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AC SERVO DRIVE

Xmotion

L7NHF Series

EtherCAT Conformance tested

User Manual

Ver1.2

Safety Precautions

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

LS ELECTRIC

Introduction

Greetings! Thank you for choosing L7NHF Series product.

The user manual describes how to correctly use this product and matters for which to exercise caution.

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 according to software versions without notice.
- 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 our company.
- Our company retains all patents, trademarks, copyrights and other intellectual property rights to the materials in this manual. Therefore, the information contained in this manual is only intended for use with our company products, and using it for any other purposes is prohibited.

Safety precautions are categorized as either Warning or Caution, depending on the severity of the consequences.

Precautions	Descriptions
Danger	Failure to comply with the guidelines may cause serious injury or death.
Caution	Failure to comply with the guidelines may cause personal injury or property damage.

- Depending on the situation, ignoring a caution may also result in serious injury. So, be mindful of this.

Electric Safety Precautions

Warning

- Before wiring or inspection, turn off the power, wait 15 minutes, make sure that the charge lamp has gone off, and check the voltage.
- Ground both the servo drive and the servo motor faultlessly.
- Only qualified and trained technicians may perform wiring on this product.
- Install both the servo drive and the 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 regeneration brake resistor on non-combustible materials.
- Disconnect the input power if the servo drive malfunctions.

■ Installation Precautions

Store and operate this product under the following environmental conditions.

<table>
<tr><th rowspan="2">Environment</th><th colspan="2">Conditions</th></tr>
<tr><th>Servo Drive</th><th>Servo Motor</th></tr>
<tr><td>Operating temp.</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>Operating humidity</td><td rowspan="2">90% RH or lower (no condensation)</td><td rowspan="2">20 ~ 80% RH (no condensation)</td></tr>
<tr><td>Storage humidity</td></tr>
<tr><td>Altitude</td><td colspan="2">1000 m or lower</td></tr>
<tr><td>Spacing</td><td>▪ When installing 1 unit:
• 40mm or more from the top or bottom of the control panel
• 10mm or more from the left or right side of the control panel
▪ When installing 2 or more units:
• 100mm or more from the top of the control panel
• 40mm or more from the bottom of the control panel
• 30mm or more from the left and right sides of the control panel
• 2mm or more between units
• Refer to Section 2.2.2, "Installation with the Control Panel."</td><td></td></tr>
<tr><td>Others</td><td colspan="2">▪ Ensure the installation location is free from dust, iron, corrosive gas, and combustible gas.
▪ Ensure the installation location is free from abnormal vibrations or potential for hard impacts.</td></tr>
</table>

⚠ Caution

- Keep the installation directions and do not drop the product or expose it to a 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 or place heavy objects on top of the product.
- 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.
- Make sure to install a gearbox-attached servo motor with the correct orientation.
- Do not accidentally touch the rotating unit of the servo motor during operation.
- Do not apply excessive force when connecting couplings to the servo motor shaft.
- Do not place loads on the servo motor shaft that exceed the permitted amount.

■ Wiring Precautions

⚠ Caution
▪ Always use an AC 200-230 V power input for the servo drive. ▪ Always connect the servo drive to a ground terminal. ▪ Do not connect a commercial power supply directly to the servo motor. ▪ Do not connect commercial power supply directly to U, V and W output terminals of the servo drive. ▪ Connect U, V and W output terminals of the servo drive directly to the U, V, W power input terminals of the servo motor, but do not install magnetic contactors between the wires. ▪ Always use pressurized terminals with insulation tubes when wiring the servo drive power terminal. ▪ When wiring, be sure to separate U, V and W power cables for the servo motor and the encoder cable. ▪ Always use the robot cable if the motor is of a moving structure. ▪ Before performing power wiring, turn off the input power of the servo drive and wait until the charge lamp goes off completely. ▪ Use N terminals to connect the external capacitor. The product may burn if a commercial power supply is connected to N terminals. Always contact the customer center or agency when it is necessary to connect the external capacitor.

■ Startup Precautions

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

■ Handling and Operating Precautions

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

■ Usage Precautions

⚠ Caution
▪ Install an emergency cut-off circuit which can immediately stop operation in an emergency. ▪ Reset the alarm only 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 is for maintaining paused 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
▪ Use a servo motor with an electric brake or install a separate brake system for use if there is potential for a dangerous situation during emergencies or device malfunctions. ▪ If an alarm occurs, eliminate the underlying cause of the problem and ensure safety in operation. Then, deactivate the alarm and resume operation. ▪ Do not approach the machine until the problem is solved.

■ Repair/Inspection Precautions

⚠ Caution
▪ Before performing repair or inspection, turn off the power, wait at least 15 minutes, make sure that the charge lamp has gone off, and check the voltage. Enough voltage may remain in the electrolytic condenser after the power is off to cause an electric shock. ▪ Only authorized personnel may repair and inspect the device or replace its parts. ▪ Never 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 product in a facility where product malfunctions may result in a major accident or a significant loss.

■ EEPROM Lifespan

⚠ Caution
▪ 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, due to the lifespan of the EEPROM. • EEPROM recording as a result of a parameter change • EEPROM recording as a result of an alarm

Table of Contents

1. Product Configuration

1.1 Product Verification

1. Check the name plate to verify that the product received matches the model ordered.

- Does the servo drive's name plate match?
- Does the servo motor's name plate match?

2. Check the product components and options.

- Are the types and lengths of cables correct?
- Does the regeneration brake resistor conform to the required standard?
    - Is the shape of the shaft correct?
    - Are there any abnormalities after mounting the oil seal or the brake?
    - Are the gearbox and the gear ratios correct?
    - Is the encoder format correct?

3. Check the exterior of the product.

- Are there any foreign substances or humidity in the product?
- 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 rotation?

1.2 Product Specifications

■ L7NHF Series Product Type

L7 NHF A 010 U AA

Series Name	Communication/Drive Type	Input voltage	Capacity	Encoder	Option
L7 Series	NHF: Network Type All In One Type + Full-Closed Type	A : 200Vac	010 : 1kW 035 : 3.5kW 050 : 5kW 075 : 7.5kW	U : Universal (Integrated Type)	Blank: StandardMarked: Dedicated use

■ Servo Motor Product Type

APM C – F E 30 A M K 1

SERVO MOTOR (200Vac)

Motor Shape

- S :Solid Shaft
- H :Hollow Shaft
- F :Flat
- (F_L : L Series)

Flange Size

- A : 40 Flange
- B : 60 Flange
- C : 80 Flange
- AL: 40 Flange
- BL: 60 Flange
- CL: 80 Flange
- E : 130 Flange
- F : 180 Flange
- G : 220 Flange

Motor Capacity

- 04 : 400[W]
- 05 : 450[W]
- 06 : 600[W]
- 08 : 800[W]
- 10 : 1.0[kW]
- ⋮
- 60 : 6.0[kW]
- 75 : 7.5[kW]

Rated RPM

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

Encoder Type

Quadrature (Pulse type)

- A : Inc. 1024 [P/R]
- C : Inc. 2048 [P/R]
- D : Inc. 2500 [P/R]
- E : Inc. 3000 [P/R]

Serial BISS (Communication type)

- N : 19bit S-Turn Abs.
- M : 19bit M-Turn Abs.
- M8 : 18bit SA/FAL M-Trun Abs

Shaft End Shape

- N : Straight
- K : Round key at one end (Standard)

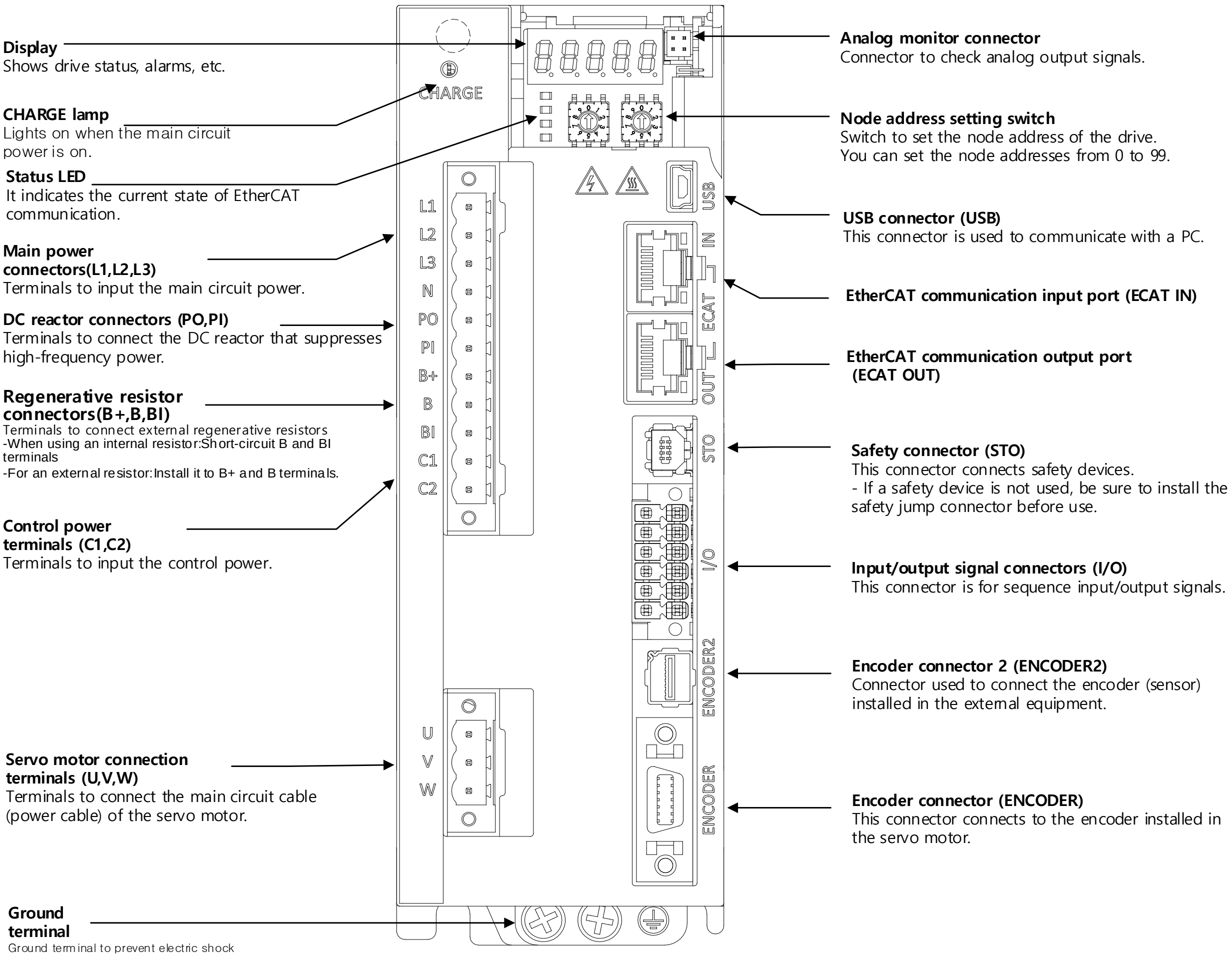
Options

- None : Not attached
- 1 : Oil Seal attached
- 2 : Brake attached
- 3 : Oil Seal and Brake attached

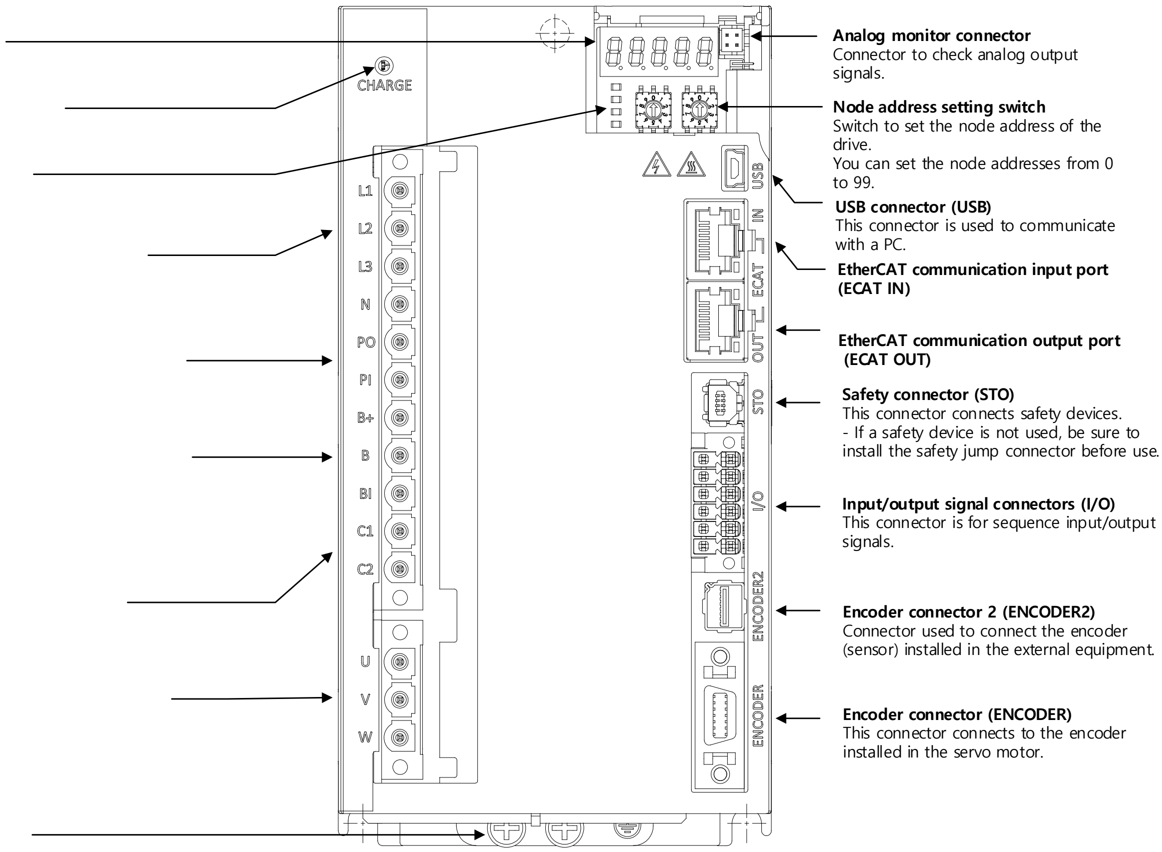
1.3 Component Names

1.3.1 Servo Drive Component Names

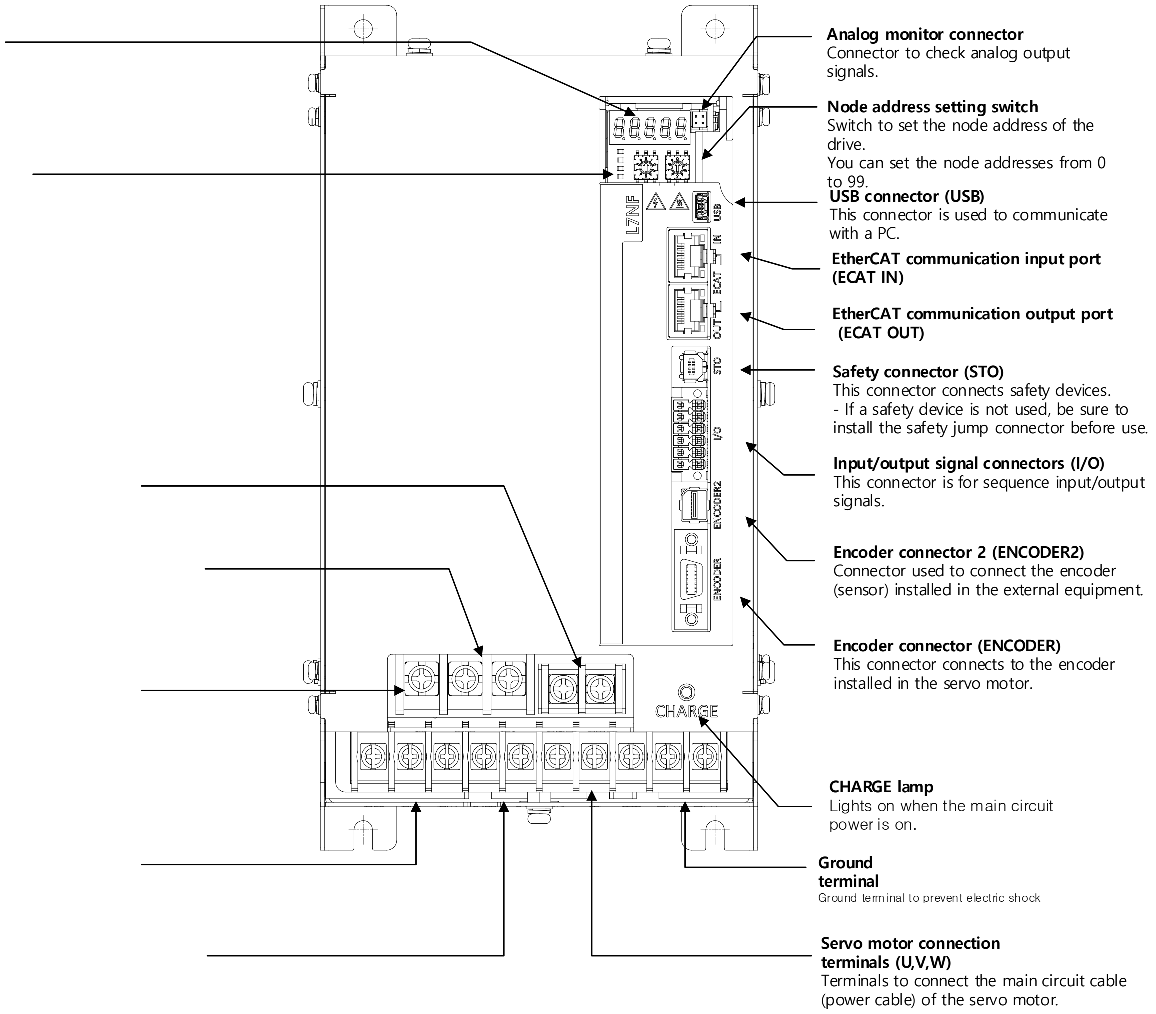
■ L7NHF Drive (1 kW)



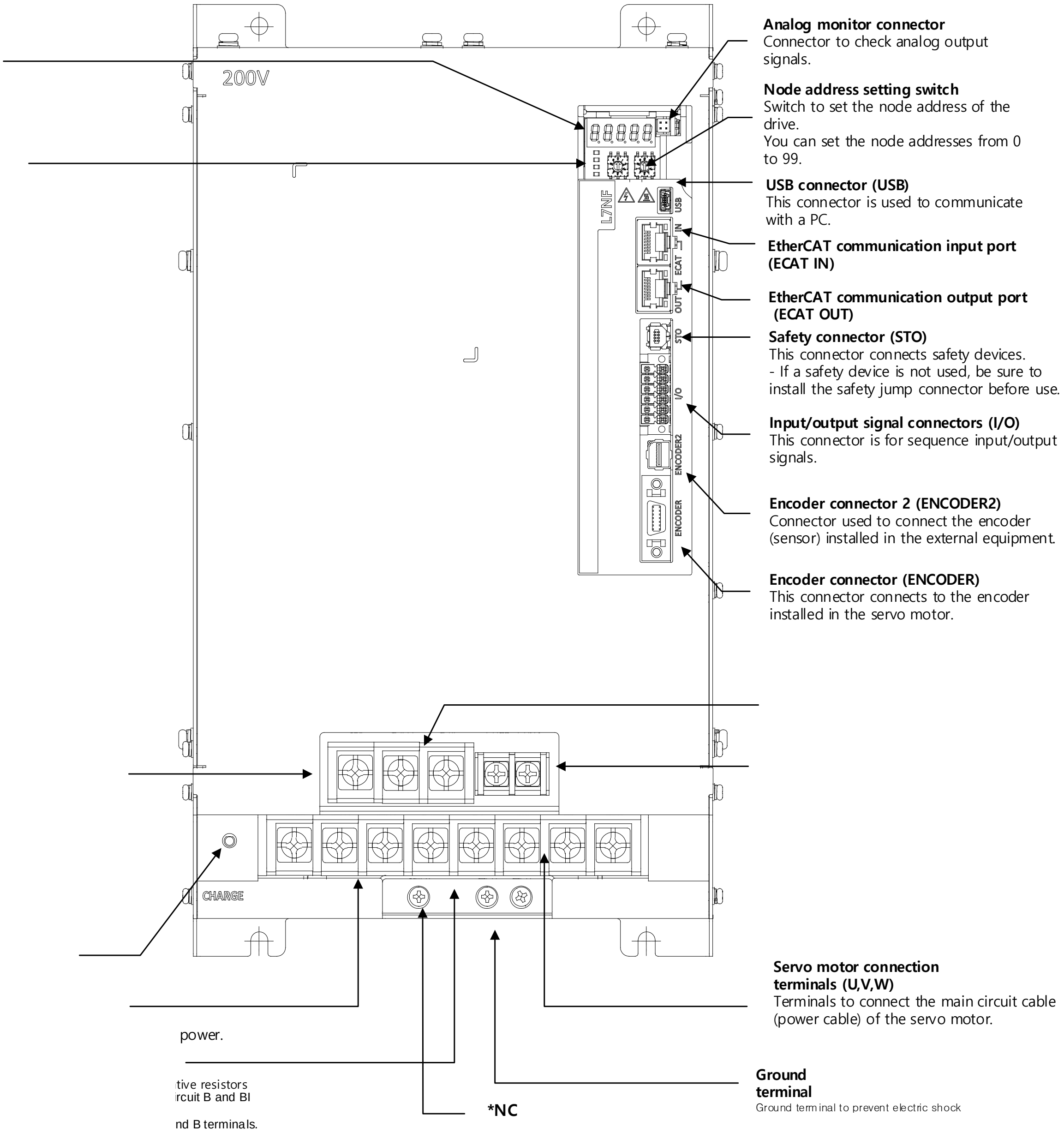
■ L7NHF Drive (3.5kW)



■ L7NHF Drive (5kW)

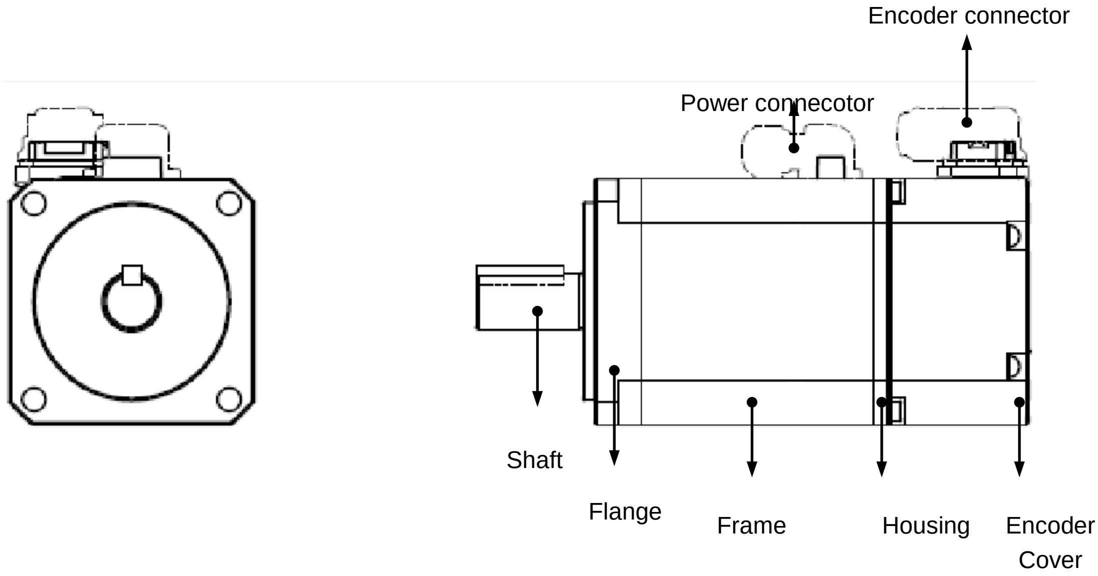


■ L7NHF Drive (7.5kW)

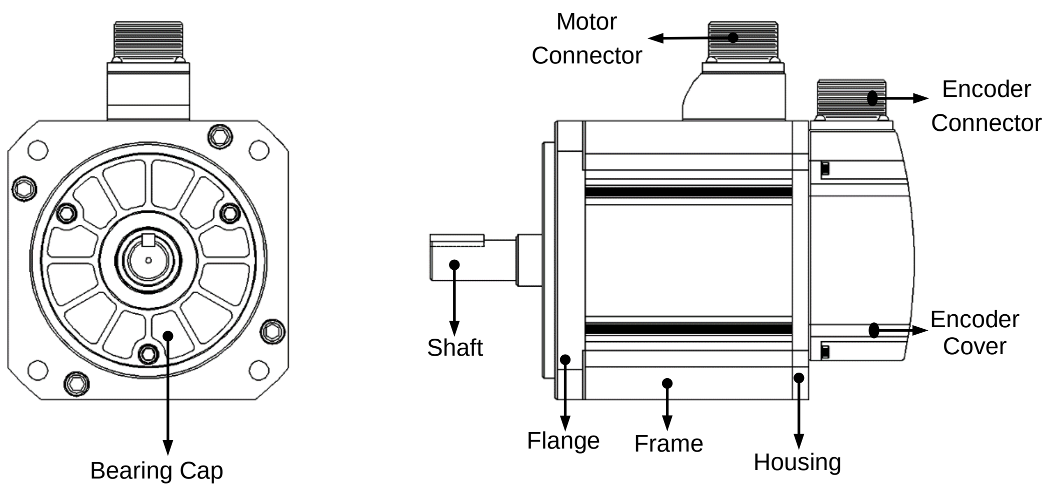


1.3.2 **Servo Motor Part Names**

•80 Flange of Lower (L series)

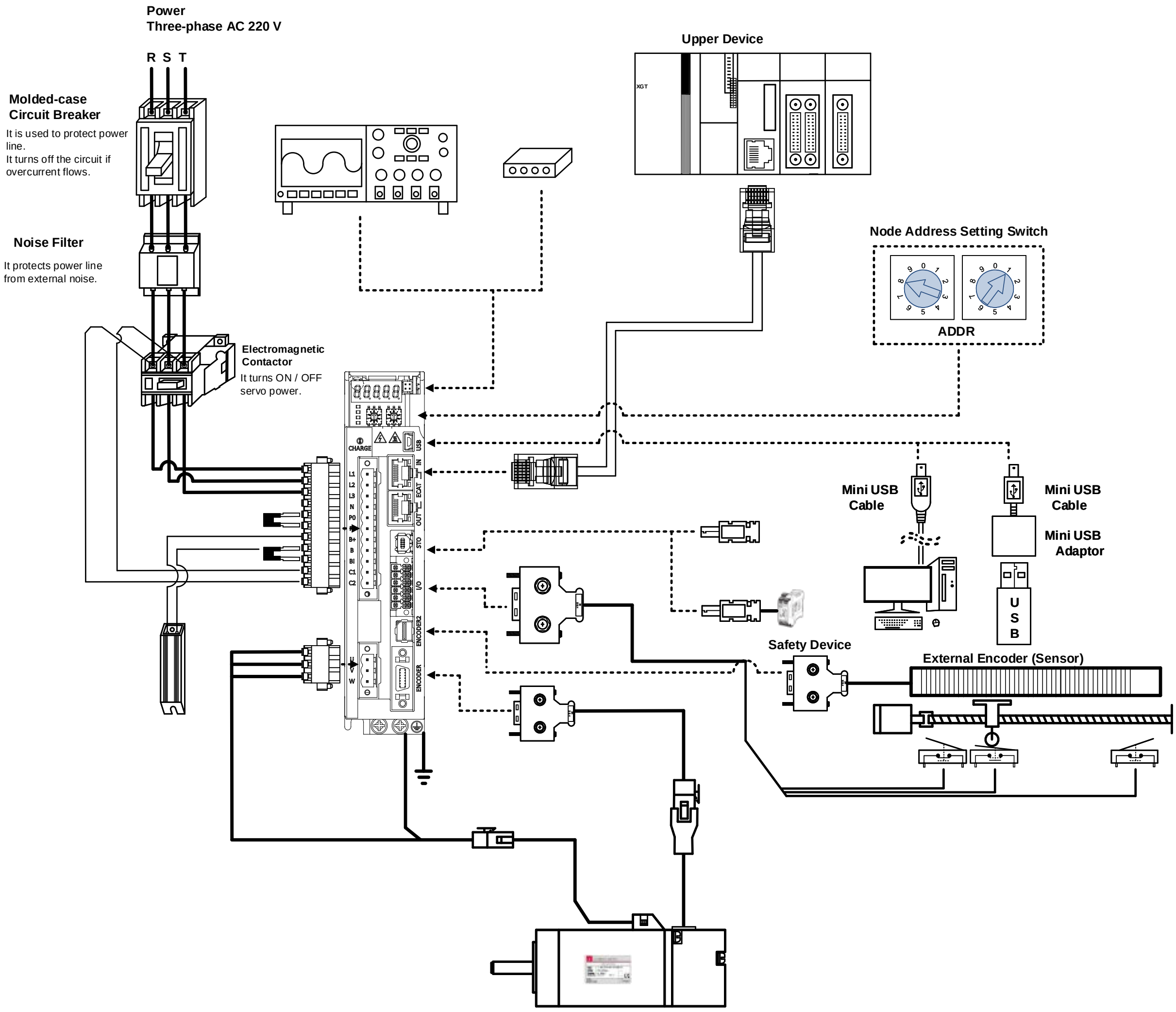


• 130 Flange or Higher



1.4 Example of System Configuration

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



⚠ Caution
▪ Use N terminals to connect the external capacitor. The product may burn if a commercial power supply is connected to N terminals. Always contact the customer center or agency when it is necessary to connect the external capacitor. ▪ PE between the servo motor and the servo and between the servo and the device must be connected.

2. Wiring and Connection

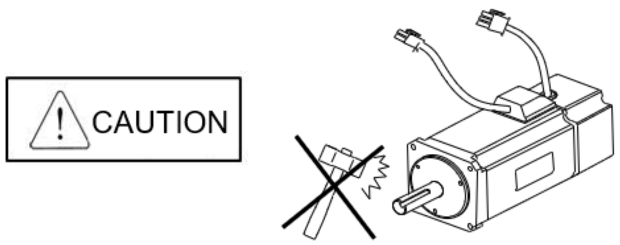
2.1 Servo Motor Installation

2.1.1 Operating Environment

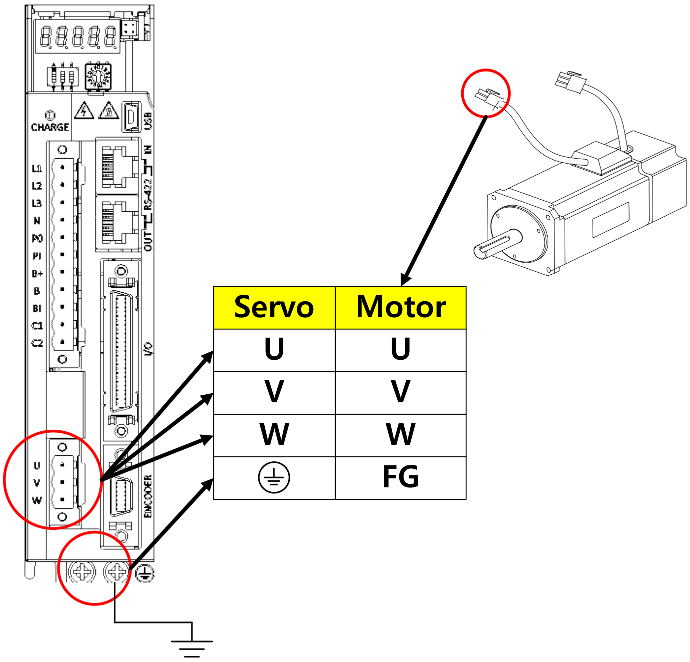
Items	Environmental conditions	Precautions
Ambient temperature	0 ~ 40[℃]	Consult our technical support team to customize the product if the temperatures in the installation environment are outside this range.
Ambient humidity	80[%] RH or lower	Do not operate this device in an environment with steam.
External vibration	Vibration acceleration 49[㎨] or below on X and Y axes	Excessive vibrations reduce the lifespan of the bearings.

2.1.2 Preventing Over-impact

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



2.1.3 Motor Connection

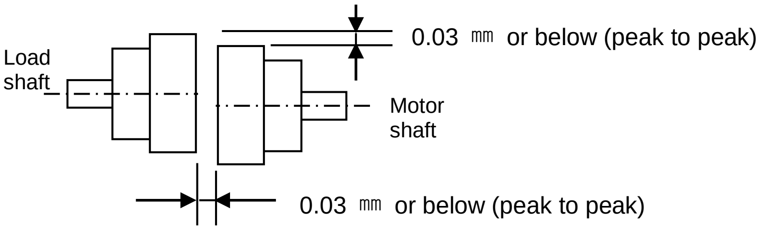


Servo	Motor
U	U
V	V
W	W
⏚	FG

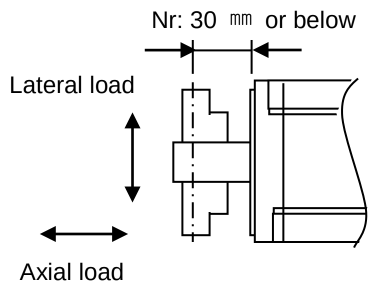
- Directly connecting the motor to a commercial power supply may burn the motor. Make sure to connect it with the specified drive before using it.
- Connect the ground terminals of the motor to either of the two ground terminals inside the drive, and attach the remaining terminal to the type-3 ground.
- Connect U, V, and W terminals of the motor to match U, V, and W terminals of the drive.
- Ensure that no pin on the motor connector is fallen off or inadequately connected.
- If there is moisture or condensation on the motor, make sure that insulation resistance is 10[MΩ] (500[V]) or higher and install only if there is no abnormality.

2.1.4 Load Device Connection

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

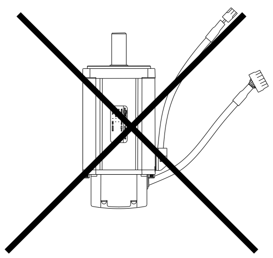


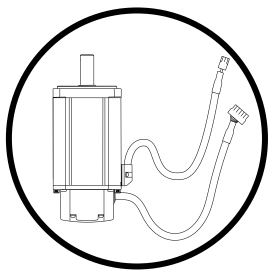
■ For Pulley Connections:

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

2.1.5 Cable Installation

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





- Do not pressurize or damage the cables. Make sure to use robot cables for a moving motor and prevent the cables from swaying.

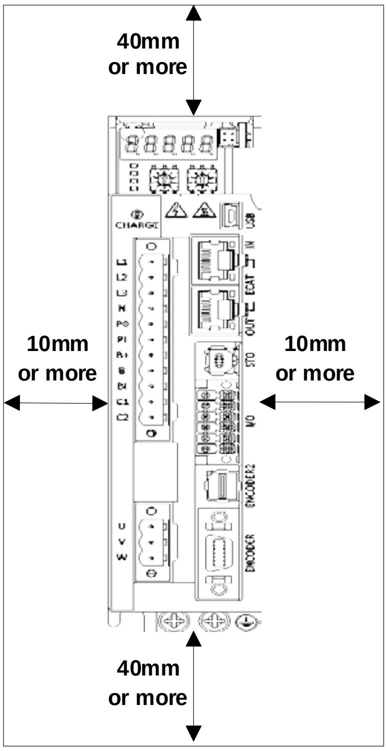
2.2 Servo Drive Installation

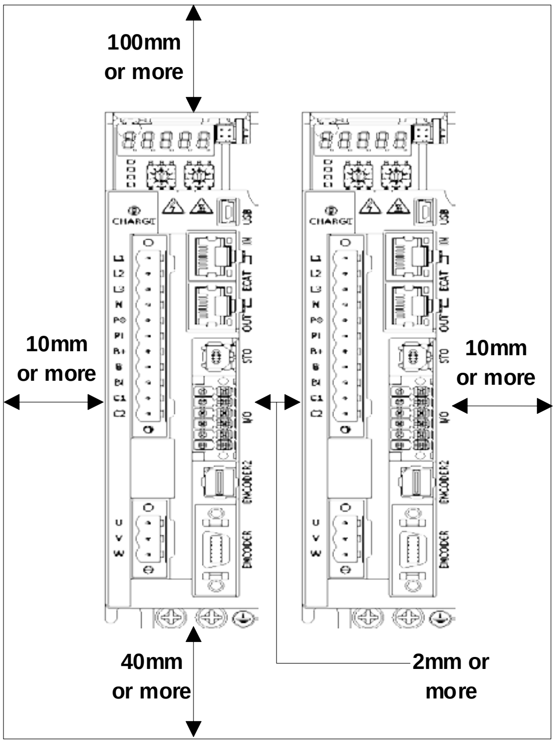
2.2.1 Installation and Usage Environment

Items	Environmental conditions	Precautions
Ambient temperature	0~50[℃]	⚠ **Caution** Install a cooling fan on the control panel for ventilation and to maintain the temperature within the range.
Ambient humidity	90% RH or lower	⚠ **Caution** Moisture developed inside the drive due to ice formation or condensation during a prolonged period of inactivity may damage the drive. 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 product, and it 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 even if installed in a confined space.	

2.2.2 Installation with the Control Panel

Comply with the spacing standard specified in the following figures when installing with the control panel.

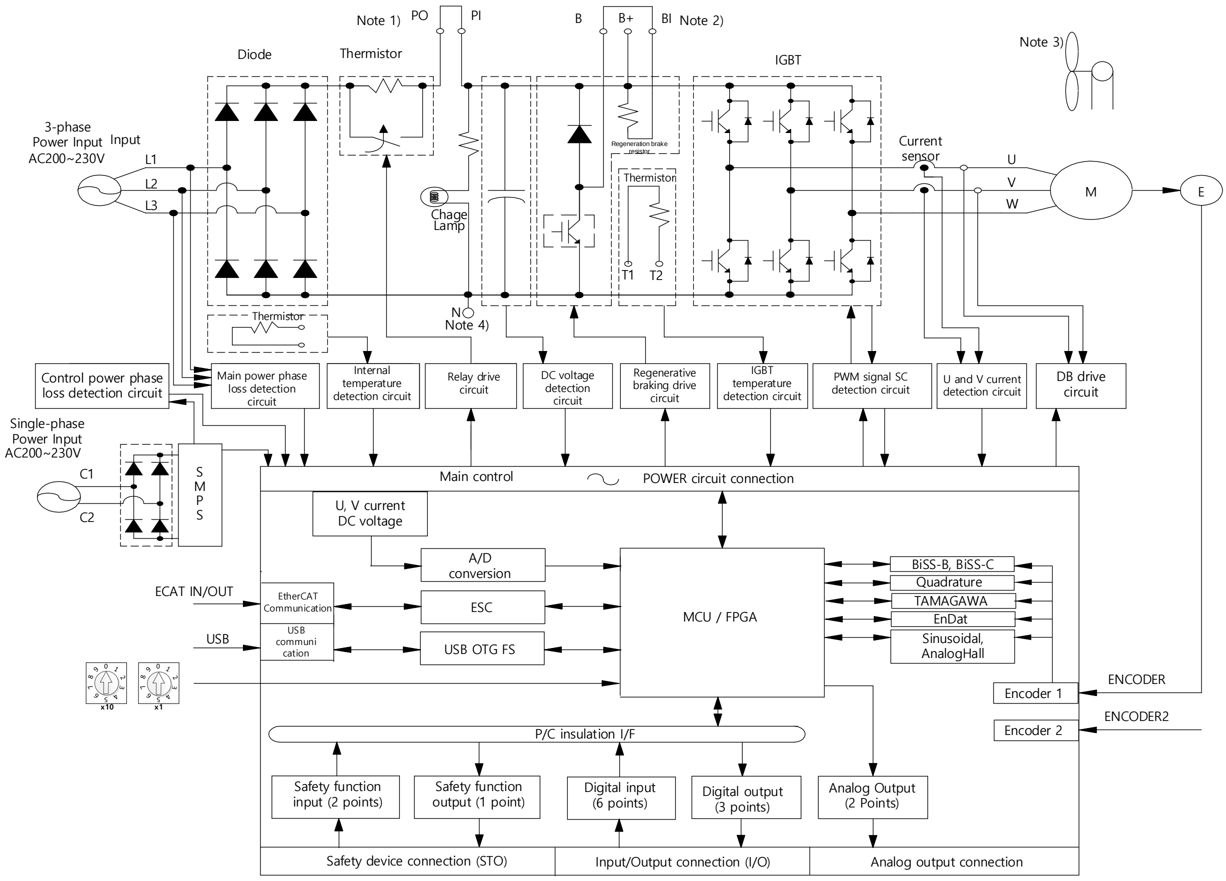




⚠Caution
▪ Install the external regeneration brake resistor properly so that generated heat does not affect the drive. ▪ Assemble the servo drive control panel so it is flat against the wall. ▪ Do not let any metal debris generated from drilling, etc. fall into the drive when assembling the control panel. ▪ Make sure that oil, water, or metal dust does not enter the drive through the gaps or roof of the control panel. ▪ Protect the control panel by using air purge system when using it in an area where there are high amounts of harmful gases or dust.

2.3 Internal Block Diagram of the Servo Drive

2.3.1 L7NHF Drive Block Diagram (L7NHFA010U and L7NHFA035U)



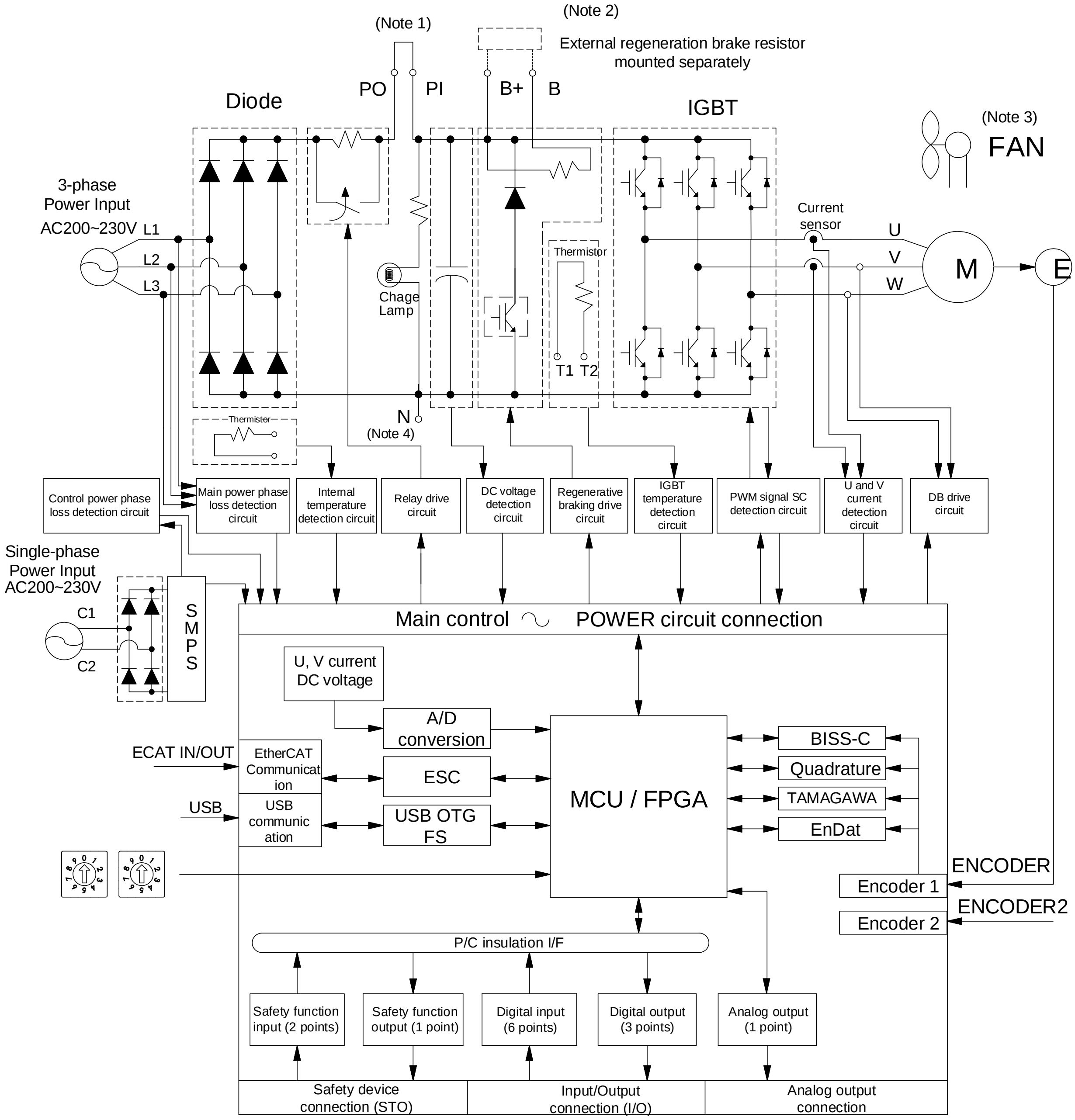
Note 1) To use a DC reactor, connect it to the PO and PI pins.

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

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

Note 4) Use N terminals to connect the external capacitor. The product may burn if a commercial power supply is connected to N terminals. Always contact the customer center or agency when it is necessary to connect the external capacitor.

2.3.2 L7NHF Drive Block Diagram (L7NHFA050U and L7NHFA075U)



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

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

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

Note 4) Use N terminals to connect the external capacitor. The product may burn if a commercial power supply is connected to N terminals.

Always contact the customer center or agency when it is necessary to connect the external capacitor.

2.4 Power Supply Wiring

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

⚠ Caution
Excessive voltage damages the drive.

- If a commercial power supply is connected to U, V and W terminals of the drive, the drive 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 regeneration brake resistors, remove the short-circuit pins and use standard resistors for the B+ and B terminals.

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

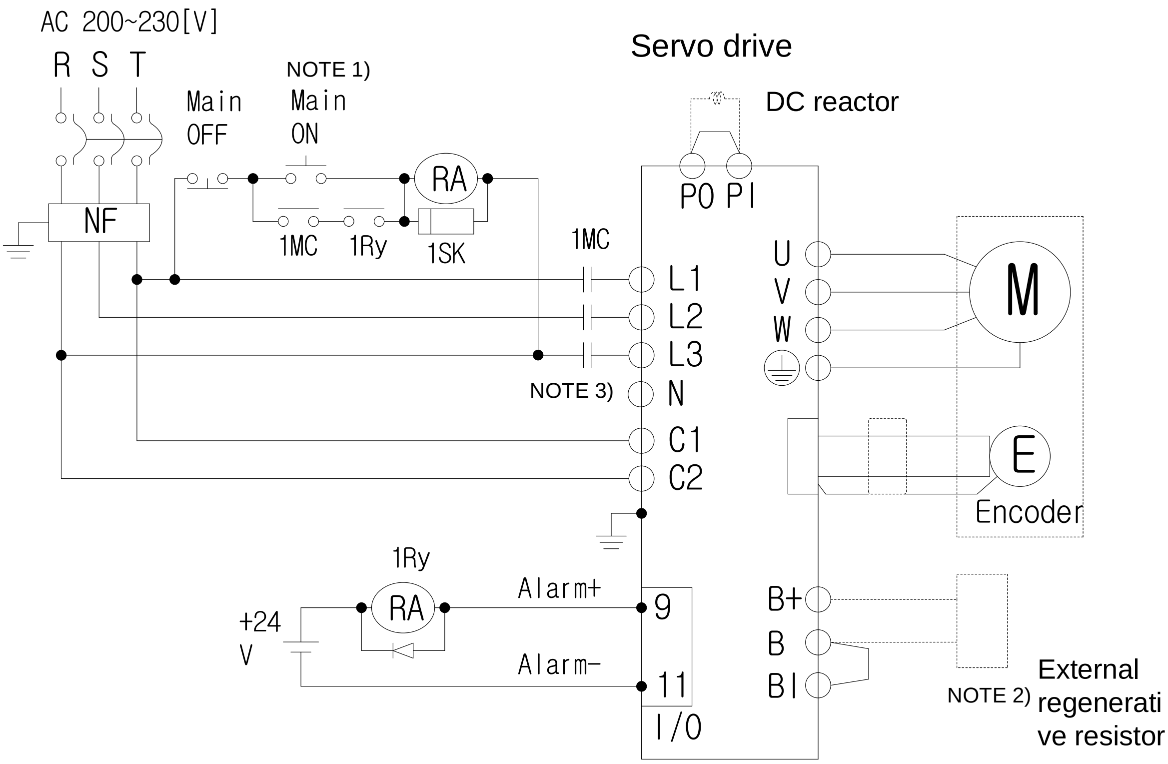
- Configure the system so that the main power (L1, L2, L3) is supplied after the control power (C1, C2). (Refer to section 2.4.1, "Power Supply Wiring Diagram.")
- High voltages may remain in the device for sometime even after the main power is disconnected. Be careful.

Warning
Before resuming wiring, make sure to disconnect the main power and that the charge lamp is completely turned off. Failure to do so may result in electric shock.

- Always ground the device using the shortest possible ground wire. Long ground wires are easily influenced by noise, which causes malfunctions.

2.4.1 Power Supply Wiring Diagram

■ Power Supply Wiring Diagram (L7NHFA010U and L7NHFA035U)

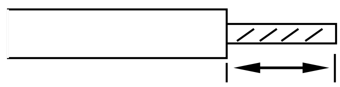


Note 1) It takes approximately 1 to 2 seconds until an alarm signal is output after you turn on the main power. Press and hold the main power ON switch for at least 2 seconds.

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

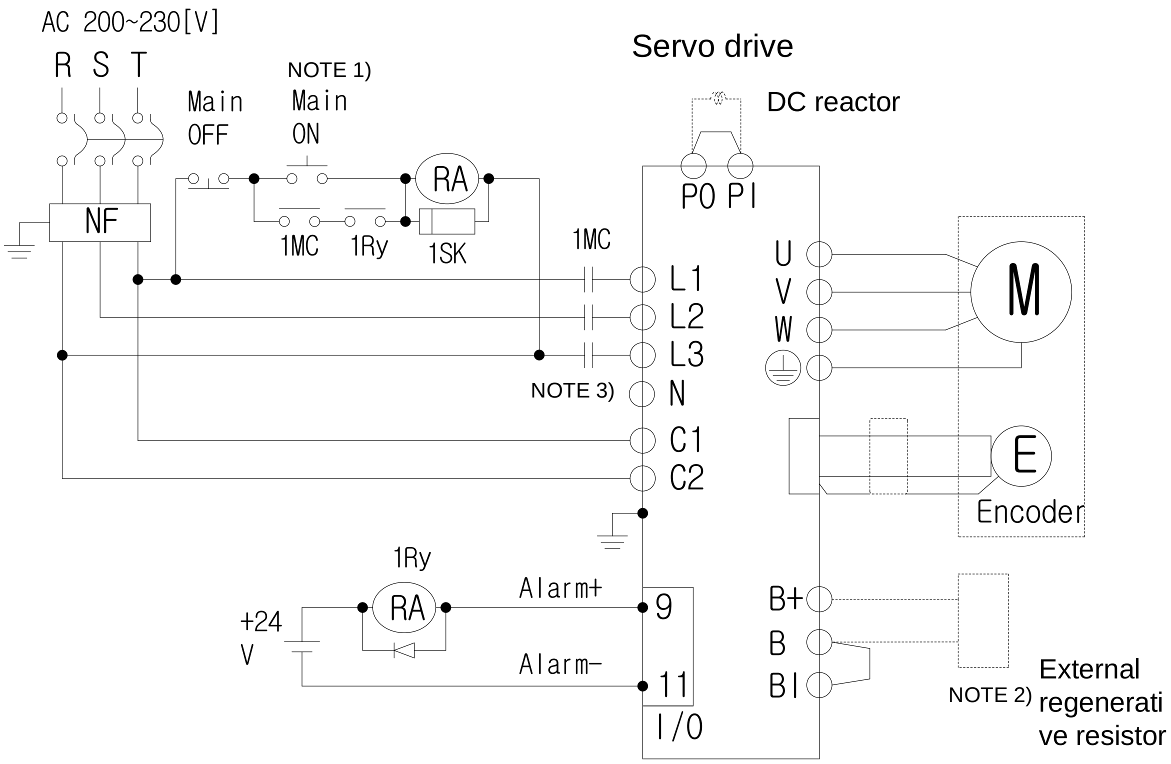
Note 3) Use N terminals to connect the external capacitor. The product may burn if a commercial power supply is connected to N terminals. Always contact the customer center or agency when it is necessary to connect the external capacitor.

Note 4) Remove approximately 7 to 10 [㎜] of the sheathing from the cables for the main circuit power and use the dedicated pressurized terminals. (Refer to Section 2.4.3, "Power Circuit Electrical Components.")



Note 5) For the [1 kW] drive, press the button on the drive terminal to attach or remove wires to the main circuit power unit. For the [3.5 kW] drive, use a (-) flathead screwdriver to attach or remove the wires.

■ Power Supply Wiring Diagram (L7NHFA050U to L7NHFA075U)



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

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

Note 3) Use N terminals to connect the external capacitor. The product may burn if a commercial power supply is connected to N terminals.

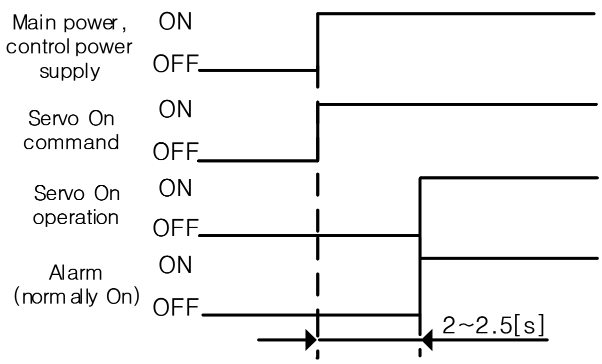
Always contact the customer center or agency when it is necessary to connect the external capacitor.

2.4.2 Power Input Sequence

Power Input Sequence

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

Timing Chart



2.4.3 Power Circuit Electrical Component Standards

■ L7NHFA010U ~ L7NHFA075U

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

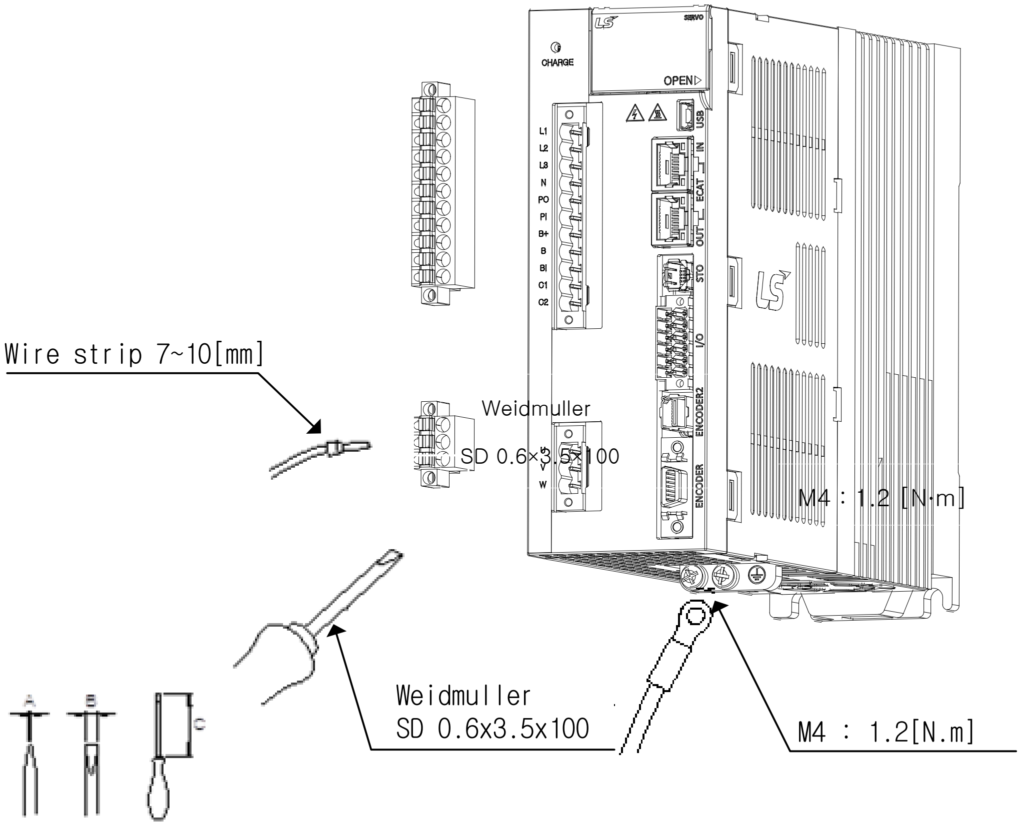
Note 1) When you select a wire, please use 600V, PVC-insulated wire.

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

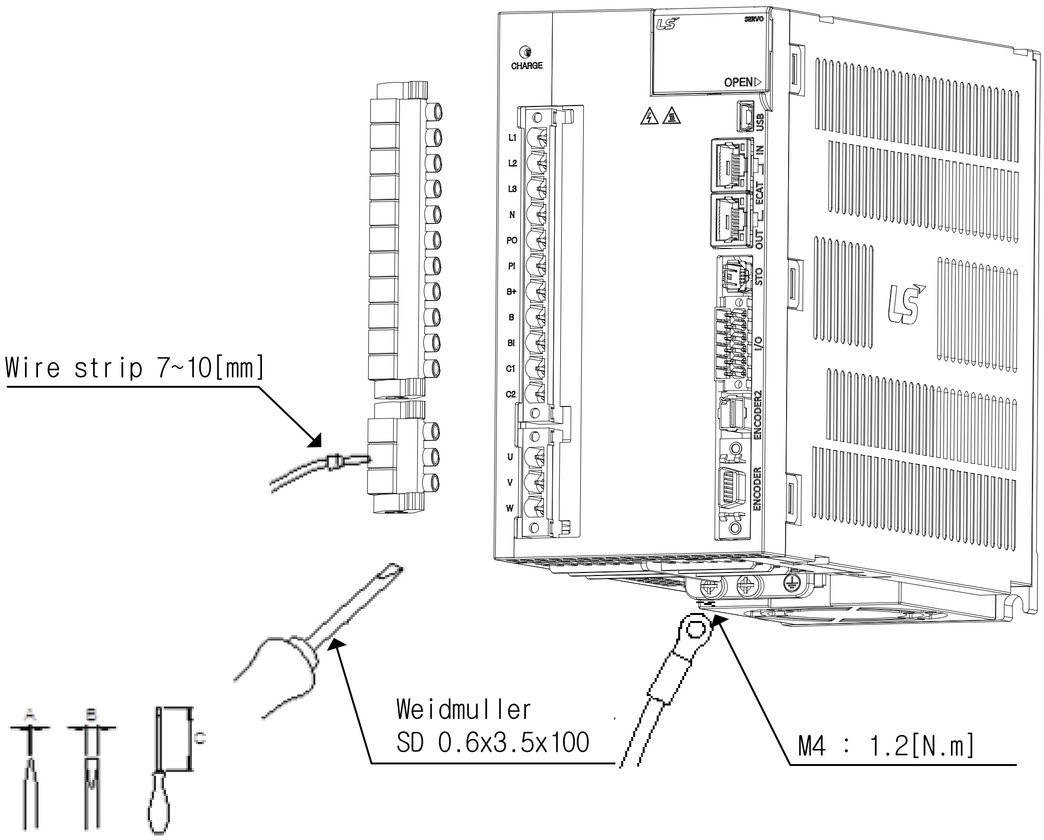
To comply with other standards, use proper wires that meet the applicable standards.

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

■ L7NHFA010U


CHARGE
OPEN
SERVO
L1
L2
L3
N
PO
PI
B+
B
BI
C1
C2
U
V
W
USB
IN
ECAT
OUT
STO
I/O
ENCODER2
ENCODER
Wire strip 7~10[mm]
Weidmuller
SD 0.6×3.5×100
M4 : 1.2 [N·m]
Weidmuller
SD 0.6x3.5x100
M4 : 1.2[N.m]
A
B
C

■ L7NHFA035U



1) For information on wiring to BLF 5.08 and BLZ7.62HP Series connectors, refer to the above procedures.

2) Insert electric wire into insert hole with upper locking screw loosened, and use applicable flathead (-) driver for each model to fully tighten screw to 0.4-0.5 N·m.

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

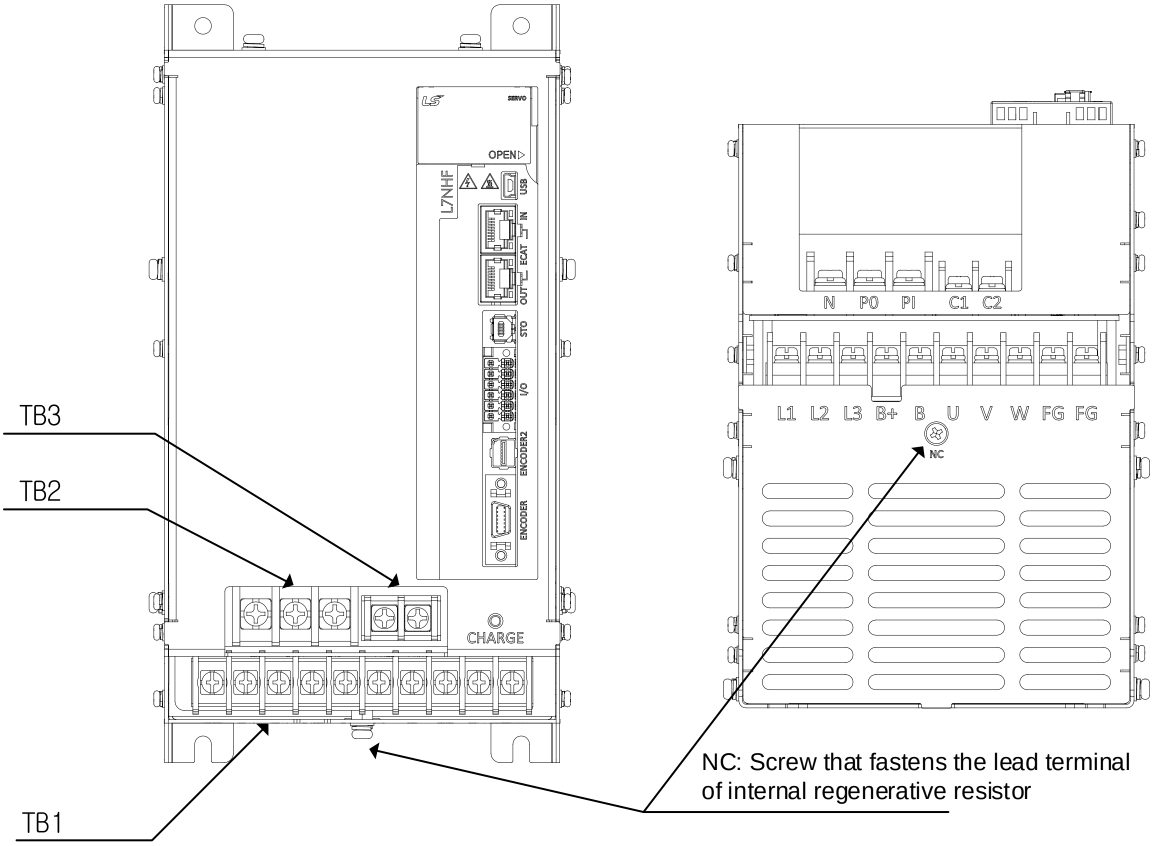
4) After you connect a wire to connector, place the connector as closely to servo drive as possible and use both locking hooks to fully lock it.

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

6) Insufficient torque of locking screw may cause PE (Protective Earth) contact failure and even malfunctioning drive.

7) We recommend that you use a Weidmüller SD 0.6 x 3.5 x 100 product for a flat-head (-) screwdriver.

■ L7NHFA050U



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

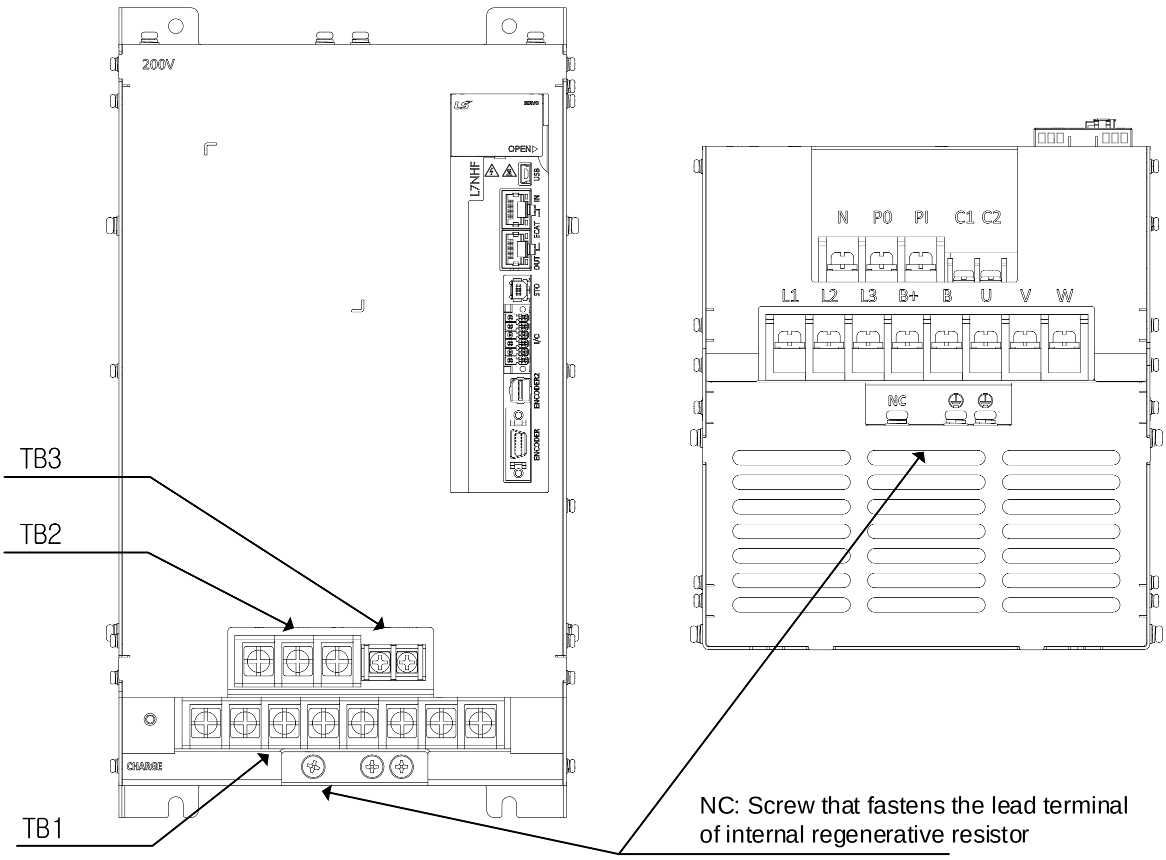
Terminal screw: M4

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

■ L7NHFA075U



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

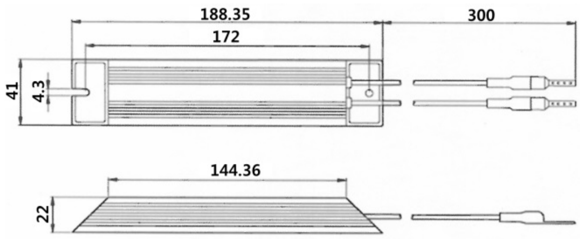
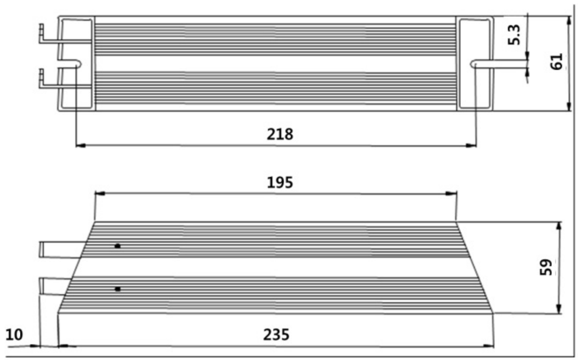
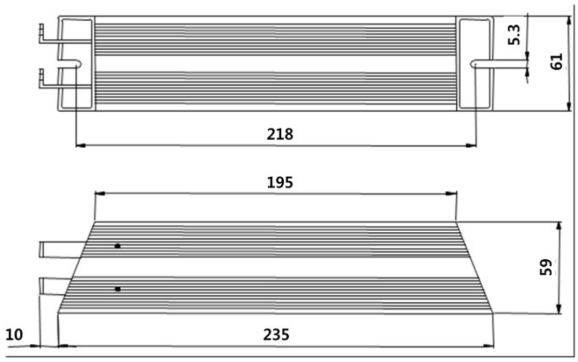
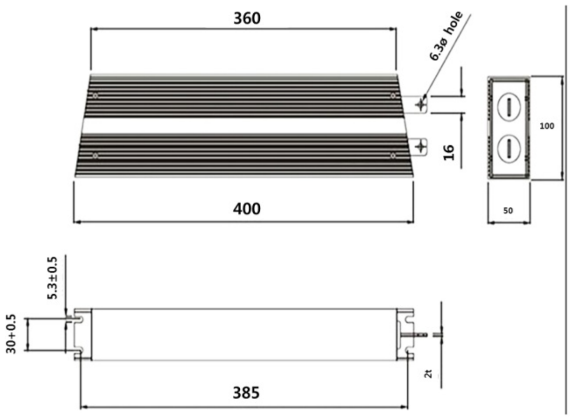
Terminal screw: M4

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.

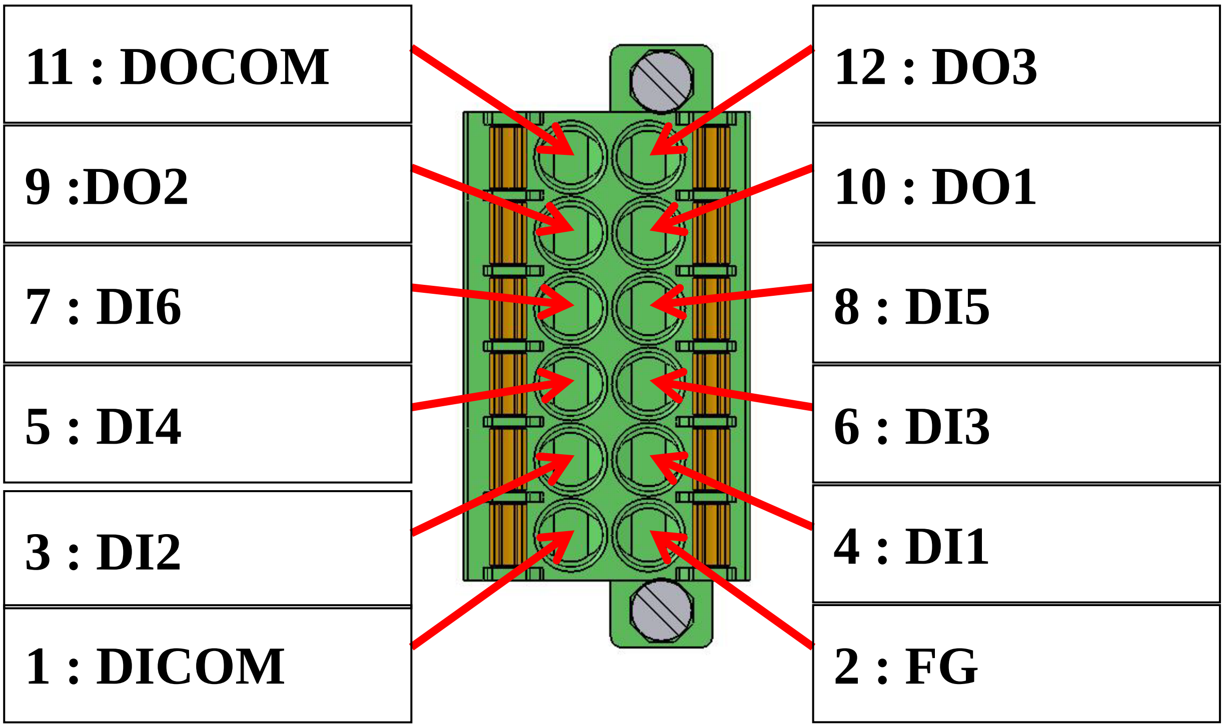
2) Use PE (Protective Earth) locking screw of M4 size (shown at the bottom of product) to tighten it to 1.2 N·m.

2.4.4 Regeneration Brake Resistor Options

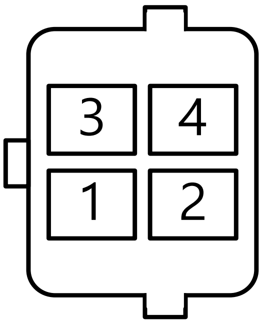
Item	Product Name	Model Name	Applicable Drive	Specifications
Resistance	Regenerative resistor	APC-300R30	L7NHFA010U	
Resistance	Regenerative resistor	APC-600R30	L7NHFA035U	
Resistance	Regenerative resistor	APC-600R28	L7NHFA050U (4P) L7NHFA075U (4P)	
Resistance	Braking Resistance	IRM2000-3.3Ω 3.3[Ω] (2000W)	L7NHFA150U	

2.5 Wiring for Input/Output Signals

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



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



2.5.1 Names and Functions of Digital Input/Output Signals

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

Pin Number	Name	Assignment	Details	Function
1	DICOM	DC 24V	DC 24V INPUT	COMMON
4	DI1	POT	Positive (CCW) Rotation Prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in the positive direction.
3	DI2	NOT	Negative (CW) Rotation Prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in the negative direction.
6	DI3	HOME	Home Position Sensor	Connects the home position sensor for homing.
5	DI4	STOP	Servo Stop	Stops the servo motor when the contact is on.
8	DI5	PCON	P Control Action	When the contact is on, it converts the mode from PI control to P control.
7	DI6	GAIN2	Switching Gain 1 to Gain 2	When the contact is on, it switches the velocity control from Gain 1 → Gain 2.
** PCL			Positive Torque Limit	When the contact is on, the positive torque limit function is activated.
** BNCL			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	Signal to use the vibration suppression filter 1 according to the vibration suppression filter function configuration (0x2515)
** LVSF2			Vibration Suppression Filter 2	Signal to use the vibration suppression filter 2 according to the vibration suppression filter function configuration (0x2515)
** SVON			Servo ON	Servo ON

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

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

■ Names and Functions of Digital Output Signals

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

** Unassigned signal. The assignment may be changed by parameter settings. For more information, refer to Section 5.2, “Input/Output Signals Setting.”

2.5.2 Names and Functions of Analog Input/Output Signals

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

Pin Number	Name	Details	Function
1	AMON1	Analog Monitor 1	Analog Monitor output (AT NC Axis in case of -10V~+10V signal 신호면 AT NC Axis 10)
2	AMON2	Analog Monitor 2	Analog Monitor output (AT NC Axis in case of -10V~+10V signal 신호면 AT NC Axis 10)
3	AGND	AGND(0V)	Analog ground
4	AGND	AGND(0V)	Analog ground

Note 1) You can change the output variables to be monitored with analog monitor output through parameter settings.

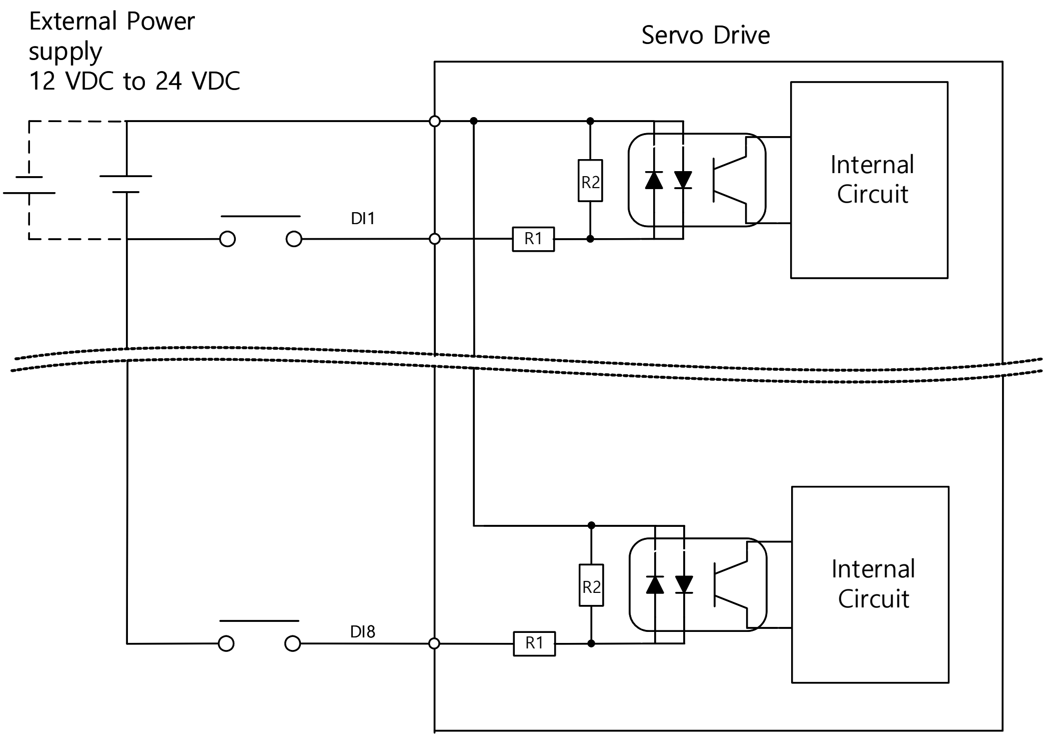
For more information, refer to Section 5.2.3 “Assignment of Analog Output Signals.”

2.5.3 Examples of Input/Output Signal Connection

■ Examples of Digital Input Signal Connection

⚠ Caution

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

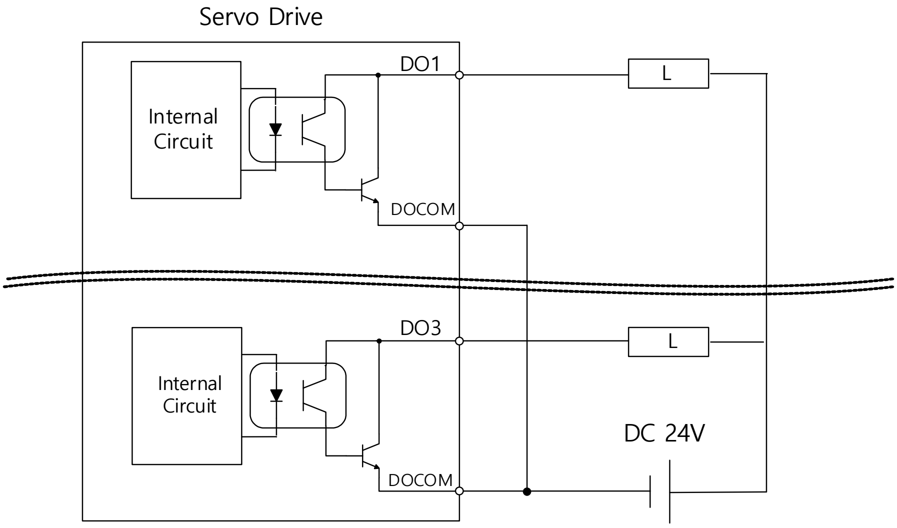


R1 : 3.3KΩ, R2 : 680Ω

■ Example of Connecting Digital Output Signals

⚠ Caution

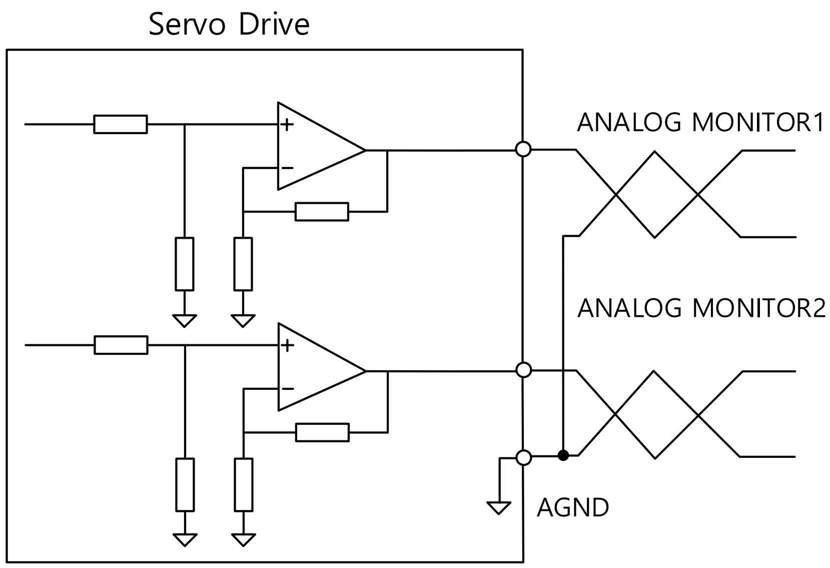
1. You can set the output contact to contact A or contact B, based on the characteristics of individual signals.
2. You can assign each output contact to one of 11 output functions.
3. For more information on signal assignment and contact change of the output contact, refer to 5.2 Input/Output Signals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



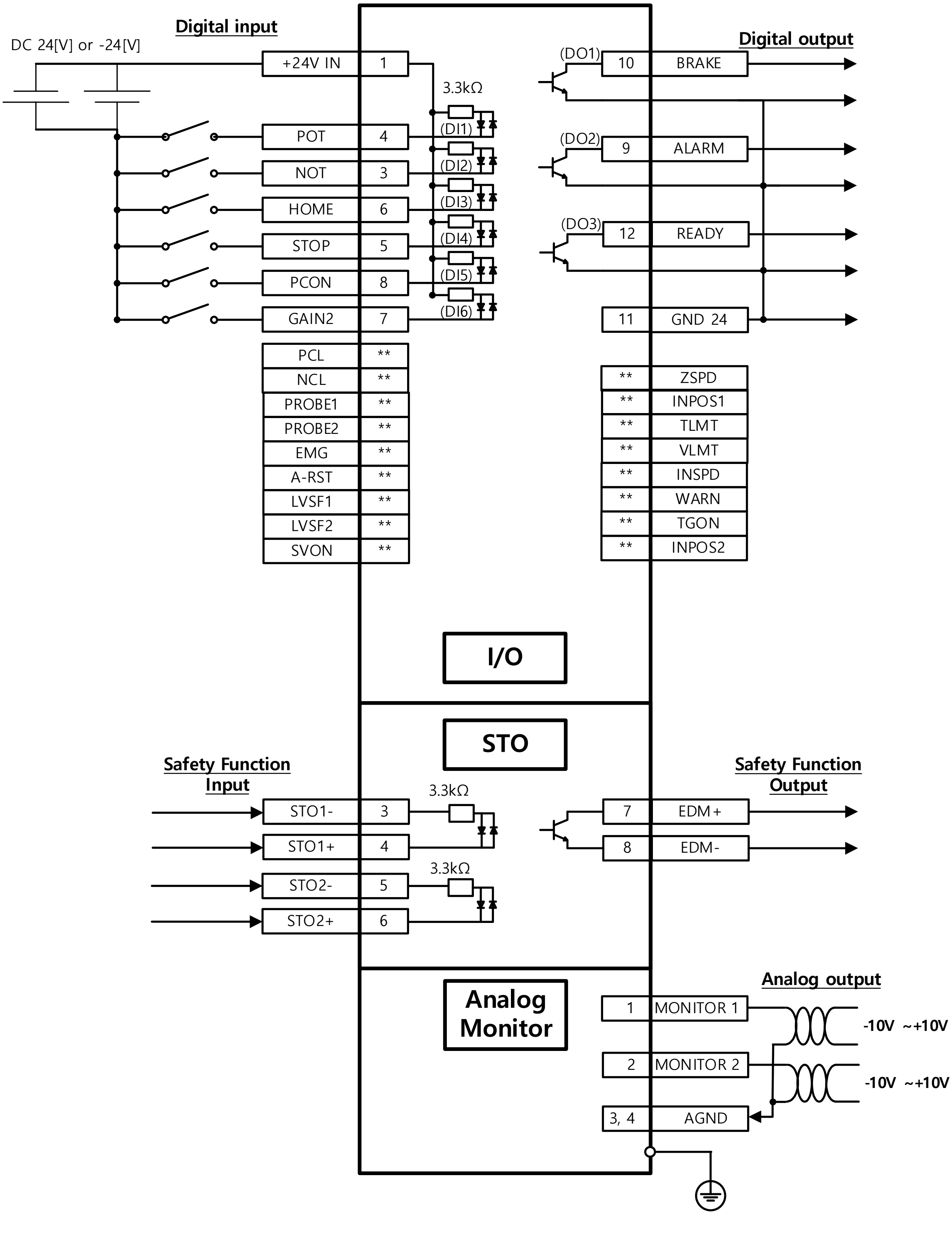
■ Examples of Connecting Analog Output Signals

⚠ **Caution**

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



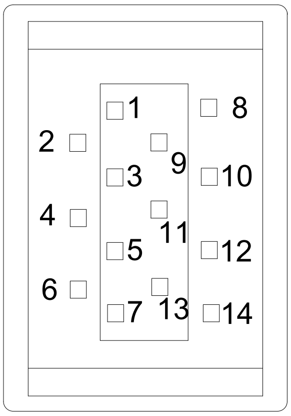
2.5.4 Input/Output Signals Configuration Diagram



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

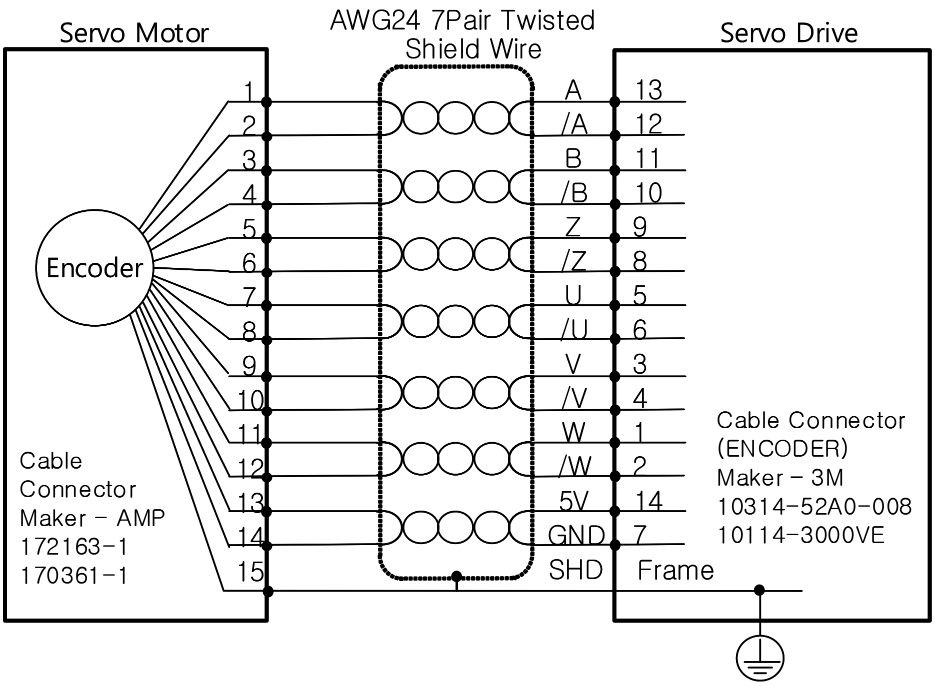
2.6 Wiring of Encoder Signal (ENCODER)

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

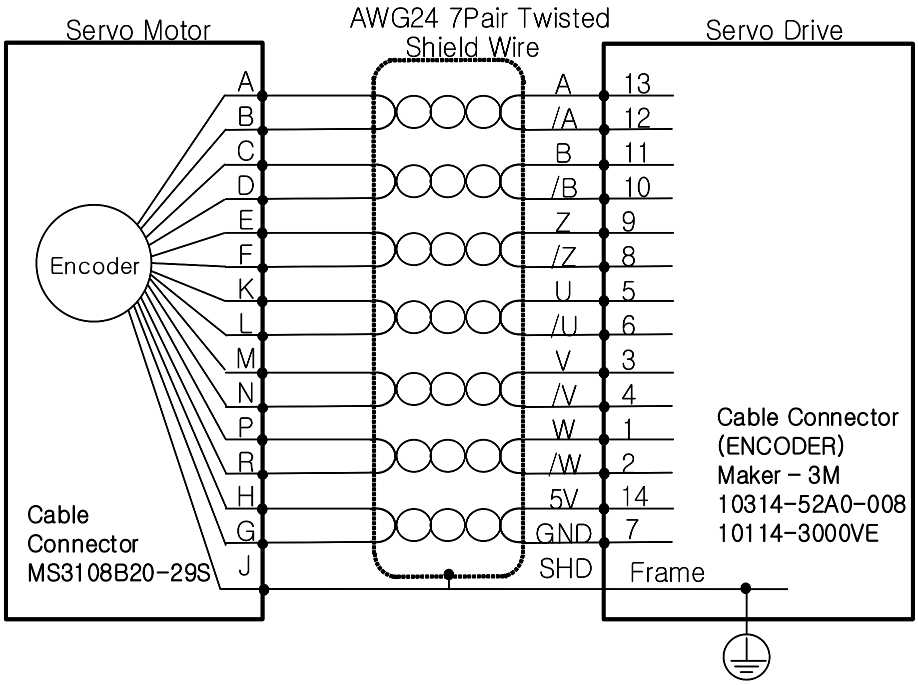


2.6.1 Quadrature Encoder Signaling Unit Wiring

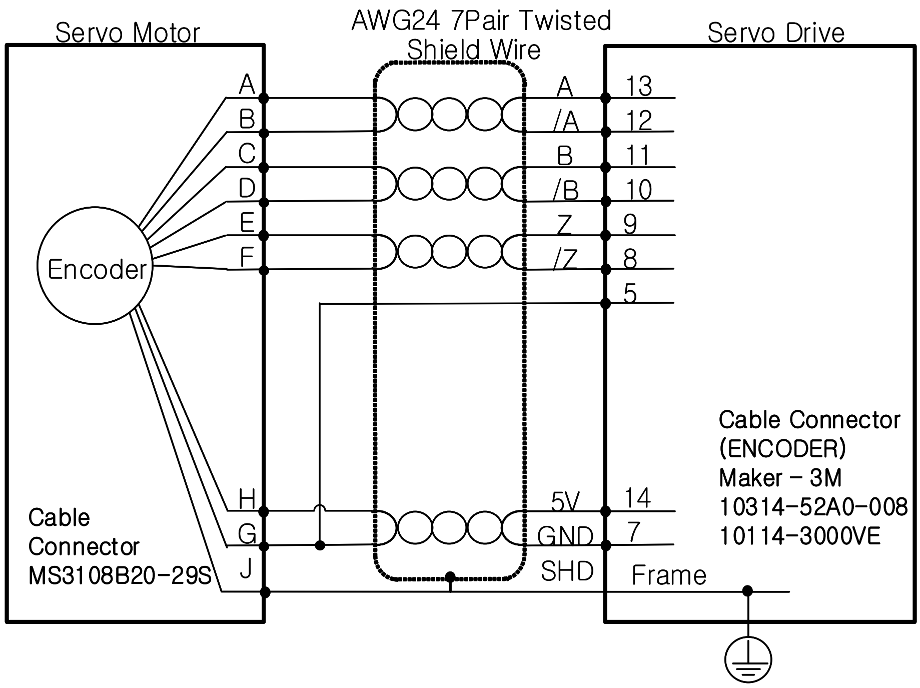
■ **APCS-E□□□AS Cable**



■ APCS-E□□□BS Cable

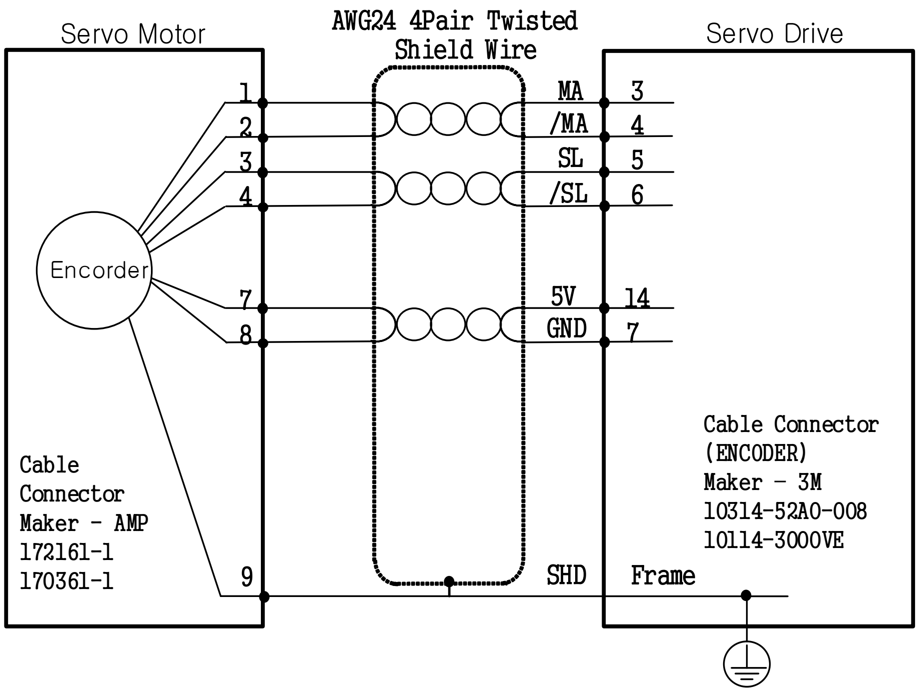


■ Without Quadrature Type Hall Sensor

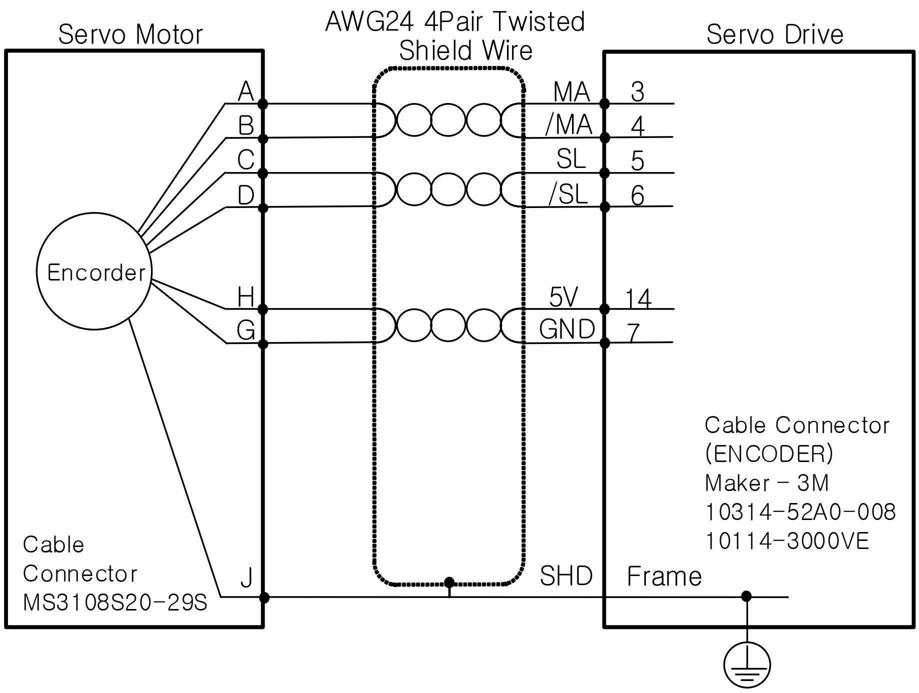


2.6.2 Serial Encoder Signaling Unit Wiring

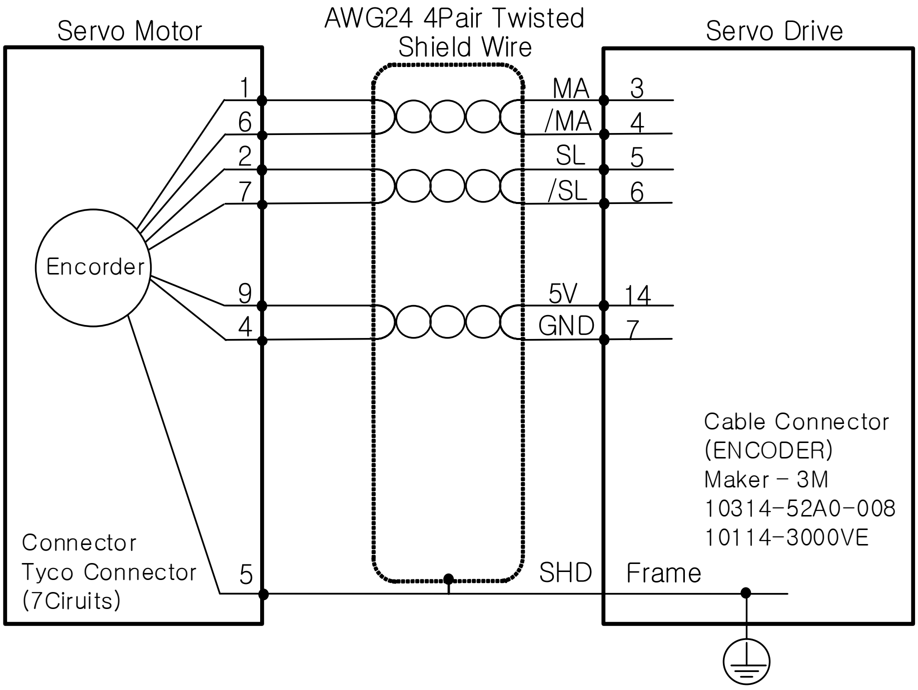
■ **APCS-E□□□CS Cable**



■ **APCS-E□□□DS Cable**

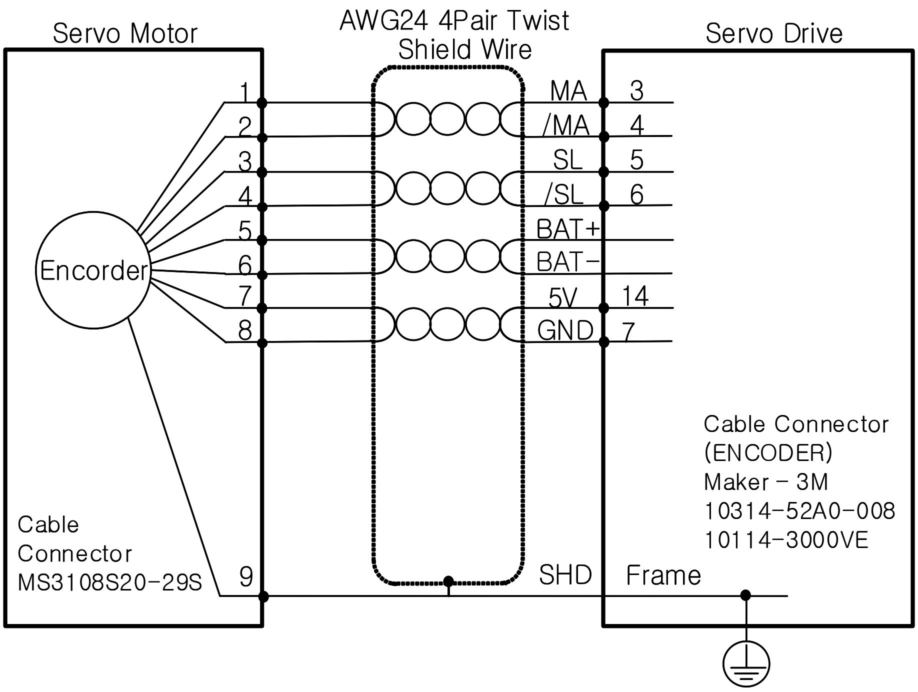


■ **APCS-E□□□ES Cable**

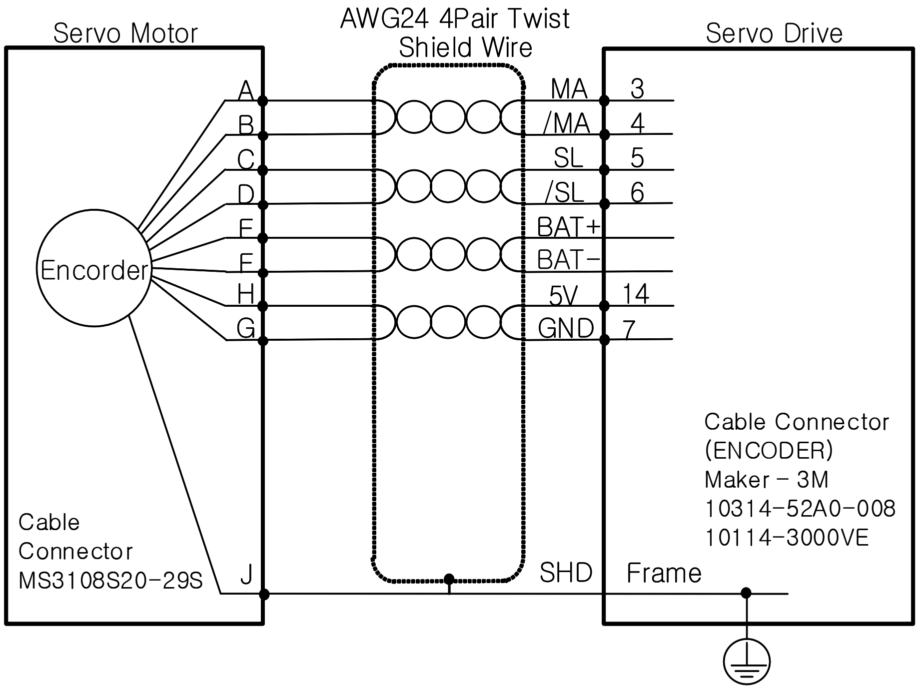


2.6.3 Multi-Turn Encoder Signaling Unit Wiring

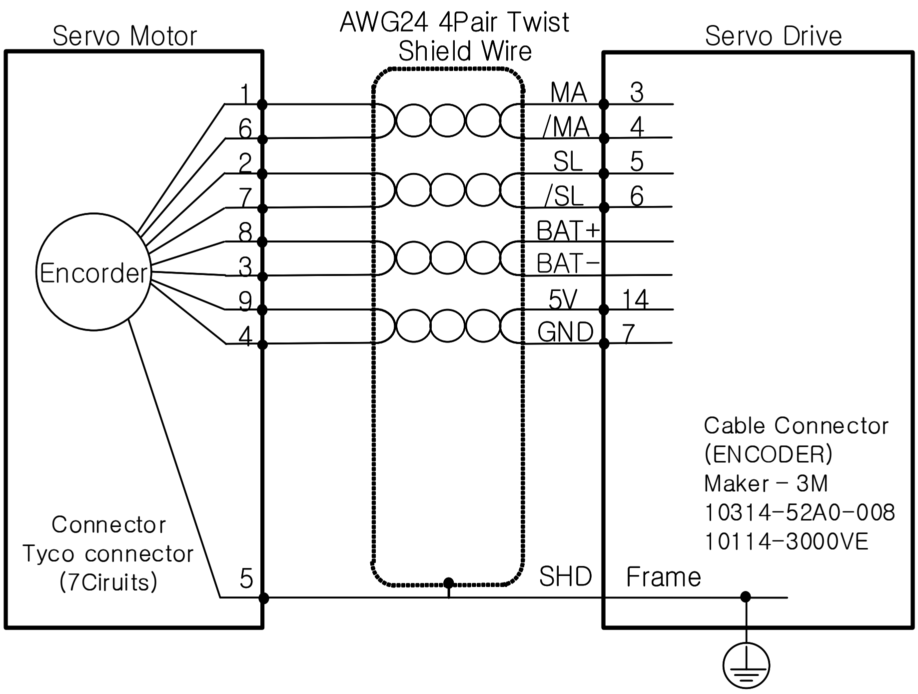
■ **APCS-E□□□CS1 Cable**



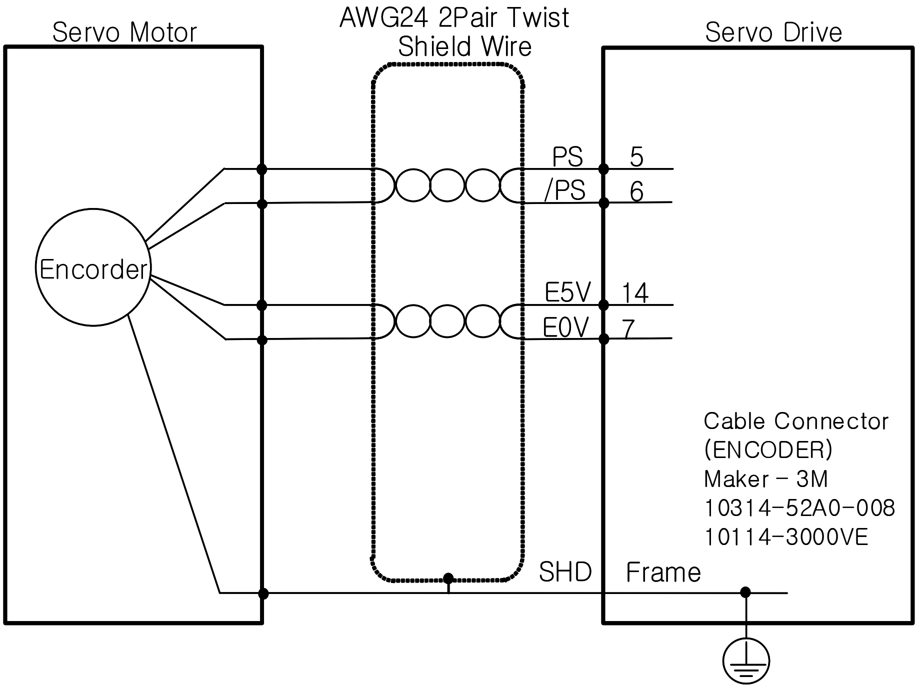
■ APCS-E□□□DS1 Cable



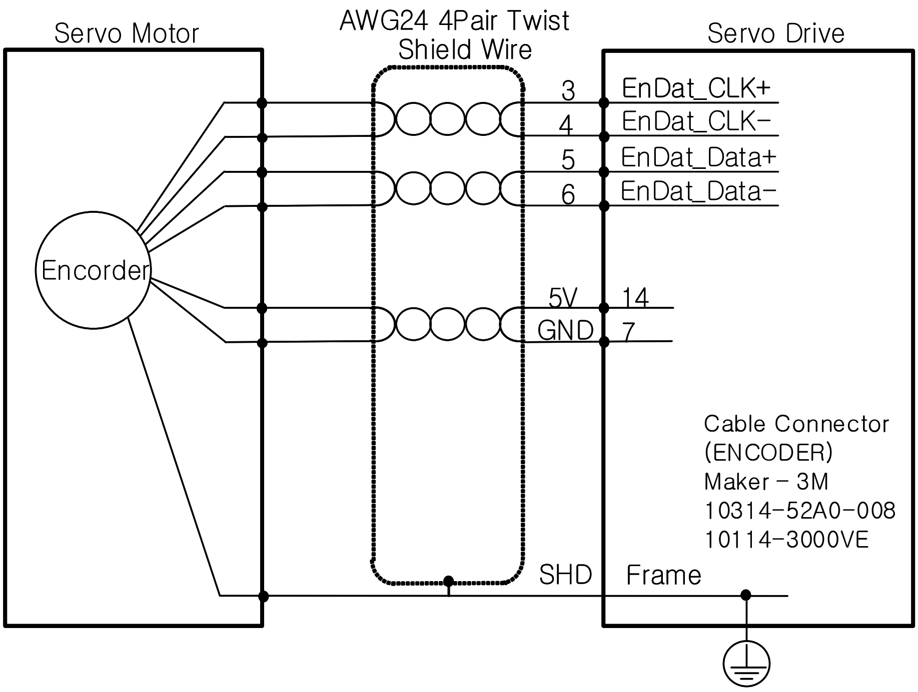
■ APCS-E□□□ES1 Cable



2.6.4 Tamagawa Encoder Signaling Unit Wiring



2.6.5 EnDat 2.2 Encoder Signaling Unit Wiring

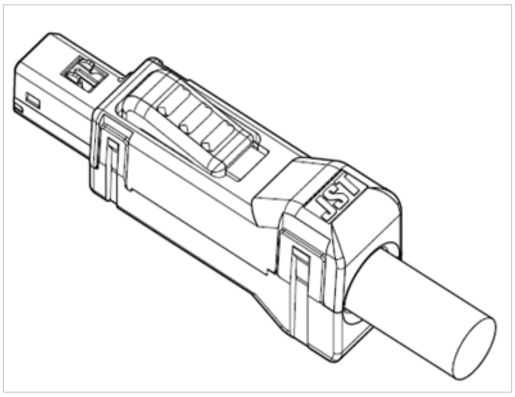


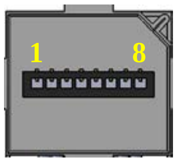
2.7 Second Encoder (Encoder 2)

■ Connector specifications

- Connector : MUF-PK8K-X

- Recommended wiring standards: AWG28 - AWG24





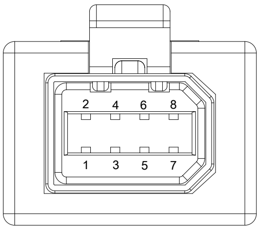
DER2 connector viewed
n the front of the drive

■ Wiring and signal name

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

2.8 Wiring for Safety Function Signals (STO)

■ **2069577-1(Tyco Electronics)**



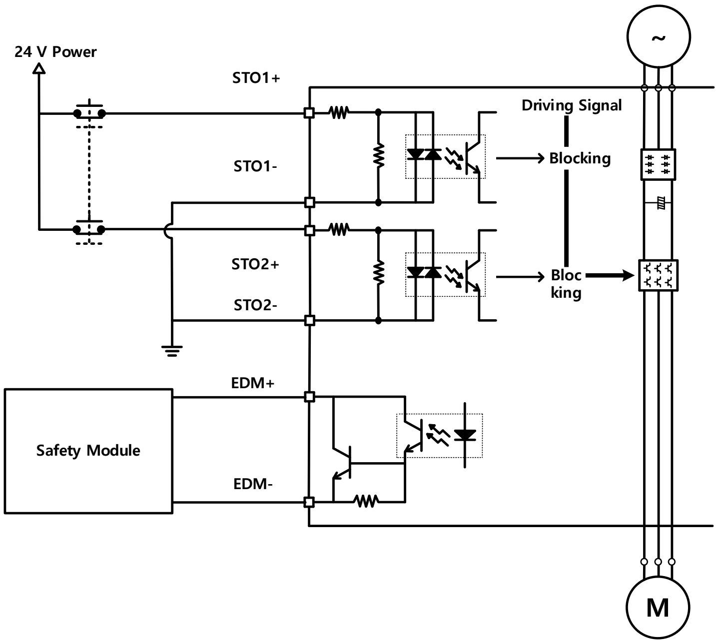
2.8.1 Names and Functions of Safety Function Signals

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

2.8.2 Example of Connecting Safety Function Signals

⚠ Caution

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

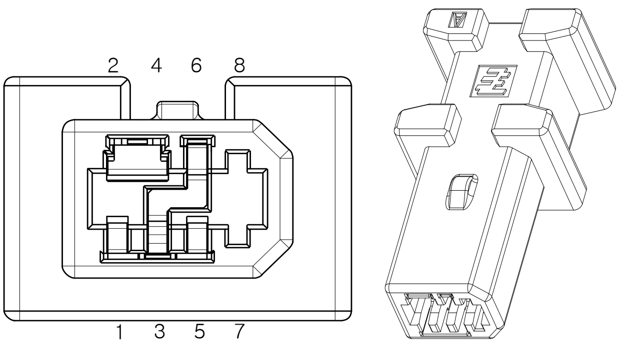


2.8.3 Bypass Wiring of Safety Function Signals

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

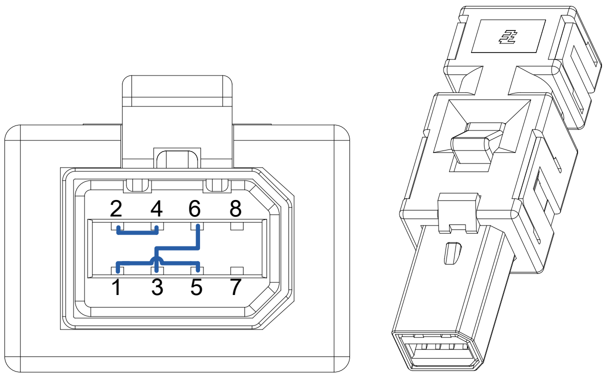
If you connect +12V to STO2-, -12V to STO1+ and STO1- to STO2+ for wiring of the Mini I/O Plug connector, you can bypass the safety function signal. Never use this power (+12 V and -12 V) except for this purpose.

■ Mini I/O By-pass Connector



1971153-1(Tyco Electronics)

■ Mini I/O Plug Connector



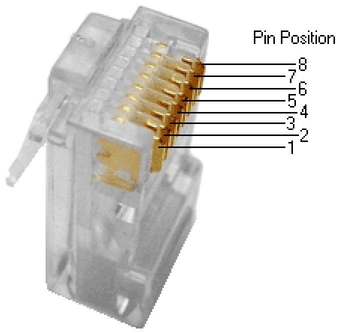
2069577-1(Tyco Electronics)

2.9 Wiring for EtherCAT Communication Signals

2.9.1 Names and Functions of EtherCAT Communication Signals

■ EtherCAT IN and EtherCAT OUT Connector

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

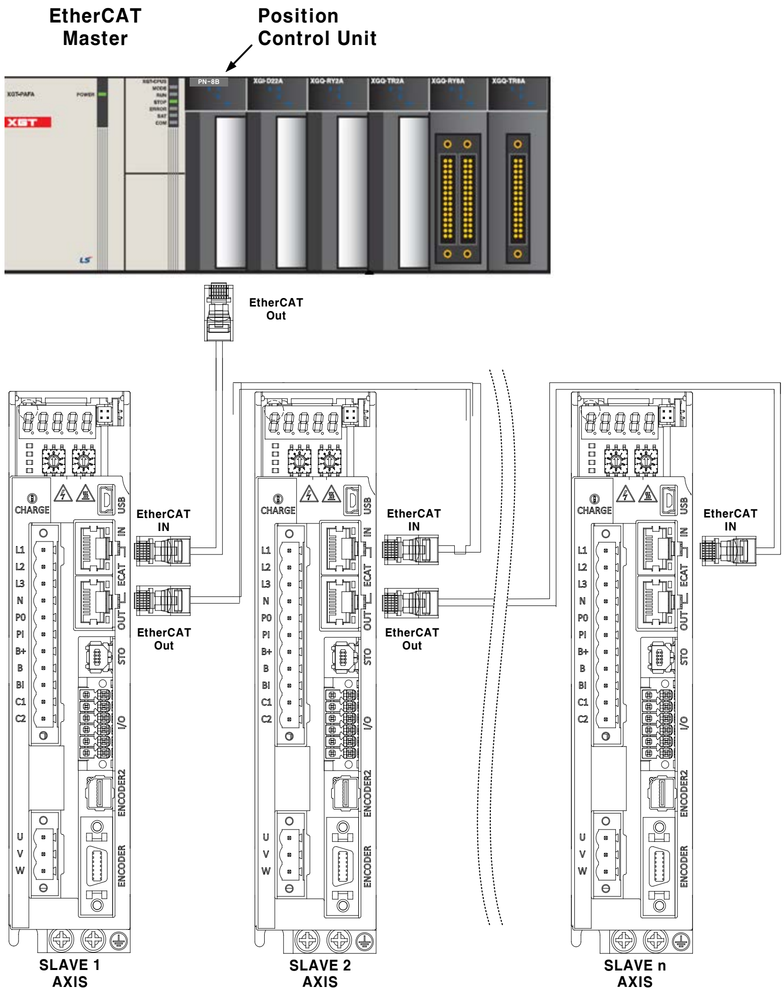


Note 1) EtherCAT only uses signals from 1, 2, 3 or 6.

2.9.2 Example of Drive Connection

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

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



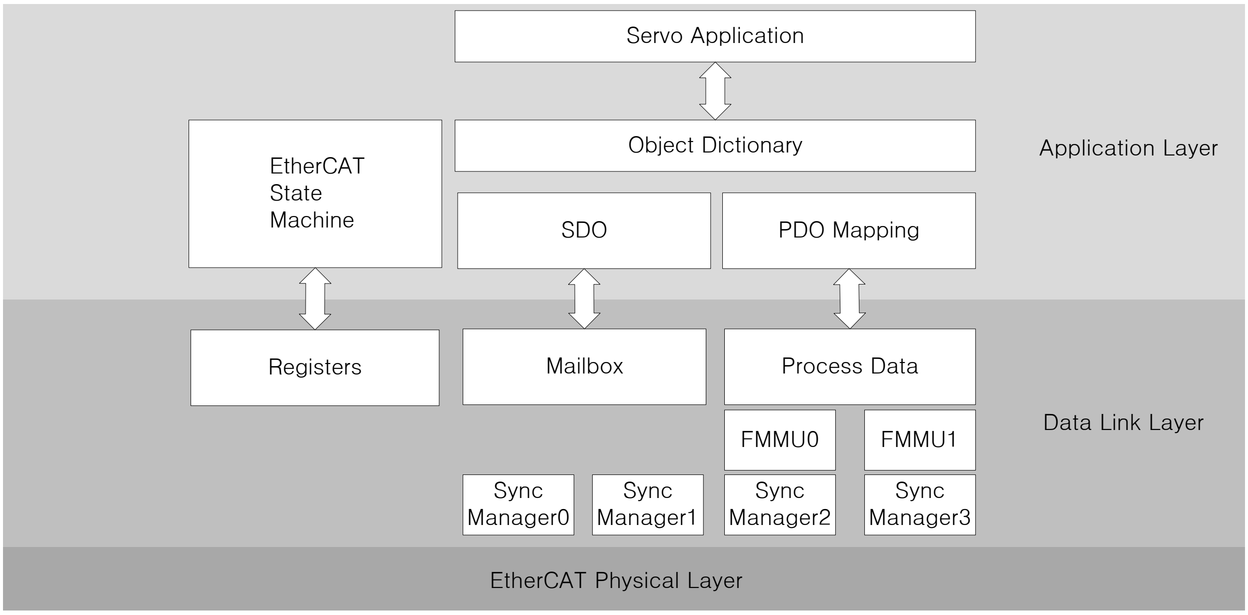
3. EtherCAT Communication

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

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

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

3.1 Structure of CANopen over EtherCAT

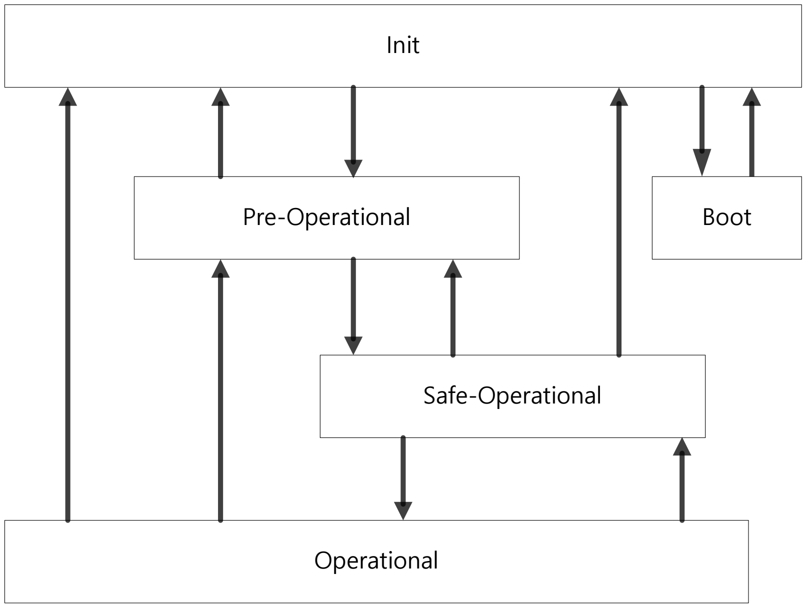


This drive supports a CiA 402 drive profile. The Object Dictionary in the application layer includes the application data and PDO (Process Data Object) mapping information from the process data interface and application data.

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

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

3.1.1 EtherCAT State Machine

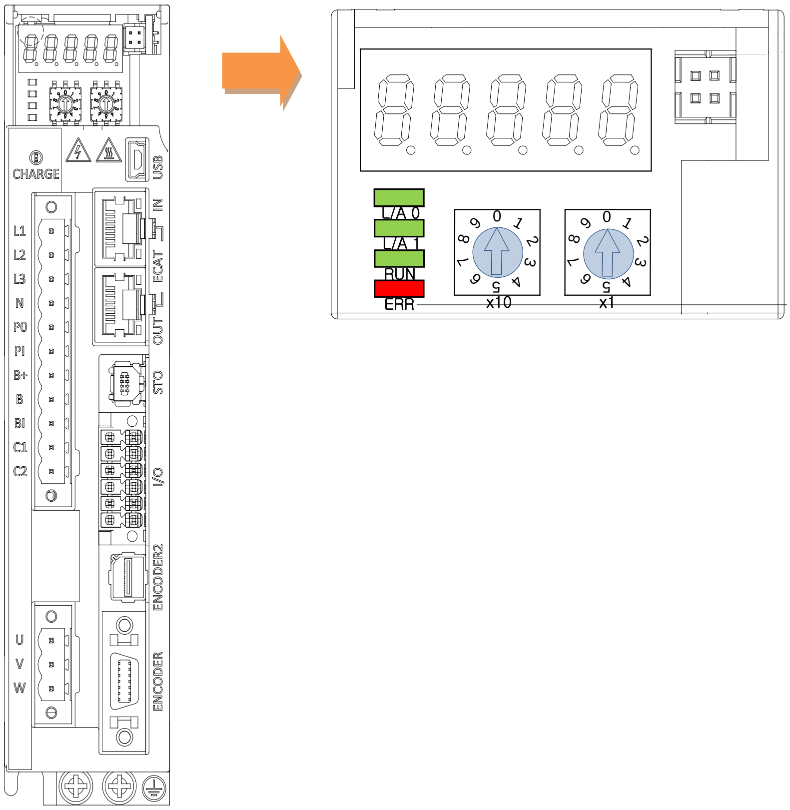


The EtherCAT drive has 5 states as shown above, and a state transition is achieved by an upper level controller (master).

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

3.2 Status LED

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



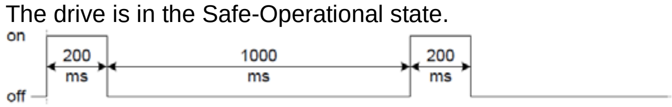
■ L/A0, L/A1 (Link Activity) LED

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

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

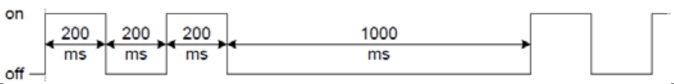
■ RUN LED

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

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

■ ERR LED

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

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

3.3 Data Type

The following table outlines the data types and ranges used in this manual.

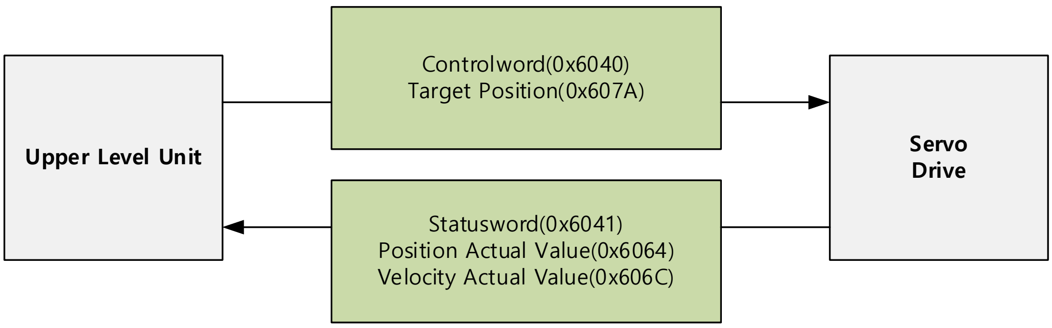
Codes	Description	Ranges
SINT	Signed 8-bit	-128 ~127
USINT	Unsigned 8-bit	0 ~ 255
INT	Signed 16-bit	-32768 ~ 32767
UINT	Unsigned 16-bit	0 ~ 65535
DINT	Signed 32-bit	-2147483648 ~ 2147483647
UDINT	Unsigned 32-bit	0 ~ 4294967295
FP32	Float 32-bit	Single precision floating point
STRING	String Value	

3.4 PDO-Mapping

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

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

The diagram below shows the PDO assignment:



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

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

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

SubIndex	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 when assigning the Statusword, the Position Actual Value, and the Actual Velocity Value with the TxPDO (0x1A00).

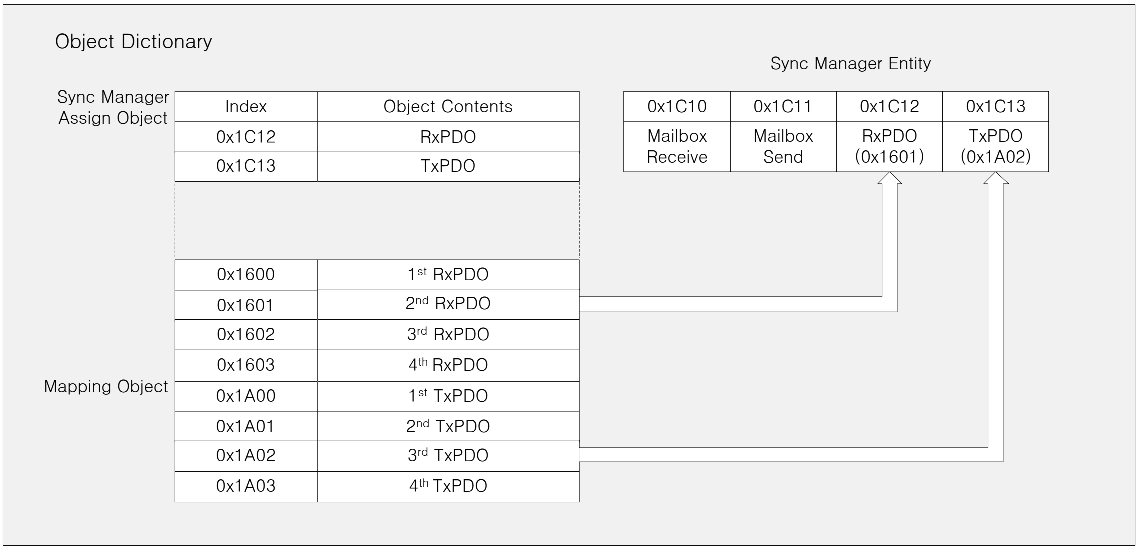
Index	SubIndex	Name	Data Type
0x6041	0x00	Statusword	UINT
0x6064	0x00	Position Actual Value	DINT
0x606C	0x00	Velocity Actual Value	DINT

The TxPDO (0x1A00) settings 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 SyncManager PDO mapping:



■ PDO Mapping

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

1st PDO Mapping:

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

2nd PDO Mapping:

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

3rd PDO Mapping:

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

4th PDO Mapping:

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

3.5 Synchronization Using the DC (Distributed Clock)

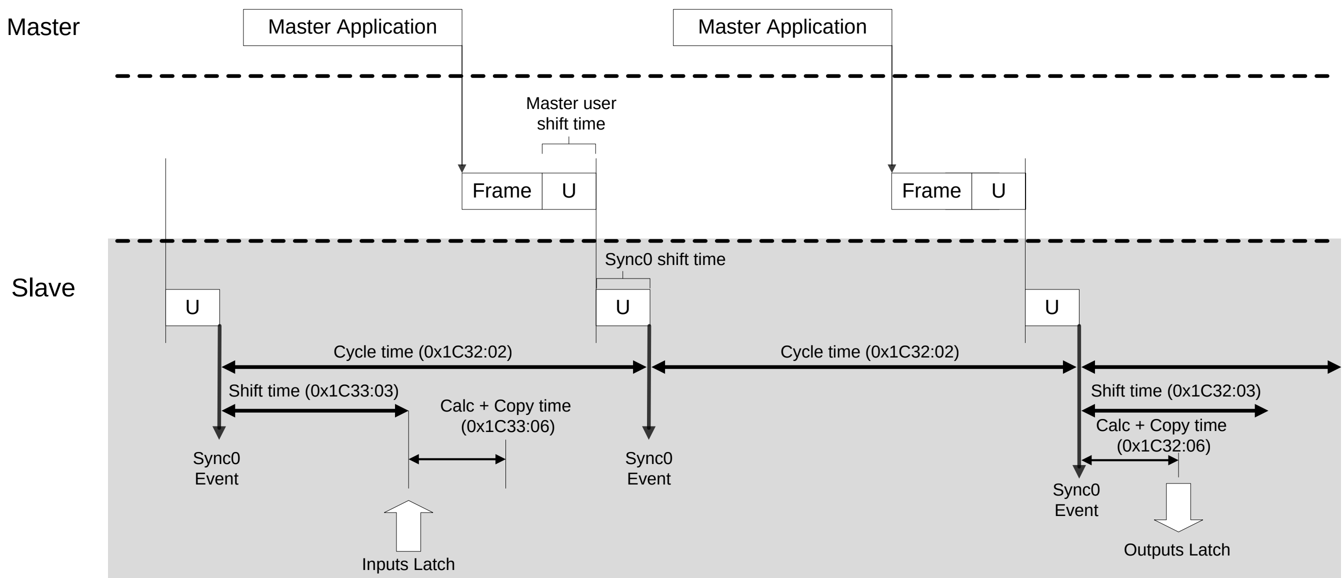
The Distributed Clock (DC) synchronizes EtherCAT communication. The master and slave share a reference clock (system time) for synchronization, and the slave synchronizes its applications with the Sync0 event generated by the reference clock. The following synchronization modes exist in this drive. You can change the mode with the sync control register.

(1) Free-run Mode:

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

(2) DC Synchronous Mode:

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



3.6 Emergency Messages

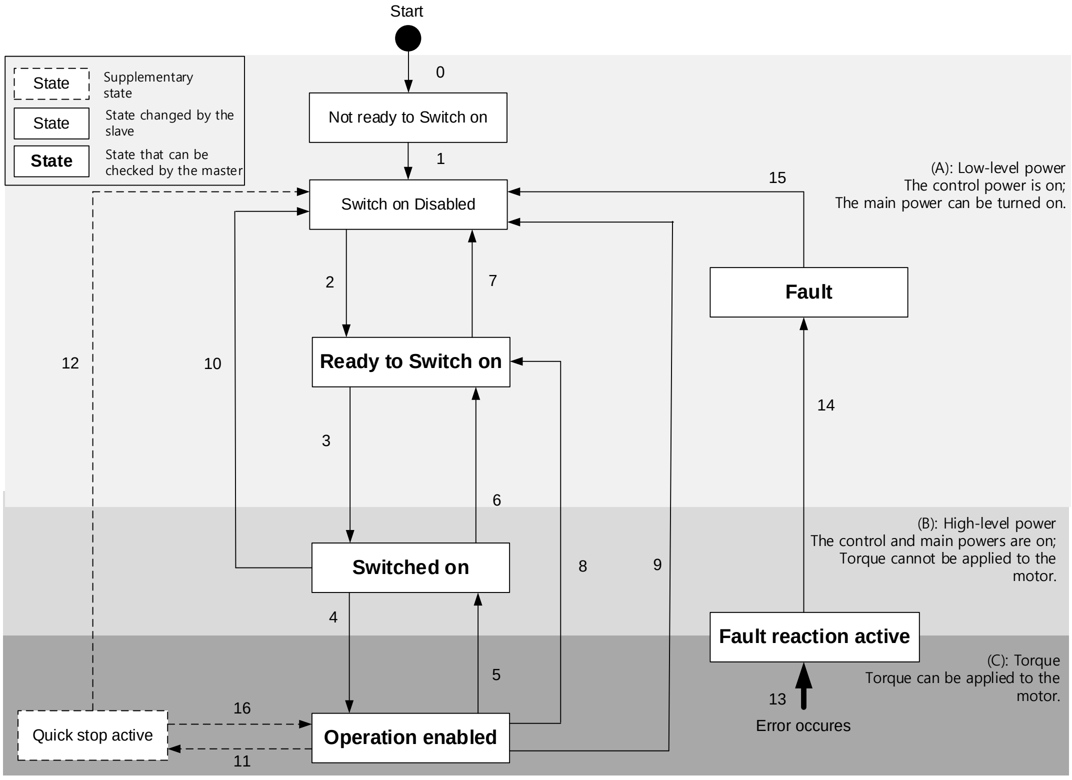
Emergency messages are passed to the master via mailbox communication when a servo alarm occurs in the drive. Emergency messages may not be sent in the event of communication failure.

Emergency messages consist of 8-byte data.

<table>
<tr><th>Byte</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td rowspan="2">Details</td><td colspan="2" rowspan="2">Emergency Error Code (0xFF00)</td><td rowspan="2">Error Register (0x1001)</td><td rowspan="2">Reserved</td><td colspan="4">Unique Field for Each Manufacturer</td></tr>
<tr><td colspan="2">Servo Alarm Code</td><td colspan="2">Reserved</td></tr>
</table>

4. CiA402 Drive Profile

4.1 State machine



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

■ **State Machine Control Commands**

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

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

■ Statusword Bit Names (0x6041)

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

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

Bit No.	Data Description	Note
0	Ready to switch on	For more information, refer to 9.3 CiA402 Objects.
1	Switched on	
2	Operation enabled	
3	Fault	
Bit No.	Data Description	Note
4	Voltage enabled	For more information, refer to 9.3 CiA402 Objects.
5	Quick stop	

6	Switched on disabled	
7	Warning	
8	-	
9	Remote	
10	Target reached	
11	Internal limit active	
12	Operation mode specific	
13	Remote	
14	ABS position valid	
15	Procedure busy	

4.2 Operation Modes

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

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

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

Function	Operation Modes			
	CSP PP	CSV PV	CST PT	HM
Electric Gear	O	O	O	O
Speed Feedforward	O	X	X	OX
Torque Feedforward	O	O	X	O
Position Command Filter	O	X	X	OX
Real-time Gain Adjustment	O	O	O	O
Notch Filter	O	O	O	O
Disturbance Observer	O	O	X	O

Note 2) For HM mode, the control mode is internally switched; thus, the function of speed feedforward and/or position command filter may or may not be applied, depending on the operation condition.

■ Related Objects

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

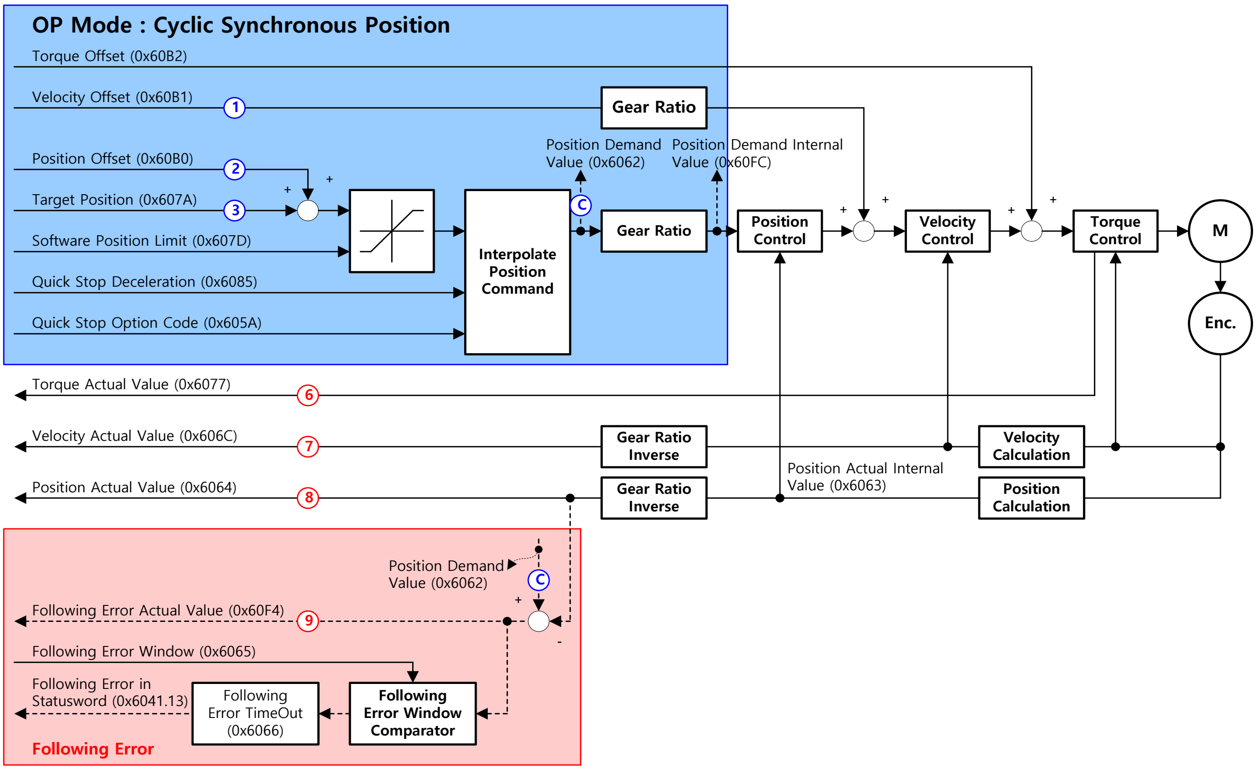
4.3 Position Control Modes

4.3.1 Cyclic Synchronous Position Mode

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

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

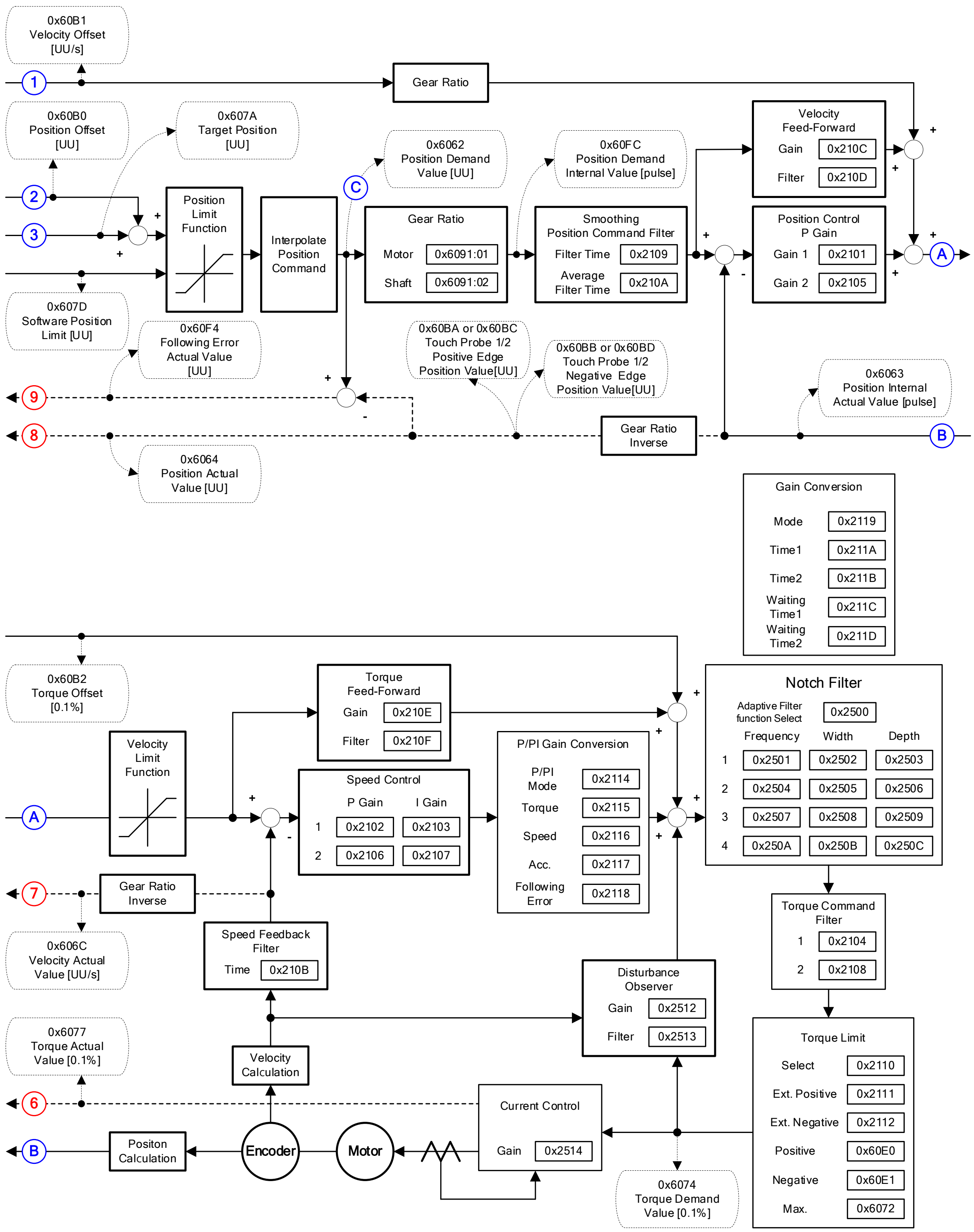
The block diagram of CSP mode is as follows:



■ Related Objects

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

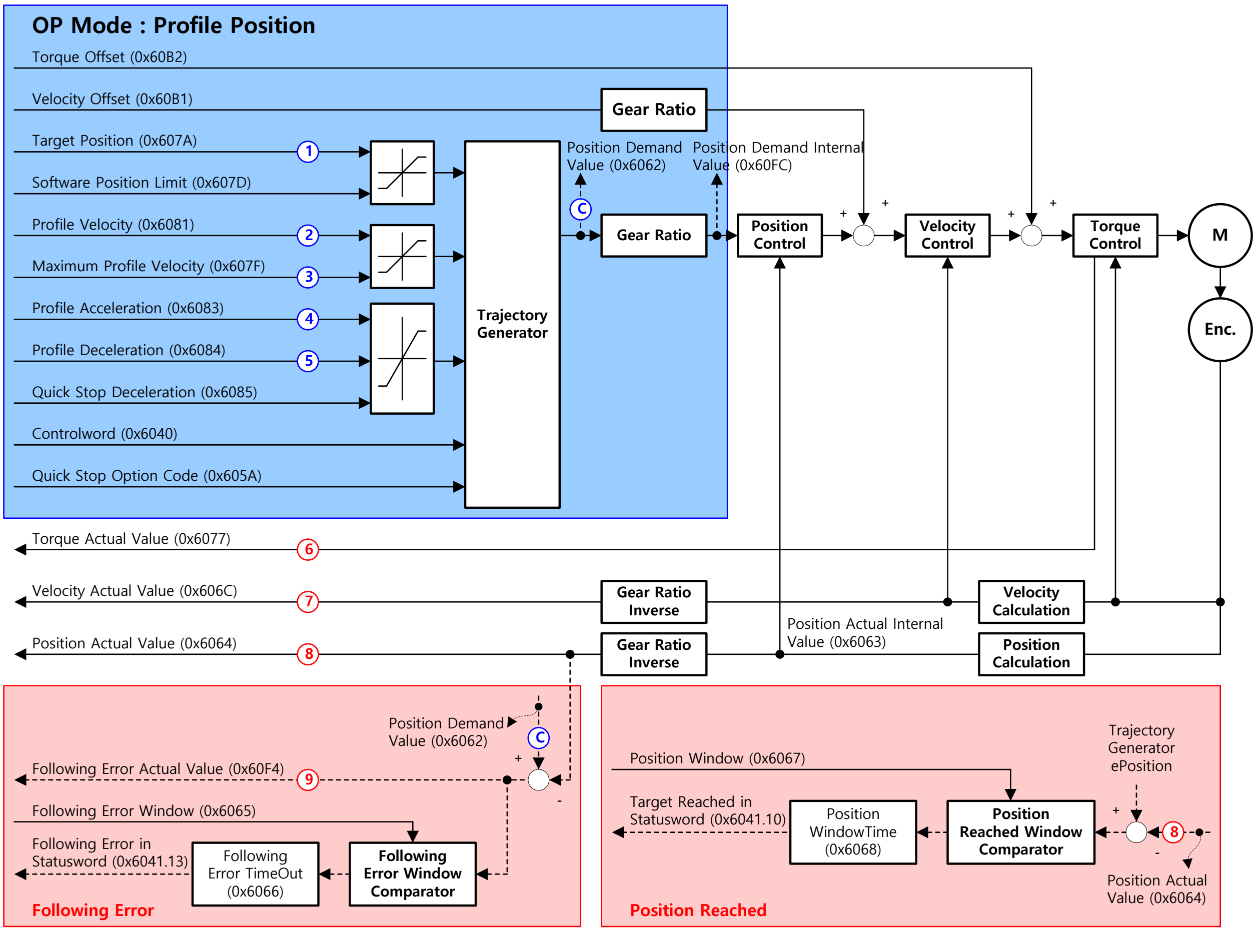
■ Internal Block Diagram of CSP Mode



4.3.2 Profile Position Mode

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

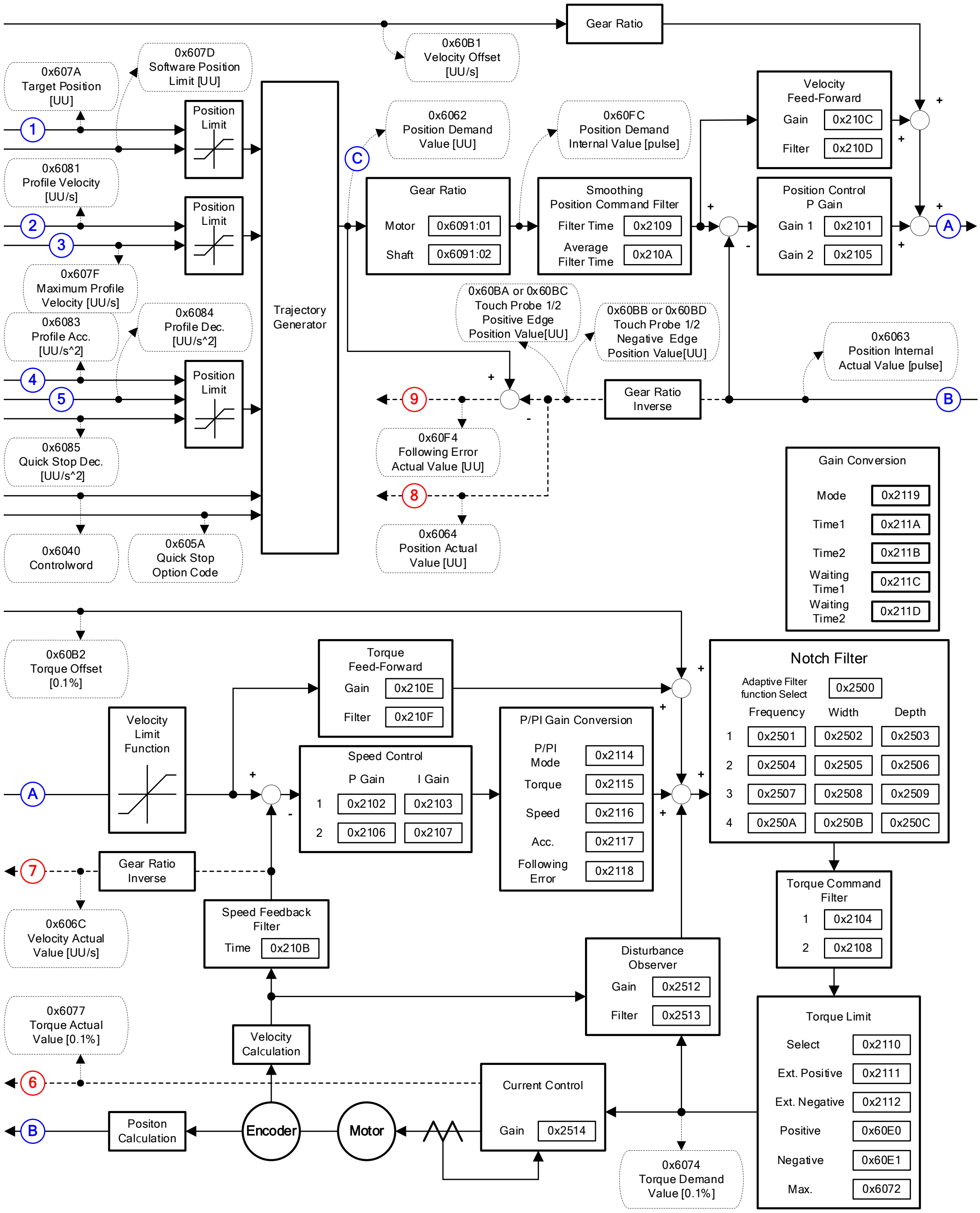
The block diagram of PP mode is as follows:



■ Related Objects

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x607A	-	Target Position	DINT	RW	Yes	UU
0x607D	-	Software Position Limit	-	-	-	-
	0	Number of entries	USINT	RO	No	-
	1	Min position limit	DINT	RW	No	UU
	2	Max position limit	DINT	RW	No	UU
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6081	-	Profile Velocity	UDINT	RW	No	UU/s
0x6083	-	Profile Acceleration	UDINT	RW	No	UU/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

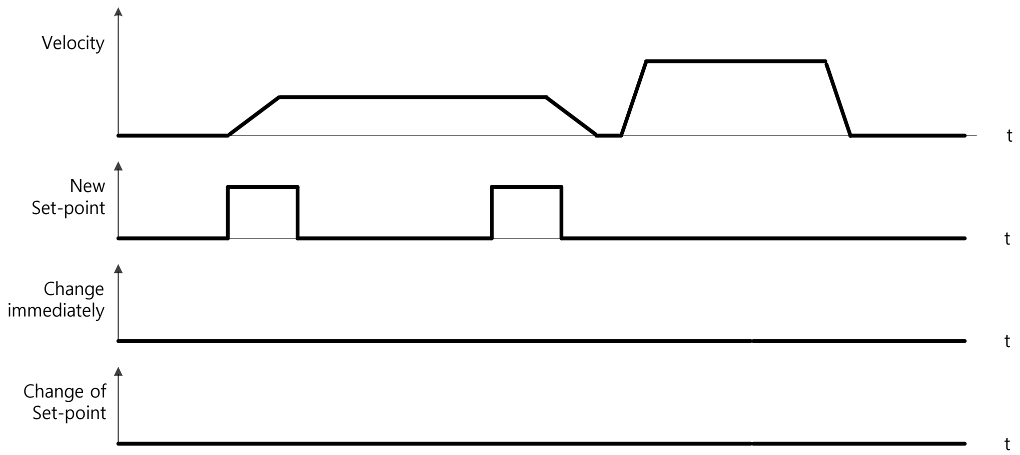
  When it receives a new position command while driving to the target position, it drives to the new position regardless of the existing target position.

- Set of Set point

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

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

■ Single Set Point Driving Procedure

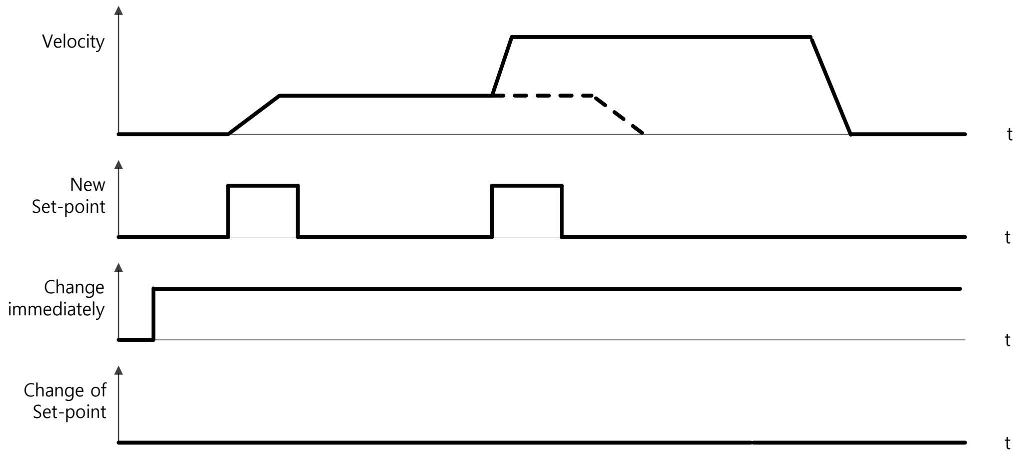


(1) Specify the target position (0x607A).

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

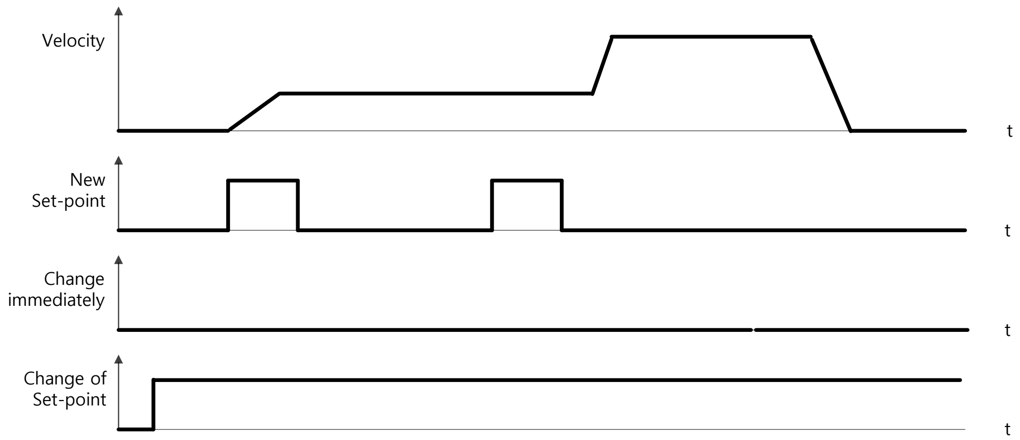
(3) The drive notifies the operator of its arrival at the target position with the Target reached bit (Statusword, 0x6041.10). The drive can suspend where it is or perform a new position operation if it receives the New set point bit.

■ Change Immediately Driving Procedure



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

■ Set of Set Point Driving Procedure



(1) Specify the target position (0x607A).
(2) Set the New set point bit to 1 and the Change of set point bit to 1 to request the position operation.
(3) After reaching the previous target position, the drive begins to move to the new position (New set point).
(4) The drive notifies the operator of its arrival at the target position with the Target reached bit (Statusword, 0x6041.10).

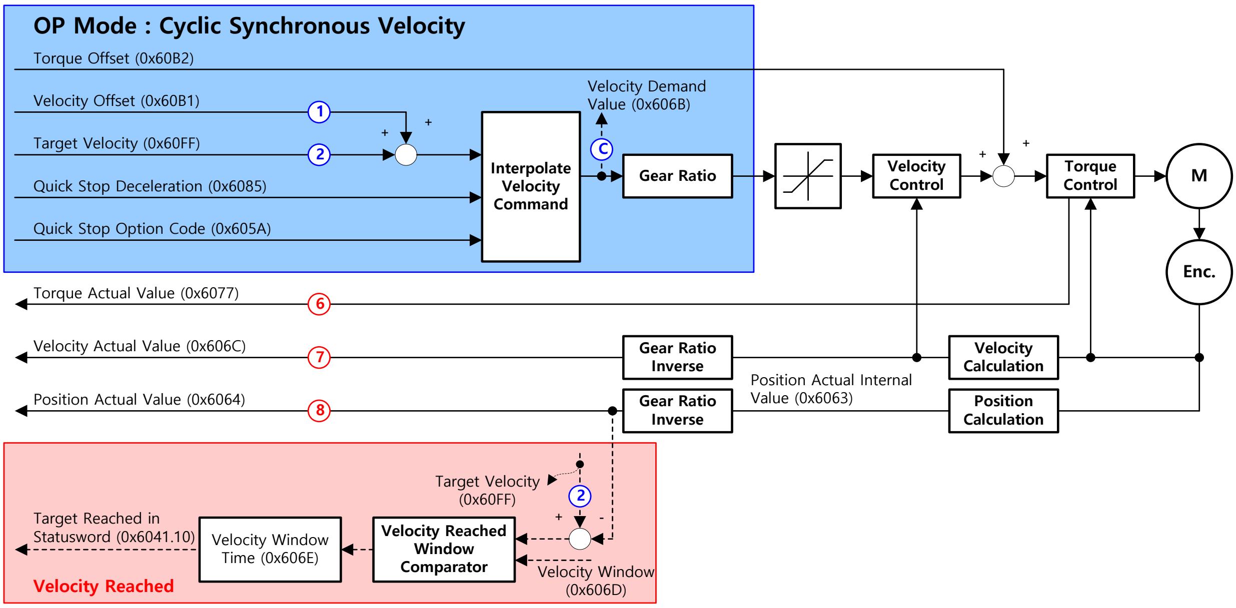
4.4 Velocity Control Modes

4.4.1 Cyclic Synchronous Velocity Mode

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

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

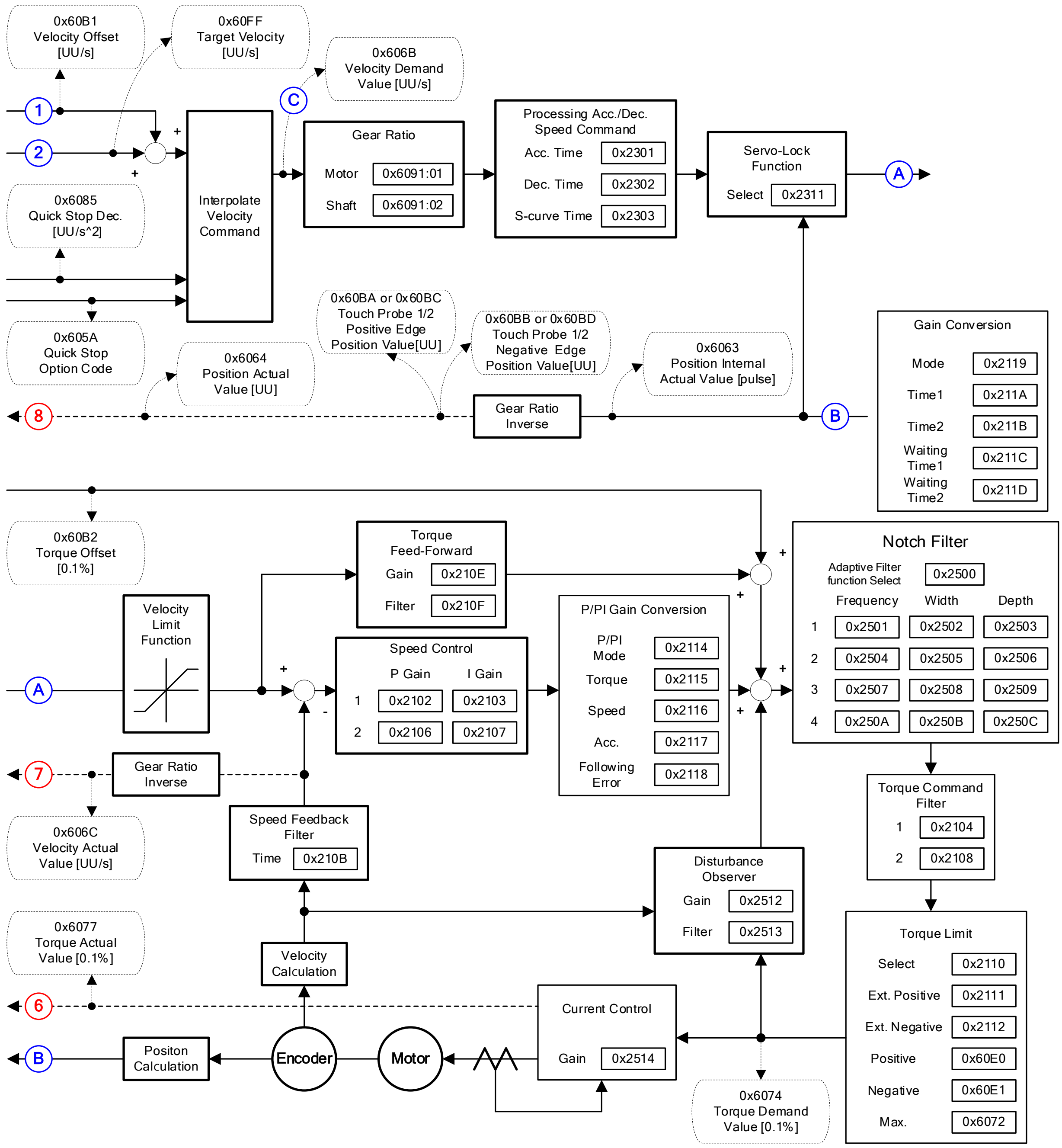
The block diagram of the CSV mode is shown below.



■ Related Objects

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

■ Internal Block Diagram of CSV Mode

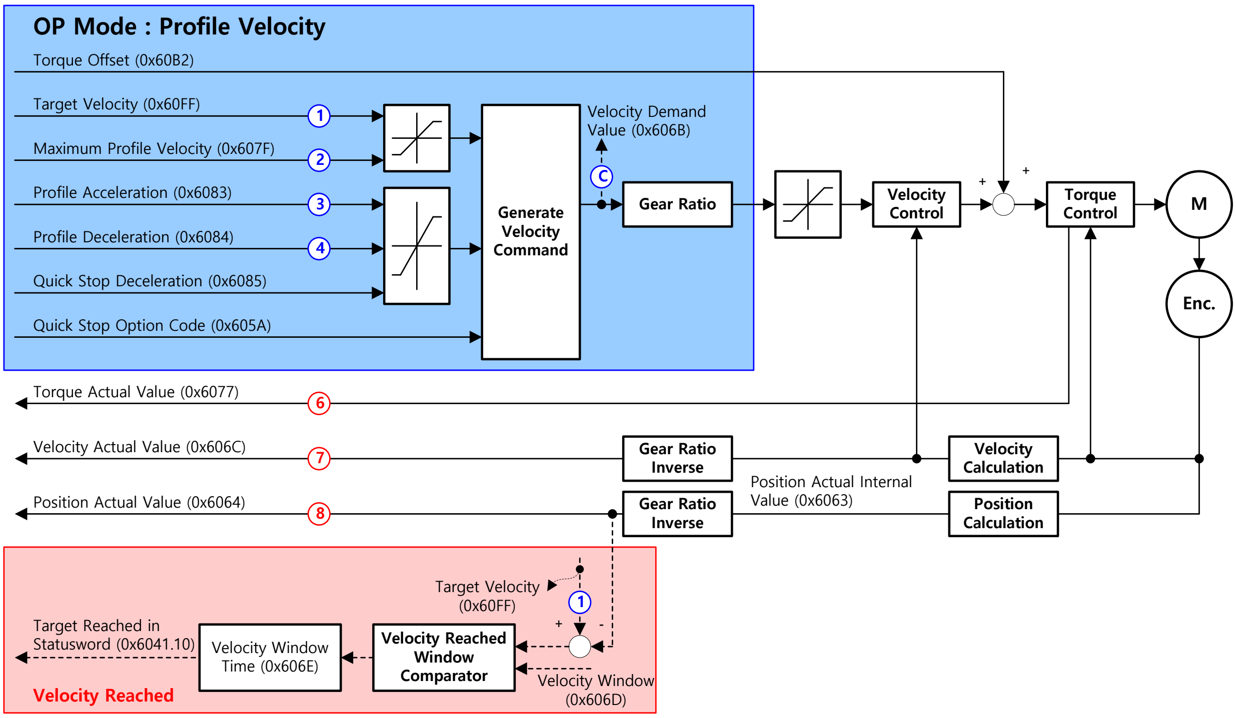


4.4.2 Profile Velocity Mode

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

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

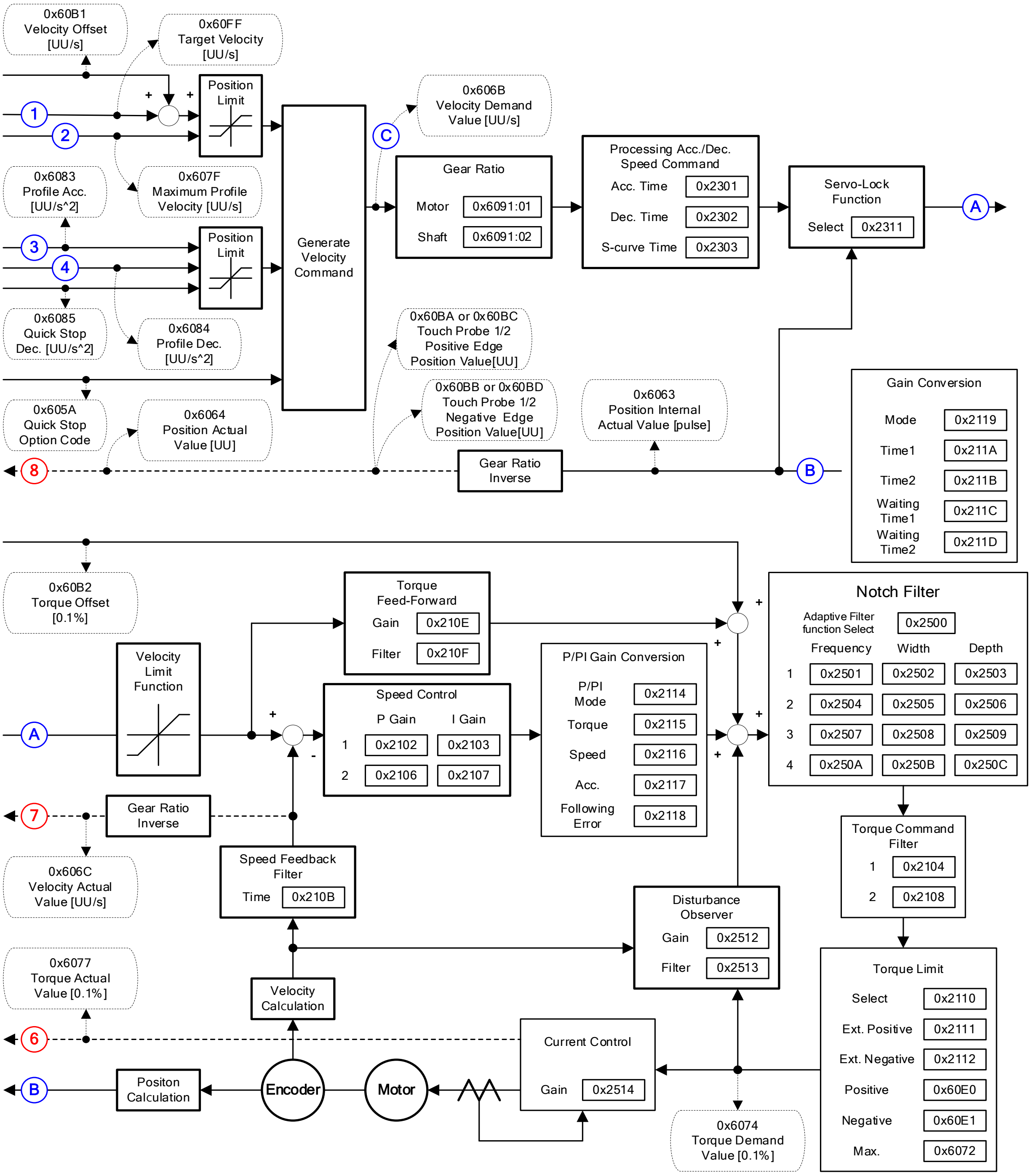
The block diagram of the PV mode is shown below.



■ Related Objects

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x60FF	-	Target Velocity	DINT	RW	Yes	UU/s
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6083	-	Profile Acceleration	UDINT	RW	No	UU/s^2
0x6084	-	Profile Deceleration	UDINT	RW	No	UU/s^2
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s^2
0x605A	-	Quick Stop Option Code	INT	RW	No	-
0x60B1	-	Velocity Offset	DINT	RW	Yes	UU/s
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x606B	-	Velocity Demand Value	DINT	RO	Yes	UU/s
0x606C	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of PV Mode



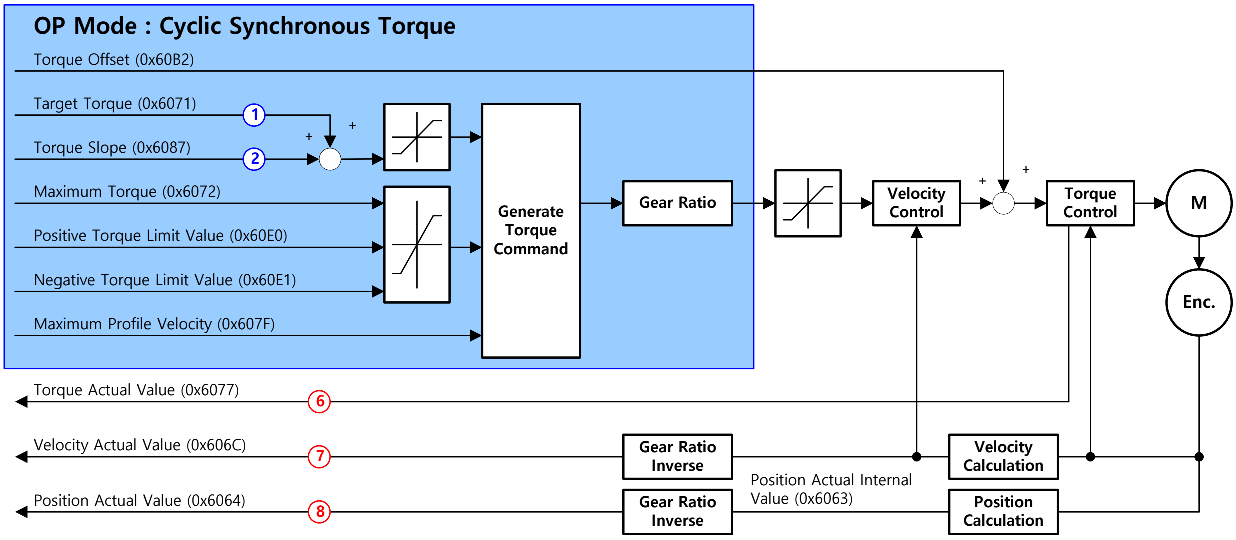
4.5 Torque Control Modes

4.5.1 Cyclic Synchronous Torque Mode

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

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

The block diagram of the CST mode is shown below.

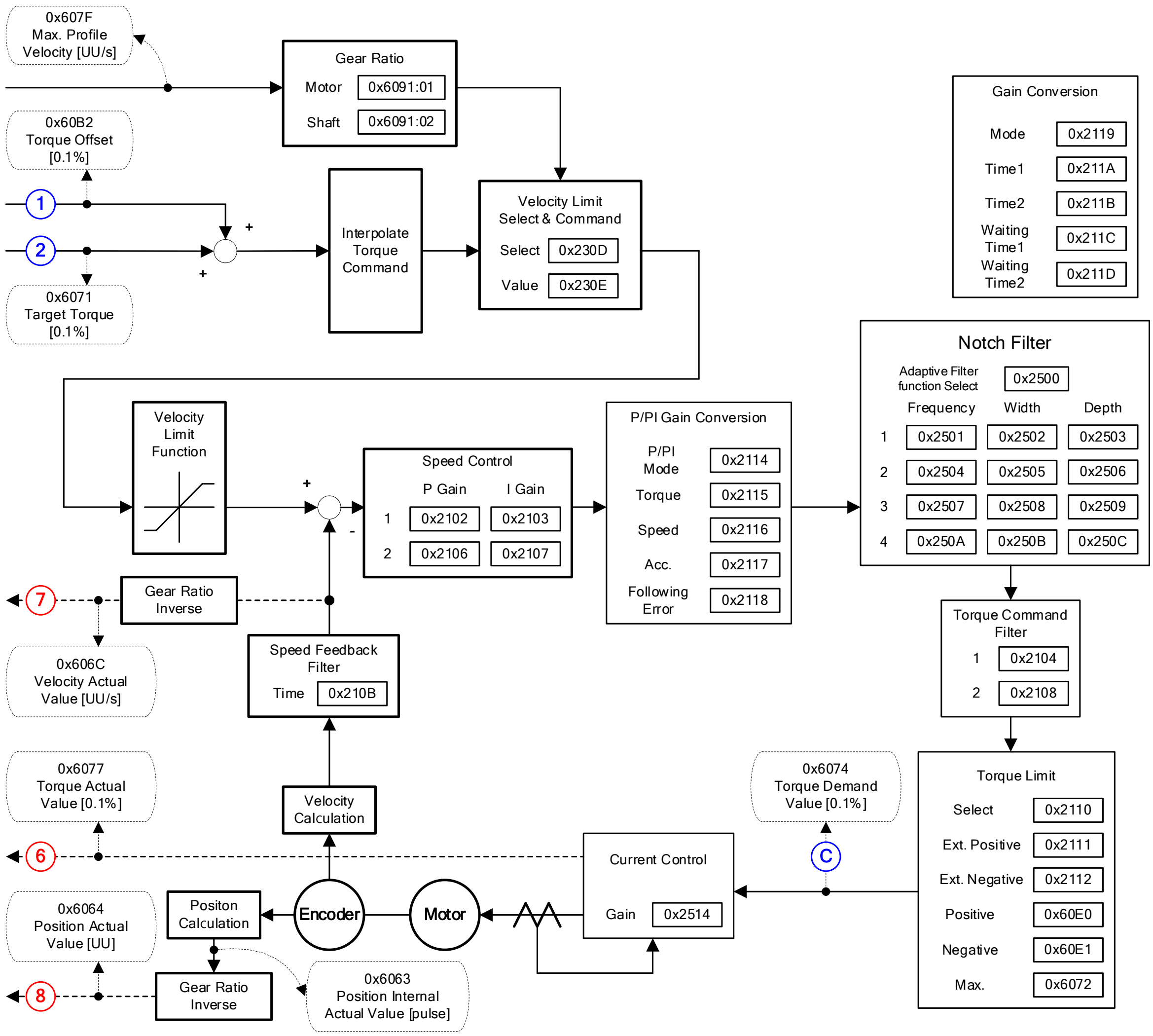


■ Related Objects

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

0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of CST Mode

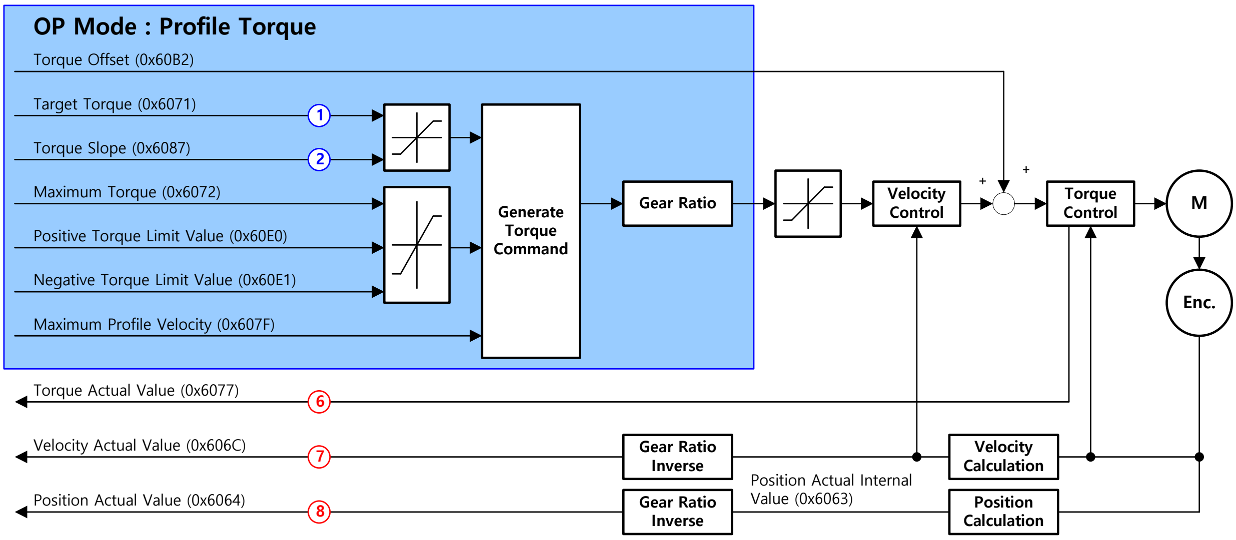


4.5.2 Profile Torque Mode

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

At this moment, the torque applied to the motor is limited depending on the 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 shown below.

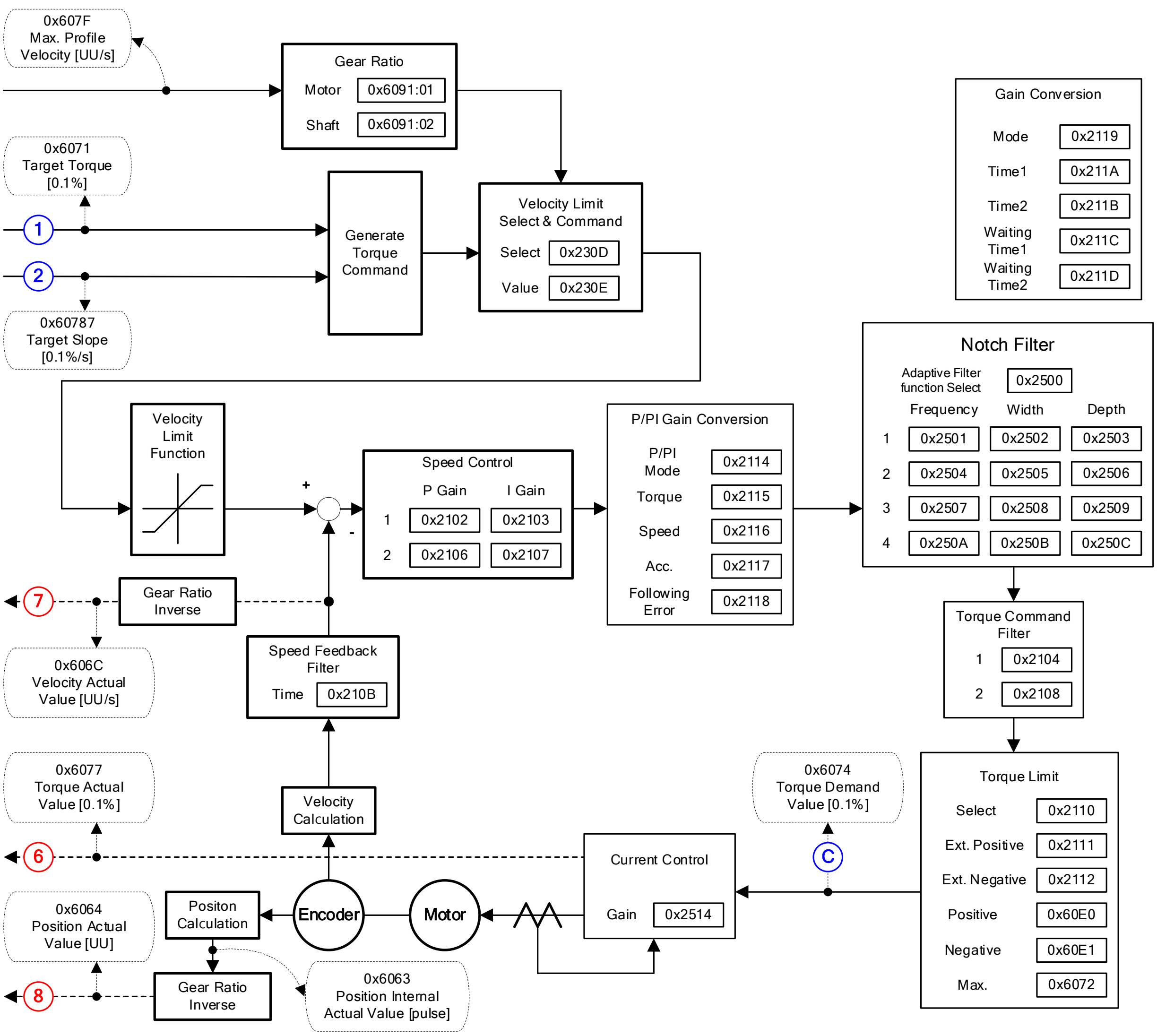


■ Related Objects

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Velocity	INT	RW	Yes	0.1%
0x6072	-	Maximum Torque	UINT	RW	Yes	0.1%
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6087	-	Torque Slope	UDINT	RW	Yes	0.1%/s
0x60E0	-	Positive Torque Limit Value	UINT	RW	Yes	0.1%
0x60E1	-	Negative Torque Limit Value	UINT	RW	Yes	0.1%
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x6074	-	Torque Demand Value	INT	RO	Yes	0.1%
0x606C	-	Velocity Actual Value	DINT	RO	Yes	UU/s

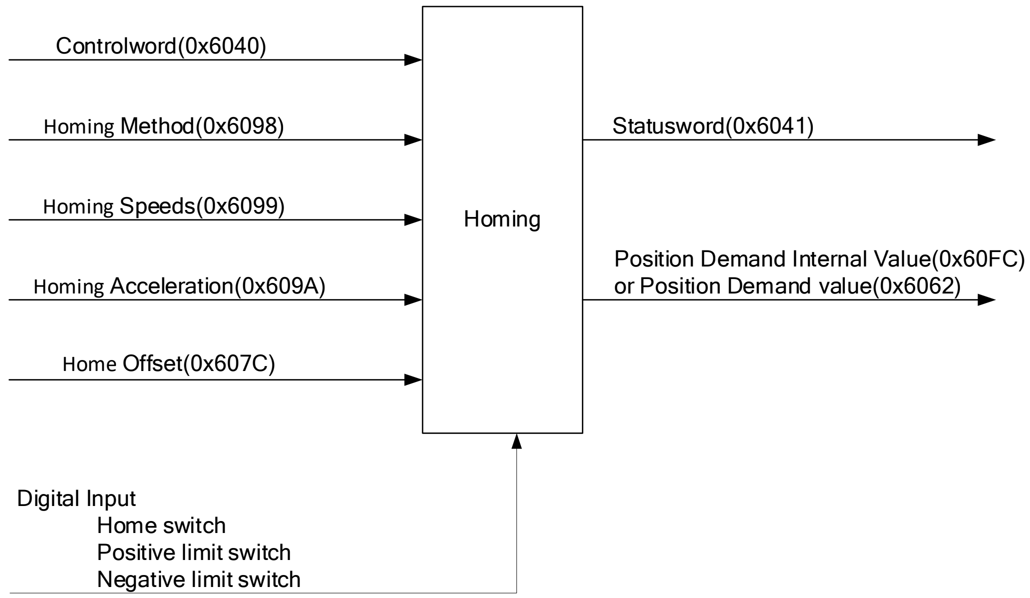
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Velocity Actual Value	DINT	RO	Yes	UU/s
0x6064	-	Position Actual Value	DINT	RO	Yes	UU
0x6063	-	Position Actual Internal Value	DINT	RO	Yes	pulse

■ Internal Block Diagram of PT Mode

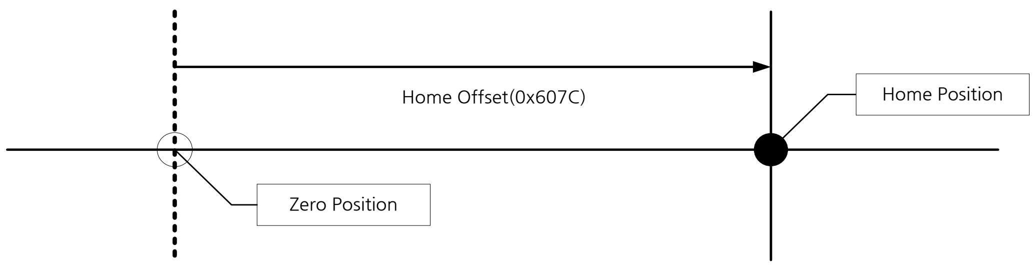


4.6 Homing

This drive provides its own homing function. The figure below represents the relationship between the input and output parameters for the Homing Mode. You can specify velocity, 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 function. The zero position indicates a point whose Position Actual Value (0x6064) is zero (0).



4.6.1 Homing Method

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

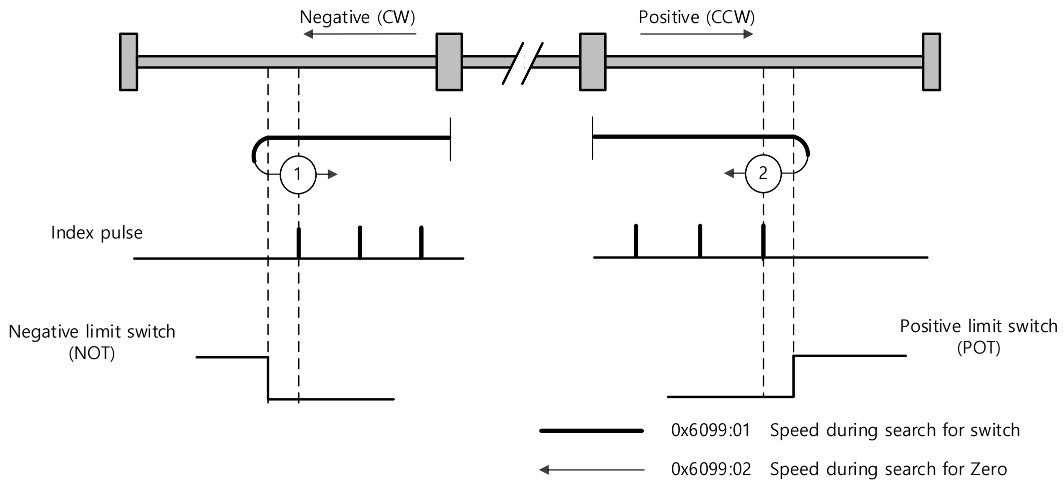
Homing Method (0x6098)	Description
1	The drive returns to the home position by the negative limit switch (NOT) and the Index (Z) pulse while driving in the negative direction.
2	The drive returns to the home position by the positive limit switch (POT) and the Index (Z) pulse while driving in the positive direction.
7,8,9,10	The drive returns to the home position by the home switch (HOME) and the Index (Z) pulse while driving in the positive direction. When the positive limit switch (POT) is input during homing, the drive switches its driving direction.
11,12,13,14	The drive returns to the home position by the home switch (HOME) and the Index (Z) pulse while driving in the negative direction. When the negative limit switch (NOT) is input during homing, the drive switches its driving direction.
Homing Method (0x6098)	Description
24	The drive returns to the home position by the home switch (HOME) while driving in the positive direction. When the positive limit switch (POT) is input during homing, the drive switches its driving direction.
28	The drive returns to the home position by the home switch (HOME) while driving in the negative direction. When the negative limit switch (NOT) is input during homing, the drive switches its driving direction.
33	The drive returns to the home position by the Index (Z) pulse while driving in the negative direction.
34	The drive returns to the home position by the Index (Z) pulse while driving in the positive direction.
35	Sets the current position as the home position.
-1	The drive returns to the home position by the negative stopper and the Index (Z) pulse while driving in the negative direction.
-2	The drive returns to the home position by the positive stopper and the Index (Z) pulse while driving in the positive direction.
-3	The drive returns to the home position only by the negative stopper while driving in the negative direction.
-4	The drive returns to the home position only by the positive stopper while driving in the positive direction.
-5	The drive returns to the home position only with the home switch (HOME) while driving in the negative direction.

-6	The drive returns to the home position only with the home switch (HOME) while driving in the positive direction.

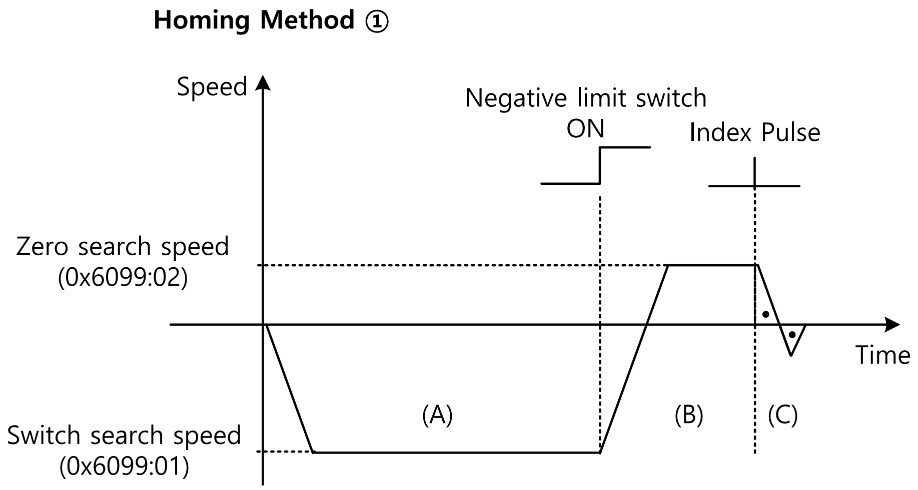
■ Related Objects

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/s^2

■ Homing Methods 1 and 2



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

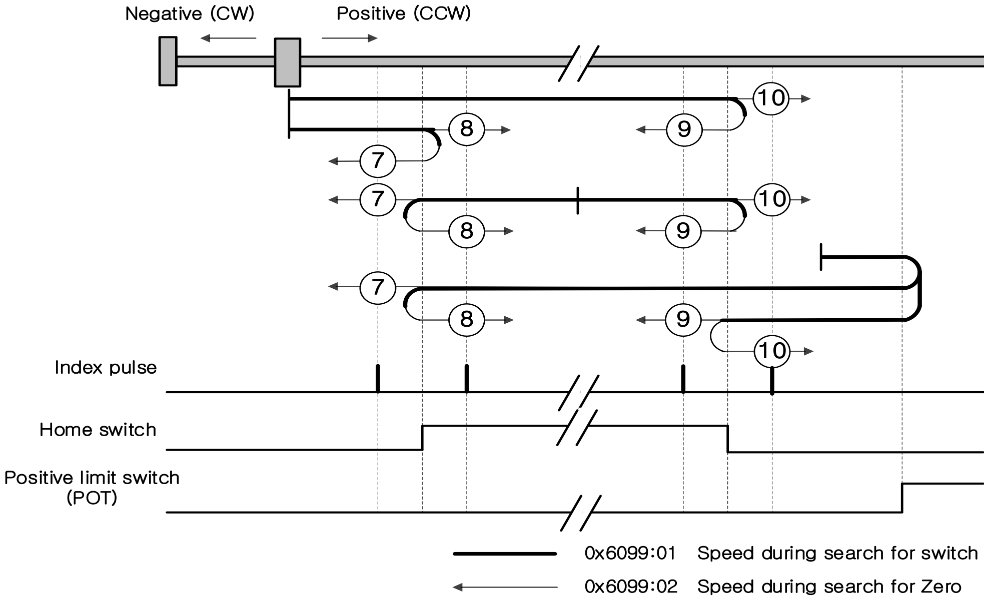


(A) The initial driving direction is negative (CW), and the drive operates at the switch search speed.

(B) When the negative limit switch (NOT) is turned on, the drive switches to the positive direction (CCW), decelerating to 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).

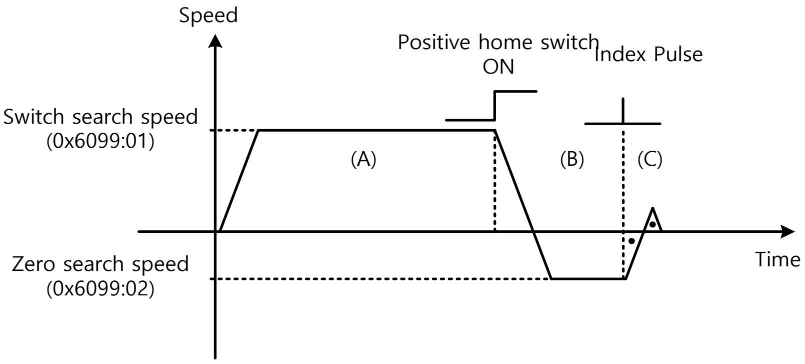
■ Methods 7, 8, 9, and 10



For homing using the homing method 7, the velocity profile according to the sequence is as follows. The sequence varies depending on the relationship between the load position and the home switch during homing, which is categorized into three cases as below. For more information, see the details below:

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

Homing Method ⑦



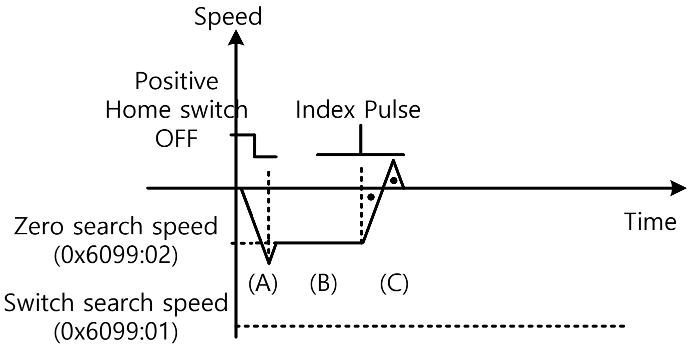
(A) The initial driving direction is positive (CCW), and the drive operates at the switch search speed.

(B) When the Positive Home switch is turned on, the drive will decelerate to zero search speed, and then switch to the negative 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



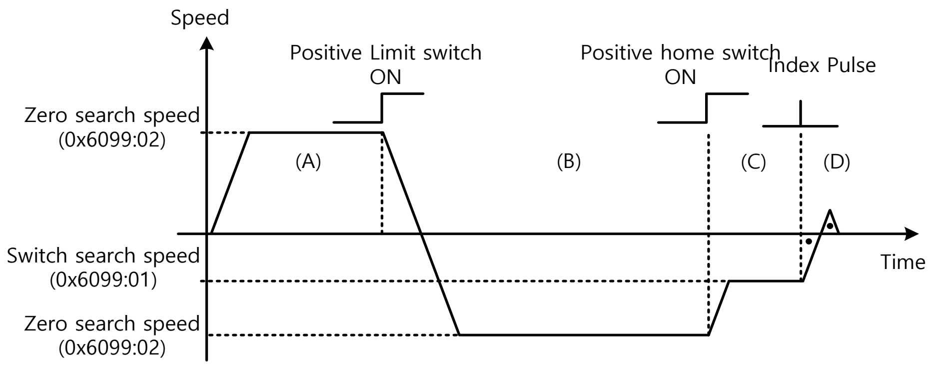
(A) Since the home signal is on, the drive operates at the switch search speed in the direction of the positive home switch (CCW). It might not reach the Switch Search Speed depending on the start position of homing.

(B) When the Home switch is turned off, the drive will decelerate to zero search speed, and then continue to operate.

(C) While operating at the zero search speed, the drive detects the first index pulse to move to the index position (Home).

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

Homing Method ⑦



(A) The initial driving direction is positive (CCW), and the drive operates at the switch search speed.

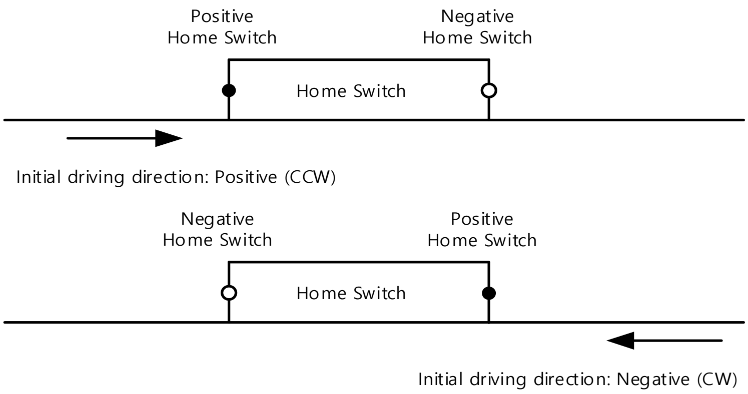
(B) When the positive limit switch (POT) is turned on, the drive will decelerate to a stop, and then operate at switch search speed in the negative direction (CW).

(C) When the positive home switch is turned off, the drive decelerates to the zero search speed, then continues to operate.

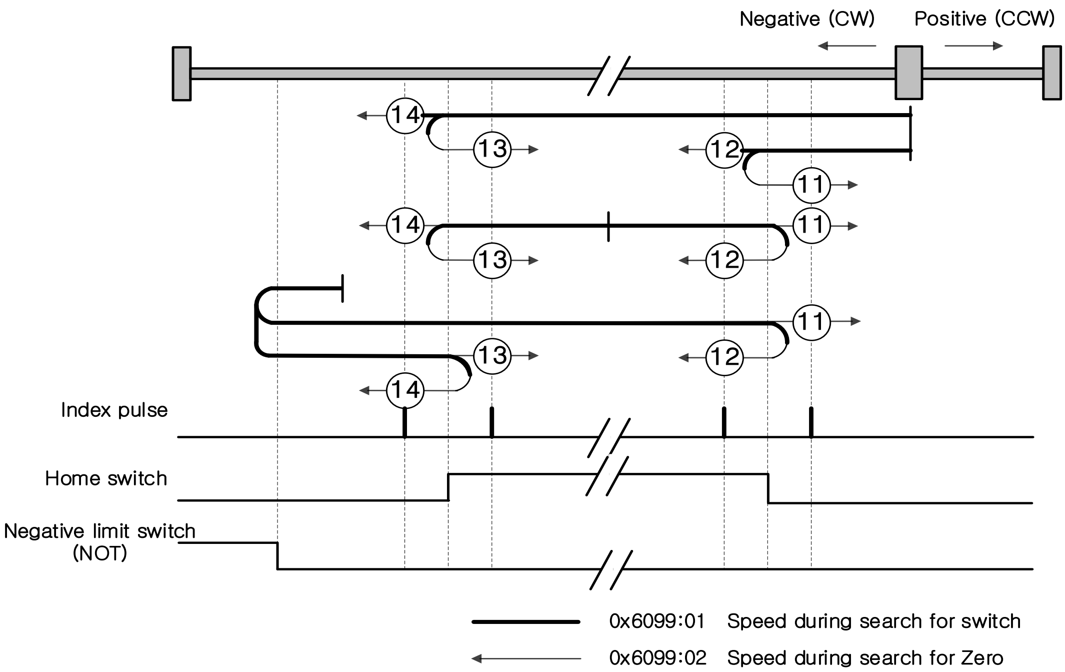
(D) While operating at the zero search speed, the drive detects the first index pulse to move to the index position (Home).

Methods 8, 9, and 10 are nearly identical to method 7 in terms of homing sequence. The only differences are the initial driving direction and the home switch polarity.

The positive home switch is determined by the initial driving direction. The home switch encountered in the initial driving direction becomes the positive home switch.



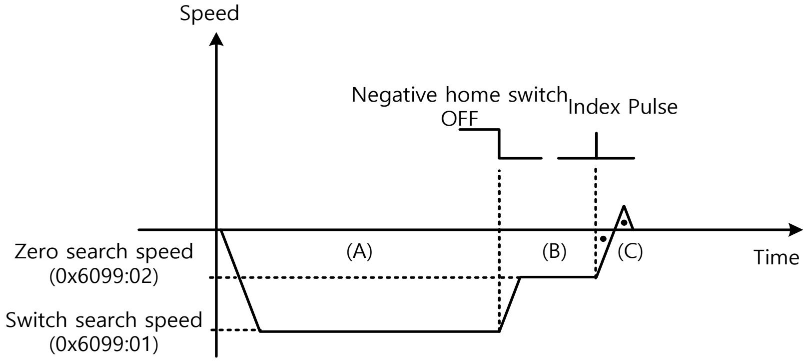
■ Methods 11, 12, 13, and 14



For homing using Homing Method 14, the velocity profile according to the sequence is as follows. The sequence varies depending on the relationship between the load position and the home switch during homing, which is categorized into three cases as below. For more information, see the details below:

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

Homing Method ⑭



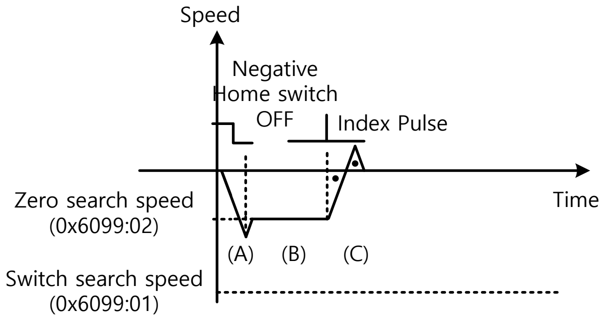
(A) The initial driving direction is negative (CW), and the drive operates at the switch search speed.

(B) When the negative home switch is turned off, the drive decelerates to the zero search speed, then continues 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



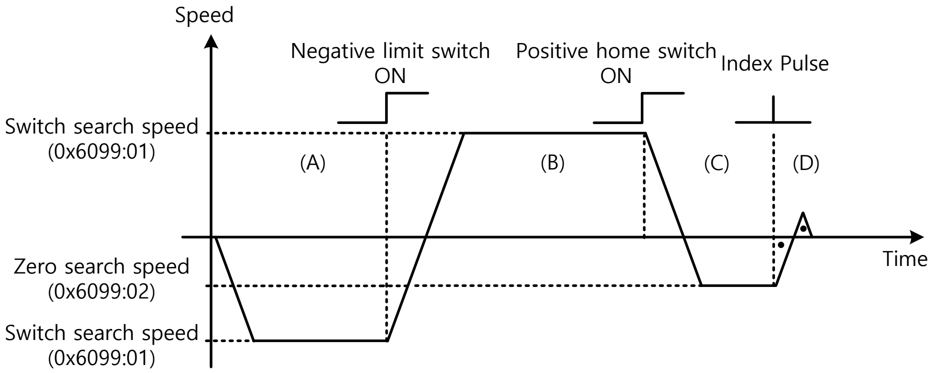
(A) Since the home signal is on, the drive operates at the switch search speed in the direction of the negative home switch (CW). It might not reach the Switch Search Speed depending on the start position of homing.

(B) When the home switch is turned off, the drive decelerates to the zero search speed, then continues to operate.

(C) While operating at zero search speed, the drive detects the first index pulse to move to the index position (Home).

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

Homing Method ⑭



(A) The initial driving direction is negative (CW), and the drive operates at the switch search speed.

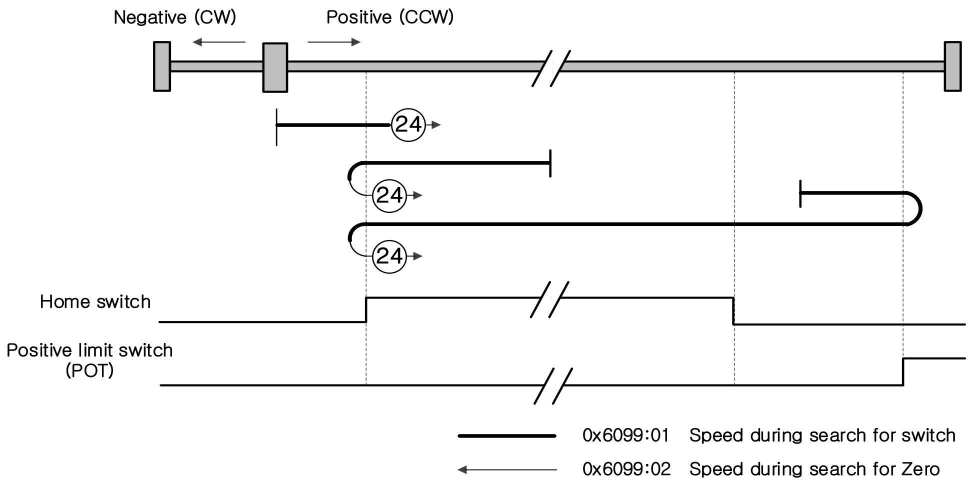
(B) When the negative limit switch (NOT) is turned on, the drive decelerates to a stop, then operates at the switch search speed in the positive direction (CCW).

(C) When the negative home switch is turned on, the drive will decelerate to zero search speed, and then switch to the negative direction (CW).

(D) While operating at zero search speed, the drive detects the first index pulse to move to the index position (Home).

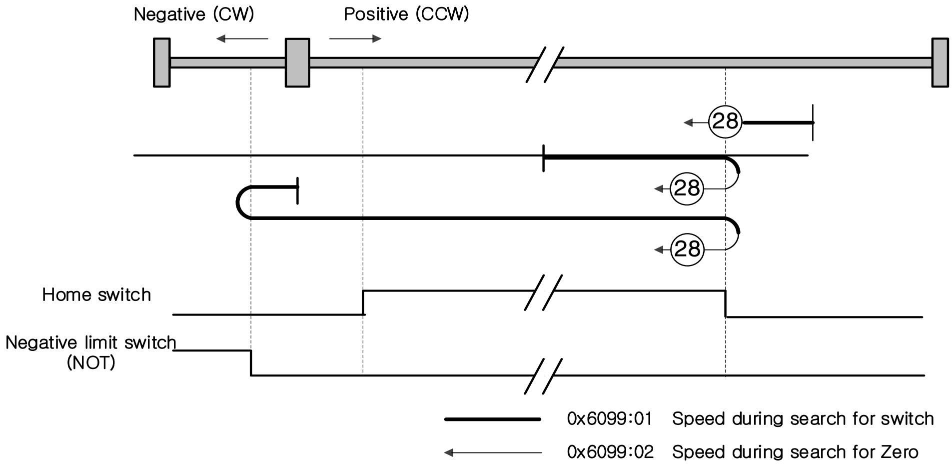
Methods 11, 12, and 13 are nearly identical to method 14 in terms of homing sequence. The only differences are the initial driving direction and home switch polarity.

■ Method 24



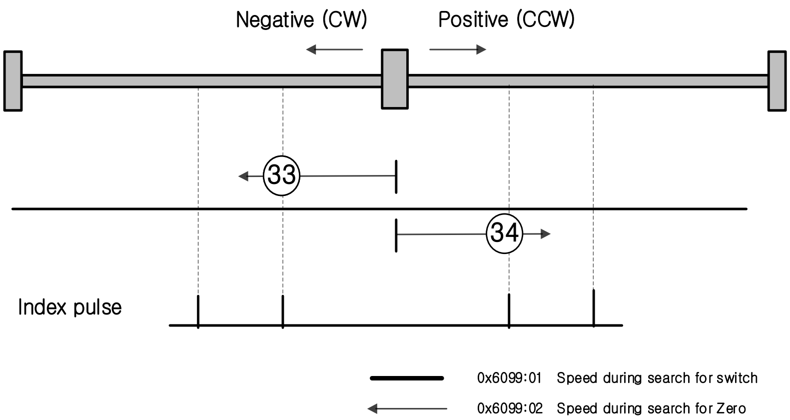
The initial driving direction is positive (CCW), and the point where the positive home switch is turned on becomes the home position.

■ Method 28



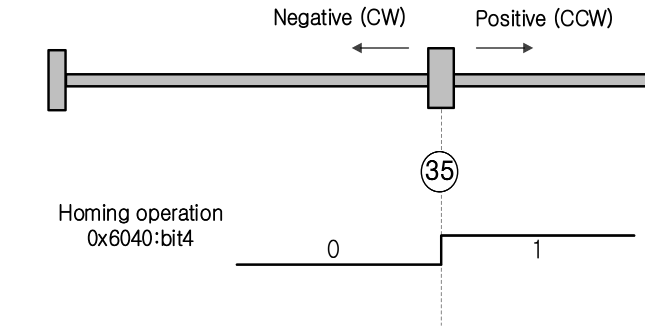
The initial driving direction is negative (CW), and the point where the positive home switch is turned on becomes the home position.

■ Method 33 and 34



The initial driving direction is negative (CW) for method 33 and positive (CCW) for method 34. The drive detects the index pulse at the zero search speed.

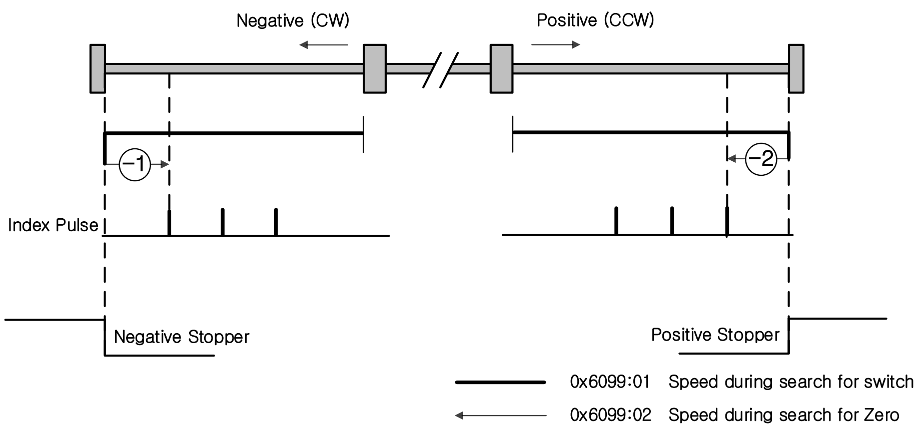
■ Method 35



The current position at start of homing operation becomes the home position. Use it to change the current position to Home Position based on the needs of the upper level controller.

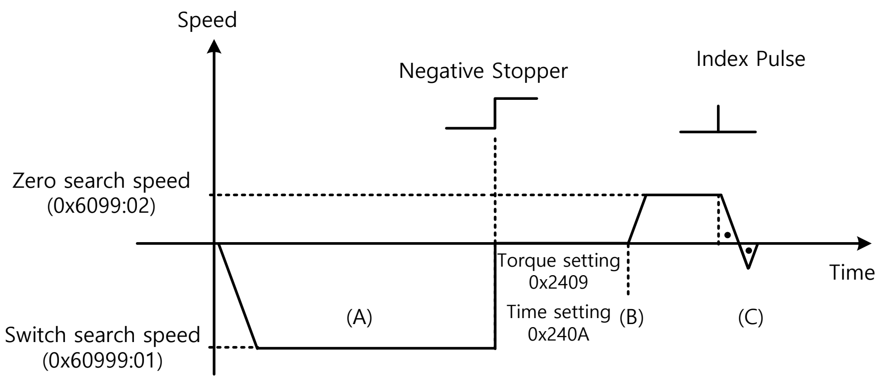
The drive supports homing methods -1, -2, -3, and -4 apart from the standard ones. These methods can only be used if the home switch is not used separately.

■ Method -1 and -2



Homing method -1 and -2 use the stopper and index (Z) pulse to perform homing. The velocity profile according to sequence is as follows. For more information, see the details below:

Homing Method -1

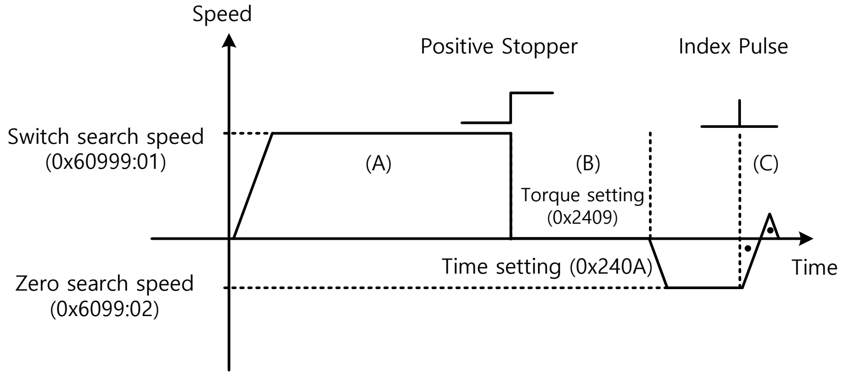


(A) The initial driving direction is negative (CW), and the drive operates at the switch search speed.

(B) When the drive hits the negative stopper, it stands by according to the torque limit value (0x2409) and the time setting value (0x240A) during homing using the stopper, then switches the 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

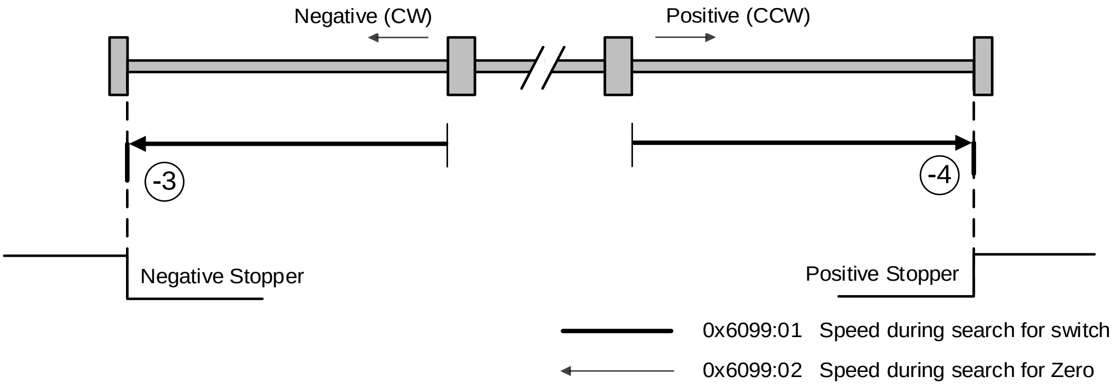


(A) The initial driving direction is positive (CCW), and the drive operates at the switch search speed.

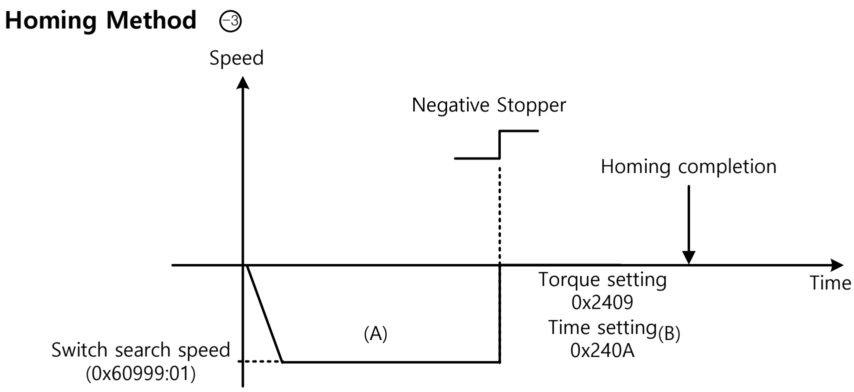
(B) When the drive hits the positive stopper, it stands by according to the torque limit value (0x2409) and the time setting value (0x240A) during homing using the stopper, then switches the direction.

(C) While operating at the zero search speed, the drive detects the first index pulse to move to the index position (Home).

■ Method -3 and -4

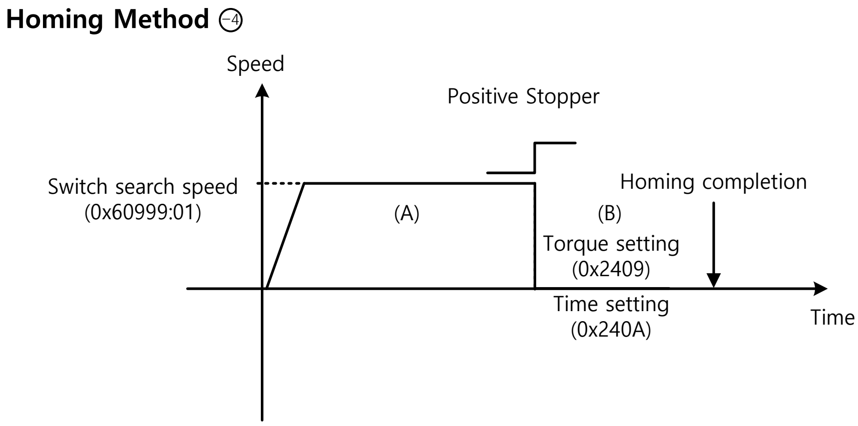


Homing methods -3 and -4 only use the stopper to perform homing. The velocity profile according to sequence is as follows. For more information, see the details below:



(A) The initial driving direction is negative (CW), and the drive operates at the switch search speed.

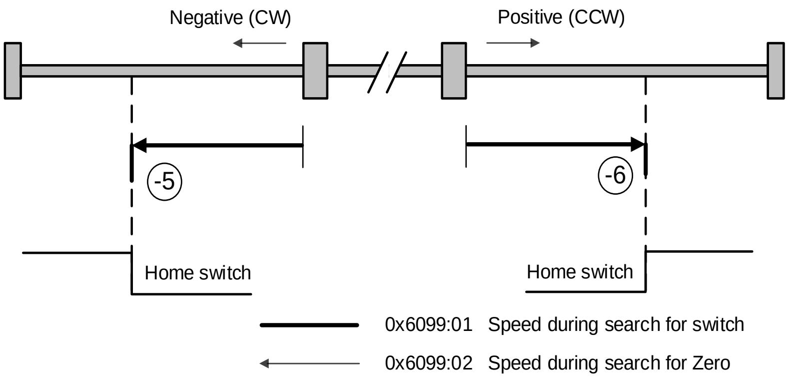
(B) When the drive hits the negative stopper, it stands by according to the torque limit value (0x2409) and the time setting value (0x240A) at the time of homing using the stopper and finishes homing.



(A) The initial driving direction is positive (CCW), and the drive operates at the switch search speed.

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

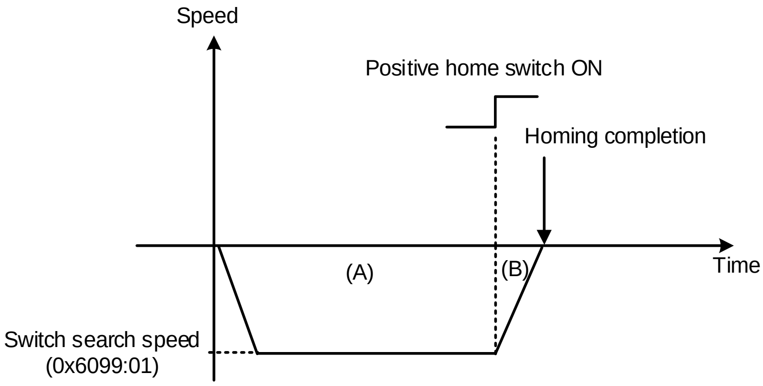
■ Method -5 and -6



Homing methods -5 and -6 perform homing only by using the stopper. The velocity profile according to sequence is as follows. Homing is stopped when the drive meets the limit switch. For more information, see the details below:

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

Homing Method -5

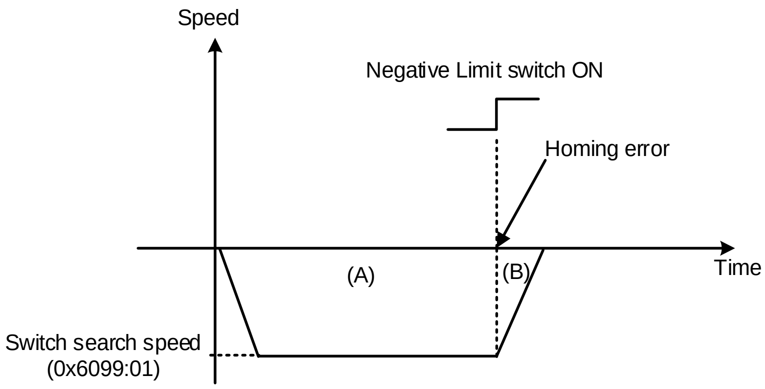


(A) The initial driving direction is negative (CW), and the drive operates at the switch search speed.

(B) If the positive home switch is turned on, the drive decelerates to a stop and completes homing.

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

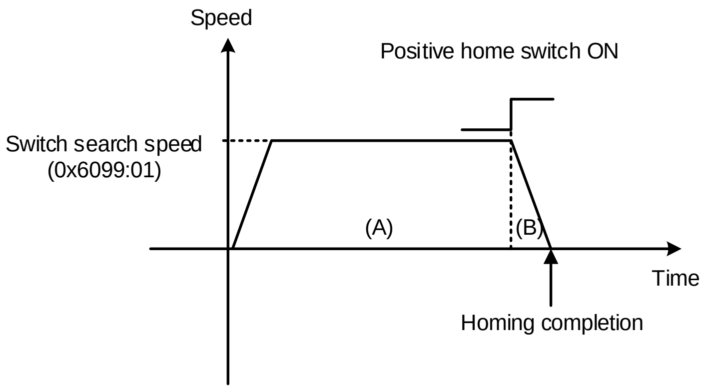
Homing Method ⑤



(A) The initial driving direction is negative (CW), and the drive operates at the switch search speed.

(B) When the negative limit switch is turned on, the drive issues a homing error and decelerates to a stop.

Homing Method ⑥



(A) The initial driving direction is positive (CCW), and the drive operates at the switch search speed.

(B) If the positive home switch is turned on, the drive decelerates to a stop and completes homing.

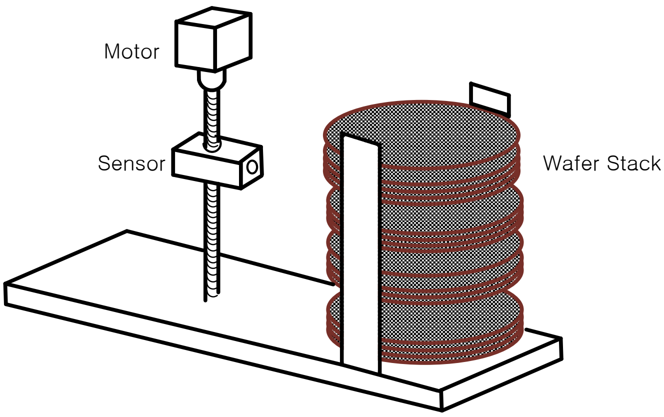
4.7 Touch Probe Function

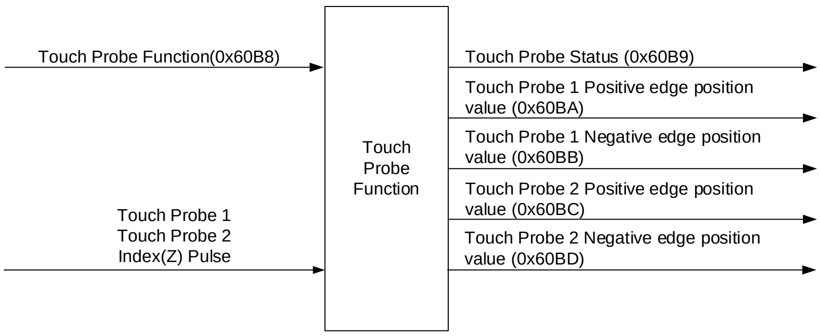
The touch probe is a function that rapidly captures the position value of the encoder with external input (PROBE 1 and 2) signals or the index (Z) pulse of the encoder.

- Example of Touch Probe

Wafer mapper system of wafer transfer robot (WTR)

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





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

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

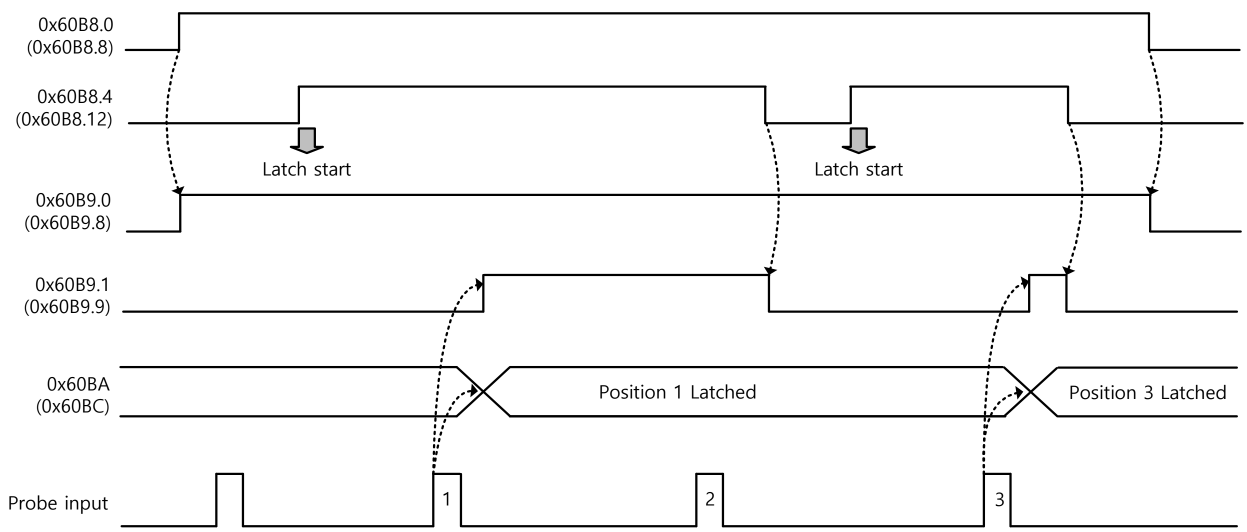
■ Related Objects

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x60B8	-	Touch Probe Function	UINT	RW	Yes	-
0x60B9	-	Touch Probe Status	UINT	RO	Yes	-
0x60BA	-	Touch Probe 1 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

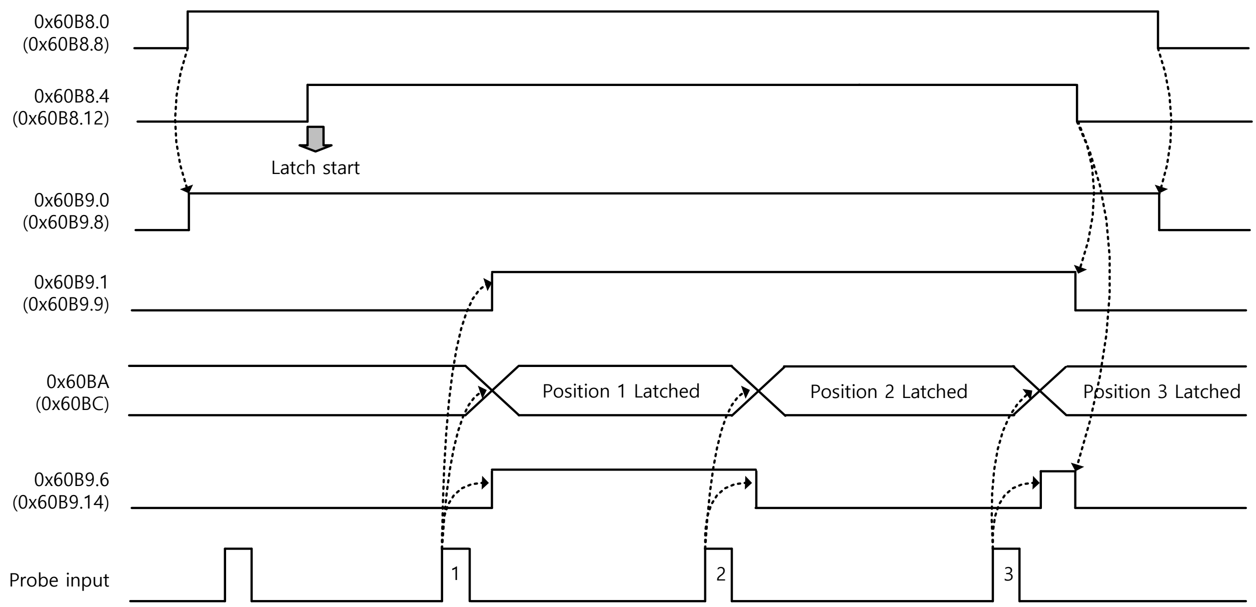
- Single Trigger Mode (0x60B8.1=0, 0x60B8.9=0):

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

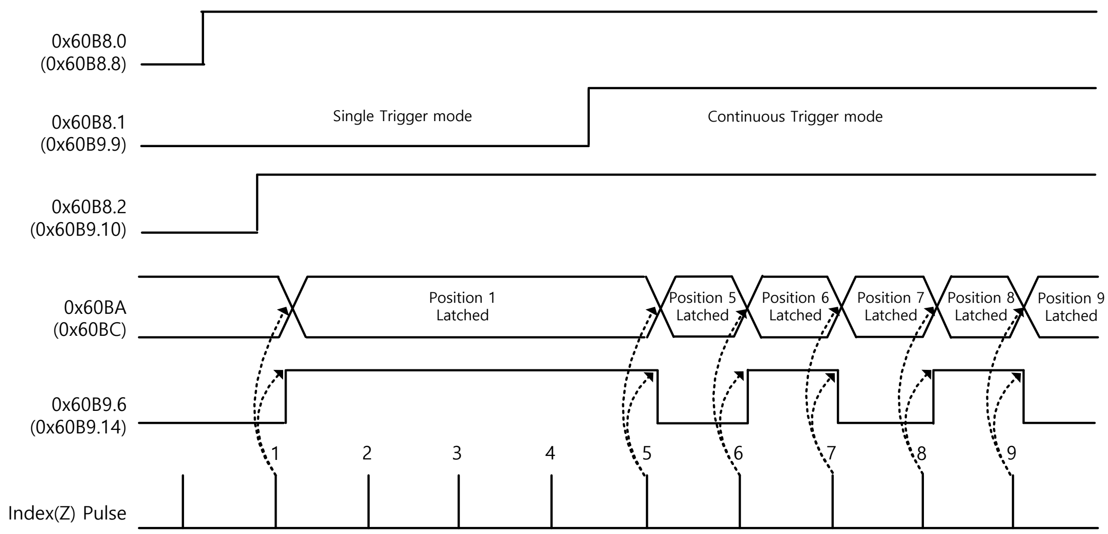


- **Continuous Trigger Mode (0x60B8.1=1, 0x60B8.9=1):**

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

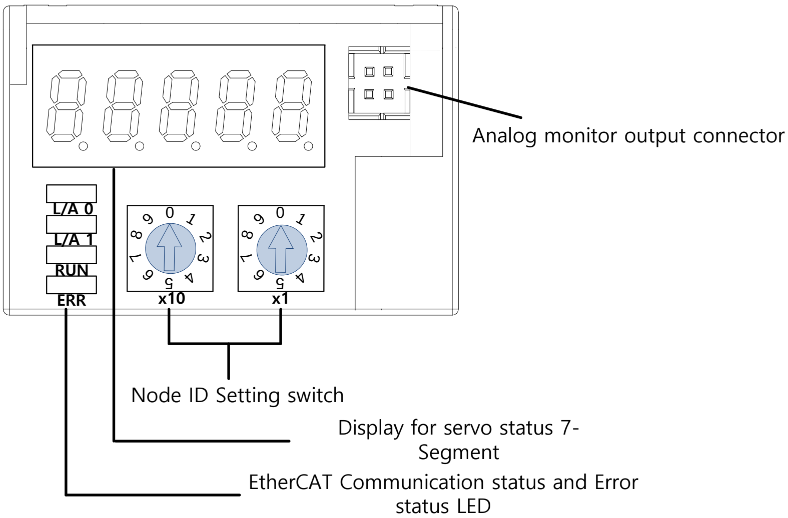


- **Index Pulse Trigger Mode (0x60B8.2=1, 0x60B8.10=1):**



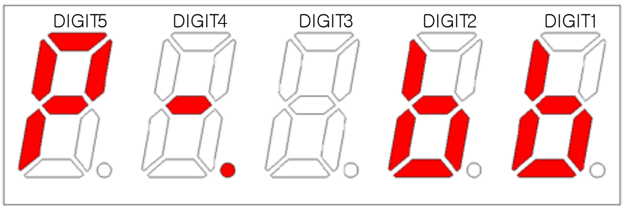
5. Drive Application Functions

5.1 Drive Front Panel

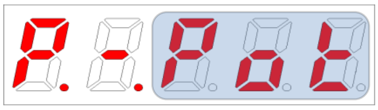
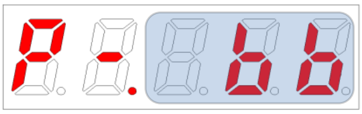
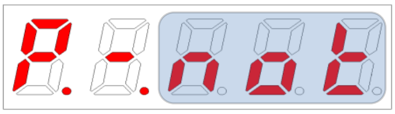
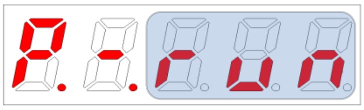
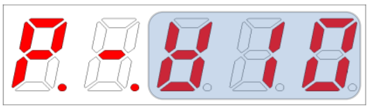


5.1.1 7-Segment for Indicating the Servo Status

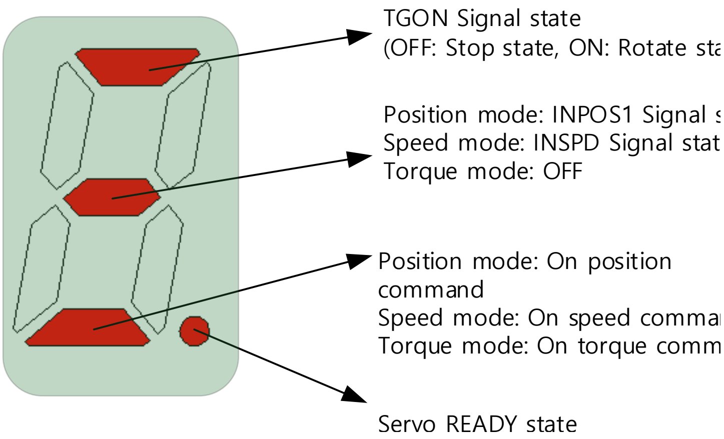
7-Segment for indicating the servo status consists of 5 digits as shown below, which are in the order of Digit 1→Digit 5 from right to left.



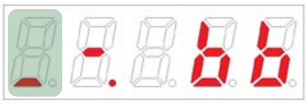
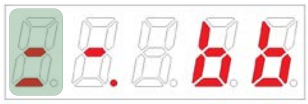
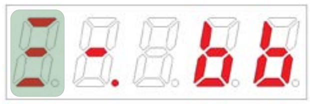
Three digits from Digit 3~1 of the 7-Segment represent the drive status as described below if no servo alarm occurs. In the event of a servo warning occurrence, the warning status display takes precedence over other status.

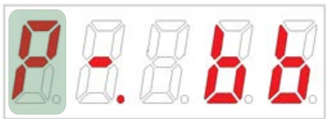
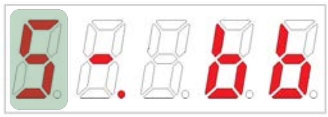
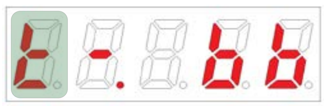
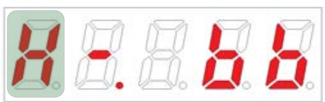
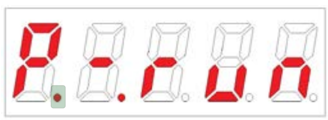
Digit 3~Digit 1 display	Status details
 STO connector not connected	 Positive limit sensor input
 Servo OFF status	 Negative limit sensor input
 Servo ON status	 Servo warning W10 occurrence (Code: 10)

Digit 4 displays the current operation status and servo ready status.

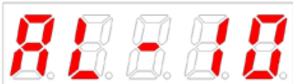


Digit5 indicates the status of the EtherCAT State Machine or of the current control mode and servo ON.

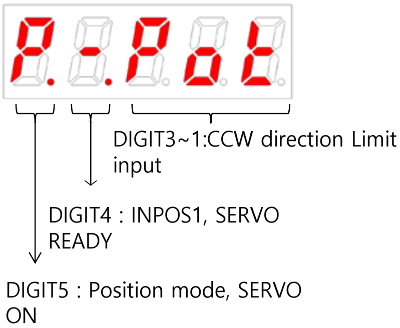
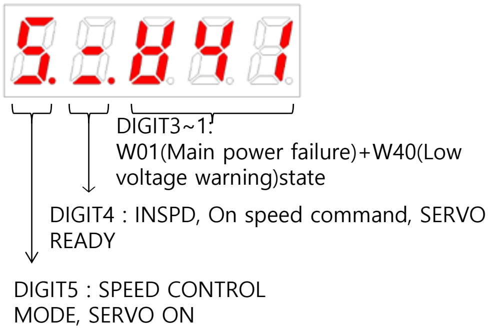
If the status of the EtherCAT State Machine is prior to the operation state (communication setup process): ➔ A preparation status, where a servo operation is not available, indicating that the EtherCAT communication is in progress.		
 Init state	 Pre-Operational state	 Safe-Operational state

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

In the event of a servo alarm occurrence, Digit 5~1 blink with the below display. Digit 2 and Digit 1 represent the alarm code. The servo alarm display takes precedence over other status.



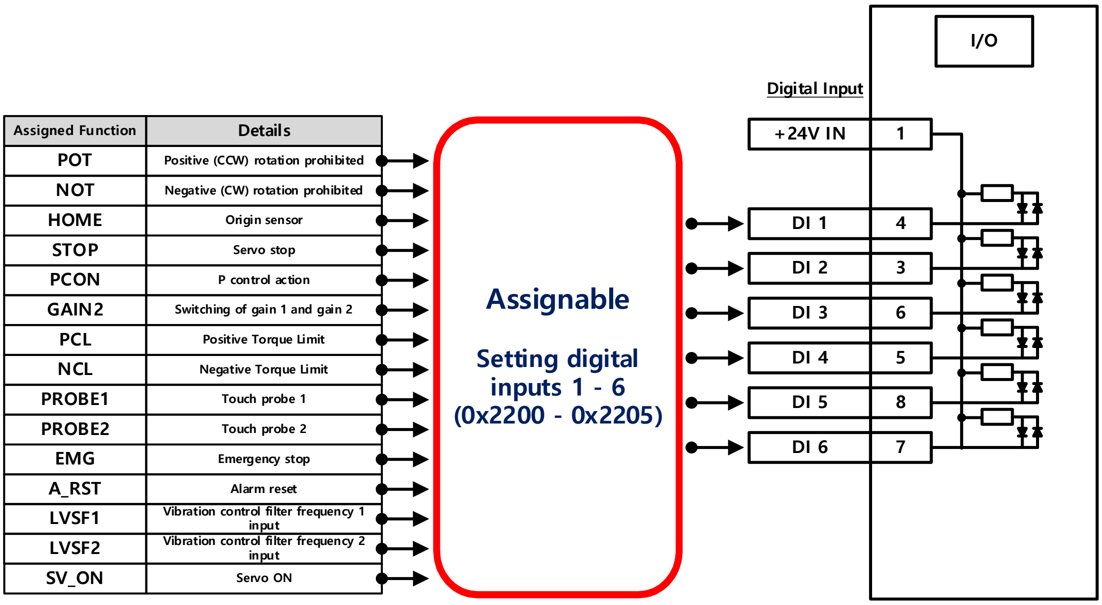
Example for Alarm state
AL-10 (IPM Fault)

ex. 1) Limit signal input	ex. 2) Servo warning occurrence
	

5.2 Input/Output Signals Setting

5.2.1 Assignment of Digital Input Signals

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



■ **Related Objects**

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x2200	-	Digital Input Signal 1 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		-

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

Bits	Setting details
15	Signal Input Level Settings (0: Contact A, 1: Contact B)
14~8	Reserved
7~0	Input Signal Assignments

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

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

Choose a signal and set the signal level

at bit 15.

Setting Value	Assignable Input Signals
0x00	Not Assigned
0x01	POT
0x02	NOT
0x03	HOME
0x04	STOP
0x05	PCON
0x06	GAIN2
0x07	PCL
0x08	NCL
0x09	PROBE1
0x0A	PROBE2
0x0B	EMG
0x0C	ARST
0x0D	LVSF1
0x0E	LVSF2
0x0F	SVON

■ Example of Digital Input Signal Assignment

The following table shows an example of assigning input signals. See the setting values for parameters 0x2200~0x2205.

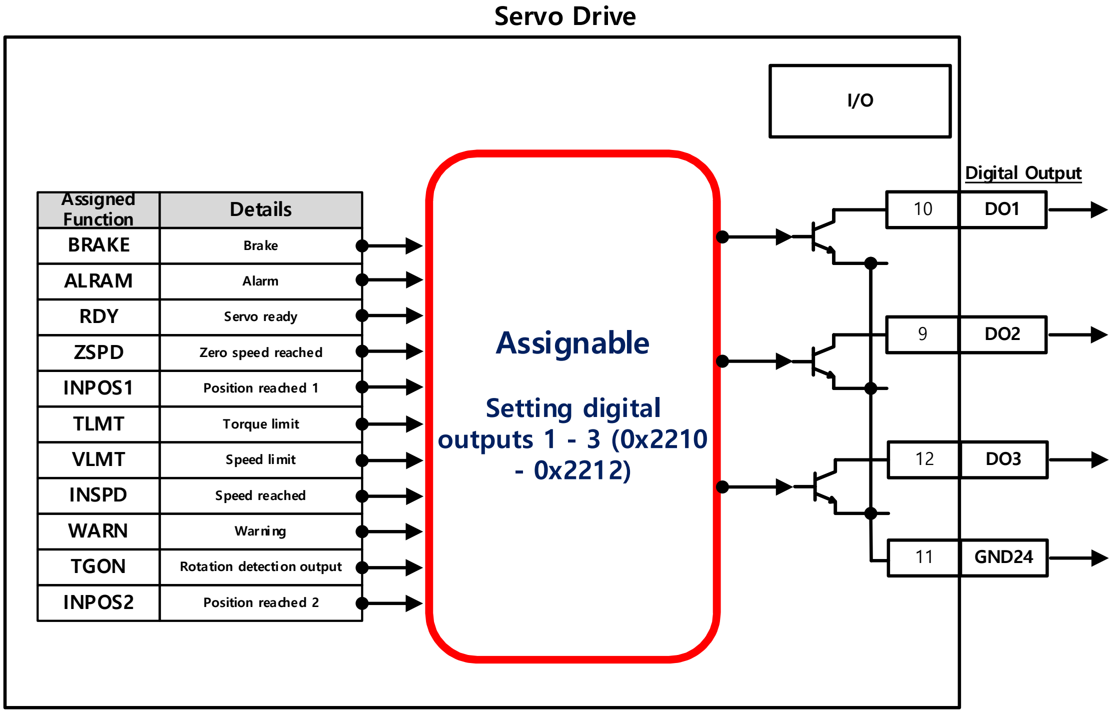
DI#1	DI#2	DI#3	DI#4	DI#5	DI#6
POT (Contact B)	NOT (Contact B)	HOME (Contact A)	STOP (Contact A)	PCON (Contact A)	GAIN2 (Contact A)

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

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

5.2.2 Digital Output Signal Assignment

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



■ **Related Objects**

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x2210	-	Digital Output Signal 1 Selection	UINT	RW		-
0x2211	-	Digital Output Signal 2 Selection	UINT	RW		-
0x2212	-	Digital Output Signal 3 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 to bits 7~0, and set the signal level to bit 15.

Bits	Setting details
15	Signal Output Level Settings (0: Contact A, 1: Contact B)
14~8	Reserved
7~0	Output Signal Assignment

Setting Value	Assignable Output Signals
0x00	Not Assigned
0x01	BRAKE
0x02	ALARM
0x03	RDY
0x04	ZSPD
0x05	INPOS1
0x06	TLMT
0x07	VLMT
0x08	INSPD
0x09	WARN
0x0A	TGON
0x0B	INPOS2

■ **Example Digital Output Signal Assignment**

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

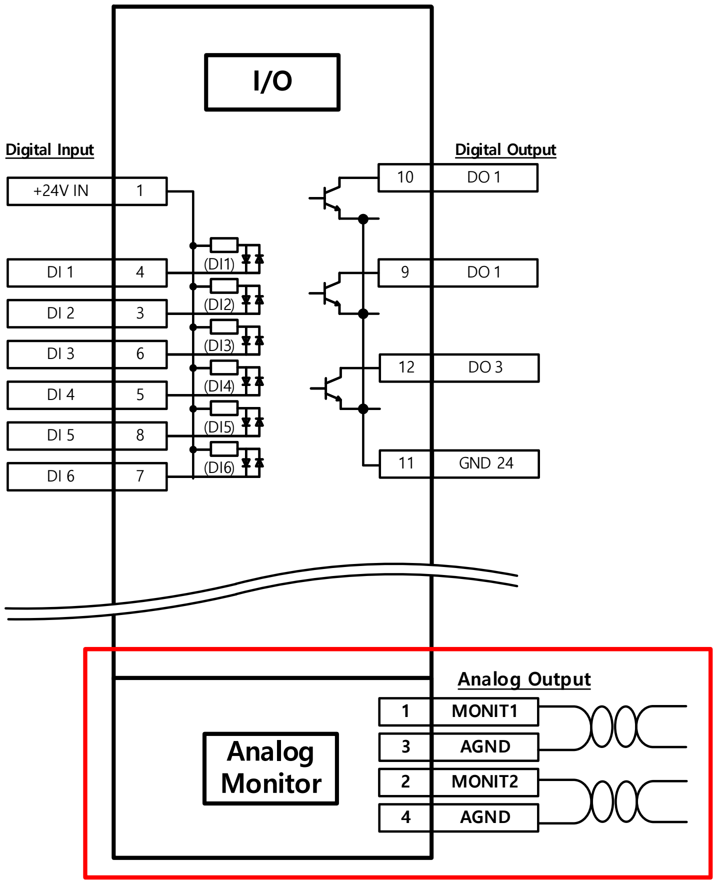
DO#1	DO#2	DO#3
BRAKE (Contact B)	ALARM (Contact B)	RDY (Contact A)

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

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

5.2.3 Assignment of Analog Output Signals

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

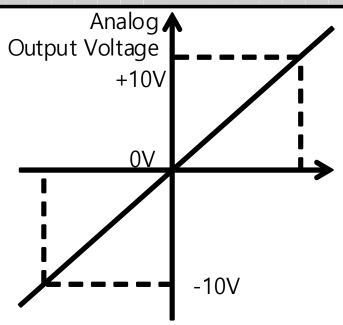
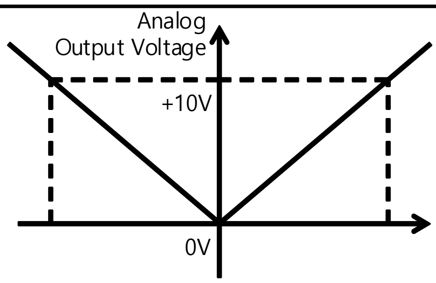


■ Related Objects

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

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

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

- Analog monitor channel 1 select (0x2221)

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

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

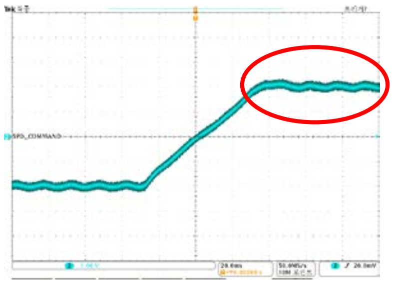
The voltage is calculated as shown below during the analog monitor output:

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

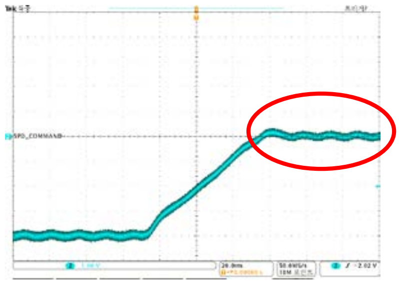
Output voltage for channel 2 (V) = [Monitoring signal value (0x2222) – Offset (0x2204)] / Scale (0x2206)

■ Setting Example

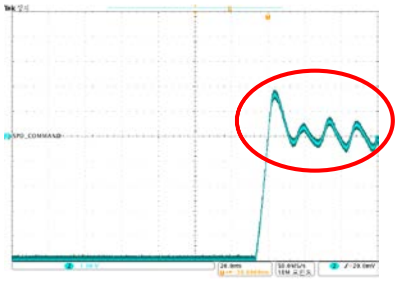
The following shows an example of monitoring ripples during the 1000 rpm operation of a speed feedback signal:



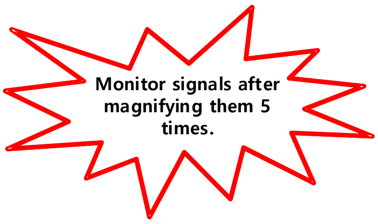
Output offset: 0 rpm
Output scale: 500rpm/V



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



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



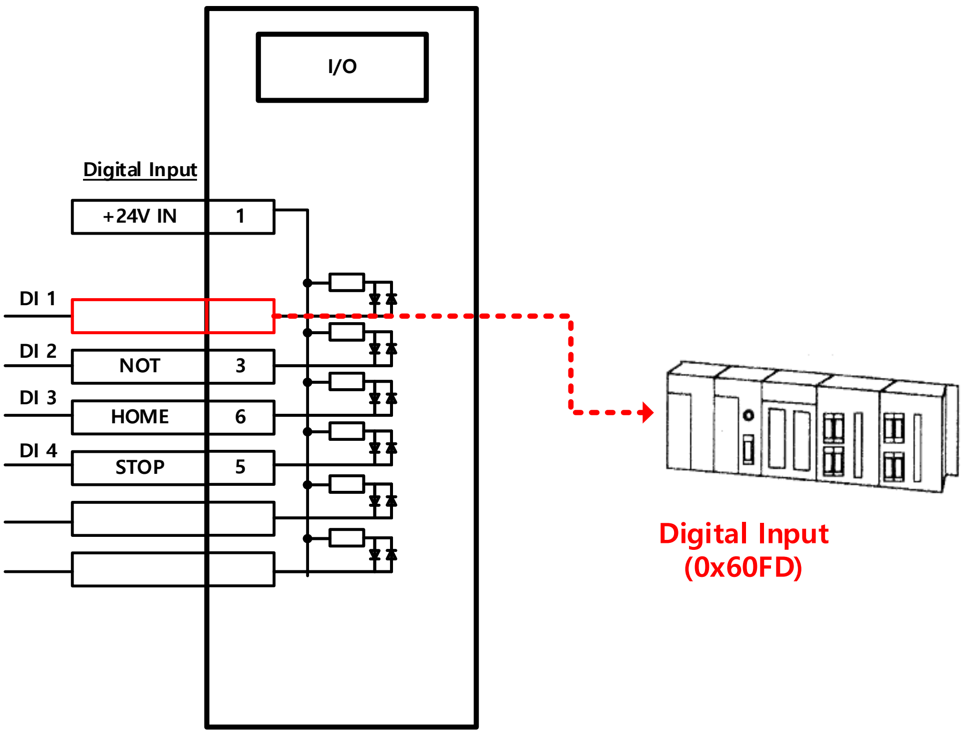
5.2.4 Use of User I/O

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

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

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

■ How to Set the User Input



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

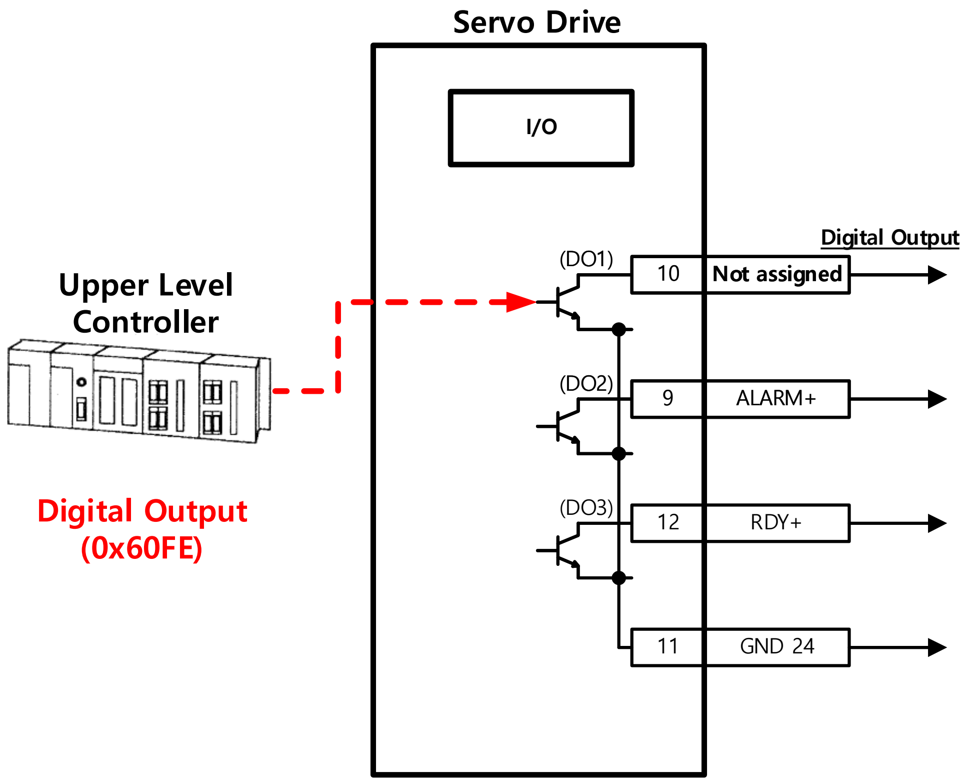
2) Read the values of the corresponding bits (0x60FD.16 - 23) from the digital input (0x60FD) to use them as the user input.

■ Related Objects

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x60FD	-	Digital Inputs	UDINT	RO	Yes	-

Bits	Description
0	NOT (Negative Limit Switch)
1	POT (Positive Limit Switch)
2	HOME (Home Position Sensor Input)
3 to 15	Reserved
16	DI #1(I/O pin 11), 0:Open, 1:Close
17	DI #2(I/O pin 12), 0:Open, 1:Close
18	DI #3(I/O pin 7), 0:Open, 1:Close
19	DI #4(I/O pin 8), 0:Open, 1:Close
20	DI #5(I/O pin 13), 0:Open, 1:Close
21	DI #6(I/O pin 14), 0:Open, 1:Close
22	Reserved
23	Reserved
24~30	Reserved
31	STO(Safe Torque Off), 0:Close, 1:Open

How to Set the User Output



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

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

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

Related Objects

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

They indicate the status of digital outputs.

- Description of physical outputs

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

- Bit mask

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

5.3 Electric Gear Setup

5.3.1 Electric Gear

This function allows you to drive the motor by the user unit in which the user intends to give commands.

The electric gear function of the drive does not allow the user to utilize the highest resolution of the encoder. If the upper level controller has the function of electric gear, it is advisable to use it instead.

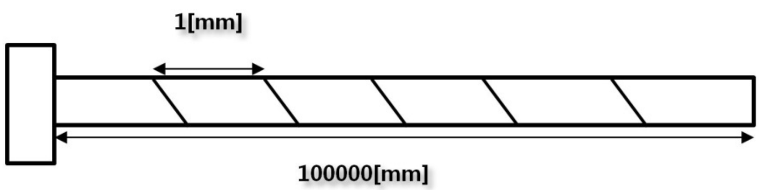
Set the gear ratio within the range of 1000~1/1000.

When using the electric gear and the STOP signal at the same time, adjust the value of Quick Stop Deceleration [0x6085] to set the method you desire to use.

Typically, electric gears are used in the following situations.

(1) To drive the load based on user unit

- The electric gear makes it easy to convert values into user units [UU].



For example, assume that there is a ball screw which moves 1 [mm] for every full turn of the motor whose encoder has a resolution of 524288 [ppr]. To move the screw by 1 [mm], you have to input 524288 [Pulses] into the servo. If you wish to move it by 27 [mm], addition calculations are necessary and you have to input the complex value of 14155776 [Pulse].

However, if you use the gear ratio, you can avoid the inconvenience of having to input the command value.

For example, if you want to move the screw by 1 [mm] by inputting 1 [Pulses] into the servo, you can set the gear ratio as follows. Since L7C is a multi-level gear, the example includes only 0x300C and 0x3010.

$$\frac{Electric\ Gear\ Numerator[0x6091{:}01]}{Electric\ Gear\ Denomiator[0x6091{:}02]} \times \text{User Demand Pluse[UU]}$$

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

If you input 524288 for the numerator and 1 for the denominator of the electric gear, the movement ratio of the ball screw for a revolution of the motor is set internally. To move the screw by 1 [mm], you only have to input the same value 1 into User Demand Pulse because the unit has been made the same, which provides convenience in entering commands.

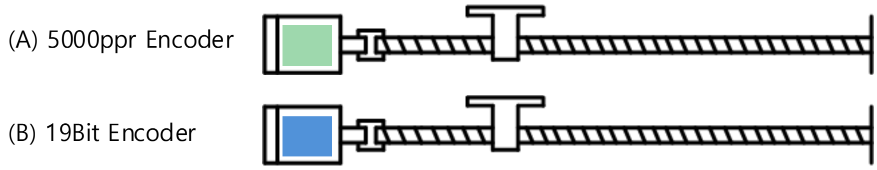
If you want to make the ball screw move by 0.0001 [mm] by inputting 1 [UU], the gear ratio formula is as follows.

$$\frac{Electric\ Gear\ Numerator[0x6091{:}01]}{Electric\ Gear\ Denomiator[0x6091{:}02]} \times \mathrm{User\ Demand\ Pluse[UU]}$$

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

By applying the above gear ratio formula, the ball screw is made to move by 0.0001 [mm]/1 [UU] and by 0.001 [mm] when you input 10 [UU]. You can conveniently input values in the desired unit [UU] into Distance of the index.

- You can command the driving based on the user unit, regardless of the encoder (motor) type. The following example is for a movement of 12mm for the ball screw type with a 10mm pitch.



<table>
<tr><th></th><th>(A) 5000 ppr encoder</th><th>(B) 19-bit (524288 ppr) encoder</th></tr>
<tr><td rowspan="2">When the electric gear

is not used</td><td>5000*12/10 = 6000</td><td>524288*12/10=629145.6</td></tr>
<tr><td colspan="2">Different commands should be given to the encoders (motor) used for the same distance movement.</td></tr>
<tr><td colspan="3"><u>For a command given in the minimum user unit of 1 um (0.001 mm)</u></td></tr>
<tr><td>Electric gear setting</td><td>Electric Gear Numerator 1 =5000

Electric Gear Denominator 1 = 10000</td><td>Electric Gear Numerator 1 =524288

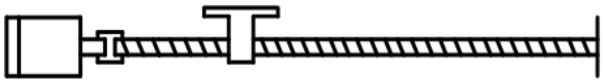
Electric Gear Denominator 1 = 10000</td></tr>
<tr><td>If the electric gear is used</td><td colspan="2">Movements can be made under the same command of 12000 (12mm= 12000*1um) regardless of the encoder (motor) used.</td></tr>
</table>

(2) When the output frequency of the upper level controller or input frequency of the drive is limited for driving a high-resolution encoder at a high speed

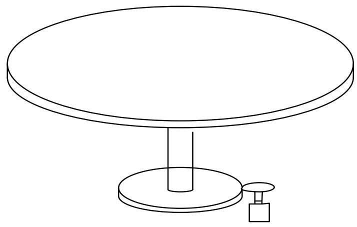
- The output frequency of a general high-speed line drive pulse output unit is approximately 500Kpps, and the possible input frequency of the drive is approximately 4Mpps. For this reason, when driving a high-resolution encoder at high speeds, be sure to use an electric gear for proper driving due to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

5.3.2 Example of Position Operation Electric Gear Setting

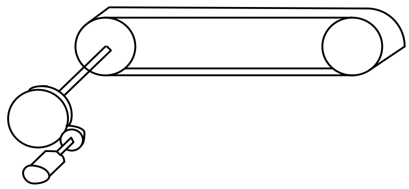
■ Ball Screw Load

Apparatus specification	 **Pitch: 10mm, Deceleration ratio: 1/1**
User Unit	1um(0.001mm)
Encoder specification	19-bit (524288 PPR)
Load movement amount/revolution	10[mm] = 10000[User Unit]
Electric gear setting	Electric Gear Numerator 1 : 524288 Electric Gear Denominator 1 : 10000

■ Turntable Load

Apparatus specification	 **Deceleration ratio: 100/1**
User Unit	0.001°
Encoder specification	19-bit (524288 PPR)
Load movement amount/revolution	360/100/0.001=3600
Electric gear setting	Electric Gear Numerator 1 : 524288 Electric Gear Denominator 1 : 3600

■ Belt + Pulley System

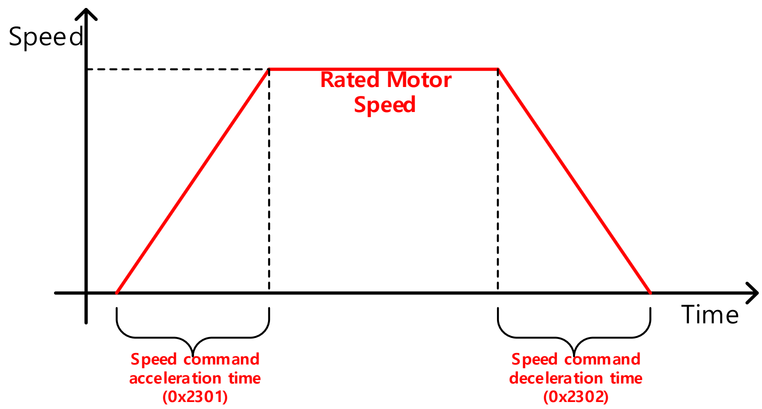
Apparatus specification	 **Deceleration ratio: 10/1, Pulley diameter: 100 mm**
User Unit	1um(0.001mm)
Encoder specification	19-bit (524288 PPR)
Load movement amount/revolution	PI*100/10/0.001=31416
Electric gear setting	Electric Gear Numerator 1 : 524288 Electric Gear Denominator 1: 31416

5.4 Velocity Control Settings

5.4.1 Smooth Acceleration and Deceleration

For smoother acceleration and deceleration during velocity control, you can generate an acceleration/deceleration profile of a trapezoidal or S-curved shape. Here, You can enable S-curve operation by setting the speed command S-curve time to 1 [ms] or higher.

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

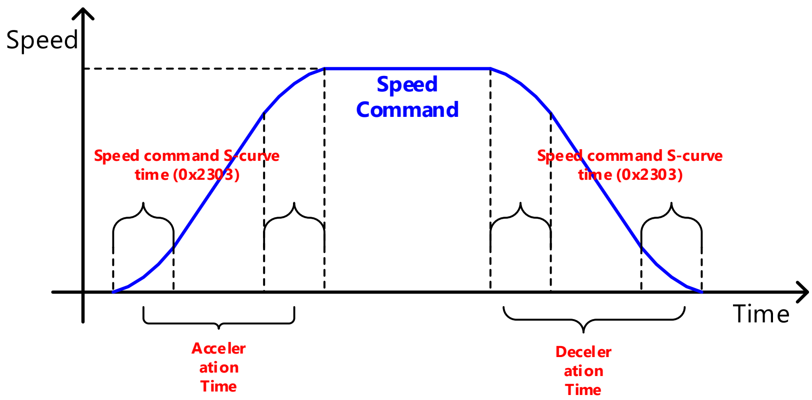


You can calculate the actual acceleration/deceleration time as below.

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 shape acceleration/deceleration profile by setting the speed command S-curve time (0x2303) to 1 or a higher value. Make sure to verify the relationship between the acceleration/deceleration time and S-curve time.



5.4.2 Servo-lock Function

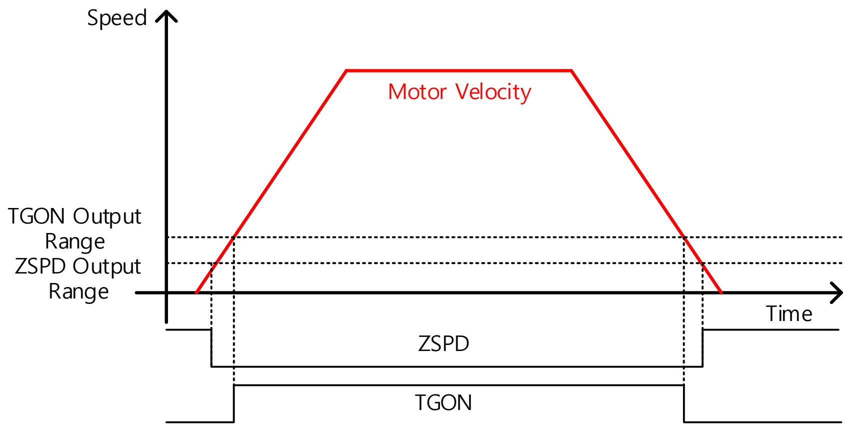
During velocity control operation, the servo position cannot be locked even when 0 is entered for the speed command. This is due to the characteristic of velocity control. Here, you can lock the servo position by enabling the servo-lock function select (0x2311).

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

Using the servo-lock function, you can internally control the positions based on the position of 0 speed command input. If you input a speed command other than 0, the mode switches to normal velocity control.

5.4.3 Velocity Control Signals

As shown in the figure below, when the value of speed feedback is below the ZSPD output range (0x2404), a ZSPD (zero speed) signal is output; and when it is above the TGON output range (0x2405), a TGON (motor rotation) signal is output.



In addition, if the difference between the command and the speed feedback (i.e., velocity error) is below the INSPD output range (0x2406), an INSPD (velocity match) signal is output.

■ Related Objects

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

5.5 Position Control Settings

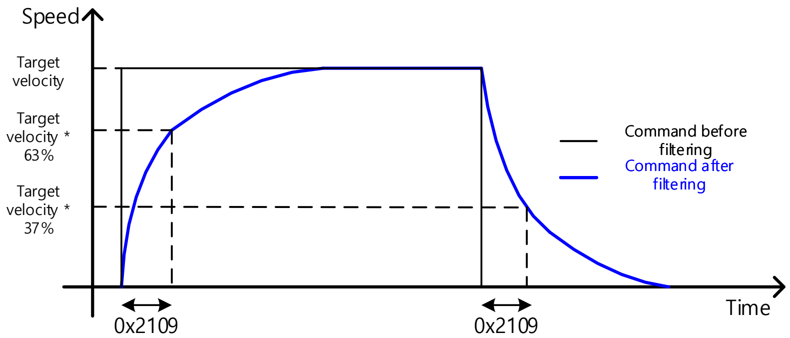
5.5.1 Position Command Filter

You can apply filters to position commands to operate the drive more smoothly. For 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 movement average.

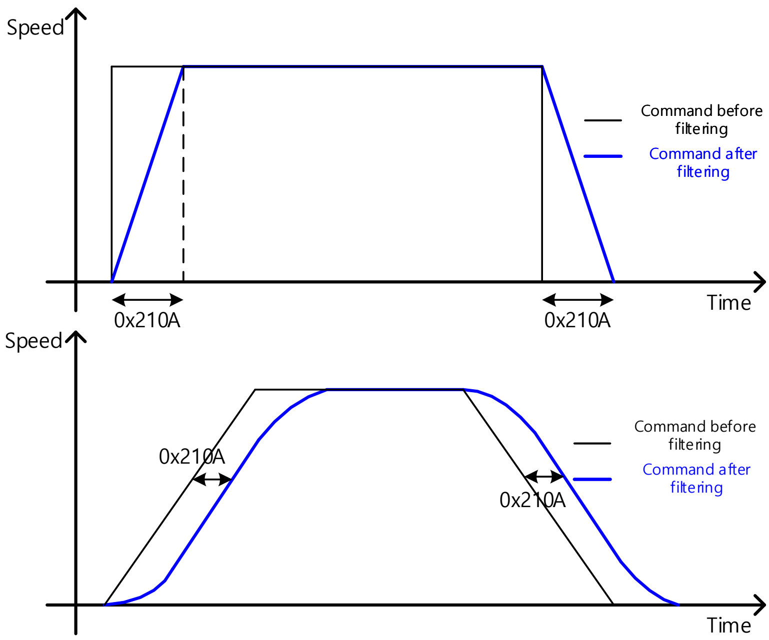
You can use a position command filter in the following cases.

(1) When the electric gear ratio is x10 or above

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



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



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

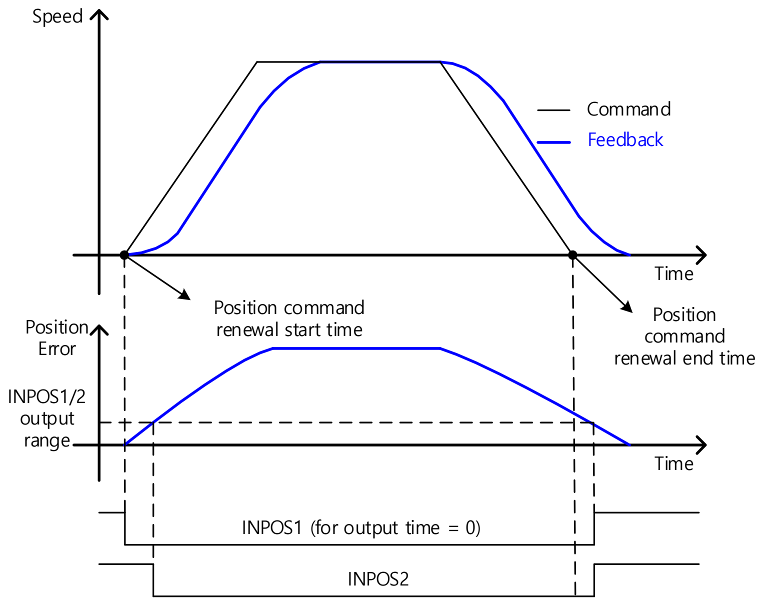
■ Related Objects

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

5.5.2 Position Control Signals

As shown in the figure below, if the following error value (i.e., the difference between the position command value input by the upper level controller and the position feedback value) is below the INPOS1 output range (0x2401) and is maintained for the INPOS1 output time (0x2402), the INPOS1 (Positioning completed 1) signal is output. However, the signal is output only when the position command is not renewed.

Here, if the following error value goes below the INPOS2 output range (0x2403), the INPOS2 (Positioning completed 2) signal is output regardless of whether or not the position command has been renewed.



■ Related Objects

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

5.6 Settings Related to Torque Control

5.6.1 Speed Limit Function

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

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

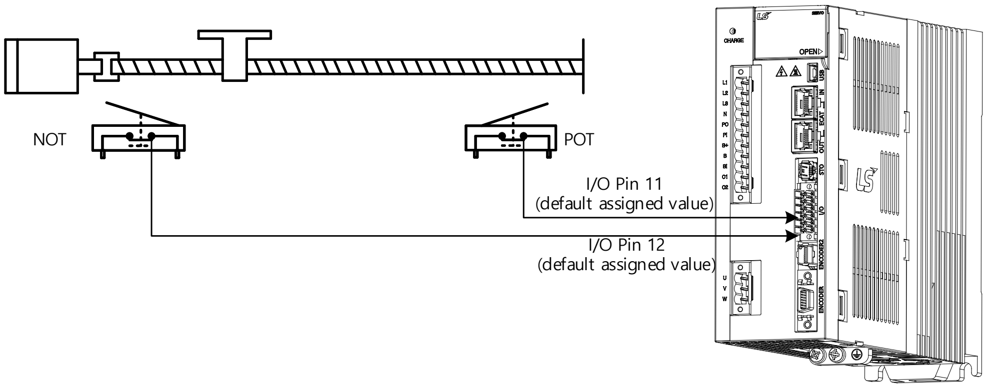
Setting Value	Setting details
0	Limited by the speed limit value (0x230E)
1	Limited by the maximum motor speed

■ Related Objects

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

5.7 Positive/Negative Limit Setting

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



When a positive/negative limit signal is input, the motor stops according to the emergency stop configuration (0x2013).

Setting Value	Description
0	The motor stops according to the method set in Dynamic Brake Control Mode (0x2012). It stops using the dynamic brake and maintains the torque command at 0.
1	The motor decelerates to a stop using the emergency stop torque (0x2113).

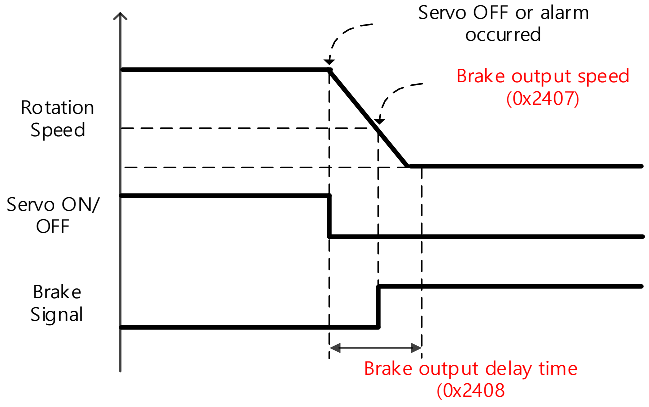
■ Related Objects

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

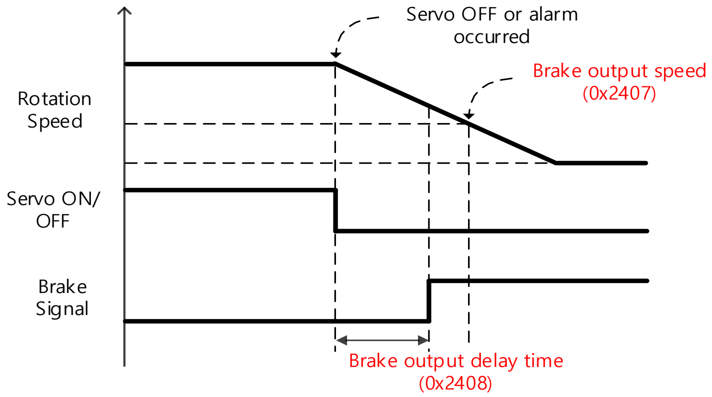
5.8 Brake Output Signal Function Setting

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

The brake signal is output if the motor rotation velocity goes below the set value (0x2407) or the output delay time (0x2408) has been reached after the servo off command.



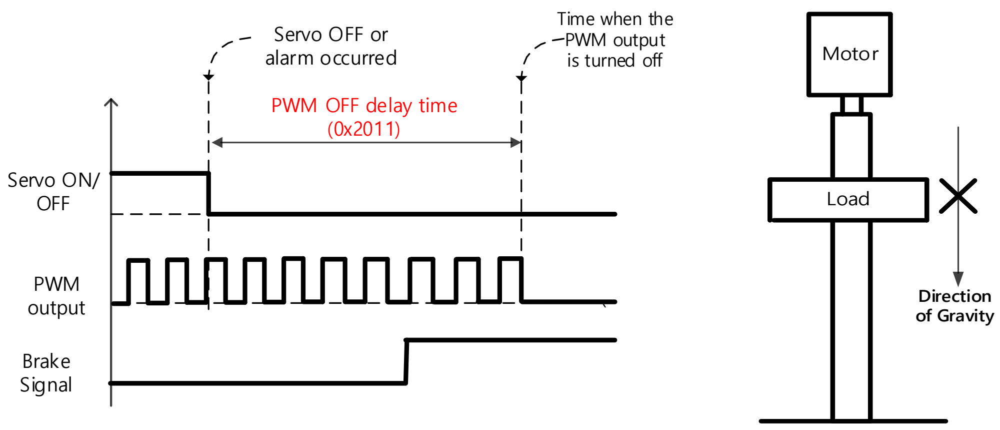
Timing diagram for signal output by the brake output speed (0x2407)



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

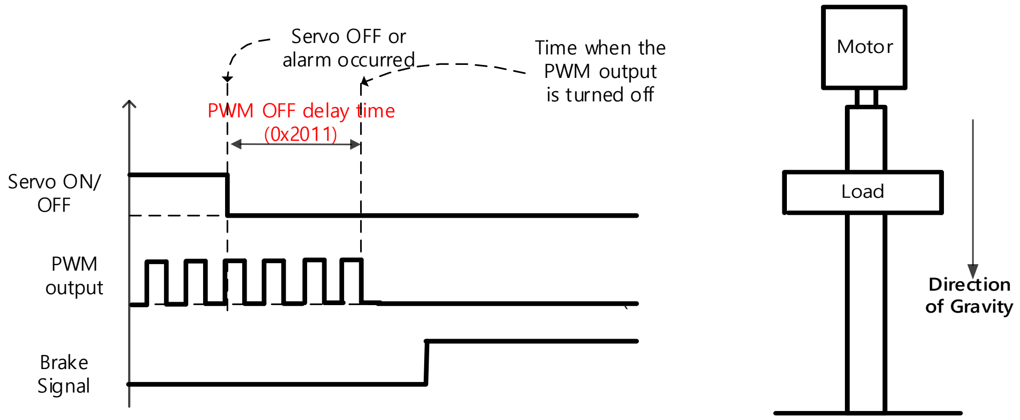
You can set the delay time until the actual PWM output goes off when the servo is turned off or a servo alarm occurs.

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



(1) When the brake signal is output before PWM output is turned off

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



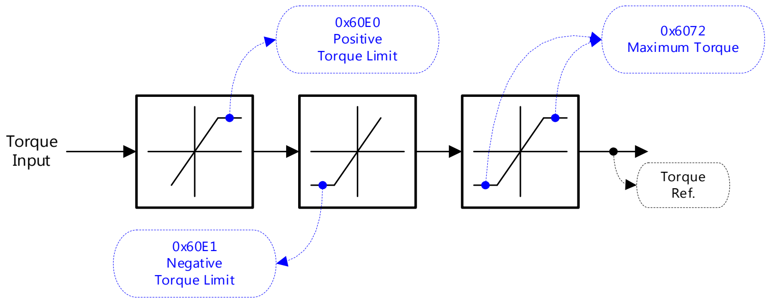
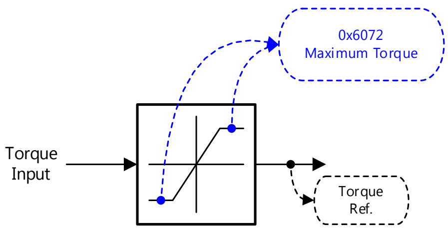
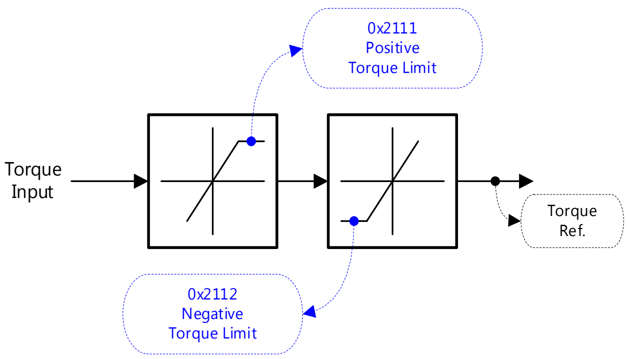
(2) If PWM output is turned off before the brake signal output

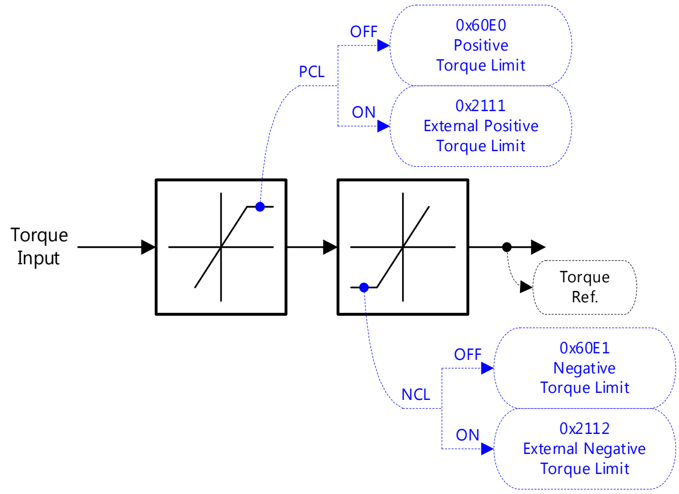
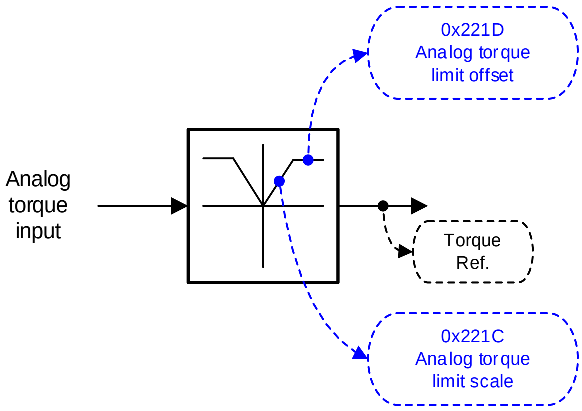
PWM output is turned off before the brake signal output, allowing the drop along the vertical axis due to gravity.

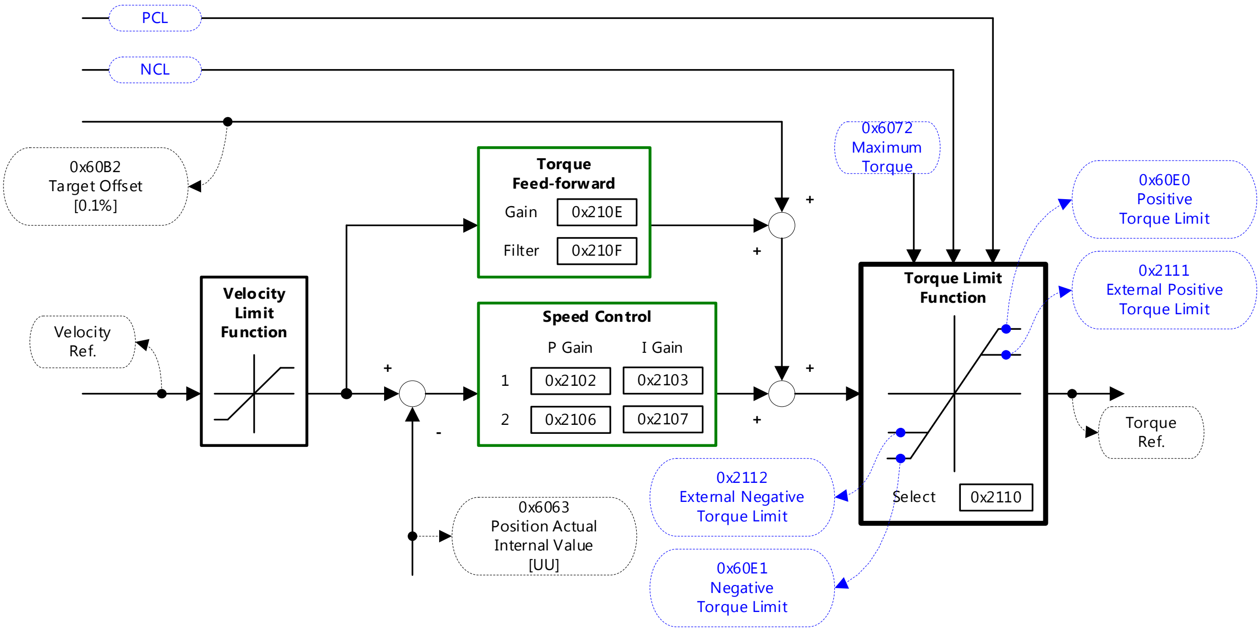
5.9 Torque Limit Function

You can limit the drive's output torque to protect the machine. You can set the limit on torque output in torque limit function select (0x2110). The setting unit of torque limit value is [0.1%].

- Description of torque limit function select (0x2110)

Limit function	Description
Internal torque limit 1 (Setting value 0)	 Limits the torque using positive/negative torque limit values according to the driving direction; the maximum value is limited by the maximum torque (0x6072). - Positive: 0x60E0, Negative: 0x60E1
Internal torque limit 2 (Setting value 1)	 Limits the torque by the maximum torque (0x6072) only regardless of the driving direction.
External torque limit (Setting value 2)	 Limits the torque value using external positive/negative torque limits according to the driving direction - Positive: 0x2111, Negative: 0x2112

Internal + External Torque Limits (Setting value 3)	 Limits the torque value using internal and external torque limits according to the driving direction and the torque limit signal - Positive: 0x60E0 (if PCL signal is not input), 0x2111 (if PCL signal is input) - Negative: 0x60E1 (if NCL signal is not input), 0x2112 (if NCL signal is input)
Analog torque limit (Setting value 4)	 The torque limits are set according to analog input voltage -The torque limit values in the positive and negative directions are set in proportion to the absolute values of input voltage, regardless of the signals of analog input voltage. . - The torque limit and the analog input voltage have the following relationship. - The limit value can be determined by using the following formula. $\textbf{Torque limit value}[\%] = \left(\frac{\lvert\textbf{Input voltage}[\textbf{mv}]\rvert - \textbf{Torqueinput offset}(\textbf{0x221D})[\textbf{mV}]}{\textbf{1000}}\right) \times \frac{\textbf{Torque command scale}[\textbf{0x221C}]}{\textbf{10}}$ ex 1) the command scaler is set to 100 and the offset is set to 0

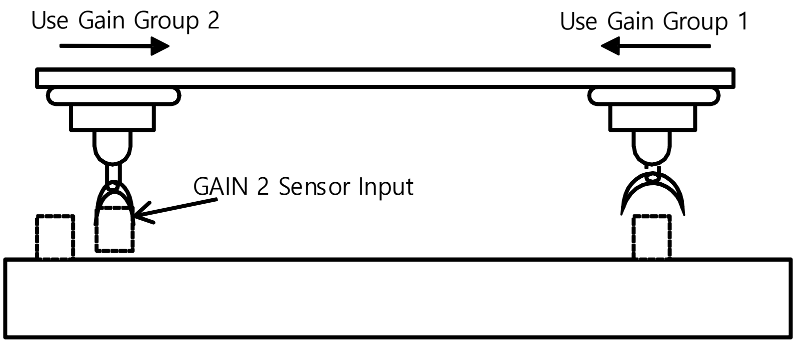


■ Related Objects

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

5.10 Gain Conversion Function

5.10.1 Gain Group Conversion



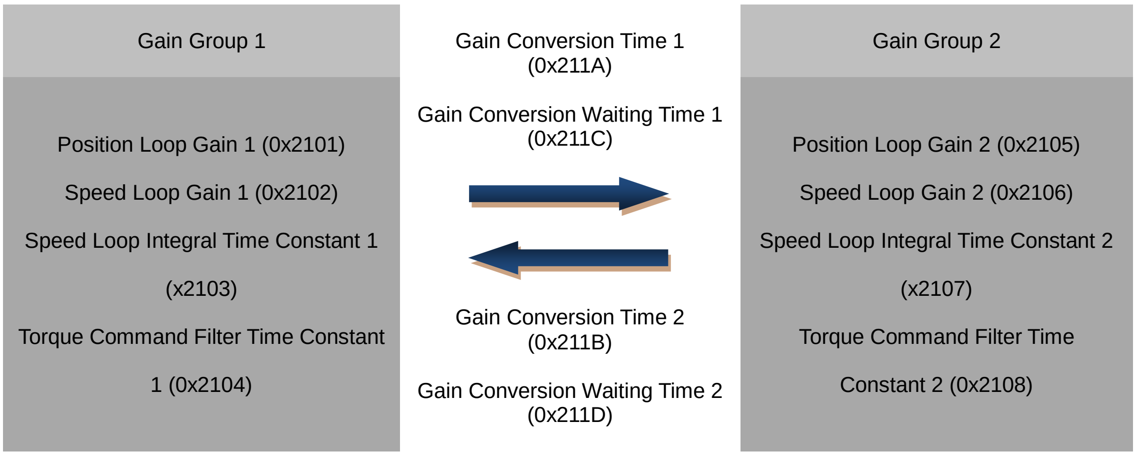
This is one of the gain adjustment functions and is used to switch between Gain Groups 1 and 2. You can reduce the time required for positioning through gain conversion.

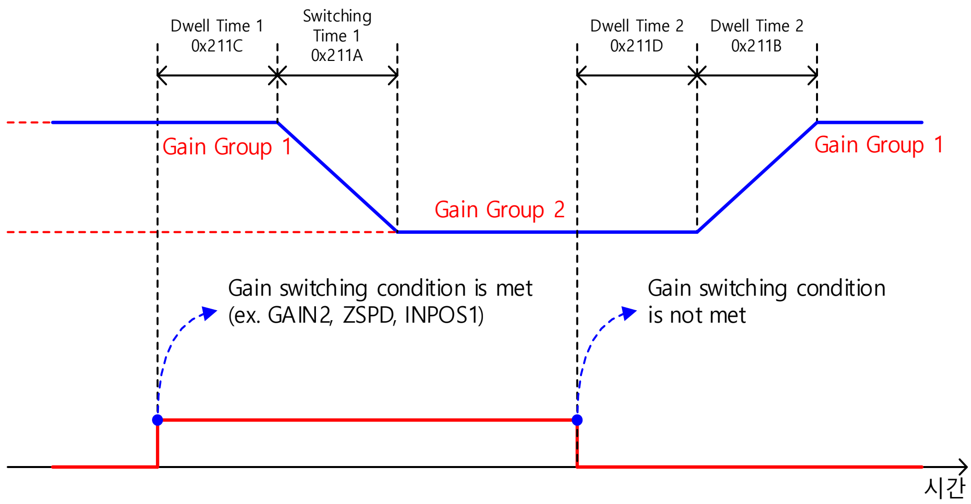
A gain group consists of position loop gain, speed loop gain, Speed Loop Integral Time Constant, and torque command filter time constant. You can set the gain conversion function (0x2119) as follows.

- Description of Gain Conversion Function (0x2119)

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

Waiting time and switching time for gain conversion are as follows.





■ Related Objects

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x2119	-	Gain Conversion Mode	UINT	RW	Yes	-
0x211A	-	Gain Conversion Time 1	UINT	RW	Yes	ms
0x211B	-	Gain Conversion Time 2	UINT	RW	Yes	ms
0x211C	-	Gain Conversion Waiting Time 1	UINT	RW	Yes	ms
0x211D	-	Gain Conversion Waiting Time 2	UINT	RW	Yes	ms

5.10.2 P/PI Control Switch

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

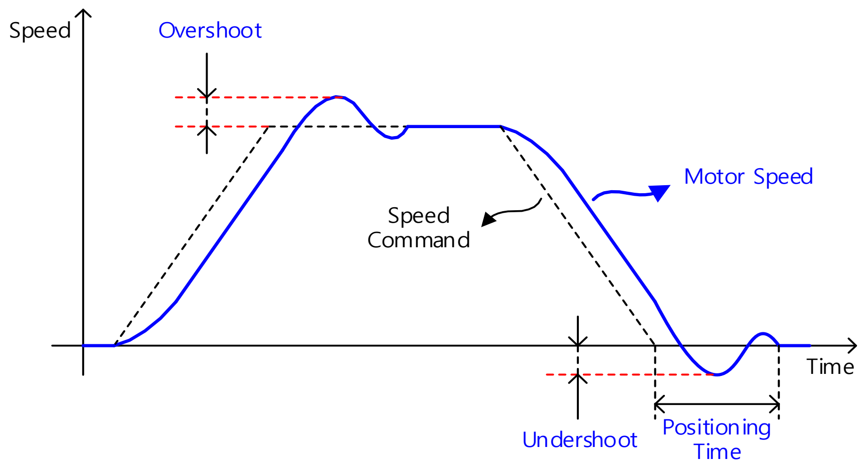
The proportional gain determines the responsiveness of the entire controller, and the integral gain is used to eliminate errors in the steady state. Too high of an integral gain will result in an overshoot during acceleration or deceleration.

The PI/P control switch function is used to switch between the PI and P controls under the condition of the parameters within the servo (torque, velocity, acceleration, position deviation); specifically, they are used in the following situations.

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

Position control: To suppress undershoots during positioning in order to reduce the positioning time

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



You make these settings in the P/PI control conversion mode (0x2114). See the details below. Switching to P control by PCON input takes precedence over this setting.

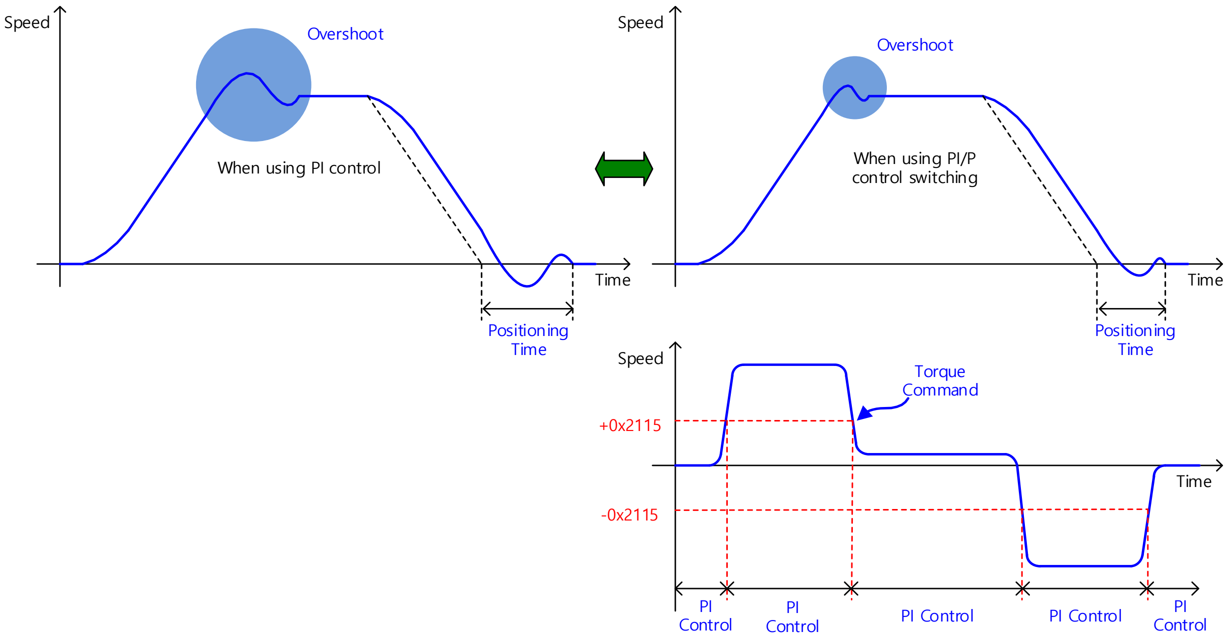
Setting Value	Setting details
0	Always use PI control
1	Switches to P control if the command torque is larger than the P control switch torque (0x2115)
2	Switches to P control if the command speed is larger than the P control switch speed (0x2116)
3	Switches to P control if the acceleration command is larger than the P control switch acceleration (0x2117)
4	Switches to P control if the following error is larger than the P control switch following 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 using PI control for all situations rather than using P/PI control switch for velocity control, the integral term of acceleration/deceleration error is accumulated, which results in an overshoot and an extended positioning time. Here, you can reduce overshoot and positioning time using an appropriate P/PI switching mode. The figure below shows an example of mode switching by torque commands.



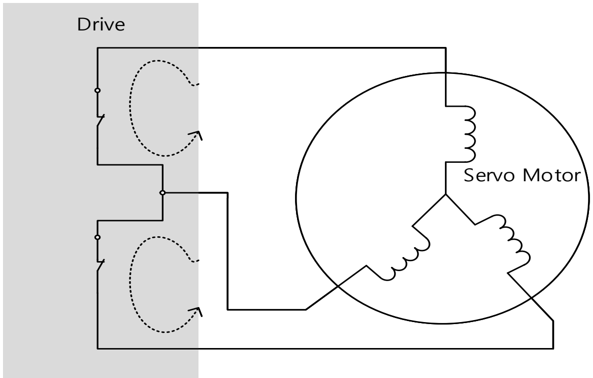
5.11 Dynamic Brake

What is dynamic brake?

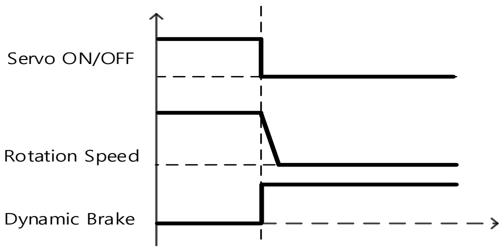
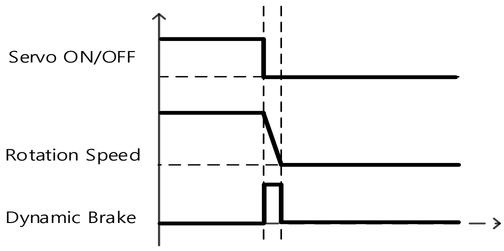
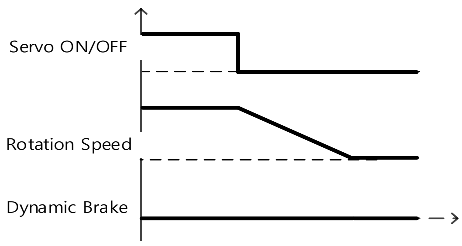
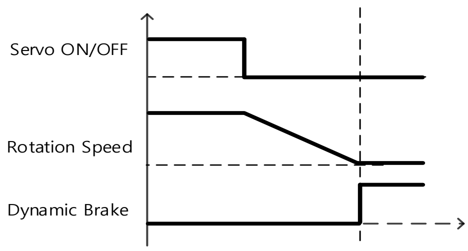
: It is a method of rapidly stopping the motor by causing an electrical short-circuit to the phases of the servo motor.

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

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



You can set various stop modes as shown below, in dynamic brake control mode (0x2012).

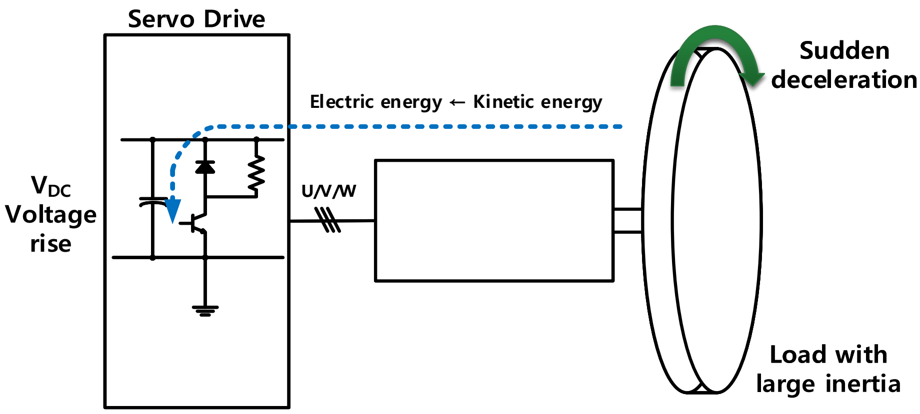
 Setting value: 0 Hold the dynamic brake after stopping the motor using the brake	 Setting value: 1 Release the dynamic brake after stopping the motor using the brake
 Setting value: 2 Release the dynamic brake after free-run stop	 Setting value: 3 Hold the dynamic brake after free-run stop

■ Related Objects

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

5.12 Regeneration Brake Resistor Configuration

Regeneration refers to a phenomenon where kinetic energy of the motor is converted to electric energy and input into the drive because of the high inertia or sudden deceleration of the load driven. Here, a regeneration brake resistor is used to suppress the rise of the drive's internal voltage(V_{DC}) caused by regeneration and prevent burnout of the drive.



■ Related Objects

Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x2009	-	Regeneration Brake Resistor Configuration	UINT	RW	No	-
0x200A	-	Regeneration Brake Resistor Derating Factor	UINT	RW	No	%
0x200B	-	Regeneration Brake Resistor Value	UINT	RW	No	Ω
0x200C	-	Regeneration Brake Resistor Capacity	UINT	RW	No	Watt

5.12.1 Use of Internal Regeneration Brake Resistor

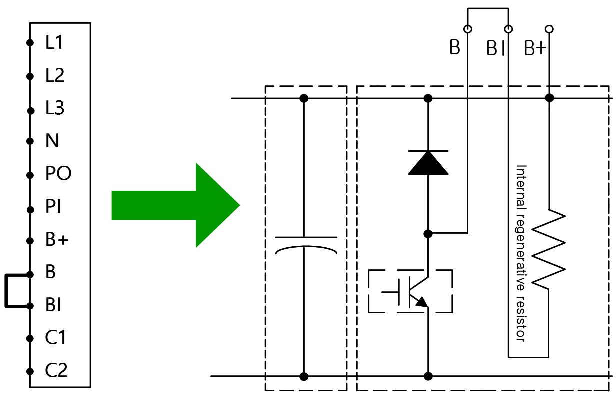
This drive essentially has internal regeneration brake resistor depending on its capacity. The integrated regeneration brake resistors depending on the drive capacity are as follows:

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

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

1. Wiring regeneration brake resistor.

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



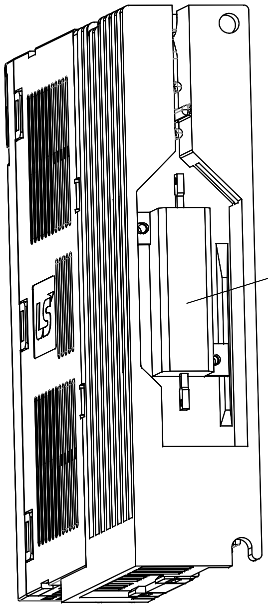
Wiring method when using internal regenerative resistor

2. Configuring regeneration brake resistor (0x2009)

   - Configure to use the regeneration brake 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 the internal regeneration brake resistor value and capacity

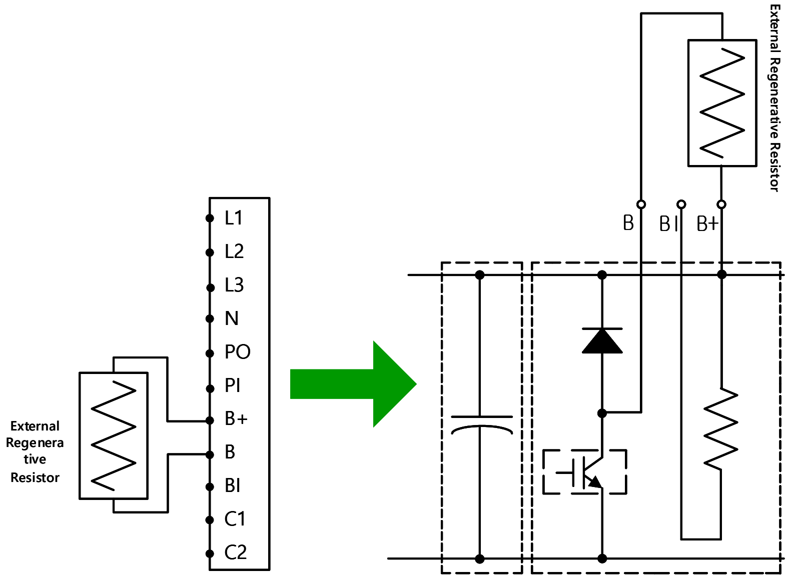
- Check the internal regeneration brake resistor value (0x200B).
- Check the regeneration brake resistor capacity (0x200C).
- 1 KW or less: Basically, the resistor is installed on the rear of the drive heat sink (see the figure below).
- 3.5 kW - 7.5 kW: It is basically installed inside the drive.



5.12.2 Use of External Regeneration Brake Resistor

When using the external regeneration brake resistor for different driving conditions, make sure to observe the order below for configuration.

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



Wiring method when using external regenerative resistor

2. Configuring regeneration brake resistor (0x2009)
   - Configure the regeneration brake resistor installed separately outside the drive (0x2009=1)
   - Set if a regeneration brake resistor is connected of a capacity which is larger than that of the internal regeneration brake resistor.
3. Configuring regeneration brake resistor value (0x200B)
   - Set regeneration brake resistor value installed separately outside the drive in the unit of [Ω]
   - Be sure to set it when you have set regeneration brake resistor configuration (0x2009) to 1
   - Initial Value: 0
4. Configuring regeneration brake resistor capacity (0x200C).
   - Set the capacity of the regeneration brake resistor installed separately outside the drive in the unit of [W]
   - Be sure to set it when you have set regeneration brake resistor configuration (0x2009) to 1
   - Initial Value: 0
5. Set the maximum capacity and allowed time of the regeneration brake resistor (0x200D, 0x200E)

- Set the maximum capacity and use time at the capacity by using the data sheet of the externally installed regeneration brake resistor

- If there are no specific values provided, set the maximum capacity to a value 5 times the regeneration brake resistor power (0x200C) and the allowed time to 5000[ms](The values may differ according to the general regeneration brake resistor specifications or the regeneration brake resistor value)

- Be sure to set it when you have set regeneration brake resistor configuration (0x2009) to 1

Our company provides the following regeneration brake resistor specifications as options for the use of external regeneration brake resistors.

Drive Capacity	Resistance Values	Resistance Capacity	Model Name
1kW	30Ω	300W	APCS-300R30
3.5kW	30Ω	600W	APC-600R30
5kW	28Ω	600W	APC-600R28 (4P)
7.5kW	28Ω	600W	APC-600R28 (4P)

5.12.3 Other Considerations

You can set the regeneration brake resistor’s Derating Factor (0x200A) by considering the ambient environment and heat radiation conditions for drive installation. If the heat radiation condition is poor, use a derated (with lowered capacity) resistor.

When it is derated for use (value set to 100 or lower), the less the set value of the regeneration overload alarm (AL-23), the faster its trigger.

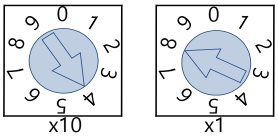
When you wish to set the derating factor to 100% or higher, be sure to fully consider the heat radiation condition of the drive installed.

5.13 Drive Node Address Setting (ADDR)

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

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

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



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

6. Safety Functions

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

6.1 Safe Torque Off (STO) Function

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

■ Safe Torque Off Operation State According to STO Input Contact

Signal Names	Function			
STO1	ON	ON	OFF	OFF
STO2	ON	OFF	ON	OFF
Operation State	Normal State	STO State	STO State	STO State

■ Electric Characteristics

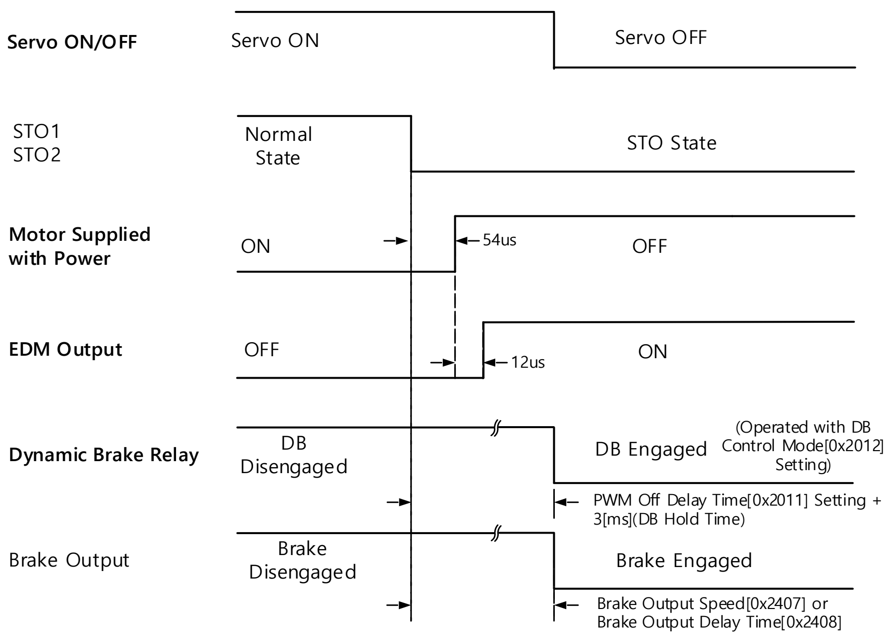
- STO1, STO2

Items	Characteristic Value
Internal impedance	3.3 kΩ
Voltage input range	DC 12V ~ DC 24V
Maximum Delay Time	1 ms or less

- EDM

Items	Characteristic Value
Maximum Allowed Voltage	DC 30V
Maximum Current	DC 120mA
Maximum Delay Time	1 ms or less

■ Timing diagram for STO operation

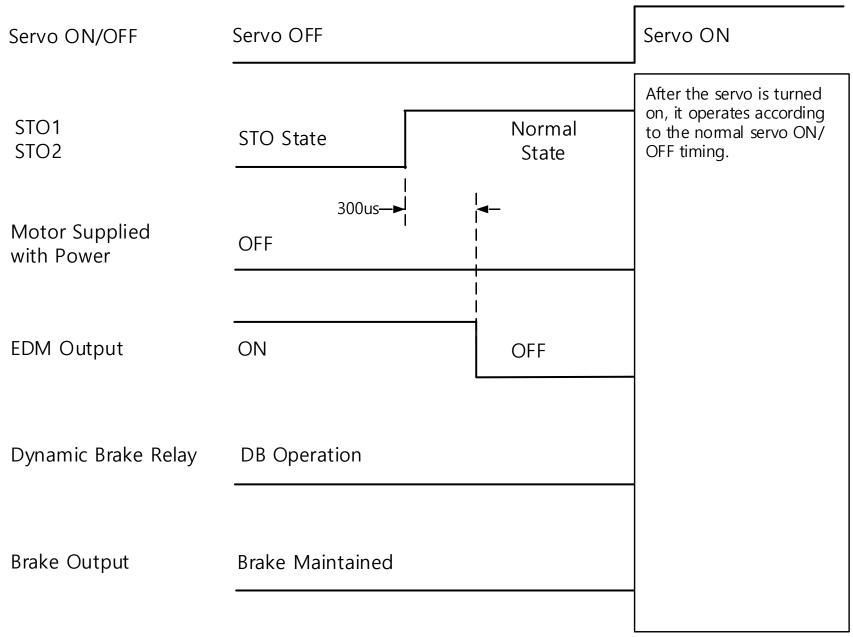


Note 3) If either STO1 or STO2 is turned off, the drive state is switched to the STO state.

Note 4) The dynamic brake operates according to the dynamic brake control mode (0x2012).

Note 5) Whichever is the earlier time, out of the points of time until the value becomes less than the setting value of the brake output delay time (0x2408) or less than the brake output speed (0x2407), will be applied.

■ Timing diagram for STO recovery



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

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

6.2 External Device Monitor (EDM)

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

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

■ Failure detection through EDM signal

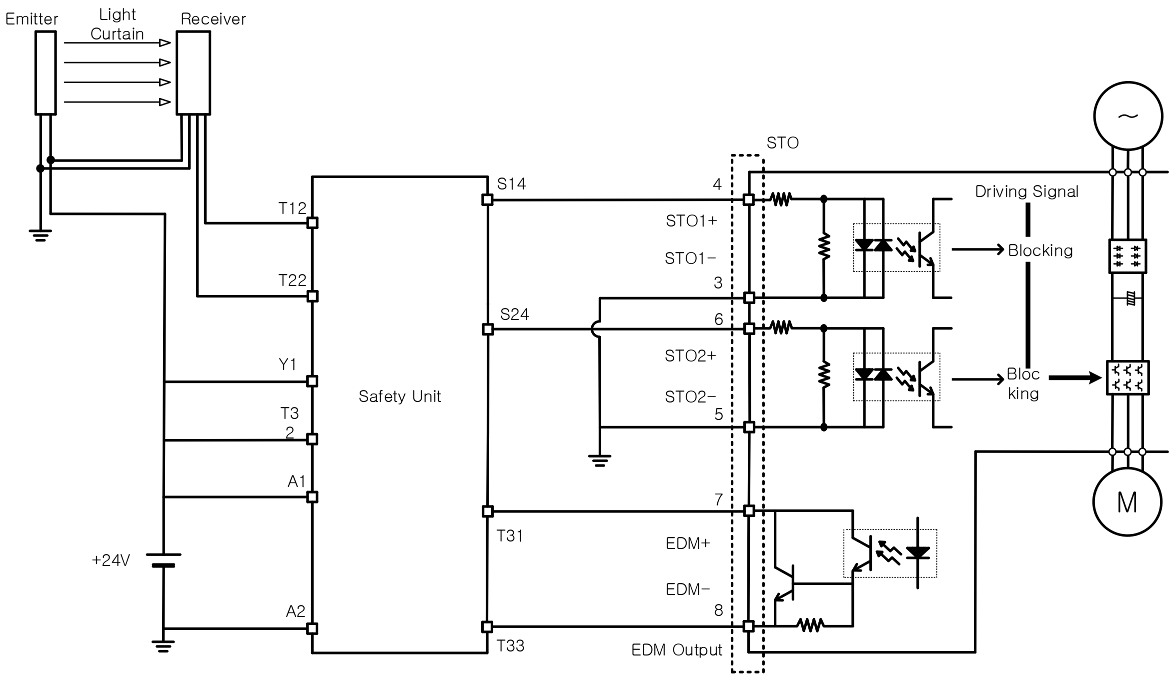
You can detect failure of the safety input circuit and the EDM output circuit by monitoring the following 4 signal states from the external device.

In case of failure, there are two possible cases:

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

Signal Names	Function			
STO1	ON	ON	OFF	OFF
STO2	ON	OFF	ON	OFF
EDM	OFF	OFF	OFF	ON

6.3 Example of Using the Safety Function



6.4 How to Verify the Safety Function

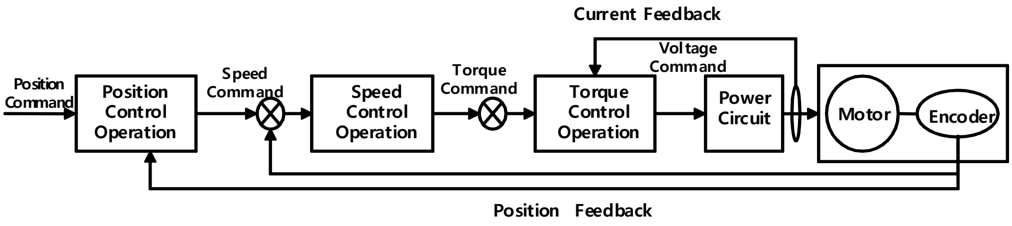
In case the servo drive was replaced prior to starting up the device or during maintenance, make sure to check the details below:

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

6.5 Precautions for Using the Safety Function

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

7. Tuning



The drive is set to the torque control, velocity control, or position control mode for use, depending on the method of connecting with the upper level controller. This drive has a control structure where position control is located at the outermost part and current control at the innermost, forming a cascade. You can tune the operation according to the purpose by setting gain parameters for the torque controller, velocity controller, and position controller for the drive’s operation modes.

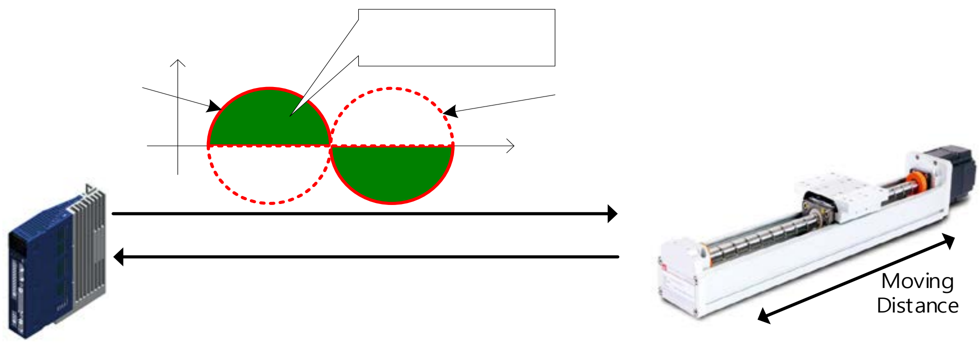
7.1 Auto Gain Tuning (Offline Auto Tuning)

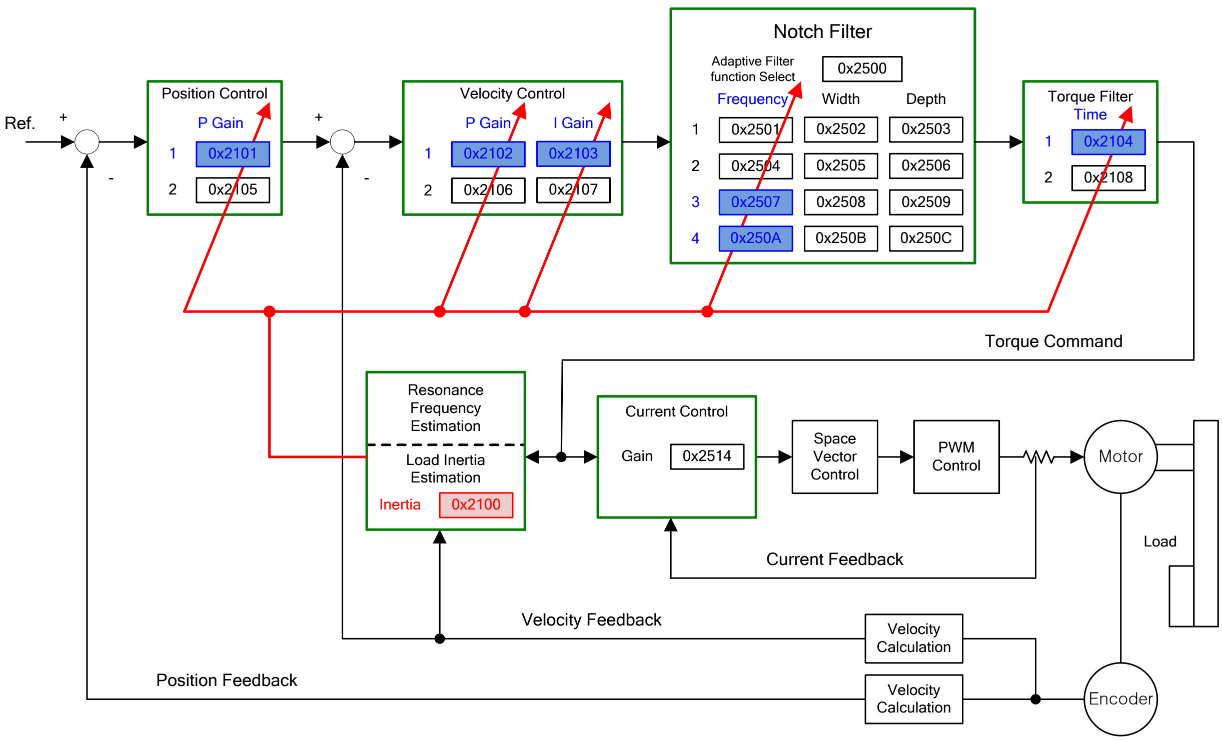
You can automatically set gain according to the load conditions by using the commands generated by the drive itself. The following gain parameters are changed.

- 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 gains are set higher or lower depending on the setting value of the system rigidity for gain tuning (0x250E). Set the appropriate value depending on the rigidity of the load driven.

As shown in the figure below, sinusoidal type commands are generated in the positive or negative direction according to the off-line gain tuning direction (0x2510) setting. You can set the movement distance for tuning by the off-line 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 (one or more motor revolutions) prior to gain tuning.





■ Related Objects

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

7.2 Automatic Gain Adjustment (On-line Auto Tuning)

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

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

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

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

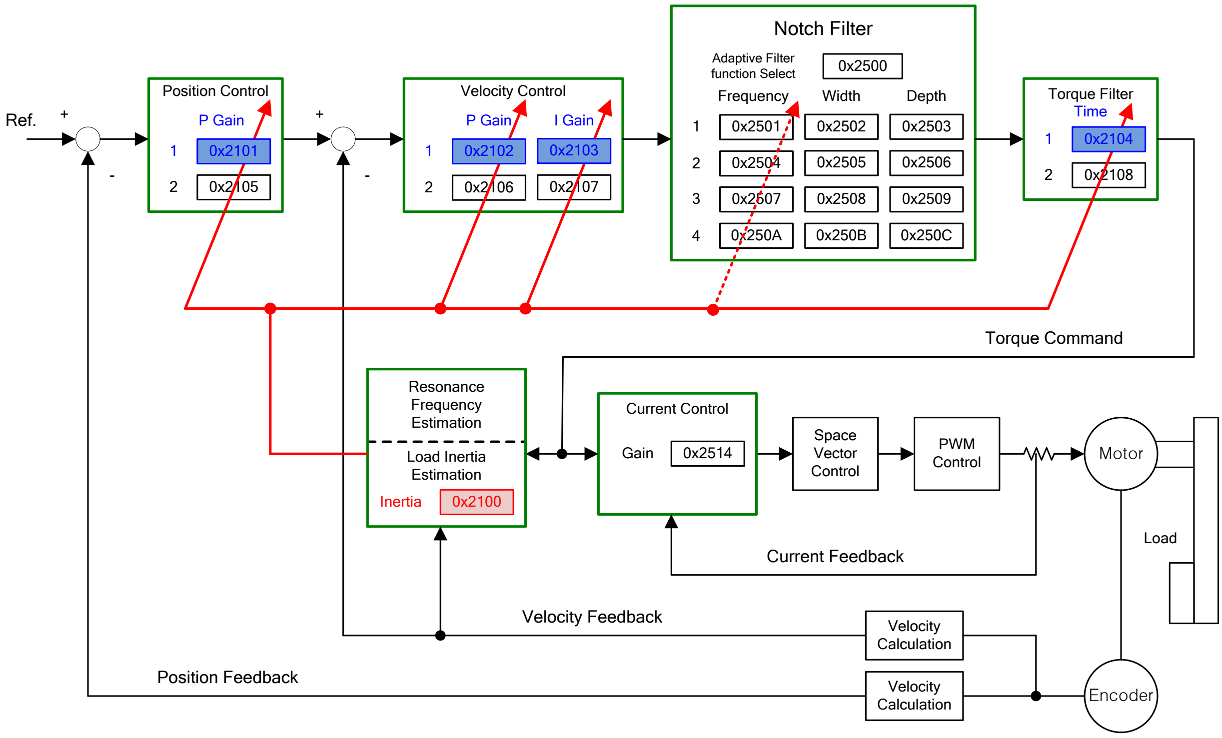
In the below cases, inertia ratio estimation may be incorrect by on-line auto tuning.

- Load variation is too high
- Load rigidity is too low or the system's backlash is severe
- Load is too small (lower than x3) or too big (higher than x20)
- Acceleration or deceleration is too low, resulting in insufficient acceleration/deceleration torque (lower than 10% of the rated value)
- Rotation velocity is low (lower than 10% of the rated value)
- Friction torque is high

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

■ Parameters Changed by Tuning

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



■ Related Objects

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

7.3 Manual Gain Tuning

7.3.1 Gain Tuning Sequence

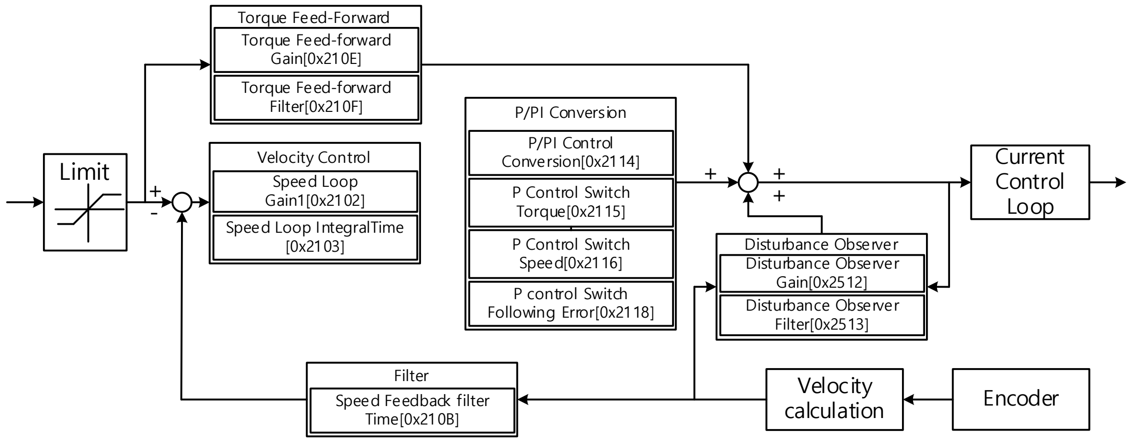
For a cascade-type controller, tune the gain of the velocity controller located at an inner position first, then tune the gain of the position controller located at an outer position.

In other words, perform tuning in the order of proportional gain→ integral gain→ feedforward gain.

The role of each individual gain is as follows.

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

■ Velocity Controller Tuning

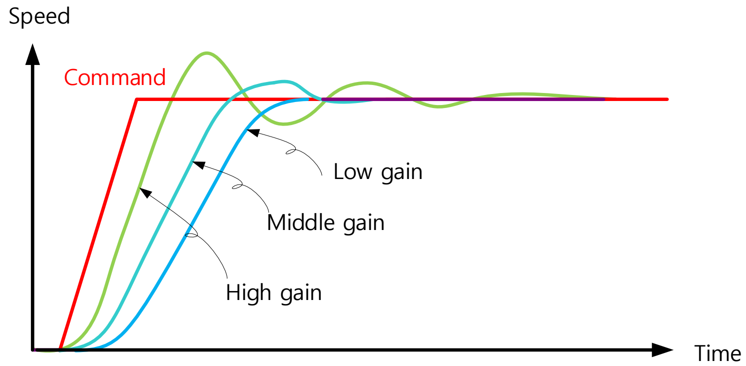


(1) Inertia ratio setting

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

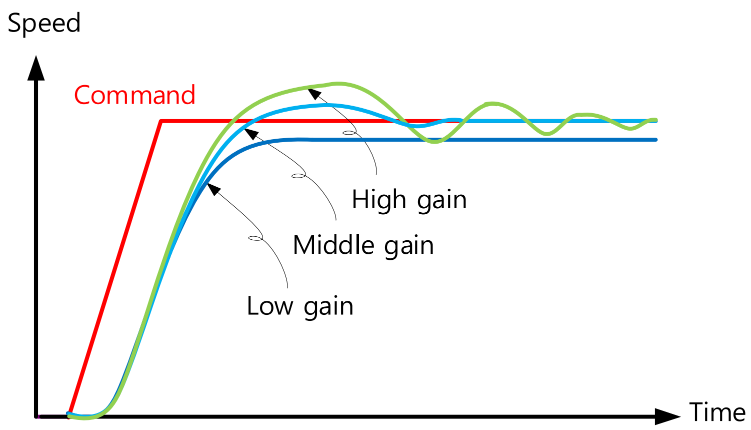
(2) Proportional gain setting

- Monitor for torque and noise before any vibration occurs



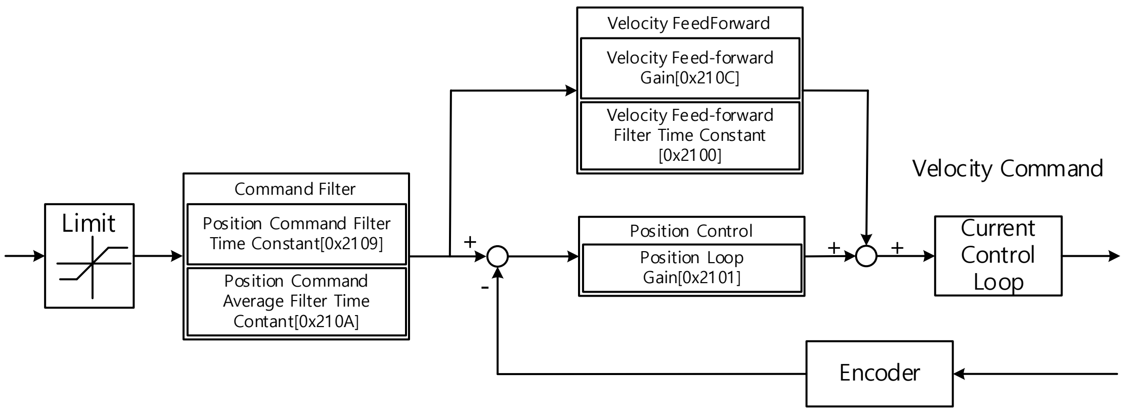
– The higher the speed proportional gain value, the feedback speed's responsiveness to the command speed becomes better. However, if the value is too high, an overshoot or ringing may occur. In contrast, if the value is too low, the responding speed becomes low, which slows down system operation.

(3) Integral gain setting

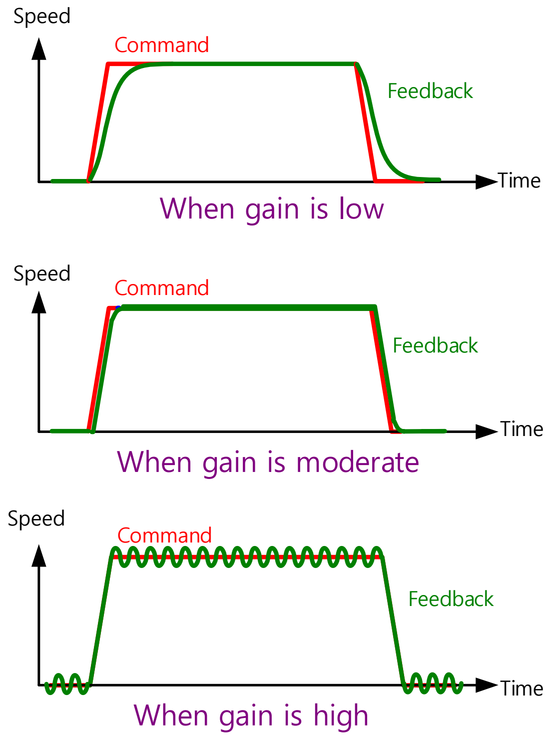


– The value and the responsiveness have an inverse proportion relationship where a higher value results in a lower responding speed.Too high of the integral gain increases the overshoot. In this case, P/PI conversion can manage the overshoot.

■ Position Controller Tuning



(1) Proportional gain setting



(2) The error between the position command and the current position is multiplied by the proportional gain, and the result is converted to a velocity command. The higher the gain, the better the responsiveness of position control. In many cases, a value that is 0.2~0.5 times of the speed proportional gain is applied for a stable structure.

(3) Feedforward setting

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

(4) Position command filter setting possible

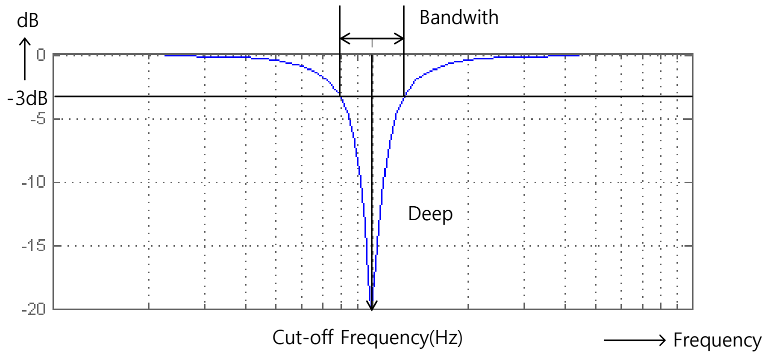
- You can smooth out the position command.

7.4 Vibration Control

7.4.1 Notch Filter

The notch filter is a sort of band stop filter that eliminates specific frequency components. You can use a notch filter to eliminate resonant frequency components of an apparatus, which allows vibration avoidance and higher gain setting.

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



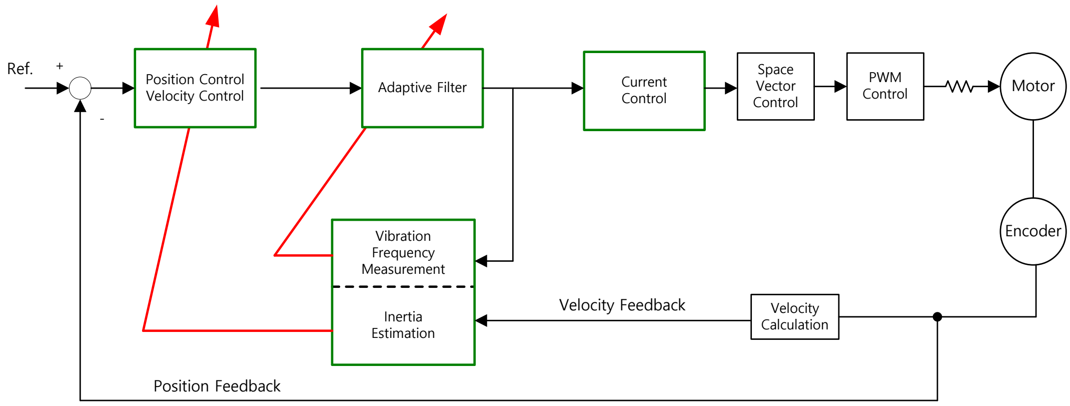
■ Related Objects

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 31 Frequency	UINT	RW	No	Hz
0x2508	-	Notch Filter 3 Width	UINT	RW	No	-
0x2509	-	Notch Filter 3 Depth	UINT	RW	No	-
0x250A	-	Notch Filter 4 Frequency	UINT	RW	No	Hz
0x250B	-	Notch Filter 4 Width	UINT	RW	No	-
0x250C	-	Notch Filter 4 Depth	UINT	RW	No	-

7.4.2 Adaptive Filter

Using speed feedback signals, the adaptive filter provides real-time analyses of the vibration frequency generated from the load during drive operation, and configures the notch filter automatically to reduce vibration.

It can detect vibration frequencies through frequency analysis in order to automatically configure one or two notch filters. Here, the frequencies and their widths are automatically set and the setting values for the depths are used unchanged.



■ Related Objects

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

- Adaptive Filter Function Select (0x2500)

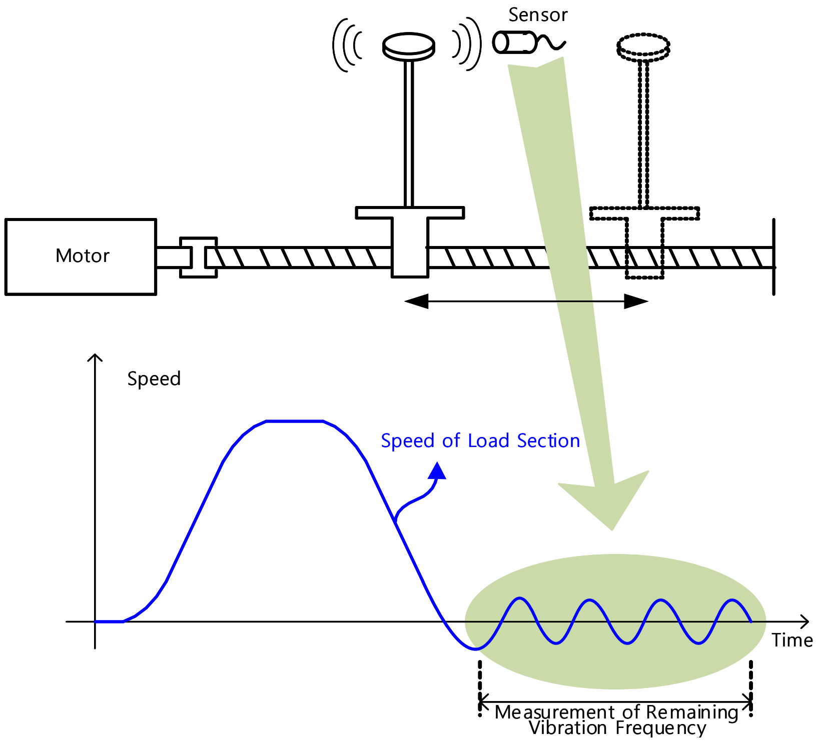
Setting Value	Setting details
0	The adaptive filter is not used
1	Only one adaptive filter is used. You can check the settings configured automatically in the notch filter 3 settings (0x2507, 0x2508, 0x2509). If an arbitrary value is set in notch filter 3, auto setting is not available. If you wish to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

7.4.3 Vibration Suppression Filter

The vibration suppression filter is a function used to reduce vibration generated in the load side.

It measures the vibration frequency in the load side using an external sensor, and uses the measurement as object data for the filter. This drive provides a vibration suppression filter in two levels, and you can set the frequency and damping amount for each filter.

It controls the lower frequency range, i.e. 1 [Hz]~100 [Hz], from the upper part of the device or the entire system, and operates only in the 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 Function Setting (0x2515)

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

8. Procedure Function

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

Procedure commands	Codes	Details
Manual JOG	0x0001	Operates manual JOG
Program JOG	0x0002	Operates program JOG
Alarm History Reset	0x0003	Deletes alarm history
Off-Line Auto-Tuning	0x0004	Performs off-line auto-tuning
Index Pulse Search	0x0005	Searches for Phase Z position
Absolute Encoder Reset	0x0006	Resets the absolute encoder
Max. Load Torque Clear	0x0007	Resets the instantaneous maximum operation overload (0x2604) value
Calibrate Phase Current Offset	0x0008	Tunes the phase current offset
Software Reset	0x0009	Resets the software
Commutation	0x000A	Performs commutation

8.1 Manual Jog Operation

Jog operation is a function that verifies servo motor operation by velocity control without an upper level controller.

Before you start jog operation, confirm the following.

- The main power is turned on
- The STO (Safe Torque Off) connector is connected;
- No alarm is active
- The servo is turned off
- The operation velocity is set in consideration of the state of the apparatus

■ Related Objects

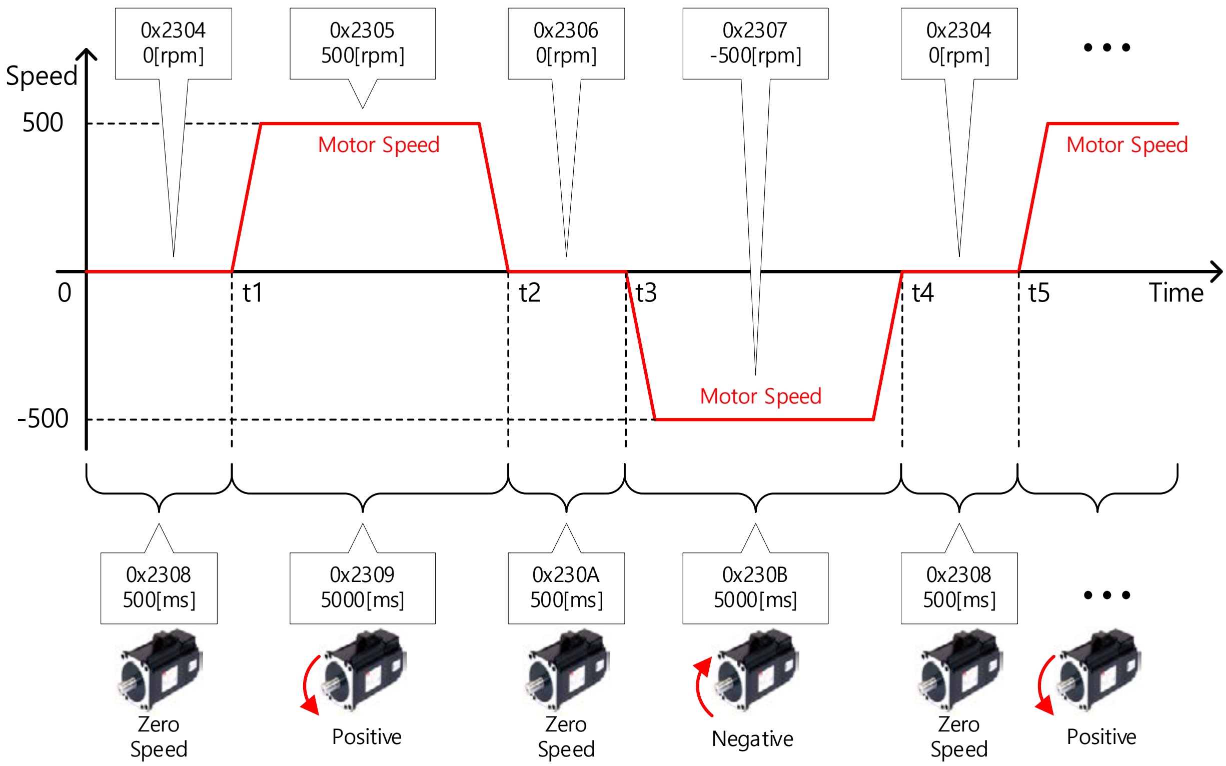
Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x2300	-	Jog Operation Speed	INT	RW	No	rpm
0x2301	-	Speed Command Acceleration Time	UINT	RW	No	ms
0x2302	-	Speed Command Deceleration Time	UINT	RW	No	ms
0x2303	-	Speed Command S-curve Time	UINT	RW	No	ms

8.2 Program Jog Operation

Program jog operation is a function that verifies servo motor operation by velocity control at predefined operation velocity and time without an upper level controller.

Before you start jog operation, confirm the following.

- The main power is turned on
- The STO (Safe Torque Off) connector is connected;
- No alarm is active
- The servo is turned off
- Velocity and time are set in consideration of the state and operation range of the apparatus



■ 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

8.3 Deleting Alarm History

This function deletes all the alarm code histories stored in the drive. Alarm histories including the latest alarm history up to the 16th previous alarm are stored.

You can check the histories as shown 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	-

8.4 Automatic Gain Tuning

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

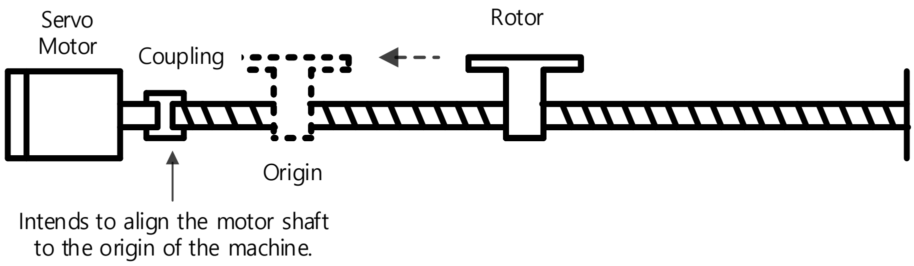
8.5 Index Pulse Search

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

You can set the velocity used to search for index pulses in 0x230C [rpm].

Before you start index pulse search, confirm the following.

- The main power is turned on
- No alarm is active
- The servo is turned off
- the Safe Torque Off (STO) connector is installed; and
- Operation velocity is set in consideration of the operation range of the machine.



■ Related Objects

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

8.6 Absolute Encoder Reset

This function resets the absolute encoder. The following are the situations where you need to reset the absolute encoder.

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

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

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

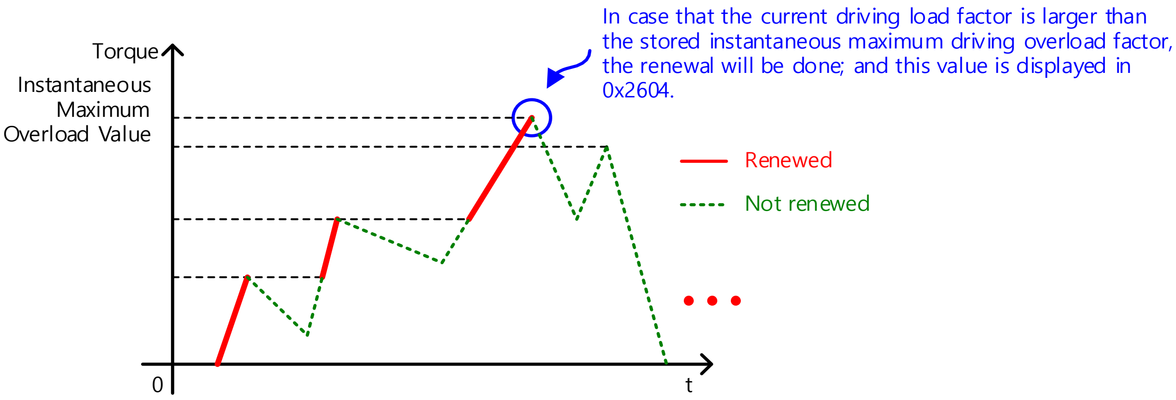
■ Related Objects

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

8.7 Instantaneous Maximum Torque Reset

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

It displays the peak load for the last 15 seconds as a percentage of the rated output. The unit is [0.1%]. Turning on the power again resets the value to 0.



■ Related Objects

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

8.8 Phase Current Offset Tuning

This function automatically tunes the current offset of the U/V/W phases. You can tune the phase current offset according to the environmental condition for use. The device is shipped with its factory default setting.

The measured U/V/W phase offsets are individually stored in 0x2015, 0x2016, and 0x2017. If an offset value is abnormally large, AL-15 is generated.

■ 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%

8.9 Software Reset

This function is used to reset the servo drive by means of software. Software reset means a restart of the drive program, which results in an effect similar to re-applying the power.

You can use this function in the following cases.

- Parameter settings which require re-application of the power have been changed
- The drive needs a re-start due to an alarm which cannot be reset

8.10 Commutation

The commutation function is to used get the information of the initial angle of the motor. When you use a motor with the 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

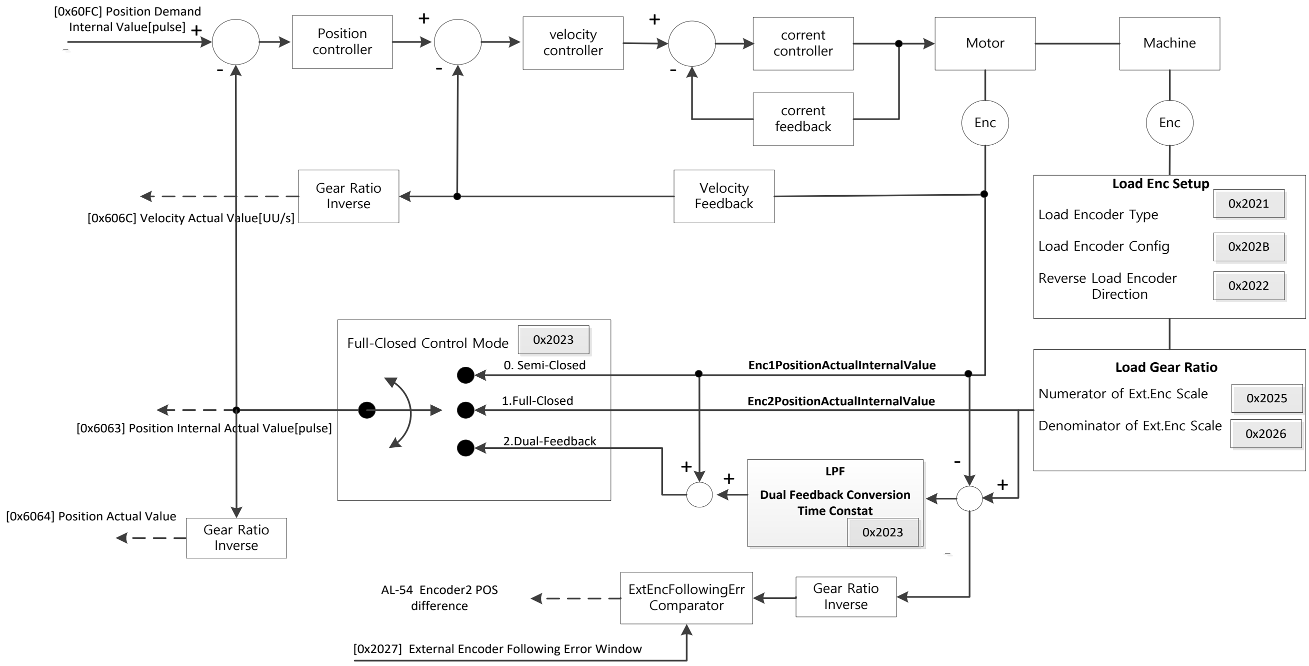
Index	Sub Index	Name	Variable Type	Accessibility	PDO Assignment	Unit
0x2019	-	Linear Scale Resolution	UINT	RW	No	nm
0x201A	-	Commutation Method	UINT	RW	No	-
0x201B	-	Commutation Current	UINT	RW	No	0.1%
0x201C	-	Commutation Time	UINT	RW	No	ms

9. Full-Closed Control

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

9.1 Full-Closed Control Internal Configuration

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



Function	Details	
Semi-Closed Control	It carries out position control based on the encoder information from the motor.	
	Advantages	Since it is rarely affected by the vibrations of the machine, you can raise the servo gain to shorten the adjustment time.
	Disadvantages	The machine's accuracy can be lowered due to the vibrations of the machine even when the motor is not running.
Full-Closed Control	It carries out position control based on information from the position sensor that is separately mounted on the machine.	
	Advantages	The machine's accuracy can be controlled regardless of whether the motor is running or is stationary.
	Disadvantages	Since it is easily affected by the vibrations of the machine, it cannot raise the servo gain too much and the adjustment time may take longer.
Dual-Feedback Control	It carries out position control using the position sensor information from either the motor or the machine. It has advantages when the sampling rate is low in the external encoder.	
	Advantages	It operates based on the position information from the motor while the motor is running and from the machine while the motor is stationary to raise the gain and shorten the adjustment time. It can stop the motor with the accuracy of the machine to improve control performance.
	Disadvantages	

9.2 Full-Closed Control Parameter Settings

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

A. Setting the full-closed control mode

0x2023	Full-Closed Control Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2	0	-	RW	No	Power cycling	Yes

This sets the full-closed control mode.

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

B. Setting the load encoder-type

0x2021	Load Encoder Type						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

This sets the second encoder type on the load side.

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

C. Entering load encoder information

0x202B	Load Encoder Configuration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 65535	13	-	RW	No	Power cycling	Yes

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

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

<table>
<tr><th>Bits</th><th>Description (if encoder type is quadrature)</th></tr>
<tr><td>3~0</td><td>Debounce filter settings
<table>
<tr><td>Settings</td><td>Cutoff Frequency</td></tr>
<tr><td>0</td><td>No Filter</td></tr>
<tr><td>1</td><td>5.000MHz</td></tr>
<tr><td>2</td><td>3.330MHz</td></tr>
<tr><td>3</td><td>2.500MHz</td></tr>
<tr><td>4</td><td>2.000MHz</td></tr>
<tr><td>5</td><td>1.667MHz</td></tr>
<tr><td>6</td><td>1.429MHz</td></tr>
<tr><td>7</td><td>1.250MHz</td></tr>
<tr><td>8</td><td>1.000MHz</td></tr>
<tr><td>9</td><td>0.833MHz</td></tr>
<tr><td>10</td><td>0.714MHz</td></tr>
</table></td></tr>
<tr><td>31~4</td><td>Reserved</td></tr>
</table>

Bits	Description (if encoder type is SSI)
0-7	Number of bits for data
8	Coding(0:binary, 1:gray)
9	Whether to ignore the first bit (0: one start bit, 1: two start bits)
10-11	Reserved
12-15	Clock rate (0:656.25kHz, 1:1.3125Mhz, 2:2.625Mhz)
16-31	Reserved

Setting example) Singleturn 24[bit] / Gray Code / One start bit / Using clock frequency : below 500[kHz]

Bits	Description (if encoder type is SSI)
0~7	24
8	1
9	0(one start bit)
10	0
11	0
12~15	0(656.25kHz)

D. Setting the load encoder direction

0x2022	Reverse Load Encoder Direction						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

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

Setting value	**Setting details**
0	Positive (CCW)
1	Negative (CW)

E. Motor encoder - setting the load encoder scale

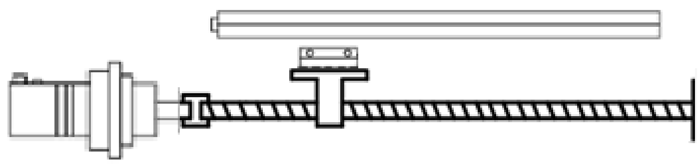
0x2025	Numerator of External Encoder Scale						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2147483647	0	-	RW	No	Power cycling	Yes

0x2026	Denominator of External Encoder Scale						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2147483647	0	-	RW	No	Power cycling	Yes

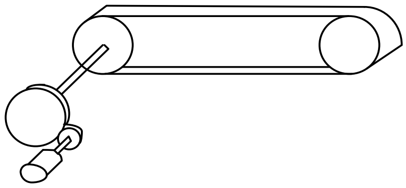
This sets the numerator/denominator scale for the external encoder to ensure the same scale as the motor encoder,

Examples of scale setting methods

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

2. Reducer structure	 - Reduction ratio: 1/10 - Ball screw lead: 20 mm - Linear encoder (external encoder): 4 um If the 1/10-ratio reducer is installed on the motor, the reducer shaft rotates 1/10 turns per motor rotation. So, the scale is calculated by multiplying the deceleration ratio with the number of external encoder pulses.
Motor encoder specifications	524288[pulse/rev]
Load movement amount/revolution	The movement of the table per rotation of the servo motor equipped with a 1/10 reducer is (1/10)*20 mm = 2 mm and the number of external encoder pulses is

	calculated as 2 mm / 4 um = 500 pulses.
Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses ● $500(\text{Number of external encoder pulses}) \times \frac{524288(\text{Numerator})}{500(\text{Denominator})} = 524288$(Number of motor encoder pulses)

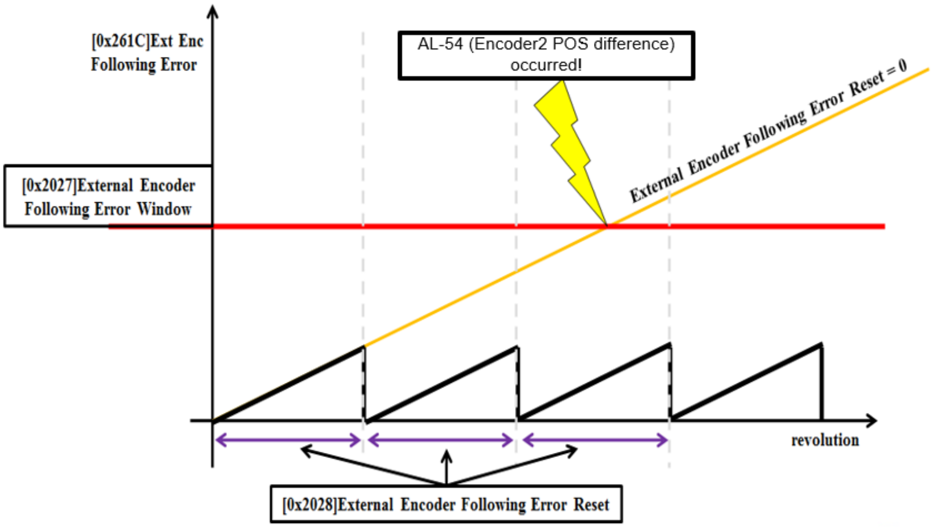
3. Belt-pulley structure	 - Motor-side pulley diameter: 30 mm - Rotary-side pulley diameter: 20 mm - External encoder resolution: 20000 pulse/rev In the case of a gear and belt-pulley system, the final gear ratio is calculated and the gear ratio is multiplied by the number of external encoder pulses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

F. Setting the load encoder position error level and initialization

0x2027	External Encoder Following Error Window						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 2147483647	100000	pulse	RW	No	Power cycling	Yes

0x2028	External Encoder Following Error Reset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 10000	10	Revolution	RW	No	Power cycling	Yes

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



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

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

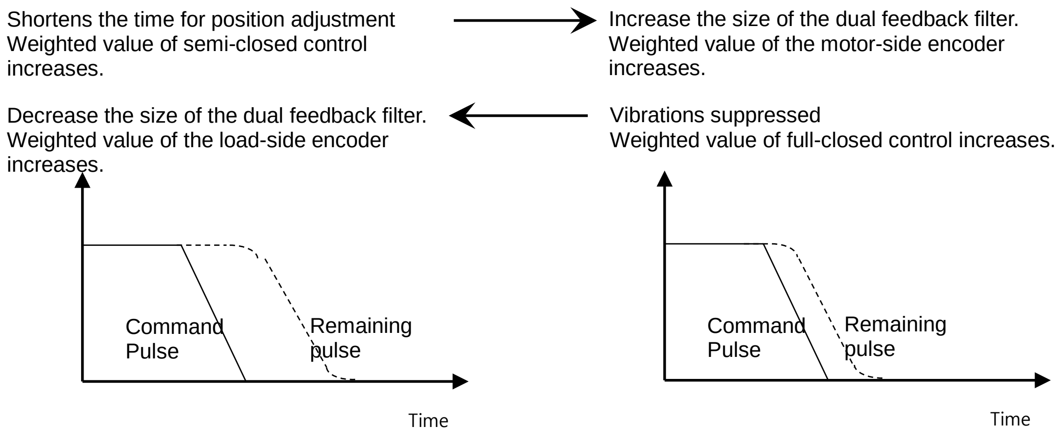
G. Setting the dual-feedback filter time constant

0x2024	Dual Feedback Conversion Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	0.1ms	RW	No	Always	Yes

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

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

Example of setting the dual-feedback filter time constant



H. Setting the dual-feedback filter time constant

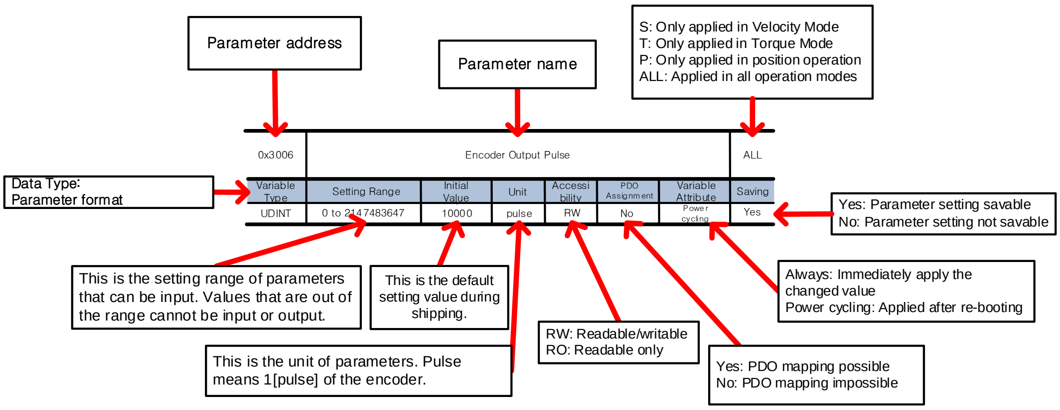
0x2029	Load Feedback Type						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

This setting determines that you can select linear type or rotary type in the load encoder type.

0 : Rotary / 1 : Linear

10. Object Dictionary

Object is a data structure which includes parameters, state variables, run commands (procedures), etc. of the 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 Data Type

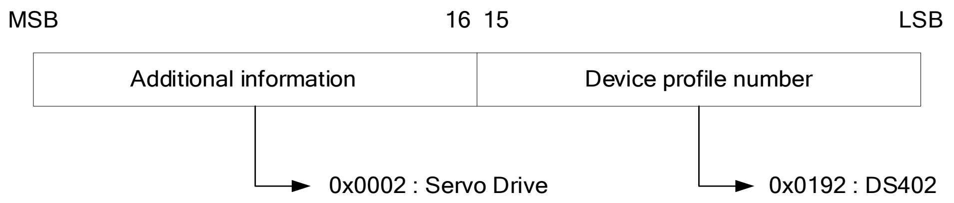
The following table outlines the data types and ranges used in this manual.

Codes	Description	Ranges
SINT	Signed 8-bit	-128 ~127
USINT	Unsigned 8-bit	0 ~ 255
INT	Signed 16-bit	-32768 ~ 32767
UINT	Unsigned 16-bit	0 ~ 65535
DINT	Signed 32-bit	-21247483648 ~ 21247483647
UDINT	Unsigned 32-bit	0 ~ 4294967295
FP32	Float 32-bit	Single precision floating point
STRING	String Value	

10.2 General Objects

0x1000	Device Type						
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0x00020192	-	RO	No	-	No

The following table lists device types and their functions.



0x1001	Error Register						
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	0x00	-	RO	No	-	No

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

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

0x1008	Device Name						
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No

Represents the device name.

0x1009	Hardware Version						
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No

Represents the hardware version of the device.

0x100A	Software Version						
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No

This parameter represents the software version of the device.

0x1010	Store Parameters						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	4	-	RO	No	-	No
SubIndex 1		Store all parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 2		Store communication parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 3		Store CiA402 parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 4		Store drive-specific parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No

Store the drive's parameters in 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 코드	0x65	0x76	0x61	0x73

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

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

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

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

0x1011	Restore Default Parameters						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	4	-	RO	No	-	No
SubIndex 1		Restore all parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 2		Restore communication parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 3		Restore CiA402 parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 4		Restore drive-specific parameters					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
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 코드	0x64	0x61	0x6F	0x6C

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

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

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

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

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

0x1018	Identity Object						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	4	-	RO	No	-	No
SubIndex 1		Vendor ID					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0x00007595	-	RO	No	-	No
SubIndex 2		Product Code					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0x00010001	-	RO	No	-	No
SubIndex 3		Revision Number					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	-	RO	No	-	No
SubIndex 4		Serial Number					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	-	RO	No	-	No

Represents the device information.

0x1600	1st Receive PDO Mapping						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving

UDINT	0 to 0xFFFFFFFF	0x60710010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x607A0020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60600008	-	RW	No	PREOP	Yes
SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

PDO Mapping :

Set 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. Set information about the objects below that you want to assign to entries1 to 10 (SubIndex 1 - 10). You have to set the number of the objects to be assigned for the number of entries (SubIndex 0).

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

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

Bits 8-15: SubIndex of objects to be mapped

Bits 16-31: Index of objects to be mapped

0x1601	2nd Receive PDO Mapping						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x607A0020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping Entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes

SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1602	3rd Receive PDO Mapping						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable	Setting Range	Initial Value	Unit	Accessibil	PDO	Variable	Saving

Type				ity	Assignment	Attribute	
UDINT	0 to 0xFFFFFFFF	0x60FF0020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping Entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1603	4th Receive PDO Mapping

SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60710010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping Entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					

Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A00	1st Transmit PDO Mapping						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	10	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60770010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping Entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60F40020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving

UDINT	0 to 0xFFFFFFFF	0x60610008	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x26010010	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x26000010	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A01	2nd Transmit PDO Mapping						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	6	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping Entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60F40020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					

Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A02	3rd Transmit PDO Mapping						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving

UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping Entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1A03	4th Transmit PDO Mapping						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping Entry 1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping Entry 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping Entry 3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping Entry 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping Entry 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping Entry 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping Entry 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping Entry 8					
Variable	Setting Range	Initial Value	Unit	Accessibil	PDO	Variable	Saving

Type				ity	Assignment	Attribute	
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping Entry 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping Entry 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1C00	Sync Manager Communication Type						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	4	-	RO	No	-	No
SubIndex 1		Communication Type SM0					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	1	-	RO	No	-	No
SubIndex 2		Communication Type SM1					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	2	-	RO	No	-	No
SubIndex 3		Communication Type SM2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	3	-	RO	No	-	No
SubIndex 4		Communication Type SM3					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	4	-	RO	No	-	No

It represents the Sync Manager Communication Type assigned by default.

0x1C10	Sync Manager 0 PDO Assignment						
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	0	-	RO	No	-	No

0x1C11	Sync Manager 1 PDO Assignment						
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	0	-	RO	No	-	No

0x1C12	Sync Manager 2 PDO Assignment						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of objects assigned to PDO					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0x1600 to 0x1603	0x1601	-	RW	No	PREOP	No

0x1C13	Sync Manager 3 PDO Assignment						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	1	-	RW	No	-	No
SubIndex 1		Index of objects assigned to PDO					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0x1A00 to 0x1A03	0x1A01	-	RW	No	PREOP	No

0x1C32	Output Sync Manager Parameter						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving

UDINT	-	0	ns	RO	No	-	No
SubIndex 11		Cycle exceeded counter					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	-	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
BOOL	-	0	-	RO	No	-	No

0x1C33	Input Sync Manager Parameter						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					

Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	ns	RO	No	-	No
Subindex 11		Cycle exceeded counter					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	-	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
BOOL	-	0	-	RO	No	-	No

10.3 Manufacturer Specific Objects

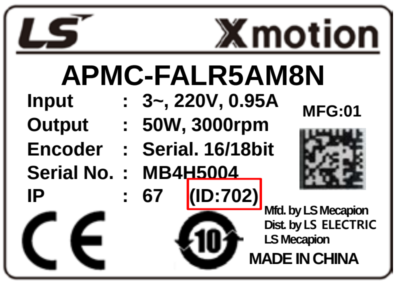
● Basic Setting(0x2000~)

0x2000	Motor ID						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 9999	13	-	RW	No	Power cycling	Yes

This is a parameter for resetting the motor ID. The company supplies a motor with a default ID and ID input is also possible.

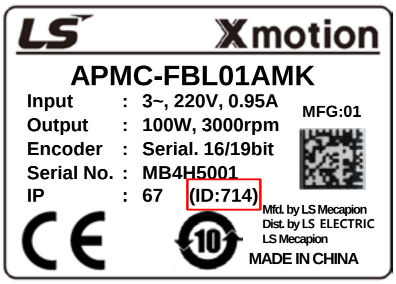
Encoder Types	Motor ID Input Method
Incremental	Direct Input
Absolute Singleturn	Automatic Recognition
Absolute Multiturn	Automatic Recognition

For a motor supplied by the company, you can enable automatic recognition or input a motor ID into the parameter. Motor IDs are provided on the sticker attached on a side of the motor.



Absolute Multiturn
(18Bit Singleturn / 16Bit Multiturn)

Absolute Singleturn
(19Bit Singleturn)



Absolute Multiturn
(19Bit singleturn / 16Bit Multiturn)

Incremental
(3000[ppr] Incremental)

Keep in mind that you need power cycling after ID registration. When connecting a motor of another brand, you have to input 9999 and make the setting to 3rd party.

0x2001	Encoder Type						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 99	2	-	RW	No	Power cycling	Yes

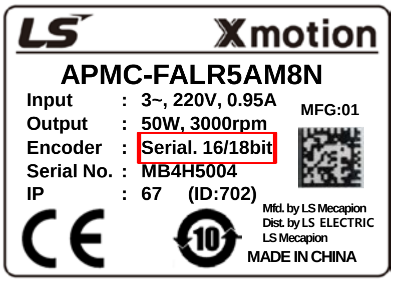
You can set the encoder type. Set it correctly by referencing the table below. However, the multi-turn encoder provided by our company (4 in the table below) is automatically recognized and configured regardless of these settings. You can view the type of the encoder automatically recognized.

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

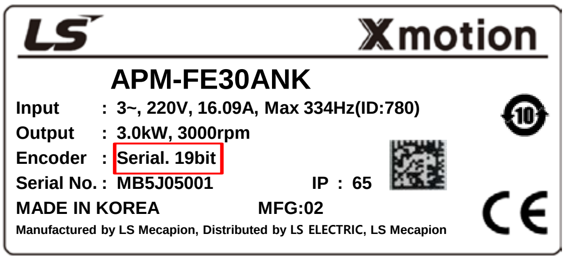
You can view the encoder type on the name plate attached on the motor. Refer to Section 1.2, “Product Specifications” for the product type of the servo motor.

0x2002	Encoder Pulse per Revolution						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 1073741824	524288	pulse	RW	No	Power cycling	Yes

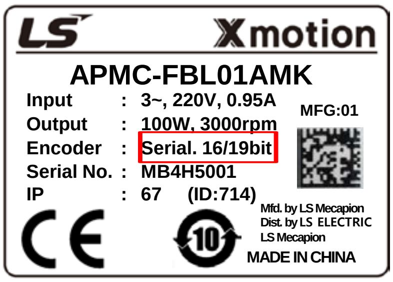
This is a parameter for setting the resolution of the encoder. Set the encoder resolution in the unit of pulse (count) and in multiples of 4. The absolute encoder and single-turn encoder provided by the company recognize the values automatically. However, for the incremental encoder, you need to input the values yourself.



Absolute Multiturn
(18Bit Singleturn / 16Bit Multiturn)



Absolute Singleturn
(19Bit Singleturn)



Absolute Multiturn
(19Bit singleturn / 16Bit Multiturn)

Incremental
(3000[ppr] Incremental)

The encoder resolution values are provided on the sticker on a side of the motor. Refer to the figures above.

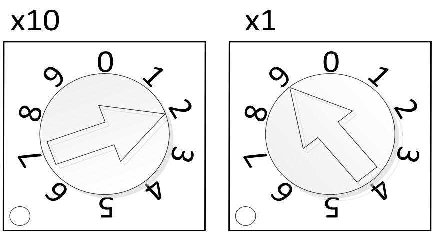
E.g. Setting for each encoder marking on the motor product nameplate

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

0x2003	Node ID						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 99	-	-	RO	No	-	No

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

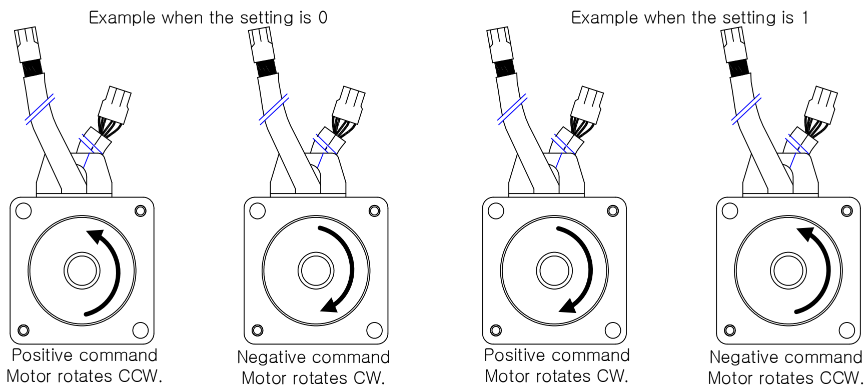
E.g. When the node ID is set to 29



0x2004	Rotation Direction Select						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

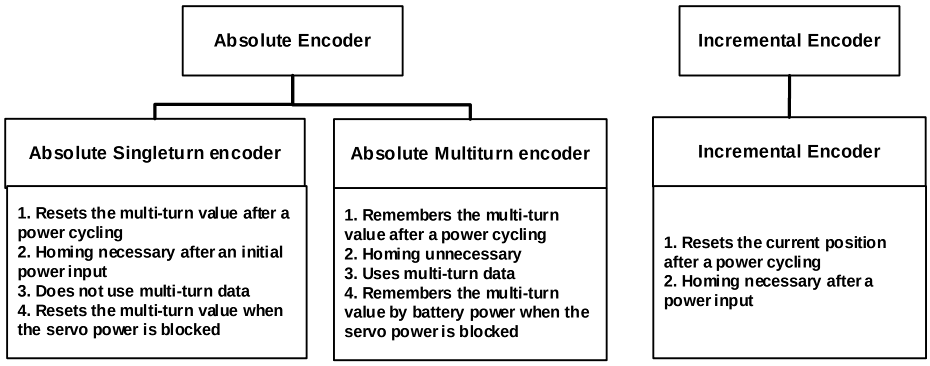
You can set the rotation direction of the motor. You can change the rotation direction with this setting between the positive and negative relative to the user in the final apparatus section.

Setting Value	Description
0	With a command for the positive direction, the motor rotates counterclockwise. Here, the position feedback value increases.
1	With a command for the positive direction, the motor rotates clockwise. Here, the position feedback value increases.



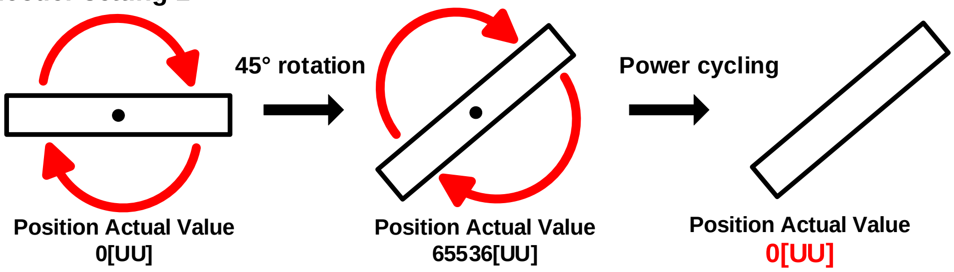
0x2005	Absolute Encoder Configuration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	1	-	RW	No	Power cycling	Yes

This is parameter for deciding whether or not to use multi-turn data when using the absolute multi-turn encoder.

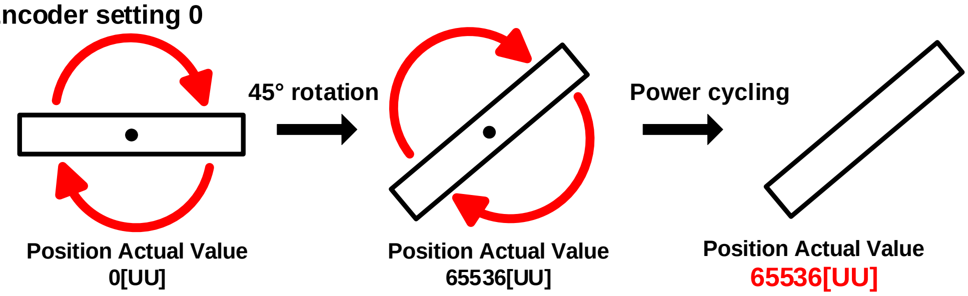


Setting Value	Description
0	Uses the absolute encoder as the absolute encoder. Uses the multi-turn data.
1	Uses the absolute encoder as the incremental encoder. Does not use the multi-turn data. Does not display any battery-related alarm/warning.

For Absolute Single-Turn Encoder setting 1



For Absolute Single-Turn Encoder setting 0



0x2006	Main Power Fail Check Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 255	0	-	RW	No	Always	Yes

You can set the main power input mode and the processing method for phase loss.

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

0x2007	Main Power Fail Check Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	20	ms	RW	No	Always	Yes

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

0x2008	7SEG Display Selection						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 100	0	-	RW	Yes	Always	Yes

You can set items to display in the 7SEG window.

Setting	Displayed Items	Unit	Description
0	Operation Status	-	
1	Speed feedback	rpm, mm/s	
2	Speed command	rpm, mm/s	
3	Torque feedback	0.1%	
4	Torque command	0.1%	
5	Accumulated operation overload	0.1%	
6	DC link voltage	V	
7	Accumulated regeneration overload	0.1%	
8	Mechanical Angle	0.1deg	
9	Electrical Angle	0.1deg	
10	Inertia ratio	%	
11	Drive temperature 1	°C	Temperature near drive power element
12	Drive temperature 2	°C	Internal temperature of the drive
13	Encoder temperature 1	°C	Internal temperature of the encoder
14	Node ID	-	
15	Instantaneous Maximum Load Factor	0.1%	Instantaneous maximum load factor for 15 seconds
16	Root Mean Square (RMS) Load Factor	0.1%	Root mean square (RMS) load factor for 15 seconds

0x2009	Regeneration Brake Resistor Configuration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Always	Yes

You can make settings related to regeneration brake resistor.

Setting Value	Description
0	Use the regeneration brake resistor installed in the drive.
1	Use the regeneration brake resistor separately installed outside the drive. Set the regeneration resistor value (0x200B) and capacity (0x200C) correctly. * Notes Power supply wiring (2.4)

0x200A	Regeneration Brake Resistor Derating Factor						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 200	100	%	RW	No	Always	Yes

You can set the derating factor for regeneration brake resistor overload checkups. When the derating factor is set to a value of 100 [%] or lower, the regeneration overload alarm (AL-23) is triggered quickly. When it is set to a value higher than 100 [%], the alarm is triggered slowly. Change the setting values according to the heat radiation condition of the regeneration brake resistor used. You must consider the heat radiation condition with more care when you set the derating factor to a value higher than 100%.

.0x200B	Regeneration Brake Resistor Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	ohm	RW	No	Always	Yes

When you use an external regeneration brake resistor (0x2009=1), set the regeneration brake resistor value in the unit of ohm. When you use an internal regeneration brake resistor (0x2009= 0), the setting value does not apply.

0x200C	Regeneration Brake Resistor Power						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 30000	0	watt	RW	No	Always	Yes

When you use an external regeneration brake resistor (0x2009=1), set the regeneration brake resistor capacity in the unit of watt. When you use an internal regeneration brake resistor (0x2009= 0), the setting value does not apply.

0x200D	Peak Power of Regeneration Brake Resistor						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 50000	100	watt	RW	No	Always	Yes

When you use an external regeneration brake resistor (0x2009=1), set the maximum allowable capacity of the regeneration brake resistor in the unit of watt. When you use an internal regeneration brake resistor (0x2009= 0),

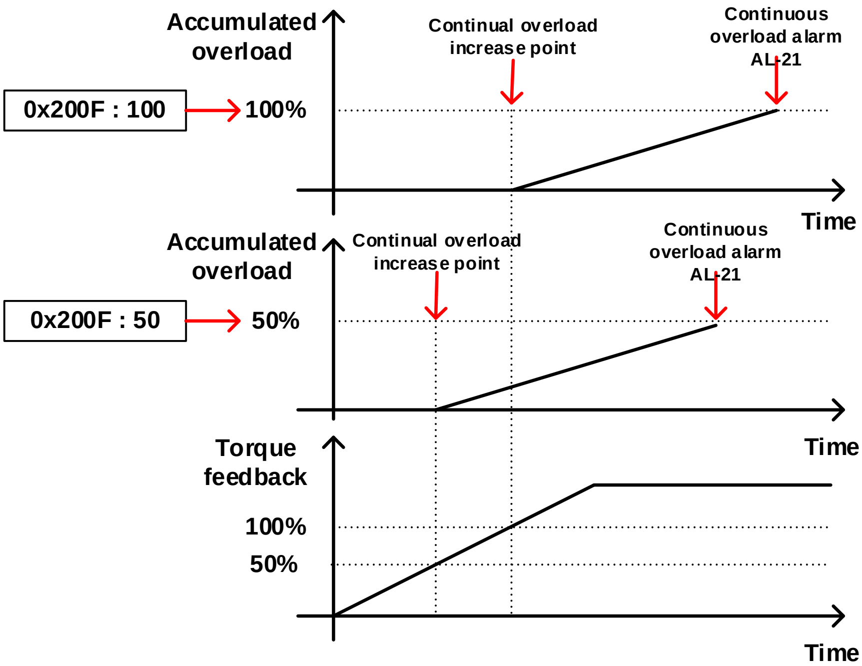
the setting value does not apply.

0x200E	Duration Time @ Peak Power of Regeneration Brake Resistor						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 50000	5000	ms	RW	No	Always	Yes

When you use an external regeneration brake resistor (0x2009=1), set the allowed time at the maximum regeneration brake resistor capacity (0x200D) in watt. When you use an internal regeneration brake resistor (0x2009= 0), the setting value does not apply.

0x200F	Overload Check Base						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	10 to 120	100	%	RW	No	Always	Yes

This is a parameter for adjusting the load factor for accumulation of continuous accumulated overload.

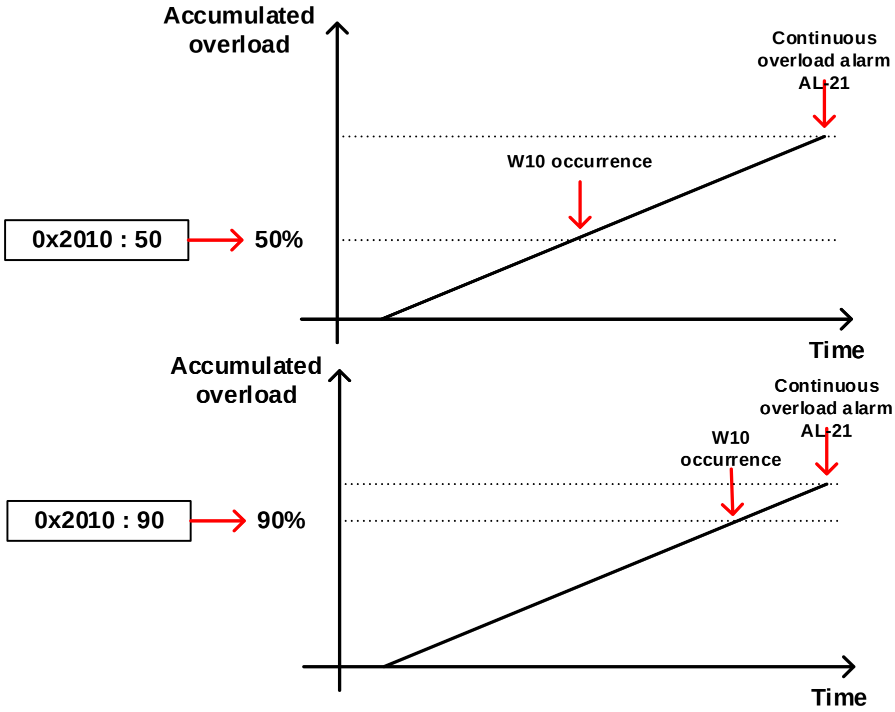


The default value is 100. If torque feedback exceeds 100 [%], accumulated overload keeps accumulating, causing an occurrence of the continuous overload alarm (AL-21). If you set the parameter value to 50 and 100, accumulated overload is activated when torque feedback exceeds 50 [%] and 100 [%], respectively. Therefore, for any given time period, the setting with 50 causes accumulation quicker than one with 100, causing AL-21 to occur earlier.

If the heat radiation condition of the drive is poor, set the value to be 100% or lower to trigger an overload alarm more quickly.

0x2010	Overload Warning Level						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	10 to 100	50	%	RW	No	Always	Yes

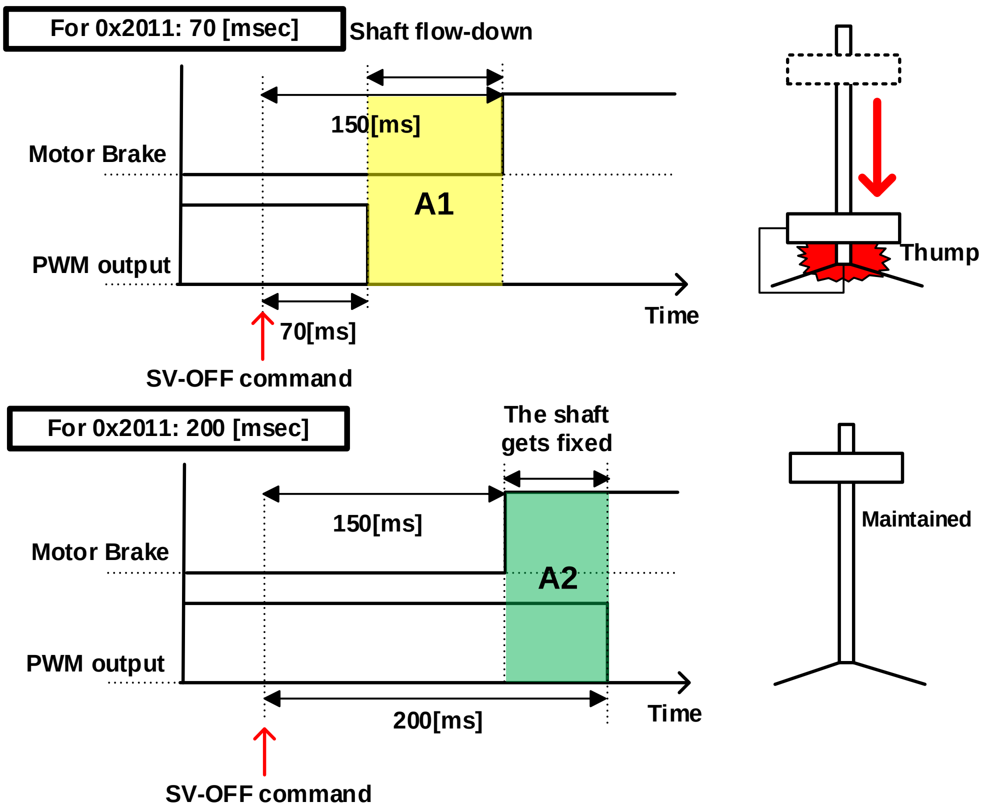
This is a parameter for adjusting the output level of the accumulated operation overload warning (W10). When the accumulated operation overload rate (0x2603) reaches the set value, a warning is output. With this setting, you can find out the time point when you need to take an appropriate action before an accumulated operation overload alarm occurs.



For example, when you input 50, W10 starts to occur at the point when accumulated overload becomes 50 [%]. If you input 90, it starts to occur at the 90 [%] mark. If accumulated overload becomes 100%, W10 is changed into AL-21.

0x2011	PWM Off Delay Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	10	ms	RW	No	Always	Yes

You can set the delay time until PWM is actually turned off after the servo off command. When you use a motor with a brake installed on the vertical axis, you can make the brake signal output to come out first then PWM be turned off after the set time, in order to prevent the axis from flowing down vertically.

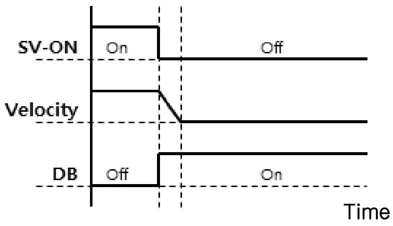


For example, assume that you have set the brake to operate 150 [msec] after a servo off command during operation of a motor with a brake installed on its vertical axis. If you set the parameter to 50 [msec], PWM is turned off in 50 [msec] after a servo off command, causing A1 to occur in which the brake cannot be held. In this case, the axis flows down because of gravity. However, if you set the parameter to 200 [msec], an overlapped section (green) appears in which PWM is output for 50 [msec] and the brake can be held, which can maintain the vertical axis.

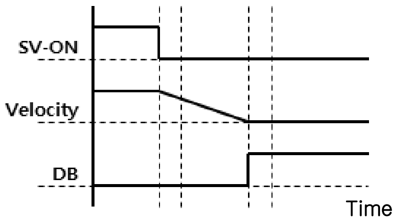
0x2012	Dynamic Brake Control Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 3	0	-	RW	No	Always	Yes

You can set the control mode of the dynamic brake in servo off.

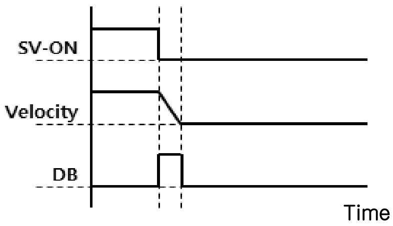
Setting Value	Description
0	Hold the dynamic brake after stopping the motor using the brake
1	Release the dynamic brake after stopping the motor using the brake
2	Release the dynamic brake after free-run stop
3	Hold the dynamic brake after free-run stop



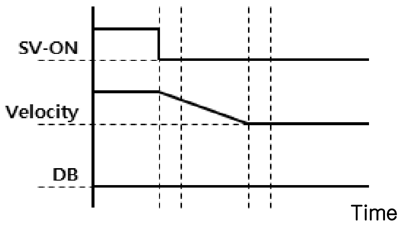
Hold after a DB stop



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 Assignment	Variable Attribute	Saving
UINT	0 to 1	1	-	RW	No	Always	Yes

You can set the method of emergency stop (for POT, NOT, or ESTOP input). In torque control mode, the deceleration stop mode which uses emergency stop torque is not applied.

Setting Value	Description
0	The motor stops according to the method set in Dynamic Brake Control Mode (0x2012). It stops using the dynamic brake and maintains the torque command at 0.
1	The motor decelerates to a stop using the emergency stop torque (0x2113).

0x2014	Warning Mask Configuration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to $FFFF_{hex}$	0	-	RW	Yes	Always	Yes

Warnings masked by this setting are not triggered.

Bits	Warning Codes	Warning name/description
0	W01	Main power phase loss
1	W02	Low voltage of encoder battery
2	W04	Software position limit
3	-	-
4	W10	Operation overload
5	W20	Abnormal combination of drive and motor, abnormal I/O setting
6	W40	Low voltage
7	W80	Emergency signal input
8 to 13	-	-
14	AL-34	Encoder phase Z loss alarm mask
15	STO	Status word fault bit setting when STO is not connected

0x2015	U Phase Current Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-1000 to 1000	0	0.1%	RW	No	Always	Yes

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

0x2016	V Phase Current Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-1000 to 1000	0	0.1%	RW	No	Always	Yes

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

0x2017	W Phase Current Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-1000 to 1000	0	0.1%	RW	No	Always	Yes

Manually set the W phase current offset. The set offset value is subtracted from the measured current value, then applied as an actual current value. Do not manually set the offset if you do not know the exact setting value. You can view the automatically-tuned value if you tune the current offset through the procedure function (Refer to the description of 0x2700). For a drive with a small to medium capacity (7.5KW or lower), this parameter is not used since the W phase current is not separately measured.

0x2018	Magnetic Pole Pitch						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 65535	2400	.01mm	RW	No	Power cycling	Yes

You can set the pitch between the magnetic poles of the linear motor. Pole pitch refers to the distance between the north poles or the south poles of magnets, which corresponds to an electrical angle of 360˚.

0x2019	Linear Scale Resolution						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 65535	1000	nm	RW	No	Power cycling	Yes

You can set linear scale resolution in the unit of nm. For a linear scale with a resolution of 1um, set it to 1000 (= 1um/1nm).

0x201A	Commutation Method						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2	0	-	RW	No	Power cycling	Yes

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

Setting Value	Description
0	Separate commutation is unnecessary or it carries out commutation using a hall sensor
1	Carries out commutation when the servo is turned on for the first time
2	Reserved

0x201B	Commutation Current						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	500	0.1%	RW	No	Always	Yes

You can set the commutation current used to get information on the initial angle of the motor.

0x201C	Commutation Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	500 to 5000	1000	ms	RW	No	Always	Yes

You can set the commutation time used to get information on the initial angle of the motor.

0x201D	Grating Period of Sinusoidal Encoder						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 65535	40	um	RW	No	Power cycling	Yes

You can set the grating period of sinusoidal encoder.

0x201E	Homing Done Behaviour						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Always	Yes

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

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

0x201F	Velocity Function Select						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2	0	-	RW	No	Always	Yes

You can select the calculation method of feedback speed when the encoder type is Quadrature.

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

0x2020	Motor and Hall Phase Correction						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 65535	0	-	RW	No	Power cycling	Yes

For a 3rd party motor, you can set the motor's rotation direction, the polarity of the hall sensor signal, and the sequence of the hall sensor's UVW by examining wiring of the motor and the hall sensor.

Bits	Description
0	Sets the motor's rotation direction (computation of the 0x2004 setting value and Exclusive OR possible)
1~7	Reserved
8	Reverses Hall U polarity
9	Reverses Hall V polarity
10	Reverses Hall W polarity
11	Reserved
12	Replaces Hall U, Hall V
13	Replaces Hall V, Hall W
14	Replaces Hall W, Hall U
15	Reserved

0x2021	Load Encoder Type						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 100	0	-	RW	No	Power cycling	Yes

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

Setting Value	**Encoder Types**
0	Not selected
1	Quadrature, Port A
2	Quadrature, Port B

0x2022	Reverse Load Encoder Direction						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

Set the direction of the second encoder on the load side.

Setting value	Setting details
0	Increase position value in the positive direction.
1	Increase position value in the negative direction.

0x2023	Full-Closed Control Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2	0	-	RW	No	Power cycling	Yes

Set the full-closed control mode.

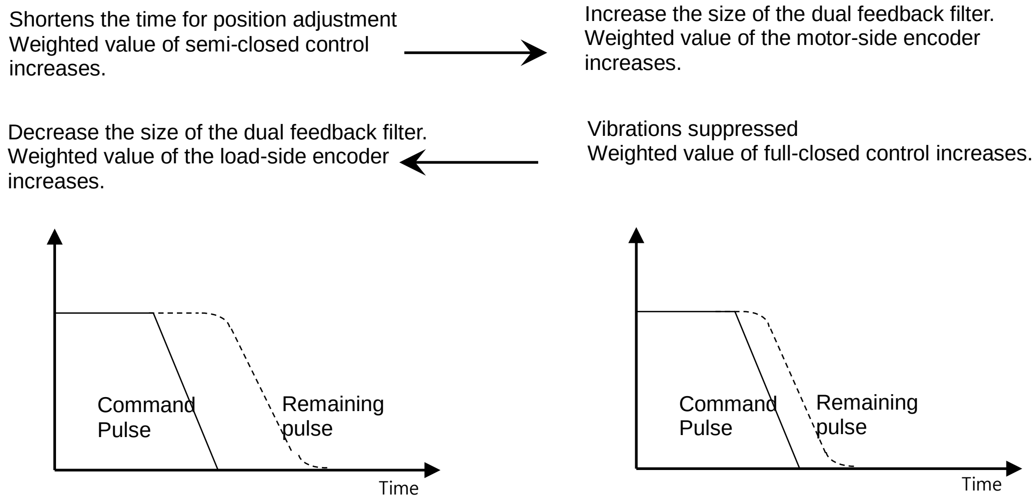
Setting value	Setting details
0	Semi-Closed Control (controls using only the motor-side encoder, default value)
1	Full-Closed Control (controls using the load-side encoder)
2	Dual-Feedback Control (controls using both the motor-side and load-side encoders)

0x2024	Dual Feedback Conversion Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	0.1ms	RW	No	Servo OFF	Yes

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

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

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



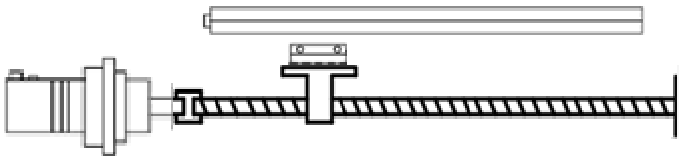
0x2025	Numerator of Load Encoder Scale						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2147483647	1	-	RW	No	Power cycling	Yes

0x2026	Denominator of Load Encoder Scale						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2147483647	1	-	RW	No	Power cycling	Yes

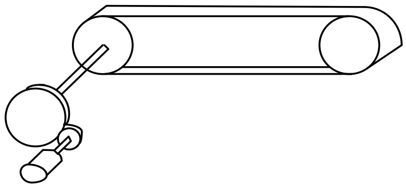
Set the numerator/denominator scale for the load encoder to ensure the same scale with the motor encoder,

Examples of scale setting methods

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

2. Reducer structure	 - Reduction ratio: 1/10 - Ball screw lead: 20 mm - Linear encoder (external encoder): 4 um If the 1/10-ratio reducer is installed on the motor, the reducer shaft rotates 1/10 turns per motor rotation. So, the scale is calculated by multiplying the deceleration ratio with the number of external encoder pulses.
Motor encoder specifications	524288[pulse/rev]
Load movement amount/revolution	The movement of the table per rotation of the servo motor equipped with a 1/10 reducer is

	(1/10) * 20 mm = 2 mm. The number of external encoder pulses is calculated as 2 mm / 4 um = 500 pulses.
Gear ratio setting	Number of external encoder pulses x (numerator / denominator) = Number of motor encoder pulses • $500(\text{Number of external encoder pulses}) \times \frac{524288(\text{numerator})}{500(\text{denominator})} =$ 524288(Number of motor encoder pulses)

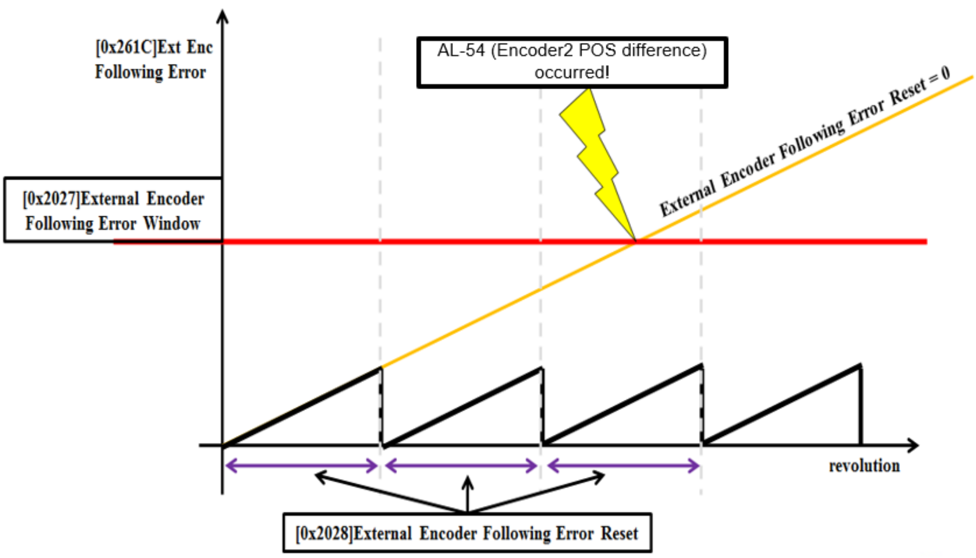
3. Belt-pulley structure	 - Motor-side pulley diameter: 30 mm - Rotary-side pulley diameter: 20 mm - External encoder resolution: 20000 pulse/rev In the case of a gear and belt-pulley system, the final gear ratio is calculated and the gear ratio is multiplied by the number of external encoder pulses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

0x2027	Load Encoder Following Error Window						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignm	Variable Attribute	Saving

					ent		
UDINT	0 to 2147483647	100000	pulse	RW	No	Always	Yes

0x2028	Load Encoder Following Error Reset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 10000	10	Rev	RW	No	Always	Yes

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



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

0x2029	External Encoder Z found						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving

UINT	0 to 1	0	-	RW	No	Power cycling	Yes

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

0x202B	Load Encoder Configuration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving

UDINT	0x0 to 0xFFFFFFFF	0	-	RW	No	Power cycling	Yes

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

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

* Debounce filter settings

Setting Value	Cutoff frequency	Setting Value	Cutoff frequency
0	No Filter	6	1.4[MHz]
1	5[MHz]	7	1.25[MHz]
2	3[MHz]	8	1.25[MHz]
3	2.5[MHz]	9	0.8[MHz]
4	2[MHz]	10	0.7[MHz]
5	1.6[MHz]	-	-

Bits	Description (if encoder type is SSI)
0-7	Number of bits for data
8	Coding(0:binary, 1:gray)
9	Whether to ignore the first bit (0: one start bit, 1: two start bits)
10-11	Reserved
12-15	Clock rate (0:656.25kHz, 1:1.3125Mhz, 2:2.625Mhz)
16-31	Reserved

Setting example) Singleturn 24[bit] / Gray Code / One start bit / Using clock frequency : below 500[kHz]

Bits	Description (if encoder type is SSI)
0~7	24
8	1
9	0(one start bit)
10	0
11	0
12~15	0(656.25kHz)

0x202C	Lines per Revolution of Sinusoidal Encoder						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignm	Variable Attribute	Saving

					ent		
UDINT	0-65535	1000	-	RW	No	Power cycling	Yes

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

0x202D	FIR Filter Window of Speed Feedback						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 8	0	-	RW	No	Power cycling	Yes

This sets the degree of FIR filter for speed feedback.

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

Gain Adjustment(0x2100~)

0x2100	Inertia Ratio						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 3000	100	%	RW	No	Always	Yes

You can set the ratio of load inertia to the motor's rotor inertia in %.

Inertia ratio= load inertia/motor's rotor inertia x 100

This inertia ratio setting is an important control parameter for operation of the servo. Therefore it is crucial to set the inertia ratio accurately for optimal servo operation. You can estimate the inertia ratio value by automatic gain tuning. The ratio is continuously estimated during operation if you carry out On-line gain tuning.

0x2101	Position Loop Gain 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 500	50	1/s	RW	Yes	Always	Yes

You can set the overall responsiveness of the position controller. The larger the setting value is, the higher the responsiveness is. Too large setting value may cause vibration depending on the load.

0x2102	Speed Loop Gain 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 2000	75	Hz	RW	Yes	Always	Yes

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

0x2103	Speed Loop Integral Time Constant 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 1000	50	ms	RW	Yes	Always	Yes

You can set integral time constant of the velocity controller. If you set it to a large value, error is reduced in the steady state (stopped or driving at a constant velocity), but vibration may occur at a transitional state (while accelerating or decelerating).

0x2104	Torque Command Filter Time Constant 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	5	0.1ms	RW	Yes	Always	Yes

You can apply a low pass filter for torque command. You can improve the system's stability by setting an appropriate value to smoothen the torque command. If you set the value to be too large, the delay for the torque command is extended, reducing the system responsiveness.

0x2105	Position Loop Gain 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 500	30	/s	RW	Yes	Always	Yes

You can set position loop gain used as Gain Group 2 for gain conversion. For more information, refer to the description of position loop gain 1 (0x2101).

0x2106	Speed Loop Gain 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 2000	50	Hz	RW	Yes	Always	Yes

You can set Speed Loop Gain used as Gain Group 2 for gain conversion. For more information, refer to the description of the Speed Loop Gain 1 (0x2102).

0x2107	Speed Loop Integral Time Constant 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 1000	50	ms	RW	Yes	Always	Yes

You can set the Speed Loop Integral Time Constant used as Gain Group 2 for gain conversion. For more information, refer to the description of Speed Loop Integral Time Constant 1 (0x2103).

0x2108	Torque Command Filter Time Constant 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	0.1ms	RW	Yes	Always	Yes

You can set time constant of the torque command filter time constant used as Gain Group 2 for gain conversion. For more information, refer to the description of torque command filter time constant 1 (0x2104).

0x2109	Position Command Filter Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	0	0.1ms	RW	Yes	Always	Yes

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

0x210A	Position Command Average Filter Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	0	0.1ms	RW	Yes	Always	Yes

You can apply a movement average filter for position command to smoothen the position command. The value of Position Command Filter Time Constant (0x2109) is first applied. Position Command Average Filter Time Constant (0x210A) is only applied if the value is 0.

0x210B	Speed Feedback Filter Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	5	0.1ms	RW	Yes	Always	Yes

You can apply a low pass filter to the speed feedback signal calculated in the encoder. When system vibration occurs or vibration occurs due to a gain load with an excessive inertia is applied, you can suppress vibration by setting an appropriate value.

0x210C	Velocity Feed-forward Gain						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 100	0	%	RW	Yes	Always	Yes

You can set feedforward gain for the velocity command during position control. The larger the setting value is, the lower the following error is. If you set too large a value for the load, vibration or an overshoot may occur. For gain tuning, increase the setting value gradually.

0x210D	Velocity Feed-forward Filter Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	10	0.1ms	RW	Yes	Always	Yes

You can apply a low pass filter to the compensation amount added to the speed command by velocity feed-forward gain. You can enhance the system’s stability by using it when you have set a large velocity feed-forward gain or when there is an excessive change in position command.

0x210E	Torque Feed-forward Gain						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 100	0	%	RW	Yes	Always	Yes

You can set feed-forward gain for the torque command during velocity control.

0x210F	Torque Feed-forward Filter Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	10	0.1ms	RW	Yes	Always	Yes

You can apply a low pass filter to the compensation amount added to the torque command by torque feed-forward gain.

0x2110	Torque Limit Function Select						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 4	2	-	RW	Yes	Always	Yes

You can set the function used to limit output torque of the drive.

Setting Value	Description
0	Limits the torque using positive/negative torque limit values according to the driving direction; the maximum value is limited by the maximum torque (0x6072). - Positive: 0x60E0, Negative: 0x60E1
1	Limits the torque by the maximum torque (0x6072) only regardless of the driving direction.
2	Limits the torque value using external positive/negative torque limits according to the driving direction - Positive: 0x2111, Negative: 0x2112
3	Limits the torque value using internal and external torque limits according to the driving direction and the torque limit signal - Positive: 0x60E0 (if P_CL signal is not input), 0x2111 (if P_CL signal is input) - Negative: 0x60E1 (if N_CL signal is not input), 0x2112 (if N_CL signal is input)

0x2111	External Positive Torque Limit Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

You can set the external positive torque limit value according to the torque limit function select (0x2110).

0x2112	External Negative Torque Limit Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

You can set the external negative torque limit value according to the torque limit function select (0x2110).

0x2113	Emergency Stop Torque						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	1000	0.1%	RW	Yes	Always	Yes

You can set torque stop during emergency stop (POT, NOT, ESTOP input).

0x2114	P/PI Control Conversion Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 4	0	-	RW	Yes	Always	Yes

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

Setting Value	Setting details
0	Always use PI control
1	Switches to P control if the command torque is larger than the P control switch torque (0x2115)
2	Switches to P control if the command speed is larger than the P control switch speed (0x2116)
3	Switches to P control if the acceleration command is larger than the P control switch acceleration (0x2117)
4	Switches to P control if the following error is larger than the P control switch following error (0x2118)

0x2115	P Control Switch Torque						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	500	0.1%	RW	Yes	Always	Yes

Refer to the description of P/PI Control Conversion Mode (0x2114).

0x2116	P Control Switch Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

Refer to the description of P/PI Control Conversion Mode (0x2114).

0x2117	P Control Switch Acceleration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 60000	1000	rpm/s	RW	Yes	Always	Yes

Refer to the description of P/PI Control Conversion Mode (0x2114).

0x2118	P Control Switch Following Error						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 60000	100	pulse	RW	Yes	Always	Yes

Refer to the description of P/PI Control Conversion Mode (0x2114).

0x2119	Gain Conversion Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
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 details
0	Only gain group 1 is used
1	Only gain group 2 is used
2	Gain is switched according to the GAIN2 input status 0: Use gain group 1 1: Use gain group 2
3	Reserved
4	Reserved
5	Reserved
6	Gain is switched according to the ZSPD output status 0: Use gain group 1 1: Use gain group 2
7	Gain is switched according to the INPOS1 output status 0: Use gain group 1 1: Use gain group 2

0x211A	Gain Conversion Time 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	2	ms	RW	Yes	Always	Yes

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

0x211B	Gain Conversion Time 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	2	ms	RW	Yes	Always	Yes

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

0x211C	Gain Conversion Waiting Time 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	ms	RW	Yes	Always	Yes

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

0x211D	Gain Conversion Waiting Time 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	ms	RW	Yes	Always	Yes

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

0x211E	Dead Band for Position Control						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	UU	RW	Yes	Always	Yes

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

0x211F	Drive Control Input 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to FFFF$_{hex}$	0	-	RW	Yes	Always	No

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

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

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

0x211F	Drive Control Input 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to FFFF$_{hex}$	0	-	RW	Yes	Always	No

Bits	Setting details
15-0	Reserved

0x2121	Drive Status Output 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to FFFF$_{hex}$	0	-	RW	Yes	Always	No

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

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

0x2122	Drive Status Output 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to FFFF$_{hex}$	0	-	RO	Yes	-	No

Bits	Setting details
15-0	Reserved

I/O Configuration(0x2200~)

0x2200	Digital Input Signal 1 Selection						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 0xFFFF	0x0001	-	RW	No	Always	Yes

This specifies the functions of digital input signal 1 of the I/O and the input signal level.

Setting example) If the setting value is 0x006:

0	0	0	6
Contact A		GAIN2 assigned	

Bits	Setting details
15	Signal Input Level Settings (0: Contact A, 1: Contact B)
14~8	Reserved
7~0	Input Signal Assignments

Setting Value	Assigned signals
0x00	Not assigned
0x01	POT
0x02	NOT
0x03	HOME
0x04	STOP
0x05	PCON
0x06	GAIN2
0x07	P_CL
0x08	N_CL
0x09	PROBE1
0x0A	PROBE2
0x0B	EMG
0x0C	A_RST
0x0D	LVSF1
0x0E	LVSF2
0x0F	SVON

0x2201	Digital Input Signal 2 Selection						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
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 Assignment	Variable Attribute	Saving
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 Assignment	Variable Attribute	Saving
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 Assignment	Variable Attribute	Saving
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 Assignment	Variable Attribute	Saving
UINT	0 to 0xFFFF	0x0006	-	RW	No	Always	Yes

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

0x2210	Digital Output Signal 1 Selection						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 0xFFFF	0x8001	-	RW	No	Always	Yes

This assigns the digital output signal 1 function and sets the output signal level of the I/O.

Setting example: If the setting is 0x8001

8	0	0	1
Contact B		Brake assigned	

Bits	Setting details
15	Signal Output Level Settings (0: Contact A, 1: Contact B)
14~8	Reserved
7~0	Output Signal Assignment

Setting Value	Assigned signals
0x00	Not assigned
0x01	BRAKE
0x02	ALARM
0x03	READY
0x04	ZSPD
0x05	INPOS1
0x06	TLMT
0x07	VLMT
0x08	INSPD
0x09	WARN
0x0A	TGON
0x0B	INPOS2

0x2211	Digital Output Signal 2 Selection						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 0xFFFF	0x8002	-	RW	No	Always	Yes

This sets the digital output signal 2 function and output signal level of the I/O. For more information, refer to the description of 0x2210.

0x2212	Digital Output Signal 3 Selection						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 0xFFFF	0x0003	-	RW	No	Always	Yes

This sets the digital output signal 3 function and output signal level of the I/O. For more information, refer to the description of 0x2210.

0x2220	Analog Monitor Output Mode						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Always	Yes

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

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

0x2221	Analog Monitor Channel 1 Select						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 65535	0	-	RW	No	Always	Yes

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

Setting Value	Displayed Items	Unit
0x00	Speed feedback	rpm
0x01	Speed command	rpm
0x02	Speed error	rpm
0x03	Torque feedback	%
0x04	Torque command	%
0x05	Following error	pulse
0x06	Accumulated operation overload	%
0x07	DC link voltage	V
0x08	Accumulated regeneration overload	%
0x09	Encoder single-turn data	pulse
0x0A	Inertia ratio	%
0x0B	Full-Closed Positional Error	UU
0x0C	Drive temperature 1	°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
Setting Value	Displayed Items	Unit
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 Assignment	Variable Attribute	Saving
UINT	0 to 65535	1	-	RW	No	Always	Yes

This sets the monitoring variables to be output to analog monitor output channel 2.

0x2223	Analog Monitor Channel 1 Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	0 to 0x40000000	0	-	RW	No	Always	Yes

Subtract the offset value from the monitoring variable of analog monitor output channel 1 to determine the final output. The unit will be that of the variable configured in the Analog Monitor Channel 1 Select (0x2221).

0x2224	Analog Monitor Channel 2 Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	0 to 0x40000000	0	-	RW	No	Always	Yes

Subtract the offset value from the monitoring variable of analog monitor output channel 2 to determine the final output. The unit will be that of the variable configured in the Analog Monitor Channel 2 Select (0x2222).

0x2225	Analog Monitor Channel 1 Scale						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x40000000	500	-	RW	No	Always	Yes

This sets the scaling of the variable to be output per 1 V when outputting the monitoring variable set as analog output channel 1. The unit will be that of the variable configured in the Analog Monitor Channel 1 Select (0x2221) per 1 V.

For example, if you set the speed feedback to channel 1 and the scale to 500, up to ±5000 rpm can be output as ±10 V.

0x2226	Analog Monitor Channel 2 Scale						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x40000000	500	-	RW	No	Always	Yes

This sets the scaling of the variable to be output per 1 V when outputting the monitoring variable set as analog output channel 2. The unit will be that of the variable configured in the Analog Monitor Channel 2 Select (0x2222) per 1 V.

Velocity Control(0x2300~)

0x2300	Jog Operation Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-6000 to 6000	500	rpm	RW	No	Always	Yes

You can set the Jog operation speed.

0x2301	Speed Command Acceleration Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	200	ms	RW	No	Always	Yes

You can set the time required for the motor to reach the rated motor speed from a stop in the unit of ms.

0x2302	Speed Command Deceleration Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	200	ms	RW	No	Always	Yes

You can set the time required for the motor to decelerate from the rated motor speed to a stop in the unit of ms.

0x2303	Speed Command S-curve Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	ms	RW	No	Always	Yes

You can set the speed command to operate in an S-curve pattern for smooth acceleration/deceleration. If it is set to 0, the drive operates in a trapezoidal pattern by default.

0x2304	Program Jog Operation Speed 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-6000 to 6000	0	rpm	RW	No	Always	Yes

For program jog operation, you can set operation velocity 1 to 4 and operation time 1 to 4 as follows.

0x2305	Program Jog Operation Speed 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-6000 to 6000	500	rpm	RW	No	Always	Yes

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

0x2306	Program Jog Operation Speed 3						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-6000 to 6000	0	rpm	RW	No	Always	Yes

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

0x2307	Program Jog Operation Speed 4						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-6000 to 6000	-500	rpm	RW	No	Always	Yes

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

0x2308	Program Jog Operation Time 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	500	ms	RW	No	Always	Yes

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

0x2309	Program Jog Operation Time 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	5000	ms	RW	No	Always	Yes

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

0x230A	Program Jog Operation Time 3						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	500	ms	RW	No	Always	Yes

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

0x230B	Program Jog Operation Time 4						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	5000	ms	RW	No	Always	Yes

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

0x230C	Index Pulse Search Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-1000 to 1000	20	rpm	RW	No	Always	Yes

You can set the velocity for index pulse search.

0x230D	Speed Limit Function Select						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 3	0	-	RW	No	Always	Yes

You can set the speed limit function for torque control.

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

0x230E	Speed Limit Value at Torque Control Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 6000	1000	rpm	RW	Yes	Always	Yes

You can set the speed limit value at torque control mode. This setting is applied only when the Speed Limit Function Select (0x230D) is set to 0.

0x230F	Over Speed Dection Level						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	6000	rpm	RW	No	Always	Yes

You can set the level of detecting overspeed alarms (AL-50). If the setting value is larger than the maximum motor speed, the detection level is set by the maximum motor speed.

0x2310	Excessive Speed Error Detection Level						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 10000	5000	rpm	RW	No	Always	Yes

You can set the level of detecting excessive speed error alarms (AL-53). If the difference between the speed command and the speed feedback exceeds the setting value, an excessive speed error alarm is generated.

0x2311	Servo-Lock Function Select						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Always	Yes

You can set the servo-lock function to fix the motor position with a position value when the speed command of 0 is for velocity control.

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

● Miscellaneos Setting(0x2400~)

0x2400	Software Position Limit Function Select						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 3	0	-	RW	No	Always	Yes

You can set the software position limit function for position control. When you use the position limit function, the upper and the lower limits in (0x607D:02) and (0x607D:01) are used. The software position limit function will not be activated prior to the homing operation. In addition, when the upper limit value is less than the lower limit value, this function will not be activated.

Setting Value	Setting details
0	None of the positive and negative direction software position limits are used
1	Only the positive direction software position limit value is used It is not limited for the negative direction
2	Only the negative direction software position limit value is used It is not limited for the positive direction
3	Both the positive and the negative direction software position limits are used

0x2401	INPOS1 Output Range						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

With the position command not newly updated, if the following error is retained within the INPOS1 output range for the INPOS1 output time, the INPOS1 signal is output.

0x2402	INPOS1 Output Time						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	ms	RW	Yes	Always	Yes

Refer to the description of 0x2401.

0x2403	INPOS2 Output Range						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

This parameter outputs the INPOS2 signal when the following error is lower than the setting value. Unlike INPOS1, the INPOS2 signal is output by calculating only the following error value.

0x2404	ZSPD Output Range						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 6000	10	rpm	RW	Yes	Always	Yes

When the current velocity is lower than the setting value, the parameter outputs the ZSPD signal.

0x2405	TGON Output Range						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

When the current velocity is higher than the setting value, the parameter outputs the TGON signal.

0x2406	INSPD Output Range						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

When the velocity error is lower than the setting value, the parameter outputs the INSPD signal.

0x2407	BRAKE Output Speed						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 6000	100	rpm	RW	No	Always	Yes

If the motor stops due to the servo off state or servo alarm during rotation, you can set the velocity (0x2407) and delay time (0x2408) for brake signal output in order to set the output timing. The brake signal is output if the motor rotation velocity goes below the set value (0x2407) or the output delay time (0x2408) has been reached after the servo off command.

0x2408	BRAKE Output Delay Time						P
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	100	ms	RW	No	Always	Yes

Refer to the description of 0x2407.

0x2409	Torque Limit for Homing Using Stopper						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2000	250	0.1%	RW	No	Always	Yes

You can set torque limits for homing using the stopper. With too large of a value configured, the machine may collide with the stopper. So be careful.

0x240A	Duration Time for Homing Using Stopper						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	50	ms	RW	No	Always	Yes

You can set the time to detect the stopper during homing. Set an appropriate value for the machine.

0x240B	Modulo Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5	0	-	RW	No	Power cycling	Yes

This specifies whether to use the Modulo function.

Setting Value	Setting details
0	Does not use the modulo function.
1	Uses the modulo function to move in the positive direction.
2	Uses the modulo function to move in the negative direction.
3	Uses the modulo function to move via the possible shortest distance.
4	Uses the modulo function to move to the absolute position.
5	Uses the modulo function to move to the relative position.

0x240C	Modulo Factor						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	1 to 0x3FFFFFFF	3600	UU	RW	No	Power cycling	Yes

You can set the factor for using the Modulo function.

0x240D	User Drive Name						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	‘Drive’	UU	RW	No	Always	Yes

You can customize the drive name. You can use up to 16 characters to set the name.

0x240E	Individual Parameter Save						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	0 to 1	0	-	RW	No	Always	No

You can set whether or not to immediately save individual parameters. This parameter is not saved and reset to 0 during power turn-on.

Setting Value	Setting details
0	Does not save parameters individually. For details on saving parameters, refer to Saving Parameters (0x1010)
1	Saves parameters individually. When a parameter is written, it is immediately saved in the memory

● Enhanced Control(0x2500~)

0x2500	Adaptive Filter Function Select						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5	0	-	RW	No	Always	Yes

You can set the adaptive filter function.

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

0x2501	Notch Filter 1 Frequency						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

You can set the frequency of Notch Filter 1.

0x2502	Notch Filter 1 Width						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 100	1	-	RW	No	Always	Yes

You can set the width of Notch Filter 1.

0x2503	Notch Filter 1 Depth						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 5	1	-	RW	No	Always	Yes

You can set the depth of Notch Filter 1.

0x2504	Notch Filter 2 Frequency						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

You can set the frequency of Notch Filter 2.

0x2505	Notch Filter 2 Width						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 100	1	-	RW	No	Always	Yes

You can set the width of Notch Filter 2.

0x2506	Notch Filter 2 Depth						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 5	1	-	RW	No	Always	Yes

You can set the depth of Notch Filter 2.

.0x2507	Notch Filter 3 Frequency						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

You can set the frequency of Notch Filter 3.

0x2508	Notch Filter 3 Width						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 100	1	-	RW	No	Always	Yes

You can set the width of Notch Filter 3.

0x2509	Notch Filter 3 Depth						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 5	1	-	RW	No	Always	Yes

You can set the depth of Notch Filter 3.

0x250A	Notch Filter 4 Frequency						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	50 to 5000	5000	Hz	RW	No	Always	Yes

You can set the frequency of Notch Filter 4.

0x250B	Notch Filter 4 Width						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 100	1	-	RW	No	Always	Yes

You can set the width of Notch Filter 4.

0x250C	Notch Filter 4 Depth						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 5	1	-	RW	No	Always	Yes

You can set the depth of Notch Filter 4.

0x250D	On-line Gain Tuning Mode						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Always	Yes

It determines whether real-time gain is adjusted during operation. The factory setting is 0 (Do not use). The estimated gain at online tuning is reflected every 64 ms, and the changed gain is stored in EEPROM about every 2 minutes.

Setting Value	Setting details
0	On-line gain tuning not used
1	On-line gain tuning used

0x250E	System Rigidity for Gain Tuning						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
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.

Increasing the system rigidity setting will increase the gain and shorten the positioning time. However, if the setting is too high, vibration may occur depending on the machine configuration. Adjust the system rigidity setting from low to high values within a range that does not cause vibration.

After the gain tuning, the following gains will be automatically changed:

Inertia ratio (0x2100), position loop gain 1 (0x2001), speed loop gain 1 (0x2102), speed integral time constant 1 (0x2103), torque command filter time constant 1 (0x2104), notch filter 3 frequency (0x2507, TBD), and notch filter 4 frequency (0x250A, TBD).

The gain values (position loop gain, speed loop gain, speed integration time constant and torque command filter time constant) according to the system rigidity settingsare determined by the values in the table below.

System Rigidity	1	2	3	4	5	6	7	8	9	10
Position Loop Gain 1	2	5	10	15	22	30	40	50	60	73
Speed Loop Gain 1	3	8	15	23	33	45	60	75	90	110
Speed Integral Time Constant 1	190	70	50	40	30	22	15	13	10	9
Torque Command Filter Time Constant 1	80	30	20	10	8	6	4	3	3	2
System Rigidity	11	12	13	14	15	16	17	18	19	20
Position Loop Gain 1	87	100	117	133	160	173	200	220	240	267
Speed Loop Gain 1	130	150	175	200	240	260	300	330	360	400
Speed Integral Time Constant 1	8	7	6	6	5	5	4	4	3	3
Torque Command Filter Time Constant 1	2	2	2	2	1	1	1	1	1	1

0x250F	On-line Gain Tuning Adaptation Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 5	1	-	RW	No	Always	Yes

You can the speed of reflecting the change in gain when performing on-line gain tuning. The larger the setting value is, the faster the gain changes are reflected. Depending on the condition of the load, the system may become unstable if it is reflected too quickly.

0x2510	Off-line Gain Tuning Direction						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessi bility	PDO Assignm ent	Variable Attribute	Savin g
UINT	0 to 1	0	-	RW	No	Always	Yes

You can set the movement direction when performing offline gain tuning. Set the function properly according to the conditions of the apparatus.

Setting Value	Setting details
0	Drives in the positive direction
1	Drives in the negative direction

0x2511	Off-line Gain Tuning Distance						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 10	5	-	RW	No	Always	Yes

You can set the distance when performing 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. Make sure to secure an enough distance(more than one revolution of the motor) prior to gain tuning.

0x2512	Disturbance Observer Gain						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 100	0	%	RW	No	Always	Yes

This function suppresses torque disturbance by compensating torque through load model. If the disturbance observer gain setting is large, the disturbance suppression works well. However, since noise occurs during operation, it is necessary to set the gain and filter time constant appropriately.

0x2513	Disturbance Observer Filter Time Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	10	0.1ms	RW	No	Always	Yes

This applies a low pass filter for the disturbance observer reference. By setting the disturbance observer gain and filter time constant appropriately, disturbance can be suppressed.

0x2514	Current Controller Gain						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 150	100	%	RW	No	Always	Yes

You can set gain of the current controller. Lowering the setting value can reduce the noise, but the drive's responsiveness decreases at the same time.

0x2515	Vibration Supression Filter Configuration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 2	0	-	RW	No	Always	Yes

Set whether to use a filter to suppress vibration generated at the load end.

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

0x2516	Vibration Supression Filter 1 Frequency						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	0.1Hz	RW	No	Always	Yes

Set the vibration suppression (damping) filter 1 frequency.

0x2517	Vibration Supression Filter 1 Damping						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5	0	-	RW	No	Always	Yes

Set the coefficient of vibration suppression (damping) filter 1. The larger the set value, the bigger the damping coefficient becomes, leading to a higher damping level.

0x2518	Vibration Supression Filter 2 Frequency						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1000	0	0.1Hz	RW	No	Always	Yes

Set the vibration suppression (damping) filter 2 frequency.

0x2519	Vibration Supression Filter 2 Damping						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5	0	-	RW	No	Always	Yes

Set the coefficient of vibration suppression (damping) filter 2. The larger the set value, the bigger the damping coefficient becomes, leading to a higher damping level.

- **Monitoring (0x2600~)**

0x2600	Feedback Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	rpm	RO	Yes	-	No

This parameter represents the current rotation velocity of the motor.

0x2601	Command Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	rpm	RO	Yes	-	No

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

0x2602	Following Error						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	pulse	RO	Yes	-	No

This parameter represents the following error of position control.

0x2603	Accumulated Operation Overload						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1%	RO	No	-	No

This parameter represents the accumulated operation overload rate. When the accumulated operation overload rate reaches the overload warning level (0x2010), an operation overload warning (W10) occurs; when it reaches 100%, an operation overload alarm (AL-21) occurs.

0x2604	Instantaneous Maximum Operation Overload						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1%	RO	Yes	-	No

This represents the maximum value of the operation overload rate output instantaneously from the drive for the last 15 seconds. This value can be initialized by instantaneous maximum operation overload reset.

0x2605	DC-Link Voltage						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	Volt	RO	Yes	-	No

This parameter represents DC link voltage by a main power input.

0x2606	Accumulated Regeneration Overload						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1%	RO	No	-	No

This parameter represents the accumulated overload rate of the regeneration brake resistor from regenerative operation. When the accumulated regeneration overload rate reaches 100%, a regeneration overload alarm (AL-23) is generated.

0x2607	SingleTurn Data						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	pulse	RO	Yes	-	No

This parameter represents the data for one revolution of the motor. A value ranging from 0 to (encoder resolution-1) is displayed.

0x2608	Mechanical Angle						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	0.1deg	RO	Yes	-	No

This parameter represents the single-turn data of the motor in the range of 0.0~359.9.

0x2609	Electrical Angle						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1deg	RO	Yes	-	No

This parameter represents the electrical angle of the motor in the range of -180.0~180.0.

0x260A	MultiTurn Data						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	rev.	RO	Yes	-	No

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

0x260B	Drive Temperature 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	ºC	RO	No	-	No

This is the temperature measured by the temperature sensor integrated into the drive power board.
If the measurement is higher 95℃ or higher, a drive overheat alarm 1 (AL-22) is generated.

0x260C	Drive Temperature 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	ºC	RO	No	-	No

This parameter represents the temperature measured by the temperature sensor integrated into the drive control board. If the measured temperature is 90℃ or higher, a drive overheat alarm 2 (AL-25) is generated.

0x260D	Encoder Temperature						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	ºC	RO	No	-	No

This parameter represents the temperature measured by the temperature sensor integrated into the serial encoder provided by our company (if the setting value of the encoder type (0x2001) are 3, 4, 5, and 6). If the measured temperature 90℃ or higher, an encoder overheat alarm (AL-26) is generated.

0x260E	Motor Rated Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	rpm	RO	No	-	No

This parameter represents the rated speed of a driving motor.

0x260F	Motor Maximum Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	rpm	RO	No	-	No

This parameter represents the maximum velocity of a driving motor.

0x2610	Drive Rated Current						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	0.1A	RO	No	-	No

This parameter represents the rated current of the drive.

0x2611	FPGA Version						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No

This parameter represents the version of FPGA within the drive.

0x2612	Hall Signal Display						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	-	RO	No	-	No

This parameter represents the signal of the hall sensor installed in the encoder (or motor). You can use this 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 positive movement, and it is repeated in the order of 1→3→2→6→4→5 for a negative movement.

Bits	Setting details
0	W phase hall sensor signal
1	V phase hall sensor signal
2	U phase hall sensor signal

0x2613	Bootloader Version						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No

This parameter represents the bootloader version of the drive.

0x2614	Warning Code						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	-	RO	Yes	-	No

This represents a warning code which has occurred in the drive.

0x2615	Analog Input Channel 1 Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	mV	RO	No	-	No

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

0x2619	RMS Operation Overload						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1%	RO	No	-	No

This displays the Root Mean Square (RMS) load factor for the last 15 seconds in 0.1% increments.

Compare the RMS load factor with the rated torque in a 15-second driving cycle to ensure that the RMS load factor is within the drive rated torque. If the RMS load factor is higher than the rated torque, check the drive and motor selection again.

0x261E	Load Encoder Position Feedback						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	pulse	RO	No	-	-

This displays the position value of the load-side encoder in pulse units of the load encoder.

0x261F	Load Encoder Position Actual Internal Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	No	-	-

This displays the position value of the load-side encoder in pulse units of the motor-side encoder considering the electronic gear ratio.

0x2620	Load Encoder Following Error						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	pulse	RO	No	-	-

This displays the position difference between the load-side encoder and motor-side encoder in UU units.

0x2621	Load Encoder Velocity						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU/s	RO	Yes	Always	No

This displays the speed of encoder 2 attached to the load side.

● Procedure and Alarm History (0x2700~)

0x2700	Procedure Command Code						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
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 a command argument value prior to entering a command code because the drive refers to the command argument for the command code input.

Command Codes	Command Arguments	Run Procedures
Manual Jog (0x0001)	1	Servo ON
	2	Servo OFF
	3	Positive (+) Operation (0x2300)
	4	Negative (-) Operation (0x2300)
	5	Zero Speed Stop
Program Jog (0x0002)	1	Servo ON
	2	Servo OFF
	3	Start Operation
	4	Zero Speed Stop (Server ON Maintained)
Servo Alarm History Reset (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	Zero Speed Stop
Absolute Encoder Reset (0x0006)	1	Resets the absolute encoder
Instantaneous Maximum Operation Overload Reset (0x0007)	1	Resets the instantaneous maximum operation overload (0x2604) value
Phase Current Offset	1	Tunes the phase current offset

Tuning (0x0008)		(U/V/W phase offsets are stored in 0x2015~0x2017, respectively. If an offset is abnormally large, AL-15 is generated)
Software Reset	1	Resets the software
Command Codes	Command Arguments	Run Procedures
(0x0009)		
Commutation (0x000A)	1	Performs commutation

0x2701	Procedure Command Argument						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to $FFFF_{hex}$	0	-	RW	No	-	No

0x2702	Servo Alarm History						ALL
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	16	-	RO	No	-	No
SubIndex 1		Alarm Code 1 (newest)					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 2		Alarm Code 2					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 3		Alarm Code 3					
Variable	Setting Range	Initial Value	Unit	Accessi	PDO	Variable	Savin

Type				bility	Assignment	Attribute	g
STRING	-	-	-	RO	No	-	No
SubIndex 4		Alarm Code 4					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 5		Alarm Code 5					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 6		Alarm Code 6					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 7		Alarm Code 7					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 8		Alarm Code 8					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 9		Alarm Code 9					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 10		Alarm Code 10					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving

STRING	-	-	-	RO	No	-	No
SubIndex 11		Alarm Code 11					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 12		Alarm Code 12					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 13		Alarm Code 13					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 14		Alarm Code 14					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 15		Alarm Code 15					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No
SubIndex 16		Alarm Code 16(oldest)					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
STRING	-	-	-	RO	No	-	No

This parameter represents the history of servo alarms generated in the drive. You can store up to 16 recently generated servo alarms. Sub-Index 1 is the latest alarm while the Sub-Index 16 is the oldest of the recently generated alarms. You can reset the servo alarm history by procedure commands.

• Third Party Motor Support(0x2800~)

The following motor parameters are provided for driving motors manufactured by a third party in addition to our motor. To drive a third party's motor with our drive, you have to enter correct parameters. In this case, however, our company neither has performed any test for combinations of our drive and a third party motor nor provides any warranty for the motors' characteristics.

0x2800	[Third Party Motor] Type						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 1	0	-	RW	No	Power cycling	Yes

You can set the motor type.

Setting Value	Setting details
0	Rotary motor
1	Linear motor

0x2801	[Third Party Motor] Number of Poles						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	2 to 1000	8	-	RW	No	Power cycling	Yes

You can set the number of motor poles. For a linear motor, set the value to 2.

0x2802	[Third Party Motor] Rated Current						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
FP32	-	2.89	Arms	RW	No	Power cycling	Yes

You can set the rated current of the motor.

0x2803	[Third Party Motor] Maximum Current						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignm	Variable Attribute	Saving

					ent		
FP32	-	8.67	Arms	RW	No	Power cycling	Yes

You can set the maximum current of the motor.

0x2804	[Third Party Motor] Rated Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 60000	3000	rpm	RW	No	Power cycling	Yes

You can set the rated speed of the motor. For a linear motor, the unit is mm/s.

0x2805	[Third Party Motor] Maximum Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 60000	5000	rpm	RW	No	Power cycling	Yes

You can set the maximum speed of the motor. For a linear motor, the unit is mm/s.

0x2806	[Third Party Motor] Inertia						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
FP32	-	0.321	Kg.m^2. 10^{-4}	RW	No	Power cycling	Yes

You can set the motor inertia. For a linear motor, set the weight of the rotor. The unit is kg.

0x2807	[Third Party Motor] Torque Constant						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
FP32	-	0.46	Nm/A	RW	No	Power cycling	Yes

You can set the torque constant of the motor. For a linear motor, set a force constant. The unit is N/A.

0x2808	[Third Party Motor] Phase Resistance						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
FP32	-	0.82	ohm	RW	No	Power cycling	Yes

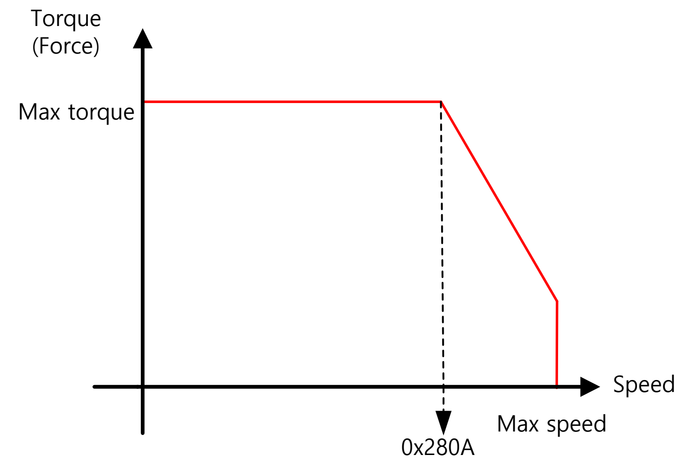
You can set the phase resistance (= resistance between lines ÷ 2) of the motor.

0x2809	[Third Party Motor] Phase Inductance						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
FP32	0 to 1000	3.66	mH	RW	No	Power cycling	Yes

You can set the phase inductance (= inductance between lines ÷ 2) of the motor.

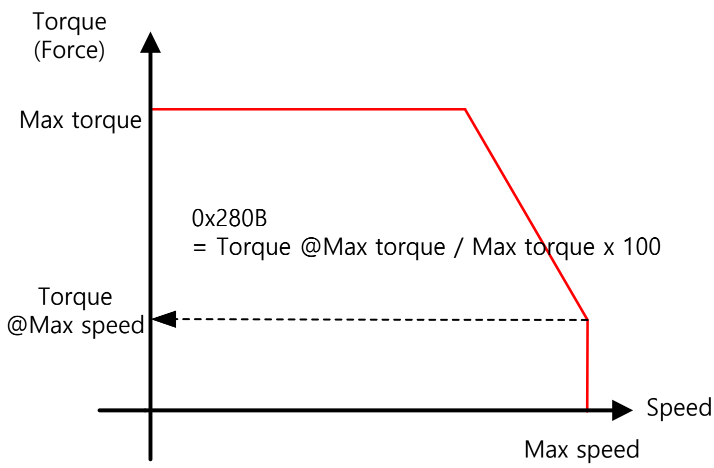
0x280A	[Third Party Motor] TN Curve Data 1						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	1 to 60000	3000	rpm	RW	No	Power cycling	Yes

You can set the data of the motor speed/torque curve. Enter the maximum speed for when the maximum torque(for a linear motor, the maximum thrust) is output. For a linear motor, the unit is mm/s.



0x280B	[Third Party Motor] TN Curve Data 2						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
FP32	-	100.0	%	RW	No	Power cycling	Yes

You can set the data of the motor speed/torque curve. Enter a torque (thrust for a linear motor) which can be output at the maximum speed in percentage (%) relative to the maximum torque.



0x280C	[Third Party Motor] Hall Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 360	0	deg	RW	No	Power cycling	Yes

The offset of the hall sensor set for the initial angle of a 3rd party motor may vary depending on manufacturer. For this, you must check the hall sensor offset and make a correct setting.

10.4 CiA402 Objects

0x603F	Error Code						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	0	-	RO	Yes	-	No

The last alarm code (HEX value) that occurred in the servo drive is displayed.

0x6040	Controlword						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 0xFFFF	0	-	RW	Yes	Always	No

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

Bits	Function	Description
0	Switch on	Refer to the description below of bits 0 to 3.
1	Enable Voltage	
2	Quick stop	
3	Enable operation	
4 to 6	Settings by Operation Mode	Refer to the description below of bits 4 to 9.
7	Fault Reset	0→1: Alarm/warning reset
8	Halt	Refer to the description below of bits 4 to 9.
9	Settings by Operation Mode	
10	–	-
11 to 15	–	-

Description of bits 0 to 3

• Bits 0 to 3: Drive state control

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

Description of bits 4 to 9

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

Bits	Function	Value	Details
4	–	0	-
5	–	0	-
6	–	0	-
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	-

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

Bit 9	Bit 5	Bit 4	Details
0	0	0 → 1	Proceeds to the next position when the operation at the current position is complete.
–	1	0 → 1	Drives to the next position immediately.
1	0	0 → 1	Drives from the current position to the profile position at the profile velocity before it applies the next position.

• Bits 6 and 8: For PP mode operation

Bits	Function	Value	Details
6	Abs/rel	0	Sets the target position to an absolute value.
		1	Sets the target position to a relative value.
8	Halt	0	Runs an operation or continues an operation.
		1	Halts the operation according to the Halt Option code (0x605D).

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

Bits	Function	Value	Details
4	–	0	Reserved
5	–	0	Reserved
6	–	0	Reserved
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

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

Bits	Function	Value	Details
4	Homing Start	0	Does not perform the homing operation.
		1	Performs or is performing the homing operation.
5	–	0	-
6	–	0	-
8	Halt	0	Runs the bit 4 command.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

0x6041	Statusword						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	-	RO	Yes	-	No

Statusword indicates the current state of the drive. It consists of bits that indicate the state according to the drive and operation mode.

Bits	Function	Description
0	Ready to switch on	Refer to the description below of bits 0 to 7.
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	–	Reserved
9	Remote	Processed as a Controlword (0x6040)
10	Operation mode specific	Refer to the description below of bits 10, 12 and 13.
11	Internal limit active	Refer to the description below of bit 11.
12 to 13	Operation mode specific	Refer to the description below of bits 10, 12 and 13.
14	ABS position valid	Refer to the description below of bit 14.
15	-	Reserved

Description of bits 0 to 7

• Bits 0 to 7: For the current state of the drive

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Drive State
–	0	–	–	0	0	0	0	Not ready to switch on
–	1	–	–	0	0	0	0	Switch on disabled
–	0	1	–	0	0	0	1	Ready to switch on
–	0	1	–	0	0	1	1	Switched on
–	0	1	–	0	1	1	1	Operation enabled
–	0	0	–	0	1	1	1	Quick stop active
–	0	–	–	1	1	1	1	Fault reaction active
–	0	–	–	1	0	0	0	Fault
–	–	–	1	–	–	–	–	Main Power On
1	–	–	–	–	–	–	–	Warning is occurred

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

Bits	State	Value	Details
10	Target reached	0	Unable to reach the target (position/velocity)
		1	Reached the target (position/velocity)
12	-	0	-
13	Following error	0	No following error (always 0 in Csv/Torque mode)
		1	Following error

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

Bits	State	Value	Details
10	Target reached	0	Halt (0x6040.8) = 0: Unable to reach the target position Halt (0x6040.8) = 1: Deceleration
		1	Halt (0x6040.8) = 0: Reached the target position Halt (0x6040.8) = 1: Speed: 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

Bits	State	Value	Details
10	Target reached	0	Halt (0x6040.8) = 0: Unable to reach the target velocity Halt (0x6040.8) = 1: Deceleration
		1	Halt (0x6040.8) = 0: Reached the target velocity Halt (0x6040.8) = 1: Speed: 0
12	ZeroSpeed	0	Not in a zero speed state
		1	In a zero speed state
13	–	0	-

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

Bit 13	Bit 12	Bit 10	Details
Homing error	Homing attained	Target reached	
0	0	0	Homing in progress
0	0	1	Homing stopped or not started
0	1	0	Performed homing operation, but did not reach the target
0	1	1	Homing completed
1	0	0	Homing error; speed not equal to 0
1	0	1	Homing error; speed equal to 0

Description of bit 11

• Bit 11: Indicates whether to use an internal limit

Bits	State	Value	Details
11	Internal Limit Active	0	Not in software position limit status or does not use the software position limit function (0x2400).
		1	Software position limit status

Description of bit 14

• Bit 14: Absolute position valid

Bits	State	Value	Details
14	ABS Position Valid	0	Homing is not complete or an alarm related to the encoder has occurred.
		1	Homing is complete (applied when the drive is connected to EtherCAT communication).

0x605A	Quick Stop Option Code						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
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	Slowly decelerates and stops according to the quick stop deceleration (0x6085) setting. (Switch On Disabled).
2	Slowly decelerates and stops according to the quick stop deceleration (0x6085) setting. (Switch On Disabled).
3	Stops using the torque limit value (Switch On Disabled)

0x605B	Shutdown Option Code						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	0 to 1	0	-	RW	No	Always	Yes

This sets the operation to shut down the servo drive (Operation Enabled state -> Ready to Switch On state).

Setting Value	Description
0	Not used
1	Decelerates to a stop; enters the Switch On Disabled state; enters the Ready state

0x605C	Disable Operation Option Code						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	0 to 1	1	-	RW	No	Always	Yes

This sets 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 Assignment	Variable Attribute	Saving
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 Assignment	Variable Attribute	Saving
INT	0	0	-	RW	No	Always	Yes

This sets the operation method that 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 Assignment	Variable Attribute	Saving
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	Names	Details
0	-	Mode not assigned
1	PP	Profile Position mode
2	-	Reserved
3	PV	Profile Velocity mode
4	PT	Profile Torque mode
6	HM	Homing Mode
7	-	Reserved
Setting Value	Names	Details
8	CSP	Cyclic Synchronous Position mode
9	CSV	Cyclic Synchronous Velocity mode
10	CST	Cyclic Synchronous Torque mode
Other	-	Reserved

0x6061	Modes of Operation Display						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
SINT	-	-	-	RO	Yes	-	No

This displays the operation mode of the current drive.

0x6062	Position Demand Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	Yes	-	No

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

0x6063	Position Actual Internal Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	pulse	RO	Yes	-	No

This parameter displays the position actual internal value in the unit of encoder pulse.

0x6064	Position Actual Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	Yes	-	No

This parameter displays the position actual value in a user-defined position unit (UU).

0x6065	Following Error Window						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x3FFFFFFF	600000	UU	RW	No	Always	Yes

This sets the following error window to check the Following Error (Statusword, 0x6041.13).

0x6066	Following Error Timeout						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This sets the timeout for when checking the Following Error (Statusword, 0x6041.13).

0x6067	Position Window						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x3FFFFFFF	100	UU	RW	No	Always	Yes

This sets the position window for the target. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x6068	Position Window Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This sets the time it takes to reach the target position. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x606B	Velocity Demand Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU/s	RO	Yes	-	No

This displays the output speed of the position controller or the command speed input to the velocity controller.

0x606C	Velocity Actual Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU/s	RO	Yes	-	No

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

0x606D	Velocity Window						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 65535	20000	UU/s	RW	No	Always	Yes

This sets the velocity window. If the difference between the target velocity and the actual velocity remains within the velocity window (0x606D) for the amount of velocity window time (0x606E), it sets bit 10 of Statusword (0x6041.10) to 1.

0x606E	Velocity Window Time						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 65535	0	ms	RW	No	Always	Yes

You can set the velocity window time. If the difference between the target velocity and the actual velocity remains within the velocity window (0x606D) for the amount of velocity window time (0x606E), it sets bit 10 of Statusword (0x6041.10) to 1.

0x6071	Target Torque						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

This sets the target torque for the motor in 0.1% increments of the rated torque during torque control.

0x6072	Maximum Torque						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	No

This sets the maximum torque that the motor can output in 0.1% increments of the rated torque

.

0x6074	Torque Demand Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1%	RO	Yes	-	No

This parameter displays the current torque demand value in the unit of 0.1% of the motor's rated torque.

0x6076	Motor Rated Torque						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	mNm	RO	No	-	No

This displays the rated torque of the motor in mNm.

0x6077	Torque Actual Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1%	RO	Yes	-	No

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

0x6078	Current Actual Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-	-	0.1%	RO	Yes	-	No

This displays the torque actual value generated by the drive in 0.1% increments of the rated torque.
A value that is the same as the torque actual value [0x6077] is displayed.

0x6079	DC Link Circuit Voltage						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	0.1V	RO	Yes	-	No

This displays the DC-link voltage supplied by the main power in 0.1 V units.

0x607A	Target Position						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	–2147483648 to 2147483647	0	UU	RW	Yes	Always	No

This sets the target position in the PP (Profile Position) mode or CSP (Cyclic Synchronous Position) mode.

In the PP mode, it is used as an absolute or relative coordinate according to the Bit4 (0x6040.4) setting of Controlword. In CSP mode, it is always used as an absolute coordinate.

0x607C	Home Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	–536870912 to 536870911	0	UU	RW	No	Always	Yes

This sets the offset value for the home position of the absolute encoder or absolute external scale and the zero position of the position actual value (0x6064).

• Incremental Encoder

If the home position is found or at the home position, the position reached by the home offset value becomes the zero position.

• Absolute Encoder

If the absolute encoder is connected, the home offset value is added to the absolute position (position actual value).

0x607D	Software Position Limit						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	2	-	RO	No	-	No
SubIndex 1		Min. position limit					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-1073741824 to 1073741823	-2000000000	UU	RW	No	Always	Yes
SubIndex 2		Max. position limit					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-1073741824 to 1073741823	2000000000	UU	RW	No	Always	Yes

You can set the software position limit. It limits the range of the position demand value (0x6062) and position actual value (0x6064) and checks the new target positions for the setting value at every cycle.

The minimum software limit value is the negative rotation limit. The maximum software limit value is the positive rotation limit.

0x607F	Max Profile Velocity						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x7FFFFFFF	0x7FFFFFFF	UU/s	RW	Yes	Always	Yes

This sets the maximum profile velocity for the PP mode operation.

0x6080	Max Motor Speed						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	RPM	RO	Yes	Always	Yes

This represents the maximum speed of the motor.

0x6081	Profile Velocity						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x7FFFFFFF	200000	UU/s	RW	Yes	Always	Yes

This sets the profile velocity for the PP mode operation.

0x6083	Profile Acceleration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x7FFFFFFF	200000	UU/s^2	RW	No	Always	Yes

This sets the profile acceleration for the PP mode operation.

0x6084	Profile Deceleration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x7FFFFFFF	200000	UU/s^2	RW	No	Always	Yes

This sets the profile deceleration for the PP mode operation.

0x6085	Quick Stop Deceleration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x7FFFFFFF	2000	UU/s^2	RW	No	Always	Yes

The system uses quick stop deceleration if the quick stop option code (0x605A) is set to 2.

0x6087	Torque Slope						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x7FFFFFFF	1000	0.1%/s	RW	Yes	Always	Yes

This sets the torque slope for the PT mode operation.

0x6091	Gear Ratio						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	2	-	RO	No	-	No
SubIndex 1		Motor Revolutions					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	0 to 0x40000000	1	-	RW	No	Power cycling	Yes
SubIndex 2		Shaft Revolutions					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	0 to 0x40000000	1	-	RW	No	Power cycling	Yes

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

0x6098	Homing Method						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
SINT	-128 to 127	34	-	RW	No	Always	Yes

You can set the homing method. For more information, refer to 4.6 Homing.

Setting Value	Details
0	Disabled
1	Homing using index pulse and negative limit contact
2	Homing using index pulse and positive limit contact
7 to 14	Homing using index pulse and home contact
24	Same as method 8 (does not use index pulse)

28	Same as method 12 (does not use index pulse)
33, 34	Homing by index pulse
35	Homing to the current position
-1	Homing using the negative stopper and index pulse
-2	Homing using the positive stopper and index pulse
-3	Homing using the negative stopper only
-4	Homing using the positive stopper only
-5	The drive returns to the home position only with the home switch (HOME) while driving in the negative direction.
-6	The drive returns to the home position only with the home switch (HOME) while driving in the positive direction.

0x6099	Homing Speeds						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	2	-	RO	No	-	No
SubIndex 1		Switch search speed (Speed during a search for switch)					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	0 to 0x40000000	500000	UU/s	RW	No	Always	Yes
SubIndex 2		Zero search speed					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	0 to 0x40000000	100000	UU/s	RW	No	Always	Yes

You can set the operation velocity for homing.

0x609A	Homing Acceleration						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0x40000000	200000	UU/s^2	RW	No	Always	Yes

You can set the operation acceleration for homing.

0x60B0	Position Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-2147483648 to 2147483647	0	UU	RW	Yes	Always	No

In CSP mode, this sets the offset value added to the position command.

0x60B1	Velocity Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

In CSP mode, this corresponds to the speed feed-forward value.

In CSV mode, this sets the offset value added to the speed command value.

0x60B2	Torque Offset						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

In CSP and CSV modes, this corresponds to the torque feed-forward value.

In CST mode, this sets the offset value added to the torque command value.

0x60B8	Touch Probe Function						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 0xFFFF	0x0033	-	RW	Yes	Always	No

This sets the touch probe function.

Bits	Value	Description
0	0	Does not use touch probe 1.
	1	Uses touch probe 1.
1	0	Single trigger mode
	1	Continuous trigger mode
2	0	Triggered by the input of touch probe 1.
	1	Triggered by the index pulse signal.
3	–	Reserved
4	0	Does not capture the positive edge position value of touch probe 1.
	1	Captures the positive edge position value of touch probe 1.
5	0	Does not capture the negative edge position value of touch probe 1.
	1	Captures the negative edge position value of touch probe 1.
6 to 7	–	Reserved
8	0	Does not use touch probe 2.
	1	Uses touch probe 2.
9	0	Single trigger mode
	1	Continuous trigger mode
10	0	Triggered by the input of touch probe 2.
	1	Triggered by the index pulse signal.
11	–	Reserved
12	0	Does not capture the positive edge position value of touch probe 2.
	1	Captures the positive edge position value of touch probe 2.
13	0	Does not capture the negative edge position value of touch probe 2.
	1	Captures the negative edge position value of touch probe 2.
14 to 15	–	Reserved

0x60B9	Touch Probe Status						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	-	-	-	RO	Yes	-	No

This displays the status of the touch probe.

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

In continuous trigger mode, you can toggle to save all update values for 6, 7, 14 and 15 bits on the positive/negative edge of the touch probe.

To disable bits 1, 2, 9 and 10 (saving the position values on the rising/falling edges of touch probes 1 and 2) of the touch probe state (0x60B9), disable bits 4, 5, 12 and 13 (using sampling on the rising/falling edges of touch probes 1 and 2) of the touch probe function (0x60B8) and enable them.

0x60BA	Touch Probe 1 Positive Edge Position Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	Yes	-	No

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

0x60BB	Touch Probe 1 Negative Edge Position Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	Yes	-	No

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

0x60BC	Touch Probe 2 Positive Edge Position Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	Yes	-	No

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

0x60BD	Touch Probe 2 Negative Edge Position Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	Yes	-	No

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

0x60E0	Positive Torque Limit Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

You can set the positive torque value limit.

0x60E1	Negative Torque Limit Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	Yes

You can set the negative torque value limit.

0x60F4	Following Error Actual Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	UU	RO	Yes	-	No

This parameter displays the following error actual value during position control.

0x60FC	Position Demand Internal Value						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	-	-	pulse	RO	Yes	-	No

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

0x60FD	Digital Inputs						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	-	-	RO	Yes	-	No

They indicate the status of digital inputs.

Bits	Description
0	NOT (Negative Limit Switch)
1	POT (Positive Limit Switch)
2	HOME (Home Position 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
Bits	Description
21	DI #6(I/O pin 14), 0:Open, 1:Close
22	DI #7(I/O pin 9), 0:Open, 1:Close
23	DI #8(I/O pin 10), 0:Open, 1:Close
24~30	Reserved
31	STO(Safe Torque Off), 0:Close, 1:Open

0x60FE	Digital Outputs						
SubIndex 0		Number of Entries					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
USINT	-	2	-	RO	No	-	No
SubIndex 1		Physical outputs					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	No
SubIndex 2		Bit mask					
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	Yes

- Description of physical outputs

Bits	Description
0 to 15	Reserved
16	Forced output (0: OFF, 1: ON) of DO #1 (I/O pins 3 and 4) Provided that the relevant bit mask (0x60FE:02.16) is set to 1.
17	Forced output (0: OFF, 1: ON) of DO #2 (I/O pins 23 and 24) Provided that the relevant bit mask (0x60FE:02.17) is set to 1.
18	Forced output (0: OFF, 1: ON) of DO #3 (I/O pins 25 and 26) Provided that the relevant bit mask (0x60FE:02.18) is set to 1.
19	Forced output (0: OFF, 1: ON) of DO #4 (I/O pins 1 and 2) Provided that the relevant bit mask (0x60FE:02.19) is set to 1.
20 to 23	Reserved
24	Output status of DO #1 (0: OFF, 1: ON)
25	Output status of DO #2 (0: OFF, 1: ON)
26	Output status of DO #3 (0: OFF, 1: ON)
27	Output status of DO #4 (0: OFF, 1: ON)
28 to 31	Reserved

- Bit mask

Bits	Description
0 to 15	Reserved
16	Forced output setting (0: Disable, 1: Enable) of DO #1 (I/O pins 3 and 4)
17	Forced output setting (0: Disable, 1: Enable) of DO #2 (I/O pins 23 and 24)
18	Forced output setting (0: Disable, 1: Enable) of DO #3 (I/O pins 25 and 26)
19	Forced output setting (0: Disable, 1: Enable) of DO #4 (I/O pins 1 and 2)
20 to 31	Reserved

0x60FF	Target Velocity						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
DINT	–2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

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

0x6502	Supported Drive Modes						ALL
Variable Type	Setting Range	Initial Value	Unit	Accessibility	PDO Assignment	Variable Attribute	Saving
UDINT	-	0x000003AD	-	RO	No	-	No

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

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

11. Product Specifications

11.1 Servo Motor

■ Heat Sink Specifications

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

Note 1. The product specifications are based on the data measured after the heat sink is mounted.

※ The product specifications are based on the measurement data obtained after mounting the heat sink.

※ IP grade products do not include the shaft penetration part.

※ IP grade is not guaranteed for any gearbox attached.

※ When a cable is bent by more than the specified bending rate, it may not qualify for the specified IP grade.

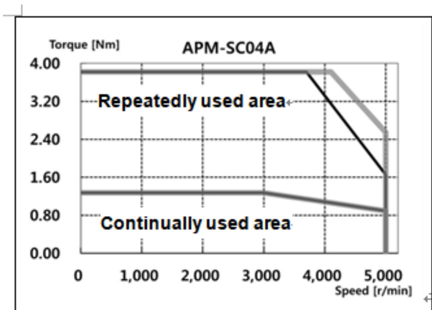
※ Use only the dedicated heat sink cables to satisfy the specified IP grade conditions.

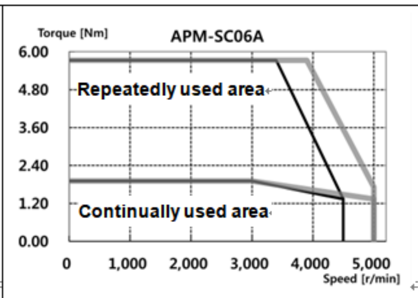
11.1.1 Product Features

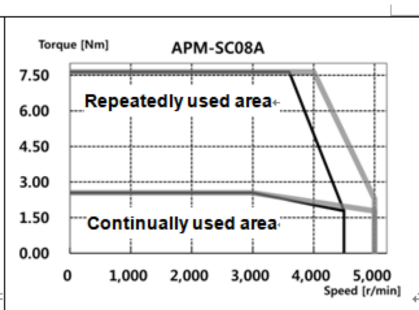
■ Product Features [200V]

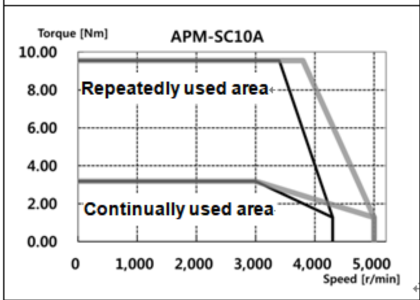
Servo Motor Type (APM-□□□□□)		SC04A	SC06A	SC08A	SC10A		
Applicable Drive (L7NHFxxxU)		**L7NHFA010**U					
Rated Output	[kW]	0.4	0.6	0.8	1.0		
Rated Torque	[N·m]	1.27	1.91	2.55	3.19		
	[kgf·cm]	12.99	19.49	25.98	32.48		
Maximum Instantaneous Torque	[N·m]	3.82	5.73	7.64	9.56		
	[kgf·cm]	38.96	58.47	77.95	97.43		
Rated Current	[A]	2.82	3.58	4.83	5.37		
Peak Current	[A]	8.46	10.74	14.49	16.11		
Rated Rotation Velocity	[r/min]	3000					
Maximum Rotation Velocity	[r/min]	5000					
Moment of Inertia	[kg·m²x10⁻⁴]	0.67	1.09	1.51	1.93		
	[gf·cm·s²]	0.69	1.11	1.54	1.97		
Permitted Load Inertia		Motor inertia x 15					
Rated Power Rate	[kW/s]	24.05	33.39	43.02	52.57		
Velocity, Position Detector	Standard	Quad. Type Incremental 3000[P/R]					
	Option	Serial Type 19[Bit]					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP55 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V** , **■: 3-phase AC230V]**





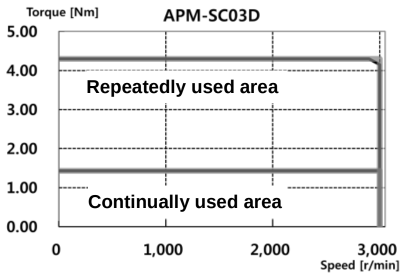


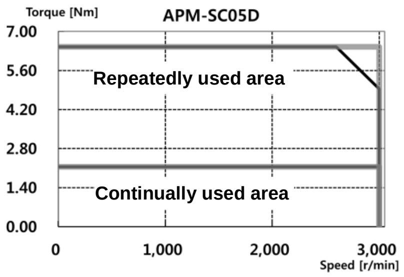


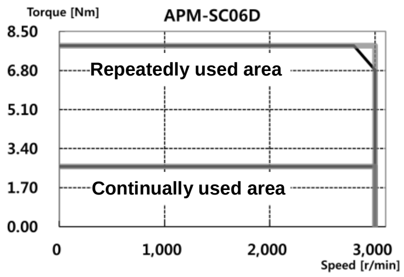
■ Product Features [200V]

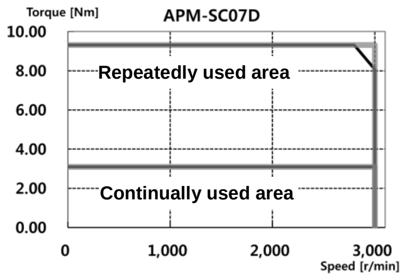
Servo Motor Type (APM-□□□□□)		SC03D	SC05D	SC06D	SC07D		
Applicable Drive (L7NHFxxxU)		**L7NHFA010**U					
Rated Output	[kW]	0.30	0.45	0.55	0.65		
Rated Torque	[N·m]	1.43	2.15	2.63	3.10		
	[kgf·cm]	14.61	21.92	26.79	31.66		
Maximum Instantaneous Torque	[N·m]	4.30	6.45	7.88	9.31		
	[kgf·cm]	43.84	65.77	80.38	94.99		
Rated Current	[A]	2.59	3.23	3.82	4.42		
Peak Current	[A]	7.77	9.69	11.46	13.26		
Rated Rotation Velocity	[r/min]	2000					
Maximum Rotation Velocity	[r/min]	3000					
Moment of Inertia	[kg·m²x10⁻⁴]	0.67	1.09	1.51	1.93		
	[gf·cm·s²]	0.69	1.11	1.54	1.97		
Permitted Load Inertia		15 times of motor inertia					
Rated Power Rate	[kW/s]	30.43	42.27	45.69	49.97		
Velocity, Position Detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial type 19-bit					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V** , ■: 3-phase AC230V**]**





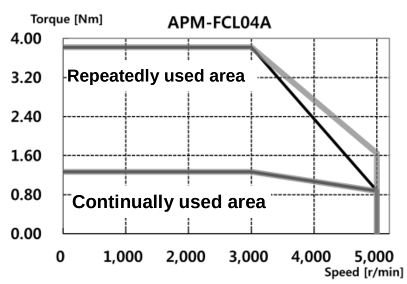


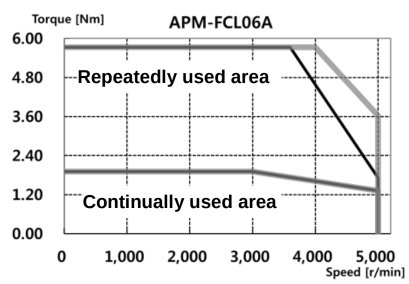


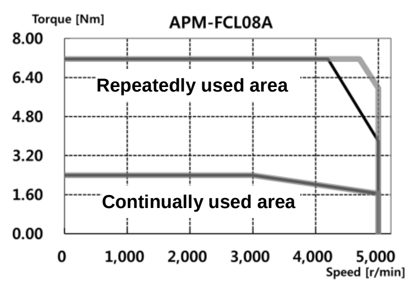
■ Product Features [200V]

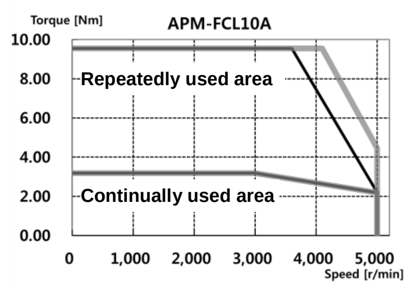
Servo Motor Type (APM-□□□□□)		FCL04A	FCL06A	FCL08A	FCL10A		
Applicable Drive (L7NHFxxxU)		**L7NHFA010**U					
Rated Output	[kW]	0.40	0.60	0.75	1.00		
Rated Torque	[N·m]	1.27	1.91	2.39	3.18		
	[kgf·cm]	12.99	19.49	24.36	32.48		
Maximum Instantaneous Torque	[N·m]	3.82	5.73	7.16	9.55		
	[kgf·cm]	38.98	58.47	73.08	97.44		
Rated Current	[A]	2.58	3.81	5.02	5.83		
Peak Current	[A]	7.75	11.42	15.07	17.50		
Rated Rotation Velocity	[r/min]	3000					
Maximum Rotation Velocity	[r/min]	5000					
Moment of Inertia	[kg·m²x10¯⁴]	0.530	0.897	1.264	1.632		
	[gf·cm·s²]	0.541	0.915	1.290	1.665		
Permitted Load Inertia		Motor inertia x 15					
Rated Power Rate	[kW/s]	30.60	40.66	45.09	62.08		
Velocity, Position Detector	Standard	Serial Multi-Turn Built-in Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP67 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V** , **■: 3-phase AC230V]**





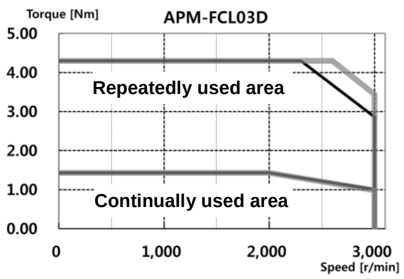


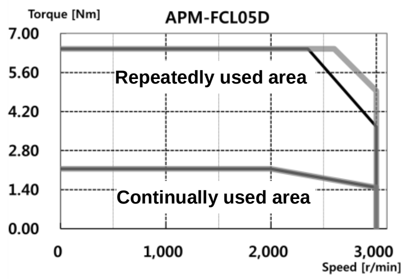


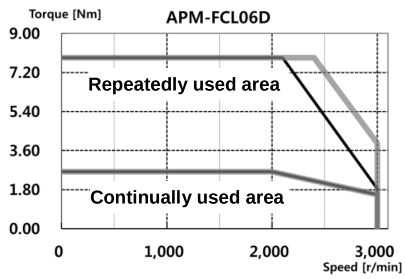
■ Product Features [200V]

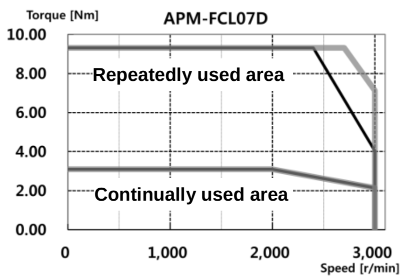
Servo Motor Type (APM-□□□□□)		FCL03D	FCL05D	FCL06D	FCL07D		
Applicable Drive (L7NHFxxxU)		**L7NHFA010**U					
Rated Output	[kW]	0.30	0.45	0.55	0.65		
Rated Torque	[N·m]	1.43	2.15	2.63	3.10		
	[kgf·cm]	14.62	21.92	26.80	31.67		
Maximum Instantaneous Torque	[N·m]	4.30	6.45	7.88	9.31		
	[kgf·cm]	43.85	65.77	80.39	95.01		
Rated Current	[A]	2.50	3.05	3.06	3.83		
Peak Current	[A]	7.51	9.16	9.18	11.50		
Rated Rotation Velocity	[r/min]	2000					
Maximum Rotation Velocity	[r/min]	3000					
Moment of Inertia	[$kg \cdot m^2 x10^{-4}$]	0.530	0.897	1.264	1.63		
	[$gf \cdot cm \cdot s^2$]	0.541	0.915	1.290	1.66		
Permitted Load Inertia		Motor inertia x 15					
Rated Power Rate	[kW/s]	38.73	51.47	54.56	59.03		
Velocity, Position Detector	Standard	Serial Multi-Turn Built-in Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP67 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V** , **■: 3-phase AC230V]**





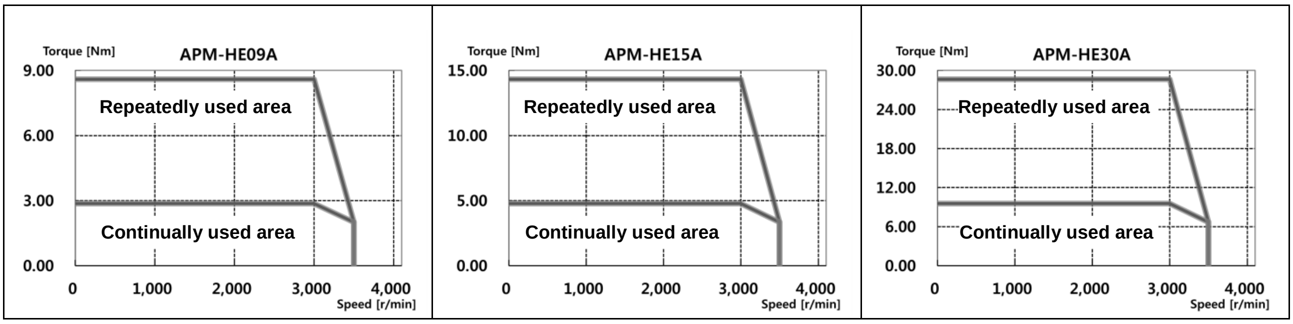




■ Product Features [200V]

Servo Motor Type (APM-□□□□□)		HE09A	HE15A	HE30A			
Applicable Drive (L7NHFxxxU)		L7NHFA010U	L7NHFA020U	L7NHFA035U			
Rated Output	[kW]	0.9	1.5	3			
Rated Torque	[N·m]	2.86	4.77	9.55			
	[kgf·cm]	29.23	48.72	97.43			
Maximum Instantaneous Torque	[N·m]	8.59	14.32	28.64			
	[kgf·cm]	87.69	146.15	292.29			
Rated Current	[A]	4.95	8.23	17.16			
Peak Current	[A]	14.85	24.69	51.48			
Rated Rotation Velocity	[r/min]	3000					
Maximum Rotation Velocity	[r/min]	5000					
Moment of Inertia	[kg·m²x10⁻⁴]	19.56	22.27	31.81			
	[gf·cm·s²]	19.96	22.72	32.46			
Permitted Load Inertia		Motor inertia x 10					
Rated Power Rate	[kW/s]	4.10	10.01	22.03			
Velocity, Position Detector	Standard	Quadrature Type Incremental 2048P/R					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP55 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	5.8	7.4	10.83			

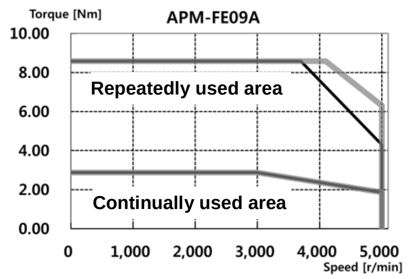
♦ Rotation velocity - Torque characteristics **[■: 3-phase AC200V , ■: 3-phase AC230V]**

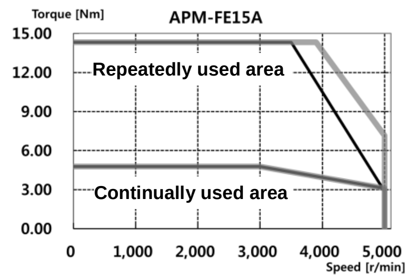


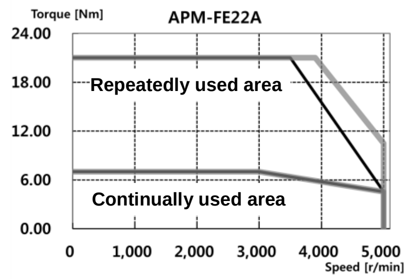
■ Product Features [200V]

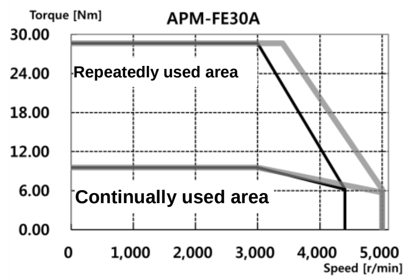
Servo Motor Type (APM-□□□□□)		FE09A	FE15A	FE22A	FE30A		
Applicable Drive (L7NHFxxxU)		**L7NHFA010U**	**L7NHFA020U**		**L7NHFA035U**		
Rated Output	[kW]	0.9	1.5	2.2	3.0		
Rated Torque	[N·m]	2.86	4.77	7.00	9.55		
	[kgf·cm]	29.20	48.70	71.40	97.40		
Maximum Instantaneous Torque	[N·m]	8.59	14.32	21.01	28.65		
	[kgf·cm]	87.70	146.10	214.30	292.20		
Rated Current	[A]	6.45	9.15	13.24	16.09		
Peak Current	[A]	19.35	27.45	39.72	48.27		
Rated Rotation Velocity	[r/min]	3000					
Maximum Rotation Velocity	[r/min]	5000					
Moment of Inertia	[kg·m²x10¯⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Permitted Load Inertia		Motor inertia x 10					
Rated Power Rate	[kW/s]	14.47	22.38	33.59	47.85		
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V** , **■: 3-phase AC230V]**





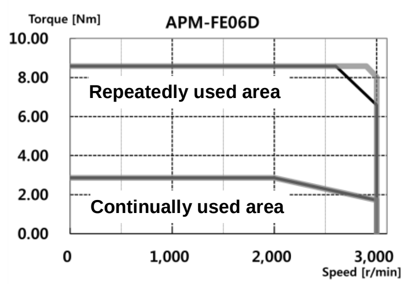


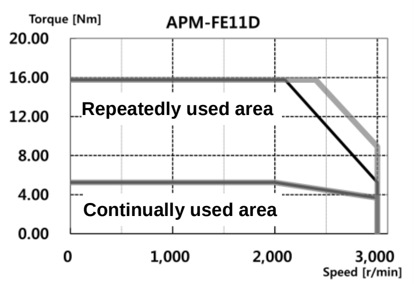


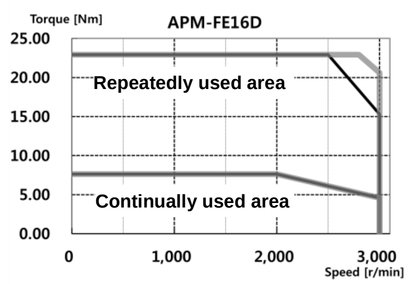
■ Product Features [200V]

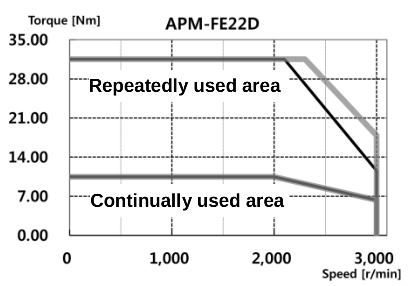
Servo Motor Type (APM-□□□□□)		FE06D	FE11D	FE16D	FE22D		
Applicable Drive (L7NHFxxxU)		L7NHFA008U	L7NHFA010U	L7NHFA020U			
Rated Output	[kW]	0.6	1.1	1.6	2.2		
Rated Torque	[N·m]	2.86	5.25	7.63	10.5		
	[kgf·cm]	29.2	53.60	77.90	107.10		
Maximum Instantaneous Torque	[N·m]	8.59	15.75	22.92	31.51		
	[kgf·cm]	87.70	160.70	233.80	321.40		
Rated Current	[A]	4.56	6.47	10.98	12.97		
Peak Current	[A]	13.68	19.41	32.94	38.91		
Rated Rotation Velocity	[r/min]	2000					
Maximum Rotation Velocity	[r/min]	3000					
Moment of Inertia	[kg·m²x10¯⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Permitted Load Inertia		Motor inertia x 10					
Rated Power Rate	[kW/s]	14.49	27.08	39.89	57.90		
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V , ■: 3-phase AC230V]**





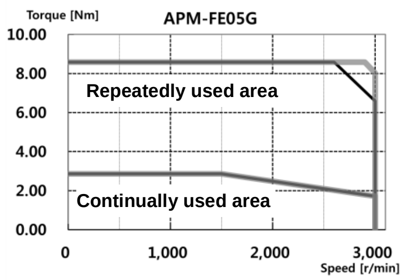


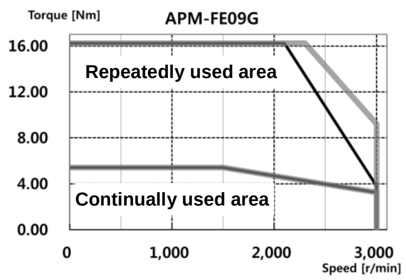


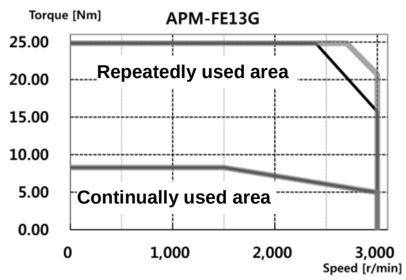
■ Product Features [200V]

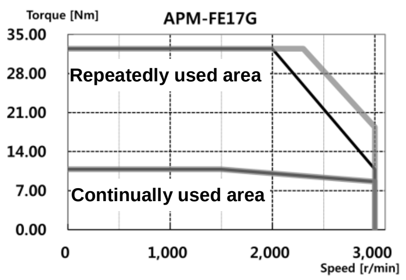
Servo Motor Type (APM-□□□□□)		FE05G	FE09G	FE13G	FE17G		
Applicable Drive (L7NHFxxxU)		L7NHFA008U	L7NHFA010U	L7NHFA020U			
Rated Output	[kW]	0.45	0.85	1.3	1.7		
Rated Torque	[N·m]	2.86	5.41	8.27	10.82		
	[kgf·cm]	29.22	55.19	84.41	110..38		
Maximum Instantaneous Torque	[N·m]	8.59	16.23	24.82	32.46		
	[kgf·cm]	87.66	165.57	253.23	331.14		
Rated Current	[A]	4.56	6.67	11.90	13.36		
Peak Current	[A]	11.68	20.01	35.70	40.08		
Rated Rotation Velocity	[r/min]	1500					
Maximum Rotation Velocity	[r/min]	3000					
Moment of Inertia	[kg·m²x10⁻⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Permitted Load Inertia		Motor inertia x 10					
Rated Power Rate	[kW/s]	14.49	28.74	46.81	61.46		
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics [■: 3-phase AC200V , ■: 3-phase AC230V]





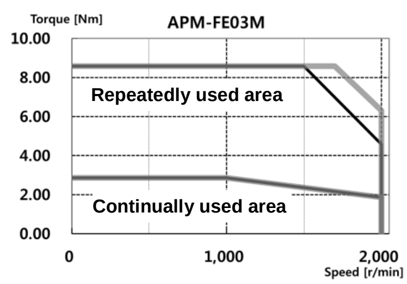


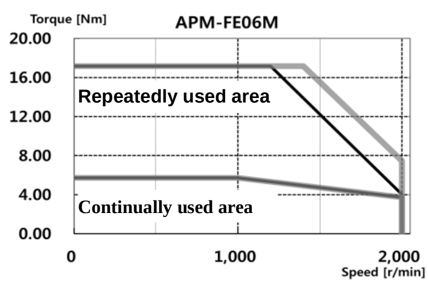


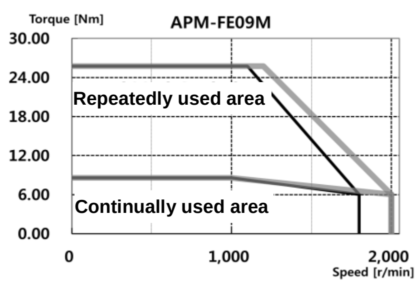
■ Product Features [200V]

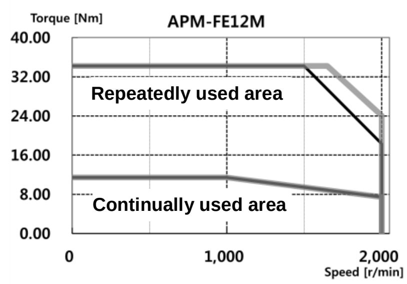
Servo Motor Type (APM-□□□□□)		FE03M	FE06M	FE09M	FE12M		
Applicable Drive (L7NHFxxxU)		L7NHFA004U	L7NHFA008U	L7NHFA010U	L7NHFA020U		
Rated Output	[kW]	0.3	0.6	0.9	1.2		
Rated Torque	[N·m]	2.86	5.72	8.59	11.46		
	[kgf·cm]	29.22	58.4	87.7	116.9		
Maximum Instantaneous Torque	[N·m]	8.59	17.18	25.77	34.22		
	[kgf·cm]	87.66	175.3	262.9	349.1		
Rated Current	[A]	2.73	4.56	6.18	10.67		
Peak Current	[A]	8.19	13.68	18.54	32.01		
Rated Rotation Velocity	[r/min]	1000					
Maximum Rotation Velocity	[r/min]	2000					
Moment of Inertia	[kg·m²x10⁻⁴]	5.66	10.18	14.62	19.04		
	[gf·cm·s²]	5.77	10.39	14.92	19.43		
Permitted Load Inertia		Motor inertia x 10					
Rated Power Rate	[kW/s]	14.49	32.22	50.48	68.91		
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V , ■: 3-phase AC230V]**





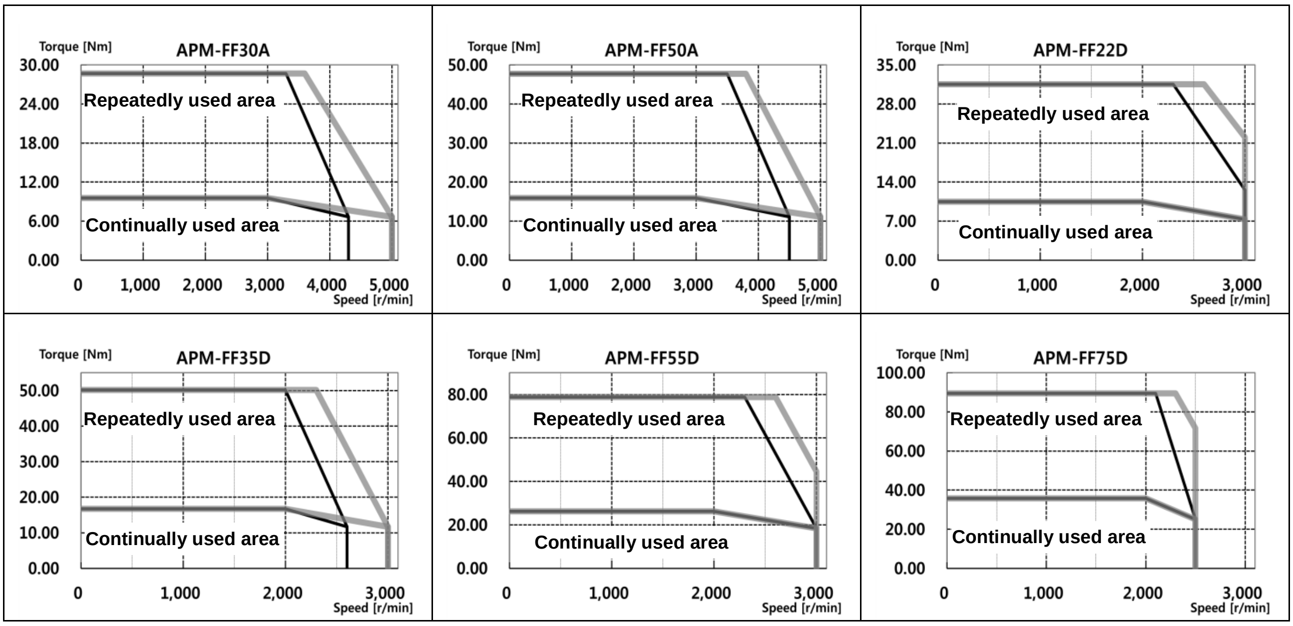




■ Product Features [200V]

Servo Motor Type (APM-□□□□□)		FF30A	FF50A	FF22D	FF35D	FF55D	FF75D
Applicable Drive (L7NHFxxxU)		L7NHFA035U	L7NHFA050U	L7NHFA020U	L7NHFA035U	L7NHFA050U	L7NHFA075U
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	107.10	170.40	267.80	365.40
Maximum Instantaneous Torque	[N·m]	28.65	47.74	35.50	50.10	78.76	89.53
	[kgf·cm]	292.30	487.00	321.30	511.40	803.40	913.50
Rated Current	[A]	15.26	26.47	13.07	16.48	28.78	32.95
Peak Current	[A]	45.78	79.41	39.21	49.44	86.34	82.375
Rated Rotation Velocity	[r/min]	3000		2000			
Maximum Rotation Velocity	[r/min]	5000		3000			2500
Moment of Inertia	[$kg\cdot m^2 x10^{-4}$]	27.96	46.56	27.96	46.56	73.85	106.70
	[$gf\cdot cm\cdot s^2$]	28.53	47.51	28.53	47.51	75.36	108.90
Permitted Load Inertia		Motor inertia x 5					
Rated Power Rate	[kW/s]	32.59	54.33	39.43	59.89	93.27	120.15
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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

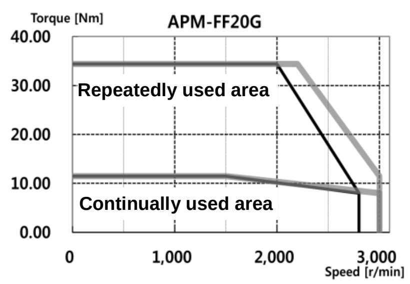
♦ Rotation velocity - Torque characteristics **[■: 3-phase AC200V** , **■: 3-phase AC230V]**

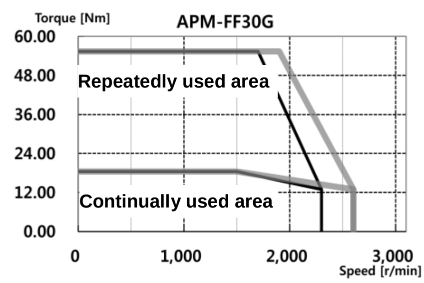


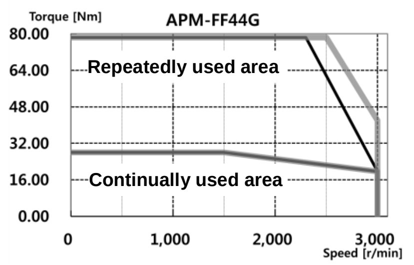
■ Product Features [200V]

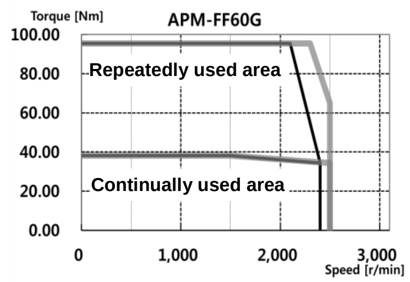
Servo Motor Type (APM-□□□□□)		FF20G	FF30G	FF44G	FF60G	FF75G	
Applicable Drive (L7NHFxxxU)		**L7NHFA020U**	**L7NHFA035U**	**L7NHFA050U**	**L7NHFA075U**		
Rated Output	[kW]	1.8	2.9	4.4	6.0	7.5	
Rated Torque	[N·m]	11.45	18.46	28.00	38.20	47.70	
	[kgf·cm]	116.90	188.30	285.70	389.80	487.20	
Maximum Instantaneous Torque	[N·m]	34.35	55.38	78.40	95.50	119.30	
	[kgf·cm]	350.60	564.90	799.60	974.90	1,217.30	
Rated Current	[A]	12.16	15.98	30.70	35.14	35.26	
Peak Current	[A]	36.48	47.94	85.96	87.85	88.15	
Rated Rotation Velocity	[r/min]	1500					
Maximum Rotation Velocity	[r/min]	3000	2700	3000	2500	2200	
Moment of Inertia	[kg·m²x10⁻⁴]	27.96	46.56	73.85	106.70	131.30	
	[gf·cm·s²]	28.53	47.51	75.36	108.90	134.00	
Permitted Load Inertia		Motor inertia x 5					
Rated Power Rate	[kW/s]	46.92	73.14	106.15	136.73	173.63	
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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	

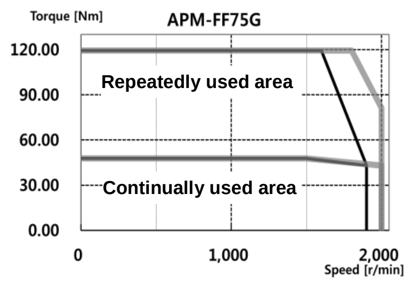
♦ Rotation velocity - Torque characteristics **[■: 3-phase AC200V , ■: 3-phase AC230V]**







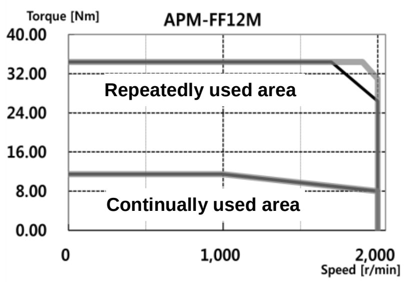


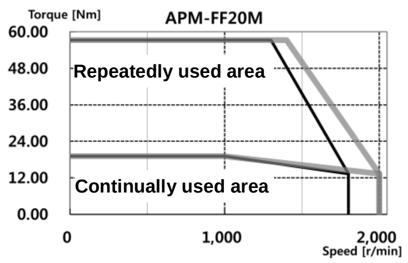


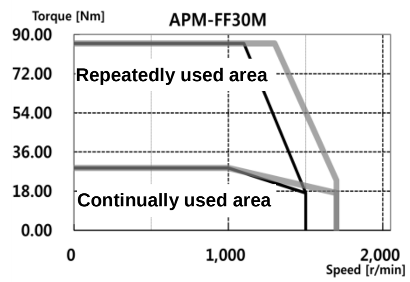
■ Product Features [200V]

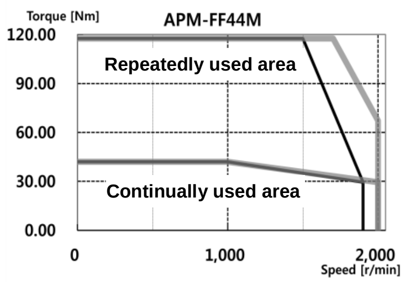
Servo Motor Type (APM-□□□□□)		FF12M	FF20M	FF30M	FF44M		
Applicable Drive (L7NHFxxxU)		L7NHFA020U		L7NHFA035U	L7NHFA050U		
Rated Output	[kW]	1.2	2.0	3.0	4.4		
Rated Torque	[N·m]	11.46	19.09	28.64	42.02		
	[kgf·cm]	116.9	194.8	292.2	428.7		
Maximum Instantaneous Torque	[N·m]	34.38	57.29	85.94	105.05		
	[kgf·cm]	350.70	584.40	876.60	1,071.52		
Rated Current	[A]	11.01	12.96	16.58	30.60		
Peak Current	[A]	33.03	38.88	49.74	85.68		
Rated Rotation Velocity	[r/min]	1000					
Maximum Rotation Velocity	[r/min]	2000		1700	2000		
Moment of Inertia	[kg·m²x10¯⁴]	27.96	46.56	73.85	106.7		
	[gf·cm·s²]	28.53	47.51	75.36	108.9		
Permitted Load Inertia		Motor inertia x 5					
Rated Power Rate	[kW/s]	46.94	78.27	111.04	165.38		
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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 velocity - Torque characteristics **[■: 3-phase AC200V** , ■: 3-phase AC230V**]**





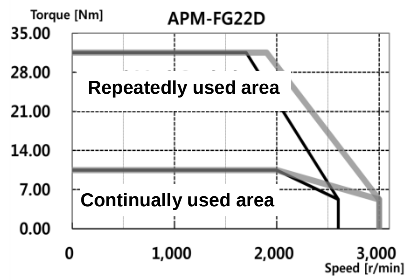


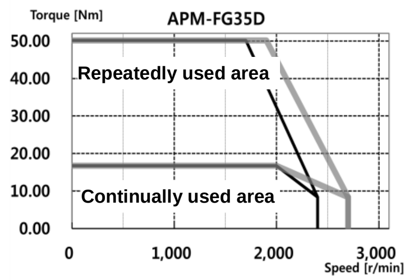


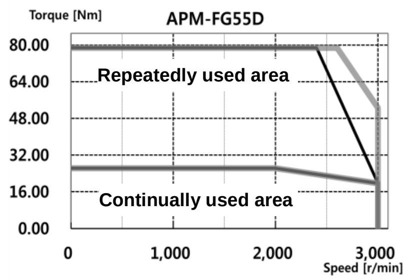
■ Product Features [200V]

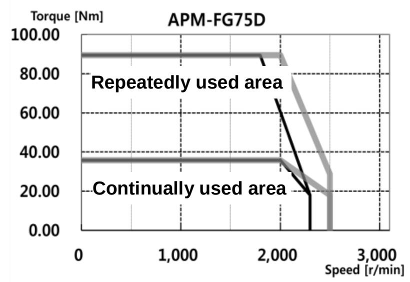
Servo Motor Type (APM-□□□□□)		FG22D	FG35D	FG55D	FG75D		
Applicable Drive (L7NHFxxxU)		L7NHFA020U	L7NHFA035U	L7NHFA050U	L7NHFA750U		
Rated Output	[kW]	2.2	3.5	5.5	7.5		
Rated Torque	[N·m]	10.50	16.71	26.25	35.81		
	[kgf·cm]	107.1	170.4	267.8	365.4		
Maximum Instantaneous Torque	[N·m]	31.51	50.12	78.76	89.53		
	[kgf·cm]	321.30	511.30	803.4	913.5		
Rated Current	[A]	10.25	14.67	29.74	30.17		
Peak Current	[A]	30.75	44.01	89.22	75.43		
Rated Rotation Velocity	[r/min]	2000					
Maximum Rotation Velocity	[r/min]	3000	2700	3000	2500		
Moment of Inertia	[kg·m²x10⁻⁴]	41.13	71.53	117.72	149.4		
	[gf·cm·s²]	41.97	72.99	120.12	152.45		
Permitted Load Inertia		Motor inertia x 5					
Rated Power Rate	[kW/s]	26.78	38.99	58.51	85.83		
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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		

♦ Rotation velocity - Torque characteristics **[■: 3-phase AC200V , ■: 3-phase AC230V]**





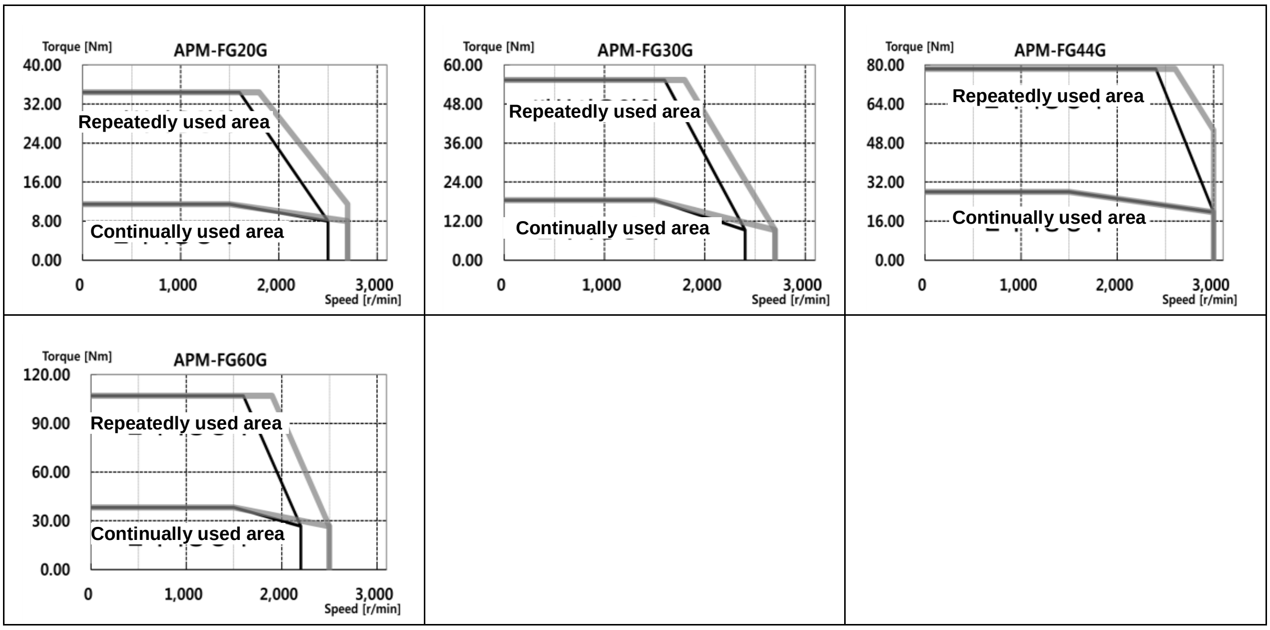




■ Product Features [200V]

Servo Motor Type (APM-□□□□□)		FG20G	FG30G	FG44G	FG60G		
Applicable Drive (L7NHFxxxU)		**L7NHFA020U**	**L7NHFA035U**	**L7NHFA050U**	**L7NHFA075U**		
Rated Output	[kW]	1.8	2.9	4.4	6.0		
Rated Torque	[N·m]	11.50	18.50	28.00	38.2		
	[kgf·cm]	116.9	188.4	285.8	389.7		
Maximum Instantaneous Torque	[N·m]	34.40	55.40	78.40	95.50		
	[kgf·cm]	350.80	565.10	800.24	974.30		
Rated Current	[A]	11.18	16.21	31.72	32.18		
Peak Current	[A]	33.54	48.63	88.82	96.54		
Rated Rotation Velocity	[r/min]	1500					
Maximum Rotation Velocity	[r/min]	2700		3000	2500		
Moment of Inertia	[kg·m²x10^{-4}]	14.13	71.53	117.72	149.4		
	[gf·cm·s²]	41.97	72.99	120.12	152.45		
Permitted Load Inertia		Motor inertia x 5					
Rated Power Rate	[kW/s]	31.91	47.66	66.64	97.63		
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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		

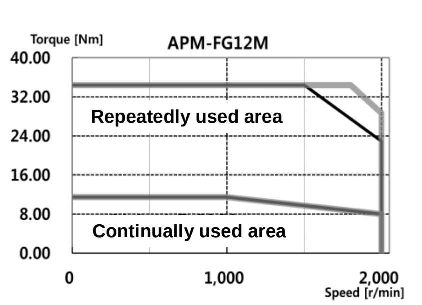
♦ Rotation velocity - Torque characteristics **[■: 3-phase AC200V** , ■: 3-phase AC230V**]**

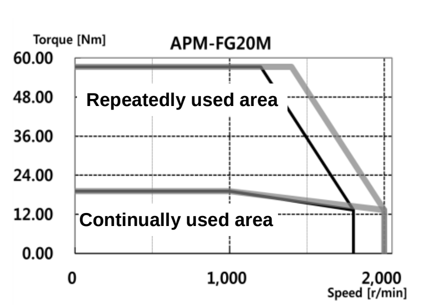


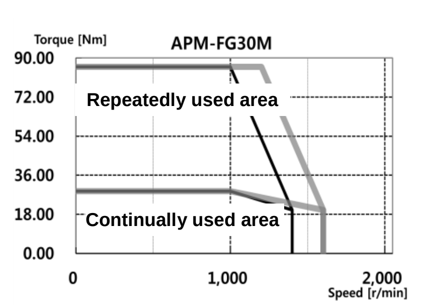
■ Product Features [200V]

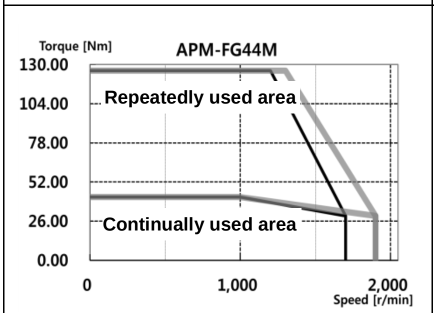
Servo Motor Type (APM-□□□□□)		FG12M	FG20M	FG30M	FG44M	FG60M	
Applicable Drive (L7NHFxxxU)		L7NHFA020U		L7NHFA020U	L7NHFA020U	L7NHFA075U	
Rated Output	[kW]	1.2	2.0	3.0	4.4	6.0	
Rated Torque	[N·m]	11.50	19.10	28.60	42.00	57.29	
	[kgf·cm]	116.9	194.9	292.3	428.7	584.6	
Maximum Instantaneous Torque	[N·m]	34.40	57.30	85.90	126.00	143.2	
	[kgf·cm]	350.8	584.6	876.9	128.61	1,432.4	
Rated Current	[A]	11.28	13.10	15.52	27.26	39.32	
Peak Current	[A]	33.84	39.3	46.56	81.78	98.30	
Rated Rotation Velocity	[r/min]	1000					
Maximum Rotation Velocity	[r/min]	2000		1600	1900	2000	
Moment of Inertia	[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	
Permitted Load Inertia		Motor inertia x 5					
Rated Power Rate	[kW/s]	31.91	51.00	69.70	118.14	112.65	
Velocity, Position Detector	Standard	Serial Multi-Turn Type(19bit)					
	Option	X					
Specifications and Features	Protection Method	Fully enclosed self-cooling IP65 (excluding shaft penetration part)·					
	Time Rating	Continuous					
	Ambient Temperature	Operating temperature: 0 - 40°C, Storage temperature: -10 - 60°C					
	Ambient Humidity	Use humidity: 80[%] RH, maintenance humidity: 90[%] RH or lower (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	

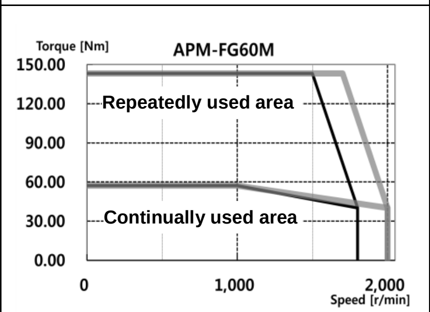
♦ Rotation velocity - Torque characteristics **[■: 3-phase AC200V , ■: 3-phase AC230V]**



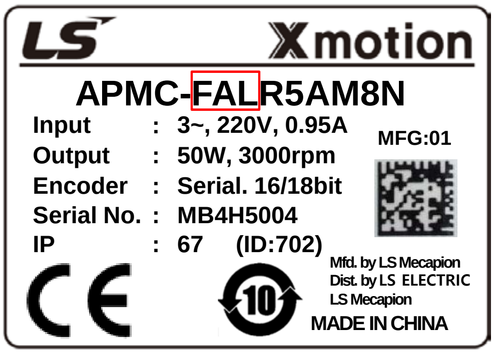


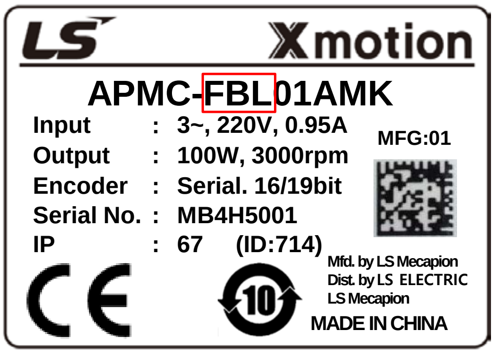






■ Electric Brake Specifications





Applicable Motor Series	FAL	FBL	FCL	FE/FEP	FF/FFP	FG/FGP	FG/FGP110G FG/FGP150G
Purpose	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance
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
Braking 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

Note 1) The same specifications apply to all electric brakes installed in our servo motors.

Note 2) Electric brakes are designed to maintain a stop. Never use them for absolute braking.

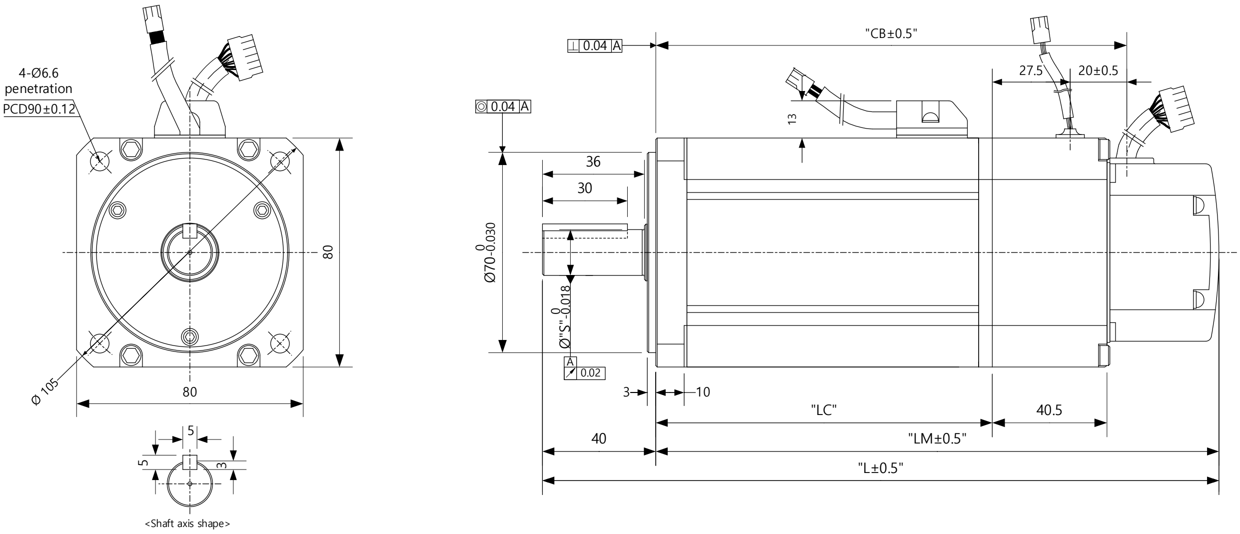
Note 3) The characteristics of the electric brakes were measured at 20°C.

Note 4) These brake specifications are subject to change. Check the voltage specifications shown on your specific motor.

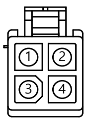
Note 5) FAL, FBL, FCL, FE, and FEP Series brakes satisfy UL specification class 2.

11.1.2 External View

■ **SC Series | APM-SC04A, SC03D, SC06A, SC05D, SC08A, SC06D, SC10A, SC07D**



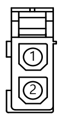
<Power Connector>



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

Plug : 172167-1(AMP)

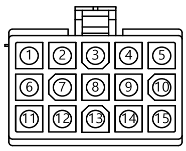
<Brake Connector>



Pin No.	Polarity
1	BK+
2	BK-

Plug : 172165-1(AMP)

<Encoder Connector>



Pin No.	Signal Names	Pin No.	Signal Names	Pin No.	Signal Names
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)

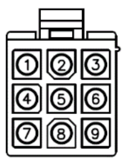
Model	External Dimensions					Weight (kg)
	L	LM	LC	CB	S	
SC04A,SC03D	158.5(199.8)	118.5(158.8)	79(78.8)	86(126.3)	14	1.88(2.92)
SC06A,SC05D	178.5(218.8)	138.5(178.8)	99(98.8)	106(146.3)	16	2.52(3.56)
SC08A,SC06D	198.5(238.8)	158.5(198.8)	119(118.8)	126(166.3)	16	3.15(4.22)
SC10A,SC07D	218.5(258.8)	178.5(218.8)	139(138.8)	146(186.3)	16	3.80(4.94)

Note 1) Use DC 24 [V] for the power to open the brake.

Note 2) The size in parentheses is of an attachable brake.

Note 3) Option: Serial Type PinMap

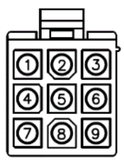
<Serial S-turn Encoder Connector>



Pin No.	Phase	Pin No.	Phase
1	MA	6	–
2	$\overline{MA}$	7	+5V
3	SL	8	0V
4	$\overline{SL}$	9	SHIELD
5	–		

Plug : 172169-1(AMP)

<Serial M-turn Encoder Connector>

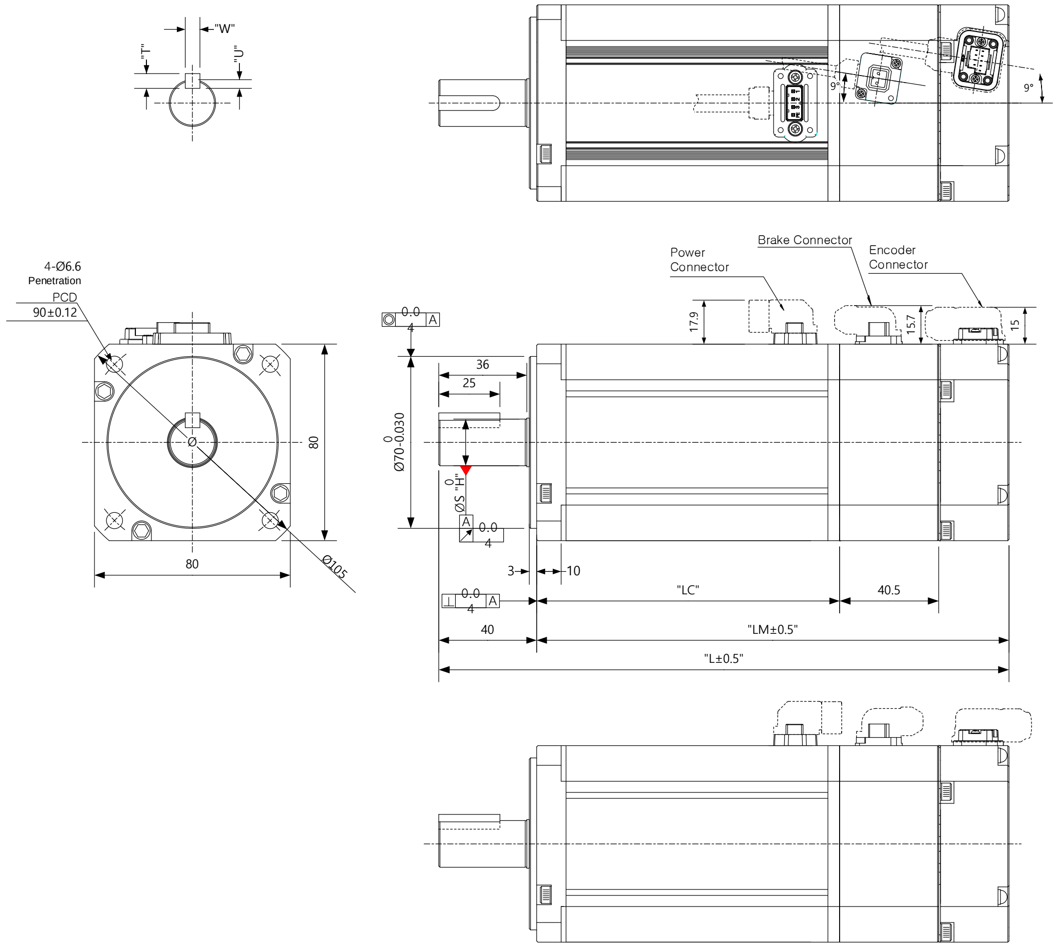


Pin No.	Phase	Pin No.	Phase
1	MA	6	GND_B
2	$\overline{MA}$	7	+5V
3	SL	8	0V
4	$\overline{SL}$	9	SHIELD
5	VDD_B		

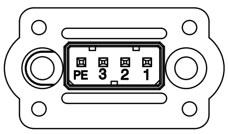
Plug : 172169-1(AMP)

■ **FCL Series | APM - FCL04A, FCL03D, FCL06A, FCL05D**

APM - FCL08A, FCL06D,FCL10A, FCL07D

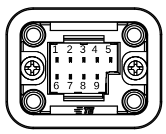


<When the cable withdraw direction is the opposite of the shaft>



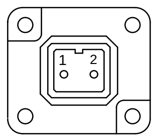
Pin No.	Signal Names
1	U
2	V
3	W
PE	FG

<Power connector pin arrangement>



Multi Turn (M)			
Pin No.	Signal Names	Pin No.	Signal Names
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 Names
1	BK+
2	BK-

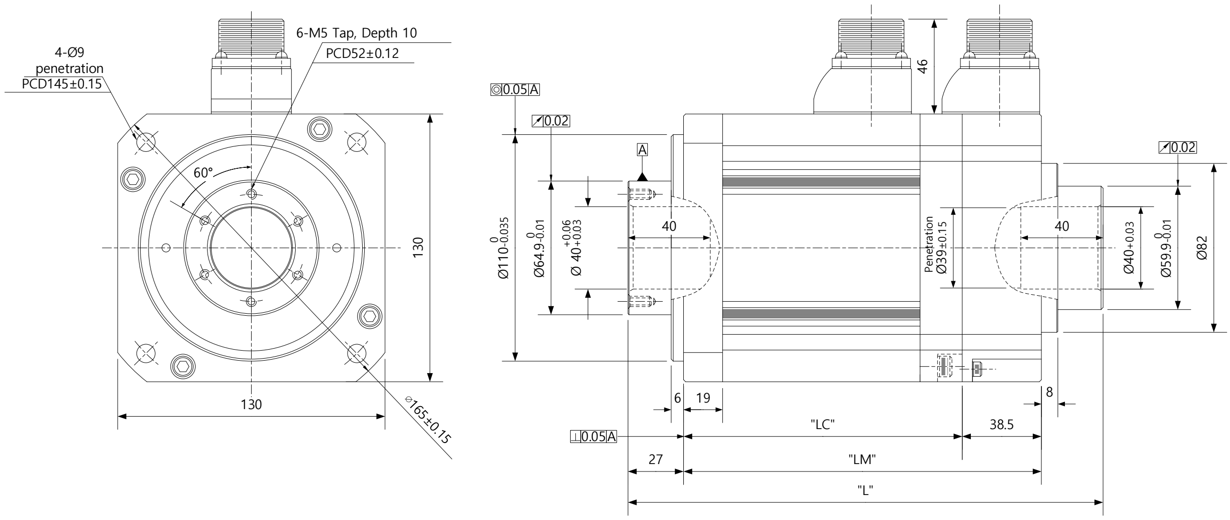
<Brake connector pin arrangement>

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

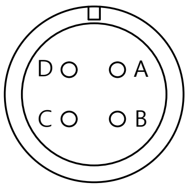
Note 1) Use DC 24 [V] for the power to open the brake.

Note 2) The size in parentheses is of an attachable brake.

■ **HE Series | APM-HE09A (Hollow Shaft)**
APM-HE15A (Hollow Shaft)
APM-HE30A (Hollow Shaft)



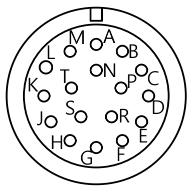
<Power Connector>



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

Plug : MS3102A20-4P

<Encoder Connector>



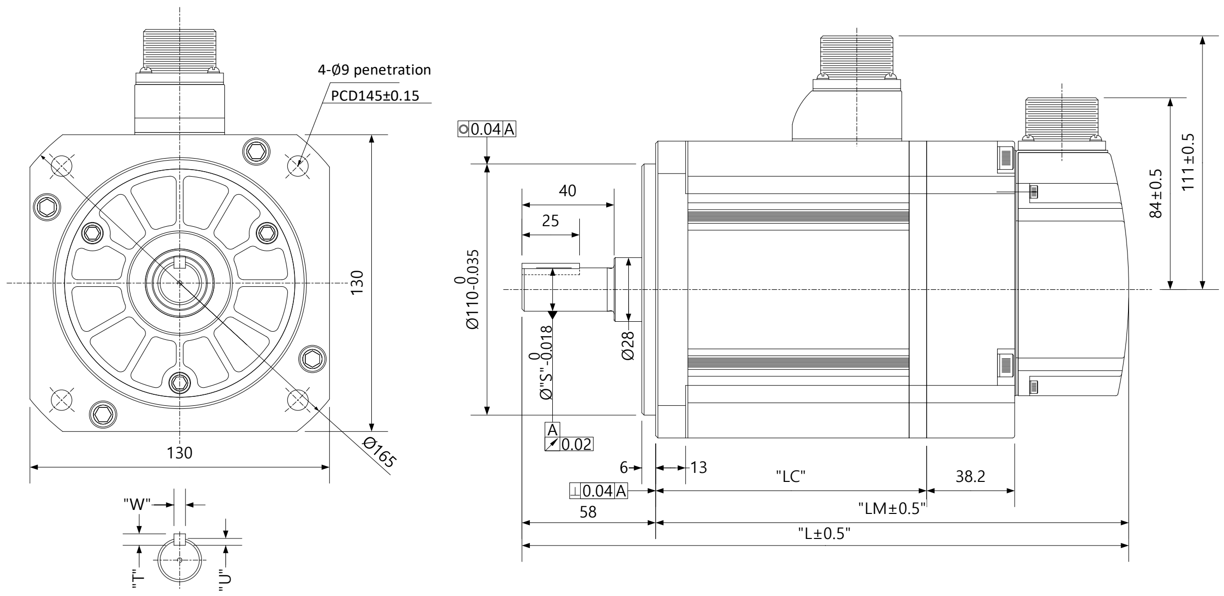
Pin No.	Signal Names	Pin No.	Signal Names	Pin No.	Signal Names
A	A	F	/Z	P	W
B	/A	K	U	R	/W
C	B	L	/U	H	+5V
D	/B	M	V	G	0V
E	Z	N	/V	J	SHIELD

Plug : MS3102A20-15P

Model	External Dimensions			Hollow Shaft Diameter	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 Series |** **APM-FE09A, FE06D, FE05G, FE03M, FE15A, FE11D, FE09G, FE06M**

APM-FE22A, FE16D, FE13G, FE09M, FE30A, FE22D, FE17G, FE12M



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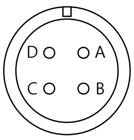
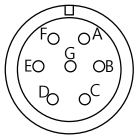


Pin No.	Signal Names
A	U
B	V
C	W
D	FG

Plug : MS3102A20-4P

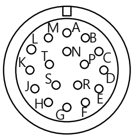
<Brake Type Connector>



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

Plug : MS3102A20-15P

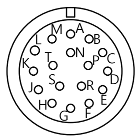
<Serial M-Turn Connector>



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

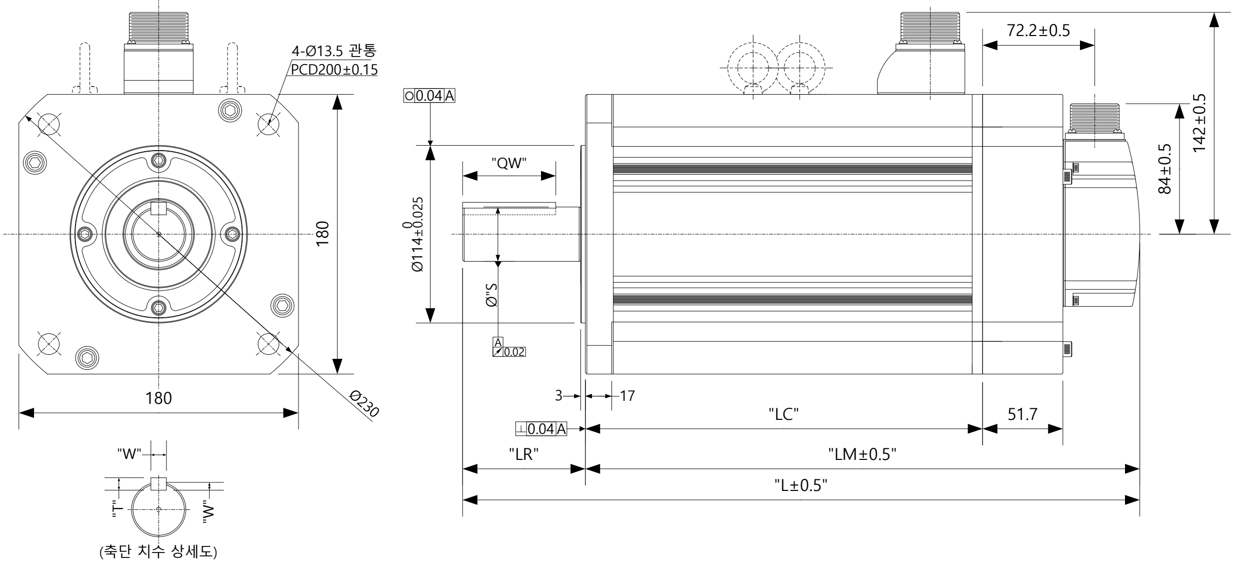
Plug : MS3102A20-29P

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

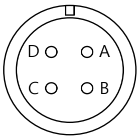
Note 1) Use DC 24 [V] for the power to open the brake.

Note 2) The size in parentheses is of an attachable brake.

■ **FF Series | APM-FF30A, FF22D, FF20G, FF12M, FF50A, FF35D, FF30G, FF20M, APM-FF55D, FF44G, FF30M, FF75D, FF60G, FF44M, FF75G**



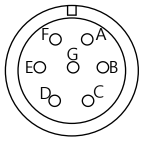
<Power Connector>



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

Plug : MS3102A22-22P

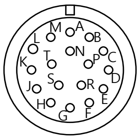
<Brake Type Connector>



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

Plug : MS3102A24-10P

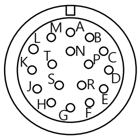
<Serial M-Turn Connector>



Pin No.	Signal Names	Pin No.	Signal Names	Pin No.	Signal Names
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 Names	Pin No.	Signal Names	Pin No.	Signal Names
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

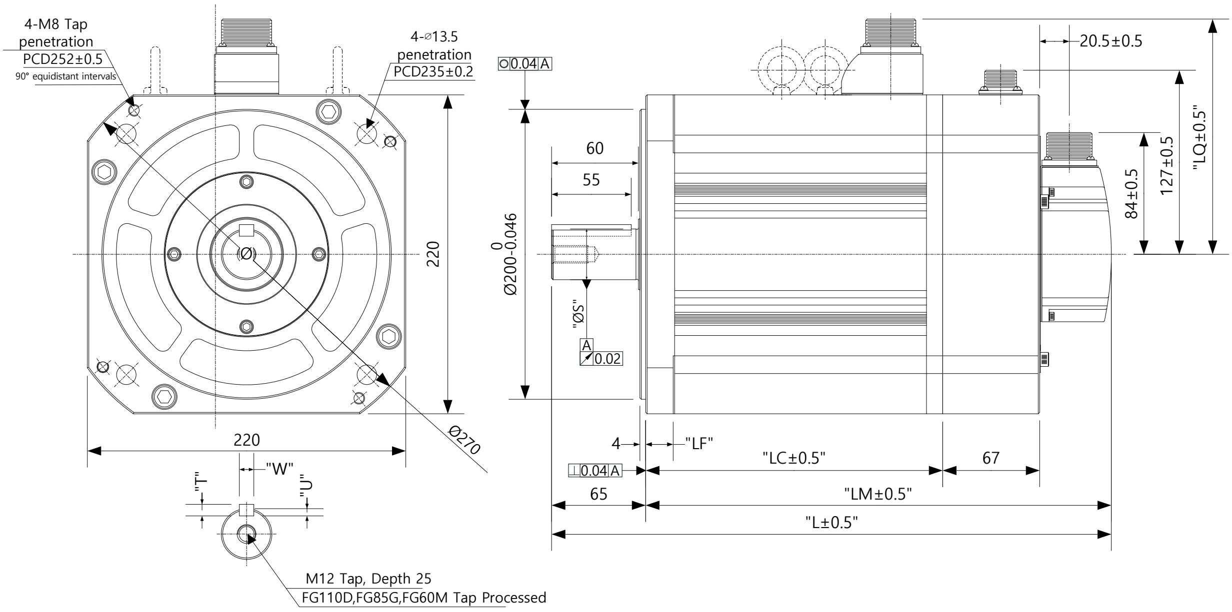
Model	External Dimensions					Key Dimensions				Eye bolt	Weight (Kg)
	L	LM	LC	LR	S	QW	T	W	U		
FF30A, FF22D FF20G, FF12M	257.5(308.9)	178.5(229.9)	129(128.7)	79	35 (0~+0.01)	60	8	10	5	X	12.5 (19.7)
FF50A, FF35D FF30G, FF20M	287.5(338.9)	208.5(259.9)	159(158.7)								17.4 (24.6)
FF55D, FF44G FF30M	331.5(382.9)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

Note 1) Use DC 24 [V] for the power to open the brake.

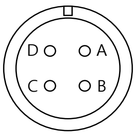
Note 2) The size in parentheses is of an attachable brake.

Note 3) FF75G models use the MS connector 32-17P.

■ **FG Series | APM-FG22D, FG20G, FG12M, FG35D, FG30G, FG20M, FG55D, APM-FG44G,FG30M, FG75D, FG60G, FG44M, FG60M**



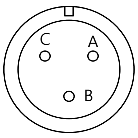
<Power Connector>



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

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

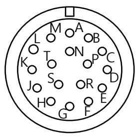
<Brake Connector>



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

Plug : MS3102A14-7P

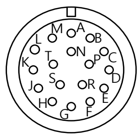
<Serial M-Turn Connector>



Pin No.	Signal Names	Pin No.	Signal Names	Pin No.	Signal Names
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 Names	Pin No.	Signal Names	Pin No.	Signal Names
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	External Dimensions						Key Dimensions			Power Connector	Weight (Kg)
	L	**LM**	**LC**	LF	LQ	S	T	W	U		
FG22D, FG20G FG12M	229.5 (295.7)	164.5 (230.7)	115 (114.2)	19	162	35 (-0.016~0)	8	10	5	MS3102A 22-22P	15.42 (29.23)
FG35D, FG30G FG20M	250.5 (316.7)	185.5 (251.7)	136 (135.2)								20.22 (34.03)
FG55D, FG44G FG30M	282.5 (348.7)	217.5 (283.7)	168 (167.2)								28.02 (41.83)
FG75D, FG60G FG44M,	304.5 (370.7)	239.5 (305.7)	190 (189.2)			42 (-0.016~0)		12			33.45 (47.26)
FG60M (Note 3)	418.5 (484.7)	353.5 (419.7)	304 (303.2)	21	173	45 (-0.016~0)		10	6	MS3102A 32-17P	66.2 (82.6)

Note 1) Use DC 90 [V] for the power to open the brake.

Note 2) The size in parentheses is of an attachable brake.

Note 3) The specifications of the connector are MS3102A32-17P.

11.2 Servo Drive

11.2.1 Product Features

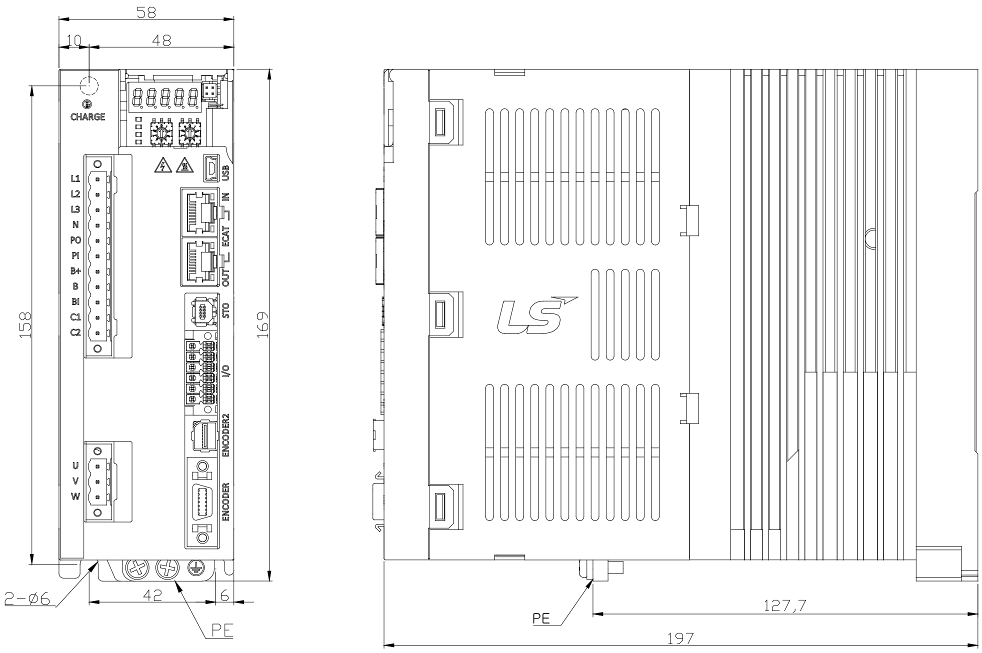
Items \ Model Name		L7NHFA010U	L7NHFA035U	L7NHFA050U	L7NHFA075U	
Input Power	Main Power	3-phase AC 200 - 230 V (-15 - +10%), 50 - 60 Hz				
	Control Power	Single-phase AC200 ~ 230[V](-15 ~ +10[%]), 50 ~ 60[Hz]				
Rated Current [A]		6.75	16.7	32	39.4	
Peak Current [A]		20.25	50.1	90.88	98.5	
1st encoder type		Quadrture(Incremental) BiSS-B, BiSS-C(Absolute, Incremental) Tamagawa Serial(Absolute, Incremental) EnDat 2.2 Sinusoidal, Analog Hall				
2nd encoder type		Quadrture(Incremental), SSI Sinusoidal, Analog Hall (using an analog-to-BiSS converter)				
Control Performance	Velocity Control Range	1:5000 Maximum				
	Frequency Response	Maximum 1[kHz] (for a 19-bit serial encoder)				
	Velocity Variation	±0.01[%] or lower (when the load changes between 0~100[%]) ±0.1[%]or lower (temperature 25±10[℃])				
	Torque Control Repeat Accuracy	Within ±1%				
EtherCAT Communication Specifications	Communication Standard	FoE (Firmware download) EoE (Parameter settings, adjustment and auxiliary functions, and parameter copy through UDP) CoE (IEC 61158 Type12, IEC 61800-7 CIA 402 drive profile)				
	Physical Layer	100BASE-TX(IEEE802.3)				
	Connector	RJ45 x 2				
	Distance	Within 100 m between nodes				
	DC	Synchronization by DC (Distributed Clock) mode Minimum DC cycle: 250 us				

	(Distributed Clock)	
	LED Display	LinkAct IN, LinkAct OUT, RUN, ERR
	Cia402 Drive Profile	Profile Position Mode Profile Velocity Mode Profile Torque Mode Cyclic Synchronous Position Mode Cyclic Synchronous Velocity Mode Cyclic Synchronous Torque Mode Homing Mode
Digital Input/Output	Digital Input	Input voltage range: DC 12[V] ~ DC 24 [V] 6 input channels in total (assignable) Possible to selectively assign up to 15 functions (*POT, *NOT, *HOME, *STOP, *PCON, *GAIN2, P_CL, N_CL, PROBE1, PROBE2, EMG, A_RST, SV_ON, LVSF1, LVSF2) Note) * Indicates signals assigned by default.
	Digital Output	Rated voltage and current: DC 24[V] ±10%, 120[㎃] A total of 3 output channels (allocable) Possible to selectively assign up to 11 outputs (*BRAKE±, *ALARM±, *READY±, ZSPD±, INPOS±, TLMT±, ,VLMT±, INSPD±, WARN±, TGON±, INPOS2±) Note) * Indicates signals assigned by default
Analog Output		A total of 2 channels (allocable) Possible to selectively assign up to 25 outputs
Safety Functions		2 input channels (STO1 and STO2) and 1 output channel (EDM±)
USB Communication	Function	Firmware download, parameter setting, adjustment, auxiliary functions and parameter copy function.
	Communication Standard	Compliant with 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	7 segments (5 DIGITS)

	Function	
	Self-setting Function	Possible to set the drive node address by using the rotary switch
	Add-on Functions	Gain adjustment, alarm history, jog operation, home search
	Protection Function	Overcurrent, overload, current limit over, overheat, overvoltage, undervoltage, encoder error, position following error, current sensing error, etc.
Use Environment	Operating Temperature /Maintenance Temperature	0 ~ +50[℃] / -20~ +65[℃]
	Operating Humidity /Maintenance Humidity	90[%] RH or lower (No condensation)
	Others	Indoor areas free from corrosive or combustible gases, liquids, or conductive dust

11.2.2 External View

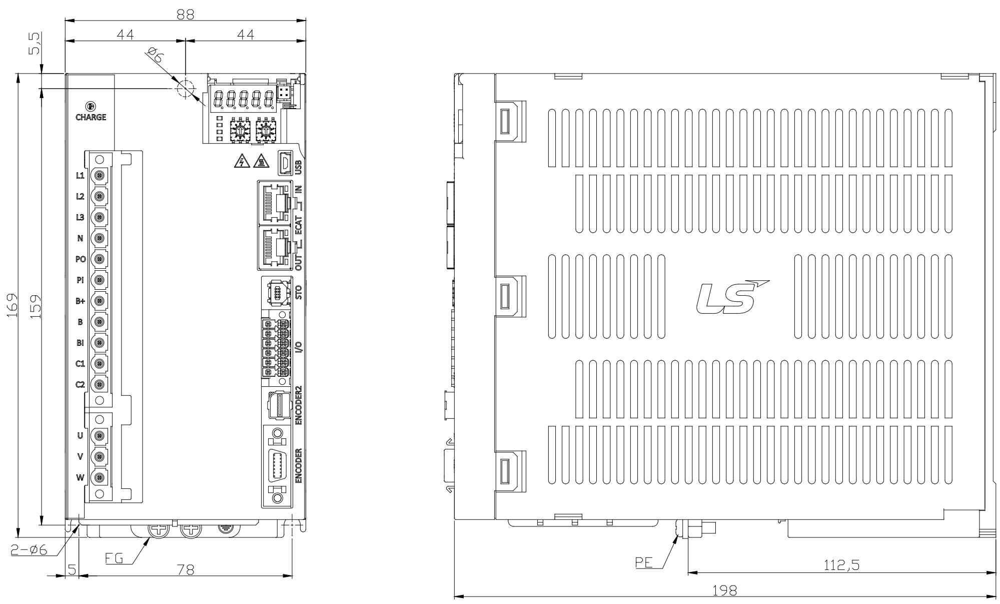
■ L7NHFA010U



*

Weight: 1.5 kg (including the cooling fan)

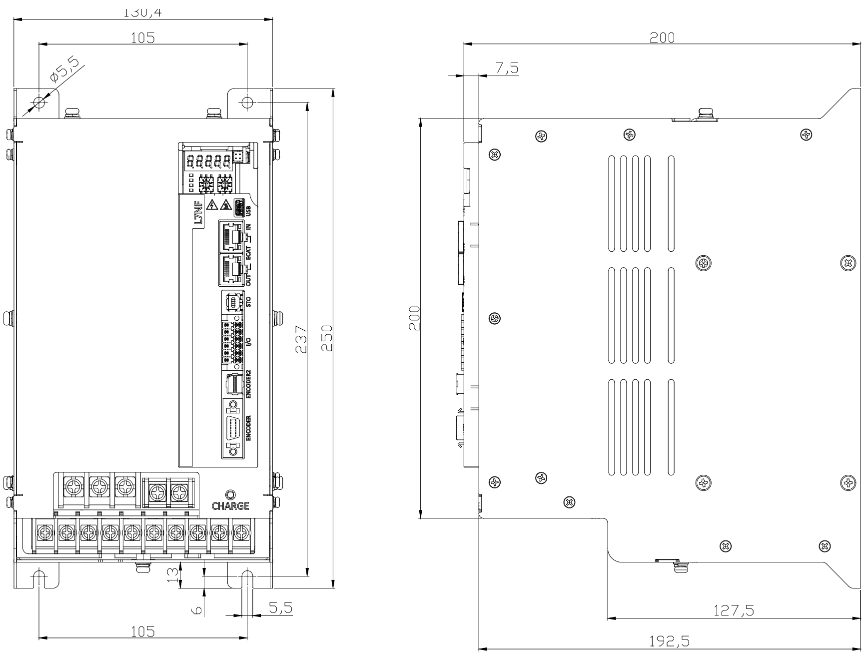
■ L7NHFA035U



*

Weight: 2.5 kg (including the cooling fan)

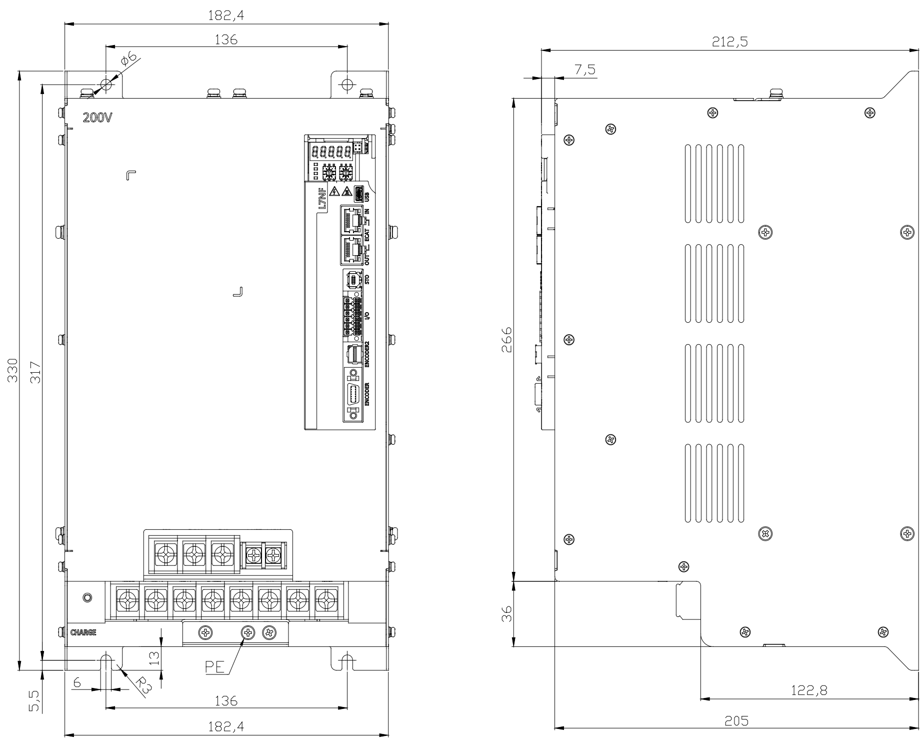
L7NHFA050U



*

Weight: 5.5 kg (including the cooling fan)

L7NHFA075U



* Weight: 9.7 kg (including the cooling fan)

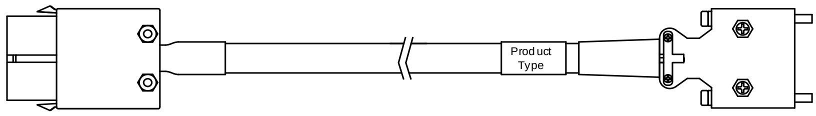
11.3 Options and Peripheral Devices

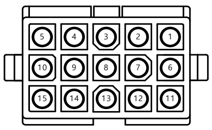
■ Option Specification (Incremental Encoder Cable)

Classification	For signals	Product Name	Small Capacity AMP Type INC Encoder Cable
Model Name (Note 1)	APCS- E□□□AS	Applicable Motor	All models of APM-SA/SB/SC/HB Series INC

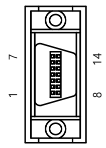
Specifications

Motor Side Connector　　　　Dirve Side Connector





Pin No.	Encoder Signal	Pin No.	Encoder Signal	Pin No.	Encoder Signal
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



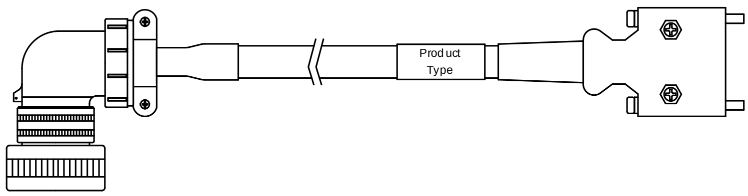
Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	W	8	/Z
2	/W	9	Z
3	V	10	/B
4	/V	11	B
5	U	12	/A
6	/U	13	A
7	0V	14	+5V
Plate		SHIELD	

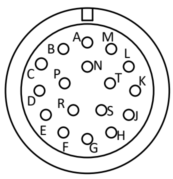
1. Motor connection
a. Cap specifications (15 Positions): 172163-1 (AMP)
b. Socket specifications: 170361-1 (AMP)
2. Drive connection (CN2)
a. CASE Model: 10314-52A0-008 (3M) or SM-14J (Suntone)
b. CONNECTOR Model: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 7Px0.2SQ or 7Px24AWG

Classification	For signals	Product Name	Medium and Large Capacity MS Type INC Encoder Cable
Model Name (Note 1)	APCS- E□□□BS	Applicable Motor	All models of APM-HE SERIES INC

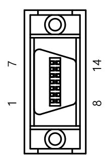
Specifications

Motor Side Connector　　　　Dirve Side Connector





Pin No.	Encoder Signal	Pin No.	Encoder Signal	Pin No.	Encoder Signal
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



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

1. Motor connection (MS: Military Standard)
a. Plug specifications: MS3108B 20-29S
2. Drive connection (CN2)
a. CASE Model: 10314-52A0-008 (3M) or SM-14J (Suntone)
b. CONNECTOR Model: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 7Px0.2SQ or 7Px24AWG

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

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

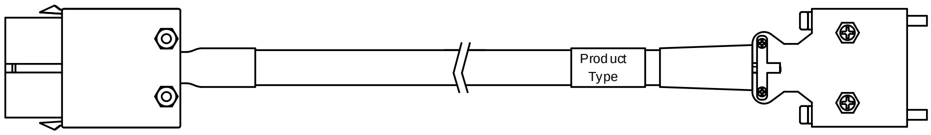
■ Option (Serial Encoder Cable)

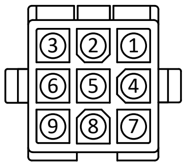
Classification	For signals	Product Name	Small Capacity AMP Type Serial Encoder Cable (Single Turn)
Model Name (Note 1)	**APCS- E□□□CS**	**Applicable Motor**	**All models of APM-SB/SC Series S-turn**

Specifications

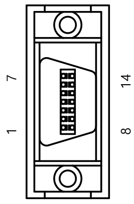
Motor Side Connector

Dirve Side Connector





Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	MA	6	-
2	/MA	7	+5V
3	SLO	8	0V
4	SLO	9	SHIELD
5	-		



Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	-	8	-
2	-	9	-
3	MA	10	-
4	/MA	11	-
5	SLO	12	-
6	/SLO	13	-
7	0V	14	+5V
Plate		SHIELD	

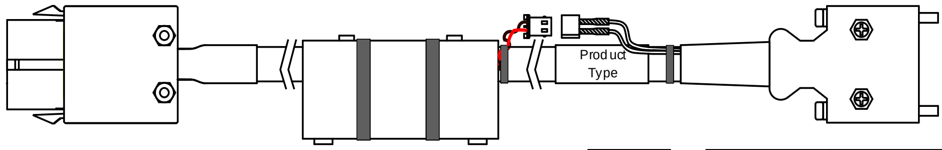
1. Motor connection
a. Cap specifications (9 Positions): 172161-1 (AMP)
b. Socket specifications: 170361-1 (AMP)
2. Drive connection (CN2)
a. CASE Model: 10314-52A0-008 (3M) or SM-14J (Suntone)
b. CONNECTOR Model: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable Model: 3Px0.2SQ or 3Px24AWG

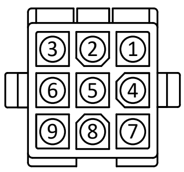
Classification	For signals	Product Name	Small Capacity AMP Type Serial Encoder Cable (Multi-turn)
Model Name (Note 1)	**APCS- E□□□CS1**	**Applicable Motor**	**All models of APM-SB/SC Series M-turn**

Specifications

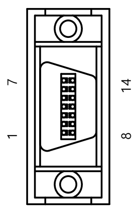
Motor Side Connector

Dirve Side Connector



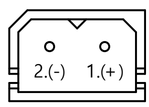


Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	MA	6	GND_B
2	/MA	7	+5V
3	SLO	8	0V
4	SLO	9	SHIELD
5	VDD_B		



Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	-	8	-
2	-	9	-
3	MA	10	-
4	/MA	11	-
5	SLO	12	-
6	/SLO	13	-
7	0V	14	+5V
Plate		SHIELD	

Battery Connector



Pin No.	Encoder Signal	Line Color
1	BATTERY(VDD_B)	Red
2	BATTERY 0V(GND_B)	Black

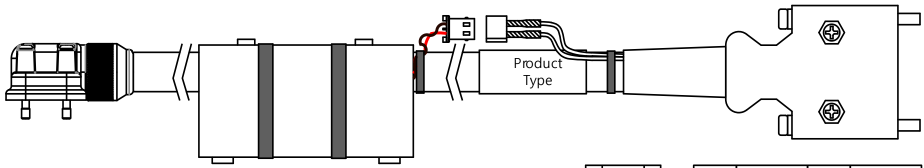
1. Motor connection
a. Cap specifications (9 Positions): 172161-1 (AMP)
b. Socket specifications: 170361-1 (AMP)
2. Drive connection (CN2)
a. CASE Model: 10314-52A0-008 (3M) or SM-14J (Suntone)
b. CONNECTOR Model: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 4Px0.2SQ or 4Px24AWG
4. Battery connection
a. Connector specifications: 5267-02A (Molex)
b. Battery specifications: ER6V (TOSHIBA, AA, 3.6V, 2000 mAh)

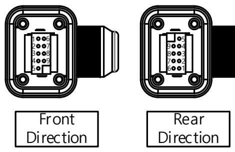
■ Option (Serial Encoder Cable)

Classification	For signals	Product Name	Serial Encoder Cable for Small Capacity Flat Motor (Multi-turn)
Model Name (Note 1)	APCS- E□□□ES1(Front Direction)/ APCS- E□□□ES1-R(Rear Direction)	Applicable Motor	All models of APM-FAL/ FBL/FCL SERIES M-turn

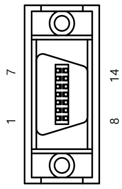
Specifications

Motor Side Connector　　　Dirve Side Connector





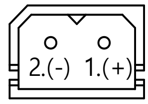
Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	MA	6	/MA
2	SLO	7	/SLO
3	-	8	-
4	0V	9	+5V
5	SHIELD		



Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	-	8	-
2	-	9	-
3	MA	10	-
4	/MA	11	-
5	SLO	12	-
6	/SLO	13	-
7	0V	14	+5V
Plate		SHIELD	

1. Motor connection
   a. Cap specifications (9 Positions): 2201825-1 (Tyco)
   b. Socket specifications: 2174065-4 (Tyco)
2. Drive connection (CN2)
   a. CASE Model: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. CONNECTOR Model: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 4Px0.2SQ or 4Px24AWG 4. Battery connection
4. Battery connection
   a. Connector specifications: 5267-02A (Molex)
b. Battery specifications: ER6V (TOSHIBA, AA, 3.6V, 2000 mAh)

Battery Connector

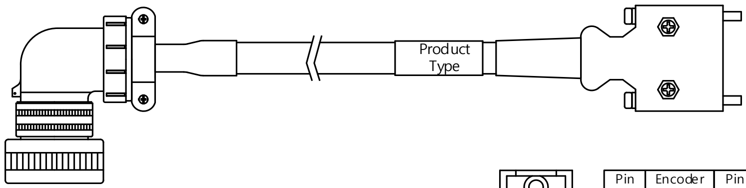


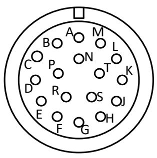
Pin No.	Encoder Signal	Line Color
1	BATTERY(VDD_B)	Red
2	BATTERY 0V(GND_B)	Black

Classification	For signals	Product Name	Medium and Large Capacity MS Type Serial Encoder Cable (Single Turn)
Model Name (Note 1)	APCS- E□□□DS	Applicable Motor	All models of APM-FE/FF/FG SERIES S-turn

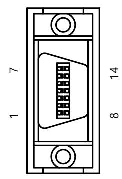
Specifications

Motor Side Connector　　　Dirve Side Connector





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



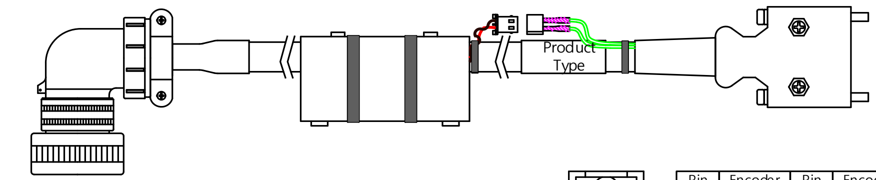
Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	-	8	-
2	-	9	-
3	MA	10	-
4	/MA	11	-
5	SLO	12	-
6	/SLO	13	-
7	0V	14	+5V
Plate		SHIELD	

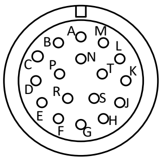
1. Motor connection (MS: Military Standard)
   a. Plug specifications: MS3108B 20-29S
2. Drive connection (CN2)
   a. CASE Model: 10314-52A0-008 (3M) or SM-14J (Suntone)
   b. CONNECTOR Model: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable Model: 3Px0.2SQ or 3Px24AWG

■ Option (serial encoder cable)

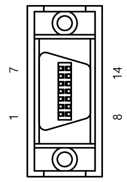
Classification	For signals	Product Name	Medium and Large Capacity MS Type Serial Encoder Cable (Multi-turn)
Model Name (Note 1)	APCS- E□□□DS	Applicable Motor	All models of APM-FE/FF/FG SERIES M-turn

Specifications





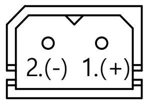
Pin No.	Encoder Signal	Pin No.	Encoder Signal	Pin No.	Encoder Signal
A	MA	F	-	P	-
B	/MA	K	-	R	-
C	SLO	L	-	H	+5V
D	/SLO	M	-	G	0V
E	-	N	-	J	SHIELD



Pin No.	Encoder Signal	Pin No.	Encoder Signal
1	-	8	-
2	-	9	-
3	MA	10	-
4	/MA	11	-
5	SLO	12	-
6	/SLO	13	-
7	0V	14	+5V
Plate		SHIELD	

1. Motor connection (MS: Military Standard)
a. Plug specifications: MS3108B 20-29S
2. Drive connection (CN2)
a. CASE Model: 10314-52A0-008 (3M) or SM-14J (Suntone)
b. CONNECTOR Model: 10114-3000VE (3M) or SM-14J (Suntone)
3. Cable specifications: 4Px0.2SQ or 4Px24AWG
4. Battery connection
a. Connector specifications: 5267-02A (Molex)
b. Battery specifications: ER6V (TOSHIBA, AA, 3.6V, 2000 mAh)

Battery Connector

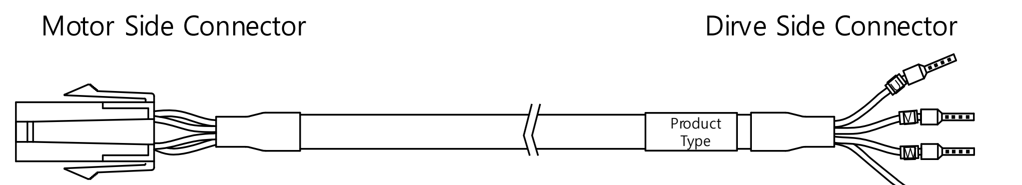


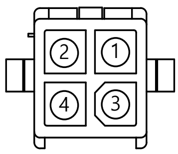
Pin No.	Encoder Signal	Line Color
1	BATTERY(VDD_B)	Red
2	BATTERY 0V(GND_B)	Black

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

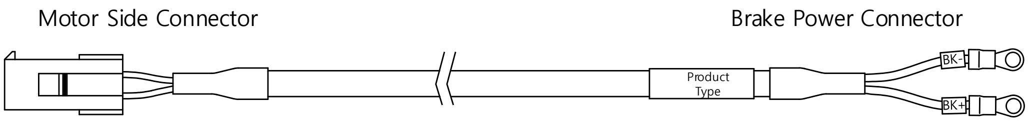
Cable Length (m)	3	5	10	20
Robot Cable	F03	F05	F10	F20
Regular Cable	N03	N05	N10	N20

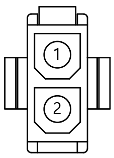
■ [200V] Option (Standard Power Cable)

<table>
<tr><td>Classification</td><td>For main power</td><td>Product Name</td><td>Small Capacity AMP Type Power Cable</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□GS</td><td>Applicable Motor</td><td>All models of APM-SA/SB/SC/HB Series</td></tr>
<tr><td>Specifications</td><td colspan="3">




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

1. Motor connection
a. Cap specifications (4 Positions): 172159-1 (AMP)
b. Socket specifications: 170362-1 (AMP)
2. Drive connection (U, V, W, FG)
a. U, V and W pin specifications: 1512
b. FG pin specifications: 1.5x4 (ring terminal)
3. Cable model: 4Cx0.75SQ or 4Cx18AWG
</td></tr>
<tr><td>Classification</td><td>For brake release</td><td>Product Name</td><td>Small Capacity AMP Type Brake Cable</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□KB</td><td>Applicable Motor</td><td>All models of APM-SA/SB/SC Series</td></tr>
<tr><td>Specifications</td><td colspan="3">




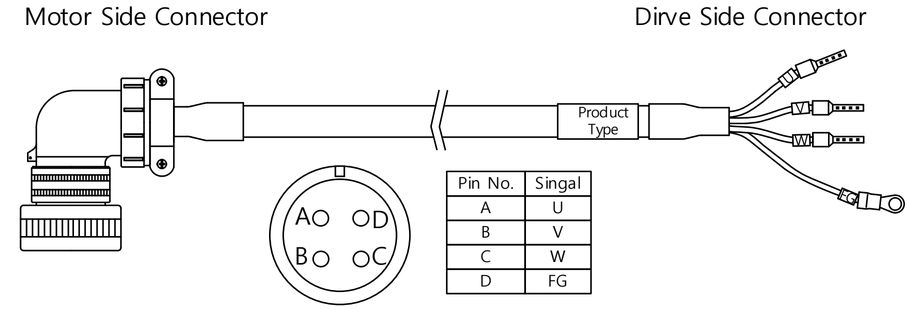
Pin No.	Phase
1	BK+
2	BK-

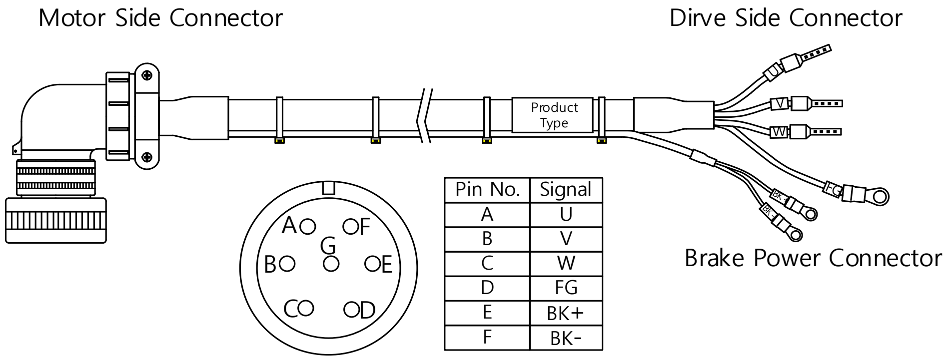
1. Motor connection
a. Cap specifications (2 Positions): 172157-1 (AMP)
b. Socket specifications: 170362-1 (AMP)
2. For braking power
a. Connection terminal specifications: 1.5x3 (ring terminal)
3. Cable specifications: 2Cx0.75SQ or 2Cx19AWG
</td></tr>
</table>

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

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

■ [200V] Option (Standard Power Cable)

<table>
<tr><td>Classification</td><td>For main power</td><td>Product Name</td><td>Medium Capacity MS Type Power Cable (for 130 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□HS</td><td>Applicable Motor</td><td>All models of APM-FE/HE Series</td></tr>
<tr><td>Specifications</td><td colspan="3">


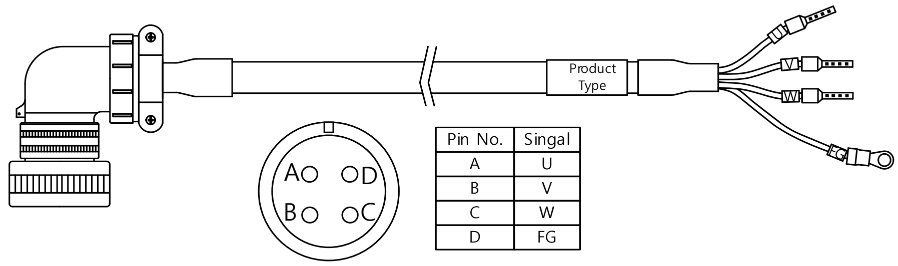
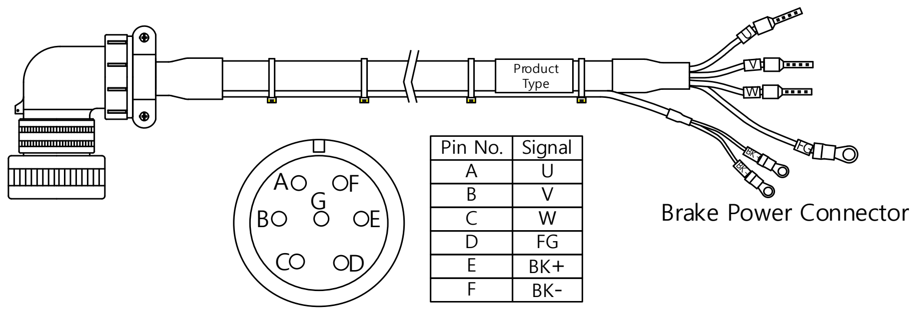
1. Motor connection (MS: Military Standard)
a. Plug specifications: MS3108B 20-4S
2. Drive connection (U, V, W, FG)
a. U, V and W pin model: 2512
b. FG pin specifications: 2.5x4 (ring terminal)
3. Cable specifications: 4Cx2.5SQ or 4Cx14AWG
</td></tr>
<tr><td>Classification</td><td>For power and brake</td><td>Product Name</td><td>Medium Capacity MS Type Power/Brake Cable (for 130 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□NB</td><td>Applicable Motor</td><td>All models of APM-FE Series</td></tr>
<tr><td>Specifications</td><td colspan="3">


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

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

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

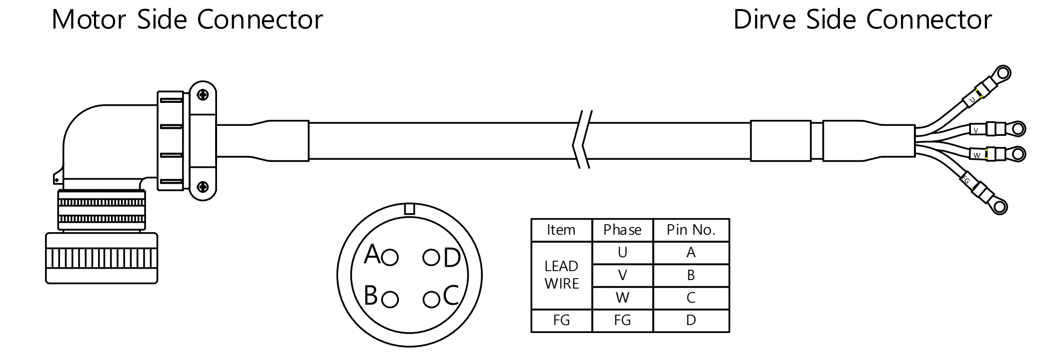
■ [200V] Option (Standard Power Cable)

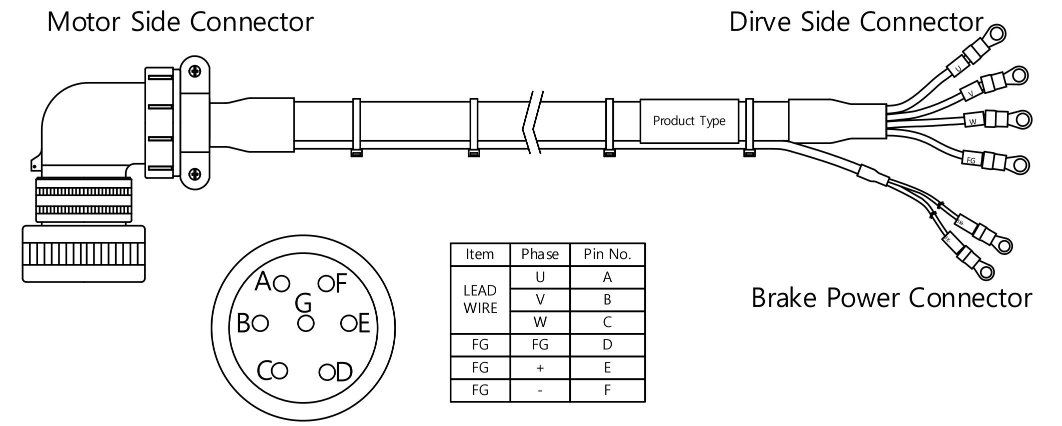
<table>
<tr><td>Classification</td><td>For main power</td><td>Product Name</td><td>Medium Capacity MS Type Power Cable (for 180/220 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□IS</td><td>Applicable Motor</td><td>FF30A, FF22D, FF35D, FF20G, FF30G,FF12M, FF20M, FF30M
FG22D, FG35D, FG20G, FG12M, FG20M, FG30M</td></tr>
<tr><td>Specifications</td><td colspan="3">Motor Side Connector Dirve Side Connector

<table><tr><th>Pin No.</th><th>Singal</th></tr><tr><td>A</td><td>U</td></tr><tr><td>B</td><td>V</td></tr><tr><td>C</td><td>W</td></tr><tr><td>D</td><td>FG</td></tr></table>
1. Motor connection (MS: Military Standard)
a. Plug specifications: MS3108B 22-22S
2. Drive connection (U, V, W, FG)
a. U, V and W pin model: 2512
b. FG pin specifications: 2.5x4 (ring terminal)
3. Cable specifications: 4Cx2.5SQ or 4Cx14AWG</td></tr>
<tr><td>Classification</td><td>For power and brake</td><td>Product Name</td><td>Medium Capacity MS Type Power/Brake Cable (for 180 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□PB</td><td>Applicable Motor</td><td>FF30A, FF22D, FF35D, FF20G, FF30G,
FF12M, FF20M, FF30M</td></tr>
<tr><td>Specifications</td><td colspan="3">Motor Side Connector Dirve Side Connector

<table><tr><th>Pin No.</th><th>Signal</th></tr><tr><td>A</td><td>U</td></tr><tr><td>B</td><td>V</td></tr><tr><td>C</td><td>W</td></tr><tr><td>D</td><td>FG</td></tr><tr><td>E</td><td>BK+</td></tr><tr><td>F</td><td>BK-</td></tr></table>
1. Motor connection
a. PLUG specifications: MS3108B 24-10S (MS)
2. Drive connection
a. U, V and W pin specifications: 2512
b. FG pin specifications: 2.5 x 4 (ring terminal)
3. Power cable specifications: 4Cx2.5SQ or 4Cx14AWG
4. Brake power connection
a. Connection terminal specifications: 1.5 x 3 (ring terminal)
5. Brake cable specifications: 2Cx0.75SQ or 2Cx19AWG</td></tr>
</table>

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

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

■ [200V] Option (Standard Power Cable)

<table>
<tr><td>Classification</td><td>For main power</td><td>Product Name</td><td>Medium Capacity MS Type Power Cable (for 180/220 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□JS</td><td>Applicable Motor</td><td>FF50A, FF55D, FF44G, FF44M, FG55D, FG44G, FG44M</td></tr>
<tr><td>Specifications</td><td colspan="3">


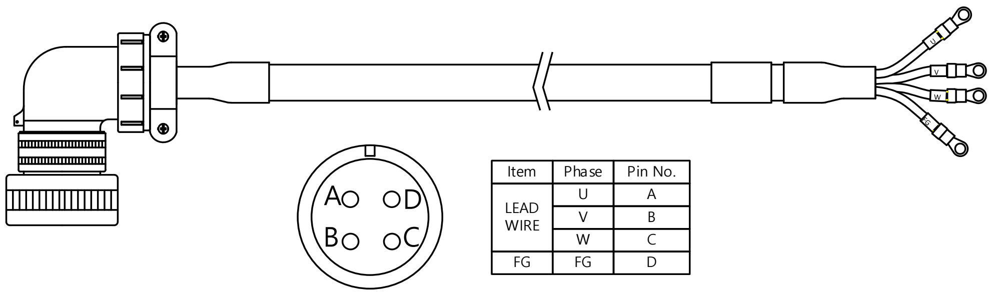
1. Motor connection (MS: Military Standard)
a. Plug specifications: MS3108B 22-22S
2. Drive connection (U, V, W, FG)
a. U, V and W pin specifications: 6. 0X5 (ring terminal)
3. Cable specifications: 4Cx6.0SQ or 4Cx10AWG
</td></tr>
<tr><td>Classification</td><td>For power and brake</td><td>Product Name</td><td>Medium Capacity MS Type Power/Brake Cable (for 180 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□LB</td><td>Applicable Motor</td><td>FF50A, FF55D, FF44G, FF44M</td></tr>
<tr><td>Specifications</td><td colspan="3">


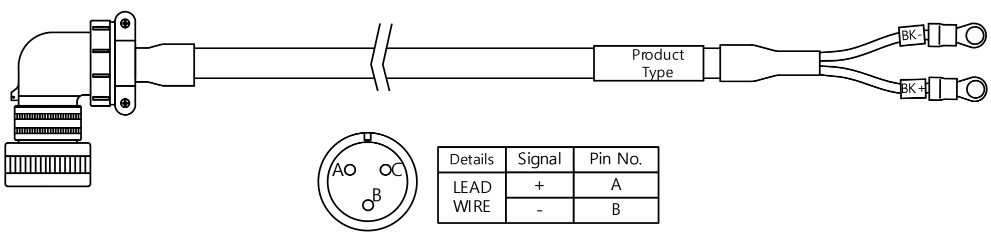
1. Motor connection (MS: Military Standard)
a. Plug specifications: MS3108B 24-10S
2. Drive connection (U, V, W, FG)
a. U, V and W pin specifications: 6. 0X5 (ring terminal)
3. Power cable specifications: 4Cx6.0SQ or 4Cx10AWG
4. Brake power connection
a. Connection terminal specifications: 1.5 x 3 (ring terminal)
5. Brake cable specifications: 2Cx0.75SQ or 2Cx19AWG
</td></tr>
</table>

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

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

■ [200V] Option (Standard Power Cable)

<table>
<tr><td>Classification</td><td>For main power</td><td>Product Name</td><td>Medium Capacity MS Type Power Cable (for 220 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□MS</td><td>Applicable Motor</td><td>FG60M, FG75G</td></tr>
<tr><td>Specifications</td><td colspan="3">

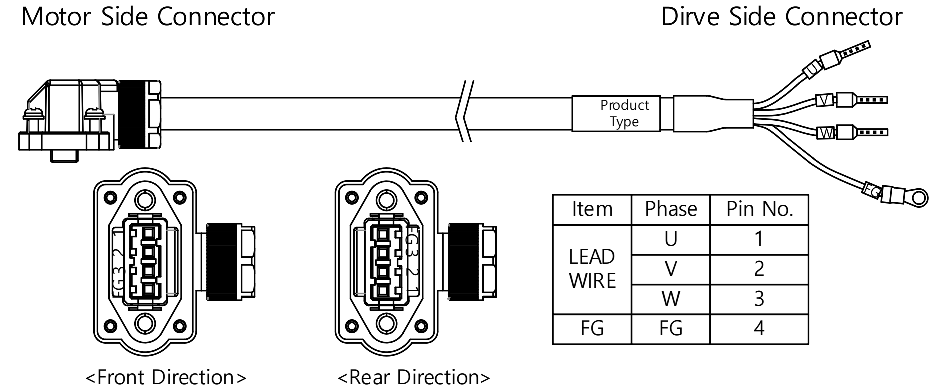
1. Motor connection (MS: Military Standard)
a. PLUG specifications: MS3108A 32-17S
2. Drive connection (U, V, W, FG)
a. FG pin specifications: 10 x 5 (ring terminal)
3. Cable specifications: 4Cx6.0SQ or 4Cx10AWG</td></tr>
<tr><td>Classification</td><td>For main power</td><td>Product Name</td><td>Medium Capacity MS Type Brake Cable (for 220 Flange)</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□SB</td><td>Applicable Motor</td><td>All models of FG Series (Used in common for FGP Series)</td></tr>
<tr><td>Specifications</td><td colspan="3">

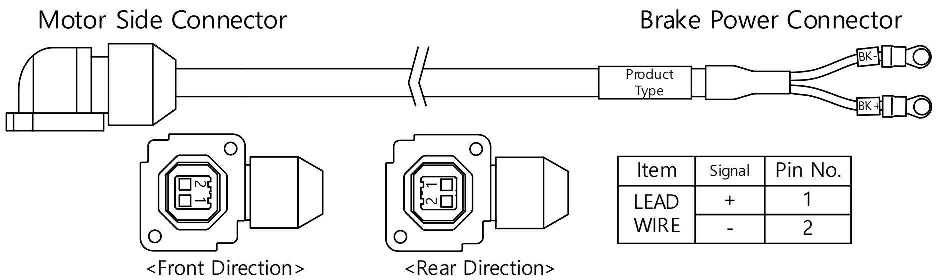
1. Motor connection
a. PLUG specifications: MS3108B 14-7S (MS)
2. For braking power
a. Connection terminal specifications: 1.5x3 (ring terminal)
3. Cable specifications: 2Cx0.75SQ or 2Cx19AWG</td></tr>
</table>

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

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

■ [200V] Option (Small Capacity L Series Power Cable)

<table>
<tr><td>Classification</td><td>For main power</td><td>Product Name</td><td>Low capacity L Series power cable</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- P□□□LS(Front Direction)/
APCS- P□□□LS-R(Rear Direction)</td><td>Applicable Motor</td><td>All APM-FAL/FBL/FCL Series models</td></tr>
<tr><td>Specifications</td><td colspan="3">

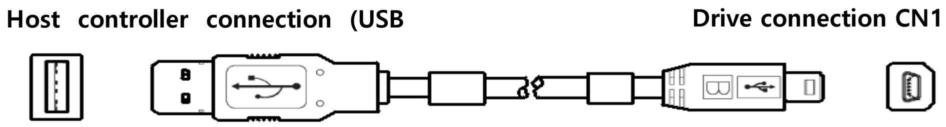
1. Motor connection
a. PLUG model: SM-JN8FT04 (Suntone)
b. Socket model: SMS-201 (Suntone)
2. Drive connection (U, V, W, FG)
a. U, V and W pin model: 1512
b. FG pin specifications: 1.5x4 (ring terminal)
3. Cable model: 4Cx0.75SQ or 4Cx18AWG
4. Other: FAL products require encoder cable installation after power cable installation.</td></tr>
<tr><td>Signal Address</td><td>For brake</td><td>Product Name</td><td>Low capacity L Series brake cable</td></tr>
<tr><td>Model Name (Note 1)</td><td>APCS- B□□□QS(Front Direction)/
APCS- B□□□QS-R(Rear Direction)</td><td>Applicable Motor</td><td>All models of APM-FAL/FBL/FCL Series</td></tr>
<tr><td>Specifications</td><td colspan="3">

1. Motor connection
a. PLUG specifications: KN5FT02SJ1 (JAE)
b. Socket specifications: ST-KN-S-C1B-3500 (JAE)
2. For braking power
a. Connection terminal specifications: 1.5x3 (ring terminal)
3. Cable specifications: 2Cx0.5SQ or 2Cx20AWG</td></tr>
</table>

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

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

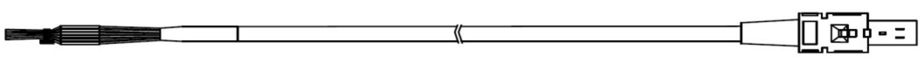
■ Option (Drive Cable)

Classification	For signal	Product Name	Communication Cable (CN5)
Model Name (Note 1)	APCS-CN5L7U	Applicable Drive	L7 Series
Specifications	 1. PC connection: USB A plug 2. Drive connection (CN5): Mini USB 5P Plug 3. Electrical requirements: Double shield, twisted pair, attachable EMI filter (Product for reference: SANWA's KU-AMB518)		

Classification	CN	Product Name	STO Connector
Model Name (Note 1)	APCS-CN6K	Applicable Drive	L7NH/NHF Series
Specifications	1. MINI I/O By-Pas 		

Classification	CN	Product Name	CN6 Connector
Model Name (Note 1)	APCS-STO□□A	Applicable Drive	L7NH/NHF Series
Specifications	1. Plug Connector Kit a. 2069577-1 (TE) 2. Cable a. 4P x 26AWG 3. Product Marking a. APCS - STO03A (0.3m) b. APCS - STO10A (1m) c. APCS - STO30A (3m)		

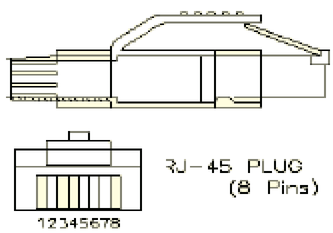
Drive connection



-Pin Map -

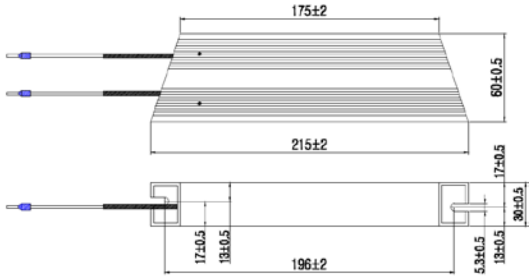
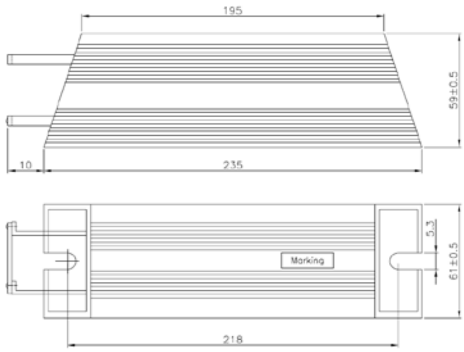
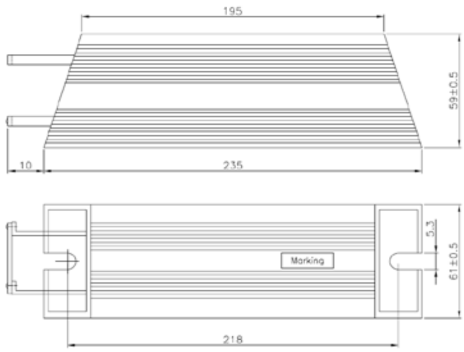
PIN No.	IO Signal	Color
1	NC	–
2	NC	–
3	HWBB1 Minus	Orange
4	HWBB1 Plus	Orange/Stripe
5	HWBB2 Minus	Yellow
6	HWBB2 Plus	Yellow/Stripe
7	EDM Plus	White
8	EDM Minus	White/Stripe

Classification	CN	Product Name	CN6 Cable
Model Name (Note 1)	APCS-CN4NNA	Applicable Drive	L7NH/NHF Series
Specifications	RJ-45 (Wlztek)		

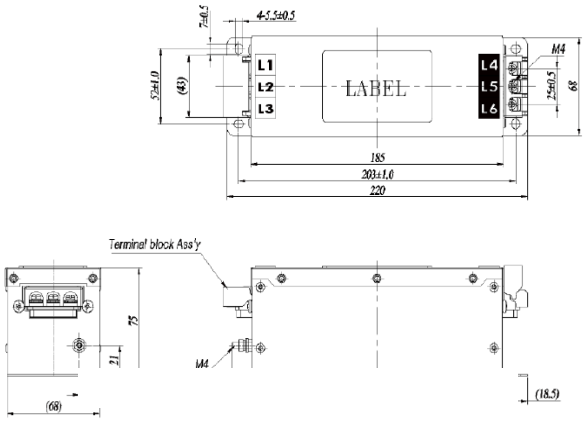
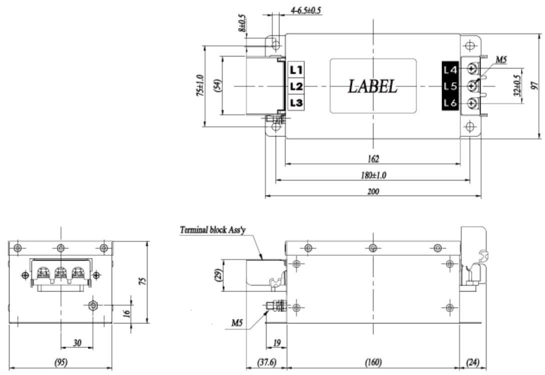
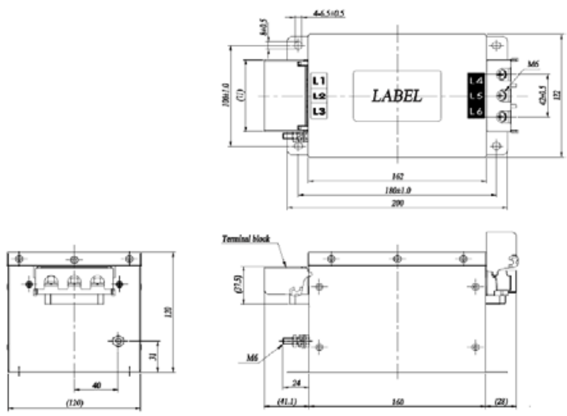


PIN No.	Signal Names	Line Color
1	Tx/Rx0+	White/Orange
2	Tx/Rx0−	Orange
3	Tx/Rx1+	White/Green
4	Tx/Rx2+	Blue
5	Tx/Rx2−	White/Blue
6	Tx/Rx1−	Green
7	Tx/Rx3+	White/Brown
8	Tx/Rx3−	Brown
Plate		Shield

■ Option Specifications (Braking Resistance)

Item	Product Name	Model Name	Applicable Drive	Specifications
Resistance	Braking Resistance	APC-300R30	L7NHFA010U	
Resistance	Braking Resistance	APC-600R30	L7NHFA035U (3P)	
Resistance	Braking Resistance	APC-600R28	L7NHFA050U (4P) L7NHFA075U (4P)	

■ **Option (Noise Filter)**

Item	Product Name	Model Name	Applicable Drive	Specifications
Resistance	Noise Filter	APCS-TB6-B010LBEI	L7NHFA010U	
		APCS-TB6-B030NBDC	L7NHFA035U	
		APCS-TB6-B040AS	L7NHFA050U	
		APCS-TB6-B060LAS	L7NHFA075U	

12. Maintenance and Inspection

This chapter explains how to perform basic maintenance and inspection tasks as well as diagnose and troubleshoot the servo motor and drive.

12.1 Maintenance and Inspection

12.1.1 Precautions

1. When 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 largely different results.

2. When measuring the motor current: Connect and use a moving-iron-type ampere meter because the motor's reactance smooths the pulse waveform to produce partial sine waves.

3. When measuring the electric power: Use an electrodynamo-meter and measure 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 an input current gauge of 1mA or lower.

12.1.2 What to Inspect

Wait at least 10 minutes after turning off the power before beginning the inspection because the condenser can hold enough voltage to cause an electrical accident.

(1) Servo Motor Inspection

⚠ Caution
Wait at least 10 minutes after turning off the power before beginning the inspection because the condenser can hold enough voltage to cause an electrical accident.

Inspection Items	Inspection Time	Inspection and Handling	Notes
Vibration and sound check	Monthly	Touch the motor and listen to sounds.	The feel and sounds must be the same as usual.
Exterior check	Depends on the level of contamination or damage.	Clean the motor with a cloth or air.	-
Insulation resistance measurement	At least once a year	Disconnect the motor from the drive and measure insulation resistance. A normal resistance level is 10[㏁] or higher. Note 1)	Contact our service center if resistance is lower than 10[㏁].
Oil seal replacement	At least once every 5,000 hours	Remove the oil seal from the motor and replace it.	Only applies to motors with an oil seal.
General inspection	At least once every 20,000 hours or 5 years.	Contact our service center.	Do not disassemble the servo motor by yourself for cleaning.

Note 4) Measure the resistance between PE and one of the U, V and W power cables in the servo motor.

(2) Servo Drive Inspection

Inspection Items	Inspection Time	Inspection Method	What to do for Abnormalities
Main body and boards cleaning	At least once a year	There must be no dust or oil.	Clean it with air pressure or cloth.
Loose screws	At least once a year	Check if terminal block or connector tightening screws, etc. are not loose.	Tighten the screws.
Defective parts of the main body or control board	At least once a year	Check for discoloration, damage or disconnection caused by heat.	Contact our company.

12.1.3 Parts Replacement Cycle

Mechanical friction or aging of objects with certain characteristics may deteriorate performance of the following parts or cause them to malfunction. Therefore it is important to conduct regular maintenance checks and regular replacement.

1. Smoothing condenser: Ripple currents and other factors can cause this part to wear down. The lifespan of the condenser depends on the operating temperature and environmental conditions. 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 certain short periods of time (inspect at least once half a year as it approaches its end of life).

   ※ Visual inspection criteria

   a. The condition of the case: Check for enlargement of the sides and bottom.

   b. The condition of the lid: Check for notable enlargement, severe cracks, or broken parts.

   c. The condition of the explosion valve: Check for notable valve enlargement and check the operation status.

   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 rated capacity degrades to 85% or lower.

2. Relays: Check for bad connection and wear and tear of the contacts caused by switching currents. A relay is obsolete when its accumulated number of switches reaches around 100,000 times, depending on the power capacity.

3. Motor bearings: Replace the bearings after 20,000 to 30,000 hours of operation at the rated velocity under the rated load. Replace the bearings if abnormal sounds or vibrations are detected during inspection, depending on the operating conditions.

[Standard Part Replacement Cycles]

Part Names	Standard Replacement Cycle	Replacement Method
Smoothing Condenser	7~8 years	Replace (Determine after inspection)
Relays	-	Determine after inspection
Fuses	10 years	Replace
Aluminum electrolytic condensers on the printed circuit board	5 years	Replace with new boards (Determine after inspection)
Cooling Fans	4~5 years	Replace
Motor Bearings	-	Determine after inspection
Motor Oil Seal	5,000 hours	Replace

12.2 Diagnosing Abnormalities and Troubleshooting

An alarm or warning is generated if a problem occurs during operation. If this happens, find the applicable code and take a proper action. If the problem persists after taking such a measure, contact our service center.

12.2.1 Servo Motor

[Cause of abnormalities, inspection procedure, and troubleshooting methods]

Symptoms	Cause	Inspection Method	Remedies
The motor does not move.	The P-OT and N-OT inputs are off.	Refer to "2. Wiring and Connection" or "2.5. Wiring for Input/Output Signals."	Turn on the P-OT and N-OT inputs.
	The motor is defective.	Use a resistance tester to measure the resistance to the motor lead terminal (resistance between phases: several ohms).	Replace the motor.
	The locking screws are loose.	Check the locking screws.	Tighten any loose screws.
	The external wiring is incorrect or the cables are disconnected.	Check the wires to the motor and the encoder.	Redo the wiring. Replace the cables.
	Encoder failure	Check the output waves.	Replace the encoder. (Contact our service center.)
Motor rotation is unstable.	The connection is bad.	Check the connection of the motor lead terminal.	Fix any bad connections.
	The input voltage is low.	Check the input voltage of the drive.	Change the power source.
	Overloads occur.	Check the condition of the machine.	Remove any foreign substances from the rotating unit and grease or lubricate it.
The motor overheats.	The ambient temperature is too high.	Check the temperature around the motor. (40℃ or lower)	Change heat transfer structure. Install a cooling fan.
	The surface of the motor is contaminated.	Check whether there are any foreign substances on the surface of the motor.	Clean the surface of the motor.
	Overloads occur.	Check the load on the drive. Check the acceleration/deceleration time.	Reduce the load. Increase the acceleration/deceleration time. Replace with a motor with a greater capacity.
	The magnetic power of the magnets is reduced.	Check the counter voltage and voltage waveforms.	Replace the motor.
The device is making a strange sound.	Coupling is bad.	Tighten the coupling screws and measure the concentricity of the connection.	Readjust the coupling.
	The bearings are abnormal.	Check the bearings for vibrations and sounds.	Contact us.
	The parameters are set incorrectly (the inertia, gain, and time constants).	Check the parameters.	Refer to Chapter 9 Object Dictionary.

12.2.2 Servo Drive

■ Servo Alarms

If the drive detects a problem, it triggers a servo alarm and transition to the servo off state for a stop. In this case, the setting value of emergency stop configuration (0x2013) is used to stop the drive.

Alarm Code Names	Causes	Inspection Items	Measures to Take
AL-10 IPM fault (Overcurrent (H/W)) AL-14 Over current (Overcurrent (S/W)) AL-16 Current limit exceeded (Overcurrent (H/W))	Motor cable abnormality	Check for abnormal wiring and short circuit.	Replace the motor cable.
	Encoder cable abnormality	Check for abnormal wiring and short circuit.	Replace the encoder cable.
	Parameter setting abnormality	Motor ID [0x2000], encoder type [0x2001], and encoder type [0x2002] settings should be the same as the motor label information.	Modify the parameters so that they match the information on the motor label.
	Motor phase resistance inspection	Inspect resistance between motor lines (U-V, V-W, W-U below several Ω)	Replace the motor.
	Apparatus abnormality	Determine whether there are conflicts or binding among the apparatuses.	Inspect the apparatuses.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
	Noise-related abnormalities	Improve the noise-related environment including wiring and installation.	Check the wiring of the PE. Adjust the PE wiring size so that it matches the size of the drive main circuit wiring.
AL-11 IPM temperature (IPM Overheat)	Ambient temperature	Check if the ambient temperature exceeds 50[℃].	Lower the temperature around the drive.
	Continual overload alarm	Check if the load is lower than 100% by the accumulated operation overload ratio value [0x2603].	Change the capacity of the drive and motor. Adjust gain.
	Highly frequent regenerative operation or continual regenerative operation	Check accumulated regeneration overload ratio [0x2606].	Adjust the setting value for regeneration brake resistor configuration [0x2009]. Use an external regeneration brake resistor.
	Installation direction of the drive	Check the installation status of the drive.	Refer to Section 2. “Wiring and Connection .”
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-15 Current offset (Current offset	Excessive setting of the motor’s U and V Phase current offset	Check whether the U, V, W phase current offsets [0x2015] - [0x2017] are 5% of the rated current or higher.	Re-adjust phase current offset.

Alarm Code Names	Causes	Inspection Items	Measures to Take
abnormality)	Drive abnormality	-	If alarms occur continually after phase current offset adjustment, replace the drive since there may be abnormalities in the drive.
AL-21 Continuous overload	Continuous operation with a load exceeding the rated value	Check if the load is lower than 100% during a constant-velocity operation or pause by the accumulated operation load rate [0x2603].	Change the capacity of the motor and drive. Adjust gain.
	Motor brake abnormality	Check for opening of the motor brake during SVON.	Supply power to the motor brake.
	Parameter setting abnormality	Check the setting values for motor ID [0x2000], encoder type [0x2001] and encoder format [0x2002] with the applied information on the motor label.	Modify the parameters so that they match the information on the motor label.
		Check the setting value of overload check base [0x200F].	Set an appropriate value.
	Apparatus abnormality	Check for any abnormality during operation.	Inspect the apparatuses.
	Motor cable abnormality	Check for abnormal wiring and short circuit.	Replace the motor cable.
	Encoder cable abnormality	Check for abnormal wiring and short circuit.	Replace the encoder cable.
AL-22 Drive temperature 1 (Drive overheat 1)	Ambient temperature	Check if the ambient temperature exceeds 50[℃].	Lower the temperature around the drive.
	Drive abnormality	Check if the displayed drive temperature 1 value [0x260B] is highly different than the ambient temperature in the normal state.	Replace the drive.
AL-23 Regeneration overload	Capacity exceeded due to highly frequent operation or continual regenerative operation.	Check the accumulated regeneration overload rate [0x2606] setting.	Adjust the regeneration brake resistor configuration [0x2009] after connecting the external regeneration brake resistor and use the external regeneration brake resistor.
	Parameter setting abnormality	Check the regeneration brake resistor-related parameters [0x2009] - [0x200E] settings.	Set an appropriate value.
	Main power input voltage abnormality	Check whether the main power voltage is 385 Vdc or higher.	Re-inspect the main power source.
	Drive abnormality	Check if the regeneration brake resistor generates any heat when not in operation.	Replace the drive.
AL-24 Motor cable open (Motor disconnection)	Parameter setting abnormality	Check the settings [0x2015], [0x2015] and [0x2015] for U, V and W phase current offsets.	Execute the command for the current offset adjustment procedure.
	Motor cable abnormality	Check for cable disconnection.	Replace the motor cable.
	Motor abnormality	Check for U, V, W short circuit inside the motor. (U-V, V-W, W-U)	Replace the motor.
	Drive abnormality	-	If an alarm occurs continuously after SV-ON, there may be a problem with the drive. Replace the drive.
AL-25 Drive temperature 2 (Drive overheat 2)	Ambient temperature	Check if the ambient temperature exceeds 50[℃].	Lower the temperature around the drive.
	Drive abnormality	In normal conditions, check if the drive temperature 2 [0x260C] is	Replace the drive.

Alarm Code Names	Causes	Inspection Items	Measures to Take
		significantly different from the ambient temperature.	
AL-26 Encoder temperature (Encoder Overheat)	Reserved	-	-
AL-30 Encoder communication (Serial Encoder Communication Error) AL-31 Encoder cable open (Encoder cable disconnection) AL-32 Encoder data (Encoder Data Error)	Encoder cable abnormality	Check for disconnection, abnormal connection and short circuit.	Replace the encoder cable.
	Parameter setting abnormality	Encoder type [0x2001] and encoder resolution [0x2002] settings should be the same as the motor label information.	Modify the parameter so it matches the motor label information. If the modified values are not applied after saving the parameters, replace the motor because there may be a problem with the motor.
	Encoder abnormality	-	If alarms occur continually after power cycling, replace the motor since there may be abnormalities in the motor.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-33 Motor setting (Motor ID Setting Error)	Motor ID setting	Motor ID [0x2000] setting should be the same as the motor label information.	Modify the parameters so that they match the information on the motor label. This alarm can be canceled after parameter modification when the power is on/off.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-34 Z Phase open (Encoder Z-phase Loss)	Parameter setting abnormality	Check the setting of the warning mask [0x2014].	If the motor does not use the Z phase (e.g. step motor), set the 14th bit in the warning mask settings to mask the AL-34.
	Encoder cable abnormality	Check for abnormal wiring and short circuit.	Replace the encoder cable.
	Encoder abnormality	-	If alarms occur continually after power cycling, replace the motor since there may be abnormalities in the motor.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-35 Low battery (Low Voltage of Encoder Battery)	Parameter setting abnormality	Check the setting value of the absolute encoder configuration [0x2005].	If you want to use an absolute encoder as an incremental encoder, set it to 1 so the alarm does not occur.
	Defective battery connection, unconnected	Check the battery connection status.	Connect the battery accurately.
	Low battery voltage	Check if the battery voltage is 3.3V or higher.	Replace the battery.
AL-36 Sinusoidal ENC amplitude (Encoder Sine Wave Amplitude Error)	Encoder cable abnormality	Check for disconnection, abnormal connection and short circuit. Check for shield and PE disconnection.	Replace the encoder cable.

Alarm Code Names	Causes	Inspection Items	Measures to Take
AL-37 Sinusoidal ENC frequncy (Encoder Sine Wave Frequency Error)	Parameter setting abnormality	Check the encoder type setting [0x2001].	Check the encoder type setting. Check the speed command. (Maximum: 250kHz)
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
	Converter failure	-	If alarms occur continually after power cycling, there may be a problem with the converter. Replace the converter.
	Encoder abnormality	-	If alarms occur continually after power cycling, there may be a problem with the encoder. Replace the encoder.
AL-38 Encoder setting error (Encoder Setting Error)	Abnormal combination of drive and motor	Check the brand label codes of the drive and motor.	Please use drives and motors with the same brand label.
	Encoder cable abnormality	Check for abnormal wiring and short circuit.	Replace the encoder cable.
	Encoder abnormality	-	If alarms occur continually after power cycling, replace the motor since there may be abnormalities in the motor.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-40 Under voltage (Low Voltage)	Main power input voltage abnormality	Check whether the main power voltage is about 134 Vac or higher.	Re-inspect the main power source.
		Check whether the DC link voltage [0x2605] is above 190 Vdc while the main power is being supplied.	Replace the drive.
	Lowered power voltage during operation	Check the wiring status of the main power.	Use a 3-phase voltage supply.
AL-41 Over voltage (Overvoltage)	Main power input voltage abnormality	Check whether the main power voltage is about 286 Vac or lower.	Re-inspect the main power source.
		Check whether the DC link voltage [0x2605] is below 405 Vdc while the main power is being supplied.	Replace the drive.
	High external regeneration brake resistor	Check the operation conditions and the regeneration brake resistor value.	Please recheck the regeneration brake resistor value considering the operation condition and load.
	Acceleration/deceleration setting values	Check whether a rapid increase/decrease occurs frequently.	Set a high value for acceleration/deceleration time.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-42 Main power fail (Main power fail)	Main power input voltage abnormality	Check the voltage range of 200-230 Vac between L1, L2 and L3 phases.	Re-check power.
	Parameter setting abnormality	Check the main power fail check mode setting [0x2006] according to the main power input status.	Make parameter settings and wiring with a 3-phase input power if possible.

Alarm Code Names	Causes	Inspection Items	Measures to Take
	Momentary power outage	Check the main power fail check time setting [0x2007].	Increase the monitoring interval of the main power fail check time [0x2007] or check the power supply.
	Drive abnormality	-	If alarms occur continually after power cycling, there may be a problem with the drive. Replace the drive.
AL-43 Control power fail (Control power fail)	A voltage failure between C1 and C2 phases.	The voltage between C1 and C2 phases should be within 200-230 Vac.	Re-verify the control power.
	Drive abnormality	-	If alarms occur continually after power cycling, there may be a problem with the drive. Replace the drive.
AL-50 Over speed limit (Over speed limit)	Motor cable abnormality	Check for abnormal wiring and short circuit.	Replace the motor cable.
	Encoder cable abnormality	Check for abnormal wiring and short circuit.	Replace the encoder cable.
	Parameter setting abnormality	Motor ID [0x2000], encoder type [0x2001], and encoder resolution [0x2002] settings should be the same as the motor label information.	Modify the parameters so that they match the information on the motor label.
		Check the gear ratio [0x6091] setting.	Set the electric gear ratio to a lower value.
		Check the gain control parameter settings [0x2100] - [0x211F].	Re-adjust gain according to the operation conditions.
	Encoder abnormality	-	If alarms occur continually after power cycling, replace the motor since there may be abnormalities in the motor.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-51 POS following (Excessive Position Error)	Parameter setting abnormality	Check the gear ratio [0x6091] setting.	Set the electric gear ratio to a low value .
		Check the settings for following error window [0x6065] and following error timeout [0x6066].	Readjust the parameter according to the operation condition.
	Apparatus abnormality	Check for binding of the apparatuses.	Inspect the apparatuses.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-53 Excessive SPD deviation (Excessive SPD deviation)	Motor cable abnormality	Check for disconnection, abnormal wiring and short circuit.	Replace the motor cable.
	Encoder cable abnormality	Check for disconnection, abnormal wiring and short circuit.	Replace the encoder cable.
	Parameter setting abnormality	Motor ID [0x2000], encoder type [0x2001], and encoder resolution [0x2002] settings should be the same as the motor label information.	Modify the parameters so that they match the information on the motor label.
		Check the gear ratio [0x6091] setting.	Set the electric gear ratio to a lower value.
	Apparatus abnormality	Check for binding of the apparatuses. Operation status of the limit contact sensor	Inspect the apparatuses.
	Encoder abnormality	-	If alarms occur continually after power cycling, replace the motor since there may be abnormalities in

Alarm Code Names	Causes	Inspection Items	Measures to Take
			the motor.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-54 Encoder2 POS differnce (Excessive position error of external encoder)	Parameter setting abnormality	Check the external encoder gear ratio settings [0x2025] and [0x2026].	Set the electronic gear ratio .
		Check the position error range setting [0x2027].	Readjust the parameter according to the operation condition.
	Apparatus abnormality	Check for binding of the apparatuses.	Inspect the apparatuses.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-63 Parameter checksum (Parameter abnormality)	O/S replacement	Check the parameters with maximum setting values in the variable format.	Restore the default parameter (0x1011). The parameter setting values are initialized after restoration. For this reason, it is necessary to set the parameters before operation.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-71 Factory setting (Factory settings abnormality)	Parameter setting abnormality	Contact our service center. Check the drive capacity with the device name setting [0x1008].	Reset the drive capacity and download the OS again. If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
AL-80 Enc2 communication (Load Encoder Communication Error) AL-81 Enc2 cable open (Load Encoder Cable Disconnection) AL-83 Enc2 Z phase open (Load Encoder Z-phase Disconnection)	Load encoder cable failure	Check for disconnection, abnormal wiring and short circuit.	Replace the encoder cable.
	Parameter setting abnormality	The load encoder type [0x2021] and load encoder setting [0x202B] parameter settings should be the same as the encoder information.	Modify the parameters so they match the motor information.
	Load encoder failure	-	If an alarm occurs continuously after power cycling, there may be a problem with the motor. Replace the motor.
	Drive abnormality	-	If an alarm occurs continuously after power cycling, there may be a problem with the drive. Replace the drive.

Servo Warnings

If the drive detects an abnormality classified as a servo warning, it triggers a warning. In this case, the drive maintains its normal operation condition. After the cause of the warning is eliminated, the warning is automatically cleared. In case of a warning, take an appropriate action. You can set the check status of each warning with warning mask configuration (0x2014).

※ When two or more warnings occur, they are displayed as the sum of warning codes.

E.g. It is displayed as follows: "W10 (operation overload) + W40 (low voltage) = W50".

Bits	Warning Codes	Warning Names
0	W01	Main power phase loss
1	W02	Low voltage of encoder battery
2	W04	Software position limit
Bits	Warning Codes	Warning Names
3	-	-
4	W10	Operation overload
5	W20	An abnormal combination of drive and motor, or an I/O setting error.
6	W40	Low voltage
7	W80	Emergency signal input

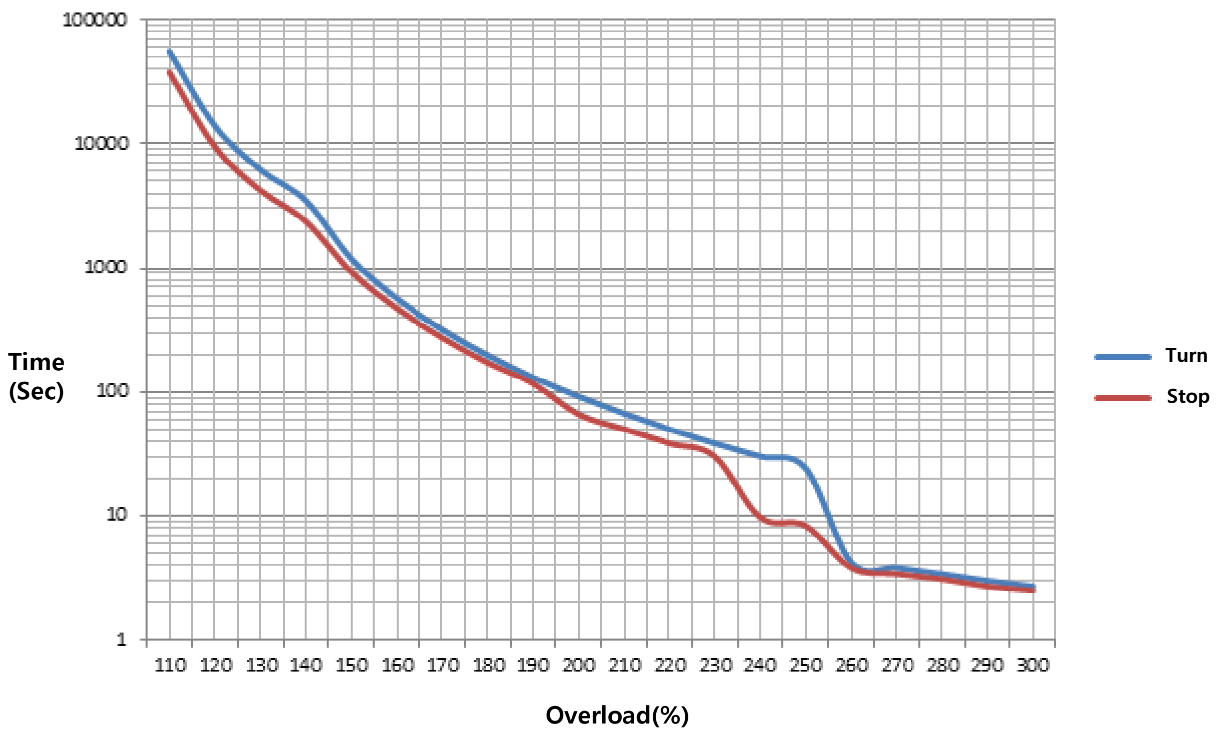
Warning Status (Code) Names	Causes	Inspection Items	Measures to Take
 PWR_FAIL (Main Power Phase Loss)	Main power input voltage failure	Check the voltage range of 200-230 Vac between L1, L2 and L3 phases.	Re-inspect the main power source.
	Parameter setting abnormality	Check the main power fail check mode setting [0x2006] according to the main power input status.	Make parameter settings and wiring with a 3-phase input power if possible.
	Momentary power outage	Check the main power fail check time setting [0x2007].	Increase the main power fail check time setting [0x2007] or check the power supply.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.
 LOW_BATT (Low Voltage of Encoder Battery)	Parameter setting abnormality	Check the setting value of the absolute encoder configuration [0x2005].	To use an incremental type absolute encoder, set the value to 1 to disable alarms.
	Defective battery connection, unconnected	Check the battery connection status.	Connect the battery accurately.
	Low battery voltage	Check if the battery voltage is 3.3V or higher.	Replace the battery.
 SW_POS_LMT (Software Position Limit)	Parameter setting abnormality	Check the software position limit function select [0x2400] and setting [0x607D] of the software position limit.	Change the settings of the software position limit function select [0x2400] or change the minimum and maximum setting values of the software position limit [0x607D].
 OV_LOAD (Operation Overload)	Continuous operation with a load exceeding the rated value	Check the accumulated operation overload rate [0x2603] and overload warning level setting [0x2010] in the constant speed area or in the stopped state.	Change the capacity of the motor and drive. Adjust gain. Adjust the overload warning level setting [0x2010].
	Motor brake abnormality	Check for opening of the motor brake during SVON.	Supply power to the motor brake.
	Parameter setting abnormality	Make sure that the setting values for motor ID [0x2000], encoder type [0x2001] and encoder format [0x2002] match the applied information on the motor label.	Modify the parameters so that they match the information on the motor label.
		Check the setting value of overload check base [0x200F].	Set an appropriate value.
	Apparatus	Check for any abnormality during	Inspect the apparatuses.

Warning Status (Code) Names	Causes	Inspection Items	Measures to Take
	abnormality	operation.	
	Motor cable abnormality	Check for abnormal wiring and short circuit.	Replace the motor cable.
	Encoder cable abnormality	Check for abnormal wiring and short circuit.	Replace the encoder cable.
 SETUP (Setting abnormality)	Abnormal combination of drive and motor	Check if the current capacity of the applied motor exceeds that of the drive.	Lower the torque limit value or replace the motor with one that has a lower current capacity than that of the drive.
	IO setting abnormality	Check whether the signal allocation has overlapped in the digital input signal selection [0x2200] - [0x2208] and the digital output signal selection [0x2210] - [0x2213].	Set the parameter appropriately for the operation conditions.
 UD_VTG (Low Voltage)	Main power input voltage abnormality	Check whether the main power voltage is 134 Vac or higher.	Re-inspect the main power source.
		Check whether the DC link voltage [0x2605] is between 190 - 405 Vdc while the main power is being supplied.	Replace the drive.
	Lowered power voltage during operation	Check the wiring status of the main power.	Use a 3-phase voltage supply.
 EMG (Emergency Signal Input)	EMG contact abnormality	This represents the state of emergency pause by EMG contacts. Check the settings of the wiring and drive parameters (drive control input 1 [0x211F], digital input signal 1 setting [0x2200] - digital input signal 16 setting [0x220F]).	Set the wiring and parameter for the operation conditions.
	Drive abnormality	-	If alarms occur continually after power cycling, replace the drive since there may be abnormalities in the drive.

12.3 Servo Drive Overload Graph

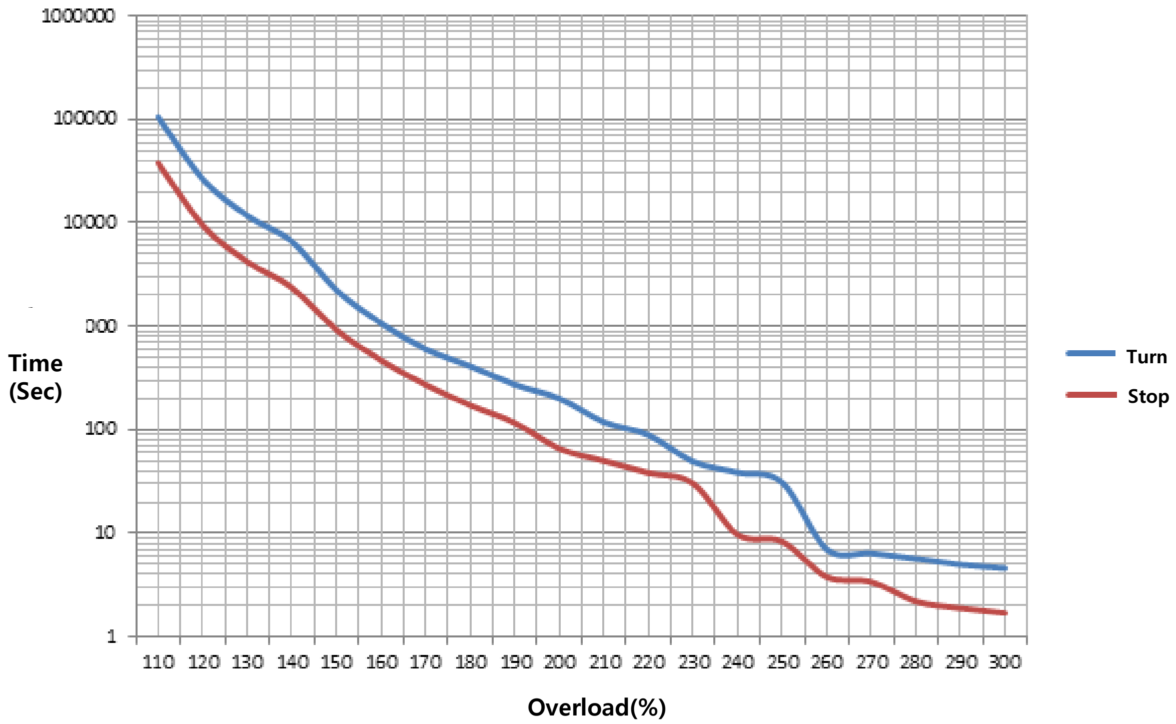
■ Servo Drive Overload Graph (400W)

Load Factor (%)	AL-21 duration (sec)		Load Factor (%)	AL-21 duration (sec)	
	Turn	Stop		Turn	Stop
100 or lower	Infinite	Infinite			
110	55776.0	37935.0	210	66.8	50.1
120	13944.0	9483.0	220	50.1	38.5
130	6197.0	4215.0	230	38.5	30.3
140	3486.0	2371.0	240	30.3	9.7
150	1183.0	926.0	250	24.2	8.3
160	566.0	470.0	260	4.2	3.8
170	318.0	273.0	270	3.8	3.4
180	198.0	173.0	280	3.4	3.1
190	131.0	117.0	290	3.0	2.7
200	92.0	66.0	300	2.7	2.5



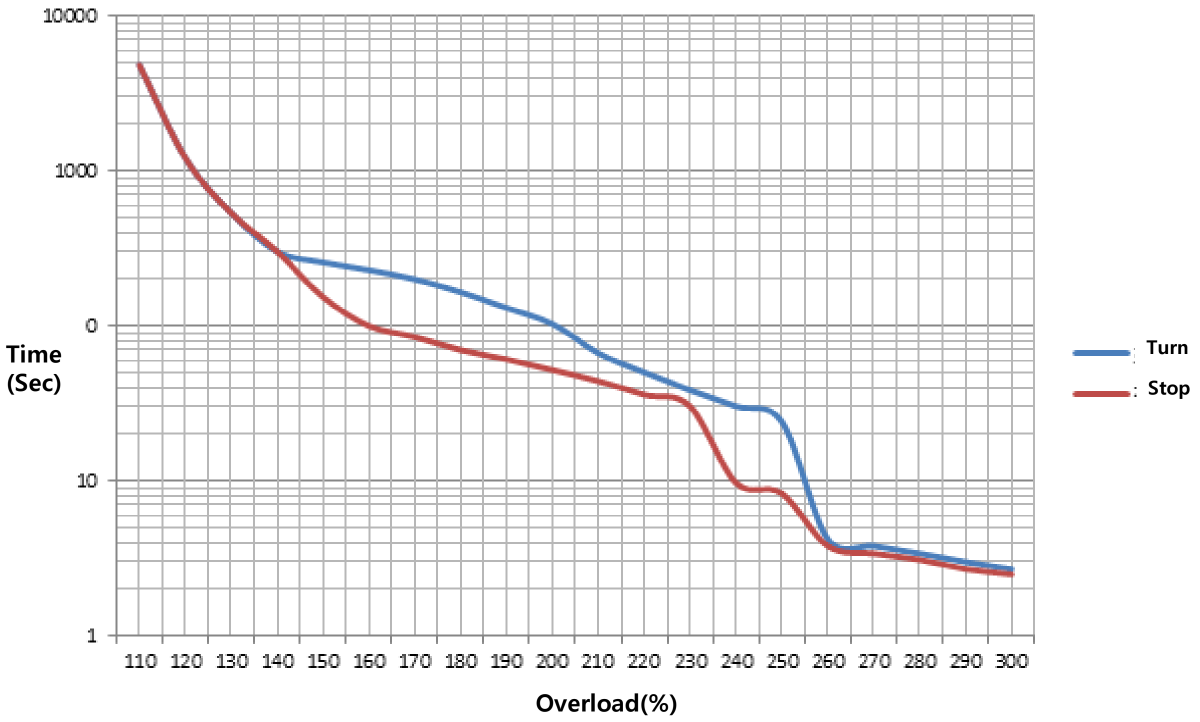
■ Servo Drive Overload Graph (750W, 1kW)

Load Factor (%)	AL-21 duration (sec) Turn	AL-21 duration (sec) Stop	Load Factor (%)	AL-21 duration (sec) Turn	AL-21 duration (sec) Stop
100 or lower	Infinite	Infinite			
110	105800.0	37935.0	210	119.0	50.1
120	26450.0	9483.0	220	89.2	38.5
130	11755.5	4215.0	230	49.3	30.3
140	6612.5	2371.0	240	38.8	9.7
150	2244.0	926.0	250	31.0	8.3
160	1073.6	470.0	260	7.0	3.8
170	603.2	273.0	270	6.4	3.4
180	413.6	173.0	280	5.7	2.2
190	273.6	117.0	290	5.0	1.9
200	201.0	66.0	300	4.6	1.7



■ Servo Drive Overload Graph (2kW, 3.5kW)

Load Factor (%)	AL-21 duration (sec)		Load Factor (%)	AL-21 duration (sec)	
	Turn	Stop		Turn	Stop
100 or lower	Infinite	Infinite			
110	4832	4832	210	66.8	44
120	1208	1208	220	50.1	36
130	536	536	230	38.5	30.3
140	302	302	240	30.3	9.7
150	257	154	250	24.2	8.3
160	229	100	260	4.2	3.8
170	200	85	270	3.8	3.4
180	165	70	280	3.4	3.1
190	131	61	290	3.0	2.7
200	103	52	300	2.7	2.5



13. Test Drive

For a safe and proper test drive, make sure to check the following prior to a test drive. If there is a problem, take appropriate measures before the test drive.

■ Servo Motor State

Is the motor correctly installed and wired?

Is each connecting part correctly tightened without looseness?

For motors with oil seal, is there any damage on the oil seal?

Is oil properly applied?

To perform a test drive of a servo motor that has been stored for an extended period, make sure to check the motor according to the maintenance and inspection method for the motor. For more information on maintenance and inspection, refer to Section 11. **Maintenance and Inspection**.

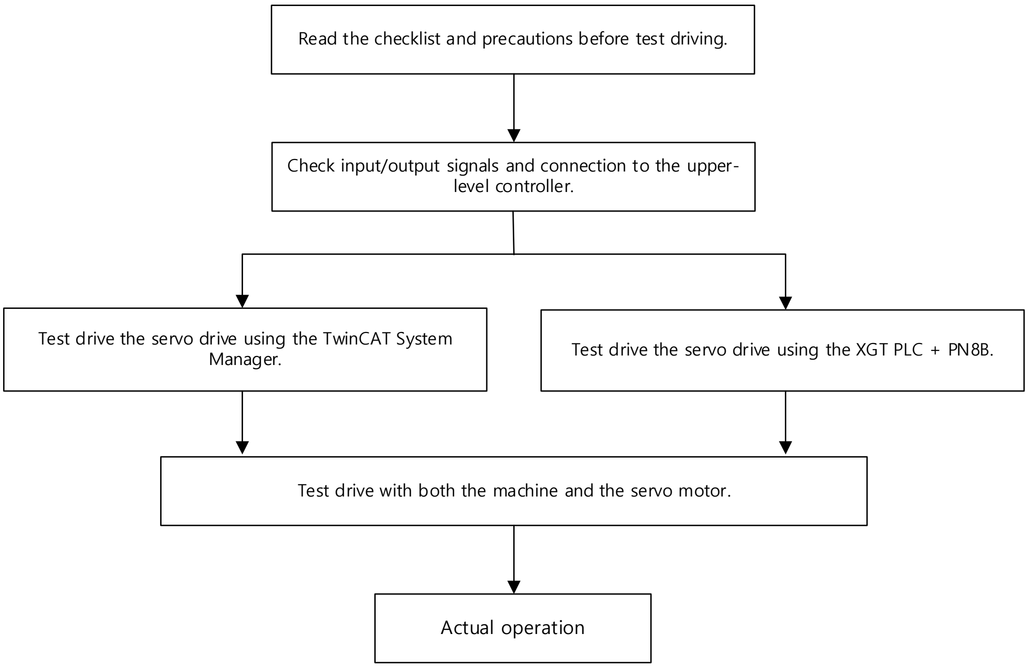
■ Servo Drive State

Is the drive correctly installed, wired and connected?

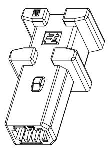
Is the power supply voltage for the servo drive correct?

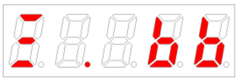
13.1 Preparation for Operation

Carry out a test drive in the following order.



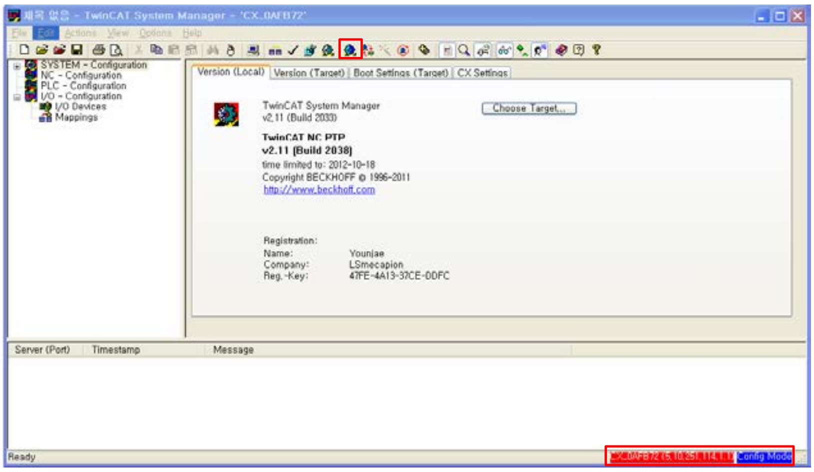
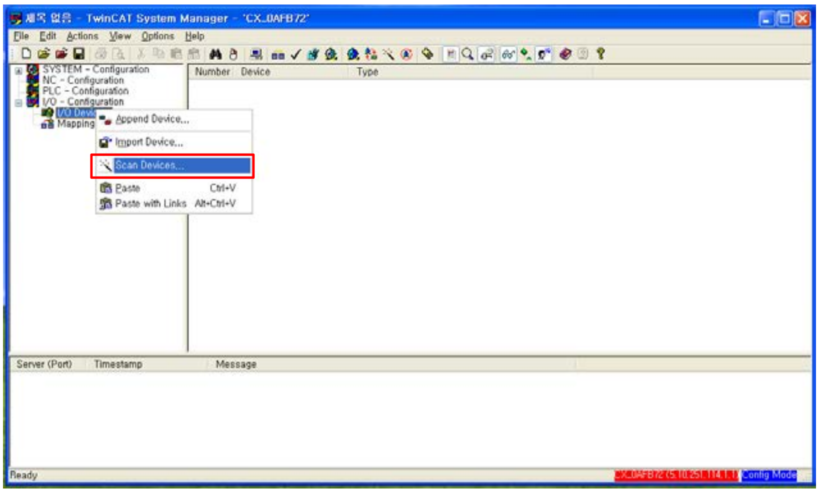
Before the test drive, check that the upper level controller and the servo drive are correctly wired, and the objects of the servo drive are correctly configured.

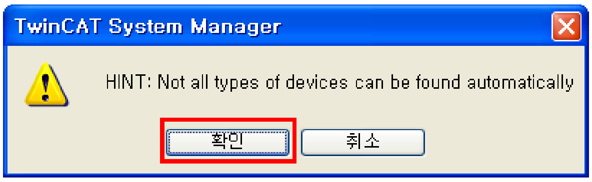
Order	Handling	Notes
1	Connect the power connector and safety function connector of Servo Drive.	Refer to Section 2.5 Wiring for Input/Output Signals.
2	Connect motor and encoder cables to the servo drive.	Refer to Section 2.5 Wiring for Input/Output Signals.
3	If you use the safety function, connect the STO safety device connector.  (Note) If you do not use the safety function, insert safety jumper connector, an accessory of the servo drive, into the STO. If you do not install the connector, motor current will be not supplied and the torque will not output from the motor. In this case, the panel monitor state at the power ON will be "Sto." (Note) When removing the safety jumper connector attached to the STO, pull out the motor main circuit connector first, and then the connector body while pressing the lock ejector on the jumper connector side towards the servo drive side. The connector may be damaged if you pull it out when the lock has not been released. Please be careful.	Refer to Section 2.5 Wiring for Input/Output Signals.
Order	Handling	Notes
4	Connect ECAT IN and OUT of the EtherCAT communication connector between the upper level device and Servo Drive. (Note) Please use the CAT5 and SFTP cables.	Refer to Section 2.5 Wiring for Input/Output Signals.

5	Turn on the servo drive. The servo drive communication is in the Safe OP state. Make sure that the state of the servo drive panel monitor is as the figure below:  The Link/Activity LED is flickering. The RUN LED is in "Single Flash." (Note) If the Error LED is flickering or on, and the monitor panel state is AL-xx, refer to Manual Maintenance and Inspection. (Note) If the Link/Activity LED is not flickering, the communication is not established.	Refer to Section 11 Maintenance and Inspection.
6	Now, we have finished checking the connection and state of input signal circuits to prepare for the test drive.	Refer to Section 11 Maintenance and Inspection.

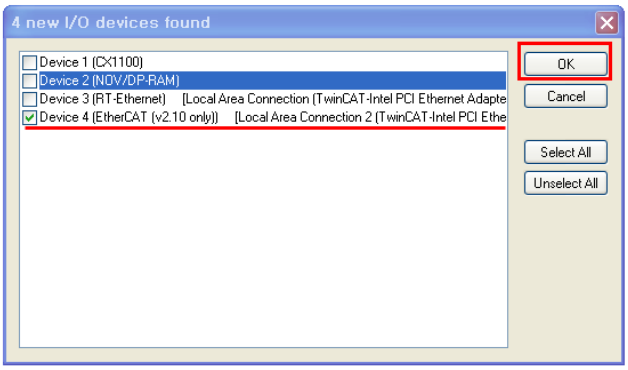
13.2 Test Drive Using TwinCAT System Manager

■ Test Drive Procedure

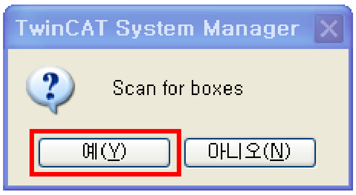
Order	Handling	Notes
1	Before launching the TwinCAT System Manager, copy the servo drive XML file into the schema folder (C:\TwinCAT\Io\EtherCAT).	
2	Launch the TwinCAT System Manager.	
3	Select a Target System. When performing the test drive using a remote system, select the device.	
4	Restart the TwinCAT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

<table>
<tr><td></td><td>

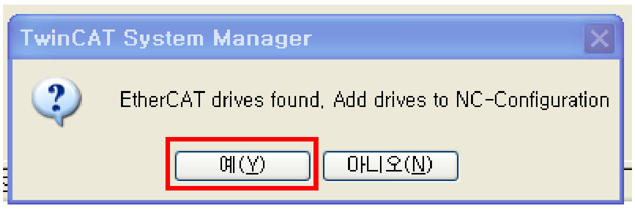
▪ If the New I/O devices found dialog window appears, select the device or servo drive that needs to be test driven and click OK.



▪ If the dialog window below appears, click Yes.


</td><td></td></tr>
<tr><td>6</td><td>Add the servo drive's NC Task to the NC-Configuration.

▪ If the dialog window below appears, click Yes.

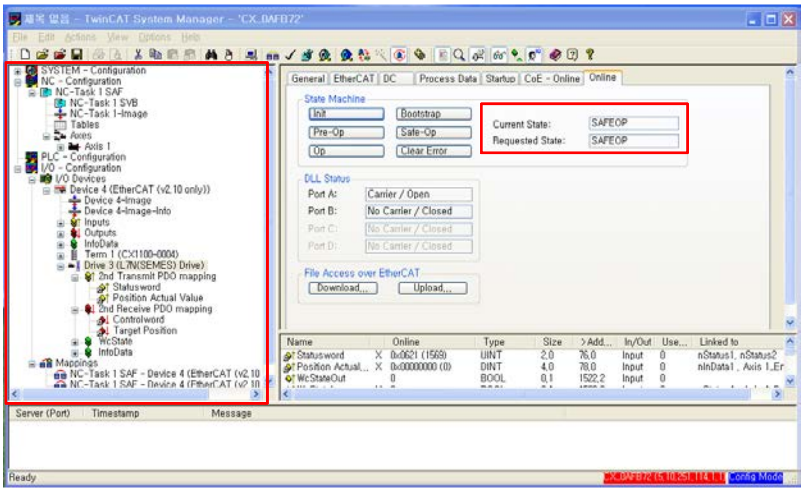
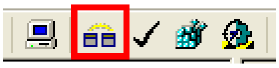
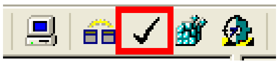
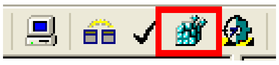

</td><td></td></tr>
<tr><td>7</td><td>Switch the TwinCAT System Manager to a free run state to allow it to control devices independently of the TwinCAT PLC and so on.

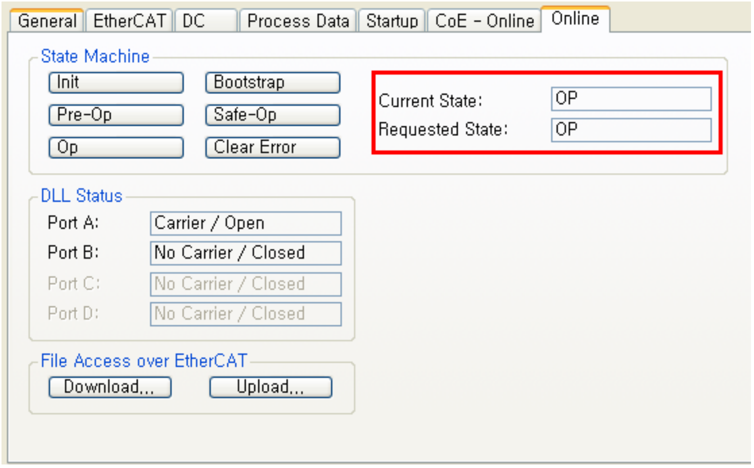
▪ If the dialog window below appears, click Yes.


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

▪ If the connected servo drive is registered, select it.

▪ Click the Online tab on the right side to verify that Current State and Requested State are in the SAFEOP state.</td><td></td></tr>
</table>

		
9	Switch the EtherCAT communication state from SafeOP to OP, enabling MailBox Communication and Process Data Communication. ▪ Click the Generate Mappings icon on the menu bar. Map the images defined in NC Task and I/O Device.  ▪ Click the Check Configuration icon on the menu bar. Check if the currently set configuration is valid.  ▪ Click the Activate Configuration icon on the menu bar. Save Project Configuration in Windows Registry. 	
10	Verify if the EtherCAT communication state has switched from SafeOP to OP. ▪ Verify if the states of the servo drive panel monitor and the I/O device (servo drive) of the TwinCAT system are in the online state as shown in the figure below. ▪ Check the panel monitor status.  ▪ Check the communication LED. The Link/Activity LED is flickering. The RUN LED is on. ▪ Check the online state of the I/O device of the TwinCAT system. In the I/O-Configuration tree of the workspace, click the servo drive, and then click the Online tab to check if Current State and Requested State are in the OP state.	

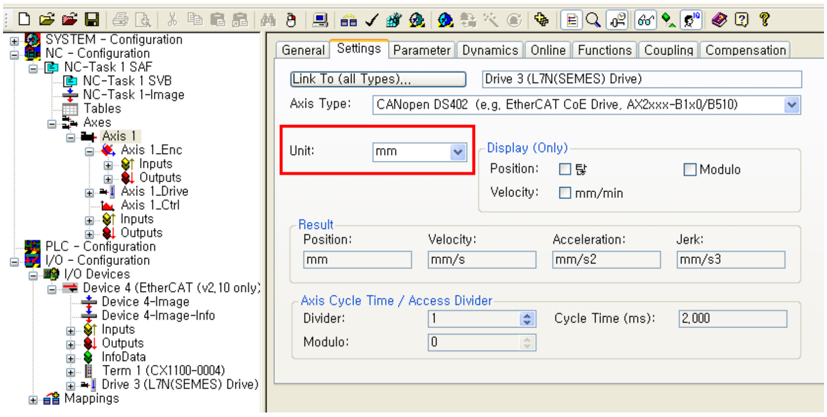
<table>
<tr><td></td><td>


Verify if the state displayed at the bottom-right of the TwinCAT System Manager menu window is in the Run state.

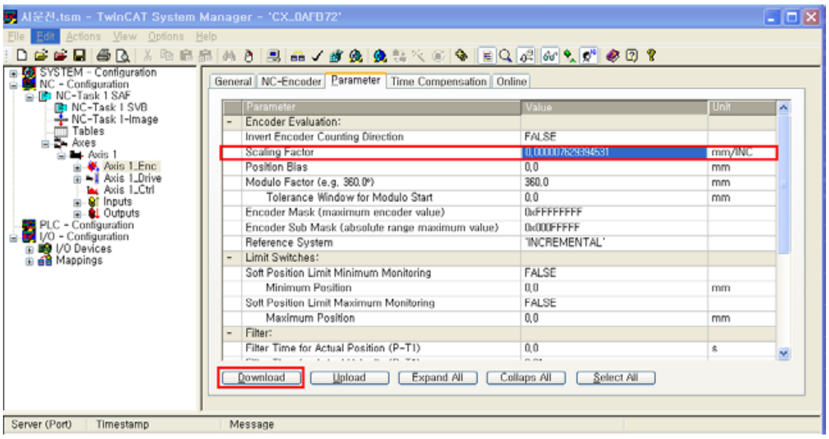
</td><td></td></tr>
<tr><td>11</td><td>We have finished adding NC-Task and I/O Devices (servo drive) to the TwinCAT System Manager.</td><td></td></tr>
</table>

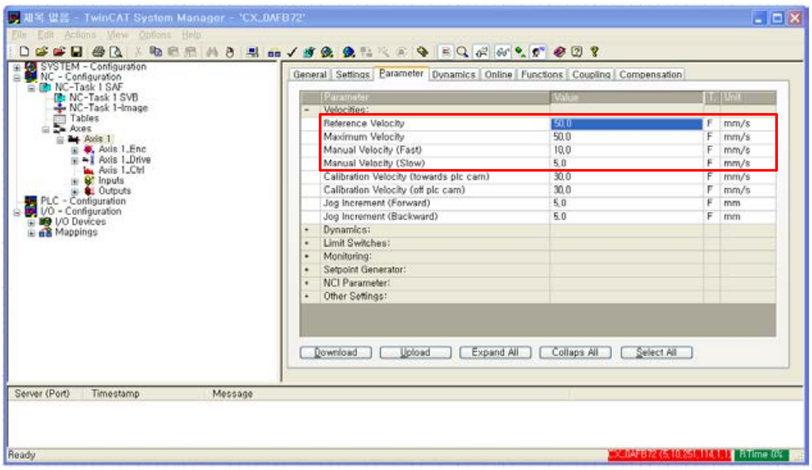
■ Setting NC-Task Axis Parameters

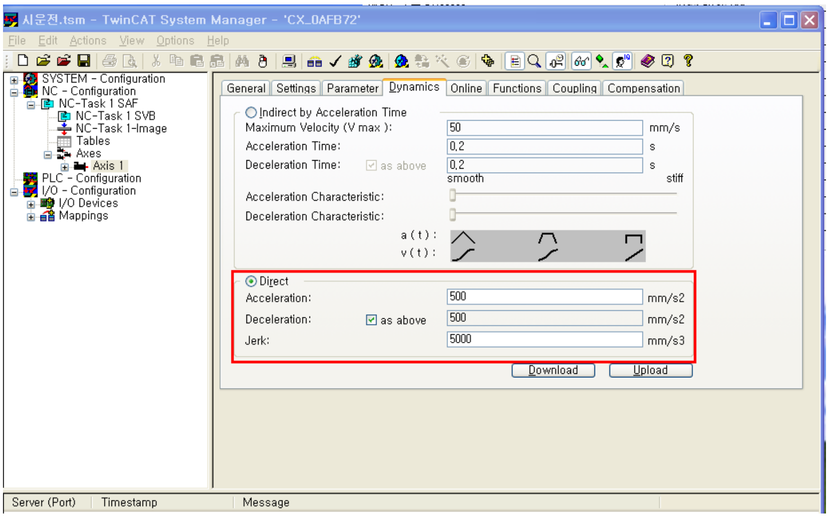
<table>
<tr><th>Order</th><th>Handling</th><th>Notes</th></tr>
<tr><td>1</td><td>Set the display units for the relevant axis.
Select Axis1.
Click the Settings tab.
Click the display units for position and speed.



Note: Remember the actual units will not be converted even if the units shown in the figure above was converted to mm or degrees.
Note: Change the units and tune the Axis Scaling Factor below.</td><td></td></tr>
<tr><td>2</td><td>Set the Axis Scaling Factor. The Axis Scaling Factor determines the distance of the axial load movement while the motor shaft makes one revolution.
Select Axis1.
Select the Parameter tab.
Set the Scaling Factor.
Then, download the settings.</td><td></td></tr>
</table>

<table>
<tr><td></td><td>

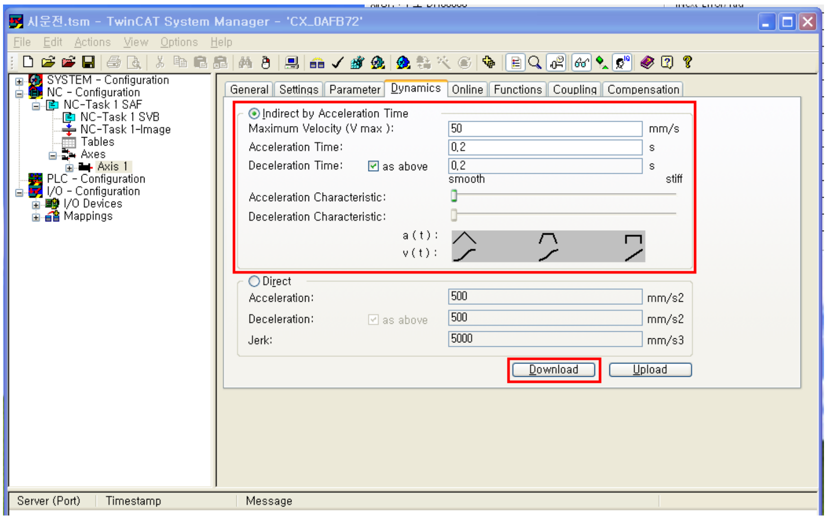
Note: The default is 0.0001 if the scaling factor is not set.
Note: After configuring the settings, download them.</td><td></td></tr>
<tr><td>3</td><td>Set the speed parameter of the test drive axis.
▪ Select Axis 1.
▪ Select the Parameter tab.
▪ Set Maximum Velocity, Manual Velocity (Fast), and Manual Velocity (Slow). Then, download the settings.

</td><td></td></tr>
<tr><td>4</td><td>Set the velocity, acceleration, and jerk of the test drive axis.
Set the acceleration, deceleration, and jerk directly for the test drive axis; the TwinCAT NC can calculate the acceleration based on the configured profile timing.
▪ Select Axis 1.
▪ Click the Dynamics tab.
▪ Set the acceleration, deceleration, and jerk directly.
  • Select the Direct button.
  • Set the acceleration, deceleration, and jerk.
  • Download the settings.</td><td></td></tr>
</table>



- Set the acceleration, deceleration, and jerk indirectly.

Set the acceleration, deceleration, and jerk indirectly by setting the acceleration time. If you change the acceleration time, the acceleration value will be automatically changed.

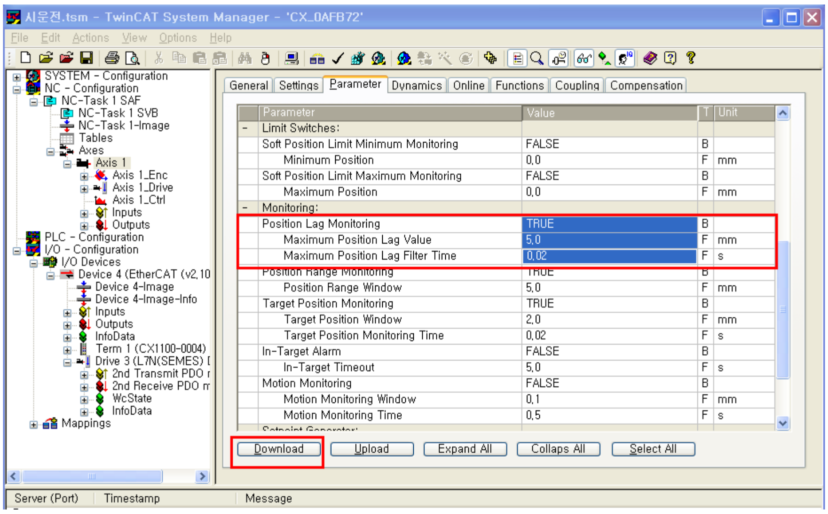
- Select the Indirect by Acceleration Time button.
- Set the acceleration, deceleration, and jerk.
- Download the settings.



5

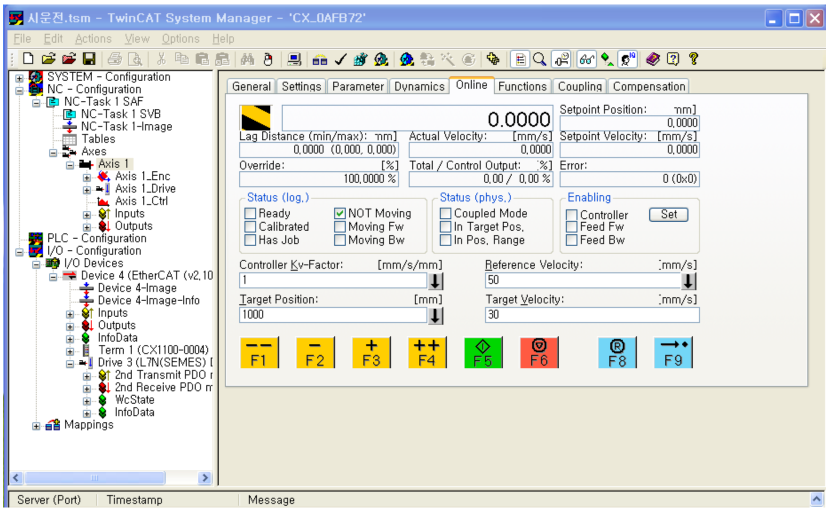
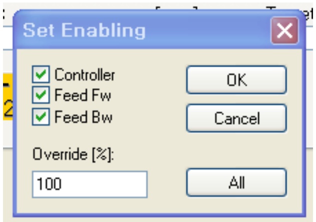
Set the Position Lag Monitoring (Following Error).

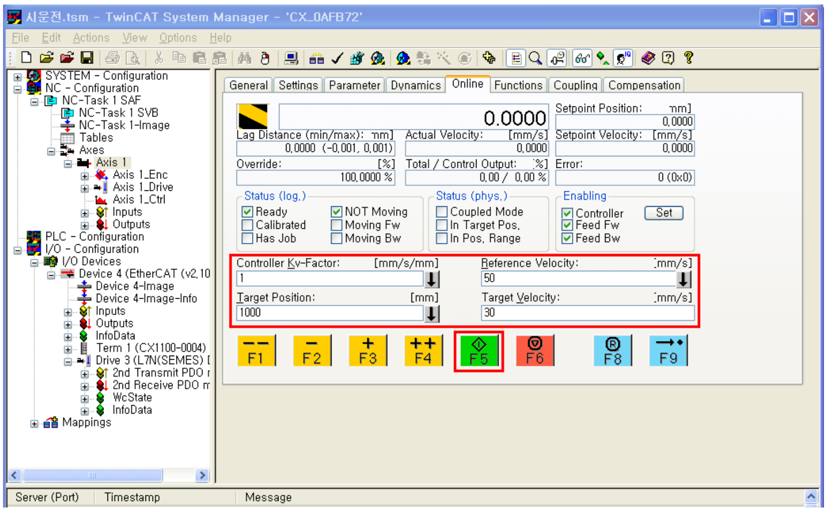
- Select Axis 1.
- Select the Parameter tab.
- Set the Position Lag Monitoring.
- Set the Position Lag Filter Time.
- Download the settings.

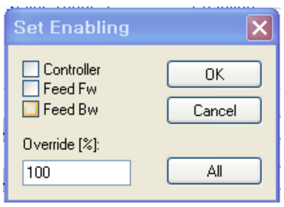


Note: The Position Lag Monitoring is the difference between the position reference and the actual position at a given cycle time. When the Position Lag Monitoring is enabled, the TwinCAT NC generates an alarm if the following error exceeds the settings.

■ Test Drive the Servo Drive Using TwinCAT NC Axis

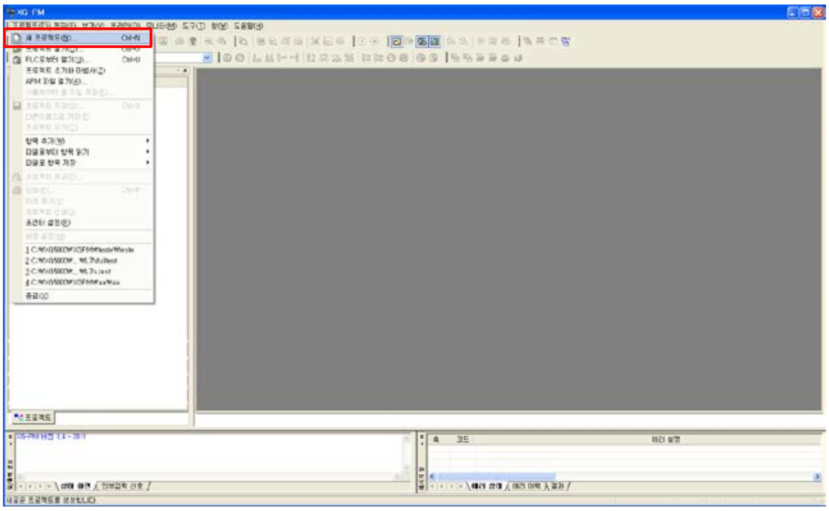
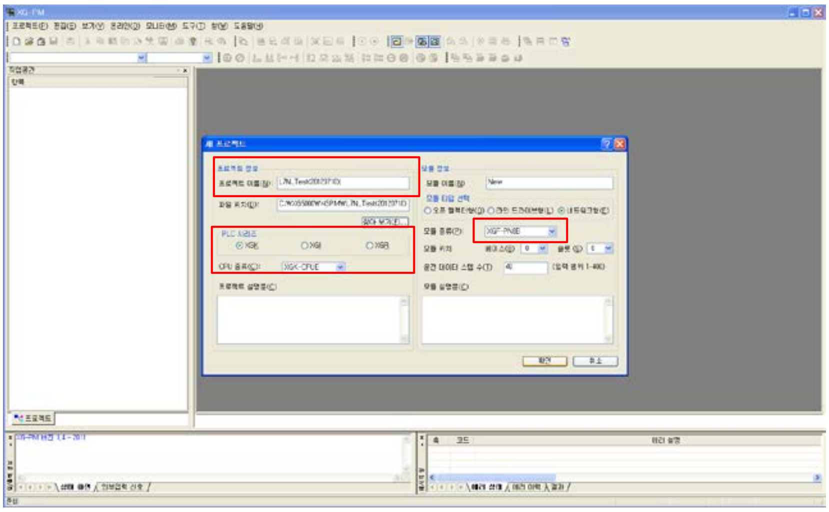
Order	Handling	Notes
1	Make sure that TwinCAT NC axis is "Servo On." ▪ Select Axis 1. ▪ Click the Online tab.  ▪ Click the Set button.  ▪ Select Controller, Feed Fw, and Feed Bw in the Set Enabling pop-up. ▪ Set the Override to 100%. ▪ Click OK. ▪ Make sure that the state of the servo drive panel monitor is as the figure below:	

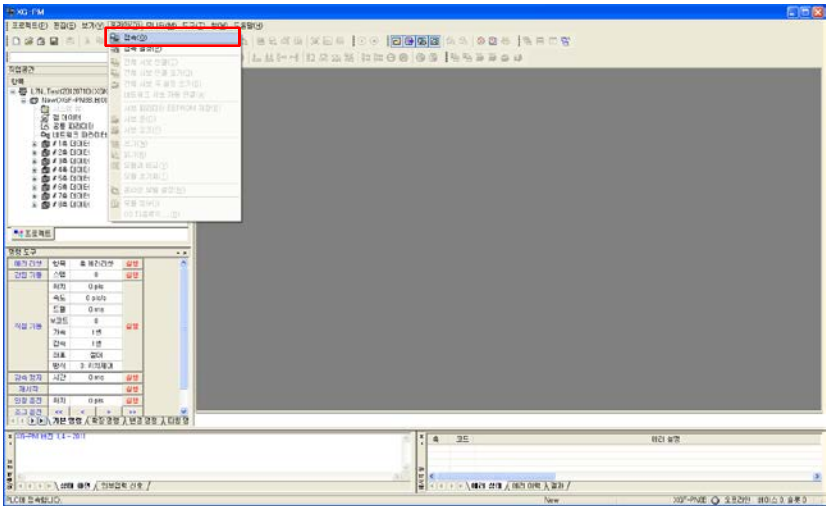
<table>
<tr><td></td><td>
</td><td></td></tr>
<tr><td>2</td><td>Use the buttons shown below to manually perform the test drive (JOG).
<table>
<tr><td>
</td><td>Perform a negative rotation at the specified Manual Velocity (Fast).</td></tr>
<tr><td>
</td><td>Perform a negative rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td>
</td><td>Perform a positive rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td>
</td><td>Perform a positive rotation at the specified Manual Velocity (Fast).</td></tr>
</table></td><td></td></tr>
<tr><td>3</td><td>Perform the test drive with relative coordinates.
▪ Set the Target Position.
▪ Set the Target Velocity.
▪ Click the F5 button.


▪ Move it to the Target Position from the current position, decelerating to a stop.
▪ After moving it to the Target Position, verify if the Set Position is the same as the Target Position.
▪ Click the F6 button to stop driving with relative coordinates.
▪ When the alarm goes off, click the F8 button to reset the alarm.
Note: If the position limit is enabled, set the Target Position within the limit.</td><td></td></tr>
<tr><td>4</td><td>Make sure the TwinCAT NC axis is "Servo Off."
▪ Click Set.
▪ Click to clear Controller, Feed Fw, and Feed Bw in Enabling.
▪ Click OK.

</td><td></td></tr>
<tr><td>5</td><td>Test driving the drive using the TwinCAT NC axis is completed.</td><td></td></tr>
</table>

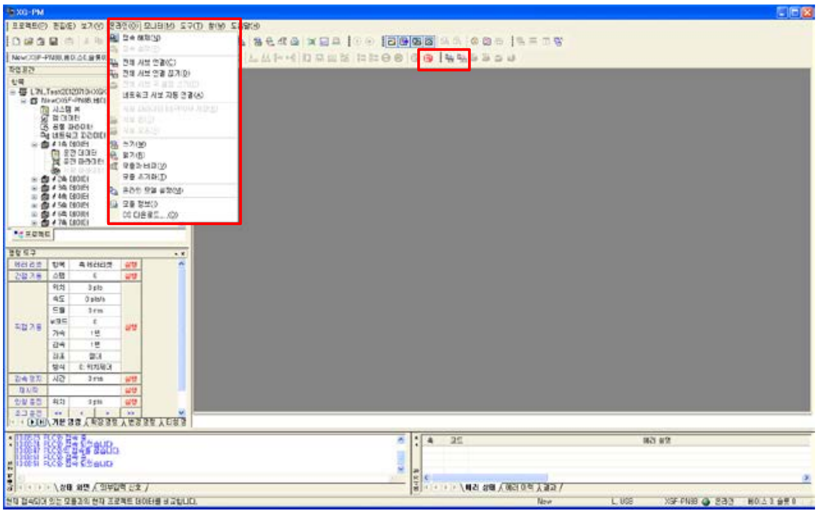
13.3 Test Drive Using LS ELECTRIC PLC (XGT + PN8B)

■ Test Drive Procedure

Order	Handling	Notes
1	Launch the XG-PM.	
2	Create a new project. ▪ On the menu bar, click Project → New Project. 	
3	Name the new project. ▪ Select the PLC series and the CPU type. ▪ Select the module type (XGF-PN8B), and click OK. 	
4	The PC and the PLC are connected for communication. ▪ On the menu bar, click Online → Connection.	

<table>
<tr>
<td></td>
<td>


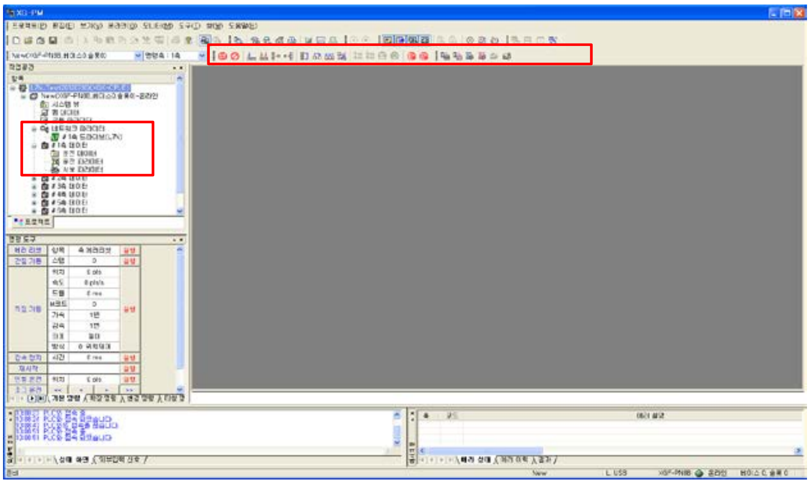
▪ When the PC and the PLC are connected, the connection between the PLC and the servo drive will be enabled as shown in the figure below.


</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>
Connect the PLC with the servo drive.

▪ For the first connection, enable the network parameters and servo parameters in the workspace on the left through Connect Network Servo Automatically.

▪ After the servo drive and the PLC are connected, the servo parameters and the motor test drive function will be enabled.

▪ Connecting multiple shafts enables as many servo parameters as the number of connected shafts.
</td>
<td></td>
</tr>
</table>



- Make sure that the state of the servo drive panel monitor is as the figure below:

- Check the state of the status LEDs.

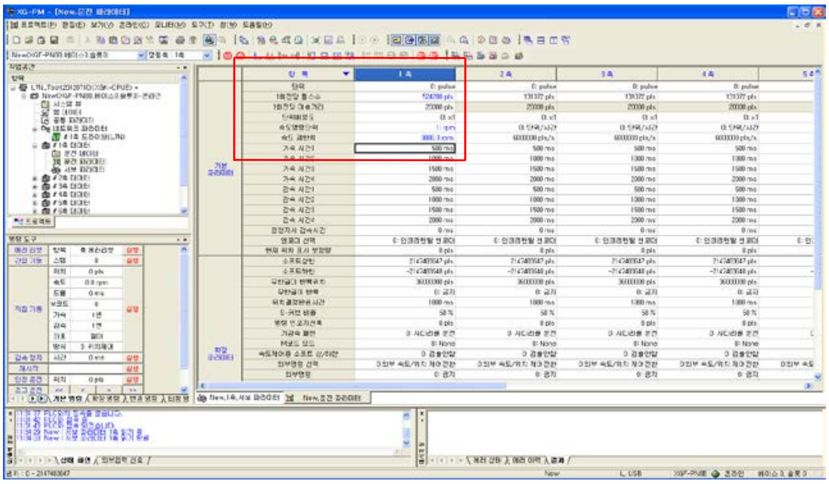
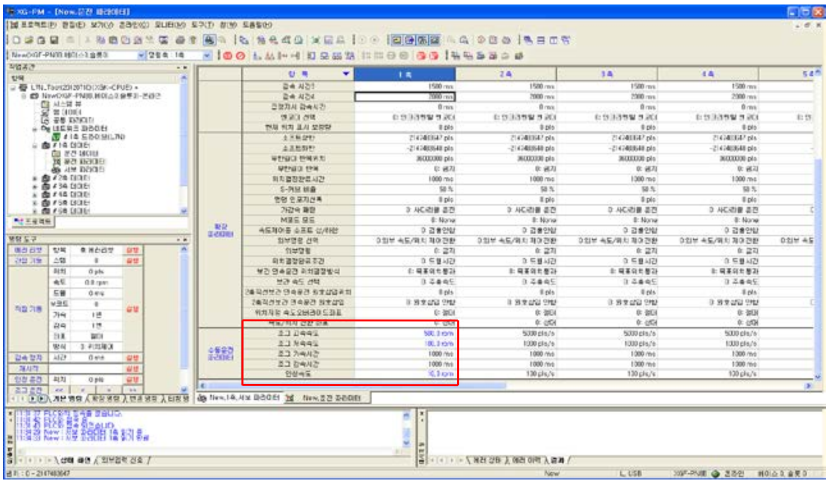
The Link/Activity LED is flickering.

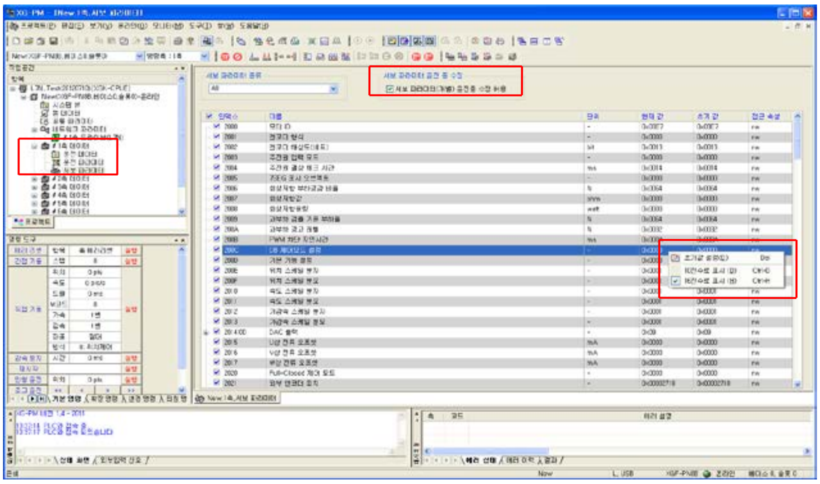
The RUN LED is on.

Note: Automatic connection of the network servo registers the device connected to the XGT, and initializes the parameters of the connected device.

Note: For subsequent connections, connect or disconnect the XGT and the servo drive by connecting the entire servo or disconnecting them respectively, since the device has been registered and its parameters initialized through automatic servo connection.

Note: In case there is any change in the XGT-connected device, initialize the parameters of the device connected by the automatic servo connection.

6	Set the Driving Parameters of Test Drive Axis → Basic Parameters. ▪ Enter the number of encoder pulses per motor revolution. • Encoder resolution of 19 bits = 524288 • Check the motor specifications, and then configure the appropriate settings. ▪ Set the units for the speed command. • It can be set as rpm or mm/s. • Set the speed limit. • Check the motor specifications, and then configure the appropriate settings. 	
8	Set the Driving Parameters of Test Drive Axis → Manual Operation (Jog) Parameters. 	
9	Set the servo parameters of the test drive axis.	

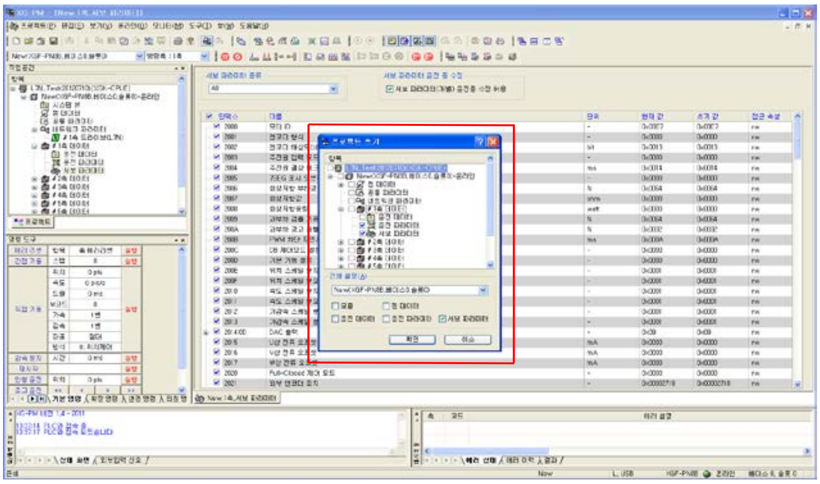


- Select parameters that you want to change, and then change them.
- To change the parameters during operation, click to select the Allow to Modify Servo Parameters During Operation checkbox at the top of the pane.
- You can display parameter values as decimals or hexadecimals.

11

Save the configured parameters.

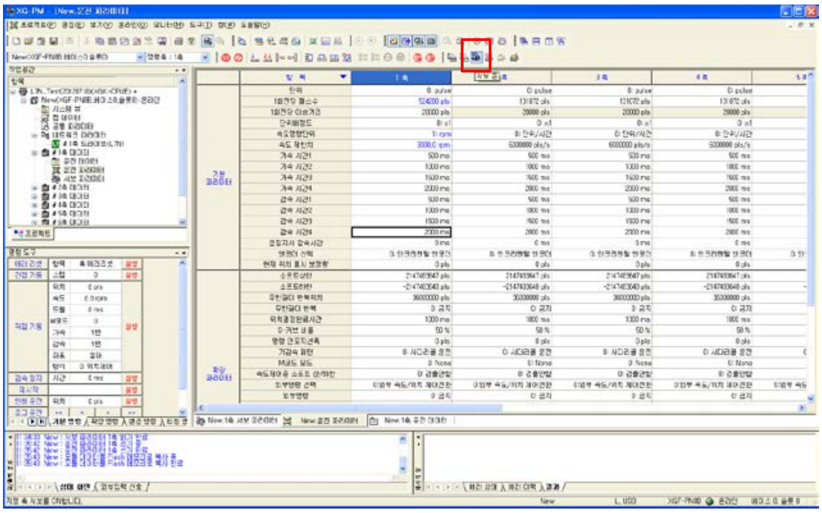
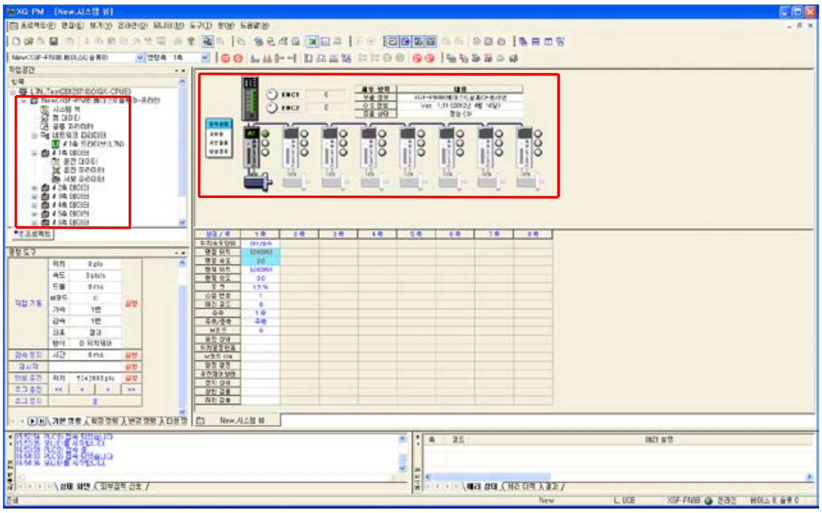
- On the menu bar, click →Online → Write.
- With the Write Project dialog window enabled, click to select the Operation Data of Test Drive Axis, the Operation Parameters, and the Servo Parameters checkboxes, and then click OK to save the configured parameters.

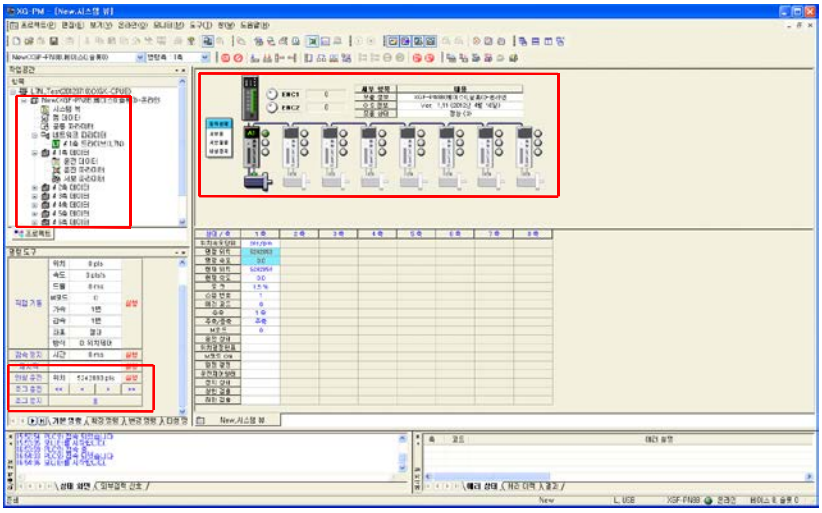
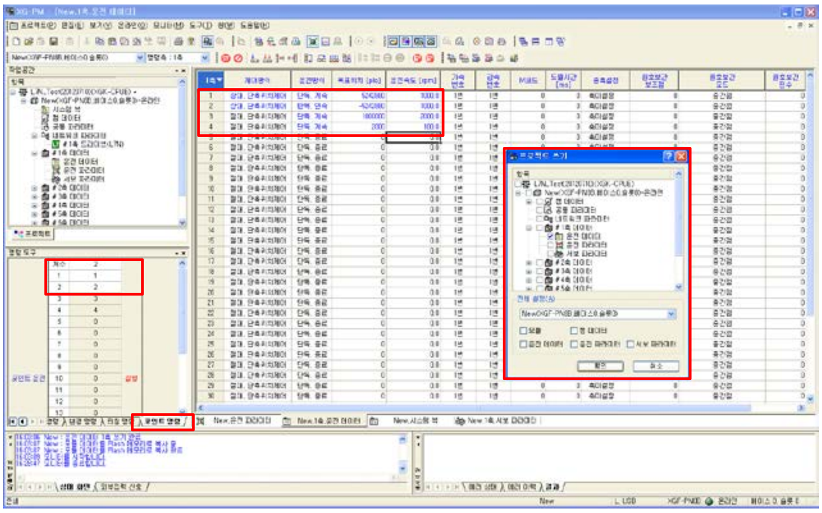


12

Turn on the servo.

- On the menu bar, click the Servo ON icon to turn on the servo of the servo drive of the test drive axis.

		
13	Save the configured parameters. ▪ Click the System View tab and the Basic Command tab in the workspace to check the state of the servo drive as shown in the figure below.  ▪ Make sure that the state of the servo drive panel monitor is as the figure below:  ▪ Check the 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 perform the test drive.	
15	Point to Point Test Drive ▪ Select Workspace → Command Tool → Point Command tab. ▪ Set the operation data. ▪ On the Point Command tab in the workspace, specify the number of point operations and the order. ▪ On the menu bar, click Online → Write to store the operation data. ▪ On the Point Command tab, click the Run button to perform the test drive. 	
16	Test driving the drive using the XGT is completed.	

14. Appendix

14.1 Firmware Update

14.1.1 Use of USB OTG

The drive performs a USB host function to search for firmware files in the USB memory and download them to the flash memory inside the drive. You can easily update the firmware using the USB memory and OTG cable without a PC. The update procedure is as follows:

(1) Prepare a download cable (USB OTG cable) and a USB memory.

Use a USB OTG cable, consisting of a USB Female Plug Type A and USB Mini B 5 pins, as the download cable.

(2) Copy the firmware file (L7NHF_FW.bin) to the USB memory.

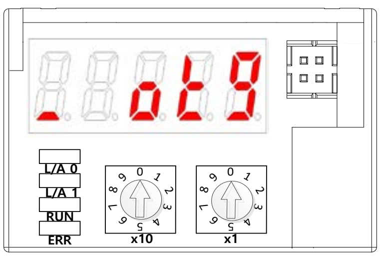
***Caution**

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) If 7-Segment for servo status display shows "boot" and then "otg", it indicates that update is in progress. If three horizontal bars of FND Digit5 are sequentially turned on from bottom to top, it indicates that download is complete. At the time, turn the power off and remove the USB OTG cable and USB memory.

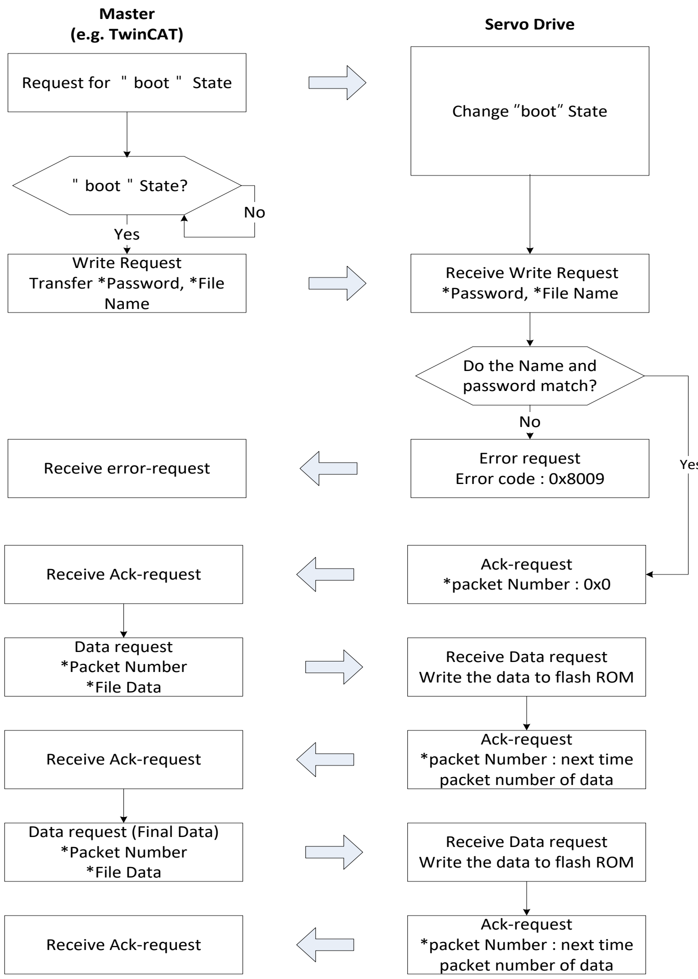


(7-Segment displays a message when downloading the firmware using the OTG)

(5) Turn on the power again, and verify if the firmware is updated.

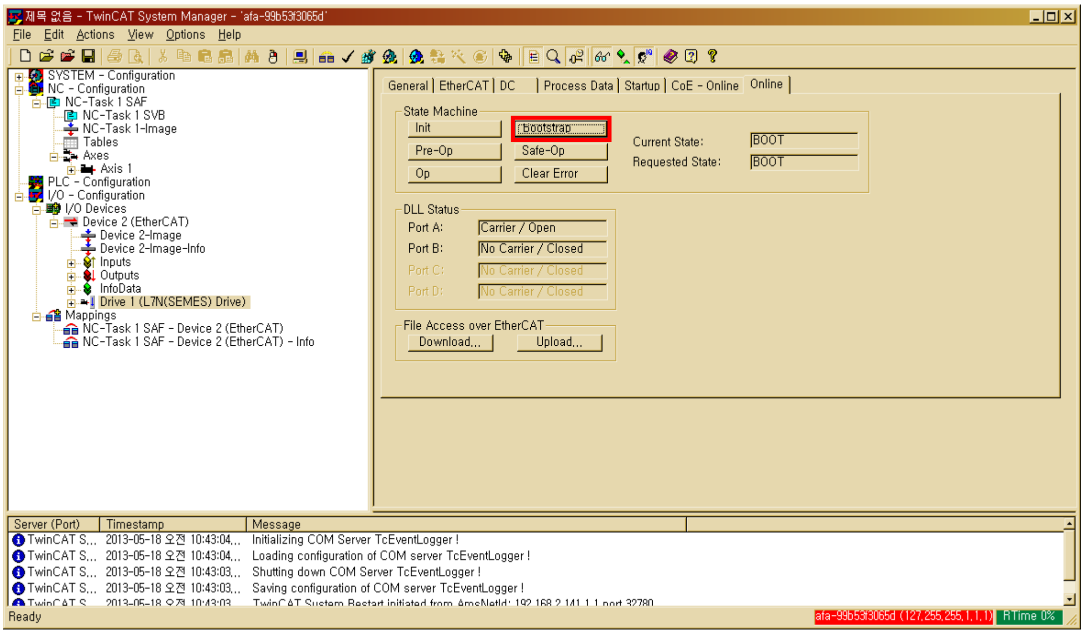
14.1.2 Use of FoE (File access over EtherCAT)

FoE is a simple file transfer protocol using the EtherCAT, enabling firmware update. When the drive and the upper level controller (e.g.: TwinCAT) are connected, you can simply update the firmware remotely via FoE. The update procedure is as follows:

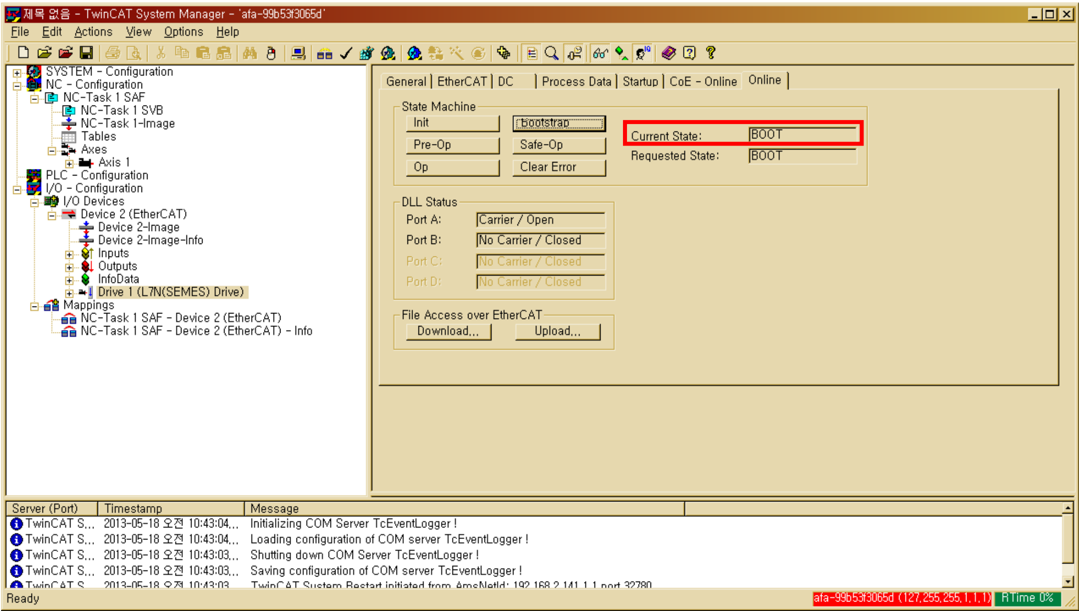


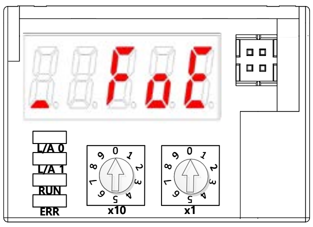
(1) Establish communication between the drive and the TwinCAT.

(2) I/O Configuration of TwinCAT - On the Online tab of the drive connected to the I/O, click Bootstrap in the State Machine menu.

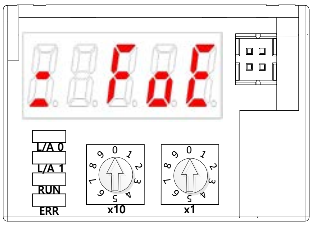


(3) After the current state is changed to BOOT and you check the drive status (7-segment displays boot), wait for approx. 10 seconds until the internal flash memory of the drive is cleared.





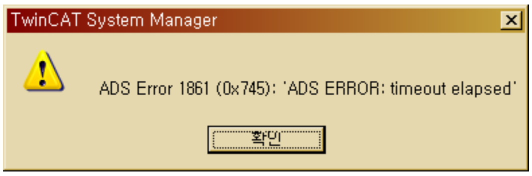
(7-Segment display appears at the start of firmware download using FoE)

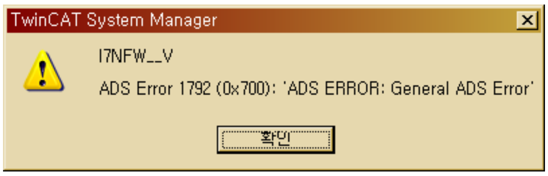


(7-Segment display appears when flash deletion is completed during the firmware download using FoE)

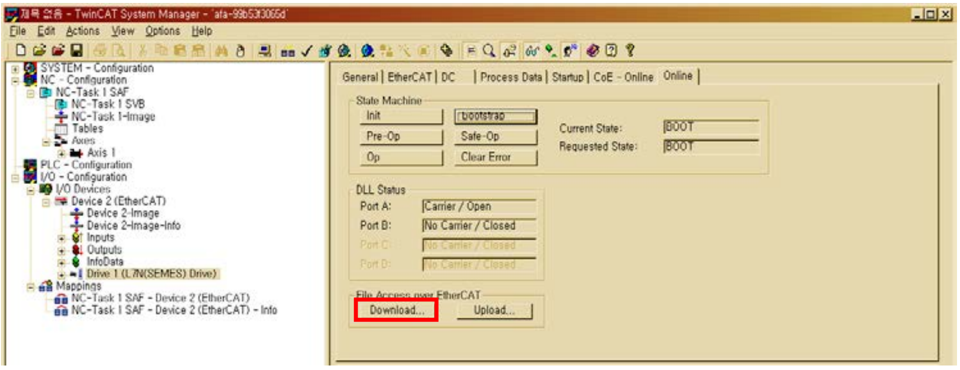
***Caution**

The following error occurs if you try to download before the required 10 seconds pass for the flash memory to be cleared. Two error windows shown below may indicate that the flash memory is not deleted completely, or the file name does not match. Check the file name, wait for 10 seconds until the flash memory is cleared, and then try it again.

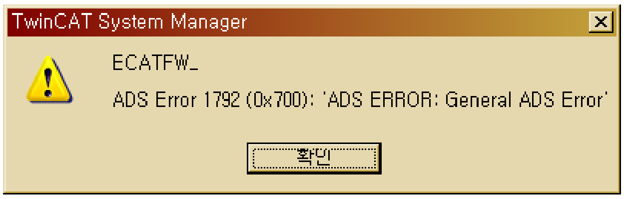




(4) Click Download in the File Access over EtherCAT menu at the bottom of the Online tab.

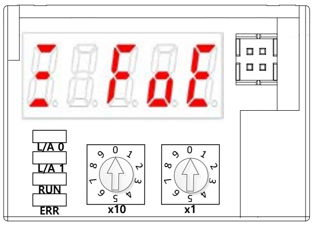


(5) Select the path of the file to be downloaded (L7NH_FW.efw or L7NH_FW.bin) and the file. If the file name does not match, download will not start and the following error will occur:



(6) Enter the password for file download and click OK to start the download. (Password: 00000000)

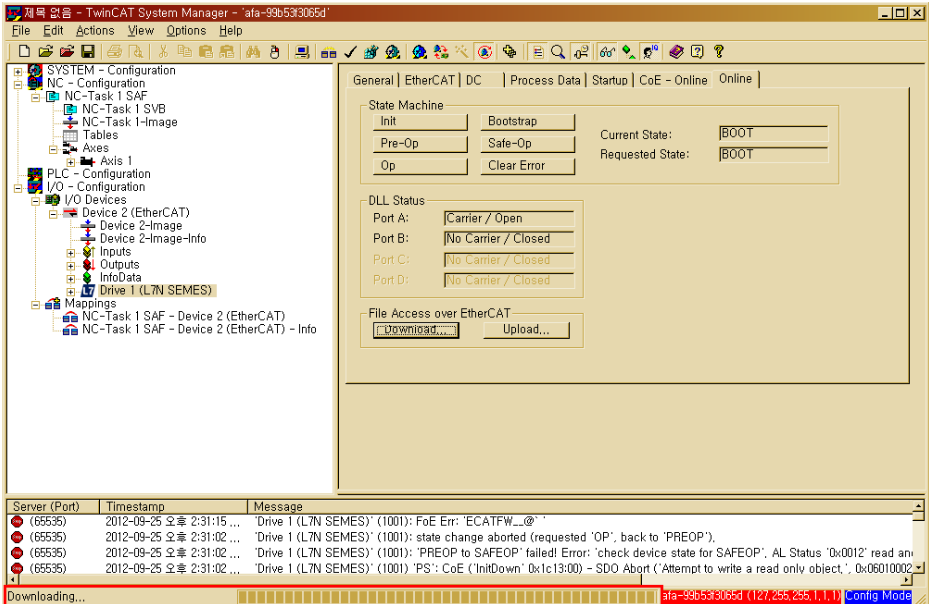
(7) If "Downloading..." is displayed as shown in the following figure, the download is in progress. If the progress bar at the bottom is full, it indicates the download is completed. After completing the download, be sure to click Init in the State Machine menu to switch it to the Init status.



(7-Segment display appears at the completion of firmware download using FoE)

***Caution**

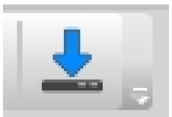
If you do not change the communication state to Init and turn on the power again according to the upper level controller, the state will be automatically changed to BOOT and the flash memory may be cleared. In this case, you have to download the firmware again according to this procedure.



(8) After the download is completed, turn on the power again and verify if the firmware is updated.

14.1.3 Using Drive CM

Drive CM allows you to upgrade the OS for the drive to the newest through the PC's USB port. The transmission time depends on the PC performance, but it usually takes from tens of seconds to several minutes.



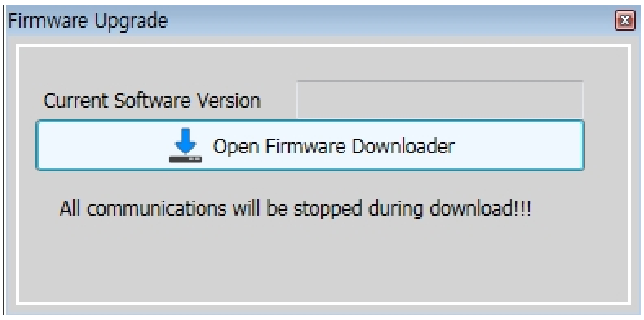
Click the icon as the image above on the top menu of Drive CM.

■ Precautions for Firmware Upgrade

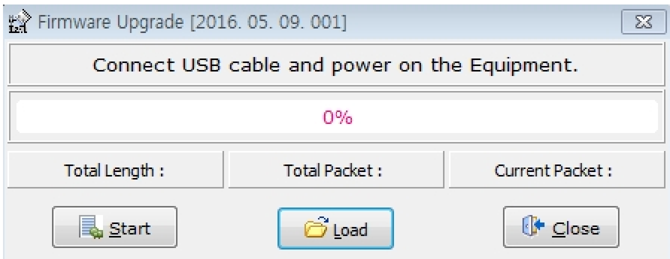
- Do not turn off the PC or drive during transmission.
- Do not unplug the USB cable or close the firmware program during transmission.
- Do not run other applications on the PC during transmission.
- Since the parameter (object) setting values in the drive may be reset, save the drive parameter (object) setting values before upgrade.

■ OS Download

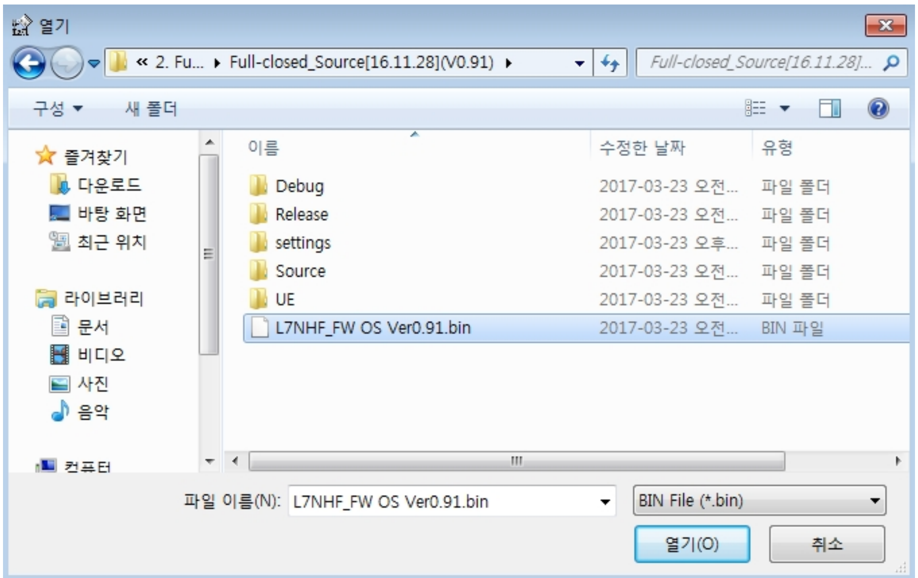
1) Click the "Open Firmware Downloader" button.



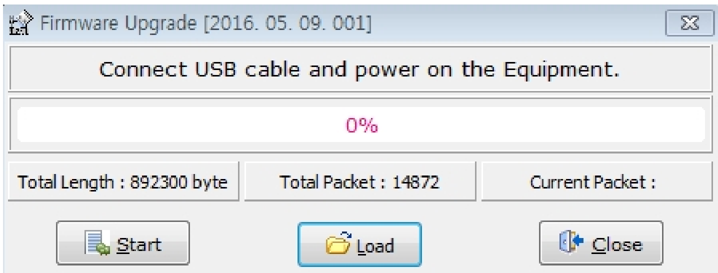
2) To load the appropriate OS file, click the "Load" button.



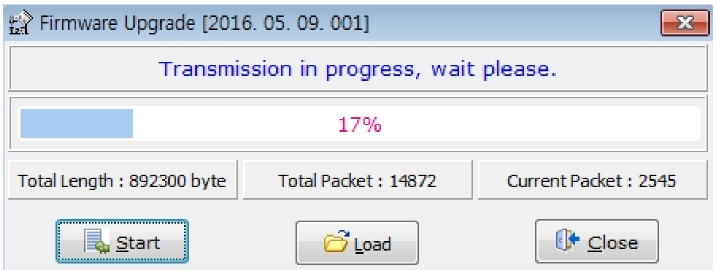
3) Select the OS file to transfer and click the Open button.



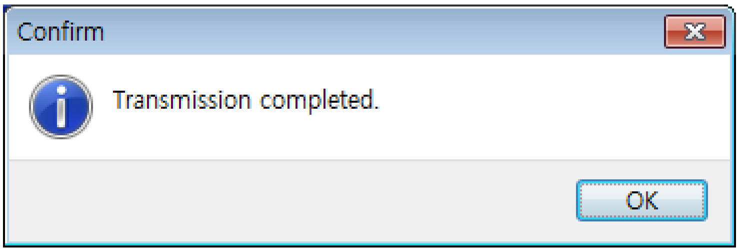
4) "Total Length" and "Total Packet" of the loaded OS are displayed.



5) Press the "Start" button to start transmission. A count-down of 10 seconds is activated 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.)

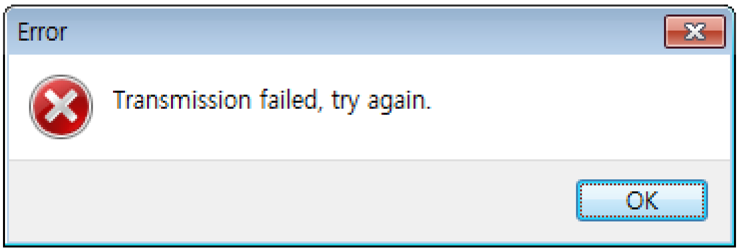


6) After clearing, the OS is transmitted automatically and the progress bar and "Current Packet" display the current transmission status. (The transmission time depends on the PC performance, but it usually takes from tens of seconds to several minutes.)

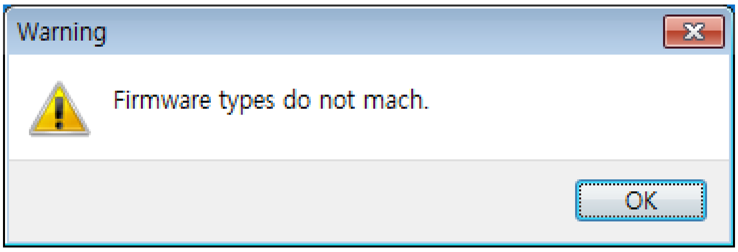


7) When transmission is completed, a popup saying "Transmission completed" is displayed. (When transmission to the PC is completed, turn the drive off and on to restart.)

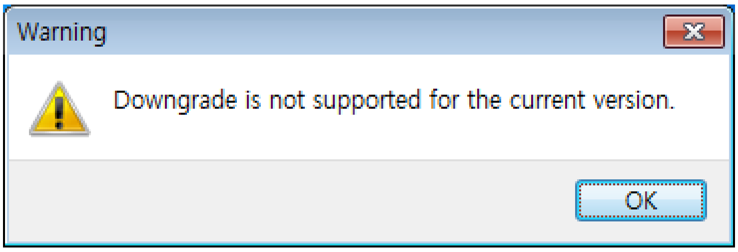
■ When an Error Occurs During Transmission



■ Turn off and on the drive and repeat the above process from (2) to (7).



■ Check the drive type and capacity of the firmware you wish to transmit.



■ Check the firmware version. You cannot download a version that is lower than the current version.

Warranty

1. Warranty Period

The product you purchased will be guaranteed for 18 months from the date of manufacturing.

2. Scope of Warranty

Any trouble or defect occurring for the above-mentioned period will be partially replaced or repaired. However, please note the following cases will be excluded from the scope of warranty.

(1) Any trouble attributable to unreasonable condition, environment or handling otherwise specified in the manual,
(2) Any trouble attributable to others' products,
(3) If the product is modified or repaired in any other place not designated by the company,
(4) Due to unintended purposes
(5) Owing to the reasons unexpected at the level of the contemporary science and technology when delivered.
(6) Not attributable to the company; for instance, natural disasters or fire

3. Since the above warranty is limited to servo product unit only, make sure to use the product considering the safety for system configuration or applications.

Environmental Policy

LS ELECTRIC Co., Ltd supports and observes the environmental policy as below.

Environmental Management	About Disposal
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.	LS ELECTRIC servo product is designed to protect the environment. For the disposal, separate aluminum, iron and synthetic resin (cover) from the product as they are reusable.

User Manual Revision History

Number	Date issued	Revised content	Version	Notes
1	2017.10.13	Newly created.	1.0	
2	2020.05.15	Change company name to ‘LS ELECRIC’	1.1	
3				
4				
5				
6				
7				

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Specifications in this instruction manual are subject to change without notice due to continuous products development and improvement.

2020. 10