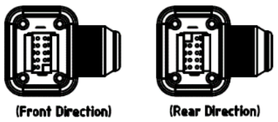
Category	For signal	Product Name	Small capacity Flat type motor serial encoder cable(single turn)
Name (Note 1)	APCS- E□□□ES(Front Direction)/ APCS- E□□□ES-R(Rear Direction)	Applicable Motors	All model of APM-FB/FC SERIES S-turn

Spec.

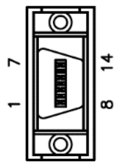
Motor Side Connector

Drive Side Connector

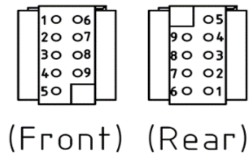




PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	MA	6	$\overline{MA}$
2	SLO	7	$\overline{SLO}$
3	–	8	–
4	0V	9	+5V
5	SHIELD		



PIN No.	Encoder Signal	PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	–	6	$\overline{SLO}$	11	–
2	–	7	0V	12	–
3	MA	8	–	13	–
4	$\overline{MA}$	9	–	14	+5V
5	SLO	10	–	Plate	SHIELD



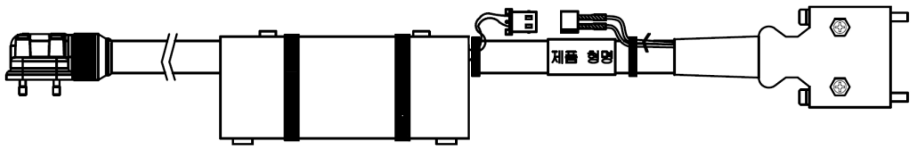
1. Motor connection
   a. CAP Spec: 2201825-1(Tyco company)
   b. SOCKET spec.:2174065-4(Tyco company)
2. Drive connection (CN2)
   a. CASE Spec. : 10314-52A0-008(3M) or SM-14J(Suntone)
   b. Connector Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec. : 3Px0.2SQ or 3Px24AWG

Category	For signal	Product Name	Small capacity Flat type motor serial encoder cable(multi turn)
Name (Note 1)	APCS- E□□□ES1(Front Direction)/ APCS- E□□□ES1-R(Rear Direction)	Applicable Motors	All model of APM-FAL/FB(L)/FC(L) SERIES M-turn

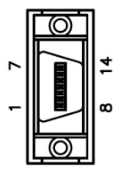
Spec.

Motor Side Connector

Drive Side Connector



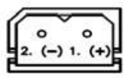
PIN 번호	Encoder 신호	PIN 번호	Encoder 신호
1	MA	6	$\overline{MA}$
2	SLO	7	$\overline{SLO}$
3	GND_B	8	VDD_B
4	0V	9	+5V
5	Shield		



PIN 번호	Encoder 신호	PIN 번호	Encoder 신호	PIN 번호	Encoder 신호
1	–	6	$\overline{SLO}$	11	–
2	–	7	0V	12	–
3	MA	8	–	13	–
4	$\overline{MA}$	9	–	14	+5V
5	SLO	10	–	Plate	SHIELD

1. Motor connection
   a. CAP Spec(9 Position) : 2201825-1(Tyco company)
   b. SOCKET Spec: 2174065-4(Tyco company)
2. Drive connection (CN2)
   a. Case spec.: 10314-52A0-008(3M) or SM-14J(Suntone)
   b. Connector Spec. : 10114-3000VE(3M) or SM-14J(Suntone)
3. Cable Spec.: 4Px0.2SQ or 4Px24AWG 4. Battery connection
4. Battery connection
   a. Connector spec.: 5267-02A(Molex)
   b. Battery spec. : ER6V(TOSHIBA, AA, 3.6V, 2000mAh)

Battery Connector

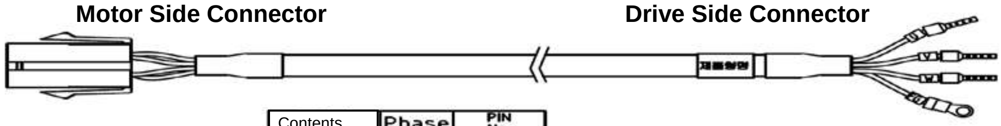


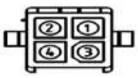
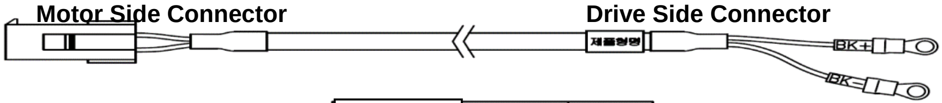
PIN 번호	Encoder 신호	선색
1	BATTERY(VDD_B)	적색
2	BATTERY 0V(GND_B)	흑색

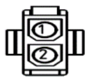
Note 3) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information

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

■ Option (Standard power cable)

<table>
<tr><td>Category</td><td>Power</td><td>Product Name</td><td>Small capacity AMP Type power cable</td></tr>
<tr><td>Name (Note 1)</td><td>APCS- P□□□GS</td><td>Applicable Motors</td><td>All model of APM-SA/SB/SC/HB SERIES</td></tr>
<tr><td>Spec.</td><td colspan="3">
Motor Side Connector Drive Side Connector


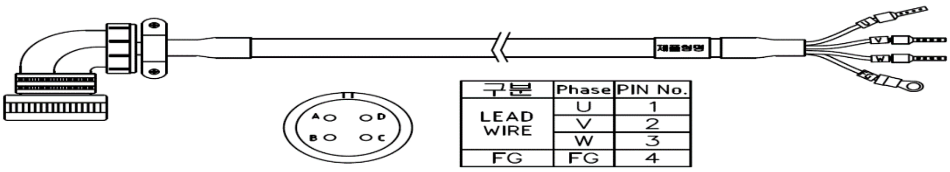

<table><tr><td>Contents</td><td>Phase</td><td>PIN No.</td></tr><tr><td rowspan="3">LEAD WIRE</td><td>U</td><td>1</td></tr><tr><td>V</td><td>2</td></tr><tr><td>W</td><td>3</td></tr><tr><td>FG</td><td>FG</td><td>4</td></tr></table>
1. Motor connection
a. CAP Spec(4 Position) : 172159-1(AMP company)
b. SOCKET spec.:170362-1(AMP company)
2. Drive connection(U,V,W,PE)
a. U,V,W pin spec. : 1512
b. PE pin spec. : 1.5x4 (Ring Terminal)
3. Cable Spec. : 4Cx0.75SQ or 4Cx18AWG
</td></tr>
<tr><td>Category</td><td>For brake open type</td><td>Product Name</td><td>Small capacity AMP Type brake cable</td></tr>
<tr><td>Name (Note 1)</td><td>APCS- P□□□KB</td><td>Applicable Motors</td><td>All model of APM-SA/SB/SC SERIES</td></tr>
<tr><td>Spec.</td><td colspan="3">
Motor Side Connector Drive Side Connector


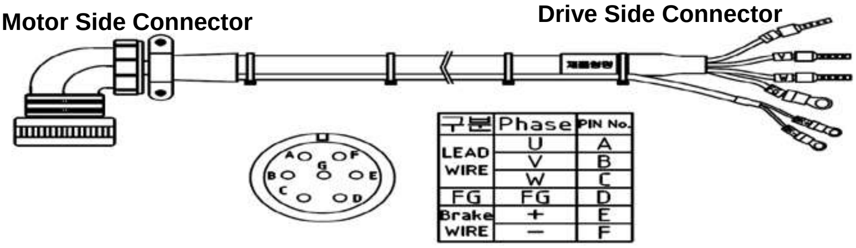

<table><tr><td>Contents</td><td>Phase</td><td>PIN No.</td></tr><tr><td rowspan="2">BRAKE WIRE</td><td>+</td><td>1</td></tr><tr><td>–</td><td>2</td></tr></table>
1. Motor connection
a. CAP Spec(2 Position) : 172157-1(AMP company)
b. SOCKET spec.:170362-1(AMP company)
2. Brake power
a. Connection terminal spec. : 1.5x3 (Ring Terminal)
3. Cable Spec. : 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

■ Option (Standard power cable)

<table>
<tr><td>Category</td><td>Power</td><td>Product Name</td><td>Medium capacity MS Type power cable(for 130 Flange)</td></tr>
<tr><td>Name (Note 1)</td><td>APCS- P□□□HS</td><td>Applicable Motors</td><td>All model of APM-SE/FE/HE SERIES</td></tr>
<tr><td>Spec.</td><td colspan="3">Motor Side Connector Drive Side Connector


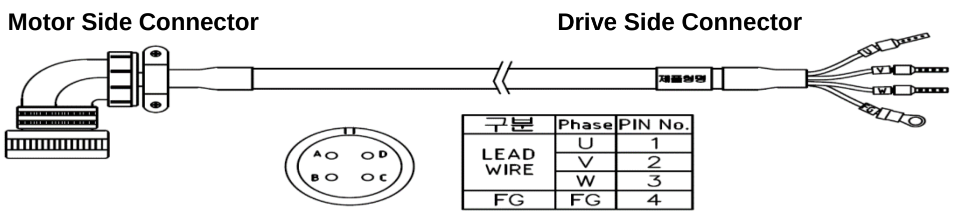
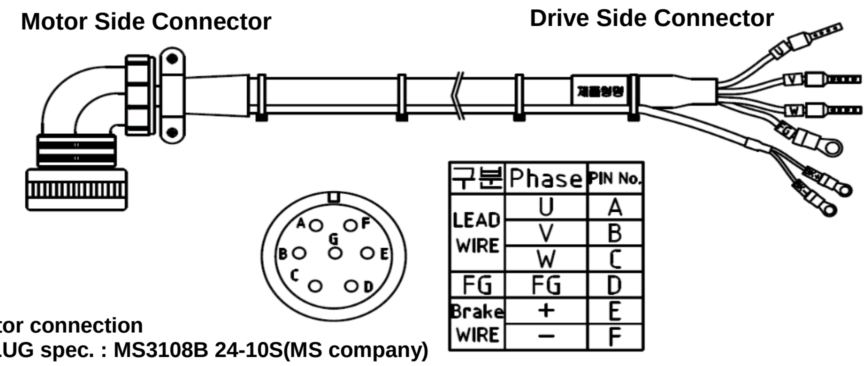
1. Motor connection(MS:Military Standard)
a. PLUG spec. : MS3108B 20-4S
2. Drive connection(U,V,W,PE)
a. U,V,W pin spec. : 2512 2512
b. PE pin spec. : 2.5x4 (Ring Terminal)
3. Cable Spec. : 4Cx2.5SQ or 4Cx14AWG</td></tr>
<tr><td>Category</td><td>Power and Brake</td><td>Product Name</td><td>Medium capacity MS Type power/brake cable(for 130 Flange)</td></tr>
<tr><td>Name (Note 1)</td><td>APCS- P□□□NB</td><td>Applicable Motors</td><td>All model of APM-SE/FE SERIES</td></tr>
<tr><td>Spec.</td><td colspan="3">Motor Side Connector Drive Side Connector


1. Motor connection
a. PLUG spec. : MS3108B 20-15S(MS company)
2. Drive connection
a. U, V, W pin spec: 2512
b. PE Pin spec : 2.5 x 4(Ring Terminal)
3. Power cable spec.: 4Cx2.5SQ or 4Cx14AWG
4. Brake power connection
a. Connection terminal spec. : 1.5 x 3(Ring Terminal)
5. Brake cable spec.: 2Cx0.75SQ or 2Cx19AWG</td></tr>
</table>

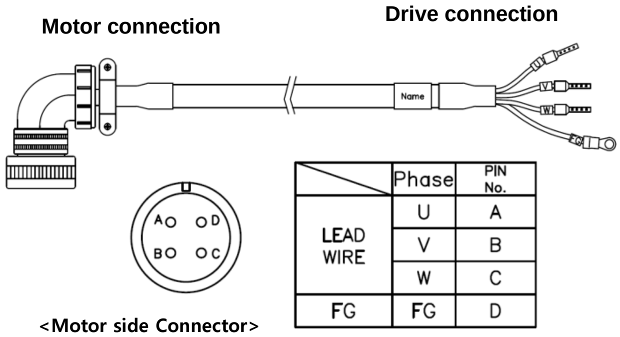
Note 1) The □□□in the name indicates the type and length of each cable. Refer to the following table for this information

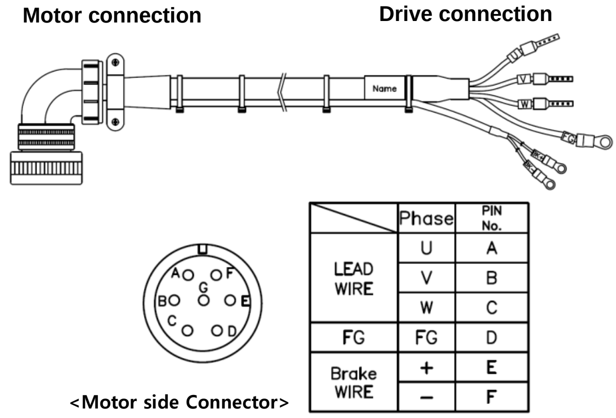
Cable length (m)	3	5	10	20
Robot cable	F03	F05	F10	F20
Regular cable	N03	N05	N10	N20

■ Option (Standard power cable)

Category	Power	Product Name	Medium capacity MS Type power cable(180/ 220 Flange)
Name (Note 1)	APCS- P□□□IS	Applicable Motors	SF30A, SF22D, LF35D, SF20G, LF30G, SF12M, SF20M LF30M SG22D, LG35D, SG20G, LG30G, SG12M, SG20M, LG30M FF30A, FF22D, FF35D, FF20G, FF30G, FF12M, FF20M, FF30M FG22D, FG35D, FG20G, FG12M, FG20M, FG30M
Spec.	 1. Motor connection(MS:Military Standard) a. PLUG spec. : MS3108B 22-22S 2. Drive connection(U,V,W,PE) a. U,V,W pin spec. : 1512 b. PE pin spec. : 2.5x4 (Ring Terminal) 3. Cable spec.: 4Cx2.5SQ or 4Cx14AWG		
Category	Power and Brake	Product Name	Medium capacity MS Type power/brake cable(for 180 Flange)
Name (Note 1)	APCS- P□□□PB	Applicable Motors	SF30A, SF22D, LF35D, SF20G, LF30G, SF12M, SF20M LF30M FF30A, FF22D, FF35D, FF20G, FF30G, FF12M, FF20M, FF30M
Spec.	 1. Motor connection a. PLUG spec. : MS3108B 24-10S(MS company) 2. Drive connection a. U, V, W pin spec: 2512 b. PE pin spec. : 2.5 x 4(Ring Terminal) 3. Power cable spec.: 4Cx2.5SQ or 4Cx14AWG 4. Brake power connection a. Connection terminal spec. : 1.5 x 3(Ring Terminal) 5. Brake cable spec.: 2Cx0.75SQ or 2Cx19AWG		

Option [Medium capacity power cable]

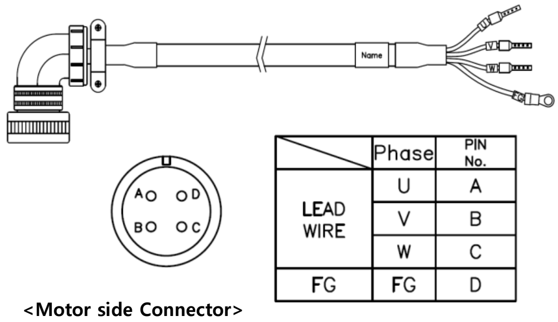
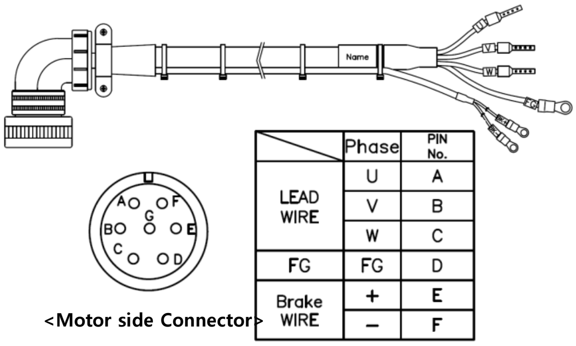
<table>
<tr><th>Classification</th><th>Product Name</th><th>Name(*Note 1)</th><th>Applicable Motors</th><th>Spec.</th></tr>
<tr><td>Power</td><td>Power cable
(400V/Medium capacity 130Flange)</td><td>APCF-P□□□HS</td><td>APM-SEP
APM-FEP
SERIES
All models</td><td>

1. Motor connection
a. PLUG spec. : MS3108A 20-4S
2. Drive connection(U,V,W,PE)
a. U,V,W pin spec. : 1512(Female)
b. FG pin spec.: 1.5x4(Ring Terminal)
3. Cable Spec. : 4Cx1.5SQ or 4Cx15AWG</td></tr>
<tr><td>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>

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

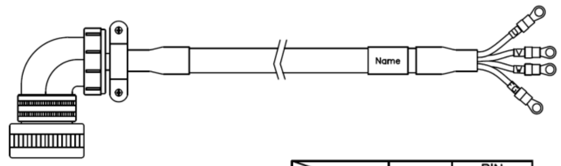
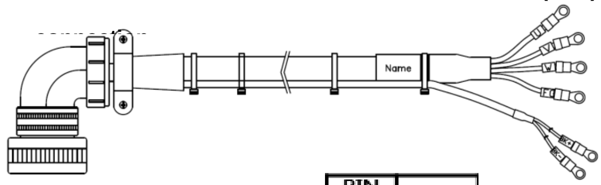
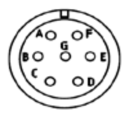
Note 1) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information

Cable length (m)	3	5	10	20
For robot	F03	F05	F10	F20

Classification	Product Name	Name(*Note 1)	Applicable Motors	Spec.
Power	Power cable (400V/medium capacity 3.5kW or less 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)**  **1. Motor connection** a. PLUG spec. : MS3108A 22-22S **2. Drive connection(U,V,W,PE)** a. U,V,W pin spec. : 2512(Female) b. FG pin spec. : 2.5x4 (Ring Terminal) **3. Cable spec.:** 4Cx1.5SQ or 4Cx15AWG
Power	Power cable (For brake) (400V/medium capacity 3.5kW or less 180Flange)	APCF-P□□□PB	SFP30A SFP22D SFP35D SFP20G SFP12M SFP20M FFP30A FFP22D FFP35D FFP20G FFP30G FFP12M FFP20M	**Motor connection** **Drive connection (CN2)**  **1. Motor connection** a. PLUG spec. : MS3108A 24-10S **2. Drive connection** a. U, V, W pin spec: 2512(Ferrule) b. FG pin spec. : 2.5 x 4(Ring Terminal) **3.** Power cable spec.: 4Cx1.5SQ or 4Cx15AWG **4. Brake power connection** a. Connection terminal spec. : 1.5 x 3(Ring Terminal) **5.** Brake cable spec.: 2Cx0.75SQ or 2Cx19AWG

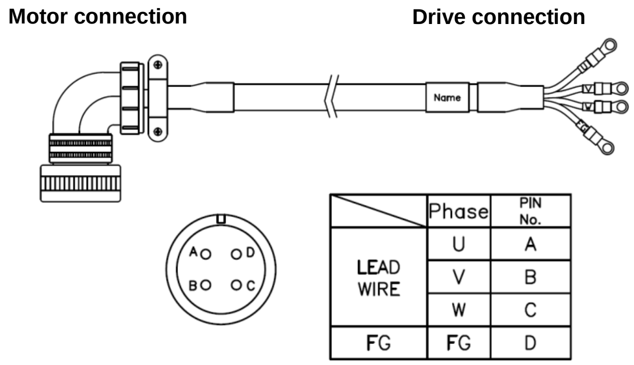
Note 1) The □□□ in the name indicates the type and length of each cable. Refer to the following table for this information

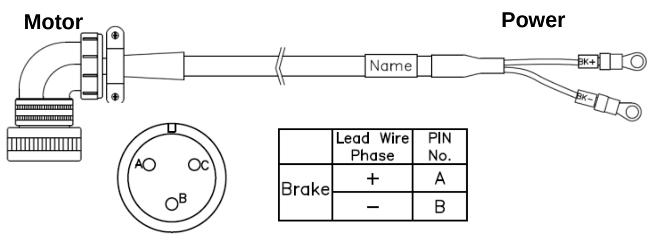
Cable length (m)	3	5	10	20
For robot	F03	F05	F10	F20

Classification	Product Name	Name(*Note 1)	Applicable Motors	Spec.
Power	Power cable (400V/medium capacity 7.5kW or less 180/220 Flange)	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	Motor Drive connection (CN2)   **1. Motor connection(MS:Military Standard)** a. PLUG spec. : MS3108A 22-22S **2. Drive connection(U,V,W,PE)** a. U,V,W,FG Pin spec.: 4.0x 5(Ring Terminal) **3. Cable spec.:** 4Cx4.0SQ or 4Cx11AWG
Power	Power cable (400V/medium capacity 7.5kW or less 180 Flange)	APCF-P□□□LB	SFP50A, SFP55D, SFP75D, SFP44G, SFP60G, SFP30M, SFP44M FFP50A, FFP55D, FFP75D, FFP44G, FFP60G, FFP75G FFP30M, FFP44M	Motor Drive connection (CN2)   **1. Motor connection** a. PLUG spec. : MS3108A 24-10S **2. Drive connection** a. U, V, W,FG pin spec.: 4.0X5 (Ring Terminal) **3.** Power cable spec.: 4Cx4.0SQ or 4Cx11AWG **4. Brake power connection** a. Connection terminal spec. : 1.5 x 3(Ring Terminal) **5.** Brake cable spec.: 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
For robot	F03	F05	F10	F20

<table>
<tr><th>Classification</th><th>Product Name</th><th>Name(*Note 1)</th><th>Applicable Motors</th><th>Spec.</th></tr>
<tr><td>Power</td><td>Power cable
(400V/medium capacity 15kW or less 180/220 Flange)</td><td>APCF-P□□□MS</td><td>SFP75G,
SGP110D,
SGP85G,
SGP110G,
SGP150G,
SGP60M
FGP110D,
FGP85G,
FGP110G,
FGP150G,
FGP60M</td><td>

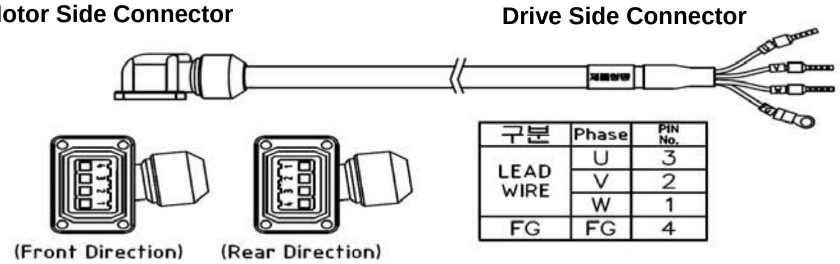
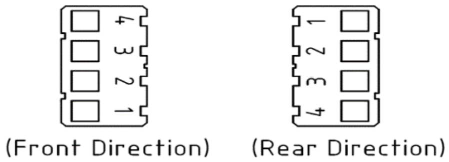
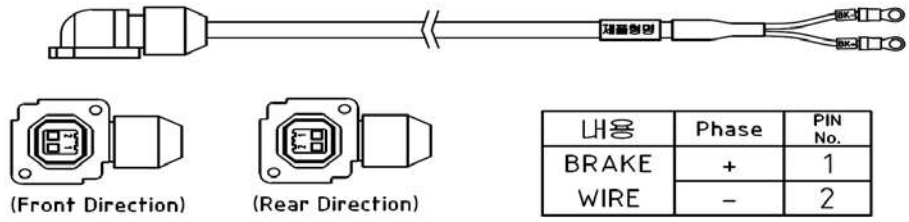
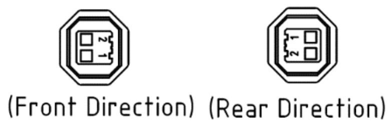
1. Motor connection
a. PLUG spec. : MS3108A 32-17S
2. Drive connection(U,V,W,PE)
a. U,V,W,FG Pin spec.: 10x5(Ring Terminal)
3. Cable spec.: 4Cx10SQ or 4Cx7AWG</td></tr>
<tr><td>Power</td><td>Brake cable
(200/400V
220 Flange)</td><td>APCS-P□□□SB</td><td>SGP22D
SGP35D
SGP55D
SGP75D
SGP12M
SGP20M
SGP30M
SGP44M
SGP20G
SGP30G
SGP44G
SGP60G
FGP22D
FGP35D
FGP55D
FGP75D
FGP20G
FGP30G
FGP30G
FGP44G
FGP60G
FGP12M
FGP20M
FGP30M
FGP44M</td><td>

1. Motor connection
a. PLUG spec. : MS3108B 14-7S(MS company)
2. Brake power
a. Connection terminal spec. : 1.5x3 (Ring Terminal)
3. Cable Spec. : 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

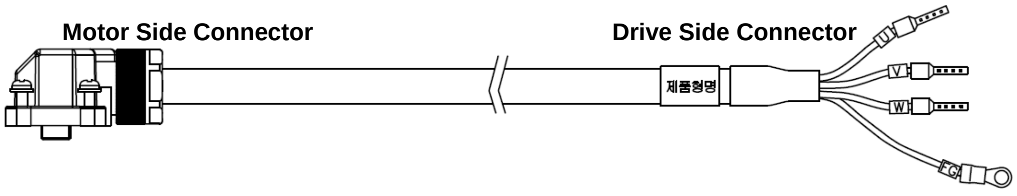
Cable length (m)	3	5	10	20
For robot	F03	F05	F10	F20

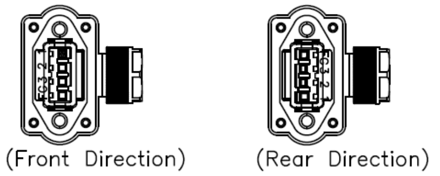
■ Options spce. (Small capacity Flat/L Series power cable)

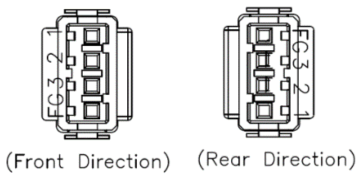
Category	Power	Product Name	Small capacity Flat Type power cable
Name (Note 1)	APCS- P□□□FS(Front Direction)/ APCS- P□□□FS-R(Rear Direction)	Applicable Motors	All model of APM-FB/FC Series
Spec.	Motor Side Connector Drive Side Connector  1. Motor connection a. PLUG Spec.: KN5FT04SJ1(JAE company) b. Socket spec. : ST-KN-S-C1B-3500 (JAE company) 2. Drive connection(U,V,W,PE) a. U,V,W pin spec. : 1512 b. PE pin spec.: 1.5x4 (Ring Terminal) 3. Cable Spec. : 4Cx0.75SQ or 4Cx18AWG  		
Category	Brake	Product Name	Small capacity Flat Type brake cable
Name (Note 1)	APCS- B□□□QS(Front Direction)/ APCS- B□□□QS-R(Rear Direction)	Applicable Motors	All model of APM-FAL/FB(L)/FC(L) series
Spec.	Motor Side Connector Drive Side Connector  1. Motor connection a. PLUG Spec.: KN5FT02SJ1(JAE company) b. Socket spec. : ST-KN-S-C1B-3500 (JAE company) 2. Brake power a. Connection terminal spec. : 1.5x3 (Ring Terminal) 3. Cable Spec. : 2Cx0.5SQ or 2Cx20AWG  		

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

<table>
<tr><td>Category</td><td>Power</td><td>Product Name</td><td>Small capacity L Series power cable</td></tr>
<tr><td>Name
(Note 1)</td><td>APCS- P□□□LS(Front Direction)/
APCS- P□□□LS-R(Rear Direction)</td><td>Applicable Motors</td><td>All model of APM- FAL/ FBL/FCL Series</td></tr>
<tr><td>Spec.</td><td colspan="3">
Motor Side Connector Drive Side Connector




<table>
<tr><td>내용</td><td>신호</td><td>PIN 번호</td></tr>
<tr><td rowspan="3">LEAD WIRE</td><td>U</td><td>1</td></tr>
<tr><td>V</td><td>2</td></tr>
<tr><td>W</td><td>3</td></tr>
<tr><td>FG</td><td>FG</td><td>4</td></tr>
</table>


1. Motor connection
a. PLUG spec. : SM-JN8FT04 (Suntone company)
b. Socket spec. : SMS-201 ((Suntone company)
2. Drive connection(U,V,W,PE)
a. U,V,W pin spec. : 1512 1512
b. PE pin spec.: 1.5x4 (Ring Terminal)
3. Cable Spec. : 4Cx0.75SQ or 4Cx18AWG
4. Others : In case of FAL products, it is necessary to install Encoder Cable after installing Power Cable.
</td></tr>
</table>

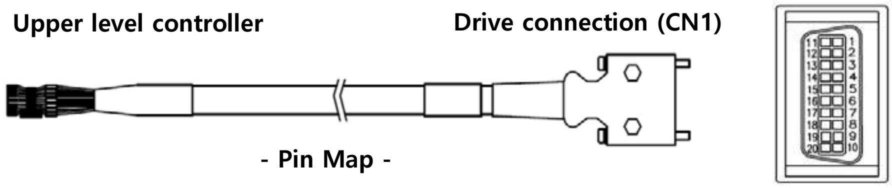
Note 1) The □□□in the name indicates the type and length of each cable. Refer to the following table for this information

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

■ **Options spec. (drive cable)**

Category	**For signal**	**Product Name**	**CN1 cable**
Name (Note 1)	**APCS-CN1□□A**	**Applicable drive**	**L7NH SERIES**

Spec.

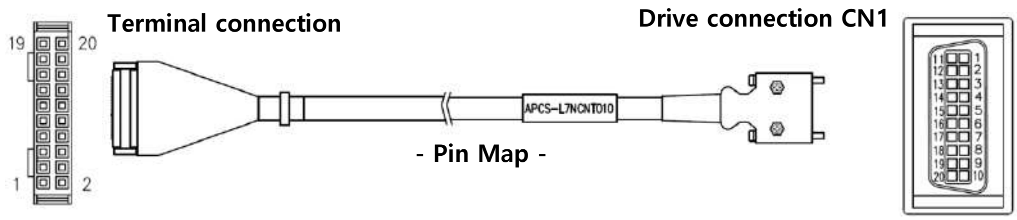


Pin No.	I/O signal	Pin No.	I/O signal	Pin No.	I/O signal	Pin No.	I/O signal
1	Break+	6	24V	11	Home	16	NC
2	Break-	7	CWL	12	Almrst	17	RDY+
3	Alarm+	8	CCWL	13	D11	18	RDY-
4	Alarm-	9	Probe1	14	D12	19	D01+
5	NC	10	Probe2	15	NC	20	D01-

1. Drive connection (CN1)
a. CASE spec. : 10320-52A0-008 (3M company)
b. Connector spec. : 10120-3000PE (3M company)
c. Cable spec.: ROW-SB0.1 x 20C (AWG 28)

Category	**T/B**	**Product Name**	**CN1 T/B**
Name (Note 1)	**APCS-7NCN1T□□□**	**Applicable drive**	**L7NH SERIES**

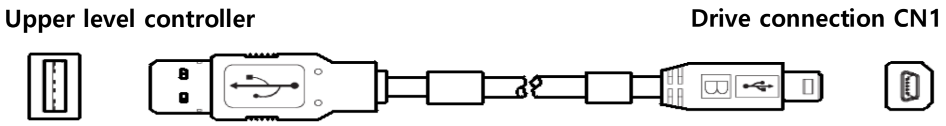
Spec.

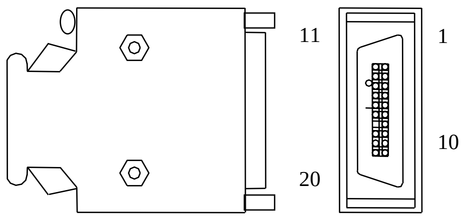


Pin No.	I/O signal	Pin No.	I/O signal	Pin No.	I/O signal	Pin No.	I/O signal
1	Break+	6	24V	11	Home	16	NC
2	Break-	7	CWL	12	Almrst	17	RDY+
3	Alarm+	8	CCWL	13	D11	18	RDY-
4	Alarm-	9	Probe1	14	D12	19	D01+
5	NC	10	Probe2	15	NC	20	D01-

1. Drive connection (CN1)
a. CASE spec. : 10320-52A0-008 (3M company)
b. Connector spec. : 10120-3000PE (3M company)
c. CABLE spec. : AWG28 x 10P
2. Terminal connection
a. Connector spec.: HIF3BA-20D-2.54R (Hirose)
b. Terminal block spec.: XTB-20H (Samwon Act company)
3. Cable length

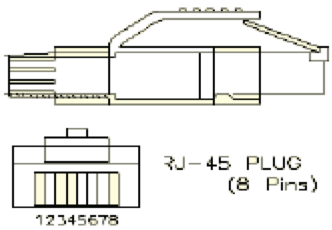
Group No.	H01	H02	H03	H03
Length	0.5 meter	1 meter	1.5 meter	2 meter

Category	For signal	Product Name	Communication Cable(CN5)
Name (Note 1)	APCS-CN5L7U	Applicable drive	L7NH SERIES
Spec.	 1. 1. PC connection: USB A Plug 2. 2. Drive connection (CN2): Mini USB 5P Plug 3. 3. Electrical requirement spec. : double shielding, Twisted Pair, EMI filter attached (Reference product : KU-AMB518 of SANWA)		

Category	CN	Product Name	CN1 Connector
Name (Note 1)	APC-CN2NNA	Applicable drive	L7NH Series
Spec.	 1. CASE spec. : 10320-52A0-008 (3M company) 2. Connector spec. : 10120-3000PE (3M company)		

Category	CN	Product Name	STO Connector
Name (Note 1)	APCS-CN6K	Applicable drive	L7NH SERIES
Spec.	 1. MINI I/O By-Pass Connector : 1971153(TE company)		

<table>
<tr><td>Category</td><td>CN</td><td>Product Name</td><td>CN6 Connector</td></tr>
<tr><td>Name (Note 1)</td><td>APCS-STO□□A</td><td>Applicable drive</td><td>L7N Series</td></tr>
<tr><td>Spec.</td><td colspan="3">Drive connection

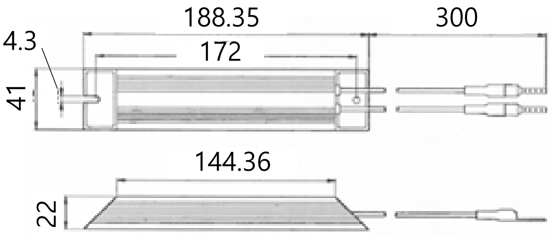
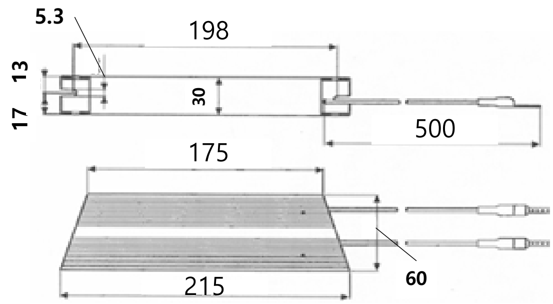
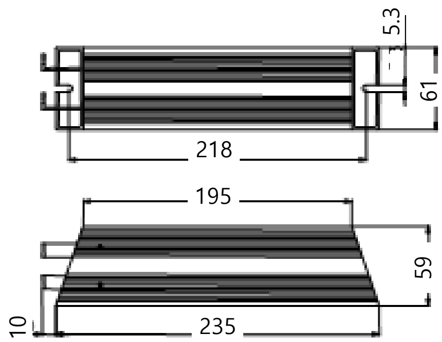
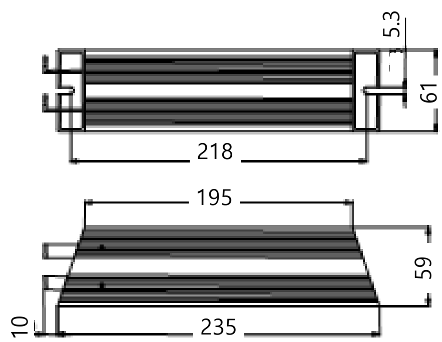
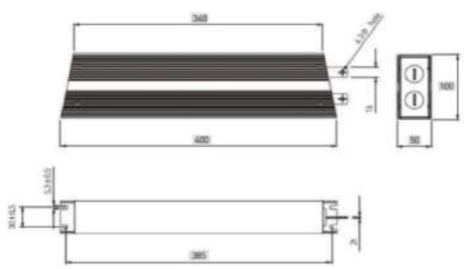
1. Plug Connector Kit
a. 2069577-1 (TE company)
2. Cable
a. 4P x 26AWG
3. How to display product Name
a. APCS - STO03A (0.3m)
b. APCS - STO10A (1m)
c. APCS - STO30A (3m)
-Pin Map -
<table>
<tr><th>PIN 번호</th><th>IO신호</th><th>Color</th></tr>
<tr><td>1</td><td>NC</td><td>–</td></tr>
<tr><td>2</td><td>NC</td><td>–</td></tr>
<tr><td>3</td><td>HWBB1 Minus</td><td>Orange</td></tr>
<tr><td>4</td><td>HWBB1 Plus</td><td>Orange/Stripe</td></tr>
<tr><td>5</td><td>HWBB2 Minus</td><td>Yellow</td></tr>
<tr><td>6</td><td>HWBB2 Plus</td><td>Yellow/Stripe</td></tr>
<tr><td>7</td><td>EDM Plus</td><td>White</td></tr>
<tr><td>8</td><td>EDM Minus</td><td>White/Stripe</td></tr>
</table></td></tr>
<tr><td>Category</td><td>CN</td><td>Product Name</td><td>CN6 Cable</td></tr>
<tr><td>Name (Note 1)</td><td>APCS-CN4NNA</td><td>Applicable drive</td><td>L7N Series</td></tr>
<tr><td>Spec.</td><td colspan="3">

1. Connector : 44915-0021(MOLEX company)
2. Plug Housing: WRJ-45(Wlztek 사)
<table>
<tr><th>PIN 번호</th><th>신호명</th><th>선 색상</th></tr>
<tr><td>1</td><td>Tx/Rx0+</td><td>White/Orange</td></tr>
<tr><td>2</td><td>Tx/Rx0−</td><td>Orange</td></tr>
<tr><td>3</td><td>Tx/Rx1+</td><td>White/Green</td></tr>
<tr><td>4</td><td>Tx/Rx2+</td><td>Blue</td></tr>
<tr><td>5</td><td>Tx/Rx2−</td><td>White/Blue</td></tr>
<tr><td>6</td><td>Tx/Rx1−</td><td>Green</td></tr>
<tr><td>7</td><td>Tx/Rx3+</td><td>White/Brown</td></tr>
<tr><td>8</td><td>Tx/Rx3−</td><td>Brown</td></tr>
<tr><td colspan="2">Plate</td><td>Shield</td></tr>
</table></td></tr>
</table>

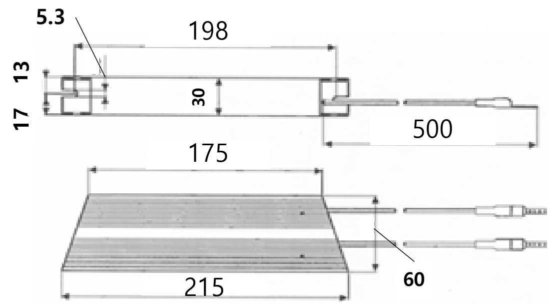
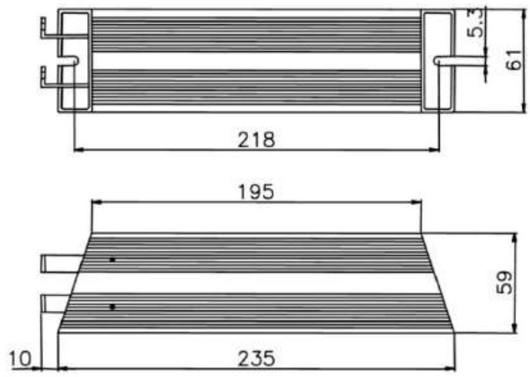
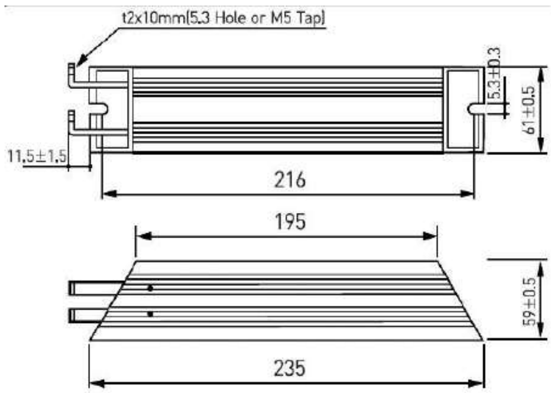
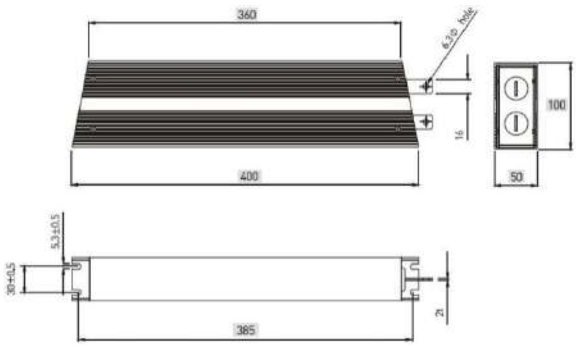
1. Note 1) The □□□in the name indicates length of each cable. Refer to the following table for this information

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

■ **Option spec. (Braking resistance) / 200[V]**

Classification	Product Name	Model name	Applicable drive	Spec.
resistance	Brake resistance	APCS-140R50	L7□A001□ L7□A002□ L7□A004□	
resistance	Brake resistance	APCS-300R30	L7□A008□ L7□A010□	
resistance	Brake resistance	APC-600R30	L7□A020□ (2P) L7□A035□ (3P)	
resistance	Brake resistance	APC-600R28	L7□A050□ L7□A075□ (4P)	
resistance	Brake resistance	APCS-2000R3R3 3.3[Ω] (2000W)	L7□A150□	

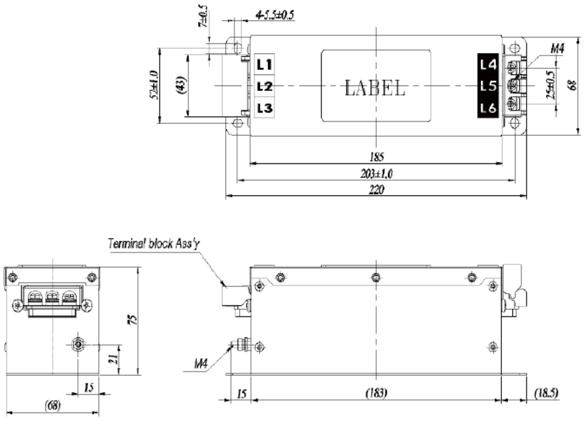
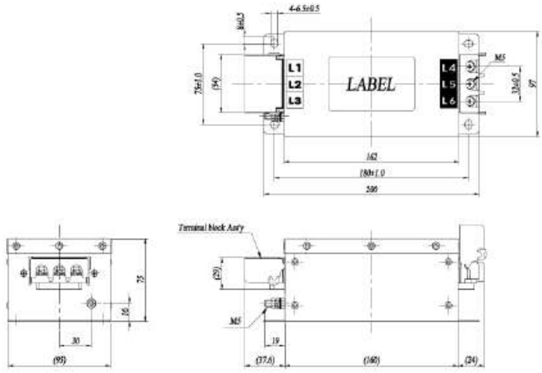
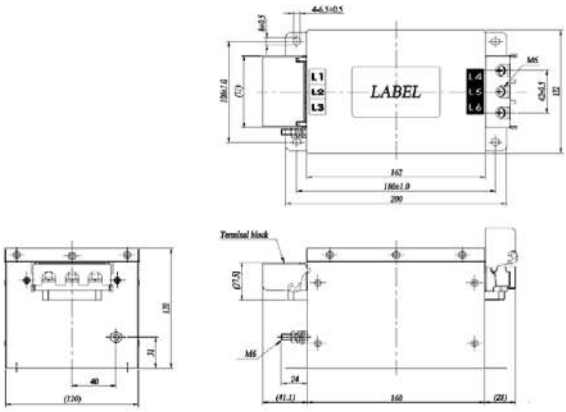
Option (Braking resistance) / 400[V]

Classification	Product Name	Model name	Applicable drive	Spec.
resistance	Brake resistance	APCS-300R82	L7□B010□	
resistance	Brake resistance	APCS-600R140 (600W x 2P)	L7□B020□ /L□PB035□ (2P)	
resistance	Brake resistance	APCS-600R75 (600W x 3P)	L7□B050□ /L7□B075□ (3P)	
resistance	Brake resistance	APCS-2000R13R4	L7□B150□	

Note 1) The P mark on the applicable drive is the number of resistors connected in parallel.

the number of resistors connected in parallel	2EA	3EA	4EA
Notation	2P	3P	4P

■ **Option (Noise filter)**

Classification	Product Name	Model name	Applicable drive	Spec.
Resistance	Noise filter	APCS-TB6-B010LBEI	L7□A 001□ L7□A 002□ L7□A 004□ L7□A 008□ L7□A 010□ L7□B 010□	
		APCS-TB6-B020NBDC	L7□B 020□ L7□B 035□	
		APCS-TB6-B030NBDC	L7□A 020□ L7□A 035□ L7□B 050□	
		APCS-TB6-B040AS	L7□A 050□ L7□B 075□	
		APCS-TB6-B060LAS	L7□B 150□	

3. Wiring and Connection

3.1 Installation of Servo Motor

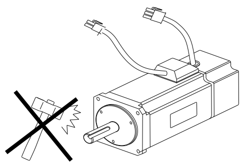
3.1.1 Operating Environment

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

3.1.2 Preventing Impact

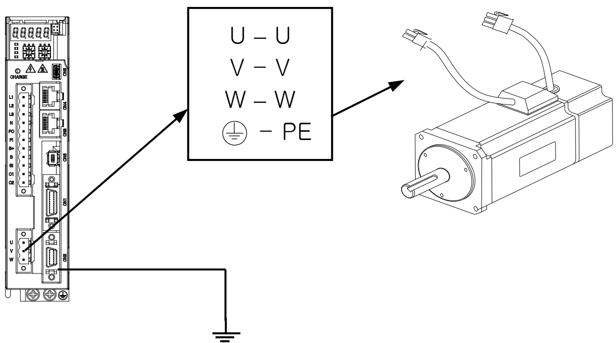
Impact to the motor during installation or handling may damage the encoder.

Caution



3.1.3 Motor Connection

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

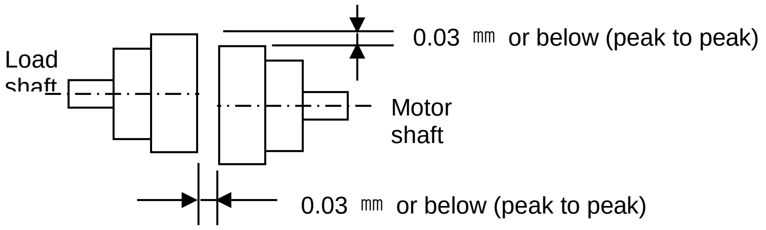


- Connect the U, V, and W terminals of the motor in the same way as the U, V, and W terminals of the drive.

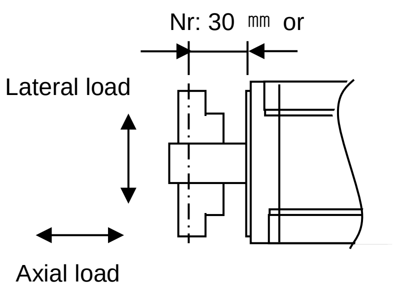
- Ensure that the pins on the motor connector are securely attached.
- In order to protect against moisture or condensation in the motor, make sure that insulation resistance is 10 MΩ (500 V) or higher before installation.

3.1.4 The Load Device Connection

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

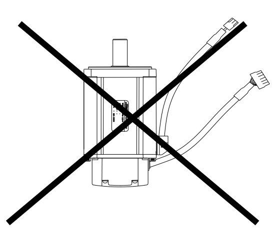


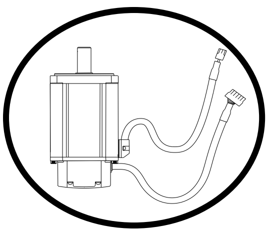
■ For pulley connections:

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	

3.1.5 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.

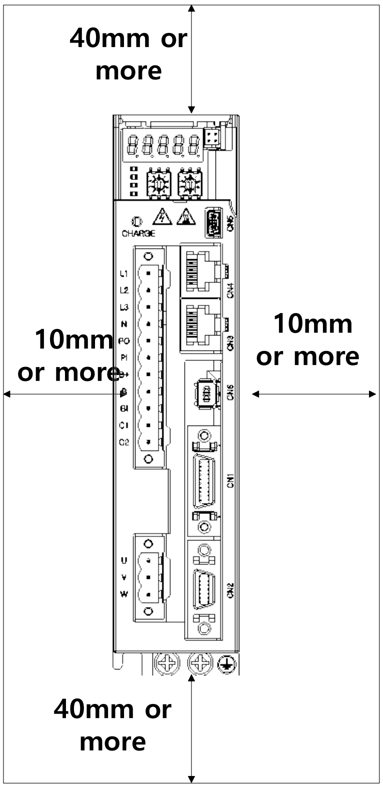
3.2 Installation of Servo Drive

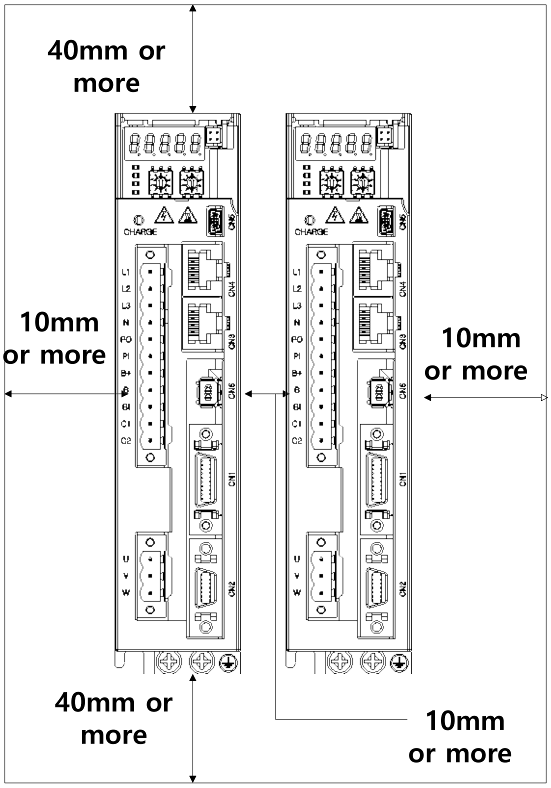
3.2.1 Installation and Usage Environment

Item	Environmental conditions	Caution
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.	

3.2.2 Installation in the Control panel

The installation interval in the control panel is as shown in the figure below.

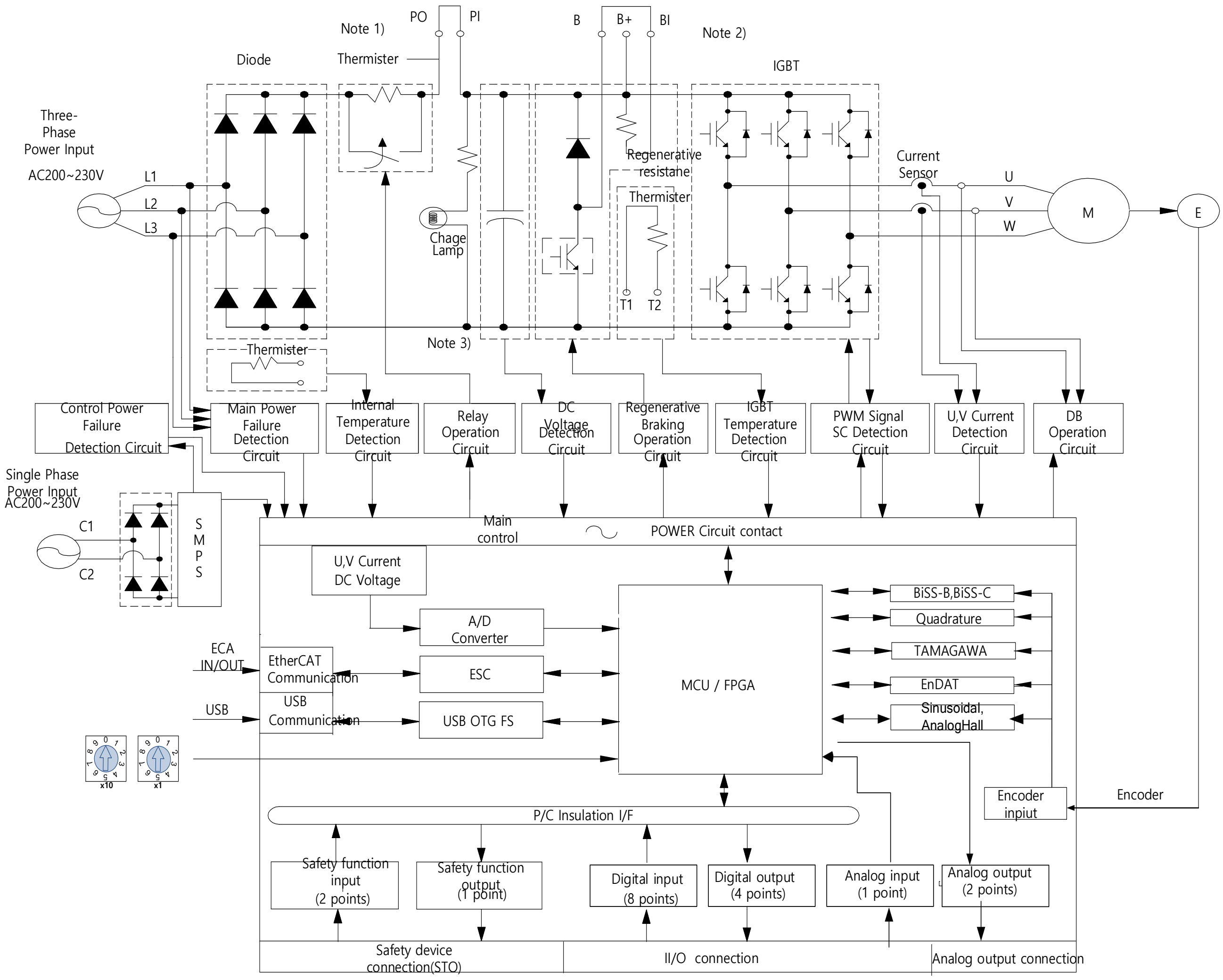




⚠Caution
▪ When installing an external regenerative resistor, install it so that it does not affect the drive due to heat. ▪ When assembling the control panel of the servo drive, make sure to assemble it in close contact with the wall. ▪ When assembling the control panel, make sure that metal powder generated by drilling, etc. does not enter the drive. ▪ Take into consideration that oil, water, and other metallic dust do not enter from the control panel gap or ceiling. ▪ Protect the control panel with an air purge when used in a place with a lot of harmful gas and dust.

3.3 Internal Block Diagram of Drive

3.3.1 Block Diagram (100W~400W/200[V])

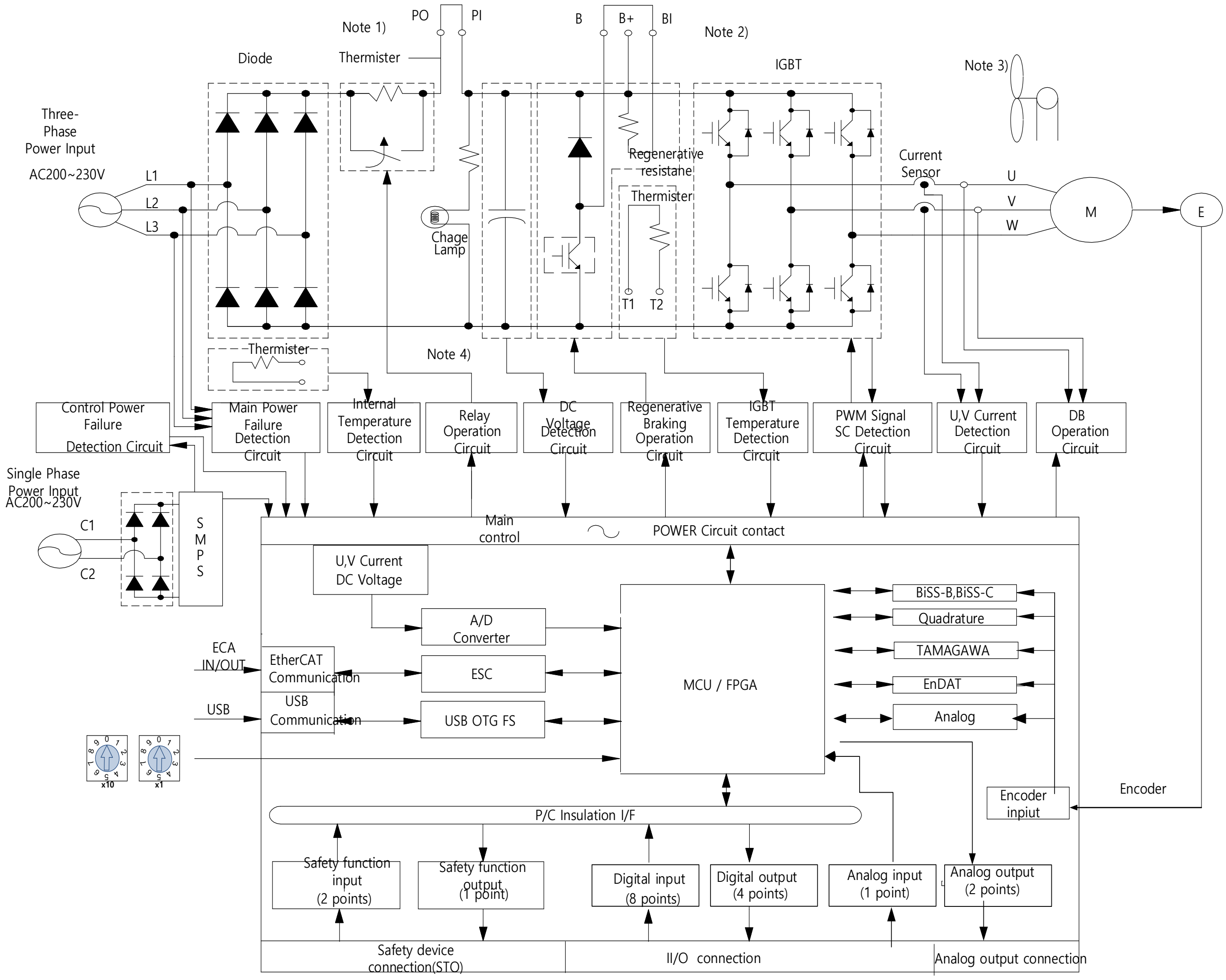


Note1) If using a DC reactor, connect the PO and PI pins.

Note2) If using an external regenerative resistor, remove the B and BI short-circuit pins and connect the B+ and B pins.

Note3) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.3.2 Block Diagram of L7NH (800W~3.5kW/200[V])



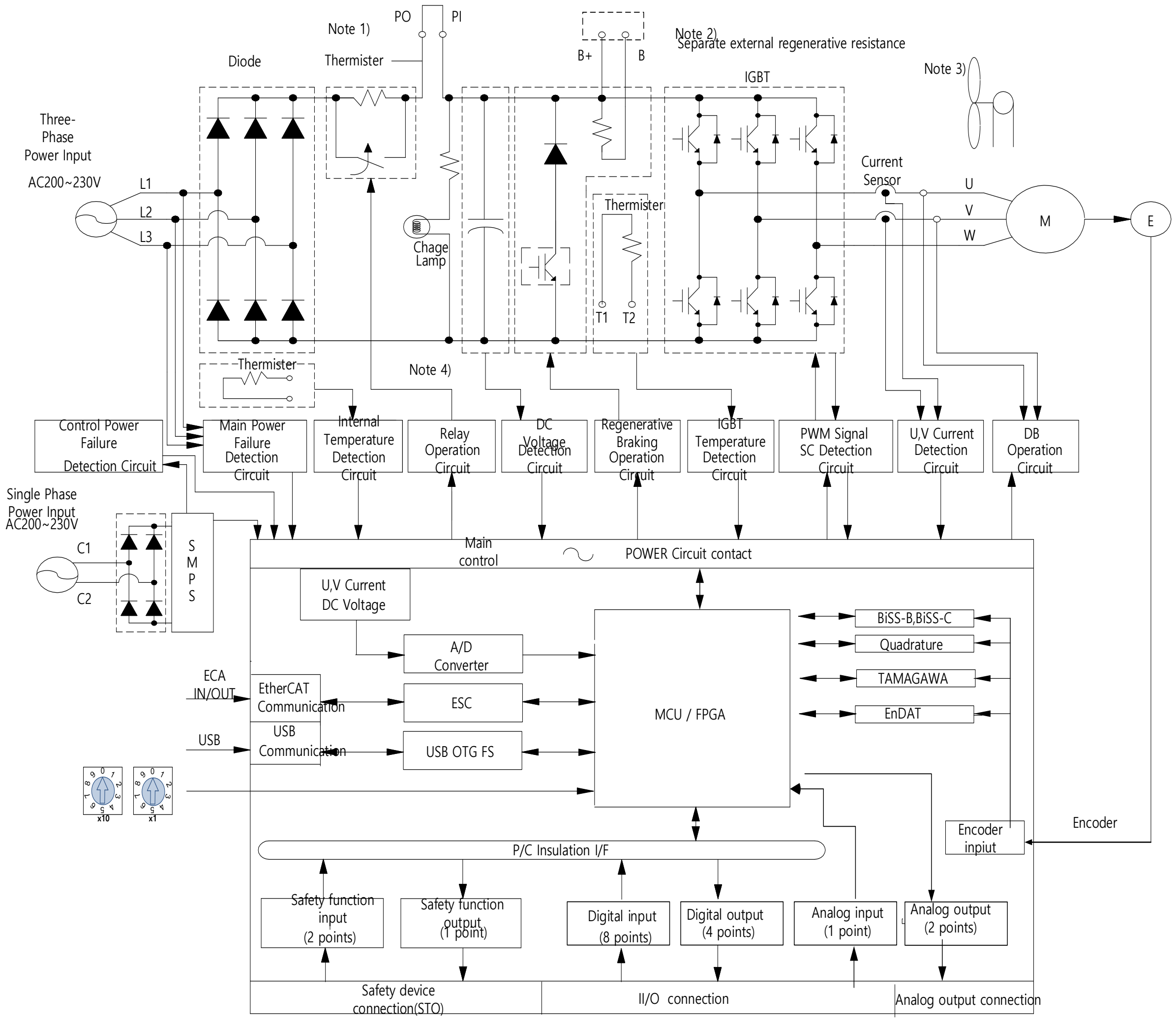
Note1) If using a DC reactor, connect the PO and PI pins.

Note2) If using an external regenerative resistor, remove the B and BI short-circuit pins and connect the B+ and B pins.

Note3) 800W ~ 3.5KW are cooled by a DC 24V cooling fan.

Note4) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.3.3 Block Diagram of L7NH (5kW~7.5kW/200[V])



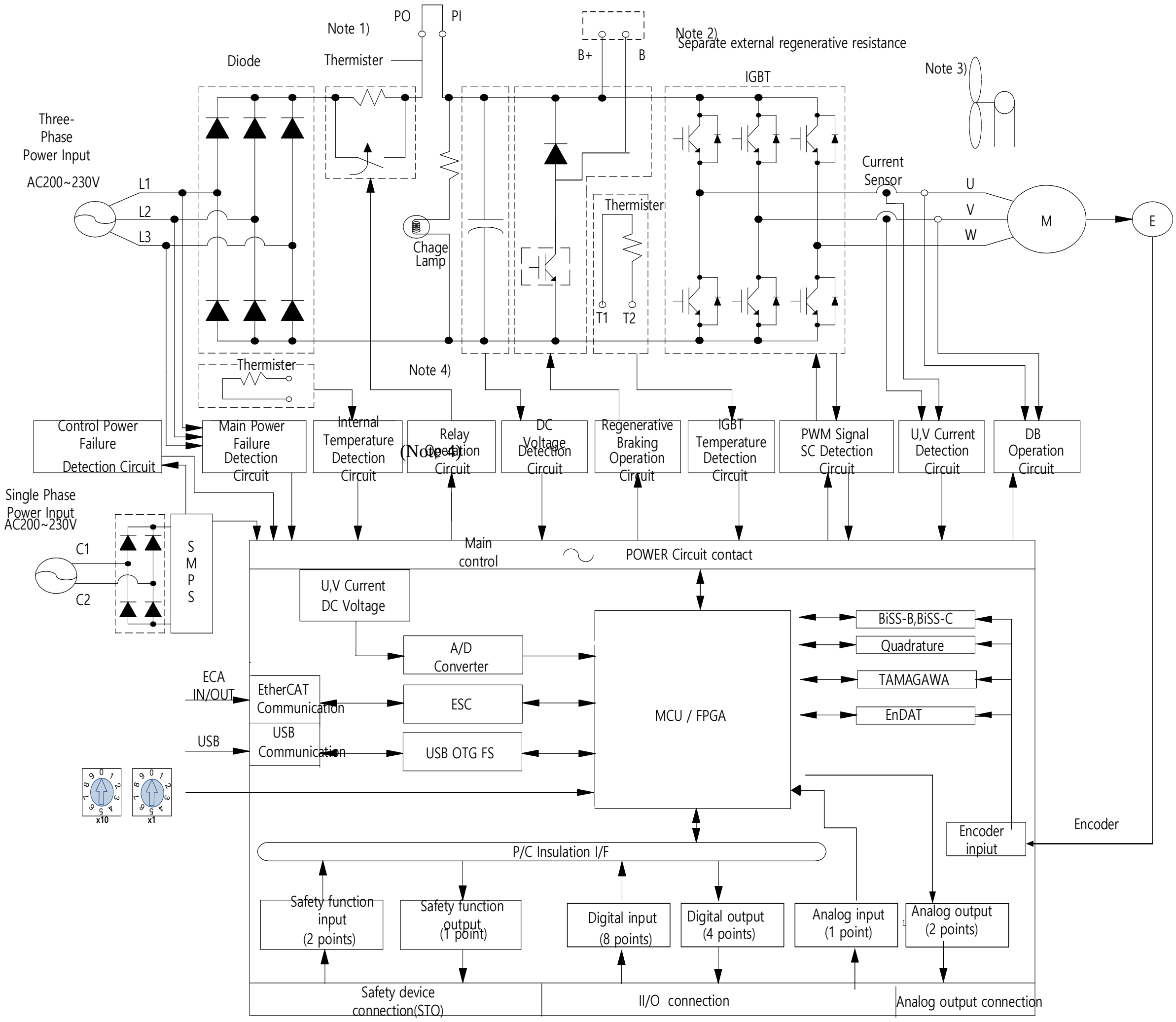
Note1) If using a DC reactor, connect the PO and PI pins.

Note2) When using an external regenerative resistor, connect the external regenerative resistor to the B+ and B terminals after attaching the wiring of the internal regenerative resistor to the internal resistance fixing hole "NC" of the case.

Note3) 5kW ~ 7.5KW are cooled by a DC 24V cooling fan.

Note4) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.3.4 Block Diagram of drive (15kW / 200[V])



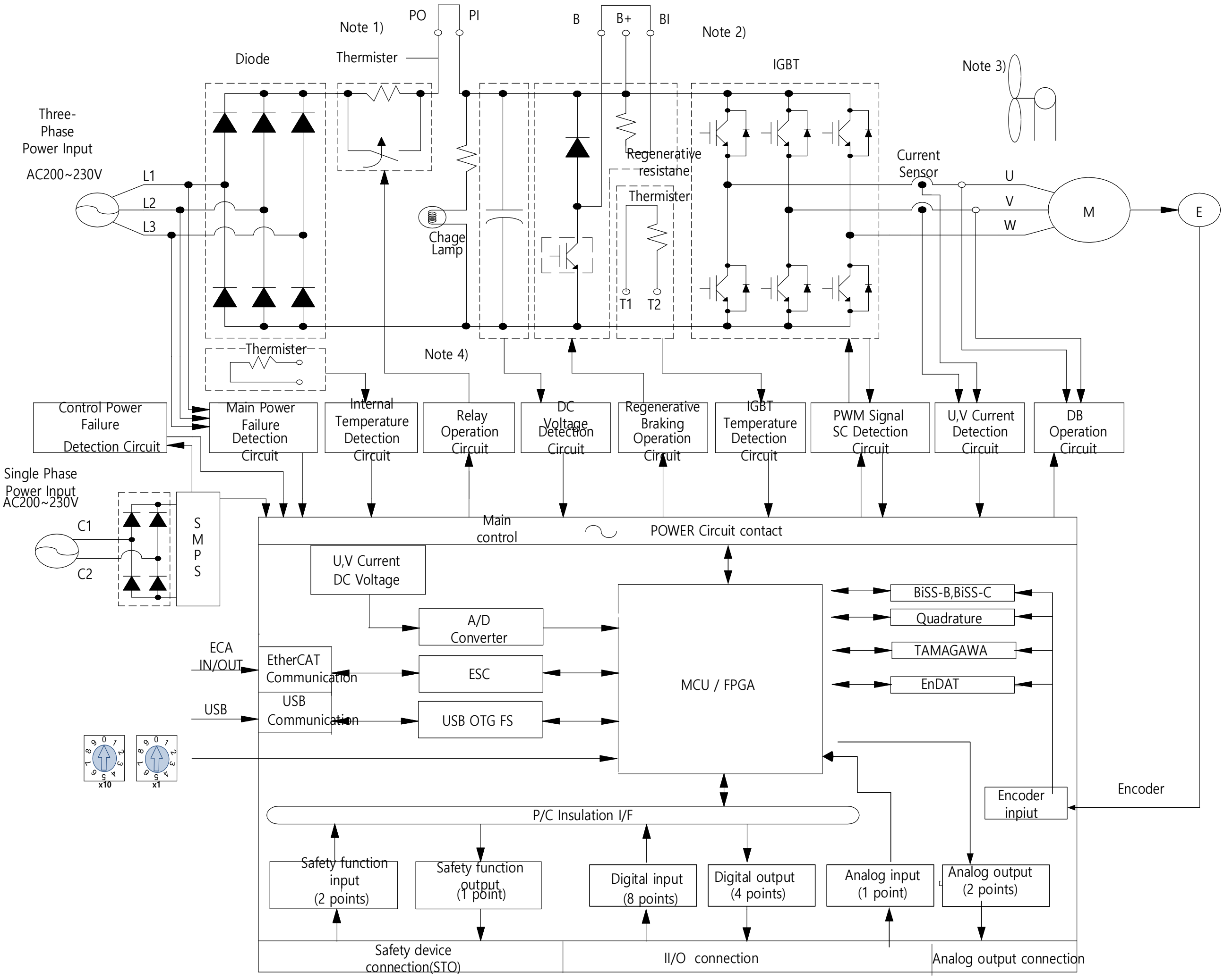
Note1) If using a DC reactor, connect the PO and PI pins.

Note2) L7NHA150U model does not have an internal regenerative resistor. Use of an external regenerative resistor It is basic, and when installing, connect to B+, B terminals.

Note3) L7NHA150U models are cooled by a DC 24V cooling fan.

Note4) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.3.5 Block Diagram of L7NH (1kW~3.5kW/400[V])



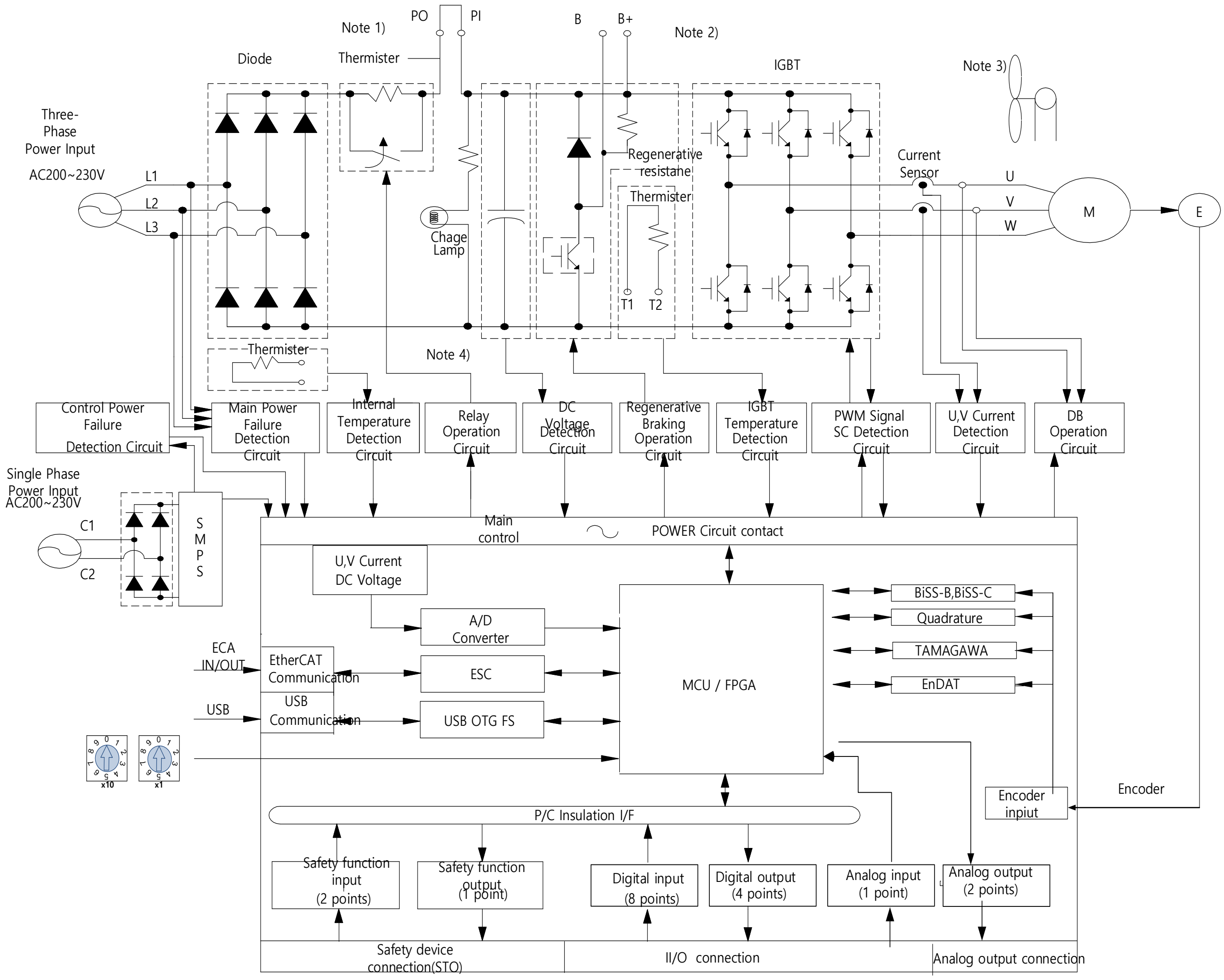
Note1) If using a DC reactor, connect the PO and PI pins.

Note2) If using an external regenerative resistor, remove the B and BI short-circuit pins and connect the B+ and B pins.

Note3) 1.0kW ~ 3.5KW are is cooled by a DC 24 V cooling fan.

Note4) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.3.6 Block Diagram of L7NH (5kW~7.5kW/400[V])



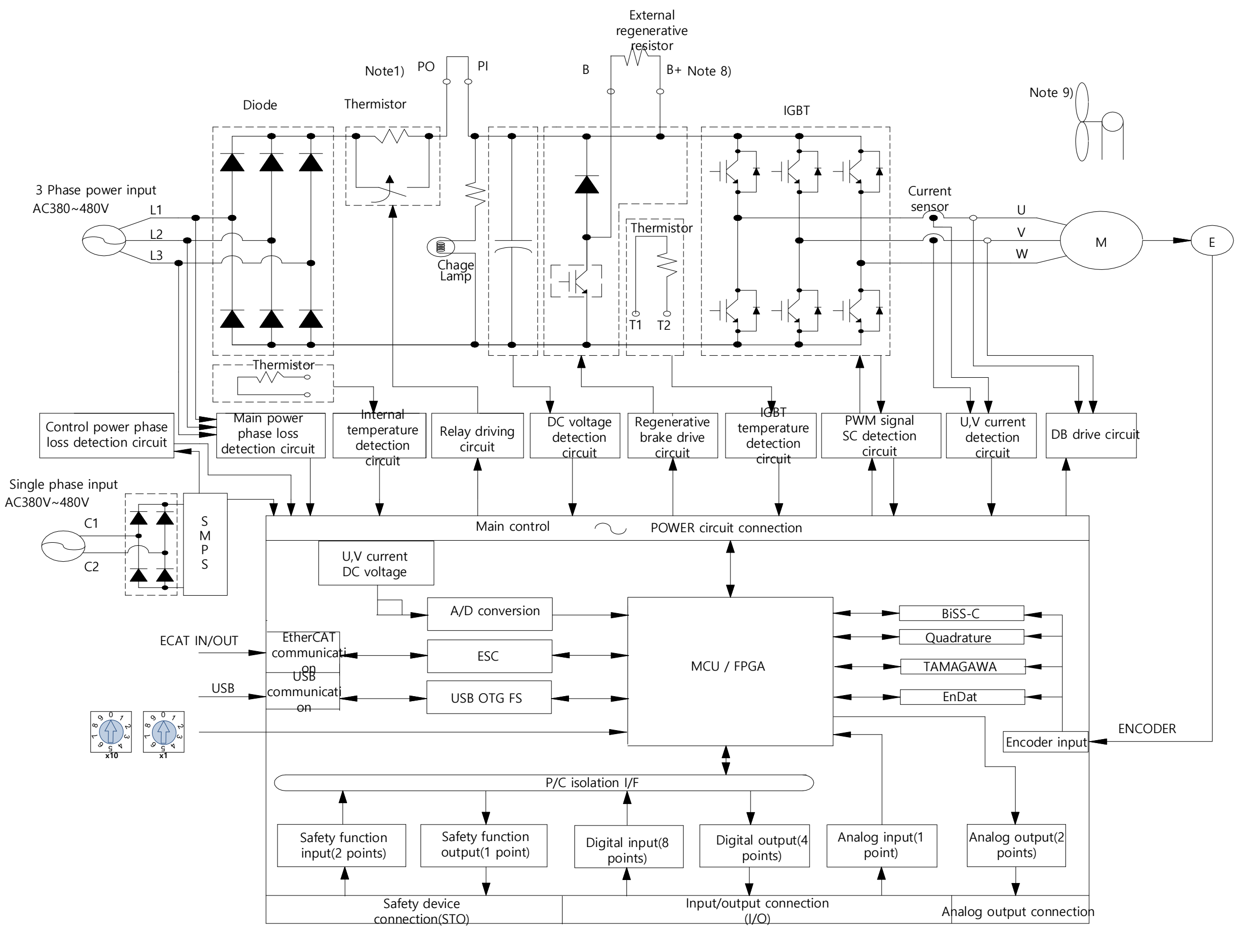
Note1) If using a DC reactor, connect the PO and PI pins.

Note2) If using an external regenerative resistor, remove the B and BI short-circuit pins and connect the B+ and B pins.

Note3) 5kW ~ 7.5KW are cooled by a DC 24V cooling fan.

Note4) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.3.7 Block Diagram of L7NH (15kW/400[V])



Note1) If using a DC reactor, connect the PO and PI pins.

Note2) L7PB150U model does not have an internal regenerative resistor. Use of an external regenerative resistor It is basic, and when installing, connect to B+, B terminals.

Note3) 15KW are cooled by a DC 24 V cooling fan.

Note4) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.4 Power Supply Wiring

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

⚠Caution
Overvoltage 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.

Voltage	Type	Resistance	Standard capacity	* Notes
200[V]	L7NHA001U~L7NHA004U	100[Ω]	Built-in 50[W]	⚠ **Caution** For information about resistance during regenerative capacity expansion, refer to Section 2.3, "Options and peripheral device."
	L7NHA008U~L7NHA010U	40[Ω]	Built-in 100[W]	
	L7NHA020U~L7NHA035U	13[Ω]	Built-in 150[W]	
	L7NHA050U	6.8[Ω]	Built-in 120[W]	
	L7NHA075U	6.8[Ω]	Built-in 120[W]	
	L7NHA150U	3.3[Ω]	External 2000[W]	
400[V]	L7NHB010U	100[Ω]	Built-in 100[W]	
	L7NHB020U~L7NHB035U	40[Ω]	Built-in 150[W]	
	L7NHB050U	27[Ω]	Built-in 120[W]	
	L7NHB075U	27[Ω]	Built-in 240[W]	
	L7NHB150U	13.4[Ω]	External 2000[W]	

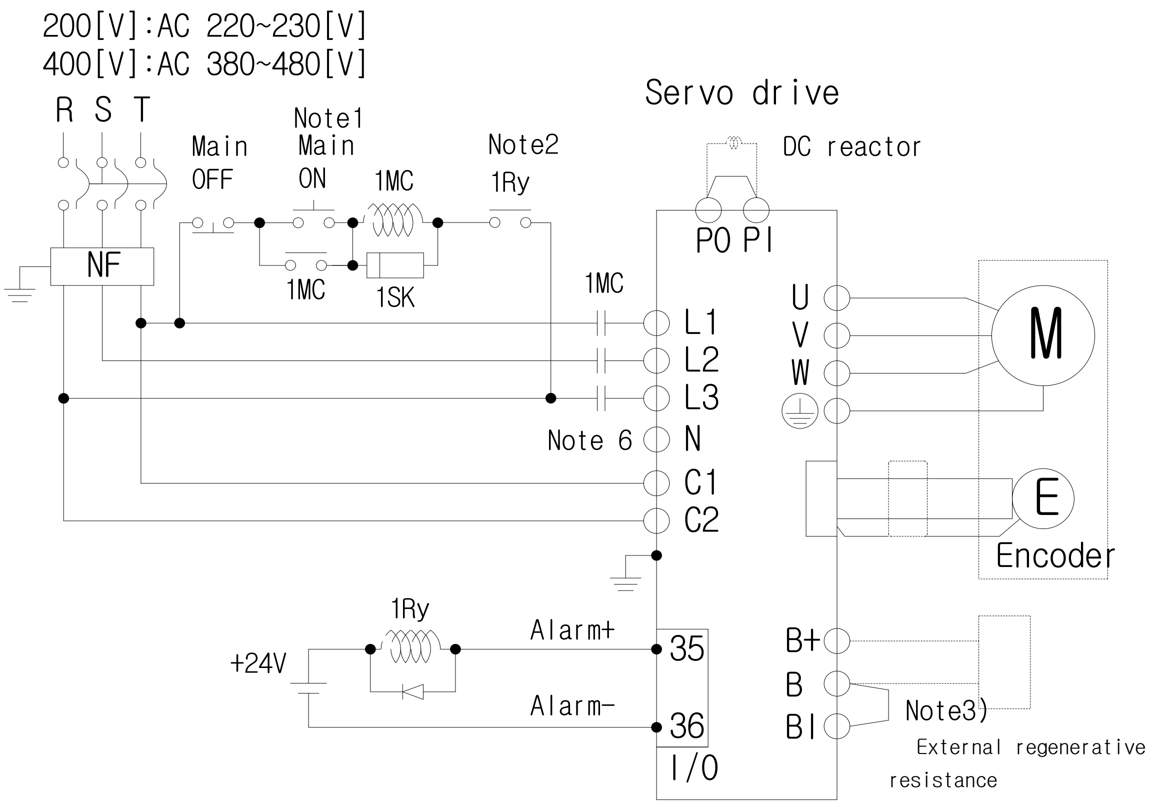
- Configure the system so that the main power (L1, L2, L3) is supplied after the control power (C1, C2). (Refer to section 2.4.1, "Power Supply Wiring Diagram.")

- High voltages may remain in the device for some time 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.

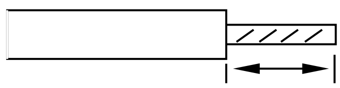
3.4.1 Power Supply Wiring 100[kW] ~3.5 [kW] (200/400[V])



Note1) 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.

Note2) Short-circuit B and BI terminals before use, because 200[V]/100[W] ~3.5[kW] and 400[V]/1[kW] ~3.5[kW] 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+.

Note3) Remove approximately 7-10 ㎜ of the sheathing from the cables for the main circuit power and attach crimp terminals. (Refer to "2.4.3 Specifications of Power Circuit Electrical Components").

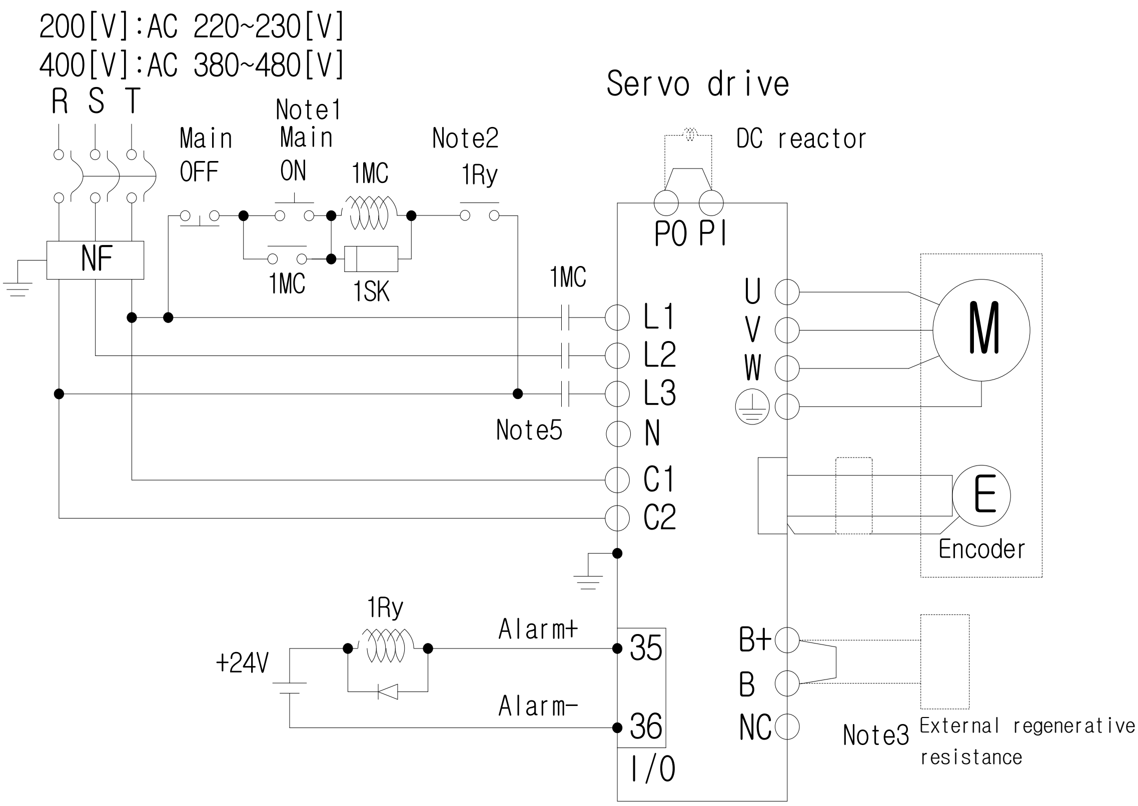


Note4) To remove the wiring of the main circuit power supply unit, connect or remove the 200[V]/100[W] ~1[kW] drive after pressing the button on the drive terminal block. Use a (-) flathead screwdriver to connect or remove the main circuit power unit wiring.

Note5) In the case of 200[V]/2[kW] ~3.5[kW] and 400[V]/1[kW] ~3.5[kW] drives, connect or remove them using a (-) screwdriver.

Note6) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

5[kW] ~7.5 [kW] (200/400[V])



Note1) 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.

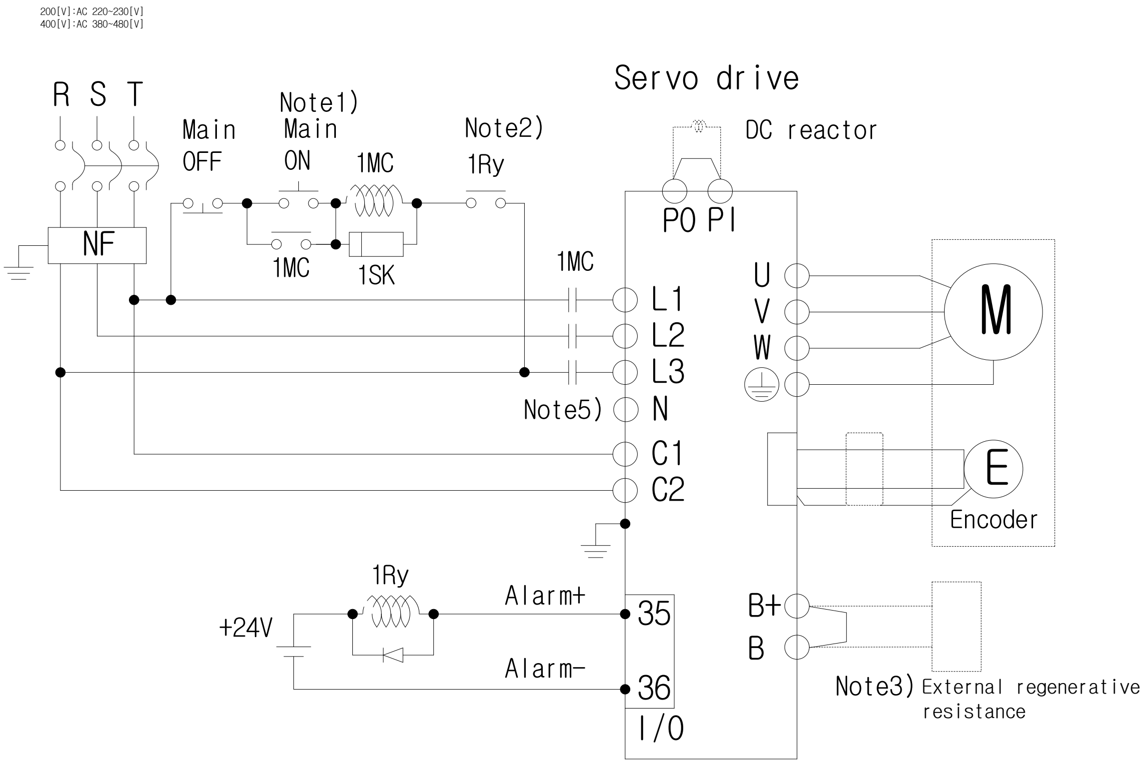
Note2) Short-circuit B and BI terminals before use, because 200[V]/5[kW] and 400[V]/5[kW] ~7.5[kW], 40[Ω]) have internal regenerative resistance. If the regenerative capacity is large due to frequent acceleration/deceleration, connect the wires of the internal regenerative resistor connected to B+ and B to the internal resistance fixing hole "NC" of the case, and then connect the external regenerative resistor to the B and B+ terminals.

Note3) For 400[V]/5[kW] ~7.5[kW] drives, be sure to use crimp terminals (GP110028_KET) within the electrical product standard (Refer to '2.4.3 Power Circuit Electrical Product Specification')

Note4) In the case of 400[V]/5[kW] ~7.5[kW], use a (+) and (-) driver to connect or remove the terminal block

Note5) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

15[kW] (200/400[V])



Note1) It takes approximately two to three 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 three seconds.

Note2) For 15[kW], external regenerative resistors for each operating voltage are used as a basis, and please connect the external regenerative resistor to terminals B+ and B.

Note3) Be sure to use crimp terminals (200[V]: JOPR 25 - S6W_JEONO || 400[V]: GP110732_KET) within the electric product standard for the wires to be used for the main circuit and control power supply. (Refer to "2.4.3 Specifications of Power Circuit Electrical Components").

Note4) In the case of 15[kW], use a (+) and (-) driver to connect or remove the terminal block

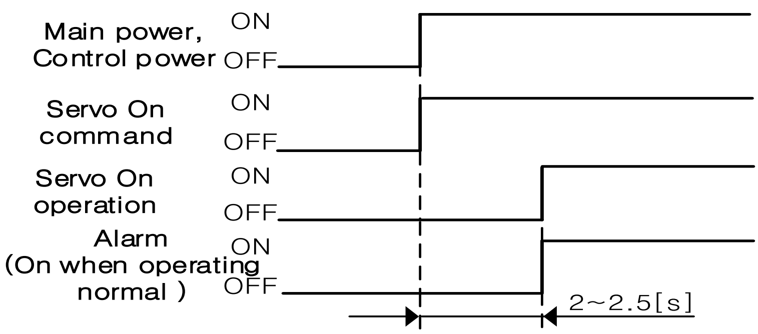
Note5) The N terminal is used to connect an external capacitor. Connecting the power used to the N terminal will damage the product. If you need to connect an external capacitor, be sure to contact the customer service center or dealer.

3.4.2 Power supply sequence

■ Power supply sequence

- For power wiring, use a magnetic contactor for the main circuit power as shown in 3.4.1 Power Supply Wiring Diagram. Configure the magnetic contactor to turn off at the same time an alarm occurs in an external sequence.
- Turn on the control power (C1, C2) at the same time as the main power (L1, L2, L3) or first. Also, when power is shut off, shut off the control power at the same time or after turning off the main power.
- The alarm signal turns on (normal state) after about 2 to 2.5 seconds after power is supplied, and then the servo on command signal is recognized. Therefore, if the Servo On command signal is at the same time as the power is supplied, the actual Servo On will operate after about 2 to 2.5 second. Please consider this when designing the power-on sequence.

■ Timing chart



3.4.3 Power circuit Electrical Components

200[V]

Model name		L7NHA001U~L7HA010U		L7NHA020U~L7NHA035U	L7NHA050U	L7NHA075U	L7NHA150U
MCCB(NFB)		30A Frame 15A (ABE33C/15)		30A Frame 30A (ABE33C/30)	50A Frame 40A (ABE53b/40)	50A Frame 50A (ABE53b/50)	100A Frame 100A (ABS103/100)
Noise Filter (NF)		TB6-B010LBEI(10A)		TB6-B030NBDC(30A)	TB6-B040A (40A)	TB6-B060LA(60A)	TB6 B080LA(80A)
DC reactor		HFN-10 (10A)	HFN-15 (15A)	HFN-30 (30A)	HFN-40 (40A)	HFN-50 (50A)	HFN-80 (80A)
MC		11A / 240V (GM□-9)	18A / 240V (GM□-18)	32A / 240V (GM□-32)	50A / 240V (GM□-50)	50A / 240V (GM□-50)	105A / 240V GM□-100)
Wire Note) 1	L1,L2,L3,PO,PI,N B+,B,BI U,V,W	AWG16 (1.5 ㎟)	AWG14 (2.5 ㎟)	AWG12 (4.0 ㎟)	AWG10 (6.0 ㎟)	AWG8 (8.0 ㎟)	AWG4 (21.1 ㎟)
	C1 C2	AWG16 (1.5 ㎟)	AWG16 (1.5 ㎟)	AWG16 (1.5 ㎟)	AWG16 (1.5 ㎟)	AWG16 (1.5 ㎟)	AWG16 (1.5 ㎟)
Crimp terminals		UA-F1510, SEOIL (10mm Strip & Twist)	UA-F2010, SEOIL (10mm Strip & Twist)	UA-F4010, SEOIL (10mm Strip & Twist)	GP110028 KET	GP110732 KET	JOPR25 – 6W JEONO
Regenerative Resistor (Default)		50[W] 100Ω	100[W] 40Ω	150[W] 13Ω	120[W] 6.8Ω	240[W] 6.8Ω	Option
Connector		• BLF 5.08/03/180F SN BK BX • BLF 5.08/11/180F SN BK BX		•BLZ7.62HP/03/180LR SN BK BX SO •BLZ7.62HP/11/180LR SN BK BX SO			

400[V]

Model 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 terminals		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				

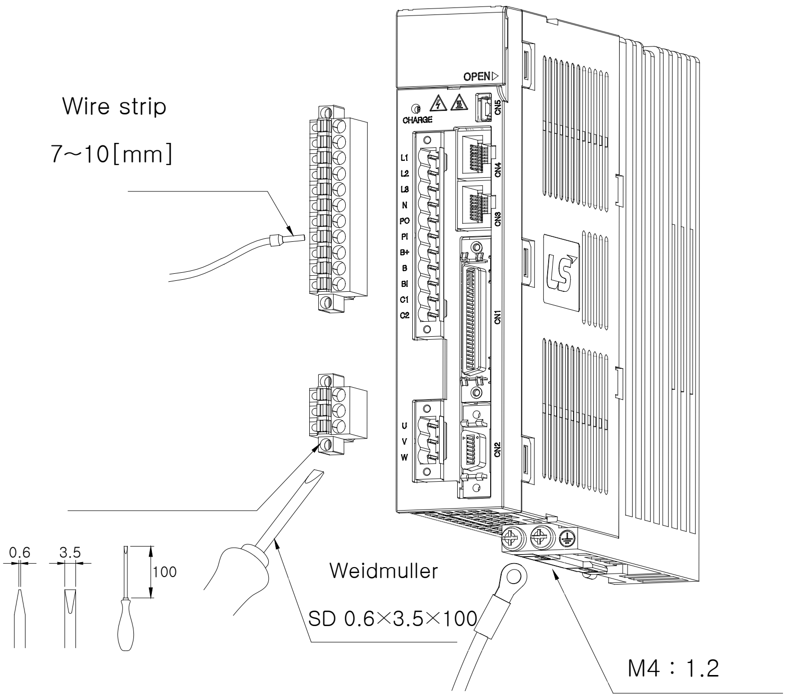
Note1) When you select a wire, please use 600V, PVC-insulated wire.

Note2) To comply with UL (CSA) standards, use UL-certified wire (heat resistant temperature 75℃ or above).

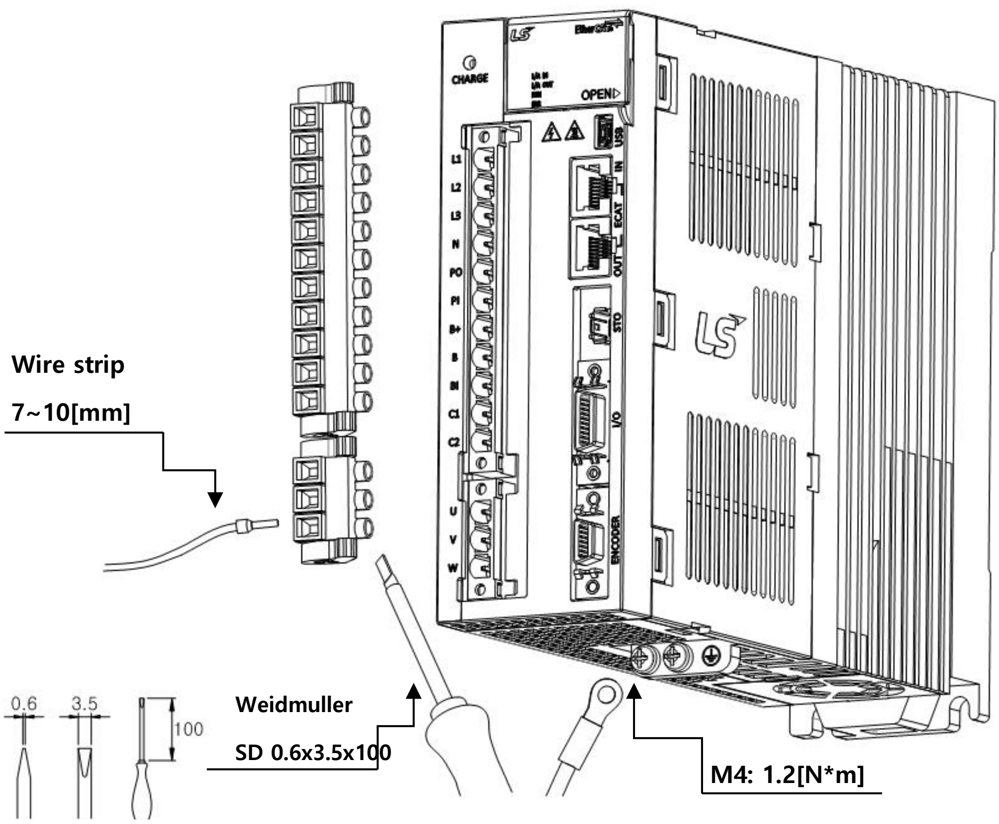
Note3) To comply with other standards, use proper wires that meet applicable standards.

Note4) For other special specifications, use wires equivalent or superior to those in this section.

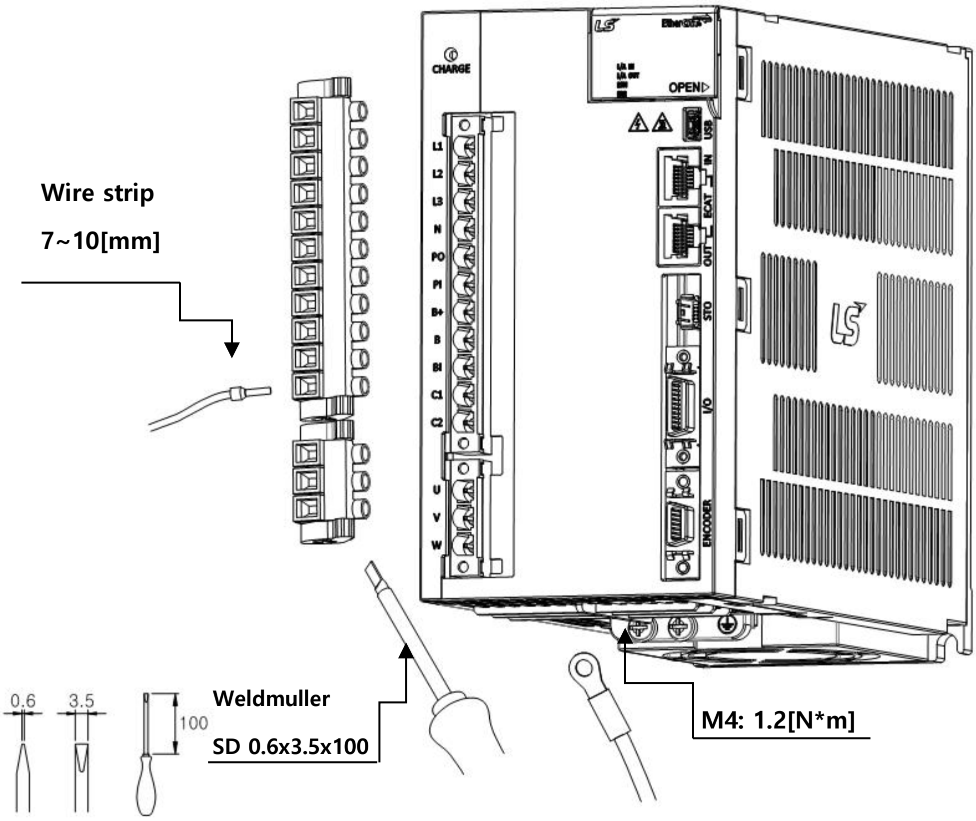
■ L7NHA004U or lower



■ L7NHA008U ~ L7NHA010U

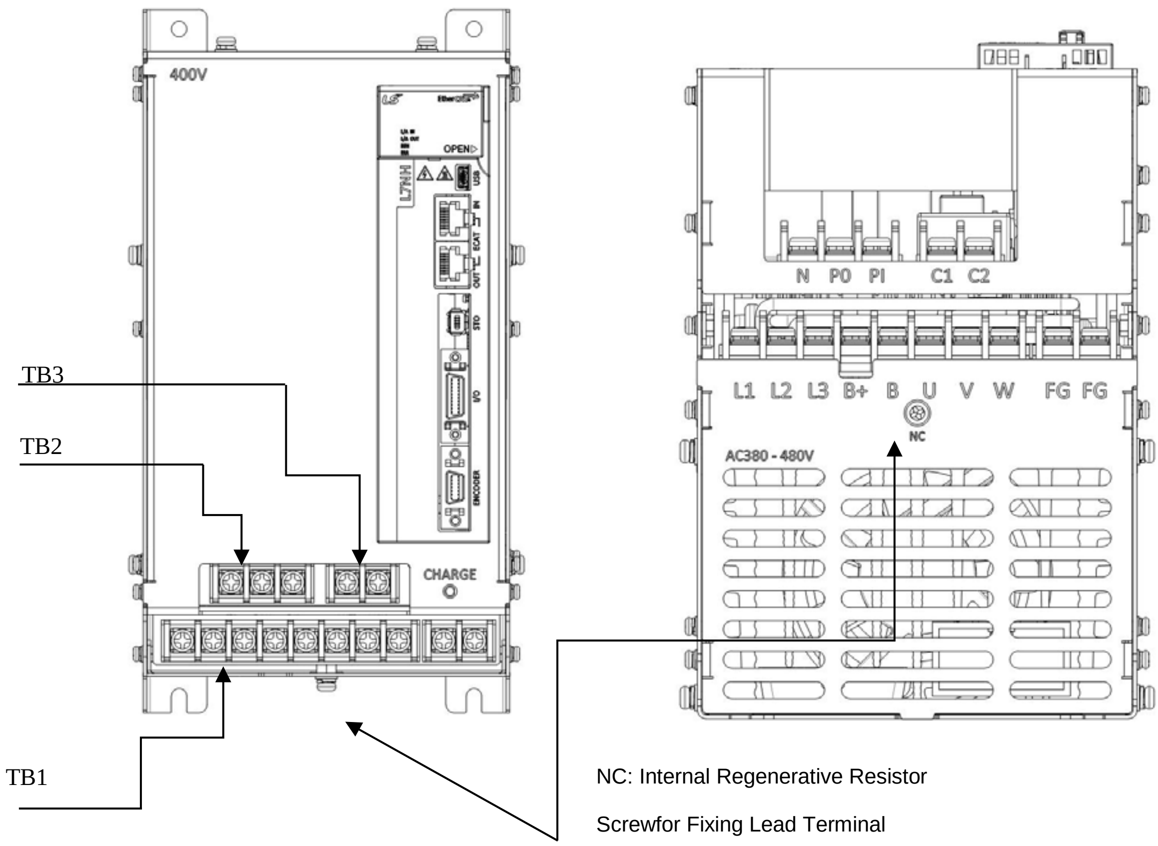


L7NHA020U ~ L7NHA035U



1) For information on wiring to BLZ 7.62HP Series connector, refer to the above procedures.
2) Insert electric wire into insert hole with upper locking screw loosened, and use applicable flathead (-) driver for each model to fully tighten screw to 0.4-0.5 N·m.
3) Otherwise, insufficient torque of locking screw may cause vibration-induced disconnection, system malfunction and contact-induced fire accident.
4) After you connect a wire to connector, place the connector as closely to servo drive as possible and use both locking hooks to fully lock it.
5) Use FG locking screw of M4 size (shown in bottom of product) to tighten it to 1.2 N·m.
6) Insufficient torque of locking screw may cause FG contact failure and even malfunctioning drive.
7) Recommended (-) driver: Use Weidmuller flathead driver (SD 0.6×3.5×100).

■ L7NHA050U



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

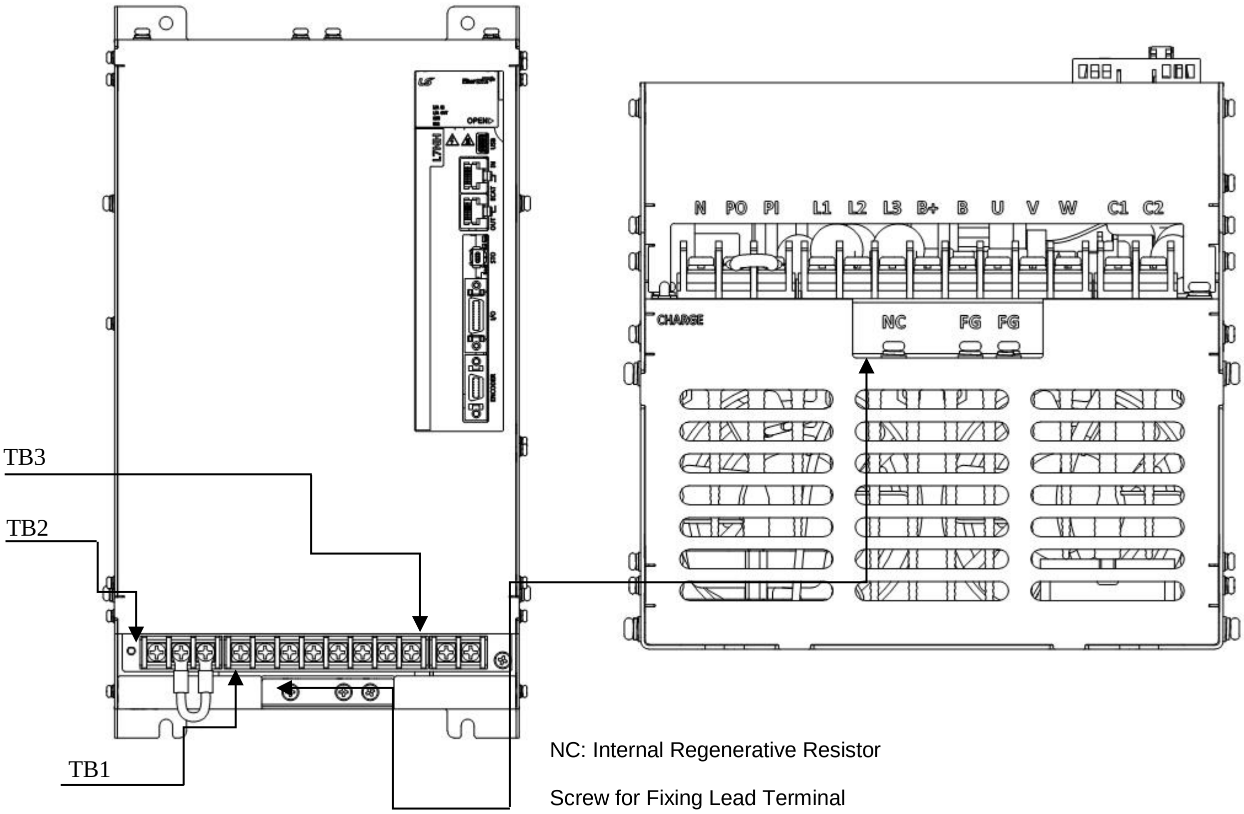
Terminal screw: M4

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.

■ L7NHA075U



Terminal signal

TB1

L1	L2	L3	B+	B	U	V	W

Terminal screw: M5

Tightening torque: 3.24[N·m]

TB2

N	PO	PI

Terminal screw: M5

Tightening torque: 3.24[N·m]

TB3

C1	C2

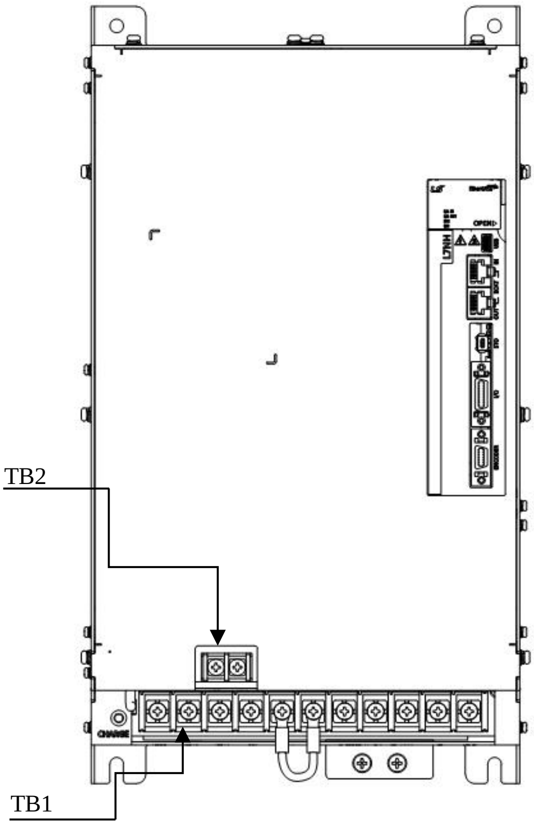
Terminal screw: M4

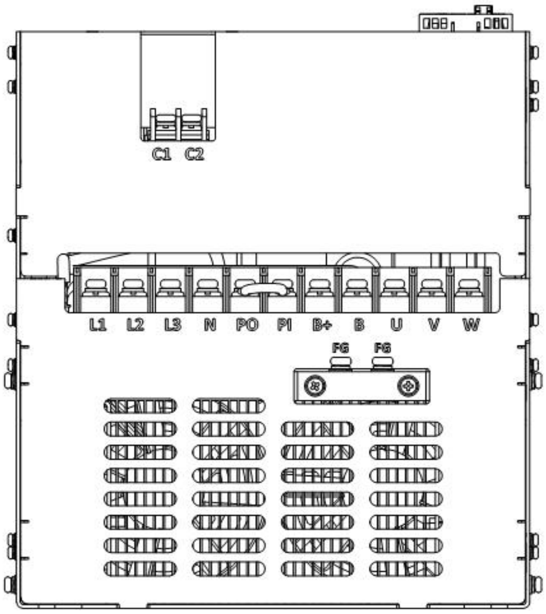
Tightening torque: 1.2[N·m]

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.

■ L7NHA150U





TB1

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

Terminal screw: M6

Tightening torque: 0.5~ 0.5[N·m]

TB2

C1	C2

Terminal screw: M4

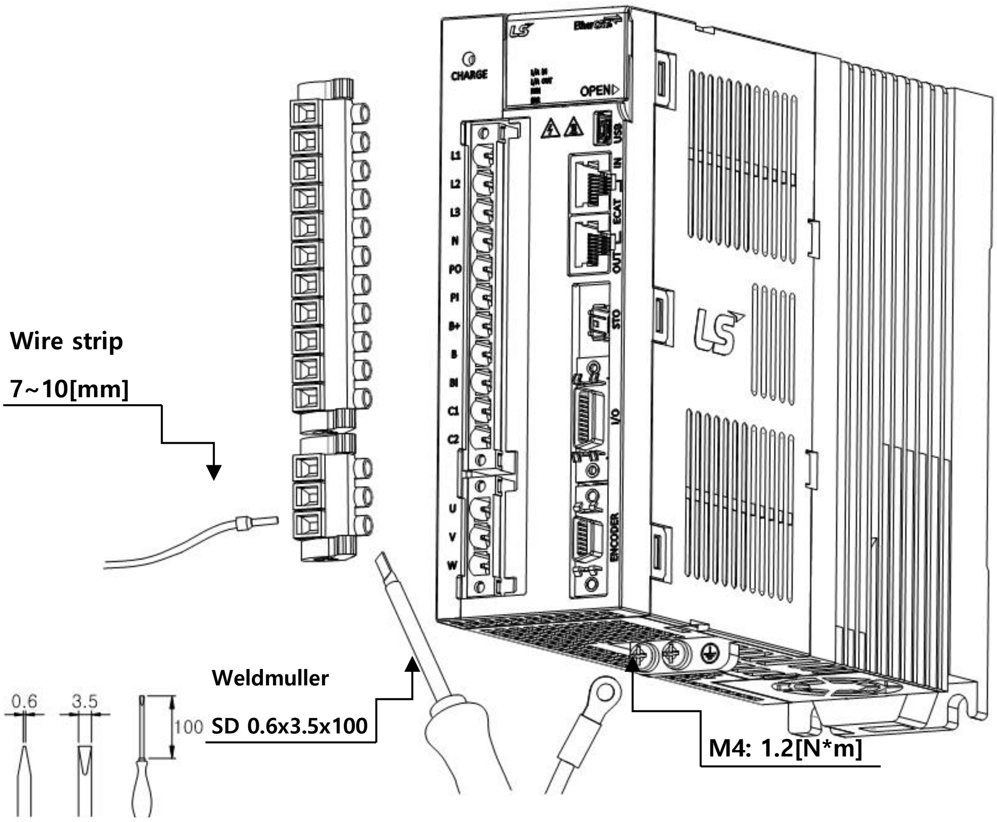
Tightening torque: 1.2[N·m]

Terminal screw: M5

Tightening torque: 3.24[N·m]

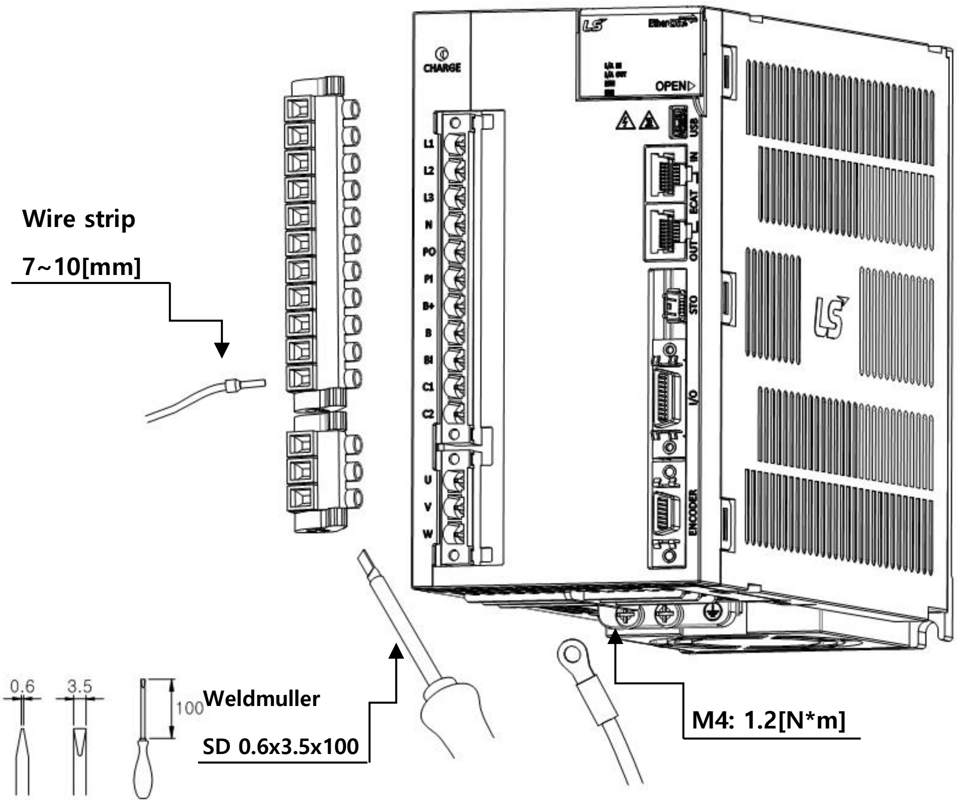
1) Otherwise, insufficient torque of locking screw may cause vibration-induced disconnection, system malfunction and contact-induced fire accident.
2) Use FG locking screw of M5 size (shown in bottom of product) to tighten it to 3.24 N·m.

■ L7NHB010U



Wire strip
7~10[mm]
Weldmuller
SD 0.6x3.5x100
M4: 1.2[N*m]
0.6
3.5
100
CHARGE
OPEN
L1
L2
L3
N
PO
PI
B+
B
BI
C1
C2
U
V
W
USB
IN
ECAT
OUT
STO
I/O
ENCODER

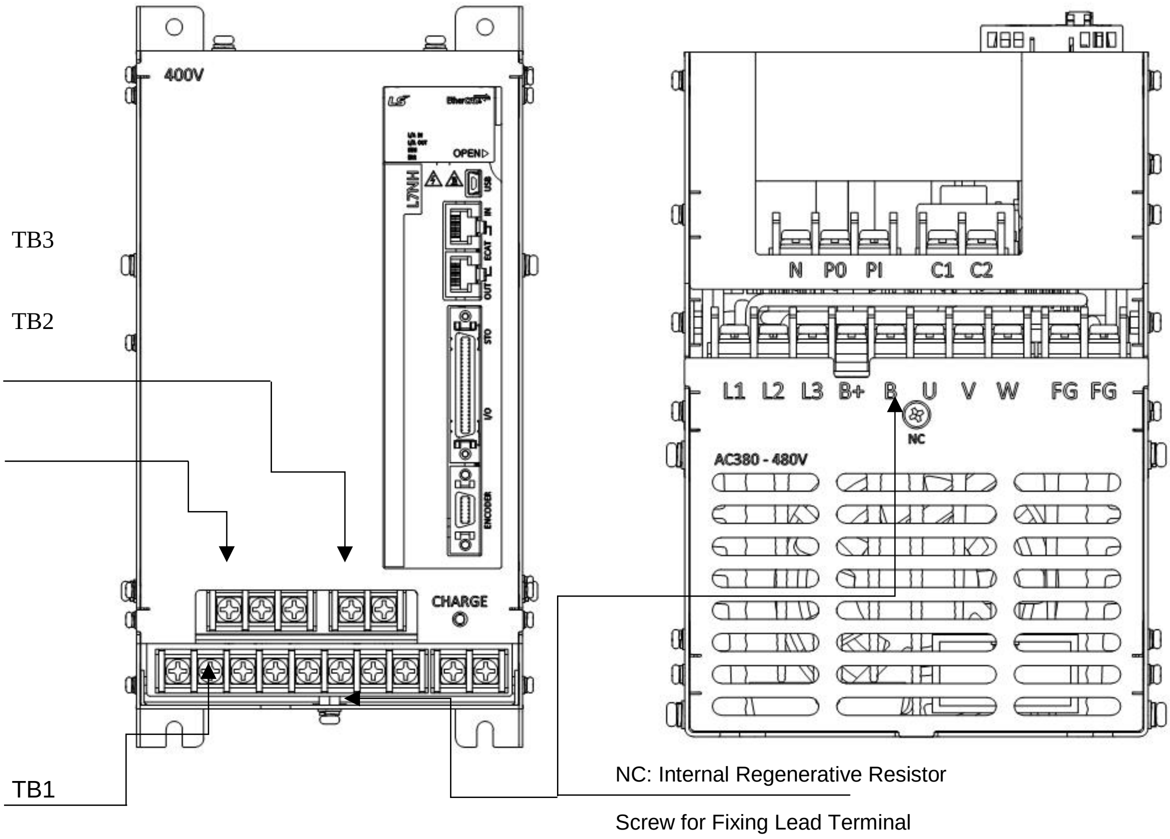
■ L7NHB010U / L7NHB035U



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



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

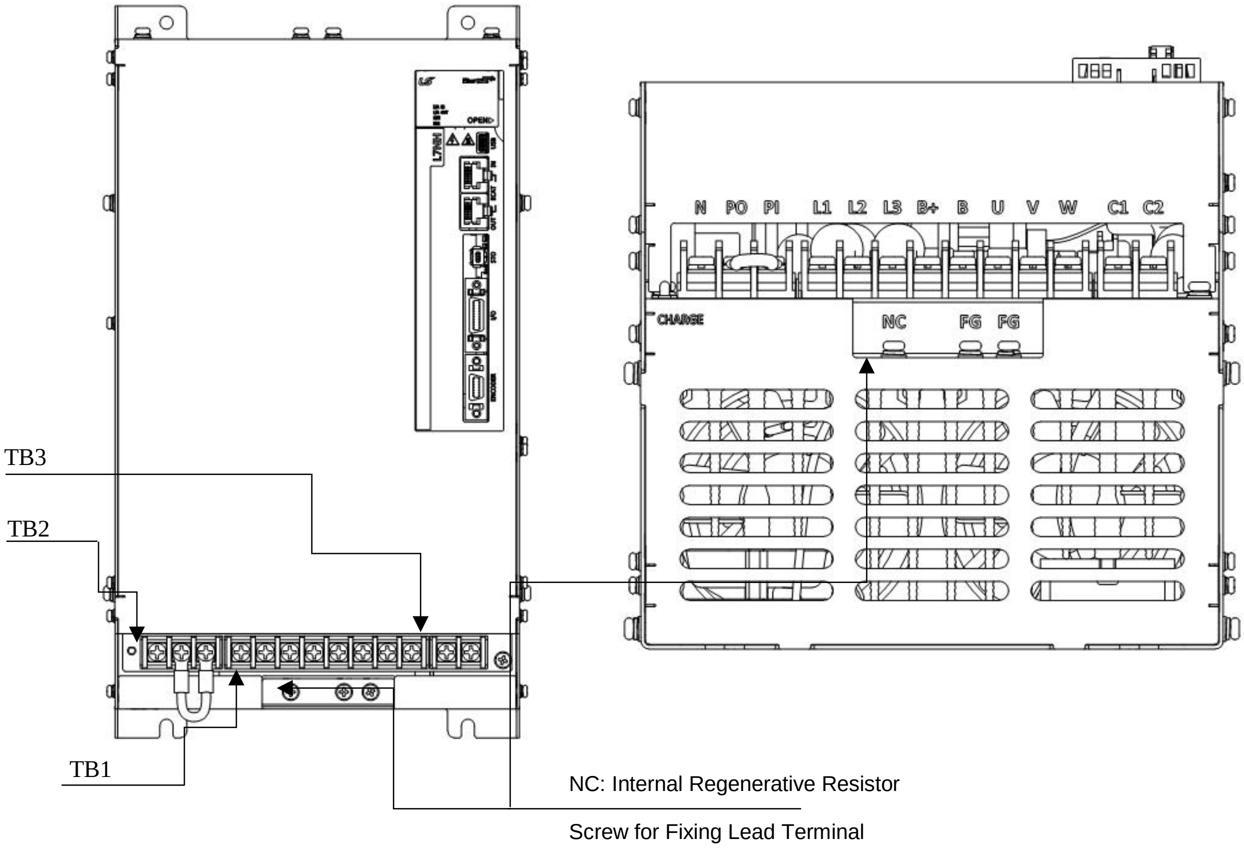
Terminal screw: M4

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



TB1

L1	L2	L3	B+	B	U	V	W

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

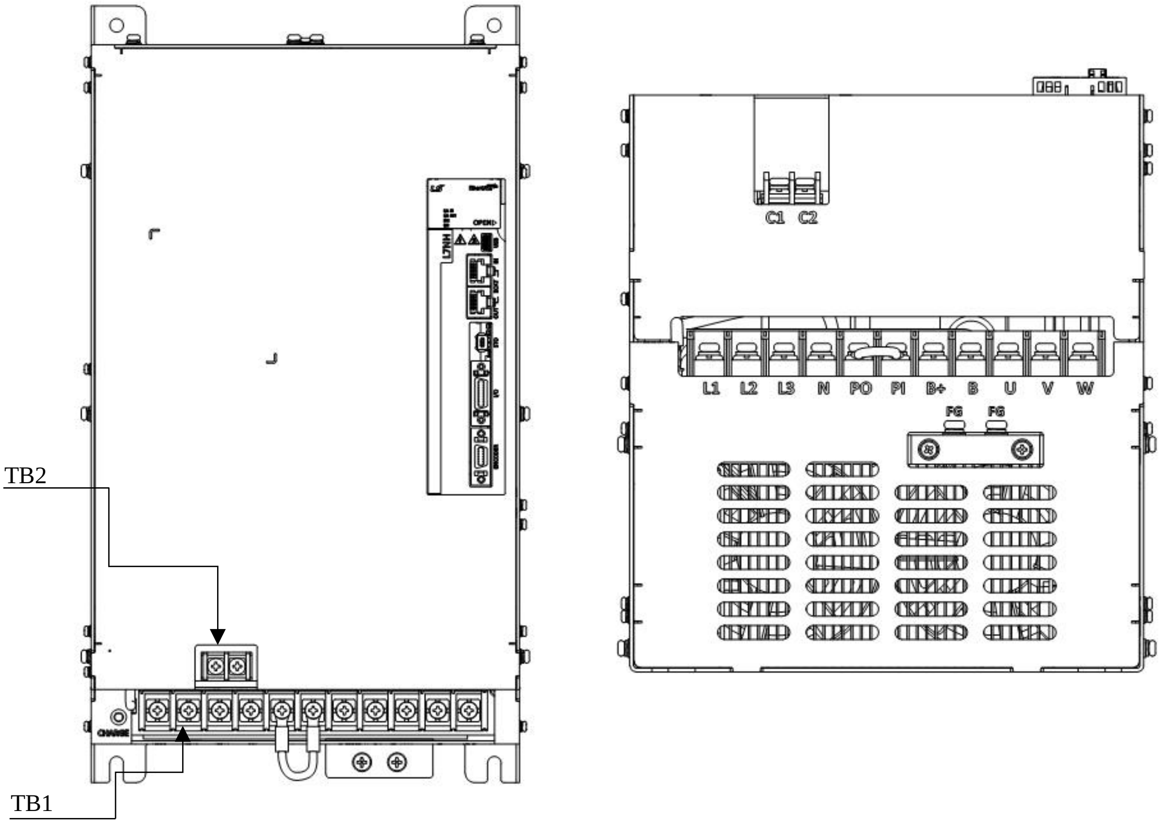
Terminal screw: M4

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.

■ L7NHB150U



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

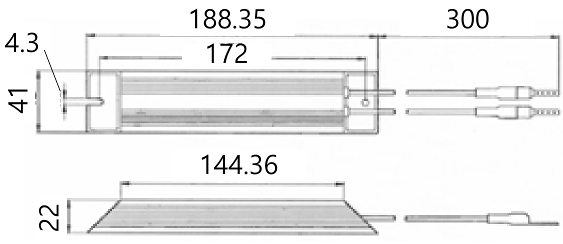
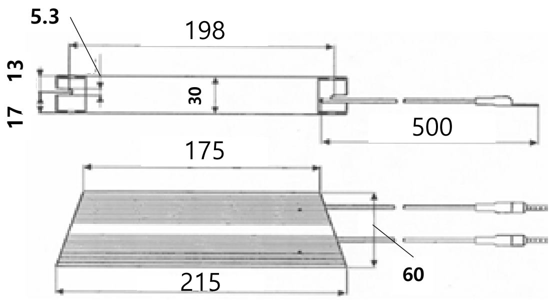
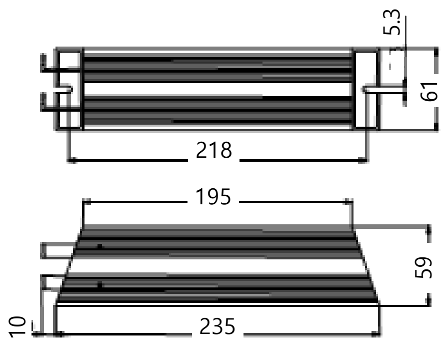
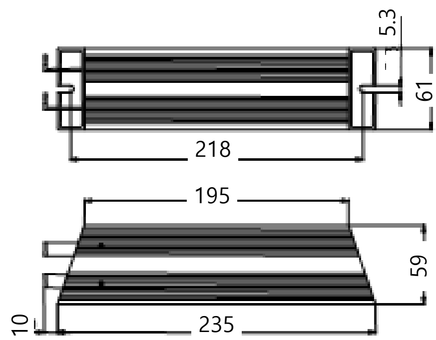
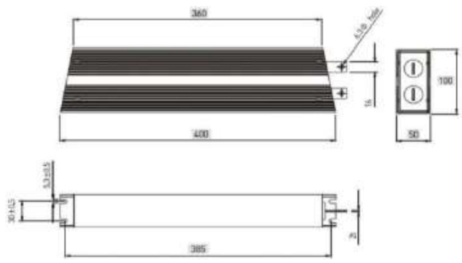
Tightening torque: 3.24[N·m]

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

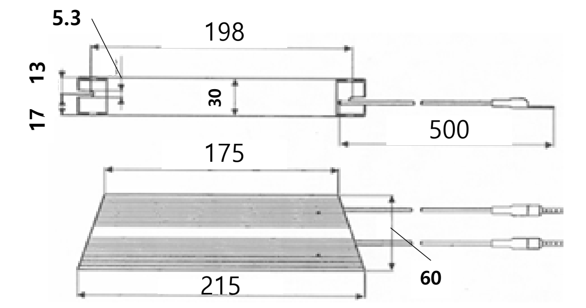
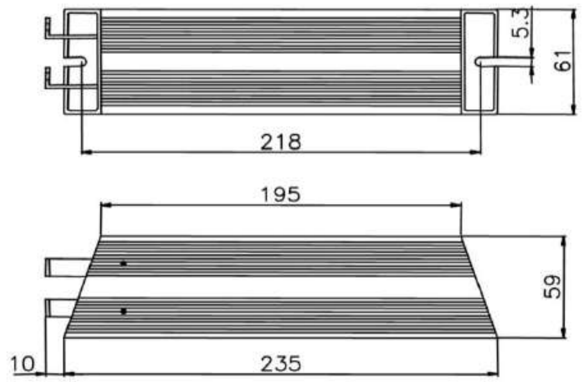
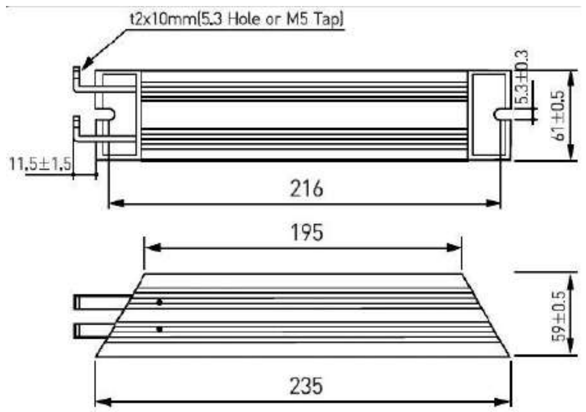
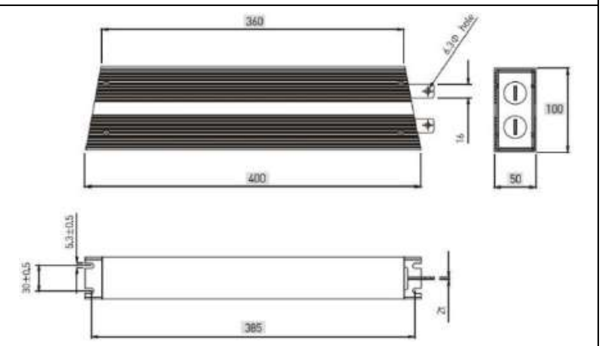
2) Use FG locking screw of M4 size (shown in bottom of product) to tighten it to 1.2 N·m.

3.4.4 Regenerative resistance option spec.

Option (Braking resistance) / 200[V]

Classification	Product Name	Model name	Applicable drive	Spec.
resistance	Brake resistance	APCS-140R50	L7□A001□ L7□A002□ L7□A004□	
resistance	Brake resistance	APCS-300R30	L7□A008□ L7□A010□	
resistance	Brake resistance	APC-600R30	L7□A020□ (2P) L7□A035□ (3P)	
resistance	Brake resistance	APC-600R28	L7□A050□ L7□A075□ (4P)	
resistance	Brake resistance	APCS-2000R3R3 3.3[Ω] (2000W)	L7□A150□	

Option (Braking resistance) / 400[V]

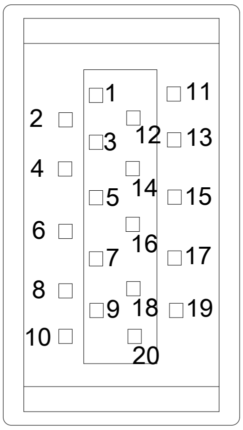
Classification	Product Name	Model name	Applicable drive	Spec.
resistance	Brake resistance	APCS-300R82	L7□B010□	
resistance	Brake resistance	APCS-600R140 (600W x 2P)	L7□B020□ /L□PB035□ (2P)	
resistance	Brake resistance	APCS-600R75 (600W x 3P)	L7□B050□ /L7□B075□ (3P)	
resistance	Brake resistance	APCS-2000R13R4	L7□B150□	

Note 1) The P mark on the applicable drive is the number of resistors connected in parallel.

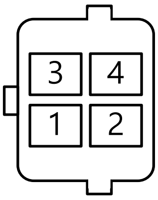
the number of resistors connected in parallel	2EA	3EA	4EA
Notation	2P	3P	4P

3.5 Wiring for Input/Output Signals

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



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



3.5.1 Names and Functions of Digital Input/Output Signals

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

Pin Number	Name	Assignment	Content	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
** ABS_Reset	Absolute value encoder reset	Initialize multiturn and singleton values.

주1) **Signals not assigned by default as factory setting. You can change their allocation by setting parameters. For more information, refer to「62 Input/Output Signals Setting.」

주2) 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 No.	Name	Assignment	Content	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 Input 2	Outputs signal when having reached the command position (2)

** Unassigned signals. You can change their allocation by setting parameters. For more information, refer to「62 Input/Output Signals Setting.」

3.5.2 Names and Functions of Analog Input/Output Signals

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

Pin No.	Name	Content	Details Function
15	A-TLMT	Analog torque limit	It applies -10~+10V between A-TMLT (AI1) and AGND to limit motor output torque. The relationship between input voltage and limit torque depends on the set value of [0x221C].
5	AGND	AGND (0V)	Analog ground

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

Pin No.	Name	Content	Details Function
1	AMON1	Analog Monitor 1	Analog monitor output(-10V ~ +10V)
2	AMON2	Analog Monitor 2	Analog monitor output(-10V ~ +10V)
3	AGND	AGND (0V)	Analog ground
4	AGND	AGND (0V)	Analog ground

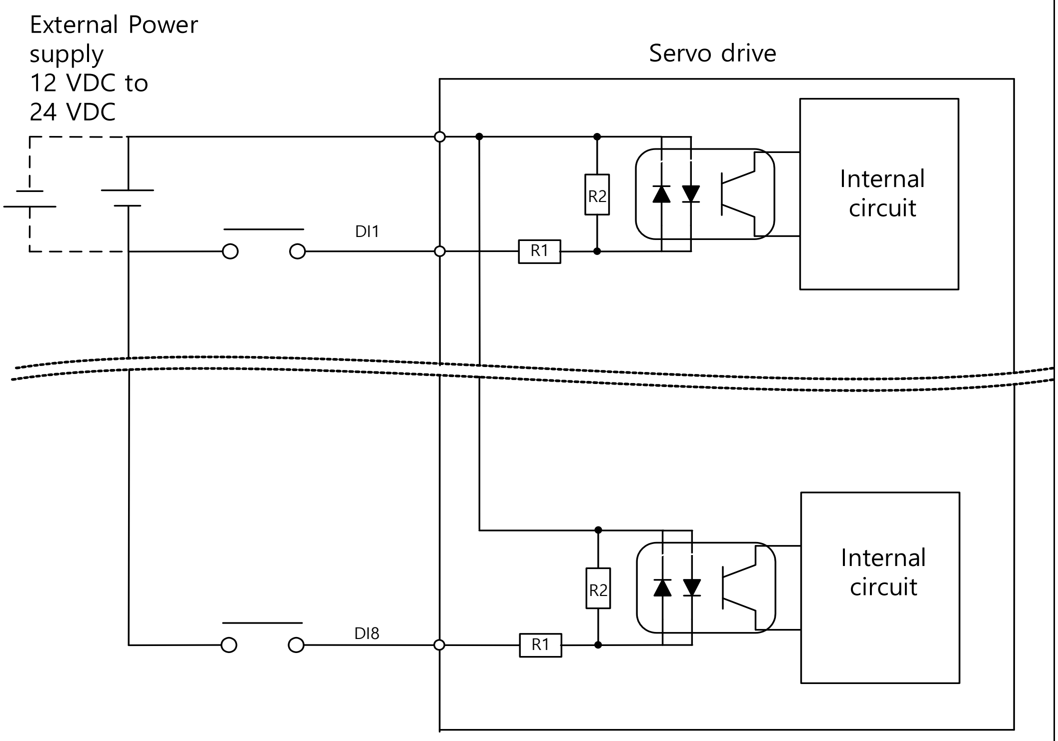
You can change the output variables to be monitored with analog monitor output by parameter setting. For more information, refer to「6.2.3 Analog Monitor.」

3.5.3 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 8 functions.
3. For more information on signal assignment and contact change of the input contact, refer to 6.2 Input/Output Signals Setting.
4. The rated voltage is DC 12 V to DC 24 V.

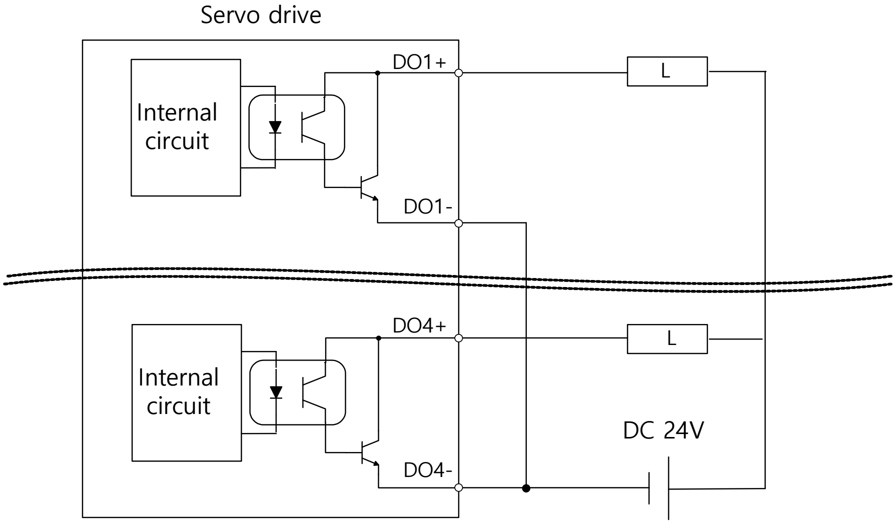


R1: 3.3KΩ, R2 : 680Ω

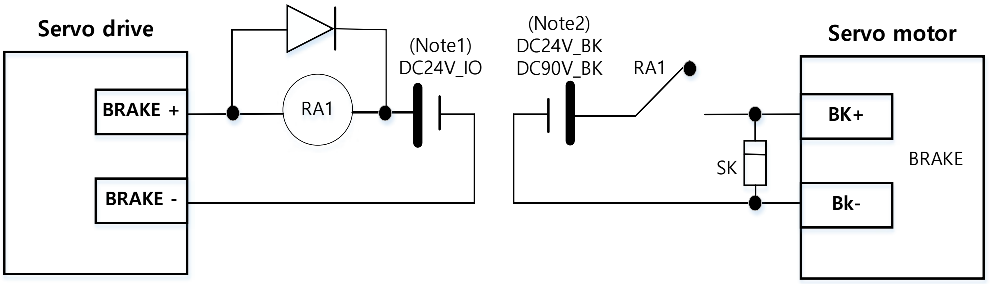
■ Example of Connecting Digital Output Signals

⚠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 6.2 Input/Output Signals Setting.
4. Overvoltage or overcurrent may damage the device because it uses an internal transistor switch.
5. The rated voltage and current are DC 24 V ± 10% and 120 [㎃].



6. When using an electronic brake, refer to the wiring diagram below for configuration.



Note1) Configure the control power supply separately from the electronic brake power supply.

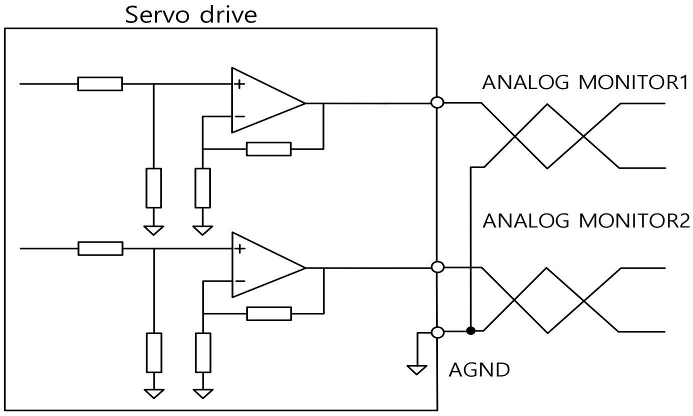
Note2) Configure it using the voltage that meets the specifications of the electronic brake. (Refer to 2. product specifications)

Note1) For DO1~ DO4 output signals, the GND24 terminal is separated.

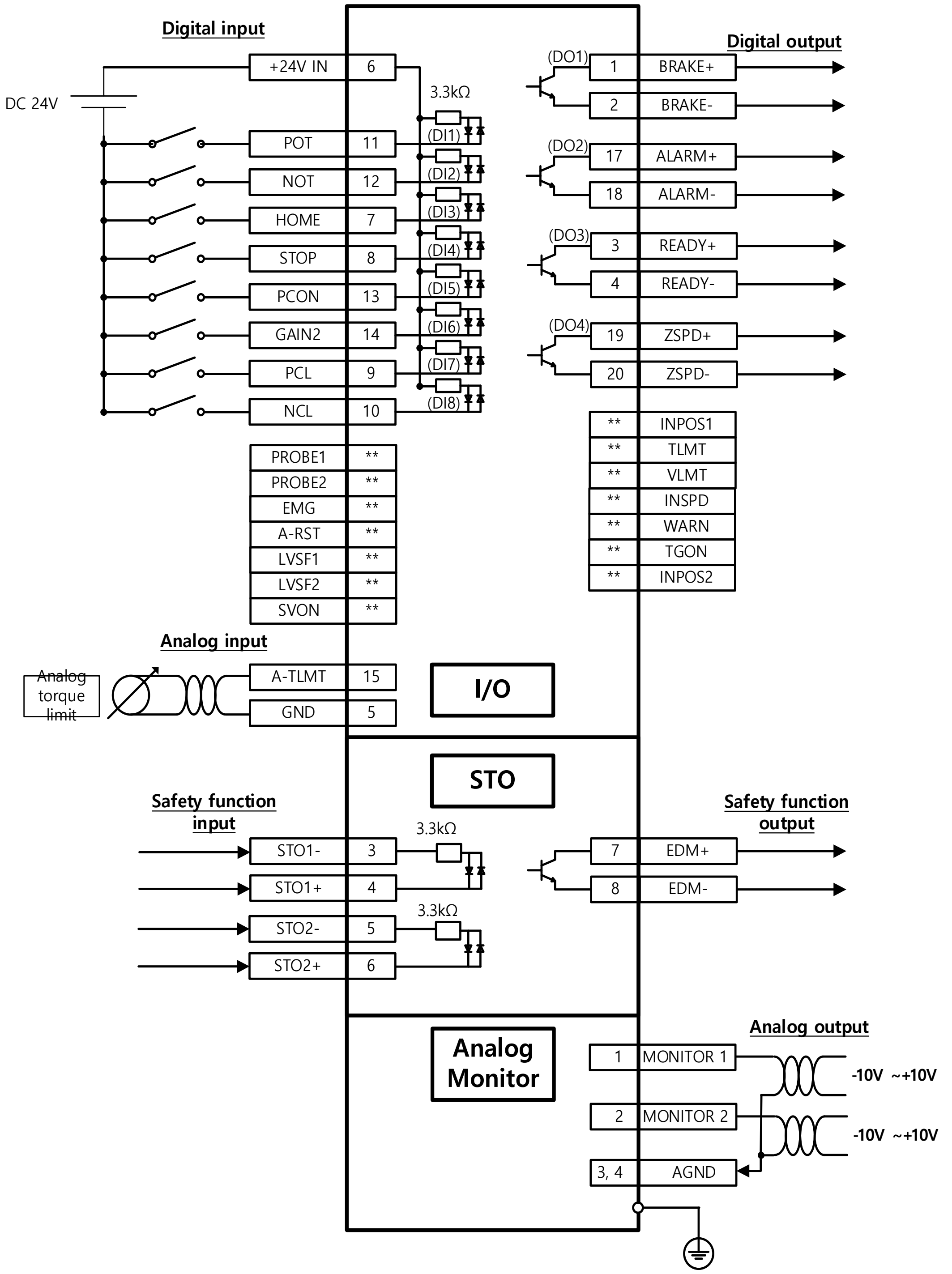
■ Example of Connecting Analog Output Signals

⚠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].



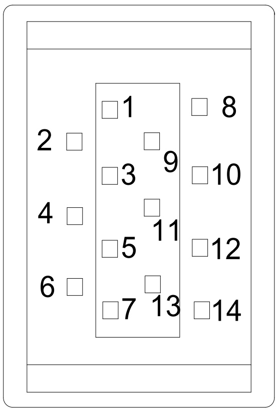
3.5.4 Connection diagram of I/O Signal



Note1) The input signals DI1 - DI8 and output signals DO1 - DO4 are the factory default signals.

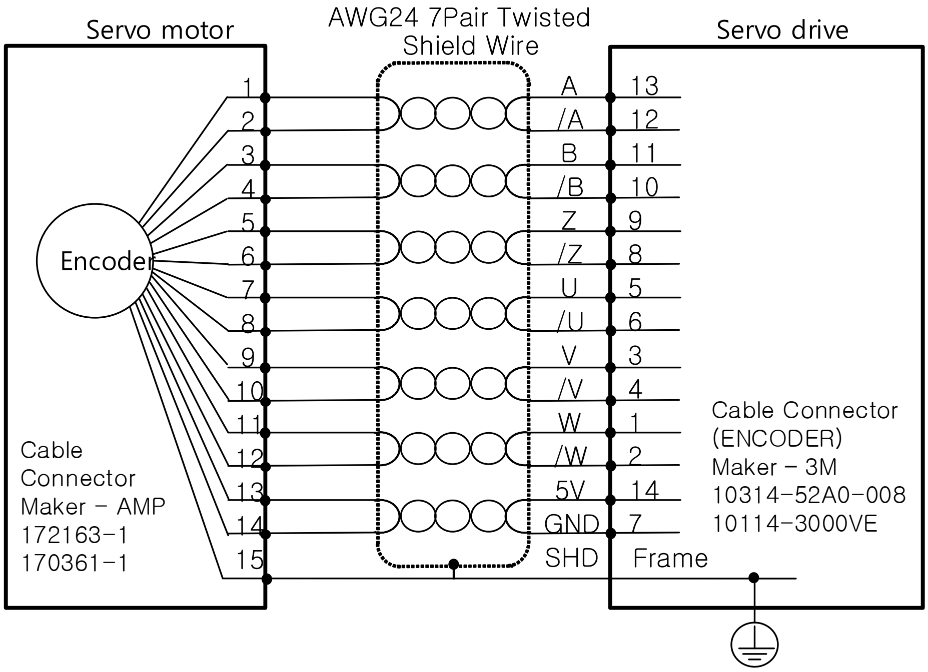
3.6 Wiring of Encoder Signal (ENCODER)

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

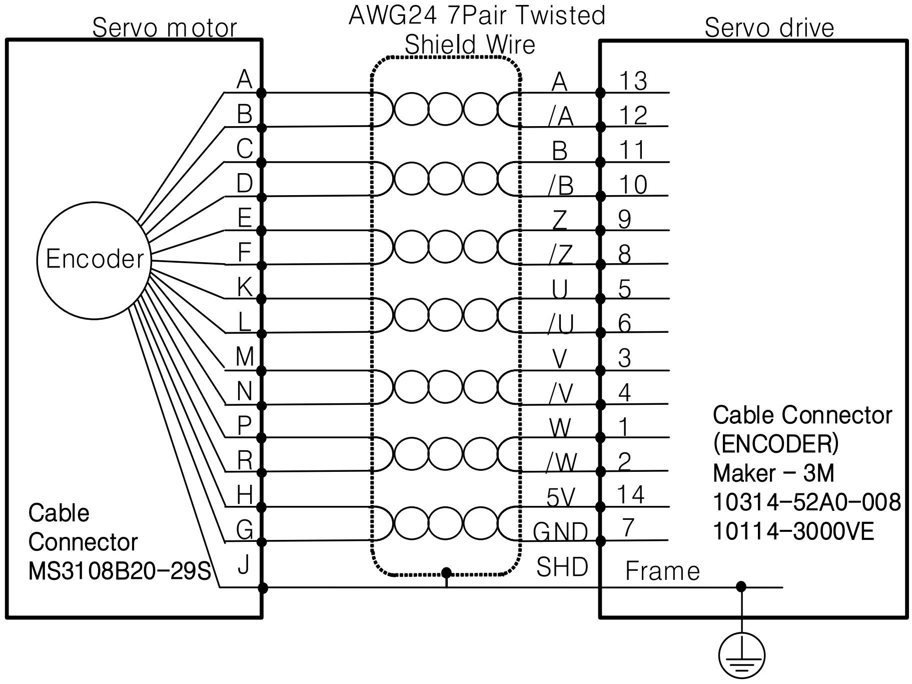


3.6.1 Quadrature Encoder Signaling Unit Wiring

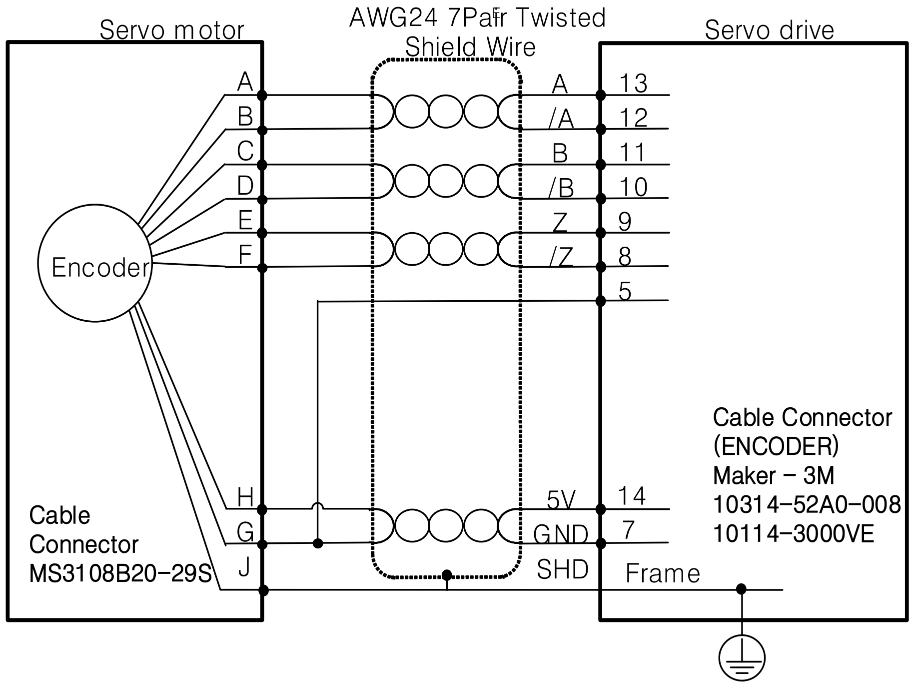
■ **APCS-E□□□AS cable**



■ APCS-E□□□BS cable

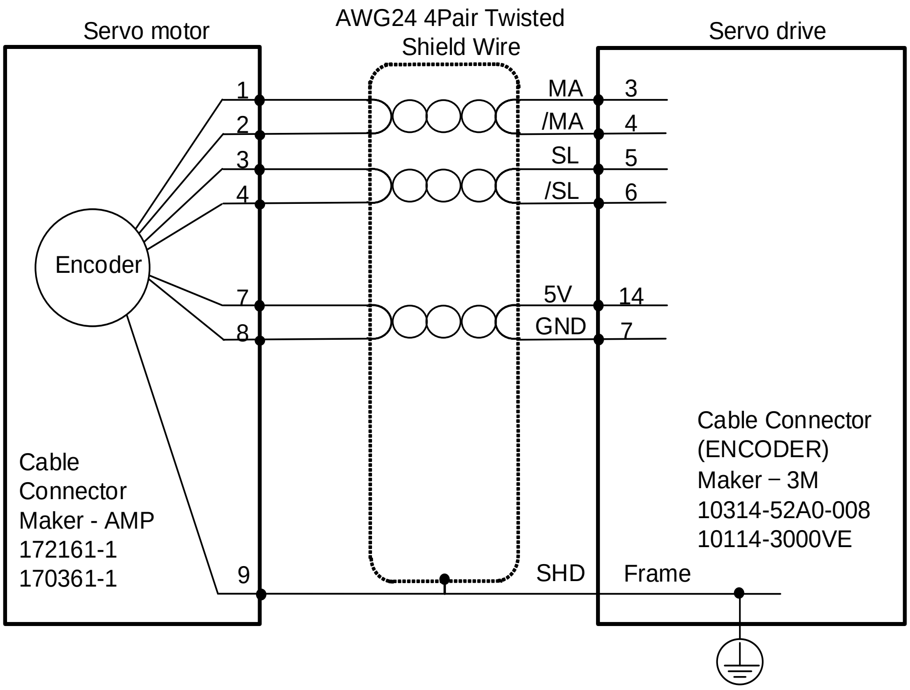


■ In case there is no quadrature type Hall sensor, serial encoder signal wiring

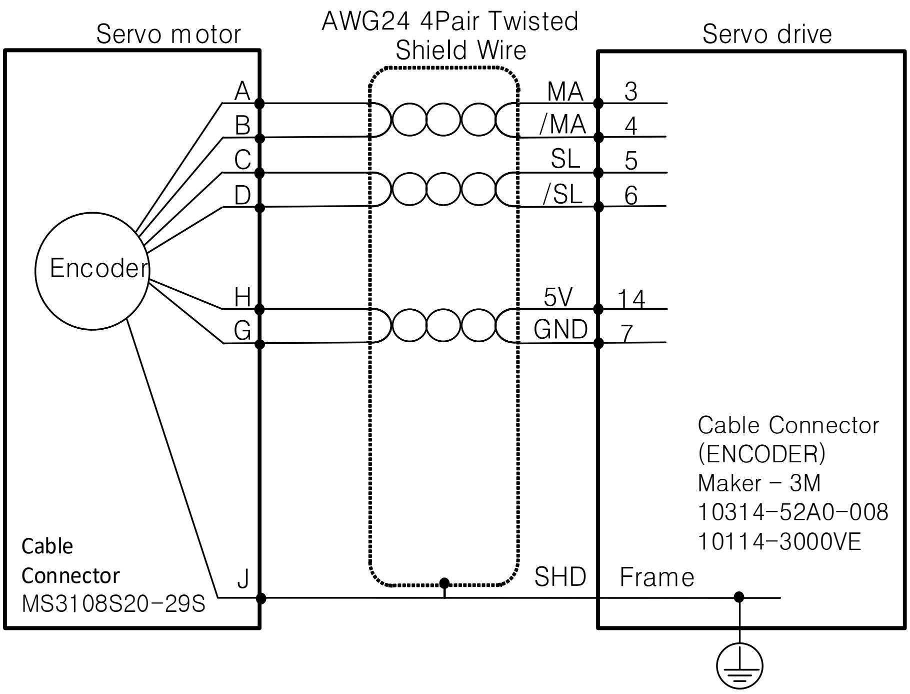


3.6.2 Serial Encoder Signaling Unit Wiring

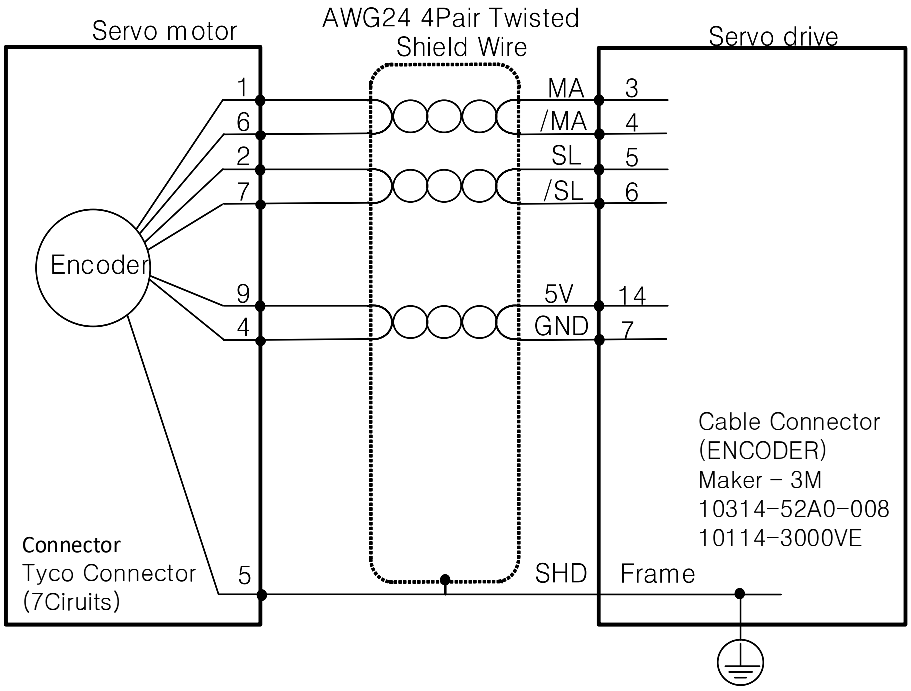
■ APCS-E□□□CS cable



■ APCS-E□□□DS cable

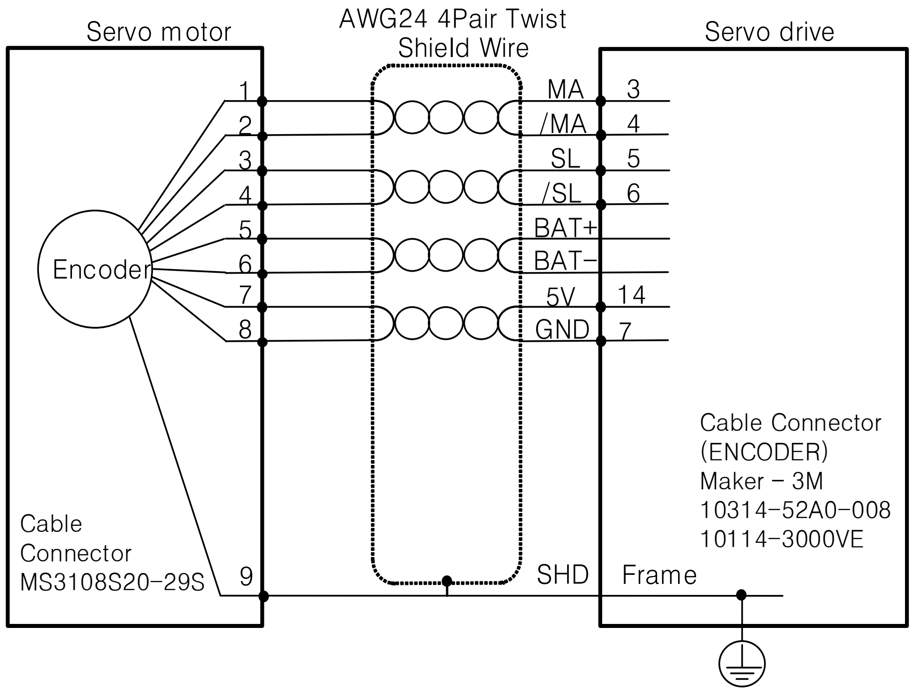


■ APCS-E□□□ES cable

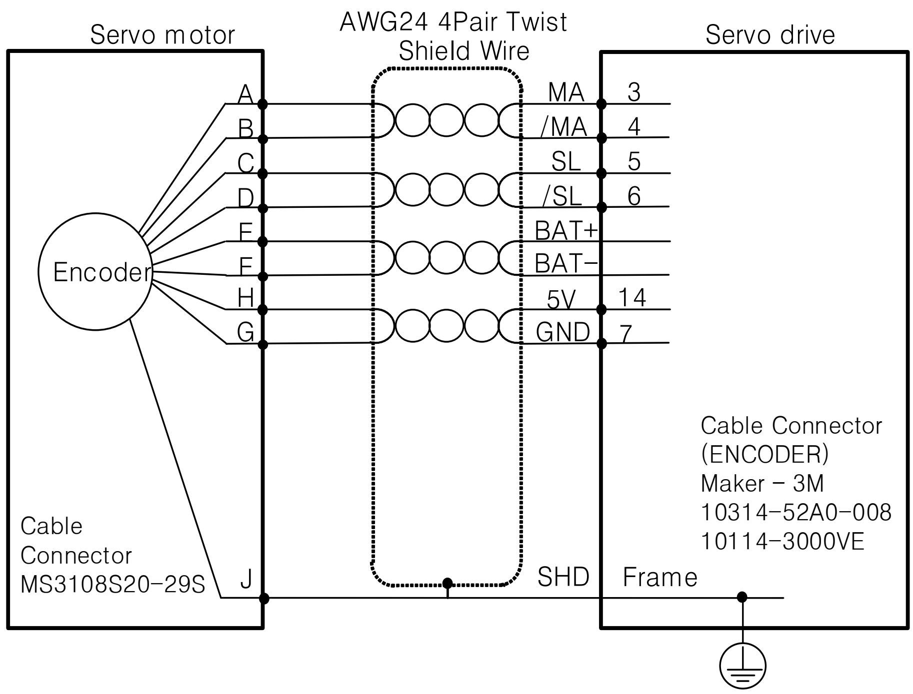


3.6.3 Multi-Turn Encoder Signaling Unit Wiring

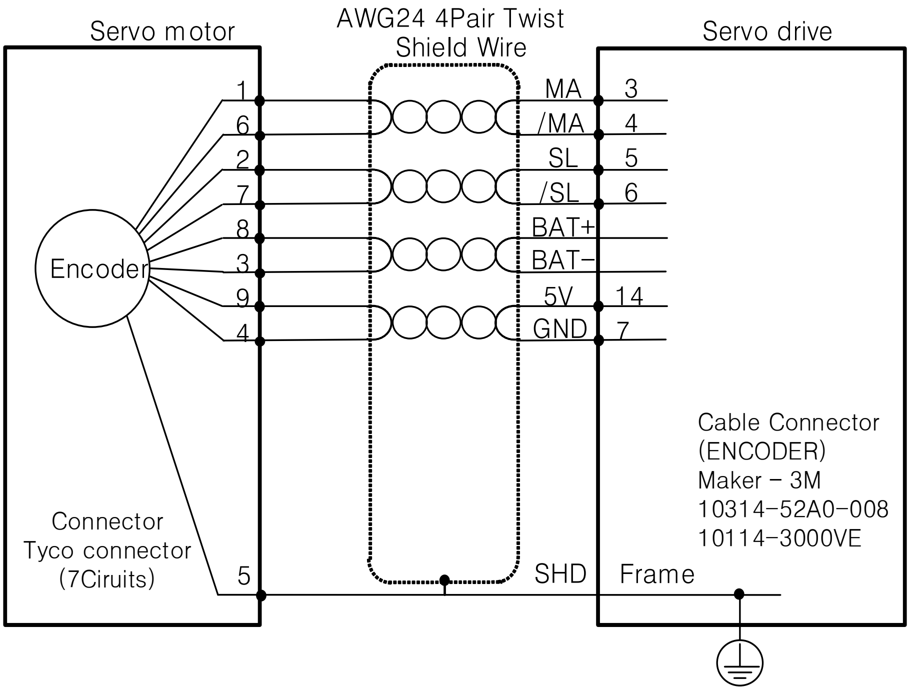
■ APCS-E□□□CS1 cable



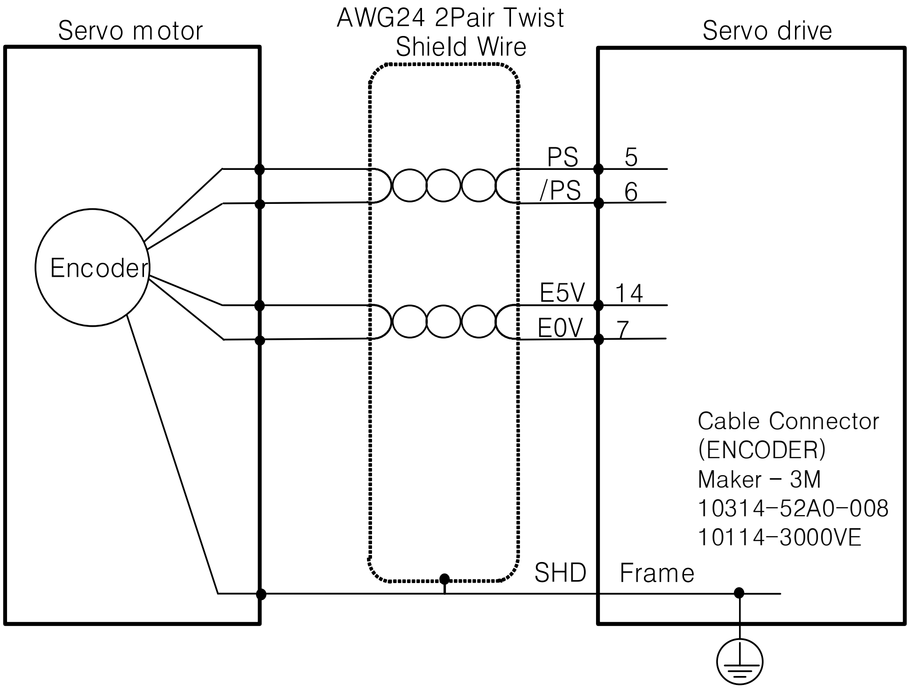
■ APCS-E□□□DS1 cable



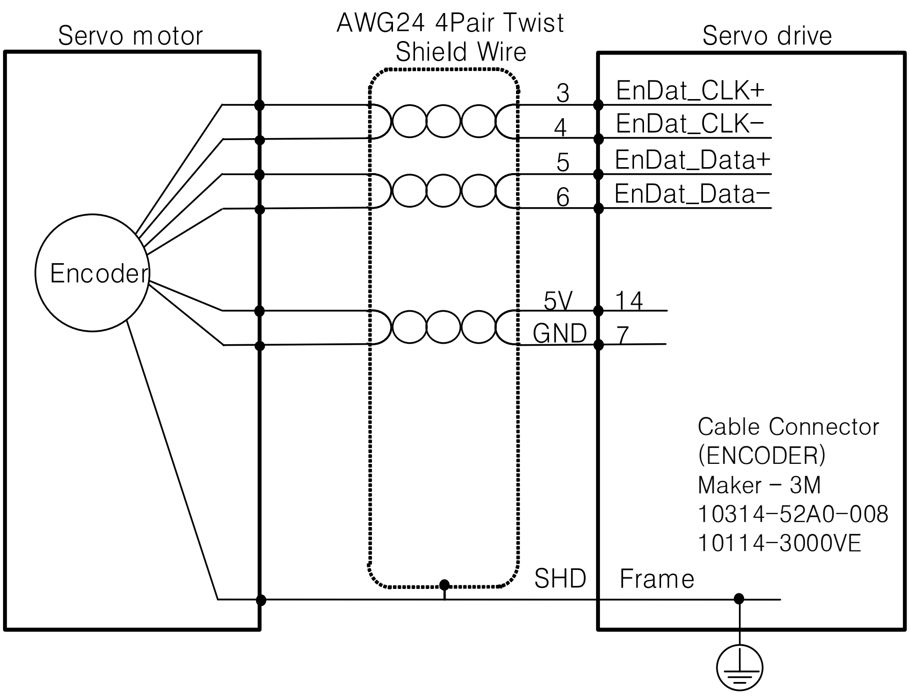
■ APCS-E□□□ES1 cable



3.6.4 Tamagawa Encoder Signaling Unit Wiring

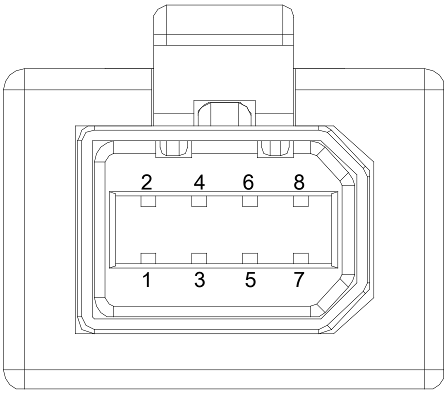


3.6.5 EnDat 2.2 Encoder Signaling Unit Wiring



3.7 Wiring for Safety Function Signals (STO)

■ **2069577-1(Tyco Electronics)**



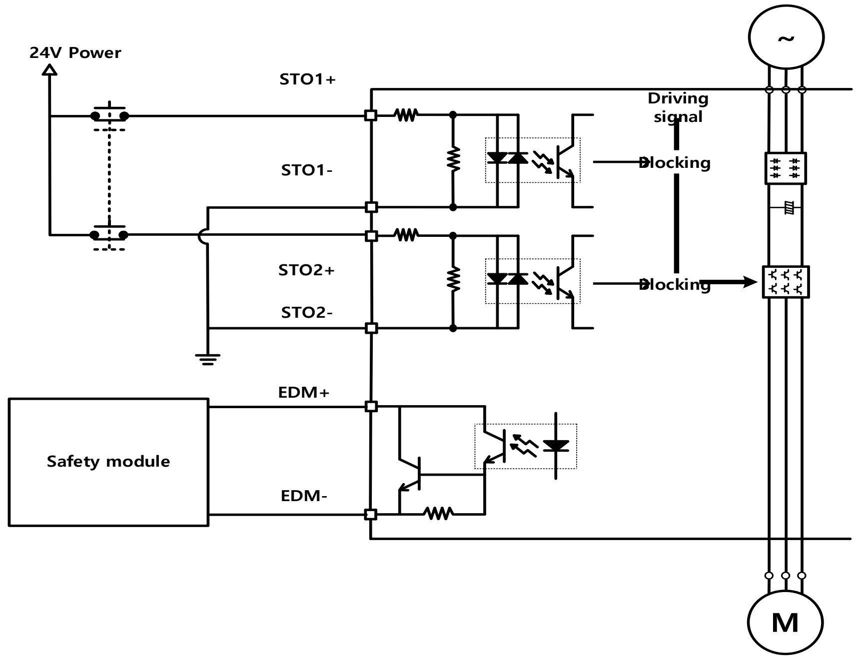
3.7.1 Names and Functions of Safety Function Signals

Pin No.	Name	Function
1	+12V	For bypass wiring
2	-12V	
3	STO1-	DC 24V GND
4	STO1+	Blocks the current (torque) applied to the motor when the signal is off.
5	STO2-	DC 24V GND
6	STO2+	Blocks the current (torque) applied to the motor when the signal is off.
7	EDM+	Monitor output signal for checking the status of safety function input signal
8	EDM-	

3.7.2 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.

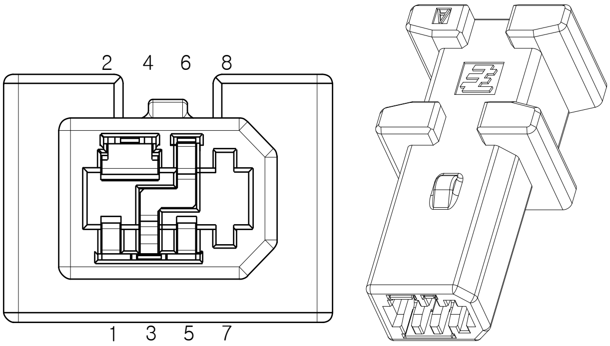


3.7.3 Bypass Wiring of Safety Function Signal

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.

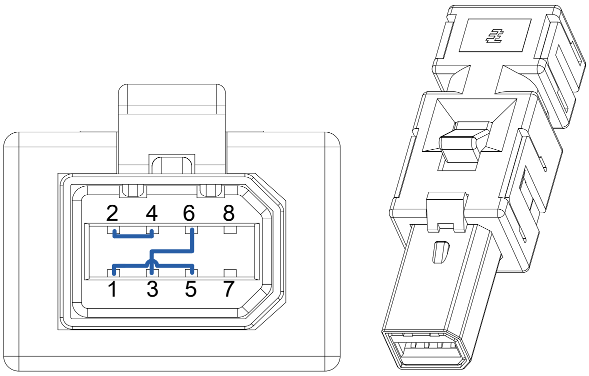
If you connect +12V to STO2-, -12V to STO1+ and STO1- to STO2+ for wiring of the Mini I/O Plug connector, you can bypass the safety function signal. Never use this power (+12V,-12V) except for this purpose.

■ Mini I/O By-pass Connector



1971153-1(Tyco Electronics)

■ Mini I/O Plug Connector



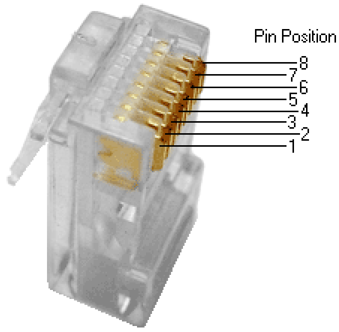
2069577-1(Tyco Electronics)

3.8 Wiring for EtherCAT Communication Signals

3.8.1 Names and Functions of EtherCAT Communication Signals

■ EtherCAT IN and EtherCAT OUT Connector

Pin No.	Signal name	Wire 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

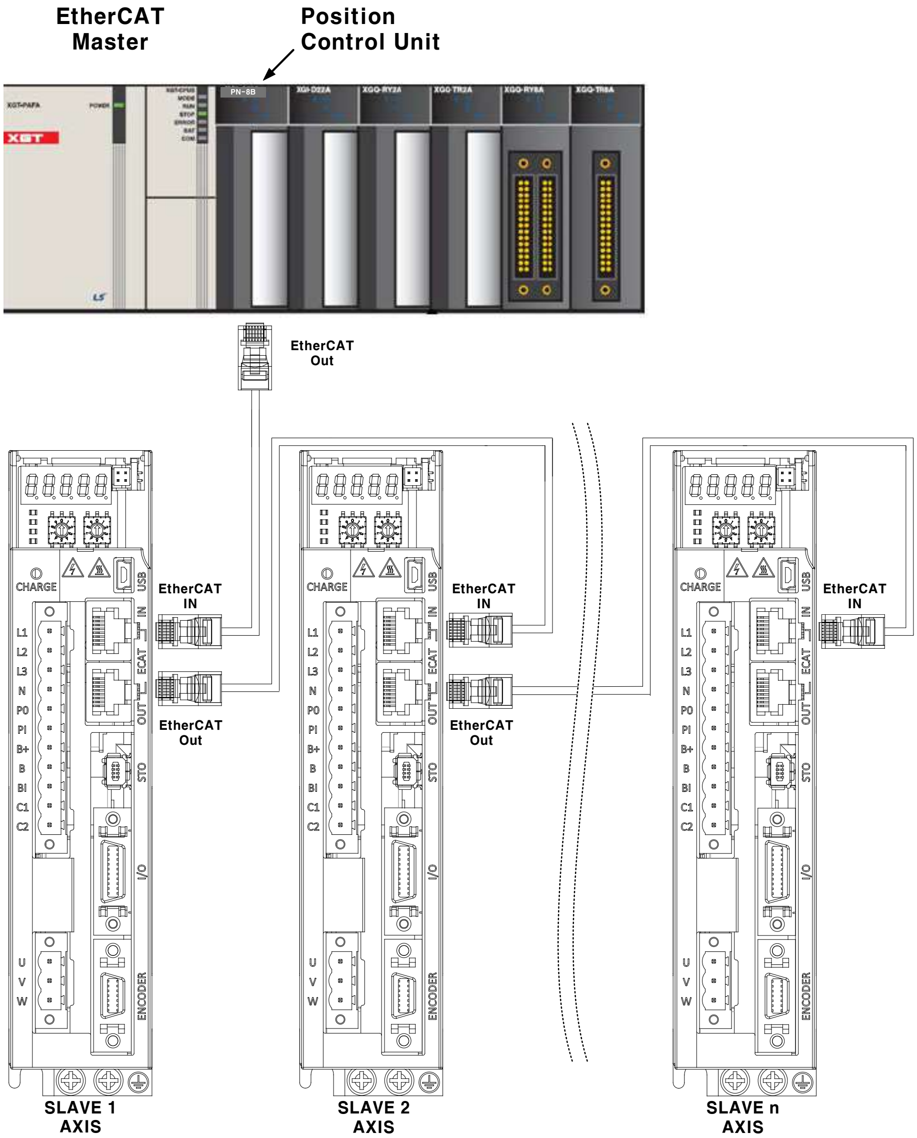


Note1) EtherCAT only uses signals from No. 1, 2, 3, and 6.

3.8.2 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.



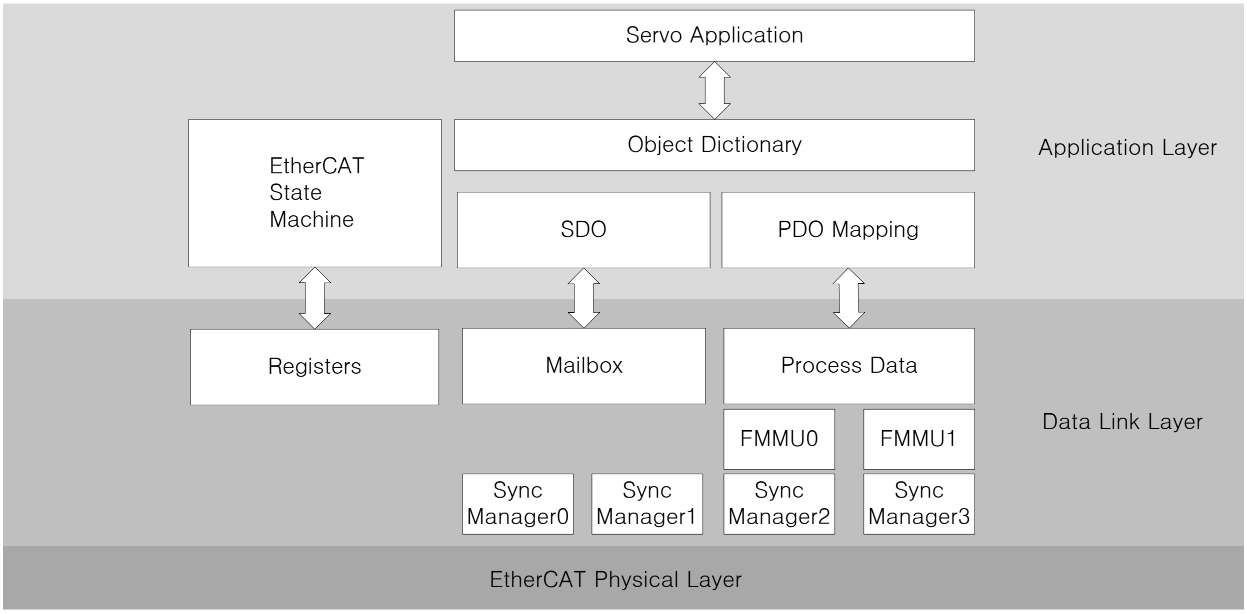
4. EtherCAT Communication

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.

4.1 Structure of CANopen over EtherCAT

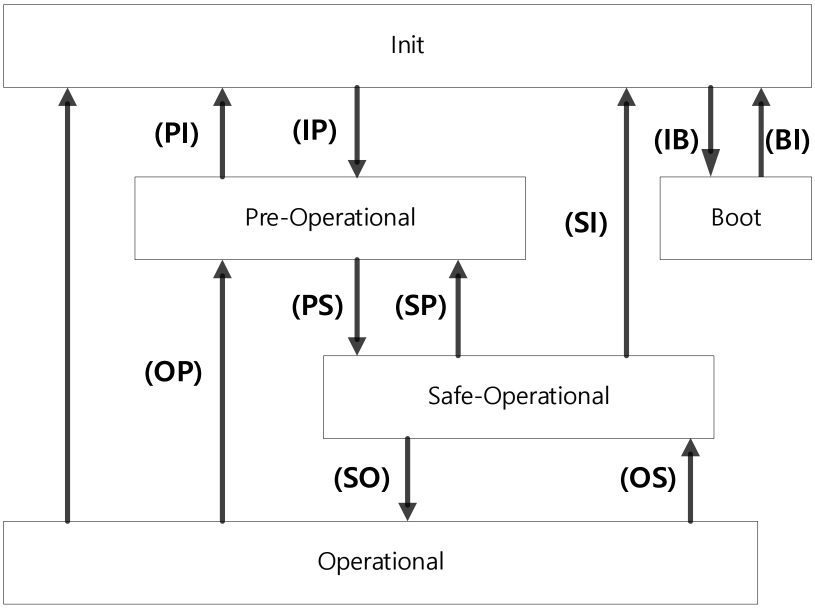


This drive supports a CiA 402 drive profile. The Object Dictionary in the application layer includes application data and PDO (Process Data Object) mapping information from the process data interface and application data.

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.

4.1.1 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. Master can only access DL-Information register.
Pre-Operational	Mailbox communication is possible.
Safe-Operational	Mailbox communication is possible and PDO can be transmitted. PDO cannot be received. The process data of the drive can be passed to an upper level controller.
Operational	Mailbox communication is possible and PDO can be transmitted and received. The process data can be properly exchanged between the drive and the upper level controller, so the drive can be normally operated.

The transition description of each state of the EtherCAT State Machine is as follows.

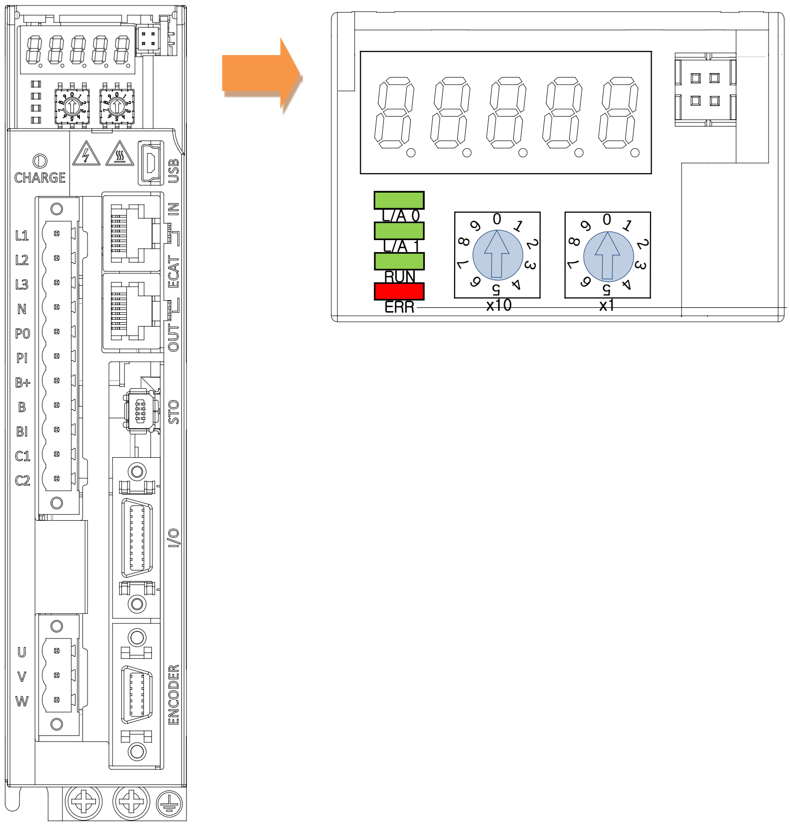
Transition state	Description
(IP)	1) The master sets the registers of the slave to configure SDO communication. - DL control register setting - Sync Manager Register setting for SDO communication 2) Master requests state transition to Pre-Operation to Slave. 3) State transition to Pre-Operation.
(PS)	1) Mailbox communication between master and slave is possible. 2) Master sets PDO Mapping parameters through mailbox communication. 3) Set Sync Manager register and FMMU* register for PDO communication. 4) Master requests Safe-Operation status from slave. 5) State transition to Safe-Operation.
(SO)	1) Perform DC (Distributed Clocks) synchronization between master and slave. 2) Master outputs valid data and confirms it with AL State Register. 3) Master requests operation status from slave. 4) State transitions to Operation.
(PI), (SI)	1) PDO (Input) Data cannot be updated, mailbox communication is not possible.
(SP), (OP)	1) PDO (Input/Output) Data cannot be updated, mailbox communication is possible
(OS)	1) Unable to update PDO (Output) Data.
(IB), (BI)	1) Mailbox communication is possible, but limited to FoE protocol.

* FMMU: Fieldbus Memoty Management Init

Settings such as each register of SDO/PDO communication, SyncManager, FMMU, and EtherCAT Slave Control are executed by the master controller based on the EtherCAT standard.

4.2 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.



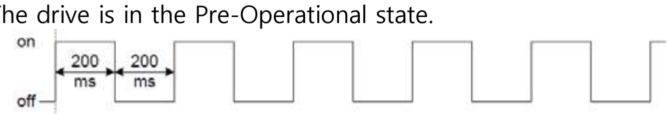
■ L/A0, L/A1 (Link Activity) LED

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.

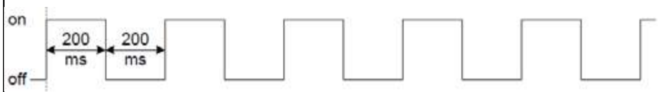
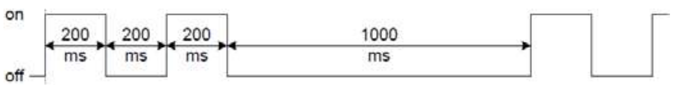
■ RUN LED

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.

4.3 Data Type

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

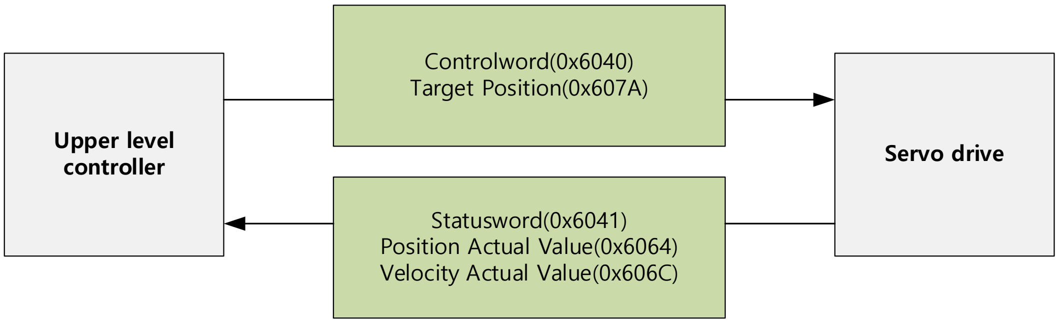
Code	Description	Range
SINT	Signed 8bit	-128 ~ 127
USINT	Unsigned 8bit	0 ~ 255
INT	Signed 16bit	-32768 ~ 32767
UINT	Unsigned 16bit	0 ~ 65535
DINT	Signed 32bit	-2147483648 ~ 2147483647
UDINT	Unsigned 32bit	0 ~ 4294967295
FP32	Float 32bit	Single precision floating point
STRING	String Value	-

4.4 PDO allocation

The EtherCAT uses the Process Data Object (PDO) to perform real-time data transfers. 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.

Here is an example of PDO allocation.



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 Value		
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).

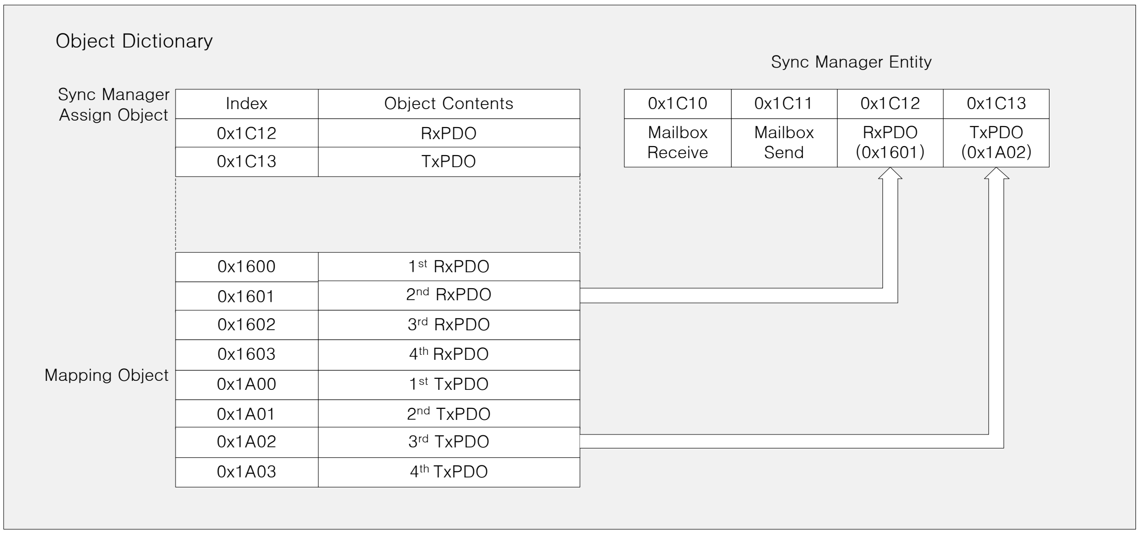
Index	SubIndex	Name	Data Type
0x6041	0x00	Statusword	UINT
0x6064	0x00	Actual Position Value	DINT
0x606C	0x00	Velocity Actual Value (Velocity Actual Value)	DINT

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

SubIndex	Setting Value		
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)	Mode of operation (0x6060)	Touch probe function (0x60B8)					
TxPDO (0x1A00)	Statusword (0x6041)	Actual code value (0x6077)	Actual position value (0x6064)	Position error actual value (0x60F4)	Digital input (0x60FD)	Operation Mode display (0x6061)	Command speed (0x2601)	Drive speed (0x2600)	Touch probe status (0x60B9)	Touch probe1 Forward position value (0x60BA)

2nd PDO Mapping:

RxPDO (0x1601)	Controlword (0x6040)	Target (0x607A)	Touch probe function (0x60B8)	Digital output (0x60FE)		
TxPDO (0x1A01)	Statusword (0x6041)	Actual position value (0x6064)	Position error actual value(0x60F4)	Touch probe status (0x60B9)	Touch probe1 Forward position value (0x60BA)	Digital input (0x60FD)

3rd PDO Mapping:

RxPDO (0x1602)	Controlword (0x6040)	Target speed (0x60FF)	Touch probe function (0x60B8)	Digital output (0x60FE)	
TxPDO (0x1A02)	Statusword (0x6041)	Actual position value (0x6064)	Touch probe status (0x60B9)	Touch probe1 Forward position value (0x60BA)	Digital input (0x60FD)

4th PDO Mapping:

RxPDO (0x1603)	Controlword (0x6040)	Target torque (0x6071)	Touch probe function (0x60B8)	Digital output (0x60FE)	
TxPDO (0x1A03)	Statusword (0x6041)	Actual position value (0x6064)	Touch probe status (0x60B9)	Touch probe1 Forward position value (0x60BA)	Digital input (0x60FD)

4.5 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.

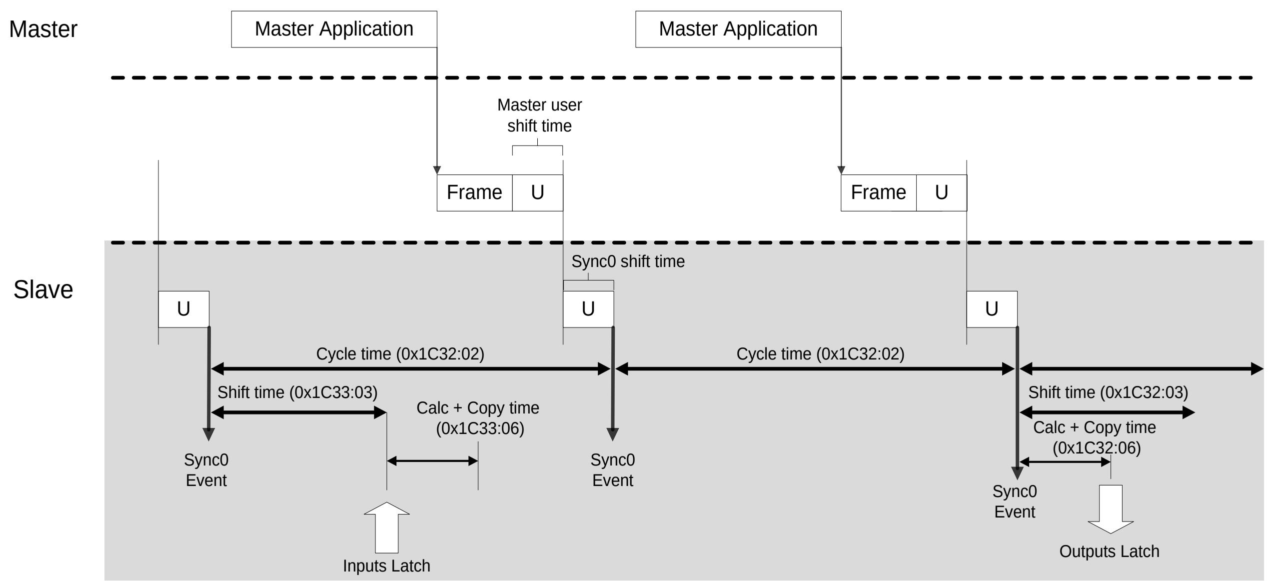
(1) Free-run Mode:

In free-run mode, it operates each cycle independent of the communication cycle and master cycle. If the transmission cycle of the master is not constant, the servo recalculates the previous increment value due to the timing difference, which may cause noise during operation.

From standard OS version 0.95 or later, it is applied as SM Sync function, and when using free-run, motor noise does not occur even if the transmission cycle of the master is misaligned. However, since the transmission period error of each cycle can be continuously accumulated, be sure to pay attention to the accumulated time error when using the free-run mode.

(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



4.6 Emergency Messages

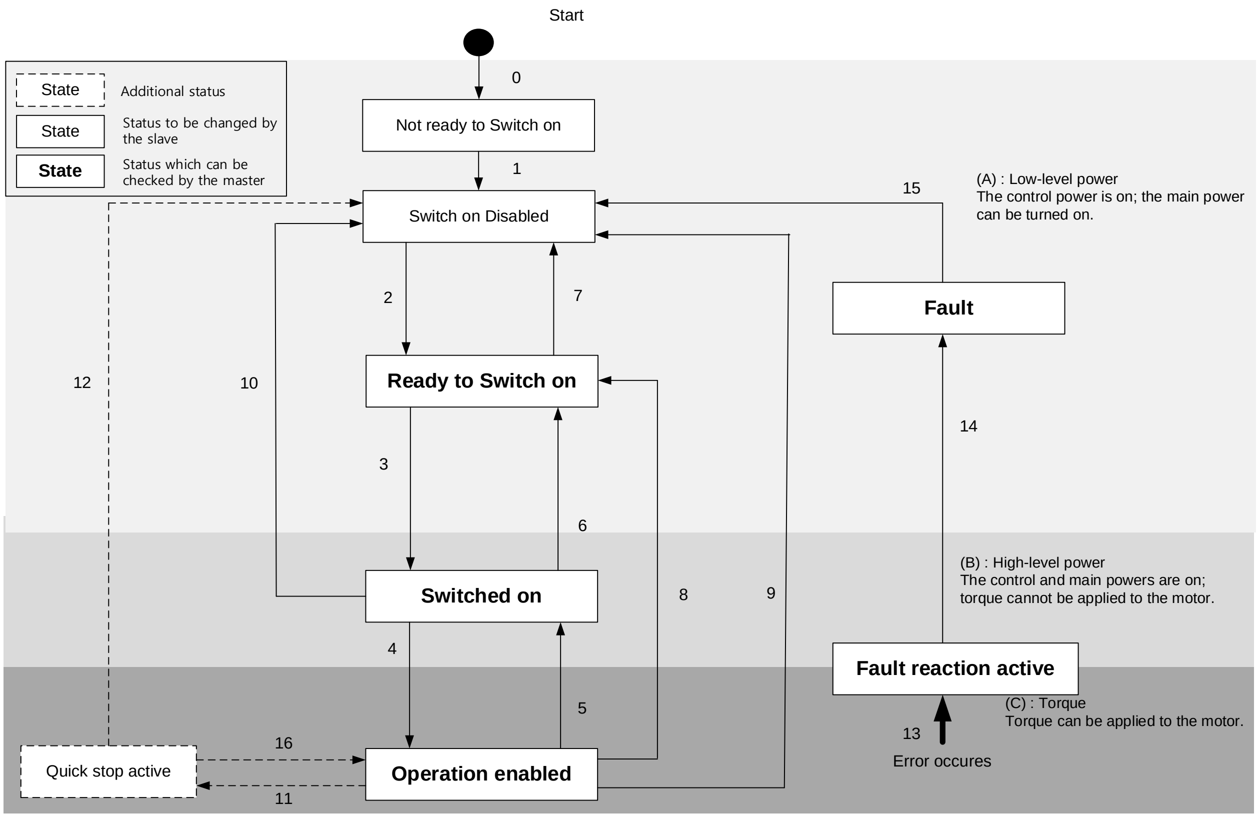
Emergency messages are passed to the master via mailbox communication when a servo alarm occurs in the drive. Emergency messages may not be sent in case of communication failure.

An emergency message consists of 8 bytes of data.

Byte	0	1	2	3	4	5	6	7
Contents	Emergency error code (0xFF00)		Error Register (0x1001)	Reserved	Unique field for each manufacturer			
					Servo alarm code		Reserved	

5. CiA402 Drive Profile

5.1 State machine



State	Details
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 status.

■ State Machine control command

You can check the state of the State Machine through bit combinations of the Controlword (0x6040), as described in the table below:

Command	bits of the Controlword (0x6040)					State Machine move
	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	ABS position valid	
15	Procedure busy	

5.2 Operation mode

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 mode			
	CSP PP	CSV PV	CST PT	HM
Electric Gear	O	O	O	O
Speed feedforward	O	X	X	O or X
Torque feedforward	O	O	X	O
Position command filter	O	X	X	O or X
Real-time gain adjustment	O	O	O	O
Notch filter	O	O	O	O
Disturbance observer	O	O	X	O

Note1) 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	-	Operation mode	SNIT	RW	Yes	-
0x6061	-	Modes of Operation Display	SNIT	RO	Yes	-
0x6502	-	Supported Drive Modes	UDINT	RO	No	-

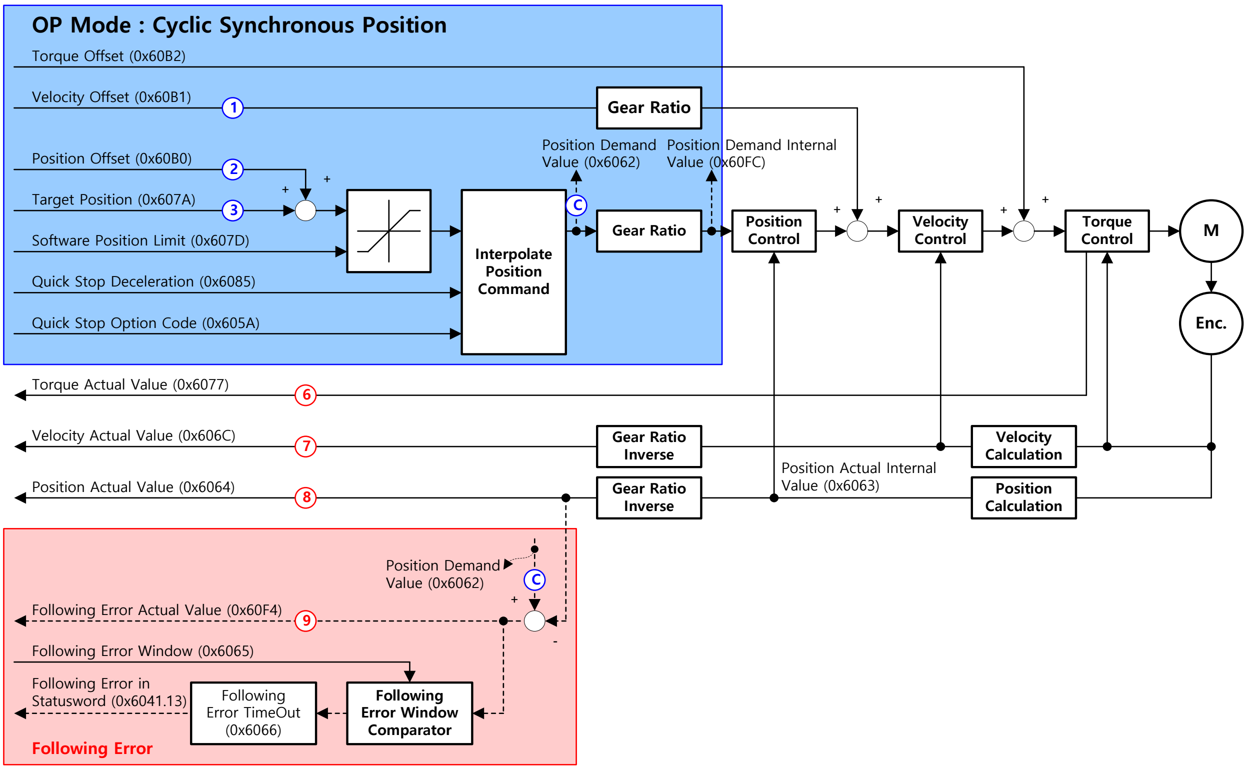
5.3 Position Control Modes

5.3.1 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.

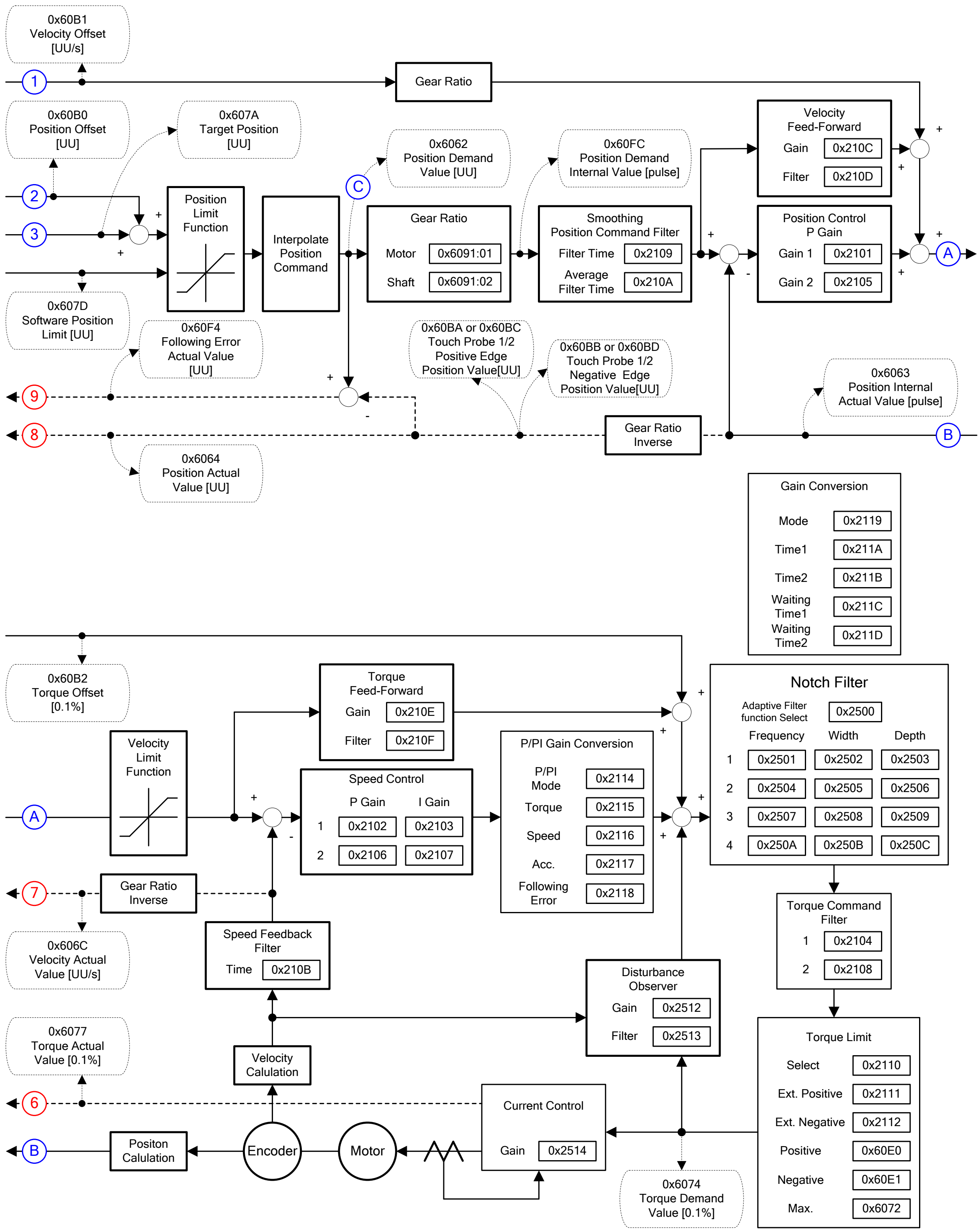
The block diagram of the CSP mode is as follows:



■ 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/s²
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s²
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

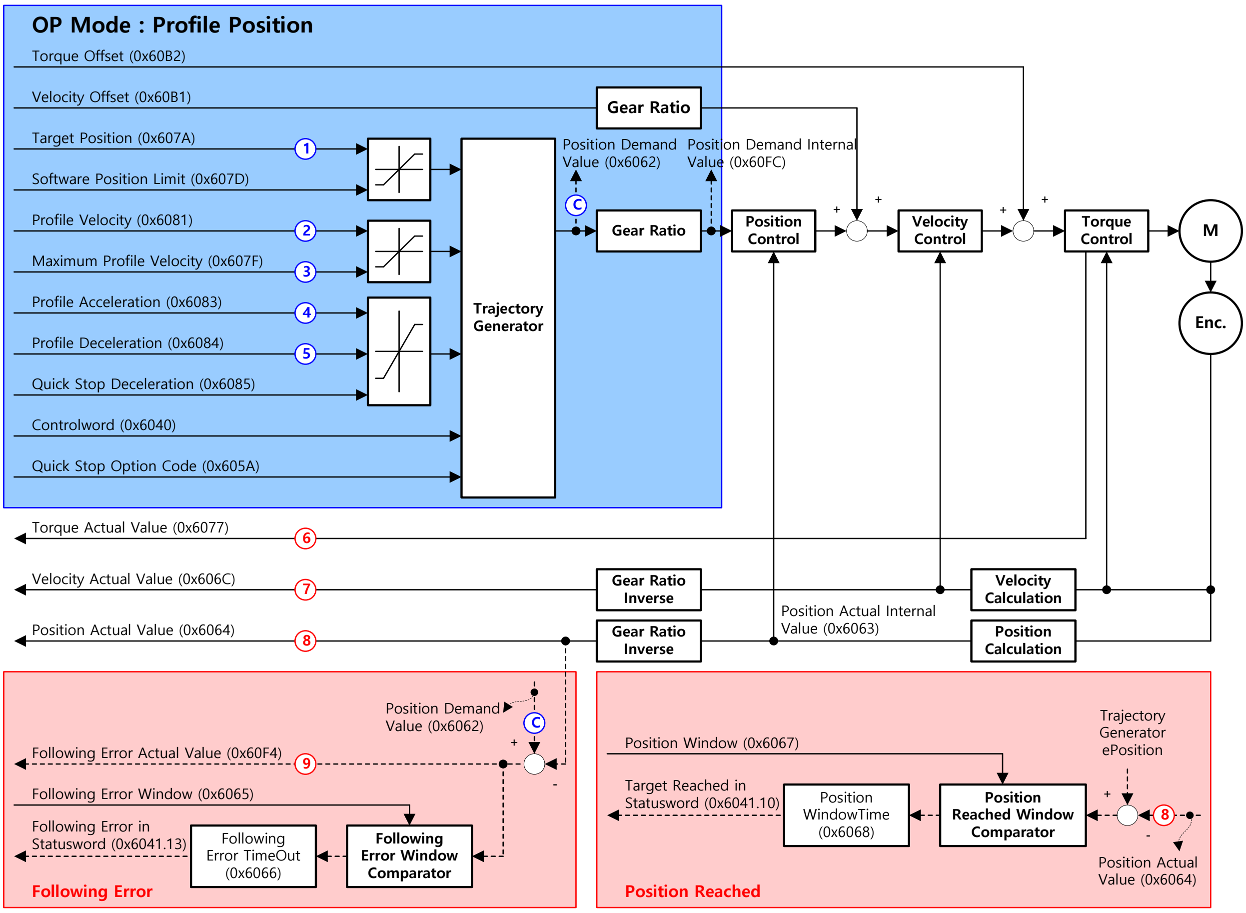
■ Internal Block Diagram of CSP Mode



5.3.2 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).

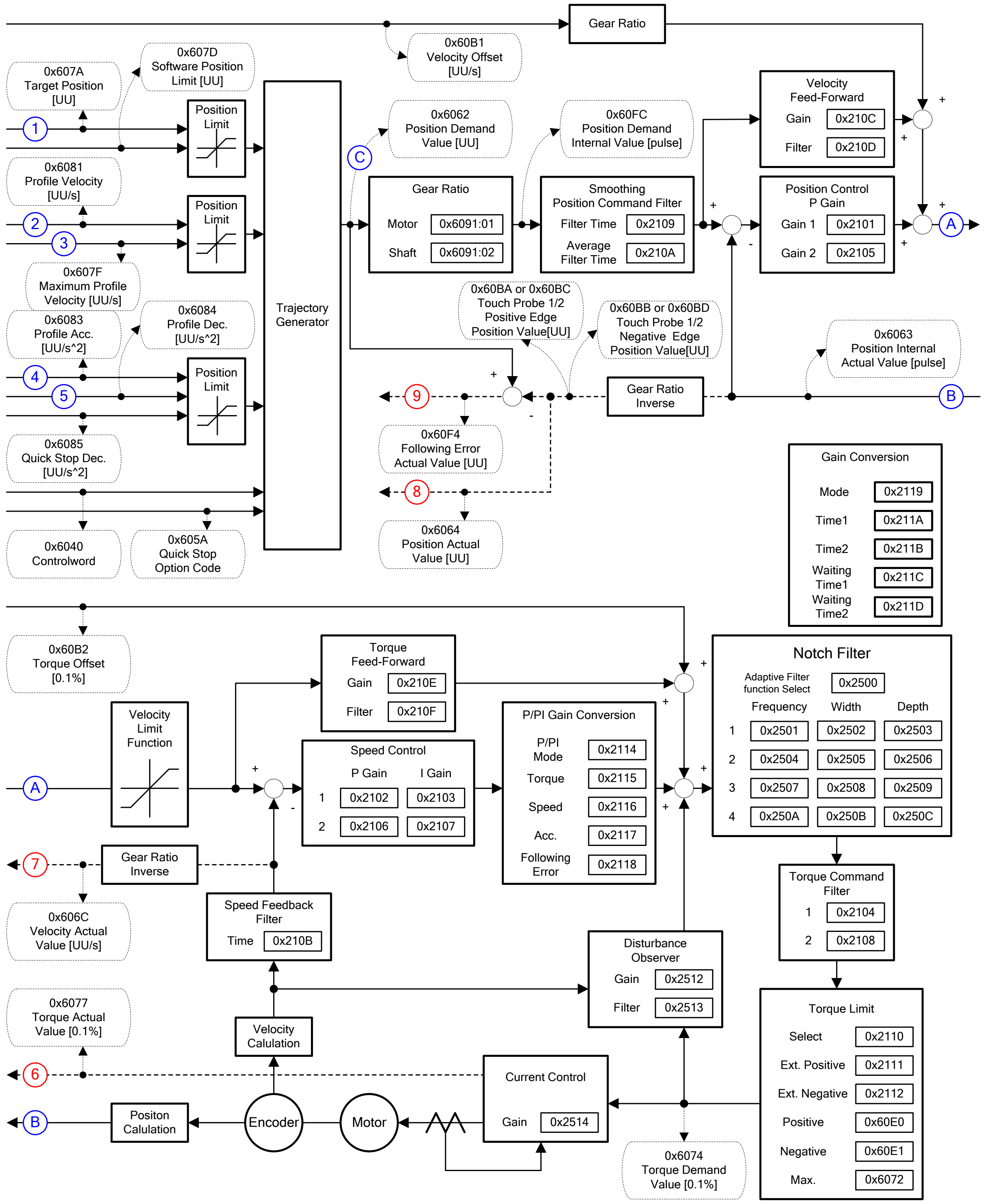
The block diagram of the PP mode is as follows:



■ 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

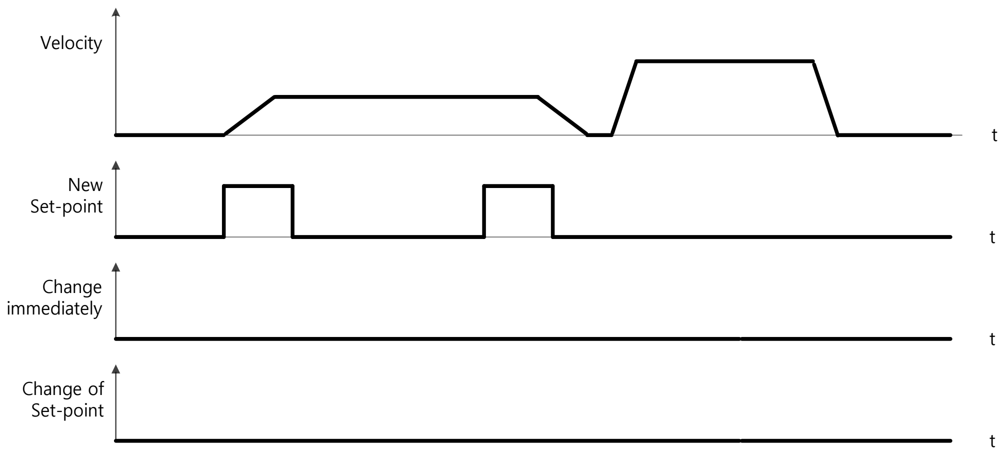
  After receiving a new position command while driving to the target position, it drives to the new position regardless of the existing target position.

- 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

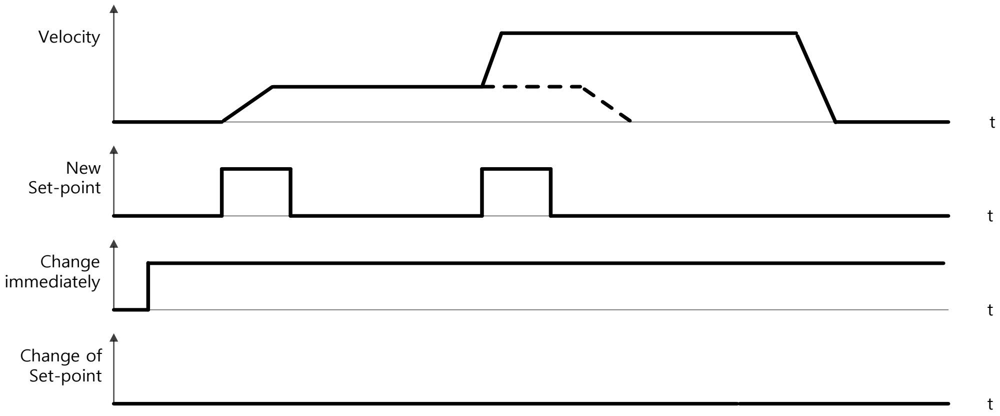


(1) Specify the target position (0x607A).

(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



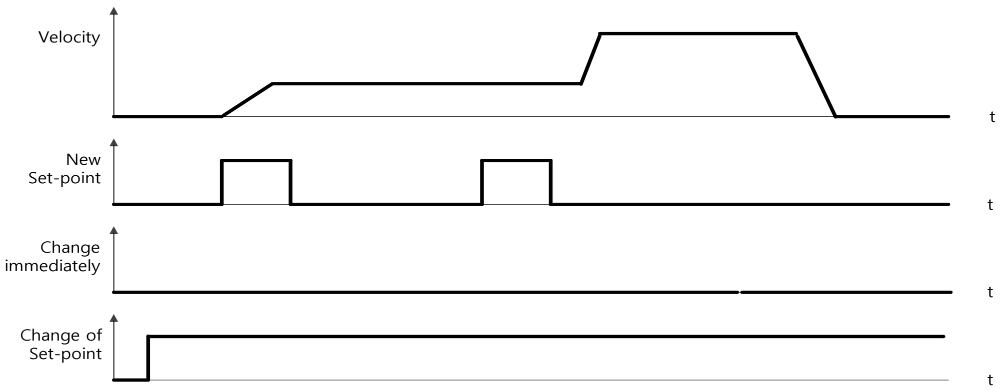
(1) Specify the target position (0x607A).

(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).

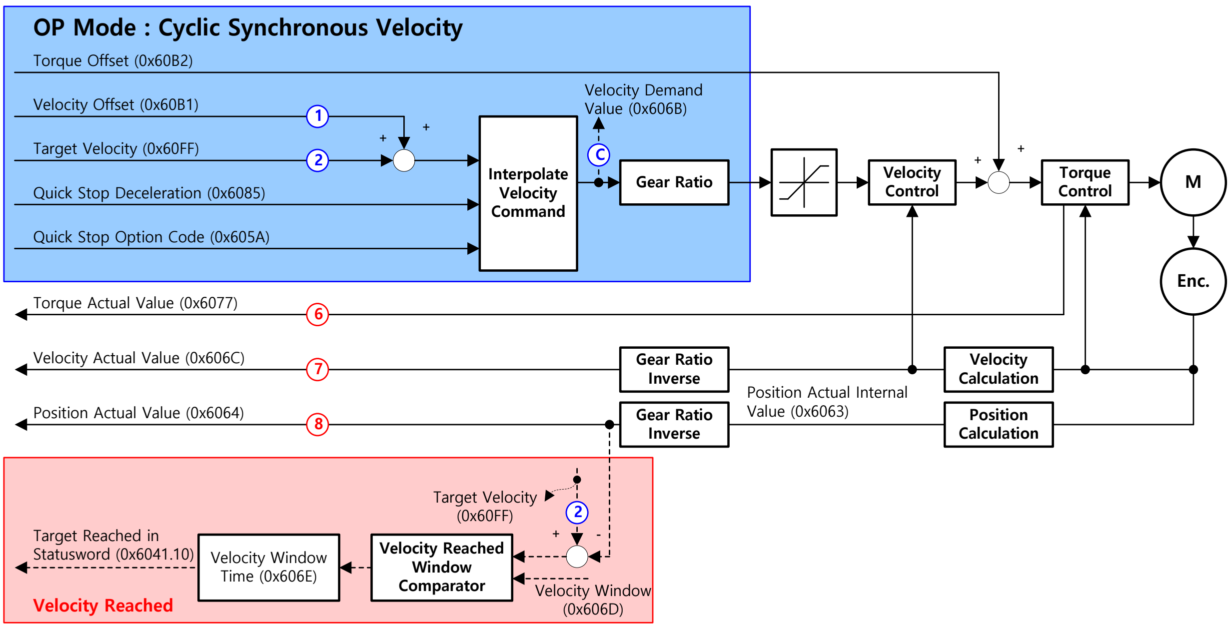
5.4 Velocity Control Mode

5.4.1 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.

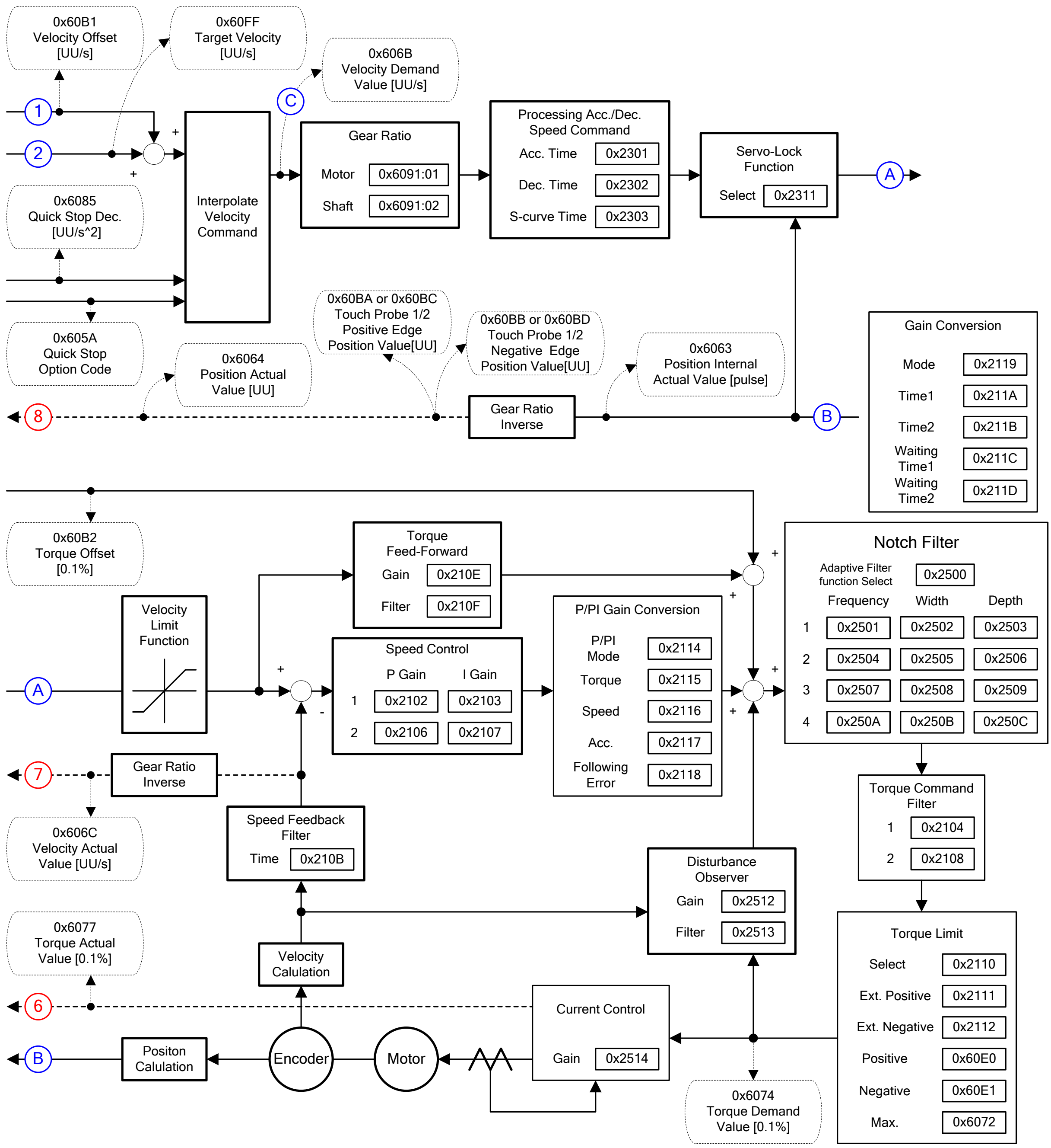
The block diagram of the CSV mode is as follows:



■ 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

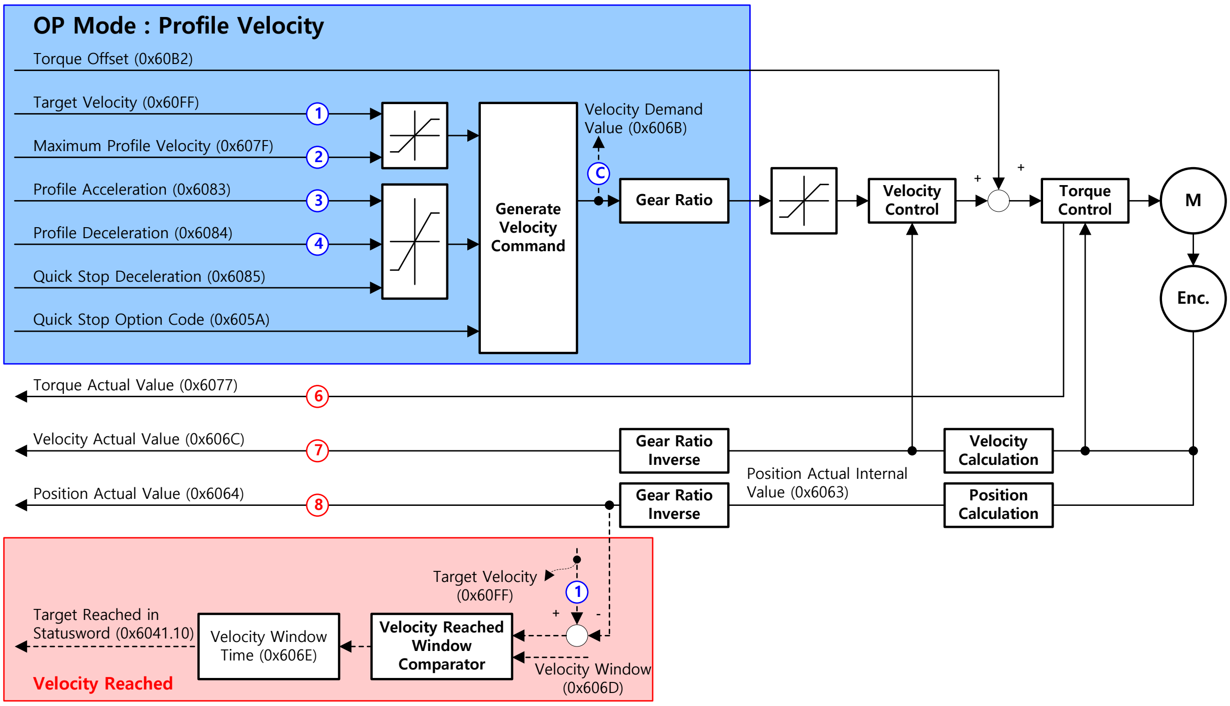


5.4.2 Profile Velocity Mode

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.

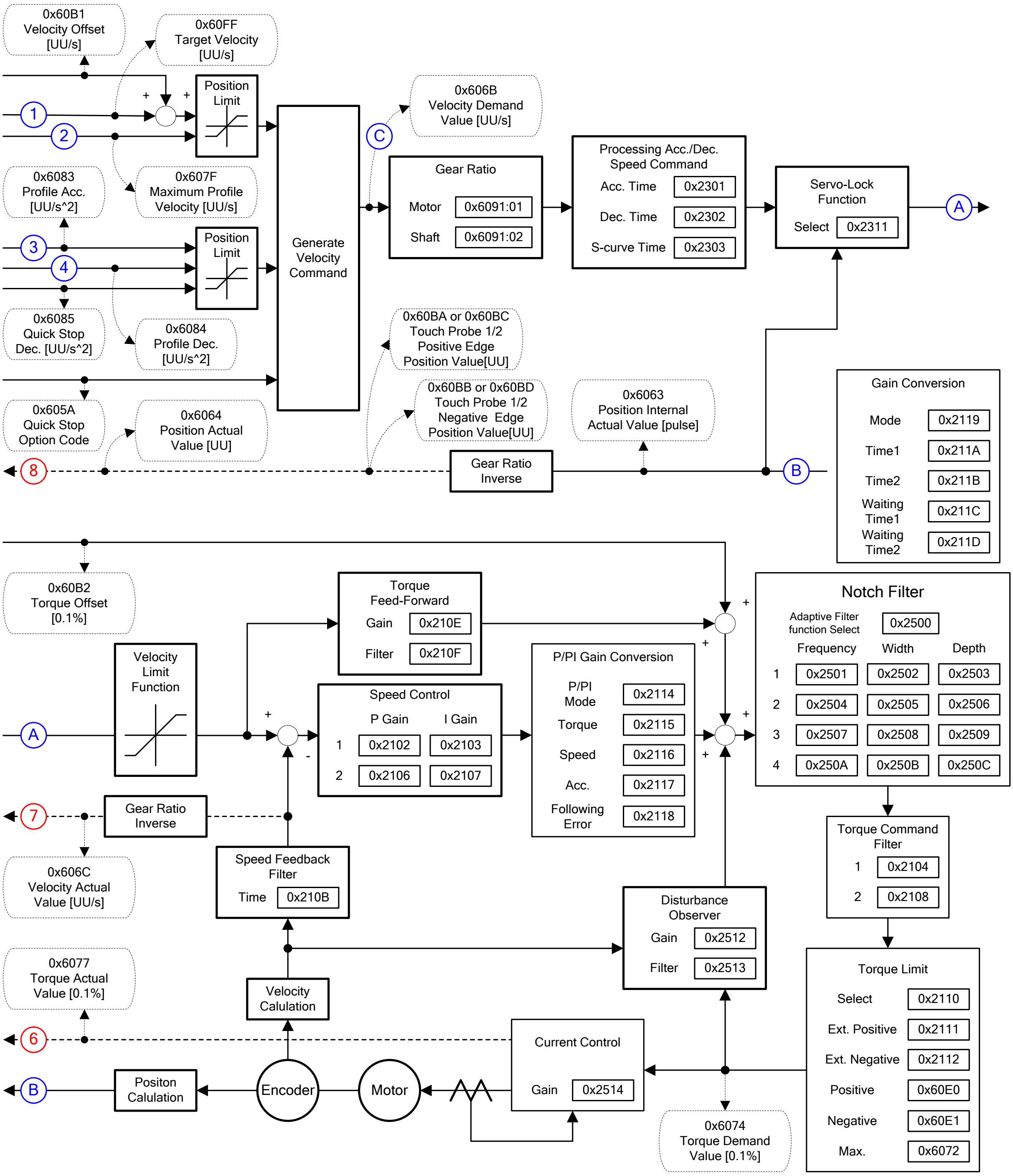
The block diagram of the PV mode is as follows:



■ 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



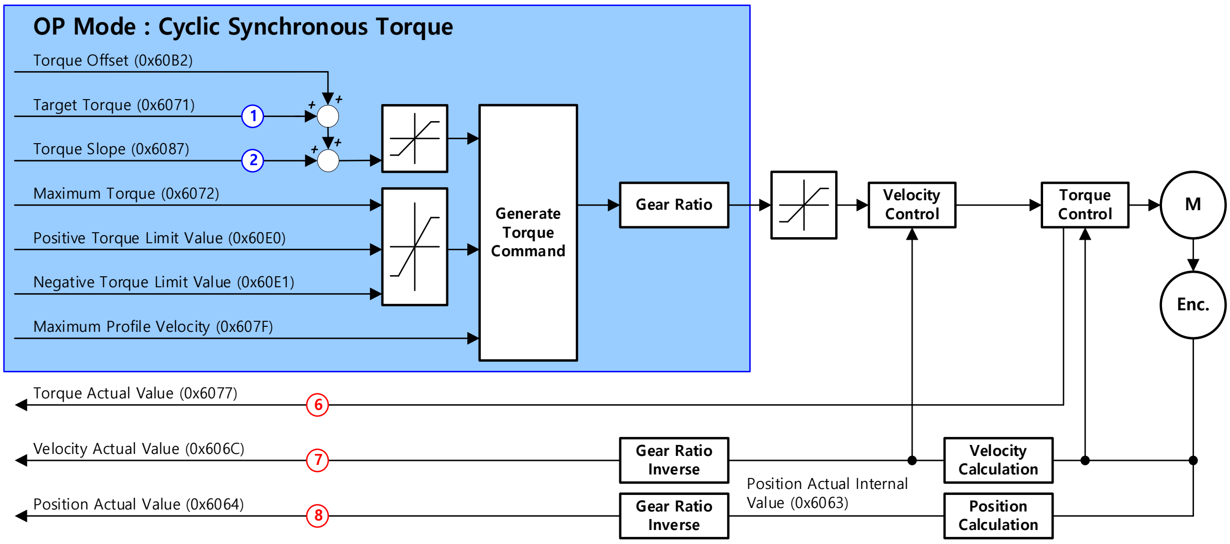
5.5 Torque control mode

5.5.1 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.

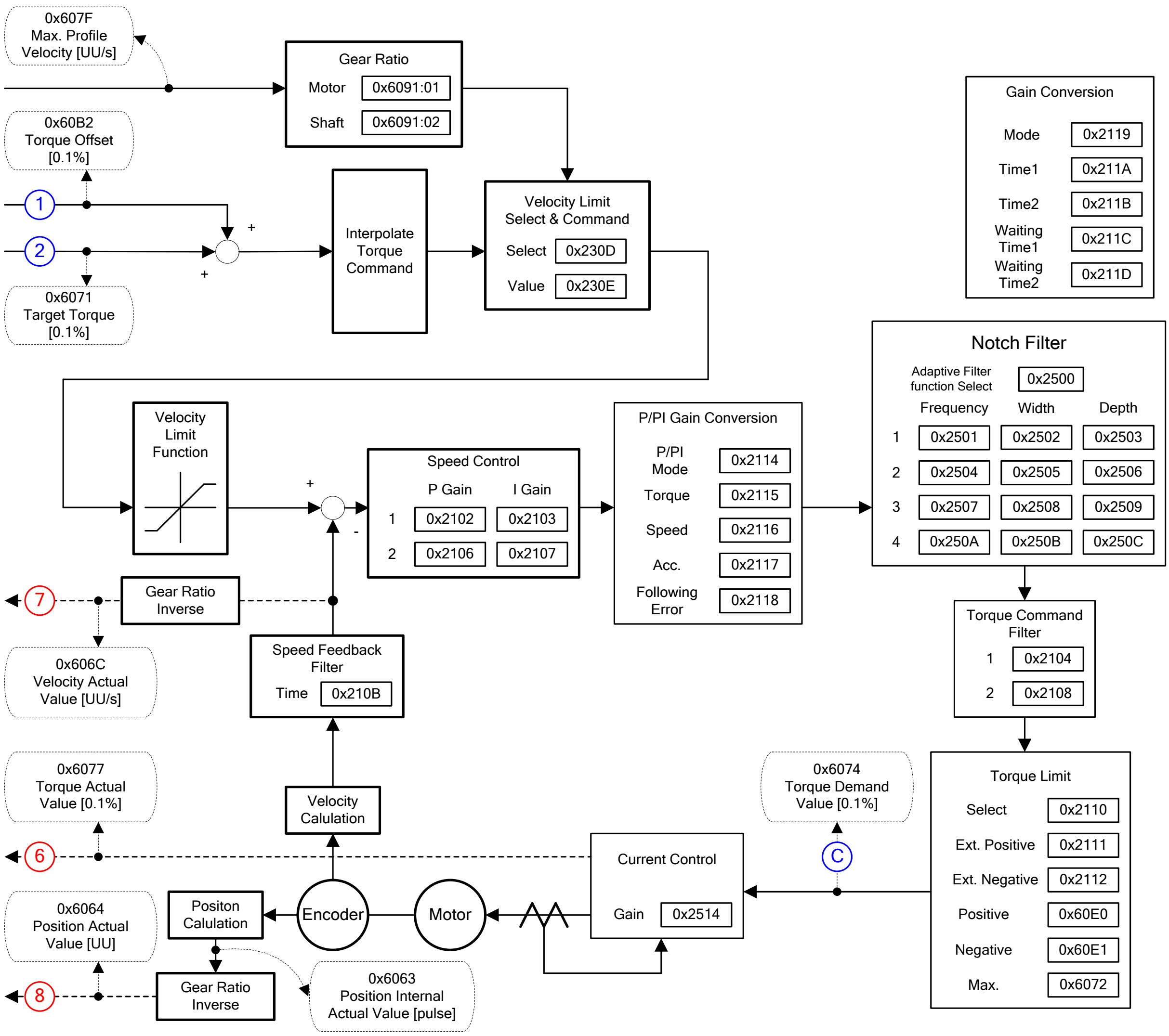
The block diagram of the CST mode is as follows:



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Torque	INT	RW	Yes	0.1%
0x6072	-	Maximum torque	UINT	RW	Yes	0.1%
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x60E0	-	Positive Torque Limit Value	UINT	RW	Yes	0.1%
0x60E1	-	Negative Torque Limit Value	UINT	RW	Yes	0.1%
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x6074	-	Torque Demand Value	INT	RO	Yes	0.1%
0x606C	-	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

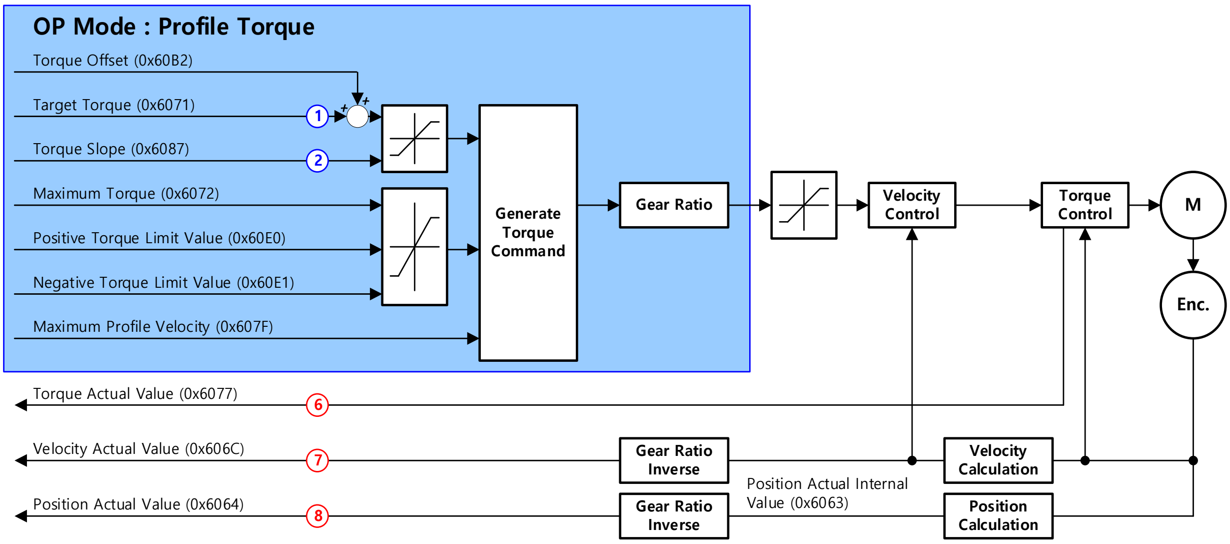


5.5.2 Profile Torque Mode

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:

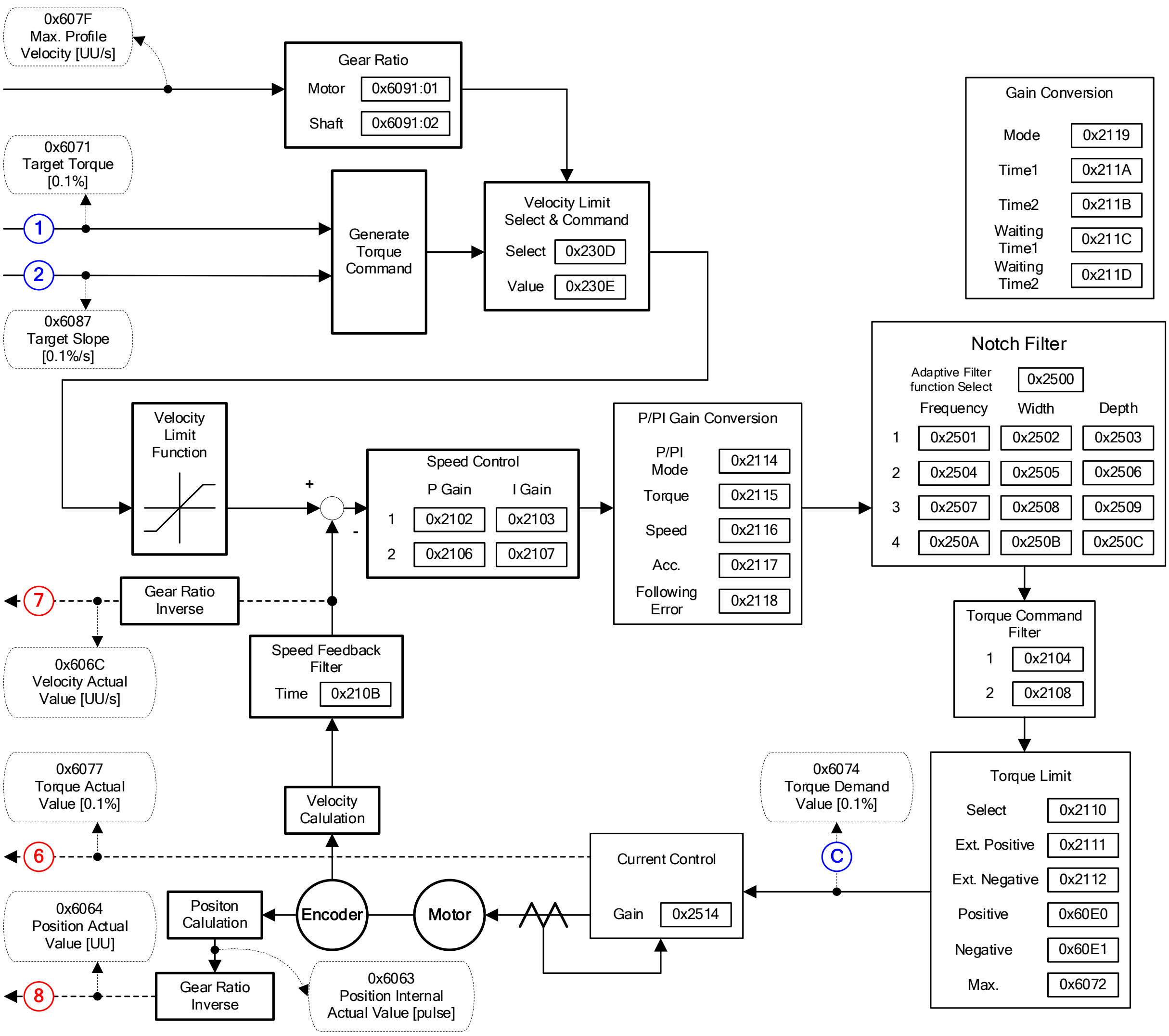


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Torque	INT	RW	Yes	0.1%
0x6072	-	Maximum torque	UINT	RW	Yes	0.1%
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6087	-	Torque slope	UDINT	RW	Yes	0.1%/s
0x60E0	-	Positive Torque Limit Value	UINT	RW	Yes	0.1%
0x60E1	-	Negative Torque Limit Value	UINT	RW	Yes	0.1%

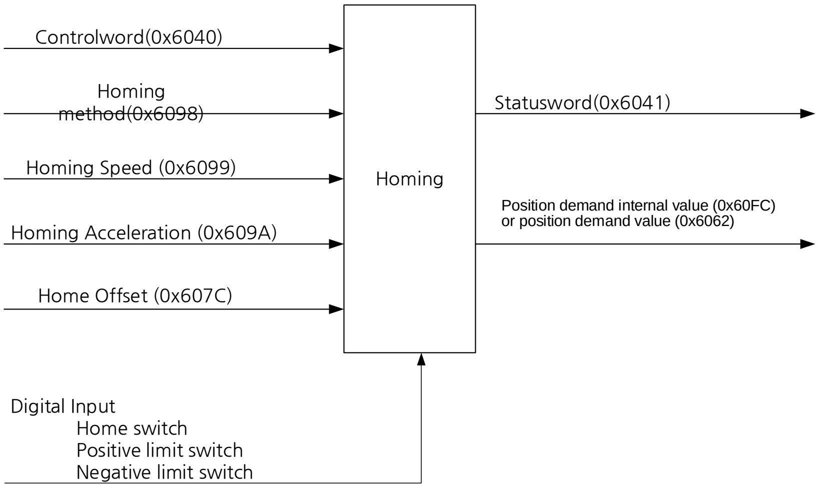
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x6074	-	Torque Demand Value	INT	RO	Yes	0.1%
0x606C	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Velocity Actual Value	DINT	RO	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

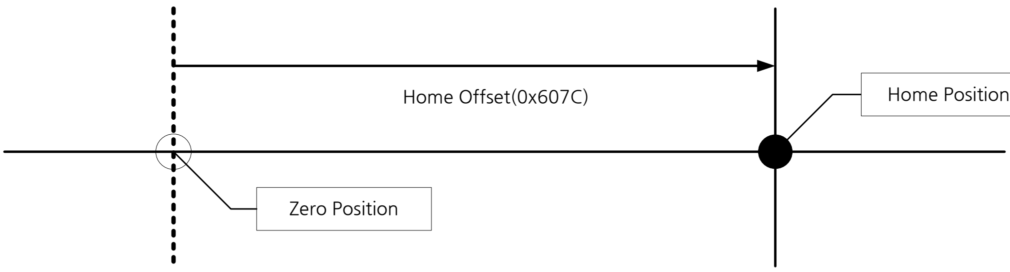


5.6 Homing

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).



5.6.1 Homing Method

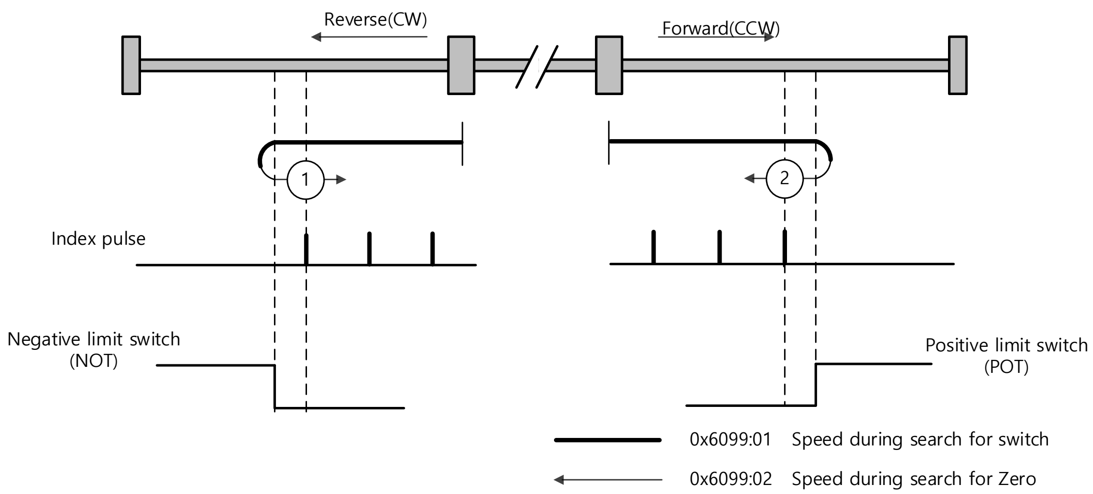
The drive supports the following homing methods (0x6098):

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	It returns to the homing only by the origin switch (HOME) while driving in the reverse direction.
-6	Return to homing only by origin switch (HOME) while driving in the forward direction

■ Related Objects

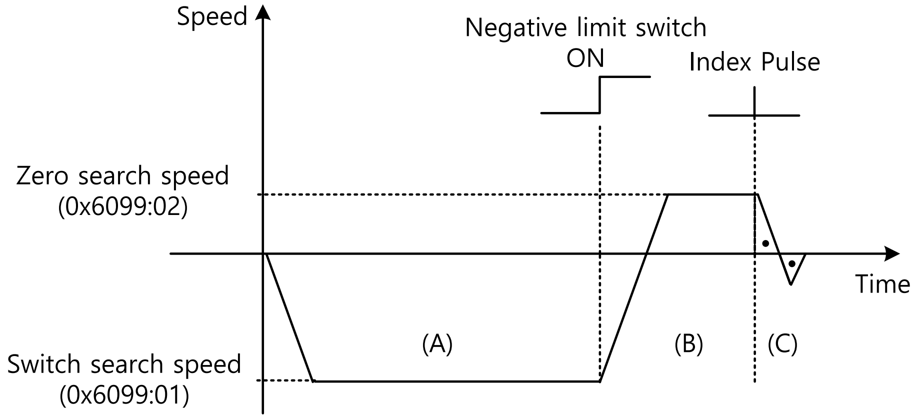
Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UNIT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x607C	-	Home Offset	DINT	RW	No	UU
0x6098	-	Homing Method	SINT	RW	Yes	-
0x6099	-	Homing Speed	-	-	-	-
	0	Number of entries	USINT	RO	No	-
	1	Speed during search for switch	UDINT	RW	Yes	UU/s
	2	Speed during search for zero	UDINT	RW	Yes	UU/s
0x609A	-	Homing Acceleration	UDINT	RW	Yes	UU/s²

■ Homing method 1, 2



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

Homing Method ①

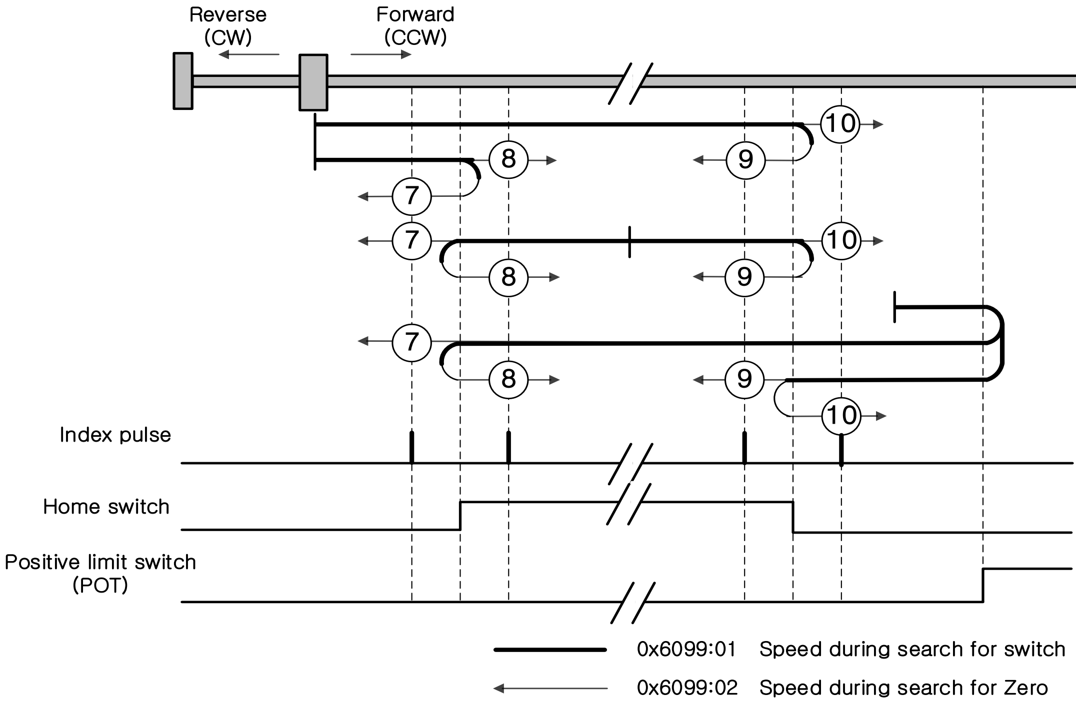


(A) The initial direction is reverse (CW). The motor operates at the switch search speed.

(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).

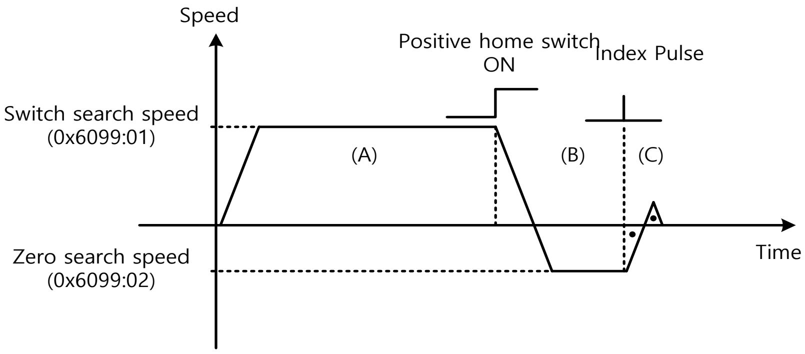
■ Methods 7, 8, 9, and 10



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. 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

Homing Method ⑦



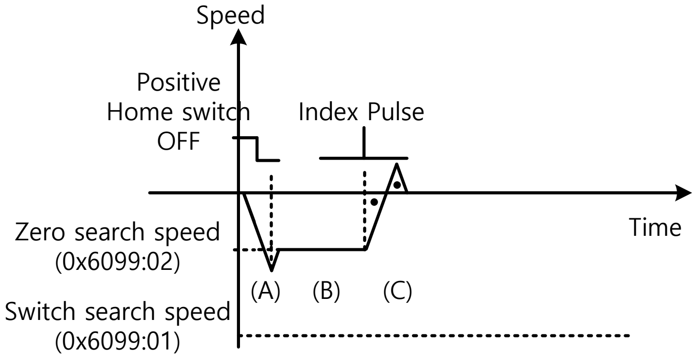
(A) The initial direction is forward (CCW). The motor operates at the switch search speed.

(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



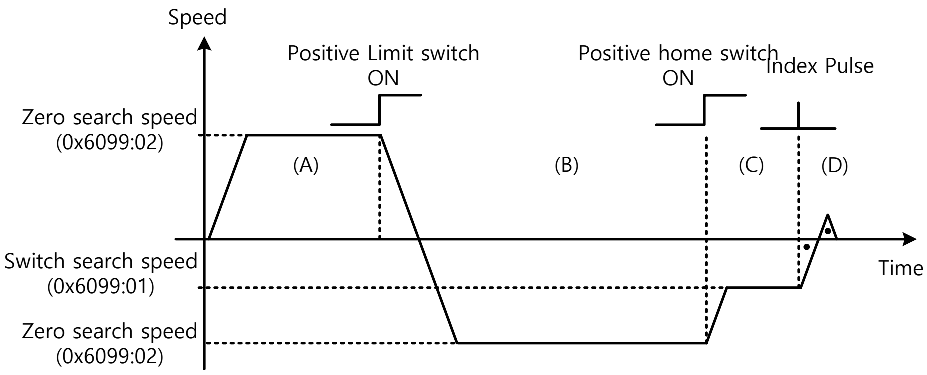
(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Positive Home Switch (CCW). It might not reach the Switch Search Speed depending on the start position of homing.

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

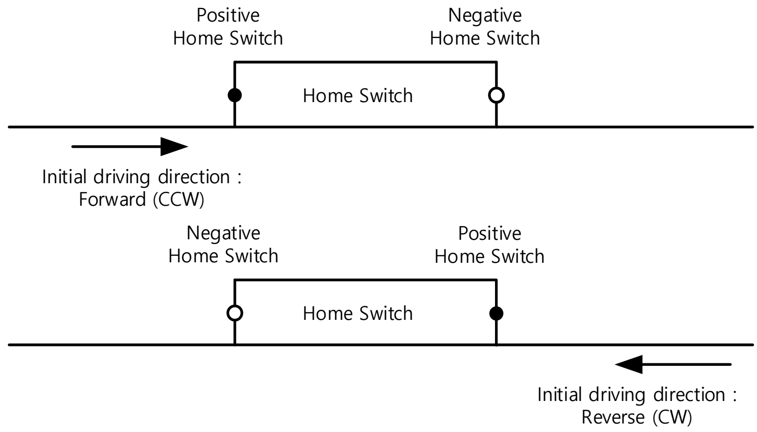
(B) When the positive limit switch (POT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the reverse direction (CW).

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

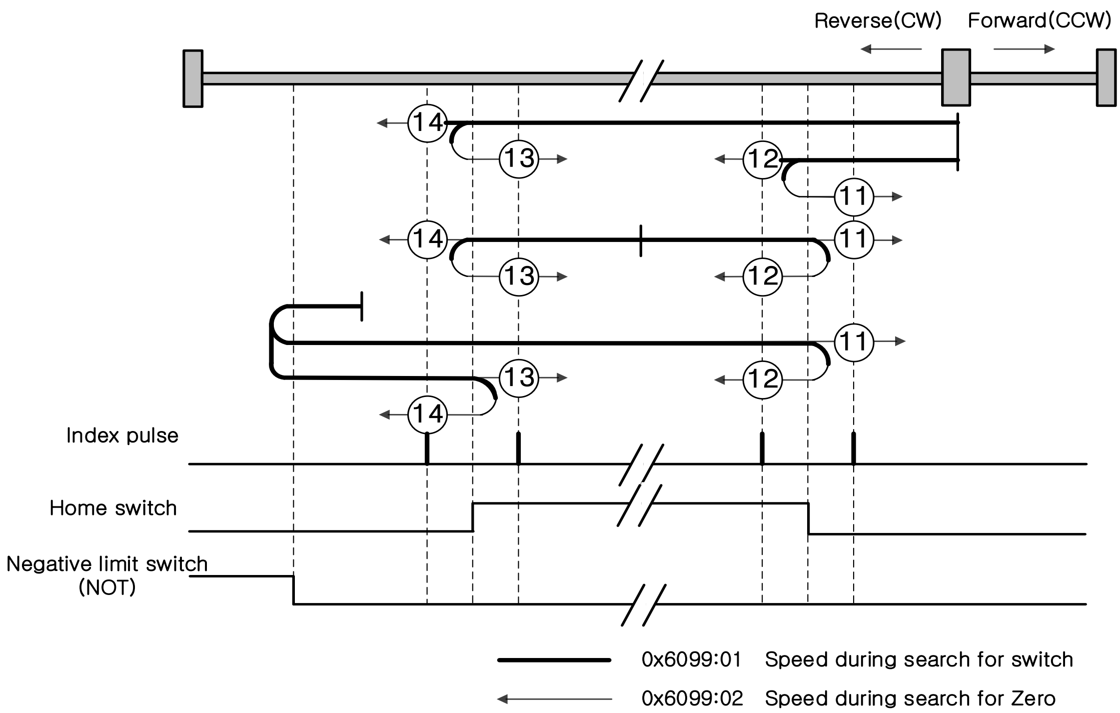
(D) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

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



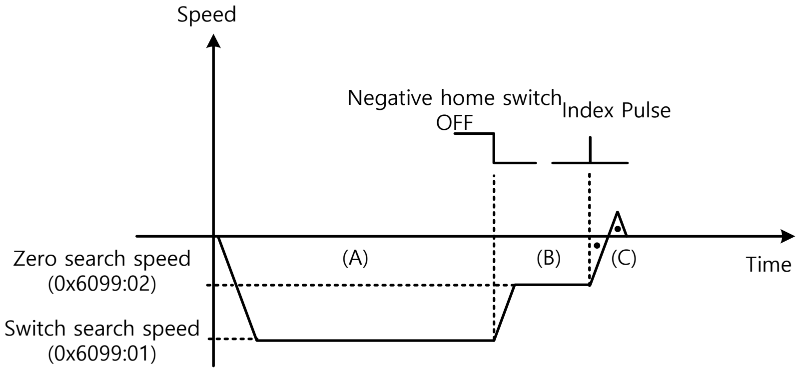
■ Methods 11, 12, 13, and 14



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. 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

Homing Method ⑭



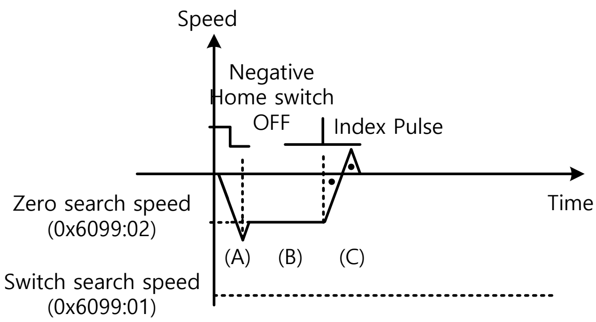
(A) The initial direction is reverse (CW). The motor operates at the switch search speed.

(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



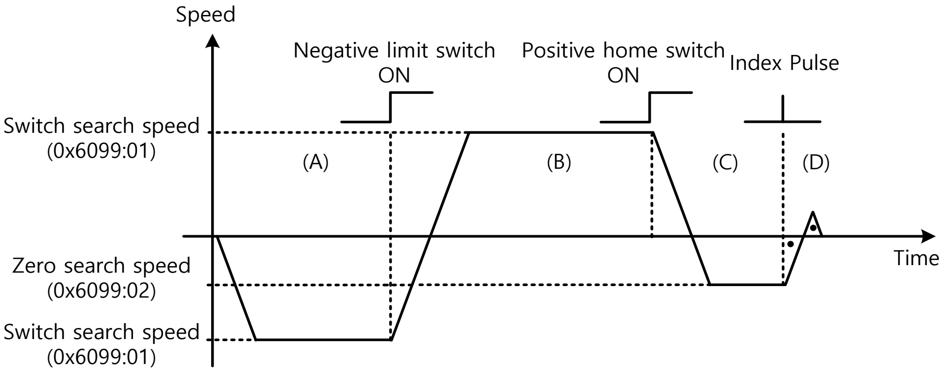
(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Negative Home Switch (CW). It might not reach the Switch Search Speed depending on the start position of homing.

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

Homing Method ⑭



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

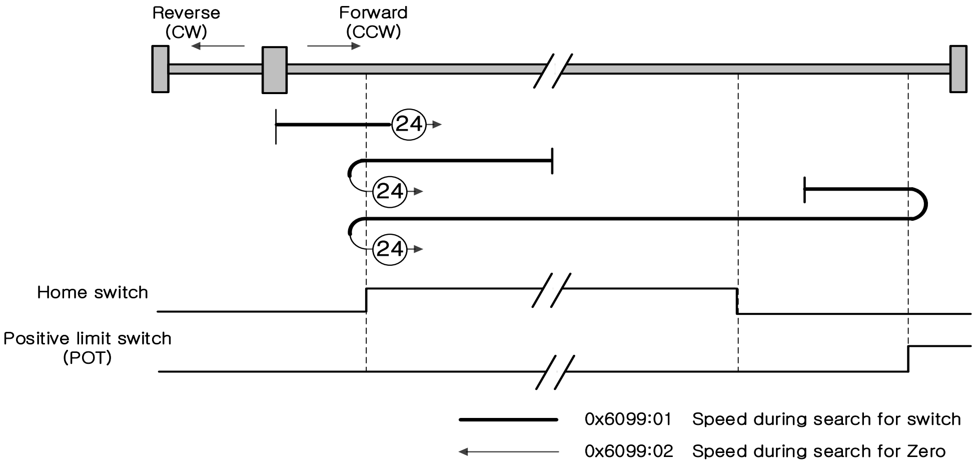
(B) When the negative limit switch (NOT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the forward direction (CCW).

(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).

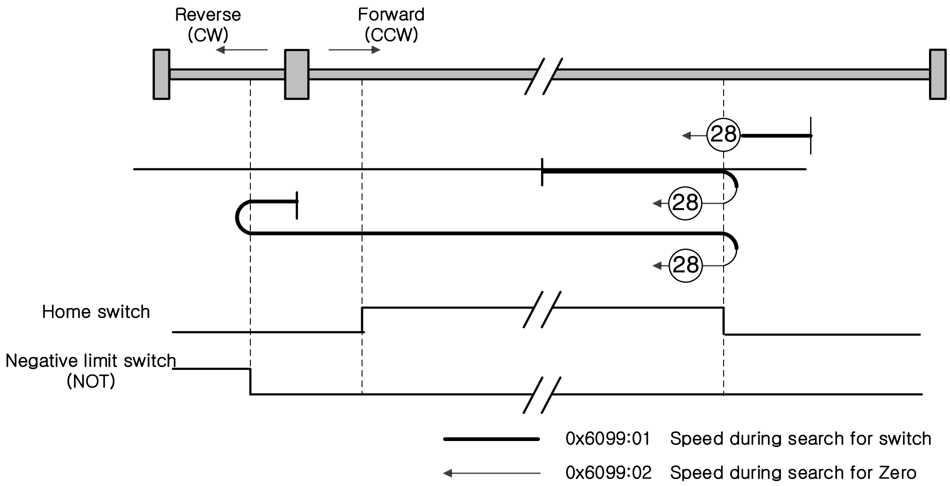
The methods from 11 to 13 are nearly identical to the method 14 in terms of the homing sequence. The only differences are the initial driving direction and Home switch polarity.

■ Method 24



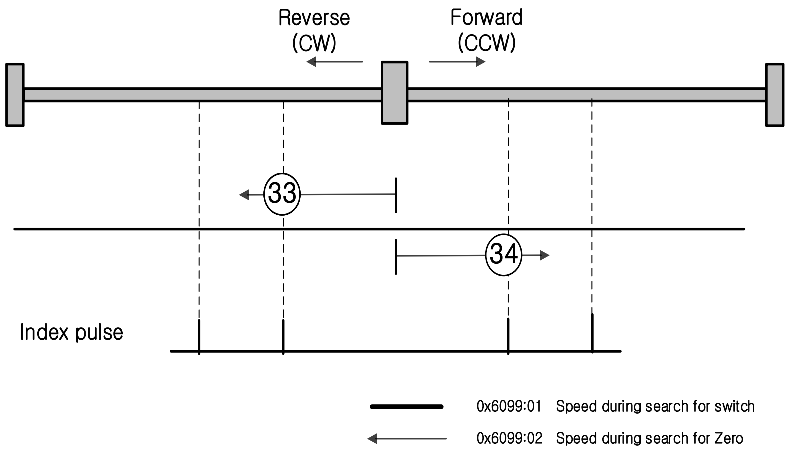
The initial driving direction is forward (CCW), and a point where the Positive Home Switch is turned on becomes the Home position.

■ Method 28



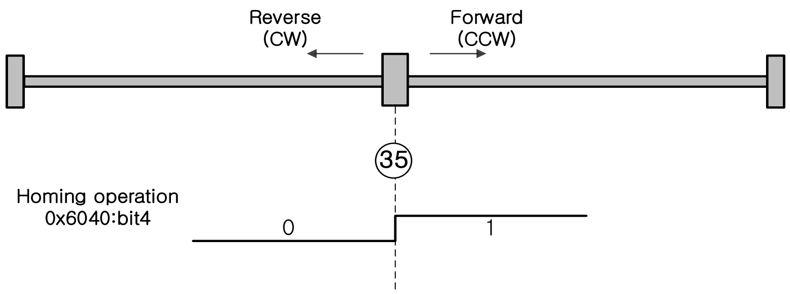
The initial driving direction is reverse (CW), and a point where the Positive Home Switch is turned on becomes the Home position.

■ Methods 33, 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.

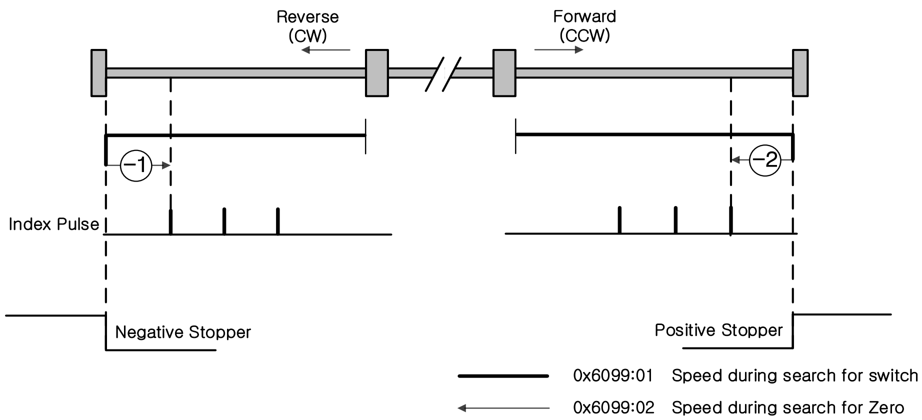
■ Methods 35



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.

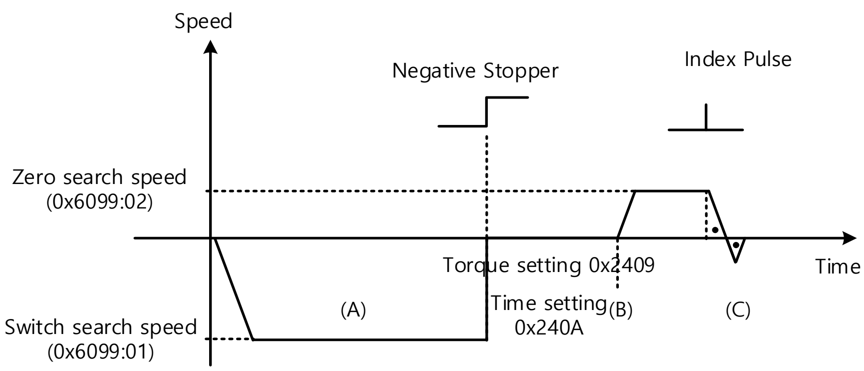
Homing methods -1, -2, -3 and -4 are supported by this drive besides the standard ones. They can be used if the Home switch is not used separately.

■ Methods -1, -2



Homing method -1 and -2 perform homing by using the Stopper and Index (Z) Pulse. The speed profile of each sequence is as follows. Please see the explanations below for further details.

Homing Method -1

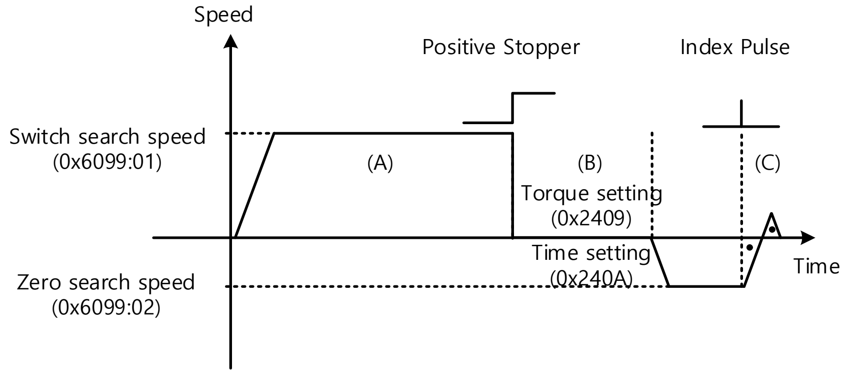


(A) The initial direction is reverse (CW). The motor operates at the switch search speed.

(B) If it collides with a reverse stopper (Negative Stopper), it waits according to the torque limit value (0x2409) when returning to the home using the stopper and the time set value (0x240A) when returning to the home using the stopper, and then changes direction.

(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

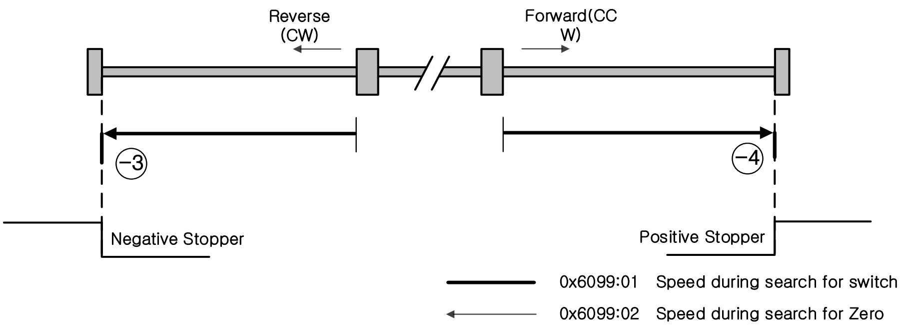


(A) The initial direction is forward (CCW). The motor operates at the switch search speed.

(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.

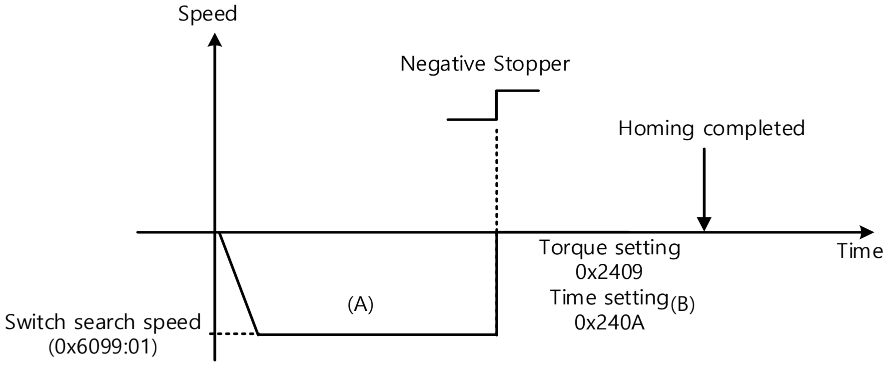
(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

■ Methods -3, -4



Homing method -3 and -4 only perform homing by using the Stopper. The speed profile of each sequence is as follows. Please see the explanations below for further details.

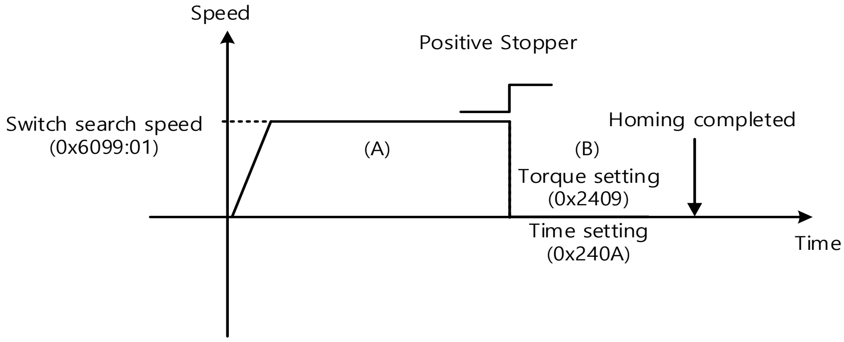
Homing Method -3



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

(B) If it hits a reverse stopper (Negative Stopper), it waits according to the torque limit value (0x2409) when returning to the origin using the stopper and the time set value (0x240A) when returning to the origin using the stopper, and then the return to the origin is completed.

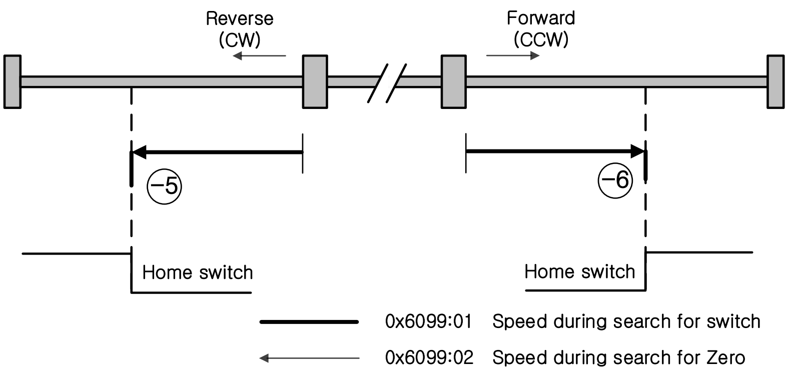
Homing Method -4



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

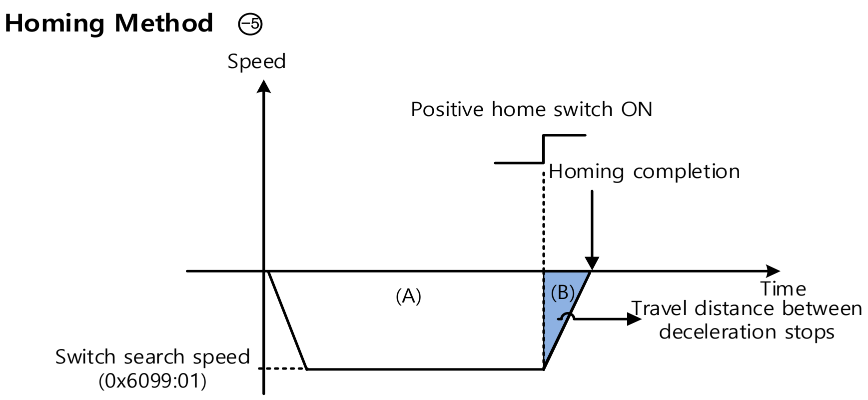
(B) When the drive hits the positive stopper, it will stand by according to the torque limit value (0x2409) and the time setting value (0x240A) at the time of homing using stopper before homing is complete.

■ 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



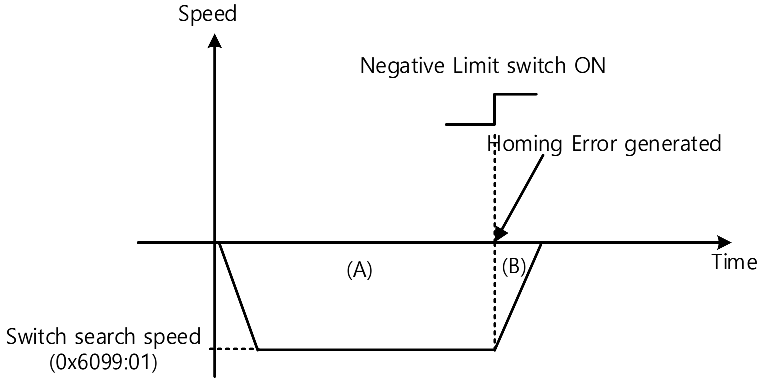
(A) The initial direction is reverse (CW). The motor operates at the switch search speed.

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

(C) (C) After homing completion, the deceleration stop transfer distance by the Homing Acceleration (0x609A) value is expressed as the current position.

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

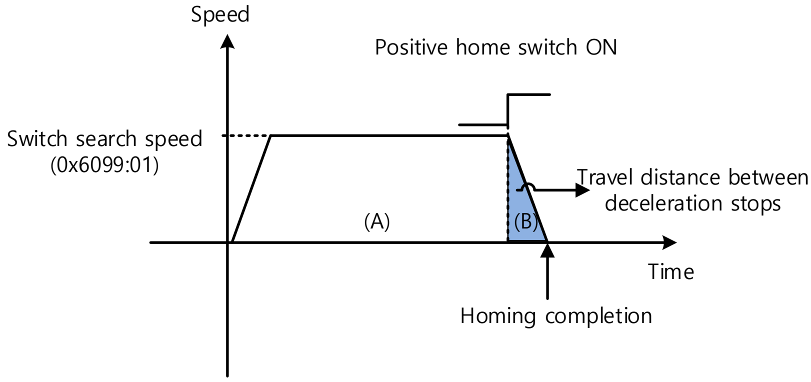
Homing Method ⊖5



(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

(C) After homing completion, the deceleration stop transfer distance by the Homing Acceleration (0x609A) value is expressed as the current position.

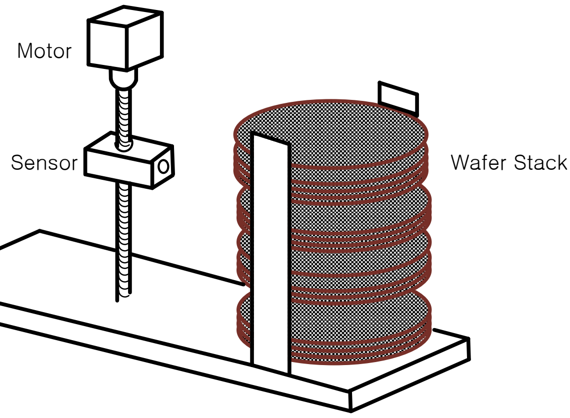
5.7 Touch Probe Function

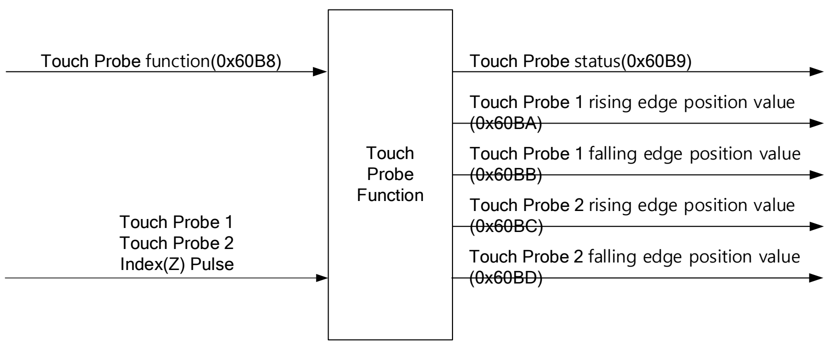
Touch probe is a function to rapidly capture the position value of the encoder with external input (PROBE 1 and 2) signals or the Index (Z) pulse of the encoder.

- 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 (Position Actual Value, 0x6064) is latched by the following trigger events according to the set value. At the same time, it is possible to latch independently at the rising/falling edge of each input of 2 channels.

- 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

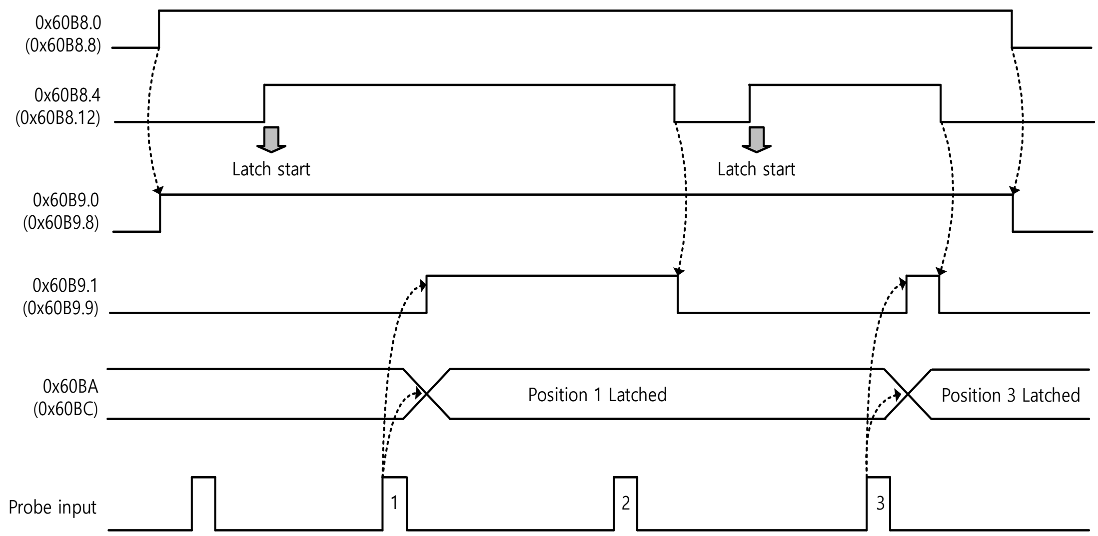
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x60B8	-	Touch Probe Function	UINT	RW	Yes	-
0x60B9	-	Touch Probe Function	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

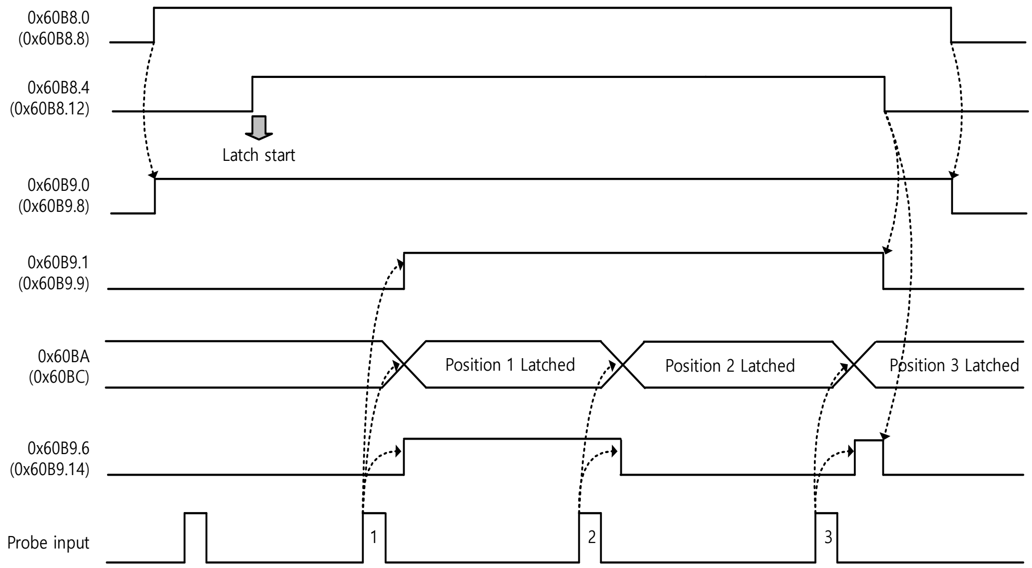
- Single Trigger Mode (0x60B8.1=0, 0x60B8.9=0):

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.

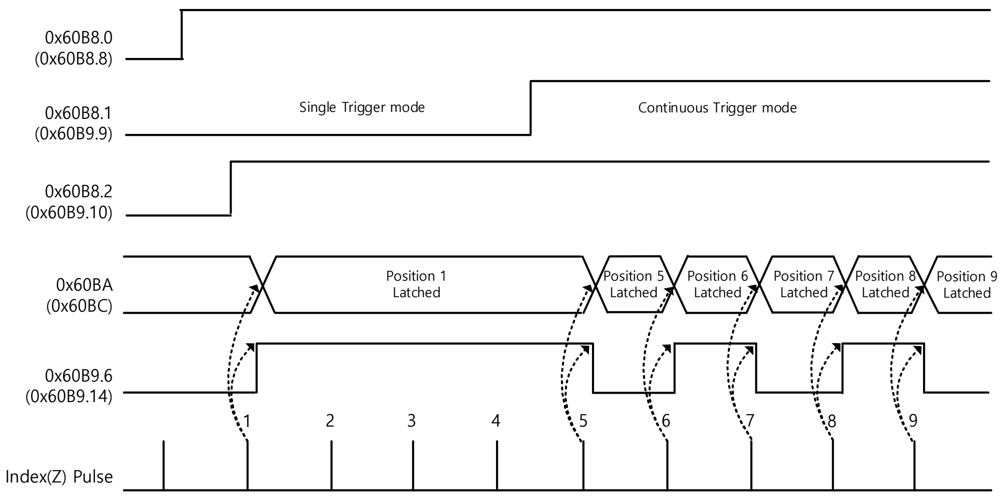


- **Continuous Trigger Mode (0x60B8.1=1, 0x60B8.9=1):**

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.

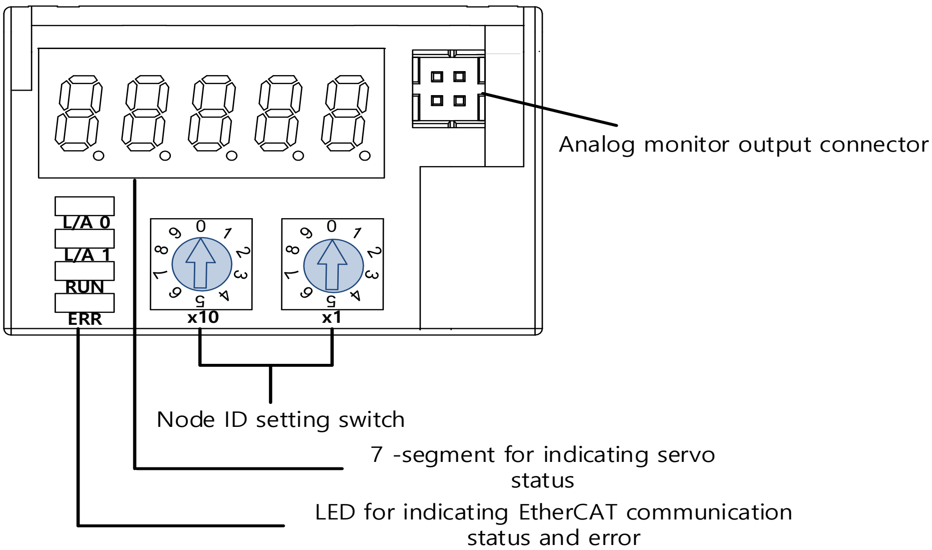


- **Index Pulse Trigger Mode (0x60B8.2=1, 0x60B8.10=1):**



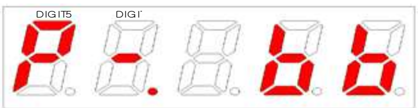
6. Drive Application Function

6.1 Drive Front Panel

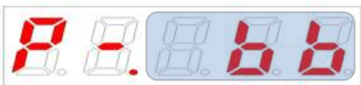


6.1.1 7-Segment for indicating servo status

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

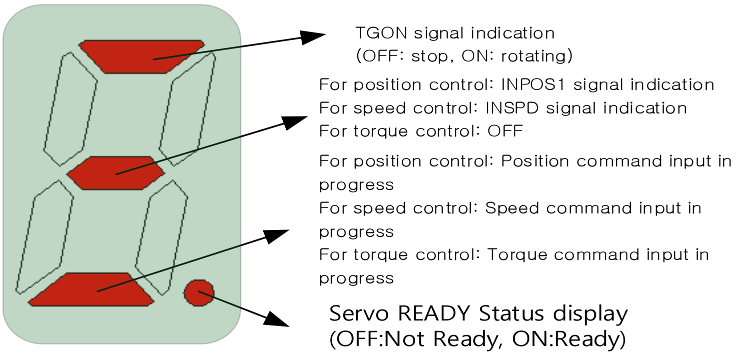


Three digits from Digits 3 to 1 of the 7 -Segment represents the drive status as described below if no servo alarm occurs. In case of servo warning, they will indicate the warning status first, rather than other ones.

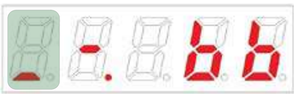
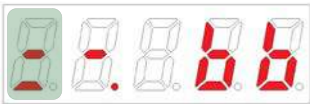
Display of Digit 3 - Digit 1	Status details
 STO connector not connected	 Positive limit sensor input
 Servo OFF	 Negative limit sensor input

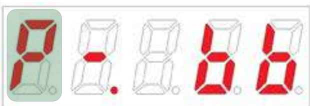
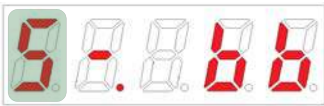
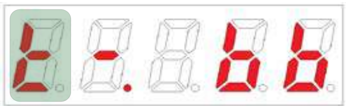
 Servo ON	 Servo warning W10 occurred (code: 10)

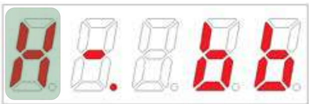
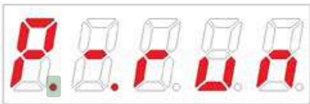
Digit4 indicates the current operation status and servo ready status.



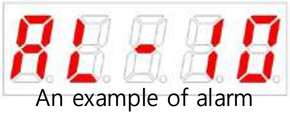
Digit5 indicates the status of the EtherCAT State Machine or of the current control mode and servo ON.

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

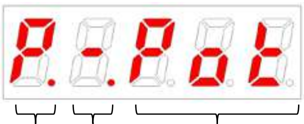
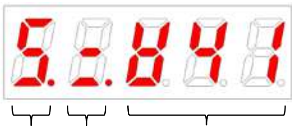
<table>
<tr><td colspan="3">If the status of the EtherCAT State Machine is the operation state (operation ready):
➔ A status, where a servo operation is available, indicating the operation mode and status.</td></tr>
<tr><td>
Position control modes: CSP, PP</td><td>
Speed control modes: CSV and PV</td><td>
Torque control modes: CST and PT</td></tr>
</table>

		
Homing mode	(On:servo ON, servo OFF)	

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.



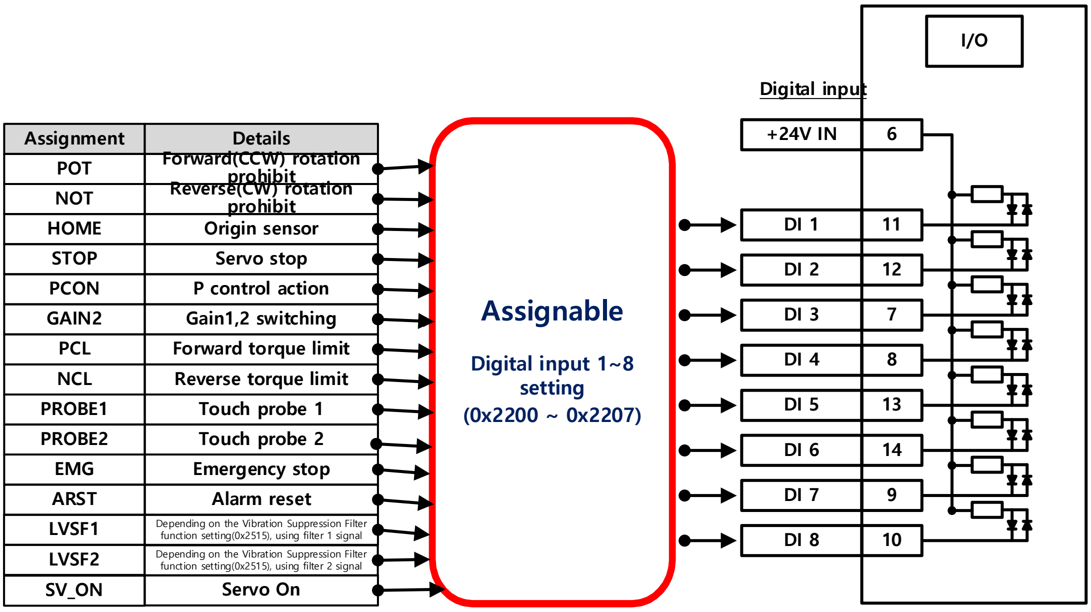
An example of alarm status output
AL-10 (IPM Fault)

Ex. 1) Limit signal input	Ex. 2) Servo warning triggered
 DIGIT3~1: Forward 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

6.2 Input/Output Signals Setting

6.2.1 Assignment of Digital Input Signals

Set the digital input signal function and input signal level of the I/O connector. As shown in the figure below, out of 15 input functions, up to 8 functions can be arbitrarily assigned to digital input signals 1 to 8.



■ **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 content
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 Value	Assignable input signals
0x00	Do not assignment
0x01	POT
0x02	NOT
0x03	HOME
0x04	STOP
0x05	PCON
0x06	GAIN2
0x07	PCL
0x08	NCL
0x09	PROBE1
0x0A	PROBE2
0x0B	EMG
0x0C	ARST
0x0D	LVSF1
0x0E	LVSF2
0x0F	SVON
0x24	ABS_Reset

■ **Example of Assigning Digital Input Signals**

The following table shows an example of assigning input signals. Please check the set value of 0x2200~0x2207.

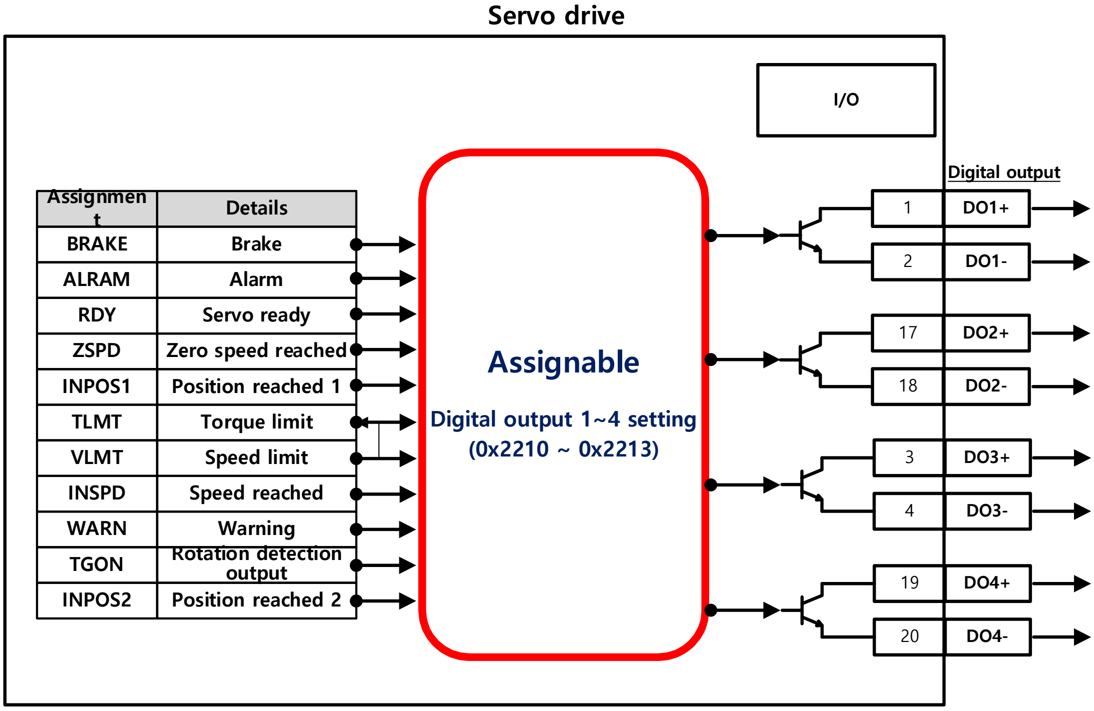
DI#1	DI#2	DI#3	DI#4	DI#5	DI#6	DI#7	DI#8
POT (Contact A)	NOT (Contact A)	HOME (Contact A)	STOP (Contact A)	PCON (Contact A)	GAIN2 (Contact A)	PROBE1 (Contact A)	ARST (Contact A)

Assignment		Contact	Details
0x01	POT	A	Forward(CCW)rotation prohibit
0x02	NOT	A	Reverse(CW) rotation prohibit
0x03	HOME	A	Origin sensor
0x04	STOP	A	Servo stop
0x05	PCON	A	P control action
0x06	GAIN2	A	Gain1,2 switching
0x07	PCL	-	Forward torque limit
0x08	NCL	-	Reverse torque limit
0x09	PROBE1	A	Touch probe 1
0x0A	PROBE2	-	Touch probe 2
0x0B	EMG	-	Emergency stop
0x0C	ARST	A	Alarm reset
0x0D	LVSF1	-	Vibration control filter 1
0x0E	LVSF2	-	Vibration control filter 2
0x0F	SVON		Servo on
0x24	ABS_Reset		Absolute value reset

I/O (pin no)	Setting parameter	Bit		Setting values	Details
		15	7~0		
DI # 1 (11)	0x2200	0	0x01	0x8001	POT(A contact)
DI # 2 (12)	0x2201	0	0x02	0x8002	NOT(A contact)
DI # 3 (7)	0x2202	0	0x03	0x0003	HOME(A contact)
DI # 4 (8)	0x2203	0	0x04	0x0004	STOP(A contact)
DI # 5 (13)	0x2204	0	0x05	0x0005	PCON(A contact)
DI # 6 (14)	0x2205	0	0x06	0x0006	GAIN2(A contact)
DI # 7 (9)	0x2206	0	0x09	0x0009	PROBE1(A contact)
DI # 8 (10)	0x2207	0	0x0C	0x000C	ARST(A contact)

6.2.2 Assignment of Digital Output Signals

Set the digital output signal function and output signal level of the I/ O connector. As shown in the figure below, out of 11 output functions, up to 4 functions can be arbitrarily assigned to digital output signals 1 to 4.



■ **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 content
15	Signal output level settings (0: contact A, 1: contact B)
14~8	Reserved
7~0	Output signal assignment

Setting Value	Assignable output signal
0x00	Do not assignment
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. Please check the set value of 0x2210~0x2213

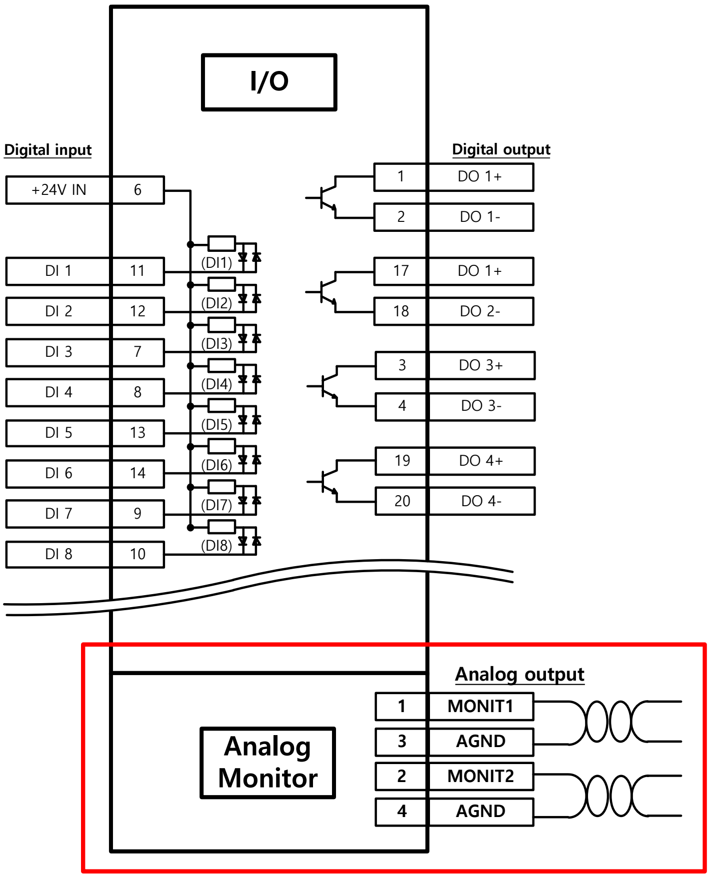
DO#1	DO#2	DO#3	DO#4
BRAKE (Contact B)	ALARM (Contact B)	RDY (Contact A)	ZSPD (Contact A)

Assignment		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 no)	Setting parameter	Bit		Setting value	Details
		15	7~0		
DO # 1 (1,2)	0x2210	1	0x01	0x8001	BRAKE(B contact)
DO # 2 (17,18)	0x2211	1	0x02	0x8002	ALARM(A contact)
DO # 3 (3,4)	0x2212	0	0x03	0x0003	RDY(A contact)
DO # 4 (19,20)	0x2213	0	0x04	0x0004	ZSPD(A contact)

6.2.3 Assignment of Analog Output Signals

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

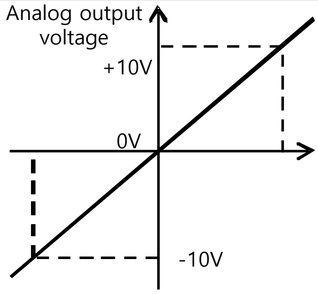
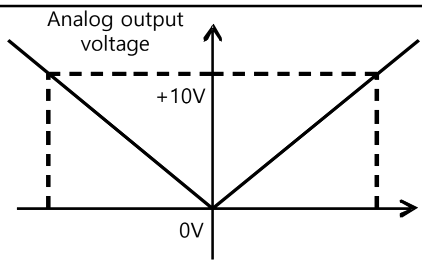


■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2220	-	Analog Monitor Output Mode	UINT	RW	No	-
0x2221	-	Analog Monitor Channel 1 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	

- Analog monitor channel 1 setting (0x2221)

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

Setting Value	Display item	Unit
0x00	Speed feedback	rpm
0x01	Speed command	rpm
0x02	Speed error	rpm
0x03	Torque feedback	%
0x04	Torque error	%
0x05	Position error	pulse
0x06	Accumulated operate overload percentage	%
0x07	DC link voltage	V
0x08	Accumulated Regeneration Overload	%
0x09	Encoder single-turn data	pulse
0x0A	Inertia ratio	%
0x0B	Full-Closed positional error	UU
0x0C	Drive Temperature 1	°C
0x0D	Drive Temperature 2	°C
0x0E	Encoder temperature 1	°C
0x0F	Hall signal	-
0x10	U phase current	A
0x11	V phase current	A
0x12	W phase current	A
0x13	Real position value	UU
0x14	Target position value	UU
0x15	Position command speed	rpm, mm/s
0x16	Hall U signal	-
0x17	Hall V signal	-
0x18	Hall W signal	-

The voltage is calculated as follow when analog monitor is output

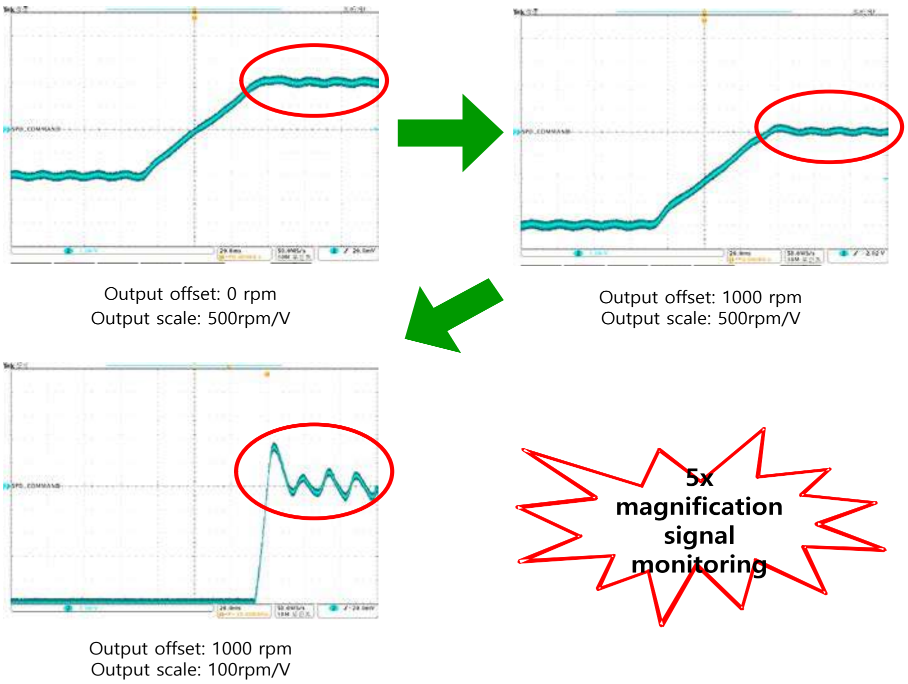
Channel 1 output voltage [V] = [Monitoring signal value (0x2221) – Offset (0x2203)] / Scale (0x2205)

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

For example, if you input 100 to the scale when monitoring the speed output, the output will be 100 [rpm] per 1 [V].

■ Setting example

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



When the servo drives from -1000[rpm] to 1000[rpm], the first figure has an offset of 0[rpm], so the 0[rpm] point is located at the Zero Crossing (middle dotted line) point. Since the scale is 500 [rpm], 500 [rpm] per 1 [V], and -1000 to 1000 [rpm] with a total of 4 squares. The second picture shows the case where the offset is entered as 1000 [rpm], and the position of the zero crossing point is changed at 1000 [rpm]. Thirdly, since the output scale is 100 [rpm], it enables monitoring by enlarging the point reaching 1000 [rpm] more precisely than the existing 500 [rpm] per 1 [V].

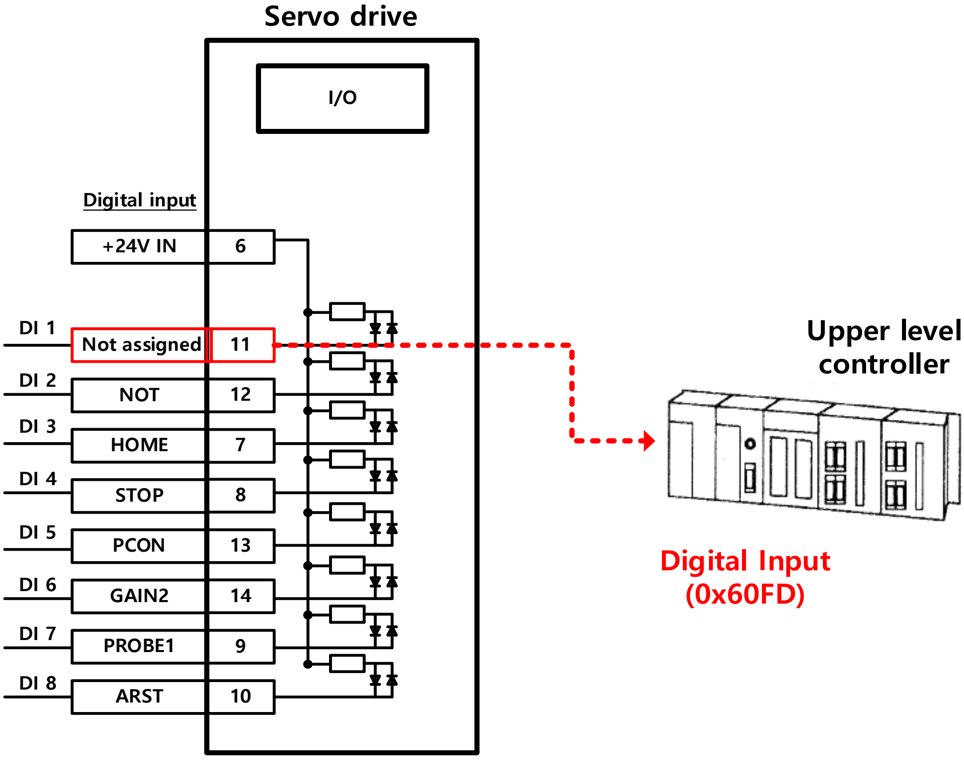
6.2.4 Use of User I/O

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.)

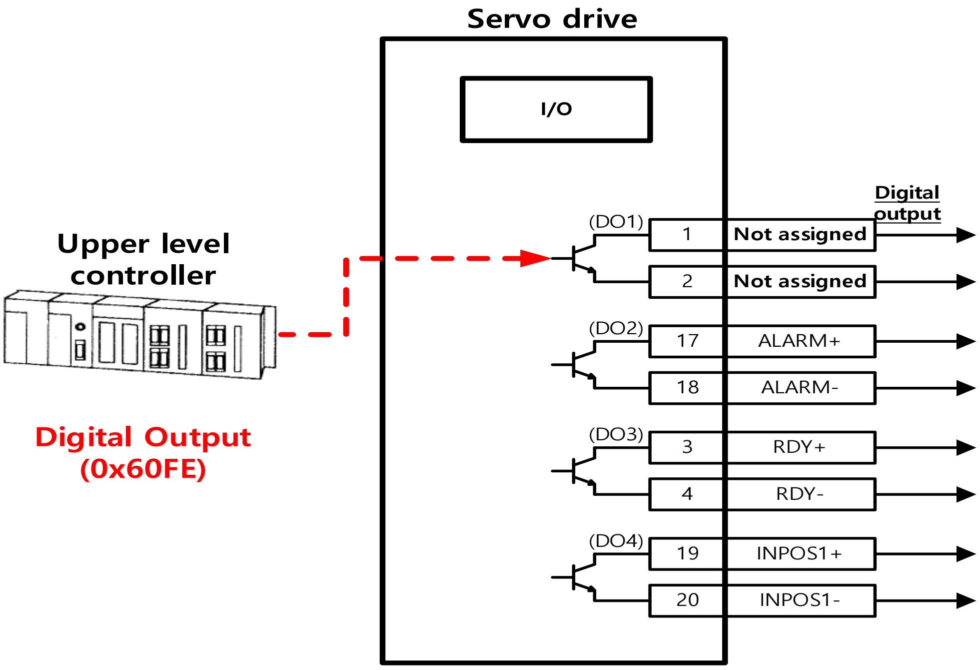
2) Read the values of the corresponding bits (0x60FD.16-23) from the digital input (0x60FD), in order to use them as the user input.

■ Related Objects

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

Bit	Description
0	NOT (negative limit switch)
1	POT (positive limit switch)
2	HOME (origin sensor input)
3 to 15	Reserved
16	DI #1(I/O pin 11), 0:Open, 1:Close
17	DI #2(I/O pin 12), 0:Open, 1:Close
18	DI #3(I/O pin 7), 0:Open, 1:Close
19	DI #4(I/O pin 8), 0:Open, 1:Close
20	DI #5(I/O pin 13), 0:Open, 1:Close
21	DI #6(I/O pin 14), 0:Open, 1:Close
22	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 output	-	-	-	-
	0	Number of entries	USINT	RO	No	
	1	Physical outputs	UDINT	RW	Yes	-
	2	Bit mask	UDINT	RW	No	-

They indicate the status of digital outputs.

- Description of physical outputs

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

6.3 Electric Gear Setup

6.3.1 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.

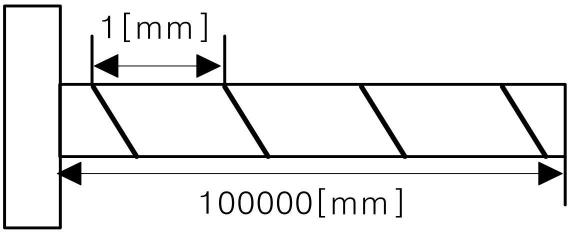
When using the electric gear function of the drive, you cannot utilize the highest resolution of the encoder; thus, in case the upper level controller has the function, please use it if possible.

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

- Electronic Gear provides convenience by converting User Unit [UU] into the unit desired by the user.



For example, let's assume that there is a ball screw that moves 1 [mm] per motor revolution. At this time, the resolution of the motor is 524288[ppr]. That is, to move 1 [mm], 524288 [Pulses] must be input to the servo If you want to move 27 [mm], you need to do additional calculations and the user must directly input the massive value of 14155776 [Pulse].

However, the inconvenience of command value input can be improved when gear ratio is used.

For example, if you want to move 1[mm] by inputting 1[Pulses] to the servo, try setting the gear ratio as follows.

$$\frac{Motor\ \ Resolution[0x6091.1]}{Shaft\ \ Resolution[0x6091.2]} \times \mathrm{User\ \ Demand\ \ Pulse[UU]}$$

$$= \frac{524288}{1} \times 1[UU] = 524288[UU] = 1[mm]$$

Entering 524288 in the motor resolution and 1 in the shaft resolution internally sets the movement ratio of the ball screw for one revolution of the motor. When moving 1 [mm], the user only needs to input 1, which is the same value as 1 [mm], in User Demand Pulse, so the unit is the same, so it is convenient for command input.

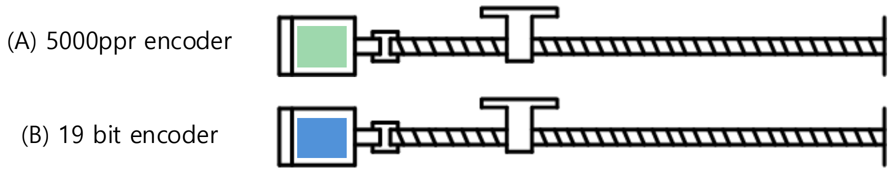
As another example, if you want to move 0.0001 [mm] when you input 1 [UU], the gear ratio calculation formula is as follows.

$$\frac{Motor\ \ Resolution[0x6091.1]}{Shaft\ \ Resolution[0x6091.2]} \times \mathrm{User\ \ Demand\ \ Pluse[UU]}$$

$$= \frac{524288}{10000} \times 1[UU] = \frac{1[mm]}{10000} \times 1[\mathrm{UU}] = 0.0001[\mathrm{mm}]$$

With the above gear ratio setting, it is possible to move by 0.0001 [mm]/1 [UU], and when inputting 10 [UU], it is possible to move by 0.001 [mm], so the user can conveniently input the desired unit [UU].

- 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:



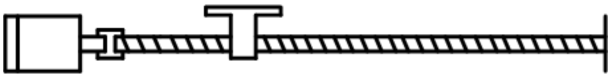
	(A) 5000 ppr encoder	**(B) 19-bit encoder**
Electric Gear Disable	5000*12/10 = 6000	524288*12/10=629145.6
	Different command should be given depending on the encoder (motor) used for the same distance movement.	
For a command given in the minimum user unit of 1 um (0.001 mm)		
Electric gear settings	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

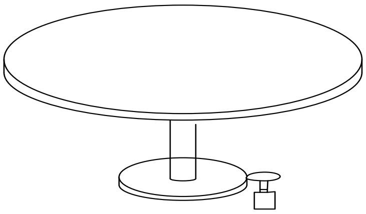
- The output frequency of a general high-speed line drive pulse output unit is approximately 500 Kpps, while the allowed input frequency of the drive is approximately 1-4 Mpps. For this reason, when driving a high-resolution encoder at high speed, be sure to use an electric gear for proper driving due to the limitations of the output frequency of the upper level controller and the input frequency of the drive.

6.3.2 Example of Electric Gear Setup

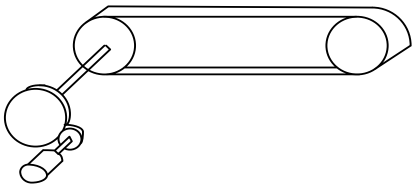
■ Ball Screw Load

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: 100mm**
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

6.3.3 Calculation of speed and acceleration/deceleration when using electronic gear

- **Index Velocity setting method**

The ratio of speed and acceleration/deceleration when the gear ratio is 1:1 is as follows.

$$Encoder\ Pulse\ per\ Resolution[ppr]\ :\ 60[rpm] = Index\ Velocity[uu/s] : Demand\ Speed[rpm]$$

If the user wants to drive a 19-bit motor at a speed of 3000 [rpm], the velocity value of the index is calculated as follows.

$$524288[ppr]\ :\ 60[rpm] = Index\ Velocity[uu/s] : 3000[rpm]$$

$$Index\ Velocity[uu/s] = 26214400[uu/s]$$

If the gear ratio is not 1:1, the speed will be affected by the gear ratio. Therefore, consider the value of the gear ratio and use the following formula.

$$Index\ Velocity[UU/sec] = Demand\ Speed[rpm] \times \frac{Encoder\ Pulse\ per\ Resolution}{Motor\ Resolution} \times \frac{Shaft\ Resolution}{60[rpm]}$$

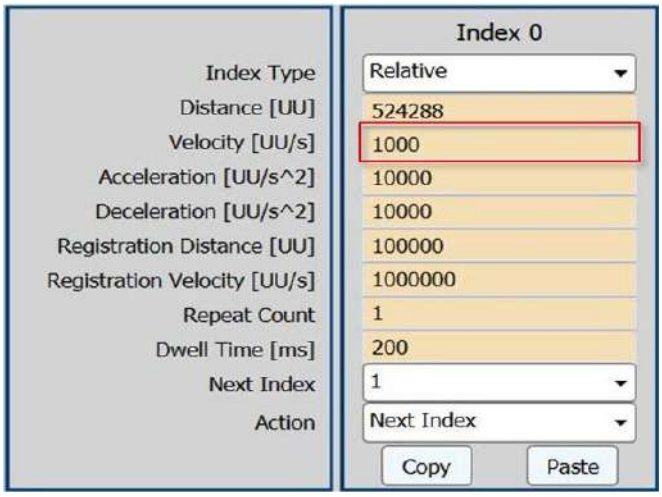
※ Application example

When applying Motor Resolution: 524288 / Shaft Resolution:

Calculate Index Velocity input value when the user wants to drive at 3000 [rpm]

$$Index\ Velocity[UU/sec] = 3000[rpm] \times \frac{524288}{524288} \times \frac{20}{60[rpm]}$$

$$Index\ Velocity[uu/s] = 1000[UU/sec]$$



If 1000 [UU/s] is input to Index Velocity, it drives at 3000 [rpm].

- **Index Acceleration / Deceleration setting method**

Acceleration and Deceleration are set based on the arrival time and set using the index Velocity value.

$$\text{Time of concentration[sec]} = \frac{Velocity[uu/s]}{Acceleration\ \ or\ \ Deceleration[uu/sec^2]}$$

Time of concentration means the time it takes for the Feedback Speed to reach the Velocity registered by the user as the target reaching time.

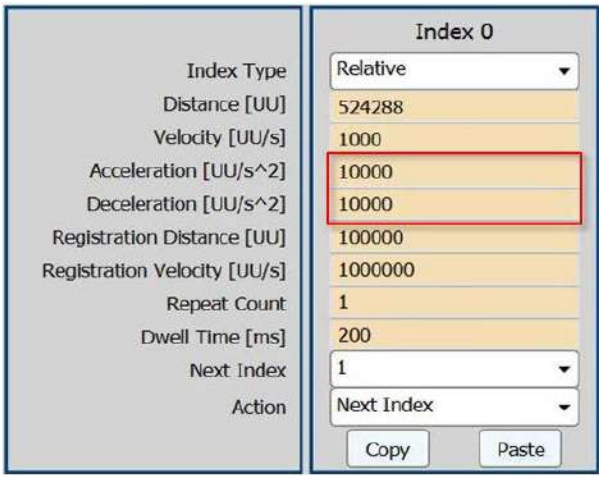
※ Application example

When applying Motor Resolution: 524288 / Shaft Resolution:

20 gear ratio to a 19-bit motor, if you want the feedback speed to reach 3000 [rpm] in 0.1 second

$$0.1[\text{sec}] \ \ = \ \frac{1000[uu/s]}{Acceleration\ \ or\ \ Deceleration[uu/sec^2]}$$

$$Acceleration\ \ or\ \ Deceleration[uu/sec^2] = 10000[UU/sec]$$



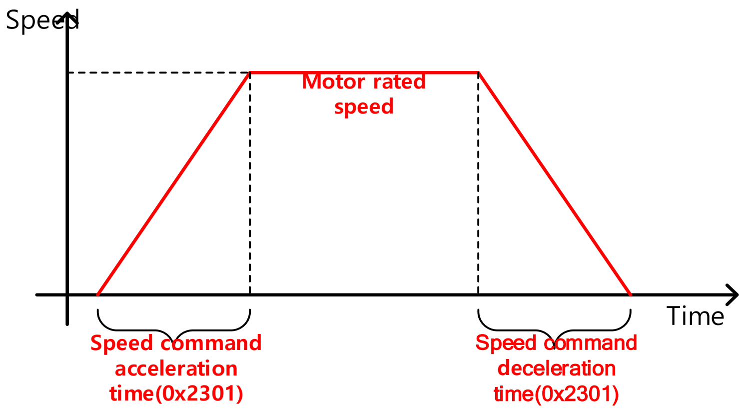
Therefore, the values of Acceleration and Deceleration can be set as above.

6.4 Settings Related to Speed Control

6.4.1 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.

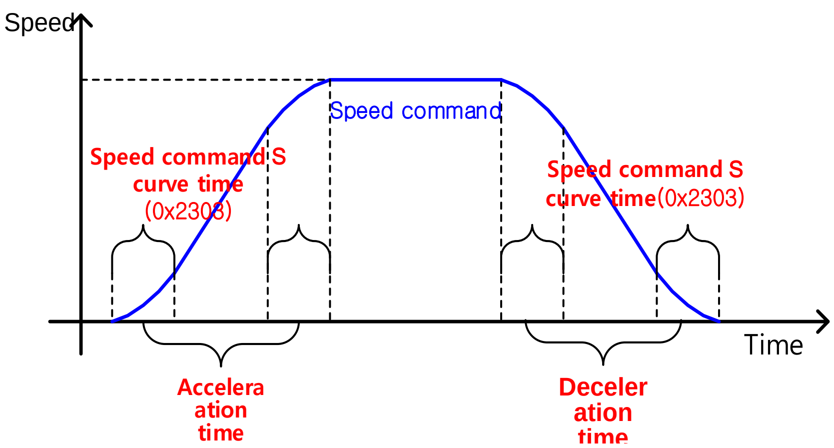


You can calculate the actual acceleration/deceleration time as below:

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.



6.4.2 Servo-lock Function

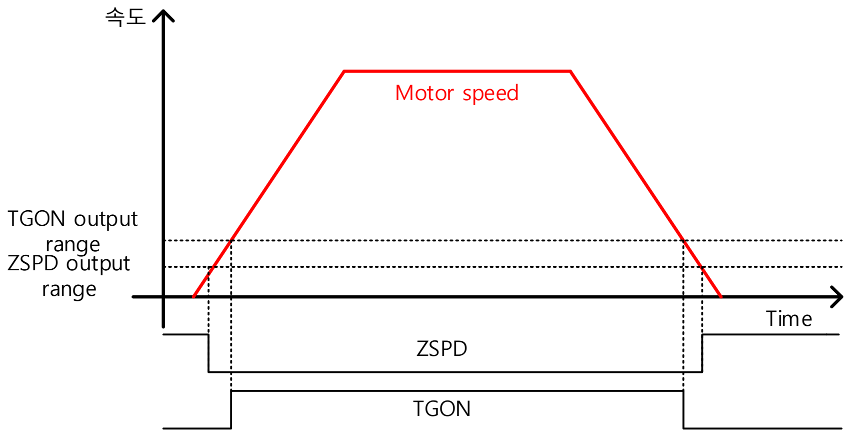
During the speed control operation, the servo position will not be locked even when 0 is entered for a speed command. This is due to the characteristic of speed control; at this moment, you can lock the servo position by enabling the servo-lock function (0x2311).

Setting Value	Setting content
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.

6.4.3 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

6.5 Settings Related to Position Control

6.5.1 Position Command Filter

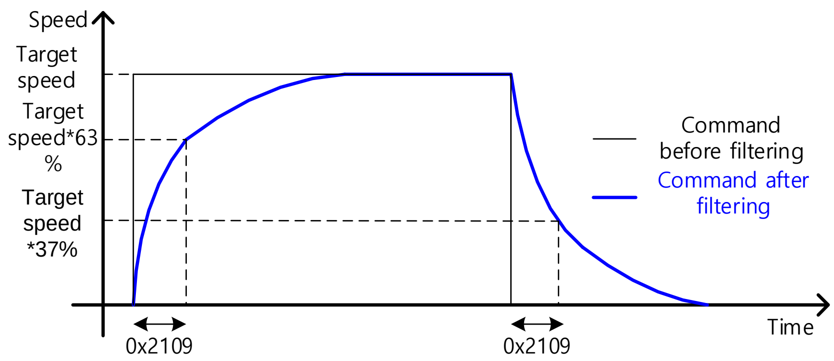
This section describes how to operate the drive more smoothly by applying a filter to a position command. In the case of motion with transient response characteristics, a shock wave (jerk) may occur. In this case, if you enter an appropriate value, critical braking (appropriate response) is possible.

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. However, if the value of position command average filter time constant (0x210A) is too large, it may reach the target position slowly, and so proper setting is required.

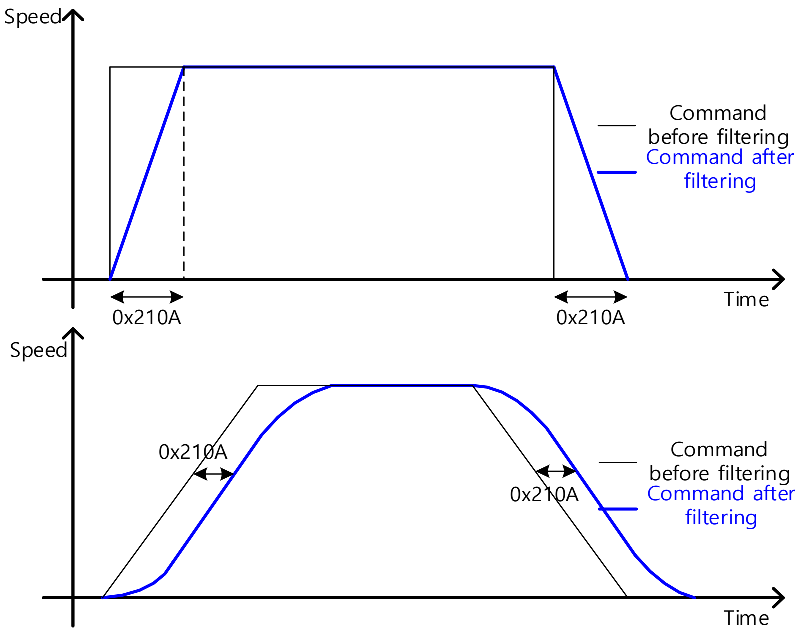
You can use a position command filter if:

(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)

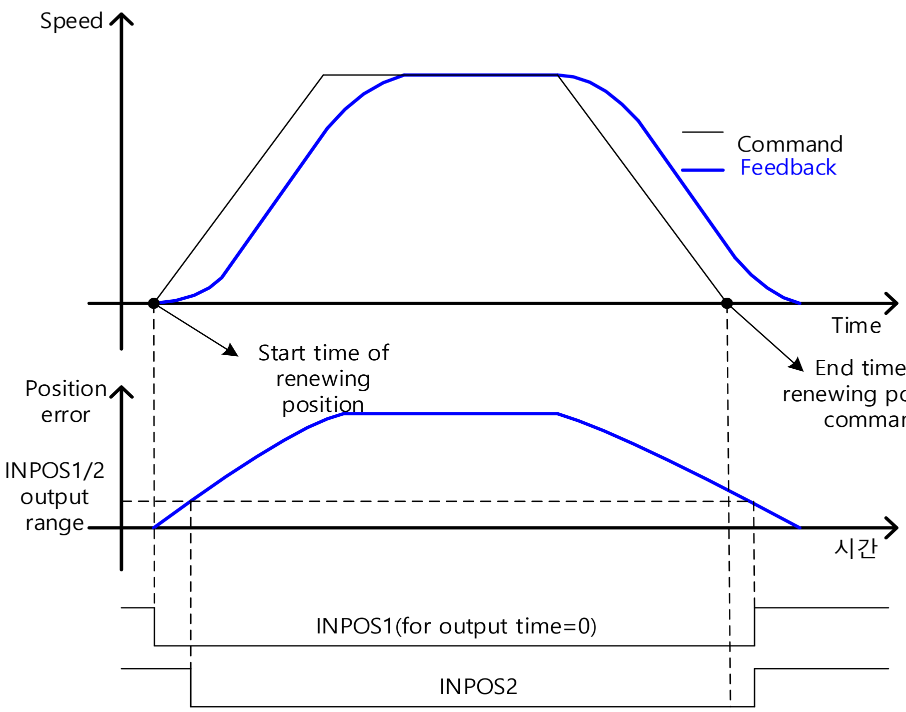
■ Related Objects

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

6.5.2 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

6.6 Settings Related to Torque Control

6.6.1 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.

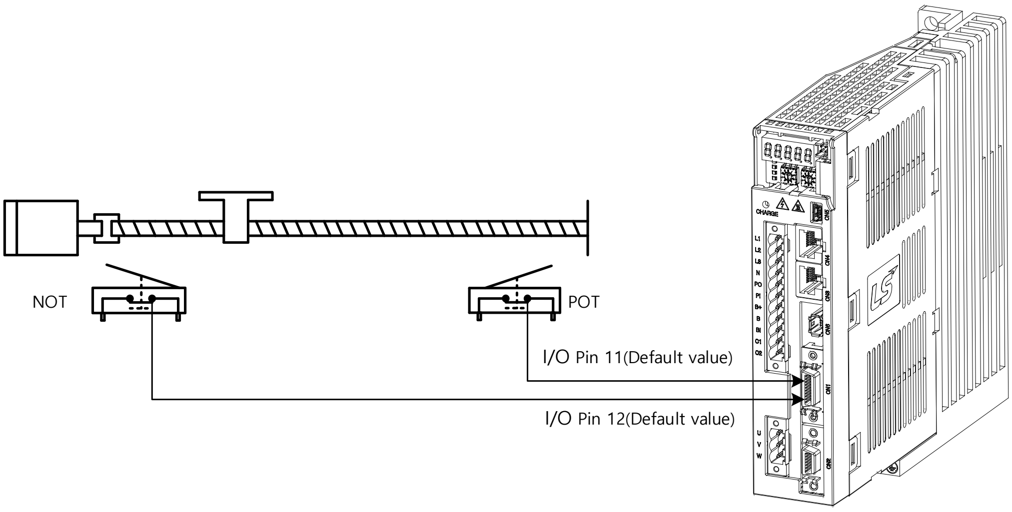
Setting Value	Setting content
0	Limited by speed limit value (0x230E)
1	Limited by the maximum motor speed

■ 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

6.7 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 6.2.1 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 Value	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).

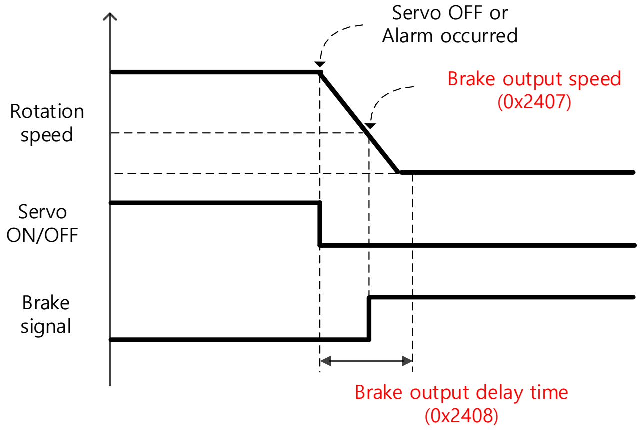
■ Related Objects

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	-

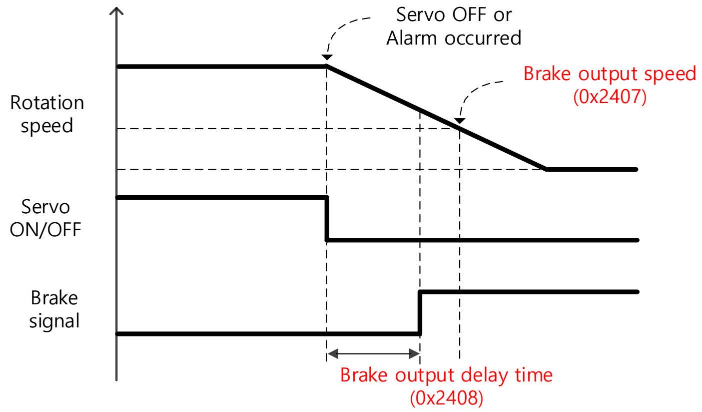
6.8 Setting the Brake Output Signal Function

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.



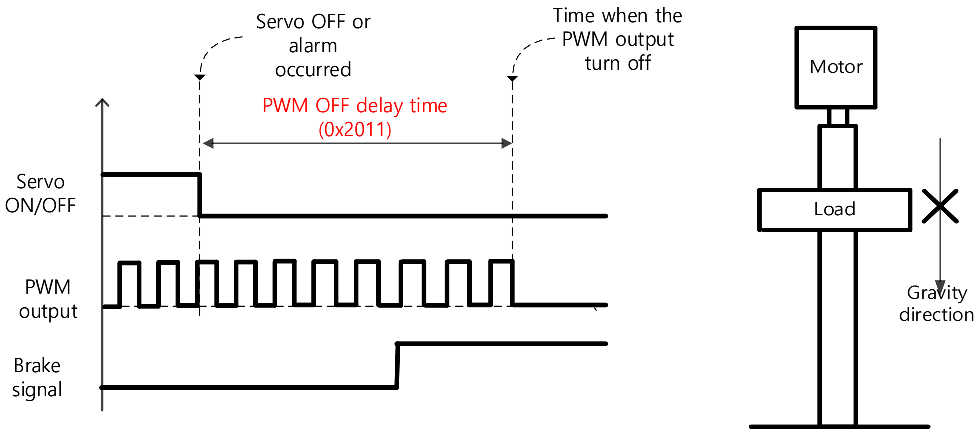
Timing diagram for signal output by the brake output speed (0x2407)



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

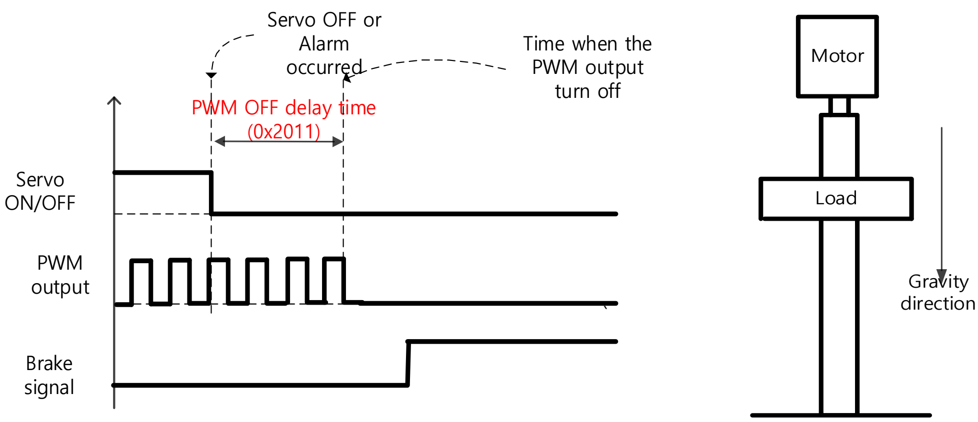
Set the time to delay until the actual PWM output goes off when the servo is turned off or a servo alarm occurs.

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

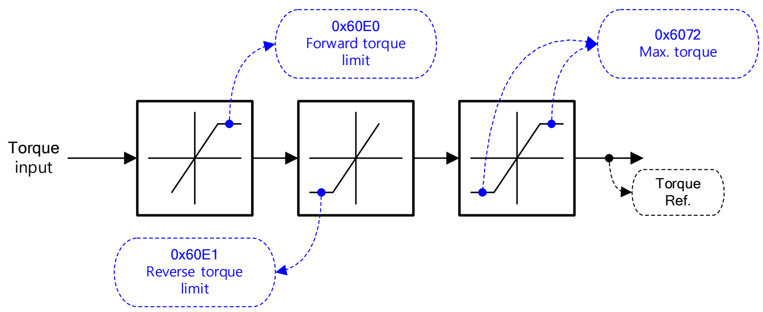
The PWM output is turned off first before the brake signal output, allowing the drop along the vertical axis due to the gravity.

6.9 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%.

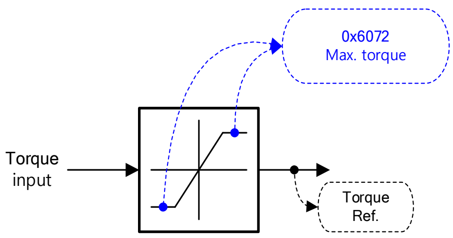
- Description of Torque Limit Function Setting (0x2110)

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

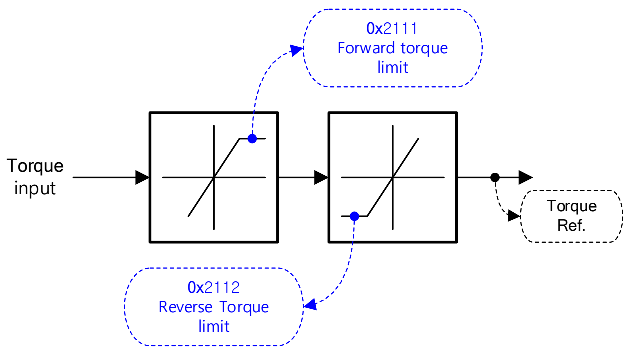
(set value 0)</td><td>

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>

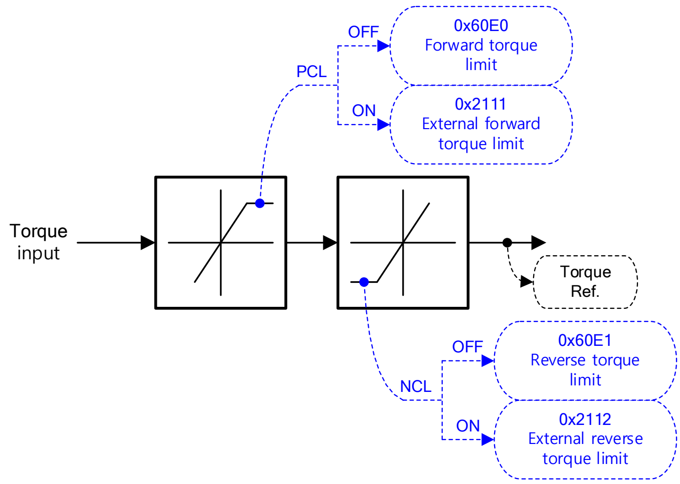
Limits the torque only by the maximum torque (0x6072) regardless of the driving direction.</td></tr>
<tr><td>External torque limit

(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>

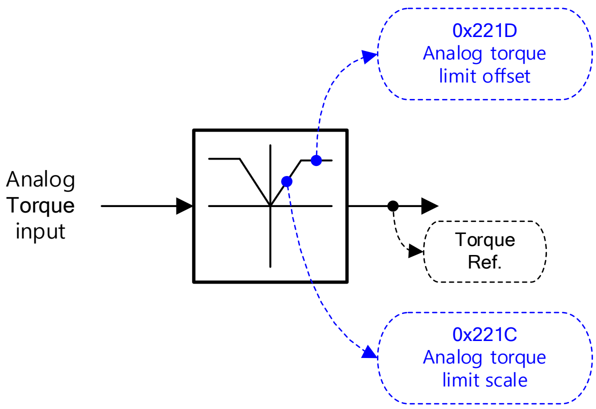
<table>
<tr>
<td>Internal and external torque limits

(set value 3)</td>
<td>


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)
</td>
</tr>
<tr>
<td>Analog torque limit

(set value 4)</td>
<td>


- Restricted by torque limited value which input as analog.

- Restricted forward direction / reverse direction torque regardless of +/ - of analog voltage.

- The torque limit against the analog input voltage is as follows.

- If the torque limit function setting (0x2110) is set to 4, the torque is limited according to the analog input voltage. The limit value is determined by the following formula.

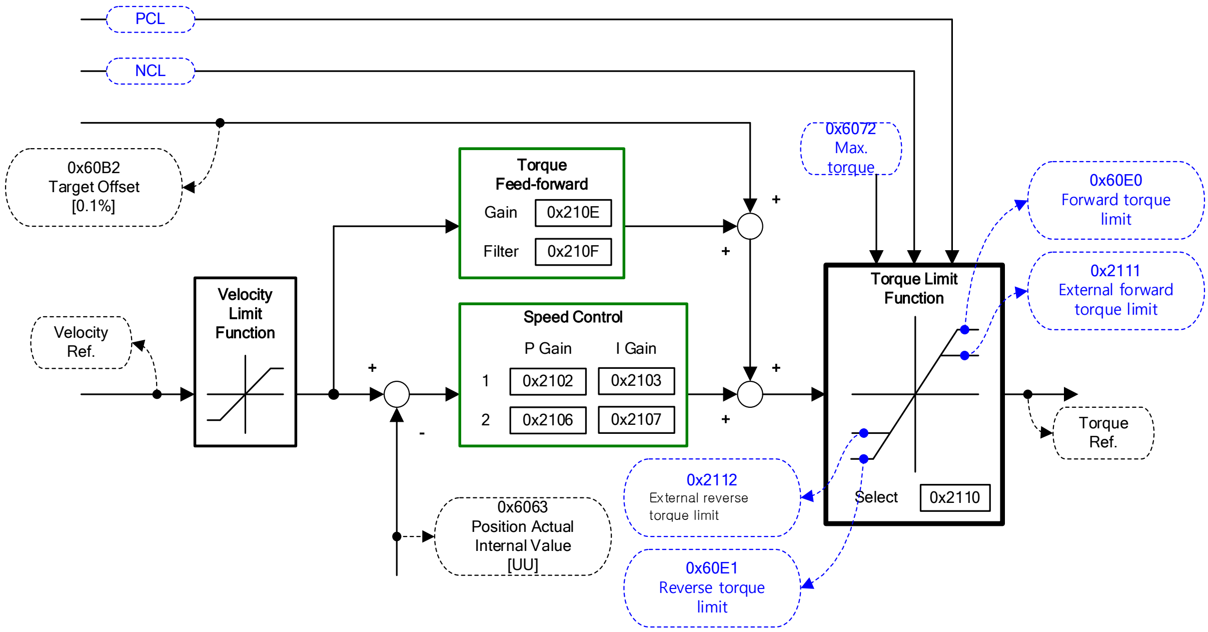
$$Torque\ \ limit\ \ value(\%) = \left(\frac{input\ \ voltage(mV) - Torque\ \ input\ \ offset(ox221C)(mV)}{1000}\right) X \frac{Torque\ \ command\ \ scale(ox221D)}{10}$$

Example 1) If the command scaler is set to 100 and the offset is set to 0

When the input voltage is -10[V]

$$Torque\ \ limit\ \ value(\%) = \left(\frac{10000(mV) - 0(mV)}{1000}\right) X \frac{100}{10} = -100[\%]$$

-Torque is limited up to 100[%]. Conversely, if the user inputs the input voltage as 10[V], the torque is limited to 100[%].
</td>
</tr>
</table>

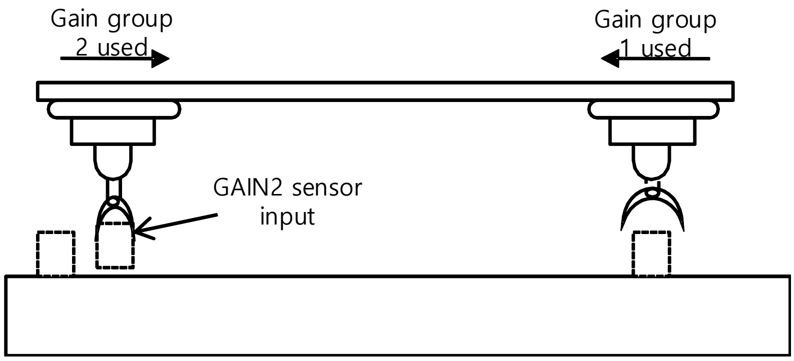


■ Related Objects

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%

6.10 Gain switching function

6.10.1 Gain group switching



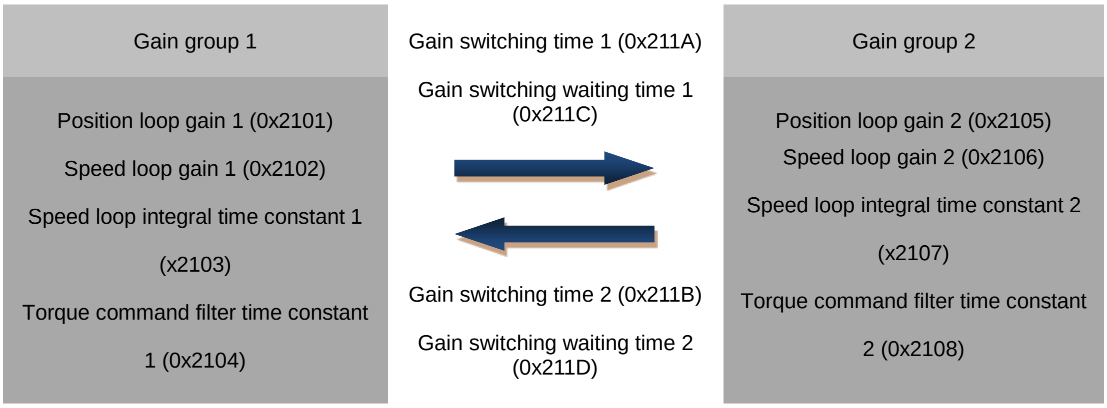
This function is to switch between the gain groups 1 and 2, as one of gain adjustment methods. You can reduce the time required for positioning through switching gains.

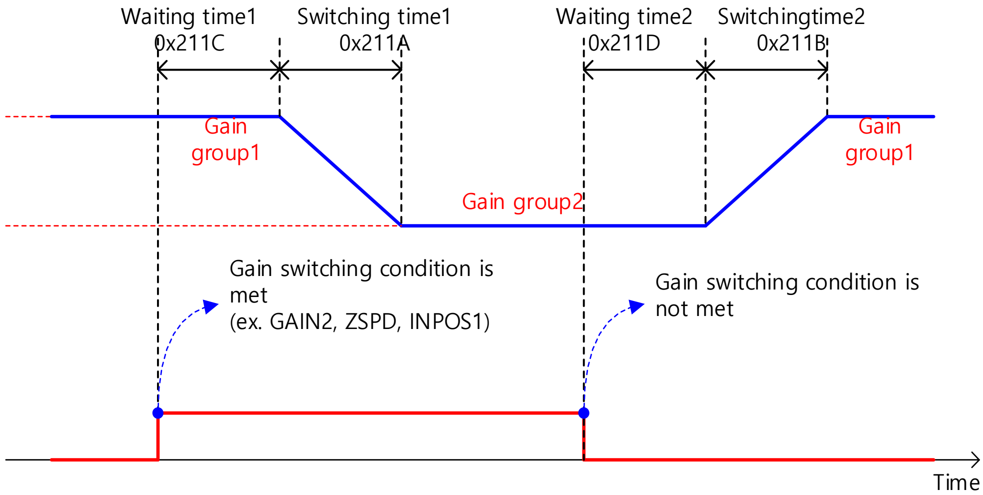
A gain group consists of position loop gain, speed loop gain, speed loop integral time constant, and torque command filter time constant. The gain switching function (0x2119) can be set as follows:

- Description of Gain Switching Function (0x2119)

Setting Value	Setting content
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

6.10.2 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.

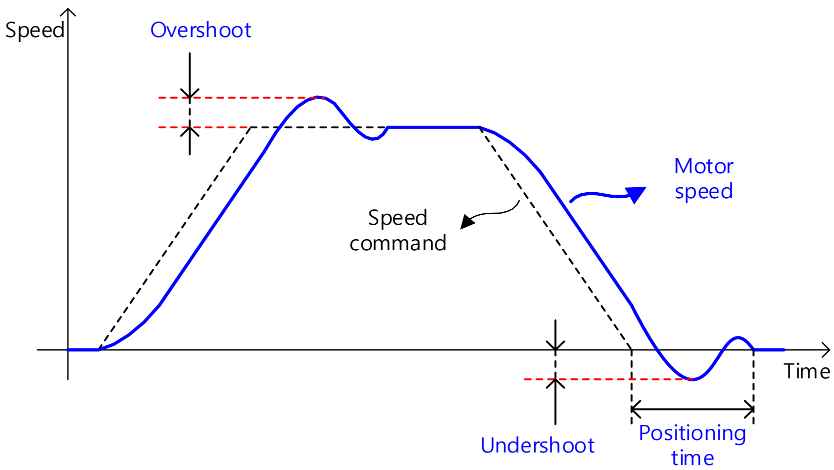
The proportional gain determines the responsiveness of the entire controller, and the integral gain is used to eliminate an error in the steady state. Too high of an integral gain will result in an overshoot during acceleration or deceleration.

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.

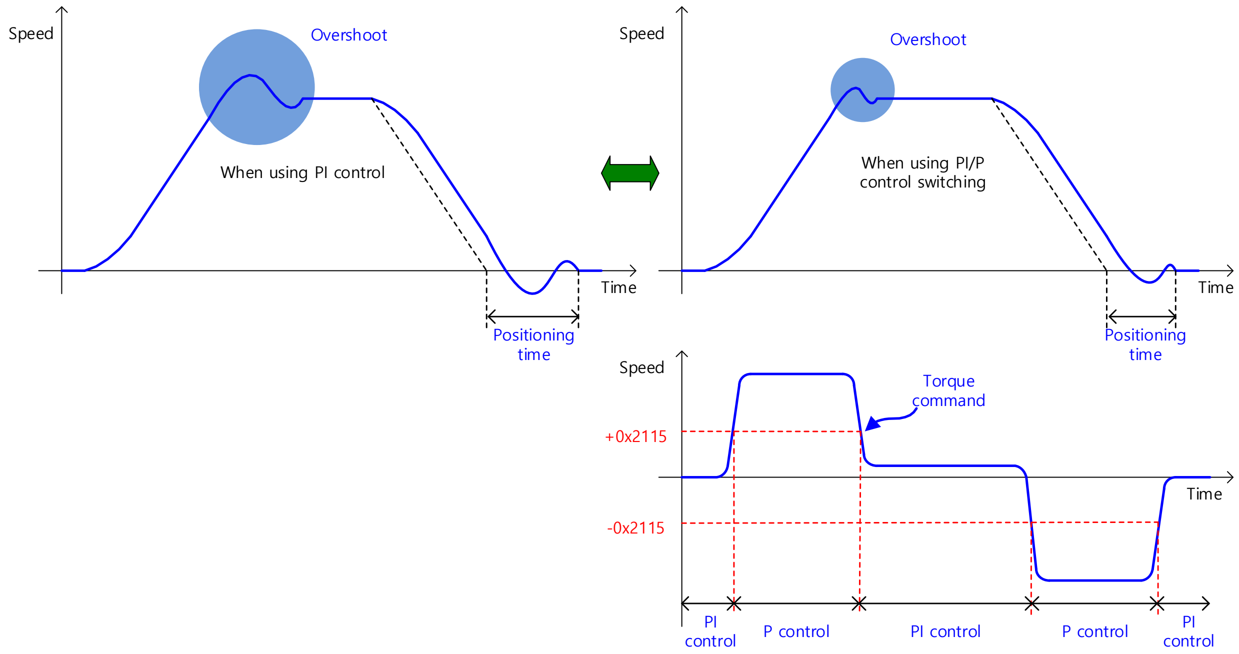
Setting Value	Setting content
0	Always PI controlled
1	Switches to the P control if the command torque is larger than the P control switching torque (0x2115).
2	Switches to the P control if the command speed is larger than the P control switching speed (0x2116).
3	Switches to the P control if the acceleration 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:



6.11 Motor Overload Protection

In order to prevent burnout due to overheating of the motor, I^2T it provides a motor overload protection function by an algorithm and a motor overload protection function through a motor thermal time constant.

6.11.1 I^2T Algorithm protection

Provides a function to cut off the motor current output when the estimated motor temperature exceeds the standard by tracking the flow of current output from the drive. Since this function is calculated based on motor parameters [0x2000] or 3^{rd} Party Motor parameters [0x2802], [0x2803] and operating time at maximum current [0x2031], it must be set accurately. (This function is available from OS Ver2.00 or higher.)

For example, assuming that the specifications of the motor are as follows,

Motor rated current: 3[A]

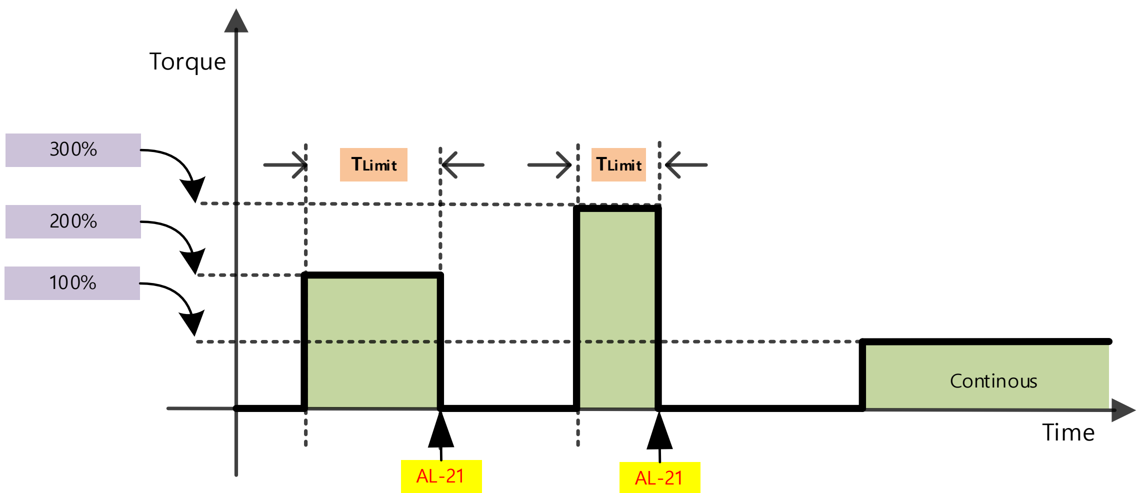
Motor maximum current: 9[A]

Operating time at maximum current: 1000[ms]

Drive output current (I_{out}): 6[A]

$$I^2T_{Limit} = ((9A)^2 - (3A)^2) \times 1000ms = 72000A^2ms$$

$$T_{LMT} = \frac{I^2T_{Limit}}{{I_{out}}^2 - (3A)^2} = \frac{72000A^2ms}{(6A)^2 - (3A)^2} = 2666ms$$



■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2000	-	Motor ID	UINT	RW	No	-
0x2031	-	Operation Time at Peak Current	UINT	RW	No	ms
0x2802	-	[3rd Party Motor] Rated Current	FP32	RW	No	Arms
0x2803	-	[3rd Party Motor] Maximum Current	FP32	RW	No	Arms

6.11.2 Protection by motor thermal time constant

Provides a function to cut off the motor current output when the temperature exceeds the standard by estimating the motor temperature based on the relationship between the winding and ambient of the motor. This function is activated when the motor thermal protection function activation [0x2034] parameter is set to 1, and it is calculated based on the motor thermal time constant [0x280D], so it must be set correctly. (This function is available from OS Ver2.00 or higher.)

The formula to calculate the motor thermal time constant is:

$$\text{Thermal time constant[sec]} = \text{Thermal resistance}\left[\frac{℃}{\text{watt}}\right] \times \text{Thermal capacitance}\left[\text{watt} * \frac{\text{sec}}{℃}\right]$$

■ Related Objects

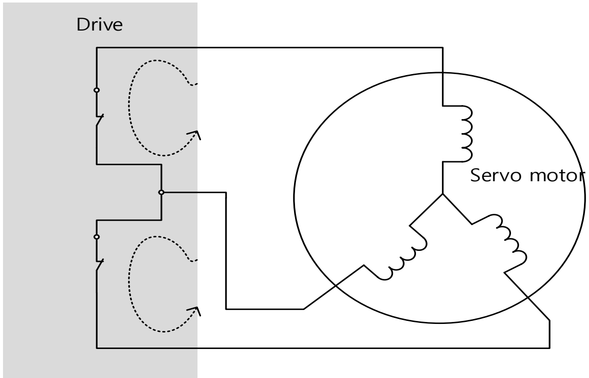
Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2034	-	Motor Thermal Protection Enable	UINT	RW	No	-
0x280D	-	[3rd Party Motor]Thermal Time Constant	FP32	RW	No	ºC /watt

6.12 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.



Precautions when using dynamic brake when main power is off, when SV_Off, protection operation (alarm occurrence, EMG stop) are as follows.

- Dynamic brake is a function for emergency stop, do not stop the motor with SV_Off signal. The built-in dynamic brake circuit may be damaged due to deterioration of internal elements.
- Do not drive the motor with an external force. The motor generates electricity by an external force, and when the dynamic brake circuit is damaged, a short-circuit current may be generated and smoke or burn may occur.
- If the dynamic brake operates while driving at rated speed, you must stop for about 10 minutes. If used under critical operating conditions, the resistor may be damaged and the dynamic brake may not operate.
- When using the dynamic brake frequently other than in an emergency, be sure to operate the dynamic brake after the servo motor stops.

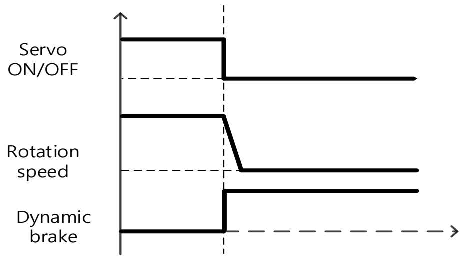
Dynamic brake operation restart time

$$Brake\ \ restart\ \ tim(min) = \frac{10[min)}{(\frac{Rated\ \ speed(rpm)}{Drving\ \ speed(rpm)})^2}$$

→Ex) n case of operation of dynamic brake during operation of rated speed 2000 [rpm] motor at 3000 [rpm]

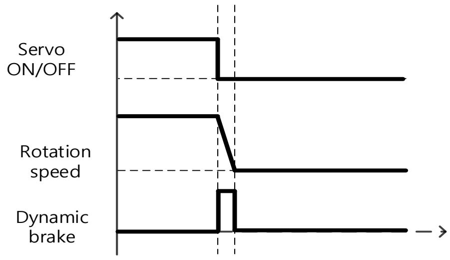
$$Brake\ \ restart\ \ tim(min) = \frac{10[min)}{(\frac{2000(rpm)}{3000(rpm)})^2}$$

Brake operation restart time [min] = 22.5min



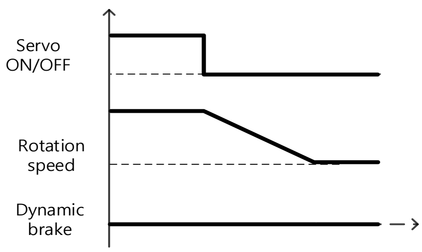
Setting value: 0

Hold the dynamic brake after stopping the motor using the brake



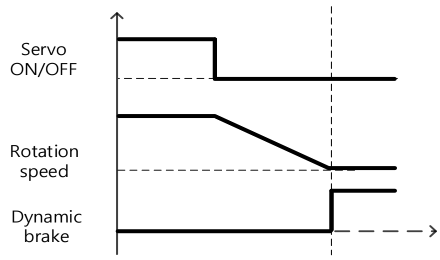
Setting value: 1

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

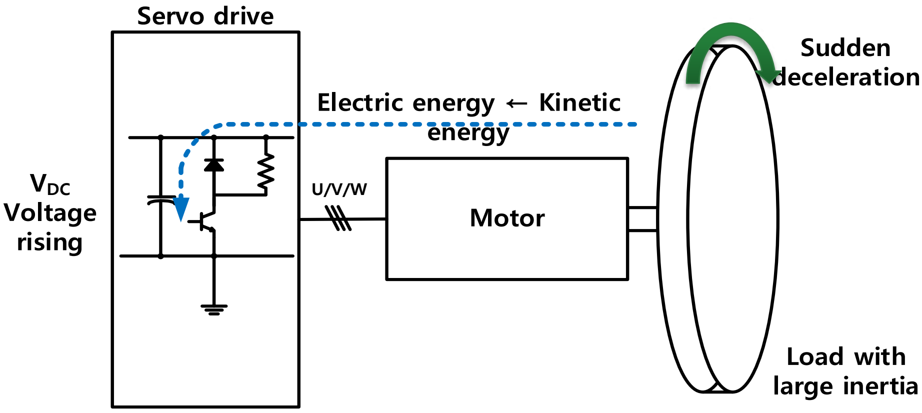
Hold the dynamic brake after free-run stop

■ 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	-

6.13 Regeneration Brake Resistor Configuration

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	-	Regenerative resistance value setting	UINT	RW	No	Ω
0x200C	-	Regenerative resistance capacity setting	UINT	RW	No	Watt
0x200D	-	Regenerative resistance maximum capacity setting	UINT	RW	No	Watt
0x200E	-	Duration Time @ Peak Power of Regeneration Brake Resistor	UINT	RW	No	ms

6.13.1 Use of Internal Regenerative Resistor

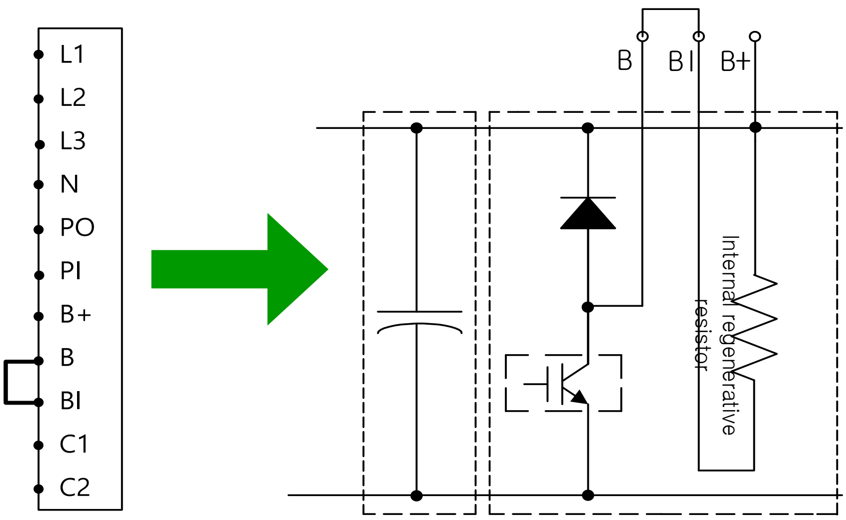
This drive essentially has internal regenerative resistor depending on its capacity. The integrated regenerative resistors depending on the drive capacity are as follows:

Voltage	Type	Resistance	Standard capacity
200[V]	L7NHA001U~L7NHA004U	100[Ω]	Built-in 50[W]
	L7NHA008U~L7NHA010U	40[Ω]	Built-in 100[W]
	L7NHA020U~L7NHA035U	13[Ω]	Built-in 150[W]
	L7NHA050U	6.8[Ω]	Built-in 120[W]
	L7NHA075U	6.8[Ω]	Built-in 120[W]
	L7NHA150U	3.3[Ω]	External 2000[W]
400[V]	L7NHB010U	100[Ω]	Built-in 100[W]
	L7NHB020U~L7NHB035U	40[Ω]	Built-in 150[W]
	L7NHB050U	27[Ω]	Built-in 120[W]
	L7NHB075U	27[Ω]	Built-in 240[W]
	L7NHB150U	13.4[Ω]	External 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, 1 kW or less).



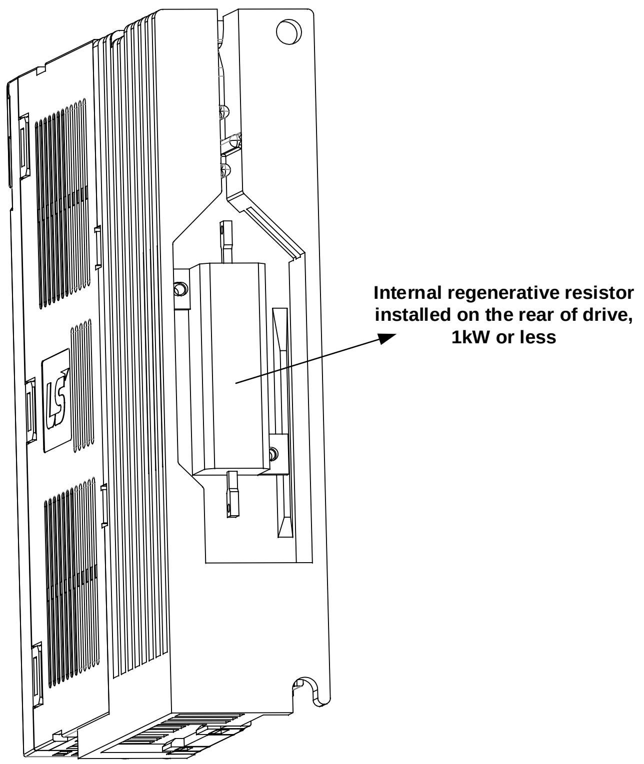
Wiring method when using internal regenerative resistor

2. Set regenerative resistance (0x2009)

   - Configure to use the regenerative resistor integrated into the drive (0x2009 = 0).
   - Basically, the resistor is attached on the rear of the drive heat sink.
   - Initial value: 0

3. Check internal regenerative resistance value and capacity

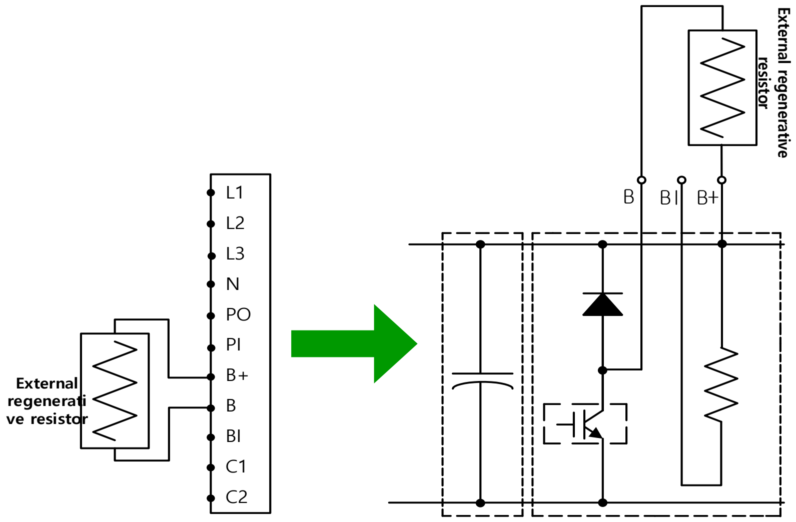
   - Check the internal regenerative resistance value (0x200B).
   - Check the regenerative resistor capacity (0x200C).
   - 1 KW or less: Basically, the resistor is installed on the rear of the drive heat sink (see the figure below).
   - 3.5 KW to 15kW: It is basically installed inside the drive.
   - 15 KW or more: Internal regenerative resistance is not installed



6.13.2 Use of External Regenerative Resistor

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

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



Wiring method when using external regenerative resistor

2. Set regenerative resistance (0x2009)
   - Configure to use the regenerative resistor installed separately outside the drive (0x2009=1).
   - Set if a regenerative resistance is connected of a capacity which is larger than that of the internal regenerative resistance.
3. Set regenerative resistance value (0x200B)
   - Configure the regenerative resistance of a resistor installed separately outside the drive in the unit of [Ω].
   - Be sure to configure it when you have set the regenerative resistor (0x2009) to 1.
   - Initial value: 0
4. Set the regenerative resistor capacity (0x200C).
   - Configure the capacity of a regenerative resistor installed separately outside the drive in the unit of [W].
   - Be sure to configure it when you have set the regenerative resistor (0x2009) to 1.
   - Initial value: 0
5. Set the maximum capacity and allowed time of the regenerative resistance (0x200D, 0x200E)
   - Set the maximum capacity and use time at the capacity by using the data sheet of the externally installed regenerative resistance
   - If there are no specific values, set the maximum capacity and allowed time to 5 times the regenerative resistance capacity setting (0x200C) and 5000[ms], respectively (It may differ according to general regenerative resistance specification or individual resistors).

- Be sure to configure it when you have set the regenerative resistor (0x2009) to 1.

LS ELECTRIC provides the following regenerative resistors as options for the purpose of external regenerative resistor (see the specifications as well) R_t: composite resistance value

Voltage	Drive capacity	Built-in		External		
		Resistance	Standard capacity	Resistance	Resistance capacity(option)	Product name
200[V]	100W ~ 400W	100	50 Ω	50 Ω	140[W]	APCS-140R50 (1P)
	800W ~ 1KW	40	100 Ω	30 Ω	300[W]	APCS-300R30 (1P)
	2kW	13	150 Ω	30 Ω R_t :15 Ω	600[W]*2P	APC-600R30 (2P)
	3.5KW	13	150 Ω	30 Ω R_t :10 Ω	600[W]*3P	APC-600R30 (3P)
	5kW	6.8	120 Ω	28 Ω R_t :7 Ω	600[W]*4P	APC-600R28 (4P)
	7.5kW	6.8	120 Ω	28 Ω R_t : 7 Ω	600[W]*4P	APC-600R28 (4P)
	15kW	-	-	3.3 Ω	2000[W]	APCS-2000R3R3 (1P)
400[V]	1KW	100	100 Ω	82 Ω	300[W]	APCS-300R82 (1P)
	2KW ~ 3.5KW	40	150 Ω	75 Ω R_t :37.5 Ω	600[W]*2P	APCS-600R75 (2P)
	5KW	27	120 Ω	75 Ω R_t :25 Ω	600[W]*3P	APCS-600R75 (3P)
	7.5KW	27	240 Ω	75 Ω R_t :25 Ω	600[W]*3P	APCS-600R75 (3P)
	15KW	-	-	13.4 Ω	2000[W]	APCS-2000R13R4 (1P)

6.13.3 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.

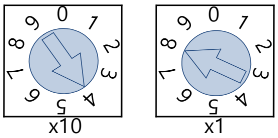
When you intend to set the derating factor to 100% or higher, be sure to fully consider the heat radiation condition of the drive installed.

6.14 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."

7. 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.

7.1 Safety standard products

The standard of safety function is as follows.

- EN ISO 13849-1 : Category 3, PL Class d
- EN 61800-5-2 (2007) : SIL2 (EN 60204-1, Stop Category 3)
- PFH : 2.12 E-08
- DC avg – 97.48%
- MTTFd – 70.08 year (High)

⚠Cautions
▪ 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.

7.2 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 status	Normal condition	STO status	STO status	STO Status

■ Electrical characteristics

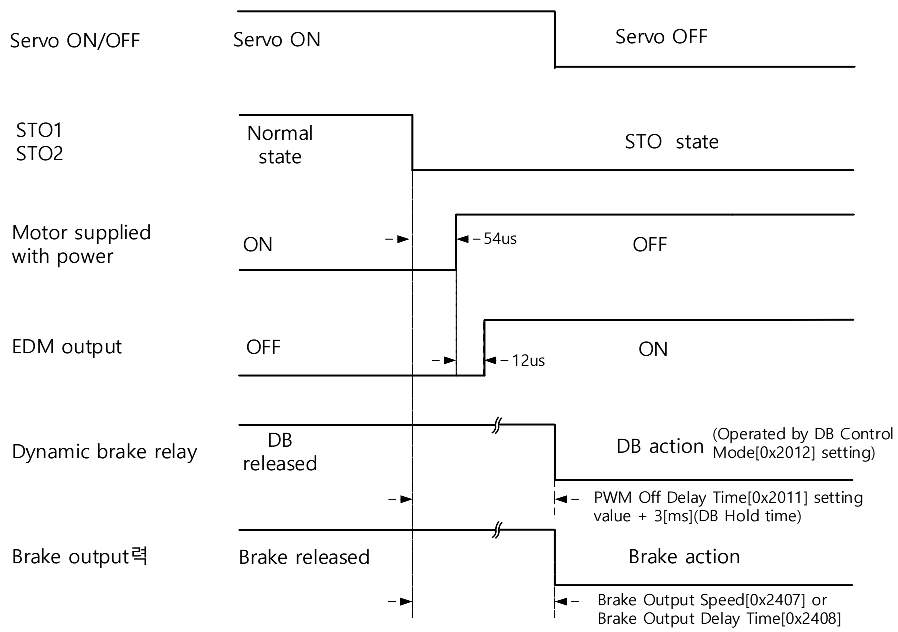
- STO1, STO2

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

- EDM

Item	Characteristic
Maximum permissible voltage	DC 30V
Max. current	DC 120mA
Maximum delay time	1ms or less

■ Timing diagram for STO operation

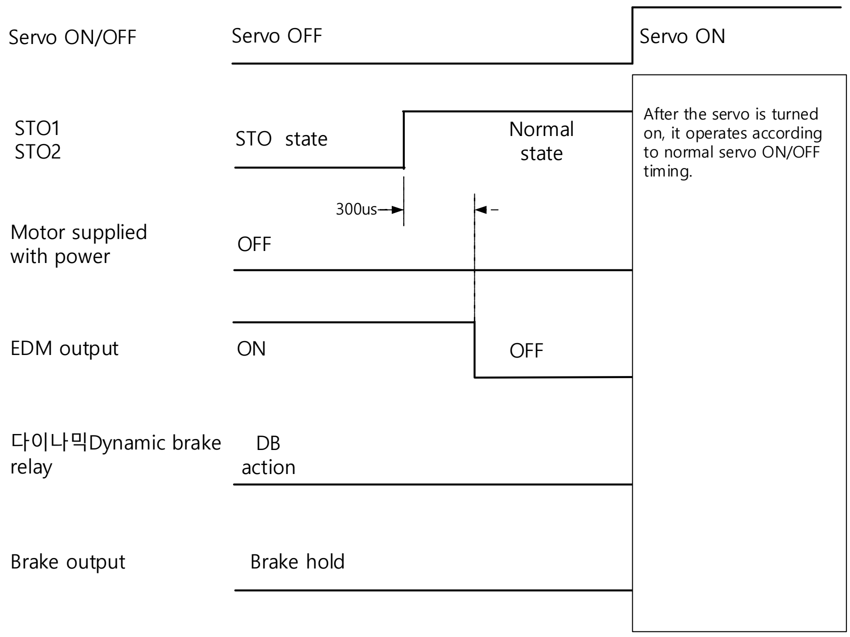


Note1) If at least one of STO1 and 2 is turned off, the drive state is switched to the STO state.

Note2) 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



Note1) 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.

Note2) 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.

7.3 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

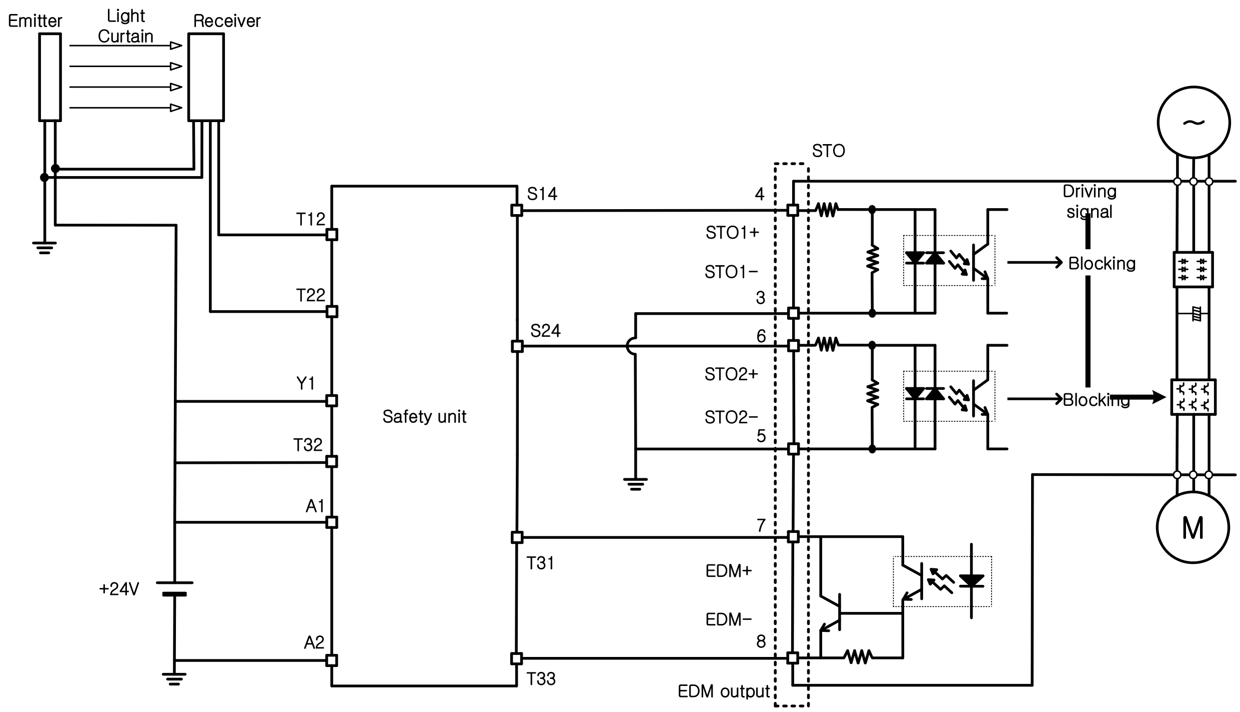
You can detect failure of the safety input circuit and the EDM output circuit by monitoring the following 4 signal states from the external device.

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

7.4 Example of Using Safety Function



7.5 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:

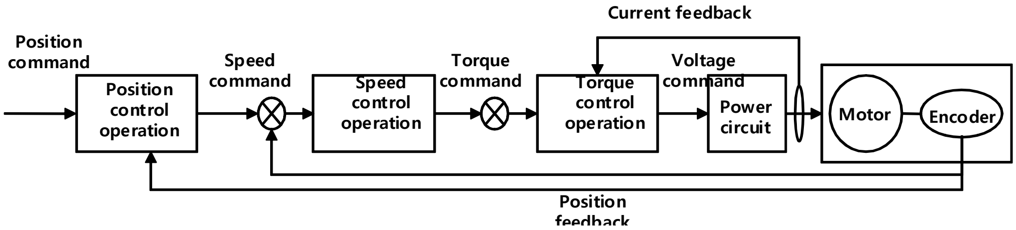
- When STO1 and STO2 signals are turned OFF, check if the drive is in STO status (Bit 31 of digital input (0x60FD) is 1).
- Make sure that the EDM signal is off during general operation by checking the input indicator for feedback circuit of the connected device.

7.6 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.

8. 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.

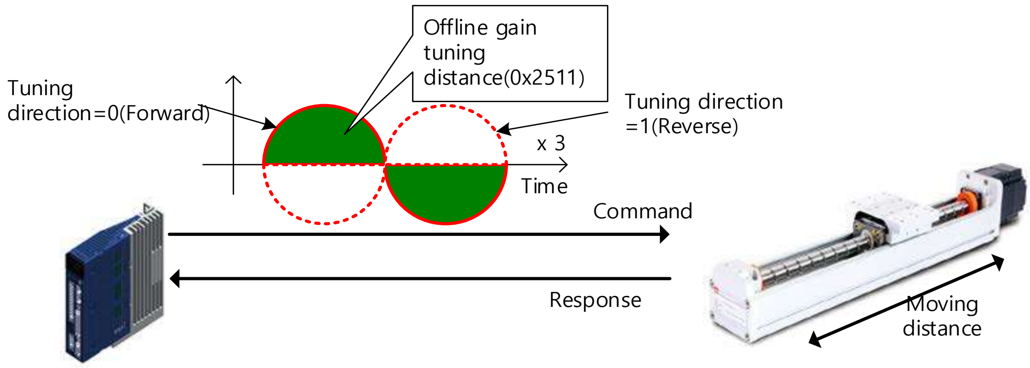
8.1 Off-line Auto Gain Tuning

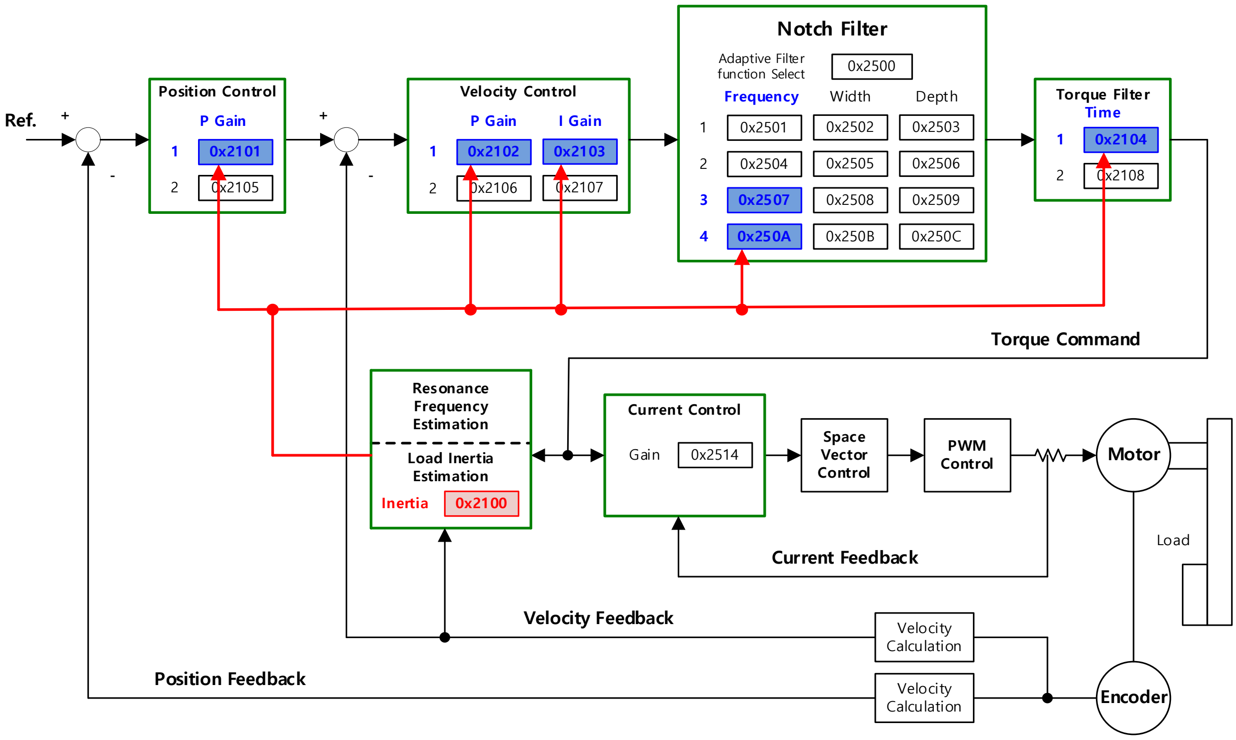
Use the command generated by the drive itself to automatically set the gain according to the load condition. The following gain-related parameters will be changed:

- 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	-

8.2 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 regularly and changed gain is stored in EEPROM every two minutes.

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

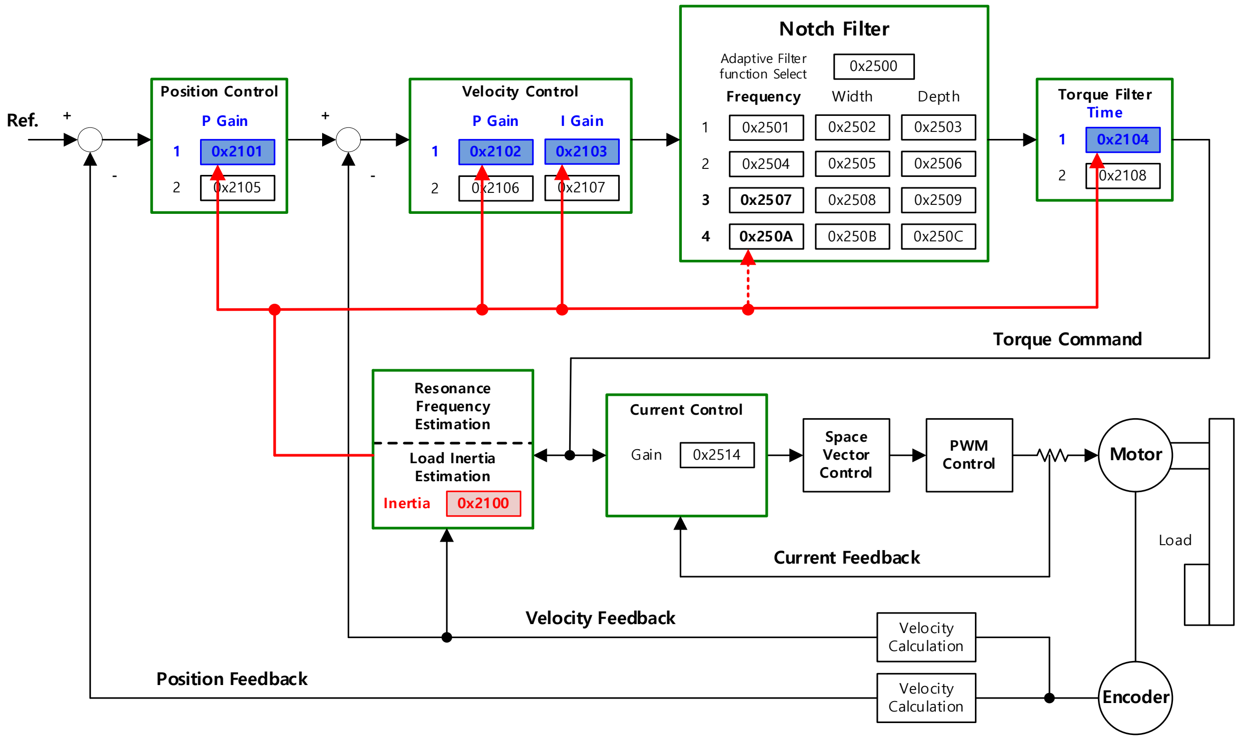
In the following cases, it may be inaccurate to estimate the inertia when online auto tuning.

- 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.

■ Parameters that change after tuning

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



■ **On-line Gain Tuning Mode object**

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x250D	-	On-line Gain Tuning Mode	UINT	RW	No	-

Setting Value	Setting content
0	On-line Gain Tuning not used
1	On-line Gain Tuning used

The factory setting is 0, and it is selected when online auto tuning is not possible or when the gain values are already known. If the setting value is set to 1, online auto tuning is performed. If the change in load inertia is small and the inertia ratio is not known, please select it. Estimated gain values during online auto tuning are saved in EEPROM approximately every 2 minutes.

■ **System rigidity setting during online auto tuning**

Index	Sub Index	Name	Variable type	Access ibility	PDO Assign ment	Unit
0x250E	-	System Rigidity for Gain Tuning	UINT	RW	No	-

There are 20 system rigidity settings for online auto tuning as follows.

The gains (Position Loop Gain 1, Velocity Loop Gain 2, Velocity Loop Integral Time Constant 1, and Torque Command Filter Time Constant 1) are automatically determined when the system stiffness setpoint is selected. The factory setting for the system rigidity setting is 5.

If the system stiffness setting value is increased, the gains become higher and the positioning time becomes shorter. However, if the set value is too high, vibration may occur depending on the mechanical configuration, so set the system rigidity value from a low value to a high value within a range that does not cause vibration.

[0x250E] System rigidity	1	2	3	4	5	6	7	8	9	10
[0x2101] position loop gain 1	2	5	10	15	22	30	40	50	60	73
[0x2102] speed loop gain 1	3	8	15	23	33	45	60	75	90	110
[0x2103] speed loop integral time constant 1	190	70	50	40	30	22	15	13	10	9
[0x2104] torque command filter time constant 1	80	30	20	10	8	6	4	3	3	2

[0x250E] System rigidity	11	12	13	14	15	16	17	18	19	20
[0x2101] position loop gain 1	87	100	117	133	160	173	200	220	240	267
[0x2102] speed loop gain 1	130	150	175	200	240	260	300	330	360	400
[0x2103] speed loop integral time constant 1	8	7	6	6	5	5	4	4	3	3
[0x2104] torque command filter time constant 1	2	2	2	2	1	1	1	1	1	1

■ **Real-time gain tuning reflection speed during online auto tuning**

Index	Sub Index	Name	Variable type	Access ibility	PDO Assign ment	Unit
0x250F	-	On-line Tuning Adaptation Speed	UINT	RW	No	-

Set the speed to reflect the gain change during online auto tuning. The higher the set value, the faster the gain change is reflected.

8.3 Manual Gain Tuning

8.3.1 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

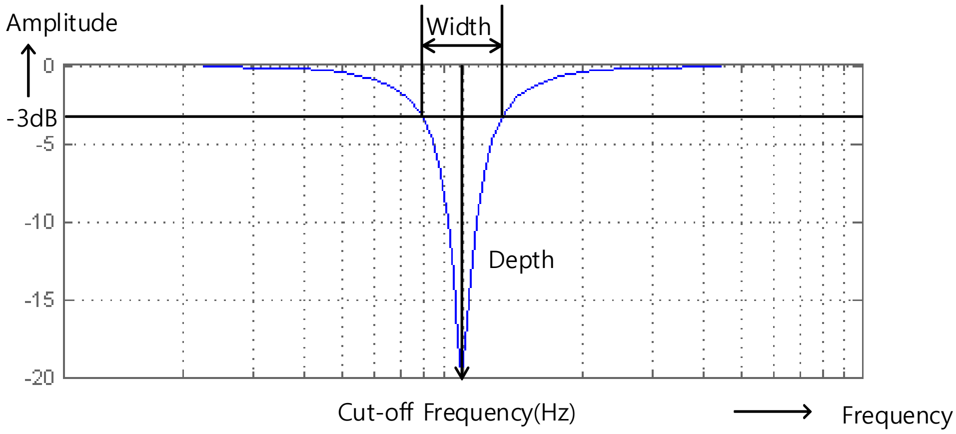
- You can smooth a position command.

8.4 Vibration Control

8.4.1 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).



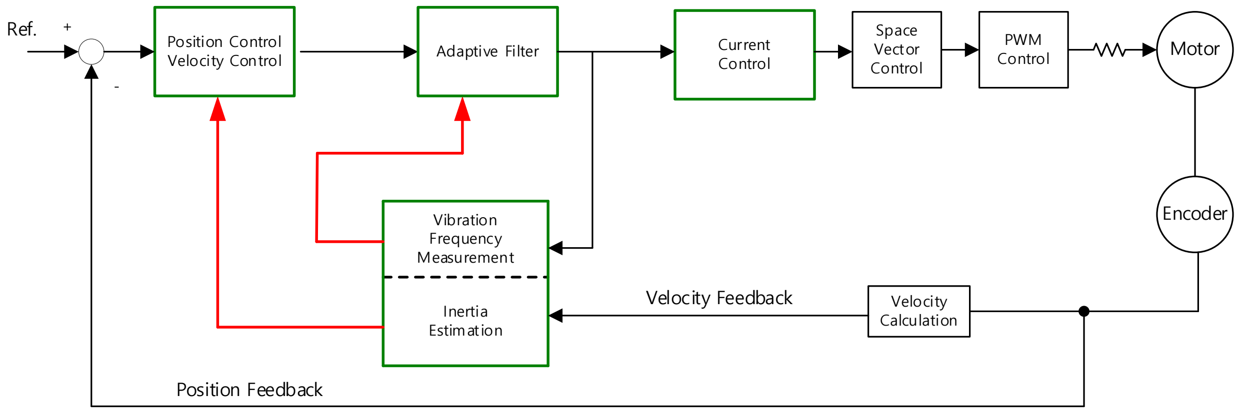
■ Related Objects

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	-

8.4.2 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)

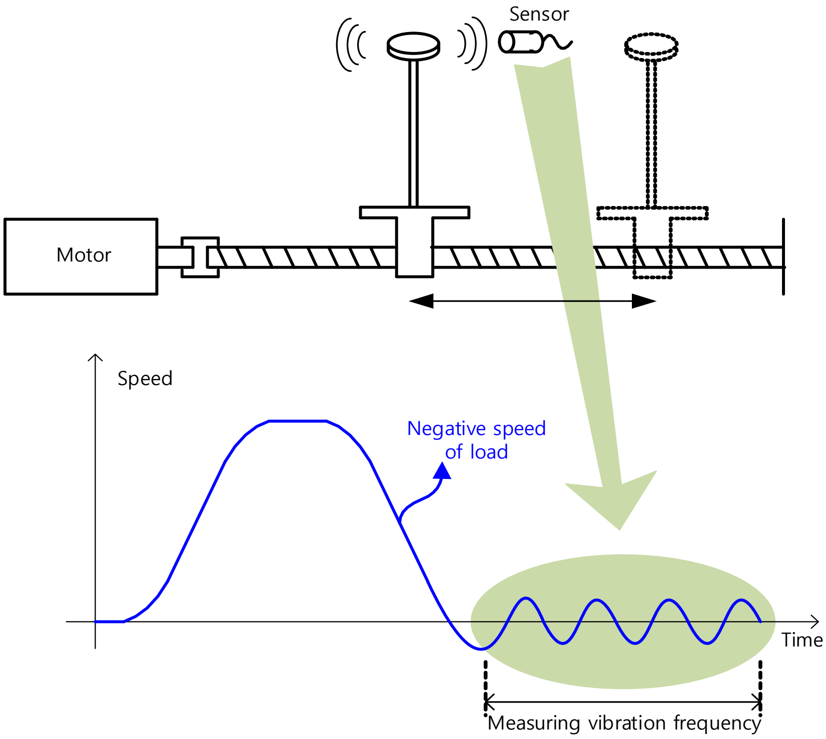
Setting Value	Setting content
0	Adaptive filter is not used.
1	Only one adaptive filter is used. You can check the settings configured automatically in the Notch Filter 4 Settings (0x250A and 0x250B). If an arbitrary value is set for notch filter 3, automatic setting is not possible, so if you want automatic setting, you must initialize notch filter 3 first.
2	Only two adaptive filters are used. You can check the settings configured automatically in the Notch Filter 3 (0x2507, 0x2508, and 0x2509) and 4 Settings (0x250A, 0x250B, 0x250C). If notch filter 3 (or 4) is set to an arbitrary value, it is automatically set to notch filter 4 (or 3), if notch filter 3 and notch filter 4 are both set to arbitrary values, the set values are maintained. If notch filter 3 and notch filter 4 are in the initialization state, both can be set automatically.
3	Reserved
4	Settings of Notch Filter 3 (0x2507, 0x2508) and Notch Filter 4 (0x250A, 0x250B, 0x250C) are initialized
5	Reserved

8.4.3 Vibration Control (Damping) Filter

The vibration control (damping) filter is a function that can reduce the vibration generated from the load end.

Measuring vibration frequency occurring in the load through 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. Regarding 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.



■ Related Objects

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 content
0	No Vibration Control (Damping) Filter
1	Applying Vibration control (damping) filter 1,2
2	Apply vibration control (damping) filters 1 and 2 according to LVSF1 and LVSF2 inputs

9. 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	Code	Contents
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

9.1 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

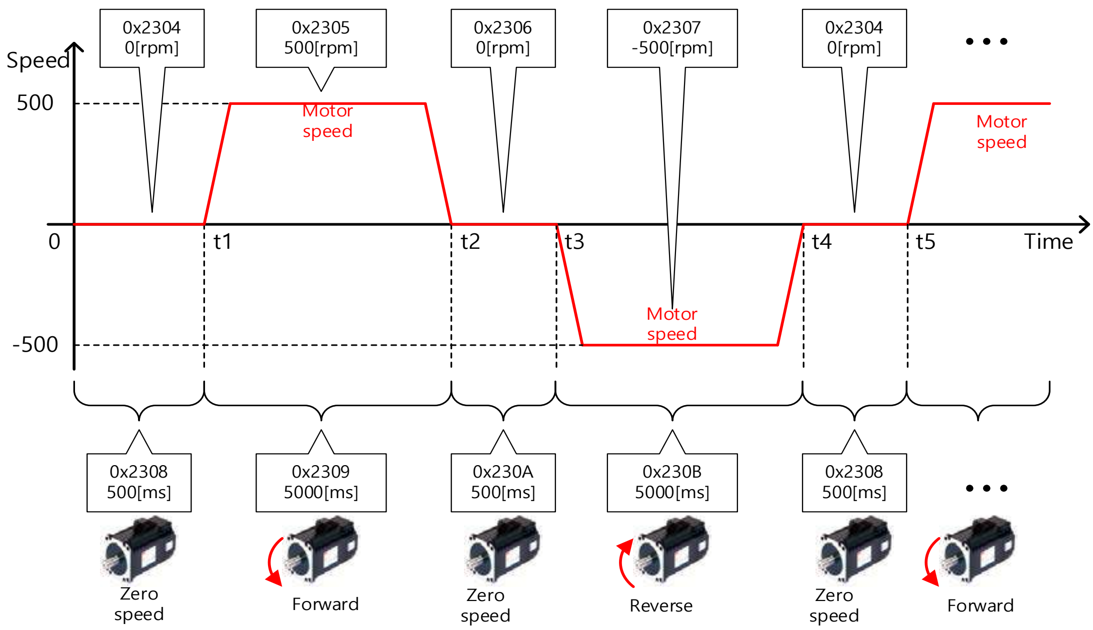
Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2300	-	Jog Operation speed	INT	RW	No	rpm
0x2301	-	Speed Command Acceleration Time	UINT	RW	No	ms
0x2302	-	Speed Command Deceleration Time	UINT	RW	No	ms
0x2303	-	Speed Command S-curve Time	UINT	RW	No	ms

9.2 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;
- Speed and time settings should be set in consideration of the state of the instrument and its range of motion.



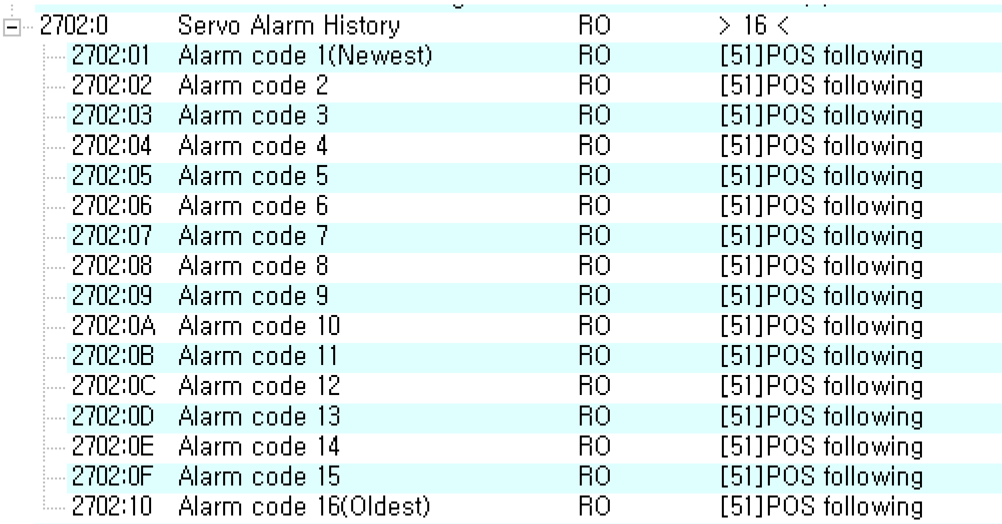
■ Related Objects

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

9.3 Alarm history reset

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	-	-	-	-
	1	Alarm code 1(Newest)	STRING	RO	No	-
	2	Alarm code 2	STRING	RO	No	-
	3	Alarm code 3	STRING	RO	No	-
	4	Alarm code 4	STRING	RO	No	-
	5	Alarm code 5	STRING	RO	No	-
	6	Alarm code 6	STRING	RO	No	-
	7	Alarm code 7	STRING	RO	No	-
	8	Alarm code 8	STRING	RO	No	-
	9	Alarm code 9	STRING	RO	No	-
	10	Alarm code 10	STRING	RO	No	-
	11	Alarm code 11	STRING	RO	No	-
	12	Alarm code 12	STRING	RO	No	-
	13	Alarm code 13	STRING	RO	No	-
	14	Alarm code 14	STRING	RO	No	-
	15	Alarm code 15	STRING	RO	No	-
	16	Alarm code 16(oldest)	STRING	RO	No	-

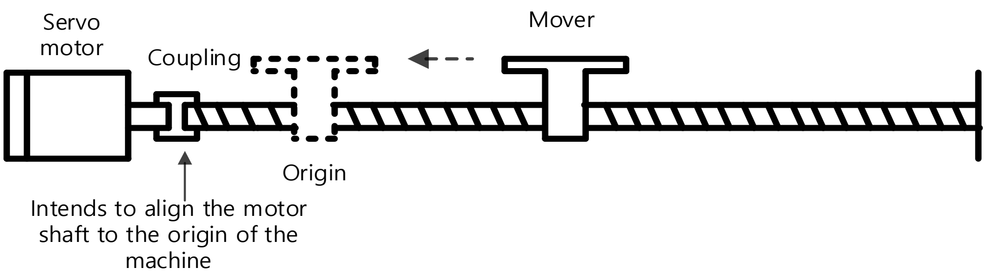
9.4 Index Pulse Search

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 Safe Torque Off (STO) connector is installed
- 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	INT	RW	No	rpm

9.5 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;
- Encoder low voltage alarm occurs
- If you want to set the multi-turn data of an absolute value 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 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. :

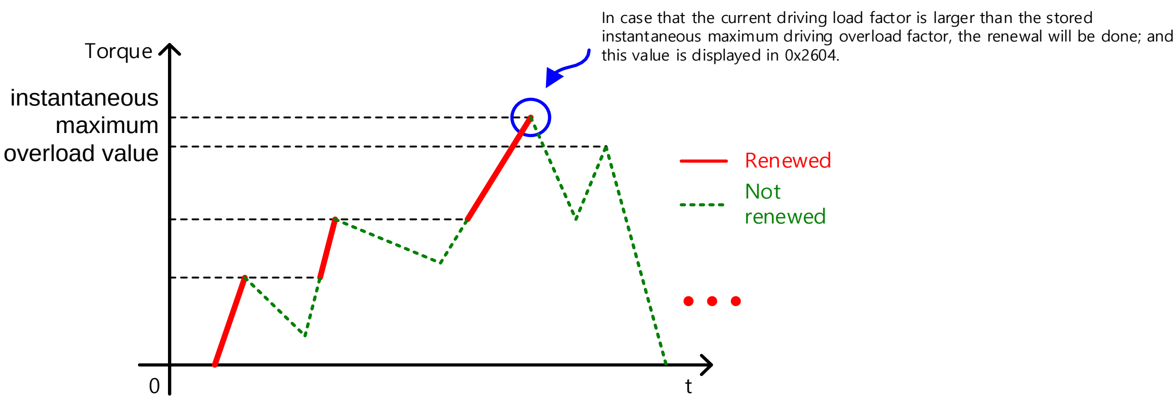
■ Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO Assignment	Unit
0x2005	-	Absolute encoder setting	UINT	RW	No	-
0x260A	-	MultiTurn Data	DINT	RO	Yes	rev

9.6 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 seconds, 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	INT	RO	Yes	0.1%

9.7 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.

■ Related Objects

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

9.8 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.

For software reset method, refer to「9. Procedure function」.

9.9 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	UINT	RW	No	nm
0x201A	-	Commutation Method	UINT	RW	No	-
0x201B	-	Commutation Current	UINT	RW	No	0.1%
0x201C	-	Commutation Time	UINT	RW	No	ms

10. Object Dictionary

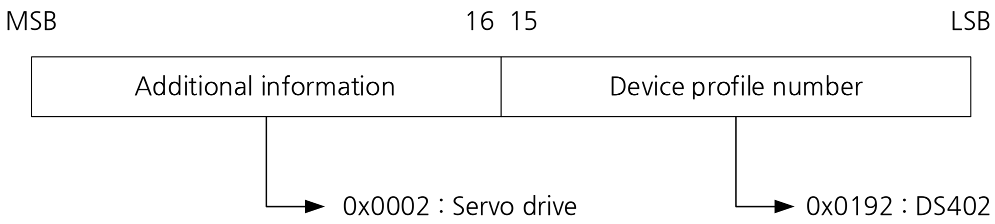
Object is a data structure including parameters, state variables, run commands (procedures), and etc. within a drive.

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.

10.1 General Objects

0x1000	Device type						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 content
0	0 : No Error
	1: Error occurs.
1 to 7	Reserved

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

Indicate the name of the device.

0x1009	Hardware version						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No

This represents the hardware version of device.

0x100A	Software version						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No

This represents the software version of device.

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

Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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
ASCII code	0x65	0x76	0x61	0x73

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

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

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

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

0x1011	Restore Default Parameters						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
USINT	-	4	-	RO	No	-	No
SubIndex 1		Restore all parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 2		Restore communication parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 3		Restore CiA402 parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 4		Restore drive specific parameters					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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
ASCII code	0x64	0x61	0x6F	0x6C

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

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

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

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

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

0x1018	Identity Object						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
USINT	-	4	-	RO	No	-	No
SubIndex 1		Vendor ID					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0x00007595	-	RO	No	-	No
SubIndex 2		Product code					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0x00010001	-	RO	No	-	No
SubIndex 3		Revision number					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	-	-	RO	No	-	No
Serial number		Serial Number					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60710010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x607A0020	-	RW	No	PREOP	Yes
Serial number		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60600008	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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

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

Bits 8 ~ 15: SubIndex of objects to be mapped

Bits 16 ~ 31: Index of objects to be mapped

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

Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60FF0020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
Serial number		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save

UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60710010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
Serial number		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	0 to 10	10	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60770010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
Serial number		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60F40020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					

Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60610008	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x26010010	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x26000010	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	0 to 10	6	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60F40020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save

UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes

SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibil	PDO	Change	Save

				ity	allocation	attribute	
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	4	-	RO	No	-	No
SubIndex 1		Communication type SM0					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
USINT	-	1	-	RO	No	-	No
SubIndex 2		Communication type SM1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
USINT	-	2	-	RO	No	-	No
SubIndex 3		Communication type SM2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
USINT	-	3	-	RO	No	-	No
SubIndex 4		Communication type SM3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	0	-	RO	No	-	No

0x1C11	Sync Manager 1 PDO Assignment						
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of object assigned to PDO					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of object assigned to PDO					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	-	0x4007	-	RO	No	-	No

SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 11		Cycle exceeded counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	-	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
BOOL	-	0	-	RO	No	-	No

0x1C33	Input Sync Manager Parameter						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save

UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	ns	RO	No	-	No
SubIndex 11		Cycle exceeded counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	-	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
BOOL	-	0	-	RO	No	-	No

10.2 Manufacturer Specific Objects

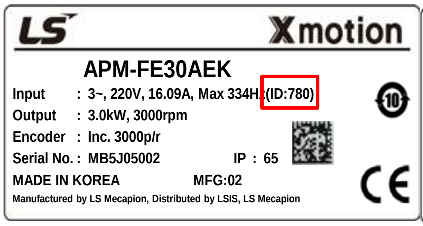
● Basic Setting(0x2000~)

0x2000	Motor ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 9999	999 or 998	-	RW	No	Power recycling	Yes

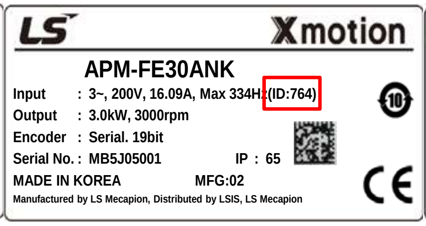
Set the motor ID. For the serial encoder provided by LS ELECTRIC, it is automatically set. You can check the automatically set IDs.

Encoder type	Motor ID entry method
Incremental	Direct entry
Absolute Singleturn	Direct entry
Absolute Multiturn	direct entry

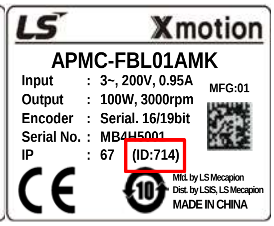
When using our company's motor, it should be read automatically according to the type of attached encoder or the user should directly write the Motor ID in the parameter. The Motor ID is written on a sticker attached to the side of the motor.



Incremental



Absolute Singleturn



Absolute Multiturn

Please be careful when using this parameter as it is applied after ID registration and power is applied again. When combining another company's motor, enter 9999 and set it as a 3rd party.

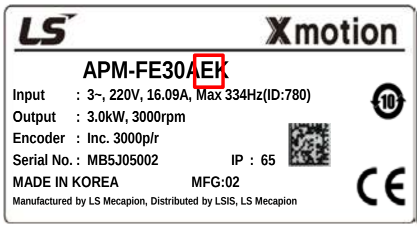
0x2001	Encoder type						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 99	4	-	RW	No	Power recycling	Yes

This parameter sets the encoder type. Refer to the table below and set it correctly. However, the serial encoders supplied by our company (3, 4 based on the table below) are automatically recognized and set regardless of this setting value. At this time, you can check the type of automatically recognized encoder.

This is a parameter to set the encoder type. When using multi-turn encoder’s No. 3 and 4, the parameter is automatically recognized, so no separate setting is required.

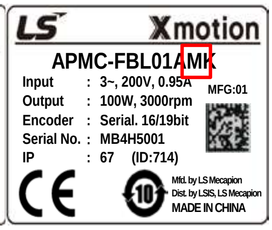
Setting Value	Encoder type	Setting Value	Encoder type
0	Quadrature(incremental, A lead B)	7	Sinusoidal(1Vpp)
1	Quadrature(incremental, B lead A)	8	Analog Hall
2	BiSS serial(Absolute Singleturn only)	10	Biss_General
3	BiSS Serial Absolute (Absolute Multiturn 12bit)	11	PANASONIC singleturn
4	BiSS Serial Absolute (Absolute Multiturn 12bit)	12	PANASONIC multiturn
5	TAMAGAWA singleturn	13	ENDAT multiturn
6	TAMAGAWA multiturn	14	PANASONIC A6 Series

When using an incremental encoder or an absolute value single-turn encoder, it must be written directly. The encoder type can be checked on the nameplate attached to the motor. Please refer to the servo motor product type in『1.2 Product Specifications』.



Incremental

Absolute Singleturn

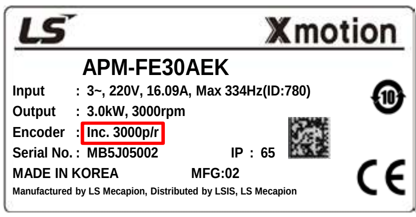


Absolute Multiturn

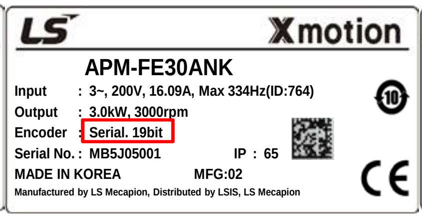
For example, if C is listed, it is an incremental encoder and input 0. If N is entered, please input absolute value singleton 2. Since M is an absolute multiturn, 4 is automatically entered.

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

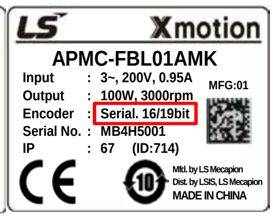
This parameter sets the resolution (resolution) of the encoder. Set the encoder resolution in the unit of pulse (count) based on a multiple of 4. However, the serial encoder provided by LS ELECTRIC is automatically recognized and configured regardless of these settings. However, incremental encoders or absolute single-turn encoders must be entered directly.



Incremental



Absolute Singleturn



Absolute Multiturn

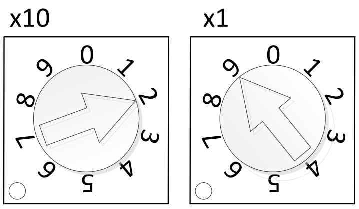
The encoder resolution is also written on the sticker on the side of the motor. Please refer to the picture above.

Encoder type	Entry method	Entry method example
Incremental	Direct entry	Enter 8192 for 2048p/r on the sticker on the side of the motor
Absolute Singleturn	Direct entry	Enter 524288 in case of 19 [bit] on the sticker on the side of the motor
Absolute Multiturn	Direct entry	Automatic recognition, no input required It can be confirmed that 524288 is automatically entered

0x2003	Node ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 99	-	-	RO	No	Power recycling	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.

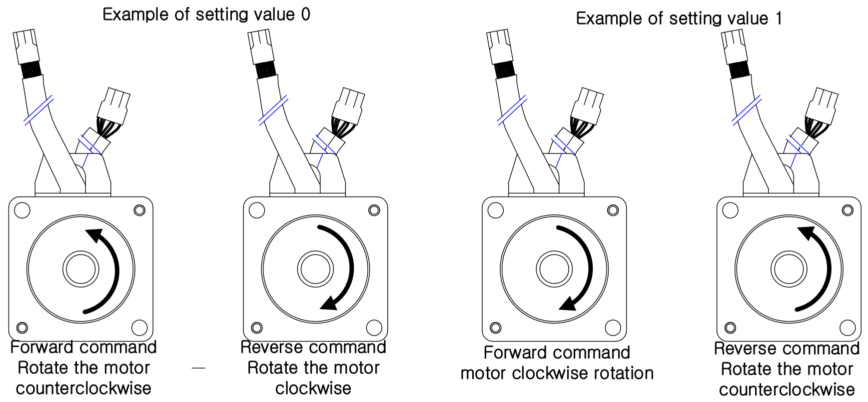
Ex) example with node ID set to 29



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

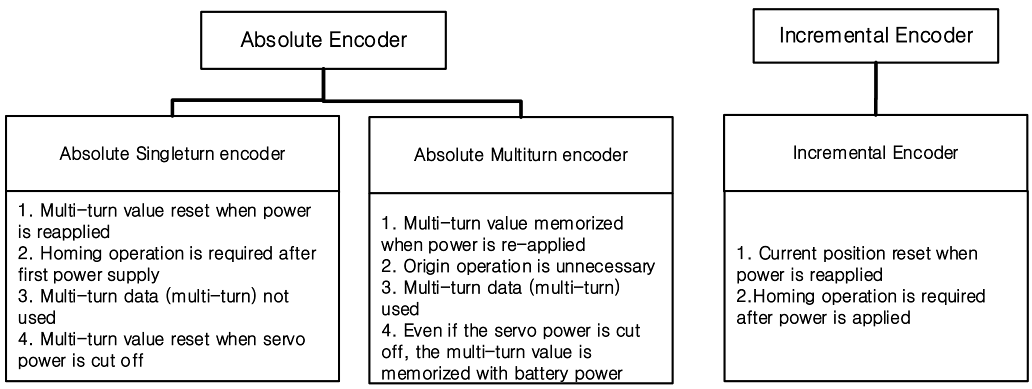
Set the rotation direction of the motor. You can change the rotation direction with this setting when the direction is changed between positive and negative relative to the user at the final apparatus section.

Setting Value	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.



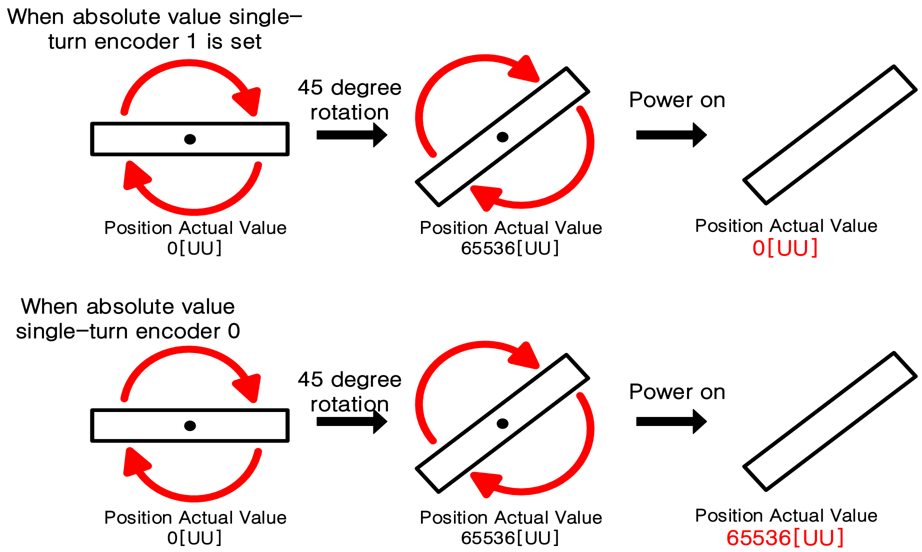
0x2005	Absolute Encoder Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 2	1	-	RW	No	Power recycling	Yes

In case of using absolute value multi-turn encoder, this parameter determines whether to use multi-turn data value.



Setting Value	Description
0	It uses the multi-turn data (multi-turn) of the absolute value multi-turn encoder.
1	The multi-turn data (multi-turn) of the absolute multi-turn encoder is not used.
2	When power is applied, the single-turn value of the encoder is used as the current position value.

If the parameter is set to 0, the multi-turn value and current position value are maintained even if the power is turned off and then restarted. However, if set to 1, both the multi-turn value and the current position are initialized when the power is re-applied.



When using an absolute value single-turn encoder, if the setting is set to 1, both the multi-turn value and the current position are initialized when the power is turned off and on. If the set value is set to 0 or 2, multi-turn data is initialized to 0 [revolution] when power is re-applied, but the current position is indicated by bringing the single-turn value of the encoder as the current position value.

0x2006	Main Power Fail Check Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 255	0	-	RW	No	Always	Yes

Set the input mode of the main power and the processing method in case of phase loss.

7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
X	X	X	X	X	X	X	X

Value	Setting content
0	When the main power phase is missing, handles AL-42
1	When the main power phase is missing, handles W-01

Value	Setting content
0	Single-phase power input
1	3-phase power input
2	DC Power input

The upper 4 bits determine the Servo status when the main power phase is missing. And the lower 4 bits are the bits that set the power input method to be used.

Main power fail check mode(0x2006)	Single-Phase input	3-phase input
0x00	Servo On	AL-42
0x01	AL-42	Servo On
0x10	Servo On	W-01
0x11	W-01	Servo On

<Servo status immediately after Servo On>

For example, enter '0x01' as the parameter and enter single-phase power. At this time, if the user issues the Servo On command, the Servo generates AL-42 immediately. No alarm occurs during Servo Off.

Main Power Fail Check Mode[0x2006]	When the main power is cut off during operation by Servo On
0x00	AL-42
0x01	
0x10	W-01 occurs, but AL-40 (low voltage) occurs after the motor continues to run
0x11	

<Servo status immediately after power off after Servo On>

And if the main power is cut off during Servo On operation, a warning or an alarm is generated according to the set values in the table above.

0x2007	Main Power Fail Check Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 100	0	-	RW	Yes	Always	Yes

This specifies items to display in the 7SEG window.

Setting Value	Display item	Unit	Description
0	Run status	-	-
1	Speed feedback	rpm, mm/s	-
2	Speed command	rpm, mm/s	-
3	Torque feedback	0.1%	-
4	Torque error	0.1%	-
5	Accumulated operate overload percentage	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	-	-
15	Instantaneous maximum load rate	0.1%	Instantaneous maximum load rate for 15 seconds
16	RMS load factor	0.1%	RMS load rate for 15 seconds

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

Perform regenerative resistance-related setting.

Setting Value	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. ※ Refer to. Power Supply Wiring(3.4)

0x200A	Regeneration Brake Resistor Derating Factor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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. Please change the setting value according to the heat dissipation condition of the regenerative resistor used. When setting to 100% or more, be sure to use it in consideration of heat dissipation conditions.

.

0x200B	Regeneration Brake Resistor Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	1 to 50000	100	watt	RW	No	Always	Yes

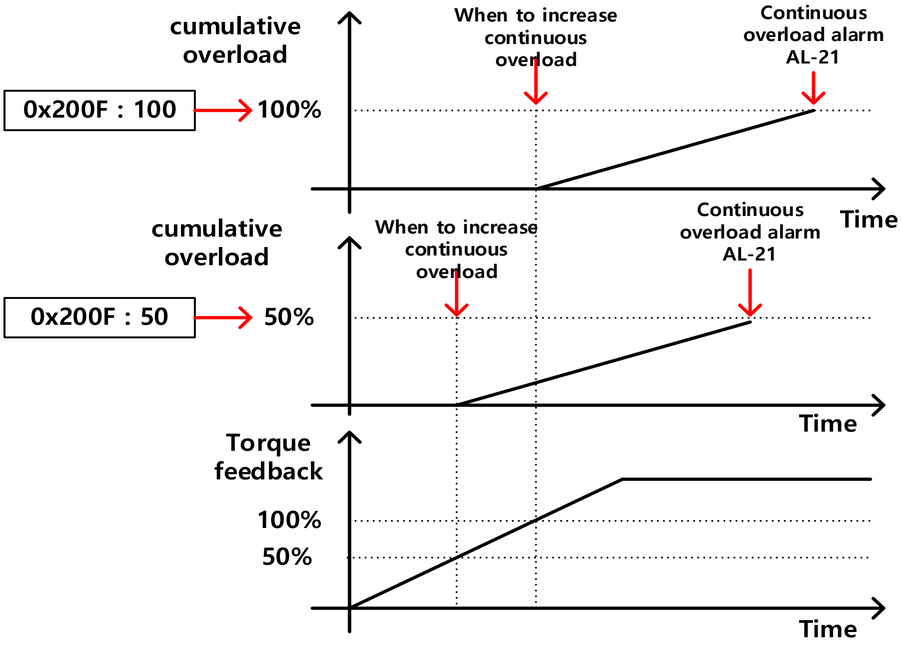
When using an external regenerative resistor (0x2009=1), set the maximum allowable capacity of the regenerative resistance in watt. When using an internal regenerative resistor (0x2009= 0), no setting values will be applied.

0x200E	Duration Time @ Peak Power of Regeneration Brake Resistor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	10 to 120	100	%	RW	No	Always	Yes

This parameter controls the load factor at which continuous cumulative overload starts to accumulate.

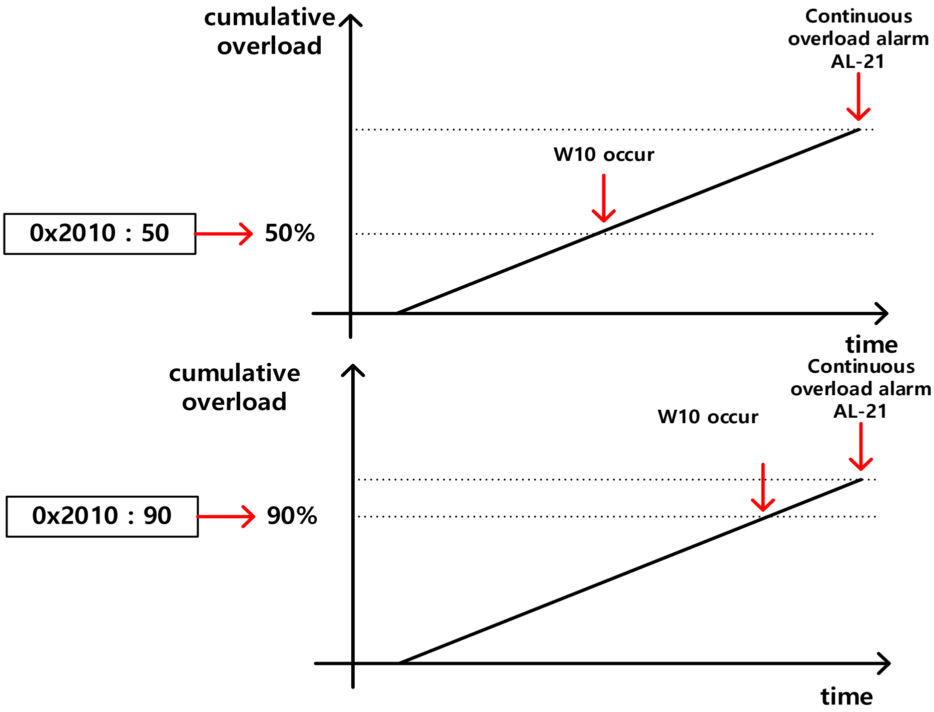


The initial value is 100, and if the torque feedback exceeds 100 [%], the continuous overload alarm (AL-21) occurs due to accumulated overload. If the parameter value is set to 50, accumulated overload will accumulate if the torque feedback exceeds 50 [%], and if it is set to 100, it will accumulate if it exceeds 100 [%]. Therefore, if you set it to 50 at the same time, it accumulates faster than 100, and AL-21 occurs.

If the heat dissipation condition of the drive is not good, set the set value below 100% to generate an overload alarm quickly.

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

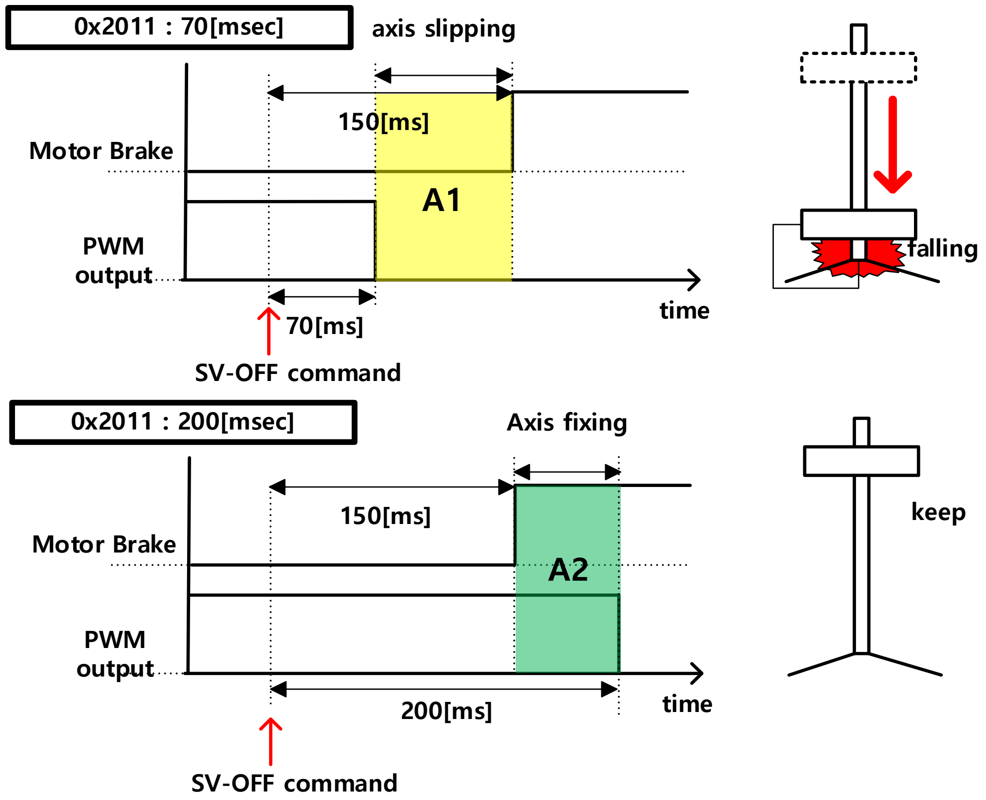
This specifies the output level of accumulated operation overload warning (W10). When the accumulated operation overload rate (0x2603) reaches the set value, a warning will be output. With this setting, you can identify the time when you need to take an appropriate action before an accumulated operation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



For example, if you enter 50, W10 occurs from the point when the cumulative overload becomes 50 [%]. If 90 is set, it occurs from the 90[%] point. When cumulative overload reaches 100%, W10 changes to AL-21.

0x2011	PWM Off Delay Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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.

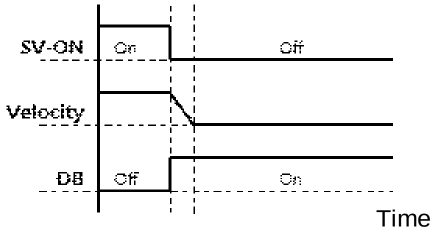


For example, let's assume that the servo off is commanded while using a motor equipped with a brake on the vertical axis, and the brake operates after 150[msec]. If the parameter is set to 50 [msec], the PWM is turned off 50 [msec] after the servo off command, and the area (A1) where the brake is not yet set occurs. Therefore, the shaft slides down due to gravity. However, when set to 200 [msec], the vertical axis is maintained because PWM is output for 50 [msec] and the overlapping section (green) where the brake is taken appears.

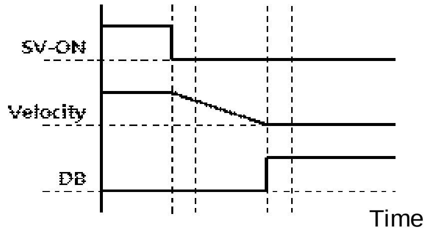
0x2012	Dynamic Brake Control Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 3	0	-	RW	No	Always	Yes

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

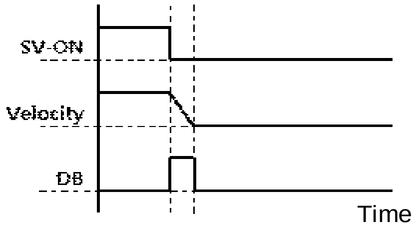
Setting Value	Description
0	Hold the dynamic brake after stopping the motor using the brake
1	Release the dynamic brake after stopping the motor using the brake
2	Release the dynamic brake after free-run stop
3	Hold the dynamic brake after free-run stop



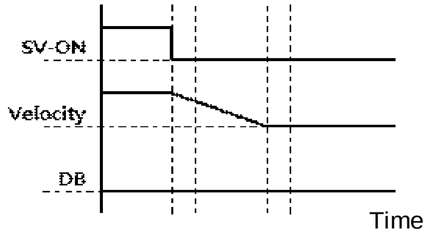
Hold after a DB stop



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 allocation	Change attribute	Save
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 Value	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 allocation	Change attribute	Save
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
0	W01	Main power source loss
1	W02	Low voltage of encoder battery
2	W04	Software Position Limit
3	W08	DB Excessive Current
4	W10	Operation overload
5	W20	Drive / Motor Combination error
6	W40	Low Voltage
7	W80	Emergency signal input

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

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

0x2017	W Phase Current Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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).

Also, from OS Ver2.00 or later, current offset is automatically performed every servo on.

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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 Value	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 allocation	Change attribute	Save
UINT	0 to 1000	500	0.1%	RW	No	Always	Yes

Set the commutation current to obtain the initial angle information of the motor.

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

Set the commutation current to obtain the initial angle information of the motor

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

Set grid of sinusoidal encoder

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

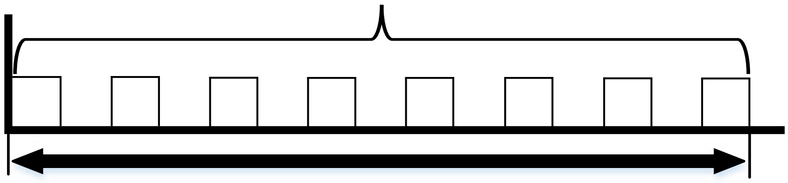
Set movement towards Zero position according to home offset [0x607C].

Setting Value	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 homing by homing method [0x6098]

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

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

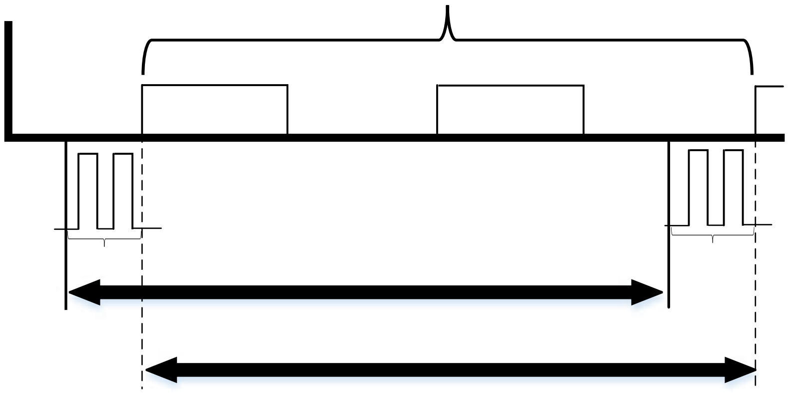
Setting Value	Description
0	MT Method + Speed Observer
1	MT Method
2	M Method



M Method calculates RPM by reading the encoder's counter at regular intervals (T).

If the value of the counter read at regular intervals (T) is Pm, the speed is as follows.

$$Velocity = \frac{p_m}{T}$$



The TM method subtracts the delay time$T_{m1}$for the first encoder pulse input in a certain period (T) and adds the delay time$T_{m2}$for the last encoder pulse input as the final cycle. At this time, the speed calculation is as follows.

$$Velocity = \frac{p_m}{T - T_{m1} + T_{m2}}$$

0x2020	Motor and Hall Phase Correction						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 65535	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.

15bit can be set according to the single-phase input or differential input of the hall signal of the encoder. When set to 0, Hall Signal can be input differentially, and when set to 1, Hall Signal can be input single-phase.

Bit	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	Hall Signal sinle-phase input setting

0x2031	Operation Time at Peak Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 65535	1000	ms	RW	No	Power recycling	Yes

Set the operating time at the maximum current of the motor. This setting value is a parameter that protects the motor byI^2Talgorithm, so it must be set accuratel. (For details on settings, refer to Section 6.11.1I^2TAlgorithm Protection.)

0x2034	Motor Thermal Protection Enable						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 1	0	-	RW	No	Power recycling	Yes

Activates the protection function by the motor's thermal parameters (Thermal resistance/Capacitance).

Setting Value	Description
0	Disable
1	Enable

Gain Adjustment(0x2100~)

0x2100	Inertia Ratio						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 1000	5	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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 1000	10	0.1ms	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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 1000	10	0.1ms	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 allocation	Change attribute	Save
UINT	0 to 4	2	-	RW	Yes	Always	Yes

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

Setting Value	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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 Value	Setting content
0	Always PI controlled
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 Value	Setting content
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 allocation	Change attribute	Save
UINT	0 to 1000	2	ms	RW	Yes	Always	Yes

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

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

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

0x211C	Gain Conversion Waiting Time 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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.

0x211D	Gain Conversion Waiting Time 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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.

0x211E	Dead Band for Position Control						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 content
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 allocation	Change attribute	Save
UINT	0 to $FFFF_{hex}$	0	-	RW	Yes	-	No

Bit	Setting content
15-0	Reserved

0x2121	Drive Status Output 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 content
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 allocation	Change attribute	Save
UINT	0 to $FFFF_{hex}$	0	-	RO	Yes	-	No

Bit	Setting content
15-0	Reserved

• I/O Configuration(0x2200~)

0x2200	Digital Input Signal 1 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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.

15Bit	14Bit	13Bit	12Bit	11Bit	10Bit	9Bit	8Bit	7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Signal input level setting (15Bit)

Setting value	status
0	A contact
1	B contact

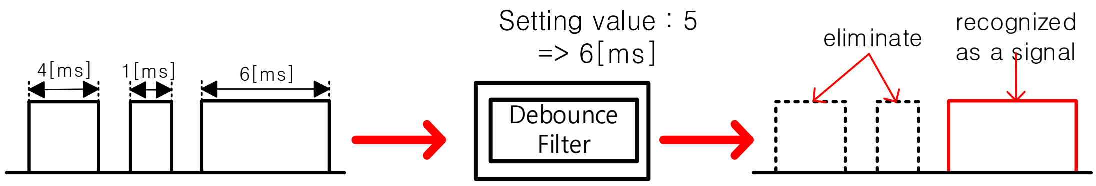
Debounce filter setting (11Bit–8Bit)

Setting value	Valid signal filtering time [msec]
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8
8	9
9	10
10	11
11	12
12	13
13	14
14	15
15	16

Input signal allocation (7Bit–0Bit)

Setting value	Allocation signal	Setting value	Allocation signal
0x00	unassigned	0x13	HSTART
0x01	POT	0x14	ISEL0
0x02	NOT	0x15	ISEL1
0x03	HOME	0x16	ISEL2
0x04	STOP	0x17	ISEL3
0x05	PCON	0x18	ISEL4
0x06	GAIN2	0x19	ISEL5
0x07	PCL	0x1A	ABS RQ
0x08	NCL	0x1B	JSTART/PJOG
0x09	PROBE1	0x1C	JDIR/NJOG
0x0A	PROBE2	0x1D	PCLR(Pulse clear)
0x0B	EMG	0x1E	AOVR(analog override)
0x0C	ARST(Alarm Reset)	0x1F	INHIBT
0x0F	SV_ON	0x20	SPD1/LVSF1
0x10	START	0x21	SPD2/LVSF2
0x11	PAUSE	0x22	SPD3
0x12	REGT	0x23	MODE
		0x24	ABS RESET

The 15th bit is used to set the contact input status. The debounce filter is applied to block the inflow of chattering component noise.



For example, if the user sets 5, only the high holding time of the input signal longer than 6 [msec] is recognized as a signal, and less than that is filtered out. The figure below is an example of contact input setting.

Example) When setting Gain2 to A contact

15Bit	14Bit	13Bit	12Bit	11Bit	10Bit	9Bit	8Bit	7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
0				0				0				6			

→ 0x0006

Example) When setting Gain2 to contact A and filtering time to 5[msec]

15Bit	14Bit	13Bit	12Bit	11Bit	10Bit	9Bit	8Bit	7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0
0				4				0				6			

→ 0x0406

The setting method is all the same up to the setting of digital input signal 16 [0x220F]

Example) When INHIBT is set to B contact and filtering time is set to 12 (msec)

15Bit	14Bit	13Bit	12Bit	11Bit	10Bit	9Bit	8Bit	7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
1	0	0	0	1	0	1	1	0	0	0	1	1	1	1	1
1				B				1				F			

→ 0x8B1F

0x2201	Digital Input Signal 2 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0002	-	RW	No	Always	Yes

This specifies the functions of digital input signal 2 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2202	Digital Input Signal 3 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0003	-	RW	No	Always	Yes

This specifies the functions of digital input signal 3 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2203	Digital Input Signal 4 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0004	-	RW	No	Always	Yes

This specifies the functions of digital input signal 4 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2204	Digital Input Signal 5 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0005	-	RW	No	Always	Yes

This specifies the functions of digital input signal 5 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2205	Digital Input Signal 6 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0006	-	RW	No	Always	Yes

This specifies the functions of digital input signal 6 of the I/O and the input signal level. For more information, refer to the description of 0x2200.

0x2206	Digital Input Signal 7 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0007	-	RW	No	Always	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 allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0008	-	RW	No	Always	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 allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x8001	-	RW	No	Always	Yes

Assign the functions of digital output signal 1 of I/O and set the output signal level. Output signal setting has no debounce filter function

15Bit	14Bit	13Bit	12Bit	11Bit	10Bit	9Bit	8Bit	7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Signal output level setting

Setting value	status
0	A contact
1	B contact

Output signal allocation

Setting value	Allocation signal
0x00	unassigned
0x01	BRAKE
0x02	ALARM
0x03	READY
0x04	ZSPD
0x05	INPOS1
0x06	TLMT
0x07	VLMT
0x08	INSPD
0x09	WARN

Setting value	Allocation signal
0x0A	TGON
0x0B	INPOS2

The method is the same until digital output signal 8 [0x2217] is set.

Ex) In case of setting the alarm to contact A

15Bit	14Bit	13Bit	12Bit	11Bit	10Bit	9Bit	8Bit	7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

0 0 0 2 → 0x0002

Ex) In case of setting the alarm to contact B

15Bit	14Bit	13Bit	12Bit	11Bit	10Bit	9Bit	8Bit	7Bit	6Bit	5Bit	4Bit	3Bit	2Bit	1Bit	0Bit
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

8 0 0 2 → 0x8002

0x2211	Digital Output Signal 2 Selection						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x8002	-	RW	No	Always	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 allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0003	-	RW	No	Always	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 allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0004	-	RW	No	Always	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 allocation	Change attribute	Save
INT	-1000 to 1000	100	0.1%/V	RW	No	Always	Yes

In case of non-torque operation, when the setting value of the torque limit function setting (0x2110) is 4 (analog torque limit), the torque is limited by the analog input torque limit value. At this time, set the scale of the analog input value.

The calculation formula is:

$$Torque\ \ limit\ \ value(\%) \\ = \left(\frac{input\ \ voltage(mV) - Torque\ \ input\ \ offset(ox221C)(mV))}{1000}\right) X \frac{Torque\ \ command\ \ scale(ox221D)}{10}$$

Please refer to 6.9 Torque limit function.

0x221D	Analog Torque Limit Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 1	0	-	RW	No	Always	Yes

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

Setting Value	Setting content
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 allocation	Change attribute	Save
UINT	0 to 65535	0	-	RW	No	Always	Yes

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

Setting Value	Display item	Unit
0x00	Speed feedback	rpm
0x01	Speed command	rpm
0x02	Speed error	rpm
0x03	Torque feedback	%
0x04	Torque error	%
0x05	Position error	pulse
0x06	Accumulated operate overload percentage	%
0x07	DC link voltage	V
0x08	Accumulated Regeneration Overload	%
0x09	Encoder single-turn data	pulse
0x0A	Inertia ratio	%
0x0B	Full-Closed positional error	UU
0x0C	Drive Temperature 1	°C
0x0D	Drive Temperature 2	°C
0x0E	Encoder temperature 1	°C
0x0F	Hall signal	-
0x10	U phase current	A
0x11	V phase current	A
0x12	W phase current	A
0x13	Current position value	UU
0x14	Target position value	UU
0x15	Position command speed	rpm, mm/s
0x16	Hall U signal	-
0x17	Hall V signal	-
0x18	Hall W signal	-

0x2222	Analog Monitor Channel 2 Select						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 3	0	-	RW	No	Always	Yes

This specifies the speed limit function for torque control.

Setting Value	Setting content
0	Limited by speed limit value (0x230E)
1	Limited by the maximum motor speed
2	Set the analog speed command as the maximum torque speed limit value
3	Reflects the smaller value between the value of 0x230E and the analog speed command value

0x230E	Speed Limit Value at Torque Control Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 Value	Setting content
0	Servo-lock function disabled
1	Servo-lock function enabled

Miscellaneous Setting(0x2400~)

0x2400	Software Position Limit Function Select						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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

Encoder spec.	Requirements for using the function
Incremental encoder	**1. After power-on, origin operation must be performed once. 2. When origin operation is completed, the function can be used.**
Absolute singleturn encoder	
Absolute multiturn encoder	**1. An external battery must be connected 2. Absolute Encoder Configuration [0x2005] must be set to 0. 3. There is no need to set the origin operation again after power is applied. 4. Functionality can be used immediately.**

The software position limit function will not be activated prior to the homing operation. Multi-turn encoder does not require origin operation when using multi-turn with Absolute Encoder Configuration [0x2005] set to 0. Also, this function does not work even if the upper limit value is smaller than the lower limit value, so please use it with caution. .

Setting Value	Setting content
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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.

0x240A	Duration Time for Homing Using Stopper						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 5	0	-	RW	No	Power recycling	Yes

This specifies whether to use the Modulo function.

This function is not supported in CSP operation mode.

Setting Value	Setting content
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.

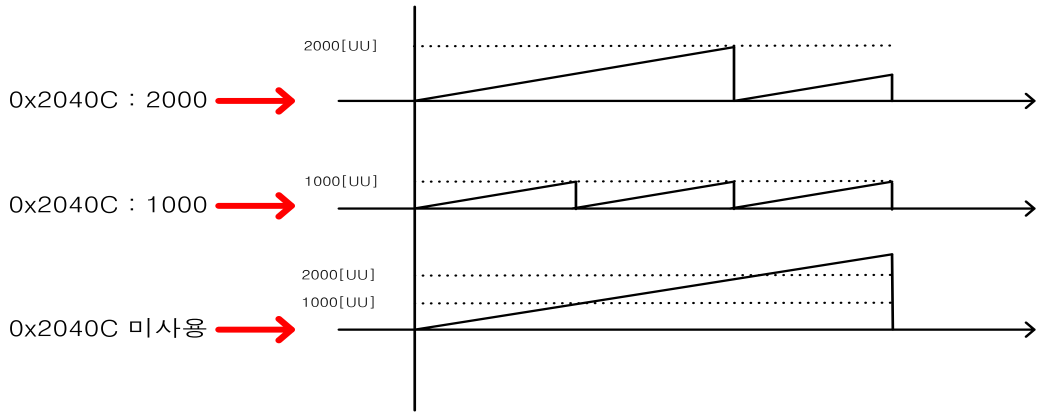
0x240C	Modulo Factor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
DINT	1 to 0x3FFFFFFF	3600	UU	RW	No	Power recycling	Yes

Set the factor when using the modulo function. The user sets the position value corresponding to one revolution when the motor is driven.

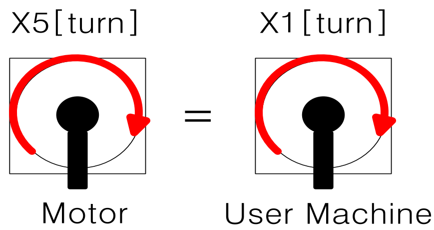
* Modulo Factor concept

The basic formula is:

$$Position\ \ Actual\ \ Value\ \ using\ \ Modulo\ \ factor = Position\ \ Actual\ \ Value - (Position\ \ Actual\ \ Value\ \ \div Modulo\ \ Factor) \times Encoder\ \ Pulse\ \ per\ \ Revolution$$



In general, if the motor rotates in one direction when the modular factor is not used, the current position continues to increase. If you use the modular factor and enter 1000, the current position (Position Actual Value) increases only up to 1000 [UU] and then resets to 0 [UU]. Likewise, even if you input 2000, it increases only up to 2000 [UU] and is initialized again. That is, the remainder value obtained by dividing the Position Actual Value by the Modulo Factor is reflected.



When the instrument of the equipment makes 1[turn], and the L7 19[bit] motor mounted on the equipment makes 5[turn], the total pulse required for the equipment to make 1[turn] is as follows.

$$524288 \times 5[turn] = 9961472[UU]$$

If the user wants to control equipment 1[turn] within 0~9961472[UU], when 9961472[UU] is input to the Modulo Factor, the equipment will appear within 1[turn] to 1~9961472[UU] in the Position Actual value and 1[turn], it starts again at 1[UU].

0x240D	User Drive Name						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
STRING	-	‘Drive’	UU	RW	No	Always	Yes

The user can customize the drive name. Up to 16 characters can be used to define the name.

0x240E	Individual Parameter Save						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 Value	Setting content
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 allocation	Change attribute	Save
UINT	0 to 5	0	-	RW	No	Always	Yes

This specifies the adaptive filter function.

Setting Value	Setting content
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). If an arbitrary value is set for notch filter 3, automatic setting is not possible, so if you want automatic setting, you must initialize notch filter 3 first.
2	Only two adaptive filters are used. You can check the settings configured automatically in the Notch Filter 3 (0x2507, 0x2508, and 0x2509) and 4 Settings (0x250A, 0x250B, 0x250C). If notch filter 3 (or 4) is set to an arbitrary value, it is automatically set to notch filter 4 (or 3), if notch filter 3 and notch filter 4 are both set to arbitrary values, the set values are maintained. If notch filter 3 and notch filter 4 are in the initialization state, both can be set automatically.
3	Reserved
4	Settings of Notch Filter 3 (0x2507, 0x2508, 0x2509) and Notch Filter 4 (0x250A, 0x250B, 0x250C) are initialized
5	Reserved

0x2501	Notch Filter 1 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	500 to 5000	5000	Hz	RW	No	Always	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 allocation	Change attribute	Save
UINT	1 to 100	1	-	RW	No	Always	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 allocation	Change attribute	Save
UINT	1 to 5	1	-	RW	No	Always	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 allocation	Change attribute	Save
UINT	500 to 5000	5000	Hz	RW	No	Always	Yes

0x2505	Notch Filter 2 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 100	1	-	RW	No	Always	Yes

0x2506	Notch Filter 2 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 5	1	-	RW	No	Always	Yes

0x2507	Notch Filter 3 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	500 to 5000	5000	Hz	RW	No	Always	Yes

0x2508	Notch Filter 3 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 100	1	-	RW	No	Always	Yes

0x2509	Notch Filter 3 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 5	1	-	RW	No	Always	Yes

0x250A	Notch Filter 4 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	500 to 5000	5000	Hz	RW	No	Always	Yes

0x250B	Notch Filter 4 Width						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 100	1	-	RW	No	Always	Yes

0x250C	Notch Filter 4 Depth						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 5	1	-	RW	No	Always	Yes

0x250D	On-line Gain Tuning Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 1	0	-	RW	No	Always	Yes

Determines whether to adjust real-time gain during operation. Factory setting is 0, which is unused. During online tuning, the estimated gain is reflected every 64 ms and the changed gain is saved in the EEPROM about every 2 minutes.

Setting Value	Setting content
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 allocation	Change attribute	Save
UINT	1 to 20	5	-	RW	No	Always	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.

If the system stiffness setting value is increased, the gain is increased and the positioning time is shortened. However, if the setting value is too high, vibration may occur depending on the machine configuration. Therefore, set the system rigidity setting value from a low value to a high value within the range of vibration.

The gain automatically changed after gain tuning is as follows.

Inertia ratio (0x2100), position loop gain 1 (0x2001), speed loop gain 1 (0x2102), speed integral time constant 1 (0x2103), torque command filter time constant 1 (0x2104), notch filter 3 frequency (0x2507, TBD), and notch filter 4 frequency (0x250A, TBD).

The gain values (position loop gain, speed loop gain, speed integration time constant, torque command filter time constant) according to the system rigidity settings are determined by the values in the table below.

system stiffness	1	2	3	4	5	6	7	8	9	10
Position loop gain 1	2	5	10	15	22	30	40	50	60	73
Speed loop gain 1	3	8	15	23	33	45	60	75	90	110
Speed Integral Time Constant 1	190	70	50	40	30	22	15	13	10	9
Torque command filter time constant 1	80	30	20	10	8	6	4	3	3	2
system stiffness	11	12	13	14	15	16	17	18	19	20
Position loop gain 1	87	100	117	133	160	173	200	220	240	267
Speed loop gain 1	130	150	175	200	240	260	300	330	360	400
Speed Integral Time Constant 1	8	7	6	6	5	5	4	4	3	3
Torque command filter time constant 1	2	2	2	2	1	1	1	1	1	1

0x250F	On-line Gain Tuning Adaptation Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 5	1	-	RW	No	Always	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. Depending on the state of the load, the system may become unstable if reflected too quickly.

0x2510	Off-line Gain Tuning Direction						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 1	0	-	RW	No	Always	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 Value	Setting content
0	Run in forward direction
1	Run in reverse direction

0x2511	Off-line Gain Tuning Distance						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 10	5	-	RW	No	Always	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 allocation	Change attribute	Save
UINT	0 to 100	0	%	RW	No	Always	Yes

This function suppresses disturbance by forward compensation of the torque through the load model. If the disturbance observer gain setting value is large, disturbance suppression is good, but noise occurs during operation, so the gain and filter time constant must be set appropriately.

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

Apply a low pass filter to the disturbance observer reference. Disturbances can be suppressed by appropriately setting the disturbance observer gain and filter time constant.

0x2514	Current Controller Gain						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 150	100	%	RW	No	Always	Yes

This specifies the current controller gain. Lowering the setting value will reduce the noise, but the drive's responsiveness decreases as well.

0x2515	Vibration Suppression Filter Configuration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 2	0	-	RW	No	Always	Yes

Set whether or not to use a filter to suppress vibrations occurring at the load end.

Setting Value	Setting content
0	Vibration control (damping) filter disabled
1	Using vibration control (damping) filters 1 and 2
2	Apply vibration control (damping) filters 1 and 2 according to LVSF1 and LVSF2 inputs

0x2516	Vibration Suppression Filter 1 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 2000	0	0.1Hz	RW	No	Always	Yes

Sets the vibration control (damping) filter 1 frequency.

0x2517	Vibration Suppression Filter 1 Damping						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 5	0	-	RW	No	Always	Yes

Sets the coefficients for vibration control (damping) filter 1. As the setting value increases, the damping coefficient increases, so the damping width increases.

0x2518	Vibration Suppression Filter 2 Frequency						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 2000	0	0.1Hz	RW	No	Always	Yes

Sets the vibration control (damping) filter 2 frequency.

0x2519	Vibration Suppression Filter 2 Damping						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	0 to 5	0	-	RW	No	Always	Yes

Sets the coefficients for vibration control (damping) filter 2. As the setting value increases, the damping coefficient increases, so the damping width increases.

Monitoring (0x2600~)

0x2600	Feedback Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
INT	-	-	ºC	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 allocation	Change attribute	Save
INT	-	-	ºC	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 allocation	Change attribute	Save
INT	-	-	ºC	RO	No	-	No

This represents the temperature measured by the temperature sensor integrated into serial encoder provided by LS ELECTRIC (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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 content
0	W phase hole signal
1	V phase hole signal
2	U phase hole signal

0x2613	Bootloader Version						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
INT	-	-	mV	RO	No	-	No

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

0x2619	RMS Operation Overload						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
INT	-	-	0.1%	RO	No	-	No

Displays the effective (RMS) load factor for the last 15 seconds in units of 0.1%.

It compares the effective (RMS) load factor and the rated torque within the 15-second driving cycle to check whether the effective (RMS) load factor is within the rated torque of the drive. If the effective (RMS) load factor is greater than the rated torque, recheck the drive and motor selection.

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

0x2700	Procedure Command Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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	Starting operation
	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 - 0x2017, respectively. If the offset is abnormally large, AL-15 will be generated.)
Software reset(0x0009)	1	Software reset
Commutation(0x000A)	1	Commutation is performed
Tamagawa / Panasonic Encoder Reset(0x000B)	1	Alarm Reset
	2	Multiturn Reset
	3	Warning Reset
Endat2.2 Encoder Reset (0x000C)	4660	Position Reset
	2	Alarm Reset
BISS-C Preset	1	AL-3b Reset

0x2701	Procedure Command Argument						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
UINT	0 to FFFF	0	-	RW	No	-	No

0x2702	Servo Alarm History						ALL
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	16	-	RO	No	-	No
SubIndex 1		Alarm code 1 (most recent)					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 2		Alarm code 2					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 3		Alarm code 3					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 4		Alarm code 4					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 5		Alarm code 5					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 6		Alarm code 6					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 7		Alarm code 7					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 8		Alarm code 8					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 9		Alarm code 9					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 10		Alarm code 10					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 11		Alarm code 11					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No

SubIndex 12		Alarm code 12					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 13		Alarm code 13					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 14		Alarm code 14					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 15		Alarm code 15					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No
SubIndex 16		Alarm code 16 (oldest)					
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO allocation	Change attribute	Save
STRING	-	-	-	RO	No	-	No

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 allocation	Change attribute	Save
UINT	0 to 1	0	-	RW	No	Power recycling	Yes

This specifies the motor type.

Setting Value	Setting content
0	Rotary motor
1	Linear motor

0x2801	[Third Party Motor] Number of Poles						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
FP32	-	2.89	Arms	RW	No	Power recycling	Yes

This specifies the motor rated current.

0x2803	[Third Party Motor] Maximum Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
FP32	-	8.67	Arms	RW	No	Power recycling	Yes

This specifies the motor maximum current.

0x2804	[Third Party Motor] Rated Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
FP32	-	0.82	ohm	RW	No	Power recycling	Yes

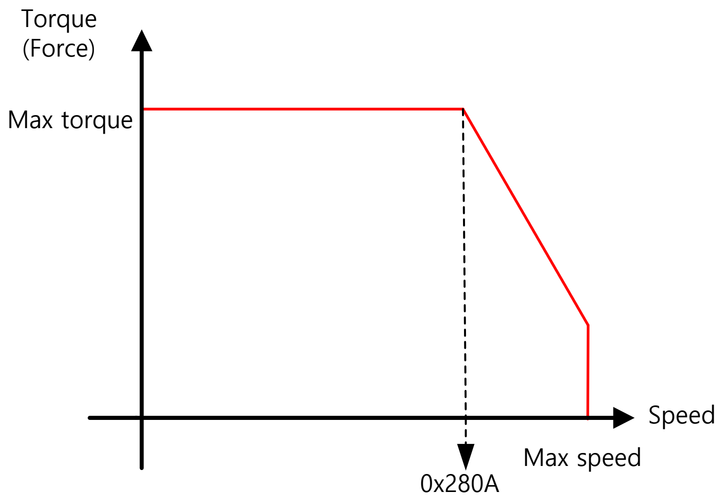
This specifies the phase resistance (= resistance between lines ÷ 2) of the motor.

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

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

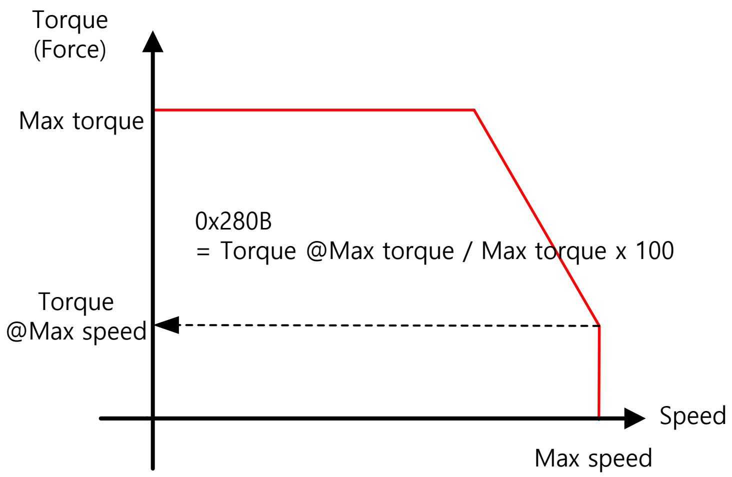
0x280A	[Third Party Motor] TN Curve Data 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	1 to 60000	3000	rpm	RW	No	Power recycling	Yes

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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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.

0x280D	[Third Party Motor] Thermal Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
FP32	-	32.77	oC /watt	RW	No	Power recycling	Yes

Set the thermal time constant between motor winding and ambient. When the motor thermal protection function is activated (0x2034 = 1), the motor temperature is estimated and the motor overheat (AL-27) alarm occurs.

Thermal time constant [sec] = Thermal resistance [oC/watt] * Thermal capacitance [watt·sec/oC]

10.3 CiA402 Objects

0x603F	Error Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 3	**Bit 2**	**Bit 1**	**Bit 0**
Shutdown	–	1	1	0
Switch on	0	1	1	1
Switch on + Enable operation	1	1	1	1
Disable voltage	–	–	0	–
Quick stop	–	0	1	–
Disable operation	0	1	1	1
Enable operation	1	1	1	1

<Description on Bits 4 to 9>

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

Bit	Function	Value	Content
4	–	0	-
5	–	0	-
6	–	0	-
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	-

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

Bit 9	**Bit 5**	**Bit 4**	Content
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	Content
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 PV, PT, or CST mode operation

Bit	Function	Value	Content
4	–	0	Reserved
5	–	0	Reserved
6	–	0	Reserved
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

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

Bit	Function	Value	Content
4	Homing Start	0	Does not perform the homing operation.
		1	Performs or is performing the homing operation.
5	–	0	-
6	–	0	-
8	Halt	0	Runs the bit 4 command.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

0x6041	Statusword						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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	ABS position valid	Refer to the section concerning bit 14.
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

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

Bit	State	Value	Content
10	Target reached	0	Unable to reach the target (position/velocity/torque)
		1	Reached the target (position/velocity/torque)
12	-	0	-
13	Following error	0	No positional error (always 0 in Csv/Torque Mode)
		1	Following error

• Bits 10, 12 and13: For PP mode operation

Bit	State	Value	Content
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 following error
		1	Following error

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

Bit	State	Value	Content
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	ZeroSpeed	0	Not in a zero speed state
		1	In zero a speed state
13	–	0	-

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

Bit 13	**Bit 12**	**Bit 10**	Content
Homing error	Homing attained	Target reached	
0	0	0	Homing in progress
0	0	1	Homing stopped or did not start
0	1	0	Performed homing operation, but did not reach the target
0	1	1	Homing completed
1	0	0	Homing error; speed not equal to 0
1	0	1	Homing error; speed equal to 0

< Description on Bit 11>

• Bit11: Use of Internal limit

Bit	State	Value	Content
11	Internal limit active	0	Software location limit status not used or software location limit function (0x2400) not used
		1	Software location limit

< Description on Bit 14>

• Bit14: ABS Position Valid

Bit	State	Value	Content
14	ABS position valid	0	Before homing completion or encoder-related alarms occur
		1	homing completion (applied while connected to EtherCAT communication)

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

This sets the Quick Stop option code.

Setting Value	Description
0	Not used (transits into Switch On Disabled).
1 **or** 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 allocation	Change attribute	Save
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 Value	Description
0	No use
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 allocation	Change attribute	Save
INT	0 to 1	1	-	RW	No	Always	Yes

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

Setting Value	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 allocation	Change attribute	Save
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 Value	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 allocation	Change attribute	Save
INT	0	0	-	RW	No	Always	Yes

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

Setting Value	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 allocation	Change attribute	Save
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 Value	Name	Content
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 allocation	Change attribute	Save
SINT	-	-	-	RO	Yes	-	No

Displays the operation mode of the current drive.

0x6062	Position Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UDINT	0 to 0x3FFFFFFF	5242880	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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UINT	0 to 65535	20000	UU/s	RW	No	Always	Yes

This specifies the velocity window. If the difference between the target speed and the actual speed remains within the velocity window (0x606D) for the velocity window time (0x606E), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x606E	Velocity Window Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
INT	-	-	0.1%	RO	Yes	-	No

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

0x6076	Motor Rated Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	-	mNm	RO	No	-	No

Displays the rated torque value of the set motor in mNm unit

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

The actual torque value generated by the drive is displayed in units of 0.1% of the rated torque.

0x6078	Current Actual Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
INT	-	-	0.1%	RO	Yes	-	No

The actual torque value generated by the drive is displayed in units of 0.1% of the rated torque. The same value as the actual torque value [0x6077] is displayed.

0x6079	DC Link Circuit Voltage						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UINT	-	-	0.1V	RO	Yes	-	No

DC-Link voltage by main power input is displayed in units of 0.1V.

0x607A	Target Position						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	2	-	RO	No	-	No
SubIndex 1		Min. position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
DINT	-1073741824 to 1073741823	-2000000000	UU	RW	No	Always	Yes
SubIndex 2		Max position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
UDINT	0 to 0x7FFFFFFF	0x7FFFFFFF	UU/s	RW	Yes	Always	Yes

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

0x6080	Max Motor Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	-	-	RPM	RO	Yes	Always	Yes

Displays the maximum speed of the motor.

0x6081	Profile Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UDINT	0 to 0x7FFFFFFF	26214400	UU/s^2	RW	No	Always	Yes

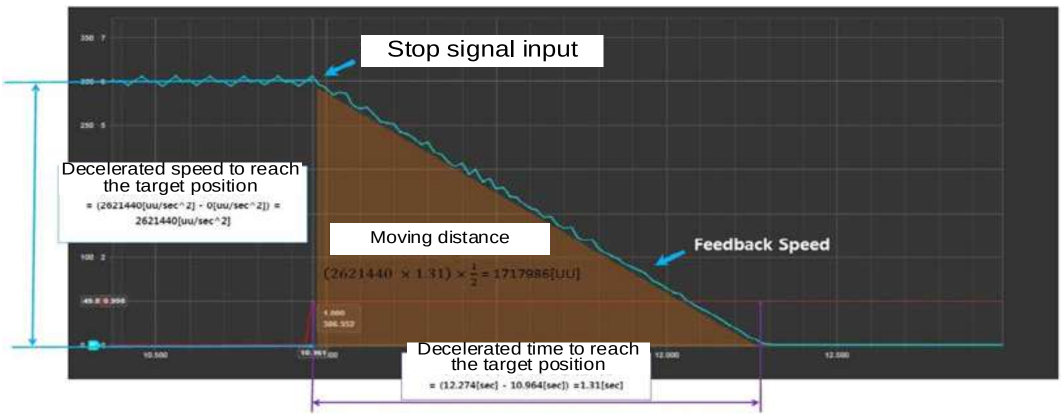
The system uses quick stop deceleration if the quick stop option code (0x605A) is set to 2.

This is the target position calculation formula for Quick Stop deceleration

$$Target\ \ Position[UU] = \frac{Velocity^2[UU^2/sec^2]}{2 \times Quick\ \ Stop\ \ Deceleration[UU/sec^2]}$$

This is the target position value calculation formula when index 0 is driven at 300[rpm], 2000000[UU/sec^2] is input to the value of 0x6085 and the stop signal is input.

$$\text{Target Position[UU]} \ = \ \frac{2621440^2}{2 \times 2000000} = 1717986[UU]$$



Since the target position is the same as the area of the movement distance in the figure, if you want to stop after about 2 seconds by inputting the stop signal while driving at 300[rpm] in index operation mode, you can calculate the deceleration value of Quick Stop as follows.

$$Target\ \ Position\ \ = (2621440[UU/sec] \times 2[sec])\ \ \times\ \frac{1}{2} =\ \ 2621440[UU]$$

$$\frac{2621440^2[UU^2/sec^2]}{2\times 2621440[UU]} =$$

$$1310720[UU/sec^2]$$

In other words, the user can use the Quick Stop deceleration to designate the desired position or time and accurately stop when the Stop signal is input.

0x6087	Torque Slope						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	2	-	RO	No	-	No
SubIndex 1		Motor revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
DINT	0 to 0x40000000	1	-	RW	No	Power recycling	Yes
SubIndex 2		Shaft revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
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 allocation	Change attribute	Save
SINT	-128 to 127	34	-	RW	No	Always	Yes

This sets the homing method. For more information, refer to 5.6 Homing.

Setting Value	Content
0	Do Not Use
1	Homing using the index pulse and reverse limit contact
2	Homing using the index pulse and forward limit contact
7 to 14	Homing using the index pulse and home contact
24	Same as method 8 (does not use the index pulse)
28	Same as method 12 (does not use the index pulse)
33, 34	Homing to the index pulse
35	Homing to the current position
-1	Homing using the negative stopper and index pulse
-2	Homing using the positive stopper and index pulse
-3	Homing using the negative stopper only
-4	Homing using the positive stopper only
-5	It returns to the homing only by the origin switch (HOME) while driving in the reverse direction.
-6	Return to homing only by origin switch (HOME) while driving in the forward direction

0x6099	Homing Speeds						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
USINT	-	2	-	RO	No	-	No
SubIndex 1		Speed during search for switch					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
DINT	0 to 0x40000000	2621440	UU/s	RW	No	Always	Yes
SubIndex 2		Speed during search for zero					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
DINT	0 to 0x40000000	524288	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 allocation	Change attribute	Save
UDINT	0 to 0x40000000	5242880	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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

Corresponds to the torque feed forward value in SP mode and CSV mode.

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 allocation	Change attribute	Save
UINT	0 to 0xFFFF	0x0033	-	RW	Yes	Always	No

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 allocation	Change attribute	Save
UINT	-	-	-	RO	Yes	-	No

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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
USINT	-	2	-	RO	No	-	No
SubIndex 1		Physical outputs					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	No
SubIndex 2		Bit mask					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO allocation	Change attribute	Save
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	Yes

- Description of physical outputs

Bit	Description
0 to 15	Reserved
16	Forced output (0: OFF, 1: ON) of DO #1 (I/O pins 3 and 4) Provided that the relevant bit mask (0x60FE:02.16) is set to 1.
17	Forced output (0: OFF, 1: ON) of DO #2 (I/O pins 23 and 24) Provided that the relevant bit mask (0x60FE:02.17) is set to 1.
18	Forced output (0: OFF, 1: ON) of DO #3 (I/O pins 25 and 26) Provided that the relevant bit mask (0x60FE:02.18) is set to 1.
19	Forced output (0: OFF, 1: ON) of DO #4 (I/O pins 1 and 2) Provided that the relevant bit mask (0x60FE:02.19) is set to 1.
20 to 23	Reserved
24	Output status of DO #1 (0: OFF, 1: ON)
25	Output status of DO #1 (0: OFF, 1: ON)
26	Output status of DO #1 (0: OFF, 1: ON)
27	Output status of DO #1 (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 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 allocation	Change attribute	Save
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 allocation	Change attribute	Save
UDINT	-	0x000003AD	-	RO	No	-	No

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

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

11. 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 Maintenance and Inspection

11.1.1 Caution

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.

Check Items	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.

Note1) 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

Check Items	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.

1. Smoothing condensers: Ripple currents and other factors can cause this part to wear. The lifespan of this part depends on the operating temperature and environment. It normally lasts for 10 years if used continuously in a normal air-conditioned environment. Inspect the condenser at least once each year because it can rapidly age over a short period of time once it starts to deteriorate (inspect it more frequently as it approaches obsolescence).

※ Visual inspection criteria:

a. The condition of the case: Check for deformations on the sides and bottom.

b. The condition of the lid: Check for notable expansion, severe cracks, or broken parts.

c. The relief valve: Check for notable valve expansion and operation.

d. Also regularly check whether the exterior is cracked, discolored, or leaking and whether there are any broken parts. The condenser is obsolete when its capacity degrades to less than 85% of the rated capacity.

2. The relays: Check for bad 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.

3. Motor bearings: Replace the bearings after 20,000 to 30,000 hours of operation at the rated speed under the rated load. Replace the bearings if abnormal sounds or vibrations are detected during inspection, depending on the operating conditions.

[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.
	External wiring is incorrect, disconnection of the cable	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 Name	Cause	Check Items	What to check
AL-10 IPM fault (over current(H/W)) AL-14 Over current (over current(S/W)) AL-16 Current limit exceeded (over current(H/W))	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 setting error	Motor ID [0x2000], encoder type [0x2001], encoder form [0x2002] setting value should be same with applied to motor label.	Modify the parameter as same as motor label information.
	Check motor phase resistor	Motor line resistance test (U-V, V-W, W-U several Ω or less).	Replace motor
	Machine part has problem	Determine whether there is a conflict or binding in the equipment.	Check machine part has problem
	Drive error	-	If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Error by noise	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 (IPM overheating)	Ambient temperature	Check whether surrounding temperature is over 50 [℃]	Lower surrounding temperature
	Continuous Overload alarm	Accumulated operate overload percentage [0x2603] Checking the load percentage is under 100%	Change drive and motor capacity, Please tune gain.
	High-frequency operation of regenerative drive or continuous regenerative operation	Check accumulated regenerative overload[0x2606]	Adjust regeneration resistor setting[0x2009] Use external regeneration resistor.
	Drive setting direction	Check drive setting status	Refer to 『2. Wiring and Connection』
	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 higher.	Rerun adjusting phase current offset

Alarm Code Name	Cause	Check Items	What to check
(Current offset error)	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 capacity, Please tune gain.
	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], Check the label of application motor and Encoder form [0x2002] setting value.	Modify the parameter as same 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
	Encoder cable error	Wiring is incorrect and check Short.	Replace encoder cable
AL-22 Drive temperature 1	Ambient temperature	Check whether surrounding temperature is over 50[℃]	Lower the 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 operating 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 if the main power voltage is over 544 [Vac].	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 motor cable
	Motor error	Check short circuit of U,V,W in Motor (U-V, V-W, W-U)	Replace the motor

Alarm Code Name	Cause	Check Items	What to check
	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 Drive temperature 2	Ambient temperature	Check whether surrounding temperature is over 50[℃]	Lower the surrounding temperature of drive
	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 (Motor ID setting error)	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	Parameter setting error	Check warning mask [0x2014] set value	For motors that do not use phase Z (e.g. step motors), mask AL-34 by setting the 14th bit among warning mask settings.
	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 the absolute value encoder [0x2005] setting value.	When you want to use an absolute value encoder as an incremental encoder, if you set it to 1, no alarm occurs.
	Poor battery contact, not connected	Check the status of battery	Connect battery rightly.
	When battery voltage is low.	Check whether battery voltage is over 3.3V	Replace battery.

Alarm Code Name	Cause	Check Items	What to check
AL-36 Sinusoidal ENC amplitude AL-37 Sinusoidal ENC frequency	Encoder cable error	Disconnect, wiring is incorrect and check Short. Check shield and FG disconnect	Replace encoder cable
	Parameter setting error	Check setting value of encoder type [0x2001]	Check setting encoder type. Check speed command.(Maximum:250kHz)
	Drive error	-	If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Converter 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-3b Preset Error	Parameter setting Error	Check the absolute value encoder [0x2005] setting value.	When you want to use an absolute value encoder as an incremental encoder, if you set it to 1, no alarm occurs.
	Poor battery contact, not connected	Check the status of battery	Connect the battery correctly, reset the alarm, and then reapply the power. Since the current position is reset, please check the mechanical home again.
	When the initial encoder power is supplied	It may occur when power is applied after the first encoder connection.	Reapply power after alarm reset. Since the current position is reset, please check the mechanical home again.
AL-40 Under voltage	Main power input voltage error	Check the main power voltage is over 134[Vac]	Recheck the power supply.
		Check [0x2605] value is over 190 [Vdc] when main power is accordingly input	Replace the drive
	Running when power voltage is low	Check wiring status of main power	Use 3 phase as supply voltage
	Main power input voltage	Check whether the main power voltage is below 286[Vac]	Recheck the power supply.

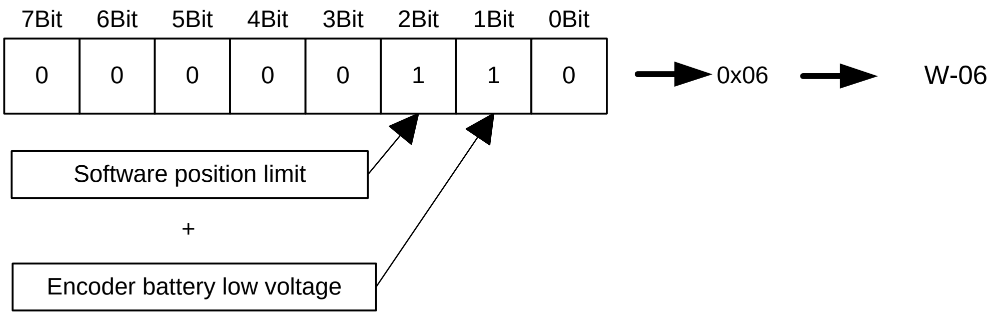
Alarm Code Name	Cause	Check Items	What to check
AL-41 Over voltage	error	Check [0x2605] value is below 405[Vdc] when main power is accordingly input.	Replace the drive
	When braking resistor is high	Check operating condition regenerative resistance.	Review the regenerative resistance consider the operating condition and load.
	Setting value of acceleration/ deceleration	In case of many time for acceleration / deceleration	Set longer acceleration / deceleration time
	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 200-230[Vac] of L1, L2, L3	Recheck the power supply.
	Parameter setting Error	Check value of main power input mode set [0x2006] according to state of main power input.	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 phases of C1, C2 is within 200-230[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 cable 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 same as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low.
		Check setting value[0x2100] ~ [0x211F]	Readjust gain according to operating condition.
	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 [0x6091]	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	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

Alarm Code Name	Cause	Check Items	What to check
Excessive SPD deviation	Parameter setting Error	Value of [0x2000], [0x2001], [0x2002] is same with application motor label.	Modify the parameter as same as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low.
	Machine part has problem	Checking it was forced by drive part operating condition of limit contact point sensor	Check machine part has problem
	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] Device Name	Please download OS or set capacity of drive again. If alarm continue after servo on again, Replace drive. Because drive may have problem.

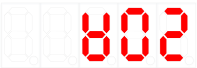
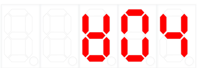
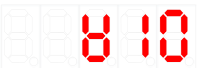
Servo Warning

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 source 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



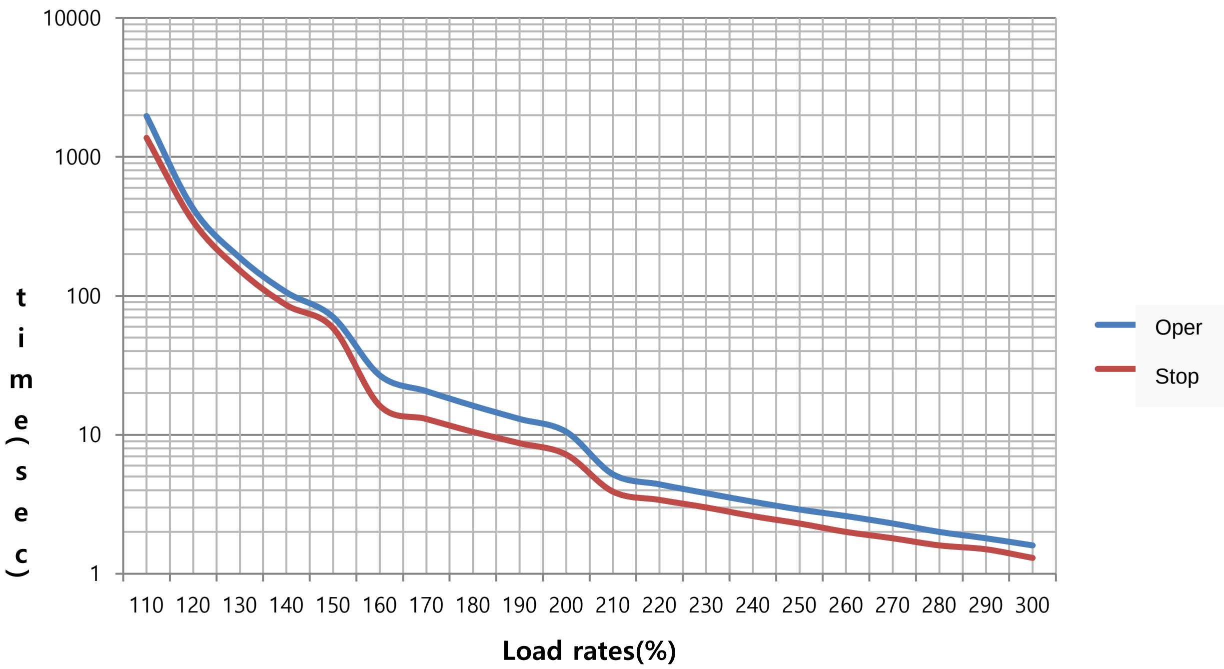
If two warnings occur simultaneously, the bit corresponding to each is set to 1. For example, since the 2nd bit is set when a software position limit warning occurs and the 1st bit is set when an encoder battery low voltage warning occurs, the two warnings are combined as '0x06' and the corresponding alarm can be confirmed by displaying 'W06' on the segment window.

Warning status(CODE) Name	Cause	Check Items	What to check
 PWR_FAIL	Main power input Voltage error	Check voltage between phase 200-230[Vac] of L1, L2, L3	Recheck the power supply.
	Parameter setting error	Check value of main power input mode set [0x2006] according 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] arrowing 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 connection 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 position and minimum position of software position limit[0x607D]
 OV_LOAD	In case of sequent operating that exceed rated load	Check overload warning level setting[0x2010] and constant speed section or accumulated operation overload rate[0x2603]	Change drive and motor capacity, Please tune gain. 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] value is same with motor label.	Modify the parameter as same 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
	Encoder 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 Low Voltage	Main power input voltage error	Check if the main power voltage is over 134 [Vac].	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 (drive control input1 [0x211F], digital input signal1 set [0x2200] ~digital input. Check signal 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.

11.2.3 Overload Operating Characteristic Curve

■ Overload Operating Characteristic Curve (SA type 100W) 200[V]/100[W]

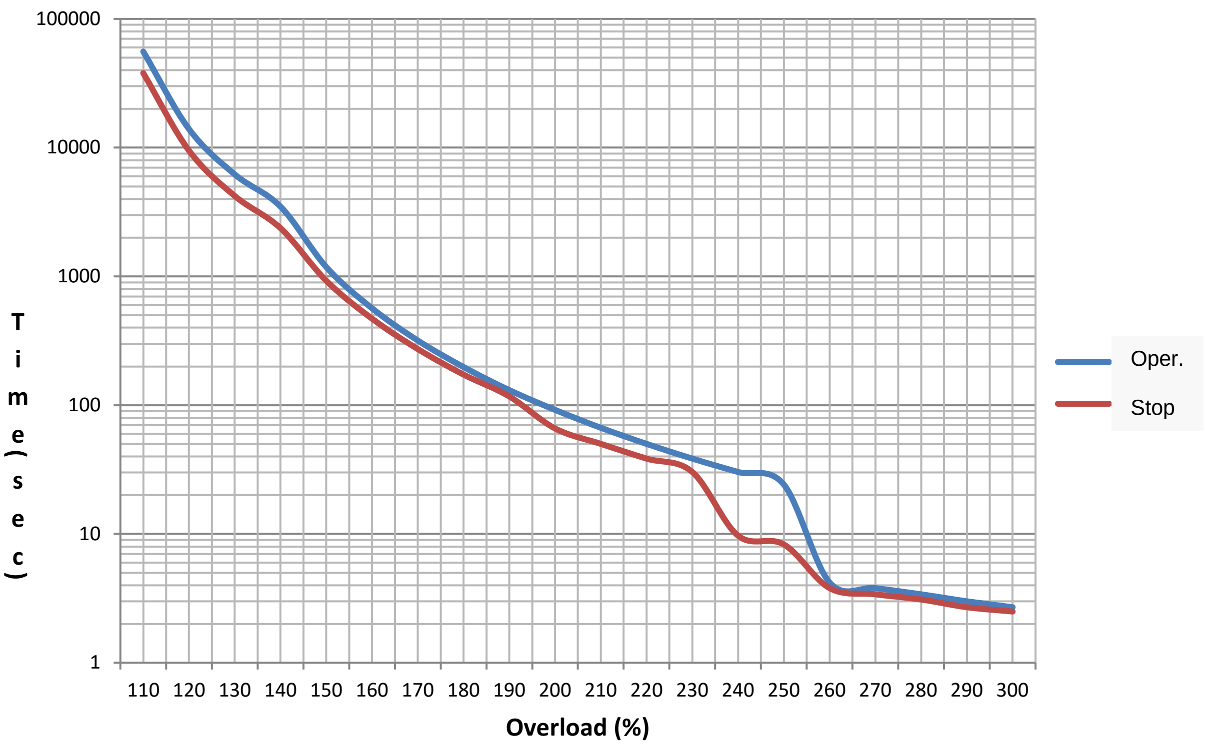
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	1969.0	1372.0	210	5.2	3.9
120	424.0	343.2	220	4.4	3.4
130	188.4	152.5	230	3.8	3.0
140	106.0	85.8	240	3.3	2.6
150	70.4	58.6	250	2.9	2.3
160	26.8	16.2	260	2.6	2.0
170	20.6	13.0	270	2.3	1.8
180	16.2	10.5	280	2.0	1.6
190	13.0	8.7	290	1.8	1.5
200	10.5	7.2	300	1.6	1.3



■ Overload Operating Characteristic Curve (400W)

200[V]/400[W]

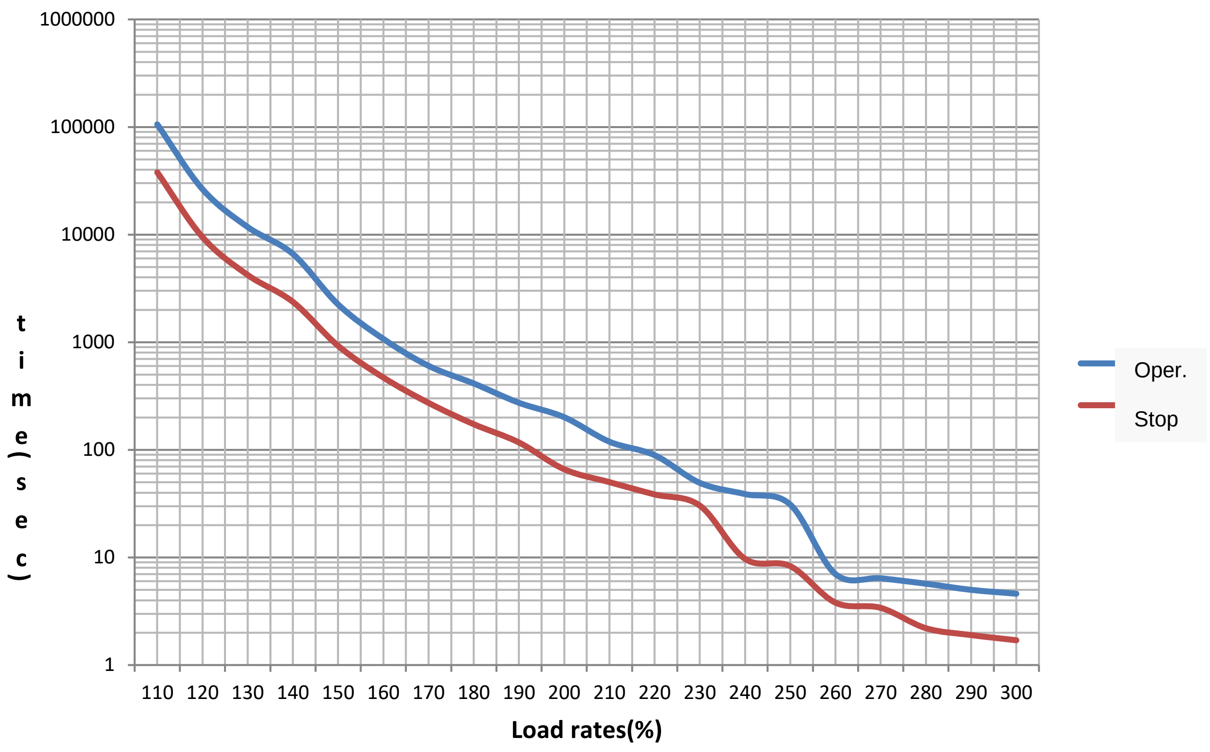
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	55776.0	37935.0	210	66.8	50.1
120	13944.0	9483.0	220	50.1	38.5
130	6197.0	4215.0	230	38.5	30.3
140	3486.0	2371.0	240	30.3	9.7
150	1183.0	926.0	250	24.2	8.3
160	566.0	470.0	260	4.2	3.8
170	318.0	273.0	270	3.8	3.4
180	198.0	173.0	280	3.4	3.1
190	131.0	117.0	290	3.0	2.7
200	92.0	66.0	300	2.7	2.5



■ Overload Operating Characteristic Curve (750W, 1kW)

200[V]/750[W], 1.0[kW]

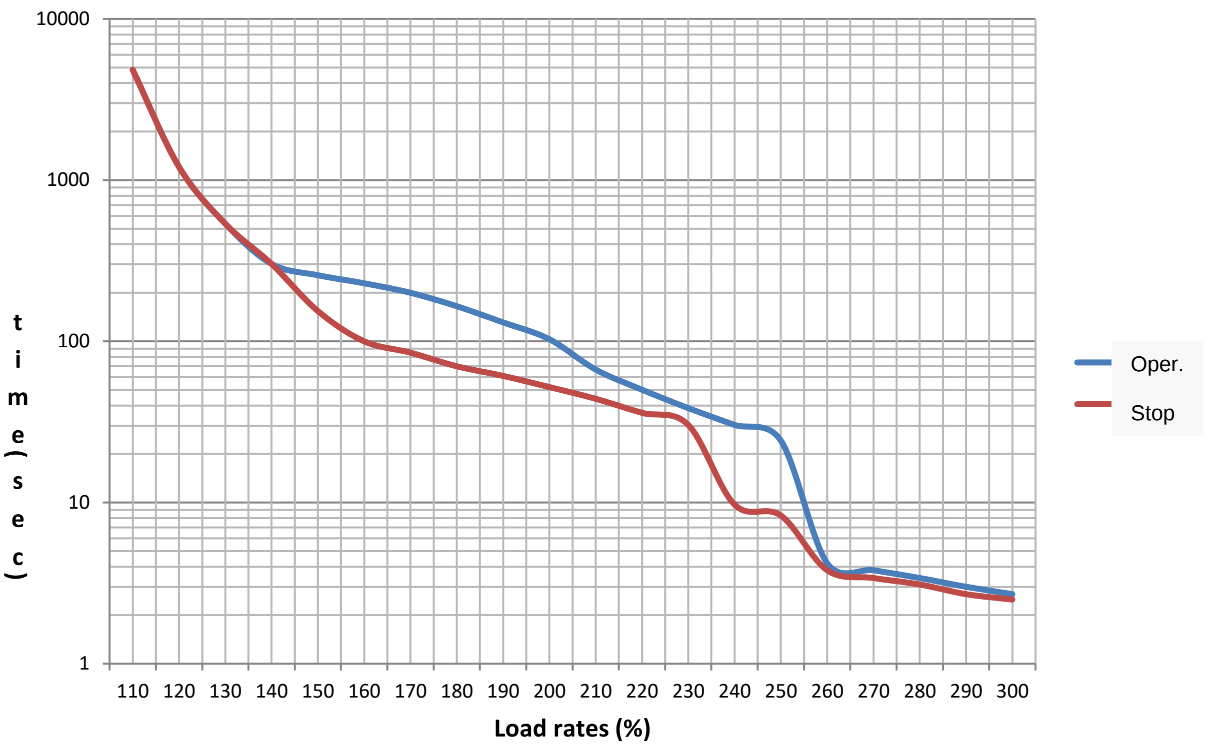
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	105800.0	37935.0	210	119.0	50.1
120	26450.0	9483.0	220	89.2	38.5
130	11755.5	4215.0	230	49.3	30.3
140	6612.5	2371.0	240	38.8	9.7
150	2244.0	926.0	250	31.0	8.3
160	1073.6	470.0	260	7.0	3.8
170	603.2	273.0	270	6.4	3.4
180	413.6	173.0	280	5.7	2.2
190	273.6	117.0	290	5.0	1.9
200	201.0	66.0	300	4.6	1.7



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

200[V]/2[kW], 3.5[kW]

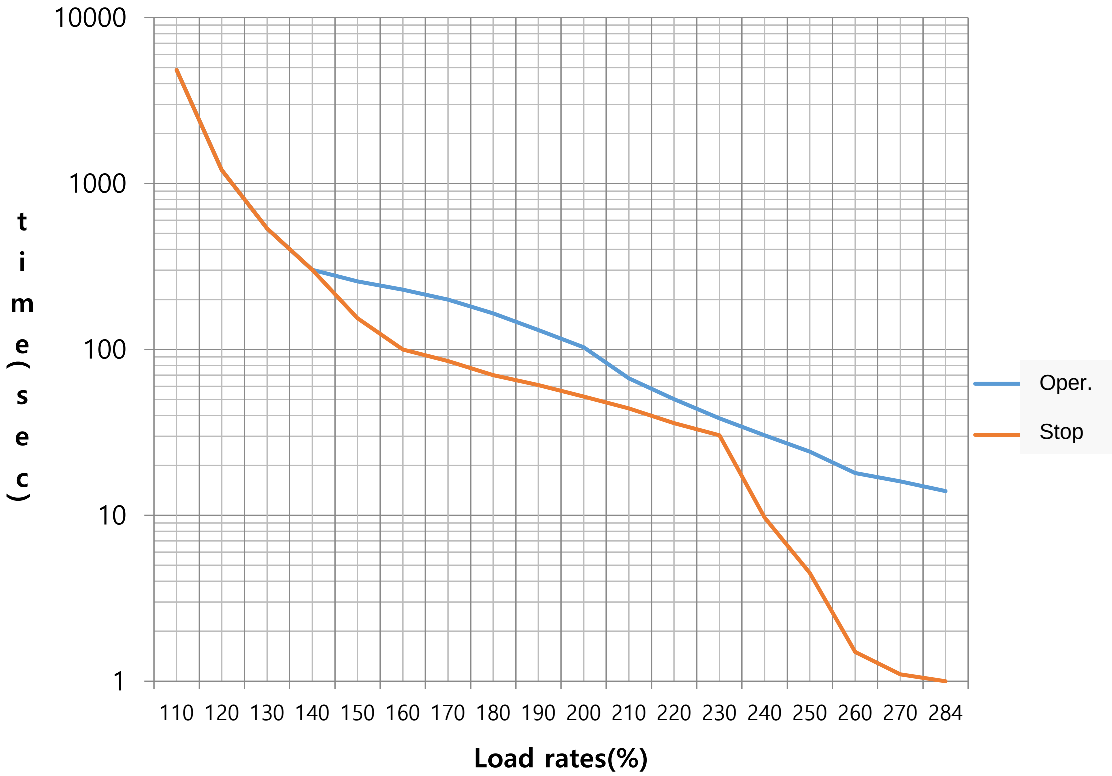
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	4832	4832	210	66.8	44
120	1208	1208	220	50.1	36
130	536	536	230	38.5	30.3
140	302	302	240	30.3	9.7
150	257	154	250	24.2	8.3
160	229	100	260	4.2	3.8
170	200	85	270	3.8	3.4
180	165	70	280	3.4	3.1
190	131	61	290	3.0	2.7
200	103	52	300	2.7	2.5



■ Overload Operating Characteristic Curve (5kW)

200[V]/5[kW]

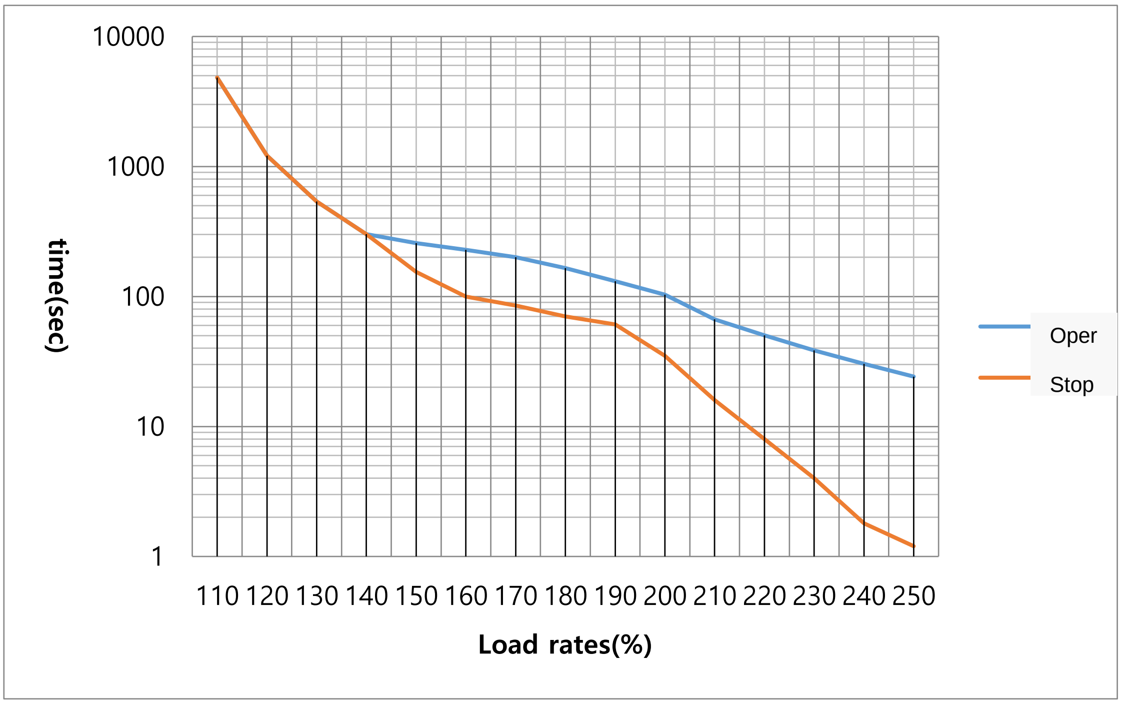
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	4832	4832	210	66.8	44
120	1208	1208	220	50.1	36
130	536	536	230	38.5	30.3
140	302	302	240	30.3	9.7
150	257	154	250	24.2	4.5
160	229	100	260	18	1.5
170	200	85	270	16	1.1
180	165	70	284	14	1
190	131	61	290		
200	103	52	300		



■ Overload Operating Characteristic Curve (7.5kW)

200[V]/7.5[kW]

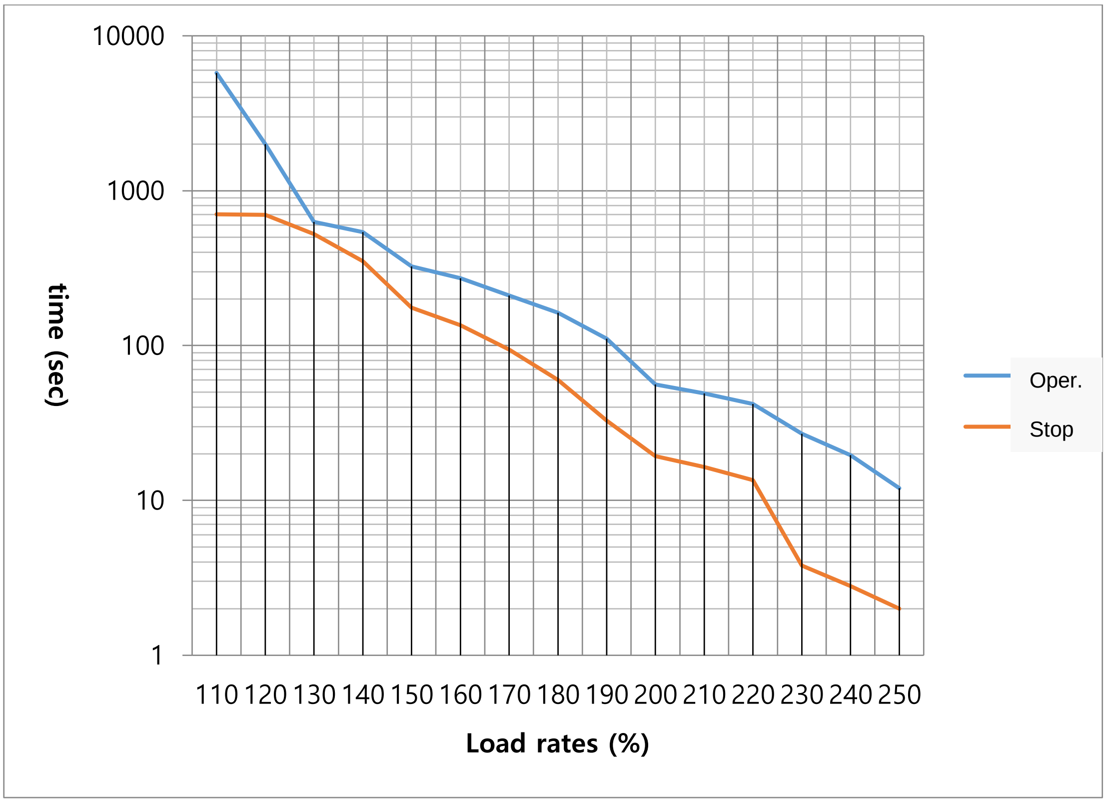
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	4832	4832	210	66.8	16
120	1208	1208	220	50.1	8
130	536	536	230	38.5	4
140	302	302	240	30.3	1.8
150	257	154	250	24.2	1.2
160	229	100	260		
170	200	85	270		
180	165	70	284		
190	131	61	290		
200	103	35	300		



■ Overload Operating Characteristic Curve (15kW)

200[V]/15[kW]

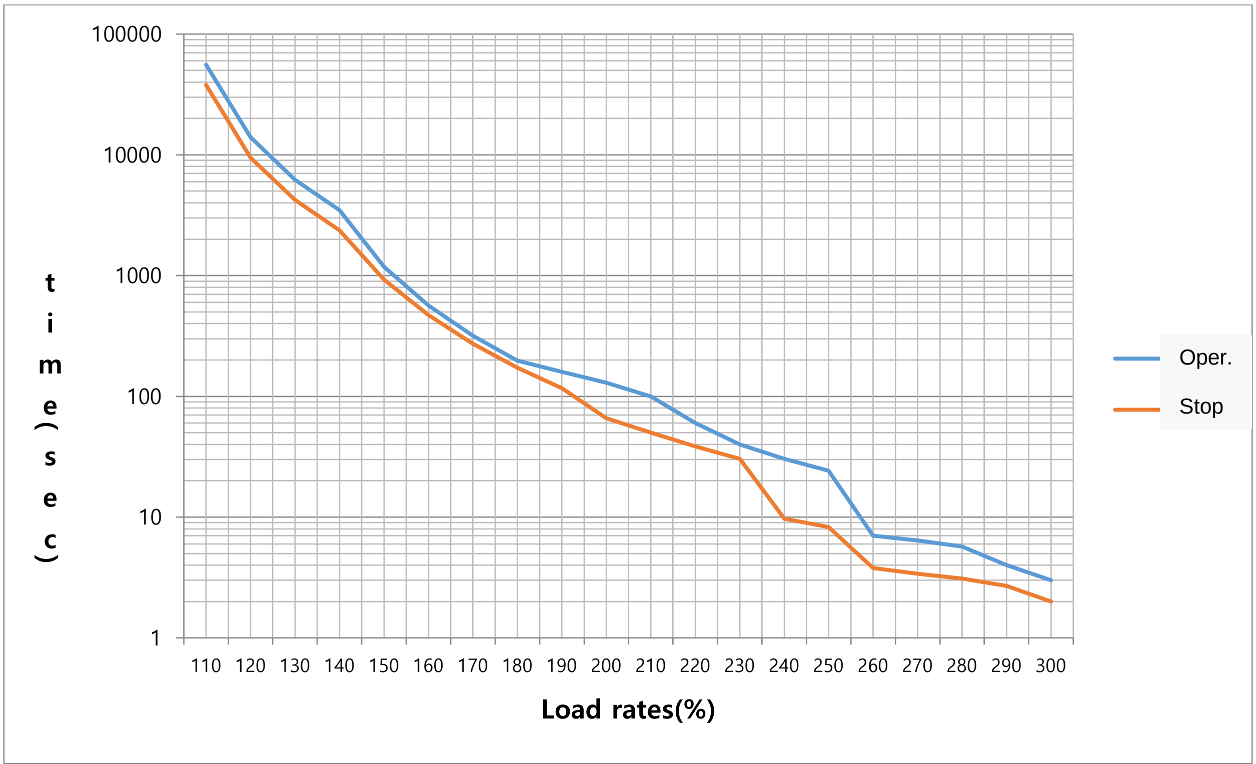
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	4832	4832	210	66.8	44
120	1208	1208	220	50.1	36
130	536	536	230	38.5	30.3
140	302	302	240	30.3	9.7
150	257	154	250	24.2	4.5
160	229	100	260		
170	200	85	270		
180	165	70	284		
190	131	61	290		
200	103	52	300		



■ Overload Operating Characteristic Curve (1.0kW)

400[V]/1.0[kW]

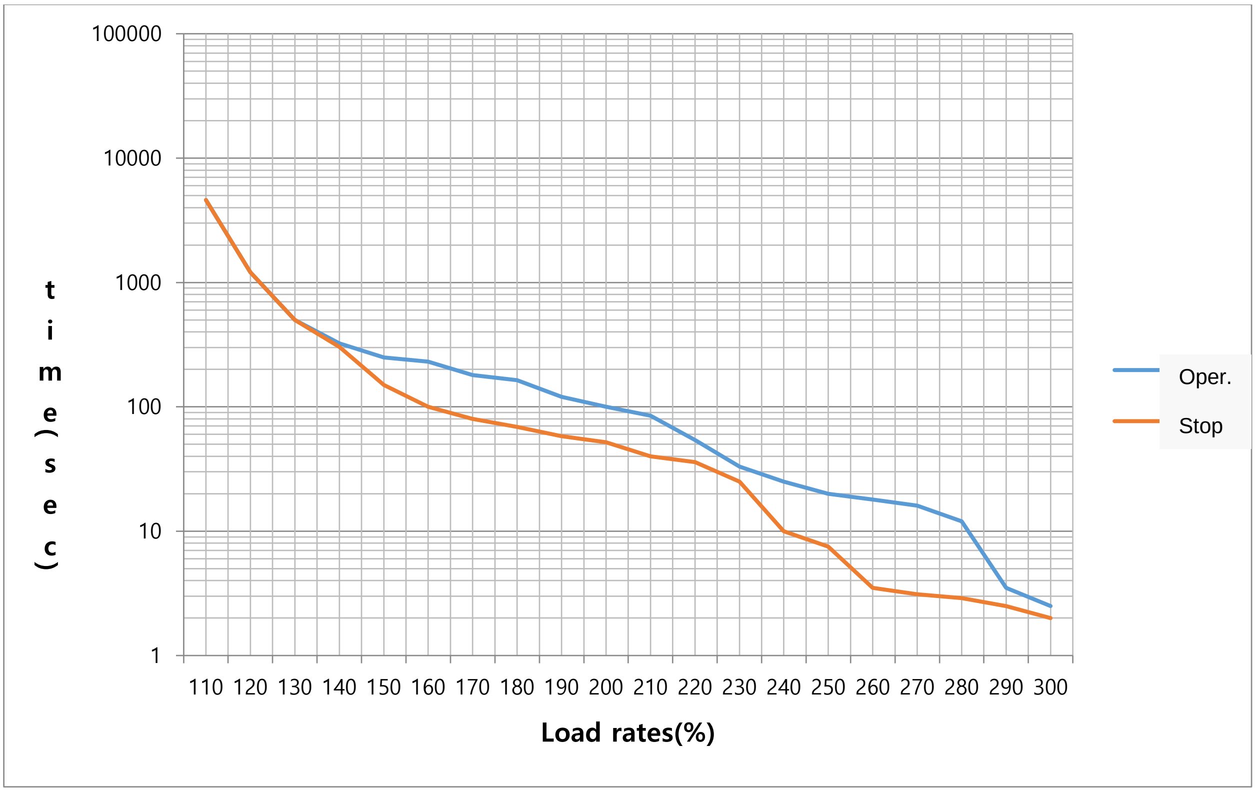
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	55776	37937.7	210	100	50.1
120	13944	9483.9	220	60	38.5
130	6197.3	4215.1	230	40	30.3
140	3486	2371	240	30.3	9.7
150	1183	926	250	24.2	8.3
160	566	470	260	7	3.8
170	318	273	270	6.4	3.4
180	198	173	280	5.7	3.1
190	160	117	290	4	2.7
200	130	66	300	3	2



■ Overload Operating Characteristic Curve (2.0kW, 3.5kW)

400[V]/2.0[kW], 3.5[kW]

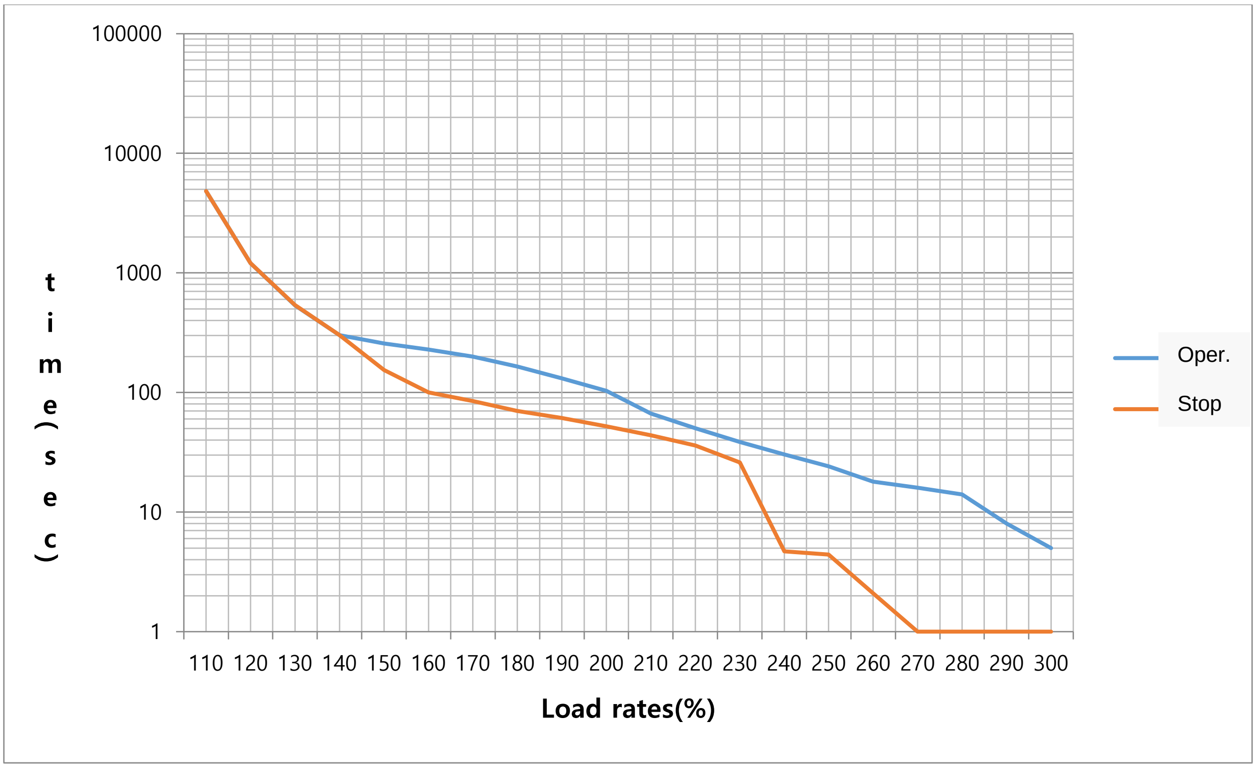
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	4602	4600	210	85	40
120	1208	1208	220	54	36
130	500	500	230	33	25
140	323	303	240	25	10
150	250	150	250	20	7.5
160	231	100	260	18	3.5
170	180	80	270	16	3.1
180	164	69	280	12	2.9
190	120	58	290	3.5	2.5
200	100	52	300	2.5	2



■ Overload Operating Characteristic Curve (5.0kW)

400[V]/5.0[kW]

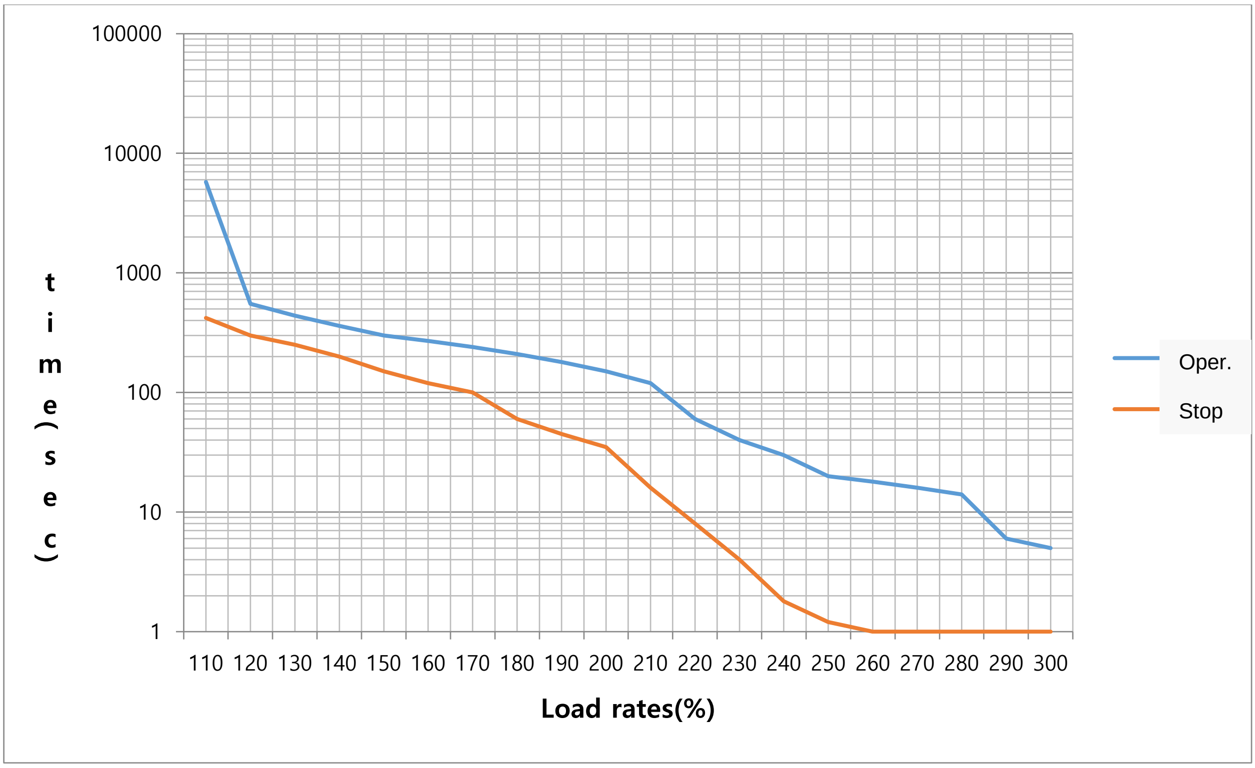
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	4832	4832	210	66.8	44
120	1208	1208	220	50.1	36
130	536	536.8	230	38.5	26
140	302	302	240	30.3	4.7
150	257	154	250	24.2	4.4
160	229	100	260	18	2.1
170	200	85	270	16	1
180	165	70	280	14	1
190	131	61	290	8	1
200	103	52	300	5	1



■ Overload Operating Characteristic Curve (7.5kW)

400[V]/7.5[kW]

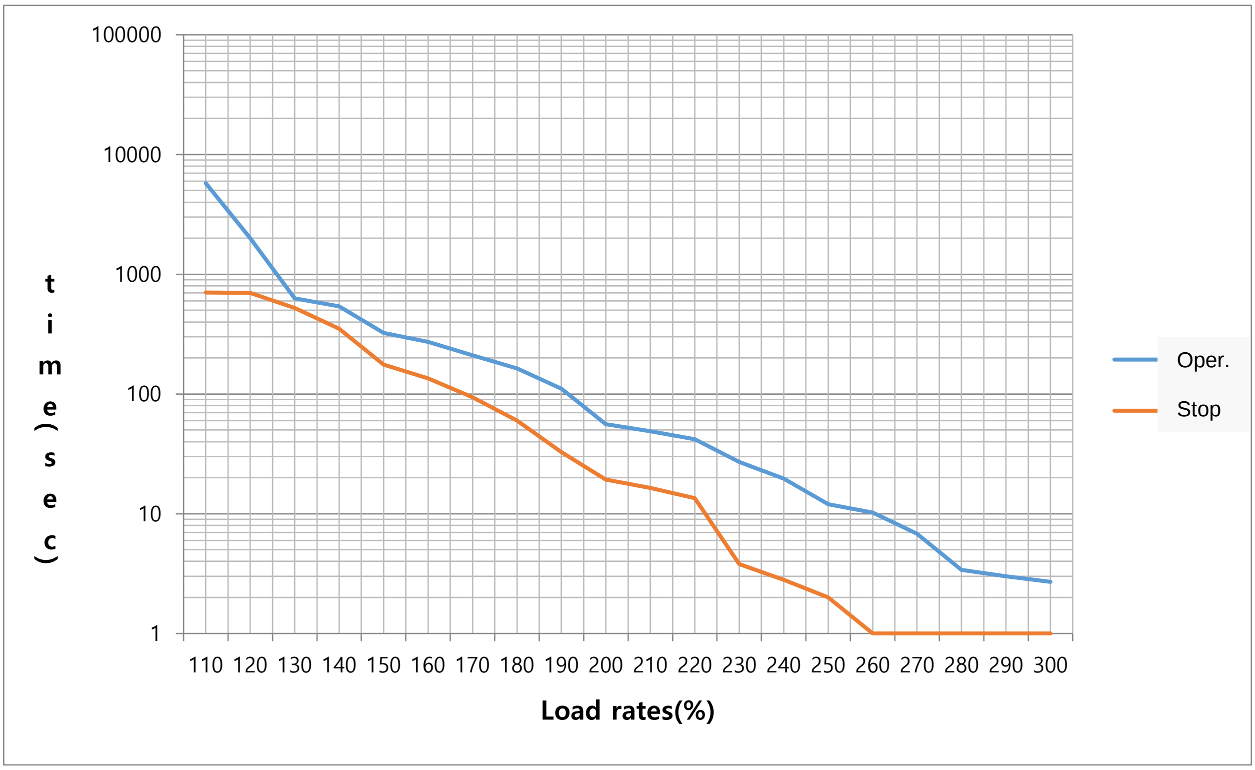
Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	5760	420	210	120	16
120	550	300	220	60	8
130	440	250	230	40	4
140	360	200	240	30	1.8
150	300	150	250	20	1.2
160	270	120	260	18	1
170	240	100	270	16	1
180	210	60	280	14	1
190	180	45	290	6	1
200	150	35	300	5	1



■ Overload Operating Characteristic Curve (15.0kW)

400[V]/15[kW]

Load rate (%)	AL-21 occurred time (sec)		Load rate (%)	AL-21 occurred time (sec)	
	Rotation	Stop		Rotation	Stop
Less than equal to 100	Infinite	Infinite	-	-	-
110	5760	704	210	49	16.4
120	1998	698.4	220	42	13.5
130	630	524.2	230	27	3.8
140	540	350.1	240	19.6	2.8
150	324	176	250	12	2
160	271.8	135	260	10.2	1
170	210.6	94	270	6.8	1
180	162.9	60	280	3.4	1
190	111	32.8	290	3	1
200	56	19.3	300	2.7	1



12. Test operation

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.

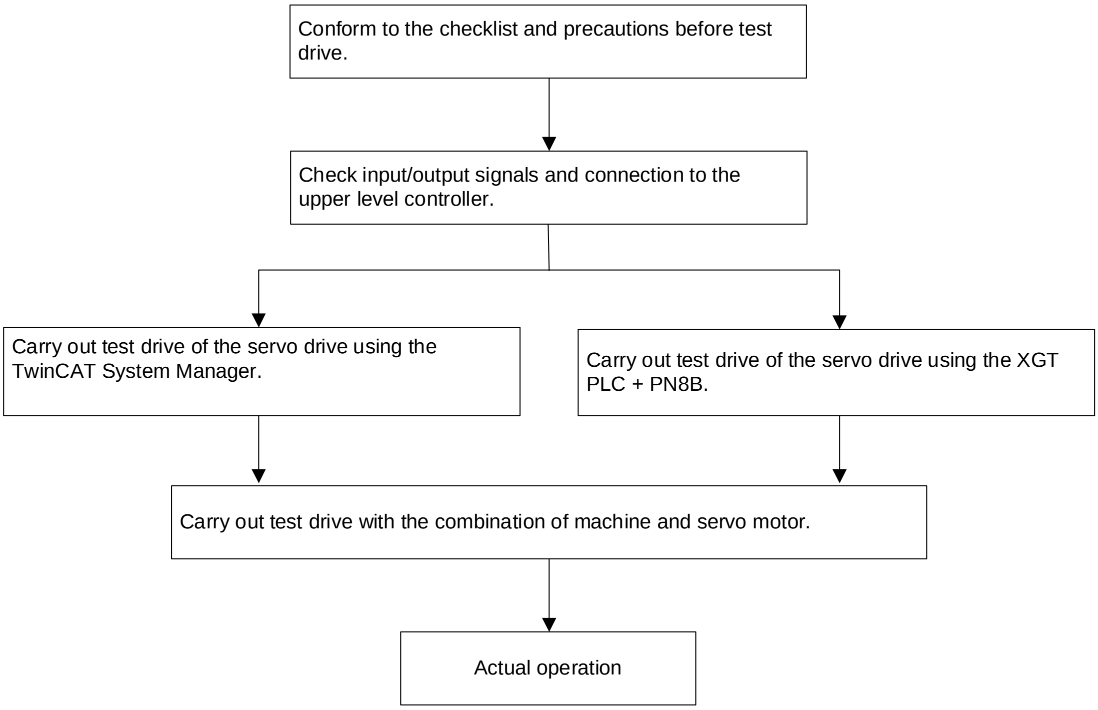
■ Maintenance and Inspection. Servo Drive State

Is the drive correctly installed, wired, and connected?

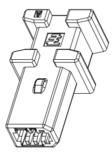
Is the supply voltage for the servo drive correct?

12.1 Preparation for Operation

Carry out test drive in the following order:



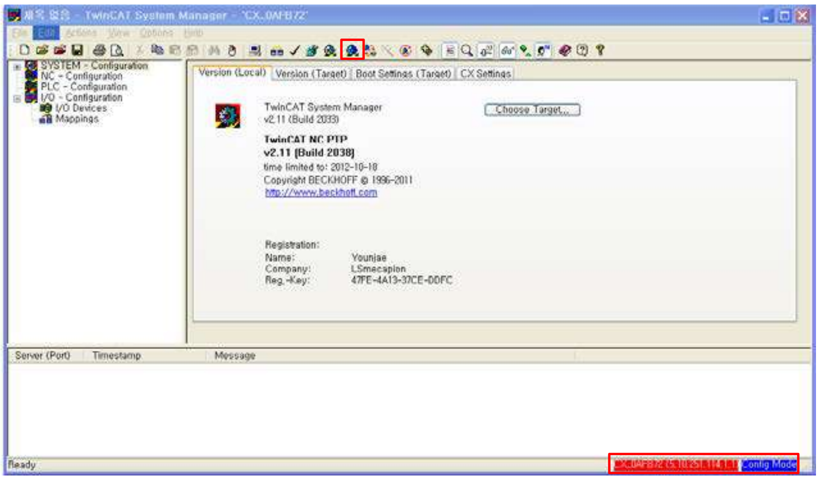
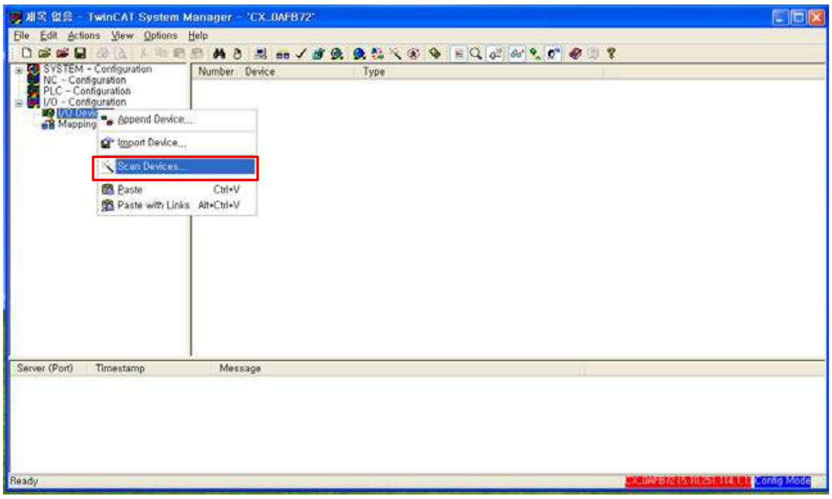
Verify that, before the test drive, the upper level controller and the servo drive are correctly wired, and the objects of the servo drive are correctly configured.

Sequence	Handling	Reference
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 did torque output from the motor. In this case, the panel monitor state at the power ON will be "Stop." (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 Procedure

Sequence	Handling	Reference
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".	

<table>
<tr>
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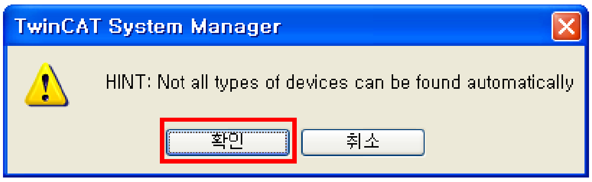
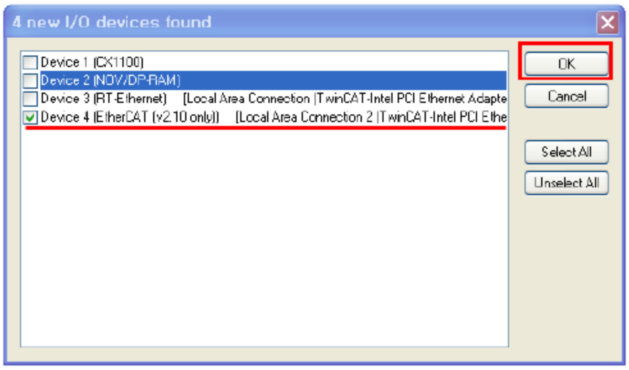
<td>


▪ 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.

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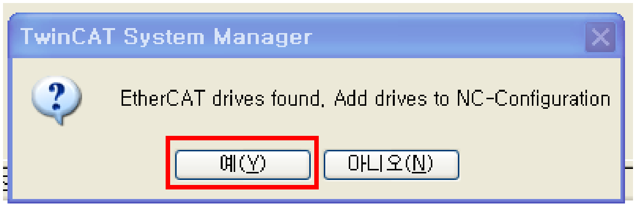
<tr>
<td>6</td>
<td>
Add the NC Task of the servo drive to the NC-Configuration.

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



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<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."

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<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.
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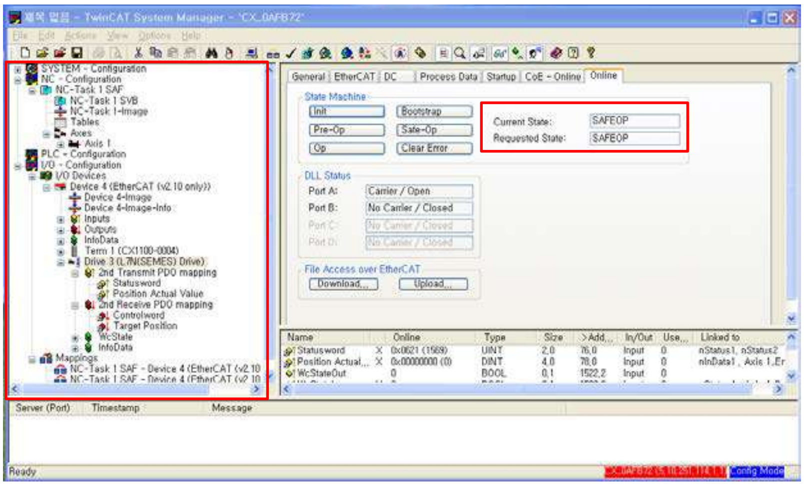
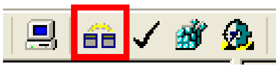


Depending on the type of drive, ‘Drive X (L7xx Drive)’ may be different.

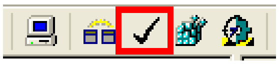
</td><td></td></tr>
<tr><td>9</td><td>

Switch the EtherCAT communication state from the SafeOP state to the OP state, enabling the MailBox Communication and the Process Data Communication.

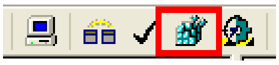
- Click the Generate Mappings icon on the menu bar.
Map the images defined in the NC Task and the I/O Device.



- 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.



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<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.

- 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.

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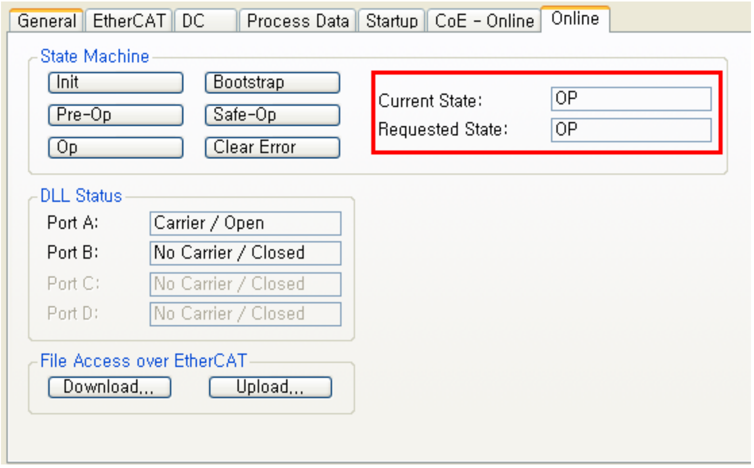
</table>

<table>
<tr><td></td><td>


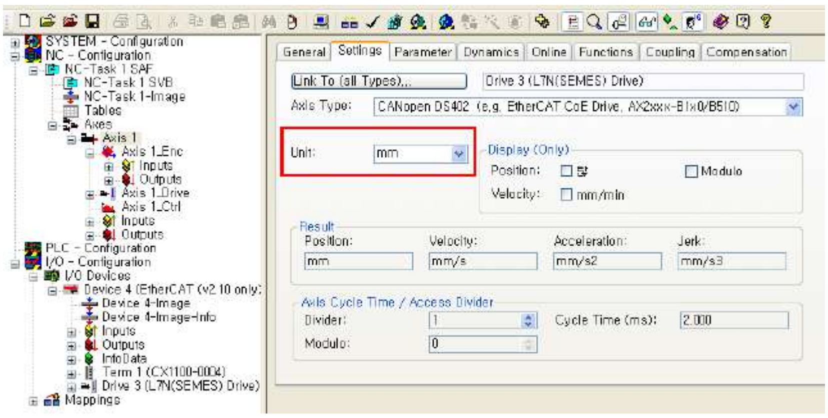
- Verify if the state displayed on the bottom right of the TwinCAT System Manager Menu window is in the Run state.

</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>Sequ
ence</th><th>Handling</th><th>Reference</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.



(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.
</td><td></td></tr>
<tr><td>2</td><td>
Set the Axis Scaling Factor. The Axis Scaling Factor determines the distance of the axial load movement while the motor shaft makes one revolution.

- Select the "Axis1."
- Select the "Parameter" tab.
- Set "Scale Factor."
- Then, download the settings.
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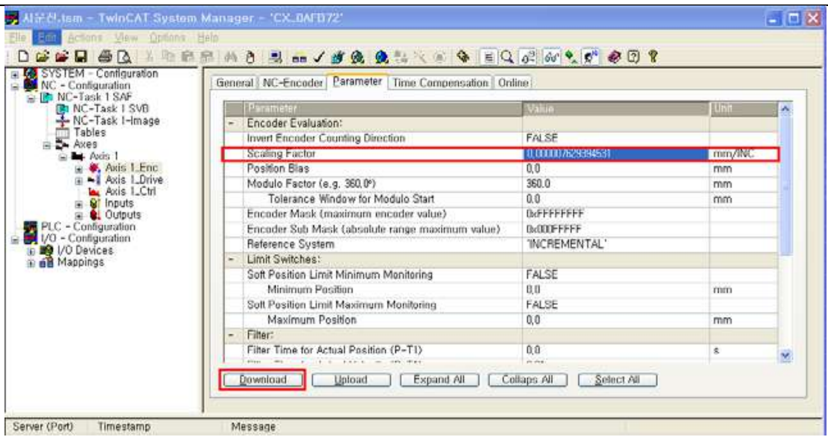

(Note) The default is 0.0001 if the scaling factor is not set.
(Note) After the setting, download the settings.
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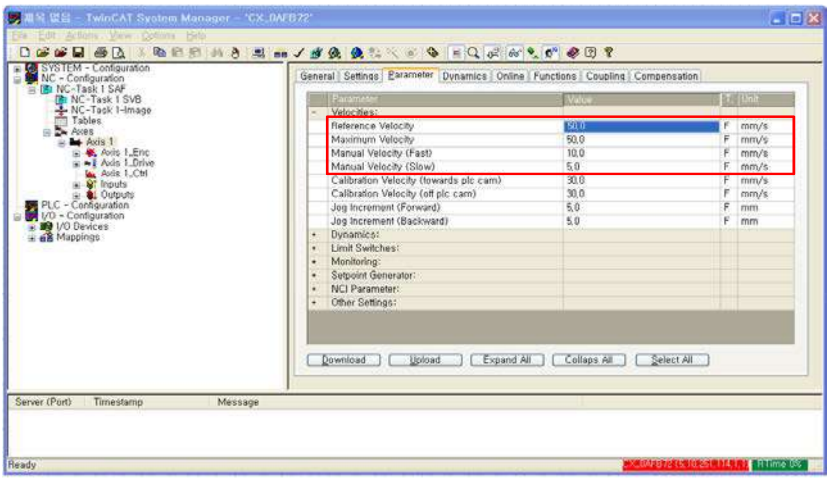
<td>3</td>
<td>
Set the speed parameter of the test drive axis.

Select "Axis 1."
Select the "Parameter" tab.
Set the "Maximum Velocity", the "Manual Velocity (Fast)", and the "Manual Velocity (Slow)." Then, download the settings.



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<tr>
<td>4</td>
<td>
Set the speed, acceleration, and jerk of the test drive axis.
Set the acceleration, deceleration, and jerk directly for the test drive axis; the TwinCAT NC can calculate the acceleration based on the configured profile timing.

Select 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.

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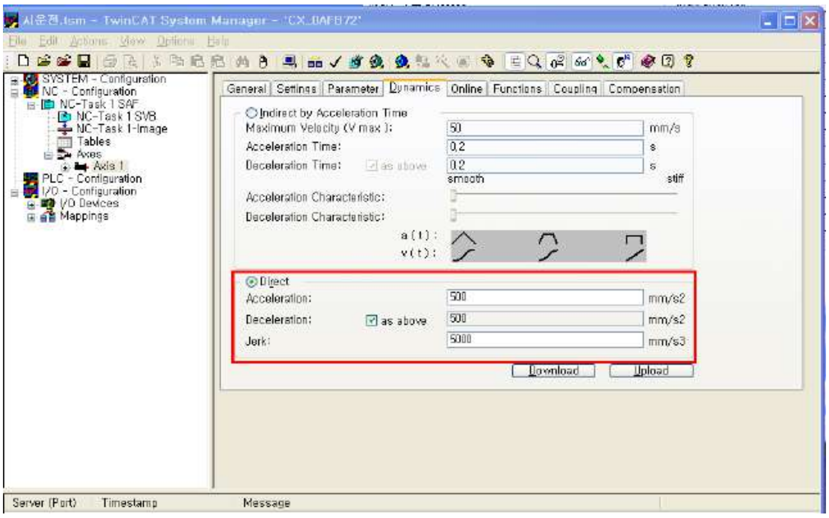
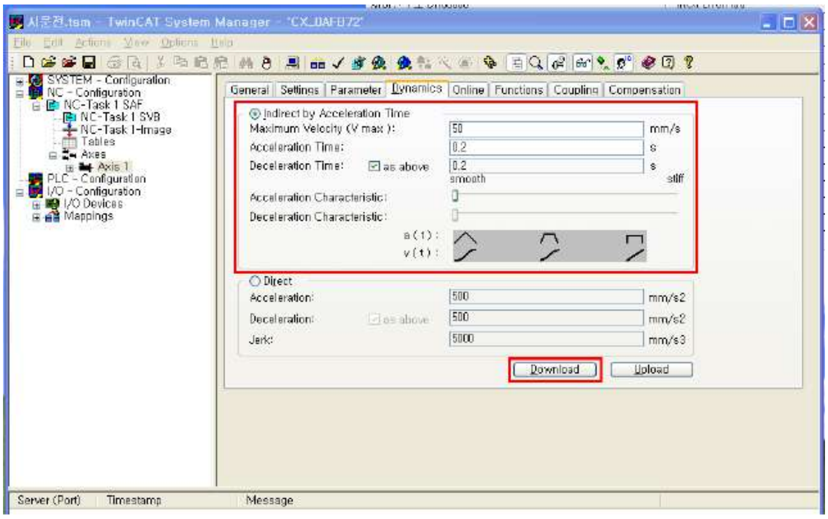


- Set the acceleration, deceleration, and jerk indirectly.

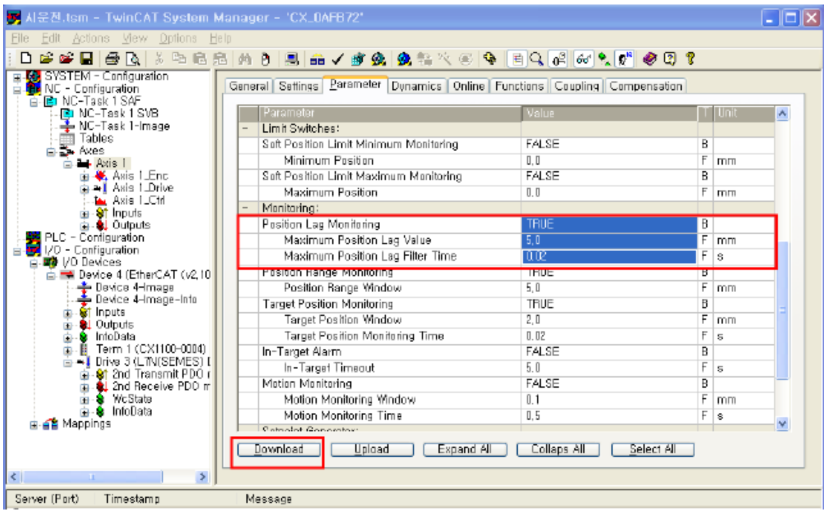
Set the acceleration, deceleration, and jerk indirectly by setting the acceleration time. If you change the acceleration time, the acceleration value will be automatically changed.

- 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.

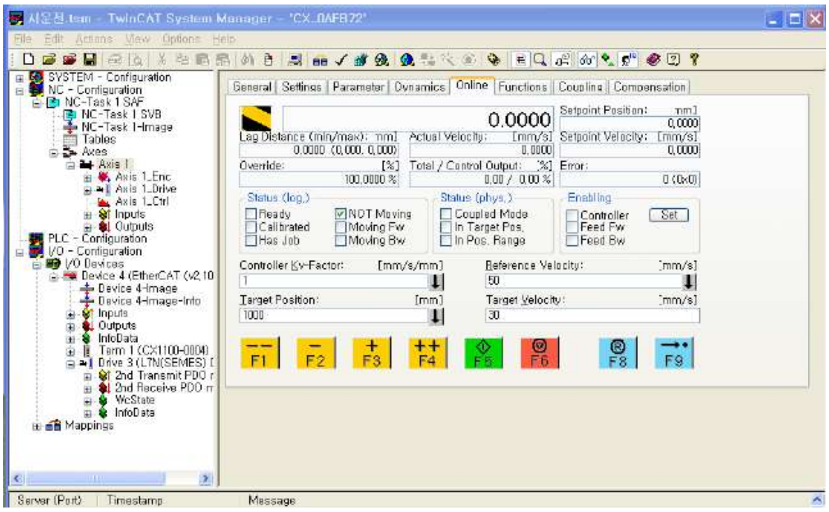


(Note) The Position Lag Monitoring is the difference between the position reference and the actual position at a given cycle time. When the Position Lag Monitoring is enabled, the TwinCAT NC generates an alarm if the positional error exceeds the settings.

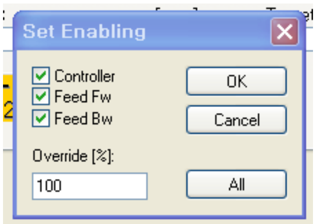
■ Test Drive of Servo Drive Using TwinCAT NC Axis

<table>
<tr><th>Sequence</th><th>Handling</th><th>Reference</th></tr>
<tr><td>1</td><td>
Make sure that the TwinCAT NC axis is "Servo On."

- Select "Axis 1."
- Select the "Online" tab.

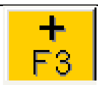
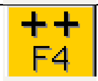


- Click the "Set" button.

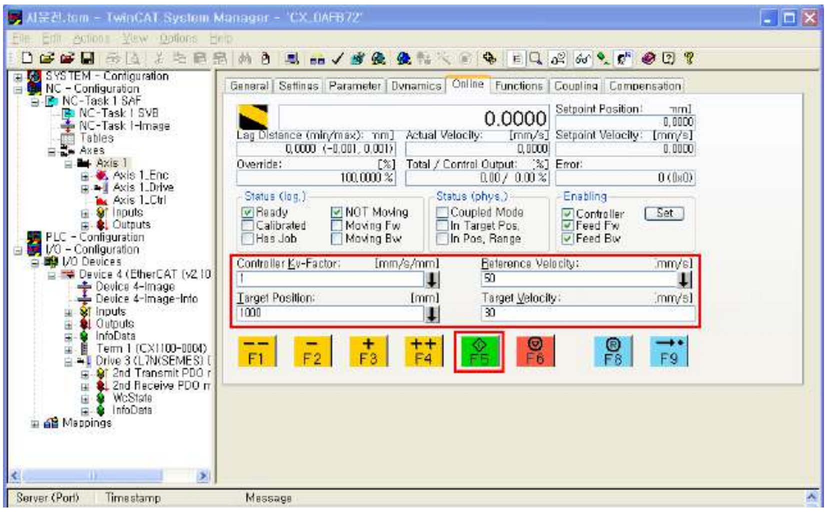
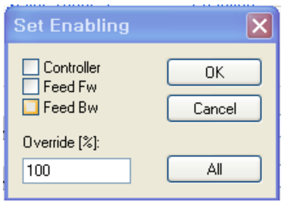


- Select "Controller", "Feed Fw", and "Feed Bw."
- Set the Override to 100%.
- Click the "OK" button.
- Make sure that the state of the servo drive panel monitor is as the figure below:


</td><td></td></tr>
<tr><td>2</td><td>
Use the buttons shown below to manually perform the drive test (JOG).

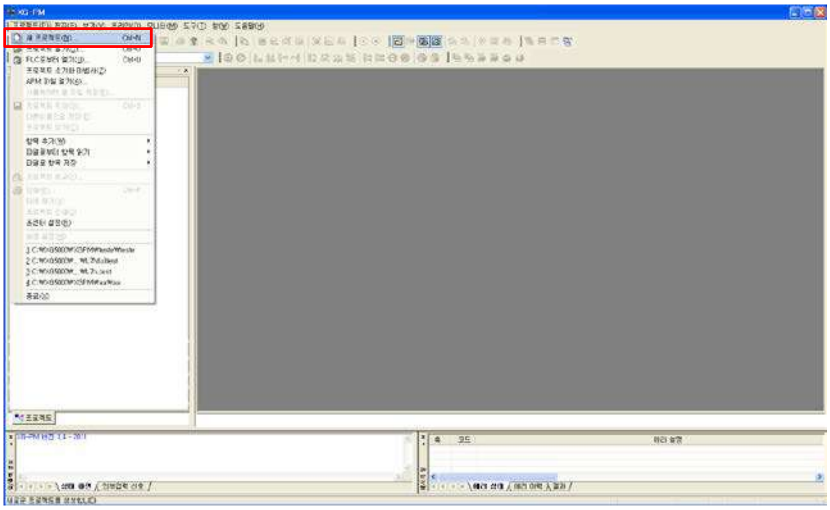
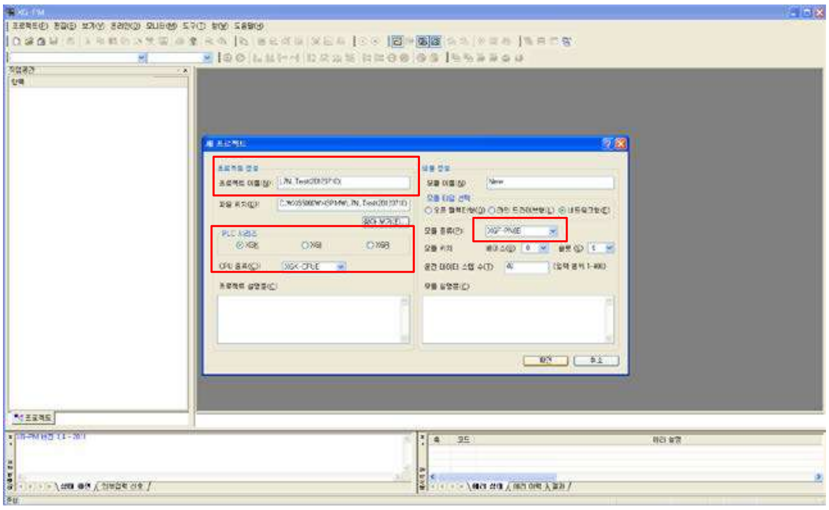
<table>
<tr><td></td><td>Make a reverse rotation at the specified Manual Velocity (Fast).</td></tr>
<tr><td></td><td>Make a reverse rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Make a forward rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Make 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.

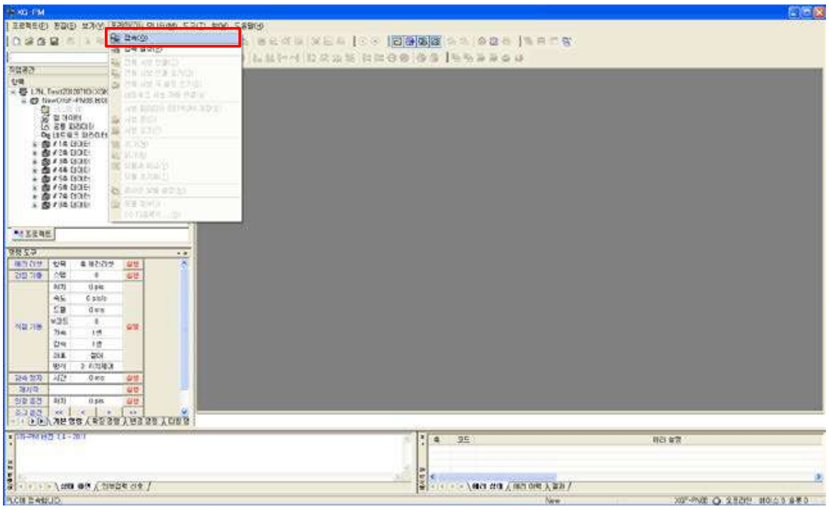
- Set the "Target Position."
- Set the “Target Velocity.”
- Click “F5.”
</td><td></td></tr>
</table>

	 ▪ 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.	
4	Make sure that the TwinCAT NC axis is "Servo Off." ▪ Click "Set." ▪ Deselect "Controller", "Feed Fw", and "Feed Bw." ▪ Click "OK". 	
5	The test drive of servo drive using the TwinCAT NC axis is completed.	

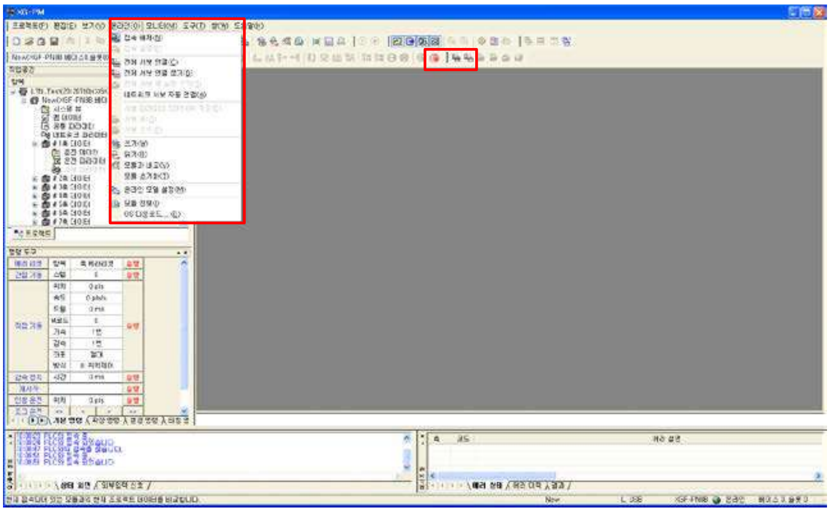
12.3 Test Drive Using LS ELECTRIC PLC (XGT + PN8B)

■ Test Procedure

Sequence	Handling	Reference
1	Launch the XG-PM.	
2	Opens 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.	



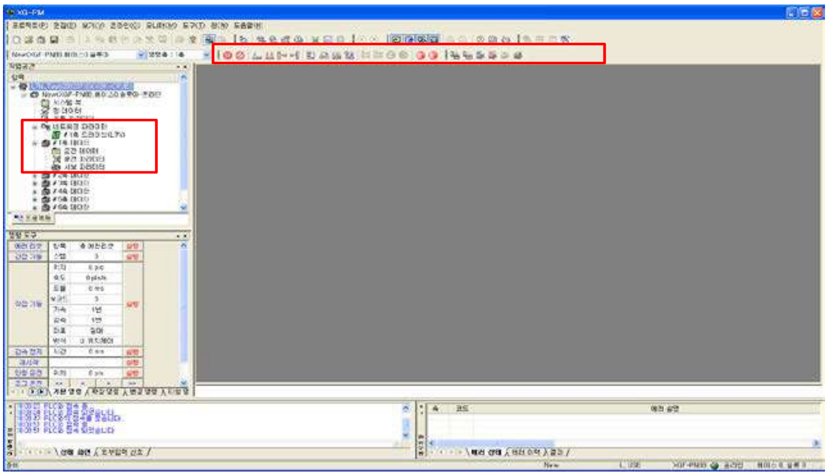
- When the PC and the PLC are connected, the connection between the PLC and the servo drive will be enabled as shown in the figure below:

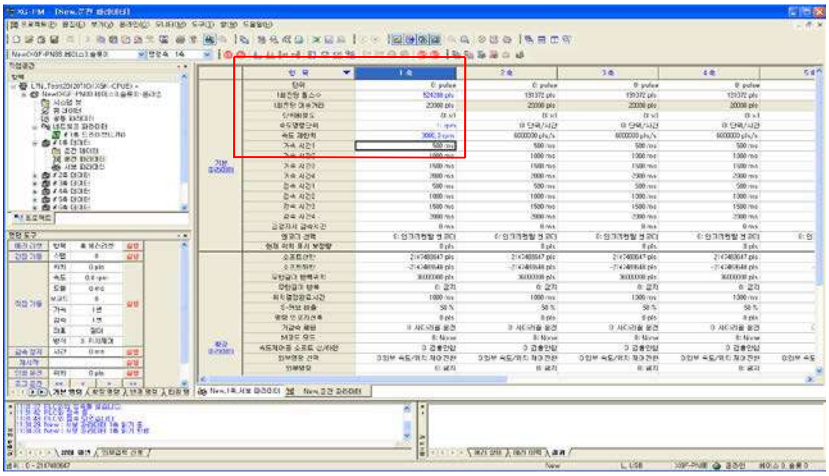


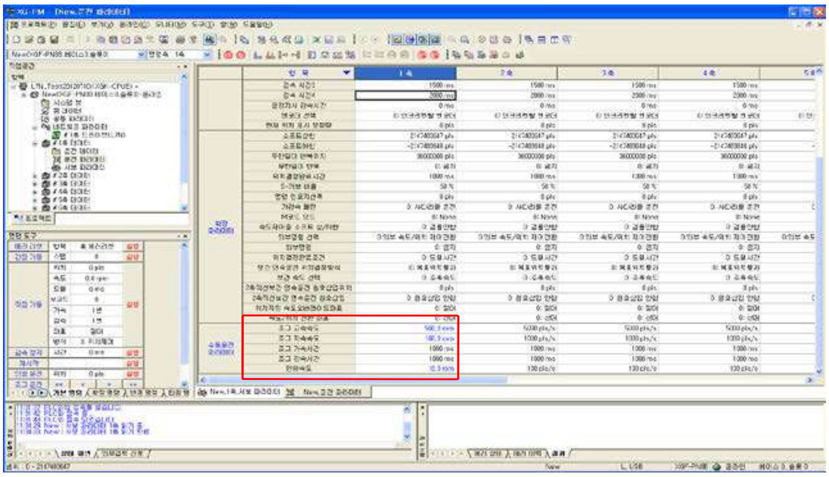
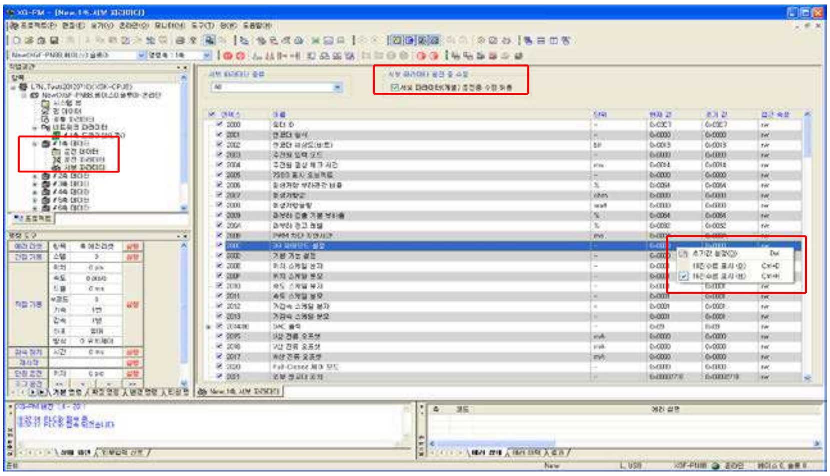
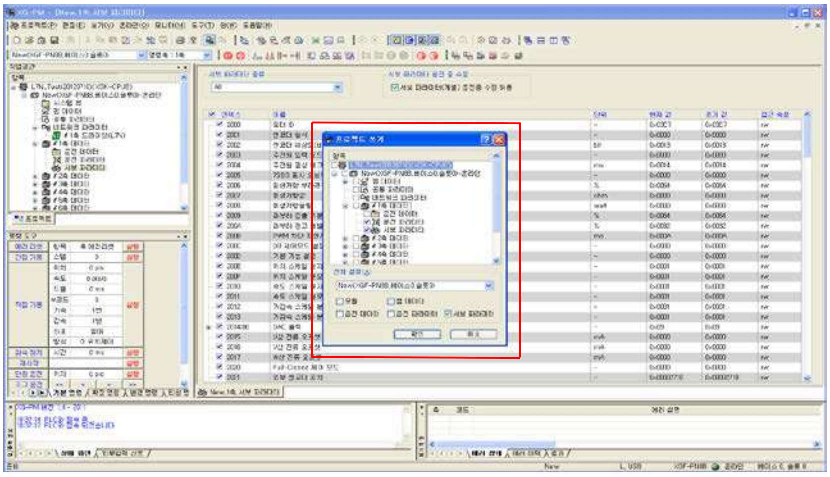
5

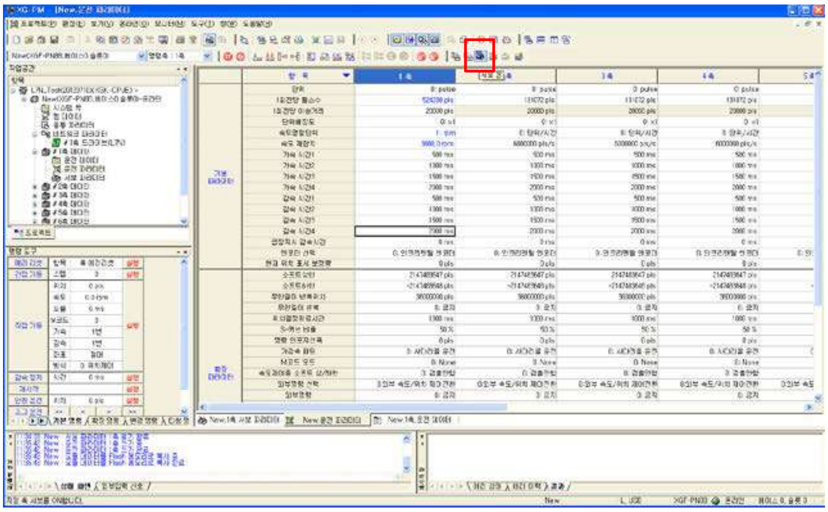
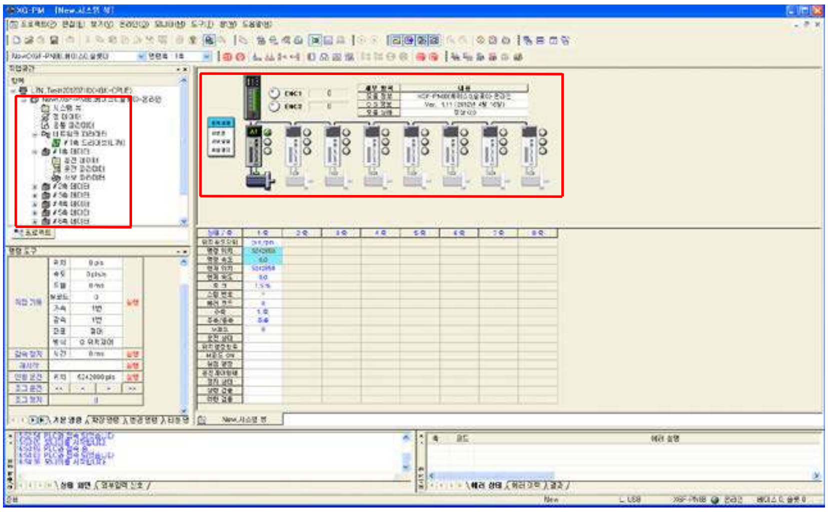
Connect PLC with Servo Drive.

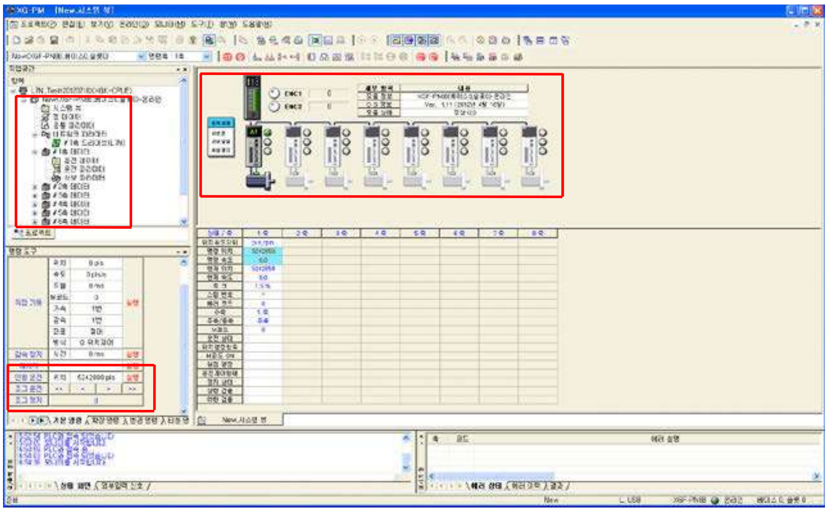
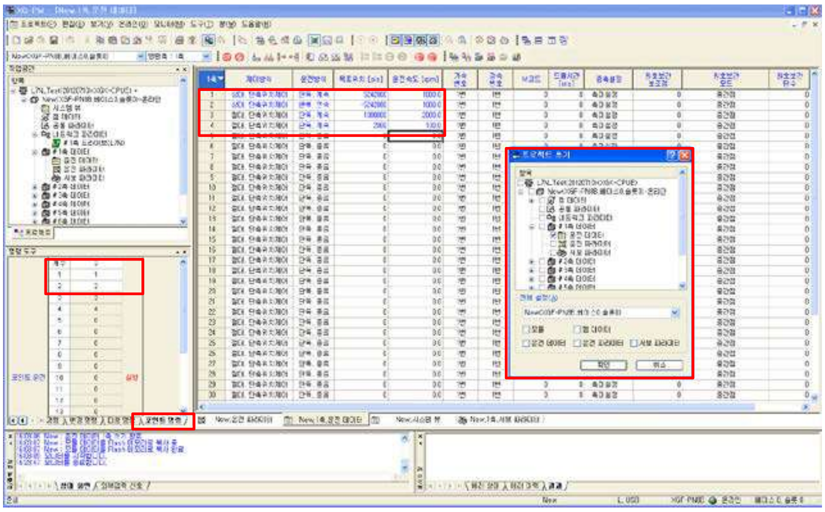
- For the first connection, enable the network parameters and the servo parameters in the workspace on the left through "Connect Network Servo Automatically."
- After the servo drive and the PLC are connected, the servo parameters and the motor test drive function will be enabled.
- Connecting multiple shafts enables the servo parameters as many as the number of the connected shafts.



	*** Depending on the type of drive, '# axis1 drive (L7xx)' may be different.** ▪ 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. 	
8	Set the Driving Parameters of Test Drive Axis → Manual Operation (Jog) Parameters.	

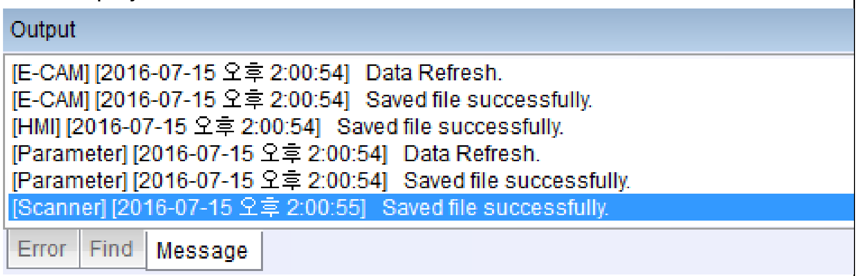
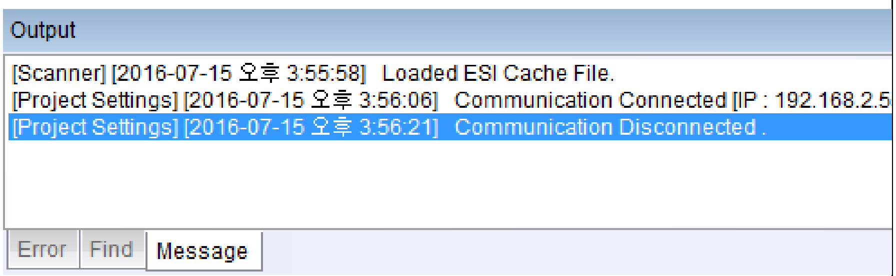
		
9	Set the servo parameters of the test drive axis.  ▪ Select parameters that you want to change, and then change them. ▪ To change any parameter during operation, check the "Allow to Modify Servo Parameters during Operation" checkbox at the top center. ▪ You can display a parameter value as a decimal or hexadecimal.	
11	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. 	
12	Turn on the servo. ▪ On the menu bar, click the Servo ON icon to turn on the servo of the servo drive of the test drive axis.	

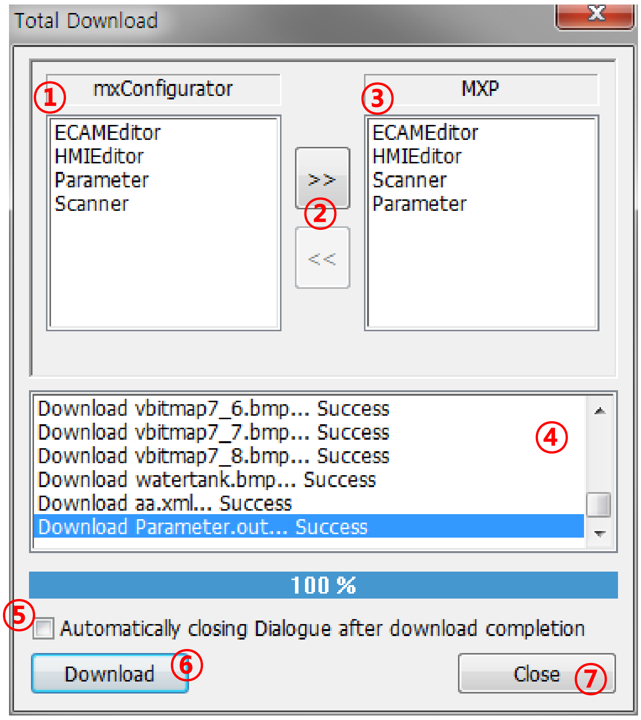
		
13	Save the configured parameters. ▪ Select the "System View" and the "Basic Command" tabs in the workspace to check the state of the servo drive as shown in the figure below:  ▪ Make sure that the state of the servo drive panel monitor is as the figure below:  ▪ Check the state of the status LEDs. The Link/Activity LED is flickering. The RUN LED is on.	
14	Test drive using jog operation and inching operation	

	 ▪ For the "Jog Operation," the motor is driven with the settings of the operation parameters. ▪ For the "Inching Operation," the motor moves to the entered position. ▪ After entering the position value, click the "Run" button to carry out the test drive.	
15	Point to Point Test Drive ▪ Select Workspace → Command Tool → Point Command tab. ▪ Set the operation data. ▪ On the "Point Command" tab in the workspace, specify the number 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. 	
16	Drive commissioning using XGT completed.	

12.4 Test Drive Using LS Mecapion MXP Series

■ Test Procedure

Sequence	Handling	Reference
1	Check if the ESI file exists. ▪ MXP installation path\MXP-CONFIGRATOR\System\Scanner\EtherCAT ▪ If the ESI file does not exist in the above path, copy and paste it.	
2	< Online Scan > ▪ First, it checks whether MXP Init is enabled or not.  ▪ If you right-click on the Master device of Network Scanner and start Scan Devices, network device information is read. ▪ Configure device information based on ESI file of connected device.	
3	< Save project > ▪ Execute [Save Project] in the [Project] menu or click on the tool bar to save the project  	
4	< Integrated download > ▪ Execute [Communication Settings] in the [On-line] menu and set the TCP/IP setting to the internal port [127.0.0.1]. ▪ Execute [On-Line] / [Off-Line] in the [On-Line] menu or click on the tool bar to request communication connection / disconnection with MXP [On-Line]. ▪ You can check whether communication is connected through the output window.  ▪ Execute [Total Download] in the [On-Line] menu or click on the toolbar to activate the [Total Download] window as shown below.	



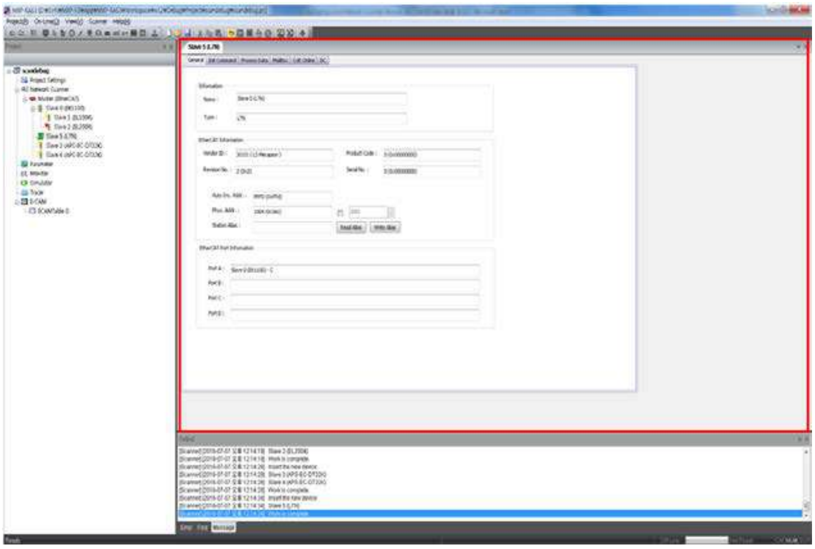
Classification	Function
1	Choose what to download from the current project
2	Move selected button
3	Display items to be downloaded
4	Show current download status
5	Check whether automatic window close function is used after download is completed
6	Download start button
7	Window close button

5

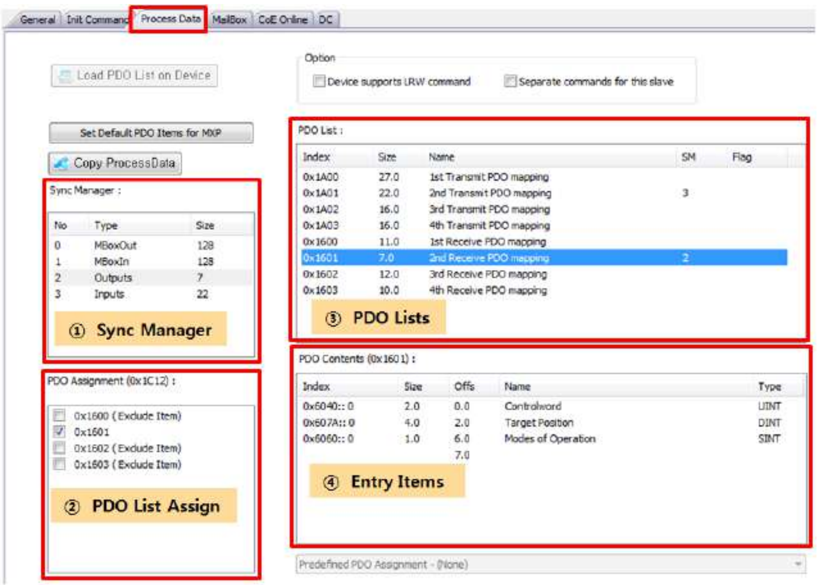
< Process Data mapping >

After scanning the servo drive, the PDO (Process Data Object) mapping function is explained.

- If you double-click the Slave device in the left Device tab of mxConfigurator, the edit window is displayed as shown in the red box on the right side of the figure.



- PDO items can be edited through the Process Data Tab in the edit window of the servo drive.



- The Process Data screen is composed as shown in the figure.
  - ① Sync Manager
    - This is a list of Sync Managers that the device has.
    - The PDO list set in the Inputs/Outputs item is read and written every communication cycle.
  - ② PDO List Assign
    - A list of PDO lists that can be selected from the corresponding SM (Sync Manager) is displayed.
    - By setting the checkbox, you can select the PDO list to be sent and received in each communication cycle.
    - Depending on the PDO list properties, selecting a specific PDO list may disable duplicate selection of other PDO lists.

③ PDO Lists

- This is an object list that contains data objects.

④ Entry Items

- Data Object registered in the PDO list.
- You can add/delete items through the right-click menu.

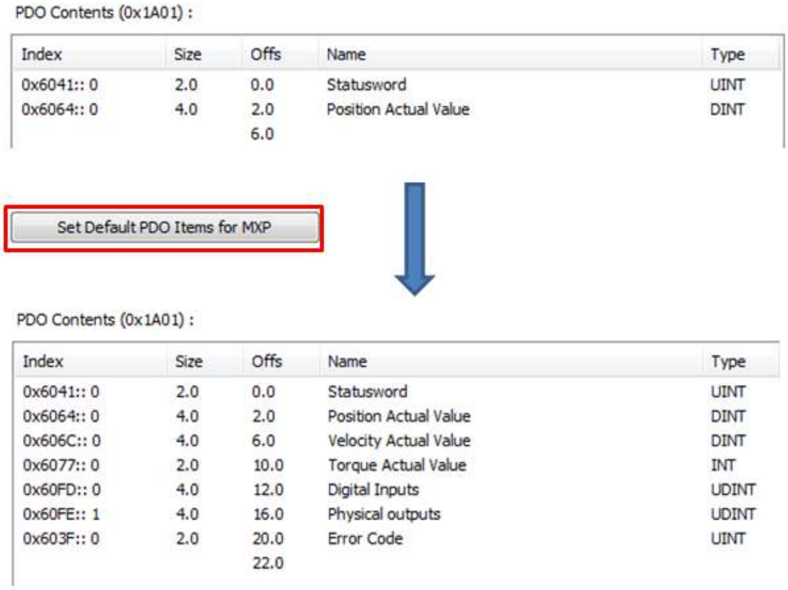
Caution The configuration of PDO data required to use all functions of MXP axis control parameter is as follows.

■ **PDO Inputs**

Index	Type	Size	Name
0x603F	UINT	2	Error Code
0x6041	UINT	2	StatusWord
0x6064	DINT	4	Position Actual Value
0x606C	DINT	4	Velocity Actual Value
0x6077	INT	2	Torque Actual Value
0x60FD	UDINT	4	Digital Inputs
0x60FE	UDINT	4	Physical Outputs
		22	

■ **PDO Outputs**

Index	Type	Size	Name
0x6040	UINT	2	ControlWord
0x6060	SINT	1	Mode Of Operation
0x607A	DINT	4	Target Position
0x60FF	DINT	4	Target Velocity
0x6071	INT	2	Target Torque
		13	

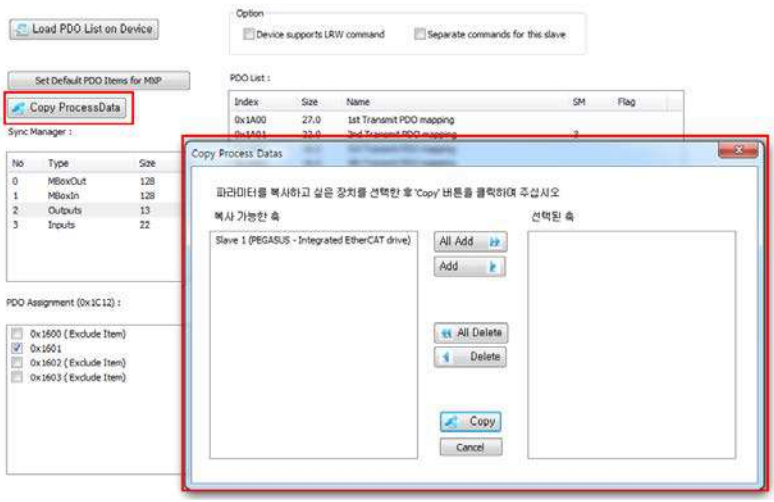


Picture1– Set Default PDO Items for MXP function screen

- Set Default PDO Items for MXP is a function provided only to our servo drives. This is a function that allows you to set items that must be PDO mapping for control using MXP with one click.

If you have multiple identical devices, you can simply copy them using the Copy Process Data function.

< Copy Process Data >



Picture2- Copy Process Data

Click the “Copy Process Data” button to display the process data copy setting window as shown in the figure.

Copying process data is possible only for the same model.

After completing the PDO assign of the slave to be copied, click the “Copy Process Data” button and double-click the slave device to be copied or add it to the selected device list with the “Add” button.

At this time, only devices of the same model that can be selected are displayed. When the selection is complete, click the “Copy” button to complete the copy.

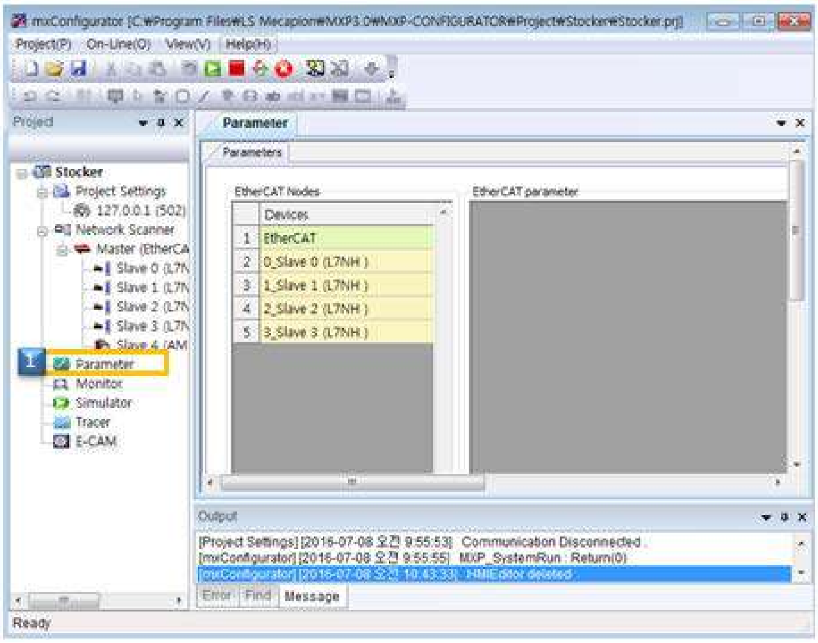
6

< Axis parameter setting >

MXP motion controller has Axis Parameter of each servo drive (motor).

This is configured separately from the servo parameters stored in the servo drive.

Axis parameters of the MXP motion controller can be executed by double-clicking the parameters in the Project tab.

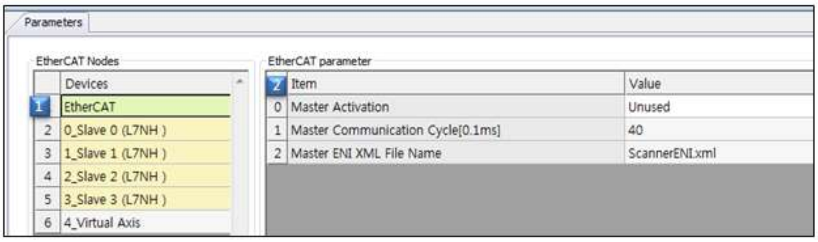


Parameter Editor has two configuration configurations as shown below.

- ✓ EtherCAT
  - E You can check EtherCAT communication and additional items.
- ✓ Axis
  - Parameters of the servo drive can be set.

< EtherCAT>

Check the settings related to EtherCAT communication and set Master Activation.



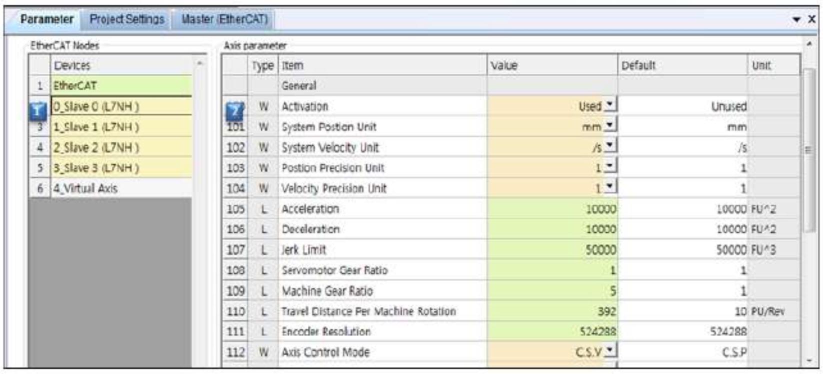
Master Activation

By setting the Master Activation item, you can select the presence or absence of simulation operation.

When [Unused] is set, it operates in simulation mode without actual communication, and when [Used] is set, actual communication is performed.

< Axis Parameter>

Set the Axis Parameter of MXP. The axis setting screen is as follows



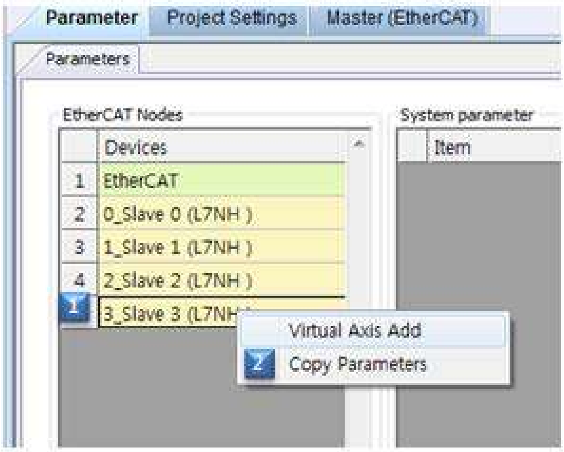
This manual simply describes the minimum parameter settings for servo drive test. For each parameter setting guide, please refer to the Help (F1) document of mxConfigurator.

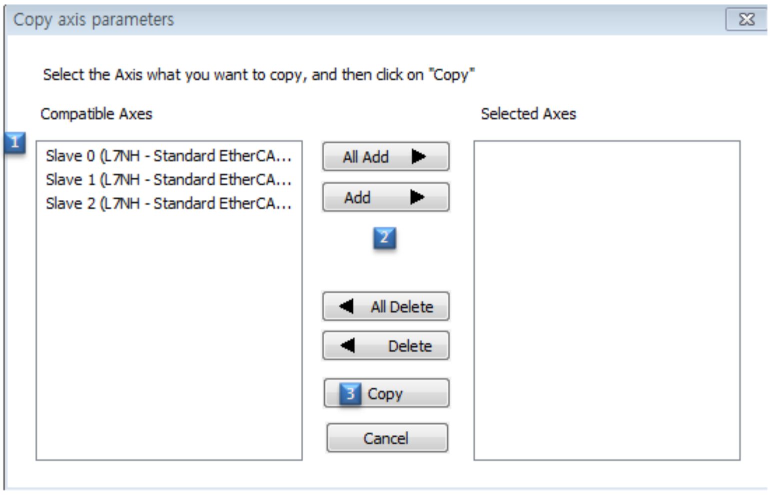
1) Encoder Resolution (Index : 111)
   - This is a parameter for the motor to rotate normally.
   - Please set the value suitable for the motor you are using.
2) Axis Control Mode (Index : 112)
   - Select servo control mode.
   - Positioning mode: CSP
   - Speed mode: CSV
   - Torque mode: CST
   - Profile positioning mode: PP

3) Hardware Limit Enable (Index : 205)
   - Set whether to use HW Limit. (NOT, POT, HOME)
4) Encoder Type (Index : 300)
   - Select the subject of Home operation.
   - Choose between MXP or servo drives.
5) SingleTurnReg (Index : 301)
   - Enter the single turn register address to be used for Home operation.
   - Refer to each servo drive manual and enter the address of the parameter in decimal.
6) Homing Mode (Index : 302)
   - Choose the homing method.
   - Please refer to the description of the servo drive manual for the operation method of the homing method.

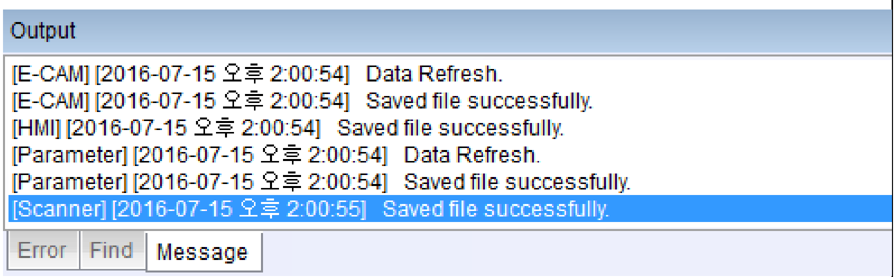
< Copy Parameter>

When setting the same Axis Parameter to multiple axes, you can use the Axis Parameter Copy function.
In the EtherCAT Node Panel, click the source device to be used for parameter copy, right-click and select Copy Axis Parameters.

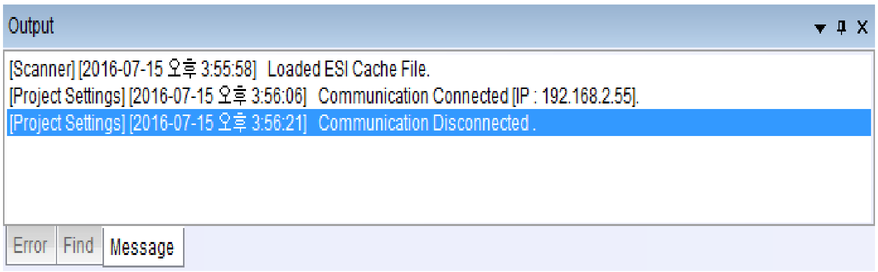


<table>
<tr>
<td></td>
<td>


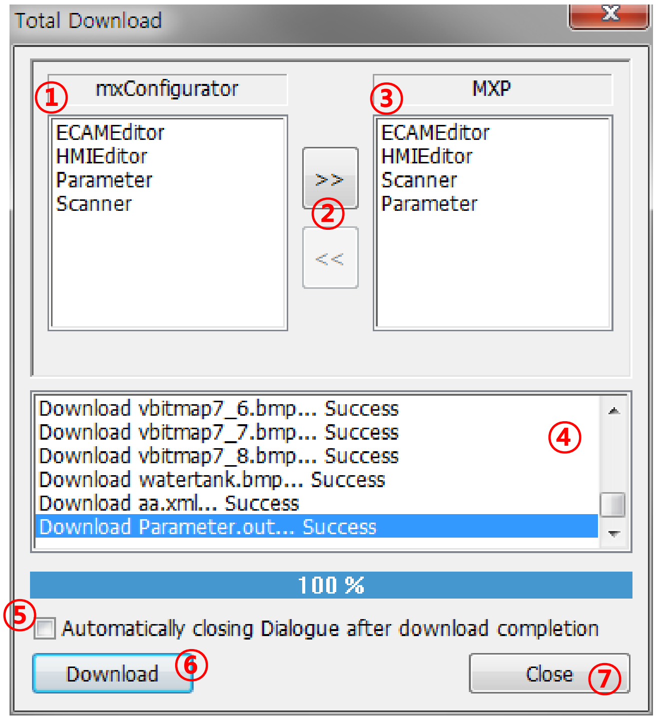
- When selecting the Copy Parameter menu, Axis list items excluding Source are displayed in (1).
- Add the target axis to be copied by using the (2) button
- Click (3) button to copy the setting data of the source axis to the target axis.
</td>
</tr>
<tr>
<td>8</td>
<td>
< Save project>
If you execute [Save Project] in the [Project] menu or click on the toolbar, the work done so far for each module is saved.
You can confirm the success of saving the project by checking the output window.



< Integrated download>
Execute [Communication Settings] in the [On-line] menu and set the TCP/IP setting to internal port [127.0.0.1].
Execute [On-Line] / [Off-Line] in the [On-Line] menu or click on the toolbar to request communication connection/disconnection with MXP.
You can check whether communication is connected through the output window.
</td>
</tr>
</table>



Execute [Total Download] in the [On-Line] menu or click on the toolbar to activate the [Total Download] window as shown below.



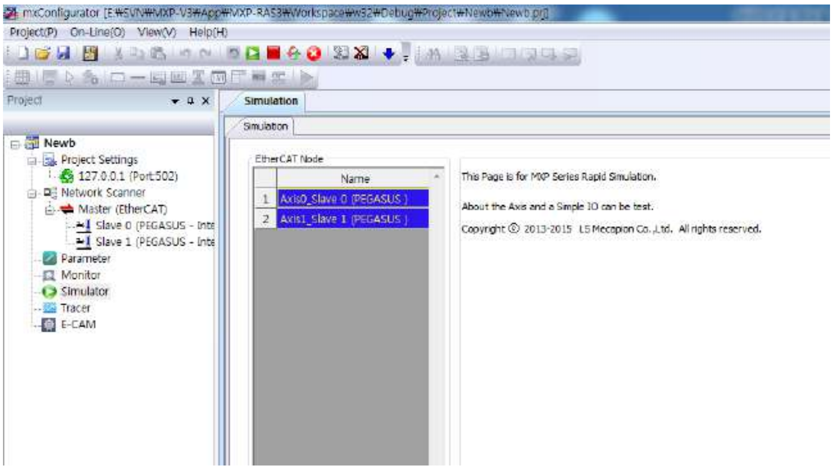
Classification	Function
1	Choose what to download from the current project
2	Move selected button
3	Display items to be downloaded
4	Show current download status
5	Check whether automatic window close function is used after download is completed
6	Download start button
7	Window close button

9

< Test run for servo motor >

Communication connection is possible by scanning the servo drive, saving and downloading the setting items.

Describes how to connect communication and test run a motor on the simulator screen of mxConfigurator.

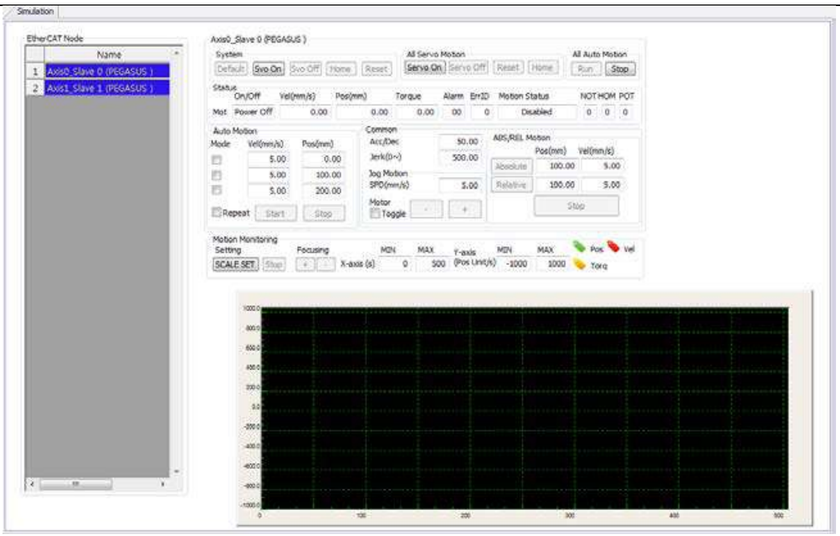


When communication is connected, it is displayed in different colors depending on the servo status.

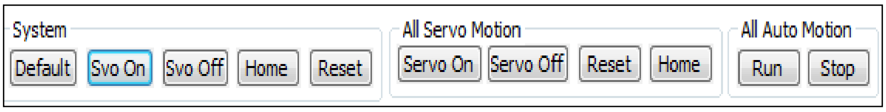
< Test run for Simulator>

If the device clicked on the simulator screen is a servo drive, the screen shown in the figure below is displayed.

You can test drive by clicking each button.



Picture3– Test run screen for Servo



- System

1) Default: Display default values in the blanks within the current page. Depending on the characteristics of the equipment, the default value may not be correct.

2) Svo On: Give Servo On command to the relevant axis.

3) Svo Off: Give Servo Off command to the relevant axis.

4) Home: Gives a homing command to the relevant axis.

5) Reset: Initializes the alarm that occurred on the relevant axis.

- All Servo Motion

1) Servo On: Give Servo On command to all axes.

2) Servo Off: Give Servo Off command to all axes.

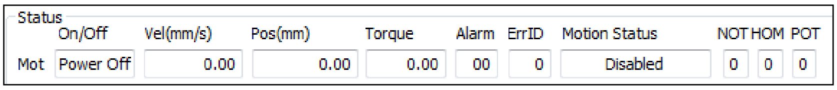
3) Reset: Initializes alarms generated in all axes. There is no change in the axis that is in normal state.

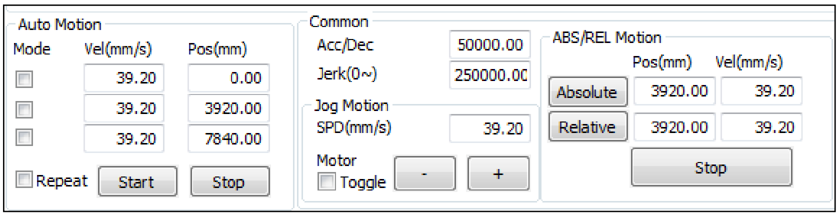
4) Home: Gives a homing command to all axes

- All Auto Motion

1) Run: It commands automatic operation to all axes. The position, speed, etc. required for automatic operation are based on the value set in [Auto Motion] on the current page, and all axes operate with the same value.

2) Stop: Cancel the automatic operation command for all axes.



	- Status: Displays the current status of the axis. If an item with that information is not mapped to a PDO, no value is displayed. (e.g. Alarm ID :0x603F - Error Code) 1) On/Off: Display Servo On/Off status. 2) Vel (PU/FU): Display current speed. 3) Pos (PU): Show your current location. 4) Torque: Shows the current torque in %. 5) Alarm: Displays the alarm code of the corresponding axis. 6) ErrID: Display MXP's Error ID. 7) Motion Status: Displays the axis status of MXP.. 8) NOT, HOM, POT: 0 and 1 indicate whether the lower limit, home, and upper limit sensors are detected.  -Auto Motion: Mode This is a function to move 1 to 3 positions according to the check box settings. When the Repeat checkbox is set, it moves repeatedly. 1) Start: Start automatic motion. 2) Stop: Stop automatic motion. **- Common**: Set the acceleration and deceleration for the command to move on the page. **- Jog Motion**: Execute jog operation. 1) -, +: It performs jog motion in the reverse and forward directions. If you check "Tog", the button works as a toggle. 2) Abs/Rel/Hom Stop: Stop motion in progress. **- ABS/REL Motion**: Absolute position, relative position movement. 1) Absolute: It moves the absolute position with Pos (PU), Vel (FU) set on the button. 2) Relative: Relative position movement with Pos (PU), Vel (FU) set on the button.	
11	Drive commissioning using MXP completed.	

13. Appendix i (Update)

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.

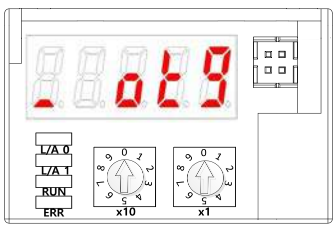
***Caution**

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.

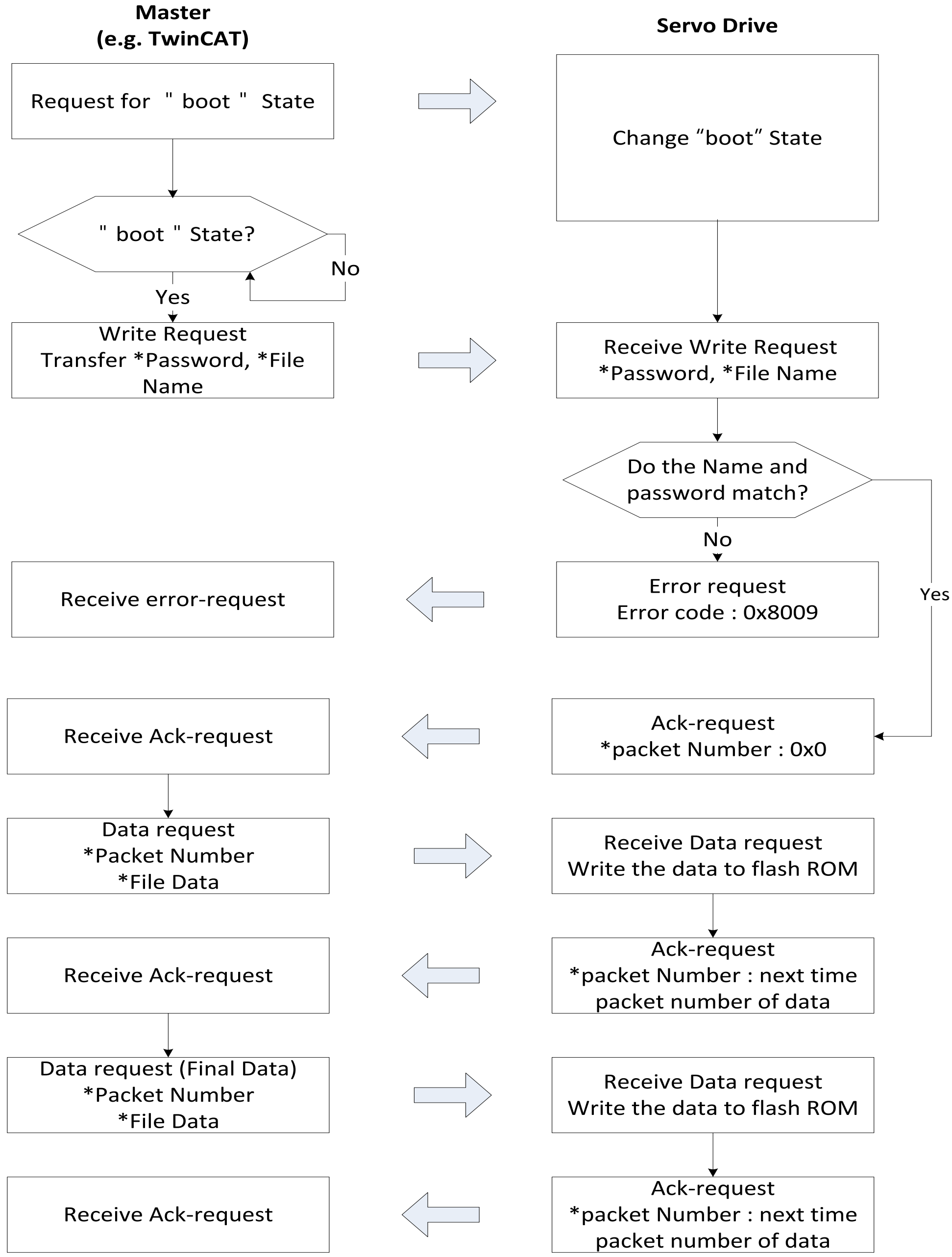


(7-segments display a message when downloading the firmware using the OTG)

(5) Turn on the power again, and verify if the firmware is updated.

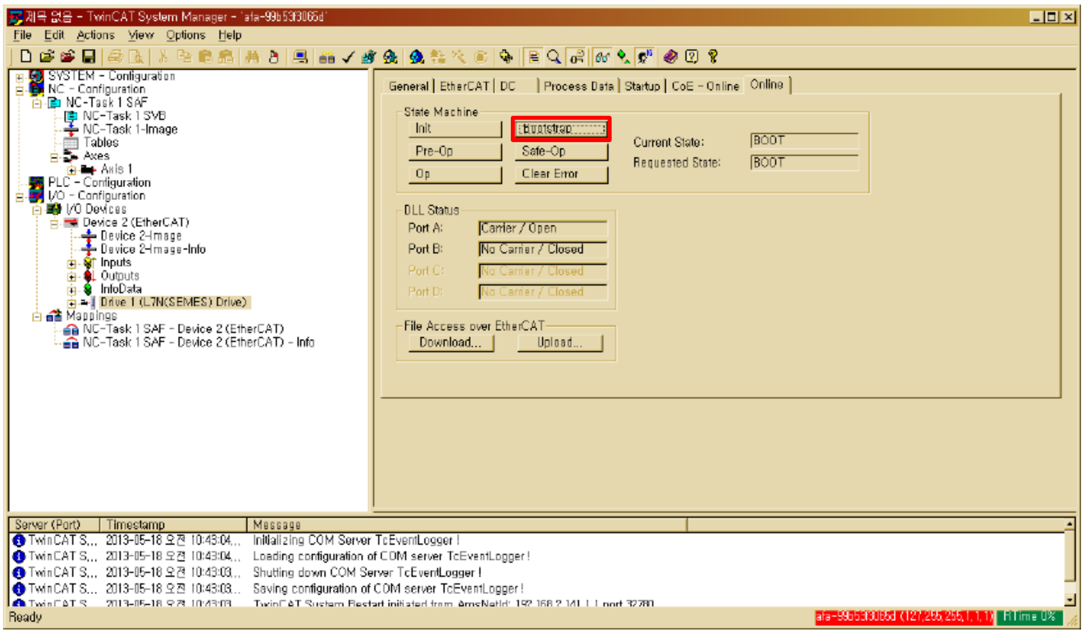
13.1.2 Use of FoE (File access over EtherCAT)

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:



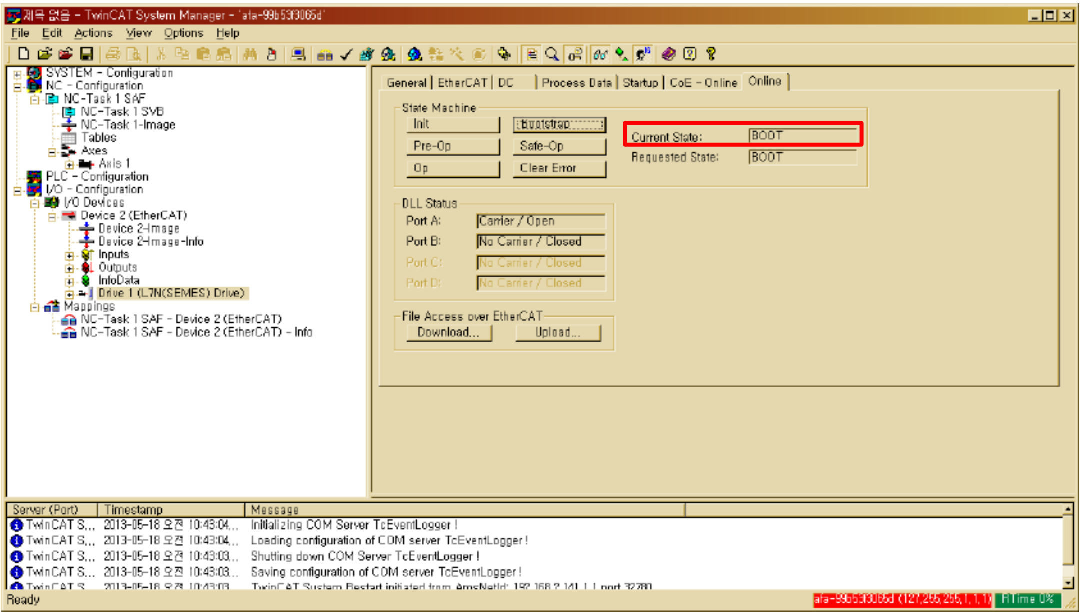
(1) Establish communication between the drive and the TwinCAT.

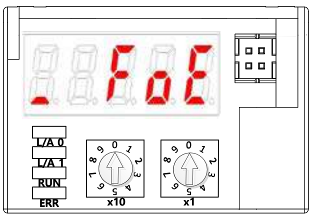
(2) I/O Configuration of TwinCAT - On the Online tab of the drive connected to the I/O, click Bootstrap in the State Machine menu.



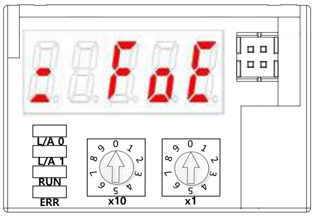
Depending on the type of drive, 'Drive X (L7xx Drive)' may be different.

(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.





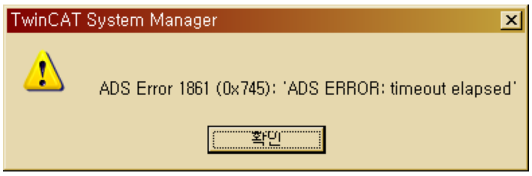
(7-segments display a message when downloading the firmware using the FoE)

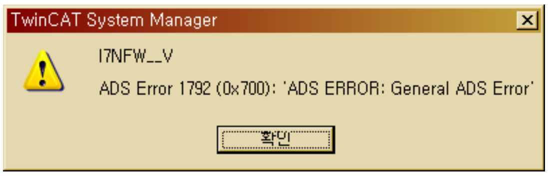


(7-segments display a message when Flash deletion is complete while downloading the firmware using the FoE)

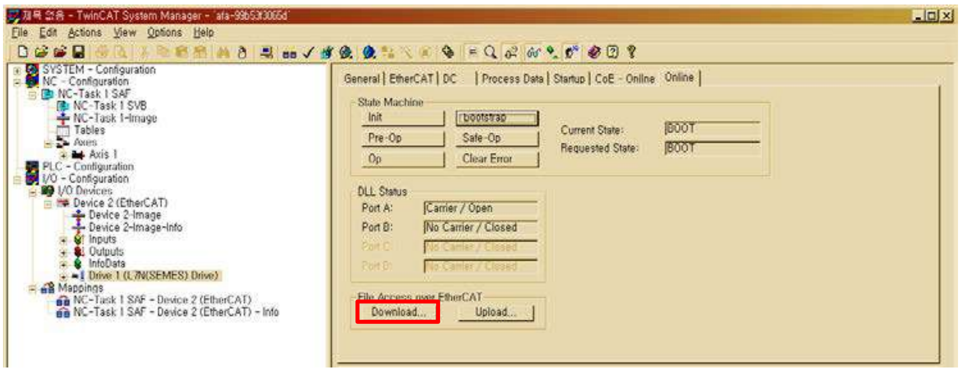
***Caution**

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.

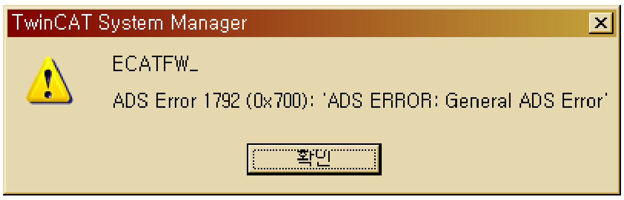




(4) Click Download in the File Access over EtherCAT menu at the bottom of the Online tab.

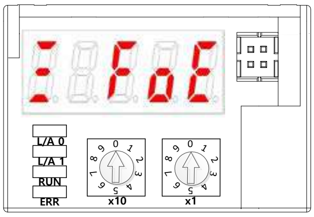


(5) Select the path of the file to be downloaded (L7NH_FW.efw or L7NH_FW.bin) and the file. If the file name does not match, download will not start and the following error will occur:



(6) Enter the password for file download and click OK to start the download. (Password : 00000000)

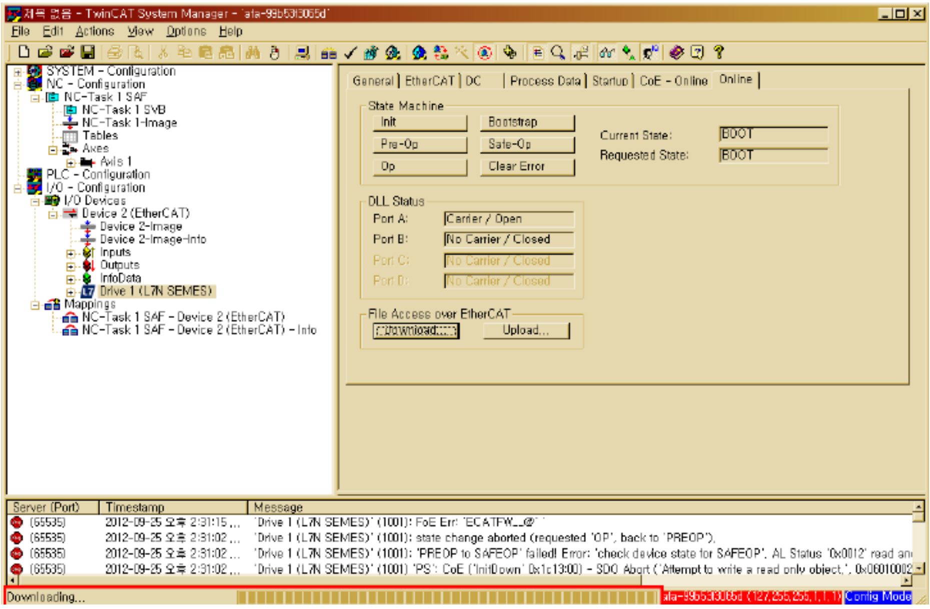
(7) If "Downloading..." is displayed as shown in the following figure, the download is in progress. If the progress bar at the bottom is full, it indicates the download is completed. After completing the download, be sure to click Init in the State Machine menu to switch it to the Init status.



(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

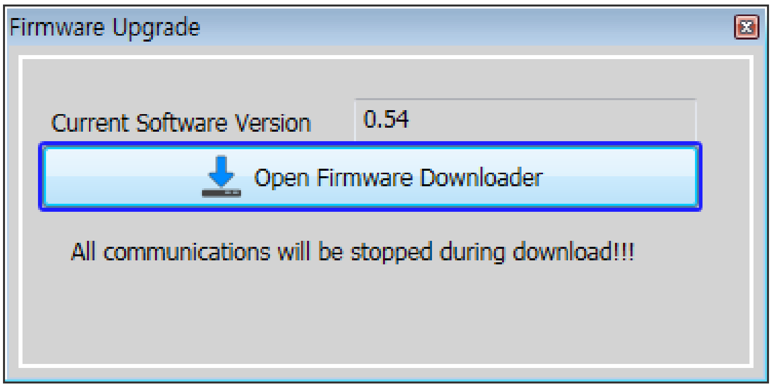
Drive CM allows the firmware upgrade through the PC's USB port. The transmission time depends on the PC performance, but it usually takes from scores of seconds to several minutes.

Select Setup Firmware Update from the top main menu or click on the corresponding shortcut icon.

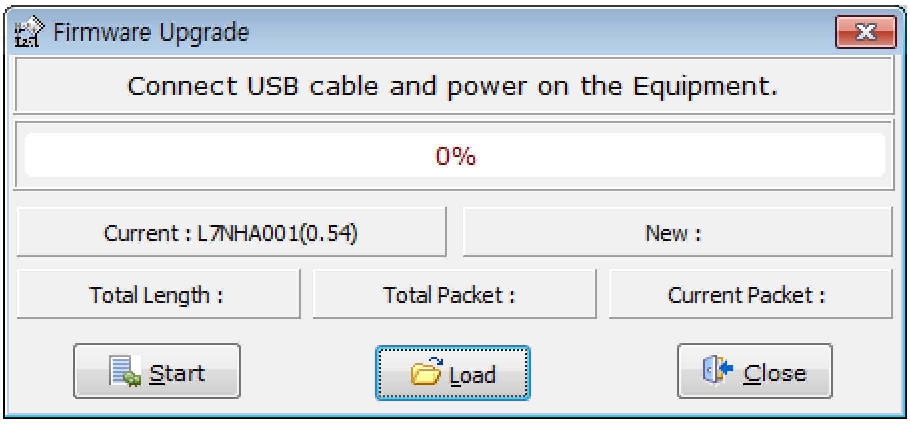
■ Precautions for Firmware Upgrade

- 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.

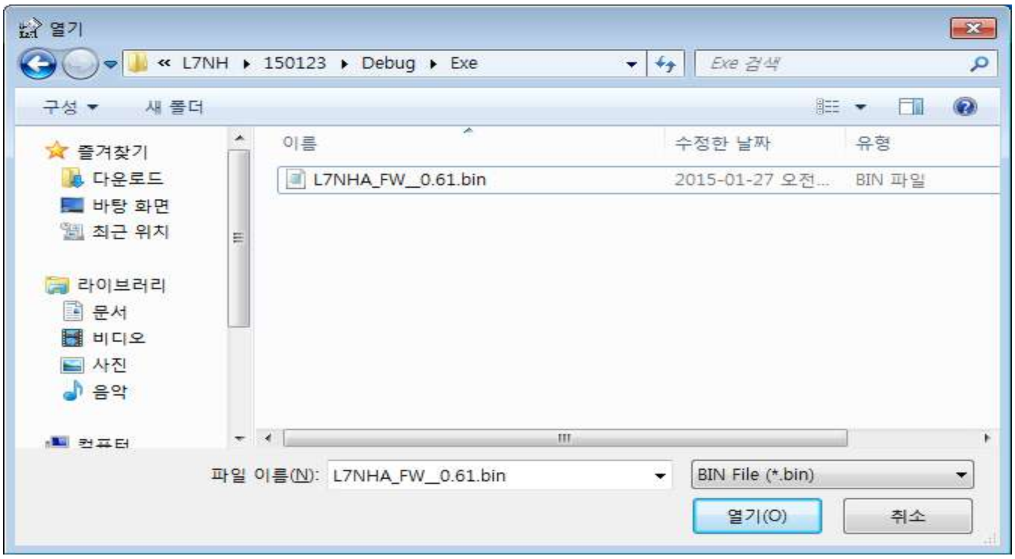
■ Operation of OS Download



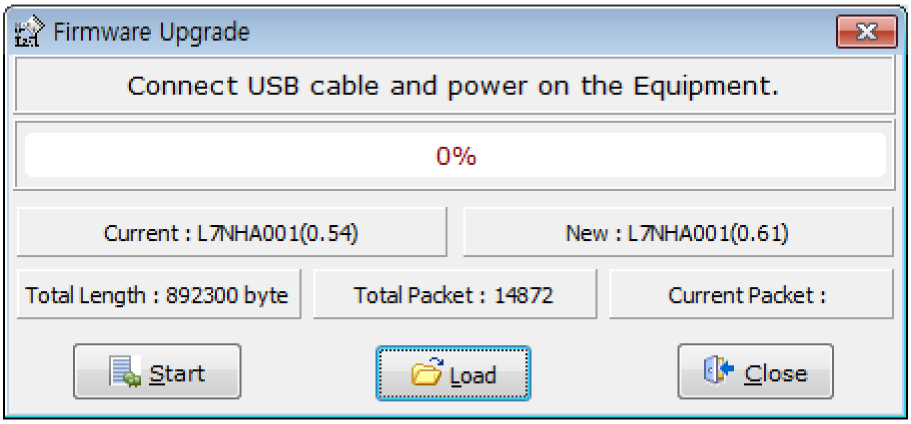
1) Click the “Open Firmware Downloader” button



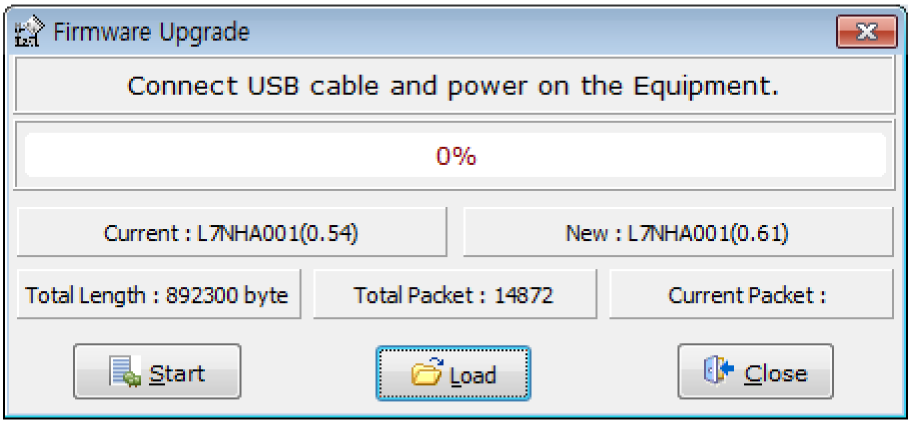
2) To load the appropriate firmware file, click the "Load" button.



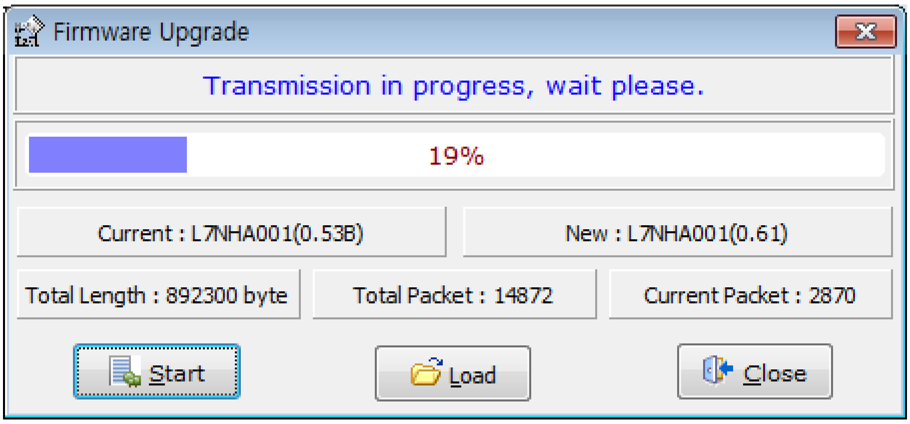
3) Select the BIN file of the firmware to transmit and press the Open button.



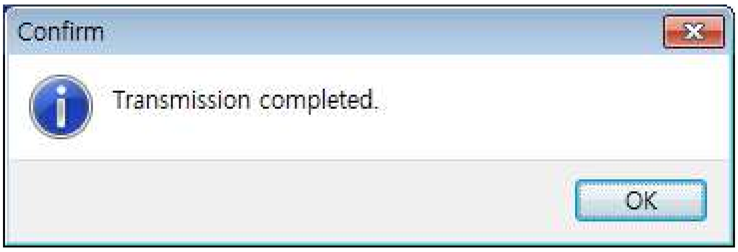
4) “Total Length" and "Total Packet" of the loaded firmware are displayed.



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.)

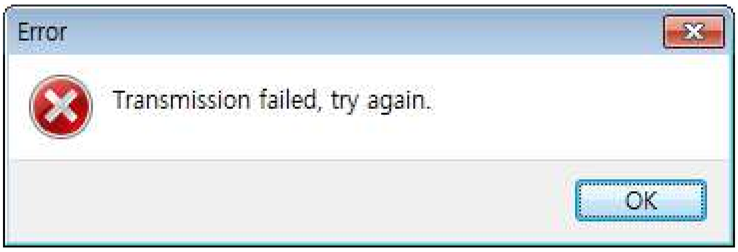


6) After clearing, the firmware is transmitted automatically and the progress bar and "Current Packet" display the current transmission status. (The transmission time depends on the PC performance, but it usually takes from scores of seconds to several minutes.)

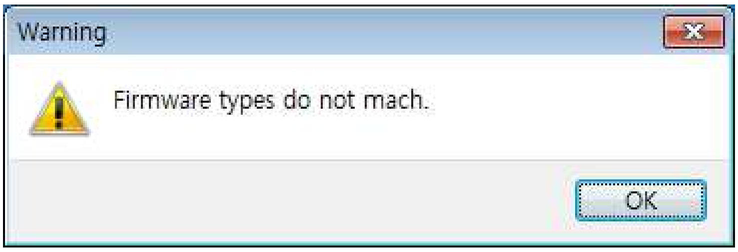


7) When transmission is completed, a pop up saying "Transmission completed" is displayed. (When transmission to the PC is completed, turn off and on the drive for rebooting.)

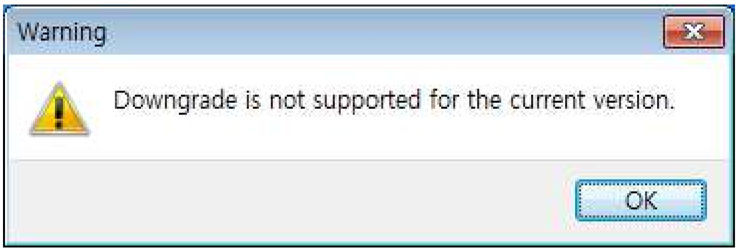
■ An Error Occurs During Transmission



■ 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

14. Appendix ⅱ (L7N → L7NH exchange)

14.1 Notes on capacity selection

14.1.1 Review of drive selection

1) L7NH has a model that supports 400V. Please be careful when selecting.

    A. L7NH (200V) : 0.1kW ~ 15kW

    B. L7NH (400V) : 1kW ~ 15kW

14.1.2 When selecting a product

1) When selecting a product, please refer to the product characteristics in Chapter 10 of the manual and the combination table in the catalog.

14.1.3 Comparison according to servo drive type

L7N

L7 N A 004 B AA

Series Name	Communication /Drive Type	Input voltage	Capacity	Encoder	Option
L7 Series	S: Standard I/O N: network	A: 220Vac B: 400Vac	001 : 100W 002 : 200W 004 : 400W 008 : 750W 010 : 1kW 020 : 2.0kW 035 : 3.5kW 050 : 5.0kW 150 : 15kW	B: Serial (communication type)	Blank: Standard Marked: Exclusive

L7NH

L7 NH B 010 U AA

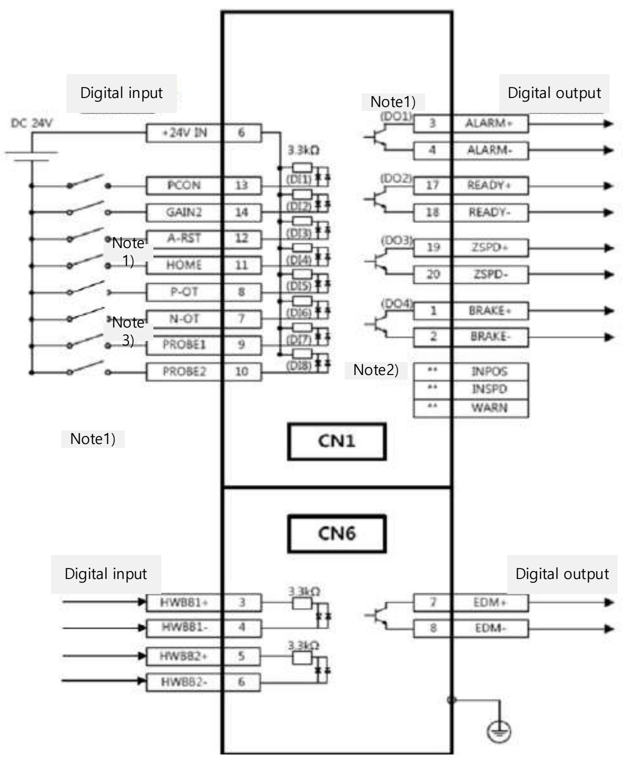
Series Name	Communication /Drive Type	Input voltage	Capacity	Encoder	Option
L7 Series	S: Standard I/O N: network NH: Network type & All-in-One Type P: Standard I/O & Index	A: 200Vac B: 400Vac	001 : 100W 002 : 200W 004 : 400W 008 : 750W 010 : 1kW 020 : 2kW 035 : 3.5kW 050 : 5.0kW 075 : 7.5kW 110 : 11.0kW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

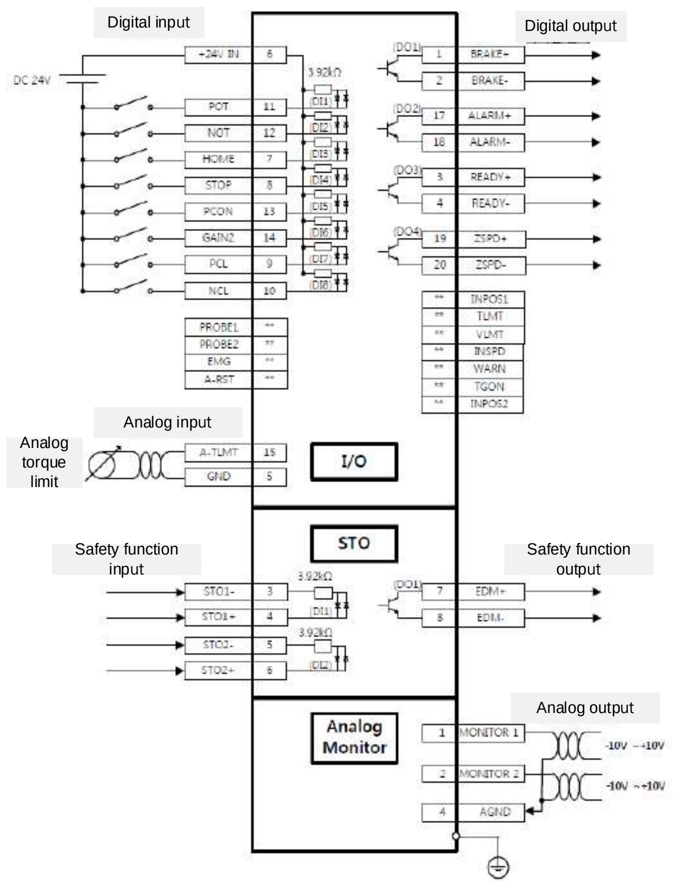
※ For more information, please refer to Product Specifications in Chapter 10 of the Manual and Product Characteristics in the catalog.

14.2 I/O Pin Map comparison

14.2.1 I/O Pin Map via wiring example

L7N	L7NH





< **Precautions**>

Note 1) The input signal and output signal are the initial signals assigned at the time of shipment from the factory.

Note 2) ** is a signal that is not assigned. Allocation can be changed by parameter setting.

14.3 Control detailed data

14.3.1 Input point (CN1)

1) PROBE signal can be assigned and changed by parameter setting.
2) Allocation of ALARM RESET signal can be changed by parameter setting.
3) The polarity can be used according to the customer's needs by basically applying a bi-directional photocoupler to the input point.
4) Use after checking the changed Pin Map.

L7N		L7NH		Note
PIN	Name	PIN	Name	
7	/N-OT	12	NOT	
8	/P-OT	11	POT-	
9	/PROBE1(Note1)	Assignment	**PROBE1	Enable mapping
10	/PROBE2(Note1)	Assignment	**PROBE2	Enable mapping
11	HOME	7	HOME	
12	ALM RST	Assignment	**ARST	Enable mapping
13	PCON	13	PCON	
14	GAIN2	14	GAIN2	
6	+24V IN	6	+24V	
		8	STOP	
		9	PCL	
		10	NCL	
		Assignment	**EMG	

(Note1) Touch probe signals cannot be mapped.

Reference) ** is an unassigned signal. Allocation can be changed by parameter setting.

14.3.2 **Output point (CN1)**

1) In L7N, two functions were used with one existing contact, but in L7NH, they are divided and must be allocated separately when using related functions. (Please refer to the table below.)

L7N		L7NH		Note
PIN	Name	PIN	Name	
1	BRAKE+	1	BRAKE+	
2	BRAKE-	2	BRAKE-	
3	ALARM+	17	ALARM+	Changed Pin map
4	ALARM-	18	ALARM-	Changed Pin map
17	/READY+	3	RDY-	Changed Pin map
18	/READY-	4	RDY+	Changed Pin map
19	/ZSPD+	19	ZSPD+	
20	/ZSPD-	20	ZSPD-	
Assignment	INPOS	Assignment	**INPOS1	
Assignment	INSPD	Assignment	**INSPD	
Assignment	WARN	Assignment	**TLMT	
		Assignment	**VLMT	
		Assignment	**WARN	
		Assignment	**TGON	
		Assignment	**INPOS2	

Reference) ** is an unassigned signal. Allocation can be changed by parameter setting.

14.3.3 **Analog signal (CN1)**

1) Limits the motor output torque by applying -10[V] ~ +10[V] between A-TMLT (AT1) and AGND. The relationship between input voltage and limit torque depends on the set value of [0x221C].

L7NH	
PIN	Name
15	A-TLMT
5	AGND

14.3.4 Analog output signal (Analog monitoring connector)

Pin Number	Name	Contents	Details Function
1	AMON1	Analog Monitor 1	Analog monitor output (-10V ~ +10V)
2	AMON2	Analog Monitor 2	Analog monitor output (-10V ~ +10V)
3	AGND	AGND (0V)	Analog ground
4	AGND	AGND (0V)	Analog ground

14.3.5 Safety (STO, Safety Toque Off)

1) When using the safety function, check Chapter 6 Safety Function.

L7N		L7NH		Function
Pin Number	Name	Pin Number	Name	
1		1	+12V	For bypass wiring
2		2	-12V	For bypass wiring
3	/HWBB1+	3	STO1-	
4	/HWBB1-	4	STO1+	
5	/HWBB2+	5	STO2-	
6	/HWBB2-	6	STO2+	
7	EDM+	7	EDM+	
8	EDM-	8	EDM-	

14.4 Parameter setting

1) L7NH automatically sets the motor ID (0x2000), encoder type (0x2001), and encoder resolution (0x2002) for the serial encoder supplied by our company.

2) If necessary, set the NODE ID using the rotary switch on the front. The set ID can be checked at 0x2003.

3) When using an absolute value encoder, change the value of 0x2005 by referring to the table below.

Setting Value	Details
0	Absolute value encoder is used as absolute value encoder. Multi-rotation data is used.
1	Absolute encoders are used as incremental encoders. Multi-rotation data is not used. Suppress battery-related alarms/warnings.

Reference) for details, please refer to Manual Section 9.2 Manufacturer Specific Objects.

4) Parameter comparison

Contents	L7N	L7NH
Motor ID	0x2000	0x2000
Encoder type	0x2001	0x2001
Encoder resolution	0x2002	0x2002
Node ID	0x2003	0x2003
Rotation direction setting	0x200D	0x2004
Absolute encoder setting	0x200D	0x2005
Main power input mode setting	0x2003	0x2006
7SEG display setting	0x2005	0x2008
Regenerative resistance setting	-	0x2009
Regenerative resistance Derating Factor setting	0x2006	0x200A
Regenerative resistance value setting	0x2007	0x200B
Regenerative resistance capacity setting	0x2008	0x200C
Regenerative resistance maximum capacity setting	-	0x200D
Inertia ratio setting	0x2100	0x2100
Position gain 1	0x2101	0x2101
Speed gain 1	0x2106	0x2102
Speed feedback filter time constant	0x210B	0x210B
Input signal definition	0x2200, 0x2201, 0x2204	0x2200 ~ 0x2207
Output signal definition	0x2202, 0x2203, 0x2205	0x2210 ~ 0x2213
Analog monitor output		0x2220 ~ 0x2226

Product warranty

Product name	Servo Drive		Installation date	
Model name	*L7NH A/B Series*		Warranty	
Customer	life span			
	Address			
	Phone			
Distributor	Name			
	Address			
	Phone			

This product is made through strict quality control and inspection process by our technical staff.
The product warranty period is normally 12 months from the installation date, and 18 months from the manufacturing date if the installation date is not written. However, it may change according to the terms of the contract.

Free service information
If a drive malfunctions within the product warranty period under normal use, contact our dealer or designated service center. We will repair it free of charge.

Free service information

Paid service information

- **When a failure occurs due to the consumer's intention or negligence**
- **When a failure occurs due to an abnormality in the power supply or a defect in the connected device**
- **When a breakdown occurs due to a natural disaster (fire, flood, gas damage, earthquake, etc.)**
- **When the product is modified or repaired at a place other than our dealer or service center**
- **When our nameplate is not attached**
- **When the free warranty period has expired**

※ After installing the servo, please fill out this quality assurance form and send it to our quality assurance department (service manager).

Warranty

This product is made through strict quality control and inspection process by our technical staff. The product warranty period for this product is normally 12 months from the installation date, and 18 months from the manufacturing date if the installation date is not written. However, it may change according to the terms of the contract. The product described in this user's manual may be discontinued or modified without notice. Be sure to check when you purchase this product.

Free service information
If a drive malfunctions within the product warranty period under normal use, contact our dealer or designated service center. We will repair it free of charge.

Paid service information
Paid service information ▪ When a failure occurs due to the consumer's intention or negligence ▪ When a failure occurs due to an abnormality in the power supply or a defect in the connected device ▪ When a breakdown occurs due to a natural disaster (fire, flood, gas damage, earthquake, etc.) ▪ When the product is modified or repaired at a place other than our dealer or service center ▪ When our nameplate is not attached ▪ When the free warranty period has expired ※ After installing the servo, please fill out this quality assurance form and send it to our quality assurance department (service manager).

Environmental Policy

LS ELECTRIC Co., Ltd supports and observes the environmental policy as below.

Environmental Management

LS ELECTRIC considers the environmental preservation as the preferential management subject and every staff of LS ELECTRIC use the reasonable endeavors for the pleasurably environmental preservation of the earth.

About Disposal

LS ELECTRIC' PLC unit is designed to protect the environment. For the disposal, separate aluminum, iron and synthetic resin (cover) from the product as they are reusable.

User Manual Revision History

No.	Issue year month	Change contents	Version number	Notes
1	2018.02. 20	200[V] / 400[V] integrated Add function description and insert picture	1.0	
2	2018.07.31	LSIS & LSM brand integration and function description added	1.1	
3	2020.07.28	Mark modified according to company name change N terminal related precautions and figure correction	1.2	
4	2023.07. 10	Add new features and add descriptions	1.3	
5	2024.08.25	Fix spelling errors	1.6	
6				
7				

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