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AC SERVO DRIVE

Xmotion

L7NH Series User Manual

EtherCAT
Conformance tested

Safety Precautions

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

LS ELECTRIC

Introduction

Hello. Thank you for choosing LS ELECTRIC L7NH Series.

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

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

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

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

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

Electric Safety Precautions

Danger

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

Fire Safety Precautions

Caution

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

Installation Precautions

Store and operate this product under the following environmental conditions.

<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 ~ 70 ℃</td><td>-10 ~ 60 ℃</td></tr>
<tr><td>Operating humidity</td><td rowspan="2">Below 90% RH (no condensation)</td><td rowspan="2">20~80% RH(no condensation)</td></tr>
<tr><td>Storage humidity</td></tr>
<tr><td>Altitude</td><td colspan="2">1000 m or lower</td></tr>
<tr><td>Spacing</td><td>▪ When installing 1 unit:
• More than 40 mm at the top and bottom of the control panel
• More than 10 mm on the left and right sides of the control panel
▪ When installing 2 or more units:
• More than 100 mm at the top of the control panel
• More than 40 mm at the bottom of the control panel
• More than 30 mm on the left and right sides of the control panel
• More than 2 mm between units
• Refer to Section 2.2.2, "Wiring the Control Panel."</td><td></td></tr>
<tr><td>Other</td><td colspan="2">▪ Ensure the installation location is free from dust, iron, corrosive gas, and combustible gas.
▪ Ensure the installation location is free from vibrations or the potential for hard impacts.</td></tr>
</table>

⚠ Caution

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

■ Wiring Precautions

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

■ Startup Precautions

⚠ Caution
▪ Check the input voltage (AC 200-230 V) and power unit wiring before supplying power to the device. ▪ The servo must be in the OFF mode when you turn on the power. ▪ Before you turn on the power, check the motor's ID and the encoder pulse for L7NHA□□□. ▪ Set the motor ID[0x2000], the encoder type[0x2001] and the encoder pulse ([0x2002]) for L7NHA□□□ first after you turn on the power. ▪ After you complete the above settings, set the drive mode for the servo drive that is connected to the upper level controller in Operation mode[0x6060]. ▪ Refer to Chapter 1.2 "System Configuration" to perform I/O wiring for the servo drive according to each drive mode. ▪ You can check the ON/OFF state for each input terminal of I/O at [0x60FD].

■ Handling and Operating Precautions

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

■ Usage Precautions

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

■ Malfunction Precautions

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

■ Repair/Inspection Precautions

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

■ General Precautions

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

■ Product Application

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

■ EEPROM Lifespan

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

Table of Contents

1. Product Configuration

1.1 Product Verification

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

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

2. Check the product components and options.

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

3. Check the exterior of the device.

- Are there any foreign substances or humidity in the device?
- Is there any discoloration, contaminant, damage or disconnected wire?
- Are the bolts tightly fastened to the joints?
- Is there any abnormal sound or excessive friction during operation?

1.2 Product Specification

■ Designation of L7NH Series

L7 NH A 004 U AA

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

■ Degination of Servo Motor

APM – S B 04 A N K 1 G1 03

Servo Motor

Motor Shape
- S: RealAxis
- H: Hollow Shaft
- B: Assembly
- F: Flat Type
- L : L7 Only

Flange Size
- A: 40 Flange
- B: 60 Flange
- C: 80 Flange
- D: 100 Flange
- E: 130 Flange
- F: 180 Flange
- G: 220 Flange
- H: 250 Flange
- J: 280 Flange

Motor Capacity
- R3: 30[W]
- R5: 50[W]
- 01: 100[W]
- 02: 200[W]
- 03: 300[W]
- 04: 400[W]
- 05: 450[W]
- 06: 550/600[W]
- 07: 650[W]
- 08: 750/800[W]
- 09: 850/900[W]
- 10: 1.0[kW]
- ……
- 150: 15.0[kW]
- 220: 22.0[kW]
- 300: 30.0[kW]
- 370: 37.0[kW]

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

Encoder Type

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

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

Shaft Cross-section
- N: Straight
- K: One-sided round
- C: C Cut
- D: D Cut
- T: Tapering
- R: Double-sided round key
- H: Hollow Shaft

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

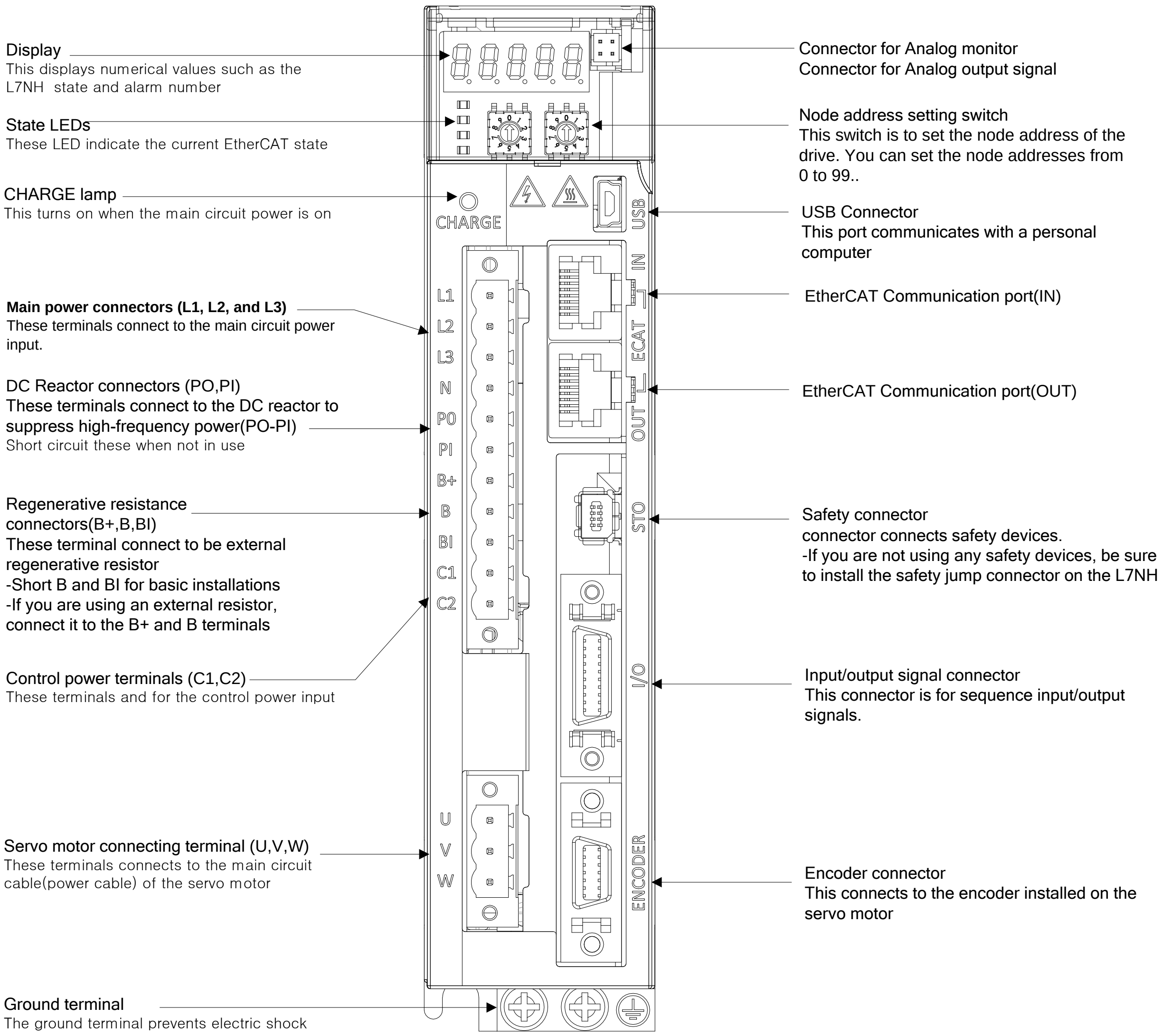
Gearbox Specifications
- Non-existent : No gearbox
- G1: For general industrial purposes (Floor Mounted)
- G2: For general industrial purposes (Flange Mounted)
- G3: Precise Gearbox

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

1.3 Part Names

1.3.1 Part Names of Servo drive

L7NH Series(100W, 200W, 400W)



L7NH Series(800W, 1KW)

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

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

State LEDs
These LED indicate the current EtherCAT state

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

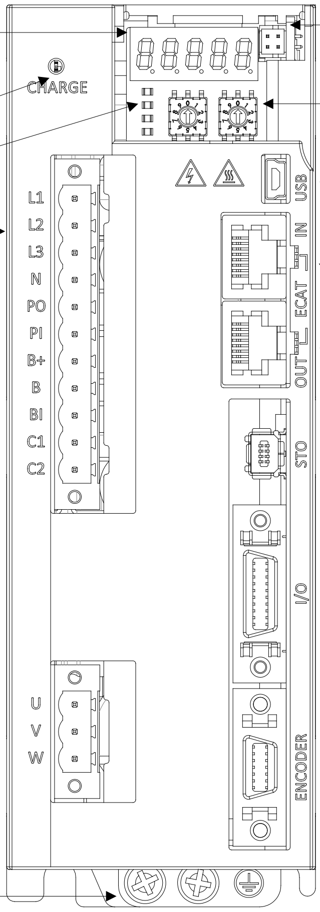
DC Reactor connectors (PO,PI)
These terminals connect to the DC reactor to suppress high-frequency power(PO-PI)
Short circuit these when not in use

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

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

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

Ground terminal
The ground terminal prevents electric shock



Connector for Analog monitor
Connector for Analog output signal

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

USB Connector
This port communicates with a personal computer

EtherCAT Communication port(IN)

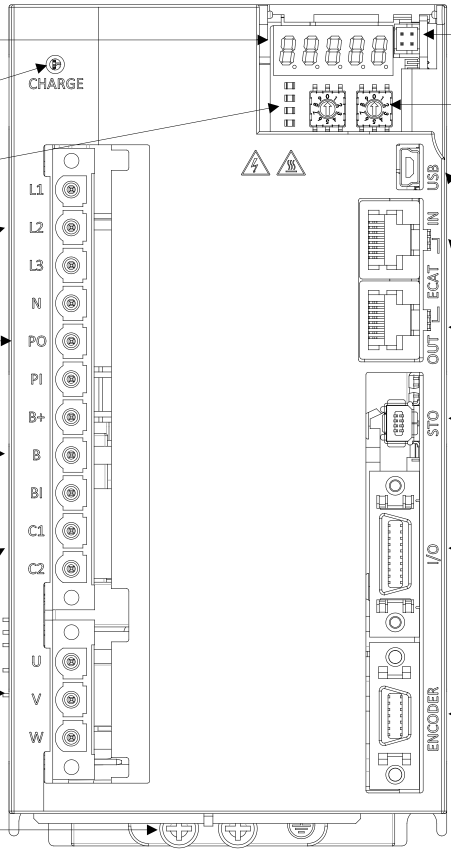
EtherCAT Communication port(OUT)

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

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

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

L7NH Series(2KW, 3.5KW)



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

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

State LEDs
These LED indicate the current EtherCAT state

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

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

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

Control power terminals (C1,C2)
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Servo motor connecting terminal (U,V,W)
These terminals connects to the main circuit cable(power cable) of the servo motor

Ground terminal
The ground terminal prevents electric shock

Connector for Analog monitor
Connector for Analog output signal

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

USB connector
This port communicates with a personal computer

EtherCAT Communication port(IN)

EtherCAT Communication port(OUT)

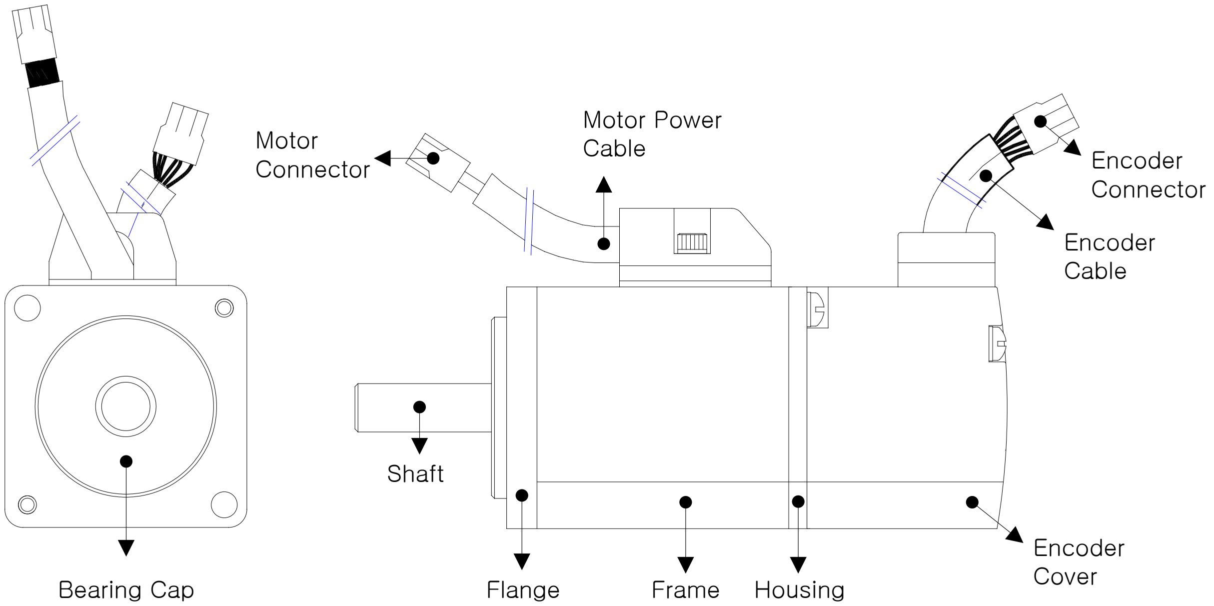
Safety connector
This connector connects safety devices.
-If you are not using any safety devices, be sure to install the safety jump connector on the L7NH

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

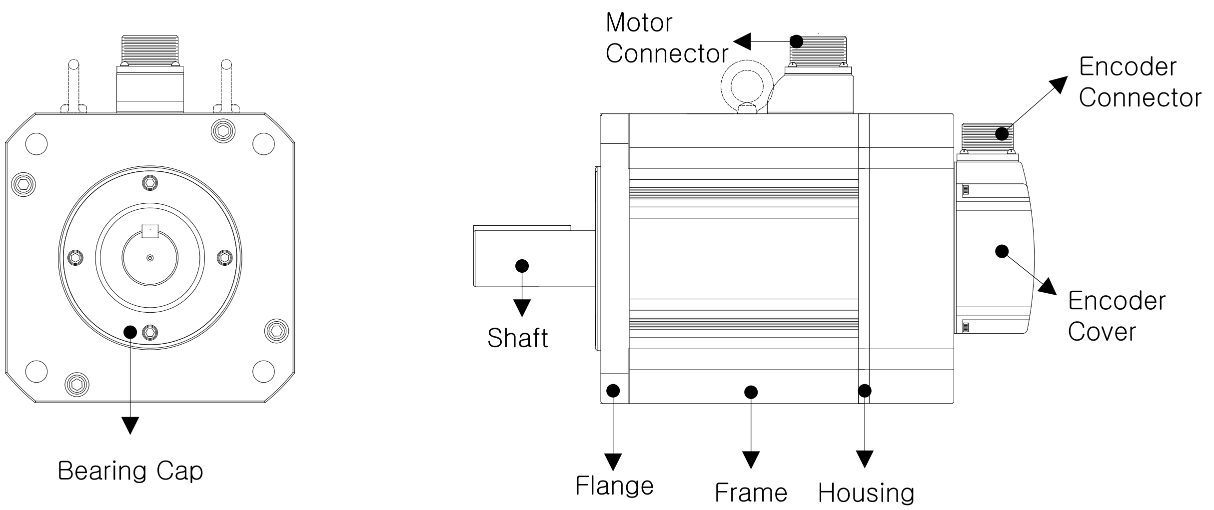
Encoder connector
This connects to the encoder installed on the servo motor

1.3.2 Part Names of Servo motor

80 Flange or below

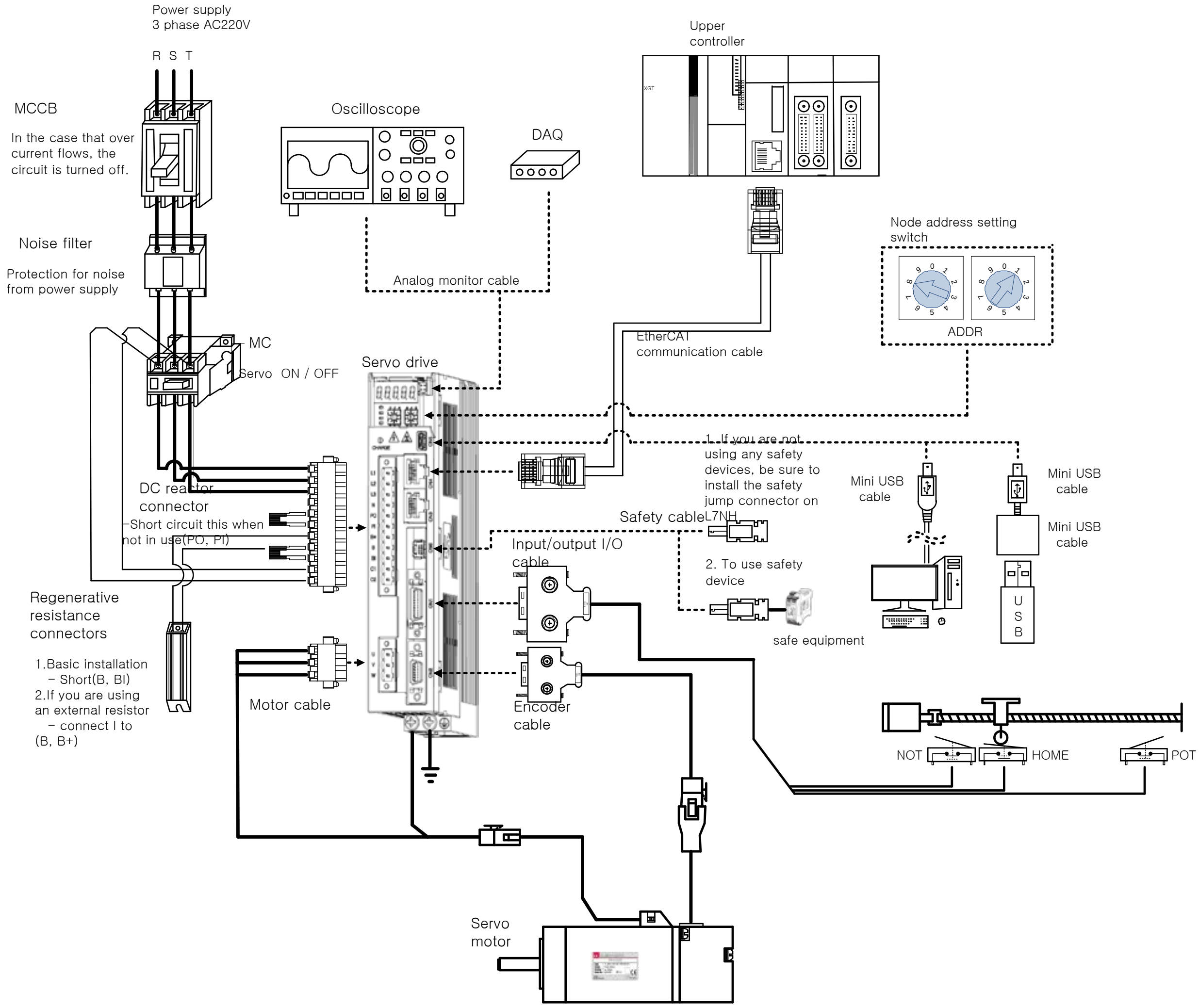


130 Flange or above



1.4 System Configuration Example

The figure below shows an example of system configuration using an L7NH drive.



2. Wiring and Connection

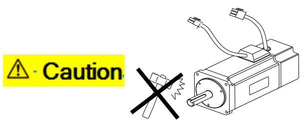
2.1 The Servo Motor

2.1.1 Operating Environment

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

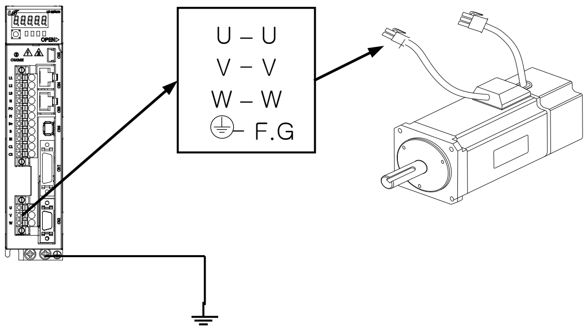
2.1.2 Preventing Impact

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



2.1.3 Motor Connection

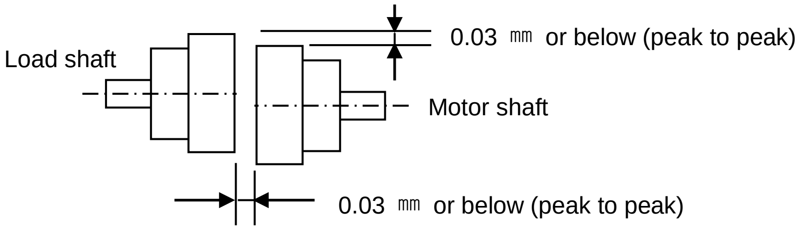
- The motor might burn out if it is connected directly to commercial power.
  Always connect the motor via the specified drive.
- Connect the ground terminals of the motor to either of the two ground terminals inside the drive, and attach the remaining terminal to the type-3 ground.



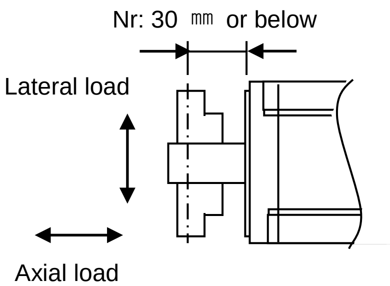
- Connect the U, V, and W terminals of the motor in the same way as the U, V, and W terminals of the drive.
- Ensure that the pins on the motor connector are securely attached.
- In order to protect against moisture or condensation in the motor, make sure that insulation resistance is 10 ㏁ (500 V) or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

2.1.4 The Load Device Connection

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

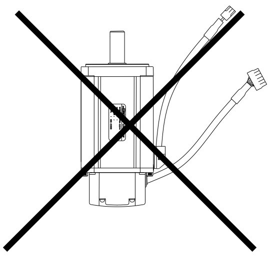


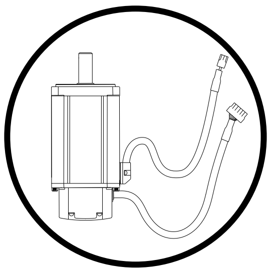
For pulley connections:

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

2.1.5 Cable Installation

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





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

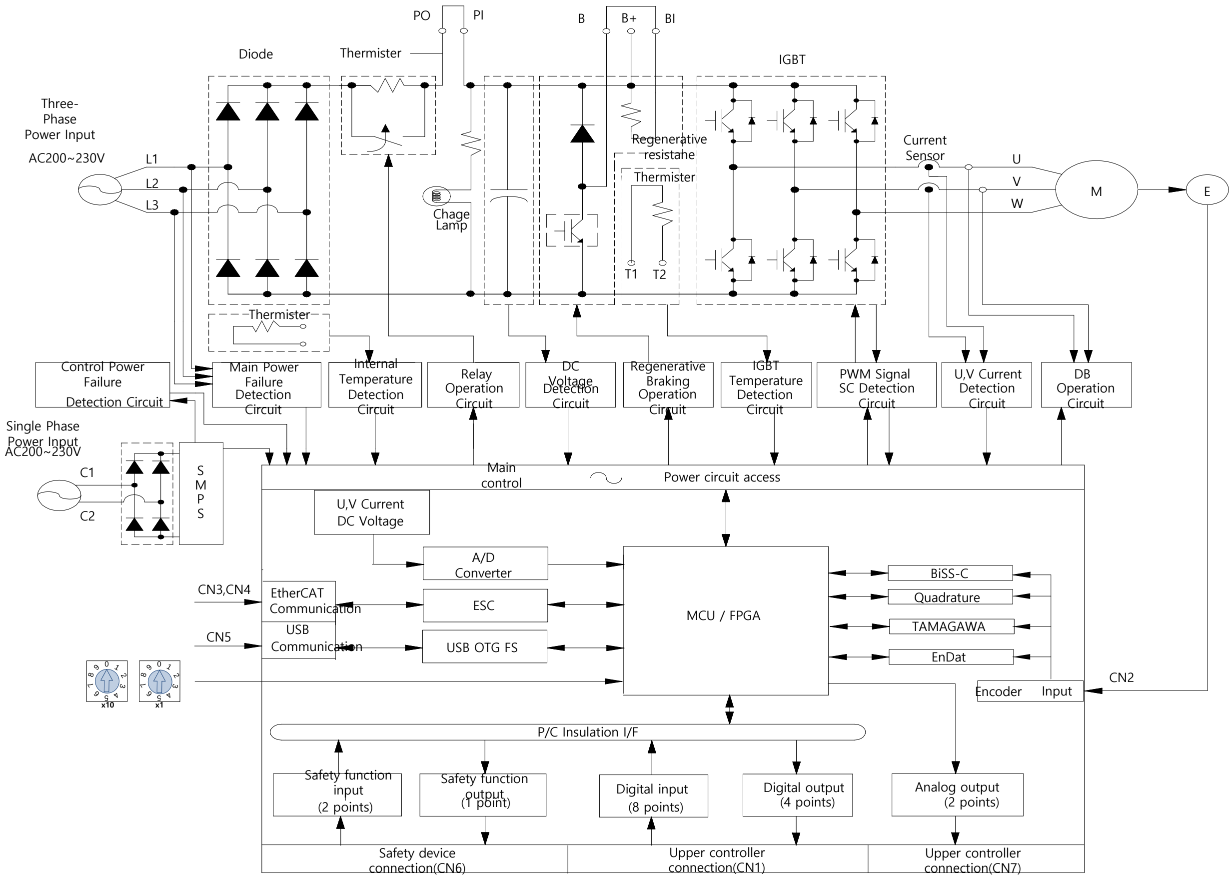
2.2 The Servo Drive

2.2.1 Operating Environment

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

2.3 Internal Block Diagram of Drive

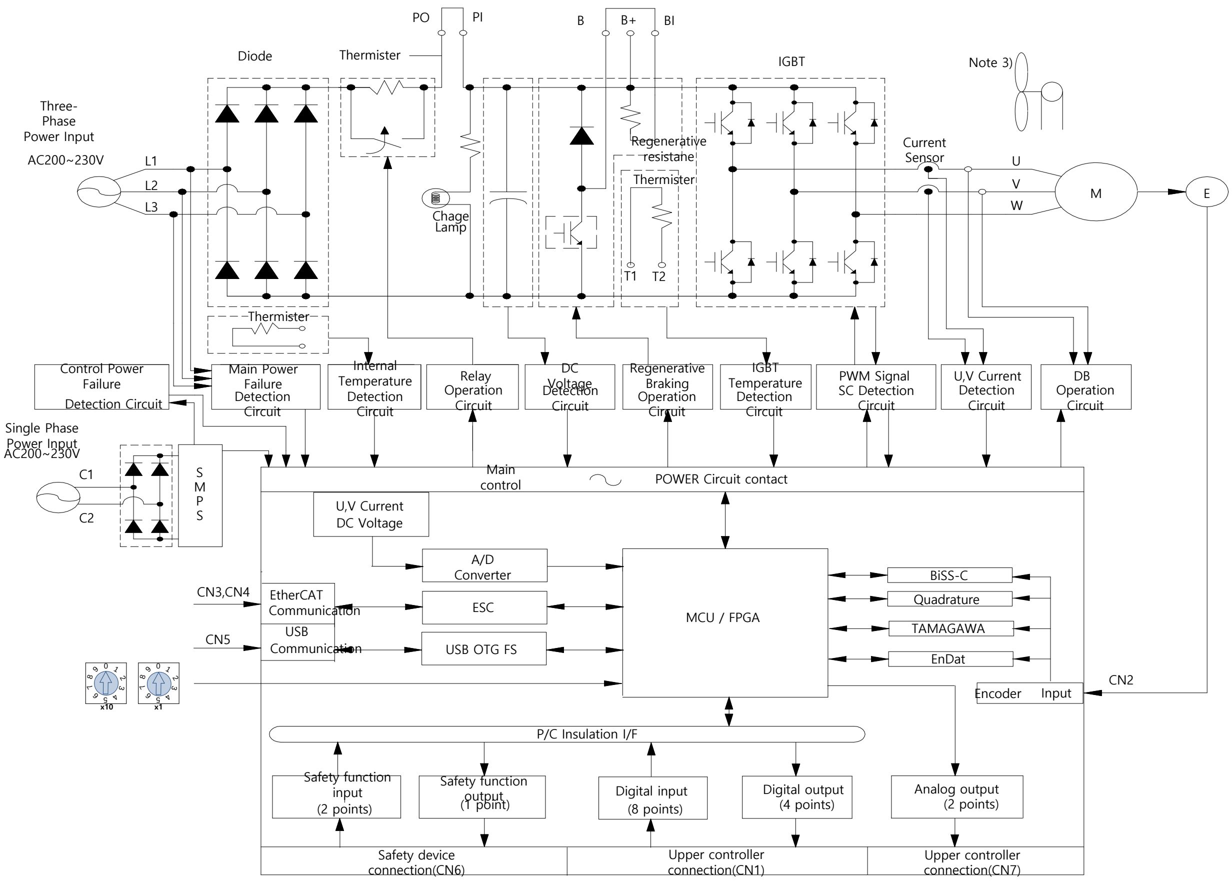
2.3.1 Block Diagram of L7NH(100W~400W)



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

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

2.3.2 Block Diagram of L7NH (800W~3.5kW)



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

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

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

2.4 Power Supply Wiring

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

⚠ Caution
Overvoltage can damage the drive.

- Connecting commercial power to the U, V and W terminals of the drive is extremely dangerous. Always supply power via the L1, L2 and L3 terminals.
- Connect short-circuit pins to the B and BI terminals. For external regenerative resistors, remove the short-circuit pins and use standard resistors for the B+ and B terminals.

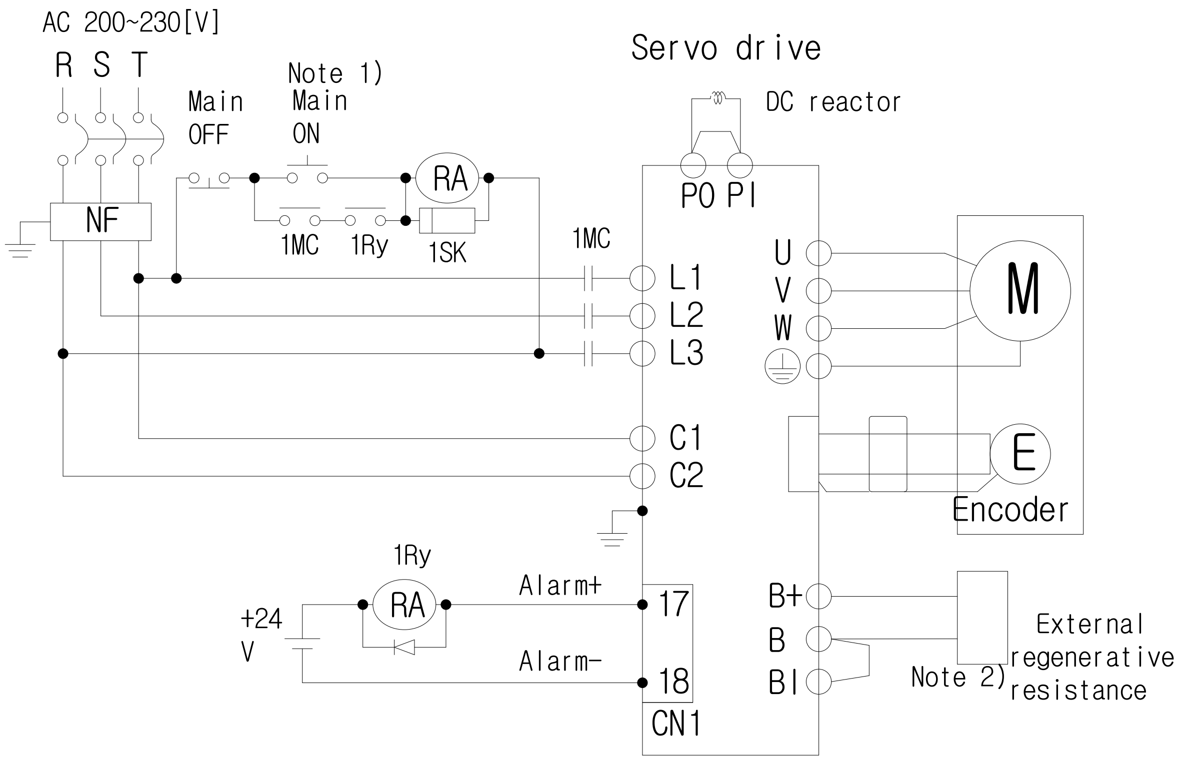
Model	Resistance Value	Standard Capacity	* Notes
100[W]	100 Ω	Built-in 50 W	⚠ **Caution** For information about resistance during regenerative capacity expansion, refer to Section 2.4.3, "Optional and Peripheral Devices."
200[W]			
400[W]			
800[W]	40 Ω	Built-in 100 W	
1[kW]			
2[kW]	13 Ω	Built-in 150 W	
3.5[kW]			

- Configure the system so that the main power (L1, L2, L3) is supplied after the control power (C1, C2). (Refer to Chapter 2.4.1 “L7NH Wiring diagram.”)
- High voltages may remain in the device for sometime even after the main power is disconnected.

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

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

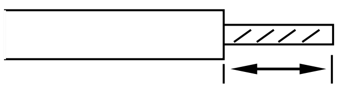
2.4.1 L7NH Wiring Diagram (100W~3.5kW)



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

Check the B and BI short-circuit terminals and the 100[W]~400[W] (50[W], 100[Ω]), 800[W]~1[KW] (100[W], 40[Ω]), and 2[KW]~3.5[KW] (150[W], 13[Ω]) regenerative resistors before use. If the regenerative capacity is higher because of frequent acceleration and deceleration, open the short-circuit pins (B, BI) and connect an external regenerative resistor to B and B+.

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

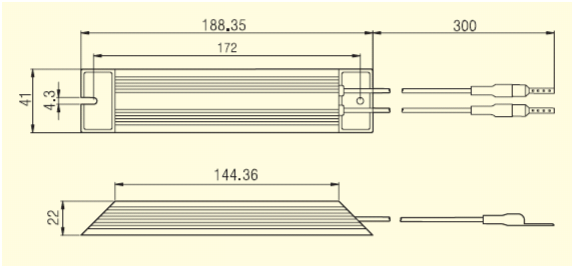
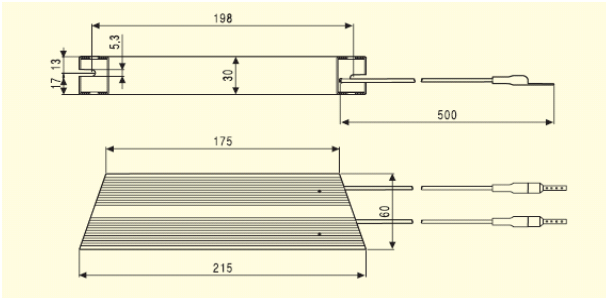
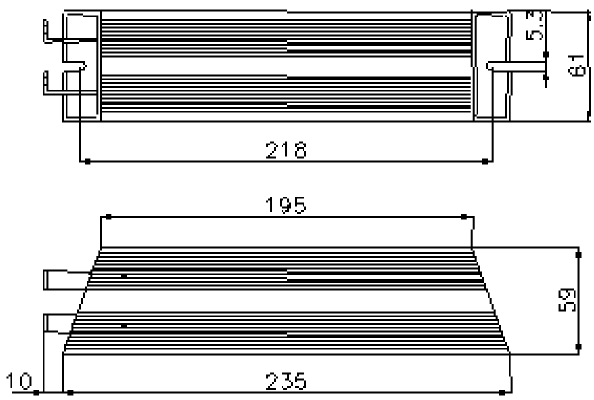


Press the button on the 100[W]~1[KW] drive terminal to attach or remove wires to the main circuit power unit. For the 2[KW]~3.5[KW] drive, use a (-) flathead screwdriver to attach or remove the wires.

2.4.2 Power Circuit Electrical Components

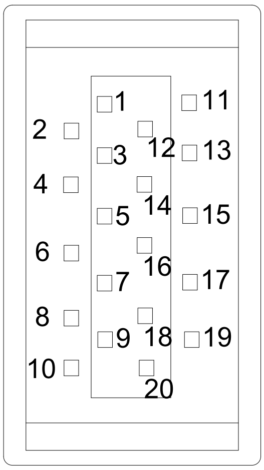
Name	100W	200W	400W	800W	1kW	2kW	3.5kW
MCCB(NFB)	ABS33bM(8A)			12A		24A	
Noise Filter (NF)	RFY-4010M					4020M	4030M
DC reactor	HFN-6(6A)			HFN-10(10A)		HFN-30(30A)	
MC	GMC-9(11A)			GMC-18(18A)		GMC-40(35A)	
Wire	AWG16 (1.25 SQ)			AWG14 (2.0 SQ)		AWG12 (4.0 SQ)	
Crimp terminal	UA-F1510, SEOIL (10mm Strip & Twist)			UA-F2010, SEOIL (10mm Strip & Twist)		UA-F4010, SEOIL (10mm Strip & Twist)	
Regenerative resistor (Default)	50[W] 100Ω			100[W] 40Ω		150[W] 13Ω	

2.4.3 Optional braking resistance

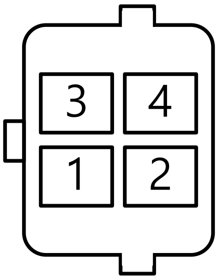
Category	Product Name	Name	Applicable Drive	Specifications
Resistance	Braking resistance	APC-140R50	100[W] 200[W] 400[W]	
Resistance	Braking resistance	APC-300R30	800[W] 1[kW]	
Resistance	Braking resistance	APC-600R30	2[kW] (2P) 3.5[kW] (3P)	

2.5 Wiring for Input/Output Signals

I/O Connector specification : 10120-3000PE (3M)



Analog Monitor Connector specification : DF-11-4DS-2C (HIROSE)



2.5.1 Names and Functions of Digital Input/Output Signals

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

Pin Number	Name	Assigned	Details	Function
6	+24V	DC 24V	DC 24 V INPUT	COMMON
11	DI1	POT	Forward rotation (CCW) prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in forward direction.
12	DI2	NOT	Reserve rotation (CW) prohibited	The actuator stops the servo motor to prevent it from moving beyond the motion range in reserve direction.
7	DI3	HOME	Origin sensor	Connects the origin sensor to return to the origin.

8	DI4	STOP	Servo stop	Stops the servo motor when the contact is on.
13	DI5	PCON	P control action	When the contact is on, it converts the mode from PI control to P control.
14	DI6	GAIN2	Switching of the gain 1 and gain 2	When the contact is on, it switches the speed control gain 1 to the gain 2.
9	DI7	PCL	Forward torque limit	When the contact is on, the forward torque limit function is activated.
10	DI8	NCL	Reverse torque limit	When the contact is on, the reverse torque limit function is activated.
** PROBE1			Touch probe 1	The probe signal to rapidly store the position value (1)
** PROBE2			Touch probe 2	The probe signal to rapidly store the position value (2)
** EMG			Emergency stop	Emergency stop when the contact is on.
** ARST			Alarm reset	Resets the servo alarm.

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

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

Names and Functions of Digital Output Signals

Pin Number	Name	Assigned	Details	Function
1	DO1+	BRAKE+	Brake	Outputs brake control signal.
2	DO1-	BRAKE-		
17	DO2+	ALARM+	Servo alarm	Outputs signal when alarm occurs.
18	DO2-	ALARM-		
3	DO3+	RDY+	Servo ready	This signal is output when the main power is established and the preparations for servo operation are complete.
4	DO3-	RDY-		
19	DO4+	ZSPD+	Zero speed reached	Outputs a signal when the current speed drops below the zero speed.
20	DO4-	ZSPD-		
** INPOS1			Position reached 1	Outputs signal when having reached the command position (1)
** TLMT			Torque limit	Outputs signal when the torque is limited.
** VLMT			Speed limit	Outputs signal when the speed is limited.
** INSPD			Speed reached	Outputs signal upon reaching the command speed.
** WARN			Servo warning	Outputs signal when 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)

Note 1) ** Unassigned signals. The assignment may be changed by parameter setting. For more information, refer to 5.2 Input/Output Signals Setting.

2.5.2 Names and Functions of Analog Input/Output Signals

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

Pin Number	Name	Details	Function
15	A-TLMT	Analog Torque Limit	Limit the torque output of the motor by supplying -10~ +10V between A-TLMT(AI1) and AGND. Set the [0x221C] for scaling between input voltage and torque limit.
5	AGND	AGND(0V)	Analog ground

Names and Functions of Analog Output Signals(Analog Monitor Connector)

Pin Number	Name	Details	Function
1	AMON1	Analog monitor1	Analog monitor output (-10V to +10V)
2	AMON2	Analog monitor2	Analog monitor output (-10V to +10V)
3	AGND	AGND(0V)	Analog ground
4	AGND	AGND(0V)	Analog ground

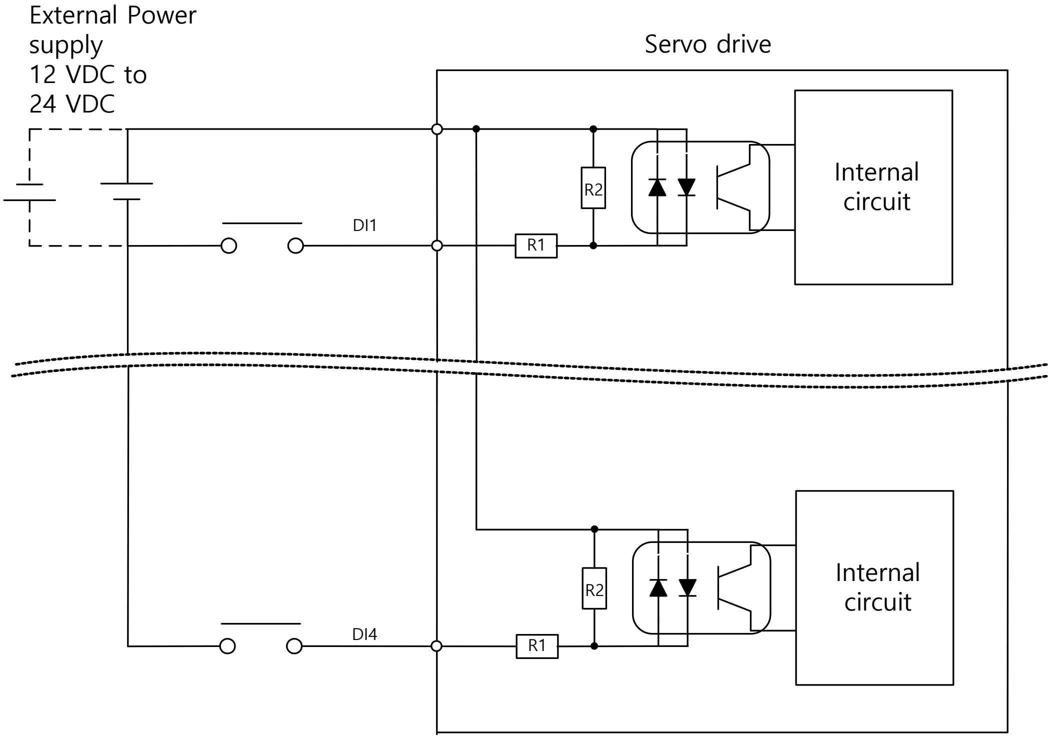
Note 1) You can change the output variables to be monitored with analog monitor output by parameter setting. For more information, refer to 8.4 Analog Monitor.

2.5.3 Examples of Connecting Input/Output Signals

Examples of Connecting Digital Input Signals

⚠ Caution

1. The input contact can be set to the Normal-OFF or the Normal-ON, based on the characteristics of individual signal.
2. Each input contact can be assigned to 12 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.

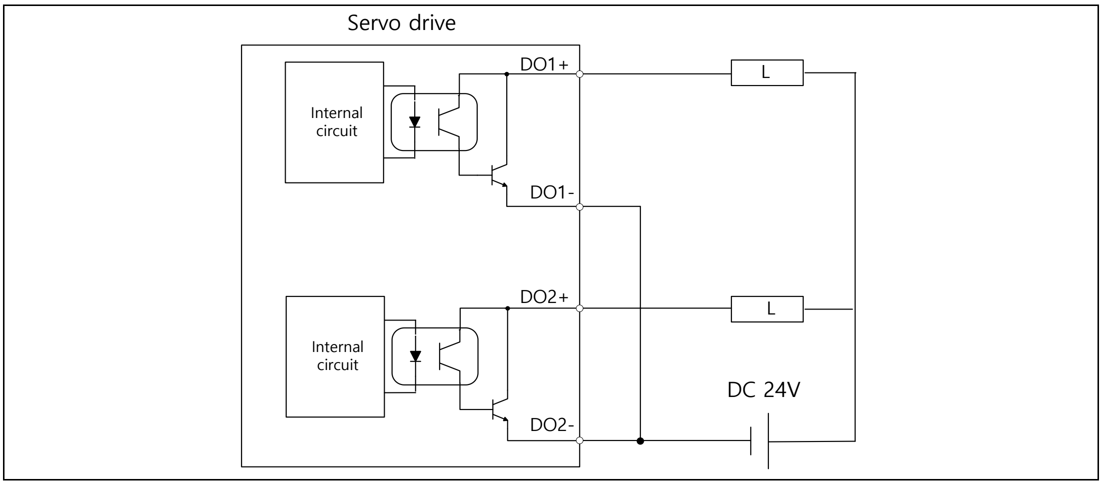


R1: 3.92KΩ, R2: 680Ω

Example of Connecting Digital Output Signals

⚠ Caution

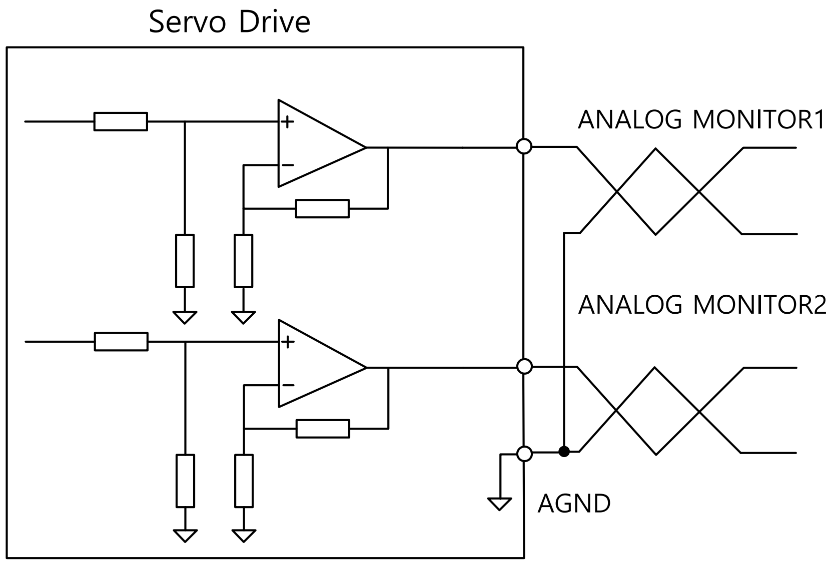
1. The output contact can be set to the Normal-OFF or the Normal-ON, based on the characteristics of individual signal.
2. Each output contact can be assigned to 11 output functions.
3. For more information on signal assignment and contact change of the output contact, refer to 5.2 Input/Output Signals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



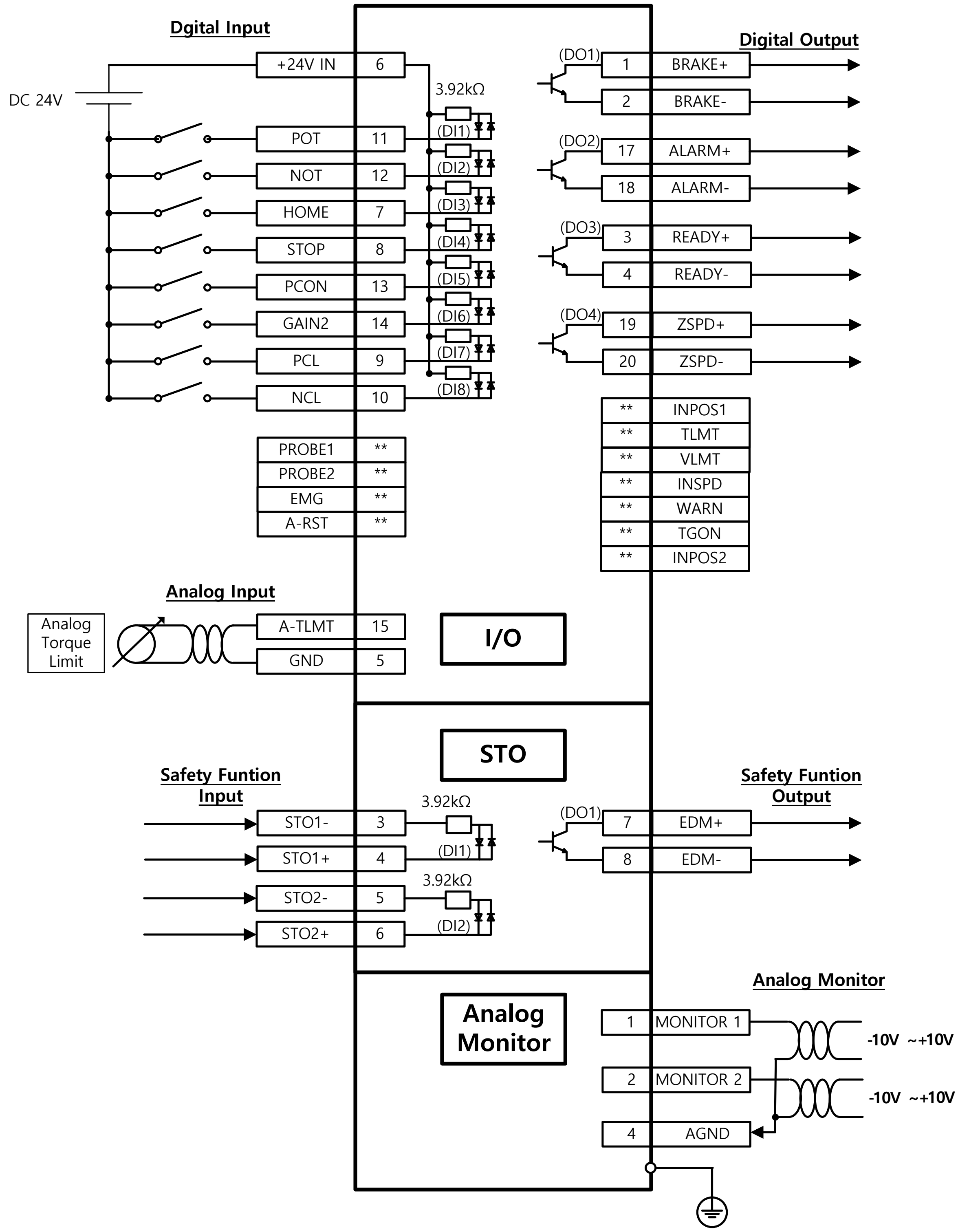
Note 1) For DO1 and DO2 output signals, the GND24 terminal is separated.

Examples of Connecting Analog Output Signals

⚠ Caution
1. For more information on settings and scale adjustment of monitoring signals, refer to 8.4 Analog Monitor. **2.** The range of analog output signals is -10V to +10V. **3.** The resolution of analog output signal is 12 bits. **4.** The maximum load current allowed is 2.5 [mA]. **5.** The stabilization time is 15 [us].



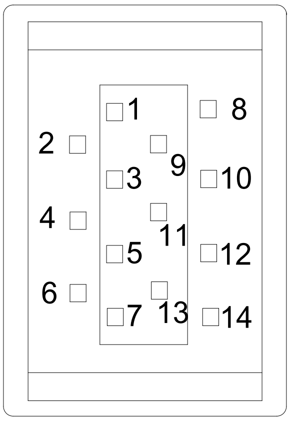
2.5.4 Examples of Connecting Input/Output Signals



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

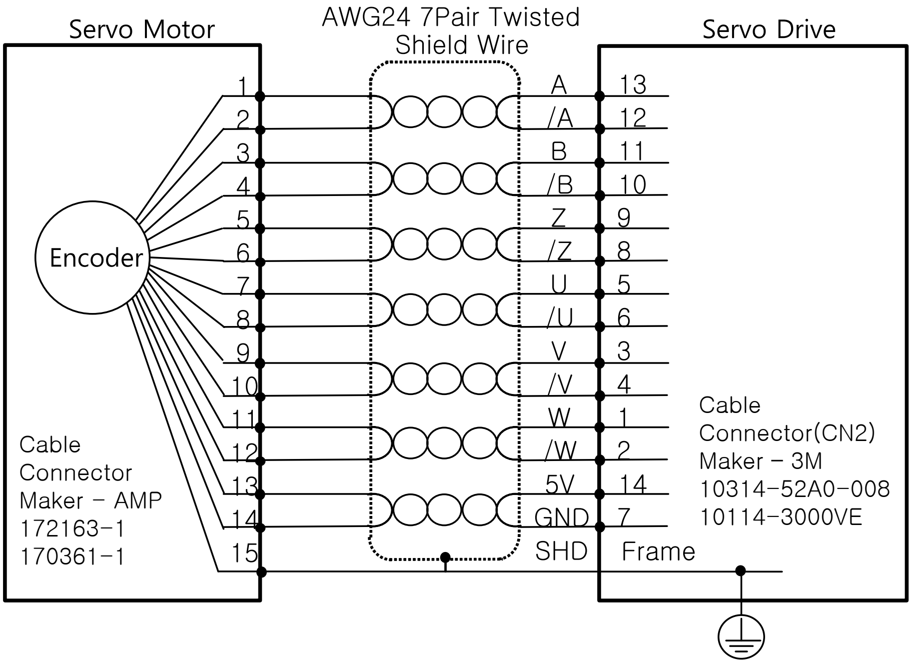
2.6 Wiring of Encoder

ENCODER Connector spec : 10114-3000VE (3M)

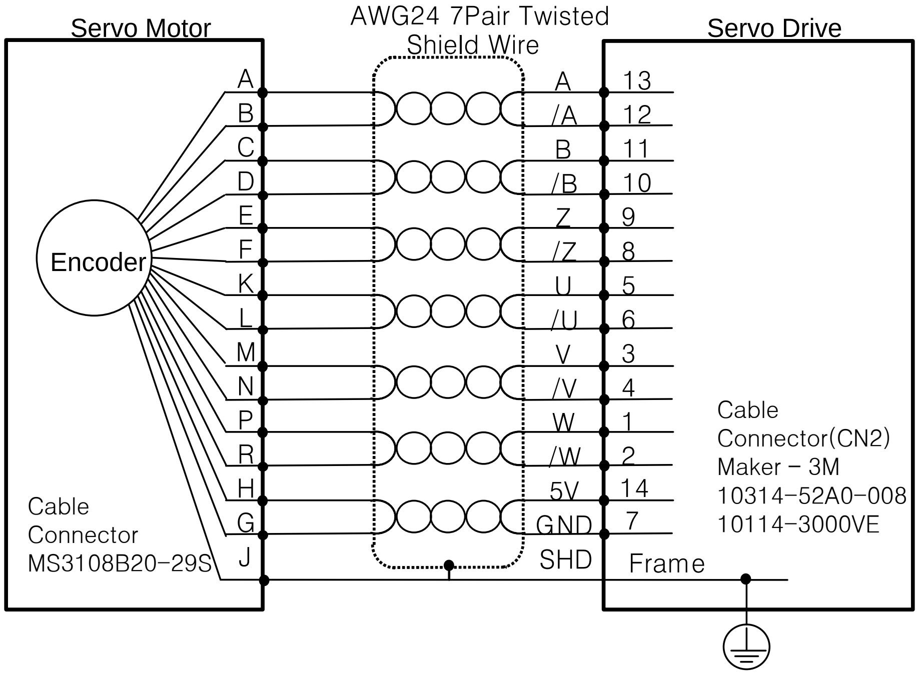


2.6.1 Wiring of Quadrature Encoder

■ APCS-E□□□AS Cable

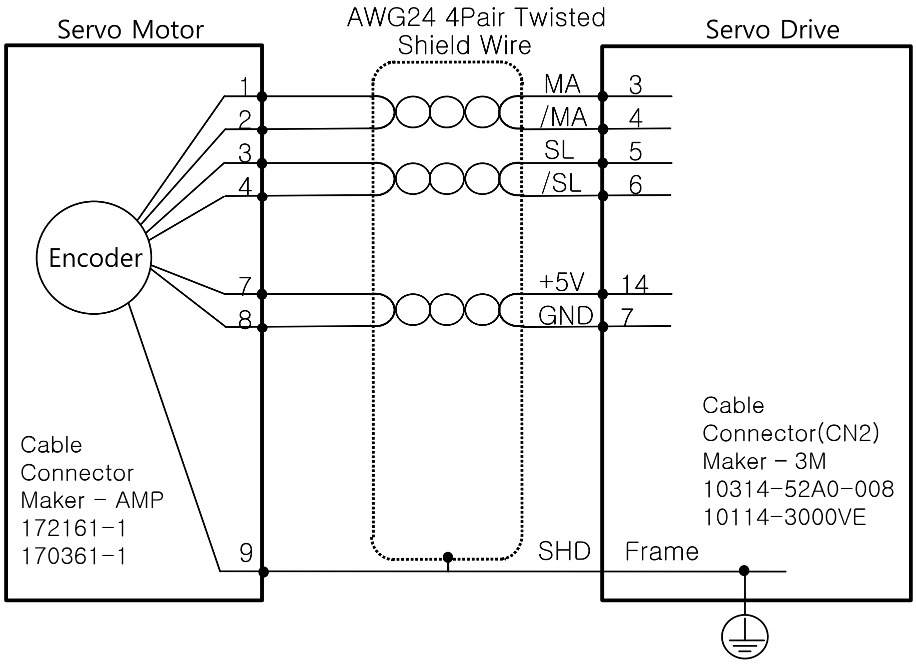


■ APCS-E□□□BS Cable

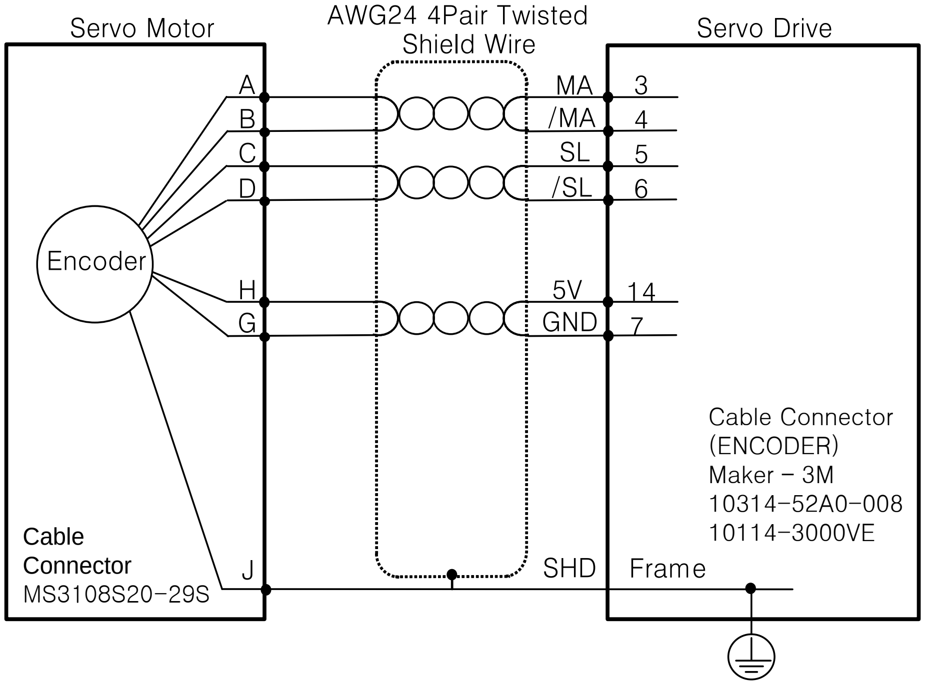


2.6.2 Wiring of Single turn Serial Encoder

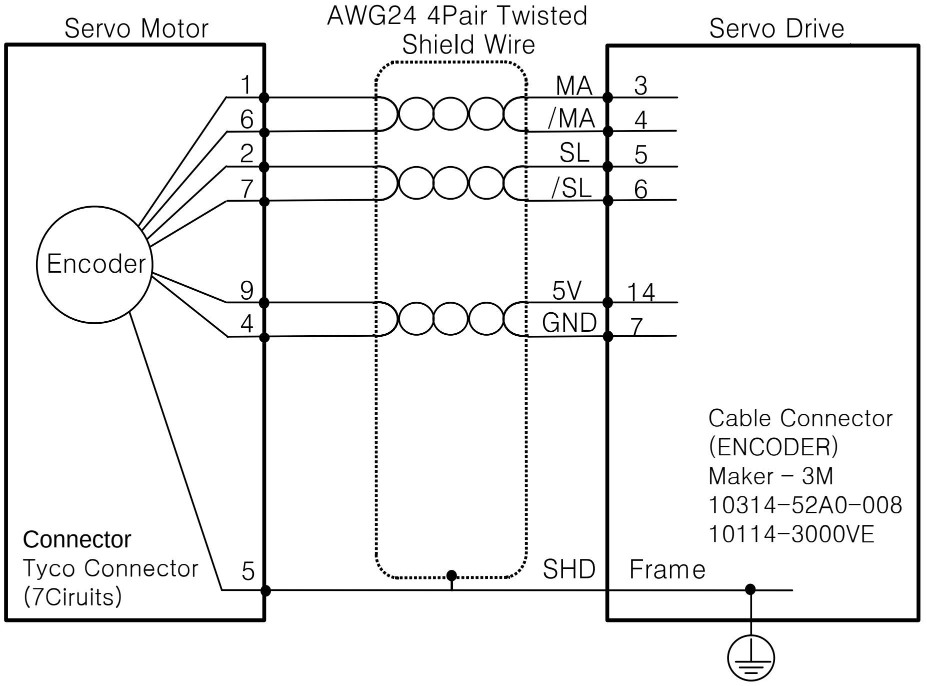
■ APCS-E□□□CS Cable



■ APCS-E□□□DS Cable

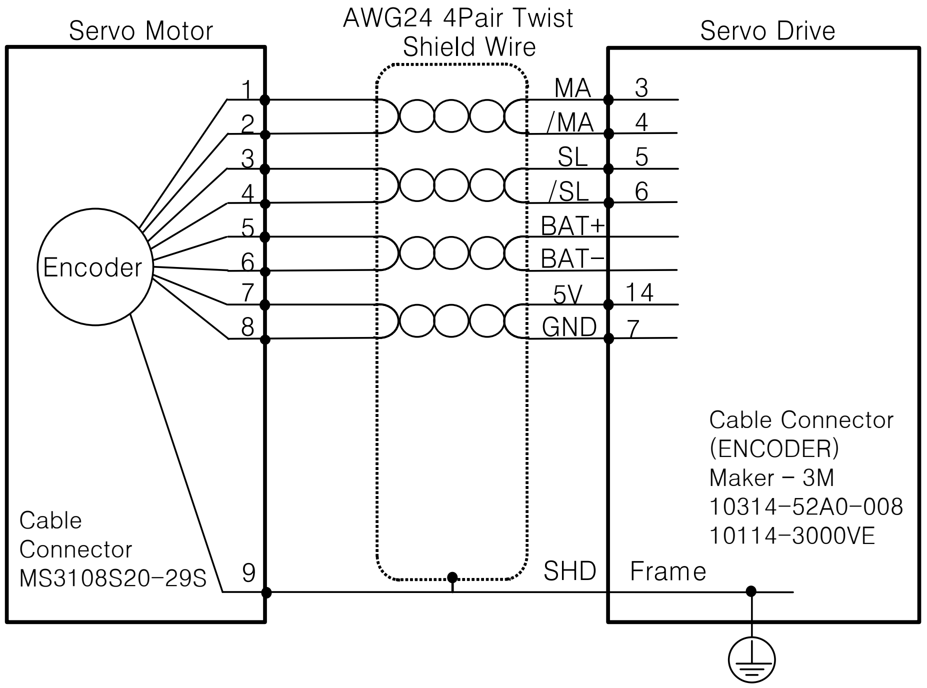


■ APCS-E□□□ES Cable

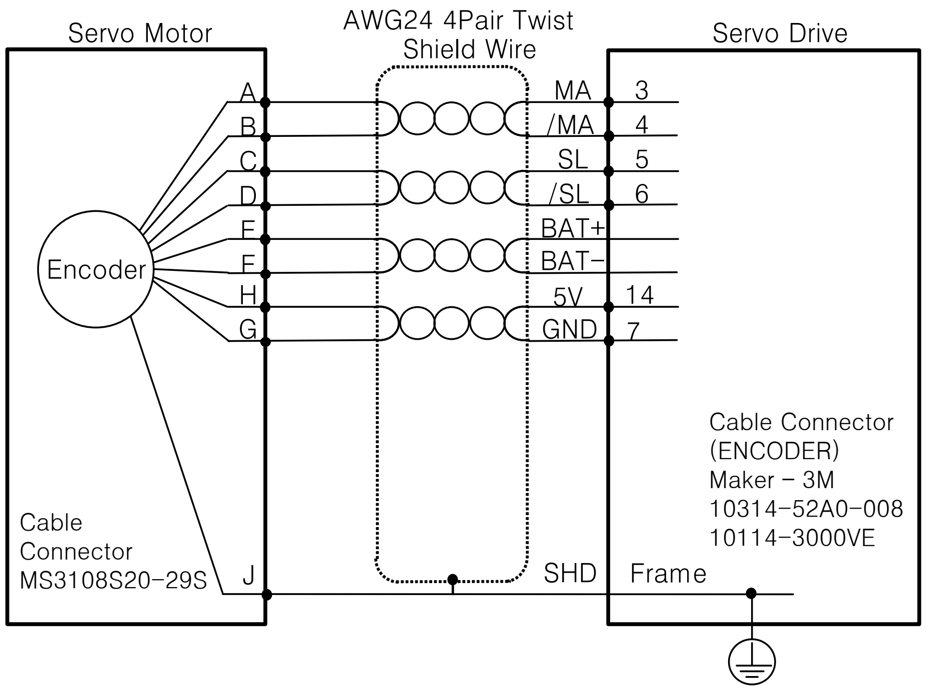


2.6.3 Wiring of Multi Turn Serial Encoder

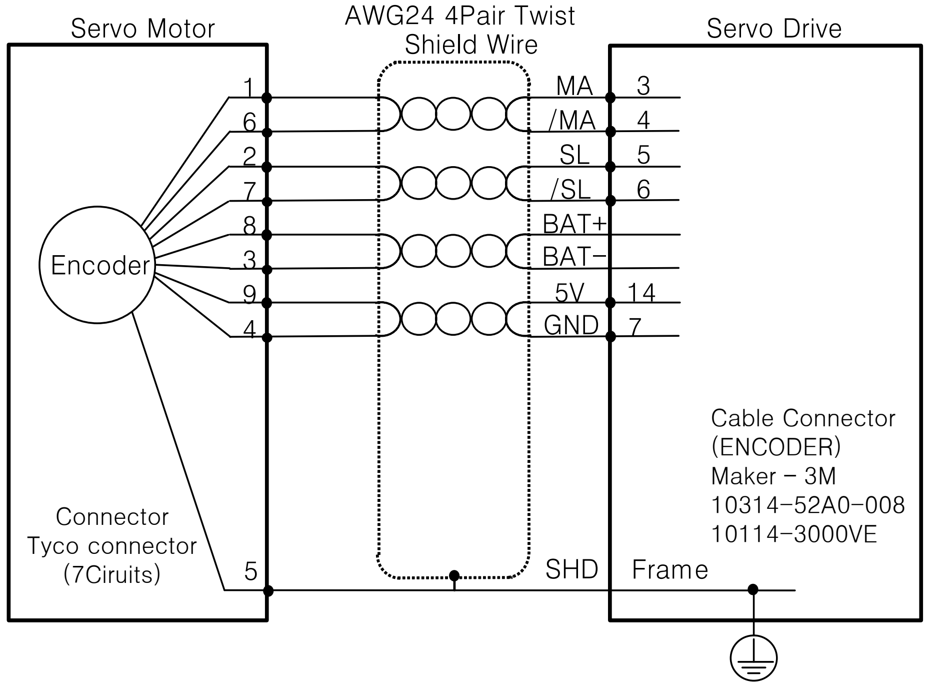
■ APCS-E□□□CS1 Cable



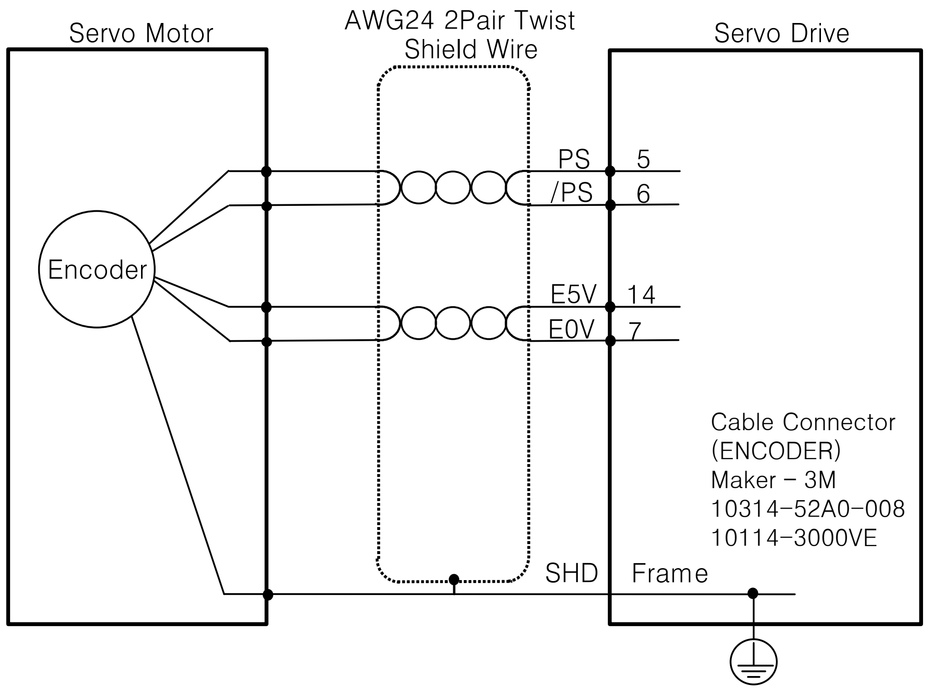
■ APCS-E□□□DS1 Cable



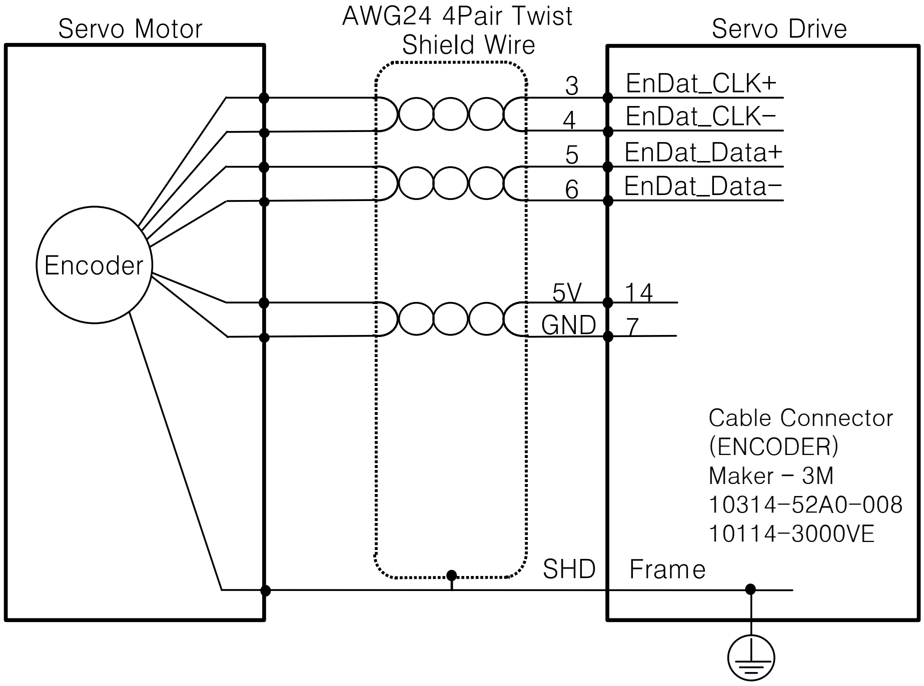
■ APCS-E□□□ES1 Cable



2.6.4 Wiring of Tamagawa Encoder

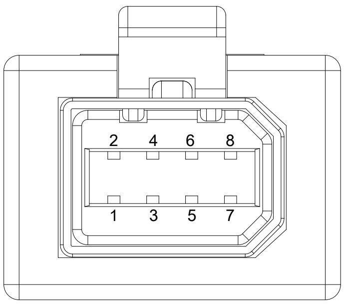


2.6.5 Wiring of EnDat 2.2 Encoder



2.7 Wiring for Safety Function Signals (STO)

2069577-1(Tyco Electronics)



2.7.1 Names and Functions of Safety Function Signals

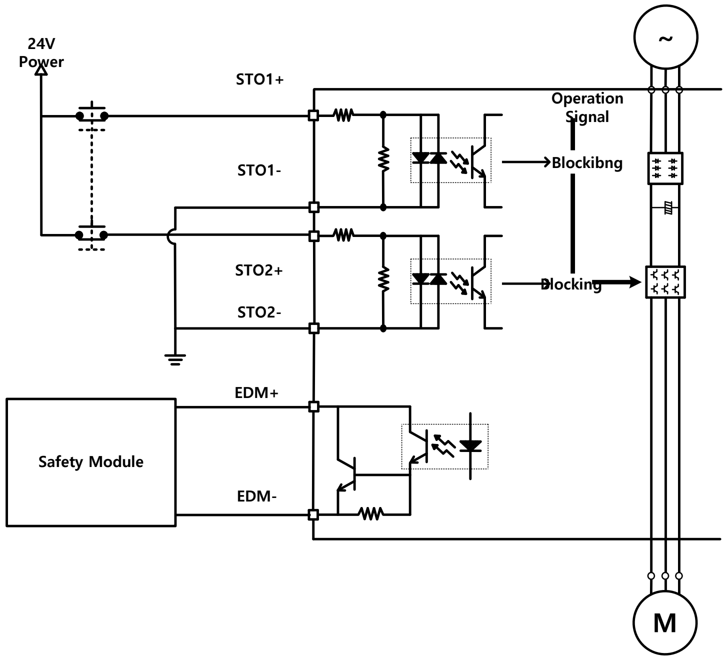
Pin Number	Name	Function
1	+12V	Bypass Wiring

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 signal output for checking state of safety function input signal.
8	EDM-	

2.7.2 Example of Connecting Safety Function Signals

⚠ Caution

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

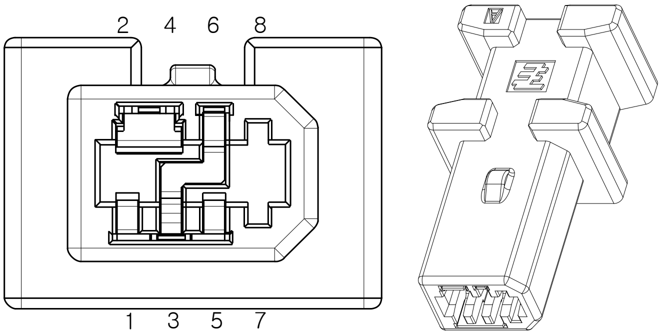


2.7.3 Wiring for Bypass Safety Function Signal

When STO function is not used due to user's convenience, L7NH Series offers Mini I/O By-pass connector with internal Bypass wiring. When using Mini I/O Plug connector, follow below instruction for using Bypass function.

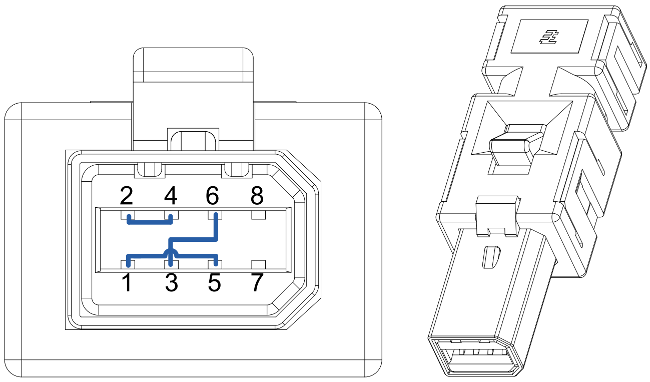
Wiring Mini I/O Plug connector as below picture. Connect +12V to STO2-, -12V to STO1+ and STO- to STO2+. Then, it will be able to use safety function signal as bypassing. Never use this Power(+12V, -12V) for other purpose.

Mini I/O By-pass Connector



1971153-1(Tyco Electronics)

Mini I/O Plug Connector



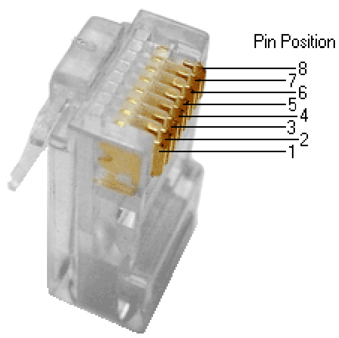
2069577-1(Tyco Electronics)

2.8 Wiring for EtherCAT Communication Signals

2.8.1 Names and Functions of EtherCAT Communication Signals

EtherCAT IN and EtherCAT OUT Connector

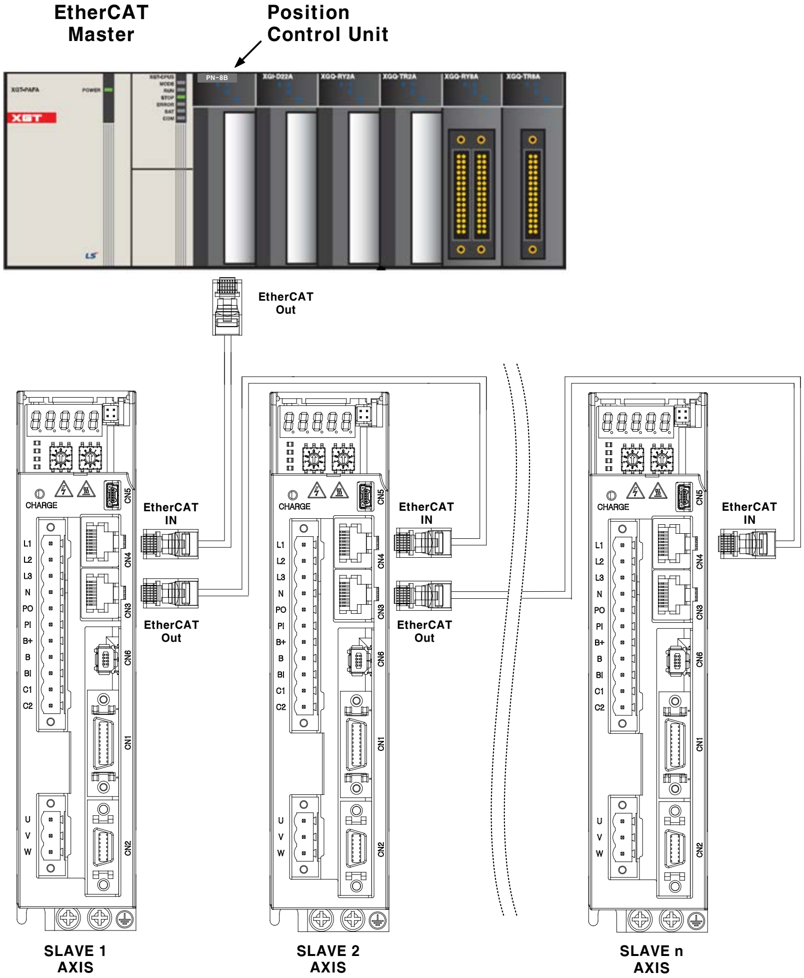
Pin Number	Signal Name	Line color
1	TX/RX0 +	White/Orange
2	TX/RX0 -	Orange
3	TX/RX1+	White/Green
4	TX/RX2 -	Blue
5	TX/RX2 +	White/Blue
6	TX/RX1 -	Green
7	TX/RX3 +	White/Brown
8	TX/RX3 -	Brown
Plate		Shield



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

2.8.2 Example of Drive Connection

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



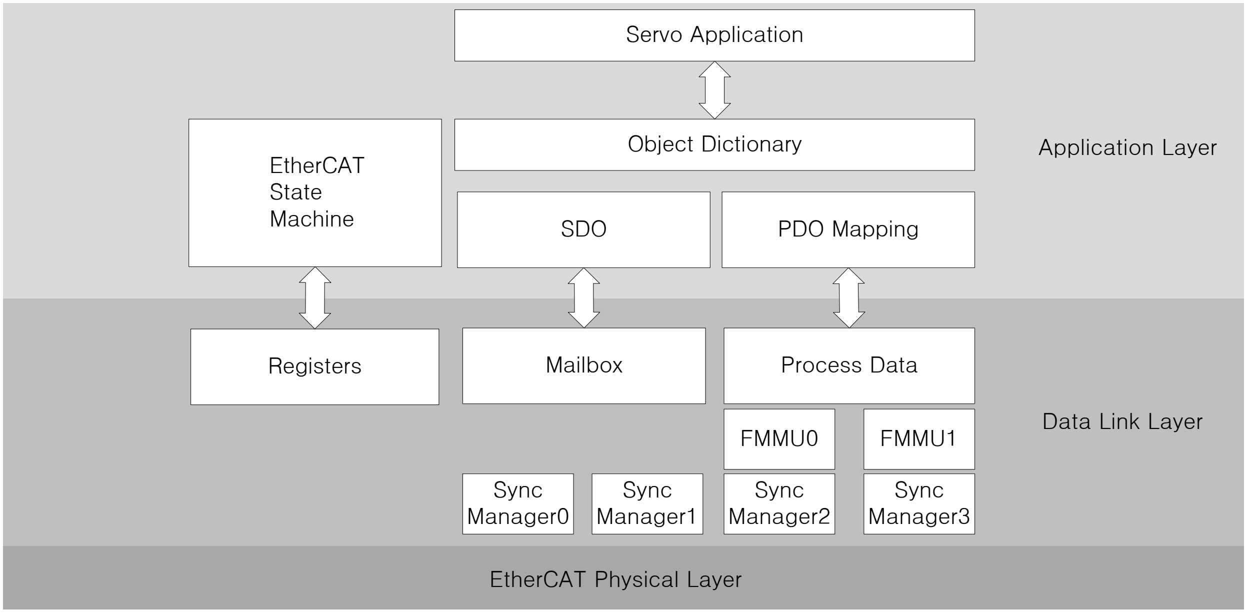
3. EtherCAT Communication

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

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

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

3.1 Structure of CANopen over EtherCAT

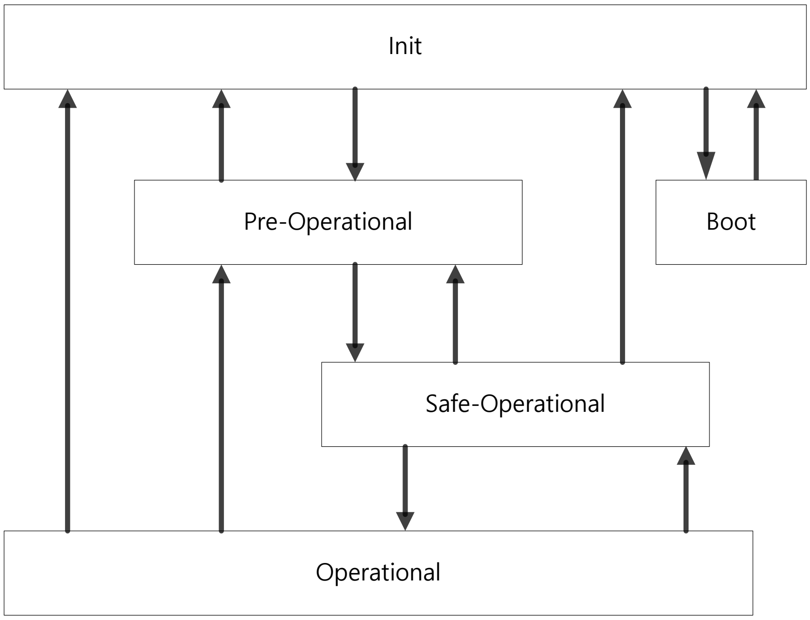


This drive supports a CiA 402 drive profile. The Object Dictionary in the application layer includes application data and PDO (Process Data Object) mapping information from the process data interface and application data.

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

The data mapped to the PDO is periodically exchanged (read and written) between an upper level controller and a slave by process data communication; the mailbox communication is not performed periodically; and all of the parameters defined in the Object Dictionary are accessible.

3.1.1 EtherCAT State Machine

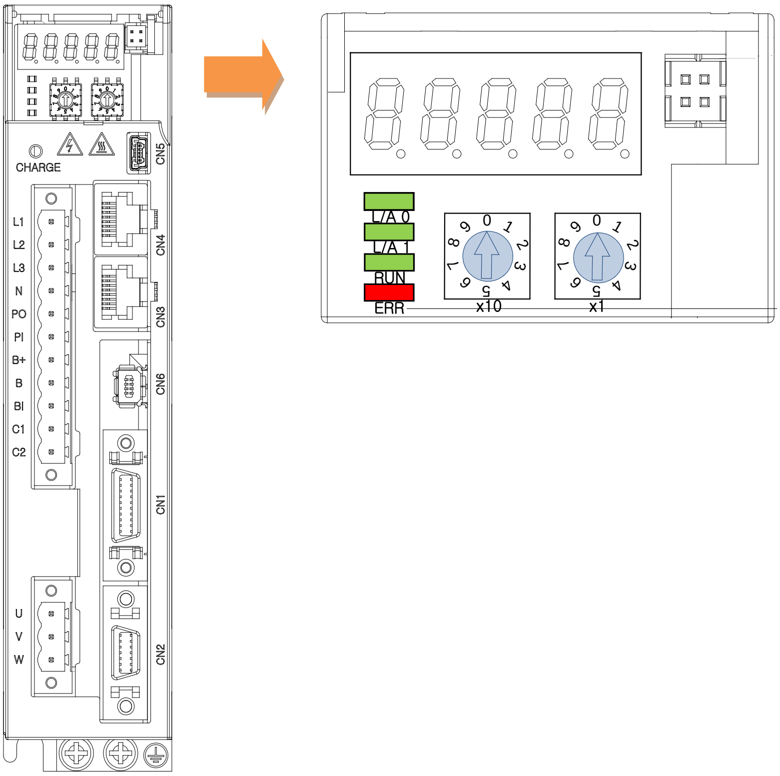


The EtherCAT drive has 5 states as above, and a state transition is done by an upper level controller (master).

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

3.2 Status LED

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



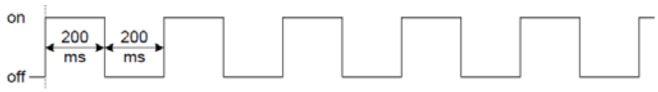
L/A0, L/A1 (Link Activity) LED

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

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

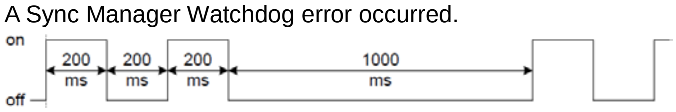
RUN LED

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

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

3.3 Data Type

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

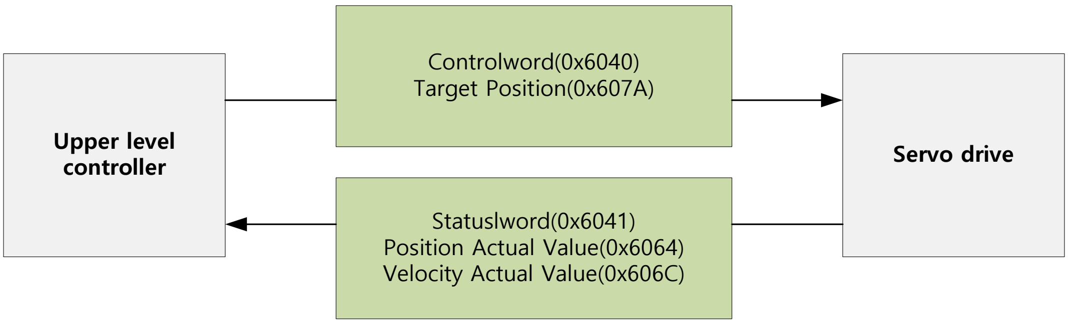
Codes	Details	Range
SINT	Signed 8-bit	-128 ~127
USINT	Unsigned 8-bit	0 ~ 255
INT	Signed 16-bit	-32768 ~ 32767
UINT	Unsigned 16-bit	0 ~ 65535
DINT	Signed 32-bit	-21247483648 ~ 21247483647
UDINT	Unsigned 32-bit	0 ~ 4294967295
FP32	Float 32-bit	Single precision floating point
STRING	String Value	

3.4 PDO Assignment

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

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

The diagram below shows the PDO assignment:



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

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

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

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

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

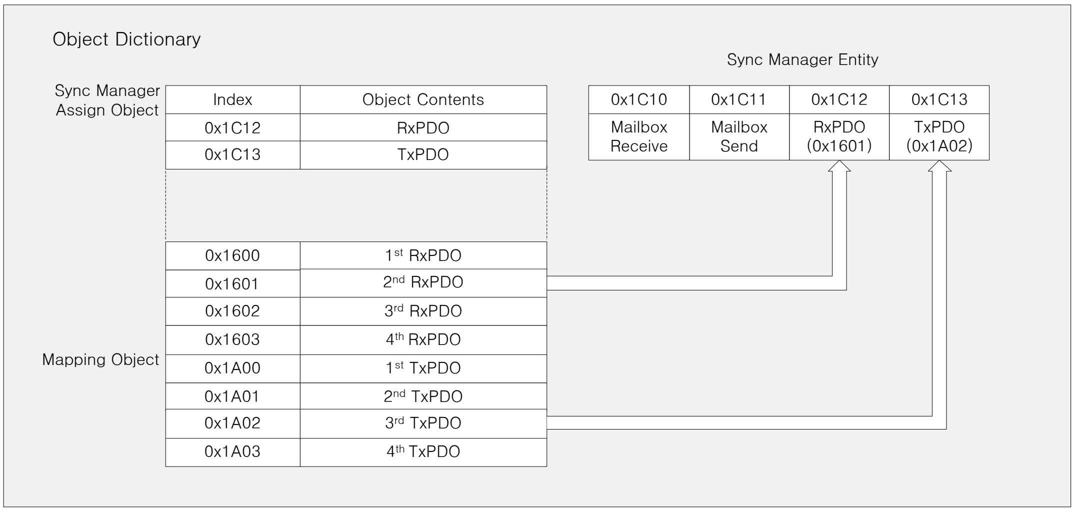
Index	SubIndex	Name	Data Type
0x6041	0x00	Statusword	UINT
0x6064	0x00	Actual Position Value	DINT
0x606C	0x00	Actual Velocity Value	DINT

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

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

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

The following figure shows an example of the SyncManager PDO mapping:



PDO Mapping

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

- 1st PDO Mapping:

RxPDO (0x1600)	Controlword (0x6040)	Target torque (0x6071)	Target position (0x607A)	Operation mode (0x6060)	Touch probe function (0x60B8)					
TxPDO (0x1A00)	Statusword (0x6041)	Actual torque value (0x6077)	Actual position value (0x6064)	Actual positional error value (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 Funtion (0x60B8)	Physical output (0x60FE)		
TxPDO (0x1A01)	Statusword (0x6041)	Actual torque value (0x6064)	Following error actual value (0x60F4)	Touch probe status (0x60B9)	Touch probe 1 positive edge position value (0x60BA)	Digital Input (0x60FD)

- 3rd PDO Mapping:

RxPDO (0x1602)	Controlword (0x6040)	Target Velocity (0x60FF)	Touch Probe Function (0x60B8)	Physical output (0x60FE)	
TxPDO (0x1A02)	Statusword (0x6041)	Position actual value (0x6064)	Touch probe status (0x60B9)	Touch probe 1 positive edge positon value (0x60BA)	Digital Input (0x60FD)

- 4th PDO Mapping:

RxPDO (0x1603)	Controlword (0x6040)	Target Torque (0x6071)	Touch Probe Function (0x60B8)	Physical output (0x60FE)	
TxPDO (0x1A03)	Statusword (0x6041)	Position actual value (0x6064)	Touch probe status (0x60B9)	Touch probe 1 positive edge position value (0x60BA)	Digital Input (0x60FD)

3.5 Synchronization with 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 by using the Sync0 event generated by the reference clock.

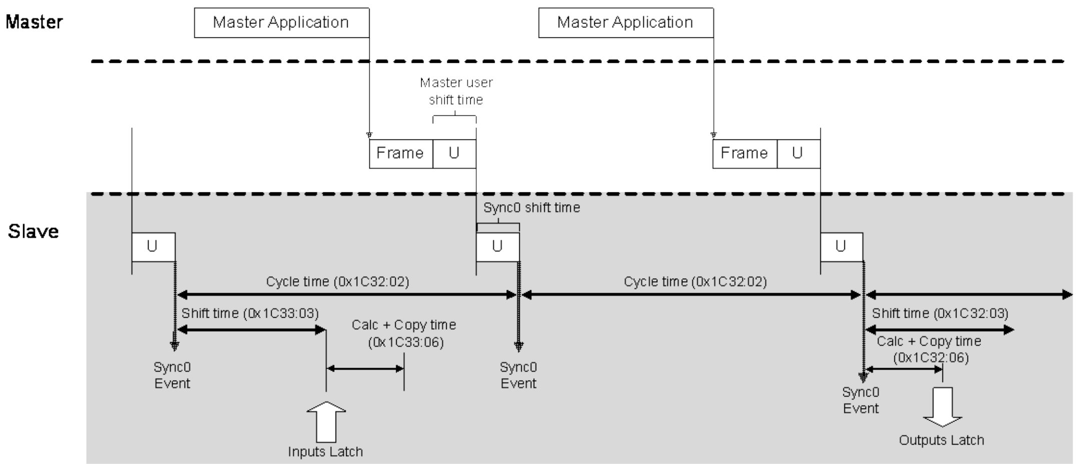
The following synchronization modes exist in this drive. You can change the mode with the sync control register.

(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

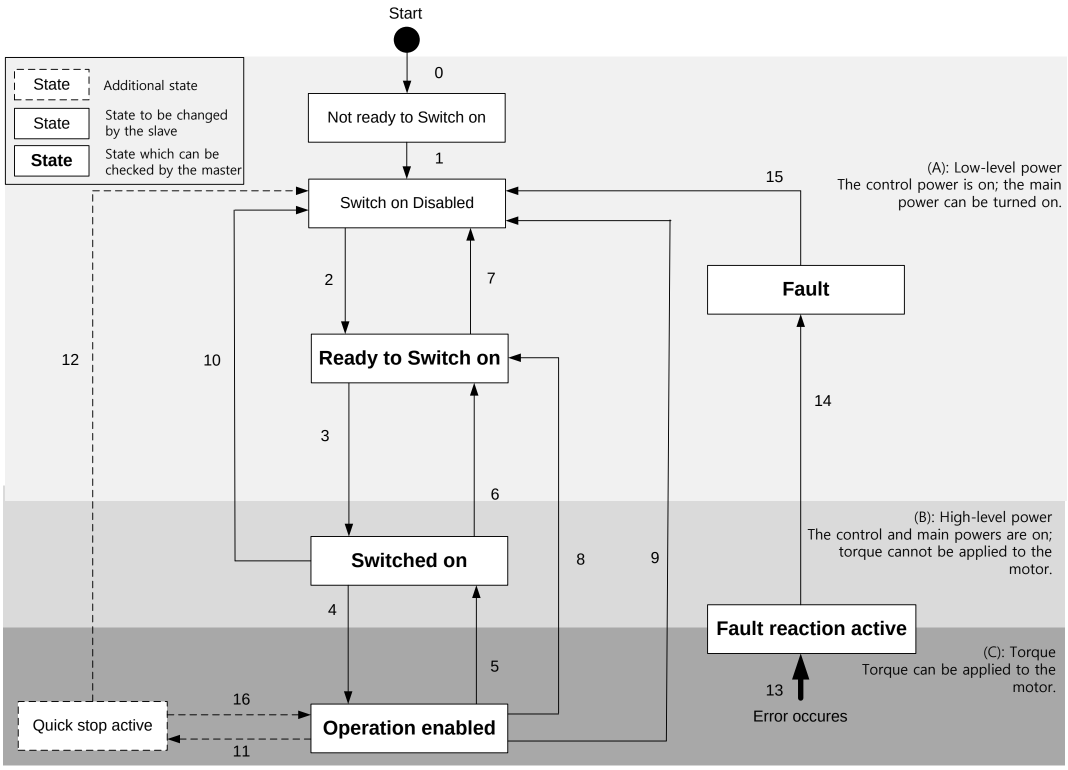
Emergency messages are passed to the master via mailbox communication when a servo alarm occurs in the drive. Emergency messages may not be sent in the event of communication failure.

Emergency messages consist of 8-byte data.

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

4. CiA402 Drive Profile

4.1 State Machine



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

State Machine Control Commands

Switching states of the State Machine can be done through combinations of Controlword (0x6040) bits setting, as described in the table below:

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

Statusword Bit Names (0x6041)

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

Command	Statusword bits (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 10.3 CiA402 Objects.
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switched on disabled	
7	Warning	
8	-	
9	Remote	
10	Target reached	
11	Internal limit active	

Bit No.	Data Description	Note
12	Operation mode specific	
13		
14	Torque limit active	
15	D specific	

4.2 Operation Modes

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

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

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

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

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

Related Objects

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

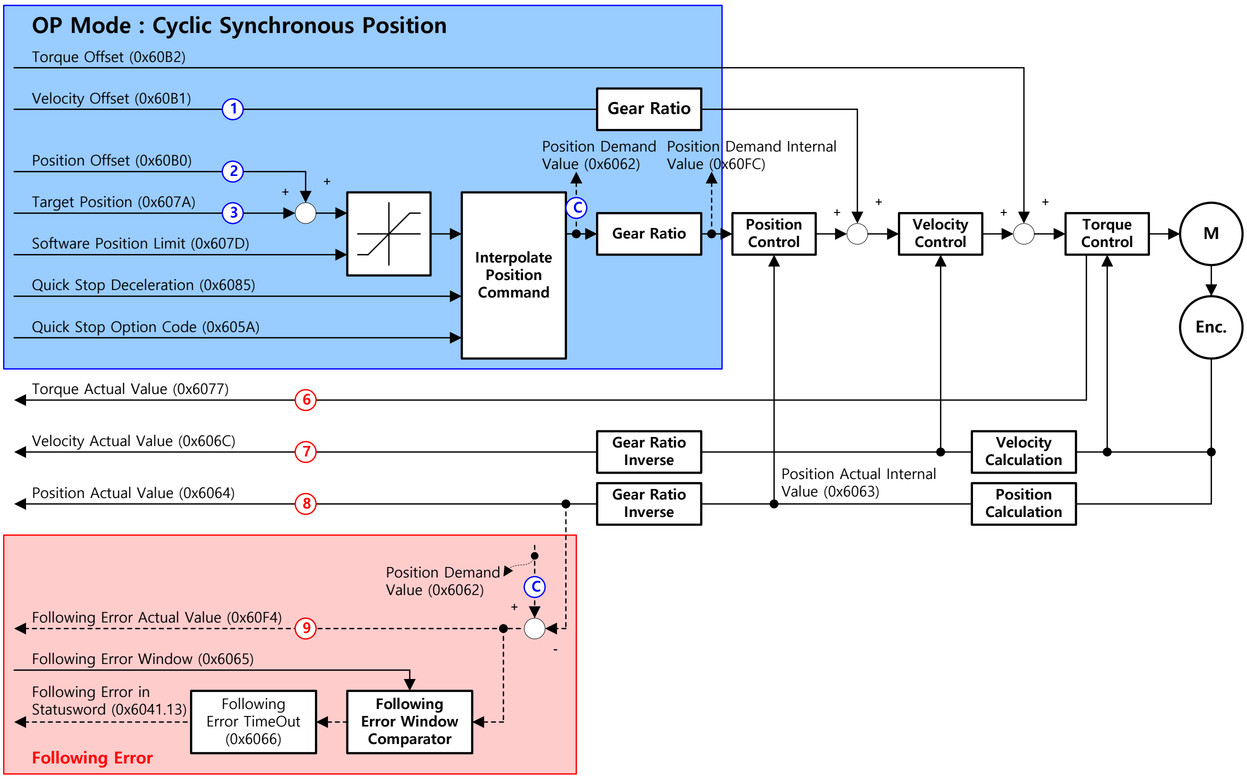
4.3 Position Control Modes

4.3.1 Cyclic Synchronous Position Mode

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

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

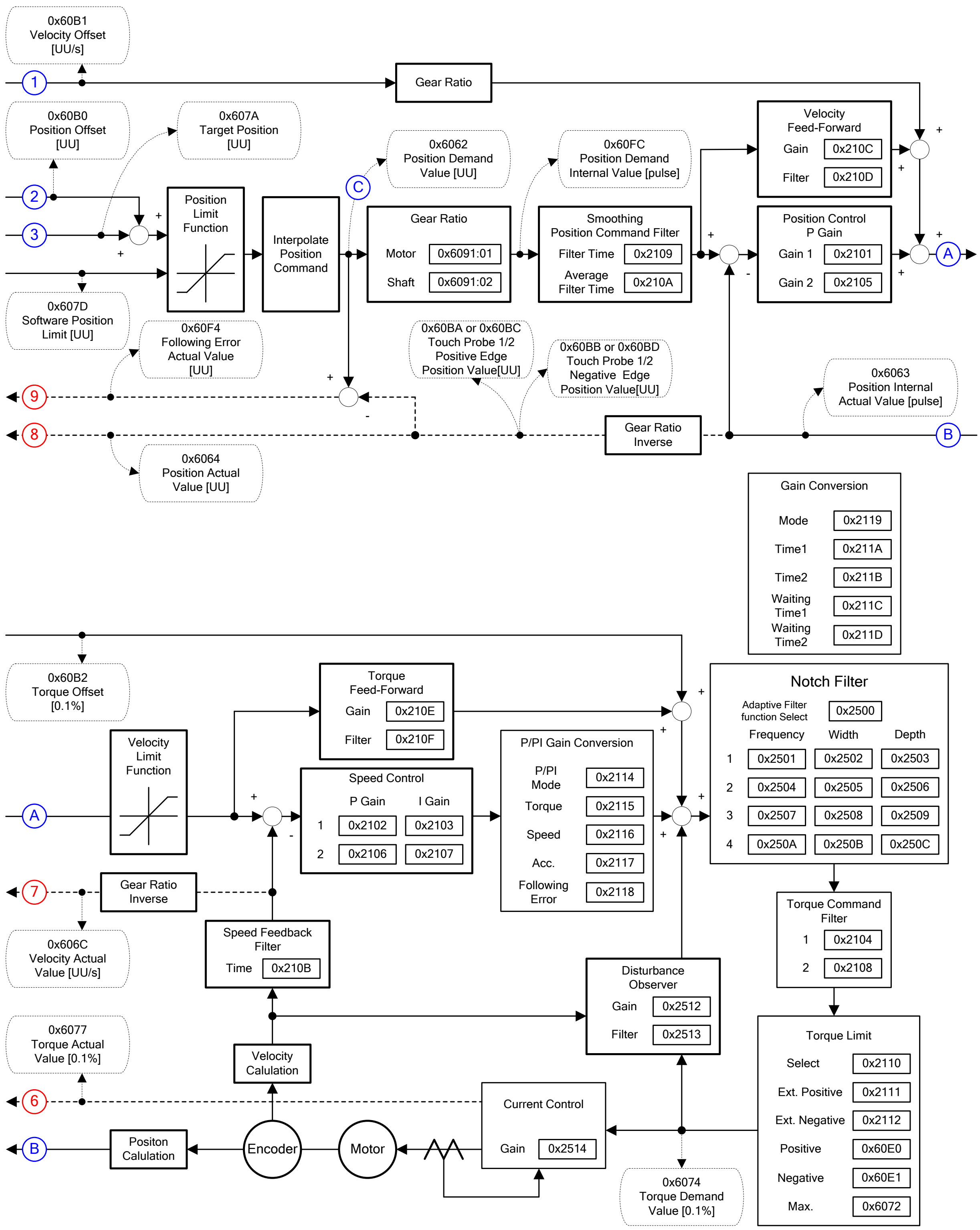
The block diagram of the CSP mode is as follows:



Related Objects

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

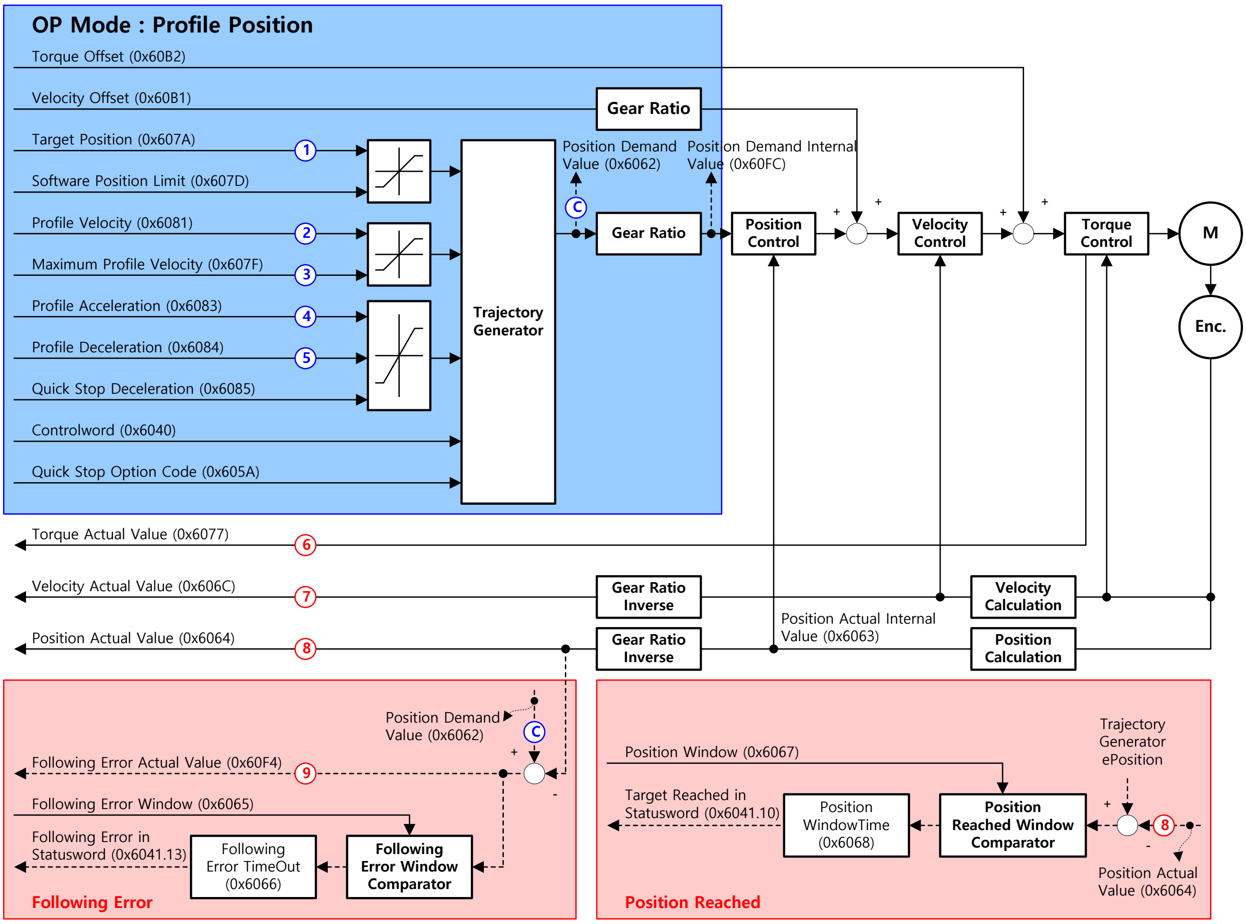
Internal Block Diagram of CSP Mode



4.3.2 Profile Position Mode

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

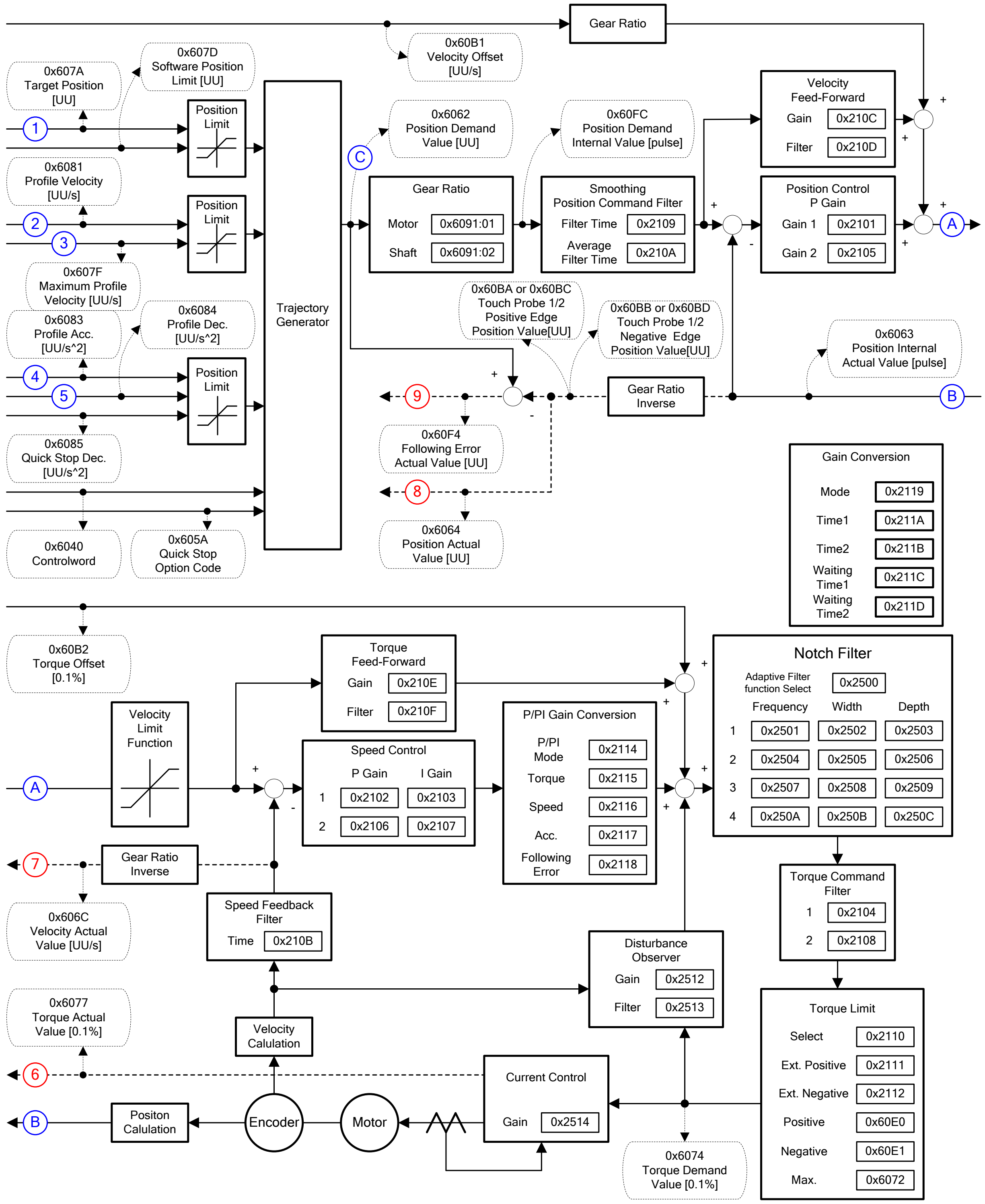
The block diagram of the PP mode is as follows:



Related Objects

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

Internal Block Diagram of PP Mode



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

- Single set point

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

- Change immediately

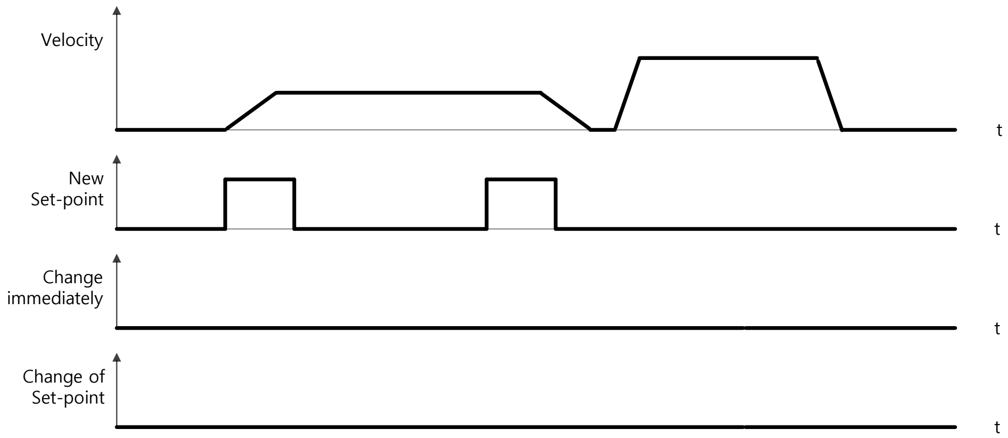
  After receiving a new position command while driving to the target position, it drives to the new position regardless of the existing target position.

- Set of Set point

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

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

Single Set Point Driving Procedure

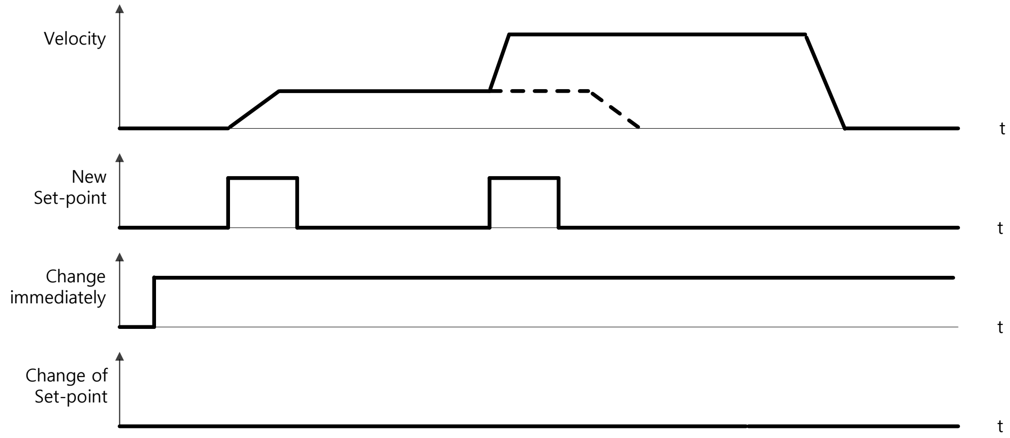


4. Specify the target position (0x607A).

5. Set the New setpoint bit to 1 and the Change set immediately bit to 0 to request the position operation.

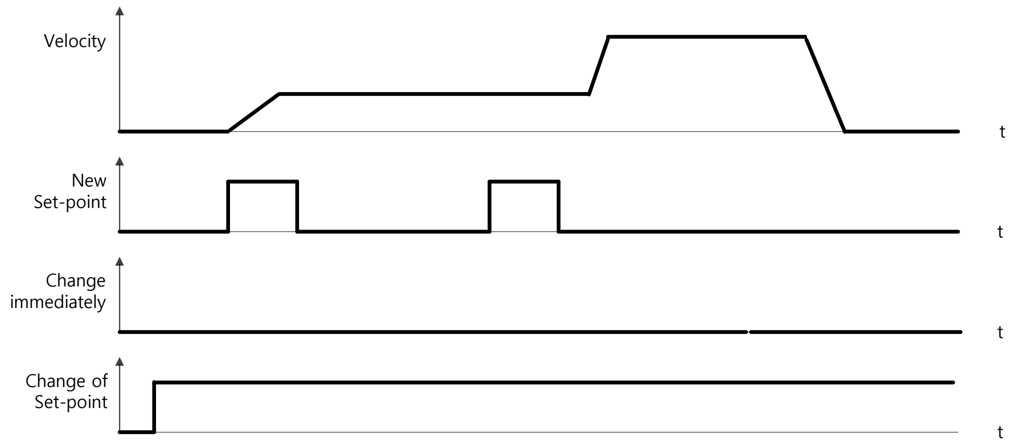
6. The drive notifies the operator of its arrival at the target position with the Target reached bit (Statusword, 0x6041.10). The drive can suspend where it is or perform a new position operation if it receives the New set point bit.

Change Immediately Driving Procedure



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

Set of Set Point Driving Procedure



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

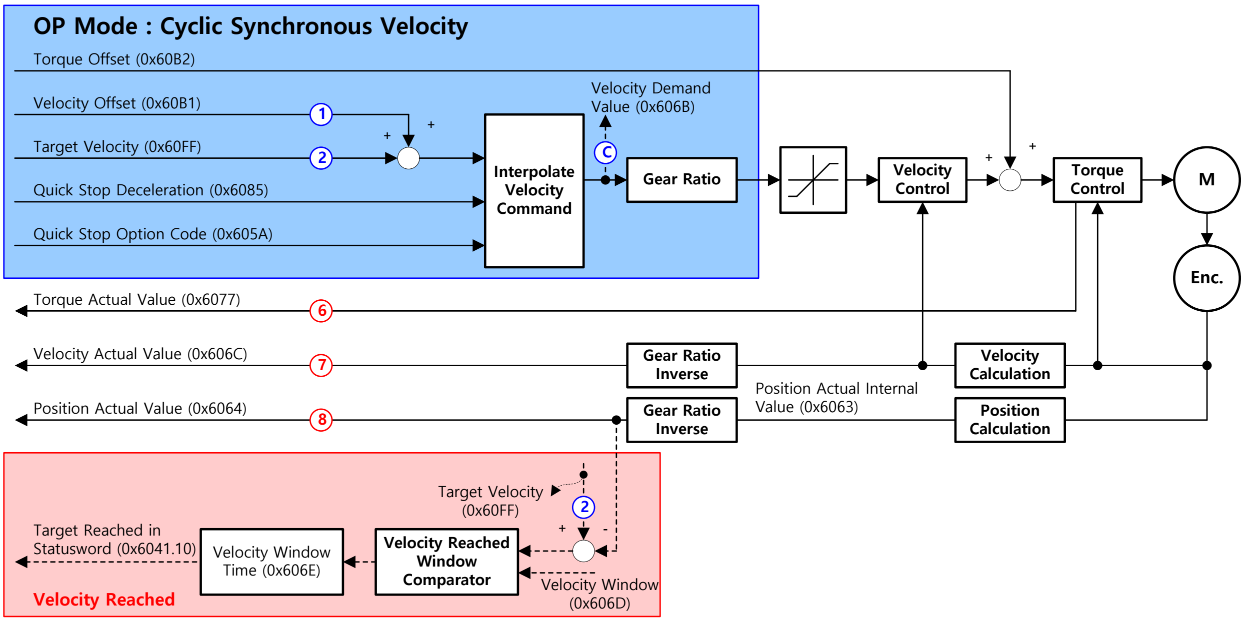
4.4 Velocity Control Mode

4.4.1 Cyclic Synchronous Velocity Mode

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

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

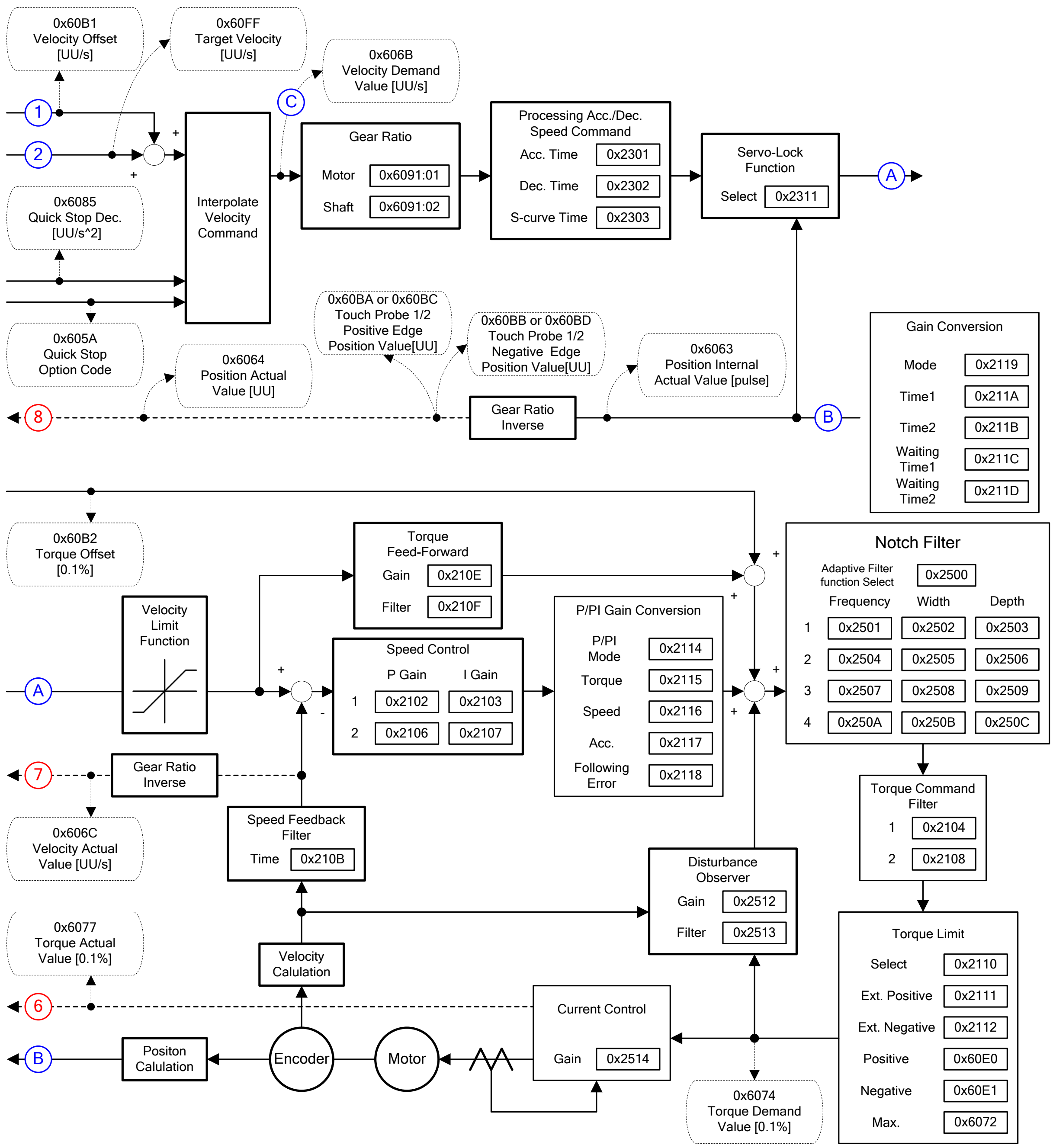
The block diagram of the CSV mode is as follows:



Related Objects

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

Internal Block Diagram of CSV Mode

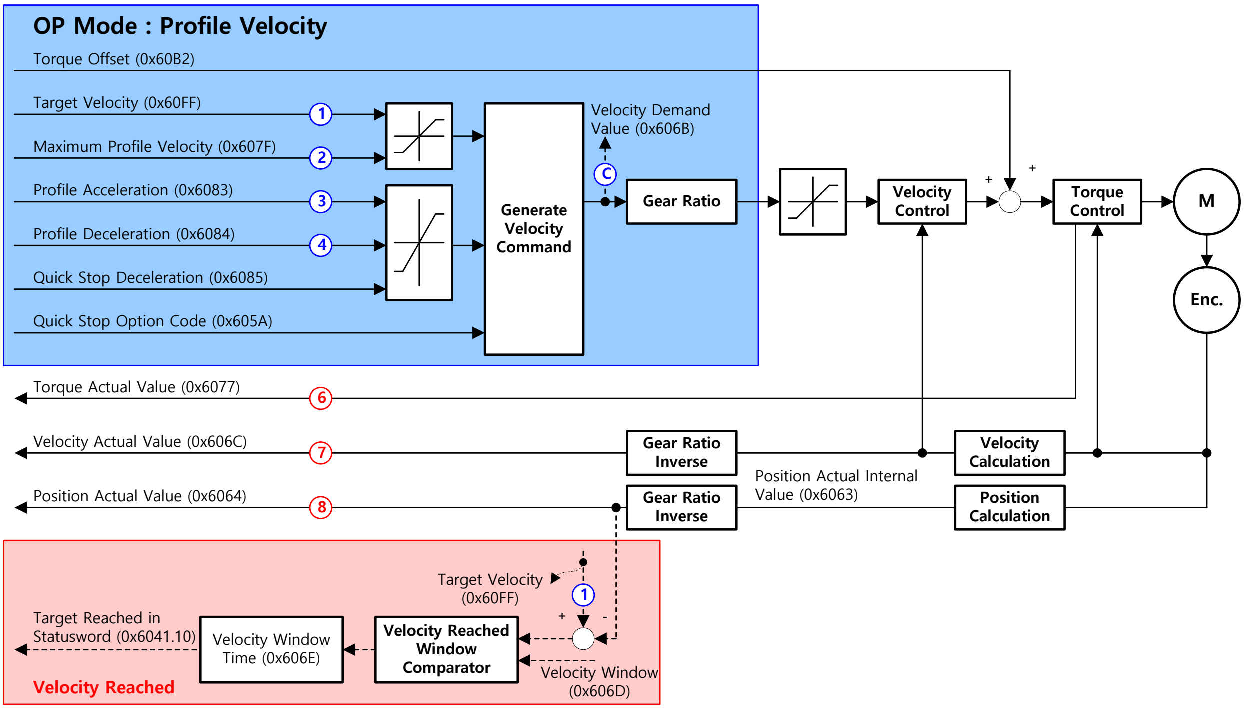


4.4.2 Profile Velocity Mode

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

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

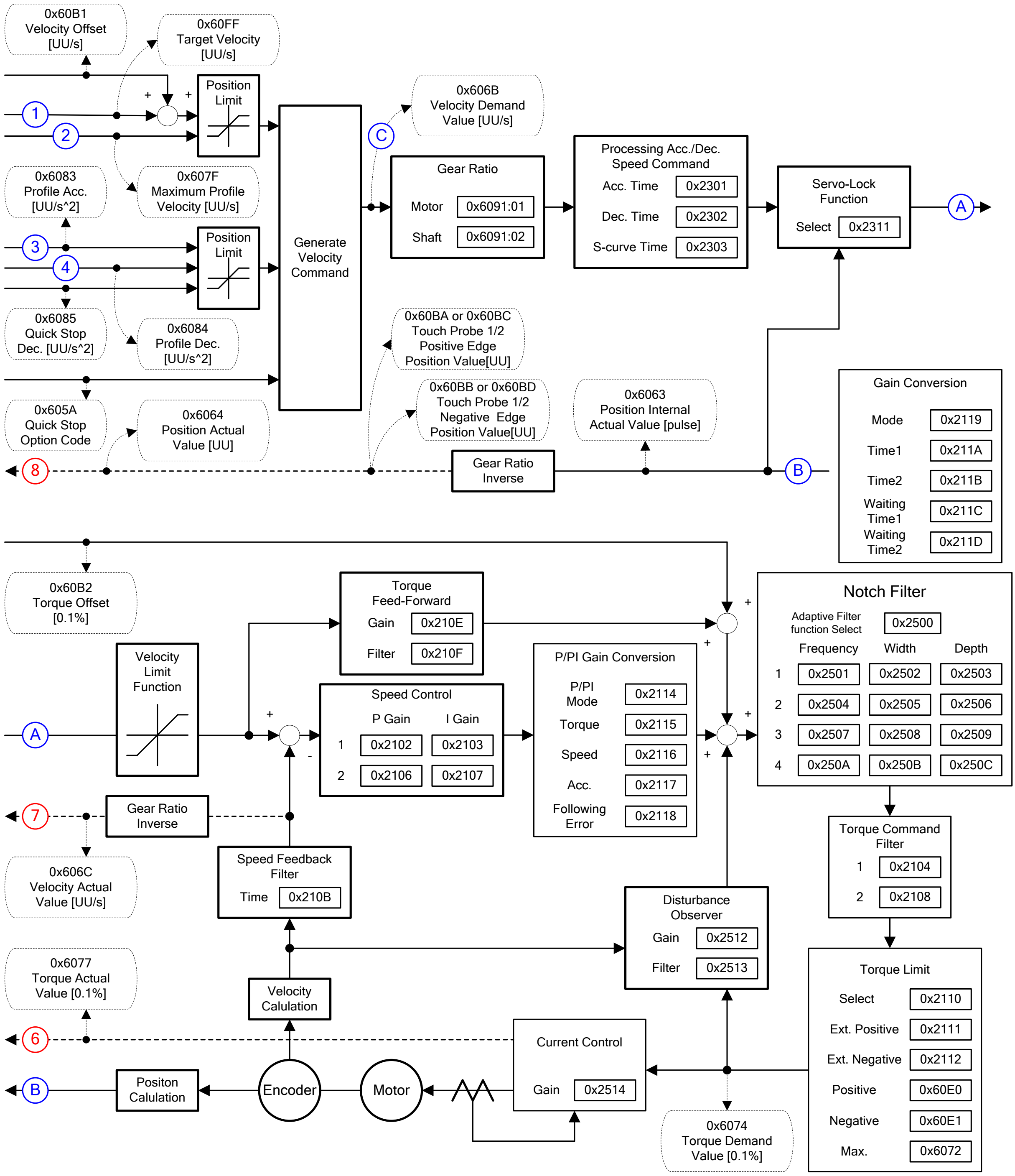
The block diagram of the PV mode is as follows:



Related Objects

Index	Sub Index	Name	Variable type	Accessi bility	PDO assign ment	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	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x606D	-	Velocity Window	UINT	RW	No	UU/s
0x606E	-	Velocity Window Time	UINT	RW	No	Ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	pulse

Internal Block Diagram of PV Mode



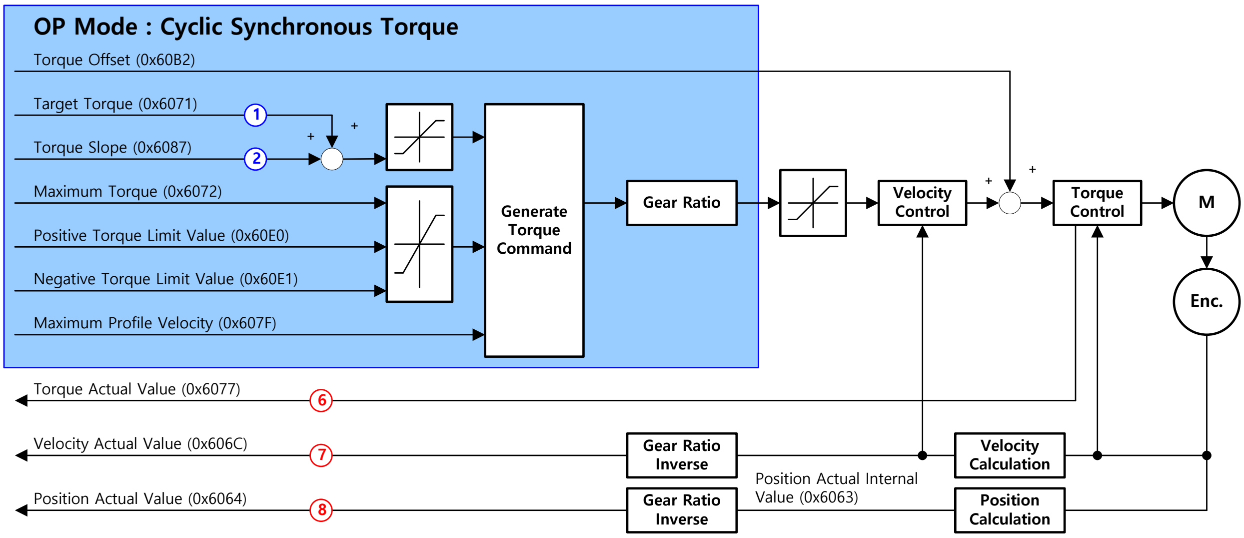
4.5 Torque Control Modes

4.5.1 Cyclic Synchronous Torque Mode

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

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

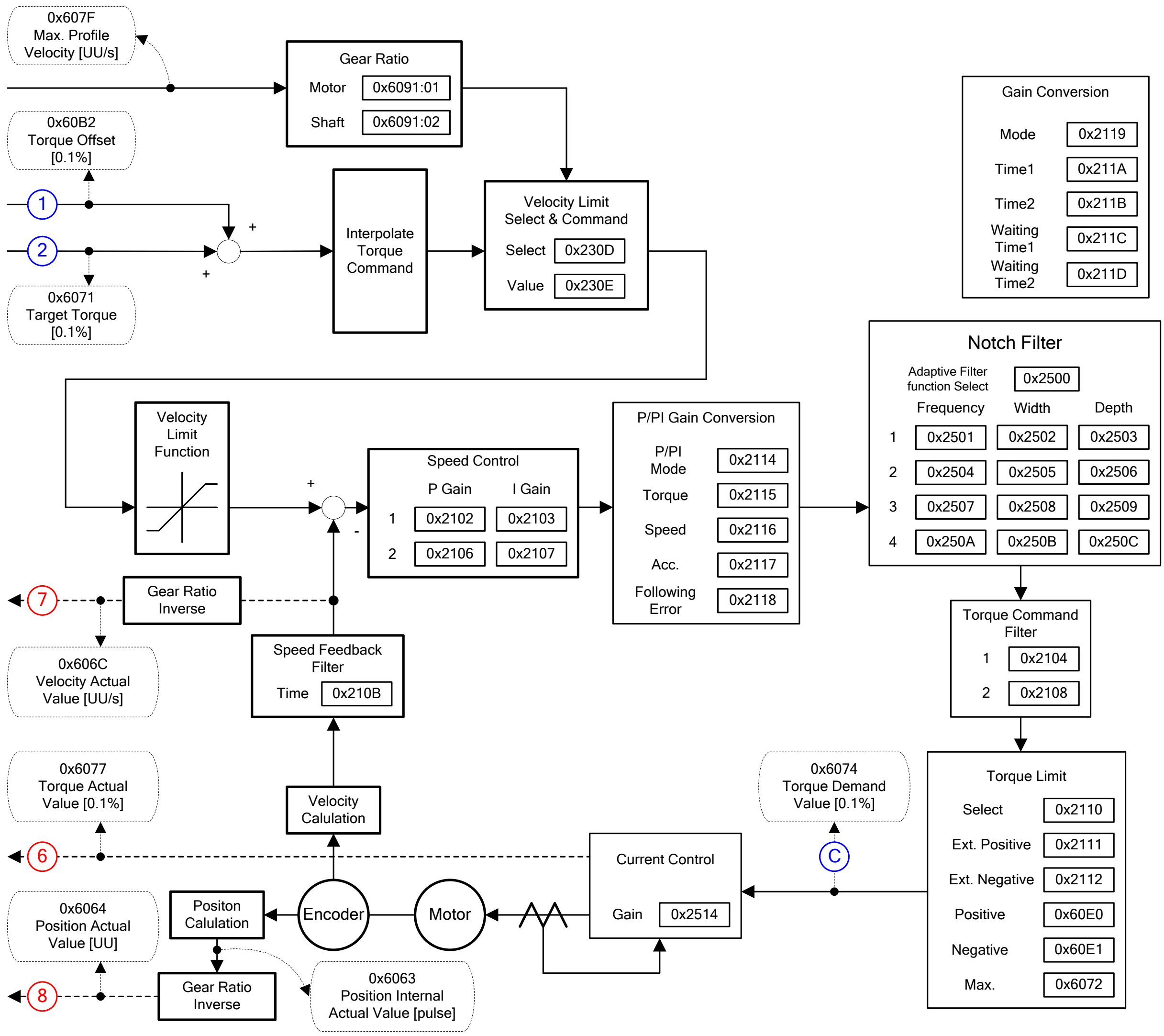
The block diagram of the CST mode is as follows:



Related Objects

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

Internal Block Diagram of CST Mode

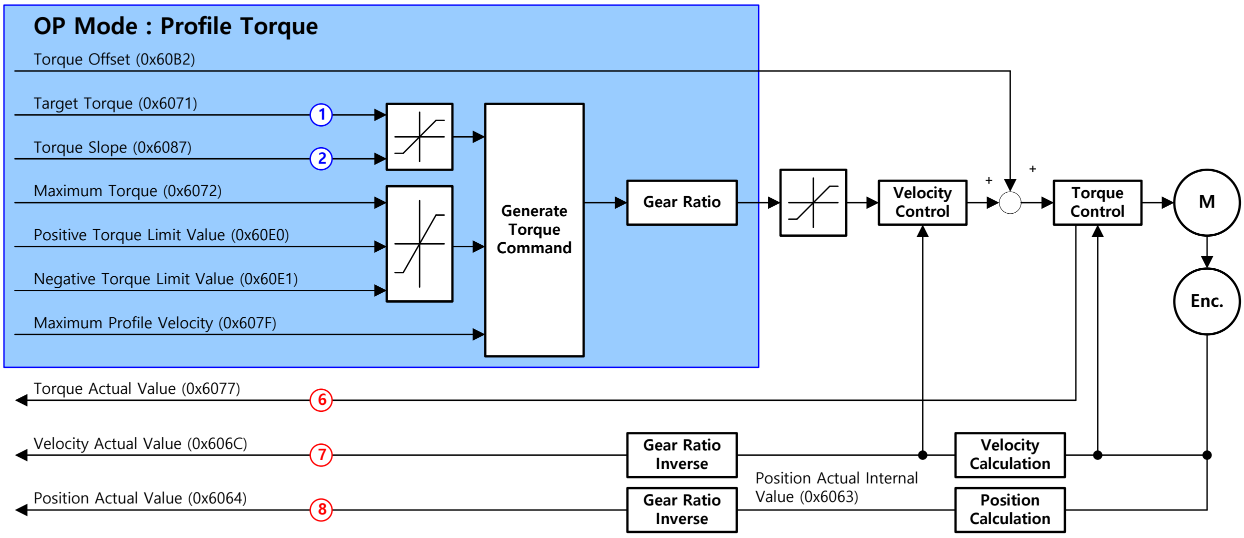


4.5.2 Profile Torque Mode

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

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

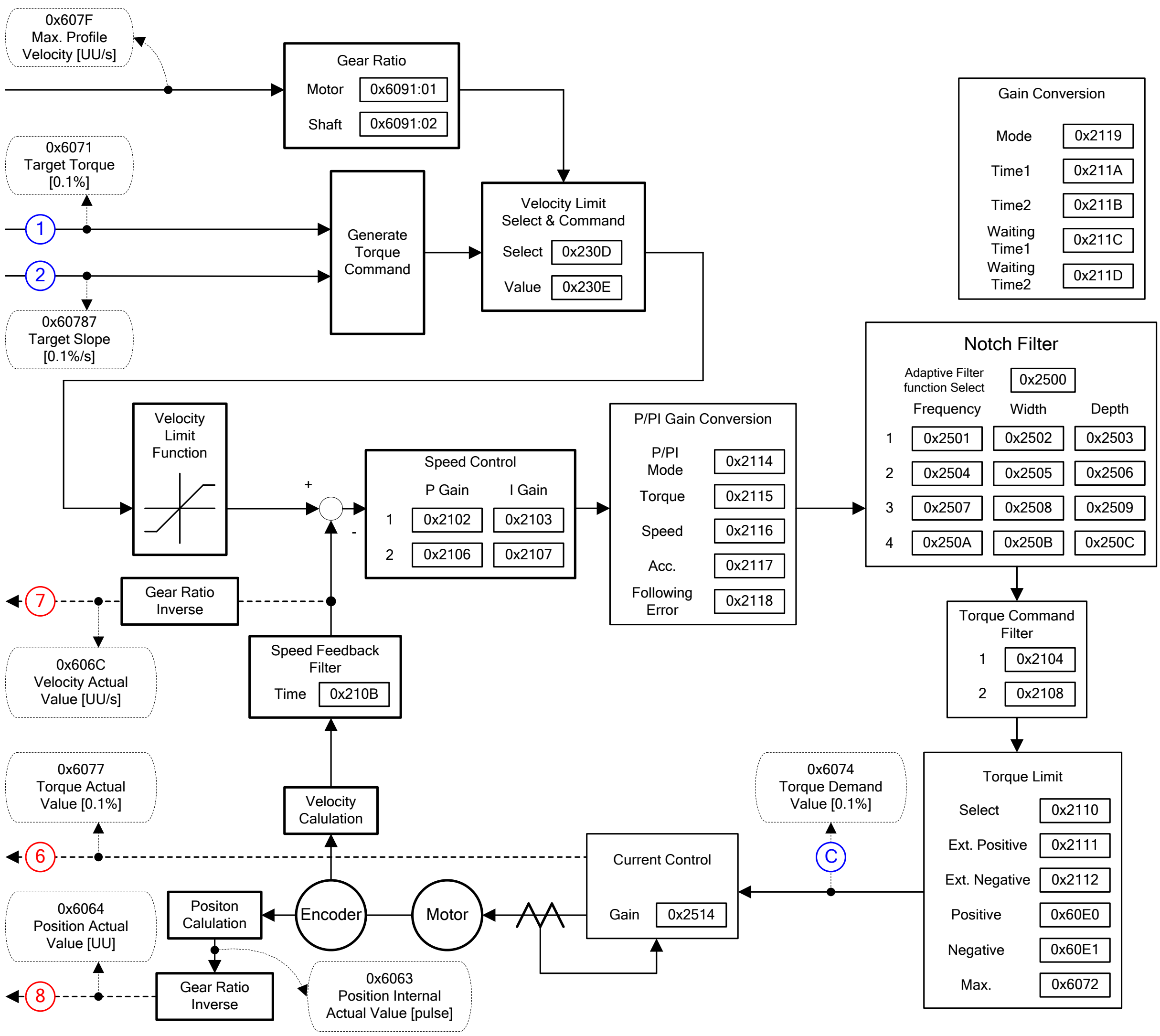
The block diagram of the PT mode is as follows:



Related Objects

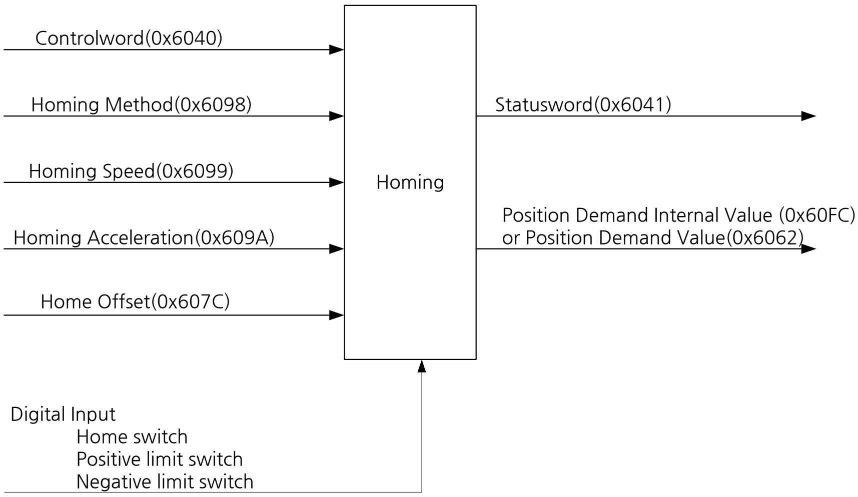
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x6071	-	Target Torque	INT	RW	Yes	0.1%
0x6072	-	Maximum Torque	UINT	RW	Yes	0.1%
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6087	-	Torque Slope	UDINT	RW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

Internal Block Diagram of PT Mode

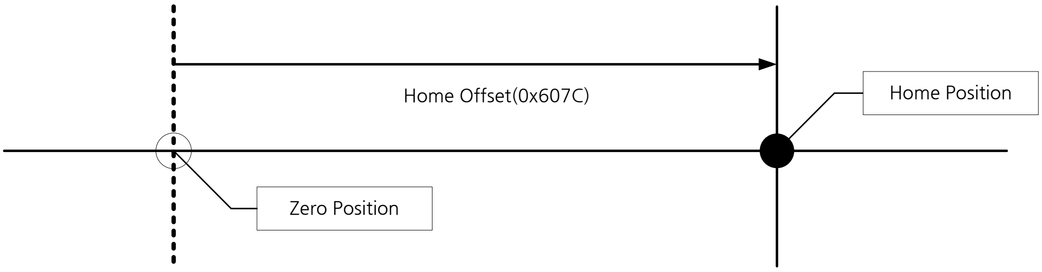


4.6 Homing

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



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



4.6.1 Homing Method

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

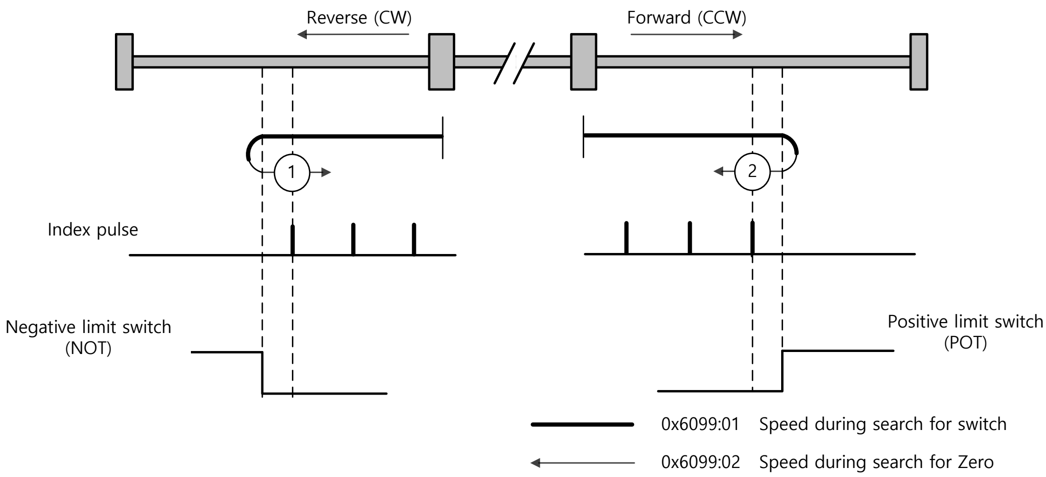
Homing Method (0x6098)	Details
1	The drive returns to the home position with the negative limit switch (NOT) and the Index (Z) pulse while driving in the reverse direction.
2	The drive returns to the home position with the positive limit switch (POT) and the Index (Z) pulse while driving in the forward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

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

Related Objects

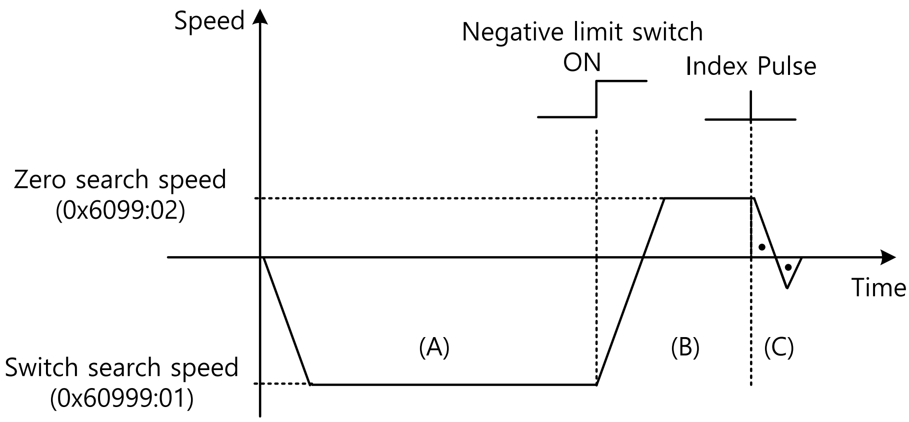
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UNIT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x607C	-	Home Offset	DINT	RW	No	UU
0x6098	-	Homing Method	SINT	RW	Yes	-
0x6099	-	Homing Speed	-	-	-	-
	0	Number of entries	USINT	RO	No	-
	1	Switch Search Speed	UDINT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

Homing Methods 1 and 2



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

Homing Method ①

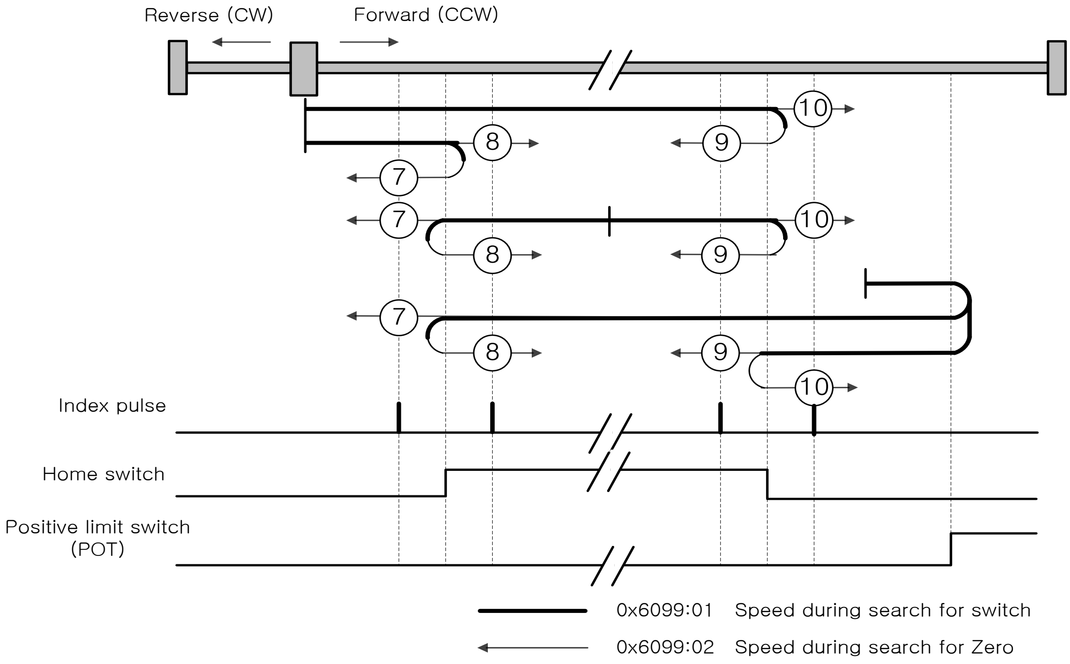


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

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

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

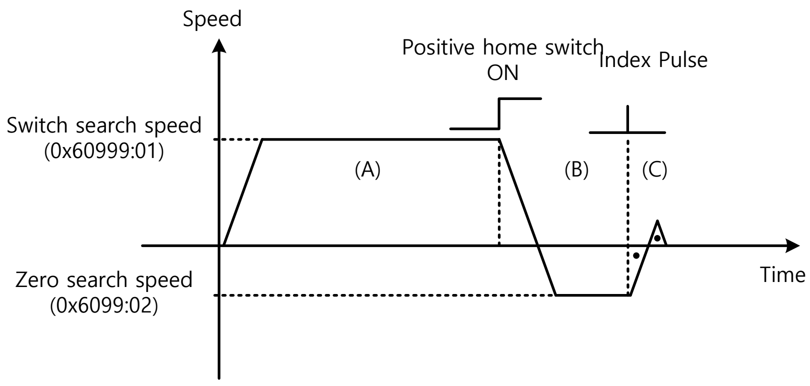
Methods 7, 8, 9, and 10



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

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

Homing Method ⑦

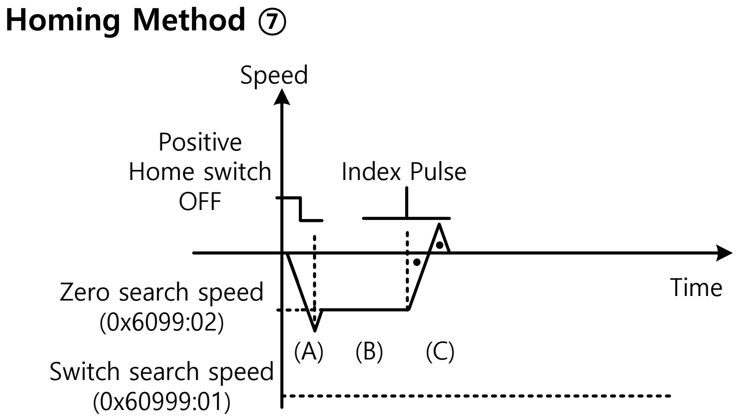


(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

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

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

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

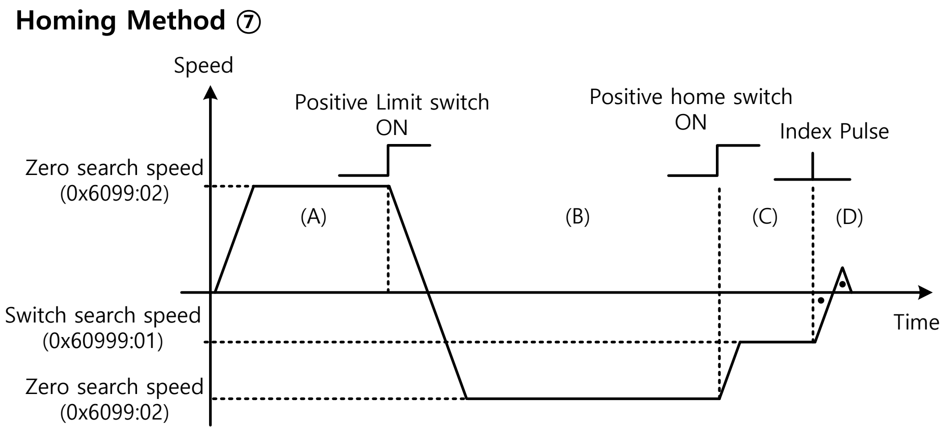


(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Positive Home Switch (CCW). It might not reach the Switch Search Speed depending on the start position of homing.

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

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

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



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

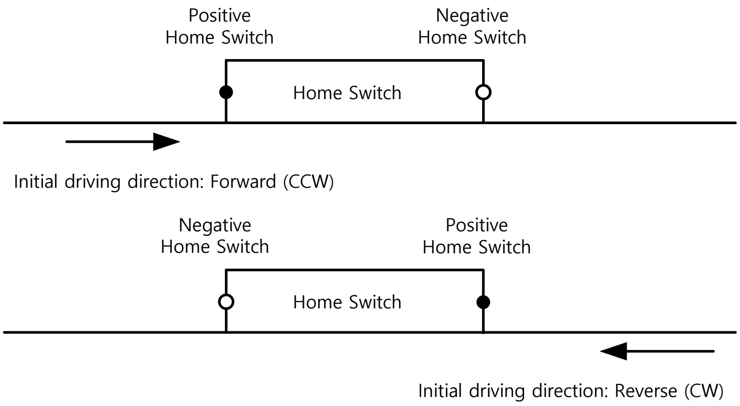
(B) When the positive limit switch (POT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the reverse direction (CW).

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

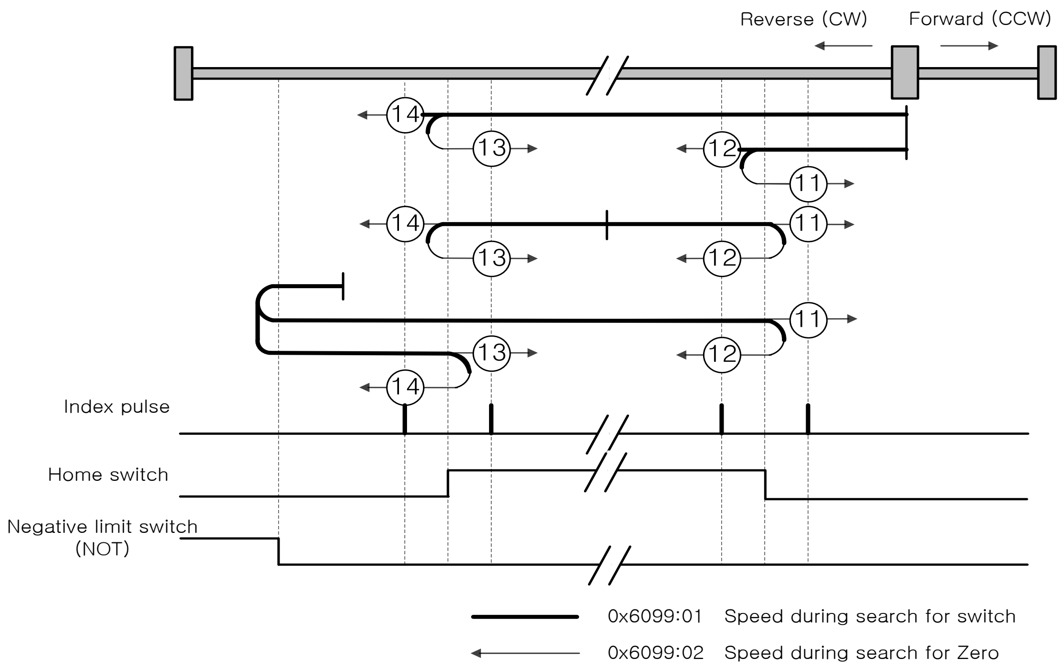
(D) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

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

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

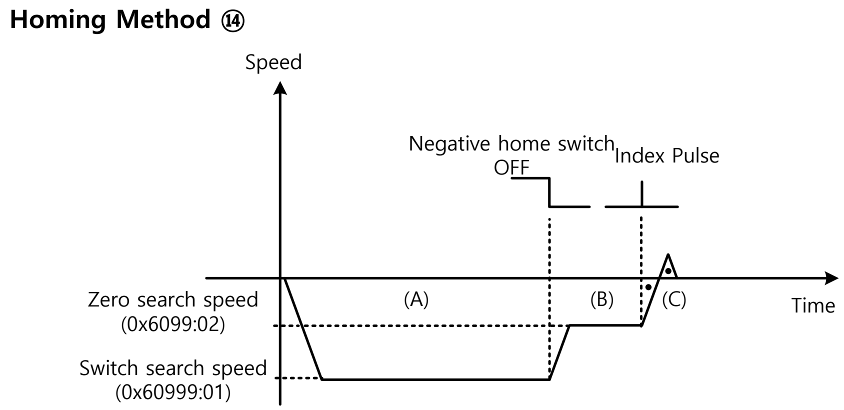


Methods 11, 12, 13, and 14



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

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

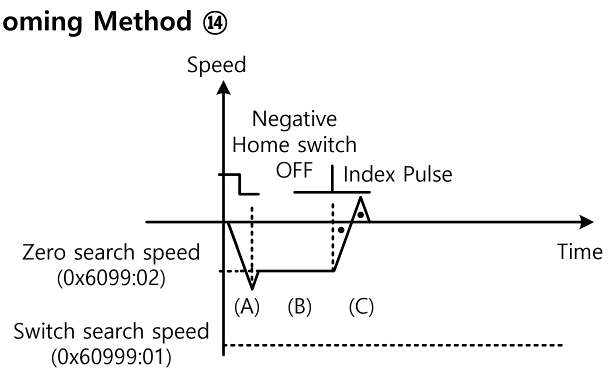


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

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

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

(2) When the switch is ON at startup:



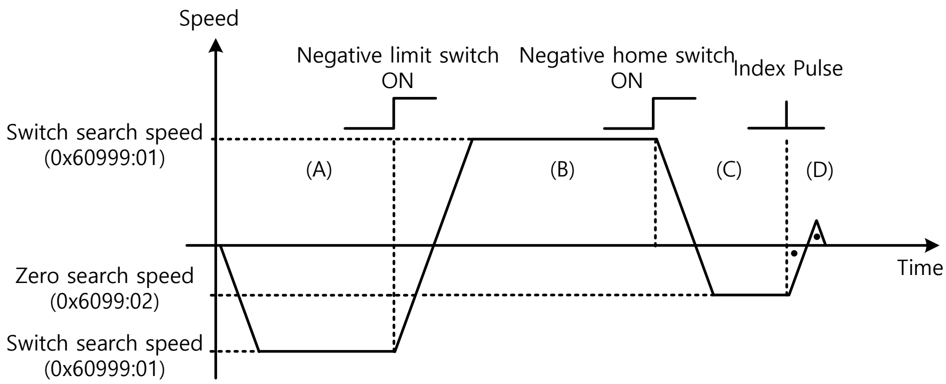
(A) Since the Home signal is on, the drive will operate at the Switch Search Speed in the direction of the Negative Home Switch (CW). It might not reach the Switch Search Speed depending on the start position of homing.

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

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

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

Homing Method ⑭



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

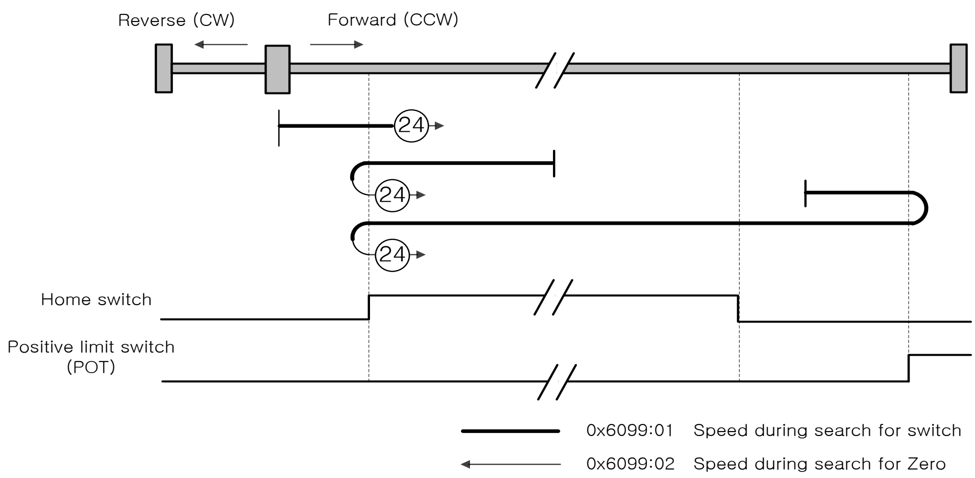
(B) When the negative limit switch (NOT) is turned on, the drive will decelerate down to stop, and then operate at the Switch Search Speed in the forward direction (CCW).

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

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

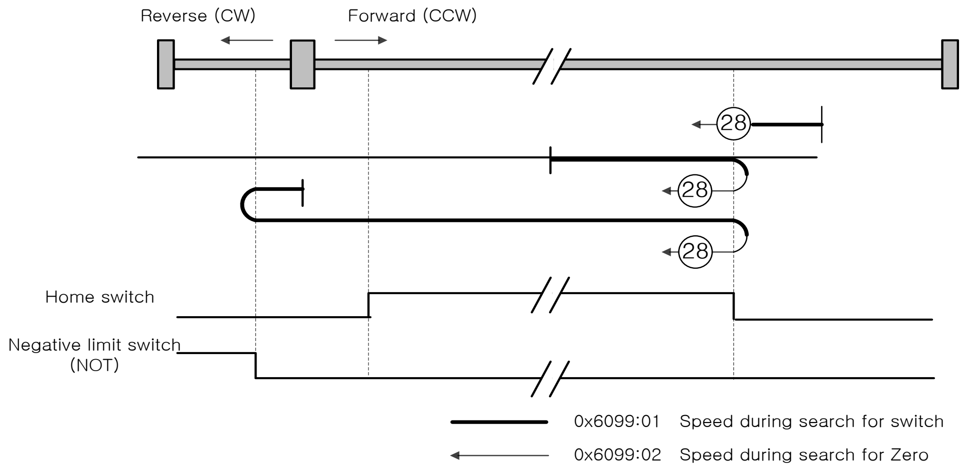
The methods from 11 to 13 are nearly identical to the method 14 in terms of the homing sequence. The only differences are the initial driving direction and Home switch polarity.

Method 24



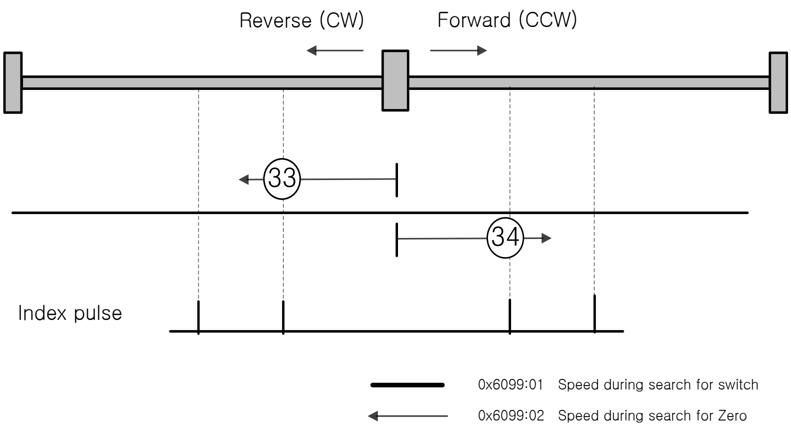
The initial driving direction is forward (CCW), and a point where the Positive Home Switch is turned on becomes the Home position.

Method 28



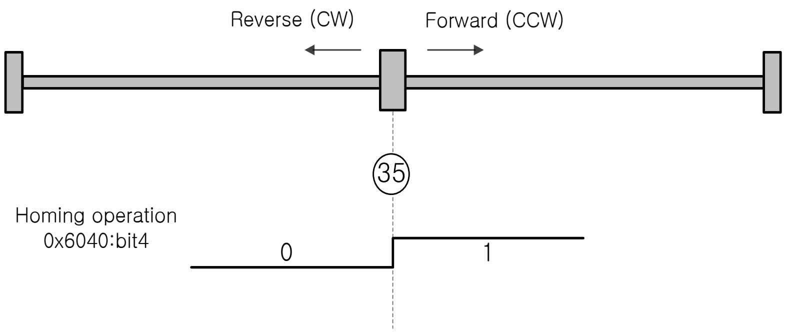
The initial driving direction is reverse (CW), and a point where the Positive Home Switch is turned on becomes the Home position.

Method 33 and 34



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

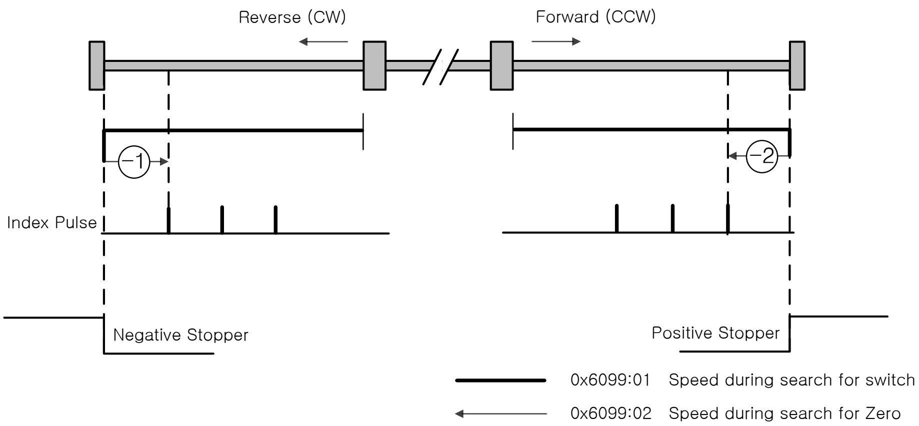
Method 35



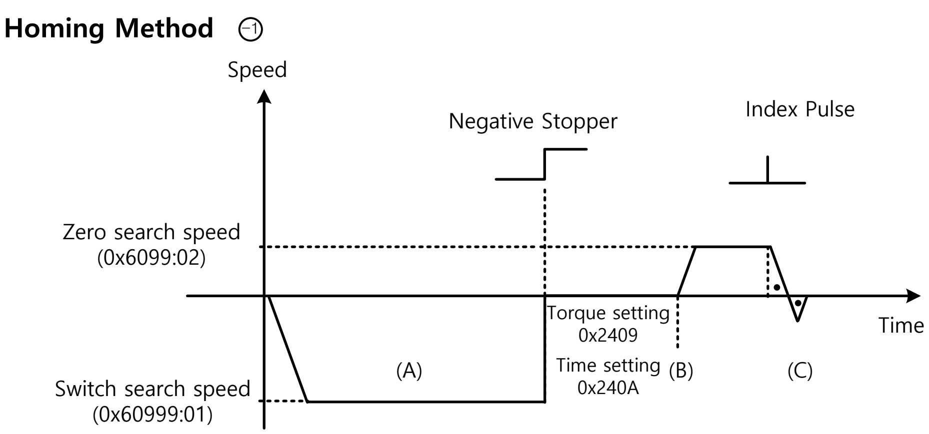
The current position at startup of homing operation becomes the Home position. This method is used to change the current position to the origin depending on demand of the upper level controller.

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

Method -1 and -2



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

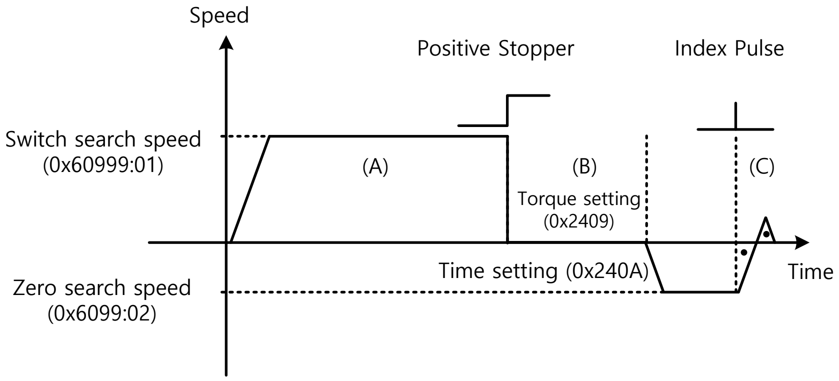


(A) The initial driving direction is reverse (CW), and the drive operates at the Switch Search Speed.

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

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

Homing Method -2

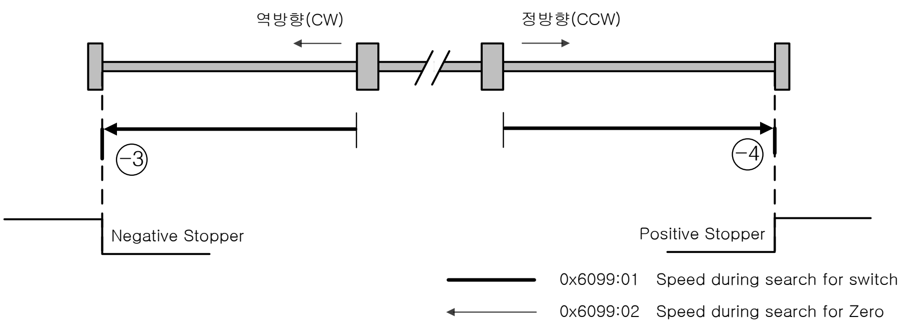


(A) The initial driving direction is forward (CCW), and the drive operates at the Switch Search Speed.

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

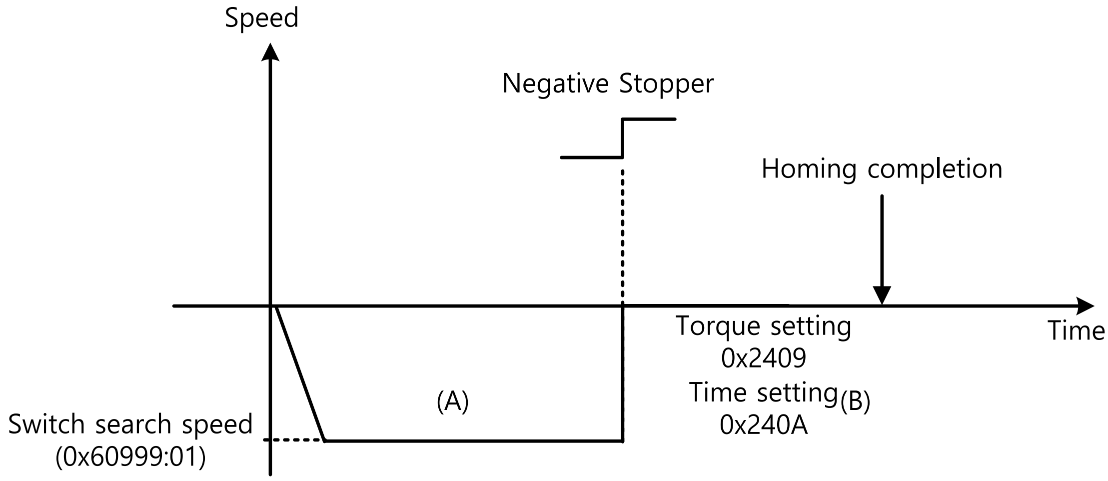
(C) While operating at the Zero Search Speed, the drive detects the first index pulse to move to the index position (Home).

Method -3 and -4



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

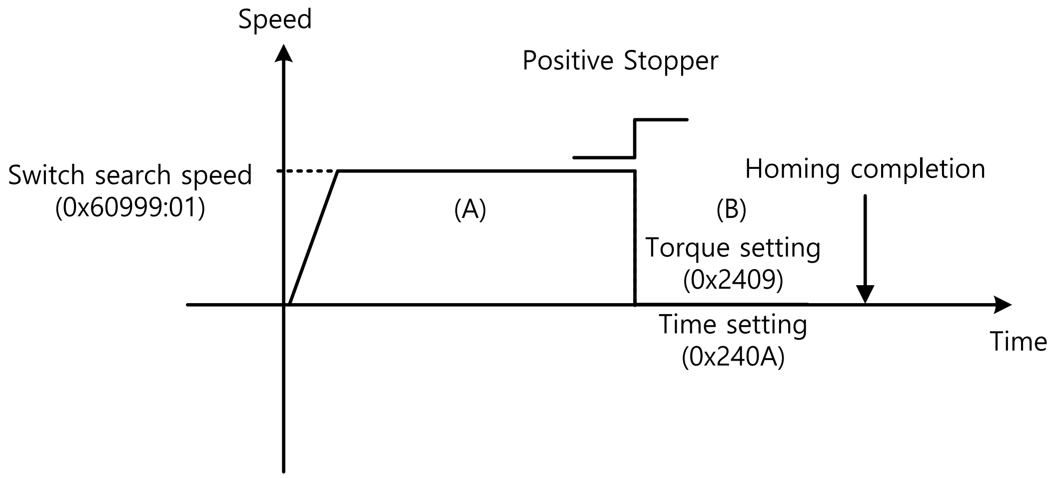
Homing Method -3



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

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

Homing Method -4



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

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

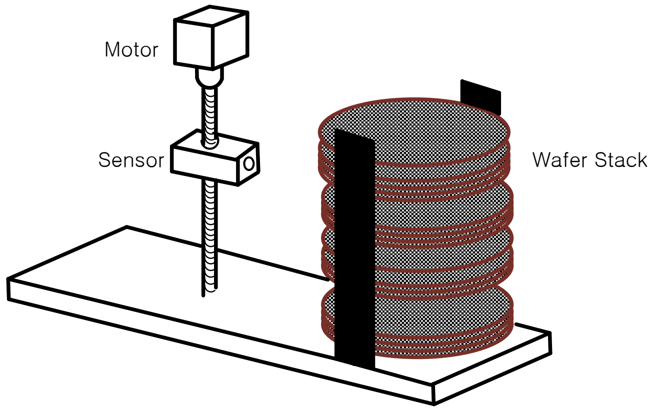
4.7 Touch Probe Function

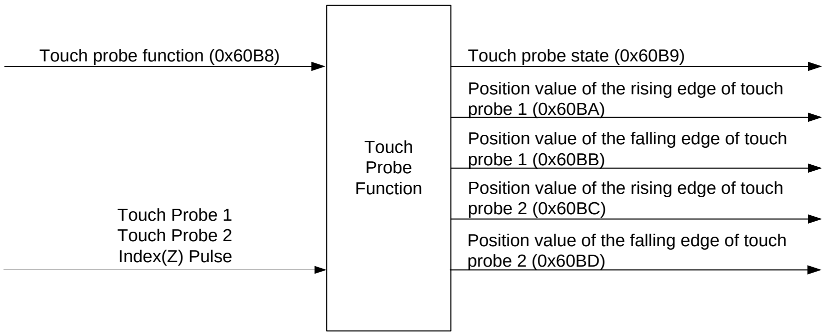
Touch probe is a function to rapidly capture the position value of the encoder with external input (PROBE 1 and 2) signals or the Index (Z) pulse of the encoder.

Example of Touch Probe

Wafer mapper system of wafer transfer robot (WTR)

In the case that wafers are piled up on a wafer stack, the presence of wafer can be determined by scanning the stack once using mapping sensor. At this moment, any unnecessary movement of robot can be prevented by use of the value of wafer loading position captured rapidly.





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

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

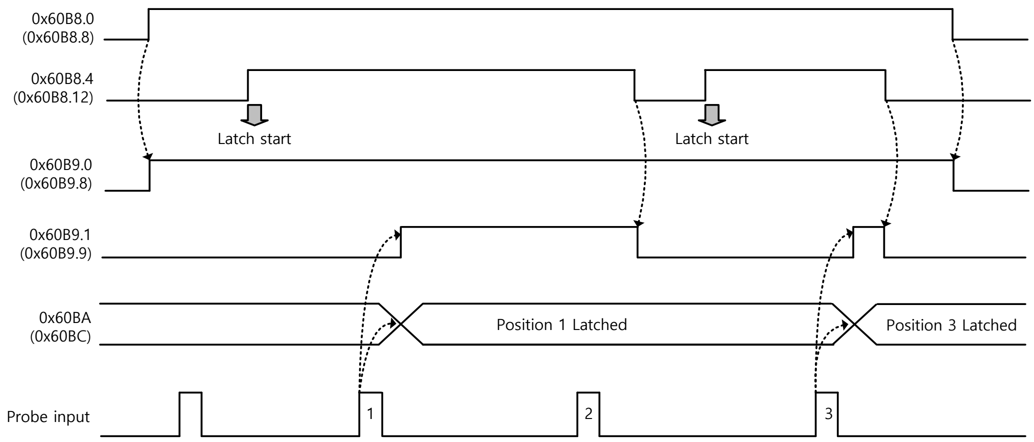
Related Objects

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

Touch Probe Timing Diagrams

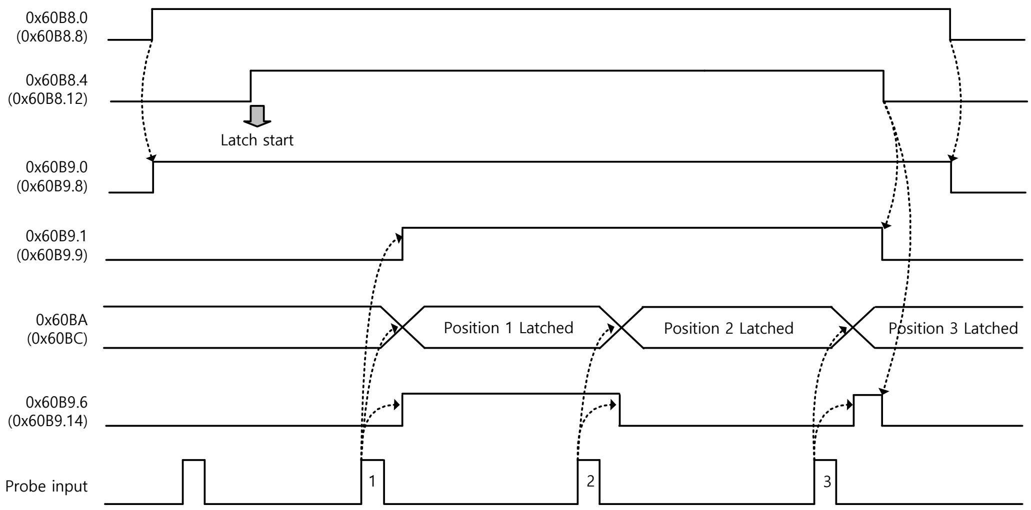
Single Trigger Mode (0x60B8.1=0, 0x60B8.9=0):

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

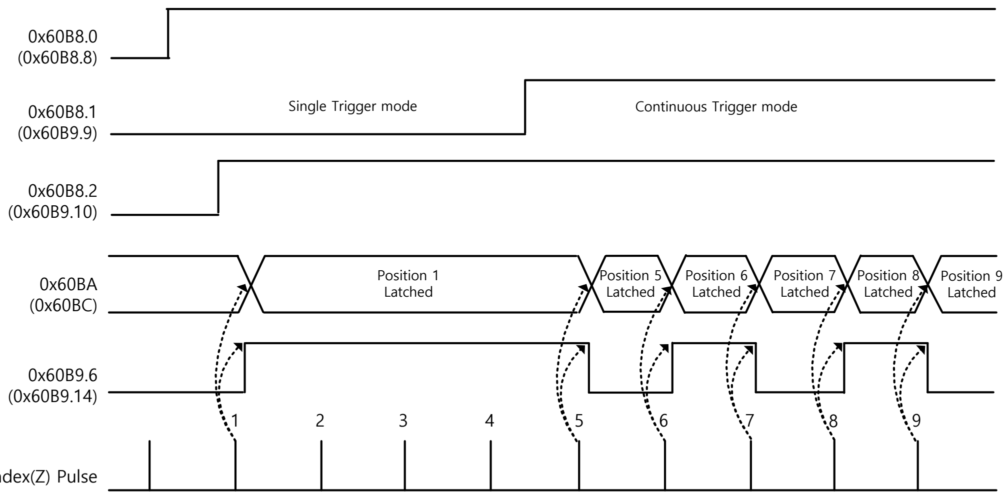


Continuous Trigger Mode (0x60B8.1=1, 0x60B8.9=1):

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

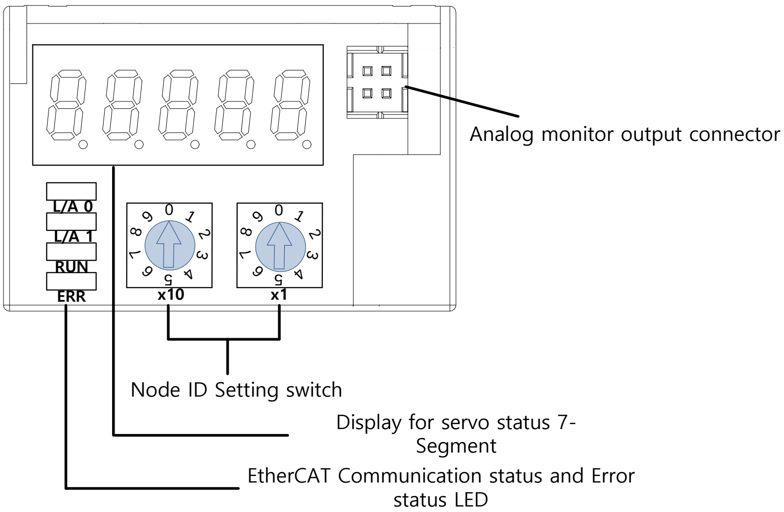


Index Pulse Trigger Mode (0x60B8.2=1, 0x60B8.10=1):



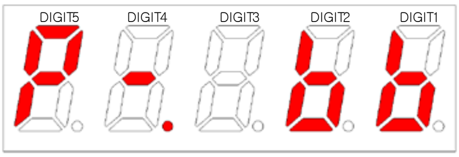
5. Drive Application Functions

5.1 Drive Front LED Specification



5.1.1 7-Segment for displaying state of Servo

7-Segment for displaying state of servo consists of 5 digit and digit number starts from the rignt.(Digit1→Digit5)

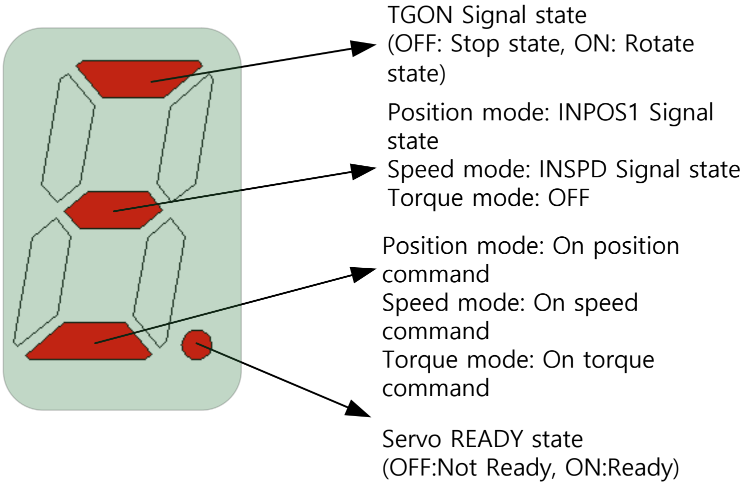


First 3digits(DIGIT3~1) on 7-Segment indicate state of servo below when there is no alarm. Warning will be displayed preferentially when warning occurs.

Display Digit 3~Digit 1	State
 Disconnecting STO	 Forward limit senser is activated
 State of servo OFF	 Reverse limit senser is activated

 State of servo ON	 State of warning 10 (Code :10)

Digit4 indicates state of current operation or servo READY.

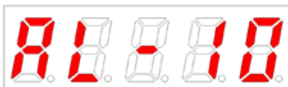


Digit5 indicates state of EtherCAT State Machine, current control mode or state of servo on.

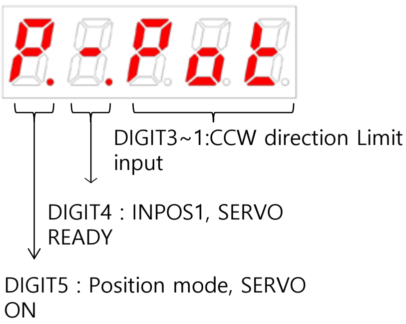
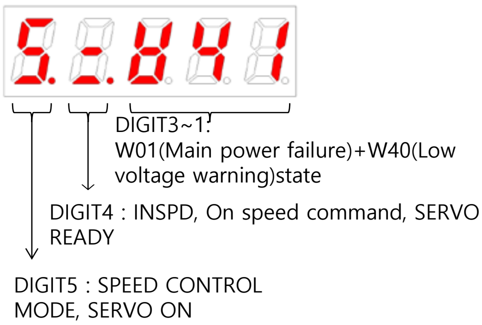
When state of EtherCAT State Machine is pre-operational state(setting up communication) ➔ Display state of EtherCAT Communication(Servo operation is not possible in this state)		
 Init state	 Pre-Operational state	 Safe-Operational state

When state of EtherCAT State Machine is Operation state(Ready to operation) ➔ Display operation mode and state(servo operation is possible in this state)		
 Position control mode : CSP, PP, IP	 Speed control mode : CSV, PV	 Torque control mode : CST, PT
 Homing mode	 (Off : Servo OFF, On : Servo ON)	

Display below figure on DIGIT5~1 when servo alarm occurs. DIGIT2 and DIGIT1 indicate alarm code. Servo alarm will be displayed preferentially.



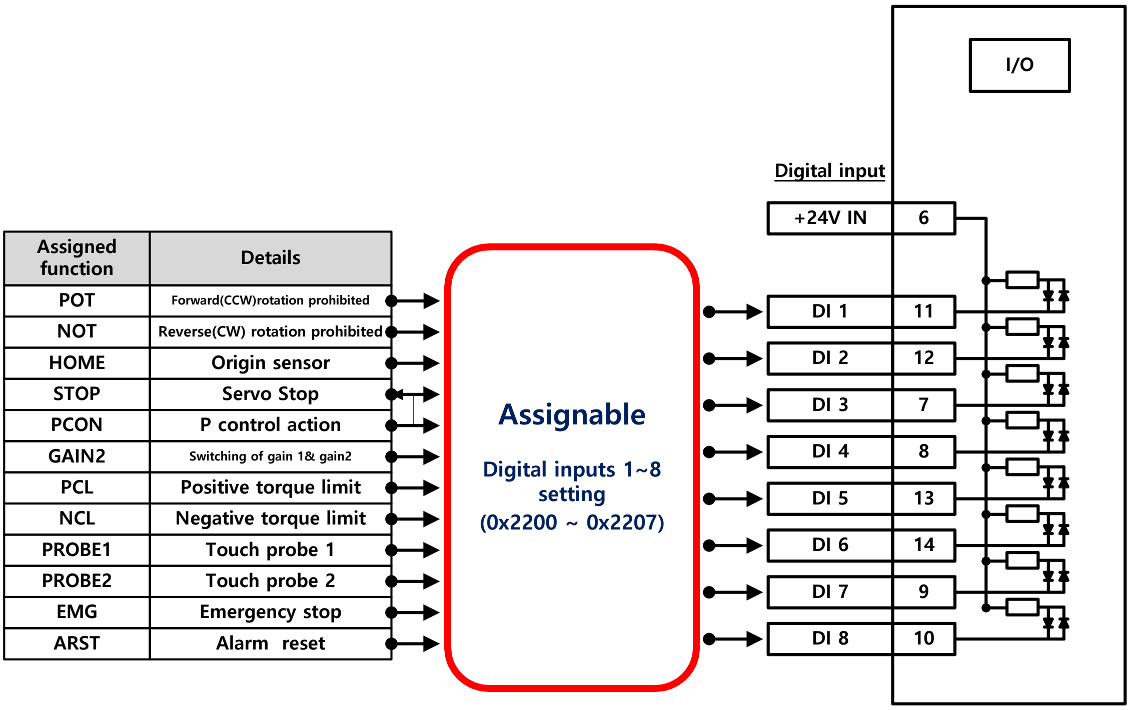
Example for Alarm state
AL-10 (IPM Fault)

E.g. 1) When limit signal is on.	E.g. 2) When warning occurs.
	

5.2 Input/Output Signals Setting

5.2.1 Assignment of Digital Input Signals

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



Related Objects

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

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

Bit	Setting details
15	Set signal input level (0: Contact A, 1: Contact B).Refer to below note.
14~8	Reserved
7~0	Assign input signal.

Setting values	Assignable input signals
0x00	Not assigned
0x01	POT
0x02	NOT
0x03	HOME
0x04	STOP
0x05	PCON
0x06	GAIN2
0x07	PCL
0x08	NCL
0x09	PROBE1
0x0A	PROBE2
0x0B	EMG
0x0C	ARST

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

Example of Assigning Digital Input Signals

The following table shows an example of assigning input signals. Verify the setting values from 0x2200 to 0x2203.

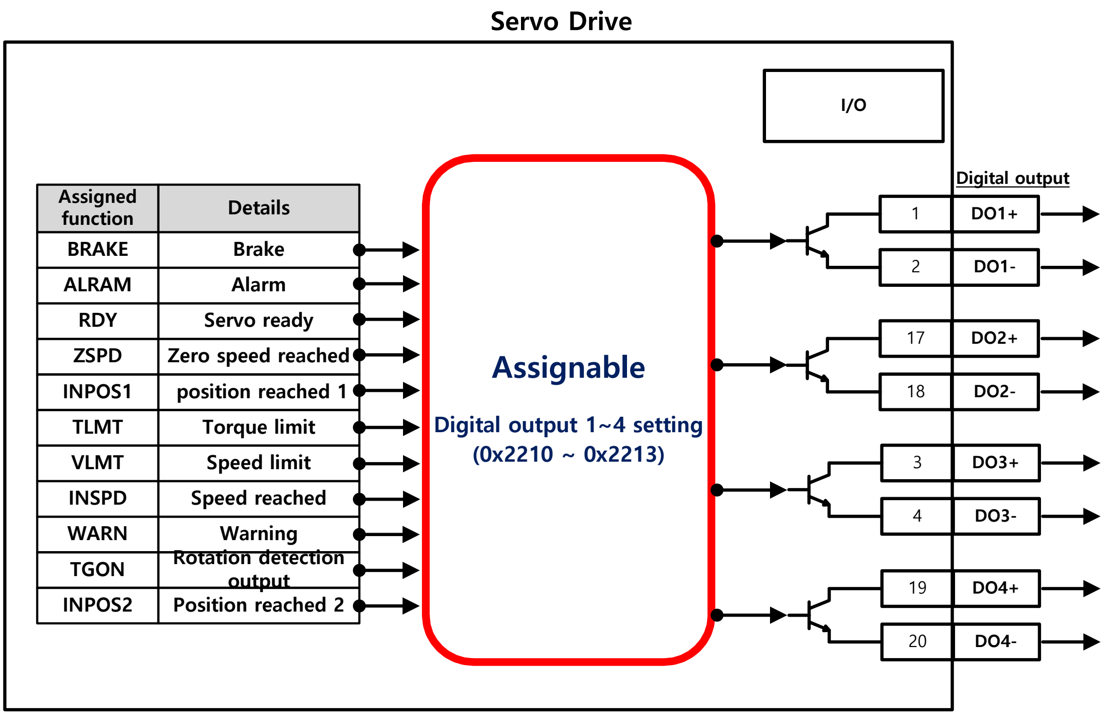
DI#1	DI#2	DI#3	DI#4	DI#5	DI#6	DI#7	DI#8
POT (Contact B)	NOT (Contact B)	HOME (Contact A)	STOP (Contact A)	PCON (Contact A)	GAIN2 (Contact A)	PROBE1 (Contact A)	ARST (Contact A)

Assigned function		Contact	Details
0x01	POT	B	Forward(CCW)rotation prohibited
0x02	NOT	B	Reverse(CW)rotation prohibited
0x03	HOME	A	Origin sensor
0x04	STOP	A	Servo stop
0x05	PCON	A	P control action
0x06	GAIN2	A	Switching of gain1 and gain2
0x07	PCL	-	Positive torque limit
0x08	NCL	-	Negative torque limit
0x09	PROBE1	A	Touch probe 1
0x0A	PROBE2	-	Touch probe 2
0x0B	EMG	-	Emergency stop
0x0C	ARST	A	Alarm reset

CN1 (Pin No)	Setting parameters	Bit		Setting value	Details
		15	7~0		
DI # 1 (11)	0x2200	1	0x01	0x8001	POT(B contact)
DI # 2 (12)	0x2201	1	0x02	0x8002	NOT(B contact)
DI # 3 (7)	0x2202	0	0x03	0x0003	HOME(A contact)
DI # 4 (8)	0x2203	0	0x04	0x0004	STOP(A contact)
DI # 5 (13)	0x2204	0	0x05	0x0005	PCON(A contact)
DI # 6 (14)	0x2205	0	0x06	0x0006	GAIN2(A contact)
DI # 7 (9)	0x2206	0	0x09	0x0009	PROBE1(A contact)
DI # 8 (10)	0x2207	0	0x0C	0x000C	ARST(A contact)

5.2.2 Assignment of Digital Output Signals

You can set the functions of digital output signals of I/O and the output signal level. You can arbitrarily assign up to 4 output functions out of 11 functions, as shown in the figure below, to the digital output signals 1-4 for use:



Related Objects

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

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

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

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

Examples of Assigning Digital Output Signals

The following table shows examples of assigning output signals. Verify the setting values from 0x2210 to 0x2213.

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

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

CN1 (Pin No)	Setting parameters	Bit		Setting value	Detailes
		15	7~0		
DO # 1 (1,2)	0x2210	1	0x01	0x8001	BRAKE(B contact)
DO # 2 (17,18)	0x2211	1	0x02	0x8002	ALARM(A contact)
DO # 3 (3,4)	0x2212	0	0x03	0x0003	RDY(A contact)
DO # 4 (19,20)	0x2213	0	0x05	0x0005	INPOS1(A contact)

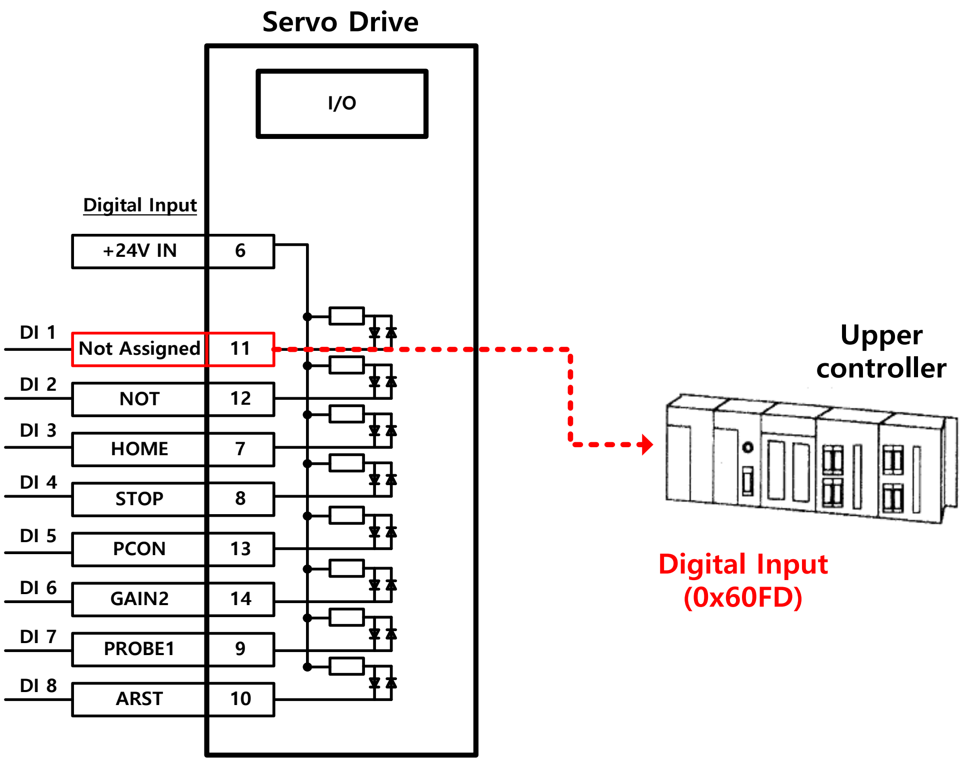
5.2.3 Use of User I/O

User I/O means that some of I/Os provided by the drive are used for individual purpose of the user, in addition to the purpose of controlling the drive itself. All contacts provided through the I/O connector 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.

L7NH series is available with up to 8 points for input signals and 4 points for output signals as the user I/O.

How to Set User Input



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

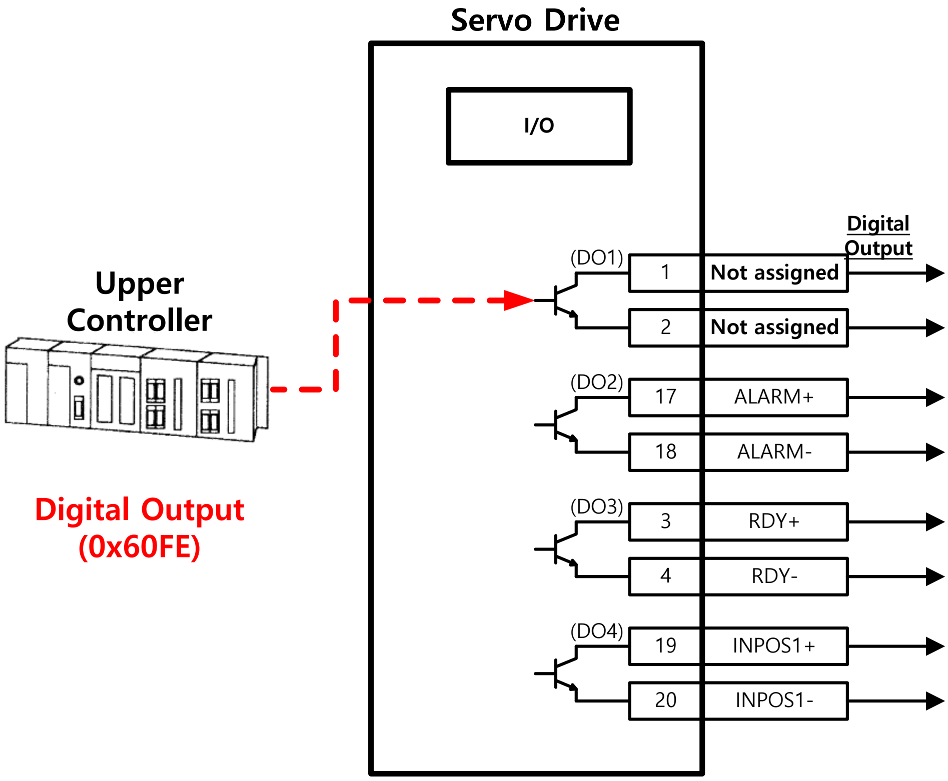
2. Read the values of the corresponding bits (0x60FD.16-23) from the digital input (0x60FD), in order to use them as the user input.

Related Objects

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

Bit	Details
0	NOT (negative limit switch)
1	POT (positive limit switch)
2	HOME (origin sensor input)
3 to 15	Reserved
16	DI #1 (I/O pin 2), 0: Open, 1: Close
17	DI #2 (I/O pin 3), 0: Open, 1: Close
18	DI #3 (I/O pin 4), 0: Open, 1: Close
19	DI #4 (I/O pin 5), 0: Open, 1: Close
20	DI #5(I/O pin 13), 0:Open, 1:Close
21	DI #6(I/O pin 14), 0:Open, 1:Close
22	DI #7(I/O pin 9), 0:Open, 1:Close
23	DI #8(I/O pin 10), 0:Open, 1:Close
24~30	Reserved
31	STO (Safe Torque Off), 0: Close, 1: Open

How to Set User Output



1. Set the function of digital output port to be used as the user output to "Not assigned (setting value of 0)." (Refer to Assignment of Output Signals.)
2. Set the bits (bits 16-19) corresponding to the port used as the user output for the bit mask (0x60FE:02) to Forced Output Enabled (setting value: 1).
3. Using physical outputs (0x60FE:01), set the value corresponding to the user output for the relevant port (bits 16-19) to 0 or 1.

Related Objects

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

They indicate the status of digital outputs.

- Description of physical outputs

Bit	Details
0 to 15	Reserved
16	Forced output (0: OFF, 1: ON) of DO #1 (I/O pins 1 and 2) Provided that the relevant bit mask (0x60FE:02.16) is set to 1.
17	Forced output (0: OFF, 1: ON) of DO #2 (I/O pins 17 and 18) Provided that the relevant bit mask (0x60FE:02.17) is set to 1.
18	Forced output (0: OFF, 1: ON) of DO #3 (I/O pins 3 and 4) Provided that the relevant bit mask (0x60FE:02.18) is set to 1.
19	Forced output (0: OFF, 1: ON) of DO #4 (I/O pins 19 and 20) Provided that the relevant bit mask (0x60FE:02.19) is set to 1.
20 to 23	Reserved
24	Output status of DO #1 (0: OFF, 1: ON)
25	Output status of DO #2 (0: OFF, 1: ON)
26	Output status of DO #3 (0: OFF, 1: ON)
27	Output status of DO #4 (0: OFF, 1: ON)
28 to 31	Reserved

- Description of bit mask

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

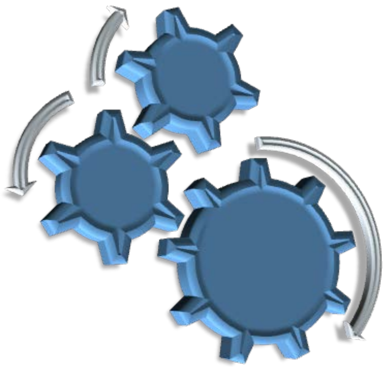
5.3 Electric Gear Setup

5.3.1 Electric Gear

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

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

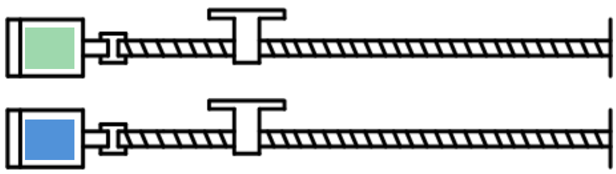
Set the gear ratio within the range of 1000-1/1000.



Typically, electric gears are used in the following situations:

(1) When Driving Loads Based on User Unit

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



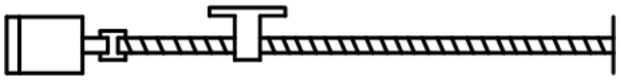
	(A) 5000 ppr encoder	(B) 19-bit (524288 ppr) encoder
When not using the electric gear	5000*12/10 = 6000	524288*12/10=629145.6
	Different command should be given depending on the encoder (motor) used for the same distance movement.	
For a command given in the minimum user unit of 1 um (0.001 mm)		
Electric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

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

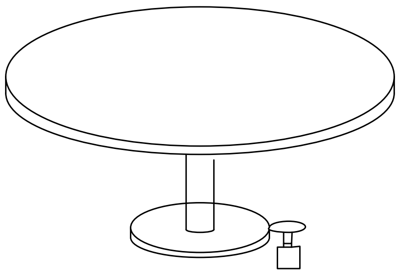
The output frequency of a general high-speed line drive pulse output unit is approximately 500 Kpps, while the allowed input frequency of the drive is approximately 1-4 Mpps. For this reason, when driving a high-resolution encoder at high speed, be sure to use an electric gear for proper driving due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

5.3.2 Example of Electric Gear Setup

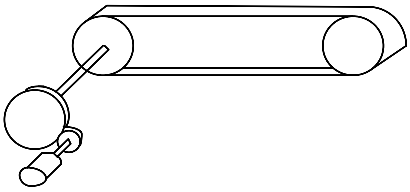
Ball Screw Load

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

Turntable Load

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

Belt + Pulley System

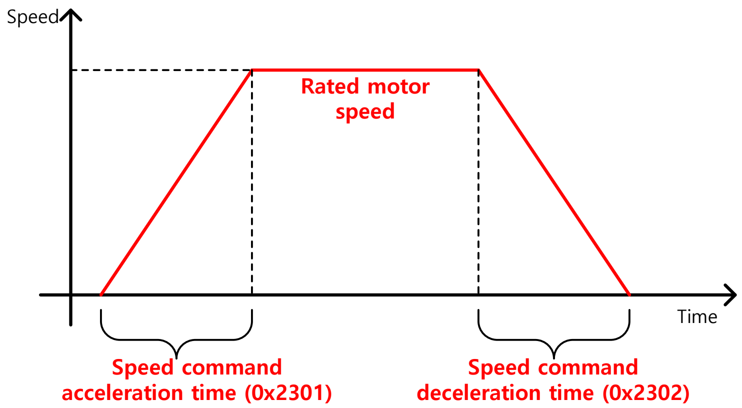
Apparatus specification	 Reduction gear ratio: 10/1, Pulley diameter: 100 mm
User Unit	1 um (0.001 mm)
Encoder specification	19-bit (524288 PPR)
Amount of load movement/revolution	PI * 100/10/0.001 = 31416
Electric gear settings	Motor Revolutions: 524288 Shaft Revolutions: 31416

5.4 Settings Related to Speed Control

5.4.1 Smooth Acceleration and Deceleration

For smoother acceleration and deceleration during speed control, you can generate an acceleration/deceleration profile with trapezoidal and S-curved shapes for driving. At this moment, S-curve operation is enabled by setting the speed command S-curve time to a value of more than 0 [ms].

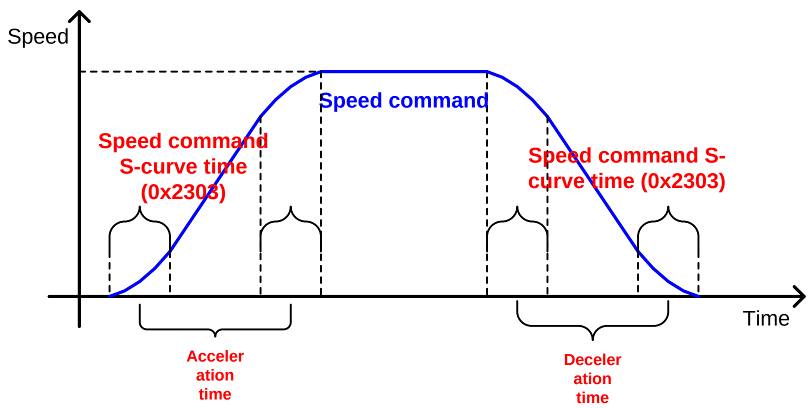
The speed command acceleration/deceleration time (0x2301 and 0x2302) is the time needed to accelerate the drive from zero speed to the rated speed or to decelerate it from the rated speed to zero speed. (See the figure below.)



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

- Acceleration time = speed command / rated speed x speed command acceleration time (0x2301)
- Deceleration time = speed command / rated speed x speed command deceleration time (0x2302)

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



5.4.2 Servo-lock Function

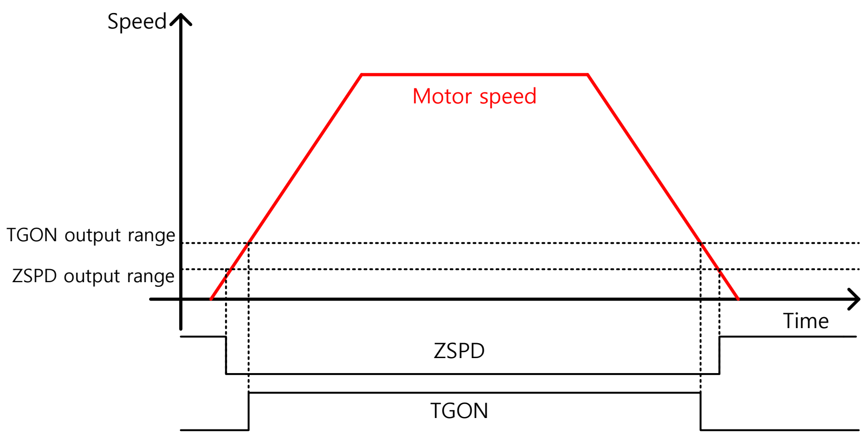
During speed control, the servo position will not be locked even when 0 is input for a speed command. This is due to the characteristic of speed control; at this moment, you can lock the servo position by enabling the servo-lock function (0x2311).

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

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

5.4.3 Signals Related to Speed Control

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



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

Related Objects

Index	Sub Index	Name	Variable type	Acces sibility	PDO assign ment	Unit
0x2404	-	ZSPD Output Range	UINT	RW	Yes	Rpm
0x2405	-	TGON Output Range	UINT	RW	Yes	Rpm
0x2406	-	INSPD Output Range	DINT	RW	Yes	Rpm

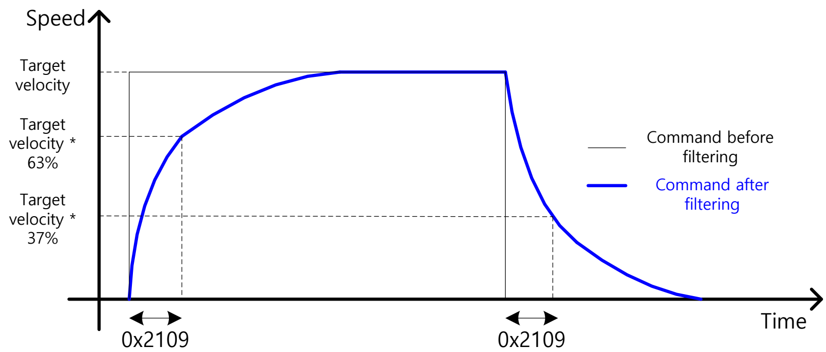
5.5 Settings Related to Position Control

5.5.1 Position Command Filter

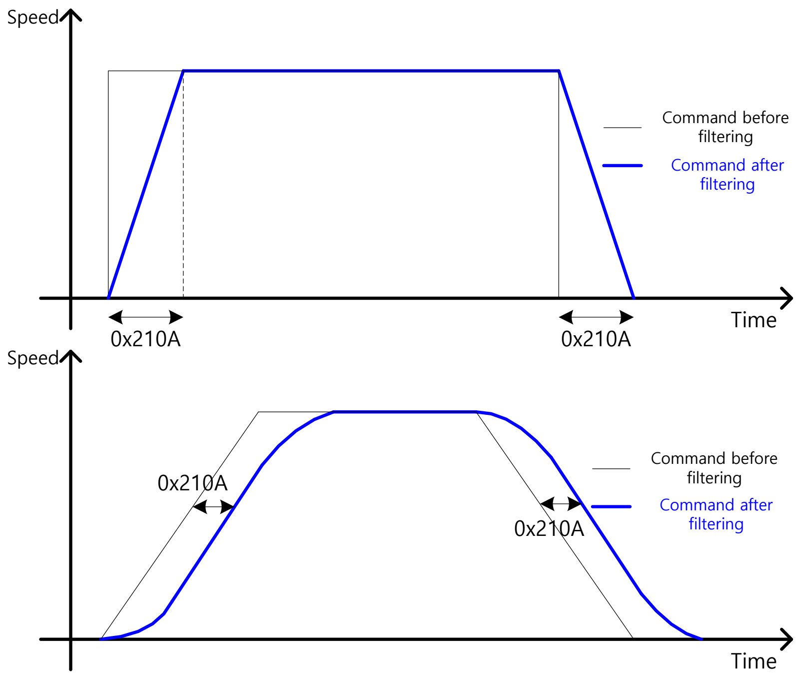
This section describes how to operate the drive more smoothly by applying a filter to a position command. For the purpose of filtering, you can set position command filter time constant (0x2109) using the primary low pass filter and position command average filter time constant (0x210A) using the moving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

You can use a position command filter if:

- the electric gear ratio is more than 10 times, or
- 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)

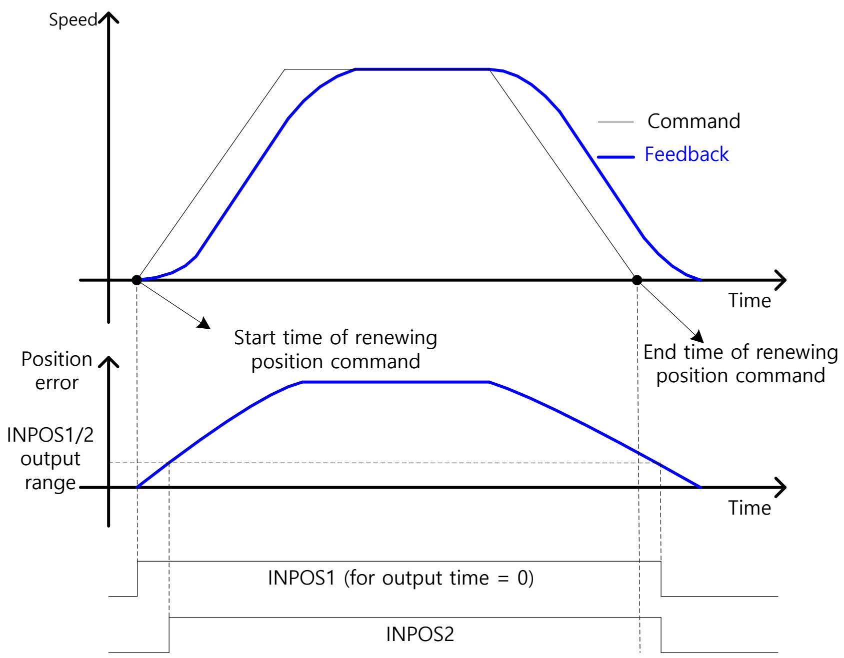
Related Objects

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

5.5.2 Signals Related to Position Control

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

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



Related Objects

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

5.6 Settings Related to Torque Control

5.6.1 Speed Limit Function

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

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

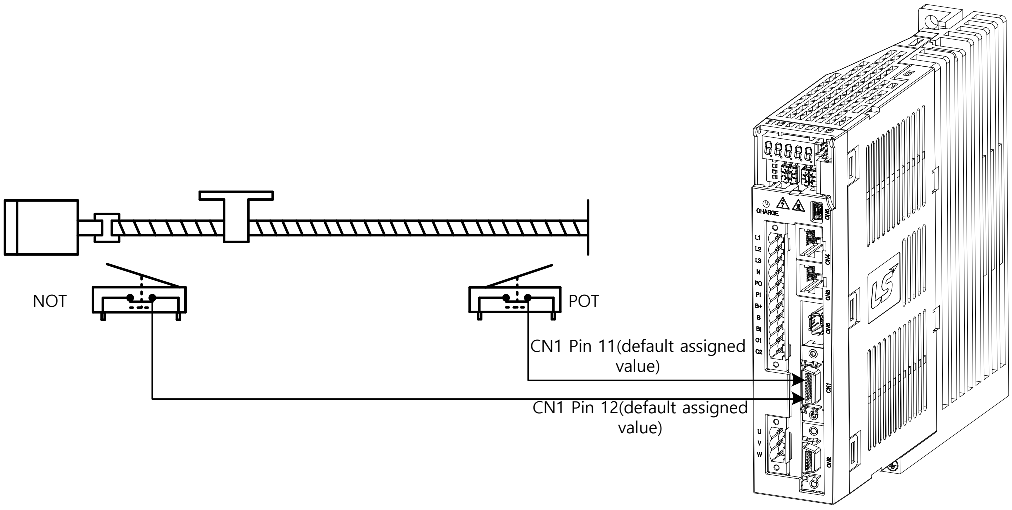
Setting values	Setting details
0	Limited by speed limit value (0x230E)
1	Limited by the maximum motor speed

Related Objects

Index	Sub Index	Name	Variable type	Accessi bility	PDO assign ment	Unit
0x230D	-	Speed Limit Function Setting	UINT	RW	No	-
0x230E	-	Speed Limit Value	UINT	RW	Yes	Rpm

5.7 Positive/Negative Limit Settings

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



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

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

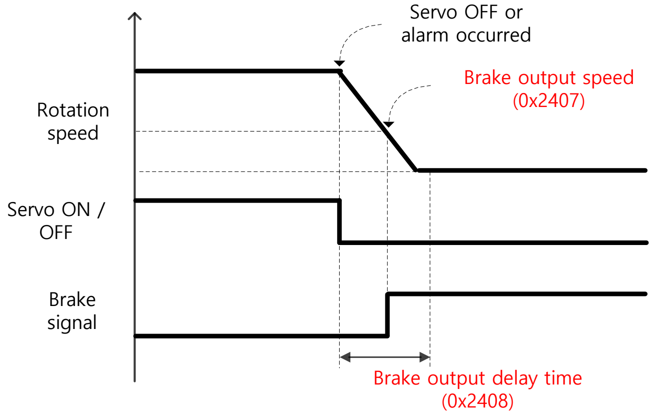
Related Objects

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

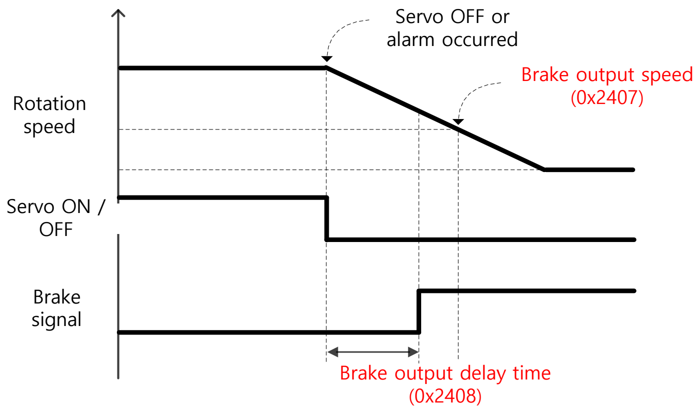
5.8 Setting the Brake Output Signal Function

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

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



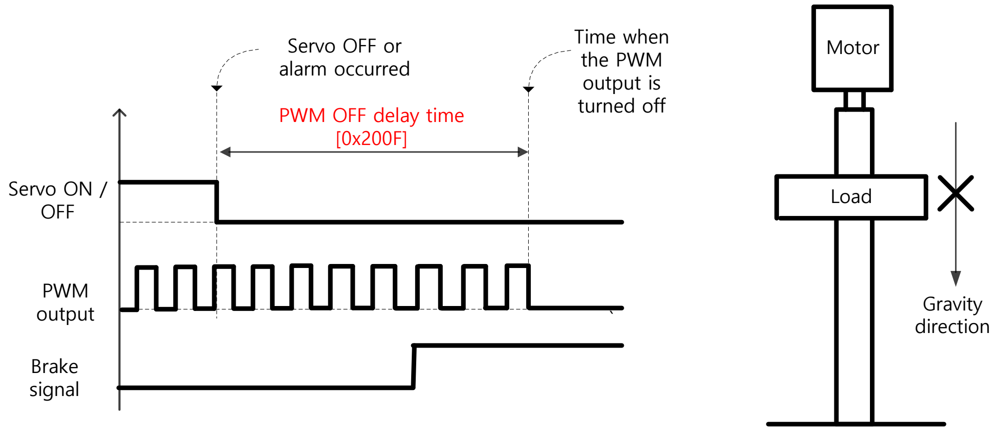
Timing diagram for signal output by the brake output speed (0x2407)



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

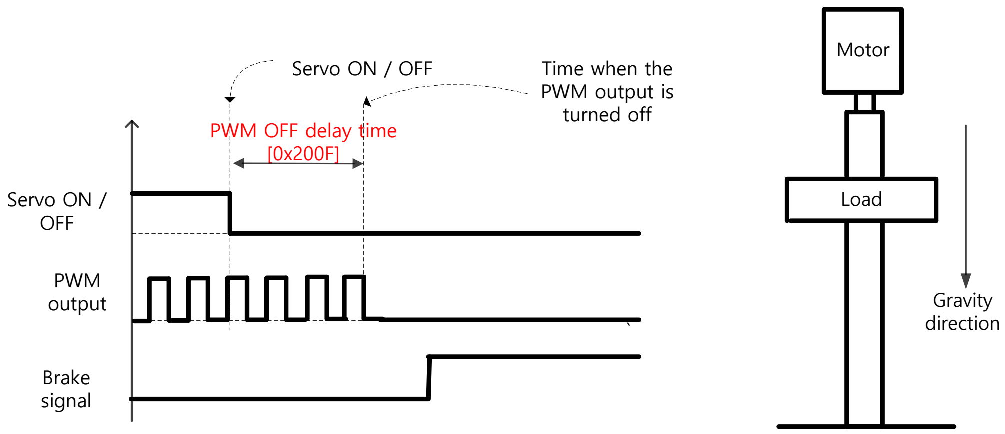
Set the time to delay until the actual PWM output goes off when the servo is turned off or a servo alarm occurs.

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



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

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



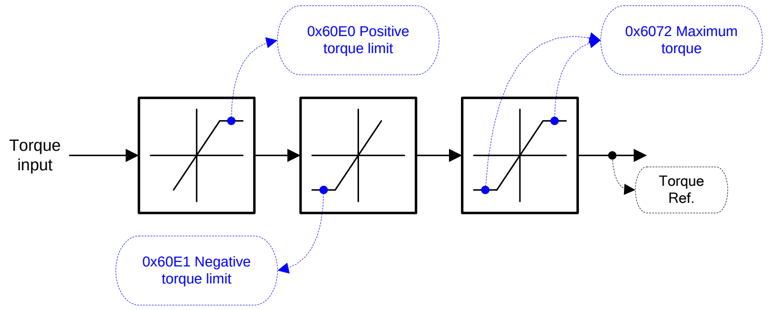
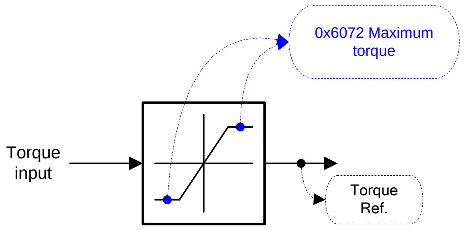
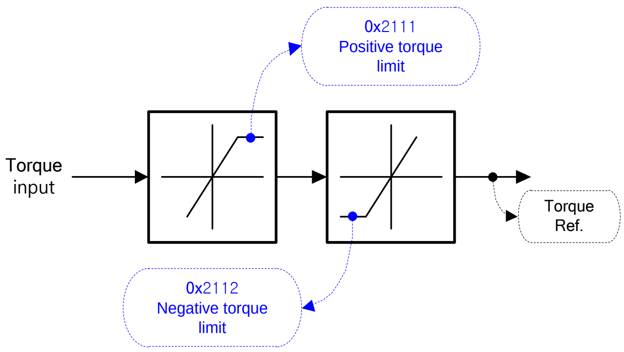
(2) If PWM Output Turns off First Before Brake Signal Outputs

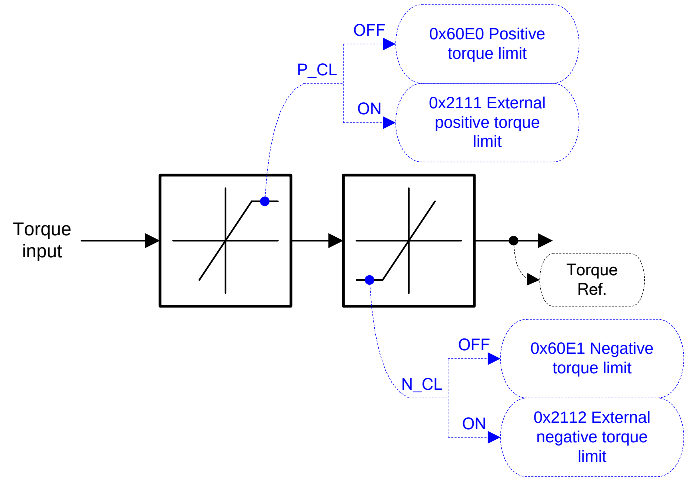
The PWM output is turned off first before the brake signal output, allowing the drop along the vertical axis due to the gravity.

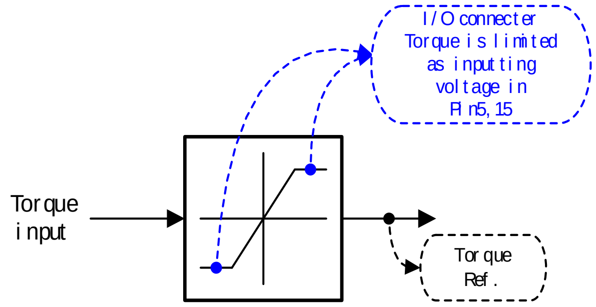
5.9 Torque Limit Function

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

Description of Torque Limit Function Setting (0x2110)

Limit function	Details
Internal torque limit 1 (set value 0)	 Limits the torque using positive/negative torque limit value according to the driving direction; the maximum value is limited by the maximum torque (0x6072). ▪ Forward: 0x60E0, Reverse: 0x60E1
Internal torque limit 2 (set value 1)	 Limits the torque only by the maximum torque (0x6072) regardless of the driving direction.
External torque limit (set value 2)	 Limits the torque using external positive/negative torque limit value according to the driving direction. ▪ Forward: 0x2111, Reverse: 0x2112

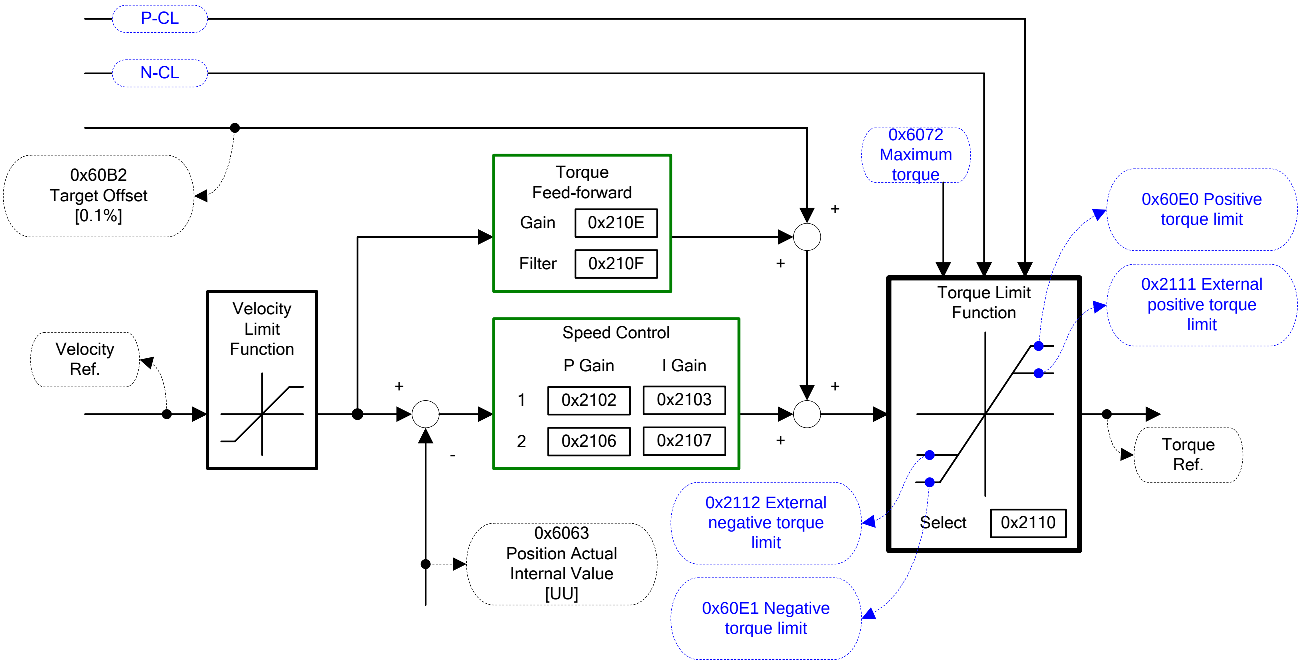
<table>
<tr><th>Limit function</th><th>Details</th></tr>
<tr><td>Internal and external torque limit
(set value 3)</td><td>

Limits the torque using internal and external torque limit value according to the driving direction and the torque limit signal.
▪ Forward: 0x60E0 (if the PCL signal is not input) or 0x2111 (if the PCL signal is input)
▪ Reverse: 0x60E1 (if the NCL signal is not input) or 0x2112 (if the NCL signal is input)</td></tr>
<tr><td>Analog torque limit
(set value 4)</td><td>

- Restricted by torque limited value which in put as analog.

- Restriced normal direction / reverse direction torque regardless of +/ - of analog voltage.

- Refer offset(0x221C) and then scale(0x221C) of analog torque limitation.</td></tr>
</table>

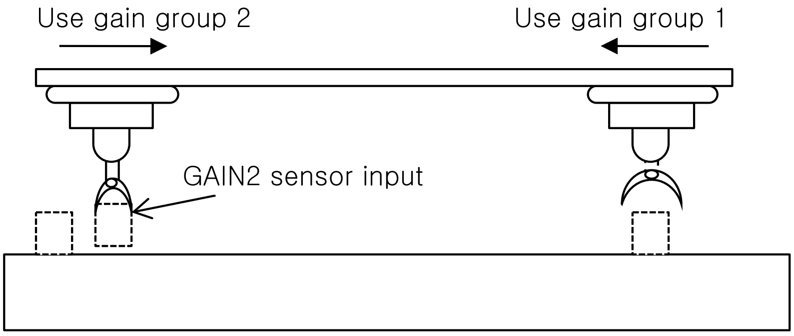


Related Objects

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

5.10 Gain Switching Function

5.10.1 Gain Group Switching



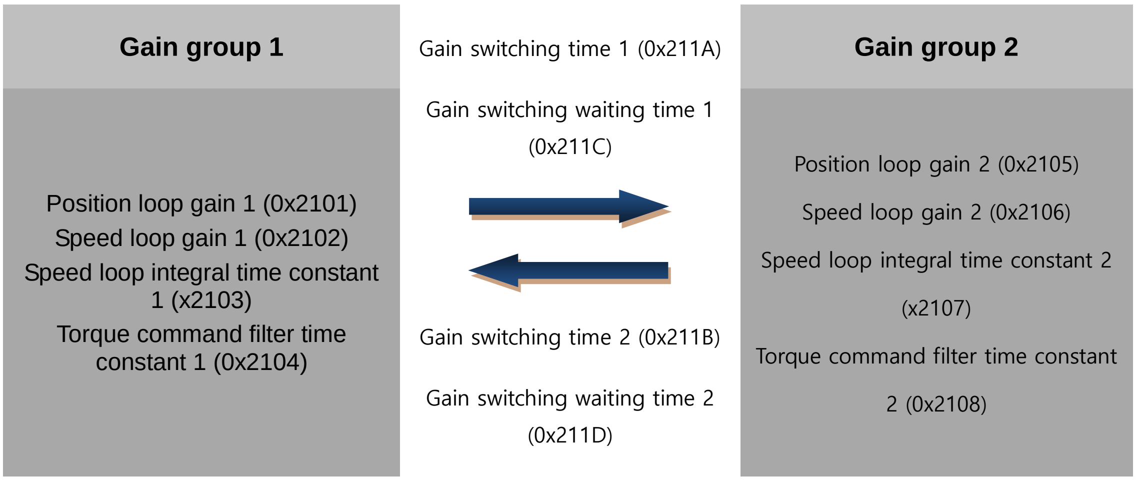
This function is to switch between the gain groups 1 and 2, as one of gain adjustment methods. You can reduce the time required for positioning through switching gains.

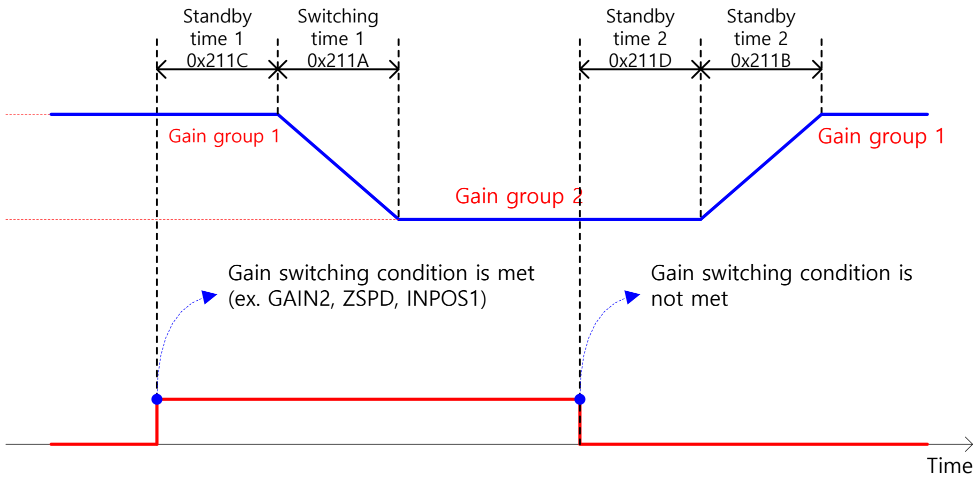
A gain group consists of position loop gain, speed loop gain, speed loop integral time constant, and torque command filter time constant. The gain switching function (0x2119) can be set as follows:

Description of Gain Switching Function (0x2119)

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

Waiting time and switching time for gain switching is as follows:





Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2119	-	Gain Switching Mode	UINT	RW	Yes	-
0x211A	-	Gain Switching Time 1	UINT	RW	Yes	Ms
0x211B	-	Gain Switching Time 2	UINT	RW	Yes	Ms
0x211C	-	Gain Switching Waiting Time 1	UINT	RW	Yes	Ms
0x211D	-	Gain Switching Waiting Time 2	UINT	RW	Yes	Ms

5.10.2 P/PI Control Switching

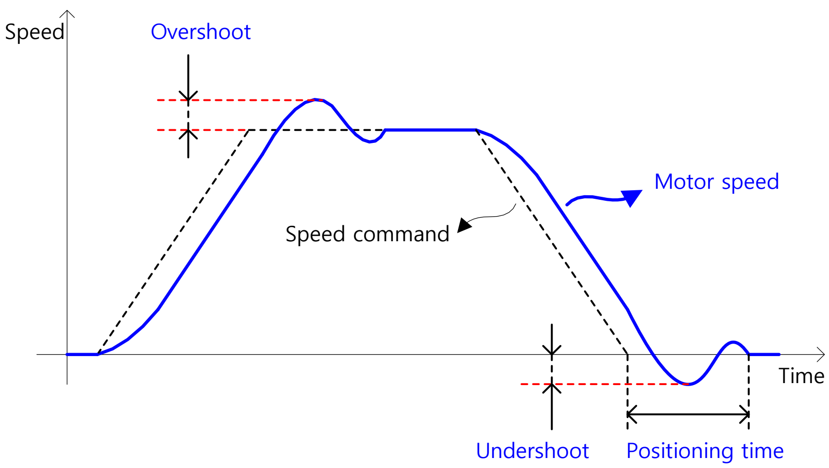
PI control uses both proportional (P) and integral (I) gains of the speed controller, while P control uses only proportional gain.

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

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

- Speed control: To suppress any overshoot or undershoot during acceleration/deceleration.
- Position control: To suppress undershoot during positioning, resulting in a reduced positioning time.

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



You can configure these settings in the P/PI control switching mode (0x2114). Please see the details below: PCON

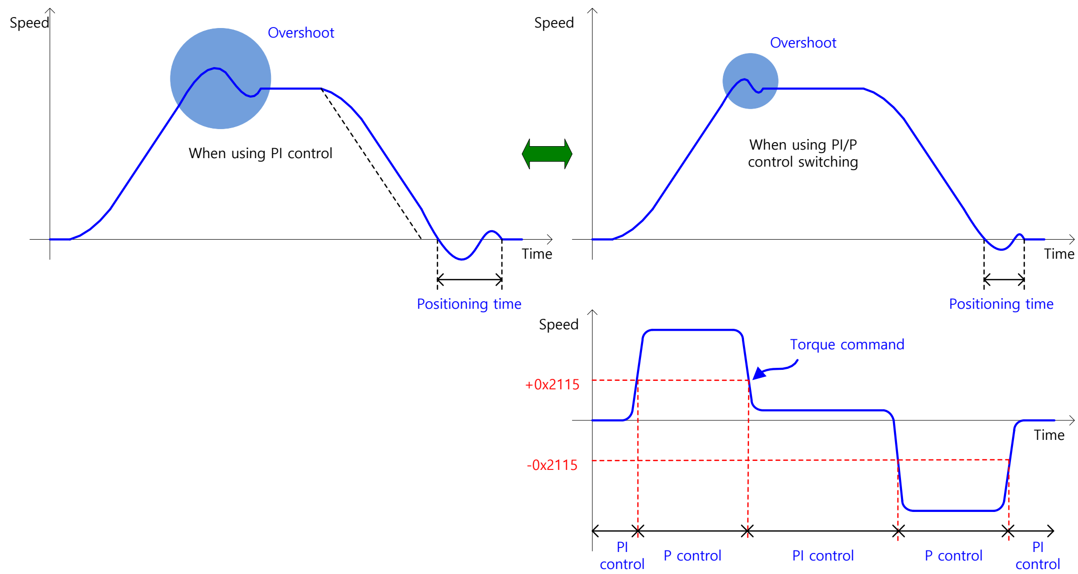
Setting values	Setting details
0	Always uses the PI control.
1	Switches to the P control if the command torque is larger than the P control switching torque (0x2115).
2	Switches to the P control if the command speed is larger than the P control switching speed (0x2116).
3	Switches to the P control if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

Related Objects

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

Example of P/PI Switching by Torque Command

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

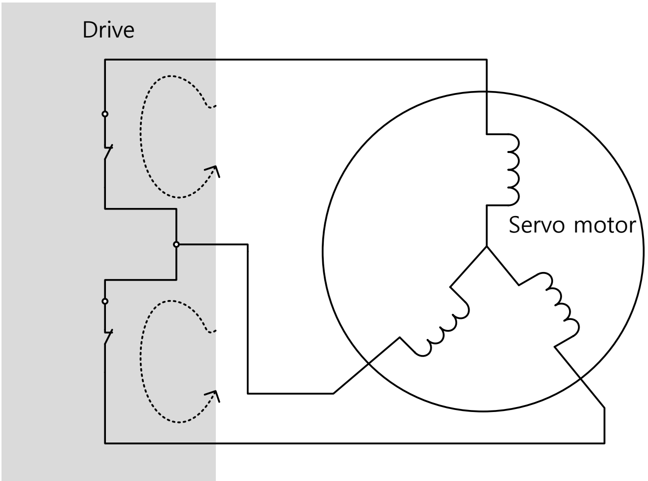


5.11 Dynamic Brake

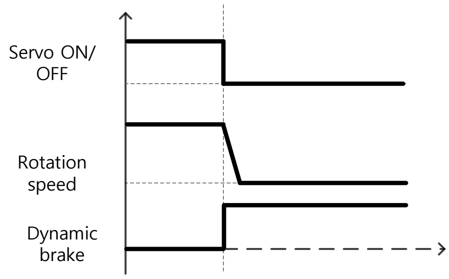
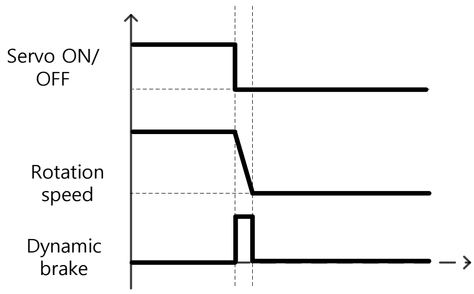
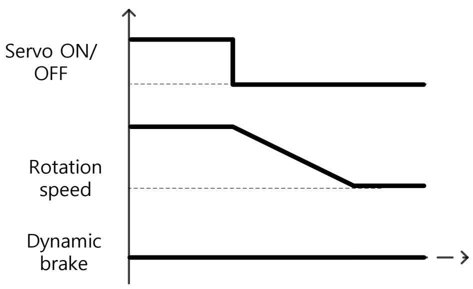
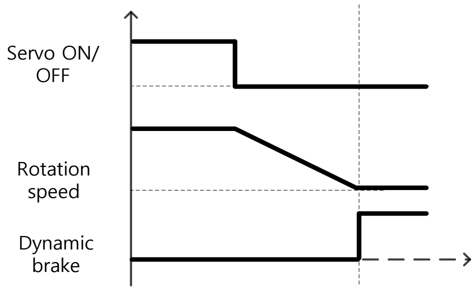
What is Dynamic Brake?

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

- Circuits related to the dynamic brake are integrated into the drive.
- The drive short-circuits only two phases or all of three phases depending on the model type.



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

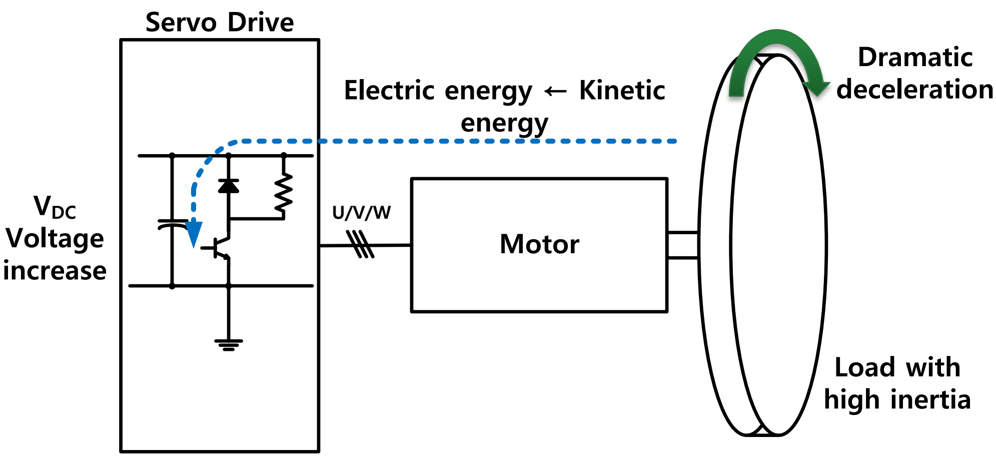
 Setting value: 0 Hold the dynamic brake after stopping the motor using the brake	 Setting value: 1 Release the dynamic brake after stopping the motor using the brake
 Setting value: 2 Release the dynamic brake after free-run stop	 Setting value: 3 Hold the dynamic brake after free-run stop

Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2012	-	Dynamic Brake Control Mode	UINT	R/W	No	-
0x2013	-	Emergency Stop Configuration	UINT	R/W	No	-

5.12 Regenerative resistor setting

Regeneration is the phenomenon which converts motor's kinetic energy to electric energy that is back to the drive when motor decelerates dramatically or runs the load with high inertia. Regenerative resistor is used for preventing a damage of drive by repressing internal voltage of drive from increase.



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 Using internal regenerative resistor

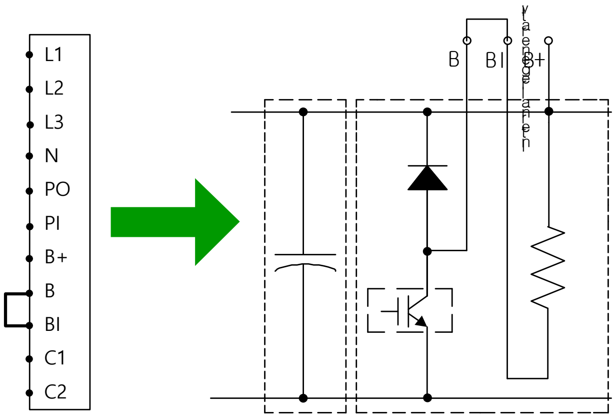
L7NH series has basic internal regenerative resistor according to drive capacity.
Specification of internal regenerative resistor is as below.

Drive capacity	Value of internal resistor	Capacity of internal resistor
100W	100Ω	50W
200W	100Ω	50W
400W	100Ω	50W
1KW	40Ω	100W
3.5KW	12.6Ω	150W

Follow the below order when using internal regenerative resistor in the drive.

1. Wiring regenerative resistor.

   - Make sure that B and BI terminals are short circuit.(Default short circuit, 1kW or below)



Wiring for external regenerative resistor

2. Set regenerative resistor.(0x2009)

   - Set to use the internal regenerative resistor.(0x2009 = 0)

   - Internal regenerative resistor is attached on rear side of heat sink of the drive.

   - Default value : 0

3. Check the capacity and value of internal regenerative resistor.

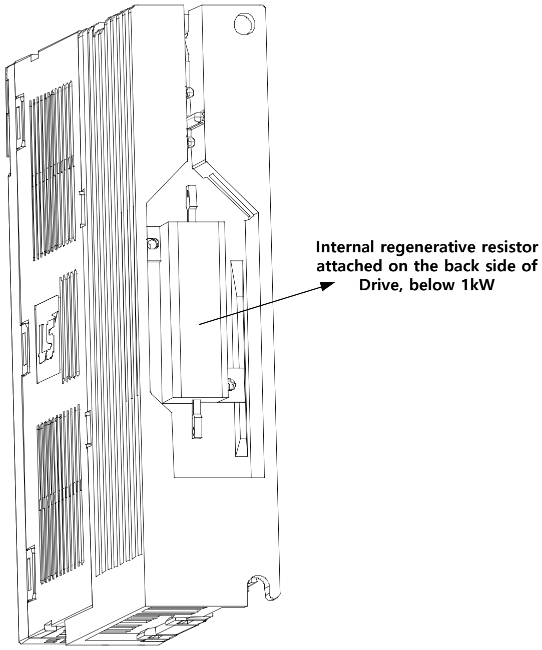
   - Check the value of internal regenerative resistor.(0x200B)

   - Check the capacity of internal regenerative resistor.(0x200C)

- 1KW or below : Basically attached on rear side of heat sink of the drive.(Refer to below figure)

- Between “3.5KW or above” and “below 15KW” : Basically attached inside of the drive.

- 15KW or above : No internal regenerative resistor.



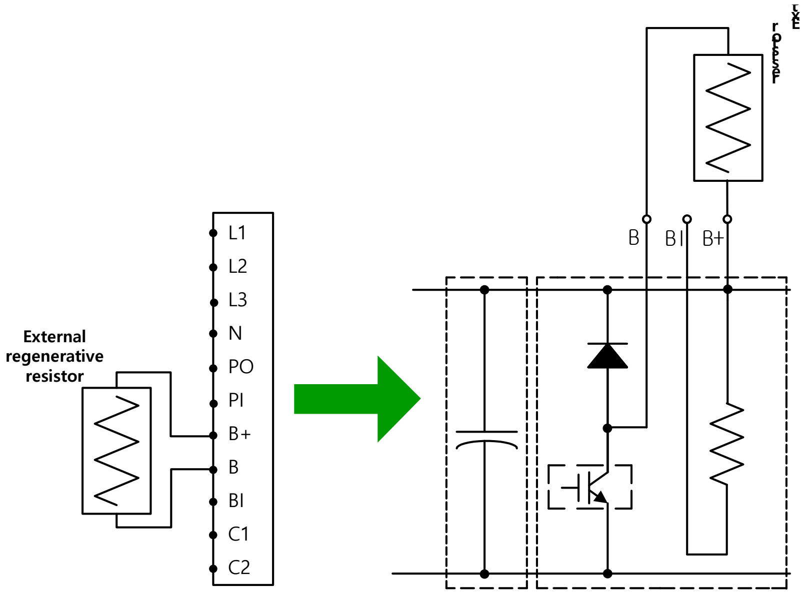
5.12.2 Using external regenerative resistor

Follow the below order when using external regenerative resistor according to state of operation.

1. Wiring external regenerative resistor

   - Remove short pin on B and BI terminals(Default short circuit, 1kW or below)

   - Connect external regenerative resistor on B and B+ terminals.



Wiring for external regenerative resistor

2. Set regenerative resistor(0x2009)

   - Set to use the external regenerative resistor.(0x2009=1)

3. Set when using an external regenerative resistor bigger than internal regenerative resistor. (0x200B)

   - Set the value of external regenerative resistor.(Unit : [Ω])

   - It is mandatory to set this value when regenerative resistor setting(0x2009) is “1”.

   - Default : 0

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

   - Set capacity of external regenerative resistor.(Unit : [W])

   - It is mandatory to set this value when regenerative resistor setting(0x2009) is “1”.

   - Default : 0

5. Set tolerate time and max. capacity of regenerative resistor.(0x200D, 0x200E)

   - Set max. capacity and tolerate time of using regenerative resistor when its max. capacity according to data sheet of regenerative resistor provided by maker.

   - If there is no reference, set max. capacity as 5 times as capacity of regenerative resistor(0x200C) and tolerate time as 5000[ms].(It is better to use data sheet because it can be different from general setting)

   - It is mandatory to set this value when regenerative resistor setting(0x2009) is “1”.

Options of external regenerative resistor provided from LS ELECTRIC are as below.

Drive capacity	Value of resistor	Capacity of resistor	Model name
100W	50Ω	140W	APCS-140R50
200W			
400W			
1KW	30Ω	300W	APCS-300R30
3.5KW	30Ω	600W	APC-600R30

5.12.3 Miscellaneous concern

It is possible to set regenerative resistor derating Factor(0x200A) according to ambient environment and radiation of heat. If the condition of radiation of heat is bad, please use derating factor.(less than capacity)

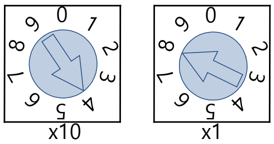
When using Derating factor(value is less than 100), regenerative overload alarm(AL-23) will occur earlier if the value is smaller.

If Derating Factor is more than 100%, it is mandatory to consider condition of radiation of heat properly.

5.13 Configuration of Drive Node Address (ADDR)

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

L7NH series consists of a two rotary switch with the configurable values of 0 to 9, as shown below; thus, you can configure a node address from 0 to 99. The below figure is the example of node value “48”.



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

L7NH series has built-in safe torque off (STO) function to reduce the risk while using the machine by protecting people around the machine against dangerous operation of its movable parts. Especially, this function can be used to prevent dangerous operation of the machine's movable parts when you need to perform tasks such as maintenance in a danger zone.

6.1 Safe Torque Off (STO) Function

The safe torque off (STO) function blocks motor current according to the input signal transferred from a safety device connected to the connector (CN6), such as safety controller and safety sensor, to stop the motor.

Safe torque off operation state according to STO input contact

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

Electric characteristics

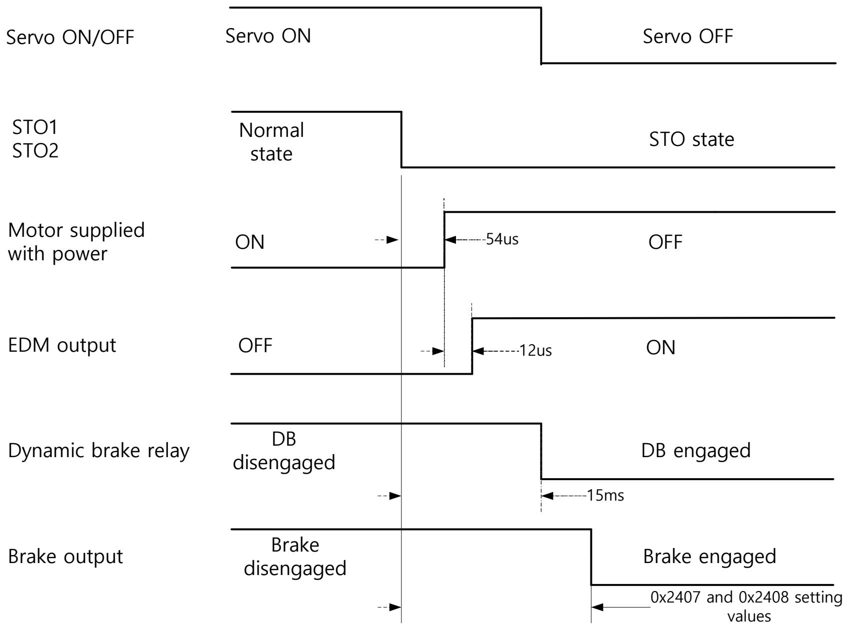
- STO1 and STO2

Item	Characteristic
Internal impedance	3.92 kΩ
Voltage input range	DC 12 V - DC 24 V
Maximum delay time	1 ms or less

- EDM

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

Timing diagram for STO operation

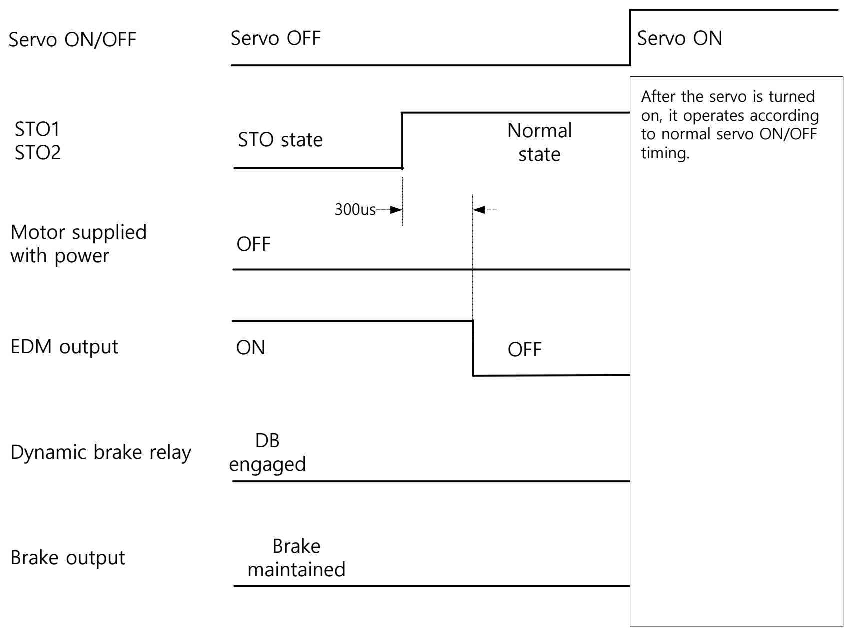


Note 1) If at least one of STO1 and 2 is turned off, the drive state is switched to the STO state.

The dynamic brake operates according to the dynamic brake control mode setting [0x2012].

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

Timing diagram for STO recovery



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

The dynamic brake operates according to the dynamic brake control mode setting [0x2012] for the STO state, the alarming state, and the servo OFF state.

6.2 External device monitoring (EDM)

EDM is the monitor output signal for observing state of safety input signal with external device. Connect EDM to external monitoring terminal on safety device, controller or sensor.

Detecting EDM malfunction by using EDM signal

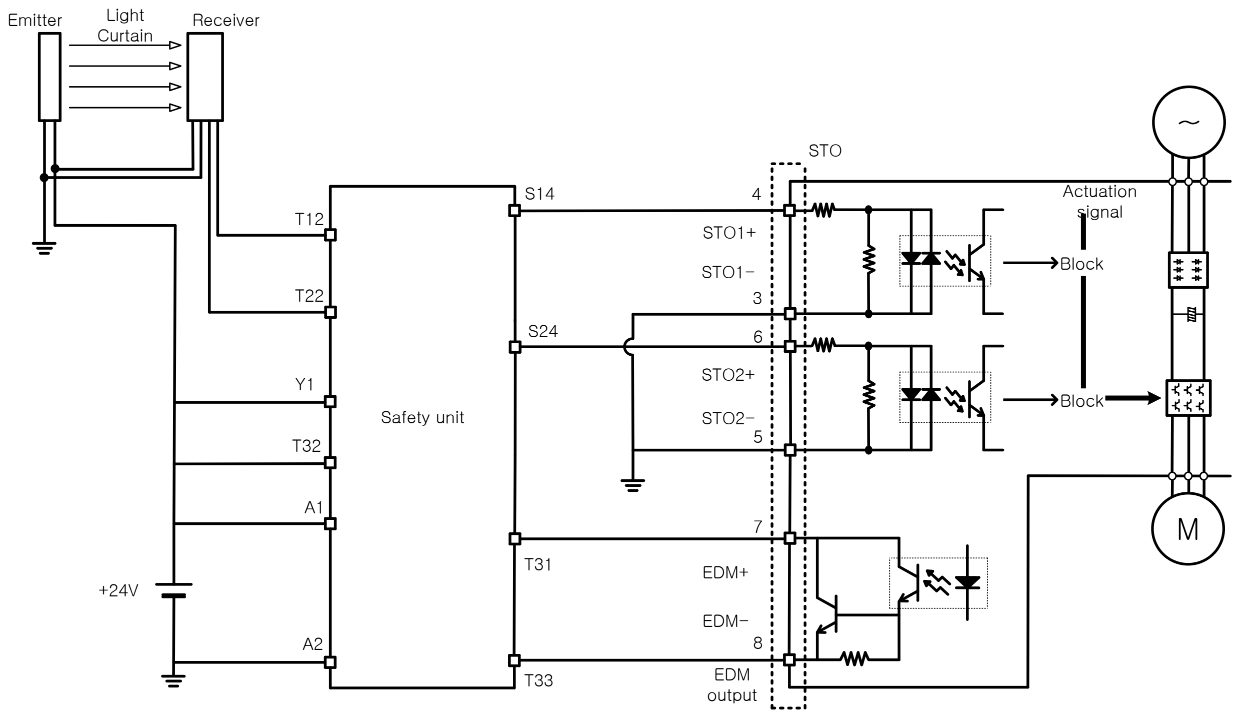
Possible to detect malfunctions of Safety input circuit and EDM output circuit when monitoring 4 signals below.

There are 2 cases when it is defected.

- When both STO 1 and 2 are OFF. Then, EDM output is not ON.
- When either or both STO 1 and 2 are ON but EDM output is ON.

Signal name	Functions			
STO1	ON	ON	OFF	OFF
STO2	ON	OFF	ON	OFF
EDM	OFF	OFF	OFF	ON

6.3 Example of Using Safety Function



6.4 How to Verify Safety Function

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

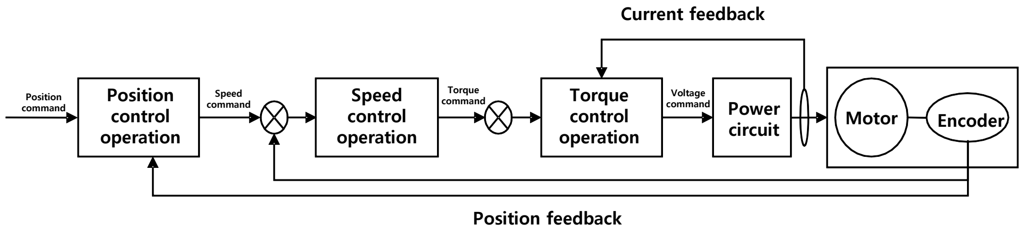
- Make sure that, when turning off the STO1 and STO2 signals, the drive becomes STO state (The bit 31 of digital input(0x60FD) is 1).
- Make sure that, in regular operation, EDM signal is OFF by using the input displaying lamp of feedback circuit of connecting device.

6.5 Precautions for Using Safety Function

- When using the STO function, be sure to carry out risk assessment for the device to check if the safety requirements of the system are met.
- There may be risks as below even if the STO function works.
- At the STO state, the motor is operated by an external force; thus, if the load needs to be maintained, arrange a separate measure such as external mechanical brake. The brake of the servo system is dedicated for maintaining the load; thus, be careful not to use it to brake the motor.
- If no external force exists and free-run stop is configured in the dynamic brake control mode setting (0x2012), note that the braking distance of load will be extended.

- The purpose of the STO function is not to block the servo drive power or electrically insulate the drive. That is why you have to disconnect the servo drive power before carrying out the maintenance of any sub-drive.

7. Tuning



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

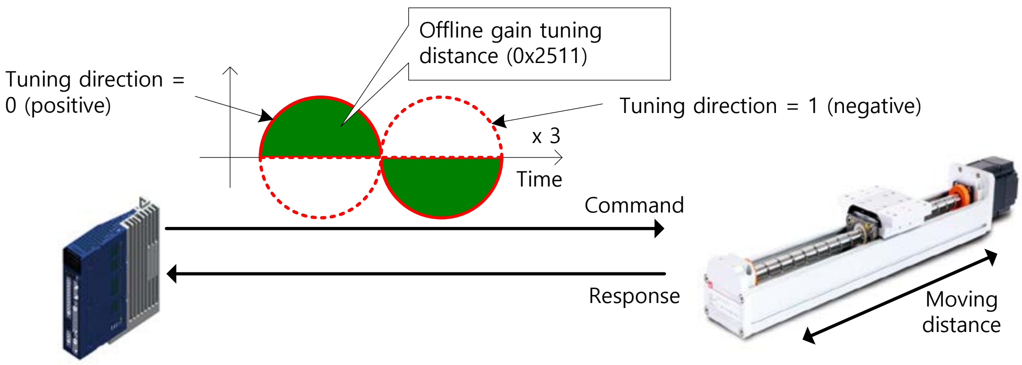
7.1 Auto Gain Tuning

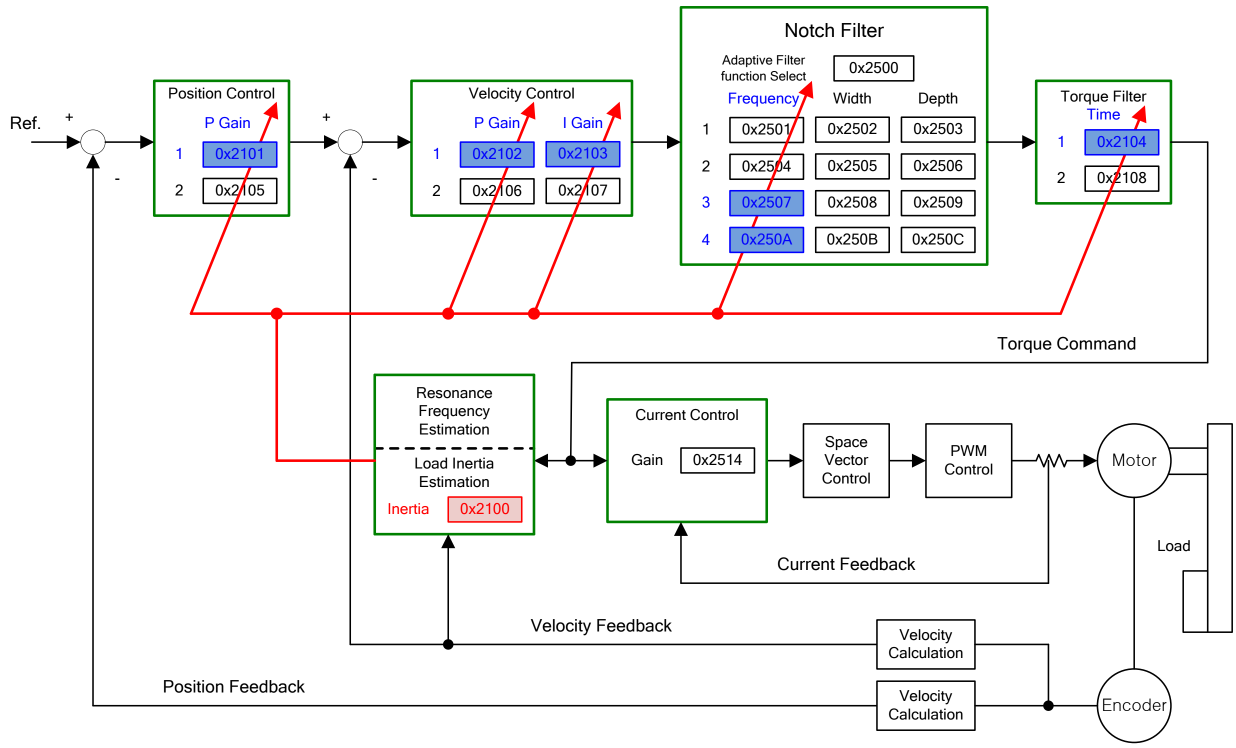
Use the command generated by the drive itself to automatically set the gain according to the load condition. The following gain-related parameters will be changed:

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

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

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





Related Objects

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

7.2 Manual Gain Tuning

7.2.1 Gain Tuning Sequence

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

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

The role of each individual gain is as follows:

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

Speed Controller Tuning

1. Inertia ratio setting
   - Use automatic inertia estimation function or carry out manual setting.

2. Proportional gain setting
   - Monitor torque and noise before any vibration occurs.

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

4. Speed command filter and speed feedback filter setting

Position Controller Tuning

1. Proportional gain setting
   - Monitor torque, positional error, and noise before any vibration occurs.

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

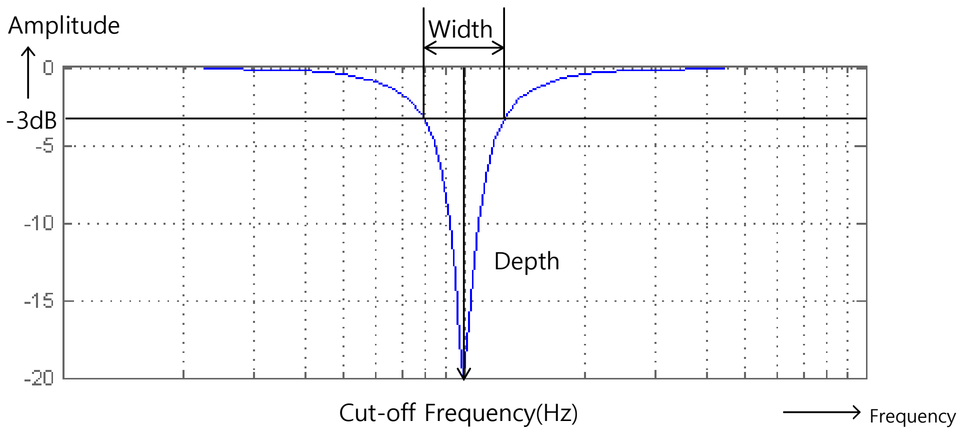
3. Able to set the position command filter
   - You can smooth a position command.

7.3 Vibration Control

7.3.1 Notch Filter

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

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



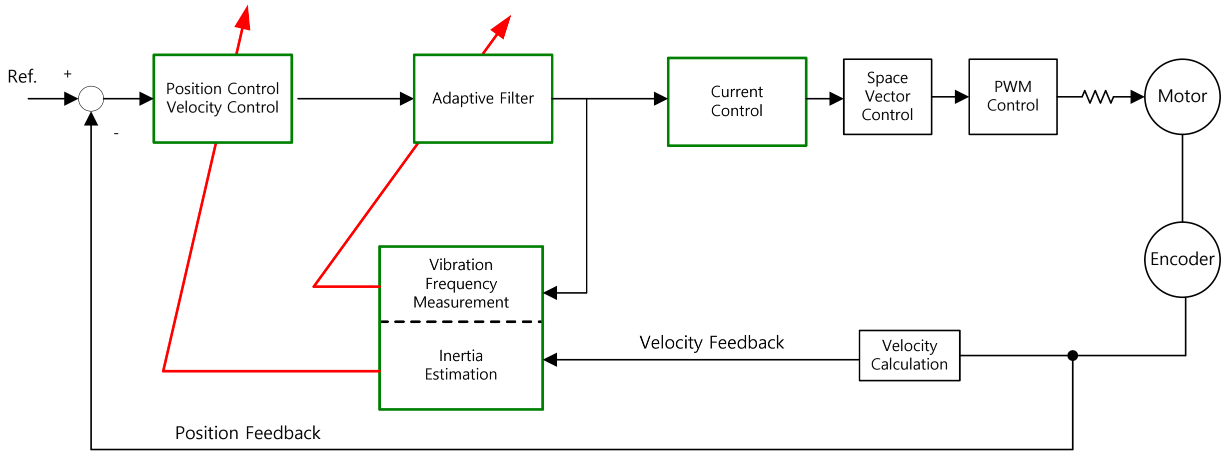
Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2501	-	Notch Filter 1 Frequency	UINT	RW	No	Hz
0x2502	-	Notch Filter 1 Width	UINT	RW	No	Hz
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	Hz
0x2506	-	Notch Filter 2 Depth	UINT	RW	No	-
0x2507	-	Notch Filter 3 Frequency	UINT	RW	No	Hz
0x2508	-	Notch Filter 3 Width	UINT	RW	No	Hz
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	Hz
0x250C	-	Notch Filter 4 Depth	UINT	RW	No	-

7.3.2 Adaptive Filter

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

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



Related Objects

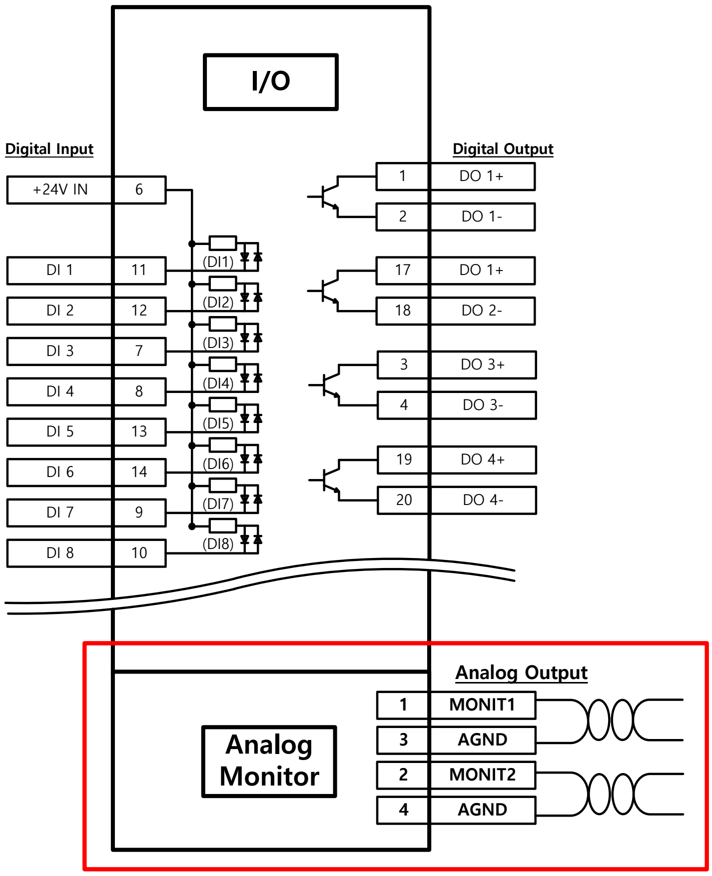
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2500	-	Adaptive Filter Function Setting	UINT	RW	No	-

- Adaptive Filter Function Setting (0x2500)

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

7.4 Analog Monitor

To monitor the gain tuning or the internal state variables of a drive, 1-channel analog monitor outputs (I/O, Pin 10 - 11) are provided.



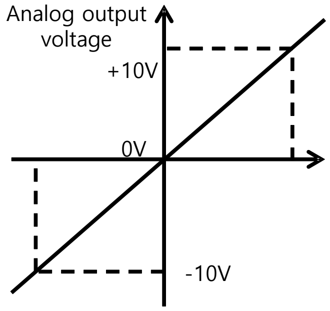
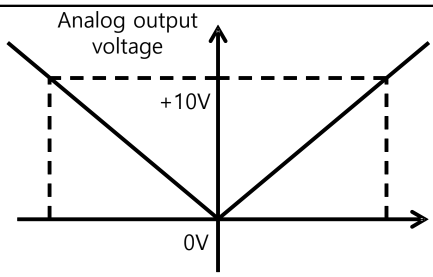
Related Objects

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

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2226	-	Analog Monitor Channel 2 Scale	UDINT	RW	No	-

Analog Monitor Output Mode (0x2220) Setting

The output range of analog monitor is from -4 V to +4 V. If the setting is 1, it takes the absolute value of the output to make the value only be positive.

Setting value	Settings	Details
0	Output as negative/ positive values	
1	Output only positive values	

Analog Monitor Channel 1 Setting (0x2221)

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

Setting values	Displayed item	Unit
0	Speed feedback	Rpm
1	Speed command	Rpm
2	Speed error	Rpm
3	Torque feedback	%
4	Torque command	%
5	Positional error	Pulse
6	Accumulated operation overload rate	%
7	DC link voltage	V
8	Accumulated regenerative overload rate	%
9	Encoder single-turn data	Pulse
10	Inertia ratio	%
11	Full-Closed positional error	UU
12	Drive temperature 1	°C
13	Drive temperature 2	°C

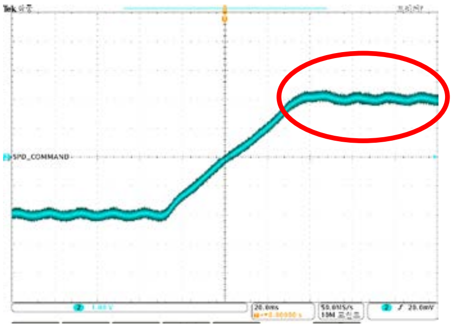
Setting values	Displayed item	Unit
14	Encoder temperature 1	°C

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

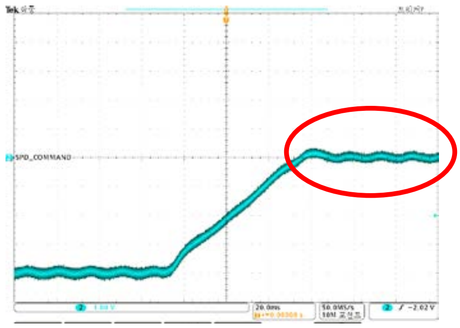
- Channel 1 output voltage [V] = [Monitoring signal value (0x2221) – Offset (0x2203)] / Scale (0x2205)
- Channel 2 output voltage [V] = [Monitoring signal value (0x2222) – Offset (0x2204)] / Scale (0x2206)

Setting Example

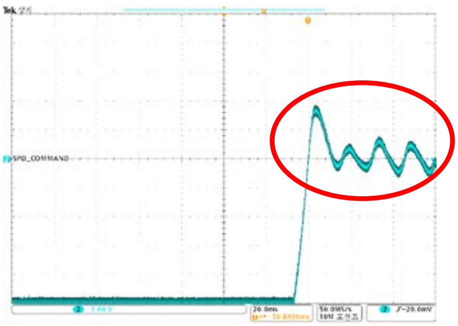
The following shows an example of monitoring ripple during 1000 rpm operation of speed feedback signal:



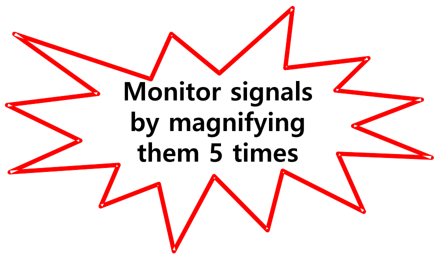
Output offset: 0 rpm
Output scale: 500 rpm/V



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



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



8. Procedure Function

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

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

8.1 Manual Jog Operation

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

Before starting the jog operation, make sure that:

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

Related Objects

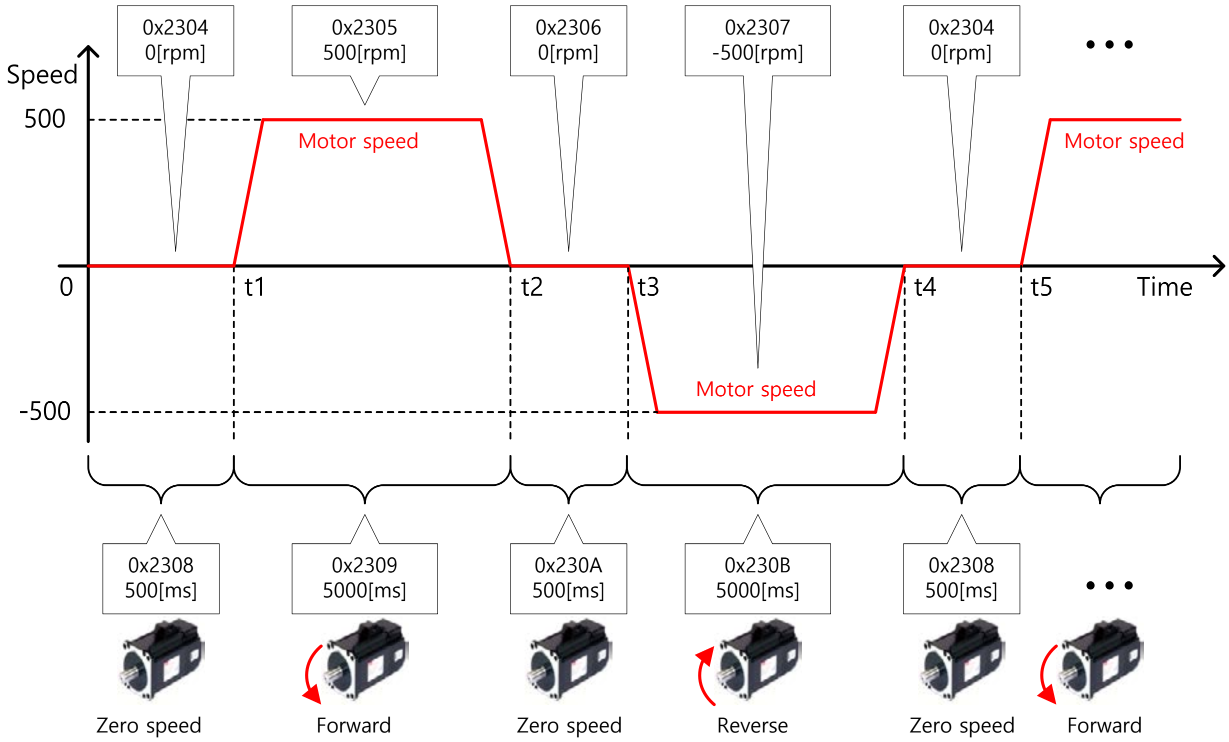
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2300	-	Jog Operation Speed	INT	RW	No	rpm
0x2301	-	Speed Command Acceleration Time	UINT	RW	No	ms
0x2302	-	Speed Command Deceleration Time	UINT	RW	No	ms
0x2303	-	Speed Command S-curve Time	UINT	RW	No	ms

8.2 Programmed Jog Operation

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

Before starting the jog operation, make sure that:

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



Related Objects

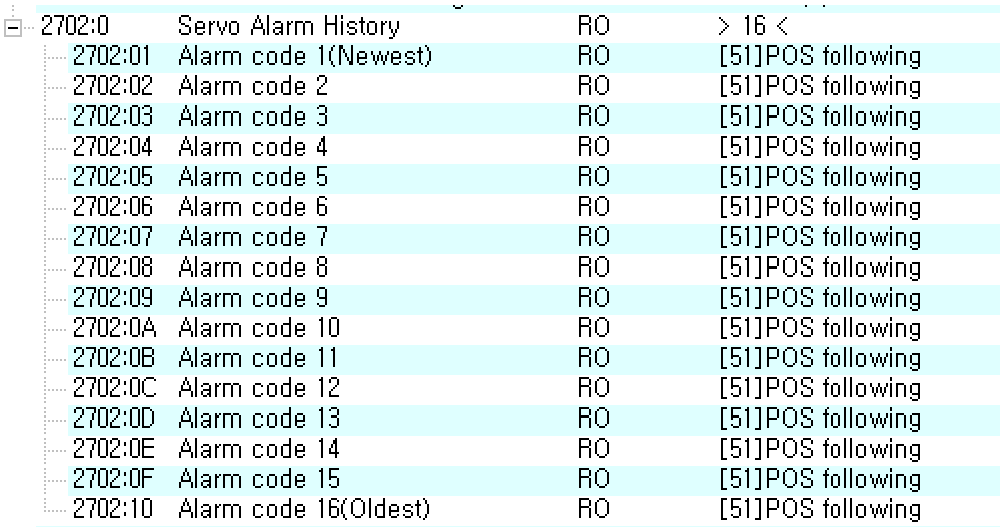
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2304	-	Programmed Jog Operation Speed 1	INT	RW	No	Rpm
0x2305	-	Programmed Jog Operation Speed 2	INT	RW	No	Rpm
0x2306	-	Programmed Jog Operation Speed 3	INT	RW	No	Rpm
0x2307	-	Programmed Jog Operation Speed 4	INT	RW	No	Rpm
0x2308	-	Programmed Jog Operation Time 1	UINT	RW	No	Ms

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2309	-	Programmed Jog Operation Time 2	UINT	RW	No	Ms
0x230A	-	Programmed Jog Operation Time 3	UINT	RW	No	Ms
0x230B	-	Programmed Jog Operation Time 4	UINT	RW	No	Ms

8.3 Deleting Alarm History

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

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



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

Related Objects

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

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
	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 Auto Gain Tuning

For more information, refer to 8.1 Auto Gain Tuning.

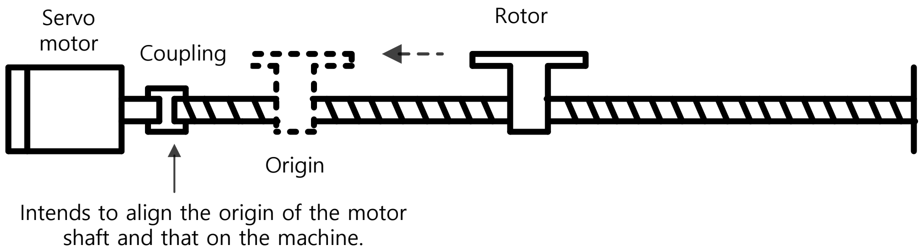
8.5 Index Pulse Search

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

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

Before starting the index pulse search, make sure that:

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



Related Objects

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

8.6 Absolute Encoder Reset

This function resets the absolute encoder. You need to reset the absolute encoder if:

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

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

After turning on the power again, the actual position value (0x6064) is displayed by reading the position of the absolute encoder and applying the home offset (0x607C).
Then, the actual position value (0x6064) will not be changed even if you change the home offset (0x607C) during operation.

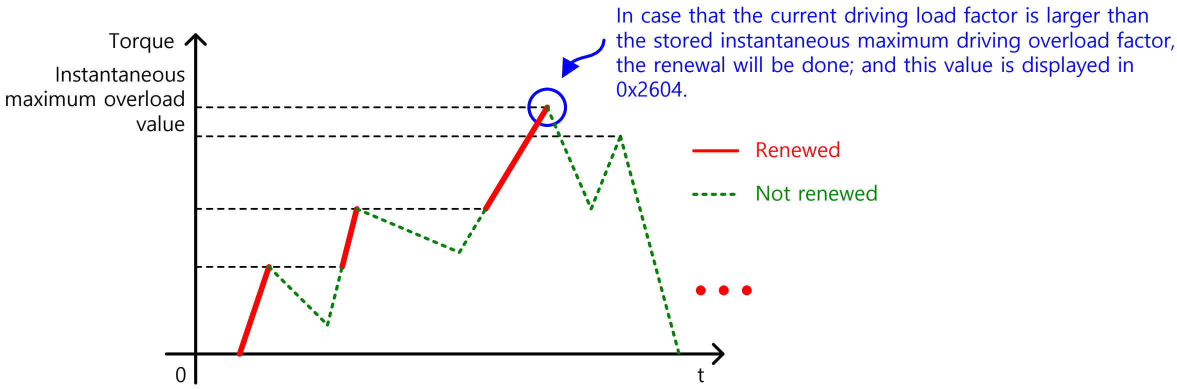
Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2005	-	Absolute Encoder Configuration	UINT	RW	No	-
0x2607		SingleTurn Data	UDINT	RO	Yes	pulse
0x260A		MultiTurn Data	DINT	RO	Yes	Rev

8.7 Instantaneous Maximum Torque Initialization

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

It displays the maximum (peak) load, between the current time and the time when the servo is turned on, as a percentage of the rated output. The unit is [0.1%]. Turning on the power again will reset it to 0.



Related Objects

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

8.8 Calibrate Current Offset

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

Measured U-/V-/W-phase offsets are individually stored in 0x2015, 0x20616, and 0x2017. If an offset is too large, AL-15 will be generated.

Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x2015	-	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 to reset the servo drive by means of software. Software reset means a restart of the drive program, resulting in an effect similar to recycling the power.

You can use this function if:

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

8.10 Commutation

Commutation function for receiving infomation of initial pole position of motor. If motor does not have hole sensor, it is crucial to receive information of initial pole position by commutation in order to operate normally.

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. Object Dictionary

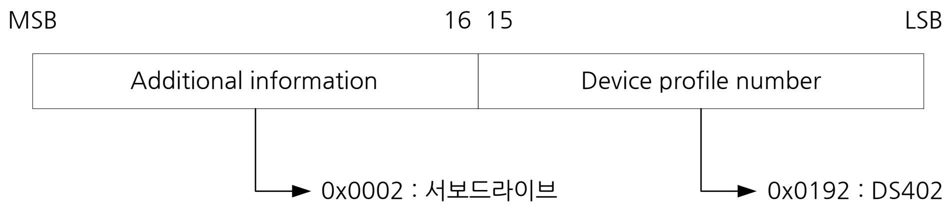
Object is a data structure including parameters, state variables, run commands (procedures), and etc. within a drive.

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

9.1 General Objects

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

The following table lists device types and their functions.



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

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

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

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

Represents the device name.

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

Represents the hardware version of the device.

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

Represents the software version of the device.

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

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

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

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

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

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

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

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

Initialize the drive's parameters. To avoid any mistake, initialize the parameters if the ASCII code value corresponding to 'load' 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 the communication parameters (from 0x1000) are initialized when "load" is written to SubIndex 2.

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

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

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

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

Represents the device information.

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

Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60600008	-	RW	No	PREOP	Yes
SubIndex 5		**Mapping entry 5**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 6		**Mapping entry 6**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		**Mapping entry 7**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		**Mapping entry 8**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		**Mapping entry 9**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		**Mapping entry 10**					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

PDO Mapping:

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

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

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

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

Bits 8-15: SubIndex of objects to be mapped

Bits 16-31: Index of objects to be mapped

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

SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600

0x1602	3rd Receive PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60FF0020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage

UINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600

0x1603	4th Receive PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	0 to 10	4	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60710010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60B80010	-	RW	No	PREOP	Yes

SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60FE0120	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600

0x1A00	1st Transmit PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	0 to 10	10	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60400010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60770010	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					

Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60F40020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60610008	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x26010010	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x26000010	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes

Refer to the description of 0x1600

0x1A01	2nd Transmit PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	0 to 10	2	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage

UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600

0x1A02	3rd Transmit PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes

SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600

0x1A03	4th Transmit PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					

Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60410010	-	RW	No	PREOP	Yes
SubIndex 2		Mapping entry 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60640020	-	RW	No	PREOP	Yes
SubIndex 3		Mapping entry 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60B90010	-	RW	No	PREOP	Yes
SubIndex 4		Mapping entry 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFFFFFF	0x60BA0020	-	RW	No	PREOP	Yes
SubIndex 5		Mapping entry 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0x60FD0020	-	RW	No	PREOP	Yes
SubIndex 6		Mapping entry 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 7		Mapping entry 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 8		Mapping entry 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 9		Mapping entry 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes
SubIndex 10		Mapping entry 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	-	-	RW	No	PREOP	Yes

Refer to the description of 0x1600.

0x1C00	Sync Manager Communication Type						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage

USINT	-	4	-	RO	No	-	No
SubIndex 1		Communication Type SM0					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	1	-	RO	No	-	No
SubIndex 2		Communication Type SM1					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 3		Communication Type SM2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	3	-	RO	No	-	No
SubIndex 4		Communication Type SM3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	4	-	RO	No	-	No

It represents the Sync Manager Communication Type assigned by default.

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

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

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

0x1C13	Sync Manager 3 PDO Assignment						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	1	-	RO	No	-	No

SubIndex 1		Index of object assigned to PDO					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0x1A00 to 0x1A03	0x1A01	-	RW	No	PREOP	No

0x1C32	Output Sync Manager Parameter						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					

Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
BOOL	-	0	-	RO	No	-	No

0x1C33	Input Sync Manager Parameter						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	32	-	RO	No	-	No
SubIndex 1		Sync mode					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	No	-	No
SubIndex 2		Cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	ns	RO	No	-	No
SubIndex 3		Shift time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 4		Sync modes supported					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	0x4007	-	RO	No	-	No
SubIndex 5		Minimum cycle time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	250000	ns	RO	No	-	No
SubIndex 6		Calc and copy time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 9		Delay time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 10		Sync0 time					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	ns	RO	No	-	No
SubIndex 12		SM event missed counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage

UDINT	-	0	-	RO	No	-	No
SubIndex 13		Shift too short counter					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0	-	RO	No	-	No
SubIndex 32		Sync error					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
BOOL	-	0	-	RO	No	-	No

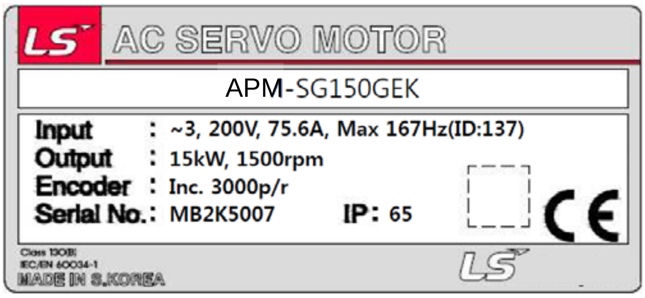
9.2 Manufacturer Specific Objects

Basic Setting (from 0x2000~)

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

Set the motor ID. Drive will set motor ID automatically if encoder is the serial encoder from LS ELECTRIC. Possible to check motor ID on the motor label.

e.g) Motor ID is 137 on motor label as below.



0x2001	Encoder Type						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 99	2	-	RW	2	Power recycling	Yes

Set the Encoder type connected to the Drive. Set properly according to chart. However, the encoder type of serial encoder from LS ELECTRIC will be automatically set regardless the chart below. You can check encoder type which is set automatically.

Setting values	Encoder type
0	Quadrature (incremental, A lead B)
1	Quadrature (incremental, B lead A)
2	BiSS Serial (single-turn only)
3	BiSS Serial Absolute (multi-turn 12-bit)
4	BiSS Serial Absolute (multi-turn 16-bit)
5~6	BiSS Serial Absolute (multi-turn 20-bit)
7	BiSS Serial Absolute (multi-turn 24-bit)
8	Analog Hall
9	Sinusoidal to BiSS
10	Reserved

Setting values	Encoder type
11	Tamagawa Serial (single-turn only)
12	Tamagawa Serial Absolute (multi-turn 16-bit)
13	EnDat 2.2

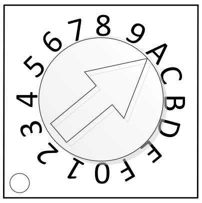
0x2002	Encoder Pulse per Revolution						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 1073741824	524288	pulse	RO	No	Power recycling	Yes

Shows the encoder resolution in the unit of pulse (count) based on a multiple of 4.

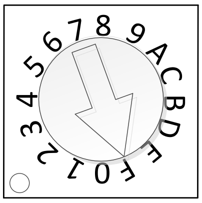
0x2003	Node ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	-	-	RO	No	-	No

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

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



ADDR

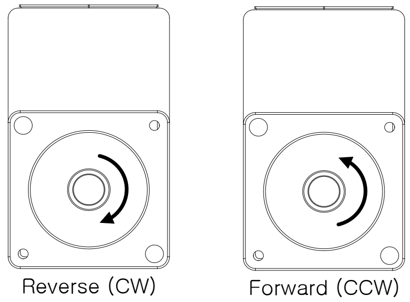


ADDR

0x2004	Rotation Direction Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Servo off	Yes

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

Setting values	Details
0	With a forward command, the motor rotates counterclockwise. Then, the position feedback value increases.
1	With a reverse command, the motor rotates clockwise. Then, the position feedback value increases.



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

Set the usage of the absolute encoder.

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

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

Set method of input mode of main power and missing phase.

Bit	Function	Vaule	Details
3~0	Setting of main power	0	Input single phase.
		1	Input 3 phases.
		2	Input DC Power
7~4	Processing method of missing phase of main power	0	AL-24 when missing phase of main power.
		1	Warning(W-01) when missing phase of main power.

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

Set the checking time of missing phase of main power. Check the possibility of voltage drop for short time and voltage sag by setting the checking time. Set the time properly according to state of external power input.

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

Set the state which will be displayed on 7SEG.

Setting value	Display	Unit	Details
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 overload rate	0.1%	
6	DC Link voltage	V	
7	Accumulated regenerative overload rate	0.1%	
8	Physical angle	0.1deg	
9	Electric angle	0.1deg	
10	Multi turn data	rev.	
11	Drive temp. 1	°C	Temperature of near drive power component.
12	Drive temp. 2	°C	Temperature of internal drive.
13	Encoder temp. 1	°C	Temperature of internal encoder.
14	Node ID	-	

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

Select the internal or external regenerative resistor.

Setting value	Details
0	Use internal regenerative resistor.
1	Use external regenerative resistor. Set value(0x200B) and capacity(0x200C) of resistor properly. Refer to 2.4 Power supply wiring for wiring of external regenerative resistor.

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

Set derating factor when checking regenerative resistor overload. If value of Derating is less than 100[%], regenerative overload alarm(AL-23) will be occurred early and if value of derating is more than 100[%], regenerative overload alarm(AL-23) will be occurred slowly. Set the values differently according to condition of radiation of heat. If value of derating is more than 100[%], it is crucial to concern the radiation of heat.

0x200B	Regeneration Brake Resistor Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	0	ohm	RW	No	Always	Yes

To use external regenerative brake resistor (0x2009=1), set the value of external regenerative brake resistor in ohm unit. When using internal regenerative brake resistor (0x2009= 0) in the drive, the setting value is not applicable

0x200C	Regeneration Brake Resistor Power						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 30000	0	watt	RW	No	Always	Yes

To use external regenerative brake resistor (0x2009=1), set the capacity of external regenerative brake resistor in watt unit. When using internal regenerative brake resistor (0x2009= 0) in the drive, the setting value is not applicable

0x200D	Peak Power of Regeneration Brake Resistor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 50000	100	watt	RW	No	Always	Yes

To use external regenerative brake resistor (0x2009=1), set the peak power of external regenerative brake resistor in watt unit. When using internal regenerative brake resistor (0x2009= 0) in the drive, the setting value is not applicable

0x200E	Duration Time @ Peak Power of Regeneration Brake Resistor						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 50000	5000	ms	RW	No	Always	Yes

To use external regenerative brake resistor (0x2009=1), set the duration time in peak power of external regenerative brake resistor in watt unit. When using internal regenerative brake resistor (0x2009= 0) in the drive, the setting value is not applicable

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

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

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

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

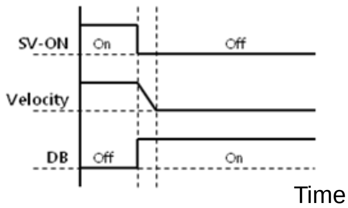
0x2011	PWM Off Delay Time						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	10	ms	RW	No	Always	Yes

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

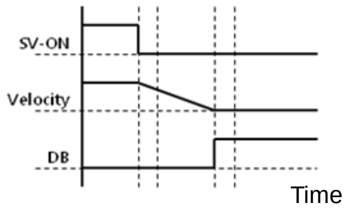
0x2012	Dynamic Brake Control Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Storage
UINT	0 to 3	0	-	RW	No	Always	Yes

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

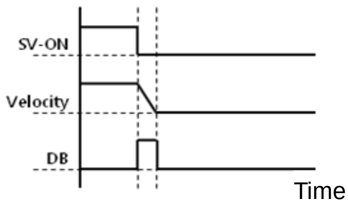
Setting values	**Details**
0	Hold the dynamic brake after stopping the motor using the brake
1	Release the dynamic brake after stopping the motor using the brake
2	Release the dynamic brake after free-run stop
3	Hold the dynamic brake after free-run stop



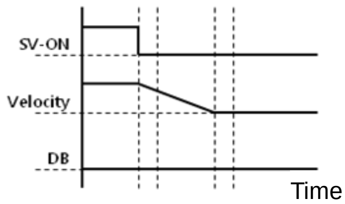
Hold after a DB stop



Hold after a free run stop



Release after a DB stop



Release after a free run stop

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

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

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

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

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

Bit	Warning Code	Warning Name
0	W01	Main power phase loss
1	W02	Low voltage of encoder battery
2	W04	Software position limit
3	-	-
4	W10	Operation overload
5	W20	Abnormal combination of drive and motor, I/O Configuration
6	W40	Low voltage
7	W80	Emergency signal input
8~14	-	-
15	STO	When STO is not connected, Statusword fault bit set

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

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

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

Manually set the V phase current offset. The configured offset value is subtracted from the measured current value, and then applied as an actual current value. Do not manually set the offset if you do not know the exact setting value. You can check the automatically-tuned value if you tune the current offset with the procedure function (refer to the description of 02.2x2700).

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

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

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

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

Set Magnetic pole pitch of Linear motor. Pole pitch is the distance between N pole and N pole or between S pole and S pole that is electric pole 360 degree.

0x2019	Linear Scale Resolution						ALL
Variabl e type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Stora ge
UINT	1 to 65535	1000	nm	RW	No	Power recycling	Yes

Set linear scale resolution in nm unit. In the case of the linear scale that is 1um resolution, set 1000(=1um/1nm)

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

Set the method of commutation to know initial pole position of Motor

Seting value	Details
0	No need extra commutation or commutation is implemented by hole sensor
1	At the time of first SERVO ON, commutation is implemented
2	Reserved

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

Set Commutation current to get information for first angle of motor

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

Set Commutation time to get information for first angle of motor

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

Set grid of sinusoidal encoder

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

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

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

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

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

Seting value	Details
0	MT Method + Speed Observer
1	MT Method
2	M Method

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

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

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

Gain Adjustment (from 0x2100)

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

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

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

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

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

This specifies the whole responsiveness of the position controller. The larger the setting is configured, the higher the responsiveness is. Too large setting value may cause vibration depending on the load.

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

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

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

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

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

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

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

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

0x2106	Speed Loop Gain 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 2000	50	Hz	R/W	Yes	Always	Yes

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

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

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

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

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

0x2109	Position Command Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	0	0.1 ms	R/W	Yes	Always	Yes

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

0x210A	Position Command Average Filter Time Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	0	0.1 ms	RW	Yes	Always	Yes

This applies a moving average filter for position command to smoothen the position command.

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

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

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

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

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

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

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

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

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

This applies low pass filter to the compensated amount added to the torque command by the torque feedforward gain.

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

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

Setting values	Details
0	Limits the torque using positive/negative torque limit value according to the driving direction; the maximum value is limited by the maximum torque (0x6072). ▪ Forward: 0x60E0, Reverse: 0x60E1
1	Limits the torque only by the maximum torque (0x6072) regardless of the driving direction.
2	Limits the torque using external positive/negative torque limit value according to the driving direction. ▪ Forward: 0x2111, Reverse: 0x2112
3	Limits the torque using internal and external torque limit value according to the driving direction and the torque limit signal. ▪ Forward: 0x60E0 (if the P_CL signal is not input) or 0x2111 (if the P_CL signal is input) ▪ Reverse: 0x60E1 (if the N_CL signal is not input) or 0x2112 (if the N_CL signal is input)
4	Limits the torque using torque limit value according to analog input - Refer to Analog Torque Limit Scale (0x221C) and Analog Torque Limit Offset (0x221D)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

0x2119	Gain Switching Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 7	0	-	RW	Yes	Always	Yes

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

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

Setting values	**Setting details**
0	Only the gain group 1 is used.
1	Only the gain group 2 is used.
2	Gain is switched according to the GAIN2 input status. ▪ 0: Use the gain group 1. ▪ 1: Use the gain group 2.
3	Reserved

Setting values	Setting details
4	Reserved
5	Reserved
6	Gain is switched according to the ZSPD output status. ▪ 0: Use the gain group 1. ▪ 1: Use the gain group 2.
7	Gain is switched according to the INPOS1 output status. ▪ 0: Use the gain group 1. ▪ 1: Use the gain group 2.

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

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

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

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

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

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

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

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

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

The output of the position controller becomes 0 at the positional error less than the setting during position control.

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

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

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

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

0x2120	Drive Status Output 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to FFFFhex	0	-	RO	Yes	-	No

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

Bit	Setting details
0	BRAKE

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

0x2121	Drive Control Input 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to FFFFhex	0	-	RW	Yes	Always	No

Bit	Setting details
15-0	Reserved

0x2122	Drive Status Output 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to FFFFhex	0	-	RO	Yes	-	No

Bit	Setting details
15-0	Reserved

I/O Configuration (from 0x2200)

0x2200	Digital Input Signal 1 Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0001	-	RW	No	Always	Yes

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

Setting example) If the setting value is 0x006:

0	0	0	6
Contact A		GAIN2 assigned	

Setting values	Assigned signal
0x00	Not assigned
0x01	POT
0x02	NOT
0x03	HOME
0x04	STOP
0x05	PCON
0x06	GAIN2
0x07	P_CL
0x08	N_CL
0x09	PROBE1
0x0A	PROBE2
0x0B	EMG
0x0C	A_RST

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

0x2201	Digital Input Signal 2 Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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 Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
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	Change attribute	Storage
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	Change attribute	Storage
UINT	0 to 0xFFFF	0x0006	-	RW	No	Always	Yes

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

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

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

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

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

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

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

Setting example) If the setting value is 0x8001:

8	0	0	1
Contact B		Brake assigned	

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

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

0x2211	Digital Output Signal 2 Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x8002	-	RW	No	Alwaysrecycling	Yes

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

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

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

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

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

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

When torque limit function (0x2110) is set as 4(Analog torque limit), torque is limited according to analog torque limit. At that time, set analog torque limit scale

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

Set analog voltage offset according to analog torque limit

0x221E	Analog Velocity Override Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Servo off	Yes

Set velocity override function by analog voltage

Setting value	Details
0	Not use Analog velocity override
1	Using Analog velocity override

0x221F	Analog Velocity Override Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-1000 to 1000	0	mV	RW	No	Servo off	Yes

Set analog voltage offset according to analog speed override

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

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

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

0x2221	Analog Monitor Channel 1 Setting						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 100	0	-	RW	No	Always	Yes

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

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

Setting values	Displayed item	Unit
6	Accumulated operation overload rate	%
7	DC link voltage	V
8	Accumulated regenerative overload rate	%
9	Encoder single-turn data	pulse
10	Inertia ratio	%
11	Full-Closed positional error	UU
12	Drive temperature 1	°C
13	Drive temperature 2	°C
14	Encoder temperature 1	°C

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

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

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

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

0x2224	Analog Monitor Channel 2 Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	0	-	RW	No	Always	Yes

Subtract the value configured for the offset from the monitoring variable configured as the analog monitor output channel 2 to determine the final output. The unit will be that of the variable configured in the Analog Monitor Channel 2 Setting (0x2221).

0x2225	Analog Monitor Channel 1 Scale						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0x40000000	500	-	RW	No	Always	Yes

When outputting the monitoring variable configured as the analog monitor output channel 1, this function will set the scaling of the variable to be output per 1 V. The unit will be that of the variable configured in the Analog Monitor Channel 1 Setting (0x2221) per 1 V.

For example, if you set the speed feedback to the channel 1 and the scale to 500, up to +/-5000 rpm can be output as +/-10 V.

0x2226	Analog Monitor Channel 2 Scale						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0x40000000	500	-	RW	No	Always	Yes

When outputting the monitoring variable configured as the analog monitor output channel 2, this function will set the scaling of the variable to be output per 1 V. The unit will be that of the variable configured in the Analog Monitor Channel 2 Setting (0x2222) per 1 V.

Velocity Control (from 0x2300)

0x2300	Jog Operation Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-6000 to 6000	500	rpm,	RW	No	Always	Yes

This specifies the jog operation speed.

0x2301	Speed Command Acceleration Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	200	ms	RW	No	Always	Yes

Specifies the time required, in ms, for the motor to reach the rated motor speed from zero speed.

0x2302	Speed Command Deceleration Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	200	ms	RW	No	Always	Yes

This specifies the time, in ms, required for the motor to decelerate from the rated motor speed to the stop.

0x2303	Speed Command S-curve Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	0	ms	RW	No	Always	Yes

You can configure the speed command in an S-curve pattern for smooth acceleration/deceleration. If it is set to 0, the drive will be operated in a trapezoidal pattern by default.

0x2304	Programmed Jog Operation Speed 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-6000 to 6000	0	rpm	RW	No	Always	Yes

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

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

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

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

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

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

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

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

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

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

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

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

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

0x230B	Programmed Jog Operation Time 4						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	5000	ms	RW	No	Always	Yes

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

0x230C	Index Pulse Search Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-1000 to 1000	20	rpm	RW	No	Always	Yes

This specifies the speed for index pulse search.

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

This specifies the speed limit function for torque control.

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

0x230E	Speed Limit Value at Torque Control Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 6000	1000	rpm	RW	Yes	Always	Yes

This specifies the speed limit value for torque control. This setting is applied only when the Speed Limit Function Setting (0x230D) is set to 0.

0x230F	Over Speed Detection Level						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	6000	rpm	RW	No	Always	Yes

This specifies the level to detect overspeed alarm (AL-50). If the setting is larger than the maximum motor speed, the detection level will be set by the maximum motor speed.

0x2310	Excessive Speed Error Detection Level						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 10000	5000	rpm	RW	No	Always	Yes

This specifies the level to detect excessive speed error alarm (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 Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1	0	-	RW	No	Always	Yes

This specifies the servo-lock function to fix the motor position with a position value when the speed command is input as 0 for speed control.

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

Miscellaneous Setting (from 0x2400)

0x2400	Software Position Limit Function Setting						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 3	0	-	RW	No	Always	Yes

This specifies the software position limit function for position control. When using the position limit function, the upper and the lower limit values will be limited to the values configured in (0x607D:02) and (0x607D:01), respectively. The software position limit function will not be activated prior to the homing operation. In addition, when the upper limit value is less than the lower limit value, this function will not be activated.

Setting values	Setting details
0	None of positive and negative software position limits are used.
1	Only positive software position limit value is used. It is not limited for the reverse direction.
2	Only negative software position limit value is used. It is not limited for the forward direction.
3	Both of the positive and the negative software position limits are used.

0x2401	INPOS1 Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

With the position command not newly updated, if the positional error is retained within the INPOS1 output range for the INPOS1 output time, the INPOS1 signal is output.

0x2402	INPOS1 Output Time						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	0	ms	RW	Yes	Always	Yes

Refer to the description of 0x2401.

0x2403	INPOS2 Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 60000	100	UU	RW	Yes	Always	Yes

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

0x2404	ZSPD Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 6000	10	rpm	RW	Yes	Always	Yes

When the current speed is less than the setting value, the ZSPD signal is output.

0x2405	TGON Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

When the current speed is more than the setting value, the TGON signal is output.

0x2406	INSPD Output Range						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 6000	100	rpm	RW	Yes	Always	Yes

When the speed error is less than the setting value, the INSPD signal is output.

0x2407	BRAKE Output Speed						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 6000	100	rpm	RW	No	Always	Yes

If the motor stops due to servo OFF or servo alarm during rotation, you can set the speed (0x2407) and delay time (0x2408) for brake signal output, in order to configure the output timing. The brake signal will be output if the motor rotation speed goes below the set speed (0x2407) or the output delay time (0x2408) has elapsed after the servo OFF command.

0x2408	BRAKE Output Delay Time						P
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	100	ms	RW	No	Always	Yes

Refer to the description of 0x2407.

0x2409	Torque Limit at Homing Using Stopper						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 2000	250	0.1%	RW	No	Always	Yes

This specifies the torque limit value for homing using a stopper. With too large of a value configured, the machine may collide with the stopper. So be careful.

0x240A	Duration Time at Homing Using Stopper						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	50	ms	RW	No	Always	Yes

This specifies the time to detect the stopper for homing using a stopper. Set an appropriate value, depending on the machine.

0x240B	Modulo Mode						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 3	0	-	RW	No	Power recycling	Yes

Sets whether the Modulo fuction is used or not.

Setting value	Contents
0	Not using the Modulo function.
1	Forward move by using Modulo fuction.
2	Reverse move by using Modulo function.
3	Shortest move by using Modulo function.
4	Absolute position move by using Modulo function
5	Incremental position move by using Modulo function

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

Sets the Factor when Modulo function is used.

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

User can make the name of Drive and use. (Maximum 16 characters)

0x240E	Individual Parameter Save						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 1	0	-	RW	No	Always	No

Set whether to save the parameter individually or not. This parameter is not saving individually, and resets to 0 when the power is on.

Setting value	Contents
0	Does not save the parameter individually. To save the parameter, refer to 'Parameter Save(0x1010).
1	Save the parameter individually. Saves directly to the memory when parameter is used.

Enhanced Control (from 0x2500)

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

This specifies the adaptive filter function.

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

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

This specifies the frequency of the notch filter 1.

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

This specifies the width of the notch filter 1.

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

This specifies the depth of the notch filter 1.

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

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

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

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

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

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

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

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

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

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

This specifies the On-line Gain Tuning Mode.

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

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

This specifies the system rigidity applied for gain tuning. After the gain tuning according to the setting, the overall gain will be set higher or lower. If the gain of the maximum setting value is not enough, carry out the tuning manually. After the gain tuning, the following gains will be automatically changed:

Inertia ratio (0x2100), position loop gain 1 (0x2001), speed loop gain 1 (0x2102), speed integral time constant 1 (0x2103), torque command filter time constant 1 (0x2104), notch filter 3 frequency (0x2507, TBD), and notch filter 4 frequency (0x250A, TBD).

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

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

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

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

Setting values	Setting details
0	Drive in the forward direction
1	Drive in the reverse direction

0x2511	Off-line Gain Tuning Distance						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 10	5	-	RW	No	Servo off	Yes

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

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

Reserved

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

Reserved

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

This specifies the current controller gain. Lowering the setting value will reduce the noise, but the drive's responsiveness decreases as well.

Monitoring (from 0x2600)

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

This represents the current rotation speed of the motor.

0x2601	Command Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	rpm	RO	Yes	-	No

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

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

This represents the positional error of position control.

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

This represents the accumulated operation overload rate. When the value of the accumulated operation overload rate reaches the overload warning level setting (0x2010), the operation overload warning (W10) will occur; when it reaches 100%, the operation overload alarm (AL-21) will occur.

0x2604	Instantaneous Maximum Operation Overload						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	0.1%	RO	Yes	-	No

This represents the maximum value of the operation overload rate output instantaneously from the drive. This value can be initialized by the initialization of the instantaneous maximum operation overload.

0x2605	DC-Link Voltage						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	Volt	RO	Yes	-	No

This represents the DC link voltage by the main power input.

0x2606	Accumulated Regeneration Overload						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	0.1%	RO	No	-	No

This represents accumulated regeneration overload. When the value of accumulated regeneration overload is reached at 100%, Regen. Overload alarm (AL-23) occurs.

0x2607	SingleTurn Data						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	pulse	RO	Yes	-	No

This represents the single-turn data of the motor. Values ranging from 0 to (encoder resolution-1) are displayed.

0x2608	Mechanical Angle						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	0.1 deg	RO	Yes	-	No

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

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

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

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

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

0x260B	Drive Temperature 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	ºC	RO	No	-	No

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

0x260C	Drive Temperature 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	ºC	RO	No	-	No

This represents the temperature measured by the temperature sensor integrated onto the drive control board. If the measured temperature is higher than 90℃, the drive overheat alarm 2 (AL-25) will be generated.

0x260D	Encoder Temperature						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	℃	RO	No	-	No

This represents the temperature measured by the temperature sensor integrated onto Serial Encoder (In the case that the setting values of Encoder type(0x2001) are 3,4,5,6). If the measured temperature is higher than 90℃, the encoder overheat alarm (AL-26) will be generated.

0x260E	Motor Rated Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	rpm	RO	No	-	No

This represents the rated speed of the driving motor.

0x260F	Motor Maximum Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	rpm	RO	No	-	No

This represents the maximum speed of the driving motor.

0x2610	Drive Rated Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	0.1 A	RO	No	-	No

This represents the rated current of the drive.

0x2611	FPGA Version						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	No	-	No

This represents FPGA version of the drive

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

This represents hall signal that is attached on encoder (or Motor). It is used to check the state of the connection of hall sensor signal or to compare U/V/W phase with hall signal direction

In the case of Forward movement 5→4→6→2→3→1, these signals are repeated. In the case of reverse, 1→3→2→6→4→5, these signals are repeated.

Bit	Details
0	The hall signal of W phase
1	The hall signal of V phase
2	The hall signal of U phase

0x2613	Bootloader Version						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	No	-	No

This represents the bootloader version of the drive.

0x2614	Warning Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	Yes	-	No

This represents the warning code of the drive.

0x2615	Analog Input Channel 1 Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	mV	RO	No	-	No

This represents voltage by mV unit in Analog input channel 1 Value

Procedure and Alarm History (from 0x2700)

0x2700	Procedure Command Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0	-	RW	No	-	No

You can run various procedures with the following procedure command codes and command arguments. Make sure to enter correct value of command argument prior to entering command code because the drive refers to the command argument at the moment of entering the command code.

Command code	Command argument	Run procedure
Manual Jog (0x0001)	1	Servo on
	2	Servo off
	3	Positive (+) driving (0x2300)
	4	Negative (-) driving (0x2300)
	5	Stop to zero speed
Programmed Jog (0x0002)	1	Start operation after servo on
	2	Servo off after operation ends
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	Stop to zero speed
Absolute Encoder Reset (0x0006)	1	Absolute encoder reset
Instantaneous Maximum Operation Overload Reset (0x0007)	1	Resets instantaneous maximum operation overload (0x2604) value
Phase Current Offset Tuning (0x0008)	1	Phase current offset tuning (The U-/V-/W-phase offsets are stored in 0x2015 - 7, respectively. If the offset is abnormally large, AL-15 will be generated.)
Software Reset (0x0009)	1	Software reset

0x2701	Procedure Command Argument						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to $FFFF_{hex}$	0	-	RW	No	-	No

0x2702	Servo Alarm History						ALL
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	16	-	RO	No	-	No
SubIndex 1		Alarm code 1 (Newest)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 2		Alarm code 2					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 3		Alarm code 3					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 4		Alarm code 4					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 5		Alarm code 5					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 6		Alarm code 6					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 7		Alarm code 7					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 8		Alarm code 8					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 9		Alarm code 9					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 10		Alarm code 10					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 11		Alarm code 11					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage

STRING	-	-	-	RO	No	-	No
SubIndex 12		Alarm code 12					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 13		Alarm code 13					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 14		Alarm code 14					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 15		Alarm code 15					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No
SubIndex 16		Alarm code 16 (Oldest)					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
STRING	-	-	-	RO	No	-	No

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

• Third Party Motor Support(0x2800~)

To operate the motor from third party with our Drive, we provide the parameters as below. To operate motor, need to be input proper parameters. For that case, we do not guarantee for motor characteristic because we do not have a test third party motor with our drive.

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

Set motor type

Setting value	Details
0	Rotary motor
1	Linear motor

0x2801	[Third Party Motor] Number of Poles						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	2 to 1000	8	-	RW	No	Power recycling	Yes

Setting for pole number of motor. In the case of linear motor, Set by 2

0x2802	[Third Party Motor] Rated Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
FP32	-	2.89	Arms	RW	No	Power recycling	Yes

Setting for rated current.

0x2803	[Third Party Motor] Maximum Current						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
FP32	-	8.67	Arms	RW	No	Power recycling	Yes

Setting for maximum current.

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

Setting for rated speed. The unit of linear motor is mm/s.

0x2805	[Third Party Motor] Maximum Speed						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 60000	5000	rpm	RW	No	Power recycling	Yes

Setting for maximum speed of motor. The unit of linear motor is mm/s.

0x2806	[Third Party Motor] Inertia						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
FP32	-	0.321	Kg.m2. 10-4	RW	No	Power recycling	Yes

Setting for inertia of motor. For linear motor, set the weight of mover. Unit is kg.

0x2807	[Third Party Motor] Torque Constant						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
FP32	-	0.46	Nm/A	RW	No	Power recycling	Yes

Setting for torque constant of motor. For linear motor, set Force Constant.The unit is N/A

0x2808	[Third Party Motor] Phase Resistance						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
FP32	-	0.82	ohm	RW	No	Power recycling	Yes

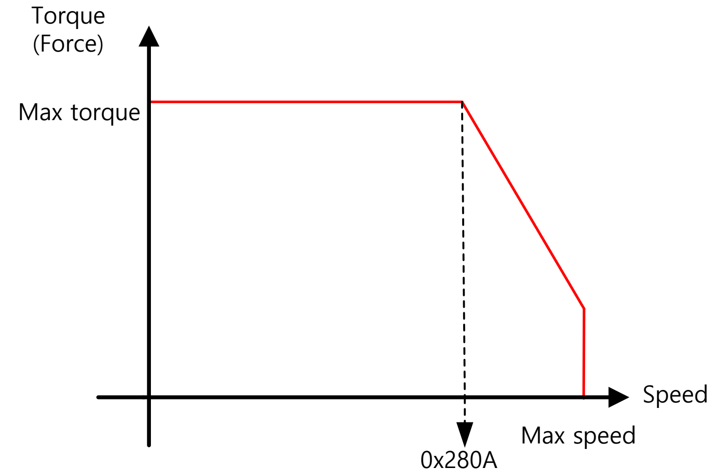
Set phase resistance of motor(=line resistance ÷2)

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

Set phase inductance of motor(=line inductance ÷2)

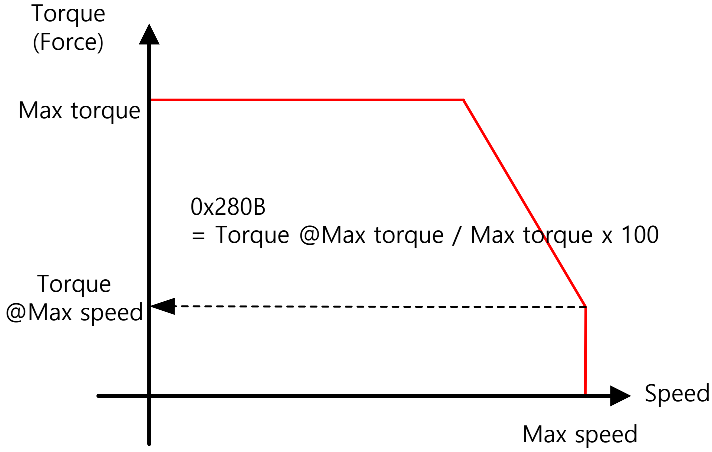
0x280A	[Third Party Motor] TN Curve Data 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 60000	3000	rpm	RW	No	Power recycling	Yes

Set the data of Speed/Torque curve. Max speed is input at output of Max torque (Max trust in the case of linear motor). The unit of linear motor is mm/s



0x280B	[Third Party Motor] TN Curve Data 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
FP32	-	100.0	%	RW	No	Power recycling	Yes

Set the data of Speed/Torque curve. For output torque in max speed, It is input by percentage on the basis of max torque (Max trust in the case of linear motor)



0x280C	[Third Party Motor] Hall Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 360	0	deg	RW	No	Power recycling	Yes

Hall sensor mounted for Initial angle of motor can differ depending on makers

For that case, it is sure to set up after check offset of hall sensor

9.3 CiA402 Objects

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

This displays the most recent alarm/warning code generated by the servo drive.

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

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

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

Details on Bits 0 to 3

- Bits 0 to 3: Drive state control

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

Details on Bits 4 to 9

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

Bit 9	Bit 5	Bit 4	Details
0	0	0 → 1	It proceeds to the next position when the operation at the current position is complete.
–	1	0 → 1	It drives to the next position immediately.
1	0	0 → 1	It drives from the current position to the profile position at the profile speed before it applies the next position.

- Bits 6 and 8: For PP mode operation

Bit	Function	Value	Details
6	Abs/rel	0	This sets the target position to an absolute value.
		1	This sets the target position to a relative value.
8	Halt	0	Runs an operation or continues an operation.
		1	Halts the operation according to the Halt Option code (0x605D).

- Bits 4, 5, 6, 8 and 9: For HM mode operation

Bit	Function	Value	Details
4	Homing start	0	Does not perform the homing operation.
		1	Performs or is performing the homing operation.
5	–	0	-
6	–	0	-
8	Halt	0	Runs the bit 4 command.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

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

Bit	Function	Value	Details
4	–	0	-
5	–	0	-
6	–	0	-
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	-

- Bits 4, 5, 6, 8 and 9: For IP mode operation

Bit	Function	Value	Details
4	Use of Interpolation	0	Interpolation disabled
		1	Interpolation enabled
5	–	0	-
6	–	0	-

Bit	Function	Value	Details
8	Halt	0	Runs the bit 4 command.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

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

Bit	Function	Value	Details
4	–	0	Reserved
5	–	0	Reserved
6	–	0	Reserved
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

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

The Statusword indicates the current state of the drive. It consists of bits that indicate the state according to the drive and operation mode.

Bit	Function	Details
0	Ready to switch on	Refer to the section concerning bits 0 to 7.
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	–	Reserved
9	Remote	Processed as a Controlword (0x6040)
10	Operation mode specific	Refer to the sections concerning bits 10, 12 and 13.
11	Internal limit active	Refer to the section concerning bit 11.
12 to 13	Operation mode specific	Refer to the sections concerning bits 10, 12 and 13.
14	Torque limit active	0: no torque limit active 1: torque limit active
15	–	Reserved

Details on Bits 0 to 7

- Bits 0 to 7: For the current state of the drive

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Drive State
–	0	–	–	0	0	0	0	Not ready to switch on
–	1	–	–	0	0	0	0	Switch on disabled
–	0	1	–	0	0	0	1	Ready to switch on
–	0	1	–	0	0	1	1	Switched on
–	0	1	–	0	1	1	1	Operation enabled
–	0	0	–	0	1	1	1	Quick stop active
–	0	–	–	1	1	1	1	Fault reaction active
–	0	–	–	1	0	0	0	Fault
–	–	–	1	–	–	–	–	Main Power On
1	–	–	–	–	–	–	–	Warning is occurred

Details about Bit 11

- Bit 11: Indicates whether to use an internal limit
  - Use of an internal limit: Both the software position limit and internal limit are applied to the target position.
    - Use N-OT/P-OT contacts
    - Interpolation speed exceeded (used only in the IP or CSP mode)

Details on Bits 10, 12 and 13

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

Bit	State	Value	Details
10	Target reached	0	Halt (0x6040.8) = 0: Failed 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	Positional error	0	No positional error
		1	Positional error

- Bits 10, 12 and 13: For homing mode operation

Bit 13	Bit 12	Bit 10	Details
Homing error	Homing attained	Target reached	
0	0	0	Homing in progress
0	0	1	Homing stopped or not started
0	1	0	Performed homing operation, but the not reach the target
0	1	1	Homing completed
1	0	0	Homing error; speed not equal to 0
1	0	1	Homing error; speed equal to 0

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

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

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

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

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

Bit	State	Value	Details
10	Target reached	0	Halt (0x6040.8) = 0: Unable to reach the target position Halt (0x6040.8) = 1: Deceleration
		1	Halt (0x6040.8) = 0: Reached the target position Halt (0x6040.8) = 1: Speed: 0
12	Speed	0	Not in a zero speed state
		1	In zero a speed state
13	–	0	-

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

Bit	State	Value	Details
10	Target reached	0	Halt (0x6040.8) = 0: Failed 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	–	0	Reserved
13	–	0	Reserved

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

This sets the Quick Stop option code.

Setting values	Details
0	Not used (transits into Switch On Disabled).
1	Slowly decelerates and then stops the drive according to the quick stop deceleration (0x6085) setting (Switch On Disabled).
2	Slowly decelerates and then stops the drive according to the quick stop deceleration (0x6085) setting (Switch On Disabled).
3	Stops using the torque limit value (Switch On Disabled).

0x605B	Shutdown Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Stora ge
INT	0 to 1	0	-	RW	No	Always	Yes

This specifies the operation to shut down the servo drive (Operation Enabled state -> Ready to Switch On state).

Setting values	Details
0	Not used
1	Decelerates to a stop; enters a Switch On Disabled state; enters a Ready state

0x605C	Disable Operation Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Stora ge
INT	0 to 1	1	-	RW	No	Always	Yes

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

Setting values	Details

Setting values	Details
0	Does not use the drive function
1	Decelerates to a stop; moves to the Switch On Disabled state; moves to the Not Ready state

0x605D	Halt Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	0 to 4	0	-	RW	No	Always	Yes

The Halt option code sets the operation method used to move from the Operation Enabled state to the Switched On state.

Setting values	Details
1	Decelerates to a stop; moves to the Operation Enabled state
2	Decelerates to a stop based on the quick stop deceleration time; move to the Operation Enabled state
3	Decelerates to a stop based on the torque limit; moves to the Operation Enabled state

0x605E	Fault Reaction Option Code						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	0	0	-	RW	No	Always	Yes

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

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

0x6060	Modes of Operation						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
SINT	0 to 10	0	-	RW	Yes	Always	No

This sets the servo drive operation mode. The master sets the operation mode when the power is turned on.

This drive provides the following operation modes:

Setting values	Name	Details
0	-	Mode not assigned
1	PP	Profile Position mode
2	-	Reserved
3	PV	Profile Velocity mode
4	PT	Profile Torque mode
6	HM	Homing mode

Setting values	Name	Details
7	IP	Interpolated Position mode
8	CSP	Cyclic Synchronous Position mode
9	CSV	Cyclic Synchronous Velocity mode
10	CST	Cyclic Synchronous Torque mode
Other	-	Reserved

0x6061	Operation Mode Display						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
SINT	-	-	-	RO	Yes	-	No

This displays the operation mode of the current drive.

0x6062	Position Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU	RO	Yes	-	No

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

0x6063	Actual Internal Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	pulse	RO	Yes	-	No

This displays the actual internal position value in encoder pulses.

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

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

0x6065	Positional Error Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0x3FFFFFFF	6000	UU	RW	No	Always	Yes

This specifies the positional error range to check the Positional Error (Statusword, 0x6041.13).

0x6066	Positional Error Time Out						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Stor age
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This specifies the timeout for when checking the Positional Error (Statusword, 0x6041.13).

0x6067	Position Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0x3FFFFFFF	100	UU	RW	No	Always	Yes

This specifies the position window for the target. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x6068	Position Window Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This sets the time it takes to reach the target position. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x606B	Velocity Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU/s	RO	Yes	-	No

This displays the output speed of the position controller or the command speed input to the speed controller.

0x606C	Actual Velocity Value						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Storage
DINT	-	-	UU/s	RO	Yes	-	No

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

0x606D	Velocity Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	200	UU/s	RW	No	Always	Yes

This specifies the velocity window. If the difference between the target speed and the actual speed remains within the velocity window (0x606D) for the velocity window time (0x606E), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x606E	Velocity Window Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This specifies the velocity window time. If the difference between the target speed and the actual speed remains within the velocity window (0x606D) for the velocity window time (0x606E), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x6071	Target Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

This specifies the target torque for the motor in 0.1% increment of the rated torque during torque control.

0x6072	Maximum Torque						ALL
Variable type	Setting range	Initial value	Unit	Accessi bility	PDO assignment	Change attribute	Stora ge
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	Accessi bility	PDO assignment	Change attribute	Stora ge
INT	-	-	0.1%	RO	Yes	-	No

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

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

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

0x607A	Target Position						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	–2147483648 to 2147483647	0	UU	RW	Yes	Always	No

This specifies the target position in Profile Position (PP) mode and Cyclic Synchronous Position (CSP) mode.

It is used as absolute coordinate or relative coordinate depending on the Bit 4 (0x6040.4) setting of the Controlword in the PP mode, and is always used as absolute value in the CSP mode.

0x607C	Home Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	–536870912 to 536870911	0	UU	RW	No	Always	Yes

This sets the offset value for the origin of the absolute encoder or absolute external scale and the zero position of the actual position value (0x6064).

- Incremental Encoder

If it finds the home position or it is at the home position, then the position moved by the home offset value becomes the zero position.

- Absolute Encoder

If the absolute encoder is connected, then the home offset value is added to the absolute position (the actual position value).

0x607D	Software Position Limit						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Min. position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-1073741823 to 1073741823	-2000000000	UU	RW	No	Always	Yes

SubIndex 2		Max. position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-1073741823 to 1073741823	2000000000	UU	RW	No	Always	Yes

This specifies the software position limit value. It limits the range of the position demand value (0x6062) and actual position value (0x6064) and checks the new target positions for the setting value at every cycle.

The minimum software limit value is the reverse rotation limit. The maximum software limit value is the forward rotation limit.

0x607F	Maximum Profile Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	1000	UU/s	RW	Yes	Always	Yes

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

0x6081	Profile Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	2000	UU/s	RW	Yes	Always	Yes

This specifies the profile speed for the PP mode operation.

0x6083	Profile Acceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	2000	UU/s^2	RW	No	Always	Yes

This specifies the profile acceleration for the PP mode operation.

0x6084	Profile Deceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	2000	UU/s^2	RW	No	Always	Yes

This specifies the profile deceleration for the PP mode operation.

0x6085	Quick Stop Deceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	2000	UU/s^2	RW	No	Always	Yes

The system uses quick stop deceleration if the quick stop option code (0x605A) is set to 2.

0x6087	Torque Slope						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	1000	0.1%/s	RW	Yes	Always	Yes

This specifies the torque slope for the PT mode operation.

0x6091	Gear Ratio						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Motor Revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	1	-	RW	No	Power recycling	Yes
SubIndex 2		Shaft Revolutions					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	1	-	RW	No	Power recycling	Yes

For more information, refer to 5.3 Electric Gear Setup.

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

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

Setting values	Details
0	Disabled
1	Homing using the index pulse and reverse limit contact
2	Homing using the index pulse and forward limit contact
7 to 14	Homing using the index pulse and home contact

Setting values	Details
24	Same as method 8 (does not use the index pulse)
28	Same as method 12 (does not use the index pulse)
33, 34	Homing to the index pulse
35	Homing to the current position
-1	Homing using the reverse stopper and index pulse
-2	Homing using the forward stopper and index pulse
-3	Homing using the reverse stopper
-4	Homing using the forward stopper

0x6099	Homing Speeds						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Switch search speed					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	5000	UU/s	RW	No	Always	Yes
SubIndex 2		Zero search speed					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	0 to 0x40000000	1000	UU/s	RW	No	Always	Yes

This specifies the operation speed for homing.

0x609A	Homing Acceleration						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0x40000000	2000	UU/s^2	RW	No	Always	Yes

This specifies the operation acceleration for homing.

0x60B0	Position Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-2147483648 to 2147483647	0	UU	RW	Yes	Always	No

In the CSP mode, this specifies the offset value added to the position command.

0x60B1	Velocity Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

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

In the CSV mode, this specifies the offset value added to the speed command value.

0x60B2	Torque Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-5000 to 5000	0	0.1%	RW	Yes	Always	No

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

In the CST mode, this specifies the offset value added to the torque command value.

0x60B8	Touch Probe Function						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 0xFFFF	0x0033	-	RW	Yes	Always	Yes

This specifies the touch probe function.

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

Bit	Value	Details
11	–	Reserved
12	0	Does not capture the rising edge position value of the touch probe 2.
	1	Captures the rising edge position value of the touch probe 2.
13	0	Does not capture the falling edge position value of the touch probe 2.
	1	Captures the falling edge position value of the touch probe 2.
14 to 15	–	Reserved

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

This displays the status of the touch probe.

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

In continuous trigger mode, you can toggle whether to save all update values for 6, 7, 14 and 15 bits on the rising/falling edge of the touch probe.

To disable bits 1, 2, 9 and 10 (saving the position values on the rising/falling edges of touch probes 1 and 2) of the touch probe state (0x60B9), disable bits 4, 5, 12 and 13 (using sampling on the rising/falling edges of touch probes 1 and 2) of the touch probe function (0x60B8) and enable them.

0x60BA	Touch Probe 1 Rising Edge Position Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU	RO	Yes	-	No

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

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

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

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

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

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

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

0x60E0	Positive Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5000	1000	0.1%	RW	Yes	Always	Yes

This specifies the torque limit value for the forward operation.

0x60E1	Negative Torque Limit Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5000	1000	0.1%	RW	Yes	Always	Yes

This specifies the torque limit value for the reverse operation.

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

This displays the actual value of the positional error for position control.

0x60FC	Position Demand Internal Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	pulse	RO	Yes	-	No

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

0x60FD	Digital Inputs						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	-	-	RO	Yes	-	No

They indicate the status of digital inputs.

Bit	Details
0	NOT (negative limit switch)
1	POT (positive limit switch)
2	HOME (origin sensor input)
3 to 15	Reserved
16	DI #1 (I/O pin 11), 0: Open, 1: Close
17	DI #2 (I/O pin 12), 0: Open, 1: Close
18	DI #3 (I/O pin 7), 0: Open, 1: Close
19	DI #4 (I/O pin 8), 0: Open, 1: Close
20	DI #5 (I/O pin 13), 0: Open, 1: Close
21	DI #6 (I/O pin 14), 0: Open, 1: Close
22	DI #7 (I/O pin 9), 0: Open, 1: Close
23	DI #8 (I/O pin 10), 0: Open, 1: Close
24~30	Reserved
31	STO (Safe Torque Off), 0: Close, 1: Open

0x60FE	Digital Outputs						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Physical outputs					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	No
SubIndex 2		Bit mask					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0xFFFFFFFF	0	-	RW	Yes	Always	Yes

They indicate the status of digital outputs.

- Description of physical outputs

Bit	Details
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, 23: ON) of DO #2 (I/O pins 1 and 24) Provided that the relevant bit mask (0x60FE:02.17) is set to 1.
18	Forced output (0: OFF, 1: ON) of DO #3 (I/O pins 25 and 26) Provided that the relevant bit mask (0x60FE:02.18) is set to 1.
19	Forced output (0: OFF, 1: ON) of DO #4 (I/O pins 1 and 2) Provided that the relevant bit mask (0x60FE:02.19) is set to 1.
20 to 23	Reserved
24	Output status of DO #1 (0: OFF, 1: ON)
25	Output status of DO #2 (0: OFF, 1: ON)
26	Output status of DO #3 (0: OFF, 1: ON)
27	Output status of DO #4 (0: OFF, 1: ON)
28 to 31	Reserved

- Description of bit mask

Bit	Details
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, 23: Enable) of DO #2 (I/O pins 1 and 24)
18	Forced output setting (0: Disable, 1: Enable) of DO #3 (I/O pins 25 and 26)
19	Forced output setting (0: Disable, 1: Enable) of DO #4 (I/O pins 1 and 2)
20 to 31	Reserved

0x60FF	Target Velocity						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	–2147483648 to 2147483647	0	UU/s	RW	Yes	Always	No

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

0x6502	Supported Drive Modes						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	-	0x000003ED	-	RO	No	-	No

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

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

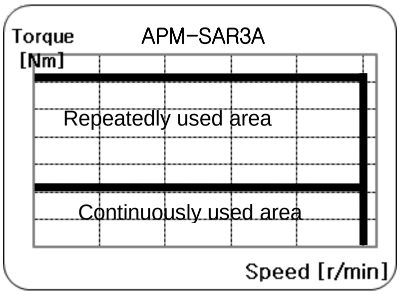
10. Product Specifications

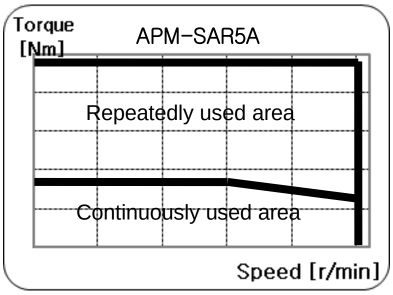
10.1 Servo Motor

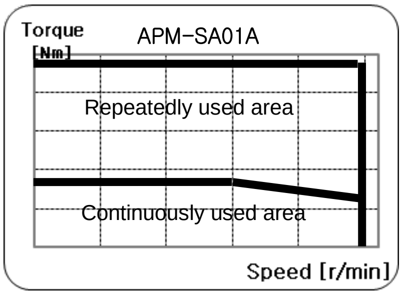
10.1.1 Product Features

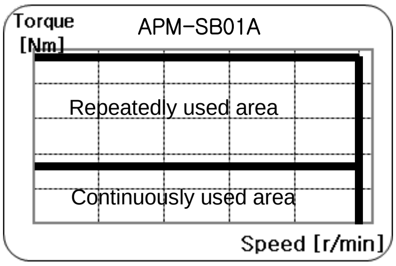
Servo Motor Name (APM-□□□□□)		SAR3A	SAR5A	SA01A	SB01A	SB02A	SB04A
Applicable Drive (L7□A□□)		**L7□A001**			**L7□A002**		**L7□A004**
Rated Output	[kW]	0.03	0.05	0.1	0.1	0.2	0.4
Rated torque	[N·m]	0.095	0.159	0.318	0.318	0.637	1.273
	[kgf·cm]	0.97	1.62	3.25	3.25	6.50	13.0
Instantaneous maximum torque	[N·m]	0.286	0.477	0.955	0.955	1.912	3.822
	[kgf·cm]	2.92	4.87	9.74	9.74	19.5	39.0
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m2x10-4]	0.0164	0.024	0.045	0.114	0.182	0.321
	[gf·cm·s2]	0.0167	0.0245	0.0459	0.116	0.186	0.327
Allowable load inertia		Motor inertia x 30			Motor inertia x 20		
Rated power rate	[kW/s]	5.57	10.55	22.52	8.92	22.26	50.65
Speed and position detector	Standard	Quad. Type Incremental 2048[P/R]			Quad. Type Incremental 2500[P/R]		
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP55 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0~40[°C]					
	Ambient humidity	20~80[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Rotation Speed - Torque Characteristics [m/s2](5G)					
Weight	[kg]	0.32	0.38	0.5	0.82	1.05	1.58

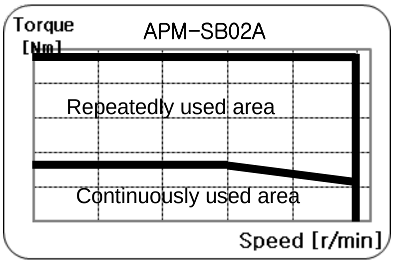
♦ Rotation Speed - Torque Characteristics ♦

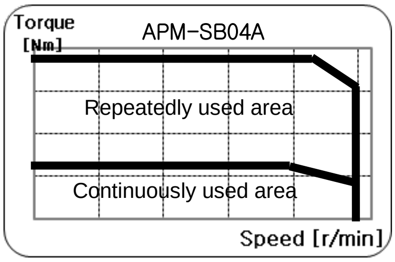








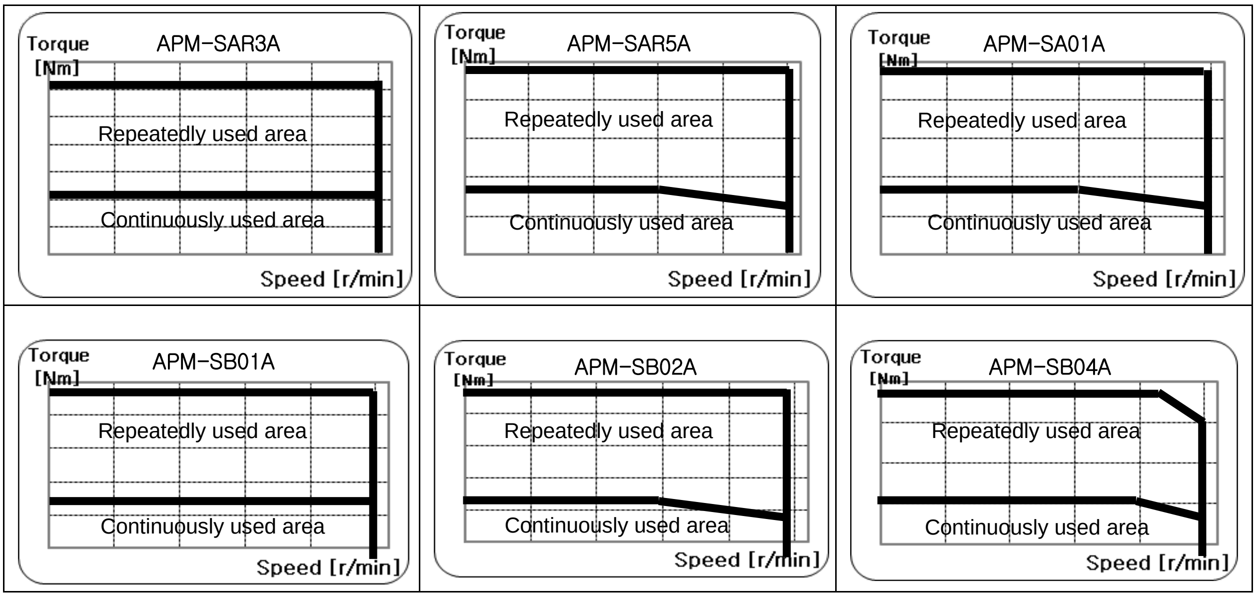




■ Product Features

Servo Motor Name (APM-□□□□□)		SAR3A	SAR5A	SA01A	SB01A	SB02A	SB04A
Applicable Drive (L7□A□□)		**L7□A001**			**L7□A002**		**L7□A004**
Rated Output	[kW]	0.03	0.05	0.1	0.1	0.2	0.4
Rated torque	[N·m]	0.095	0.159	0.318	0.318	0.637	1.273
	[kgf·cm]	0.97	1.62	3.25	3.25	6.50	13.0
Instantaneous maximum torque	[N·m]	0.286	0.477	0.955	0.955	1.912	3.822
	[kgf·cm]	2.92	4.87	9.74	9.74	19.5	39.0
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m2x10-4]	0.0164	0.024	0.045	0.114	0.182	0.321
	[gf·cm·s2]	0.0167	0.0245	0.0459	0.116	0.186	0.327
Allowable load inertia		Motor inertia x 30			Motor inertia x 20		
Rated power rate	[kW/s]	5.57	10.55	22.52	8.92	22.26	50.65
Speed and position detector	Standard	Quad. Type Incremental 2048[P/R]			Quad. Type Incremental 2500[P/R]		
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP55 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0~40[°C]					
	Ambient humidity	20~80[%]RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2](5G)					
Weight	[kg]	0.32	0.38	0.5	0.82	1.05	1.58

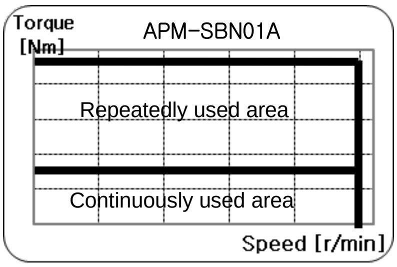
♦ Rotation Speed - Torque Characteristics ♦

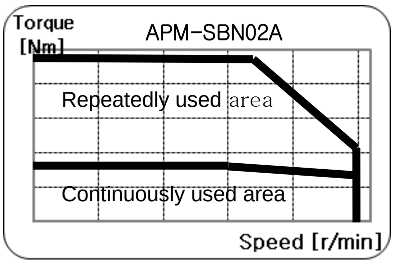


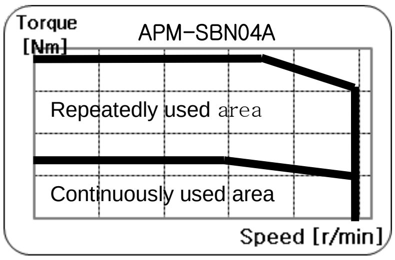
■ Product Features

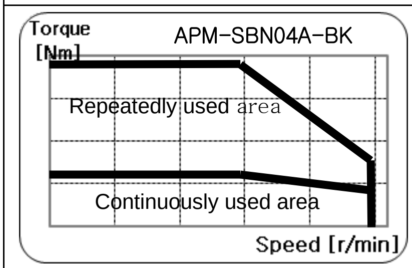
Servo Motor Type (APM-□□□□□)		SBN01A	SBN02A	SBN04A	SBN04A-BK	SC04A	SC06A
Applicable Drive (L7□A□□)		**L7□A002**		**L7□A004**			**L7□A008**
Rated Output	[kW]	0.1	0.2	0.4	0.4	0.4	0.6
Rated torque	[N·m]	0.318	0.637	1.273	1.273	1.273	1.91
	[kgf·cm]	3.25	6.49	12.99	12.99	13.0	19.5
Instantaneous maximum torque	[N·m]	0.955	1.910	3.82	3.82	3.82	5.34
	[kgf·cm]	9.74	19.48	38.96	38.96	39.0	54.5
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m2x10-4]	0.114	0.182	0.322	0.254	0.674	1.092
	[gf·cm·s2]	0.116	0.186	0.328	0.259	0.687	1.114
Allowable load inertia		Motor inertia x 20				Motor inertia x 15	
Rated power rate	[kW/s]	8.91	22.22	50.41	63.84	24.07	33.45
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]			2500[P/R]		
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP55 (excluding axis penetration)				Fully closed·self-cooling IP65 (excluding axis penetration)	
	Time rating	Continuous					
	Ambient temperature	0~40[°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	0.84	1.11	1.63	1.63	1.85	2.52

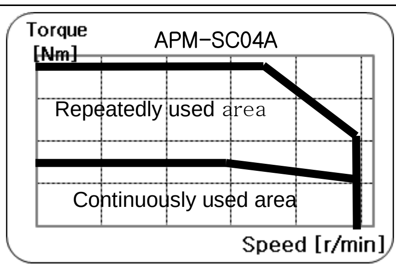
♦ Rotation Speed - Torque Characteristics ♦

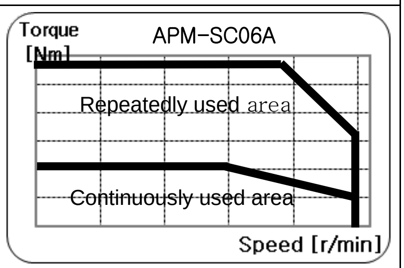








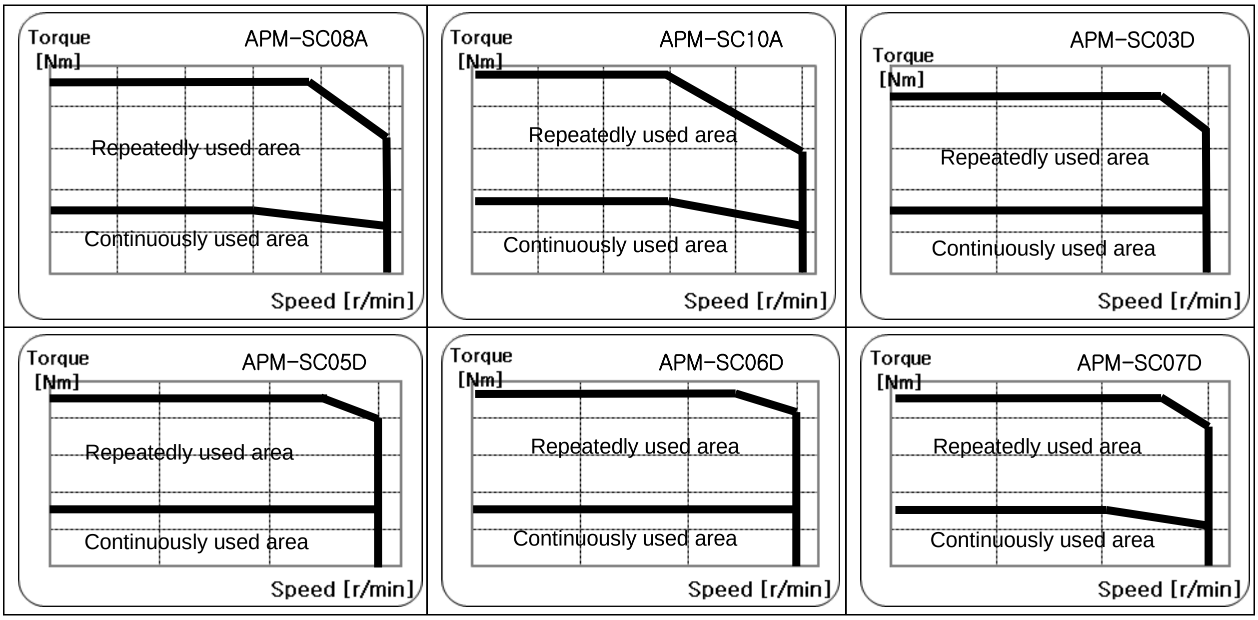




■ Product Features

Servo Motor Type (APM-□□□□□)		SC08A	SC10A	SC03D	SC05D	SC06D	SC07D
Applicable Drive (L7□A□□)		L7□A008	L7□A010	L7□A004	L7□A008	L7□A008	
Rated Output	[kW]	0.8	1.0	0.3	0.45	0.55	0.65
Rated torque	[N·m]	2.55	3.19	1.43	2.15	2.63	3.09
	[kgf·cm]	26.0	32.5	14.6	21.9	26.8	31.6
Instantaneous maximum torque	[N·m]	6.88	9.56	4.29	6.44	7.88	9.29
	[kgf·cm]	70.2	97.5	43.8	65.7	80.4	94.8
Rated rotation speed	[r/min]	3000		2000			
Maximum rotation speed	[r/min]	5000		3000			
Inertia moment	[kg·m2x10-4]	1.509	1.927	0.674	1.092	1.509	1.927
	[gf·cm·s2]	1.539	1.966	0.687	1.114	1.539	1.966
Allowable load inertia		Motor inertia x 15					
Rated power rate	[kW/s]	43.02	52.65	30.44	42.28	45.7	47.98
Speed and position detector	Standard	Quadrature Type Incremental 2500[P/R]				2500[P/R]	
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	3.15	3.80	1.85	2.52	3.18	3.9

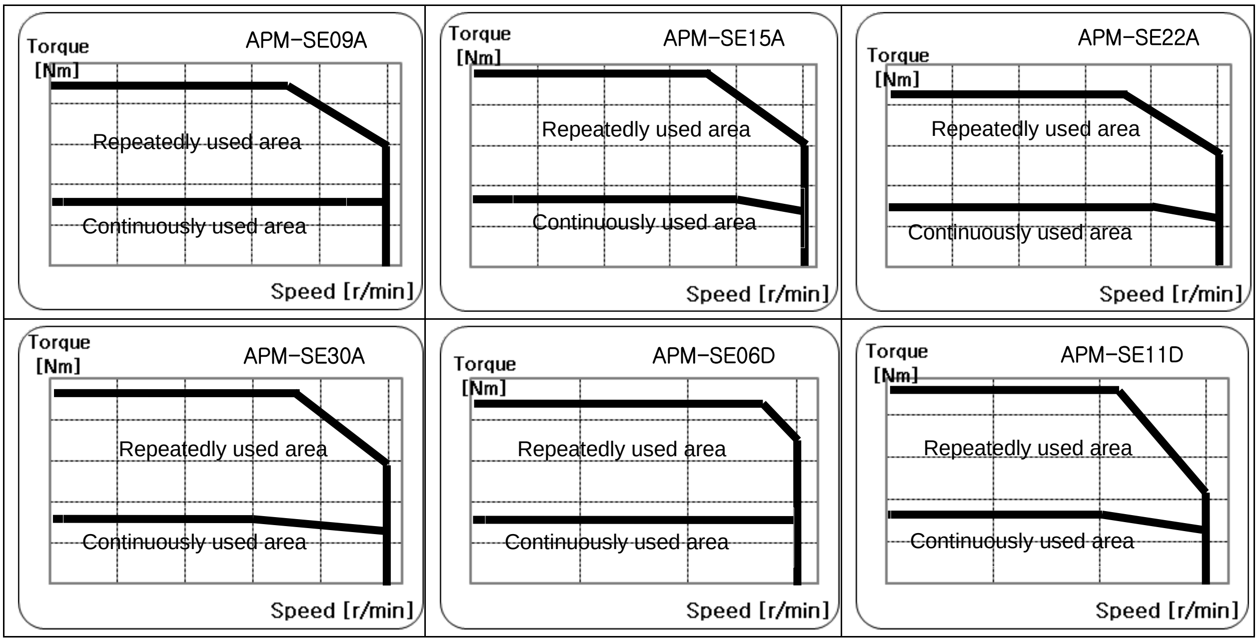
♦ Rotation Speed - Torque Characteristics ♦



■ Product Features

Servo Motor Type (APM-□□□□□)		SE09A	SE15A	SE22A	SE30A	SE06D	SE11D
Applicable Drive (L7□A□□)		**L7□A008**	**L7□A020**		**L7□A035**	**L7□A008**	**L7□A010**
Rated Output	[kW]	0.9	1.5	2.2	3.0	0.6	1.1
Rated torque	[N·m]	2.86	4.77	7.0	9.55	2.86	5.25
	[kgf·cm]	29.2	48.7	71.4	97.4	29.2	53.6
Instantaneous maximum torque	[N·m]	8.59	14.32	21.01	28.65	8.59	15.75
	[kgf·cm]	87.7	146.1	214.3	292.2	87.7	160.7
Rated rotation speed	[r/min]	3000				2000	
Maximum rotation speed	[r/min]	5000				3000	
Inertia moment	[kg·m2x10-4]	6.659	11.999	17.339	22.679	6.659	11.999
	[gf·cm·s2]	6.792	12.238	17.685	23.132	6.792	12.238
Allowable load inertia		Motor inertia X10					
Rated power rate	[kW/s]	12.31	18.98	28.25	40.17	12.31	22.97
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	5.5	7.54	9.68	11.78	5.5	7.54

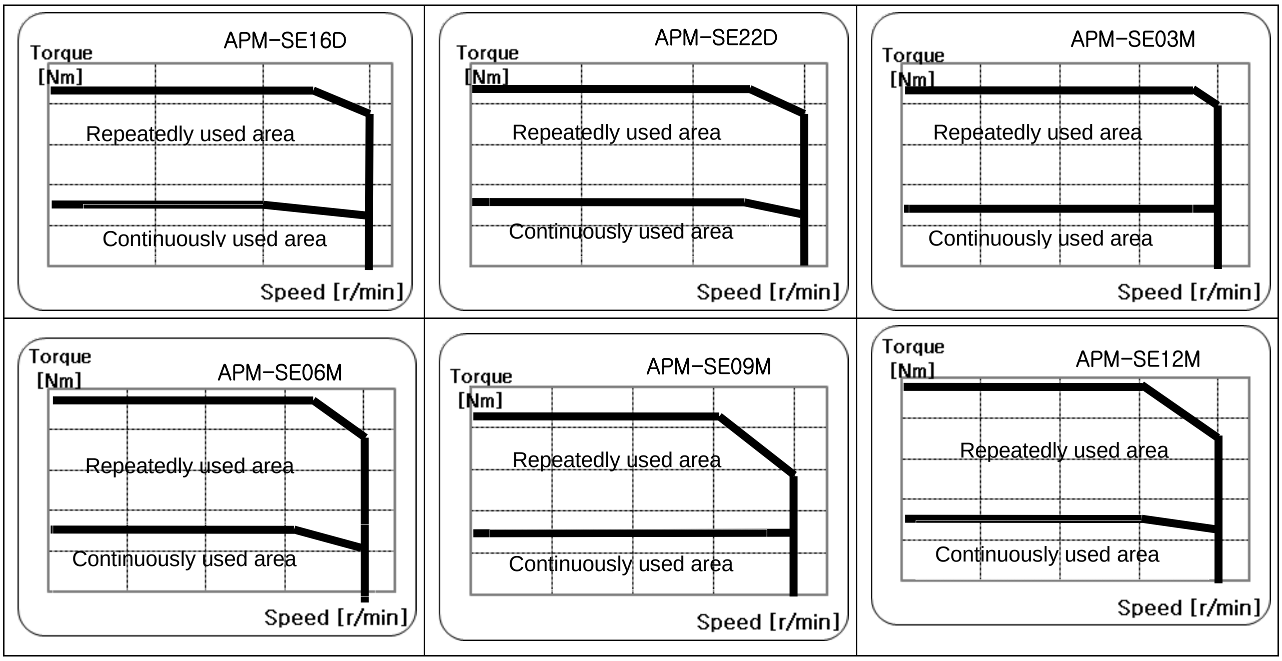
♦ Rotation Speed - Torque Characteristics ♦



■ Product Features

ServoMotorType(APM-□□□□□)		SE16D	SE22D	SE03M	SE06M	SE09M	SE12M
Applicable Drive (L7□A□□)		L7□A020		L7□A004	L7□A008	L7□A010	L7□A020
Rated Output	[kW]	1.6	2.2	0.3	0.6	0.9	1.2
Rated torque	[N·m]	7.63	10.5	2.86	5.72	8.59	11.46
	[kgf·cm]	77.9	107.1	29.2	58.4	87.7	116.9
Instantaneous maximum torque	[N·m]	22.92	31.51	8.59	17.18	25.77	34.22
	[kgf·cm]	233.8	321.4	87.7	175.3	262.9	349.1
Rated rotation speed	[r/min]	2000		1000			
Maximum rotation speed	[r/min]	3000		2000			
Inertia moment	[kg·m2x10-4]	17.339	22.679	6.659	11.999	17.339	22.679
	[gf·cm·s2]	17.685	23.132	6.792	12.238	17.685	23.132
Allowable load inertia		Motor inertia X10					
Rated power rate	[kW/s]	33.63	48.61	12.31	27.34	42.56	57.85
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	9.68	11.78	5.5	7.54	9.68	11.78

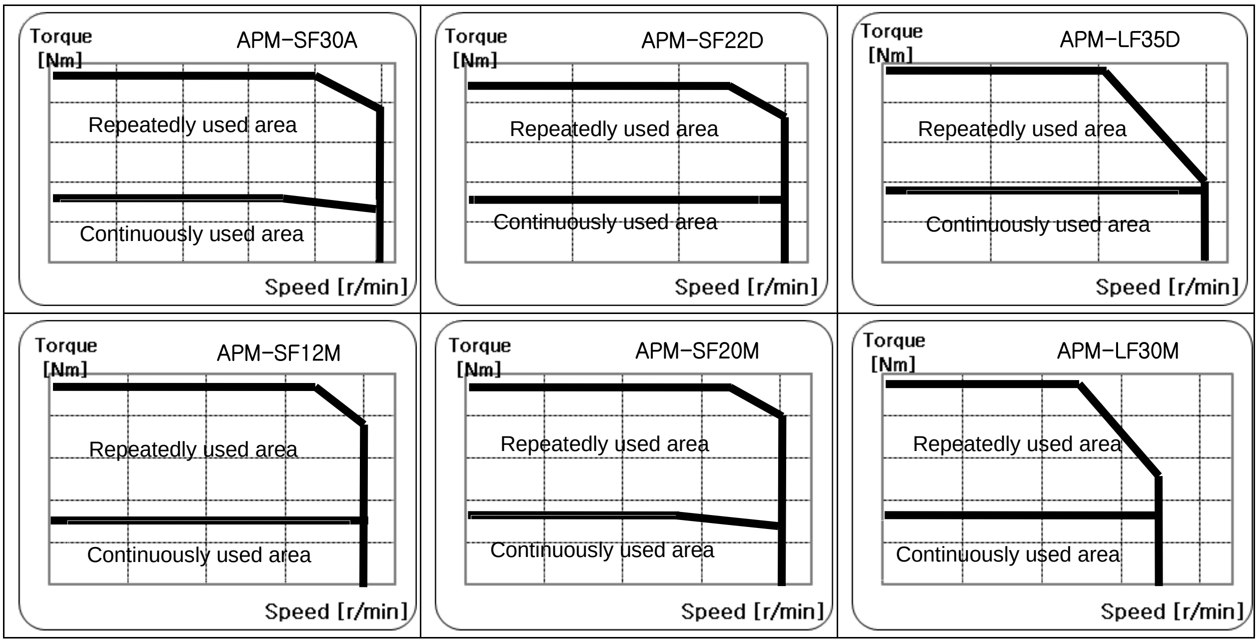
♦ Rotation Speed - Torque Characteristics ♦



■ Product Features

Servo Motor Type(APM-□□□□□)		SF30A	SF22D	LF35D	SF12M	SF20M	LF30M
Applicable Drive (L7□A□□)		L7□A035			L7□A020	L7□A035	
Rated Output	[kW]	3.0	2.2	3.5	1.2	2.0	3.0
Rated torque	[N·m]	9.55	10.5	16.71	11.46	19.09	28.65
	[kgf·cm]	97.4	107.1	170.52	116.9	194.8	292.33
Instantaneous maximum torque	[N·m]	28.64	31.5	50.13	34.38	57.29	85.94
	[kgf·cm]	292.2	321.3	511.57	350.7	584.4	876.98
Rated rotation speed	[r/min]	3000	2000		1000		
Maximum rotation speed	[r/min]	5000	3000		2000		1700
Inertia moment	[kg·m2x10-4]	30.74	30.74	52.13	30.74	52.13	83.60
	[gf·cm·s2]	31.35	31.35	53.16	31.35	53.16	85.24
Allowable load inertia		Motor inertia X 5					
Rated power rate	[kW/s]	29.66	35.88	53.56	42.70	69.96	98.16
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	12.4	12.4	17.7	12.4	17.7	26.3

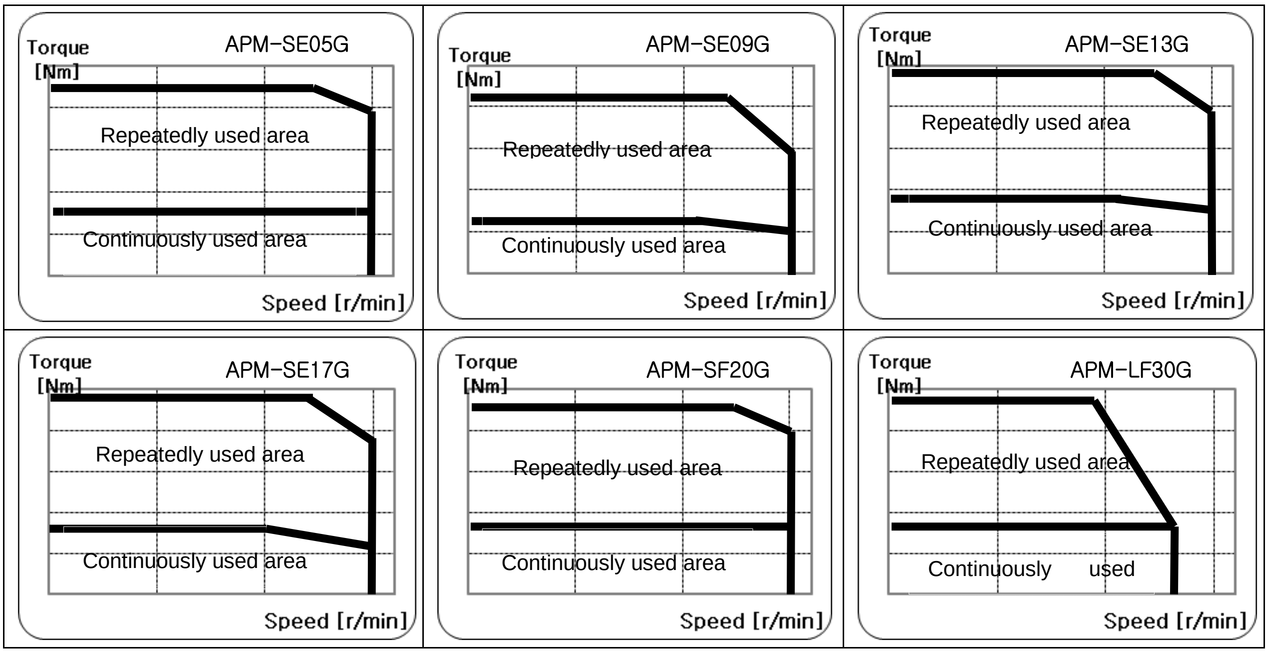
♦ Rotation Speed - Torque Characteristics ♦



■ Product Features

Servo Motor Type (APM-□□□□□)		SE05G	SE09G	SE13G	SE17G	SF20G	LF30G
Applicable Drive (L7□A□□)		L7□A008	L7□A010	L7□A020		L7□A035	
Rated Output	[kW]	0.45	0.85	1.3	1.7	1.8	2.9
Rated torque	[N·m]	2.86	5.41	8.27	10.82	11.45	18.46
	[kgf·cm]	29.22	55.19	84.41	110.38	116.88	188.39
Instantaneous maximum torque	[N·m]	8.59	16.23	24.82	32.46	34.37	55.39
	[kgf·cm]	87.66	165.57	253.23	331.14	350.6	565.16
Rated rotation speed	[r/min]	1500					
Maximum rotation speed	[r/min]	3000					2700
Inertia moment	[kg·m2x10-4]	6.659	11.999	17.339	22.679	30.74	52.13
	[gf·cm·s2]	6.792	12.238	17.685	23.132	31.35	53.16
Allowable load inertia		Motor inertia X 10				Motor inertia X 5	
Rated power rate	[kW/s]	12.28	24.39	39.54	51.61	42.70	65.36
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	5.6	7.2	8.7	10.2	12.4	17.7

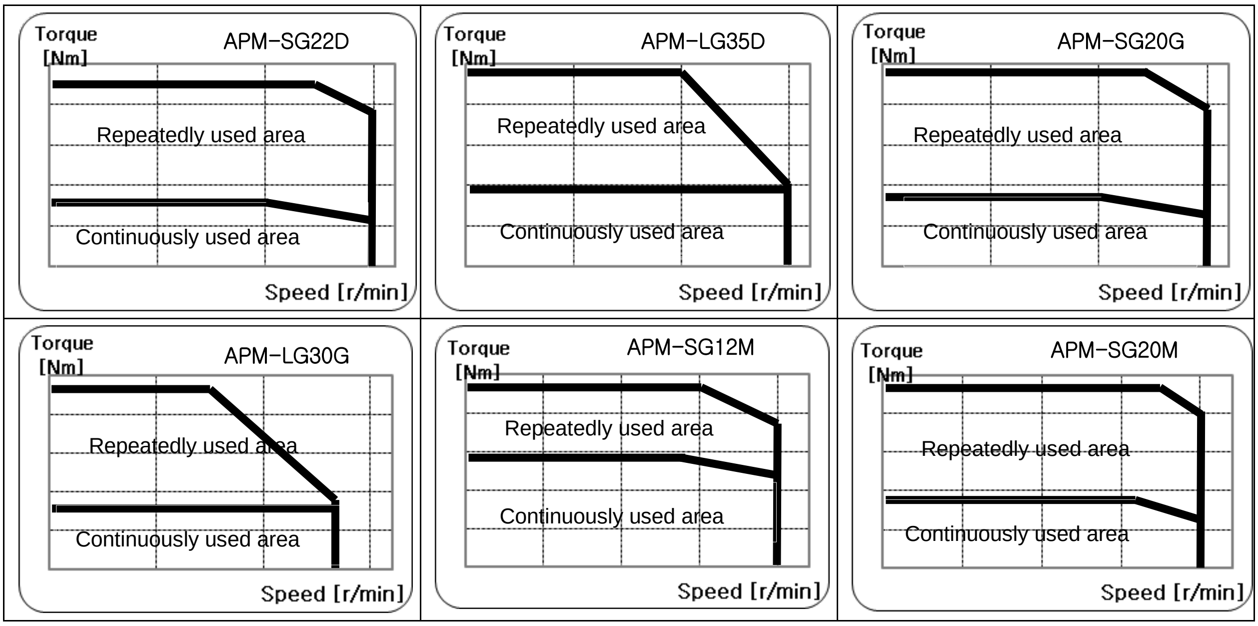
♦ Rotation Speed - Torque Characteristics ♦



■ Product Features

Servo Motor Type(APM-□□□□□)		SG22D	LG35D	SG20G	LG30G	SG12M	SG20M
Applicable Drive (L7□A□□)		L7□A035				L7SA020	L7SA035
Rated Output	[kW]	2.2	3.5	1.8	2.9	1.2	2.0
Rated torque	[N·m]	10.5	16.71	11.5	18.46	11.5	19.1
	[kgf·cm]	107.2	170.52	116.9	188.39	116.9	194.9
Instantaneous maximum torque	[N·m]	31.5	50.13	34.4	55.39	34.4	57.3
	[kgf·cm]	321.5	511.57	350.8	565.16	350.8	584.6
Rated rotation speed	[r/min]	2000		1500		1000	
Maximum rotation speed	[r/min]	3000		3000	2700	2000	
Inertia moment	[kg·m2x10-4]	51.42	80.35	51.42	80.35	51.42	80.35
	[gf·cm·s2]	52.47	81.99	52.47	81.99	52.47	81.99
Allowable load inertia		Motor inertia X 5					
Rated power rate	[kW/s]	21.45	34.75	25.53	42.41	25.53	45.39
Speed and position detector	Standard	Quadrature Type Incremental 3000[P/R]					
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	16.95	21.95	16.95	21.95	16.95	21.95

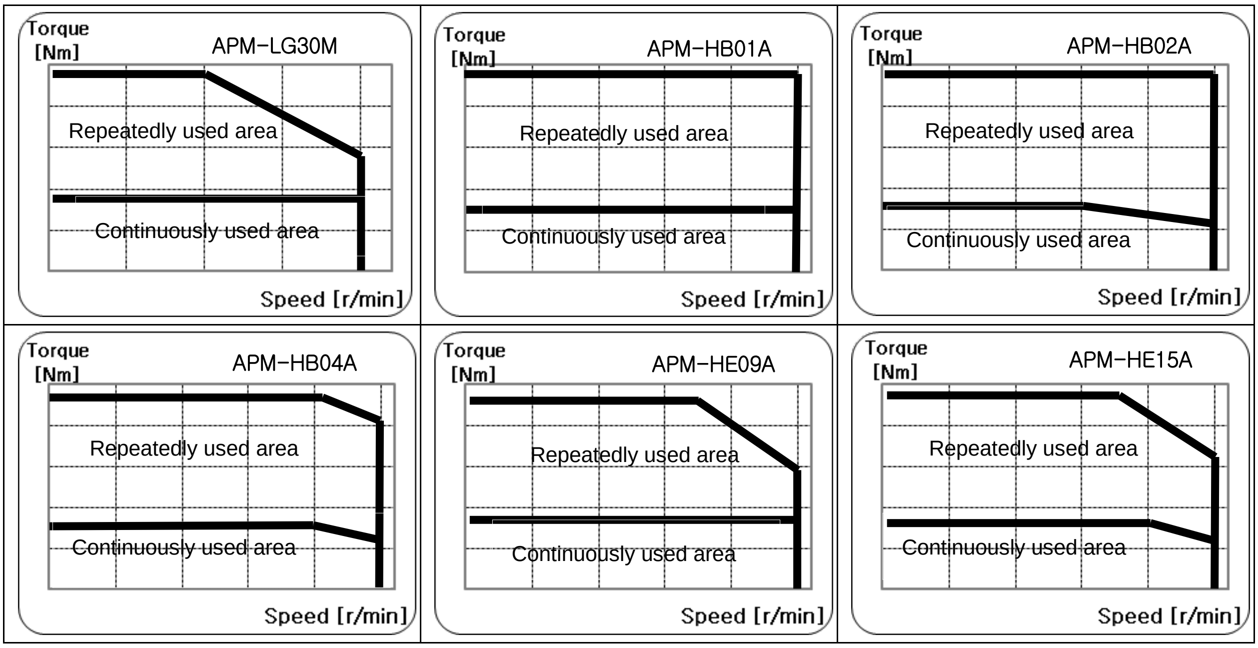
♦ Rotation Speed - Torque Characteristics ♦



■ Product Features

Servo Motor Type (APM-□□□□□)		LG30M	HB01A	HB02A	HB04A	HE09A	HE15A
Applicable Drive (L7□A□□)		**L7□A035**	**L7□A002**	**L7□A002**	**L7□A004**	**L7□A008**	**L7□A020**
Rated Output	[kW]	3.0	0.1	0.2	0.4	0.9	1.5
Rated torque	[N·m]	28.6	0.318	0.637	1.274	2.86	4.77
	[kgf·cm]	292.3	3.25	6.50	13.0	29.2	48.7
Instantaneous maximum torque	[N·m]	85.9	0.955	1.912	3.822	8.59	14.32
	[kgf·cm]	876.9	9.74	19.5	39.0	87.7	146.1
Rated rotation speed	[r/min]	1000	3000				
Maximum rotation speed	[r/min]	2000	5000				
Inertia moment	[kg·m2x10-4]	132.41	0.269	0.333	0.461	19.558	22.268
	[gf·cm·s2]	135.11	0.274	0.339	0.470	19.943	22.707
Allowable load inertia		X 5	Motor inertia X 20			Motor inertia X 10	
Rated power rate	[kW/s]	61.97	3.34	11.98	34.47	4.10	10.01
Speed and position detector	Standard	Quadrature Type Incremental 1024P/R				2048 P/R	
	Option	Serial Type 17~21[bit]					
Specifications and features	Method of protection	IP65	Fully closed·self-cooling IP55 (excluding axis penetration)				
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	30.8	0.89	1.16	1.69	5.82	7.43

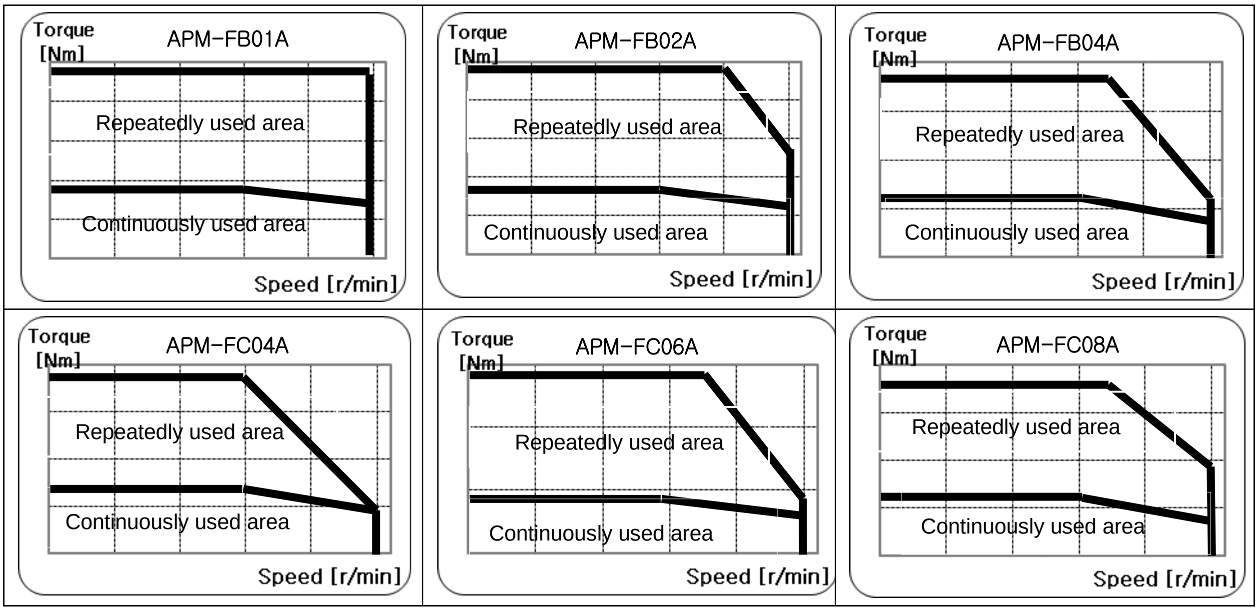
♦ Rotation Speed - Torque Characteristics ♦



■ Product Features

Servo Motor Type (APM-□□□□□)		FB01A	FB02A	FB04A	FC04A	FC06A	FC08A
Applicable Drive (L7□A□□)		L7□A001	L7□A002	L7□A002	L7□A004	L7□A008	L7□A010
Rated Output	[kW]	0.1	0.2	0.4	0.4	0.4	0.75
Rated torque	[N·m]	0.318	0.637	1.273	1.273	1.910	2.387
	[kgf·cm]	3.25	6.50	12.99	12.99	19.49	24.36
Instantaneous maximum torque	[N·m]	0.955	1.910	3.820	3.82	5.73	7.16
	[kgf·cm]	9.74	19.49	38.98	38.977	58.465	73.081
Rated rotation speed	[r/min]	3000					
Maximum rotation speed	[r/min]	5000					
Inertia moment	[kg·m2x10-4]	0.089	0.145	0.246	0.497	0.875	1.245
	[gf·cm·s2]	0.09	0.148	0.252	0.508	0.893	1.270
Allowable load inertia		Motor inertia x 20			Motor inertia x 15		
Rated power rate	[kW/s]	11.38	27.95	65.90	32.62	41.69	45.78
Speed and position detector	Standard	Serial Type 19[bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0-40 [°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	0.72	0.94	1.32	1.56	2.18	2.72

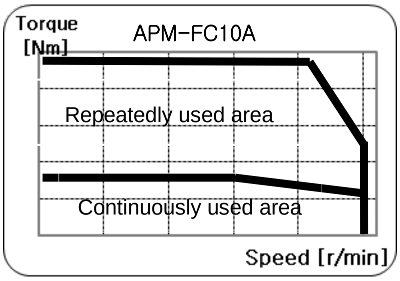
♦ Rotation Speed - Torque Characteristics ♦

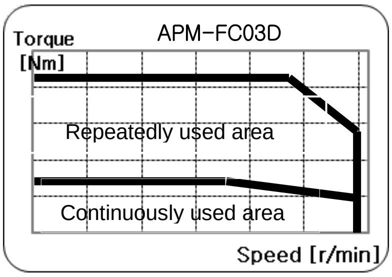


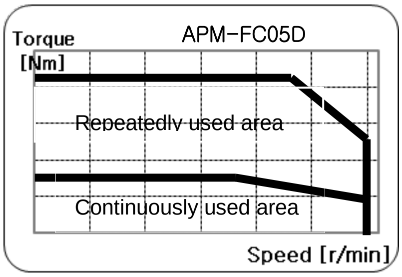
■ Product Features

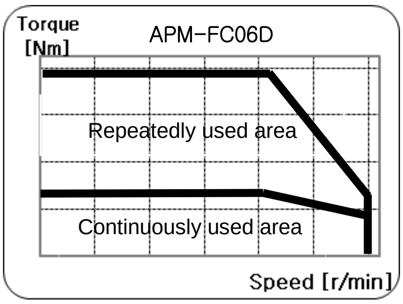
Servo Motor Type (APM-□□□□□)		FC10A	FC03D	FC05D	FC06D	FC07D	
Applicable Drive (L7□A□□)		**L7□A010**	**L7□A004**	**L7□A008**	**L7□A008**	**L7□A010**	
Rated Output	[kW]	1.0	0.3	0.45	0.55	0.65	
Rated torque	[N·m]	3.183	1.432	2.149	2.626	3.104	
	[kgf·cm]	32.48	14.62	21.92	26.80	31.67	
Instantaneous maximum torque	[N·m]	9.55	4.30	6.45	7.88	9.31	
	[kgf·cm]	97.442	43.849	65.773	80.389	95.006	
Rated rotation speed	[r/min]	3000	2000				
Maximum rotation speed	[r/min]	4500	3000				
Inertia moment	[kg·m2x10-4]	1.615	0.497	0.875	1.245	1.615	
	[gf·cm·s2]	1.648	0.508	0.893	1.270	1.648	
Allowable load inertia		Motor inertia x 15					
Rated power rate	[kW/s]	62.74	41.28	52.76	55.39	59.64	
Speed and position detector	Standard	Serial Type 19[bit]					
	Option	X					
Specifications and features	Method of protection	Fully closed·self-cooling IP65 (excluding axis penetration)					
	Time rating	Continuous					
	Ambient temperature	0~40[°C]					
	Ambient humidity	20-80[%] RH (no condensation)					
	Atmosphere	No direct sunlight, corrosive gas, or combustible gas					
	Anti-vibration	Vibration acceleration 49 [m/s2] (5G)					
Weight	[kg]	3.30	1.56	2.18	2.72	3.30	

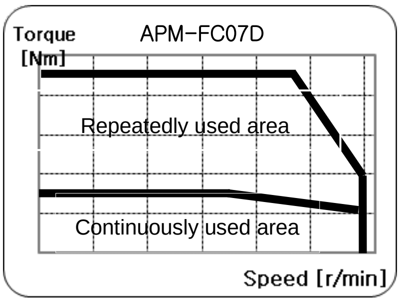
♦ Rotation Speed - Torque Characteristics ♦











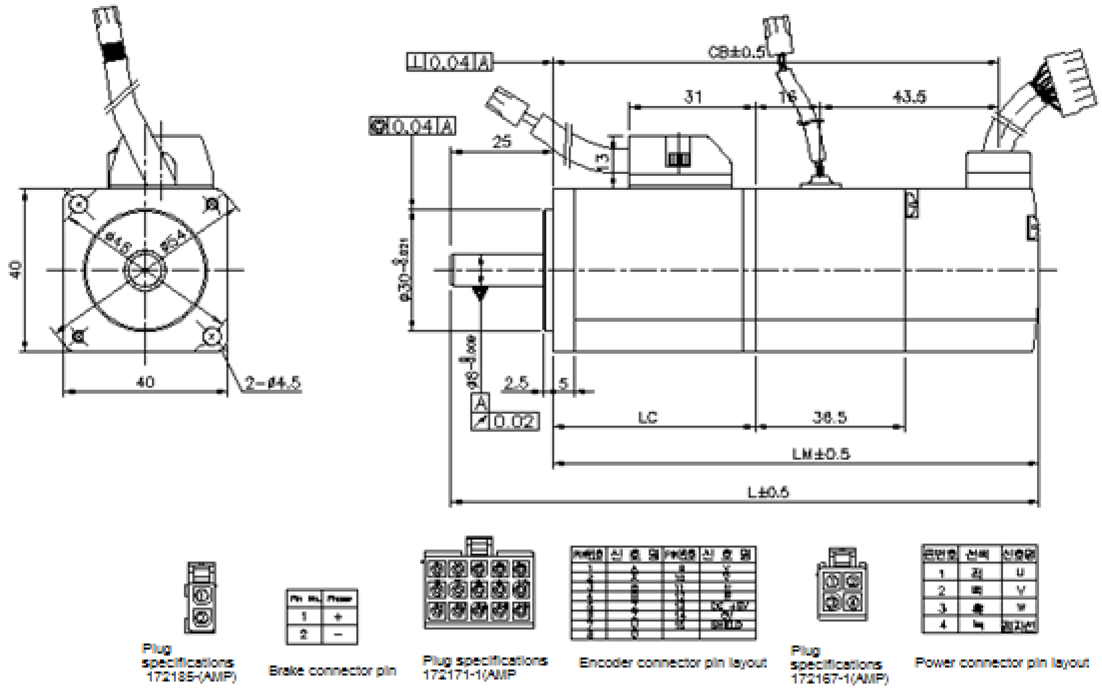
■ Electric Brake Specifications

Applicable Motor Series	APM-SA	APM-SB	APM-SC	APM-SE	APM-SF	APM-SG
Purpose	Maintenance of stop(Refer to Note 2 below)					
Input voltage [V]	DC 24V					DC 90V
Static friction torque [N•m]	0.32	1.47	3.23	10.4	40	74
Capacity [W]	6	6.5	9	19.4	25	32
Coil resistance [Ω]	96	89	64	29.6	23	327
Rated current [A]	0.25	0.27	0.38	0.81	1.04	0.28
Braking mechanism	Spring brake					
Insulation grade	Grade F					
Applicable Motor Series	**APM-FB**	**APM-FC**				
Purpose	Maintenance of stop(Refer to Note 2 below)					
Input voltage [V]	DC 24V					
Static friction torque [N•m]	1.47	3.23				
Capacity [W]	6.5	9				
Coil resistance [Ω]	89	64				
Rated current [A]	0.27	0.38				
Braking mechanism	Spring brake					
Insulation grade	Grade F					

- The same specifications apply to all electric brakes installed in our servo motors.
- Electric brakes are designed to maintain a stop. Never use them for absolute braking
- The characteristics of the electric brakes were measured at 20°C
- These brake specifications are subject to change. Check the voltage specifications on your specific motor.

10.1.2 Outline Diagram

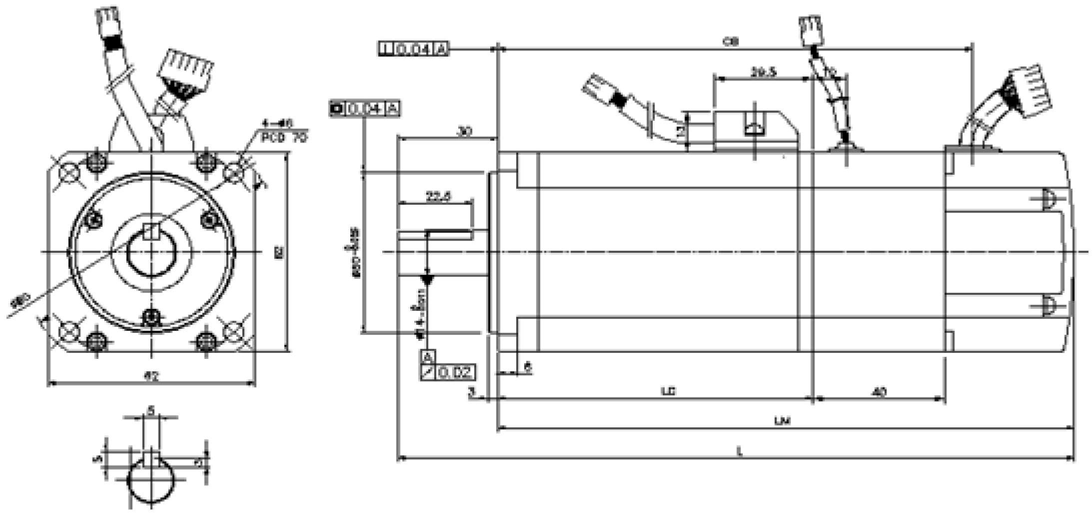
■ SA Series | APM-SAR3A, APM-SAR5A, APM-SA01A, APM-SA015A



Name	External Dimensions				Weight (kg)
	L	LM	LC	CB	
SAR3A	101.3(137.6)	76.3(112.6)	42.5(102.3)	66.3(102.3)	0.32(0.67)
SAR5A	108.3(144.6)	83.3(119.6)	49.5(49.4)	73.3(109.3)	0.38(0.73)
SA01A	125.3(161.6)	100.3(66.4)	66.5(66.4)	90.3(126.3)	0.5(0.85)
SA015A	145.3	120.3	86.5	110.3	0.7

- The standard shaft end for 40 flange model is a straight shaft end
- Use DC power (24 V) to operate the brake
- The sizes in parentheses apply when attached to the brakes.(Except SA015A)

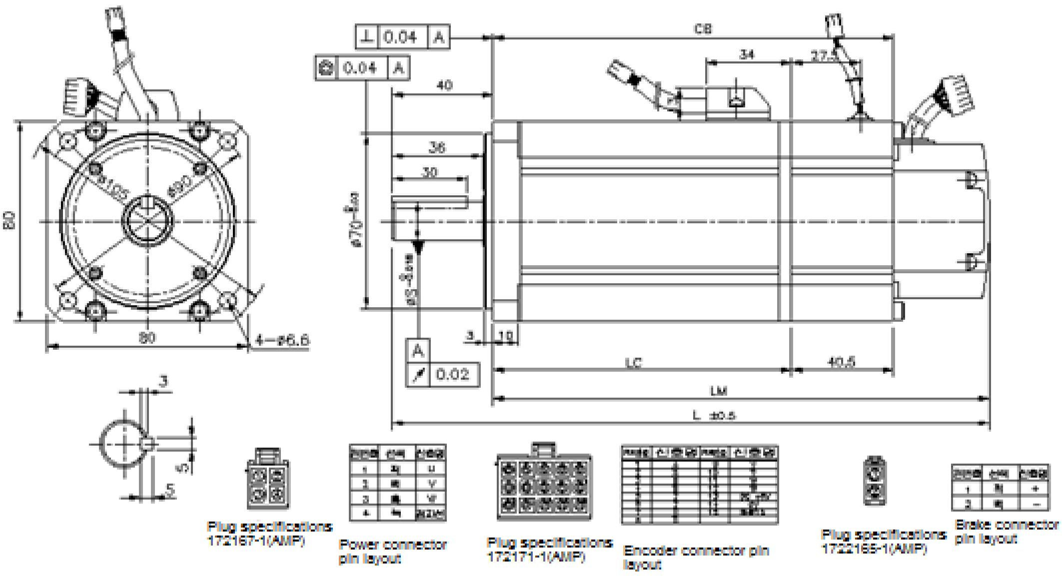
■ SB Series | APM-SB01A, APM-SB02A, APM-SB04A



Name	External Dimensions				Weight (kg)
	L	LM	LC	CB	
SB01A	122(162)	92 (132)	52.5(52.3)	59.5(99.5)	0.82(1.4)
SB02A	136(176)	106 (146)	66.5(66.3)	73.5(113.5)	1.08(1.66)
SB04A	1634(199)	134(169)	94.5(94.3)	101.5(141.5)	1.58(2.16)

- Use DC power (24 V) to operate the brake
- The sizes in parentheses apply when attached to the brakes.

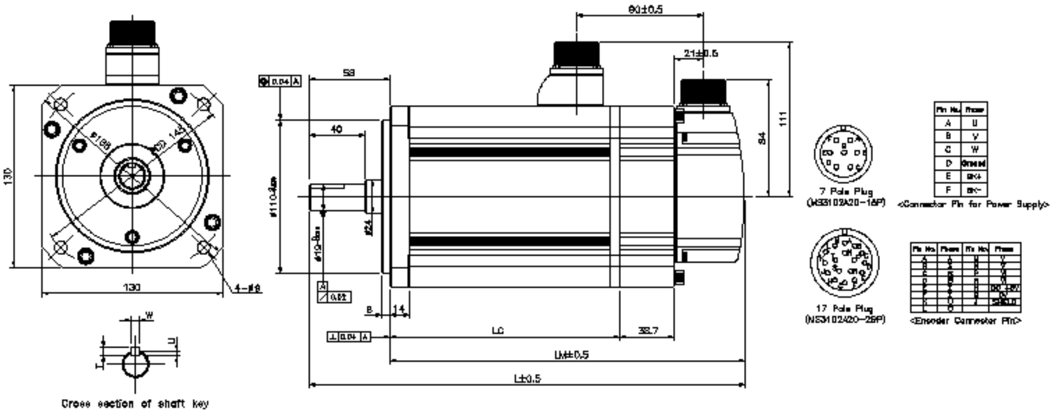
■ SC Series | APM-SC04A,SC03D, APM-SC06A,SC05D, APM-SC08A,SC06D, APM-SC10A,SC07D



Name	External Dimensions					Weight (kg)
	L	LM	LC	CB	S	
SC04A, SC03D	158.5(198.5)	118.5(158.5)	79(78.8)	86(126.5)	14	1.88(2.92)
SC06A, SC05D	178.5(218.5)	138.5(178.5)	99(98.8)	106(146.5)	16	2.52(3.56)
SC08A, SC06D	198.5(238.5)	158.5(198.5)	119(118.8)	126(166.5)	16	3.15(4.22)
SC10A, SC07D	218.5(258.5)	178.5(218.5)	139(138.8)	146(186.5)	16	3.80(4.94)

- Use DC power (24 V) to operate the brake.
- The sizes in parentheses apply when attached to the brakes.

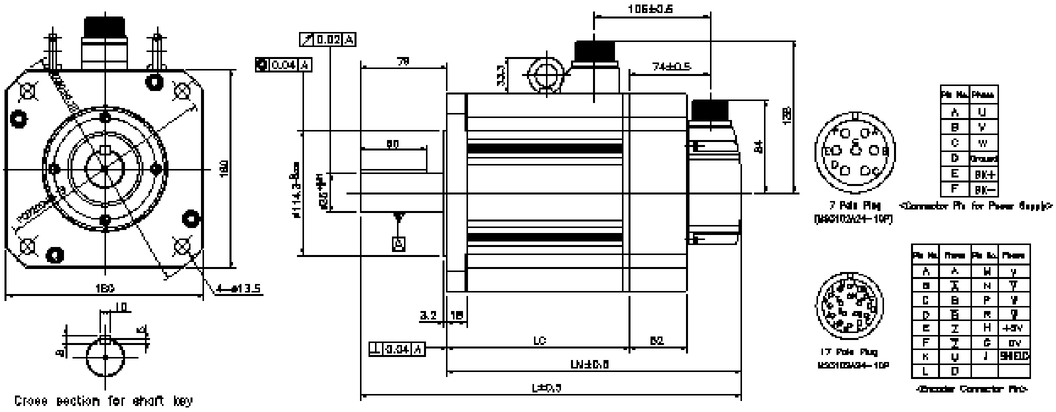
■ SE Series | APM-SE09A, SE06D, SE05G, SE03M, APM-SE15A, SE11D,SE09G,SE06M, APM-SE22A, SE16D, SE13G, SE09M, APM-SE30A, SE22D, SE17G, SE12M



Name	External Dimensions				Key Dimensions			Weight (kg)
	L	LM	LC	S	T	W	U	
SE09A,SE06D,SE05G,SE03M	201(240)	143(182)	94	19	5	5	3	5.5(7.04)
SE15A,SE11D,SE09G,SE06M	225(264)	167(206)	118	19	5	5	3	7.54(9.08)
SE22A,SE16D,SE13G,SE09M	249(288)	191(230)	142	22	6	6	3.5	9.68(11.22)
SE30A,SE22D,SE17G,SE12M	273(312)	215(254)	166	22	6	6	3.5	11.78(13.32)

- Use DC power (24 V) to operate the brake.
- The sizes in parentheses apply when attached to the brakes.

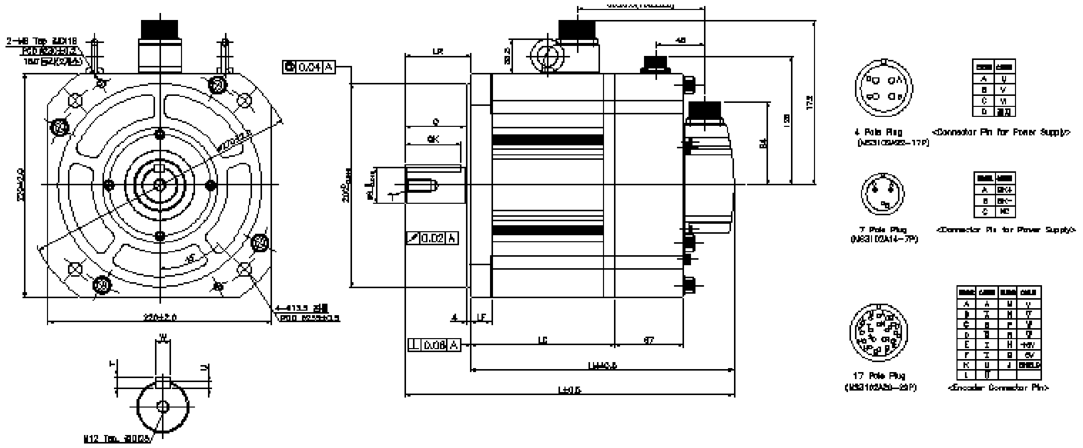
■ SF Series | APM-SF30A, SF22D, SF20G, SF12M, APM-LF35D, LF30G, SF20M, APM-LF30M



Name	External Dimensions			Weight (Kg)
	L	LM	LC	
SF30A, SF22D, SF20G, SF12M	261.5(312.9)	182.5(233.9)	133(132.7)	12.4(19.2)
SF50A, LF35D, LF30G, SF20M	295.5(346.9)	216.5(267.9)	167(166.7)	17.7(24.9)
SF55D, SF44G LF30M	345.5(396.9)	266.5(317.9)	217(216.7)	26.3(33.4)
SF44M	405.5(456.9)	326.5(377.9)	277(276.7)	35.6(42.8)

- SF30M or above models have eye bolts
- Use DC power (24 V) to operate the brake
- The sizes in parentheses apply when attached to the brakes.

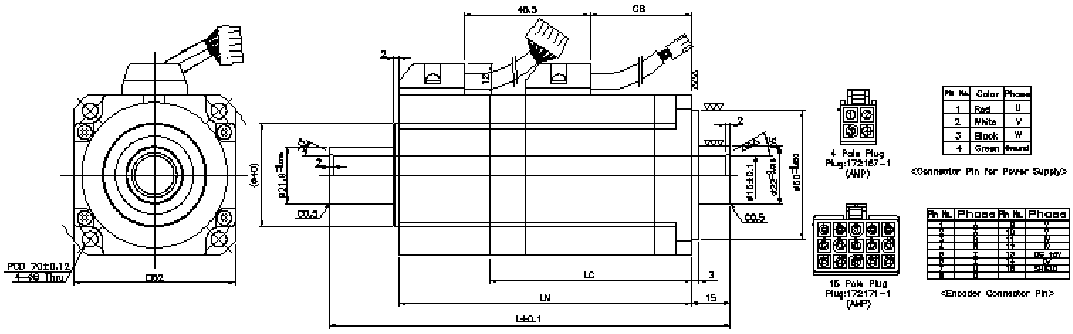
■ SG Series | APM-SG22D, SG20G, SG12M, APM-LG35D, LG30G, SG20M, APM-LG30M



<table>
<tr><th rowspan="2">Name</th><th colspan="5">External Dimensions</th><th colspan="6">Shaft, Key Dimensions</th><th rowspan="2">Weight
(Kg)</th></tr>
<tr><th>L</th><th>LM</th><th>LC</th><th>LR</th><th>LF</th><th>S</th><th>Q</th><th>QK</th><th>T</th><th>W</th><th>U</th></tr>
<tr><td>SG22D,
SG20G,SG12M</td><td>237
(303)</td><td>172
(238)</td><td>122</td><td rowspan="3">65</td><td rowspan="3">22</td><td rowspan="3">35-0.016</td><td rowspan="3">60</td><td rowspan="3">55</td><td rowspan="3">8</td><td rowspan="3">10</td><td rowspan="3">5</td><td>16.95
(30.76)</td></tr>
<tr><td>LG35D,
LG30G,SG20M</td><td>257
(323)</td><td>192
(258)</td><td>142</td><td>21.95
(35.7)</td></tr>
<tr><td>LG30M</td><td>293
(359)</td><td>228
(294)</td><td>178</td><td>30.8
(44.94)</td></tr>
</table>

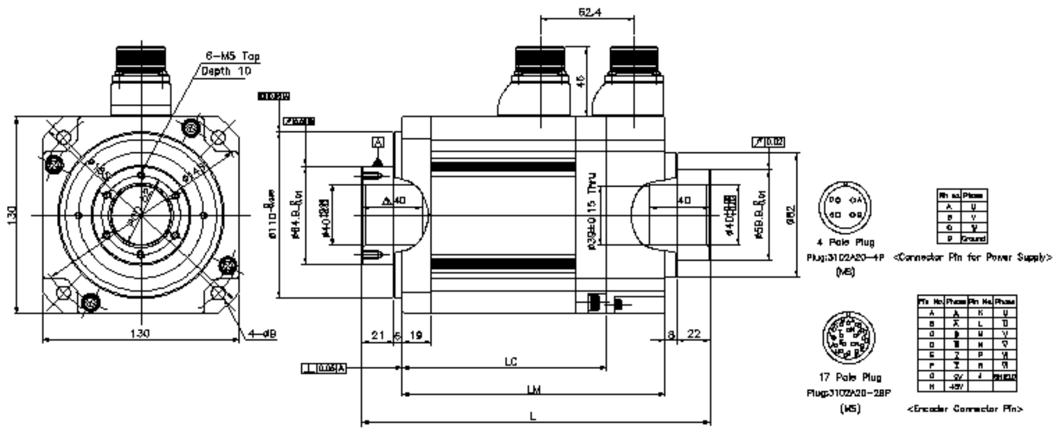
- Use DC power (90 V) to operate the brake.
- The sizes in parentheses apply when attached to the brakes.

■ APM-HB01A(Hollow Shaft), APM-HB02A(Hollow Shaft), APM-HB04A(Hollow Shaft)



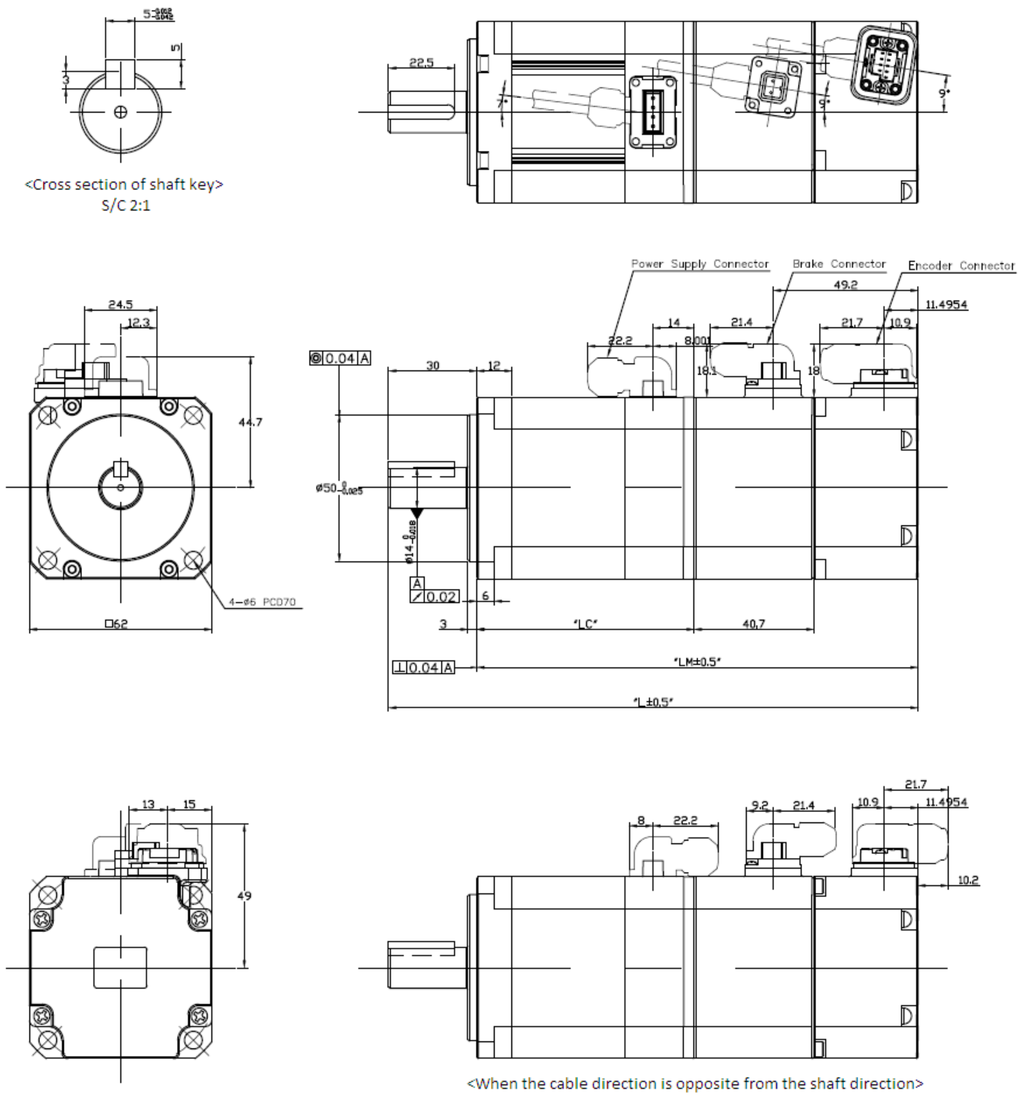
Name	External Dimensions					Weight (kg)
	L	LM	LC	CB	Hollow Shaft Diameter	
HB01A	140.5	98.5	68.5	24	15	0.89
HB02A	154.5	112.5	82.5	38	15	1.16
HB04A	182.5	140.5	105.5	66	15	1.69

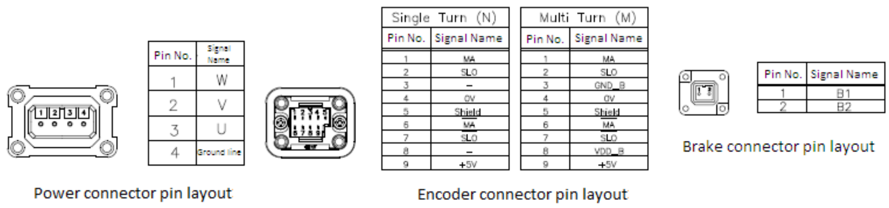
■ APM-HE09A(Hollow Shaft), APM-HE15A(Hollow Shaft)



Name	External Dimensions				Weight (kg)
	L	LM	LC	Hollow Shaft Diameter	
HE09A	207	150	111.5	40	5.82
HE15A	231	174	135.5	40	7.43

■ FB Series | APM-FB01A, APM-FB02A, APM-FB04A

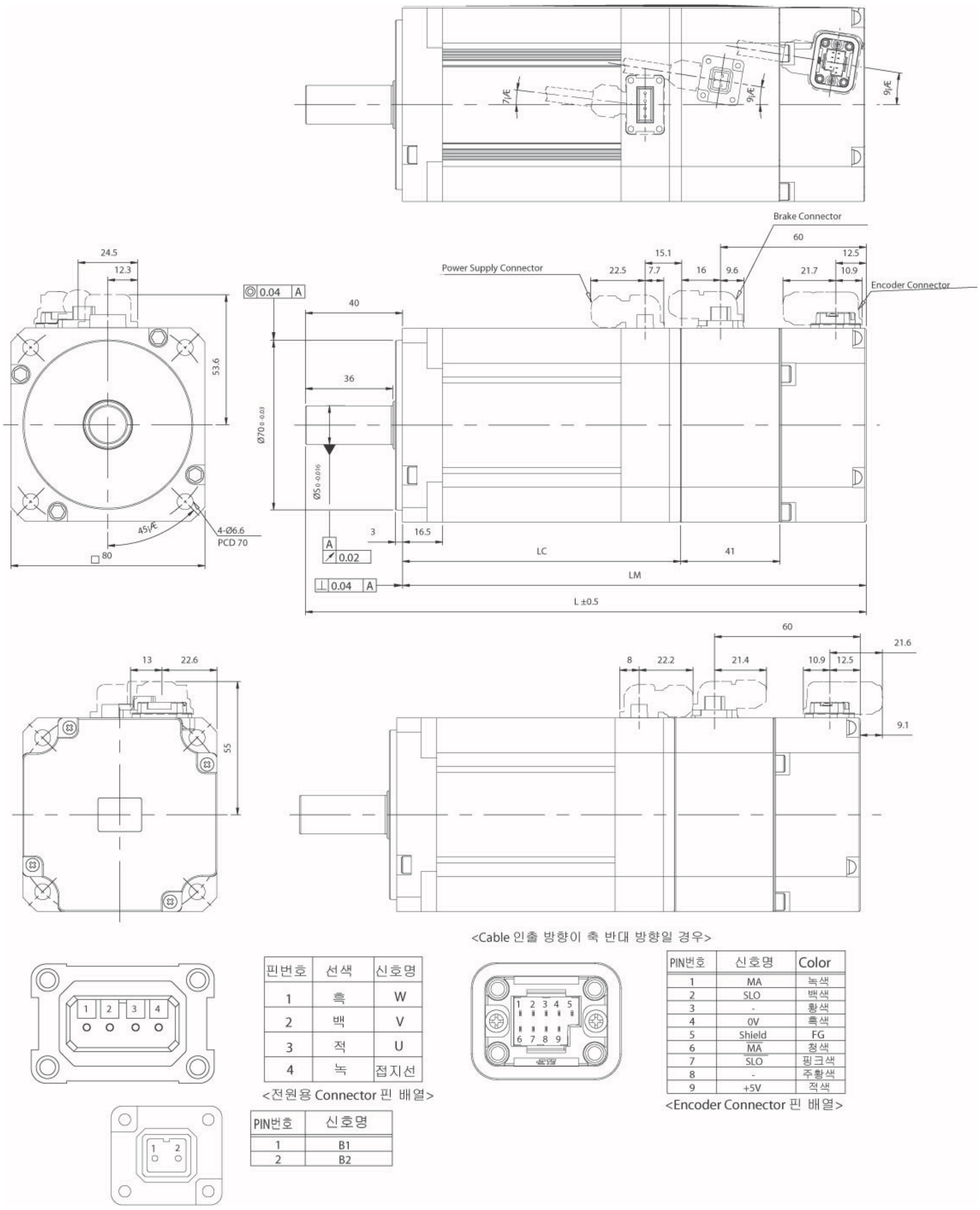




Name	External Dimensions			Weight(kg)
	L	LM	LC	
FB01A	109(149.2)	79(119.2)	43.5(43)	0.72(1.3)
FB02A	120(160.2)	90(130.2)	54.5(54)	0.94(1.49)
FB04A	140(150.2)	110(150.2)	74.5(74)	1.32(1.87)

- Use DC power (24V) to operate the brake.
- The sizes in parentheses apply when attached to the brakes.

■ FC Series | APM-FC04A,FC03D, APM-FC06A,FC05D,
APM-FC08A,FC06D, APM-FC10A,FC07D



Name	External Dimensions				Weight (kg)
	L	LM	LC	S	
FC04A,FC03D	136.5(177)	96.5(137)	61(60.5)	14	1.56(2.6)
FC06A,FC05D	154.5(195)	114.5(155)	79(78.5)	16	2.18(3.22)
FC08A,FC06D	172.5(213)	132.5(173)	97(96.5)	16	2.72(3.76)
FC10A,FC07D	190.5(231)	150.5(191)	115(114.5)	16	3.30(4.34)

- Use DC power (24V) to operate the brake
- The sizes in parentheses apply when attached to the brakes.

10.2 Servo Drive

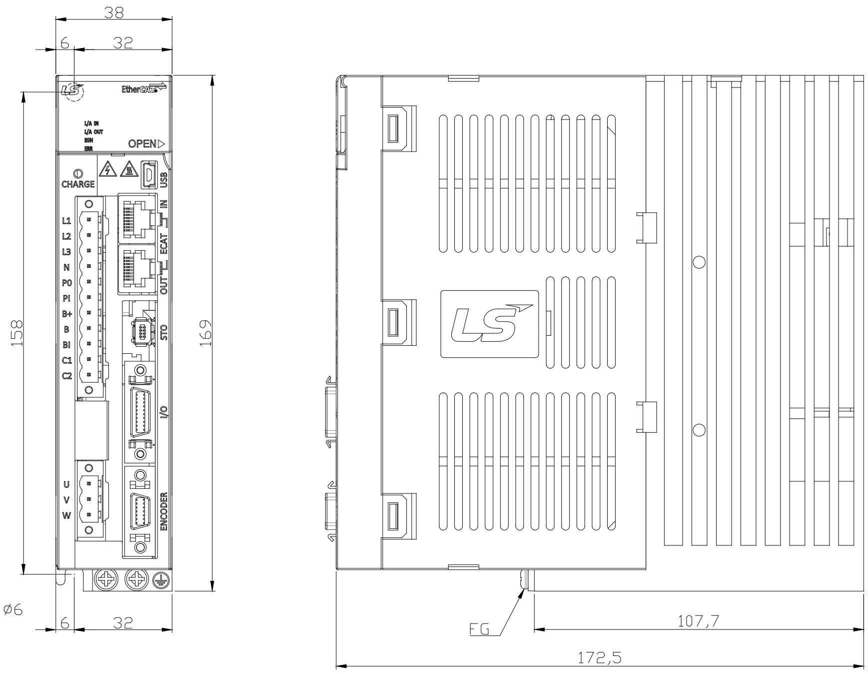
10.2.1 Product Features

Item \ Name		L7NHA001U	L7NHA002U	L7NHA004U	L7NHA008U	L7NHA010U	L7NHA020U	L7NHA035U
Input power	Main power	3-phase AC200 ~ 230[V](-15 ~ +10[%]), 50 ~ 60[Hz]						
	Control power	Single-phase AC200 ~ 230[V](-15 ~ +10[%]), 50 ~ 60[Hz]						
Rated current (A)		1.4	1.7	3.0	5.2	6.75	13.5	16.7
Peak current (A)		4.2	5.1	9.0	15.6	20.25	40.5	50.1
Encoder Type		Quadrture(Incremental) BiSS-B, BiSS-C(Absolute, Incremental) Tamagawa Serial(Absolute, Incremental) EnDat 2.2						
Control performance	Speed control range	Maximum 1 : 5000						
	Frequency response	Maximum 1 kHz or more (when the 19-bit serial encoder is applied)						
	Speed change rate	±0.01% or lower (when the load changes between 0 and 100%) ±0.1% or less (temperature of 25℃ (±10))						
	Torque control repetition accuracy	Within ±1%						
EtherCAT Communication specifications	Communication standard	FoE (Firmware download) EoE (Parameter setting by UDP, Tuning, Secondary function, Parameter copy) CoE (IEC 61158 Type12, IEC 61800-7 CIA 402 Drive profile)						
	Physical layer	100BASE-TX(IEEE802.3)						
	Connector	RJ45 x 2						
	Communication distance	Within connection between nodes 100[m]						
	DC (Distributed Clock)	By DC mode synchronism. minimum DC cycle: 250[us]						
	LED display	LinkAct IN, LinkAct OUT, RUN, ERR						
	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] Total 8 input channels (allocable) Above 12 functions can be used selectively for assignment. (*POT, *NOT, *HOME, *STOP, *PCON, *GAIN2, *P_CL, *N_CL, PROBE1, PROBE2, EMG, A_RST) Note) * Basic allocation signal
	Digital output	Service rating: DC 24[V] ±10%, 120[㎃] Total 4 input channels (allocable) Above 11 functions can be used selectively for assignment. (*BRAKE±, *ALARM±, *READY±, *ZSPD±, INPOS±, TLMT±, ,VLMT±, INSPD±, WARN±, TGON±, INPOS2±) Note) * Basic allocation signal
Analog Monitor		There are 2 input channels. Above 15 functions can be used selectively for assignment.
Safety function		2 input channels (STO1, STO2), 1 output channels (EDM±)
USB Communication	Fuction	Firmware download, Parameter setting, Tuning, Secondary function, Parameter copy
	Communication standard	USB 2.0 Full Speed (applies standard)
	Connect	PC or USB storing medium
Internal function	Dynamic braking	Standard built-in brake (activated when the servo alarm goes off or when the servo is off).
	Regenerative braking	Both the default built-in brake and an externally installed brake are possible.
	Display function	Seven segments (5 DIGIT)
	Self-setting function	The [Mode] key changes the content displayed in the 7 segments.
	Additional function	Auto gain tuning function
	Protection function	Overcurrent, overload, overvoltage, low voltage, main power input error, control power input error, overspeed, motor cable, heating error (power module heating, drive temperature error), encoder error, excessive regeneration, sensor error, communication error
Environment	Temperature	0 ~ +50[℃] / -20~ +70[℃]
	Humidity	90% RH or less (no condensation)
	Environment	Indoors in an area free from corrosive or combustible gases, liquids, or dust.

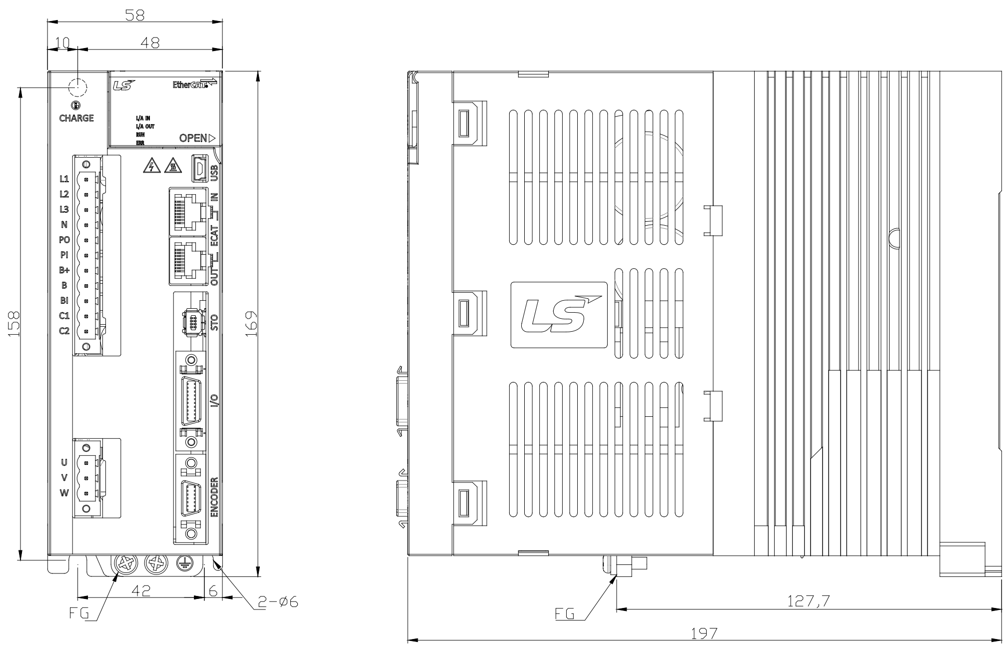
10.2.2 Outline Diagram

■ L7NHA001U ~ L7NHA004U



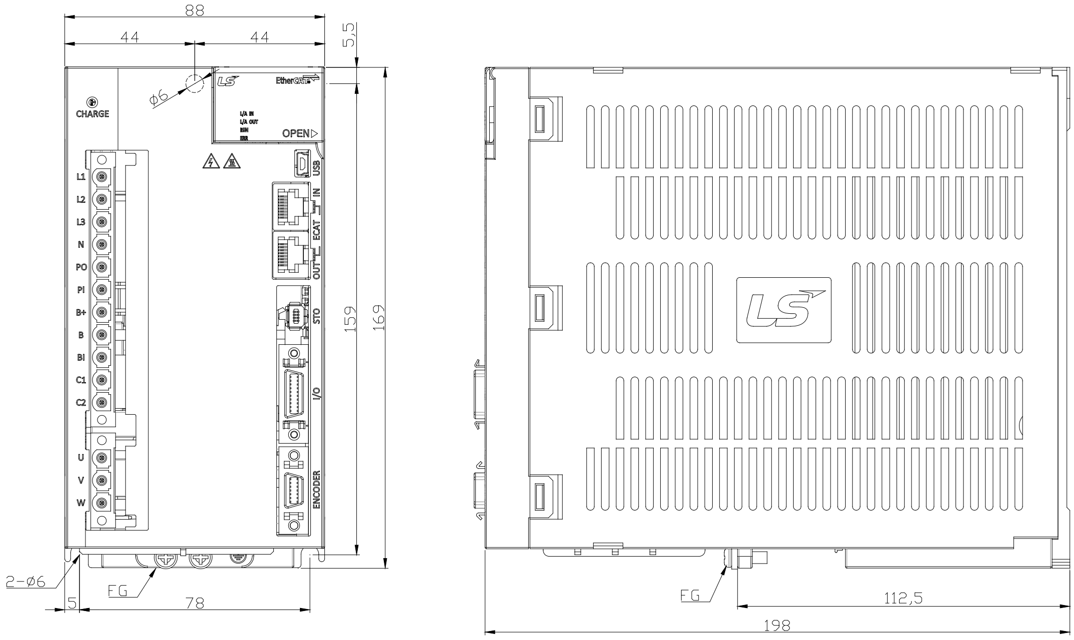
* Weight : 1.0[kg]

■ L7NHA008U ~ L7NHA010U



* Weight : 1.5[kg] (Including cooling fan)

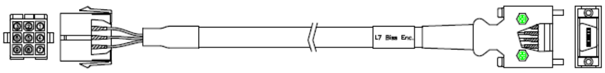
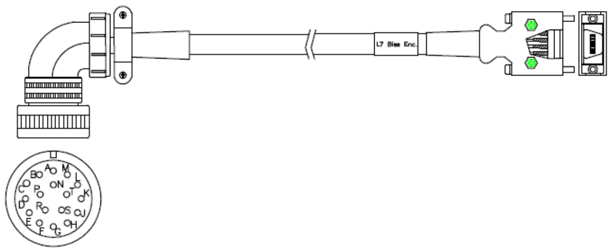
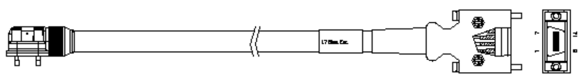
■ L7NHA020U / L7NHA035U



* Weight : 2.5[kg] (Including cooling fan)

10.3 Options and Peripheral Devies

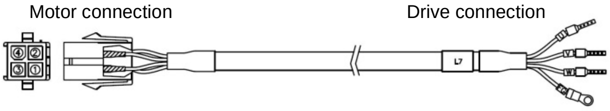
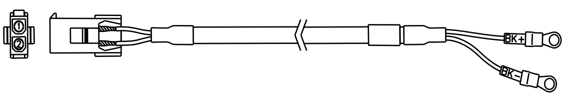
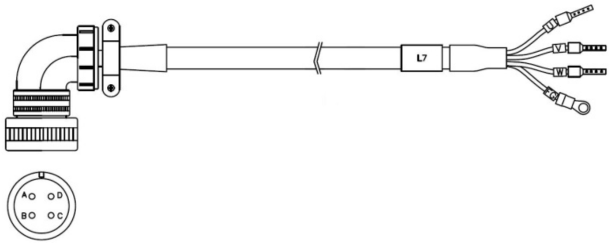
■ Option (serial encoder cable)

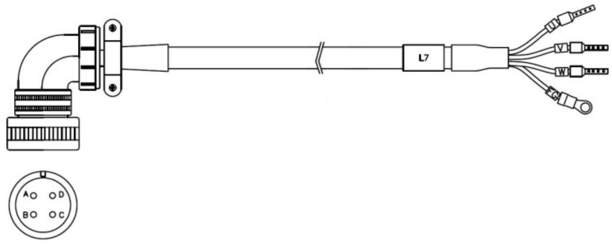
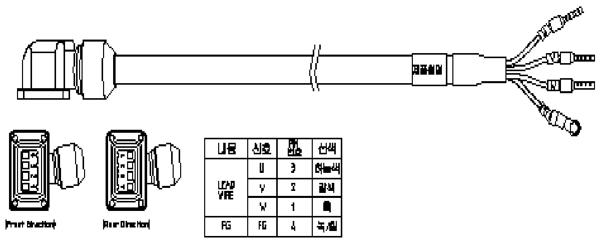
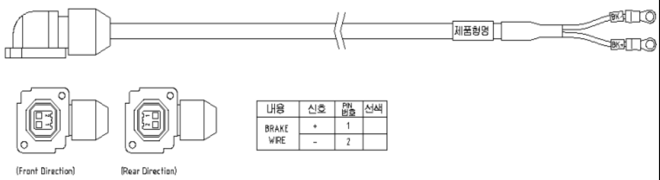
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For signaling	Serial type encoder cable (Small capacity)	APCS-E□□□CS	All models of APM-SA, (Coming) APM-SB, and APM-SC Series	 1. Motor connection a. Cap specifications (9 positions): 172161-1 (AMP) b. Socket specifications: 170361-1 (AMP) 2. Drive connection (ENCODER) a. Case specifications: 10314-52A0-008 (3M) b. Connector specifications: 10114-3000VE (3M) 3. Cable specifications:: 4Px0.2SQ(AWG24)
For signaling	Serial type encoder cable (medium capacity)	APCS-E□□□DS	All models of APM-SE APM-SF APM-SG APM-LF APM-LG APM-HE SERIES	 1. Motor connection (MS:Military Standard) a. Plug specifications : MS3108B(MS3106B) 20-29S 2. Drive connection (ENCODER) a. Case specifications: 10314-52A0-008(3M) b. Connector specifications: 10114-3000VE(3M) 3. Cable specifications: 4Px0.2SQ(AWG24)
For signaling	Flat motor type encoder cable (small capacity)	APCS-E□□□ES	All models of APM-FB APM-FC SERIES	 1. Motor connection a. Cap specifications:: Tyco 7Pin 2. Drive connection (ENCODER) a. Case specifications: 10314-52A0-008(3M) b. Connector specifications: 10114-3000VE(3M) 3.Cable specifications: 4Px0.2SQ(AWG24)

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

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

■ Option (serial encoder cable)

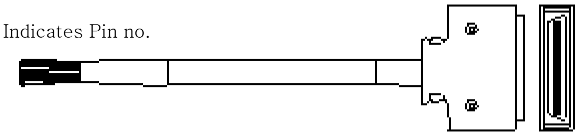
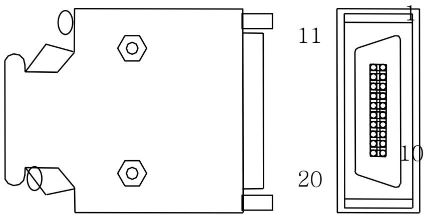
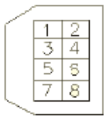
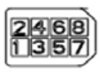
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For power	Standard power cable	APCS-P□□□GS	All models of APM-SA, APM-SB, APM-SC and APM-HB Series	Motor connection Drive connection  1. Motor connection a. Cap specifications (4 Position) : 172159-1(AMP) b. Socket specifications: 170362-1(AMP) 2. Drive connection (U,V,W,FG) a. U, V and W pin specifications: UA-F1512(서일전자) b. FG pin specifications: 1.25-4 (Ring Terminal) 3. Cable specifications: 4Cx0.75SQ(AWG18) (APM-SAR3A, SAR5A, SA01A 는 0.5SQ)
For power	Brake power cable	APCS-P□□□KB	All models of APM-SA APM-SB APM-SC Series	Motor connection Drive connection  1. Motor connection a. Cap specifications (6 Position) : 172157-1(AMP 사) b. Socket specifications: 170362-1(AMP 사) 2. Brake power connection a. Connection terminal specifications: 1.25x3(KET GP110012) b. Cable specifications: 2Cx0.75SQ(AWG18)
For power	Standard power cable	APCS-P□□□HS	All models of APM-SE APM-HE Series	Motor connection Drive connection  1. Motor connection (MS : Military Standard) a. Plug specifications: MS3108B(MS3106B)20-4S 2. Drive connection (U,V,W,FG) a. U, V and W pin specifications:: UA-F2012(서일전자) b. FG pin specifications: 2.5-4 (Ring Terminal) 3. Cable specifications: 4Cx2.0SQ(AWG14) Note) Apply UA-F1512 Pin ti Drive connection part of APM-Series cable.

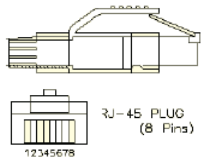
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For power	Standard power cable	APCS-P□□□IS	APM-SF30A APM-SF22D APM-LF35D APM-SF20G APM-LF30G APM-SF12M APM-SF20M APM-LF30M APM-SG22D APM-LG35D APM-SG20G APM-LG30G APM-SG12M APM-SG20M APM-LG30M	 1. Motor connection (MS : Military Standard) a. Plug specifications: MS3108B(MS3106B)22-22S 2. Drive connection (U,V,W,FG) a. U, V and W pin specifications: UA-F4012(서일전자) b. FG pin specifications: 3.5-4 (Ring Terminal) 3. Cable specifications: 4Cx3.5SQ(AWG12)
For power	Flat motor type power cable (small capacity)	APCS-P□□□FS	All models of APM-FB APM-FC SERES	 1. Motor connection a. Plug specifications: JN4AT04NJ1-R(JAE) b. Plug specifications: ST-TMH-SC1B(JAE) 2. Drive connection (U,V,W,FG) a. U, V and W pin specifications: UA-F4012(서일전자) b. FG pin specifications: 1.25-4 (Ring Terminal) 3. Cable specifications: 4Cx0.75SQ(AWG18)
	Flat motor brake cable (small capacity)	APCS-B□□□QS	All models of APM-FB APM-FC SERES	 1. Motor connection a. Plug specifications: JN4FT02SJ1-R(JAE 사) b. Socket specifications: ST-TMH-S-C1B(JAE 사) 2. Drive connection a. Connection Terminal sepecifications : 1.25x3(KET GP110012) 3. Cable specifications: 2Cx0.75SQ(AWG18)

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

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

■ Option (serial encoder cable)

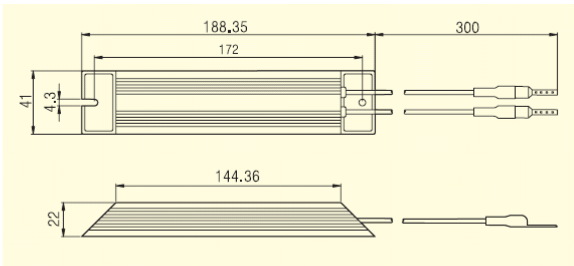
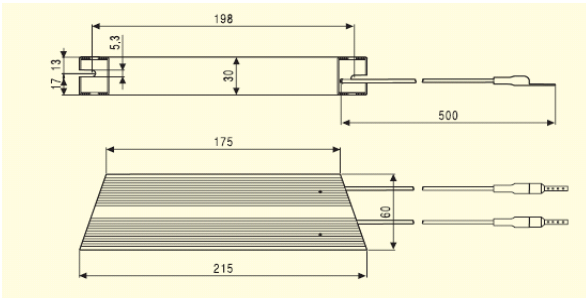
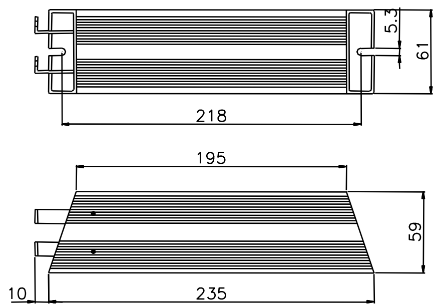
Category	Product Name	Name (Note 1)	Applicable Motors	Specifications
For signaling	I/O Cable	APCS-CN1□□A	L7NH Series	[Upper controller] [Servo drive – I/O]  **3.** Drive connection (I/O) **a.** Case specifications: 10320-52A0-008(3M) **b.** Connector specifications: 10120-3000PE(3M) Cable specifications: ROW-SB0.1Cx20C(AWG28)
For signaling	Communication Cable	APCS-CM5L7U	L7NH SERIES	[PC - USB Port] [Servo Drvie – USB]  1. PC connection: USB A Plug 2. Drive connection (USB): Mini USB 5P Plug 3. Electrical requirements: Double shielded, twisted pair, EMI filter installation (similar product: KU-AMB518 by SANWA)
CN	I/O Connector	APC-CN2NNA	L7N SERIES	 1. Case specifications: 10320-52A0-008(3M) 2. Connector specifications: 10120-3000VE(3M)
CN	STO Connector	APCS-CN6J	L7N SERIES	  1. Case specifications: 2069577-1 (Tyco)
CN	STO Connector	APCS-CN6K	L7N SERIES	   1. Mini I/O By-Pass Connector : 1971153-1(Tyco사)

<table>
<tr><td>CN</td><td>ECAT In/Out Connector</td><td>APCS-CN4NNA</td><td>L7N SERIES</td><td>
<table>
<tr><td>PIN 번호</td><td>신호명</td><td>선 색상</td></tr>
<tr><td>1</td><td>TX/RX0 Plus</td><td>White/Orange</td></tr>
<tr><td>2</td><td>TX/RX0 Minus</td><td>Orange</td></tr>
<tr><td>3</td><td>TX/RX1 Plus</td><td>White/Green</td></tr>
<tr><td>4</td><td>TX/RX2 Plus</td><td>Blue</td></tr>
<tr><td>5</td><td>TX/RX2 Minus</td><td>White/Blue</td></tr>
<tr><td>6</td><td>TX/RX1 Minus</td><td>Green</td></tr>
<tr><td>7</td><td>TX/RX3 Plus</td><td>White/Brown</td></tr>
<tr><td>8</td><td>TX/RX3 Minus</td><td>Brown</td></tr>
<tr><td colspan="2">Plate</td><td>SHILDE</td></tr>
</table>
1. Case specifications: 10320-52A0-008(3M사)</td></tr>
</table>

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

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

■ Optional braking resistance

<table>
<tr><th>Category</th><th>Product Name</th><th>Name (Note 1)</th><th>Applicable Motors</th><th>Specifications</th></tr>
<tr><td>Resistance</td><td>Braking resistance</td><td>APCS-140R50</td><td>L7NHA001U
L7NHA002U
L7NHA004U</td><td></td></tr>
<tr><td>Resistance</td><td>Braking resistance</td><td>APCS-300R30</td><td>L7NHA008U
L7NHA010U</td><td></td></tr>
<tr><td>Resistance</td><td>Braking resistance</td><td>APC-600R30</td><td>L7NHA020U
(2P)
L7NHA035U
(3P)</td><td></td></tr>
</table>

11. Maintenance and Inspection

11.1 Maintenance and Inspection

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

11.1.1 Precautions

1. Measuring the motor voltage: The PWM controls the voltage output from the servo amp to the motor. Because of this, the waves take the form of pulses. Use a rectifier voltmeter for accurate measurements because different meters may produce different results.
2. Measuring the motor current: Use a moving iron ammeter and wait for the motor's reactance to smooth the pulse waveform into sine waves.
3. Measuring the electric power: Use an electrodynamometer based on the 3 power meter method.
4. Other gauges: When using an oscilloscope or digital voltmeter, do not allow them to touch the ground. Use a 1 mA or less input current gauge.

11.1.2 What to Inspect

Wait at least 10 minutes after turning off the power before beginning the inspection because the condenser can hold enough voltage to cause an electrical accident.

(1) Inspecting the Servo Motor

⚠ Caution
Wait at least 10 minutes after turning off the power before beginning the inspection because the condenser can hold enough voltage to cause an electrical accident.

Inspection Item	Inspection Period	Inspection and Handling	Notes
Vibration and sound check	Monthly	Touch the motor and listen for sounds.	The feel and sounds should be the same as usual.
Inspect the exterior of the motor	Depends on the amount of contamination or damage.	Clean the motor with a cloth or air pressure.	-
Measure the insulation resistance	At least once a year	Disconnect the motor from the drive and measure the insulation resistance. A normal resistance level is 10 ㏁ or higher. Note 1)	Contact our service center if the resistance is lower than 10 ㏁.
Replace the oil seal	At least once every 5,000 hours	Remove the oil seal from the motor and	This only applies to motors with an oil seal.

Inspection Item	Inspection Period	Inspection and Handling	Notes
		replace it.	
General inspection	At least once every 20,000 hours or after 5 years.	Contact our service center.	Do not disassemble the servo motor yourself.

11.1.3 Replacing Parts

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

1. The smoothing condenser: Ripple currents and other factors can cause this part to wear. The lifespan of this part depends on the operating temperature and environment. It normally lasts for 10 years if used continuously in a normal air-conditioned environment. Inspect the condenser at least once each year because it can rapidly age over a short period of time once it starts to deteriorate (inspect it more frequently as it approaches obsolescence).

   ※ Visual inspection criteria:

   a. The condition of the case: Check for deformations on the sides and bottom.

   b. The condition of the lid: Check for notable expansion, severe cracks, or broken parts.

   c. The relief valve: Check for notable valve expansion and operation.

   d. Also regularly check whether the exterior is cracked, discolored, or leaking and whether there are any broken parts. The condenser is obsolete when its capacity degrades to less than 85% of the rated capacity.

2. The relays: Check for bad connections and wear and tear on the contacts caused by switching currents. A relay is obsolete when its accumulated number of switches reaches 100,000, depending on the power capacity.

3. Motor bearings: Replace the bearings after 20,000 to 30,000 hours of operation at the rated speed under the rated load. Replace the bearings if abnormal sounds or vibrations are detected during inspection, depending on the operating conditions.

The Standard Part Replacement Cycle

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

11.2 Diagnosing and Troubleshooting Abnormalities

AL-□ appears if a problem occurs during operation. If this happens, try to solve the problem by following the troubleshooting advice given in this section. If the problem persists, contact our service center.

11.2.1 The Servo Motor

Cause of abnormalities, inspection procedure, and troubleshooting methods

Symptoms	Causes	Inspection process	Remedies
The motor does not move.	The P-OT and N-OT inputs are off.	Refer to section 3.6, "Signals."	Turn on the P-OT and N-OT inputs.
	The motor has defects.	Use a resistance tester to measure the resistance to the motor lead terminal (resistance between phases: several ohms).	Replace the motor.
	The locking screws are loose.	Check the locking screws.	Tighten any loose screws.
	The external wiring is incorrect or the cables are disconnected.	Check the wires to the motor and the encoder.	Redo the wiring. Replace the cables.
	The encoder has defects.	Check the output waves.	Replace the encoder. (Contact our service center.)
Motor rotation is unstable.	The connection is bad.	Check the connection of the motor lead terminal.	Fix any bad connections.
	The input voltage is low.	Check the input voltage of the drive.	Change the power source.
	Overloads occur.	Check the condition of the machine.	Remove any foreign substances from the rotating unit and grease or lubricate it.
The motor overheats.	The ambient temperature is too high.	Check the temperature around the motor. (40℃ or 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. Use a motor with a greater capacity.
	The magnetic power of the magnets is reduced.	Check the counter voltage and voltage waveforms.	Replace the motor.
The device is making a strange sound.	Coupling is bad.	Tighten the coupling screws and measure the concentricity of the connection.	Readjust the coupling.
	The bearings are abnormal.	Check the bearings for vibrations and sounds.	Contact us.
	The parameters are set incorrectly (the inertia, gain, and time constants).	Check the parameters.	Refer to Chapter 6, "Object Dictionary."

11.2.2 Servo Drive

■ Servo Alram

If the drive detects a problem, it will trigger a servo alarm and transition to the servo off state to stop. In this case, the value of the emergency stop setting (0x2013) is used to stop the drive.

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

Alarm Code	Causes	Details	What to check
AL-21 Continuous overload	In case of sequent operating that exceed rated load	Check if load which is accumulating driving load rate[0x2603] is below 100% when it is in constant speed section and stop	Change drive and motor capacitiy, Please tune gain.
	Motor brake error	Checking whether the motor brake is not holding	Provide power to motor brake
	Parameter setting error	Motor ID[0x2000], Encoder type[0x2001], Check the label of application motor and Encoder form[0x2002] setting value.	Modify the parameter as same as motor label information.
		Over load detected standard load rate setting [0x200F] Value checking	Set as proper value
	Machine part has problem	there is no problem for running	Check machine part.
	Motor cable error	Wiring is incorrect and check short	Replace motor cable.
	Encoder cable error	Wiring is incorrect and check short	Replace encoer cable.
AL-22 Drive temperature 1	surrounding temerature	Check wherther surrounding temperature is over 50 [℃]	Lower surrounding temperature of drive.
	Drive error	Check if displayed value 1 [0x260B] of drive temperature is much different with surrounding temperature when it is normal condition.	Replace the drive
AL-23 Regeneration overload	Capacity excess by high frequency operationg or continue regenerative operating	Checking overload rate accumulated regeneration on 0x2606	Adjust value on 0x2009. Use braking resistor
	Parameter setting error	Check setting value[0x2009] ~ [0x200E]	Set as proper value
	Main power input voltage error	Check whether Main power has problem or not.	Recheck the power supply
	Drive error	Checking the temperature of regenerative resistance on Servo-off status	Replace the drive
AL-24 Motor cable open	Parameter setting error	Check [0x2015], [0x2015], [0x2015] Check value offset current	Process the Phase current offset control procedure command
	Motor cable error	Check whether cable is disconnected.	Replace the motor cable.
	Motor error	Check short circuit of U,V,W in Motor (U-V, V-W, W-U)	Replace the motor
	Drive error		If specific alarm signal is persistently occurred, It is highly possible to have fault, so Kindly recommend you to change the servo drive.
AL-25	Surrounding temperature	Check whether surrounding temperature is over 50[℃]	Lower the surrondng termpertaure of drive

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

Alarm Code	Causes	Details	What to check
AL-37 Sinusoidal ENC frequncy	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	resolver error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-38 Encoder setting error	Drive / Motor combination error	Check brand label code of motor and drive.	Use motor and drive of same brand label.
	Encoder cable error	Wiring is incorrect and check Short	Replace encoder cable.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-40 Under voltage	Main power input voltage error	Check the main power voltage is over 3phase 134[Vac]	Recheck the power supply.
		Check DC link value [0x2605] is over 190[Vdc] when main power is accordingly input	Replace the drive.
	running when power voltage is low	Check wiring of main power supply	Use 3 phase as supply voltage.
AL-41 Over voltage	Main power input voltage error	Check whether the main power voltage is below 253[Vac]	Recheck the power supply.
		Check DC link value [0x2605] is below 405[V] when main power is accordingly input	Replace the drive.
	When braking resistor is high	Check operating condition regenerative resistance.	Review the regenerative resistance consider the operating condition and load.
	Setting value of acceleration/	In case of many time for acceleration/ deceleration	Set longer acceleration/ deceleration time

Alarm Code	Causes	Details	What to check
	deceleration		
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-42 Main power fail	Main power input voltage error	check voltage between phase 200- 230[Vac] of L1, L2, L3	Recheck power supply.
	Parameter setting error	Check setting value arroding to state of main power [0x2006]	Wire or set parameter as input power on (possible 3 phase)
	momentary power failure	Check setting value [0x2007]	Check main power source or reduce value of [0x2007]
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-43 Control power fail	Voltage between phase of C1, C2 error	Voltage between phase of C1, C2 is within 200-230[Vac].	Recheck power supply of drive
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-50 Over speed limit	Motor Encoder error	Wiring is incorrect and check Short.	Replace motor cable.
	Encoder cable error	Wiring is incorrect and check Short.	Replace encoder cable.
	Parameter setting error	Value of [0x2000], [0x2001], [0x2002] is same with application motor label.	Modify the parameter as sams as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low.
		Check setting value[0x2100] ~ [0x211F]	Readjust gain according to operating condtion.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-51 POS following	Parameter setting error	Check setting value [0x3000], [0x3003], [0x3004].	Set up correct parameter according to operating method.
		Check [0x6091] Setting value	Set Electronic gear ratio low.
		Check setting value on 0x6066 of position error excess time, 0x6065 of position error range	Set up correct parameter according to operating method.
	Machine part has problem	Checking it was forced by drive part	Check Machine part has problem
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-53 Excessive SPD deviation	Motor cable error	Disconnect, wiring is incorrect and check Short.	Replace motor cable
	Encoder cable error	Disconnect, wiring is incorrect and check Short.	Replace encoder cable
	Parameter setting	Value of [0x2000], [0x2001], [0x2002] is same with application motor label.	Modify the parameter as sams as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low..

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

11.3 Servo Warning

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

Bit	Warning code	Warning name
0	W01	Main power phase loss
1	W02	Low voltage of encoder battery
2	W04	Software position limit
3	-	-
4	W10	Operation overload
5	W20	Abnormal combination of drive/motor and IO Config.
6	W40	Low voltage
7	W80	Emergency signal input

Alarm Code	Causes	Detail	What to check
 PWR_FAIL	Main power input voltage error	check voltage between phase 200-230[Vac] of L1, L2, L3	Recheck power supply.
	Parameter setting error	Check value of main power input mode set[0x2006] arroding to state of main power input.	Wire or set parameter as input power on(possible 3 phase)
	Momentary power failure	Check value of main power input mode set[0x2006] arroding to state of main power input.	Check actual main power or increase value of checking time of loss of main power.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
 LOW_BATT	Parameter setting error	Check setting value of absolute encoder [0x2005]	Alarm will be disappeared if you set “1” when using ABS encoder as incremental encoder.
	Bad conection of battery, No connected.	Check the status of battery	Connect battery rightly.
	When battery voltage is low.	.Check whether battery voltage is over 3.3V	Replace battery.
 SW_POS_LMT	Parameter setting error	Setting function of software restriction on location [0x2400], Check value of software restriction on location[0x607D]	Change value of software position limit function[0x2400] or change the set of limit value of maximum postion and minimum position of software position limit[0x607D]

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

12. Test Drive

For safe and proper test drive, make sure to check the following prior to test drive. If there is a problem, take an appropriate measure before the test drive.

Servo Motor State

- Is the motor correctly installed and wired?
- Is each connecting part correctly tightened without loosening?
- For a motor with oil seal fitted, is there any damage on the oil seal?
- Is oil properly applied?

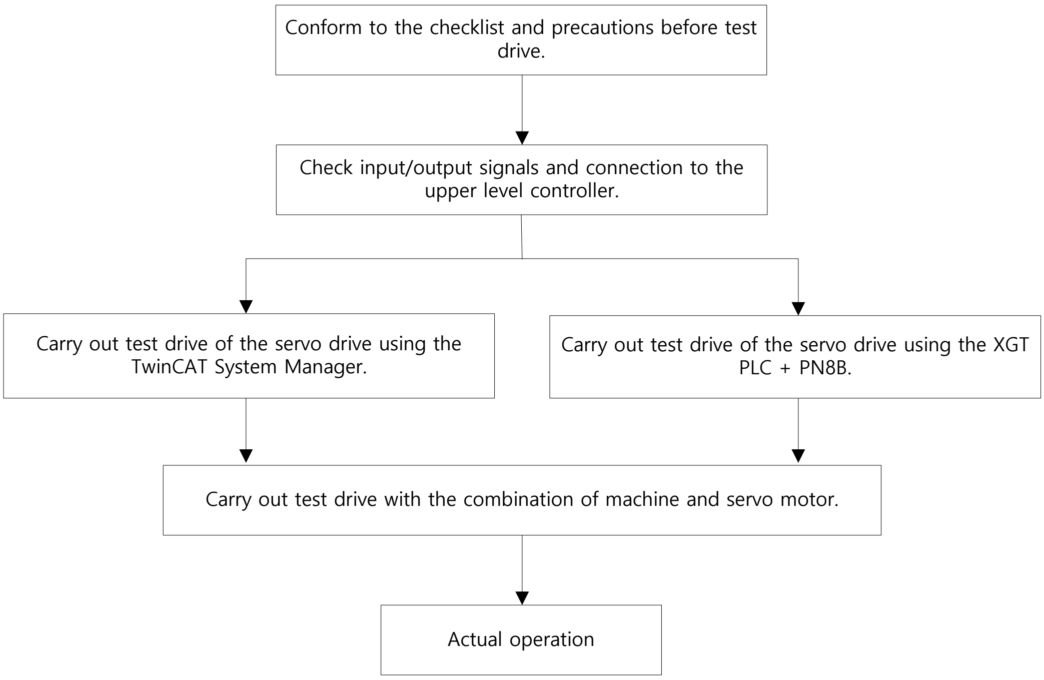
If you perform test drive of a servo motor having been stored for an extended period, make sure to check the motor according to the maintenance and inspection method for servo motor. For more information on maintenance and inspection, refer to 11. Maintenance and Inspection.

Servo Drive State

- Is the drive correctly installed, wired, and connected?
- Is the supply voltage for the servo drive correct?

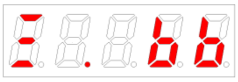
12.1 Preparation for Operation

Carry out test drive in the following order:



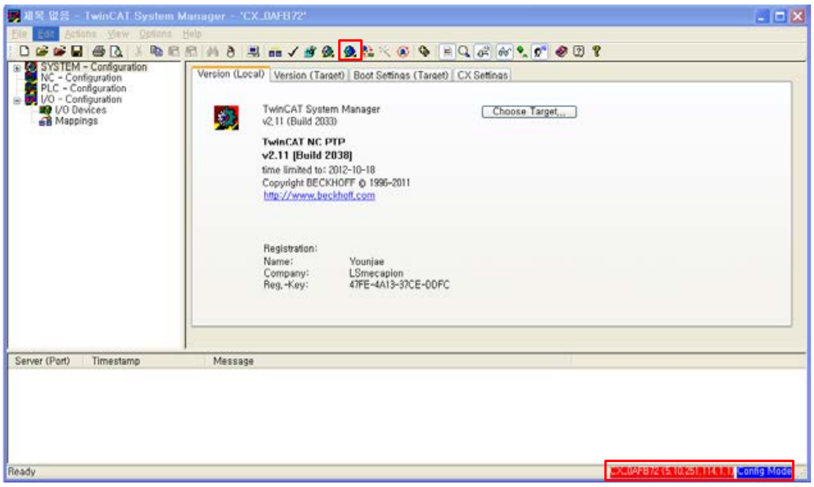
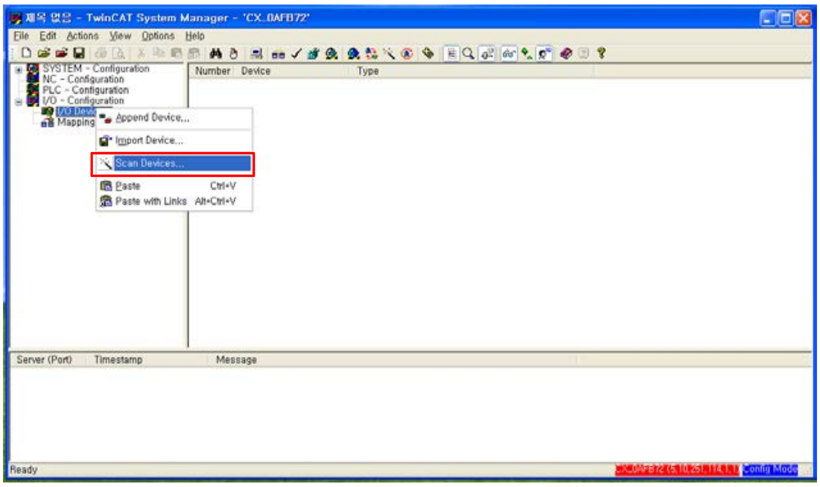
Verify that, before the test drive, the upper level controller and the servo drive are correctly wired, and the objects of the servo drive are correctly configured.

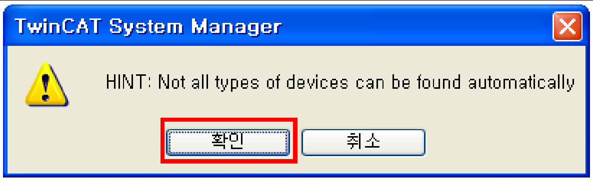
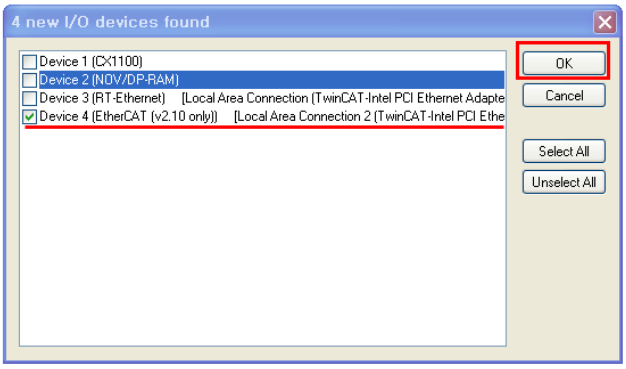
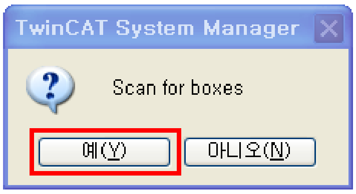
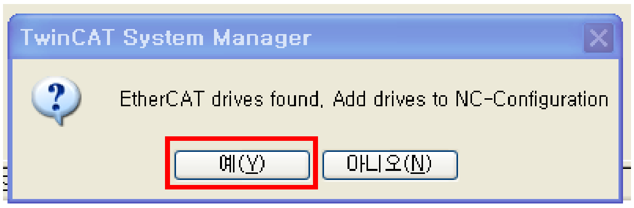
Order	Operation	Note
1	Connect power connector and safety function connector on servo drive.	Refer to「2.5 Wiring for input/output signal」
2	Connect motor cable and encoder cable on servo drive.	Refer to「2.5 Wiring for input/output signal」
3	If you use safety function, wire safety function connector on STO.  (Note1) Connect safety bypass connector on STO when safety function is not needed. If bypass connector is not connected to drive, There will be no input current to motor and no output torque. In this case, the state of panel monitor will be “sto”. (Note2) When disconnecting safety bypass connector on STO, push the lock ejector toward drive side and remove the connector. If lock is still connected, it is possible to break the connector. Pay attention to the lock ejector.	Refer to「2.5 Wiring for input/output signal」
4	Connector communication connector on ECAT IN and OUT between servo drive and upper controller. (Note1) Use CAT5, SFTP cable.	Refer to「2.5 Wiring for input/output signal」

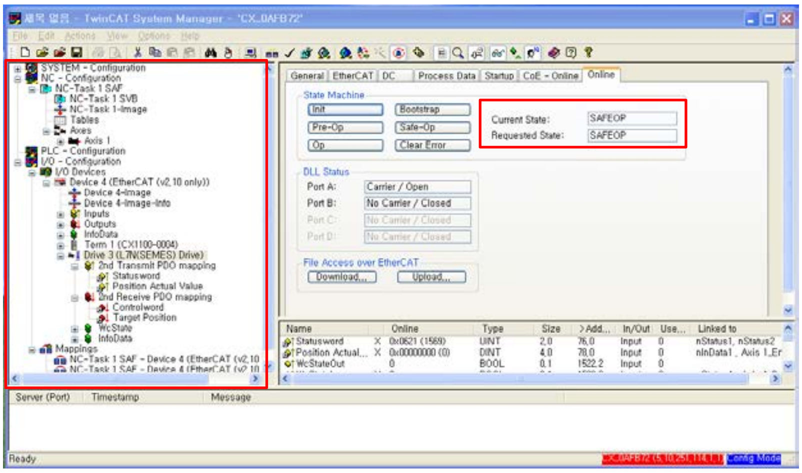
5	Supply power to servo drive. State of communication on servo drive will be "Safe OP". Check that the state of panel monitor on servo drive is the same as below drawing.  Link/Activity LED will be flickering. RUN LED will be Single flash. (Note1) If Error LED is flickering or ON or panel monitor displays AL-xx, refer to 11. Maintenance and inspection section. (Notoe2) If Link/Activity LED is not flickering, it means communication is not connected.	Refer to 「11 Maintenance and inspection」
6	Now, you have done all the procedure for checking the state and connection of input signal.	Refer to 「11 Maintenance and inspection」

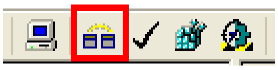
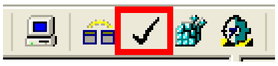
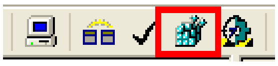
12.2 Test Drive Using TwinCAT System Manager

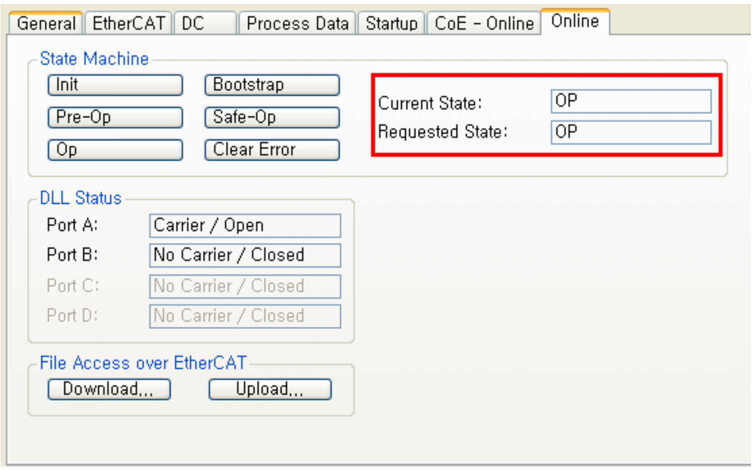
■ Test Drive Procedure

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

Order	Handling	Notes
	 ▪ If the "new I/O devices found" dialog window pops up, select any device or servo drive required to be driven for test and select the "OK" button.  ▪ If the dialog window below pops up, select the "Yes" button. 	
6	Add the NC Task of the servo drive to the NC-Configuration. ▪ If the dialog window below pops up, select "Yes." 	
7	Switch the TwinCAT System Manager to Free Run state, allowing it to control devices independently of the TwinCAT PLC and so on. ▪ If the dialog window below pops up, select "Yes." 	
8	Make sure that the NC Task is added to the NC-Configuration tree in the workspace on the left, and the servo drive is registered to the "I/O-Configuration" tree. ▪ If the connected servo drive is registered, select it. ▪ Click the "Online" tab on the right side to verify that the "Current State" and the "Requested State" are in the "SAFEOP" state.	

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

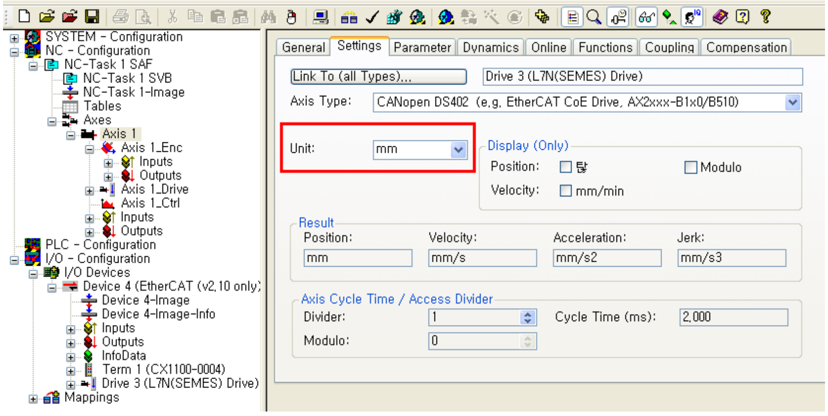
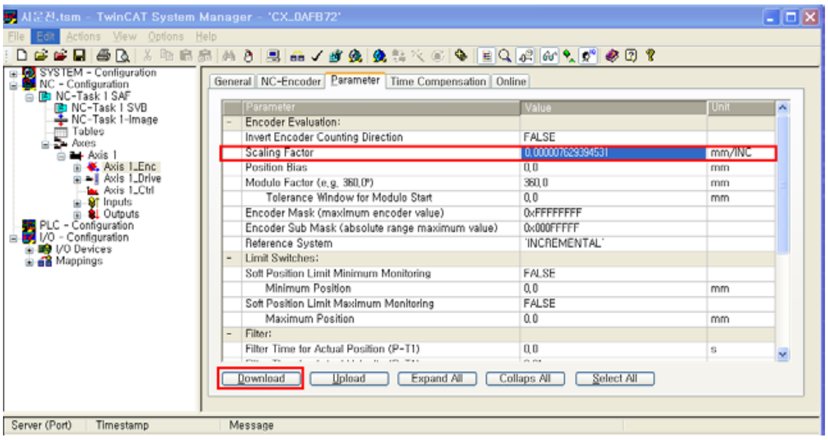
Click the Generate Mappings icon on the menu bar.
Map the images defined in the NC Task and the I/O Device.

Click the Check Configuration icon on the menu bar.
Check if the configuration currently set is valid.

Click the Activate Configuration icon on the menu bar.
Save the Project Configuration in the Windows Registry.

</td><td></td></tr>
<tr><td>10</td><td>Verify if the EtherCAT communication state is switched from the SafeOP state to the OP state.

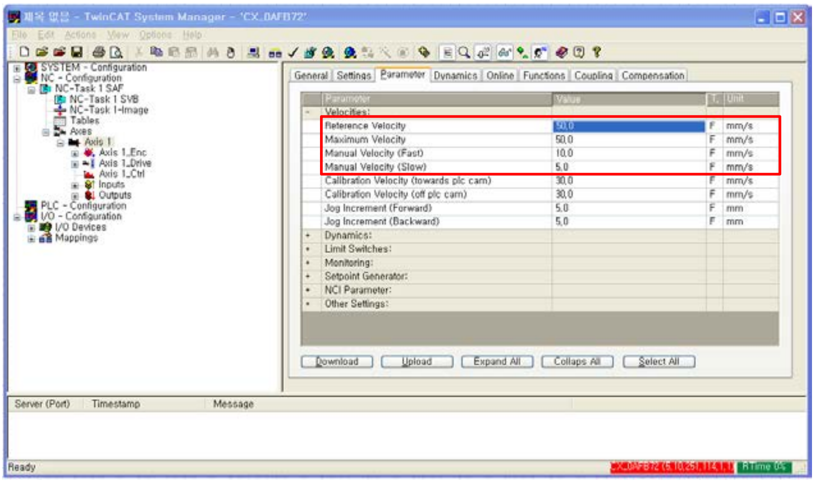
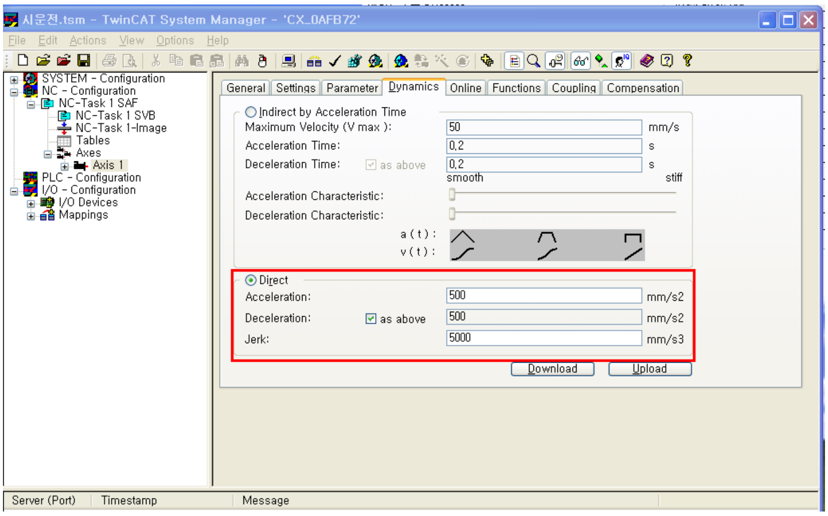
Check the communication LED.
The Link/Activity LED is flickering.
The RUN LED is on.
Check the online state of the I/O device of the TwinCAT system.
In the I/O-Configuration tree of the workspace, select the servo drive under the test drive, and then the "Online" tab, to check to see if the "Current State" and the "Requested State" are in the OP state.


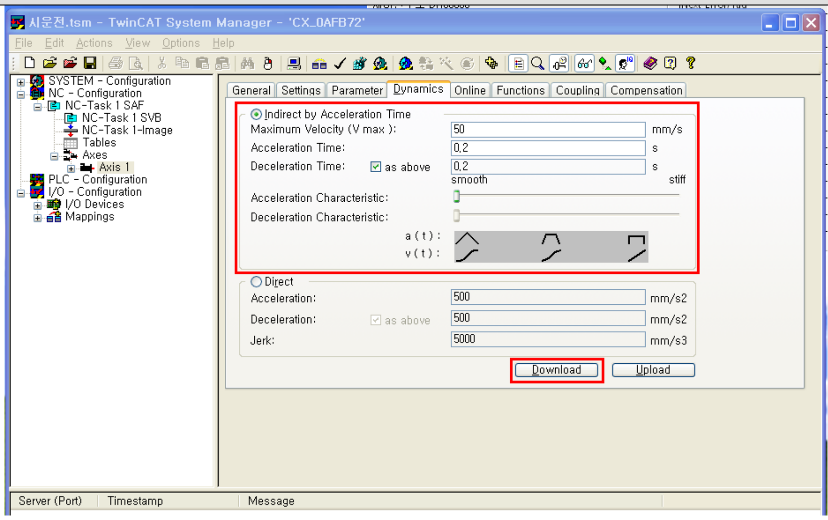
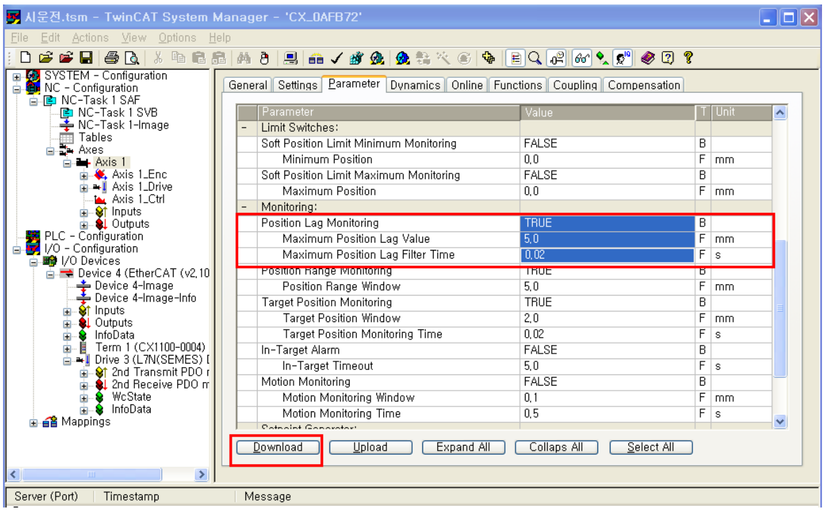
Verify if the state displayed on the bottom right of the TwinCAT System Manager menu window is in the Run state.
</td><td></td></tr>
</table>

Order	Handling	Notes
		
11	We finished adding the NC-Task and I/O Devices (servo drive) to the TwinCAT System Manager.	

■ Setting NC-Task Axis Parameters

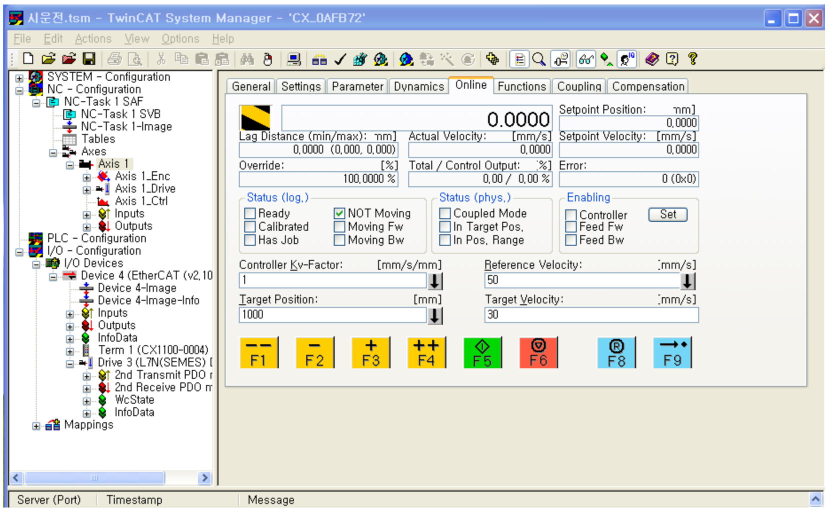
Order	Handling	Notes
1	Set the unit of display of the relevant axis. ▪ Select the "Axis1." ▪ Select the "Settings" tab. ▪ Select the unit of display for position and speed.  (Note) Note that the actual unit will not be converted even when the unit shown in the figure above was converted to mm or degree. (Note) Change the unit and tune the Axis Scaling Factor below.	
2	Set the Axis Scaling Factor. The Axis Scaling Factor determines the distance of the axial load movement while the motor shaft makes one revolution. ▪ Select the "Axis1." ▪ Select the "Parameter" tab. ▪ Set the "Scale Factor." Then, download the settings.  (Note) The default is 0.0001 if the scaling factor is not set. (Note) After the setting, download the settings.	
3	Set the speed parameter of the test drive axis. ▪ Select the "Axis 1." ▪ Select the "Parameter" tab.	

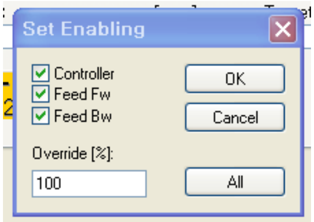
Order	Handling	Notes
	▪ Set the "Maximum Velocity", the "Manual Velocity (Fast)", and the "Manual Velocity (Slow)." Then, download the settings. 	
4	Set the speed, acceleration, and jerk of the test drive axis. ▪ Set the acceleration, deceleration, and jerk directly for the test drive axis; the TwinCAT NC can calculate the acceleration based on the configured profile timing. ▪ Select the Axis 1. ▪ Select the "Dynamics" tab. ▪ Set the acceleration, deceleration, and jerk directly. ▪ Select the "Direct" radio button. ▪ Set the acceleration, deceleration, and jerk. ▪ Download the settings.  ▪ Set the acceleration, deceleration, and jerk indirectly. ▪ Set the acceleration, deceleration, and jerk indirectly by setting the acceleration time. If you change the acceleration time, the acceleration value will be automatically changed. ▪ Select the "Indirect by Acceleration Time" radio button. ▪ Set the acceleration, deceleration, and jerk. ▪ Download the settings.	

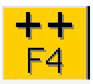
<table>
<tr><th>Order</th><th>Handling</th><th>Notes</th></tr>
<tr><td></td><td>
</td><td></td></tr>
<tr><td>5</td><td>Set the Position Lag Monitoring (Positional Error).
▪ Select the "Axis 1."
▪ Select the "Parameter" tab.
▪ Set the Position Lag Monitoring.
▪ Set the Position Lag Filter Time.
▪ Download the settings.


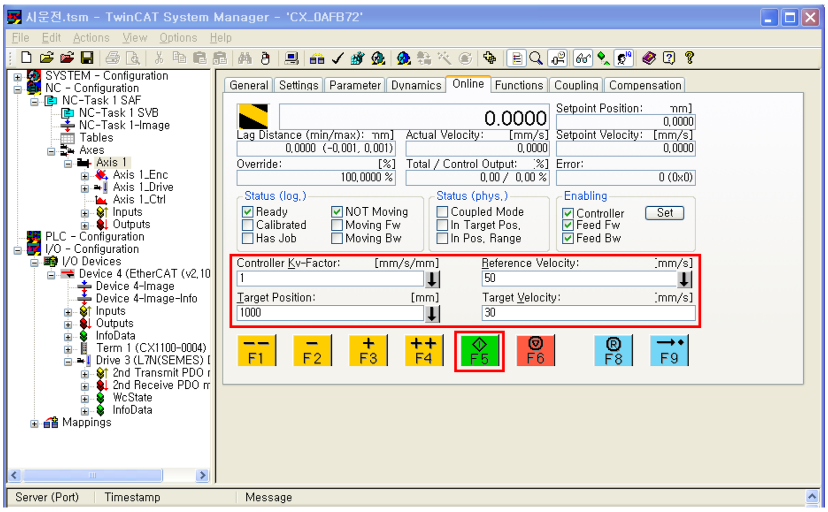
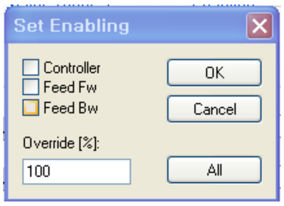
(Note) The Position Lag Monitoring is the difference between the position reference and the actual position at a given cycle time. When the Position Lag Monitoring is enabled, the TwinCAT NC generates an alarm if the positional error exceeds the settings.</td><td></td></tr>
</table>

■ Test Drive of Servo Drive Using TwinCAT NC Axis

<table>
<tr><th>Order</th><th>Handling</th><th>Notes</th></tr>
<tr><td>1</td><td>
Make sure that the TwinCAT NC axis is "Servo On."
▪ Select the "Axis 1."
▪ Select the "Online" tab.


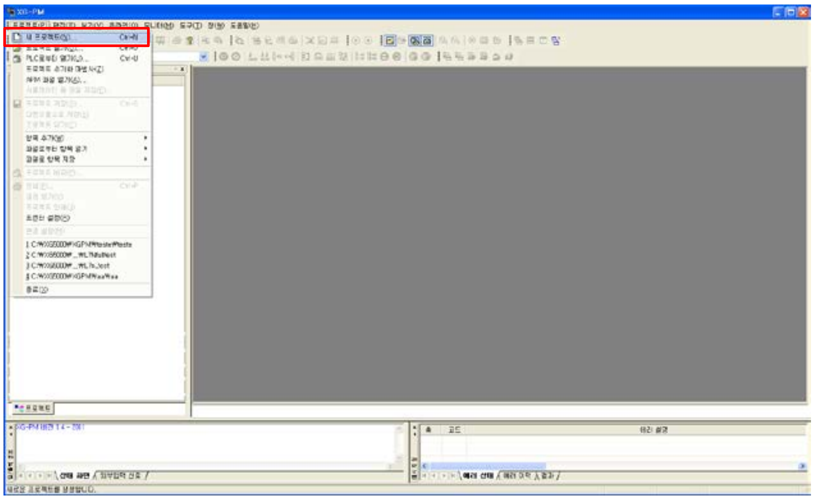
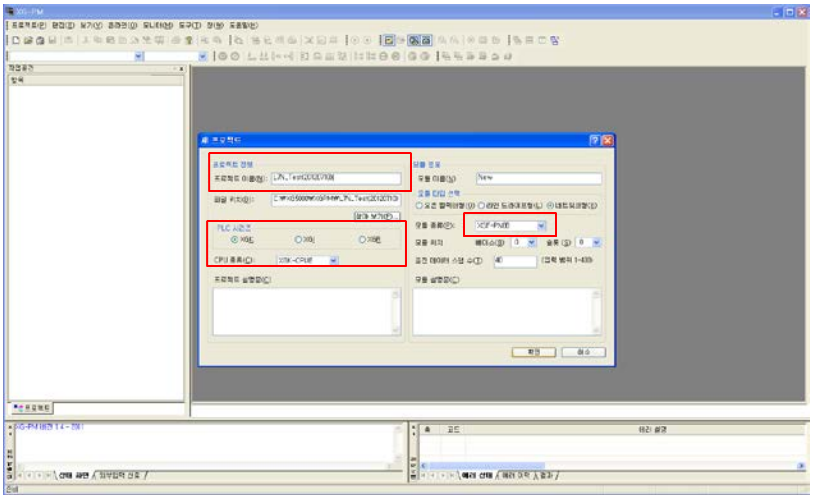
▪ Click the "Set" button.


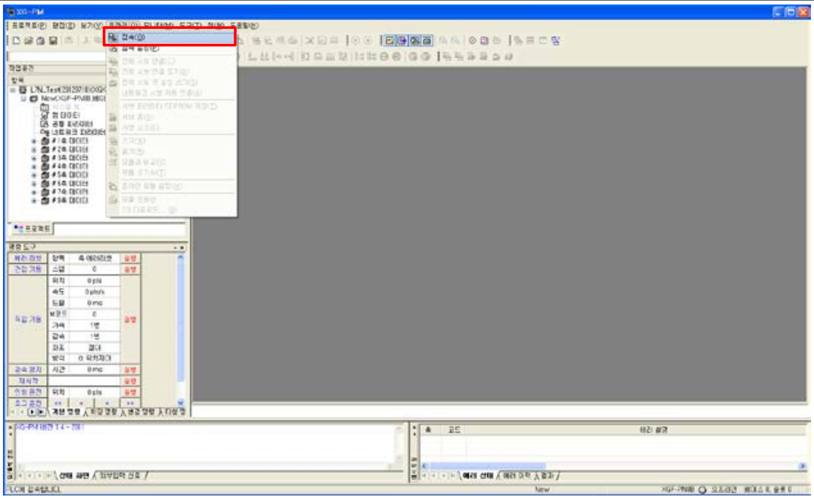
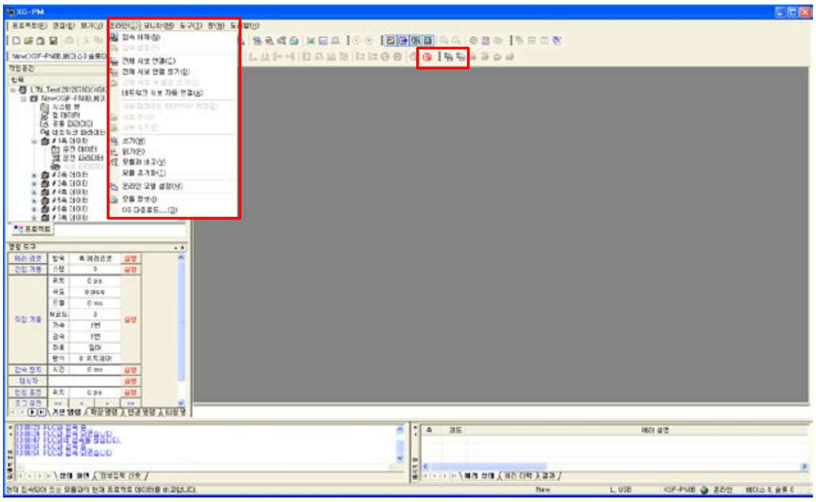
▪ Select the "Controller", "Feed Fw", and "Feed Bw."
▪ Set the Override to 100%.
▪ Click the "OK" button.
</td><td></td></tr>
<tr><td>2</td><td>
Use the buttons shown below to manually perform the drive test (JOG).
<table>
<tr><td></td><td>Make a reverse rotation at the specified Manual Velocity (Fast).</td></tr>
<tr><td></td><td>Make a reverse rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Make a forward rotation at the specified Manual Velocity (Slow).</td></tr>
<tr><td></td><td>Make a forward rotation at the specified Manual Velocity (Fast).</td></tr>
</table>
</td><td></td></tr>
<tr><td>3</td><td>
Carry out the test drive with a relative coordinate.
▪ Set the "Target Position."
</td><td></td></tr>
</table>

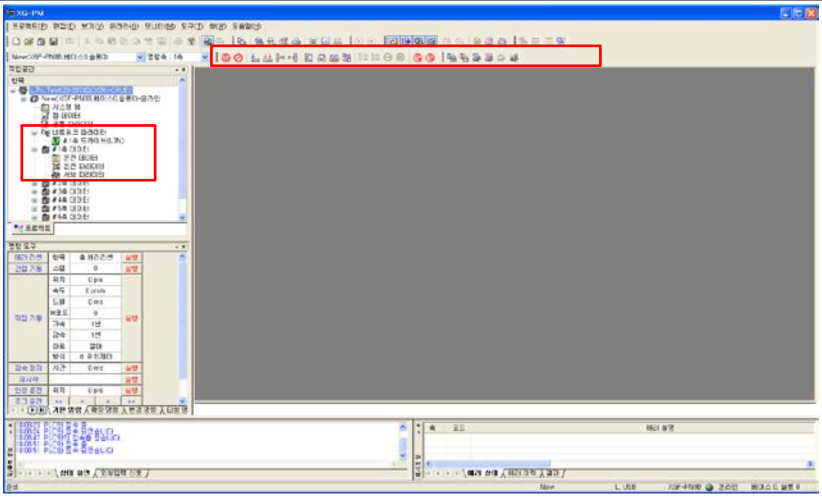
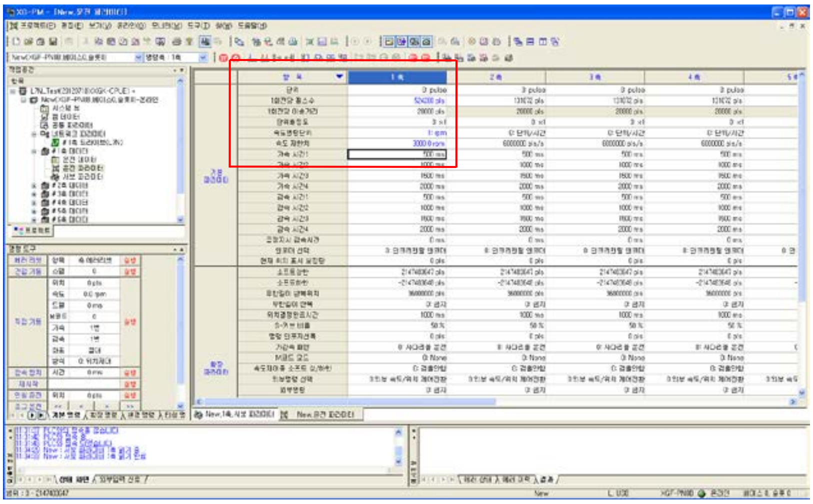
Order	Handling	Notes
	▪ Set the “Target Velocity.” ▪ Click “F5.”  ▪ Move it to the Target Position from the current position, decelerating to stop. ▪ After moving it to the Target Position, verify if the Set Position is identical to the Target Position. ▪ Click "F6" to stop during the relative coordinate driving. ▪ When the alarm goes off, click "F8" to reset the alarm. (Note) If the position limit is enabled, set the Target Position within the limit.	
4	Make sure that the TwinCAT NC axis is "Servo Off." ▪ Click "Set." ▪ Deselect the "Controller", "Feed Fw", and "Feed Bw." ▪ Click the "OK" button.  	
5	▪ The test drive of servo drive using the TwinCAT NC axis is completed.	

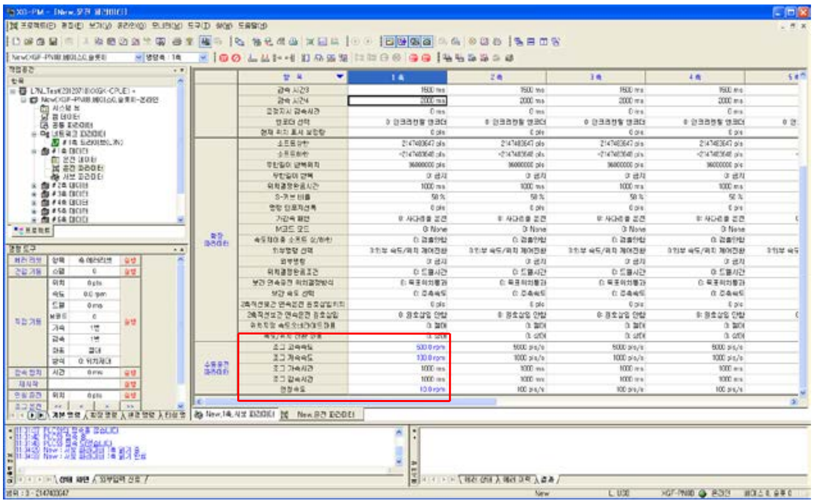
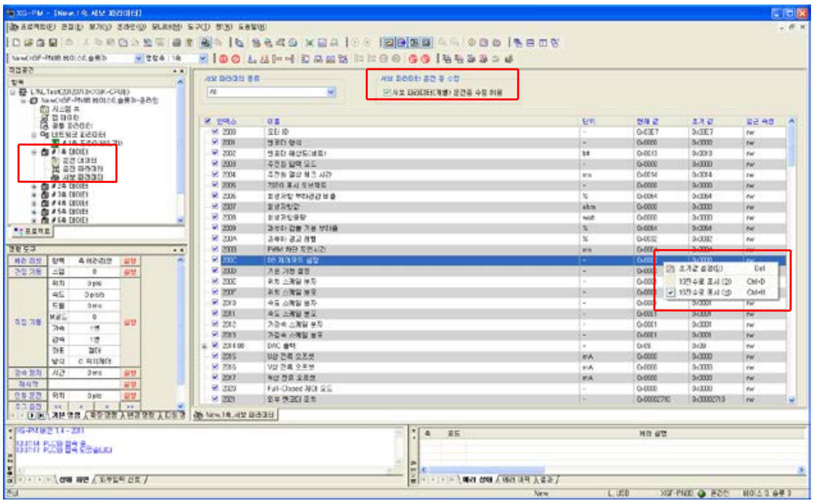
12.3 Test Drive Using LS ELECTRIC PLC (XGT + PN8B)

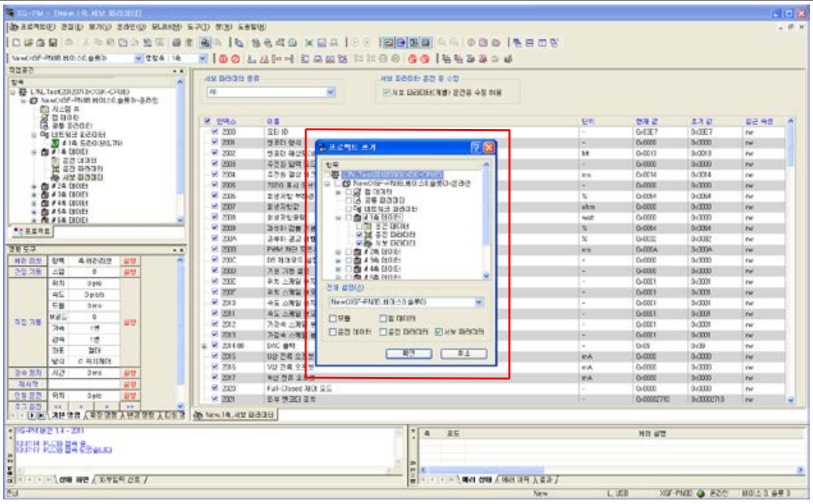
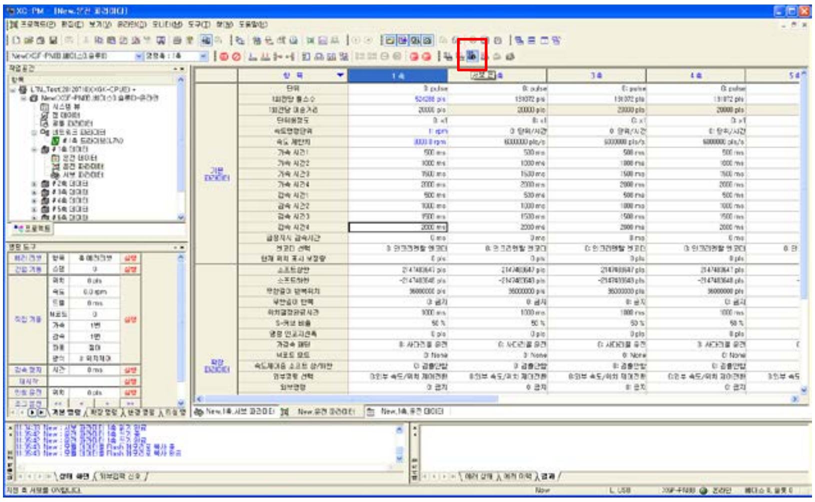
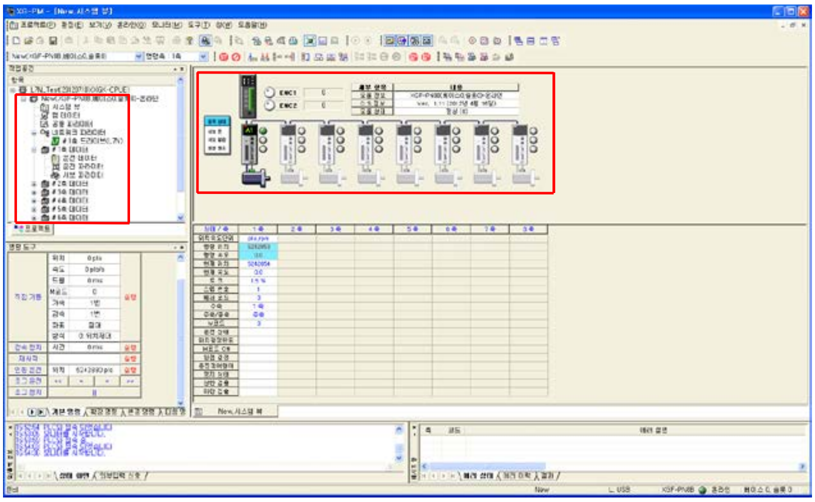
■ Test Drive Procedure

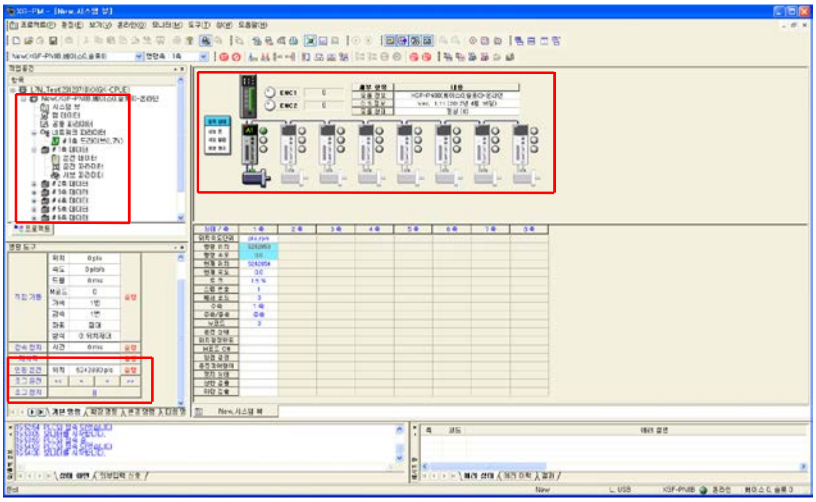
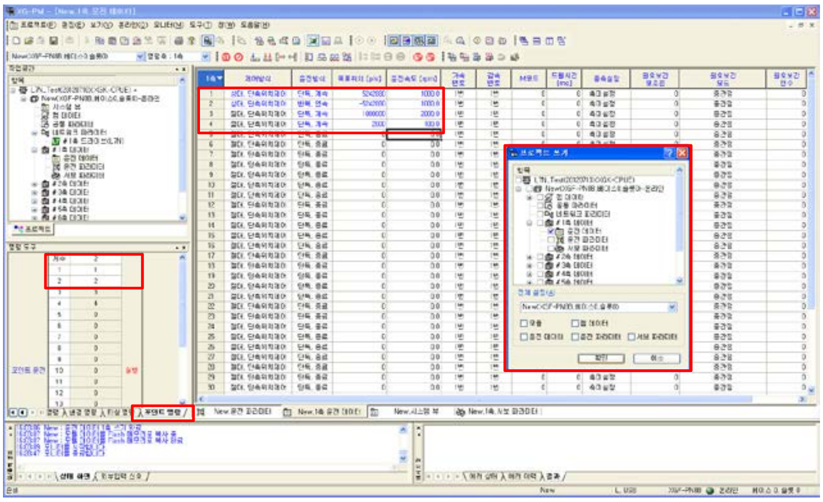
Order	Handling	Notes
1	▪ Launch the XG-PM.	
2	Create a new project. ▪ On the menu bar, click Project → New Project. 	
3	Name the new project. ▪ Select the PLC series and the CPU type. ▪ Select the module type (XGF-PN8B), and click OK. 	
4	The PC and the PLC are connected for communication. ▪ On the menu bar, click Online → Connection.	

<table>
<tr><th>Order</th><th>Handling</th><th>Notes</th></tr>
<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 the servo parameters in the workspace on the left through "Connect Network Servo Automatically."
▪ After the servo drive and the PLC are connected, the servo parameters and the motor test drive function will be enabled.
▪ Connecting multiple shafts enables the servo parameters as many as the number of the connected shafts.</td><td></td></tr>
</table>

Order	Handling	Notes
	 ▪ Check the state of panel monitor on servo drive as below.  ▪ Check the state of the status LEDs. ▪ The Link/Activity LED is flickering. ▪ The RUN LED is on. (Note) The automatic connection of network servo registers the device connected to the XGT, and initializes the parameters of the connected device. (Note) For subsequent connections, connect or disconnect the XGT and the servo drive by connecting the entire servos or disconnecting them respectively, since the device has been registered and its parameters initialized through automatic servo connection. (Note) In case that there is any change in the connected device of the XGT, initialize the parameters of the device connected by the automatic servo connection.	
6	Set the Driving Parameters of Test Drive Axis → Basic Parameters. ▪ Enter the number of encoder pulses per motor revolution. ▪ Encoder resolution of 19 bits = 524288 ▪ Check the motor specifications, and then configure appropriate settings. ▪ Set the unit of the speed command. ▪ It can be set as rpm or mm/s. ▪ Set the speed limit. ▪ Check the motor specifications, and then configure appropriate settings. 	

Order	Handling	Notes
8	Set the Driving Parameters of Test Drive Axis → Manual Operation (Jog) Parameters. 	
9	Set the servo parameters of the test drive axis.  ▪ Select parameters that you want to change, and then change them. ▪ To change any parameter during operation, check the "Allow to Modify Servo Parameters During Operation" checkbox at the top center. ▪ You can display a parameter value in decimal or hexadecimal.	
11	Save the configured parameters. ▪ On the menu bar, click Online → Write. ▪ With the Write Project dialog window enabled, check the Operation Data of Test Drive Axis, the Operation Parameters, and the Servo Parameters checkboxes, and then click OK to save the configured parameters.	

Order	Handling	Notes
		
12	Turn on the servo. ▪ On the menu bar, click the Servo ON icon to turn on the servo of the servo drive of the test drive axis. 	
13	Save the configured parameters. ▪ Select the "System View" and the "Basic Command" tabs in the workspace to check the state of the servo drive as shown in the figure below:  ▪ Check the state of the status LEDs.	

<table>
<tr><th>Order</th><th>Handling</th><th>Notes</th></tr>
<tr><td></td><td>The Link/Activity LED is flickering.
The RUN LED is on.</td><td></td></tr>
<tr><td>14</td><td>Test drive using jog operation and inching operation

For the "Jog Operation," the motor is driven with the settings of the operation parameters.
For the "Inching Operation," the motor moves to the entered position.
After entering the position value, click the "Run" button to carry out the test drive.</td><td></td></tr>
<tr><td>15</td><td>Point to Point Test Drive
Select Workspace → Command Tool → Point Command tab.
Set the operation data.
On the "Point Command" tab in the workspace, specify the number and the rank of point operations.
On the menu bar, click Online → Write to store the operation data.
On the Point Command tab, click the "Run" button to carry out the test drive.
</td><td></td></tr>
<tr><td>16</td><td>The test drive of serve drive using the XGT is completed.</td><td></td></tr>
</table>

13. Appendix

13.1 Firmware Update

13.1.1 Use of USB OTG

The drive performs USB host function to search for firmware files in the USB memory and download them to flash memory inside the drive. You can easily update the firmware using the USB memory and OTG cable without a PC. The update procedure is as follows:

1. Prepare a download cable (USB OTG cable) and a USB memory.

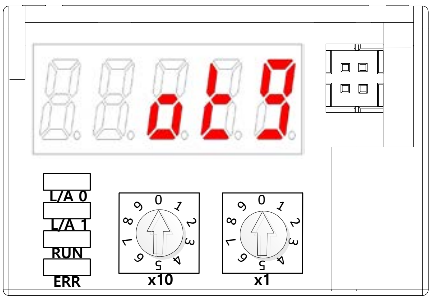
Use a USB OTG cable, consisting of USB Female Plug Type A and USB Mini B 5 pins, as the download cable.

2. Copy the firmware file (L7NH_FW.bin) to update to the USB memory.

***Caution - 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.**

3. After connecting the USB memory to the USB OTG cable, connect it to the USB terminal and power on the drive.

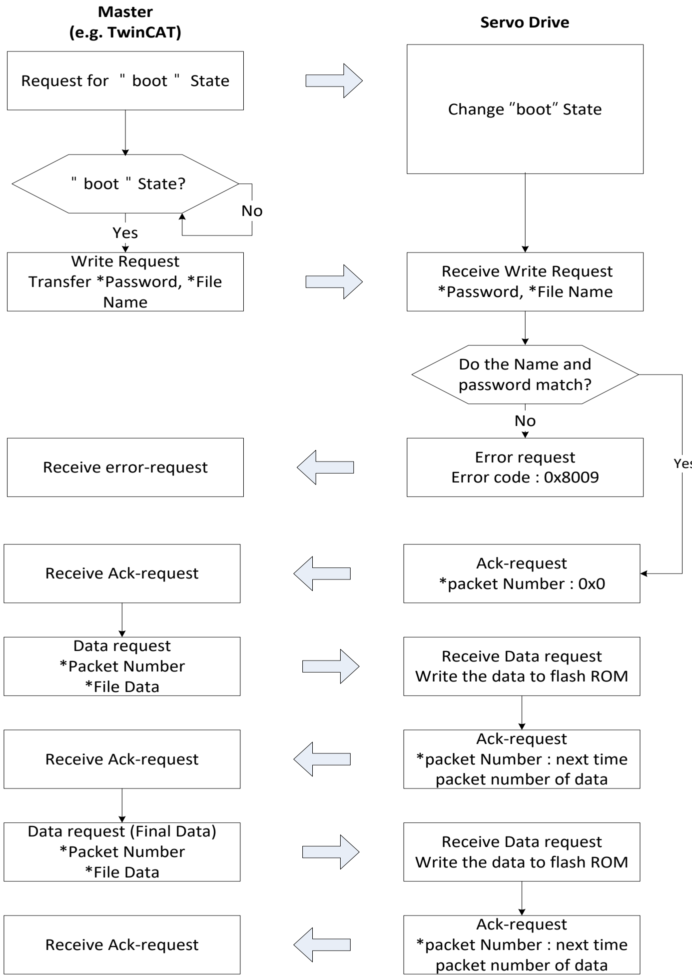
4. For an all-in-one drive, if the ERR LED is on, the firmware update is in progress while, if it is off, the download is completed; thus, you can remove the USB cable and the USB memory.



5. Turn on the power again, and verify if the firmware is updated.

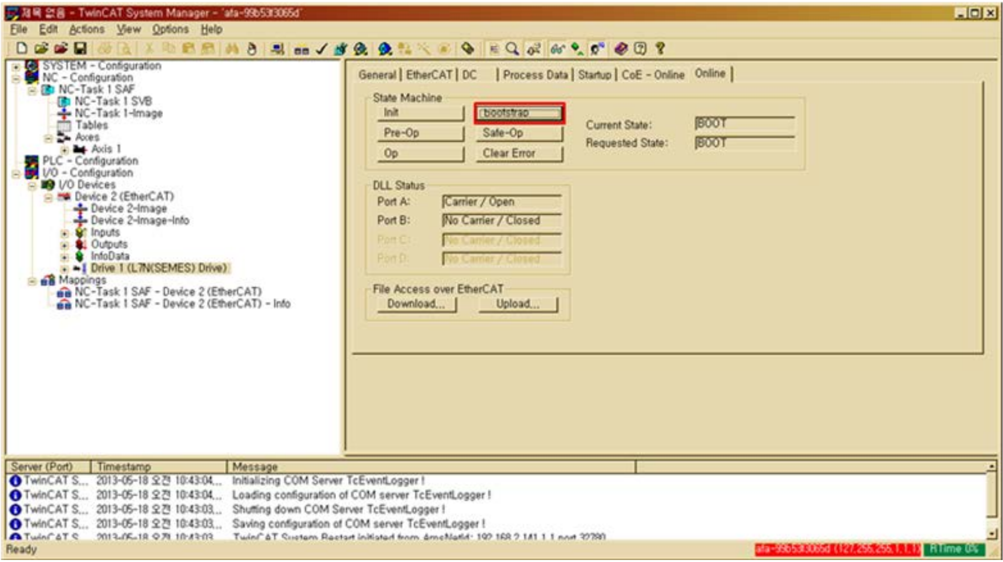
13.1.2 Use of FoE (File access over EtherCAT)

FoE is a simple file transfer protocol using the EtherCAT, enabling firmware update. When the drive and the upper level controller (e.g.: TwinCAT) are connected, you can simply update the firmware remotely via FoE. The update procedure is as follows:

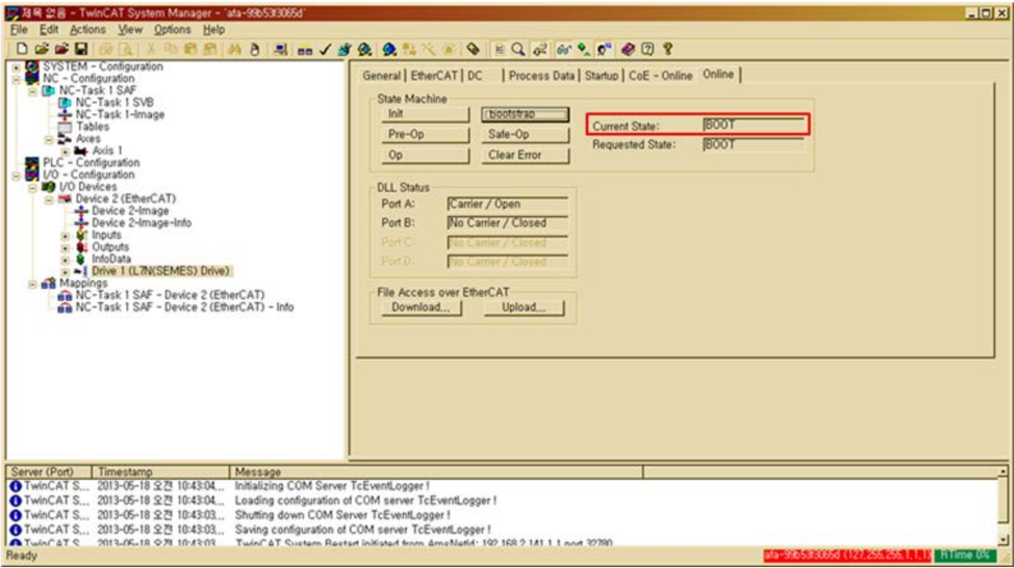


1. Establish communication between the drive and the TwinCAT.

2. I/O Configuration of TwinCAT - On the Online tab of the drive connected to the I/O, click Bootstrap in the State Machine menu.

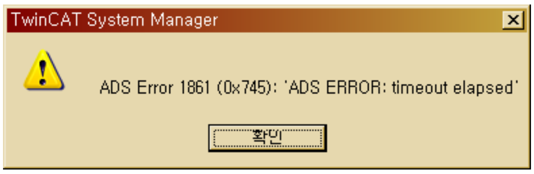


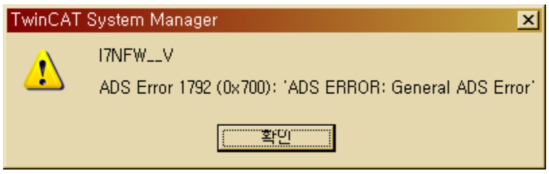
3. After the current state is changed to BOOT and you check the drive status (ERR LED ON), wait for approx. 10 seconds until the internal flash memory of the drive is cleared.



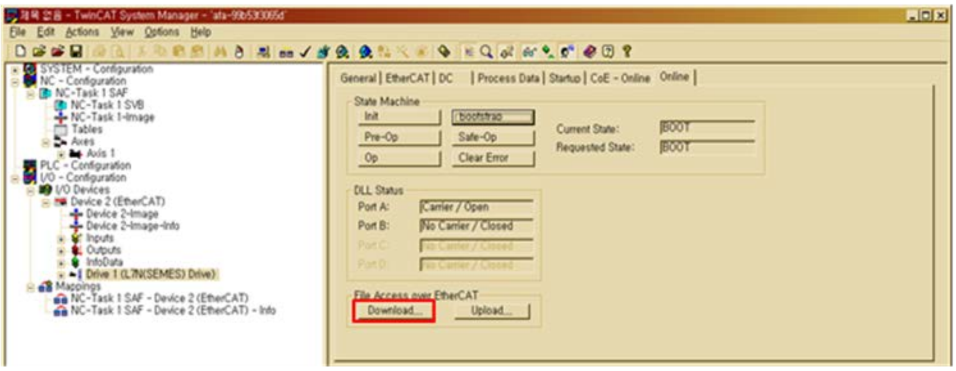
***Caution**

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.

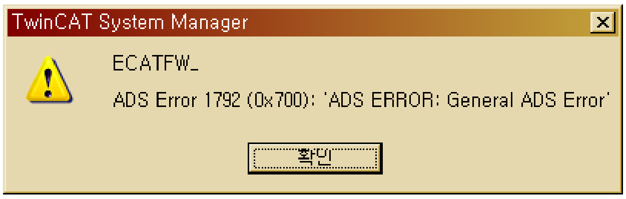




4. Click Download in the File Access over EtherCAT menu at the bottom of the Online tab.



5. Select the path of the file to be downloaded (I7NFW__V.efw or I7NFW__V.bin) and the file. If the file name does not match, download will not start and the following error will occur:

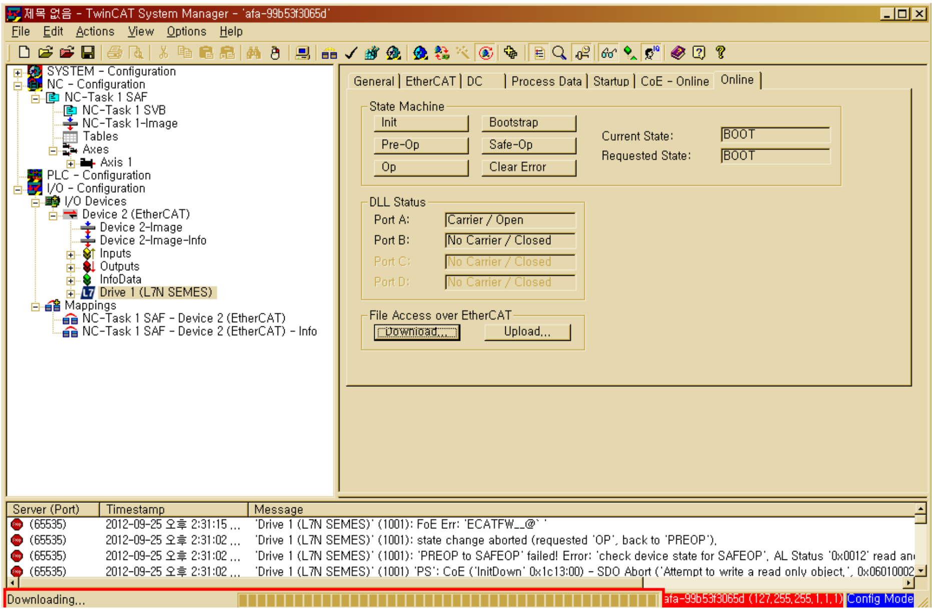


6. Enter the password for file download and click OK to start the download. (Password: 00000000)

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.

***Caution**

If you do not change the communication state to Init and turn on the power again according to the upper level controller, the state will be automatically changed to BOOT and the flash memory may be cleared. In this case, you have to download the firmware again according to this procedure.



8. After the download is completed, turn on the power again and verify if the firmware is updated.

13.1.3 How to use DriveCM

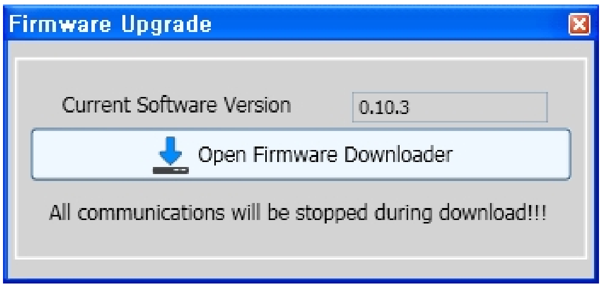
Drive CM allows the firmware upgrade through the PC's USB port. The transmission time depends on the PC performance, but it usually takes from scores of seconds to several minutes.

Select Setup→ Firmware Update from the top main menu or click on the corresponding shortcut icon.

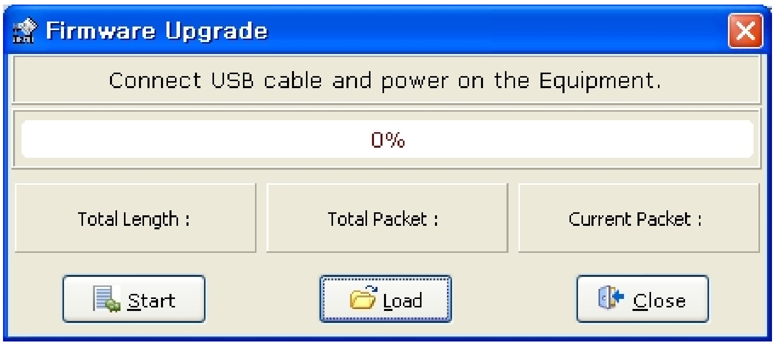
■ Precautions for Firmware Upgrade

- Do not turn off the PC or drive during transmission.
- Do not unplug the USB cable or close the firmware program during transmission.
- Do not run other applications on the PC during transmission.

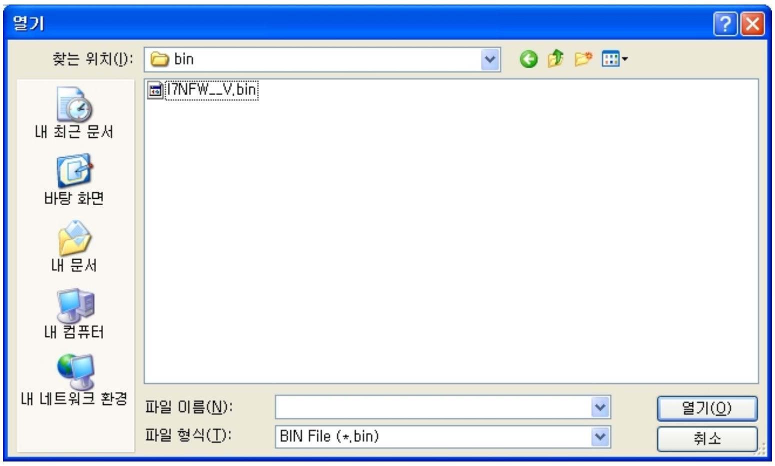
■ Operation of OS Download



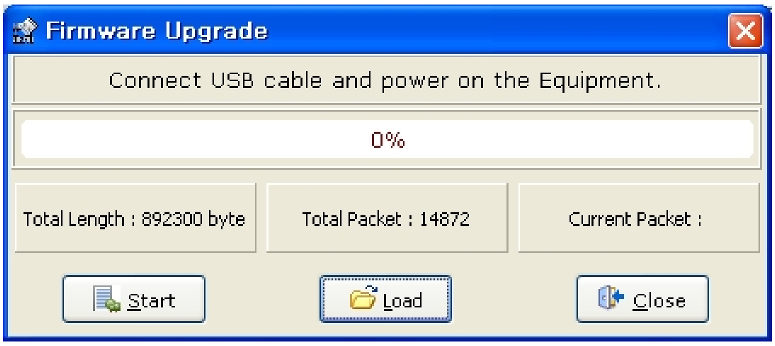
1) Click the “Open Firmware Downloader” button



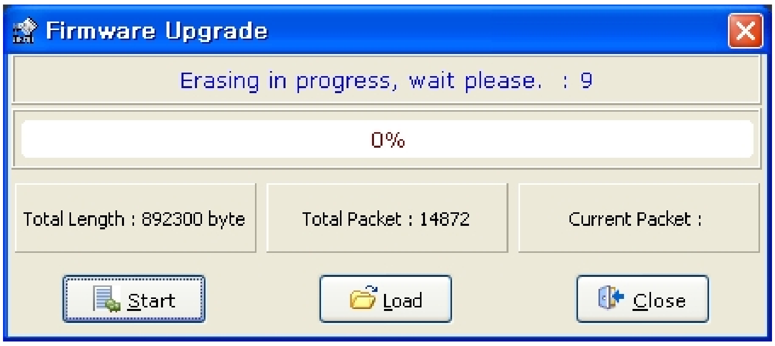
2) To load the appropriate firmware file, click the "Load" button..



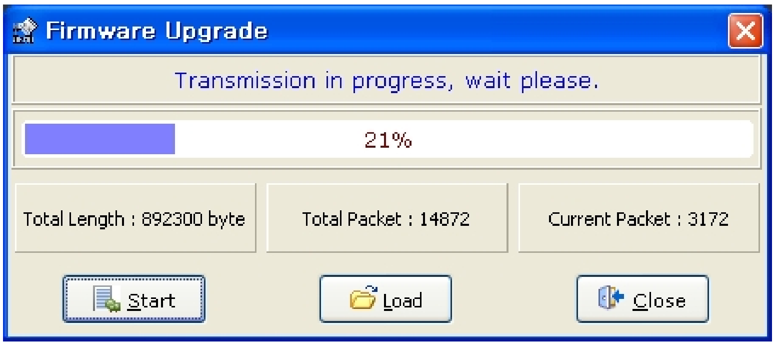
3) Select the BIN file of the firmware to transmit and press the Open button.



4) “Total Length" and "Total Packet" of the loaded firmware are displayed.



5) Press the "Start" button to start transmission. 10 seconds are counted down to clear the internal memory in the drive. (For XDL-L7NH and L7P, the segment 7 should display "USB". For PEGASUS, a red "ERR" LED should be illuminated.)



6) After clearing, the firmware is transmitted automatically and the progress bar and "Current Packet" display the current transmission status. (The transmission time depends on the PC performance, but it usually takes from scores of seconds to several minutes.)

7) When transmission is completed, a popup saying "Transmission completed" is displayed. (When transmission to the PC is completed, turn off and on the drive for rebooting.)

■ An Error Occurs During Transmission

1) Turn off and on the drive and repeat the above process from (2) to (7)

User Manual Revision History

Number	Date issued	Revised content	Version	Notes
1	2014.09.24	Added functions and precautions	1.1	
2	2014.10.05	Added funtions	1.2	
3	2014.11.10	Added precautions, assurance and revision history	1.3	
4	2020.05.30	Changed company name to 'LS ELECTRIC'	1.5	
5				
6				
7				
8				
9				

Green Management

LS ELECTRIC considers protecting the environment a high priority. We work hard to protect the Earth.

Product Disposal

The LS ELECTRIC servo drive is environmentally friendly.

You can disassemble the drive and recycle the iron, aluminum, bronze, and synthetic resin (cover) components.

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Specifications in this instruction manual are subject to change without notice due to continuous products development and improvement.

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