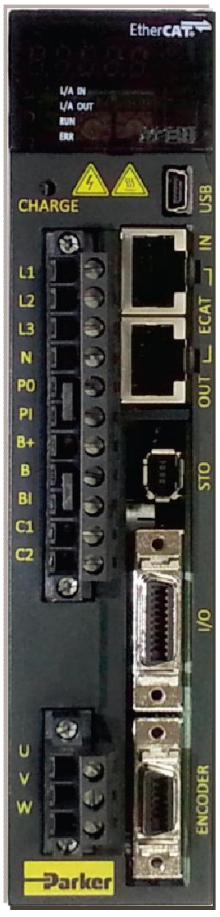
P Series User Guide
EtherCAT Drive

88-032556-01A June 1, 2015



ENGINEERING YOUR SUCCESS.

User Information

Warning
P series products are used to control electrical and mechanical components of motion control system. You should test your motion system for safety under all potential conditions.
Failure to do so can result in damage to equipment and/or serious injury to personnel.

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Since Parker Hannifin constantly strives to improve all of its products, we reserve the right to change this user guide and software and hardware mentioned therein at any time without notice.

In no event will the provider of the equipment be liable for any incidental, consequential, or special damages of any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this user guide.

Technical Assistance

Contact your local automation technology center (ATC) or distributor.

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Warning — Risk of damage and/or personal injury
The P series described in this guide contain no user-serviceable parts. Attempting to open the case of any unit, or to replace any internal component, may result in damage to the unit and/or personal injury. This may also void the warranty.

Symbols	Description
	Protective Earth Ground
	Functional Earth (Ground) Terminal
	Shield, Frame, or Chassis Terminal
	Caution Risk of Electrical Shock
	Caution, Refer to Accompanying Documentation

Important User Information

It is important that motion control equipment is installed and operated in such a way that all applicable safety requirements are met. It is your responsibility as an installer to ensure that you identify the relevant safety standards and comply with them; failure to do so may result in damage to equipment and personal injury. In particular, you should study the contents of this user guide carefully before installing or operating the equipment.

The installation, set up, test and maintenance procedures given in this User Guide should only be carried out by competent personnel trained in the installation of electronic equipment. Such personnel should be aware of the potential electrical and mechanical hazards associated with mains-powered motion control equipment—please see the safety warnings below. The individual or group having overall responsibility for this equipment must ensure that operators are adequately trained.

Under no circumstances will the suppliers of the equipment be liable for any incidental, consequential or special damages of any kind whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this guide.

Warning

High-performance motion control equipment is capable of producing rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. KEEP WELL CLEAR of any machinery driven by stepper or servo motors. Never touch any part of the equipment while it is in operation.
This product is sold as a motion control component to be installed in a complete system using good engineering practice. Care must be taken to ensure that the product is installed and used in a safe manner according to local safety laws and regulations. In particular, the product must be positioned such that no part is accessible while power may be applied.
This and other information from Parker Hannifin Corporation, its subsidiaries, and authorized distributors provides product or system options for further investigation by users having technical expertise. Before you select or use any product or system, it is important that you analyze all aspects of your application and review the information concerning the product in the current product catalog. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, safety, and warning requirements of the application are met.
If the equipment is used in any manner that does not conform to the instructions given in this user guide, then the protection provided by the equipment may be impaired.

Change Summary

1.Introduction

IN THIS CHAPTER

1.1 P Series Products Overview

The PD drives are a family of super compact, super economic digital servo drives. Their maximum continuous shaft power ranges from 100 Watts to 3500 Watts (3.5kW). Ready for direct panel mounting, you can select the precise power level needed for your application.

1.1.1 P series Features and Specification

PD drives support auto-configuration through BiSS-C protocol when using PM series servo motors. Also, drives have multiple feedback interfaces like EnDAT2.2, Quadrature, Sin/Cos and Tamagawa serial encoder. Especially PD-xxC drive can support EtherCAT communication to control various servo motor and actuators.

PM motors are economic, flexible and reliable rotary servo motor. Those are available in 40, 62, 80, 130 and 180 frame size. Rated output power ranges from 50W to 3500W with rated torque of 0.16Nm to 16.7Nm at 3000rpm rated speed.

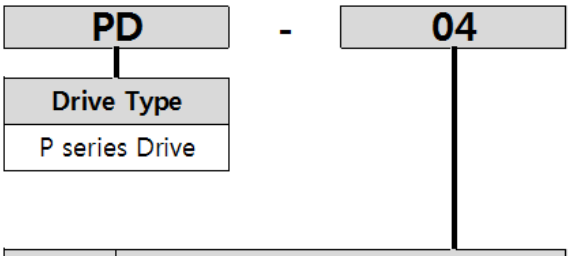
Drive support tool software to setup the servo motor has user-friendly and easy features. It also has many features like support step by step configuration, pre-defined profile function, auto tuning (real-time), various homing mode, jog motion, point to point movement, 4 channel oscilloscope and easy firmware update with PD drives.

Item \ Name		PD-04C	PD-10C	PD-35C
Input power	**Main power**	120VAC 1/3-phase 200-230[V](-15 ~ +10[%]), 50 ~ 60[Hz]	1/3-phase AC200 ~ 230[V](-15 ~ +10[%]), 50 ~ 60[Hz]	
	Control power	Single-phase AC200 ~ 230[V](-15 ~ +10[%]), 50 ~ 60[Hz]		
Rated current (A)		3.0	6.75	16.7
Peak current (A)		9.0	20.25	50.1
Encoder Type		Quadrature(Incremental) BiSS-B, BiSS-C(Absolute, Incremental) Tamagawa Serial(Absolute, Incremental) EnDat 2.2		
Control performance	**Speed control range**	Maximum 1 : 5000		
	Frequency response	Maximum 1 kHz or 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	**Function**	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, over speed, 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.

1.1.2 PD Drive Names

The following diagram explains the PD drive part numbers:



Code	Maximum Shaft Power
04	400W
10	1000W
35	3500W

Code	Command Interface
P	Pulse Command Torque(±10V) Command
C	EtherCAT

Figure 1. PD Drive Names

1.1.3 Input Power

Motor Power

PD - 04x, PD - 10x
PD - 35x…….....230 VAC, 3-phase, 50/60Hz

Control Power

PD - 04x, PD - 10x
PD - 35x…….....230 VAC, Single-phase, 50/60Hz

In Table 1, the maximum current is given at 230 VAC input, which equates to a motor bus voltage of 340 VDC.

Motor Output Power	PD-04x	PD-10x	PD-35x
Shaft Power @Continuous Current	400 Watts	1,000 Watts	3,500 Watts
Shaft Power @ Peak Current	1,200 Watts	3,000 Watts	10,500 Watts
Drive Output Power			
Continuous Current (RMS)	3.0 Amps	6.75 Amps	16.7 Amps
Peak Current (RMS)	9.0 Amps	20.25 Amps	50.1 Amps
Drive Input Voltage	120/230 VAC, 1Ø, 230 VAC, 3Ø, 50/60Hz	230 VAC, 1/3Ø, 50/60Hz	230 VAC, 1/3Ø, 50/60Hz
Drive Control Voltage	230 VAC, 1Ø, 50/60Hz	230 VAC, 1Ø, 50/60Hz	230 VAC, 1Ø, 50/60Hz

Table 1. Output Power Level

1.1.4 Front panel description of representative drives

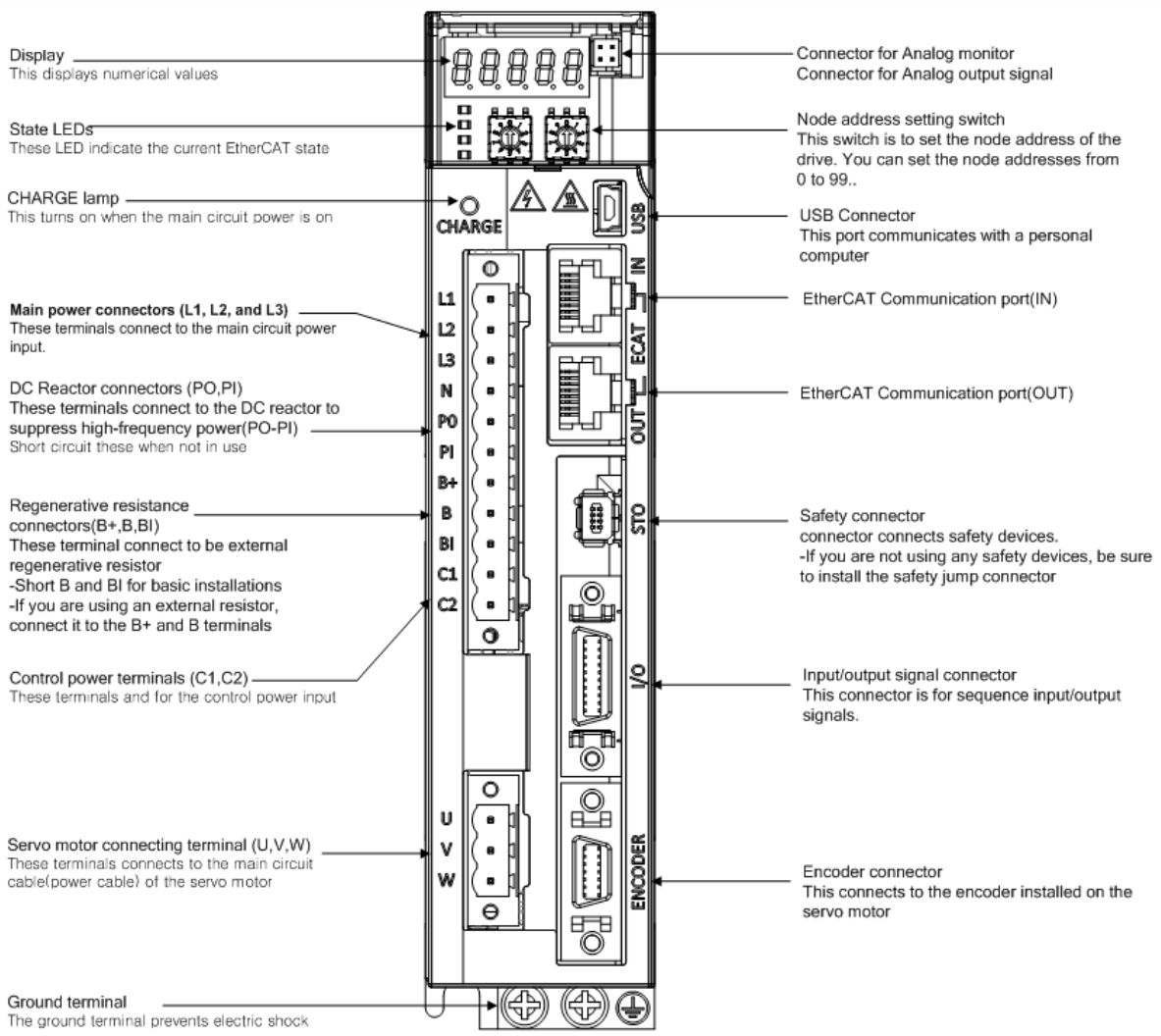


Figure 2. 400W Drive Front Description

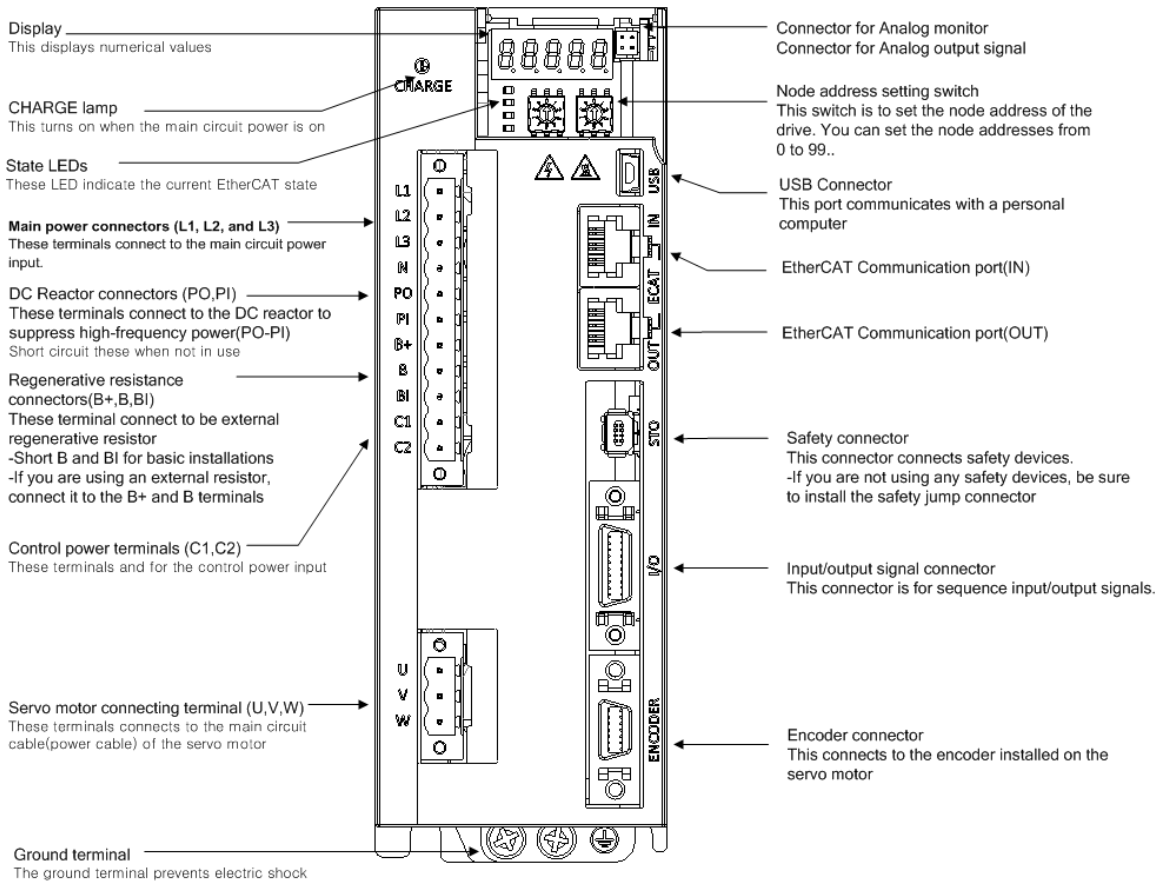


Figure 3. 1000W Drive Front Description

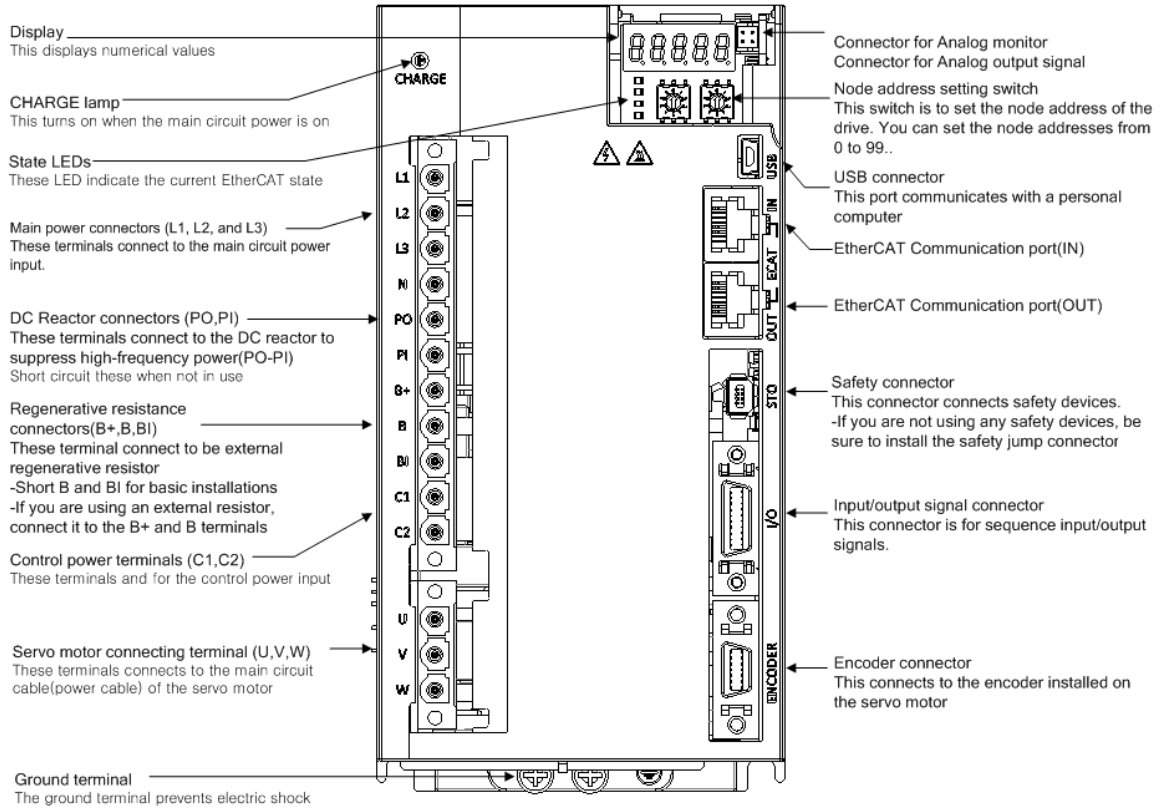


Figure 4. 3500W Drive Front Description

1.2 Compatible Parker Product

PAC(Parker Automation Controller) ..... PAC320 series, EtherCAT Master controller

Software ..... PAM(Parker Automation Manager) for controller
Drive Support Tool (Easy configuration) for drive

Rotary Servo / Direct Drive Rotary Motor…….. PM-F/PM-DD Series motors

For information about cables, motors, etc., see "*Chapter 2 Mechanical Installation*".

1.4 Illustrations in this Installation Guide

Typically, the illustrations in this guide show the P series PD-04x, PD-10x and the PD-35x.

If there is a need to illustrate *differences* between drives, relevant drawings are shown for each drive.

1.3 Assumptions of Technical Experience

The PD Drive is designed for industrial applications. To effectively install and troubleshoot the PD Drive, you must have a fundamental understanding of the following:

• Motion control applications
• Electromechanical actuators
• Electrical concepts such as voltage, current, switch, etc.
• Serial(RS-422, PD-xxP) / EtherCAT(PD-xxC) Communication depending on which communications protocol you are using.

1.4 Technical Support

For solutions to your questions about implementing the PD Drive, first refer to this manual. If you cannot find the answer in this documentation, contact your distributor for assistance.

If you need to talk to our in-house Application Engineers, please contact us at the telephone numbers listed on page 2.

2.Mechanical Installation

IN THIS CHAPTER

2.1 Environment

The PD drive operates in an ambient temperature range of 0°C (32°F) to 50°C (122°F) ambient air temperature for all models.

Items	Environment Requirements	Notes
Ambient Temperature	0～50[℃]	⚠**Caution** Please attach the cooling fan to the control panel, so that the temperature does not exceed the workable temperature.
Surrounding Humidity	90[%]RH or below	⚠**Caution** Freezing or condensation inside the drive due to long-term non-use may damage the drive. When operating after non-use, please remove water before operating.
External Vibration	Vibration Acceleration 4.9[㎨] or below	Excessive vibration may shorten the life cycle of the bearings
Environmental Requirements	No exposure to direct sunlight No corrosive/flammable gas No oil or dust In case of a closed space, adequate ventilation	

Table 2. Drive Installation Environment

2.2 Dimensions

There are three basic housing sizes for the PD drives. This section contains the dimensions for all PD drive models.

2.2.1 PD Drive Dimensions (PD-04Cto PD-35C)

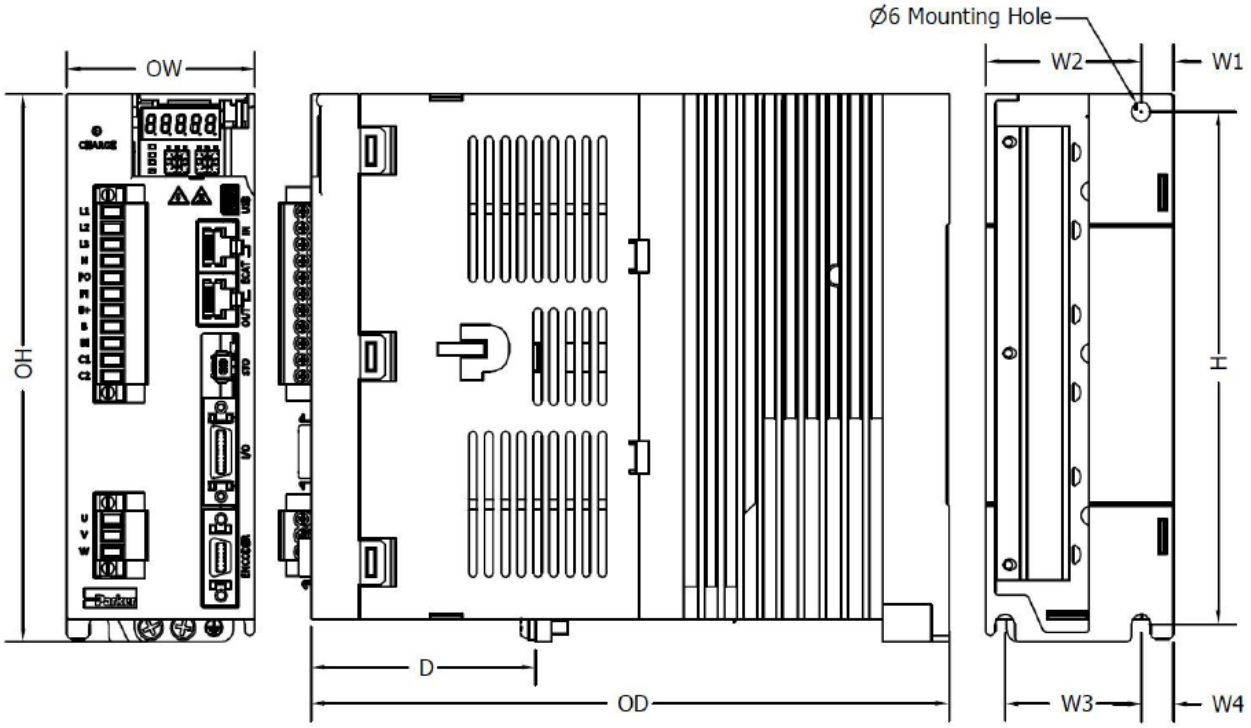


Figure 5. PD Drive Dimensions

(Unit : mm)

		PD-04	PD-10	PD-35
H	**Height**	158	158	158.5
OH	**Overall Height**	169	169	169
OW	**Overall Width**	38	58	88
W1	**Width 1**	6	10	44
W2	**Width 2**	32	48	44
W3	**Width 3**	32	42	78
W4	**Width 4**	-	10	5
D	**Depth**	64.8	69.3	85.5
OD	**Overall Depth**	172.5	197	198

Table 3. PD Drive Dimensions

2.3 Weight

	PD-04	PD-10	PD-35

Weight	1.0kg **Included heat-sink**	1.5kg **Included heat-sink**	2.5kg **Included heat-sink**

Table 4. PD Drive Weight

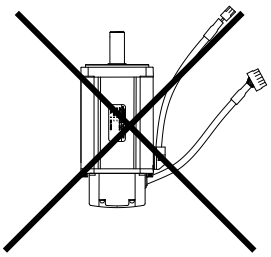
2.4 Mounting Guidelines

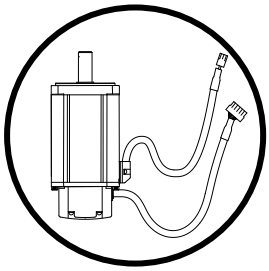
The P series drive is a vented product. To prevent material spilling into the drive, mount it under an overhang or in a suitable enclosure.

2.4.1 Cable Routing

Route high power cables (motor and mains) at right angles to low power cables (communications and inputs/outputs). Never route high and low power cables parallel to each other.

When installing the product vertically, please make sure no oil or water flows into the connection unit.





Please do not stress or damage the cable. When moving the motor, please use movable cable and make sure the cable does not wiggles.

2.4.2 Panel Mounting

Please attach the cooling fan to the control panel, so that the temperature does not exceed the workable temperature. Also, the proper mounting clearance is required to maintain workable temperature while motor and drive are working.

Please refer to each drive mounting informations as below.

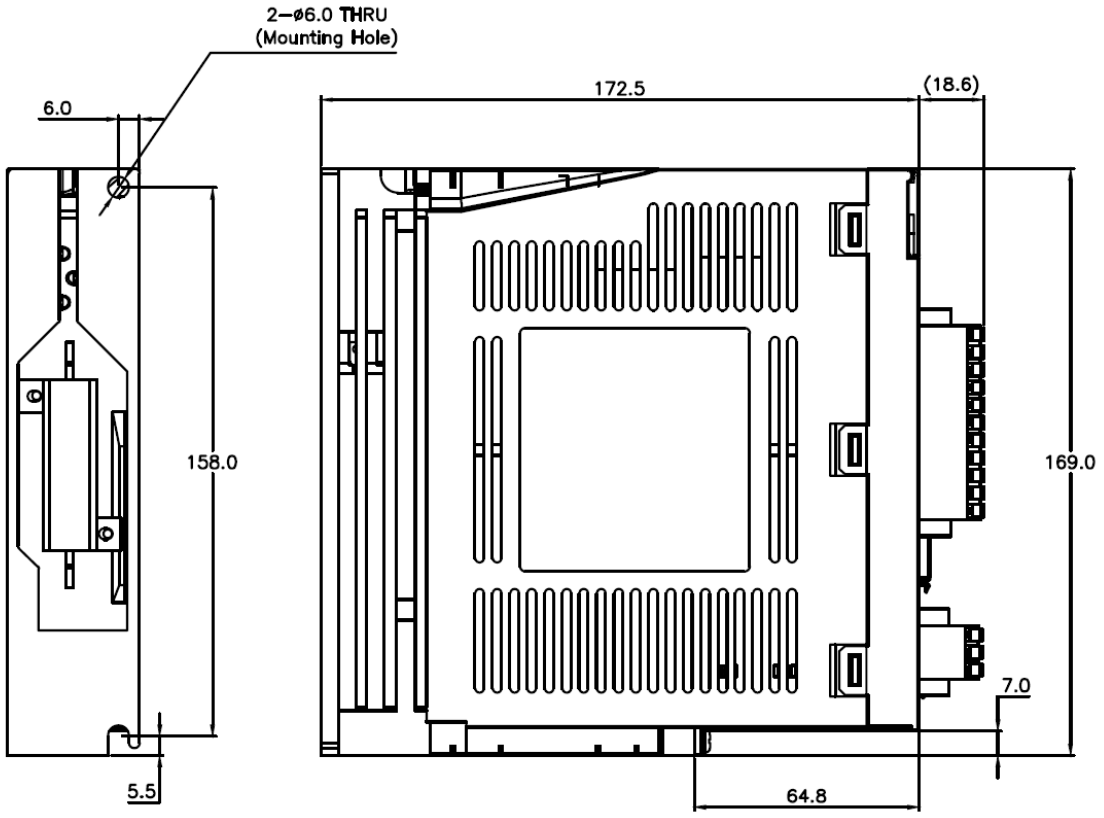


Figure 6. PD-04P Mounting Information

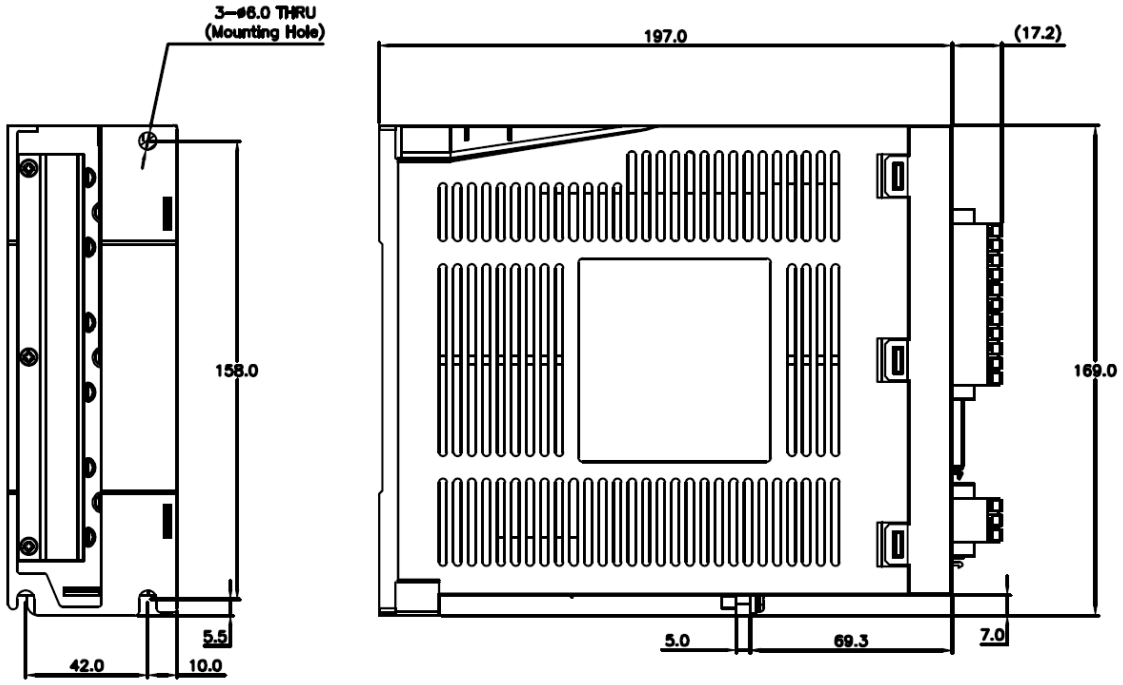


Figure 7. PD-10P Mounting Information

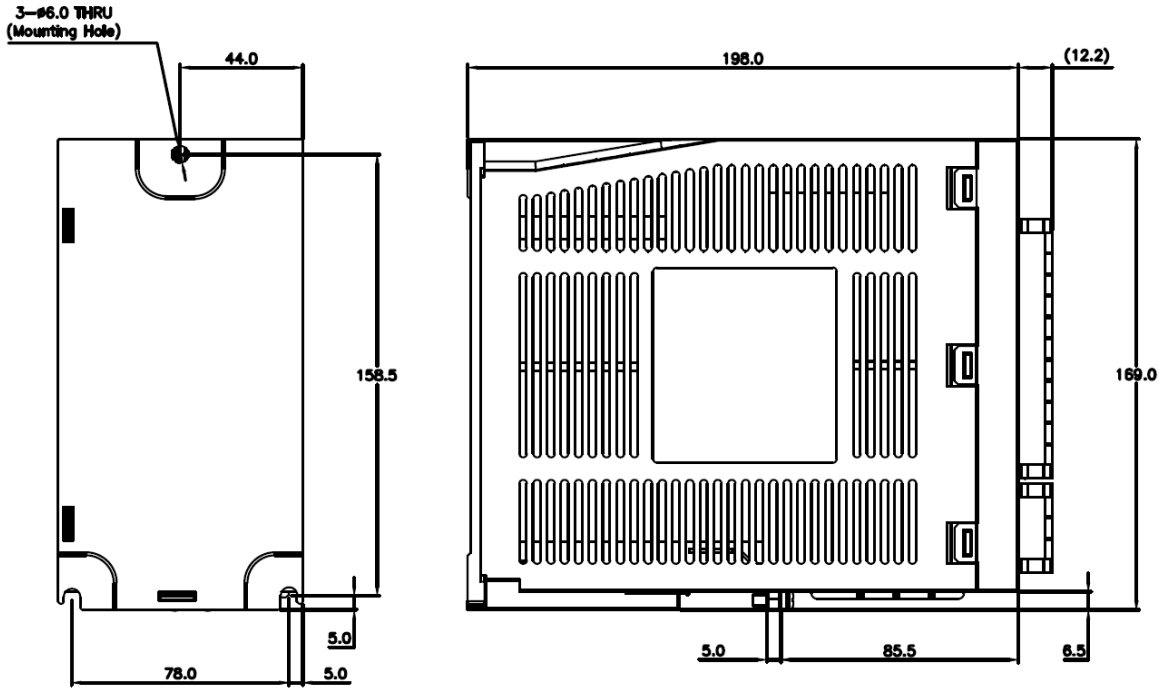


Figure 8. PD-35P Mounting Information

3.Electrical Installation

IN THIS CHAPTER

3.1 Installation Safety Requirements

PD drives meet the requirements of both the European LVD (Low Voltage Directive) and EMC (Electromagnetic Compliance) directives when installed according to the instructions.

As a rule, it is recommended that you install the drive in an enclosure to protect it from atmospheric contaminants and to prevent operator access while power is applied. Metal equipment cabinets are ideally suited for housing the equipment because they provide operator protection, EMC screening, and can be fitted with interlocks arranged to remove all hazardous motor and drive power when the cabinet door is opened.

Do not arrange the interlocks to open circuit the motor phase connections while the system is still powered as this could damage the drive.

3.1.1 Precautions

During installation, take the normal precautions against damage caused by electrostatic discharges.

- Wear earth wrist straps.
- Include a mains power switch or circuit breaker within easy reach of the machine operator. Label, clearly, the switch or breaker as the disconnecting device.

3.1.2 Auto-Configuration for Encoders

The PD drives recognize “smart encoders” attached to Parker motors. You can apply power to the drive, and the drive reads all necessary motor parameters from the motor. The drive and motor are then ready to use.

If a drive is swapped out for any reason, you can insert a replacement—the replacement drive automatically reads the motor parameters.

3.2 System Installation Overview

The figures in this section illustrate the components necessary for electrical installation and configuration of the PD drive. Figure xx represents the installation of models PD-04xx through PD-35xx.

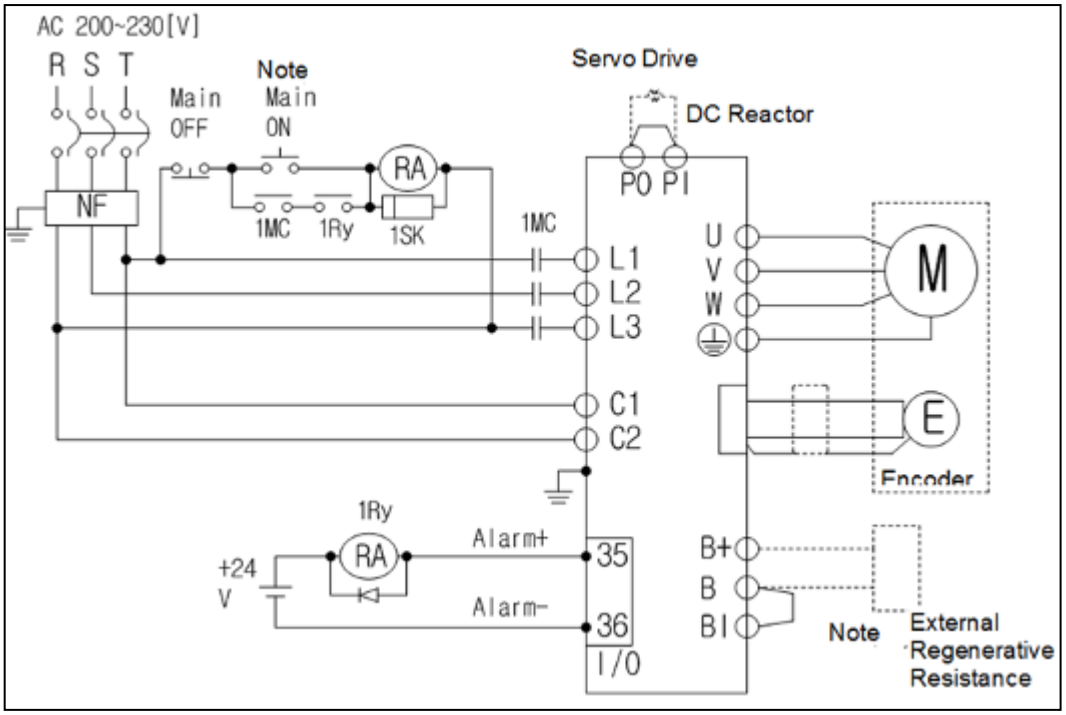


Figure 9. System Installation Overview

Warning

This product has been developed for industrial environments. Due to exposed high voltage terminals, this product must not be accessible to users while under normal operation.

3.3 Power Supply

3.3.1 Power Circuit Electronics Specification

Type	400W	1kW	3.5kW	
MCCB	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)	
Power Cable	AWG16 (1.25 SQ)	AWG14 (2.0 SQ)	AWG12 (4.0 SQ)	
Pressure Terminal	UA-F1510, SEOIL (10mm Strip & Twist)	UA-F2010, SEOIL (10mm Strip & Twist)	UA-F4010, SEOIL (10mm Strip & Twist)	
Recovery Resistance (default)	50[W] 100Ω	100[W] 40Ω	150[W] 13Ω	

Table 5. Power Circuit Electronics Specification

3.4 Braking Resistance (Optional)

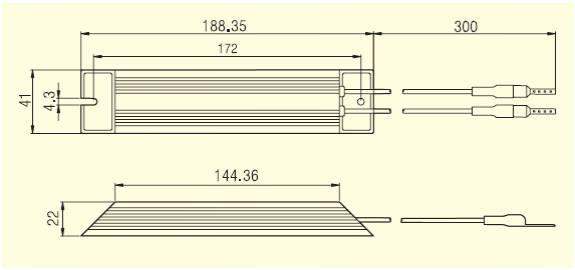
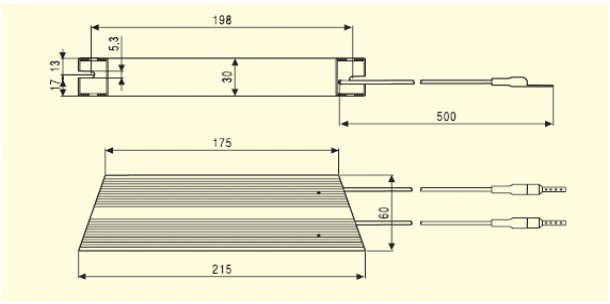
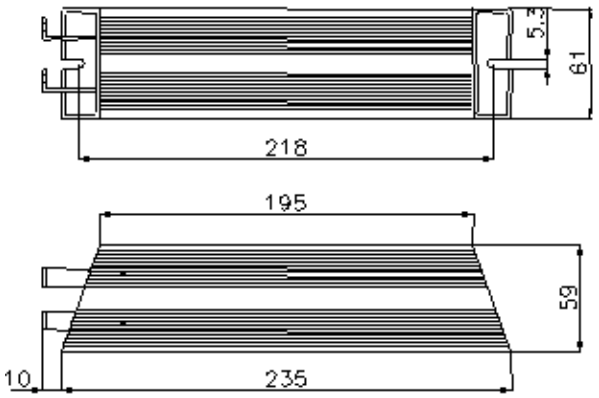
Category	Product Name	Name	Applicable Drive	Specification
Resistance	Braking resistance	APC-140R50	100[W] 200[W] 400[W]	
Resistance	Braking resistance	APC-300R30	800[W] 1[kW]	
Resistance	Braking resistance	APC-600R30	2[kW] (2P) 3.5[kW] (3P)	

Table 6. Braking Resistance (Optional)

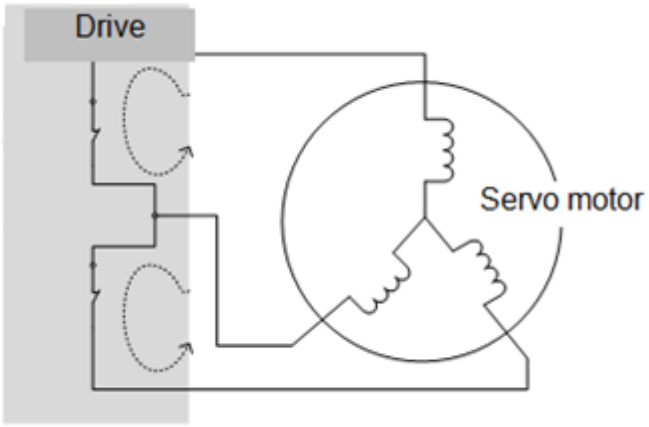
3.5 Brake Relay (Optional)

3.5.1 Dynamic Brake

It refers to rapidly stopping the motor by electrically shorting the phase of the servo motor

Circuits related with dynamic brake are installed inside the drive.

This drive shorts either 2 phases or 3 phases, depending on the model.



You can set various stop modes shown below by configuring the dynamic brake control mode. (0x2012)

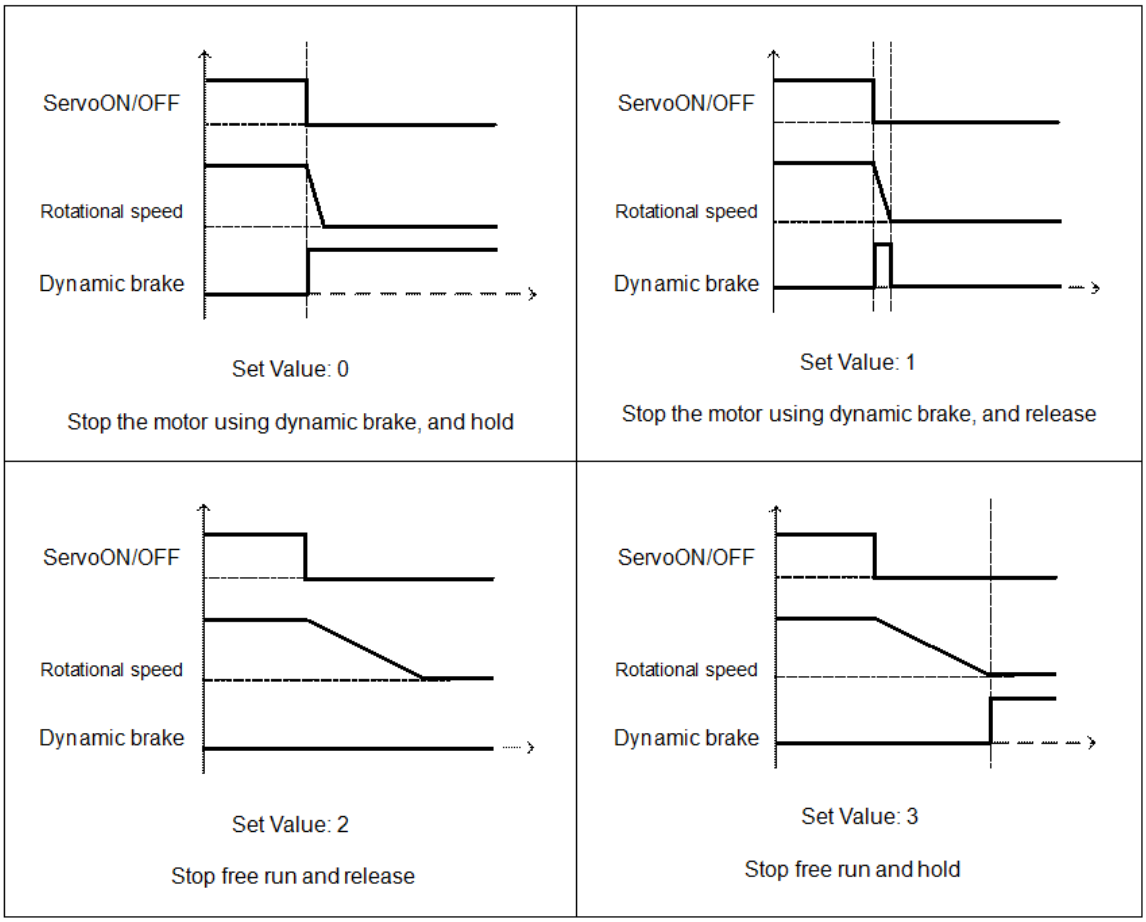


Figure 10. Dynamic Brake Sequence

- **Related Objects**

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

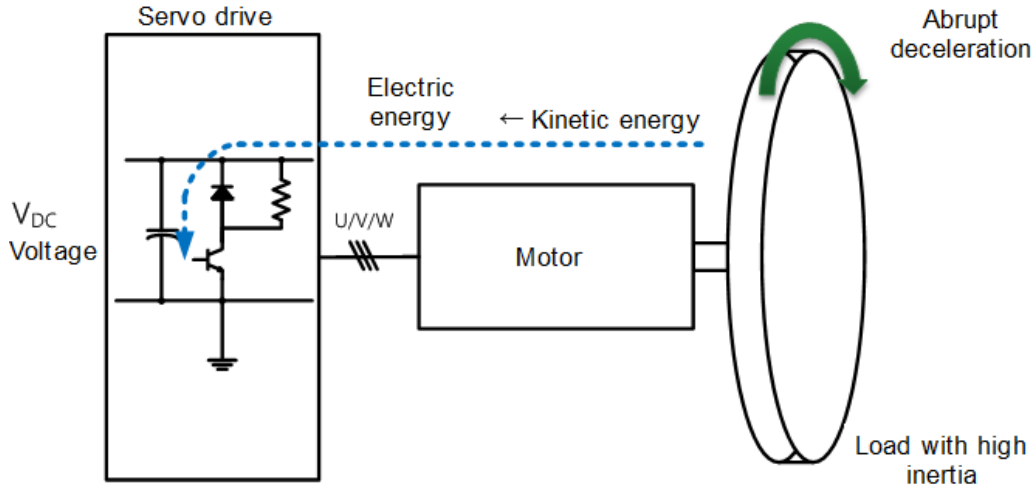
Table 7. Dynamic Brake Related Objects

3.5.2 Signal Output Function Setting

Please refer to " *3.5.2 Brake Output Signal Function* Setting ".

3.6 Regeneration Protection

Regeneration refers to the motor's kinetic energy being converted to electrical energy due to driving a load with high inertia or abrupt deceleration, which then flows into the drive. When this happens, regeneration brake is used to inhibit the rise of the drive's internal voltage (V_{DC}) and thereby prevent damage to the drive.



- **Related Objects**

Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	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 Power	UINT	RW	No	Watt
0x200D	-	Peak Power of Regeneration brake Resistor	UINT	RW	No	Watt
0x200E	-	Duration Time @ Peak Power of Regeneration brake Resistor	UINT	RW	No	ms

Table 8. Regeneration Related Objects

3.6.1 Internal Resistor Setting

This drive has a built-in regeneration brake corresponding to the drive power. Specifications of internal regeneration brake for each drive power are as follows.

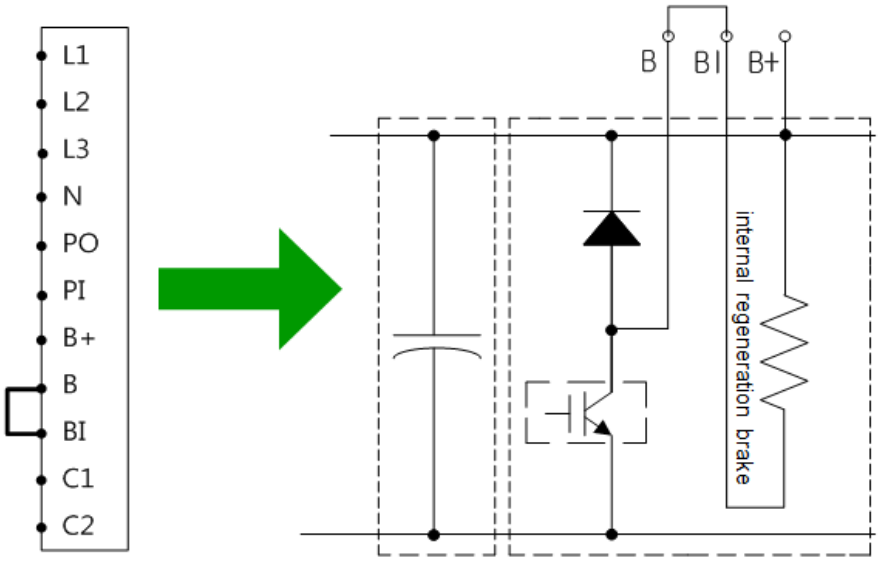
Drive Power	Internal Resistance	Internal Resistance Power
400W	100Ω	50W
1KW	40Ω	100W
3.5KW	12.6Ω	150W

Table 9. Internal Resistor Setting

To use the regeneration broke built in the drive, you should set the brake in the following order.

A. Regeneration brake wiring

- Check for B, BI terminal short (default short at the time of release from the factory, 1kW or less)



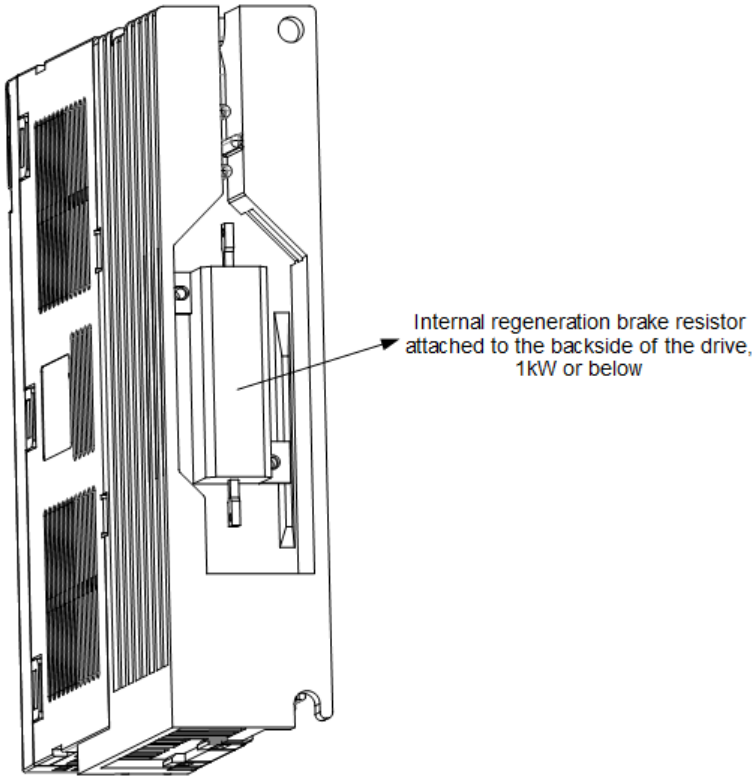
Wiring for internal regeneration brake resistor

B. Regeneration brake resistor setting (0x2009)

- Select the built-in regeneration brake (0x2009 = 0)
- Attach to the backside of the heat protection panel
- Default value: 0

C. Check the internal regeneration brake value and power

- Check internal regeneration brake value (0x200B)
- Check regeneration brake power (0x200C)
- 1KW or less : Attach to the backside of the heat protection panel(See the figure below)
- 3.5KW ~ 15KW : install inside the drive
- 15KW or above: no internal regeneration brake

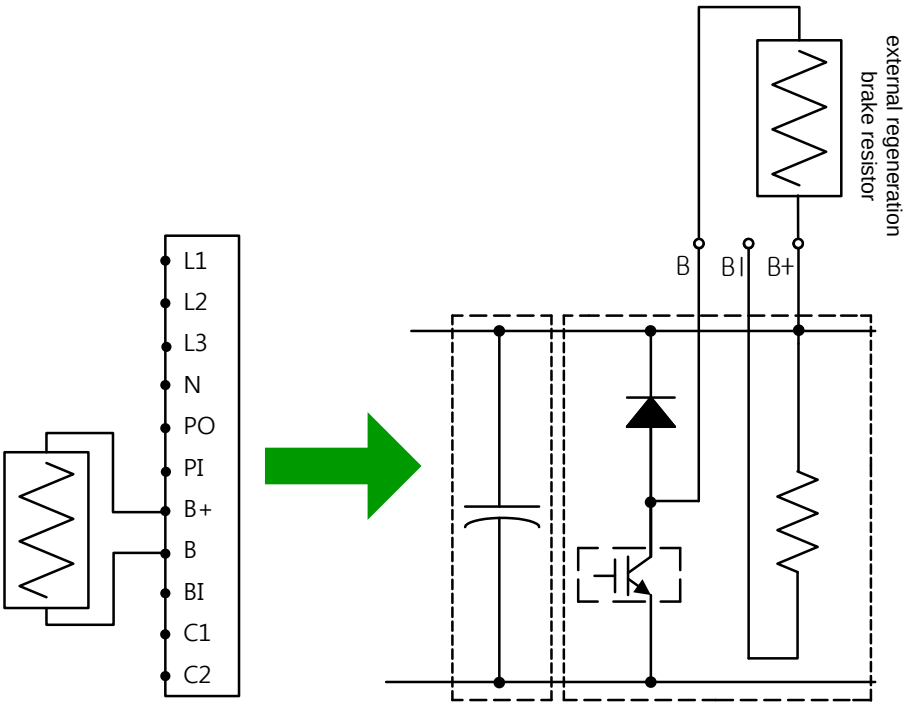


3.6.2 External Resistor Setting

When using an external regeneration brake under consideration of the operation environment, you should set the brake in the following order.

A. External regeneration brake wiring

- Connect the external regeneration brake to the B, B+ terminal.
- Remove shorts from B, BI terminals (default short at the time of release from the factory, 1kW or less)



B. Regeneration brake setting (0x2009)

- Select the external regeneration brake (0x2009=1)
- Select this when connecting a regeneration brake with power larger than the internal regeneration brake

C. Regeneration brake value setting (0x200B)

- Set the resistance value of the regeneration brake regeneration brake to [Ω]Unit
- The value should be set if the regeneration brake setting (0x2009) is 1.
- Default value: 0

D. Regeneration brake power setting (0x200C)

- Set the power of the external regeneration brake to [W]Unit.
- The value should be set if the regeneration brake setting (0x2009) is 1.
- Default value: 0

E. Regeneration brake peak power and duration setting (0x200D, 0x200E)

- Set the power and time to the peak power and the duration time provided by the data sheet of the external regeneration brake
- When there is no separately provided values, set the peak power to 5 times the regeneration brake power setting(0x200C), and set the duration time to 5000[ms] (the exact values may vary depending on the regeneration brake specifications and brakes)
- The value should be set if the regeneration brake setting (0x2009) is 1.

The specifications of the optional regeneration brake provided by us for use of external regeneration brake are as follows

Drive Power	Resistance	Brake Power	Model
100W	50Ω	140W	APCS-140R50
200W			
400W			
1KW	30Ω	300W	APCS-300R30
3.5KW	30Ω	600W	APC-600R30

Table 10. External Regeneration Resistor Setting

3.6.3 Other Consideration

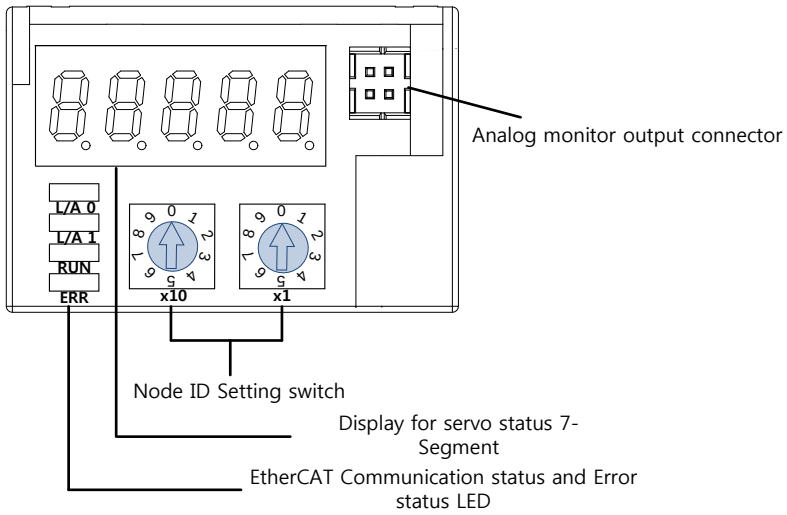
You can set the regeneration brake derating factor(0x200A) based on consideration of the installation environment and heat protection condition. If the heat protection condition is poor, use the brake after derating (below the power).

When derating (set the vale to 100 or below), the regeneration overload alarm (AL-23) sets off faster if the set value is smaller.

If you want to set the derating factor to 100% or above, you should fully consider the heat protection condition of the installed drive.

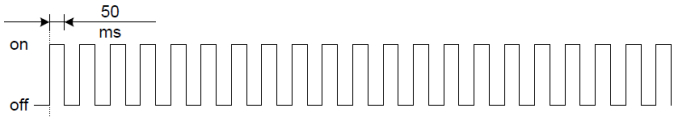
3.7 Drive Status Indicators

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.

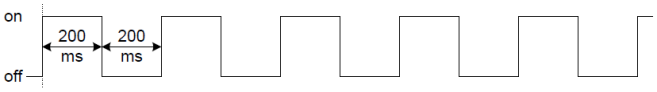
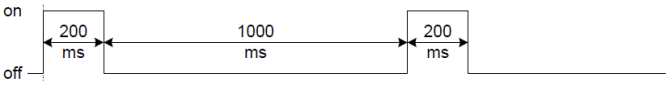
LED status	Details
Blinking	The drive is in the Pre-Operational state. 
Single Flash	The drive is in the Safe-Operational state. 
ON	The drive is in the Operational state.

Table 11. LED Status - RUN

- **ERR LED**

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

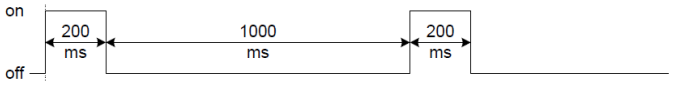
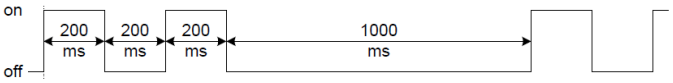
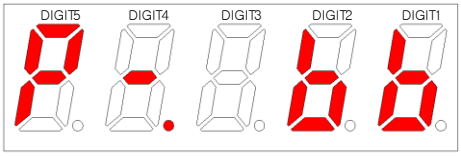
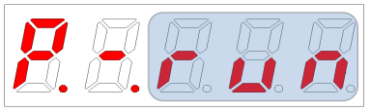
LED status	Details
OFF	Indicates normal state of the EtherCAT communication without any error.
Blinking	Indicates that the drive has received a command from the EtherCAT master, instructing it to perform a setting which is not feasible in the present state or to perform an impossible state transition.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

Table 12. LED Status - Error

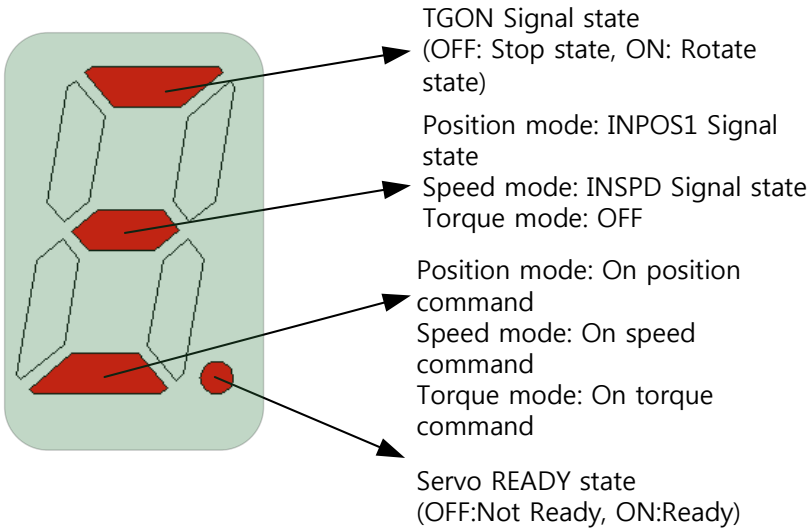
7-Segment for displaying state of servo consists of 5 digit and digit number starts from the right.(Digit1→Digit5)



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

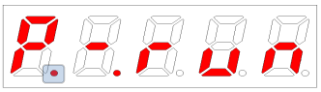
Display Digit 3~Digit 1	State
	
Disconnecting STO	Forward limit senser is activated
	
State of servo OFF	Reverse limit senser is activated
	
State of servo ON	State of warning 10 (Code :10)

Digit4 indicates state of current operation or servo READY.

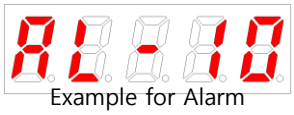


Digit5 indicates state of EtherCAT State Machine, current control mode or state of servo on.

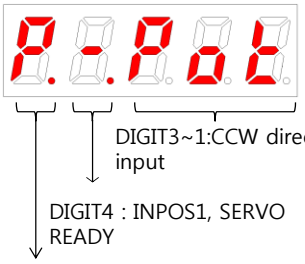
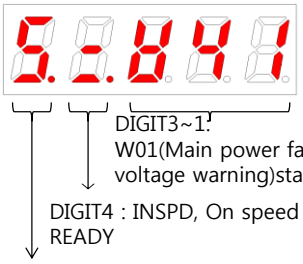
When state of EtherCAT State Machine is pre-operational state(setting up communication) ➔ Display state of EtherCAT Communication(Servo operation is not possible in this state)		
 Init state	 Pre-Operational state	 Safe-Operational state

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.
	

3.7.1 PD Drive Alarm Code List

AL-10 IPM fault	AL-25 Drive temperature 2	AL-41 Over voltage	AL-60 USB communication
AL-11 IPM temperature	AL-26 Encoder temperature	AL-42 Main power fail	AL-61 reserved
AL-14 Over current	AL-30 Encoder communication	AL-43 Control power fail	AL-62 reserved
AL-15 Current offset	AL-31 Encoder cable open	AL-50 Over speed limit	AL-63 Parameter checksum
AL-16 Current limit exceeded	AL-32 Encoder data	AL-51 POS following	AL-64 Parameter range
AL-21 Continuous overload	AL-33 Motor setting	AL-52 Emergency stop	AL-70 Drive motor combination
AL-22 Drive temperature 1	AL-34 Encoder setting	AL-53 Excessive SPD deviation	AL-71 Factory setting
AL-23 Regeneration overload	AL-35 Low battery	AL-54 Encoder2 POS differnce	AL-72 GPIO setting
AL-24 Motor cable open			

Table 13. PD Drive Alarm Code List

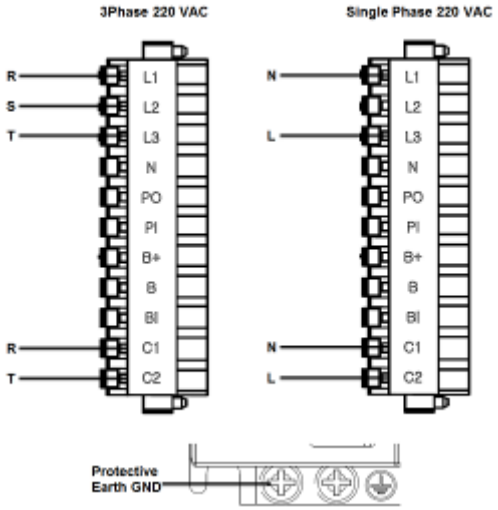
3.7.2 PD Drive Warning Code List

A01 Main power fail	A10 Operation overload
A02 Low encoder battery	A20 Driver/motor combination fail
A04 Software position limit	A40 Low voltage
A08 Excessive DB current	A80 Emergency signal input

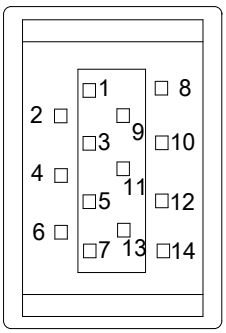
Table 14. PD Drive Warning Code List

3.8 Connector Descriptions

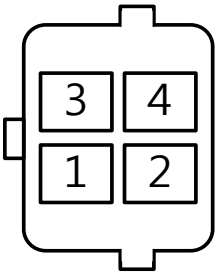
- **Power Input Connector Specification :**
  BLT 5.08HC 11 180F SN BK BX (Weidmuller, PD-04, 300V/10A)
  BLZP 5.08 11 180F SN BK BX (Weidmuller, PD-10, 300V/15A)



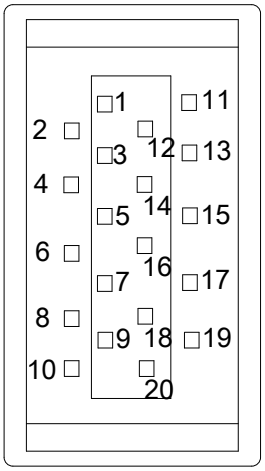
- **Feedback Connector Specifications: 10114-3000VE (3M)**



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

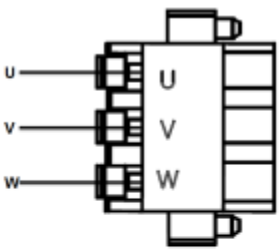


- **I/O connector Specification : 10120-3000PE (3M)**

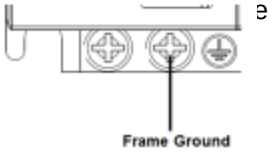


- **Motor U/V/W Connector Specification :**

BLT 5.08HC 03 180F SN BK BX (Weidmuller, PD-04, 300V/10A)
BLZP 5.08 03 180F SN BK BX (Weidmuller, PD-10, 300V/15A)



P series Eth e



3.9 Installation Test

Once you have made the necessary mechanical and electrical connections, you can test the drive. The PD drives Support Tool contains the easy configuration, which exercises basic functions of the PD drives.

You *must* do the following before testing the drive:

• Configure the drive for the motor to which it is connected. Resolve any configuration errors before proceeding with the test.

• Enable the drive.

• If the PD drive is connected to a controller, disable the controller's servo loop.

• If the motor is connected to a load, disconnect the motor so that it is free to turn unimpeded.

Warning

High-performance motion control equipment is capable of producing rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. KEEP WELL CLEAR of any machinery driven by stepper or servo motors. Never touch any part of the equipment while it is in operation.

3.10 Drive Blocks

3.10.1 Drive Block

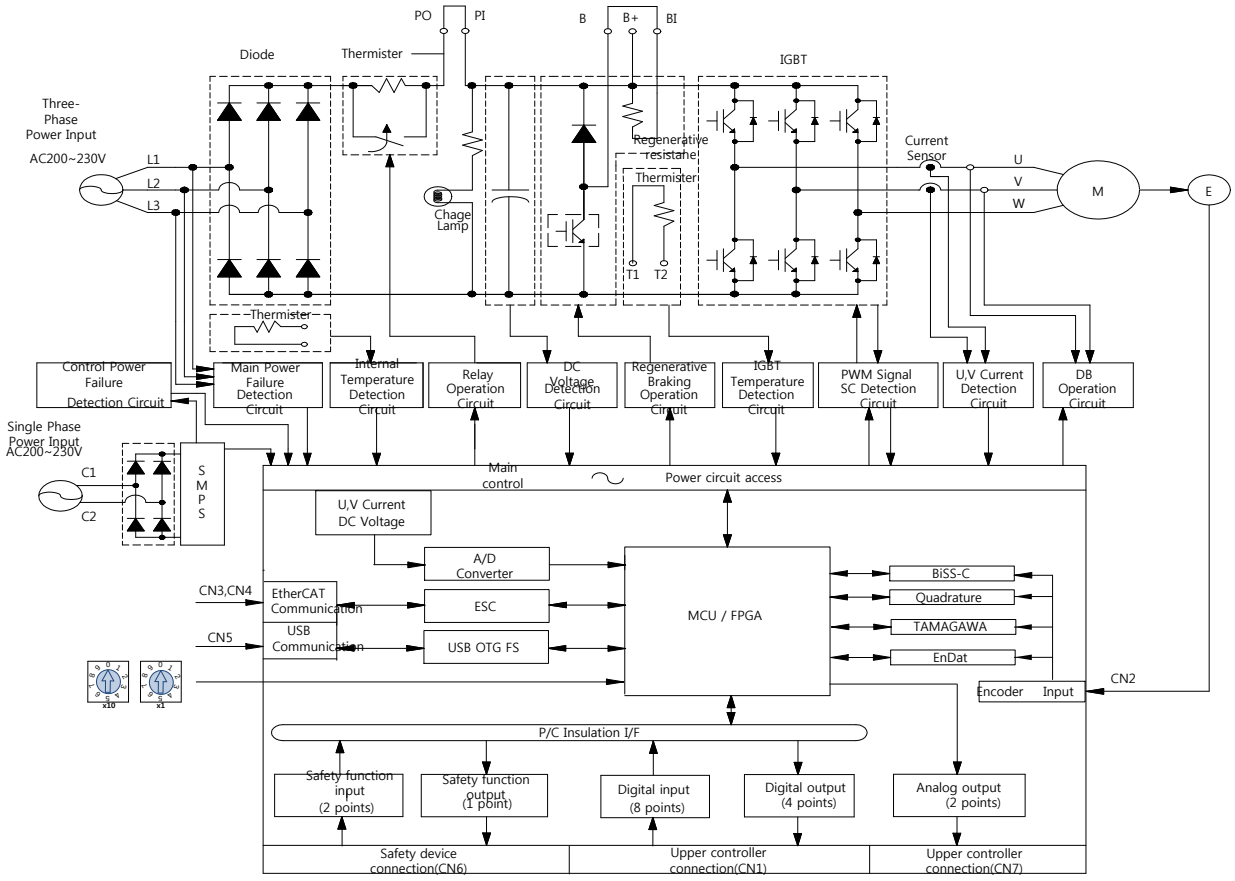


Figure 11. PD Drive Block Diagram

Note 1) When using DC reactor, please connect with PO, PI.

Note 2) When using external recovery resistance, remove the shorting pins B, BI and then connect with the B+, B pins.

3.11 Wiring

3.11.1 Power

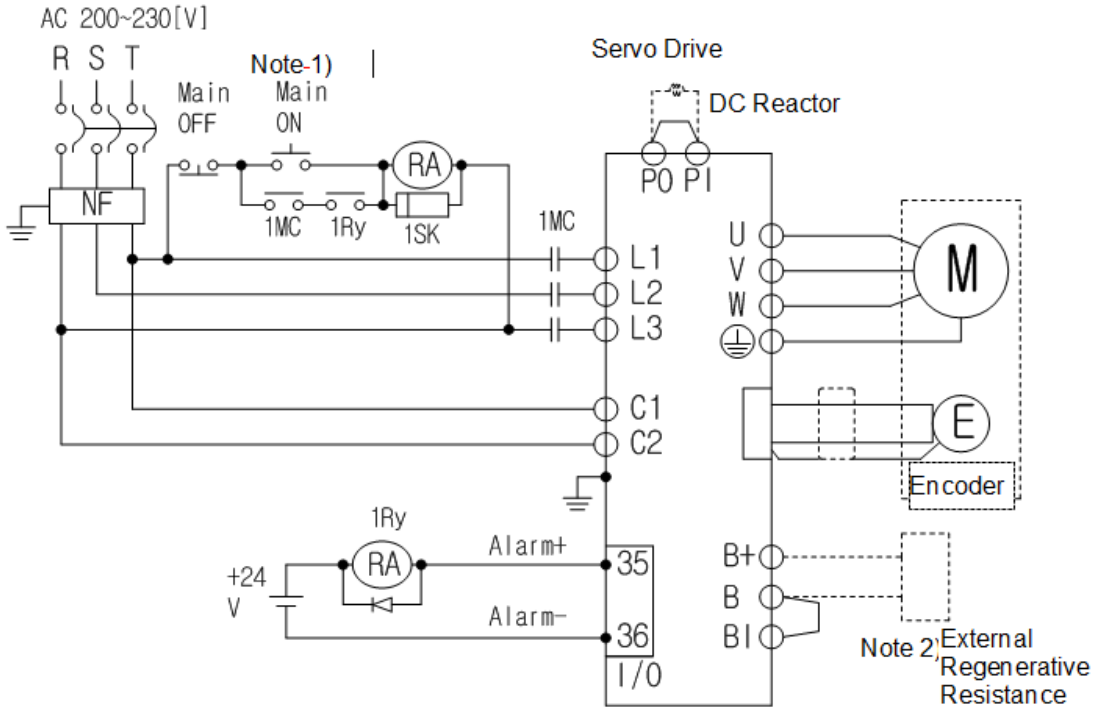
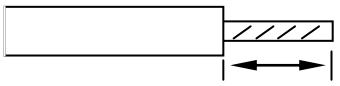


Figure 12. Drive Wiring Example

Note 1) Please press the ON switch for the main power for at least 2 seconds, as the alarm signal input takes 1~2 seconds after the main power is turned on.

Note 2) 100[W]~400[W]drive has built-in recovery resistance of 50[W], 100[Ω], 800[W]~1[kW]drive has 100[W], 40[Ω]; and 2[kW]~ 3.5[kW]drive has 150[W], 13[Ω] recovery resistance. Please use them by shorting terminals B and BI. If the recovery resistance is high due to frequent acceleration/deceleration, please open the shorting pins (B, BI) and connect external recovery resistance to B, B+.

Note 3) Please peel off the 7~10[mm] of the sheath of the power cable to be used for the power unit as shown in the figure below. And use the dedicated pressure terminal (see " *3.3.1 Power Circuit Electronics Specifications* ")



Note 4) When removing power unit wiring from 100[W]~1[kW] drive, remove or connect it after pressing the button at the drive's terminal block. In case of 2[kW]~3.5[kW] drive, remove or connect it using a flat-head driver.

Please check the voltage of the input power so that it does not exceed the permissible window.

- Connecting commercial power with the drive's U, V, W terminals may cause damage. Please connect the power to the L1, L2, L3 terminals.

- Please use the product by connecting shorting pins to the drive's B, BI terminals. And when using an external recovery resistance, please connect with the B+, B terminals after removing the shorting pin, at the standard resistance.

Type	Resistance	Standard Capacity	* Notes
400[W]	100[Ω]	Internal 50[W]	⚠**Caution** Please see " *3.6.2 External Resistor Setting* " for resistance values when expanding recovery capacity.
1[kW]	40[Ω]	Internal 100[W]	
3.5[kW]	13[Ω]	Internal 150[W]	

- Please construct the system so that the main power (L1, L2, L3) is always supplied after the control power (C1, C2) is supplied (see " *3.2 System Installation Overview* ")
- High voltage remains even after the main power is shut off. Please exercise caution.
- The length of the earth cable should be as short as possible. Too long cables may cause noises that might cause malfunction.

Warning

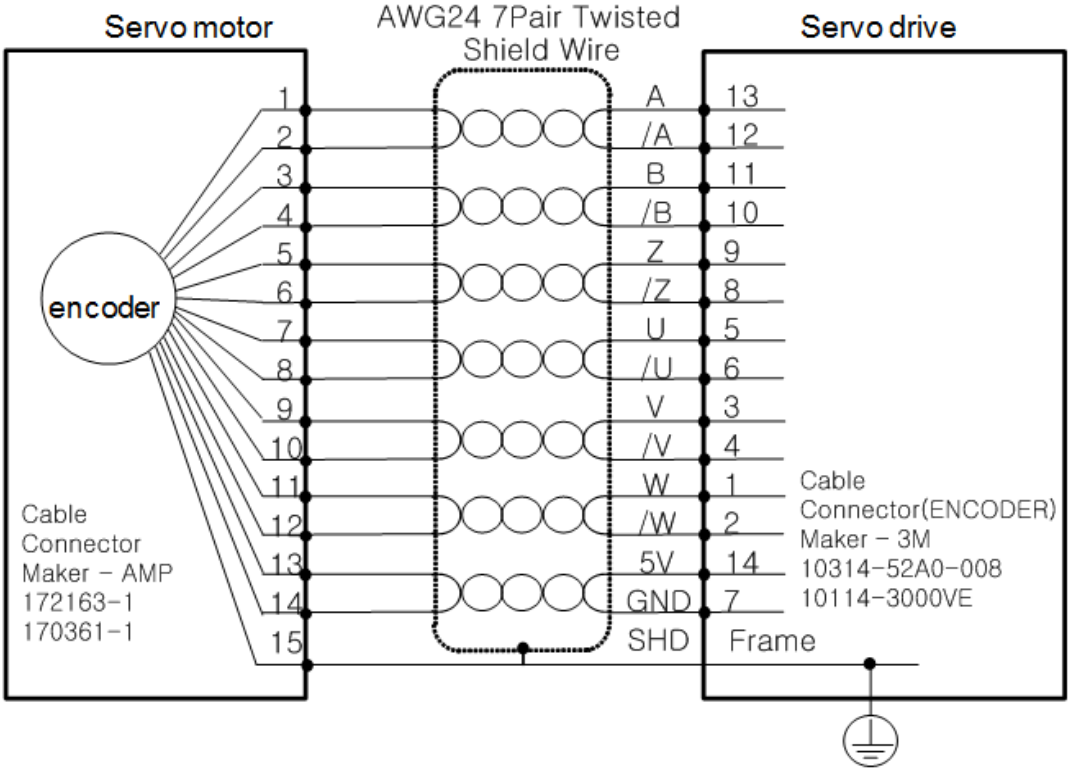
Connecting excessive voltage will damage the drive.

Caution

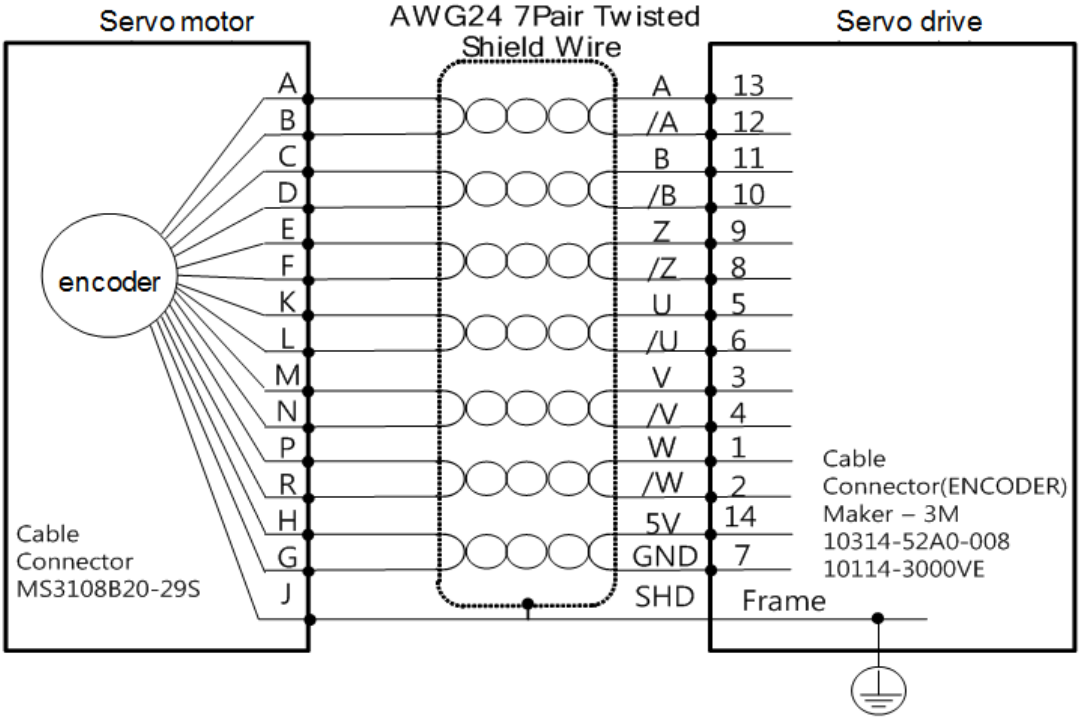
Start re-wiring after making sure that the charge lamp is off after shutting off the main power, to avoid being electrocuted.

3.11.2 Feedback Signal

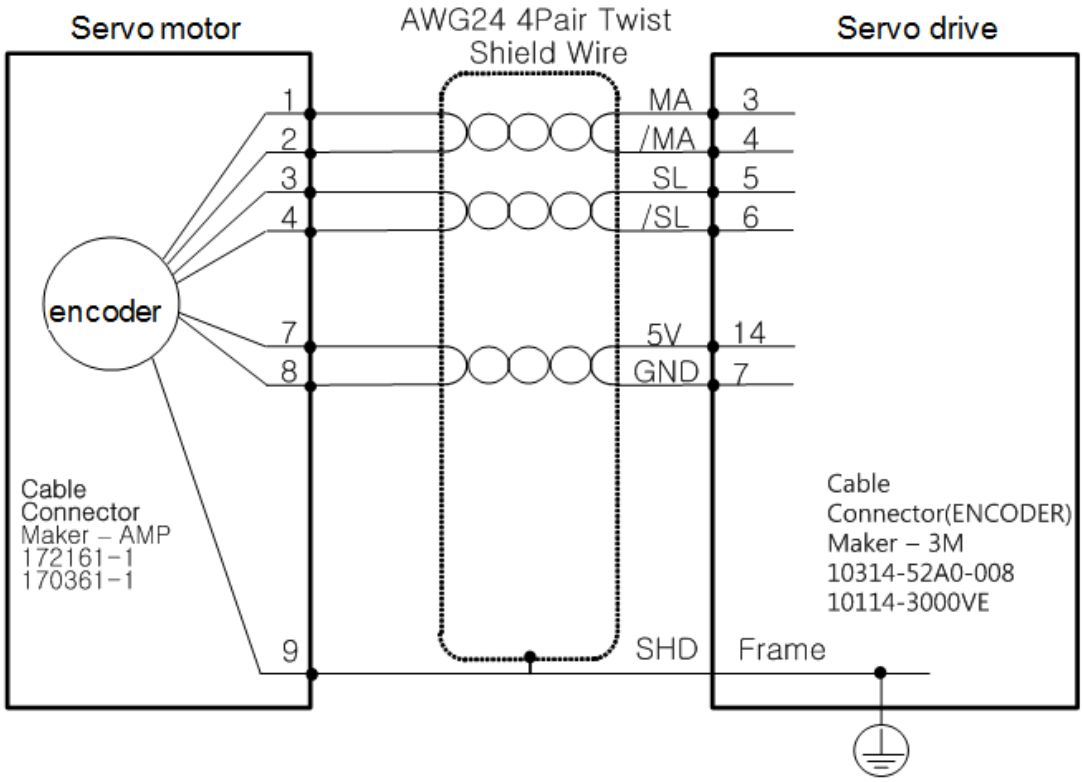
- **APCS-ExxxAS Cable (Quadrature type)**



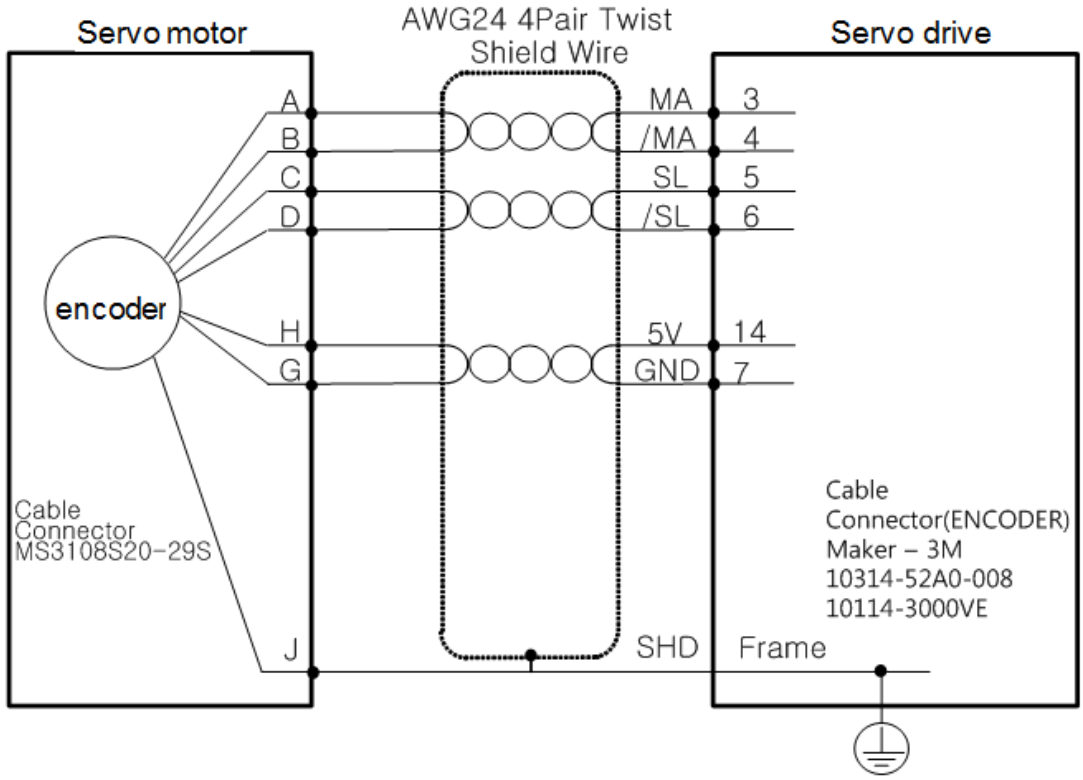
- **APCS-ExxxBS Cable (Quadrature type)**



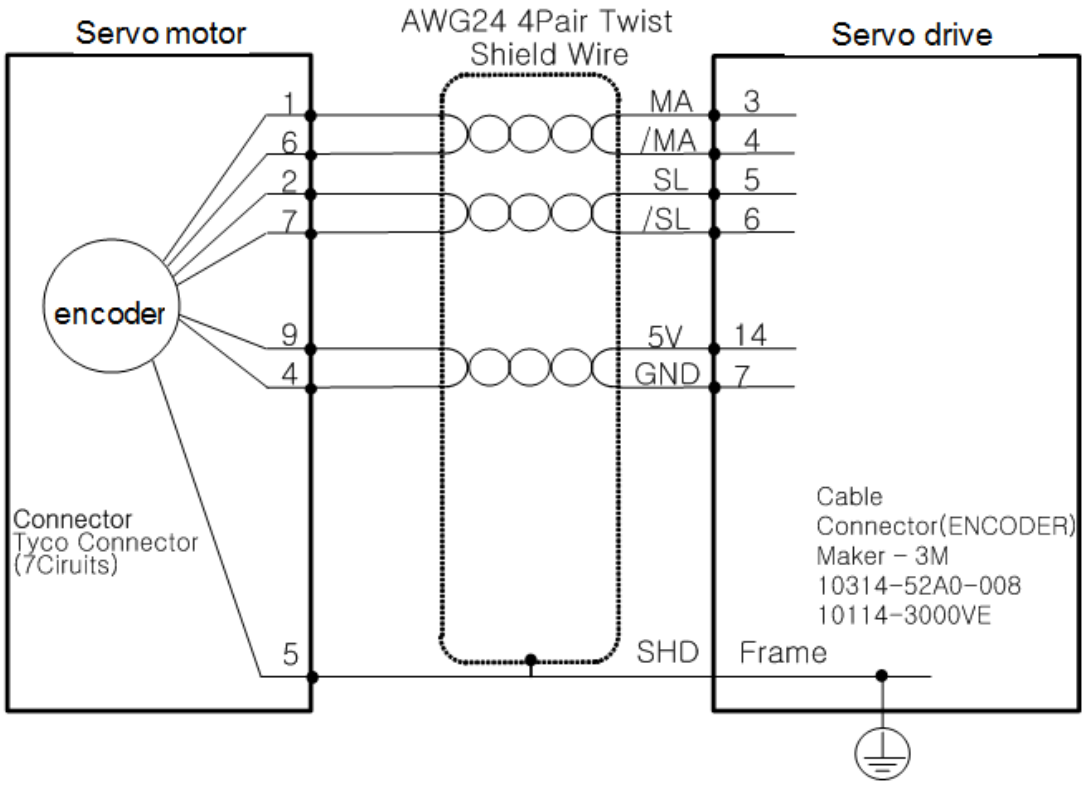
- **APCS-ExxxCS Cable (Serial Single-turn type)**



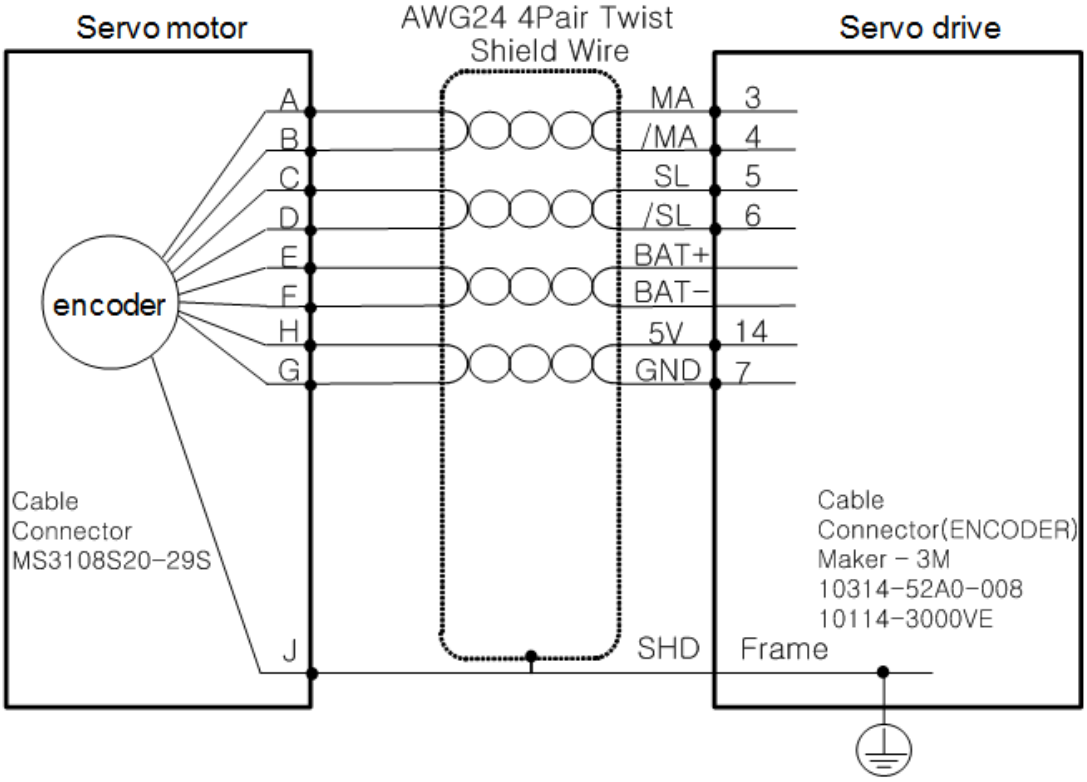
- **APCS-ExxxDS Cable (Serial Single-turn type)**



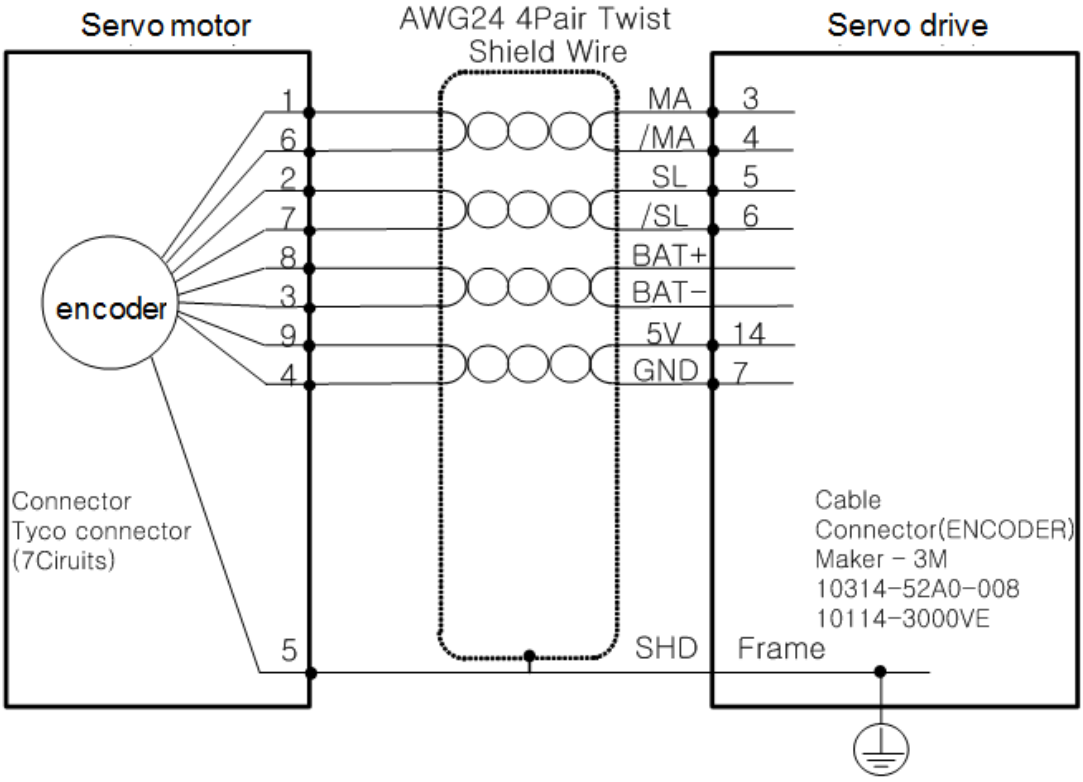
- **APCS-ExxxES Cable (Serial Single-turn type)**



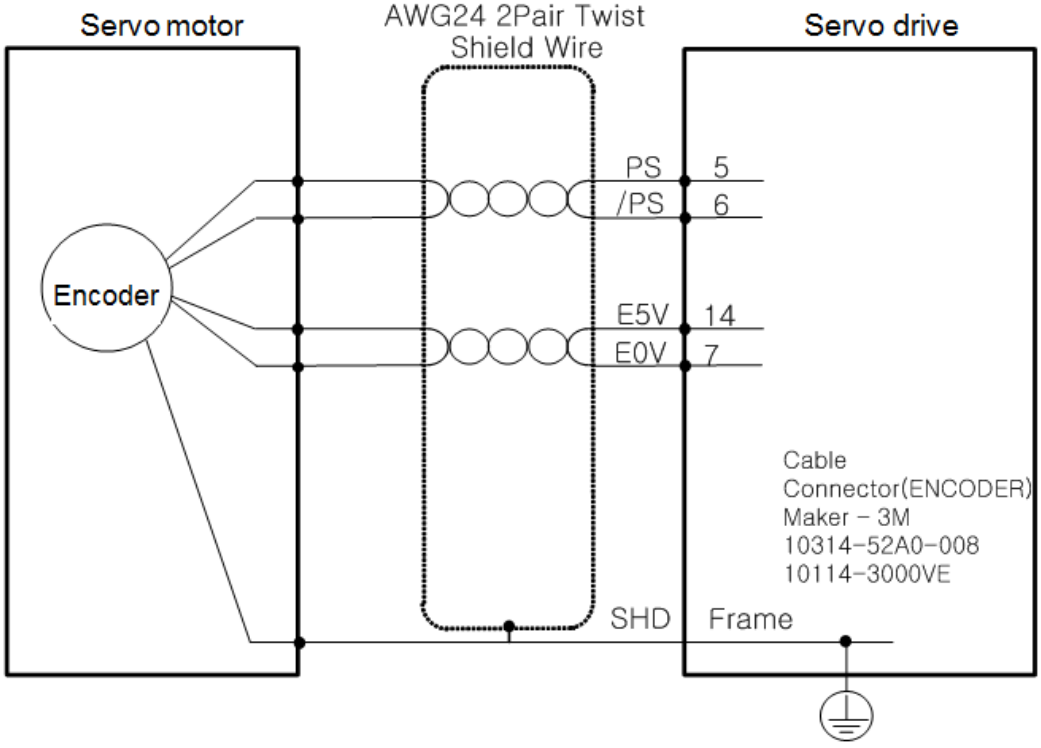
- **APCS-ExxxDS1 Cable (Serial Multi-turn type)**



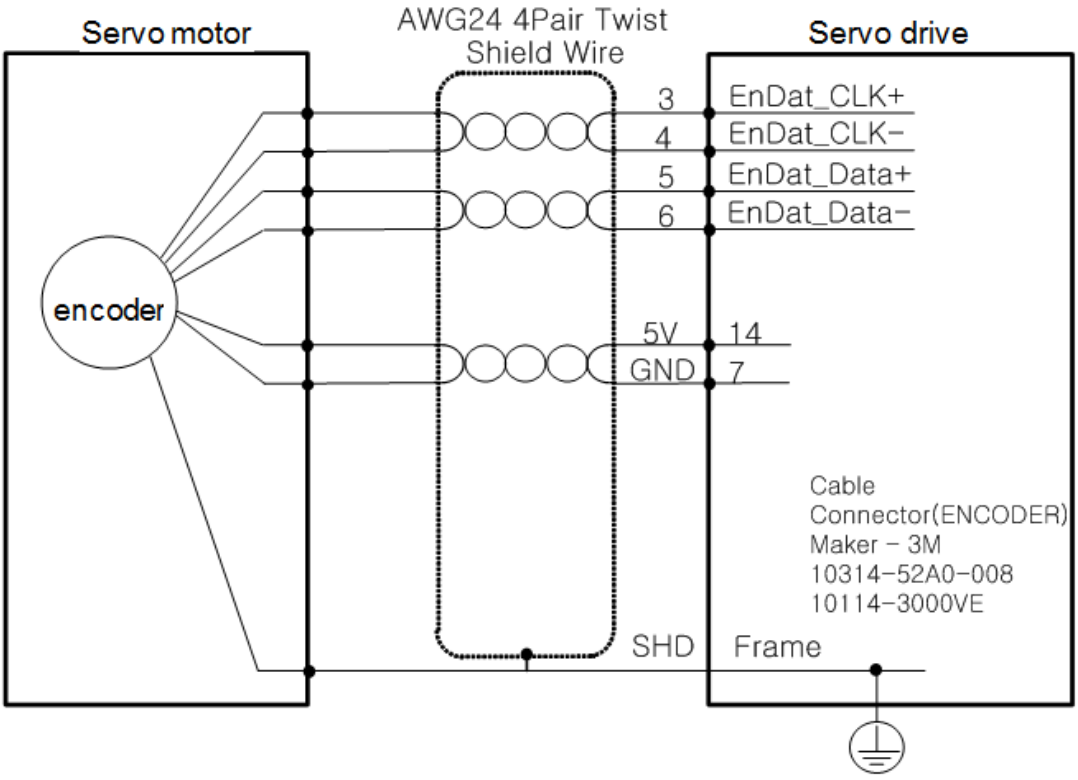
- **APCS-ExxxES1 Cable (Serial Multi-turn type)**



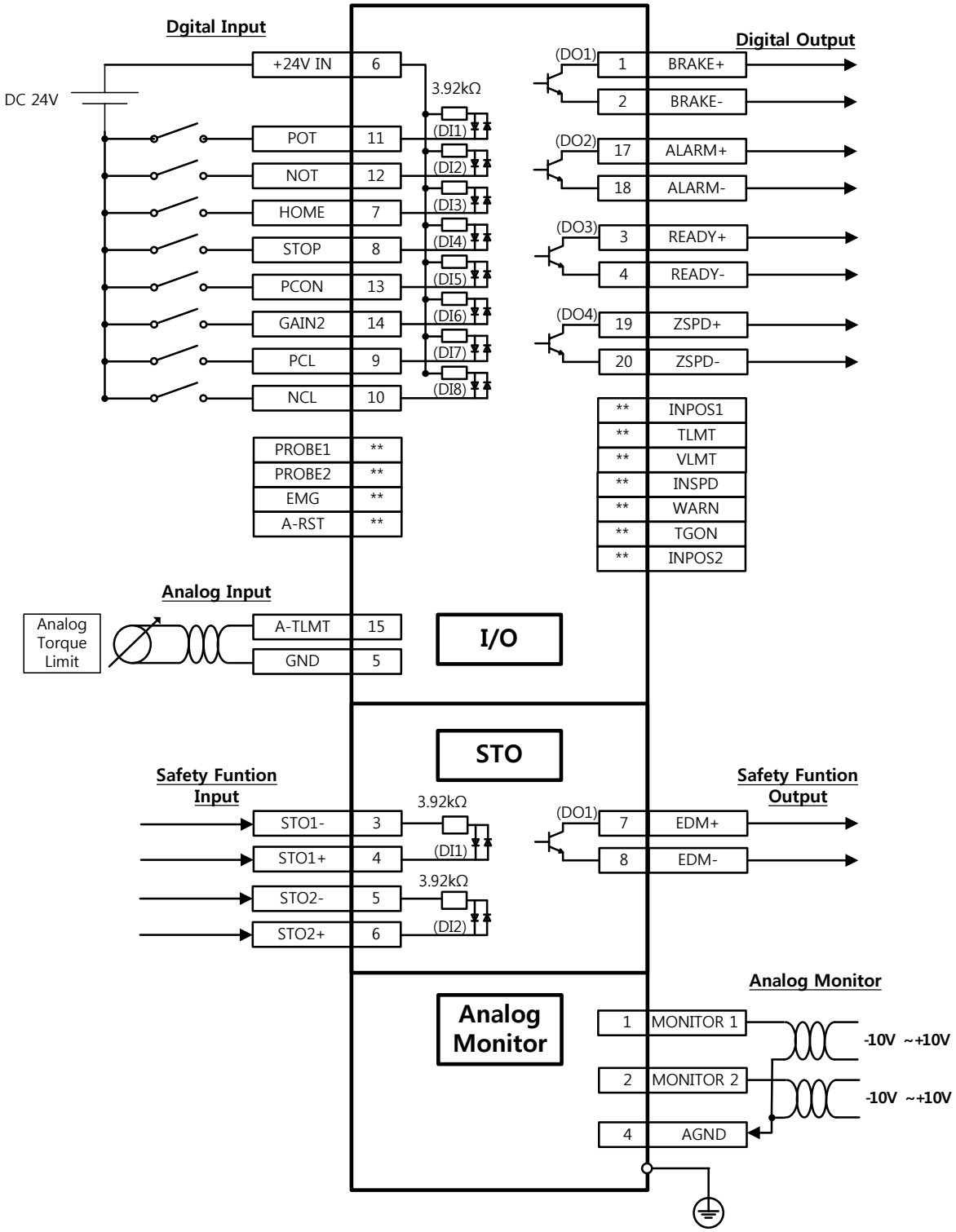
- **Tamagawa Feedback (17bit incremental)**



- **EnDAT2.2 Feedback**



3.11.3 I/O Signal Wiring



- **Example of Digital Input Signal Wiring**

  Input contact point can be set at Contact Point A or B, depending on the characteristics of each signal. Each input contact point can be allotted to 28 functions.

  Please see *" 4.5 I/O Signals Setting "* for signal allotment and contact point change of input contact points. The service rating is DC12V~ DC 24V.

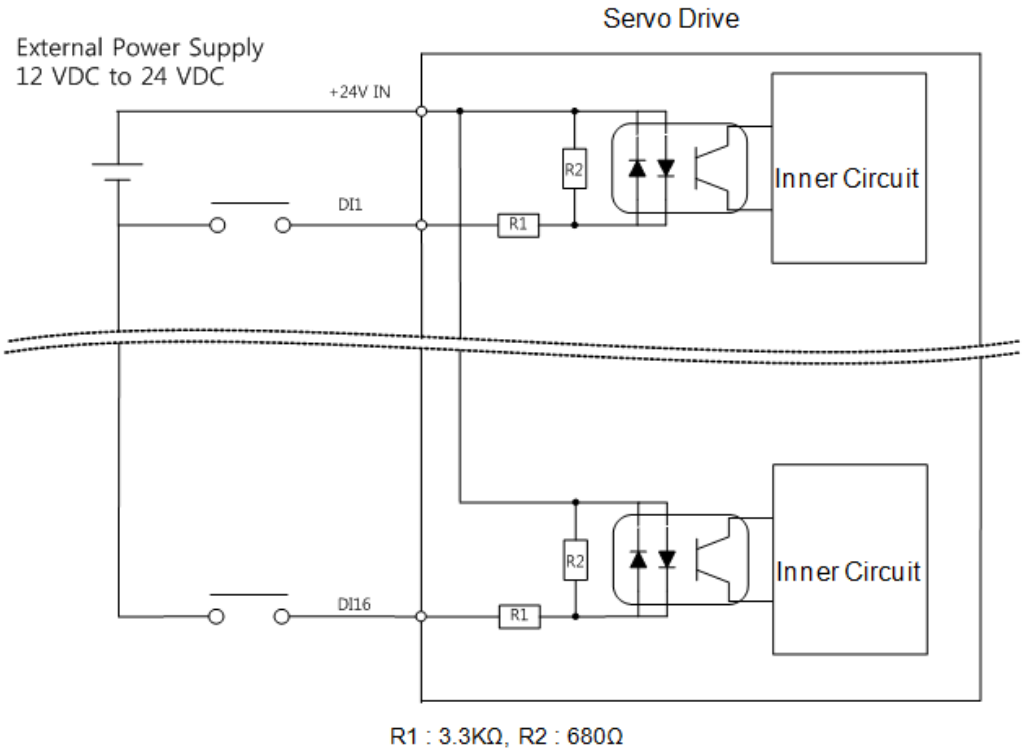


Figure 13. Example of Digital Input Signal Wiring

- **Example of Digital Output Signal Wiring**

  Input contact point can be set at Contact Point A or B, depending on the characteristics of each signal. Each input contact point can be allotted to 19 functions.

  Please see *" 4.5 I/O Signals Setting "* for signal allotment and contact point change of input contact points.
  As transistor switches are used, over voltages/current may cause damage. Please exercise caution. The service rating is DC 24V ±10%, 120[㎃].

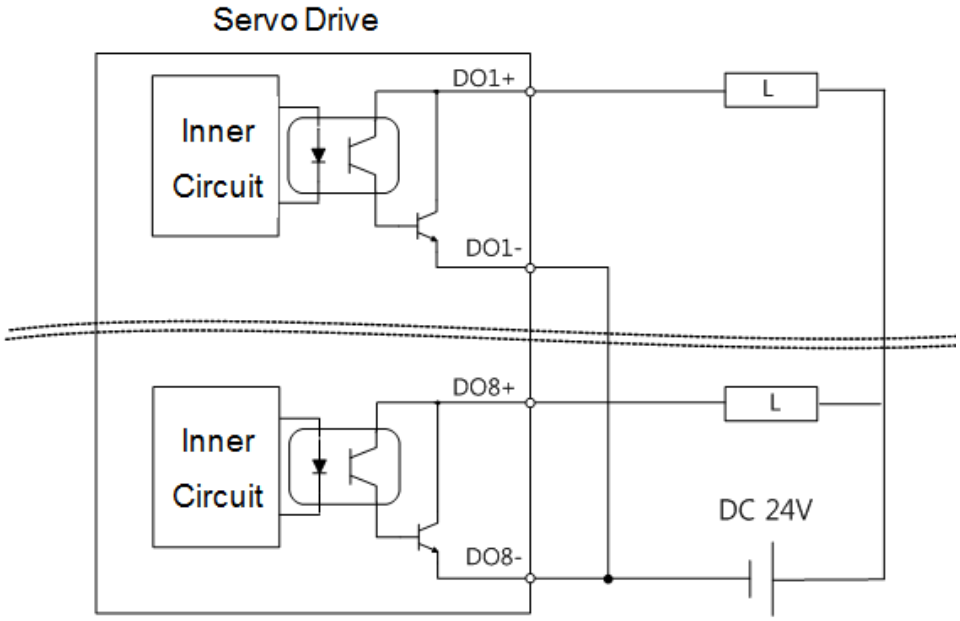


Figure 14. Example of Digital Output Signal Wiring

Note) For output signals DO1~ DO8, GND24 terminal is disconnected GND24.

- **Example of Analog Input Signal Wiring**

  Please see " *8.5 Analog Speed Override* " and " 6.8.3 Torque Limit Setting " for operation of analog input signals.
  The window if analog input signal is -10V ~ 10V.
  Impedance of the input signals is approximately 22KΩ.
  Example of resistance selection

R1	R2
5KΩ	6KΩ
10KΩ	12KΩ

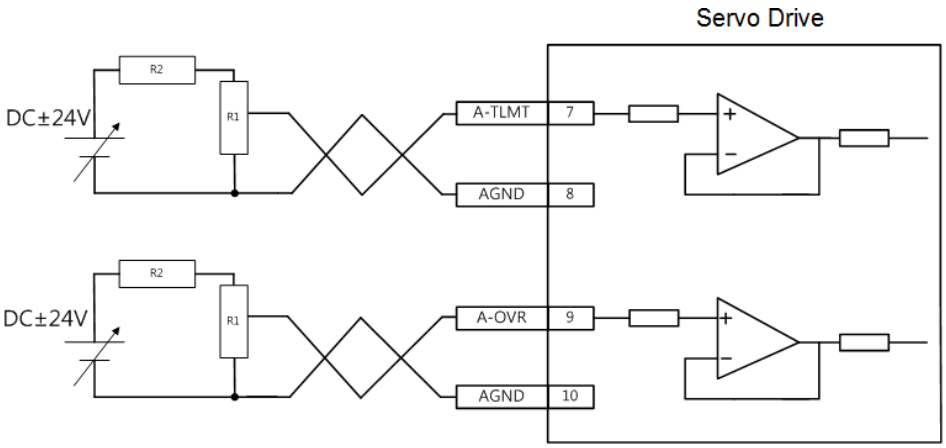


Figure 15. Example of Analog Input Signal Wiring

- **Example of Analog Output Signal Wiring**

Please see " *5.8 Analog Monitor* " for setting and scale adjustment of monitoring signals. The window of analog output signal is -10V ~ 10V.
The resolution of analog output signals is 12bit.
The permissible maximum load current is 2.5[mA] or below.
The stabilization time is 15[us].

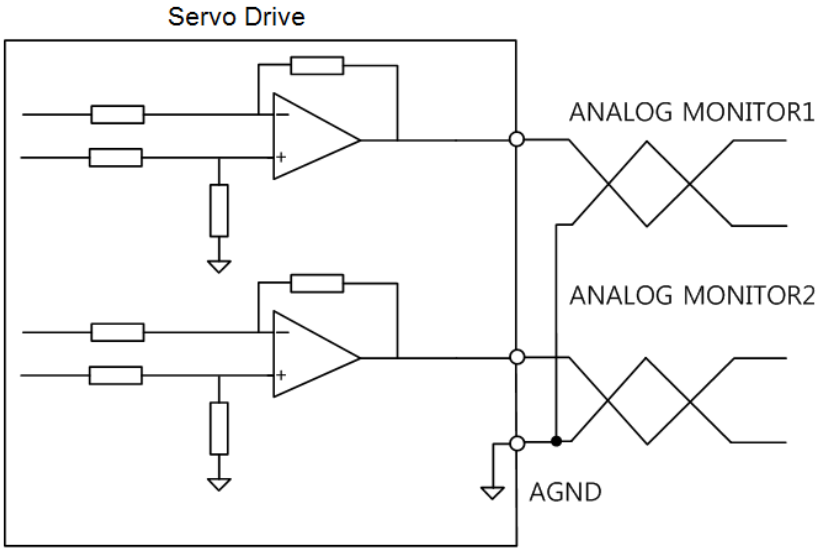
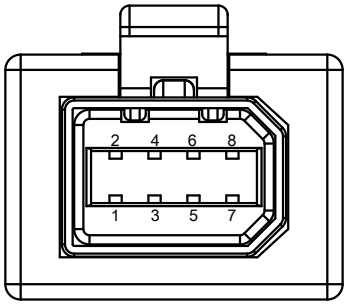


Figure 16. Example of Analog Output Signal Wiring

3.11.4 Safety Function Signal (STO) Wiring

2069577-1(Tyco Electronics)



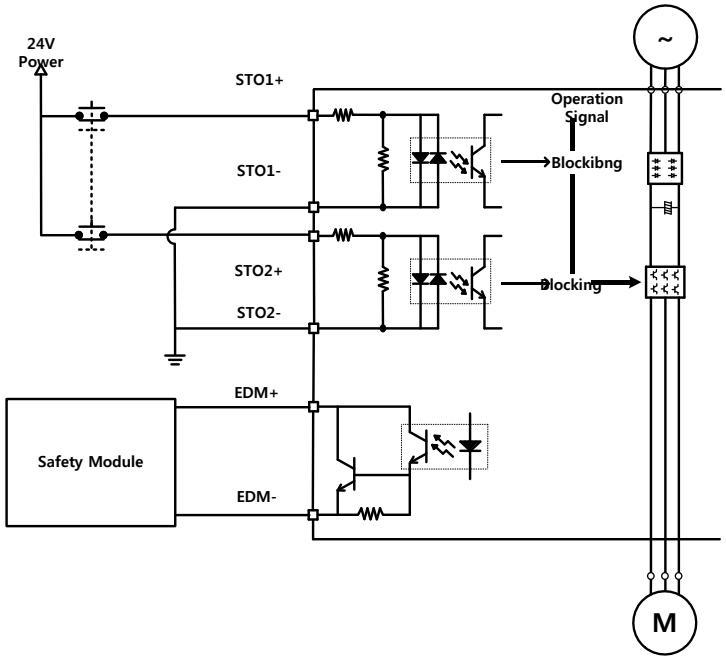
Pin Number	Name	Function
1	+12V	Bypass Wiring
2	-12V	
3	STO1-	DC 24V GND
4	STO1+	Blocks the current (torque) applied to the motor when the signal is off.
5	STO2-	DC 24V GND
6	STO2+	Blocks the current (torque) applied to the motor when the signal is off.

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

Table 15. Names and Functions of Safety Function Signal (STO)

- **Example of Connecting Safety Function Signals**

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

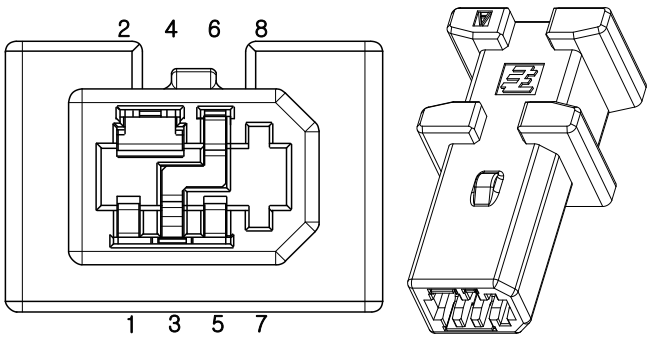


- **Wiring for Bypass Safety Function Signal**

When STO function is not used due to user's convenience, PD-xxC 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.

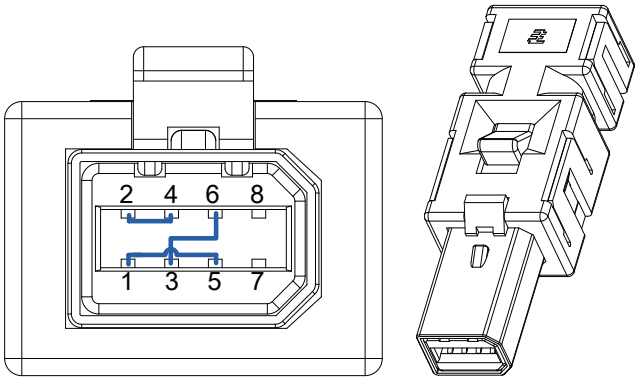
Wiring Mini I/O Plug connector as below picture. Connect +12V to STO2-, -12V to STO1+ and STO- to STO2+. Then, it will be able to use safety function signal as bypassing. Never use this power(+12V, -12V) for other purpose.

Mini I/O By-pass Connector



1971153-1(Tyco Electronics)

Mini I/O Plug Connector



2069577-1(Tyco Electronics)

3.12 Digital Input/Output

- **Digital Input Signal (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.

Table 16. Digital Input Signal Description

Note) **These signals are not allotted at the time of the product's release from the factory. You can change allotment by configuring the parameters. Please see *" 4.5 I/O Signal Setting "* for further details.

Note) You may perform wiring by using the COMMON (DC 24V) of the input signal as GND.

- **Digital Output Signals (I/O Connector)**

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)

Table 17. Digital Output Signal Description

Note) **These signals are not allotted at the time of the product's release from the factory.

You can change allotment by configuring the parameters. Please see *" 4.5 I/O Signal Setting "* for further details.

3.13 Analog Input/Output

- **Analog Input Signals (I/O Connector)**

Pin No.	Name	Description	Function Details
15	A-TLMT	Analog Torque Limit	-10~ + 10Vis connected between A-TLMT(AI1) and AGND to limit the motor's output torque. The relationship between input voltage and torque limit varies depending on the set [0x221C] value.
5	AGND	AGND(0V)	Analog ground

Table 18. Analog Input Signal Description

- **Analog Output Signals (Analog Monitoring Connector)**

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

Table 19. Analog Output Signal Description

Note) You can change the output variables to monitor through analog monitor output by adjusting the parameters. Please see *" 5.8 Analog Monitor "* for further details.

4.EtherCAT Communications

IN THIS CHAPTER

4.1 Overview

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 Data Frame sent from a master passes through a slave, the slave passes the received data to the Data Frame as soon as it receives the data.

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

4.2 EtherCAT Communication

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

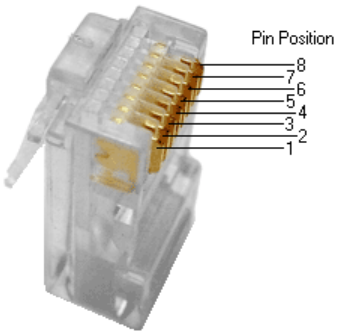


Figure 17. EtherCAT IN/OUT Connector

Note) EtherCAT communication uses signals from Pin 1,2,3, and 6.

4.2.1 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.

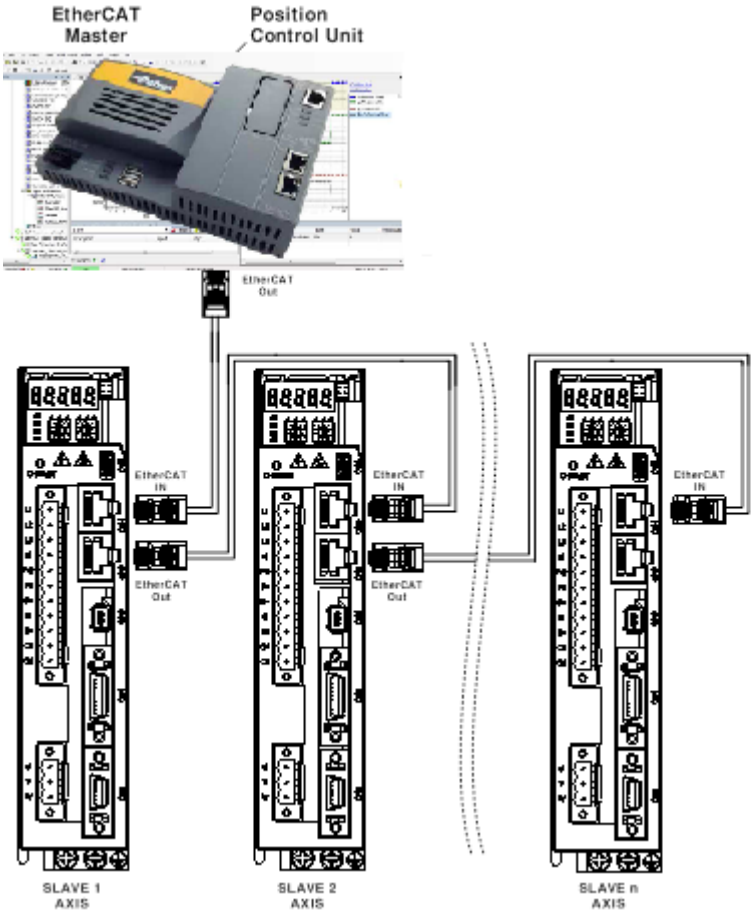
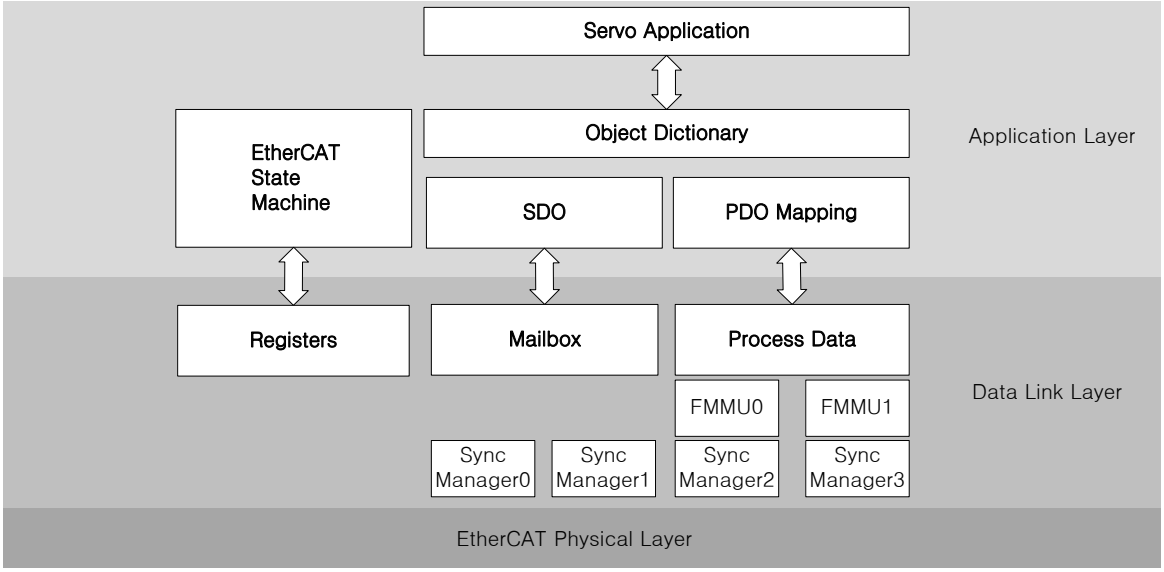


Figure 18. Example of Drive Connection

4.2.2 Structure of CANopen over EtherCAT

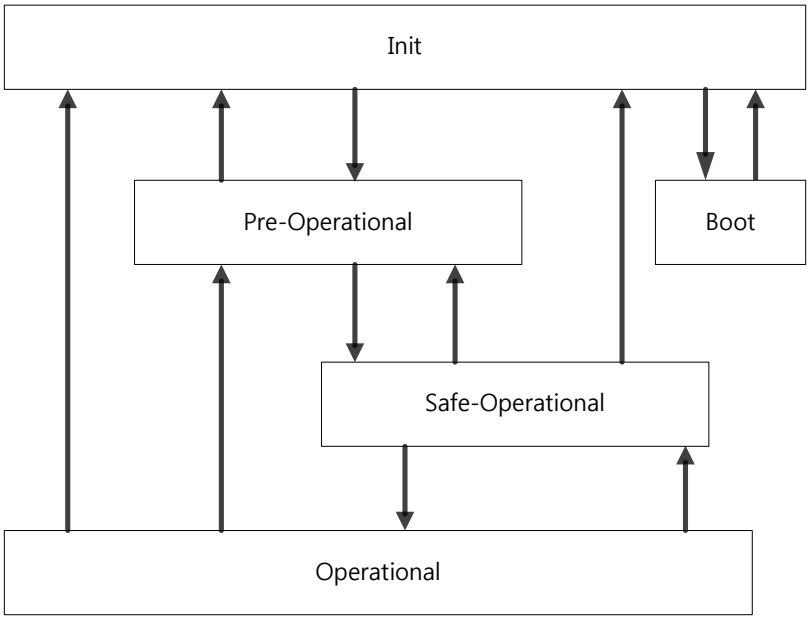


This drive supports a CiA 402 drive profile. The Object Dictionary in the application layer includes application data and PDO (Process Data Object) mapping information from the process data interface and application data.

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

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

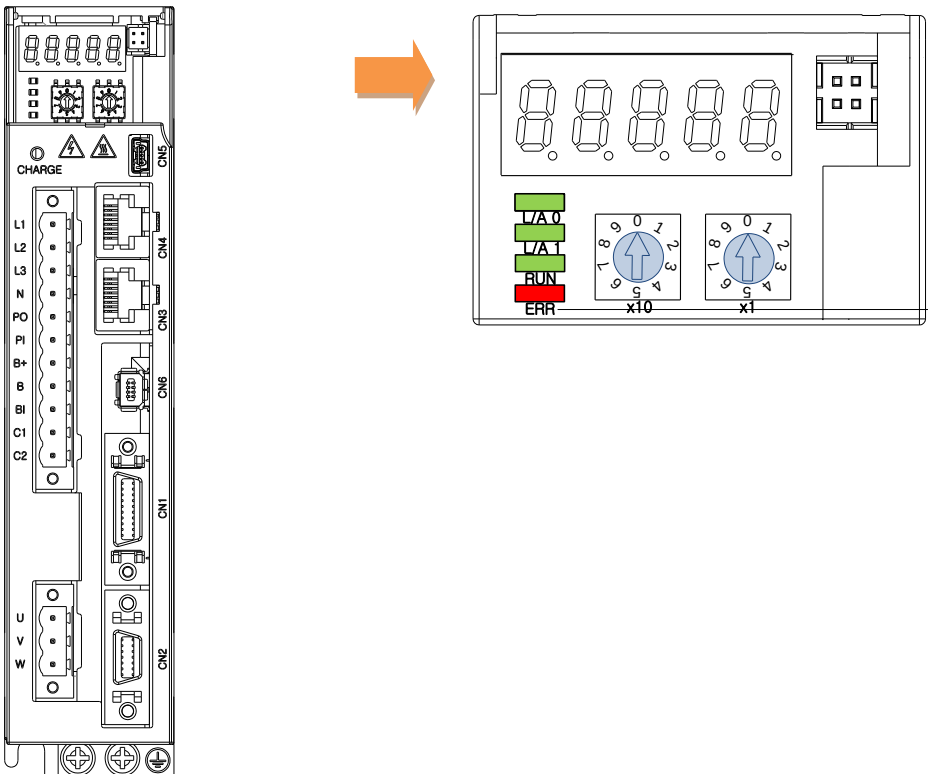
4.2.3 EtherCAT State machine



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

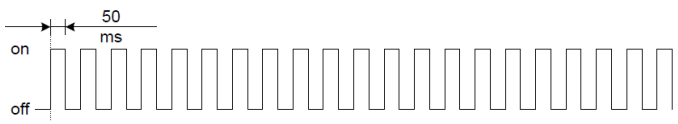
State	Details
Boot	A state for firmware update. Only mailbox communication using the FoE (File access over EtherCAT) protocol is available. The drive can transit to the Boot state only when in the Init state.
Init	Initializes the communication state. Unable to perform mailbox or process data communication.
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.

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.



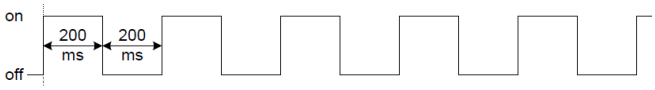
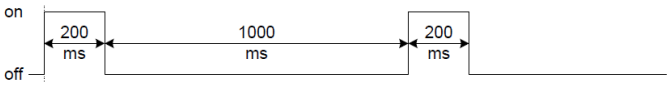
- **L/A0, L/A1 (Link Activity) LED**

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.

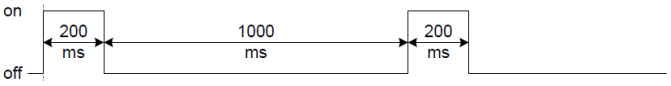
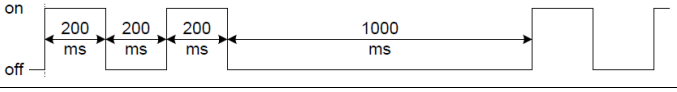
- **RUN LED**

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.

4.3 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	

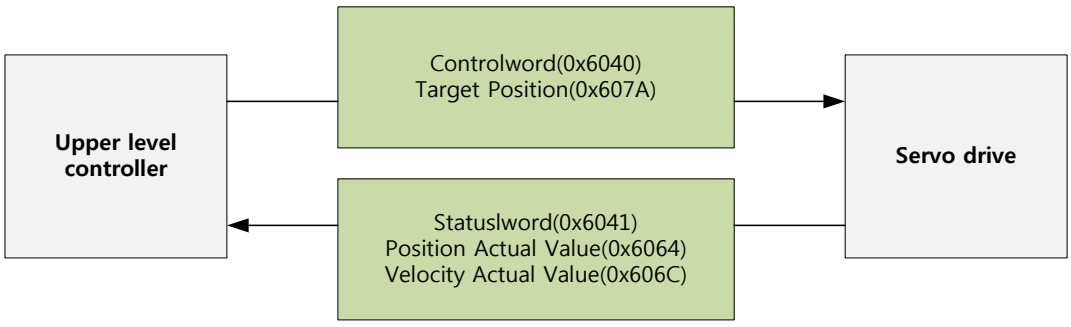
Table 20. Data Type and Range

4.5 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 Control word and the Target Position with the RxPDO (0x1600).

Index	SubIndex	Name	Data Type
0x6040	0x00	Control word	UINT

Index	SubIndex	Name	Data Type
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 Status word, the Actual Position Value, and the Actual Velocity Value with the TxPDO (0x1A00).

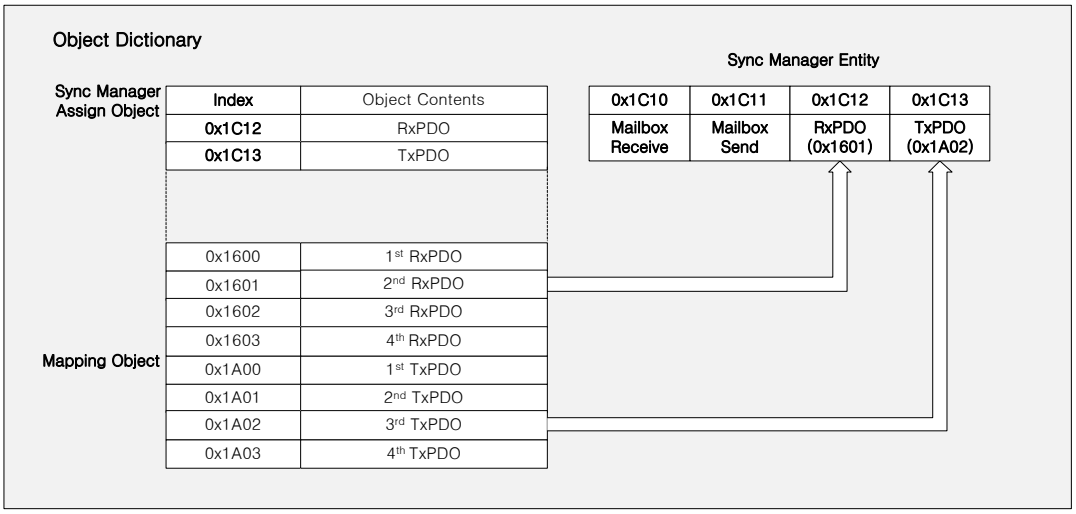
Index	SubIndex	Name	Data Type
0x6041	0x00	Status word	UINT
0x6064	0x00	Actual Position Value	DINT
0x606C	0x00	Actual Velocity Value	DINT

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)

4.6 Synchronization with the DC

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.

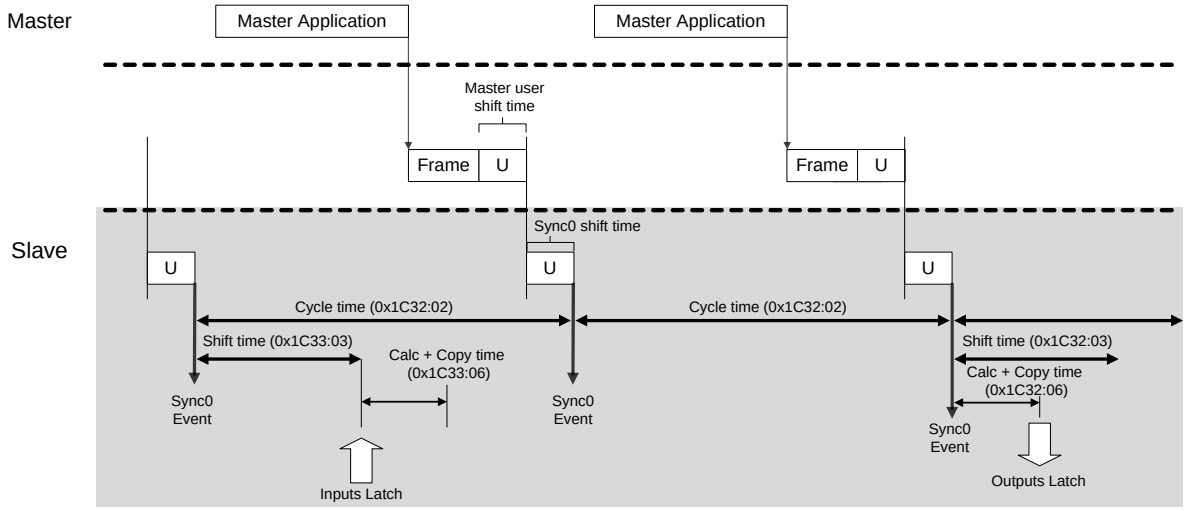
The following synchronization modes exist in this drive. You can change the mode with the sync control register.

- Free-run Mode:

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

- 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.



4.7 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	

5.CiA402 Drive Profile

IN THIS CHAPTER

5.1 State Machine

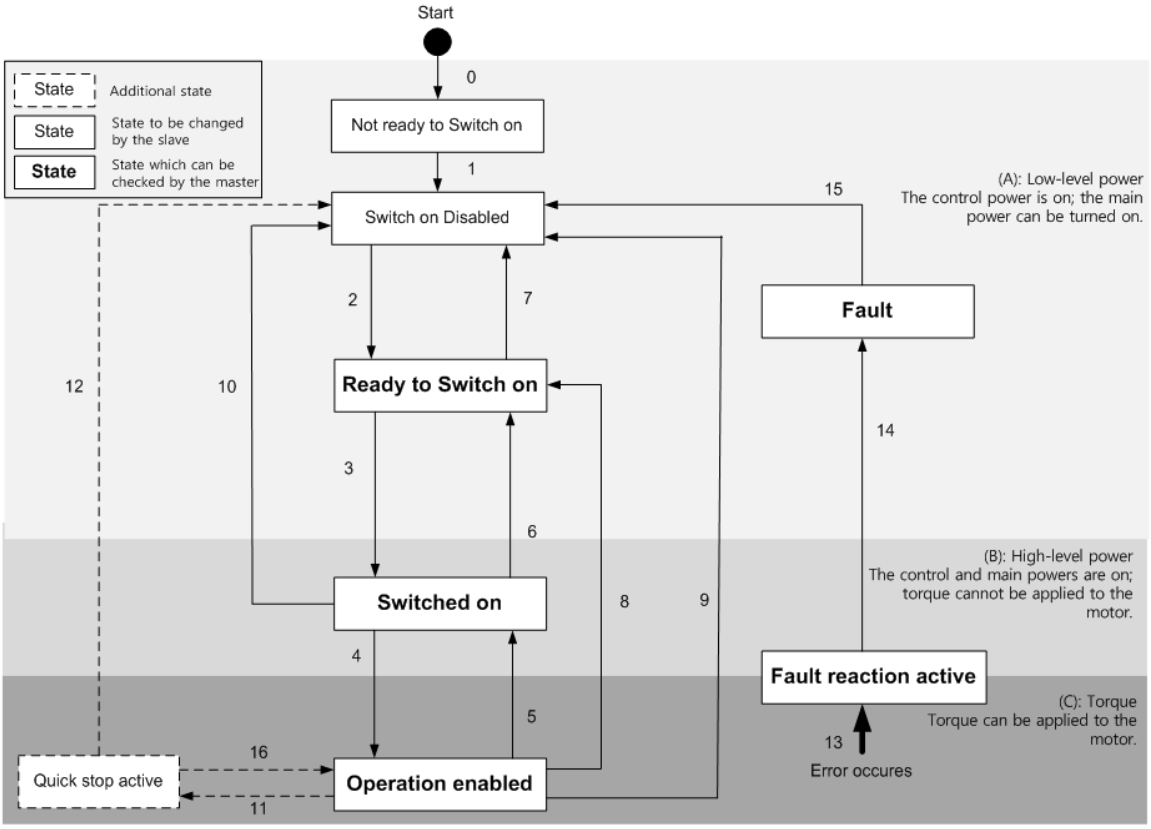


Figure 19. CiA402 State Machine Diagram

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.

Table 21. CiA402 State Machine Description

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

Table 22. State Machine Control Command

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 10.1.4 CiA402 Objects.
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switched on disabled	
7	Warning	
8	-	

Bit No.	Data Description	Note
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	

5.1.1 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**

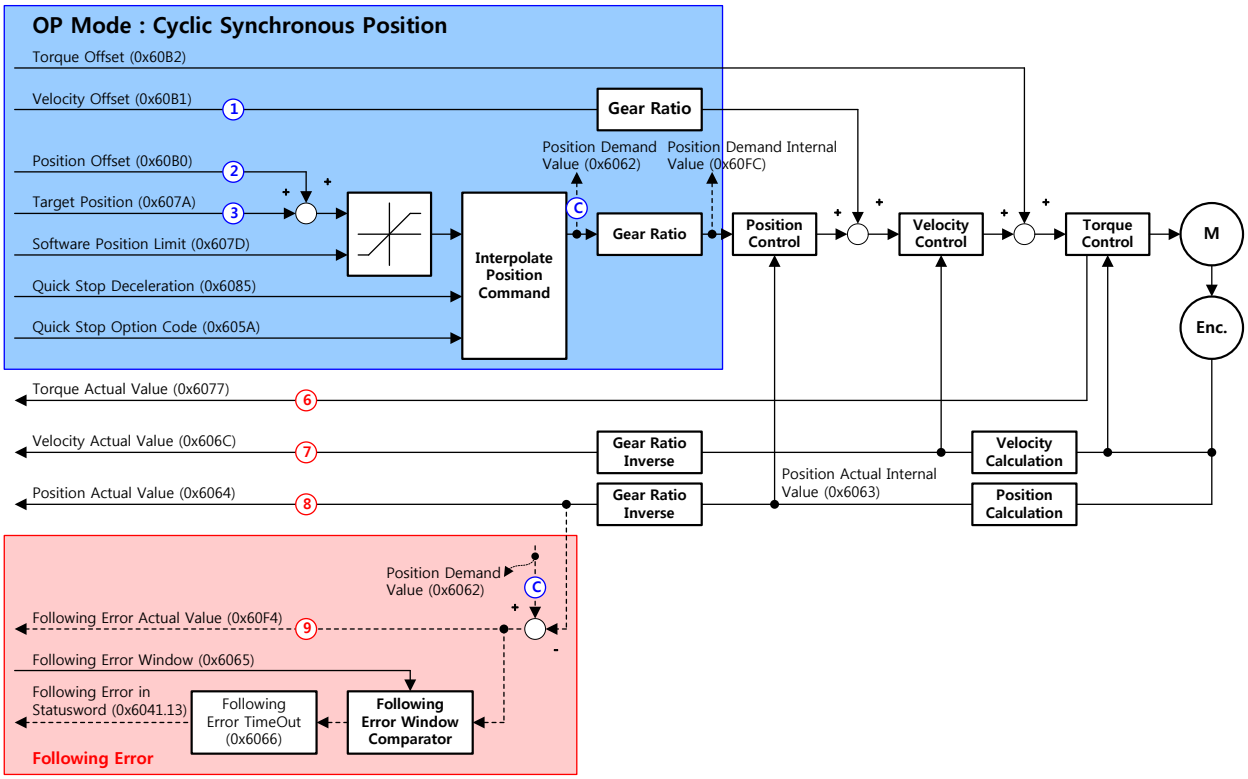
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6060	-	Modes of Operation	SNIT	RW	Yes	-
0x6061	-	Operation Mode Display	SNIT	RO	Yes	-
0x6502	-	Supported Drive Modes	UDINT	RO	No	-

5.2 Position Control Modes

5.2.1 Cyclic Synchronous Position(CSP) 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 feedforward respectively, and pass them to the drive.

The block diagram of the CSP mode is as follows:

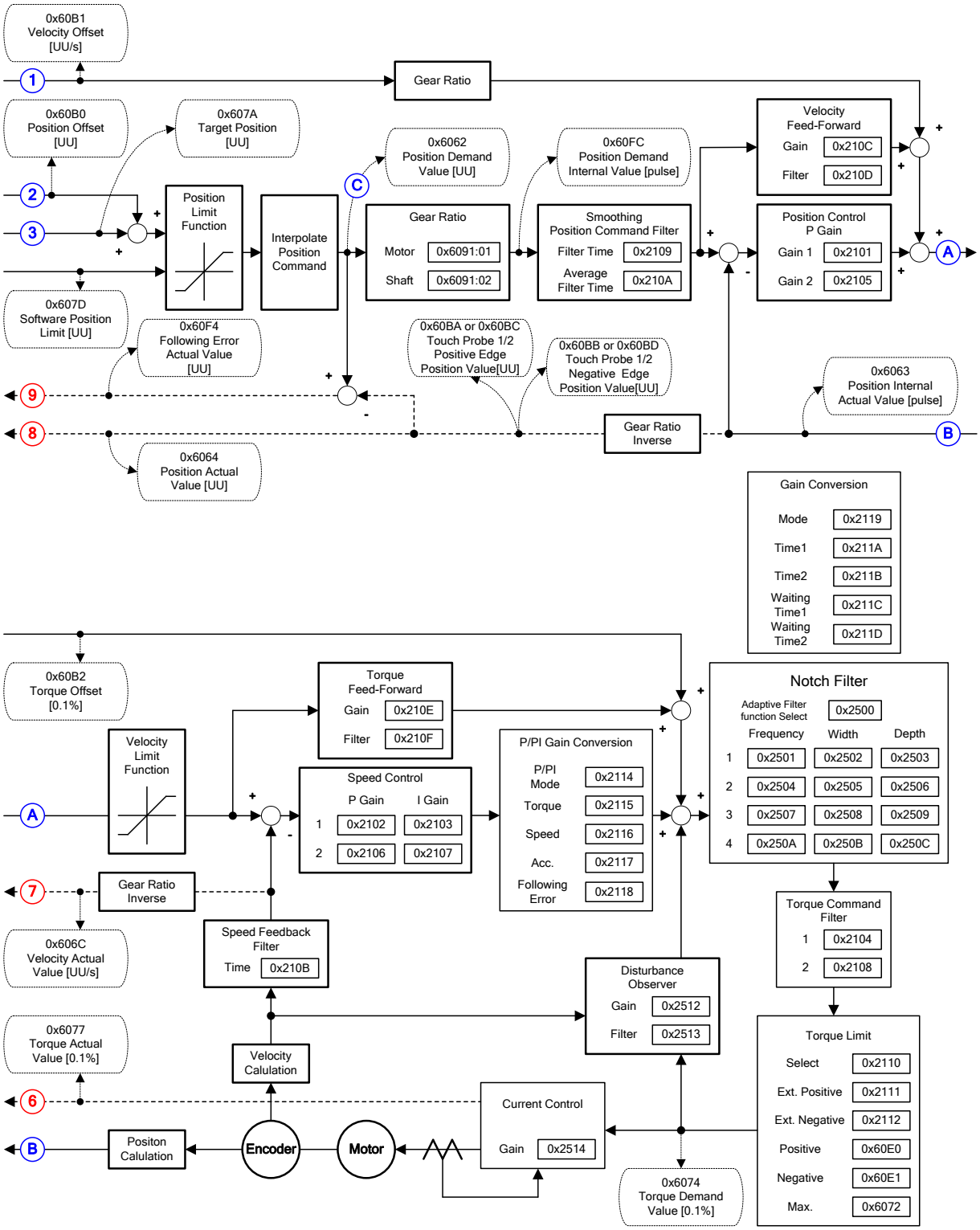


Related Objects

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

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
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

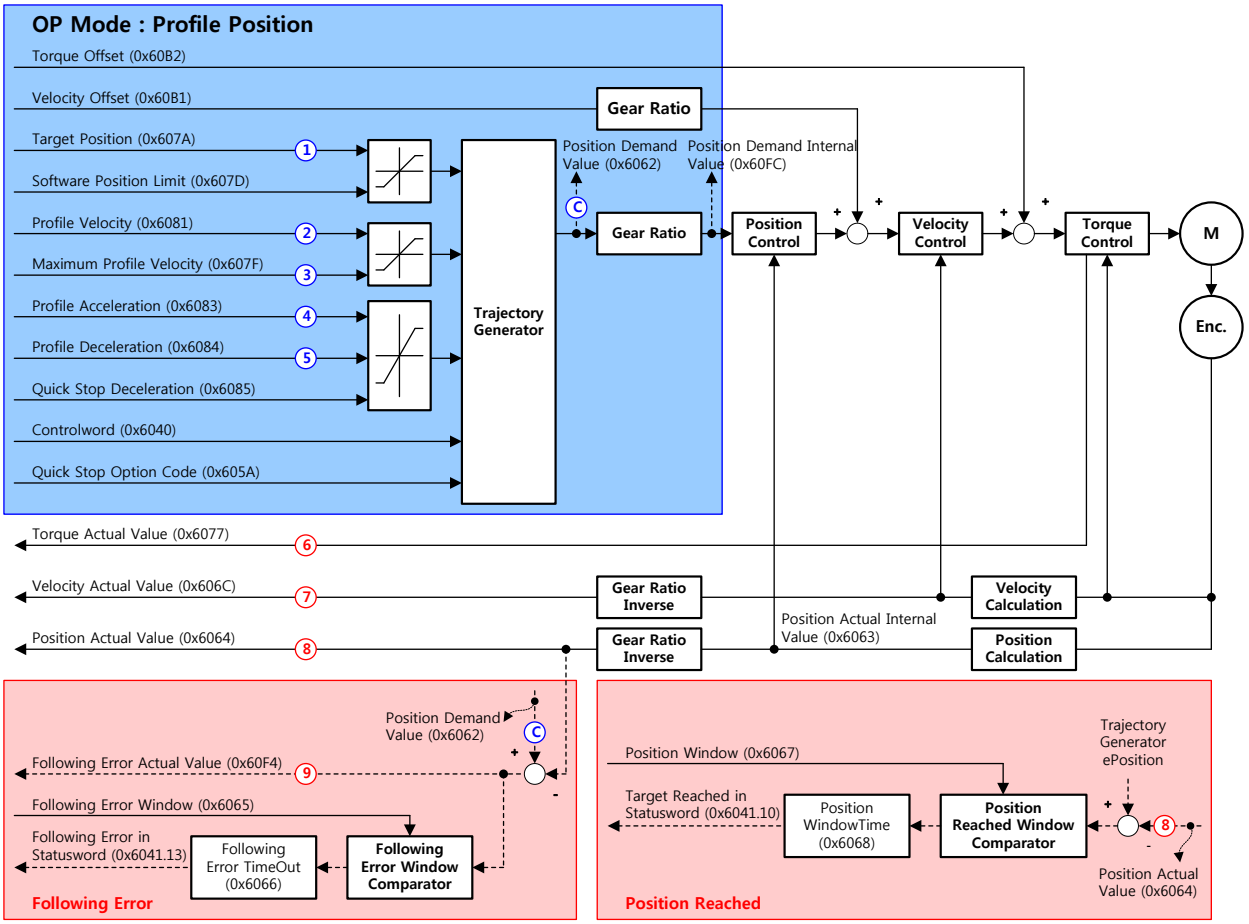
Internal Block Diagram of CSP Mode



5.2.2 Profile Position(PP) 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).

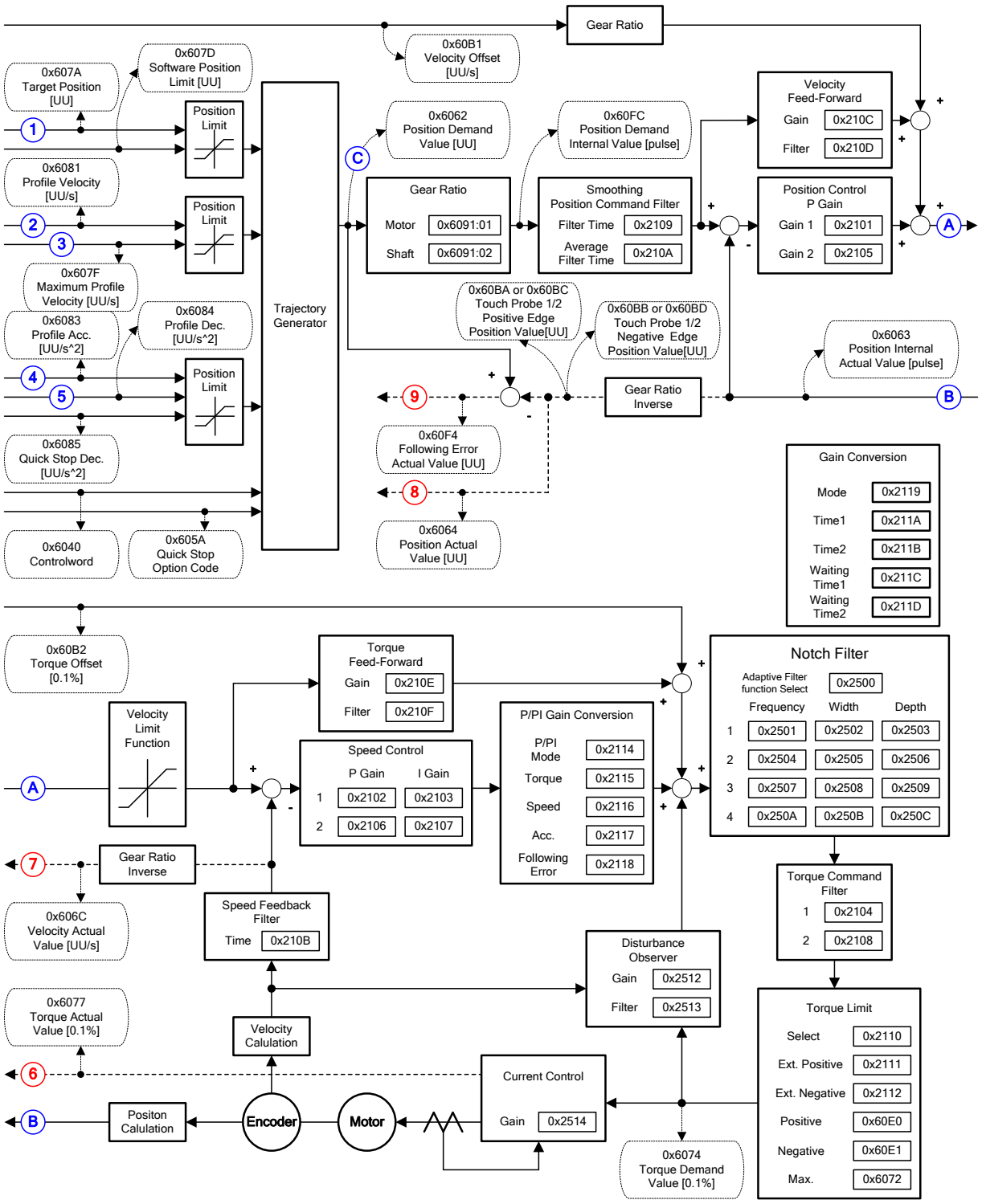
The block diagram of the PP mode is as follows:



- **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

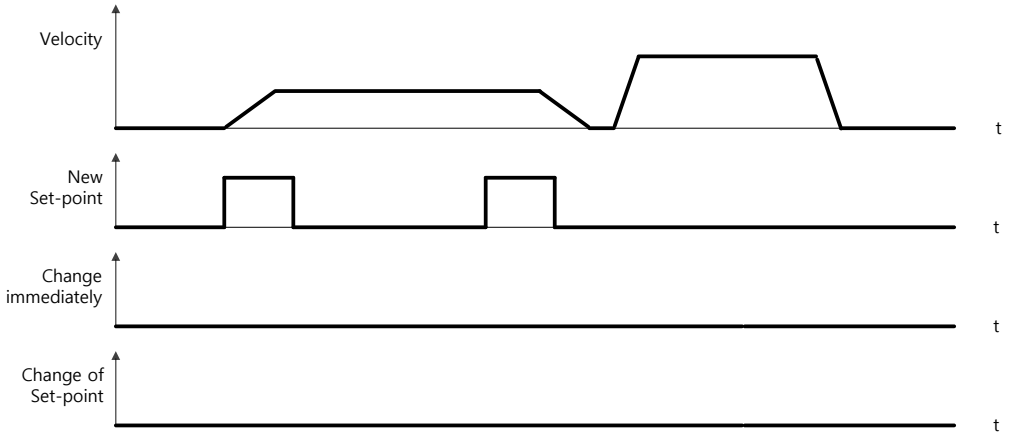
  After receiving a new position command while driving to the target position, it drives to the new position regardless of the existing target position.

- 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.

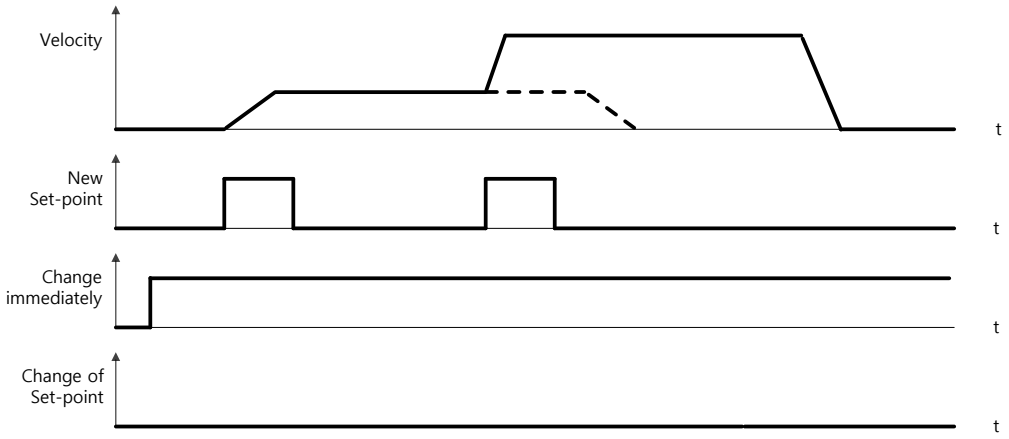
  The three methods mentioned above are set by the combination of New setpoint bit (Controlword, 0x6040.4), the Change set immediately bit (Controlword, 0x6040.5), and the Change setpoint bit (Controlword, 0x6040.9).

- **Single Set Point Driving Procedure**



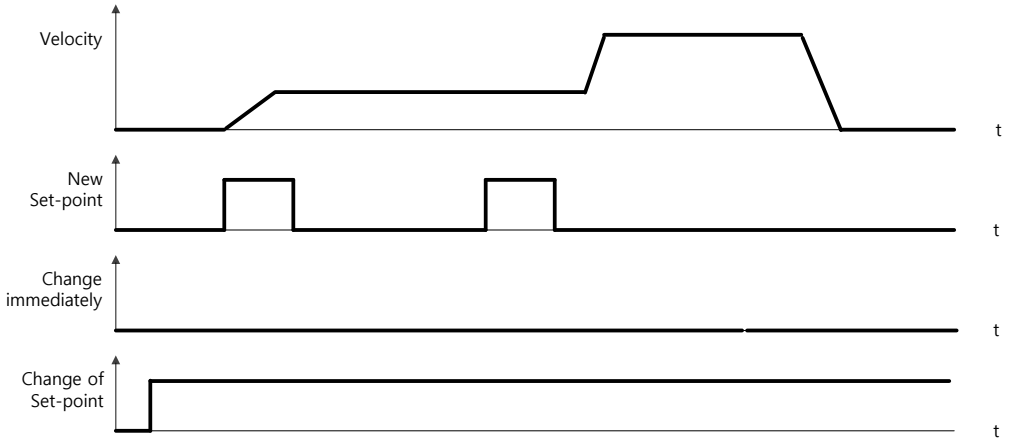
1. Specify the target position (0x607A).
2. Set the New setpoint bit to 1 and the Change set immediately bit to 0 to request the position operation.
3. The drive notifies the operator of its arrival at the target position with the Target reached bit (Statusword, 0x6041.10). The drive can suspend where it is or perform a new position operation if it receives the New set point bit.

● Change Immediately Driving Procedure



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

● Set of Set Point Driving Procedure

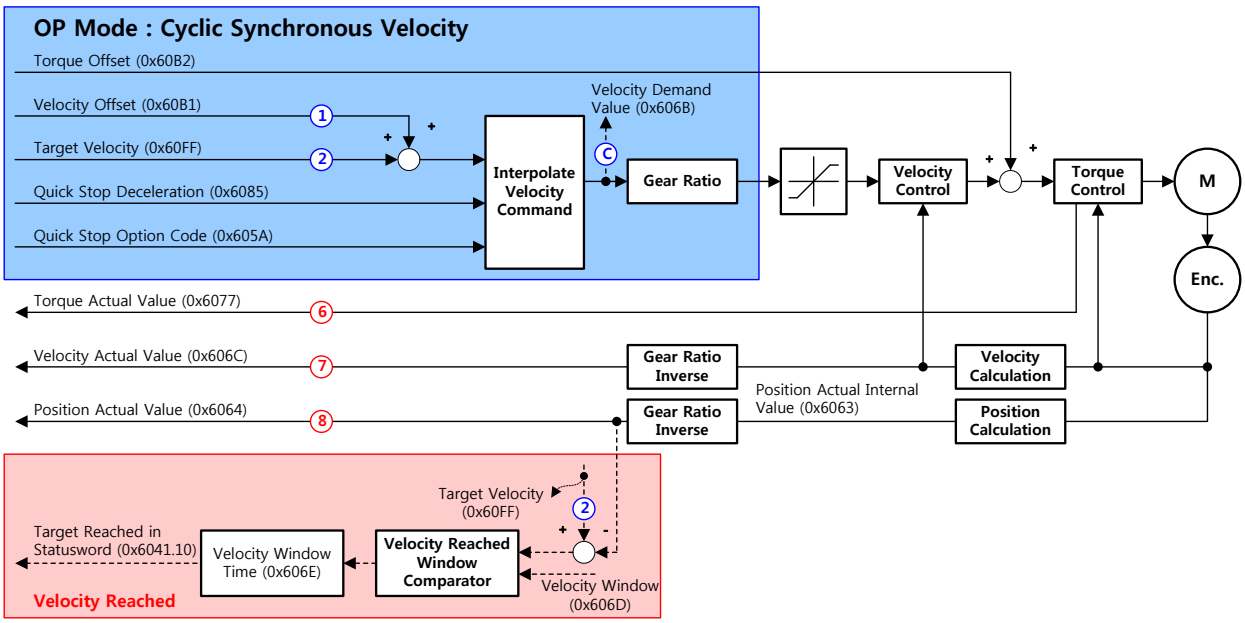


1. Specify the target position (0x607A).
2. Set the New setpoint bit to 1 and the Change of Set point bit to 1 to request the position operation.
3. After reaching the previous target position, the drive begins to move to the new position (New setpoint).
4. The drive notifies the operator of its arrival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

5.3 Velocity Control Modes

5.3.1 Cyclic Synchronous Velocity(CSV) 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:

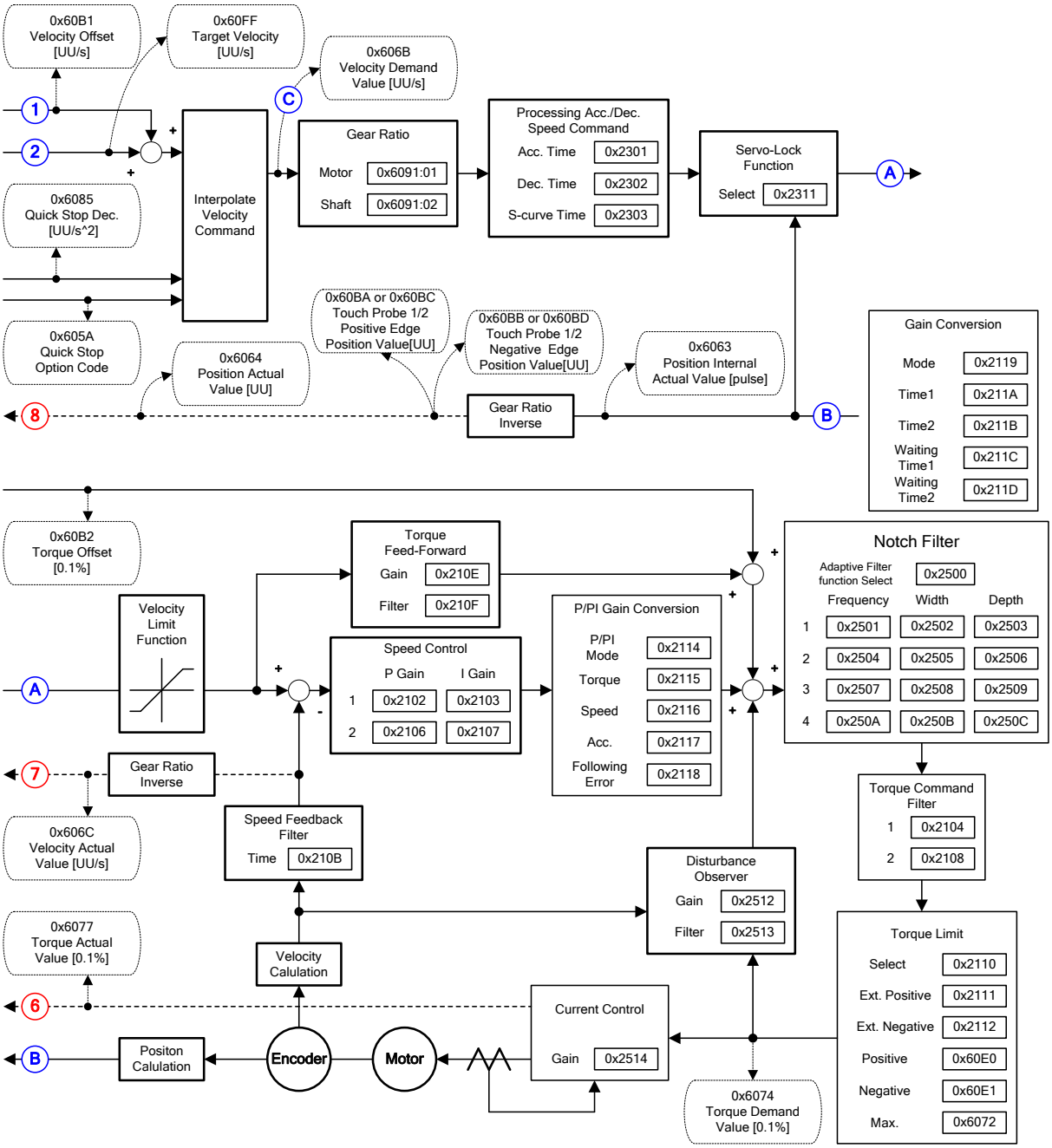


- **Related Objects**

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

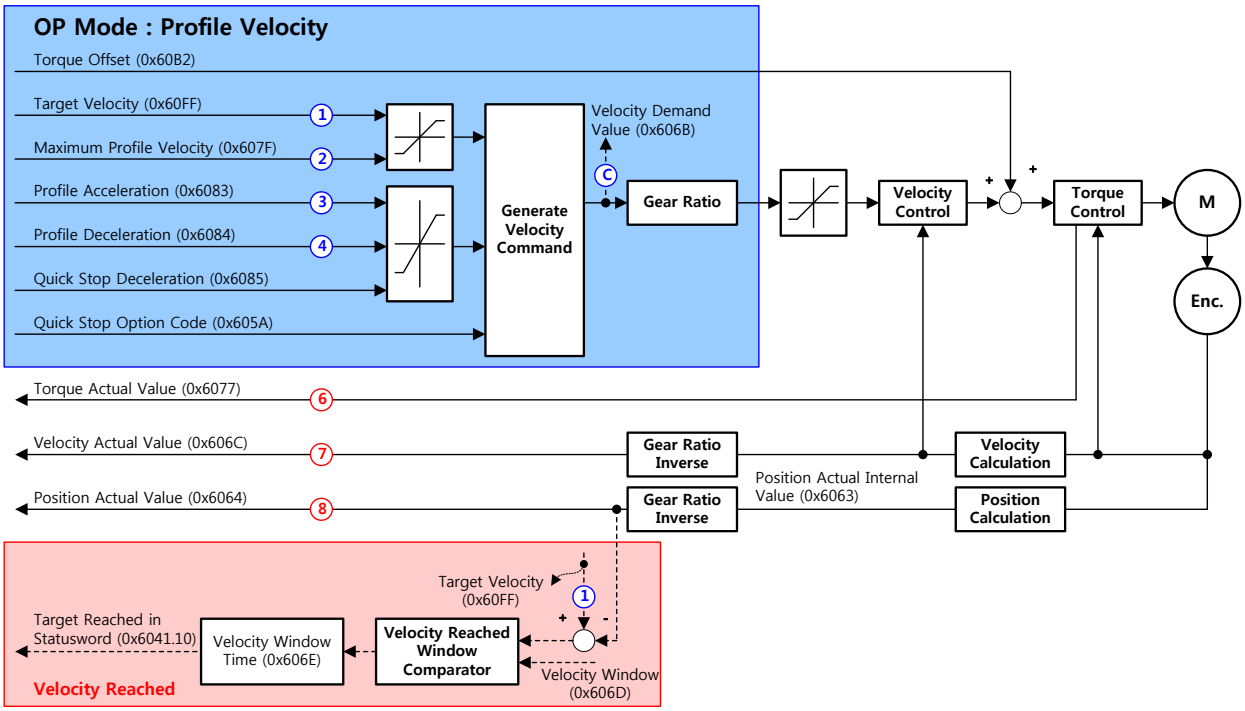
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x606E	-	Velocity Window Time	UINT	RW	No	Ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	Pulse

● **Internal Block Diagram of CSV Mode**



5.3.2 Profile Velocity(PV) Mode

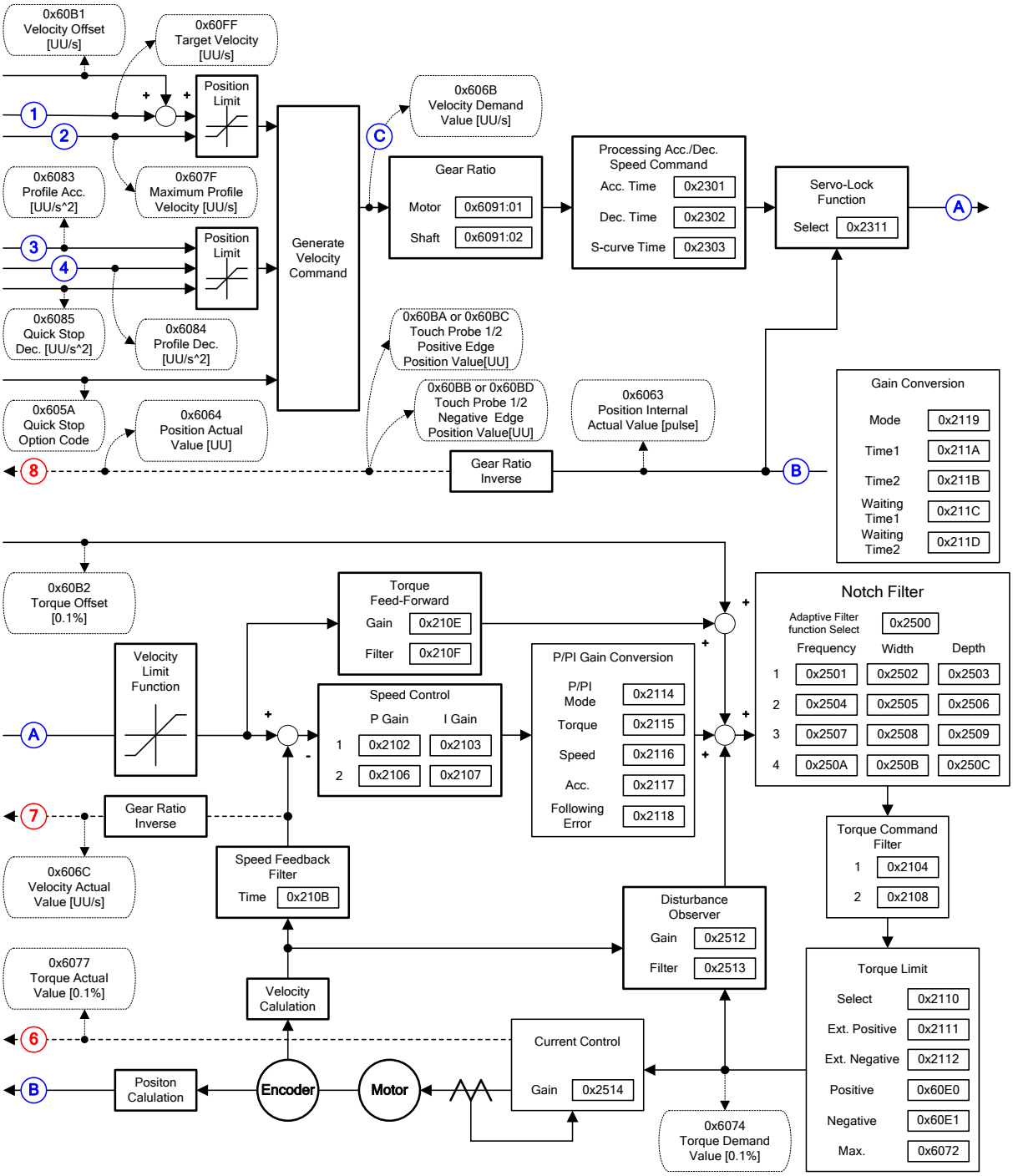
Unlike the CSV mode receiving the target velocity, renewed at every PDO update cycle, from the upper level controller, in the Profile Velocity (PV) mode, the drive generates a velocity profile internally up to the target velocity (0x60FF) using the profile acceleration (0x6083) and deceleration (0x6084), in order to control its velocity. At this moment, the max. profile velocity (0x607F) limits the maximum velocity. The block diagram of the PV mode is as follows:



● Related Objects

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x6040	-	Controlword	UINT	RW	Yes	-
0x6041	-	Statusword	UINT	RO	Yes	-
0x60FF	-	Target Velocity	DINT	RW	Yes	UU/s
0x607F	-	Maximum Profile Velocity	UDINT	RW	Yes	UU/s
0x6083	-	Profile Acceleration	UDINT	RW	No	UU/s^2
0x6084	-	Profile Deceleration	UDINT	RW	No	UU/s^2
0x6085	-	Quick Stop Deceleration	UDINT	RW	No	UU/s^2
0x605A	-	Quick Stop Option Code	INT	RW	No	-
0x60B1	-	Velocity Offset	DINT	RW	Yes	UU/s
0x60B2	-	Torque Offset	INT	RW	Yes	0.1%
0x606B	-	Velocity Demand Value	DINT	RO	Yes	UU/s
0x606C	-	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

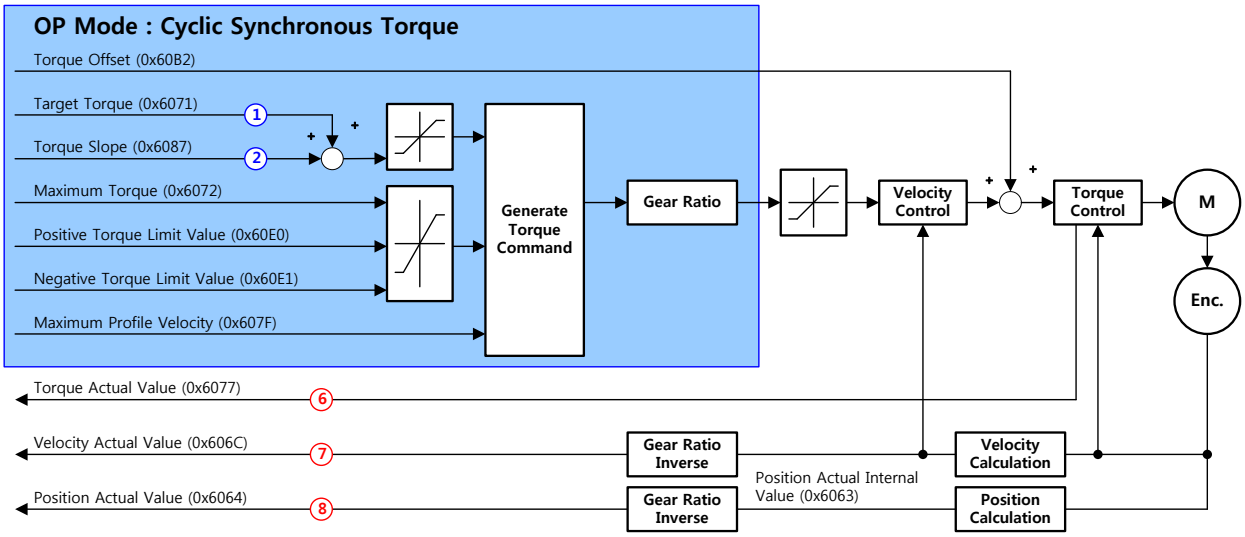
● Internal Block Diagram of PV Mode



5.4 Torque Control Modes

5.4.1 Cyclic Synchronous Torque(CST) 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:

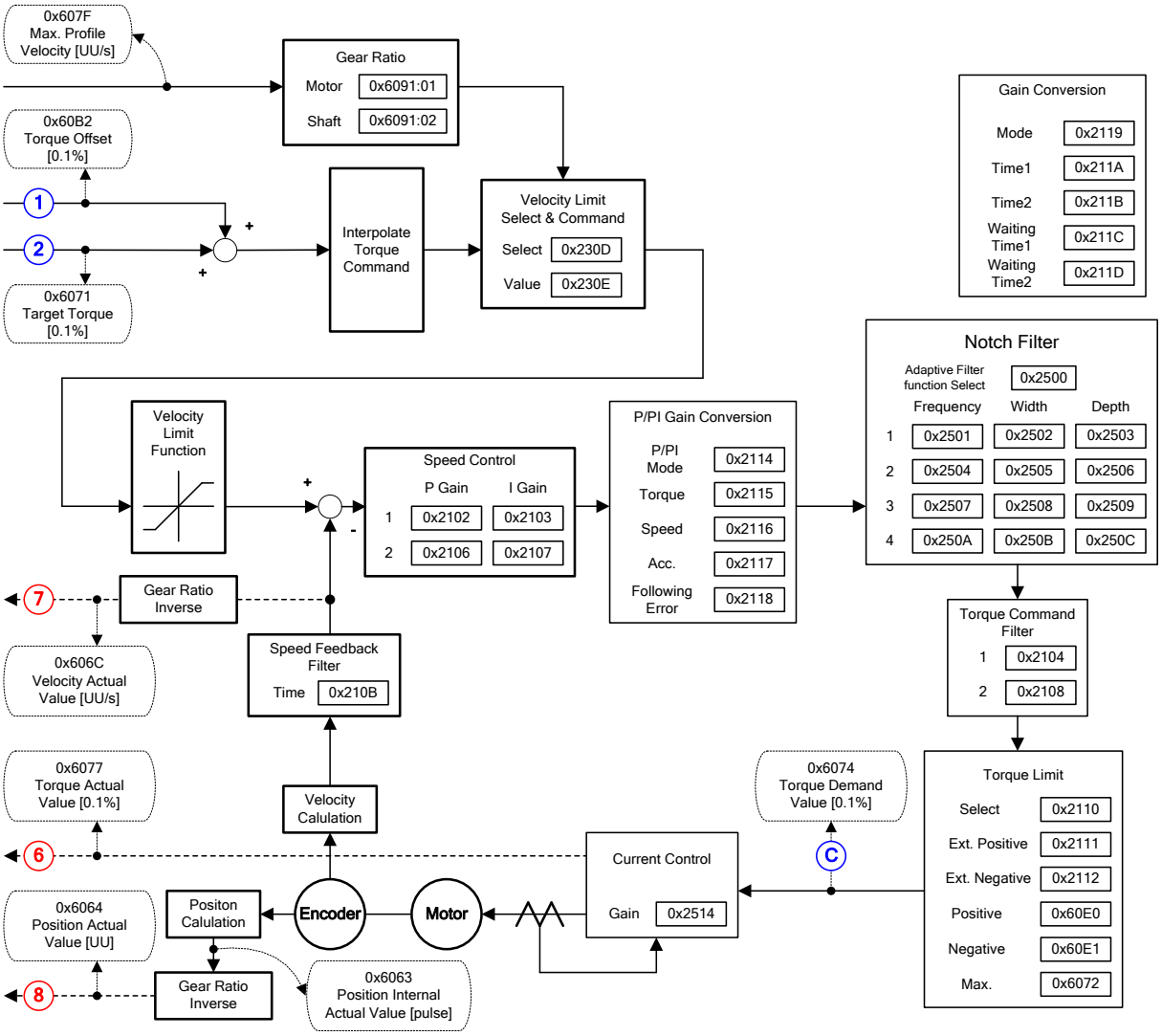


- **Related Objects**

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

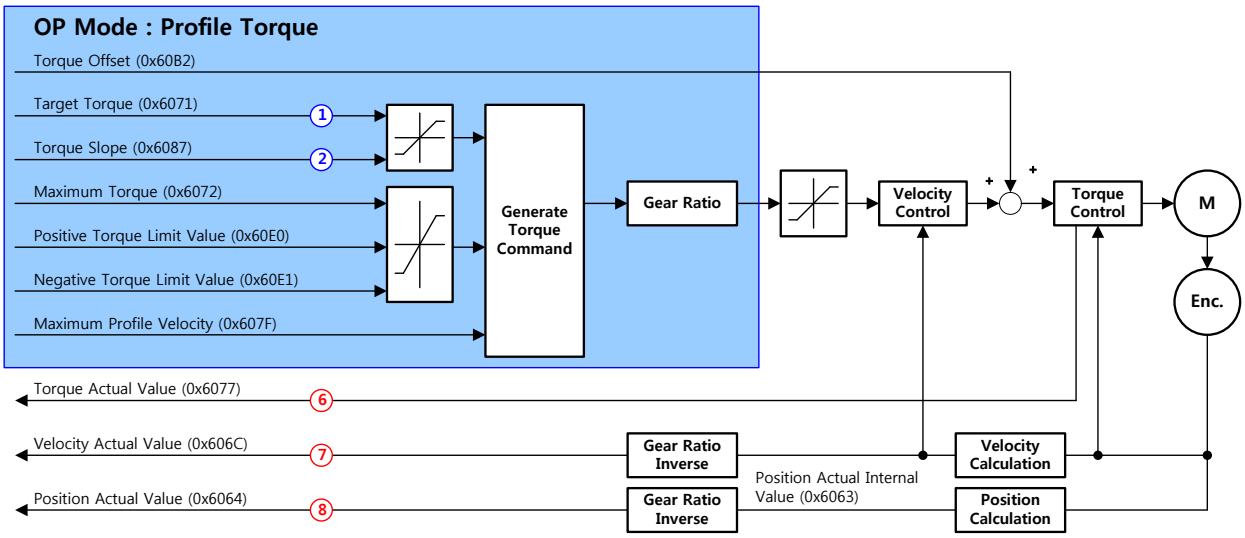
Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x606E	-	Velocity Window Time	UINT	RW	No	Ms
0x6077	-	Torque Actual Value	INT	RO	Yes	0.1%
0x606C	-	Actual Velocity Value	DINT	RO	Yes	UU/s
0x6064	-	Actual Position Value	DINT	RO	Yes	UU
0x6063	-	Actual Internal Position Value	DINT	RO	Yes	Pulse

● Internal Block Diagram of CST Mode



5.4.2 Profile Torque(PT) 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:



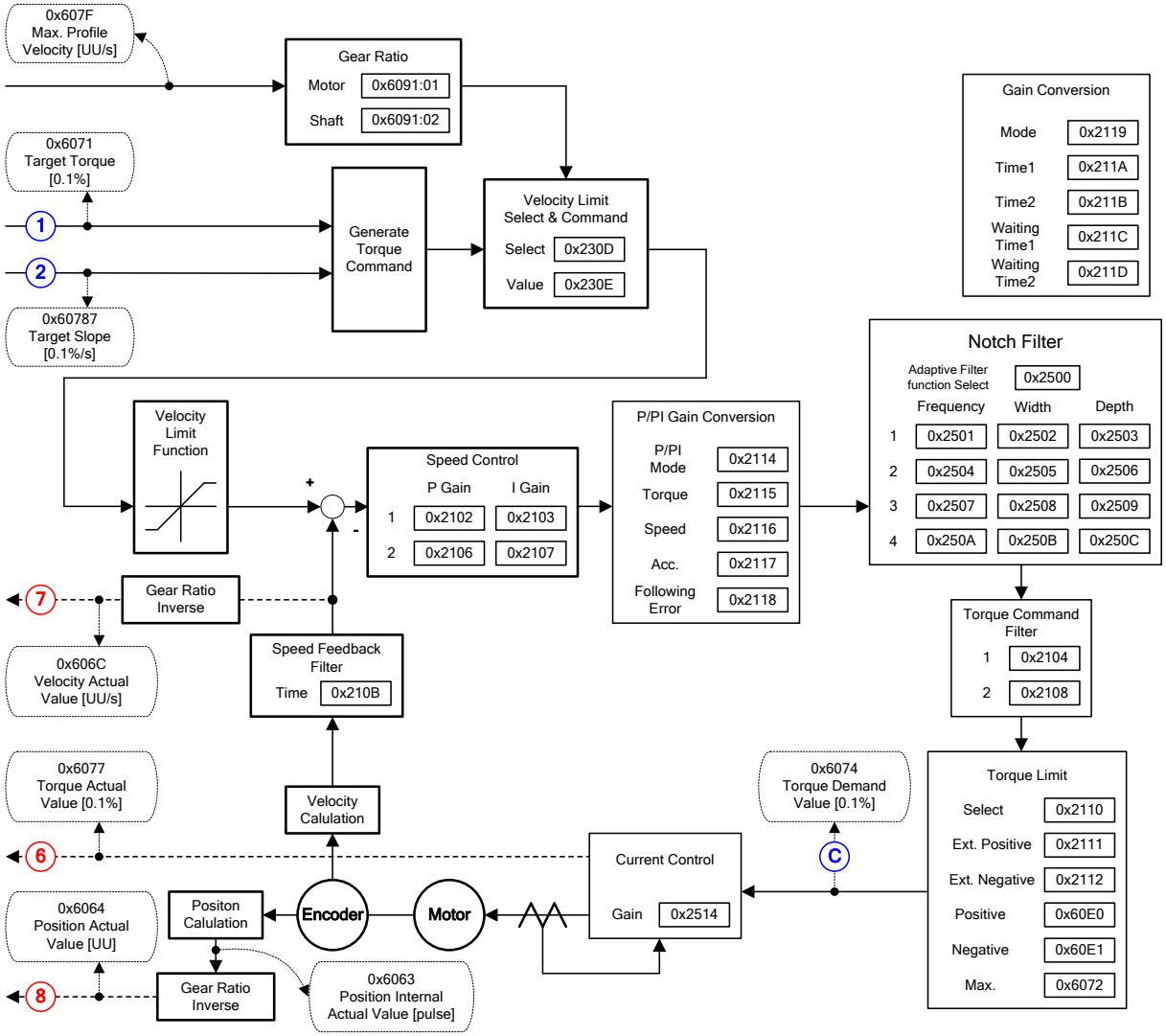
● Related Objects

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

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
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

Table 23. Profile Torque Mode Related Objects

● Internal Block Diagram of PT Mode



5.5 Homing

5.5.1 Homing Method

This drive provides built-in homing function (return to origin). The figure below shows the relationship of input/out parameters to the homing mode. You can select speed, acceleration, offset and homing methods.

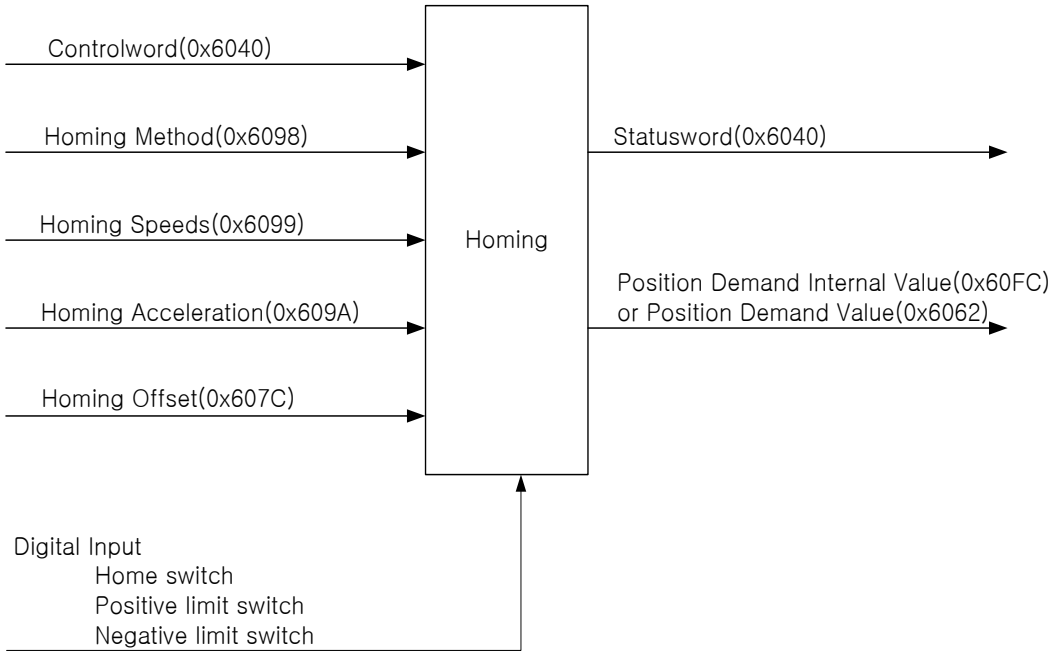
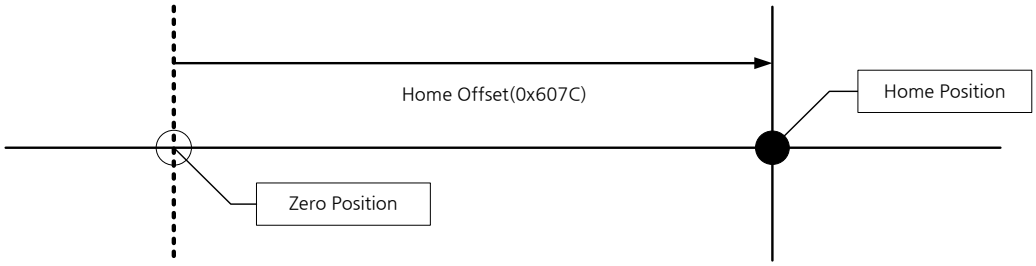


Figure 20. Homing Function

Using Home Offset, you can set the offset between the home position and the zero position of the machine, where 'zero position' means the position where the Position Actual Value (0x6064) is 0.



- **Homing Methods**

This drive supports the following homing methods (0x6098).

Homing Methods (0x6098)	Description
1	During reverse operation, the motor is returned to origin by negative limit switch (NOT) and index (Z) pulse.

2	During forward operation, the motor is returned to origin by positive limit switch (POT) and index (Z) pulse.
7,8,9,10	During forward operation, the motor is returned to origin by homing switch (POT) and index (Z) pulse. While returning to origin, when positive limit switch (POT) is input, the direction changes.
11,12,13, 14	During reverse operation, the motor is returned to origin by homing switch (POT) and index (Z) pulse. While returning to origin, when negative limit switch (NOT) is input, the direction changes.
24	During forward operation, the motor is returned to origin by homing switch (POT). While returning to origin, when positive limit switch (POT) is input, the direction changes.
28	During reverse operation, the motor is returned to origin by homing switch (POT). While returning to origin, when negative limit switch (NOT) is input, the direction changes.
33	During reverse operation, the motor is returned to origin by index (Z) pulse.
34	During forward operation, the motor is returned to origin by index (Z) pulse.
35	The current position is set as origin.
-1	During reverse operation, the motor is returned to the origin by reverse stopper and index (Z) pulse.
-2	During forward operation, the motor is returned to the origin by forward stopper and index (Z) pulse.
-3	During reverse operation, the motor is returned to the origin by reverse stopper
-4	During forward operation, the motor is returned to origin by forward stopper

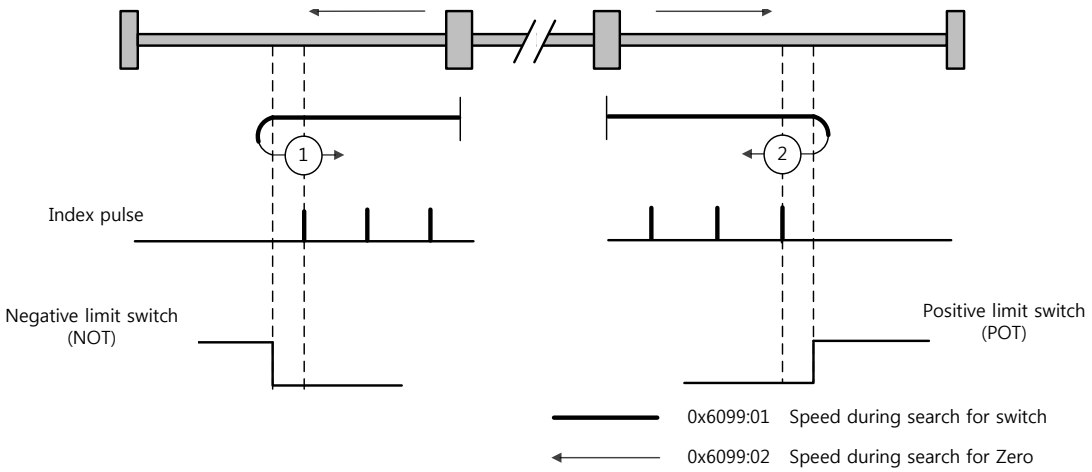
Table 24. Homing Methods

- **Related Objects**

Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	Unit
0x6040	-	Control word	UINT	RW	Yes	-
0x6041	-	Status word	UINT	RO	Yes	-
0x607C	-	Home Offset	DINT	RW	No	UU
0x6098	-	Homing Method	SINT	RW	Yes	-
0x6099	-	Homing speed	-	-	-	-
	0	Number of entries	USINT	RO	No	-
	1	Speed during search for switch	UDINT	RW	Yes	UU/s
	2	Speed during search for zero	UDINT	RW	Yes	UU/s
0x609A	-	Homing Acceleration	UDINT	RW	Yes	UU/s^2

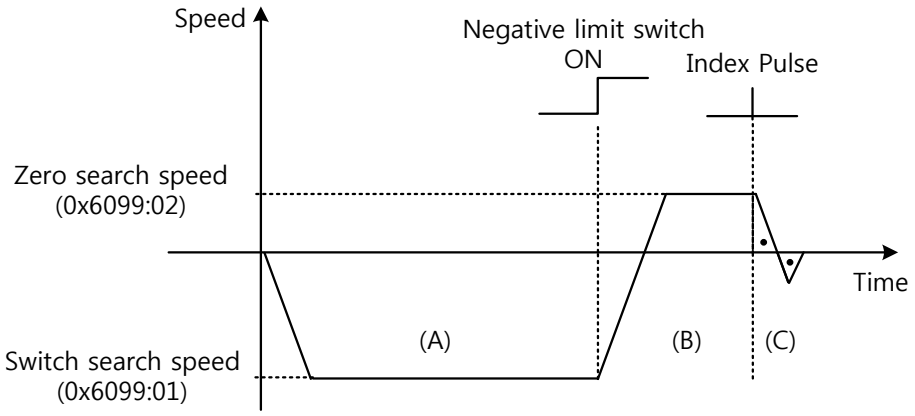
Table 25. Homing Related Objects

- **Homing Methods 1, 2**



The speed profile for each sequence in case of using Homing Method 1 is as shown below. Please see the explanations below for further details.

Homing Method ①

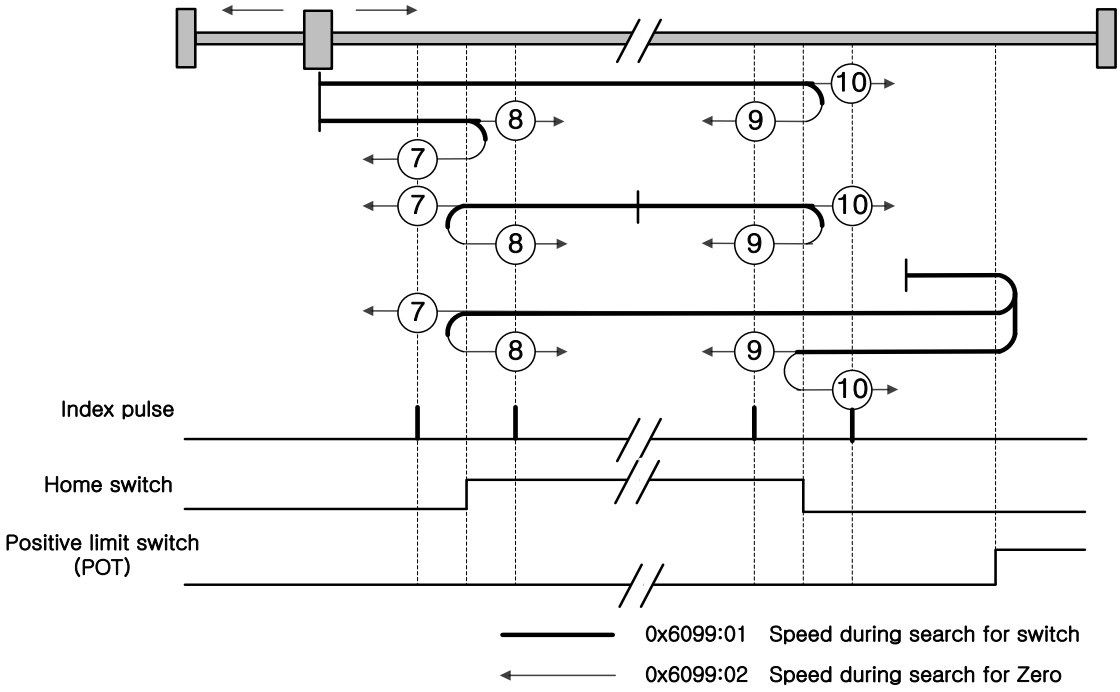


A. The initial direction is reverse (CW). The motor operates at the switch search speed.

B. When the negative limit switch (NOT) is on, the direction changes to forward (CCW). The motor decelerates to Zero search speed.

C. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

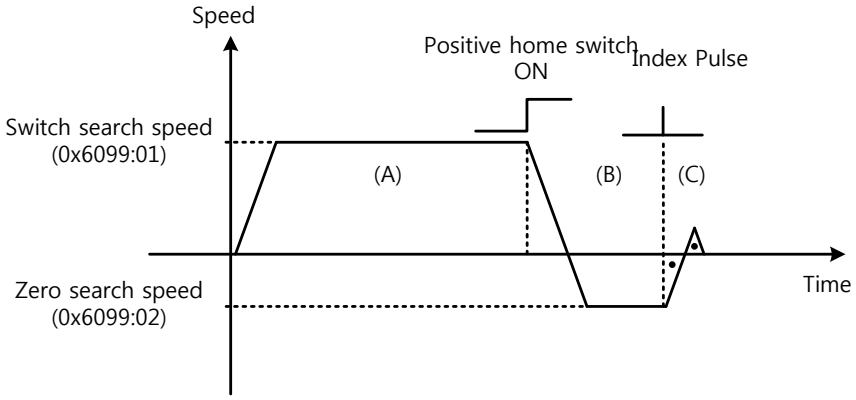
- **Methods 7, 8, 9, 10**



The speed profile for each sequence in case of using Homing Method 7 is as shown below. Please see the explanations below. The sequence varies in each of the three cases below, depending on the load position at the time of homing and the relationship of home switches. Please see the explanations below. Please see the explanations below for further details.

- **Cases where the home witch is off when homing begins, and the limit is not met in the process**

Homing Method ⑦



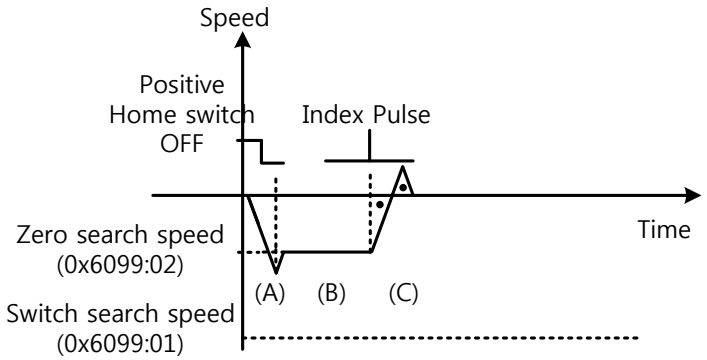
A. The initial direction is forward (CCW). The motor operates at the switch search speed.

B. When the positive limit switch (POT) is on, the motor decelerates to Zero search speed, and the direction changes to reverse (CW).

C. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

- **Cases where the home switch is on when homing begins**

Homing Method ⑦



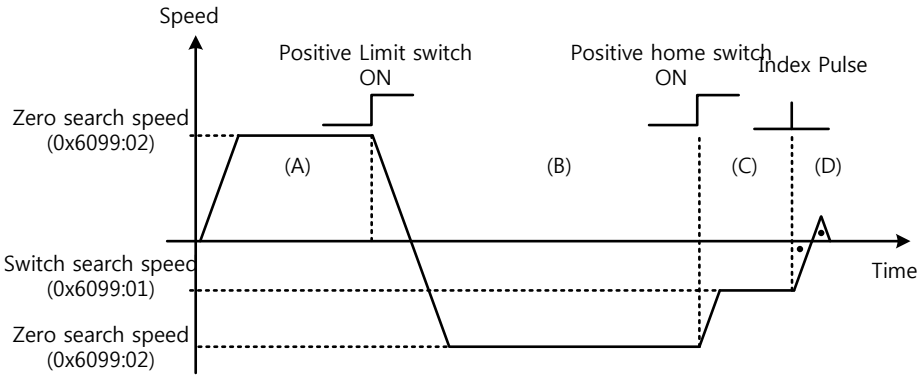
A. Since the home signal is on, the motor operates at the switch search speed in the positive home switch direction (CCW). Depending on the starting position, the switch search speed may not be reached.

B. When the Home Switch is off, the motor decelerates to Zero search speed.

C. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

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

Homing Method ⑦



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

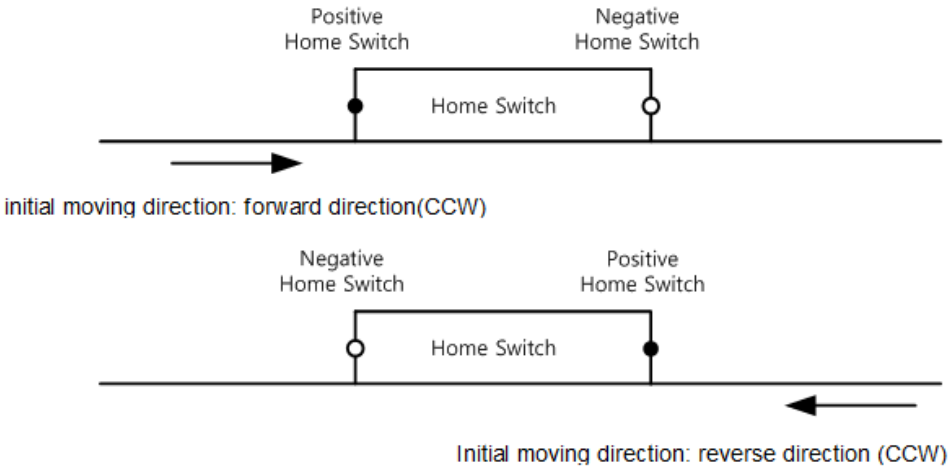
B. When the positive limit switch (POT) is on, the motor decelerates and stops. Then, the motor operates reverse (CW) at the switch search speed.

C. When the Positive Home Switch is off, the motor decelerates to Zero search speed.

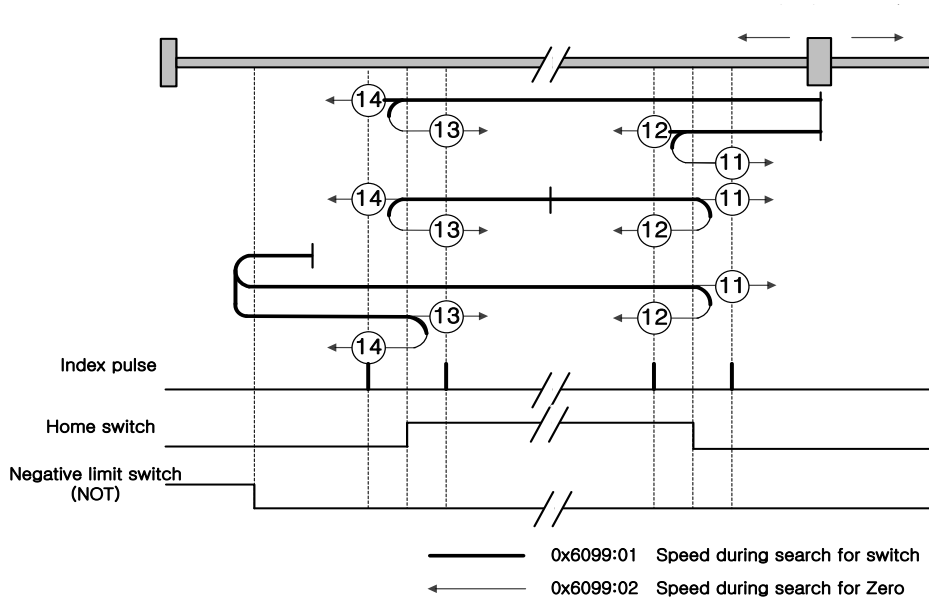
D. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

The homing sequences of Methods 8, 9, 10 above are almost identical to those of Method 7 explained above, except for differences in initial direction and actions pertaining to Home switch positivity/negativity.

Positive Home Switch is determined based on the initial direction. The home switch first met while operating in the initial direction becomes the Positive Home Switch.



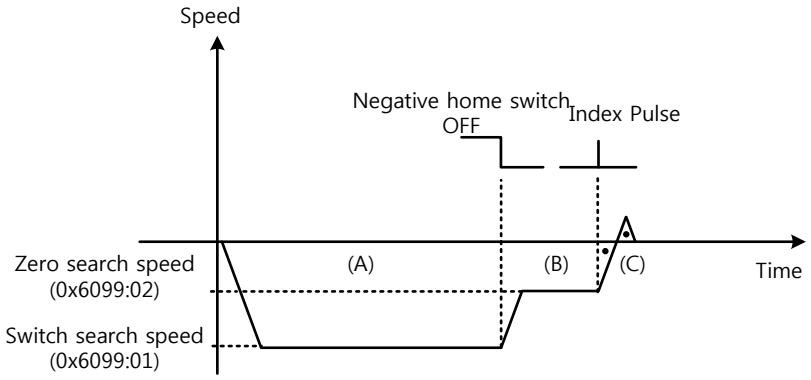
- **Methods 11,12,13,14**



The speed profile for each sequence in case of using Homing Method 14 is as shown below. Please see the explanations below. The sequence varies in each of the three cases below, depending on the load position at the time of homing and the relationship of home switches. Please see the explanations below. Please see the explanations below for further details.

- **Cases where the home witch is off when homing begins, and the limit is not met in the process**

Homing Method ⑭

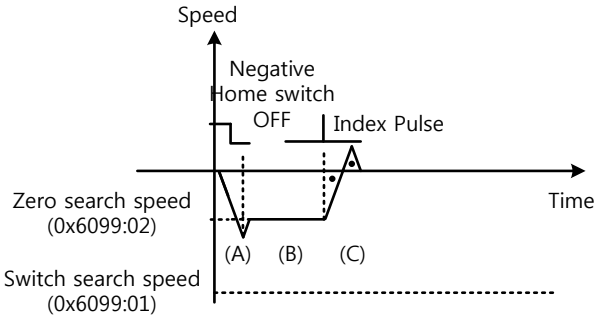


A. The initial direction is reverse (CW). The motor operates at the switch search speed.

B. When the negative limit switch (NOT) is off, the motor decelerates to Zero search speed, and the direction changes to reverse (CW).

C. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

- **Cases where the home switch is on when homing begins**



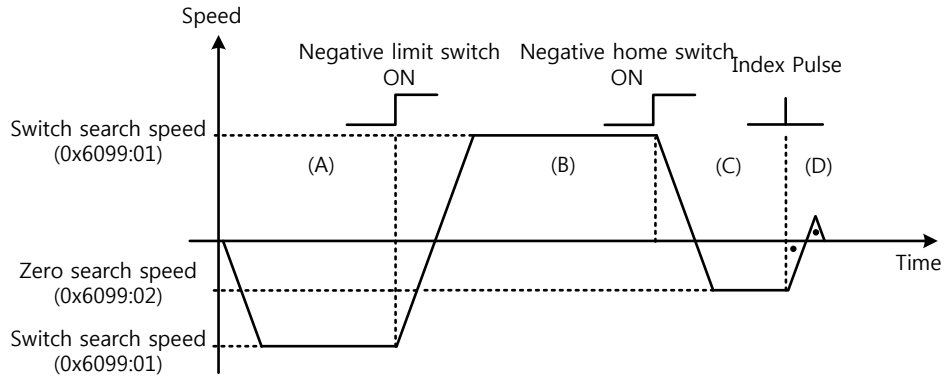
A. Since the home signal is on, the motor operates at the switch search speed in the negative home switch direction (CW). Depending on the starting position, the switch search speed may not be reached.

B. When the Home Switch is off, the motor decelerates to Zero search speed.

C. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

- **Cases where the home switch is off when homing begins, and the limit is met in the process**

Homing Method ⑭



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

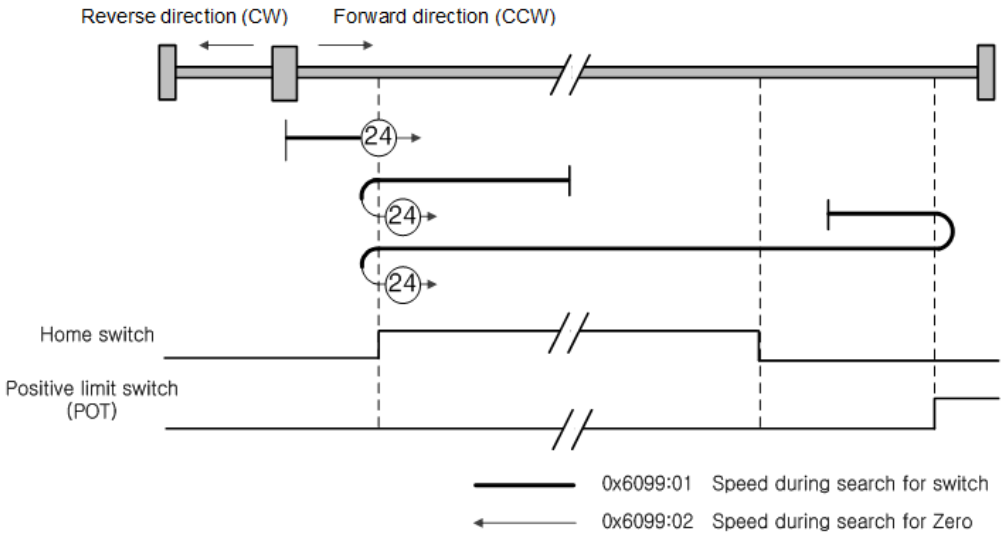
B. When the negative limit switch (NOT) is on, the motor decelerates and stops. Then, the motor operates forward (CCW) at the switch search speed.

C. When the Negative Home Switch is on, the motor decelerates to Zero search speed. Then the direction changes to reverse (CW).

D. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

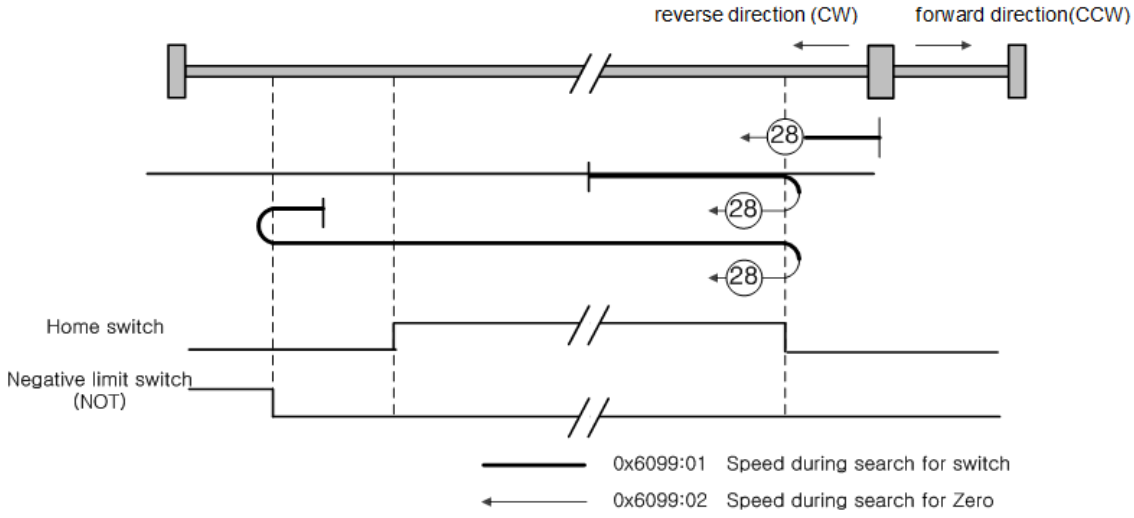
The homing sequences of Methods 11, 12, 13 above are almost identical to those of Method 14 explained above, except for differences in initial direction and actions pertaining to Home switch positivity/negativity.

- **Method 24**



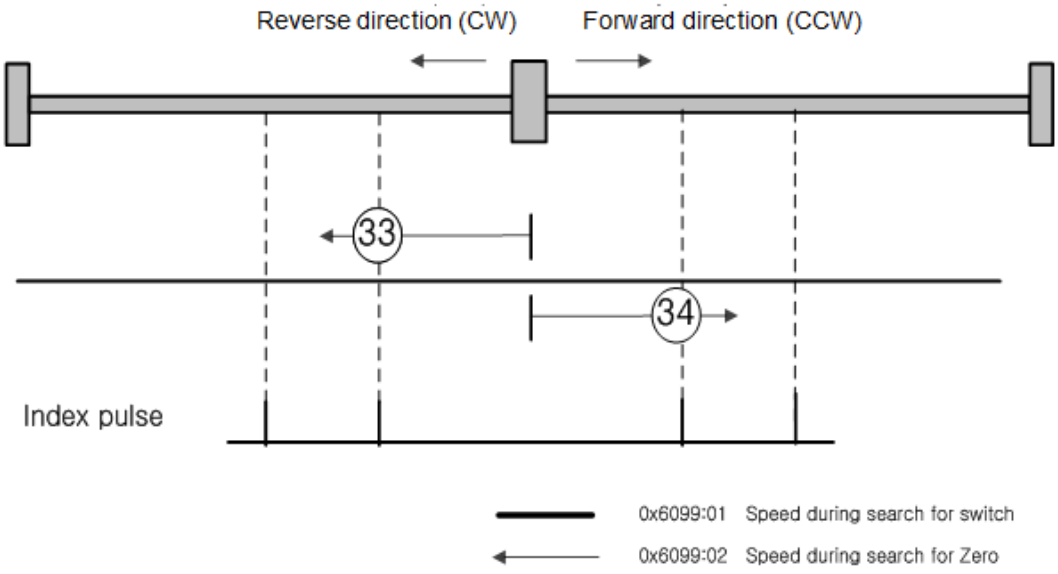
The initial direction is forward (CCW), and the position where the Positive Home Switch is on becomes the home position home position.

- **Method 28**



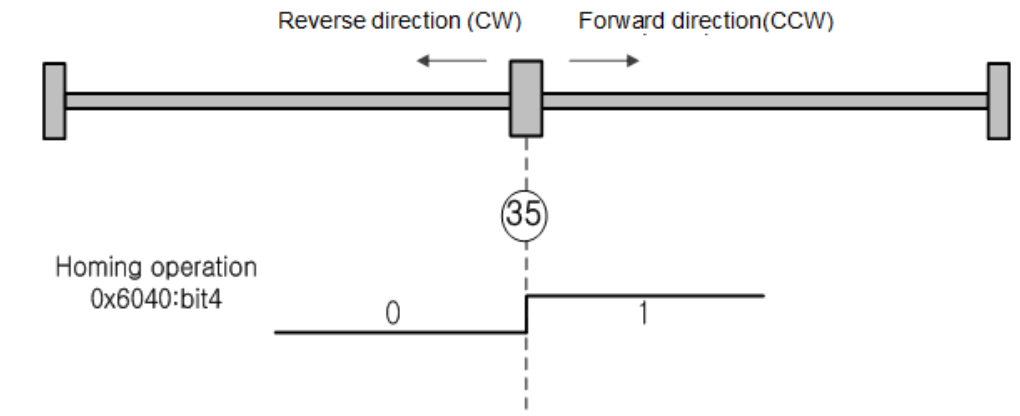
The initial direction is reverse (CW), and the position where the Positive Home Switch is on becomes the home position home position

- **Methods 33, 34**



The initial position is reverse (CW) for Method 33 and forward (CCW) for Method 44. The index pulse is detected at Zero search speed.

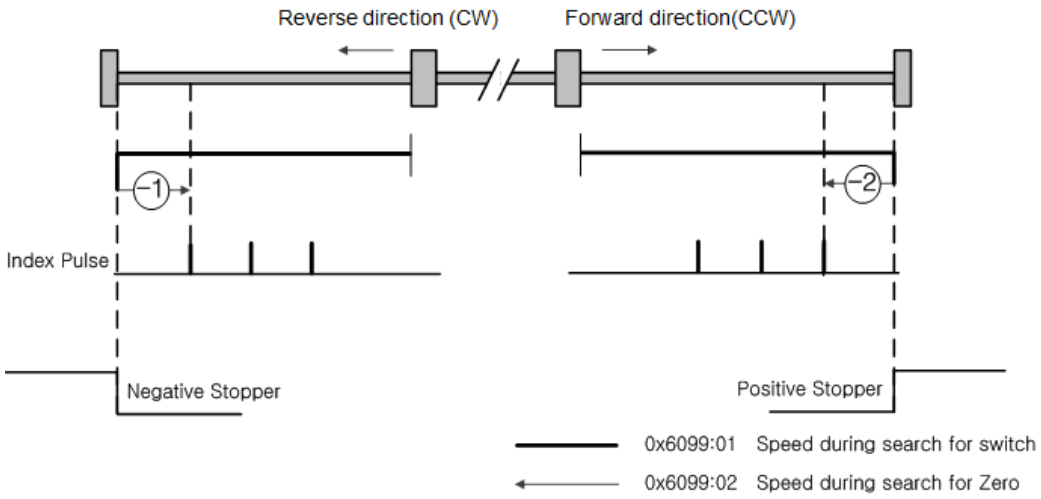
- **Method 35**



The current position when the homing begins becomes the home position. This method is used when changing the origin to the current position, as needed by the host controller.

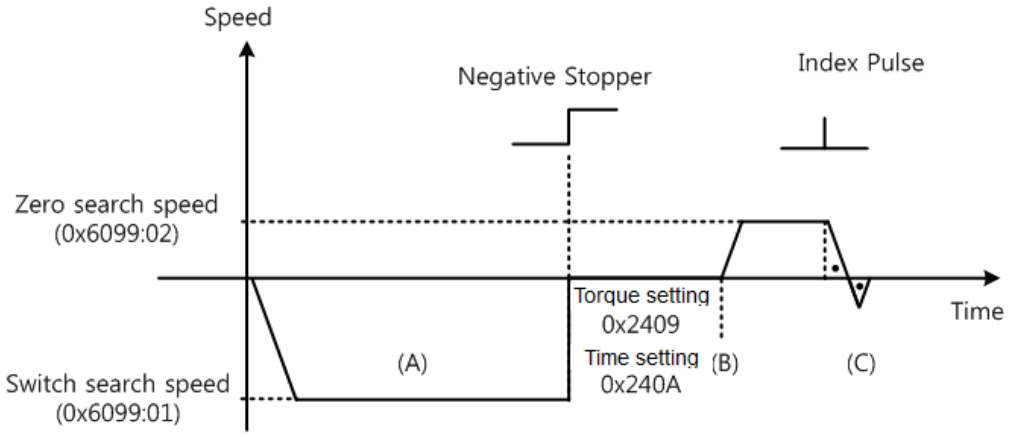
Homing methods -1, -2, -3, -4 are homing methods supported by this drive other than the standard methods. You can use these methods when not using a separate home switch.

- **Methods -1, -2**



Homing Methods -1, -2 uses Stopper and Index(Z) pulse to return to origin. The speed profile of each sequence is as follows. Please see the explanations below for further details.

Homing Method ①

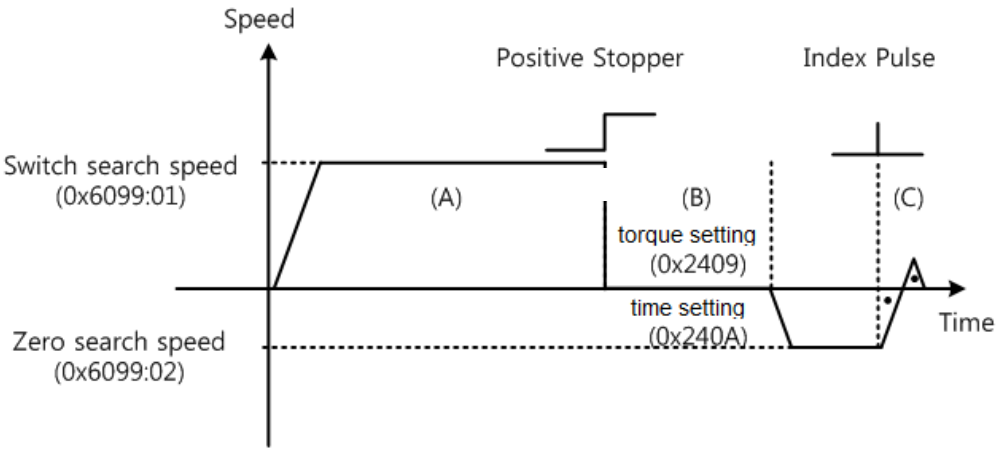


A. The initial direction is reverse (CW). The motor operates at the switch search speed.

B. When the motor hits the Negative Stopper, the motor stands by based on the torque limit for homing using stopper (0x2409) and set value of homing time (0x240A), and changes direction..

C. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

Homing Method ②

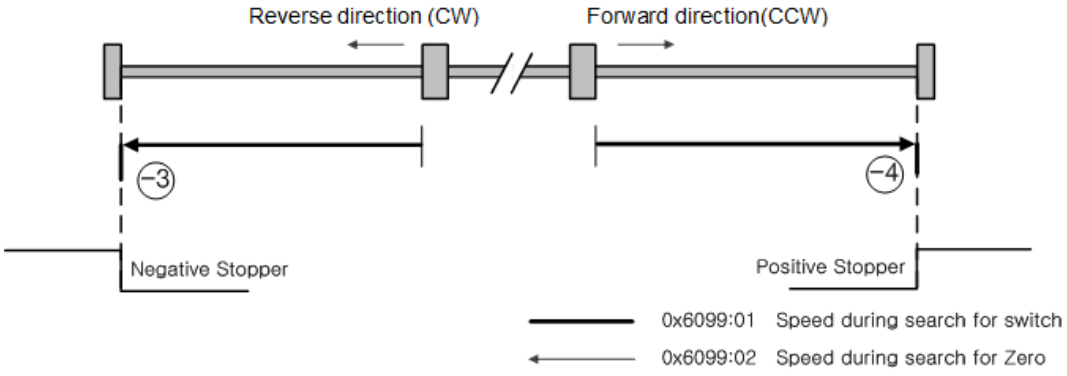


A. The initial direction is forward (CCW). The motor operates at the switch search speed.

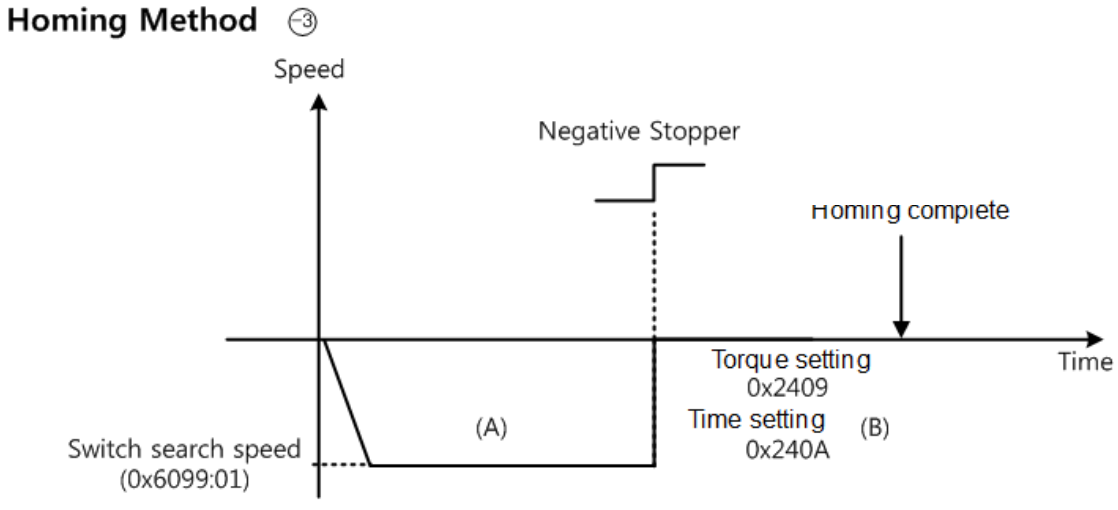
B. When the motor hits the Positive Stopper, the motor stands by based on the torque limit for homing using stopper (0x2409) and set value of homing time (0x240A), and changes direction..

C. While operating at Zero search speed, the first index pulse is detected, and the motor rotates to the index position (Home).

- **Methods -3, -4**

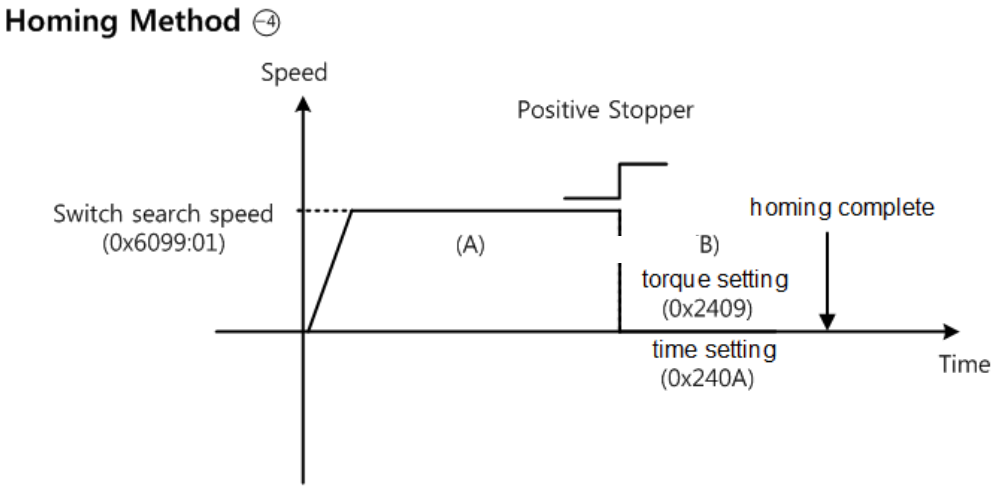


Homing Methods -1, -2 uses only Stopper to return to origin. The speed profile of each sequence is as follows. Please see the explanations below for further details.



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

B. When the motor hits the Negative Stopper, the motor stands by based on the torque limit for homing using stopper (0x2409) and set value of homing time (0x240A), and changes direction.



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

B. When the motor hits the Positive Stopper, the motor stands by based on the torque limit for homing using stopper (0x2409) and set value of homing time (0x240A), and changes direction.

5.6 Touch Probe Function

Touch probe captures the encoder's position value using external input(PROBE1,2) signals or the Index(Z) pulse of the encoder.

Example of using touch probe

Water Mapper System of WTR (Wafer transfer robot)

When multiple layers of waters are loaded on the Wafer Stack, the sensor determines the existence of waters through a single scan. Using the water load position value, the robot's unnecessary movements can be minimized

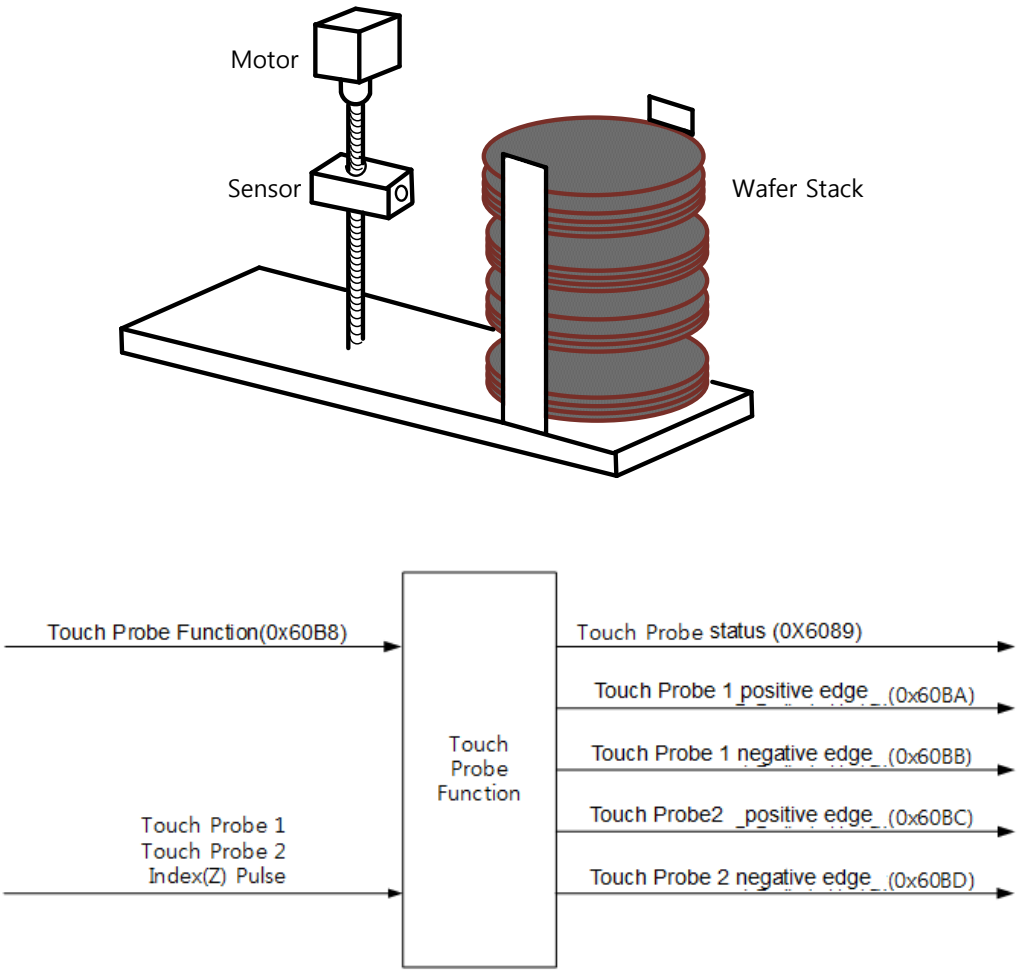


Figure 21. Touch Probe Function

The position value of the encoder (Position Actual Value, 0x6064) are latched by the following trigger events depending on the set value. In case of simultaneous input through 2 channels, the values can be separately latched at each of the positive/negative edges.

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

- **Related Objects**

Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	Unit
0x60B8	-	Touch Probe Function	UINT	RW	Yes	-

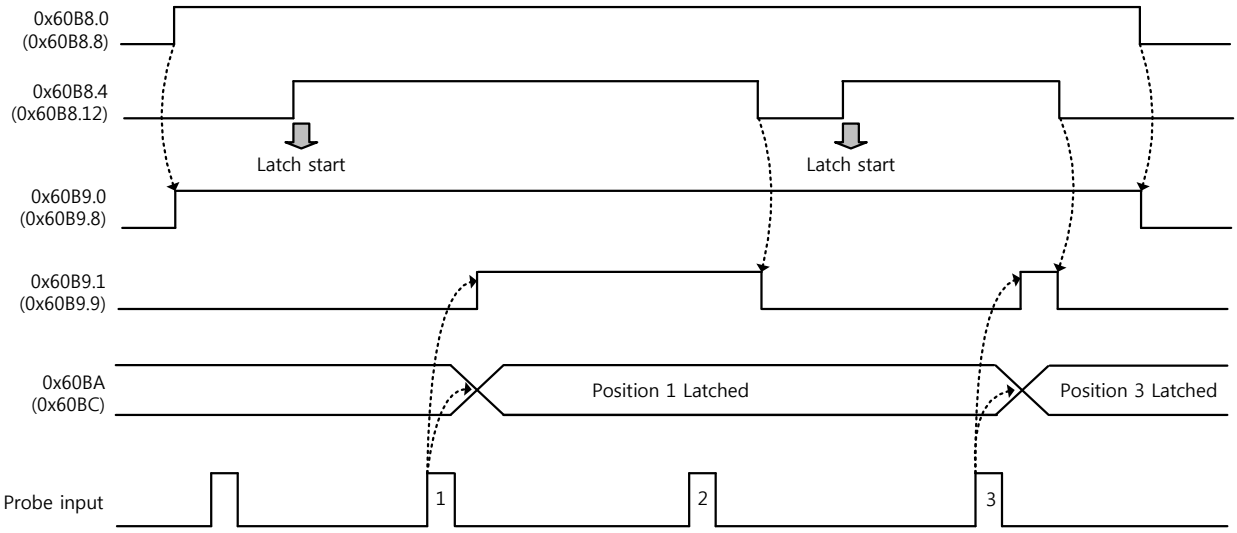
0x60B9	-	Touch Probe Status	UINT	RO	Yes	-
0x60BA	-	Touch Probe 1 Positive Edge Position Value	DINT	RO	Yes	UU
0x60BB	-	Touch Probe 1 Negative Edge Position Value	DINT	RO	Yes	UU
0x60BC	-	Touch Probe 2 Positive Edge Position Value	DINT	RO	Yes	UU
0x60BD	-	Touch Probe 2Negative Edge Position Value	DINT	RO	Yes	UU

Table 26. Touch Probe Function Related Objects

- **Touch Probe Timing Diagram**

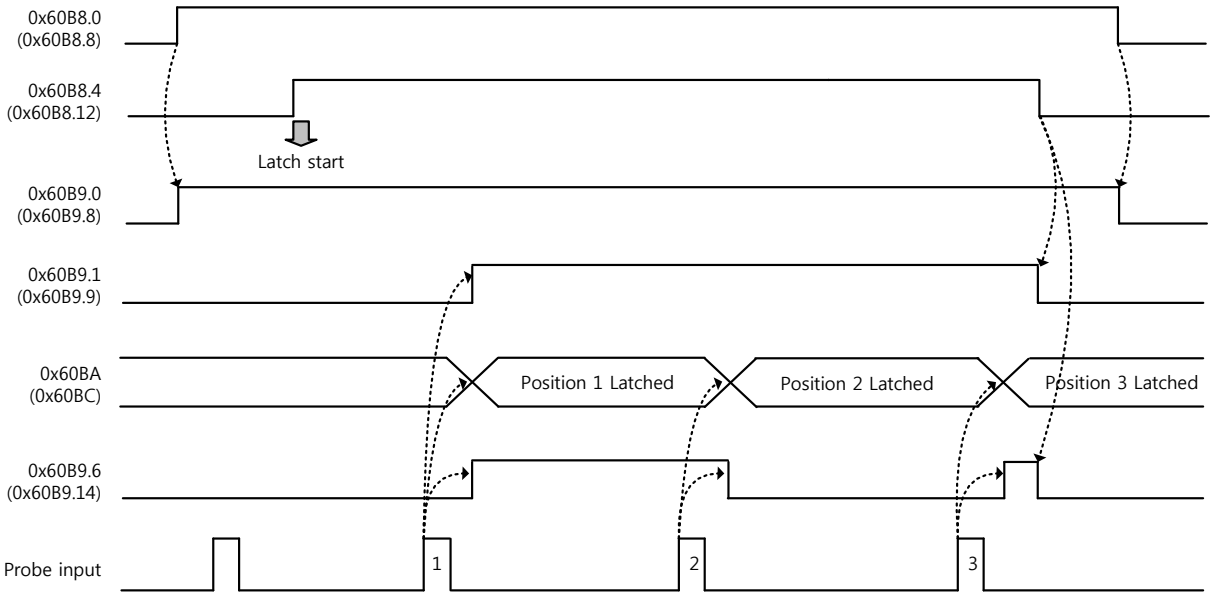
Single Trigger Mode (0x60B8.1=0, 0x60B8.9=0):

In command to reset Bit 1, 2,9,10 of the touch probe status (0x60B9) at the single trigger mode, set the relevant bits (4, 5, 12, 13) of touch probe function (0x60B8) to 0.



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

At continuous trigger mode, Bits 6, 7, 14, 15 of touch probe status (0x60B9) toggles between 0 and 1 every time the relevant input/edge is input.



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

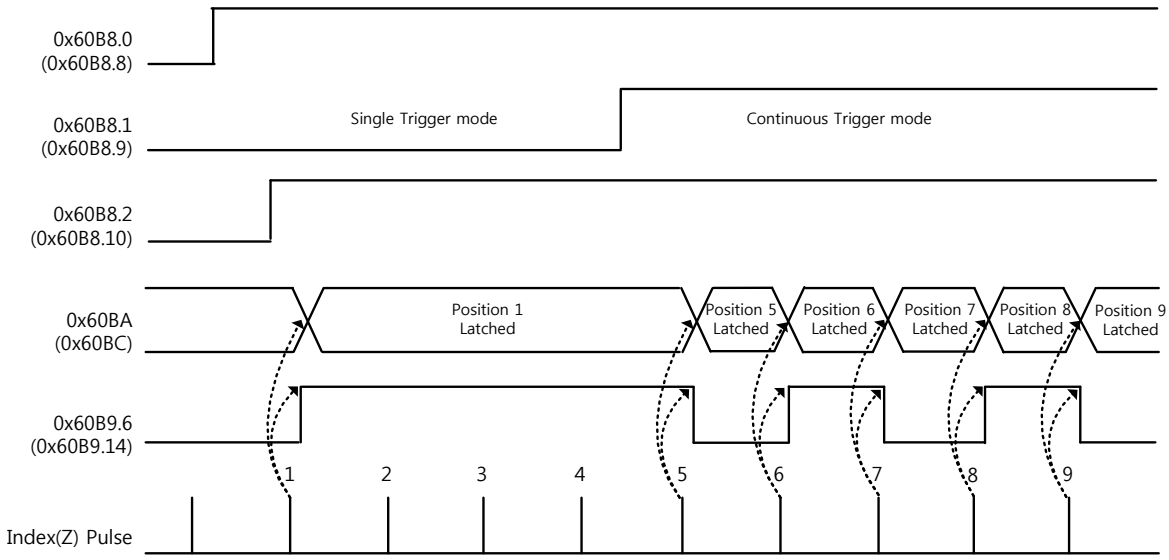


Figure 22. Touch Probe Function Timing Diagram

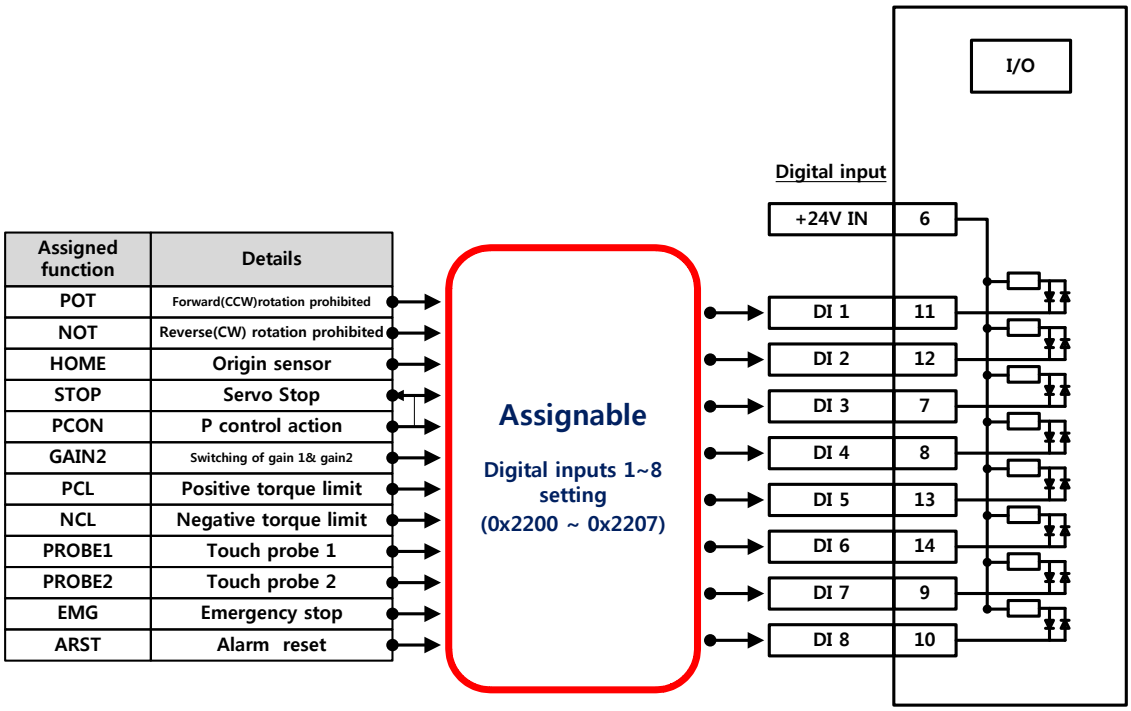
6.Drive Application Functions

IN THIS CHAPTER

6.1 Input / Output Signal

6.1.1 Assignment of Digital Input Signal

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	UINT	RW		-

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
		Setting				
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	GAIN2 (Contact	PROBE1 (Contact	ARST (Contact

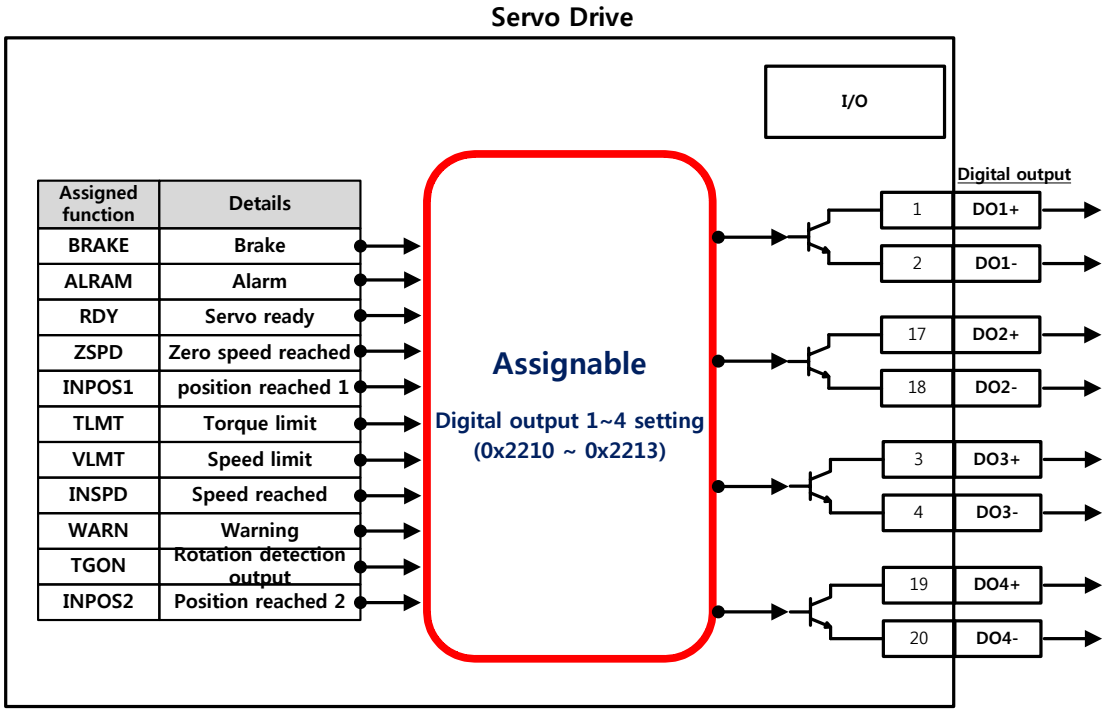
DI#1	DI#2	DI#3	DI#4	DI#5	DI#6	DI#7	DI#8
				A)	A)	A)	A)

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)

6.2 Assignment of Digital Output Signal

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)

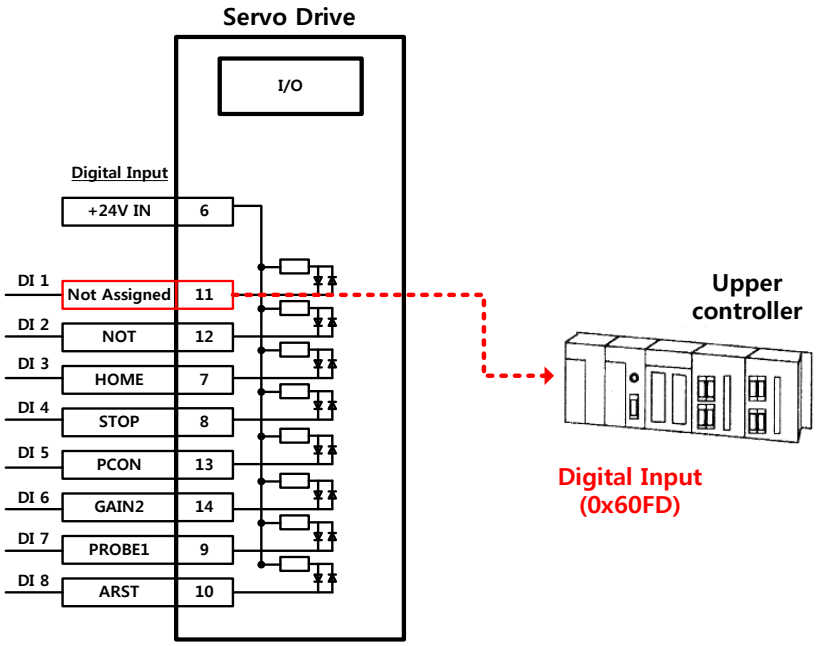
Assigned function		Contact	Details
0x01	BRAKE	B	Brake
0x02	ALARM	B	Alarm
0x03	RDY	A	Servo ready
0x04	ZSPD	-	Zero speed reached
0x05	INPOS1	A	Position reached 1
0x06	TLMT	-	Torque limit
0x07	VLMT	-	Speed limit
0x08	INSPD	-	Speed reached
0x09	WARN	-	Warning
0x0A	TGON	-	Rotation detection output
0x0B	INPOS2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

6.3 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. PD-xxC 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**



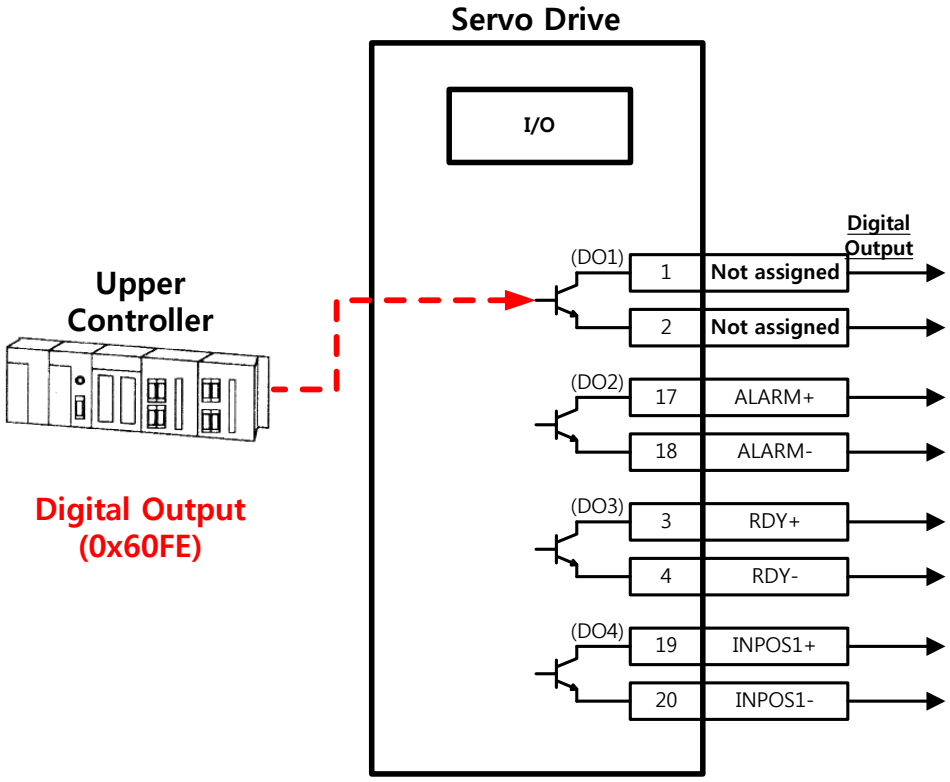
1. Set the function of digital input port to be used as the user input to "Not assigned (setting value of 0)." (Refer to Assignment of Input Signals.)
2. Read the values of the corresponding bits (0x60FD.16-23) from the digital input (0x60FD), in order to use them as the user input.

● 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

6.4 Electric Gear

This function allows the user to rotate the motor by the minimum unit that the user wants to command (User Unit).

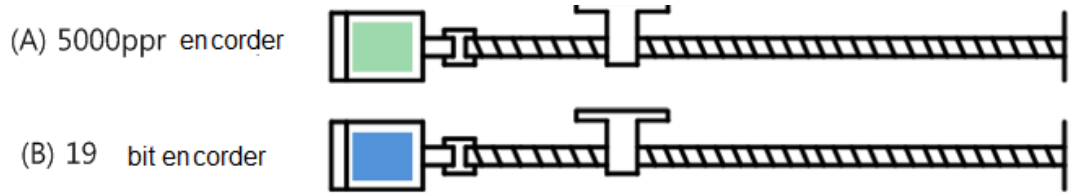
Using the drive's electronic gear function prohibits maximizing the use of the encoder's resolution. Therefore, if the host device has an electronic gear function, we recommend using the host device.

Please set the gear ratio between 1000~1/1000.

Electronic gears are generally used for the following purposes.

- **When driving loads based on the user unit.**

- You can give command based on the user unit, regardless of the encoder (motor) type. The table below shows comparison between 5000ppr encoder and 19bit encoder, when moving 12mm using the same 10mm-pitch ball screw.



	(A) 5000ppr Encoder	**(B) 19bit (524288 ppr) Encoder**
Without electronic gear	5000*12/10 = 6000	524288*12/10=629145.6
	Different commands should be given to each encoder (motor) when moving the same distance	
When giving command based on the minimum unit (user unit) of 1um(0.001mm)		

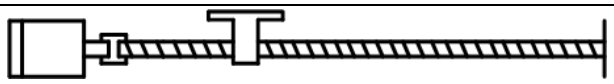
Electronic gear setting	Motor Revolutions =5000 Shaft Revolutions = 10000	Motor Revolutions =524288 Shaft Revolutions = 10000
With electronic gear	You can give the same command to move 12000(12mm= 12000*1um) regardless of the encoder (motor) type.	

- **When the output frequency of the host device and the drive's input frequency are restricted when driving a high-resolution encoder at a high speed**

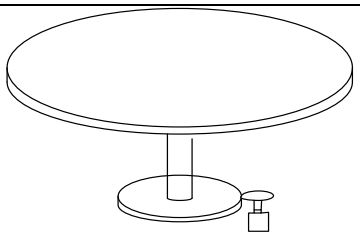
  The output frequency of a general high-speed line drive pulse output unit is approximately 500 Kpps, while the allowed input frequency of the drive is approximately 1-4 Mpps. For this reason, when driving a high-resolution encoder at high speed, be sure to use an electric gear for proper driving due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

6.4.1 Example of Electric Gear Setting

- **Ball Screw Load**

Unit Specifications	 **Pitch: 10mm, Deceleration ratio:1/1**
User Unit	1um(0.001mm)
Encoder Specifications	19bit(524288 PPR)
Load Movement / 1 revolution	10[mm] = 10000[User Unit]
Electronic Gear setting	Motor Revolutions : 524288 Shaft Revolutions : 10000

- **Turntable Load**

Unit Specifications	 **Deceleration ratio:100/1**
User Unit	0.001°

Encoder Specifications	19bit(524288 PPR)
Load Movement / 1 revolution	360/100/0.001=3600
Electronic Gear setting	Motor Revolutions : 524288 Shaft Revolutions : 3600

- **Belt + Pulley System**

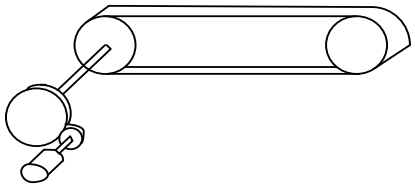
Unit Specifications	 **Deceleration ratio:10/1, Pulley diameter:100mm**
User Unit	1um(0.001mm)
Encoder Specifications	19bit(524288 PPR)
Load Movement / 1 revolution	PI*100/10/0.001=31416
Electronic Gear setting	Motor Revolutions : 524288 Shaft Revolutions : 31416

Table 27. Examples of Gear Setting

6.5 Setting Related to Speed Control

6.5.1 Smooth Acceleration/Deceleration

For smooth acceleration/deceleration during speed control, you can operate the motor by creating acceleration/deceleration profile in trapezoidal and s-curve shapes. In addition, you can perform s-curve operation by setting the speed command s-curve time to 1[ms] or more.

The speed command acceleration/deceleration time (0x2301, 0x2302) is the time it takes to accelerate to the rated speed or decelerate from the rated speed to full stop. (See the figure below)

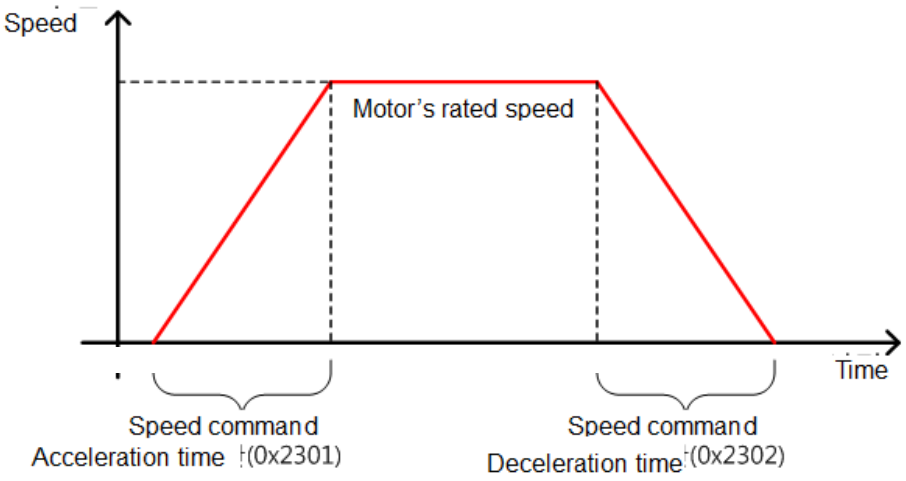


Figure 23. Speed Control

The actual acceleration/deceleration time can be calculated as follows.

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

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

As shown in the figure below, you can operate the machine by creating a S-curve acceleration/deceleration profile by setting the speed command s-curve time to 1[ms] or more. Please note the relationship between acceleration/deceleration time and S-curve time.

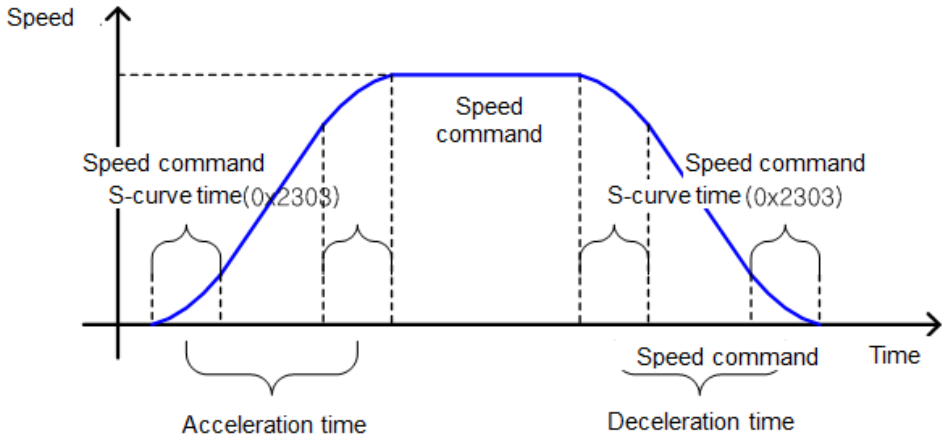


Figure 24. Smooth Acceleration and Deceleration

6.5.2 Servo Lock Function

When controlling speed, the servo's position is not locked even when the speed command is 0. This is due to the characteristic of speed control. By setting the servo-lock function (0x2311), you can lock the servo position.

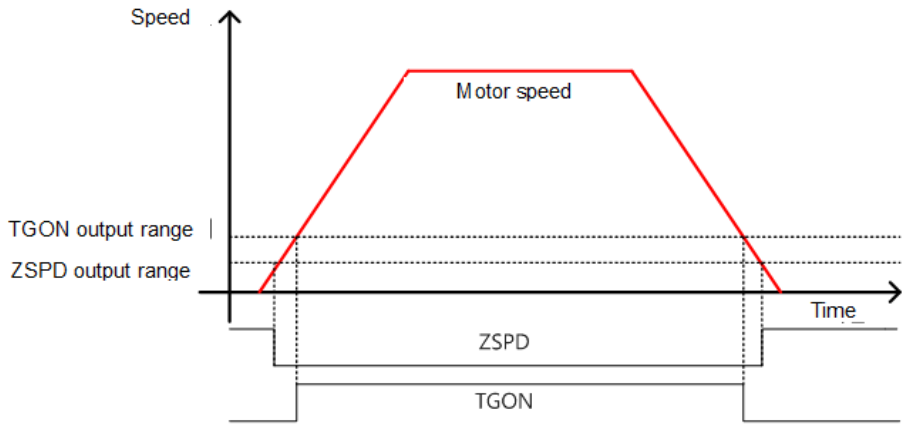
Set Value	Details
0	Servo-lock function not used
1	Servo-lock function used

Table 28. Servo Lock Function

When using the servo-lock function, the position is internally control based on the position at the time when the speed command is input as 0. When the speed command is not 0, the control is changed into normal speed.

6.5.3 Related Signal

As shown in the figure below, when the value of the speed feedback goes under the ZSPD output range (0x2404), the ZSPD (0 speed) signal is displayed. If the value goes over the TGON output range (0x2405), the TGON (motor revolution) signal is displayed.



And when the difference between the command and the speed feedback, that is, the speed error is within the INSPD output range (0x2406), the INSPD(speed match) signal is displayed.

- **Related Objects**

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

Table 29. Servo Lock Function Related Objects

6.6 Settings Related to Position Control

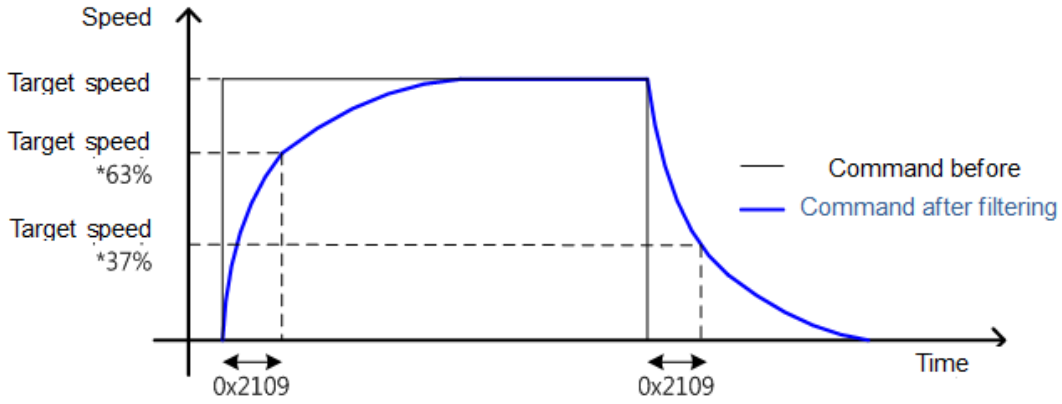
6.6.1 Position Command Filter

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

You can use a position command filter if:

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

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



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

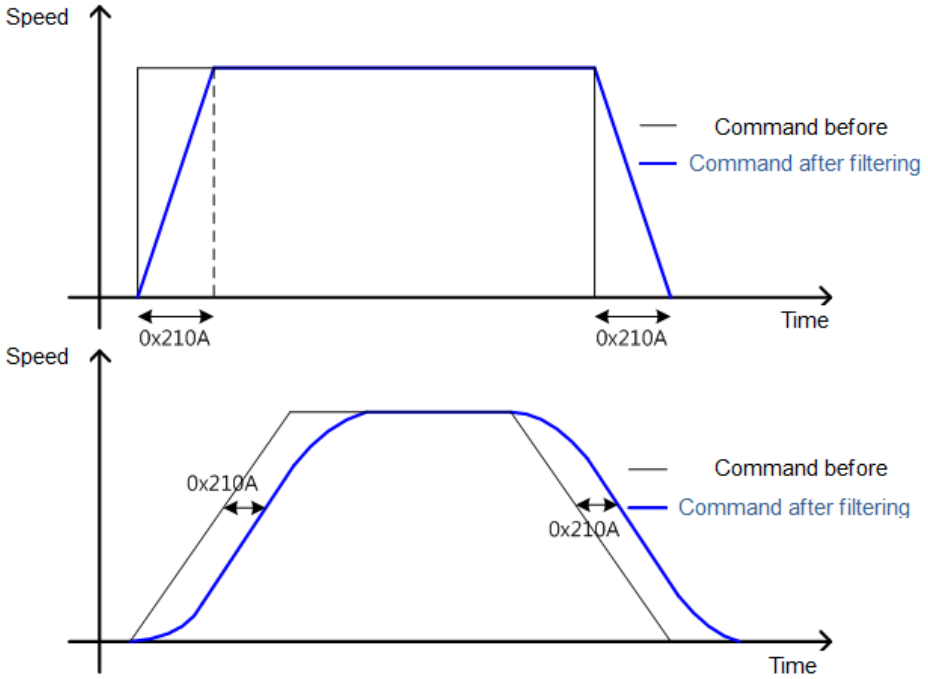


Figure 25. Position Command Filter

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

- **Related Objects**

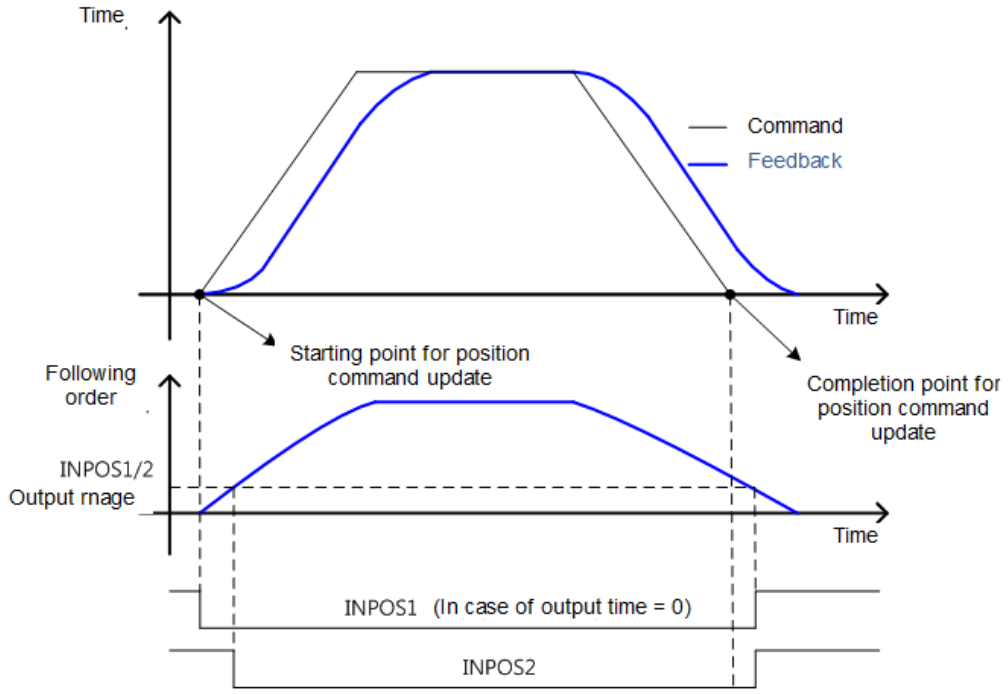
Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	Unit
0x2109	-	Position Command Filter Time Constant	UINT	RW	Yes	0.1ms
0x210A	-	Position Command Average Filter Time Constant	UINT	RW	Yes	0.1ms

Table 30. Position Command Filter Related Objects

6.6.2 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 Format	Accessibility	PDO Allocation	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

Table 31. Position Control Related Objects

6.7 Settings Related to Torque Control

6.7.1 Speed Limit Function

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

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

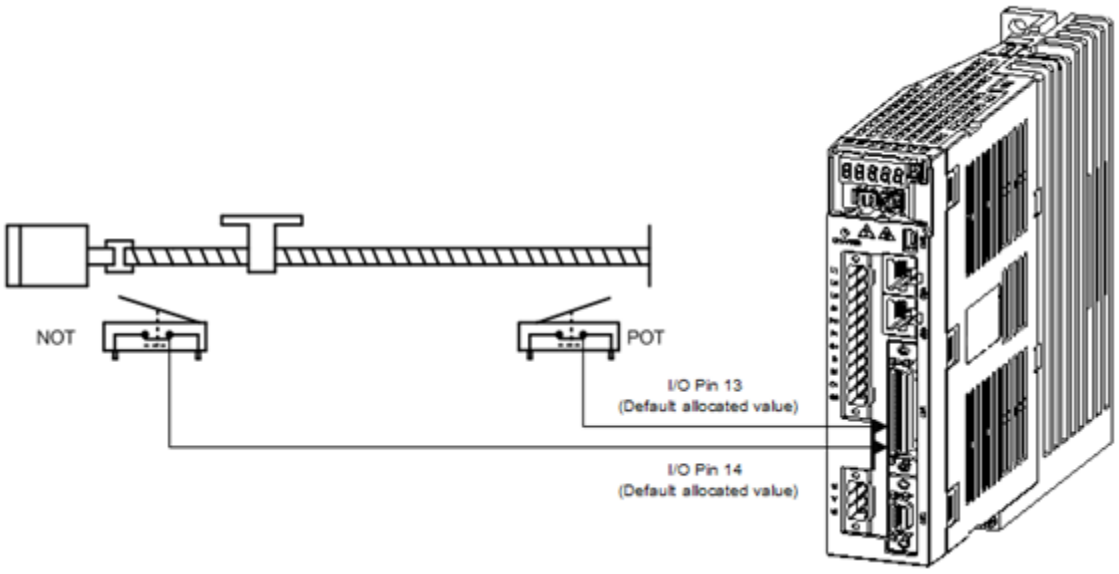
Setting values	Setting details
0	Limited by speed limit value (0x230E)
1	Limited by the maximum motor speed

- **Related Objects**

Index	Sub Index	Name	Variable type	Accessibility	PDO assignment	Unit
0x230D	-	Speed Limit Function Setting	UINT	RW	No	-
0x230E	-	Speed Limit Value	UINT	RW	Yes	Rpm

6.8 Positive/Negative Limit Settings

This function is to safely operate the drive within the movable range of the apparatus using the positive/negative limit signals of the drive. Be sure to connect and set the limit switch for safe operation. For more information about the settings, refer to 6.2 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.

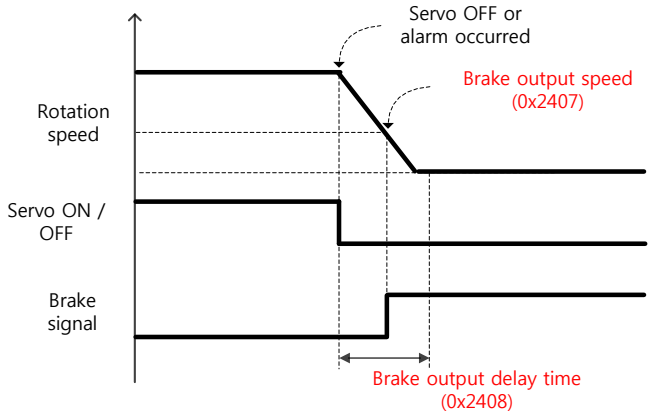
Related Objects

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	-

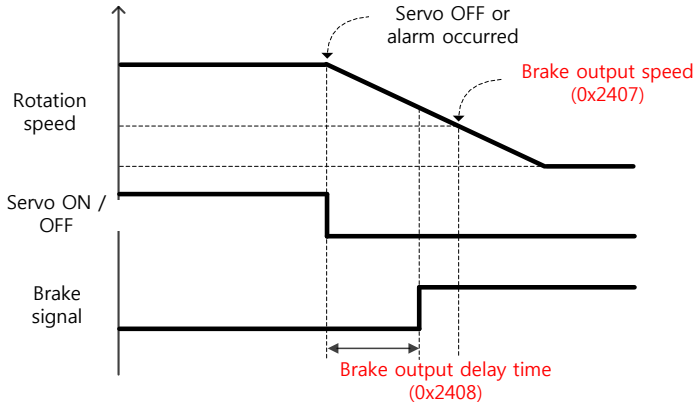
6.9 Settings the Brake Output Signal Function

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.



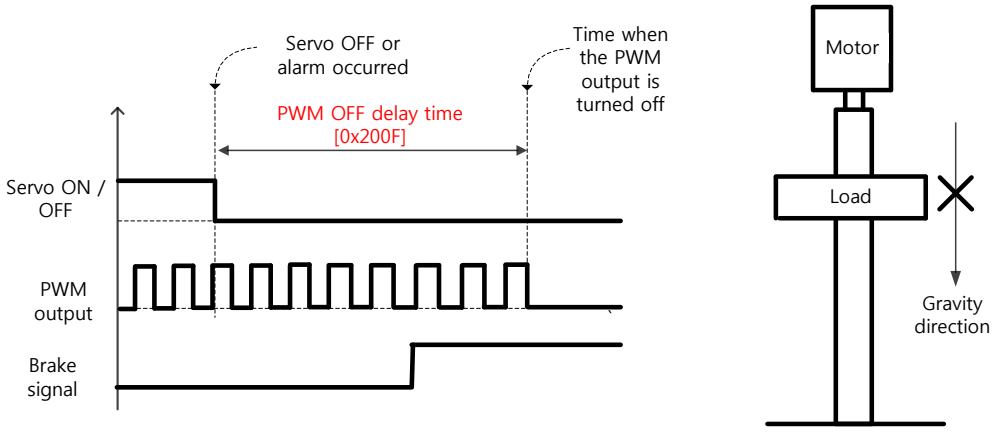
Timing diagram for signal output by the brake output speed (0x2407)



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

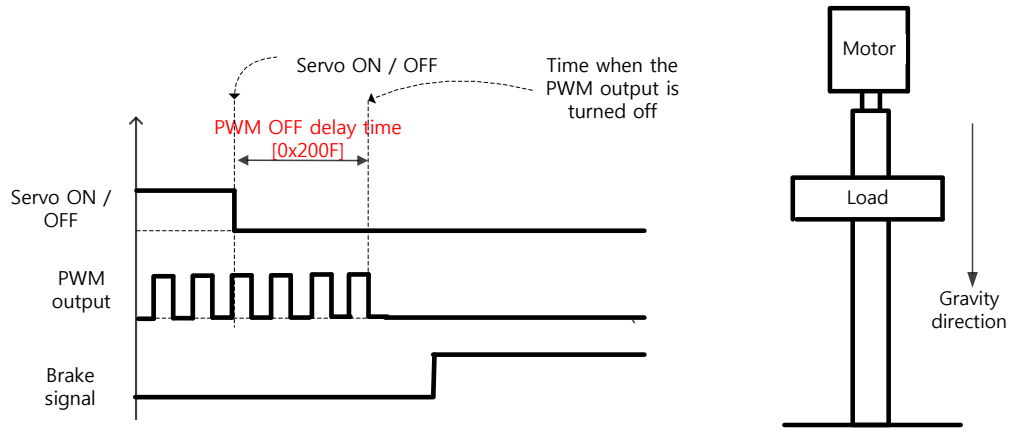
Set the time to delay until the actual PWM output goes off when the servo is turned off or a servo alarm occurs.

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.



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.



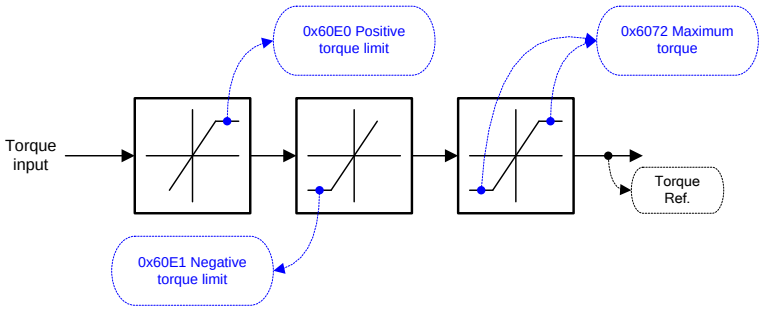
If PWM Output Turns off First Before Brake Signal Outputs

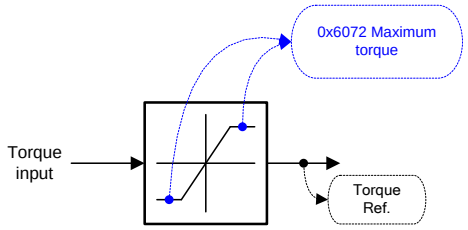
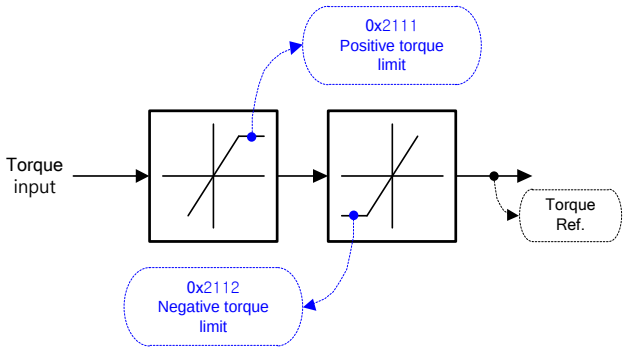
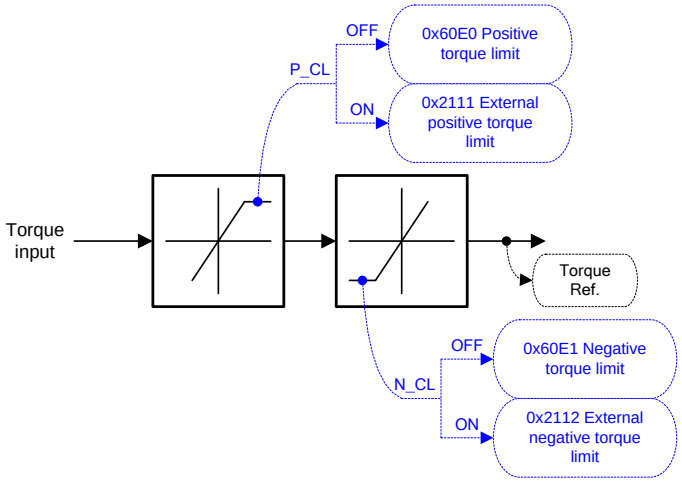
The PWM output is turned off first before the brake signal output, allowing the drop along the vertical axis due to the gravity.

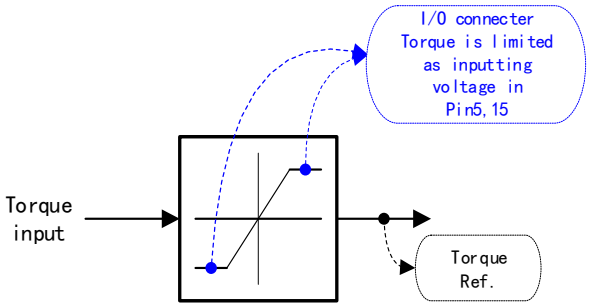
6.10 Torque Limit Function

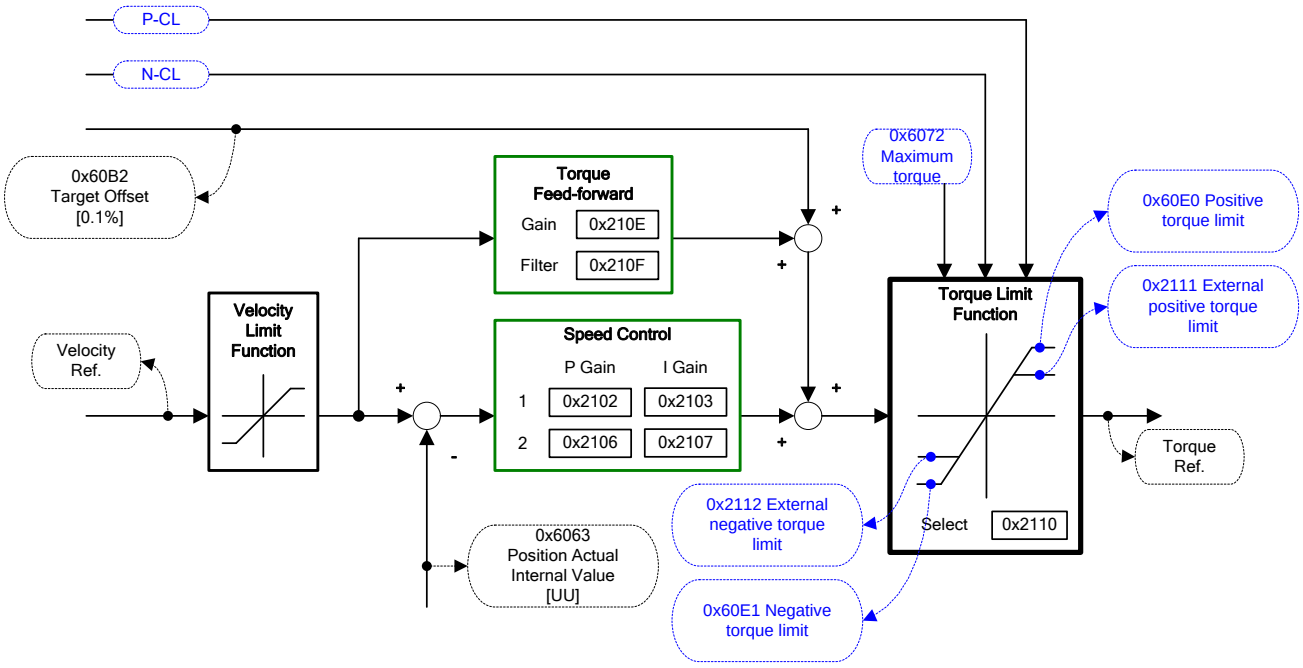
You can limit the drive output torque to protect the machine. It can be set by the torque limit function (0x2110). The setting unit of torque limit value is 0.1%.

- **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

Limit function	Details
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
Internal and external torque limit (set value 3)	 Limits the torque using internal and external torque limit value according to the driving direction and the torque limit signal. ▪ Forward: 0x60E0 (if 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)

Limit function	Details
Analog torque limit (set value 4)	 - Restricted by torque limited value which in put as analog. - Restriced normal direction / reverse direction torque regardless of +/ - of analog voltage. - Refer offset(0x221C) and then scale(0x221C) of analog torque limitation.

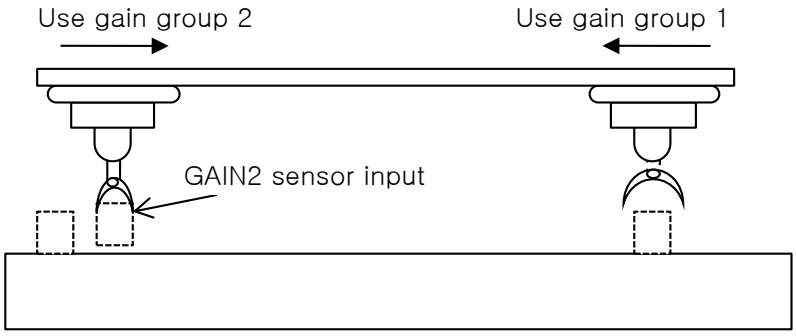


● Related Objects

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

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

6.11Gain Switching Function



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.

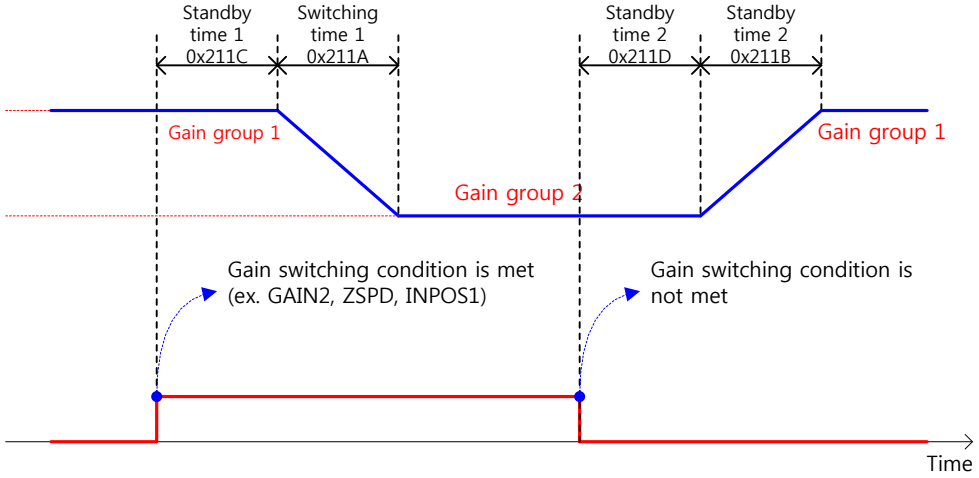
A gain group consists of position loop gain, speed loop gain, speed loop integral time constant, and torque command filter time constant. The gain switching function (0x2119) can be set as follows:

- **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:

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)	Gain switching time 1 (0x211A) Gain switching waiting time 1 (0x211C) ⇄ Gain switching time 2 (0x211B) Gain switching waiting time 2 (0x211D)	Position loop gain 2 (0x2105) Speed loop gain 2 (0x2106) Speed loop integral time constant 2 (x2107) Torque command filter time constant 2 (0x2108)



- **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

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.

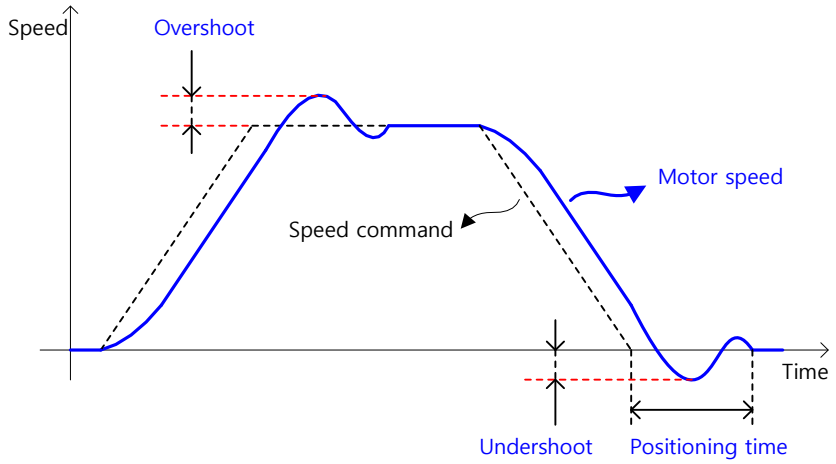
The proportional gain determines the responsiveness of the entire controller, and the integral gain is used to eliminate an error in the steady state. Too high of an integral gain will result in an overshoot during acceleration or deceleration.

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

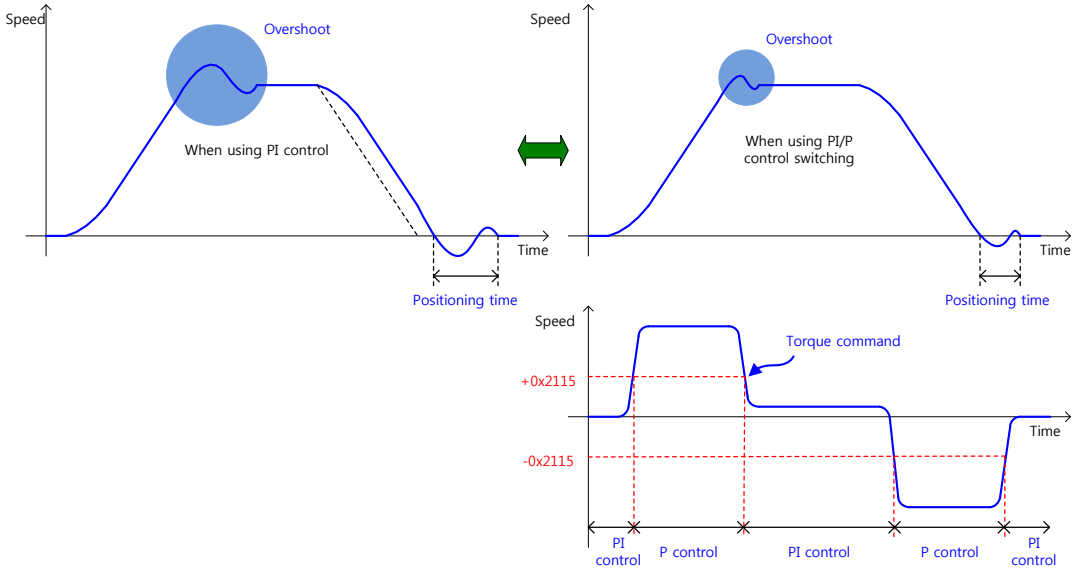
Setting values	Setting details
0	Always uses the PI control.
1	Switches to the P control if the command torque is larger than the P control switching torque (0x2115).
2	Switches to the P control if the command speed is larger than the P control switching speed (0x2116).
3	Switches to the P control if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

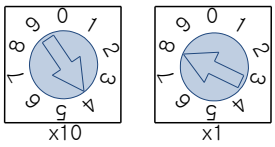
When always using the PI Control rather than P/PI control switching for speed control, the integral term of acceleration/deceleration error is accumulated, resulting in an overshoot and an extended positioning time. At this moment, you can reduce the overshoot and the positioning time using an appropriate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



6.12 Configuration of Device 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.

PD-xxC 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."

7.Safety Functions

IN THIS CHAPTER

7.1 Safe Torque Off(STO) Function

PD-xxC 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.

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**

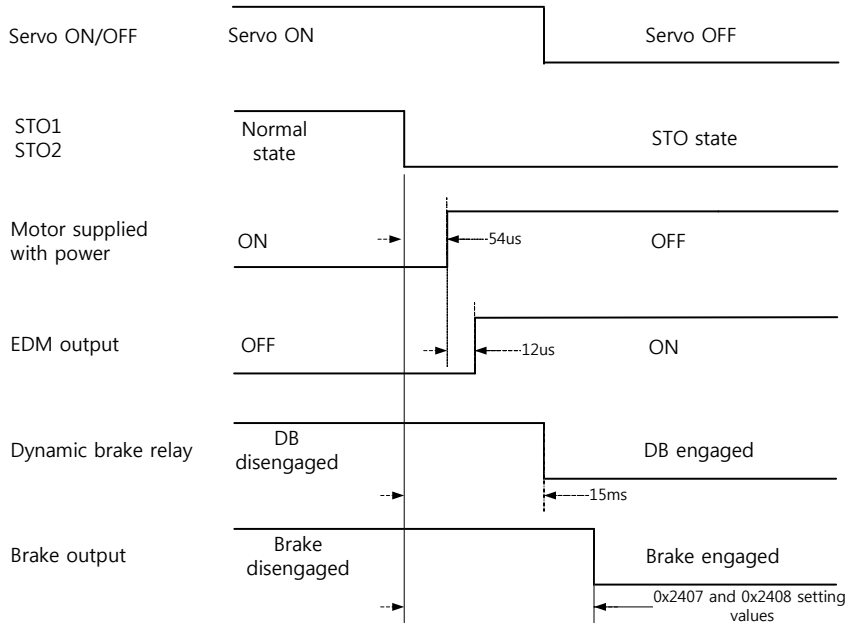
- **STO1 and STO2**

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

- **EDM**

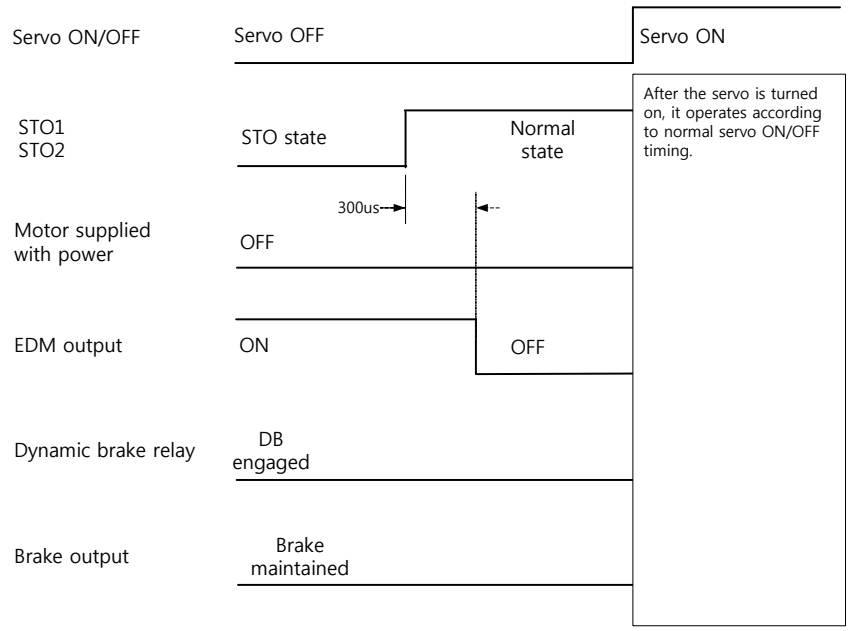
Item	Characteristic
Max. tolerate voltage	DC 30V
Max. current	DC 120mA
Maximum delay time	1ms or less

- **Timing diagram for STO operation**



Note) 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) 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.

7.2 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**

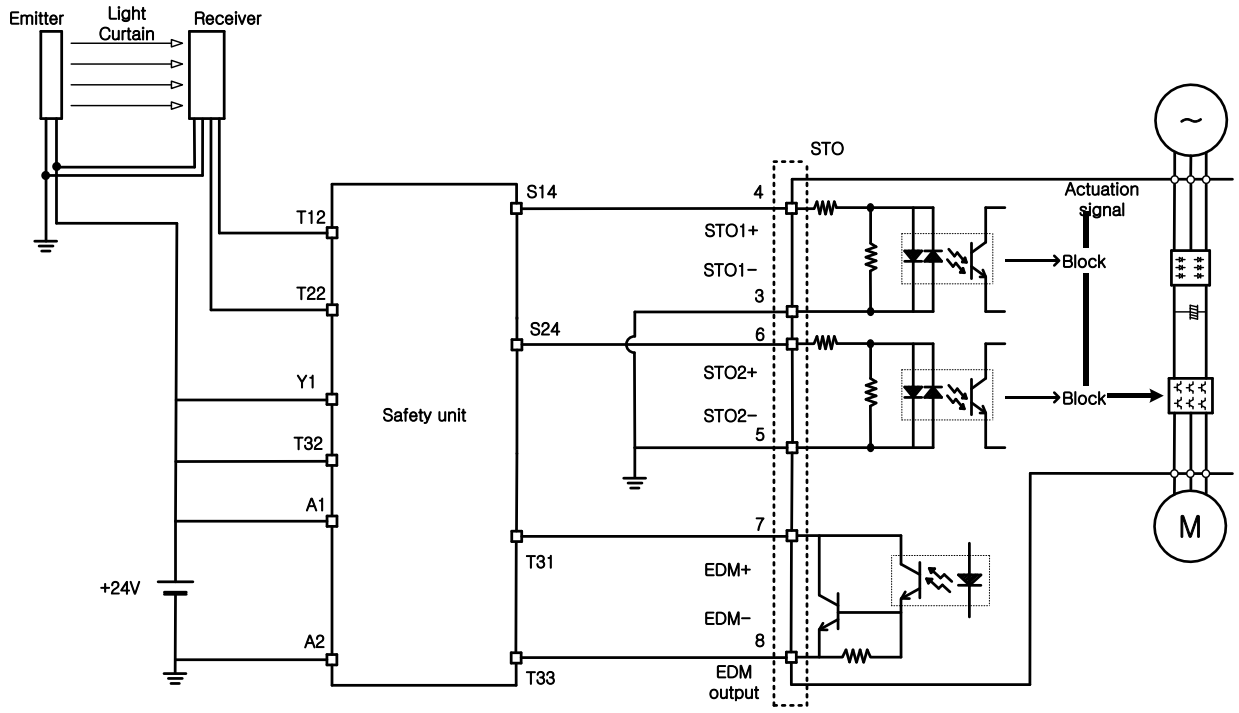
Possible to detect malfunctions of Safety input circuit and EDM output circuit when monitoring 4 signals below.

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

7.3 Example of Using Safety Function



7.4 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.

7.5 Precautions

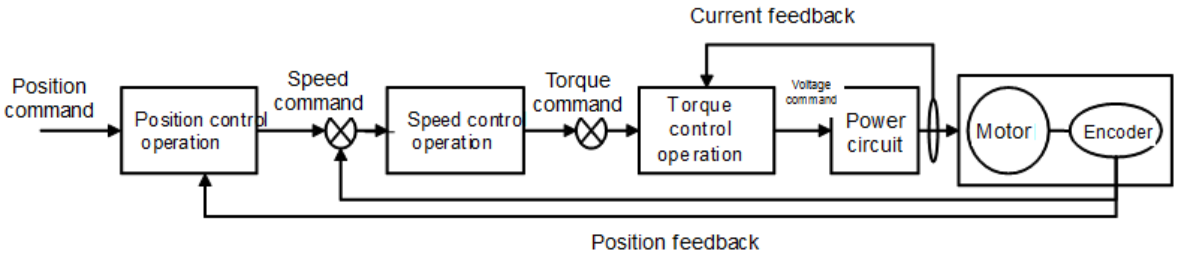
- When using the STO function, be sure to carry out risk assessment for the device to check if the safety requirements of the system are met.
- There may be risks as below even if the STO function works.
- At the STO state, the motor is operated by an external force; thus, if the load needs to be maintained, 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.

8.Tuning

IN THIS CHAPTER

8.1 Servo Tuning Overview



You can use the drive at the torque control mode, speed control mode or position control mode, depending on the connection method with the host device. The drive's control structure takes the cascade form, where the position control is positioned at the outermost and the current control is positioned at the innermost. Depending on the drive's operation mode, you can tune the gain-related parameters of the torque controller, speed controller or position controller to suit your purposes.

8.2 Position Variable Overview

In a servo system, the drive uses two types of position information:
commanded position and actual position. As these positions change with time, you can use the position values to determine if the system is positioning as you expect.

8.2.1 Commanded Position

The commanded position is calculated by the motion profile routine from the controller and it is updated every servo sampling period. Therefore, the commanded position is the intended position at any given point of time.
To view the commanded position, use the drive support tool. (drive setup software)

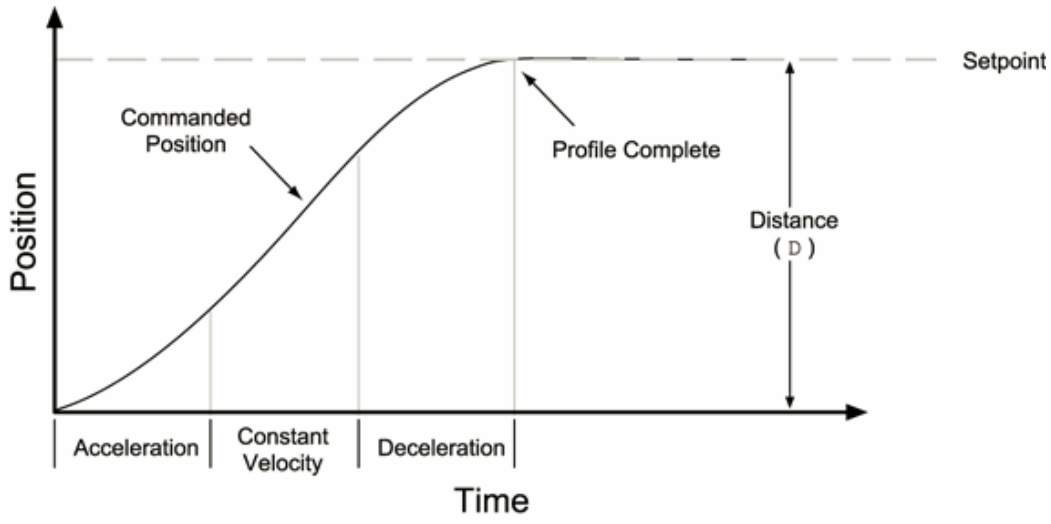


Figure 26. Commanded Position

8.2.2 Actual Position

The actual position of the motor/load is the drive's response to the commanded position, and is measured with the feedback device. The profile resulting from the actual position across time is the position response.
To view the actual position, also use the drive support tool software.

The difference between commanded and actual positions is called *position error*.
Even when the system is properly tuned, the position error can still be quite significant due to a combination of factors such as the desired profile, the motor's limitation, the dynamic characteristics of the system, etc. For example, if the commanded velocity is higher than the maximum velocity the motor can physically achieve, the actual position will always lag behind the commanded position. Under these circumstances, a position error will accumulate no matter how high the gains are set.

8.3 Servo Response Overview

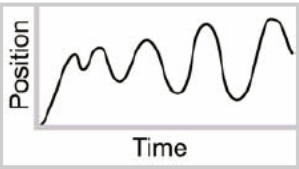
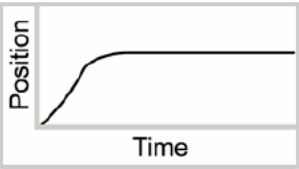
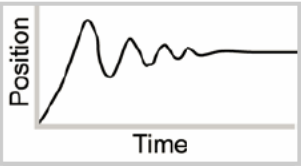
8.3.1 Stability

The first objective of tuning is to stabilize the system. The formal definition of system stability is when a bounded input is introduced to the system, the output of the system is also bounded. What this means to a motion control system is if the system is stable, and the position set-pint is a finite value, the final actual position of the system is also a finite value.

In contrast, if the system is unstable, no matter how small the position set-point or how little a disturbance (motor torque variation, load change, noise from the feedback device, etc.) the system receives, the position error will increase exponentially in almost all cases. In practice, when the system experiences instability, the actual position will oscillate in an exponentially diverging fashion as shown in Table 38.

One common misperception is that whenever there is oscillation, the system is unstable. It is important to recognize that a system is considered stable if the oscillation finally diminishes (damps out), even if it takes a long time.

8.3.2 Position Response Types

Response	Description	Profile (position/time)
Unstable	Instability causes the position to oscillate in an exponentially diverging fashion.	
Over-damped	A highly damped, or over-damped, system gives a smooth but slower response.	
Under-damped	A slightly damped, or under-damped, system gives a slightly oscillatory response.	

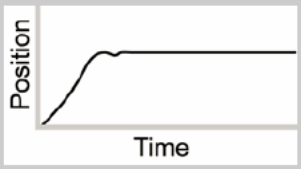
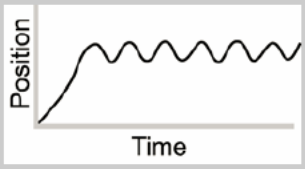
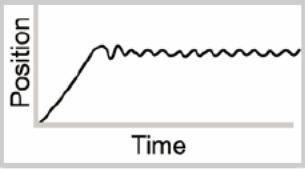
Response	Description	Profile (position/time)
Critically damped	A critically-damped response is the most desirable because it optimizes the trade-off between damping and speed of response.	
Oscillatory	An oscillatory response is characterized by a sustained position oscillation of equal amplitude.	
Chattering	Chattering is a high-frequency, low-amplitude oscillation that is usually audible.	

Figure 27. Position Response Types

Identify the six basic types of position responses. The primary difference among these responses is due to *damping*—the suppression (or cancellation) of oscillation.

8.3.3 Performance Measurements

If you plot of the position response versus time, you can make a few measurements to quantitatively assess the performance of the servo. These three measurements are made before or shortly after the motor stops moving:

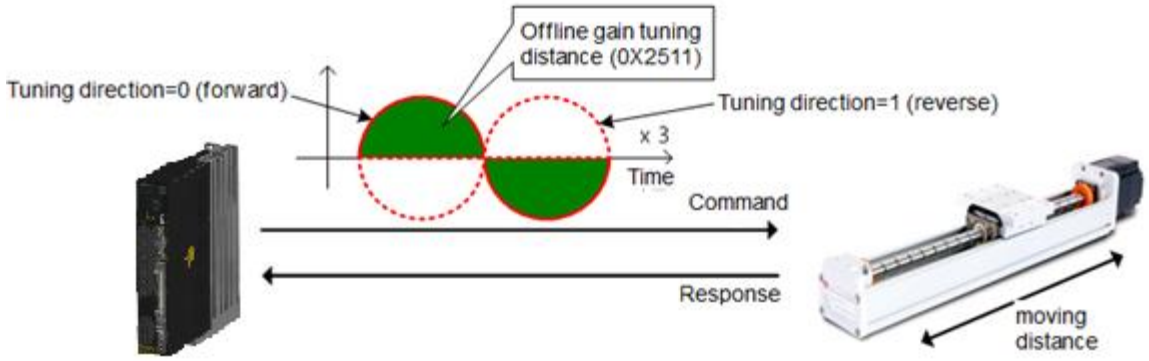
• **Overshoot**—The measurement of the maximum magnitude that the actual position exceeds the position set-point. It is usually measured in terms of the percentage of the set-point value.

• **Rise Time**—The time it takes the actual position to pass the Set-point.

• **Settling Time**—The time between when the commanded position reaches the set-point and the actual position settles within a certain percentage of the position set-point. (Note the settling time definition here is different from that of a control engineering text book, but the goal of the performance measurement is still intact.).

8.4 Automatic Gain Tuning

You can automatically set gains corresponding to the load conditions, using commands generated by the drive itself. The gain-related parameters subject to change are as follows.
Inertia, inertia ratio, position loop gain, speed loop gain, speed integral time constant, torque command filter time constant, notchfilter3frequency, notch filter frequency.
The overall gain is set to either high or low, depending on the set value of the system rigidity for gain tuning. Please set the appropriate value depending on the rigidity of the load being operated.
As shown in the figure below, commands in the sinusoidal form are generated either in the forward or reverse direction depending on the set value of the offline gain tuning direction. You can set the distance covered during tuning with the offline gain tuning distance (0x2511). The distance increases along with the set value: please set the appropriate



distance depending on the situation. Please secure a sufficient distance before gain tuning (1 rotation or above).

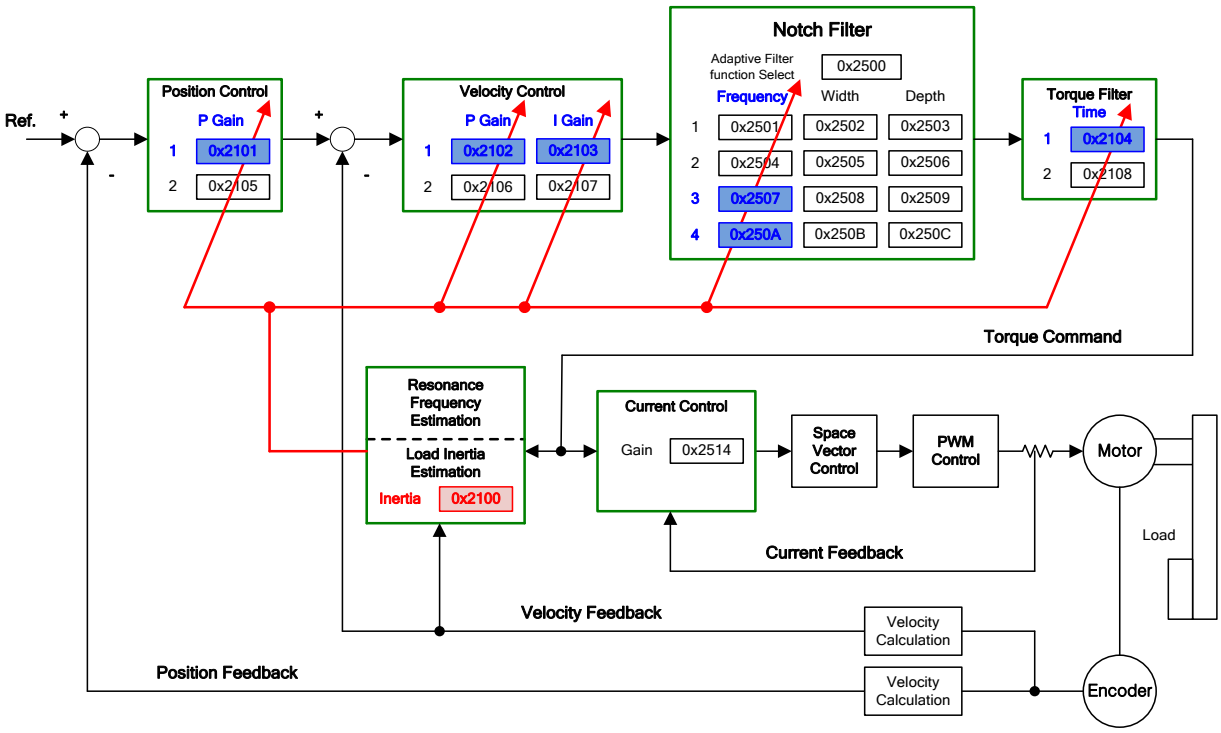


Figure 28. Control Loop Block Diagram

8.4.1 Related Objects

Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	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	-

Table 32. Auto Tuning Related Objects

8.5 Manual Gain Tuning

When using a cascade-type controller, first tune the gain of the speed controller positioned inside, and then tune the gain of the position controller positioned outside.

That is, the order tuning is proportion gain→integral gain→ Feed forward gain.

The role of each gain is as follows.

Proportion gain: determines controller BW Integral gain: determines error of the steady state, causes overshoot Feed forward gain: improves the system's lag characteristic Differential gain: damping for the system (not provided)

8.5.1 Speed Controller Tuning

A. Inertial ratio setting

- Use automatic inertia estimation function, or manual tuning

B. Proportion gain setting

- Torque/noise monitoring before vibration occurs

C. Integral gain setting

- Speed overshoot and steady-state error monitoring
- If you want to increase integral gain but overshoot occurs, you can use the P/PI conversion mode
- The integral gain of this drive is integral time constant,

D. Speed command filter and speed feedback filter setting

8.5.2 Position Controller Tuning

A. Proportion gain setting

- Torque, position error, noise monitoring before vibration occurs

B. Feed forward setting

- Position error monitoring
- Feed forward filter can be set
- If you want to increase feed forward but overshoot occurs, set filter
- Feed forward value can be set from 0 to 100%. The value is the ratio of the position command value currently being input against the difference

C. Position command filter setting

- It provides smoother position command

8.6 Vibration Control

The vibration control function has the following features.

- Provides 4-layer notch filter
- Frequency, width, depth setting
- Automatic setting through real-time FFT
- 50[Hz] ≤setting range≤ 5000[Hz]

- Provides 2-layer vibration inhibition filter, for vibration inhibition of the load
- Measures the vibration frequency of the load
- 1.0[Hz] ≤setting range≤ 100.0[Hz]

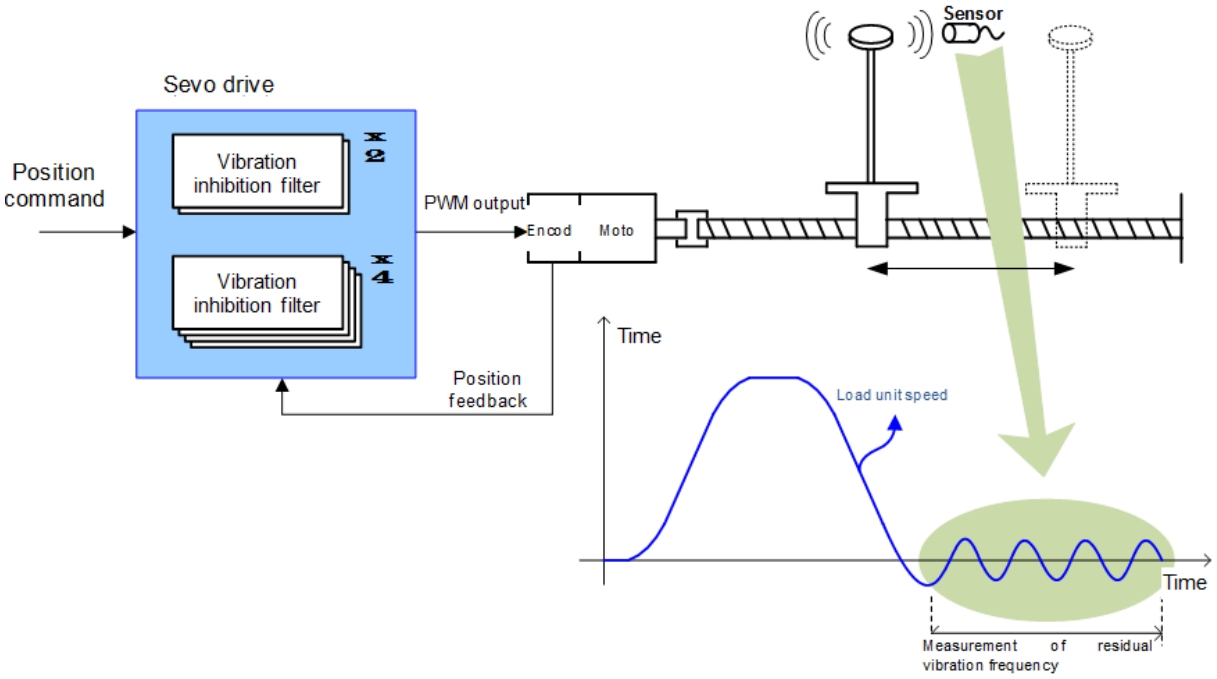


Figure 29. Vibration Control

8.7 Filters

Notch filter is a type of Band Stop filter which removes certain frequency components. By removing resonance frequency component of the mechanic unit using the notch filter, you can remove vibration while setting high gains.

This drive provides a total of 4 layers of notch filters, and the frequency, width, depth can be set separately for each filter. One or two notch filters can be used as adaptive filters with automatic frequency and width setting, through real-time frequency analysis (FTT).

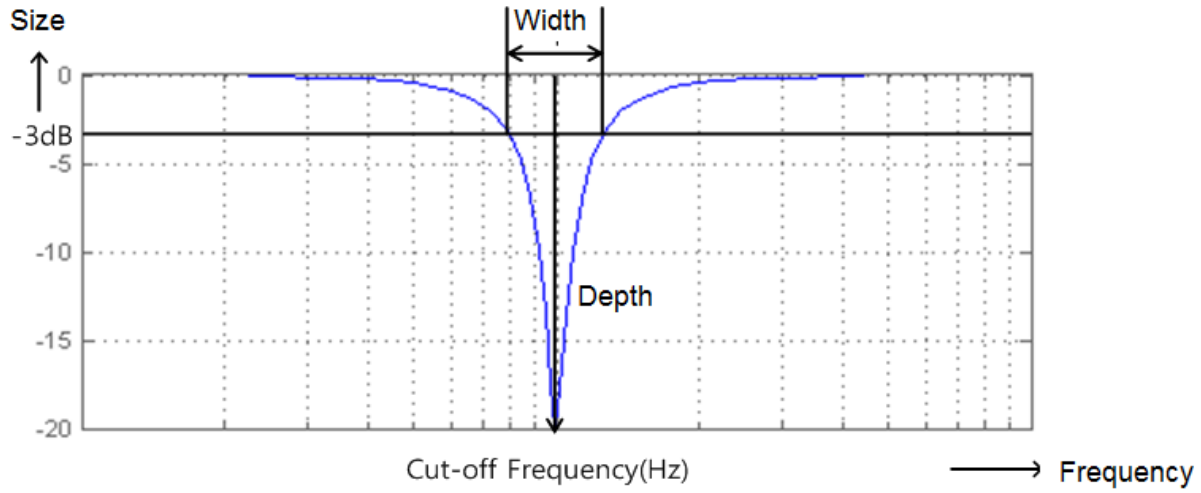


Figure 30. Meaning of Notch Filter

8.4.1 Related Objects

Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	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	-

Table 33. Notch Filter Related Objects

8.4.2 Adaptive Filter

Adaptive filter reduces vibration by automatically setting the notch filters by performing real-time analysis on vibration frequency generated from the load during drive operation through speed feedback signals.

One or two notch filters can be automatically set by detecting the vibration frequency through frequency analysis. The frequency and width are automatically set, and the set value is used for depth.

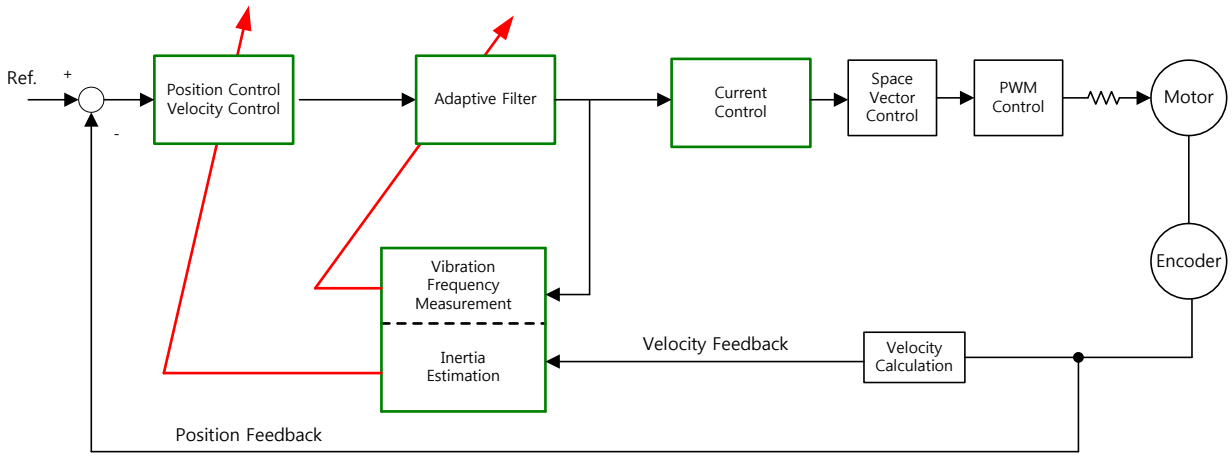


Figure 31. Adaptive Filter Diagram

8.4.3 Related Objects

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

Set Value	Details
0	No adaptive filter
1	Uses only 1 adaptive filter. The automatically set values can be confirmed at notch filter 4 setting (0x250A, 0x250B).
2	Uses only 2 adaptive filters. The automatically set values can be confirmed at notch filter3 (0x2507, 0x2508) and notch filter 4 (0x250A, 0x250B) setting.
3~5	Reserved

Table 34. Adaptive Filter Related Objects

8.8 Analog Monitor

The drive provides 2-channel analog monitor output, for drive gain tuning or internal status parameter monitoring.

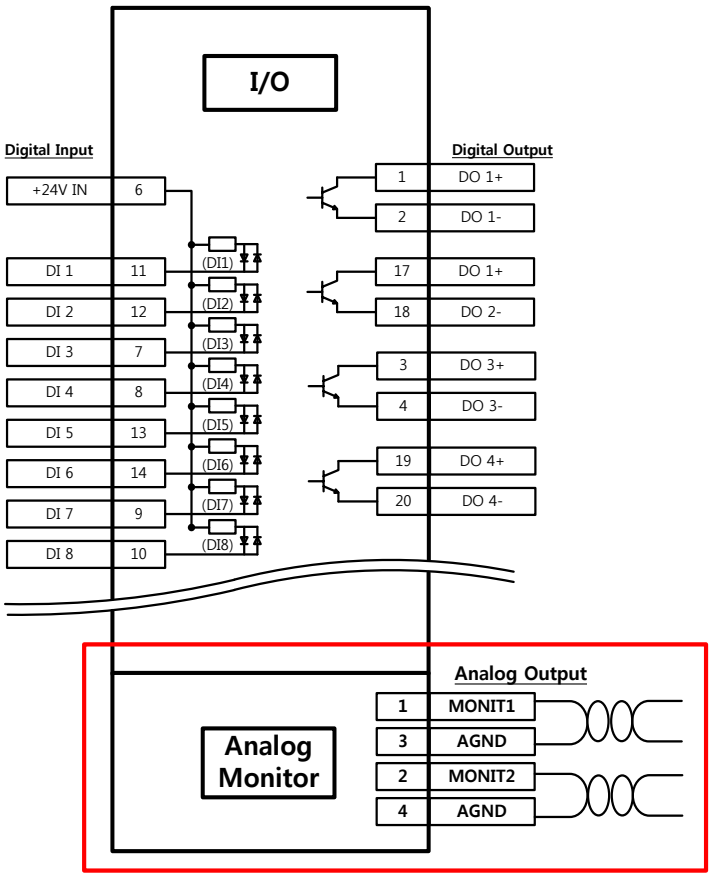


Figure 32. Analog Monitor

8.4.1 Related Objects

Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	Unit
0x2220	-	Analog Monitor Output Mode	UINT	RW	No	-
0x2221	-	Analog Monitor Channel 1 Select	UINT	RW	No	-
0x2222	-	Analog Monitor Channel 2 Select	UINT	RW	No	-
0x2223	-	Analog Monitor Channel 1 Offset	DINT	RW	No	-
0x2224	-	Analog Monitor Channel 2 Offset	DINT	RW	No	-

0x2225	-	Analog Monitor Channel 1 Scale	UDINT	RW	No	-
0x2226	-	Analog Monitor Channel 2 Scale	UDINT	RW	No	-

Table 35. Analog Monitor Related Objects

8.8.2 Analog monitor output mode(0x2220) setting

The output range of analog monitor is -10~+10V. With set value of 1, only the absolute value (positive value) of the output value is displayed.

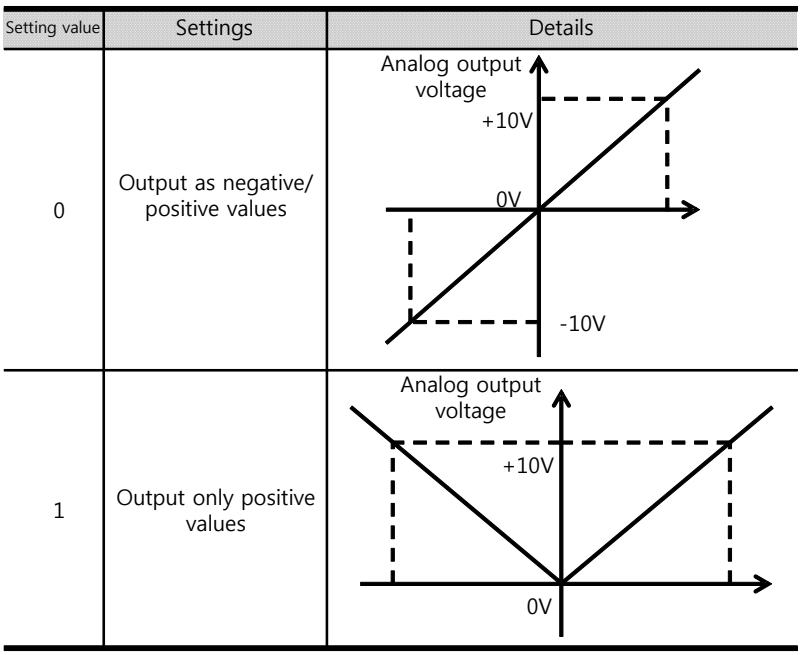


Figure 33. Analog Monitor Output Setting

8.8.3 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	%

Setting values	Displayed item	Unit
9	Encoder single-turn data	Pulse
10	Inertia ratio	%
11	Full-Closed positional error	UU
12	Drive temperature 1	°C
13	Drive temperature 2	°C
14	Encoder temperature 1	°C

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

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

8.8.4 Analog Monitor Setting Example

The figure below shows an example of monitoring when driving with speed feedback signal of 1000rpm.

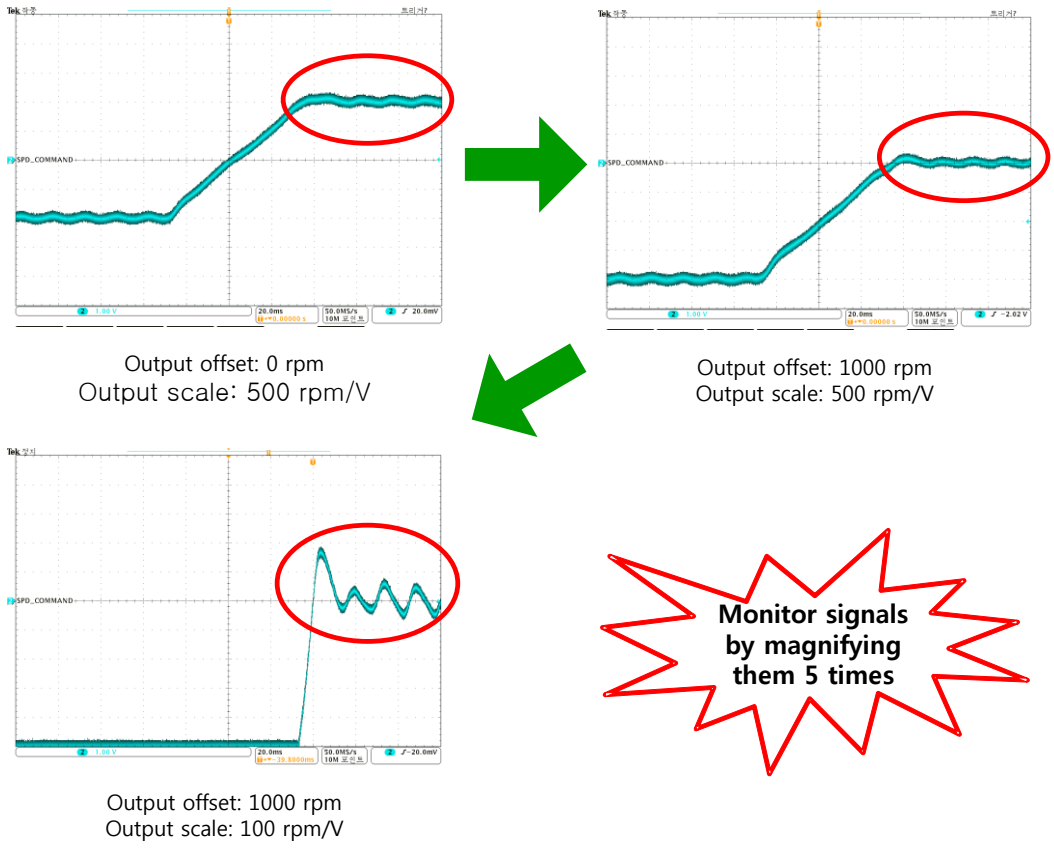


Figure 34. Analog Monitor Setting Example

9.Procedure

IN THIS CHAPTER

9.1 Procedure Function

These functions are auxiliary function provided by the dive. The list of the functions is provided below. These functions can be performed with procedure command code (0x2700) and procedure command factor (0x2701). The procedure functions can be activated using the servo setting tool.

Procedure Command	Code	Description
Manual JOG	0x0001	Manual JOG operation
Program JOG	0x0002	Program JOG operation
Alarm History Reset	0x0003	Remove alarm history
Off-Line Auto-Tuning	0x0004	Off-Line Auto-Tuning
Index Pulse Search	0x0005	Index (Z) Pulse Search
Absolute Encoder Reset	0x0006	Reset absolute encoder
Max. Load Torque Clear	0x0007	Reset maximum operation overload (0x2604)
Calibrate Phase Current Offset	0x0008	Calibrate phase current offset
Software Reset	0x0009	Software reset
Commutation	0x000A	Commutation

Table 36. Procedure Function

9.1.1 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 Format	Accessibility	PDO Allocation	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

Table 37. Procedure Function Related Objects

9.1.2 Program 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.

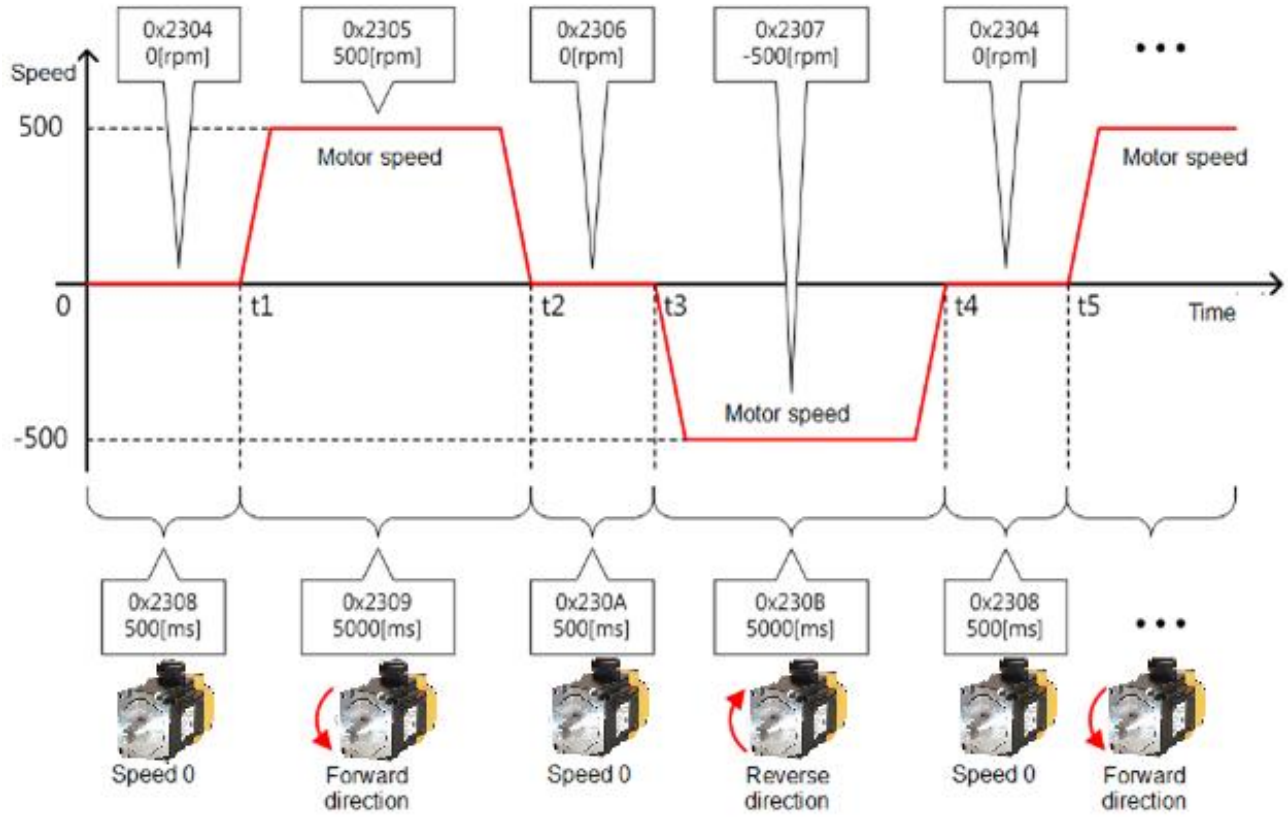


Figure 35. Program Jog Operation

- **Related Objects**

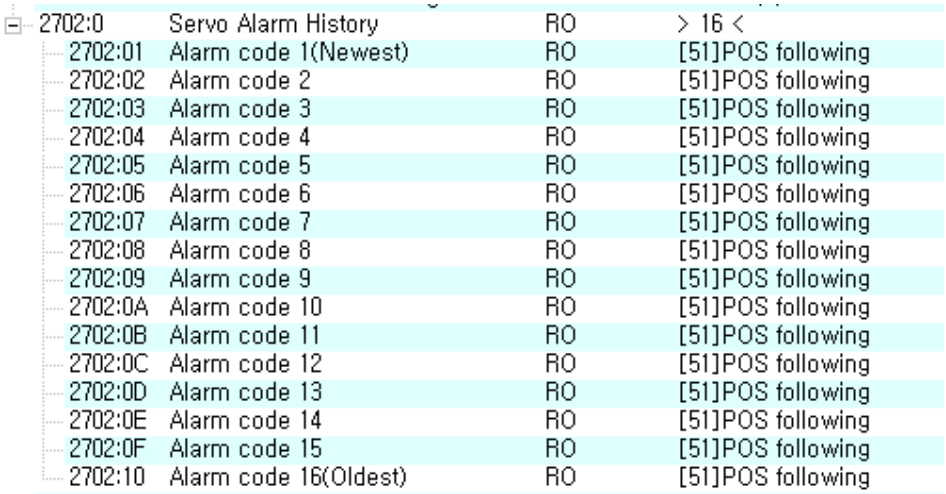
Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	Unit
0x2304	-	Program Jog Operation Speed 1	INT	RW	No	rpm
0x2305	-	Program Jog Operation Speed 2	INT	RW	No	rpm
0x2306	-	Program Jog Operation Speed 3	INT	RW	No	rpm
0x2307	-	Program Jog Operation Speed 4	INT	RW	No	rpm
0x2308	-	Program Jog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

Table 38. Program Jog Operation Related Objects

9.1.3 Alarm Record Detection

This function deletes all alarm code history Stored in the drive. The alarm history of the newest alarm and up to 16 previous alarms is Stored in the drive.

The alarm history can be viewed at0x2702:01~16, as shown below. The newest recent alarm is displayed at 0x2702:01.



- **Related Objects**

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

Table 39. Alarm Detection Related Objects

9.1.4 Automatic Gain Tuning

See “ 5.4 Automatic Gain Tuning “ for further details.

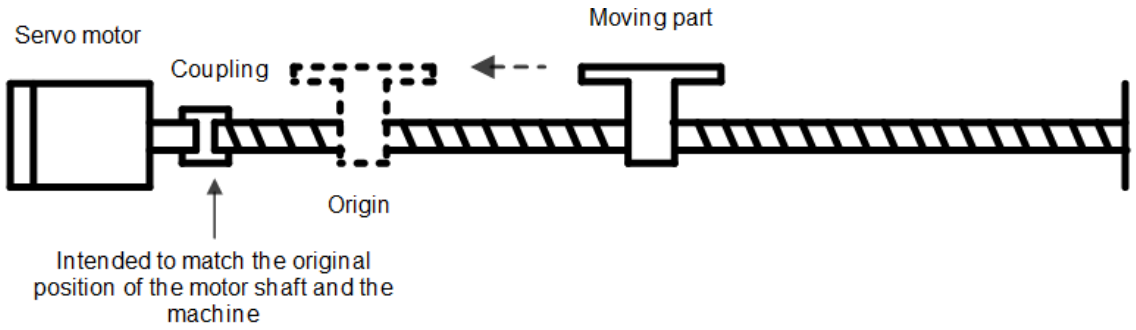
9.1.5 Index Pulse Search

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 Format	Accessibility	PDO Allocation	Unit
0x230C	-	Index Pulse Search Speed	INT	RW	No	rpm

Table 40. Index Pulse Probing Related Objects

9.1.6 Absolute Encoder Reset

Absolute encoder reset is needed in the following cases.

- Setting up the mechanical unit for the first time
- Encoder low voltage occurs
- The multi-turn data of absolute encoder needs to be 0

Resetting the absolute encoder resets multi-turn data(0x260A) and single-turn data(0x2607) back to 0. Re supplying power after reset changes the position actual value (0x6064) to the reset position value.

After power resupply, the position actual value (0x6064) of the absolute encoder is read and displayed by applying Home offset(0x607C).
Changing the home offset (0x607C) during operation will not change the position actual value (0x6064).

- **Related Objects**

Index	Sub Index	Name	Variable Format	Accessibility	PDO Allocation	Unit
0x2005	-	Absolute Encoder Configuration	UINT	RW	No	-

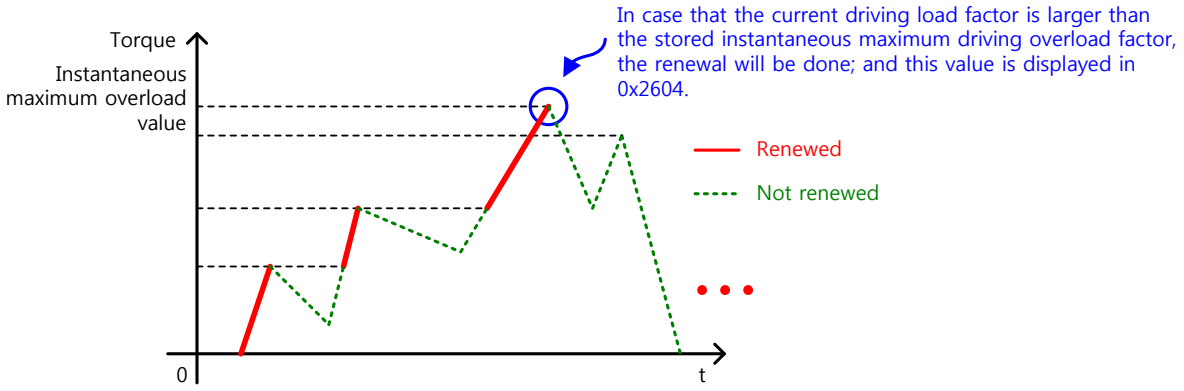
0x2607		Single Turn Data	UDINT	RO	Yes	pulse
0x260A		Multi Turn Data	DINT	RO	Yes	rev

Table 41. Absolute Encoder Reset Related Objects

9.1.7 Instantaneous Maximum Torque Reset

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 Format	Accessibility	PDO Allocation	Unit
0x2604	-	Instantaneous Maximum Operation Overload	INT	RO	Yes	0.1%

Table 42. Instantaneous Maximum Torque Reset Related Objects

9.1.8 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 Format	Accessibility	PDO Allocation	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%

Table 43. Phase Current Offset Related Objects

9.1.9Software 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.

9.1.10 Commutation

Commutation function for receiving information of initial pole position of motor. If motor does not have hall 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 Format	Accessibility	PDO Allocation	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

Table 44. Commutation Related Objects

10. Object Dictionary

IN THIS CHAPTER

10.1 Object Dictionary

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

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

10.1.1 Data Type

The types and scope of data type used for this drive is as follows.

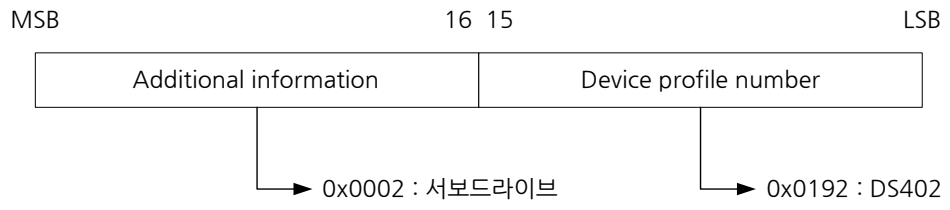
Code	Description	Scope
SINT	Signed 8bit	-128 ~127
USINT	Unsigned 8bit	0 ~ 255
INT	Signed 16bit	-32768 ~ 32767
UINT	Unsigned 16bit	0 ~ 65535
DINT	Signed 32bit	-21247483648 ~ 21247483647
UDINT	Unsigned 32bit	0 ~ 4294967295
FP32	Float 32bit	Single Precision floating point
STRING	String Value	

Table 45. Object Dictionary Data Type

10.1.2 General Objects

0x1000	**Device Type**						
Variable Format	Set Range	Default value	Unit	Accessibility	PDO Allocation	Change Property	Store
UDINT	-	0x00020192	-	RO	No	-	No

Displays the device type and functions



0x1001	**Error Register**

Variable Format	Setting Range	Default Value	Unit	Accessibility	PDO Allocation	Change Property	Store
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 Format	Setting Range	Default Value	Unit	Accessibility	PDO Allocation	Change Property	Store
STRING	-	-	-	RO	No	-	No

Represents the device name.

0x1009	Hardware Version						
Variable Format	Setting Range	Default Value	Unit	Accessibility	PDO Allocation	Change Property	Store
STRING	-	-	-	RO	No	-	No

Table 46. Hardware Version

Represents the hardware version of the device.

0x100A	Software Version						
Variable Format	Setting Range	Default Value	Unit	Accessibility	PDO Allocation	Change Property	Store
STRING	-	-	-	RO	No	-	No

Table 47. Software Version

Represents the software version of the device.

0x1010	Store Parameters						
Sub Index 0		Number of entries					
Variable Format	Setting Range	Default Value	Unit	Accessibility	PDO Allocation	Change Property	Store
USINT	-	4	-	RO	No	-	No
Sub Index 1		Store all parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibility	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
Sub Index 2		Store communication parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibility	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
Sub Index 3		Store CiA402 parameters					
Variable	Setting Range	Default Value	Unit	Accessibil	PDO	Change	Store

Format				ity	Allocation	Property	
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
Sub Index 4		Store drive specific parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibil ity	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
Sub Index 5		Store index parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibil ity	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No

Table 48. Store Parameters

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 Format	Setting Range	Default Value	Unit	Accessibil ity	PDO Allocation	Change Property	Store
USINT	-	4	-	RO	No	-	No
SubIndex 1		Restore all parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibil ity	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 2		Restore communication parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibil ity	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 3		Restore CiA402 parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibil ity	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 4		Restore drive specific parameters					
Variable Format	Setting Range	Default Value	Unit	Accessibil ity	PDO Allocation	Change Property	Store
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No
SubIndex 5		Restore index parameters					
Variable	Setting Range	Default Value	Unit	Accessibil	PDO	Change	Store

Format				ity	Allocation	Property	
UDINT	0 to 0xFFFFFFFF	0	-	RW	No	-	No

Table 49. Restore Parameters

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.

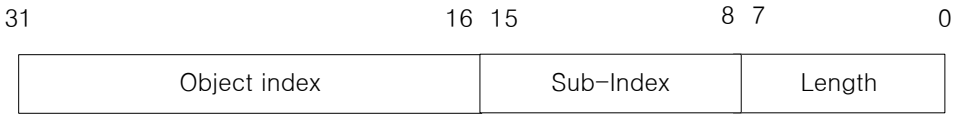
0x1600	1st Receiving PDO-Mapping						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	0 to 10	5	-	RW	No	PREOP	Yes
SubIndex 1		Mapping entry 1					
Variable type	Setting range	Initial value	Unit	Accessibility	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

10.1.3 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).



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	Setting range	Initial value	Unit	Accessibil	PDO	Change	Storage

type				ity	assignment	attribute	
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

10.1.3 Manufacturer Specific Objects

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 Parker.

Possible to check motor ID on the motor label.

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 will be automatically set regardless the chart below.

You can check encoder type which is set automatically.

Setting values	**Encoder type**

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

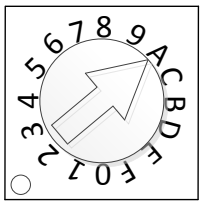
0x2002	Encoder Pulse per Revolution						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 1073741824	524288	pulse	RO	No	Power recycling	Yes

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

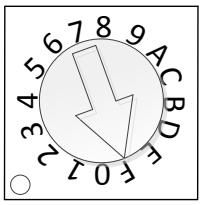
0x2003	Node ID						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	-	-	RO	No	-	No

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



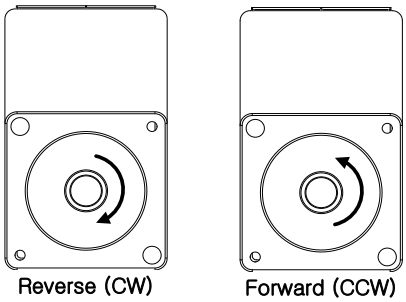
ADDR

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

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

Bit	Function	Value	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	Accessibility	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 3.6 Regeneration Protection 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	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 1000	10	ms	RW	No	Always	Yes

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

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

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

Setting values	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

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

This specifies the method to 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 FFFFH	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
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 65535	1000	nm	RW	No	Power recycling	Yes

Set linear scale resolution in nm 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.

Setting 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 Behavior						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].

Setting 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 homing 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.

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

0x2020	Motor Hall Phase Configuration						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	Details
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.

Setting values	Setting details
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.

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 $FFFF_H$	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 FFFFH	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

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

0x2121	Drive Control Input 2						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to FFFFH	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 FFFFH	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	Always recycling	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	$0x0003_x$	-	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
6	Accumulated operation overload rate	%
7	DC link voltage	V

Setting values	Displayed item	Unit
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 over speed 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 function is used or not.

Setting value	Contents
0	Not using the Modulo function.
1	Forward move by using Modulo function.
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	Setting range	Initial	Unit	Accessibility	PDO	Change	Storage

type		value			assignment	attribute	
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	Setting	Initial value	Unit	Accessibility	PDO	Change	Storage

type	range				assignment	attribute	
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%, Regeneration Overload alarm (AL-23) occurs.

0x2607	Single Turn 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	Multi Turn 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	-	-	°C	RO	No	-	No

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

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

This represents the temperature measured by the temperature sensor integrated onto the drive control board. If the measured temperature is higher than 90℃, the drive overheat alarm 2 (AL-25) will be generated.

0x260D	Encoder Temperature						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	°C	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	Boot loader Version						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	-	-	-	RO	No	-	No

This represents the boot loader 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

Command code	Command argument	Run procedure
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 $FFFF_H$	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	Setting	Initial value	Unit	Accessibility	PDO	Change	Storage

type	range				assignment	attribute	
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 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 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 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[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

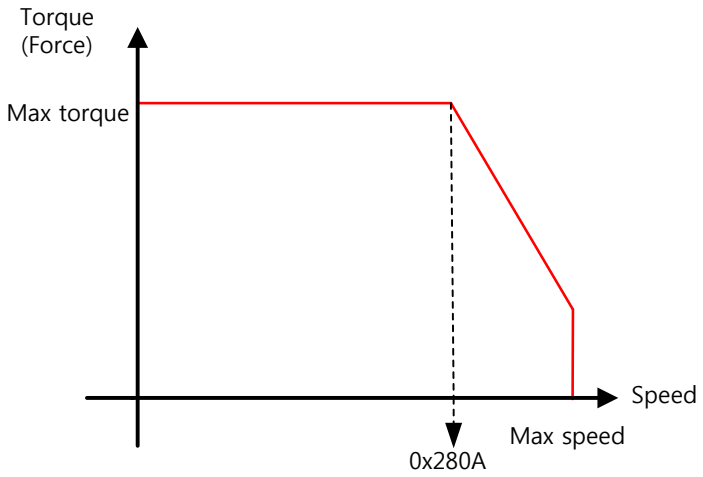
Set phase resistance of motor.(=line resistance ÷2)

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)

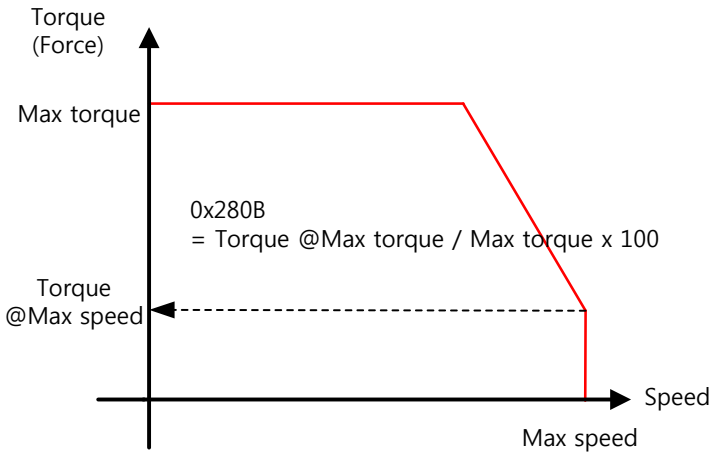
0x280A	[Third Party Motor] TN Curve Data 1						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	1 to 60000	3000	rpm	RW	No	Power recycling	Yes

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.

10.1.4 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**

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

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	Absolute/relative	0	This sets the target position to an absolute value.
		1	This sets the target position to a relative value.
8	Halt	0	Runs an operation or continues an operation.
		1	Halts the operation according to the Halt Option code (0x605D).

Bits 4, 5, 6, 8 and 9: For HM mode operation

Bit	Function	Value	Details
4	Homing start	0	Does not perform the homing operation.
		1	Performs or is performing the homing operation.
5	–	0	-
6	–	0	-
8	Halt	0	Runs the bit 4 command.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	Reserved

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

Bit	Function	Value	Details
4	–	0	-
5	–	0	-
6	–	0	-
8	Halt	0	Continues to perform the operation.
		1	Halts the operation according to the Halt Option code (0x605D).
9	–	0	-

Bits 4, 5, 6, 8 and 9: For IP mode operation

Bit	Function	Value	Details
4	Use of Interpolation	0	Interpolation disabled
		1	Interpolation enabled
5	–	0	-
6	–	0	-
8	Halt	0	Runs the bit 4 command.

Bit	Function	Value	Details
		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**

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

Bit	State	Value	Details
		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	Accessibility	PDO assignment	Change attribute	Storage
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	Accessibility	PDO assignment	Change attribute	Storage
INT	0 to 1	0	-	RW	No	Always	Yes

This specifies the operation to shut down the servo drive (Operation Enabled state -> Ready to Switch On state).

Setting values	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	Accessibility	PDO assignment	Change attribute	Storage

INT	0 to 1	1	-	RW	No	Always	Yes

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

Setting values	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
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	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This specifies the timeout for when checking the Positional Error (Statusword, 0x6041.13).

0x6067	Position Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UDINT	0 to 0x3FFFFFFF	100	UU	RW	No	Always	Yes

This specifies the position window for the target. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x6068	Position Window Time						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	0	ms	RW	No	Always	Yes

This sets the time it takes to reach the target position. If the drive remains within the position window (0x6067) for the position window time (0x6068), then it sets bit 10 of the Statusword (0x6041.10) to 1.

0x606B	Velocity Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU/s	RO	Yes	-	No

This displays the output speed of the position controller or the command speed input to the speed controller.

0x606C	Actual Velocity Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-	-	UU/s	RO	Yes	-	No

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

0x606D	Velocity Window						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 65535	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	Accessibility	PDO assignment	Change attribute	Storage
UINT	0 to 5000	3000	0.1%	RW	Yes	Always	No

This sets the maximum torque that the motor can output in 0.1% increments of the rated torque.

0x6074	Torque Demand Value						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
INT	-	-	0.1%	RO	Yes	-	No

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

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

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

the rated torque.

0x607A	Target Position						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	–2147483648 to 2147483647	0	UU	RW	Yes	Always	No

This specifies the target position in Profile Position (PP) mode and Cyclic Synchronous Position (CSP) mode.

It is used as absolute coordinate or relative coordinate depending on the Bit 4 (0x6040.4) setting of the Controlword in the PP mode, and is always used as absolute value in the CSP mode.

0x607C	Home Offset						ALL
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	–536870912 to 536870911	0	UU	RW	No	Always	Yes

This sets the offset value for the origin of the absolute encoder or absolute external scale and the zero position of the actual position value (0x6064).

- **Incremental Encoder**

  If it finds the home position or it is at the home position, then the position moved by the home offset value becomes the zero position.

- **Absolute Encoder**

  If the absolute encoder is connected, then the home offset value is added to the absolute position (the actual position value).

0x607D	Software Position Limit						
SubIndex 0		Number of entries					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
USINT	-	2	-	RO	No	-	No
SubIndex 1		Min. position limit					
Variable type	Setting range	Initial value	Unit	Accessibility	PDO assignment	Change attribute	Storage
DINT	-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 0xFFFFFFF	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 0xFFFFFFF	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 5.5 Homing.

Setting values	Details
0	Disabled
1	Homing using the index pulse and reverse limit contact
2	Homing using the index pulse and forward limit contact
7 to 14	Homing using the index pulse and home contact
24	Same as method 8 (does not use the index pulse)
28	Same as method 12 (does not use the index pulse)
33, 34	Homing to the index pulse
35	Homing to the current position
-1	Homing using the 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	Setting range	Initial value	Unit	Accessibility	PDO	Change	Storage

type					assignment	attribute	
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.
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

Bit	Value	Details
		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	Setting range	Initial	Unit	Accessibility	PDO	Change	Storage

type		value			assignment	attribute	
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

Bit	Details
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	VI (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

11. Troubleshooting

IN THIS CHAPTER
11.1 Troubleshooting Guidelines
11.2 Servo Alarm and Check List
11.3 Servo Warning and Check List

11.1 Troubleshooting Guidelines

Abnormality Diagnosis and Actions

Abnormality during operation sets off alarm or warning. In such cases, please check the corresponding code and take appropriate actions. When the abnormality is not corrected after such actions, please contact us at our service department.

11.2 Servo Alarm and Check List

Upon detecting abnormality, the drive sets off the servo alarm, and transitions to servo off status ad stops. In such case, the stop method follows the set value of the emergency stop setting (0x2013).

Alarm Code	Causes	Details	What to check
 IPM fault  Over current  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 value should be same with applied to motor label.	Modify motor label and parameter concordantly
	Check motor phase resistor	Check if U/V/W phase current offset(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.
 IPM temperature	surroundings temperature	Check surrounding temperature is over 50 [℃]	Lower surrounding temperature
	Continuous Overload alarm	Accumulated operate overload percentage [0x2603] Checking the load percentage is under 100%	Change drive and motor capacity, Please tune gain.
	Motor cable open	Check accumulated regenerative overload[0x2606]	Adjust regeneration resistor setting[0x2009] Use external regeneration 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.

Alarm Code	Causes	Details	What to check
AL-15 Current offset	Motor U/V/W phase current offset oversetting	Check whether the U/V/W phase current offset [0x2015~0x2017] are 5% of the rated current or higher.	Rerun adjusting phase current offset
	Drive error		If alarm occurs continually after adjusting offset of phase current, please replace new drive because drive has problem.
AL-21 Continuous overload	In case of sequent operating that exceed rated load	Check if load which is accumulating driving load rate[0x2603] is below 100% when it is in constant speed section and stop	Change drive and motor capacity, Please tune gain.
	Motor brake error	Checking 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 encoder cable.
AL-22 Drive temperature 1	surrounding temperature	Check 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 operation 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	Parameter setting error	Check [0x2015], [0x2015], [0x2015] Check value offset	Process the Phase current offset control procedure command

Alarm Code	Causes	Details	What to check
Motor cable open		current	
	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.
 Drive temperature 2	Surrounding temperature	Check whether surrounding temperature is over 50[℃]	Lower the surrounding temperature of drive
	Drive error	Comparing displayed drive temperature 2 [0x260C] in normal status and the surrounding temperature.	Replace the drive
 Encoder temperature	Reserved		
 Encoder communication  Encoder cable open  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.
 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.
 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.
 Low battery	Parameter setting error	Check setting value [0x2005]	It will be no alarm to set as 1 when you use absolute encoder as the incremental encoder.

Alarm Code	Causes	Details	What to check
	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 battery
 Sinusoidal ENC amplitude  Sinusoidal ENC frequncy	Encoder cable error	Wiring is incorrect and check short Check shield and FG disconnect	Replace encoder cable.
	Parameter setting error	Check setting valid of encoder type [0x2001]	Check setting encoder type. Check speed command. (Maximum: 250kHz)
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	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.
 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.
 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.
 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/ deceleration	In case of many time for acceleration/ deceleration	Set longer acceleration/ deceleration time
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.

Alarm Code	Causes	Details	What to check
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 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 same as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low.
		Check setting value[0x2100] ~ [0x211F]	Readjust gain according to operating condition.
	Encoder error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
AL-51 POS following	Parameter setting error	Check setting value [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 same as motor label information.
		Check setting value [0x6091]	Set Electronic gear ratio low..
	Machine part has problem	Checking it was forced by drive part	Check Machine part.

Alarm Code	Causes	Details	What to check
		operating condition of limit contact point sensor	
	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.
 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.
 Factory setting	Parameter setting error	Contact our service center Check [0x1008] Device Name	Please download OS or set capacity of drive again. If alarm continue after servo on again, Replace drive. Because drive may have problem.

Table 50. Servo Alarm Check List

11.3 Servo Warning and Check List

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 Configuration.
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] to state of main power input.	Wire or set parameter as input power on(possible 3 phase)

Alarm Code	Causes	Detail	What to check
	Momentary power failure	Check value of main power input mode set[0x2006] to state of main power input.	Check actual main power or increase value of checking time of loss of main power.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.
 LOW_BATT	Parameter setting error	Check setting value of absolute encoder [0x2005]	Alarm will be disappeared if you set “1” when using ABS encoder as incremental encoder.
	Bad connection of battery, No connected.	Check the status of battery	Connect battery rightly.
	When battery voltage is low.	.Check whether battery voltage is over 3.3V	Replace battery.
 SW_POS_LMT	Parameter setting error	Setting function of software restriction on location [0x2400], Check value of software restriction on location[0x607D]	Change value of software position limit function[0x2400] or change the set of limit value of maximum position and minimum position of software position limit[0x607D]
 OV_LOAD	In case of sequent operating that exceed rated load	Check overload warning level setting[0x2010] and constant speed section or accumulated operation overload rate[0x2603]	Change drive and motor capacity, Please tune gain. Adjust the setting value overload warning level[0x2010].
	Motor brake error	Checking the motor brake is not holding	Provide supply power to motor brake.
	Parameter setting error	Motor ID[0x2000], Encoder type[0x2001], Encoder form [0x2002] value is same with motor label.	Modify the parameter as same as motor label information.
		check value of set of overload detecting basic load rate[0x200F]	Set as proper value.
	Machine part has problem	There is no problem for running	Check machine part has problem
	Motor cable error	Wiring is incorrect and check Short.	Replace motor cable
	Encoder cable error	Wiring is incorrect and check Short.	Replace encoder cable
 SETUP	Drive / Motor Combination error	Check whether capacity of current of motor is bigger than capacity of current of drive or not.	reduce value of torque limit or use the motor which capacity is lower than capacity of current of drive
	IO setting error	Check whether one signal is assigned more than 2 in digital input signal assignment[0x2200] ~ [0x2208] and digital output signal assignment[0x2210]~[0x2213].	Set up correct parameter according to operating method.
 UD_VTG	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

Alarm Code	Causes	Detail	What to check
	Running when power voltage is low	Check wiring status of main power	Use 3 phase as supply voltage
 EMG	EMG contact error	It is state of EMG Wiring or drive parameter(drive control input1[0x211F], digital input signal1 set[0x2200]~digital input Check signal 16 setting[0x220F]	Set up correct parameter according to operating method.
	Drive error		If alarm continue after servo on again, Replace drive. Because drive may have problem.

Table 51. Servo Warning Check List