VEICHI

Manual

SD100 Series Servo Drive

Manual Use Guide

- Basic Terms

Unless stated in advance, the following terms in this manual are defined as follows:

- Servo motor or motor: V7E series servo motor (permanent magnet synchronous motors).
- Servo drive: SD100 series servo motor controller.
- Servo system: Servo drive with the servo motor.

- Composition

Please read the relevant chapters according to the purpose of use.

<table>
<tr><th>Chapter</th><th>Title</th><th>Models and Peripheral Equipment</th><th>Rating and Characteristics</th><th>System Design</th><th>Installation and Wiring</th><th>Trial Operation and Adjustment</th><th>Maintenance and Inspection</th></tr>
<tr><td>Chapter 1</td><td>Pre-use Safety Precautions</td><td>●</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td></tr>
<tr><td>Chapter 2</td><td>Product Information</td><td>●</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Chapter 3</td><td>Wiring and Installation</td><td rowspan="2">●</td><td rowspan="2">●</td><td rowspan="2">●</td><td rowspan="2">●</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
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<tr><td>Chapter 7</td><td>Parameters</td><td>-</td><td>-</td><td>-</td><td>-</td><td>●</td><td>●</td></tr>
<tr><td>Chapter 8</td><td>Troubleshooting</td><td>-</td><td>-</td><td>-</td><td>-</td><td>●</td><td>●</td></tr>
<tr><td>Chapter 9</td><td>Communication</td><td>-</td><td>-</td><td>-</td><td>●</td><td>●</td><td></td></tr>
<tr><td>Chapter 10</td><td>Motion Functions</td><td>-</td><td>-</td><td>-</td><td>-</td><td>●</td><td>●</td></tr>
<tr><td>-</td><td>Appendix</td><td>●</td><td>-</td><td>●</td><td>-</td><td>●</td><td>●</td></tr>
</table>

- DI/DO Terminal Logic

In this manual, the input terminals of the servo drive are all low when the external terminals are not closed, and high when closed.

- Low level (OFF) - switch open (OFF)
- High level (ON) - switch closed (ON)
- Rising edge (↑) - switch open to closed
- Falling edge (↓) - switch closed to open

- Statement

VEICHI is committed to continuously improving our products, and constantly upgrading the product features. Please note that the provided information is subject to change without prior notice. For the latest news, please pay attention to our official website.

Catalog

Version Change Log

Date	Version	Content
2026.02	V1.0	First version released

1 Pre-use Safety Precautions

Please note that the following symbols are used in this manual for safety-related purposes. The description of the safety markings related to the operation is very important for its content, so please be sure to follow them.

⚠	Danger	Situations in which serious injury, or even death, may result from dangers caused by failure to operate as required.
⚠	Caution	Situations in which moderate or minor injuries or damage to equipment may result from dangers caused by failure to operate as required.

1.1 Safety Checks

This section explains safety precautions to be observed during installation, wiring, operation, maintenance and inspection.

⚠ Danger
● Check that the power supply voltage is the same as the rated voltage of the servo drive, or it may cause injury, fire, or damage to the drive. ● Do not connect the input power cables to the output terminals U, V and W, or it will damage the servo drive. ● Do not perform insulation withstand voltage tests on the drive, and do not use a megohmmeter to test the drive's control circuits. ● Connect the drive to the motor in the correct phase sequence, or it may cause drive failure or damage. ● Please disengage the motor load and run the motor alone before trial operation to avoid accidents. ● Check that the power supply can be disconnected from the drive at any time with the emergency stop switch before trial operation. ● Set the appropriate parameters before operation, or it may cause unusual or unanticipated actions due to the load. ● Check with an electrical engineer for wiring work, or it may cause electric shock or fire. ● Do not touch the conductive parts directly, and the output wires of the drive should never be connected or short-circuited to the housing, or it may cause electric shock or short-circuit. ● Disconnect the power and wait 20 seconds before rewiring the drive, or it may cause an electric shock. ● Take reliable grounding measures since the contact current can be up to 0.5 mA, or it may cause electric shock. ● Do not touch the radiator or external braking resistor during operation, or it may cause burns. ● Install the overcurrent protector, leakage current protector and emergency stop device, and make sure they are effective after the wiring is completed, or it may cause electric shock, injury, and fire. ● Ground the drive reliably and ensure that the grounding resistance is less than 10Ω, and that the conductivity of the PE grounding conductor is the same as that of the phase conductor (with the same cross-sectional area) since leakage current may exceed 0.5mA during operation. ● Dispose of the drives as industrial waste as the components inside contain heavy metals.

1.2 Product Checks

Item	Description
If the received product matches the ordER.	The box contains the machine stated in the order and the simplified SD100 servo drive manual. Please confirm the product code against the nameplate on the servo motor and servo drive.
If there is any damage to the product.	Please check the whole appearance of the machine for cracks or damages during transportation, and contact us or your supplier as soon as possible if you find any.
If the servo motor rotary axis run smoothly.	It is normal if it can be turned gently by hand except the servo motors with brake.

1.3 Handling and Storage Precautions

Caution

- Do not store or place the products in the following environments, as this may cause fire, electric shock or machine damage:
  - Locations exposed to direct sunlight
  - Locations where ambient temperature exceeds storage limits
  - Locations with large temperature fluctuations or condensation
  - Locations where relative humidity exceeds storage limits
  - Locations near corrosive gases
  - Locations near flammable gases
  - Locations where water, oil, or chemicals may drip
  - Locations with dust, or too much particulates, high salt or metal dust exposure
  - Locations where vibrations or shocks may affect the equipment
- Do not hold the cable or motor shaft for handling as this may cause injury or malfunction.
- Do not overstack this product during handling or storage, or it may cause injury or malfunction.

1.4 Installation Precautions

Caution

- Do not install this product in a place where water will splash or in an environment prone to corrosion.
- Do not use this product in the vicinity of flammable gases and combustible materials, or it may cause electric shock or fire.
- Do not sit on this product or place heavy objects on top of it, or this may cause injury.
- Install this product in an installation cabinet that provides fire protection and electrical protection, or it may cause a fire.
- Do not block the suction and exhaust ports or allow foreign matter to enter the product's interior, as this may cause malfunction and fire due to deterioration of the internal components.
- Observe the mounting direction, or it may cause malfunction.
- Maintain the specified spacing distance between the servo drive and the inner surface of the electrical cabinet and other machines, or it may cause fire or malfunction.
- Do not apply excessive shocks, or it may cause malfunction.

1.5 Wiring Precautions

Caution

- Do not connect a DC power supply to the servo drive's output terminals (U, V, W), or it may cause injury or fire.
- Directly connect the servo drive outputs (U, V, W) to the servo motor terminals (U, V, W) without an electromagnetic contactor in between, as this may cause abnormal operation or failure.
- Connect the power and motor terminals securely or it may cause fire.
- Do not route or bundle the power and signal cables together through the same duct, and keep them at least 30cm to avoid interference. Maintain a safe distance of 30cm or more between the power cable and these signal cables during wiring.
- Use twisted shielded cables with the shield grounded at both ends for signal and encoder cables.
- A high voltage may still remain inside the drive after the power is turned off. Do not touch the power terminals for 20 seconds.
- Proceed with inspection work after the indicator light is off.
- Do not turn on/off the power supply frequently. If this is necessary, ensure the time interval is at least one minute,
- because that the capacitor in the servo drive's power supply experiences a large charging current(charging time 1s) upon powering on, resulting in performance deterioration of the main circuit components inside the servo drive.
- Observe the following precautions when wiring the main circuit connector:
  - Remove the connector from the servo drive during wiring.
  - Insert only one wire into one of the connector's wire sockets. Prevent short-circuits between adjacent wires when insert wires.
  - Please wire the machine correctly and reliably, or it may cause loss of control, injury or malfunction of the motor.
  - Use the specified power supply voltage, or it may cause product burnout.
  - Ensure that the input power is supplied within the specified voltage variation range for use in the event of poor power supply conditions, or it may cause damage to the machine.
  - Install a safety device such as a circuit breaker to prevent short-circuiting of external wiring, or it may cause a fire.
- Please take adequate and appropriate shielding measures when in the following places, otherwise the machine may be damaged:
  - Places where interference occurs due to static electricity;
  - Places where strong electric or magnetic fields are generated;
  - Places where radioactive radiation may be present;
  - Places where power lines are nearby.

1.6 Precautions During Operation

⚠Caution
● Perform test runs with the servomotor unloaded (not connected to the drive shaft) to prevent accidents, or it may cause injury. ● Do not touch the rotating parts during servo motor operation, or it may cause injury. ● Set the user's parameters in advance to match the machines when starting operation, or it may cause control loss or failure of the product. ● Disable positive limit (P-OT) and negative limit (N-OT) signals under home mode. ● Set up a safety device to prevent the workpiece from falling down in case of alarm or overtravel on the vertical axis. And set the servo motor to be locked under overtravel stop, or it may cause workpiece fall-down. ● Set the correct inertia ratio when online auto-tuning, is off, or it may cause vibration. ● Do not touch the servo driver's heat sink, external braking resistor, motor, etc., which are in a high temperature state when power is on or when the power has just been cut off, or it may cause burns. ● Do not set extreme parameters as extreme adjustments and setting changes, or it may cause unstable servo system operation, or injury. ● Only reset the errors after eliminating the causes and making sure it is safe to restart operation, or it may cause injury. ● Do not use the brake of the braking motor for common deceleration, as it may cause a malfunction.

1.7 Maintenance and Inspection Precautions

⚠Caution
● Make a professional operator to turn on and off the power supply. ● Cut off all circuits connected to the drive before performing the insulation resistance test of the drive, or it will cause the drive to malfunction. ● Do not use gasoline, thinner, alcohol, acidic and alkaline detergents to avoid discoloration or breakage of the housing. ● Send the user parameters of the servo drive to be replaced to the new one, and then restart the operation, or it may cause damage to the machine. ● Do not change the wiring under energized condition, or it may cause electric shock. ● Do not disassemble the servomotor, or it may cause electric shock or injury.

1.8 Maintenance and Inspection of Servo System

The servo system is composed of many parts, and only when all parts operate normally can the equipment deliver its due functions. So, they must be checked or replaced periodically according to service life to ensure that the servo motor and servo drive can operate normally for the whole life span.

1.8.1 Servo Motor Maintenance

Only routine simple overhaul is required since the servo motor does not have brushes. The overhaul period in the table is just for your reference. Please make adjustments based on the usage and environment to decide the most appropriate maintenance period, and see the table below for the maintenance details.

Table 1-1 Servo Motor Maintenance

<table>
<tr><th>Item</th><th>Cycle</th><th>Inspection Content</th><th>Comment</th></tr>
<tr><td>Vibration and sound</td><td>Daily</td><td>Judge by touch and hearing</td><td>No louder than normal operation</td></tr>
<tr><td>Appearance</td><td>Check for defacement</td><td>Wipe with a cloth or to sweep with an air gun</td><td>-</td></tr>
<tr><td>Insulation resistance</td><td>At least once a year</td><td>Cut off its connection to the servo drive and measure the insulation resistance with a 500V megohmmetER. It is normal if resistance value exceeds 10MΩ.</td><td>And when it is below 10MΩ, please contact our maintenance department.</td></tr>
<tr><td>Oil seal</td><td>Replace it at least every 5000 hours</td><td rowspan="2">Please contact our agent or technical support.</td><td>Servo motors with oil seals only</td></tr>
<tr><td>Comprehensive overhaul</td><td>At least 20,000 hours or once every five years</td><td>-</td></tr>
</table>

1.8.2 Servo Drive Maintenance

There is no need to overhaul the drive unit on a daily basis, but please overhaul it more than once a year, see the table below.

Table 1-2 Servo Drive Maintenance

<table>
<tr><th>Item</th><th>Cycle</th><th>Inspection Content</th><th>Solution</th></tr>
<tr><td>Appearance</td><td rowspan="2">At least once a year</td><td>Check for rubbish, dust, oil, etc.</td><td>Wipe with cloth or sweep with an air gun</td></tr>
<tr><td>Screws</td><td>Check for loose screws on the wiring board and connector.</td><td>Fasten them.</td></tr>
</table>

1.8.3 Replacement of Internal Components of Servo System

Electrical and electronic components may be worn by mechanical force or aging. Please make regular overhauls to ensure safety.

In addition, please refer to the replacement years in the following table, and contact the agency or our office, and we will determine whether the parts need to be replaced after investigation. For the servo drives that have been repaired by VEICHI, please note that the user parameters are default to the factory settings, so please remember to back up the user parameters and upload them before operation.

Table 1-3 Replacement of Internal Components of Servo Units

Name	Cycle	Requirement
Smoothing capacity	7~8 years	Environment temp.: 30℃ on average yearly Load ratio: <80% Operation rate: <20 hours/day
Aluminum electrolytic capacitors on printed circuit boards	5 years	

2 Product Information

2.1 Servo Drive Introduction

2.1.1 Servo Drive Nameplate and Models

SD	100	-	210	G	-	C	A	-	2	-	L
①	②		③	④		⑤	⑥		⑦		⑧

①	Product Series	SD	Servo drive	⑤	Product Type	P	Pulse
②	Product Series	100	100 series			C	CANopen
③	Rated Current	110	11A			E	EtherCAT
		210	21A	⑥	Encoder Type	A	Serial encoder
		300	30A	⑦	Output Axes	Blank	Single-axis
		400	40A			2	Dual-axis
		800	80A			A	Analog output
④	Voltage Level	G	48V	⑧	Version	Blank	Standard
						L	Low-temp.

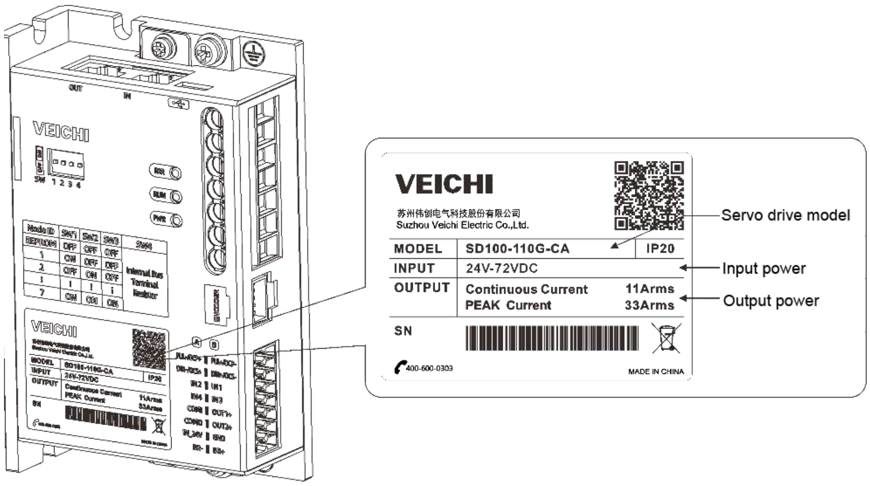


Figure 2-1 Nameplate and Model Description

2.1.2 Technical Specification

- Electrical Specification

Table 2-1 Drive Input Voltage and Output Current

Model	Rated Input Voltage (V)	Rated Output Current (A)	Max. Output Current (A)
SD100-110G□A	24-72	11	33
SD100-210G□A	24-72	21	63
SD100-300G□A	24-72	30	90
SD100-400G□A	24-72	40	120
SD100-800G□A	24-72	80	240

SD100-110G□A-2	24-72	11 (dual-axis)	33
SD100-210G□A-2	24-72	21 (dual-axis)	63

- Basic Specification

Table 2-2 Drive specification

<table>
<tr><th colspan="3">Item</th><th>Specification</th></tr>
<tr><td colspan="3">Voltage range</td><td>24V~72V</td></tr>
<tr><td colspan="3">Control mode</td><td>MOSFET PWM controlled, sine wave current drive mode</td></tr>
<tr><td colspan="3">Encoder type</td><td>Serial encoder: absolute encoder</td></tr>
<tr><td rowspan="9">Environmental Condition</td><td colspan="2">Working temperature</td><td>0℃~55℃(Derate to use between 55℃~60℃)</td></tr>
<tr><td colspan="2">Storage temperature</td><td>-20℃~65℃</td></tr>
<tr><td colspan="2">Working humidity</td><td><95%RH (No freezing, no condensation)</td></tr>
<tr><td colspan="2">Storage humidity</td><td><95%RH (No freezing, no condensation)</td></tr>
<tr><td colspan="2">Vibration resistance</td><td>4.9m/s²</td></tr>
<tr><td colspan="2">Impact resistance</td><td>19.6m/s²</td></tr>
<tr><td colspan="2">Protection level</td><td>IP20</td></tr>
<tr><td colspan="2">Altitude</td><td><1000m (derate between 1000m~2000m)</td></tr>
<tr><td colspan="2">Others</td><td>No electrostatic interference, strong electric field, strong magnetic field, radiation, etc.</td></tr>
<tr><td rowspan="2">I/O Control</td><td colspan="2">Input signal</td><td>Working voltage range: DC24V±20%
Input mode: common collector input, and common emitter input
4 channels for function input and positive/negative logic change</td></tr>
<tr><td colspan="2">Output signal</td><td>Working voltage range: 5V~30V DC
Output mode: photocoupler output (isolated)
2 channels for function input and positive/negative logic change</td></tr>
<tr><td rowspan="5">Position Control</td><td colspan="2">Feedforward compensation</td><td>0%~100%</td></tr>
<tr><td rowspan="3">Reference pulse</td><td>Reference pulse pattern</td><td>Three types: "Pulse + Direction", "CW + CCW Pulse Sequence", and "A and B Phase Quadrature Pulse"</td></tr>
<tr><td>Input pattern</td><td>Linear drive, and open collector</td></tr>
<tr><td>Max. input frequency</td><td>Differential input: 4Mpps max.
Open collector: 200Kpps max.</td></tr>
<tr><td colspan="2">Control functions</td><td>Basic configurations such as position reference selection, electronic gear setting, gear backlash compensation, home, positioning control output, etc., and also position control functions such as LF vibration suppression and model following control.</td></tr>
</table>

Item			Specification
Velocity Control	Velocity control range		1:5000 (lower limit of speed control range is the threshold value under non-stop operation at rated torque load)
	Velocity fluctuation rate	Load fluctuation	<±0.01% of rated speed (load fluctuation: 0%~100%)
		Voltage fluctuation	0% of rated speed (voltage fluctuation: ±10%)
		Temperature fluctuation	<±0.1% of rated speed (temperature fluctuation: 25°C ± 25°C)
	Control functions		Internal speed setting, acceleration/deceleration setting, zero-speed clamp, speed-based output adjustment and others
Torque Control	Torque control accuracy		±1% (reproducible)
	Control functions		Internal torque setting, torque filtering, single trigger, torque-based output adjustment and others
Communication Functions	RS485		Modbus protocol
	CAN		CiA-301 V4.02: CANopen application layer and communication protocols DSP-402 V2.0: drive and motion control sub-protocols
	USB		USB 2.0 Type-C port for PC (12Mbps)
Display			3 LED indicators (ERR, RUN, PWR)
Regenerative brake			External
Protections			Overcurrent, overvoltage, undervoltage, overload, regeneration brake fault, encoder disconnection, etc.
Utility functions			Intelligent setting, error history, jogging operation, inertia detection, FFT analysis, etc.

2.1.3 Drive Installation Dimensions

SIZE A	SD100-110G、SD100-210G
SIZE B	SD100-300G、SD100-400G
SIZE C	SD100-110G-2、SD100-210G-2
SIZE D	SD100-800G

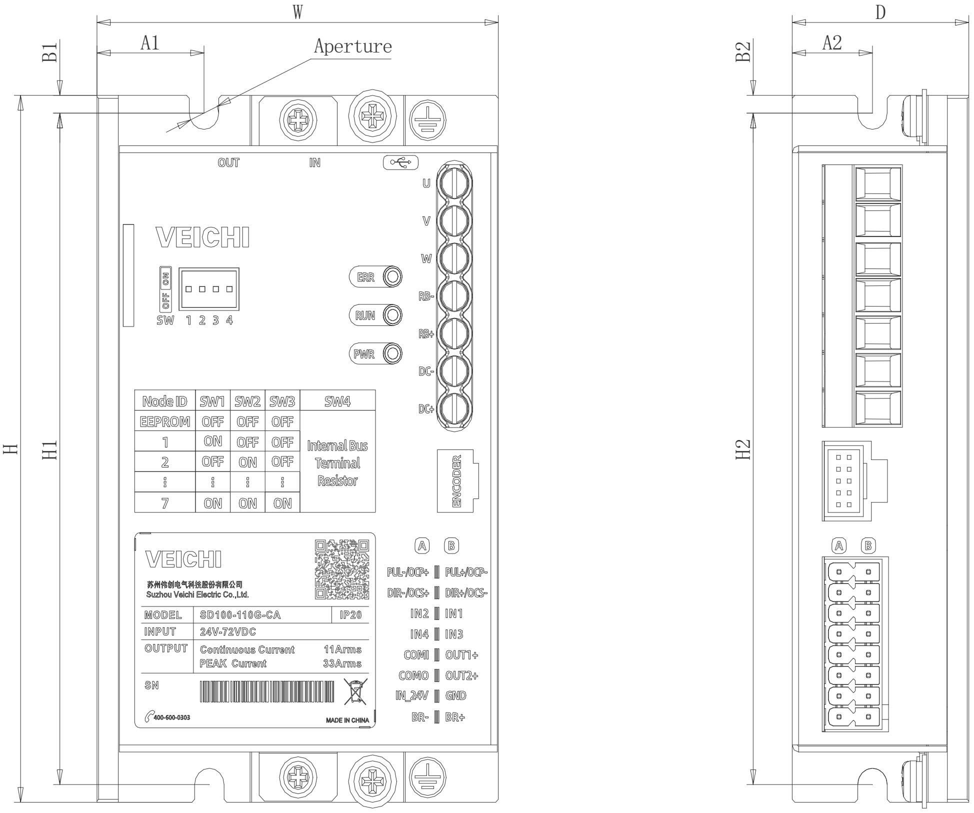


Figure 2-2 Drive Appearance Diagram

Table 2-3 External Dimensions and Installation Dimensions Relationship

Structure	Outer Dimension (mm)			Installation Dimension (mm)						Aperture
	W	H	D	H1	A1	B1	H2	A2	B2	-
SIZE A	75	119.5	33	113.5	20	3	113.5	15	3	4-M4
SIZE B	90	175	33.5	169	23	3	169	15.5	3	4-M4
SIZE C	90	202	33.5	196	22	3	194	15.5	3	4-M4

2.2 Servo Motor Introduction

2.2.1 Servo Motor Nameplate

V7E	-	L	06	G	-	R4	30	Q	1	-	Y	-	( )
①		②	③	④		⑤	⑥	⑦	⑧		⑨		⑩

①	Product Series	V7E	V7series	⑥	Rated Velocity	25	2500rpm
						30	3000rpm
				⑦	Encoder Type	Q	17-bit single-turn magnetic encoder
②	Inertia Level	L	Low inertia			R	17-bit multi-turn magnetic encoder
		M	Medium	⑧	Brake Type	1	W/o Without brake
③	Flange	04	40x40			2	With brake

		06	60×60	⑨	Outlet Method	K	Power cable/encoder cable direct out
		08	80×80				
		13	130×130				
④	Voltage Level	E	24V			Y	Direct out for power cables, plug-in terminals for encoder cables
		G	48V				
		I	72V				
⑤	Rated Power	R10	0.1kW			U	0.5m power cable with adapter, encoder cable with plug-in terminals
		R20	0.2kW				
		R40	0.4kW				
		R60	0.6kW			S	Power: 0.5m + waterproof adapter Encoder: pluggable terminal
		R75	0.75kW				
		1R0	1kW				
		1R2	1.2kW	⑩	Version	Blank	Standard
		1R5	1.5kW				
		2R0	2kW			Others	Specical
		2R5	2.5kW				
		3R0	3kW				

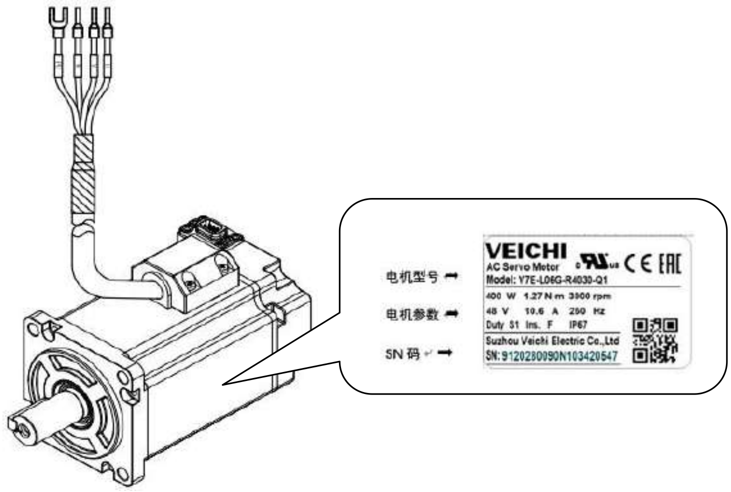


Figure 2-3 Motor Model and Nameplate

2.2.2 Servo Motor Structure

The left side shows the motor structure without brake and the right side shows the motor with brake.

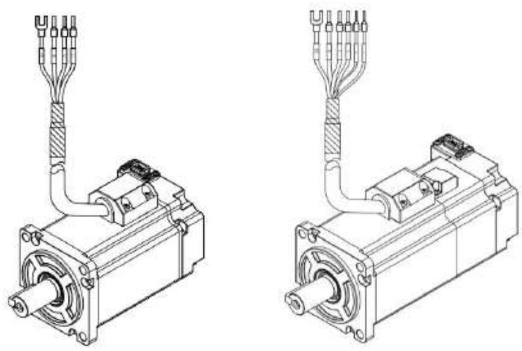


Figure 2-4 Motor Structure

2.2.3 Motor Specification

- Motor Mechanical Characteristics and Specification

Table 2-4 Motor Mechanical Characteristics and Specification

Item	Description
Work mode	Continuous
Vibration resistance	≤49m/s²(5G) during operation, and ≤24.5m/s²(2.5G) during shutdown
Insulation resistance	>10MΩ under 48V DC
Ambient temperature	-20℃~40℃
Ambient humidity	20%~ 80% (no condensation)
Excitation method	Permanent magnet
Installation method	Flange
Thermal class	F
Insulation voltage	1500V AC for 1 min (200V models)

- Motor Ratings

Motor Model	V7E-L06G-R2030-#1△	V7E-L06G-R2030-#2△	V7E-L06G-R4030-#1△	V7E-L06G-R4030-#2△
Rated power (W)	200	200	400	400
Rated torque (N·m)	0.64	0.64	1.27	1.27
Max. torque (N·m)	1.92	1.92	3.81	3.81
Rated current (Arms)	5.3	5.3	10.6	10.6
Max. current (Arms)	15.9	15.9	31.8	31.8
Rated speed (rpm)	3000	3000	3000	3000
Maximum speed (rpm)	4000	4000	4000	4000
Torque coefficient (N·m/Arms)	0.12	0.12	0.12	0.12
Rotational inertia (10^{-4} kg·m^2)	0.18	0.2	0.34	0.36
Radial load (N)	245	245	245	245
Axial load (N)	74	74	74	74

Motor Model	V7E-L06G-R6030-#1△	V7E-L06G-R6030-#2△	V7E-L08G-R7530-#1△	V7E-L08G-R7530-#2△
Rated power (W)	600	600	750	750
Rated torque (N·m)	1.91	1.91	2.4	2.4
Max. torque (N·m)	5.73	5.73	7.2	7.2
Rated current (Arms)	15.8	15.8	19.9	19.9
Max. current (Arms)	47.4	47.4	60	60
Rated speed (rpm)	3000	3000	3000	3000
Maximum speed (rpm)	4000	4000	4000	4000
Torque coefficient (N·m/Arms)	0.12	0.12	0.12	0.12

Motor Model	V7E-L06G-R6030-#1△	V7E-L06G-R6030-#2△	V7E-L08G-R7530-#1△	V7E-L08G-R7530-#2△
Rotational inertia (10^{-4} kg·m^2)	0.51	0.53	1.02	1.13
Radial load (N)	245	245	392	392
Axial load (N)	74	74	174	174

Motor Model	V7E-L08G-1R030-#1△	V7E-L08G-1R030-#2△	V7E-L08G-1R230-#1△	V7E-L08G-1R230-#2△
Rated power (W)	1000	1000	1200	1200
Rated torque (N·m)	3.18	3.18	3.82	3.82
Max. torque (N·m)	9.54	9.54	11.46	11.46
Rated current (Arms)	27.6	27.6	28	28
Max. current (Arms)	82.8	82.8	84	84
Rated speed (rpm)	3000	3000	3000	3000
Maximum speed (rpm)	4000	4000	4000	4000
Torque coefficient (N·m/Arms)	0.12	0.12	0.14	0.14
Rotational inertia (10^{-4} kg·m^2)	1.34	1.45	2	2.11
Radial load (N)	392	392	392	392
Axial load (N)	174	174	174	174

Motor Model	V7E-L08G-1R530-#1△	V7E-L08G-1R530-#2△	V7E-M13G-1R530-#1△	V7E-M13G-1R530-#2△
Rated power (W)	1500	1500	1500	1500
Rated torque (N·m)	4.76	4.76	4.8	4.8
Max. torque (N·m)	14.28	14.28	14.4	14.4
Rated current (Arms)	35	35	38.7	38.7
Max. current (Arms)	105	105	116.1	116.1
Rated speed (rpm)	3000	3000	3000	3000
Maximum speed (rpm)	3400	3400	4000	4000
Torque coefficient (N·m/Arms)	0.16	0.16	0.11	0.11
Rotational inertia (10^{-4} kg·m^2)	2	2.11	10.51	12.65
Radial load (N)	392	392	686	686
Axial load (N)	174	174	196	196

Motor Model	V7E-M13G-2R030-#1△-X	V7E-M13G-2R030-#2△-X	V7E-M13G-2R520-#1△-X	V7E-M13G-2R520-#2△-X
Rated power (W)	2000	2000	2500	2500
Rated torque (N·m)	6.4	6.4	12	12
Max. torque (N·m)	12.8	12.8	24	24
Rated current (Arms)	53.3	53.3	61.3	61.3
Max. current (Arms)	106.6	106.6	122.6	122.6
Rated speed (rpm)	3000	3000	2000	2000
Maximum speed (rpm)	4000	4000	2500	2500
Torque coefficient (N·m/Arms)	0.132	0.132	0.215	0.215
Rotational inertia (10^{-4} kg·m^2)	10.1	10.8	17.1	17.8
Radial load (N)	900	900	900	900
Axial load (N)	450	450	450	450

Motor Model	V7E-M13G-2R530-#1△-X	V7E-M13G-2R530-#2△-X	V7E-M13G-3R020-#1△-X	V7E-M13G-3R020-#2△-X
Rated power (W)	2500	2500	3000	3000
Rated torque (N·m)	8	8	14.3	14.3
Max. torque (N·m)	16	16	28.6	28.6
Rated current (Arms)	66.6	66.6	79.4	79.4
Max. current (Arms)	133.2	133.2	158.8	158.8
Rated speed (rpm)	3000	3000	2000	2000
Maximum speed (rpm)	4000	4000	2700	2700
Torque coefficient (N·m/Arms)	0.132	0.132	0.198	0.198
Rotational inertia (10^{-4} kg·m^2)	10.1	10.8	17.1	17.8
Radial load (N)	900	900	900	900
Axial load (N)	450	450	450	450

Motor Model	V7E-M13G-3R030-#1△-X	V7E-M13G-3R030-#2△-X
Rated power (W)	3000	3000
Rated torque (N·m)	9.55	9.55
Max. torque (N·m)	19.1	19.1
Rated current (Arms)	79.5	79.5
Max. current (Arms)	158.8	158.8
Rated speed (rpm)	3000	3000
Maximum speed (rpm)	4000	4000
Torque coefficient (N·m/Arms)	0.132	0.132
Rotational inertia (10^{-4} kg·m^2)	14.1	14.8

Motor Model	V7E-M13G-3R030-#1△-X	V7E-M13G-3R030-#2△-X
Radial load (N)	900	900
Axial load (N)	450	450

Motor Model	V7E-L06E-R2030-#1△	V7E-L06E-R2030-#2△	V7E-L06E-R4030-#1△	V7E-L06E-R4030-#2△
Rated power (W)	200	200	400	400
Rated torque (N·m)	0.64	0.64	1.27	1.27
Max. torque (N·m)	1.92	1.92	3.81	3.81
Rated current (Arms)	10.6	10.6	21.2	21.2
Max. current (Arms)	31.8	31.8	63.6	63.6
Rated speed (rpm)	3000	3000	3000	3000
Maximum speed (rpm)	4000	4000	4000	4000
Torque coefficient (N·m/Arms)	0.06	0.06	0.05	0.05
Rotational inertia (10^{-4} kg·m^2)	0.18	0.2	0.34	0.36
Radial load (N)	245	245	245	245
Axial load (N)	74	74	74	74

Motor Model	V7E-L06E-R6030-#1△	V7E-L06E-R6030-#2△	V7E-L08E-R7530-#1△	V7E-L08E-R7530-#2△
Rated power (W)	600	600	750	750
Rated torque (N·m)	1.91	1.91	2.38	2.38
Max. torque (N·m)	5.73	5.73	7.14	7.14
Rated current (Arms)	30	30	36.7	36.7
Max. current (Arms)	90	90	110.1	110.1
Rated speed (rpm)	3000	3000	3000	3000
Maximum speed (rpm)	4000	4000	4000	4000
Torque coefficient (N·m/Arms)	0.06	0.06	0.06	0.06
Rotational inertia (10^{-4} kg·m^2)	0.51	0.53	1.02	1.13
Radial load (N)	245	245	392	392
Axial load (N)	74	74	174	174

Note:

stands for 17-bit single-turn absolute encoder (Q) or 17-bit multi-turn absolute encoder (R).

△ stands for motor outlet mode U or Y.

2.2.4 Electrical Specification for Motors with Brake

Table 2-5 Electrical Specification for Motors with Brake

Model	Holding torque (N.m)	Input voltage (V)±10%	Release time (ms)	Engage time (ms)	Backlash (°)
V7E-L06G-R2030-#2△	≥1.5	DC24	＜20	＜60	＜0.5
V7E-L06G-R4030-#2△					
V7E-L06E-R4030-#2△					
V7E-L06G-R4030-#2△					
V7E-L06E-R6030-#2△					
V7E-L08G-R7530-#2△	≥3.8		＜80	＜100	
V7E-L08E-R7530-#2△					
V7E-L08G-1R030-#2△					
V7E-L08G-1R230-#2△					
V7E-L08G-1R530-#2△					
V7E-M13G-1R530-#2△	≥16				
V7E-M13G-2R030-#2△-X	≥15				
V7E-M13G-2R520-#2△-X					
V7E-M13G-2R530-#2△-X					
V7E-M13G-3R020-#2△-X					
V7E-M13G-3R030-#2△-X					

Note:

stands for 17-bit single-turn absolute encoder (Q) or 17-bit multi-turn absolute encoder (R).

△ stands for motor outlet mode U or Y.

2.2.5 Servo Motor Installation Dimensions

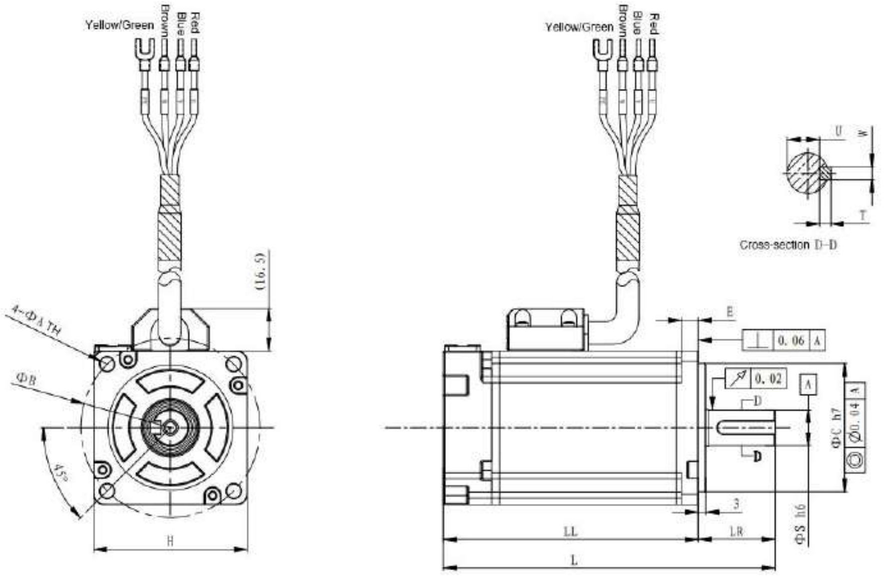


Figure 2-5 Servo Motor Installation Dimensions

Table 2-6 Dimensions for Different Motors

Model	Outer Dimension (mm)					
	A	B	C	S	E	F
V7E-L06G-R2030-#1△	5.5	70	50	14	6.5	M5 × 10
V7E-L06G-R2030-#2△						
V7E-L06G-R4030-#1△						
V7E-L06G-R4030-#2△						
V7E-L06G-R6030-#1△						
V7E-L06G-R6030-#2△						
V7E-L08G-R7530-#1△	6.6	90	70	19	8	M6 × 12
V7E-L08G-R7530-#2△						
V7E-L08G-1R030-#2△						
V7E-L08G-1R230-#2△						
V7E-L08G-1R530-#1△						
V7E-L08G-1R530-#2△						
V7E-M13G-1R530-#1△	9	145	110	22	12.2	M5 × 12
V7E-M13G-1R530-#2△						
V7E-M13G-2R030-#1△-X						M6 × 18
V7E-M13G-2R030-#2△-X						
V7E-M13G-2R520-#1△-X						
V7E-M13G-2R520-#2△-X						
V7E-M13G-2R530-#1△-X						

V7E-M13G-2R530-#2△-X						
V7E-M13G-3R020-#1△-X						
V7E-M13G-3R020-#2△-X						
V7E-M13G-3R030-#1△-X						
V7E-M13G-3R030-#2△-X						

Note:

stands for 17-bit single-turn absolute encoder (Q) or 17-bit multi-turn absolute encoder (R).

△ stands for motor outlet mode U or Y.

Model	Outer Dimension（mm）						
	H	L	LL	LR	T	W	U
V7E-L06G-R2030-#1△	60	110.5	80.5	30	5	5	11
V7E-L06G-R2030-#2△		141.5	111.5				
V7E-L06G-R4030-#1△		129.5	99.5				
V7E-L06G-R4030-#2△		160.5	130.5				
V7E-L06G-R6030-#1△		148.5	118.5				
V7E-L06G-R6030-#2△		179.5	149.5				
V7E-L08G-R7530-#1△	80	147	112	35	6	6	15.5
V7E-L08G-R7530-#2△		179	144				
V7E-L08G-1R030-#1△		161	126				
V7E-L08G-1R030-#2△		193	158				
V7E-L08G-1R230-#1△		179	144				
V7E-L08G-1R230-#2△		211	176				
V7E-L08G-1R530-#1△		179	144				
V7E-L08G-1R530-#2△		211	176				
V7E-M13G-1R530-#1△	130	191	136	55	7	8	18
V7E-M13G-1R530-#2△		219	165				
V7E-M13G-2R030-#1△-X		274.5	219.5				
V7E-M13G-2R030-#2△-X							
V7E-M13G-2R520-#1△-X		294.5	239.5				
V7E-M13G-2R520-#2△-X							
V7E-M13G-2R530-#1△-X		274.5	219.5				
V7E-M13G-2R530-#2△-X							
V7E-M13G-3R020-#1△-X		314.5	259.5				
V7E-M13G-3R020-#2△-X							
V7E-M13G-3R030-#1△-X		294.5	239.5				
V7E-M13G-3R030-#2△-X							

Note:

stands for 17-bit single-turn absolute encoder (Q) or 17-bit multi-turn absolute encoder (R)

△ stands for motor outlet mode U or Y.

2.3 Servo System Configuration

Table 2-7 Servo System Configuration (48V)

Servo Drive		Servo Motor				
Model	Rated Current (Arms)	Power (W)	Model	Torque (N·m)	Rated Current (Arms)	Rated Speed (rpm)
SD100-110G	11	200	V7E-L06G-R2030-#1△	0.64	5.3	3000
			V7E-L06G-R2030-#2△			
		400	V7E-L06G-R4030-#1△	1.27	10.6	3000
			V7E-L06G-R4030-#2△			
SD100-210G	21	600	V7E-L06G-R6030-#1△	1.91	15.8	3000
			V7E-L06G-R6030-#2△			
		750	V7E-L08G-R7530-#1△	2.38	19.9	3000
			V7E-L08G-R7530-#2△			
SD100-300G	30	1000	V7E-L08G-1R030-#1△	3.18	27.6	3000
			V7E-L08G-1R030-#2△			
SD100-400G	40	1200	V7E-L08G-1R230-#1△	3.82	28	3000
			V7E-L08G-1R230-#2△			
		1500	V7E-L08G-1R530-#1△	4.76	35	3000
			V7E-L08G-1R530-#2△			
			V7E-M13G-1R530-#1△	4.8	38.7	3000
			V7E-M13G-1R530-#2△			
SD100-800G	80	2000	V7E-M13G-2R030-#1△-X	6.4	53.3	3000
			V7E-M13G-2R030-#2△-X			
		2500	V7E-M13G-2R520-#1△-X	12	61.3	2000
			V7E-M13G-2R520-#2△-X			
			V7E-M13G-2R530-#1△-X	8	66.6	3000
			V7E-M13G-2R530-#2△-X			
		3000	V7E-M13G-3R020-#1△-X	14.3	79.4	2000
			V7E-M13G-3R020-#2△-X			
			V7E-M13G-3R030-#1△-X	9.55	79.5	3000
			V7E-M13G-3R030-#2△-X			

Table 2-8 Servo System Configuration (24V)

Servo Drive		Servo Motor				
Model	Rated Current (Arms)	Power (W)	Model	Torque (N·m)	Rated Current (Arms)	Rated Speed (rpm)
SD100-110G	11	200	V7E-L06E-R2030-#1△ V7E-L06E-R2030-#2△	0.64	10.6	3000
SD100-210G	21	400	V7E-L06E-R4030-#1△ V7E-L06E-R4030-#2△	1.27	21.2	3000
SD100-300G	30	600	V7E-L06E-R6030-#1△ V7E-L06E-R6030-#2△	1.91	30	3000
SD100-400G	40	750	V7E-L08E-R7530-#1△ V7E-L08E-R7530-#2△	2.38	36.7	3000

Note:

stands for 17-bit single-turn absolute encoder (Q) or 17-bit multi-turn absolute encoder (R)

△ stands for motor outlet mode U or Y.

3 Wiring and Installation

3.1 Servo Drive Terminal Pin Layout

The terminal pins of the SD100 are shown in the following diagram:

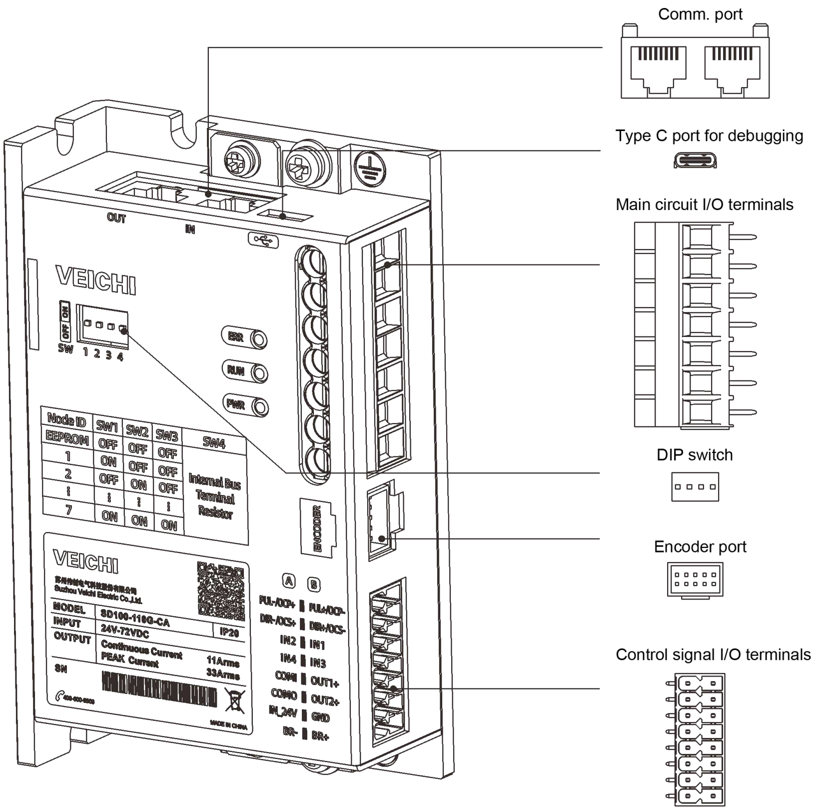
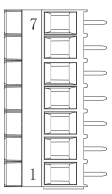


Figure 3-1 Drive Terminal Pins

3.2 Main Circuit I/O Terminals

3.2.1 Main Circuit I/O Pin Definition

Table 3-1 Main Circuit Terminal Pin Description of Servo Drive

Diagram	Pin No	Name	Function
	1	DC+	DC power positive (DC: 24V~72V)
	2	DC-	DC power negative
	3	RB+	Braking resistor positive
	4	RB-	Braking resistor negative
	5	W	Motor power cable W-phase
	6	V	Motor power cable V-phase
	7	U	Motor power cable U-phase

3.2.2 Wiring Illustrations and Precaution

The wiring diagram is shown below:

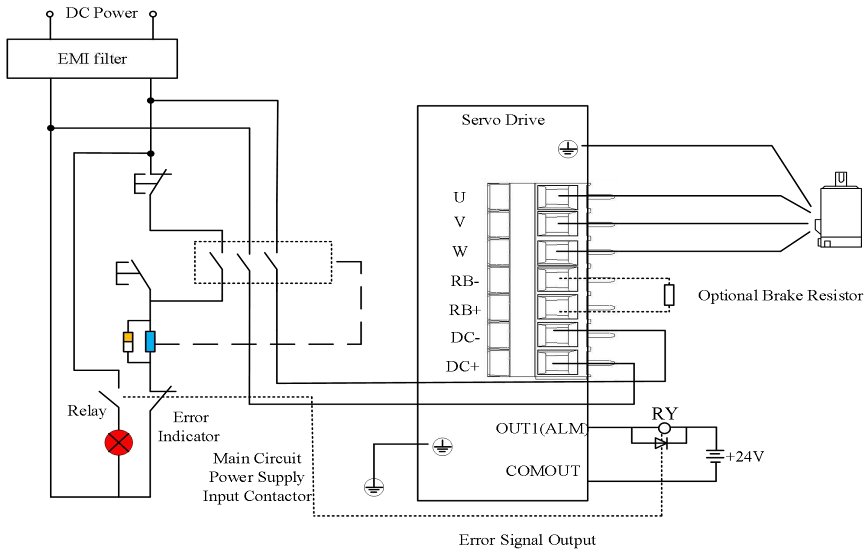


Figure 3-2 Main Circuit I/O Wiring Diagram

Table 3-2 Main Circuit Cable Specifications

Input Voltage (V)	Drive Model	Input Cable (DC+、DC-)	Rated Output Current (A)	Output Cable (U、V、W)	Ground Cable (PE)
		mm^2	-	mm^2	mm^2
24-72	SD100-110G	1.5	11	1.5	1.5
	SD100-210G	2.5	21	2.5	2.5
24-72	SD100-300G	3.5	30	4.0	3.5
	SD100-400G	4.0	40	4.0	4.0
24-72	SD100-800G	⩾8.3	80	⩾8.3	⩾8.3

Precautions

- All of the above cables are copper core cables, if aluminum cables are used, their diameter should be 1.5 times ~ 2 times of the copper wire.
- Do not connect the input power cable to the output terminals U, V, and W, or the servo drive will be damaged.
- When cables are bundled in a duct, take the derating ratio into consideration due to the deteriorating thermal conditions.
- When the temperature inside the cabinet is higher than the temperature limit value of the cables, use cables with a higher temperature limit value, Teflon cables perhaps; when surrounded by a low-temperature environment, take warming measures, as the surface of the cables tends to harden and rupture.
- Ensure that the bending radius of the cables is more than 10 times the outer diameter of themselves to prevent the core of the cables from breaking due to long-term bending.
- Do not route or bundle the power and signal cables together through the same duct, and keep them at a distance of 30cm or more to avoid interference.
- High voltage may still remain inside the drive after power off, so do not touch the power terminals within 5 minutes.
- Do not turn on/off the power supply frequently. If it is necessary, keep the interval at least one minute, since the capacitor in the servo drive's power supply section experiences a large charging current upon powering on, resulting in performance deterioration of the main circuit components inside the servo drive.
- If the cross-sectional area of the main circuit cables is $1.6mm^2$, use a $2.0mm^2$ ground cable.
- Ground the servo drive reliably.
- Do not turn on the power when the terminal block screws are loose or the wiring is loose, or it may cause a fire.

3.2.3 Braking Resistor Selection

When the torque and speed of the motor are in opposite directions, motor energy is fed back into the drive, raising the drive bus voltage until it exceeds the preset braking point, then the energy can only be consumed by the braking resistor. The braking energy must be consumed at this point, otherwise, it will cause damage to the drive.

SD100 only supports external braking resistors, which needs to be connected to RB+ and RB- terminals for use. When selecting an external regenerative braking resistor, be sure to check that the capacity is appropriate, or it may cause injury or fire.

Recommended brake resistor specification is as follows:

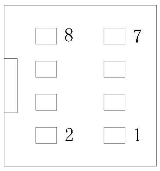
Table 3-3 Servo Drive Brake Resistor Specification

Model	Braking Voltage （V）	Min. External Resistance （Ω）	Resistor Power （W）
SD100-110G	75	10	100

SD100-210G	75	5	100
SD100-300G	75	5	200
SD100-400G	75	5	200
SD100-800G	75	0.8	700

3.3 Encoder Terminal

Table 3-4 Encoder Terminal Function Configuration

Diagram	Pin No.	Name	Function
	1	PE	Shielding layer grounded
	2	-	-
	3	GND	5V power output for encoder
	4	+5V	
	5	BAT-	Battery for multi-turn encoder
	6	BAT+	
	7	485-B	Serial encoder input
	8	485-A	

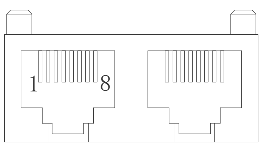
Precautions	
	• When using a multi-turn absolute encoder, pay attention to the battery and serial data. • When soldering the encoder wiring by hand, refer to the pin definitions in the figure above.

3.4 Communication Terminal

3.4.1 CAN/RS485/EtherCAT Communication Terminal

This ports differs on models. Please confirm the model and its definition accordingly before use. If field identification bit is S (standard) or C (CANopen), the pin definition of the communication interface is shown in the table below.

Table 3-5 CAN/RS485 Communication Terminal Definition

Diagram	Pin No.	Name	Function	Comment
 IN OUT	1	CANH	CANH Data+	Pulse type is not supported and the built-in termination resistor can be connected via SW4
	2	CANL	CANH Data-	
	3	CANG	CAN signal ground	
	4	485-(B-)	485 Data-	Pulse and CANopen both supported
	5	485+(A+)	485 Data+	
	6	-	-	

	7	GND	Signal ground	
	8	-	-	-
	Case	Shielded	Shielded	-

When multiple drives are used at the same time, the cascade cables should be 50cm or shorter, left in and right out, and the last right port should be connected with a terminating resistor if necessary.

If field identification bit is E (EtherCAT), the pin definitions are shown in the table below.

Table 3-6 EtherCAT Communication Terminal Definition

Pin No.	Name	Function
1	TX+	Transmitting signal
2	TX-	Transmitting signal
3	RX+	Receiving signal
4	-	-
5	-	-
6	RX-	Receiving signal
7	-	-
8	-	-
9	Case	Shielded

- CAN Usage Precautions

When CAN communication is used, note that CGND in the upper unit is connected to the CGND terminal of the servo drive as shown below:

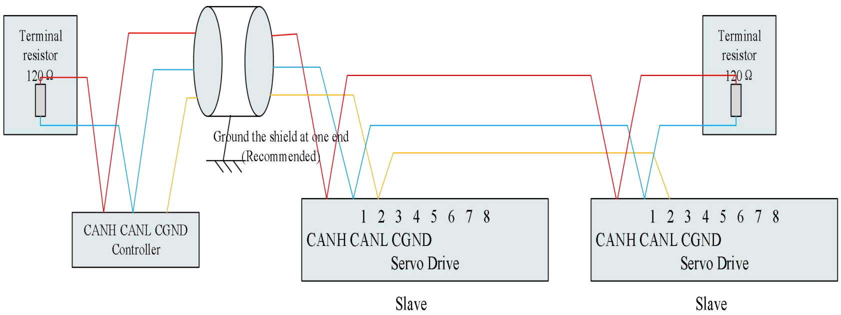


Figure 3-3 CAN and Controller Connection Method

Precautions	
⚠	● Ground the shielding layer at one end. ● The controller-side termination resistor needs to be connected or turned on. ● Do not connect the CGND terminal in the host controller to the GND terminal of the servo drive, or it may cause product damage.

- RS485 Communication Precautions

When using 485 communication, please note that the ⏚(GND) terminal of the upper unit is connected to the GND terminal of the servo drive, as shown in the following figure:

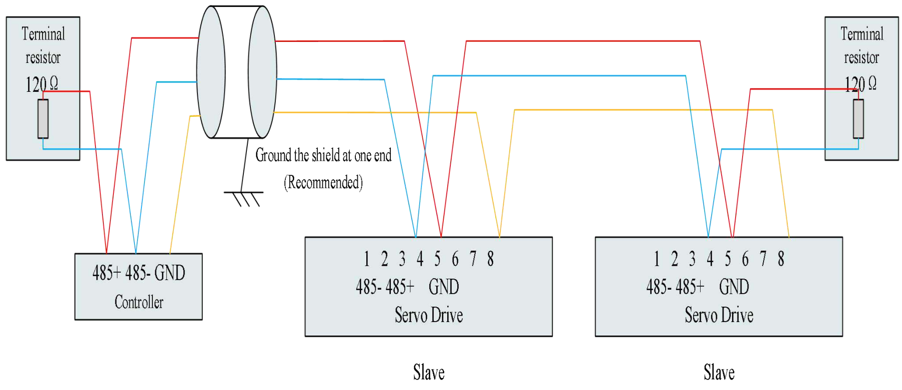


Figure 3-4 RS485 and Controller Connection Method

Precautions	
⚠	● Ground the shielding layer at one end. ● The controller-side termination resistor needs to be connected or turned on. ● Do not connect the CGND terminal in the upper unit to the GND terminal of the servo drive, or it may cause product damage.

● EtherCAT Communication Precautions

(1) Topology

The SD100 Servo Drive EtherCAT topology connection is flexible and essentially unlimited, as shown below.

Liner topology:

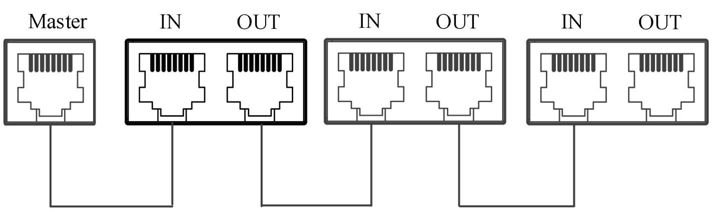


Figure 3-5 Liner Topology

Ring redundant topology:

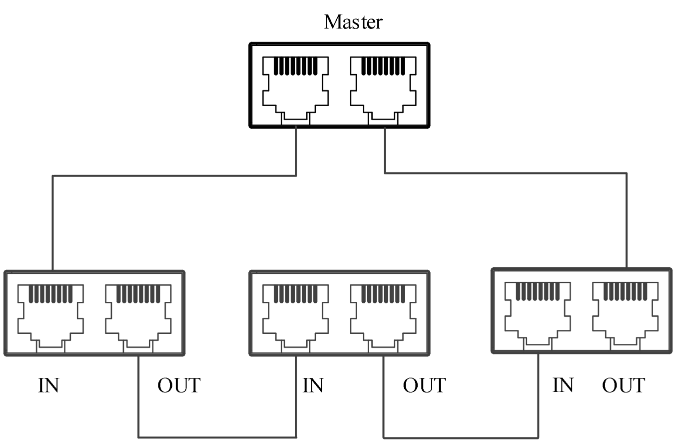


Figure 3-6 Ring Redundant Topology

(2) Communication Cable

Use Ethernet Category 5 (100BASE-TX) network cables or high-strength network cables with shielding for EtherCAT communication. And it's better to shielded cables for SD100-EtherCAT Servo Drive to enhance immunity to interference.

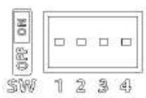
3.4.2 Dip Switch Address

RS485/CAN communication can be configured via the dip switches.

When SW1 and SW3 are dialed OFF, the device address in the EEPROM decides the communication ID (refer to Pn080 setting via the host controller);, while users need to manually choose communication addresses under other circumstance by SW1~ SW3.

When used as CAN communication, the 120Ω built-in termination resistor is connected when SW4 dialed as ON.

Table 3-7 SW Dip Switch Functions

<table>
<tr><th>Diagram</th><th>SW1</th><th>SW2</th><th>SW3</th><th>SW4</th><th>Communcation ID</th></tr>
<tr><td rowspan="5"></td><td>OFF</td><td>OFF</td><td>OFF</td><td rowspan="5">OFF:
No terminal resistor
ON:
Built-in terminal resistor</td><td>EEPROM</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>1</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>2</td></tr>
<tr><td>……</td><td>……</td><td>……</td><td>……</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>7</td></tr>
</table>

3.4.3 USB Commissioning Interface

Connect the VCDSoft debugging software on PC through the Type-C data cable interface for assisted debugging. Please refer to 6 Debugging Software Guide for details.

Table 3-8 Type-C Interface

<table>
<tr><th>Diagram</th><th>Pin No.</th><th>Name</th><th>Function</th></tr>
<tr><td rowspan="4"></td><td>A6</td><td>D+</td><td>Data positive</td></tr>
<tr><td>A7</td><td>D-</td><td>Data negative</td></tr>
<tr><td>-</td><td>-</td><td>-</td></tr>
<tr><td>A1, A12, B1, B12</td><td>GND</td><td>Ground</td></tr>
</table>

3.5 Control SignalI/O Terminals

Table 3-9 Position Reference Input Signal Description-Single-axis

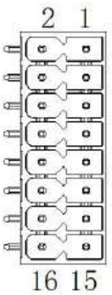
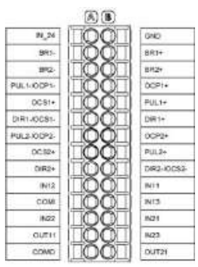
<table>
<tr><th>Diagram</th><th>Pin No.</th><th>Name</th><th colspan="2">Function</th></tr>
<tr><td rowspan="16"></td><td>1</td><td>PULSE+/OCP-</td><td rowspan="4">Pulse reference input method:
①Differential drive input
②Open collector input</td><td rowspan="4">Input pulse pattern:
①Direction+Pulse
②A/B-phases orthogonal to each other
③CW/CCW</td></tr>
<tr><td>2</td><td>PULSE-/OCP+</td></tr>
<tr><td>3</td><td>DIR+/OCS-</td></tr>
<tr><td>4</td><td>DIR-/OCS+</td></tr>
<tr><td>5</td><td>IN1</td><td colspan="2" rowspan="4">DI1~DI4</td></tr>
<tr><td>6</td><td>IN2</td></tr>
<tr><td>7</td><td>IN3</td></tr>
<tr><td>8</td><td>IN4</td></tr>
<tr><td>9</td><td>OUT1+</td><td colspan="2">DO1</td></tr>
<tr><td>10</td><td>COMI</td><td colspan="2">DI common end</td></tr>
<tr><td>11</td><td>OUT2+</td><td colspan="2">DO2</td></tr>
<tr><td>12</td><td>COMO</td><td colspan="2">DO common end</td></tr>
<tr><td>13</td><td>GND</td><td colspan="2">Analog GND</td></tr>
<tr><td>14</td><td>IN_24V</td><td colspan="2">External input backup supply 24V</td></tr>
<tr><td>15</td><td>BR+</td><td colspan="2" rowspan="2">Brake output power supply 24V</td></tr>
<tr><td>16</td><td>BR-</td></tr>
</table>

Table 3-10 Position Reference Input Signal Description-Dual-axis

<table>
<tr><th>Diagram</th><th>Pin No.</th><th>Name</th><th>Function</th></tr>
<tr><td rowspan="12"></td><td>1</td><td>GND</td><td>External input backup power supply 0V</td></tr>
<tr><td>2</td><td>IN_24V</td><td>External input backup power supply 24V</td></tr>
<tr><td>3</td><td>BR1+</td><td>Brake 1 output power supply 24V</td></tr>
<tr><td>4</td><td>BR1-</td><td>Brake 1 output power supply 0V</td></tr>
<tr><td>5</td><td>BR2+</td><td>Brake 2 output power supply 24V</td></tr>
<tr><td>6</td><td>BR2-</td><td>Brake 2 output power supply 0V</td></tr>
<tr><td>7</td><td>OCP1+</td><td rowspan="6">Pulse reference input method:
①Differential drive input
②Open collector input
Input pulse pattern:
①Direction+Pulse
②A/B-phases orthogonal to each other
③CW/CCW</td></tr>
<tr><td>8</td><td>PUL1-/OCP1-</td></tr>
<tr><td>9</td><td>PUL1+</td></tr>
<tr><td>10</td><td>OCS1+</td></tr>
<tr><td>11</td><td>DIR1+</td></tr>
<tr><td>12</td><td>DIR1-/OCS1-</td></tr>
</table>

	13	OCP2+	Pulse reference input method: ①Differential drive input ②Open collector input Input pulse pattern: ①Direction+Pulse ②A/B-phases orthogonal to each other ③CW/CCW
	14	PUL2-/OCP2-	
	15	PUL2+	
	16	OCS2+	
	17	DIR2-/OCS2-	
	18	DIR2+	
	19	IN11	Axis 1 digital input channel 1
	20	IN12	Axis 1 digital input channel 2
	21	IN13	Axis 1 digital input channel 3
	22	COMI	Digital input common terminal
	23	IN21	Axis 2 digital input channel 1
	24	IN22	Axis 2 digital input channel 2
	25	IN23	Axis 2 digital input channel 3
	26	OUT11	Axis 1 digital output channel 1
	27	OUT21	Axis 2 digital output channel 1
	28	COMO	Digital output common terminal

3.5.1 Position Reference Input Signal

The pulse output circuit of the upper unit can be configured on demand as differential drive or open collector. Its maximum input frequency and minimum width values are shown in table 3-10.

Table 3-11 Pulse Input Frequency and Width Frequency

Pulse mode	Max. frequency (PPS)	Min. pulse width (μs)
Differential	4M	0.125
Open collector	200k	2.5

Notes	
⚠	• If the output pulse width of the upper unit is lower than the minimum pulse width value, it will cause the incorrect pulses received by the drive.

(1) Pulse input reference

①Differential input

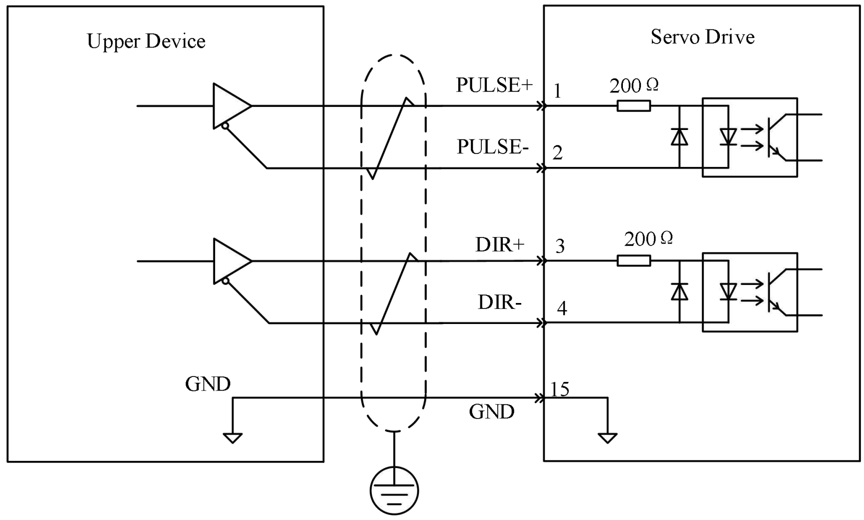
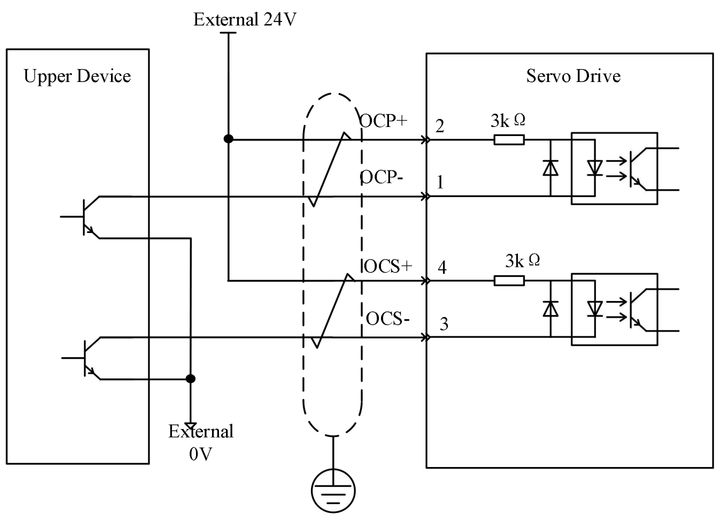


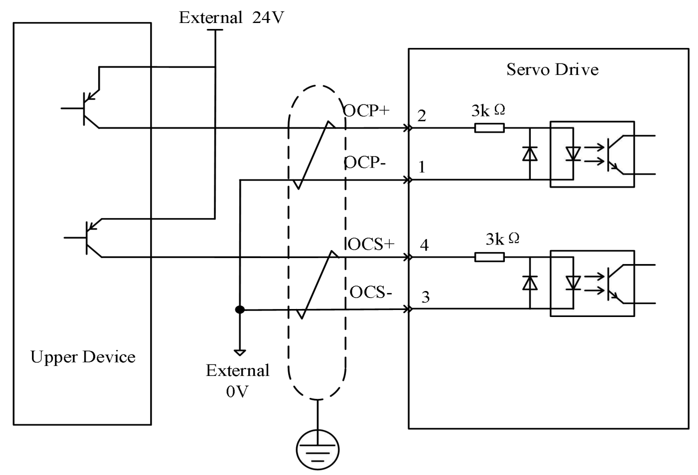
Figure 3-7 Connection example of Linear Drive Input

Notes	
⚠	● Be sure that the differential input is 5V, or the input pulse of the drive will be unstable and further cause: ①pulse loss, or ② opposite reference direction. ● Be sure to connect the GND of the upper unit to the GND of the drive to minimize noise interference.

②Open collector input

Table 3-12 Open Collector Input Wiring under External 24V Power Supply

<table>
<tr><th>Drive Module</th><th>Wiring</th></tr>
<tr><td>NPN
(Common cathode)</td><td>
</td></tr>
</table>

PNP (Common anode)	

Precautions	
⚠	● Incorrect wiring of NPN ports can cause port burnout.

3.5.2 DI/DO Signal

3.5.2.1 DI Circuit

The circuits of X1~X4 are the same, take X1 as an example.

(1) Relay output from upper device

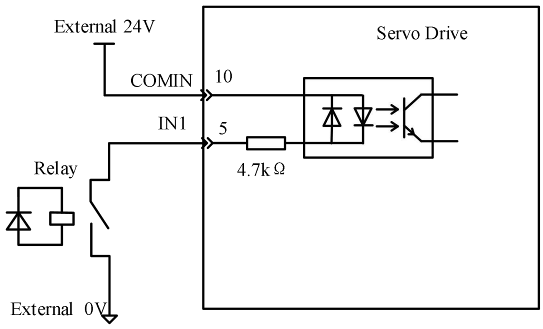


Figure 3-8 Example of relay connection

(2) Open collector output from the upper device

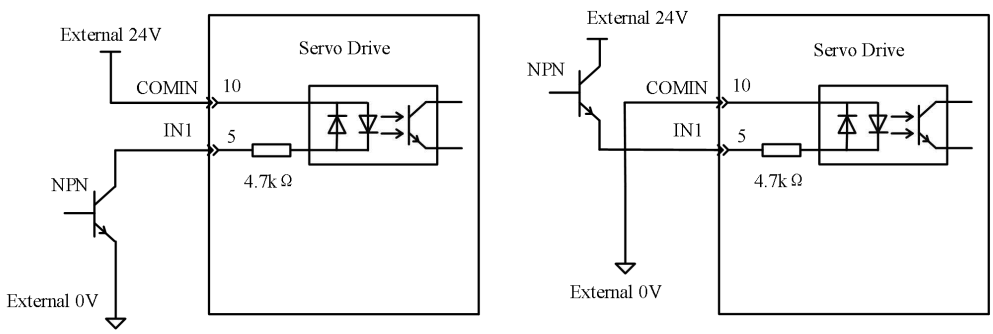


Figure 3-9 Connection example of NPN/PNP open collector

Notes	
	● Mixed use of NPN and PNP inputs is not supported.

3.5.2.2 DO Circuit

The circuit diagram for digital output is illustrated with Y1 as an example. The Y0 and Y1 interface circuits are the same.

(1) Drive output for external relay control

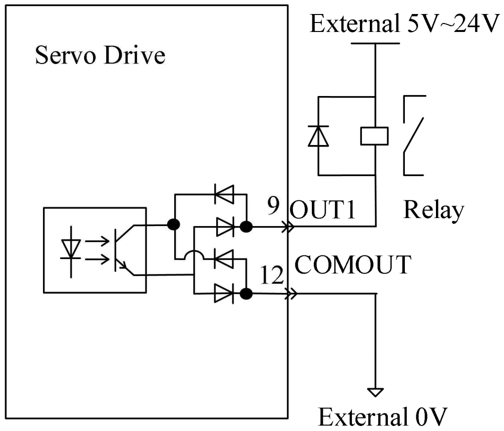


Figure 3-10 Example of Relay Control Wiring

Notes	
	● In this case, be sure to connect a current-continuing diode, or the Y terminal connector may be damaged.

(2) Drive output for optocoupler control

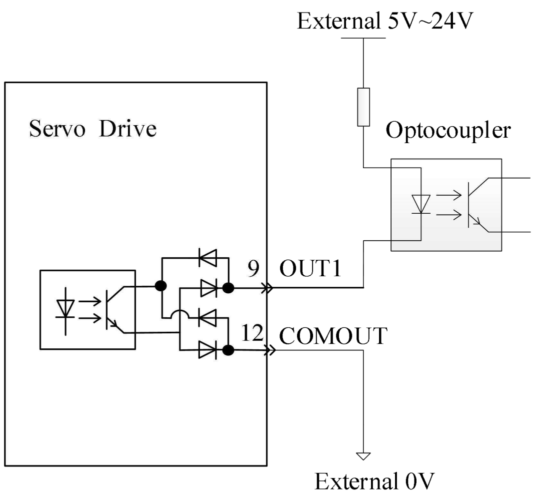


Figure 3-11 Example of Optocoupler Control Wiring

The maximum voltage and current capacity of the servo drive's internal optocoupler output circuit are as follows:

- Voltage: DC 30V (maximum)

- Current: DC 50mA (maximum)

3.5.3 Brake Wiring

When the servo motor is used on vertical axes, the brake can be used to stop or maintain the load from falling during power cut. The electromagnetic brake is connected as shown below:

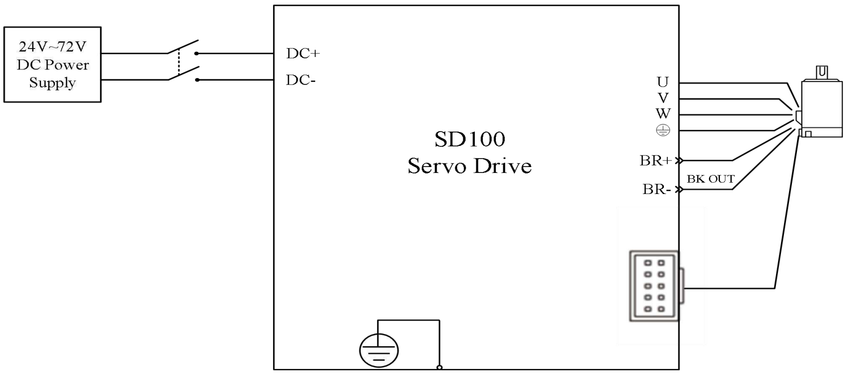


Figure 3-12 Example of Brake Wiring

Brake wiring precautions:

Please fully consider the voltage drop caused by the resistance of the cable during length selection, and make sure the input voltage is at least 21.6 V. The brake parameters of the motor are shown in the following table. The brake engage parameters of the motor are specified in the following table:

Table 3-13 Brake Parameters

电机型号	Holding torque (N·m)	Input Voltage(V) ±10%	Release Time (ms)	Engage Time (ms)	Backlash(°)
V7E-L06G-R2030-#2△	≥1.5	24	20	50	0.5
V7E-L06G-R4030-#2△					
V7E-L06G-R6030-#2△					
V7E-L08G-R7530-#2△	≥3.8	24	80	100	
V7E-L08G-1R030-#2△					
V7E-L08G-1R230-#2△					
V7E-L08G-1R530-#2△					
V7E-L08G-R7530-#2L△					
V7E-L08G-1R030-#2L△					
V7E-L08G-1R230-#2L△					
V7E-L08G-1R530-#2L△					

3.6 Anti-interference Measures for Electrical Wiring

Please take the following measures to suppress interference,:

1. Keep the length of the reference input cable within 3m, and the encoder cable within 20m.

2. Use thick cables ($2mm^2$ and above) for grounding as much as possible.

1) Use cables of D-type or higher classes for grounding (grounding resistance of 100Ω or lower).

2) Ground at 1 point.

3. Use a noise filter on the input side of the power line to prevent RF interference if the product is used in a residential environment or in an environment with strong voltage interference noise.

4. To prevent malfunction caused by electromagnetic interference, the following treatment can be used.

1) Install the upper unit and noise filter near the servo drive if possible.

2) Install surge suppressors on the coils of relays, solenoids, and electromagnetic contactors.

3) Separate strong power lines from weak ones and maintain an interval of at least 30cm, and do not put them into the same duct or bundle them togethER.

Do not use the same power supply with welding machines, EDM machines, etc.

3.6.1 Anti-interference Wiring Examples and Grounding

The “high-speed switching element” in the main circuit of the servo drive may cause switching noise that affects the normal operation of the system depending on the peripheral wiring and grounding. Therefore, it is important to use proper grounding methods and wiring treatments, and to add noise filters where necessary.

(1) Example of anti-interference wiring

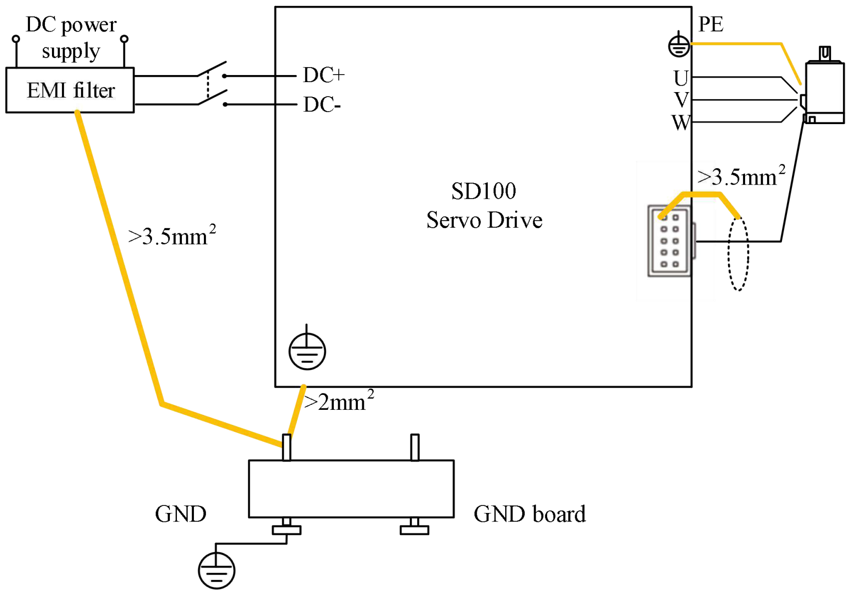


Figure 3-13 Anti-interference Wiring Example

Whenever possible, use a thick cable of 3.5 mm² or above (braided copper cable is recommended) for the connection to the outer case that is grounded;

When using the noise filter, observe the precautions described in "How to use the noise filter" below.

(2) Grounding

To avoid possible interference problems, ground the product as follows.

1. Ground the servo motor casing. Connect the ground terminal of the servo motor to the ground terminal PE of the servo drive, and ground the PE terminal reliably to minimize potential electromagnetic interference.

2. Ground the encoder cable shield. Ground both ends of the shield of the motor encoder cables.

3.6.2 Noise Filter Use Guide

Select an appropriate noise filter at the power supply input based on the input current to prevent interference of the servo drive from affecting sensitive device. And install a noise filter on the power supply cable end of the peripheral device as needed. Please follow the installation and wiring guidelines to ensure optimal performance.

1. Separate the noise filter input and output wiring, and do not put them in the same pipe or bundle them togethER.
2. Separate the noise filter's connection cables from its output power cables.
3. Ground the noise filter separately with a thick cable as short as possible, and do not share a ground cables with other grounding equipment.
4. Installation and grounding of the noise filter in the control cabinet: When the noise filter and the servo drive are installed in the same control cabinet, please fix the filter and the servo drive to the same metal plate to ensure that the contacting parts are conductive and well lapped, and that the metal plate is grounded.

3.7 Cable Usage Precautions

1. Do not bend the cable or subject it to tension, as the core wire of signaling cables is only 0.2mm or 0.3mm in diameter, and it is susceptible to breakage.
2. Use flexible cable for moving cables, as ordinary cables are easily damaged by long-term bending. The cable that comes with the low-power motor cannot be used for such occasions.
3. When using cable protection chain, please make sure that:
   1) The bending diameter of the cable is more than 10 times of the outer diameter;
   2) Do not fix or bundle cables inside cable carriers, except at the two immovable ends;
   3) Avoid cable twisting or coiling;
   4) Keep the fill ratio inside cable carriers below 60%;
   5) Do not route cables with significantly different sizes together to prevent thinner cables from being crushed by thicker ones. If mixed routing is necessary, install partition plates between cables.

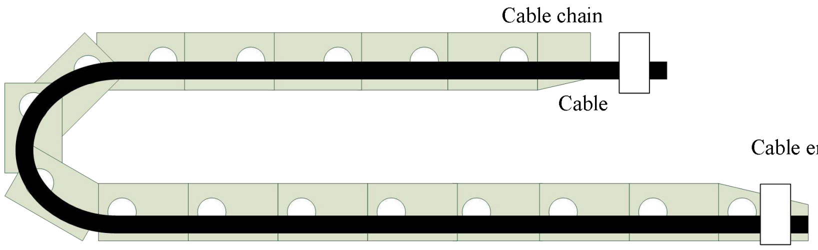


Figure 3-14 Cable Protection Chain

3.8 Typical Wiring

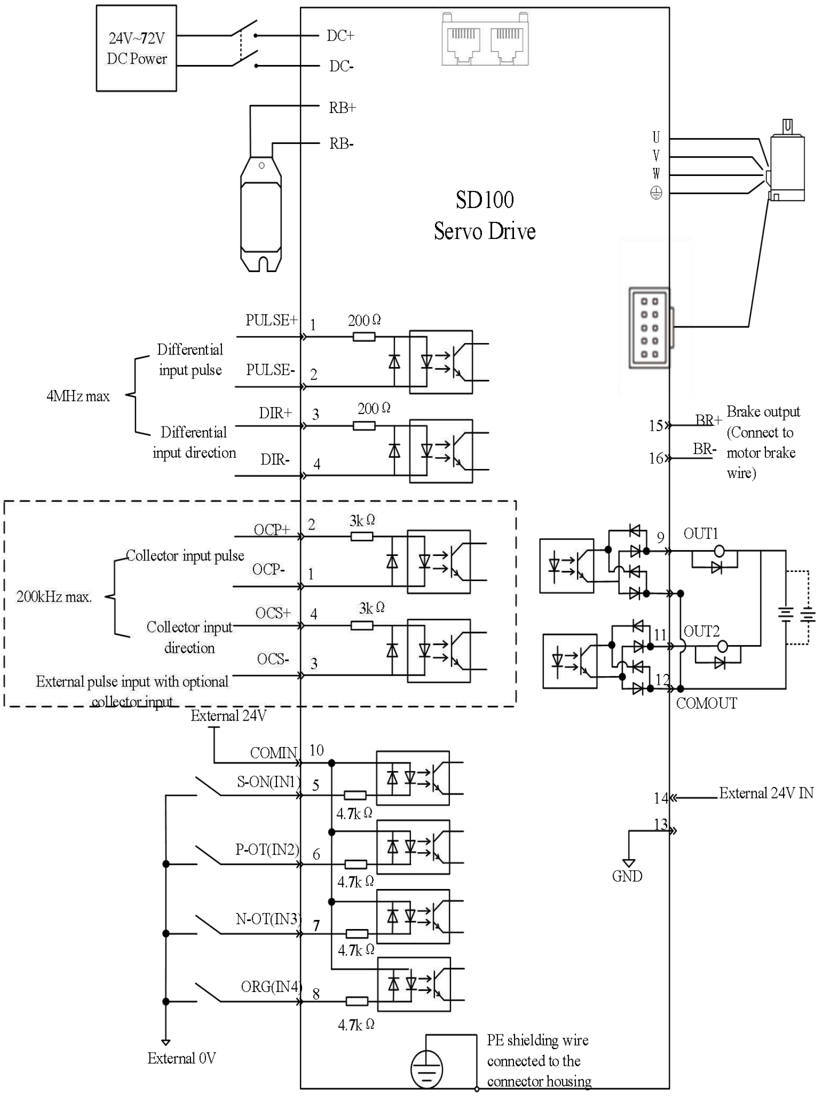


Figure 3-15 Typical Wiring Example under Position Control

1. External power supply is used in the example;
2. IN1~IN4: Signal I/O input terminals (X1~X4). OUT1~OUT2: Signal I/O output terminals (Y1~Y2). Use as required by function.
3. Use twisted shielded cables for the pulse port, and connect shield to PE (both ends) and GND to host controller signal ground.
4. The Y output power supply is provided by users, with a range of 5V~24V. The Y port accepts a max. voltage of 30VDC and a max. current of 50mA.
5. Use shielded twisted-pair cables for encoder divider output and connect shield to PE (both ends) and GND to host controller signal ground.

4 Commissioning and Trial Operation

4.1 Basic Settings

4.1.1 Pre-operation Inspection

Please check the following items beforehand to ensure safe motor operation, and solve the problems properly if there are any.

Table 4-1 Check List before Power-on

No.	Content
1	The power input terminals (DC+, DC-) of the servo drive must be connected correctly.
2	The servo drive output terminals (U, V, W) and servo motor power cable (U, V, W) phases must be connected correctly.
3	The power input terminals (DC+, DC-) and output terminals (U, V, W) of the servo drive must be connected correctly.
4	The external resistor connection port (RB+/RB-) must be wired correctly.
5	The control signal cable of the servo drive must be wired correctly; External signal cables such as brake and overtravel protection are connected reliably. The power supply of the brake is correct.
6	Servo drive and servo motor must be reliably grounded.
7	Cable diameter, force, etc. are within the specified range.
8	No foreign objects such as metal shavings or cable ends inside or outside the servo drive that may cause short circuit of the signals and power cables.
9	The external braking resistor is not placed on a combustible object.
10	Servo motor installation, shaft and mechanical connections must be reliable.
11	The servomotor and the connected machines must be in operable condition.

4.1.2 Power On

After the input power is turned on, the bus voltage indicators are on to show that there is no abnormality, and the drive will wait for enable signal from the host controller.

4.1.3 DI and DO

Users can configure the input and output terminals of the servo drive by means of function codes and configure the signal source by

① external terminals

② virtual terminals

The virtual terminal means that the signals are given through communication.

(1) DI example: configure X1 terminal as the enable signal source

Table 4-2 DI Configuration Steps

Step	Item	Step
1	Power up	After the drive is powered up, the PWR green indicator turns on, indicating power supply is normal.
2	Terminal configuration	Set X1 signal as "servo enable signal" by Pn601=0x0001. That is, the multifunction terminal In1 is valid and NC (normal).
3	External terminal	Disconnect the terminal switch, the indicator RUN green light is on, and then the servo has been enabled; Disconnect the terminal switch, the red indicator RUN is on, and then the servo is ready but not enabled.
4	External terminal signal monitoring	The current input terminal X1 signal status can be monitored by monitoring function code Un100.01.

(2) DO example: configure Y1 terminal as the ready signal source

Table 4-3 DO Configuration Steps

Step	Item	Step
1	Power up	After the drive is powered up, the PWR green indicator turns on, indicating power supply is normal.
2	Output terminal assignment	Set Pn611=0x0001 (Y1 output signal is "servo ready"), at this time, Un101.01=1, Y1 terminal output low level. That is, the multifunction terminal OUT1 is valid to "servo ready".
3	Output terminal monitoring	The servo drive outputs the corresponding signal state without being ready. For example, the drive is currently faulty, bus voltage is not established, etc.
4	Output terminal signal monitoring	The output Y1 terminal signal can be monitored by monitoring function code Un101.01.

(3) Example of virtual terminal input/output operation

Table 4-4 Example of virtual terminal input/output operation steps

Step	Item	Step
1	Power up	After the drive is powered up, the PWR green indicator turns on, indicating power supply is normal.
2	Terminal configuration	Set Pn601=0x1001 to configure X1 terminal as the servo enable signal source, and the signal of this terminal is given by Pn630.01 rather than external terminal; Set Pn611=0x1001, that is, the output signal of Y1 terminal is controlled by function code Pn631.01.
3	Input via virtual terminal	Set Pn630.01=1, the green RUN indicator is on, i.e. the drive is enabled; Set Pn630.01=0, the green RUN indicator is off, i.e. the drive is enabled;

4	Virtual terminal output configuration	Set Pn631.01=1, at this time Un101.01=1, output terminal Y1 is low level; Set Pn631.01=0, at this time Un101.01=0, output terminal Y1 is low level.

4.1.4 Jog Trial Operation

Trial jogging refers to the function of checking whether the servo motor can rotate normally through internal commands without connecting to the upper unit, and it can be used to judge whether there is any abnormal vibration or noise during motor rotation.

Jog operation includes:

- Jog mode (speed control)
- Programed Jog mode (position control).

4.1.4.1 Jog Mode (Velocity)

Jog mode (speed) is the internal operating speed mode of the drive, which performs the speed trajectory planning function in accordance with the parameter Pn500 and the acceleration and deceleration times on Pn310 and Pn311.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn500	Jog Velocity	0~3000	200	rpm
Pn310	Trapezoidal ACC Time	0~10000	200	ms
Pn311	Trapezoidal DEC Time	0~10000	200	ms

Related input terminals:

Setting	Mark	Name	Description	Trigger	Applicable Mode
0x17	JOGP	Positive jog	Motor positive jog at high level	By level	P S T
0x18	JOGN	Reverse jog	Reverse jog at high level	By level	P S T

(1) Operation of the host controller

Open the debugging software, enter the jogging interface, and set the related parameters. The previously set speed value to Pn500 will still be saved after the interface is closed and the jog operation is exited.

(2) Terminal jogging

Configure the corresponding input terminals to perform positive and negative jogging.

Table 4-5 Terminal Jogging

No.	Item	Step
1	Power up	After the drive is powered up, the PWR green indicator turns on, indicating power supply is normal.
2	Terminal configuration	Set Pn605=0x0017 (positive jogging under high level); Pn606=0x0018 (negative jogging under high level);
3	Trial operation	After enabling the servo drive, X1 or X2 continuously sends high level to perform jogging, the speed is determined by Pn500.

Notes	
	● Terminal jog is not affected by the control mode, and it's valid under any mode; ● Terminal positive and negative jog cannot be valid at the same time.

4.1.4.2 Programmed Jog (Position)

Program jog is a function that runs continuously along the pre-set operation mode, travel distance, travel speed, acceleration and deceleration time, delay time, and number of moves.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn502	Programmed Jog Mode	0~5	0	-
Pn503	Programmed Jog Distance	1~1073741824	60000	pulse
Pn505	Programmed Jog ACC/DEC Time	2~10000	100	ms
Pn506	Programmed Jog Delay	0~10000	100	ms
Pn507	Programmed Jog Times	0~1000	1	times
Pn508	Programmed JOG Velocity	1~10000	500	rpm

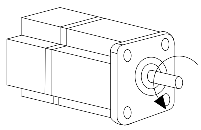
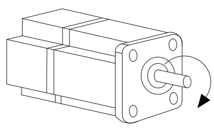
Notes	
	● Programmed Jog operation is valid under position control, and gear ratio and position reference filter is valid. ● To prevent accidents, it is recommended that the over-travel protection function be turned on during use. ● When Pn507 is set to 0, the programmed jog runs cyclically all the time.

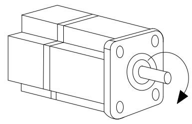
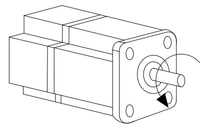
The specific steps of the jog mode on the host controller operation program is shown here:

4.1.5 Rotation Direction

Set the Pn002[Motor Direction] to change the rotation direction of the motor without changing the polarity of the input reference.

Table 4-6 Motor Rotation Direction

Function Code Pn002	Reference Direction	Motor Direction
Pn002=0	Positive reference	 Face the axis end and rotate counterclockwise (CCW)
	Negative reference	 Face the axis end and rotate clockwise (CW)

Pn002=1	Positive reference	 Face the axis end and rotate clockwise (CW)
	Negative reference	 Face the axis end and rotate counterclockwise (CCW)

When Pn002[Motor Direction] setting is changed, the servo drive output pulse pattern and the positive and negative monitoring parameters will not change simultaneously.

4.1.6 Brake Setting

Brake is a mechanism that prevents the servo motor shaft from moving when the servo drive is in a non-operational state and keeps the motor locked in position so that the moving parts of the machinery will not move due to self-weight or external forces.

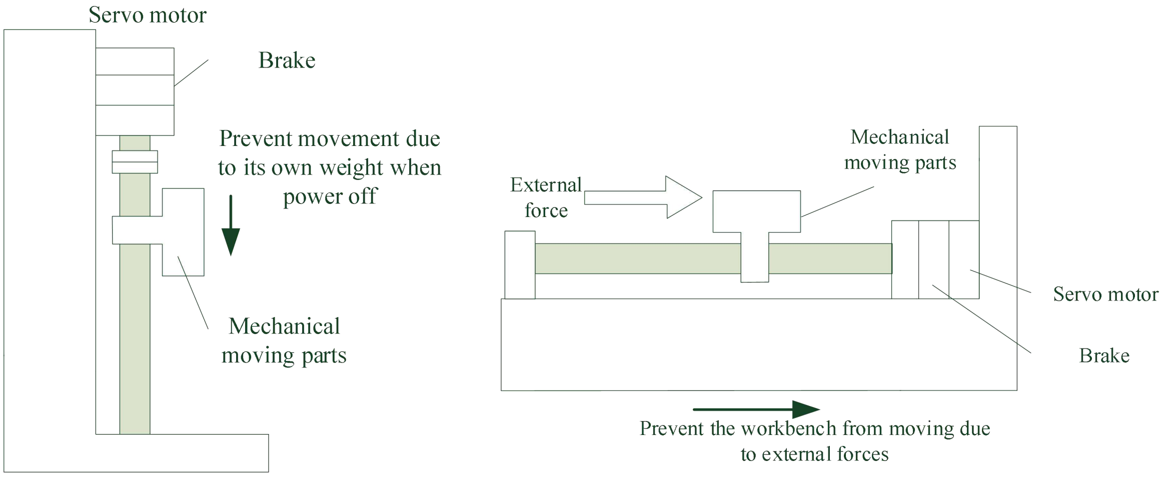


Figure 4-1 Brake used for vertical axis and. Brake used for horizontal axis

Notes	
	● The brake coil is non-polarized. ● After the servo motor stops, disable the servo enable (S-ON) signal. ● During operation of motors with built-in brakes, clicking sounds may occur from the brake, which do not affect functionality. ● When brake coils are energized (brake released), magnetic flux leakage may occur at the shaft end. Exercise caution when using magnetic sensors or similar devices near the motor. ● The brake mechanism is a non-energized actuation type, designed for holding purposes only. Do not use it for dynamic braking;

(1) /BK ON at motor startup

When a servo motor starts, uses can set Pn00B[Brake Release Daley] to control the time from the ON signal reception of the servo drive to actual power provided to the motor.

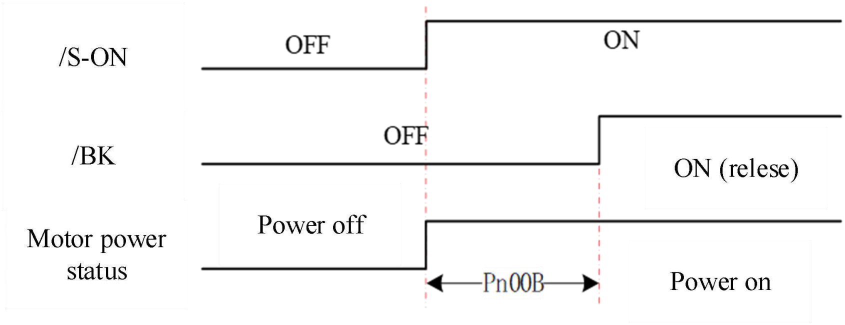


Figure 4-2 /BK ON at Motor Startup Sequence

(2) /BK OFF at motor shutdown (locked)

When the servo motor stops, the brake(/BK) and servo ON(/S-ON) signal are OFF at the same time, set this parameter to change the time from when the /BK signal is OFF to when the motor power is actually cut.

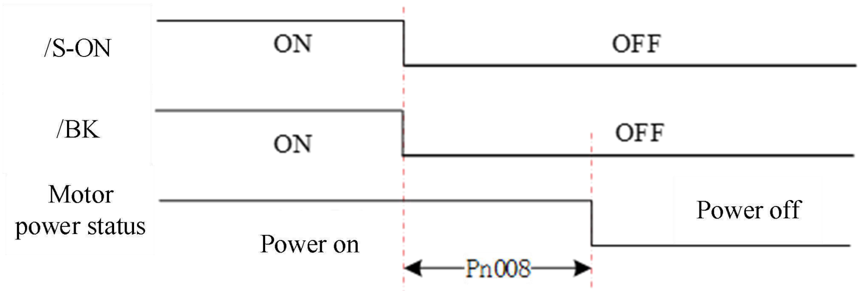


Figure 4-3 /BK signal OFF when the motor stops/locks

(3) /BK) OFF during motor operation

When an error occurs during the rotation of the servo motor, the servo motor stops and the brake signal(/BK) is OFF. In this case, the brake(/BK) sending time can be adjusted by Pn00A[/BK ON Velocity Level] and Pn009[Motor Velocity Level for /BK OFF].

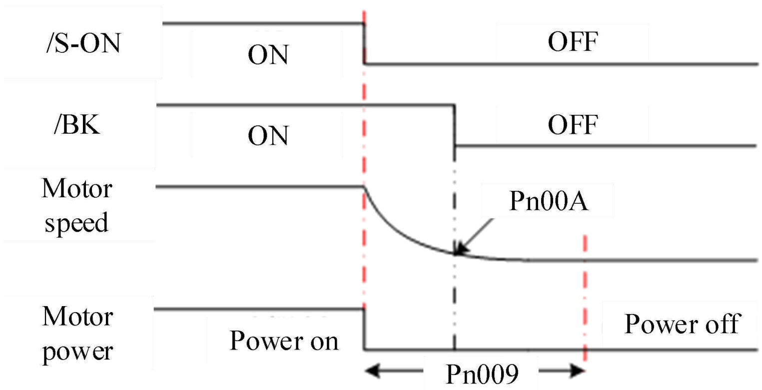


Figure 4-4 /BK signal OFF during Motor Operation

Notes	
	● Brake engage and release time may differ slightly depending on the brake model; ● Make sure that the input reference comes after the brake release time to ensure the accuracy of the reference. ● When the motor is locked, to prevent large mechanical vibration caused by the brake engage during stop, Pn008[ ] can be set to ensure that the motor does not move then.

4.1.7 Overtravel Setting

The over-travel prevention function of the servo unit regarding safety enables the servo motor to be forced to stop by limit signal input when the movable part of the machinery exceeds the allowed area.

The overtravel signals includes positive-overtravel (P-OT) signal and negative-overtravel (N-OT) which are installed at a specific position of the mechanical load, and when that load exceeds the specific position, it is stopped by the /P-OT and /N-OT.

(1) External overtravel signal

Use the switch signal of an external limit switch as follows:

Setting	Mark	Name	Description	Trigger	Applicable Mode
0x02	P-OT	Positive overtravel	When the mechanical movement exceeds the allowable range, the overtravel prevention function is on: ON-Positive overtravel disable OFF-Positive overtravel enable	Level	P S T
0x03	N-OT	Negative overtravel	When the mechanical movement exceeds the allowable range, the overtravel prevention function is on: ON-Negative overtravel disable OFF-Negative overtravel enable	Level	P S T

Connect the input signal of the overtravel limit switch to the pre-assigned input terminal correctly to use the overtravel function. In the case of linear drive (screw), etc., be sure to connect the limit switch as shown in the following diagram to prevent damage to the machine. For the wiring diagram of the input signal, refer to "Control Signal Terminal Wiring".

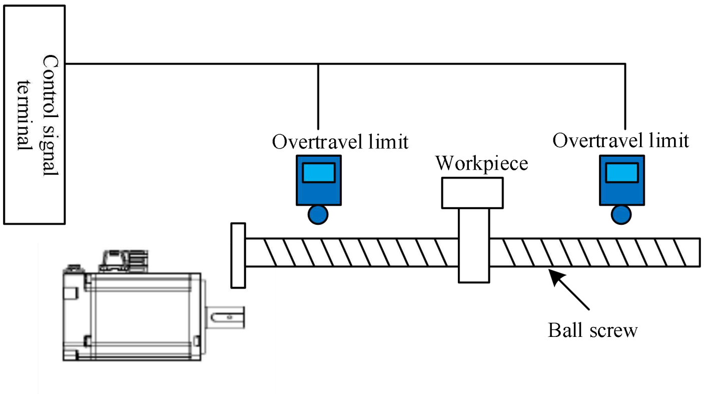


Figure 4-5 External Over-travel Limit Connection

When the positive limit signal of the servo unit is valid, the servo system will allow reverse operation only while when the negative limit switch signal is valid, the servo system will allow forward operation only.

If the servo motor meets the positive limit during forward operation or the negative limit during reverse operation, the drive will stop immediately until the limit switch is released.

(2) Software limit

The switches for the internal software limit can be enabled by setting Pn00D.W.

Related funcodes:

Funcode	Name	Range	Default	Unit
Pn00D.W	Absolute Position Limit	0~2	0	-
Pn030	Soft Limit-Max. Absolute Single Turn	-2^{31}~$(2^{31}-1)$	0	-
Pn032	Soft Limit-Max. Absolute Multi-Turn	-2^{15}~$(2^{15}-1)$	32767	-
Pn033	Soft Limit-Min. Absolute Single Turn	-2^{31}~$(2^{31}-1)$	0	-
Pn035	Soft Limit-Min. Absolute Multi-Turn	-2^{15}~$(2^{15}-1)$	-32768	-

Notes	
⚠	● It must be an absolute encoder for the motor (PnF00.W=1 and Pn00D.W=1) to use the software limit function. ● The soft limit function only distinguishes the number according to the absolute encoder position, and considers the larger value to be the positive limit and the smaller one to be the negative limit.

4.1.8 Overload Setting

Overloads include instantaneous overload and continuous overload.

(1) AL.910 (Overload) detection time modification

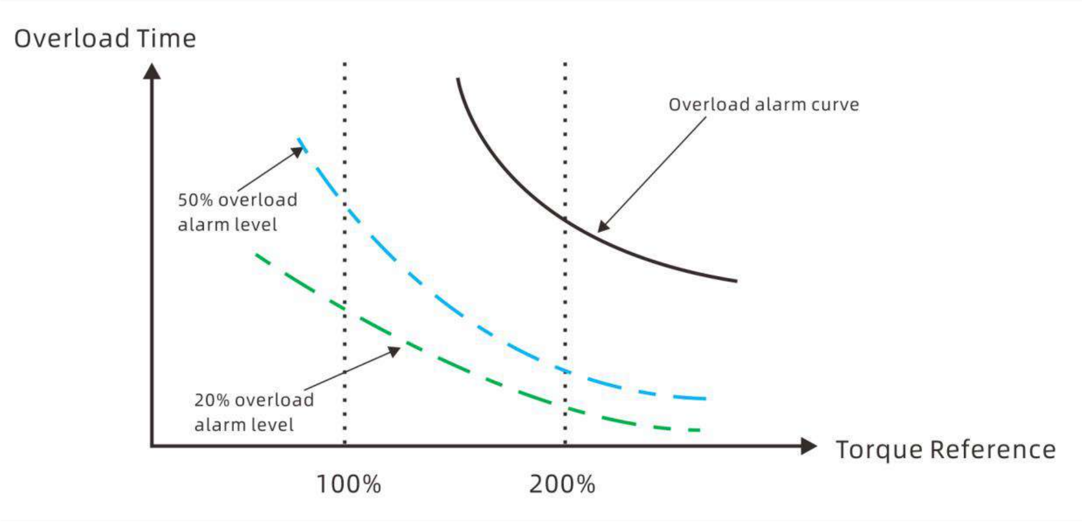


Figure 4-6 Overload Alarm Detection Time Setting

The overload alarm detection time at default is 20% of the overload error detection time, which can be set on Pn015[Overload Alarm Detection Time]. So, it can be used as an overload protection to improve safety.

Example: After changing the overload alarm value by Pn015 from 20% to 50% as shown above, its detection time is half (50%) of the overload error detection time.

(2) Instantaneous overload and continuous overload

Detect an overload alarm via setting Pn016[Motor Overload Derating] to shorten the whole selection time, and the instantaneous overload alarm detection can be changed accordingly.

Motor overload derating = motor current threshold for derating calculation (default is 1.15 times the motor) × Pn016[Motor Overload Derating].

Example: As shown in Figure 4-7, if Pn016 is set to 50%, an overload alarm is reported earlier because the motor overload is calculated from 50% of the base current.

When the value of Pn016 is changed, the overload alarm detection time is changed accordingly due to the change of overload alarm current.

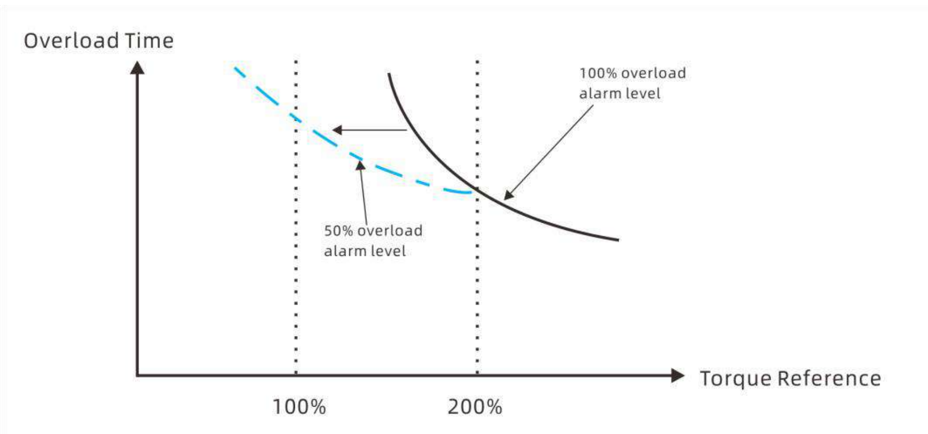


Figure 4-7 Overload Alarm Detection Time Setting

As shown in the following figure overload curve example of drive and motor, the motor curve in it shows (the lower one), the starting point is 115%, continuous overload and instantaneous overload threshold is 180%; drive curve (the higher one) shows that starting point is 115% and the critical point is 170%.

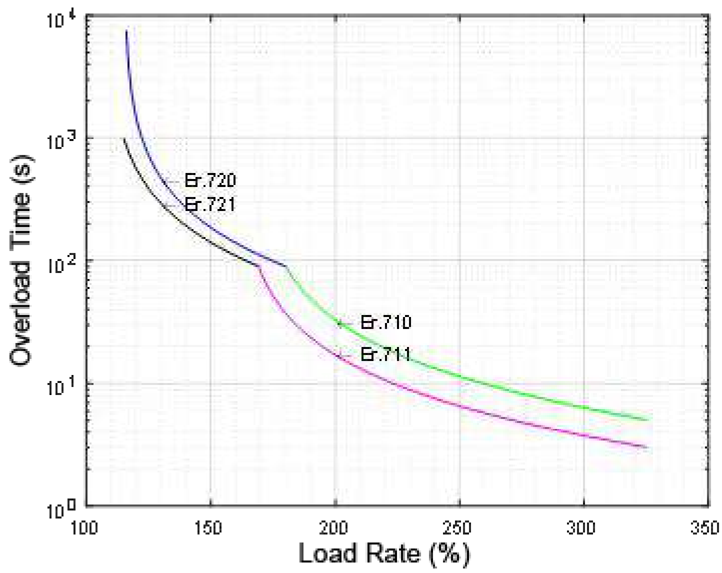


Figure 4-8 Example of Servo Drive and Servomotor Overload Curve

Notes	
⚠	● The overload curves are different up to motors and drives.

4.1.9 Torque Limit

(1) Torque limit method

Output torque can be limited to protect the machine, etc., and it can be divided into internal and external setting on Pn050.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn050	Torque Limit Mode	0~5	2	-
Pn051	Internal Positive Torque Limit	0~500	300	%
Pn052	Internal Negative Torque Limit	0~500	300	%
Pn053	Emergency Stop Torque	0~800	800	%
Pn054	External Torque Limit 1	0~500	300	%
Pn055	External Torque Limit 2	0~500	300	%

Notes	
⚠	● If the set value exceeds the maximum torque of the servo motor, the actual torque will still be limited by the lattER. ● If the set value is too low, insufficient torque may occur when the servo motor accelerates or decelerates, so please set it according to the actual needs.

(2) Torque limit output signal(/TLT)

When torque limit(/TLT) is ON, it means that the output torque of the motor is limited, so users can check the current torque limit state of the motor through this signal.

Setting	Mark	Name	Description	Trigger	Applicable Mode
0x05	TLT	Torque limit	When the output torque of the motor is within the set range, this signal is ON. While when the motor output torque is beyond the set range, this signal is OFF.	Level	🄿🅂🅃

(3) Torque limit during undervoltage

Due to instantaneous power outage or insufficient voltage of the main loop in a short period of time, the DC voltage of the main loop of the servo drive may be lowered below the specified value, and at this time an undervoltage alarm will be reported. Set the parameters below to limit the output torque:

Funcode	Name	Range	Default	Unit
Pn045	Main Circuit (DC) Undervoltage Alarm Enable	0: OFF 1: ON 2: ON, with torque limited both by Pn046 and Pn047	0	-
Pn046	Main Circuit (DC) Undervoltage Torque Limit	0~100	50	%
Pn047	Main Circuit (DC) Undervoltage Torque Limit Release Time	0~1000	100	ms

Use this function with the instantaneous stop holding time function together to avoid shutdown caused by error reports when the power supply voltage is insufficient, so that operation can still continues without power restoration .

When an undervoltage alarm is issued, the drive will apply a torque limit internally for the release time, and the logic timing is shown in the following figure.

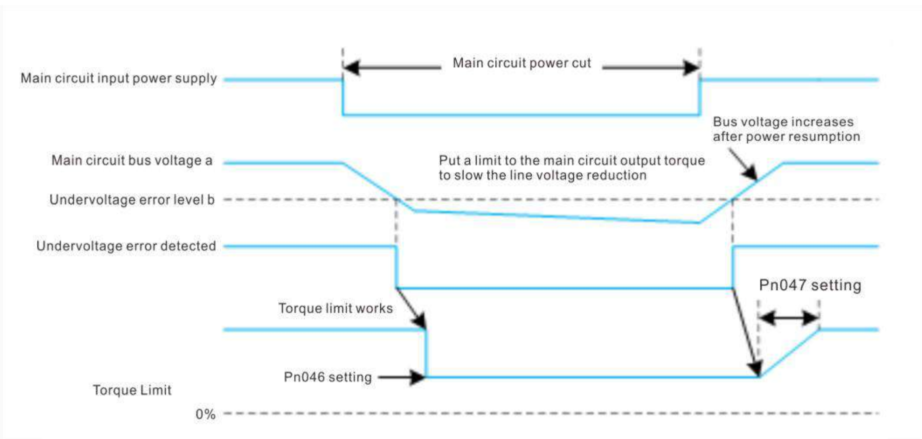


Figure 4-9 Undervoltage Alarm i.e. Release Sequence

4.1.10 Stop Mode

The servo drive will stop in different situations of errors, servo OFF or overtravel protection. In the case of servo-OFF stop and Gr.1 error stop, even when Pn039 is set to 0, the deceleration stop function is invalid and the drive will perform coasting stop.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn004	Gr.1 Error and Servo OFF Stop Mode	2: Coasting stop	2	-
Pn005	Gr.2 Error Stop Mode	0: Zero-speed stop 1: The same as Pn004[Servo OFF and Gr.1 Error Stop Mode] setting	0	-
Pn007	Overtravel Stop Mode	0: Coasting stop 1: Take Pn053[Emergency Stop Torque] as the maximum deceleration torque, and servo motor is locked 2: Take Pn053[Emergency Stop Torque] as the maximum deceleration torque, and servo motor coasts to stop	0	-
Pn039	Servo OFF Deceleration Stop Time	0~10000	0	1ms

Notes
● For the vertical axis, after entering overtravel, the workpiece may fall due to the brake signal (/BK) being turned ON (brake is release). To prevent this, set to make the servomotor fixed at the zero position after stopping (Pn007=1). ● When overtravel occurs due to external force, the motor stops and the transistor is cut off forcibly, and the load axis end may be pushed back by the external force. To prevent this, set to make the servo motor fixed at the zero position after stopping (Pn007=1). ● When the servo motor is stopped or rotating at a very low speed, if dynamic braking is used here, no braking force will be generated as coasting stop. ● Zero-speed stop is valid only for position control and speed control.

4.1.11 Regenerative Brake Setting

When the torque and speed of the motor are in opposite directions, motor energy is fed back into the drive, raising the drive bus voltage until it exceeds the preset braking point, then the energy can only be consumed by the braking resistor. The braking energy must be consumed at this point, otherwise, it will cause damage to the drive.

Notes	
	● When connecting an external regenerative braking resistor, be sure to set appropriate values for Pn012 and Pn013, otherwise the regenerative overload alarm will not be reported properly and the external regenerative resistor may be damaged. ● When selecting an external regenerative braking resistor, be sure to check that the capacity is appropriate, otherwise it may cause injury or fire.

4.2 Position Mode

Position control refers to controlling the position of the motor by position references. The position reference number decides the motor target position while the reference frequency decides the motor speed. And users can send position references via external pulse or internal settings. Through the internal encoder (which comes withthe motor), the servo drive realizes fast and precise control of the position and speed of the machines

under occasions requiring positioning.

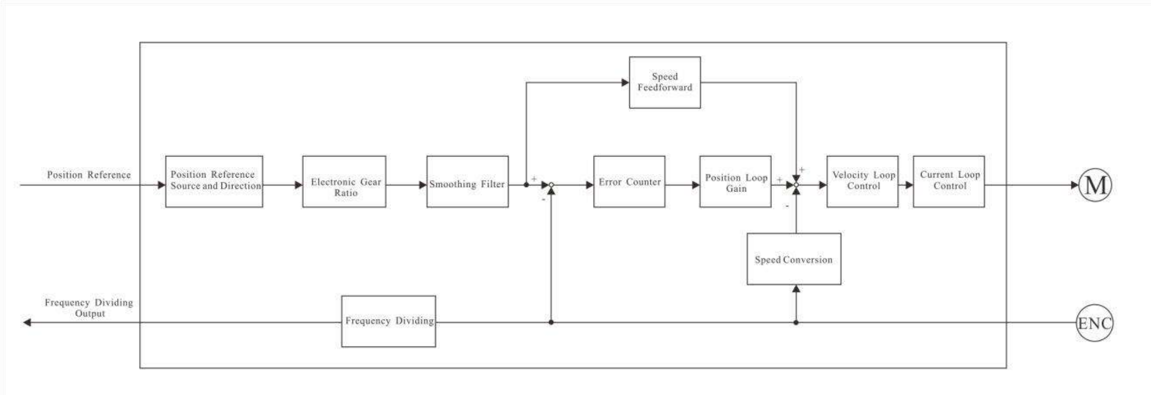


Figure 4-10 Position Control Diagram

4.2.1 Pulse Reference Source

Set the position reference source via function code Pn200 under position control according to actual needs.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn200.X	Pulse Reference Source	0:External high-speed pulse train 1: External low-speed pulse train 2: Reserved 3: Internal position reference	0	-

4.2.2 Reference Pulse Filter

Select the appropriate reference pulse filter via parameter Pn202.Y based on the frequency of the highest pulse during operation. Inappropriate selection may cause abnormal pulse reception.

If the instantaneous pulse frequency is too high, the pulse width will be lower than the filter width setting, in this case, and the pulse will be filtered out as noise. Therefore, the filter width setting must be lower than the actual pulse width, 4 times or lower than the latter is highly recommended.

Example: A filter width duration shorter than 150ns is regarded as an interference signal.

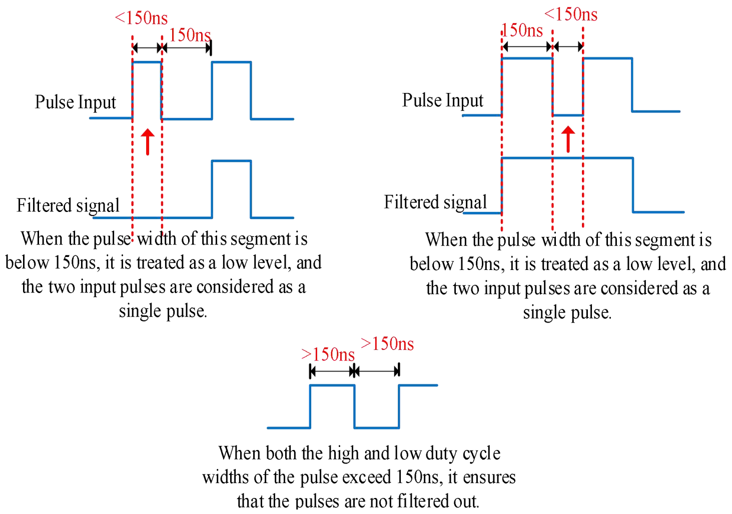


Figure 4-11 Pulse Reference Filter

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn200.Y	Pulse Reference Filter	0: Pulse reference filter time 1 1: Pulse reference filter time 2 2: Pulse reference filter time 3 3: Pulse reference filter time 4 4: Pulse reference filter time 5 5: Pulse reference filter time 6 6: Pulse reference filter time 7 7: Pulse reference filter time 8 8: Pn011 setting	0	-
Pn011	Pulse Filter Time	0~5000	400	12.5ns

4.2.3 Pulse Reference Multiplier

The input multiplier of the position reference pulse can be switched by the /P-GAIN signal. It is a multiplier that multiplies the reference pulse input to the servo unit, which varies from 1 to any set n times (max. 100 times), on funcode Pn203.

Whether the multiplier is switched or not can be confirmed by reference pulse input multiplier shift (/PSELA) signal.

Related function codes:

Funcode	Name	Range	Default	Unit
Pn271	Pulse Reference Multiplier Mode	0: OFF 1: ON 2: Up to DI terminal /P-GAIN signal	0	-
Pn203	Pulse Reference Multiplier	1~100	1	-

Related input terminals:

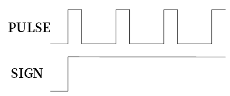
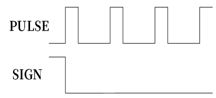
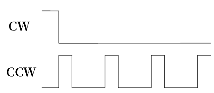
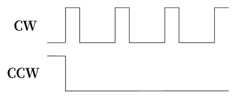
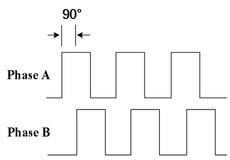
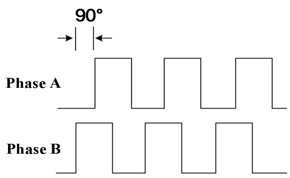
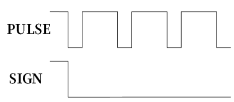
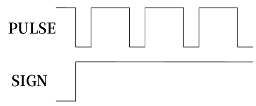
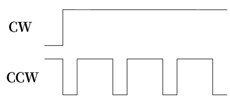
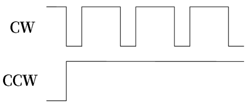
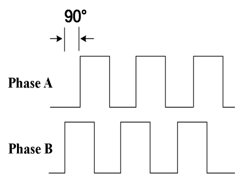
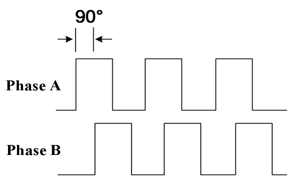
Setting	Mark	Name	Description	Trigger	Mode
0x10	P-GAIN	Pulse reference multiplier shift	Set the frequency of the reference pulse input under position mode. Invalid: General pulse input. Valid: Set multipliER.	Level	🄿

Users can configure the switching input when the reference pulse input multiplier signal is set to general type, and the wiring is described in 3.5 Control SignalI/O Terminals .

Notes
● If the input pulse frequency is too low and the Pn203 is too large, the speed may not be smooth. ● Please switch the reference pulse multiplier when the position reference pulse is 0. If it is not 0, then the servo motor may deviate from the position or lose the position.

4.2.4 Pulse Input Pattern

Table 4-7 Pulse Input Patterns

Pn202.X Setting	Pn201 Setting	Reference Pattern	POS	NEG
0	0	Pulse + Direction		
0	1	CW+ CCW		
0	4	4×Orthogonal frequency		
1	0	Pulse + Direction		
1	1	CW+ CCW		
1	4	4×Orthogonal frequency		

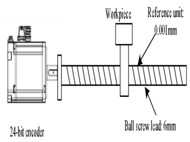
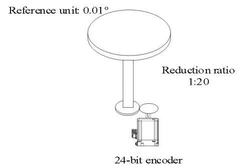
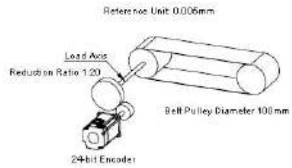
Select the pulse input pattern of the servo unit according to the pulse output pattern of the upper system.

4.2.5 Electronic Gear Ratio

When the deceleration ratio between the motor axis and the load axis is n/m (the load axis at n revolutions when the motor at m revolutions), the setting value of the electronic gear ratio can be obtained by the following formula:

$$\text{Gear ratio} = \frac{\text{Pn204}}{\text{Pn206}} = \frac{\text{Encoder resolution}}{\text{Load axis travel per revolution (reference unit)}} \times \frac{m}{n}$$

Table 4-8 Electronic Gear Ratio Setting Method

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Content</th><th colspan="3">Composition</th></tr>
<tr><th>Ball screw</th><th>Round table</th><th>Belt + pulley</th></tr>
<tr><td>-</td><td>-</td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>1</td><td>Specification</td><td>Ball screw lead: 6mm
Deceleration ratio: 1/1</td><td>Rotation angle of 1 turn: 360°
Deceleration ratio: 1/20</td><td>Pulley diameter: 100mm
(Pulley diameter: 314mm)
Deceleration ratio: 1/20</td></tr>
<tr><td>2</td><td>Encoder Resolution</td><td>131072(17-bit)</td><td>131072(17-bit)</td><td>131072(17-bit)</td></tr>
<tr><td>3</td><td>Reference unit</td><td>0.001mm</td><td>0.01°</td><td>0.005mm</td></tr>
<tr><td>4</td><td>Movement per load shaft turn (reference unit)</td><td>6mm/0.001mm=6000</td><td>360°/0.01°=36000</td><td>314mm/0.005mm=62800</td></tr>
<tr><td>5</td><td>Electronic gear ratio</td><td>$\frac{B}{A} = \frac{131072}{6000} \times \frac{1}{1}$</td><td>$\frac{B}{A} = \frac{131072}{36000} \times \frac{20}{1}$</td><td>$\frac{B}{A} = \frac{131072}{62800} \times \frac{20}{1}$</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Parameters</td><td>Pn204: 131072;</td><td>Pn204: 131072;</td><td>Pn204: 131072;</td></tr>
<tr><td>Pn206: 6000</td><td>Pn206: 1800</td><td>Pn206: 3140</td></tr>
</table>

Notes
● If the numerator of the electronic gear ratio is 0, the denominator is the number of reference pulses per motor turn. ● If the setting range: 0.001 ≤ electronic gear ratio (B/A) ≤ 64000 is exceeded, a "parameter error (ER.d04)" occurs. ● If the electronic gear ratio range is exceeded after the deceleration ratio is calculated, consider to adjust the pulse input multipliER.

4.2.6 Pulse Deviation Clear

The deviation clear signal (/CLR) is an input signal to clear the servo drive pulse deviation countER.

Related Funtion Codes

Funcode	Name	Range	Default	Unit
Pn272	/CLR Trigger Mode	0: At high level (H) 1: At rising edge 2: At low level (L) 3: At falling edge	0	-
Pn273	Pulse Deviation Clear Mode	0: ON under Servo OFF or errors 1: OFF (cleared only by /CLR signal) 2: ON under errors	0	-

Related Input Terminals

Setting	Mark	Name	Description	Trigger	Mode
0x11	CLR	Pulse deviation clear	When this signal is valid, the position pulse deviation accumulated by the servo drive is cleared to zero.	Level	P

Notes	
	● If it is set to the pulse deviation clear, the servo axis is not locked, so the servo motor may turn at a slight speed due to the drift pulse in the speed loop. ● In position control, when the servo motor is stopped due to travel limit, the position deviation remains unchanged, so please check the motor action when releasing the position limit.

4.2.7 Reference Pulse Inhibit

The reference pulse inhibit (INHIBIT) function stops the counting of reference pulse input during position control. When this function is valid, the servo unit cannot receive any reference pulse input.any more.

Related Input Terminals

Setting	Mark	Name	Description	Trigger	Mode
0x0D	INHIBIT	Reference pulse inhibit	This signal is used to control the drive from receiving any reference pulses. Valid: stops receiving reference pulses and counting. Invalid: allows receiving reference pulses and counting.	Level	P S T

4.2.8 Position Near

Under position near (/NEAR) control, the upper unit can receive the position near beforehand to prepare for the sequence of actions after position completion. In this way, the time required for positioning completion can be shortened. This signal is usually used in pairs with the position completion signal. For details on the position completion signal, refer to the 4.2.9 Position Coincidence .

Related Output Terminals

Setting	Mark	Name	Description	Trigger	Mode
0x09	/NEAR	Position near signal	This signal output is ON when the current position deviation is lower the Pn260[/Near Signal Width]. While it is off when it' s highER.	Level	PST

Output the position near signal when the difference between the reference pulses from the host controller and the servo motor position(position deviation) is lower than Pn260[/Near Signal Width].

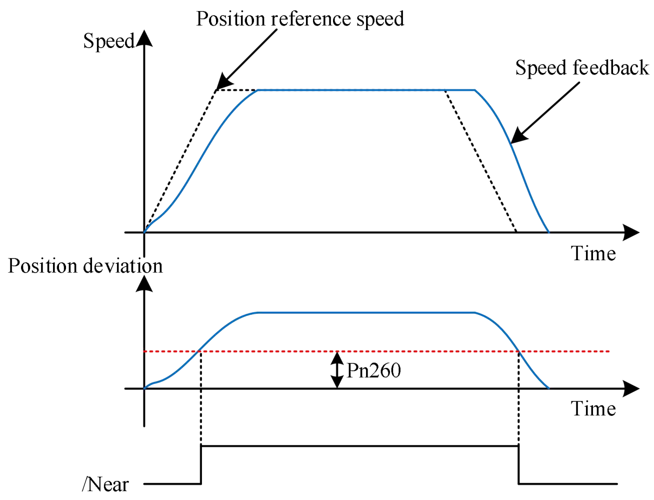


Figure 4-12 /NEAR Signal Output Diagram

4.2.9 Position Coincidence

It means the /COIN signal under position control.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn262	/COIN Signal Width	0~1073741824	7	User unit

Pn200.W	/COIN Signal Output Sequence	0: ON when the absolute value of position deviation is lower than Pn262[/COIN Signal Width] 1: ON when the absolute value of position deviation is lower than Pn262[/COIN Signal Width] and the filtered position reference is 0 2: ON when the absolute value of position deviation is lower than Pn262[/COIN Signal Width] and position reference is 0	0	-

Related Output Terminals

Setting	Mark	Name	Description	Trigger	Mode
0x02	COIN	/COIN Signal Width	This signal is ON when the current position deviation is lower the Pn262 [/COIN Signal Width]. While it is off when it's highER.	Level	P S T

Under position control, a signal indicating completion of servo motor positioning is sent when the difference between the number of reference pulses from the upper unit and the amount of servo motor movement (position deviation) is lower than the setting here, so that the upper unit can confirm that positioning has been completed. If the setting value of Pn262 is too large and the deviation is small in low-speed operation, the positioning completion signal may be output repeatedly. In this case, please reduce the set value on Pn262.

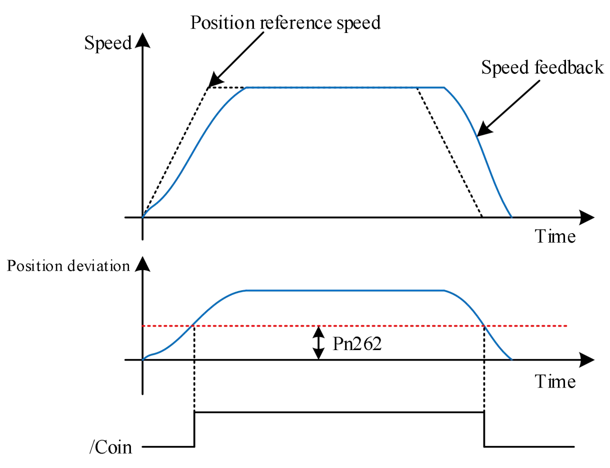


Figure 4-13 /COIN Output Diagram

4.2.10 Position Reference Smoothing (Position Reference Filter)

Set this to filter the reference pulse to smooth the rotation of the servo motor. This function is valid in the following situations:

1. When there is no acceleration or deceleration from the upper device;

2. When the reference pulse frequency is extremely low;

Note:

If the position reference smoothing function is valid, it may slower the system response, so please use it appropriately.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn211	Position Reference Filter Time	0~655	0	ms
Pn212	Position Reference Moving Average Filter	0~1000	0	ms

Set the low-pass filter for position references to reduce the mechanical shocks in case of sudden changes in the input frequency of the pulse references.

The difference between the position reference low-pass filter time and the position reference moving average filter time is shown below:

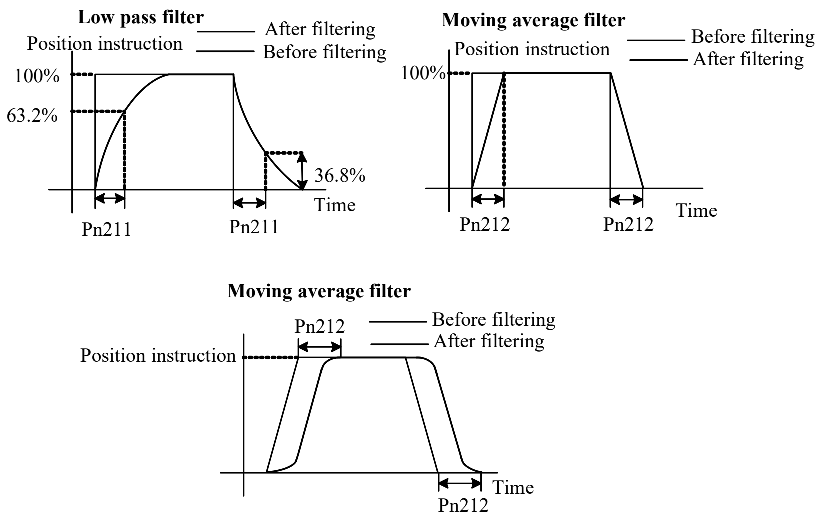


Figure 4-14 Effect of Several Filters

4.2.11 Position Control Operation Example

The general open collector pulse reference frequency is 200kHz max., so please use a linear differential input interface when higher frequency or specific linear output pulses are necessary.

For details of pulse wiring, please refer to "Control Signal Terminal Wiring".

Take the linear differential input as an example to introduce the operation of servo driver position control.

Example: PLC linear differential output pulses in orthogonal AB phases, the motor rotates one turn for every 10,000 pulses. The operation steps are shown in the table below.

Table 4-9 External Encoder Debugging Example with 5V Differential Output

No.	Item	Step
1	Power up	After the drive is powered up, the PWR green indicator turns on, indicating power supply is normal.

2	Select control mode	Pn000.X=0 (Velocity mode); Pn200.X=0 (Reference pulse from multi-functional terminals)
3	Select pulse pattern	Pn201=4 (Orthogonal AB); Pn202.X=0 (Positive logic).
4	Set electronic gear ratio	Pn204=8388608 (23-bit encoder), Pn206=10000. (One motor turn per 1000 pulses received).
5	Send pulses to servo drive	PLC sends pulses at a constant frequency in a certain number of ways at certain intervals.
6	Received pulse frequency and number checking	Monitor function code Un005 to determine whether the speed of the received pulses matches the actual ones sent; Monitor Un006 to check whether the input pulse counter Un006 matches the actual number sent.

4.3 Velocity Mode (Internal Setting)

4.3.1 Function Brief

The speed reference source supported by this product is mainly set by an internal register,

which allows the motor speed to be pre-configured through the servo drive's internal user parameters, and they can be selected by an external input signal, enabling speed control operation without the need for an external speed generator or pulse generator.

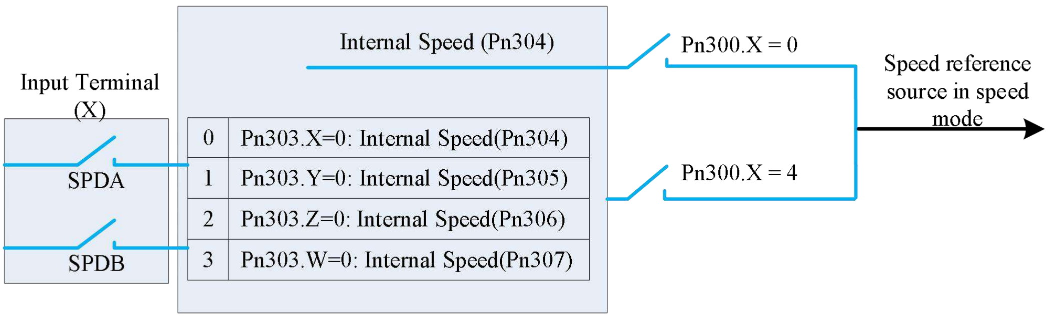


Figure 4-15 Velocity Reference Source Diagram

Related Funtion Codes

Funcode	Name	Range	Default	Unit
Pn300	Velocity Reference Source	0: Pn304 setting 1: AI 1 2: AI 2 3: Reserved 4: Hybrid setting 7: Internal signal	0	-
Pn301	Velocity Reference Direction	0: Positive 1: Negative	0	-
Pn302	Velocity Reference Filter Time	0.00~655.35	0.4	ms

Pn304	Velocity Reference Source 1	-10000~10000	100	rpm
Pn305	Speed Reference Source 2	-10000~10000	200	rpm
Pn306	Velocity Reference Source 3	-10000~10000	300	rpm
Pn307	Velocity Reference Source 4	-10000~10000	400	rpm
Pn314	Zero-speed Clamp Level	50~10000	1000	rpm
Pn317	Rotation Detection Level	1~10000	20	rpm
Pn318	Maximum Motor Velocity	0~10000	10000	rpm
Pn320	/V-CMP Signal Width	0~100	10	rpm

Related Input Terminals

<table>
<tr><th>Setting</th><th>Mark</th><th>Name</th><th>Description</th><th>Trigger</th><th>Mode</th></tr>
<tr><td>0x08</td><td>SPD-D</td><td>Velocity reference direction shift</td><td>Adjust the output direction of the torque reference through this terminal under speed control:
0: Positive logic
1: Negative logic</td><td>Level</td><td>S</td></tr>
<tr><td>0x09</td><td>SPD-A</td><td>Internal register speed reference buffer 1</td><td rowspan="2"><table><tr><th>SPD-B</th><th>SPD-A</th><th>Reference source</th></tr><tr><td>0</td><td>0</td><td>Pn304</td></tr><tr><td>0</td><td>1</td><td>Pn305</td></tr><tr><td>1</td><td>0</td><td>Pn306</td></tr><tr><td>1</td><td>1</td><td>Pn307</td></tr></table></td><td rowspan="2">Level</td><td rowspan="2">S</td></tr>
<tr><td>0x0A</td><td>SPD-B</td><td>Internal register speed reference buffer 2</td></tr>
</table>

4.3.2 Soft Start

The soft start function refers to the conversion of a step speed reference into a smoother constant acceleration and deceleration references, and the acceleration and deceleration time can be set separately. Please use this function when you want smother speed control.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn310	Soft Start ACC Time	0~10000	200	ms
Pn311	Soft Start DEC Time	0~10000	200	ms

Pn310 is the time required for the motor to reach the maximum speed from stop; Pn311 is the time required for the motor from stop to the maximum speed. The actual acceleration and deceleration times are calculated by the following formula.

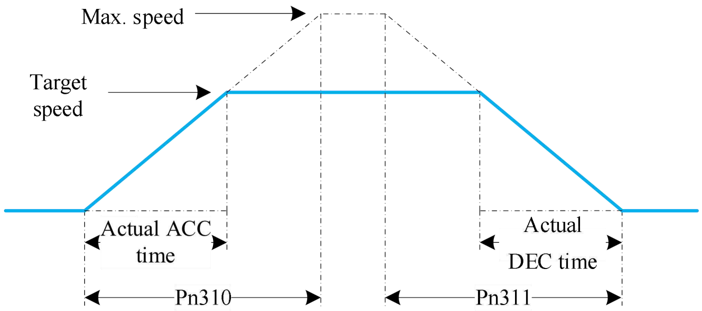


Figure 4-16 Soft start acceleration and deceleration time effect

4.3.3 Zero-speed Clamp

The zero clamp function refers to the function to lock the servo drive when the speed reference is lower than Pn313[Zero Clamp Level] when this signal(/ZCLAMP) is ON. Afterwards, a position loop is formed inside the servo drive, and the speed references will be ignored. This function is to lock the servo motor among ±1 pulse of the valid clamping position, and it will still back to the fixture position even though there is external force.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn313	Zero-speed Clamp Velocity Level	0~10000	10	rpm

Related input terminals

Setting	Mark	Name	Description	Trigger	Mode
0x0C	/ZCLAMP	Zero-speed clamp	Lock the servo motor at high level when the speed reference is lower than Pn313.	Level	S

Notes	
⚠	● When the servo motor is fixed at the zero position, there is a ±1 pulse margin, and even if rotation occurs due to an external force, it returns to the zero fixed position.

4.3.4 Rotation Signal

If the motor speed exceeds Pn317[Rotation Detection Level], the switching rotation detection signal (/TGON) is output.

Related Function Codes

Funcodes	Name	Range	Default	Unit
Pn317	Rotation Detection Level	0~10000	20	rpm

Related Output Terminals

Setting	Mark	Name	Description	Trigger	Mode
0x04	/TGON	Motor rotation signal	This signal is output when the motor running speed is lower than Pn317[Rotation Detection Level].	Level	P S T

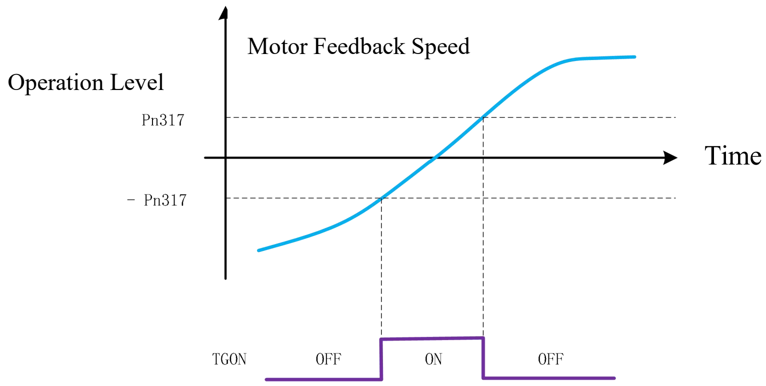


Figure 4-17 /TGON Output Diagram

4.3.5 Velocity Completion

This means that when the absolute value of the deviation between the actual feedback speed of the motor and the target reference speed is lower than the Pn320 setting, the /V-CMP signal will be output.

Example: Pn320 = 50rpm, the target speed is 2000rpm, and the /V-CMP signal is output when the motor speed is in the range of 1950rpm to 2050rpm.

Related Function Codes

Funcode	Name	Range	Default	Unit
Pn320	/V-CMP Signal Width	0~100	10	rpm

Related output terminals:

Setting	Mark	Name	Description	Trigger	Mode
0x03	/V-CMP	Velocity clamp	This signal is output when the absolute value of the deviation between the actual feedback speed of the motor and the target reference speed is lower than the Pn320 setting.	Level	P S T

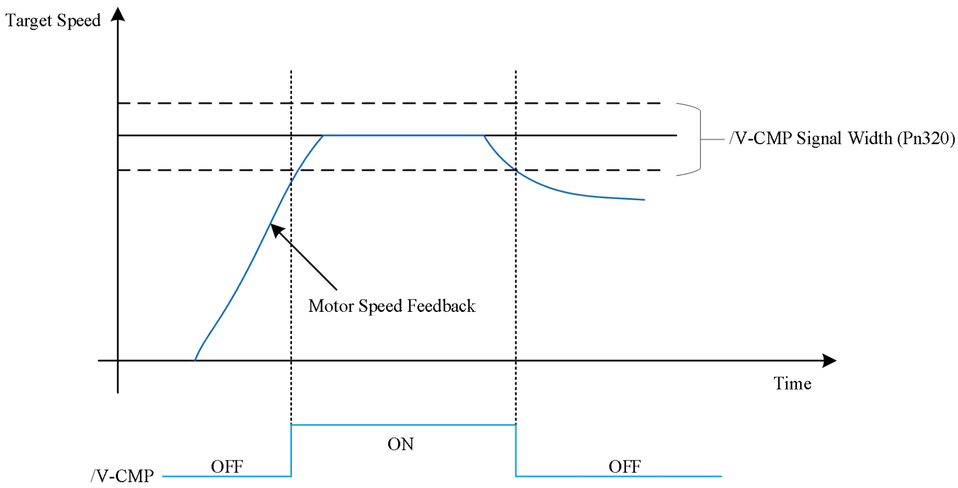


Figure 4-18 /V-CMP Output Diagram

4.3.6 Velocity Control Operation Example

Example 1: Set the speed through the internal function code registER.

Table 4-10 Example of Internal Target Velocity Setting

No.	Item	Step
1	Power up	After the drive is powered up, the PWR green indicator turns on, indicating power supply is normal.
2	Select control mode	Pn000.X=1 (Velocity mode); Pn300=0 (Velocity reference source is Pn304).
3	Enable servo control	Pn001=1, enable the servo drive
4	Adjust speed	Set Pn304 to adjust the motor speed. Pn304=100, the motor runs positive at 100rpm; Pn304=-100, the motor runs negative at 100rpm; Pn304=0, the motor is stopped and locked.

Example 2: Set the speed through the terminal

Table 4-11 Example of internal speed mixing operation

No.	Item	Step
1	Power up	After the drive is powered up, the PWR green indicator turns on, indicating power supply is normal.
2	Select control mode	Pn000.X=1 (Velocity mode); Pn300=4 (Velocity reference source to hybrid setting).
3	Assign terminal	Pn601.YX=0x08 (IN1 to SPD-D); Pn602.YX=0x09 (IN2 to SPD-A); Pn603.YX=0x0A (IN3 to SPD-B).
4	Set speed reference source	Pn303.X=0 (Velocity reference source to Pn304) Pn303.Y=0 (Velocity reference source to Pn305) Pn303.Z=0 (Velocity reference source to Pn306) Pn303.W=0 (Velocity reference source to Pn307)
5	Set multi-speed	Set the target speeds at Pn304, Pn305, Pn306 and Pn307.
6	Enable servo control	Pn001.X=1.
7	Switching setting	Adjust three speed switches for speed selection; SPD-D regulates the direction of operation; SPD-A and SPD-B together control the segment number of the internal speed.

4.4 Torque Mode (Internal Setting)

4.4.1 Function Brief

This enables torque control by four preset torque references which is selected by external signal input. Any one of the four torques can be used for toque control, and no external torque generator is required.

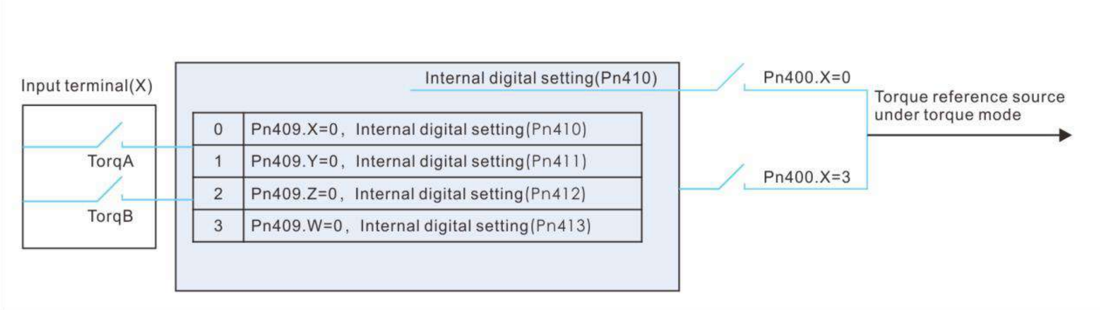


Figure 4-19 Torque Reference Source in Torque Mode

Related funcodes:

Funcode	Name	Range	Default	Unit
Pn400.X	Torque Mode Reference Source	0: Internal digit 1: Reserved 2: Reserved 3: Hybrid setting 4: External single trigger 5: Internal signal	0	-
Pn400.Y	Torque Mode-Velocity Limit Source	0: Reserved 1: Reserved 2: Pn415 setting 3: DI terminal 4: Torque reference direction	2	-
Pn403	Torque Reference Direction	0: Positive logic 1: Negative logic	0	-
Pn404	Torque Reference Filter Time	0.00~655.35	0.00	ms
Pn410	Torque Reference Source 1	-500.0~500.0	0.0	%
Pn411	Torque Reference Source 2	-500.0~500.0	0.0	%
Pn412	Torque Reference Source 3	-500.0~500.0	0.0	%
Pn413	Torque Reference Source 4	-500.0~500.0	0.0	%
Pn415	Torque Mode-Internal Velocity Limit	0~10000	1000	rpm

Related input terminals:

Setting	Mark	Name	Description	Trigger	Mode
0x0F	TPR-D	Torque reference direction shift	Adjust the output direction of the torque reference via this terminal in the torque mode: Invalid: positive logic Valid: negative logic	Level	T

<table>
<tr><td>0x12</td><td>TOR-A</td><td>Internal register torque reference buffer 1</td><td rowspan="2"><table><tr><th>TOR-B</th><th>TOR-A</th><th>Reference source</th></tr><tr><td>0</td><td>0</td><td>Pn410</td></tr><tr><td>0</td><td>1</td><td>Pn411</td></tr><tr><td>1</td><td>0</td><td>Pn412</td></tr><tr><td>1</td><td>1</td><td>Pn413</td></tr></table></td><td rowspan="2">Level</td><td rowspan="2">T</td></tr>
<tr><td>0x13</td><td>TOR-B</td><td>Internal register torque reference buffer 2</td></tr>
</table>

4.4.2 Torque Mode-Velocity Limit

It is a function to limit the speed of the servo motor for safety. Under torque control, the servo motor is controlled to output as the torque reference, but the motor speed is uncontrolled actually. Therefore, when the torque reference is greater than the mechanical torque, the motor speed will be greatly increased. In this case, the speed needs to be limited through this function.

Related funcodes:

Funcode	Name	Range	Default	Unit
Pn415	Torque Mode-Internal Velocity Limit	0~10000	0	rpm

4.4.3 Torque Control Operation Example

Example 1:

Table 4-12 Example of Internal Velocity Operation

No.	Item	Step
1	Select control mode	Pn000.X=2 (Torque mode); Pn400.X=0 (Torque reference source to Pn410); Pn400.X=2 (Torque mode speed limit Pn415);
2	Set torque	Pn410=0, enanble the servo drive and the motor stays still
3	Set speed limit	Pn415=1000 (Torque mode speed limit to 1000rpm);
4	Enable servo control	Pn001.X=1.
5	Adjust torque	Pn410=20, the motor speed reaches 1000 rpm with no load.

Example 2:

Table 4-13 Example of Hybrid Internal Torque Operation

No.	Item	Step
1	Select control mode	Pn000.X=2 (Torque mode); Pn400.X=3 (Torque source to hybrid); Pn400.Y=2 (Torque mode speed limit Pn415);
2	Assign terminal	Pn601.YX=0x0F (IN1 to TOR-D); Pn602.YX=0x12 (IN2 to TOR-A); Pn603.YX=0x13 (IN3 to TOR-B).

3	Set torque reference source	Pn409.X=0 (Torque reference source to Pn410) Pn409.Y=0 (Torque reference source to Pn411) Pn409.Z=0 (Torque reference source to Pn412) Pn409.W=0 (Torque reference source to Pn413)
4	Set torque reference	Set the relevant torque values for the internal torque Pn410, Pn411, Pn412, and Pn413.
5	Set speed limit	Set the speed limit value on Pn415 in torque mode.
6	Enable servo control	Pn001.X=1.
7	Shift torque switching signal	Shift the relevant switching signal for torque control. TOR-D signal regulates the direction of operation; TOR-A and TOR-B together control the internal torque reference source (Pn409.X~Pn409.W).

4.5 Hybrid Control Mode

4.5.1 Basic Setting of Hybrid Control Mode

Users can control the servo unit by switching between a combination of two of the various control methods.

Related funcodes

Funcode	Name	Range	Default	Unit
Pn000.X	Control Mode	0: Position mode 1: Velocity mode 2: Torque mode 3: Velocity-Position mode 4: Torque-Position mode 5: Velocity-Torque mode 6: Velocity-Position-Torque mode	0	-

Related input signals

Setting	Mark	Name	Description	Trigger	Mode
0x0B	C-SEL	Control mode shift	This signal is used to shift the control mode.	Level	PST
0x1A	C-SEL2	Control mode switch	This signal is used to shift the control mode.	Level	PST
0x1B	C-Ctrig	Control mode confirmation	This signal is used to confirm the control mode selection.	Edge	PST

Under hybrid control, switch the speed mode, torque mode, and position mode among the combinations via "C-SEL".

P000.X Setting	Control Mode Shift Signal (/C-SEL)	
	High level	Low level
3	Position mode	Velocity mode
4	Position mode	Torque mode
5	Torque mode	Velocity mode

Pn000.X Setting	Control Mode Shift Signal		C-Ctrig	Control Mode
	C-SEL	C-SEL2		
6	0	0	-	Velocity mode
	0	1		Position mode
	1	0		Torque mode

4.5.2 Velocity/Position Mode

After setting the control mode selection signal (/C-SEL), users can select the corresponding control mode through the host controller.

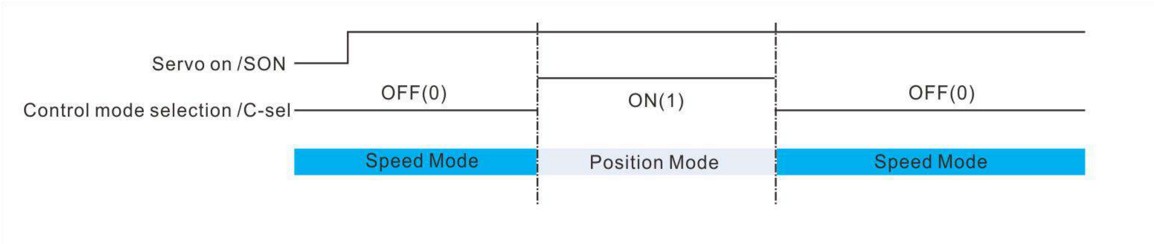


Figure 4-20 Timing diagram of speed-position control

4.5.3 Torque-Position Mode

After setting the control mode selection signal (/C-SEL), users select the corresponding control mode through the host controller.

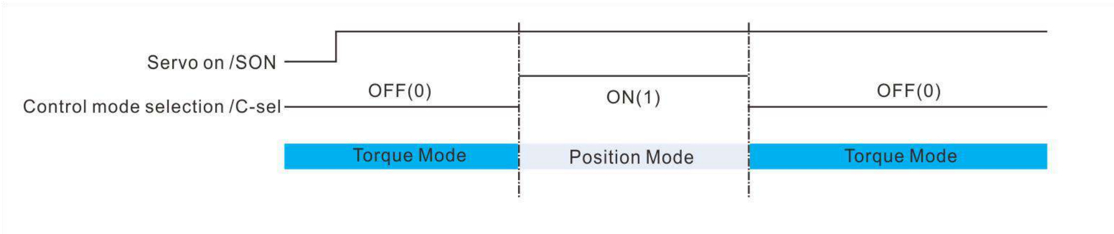


Figure 4-21 Velocity-Position Control Sequence

4.5.4 Velocity-Torque Control Mode

After setting the control mode selection signal (/C-SEL), users select the corresponding control mode through the host controller.

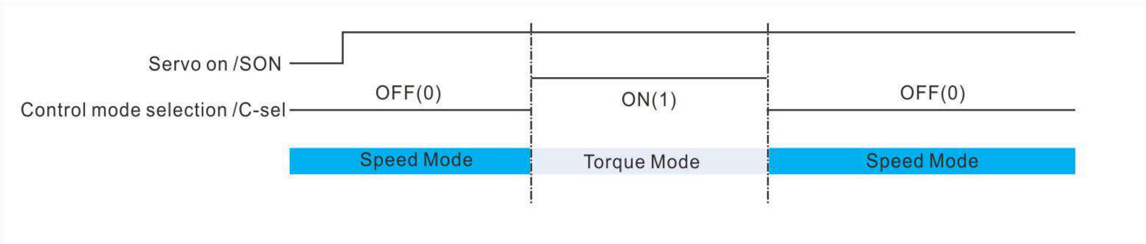


Figure 4-22 Velocity-Position Control Sequence

4.5.5 Velocity-Position-Torque Control Mode

After setting the control mode selection signal (/C-SEL, /C-SEL2, and /C-Ctrig), users can use them to select the corresponding control mode through the host controller.

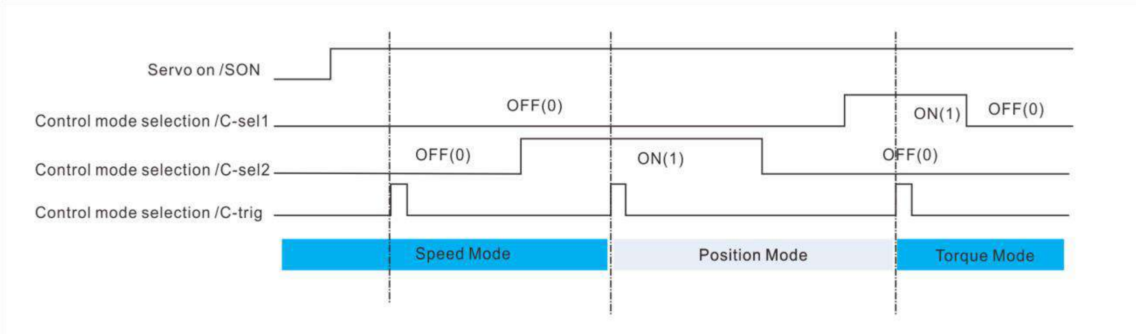


Figure 4-23 Velocity-Position-Torque Control Sequence

Notes	
⚠	● In speed-position-torque mode (Pn000.X=6), after the drive is powered on, the drive is in speed mode before the /C-Trig rising edge signal is triggered.

4.6 Absolute Encoder

When using a multi-turn absolute encoder, users can have an absolute position detection system through the host controller, and through this system, repeated home operation can be saved after power is turned on.

Related function codes:

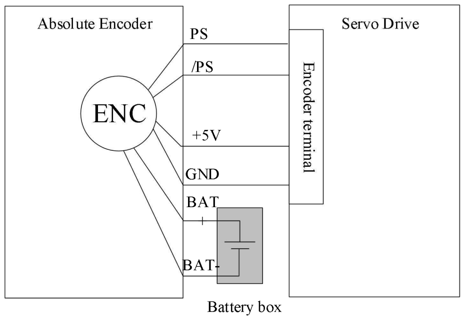
Funcode	Name	Range	Default	Unit
Pn040.X	Standard pulse-type absolute encoder mode	0: As an absolute encoder 1: As an incremental encoder	1	-
Pn040.Y	EtherCAT absolute encoder mode	0: As an absolute encoder 1: As an incremental encoder 2: As a single-turn absolute encoder	0	-
Pn041	Multi-turn Absolute Encoder Undervoltage Error/Alarm	0: Error 1: Alarm	0	-

4.6.1 Connection of Absolute Encoder

In order to save the position data of the absolute encoder, a battery unit needs to be installed.

When it is an encoder cable with a battery box, install the battery inside the box.

Table 4-14 Example of absolute encoder wiring

Absolute Encoder Cable	Wiring Diagram
Encoder cable with battery box	

4.6.2 Absolute Encoder Data Reading

Read encoder data via communication.

Related funcodes

Code	Name	Range	Unit	Address
Un010	Absolute Encoder Single-turn Value	0~224	Encoder unit	0xE010
Un011	Absolute Encoder Multi-turn Value	-32768~32767	rev	0xE011
Un600	Absolute Encoder Pulse (32-bit)	int32	Reference unit	0xE600
Un603	Absolute Encoder Pulse (64-bit)	Int64	Encoder unit	0xE603

4.6.3 Battery Replacement

If the battery voltage is about 2.7V or lower, ER.83(Encoder undervoltage error) or A.930 (Absolute encoder battery undervoltage alarm) appears. When ER.830 or AL.930 pops up, check if the battery is loose first; If not, the battery is undervoltage, please replace it with a new one.

Table 4-15 Absolute Encoder Battery Replacement

No.	Item	Step
1	Power up	Turn on the control power of the servo drive only.
2	Replace the battery.	Battery on the encoder cable: open the battery box on the absolute encoder cable→remove the old battery→put the new battery inside→close the battery box again. Battery on the upper unit: remove the old battery→put the new battery inside.
3	Clear fault or warning	ERR red indicator flashes: wait for about 5s after replacing the battery, the alarm will be eliminated automatically;. ERR red indicator ON: replace the batteries and repower-up the drive to eliminate the error.
4	Check the fault again	After the drive is repowered up, the ERR green indicator is always on to indicate that the battery replacement is successful.

	Notes
⚠	● When replacing the battery, please ensure that drive is powered on and the encoder is normally connected, otherwise it will cause encoder data loss. ● The operation of clearing the encoder multi-turn value can be operated by the "Control panel" on the host controller software VCSD.exe. If it is a non-multi-turn absolute encoder, the clear operation will fail.

4.7 Rotation Upper Limit

4.7.1 Overview

When controlling the position of the rotary table, it can only rotate in one direction, so the number of rotation cycles will surely exceed the upper limit value of an absolute encoder after a certain period.

For example, suppose that the rotary table below can only move in one direction.

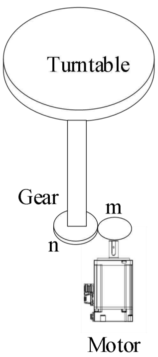
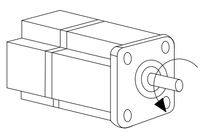
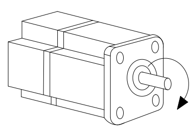


Figure 4-24 ypical Mechanical Device

The absolute encoder multi-turn value will overflow in some time, to address this, users need to adjust the absolute multi-turn upper limit value in position control.

Term explanation

Positive	Negative
 Motor rotates counterclockwise in face of the axis end (CCW)	 Motor rotates clockwise in face of the axis end (CW)

4.7.2 Related Principles

Generally, the display range of the multi-turn absolute encoder is[-32768, +32767], as shown in the following figure: The maximum turn for positive operation is +32767, but if it continues to run, and the encoder data will overflow. And if the drive is repowered up, this value is no longer suitable for the absolute system.

For example: system transmission ratio n: m=1:5, that is, the motor rotates 5 turns, the rotary table rotates 1 turn. When the multi-turn value of the absolute coordinate zero position is 0, and the value of the single turn is 0, after the rotary table rotates about 6554 turns, the encoder multi-turn data will overflow. Theoretically when the motor rotates 32770 turns, and rotary table rotates about 6554 turns, and there are 3 more turns, then the feedback of the multi-turn encoder turns into -32766. At this time, the zero position of the rotary table is offset based on the host controller system calculation.

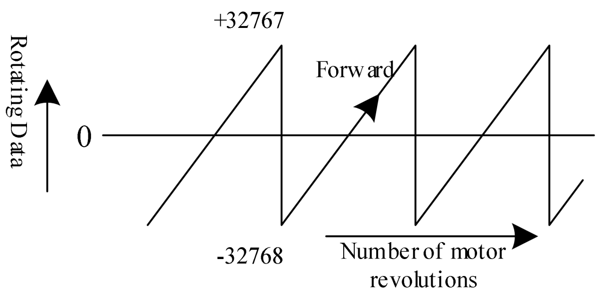


Figure 4-25 Forward encoder revolution overflow

When the upper limit of revolutions is used, the ratio of integers of the motor revolutions and rotary table revolutions will be free of mantissa.

Still taking the above as an example, for a transmission ratio n: m= 1:5 in the system (that is, the motor rotates 5 turns, the table rotates 1 turn), when the upper limit of rotation is set to 5, the table coordinates are no longer affected by the encoder multi-turn overflow.

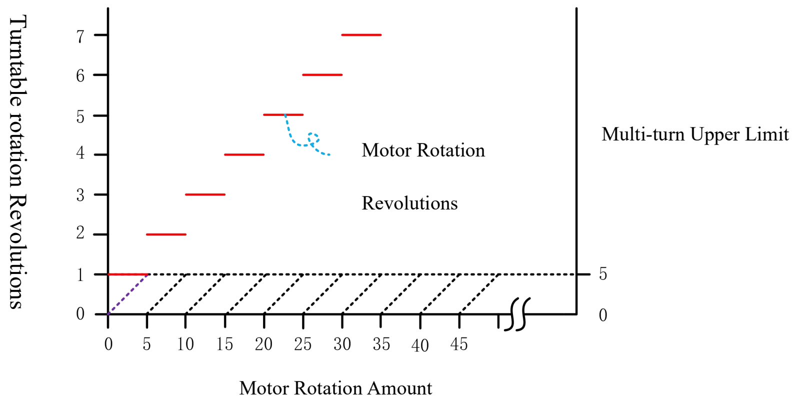
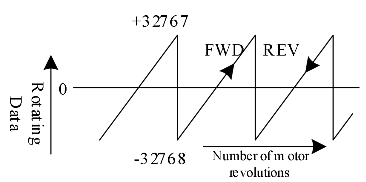
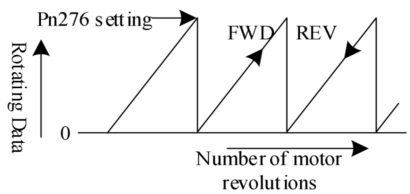


Figure 4-26 Rotary Table and Motor Relationship under Multi-turn Limit

The encoder multiturn values (Un011) are shown below respectively when rotation count is off and on:

Pn276=0	Pn276≠0
	

4.7.3 Relevant Funcodes

Funcode	Name	Range	Default	Unit
Pn276	Turn Upper Limit	0~30000	0	Turn
Pn277.X	Encoder Unidirection Mode Enable	0: OFF 1: ON	0	-
Pn277.Y	Position Direction Feedback	0: Cyclic 1: Acyclic	0	-

4.7.4 Steps

- Method A: The host controller needs to read periodic position information, such as: rotary table 0°~360°:

  Step 1: Set the Pn276[Turn Upper Limit], that is, the value of the motor revolution cycle, according to the actual conditions of machines.

  Step 2: Enable the multi-turn upper limit overflow function (Pn277.X=1);

  Step 3: Enable the cycle mode to record cyclic position change (Pn277.Y=0);

  Step 4: Use the upper computer to clear the multi-turn value of the absolute encoder;

- Method B: Only the current absolute position is needed in the user system:

  Step 1: Enable the multi-turn upper limit overflow function (Pn277.X=1);

  Step 2: Enable the non-cycle mode for position accumulation (Pn277.Y=1);

  Step 3: Use the host controller to clear the multi-turn value of the absolute encoder;

Notes	
	● This function is only valid when an absolute encoder is used.

5 Operation Tuning

5.1 Pre-tuning Precautions

5.1.1 Tuning Types

Users can adjust gains of the servo unit to improve its responsiveness,

while outstanding responsiveness requires a balanced combination of multiple parameters (speed loop gain, position loop gain, filter, fiction compensation, moment of inertia ratio,etc), which are interactive between each othER.

The factory settings of the servo gain focus on stability, so please adjust them based on the actual mechanical performance to further improve responsiveness.

The tuning types include no-tuning function, inertia identification, gain adjustment, filter adjustment, fiction compensation, A-type vibration suppression, low-frequency vibration suppression, Easy FFT, etc.

5.1.2 Precautions during Adjustment

When adjust the servo unit protection functions shown below should be set to a more appropriate value.

(1) Overtravel setting

For details about overtravel settings, please refer to 4.1.7 Overtravel Setting .

(2) Torque limit setting

Set to limit the output torque when the calculated torque required for the operation is higher than the actual mechanical torque, so as to reduce impact in the event of mechanical failure such as interference or collision. If the torque limit is set below the value required, overtravel or vibration may occur. See function codes Pn050~Pn055 for details.

(3) Position deviation error level setting

Set the position deviation error is to offer effective protection during position control. When the motor does not confirm to the reference, it can be detected to stop the motor by setting this parametER.

Position deviation refers to the difference between the position reference value and the actual position, see function codes Pn264 and Pn266 for details.

It can be calculated by the following formula between Pn101[Position Loop Gain] and the motor speed:

$$\text{Position deviation (reference unit)} = \frac{\text{Motor speed (rpm)}}{60} \times \frac{\text{Encoder resolution}}{\text{Pn101}} \times \frac{\text{Pn206}}{\text{Pn204}}$$

However, when the acceleration and deceleration speed of the position reference exceeds the tracking capability of the motor, and the formula will fail due to enlarged deviation. So please set a proper acceleration or deceleration of the position reference, or increase the alarm value for excessive position deviation.

(4) Servo ON position deviation error level

If the servo drive is set to ON when position deviation keeps accumulating, to make the position deviation reset to 0, the motor will return to the original position, and it may cause dangER. So please set the error value of position deviation when the servo drive is ON to impose a limit.

(5) Vibration detection

In the debugging software there is an "auto-tuning” function to set an appropriate value for the vibration detection function.

5.2 No-tuning Function

5.2.1 No-tuning Introduction

This function means obtain automatic adjustment regardless of the type of machinery and load fluctuations to obtain a stable response.

Related function codes

Funcode	Name	Range	Default	Unit
Pn175.X	No-tuning Enable	0: OFF 1: ON	1	-
Pn175.Y	No-tuning Mode	0: Used for speed control 1: Used for speed control and upper device used for position control	0	-
Pn175.Z	No-tuning Rigidity	0~9	0	-
Pn175.W	No-tuning Load Inertia	0: Low 1: Medium 2. High	0	-

The bandwidth values according to the no-tuning rigidity are shown below:

No-tuning Rigidity (Pn175.Z)	Content
0	Response: slow
1	↕
2	
3	
4	
5	
6	
7	
8	
9	Response: fast

5.2.2 Invalid Parameters under No-tuning

These parameters are invalid when no-tuning is on (Pn175.X=1):

Item	Name	Funcode
Gain	Moment of Inertia	Pn100
	2nd ASR Gain	Pn105

	2nd ASR Integral Time	Pn106
	2nd Position Loop Gain	Pn107
	2nd Torque Reference Filter Time	Pn108
Intelligent Functions	Friction Compensation	Pn150.W
	A-type Vibration Suppression	Pn140.X
Shift enable	Gain Shift	Pn110.X

5.2.3 No-tuning Steps

<table>
<tr><th>No.</th><th>Content</th></tr>
<tr><td>1</td><td>Enable no-tuning
Pn175.X=1.</td></tr>
<tr><td>2</td><td>Set Pn175.Z[No-tuning Rigidity]
Increase the value to improve responsiveness. Reduce the value to suppress vibration.
<table>
<tr><th>No-tuning Rigidity (Pn175.Z)</th><th>Content</th></tr>
<tr><td>0</td><td>Response: slow</td></tr>
<tr><td>1</td><td rowspan="8">↕</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td><td>Response: fast</td></tr>
</table>
</td></tr>
</table>

Notes
● This function is valid for position control and speed control, but not for torque control. ● When using the motor with a load inertia exceeding the allowable load, the motor may vibrate. In this case, reduce Pn175.W setting. ● During operation, perform this function when emergency stop is possible at any time to ensure safety.

5.3 Intelligent Setting

5.3.1 Intelligent Setting Overview

Intelligent setting refers to the function that the servo drive automatically adjusts according to the mechanical characteristics when performs automatic operation (forward + reverse reciprocating motion) within the set range of motion.

See 6 Debugging Software Guide for intelligent setting in the VCS debugging software.

(1) Advanced auto-tuning without reference

When this function is enabled, the following items will be adjusted:

1. Moment of inertia ratio
2. Gain(speed loop gain, position loop gain, etc.)
3. Filter (torque reference filter, notch filter)
4. Friction compensation
5. A-type vibration suppression
6. Vibration suppression

(2) Advanced auto-tuning with reference

When this function is enabled, the following items will be adjusted.

1. Gain(speed loop gain, position loop gain, etc.)
2. Filter (torque reference filter, notch filter)
3. Friction compensation
4. A-type anti-vibration
5. Vibration suppression

Notes	
	● Advanced auto-tuning with reference is based on Pn101[ASR Gain]. Vibration at the start of auto-tuning may lead to incorrect results. At this time, please decrease Pn101[ASR Gain].

5.3.2 Intelligent Setting Steps

(1) Precautions

Please be sure to confirm the following settings before intelligent setting, since improper setting may cause function failure.

1. No overtravel
2. Not torque mode
3. Manual gain shift (Pn110.X=0) and 1st gain is valid
4. No alarm or error
5. No-tuning is invalid (Pn175.X=0)

Notes	
	● When performing reference-free intelligent setting under speed control, it will automatically switch to position control, and return to the speed control after the auto-tuning is finished. ● Intelligent setting with reference is invalid under torque control. ● In the process of executing intelligent setting, the reference pulse multiplier shift function is invalid.

(2) Examples of auto-tuning failures

In the following cases, the intelligent settings will not be executed normally:

1. When the motor is energized (servo ON) and it is under position control (intelligent setting with reference)
2. When the mechanical system can only operate in one direction
3. When the motor operation range is below 0.5 turn
4. When the moment of inertia changes within the set operating range
5. When the dynamic fiction of the machine is too high
6. When the rigidity of the machine is low and the vibration occurs during the positioning
7. When the speed feed-forward is set
8. When Pn262[/COIN Signal Width] setting is low

Notes	
	● If reference-free intelligent setting for inertia load adjustment fails, please change the tuning mode to bandwidth setting or the no-tuning function. ● During intelligent adjustment, please set Pn204/Pn206[Electronic Gear Ratio] and Pn262[/COIN Signal Width] to the test results, otherwise the tuning may fail or the result are inconsistent with the test operation.

5.4 BandwidthSetting

This function means manual tunning under speed or position references input from the upper devices. Adjust one or two values through the bandwidth setting to adjust the associated servo gain parameters automatically.

This mode will change the following items:

1. Gain (speed loop gain, position loop gain, etc.)
2. Filter (torque reference filter, notch filter);
3. Friction compensation
4. A-type vibration suppression;
5. Model following control(Model following gain)

If the response characteristics is not satisfactory after intelligent setting, please use the bandwidth setting. And if you want to adjust each servo gain further afterwards, please refer to "Manual Tuning".

Improper setting may cause function failure, and“NO-OP”is displayed. Please confirm the following settings before bandwidth setting.

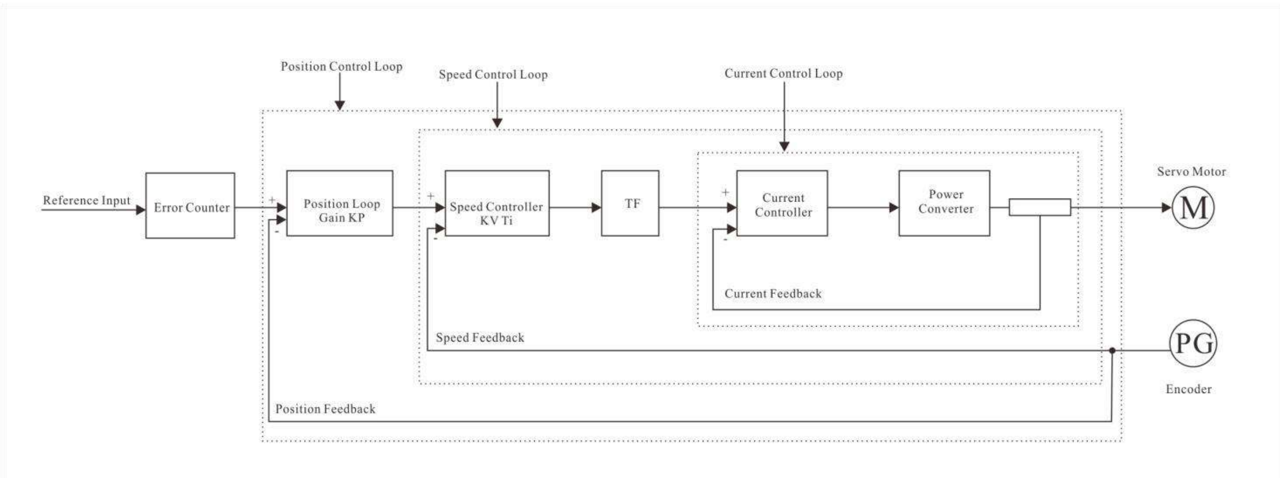
1. No-tuning is invalid (Pn175.X=0)
2. Tuning mode is set to 0 or 1 under speed control

Bandwidth setting can be performed by debugging software, see "Debugging Software" for details.

Notes	
!	● Please set Pn100[Moment of Inertia Ratio]correctly beforehand.

5.5 Function Tuning

When you want to manually adjust the servo gain, please adjust one by one on the basis of the composition and characteristics of the servo drive. In most cases, if a large change occurs in one parameter, the other gain parameters must be adjusted togethER. Users can capture the waveforms of the relevant monitoring quantities with the relevant debugging tools to check the response characteristics.



The servo drive is composed of position loop, speed loop and current loop. The more inner the loop is, the more the response characteristics need to be improved. If this principle is not followed, it may lead to poor responsiveness or vibration.

The current loop ensures adequate responsiveness itself, so users do not have to make adjustments on it.

By manually adjusting the servo gain, users can not only improve the response characteristics but also shorten the positioning time under position control for example.

Please use manual tuning in the following situations:

1. When auto-tuning is not possible;

2. When servo gains are not enough after auto-uning;

3. When users want different servo gains and moment of inertia ratio.

Notes	
!	● Please tune the servo drives from the factory setting of each parametER. ● Vibration may occur when adjusting the servo drive gain, so please set Pn185.X=1 to set vibration error function on.

5.5.1 Gain Adjustment

Here is the adjustment steps:

No.	Content
1	Adjust the Pn104[Torque Reference Filter Time] until there is no vibration.

2	Increase Pn101[ASR Gain] as much as possible on the basis of no vibration, while decrease Pn102[ASR Integral Time]
3	Repeat step 1 and 2 to reduce the value by 10%~20%.
4	For position control, increase Pn103[Position Loop Gain 1] on the basis of no vibration.

Notes	
	● When adjusting the servo drive gain, if you change one parameter, the other parameters need to be readjusted as well, so, please do not make large changes to one parameter alone. Adjust each gain parameter by 5% each time to check effect before further adjustments. ● Please follow the procedure below for servo parameter changes: To raise higher response is needed: ① Decrease Pn104[Torque Reference Filter Time]; ② Increase Pn101[ASR Gain]; ③ Decrease Pn102[ASR Integral Time]; ④ Increase Pn103[Position Loop Gain 1]. To prevent vibration and overtravel when slower the response: ① Decrease Pn104[Torque Reference Filter Time]; ② Decrease Pn101[ASR Gain]; ③ Increase Pn102[ASR Integral Time]; ④ Decrease Pn103[Position Loop Gain 1].

(1) Velocity loop gain adjustment

The response of the servo system is determined by the position loop gain. The higher the latter, the fast the former, and the positioning time will be shorter accordingly. Generally, the position loop gain should not be increased beyond the inherent vibration range of the mechanical system. Please increase the system rigidity and increase the intrinsic vibration parameter if you neewant higher position loop gain.

Funcode	Name	Range	Default	Unit
Pn103	Position Loop Gain 1	1.0~2000.0	40.0	1/s

Notes	
⚠	● Do not set Pn103[Position Loop Gain 1] too high during motor operation, otherwise an overcurrent alarm may occur when the machine is operating at high speeds. In this case, it will be difficult to detect faults with excessive position deviation, so refer to the following conditions as a standard: $$\text{Position Deviation Error Threshold Pn264}=\frac{F_c}{K_p}\times(1.2\sim2.0)$$ In the formula: F_c: Max. position reference pulse (pulse/s); K_p: position loop gain (1/s); 1.2~2.0: Safety coefficient (protection against frequent excessive position deviation). ● When using the position reference filter, the transitional deviation will increase due to the filter time setting. Please take the filter signal accumulation into consideration during setting.

(2) Velocity loop gain and speed loop integral time adjustment

Velocity loop gain determines the responsiveness of the velocity loop. Lower responsiveness of the velocity loop will delay the position loop, and overshooting or vibration of the velocity command occurs. So, the higher the setting, the more stable the servo system is and the better the responsiveness on the basis of no vibration.

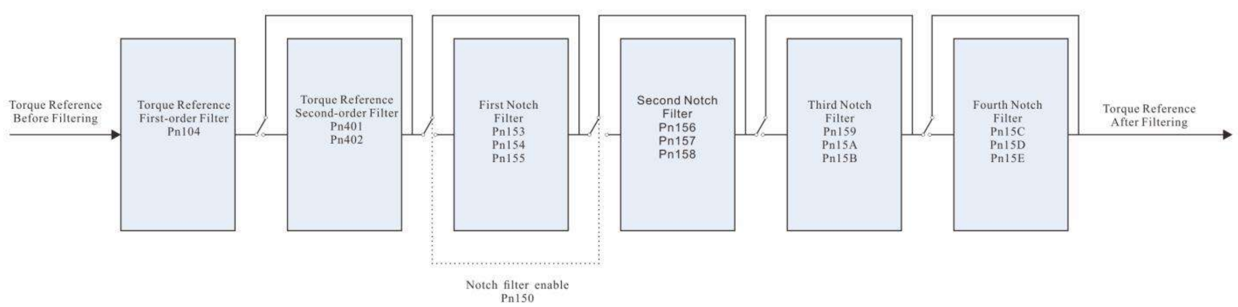
Funcode	Name	Range	Default	Unit
Pn101	ASR Gain	1.0~2000.0	40.0	Hz

The integral time in the speed loop allows response to even minor inputs, but it will delay the servo system, so when the integral time setting is too high, overshoot will occur, or positioning time will be longer, and responsiveness will be slowER.

Funcode	Name	Range	Default	Unit
Pn102	ASR Integral Time	0.15~512.00	20.0	ms

(3) Torque reference filter

The torque reference filters are serially configured with primary delay filters, secondary delay filters, and notch filters for different functions.



Notes
● The torque reference 2nd-order filter is not valid when Pn401[Torque Reference Filter Cutoff Frequency]=5000Hz and valid when Pn401<5000Hz. ● The 3rd notch filter is not valid when Pn159[Notch Filter 3 Frequency]=5000Hz and valid when Pn159<5000Hz. ● The 4th notch filter is not valid when Pn15C[[Notch Filter 4 Frequency]=5000Hz and valid when Pn159<5000Hz.

(4) Low-pass filter adjustment

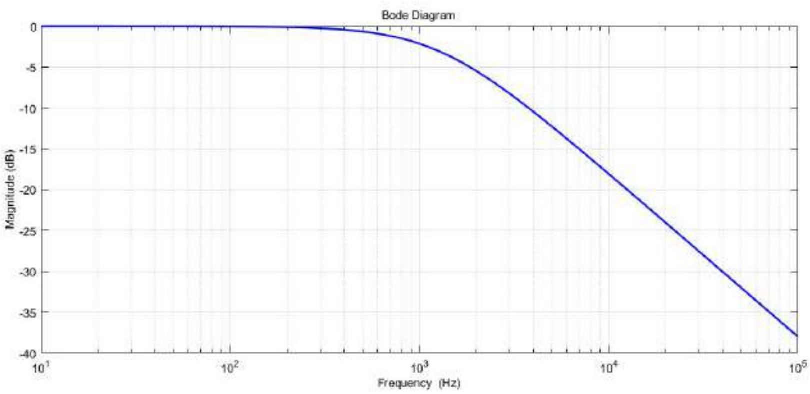
When mechanical vibration is caused by the servo drive, users can reduce or even eliminate the vibration by adjusting the torque reference filter time.

The smaller the value, the better the responsive control, but it is subject to mechanical conditions.

Funcode	Name	Range	Default	Unit
Pn104	Torque Reference Filter Time	0.00~655.35	1.00	ms
Pn401	Torque Reference 2nd Filter Cutoff Frequency	100~5000	5000	Hz
Pn402	Torque Reference 2nd Filter Q Factor	0.50~1.00	1.00	ms

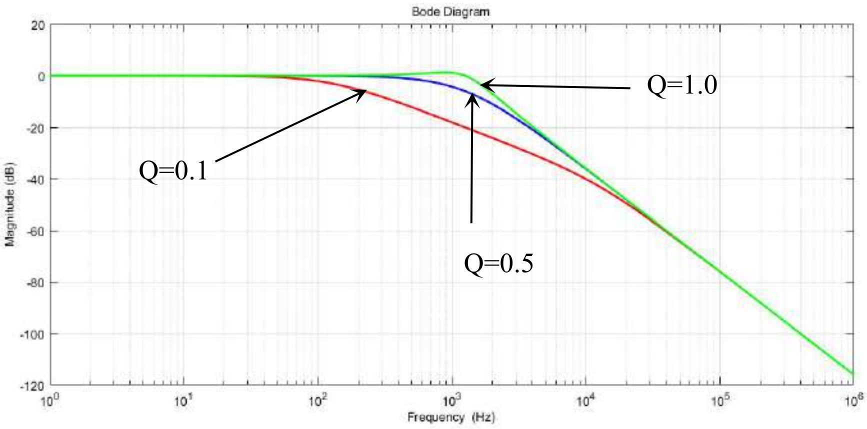
Notes
● The torque reference 2nd-order filter is not valid when Pn401[Torque Reference Filter Cutoff Frequency]=5000Hz and valid when Pn401<5000Hz; ● The 3rd notch filter is not valid when Pn159 [Notch Filter 3 Frequency]=5000Hz and valid when Pn159<5000Hz; ● The 4th notch filter is not valid when Pn15C[[Notch Filter 4 Frequency]=5000Hz and valid when Pn159<5000Hz;

Example 1: When Pn104[Torque Reference Filter Time]=5ms, the cutoff frequency of the 2nd filter is 1256Hz, and the corresponding amplitude-frequency characteristics of the filter are shown in the following figure: amplitude attenuation -3DB at 1256Hz.



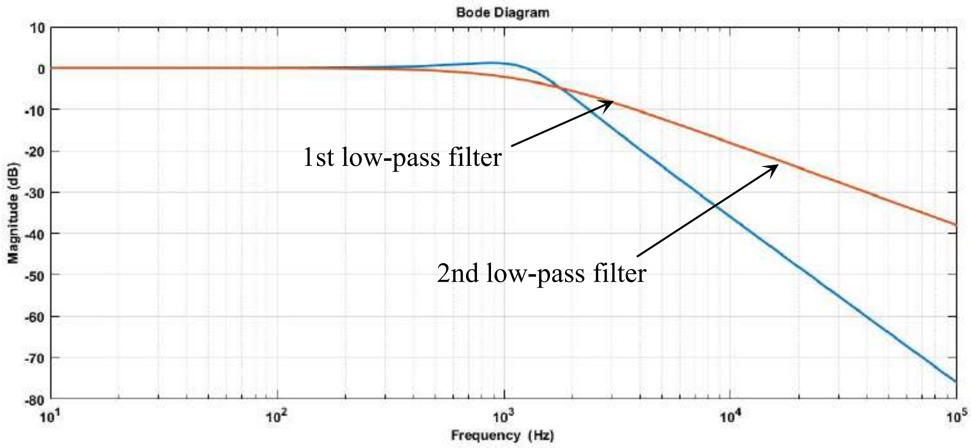
Notes	
⚠	● The above low-pass filter frequency characteristics are simulated from the theoretical model calculations, so there are some differences from the actual characteristics.

Example 2: Pn401[Torque Reference 2nd Filter Cutoff Frequency]=1256 Hz, the attenuation of the amplitude diminishes with the gradual increase of the Q factor.



Notes	
⚠	● The above filter frequency characteristics are simulated from the theoretical model calculations, so there are some differences from the actual characteristics.

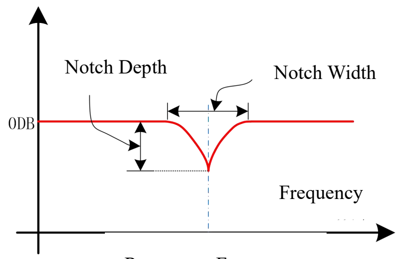
Example 3: When torque reference 1st low-pass filter cutoff frequency=1256Hz, Pn401[Torque Reference 2nd Filter Cutoff Frequency]=1256 Hz, Pn402[Torque Reference 2nd Filter Q Factor]=1.0, the filter frequency characteristics are shown below:

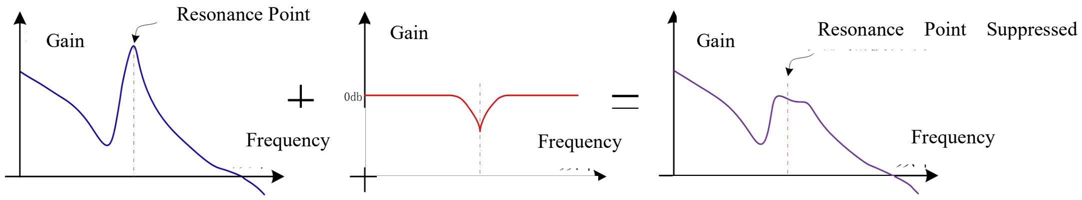


Notes	
⚠	● The above filter frequency characteristics are simulated from the theoretical model calculations, so there are some differences from the actual characteristics.

(5) Notch filter adjustment

A notch filter is used to remove a specific vibration frequency caused by resonance of the Ball Screw shaft or the like. The gain curve is shown in the figure below, and a specific frequency (hereinafter referred to as the notch frequency) has a trap shape. This feature makes it possible to eliminate or reduce frequency components near the notch frequency. Users can set the notch filter by the notch filter frequency, notch filter Q factor and notch filter depth(D).





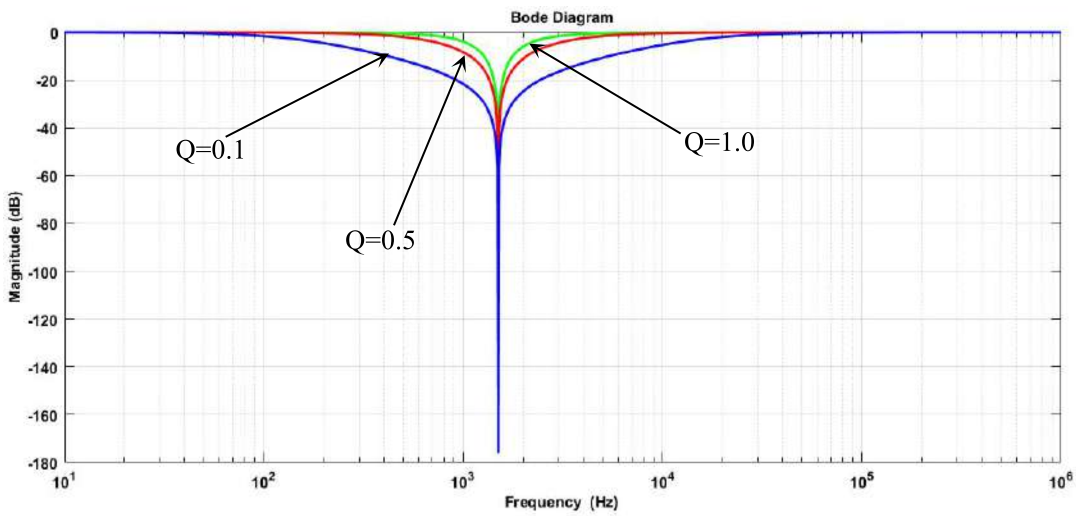
Here is an explanation on them below.

Notch Filter Q Factor

It determines the width of the notch filter at a certain notch filter frequency, and at the same time the width of the notch.

The smaller the Q factor, the wider the notch, and the wider the filter frequency width is.

Example: When the center frequency of the notch filter is 1500Hz and notch filter depth=0, the attenuation effect at different width settings are shown below:



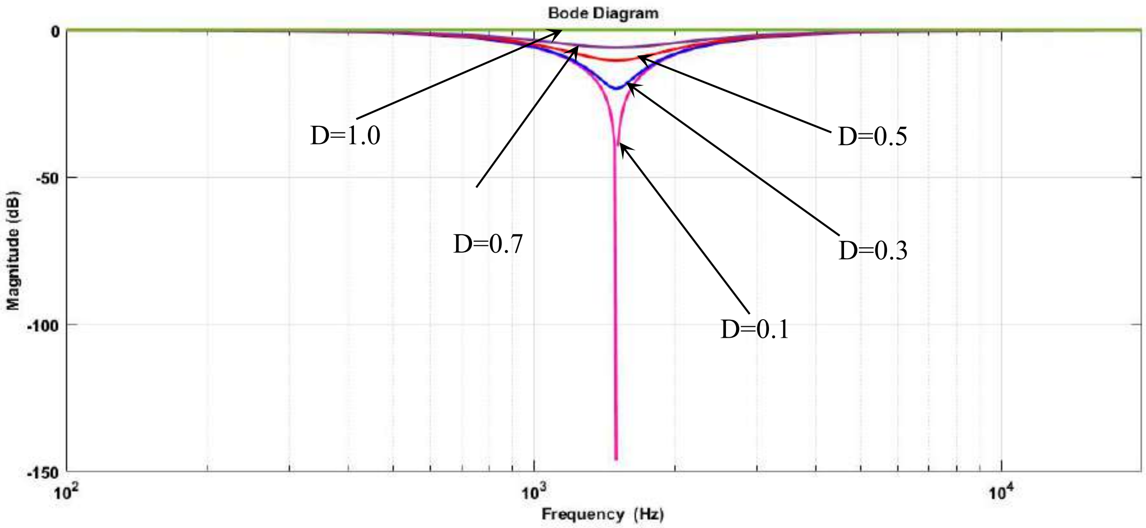
Notes	
⚠	• The notch filter above frequency characteristics are simulated from the theoretical model calculations, so there are some differences from the actual characteristics.

Notch Filter Depth (D)

It determines the depth (amplitude) of the notch filter at a certain determined notch center frequency, and at the same time the depth of the notch.

The smaller the notch filter depth setting is, the deeper the notch, and the better the vibration suppression control is, but if it is too small, it will increase the vibration.

Example: Notch filter center frequency 1500Hz, notch filter Q factor=0.7. The attenuation effect at different width settings are shown below:



Notes	
⚠	● The notch filter above frequency characteristics are simulated from the theoretical model calculations, so there are some differences from the actual characteristics.

Related funcodes:

Funcode	Name	Range	Default	Unit
Pn153	Notch Filter 1 Frequency	50~5000	5000	Hz
Pn154	Notch Filter 1 Q Factor	0.50~10.00	7.00	-
Pn155	Notch Filter 1 Depth (D)	0.000~1.000	0.000	-
Pn156	Notch Filter 2 Frequency	50~5000	5000	Hz
Pn157	Notch Filter 2 Q Factor	0.50~10.00	7.00	-
Pn158	Notch Filter 2 Depth (D)	0.000~1.000	0.000	-
Pn159	Notch Filter 3 Frequency	50~5000	5000	Hz
Pn15A	Notch Filter 3 Q Factor	0.50~10.00	7.00	-
Pn15B	Notch Filter 3 Depth (D)	0.000~1.000	0.000	-
Pn15C	Notch Filter 4 Frequency	50~5000	5000	Hz
Pn15D	Notch Filter 4 Q Factor	0.50~10.00	7.00	-
Pn15E	Notch Filter 4 Depth (D)	0.000~1.000	0.000	-

5.5.2 Gain Shift

Users can manually swich gains by external signal input, or set it to auto gain shift.

By this function, users can increase the gain to shorten the time during positioning, while reduce gain and suppress vibration during stopping more easily.

Funcode	Name	Range	Default	Unit
Pn110.X	Gain Shift Mode	0: Manual 1: Auto	0	-
Pn110.Y	Auto Gain Shift Condition	0: /COIN ON 1: /COIN OFF 2: /NEAR ON 3: /NEAR OFF 4: Position reference filtered to 0 and pulse input OFF 5: Position reference pulse input ON	0	-
Pn112	Gain Shift Transition Time 1	0~65535	0	ms
Pn113	Gain Shift Transition Time 2	0~65535	0	ms
Pn114	Gain Shift Delay 1	0~65535	0	ms
Pn115	Gain Shift Delay Time 2	0~65535	0	ms

Gain combinations for shifting

Name	1st Gain	2nd Gain
ASR Gain	Pn101	Pn105
ASR Integral Time	Pn102	Pn106
Position Loop Gain	Pn103	Pn107
Torque Reference Filter Time	Pn104	Pn108
Model Following Gain 1	Pn241	Pn246
Model Following Gain Attenuation Factor	Pn242	Pn247

Notes	
	● Shift of model following control gain and model following attenuation coefficient gain can only be manually shifted. ● Shift of model following control gain and model following attenuation coefficient gain is valid only when there is no reference from the drive and the motor is stopped.

Gain can be shifted

- manually and
- automatically.

In the manual mode, users need to configure the external signal, while in the auto mode, users need to set the conditions to determine whether to switch or not.

(1) Manual shift

Related input signals:

Setting	Mark	Name	Description	Trigger	ApplicableMode
0x0E	/G-SEL	Gain shift	This signal is used to select the two gains of the speed mode and the position mode. OFF: Switch to 1st gain. ON: Switch to 2nd gain.	Level	P S T

(2) Auto shift

"Auto shift" is valid only for position control when the conditions are met.

Funcode	Condition	Gain	Delay Time	Transition Time
Pn110.Y	Condition met	1st gain→2nd gain	Delay Time 1 (Pn114)	Transition Time 1 (Pn112)
	Condition not met	2nd gain→1st gain	Delay 2 (Pn115)	Transition Time 2 (Pn113)

Example: Pn103[Position Loop Gain 1] switched to the Pn107[Position Loop Gain 2] in the auto mode conditioned on /COIN ON After the /COIN signal is ON for Pn114[Transition Time 1] setting, Pn103[Position Loop Gain 1] is switched to the Pn107[Position Loop Gain 2] in the Pn112[Transition Time 1] setting.

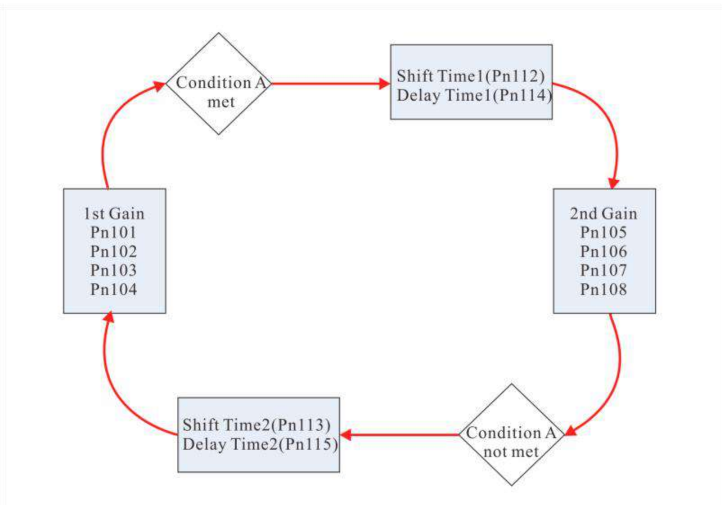
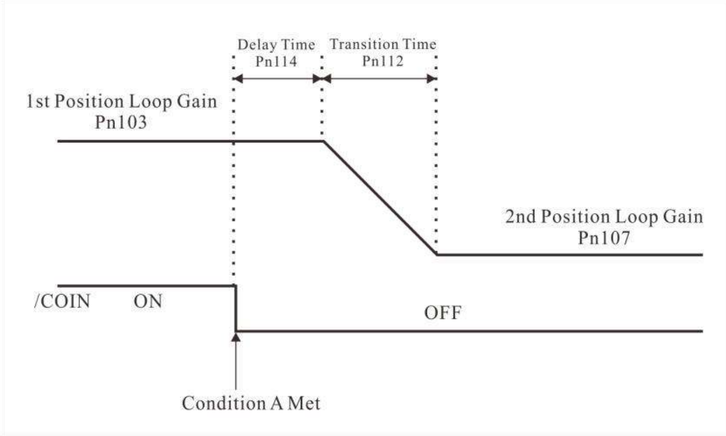
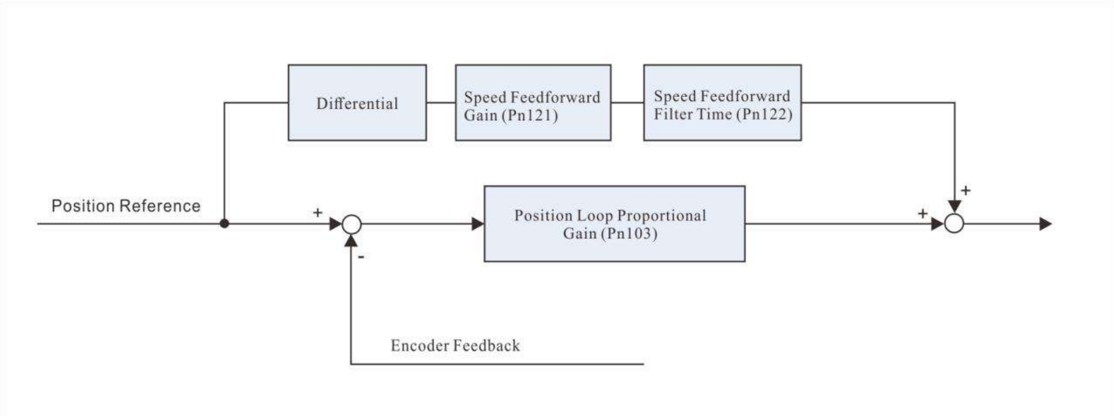


Figure 5-1 Shift Logic



5.5.3 Velocity Feedforward

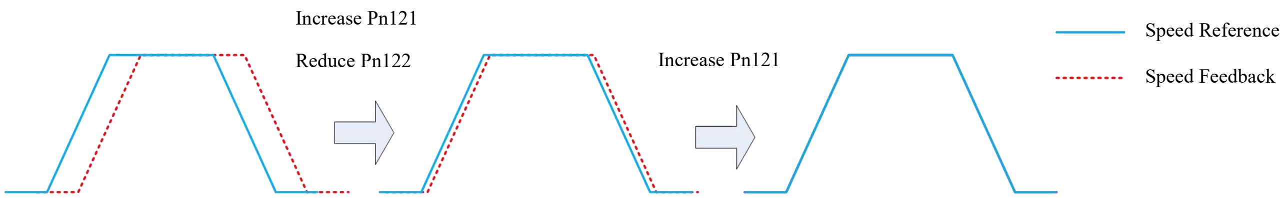
Velocity feedforward is a function that reduces position time by feedforward compensation during position control.



Related function codes:

Funcode	Name	Range	Default	Unit
Pn121	Velocity Feedforward Gain	0~100	0	%
Pn122	Velocity Feedforward Filter Time	0.00~64.00	0.00	ms

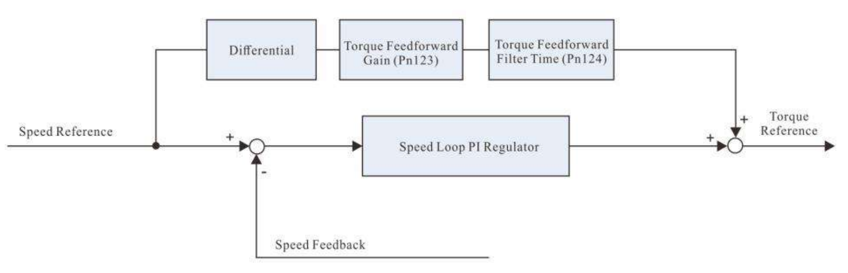
When Pn121[Velocity Feedforward Gain] is on, increase this setting to improve speed following error under smoothing speed references, and reduce this setting to reduce the mechanism vibration under non-smoothing speed references. The higher the setting, the more better the feedforward compensation, and the smaller the dynamic following error.



Notes	
	● If Pn121[Velocity Feedforward Gain] is set too high, it may cause vibration, so please set it below 80%. ● If Pn121[Velocity Feedforward Gain] is set to 0%, the speed feedforward function is invalid.

5.5.4 Torque Feedforward

Internal torque feedforward is used to improve the torque reference response and reduce the position deviation at fixed acceleration and deceleration under position control, and improve the torque reference response and reduce the speed deviation at fixed speeds under speed mode.



Related function codes:

Funcode	Name	Range	Default	Unit
Pn123	Torque Feedforward Gain	0~100	0	%
Pn124	Torque Feedforward Filter Time	0.00~64.00	0.00	ms

Notes	
	● When Pn123[Torque Feedforward Gain] is set to 0%, the torque feedforward function is invalid.

5.5.5 PI/P Shift

PI/P control can be switched under speed or position mode, while hybrid PI/P control is only valid under speed mode and position mode. It can be switched by the PI/P control signal (/P-CON) manually. When this signal is on, P control is valid. Or users can switch them by setting Pn130[PI/P Auto Shift] to enable conditioned auto shift.

(1) Manual PI/P shift

Here are configuration of manual PI-P control.

Related input signals:

Setting	Mark	Name	Description	Trigger Method	Applicable Mode
0x05	P-CON	PI/P shift shift	This signal is used to switch the PI (Proportional/Integral) and P (Proportional) regulators of the drive's speed loop. OFF: PI control (proportional/integral). ON: P control (proportional).	Level	P S T

(2) Auto shift

For auto PI/P shift, set the conditions is set via Pn10C~Pn10F. By setting the switching conditions and condition values appropriately, overshooting during acceleration and deceleration can be suppressed for shorter positioning time.

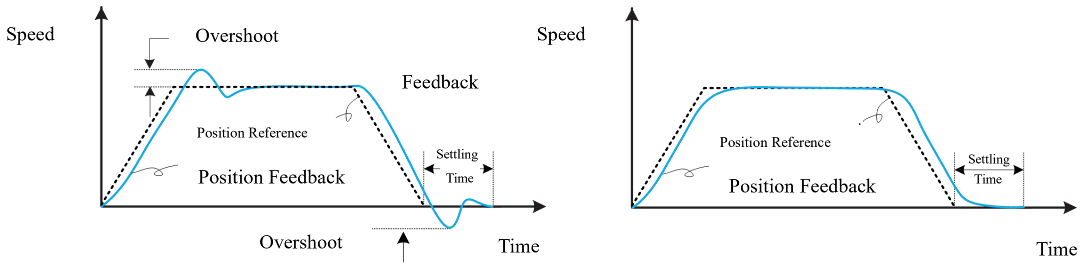
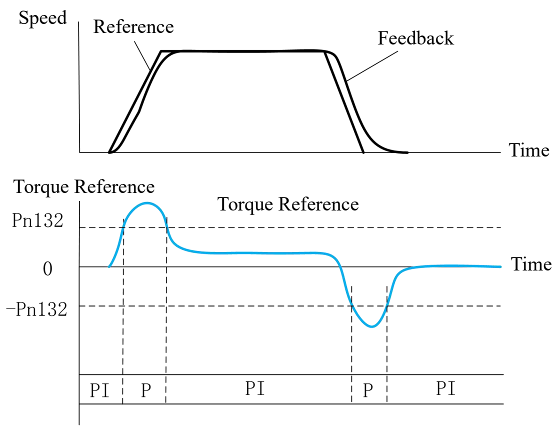


Figure 5-2 Unswitched PI Control and Auto PI-P Shift Control

Funcode	Name	Range	Default	Unit
Pn130.X	ASR PI/P Shift Condition	0: Torque reference 1: Velocity reference 2: Acceleration 3: Position deviation 4: OFF	0	-
Pn132	ASR PI/P Shift Condition (Torque Reference)	0~800	200	%
Pn133	ASR PI/P Shift Condition (Velocity Reference)	0~10000	0	rpm
Pn134	ASR PI/P Shift Condition (Acceleration)	0~30000	0	rpm/s
Pn135	ASR PI/P Shift Condition (Position Deviation)	0~10000	0	Reference unit

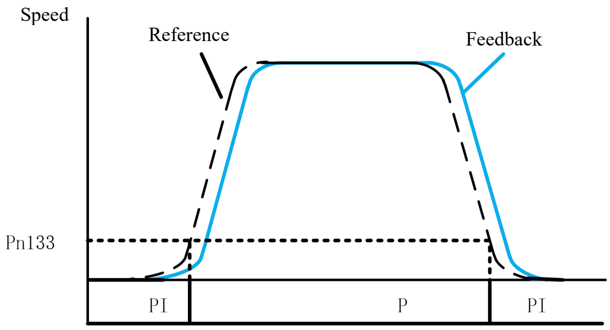
ASR PI/P Shift Condition (Torque Reference)

When PI/P control is switched according to torque reference (factory default), if the torque reference exceeds Pn132 setting, and then P control is valid, as shown in Figure 6-8. The torque reference value is set to 200% at the factory.



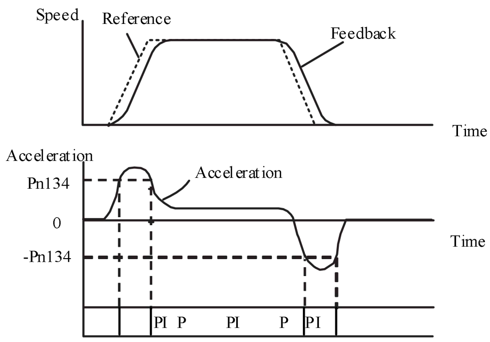
ASR PI/P Shift Condition (Velocity Reference)

When PI/P control is switched according to speed reference, if the speed reference exceeds Pn133 setting, P control is valid.



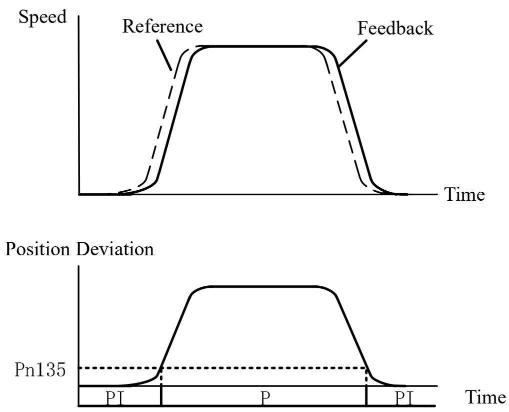
ASR PI/P Shift Condition (Acceleration)

When PI/P control is switched according to acceleration reference, if the speed reference exceeds Pn134 setting, and then P control is valid.



ASR PI/P Shift Condition (Position Deviation)

When PI/P control is switched according to position deviation, if the position deviation exceeds Pn135 setting and then P control is valid. But this mode is avaible only under position control.



5.5.6 Friction Compensation

The friction compensation is to compensate for viscous friction variations and fixed load variations.

Auto-tuning auxiliary functions for friction compensation are:

1. Intelligent tuning without reference;
2. Intelligent tuning with reference;
3. Bandwidth setting.

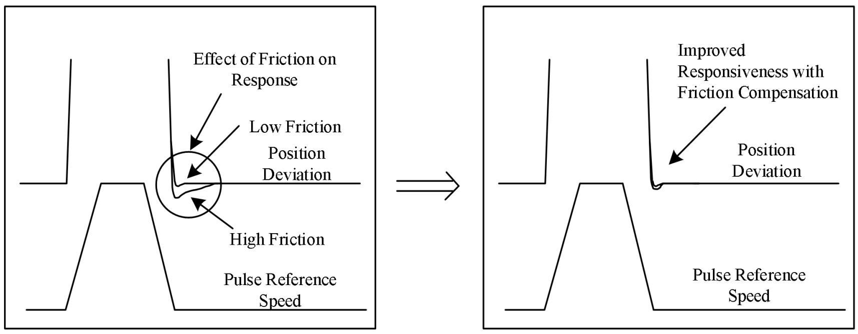
The following describes the manual adjustment of the friction compensation parameters.

(1) Related funcodes

Funcode	Name	Range	Default	Unit
Pn150.W	Friction Compensation Enable	0: OFF 1: ON	1	-
Pn161	Friction Compensation Gain 1	10~1000	100	%
Pn162	Friction Compensation Gain 2	10~1000	100	%
Pn163	Friction Compensation Factor	0~100	0	%
Pn164	Friction Compensation Frequency Correction	1.0~1000.0	0.0	Hz
Pn165	Friction Compensation Gain Correction	0~1000	100	%

Notes	
!	• When using the friction compensation function, set Pn100[Moment of Inertia Ratio] as accurate as possible, or it may cause vibration.

(2) Friction compensation procedure

No.	Item	Step
1	Parameter setting	Pn161[Friction Compensation Gain 1]=100; Pn162[Friction Compensation Gain 2]=100; Pn163[Friction Compensation Factor]=0 (no compensation); Pn164[Friction Compensation Frequency Correction]=0; Pn165[Friction Compensation Gain Correction]=100; Note: Please keep Pn164 and Pn165 at factory setting.
2	Friction compensation factor adjustment	Pn163：Friction Compensation Coefficient During operation, please monitor the position deviation by oscilloscope function in the software. At the same time, progressively adjust Pn163 [Friction Compensation Factor] and check whether the actual position deviation is improved.
3	Friction compensation gain adjustment	Pn161：Friction Compensation Gain If step 2 does not meet your requirements, please adjust Pn161[Friction Compensation Gain 1] again, and repeat step 2 and 3.
4	Effect comparison	The following diagram shows the effect before and after adjustment:  Before Friction Compensation After Friction Compensation

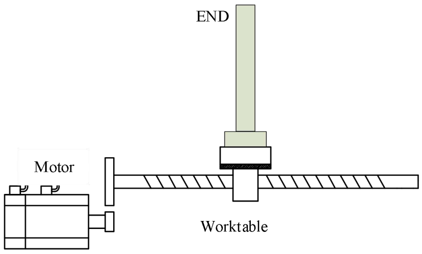
Notes	
⚠	● The higher Pn161 [Friction Compensation Gain 1] is, the better the responsiveness to external disturbances, but it is prone to vibration; ● The higher Pn163 [Friction Compensation Factor] is, the better the effect, but it is prone to vibration. Values below 90% are recommended.

5.5.7 Low-frequency Vibration Suppression

This function is used to reduce vibration at the mechanical transmission end after the positioning reference is finished and the motor is close to static due to insufficient system rigidity,

ranging 1.0 Hz~100.0 Hz.

Please check the details below:

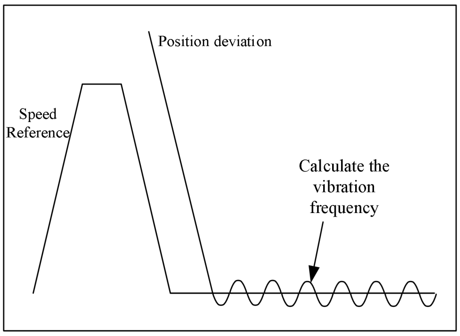


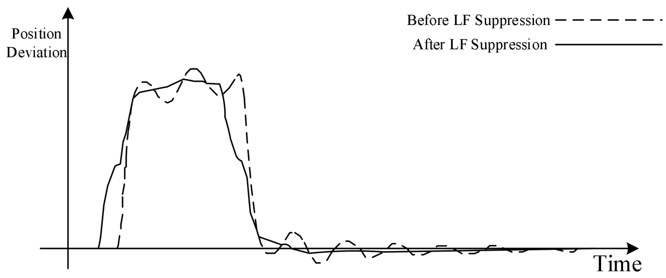
Related function codes

Funcode	Name	Range	Default	Unit
Pn232	LF Vibration Detection Sensitivity (/COIN Signal Width)	0.1~300.0	40.0	%
Pn233	LF Vibration Suppression 1 Level A	1.0~250.0	50.0	Hz
Pn234	LF Vibration Suppression 1 Level B	1.0~250.0	70.0	Hz
Pn235	LF Vibration Suppression 2 Level	1.0~200.0	80.0	Hz
Pn236	LF Vibration Suppression 2 Correction	10~1000	100	%

Notes	
	● Vibration detection level = Pn232[LF Vibration Detection Sensitivity]× Pn262[/COIN Signal Width]. The smaller this level, the easier it is to detect vibration.

Low-frequency vibration suppression function procedure

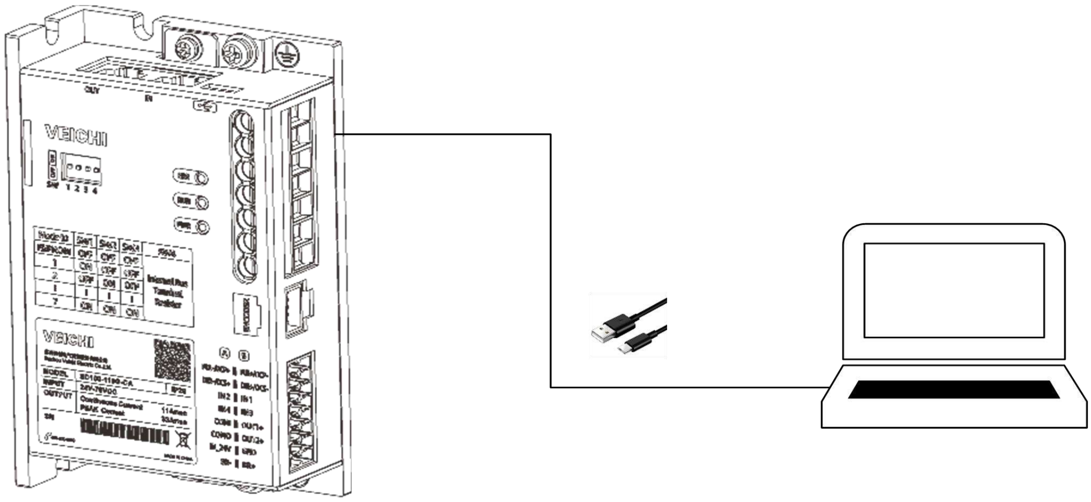
No.	Item	Step
1	Vibration frequency detection	Use the digital oscilloscope in the debugging software to monitor the real-time position deviation value, and acquire the corresponding frequency for the position deviation obtained. 
2	Parameter setting	Set the frequency in the step 1 to Pn235 [LF Vibration Suppression 2 Level].

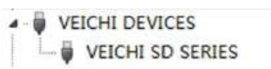
3	Effect Comparison	Check if the vibration is satisfactory, if not, adjust Pn235 again slightly. 

6 Debugging Software Guide

6.1 VCDSoft Introduction

VCDSoft is the monitoring and debugging software for SD100 servo drive used on PC. Users can connect the servo drive to PC via a USB-to-Type-C cable and install the specified software and USB driver to use the functions and performance debugging.

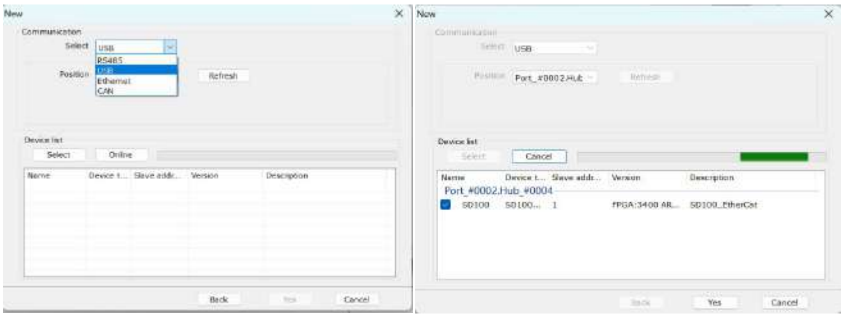


VCDSoft	Requirement
Software version	SDSoft V1.11.26 For SD100/SD700/SD710 products
Environment	Windows 7/Windows10/Windows11
Software driver	 Found via \SDSoft V1.11.26\driver
Communication cable	USB-to-Type-C cable
Web	https://www.veichi.cn/service/datadownload/

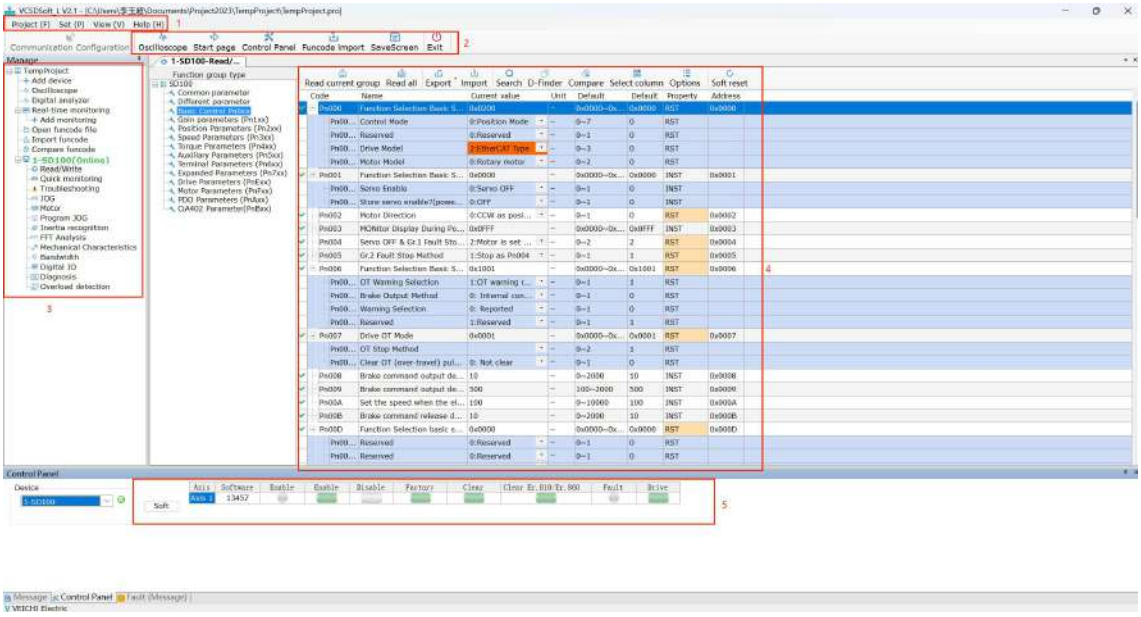
6.2 Basic Guide

6.2.1 Connection

Open the debugging software, and connect the debugging software through USB or RS485, here we choose USB.



Wait until it’s done, and then it’s the home page.



1. Menu Bar: Includes functions such as Project, Settings, View, Help, Communication Disconnect, Communication Connect, JOG, Program JOG, Soft Reset, Restore Factory Settings, Parameter Settings, Parameter Monitoring, Exit, etc.
2. Toolbar: Includes Oscilloscope, Start Page, Control Panel, Function Import, Screenshot, Exit System.
3. Project Window: The project includes functions such as Current Device, Function Code Import, Function Code Comparison, Real-time Monitoring, Oscilloscope, etc.
4. Output Window: Double-click the current function to display a detailed window.
5. Function Code Annotation.
6. Navigation Bar: Includes Messages, Control Panel, Fault Notifications.

6.2.2 Parameter Setting and Monitoring

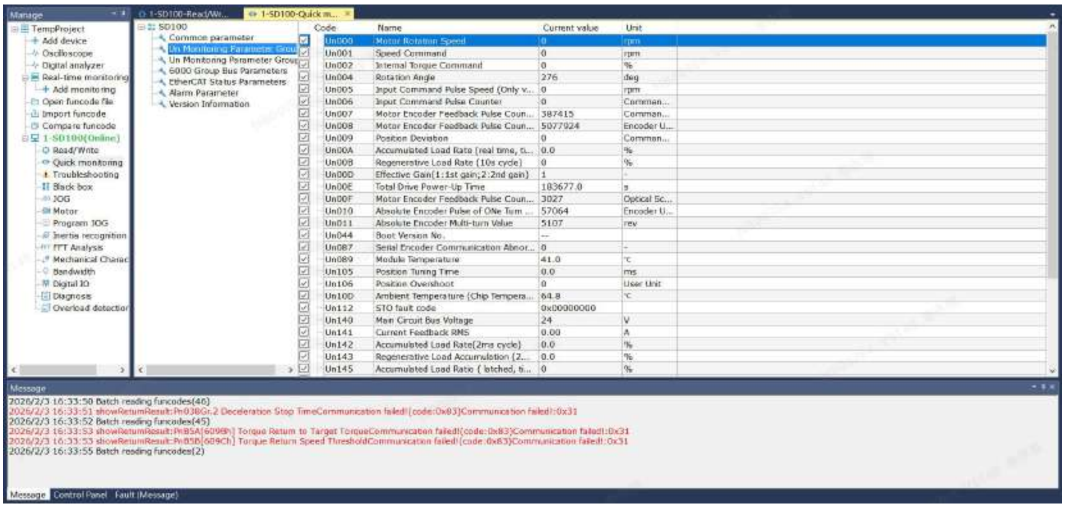
The parameter setting interface allows reading and writing of all Pn parameters and supports the following functions:

1. Individual Pn parameter writing: Simply select the target function code, enter the appropriate parameter value, and press Enter to complete the write operation.
2. Batch parameter reading: Click Read current group to batch read parameters from the current group or all groups.
3. Batch parameter import/export: Modified parameters can be exported as an .sd file for the current parameter group. Previously saved parameter records can be batch imported via .sd files.

4. Frequently used parameter records: Add commonly used parameters to a dedicated toolbar for quick access during modifications.

5. Parameter comparison: Compare current parameters with default values or previous .sd files to identify modified parameters and facilitate differential analysis.

In the real-time monitoring interface, all Un parameters can be read in real time. Frequently used parameters can be selected from the monitoring parameters and added to the common parameters toolbar for cyclic real-time data reading.



6.2.3 Trial Operation

(1) Jogging

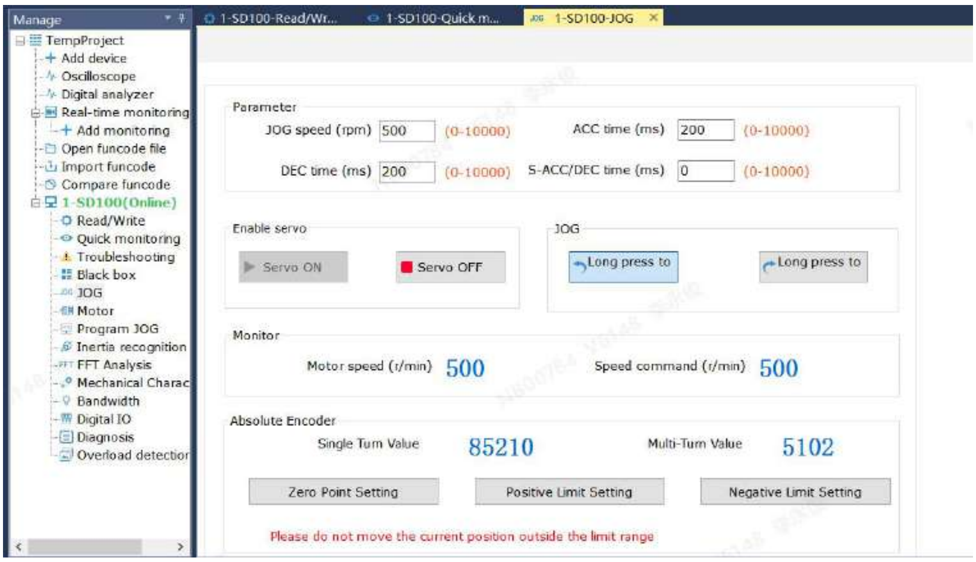
JOG operation is a function that confirms servo motor movement through speed control. The debugging software execution steps are as follows:

Step 1: Select from the toolbar to enter the JOG operation interface.

Step 2: Set the JOG speed→Enable [Servo ON]→Press and hold [Forward] to observe whether the motor rotates forward normally.

Step 3: Press and hold [Reverse] to observe whether the motor reverses normally.

Step 4: If operation is normal, click [Back] to exit the current interface.

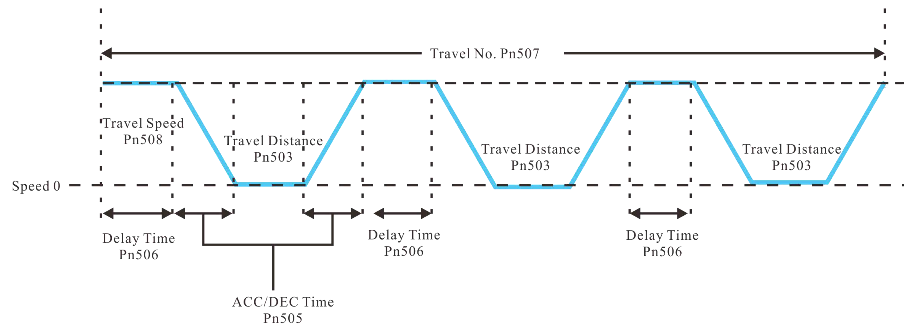


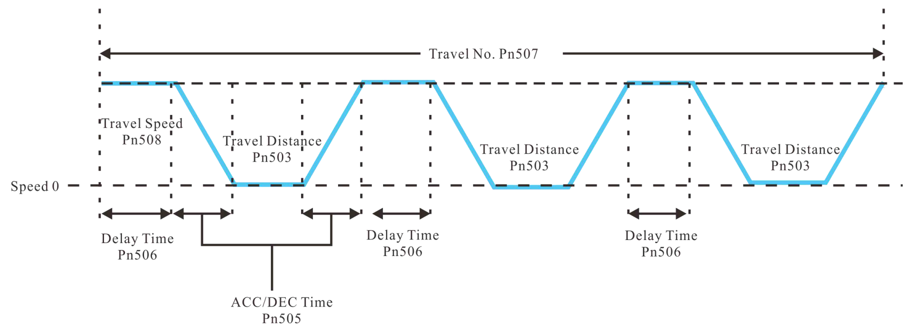
Precautions	
	● Set an appropriate JOG speed value; ● Ensure that the JOG operation remains within the mechanical travel limits; ● The main circuit power must be connected; ● There should be no errors; ● The servo must be in the OFF state.

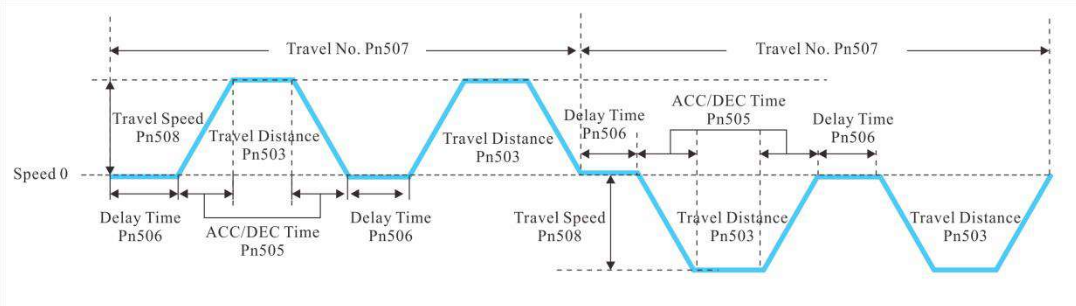
(2) Programmed jogging

This function enables point-to-point motor jogging in position control mode, allowing simple positioning actions to be executed without a PLC. Programmed JOG operation performs continuous movement based on pre-configured parameters including Pn502, Pn503, Pn505 , Pn506 , Pn507 and Pn508.

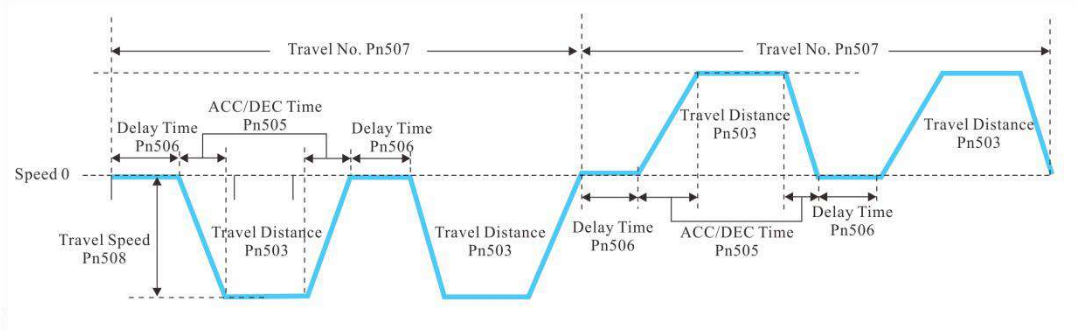
An example of programmed JOG operation mode is shown below:

Pn502=0	(Pn506→Forward Pn503)×Pn507
Speed Diagram	 Note: Setting Pn507 to “0” enables unlimited runs.

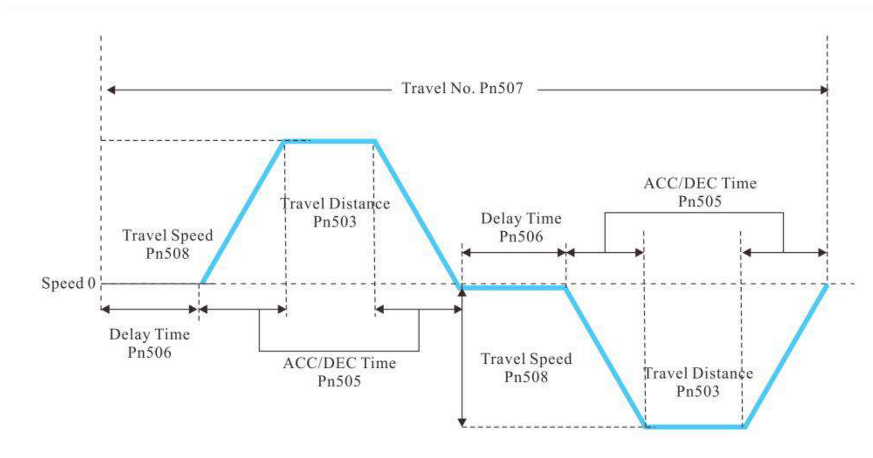
Pn502=1	(Pn506→Forward Pn503)×Pn507
Speed Diagram	 Note: Setting Pn507 to “0” enables unlimited runs.

<table>
<tr><th>Pn502=2</th><th>(Pn506→Forward Pn503→Pn506→Forward Pn503)×Pn507
(Pn506→Reverse Pn503→Pn506→Reverse Pn503)×Pn507</th></tr>
<tr><td>Speed
Diagram</td><td>

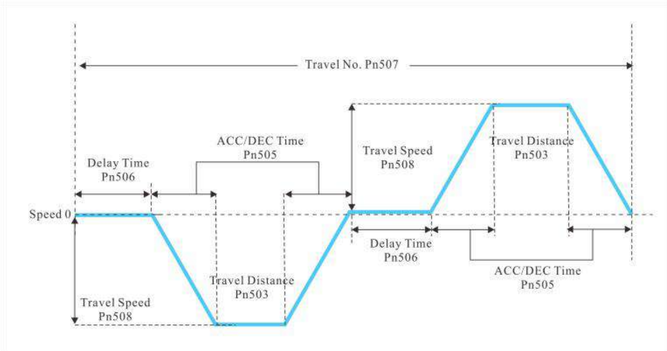
Note: Setting Pn507 to “0” enables unlimited runs.</td></tr>
</table>

<table>
<tr><th>Pn502=3</th><th>(Pn506→Reverse Pn503→Pn506→Reverse Pn503)×Pn507</th></tr>
<tr><td>Speed
Diagram</td><td>

Note: Setting Pn507 to “0” enables unlimited runs.</td></tr>
</table>

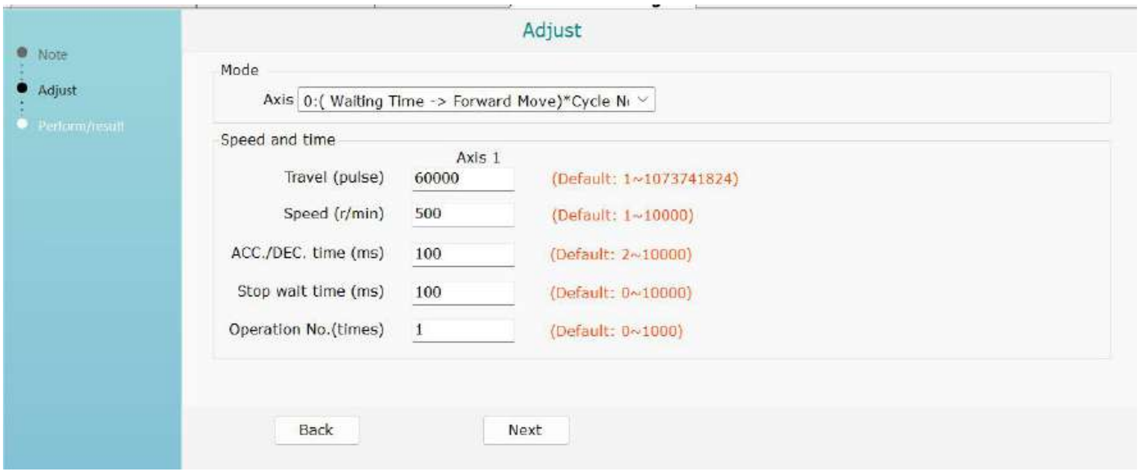
<table>
<tr><th>Pn502=4</th><th>(Pn506→Forward Pn503→Pn506→Reverse Pn503)×Pn507</th></tr>
<tr><td>Speed
Diagram</td><td>

Note: Setting Pn507 to “0” enables unlimited runs.</td></tr>
</table>

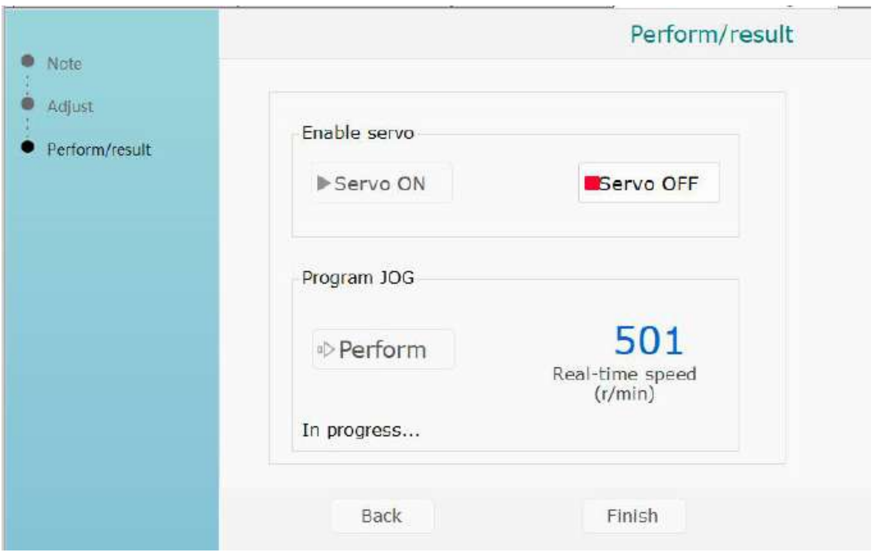
Pn502=5	(Pn506→Reverse Pn503→Pn506→Forward Pn503)×Pn507
Speed Diagram	 Note: Setting Pn507 to “0” enables unlimited runs.

The execution steps for Programmed JOG settings are as follows:

Step 1: Select  from the toolbar, click [Next] to enter the Programmed JOG operation interface.



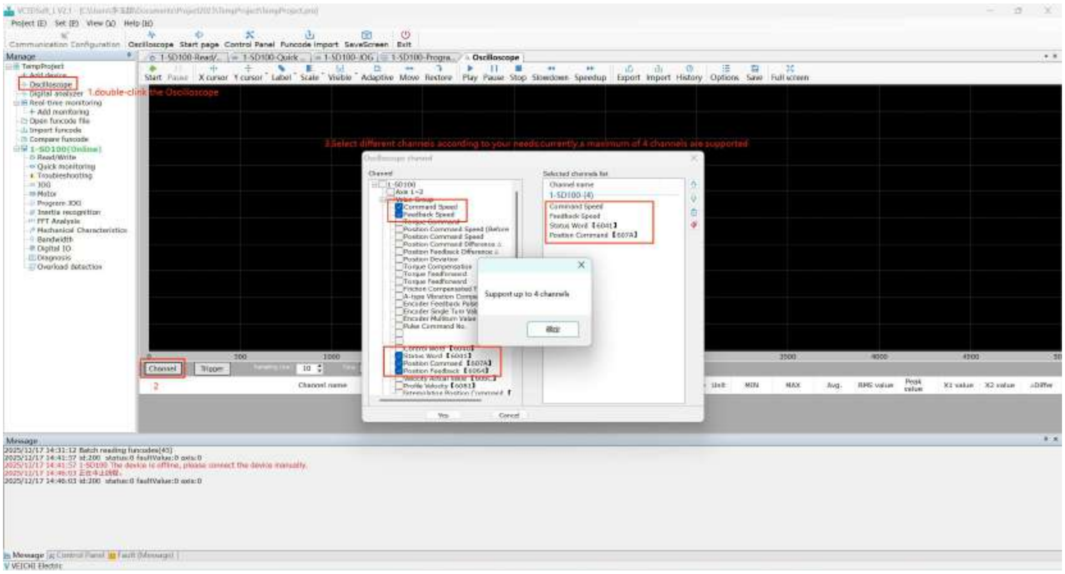
Step 2: After completing the configuration, click on Next-Servo ON-Perform for the automatical execution of the JOG program.

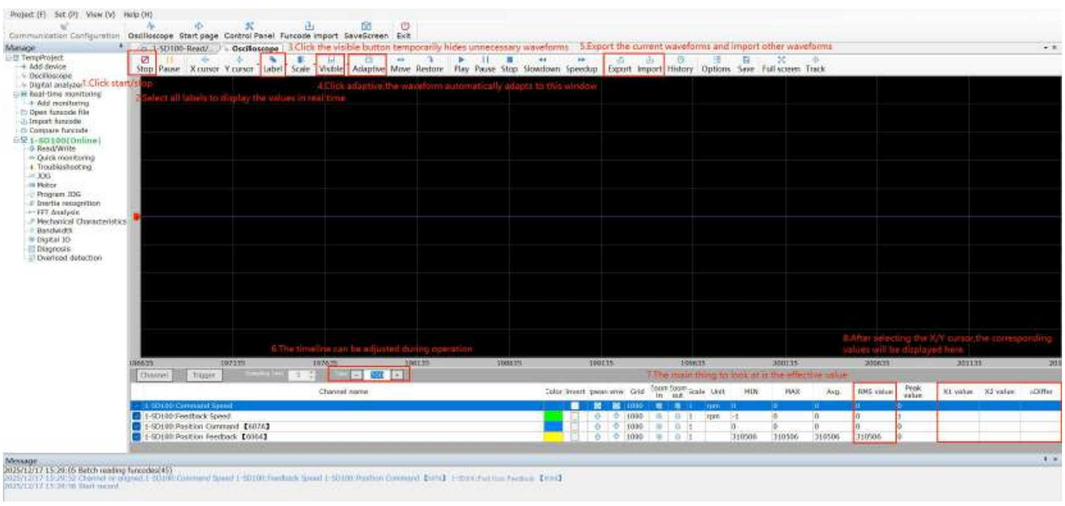


Precautions	
⚠	● Set an appropriate JOG speed value; ● Ensure that the JOG operation remains within the mechanical travel limits; ● If overtravel occurs during operation, the corresponding overtravel protection will be triggered. ● When setting the travel distance and speed, take the operational range and safe moving speed of the machinery into consideration; ● Although Programmed JOG operates in position control mode, it cannot accept pulse commands from the servo unit. ● During Programmed JOG operation, the position command filter function is valid.

6.3 Oscilloscope

The digital oscilloscope captures data at high speed and displays it graphically, facilitating data analysis. Its interface structure is as follows:





6.4 Advanced Applications

6.4.1 Inertia Identification

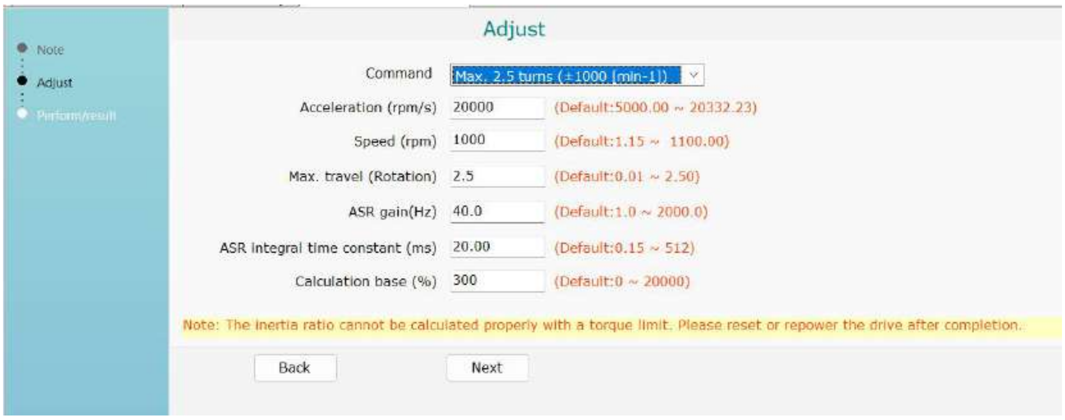
The inertia ratio (ratio of load inertia to motor rotor inertia) is a benchmark parameter for gain adjustment and must be set as accurately as possible. While load inertia can be calculated based on the weight and composition of mechanical components, the process is highly complex. So, this function enables high-precision load inertia measurement by driving the motor forward and reverse several times.

Debugging software steps:

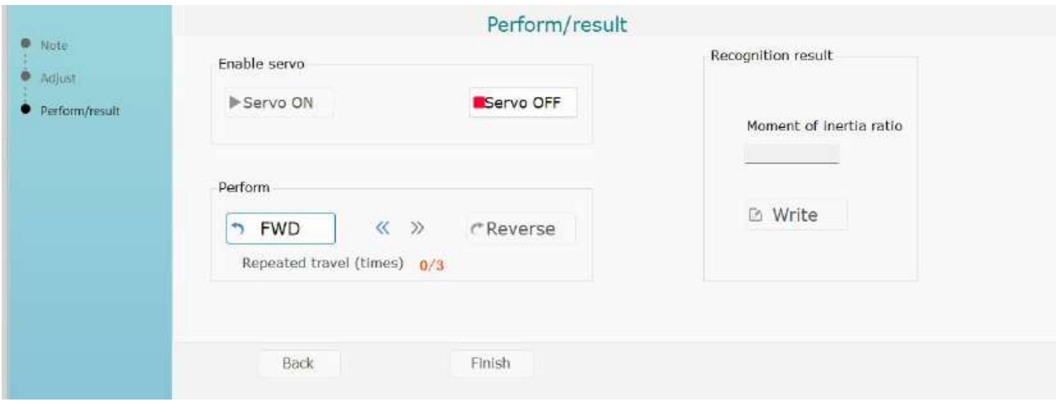
Step 1: Select from the toolbar, click [Next] to enter the inertia identification interface.

Step 2: Set inertia identification parameters and plan acceleration/deceleration curves→click [Next].

Step 3: Write parameters → click [Next].



Step 4: Enable the servo, repeatedly run forward and reverse more than three times, obtain the identification results, and click [Write] to complete parameter identification.



6.4.2 Bandwidth Setting

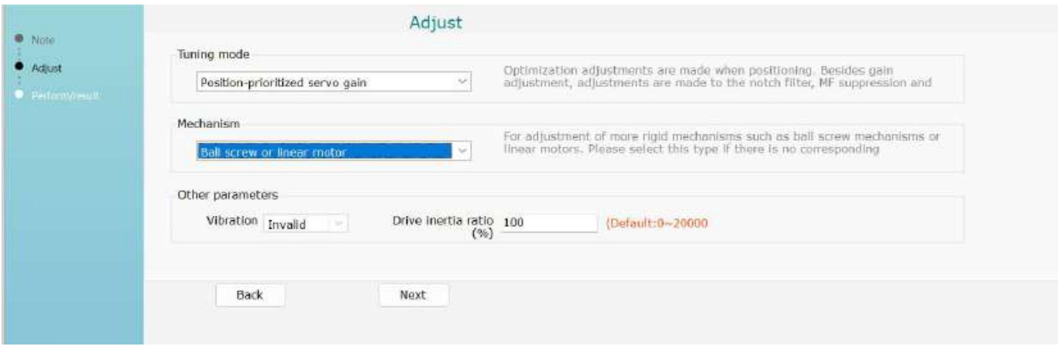
Bandwidth setting involves manually adjusting the system while speed or position commands are input from the host device. By setting one or two tuning values, related servo gain settings can be automatically adjusted.

Debugging software steps:

Step 1: Enable the motor, confirm safe range, and continuously run forward and reverse in speed or position mode.

Step 2: Select  from the toolbar, click [Next] to enter the bandwidth setting interface.

Step 3: Configure based on mechanical load structure and tuning requirements, select whether to enable friction compensation, and click [Next].Input the actual inertia value, click [Next].



Step 4: Click [Start Adjustment], begin debugging from the initial tuning value, and gradually adjust. If significant high-frequency vibration occurs, enable vibration detection for automatic suppression. If suppression is ineffective, reduce the adjustment value appropriately. Finally, adjust gains until vibration disappears and response meets user requirements.

Step 5: If results are satisfactory, end tuning and click [Next] to automatically match gain parameters under the current response conditions.

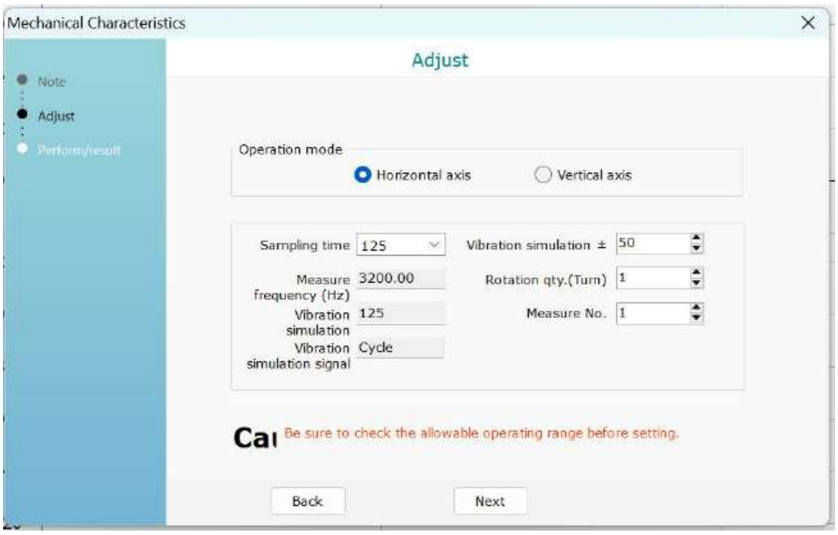
Precautions	
	● Ensure the operational safety range is confirmed and perform debugging with the servo in the enabled state. ● If significant response fluctuations occur during debugging, execute an emergency stop or cut off power immediately. ● During custom adjustments, adjust the gains until vibrations are completely eliminated.

6.4.3 Mechanical Characteristics Analysis

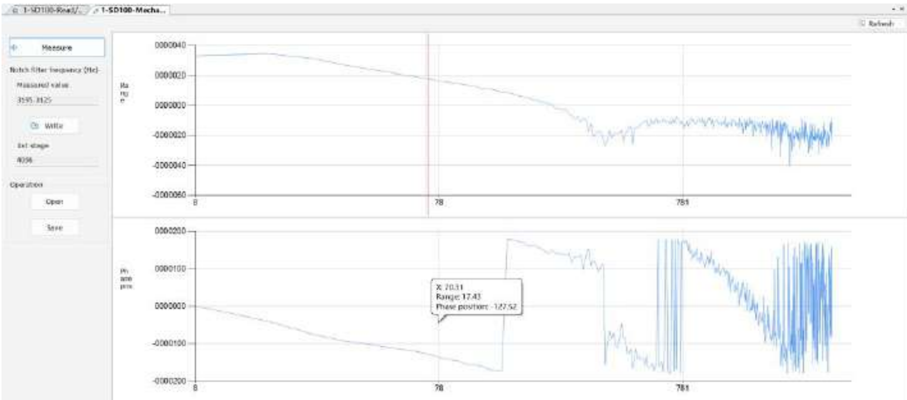
The servo unit performs automatic operation (reciprocating motion in forward and reverse directions) to estimate the mechanical system's resonance frequency during operation.

Debugging software operation steps are as follows:

Step 1: From the toolbar, select  and click [Start Measurement]→[Next] to enter the parameter adjustment interface. Adjust the corresponding parameters according to the actual situation, as shown in the figure below:



Step 2: Click [Next]→[Write]→[Next]→[Enable]→[Forward]→[Enable]→[Reverse]→[Next]→[Finish] to enter the FFT analysis interface for mechanical characteristics, as shown in the figure below:



Step 3: From the above interface, analyze the resonance frequency point, amplitude, and phase. Click [Set] to configure the first-stage notch filter frequency. After completing the settings, close the window to finish the mechanical characteristic operation.

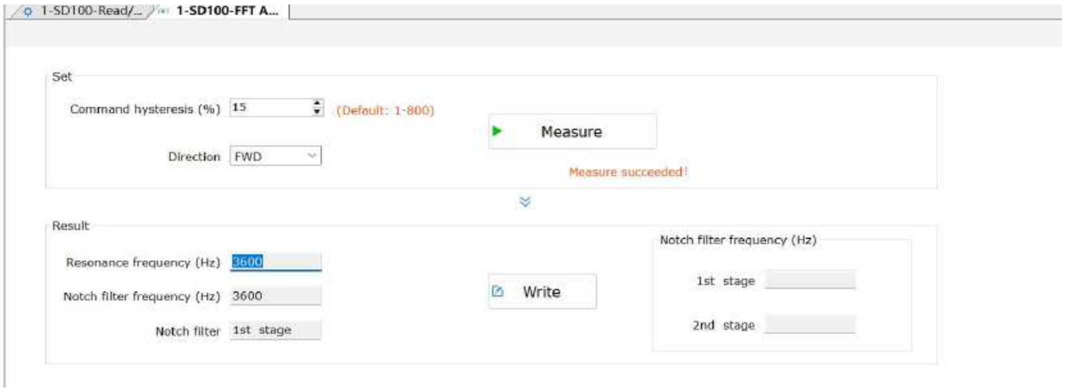
6.4.4 FFT Analysis

EasyFFT transmits periodic waveform commands from the servo unit to the servo motor, causing slight rotational movements over a specified time to induce mechanical vibration. And the servo unit detects the resonance frequency from the generated vibrations and automatically configures the corresponding notch filter, which can effectively eliminate high-frequency vibrations and noise.

Debugging software operation steps are as follows:

Step 1: Select  from the toolbar, click [Next] to enter the FFT interface.

Step 2: In the FFT measurement interface, set the command amplitude and rotation direction in the measurement conditions. Click [Start Measurement] to detect the first-stage notch filter frequency, as shown in the figure below:



Step 3: Click [Start Measurement] to detect the first notch frequency, then click [Write] to save the first-stage notch filter frequency.

Step 4: Click [Start Measurement] to detect the second notch frequency, then click [Write] to save the second-stage notch filter frequency.

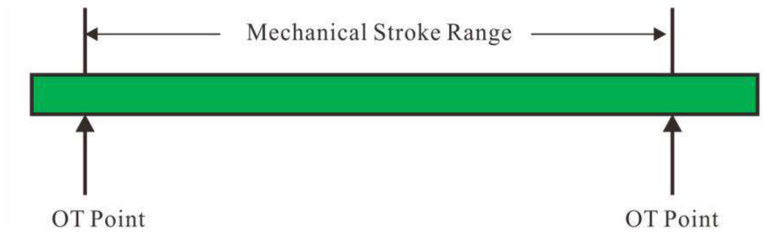
Step 5: Click [Next]→[Finish] to close the operation interface and complete the FFT analysis.

Precautions	
	● During this operation, the servo motor will rotate slightly. Never touch the servo motor or equipment during execution. or they may cause personal injuries. ● This function must be used only during the initial servo tuning phase when gains are set to low values. If EasyFFT is executed with high gain settings, the machine may experience severe vibrations due to mechanical resonance and gain imbalance.

6.5 Other Functions

6.5.1 Software Limit

Soft limit setting refers to defining the left and right travel limits using the single-turn and multi-turn values of the absolute encoder, without relying on external limit switches.



The automatic configuration procedure is as follows:

Set the JOG speed→Servo ON
Press and hold [Forward] or [Reverse] to move to the positive limit position→Set the current position as the positive limit.
Press and hold [Forward] or [Reverse] to move to the negative limit position → Set the current position as the negative limit.

The same applies to the zero point setting.

To confirm whether the soft overtravel setting was successful, check Pn00D, Pn030, Pn032, Pn033, Pn035.

To confirm whether the zero point setting was successful, check Pn290, Pn296, Pn297.

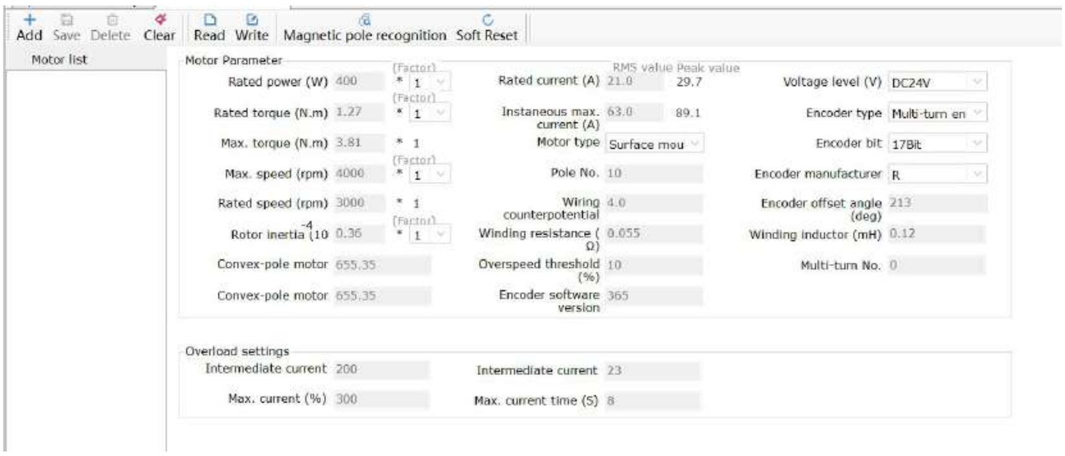
Precautions	
⚠	● Please set an appropriate speed value. ● Please ensure it is within the mechanical operating range. ● Please ensure the soft limit switch function is not enabled (Pn00D.W = 0).

6.5.2 Motor Parameter Setting

This interface primarily includes the following two functions:

(1) Motor Parameter Read/Write: Allows writing preset motor parameters to the serial encoder's EEPROM, and reading current motor parameters from the EEPROM.

(2) Motor Pole Position Identification: This function is used to identify the motor's initial zero position.



Precautions	
	● For third-party motors with unknown bias angles, motor pole identification must be performed before operation to determine the encoder offset angle. ● Parameter read/write operations are only supported for third-party motors with serial encoders. ● Parameters for third-party motors must strictly follow the manufacturer's specifications. Incorrect settings may cause abnormal motor operation.

6.5.3 Absolute Encoder Setting

The absolute encoder must be initialized under the following circumstances:

- During initial mechanical startup
- When an "Encoder Backup Error (ER.810)" occurs
- When initializing the rotational data serial communication of the absolute encoder

Precautions	
	● After initializing the absolute encoder, the rotation data range will be reset to values between -2 and +2 revolutions. As the reference position of the mechanical system will change, the reference position of the host device must be recalibrated based on the newly set position. ● Operating the machine without properly configuring the host device's positioning may result in unexpected mechanical movements, potentially causing personal injury or equipment damage. ● All basic settings (initialization) must be performed while the servo is in the OFF state. ● The "Encoder Backup Error (ER.810)" cannot be cleared using the servo unit's alarm reset input signal (/ALM-RST). It must be resolved by executing Fn008 for initialization. ● When an encoder internal monitoring error (ER.8□□) occurs, never attempt to clear it by disconnecting the power supply.

Debugging software steps:

In the function panel, navigate to the common functions interface and click [Clear ER.810/ER.860].

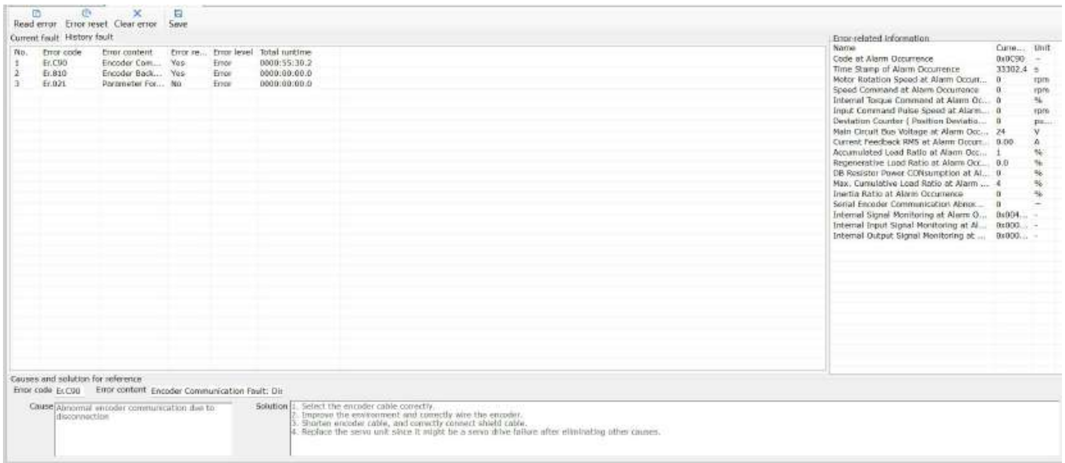
6.5.4 Error Message Clear and Check

The fault information interface displays: current errors, historical errors, error causes, recommended handling measures, relevant information recorded at the time of fault occurrence and reset operation capability.

The historical fault interface can display up to ten past errors, including:

①Error identification codes;

②Timestamps of error occurrences.



Precautions	
	● For consecutive identical errors, if the time interval between occurrences is lower than 1 hour, the duplicate error will not be saved, otherwise, it's saved. ● Error records can be only cleared through the "Clear Error Records" function. Neither alarm reset commands nor cutting power to the servo unit's main circuit will clear historical alarm records.

6.5.5 Soft Reset and Factory Reset

(1) Soft Reset Operation

Users can perform an internal reset of the servo drive via software. Parts of the parameters need power cycling up to take effect if they are modified. But this function allows settings to be applied without physically power cycling the drive.

Debugging software steps: Click “Soft Reset”.

Precautions	
	● This function must be used only with the servo drive OFF. ● Independently resets the servo drive (similar to power cycling). The drive will output an error signal, and other output signals may be forcibly changed.

(2) Factory Reset

Restores all parameters to factory default settings.

Debugging software steps:

In the Function Panel, select the Common Functions interface and click [Restore Factory Defaults].

Precautions	
	● Parameter initialization must be performed with the servo in the OFF state. ● After the operation, the servo unit must be power-cycled for the new settings to take effect. ● Upon completion of parameter initialization, always restart the servo unit's power supply.

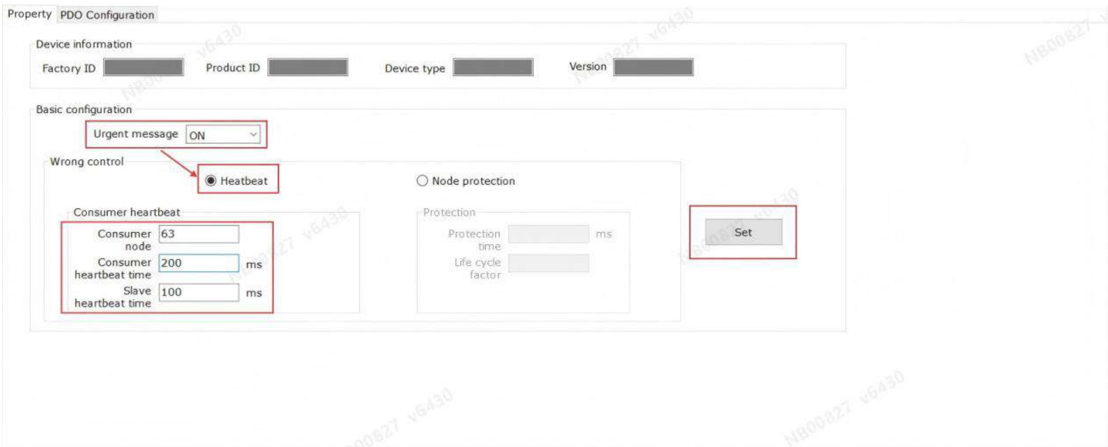
6.5.6 CAN Communication Configuration

The CAN communication configuration interface allows users to configure power-saving protection, heartbeat settings, emergency messages, and PDO mapping without requiring a CAN master station.

Configuration steps are as follows:

(1) Before establishing communication, manually load an EDS file to obtain default configurations.

(2) Configure emergency messages, heartbeat attributes, and power-saving protection in the properties settings interface.



(3) Delete existing PDO mappings and add new mapping parameters.

nfiguration

Name	Current value	Data type	R/W	Comment
Receive PDO1 mapping				
1.mapped object	0x00	-	RW	
2.mapped object	0x00	-	RW	
3.mapped object	0x00	-	RW	
4.mapped object	0x00	-	RW	
COB-ID	0x00	-	RO	
Transmission type	0	-	RW	0: Acyclic-Synchronous;1~240: Cyclic-Synchronou
Receive PDO2 mapping				
1.mapped object	0x00	-	RW	
2.mapped object	0x00	-	RW	
3.mapped object	0x00	-	RW	
4.mapped object	0x00	-	RW	
COB-ID	0x00	-	RO	
Transmission type	0	-	RW	0: Acyclic-Synchronous;1~240: Cyclic-Synchronou
Receive PDO3 mapping				
1.mapped object	0x00	-	RW	
2.mapped object	0x00	-	RW	
3.mapped object	0x00	-	RW	
4.mapped object	0x00	-	RW	
COB-ID	0x00	-	RO	

uration

me	Current value	Data type	R/W	Comment
ceive PDO4 mapping				
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	
B-ID	0x00	-	RO	
nsmission type	0	-	RW	0: Acyclic-Synchronous;1~240: Cyclic-Synch
nsmit PDO1 mapping				
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	
B-ID	0x00	-	RO	
nsmission type	0	-	RW	0: Acyclic-Synchronous;1~240: Cyclic-Synch
ibit timer	0	-	RW	0.1ms
nt time	0	-	RW	1ms
nsmit PDO2 mapping				
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	
mapped object	0x00	-	RW	

Configuration

Name	Current value	Data type	R/W	Comment
Inhibit timer	0	-	RW	0.1ms
Event Time	0	-	RW	1ms
Transmit PDO3 mapping				
1.mapped object	0x00	-	RW	
2.mapped object	0x00	-	RW	
3.mapped object	0x00	-	RW	
4.mapped object	0x00	-	RW	
COB-ID	0x00	-	RO	
Transmission type	0	-	RW	0: Acyclic-Synchronous;1~240: Cyclic-Synchronous;
Inhibit timer	0	-	RW	0.1ms
Event Time	0	-	RW	1ms
Transmit PDO4 mapping				
1.mapped object	0x00	-	RW	
2.mapped object	0x00	-	RW	
3.mapped object	0x00	-	RW	
4.mapped object	0x00	-	RW	
COB-ID	0x00	-	RO	
Transmission type	0	-	RW	0: Acyclic-Synchronous;1~240: Cyclic-Synchronous;
Inhibit timer	0	-	RW	0.1ms
Event Time	0	-	RW	1ms

(4) Power cycle the system to retain settings, then start network operation. The updated mappings will enable data exchange between the CAN network and the master station.

Precautions	
	● The CAN host device address must be configured before establishing the CANopen network.

7 Parameter List

7.1 Parameter Classification

The SD100 drive has a total of 11 sets of Pn parameters and 1 set of Un monitoring parameters. All parameters are categorized as follows.

Group	Type	Description
Pn0xx	Basic Parameters	Contains control mode, brake control, encoder reset, and communication.
Pn1xx	Gain Parameters	Contains the gain parameters of the basic speed, position loop and speed loop, as well as the setting of advanced debugging functions such as auto-tuning, no-tuning, A-type vibration suppression, auto notch filter, friction compensation, speed observation, and disturbance observation.
Pn2xx	Position Parameters	Basic configurations such as position reference selection, electronic gear setting, gear backlash compensation, home, positioning control output, etc., and also position control functions such as LF vibration suppression and model following control.
Pn3xx	Velocity Parameters	Contains the speed parameters such as the internal speed, acceleration/deceleration, zero-speed clamp, and speed control.
Pn4xx	Torque Parameters	Contains the torque parameters such as internal torque, torque filter, and speed limit.
Pn5xx	Utility Parameters	Contains jogging parameters.
Pn6xx	Terminal Parameters	Contains the DI/DO terminal enable switches, functions and polarity configuration and virtual I/O functions.
Pn7xx	Expansion Parameters	Contains the expansion parameters.
Pn8xx	Motion Control Parameters	Contains Pr internal position parameters.
PnExx	Drive Parameters	Contains the internal drive(not recommended for modification).
PnFxx	Motor Parameters	Contains the internal settings(not recommended for modification).
Unxxx	Monitor Parameters	Contains the monitoring parameters.

7.2 Pn Parameter Reading Guide

7.2.1 Value Setting Parameters

Parameter code
※ indicates user permission 2
☆ indicates manufacturer parameters

Enable condition
○ indicates enable immediately
■ indicates enable after re-power-up

Communication address
★ **indicates** 32-bit data
Hexadecimal display

Pn204	Electronic Gear Ratio Numerator	■	Address: 0x0204★
Default: 4	Range: 1~1073741824	Unit: Reference unit	Control Mode: P

Mode for this parameter
P: Position control
S: Velocity control
T: Torque control

7.2.2 Function Selection Parameters

Parameter Code
※ Indicates user parameters
☆ Indicates manufacture parameters

Enable condition
○Indicates enable immediately
■ Indicates enable after re-power-up

Communication address
★ indicates 32-bit data
Hexadecimal display

Pn001	Basic Switch 1	○	Address: 0x0001
Default: 4	Range: 0x0000~0x0011	Unit: N/A	Control mode: P S T

3-rd bit 2-nd bit 1-st bit 0-th bit
W Z Y X

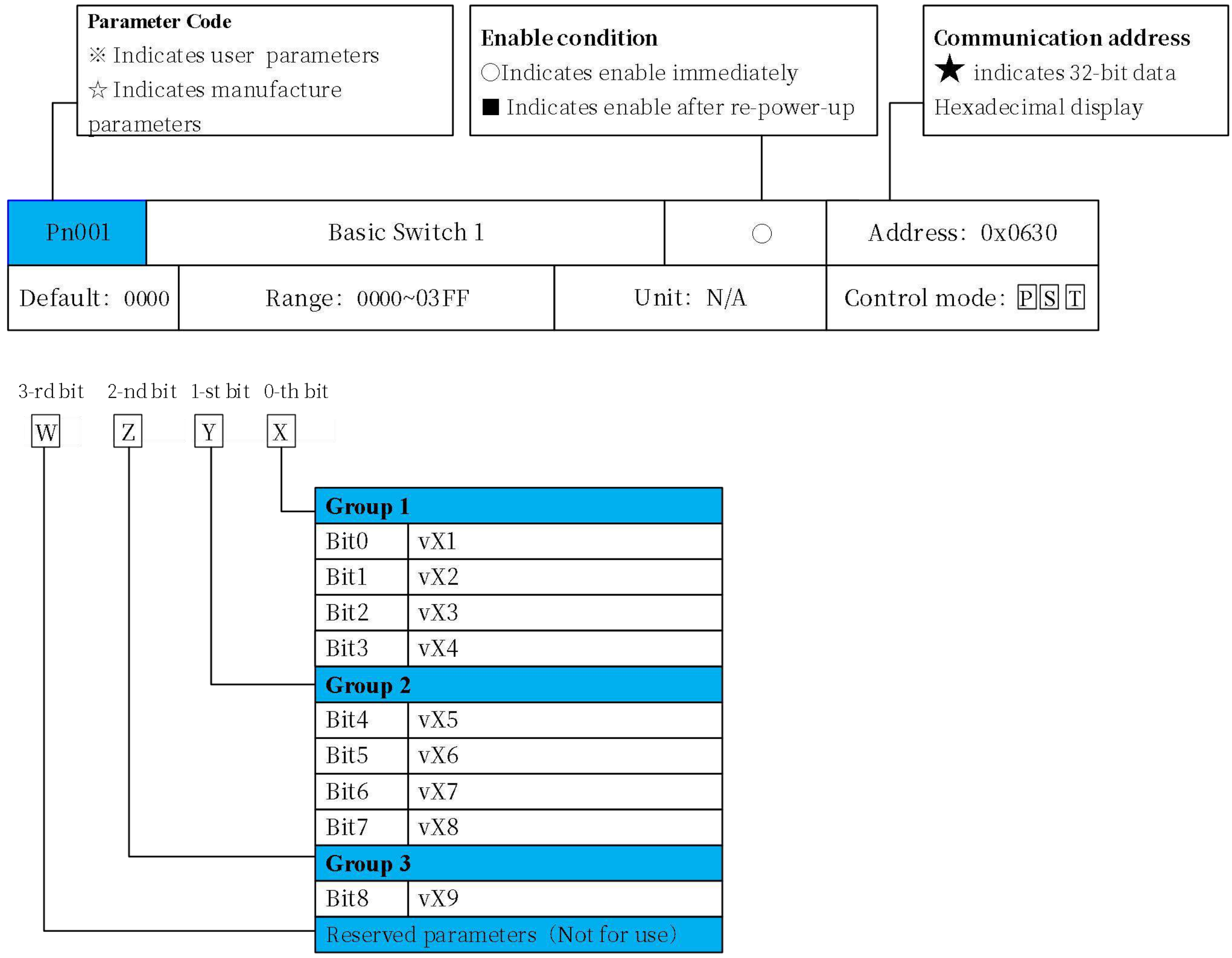
Servo enable	
0	OFF
1	ON
Power-down save	
0	OFF
1	ON
Reserved parameters（Not for use）	
Reserved parameters（Not for use）	

W/Z/Y/X represents setting on each bit.

- Pn001.X indicates settings on 0~3 bits
- Pn001.Y indicates settings on 4~7 bits
- Pn001.Z indicates settings on 7~11 bits
- Pn001.W indicates settings on 11~15 bits

（hexadecimal）

7.2.3 Switching Parameters



7.3 Pn Parameter Overview

7.3.1 Basic Parameters (Pn0xx)

Pn000	Basic Switch 0		■	Address: 0x0000
Default: 0x0000	Range: 0x0000~0x2217		Unit: N/A	Control Mode: P S T
parameter setting	0-th bit X	Control mode		
		0	Position mode	
		1	Velocity mode	
		2	Torque mode	
		3	Velocity-Position mode	
		4	Torque-Position mode	
		5	Velocity-Torque mode	
		6	Velocity-Position-Torque mode	
		7	I-F mode	

<table>
<tr><td rowspan="10"></td><td>1-st bit
Y</td><td colspan="2">Reserved parameters (Not for use)</td></tr>
<tr><td rowspan="4">2-nd bit
Z</td><td colspan="2">Drive type</td></tr>
<tr><td>0</td><td>Standard pulse</td></tr>
<tr><td>1</td><td>CANopen</td></tr>
<tr><td>2</td><td>EtherCAT</td></tr>
<tr><td rowspan="4">3-rd bit
W</td><td colspan="2">Motor type</td></tr>
<tr><td>0</td><td>Rotary motor</td></tr>
<tr><td>1</td><td>Liner motor</td></tr>
<tr><td>2</td><td>Virtual motor</td></tr>
<tr></tr>
<tr><td>Description</td><td colspan="3">Set the reference source of the drive, Pn200 under position mode, Pn300 under speed mode, while Pn400 under torque mode.</td></tr>
</table>

<table>
<tr><td>Pn001</td><td colspan="2">Basic Switch 1</td><td>○</td><td>Address: 0x0001</td></tr>
<tr><td>Default: 0x0000</td><td>Range: 0x0000~0x0011</td><td colspan="2">Unit: N/A</td><td>Control Mode:: P S T</td></tr>
</table>

<table>
<tr><td rowspan="8">parameter setting</td><td rowspan="3">0-th bit
X</td><td colspan="2">Servo enable</td></tr>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>Servo ON</td></tr>
<tr><td rowspan="3">1-st bit
Y</td><td colspan="2">Power-down save</td></tr>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>ON</td></tr>
<tr><td>2-nd bit
Z</td><td colspan="2">Reserved parameters (Not for use)</td></tr>
<tr><td>3-rd bit
W</td><td colspan="2">Reserved parameters (Not for use)</td></tr>
</table>

<table>
<tr><td>Pn002</td><td colspan="2">Motor Direction</td><td>■</td><td>Address: 0x0002</td></tr>
<tr><td>Default: 0x0000</td><td>Range: 0x0000~0x0001</td><td colspan="2">Unit: N/A</td><td>Control Mode: P S T</td></tr>
</table>

Set the motor operation direction.

Setting	Description	Comment
0	CCW(counterclockwise) as positive direction	-
1	CW(clockwise) as positive direction	-

Motor rotates counterclockwise in face of the axis end (CCW)

Motor rotates clockwise in face of the axis end (CW)

Pn004	Servo OFF and Gr.1 Error Stop Mode	■	Address: 0x0004
Default: 0x0002	Range: 0x0000~0x0002	Unit: N/A	Control Mode: P S T

To set drive stop mode during OFF and a 1st fault type warning

Setting	Description	Comment
2	Coasting stop	By default

Pn005	Gr.2 Error Stop Mode	■	Address: 0x0005
Default: 0x0000	Range: 0x0000~0x0001	Unit: N/A	Control Mode: P S T

To set drive stop mode during Gr.2 errors.

Setting	Description	Comment
0	Zero-speed stop	-
1	The same as Pn004[Servo OFF and Gr.1 Error Stop Mode] setting	Up to model

Pn006	Basic Switch 6	■	Address: 0x0006
Default: 0x1001	Range: 0x0000~0x4121	Unit: N/A	Control Mode: P S T

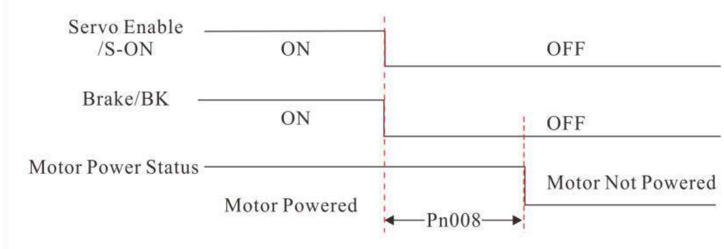
parameter setting	Bit	Setting	Description
	0-th bit X	Over-travel alarm enable	
		0	OFF
		1	ON
	1-st bit Y	Brake mode	
		0	Internal control
		1	External control
	2-nd bit Z	Alarm enable	
		0	ON
		1	OFF(A.971 excluded)

	3-rd bit W	Reserved

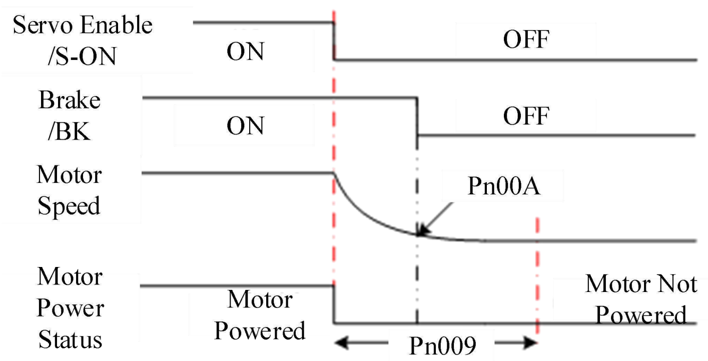
Pn007	Over-travel (OT) Stop Mode	■	Address: 0x0007
Default: 0x0001	Range: 0x0000~0x0012	Unit: N/A	Control Mode: P S T
parameter setting	0-th bit X	Over-Travel alarm enable	
		0	DB stop or coasting stop (the same as Pn004[Servo OFF and Gr.1 Error Stop Mode])
		1	Pn053 as the max. torque to stop motor and motor locked
		2	Pn053 as the max. torque to stop motor and motor not locked
	1-st bit Y	Pulse deviation clear during overtravel	
		0	OFF
		1	ON
	2-nd bit Z	Reserved parameters (not for modification)	
	3-rd bit W	Reserved parameters (not for modification)	

Notes	
⚠	• For the vertical axis, the workpiece may fall after overtravel, since the brake signal (/BK) being turned ON (brake released). To prevent this, set to make the servomotor fixed at the zero position after stopping (Pn007=1)". • When overtravel occurs due to external force, the motor stops and the transistor is cut off forcibly, and the load axis end may be pushed back by the external force. To prevent this, set to make the servo motor fixed at the zero position after stopping (Pn007=1)".

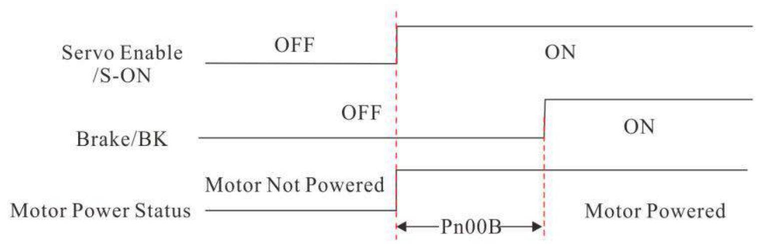
Pn008	Non-operational /BK OFF Power Delay	○	Address: 0x0008
Default: 10	Range: 0~2000	Unit: ms	Control Mode: P S T

Description	● When the servo motor stops, the brake(/BK) and servo ON(/S-ON) signal are OFF at the same time. Set Pn008 to change the duration from the /S-ON signal is turned off to power to the motor is actually cut off. ● When used for a vertical axis, the self-weight of the mechanical moving part or external forces may cause slight movement. After setting this function code, the motor will remain powered for an extended period after the brake is engaged to eliminate minor mechanical displacement.  Note: When an error occurs, this setting will not be valid, so the servomotor immediately loses power and sometimes moves before the brake is engaged due to the self-weight of the mechanical moving part or an external force.

Pn009	Operational /BK OFF Power Delay		○	Address: 0x0009
Default: 500	Range: 100~2000	Unit: ms		Control Mode: $\boxed{P}$ $\boxed{S}$ $\boxed{T}$

Pn00A	Operational /BK ON Velocity Level		○	Address: 0x000A
Default: 100	Range: 0~10000	Unit: rpm		Control Mode: $\boxed{P}$ $\boxed{S}$ $\boxed{T}$
Description	When an error occurs during the the servo motor operation, the servo motor stops and the brake signal(/BK) is OFF. In this case, the actual brake(/BK) OFF time can be adjusted by setting /BK OFF Velocity and Servo OFF /BK OFF Delay Time. When any of the following conditions is true, the brake will engage: ● After the motor loses power, the motor speed is lower than the /BK ON speed level. ● After the motor loses power, it passes the Servo OFF /BK OFF Delay Time setting.  			

Precautions	
	● When an error occurs under zero-speed stop, the system outputs a brake engage signal as Pn007 setting after the motor stops at a zero-speed command. ● Even if Pn009[Operational /BK OFF Delay] exceeds the max. speed of the servomotor, it is still limited to the max. speed.

Pn00B	Servo-ON /BK ON Power Delay		○	Address: 0x000B
Default: 10	Range: 0~2000		Unit: ms	Control Mode: P S T
Description	● When a servo motor starts, set the brake release delay time to control the time from /S-ON signal reception to actual power provided to the motor. ● When used for vertical axes, the self-weight of or external force may cause slight movement of the mechanical moving part. Set this function code to make sure the brake is released after enabling the motor. 			

Notes	
	● For single-IGBT circuits, after /S-ON is sent when Pn00B=0, the brake is released after about 20ms.

Pn00D	Basic Switch D		■	Address: 0x000D
Default: 0x0000	Range: 0x0000~0x2111		Unit: N/A	Control Mode: P S T
parameter setting	0-th bit X	Reserved parameters (not for modification)		
	1-st bit Y	Reserved parameters (not for modification)		
	2-nd bit Z	Speed detection mode		
		0	Mode 0	
		1	Mode 1	
		2	Mode 2	
		3	Mode 3	

	3-rd bit W	Absolute position limit enable (software)	
		0	OFF
		1	ON as Pn030[Soft Limit-Max. Absolute Single Turn] and Pn032[Soft Limit-Max. Absolute Multi Turn] setting
		2	ON as 607Dh[Min/Max Soft Limit] setting

Notes
● The absolute soft limit switch can only be switched on when both of the following conditions are met: ➢ It is an absolute encoder for the motor (PnF00.W[Encoder Type and Motor Voltage Level]=1). ➢ The absolute encoder is normal (Pn040[Absolute Encoder Usage]=0). ● The external input terminal limit switch is always ON (when configured) no matter the absolute limit switch is ON or OFF.

Pn00E	Basic Switch E	■	Address: 0x000E
Default: 0x4000	Range: 0x0000~0x4111	Unit: N/A	Control Mode: P S T

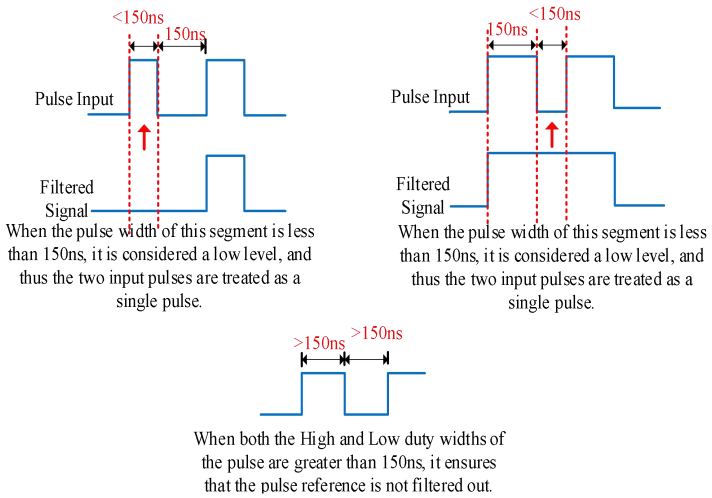
parameter setting	0-th bit X	Absolute encoder multi-turn overflow error enable (ER.C21)	
		0	ON
		1	OFF
	1-st bit Y	Drive and motor voltage match detection enable	
		0	ON
		1	OFF
	2-nd bit Z	Virtual motor encoder type	
		0	Incremental
		1	Absolute
	3-rd bit W	Virtual motor encoder bit	
		0	16-bit
		1	17-bit
		2	20-bit
		3	23-bit
		4	24-bit

Notes
● The absolute encoder multi-turn overflow monitoring function is ON only when both of the following conditions are valid: ➢ It is an absolute encoder for the motor (PnF00.W[Encoder Type and Motor Voltage Level]=1). ➢ The absolute encoder is normal (Pn040[Absolute Encoder Usage]=0). ● The absolute encoder multi-turn count range is [-32768, 32767], beyond which ER.C21 will be reported. ● When Pn276 [Rotation Upper Limit] is ON(=1), the absolute multiturn overflow detection is off automatically.

Pn011	Pulse Filter Time	○	Address: 0x0011
Default: 400	Range: 0~5000	Unit: 12.5ns	Control Mode: P

Description

- Set the filter time for external reference pulses.
- When Pn011[External Regenerative Resistor Power]=12 (12×12.5ns=150ns), the filter width shorter than 150ns will be regarded as interference.



- Calculation method: The maximum pulse frequency sent by the host controller is fkHz, then

$$\text{Pn011} = \frac{40000}{f} + 1$$

Note: This time calculation is valid when the hardware filter is turned off, please adjust it according to the actual working condition if the hardware filter is actually on.

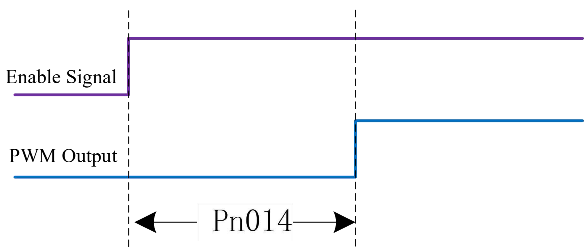
Pn012	External Regenerative Resistor Power	○	Address: 0x0012
Default: 0	Range: 0~65535	Unit: 10W	Control Mode: P S T

Description	● Set this according to the connected external regenerative resistor. Note: It varies according to the cooling condition of the external regenerative resistor. When an error occurs and the temperature of the regenerative resistor is not high, please increase the corresponding power value, otherwise set a smaller value. ● Self-cooling method (natural): Set the regenerative resistor power to 20% or lower (W). ● Forced air cooling: Set the regenerative resistor power to 50% or lower (W). For example, if the power of self-cooling external regenerative resistor is 100W, 100W×20%=20W, Pn012 should be set to "2" (Unit: 10W).

Notes	
	● If the drive is standard with a built-in regenerative braking resistor, the drive protects the built-in resistor when this setting is 0. ● If the setting value is inappropriate, the drive may report ER.320.

Pn013	External Regenerative Resistance		○	Address: 0x0013
Default: 0	Range: 0~65535	Unit: 1Ω		Control Mode: P S T
Description	Set this according to the connected external regenerative resistor.			

Notes	
	● The min. regeneration resistance allowed for each power band is different, see "Setting Regeneration Resistance" for details, otherwise the internal components of the servo unit may be damaged.

Pn014	Servo Drive Power ON Delay		○	Address: 0x0014
Default: 0	Range: 0~6000	Unit: ms		Control Mode: P S T
Description	Set a period of time after the bus voltage is built up before power to the drive is enabled. 			

Pn015	Motor Overload Alarm Level		■	Address: 0x0015
Default: 50	Range: 1~100	Unit: %		Control Mode: P S T

Pn016	Overload Base Current Derating	■	Address: 0x0016
Default: 100	Range: 10~100	Unit: %	Control Mode: P S T

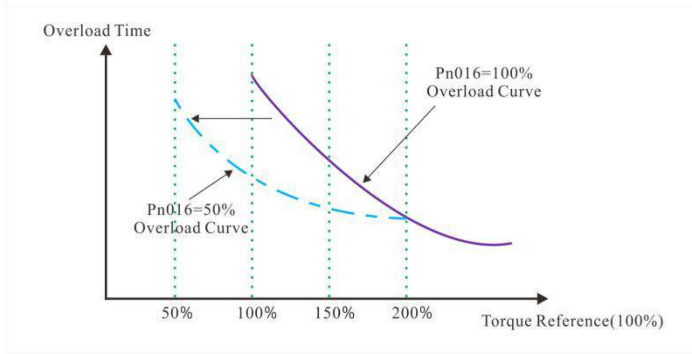
Description

- ER.720 (Continuous overload) can be reported in advance to prevent the motor from being overloaded, which can cause motor burnout.
- Set the derated base current to detect the formula: overload error and shorten its detection time. Note: The detection threshold of ER.710 (Max.Instantaneous Overload Error) can not be changed.
- Motor base current after derating = Motor base current × Motor overload base current derating setting.

Terminology:

- Motor base current: The motor current threshold at which the overload error is started to be calculated.
- Motor overload base current derating: Derating rate of motor base current.

Example: As shown in the figure below, if Pn018 is set to 50%, then an overload error is reported earlier because the motor overload is calculated from 50% of the base current. And after Pn018 is changed, the overload error detection time is changed accordingly, so overload alarm detection time is changed, too.



Pn017	Overload Current Derating at Single-phase Power Input	40	Address: 0x0017★
Default: 50	Range: 10~100	Unit: %	Control Mode: P S T

Pn030	Soft Limit-Max. Absolute Single Turn	○	Address: 0x0030★
Default: 0	Range:-2^{31}~$(2^{31}-1)$	Unit: Encoder unit	Control Mode: P S T

Pn032	Soft Limit-Max. Absolute Multi-Turn	○	Address: 0x0032
Default: 32767	Range: -32768~32767	Unit: Turn	Control Mode: P S T

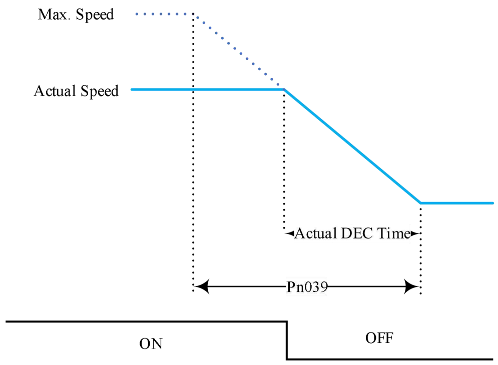
Description	Set to compare with the internal position feedback of the drive, and report error and enable related operations once this setting is exceeded. Users can make relevant selections via Pn000A.3. Note: ● When (Pn030×one turn pulse count+Pn032) is lower than (Pn035×one turn pulse count+Pn033), the absolute position limit minimum and maximum values will be interchanged. ● Only applicable to absolute encoders.

Pn033	Soft Limit-Min. Absolute Single Turn	○	Address: 0x0033★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: Encoder unit	Control Mode: P S T

Pn035	Soft Limit-Min. Absolute Multi-Turn	○	Address: 0x0035
Default: -32768	Range: -32768~32767	Unit: Turn	Control Mode: P S T
Description	Set to compare with the internal position feedback of the drive, and report error and enable related operations once this setting is exceeded. Users can make relevant selections via Pn000A.3. Note: ● When (Pn030×one turn pulse count+Pn032) is lower than (Pn035×one turn pulse count+Pn033), the absolute position limit minimum and maximum values will be interchanged. ● Only applicable to absolute encoders.		

Pn036	Soft Limit-Absolute Limit Hysteresis	○	Address: 0x0036
Default: 200	Range: 0~30000	Unit: Encoder unit	Control Mode: P S T
Description	Since this setting is in encoder unit, frequent entering and exiting may occur after entering soft limit state. Set the corresponding hysteresis according to the actual situation to avoid this problem.		

Pn039	Servo OFF DEC Stop Time	○	Address: 0x0039
Default: 0	Range: 0~10000	Unit: 1ms	Control Mode: P S T

Description	

Notes	
⚠	● When Pn039 is set to 0, the deceleration stop function is invalid when the servo is OFF. ● This function is valid only for the external input terminal and internal Pn001.X. ● This function is valid for position mode, speed mode, and torque mode.

Pn040	Absolute Encoder Usage		■	Address: 0x0040
Default: 0x0001	Range: 0x0000~0x0021		Unit: N/A	Control Mode: P S T
parameter setting	0-th bit X	Standard pulse-type absolute encoder mode		
		0	Use as an absolute encoder	
		1	Use as an incremental encoder	
	1-st bit Y	EtherCAT absolute encoder mode		
		0	Use as an absolute encoder	
		1	Use as an incremental encoder	
		2	Use as a single-turn absolute encoder	
	2-nd bit Z	Reserved parameters (Not for use)		
	3-rd bit W	Reserved parameters (Not for use)		

Notes	
⚠	● An externally equipped battery is required when it is used as an absolute encoder, otherwise the drive generates a battery undervoltage error or alarm.

Pn041	Multi-turn Absolute Encoder Undervoltage Error/Alarm	○	Address: 0x0041
Default: 0x0000	Range: 0x0000~0x0001	Unit: N/A	Control Mode: P S T

Set the encoder undervoltage fault prompt mode.

Setting	Description	Comment
0	Error (ER.830)	-
1	Alarm (AL.930)	-

- ER.830: The drive checks whether the encoder backup battery is normal within 8 seconds after power-up and no longer check it afterwards.
- AL.930: The drive dynamically checks the voltage of the encoder backup battery in time after power-up and generates a corresponding alarm if it is below the set value, and the alarm disappears automatically if it is above the set value.

Pn045	Main Circuit (DC) Undervoltage Alarm Enable	○	Address: 0x0045
Default: 0x0000	Range: 0x0000~0x0002	Unit: N/A	Control Mode: P S T

Set to turn on or off the DC undervoltage alarm prompt.

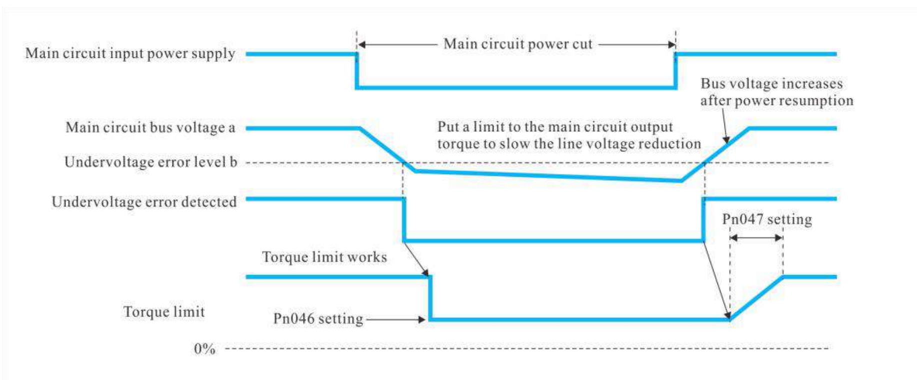
Setting	Description	Comment
0	OFF	-
1	ON	-
2	ON and torque limit executed via Pn046 and Pn047.	-

Pn046	Main circuit (DC) Undervoltage Alarm Torque Limit	○	Address: 0x0046
Default: 50	Range: 0~100	Unit: 1%	Control Mode: P S T
Description	Set the percentage to the rated torque of the motor.		

Pn047	Main Circuit (DC) Undervoltage Torque Limit Release Time	○	Address: 0x0047
Default: 100	Range: 0~1000	Unit: 1ms	Control Mode: P S T

Description

When there is a torque limit within the servo drive valid in response to an undervoltage alarm. Set its valid duration here in face of a undervoltage alarm to limit the torque.



Pn050	Torque Limit Source	○	Address: 0x0050
Default: 0x0002	Range: 0x0000~0x0005	Unit: N/A	Control Mode: P S

Set the torque limit source for the drive output.

Setting	Description	Comment
0	Reserved	-
1	Reserved	-
2	Pn051[Internal Positive Torque Limit]	-
3	Pn051[Internal Positive Torque Limit] and Pn052[Internal Negative Torque Limit]	-
4	External terminal input	-
5	ON when reference pulse is 0 and positioning is done.	-

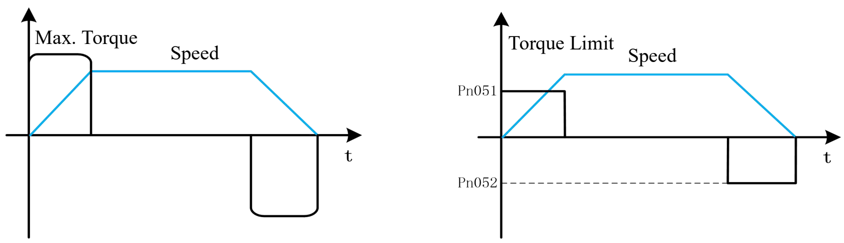
Here is an explanation on torque limit method:

Pn050		POS	NEG	Description
0		Reserved		-
1		Reserved		-
2		Pn051		Set the max. toque limit forward operation on Pn051.
3		Pn051	Pn052	Set the max. torque for forward rotation by Pn051. Set the max. torque for reverse rotation by Pn052.
4	OFF	Pn054		External terminal input decides the torque limit value. When TL-SEL is low (OFF), set Pn054[External Torque Limit 1] to limit the max. torque for positive/negative operation. When TL-SEL is high (ON), set Pn055[External Torque Limit 2] to limit the max. torque for positive/negative operation.
	ON	Pn055		
5	OFF	Pn051		① When the pulse reference is 0 (filtered); ② Positioning is complete. When either of the two conditions is not true, the max. torque for positive/negative rotation is limited by Pn051. When both conditions are true, the max. torque for positive/negative rotation is limited by Pn052.
	ON	Pn052		

Notes

- The torque limit method is only valid for non-torque mode While torque limit in torque mode can only be performed by:
  - Positive torque limit and negative torque limit by Pn051.
  - External torque limit by external X terminal to switch to external torque limit Pn051.

Pn051	Internal Positive Torque Limit	○	Address: 0x0051
Default: Up to model	Range: 0~500	Unit: 1%	Control Mode: $\boxed{P}$ $\boxed{S}$ $\boxed{T}$

Pn052	Internal Negative Torque Limit	○	Address: 0x0052
Default: Up to model	Range: 0~500	Unit: 1%	Control Mode: $\boxed{P}$ $\boxed{S}$ $\boxed{T}$
Description	Set the internal torque limit on the max torque output to protect the products. Under torque mode, set Pn051 or Pn052 to select the limit direction. Note: (1) The setting unit is a percentage of the rated torque of the motor. (2) If the torque limit setting is too low, the servo motor may not have enough torque during acceleration and deceleration. Without internal torque limit With internal torque limit 		

Pn053	Emergency Stop Torque	○	Address: 0x0053
Default: 800	Range: 0~800	Unit: 1%	Control Mode: $\boxed{P}$ $\boxed{S}$ $\boxed{T}$
Description	Set for the maximum torque display for emergency stop in specific cases and overtravel.		

Pn054	External Torque Limit 1	○	Address: 0x0054
Default: 100	Range: 0~500	Unit: 1%	Control Mode: $\boxed{P}$ $\boxed{S}$

Pn055	External Torque Limit 2	○	Address: 0x0055
Default: 100	Range: 0~500	Unit: 1%	Control Mode: $\boxed{P}$ $\boxed{S}$

Pn056	Overspeed Torque Level	○	Address: 0x0056
Default: 100	Range: 0~255	Unit: 1%	Control Mode: $\boxed{P}$ $\boxed{S}$ $\boxed{T}$
Description	When the current torque exceeds the setting here at the same time, the current speed exceeds Pn057[Overspeed Velocity Level], the overspeed detection function is ON. Note: ● This torque threshold is the max. Torque. ● When Pn056 is set to 0, the overspeed detection function is OFF.		

Pn057	Overspeed Velocity Level		○	Address: 0x0057
Default: 20	Range: 0~200	Unit: 1%		Control Mode: P S T
Description	When the current speed exceeds the setting here at the same time, the current torque exceeds Pn056[Overspeed Torque Level], the overspeed detection function is ON. Note: This speed is the max. overspeed threshold.			

Pn059	KTY Temperature Sensor Error Level		○	Address: 0x0059
Default: 0	Range: 0~180	Unit: 1°C		Control Mode: P S T
Description	Set the temperature threshold for motors configured with KTY-type sensors, so that when the motor temperature exceeds the setting here, ER.42A (KTY temp. sensor overheat error) will be reported. Note: ● When it is set to 0, the overheat monitoring function is OFF. ● This is valid only for motors configured with KTY type temperature sensors.			

Pn076	Serial Encoder Single-turn Resolution		■	Address: 0x0076
Default: 0x0020	Range: 0x0000~0x0051	Unit: N/A		Control Mode: P S T
Parameter setting	0-th bit X	Encoder single-turn resolution adjustment enable		
		0	OFF	
		1	ON	
	1-st bit Y			
		0	15-bit	
		1	16-bit	
		2	17-bit	
		3	18-bit	
		4	19-bit	
		5	20-bit	
	2-nd bit Z	Reserved parameters (Not for use)		
	3-rd bit W	Reserved parameters (Not for use)		

Precautions	
⚠	● This is valid only for serial encoders. ● Refer to the actual encoder resolution if the set resolution is lower than the actual encoder resolution.

Pn07F	Serial Encoder Multi-turn Clear and Error Reset	○	Address: 0x007F
Default: 0x0000	Range: 0x0000~0xFFFF	Unit: N/A	Control Mode: P S T
Description	Set to reset the serial encoder battery's multi-turn values and failures. This function is on if set to 1, which delivers the same effect as utility function Fn008 that is used to reset multi-turn of absolute encoder via RS485.		

Precautions	
	● It is valid only for absolute serial encoders. ● Pn07F is not saved when power is cut and is automatically reset when execution is completed. ● Execution under drive enable state is prohibited.

Pn080	Node ID (RS485&CANopen)	■	Address: 0x0080
Default: 1	Range: 0~255	Unit: N/A	Control Mode: P S T
Description	Set the drive axis address here. 0: Broadcast address, users can write to all drives by broadcasting the address by the upper controller, and the drives receive the frames of the broadcast addresses to perform accordingly, but do not respond them. 1~255:When multiple servo drives are networked, assign each drive with a unique address, or it may cause communication failure. Note: For CANopen models, the allowed max. value of this communication address is 63.		

<table>
<tr><td>Pn081</td><td colspan="2">Local Communication Format</td><td>■</td><td>Address: 0x0081</td></tr>
<tr><td>Default: 0x0502</td><td>Range: 0x0000~0x0655</td><td></td><td>Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="14">Parameter setting</td><td rowspan="7">0-th bit
X</td><td colspan="3">RS485 baud rate</td></tr>
<tr><td>0</td><td colspan="2">4800bps</td></tr>
<tr><td>1</td><td colspan="2">9600bps</td></tr>
<tr><td>2</td><td colspan="2">19200bps</td></tr>
<tr><td>3</td><td colspan="2">38400bps</td></tr>
<tr><td>4</td><td colspan="2">57600bps</td></tr>
<tr><td>5</td><td colspan="2">115200bps</td></tr>
<tr><td rowspan="7">1-st bit
Y</td><td colspan="3">RS485 communication parity</td></tr>
<tr><td>0</td><td colspan="2">No parity, 8-bit data, 1 stop bit (N-8-1)</td></tr>
<tr><td>1</td><td colspan="2">Even parity, 8 bits data, 1 stop bit (N-8-1)</td></tr>
<tr><td>2</td><td colspan="2">Odd parity, 8-bit data, 1 stop bit (O-8-1)</td></tr>
<tr><td>3</td><td colspan="2">No parity, 8-bit data, 2 stop bit (N-8-2)</td></tr>
<tr><td>4</td><td colspan="2">Even parity, 8 bits data, 2 stop bit (N-8-2)</td></tr>
<tr><td>5</td><td colspan="2">Odd parity, 8-bit data, 2 stop bit (N-8-2)</td></tr>
</table>

	2-nd bit Z	CAN communication baud rate	
		0	20K
		1	50K
		2	100K
		3	125K
		4	250K
		5	500K
		6	1000K(1M)
	3-rd bit W	CanOpen configuration	
		0	Velocity reference in pps
		1	Velocity reference in rpm

Notes	
⚠	• The baud rate and communication parity method of the servo drive must be the same as that of the host controller, otherwise communication will fail.

Pn082	EtherCAT Station Alias		■	Address: 0x0082
Default: 0	Range: 0x0000~0xFFFF		Unit: N/A	Control Mode: P S T

Pn083	EtherCAT Master		○	Address: 0x0083
Default: 0x0000	Range: 0x0000~0x0001		Unit: N/A	Control Mode: P S T

Set the master brand for EtherCAT communication.

Setting	Description	Comment
0	Others	-
1	Omron NJ series controller	-

Pn084	EtherCat Sync Frame Count Limit	■	Address: 0x0084
Default: 0x0000	Range: 0x0000~0x000F	Unit: N/A	Control Mode: P S T

Pn085	Communication Modification Power-down Save		○	Address: 0x0085
Default: 0x0000	Range: 0x0000~0x0111		Unit: N/A	Control Mode: P S T
Parameter setting	0-th bit X	RS485 power-down save enable		
		0	OFF	
		1	ON	

	1-st bit Y	CANopen power-down save enable	
		0	OFF
		1	ON
	2-nd bit Z	Ethercat power-down save enable	
		0	OFF
		1	ON
	3-rd bit W	Reserved parameters (Not for modification)	
Description	If the changed parameter does not need to be stored during power down, please set the corresponding function to off, otherwise, it will take up too much room in the EEPROM, and cause damage, and the drive will report ER.021.		

Pn087	Modbus Register Address Mapping Enable	○	Address: 0x0087
Default: 0x0000	Range: 0x0000~0x0011	Unit: N/A	Control Mode: P S T
Parameter setting	0-th bit X	Register 1 address mapping enable	
		0	OFF
		1	ON
	1-st bit Y	Register 2 address mapping enable	
		0	OFF
		1	ON
	2-nd bit Z	Reserved parameters (Not for use)	
	3-rd bit W	32-bit register high/low bit order	
		0	Low 16 bits~high 16 bits
		1	High16 bits~low 16 bits

Pn088	Register 1 Mapping Source Address	○	Address: 0x0088
Default: 0x0000	Range: 0x0000~0x1FFF	Unit: N/A	Control Mode: P S T

Pn089	Register 1 Mapping Target Address	○	Address: 0x0089
Default: 0x0000	Range: 0x0000~0x1FFF	Unit: N/A	Control Mode: P S T

Pn08A	Register 2 Mapping Source Address	○	Address: 0x008A
Default: 0x0000	Range: 0x0000~0x1FFF	Unit: N/A	Control Mode: P S T

Pn08B	Register 2 Mapping Target Address	○	Address: 0x008B
Default: 0x0000	Range: 0x0000~0x1FFF	Unit: N/A	Control Mode: P S T

7.3.2 Gain Parameter(Pn1xx)

Pn100	Moment of Inertia Ratio (J)	○	Address: 0x0100
Default: 100	Range: 0~20000	Unit: 1%	Control Mode: P S T
Description	Sets the ratio between the total inertia and the motor rotor inertia. $\text{Pn100}=\frac{\text{Load Inertia}+\text{Motor Rotor Inertia}}{\text{Motor Rotor Inertia}}\times 100\%$		

Pn101	ASR Gain 1	○	Address: 0x0101
Default: 40.0	Range: 1.0~2000.0	Unit: Hz	Control Mode: P S T
Description	Set to determine the responsiveness of the speed control loop. The higher this setting is, the higher the speed loop response frequency and the better the speed reference following effect. Higher setting improves the response characteristics, but it may lead to vibration.		

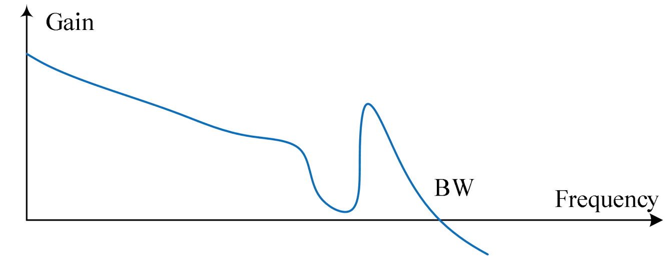
Pn102	ASR Integral Time 1	○	Address: 0x0102
Default: 20.00	Range: 0.15~512.00	Unit: ms	Control Mode: P S T
Description	Set to determine the responsiveness of the speed control loop. The lower the setting is, the higher the response frequency of the speed loop and the better the speed reference following effect. Lower setting improves the response characteristics, but it may lead to vibration.		

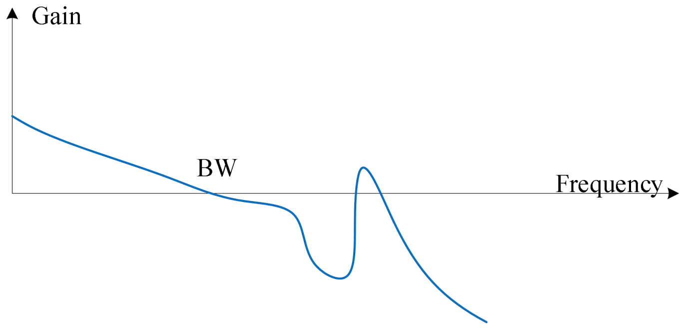
Pn103	APR Gain	○	Address: 0x0103
Default: 40.0	Range: 1.0~2000.0	Unit: 1/s	Control Mode: P S T
Description	Set to determine the responsiveness of the position control loop. Higher setting leads to higher position response frequency, better position reference following effect, lower position deviation, and shorter positioning time, but it may lead to vibration.		

Pn104	Torque Reference Filter Time	○	Address: 0x0104
Default: 1.00	Range: 0.00~655.35	Unit: ms	Control Mode: P S T

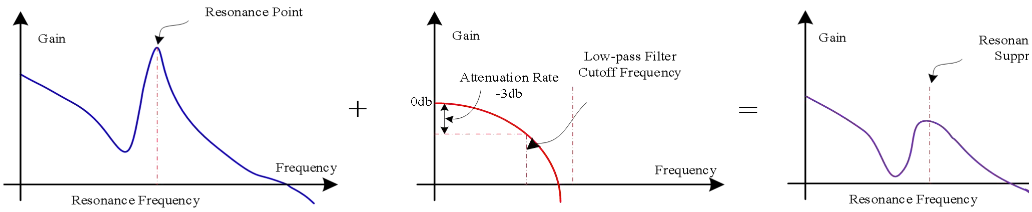
<table>
<tr>
<td>Description</td>
<td>

Set the resonance suppression low-pass filter time constant. When the constant is set to 0, this function is disabled.: If resonance occurs in the mechanical structure, it may be caused by excessive stiffness or overly fast response bandwidth in the drive control system. By adjusting this parameter in conjunction with the anti-resonance notch filter time, the control system's resonance can be suppressed without altering the control parameters.





As the torque reference filter time is gradually increased from 0, the corresponding bandwidth (BW) point will become smallER. While the resonance frequency issue will be resolved, the system's response bandwidth and phase margin will also decrease.
When the constant is set to 1, this function is enabled:



When the low-pass filter is increased from 0, the frequency band will progressively narrow. Although the resonance problem is mitigated, the system's response bandwidth and phase margin are reduced, making the system less stable.
So we recommend:

$$\text{Stabilizing control range:Pn104[ms]} = \frac{1000}{2\pi \times \text{Pn102[Hz]} \times 4}$$

$$\text{Limit control range: Pn104[ms]} = \frac{1000}{2\pi \times \text{Pn102[Hz]} \times 1}$$

</td>
</tr>
</table>

Pn105	ASR Gain 2		○	Address: 0x0105
Default: 40.0	Range: 1.0~2000.0	Unit: Hz		Control Mode: P S T

Pn106	ASR Integral Time 2		○	Address: 0x0106
Default: 20.0	Range: 0.15~512.00	Unit: ms		Control Mode: P S T

Pn107	APR Gain 2		○	Address: 0x0107
Default: 40.0	Range: 1.0~2000.0	Unit: 1/s		Control Mode: P S T

Pn108	Torque Reference Filter Time 2		○	Address: 0x0108
Default: 1.00	Range: 0.00~655.35	Unit: 1ms		Control Mode: P S T

Pn10A	Adjustment Mode		○	Address: 0x010A
Default: 0	Range: 0~1	Unit: -		Control Mode: P S T

Setting	Description	Comment
0	Manual adjustment	-
1	Auto adjustment according to standard rigidity table	-

Pn10B	Rigidity Level		○	Address: 0x010B
Default: 15	Range: 1~32	Unit: -		Control Mode: P S T

Pn110	Auto Gain Shift		○	Address: 0x0110
Default: 0x0000	Range: 0x0000~0x0051	Unit: N/A		Control Mode: P S T

Parameter setting	0-th bit X	Gain shift mode	
		0	Manual shift by external gain signal (/G-SEL)
		1	Auto shift When condition is true, the gain is automatically switched from the 1st gain to the 2nd gain. When condition is not true, the gain is automatically switched from the 2nd gain to the 1st gain.
	1-st bit Y	Shift condition	
		0	/COIN ON
		1	/COIN OFF
		2	/NEAR ON
		3	/NEAR OFF

		4	Position reference filter output equal to 0 and reference input OFF
		5	Position reference pulse input ON
	2-nd bit Z	Reserved parameters (Not for modification)	
	3-rd bit W	Reserved parameters (Not for modification)	

Pn112	Gain Shift Time 1	○	Address: 0x0112
Default: 0	Range: 0~65535	Unit: ms	Control Mode: P S T

Pn113	Gain Shift Time 2	○	Address: 0x0113
Default: 0	Range: 0~65535	Unit: ms	Control Mode: P S T

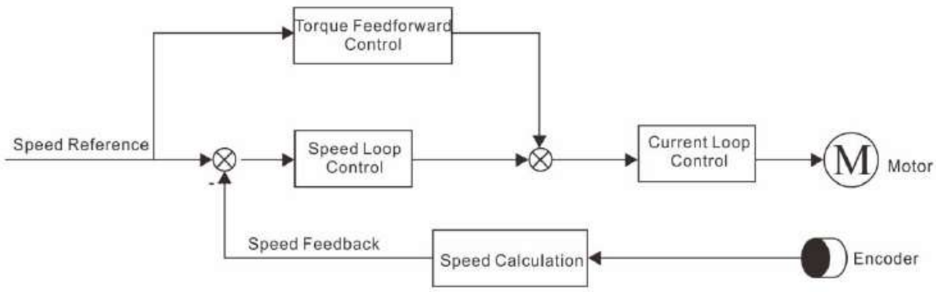
Pn114	Gain Shift Delay 1	○	Address: 0x0114
Default: 0	Range: 0~65535	Unit: ms	Control Mode: P S T

Pn115	Gain Shift Delay 2	○	Address: 0x0115
Default: 0	Range: 0~65535	Unit: ms	Control Mode: P S T

Pn120	APR Integral Time	○	Address: 0x0120
Default: 0.0	Range: 0.0~5000.0	Unit: ms	Control Mode: P
Description	Set the integral function of the position loop for electronic cams and electronic shafts. Note: It is OFF when set to 0.		

Pn121	Velocity Feedforward Gain	○	Address: 0x0121
Default: 0	Range: 0~100	Unit: 1%	Control Mode: P
Description	Set to shorten the positioning time, and it is valid under position control. It works by differentiating the position reference from the host device to generate an additional velocity reference. When the position reference changes smoothly, increase the feedforward gain to improve the following accuracy. But if the position reference is not smooth (e.g., contains abrupt changes), reduce the position feedforward gain to minimize mechanical vibration. Feedforward Gain: Reduces phase lag error.		

Pn122	Velocity Feedforward Filter Time	○	Address: 0x0122
Default: 2.00	Range: 0.00~64.00	Unit: ms	Control Mode: P

<table>
<tr><td>Pn123</td><td>Torque Feedforward Gain</td><td>○</td><td>Address: 0x0123</td></tr>
<tr><td>Default: 0</td><td>Range: 0~500</td><td>Unit: %</td><td>Control Mode: P S</td></tr>
<tr><td>Description</td><td colspan="3">This setting is only valid for position and speed mode.

</td></tr>
</table>

Pn124	Torque Feedforward Filter Time	○	Address: 0x0124
Default: 2.00	Range: 0.00~64.00	Unit: ms	Control Mode: P S

Pn125★	Velocity Feedback Filter Time	○	Address: 0x0125
Default: 0.00	Range: 0.00~655.35	Unit: ms	Control Mode: P S T
Description	Set the 1st low-pass filter to the speed feedback in ASR, to reduce resonance and high-frequency noise interference within. This setting will smooth the feedback speed and reduce vibration, but if it is too high, it will introduce delay, degrading response performance and slowing down the loop control.		

Pn130	ASR P/PI Shift	■	Address: 0x0130
Default: 0x0000	Range: 0x0000~0x0114	Unit: N/A	Control Mode: P S T

Parameter setting	0-th bit X	ASR P/PI shift condition	
		0	Pn132 [P/PI Shift Condition (Torque Reference)]
		1	Pn133 [P/PI Shift Condition (Velocity Reference)]
		2	Pn134 [P/PI Shift Condition (Acceleration)]
		3	Pn135 [P/PI Shift Condition (Position Deviation)]
		4	OFF
	1-st bit Y	ASR control mode	
		0	PI control
		1	P control

	2-nd bit Z	Reserved parameters (Not for modification)
	3-rd bit W	Reserved parameters (Not for modification)

Pn132	P/PI Shift Condition (Torque Reference)		○	Address: 0x010C
Default: 200	Range: 0~800		Unit: 1%	Control Mode: P S T

Pn133	P/PI Shift Condition (Velocity Reference)		○	Address: 0x010D
Default: 0	Range: 0~10000		Unit: 1rpm	Control Mode: P S T

Pn134	P/PI Shift Condition (Acceleration)		○	Address: 0x010E
Default: 0	Range: 0~30000		Unit: 1rpm/s	Control Mode: P S T

Pn135	P/PI Shift Condition (Position Deviation)		○	Address: 0x010F
Default: 0	Range: 0~10000		Unit: 1 reference unit	Control Mode: P S T

Pn140	Type-A Vibration Suppression		○	Address: 0x0140
Default: 0x0010	Range: 0x0000~0x0011		Unit: N/A	Control Mode: P S
Parameter setting	0-th bit X	Type-A vibration suppression enable		
		0	OFF	
		1	ON	
	1-st bit Y	Type-A vibration suppression utility function		
		0	OFF	
		1	ON	
	2-nd bit Z	Reserved parameters (Not for modification)		
	3-rd bit W	Reserved parameters (Not for modification)		

Pn141	Type-A Vibration Suppression Gain Compensation		○	Address: 0x0141
Default: 100	Range: 1~1000		Unit: %	Control Mode: P S T

Pn142	Type-A Vibration Suppression Frequency		○	Address: 0x0142
Default: 100.0	Range: 1.0~2000.0	Unit: Hz		Control Mode: P S T

Pn143	Type-A Vibration Suppression Damping Gain		○	Address: 0x0143
Default: 0	Range: 0~300	Unit: %		Control Mode: P S T

Pn144	Type-A Vibration Suppression Filter Time Compensation 1		○	Address: 0x0144
Default: 0	Range: -10.00~10.00	Unit: ms		Control Mode: P S T

Pn145	Type-A Anti-vibration Filter Time Compensation 2		○	Address: 0x0145
Default: 0	Range: -10.00~10.00	Unit: ms		Control Mode: P S T

Pn14A	Type-IINotch Filter 1 Frequency		○	Address: 0x014A
Default: 5000	Range: 50~5000	Unit: Hz		Control Mode: P S T
Set the center frequency of the 1st notch filtER.				

Pn14B	Type-II Notch Filter 2 Attenuation Rate		○	Address: 0x014B
Default: 0	Range: 0~32	Unit: dB		Control Mode: P S T
Description: Set the center frequency of the 1st notch filter, it's invalid when set to 0.				

Pn14C	Type-IINotch Filter 2 Frequency		○	Address: 0x014C
Default: 5000	Range: 50~5000	Unit: Hz		Control Mode: P S T
Set the center frequency of the 2nd notch filtER.				

Pn14D	Type-IINotch Filter 2 Attenuation Rate		○	Address: 0x014D
Default: 0	Range: 0~32	Unit: dB		Control Mode: P S T
Description: Set the center frequency of the 2nd notch filter, it's invalid when set to 0.				

Pn150	Notch Filter Enable		○	Address: 0x0150
Default: 0x0000	Range: 0x0000~0x1101	Unit: N/A		Control Mode: P S T

Parameter setting	0-th bit X	Notch filter 1 enable	
		0	OFF
		1	ON

	1-st bit Y	Reserved parameters (Not for modification)	
	2-nd bit Z	Notch filter 2 enable	
		0	OFF
		1	ON
	3-rd bit W	Friction compensation enable	
		0	OFF
		1	ON

Pn151	Notch Filter Utility Function Enable		○	Address: 0x0151
Default: 0x0101	Range: 0x0000~0x0101		Unit: N/A	Control Mode: P S T
Parameter setting	0-th bit X	Notch filter 1 utility function enable		
		0	OFF	
		1	ON	
	1-st bit Y	Reserved parameters (Not for modification)		
	2-nd bit Z	Notch filter 2 utility function enable		
		0	OFF	
		1	ON	
	3-rd bit W	Reserved parameters (Not for modification)		

Pn152	Auto-Notching Resonance(ANR) Detection Sensitivity	○	Address: 0x0152
Default: 100	Range: 1~200	Unit: %	Control Mode: P S T

Pn153	Notch Filter 1 Frequency	○	Address: 0x0153
Default: 5000	Range: 50~5000	Unit: Hz	Control Mode: P S T

Pn154	Notch Filter 1 Q Factor	○	Address: 0x0154
Default: 0.70	Range: 0.50~10.00	Unit: N/A	Control Mode: P S T

Pn155	Notch Filter 1 Depth (D)	○	Address: 0x0155
Default: 0.000	Range: 0.000~1.000	Unit: N/A	Control Mode: P S T

Pn156	Notch Filter 2 Frequency	○	Address: 0x0156
Default: 5000	Range: 50~5000	Unit: Hz	Control Mode: P S T

Pn157	Notch Filter 2 Q Factor	○	Address: 0x0157
Default: 0.70	Range: 0.50~10.00	Unit: N/A	Control Mode: P S T

Pn158	Notch Filter 2 Depth (D)	○	Address: 0x0158
Default: 0.000	Range: 0.000~1.000	Unit: N/A	Control Mode: P S T

Pn159	Notch Filter 3 Frequency	○	Address: 0x0159
Default: 5000	Range: 50~5000	Unit: Hz	Control Mode: P S T
Set the center frequency of the notch filtER. When the notch filter frequency is set to 5000, it is invalid.			

Pn15A	Notch Filter 3 Q Factor	○	Address: 0x015A
Default: 0.70	Range: 0.50~10.00	Unit: N/A	Control Mode: P S T

Pn15B	Notch Filter 3 Depth (D)	○	Address: 0x015B
Default: 0.000	Range: 0.000~1.000	Unit: N/A	Control Mode: P S T

Pn15C	Notch Filter 4 Frequency	○	Address: 0x015C
Default: 5000	Range: 50~5000	Unit: Hz	Control Mode: P S T
Set the center frequency of the notch filtER. When the notch filter frequency is set to 5000, it is invalid.			

Pn15D	Notch Filter 4 Q Factor	○	Address: 0x015D
Default: 0.70	Range: 0.50~10.00	Unit: N/A	Control Mode: P S T

Pn15E	Notch Filter 4 Depth (D)	○	Address: 0x015E
Default: 0.000	Range: 0.000~1.000	Unit: N/A	Control Mode: P S T

Pn161	Friction Compensation Gain 1	○	Address: 0x0161
Default: 100	Range: 10~1000	Unit: %	Control Mode: P S

Pn162	Friction Compensation Gain 2	○	Address: 0x0162
Default: 100	Range: 10~1000	Unit: %	Control Mode: P S

Pn163	Friction Compensation Factor		○	Address: 0x0163
Default: 0	Range: 0~100	Unit: %		Control Mode: P S

Pn164	Friction Compensation Frequency Correction		○	Address: 0x0164
Default: 0.0	Range: 0.0~1000.0	Unit: Hz		Control Mode: P S

Pn165	Friction Compensation Gain Correction		○	Address: 0x0165
Default: 100	Range: 0~1000	Unit: %		Control Mode: P S

<table>
<tr><td>Pn175</td><td colspan="3">No-tuning Control</td><td>■</td><td>Address: 0x0175</td></tr>
<tr><td>Default: 0x1400</td><td colspan="2">Range: 0x0000~0x2911</td><td colspan="2">Unit: N/A</td><td>Control Mode: P</td></tr>
<tr><td rowspan="24">Parameter setting</td><td rowspan="3">0-th bit
X</td><td colspan="4">No-tuning enable</td></tr>
<tr><td>0</td><td colspan="3">OFF</td></tr>
<tr><td>1</td><td colspan="3">ON</td></tr>
<tr><td rowspan="3">1-st bit
Y</td><td colspan="4">No-tuning speed control mode</td></tr>
<tr><td>0</td><td colspan="3">For speed control</td></tr>
<tr><td>1</td><td colspan="3">For speed control and upper device used for position control</td></tr>
<tr><td rowspan="11">2-nd bit
Z</td><td colspan="4"></td></tr>
<tr><td>0</td><td colspan="2">Rigidity 0</td><td>Response: slow</td></tr>
<tr><td>1</td><td colspan="2">Rigidity 1</td><td rowspan="8"></td></tr>
<tr><td>2</td><td colspan="2">Rigidity 2</td></tr>
<tr><td>3</td><td colspan="2">Rigidity 3</td></tr>
<tr><td>4</td><td colspan="2">Rigidity 4</td></tr>
<tr><td>5</td><td colspan="2">Rigidity 5</td></tr>
<tr><td>6</td><td colspan="2">Rigidity 6</td></tr>
<tr><td>7</td><td colspan="2">Rigidity 7</td></tr>
<tr><td>8</td><td colspan="2">Rigidity 8</td></tr>
<tr><td>9</td><td colspan="2">Rigidity 9</td><td>Response: fast</td></tr>
<tr><td rowspan="4">3-rd bit
W</td><td colspan="4">No-tuning load inertia</td></tr>
<tr><td>0</td><td colspan="3">Low</td></tr>
<tr><td>1</td><td colspan="3">Medium</td></tr>
<tr><td>2</td><td colspan="3">High</td></tr>
</table>

Pn17A	No-tuning Interference Compensation Gain		○	Address: 0x017A
Default: 600.0	Range: 0:0.0~6553.5	Unit: Hz		Control Mode: P S

Pn17B	No-tuning Inertia Correction Factor		○	Address: 0x017B
Default: 100	Range: 0~100	Unit: %		Control Mode: P S

Pn17C	No-tuning Torque Filter Time		○	Address: 0x017C
Default: 0.10	Range: 0:00~655.35	Unit: ms		Control Mode: P S

Pn17D	No-tuning Velocity Feedback Filter Time		○	Address: 0x017D
Default: 0.10	Range: 0:00~655.35	Unit: ms		Control Mode: P S

Pn185	Vibration Error/Alarm		○	Address: 0x0185
Default: 0x0000	Range: 0x0000~0x0002		Unit: N/A	Control Mode: P
Parameter setting	0-th bit X	Vibration fault prompt mode		
		0	OFF	
		1	ON and report AL.911	
		2	ON and report ER.520	
	1-st bit Y	Reserved parameters (Not for modification)		
	2-nd bit Z	Reserved parameters (Not for modification)		
	3-rd bit W	Reserved parameters (Not for modification)		

Pn186	Vibration Error/Alarm Detection Sensitivity		○	Address: 0x0186
Default: 100	Range: 50~500	Unit: %		Control Mode: P S T

Pn187	Vibration Error/Alarm Level		○	Address: 0x0187
Default: 50	Range: 0~5000	Unit: rpm		Control Mode: P S T
Description	Set the threshold for low-frequency vibration detection, vibration detection value = Pn186[Vibration Error/Alarm Detection Sensitivity] × Pn187[Vibration Error/Alarm Level]. The lower the setting, the easier it is to detect vibration, but it may lead to misdetection during normal operation if it's too low.			

Pn192	Overshoot Detection Sensitivity(/COIN Signal Width)	○	Address: 0x0192
Default: 100	Range: 0~100	Unit: %	Control Mode: P S T

Pn193	Max. Advanced Tuning Gain	○	Address: 0x0193
Default: 300.0	Range: 1.0~400.0	Unit: Hz	Control Mode: P S T

7.3.3 Position Parameters(Pn2xx)

Pn200	Position Reference Source	■	Address: 0x0200
Default: 0x0020	Range: 0x0000~0x0084	Unit: N/A	Control Mode: P

Parameter setting	0-th bit X	Pulse reference type	
		0	High-speed pulse train
		1	Low-speed pulse train
		2	Reserved
		3	Internal target position
	1-st bit Y	Pulse reference filter (software)	
		0	Filter 1 (~52Kpps, 9.6μs)
		1	Filter 2 (~104Kpps, 4.8μs)
		2	Filter 3 (~208Kpps, 2.4μs)
		3	Filter 4 (~416Kpps, 1.2μs)
		4	Filter 5 (~832Kpps, 0.6μs)
		5	Filter 6 (~1664Kpps, 0.3μs)
		6	Filter 7 (~3328Kpps, 0.15μs)
		7	Filter 8 (~4Mpps, 0.125μs)
		8	Pn011 setting
	2-nd bit Z	Reserved parameters (Not for modification)	
	3-rd bit W	Reserved parameters (Not for modification)	

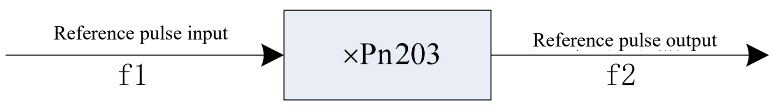
Notes	
⚠	• The max. pulse frequency of the open collector pulse is 200kHz, pulse filter 0~2 is valid. • There are differences in the interface definitions for open collector inputs and differential pulse inputs, so please refer to typical wiring for connection.

Pn201	Pulse Input Pattern	■	Address: 0x0202
Default: 0x0000	Range: 0x0000~0x0004	Unit: N/A	Control Mode: P

Set the form of the pulses sent to the drive in the position mode.

Setting	Description	Comment
0	Pulse + direction	-
1	Positive and negative pulse train (CW+CCW)	-
2~3	Reserved	-
4	90° difference of orthogonal AB-phase (4×)	-

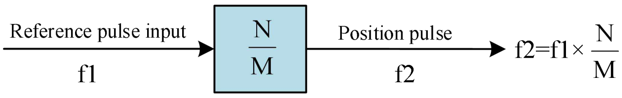
Pn202	Pulse Reference Logic		■	Address: 0x0202
Default: 0x0000	Range: 0x0000~0x0001		Unit: N/A	Control Mode:Ⓟ
Parameter setting	0-th bit X	Pulse reference logic		
		0	Positive (Default)	
		1	Negative (Reverse)	
	1-st bit Y	Reserved parameters (Not for modification)		
	2-nd bit Z	Reserved parameters (Not for modification)		
	3-rd bit W	Reserved parameters (Not for modification)		

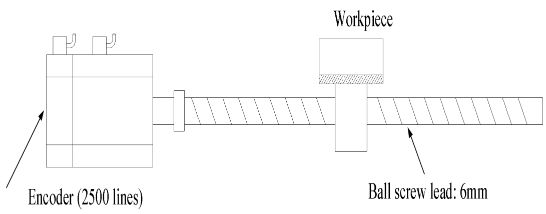
Pn203	Pulse Reference Multiplier	○	Address: 0x0203
Default: 1	Range: 1~100	Unit: ×1	Control Mode:Ⓟ
Description	Set to perform multiplication of reference pulses, which can be switched via DI terminal X (/P-GAIN) from 1x to Nx (max. 100x).  Note: The multiplier is valid only for external reference pulses, but not for internal programmed JOG and intelligent tuning.		

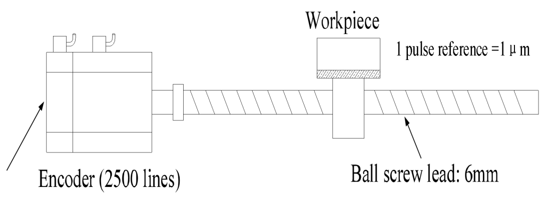
Pn204	Electronic Gear Ratio Numerator (N)	○	Address: 0x0204★
Default: 1	Range: 0~1073741824	Unit: N/A	Control Mode:Ⓟ
Description	Set the numerator value of the gear ratio.		

Notes
When this is set to 0, the drive automatically sets the electronic gear numerator internally with the resolution of the encodER. For example: ● When it is a 17-bit the serial encoder and set to 0, the drive sets N=131072. ● When it is a 24-bit the serial encoder and set to 0, the drive sets N=16777216. ● When it is a 23-bit the serial encoder and set to 0, the drive sets N=8388608.

Pn206	Electronic Gear Ratio Denominator (M)	○	Address: 0x0206★
Default: 1	Range: 1~1073741824	Unit: NA	Control Mode:🄿

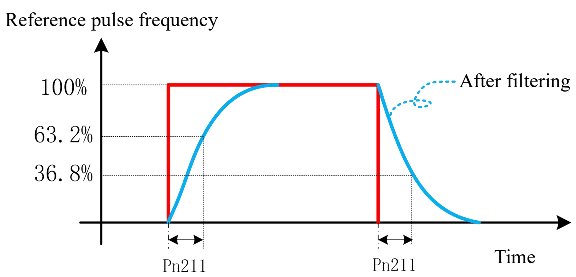
<table>
<tr>
<td>Description</td>
<td>
The electronic gear feature allows for simple adjustment of the travel ratio. However, a higher electronic gear ratio may cause position references to become step-like (quantized). Mitigate this problem by applying S-curve acceleration/deceleration or low-pass filtering to smooth the reference signals. For example, When the electronic gear ratio=1, the motor encoder resolution is 10,000 pulses per revolution (ppr).
When the electronic gear ratio=0.5, every 2 reference pulses make the motor rotate by 1 pulse. Incorrect settings may cause sudden jerks in the servo motor. Users must configure the ratio properly to avoid instability.


If the mechanical reduction ratio between the motor shaft and load is A:B (i.e., the motor rotates B turns while the load rotates A turns), the electronic gear ratio (N/M) should be set as:
Electronic gear ratio= M/N=Encoder Resolution×B/Desired Reference Pulses per Load Revolution×A
Example: Calculating Reference Pulses with/without Electronic Gear Ratio
Servo motor encoder resolution: 10,000 pulses/revolution (ppr)
Ball screw lead: 6 mm/rev
Target workpiece movement: 10 mm


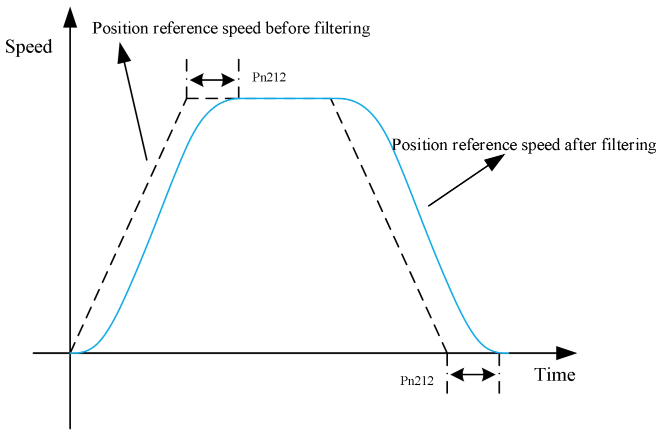
Case 1: Without Electronic Gear Ratio
Motor rotation per 6 mm movement: 1 revolution
Motor rotation for 10 mm: 10mm/6mm/rev=1.6 rev
Required reference pulses (4x multiplier applied): 1.
6rev×10,000 ppr=16,666 pulses
Thus host controller must output: 16,666 pulses


Case 2: With Electronic Gear Ratio
Target movement in μm: 10 mm=10,000 μm
Since 1 pulse = 1 μm: 10,000 μm/1μm/pulse=10,000 pulses
Thus host controller only needs to output: 10,000 pulses
</td>
</tr>
</table>

Notes	
	● Change the electronic gear ratio only when the motor is stopped or running at low speed to avoid excessive vibration. If vibration occurs during switching, use position smoothing parameters (e.g., S-curve acceleration/deceleration or low-pass filtering) to mitigate instability. ● If the electronic gear ratio is modified during a segment's execution, the change does not take effect immediately. And the new ratio is applied only after the current segment completes and before the next segment begins. ● The electronic gear ratio changes take effect immediately for incoming pulse references. ● The electronic gear ratio must be within the drive’s allowable range, or it will report ER.D04 (Electronic gear ratio setting overrun).

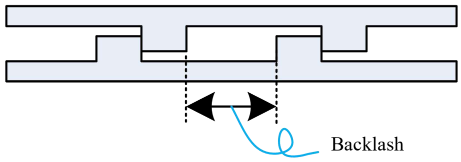
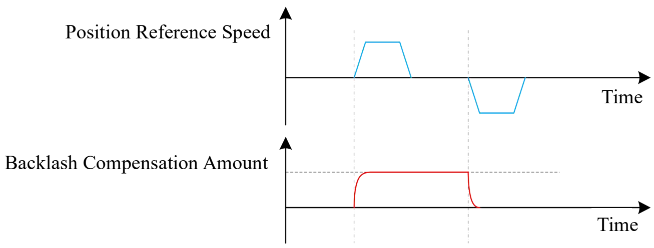
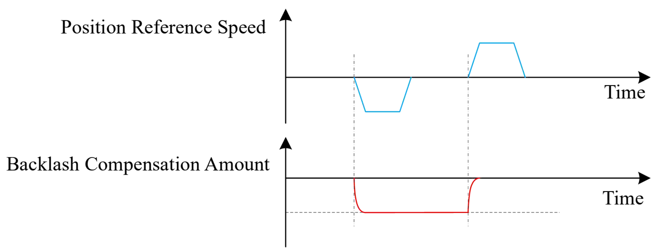
Pn211	Position Reference Filter Time	○	Address: 0x0211
Default: 0.0	Range: 0.0~655.0	Unit: ms	Control Mode:🄿
Description	Set to apply 1st-order low-pass filter to buffer the excessive changes in the input reference pulse signals. Note: This function is invalid when set to 0.  Typical applications are: ①No ACC/DEC on host controllers; ②High electronic gear ratios; ③Low pulse frequency; ④Step-like motions.		

Pn212	Position Reference Moving Average Filter	○	Address: 0x0212
Default: 0.0	Range: 0.0~1000.0	Unit: ms	Control Mode:🄿

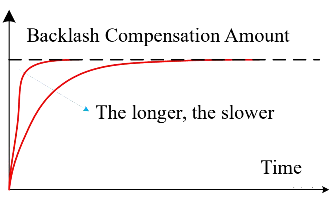
Funcode Description	Set to smooth the step-like position references at the beginning and end of the motion, but it may cause a delay to the position references. 

Notes	
	● This function is off when set to 0.

Pn220	Backlash Compensation		■	Address: 0x0220
Default: 0x0000	Range: 0x0000~0x0011		Unit: N/A	Control Mode: P
Parameter setting	0-th bit X	Backlash compensation enable		
		0	OFF	
		1	ON	
	1-st bit Y	Backlash compensation direction		
		0	Positive	
		1	Negative	
	2-nd bit Z	Reserved parameters (Not for use)		
	3-rd bit W	Reserved parameters (Not for use)		

Description	For ball screws and other similar drive mechanisms, there will be a repeatability error after a long period of wear and tear. Set backlash compensation at this time to reduce the error caused by the design of the mechanism.  Pn220.Y=0 (Positive)  Pn220.Y=1 (Negative) 

Pn221	Backlash Compensation Level		○	Address: 0x0221★
Default: 0.0	Range: -5000.0~5000.0	Unit: 0.1 reference unit		Control Mode: $\boxed{P}$

Pn223	Backlash Compensation Filter Time		○	Address: 0x0223
Default: 10.00	Range: 0.00~100.00	Unit: ms		Control Mode: $\boxed{P}$
Description	Set the filter time which is in an exponential relationship with the amount of backlash compensation and decides the rate of convergence of the compensation curve.  			

Pn232	LF Vibration Detection Sensitivity (/COIN Signal Width)		○	Address: 0x0232
Default: 40.0	Range: 0.1~300.0	Unit: %		Control Mode: $\boxed{P}$

Description	Set the threshold for low-frequency vibration detection, vibration detection value=Pn232[LF Vibration Detection Sensitivity]×Pn262[/COIN Signal Width] . The smaller the the easier it is to detect vibration.

Pn233	LF Vibration Suppression 1 Level A	○	Address: 0x0233
Default: 50.0	Range: 1.0~250.0	Unit: Hz	Control Mode:🄿

Pn234	LF Vibration Suppression 1 Level B	○	Address: 0x0234
Default: 70.0	Range: 1.0~250.0	Unit: Hz	Control Mode:🄿

Pn235	LF Vibration Suppression 2 Level	○	Address: 0x0235
Default: 200.0	Range: 1.0~200.0	Unit: Hz	Control Mode:🄿
Description	Set the center frequency for low frequency vibration suppression, this function is on when this function code is not 200.0Hz, and the response of the drive is slowER. If the model following function is on (Pn240.X=1), users can also use this function when Pn240.Y=2.		

Pn236	LF Vibration Suppression 2 Gain	○	Address: 0x0236
Default: 100	Range: 10~1000	Unit: %	Control Mode:🄿
Description	Set the suppression gain for low-frequency vibration, the smaller this setting, the more obvious the suppression of vibration, but it may lead to excessive positioning time.		

Pn240	Model Following Control (MFC)	○	Address: 0x0240
Default: 0x0100	Range: 0x0000~0x1121	Unit: N/A	Control Mode:🄿

Parameter setting	0-th bit X	MFC enable	
		0	OFF
		1	ON
	1-st bit Y	LF vibration suppression	
		0	OFF
		1	ON for specific frequencies
		2	ON for two different frequencies
	2-nd bit Z	LF vibration suppression utility function	
		0	0: OFF
		1	1: ON
	3-rd bit W	Position/Torque reference feed-forward	
		0	MFC only, position/torque reference feed-forward off
		1	MFC and position/torque reference on

Pn241	MFC Gain 1		○	Address: 0x0241
Default: 50.0	Range: 1.0~2000.0	Unit: 1/s		Control Mode:🄿

Pn242	MFC Gain Correction		○	Address: 0x0242
Default: 100.0	Range: 50.0~200.0	Unit: %		Control Mode:🄿

Pn243	MFC Velocity Feedforward Compensation		○	Address: 0x0243
Default: 100.0	Range: 0.0~1000.0	Unit: %		Control Mode:🄿

Pn244	MFC Offset(Positive)		○	Address: 0x0244
Default: 100.0	Range: 0.0~1000.0	Unit: %		Control Mode:🄿

Pn245	MFC Offset(Negative)		○	Address: 0x0245
Default: 100.0	Range: 0.0~1000.0	Unit: %		Control Mode:🄿

Pn246	MFC Gain 2		○	Address: 0x0246
Default: 50.0	Range: 1.0~2000.0	Unit: 1/s		Control Mode:🄿

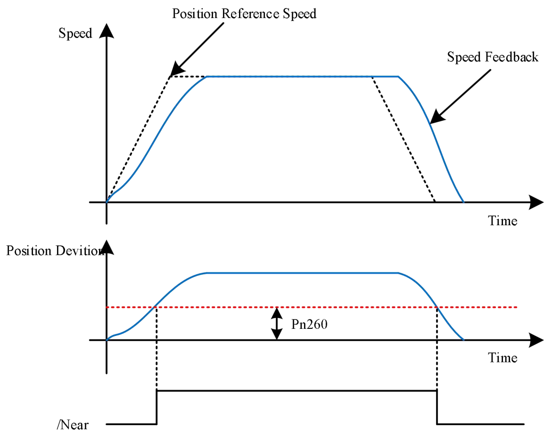
Pn247	MFC Gain 2 Correction		○	Address: 0x0247
Default: 100.0	Range: 50.0~200.0	Unit: %		Control Mode:🄿

Pn248※	Control Switch		■	Address: 0x0248
Default: 0x0001	Range: 0x0000~0x0011	Unit: N/A		Control Mode:🄿🅂🅃
Parameter setting	0-th bit X	MFC mode		
		0	I-type MFC	
		1	II-type MFC	
	1-st bit Y	No-tuning mode		
		0	I-type no-tuning	
		1	II-type no-tuning	
	2-nd bit Z	Reserved parameters (Not for modification)		
	3-rd bit W	Reserved parameters (Not for modification)		

Pn260	/Near Signal Width	○	Address: 0x0260★
Default: 1073741824	Range: 1~1073741824	Unit: Reference unit	Control Mode:P

Description

Output this signal when the difference between the reference pulse number of the host controller and the servomotor movement (position deviation) is lower than this setting. In position control, the host controller can receive /NEAR before /COIN to prepare for the sequence of movements or other operations that are to be performed after the positioning is completed.

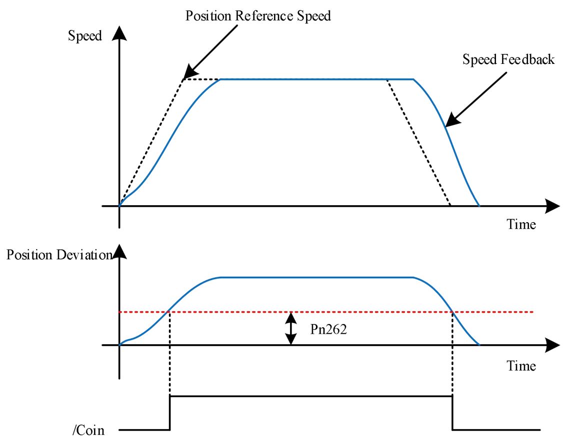


Note: Set a value greater than Pn262[/COIN Signal Width].

Pn262	/COIN Signal Width	○	Address: 0x0262
Default: 7	Range: 0~1073741824	Unit: Reference unit	Control Mode:P

Description

Output this signal when the difference between the command pulse number of the host controiller and the servomotor movement (position deviation) is lower than Pn262.



Note:

① This parameter has no effect on the final positioning accuracy.

② If the setting is too high while the deviation is small in low-speed operation, /COIN may be output for a long time, at this time, please lower this setting until the signal is no longer output.

Pn264	Position Deviation Error Level		○	Address: 0x0264★
Default: 5242880	Range: 1~1073741824	Unit: Reference unit		Control Mode:Ⓟ
Description	If the deviation between the position reference and the actual feedback during motor operation exceeds this setting, a position deviation error is generated. The position deviation during normal operation varies according to the setting of operation speed, gain, feedforward, etc. Therefore, it is set by the following formula during actual use:. $$Pn264=\frac{F_c}{K_p}\times(1.2\sim2.0)$$ In the formula: F_c: Max. position reference pulse (pulse/s); K_p: Position loop gain (1/s) 1.2~2.0: Safety factor (protection against frequent excessive position deviation).			

Pn266	Position Deviation Alarm Level		○	Address: 0x0266
Default: 100	Range: 10~100	Unit: %		Control Mode:Ⓟ
Description	Set the excessive position deviation alarm threshold. The drive generates an excessive position deviation alarm when the current position deviation value is higher than this setting.			

Pn267	Servo-ON Position Deviation Error Level		○	Address: 0x0267★
Default: 5242880	Range: 1~1073741823	Unit: Reference unit		Control Mode:Ⓟ
Description	If the position deviation exceeds this setting at the moment when servo drive starts to operate, the drive generates this error.			

Pn269	Servo-ON Position Deviation Alarm Level		○	Address: 0x0269
Default: 100	Range: 10~100	Unit: %		Control Mode:Ⓟ
Description	If the position deviation exceeds this setting at the moment when servo drive starts to operate, the drive generates this alarm.			

Pn270	Servo-ON Speed Limit		○	Address: 0x0270
Default: 1000	Range: 0~10000	Unit: rpm		Control Mode:Ⓟ

Pn271	External Reference Pulse Multiplier		■	Address: 0x0271
Default: 0x0000	Range: 0x0000~0x0002	Unit: N/A		Control Mode:Ⓟ

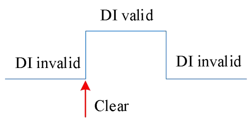
Pn272	/CLR Condition	■	Address: 0x0272
Default: 0x0000	Range: 0x0000~0x0003	Unit: N/A	Control Mode: $\boxed{P}$

Set the method of clearing the position deviation by /CLR signal in the position mode.

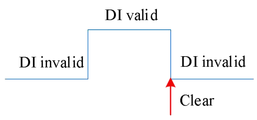
Setting	Description	Comment
0	At high level (H)	-
1	At rising edge	-
2	At low level (L)	-
3	At falling edge	-

/CLR signal status:

Clear at rising edge



Clear at falling edge



Pn273	Position Deviation Clear Mode	■	Address: 0x0273
Default: 0x0000	Range: 0x0000~0x0002	Unit: N/A	Control Mode: $\boxed{P}$

Set the work mode of the /CLR signal.

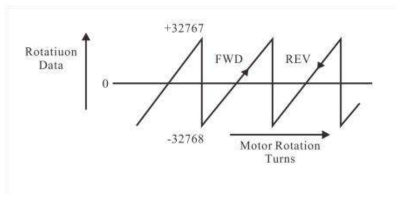
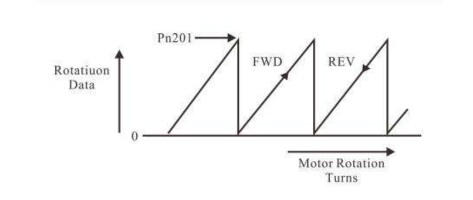
Setting	Description	Comment
0	ON under Servo OFF and errors	-
1	ON at /CLR signal only	-
2	ON under errors	-

Pn274	/COIN Output Sequence	○	Address: 0x0274
Default: 0x0000	Range: 0x0000~0x0002	Unit: N/A	Control Mode: $\boxed{P}$

Set the output sequence of the /COIN signal.

Setting	Description	Comment
0	When the absolute value of the position deviation< Pn262 [/COIN Signal Width]	-
1	When the absolute value of position deviation<Pn262 [/COIN Signal Width] and the position reference filtered is 0.	-
2	When the absolute value of position deviation <Pn262 [/COIN Signal Width] and the position reference input is 0.	-

Pn276	Turn Upper Limit	■	Address: 0x0276
Default: 0	Range: 0~30000	Unit: Turn	Control Mode: $\boxed{P}$ $\boxed{S}$ $\boxed{T}$

<table>
<tr><td>Description</td><td>Set for position control of rotary parts such as turntables to keep the number of revolutions of the motor and the rotary table to an integer ratio without any decimals.<table><tr><th>Pn201=0</th><th>Pn201=1</th></tr><tr><td>
</td><td>
</td></tr></table></td></tr>
</table>

Notes	
⚠	● The setting of the upper limit of revolutions is valid only when an absolute encoder is used; ● When Pn201=0, the setting is invalid.

Pn277	Encoder Unidirection Mode		■	Address: 0x0277
Default: 0x0000	Range: 0x0000~0x0011	Unit: N/A		Control Mode:PST
Parameter setting	0-th bit X	Encoder unidirection enable		
		0	OFF	
		1	ON	
	1-st bit Y	Position feedback period		
		0	Cyclic	
		1	Acyclic	
	2-nd bit Z	Reserved parameters (Not for modification)		
	3-rd bit W	Reserved parameters (Not for modification)		

Notes	
⚠	● If Pn277[Encoder Unidirection Mode] setting is wrong, it may cause an absolute position failure and a ER.840 prompt.

Pn290	Home Mode		○	Address: 0x0290
Default: 0.100	Range: 0x0000~0x23B4	Unit: N/A		Control Mode:PST

<table>
<tr><td rowspan="40">Parameter setting</td><td rowspan="6">0-th bit
X</td><td colspan="2">Home enable</td></tr>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>ON by DI terminal</td></tr>
<tr><td>2</td><td>ON after power-up, and then enable the drive</td></tr>
<tr><td>3</td><td>Home immediately</td></tr>
<tr><td>4</td><td>Take the current position as the home position</td></tr>
<tr><td rowspan="13">1-st bit
Y</td><td colspan="2">Home mode</td></tr>
<tr><td>0</td><td>Positive, deceleration point and home point are home switches</td></tr>
<tr><td>1</td><td>Negative, deceleration point and home point are home switches</td></tr>
<tr><td>2</td><td>Positive, deceleration point and home point are Z signals</td></tr>
<tr><td>3</td><td>Negative, deceleration point and home point are Z signals</td></tr>
<tr><td>4</td><td>Positive, deceleration point is the home switch, and home point is the motor Z signal</td></tr>
<tr><td>5</td><td>Negative, deceleration point is the home switch, and home point is the motor Z signal</td></tr>
<tr><td>6</td><td>Positive, deceleration point and home point are positive OT switches</td></tr>
<tr><td>7</td><td>Negative, deceleration point and home point are negative OT switches</td></tr>
<tr><td>8</td><td>Positive, deceleration point and home point are Z signals</td></tr>
<tr><td>9</td><td>Negative, deceleration point and home point are Z signals</td></tr>
<tr><td>A</td><td>Absolute position home</td></tr>
<tr><td>B</td><td>Current position as the home position</td></tr>
<tr><td rowspan="5">2-nd bit
Z</td><td colspan="2">Trigger mode</td></tr>
<tr><td>0</td><td>Trigger at low level and stop at high level</td></tr>
<tr><td>1</td><td>Trigger at rising edge</td></tr>
<tr><td>2</td><td>Trigger at falling edge</td></tr>
<tr><td>3</td><td>Trigger at high level and stop at low</td></tr>
<tr><td rowspan="4">3-rd bit
W</td><td colspan="2">Home timeout unit</td></tr>
<tr><td>0</td><td>1ms</td></tr>
<tr><td>1</td><td>10ms</td></tr>
<tr><td>2</td><td>100ms</td></tr>
</table>

Pn291	Home High Speed Level		○	Address: 0x0291
Default: 100.0	Range: 0.0~3000.0		Unit: rpm	Control Mode:🄿
Description	Set the speed during search for the reference point (deceleration point), which determines the homing range. Do not set this value too low or it may report the home timeout error.			

Pn292	Home Low Speed Level		○	Address: 0x0292
Default: 10.0	Range: 0.0~1000.0		Unit: rpm	Control Mode:🄿
Description	Set the speed during search for home point and finally locate it. Do not set this value too high, or home position may be lost or the difference too large.			

Pn293	Home ACC/DEC Time		○	Address: 0x0293
Default: 3000	Range: 0~3000		Unit: ms	Control Mode:🄿
Description	Set the time required for the motor to accelerate from 0rpm to 3000rpm. And set the time required for the motor to decelerate from 3000rpm to 0 rpm.			

Pn294	Home Position Offset		○	Address: 0x0294★
Default: 0	Range:-2^{31}~$(2^{31}-1)$		Unit: Reference unit	Control Mode:🄿
Description	Set the distance for the motor after finding the home position, i.e., the motor's absolute position coordinates.			

Pn296	Absolute Zero Multi-turn Value		○	Address: 0x0296
Default: 0	Range: -32768~32767		Unit: rev	Control Mode:🄿🅂🅃

Pn297	Absolute Zero Single-turn Value		○	Address: 0x0297★
Default: 0	Range: 0~2147483647		Unit: Encoder unit	Control Mode:🄿🅂🅃
Description	The multi-turn value and the single-turn value of together indicate the target absolute position of the motor, which is used to set the target position of the motor when Pn290.Y is set to A, i.e., the multi-turn and the single-turn feedback of the motor at shutdown are equal to or close to the settings here.			

Pn299	Home Timeout		○	Address: 0x0299
Default: 10000	Range: 0~65535		Unit: ms	Control Mode:🄿🅂🅃

Description	Set the maximum time to search for a home signal. If this setting is too low or the home signal is not searched within this setting, the drive will generate ER.8A1. Note: This function is off when set to 0.

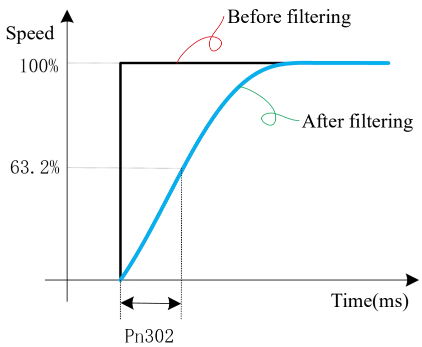
7.3.4 Velocity Parameters(Pn3xx)

<table>
<tr><td>Pn300</td><td colspan="2">Velocity Reference Source</td><td>○</td><td>Address: 0x0300</td></tr>
<tr><td>Default: 0000</td><td>Range: 0x0000~0x0005</td><td colspan="2">Unit: N/A</td><td>Control Mode:S</td></tr>
<tr><td colspan="5">Set the speed reference source in speed mode.</td></tr>
</table>

<table>
<tr><th>Setting</th><th>Description</th><th colspan="3">Comment</th></tr>
<tr><td>0</td><td>Internal digital setting</td><td colspan="3">Pn304[Velocity Reference Source]</td></tr>
<tr><td>2</td><td>Reserved</td><td colspan="3">-</td></tr>
<tr><td>3</td><td>Reserved</td><td colspan="3">-</td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">Hybrid setting</td><td>SPDB</td><td>SPDA</td><td>Reference source</td></tr>
<tr><td>0</td><td>0</td><td>Pn303.X</td></tr>
<tr><td>0</td><td>1</td><td>Pn303.Y</td></tr>
<tr><td>1</td><td>0</td><td>Pn303.Z</td></tr>
<tr><td>1</td><td>1</td><td>Pn303.W</td></tr>
<tr><td>5</td><td>Reserved</td><td colspan="3">-</td></tr>
</table>

<table>
<tr><td>Pn301</td><td colspan="2">Velocity Reference Direction</td><td>○</td><td>Address: 0x0301</td></tr>
<tr><td>Default: 0x0000</td><td>Range: 0x0000~0x0001</td><td colspan="2">Unit: N/A</td><td>Control Mode:S</td></tr>
</table>

Setting	Description	Comment
0	Positive logic	-
1	Negative logic	-

<table>
<tr><td>Pn302</td><td colspan="2">Velocity Reference Filter Time</td><td>○</td><td>Address: 0x0302</td></tr>
<tr><td>Default: 0.40</td><td>Range: 0.00~655.35</td><td colspan="2">Unit: ms</td><td>Control Mode:S</td></tr>
<tr><td>Description</td><td colspan="4">Set to apply low-pass filter to the speed reference to smooth it.
</td></tr>
</table>

<table>
<tr><td>Pn303</td><td colspan="2">Speed Control 1</td><td>■</td><td>Address: 0x0303</td></tr>
<tr><td>Default: 0x0000</td><td colspan="2">Range: 0x0000~0x2222</td><td>Unit: N/A</td><td>Control Mode:S</td></tr>
<tr><td rowspan="8">Parameter setting</td><td rowspan="2">0-th bit X</td><td colspan="3">Speed reference source 1</td></tr>
<tr><td>0</td><td colspan="2">Pn304 setting</td></tr>
<tr><td rowspan="2">1-st bit Y</td><td colspan="3">Speed reference source 2</td></tr>
<tr><td>0</td><td colspan="2">Pn305 setting</td></tr>
<tr><td rowspan="2">2-nd bit Z</td><td colspan="3">Speed reference source 3</td></tr>
<tr><td>0</td><td colspan="2">Pn306 setting</td></tr>
<tr><td rowspan="2">3-rd bit W</td><td colspan="3">Speed reference source 4</td></tr>
<tr><td>0</td><td colspan="2">Pn307 setting</td></tr>
</table>

Pn304	Internal Speed 0		○	Address: 0x0304
Default: 100	Range: -10000~10000	Unit: 1rpm		Control Mode:S

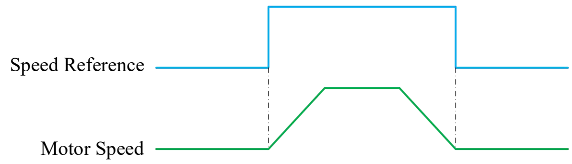
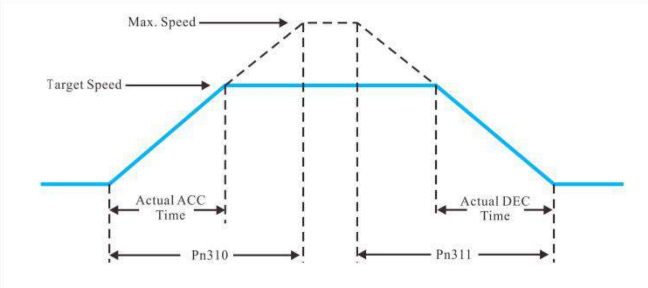
Pn305	Internal Speed 1		○	Address: 0x0305
Default: 200	Range: -10000~10000	Unit: 1rpm		Control Mode:S

Pn306	Internal Speed 2		○	Address: 0x0306
Default: 300	Range: -10000~10000	Unit: 1rpm		Control Mode:S

Pn307	Internal Speed 3		○	Address: 0x0307
Default: 400	Range: -10000~10000	Unit: 1rpm		Control Mode:S

Pn310	Soft Start ACC Time		○	Address: 0x0310
Default: 200	Range: 0~10000	Unit: 1ms		Control Mode:S

Pn311	Soft Start DEC Time		○	Address: 0x0311
Default: 200	Range: 0~10000	Unit: 1ms		Control Mode:S

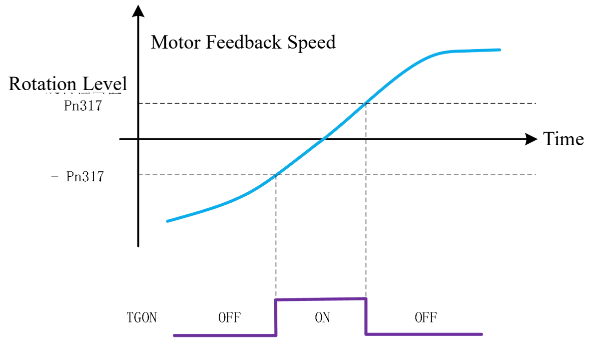
Description	Set the acceleration time and deceleration time to convert a step speed reference into a smoother ACC/DEC speed reference.  Pn310:The time required for the motor to reach the maximum speed of the motor from the stop state. Pn311: The time required for the motor to reach the motor stop from the maximum speed. The actual acceleration and deceleration time is calculated by the following formula: 

Pn313	Zero Clamping Velocity Level	○	Address: 0x0313
Default: 10	Range: 0~10000	Unit: rpm	Control Mode: S
Description	Set this function to lock the servo drive when the zero-position clamping signal (/ZCLAMP) is on and the speed reference is lower than this setting here. At this time, the servo unit internally forms a position loop, and the speed command will not be taken. And it can be used for speed control systems when a position loop has yet to be configured in the host controller.		

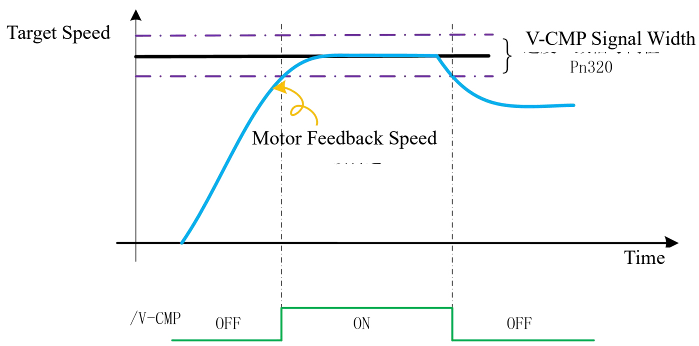
Notes	
⚠	● When the servo motor is clamped at zero position, it maintains a ±1 pulse fluctuation. Even if forced to rotate by external torque, it will return to the zero position.

Pn314	Max Zero Clamping Compensation Velocity	○	Address: 0x0314
Default: 1000	Range: 50~10000	Unit: rpm	Control Mode: S
Description	Set to limit the maximum speed during return when the servomotor is fixed in the zero position and moves by external force.		

Pn317	/TGON Signal Width	○	Address: 0x0317
Default: 20	Range: 1~10000	Unit: rpm	Control Mode: P S T

Description	Set the valid motor speed feedback range during which /TGON will be output. 

Pn318	Max. Motor Speed		○	Address: 0x0318
Default: 10000	Range: 0~10000	Unit: rpm		Control Mode: P S
Description	Set the maximum running speed of the servo motor. When this setting is greater than the maximum motor speed, take the latter as the actual maximum speed.			

Pn320	/V-CMP Signal Width		○	Address: 0x0320
Default: 10	Range: 0~100	Unit: rpm		Control Mode: P S T
Description	Set to tell whether the actual speed reaches the speed reference. If the deviation value between the motor feedback speed and the speed reference is within this setting, it means that the user speed is reached, and the output terminal assigned to /V-CMP signal outputs a high level(ON). Example: Pn320=50rpm, the target speed is 2000rpm, the motor speed is in the range of 1950rpm~2050rpm, then /V-CMP signal is sent. 			

7.3.5 Torque Parameters (Pn4xx)

Pn400	Torque Control 1		■	Address: 0x0400
Default: 0x0020	Range: 0x0000~0x0045	Unit: N/A		Control Mode: T

<table>
<tr><td rowspan="25">Parameter setting</td><td rowspan="11">0-th bit
X</td><td colspan="5">Torque reference source</td></tr>
<tr><td>0</td><td>Internal digital setting</td><td colspan="3">Pn410[Torque Reference Source 1] setting</td></tr>
<tr><td>1</td><td>Reserved</td><td colspan="3">-</td></tr>
<tr><td>2</td><td>Reserved</td><td colspan="3">-</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">Hybrid setting</td><td>TorqB</td><td>TorqA</td><td>Reference Source</td></tr>
<tr><td>0</td><td>0</td><td>Pn409.X setting</td></tr>
<tr><td>0</td><td>1</td><td>Pn409.Y setting</td></tr>
<tr><td>1</td><td>0</td><td>Pn409.Z setting</td></tr>
<tr><td>1</td><td>1</td><td>Pn409.W setting</td></tr>
<tr><td>4</td><td>Single trigger mode</td><td colspan="3">-</td></tr>
<tr><td>5</td><td>CANopen</td><td colspan="3">-</td></tr>
<tr><td rowspan="6">1-st bit
Y</td><td colspan="5">Torque mode velocity limit source</td></tr>
<tr><td>0</td><td>Reserved</td><td colspan="3">-</td></tr>
<tr><td>1</td><td>Reserved</td><td colspan="3">-</td></tr>
<tr><td>2</td><td>Internal digital setting</td><td colspan="3">Pn415 setting</td></tr>
<tr><td>3</td><td>DI terminal</td><td colspan="3">OFF: Pn415 setting ON: Pn416 setting</td></tr>
<tr><td>4</td><td>Torque reference direction</td><td colspan="3">Positive: Pn415 setting Negative: Pn416 setting</td></tr>
<tr><td>2-nd bit
Z</td><td colspan="5">Reserved parameters (Not for modification)</td></tr>
<tr><td>3-rd bit
W</td><td colspan="5">Reserved parameters (Not for modification)</td></tr>
</table>

Pn401	Torque Reference 2nd-order Filter Cutoff Frequency	○	Address: 0x0401
Default: 5000	Range: 100~5000	Unit: Hz	Control Mode: T
Description	This function is invalid when set to 5000.		

Pn402	Torque Reference 2nd-order Filter Q Factor	○	Address: 0x0402
Default: 0.50	Range: 0.50~1.00	Unit: N/A	Control Mode: T

Pn403	Torque Reference Direction	○	Address: 0x0403
Default: 0x0000	Range: 0x0000~0x0001	Unit: N/A	Control Mode: T

Setting	Description	Comment
0	Positive logic	-
1	Negative logic	-

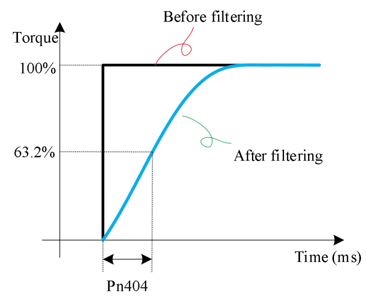
Notes

● Pn403 and external terminal signal (/TPR-D) are valid for torque references from the internal registER.

● The logic for combining Pn403 with the external terminal signal (/TPR-D) is as follows (CCW direction as positive):

Target Torque Reference	External Terminal TPR-D	Pn403.X	Actual Reference Direction
Positive reference	OFF	0	Positive reference
		1	Negative reference
	ON	0	Negative reference
		1	Positive reference
Negative reference	OFF	0	Negative reference
		1	Positive reference
	ON	0	Positive reference
		1	Negative reference

Pn404	Torque Reference Filter Time	○	Address: 0x0404
Default: 0.00	Range: 0.00~655.35	Unit: ms	Control Mode:T
Description	Set to apply a 1st order low-pass filter to the torque reference to smooth it.		



Pn409	Torque Control 3	○	Address: 0x0409
Default: 0x0000	Range: 0x0000~0x2222	Unit: N/A	Control Mode:T

Parameter setting	Bit	Value	Setting
	0-th bit X	Torque reference source 1	
		0	Pn410 setting
	1-st bit Y	Torque reference source 2	
		0	Pn411 setting
	2-nd bit Z	Torque reference source 3	
		0	Pn412 setting

	3-rd bit W	Torque reference source 4	
		0	Pn413 setting

Pn410	Internal Torque Reference 1	○	Address: 0x0410
Default: 0.0	Range: -500.0~500.0	Unit: %	Control Mode: T

Pn411	Internal Torque Reference 2	○	Address: 0x0411
Default: 0.0	Range: -500.0~500.0	Unit: %	Control Mode: T

Pn412	Internal Torque Reference 3	○	Address: 0x0412
Default: 0.0	Range: -500.0~500.0	Unit: %	Control Mode: T

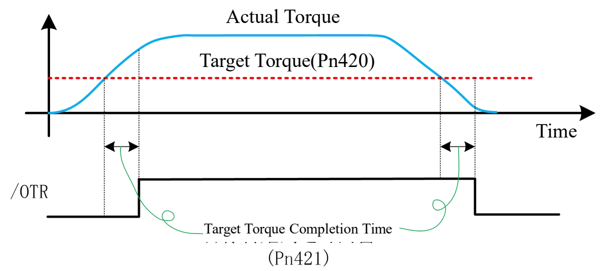
Pn413	Internal Torque Reference 4	○	Address: 0x0413
Default: 0.0	Range: -500.0~500.0	Unit: %	Control Mode: T

Pn415	Torque Mode Internal Speed Limit 1	○	Address: 0x0415
Default: 1000	Range: 0~10000	Unit: rpm	Control Mode: T

Pn416	Torque Mode Internal Speed Limit 2	○	Address: 0x0416
Default: 1000	Range: 0~10000	Unit: rpm	Control Mode: T

Pn420	Target Torque Level	○	Address: 0x0420
Default: 100.0	Range: 0.0~500.0	Unit: %	Control Mode: P S T

Pn421	Target Torque Completion Time	○	Address: 0x0421
Default: 5	Range: 0~1000	Unit: ms	Control Mode: P S T
Description	When the torque output from the drive is greater than the set target torque for the set time here, the target torque arrival signal is output.		



<table>
<tr><td>Pn430</td><td colspan="2">Torque Control 2</td><td>○</td><td>Address: 0x0430</td></tr>
<tr><td>Default: 0x0001</td><td colspan="2">Range: 0x0000~0x0013</td><td>Unit: N/A</td><td>Control Mode:T</td></tr>
<tr><td rowspan="6">Parameter setting</td><td>0-th bit X</td><td colspan="3">Reserved parameters (Not for modification)</td></tr>
<tr><td rowspan="3">1-st bit Y</td><td colspan="3">Control priority in torque mode</td></tr>
<tr><td>0</td><td colspan="2">Speed first</td></tr>
<tr><td>1</td><td colspan="2">Torque first</td></tr>
<tr><td>2-nd bit Z</td><td colspan="3">Reserved parameters (Not for modification)</td></tr>
<tr><td>3-rd bit W</td><td colspan="3">Reserved parameters (Not for modification)</td></tr>
</table>

7.3.6 Auxiliary Parameters (Pn5xx)

<table>
<tr><td>Pn500</td><td>Jog Speed</td><td>○</td><td>Address: 0x0500</td></tr>
<tr><td>Default: 200</td><td>Range: 0~3000</td><td>Unit: rpm</td><td>Control Mode:P S T</td></tr>
</table>

<table>
<tr><td>Pn502</td><td colspan="2">Programmed Jog Mode</td><td>○</td><td>Address: 0x0502</td></tr>
<tr><td>Default: 0x0000</td><td colspan="2">Range: 0x0000~0x0005</td><td>Unit: N/A</td><td>Control Mode:P S T</td></tr>
<tr><td rowspan="9">Parameter setting</td><td rowspan="7">0-th bit X</td><td colspan="3">Programmed jog mode</td></tr>
<tr><td>0</td><td colspan="2">(Pn535→Forward Pn531)×Pn536</td></tr>
<tr><td>1</td><td colspan="2">(Pn535→Reverse Pn531)×Pn536</td></tr>
<tr><td>2</td><td colspan="2">(Pn535→Forward Pn531)×Pn536
(Pn535→Reverse Pn531)×Pn536</td></tr>
<tr><td>3</td><td colspan="2">(Pn535→Reverse Pn531)×Pn536
(Pn535→Forward Pn531)×Pn536</td></tr>
<tr><td>4</td><td colspan="2">(Pn535→Forward Pn531→
Pn535→Reverse Pn531)×Pn536</td></tr>
<tr><td>5</td><td colspan="2">(Pn535→Reverse Pn531→
Pn535→Forward Pn531)×Pn536</td></tr>
<tr><td>1-st bit Y</td><td colspan="3">Reserved parameters (Not for modification)</td></tr>
<tr><td>2-nd bit Z</td><td colspan="3">Reserved parameters (Not for modification)</td></tr>
</table>

	3-rd bit W	Reserved parameters (Not for modification)

Pn503	Programmed Jog Distance		○	Address: 0x0503★
Default: 60000	Range: 1~1073741824	Unit: Reference unit		Control Mode: P S T

Pn505	Programmed Jog ACC/DEC Time		○	Address: 0x0505
Default: 100	Range: 2~10000	Unit: ms		Control Mode: P S T

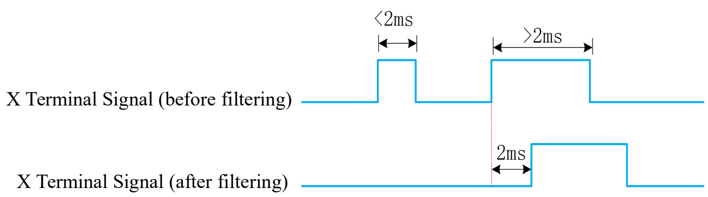
Pn506	Programmed Jog Delay		○	Address: 0x0506
Default: 100	Range: 0~10000	Unit: ms		Control Mode: P S T

Pn507	Programmed Jog Cycle		○	Address: 0x0507
Default: 1	Range: 0~1000	Unit: Times		Control Mode: P S T
Description	Set the cycle times during jogging programs.			

Notes	
⚠	When Pn502 is set to 2 or 3 and Pn507 is set to 0, the JOG is invalid. When Pn507 = 0, the JOG move times is not limited.

Pn508	Programmed Jog Velocity		○	Address: 0x0508
Default: 500	Range: 1~10000	Unit: rpm		Control Mode: P S T

7.3.7 Terminal Parameters(Pn6xx)

Pn600	X Terminal Filter Time		○	Address: 0x0600
Default: 2	Range: 0~3000	Unit: ms		Control Mode: P S T
Description	Set the filter time for external signals input to the drive from the X terminals. Example: When Pn600 filter time is 2ms, signals smaller than 2ms are filtered out. 			

Notes
• This filter time setting is valid for X1~X4; • The monitoring function code Un100 monitors filtered DI terminals.

Pn601	IN1 Configuration	○	Address: 0x0601
Default: 0x0001	Range: 0x0000~0x112F	Unit: N/A	Control Mode: P S T

Parameter setting	Bit	Value	Description
	0-th bit 1-st bit X Y	Assigned Value	
		00	OFF
		01	See 11.1 Attachment 1 Input Terminal Definitions
		...	
		2F	
	2-nd bit Z	Input terminal contact property	
		0	NO
		1	NC
	3-rd bit W	Input terminal signal source	
		0	External hardware terminal X1
		1	Pn630.X[Internal Setting on X Terminal]

Pn602	IN2 Configuration	○	Address: 0x0602
Default: 0x0002	Range: 0x0000~0x112F	Unit: N/A	Control Mode: P S T

Parameter setting	Bit	Value	Description
	0-th bit 1-st bit X Y	Assigned Value	
		00	OFF
		01	See 11.1 Attachment 1 Input Terminal Definitions
		...	
		2F	
	2-nd bit Z	Input terminal contact property	
		0	NO
		1	NC
	3-rd bit W	Input terminal signal source	
		0	External hardware terminal X2
		1	Pn630.Y[Internal Setting on X Terminal]

Pn603	IN3 Configuration	○	Address: 0x0603
Default: 0x0003	Range: 0x0000~0x112F	Unit: N/A	Control Mode: P S T

<table>
<tr><td rowspan="12">Parameter setting</td><td rowspan="5">0-th bit 1-st bit
X Y</td><td colspan="2">Assigned Value</td></tr>
<tr><td>00</td><td>OFF</td></tr>
<tr><td>01</td><td rowspan="3">See 11.1 Attachment 1 Input Terminal Definitions</td></tr>
<tr><td>...</td></tr>
<tr><td>2F</td></tr>
<tr><td rowspan="3">2-nd bit
Z</td><td colspan="2">Input terminal contact property</td></tr>
<tr><td>0</td><td>NO</td></tr>
<tr><td>1</td><td>NC</td></tr>
<tr><td rowspan="3">3-rd bit
W</td><td colspan="2">Input terminal signal source</td></tr>
<tr><td>0</td><td>External hardware terminal X3</td></tr>
<tr><td>1</td><td>Pn630.Z [Internal Setting on X Terminal]</td></tr>
</table>

<table>
<tr><td>Pn604</td><td colspan="2">IN4 Configuration</td><td>○</td><td>Address: 0x0604</td></tr>
<tr><td>Default: 0x0005</td><td colspan="2">Range: 0x0000~0x112F</td><td>Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="11"></td><td rowspan="5">0-th bit 1-st bit
X Y</td><td colspan="3">Assigned Value</td></tr>
<tr><td>00</td><td colspan="2">OFF</td></tr>
<tr><td>01</td><td colspan="2" rowspan="3">See 11.1 Attachment 1 Input Terminal Definitions</td></tr>
<tr><td>...</td></tr>
<tr><td>2F</td></tr>
<tr><td rowspan="3">2-nd bit
Z</td><td colspan="3">Input terminal contact property</td></tr>
<tr><td>0</td><td colspan="2">NO</td></tr>
<tr><td>1</td><td colspan="2">NC</td></tr>
<tr><td rowspan="3">3-rd bit
W</td><td colspan="3">Input terminal signal source</td></tr>
<tr><td>0</td><td colspan="2">External hardware terminal X4</td></tr>
<tr><td>1</td><td colspan="2">Pn630.W [Internal Setting on X Terminal]</td></tr>
</table>

<table>
<tr><td>Pn611</td><td colspan="2">OUT1 Configuration</td><td>○</td><td>Address: 0x0611</td></tr>
<tr><td>Default: 0x0001</td><td colspan="2">Range: 0x0000~0x110F</td><td>Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="7">Parameter setting</td><td rowspan="4">0-th bit 1-st bit
X Y</td><td colspan="3">Assigned Value</td></tr>
<tr><td>00</td><td colspan="2" rowspan="3">See 11.2 Attachment 2 Output Terminal Definitions</td></tr>
<tr><td>...</td></tr>
<tr><td>0F</td></tr>
<tr><td rowspan="3">2-nd bit
Z</td><td colspan="3">Output terminal contact property</td></tr>
<tr><td>0</td><td colspan="2">NO</td></tr>
<tr><td>1</td><td colspan="2">NC</td></tr>
</table>

	3-rd bit W	Output terminal signal source	
		0	Pn610 setting
		1	Pn631.X setting

Pn612	OUT2 Configuration		○	Address: 0x0612
Default: 0x0002	Range: 0x0000~0x110F		Unit: N/A	Control Mode: P S T
Parameter setting	0-th bit X 1-st bit Y	Assigned Value		
		00	See 11.2 Attachment 2 Output Terminal Definitions	
		…		
		0F		
	2-nd bit Z	Output terminal contact property		
		0	NO	
		1	NC	
	3-rd bit W	Output terminal signal source		
		0	Pn610 setting	
		1	Pn631.Y setting	

Pn630	Internal Setting on X Terminal		○	Address: 0x0630
Default: 0x0000	Range: 0x0000~0x03FF		Unit: N/A	Control Mode: P S T
Parameter setting	0-th bit X	Group 1		
		Bit0	vX1	
		Bit1	vX2	
		Bit2	vX3	
		Bit3	vX4	
	1-st bit Y	Group 2		
		Bit4	Reserved	
		Bit5	Reserved	
		Bit6	Reserved	
		Bit7	Reserved	
	2-nd bit Z	Group 3		
		Bit8	Reserved	
	3-rd bit W	Reserved parameters (Not for use)		

Pn631	Internal Setting on Y Terminal		○	Address: 0x0631
Default: 0x0000	Range: 0x0000~0x003F		Unit: N/A	Control Mode: P S T

Parameter setting	0-th bit X	Group 1	
		Bit0	Y1 status
		Bit1	Y2 status
		Bit2	Reserved
		Bit3	Reserved
	1-st bit Y	Group 2	
		Bit4	Reserved
		Bit5	Reserved
	2-nd bit Z	Reserved parameters (Not for use)	
	3-rd bit W	Reserved parameters (Not for use)	

7.3.8 Expansion Parameters(Pn7xx)

Pn702	Advanced Tuning Range		○	Address: 0x0702
Default: 3.0	Range: 0.5~10.0	Unit: Turn		Control Mode:PST

Pn705	Inertia Recognition Initial		○	Address: 0x0705
Default: 300	Range: 0~20000	Unit: %		Control Mode:PST

Pn706	Vibration Detection Level in Inertia Detection		○	Address: 0x0706
Default: 250	Range: 0~5000	Unit: rpm		Control Mode:PST

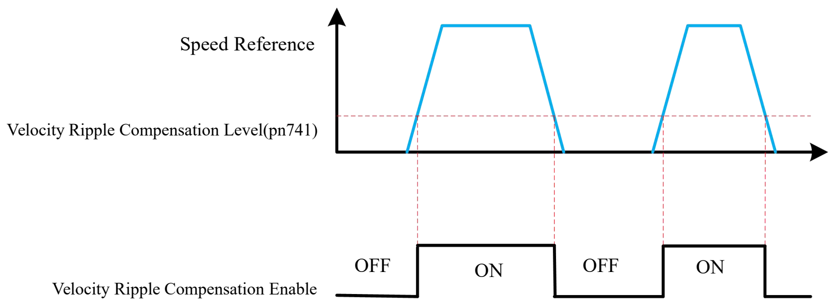
Pn720※	EasyFFT Sweep Start Frequency		○	Address: 0x0720
Default: 400	Range: 1~5000	Unit: Hz		Control Mode:PST

Pn721※	EasyFFT Sweep End Frequency		○	Address: 0x0721
Default: 4000	Range: 50~5000	Unit: Hz		Control Mode:PST

Pn722※	EasyFFT Resonance Frequency Lower Limit		○	Address: 0x0722
Default: 500	Range: 50~5000	Unit: Hz		Control Mode:PST

Pn723※	EasyFFT Scanning Torque Reference Range		○	Address: 0x0723
Default: 15	Range: 1~800	Unit: %		Control Mode:PST
Description	Set the amplitude value for the EasyFFT scanning torque references.			

<table>
<tr><td>Pn740※</td><td colspan="3">Velocity Ripple Compensation</td><td>○</td><td>Address: 0x0740</td></tr>
<tr><td colspan="2">Default: 0x0000</td><td colspan="2">Range: 0x0000~0x0011</td><td>Unit: N/A</td><td>Control Mode:PST</td></tr>
<tr><td rowspan="8">Parameter setting</td><td rowspan="3">0-th bit
X</td><td colspan="4">Velocity ripple compensation enable</td></tr>
<tr><td>0</td><td colspan="3">OFF</td></tr>
<tr><td>1</td><td colspan="3">ON</td></tr>
<tr><td rowspan="3">1-st bit
Y</td><td colspan="4">Velocity ripple compensation condition</td></tr>
<tr><td>0</td><td colspan="3">Velocity reference</td></tr>
<tr><td>1</td><td colspan="3">Motor speed</td></tr>
<tr><td>2-nd bit
Z</td><td colspan="4">Reserved parameters (Not for use)</td></tr>
<tr><td>3-rd bit
W</td><td colspan="4">Reserved parameters (Not for use)</td></tr>
<tr><td>Description</td><td colspan="5">Set to turn the speed ripple compensation on and off.</td></tr>
</table>

<table>
<tr><td>Pn741※</td><td colspan="2">Velocity Ripple Compensation Velocity</td><td>■</td><td>Address: 0x0741</td></tr>
<tr><td>Default: 0</td><td>Range: 0~10000</td><td>Unit: rpm</td><td colspan="2">Control Mode:PST</td></tr>
<tr><td>Description</td><td colspan="4">When the speed ripple compensation function is enabled, even when the speed reference is 0 or the motor speed is 0, this compensation will still be processed. So users need to set the valid speed level to trigger the compensation function.

</td></tr>
</table>

Pn742※	Speed Ripple Compensation Gain	■	Address: 0x0742
Default: 80	Range: 0~100	Unit: %	Control Mode:PST

Pn743※	1st Order Ripple Frequency	■	Address: 0x0743
Default: 0	Range: 0~100	Unit: N/A	Control Mode:PST

Pn744※	1st Order Ripple Amplitude	■	Address: 0x0744
Default: 0.0	Range: -10.0%~10.0%	Unit: %	Control Mode:ⓅⓈⓉ

Pn745※	1st Order Ripple Phase	■	Address: 0x0745
Default: 0	Range: 0~360	Unit: °(deg)	Control Mode:ⓅⓈⓉ

Pn746※	2nd Order Ripple Frequency	■	Address: 0x0746
Default: 0	Range: 0~100	Unit: N/A	Control Mode:ⓅⓈⓉ

Pn747※	2nd Order Ripple Amplitude	■	Address: 0x0747
Default: 0.0	Range: -10.0%~10.0%	Unit: %	Control Mode:ⓅⓈⓉ

Pn748※	2nd Order Ripple Phase	■	Address: 0x0748
Default: 0	Range: 0~360	Unit: °(deg)	Control Mode:ⓅⓈⓉ

Pn749※	3rd Order Ripple Frequency	■	Address: 0x0749
Default: 0	Range: 0~100	Unit: N/A	Control Mode:ⓅⓈⓉ

Pn74A※	3rd Order Ripple Amplitude	■	Address: 0x074A
Default: 0.0	Range: -10.0%~10.0%	Unit: %	Control Mode:ⓅⓈⓉ

Pn74B※	3rd Order Ripple Phase	■	Address: 0x074B
Default: 0	Range: 0~360	Unit: °(deg)	Control Mode:ⓅⓈⓉ

Pn74C※	4th Order Ripple Frequency	■	Address: 0x074C
Default: 0	Range: 0~100	Unit: N/A	Control Mode:ⓅⓈⓉ

Pn74D※	4th Order Ripple Amplitude	■	Address: 0x074D
Default: 0.0	Range: -10.0%~10.0%	Unit: %	Control Mode:ⓅⓈⓉ

Pn74E※	4th Order Ripple Phase	■	Address: 0x074E
Default: 0	Range: 0~360	Unit: °(deg)	Control Mode:ⓅⓈⓉ

Pn755	Field Weakening Control		○	Address: 0x0755
Default: 0x0001	Range: 0x0000~0x0001		Unit: N/A	Control Mode: P S T
Parameter setting	0-th bit X	Field weakening control enable		
		0	OFF	
		1	ON	
	1-st bit Y	Reserved parameters (Not for use)		
	2-nd bit Z	Reserved parameters (Not for use)		
	3-rd bit W	Reserved parameters (Not for use)		

Pn756	Field Weakening Control Gain	○	Address: 0x0756
Default: 30	Range: 10~1000	Unit: Hz	Control Mode: P S T

Pn757	Field Weakening Control Integral Time	○	Address: 0x0757
Default: 16	Range: 10~1000	Unit: us	Control Mode: P S T

Pn758	Field Weakening Control Integral Upper Limit	○	Address: 0x0758
Default: 100	Range: 0~200	Unit: %	Control Mode: P S T

Pn759	Field Weakening Control Voltage	○	Address: 0x0759
Default: 115	Range: 50~150	Unit: %	Control Mode: P S T

Pn75A	Max. Field Weakening Control Current	○	Address: 0x075A
Default: 95	Range: 50~150	Unit: %	Control Mode: P S T

Pn75B	Field Weakening-Main Circuit Voltage Filter Time i	○	Address: 0x075B
Default: 2.0	Range: 1.0~10.0	Unit: ms	Control Mode: P S T
Description	Set the number of moving average filters on the DC voltage used for weak magnetic calculations.		

Pn781※	Drive Bus Overvoltage Level	■	Address: 0x0781
Default: Up to model	Range: 0~1000	Unit: V	Control Mode:🄿🅂🅃
Description	Set the bus over-voltage threshold so that when the bus voltage is greater than this setting, the drive will report over-voltage error. For DC 48V model, the default overvoltage level is 85V, and the setting range is 80V~90V. Note: Do not change the parameters without the factory's permission, or it may cause irreversible damage to the machine!		

Pn782※	Drive Regen Braking Level	■	Address: 0x0782
Default: Up to model	Range: 0~1000	Unit: V	Control Mode:🄿🅂🅃
Description	Set the threshold value when the bus regenerative voltage is braked to release the capacitor charge to drop the bus voltage. For DC 48V model, the default value of driver overvoltage is 75V, and the setting range is 70V~80V.		

Pn783※	Regen Braking Hysteresis Band Width	■	Address: 0x0783
Default: Up to model	Range: 0~50	Unit: V	Control Mode:🄿🅂🅃
Description	For DC 48V models, the default value is 3V. Set this to effectively reduce frequent regenerative braking and prevent DC bus voltage relief. But a large value may cause great fluctuations in the DC bus.		

Pn784※	Drive Bus Undervoltage Level	■	Address: 0x0784
Default: Up to model	Range: 0~500	Unit: V	Control Mode:🄿🅂🅃
Description	Set the bus under-voltage threshold so that when the bus voltage is lower than this setting, the drive will report under-voltage error. For DC 48V model, the default value of drive undervoltage point is 18V, and the setting range is 18V~20V.		

Pn785※	Drive Bus Undervoltage Filter Time	■	Address: 0x0785
Default: 10	Range: 0~2000	Unit: ms	Control Mode:🄿🅂🅃

Pn786※	Drive Bus Undervoltage Alarm Level	■	Address: 0x0785
Default: Up to model	Range: 0~1000	Unit: V	Control Mode:🄿🅂🅃
Description	Set the bus undervoltage level so when the bus voltage is lower than this value, it will report undervoltage alarm. For DC 48V models, the drive undervoltage alarm value defaults to 20V.		

Pn788	Max Motor Speed Calibration		■	Address: 0x0788
Default: 0	Range: 0~2	Unit: 100rpm		Control Mode: P S T

Pn790※	Motor Code		○	Address: 0x0790
Default: Up to model	Range: 0x0000~0xFFFF	Unit: N/A		Control Mode: P S T
Description	Used to set the motor type assigned to the drive, the specific code setting value is based on the motor nameplate only for photoelectric incremental encoder motors. Serial encoder motor (factory value): 0x1000. When this function code is set to 0x1000, the drive recognizes the encoder type by itself. Currently, only Nikon 24-bit encoders and Tamagawa 17-bit or 23-bit encoders are supported. At the same time, the drive will update the corresponding recognized encoder to function code Pn791. Note: When Pn790 is set to 0x1000, the set value of function code Pn791 is invalid. Incremental encoder motor (set according to ID value). Custom serial encoder motor:0x3000 When this function code is set to 0x3000, the drive processes serial communication according to the encoder set by function code Pn791.			

Pn791※	Encoder Control		○	Address: 0x0791
Default: Up to model	Range: 0x0000~0x000A	Unit: N/A		Control Mode: P S T
Parameter setting	0-th bit X	Encoder type		
		0	Non-complementary incremental encoder (2500 PPR)	
		1	Complementary incremental encoder (2500 PPR)	
		2	Tamagawa 17-bit absolute encoder	
		3	Tamagawa 23-bit absolute encoder	
		4	Nikon 20-bit single-turn encoder	
		5	Nikon 20-bit multi-turn encoder	
		6	Nikon 24-bit single-turn encoder	
		7	Nikon 24-bit multi-turn encoder	
		8	Serial incremental encoder (10000 lines)	
		9	Nikon 24-bit encoder	
		10	Veichi in-house encoder	
	1-st bit Y	Reserved parameters (Not for use)		

	2-nd bit Z	Reserved parameters (Not for use)
	3-rd bit W	Reserved parameters (Not for use)
Description	Set the encoder type.	

Notes	
	● When using an absolute encoder, set the value in Pn790[Motor Code] to 1000, and Pn791 [Encoder Type] according to the actual encoder installed. ● When the value set in Pn790 indicates an incremental encoder, Pn791 setting is invalid and the encoder type is set automatically. ● Pn790 has the highest priority. The driver automatically determines the encoder type based on the value in Pn790.

Pn792※	Motor Zero Pole Position	○	Address: 0x0792
Default: Up to model	Range: -360~360	Unit: °	Control Mode: P S T
Description	Set to display the reference position of the motor's zero pole. The auxiliary function Fn080 will update this after identification, and it is exclusively used for serial encoders.		

Pn793※	Position Sensor Resolution	■	Address: 0x0793★
Default: 10000	Range: $1\sim2^{31}$	Unit: N/A	Control Mode: P S T
Description	Set the encoder resolution for customized motor parameters. For incremental encoders, the setting should be 4 times highER. Example: Incremental encoder is 2500 PPR, then the value of position sensor resolution is 10000.		

Pn79E	Reserved	■	Address: 0x079E
Default: 0000	Range: 00000~65535	Unit: N/A	Control Mode: P S T

Pn79F	User Password	○	Address: 0x079F
Default: 0x0000	Range: 0x0000~0xFFFF	Unit: N/A	Control Mode: P S T

7.3.9 Motion Control Parameters(Pn8xx)

Pn800	Internal Position Reference	■	Address: 0x0800
Default: 0x0000	Range: 0x0000~0x0000	Unit: N/A	Control Mode: P

Parameter setting	0-th bit X	Internal position reference source	
		0	Internal Pr reference
	1-st bit Y	Reserved parameters (Not for use)	
	2-nd bit Z	Reserved parameters (Not for use)	
	3-rd bit W	Reserved parameters (Not for use)	

Pn802	Internal Pr Reference	○	Address: 0x0802
Default: 0x0000	Range: 0x0000~0x1113	Unit: N/A	Control Mode:P

Parameter setting	0-th bit X	Internal position mode	
		0	Single segment (X terminal or communication)
		1	Single cycle and stop
		2	Cyclic
		3	Sequential
	1-st bit Y	Remaining path handling	
		0	Finish the remaining path
		1	Restart from path 1
	2-nd bit Z	Single-segment operation update	
		0	Non-immediate update
		1	Immediate update after communication reference
	3-rd bit W	Absolute position reference	
		0	Post-homing motor position
		1	Pn296[Absolute Zero Multi-turn Value] and Pn297[Absolute Zero Single-turn Value]
Description	When Pn802.Z=0, the DI or communication-based Pr commands are buffered until and the system finishes the current command, then the Pr commands are retrieved. When Pn802.Z=1, the communication-based Pr command is executed immediately.		

Pn803	Pr Reference-End Path	○	Address: 0x0803
Default: 1	Range: 1~15	Unit: N/A	Control Mode:P

Pn804	Pr Reference-Sequential Operation Start Path	○	Address: 0x0804
Default: 1	Range: 0~15	Unit: N/A	Control Mode:P

Description	①The first round of sequential operation starts from Pr1 and runs to the path pointed by Pn803. ②If Pn804=0 or Pn804＞Pn803, the sequence runs for 1 cycle and then stops. ③If Pn804≤Pn803, the first round is followed by cyclic operation, and the starts from Pn804. ④The enable signal CTRG is valid at high level.

Pn806	Pr Reference-Communication (Single Segment)	○	Address: 0x0806
Default: 10000	Range: 0~65535	Unit: N/A	Control Mode:Ⓟ
Description	①When DI terminal switching is valid, input 1~15 to trigger the corresponding Pr path, and input 1000 to stop the current operation mode at once. ②When in position mode, input 0 to trigger home and input 1000 to stop homing at once.		

Pn810	Pr Reference-Path1 Control Word L		○	Address: 0x0810
Default: 0x0000	Range: 0x0000~0x0121		Unit: N/A	Control Mode:Ⓟ
Parameter setting	0-th bit X	Control type		
		0	Position control	
		1	Speed control	
	1-st bit Y	Position control type		
		0	Incremental position	
		1	Absolute position	
		2	Relative position	
	2-nd bit Z	Speed control unit		
		0	In 0.1rpm	
		1	In PPS	
	3-rd bit W	Reserved parameters (Not for use)		

Pn811	Pr Reference-Path 1 Control Word H		○	Address: 0x0811
Default: 0x0000	Range: 0x0000~0x7777		Unit: N/A	Control Mode:Ⓟ
Parameter setting	0-th bit X	Acceleration time (ACC)		
		0	Set on Pn890~Pn89F for acceleration time	
		...		
		7		
	1-st bit Y	Deceleration time (DEC)		
		0	Set on Pn890~Pn89F for deceleration time	
		...		
		7		

	2-nd bit Z	Internal target velocity	
		0	Set on Pn8B0~Pn8BF.
		...	
		7	
	3-rd bit W	Delay time (pause time)	
		0	Set Pn8A0~Pn8AF for Position Coincidence Delay.
		...	
		7	

Pn812	PR1 Data	○	Address: 0x0812★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A	Control Mode:P

Pn814	PR2 Control Word L	○	Address: 0x0814
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:P

Pn815	PR2 Control Word H	○	Address: 0x0815
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:P

Pn816	PR2 Data	○	Address: 0x0816★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A	Control Mode:P

Pn818	PR3 Control Word L	○	Address: 0x0818
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:P

Pn819	PR3 Control Word H	○	Address: 0x0819
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:P

Pn81A	PR3 Data	○	Address: 0x081A★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A	Control Mode:P

Pn81C	PR4 Control Word L	○	Address: 0x081C
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:P

Pn81D	PR4 Control Word H	○	Address: 0x081D
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:Ⓟ

Pn81E	PR4 Data	○	Address: 0x081E★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A	Control Mode:Ⓟ

Pn820	PR5 Control Word L	○	Address: 0x0820
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:Ⓟ

Pn821	PR5 Control Word H	○	Address: 0x0821
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:Ⓟ

Pn822	PR5 Data	○	Address: 0x0822★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A	Control Mode:Ⓟ

Pn824	PR6 Control Word L	○	Address: 0x0824
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:Ⓟ

Pn825	PR6 Control Word H	○	Address: 0x0825
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:Ⓟ

Pn826	PR6 information	○	Address: 0x0826★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A	Control Mode:Ⓟ

Pn828	PR7 Control Word L	○	Address: 0x0828
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:Ⓟ

Pn829	PR7 Control Word H	○	Address: 0x0829
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:Ⓟ

Pn82A	PR7 Data	○	Address: 0x082A★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A	Control Mode:Ⓟ

Pn82C	PR8 Control Word L	○	Address: 0x082C
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:🄿

Pn82D	PR8 Control Word H	○	Address: 0x082D
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:🄿

Pn82E	PR8 Data	○	Address: 0x082E★
Default: 0	Range:$-2^{31}\sim(2^{31}-1)$	Unit: N/A	Control Mode:🄿

Pn830	PR9 Control Word L	○	Address: 0x0830
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:🄿

Pn831	PR9 Control Word H	○	Address: 0x0831
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:🄿

Pn832	PR9 Data	○	Address: 0x0832★
Default: 0	Range:$-2^{31}\sim(2^{31}-1)$	Unit: N/A	Control Mode:🄿

Pn834	PR10 Control Word L	○	Address: 0x0834
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:🄿

Pn835	PR10 Control Word H	○	Address: 0x0835
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:🄿

Pn836	PR10 Data	○	Address: 0x0836★
Default: 0	Range:$-2^{31}\sim(2^{31}-1)$	Unit: N/A	Control Mode:🄿

Pn838	PR11 Control Word L	○	Address: 0x0838
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A	Control Mode:🄿

Pn839	PR11 Control Word H	○	Address: 0x0839
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:🄿

Pn83A	PR11 Data		○	Address: 0x083A★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A		Control Mode:Ⓟ

Pn83C	PR12 Control Word L		○	Address: 0x083C
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A		Control Mode:Ⓟ

Pn83D	PR12 Control Word H		○	Address: 0x083D
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A		Control Mode:Ⓟ

Pn83E	PR12 Data		○	Address: 0x083E★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A		Control Mode:Ⓟ

Pn840	PR13 Control Word L		○	Address: 0x0840
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A		Control Mode:Ⓟ

Pn841	PR13 Control Word H		○	Address: 0x0841
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A		Control Mode:Ⓟ

Pn842	PR13 Data		○	Address: 0x0842★
Default: 0	Range:-2^{31}~(2^{31}-1)	Unit: N/A		Control Mode:Ⓟ

Pn844	PR14 Control Word L		○	Address: 0x0844
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A		Control Mode:Ⓟ

Pn845	PR14 Control Word H		○	Address: 0x0845
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A		Control Mode:Ⓟ

Pn846	PR14 Data		○	Address: 0x0846★
Default: 0	Range: -2^{31}~(2^{31}-1)	Unit: N/A		Control Mode:Ⓟ

Pn848	PR15 Control Word L		○	Address: 0x0848
Default: 0x0000	Range: 0x0000~0x0121	Unit: N/A		Control Mode:Ⓟ

Pn849	PR15 Control Word H	○	Address: 0x0849
Default: 0x0000	Range: 0x0000~0x7777	Unit: N/A	Control Mode:🄿

Pn890	ACC/DEC Time 0	○	Address: 0x0890
Default: 30	Range: 0~65500	Unit: ms	Control Mode:🄿
Description	Set the Pr reference acceleration and deceleration time between 0rpm~3000rpm, the same below.		

Pn891	ACC/DEC Time 1	○	Address: 0x0891
Default: 50	Range: 0~65500	Unit: ms	Control Mode:🄿

Pn892	ACC/DEC Time 2	○	Address: 0x0892
Default: 200	Range: 0~65500	Unit: ms	Control Mode:🄿

Pn893	ACC/DEC Time 3	○	Address: 0x0893
Default: 300	Range: 0~65500	Unit: ms	Control Mode:🄿

Pn894	ACC/DEC Time 4	○	Address: 0x0894
Default: 500	Range: 0~65500	Unit: ms	Control Mode:🄿

Pn895	ACC/DEC Time 5	○	Address: 0x0895
Default: 600	Range: 0~65500	Unit: ms	Control Mode:🄿

Pn896	ACC/DEC Time 6	○	Address: 0x0896
Default: 800	Range: 0~65500	Unit: ms	Control Mode:🄿

Pn897	ACC/DEC Time 7	○	Address: 0x0897
Default: 900	Range: 0~65500	Unit: ms	Control Mode:🄿

Pn898	Pr Reference-Delay Time 1	○	Address: 0x0898
Default: 0	Range: 0~60000	Unit: ms	Control Mode:🄿
Description	Set the delay time after a Pr reference is finished, the same below.		

Pn89A	Pr Reference-Delay Time 2		○	Address: 0x089A
Default: 200	Range: 0~60000	Unit: ms		Control Mode:Ⓟ

Pn89B	Delay time after position arrival (No. #3)		○	Address: 0x089B
Default: 400	Range: 0~60000	Unit: ms		Control Mode:Ⓟ

Pn89C	Pr Reference-Delay Time 4		○	Address: 0x089C
Default: 500	Range: 0~60000	Unit: ms		Control Mode:Ⓟ

Pn89D	Pr Reference-Delay Time 5		○	Address: 0x089D
Default: 800	Range: 0~60000	Unit: ms		Control Mode:Ⓟ

Pn89E	Pr Reference-Delay Time 6		○	Address: 0x089E
Default: 1000	Range: 0~60000	Unit: ms		Control Mode:Ⓟ

Pn89F	Delay time after position arrival (No. #7)		○	Address: 0x089F
Default: 1500	Range: 0~60000	Unit: ms		Control Mode:Ⓟ

Pn8A0	Internal Target Velocity 1		○	Address: 0x08A0
Default: 20.0	Range: 0.0~6000.0	Unit: rpm		Control Mode:Ⓟ
Description	Set the speed target in PR mode, the same below.			

Pn8A2	Internal Target Velocity 2		○	Address: 0x08A2
Default: 100.0	Range: 0.0~6000.0	Unit: rpm		Control Mode:Ⓟ

Pn8A3	Internal Target Velocity 3		○	Address: 0x08A3
Default: 200.0	Range: 0.0~6000.0	Unit: rpm		Control Mode:Ⓟ

Pn8A4	Internal Target Velocity 3		○	Address: 0x08A4
Default: 300.0	Range: 0.0~6000.0	Unit: rpm		Control Mode:Ⓟ

Pn8A5	Internal Target Velocity 5		○	Address: 0x08A5
Default: 500.0	Range: 0.0~6000.0	Unit: rpm		Control Mode:Ⓟ

Pn8A6	Internal Target Velocity 6		○	Address: 0x08A6
Default: 600.0	Range: 0.0~6000.0	Unit: rpm		Control Mode:🄿

Pn8A7	Internal Velocity Reference 7		○	Address: 0x08A7
Default: 800.0	Range: 0.0~6000.0	Unit: rpm		Control Mode:🄿

7.3.10 Drive Parameters(PnExx)

PnE00☆	Servo Drive Model		■	Address: 0x0E00
Default: Up to model	Range: 0x0000~0xFFFF	Unit: N/A		Control Mode:🄿🅂🅃
Description	Set the servo drive model and repower it up to take effect.			

Setting	Servo Drive Model	Comment
0x110A	SD100-110A	Rated current 11A, main circuit power: DC 48V
0x210A	SD100-210A	Rated current 21A, main circuit power: DC 48V
0x300A	SD100-300A	Rated current 30A, main circuit power: DC 48V
0x400A	SD100-400A	Rated current 40A, main circuit power: DC 48V
0x800A	SD100-800A	Rated current 80A, main circuit power: DC 48V

PnE01☆	Servo Drive Power		■	Address: 0x0E01
Default: Up to model	Range: 0~65535	Unit: W		Control Mode:🄿🅂🅃

PnE02☆	Servo Drive Voltage		■	Address: 0x0E02
Default: Up to model	Range: 0x0000~0x0004	Unit: N/A		Control Mode:🄿🅂🅃

Parameter setting	Bit	Servo drive voltage	
	0-th bit X	0	AC 100V (reserved)
		1	AC 220V
		2	AC 380V
		3	DC 24V
		4	DC 48V
	1-st bit Y	Reserved parameters (Not for modification)	
	2-nd bit Z	Reserved parameters (Not for modification)	
	3-rd bit W	Reserved parameters (Not for modification)	

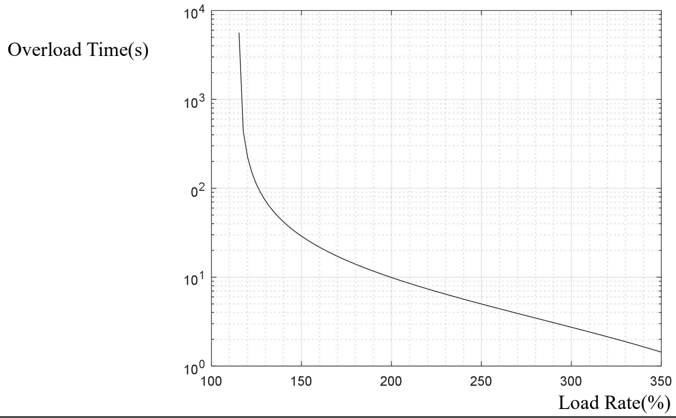
PnE03☆	Servo Drive Rated Current		■	Address: 0x0E03
Default: up to model	Range: 0.0~6553.5	Unit: A		Control Mode: P S T

PnE04☆	Servo Drive Peak Current		■	Address: 0x0E04
Default: Up to model	Range: 0.0~6553.5	Unit: A		Control Mode: P S T

PnE05☆	Drive Module Overheat Error Level		■	Address: 0x0E05
Default: Up to model	Range: 60.0~100.0	Unit: ℃		Control Mode: P S T
Description	Set the threshold for the drive module overheat error, when its actual temperature is greater than this setting, the drive will report a module overheat error			

<table>
<tr><td>PnE06☆</td><td colspan="3">Drive Overload Current Level</td><td>■</td><td>Address: 0x0E06</td></tr>
<tr><td>Default: Up to model</td><td colspan="2">Range: 0x0000~0xFFFF</td><td colspan="2">Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="8">Parameter setting</td><td rowspan="4">0-th bit 1-st bit
X Y</td><td colspan="4">Base overload current</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 1%</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
<tr><td rowspan="4">2-nd bit 3-rd bit
Z W</td><td colspan="4">Intermediate overload current</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 10%</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
</table>

<table>
<tr><td>PnE07☆</td><td colspan="3">Drive Overload Time Level</td><td>■</td><td>Address: 0x0E07</td></tr>
<tr><td>Default: Up to model</td><td colspan="2">Range: 0x0000~0xFFFF</td><td colspan="2">Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="8">Parameter setting</td><td rowspan="4">0-th bit 1-st bit
X Y</td><td colspan="4">Drive overload intermediate time</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 1s</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
<tr><td rowspan="4">2-nd bit 3-rd bit
Z W</td><td colspan="4">Drive overload maximum time</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 1s</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
</table>

<table>
<tr><td>Description</td><td>Sets the time threshold for the drive to trigger an overload protection.

</td></tr>
</table>

<table>
<tr><td>PnE08☆</td><td colspan="3">Drive Overload Time Calibration</td><td>■</td><td>Address: 0x0E08</td></tr>
<tr><td colspan="2">Default: Up to model</td><td>Range: 0x0000~0xFFFF</td><td colspan="2">Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="8">Parameter setting</td><td rowspan="4">0-th bit 1-st bit
X Y</td><td colspan="4">Intermediate time fine tuning</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 1%</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
<tr><td rowspan="4">2-nd bit 3-rd bit
Z W</td><td colspan="4">Max. time calibration</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 1%</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
</table>

<table>
<tr><td>PnE09☆</td><td colspan="3">Motor Overload Time Calibration</td><td>■</td><td>Address: 0x0E09</td></tr>
<tr><td colspan="2">Default: Up to model</td><td>Range: 0x0000~0xFFFF</td><td colspan="2">Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="8">Parameter setting</td><td rowspan="4">0-th bit 1-st bit
X Y</td><td colspan="4">Intermediate time calibration</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 1%</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
<tr><td rowspan="4">2-nd bit 3-rd bit
Z W</td><td colspan="4">Max. time calibration</td></tr>
<tr><td>00</td><td colspan="3" rowspan="3">Range: 0~255, unit: 1%</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
</table>

<table>
<tr><td>PnE0A☆</td><td colspan="2">Low 8 bits (L): Reserved
High 8 bits (H): Motor Overspeed Level Calibration</td><td>■</td><td>Address: 0x0E0A</td></tr>
<tr><td>Default: Up to model</td><td>Range: 0x0000~0xFFFF</td><td colspan="2">Unit: N/A</td><td>Control Mode: P S T</td></tr>
</table>

<table>
<tr><td rowspan="8">Parameter setting</td><td rowspan="4">0-th bit 1-st bit
X Y</td><td colspan="2">Reserved parameters (Not for use)</td></tr>
<tr><td>00</td><td rowspan="3">Reserved</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
<tr><td rowspan="4">2-nd bit 3-rd bit
Z W</td><td colspan="2">Motor overspeed level calibration</td></tr>
<tr><td>00</td><td rowspan="3">Range: 0~255, and the overspeed level calibration is calculated as follows:
Overspeed level =PnE0A.WZ*PnF06.YX</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
</table>

PnE0B☆	Built-in Rege Braking Resistance	■	Address: 0x0E0B
Default: Up to model	Range: 0~65535	Unit: Ω	Control Mode:PST

PnE0C☆	Built-in Rege Braking Resistor Capacity	■	Address: 0x0E0C
Default: Up to model	Range: 0.0~6553.5	Unit: %	Control Mode:PST

<table>
<tr><td>PnE10☆</td><td colspan="2">DC Bus Voltage(Hardware Limit)</td><td>■</td><td>Address: 0x0E10</td></tr>
<tr><td>Default: Up to model</td><td colspan="2">Range: 0~1000</td><td>Unit: V</td><td>Control Mode:PST</td></tr>
<tr><td>Description</td><td colspan="4">Set the rated value for bus voltage detection, which is adjusted based on the hardware.
For DC48V models, set it to 123V.
Note: Do not change the parameters without the factory's permission, or it may cause irreversible damage to the machine!</td></tr>
</table>

PnE11☆	DC Bus Voltage Detection Filter Time	■	Address: 0x0E11
Default: 0	Range: 0~10000	Unit: us	Control Mode:PST

PnE12☆	DC Bus Voltage Zero Calibration	○	Address: 0x0E12
Default: Up to factory	Range: -50~50	Unit: V	Control Mode:PST

<table>
<tr><td>PnE13☆</td><td colspan="2">DC Bus Voltage Gain Calibration</td><td>○</td><td>Address: 0x0E13</td></tr>
<tr><td>Default: 0</td><td colspan="2">Range: -127~127</td><td>Unit: N/A</td><td>Control Mode:PST</td></tr>
<tr><td>Description</td><td colspan="4">Set the linearity of busbar voltage detection.
$U_{dc} \times \frac{256+PnE13}{256}$
Note: Do not change the parameters without the factory's permission, or it may cause irreversible damage to the machine!</td></tr>
</table>

PnE14☆	Main Circuit Filter		■	Address: 0x0E14
Default: 0x0055	Range: 0x0000~0x7777		Unit: N/A	Control Mode:ⓅⓈⓉ

Parameter setting	0-th bit X	Voltage error filter	
		0 ... 7	Range: 0~7, unit: 250μs
	1-st bit Y	Overvoltage error filter	
		0 ... 7	Range: 0~7, unit: 250μs
	2-nd bit Z	Rege braking filter start	
		0 ... 7	Range: 0~7, unit: 250μs
	3-rd bit W	Rege braking filter end	
		0 ... 7	Range: 0~7, unit: 250μs

PnE15☆	Error Prompt 1		■	Address: 0x0E15
Default: 0x0000	Range: 0x0000~0xFFFF		Unit: N/A	Control Mode:Ⓟ

Parameter setting	0-th bit X	System switch A	
		Bit0	ER.BF4(Drive hardware overcurrent) detection (0:ON;1:OFF)
		Bit1	Motor and drive capacity 4 × detection (0:ON;1:OFF)
		Bit2	Motor and drive overload detection (0:ON;1:OFF)
		Bit3	ER.860 (Abs encoder overheat) detection (0:ON;1:OFF)
	1-st bit Y	System switch B	
		Bit4	EtherCAT mode supported by drive detection (0:OFF;1:ON)
		Bit5	FPGA backup program operation detection (0:ON;1:OFF)
		Bit6	Non-standard CANopen lifespan detection (0:ON;1:OFF)
		Bit3	Reserved

	2-nd bit Z	Reserved parameters (Not for use)	
		Bit7	FPGA backup operation detection switch(0:ON;1:OFF)
		Bit8	MicroChip ESC manual mode (0:9253;1:9252)
		Bit9	MicroChip ESC mode (0: Auto;1: Manual)
		Bit10	Reserved
	3-rd bit W	Reserved parameters (Not for use)	

PnE17☆	Single-IGBT Protection & Bootstrap Charging Time	■	Address: 0x0E17
Default: Up to model	Range: 0x0000~0xFFFF	Unit: N/A	Control Mode:Ⓟ Ⓢ Ⓣ
Parameter setting	0-th bit X 1-st bit Y	Rated velocity Range: 0~255 Unit: 1ms Incremental encoder	
	2-nd bit Z 3-rd bit W	Max. speed Range: 0~255 Unit: 1ms Incremental encoder	

PnE1C☆	System Switch 2	■	Address: 0x0E1C
Default: 0x0003	Range: 0x0000~0xFFFF	Unit: N/A	Control Mode:Ⓟ
Parameter setting	0-th bit X	System switch 2A	
		Bit0	Rege braking protection (0:OFF;1:ON)
		Bit1	Phase compensation (0:ON;1:OFF)
		Bit2	DB brake protection (0:ON;1:OFF)
		Bit3	ESC manufacturer (0:MicroChip;1:Beckoff)
	1-st bit Y	System switch 2B	
		Bit4	ER.C91 (Encoder acceleration error) (0:ON;1:OFF)
		Bit5	ER.C92 (Incremental encoder Z signal loss error) (0:ON;1:OFF)
		Bit6	FPGA-to-ARM watchdog error (0:ON;1:OFF)
		Bit7	EtherCAT model auto-detection (0:ON;1:OFF)

	2-nd bit Z	System switch 2C	
		Bit8	ACR work mode (0: Mode 1; 1: Mode 2)
		Bit9	Current feedback mode (0: Mode 0; 1: Mode 1)
		Bit100	Silent mode (0:OFF; 1:ON)
		Bit11	Manual bootstrap charge (0:ON;1:OFF)
	3-rd bit W	System switch 2D	
		Bit12	Bootstrap mode (0:ON;1:OFF)
		Bit13	Current sensor IC 0: C796/NSI1306, 1: AM1305)
		Bit14	Power rating detection (0:ON; 1:OFF)
		Bit15	Auto-identification enable for current sampling chip in single-IGBT models (0:ON;1:OFF)

PnE1D☆	System Switch 3	■	Address: 0x0E1D
Default: 0000	Range: 0x0000~0x0001	Unit: N/A	Control Mode:P
Parameter setting	0-th bit X	System switch 3A	
		0	Funcode write enable
		1	Funcode write disable
	1-st bit Y	Reserved parameters (Not for use)	
	2-nd bit Z	Reserved parameters (Not for use)	
	3-rd bit W	Reserved parameters (Not for use)	

PnE1E☆	Serial Encoder Communication Consecutive Failure Count	■	Address: 0x0E1E
Default: Up to model	Range: 0x0000~0x00FF	Unit: N/A	Control Mode:PST
Parameter setting	0-th bit 1-st bit X Y	Serial encoder consecutive failure count	
		00	Range: 0~255, unit: Times
		...	
		FF	
	2-nd bit 3-rd bit Z W	Reserved parameters (Not for use)	
Description	Set the number of consecutive communication failures between the drive and the serial encoder, and it reports ER.C90 when actual count is higher than this setting.		

PnE1F☆	Silent Mode Filter Time		■	Address: 0x0E1F
Default: Up to model	Range: 1~65535		Unit: μs	Control Mode:ⓅⓈⓉ

PnE20☆	ACR D-axis Gain		■	Address: 0x0E20
Default: Up to model	Range: 100~10000		Unit: Hz	Control Mode:ⓅⓈⓉ

PnE21☆	ACR Q-axis Gain		■	Address: 0x0E21
Default: Up to model	Range: 100~10000		Unit: Hz	Control Mode:ⓅⓈⓉ

PnE22☆	ACR D-axis Integral Time		■	Address: 0x0E22
Default: Up to model	Range: 0~65535		Unit: μs	Control Mode:ⓅⓈⓉ

PnE23☆	ACR Q-axis Integral Time		■	Address: 0x0E23
Default: Up to model	Range: 0~65535		Unit: μs	Control Mode:ⓅⓈⓉ

PnE24☆	ACR D-axis Integral Limit		■	Address: 0x0E24
Default: 10430	Range: 0~65535		Unit: N/A	Control Mode:ⓅⓈⓉ

PnE25☆	ACR Q-axis Integral Limit		■	Address: 0x0E25
Default: 10430	Range: 0~65535		Unit: N/A	Control Mode:ⓅⓈⓉ

PnE28☆	Current Detection Gain 1		■	Address: 0x0E28
Default: Up to model	Range: 0~16384		Unit: N/A	Control Mode:ⓅⓈⓉ
Description	Set the hardware current detection factor of the drive. $\mathrm{PnE28} = \frac{\text{Current Sense Resistor Value (m}\Omega) \times \text{Drive Peak Current PnE15 (0.1 A)}}{\text{ADC Full} - \text{scale Voltage (320 mV)}} \times 8192$ Note: Do not change the parameters without the factory's permission, or it may cause irreversible damage to the machine!			

PnE29☆	Voltage Compensation Gain		■	Address: 0x0E29
Default: 115	Range: 0~300		Unit: %	Control Mode:ⓅⓈⓉ
Description	Set the voltage compensation gain.			

PnE2A☆	Carrier Frequency		■	Address: 0x0E2A
Default: Up to model	Range: 2000~16000	Unit: HZ		Control Mode:🄿🅂🅃
Description	Set the carrier (PWM) frequency of the servo drivER.			

PnE2B☆	Deadband Compensation Gain/Time		■	Address: 0x0E2B
Default: Up to model	Range: 0x0000~0xFFFF	Unit: N/A		Control Mode:🄿🅂🅃
Parameter setting	0-th bit 1-st bit X Y	Deadtime		
		00	Range: 1.6~6.0, unit: 0.1μs	
		...		
		FF		
	2-nd bit 3-rd bit Z W	Deadband compensation gain		
		00	Range: 0~100, unit: 1%	
		...		
		FF		

PnE2C☆	Current Detection Gain 1		■	Address: 0x0E2C
Default: Up to model	Range: 0.00~100.00	Unit: N/A		Control Mode:🄿🅂🅃

PnE2D☆	Current Detection Gain 2		■	Address: 0x0E2D
Default: Up to model	Range: 0~16384	Unit: N/A		Control Mode:🄿🅂🅃

PnE30☆	Max. Drive Overvoltage Level		■	Address: 0x0E30
Default: Up to model	Range: 0~1000	Unit: V		Control Mode:🄿🅂🅃
Description	Set the max. overvoltage of the servo drive allowed.			

PnE31☆	Min. Drive Overvoltage Level		■	Address: 0x0E31
Default: Up to model	Range: 0~1000	Unit: V		Control Mode:🄿🅂🅃
Description	Set the min. overvoltage of the servo drive allowed.			

PnE32☆	Drive Overcurrent Protection Filter Time		■	Address: 0x0E32
Default: Up to model	Range: 0x0000~0xFFFF	Unit: NA		Control Mode:🄿🅂🅃
Parameter setting	0-th bit 1-st bit X Y	Drive overcurrent protection filter time		
		00	Range: 0~255, unit: 1.6μs	
		...		
		FF		

<table>
<tr><td rowspan="4"></td><td rowspan="4">2-nd bit 3-rd bit
Z W</td><td colspan="2">External hardware overcurrent filter time</td></tr>
<tr><td>00</td><td rowspan="3">Range: 0~255, unit: 1μ</td></tr>
<tr><td>...</td></tr>
<tr><td>FF</td></tr>
</table>

PnE33☆	Drive Overcurrent Protection Level	■	Address: 0x0E33
Default: Up to model	Range: 0.0~6553.5	Unit: A	Control Mode:P S T
Description	Set the hardware overcurrent thresholds of the drive for different models. Do not change the parameter without the manufacturer's permission, or it may cause irreversible damage to the machine!		

PnE35☆	PWM Frequency Upper Limit	■	Address: 0x0E34
Default: Up to model	Range: 3000~16000	Unit: Hz	Control Mode:P S T
Description	Set the upper limit frequency of the PWM control.		

PnEA8☆	2nd Speed Feedback Filter Time	■	Address: 0x0EA8
Default: Up to model	Range: 0.02~655.35	Unit: ms	Control Mode:P S T

PnEF3	I-F ACC/DEC Time	○	Address: 0x0EF3
Default: 5.0	Range: 0.1~3600.0	Unit: s	Control Mode:P S T

PnEF4	I-F Target Frequency	○	Address: 0x0EF4
Default: 20.0	Range: -400.0~400.0	Unit: Hz	Control Mode:P S T

PnEF5	I-F Target Current	○	Address: 0x0EF5
Default: 0.0	Range: 0.0~500.0	Unit: %	Control Mode:P S T

7.3.11 Motor Parameters(PnFxx)

PnF00☆	Encoder Type & Motor Voltage	■	Address: 0x0F00
Default: Up to model	Range: 0x0000~0x22FF	Unit: N/A	Control Mode:P S T

<table>
<tr><td rowspan="5">Parameter setting</td><td>0-th bit 1-st bit
X Y</td><td colspan="2">Reserved parameters (Not for use)</td></tr>
<tr><td rowspan="4">2-nd bit
Z</td><td colspan="2">Motor voltage</td></tr>
<tr><td>0</td><td>Reserved</td></tr>
<tr><td>3</td><td>DC24V</td></tr>
</table>

<table>
<tr><td rowspan="4"></td><td></td><td>4</td><td>DC48V</td></tr>
<tr><td rowspan="3">3-rd bit
W</td><td colspan="2">Encoder type</td></tr>
<tr><td>1</td><td>Multi-turn absolute encoder</td></tr>
<tr><td>2</td><td>Incremental or single-turn absolute encoder</td></tr>
</table>

PnF02☆	Motor Power	■	Address: 0x0F02
Default: Up to model	Range: 0~65535	Unit: W	Control Mode:P S T

<table>
<tr><td>PnF03☆</td><td colspan="2">Encoder Bit/Resolution</td><td>■</td><td>Address: 0x0F03</td></tr>
<tr><td>Default: Up to model</td><td>Range: 0x0000~0x00FF</td><td colspan="2">Unit: N/A</td><td>Control Mode:P S T</td></tr>
<tr><td rowspan="3">Parameter setting</td><td rowspan="2">0-th bit 1-st bit
X Y</td><td colspan="3">Encoder bit</td></tr>
<tr><td colspan="3">0x01: 2500 PPR
0X11: 17-bit
0X17: 23-bit
0X18: 24-bit</td></tr>
<tr><td>2-nd bit 3-rd bit
Z W</td><td colspan="3">Reserved parameters (Not for use)</td></tr>
</table>

<table>
<tr><td>PnF05☆</td><td colspan="2">Max. Velocity & Rated Velocity</td><td>■</td><td>Address: 0x0F05</td></tr>
<tr><td>Default: Up to model</td><td>Range: 0x0000~0xFFFF</td><td colspan="2">Unit: N/A</td><td>Control Mode:P S T</td></tr>
<tr><td rowspan="4">Parameter setting</td><td rowspan="2">0-th bit 1-st bit
X Y</td><td colspan="3">Rated speed</td></tr>
<tr><td colspan="3">Range: 0~255
Unit: 100rpm
Incremental encoder</td></tr>
<tr><td rowspan="2">2-nd bit 3-rd bit
Z W</td><td colspan="3">Max. speed</td></tr>
<tr><td colspan="3">Range: 0~255
Unit: 100rpm
Incremental encoder</td></tr>
</table>

<table>
<tr><td>PnF06☆</td><td colspan="2">Motor Poles & Overspeed Level</td><td>■</td><td>Address: 0x0F06</td></tr>
<tr><td>Default: Up to model</td><td>Range: 0x0000~0xFF32</td><td colspan="2">Unit: N/A</td><td>Control Mode:P S T</td></tr>
<tr><td rowspan="2">Parameter setting</td><td rowspan="2">0-th bit 1-st bit
X Y</td><td colspan="3">Overspeed level</td></tr>
<tr><td colspan="3">Range: 0x00~0x32
Unit:%
Incremental encoder</td></tr>
</table>

		Motor poles	
	2-nd bit 3-rd bit Z W	06	6-pole (3 pairs)
		08	8-pole (4 pairs)
		0A	10-pole (5 pairs)

PnF07☆	Rated Torque		■	Address: 0x0F07
Default: Up to model	Range: 0.00~655.35	Unit: Nm		Control Mode:P S T

PnF08☆	Max. Torque		■	Address: 0x0F08
Default: Up to model	Range: 0~65535	Unit: %		Control Mode:P S T

PnF09☆	Motor Rated Current		■	Address: 0x0F09
Default: Up to model	Range: 0.0~6553.5	Unit: A		Control Mode:P S T

PnF0A☆	Motor Peak Current		■	Address: 0x0F0A
Default: Up to model	Range: 0.0~6553.5	Unit: A		Control Mode:P S T

PnF0B☆	Reverse Potential (RMS)		■	Address: 0x0F0B
Default: Up to model	Range: 0.0~6553.5	Unit: mV/rpm		Control Mode:P S T

PnF0C☆	Motor Rotor Inertia		■	Address: 0x0F0C
Default: Up to model	Range: 0~65535	Unit: 10-6kgm2		Control Mode:P S T

PF0D☆	Motor Stator Resistance (Line Resistance)		■	Address: 0x0F0D
Default: Up to model	Range: 0.000~65.535	Unit: Ω		Control Mode:P S T

PF0E☆	Motor Inductance (Line Inductance)		■	Address: 0x0F0E
Default: Up to model	Range: 0.00~655.35	Unit: mH		Control Mode:P S T

PnF0F☆	Motor Overload Base Current		■	Address: 0x0F0F
Default: Up to model	Range: 0~65535	Unit: %		Control Mode:P S T

PnF10☆	Motor Overload Intermediate Current		■	Address: 0x0F10
Default: Up to model	Range: 0~65535	Unit: %		Control Mode:PST

PnF11☆	Motor Overload Intermediate Current Duration		■	Address: 0x0F11
Default: Up to model	Range: 0~65535	Unit: 10s		Control Mode:PST

PnF12☆	Max. Motor Overload Current		■	Address: 0x0F12
Default: Up to model	Range: 0~65535	Unit: %		Control Mode:PST

PnF13☆	Max. Motor Overload Current Duration		■	Address: 0x0F13
Default: Up to model	Range: 0~65535	Unit: S		Control Mode:PST

PnF15☆	Rotary Motor Type & Encoder Manufacturer		■	Address: 0x0F15
Default: 0000	Range: 0x0000~0xFFFF	Unit: N/A		Control Mode:PST
Parameter setting	0-th bit X	Encoder Manufacturer		
		0	General	
		1	NK	
		2	DMC	
		3	RY	
	1-st bit Y	Rotary Motor Type		
		0	Surface mounted permanent magnet (SPM)	
		1	Interior permanent magnet (IPM)	
	2-nd bit Z	Reserved parameters (Not for use)		
	3-rd bit W	Reserved parameters (Not for use)		

PF16☆	Quadrature-axis Inductance		■	Address: 0x0F16
Default: Up to model	Range: 0.00~655.35	Unit: mH		Control Mode:PST

PF17☆	Direct-axis Inductance		■	Address: 0x0F17
Default: Up to model	Range: 0.00~655.35	Unit: mH		Control Mode:PST

PnF18☆	Rotor Inertia/Rated Torque Index Unit		■	Address: 0x0F18
Default: Up to model	Range: 0x0000~0xFFFF		Unit: N/A	Control Mode:🄿🅂🅃
Parameter setting	0-th bit 1-st bit X Y	Rated torque index unit		
		n	Range: -128~127, 10n	
	2-nd bit 3-rd bit Z W	Rotor inertia index unit		
		n	Range: -128~127, 10n	

PnF19☆	Velocity/Power Index Unit		■	Address: 0x0F19
Default: Up to model	Range: 0x0000~0xFFFF		Unit: N/A	Control Mode:🄿🅂🅃
Parameter setting	0-th bit 1-st bit X Y	Power index unit		
		n	10n	
	2-nd bit3-rd bit Z W	Velocity index unit		
		n	10n	

PnF1B☆	Motor Pole Start Position		■	Address: 0x0F1B
Default: Up to model	Range: -360~360		Unit: deg	Control Mode:🄿🅂🅃

PnF1E☆	Associated flag bit (FLAG)		■	Address: 0x0110
Default: Up to model	Range: 0x0000~0xFFFF		Unit: N/A	Control Mode:🄿🅂🅃
Parameter setting	0-th bit X	Flag bit switch 1		
		Bit0	Reserved	
		Bit1	Reserved	
		Bit2	Velocity feedback 2nd filter enable (0:OFF;1: ON)	
		Bit3	Reserved	
	1-st bit Y	Flag Bit Switch 2		
		Bit4	Reserved	
		Bit5	Reserved	
		Bit6	Reserved	
		Bit7	Reserved	
	2-nd bit Z	Reserved parameters (Not for modification)		

	3-rd bit W	Reserved parameters (Not for modification)

7.4 Un Parameter Overview

The monitor display function starts with Un for displaying the status of input and output signals and related information of the servo drive.

Un No.	Display Description	Unit	Data Type①	Communication Address
Un000	Motor Feedback Velocity	rpm	int16	0xE000
Un001	Velocity Reference	rpm	int16	0xE001
Un002	Internal Torque Reference	%	int16	0xE002
Un004	Electrical Angle (from Magnetic Pole Origin)	deg	uint16	0xE004
Un005	Reference Pulse Velocity (Position Mode)	rpm	int16	0xE005
Un006	Reference Pulse Counter	Reference unit	int32	0xE006
Un007	Encoder Pulse Counter 1	Reference unit	int32	0xE007
Un008	Encoder Pulse Counter 2	Encoder unit	int32	0xE008
Un009	Position Deviation (Position Mode)	User unit	int32	0xE009
Un00A	Accumulated Load Ratio (100% of rated torque, 10s-cycle RMS)	%	uint16	0xE00A
Un00B	Regenerative load factor (display of regenerative power consumption for a 10s cycle with the value at 100% of the regenerative power that can be handled)	%	uint16	0xE00B
Un00D	Effective Gain Monitoring (1: Gain 1 2: Gain 2)	-	uint16	0xE00D
Un00E	Total Drive Power-On Time②	0.1s	uint32	0xE00E
Un00F	Terminal Input Signal Monitoring	-	uint16	0xE00F
Un010	Absolute Encoder Single-turn Value	Encoder unit	uint32	0xE010
Un011	Absolute Encoder Multi-turn Value	rev	int16	0xE011
Un017	Encoder Z Signal Count	-	int32	0xE017
Un018	Encoder Unidirectional Z Signal Count	-	int32	0xE018
Un02A	Internal Control Status 1	-	uint16	0xE02A
Un02B	Internal Control Status (Input Terminal) 2	-	uint16	0xE02B
Un02C	Internal Control Status (Input Terminal) 3	-	uint16	0xE02C

Un02D	Internal Control Status (Input Terminal) 4	-	uint16	0xE02D
Un02E	CAN Status		uint16	0xE02E
Un02F	CANopen Command Word		uint16	0xE02F
Un030	Servo Operation Status	-	uint16	0xE030
Un031	CANopen Operation Status	-	uint16	0xE031
Un035	MCU Version	-	uint16	0xE035
Un036	FPGA Version	-	uint16	0xE036
Un037	MCU Sub-version	-	uint16	0xE037
Un038	FPGA Sub-version	-	uint16	0xE038
Un087	Serial Encoder Communication Error Counter	times	uint16	0xE087
Un089	Module Temperature	0.1℃	uint16	0xE089
Un100	Input Signal Monitor	-	uint16	0xE100
Un101	Output Signal Monitor	-	uint16	0xE101
Un105	Position Tuning Time	0.1ms	uint16	0xE105
Un106	Position Overshoot	Reference unit	uint16	0xE106
Un10B	KTY Temperature Sensor Detection	1℃	uint16	0xE10B
Un10D	Internal Chip Temperature (Ambient Temperature)	0.1℃	uint16	0xE10D
Un140	Bus Voltage	1V	uint16	0xE140
Un141	Current Detection Value (Rms)	0.1A	uint16	0xE141
Un142	Accumulated Load Ratio (100% of rated torque, 2ms-cycle RMS)	0.1%	uint16	0xE142
Un143	Accumulated Regenerative Load	0.1%	uint16	0xE143
Un144	Accumulated DB Load	%	uint16	0xE144
Un203	Error Parameter Funcode (ER.040)	-	uint16	0xE203
Un212	System Time Monitor A (Avg)	0.1us	uint16	0xE212
Un213	System Time Monitor A (Max)	0.1us	uint16	0xE213
Un214	System Time Monitor B (Avg)	0.1us	uint16	0xE214
Un215	System Time Monitor B (Max)	0.1us	uint16	0xE215
Un216	System Time Monitor C (Avg)	0.1us	uint16	0xE216
Un217	System Time Monitor C (Max)	0.1us	uint16	0xE217
Un218	System Time Monitor R (Avg)	0.01ms	uint16	0xE218
Un219	System Time Monitor R (Max)	0.01ms	uint16	0xE219
Un511	U-phase Current Offset	-	int16	0xE511
Un512	V-phase Current Offset	-	int16	0xE512
Un513	W-phase Current Offset	-	int16	0xE513
Un603	Absolute Encoder Pulse[Low 32 bits]	Encoder unit	uint32	0xE603

Un605	Absolute Encoder Pulse[High 32 bits]	Encoder unit	uint32	0xE605
Un607	Mechanical Absolute Position[Low 32 bits]	Encoder unit	uint32	0xE607
Un609	Mechanical Absolute Position[High 32 bits]	Encoder unit	uint32	0xE609
Un800	Current Error or Alarm Code	-	uint16	0xE800
Un801	Error-Code	-	uint16	0xE801
Un802	Error-Timestamp	100ms	uint32	0xE802
Un803	Error-Actual Motor Velocity	rpm	int16	0xE803
Un804	Error-Velocity Reference	rpm	int16	0xE804
Un805	Error-Internal Torque Reference	%	int16	0xE805
Un806	Error-Input Pulse Velocity	rpm	int16	0xE806
Un807	Position Deviation at Error	pulse	int32	0xE807
Un808	Error-Main Circuit Bus Voltage	V	uint16	0xE808
Un809	Error-Current Feedback RMS	A	int16	0xE809
Un80A	Error-Accumulated Load Factor	%	uint16	0xE80A
Un80B	Error-Regenerative Load Rate[2ms]	%	uint16	0xE80B
Un80C	Error-DB Resistor Power Consumption[2ms]	%	uint16	0xE80C
Un80D	Error-Max. Cumulative Load Rate	%	uint16	0xE80D
Un80E	Error-Moment of Inertia Ratio	%	uint16	0xE80E
Un80F	Error-Serial Encoder Communication Exception Count	-	uint16	0xE80F
Un810	Error-Internal Signal Monitor	-	uint32	0xE810
Un814	Error-Internal Input Signal Monitor	-	uint32	0xE814
Un818	Error-Internal Output Signal Monitor	-	uint32	0xE818
Un820	Alarm History 0	-	uint16	0xE820
Un821	Alarm History 1	-	uint16	0xE821
Un822	Alarm History 2	-	uint16	0xE822
Un823	Alarm History 3	-	uint16	0xE823
Un824	Alarm History 4	-	uint16	0xE824
Un825	Alarm History 5	-	uint16	0xE825
Un826	Alarm History 6	-	uint16	0xE826
Un827	Alarm History 7	-	uint16	0xE827
Un828	Alarm History 8	-	uint16	0xE828
Un829	Alarm History 9	-	uint16	0xE829
Un830	Alarm History 0 Time	0.1s	uint32	0xE830
Un832	Alarm History 1 Time	0.1s	uint32	0xE832
Un834	Alarm History 2 Time	0.1s	uint32	0xE834
Un836	Alarm History 3 Time	0.1s	uint32	0xE836
Un838	Alarm History 4 Time	0.1s	uint32	0xE838

Un83A	Alarm History 5 Time	0.1s	uint32	0xE83A
Un83C	Alarm History 6 Time	0.1s	uint32	0xE83C
Un83E	Alarm History 7 Time	0.1s	uint32	0xE83E
Un840	Alarm History 8 Time	0.1s	uint32	0xE840
Un842	Alarm History 9 Time	0.1s	uint32	0xE842

Note:

The data type definitions marked ① in the above table are described as follows.

Data Type	Description
int16	Signed (16-bit)
uint16	Unsigned (16-bit)
int32	Signed (32-bit)
uint32	Unsigned (32-bit)

② The monitoring function code Un00E may actually have a deviation of ±1 hour.

8 Troubleshooting

8.1 Classification of Errors and Alarms

Errors and alarms for servo drives are categorized into two types: Group 1 (referred to as "Gr.1") and Group 2 (referred to as "Gr.2").

Stop mode in case of malfunction：

- Gr.1: Stop as Pn004 [Servo OFF and Gr.1 Error Stop Mode] setting, and the factory setting is coasting stop.
- Gr.1: Stop as Pn005[Gr.2 Error Stop Mode] setting, and the factory setting is a zero-speed stop with zero speed reference

Fault reset:

- Yes: Fault can be cleared by reset.
- No: Faults cannot be cleared by reset.

"Fault can be cleared by reset" means that users can cancel the fault display by the reset signal. Specific operation methods are as follows:

- Method 1: By the host controller operation.
- Method 2: By the DI terminal X.

Related error clear terminal No. :

Setting: 0x04			
Mark	Error Reset	Trigger	Control Mode
ALM-RST	This signal is used to clear an error prompt that has occurred in the drive. ON: Prompt clear OFF: Prompt clear inhibit	High/low level	P S T

Precautions	
	• For some releasable errors, the cause of the fault must be removed by changing the relevant settings. • For some non-resettable errors, please investigate the causes and eliminate them before re-power-up or re-enabling.

8.2 Error and Alarm List

Table 8-1 List of Error Messages

Error Code	Name	Error Type	Reset
ER.020	User parameter and parity error	Gr.1	No
ER.021	Parameter formatting error (Version mismatch)	Gr.1	No

ER.022	Manufacturer parameter and parity error	Gr.1	No
ER.023	MCU and FPGA communication error	Gr.1	No
ER.030	FPGA running backup code error	Gr.1	No
ER.040	Parameter setting out of range error	Gr.1	Yes
ER.041	Single-IGBT device parameter setting error	Gr.1	No
ER.042	Parameter combination error	Gr.1	Yes
ER.044	Axis A/B address conflict error	Gr.1	Yes
ER.050	Motor-drive capacity mismatch error	Gr.1	Yes
ER.051	Drive power setting error	Gr.1	Yes
ER.080	Program error	Gr.1	No
ER.0B0	Invalid servo-ON reference error	Gr.1	Yes
ER.100	Drive software overcurrent error	Gr.1	Yes
ER.BF4	Drive hardware overcurrent error	Gr.1	No
ER.102	Single-IGBT operation error	Gr.1	No
ER.320	Regenerative overload error	Gr.2	Yes
ER.400	Overvoltage error	Gr.1	Yes
ER.410	Undervoltage error	Gr.2	Yes
ER.42A	KTY temp. sensor overheat error	Gr.1	Yes
ER.450	DI terminal assignment conflict error	Gr.2	No
ER.451	DO terminal assignment conflict error	Gr.2	No
ER.452	Torque mode AI assignment error	Gr.1	Yes
ER.520	Vibration error	Gr.1	Yes
ER.521	No-tuning vibration error	Gr.1	Yes
ER.710	Instantaneous drive overload error	Gr.1	Yes
ER.711	Instantaneous motor overload error	Gr.1	Yes
ER.720	Continuous drive overload error	Gr.1	Yes
ER.721	Continuous motor overload error	Gr.1	Yes
ER.7A0	Drive overheat error	Gr.2	Yes
ER.810	Abs encoder multi-turn data error	Gr.1	Yes
ER.820	Abs encoder data parity error	Gr.1	No
ER.830	Abs encoder undervoltage error	Gr.1	Yes
ER.840	Multi-turn upper limit direction error	Gr.1	Yes
ER.860	Abs encoder overheat error	Gr.1	Yes
ER.890	Invalid motor ID error	Gr.1	No
ER.8A1	Home timeout error	Gr.1	Yes
ER.B31	U-phase circuit error	Gr.1	No
ER.B32	V-phase circuit error	Gr.1	No
ER.B33	W-phase circuit error	Gr.1	No

ER.BF0	System operation error SCANB	Gr.1	No
ER.BF1	System operation error SCANA	Gr.1	No
ER.BF2	MCU-FPGA data transfer error	Gr.1	No
ER.C10	Overspeed error	Gr.1	Yes
ER.C21	Abs encoder multi-turn overflow error	Gr.1	Yes
ER.C90	Serial encoder disconnection error	Gr.1	Yes
ER.C91	Encoder acceleration error	Gr.1	Yes
ER.C92	Incremental encoder z signal loss error	Gr.1	Yes
ER.CC0	Output torque beyond target error	Gr.2	Yes
ER.CC1	Motor overspeed error	Gr.2	Yes
ER.CF2	External error	Gr.1	No
ER.D00	Excessive position deviation error	Gr.1	Yes
ER.D01	Servo-ON excessive position deviation error	Gr.1	Yes
ER.D02	Servo-ON excessive position deviation error due to speed limit	Gr.2	Yes
ER.D04	Electronic gear ratio setting error	Gr.1	Yes
ER.E00	EtherCAT chip error	Gr.2	No
ER.E01	EtherCAT Eeprom load error	Gr.2	No
ER.E02	EtherCAT SM0/SM1 mailbox data length error	Gr.1	Yes
ER.E03	Home mode setting error (CANopen)	Gr.1	Yes
ER.E04	EtherCAT sync cycle error	Gr.2	Yes
ER.E05	Control mode not supported by 6060h	Gr.2	Yes
ER.E06	EtherCAT data read error	Gr.1	No
ER.E12	EtherCAT sync frame loss	Gr.1	Yes
ER.E20	CANopen master disconnection(life factor)	Gr.2	Yes
ER.E21	CANopen master disconnection(consumer time)	Gr.2	Yes
ER.E22	CAN master node monitoring line configuration conflict error	Gr.1	No
ER.EC3	Two-axis sync error	Gr.1	Yes
ER.F10	External power supply loss error	Gr.2	Yes

Table 8-2 List of Alarm Messages

Alarm Code	Name	Content
AL.900	Excessive position deviation alarm	Accumulated position deviation beyond setting
AL.901	Servo-ON excessive position deviation alarm	Accumulated position deviation beyond setting during servo-ON
AL.902	Emergency stop alarm	External emergency stop signal received

AL.910	Motor or drive overload alarm	Approaching overload alarm (precursor to ER.710/ER.720. which may occur if operation continues.)
AL.911	Motor vibration alarm	Abnormal vibration detected (threshold same as ER.520), on/off setting by Pn185.X
AL.920	Regeneration overload alarm	Approaching regeneration overload alarm (precursor to ER.320, which may occur if operation continues.)
AL.921	Dynamic brake overload alarm	Dynamic brake overload occurs
AL.930	Absolute encoder undervoltage alarm	Low voltage detected in encoder backup battery
AL.931	Jog signal conflict alarm	Both forward/reverse jog signals active simultaneously via JOGP/JOGN signal During normal operation, either a positive jog signal or a negative jog signal is applied individually.
AL.940	Servo ON sequence alarm	Enable signal by the input terminal (S-ON) or the internal register before bus voltage established
AL.941	Parameter reset required alarm	ower cycle needed for parameter update
AL.950	Bootstrap circuit alarm	Motor speed beyond rating during enable
AL.955	External power supply loss alarm	External power loss detected
AL.971	Undervoltage alarm	Bus voltage below Pn786 level (precursor to ER.410 which may occur if operation continues.)
AL.9A0	+OT alarm	Positive overtravel (P-OT) signal detected
AL.9A1	-OT alarm	Negative overtravel (N-OT) signal detected
AL.9A2	Servo-ON speed limit	Speed beyond Pn270 setting during Servo-ON/limit release
AL.9B0	STO alarm	STO input protection on
AL.9F0	EtherCAT sync0 alarm	EtherCAT sync0 failure detected

8.3 Error Causes and Solutions

Code	ER.020	User parameter and parity error
Cause:	The drive unit performs a parity verification on function codes (user parameter groups) but it fails.	
Details		
Cause	Check	Solution

1. Momentary control power voltage dip	● Measure the power supply voltage	Set the power supply voltage within the specified range and initialize the parameter settings.
2. Power loss during parameter write	● Confirm if power interruption occurred during parameter storage	Reinitialize parameters and reconfigure function codes.
3. Excessive parameter write frequency	● Check if host controller frequently modifies parameters	Potential drive failure. Replace unit and modify parameter writing method.
4. Noise interference (power/grounding/ESD) causing data corruption	● Error persists after parameter reinitialization	Implement noise countermeasures.
5. Servo unit hardware failure	● Fault recurs after multiple reinitializations	Potential drive failure. Replace the servo drive.

Code	ER.021	Parameter formatting error (Version mismatch)
Cause:	● Number of function codes changed (typically after software update) ● Software version number updated ● Drive power rating code not configured	
Details		
Cause	Check	Solution
1. Software update	● Check if software was updated	Reset the drive model (PnE00).
2. Unconfigured power rating code	● Check if PnE00 = 0	Reset the drive model (PnE00).
3. Drive hardware failure	● Check if error persists after multiple resets	Potential drive failure. Replace the servo drive.

Code	ER.022	Manufacturer parameter parity error
Cause	The drive unit internally performs a checksum verification on the function codes (manufacturer parameter group). A checksum failure triggers this error.	
Details		
Cause	Check	Solution
1. Momentary drop in control power supply voltage	● Measure the power supply voltage.	Set the power supply voltage within the specified range and reconfigure the manufacturer parameters.
2. Power interruption during parameter write operation	● Check if a momentary power loss occurred during parameter storage.	Reconfigure the manufacturer parameters.

3. Frequent parameter writing	● Check if the host device frequently performs parameter modification operations.	Replace the servo drive and modify the parameter writing method.
4. Data storage malfunction due to noise such as power grounding issues or electrostatic discharge	● Check if the error persists frequently after initializing parameter settings and reconfiguring function code parameters,	Implement measures to prevent noise interference.
5. Servo unit failure	● Check if the corresponding fault reoccurs after multiple initializations and reconfigurations of function code parameters,	Replace the servo drive.

Code	ER.023	MCU and FPGA communication error
Cause:	During initialization, MCU writes test data to specific FPGA addresses and reads back for verification. Failure indicates issues with address/data buses and control signals between MCU and FPGA.	
Details		
Cause	Check	Solution
Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.030	FPGA running backup code error
Cause:	FPGA reverted to backup firmware image	
Details		
Cause	Check	Solution
1. Recent FPGA firmware update	● Check update history	Reflash FPGA firmware.
2. Power-on interference	● Check if error occurs at startup	Repower-up.

Code	ER.040	Parameter setting out of range error
Cause:	Function code value exceeding allowable limits	
Details		
Cause	Check	Solution

1. Invalid parameter entry	● Check modified parameters (via Un203)	Adjust to valid range.

Code	ER.041	Single-IGBT device parameter setting error
Cause:	System switch 2 (PnEIC.16) is enabled in single-module device.	
Details		
Cause	Check	Solution
1. Dual-axis sync function enabled in single-module mode	● Check value of PnEIC.16	Disable PnEIC.16.

Code	ER.042	Parameter combination error
Cause:	Invalid parameter combination detected	
Details		
Cause	Check	Solution
1. Program jog speed out of range due to electronic gear ratio/encoder resolution change	● Check the detection formula	Reduce the electronic gear ratio.
2. Program jog speed (Pn508) modification causing out-of-range operation		Increase Pn508 value.
3. Advanced tuning speed out of range due to gear ratio/encoder resolution change		Reduce the electronic gear ratio.

Code	ER.044	Axis A/B address conflict error
Cause:	Duplicate address assignment between Axis 1 and Axis 2 in dual-axis drive	
Details		
Cause	Check	Solution
Identical address settings for Axis 1/2	● Check Pn080 settings in dual-axis function codes ● Check for address conflicts in the DIP switch settings on the drive unit - DIP switch settings have the highest priority	Modify Pn080 or set DIP switches for unique addresses.

Code	ER.050	Motor-drive capacity mismatch error
Cause:	Capacity mismatch between motor and drive.	
Details		

Cause	Check	Solution
1. Rating mismatch	● Compare motor/drive capacities $\frac{1}{4} \leq \frac{Motor\ capacity}{Servo\ drive\ capacity} \leq 4$	Match drive to the motor rating.
2. Motor parameter error	● Verify the motor parameters	Correct the motor parameter settings.
3. Drive parameter error	● Verify the drive parameters	Correct the drive parameter settings.

Code	ER.051	Drive power setting error
Cause:	Wrong setting against rating	
Details		
Cause	Check	Solution
Wrong PnE00 setting	● Check PnE00 value.	Configure correct power rating.

Code	ER.0B0	Invalid servo-ON reference error
Cause:	Utility functions and other method used at the same time to enabke the drive	
Details		
Cause	Check	Solution
1. Internal enable conflict	● Check Pn001.X setting	Disable the internal enable.
2. External enable conflict	● Verify S-ON signal	Configure X terminals properly.

Code	ER.100	Drive software overcurrent error
Code	ER.BF4	Drive hardware overcurrent error
Cause:	Drive output current exceeding the configured threshold	
Details		
Cause	Check	Solution
1. Motor cable U, V, W short circuit	● Check if motor power cables U, V, W are short-circuited and if connector pins have burrs.	Correctly connect the motor cables.

2. Motor cable U, V, W grounded	● Check insulation resistance between motor power cables U, V, W and motor housing. Measure whether insulation resistance between drive terminals U, V, W and ground (PE) is in the megaohm (MΩ) range.	Replace motor if insulation is poor.
3. Motor burnout	● Check if the resistance between motor windings is balanced.	Replace motor if resistance is unbalanced.
4. Poor contact in motor power cables	● Check whether terminals of U, V, W connectors at motor connection are loose or detached.	If loose or detached, secure them properly.
5. Improper gain setting causing vibration during motor operation	● Check if the motor vibrates or produces abnormal noise during startup and operation.	Adjust the gain settings.
6. Braking resistor too small or short-circuited	● Check if external braking resistor is used, measure resistance value between RB+ and RB-.	If resistance is infinite "∞", the braking resistor is internally open: If using external braking resistor, replace with a new one and reconnect between RB+ and RB-.
7. Encoder wiring error or loose connector	● Check if standard encoder cables from our company are used and whether connectors are loose. ● Disable servo enable signal, manually rotate motor shaft, and check if encoder feedback position changes with rotation.	Re-solder, firmly reconnect, or replace encoder cables.

Code	ER.102	Single-IGBT operation error
Cause:	Abnormal voltage in single-IGBT drive circuit	
Details		
Cause	Check	Solution
1. Phase loss/motor stall	● Check for output phase loss ● Check for motor stalling	Verify load is within motor rating.

Code	ER.320	Regenerative overload error
Cause:	Accumulated heat in braking resistor exceeding level setting	
Details		
Cause	Check	Solution
1. Power voltage out of range	● Measure input voltage	Adjust to specified range.
2. External braking resistance or power capacity below required specification or continuous regeneration exceeding resistor's thermal capacity	● Verify resistor rating/capacity	Update the resistance or capacity.
3. Incorrect resistor setting	● Check resistor configuration	Correct parameter settings.
4. Resistance too high	● Verify the resistance.	Use a proper resistor.
5. External forced regeneration	● Check for external drag.	Optimize system conditions and use a common DC bus.
6. Higher DC bus voltaghe and insufficient energy absorption of regenerative power due to high load inertia	● Check deceleration time ● Check the regenerative resistor loading rate. ● Check the regeneration alarm display.	Increase the motor and drive capacity and extend deceleration time, and add an external resistor.
7. Regen capacity exceeded during deceleration due to high motor speed	● Check the deceleration time ● Check the regenerative resistor load rate ● Check the regeneration alarm display	Increase the motor and drive capacity and extend deceleration time, and add an external resistor.
8. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.400	Overvoltage error
Cause:	DC bus voltage between DC+ and DC- exceeding the error level: normal-48V, error-80V.	
Details		
Cause	Check	Solution
1. High input voltage	● Measure input voltage (spec: ±10%, 43V~53V) ● Normal: 48V ● Deviation: ±10% (43V~53V)	Adjust the power supply.

2. Power instability/lightning	● Monitor whether the driver input power is affected by lightning strikes, and measure whether the input power is stable and meets the above specifications.	After installing surge suppressor, power ON control & main circuits - if the error persists, replace the servo drive.
3. External braking resistor failure	● If an external braking resistor is used, measure the resistance value between RB+ and RB-.	If the resistance value is infinite "∞", it indicates a broken brake resistor wire. Replace the resistor connected to RB+/RB-.
4. Energy not absorbed fully due to large external braking resistor.	● Measure the resistance value between RB+ and RB- and compare it with the recommended value.	Install a proper resistor as recpmmanded and connect it to P⊕/B2.
5. Braking energy exceeding absorption capacity during motor operation or emergency deceleration	● Measure the resistance value between RB+ and RB- and compare it with the recommended value.	Increase ACC/DEC time when the main circuit input voltage is within drive specifications.
6. Excessive voltage measurement deviation	● Measure the DC bus voltage and compare with Un140 reading.	Contact us for technical support.
7 High inertia operation	● Check if the moment of inertia ratio is operating within the permissible range of the moment of inertia ratio.	Reduce load or extend the deceleration time.
8. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.410	Undervoltage error
Cause:	DC bus voltage below the set error level: normal-48V, error-80V.	
Details		
Cause	Check	Solution
1. Unstable power or instantaneous power failure	● Measure input voltage (spec: 48V±10%, 43V~53V)	Adjust the power supply.

2. Power supply voltage drops during operation.	● Detect the power supply voltage on the input side of the drive and check whether the main circuit power supply is too large, resulting in insufficient power supply capacity and reduced voltage.	Replace or adjust the input power supply.
3. Poor contact of DC power supply.	● Check whether the main circuit wiring is correct and reliable.	Replace the cables and connect the main circuit power cables correctly.
4. Large deviation of bus voltage measurement.	● Measure the DC bus voltage and compare it with Un140 reading.	Contact us for technical support.
5. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.42A	KTY temp. sensor overheat error
Cause:	KTY temp higher than the set overhear level (Pn059)	
Details		
Cause	Check	Solution
1. Low threshold	● Check Pn059 value	Set the overheat threshold appropriately.
2. Poor ventilation	● Check the cooling duct.	Clear the air duct.
3. Overload operation	● Check motor torque condition.	Select a model appropriately.
4. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.450	DI terminal assignment conflict error
Cause:	Duplicate or invalid function assignments to digital input terminals X	
Details		
Cause	Check	Solution
1. Duplicate function assignments	● Check Pn601.YX/Pn609.YX for identical function codes	Reassign unique function codes to X terminals.
2. Invalid function code	● Verify function code validity	Correct invalid function codes.

Code	ER.451	DO terminal assignment conflict error
Cause:	Duplicate or invalid function assignments to digital output terminals Y	

Details		
Cause	Check	Solution
1. Duplicate function assignments	● Check Pn611.YX/Pn614.YX for identical function codes	Reassign unique function codes to Y terminals.
2. Invalid function code	● Verify function code validity	Correct invalid function codes.

Code	ER.452	Torque mode AI assignment error
Cause:	Torque reference and speed limit signals assigned to the same analog input channel in torque mode	
Details		
Cause	Check	Solution
1. Analog signal conflict in torque mode	● Check Pn400 settings	Correct Pn400.X configuration.

Code	ER.520	Vibration error
Cause:	Speed fluctuation exceeding threshold (Max./Min./Cycle)	
Details		
Cause	Check	Solution
1. Abnormal motor vibration	● Monitor speed/torque waveforms.	Reduce the motor speed or the speed loop gain.
2. Incorrect inertia ratio	● Verify inertia ratio	Adjust the system inertia ratio.

Code	ER.521	No-tuning vibration error
Cause:	Speed fluctuation exceeding threshold (Max./Min./Cycle)	
Details		
Cause	Check	Solution
1. Strong motor vibration.	● Monitor speed waveforms.	Reduce the load to lower the allowable moment of inertia ratio, or reduce the rigidity value.

Code	ER.710	Instantaneous drive overload error
Code	ER.711	Instantaneous motor overload error
Code	ER.720	Continuous drive overload error
Code	ER.721	Continuous motor overload error
Cause:	Accumulated heat greater than the set error level	
Details		
Cause	Check	Solution

1. Excessive load rate	● Check if Un142 is higher than 100%.	Replace with a higher power drive.
2. Wiring issues	● Check the motor power cables	Correct connections.
3. Parameter errors	● Verify drive/motor parameters	Reconfigure per model specs.
4. Wrong motor parameters	● Check the motor parameters	Correct the motor parameters.
5. Excessive load due to mechanical issues	● Check for zero-speed at non-zero command	Resolve the mechanical issues.
6. Brake not released on brake-equipped motor	● Check voltage at brake terminals	Resolve the brake issues.
7. Vibration and noise due to wrong gain settings	● Review gain parameters	Retune servo gains.
6. Cross-wired axes	● Verify the cable routing	Correct the axis connections.
9. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.7A0	Drive overheat error
Cause:	Drive module temperature exceeding the set error level	
Details		
Cause	Check	Solution
1. High ambient temperature	● Measure the ambient temperature	Improve the cooling conditions and reduce the ambient temperature.
2. Blocked cooling duct	● Check airflow paths	Clear the air duct.
3. Improper installation	● Check mounting orientation and distance	Reinstall per manual.
4. Overload cycling	● Check overload history	Increase capacity/extend acceleration/deceleration time.
5. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.810	Abs encoder multi-turn data error
Cause:	Backup battery power loss detected. [Applies only to multi-turn absolute encoders]	
Details		
Cause	Check	Solution
1. First power-on	● Check power connection status	Execute Pn07F=1 setup.
2. Cable power connection status	● Check power connection status	Reinitialize encoder (Pn07F=1).

3. Control power(+5V)/battery failure	● Check encoder and motor powER.	Replace battery and reinitialize the encoder (Pn07F=1).
4. Low encoder battery	● Check the battery voltage	Replace battery and reinitialize the encoder (Pn07F=1).
5. Absolute encoder failure	● Check if error persists after multiple Fn008 settings	Replace the servo motor.
6. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.820	Absolute encoder data parity error
Cause:	Discrepancy between stored ROM parameters and expected values in serial encoder	
Details		
Cause	Check	Solution
1. Drive/motor mismatch	● Verify compatibility	Match drive/motor per Pr790=1000, Pr791=encoder type.
2. Encoder ROM corruption	● Check encoder cable integrity ● Check if the signals at both ends of the encoder cable: PS+, PS-, +5V, GND are the same	Use our standard encoder cables, make sure the terminals are securely connected at the motor end and tightened at the drive end. Replace the encoder cable with a new one if necessary. Separate the encoder cables with the power cables (R, S, T, U, V, W).
3. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.
4. Motor encoder failure	● Check if error persists after multiple power cycles	Replace a servo motor and encodER.

Code	ER.830	Abs encoder battery low error
Cause:	Abs encoder battery voltage below the specified value	
Details		
Cause	Check	Solution
1. Battery poorly connected or disconnected.	● Check the battery connection.	Connect the battery correctly.
2. Battery voltage below specified value (2.7V).	● Measure the battery voltage.	Replace the battery.

3. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.840	Multi-turn upper limit direction error
Cause:	Different encoder operation from Pn277 setting	
Details		
Cause	Check	Solution
1. Incorrect parameter setting	● Check Pn277 setting	Correct the direction parameter setting.
2. Motion reversal	● Monitor actual rotation direction	Adjust the control logic.
3. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.860	Abs encoder overheat error
Cause:	Motor encoder temperature greater than the set error level	
Details		
Cause	Check	Solution
1. High ambient temperature	● Measure the ambient temperature	Improve cooling.
2. Overload operation	● Check Un00A	Reduce load to the rated capacity.
3. Improper sizing	● Check Un00A	Reselect the motor or drive.
4. Encoder failure	● Check if error persists after multiple power cycles	Replace the servo motor.
5. Encoder failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.890	Invalid motor ID error
Cause:	Motor ID setting mismatch	
Details		
Cause	Check	Solution
Abnormal motor ID setting	● Check Pn790	Correct the motor ID setting.

Code	ER.8A1	Home timeout error
Cause:	Low home timeout setting or home signal not found within the set time.	
Details		
Cause	Check	Solution

1. Low home timeout setting	● Compare with homing duration with Pn299 setting	Correct Pn299 setting.
2. Home signal failure	● Force test the home signal	Set the home signal reasonably.

Code	ER.B31	U-phase circuit error
Code	ER.B32	V-phase circuit error
Code	ER.B33	W-phase circuit error
Cause:	Abnormal home signal sampled by the drive	
Details		
Cause	Check	Solution
1. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.BF0	System operation error SCANB
Code	ER.BF1	System operation error SCANA
Cause:	System operation failure	
Details		
Cause	Check	Solution
1. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.BF2	MCU-FPGA data transfer error
Cause:	Data written from MCU to FPGA fails verification readback, indicating communication integrity failure	
Details		
Cause	Check	Solution
1. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.C10	Overspeed error
Cause:	● Torque reference direction ≠ speed feedback direction ● Speed feedback ≠speed reference direction	
Details		
Cause	Check	Solution
1. Phase sequence wiring error	● Check U/V/W sequence at drive/motor terminals	Correct the phase wiring.

2. Initial position error	● Fault occurs immediately at servo ON when e phase sequence is correct	Repower-up.
3. Wrong encoder model or wiring error	● Check compatibility by Pn790=1000, Pn791=encoder code	Replace with the matched drive/encodER. If it is a Veichi drive and motor with a serial encoder, make sure Pn790=1000 and Pn791 encoder code setting is correct.
4. Encoder wiring issues	● Check cables/connectors for damage or loose joints ● Rotate the motor shaft without enabling to see if there is any change in the motor feedback pulse	Re-solder/reconnect or replace encoder cable.
5. Vertical axis overload	● Check gravity load and brake parameters	Reduce the vertical axis load or increase the rigidity of the servo drive, or reset the error on the basis of safe operation.

Code	ER.C21	Abs encoder multi-turn overflow error
Cause:	Overflow of the absolute encoder multiturn count detected	
Details		
Cause	Check	Solution
Abs encoder multi-turn overflow error	-	Clear fault via host controller, and repower up and ensure mechanical travel within encoder's multi-turn range.

Code	ER.C90	Encoder disconnection error
Code	ER.C91	Encoder acceleration error
Cause:	The drive has not received answer feedback from the encoder several times consecutively (serial encoder).	
Details		
Cause	Check	Solution
1. Loose connection	● Check encoder ports	Reconnect securely.
2. Cable damage	● Check continuity/shielding	Use the OEM-specified cable.

3. Noise interference	● Check the operating environment	Correct wiring of the encodER. Separate the encoder cables with the power cables (R, S, T, U, V, W).
4. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.CC0	Output torque beyond target error
Cause:	Motor output torque value exceeding the set target	
Details		
Cause	Check	Solution
Load above target	● Check motor output torque	Adjust the forward and reverse torque ranges. Reduce the load.

Code	ER.CC1	Motor overspeed error
Cause:	Motor speed value exceeding the set target	
Details		
Cause	Check	Solution
Overspeed	● Check target speed setting	Adjust target speed. Check encoder operation.

Code	ER.CF2	External error
Cause:	Drive error due to external error signal	
Details		
Cause	Check	Solution
1. External error signal input	● Check the signal.	Resolve the external problem.

Code	ER.D00	Excessive position deviation error
Cause:	Position deviation larger than the set error level in position control mode	
Details		
Cause	Check	Solution
1. Phase loss or wrong phase sequence	● Check the motor wiring (power off)	Correct the wiring or replace the cables.
2. Phase disconnection	● Check the wiring	Correct the wiring.

3. Motor stalling due to mechanical issues	● Check if internal torque reference ≠ 0 while motor speed = 0	Resolve the mechanical issues.
4. Low servo drive gain	● Check position/speed loop gain parameters	Adjust gain values.
5. Low position deviation error level setting	● Check position deviation error level setting	Set an appropriate position deviation error level.
6. High input pulse frequency	● For pulse-based position references: check if frequency is too high ● Check if pulse reference acceleration/deceleration time = 0 or too low ● Check if the electronic gear ratio is too high	Reduce the position reference pilse or electronic gear ratio. When using host controller pulses: set proper acceleration time in controller. If controller lacks acceleration settings, use drive's position reference smoothing function.
7. Internal speed limit	● Check motor speed limit (Parameter Pn316) vs. pulse reference speed	Configure proper maximum motor speed.
8. Drive hardware failure	● Check if error persists after multiple power cycles	Replace the servo drive.

Code	ER.D01	Servo-ON excessive position deviation error
Cause:	Position deviation exceeding error level upon servo activation	
Details		
Cause	Check	Solution
1. Large position deviation when servo drive on	◆ Check Un009	Clear the position deviation before servo enabling. Adjust the servo-ON position deviation error level.

Code	ER.D02	Servo-ON excessive position deviation error due to speed limit
Cause:	Position deviation caused by speed limit greater than the error threshold when servo drive on	
Details		
Cause	Check	Solution

Servo ON enabled while position deviation is accumulating, and the speed limited at this time, and then a position reference is input, exceeding the position deviation error level	● Check Un009	Clear the position deviation before servo enabling. Adjust the servo-ON position deviation error level. Adjust the servo-ON speed limit.

Code	ER.D04	Electronic gear ratio setting error
Cause:	Incorrect electronic gear ratio	
Details		
Cause	Check	Solution
1. Pn204/Ph206 >64000 or <0.001	● Check Pn204 and Pn206 setting	Correct Pn204 and Pn206 setting.
2. Object dictionary 6091h gear ratio numerator or denominator = 0	● Check 6091h setting	Make sure object directory 6091h ≠1.

Code	ER.E00	EtherCAT chip error
Cause:	EtherCAT slave controller and device hardware initialization error	
Details		
Cause	Check	Solution
1. EtherCAT chip initialization failure	● Check the ESC manufacturer code.	Correct the ESC manufacturer code.

Code	ER.E01	EtherCAT Eeprom load error
Cause:	CRC error for the ESC chip's EEPROM, or EEPROM loading failed	
Details		
Cause	Check	Solution
1. EtherCAT Eeprom data failure	-	Repower up.

Code	ER.E02	EtherCAT SM0/SM1 mailbox data length error
Cause:	EtherCAT SM0/SM1 mailbox data length error	
Details		
Cause	Check	Solution
1. EtherCAT mailbox data length error	-	Check mailbox data length.

Code	ER.E03	Home mode setting error
Cause:	Home mode set by object dictionary 6098 out of range	
Details		
Cause	Check	Solution
1. Home mode setting error	● Check 6098h value	Correct home mode.

Code	ER.E04	EtherCAT sync cycle error
Cause:	EtherCAT sync cycle not 125μs multiple	
Details		
Cause	Check	Solution
1. Wrong EtherCAT sync cycle	● Check the sync cycle	Correct EtherCAT sync cycle setting.

Code	ER.E05	Control mode not supported by 6060h
Cause:	Write the control mode not supported by object 6060h	
Details		
Cause	Check	Solution
1. Invalid control mode	● Check 6060h setting	Correct 6060h setting

Code	ER.E06	EtherCAT data read error
Cause:	EtherCAT data read error	
Details		
Cause	Check	Solution
Incorrect data	● Check EtherCAT data format	Validate data format.

Code	ER.E12	EtherCAT sync frame loss error
Cause:	EtherCAT sync frame loss	
Details		
Cause	Check	Solution
1. EtherCAT sync frame loss error	● Check cables ● Check for jitter in the master's transmit data frame time	● Correct the cables. ● Apply clock offset compensation.

Code	ER.E20	CANopen master disconnection(life factor)
Cause:	No heartbeat received when slave monitors the master's heartbeat within the timeout period set in 1016h)	

Details		
Cause	Check	Solution
1.Slave dropout	● Check master status ● Check the cable connection	● Correct master configuration. ● Change network cable.
2.Low time setting in 100Ch*100Dh	● Check that the protection time meets requirements	● Increase 100Ch or 100Dh.

Code	ER.E21	CANopen master disconnection(consumer timeout)
Cause:	No master's remote frames received within the configured timeout (100Ch × 100Dh) by the slave when node guarding is enabled	
Details		
Cause	Check	Solution
1. Master offline	● Check master status & cable connection	Restart master and inspect cables.
2.Low time setting in 1016h	● Check consumer timeout requirements	Increase timeout values.

Code	ER.EC3	Two-axis sync error
Cause:	One axis failure in a two-axis model	
Details		
Cause	Check	Solution
Fault in one axis	Check both axes' status	Resolve the faulty axis issue.

Code	ER.F10	External power supply loss error
Cause:	No power detected between DC+/DC- when main circuit is ON	
Details		
Cause	Check	Solution
1. Power input failure	● Check external power supply ● Check DC+/DC- connections	Wire correctly.
2. Low external power loss detection filter time	Check Pn780 setting	Adjust Pn780 setting.

9 Communication

9.1 RS485 Communication

The host computer communication of the servo drive adopts the standard Modbus protocol based on the RS485 interface. For the SD100 servo drive RS485 communication details, refer to "3.4.1 CAN/RS485/EtherCAT Communication Terminal".

Modbus is a serial, asynchronous communication protocol, serving as a universal language applied in PLCs or other controllers. This protocol defines a message structure used for intelligent control recognition, regardless of the network through which they are transmitted. And it does not require a specialized interface; a typical physical interface is RS485.

The function codes of the servo drive are divided into 16-bit and 32-bit based on data length. Data read and write operations on the function codes can be performed via the Modbus RTU protocol. And when writing function codes, the command code varies depending on the data length.

Command code	Description
03h	Read 16/32-bit function code
06h	Write 16-bit function code
10h	Write 32-bit function code

9.1.1 Communication Parameter Setting

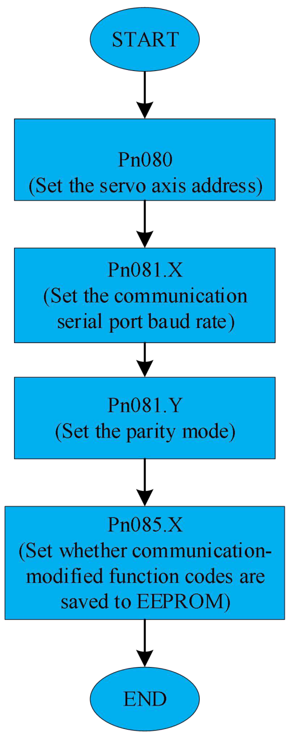


Figure 9-1 Communication Parameter Setting Step

(1) Pn080: CAN Node-ID

The host controller can perform write operations on all slave drives through the broadcast address. And the slave drives perform corresponding operations upon receiving frames with the broadcast address but do not reply.

Station No.	Description	Default
0	Broadcast address	1
1~255	Slave address	

(2) Pn081.X: Communication Serial Port Baud Rate

The communication rate of the servo drive must be set consistent with that of the host controller, otherwise, communication cannot be established. When multiple servo drives are networked, if the data communication rates are not entirely consistent with the host, it will cause communication errors or affect other communications.

Funcode	Description	Default
Pn081.X=0	4800bps	Pn081.X=2
Pn081.X=1	9600bps	
Pn081.X=2	19200bps	
Pn081.X=3	38400bps	
Pn081.X=4	57600bps	
Pn081.X=5	115200bps	

(3) Pn081.Y: Parity method

There are 6 parity methods for SD100 servo drives.

Funcode	Description	Default
Pn081.Y=0 [N, 8, 1]	No parity, 8-bit data, 1 stop bit	Pn081.Y=0
Pn081.Y=1 [E, 8, 1]	Even parity, 8-bit data, 1 stop bit	
Pn081.Y=2 [O, 8, 1]	Odd parity, 8-bit data, 1 stop bit	
Pn081.Y=3 [N, 8, 2]	No checksum, 8-bit data, 2 stop bit	
Pn081.Y=4 [E, 8, 2]	Even parity, 8-bit data, 2 stop bit	
Pn081.Y=5 [O, 8, 2]	Odd parity, 8-bit data, 2 stop bit	

(4) Pn085.X: Communication Modification Power-down Save

The corresponding function code value is saved into the EEPROM on this product in real time after modification.

Funcode	Description	Default
Pn085.X=0	OFF	Pn085.X=0
Pn085.X=1	ON	

9.1.2 Modbus Protocol

(1) Transmission mode

Transmission modes include ASCII mode and RTU mode, but this product only supports RTU mode. Characters sent in RTU mode are represented in hexadecimal. For example, to send 30H, directly input 30H into the data packet.

(2) Baud rate

Range: 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps.

(3) Data frame format

The format of RTU data frame is shown in the table below:

Table 9-1 RTU Data Frame Format

Start Bit	Address	Command	Data	CRC Check	End Bit
T1-T2-T3-T4	1 byte	1 byte	N bytes	2 bytes	T1-T2-T3-T4

(4) 03H command code reads N consecutive words

Command code: 03H, it allows for reading N words, up to 16 words consecutively.

Example: Read 2 words continuously starting from address 02B0H of slave drive with station number 01H. The command information and response information are as follows:

Table 9-2 03H Command Format

Command Information (Host)		Response Information (Slave)	
Address:	01H	Address:	01H
Command	03H	Command	03H
Starting address	02H(High byte)	Data quantity (in bytes)	02H
	90H(Low byte)		
Data quantity (in words)	00H	Data	01H
	01H		01H
CRC check (Low)	85H	CRC check (Low)	78H
CRC check (High)	9FH	CRC checksum(High)	14H

(5) 06H command code writes 1 word

Function: Write 1 word.

Example: Write 1000 (03E8H) to address 0A00H of the servo drive with station number 01H.

Table 9-3 06H Command Write One Word

Command Information (Host)		Response Information (Slave)	
Address:	01H	Address:	01H
Command	06H	Command	06H
Starting address	0AH	Starting address	0AH
	00H		00H
Data content	03H	Data content	03H
	E8H		E8H
CRC check	8AH	CRC checksum	8AH
	ACH		ACH

(6) 10H command code writes N words (N≥2).

Function: Write N words (Word), N≥2.

Example: Write 100 to address 0100H and 400 to address 0101H of the slave drive with address 01H.

Table 9-4 10H Command Write N Words

<table>
<tr><th colspan="2">Command Information (Host)</th><th colspan="2">Response Information (Slave)</th></tr>
<tr><td>Address:</td><td>01H</td><td>Address:</td><td>01H</td></tr>
<tr><td>Command</td><td>10H</td><td>Command</td><td>10H</td></tr>
<tr><td rowspan="2">Write data address</td><td>01H</td><td rowspan="2">Write data address</td><td>01H</td></tr>
<tr><td>00H</td><td>00H</td></tr>
<tr><td rowspan="2">Data quantity</td><td>00H</td><td rowspan="2">Data qty.</td><td>00H</td></tr>
<tr><td>02H</td><td>02H</td></tr>
<tr><td>Byte</td><td>04H</td><td rowspan="2">CRC check</td><td>40H</td></tr>
<tr><td>Data content (1st word high byte)</td><td>00H</td><td>34H</td></tr>
<tr><td>Data content (1st word low byte)</td><td>64H</td><td>-</td><td>-</td></tr>
<tr><td>Data content (2nd word high byte)</td><td>01H</td><td>-</td><td>-</td></tr>
<tr><td>Data content (2nd word low byte)</td><td>90H</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">CRC check</td><td>BEH</td><td rowspan="2">-</td><td>-</td></tr>
<tr><td>1CH</td><td>-</td></tr>
</table>

(7) RTU mode check code calculation

RTU mode uses CRC (Cyclic Redundancy Check) check value.

The calculation of the CRC check value is explained in the following steps:

Step 1: Set a 16-bit register with an initial value of FFFFH, called the CRC registER.

Step 2: XOR the first byte of the command information (Address) with the low byte of the 16-bit CRC register and store the result back in the CRC registER.

Step 3: Check the least significant bit (LSB) of the CRC registER. If this bit is 0, shift right by one bit; if this bit is 1, shift the CRC register value right by one bit, then XOR with A001H.

Step 4: Return to Step 3 until Step 3 has been executed 8 times, then proceed to Step 5.

Step 5: Repeat Steps 2 to 4 for the next byte of the command information until all bytes have been processed. The content of the CRC register at this time is the CRC check value.

Note:

After calculating the CRC check value, the low byte of the CRC must be filled first in the command information, followed by the high byte.

Example: Read 2 words starting from address 0004H of the servo drive with station number 01H. The final content of the CRC register calculated from the Address to the last byte of the data quantity is 8A5CH. Then the command information is as follows. Note that 5CH is transmitted before 8AH.

Table 9-5 CRC Check Code Calculation

Command Meaning	Command Content
Address	01H
Command	03H
Starting address	00H(High byte)
	04H(Low byte)
Qty.	00H
(in words)	02H
CRC check (Low byte)	85H
CRC check (High byte)	CAH

(8) Error information

When a command sent from the master station is erroneous, such as abnormal function code address or CRC check error, the drive will reply with the corresponding error code to the master station.

9.1.3 Communication Related Settings

(1) RS485 bus structure

The servo drive uses half-duplex communication via RS485, which must use a daisy-chain structure, rather than a star or branched structure, since star or branched structures are prone to generate reflected signals, which cause interference to 485 communication.

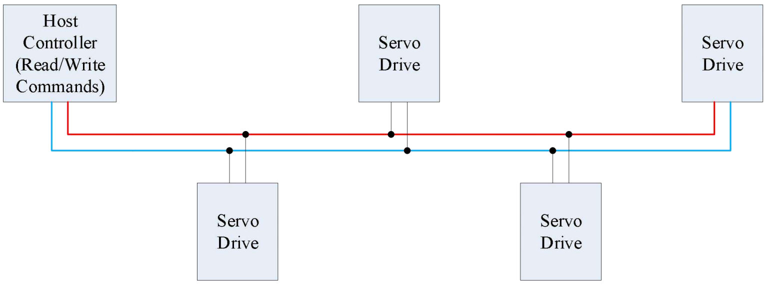


Figure 9-2 RS485 Communication Bus Connection

During use, users must use shielded twisted pair cables, keep them as far away from high-power electrical equipment as possible, avoid running them parallel to power cables, and must not bundle them togethER. It is important to Note that in a half-duplex connection, only one servo drive can communicate with the host controller at any given time. If two or more servo drives attempt to upload data simultaneously, bus contention will occur, which can not only lead to communication failure but may also cause high currents in certain components, potentially damaging them.

(2) Grounding and Termination

The ends of an RS485 network must be terminated with a 120Ω termination resistor to mitigate signal reflection, but termination resistors should not be used on nodes in the middle of the network.

No point in an RS485 network should be directly grounded, but all devices on the network must be properly grounded through their own grounding terminals. And please Note that ground wires do not form closed loops under any circumstances.

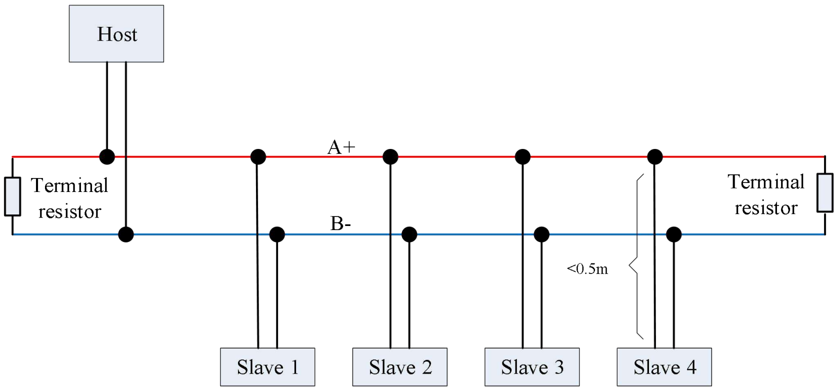


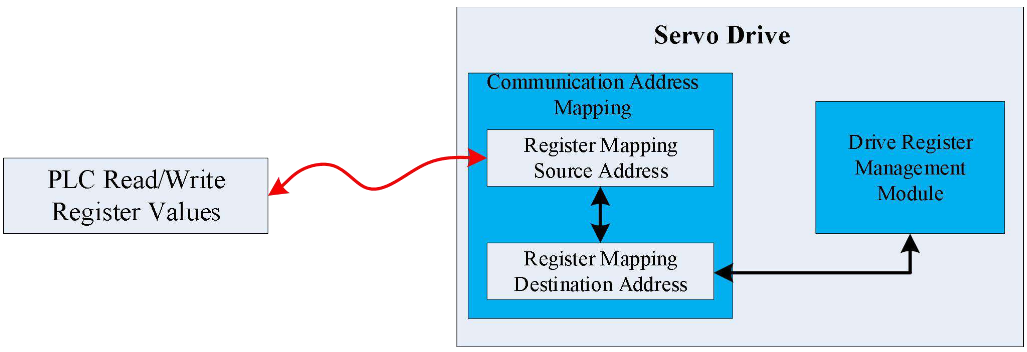
Figure 9-3 Termination Resistor Connection

Recommendation: Termination resistor value is 120Ω.

NOTE	
⚠	● When perform write operations on the drive's function code parameters via the Modbus communication protocol, please avoid frequent writing and storage to EEPROM operations due to the limited number of erase/write cycles of the data storage chip (EEPROM), otherwise, the data storage chip may be damaged. For example: Performing a write operation on function code Pn300. ● If the desired data is to be written to both RAM and stored to EEPROM, the corresponding address is 0x0300. ● If the desired data is to be written only to RAM and not stored to EEPROM, the corresponding address is 0x1300.

9.1.4 Register Address Mapping

Users can use the register address mapping function during 485 communication, to read from or write to corresponding register addresses without changing the specific register addresses in existing configuration software (HMI) or PLC programs.



Related funcodes:

Funcode	Name	Range	Default
Pn087.X	Modbus Register Address Mapping Enable	0~1	0
Pn087.Y		0~1	0

Pn088	Register 1 Mapping Source Address	0x000~0x1FFF	0
Pn089	Register 1 Mapping Target Address	0x000~0x1FFF	0
Pn08A	Register 2 Mapping Source Address	0x000~0x1FFF	0
Pn08B	Register 2 Mapping Target Address	0x000~0x1FFF	0

For example, if an existing PLC program writes speed command values to address 0x0400, users can use the this function to map this address to the corresponding address in this product without modifying the PLC program.

No.	Content
1	Set Node ID(RS485&Canopen)(Pn080)
2	Set communication baud rate (Pn081.X)
3	Set communication parity method (Pn081.Y)
4	Enable Modbus register address mapping(Pn087.X=1)
5	Set register 1 mapping source address(Pn088=0x0A00)
6	Set register 1 mapping target address (Pn089=0x0304)

NOTE	
	● The register address mapping function is only effective for RS485 communication and does not affect USB use.

9.2 CANopen Communication

9.2.1 CANopen Performance Parameters

Table 9-6 CAN Performance Parameter Description

Name	Description
Link layer protocol	CAN bus
Application layer protocol	CANopen
CAN-ID type	11bit-CAN2.0A
Baud rate	1Mbit/s (default), 500Kbit/s, 250Kbit/s, 125Kbit/s, 100Kbit/s, 50Kbit/s, 20Kbit/s
Maximum nodes	63
CAN frame length	0~8
Application layer CAN frame type	Standard
Termination resistance	120Ω

Sub-protocol	CIA-301-V4.02: CANopen Application Layer and Communication Protocol DSP-402-V2.0: Drive and Motion Control Sub-protocol
Service	NMT: Network Management SDO: Service Data Object PDO: Process Data Object SYNC: Synchronization Generator
PDO transmission type	Event-triggered, synchronous-triggered
PDO data	4×RPDO, 4×TPDO
SDO transmission method	Accelerated SDO transmission
Servo drive mode	Profile position mode (PP) Profile velocity mode (PV) Profile torque mode (PT) Home mode (HM) Interpolation position mode (IP)

The CANopen communication function of the servo drive supports the following different baud rates. And the commuication distance is related to baud rate and the cable quality. For the SD100 servo drive RS485 communication details, refer to "3.4.1 CAN/RS485/EtherCAT Communication Terminal".

Table 9-7 Baud Rate Description

Data Transfer Rate	Bus Length (m)
1Mbit/s	25
500kbit/s	100
250kbit/s	250
125kbit/s	500
50kbit/s	1000
25kbit/s	2500

Table 9-8 CAN Communication Transmission Distance, Speed, and Node Relationship

No.	Transmission Distance	Speed Rate	Node	Cable Diameter
①	25m	1Mbps	64	$0.205mm^2$
②	95m	500Kbps	64	$0.34mm^2$
③	560m	100Kbps	64	$0.5mm^2$
④	1100m	50Kbps	64	$0.75mm^2$

9.2.2 Communication Object

(1) SDO (Service Data Object)

① R-SDO (Receive SDO) and T-SDO (Transmit SDO);

② Clients can access the device object dictionary via SDO using index and sub-index;

③ Each SDO request and response message consists of 8 bytes;

④ SDO is implemented through the CMS object in CAL and can transmit data of varying byte lengths. When the data exceeds 4 bytes, it is automatically split into multiple messages.

(2) PDO (Process Data Object)

① R-PDO (Receive PDO) and T-PDO (Transmit PDO);

② PDO data transmits 1 to 8 bytes of real-time data to one or more recipients;

③ The communication parameters corresponding to PDO determine synchronous or asynchronous transmission;

④ Each CANopen device includes 4 transmit PDO channels and 4 receive PDO channels.

(3) SYNC (Synchronization Object)

The SYNC object is a message periodically broadcast by the CANopen master to the CAN bus, used to provide a basic network clock signal. Each device can decide whether to use this event for synchronized communication with other network devices based on its own configuration.

(4) NMT (Network Management)

Network Management objects include Boot-up messages, Heartbeat protocol, and NMT messages. Based on the master-slave communication mode, NMT is used to manage and monitor individual nodes in the network, primarily for three functions: node state control, error control, and node startup.

(5) EMCY (Emergency Message)

This indicates the message sent when an internal communication or application error occurs in the device.

9.2.3 Network Parameter Configuration

9.2.3.1 Communication Object Identifier

The Communication Object Identifier (COB-ID) specifies the priority of the object and the identification of the communication object. The COB-ID corresponds to the 11-bit frame ID in CAN. The 11-bit COB-ID consists of two parts: the object function code and the 7-bit node address, as detailed in the table below.

Table 9-9 COB-ID Composition Description

10	9	8	7	6	5	4	3	2	1	0
Code				Node ID						

Each communication object in CANopen has a default COB-ID, which can be read via SDO, part of which can also be modified via SDO. The object list is shown in the table below:

Table 9-10 Object COB-ID

Communication Object	Function Code	Node Address	COB-ID	Index Number
NMT	0000b	0	0h	-
Object	0001b	0	80h	1005h, 1006h
Urgent message	0001b	0~127	80h+Node-ID	1014h
TPDO1	0011b	0~127	180h+Node-ID	1800h
RPDO1	0100b	0~127	200h+Node-ID	1400h
TPDO2	0101b	0~127	280h+Node-ID	1801h

RPDO2	0110b	0~127	300h+Node-ID	1401h
TPDO3	0111b	0~127	380h+Node-ID	1802h
RPDO3	1000b	0~127	400h+Node-ID	1402h
TPDO4	1001b	0~127	480h+Node-ID	1803h
RPDO4	1010b	0~127	500h+Node-ID	1403h
T-SDO	1011b	0~127	580h+Node-ID	1200h
R-SDO	1100b	0~127	600h+Node-ID	1200h
NMT error	1110b	0~127	700h+Node-ID	1016h，1017h

For example: The COB-ID of R-SDO for slave station No. 2 is 600h+2h=602h.

9.2.3.2 System Code Parameters

To connect the servo drive to the EthrCAT fieldbus network, please set the relevant function codes of the servo drive properly.

Table 9-11 System Settings Function Codes

Funcode	Name	Range	Setting
Pn000.Z	Drive Type	0: Standard pulse 1: CANopen	1
Pn080	Node ID (RS485&CANopen)	1~127	1(Default)
Pn081.Z	CANopen Baud Rate	0: 20kbit/s 1: 50kbit/s 2: 100kbit/s 3: 125kbit/s 4: 250kbit/s 5: 500kbit/s 6: 1 Mbit/s	4(Default)

9.2.3.3 NMT Service

Network Management System (NMT) is responsible for initializing, starting, and stopping the network, operating as a master-slave system. In the entire CANopen network, there is only one Network Management System (NMT) master, which can configure the CANopen network, including itself. Some state transitions are automatically implemented internally, while others must be initiated by the NMT master sending NMT messages.

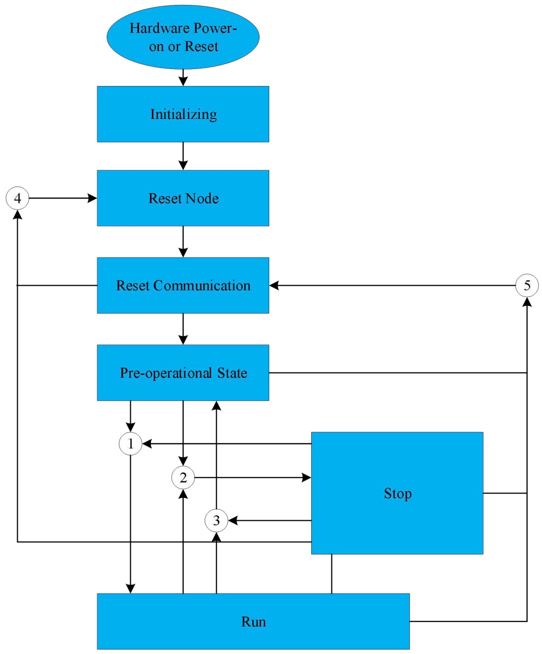


Figure 9-4 NMT State Machine

The format of the Network Management System (NMT) message is shown in the table below.

Table 9-12 NMT Message Format

COB-ID	RTR	Data(byte)	
		0	1
0x000	0	Command word	Node_ID

NMT: The COB-ID of the message is fixed at "0x000".

The data field consists of two bytes. The first byte is the command code, which specifies the control function of the frame, as detailed in the table below.

Table 9-13 NMT Message Commands

Command Word	Transition Code	Description
01h	①	Start Remote Node (all nodes in the network operate).
02h	②	Stop Remote Node (only NMT remains operational in the entire network).
80h	③	Enter Pre-operational State (only SDO, Heartbeat, and NMT are operational).
81h	④	Reset Node.
82h	⑤	Reset Communication.

The second byte is the node address of the CANopen device. When it is "0", it is a broadcast message, and all slave devices in the network are valid.

Table 9-14 State Transition

	Initialization	Pre-operation	Operation	Stop
PDO			○	
SDO		○	○	

SYNC		○	○	
EMCY		○	○	
Boot-Up	○			
NMT		○	○	○

Note:

○ means valid.

For example, to enable the SDO operation of the drive (drive node address is 1), you can send a command word of 80.

Frame Format	COB-ID	RTU	0	1	2	3	4	5	6	7
Data frame	00	0	80	01	-	-	-	-	-	-

9.2.3.4 NMT Error Control

NMT error control is primarily used to detect whether devices in the network are online and their current states, including Node Guarding/Life Guarding and Heartbeat monitoring. In practical applications, enabling both Life Guarding and Heartbeat simultaneously is prohibited. And the timing parameters for Node Guarding/Life Guarding and Heartbeat should not be set too short, as this may increase network load.

(1) Node Guarding/Life Guarding

Node Guarding involves the NMT master periodically querying the status of NMT slaves via remote frames. While Life Guarding, on the other hand, allows slaves to indirectly monitor the master status based on the intervals of received remote frames used for monitoring. Node Guarding follows a master-slave model, where each remote frame must be acknowledged.

The objects related to Node Guarding/Life Guarding include the Guard Time (100Ch) and the Life Time Factor (100Dh). The former represents the normal interval (in milliseconds) between Node Guarding remote frames and the product of them determines the maximum allowable time for the master to query. Node Guarding can be reliably implemented under normal circumstances, When Life Guarding is activated when both100Ch and 100Dh are non-zero and a Node Guarding request frame is received.

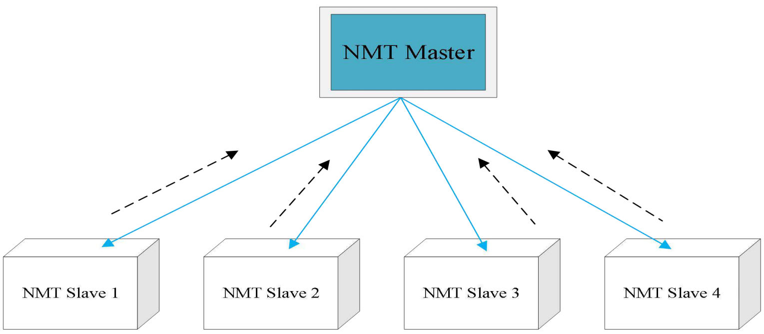


Figure 9-5 Link Diagram

The NMT master sends a Node Guarding remote frame at intervals specified by the Guard Time (100Ch). The slave must respond to this frame; otherwise, the slave is considered offline. If the slave does not receive a Node Guarding remote frame within the time period defined by 100Ch × 100Dh, the master is considered offline.

The format of the remote frame sent by the NMT master is shown in the table below.

Table 9-15 Node Guarding Remote Frame Message

COB-ID	RTR
0x700+Node-ID	1

The response message returned by the NMT slave node is shown in the table below.

Table 9-16 Node Guarding Response Message

COB-ID	RTR	Data
0x700+Node-ID	0	Status word

The data field consists of a one-byte Status Word. The data format is described in the table below.

Table 9-17 Data Field Description

Data Bit	Description
bit7	Must toggle between "0" and "1" with each subsequent response
bit6~bit0	4: Stopped state 5: Operational state 127: Pre-operational state

(2) Heartbeat

The Heartbeat protocol employs a producer-consumer model.

A CANopen device can transmit Heartbeat messages at intervals defined by the Producer Heartbeat Time object (1017h), unit in milliseconds. Nodes in the CAN network equipped with the consumer heartbeat function monitor this producer based on the Consumer Heartbeat Time set in object 1016h. If the corresponding node's producer heartbeat is not received within the consumer heartbeat time window, that node is considered to have failed. The Heartbeat protocol requires that the Node ID of the master node must not exceed 63.

Once the Producer Heartbeat Time (1017h) is configured, the node's heartbeat function is activated, and it begins generating heartbeat messages. After configuring a valid sub-index for the Consumer Heartbeat (1016h), monitoring of the corresponding node begins upon receipt of its first heartbeat message.

The master sends heartbeat messages according to its producer time. If a slave monitoring the master does not receive a heartbeat message within the time specified by the respective sub-index of object 1016h, the master is considered offline. The time specified in the sub-index of object 1016h must be greater than or equal to twice the master's producer time; otherwise, the slave may erroneously determine that the master is offline.

Each slave sends heartbeat messages at the interval defined by its object 1017h. If the master, which is monitoring the slave, does not receive a heartbeat message within its consumer time, that slave is considered offline.

The format of the Heartbeat message is shown in the table below.

Table 9-18 Heartbeat Message Format

COB-ID	RTR	Data
0x700+Node-ID	0	Status word

The data field consists of a single byte, with the most significant bit (MSB) fixed as "0".

Table 9-19 Data Field Description

Data Bit	Description
bit7	Fixed at “0”
bit6~bit0	4: Stopped state 5: Operational state 127: Pre-operational state

9.2.4 Service Data Object (SDO)

The Service Data Object (SDO) establishes a connection with the Object Dictionary via an object index and sub-index. By using SDOs, users can read or where permitted, modify the contents of objects within the Object Dictionary.

9.2.4.1 SDO Transfer Protocol

The SDO transfer protocol follows a Client-Server model, which is a request-response mechanism, similar to the concept of a free format in serial communication. It is initiated by an SDO Client on the CAN bus network, and the SDO Server responds accordingly. Data exchange via SDO requires at least two CAN messages to complete, and the CAN identifiers (COB-IDs) of these two messages are different. The transfer process is illustrated in the figure below:

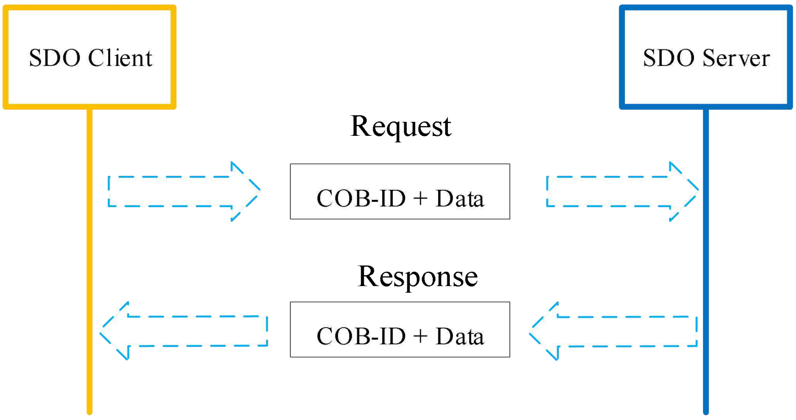


Figure 9-6 SDO Client Reads and Writes Object Dictionaries in SDO Server

9.2.4.2 SDO Transfer Format

SDO transfers are categorized into two types: those for object data not exceeding 4 bytes and those exceeding 4 bytes. Expedited SDO Transfer is suitable for data not exceeding 4 bytes, while Segmented Transfer or Block Transfer methods are employed for data exceeding 4 bytes. **Note**: The SD100 series only supports SDO mode. The basic composition of an SDO communication message is: COB-ID + Command Code + Index + Sub-index + Data, among which, the data segment uses Little-Endian format, meaning the least significant byte is transmitted first, followed by the more significant bytes. The SDO transfer message format is shown in the table below.

Table 9-20 SDO Transfer Message

COB-ID	0	1	2	3	4	5	6	7
600h+Node-ID	Command Code	Index		Subindex	Data area			
580h+Node-ID		Index		Subindex	Data area			

Example: If the data to be sent or received is the 32-bit value 0x11223344, it will be arranged in the message as 44 33 22 11.

(1) Expedited SDO Write Transfer Message

This is used for reads and writes not exceeding 4 bytes. The structure of the transfer message varies depending on the read/write method and the data length. See details in the table below.

Table 9-21 Expedited SDO Message Format

<table>
<tr><th></th><th>COB-ID</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td rowspan="3">Client
→</td><td rowspan="3">600h+Node-ID</td><td>23H</td><td colspan="2" rowspan="3">Index</td><td rowspan="3">Subindex</td><td colspan="4">Data</td></tr>
<tr><td>2BH</td><td colspan="2">Data</td><td>-</td><td>-</td></tr>
<tr><td>2FH</td><td>Data</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Server
←</td><td rowspan="2">580h+Node-ID</td><td>60H</td><td colspan="2" rowspan="2">Index</td><td rowspan="2">Subindex</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>80H</td><td colspan="4">Abort Code</td></tr>
</table>

Note:

1. “-” indicates data exists but can be ignored; Write it to 0.

2. The command words currently supported by this servo drive are listed below:

Table 9-22 SDO Write Command Word

Command Word	Description
2Fh	Write 1 byte
2Bh	Write 2 bytes
23h	Write 4 bytes

Example 1: The slave node ID is 1. Use SDO to write to object 100Dh (00). The data has 8 bits. To write data 64h to this object, you should send data command:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	601	2F	0D	10	00	64	-	-	-

If the parameter is written successfully, the returned data frame will be:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	581	60	0D	10	00	-	-	-	-

Example 2: The slave node ID is 1. Use SDO to write Pn500 (2003h-01). The data has 16 bits. To write data 64h to this object, you should send data command:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	601	2B	05	20	01	64	00	-	-

If the parameter is written successfully, the returned data frame will be:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	581	60	05	20	01	-	-	-	-

(2) SDO Expedited Read Transmission Message

When reading SDO data for objects not exceeding 4 bytes, the expedited method is used. The format of the expedited SDO read message is shown in the table below.

Table 9-23 Expedited SDO Message Format

<table>
<tr><th></th><th>COB-ID</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td>Client
→</td><td>600h+
Node-ID</td><td>40</td><td>Index</td><td colspan="2">Subindex</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="4">Server
←</td><td rowspan="4">580h+
Node-ID</td><td>43H</td><td rowspan="4">Index</td><td colspan="2" rowspan="4">Subindex</td><td colspan="4">Data</td></tr>
<tr><td>4BH</td><td colspan="2">Data</td><td>-</td><td>-</td></tr>
<tr><td>4FH</td><td>Data</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>80H</td><td colspan="4">Abort Code</td></tr>
</table>

Example 1: Use SDP to read object 100Dh(00) from station Node-ID 1, and send the following command:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	601	40	0D	10	-	-	-	-	-

Under normal circumstances, the returned data frame is:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	581	4F	0D	10	00	00	-	-	-

Example 2: Use SDO to read object P204(05) from station Node-ID 1, and send the following command:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	601	40	02	20	05	-	-	-	-

If the electronic gear ratio of the drive is 16777216:10000, i.e., Pn204=16777216, then the data frame returned under normal circumstances is:

Frame Format	COB-ID	0	1	2	3	4	5	6	7
Data frame	581	4B	02	20	05	00	00	00	01

9.2.5 Process Data Object (PDO)

The Process Data Object (PDO) is used to transmit real-time data and is the primary data transfer method in CANopen. It does not require an acknowledgment, and the length of a PDO must not exceed 8 bytes, resulting in high transmission speed.

The mapping configuration process for PDO is as follows:

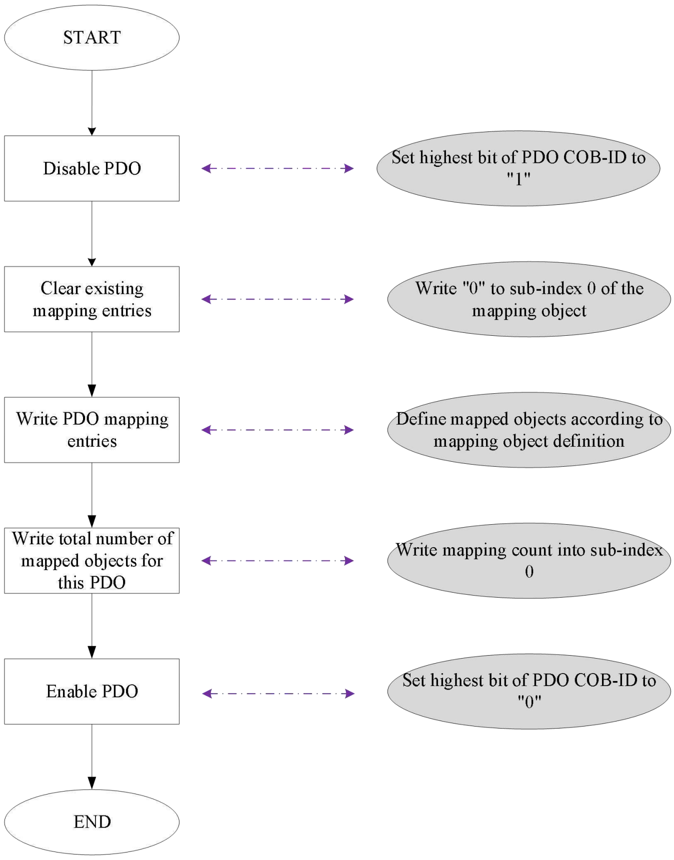


Figure 9-7 PDO Mapping Configuration Process

(1) PDO transmission method

PDO uses a producer/consumer model. Each network node can listen to messages from transmitting nodes and determine whether the received message needs to be processed. PDO data can be transmitted in a point-to-point or broadcast (point-to-multipoint) mannER. Each PDO message consists of a Transmit PDO (TxPDO) and a Receive PDO (RxPDO). Its transmission method is defined in the PDO communication parameter index. The transmission method is illustrated below:

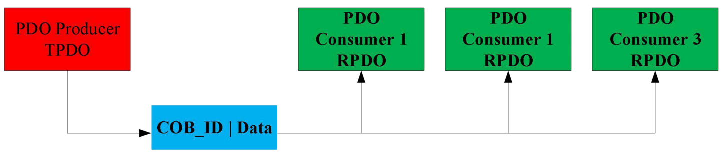


Figure 9-8 PDO Transmission Method

(2) PDO Object

PDOs can be divided into Receive PDOs (RxPDO) and Transmit PDOs (TxPDO). The transmission method and content of a PDO are determined by both its communication parameters and mapping parameters. This servo drive is designed with 4 RxPDOs and 4 TxPDOs to handle PDO data transmission. The related object list is shown in the table below.

Table 9-24 PDO-related Object List

Name		COB-ID	Communication Object	Mapping Object
RPDO	RPDO1	200h+Node-ID	1400h	1600h

	RPDO2	300h+Node-ID	1401h	1601h
	RPDO3	400h+Node-ID	1402h	1602h
	RPDO4	500h+Node-ID	1403h	1603h
TPDO	TPDO1	180h+Node-ID	1800h	1A00h
	TPDO2	280h+Node-ID	1801h	1A01h
	TPDO3	380h+Node-ID	1802h	1A02h
	TPDO4	480h+Node-ID	1803h	1A03h

(3) PDO Communication Code

The COB-ID of a PDO contains control bits and identifier data, which are used to determine the bus priority of that PDO. The COB-ID is located in sub-index 01 of the communication parameter objects (RxPDO: 1400h~1403h; TxPDO: 1800h~1803h). The Most Significant Bit (MSB) determines whether the PDO is valid or not.

MSB	LSB
31	30 0
0: ON 1: OFF	1400h~1403h + Node-ID 1800h~1803h+Node-ID

For example: For a site with Node-ID 1, RPDO1 has a COB-ID of “80000201h” when it is invalid. Write “00000201h” to this COB-ID to activate it.

(4) PDO Transmission Type

The PDO-ID is located in sub-index 02 of the communication parameter objects (RxPDO: 1400h~1403h; TxPDO: 1800h~1803h).

Table 9-25 PDO Transmission Type Classification

Transmission Type Value	Synchronous		Asynchronous
	Cyclic	Acyclic	
0		○	
1~240	○	-	-
241~253	-		
254~255	-	-	○

When the transmission type of a TxPDO is 0, it is sent if the mapped data changes and a Synchronization (SYNC) frame is received (synchronous, event-driven).

When the transmission type of a TxPDO is in the range 1 to 240, it is sent after receiving the corresponding number of SYNC frames (synchronous, cyclic).

When the transmission type of a TxPDO is 254 or 255, it is sent either when the mapped data changes or when the event timer expires (asynchronous).

When the transmission type of an RxPDO is in the range 0 to 240, the latest received data is applied to the application upon receipt of one SYNC frame.

When the transmission type of an RxPDO is 254 or 255, the received data is applied to the application immediately.

(5) Inhibit Time

An Inhibit Time is configured for TxPDOs to prevent the CAN network from being continuously occupied by lower-priority PDOs. This parameter is stored in sub-index 03 of the communication parameters (1800h~1803h). Its unit is 125 microseconds (μs). Once set, the transmission interval for the same TxPDO cannot be shorter than the time specified by this parametER.

For example: If the Inhibit Time for TxPDO1 is set to 16, the minimum transmission interval for TxPDO1 is 16*125μs=2000μs=2ms.

NOTE	
⚠	The Inhibit Time should not be set too low, or it may cause excessive bus load. Please appropriately set the Inhibit Time .

(6) Event Timer

For asynchronously transmitted TxPDOs (Transmission Type 254 or 255), an Event Timer is defined in sub-index 05 of 1800h~1803h. The Event Timer can be thought of as a trigger (timer); for the corresponding TxPDO when the set time is reached.

(7) PDO Mapping Parameters

All data transmitted via a PDO must be mapped to the corresponding index area in the object dictionary. During mapping, the index, sub-index, and length of the mapped object must be configured according to a specific format. And the total data length of each PDO mapping variable shall not be longer than 8 bits. Sub-index 0 of the mapping parameter object records the number of objects mapped to this PDO. Sub-indexes 1~4 contain the actual mapping entries. The content of a mapping parameter is defined as follows:

Table 9-26 PDO Mapping Parameter Description

<table>
<tr><th>Bit</th><th>31</th><th>…</th><th>16</th><th>15</th><th>…</th><th>8</th><th>7</th><th>…</th><th>0</th></tr>
<tr><td rowspan="4">Definition</td><td colspan="3" rowspan="4">Index</td><td colspan="3" rowspan="4">Subindex</td><td colspan="2">Object Length</td><td>Bit Length</td></tr>
<tr><td colspan="2">08h</td><td>8-bit</td></tr>
<tr><td colspan="2">10h</td><td>16-bit</td></tr>
<tr><td colspan="2">20h</td><td>32-bit</td></tr>
</table>

For example:

RPDO1 mapping object 6040h:

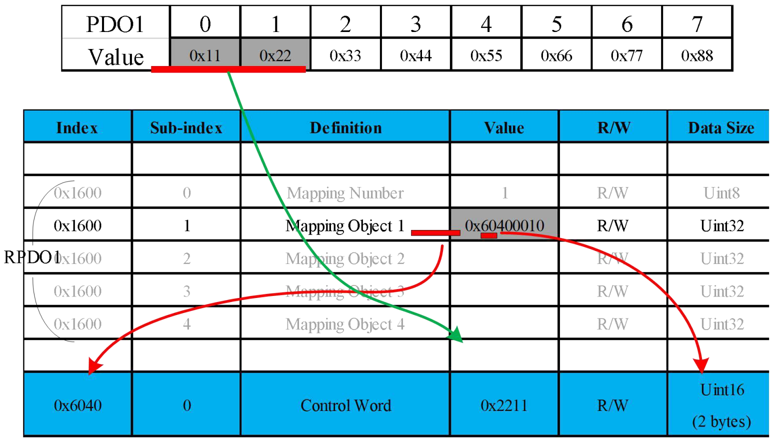


Figure 9-9 RPDO1 Mapping

TPDO1 mapping object 6041h:

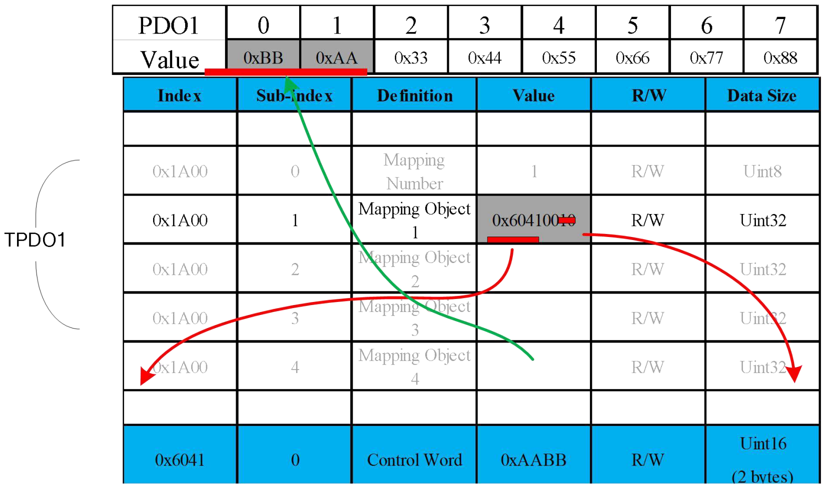


Figure 9-10 TPDO1 Mapping

（8）Configuring PDO Parameters and Example of Reading/Writing PDO Messages

PDOs (Process Data Objects) belong to process data and are used for transmitting real-time data in a unidirectional manner, meaning no response CAN message from the receiving node is required to confirm success. In communication terminology, this follows the "producer-consumer" model. Therefore, when using PDO communication, the focus is on the data being exchanged. Below, taking station number 1 as an example, we demonstrate the configuration and reading methods for RPDO and TPDO messages.

Example 1: RPDO Configuration and Parameter Writing

Scenario: When frequent changes to object [6040] are required to operate the drive, this object can be mapped into an RPDO to allow direct data transmission.

Steps:

1. Invalidate the mapping objects of RPDO1 via SDO. (The mapping parameters in [1600] can only be modified when the PDO is in an invalid state.) Send the following message via a CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	2Fh	00	16	00	00	00	00	00

2. ap [6040] to mapping object 1 of RPDO1, and directly send the message via the CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	23h	00	16	01	10	00	40	60

3. Set the number of valid objects for RPDO1, and directly send the message via the CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	2Fh	00	16	00	03	00	00	00

4. Enable RPDO1 by configuring its communication parameters, and send the message directly via the CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	23h	00	14	01	01	02	00	00

5. Write to object [6040] directly via RPDO1, and send the message directly via the CAN debugging tool:

Frame ID	Data				Data			
201h	07	00	00	00	00	00	00	00

The result of writing to [6040] via RPDO by sending messages frame-by-frame through a CAN debugging tool is shown in the figure below:

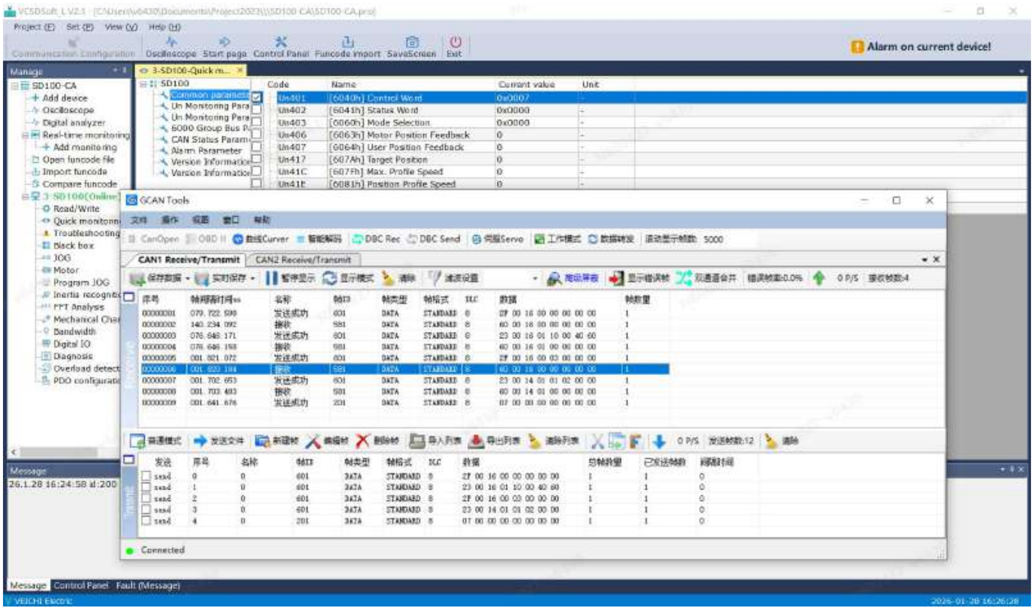


Figure 9-11 Operating RPDO Messages

Example 2: TPDO Configuration and Parameter Reading

Scenario: When real-time monitoring of the servo motor's user position feedback is required, object [6064] from the object dictionary can be mapped to TPDO1 for cyclic transmission.

Steps:

1. Invalidate the mapping objects of RPDO1 via SDO (The mapping parameters in [1600] can only be modified when the PDO is in an invalid state.) Send the following message via a CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	2Fh	00	1A	00	00	00	00	00

2. Map [6064] to mapping object 1 of TPDO1, and directly send the message via the CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	23h	00	1A	01	20	00	64	60

3. Set the number of valid objects for TPDO1, and directly send the message via the CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	2Fh	00	1A	00	02	00	00	00

4. Enable TPDO1 by configuring its communication parameters, and send the message directly via the CAN debugging tool:

Frame ID	Command Code	Index		Sub-index	Data			
601h	23h	00	18	01	81	01	00	00

The result of reading [6064] via TPDO by sending messages frame-by-frame through a CAN debugging tool is shown in the figure below:

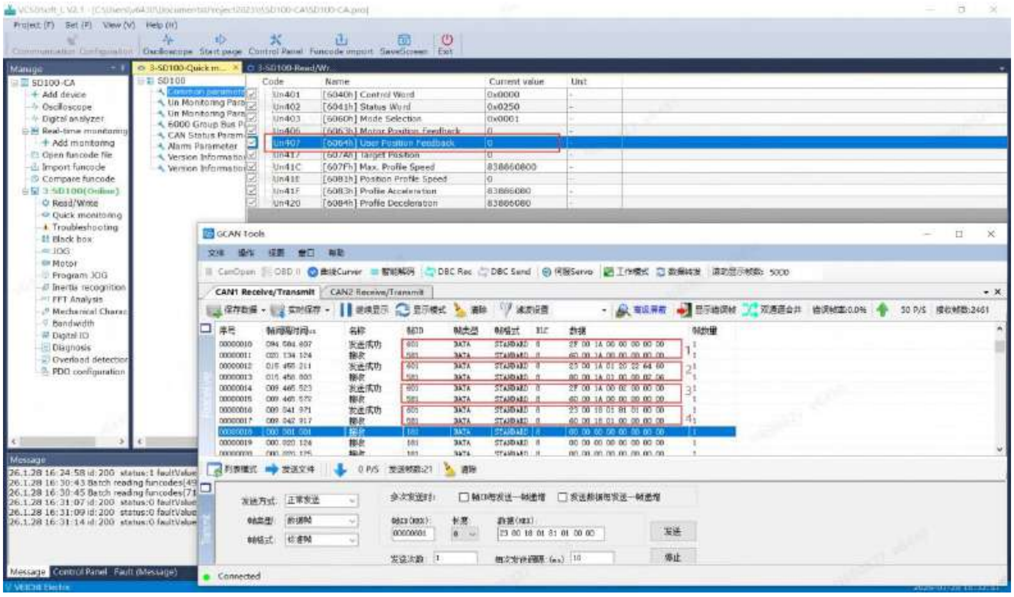


Figure 9-12 Operating TPDO Messages

9.2.6 Synchronization Object (SYNC)

The servo drive can act not only as a synchronous consumer but also as a synchronous producER. The objects related are the Synchronous Object COB-ID (1005h) and the Synchronous Cycle Period (1006h).

The second highest bit of the Synchronous Object COB-ID (1005h) determines whether the sync generator is activated:

MSB		LSB
31	30	29 0
0	0: OFF 1: ON	0x80

Similar to PDO transmission, the transmission of the SYNC object follows a producer-consumer model. In a CANopen network, only one node is allowed to transmit the Synchronization Object (SYNC). The node transmitting the SYNC is the producer, and the nodes receiving it are the consumers. The transmission framework is illustrated in the figure below.

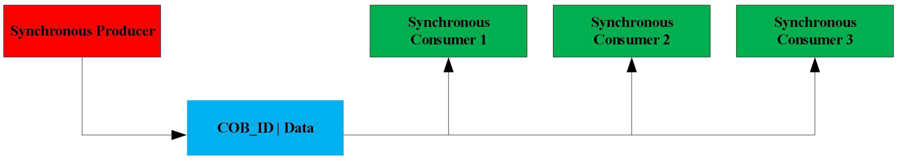


Figure 9-13 SYNC Transmission Method

To achieve synchronization in CANopen, PDOs are used to send control data to every slave node. Each slave node that receives a control command from the master temporarily stores it. Only after all control commands have been sent to the slaves does the master transmit a SYNC broadcast message. And all slave nodes that support synchronous transmission mode will then simultaneously execute the previously received control commands upon receiving this SYNC message.

The transmission of synchronous PDOs is tightly coupled with the SYNC frame. Their specific application is detailed in the table below:

Table 9-27 PDO Transmission Method

Transmission Type Value	Synchronous		Asynchronous
	Cyclic	Acyclic	
0	-	○	
1~240	○	-	-
241~253	-		
254~255	-	-	○

When the transmission type of a TxPDO is 0, it is sent if the mapped data changes and a Synchronization (SYNC) frame is received (synchronous, event-driven).

When the transmission type of a TxPDO is in the range 1 to 240, it is sent after receiving the corresponding number of SYNC frames (synchronous, cyclic).

When the transmission type of a TxPDO is 254 or 255, it is sent either when the mapped data changes or when the event timer expires (asynchronous).

When the transmission type of an RxPDO is in the range 0 to 240, the latest received data is applied to the application upon receipt of one SYNC frame.

When the transmission type of an RxPDO is 254 or 255, the received data is applied to the application immediately.

9.2.7 Emergency Object Service (EMCY)

When a fault occurs in a CANopen node, the node will transmit an Emergency message according to a standardized mechanism. Emergency messages also follow the producer-consumer model. After a node transmits a fault, other nodes in the CAN network can choose to process it. This servo drive acts only as an Emergency message producer and does not process Emergency messages from other nodes.

So when a node fault occurs, regardless of whether Emergency messages are activated or not, the drive will update the Error Register (1001h) and the Pre-defined Error Field (1003h).

To use Emergency messages, they must be activated accordingly via the Emergency COB-ID object (1014h):

MSB			LSB
31	30	0	0

0: ON 1: OFF	0x80+Node-ID

The format of the emergency message sent by the servo drive is as follows:

COB-ID	0	1	2	3	4	5	6	7
0x80+Node-ID	Error Code		Error Register	NA	Auxiliary Bytes			

Note:

The Error Register in the message always remains consistent with the value in object 1001h.

1. When a communication error occurs, the Error Code is consistent with the requirements of DS301, and the Auxiliary Bytes are zero.
2. When a user-specified exception occurs, the Error Code is 0xFF00, and the Auxiliary Bytes display the user-specified error code.

Example: Activate Emergency messages for Node 1 (Pn080=1).

(1) Set the node to Pre-operational state (Enable SDO operations).

Frame Type	COB-ID	0	1
Data frame	00	80	01

Note:

This is an NMT Command Frame.

(2) 1014H Bit31 is used to activate/deactivate the Emergency message. Accordingly, the data sent by the host controller is: Write data 0x00000081.

COB-ID IDID	0	1	2	3	4	5	6	7
601H	23	14	10	00	81	00	00	00

Note:

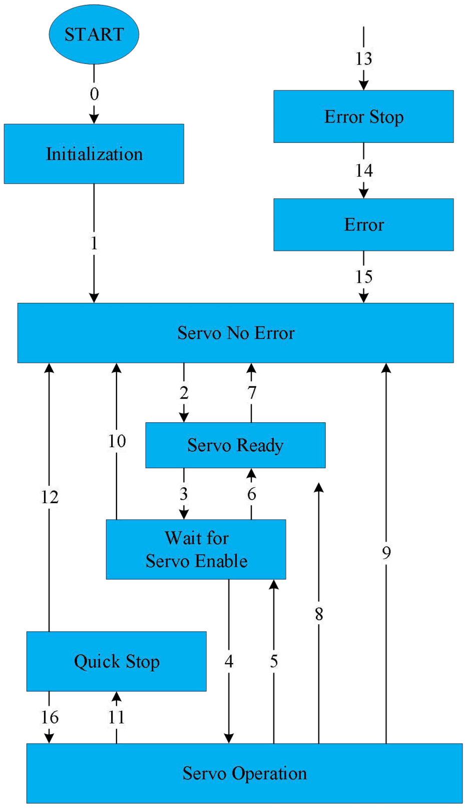
This is an SDO Write Request (Data Frame).

(3) Check if the drive has activated Emergency messages by Un031 (0xE031).

9.2.8 Servo Motor Status

9.2.8.1 Servo State Machine

The SD100 CANopen drive is controlled in accordance with the CiA402 standard protocol. The overall operating status diagram is as follows:



See the status details in the following table:

Drive Status and Descriptions

Drive State	Description
Initialization	The drive is initializing and internal self-test is in progress. Drive parameters cannot be set for now and the drive is not for operation.
Servo no error	The drive is fault-free and drive parameters can be configured.
Servo ready	The drive is ready. Drive parameters are configurable.
Wait for servo enable	The drive is waiting for the Servo Enable signal to be activated. Drive parameters are configurable.
Servo operation	The drive is operating normally. An operation mode is enabled and the motor is powered. Drive parameters are modifiable based on the specific active mode.
Quick stop	The Quick Stop function is valid and the drive is executing this function. Drive parameters are modifiable based on the specific active mode.
Error stop	A drive error has occurred and the drive is executing this function. Drive parameters are modifiable based on the specific active mode.
Error	The error stop procedure is complete. All drive functions are disabled, and only relevant drive parameters can be changed at this time to troubleshoot and clear the errors Example: For resettable faults, reset them by setting control word 6040h=0x80.

The control commands and corresponding state transitions are shown in the table below:

CiA402 Status Transition		6040h (Control Word)	6041H (Status Word) bit0~bit9[1]
0	Power-on→Initialization	Natural transition with no control command required.	0x0000
1	Initialization→Servo no error	Natural transition with no control command required. If an error occurs during initialization, it transitions directly to step 13 (Error).	0x0250
2	Servo no error→Servo ready	0x06	0x0231
3	Servo ready→Wait for servo enable	0x07	0x0233
4	Wait for servo enable→ Enable servo operation	0x0F	0x0237
5	Enable servo operation→ Wait for servo enable	0x07	0x0233
6	Wait for servo enable→Servo ready	0x06	0x0231
7	Servo ready→Servo no error	0x00	0x0250
8	Enable servo operation→ Servo no error	0x06	0x0231
9	Wait for servo enable→Servo no error	0x00	0x0250
10	Wait for servo enable→Servo no error	0x00	0x0250
11	Enable servo operation→ Quick stop	0x02	0x0217
12	Quick stop→Servo no error	Natural transition after Quick Stop completes; no control command needed.	0x0250
13	Any state→Error stop	Automatic transition upon error detection; no control command needed.	0x021F
14	Error stop→Error	Automatic transition after Error Stop procedure completes; no control command needed.	0x0218
15	Error→Servo no error	0x80: Error reset	0x0250

16	Quick stop→Enable servo operation	Send 0x0F after stop completes.	0x0237

Note:

Since bits 10 and 15 of the Status Word (6041h) are related to the operational state of various servo modes, they are represented as "0" in this context.

9.2.8.2 Status Word 6041h

6041h	-			PP	PV	PT	HM	IP
Index	6041h	-						
Name	Status Word							
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535			
Mapping	Y	W/R	RO	Default	0			

Function	Status word bit definitions are as follows: <table><tr><th>Bit</th><th>Content</th><th>Setting</th></tr><tr><td>0</td><td>Servo ready</td><td>0: OFF 1:ON</td></tr><tr><td>1</td><td>Wait for servo enable</td><td>0: OFF 1:ON</td></tr><tr><td>2</td><td>Enable servo operation</td><td>0: OFF 1:ON</td></tr><tr><td>3</td><td>Error</td><td>0: No error 1: Error</td></tr><tr><td>4</td><td>Enable main power circuit</td><td>0: OFF 1:ON</td></tr><tr><td>5</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr><tr><td>6</td><td>Enable power-on operation</td><td>0: OFF 1:ON</td></tr><tr><td>7</td><td>Alarm</td><td>0: OFF 1:ON</td></tr><tr><td>8</td><td>Manufacturer-defined</td><td>-</td></tr><tr><td>9</td><td>Remote control</td><td>0: Non-CANopen 1: CANopen</td></tr><tr><td>10</td><td>Target reached</td><td>Velocity mode 0: Not reached 1: Reached Position mode 0: Not reached 1: Reached</td></tr><tr><td>11</td><td>Internal position limit</td><td>0: No error 1: Error</td></tr><tr><td>12~13</td><td>Operation mode-related</td><td>-</td></tr><tr><td>14</td><td>NA</td><td>-</td></tr><tr><td>15</td><td>Home completed</td><td>0: Not performed or not completed 1: Completed and reference point established</td></tr></table>

9.2.8.3 Stop Modes

SD100-CANopen supports the following stop methods:

(1) Servo Enable OFF Stop

The servo stops running when the Servo Enable signal is turned OFF.

(2) Servo Error Stop

The servo automatically enters a stop state when an error occurs.

(3) Quick Stop

Set Control Word 6040h.bit2=0 to enable quick stop when there is no error. The stop method is selected via 605Ah.

605Ah	-				PP	PV	PT	HM	IP
Index	605Ah	-							
Name	Quick Stop Mode								
Object Structure	VAR	Data Type	Int16	Data Range	0~2				
Mapping	NO	W/R	RW	Default	2				

Function:

Display	Control Mode
0	Coast to stop and motor shaft not locked
1	Stop by 0x6084 (0x609A during home) setting and motor shaft not locked
2	Stop by 0x6085h setting and motor shaft not locked
5	Stop by 0x6084 (0x609A during home) setting and motor shaft locked
6	Stop by 0x6085h setting and motor shaft locked

(4) Halt Stop

Set Control Word 6040h.bit8=0 to enable halt stop when there is no error. The stop method is selected via 605Dh.

605Dh	-				PP	PV	PT	HM	IP
Index	605Dh	-							
Name	Halt Stop Mode								
Object Structure	VAR	Data Type	Int16	Data Range	1~3				
Mapping	NO	W/R	RW	Default	1				

Function:

Display	Control Mode
1	Stop by 6084h/6087h (0x609A during home) setting and motor shaft locked
2	Stop by 6085h/6087h setting and motor shaft locked
3	Stop as emergency stop and motor shaft locked

9.2.8.4 Servo Drive Operation Modes

SD100-CANopen supports 5 operation modes,

which can be set via object dictionary entry 6060h. The current servo operation mode can be read via 6061h.

(1) 6060h Operation Mode

6060h	-				PP	PV	PT	HM	IP
Index	6060h	-							
Name	Operation Mode								
Object Structure	VAR	Data Type	Int8	Data Range	0~7				
Mapping	Y	W/R	RW	Default	1				

Function	Set the servo drive operation mode.	
	Setting	Description
	0	NA
	1	Profile position mode (PP)
	3	Profile velocity mode (PV)
	4	Profile torque mode (PT)
	6	Home mode (HM)
	7	Interpolation position mode (IP)

(2) 6061h Operation Mode Display

6061h	-		PP	PV	PT	HM	IP
Index	6061h	-					
Name	Operation Mode Display						
Object Structure	VAR	Data Type	Int8	Data Range	0~7		
Mapping	Y	W/R	RO	Default	0		
Function	Display	Control Mode					
	0	NA					
	1	Profile position mode (PP)					
	3	Profile velocity mode (PV)					
	4	Profile torque mode (PT)					
	6	Home mode (HM)					
	7	Interpolation position mode (IP)					

9.2.8.5 Conversion Factor

Encoder Unit: The direct user of the drive is the motor, and the motor's position feedback is in pulses, therefore, the encoder unit is the pulse unit.

Reference Unit: The reference unit and the encoder unit are converted using the gear ratios $\frac{\text{Pn204}}{\text{Pn206}}$ and $\frac{\text{0x6091:01}}{\text{0x6091:02}}$.

If the encoder unit and reference unit are inconsistent, it will cause wrong motor operation. Therefore, before operating the servo drive, users need to set the conversion factor correctly. This factor establishes the proportional relationship between the two units, as shown below:

$$\text{6063h}=\text{6064h}\times\left(\frac{\text{6091:01h}}{\text{6091:02h}}\right)\times\left(\frac{\text{Pn204}}{\text{Pn206}}\right)$$

$$\text{Example: } \frac{\text{Pn204}}{\text{Pn206}}=\frac{8388608}{10000},\ \frac{\text{6091:01h}}{\text{6091:02h}}=\frac{2}{1}$$

When 6064h = 10000 (reference unit), $\text{6063h}=\text{6064h}\times\left(\frac{\text{6091:01h}}{\text{6091:02h}}\right)\times\left(\frac{\text{Pn204}}{\text{Pn206}}\right)=16777216$(encoder unit).

6091h	-		PP	PV	PT	HM	IP
Index	6091h	-					
Name	Gear Ratio						

Object Structure	ARR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	-
Function	Set a proportional relationship between load position and motor turns: $\text{Motor Displacement (Motor Units)} = \text{Load Displacement (User Units)} \times \text{Position Factor}$ The position factor is related to the mechanical reduction ratio, mechanical dimension parameters, and motor resolution. The calculation method is as follows: $\text{Position Factor} = \frac{\text{Motor Resolution} \times \text{Gear Transmission Ratio}}{\text{Load Feed}}$				

Sub-index	00h	-			
Name	Number of Entries				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	Y	W/R	RO	Default	2

Subindex	01h	-			
Name	Motor Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

Subindex	02h	-			
Name	Shaft Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

9.2.9 Operation Mode

9.2.9.1 Profile Position Mode (PP)

In Profile Position Mode, the master station sends relevant object dictionary entries—such as the target position (absolute or relative), the velocity for the position profile, acceleration, and deceleration—to the servo drive. The servo drive then generates the target trajectory reference based on the received data and commands.

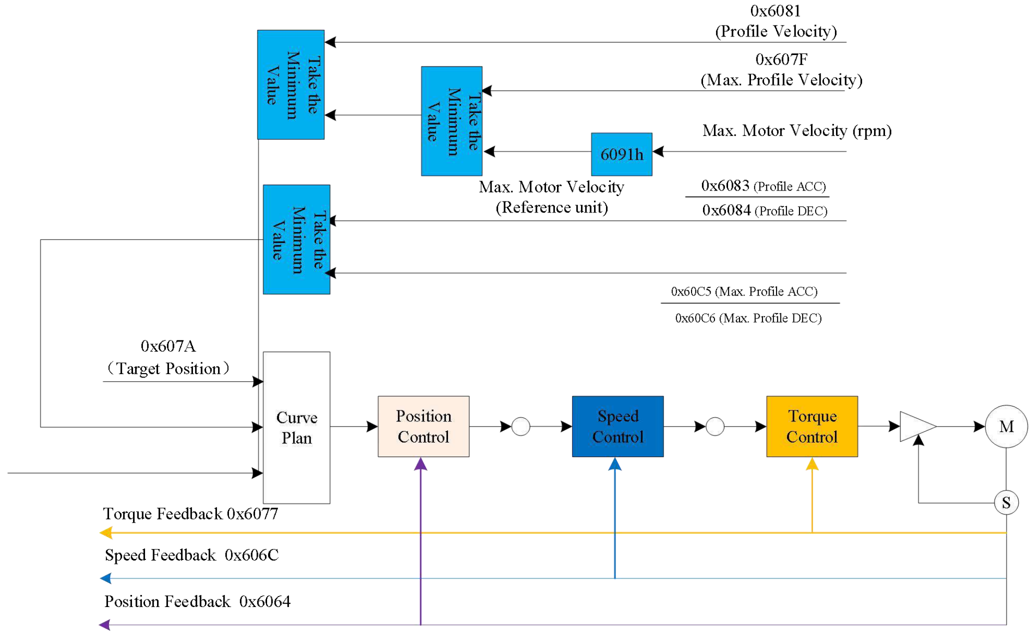
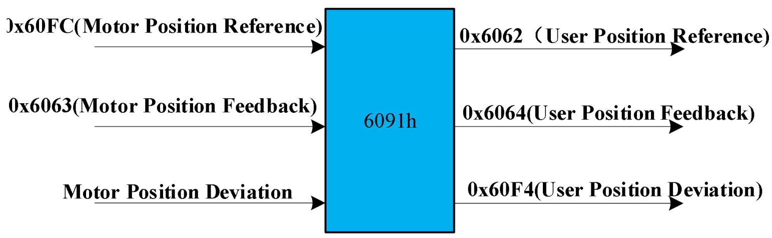


Figure 9-14 Position Position Mode Conttrol

The conversion diagram for user unit and encoder unit in Profile Position Mode via 0x6091 is as follows:

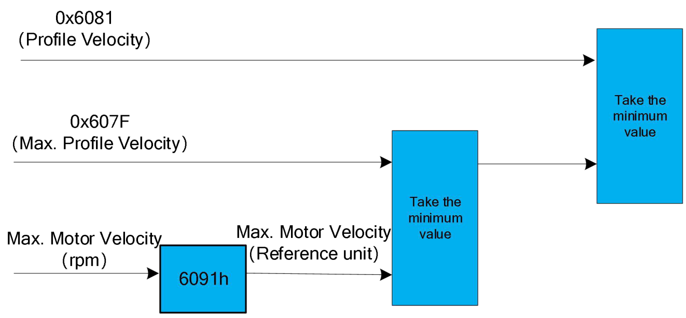


$$\text{Electronic Gear Ratio (0x6091)}=\frac{0\times6091{:}01}{0\times6092{:}02}$$

The relationship between Motor Position Feedback (0x6063) and user position feedback (0x6064):

$$\text{0x6063 (encoder unit)} = \text{0x6064 (reference unit)} \times \frac{0\times6091{:}01}{0\times6092{:}02} \times \left(\frac{\text{Pn204}}{\text{Pn206}}\right)$$

The following relationships exist between Profile Velocity (0x6081), Max Profile Velocity (0x607F), and the corresponding motor maximum speed after conversion:



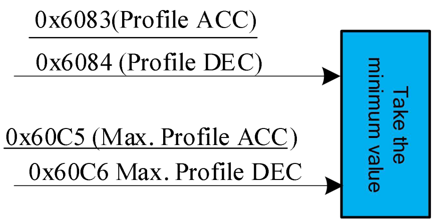
Relationship between motor speed (rpm) and load shaft speed (reference unit/s):

$$\text{Rated speed(rpm)}=\frac{\text{Load Axis Velocity}\times\frac{0\times6091{:}01}{0\times6091{:}02}}{\text{Encoder Resolution}}\times 60$$

Example: Gear ratio = 1:1, 23-bit encodER.

Motor speed=500rpm(0× 6081(Load Axis Velocity))=500× $\frac{8388608}{60}$=69905066(reference unit/s)

$\frac{0\times6085}{0\times6084}$(Profile ACC/DEC) and $\frac{0\times60C5}{0\times60C6}$ (Max. Profile ACC/DEC) are related as follows:



Example: Gear ratio = 1:1, 23-bit encodER.

Motor speed=500rpm/s(Load Axis ACC/DEC)=500× $\frac{8388608}{60}$=69905066(reference unit/s²).

Relevant object directories:

Control Word 6040h		
Bit	Name	Description
0	Servo ready	0: OFF 1: ON
1	Enable main circuit	0: OFF 1: ON
2	Quick stop	0: ON 1: OFF
3	Enable servo operation	0: OFF 1: ON
4	Enable new position reference	New target position triggered at rising edge
5	Position reference update mode	0: Non-immediate 1: Immediate
6	Position reference type	0: Absolute position reference 1: Relative position reference

Status Word (6041h)		
Bit	Name	Description
12	Position reference update enable	0: ON 1: OFF
13	Position deviation	0: No error 1: Error
15	Home completed	0: Not completed 1: Completed

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x603F	00h	Error Code	RO	UINT16	-	0~65535
0x6040	00	Control Word	RW	UINT16	-	0~65535
0x6041	00	Status Word	RO	UINT16	-	0~65535
0x6060	00	Operation Mode	RW	INT8	-	0~10

0x6061	00	Operation Mode Display	RO	INT8	-	0~10
0x6062	00	Position Reference	RO	DINT32	Reference unit	-
0x6063	00	Motor Position Feedback	RO	INT32	Encoder unit	-
0x6064	00	User Position Feedback	RO	INT32	Reference unit	-
0x606C	00	Velocity Feedback	RO	INT32	Reference unit/s	-
0x607A	00	Target Position	RW	INT32	Reference unit	-2^{31}~$(2^{31}-1)$
0x6081	00	Profile Velocity	RW	UINT32	Reference unit/s	0~$(2^{32}-1)$
0x6083	00	Profile Acceleration	RW	UINT32	Reference unit/s^2	0~$(2^{32}-1)$
0x6084	00	Profile Deceleration	RW	UINT32	Reference unit/s^2	0~$(2^{32}-1)$

The steps for setting the profile position mode are shown in the table below:

Item	No.	Parameter input	Status Word (6041h)
Profile position parameter values	0	607Ah=10000 pp	0x0250
	1	6081h=1000 pp/s	0x0250
	2	6083h=200 pp/s^2	0x0250
	3	6084h=200 pp/s^2	0x0250
Control mode	4	6060h=0x01	0x0250
Enable servo	5	6040h=0x06	0x0231
	6	6040h=0x07	0x0233
	7	6040h=0x0F	0x0637
Absolute/relative position	8	6040hBit6 to 1 (relative position)	0x0637
Position reference trigger	9	6040hBit4 to 1 (rising edge)	0x1237

Item	No.	Parameter input	Status Word (6041h)
Position coincidence	10	6041h Bit10 to 1	0x0637
Trigger bit cleared for next use	11	6040hBit4 cleared	0x0637

Control word 6040h and status word 6041h in profile position mode are as follows:

6040h	-		PP	PV	PT	HM	IP
Index	6040h	-					

<table>
<tr><td>Name</td><td colspan="5">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td>0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td>0</td></tr>
<tr><td>Function</td><td colspan="5">Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4</td><td>Enable new position reference</td><td>0→1: When a new position reference needs to be updated, whether it is valid is determined by the servo drive status.
1→0: Set 6041h:bit12 from 1→0. Whether it is valid is determined by the servo drive status.</td></tr>
<tr><td>5</td><td>Position reference update mode</td><td>0: Non-immediate update
1: Immediate update</td></tr>
<tr><td>6</td><td>Position reference type</td><td>0: Absolute position reference
1: Relative position reference</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
Bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Pause</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table>
Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>IP</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="7">-</td></tr>
<tr><td>Name</td><td colspan="8">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td colspan="4">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td>Default</td><td colspan="4">0</td></tr>
</table>

Function	Status word bit descriptions are as follows:

Bit	Definition	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: Non-CANopen 1: CANopen
10	Target reached	0: Not reached 1: Reached
11	Internal position limit	0: No error 1: Error
12	Position command update signal	0: Allow receiving new position 1: Do not allow receiving new position
13	Position deviation status	0:Position deviation within 6065h 1: Position deviation exceeds 6065h
14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

When operating in Profile Position Mode, there are two methods for position reference updates: immediate update and non-immediate update. The specific implementation processes of these two methods are described below.

(1) Absolute Position Command or Relative Position Command with Immediate Update

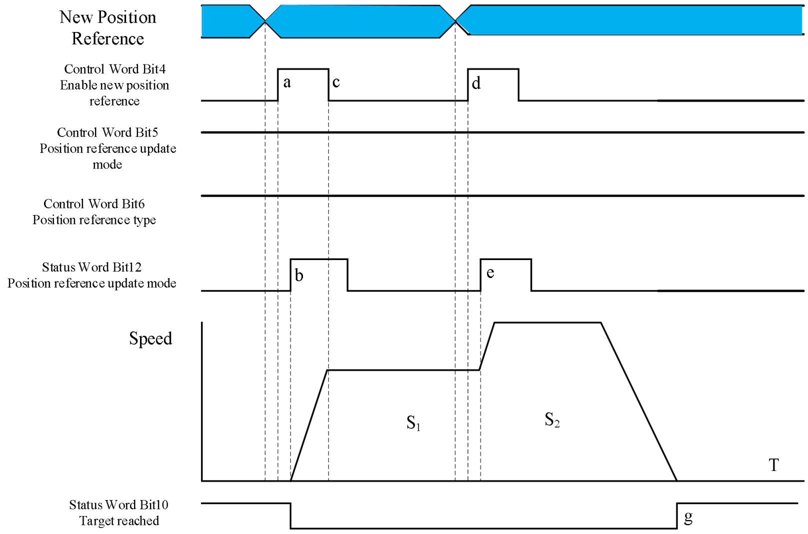


Figure 9-15 Immediate Update Mode of Relative Position Reference Timing

When 0x6040:bit5 = 1 (immediate update), the first segment S_1 position reference is executed. If, before the completion of S_1, 0x6040:bit4 transitions from 1→0 and bit12 transitions from 1→0, it indicates that a new position reference S_2 requires updating. When 0x6040:bit4 transitions from 0→1 and bit12 transitions from 0→1, it signifies that the new position reference has been updated and is immediately executed.

When 0x6040:bit6 = 1 (relative position reference), after the second segment position reference is executed, the total displacement reference = target position of the first segment 0x607A + target position of the second segment 0x607A.

When 0x6040:bit6 = 0 (absolute position reference), after the second segment position reference is executed, the total displacement reference = target position of the second segment 0x607A.

The timing diagram shown in the figure above corresponds to the operational steps listed in the table below:

No.	Control Word (6040h)	Status Word (6041h)	Description (Relative Position Mode)
1	0x0006	0x1231	New references cannot be accepted, servo ready
2	0x0007	0x1233	New references cannot be accepted, servo ready, wait for servo enable
3	0x006F	0x0637	New references can be accepted, servo enable Note: 1: 6040h: bit5=1 indicates immediate position reference update, bit6=1 indicates relative position reference). 2: At this point, 6041h: bit10=1 because the initial target position is 0, indicating the target position is reached by default).

4	0x007F	0x1237	The servo drive has received the new target position (607Ah), profile target velocity (6081h), profile acceleration (6083h), and profile deceleration (6084h), and immediately starts operation.
5	If no new position reference requires immediate update, proceed to step 6 and wait for completion. If a new position reference requires immediate update, proceed to step 7.		
6	0x007F	0x1637	6041h:bit10=1 Target position reached, operation completed.
7	0x006F	0x0237	6040h: bit 10 changes from 1 to 0. At this point, 6041h: bit 12 also changes from 1 to 0, indicating that a new position reference can be received.
8	0x007F	0x1237	Servo drive has received new position reference, immediately updates and executes the relevant position reference, cycling from step 5. (Note: If there are only two reference segments, then relative target position = first segment relative position + second segment relative position).

No.	Control Word (6040h)	Status Word (6041h)	Description (Absolute Position Mode)
1	0x0006	0x1231	New references cannot be accepted, servo ready
2	0x0007	0x1233	New references cannot be accepted, servo ready, wait for servo enable
3	0x002F	0x0637	New references can be accepted, servo enable Note: 1: 6040h: bit5=1 indicates immediate position reference update, bit6=0 indicates absolute position reference). 2: At this point, 6041h: bit10=1 because the initial target position is 0, indicating the target position is reached by default).
4	0x003F	0x1237	The servo drive has received the profile target position (607Ah), profile target velocity (6081h), profile acceleration (6083h), profile deceleration (6084h), and other relevant references, and immediately starts operation.

5	If no new position reference requires immediate update, proceed to step 6 and wait for completion. If a new position reference requires immediate update, proceed to step 7.		
6	0x003F	0x1637	6041h:bit10=1, target position reached, operation completed.
7	0x002F	0x0237	6040h: bit 10 changes from 1 to 0. At this point, 6041h: bit 12 also changes from 1 to 0, indicating that a new position reference can be received.
8	0x003F	0x1237	Servo drive has received new position reference, immediately updates and executes the relevant position reference, cycling from step 5. (Note: If there are only two reference segments, then relative target position = first segment relative position + second segment relative position).

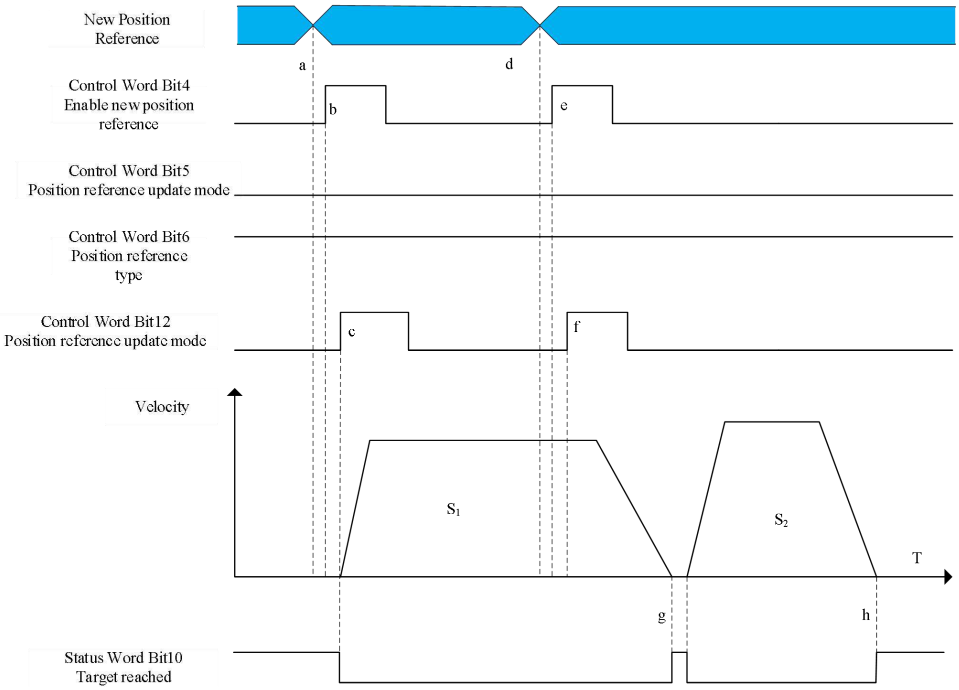


Figure 9-16 Non-immediate Update Mode of Relative Position Reference Timing

(2) Absolute/Relative Position Reference with Immediate Update

When 0x6040:bit5=1 (immediate update mode), the first segment S_1 position reference is executed. If, before the completion of S_1, 0x6040:bit4 transitions from 1→0 and bit12 transitions from 1→0, it indicates that a new position reference S_2 requires updating. When 0x6040:bit4 transitions from 0→1 and bit12 transitions from 0→1, it signifies that the new position reference has been updated but will wait for the first segment to complete before executing the second one.

The timing diagram shown in the figure above corresponds to the operational steps listed in the table below:

No.	Control Word (6040h)	Status Word (6041h)	Description (Relative Position Mode)
1	0x0006	0x1231	New references cannot be accepted, servo ready

2	0x0007	0x1233	New references cannot be accepted, servo ready, wait for servo enable
3	0x004F	0x0637	New references can be accepted, servo enable Note: 1: 6040h: bit5=0 indicates non-immediate position reference update, bit6=1 indicates relative position reference). 2: At this point, 6041h: bit10=1 because the initial target position is 0, indicating the target position is reached by default).
4	0x005F	0x1237	The servo drive has received the new target position (607Ah), profile target velocity (6081h), profile acceleration (6083h), and profile deceleration (6084h), and immediately starts operation.
5	If no new position reference requires immediate update, proceed to step 6 and wait for completion. If a new position reference requires immediate update, proceed to step 7.		
6	0x005F	0x1637	6041H:bit10=1, target position reached, operation completed.
7	0x004F	0x0237	6040h: bit 10 changes from 1 to 0. At this point, 6041h: bit 12 also changes from 1 to 0, indicating that a new position reference can be received.
8	0x005F	0x1237	The servo drive has received the new position reference and will wait until the first segment operation is completed, cycling from step 5. (Note: If there are only two reference segments, the relative target position = first segment relative position + second segment relative position).

No.	Control Word (6040h)	Status Word (6041h)	Description (Absolute Position Mode)
1	0x0006	0x1231	New references cannot be accepted, servo ready
2	0x0007	0x1233	New references cannot be accepted, servo ready, wait for servo enable

3	0x000F	0x0637	New references can be accepted, servo enable Note: 1: 6040h: bit5=0 indicates non-immediate position reference update, bit6=0 indicates absolute position reference). 2: At this point, 6041h: bit10=1 because the initial target position is 0, indicating the target position is reached by default).
4	0x001F	0x1237	The servo drive has received the profile target position (607Ah), profile target velocity (6081h), profile acceleration (6083h), profile deceleration (6084h), and other relevant references, and immediately starts operation.
5	If no new position reference requires immediate update, proceed to step 6 and wait for completion. If a new position reference requires immediate update, proceed to step 7.		
6	0x001F	0x1637	6041h:bit10=1, target position reached, operation completed.
7	0x000F	0x0237	6040h: bit 10 changes from 1 to 0. At this point, 6041h: bit 12 also changes from 1 to 0, indicating that a new position reference can be received.
8	0x001F	0x1237	The servo drive has received the new position reference and will wait until the first segment operation is completed, cycling from step 5. (Note: If there are only two reference segments, then relative target position = first segment relative position + second segment relative position).

9.2.9.2 Profile Velocity Mode (PV)

When in the profile velocity mode, the master transmits the demanded target velocity, acceleration time, and deceleration time to the servo drive, which performs velocity and torque regulation.

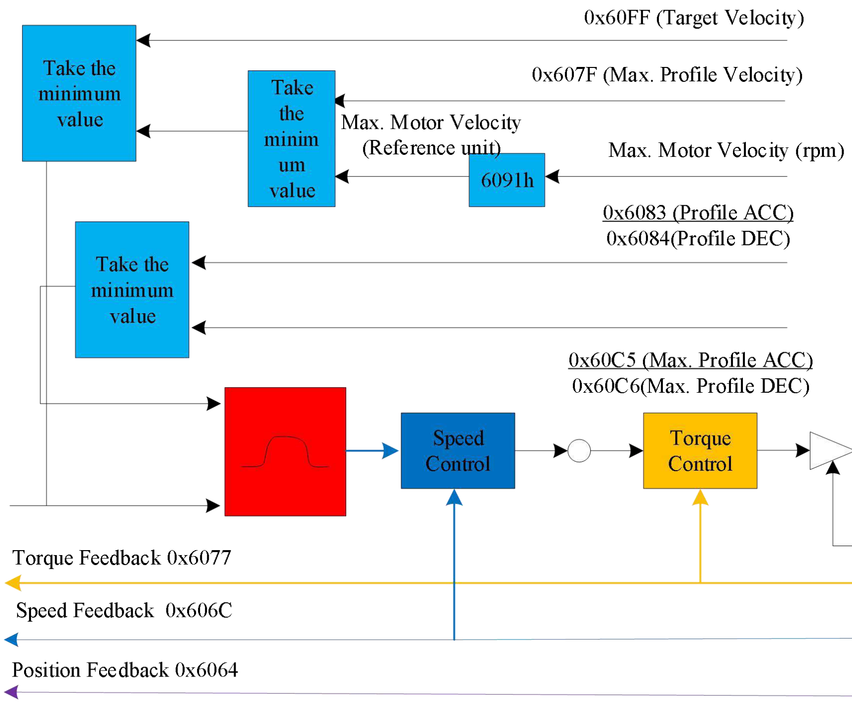
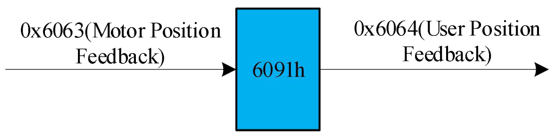


Figure 9-17 Profile Velocity Mode Control

The conversion diagram for user unit and encoder unit in Profile Velocity Mode via 0x6091 is as follows:

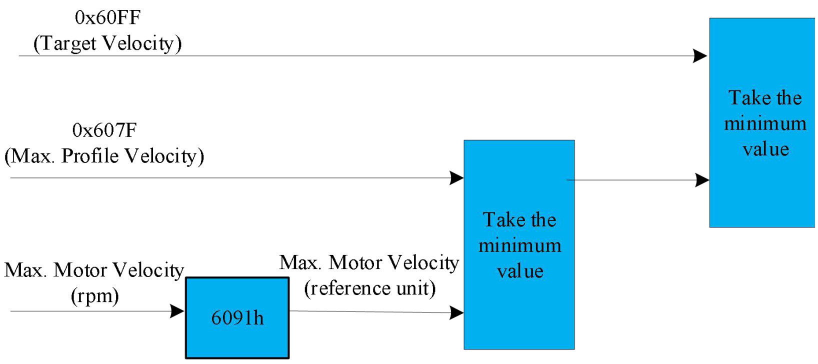


$$0\times 6091\text{（Gear Ratio）} = \frac{0\times 6091{:}01}{0\times 6091{:}02}$$

The relationship between Motor Position Feedback (0x6063) and user position feedback (0x6064):

$$0\times 6063\text{（Gear Ratio）} = 0\times 6064\text{（Gear Ratio）} \times \frac{0\times 6091{:}01}{0\times 6091{:}02} \times \left(\frac{Pn204}{Pn206}\right)$$

The following relationships exist between Velocity Reference (0x60FF), Max Profile Velocity (0x607F), and the corresponding motor maximum speed after conversion:



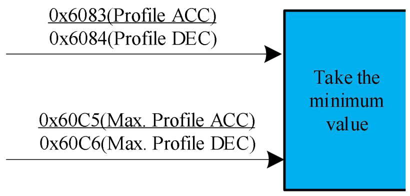
Relationship between motor speed (rpm) and load shaft speed (reference unit/s):

$$\text{Motor speed(rpm)}=\frac{\text{Load Axis Speed}\times\frac{0\times6091:01}{0\times6091:02}}{\text{Encoder Resolution}}\times60$$

Example: Gear ratio = 1:1, 23-bit encodER.

Motor speed=500rpm/s(Load Axis ACC/DEC)=500× $\frac{8388608}{60}$=69905066(reference unit/s^2).

$\frac{0\times6083}{0\times6084}$(Profile ACC/DEC) and $\frac{0\times60c5}{0\times60c6}$ (Max. Profile ACC/DEC) are related as follows:



Example: Gear ratio = 1:1, 23-bit encodER.

Motor speed=500rpm/s(Load Axis ACC/DEC)=500× $\frac{8388608}{60}$=69905066(reference unit/s^2).

Relevant object directories:

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x603F	00h	Error Code	RO	UINT16	-	0~65535
0x6040	00h	Control Word	RW	UINT16	-	0~65535
0x6041	00h	Status Word	RO	UINT16	-	0~65535
0x6060	00h	Operation Mode	RW	INT8	-	0~7
0x6061	00h	Operation Mode Display	RO	INT8	-	0~7
0x606C	00h	Velocity Feedback	RO	INT32	Reference unit/s	-
0x607F	00h	Max. Profile Velocity	RW	UINT32	Reference unit/s	0~(2^{32}-1)
0x6083	00h	Profile Acceleration	RW	UINT32	Reference unit/s^2	0~(2^{32}-1)

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x6084	00h	Profile Deceleration	RW	UINT32	Reference unit/s^2	0~(2^{32}-1)
0x60FF	00h	Velocity Reference	RW	INT32	Reference unit/s	-2^{31}~(2^{31}-1)

Note:

The speed limit value is determined by the smaller value between 0x607F and the maximum motor speed.

The steps for setting the profile velocity mode are shown in the table below:

Item	No.	Parameter input	Status Word (6041h)
Profile position parameter assignment	1	6083h=200 pp/s^2	0x1250
	2	6084h=200 pp/s^2	0x1250
	3	60FFh=10000 pp/s	0x1250
Control mode	4	6060h=0x03	0x1250
Enable servo	5	6040h=0x06	0x1231
	6	6040h=0x07	0x1233
	7	6040h=0x0F	0x0637

Control word 6040h and status word 6041h in profile velocity mode are as follows:

6040h	-				PP	PV	PT	HM	IP
Index	6040h	-							
Name	Control Word								
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535				
Mapping	Y	W/R	RW	Default	0				
Function	Control word bit definitions are as follows:								

Bit	Content	Setting
0	Servo ready	0: OFF 1: ON
1	Enable main power circuit	0: OFF 1: ON
2	Quick stop	0: ON 1: OFF
Servo ready 3	Enable servo operation	0: OFF 1: ON
4~6	NA	-
7	Error reset	bit7 rising edge valid bit7 set to 1, and other control references invalid
8	Halt	0: OFF 1: ON
9~10	NA	-
11~15	Manufacturer-defined	-

Note: Each bit in the control word must be combined with other bits to form a control reference.

6041h	-				PP	PV	PT	HM	IP
Index	6041h	-							
Name	Status Word								
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535				
Mapping	Y	W/R	RO	Default	0				

Function	Status word bit descriptions are as follows:

Bit	Content	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: Non-CANopen 1: CANopen
10	Target reached	0: Not reached 1: Reached
11	Internal position limit	0: No error 1: Error
12	Zero-speed signal	0: Speed not be 0 1: Speed be 0
13~14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

Immediate update mode under PV mode will operate in the following order in the figure below:

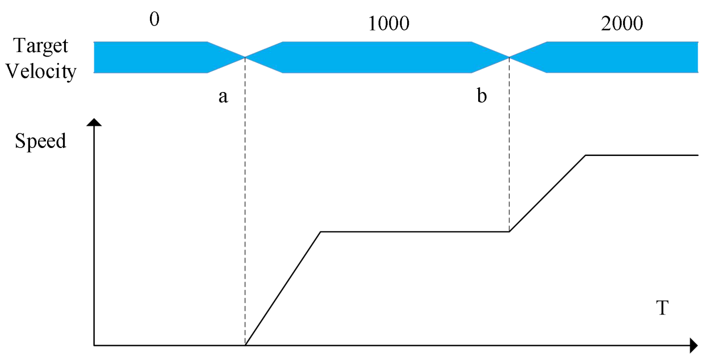


Figure 9-18 Profile Velocity Mode Control

The timing diagram shown in the figure above corresponds to the operational steps listed in the table below:

No.	Item	Step
1	Set speed target	After the speed reference is set, the servo drive controls the motor to run at the this speed.
2	Modify velocity reference	After the speed reference modification, the servo drive controls the motor to run at the new speed.

9.2.9.3 Profile Torque Mode (PT)

In Profile Torque Mode, the master station sends the target torque reference (6071h) and profile torque acceleration (6087h) to the servo drive, which will execute torque regulation internally. When the speed reaches the maximum limit, the system will enter the speed regulation phase.

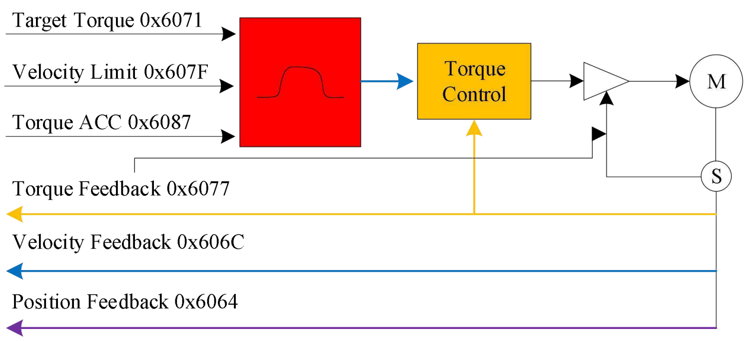


Figure 9-19 Profile Torque Mode Control

Relevant object directories:

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x603F	00h	Error Code	RO	UINT16	-	0~65535
0x6040	00h	Control Word	RW	UINT16	-	0~65535
0x6041	00h	Status Word	RO	UINT16	-	0~65535
0x6060	00h	Operation Mode	RW	INT8	-	0~10
0x6061	00h	Operation Mode Display	RO	INT8	-	0~10
0x606C	00h	Velocity Feedback	RO	INT32	Reference unit/s	-
0x6071	00h	Target Torque	RW	INT16	0.1%	-3000~3000
0x6072	00h	Max. Profile Torque	RW	UINT16	0.1%	0~3000
0x6074	00h	Torque Reference	RO	INT16	0.1%	-
0x6077	00h	Torque Feedback	RO	UINT16	1%	-
0x6087	00h	Torque ACC	RW	UINT32	0.1%/s	0~(2^{32}-1)

The steps for setting the profile torque mode are shown in the table below:

Item	No.	Parameter input	Status Word (6041h)
Profile torque parameter assignment	1	6071h=50	0x0250
	2	6087h=50	0x0250
Control Mode	3	6060h=0x04	0x0250

Enable servo	4	6040h=0x06	0x0231
	5	6040h=0x07	0x0233
	6	6040h=0x0F	0x0637

Control word 6040h and status word 6041h in profile torque mode are as follows:

6040h	-			PP	PV	PT	HM	IP
Index	6040h	-						
Name	Control Word							
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535			
Mapping	Y	W/R	RW	Default	0			
Function	Control word bit definitions are as follows:							

Bit	Content	Setting
0	Servo ready	0: OFF 1: ON
1	Enable main power circuit	0: OFF 1: ON
2	Quick stop	0: ON 1: OFF
3	Enable servo operation	0: OFF 1: ON
4~6	NA	-
7	Error reset	bit7 rising edge valid bit7 set to 1, and other control references invalid
8	Halt	0: OFF 1: ON
9~10	NA	-
11~15	Manufacturer-defined	-

Note: Each bit in the control word must be combined with other bits to form a control reference.

6041h	-			PP	PV	PT	HM	IP
Index	6041h	-						
Name	Status Word							
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535			
Mapping	Y	W/R	RO	Default	0			

Function	Status word bit definitions are as follows:

Bit	Content	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: Non-CANopen 1: CANopen
10	NA	-
11	Internal position limit	0: Position command/feedback not reaching software position limit 1: Position command/feedback reaching software position limit
12~14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

9.2.9.4 Home Mode (HM)

The home mode is used to find the mechanical home point and determine the positional relationship between the mechanical home point and the mechanical zero point.

Mechanical Home: A fixed mechanical position that corresponds to a certain home signal switch.

Mechanical Zero Point: Mechanical Zero Point = Mechanical Home Position + 0x607C (Home Offset). If 0x607C = 0, the mechanical zero point equals the mechanical home position.

After the homing process is completed, the servo drive will stop the motor at the mechanical zero point. The positional relationship between the mechanical home position and the mechanical zero point can be adjusted by setting 0x607C.

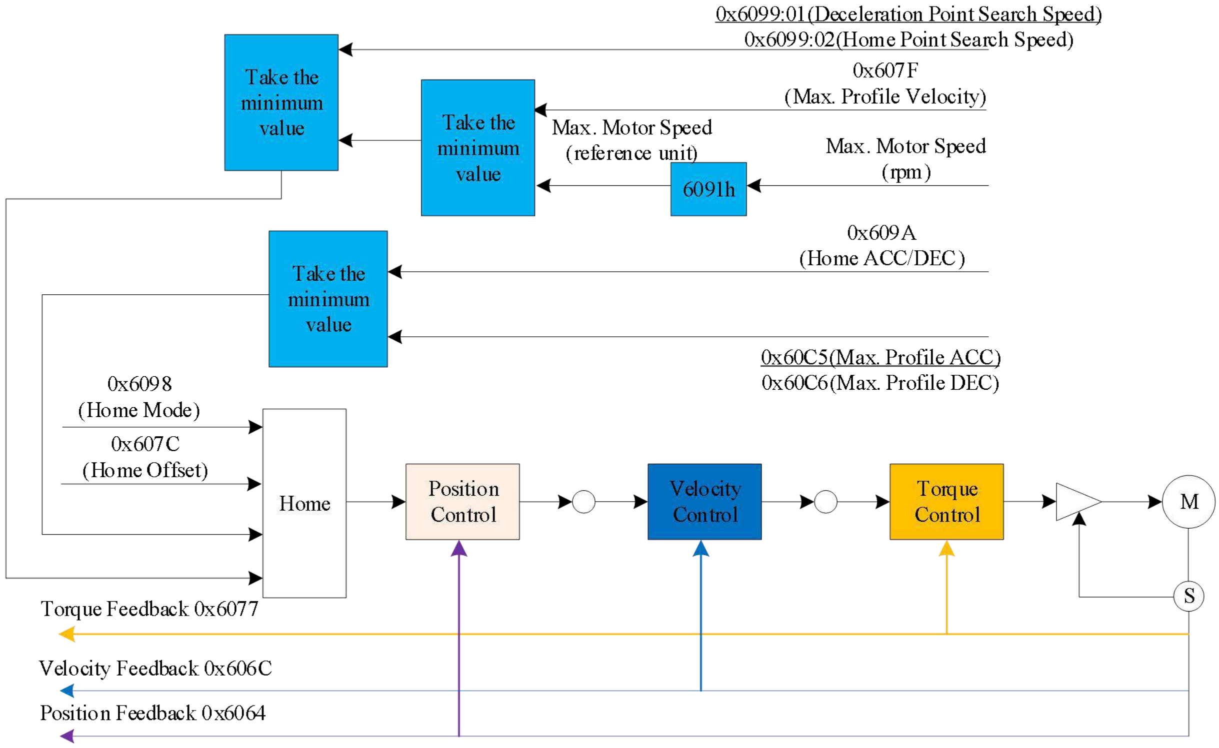
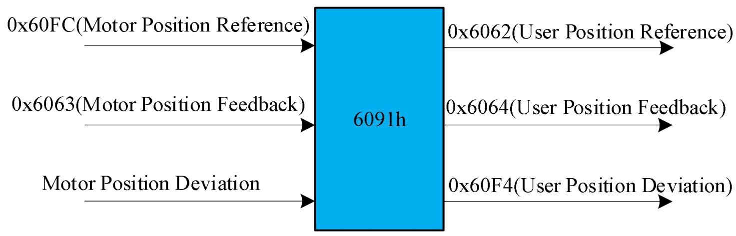


Figure 9-20 Home Mode Control

The conversion diagram for user unit and encoder unit in Home Mode via 0x6091 is as follows:



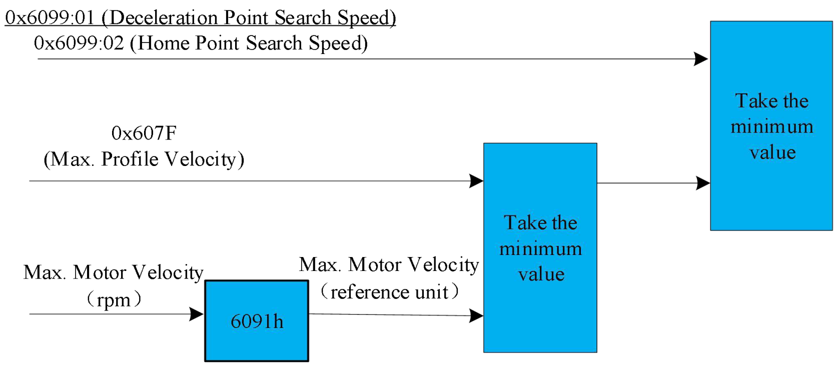
$$0 \times 6091\text{（Gear Ratio）} =$$

$$0x6091(\text{Gear Ratio}) = \frac{0\text{x}6091\text{:}01}{0\text{x}6091\text{:}02}$$

The relationship between Motor Position Feedback (0x6063) and User Position Feedback (0x6064):

$$0\text{x}6063(\text{Encoder unit})=0\text{x}6064(\text{Reference unit}) \times \frac{0\text{x}6091\text{:}01}{0\text{x}6091\text{:}02} \times \left(\frac{\text{Pn}204}{\text{Pn}206}\right)$$

There is the following relationship between Deceleration Point Search Speed (0x6099-01), Home Point Search Speed (0x6099-02), and the converted maximum motor speed:



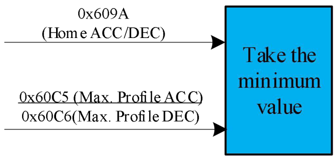
Relationship between motor speed (rpm) and load shaft speed (reference unit/s):

$$\text{Motor Velocity(rpm)} = \frac{\text{Load Axis Velocity} \times \frac{0x6091{:}01}{0x6091{:}02}}{\text{Encoder Resolution}} \times 60$$

Example: Gear ratio = 1:1, 23-bit encodER.

$$\text{Motor Velocity=500rpm}\big(\text{0x6099(Load Axis Velocity)}\big)\text{=500}\times\frac{8388608}{60}\text{=69905066(Reference unit/s)}$$

Profile ACC/DEC (0x609A) and $\frac{0x60C5}{0x60C6}$ (Max. Profile ACC/DEC) are related as follows:



Example: Gear ratio = 1:1, 23-bit encodER.

$$\text{Motor ACC/DEC} = \text{500rpm/s(0x609A(Load Axis ACC/DEC))} = 500 \times \frac{8388608}{60}$$
$$= \text{69905066(Reference unit/s}^2\text{)}$$

Relevant Object Directory

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x603F	00h	Error Code	RO	UINT16	-	0~65535
0x6040	00h	Control Word	RW	UINT16	-	0~65535
0x6041	00h	Status Word	RO	UINT16	-	0~65535
0x6060	00h	Control Mode	RW	INT8	-	0~7
0x6061	00h	Mode Display	RO	INT8	-	0~7
0x6064	00h	Position Feedback	RO	INT32	Reference unit	-
0x606C	00h	Velocity Feedback	RO	INT32	Reference unit/s	-
0x6098	00h	Home Mode	RW	INT8	-	1~35

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x6099	01h	Deceleration Point Search Velocity	RW	UINT32	Reference unit/s	0~(2^{32}-1)
	02h	Home Point Search Velocity	RW	UINT32	Reference unit/s	0~(2^{32}-1)
0x609A	00h	Home ACC/DEC	RW	UINT32	Reference unit/s^2	0~(2^{32}-1)

Control word 6040h and status word 6041h in home mode are as follows:

<table>
<tr><th>6040h</th><th colspan="4">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>IP</th></tr>
<tr><td>Index</td><td>6040h</td><td colspan="8">-</td></tr>
<tr><td>Name</td><td colspan="9">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td colspan="5">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td colspan="5">0</td></tr>
<tr><td>Function</td><td colspan="9">Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4</td><td>Enable home mode</td><td>0: OFF
0→1: ON
1: Homing
1→0: Cancel</td></tr>
<tr><td>5~6</td><td>NA</td><td></td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="2">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>IP</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="6">-</td></tr>
<tr><td>Name</td><td colspan="7">Status Word</td></tr>
</table>

<table>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td>0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td>Default</td><td>0</td></tr>
<tr><td>Function</td><td colspan="5">Status Word
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1:ON</td></tr>
<tr><td>1</td><td>Wait for servo enable</td><td>0: OFF 1:ON</td></tr>
<tr><td>2</td><td>Enable servo operation</td><td>0: OFF 1:ON</td></tr>
<tr><td>3</td><td>Error</td><td>0: No error 1: Error</td></tr>
<tr><td>4</td><td>Enable main power circuit</td><td>0: OFF 1:ON</td></tr>
<tr><td>5</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>6</td><td>Enable power-on operation</td><td>0: OFF 1:ON</td></tr>
<tr><td>7</td><td>Alarm</td><td>0: OFF 1:ON</td></tr>
<tr><td>8</td><td>Manufacturer-defined</td><td>-</td></tr>
<tr><td>9</td><td>Remote control</td><td>0: Non-CANopen 1: CANopen</td></tr>
<tr><td>10</td><td>Target reached</td><td>0: Not reached
1: Reached</td></tr>
<tr><td>11</td><td>Internal position limit</td><td>0: No error 1: Error</td></tr>
<tr><td>12</td><td>Home completed</td><td>0: Not Completed
1: Completed</td></tr>
<tr><td>13</td><td>Home error</td><td>0: No error
1: Error</td></tr>
<tr><td>14</td><td>NA</td><td>-</td></tr>
<tr><td>15</td><td>Home completed</td><td>0: Not performed or not completed
1: Completed and reference point established</td></tr>
</table></td></tr>
</table>

The steps to activate the home mode are as follows:

Item	No.	Parameter input	Status Word (6041h)
Home parameter assignment	0	609Ah=1000 pp/s^2	0x0250
	1	6099:01h=1000 pp/s	0x0250
	2	6099:02h=100 pp/s	0x0250
	3	6098h= 0x01	0x0250
Control mode	4	6060h=0x06	0x0250

Item	No.	Parameter Input	Status Word (6041h)
Enable servo drive	5	6040h=0x06	0x0231
	6	6040h=0x07	0x0233

	7	6040h=0x0F	0x0637
	8	6040h=0x1F	0x0237
Enable home mode	10	6040h=0x1F	0x9637

9.2.9.5 Interpolation Position Mode (IP)

In Interpolation Position Mode, the host controller sends one position value per synchronous cycle, which represents an absolute position based on 0x60C1. After the servo drive receives the interpolation position value in the first cycle, it begins planning the curved path. And when the second cycle arrives and a new position value is received, the planned path curve from the previous cycle is sent to the servo execution unit, while simultaneously beginning to plan the new position curve.

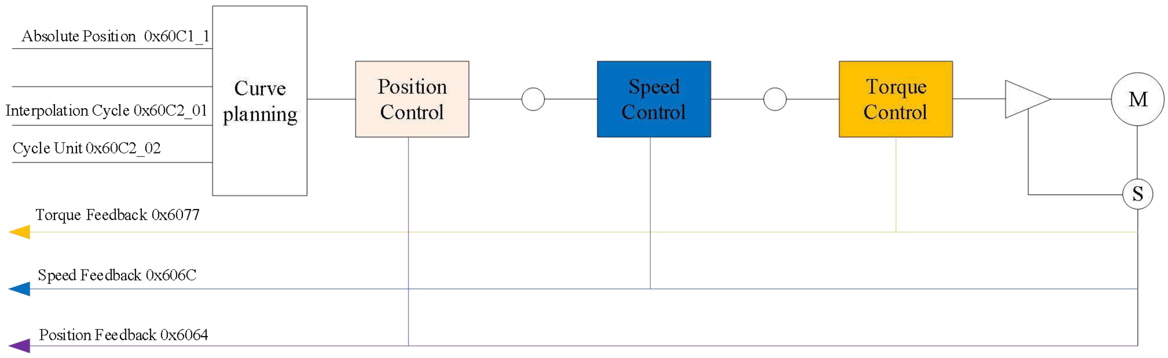
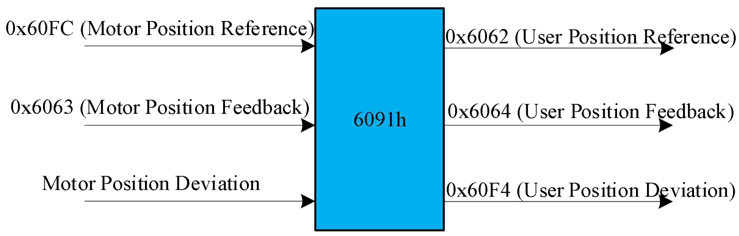


Figure 9-21 Interpolation Mode Control

The conversion diagram for user unit and encoder unit in Interpolation Mode via 0x6091 is as follows:



As shown in the figure below, at time t0, the host controller (master) sends an interpolated position command, and then the servo drive generates the motion trajectory POS0. At time t1, the drive sends the trajectory POS0 to the execution unit for processing. Simultaneously, it uses the new interpolated position value to calculate the next motion trajectory, POS1. At time t2, the execution unit begins processing trajectory POS1, while the drive plans the subsequent trajectory, POS2. In this way, the drive consistently plans the motion trajectory for the next cycle during the current to ensure the smooth and continuous operation of the servo motor.

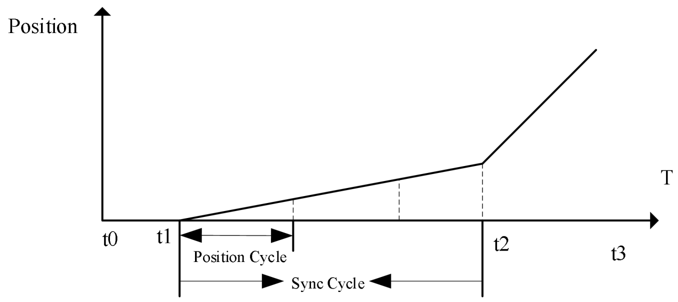


Figure 9-22 Interpolation Position

Relevant object directories:

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x603F	00h	Error Code	RO	UINT16	-	0~65535
0x6040	00h	Control Word	RW	UINT16	-	0~65535
0x6041	00h	Status Word	RO	UINT16	-	0~65535
0x6060	00h	Control Mode	RW	INT8	-	0~7
0x6061	00h	Control Mode Display	RO	INT8	-	0~7
0x6064	00h	User Position Feedback	RO	INT32	Reference unit	-2^{31}~$(2^{31}-1)$
0x6065	00h	Position Deviation Error Level	RW	UINT32	Reference unit	0~$(2^{32}-1)$
0x6067	00h	/COIN Signal Width	RW	UINT32	Reference unit	0~$(2^{32}-1)$
0x6068	00h	/COIN Signal Time	RW	UINT16	0.1ms	0~65535
0x607A	00h	Target Position	RW	INT32	Reference unit	-2^{31}~$(2^{31}-1)$
0x607D	01h	Min. Internal Position Limit	RW	INT32	Reference unit	-2^{31}~$(2^{31}-1)$
	02h	Max. Internal Position Limit	RW	INT32	Reference unit	-2^{31}~$(2^{31}-1)$
0x60C1	01h	Absolute Interpolation Position	RW	INT32	Reference unit	-2^{31}~$(2^{31}-1)$
0x60C2	01h	Interpolation Period	RW	UINT8	-	1~20
	02h	Interpolation Period Unit	RW	INT8	-	-3

Control word 6040h and status word 6041h in interpolation mode are as follows:

<table>
<tr><th>6040h</th><th colspan="4">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>IP</th></tr>
<tr><td>Index</td><td>6040h</td><td colspan="8">-</td></tr>
<tr><td>Content</td><td colspan="9">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="2">Data Range</td><td colspan="4">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td colspan="2">Default</td><td colspan="4">0</td></tr>
</table>

<table>
<tr><td>Function</td><td>Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4</td><td>Enable interpolation position</td><td>0: OFF
1: ON</td></tr>
<tr><td>5~6</td><td>NA</td><td>-</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table>
Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>IP</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="7">-</td></tr>
<tr><td>Name</td><td colspan="8">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="2">Data Range</td><td colspan="3">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td colspan="2">Default</td><td colspan="3">0</td></tr>
</table>

Function	Status word bit definitions are as follows:

Bit	Content	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: Non-CANopen 1: CANopen
10	Target reached	0: Not reached 1: Reached
11	Internal position limit	0: No error 1: Error
12	Interpolation position enable	0: OFF 1: ON
13~14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

During each synchronous cycle, the host controller calculates the interpolation command value and transmits it to the servo drive via a PDO to control the motor's operation. The operational method of the interpolation mode is detailed in the following table:

Item	No.	Parameter Input	Status Word (6041h)
Interpolation period assignment	0	60C2:01h=200(or 0xC8)	0x0250
	1	60C2:02h=-3(or 0xFD)	0x0250
Interpolation position assignment	2	60C1h=10000	0x0250
Control mode	3	6060h=0x07	0x0250
Enable servo drive	4	6040h=0x06	0x0231
	5	6040h=0x07	0x0233
	6	6040h=0x0F	0x0637
	7	6040h=0x1F	0x0237
Position coincidence	8	6040h=0x1F	0x0637

9.2.10 Object Dictionary

9.2.10.1 Object Property

Term explanation

"Index": specifies the position of each object in the object dictionary, expressed in hexadecimal (h).

"Data Type": see the table below for details.

Table 9-28 Data Type

Data Type	Data Range	Data Length	DS301 Value
Int8	-128~127	1 byte	2
Uint8	0~255	1 byte	5
Int16	-32768~+32767	2 bytes	3
Uint16	0~65535	2 bytes	6
Int32	-2147483648~+2147483647	4 bytes	4
Uint32	0~4294967295	4 bytes	7
String	ASCII	-	9

"R/W Type": see the table below for details.

Table 9-29 R/W Type

R/W	Description
RW	Read and write
WO	Write only
RO	Read only
CONST	Constant, read only

"Object Structure": see the table below for details.

Table 9-30 Object Structure Description

Object Structure	Description	DS301 Value
VAR	Clean values containing the data types in "Table 9-28"	7
ARR	Data blocks of the same type	8
REC	Data blocks of different types	9

9.2.10.2 1000h Object List

Index	Subindex	Name	Object Structure	Data Type	R/W	Mapping
1000h	-	Device Type	VAR	Uint16	RO	N
1001h	-	Error Register	VAR	Uint8	RO	N
1003h	-	Pre-defined Error Field	ARR	Uint32	RO	N
	00h	Error Number	VAR	Uint8	RW	N
	01 ~ 04h	Error Field	VAR	Uint32	RO	N

1005h	-	SYNC COB-ID	VAR	Uint32	RW	N
1006h	-	Synchronous Cycle Period	VAR	Uint32	RW	N
100Ch	-	Guard Time	VAR	Uint16	RW	N
100Dh	-	Life Time Factor	VAR	Uint8	RW	N
1010h	-	Parameter Save	ARR	Uint32	RW	N
	00h	Entry Number	VAR	Uint8	RO	N
	02h	All Parameter Save	VAR	Uint16	RW	N
1011h	-	Parameter Restore to Default	ARR	Uint32	RW	N
	00h	Entry Number	VAR	Uint8	RO	N
	02h	All Parameter Restore to Default	VAR	Uint16	RW	N
1014h	-	Emergency COB-ID	VAR	Uint32	RW	N
1016h	-	Consumer Heartbeat Time	ARR	-	-	-
	00h	Entry Number	VAR	Uint8	RO	N
	01h	Consumer Heartbeat Time	VAR	Uint32	RW	N
1017h	-	Producer Heartbeat Time	VAR	Uint16	RW	N
1018h	-	Device Object Description	REC	-	-	-
	00h	Entry Number	VAR	Uint8	RO	N
	01h	Manufacturer ID	VAR	Uint16	RO	N
	02h	Device Code	VAR	Uint16	RO	N
	03h	Device Revision Number	VAR	Uint16	RO	N
1029h	-	Error Behavior Object	ARR	-	-	-
	00h	Entry Number	VAR	Uint8	RO	N
	01h	Communication error!	VAR	Uint8	RW	N
1200h	-	SDO Server Parameter	ARR	-	-	-
	00h	Entry Number	VAR	Uint8	RO	N
	01h	Client-Server COB-ID	VAR	Uint32	RW	N
	02h	Server-Client COB-ID	VAR	Uint32	RW	N
1400h	-	RPDO1 Mapping	REC	-	-	-
	00h	RPDO1 Entry Number	VAR	Uint8	RO	N
	01h	RPDO1 COB-ID	VAR	Uint32	RW	N
	02h	RPDO1 Transmission Type	VAR	Uint8	RW	N
1401h	-	RPDO2 Mapping	REC	-	-	-
	00h	Entry Number	VAR	Uint8	RO	N
	01h	RPDO2 COB-ID	VAR	Uint32	RW	N
	02h	RPDO2 Transmission Type	VAR	Uint8	RW	N
1402h	-	RPDO3 Mapping	REC	-	-	-
	00h	Entry Number	VAR	Uint8	RO	N

	01h	RPDO3 COB-ID	VAR	Uint32	RW	N
	02h	RPDO3 Transmission Type	VAR	Uint8	RW	N
1403h	-	RPDO4 Mapping	REC	-	-	-
	00h	Entry Number	VAR	Uint8	RO	N
	01h	RPDO4 COB-ID	VAR	Uint32	RW	N
	02h	RPDO4 Transmission Type	VAR	Uint8	RW	N

Index	Subindex	Name	Object Structure	Data Type	R/W Type	Mapping
1600h	-	RPDO1 Mapping	REC	-	-	-
	00h	RPDO1 Mapping	VAR	Uint8	RW	N
	01h	RPDO1 Mapping Object 1	VAR	Uint32	RW	N
	02h	RPDO1 Mapping Object 2	VAR	Uint32	RW	N
	03h	RPDO1 Mapping Object 3	VAR	Uint32	RW	N
	04h	RPDO1 Mapping Object 4	VAR	Uint32	RW	N
1601h	-	RPDO2 Mapping	REC	-	-	-
	00h	RPDO2 Mapping Entry	VAR	Uint8	RW	N
	01h	RPDO2 Mapping Object 1	VAR	Uint32	RW	N
	02h	RPDO2 Mapping Object 2	VAR	Uint32	RW	N
	03h	RPDO2 Mapping Object 3	VAR	Uint32	RW	N
	04h	RPDO2 Mapping Object 4	VAR	Uint32	RW	N
1602h	-	RPDO3 Mapping	REC	-	-	-
	00h	RPDO3 Mapping Entry Number	VAR	Uint8	RW	N
	01h	RPDO3 Mapping Object 1	VAR	Uint32	RW	N
	02h	RPDO3 Mapping Object 2	VAR	Uint32	RW	N
	03h	RPDO3 Mapping Object 3	VAR	Uint32	RW	N
	04h	RPDO3 Mapping Object 4	VAR	Uint32	RW	N
1603h	-	RPDO4 Mapping	REC	-	-	-
	00h	RPDO4 Mapping Entry Number	VAR	Uint8	RW	N
	01h	RPDO4 Mapping Object 1	VAR	Uint32	RW	N
	02h	RPDO4 Mapping Object 2	VAR	Uint32	RW	N
	03h	RPDO4 Mapping Object 3	VAR	Uint32	RW	N
	04h	RPDO4 Mapping Object 4	VAR	Uint32	RW	N
1800h	-	TPDO1 Mapping	REC	-	-	-
	00h	TPDO1 Mapping Entry Number	VAR	Uint8	RO	N

	01h	TPDO1 COB-ID	VAR	Uint32	RW	N
	02h	TPDO1 Transmission Type	VAR	Uint8	RW	N
	03h	Inhibit Time	VAR	Uint16	RW	N
	04h	NA	VAR	Uint8	RW	N
	05h	Event Timer	VAR	Uint16	RW	N
1801h	-	TPDO2 Mapping	REC	-	-	-
	00h	TPDO2 Mapping Entry Number	VAR	Uint8	RO	N
	01h	TPDO2 COB-ID	VAR	Uint32	RW	N
	02h	TPDO2 Transmission Type	VAR	Uint8	RW	N
	03h	Inhibit Time	VAR	Uint16	RW	N
	04h	NA	VAR	Uint8	RW	N
	05h	Event Timer	VAR	Uint16	RW	N

Index	Subindex	Name	Object Structure	Data Type	R/W Type	Mapping
1802h	-	TPDO3 Mapping	REC	-	-	-
	00h	TPDO3 Mapping Entry Number	VAR	Uint8	RO	N
	01h	TPDO3 COB-ID	VAR	Uint32	RW	N
	02h	TPDO3 Transmission Type	VAR	Uint8	RW	N
	03h	Inhibit Time	VAR	Uint16	RW	N
	04h	NA	VAR	Uint8	RW	N
	05h	Event Timer	VAR	Uint16	RW	N
1803h	-	TPDO4 Mapping	REC	-	-	-
	00h	TPDO1 Mapping Entry Number	VAR	Uint8	RO	N
	01h	TPDO4 COB-ID	VAR	Uint32	RW	N
	02h	TPDO4 Transmission Type	VAR	Uint8	RW	N
	03h	Inhibit Time	VAR	Uint16	RW	N
	04h	NA	VAR	Uint8	RW	N
	05h	Event Timer	VAR	Uint16	RW	N
1A00h	-	TPDO1 Mapping	REC	-	-	-
	00h	TPDO1 Mapping Entry Number	VAR	Uint8	RW	N
	01h	TPDO1 Mapping Object 1	VAR	Uint32	RW	N
	02h	TPDO1 Mapping Object 2	VAR	Uint32	RW	N
	03h	TPDO1 Mapping Object 3	VAR	Uint32	RW	N

	04h	TPDO1 Mapping Object 4	VAR	Uint32	RW	N
1A01h	-	TPDO4 Mapping	REC	-	-	-
	00h	TPDO2 Mapping Entry Number	VAR	Uint8	RW	N
	01h	TPDO2 Mapping Object 1	VAR	Uint32	RW	N
	02h	TPDO2 Mapping Object 2	VAR	Uint32	RW	N
	03h	TPDO2 Mapping Object 3	VAR	Uint32	RW	N
	04h	TPDO2 Mapping Object 4	VAR	Uint32	RW	N
1A02h	-	TPDO3 Mapping	REC	-	-	-
	00h	TPDO3 Mapping Entry Number	VAR	Uint8	RW	N
	01h	TPDO3 Mapping Object 1	VAR	Uint32	RW	N
	02h	TPDO3 Mapping Object 2	VAR	Uint32	RW	N
	03h	TPDO3 Mapping Object 3	VAR	Uint32	RW	N
	04h	TPDO3 Mapping Object 4	VAR	Uint32	RW	N
1A03h	-	TPDO4 Mapping	REC	-	-	-
	00h	TPDO4 Mapping Entry Number	VAR	Uint8	RW	N
	01h	TPDO4 Mapping Object 1	VAR	Uint32	RW	N
	02h	TPDO4 Mapping Object 2	VAR	Uint32	RW	N
	03h	TPDO4 Mapping Object 3	VAR	Uint32	RW	N
	04h	TPDO4 Mapping Object 4	VAR	Uint32	RW	N

9.2.10.3 2000h Object List

The Group 2000h object dictionary provides a mapping to the drive's internal parameters, among which, 2000h~2006h correspond to parameter groups Pn0xx to Pn6xx, respectively, and 2E00h~2E08h correspond to the monitoring parameters Un0xx to Un8xx. The specific function codes of the drive correspond to the subindexes within the Group 2000h object dictionary.

The correspondence rule is as follows: the corresponding object dictionary subindex is calculated by adding 1 to the last two digits of the function code.

The corresponding relationship between the object dictionary index number 2000h and the drive function codes is shown in the table below. For the specific meanings of the function codes, please refer to"7.3 Pn Parameter Overview"and "7.4 Un Parameter Overview"。

Index	Subindex	Description	Data Type	R/W Type	Mapping
2000h	-	Pn0xx Basic: Basic Parameters	-	-	-
	00h	Entry Number	Uint8	RO	N
	01h	Pn000: Basic Switch 0	Uint16	RW	N
	02h	Pn001: Basic Switch 1	Uint16	RW	N

	03h	Pn002: Motor Direction	Uint16	RW	N
	...	...	...	RW	N
	82h	Pn081: Local Communication Format	Uint16	RW	N
	86h	(4) Pn085: Communication Modification Power-down Save	Uint16	RW	N
2001h	-	Pn1xx Gain Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn100: Moment of Inertia (MOI) Ratio	Uint16	RW	N
	02h	Pn101: ASR Gain	Uint16	RW	N
	...	...	...	RW	N
	94h	Pn193: Max. Advanced Tuning Gain	Uint16	RW	N
2002h	-	Pn2xx Position Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn200: Position Reference Source	Uint16	RW	N
	02h	Pn201: Pulse Input Pattern	Uint16	RW	N
	03h	Pn202: Pulse Reference Logic	Uint16	RW	N
	04h	Pn203: Pulse Reference Multiplier	Uint16	RW	N
	...	...	...	RW	N
	98h	Pn297: Absolute Zero Single-turn Value	Uint16	RW	N
	9Ah	Pn299: Home Timeout	Uint16	RW	N
2003h	-	Pn3xx Velocity Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn300: Velocity Reference Source	Int16	RW	N
	02h	Pn301: Velocity Reference Direction	Int16	RW	N
	...	...	...	RW	N
	21h	Pn320: /V-CMP Signal Width	Uint16	RW	N
2004h	-	Pn4xx Torque Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn400: Torque Control 1	Uint16	RW	N
	02h	Pn401: Torque Reference Filter Cutoff Frequency	Uint16	RW	N
	...	...	...	RW	N
	31h	Pn430: Torque Control 2	Uint16	RW	N

Index	Subindex	Description	Data Type	R/W Type	Mapping
2005h	-	Pn5xx Torque Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N

	01h	Pn500: Jog Velocity	Uint16	RW	N
	02h	Pn502: Programmed Jog Mode	Uint16	RW	N
	...	...	...	RW	N
	09h	Pn508: Programmed Jog Velocity	Uint16	RW	N
2006h	-	Pn6xx Terminal Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn600: X Terminal Filter Time	Uint16	RW	N
	02h	Pn601: X1 Configuration	Uint16	RW	N
	...	...	...	RW	N
	31h	Pn630: Internal software setting for input terminal (X) state	Uint16	RW	N
2E00h	-	Un0xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Un000: Motor Feedback Velocity	Int16	RO	N
	02h	Un001: Reference Velocity	Int16	RO	N
	...	...	...	RO	N
	36h	Un035: MCU Version (Main Version)	Uint16	RO	N
	3Ah	Un039: FPGA Version (Sub-version)	Uint16	RO	N
2E01h	-	Un1xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Un100: Input Signal Monitoring	Uint16	RO	N
	02h	Un101: Output Signal Monitoring	Uint16	RO	N
	06h	Un105: Position Tuning Time	Uint16	RO	N
	...	...	...	RO	N
	45h	Un144: Accumulated DB Load	Uint16	RO	N
2E02h	-	Un2xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	04h	Un203: Error Parameter Funcode (ER.040)	Uint16	RO	N
	13h	Un212: System Time Monitor A (Avg)	Uint16	RO	N
	...	...	...	RO	N
	1Ah	Un219: System Time Monitor R (Max)	Uint16	RO	N
2E05h	-	Un5xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	12h	Un511: U-phase Zero Crossing	Uint16	RO	N
	13h	Un512: V-phase Zero Crossing	Uint16	RO	N

Index	Subindex	Description	Data Type	R/W Type	Mapping
2E06h	-	Un6xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	04h	Un603: Absolute Encoder Pulse [Low 32 bits]	Uint32	RO	N
	06h	Un605: Absolute Encoder Pulse [High 32 bits]	Uint32	RO	N
2E08h	-	Un8xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Un800: Current Error or Alarm Code	Uint16	RO	N
	02h	Un801: Error-Code	Uint16	RO	N
	...	...	...	RO	N
	43h	Un842: Alarm History 9 Time	Uint32	RO	N

NOTE
● The last two digits of the function code correspond to the sub-index. Both the function code and sub-index are hexadecimal values. Example: When reading from or writing to function code Pn299, the corresponding object dictionary entry is 2002h:9Ah.

9.2.10.4 6000h Object List

The CANopen6000h groups object dictionary assignment is shown in the table below:

Index	Subindex	Name	R/W	Mapping	Data Type	Unit	Range
603Fh	00h	Error Code	RO	Y	UINT16	-	UINT16
6040h	00h	Control Word	RW	Y	UINT16	-	UINT16
6041h	00h	Status Word	RO	Y	UINT16	-	UINT16
605Ah	00h	Quick Stop Mode	RW	Y	UINT16		UINT16
605Dh	00h	Halt Stop Mode	RW	Y	UINT16		UINT16
6060h	00h	Operation Mode	RW	Y	INT8	-	INT8
6061h	00h	Operation Mode Display	RO	Y	INT8	-	INT8
6062h	00h	User Position Reference	RO	Y	INT32	Reference unit	INT32
6063h	00h	Motor Position Feedback	RO	Y	INT32	Encoder unit	INT32
6064h	00h	User Position Feedback	RO	Y	INT32	Reference unit	INT32
6065h	00h	Position Deviation Error Level	RW	Y	UINT32	Reference unit	UINT32

6067h	00h	/COIN Signal Width	RW	Y	UINT32	Reference unit	UINT32
6068h	00h	/COIN Signal Time	RW	Y	UINT16	0.1ms	UINT16
606Bh	00h	Velocity Reference	RO	Y	INT32	0.1rpm	INT32
606Ch	00h	Velocity Feedback	RO	Y	INT32	Reference unit/s	INT32
606Dh	00h	/V-CMP Signal Width	RW	Y	UINT16	0.1rpm	UINT16
606Eh	00h	/V-CMP Signal Time	RW	Y	UINT16	2ms	UINT16
606Fh	00h	Zero-speed Reach Level	RW	Y	UINT16	0.1rpm	UINT16
6070h	00h	Zero-speed Reach Time	RW	Y	UINT16	ms	UINT16

Index	Subindex	Name	R/W	Mapping	Data Type	Unit	Range
6071h	00h	Target Torque	RW	Y	INT16	0.1%	INT16
6072h	00h	Max. Profile Torque	RW	Y	UINT16	0.1%	UINT16
6074h	00h	Torque Reference	RO	Y	INT16	0.1%	INT16
6075h	00h	Rated Current	RO	Y	UINT32	mA	UINT32
6076h	00h	Rated Torque	RO	Y	UINT32	mNm	UINT32
6077h	00h	Torque Feedback	RO	Y	INT16	0.1%	INT16
6078h	00h	Current Feedback	RO	Y	INT16	0.01A	INT16
607Ah	00h	Target Position	RW	Y	INT32	Reference unit	INT32
607Ch	00h	Home Offset	RW	Y	INT32	Reference unit	INT32
607Dh	01h	Min. Internal Position Limit	RW	Y	INT32	Reference unit	INT32
	02h	Max. Internal Position Limit	RW	Y	INT32	Reference unit	INT32
607F	00h	Max. Speed Limit	RW	Y	UINT32	Reference unit/s	UINT32
6080h	00h	Max. Motor Velocity	RW	Y	UINT32	rpm	UINT32
6081h	00h	Profile Velocity	RW	Y	INT32	Reference unit/s	INT32
6083h	00h	Profile ACC	RW	Y	UINT32	Reference unit/s^2	UINT32

6084h	00h	Profile DEC	RW	Y	UINT32	Reference unit/s^2	UINT32
6085h	00h	Profile Emergency Stop DEC	RW	Y	UINT32	Reference unit/s^2	UINT32
6086h	00h	Motor Operation Curve	RW	Y	INT16	-	INT16
6087h	00h	Torque Smoothing Time	RW	Y	UINT32	0.1%/s	UINT32
6091h	01h	Gear Ratio Numerator	RW	Y	UINT32	-	UINT32
	02h	Gear Ratio Denominator	RW	Y	UINT32	-	UINT32
6098h	00h	Home Mode	RW	Y	INT8	-	INT8
6099h	01h	Home Velocity (High)	RW	Y	UINT32	Reference unit/s	UINT32
	02h	Home Velocity (Low)	RW	Y	UINT32	Reference unit/s	UINT32
609Ah	00h	Home ACC/DEC	RW	Y	UINT32	Reference unit/s^2	UINT32
60C1h	01h	Absolute Interpolation Position	RW	Y	INT32	Reference unit	INT32
60C2h	01h	Interpolation Period	RW	Y	UINT8	-	UINT8
	02h	Interpolation Period Unit	RW	Y	INT8	-	INT8
60C5h	00h	Max. Profile ACC	RW	Y	UINT32	Reference unit/s^2	UINT32
60C6h	00h	Max. Profile DEC	RW	Y	UINT32	Reference unit/s^2	UINT32
60E0h	00h	Positive Torque Limit	RW	Y	UINT16	0.1%	UINT16
60E1h	00h	Negative Torque Limit	RW	Y	UINT16	0.1%	UINT16
60F4h	00h	User Position Deviation	RO	Y	INT32	Reference unit	INT32
60FCh	00h	Motor Position Reference	RO	Y	INT32	Encoder unit	INT32
60FDh	00h	DI Status	RO	Y	UINT32	-	UINT32
60FEh	00h	DO Qty	RO	N	UINT8	-	UINT8
	01h	DO Status	RO	Y	UINT32	-	UINT32
60FFh	00h	Target Velocity	RW	Y	INT32	Reference unit/s	INT32

6502h	00h	Operation Mode	RO	Y	UINT16	-	UINT16

9.2.10.5 1000h Object Details

1000h					
Index	1000h	-			
Name	Device Type				
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RO	Default	0x04020192
Function	It indicates the device subprotocol or application specification employed.				

Bit	Name	Description
0~15	Device sub-protocol	402(0x192): Device sub-protocol
16~23	Type	02: Servo drive
25~31	Mode	Manufacturer-defined

1001h					
Index	1001h	-			
Name	Error Register				
Object Structure	VAR	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RO	Default	0x0
Function	It indicates the error information by bit as below:				

Bit	Content	Bit	Content
0	General	4	Communication
1	Current	5	Sub-protocol
2	Voltage	6	NA
3	Temperature	7	Manufacturer-defined

When an error occurs, the corresponding bit is set to “1”, and whenever an error is present, bit0 must be “1”.

1003h					
Index	1003h	-			
Name	Pro-defined Error Field				
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RO	Default	-

Subindex	00h	-			
Name	Error Number				
Object Structure	-	Data Type	Uint8	Data Range	Uint8

Mapping	NO	W/R	RW	Default	0x0
Function	Write 0 only to clear all error records.				

Subindex	1h ~ 4h	-			
Name	Standard Error Field				
Object Structure	-	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RO	Default	0x0
Function	When the subindex is 0, it is unreadable; when an error occurs, the error is stored in the following format:				

MSB			LSB
31	16	15	0
Manufacturer error code		Standard error code	

1005h					
Index	1005h	-			
Name	COB-ID SYNC Message				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	0x80
Function	Function Description: Only 0x80 and 0x40000080 are writable. When writing 0x80, the sync generator is disabled. When writing 0x40000080, the sync generator is activated. Before activating the sync generator, the sync cycle period (1006h) must be configured to a non-zero value.				

1006h					
Index	1006h	-			
Name	Communication Cycle Period				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	0x0
Function	The cycle period time for the sync generator, unit: 125μs.				

1008h					
Index	1008h	-			
Name	Manufacturer Device Name				
Object Structure	REC	Data Type	Uint8	Data Range	-
Mapping	NO	W/R	RO	Default	Servo Device

100Ah					
Index	100Ah	-			
Name	Software Version				
Object Structure	REC	Data Type	Uint8	Data Range	-
Mapping	NO	W/R	RO	Default	Up to model

100Ch					
Index	100Ch	-			
Name	Guard Time				
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RW	Default	0x0
Function	Only applicable to the sync generator, unit: ms. Used together with the lifetime factor for node protection.				

100Dh					
Index	100Dh	-			
Name	Life Time Factor				
Object Structure	VAR	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RW	Default	0x0
Function	It must be greater than 1 when in use.				

1010h					
Index	1010h	-			
Name	Auto Parameter Save				
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	1

<table>
<tr>
<td>Function</td>
<td>
This saves the current parameter values to EEPROM. The next time the EEPROM is loaded (upon power cycling, node reset, or communication reset), these saved values will be loaded.
To store parameters, in addition to specifying the sub-index corresponding to the storage area, the ASCII characters "load" must be written, or any other value will not result in a successful save.
The corresponding write values are as follows:
<table>
<tr><td colspan="5">MSB LSB</td></tr>
<tr><th>ASCII</th><th>E</th><th>v</th><th>a</th><th>s</th></tr>
<tr><td>Hexadecimal</td><td>65h</td><td>76</td><td>61h</td><td>73h</td></tr>
</table>
The corresponding subindex reading return value indicates how the subindex restores parameters to default. Return format and meaning:
MSB LSB
<table>
<tr><th>31</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td colspan="2">NA</td><td>0/1</td><td>0/1</td></tr>
</table>
<table>
<tr><th>Value</th><th>Content</th></tr>
<tr><td>0</td><td>OFF, save parameter command invalid</td></tr>
<tr><td>1</td><td>OFF, save parameter command valid</td></tr>
<tr><td>2</td><td>ON, save parameter command invalid</td></tr>
<tr><td>3</td><td>ON, save parameter command valid</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr><th colspan="6">1011h</th></tr>
<tr><td>Index</td><td>1011h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">Restore Parameters</td></tr>
<tr><td>Object Structure</td><td>ARR</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>Uint32</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>1</td></tr>
</table>

<table>
<tr><td>Function</td><td>Store Parameters saves the current parameter values to EEPROM. The next time the EEPROM is loaded (upon power cycle, node reset, or communication reset), these saved values will be loaded. To store parameters, in addition to specifying the sub-index corresponding to the storage area, the ASCII characters "load" must be written, or any other value will not result in a successful save.
The corresponding write values are as follows:
<table>
<tr><td colspan="3">MSB</td><td colspan="2">LSB</td></tr>
<tr><td>ASCII</td><td>d</td><td>a</td><td>○</td><td>l</td></tr>
<tr><td>Hexadecimal</td><td>64h</td><td>61h</td><td>6Fh</td><td>6Ch</td></tr>
</table>
The corresponding subindex reading return value indicates how the subindex stores parameters. Return format and meaning:
<table>
<tr><td>MSB</td><td>LSB</td></tr>
<tr><td>31 1</td><td>0</td></tr>
<tr><td>NA</td><td>0/1</td></tr>
</table>
<table>
<tr><th>Value</th><th>Content</th></tr>
<tr><td>0</td><td>Parameters can’t be restore to default</td></tr>
<tr><td>1</td><td>Parameters can be restore to default</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th colspan="6">1014h</th></tr>
<tr><td>Index</td><td>1014h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">COB-ID Emergency Message</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>Uint32</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>0x80+Node-ID</td></tr>
<tr><td>Function</td><td colspan="5">Bit 31 being 0 indicates the Emergency (EMCY) function is on (the servo will send EMCY commands).
Bit 31 being 1 indicates the Emergency (EMCY) function is off (the servo will not send EMCY commands).
<table>
<tr><td colspan="2">MSB</td><td>LSB</td></tr>
<tr><td>31</td><td>30 11</td><td>10 0</td></tr>
<tr><td>0/1</td><td>0x0</td><td>11-bit COB-ID</td></tr>
</table>
When the emergency message is active, its COB-ID must match the value in this object.</td></tr>
</table>

<table>
<tr><th colspan="6">1016h</th></tr>
<tr><td>Index</td><td>1016h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">Consumer Heartbeat Time</td></tr>
<tr><td>Object Structure</td><td>ARR</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>Uint32</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>-</td></tr>
</table>

<table>
<tr><td>Function</td><td>This includes the monitored node address and the actual consumer time. This time must be greater than the heartbeat producer time of the corresponding node (unit: ms). Two consumer times cannot be set for the same node.
The parameter content is as follows:
<table><tr><td colspan="3">MSB LSB</td></tr><tr><td>31 24</td><td>23 16</td><td>15 0</td></tr><tr><td>NA</td><td>Monitored Address</td><td>Monitoring Time</td></tr></table>The corresponding subindex reading return value indicates how the subindex restores parameters to default.</td></tr>
</table>

Subindex	00h	-			
Name	Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	1
Mapping	NO	W/R	RO	Default	1
Function	Write 0 only to clear all error records.				

Subindex	01h	-			
Name	Consumer Heartbeat Time				
Object Structure	-	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	0
Function	Save all the parameters in the object list.				

1017h					
Index	1017h	-			
Name	Producer Heartbeat Time				
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RW	Default	
Function	Unit: ms				

1018h					
Index	1018h	-			
Name	Producer Heartbeat Time				
Object Structure	REC	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	

Subindex	00h	-			
Name	Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	3
Mapping	NO	W/R	RO	Default	3

Subindex	01h	-			
Name	Manufacture Identity				
Object Structure	-	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RO	Default	0xF00002B5
Function	A unique number assigned uniformly by the CiA.				

Subindex	02h	-			
Name	Product Code				
Object Structure	-	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RO	Default	0x0006
Function	The device code corresponds to the product series and product model on the electronic label, and the correspondence is as follows:				

MSB			LSB
31	16	15	0
Product Series		Product Model	

Subindex	03h	-			
Name	Revision Number				
Object Structure	-	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RO	Default	-
Function	The specific meanings corresponding to the software version number 100Ah are as follows:				

MSB			LSB
31	16	15	0
Primary revision number		Secondary revision number	

1029h					
Index	1029h	-			
Name	Error Behavior				
Object Structure	ARR	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RW	Default	0x0002

<table>
<tr><td>Function</td><td>It defines the NMT state to which the CANopen communication shall automatically transition when different classes of errors occur based on the value set.
<table>
<tr><th>Value</th><th>Content</th></tr>
<tr><td>0</td><td>Transition to Pre-operational state (if currently in Operational state)</td></tr>
<tr><td>1</td><td>Remain in the current state</td></tr>
<tr><td>2</td><td>Transition to stopped state</td></tr>
<tr><td>Others</td><td>NA</td></tr>
</table></td></tr>
</table>

Subindex	00h	-			
Name	Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RO	Default	1

Subindex	01h	-			
Name	Communication Error				
Object Structure	-	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RW	Default	0
Function	It includes NMT error control timeout, PDO length error, Bus-off, etc.				

<table>
<tr><th colspan="6">1200h</th></tr>
<tr><td>Name</td><td colspan="5">SDO Server Parameter</td></tr>
<tr><td>Object Structure</td><td>REC</td><td>Data Type</td><td>-</td><td>Data Range</td><td>-</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RO</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">Only the most significant bit can be altered. “0” for this bit indicates the SDO is valid, while “1” indicates the SDO is invalid. The default SDO always exists and is a read-only constant.
<table>
<tr><td colspan="2">MSB</td><td>LSB</td></tr>
<tr><td>31</td><td>30 11</td><td>10 0</td></tr>
<tr><td>0/1</td><td>0x0</td><td>11-bit COB-ID</td></tr>
</table></td></tr>
</table>

Subindex	00h	-			
Name	Number of Entries				
Object Structure	-	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RO	Default	2

Subindex	01h	-			
Name	COB-ID Client→Server(rx)				
Object Structure	-	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	0x600+Node-ID

Subindex	02h	-			
Name	COB-ID Server→Client(tx)				
Object Structure	-	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	0x580+Node-ID

1400h: RPDO1 Communication Parameter 1402h: RPDO2 Communication Parameter 1403h: RPDO3 Communication Parameter 1404h: RPDO4 Communication Parameter					
Index	1400h~1403h	-			
Name	RPDO COB-ID				
Object Structure	REC	Data Type	-	Data Range	-
Mapping	NO	W/R	RW	Default	-

Subindex	00h	-			
Name	Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	0~2
Mapping	NO	W/R	RO	Default	2

Subindex	01h	-			
Name	COB-ID Used by RPDO				
Object Structure	-	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	See the function description.

<table>
<tr><td>Function</td><td>Only the most significant bit can be altered. “0” for this bit indicates the PDO is valid, while “1” indicates the PDO is invalid.
<table>
<tr><td colspan="5">MSB LSB</td></tr>
<tr><td>31</td><td>30</td><td>11</td><td>10</td><td>0</td></tr>
<tr><td>0/1</td><td colspan="2">0</td><td colspan="2">11-bit COB-ID</td></tr>
</table>
Factory default settings are as follows (Node-ID default value is 1):
1400H: 0x80000200 + Node-ID
1401h: 0x80000300+Node-ID
1402h: 0x80000400+Node-ID
1403h: 0x80000500+Node-ID</td></tr>
</table>

<table>
<tr><td>Subindex</td><td>02h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">RPDO Reception type</td></tr>
<tr><td>Object Structure</td><td>-</td><td>Data Type</td><td>Uint8</td><td>Data Range</td><td>Uint8</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>0</td></tr>
<tr><td>Function</td><td colspan="5">This object can be modified only when PDO is invalid.
Different values represent different PDO transmission types as shown in the table below:
<table>
<tr><th>Value</th><th>Content</th></tr>
<tr><td>0</td><td>Synchronous, acyclic</td></tr>
<tr><td>1~240</td><td>Synchronous, cyclic</td></tr>
<tr><td>254, 255</td><td>Asynchronous and acyclic</td></tr>
</table></td></tr>
</table>

<table>
<tr><td colspan="6">1600h: RPDO1 Mapping
1601h: RPDO2 Mapping
1602h: RPDO3 Mapping
1603h: RPDO4 Mapping</td></tr>
<tr><td>Subindex</td><td>1600h~1603h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">RPDO Mapping Parameter</td></tr>
<tr><td>Object Structure</td><td>REC</td><td>Data Type</td><td>-</td><td>Data Range</td><td>-</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">This object can be modified only when PDO is invalid, The total bit length of the mapped object must not exceed 64 bits, and only byte-level mapping is supported, no bit-level mapping.</td></tr>
</table>

Subindex	00h	-			
Name	PDO Mapping Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	0~4
Mapping	NO	W/R	RW	Default	-

Function	When it is written 0, the other sub-index mapping entries are invalid.

<table>
<tr><td>Subindex</td><td>1h~4h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">PDO Mapping for the nth Application Object to be Mapped</td></tr>
<tr><td>Object Structure</td><td>-</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>Uint32</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">The mapping object index and subindex must exist in the object dictionary list, be writable, and be mappable. Write the corresponding mapping object in the following format:
<table>
<tr><td>MSB</td><td></td><td>LSB</td></tr>
<tr><td>31 16</td><td>15 8</td><td>7 0</td></tr>
<tr><td>Index</td><td>Subindex</td><td>Object Length</td></tr>
</table></td></tr>
</table>

RPDO default mapping contents are:

(1) RPDO1 (1600h)

Index	Value	Setting
0	1	Map one entry
1	0x60400010	Control Word

(2) RPDO2 (1601h)

Index	Value	Setting
0	2	Map two entries
1	0x60400010	Control Word
2	0x60600008	Operation Mode

(3) RPDO3 (1602h)

Index	Value	Setting
0	2	Map two entries
1	0x60400010	Control Word
2	0x607A0020	Target position (Position reference)

(4) RPDO4 (1603h)

Index	Value	Setting
0	2	Map two entries
1	0x60400010	Control Word
2	0x60FF0020	Target Velocity (Velocity Reference)

<table>
<tr><td colspan="3">1800h: TPDO1 Communication Parameter
1801h: TPDO2 Communication Parameter
1802h: TPDO3 Communication Parameter
1803h: TPDO4 Communication Parameter</td></tr>
<tr><td>Index</td><td>1800h~1803h</td><td>-</td></tr>
</table>

Name	TPDO Communication Parameter				
Object Structure	REC	Data Type	-	Data Range	-
Mapping	NO	W/R	RW	Default	-

Subindex	00h	-			
Name	Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	0~4
Mapping	NO	W/R	RO	Default	5

Subindex	01h	-			
Name	COB-ID Used by TPDO				
Object Structure	-	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RW	Default	See the function description.
Function	Only the most significant bit can be altered. "0" for this bit indicates the TPDO is valid, while "1" indicates the TPDO is invalid.				

MSB					LSB
31	30	11	10		0
0/1	0		11-bit COB-ID		

Factory default settings are as follows (Node-ID default value is 1):
1800h: 0x80000180+Node-ID
1801h: 0x80000280+Node-ID
1802h: 0x80000380+Node-ID
1803h: 0x80000480+Node-ID

Subindex	02h	-			
Name	TPDO Type				
Object Structure	-	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RW	Default	255
Function	This object can be modified only when PDO is invalid. Different values represent different PDO transmission types as shown in the table below:				

Value	Type
0	Synchronous, acyclic
1~240	Synchronous, cyclic
255	Asynchronous, cyclic

Subindex	03h	-			
Name	Inhibit Time				
Object Structure	-	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RW	Default	0
Function	This object can be modified only when PDO is invalid, unit in 125μs Note: It is OFF when set to 0.				

Subindex	04h	-			
Name	Reserved				
Object Structure	-	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RW	Default	0

Subindex	05h	-			
Name	Event Timer				
Object Structure	-	Data Type	Uint16	Data Range	Uint16
Mapping	NO	W/R	RW	Default	0
Function	This object can be modified only when PDO is invalid, unit in 1ms. Note: It is OFF when set to 0.				

1A00h: TPDO1 Mapping Parameter 1A01h: TPDO2 Mapping Parameter 1A02h: TPDO3 Mapping Parameter 1A03h: TPDO4 Mapping Parameter					
Index	1A00 h ~1A03h	-			
Name	TPDO Mapping Parameter				
Object Structure	REC	Data Type	-	Data Range	-
Mapping	NO	W/R	RW	Default	-
Function	This object can be modified only when PDO is invalid, The total bit length of the mapped object must not exceed 64 bits, and only byte-level mapping is supported, no bit-level mapping.				

Subindex	00h	-			
Name	PDO Mapping Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	0~4
Mapping	NO	W/R	RW	Default	-
Function	When it is written 0, the other sub-index mapping entries are invalid.				

<table>
<tr><th>Subindex</th><th>1h~4h</th><th colspan="4">-</th></tr>
<tr><td>Name</td><td colspan="5">TPDO Mapping Entry</td></tr>
<tr><td>Object Structure</td><td>-</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>Uint32</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">The mapping object index and subindex must exist in the object dictionary list, be writable, and be mappable.
Write the corresponding mapping object in the following format:
<table>
<tr><td colspan="3">MSB LSB</td></tr>
<tr><td>31 16</td><td>15 8</td><td>7 0</td></tr>
<tr><td>Index</td><td>Subindex</td><td>Object Length</td></tr>
</table></td></tr>
</table>

TPDO default mapping contents are:

(1) TPDO1 (1A00h)

Index	Value	Description
0	1	Map one entry
1	0x60410010	Status word

(2) TPDO2 (1A01h)

Index	Value	Description
0	2	Map two entries
1	0x60410010	Status word
2	0x60610008	Current operation mode

(3) TPDO3 (1A02h)

Index	Value	Description
0	2	Map two entries
1	0x60410010	Status word
2	0x60640020	Current position

(4) TPDO4 (1A03h)

Index	Value	Description
0	2	Map two entries
1	0x60410010	Status word
2	0x606C0020	Current velocity

9.2.10.6 6000h Object Details

<table>
<tr><th>603Fh</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>IP</th></tr>
<tr><td>Index</td><td>603Fh</td><td colspan="7">-</td></tr>
<tr><td>Name</td><td colspan="8">Error Code</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td colspan="4">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td>Default</td><td colspan="4">-</td></tr>
</table>

Function	The error code indicates the last error that occurred in the drive. See “ 9.4 Error Diagnosis ” for details.

6040h	-			PP	PV	PT	HM	IP
Index	6040h	-						
Name	Control Word							
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535			
Mapping	Y	W/R	RW	Default	0			

<table>
<tr><td>Function</td><td>
Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4~6</td><td>Operation mode-related</td><td>
<table>
<tr><th rowspan="2">Bit</th><th colspan="4">Control Mode</th></tr>
<tr><th>PP</th><th>PV</th><th>PT</th><th>HM</th></tr>
<tr><td>4</td><td>New position rising edge trigger</td><td>NA</td><td>NA</td><td>Home starts</td></tr>
<tr><td>5</td><td>0: Non-immediate update
1: Non-immediate update</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>6</td><td>0: Absolute position
1: Relative position</td><td>NA</td><td>NA</td><td>NA</td></tr>
</table>
</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
Bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Pause</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table>
Note: Each bit in the control word must be combined with other bits to form a control reference.
</td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>IP</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="7">-</td></tr>
<tr><td>Name</td><td colspan="8">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="2">Data Range</td><td colspan="3">0~65535</td></tr>
</table>

Mapping	Y	W/R	RO	Default	0
Function	Status word bit descriptions are as follows:				

Bit	Content	Setting
0	Servo ready status	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: Non-CANopen 1: CANopen
10	Target reached	Velocity mode 0: Not reached 1: Reached Position mode 0: Not reached 1: Reached
11	Internal position limit	0: No error 1: Error
12~13	Operation mode-related	-
14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

605Ah	-		PP	PV	PT	HM	IP
Index	605Ah	-					
Name	Quick Stop Mode						
Object Structure	VAR	Data Type	Int16	Data Range	0~2		
Mapping	NO	W/R	RW	Default	2		

Function	Display	Control Mode
	0	Coast to stop and motor shaft not locked
	1	Stop by 0x6084 (0x609A during home) setting and motor shaft not locked
	2	Stop by 0x6085h setting and motor shaft not locked
	5	Stop by 0x6084 (0x609A during home) setting and motor shaft locked
	6	Stop by 0x6085h setting and motor shaft locked

605Dh	-				PP	PV	PT	HM	IP
Index	605Dh	-							
Name	Halt Stop Mode								
Object Structure	VAR	Data Type	Int16	Data Range	1~3				
Mapping	NO	W/R	RW	Default	1				
Function	Display	Control Mode							
	1	Stop by 6084h/6087h (0x609A during home) setting and motor shaft locked							
	2	Stop by 6085h/6087h setting and motor shaft locked							
	3	Stop as emergency stop and motor shaft locked							

6060h	-				PP	PV	PT	HM	IP
Index	6060h	-							
Name	Control Mode								
Object Structure	VAR	Data Type	Int8	Data Range	0~7				
Mapping	Y	W/R	RW	Default	1				
Function	Set the servo drive operation mode:								
	Setting	Description							
	0	NA							
	1	Profile position mode (PP)							
	3	Profile velocity mode (PV)							
	4	Profile torque mode (PT)							
	6	Home mode (HM)							
	7	Interpolation position mode (IP)							

6061h	-				PP	PV	PT	HM	IP
Index	6061h	-							
Name	Operation Mode Display								
Object Structure	VAR	Data Type	Int8	Data Range	0~7				

Mapping	Y	W/R	RO	Default	0

Function	Display	Control Mode
	0	NA
	1	Profile position mode (PP)
	3	Profile velocity mode (PV)
	4	Profile torque mode (PT)
	6	Home mode (HM)
	7	Interpolation position mode (IP)

6062h	-				PP	HM	IP
Index	6062h	-					
Name	User Position Reference						
Object Structure	VAR	Data Type	Int 32	Data Range	-2^{31}~$(2^{31}-1)$		
Mapping	Y	W/R	RO	Default	0		
Function	It indicates the required value in reference unit.						

6063h	-		PP	PV	PT	HM	IP
Index	6063h	-					
Name	Motor Position Feedback						
Object Structure	VAR	Data Type	Int32	Data Range	-2^{31}~$(2^{31}-1)$		
Mapping	Y	W/R	RO	Default	0		
Function	It indicates the actual position feedback value in encoder unit.						

6064h	-		PP	PV	PT	HM	IP
Index	6064h	-					
Name	User Position Feedback						
Object Structure	VAR	Data Type	Int32	Data Range	-2^{31}~$(2^{31}-1)$		
Mapping	Y	W/R	RO	Default	0		
Function	● It indicates the actual position feedback value in reference unit. ● Position Actual Value= User Position Feedback (6062h) × Gear Ratio (6091h).						

6065h	-				PP	HM	IP
Index	6065h	-					
Name	Position Deviation Error Level						
Object Structure	VAR	Data Type	Uint32	Data Range	0~$(2^{31}-1)$		
Mapping	Y	W/R	RW	Default	38400000		

Function	● Set the position deviation error level in reference unit. ● When the difference between the user position reference (6062h) and the user position feedback (6064h) exceeds ±6065h, a position deviation excess error (ER.d00) occurs. ● If 6065h is set to 4294967295, the servo drive will not monitor position deviation status.

6067h	-				PP	HM	IP
Index	6067h	-					
Name	/COIN Signal Width						
Object Structure	VAR	Data Type	Uint32	Data Range	$0\sim(2^{31}-1)$		
Mapping	Y	W/R	RW	Default	100		
Function	● Set the position arrival level in reference unit. ● When the difference between the user position reference (6062h) and the actual user position feedback (6064h) is within ±6067h, and the duration reaches 6068h, the position is considered to be reached. In profile position mode, bit 10 of the status word (6041h) is set to 1.						

6068h	-				PP	HM	IP
Index	6068h	-					
Name	/COIN Signal Time						
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535		
Mapping	Y	W/R	RW	Default	0		
Function	● Set the time range to judge if the position target is reached (unit: 0.1ms). ● When the difference between the user position reference (6062h) and the actual user position feedback (6064h) is within ±6067h, and the duration reaches 6068h, the position is considered to be reached. In profile position mode, bit10 of the status word (6041h) is set to 1.						

606Bh	-			PP	PV	PT	HM	IP
Index	606Bh	-						
Name	Velocity Reference							
Object Structure	VAR	Data Type	Int32	Data Range	$-2^{31}\sim(2^{31}-1)$			
Mapping	Y	W/R	RO	Default	-			
Function	● It indicates the actual position reference value (unit: 0.1rpm). ● In position mode, it reflects the speed reference corresponding to the output of the position regulator. ● while in velocity mode, it reflects the input reference of the speed regulator.							

606Ch	-				PP	PV	PT	HM	IP
Index	606Ch	-							
Name	User Velocity Reference								
Object Structure	VAR	Data Type	Int32	Data Range	-2^{31}~$(2^{31}-1)$				
Mapping	Y	W/R	RO	Default	-				
Function	It indicates the actual position feedback value (unit: reference unit/s).								

606Dh	-					PV
Index	606Dh	-				
Name	V-CMP Signal Width					
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535	
Mapping	Y	W/R	RW	Default	100	
Function	● Set the threshold for velocity arrival (unit: 0.1rpm). ● If the difference between the target speed 60FFh and the actual speed feedback 606Ch is within ±606Dh and the time reaches 606Eh, the target speed is considered to have been reached, and bit10 of status word 6041h is set to 1 in profile speed mode, otherwise, bit10 is 0.					

606Eh	-					PT
Index	606Eh	-				
Name	Target Torque					
Object Structure	VAR	Data Type	Int16	Data Range	0~65535	
Mapping	Y	W/R	RW	Default	0	
Function	● Set the time range to judge if the position target is reached (unit: ms). ● If the difference between the target speed 60FFh and the actual speed feedback 606Ch is within ±606Dh and the time reaches 606Eh, the target speed is considered to have been reached, and bit10 of status word 6041h is set to 1 in profile speed mode, otherwise, bit10 is 0.					

606Fh	-					PV
Index	$606F_h$	-				
Name	Zero-velocity Level					
Object Structure	VAR	Data Type	Uint16	Data Range	0 ~ 65535	
Mapping	Y	W/R	RW	Default	10	

Function	● Set the threshold for determining whether the user speed is zero (unit: 1rpm). ● When the user speed feedback (606Ch) is within the range of ±606Fh, and the duration reaches the 6070h setting, it indicates that the user speed is zero. In this case, bit 12 of the status word (6041h) = 1. If either of these two conditions is not met, the user speed is considered non-zero, and bit 12 of the status word (6041h) = 0.

6070h	-				PT
Index	6070_h	-			
Name	Zero-velocity Time				
Object Structure	VAR	Data Type	Int16	Data Range	0 ~ 65535
Mapping	Y	W/R	RW	Default	0
Function	● Set the time duration for determining whether the user speed is zero (unit: 2ms). ● When the user speed feedback (606Ch) is within the range of ±606Fh, and the duration reaches the 6070h setting, it indicates that the user speed is zero. In this case, bit 12 of the status word (6041h) = 1. If either of these two conditions is not met, the user speed is considered non-zero, and bit 12 of the status word (6041h) = 0.				

6071h	-				PT
Index	6071h	-			
Name	Target Torque				
Object Structure	VAR	Data Type	Int16	Data Range	-5000~5000
Mapping	Y	W/R	RW	Default	0
Function	set the target reference value in profile torque mode and cyclic synchronous torque mode(unit: 0.1%).				

6072h	-		PP	PV	PT	HM	IP
Index	6072h	-					
Name	Max. Torque Limit						
Object Structure	VAR	Data Type	Uint16	Data Range	-5000~5000		
Mapping	Y	W/R	RW	Default	3000		
Function	Set the maximum output torque value for the servo drive (unit: 0.1%).						

6074h	-		PP	PV	PT	HM	IP
Index	6074h	-					
Name	Torque Reference						
Object Structure	VAR	Data Type	Uint16	Data Range	-5000~5000		
Mapping	Y	W/R	RO	Default	-		
Function	It indicates the current torque command value (unit: 0.1%).						

6075h	-			PP	PV	PT	HM	IP
Index	6075h	-						
Name	Rated Motor Torque							
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32			
Mapping	Y	W/R	RO	Default	0			
Function	It indicates the motor rated current on the nameplate (unit: mA). All current-related parameter values are tied to this parametER.							

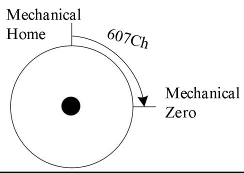
6076h	-			PP	PV	PT	HM	IP
Index	6076h	-						
Name	Rated Motor Torque							
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32			
Mapping	Y	W/R	RO	Default	0			
Function	It indicates the motor rated torque on the nameplate (unit: mNm). All torque-related parameter values are tied to this parametER.							

6077h	-			PP	PV	PT	HM	IP
Index	6077h	-						
Name	Motor Torque Feedback							
Object Structure	VAR	Data Type	Int16	Data Range	Int16			
Mapping	Y	W/R	RO	Default	0			
Function	It indicates the instantaneous torque output value of the servo motor (unit: 0.1%).							

6078h	-			PP	PV	PT	HM	IP
Index	6078h	-						
Name	Current Feedback							
Object Structure	VAR	Data Type	Int16	Data Range	Int16			
Mapping	Y	W/R	RO	Default	0			
Function	It indicates the instantaneous torque output value of the servo motor (unit:0.01A).							

607Ah	-		PP
Index	607Ah	-	

Name	Target Position				
Object Structure	VAR	Data Type	Int32	Data Range	-2^{31}~$(2^{31}-1)$
Mapping	Y	W/R	RW	Default	0
Function	● Set the target position in reference unit under the profile position mode and cyclic synchronous position mode. ● When Control Word (6040h-bit6) is 0, 607Ah is the absolute position of the current stage. ● When Control Word (6040h-bit6) is 1, 607Ah is the incremental position of the current stage.				

607Ch	-				HM
Index	607Ch	-			
Name	Home Offset				
Object Structure	VAR	Data Type	Int32	Data Range	-2^{31}~$(2^{31}-1)$
Mapping	Y	W/R	RW	Default	0
Function	Set the physical position by which the mechanical zero point deviates from the motor home position in encoder unit under the position mode. Mechanical zero point = Mechanical home + 607Ch (home offset). When it is set to 0, then home point has no offset at all. 				

607Dh	-	PP	PV	PT	HM	IP
Index	607Dh	-				
Name	Internal Absolute Position Limit					
Object Structure	ARR	Data Type	Int32	Data Range	Int32	
Mapping	Y	W/R	RW	Default	0	

Function	Set the minimum and maximum value of the absolute position limit in the software. ● The min. absolute position limit is set on 607D:01h; ● The max. absolute position limit is set on 607D:02h; The software position limit will ● When both (607Dh:01h) and (607Dh:02h) are set to their default values, the software position limits are disabled. ● If the minimum absolute position limit (607Dh:01h) is greater than the maximum absolute position limit (607Dh:02h), the software will automatically adjust these values internally. ● When the position reference or position feedback reaches the software limit value: In position mode, the servo drive will treat the limit value as the target position, move to it, and then stop, and an overtravel alarm will be triggered. By inputting a reverse direction reference, the motor can exit the overtravel state. ● Absolute position limits are defined relative to the motor feedback position (6064h in user unit).

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	Y	W/R	RO	Default	2

Subindex	01h	-			
Name	Min. Internal Absolute Position Limit				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	-2^{31}

Subindex	02h	-			
Name	Max. Internal Absolute Position Limit				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	$2^{31}-1$

607Eh	-	PP	PV	PT	HM	IP
Index	607Eh	-				
Name	Reference Polarity					
Object Structure	VAR	Data Type	Uint8	Data Range	Int8	
Mapping	Y	W/R	RW	Default	0	

<table>
<tr><td>Function</td><td>Set the polarity of position, speed and torque references.
<table>
<tr><td colspan="3">MSB</td><td>LSB</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4 0</td></tr>
<tr><td>Position reference polarity</td><td>Speed reference polarity</td><td>Torque reference polarity</td><td>NA</td></tr>
</table>

Bit7=1: Indicates standard position mode. Multiply the position reference by (-1) to reverse the motor rotation direction. In profile position mode and cyclic synchronous position mode, both the position reference and target position are inverted.
Bit6=1: Indicates velocity mode. Multiply the velocity reference by (-1) to reverse the motor rotation direction.
Bit5=1: Indicates torque mode. Multiply the torque reference by (-1) to reverse the motor rotation direction.
</td></tr>
</table>

<table>
<tr><td>607Fh</td><td colspan="3">-</td><td>PP</td><td>PV</td><td>PT</td><td>HM</td><td>IP</td></tr>
<tr><td>Index</td><td>607Fh</td><td colspan="7">-</td></tr>
<tr><td>Name</td><td colspan="8">Max. Profile Velocity</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td colspan="2">Uint32</td><td colspan="2">Data Range</td><td colspan="2">0~(2^32-1)</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td colspan="2">RW</td><td colspan="2">Default</td><td colspan="2">838860800</td></tr>
<tr><td>Function</td><td colspan="8">Set the user maximum operating speed (unit: reference units/s).
This value takes effect when the slave's speed reference changes.
$$\text{Max. Profile Velocity(rpm)} = \frac{607\text{Fh}\times\frac{6091{:}01\text{h}}{6091{:}02\text{h}}}{\text{Encoder Resolution}}\times 60$$
Note: In all operating modes, the maximum operating speed is limited not only by 607Fh but also by Pn318. The smaller value between these two values works actually.</td></tr>
</table>

<table>
<tr><td>6080h</td><td colspan="3">-</td><td>PP</td><td>PV</td><td>PT</td><td>HM</td><td>IP</td></tr>
<tr><td>Index</td><td>6080h</td><td colspan="7">-</td></tr>
<tr><td>Name</td><td colspan="8">Max. Motor Velocity</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td><td colspan="2">Data Range</td><td colspan="3">0~(2^32-1)</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td colspan="2">Default</td><td colspan="3">Max. Velocity Limit</td></tr>
<tr><td>Function</td><td colspan="8">It indicates the maximum permissible operating speed of the motor that can be obtained from the manual of the servomotor (unit: rpm).</td></tr>
</table>

6081h	-				PP
Index	6081h	-			
Name	Profile Velocity				
Object Structure	VAR	Data Type	Uint32	Data Range	0~(2^{32}-1)
Mapping	Y	W/R	RW	Default	8388608
Function	Set the running speed of the constant stage after completing the acceleration in the profile position mode (unit: reference unit/s). $$\text{Motor Speed(rpm)} = \frac{6081\text{h}\times\frac{6091:01\text{h}}{6091:02\text{h}}}{\text{Encoder Resolution}} \times 60$$				

6083h	-			PP	PV
Index	6083h	-			
Name	Profile ACC				
Object Structure	VAR	Data Type	Uint32	Data Range	0~(2^{32}-1)
Mapping	Y	W/R	RW	Default	83886080
Function	● Sets the acceleration for profile position mode and profile velocity mode (unit: command units/s²). ● In profile position mode: Acceleration changes take effect before the next segment reference is triggered. If modified during the execution of this segment, the new value will apply after the current segment completes. ● In profile velocity mode, the acceleration changes take effect immediately. ● If this is set to 0, the software internally forces it to 1.				

6084h	-			PP	PV
Index	6084h	-			
Name	Profile DEC				
Object Structure	VAR	Data Type	Uint32	Data Range	0~(2^{32}-1)
Mapping	Y	W/R	RW	Default	83886080
Function	● Set the deceleration for profile position mode and profile velocity mode (unit: reference units/s²). ● In profile velocity mode, the deceleration changes take effect immediately. ● If this is set to 0, the software internally forces it to 1.				

6085h	-	PP	PV	PT	HM	IP
Index	6085h	-				
Name	Quick Stop DEC					

Object Structure	VAR	Data Type	Uint32	Data Range	$0\sim(2^{32}-1)$
Mapping	Y	W/R	RW	Default	2147483647
Function	When Quick Stop (6040h: bit2 = 0) is enabled and Quick Stop Mode (605Ah = 2), this setting defines the deceleration rate during the quick stop deceleration phase.				

6086h	-				PP	PV
Index	6086h	-				
Name	Motion Profile Type					
Object Structure	VAR	Data Type	Int16	Data Range	Int16	
Mapping	Y	W/R	RW	Default	0	
Function	It indicates the profile type of the position, speed or torque reference.					

6087h	-					PT
Index	6087h	-				
Name	Torque ACC					
Object Structure	VAR	Data Type	Uint32	Data Range	0~65535	
Mapping	Y	W/R	RW	Default	1000	
Function	● Set the torque acceleration in profile torque mode, representing the torque reference increment per second (0.1%/s). ● In profile torque mode, when quick stop (605Ah = 1 or 2) or halt stop (605Dh = 1 or 2) is triggered, the drive will decelerate to stop according to the value set in 6087h. ● If this is set to 0, the software internally forces it to 1.					

6091h	-			PP	PV	PT	HM	IP
Index	6091h	-						
Name	Gear Ratio							
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32			
Mapping	Y	W/R	RW	Default	-			

Function	Set a proportional relationship between load position and motor turns: $\text{Motor Displacement (motor unit)} = \text{Load Displacement (user unit)} \times \text{Position Factor}$ The position factor is related to the mechanical reduction ratio, mechanical dimension parameters, and motor resolution. The calculation method is as follows: $\text{Position Factor} = \frac{\text{Motor Resolution} \times \text{Gear Ratio}}{\text{Load Feed}}$ The gear ratio set in 6091h is in a cascaded relationship with the gear ratios set in Pn204 and Pn206. For CAN-based models, the resulting electronic gear ratio is calculated as follows: $\text{Gear Ratio} = \frac{\text{Pn204}}{\text{Pn206}} \times \frac{6091:01\text{h}}{6091:02\text{h}}$

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	Y	W/R	RO	Default	2

Subindex	01h	-			
Name	Motor Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

Subindex	02h	-			
Name	Shaft Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

6098h	-				HM
Index	6098h	-			
Name	Home Mode				
Object Structure	VAR	Data Type	Int8	Data Range	0~35
Mapping	Y	W/R	RW	Default	1

Function	Select the home mode here.	
	Value	**Description**
	1	Starts at the negative limit switch and Z-pulse
	2	Starts at the positive limit switch and Z-pulse
	3, 4	Starts at the positive home switch and Z-pulse
	5, 6	Starts at the negative home switch and Z-pulse
	7~14	Starts at the home switch and Z-pulse
	15~16	NA
	17~30	Home without reference to Z-pulse
	31~32	NA
	33~34	Home without reference to Z-pulse
	35	Current position as the zero position

NOTE	
.	● ER.E03 will occur when data other than the above is set.

6099h	-				HM
Index	6099h	-			
Name	Home Velocity				
Object Structure	ARR	Data Type	Uint8	Data Range	Uint32
Mapping	Y	W/R	RW	Default	-
Function	There are two speed settings under the home mode, ● 6099-1h: Deceleration Point Search Velocity (unit: reference unit/s). ● 6099-2h: Home Point Search Velocity (unit: reference unit/s).				

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	Y	W/R	RO	Default	2

Subindex	01h	-			
Name	Deceleration Point Search Velocity				
Object Structure	VAR	Data Type	Uint32	Data Range	$0\sim2^{32}-1$

Mapping	Y	W/R	RW	Default	27962026
Function	Set to configure the search speed for the deceleration point signal. We recommend a higher setting to prevent extended homing duration and homing timeout errors.				

Subindex	02h	-			
Name	Home Point Search Velocity				
Object Structure	VAR	Data Type	Uint32	Data Range	1~500
Mapping	Y	W/R	RW	Default	5592405

NOTE	
	• During homing, the slave will decelerate after detecting the deceleration point signal. • During deceleration, the slave device ignores changes in the home signal. To avoid finding the home signal during deceleration, please set the deceleration point switch signal appropriately. For example, ensure sufficient deceleration distance or increase the homing acceleration rate.

609Ah	-				HM
Index	609Ah	-			
Name	Home ACC/DEC				
Object Structure	VAR	Data Type	Uint32	Data Range	0~(2^{32}-1)
Mapping	Y	W/R	RW	Default	83886080
Function	Set the acceleration and deceleration under the home mode (unit: reference unit/s^2).				

60C1h	-				IP
Index	60C1h	-			
Name	Interpolation Record				
Object Structure	ARR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	0
Function	Set the parameters of interpolation mode.				

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	3
Mapping	N	W/R	RO	Default	1

Subindex	01h	-			
Name	Absolute Position Reference				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	0
Function	It indicates the required absolute value in reference unit.				

60C2h	-				IP
Index	60C2h	-			
Name	Interpolation Period				
Object Structure	ARR	Data Type	Uint8	Data Range	Uint8
Mapping	Y	W/R	RW	Default	0

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	N	W/R	RO	Default	2
Function	Set the entry number for the object dictionary in the interpolation cycle.				

Subindex	01h	-			
Name	Interpolation Period Time				
Object Structure	VAR	Data Type	Uint8	Data Range	Uint8
Mapping	Y	W/R	RW	Default	2
Function	Set the time constant of the interpolation period. Example: If 60C2:01h is set to 1 while 60C2:02h is set to -3, it means that the current set interpolation cycle is 1ms. Note: The interpolation cycle and synchronization cycle must be the same.				

Subindex	02h	-			
Name	Interpolation Period Time Unit				
Object Structure	VAR	Data Type	Int8	Data Range	Int8
Mapping	Y	W/R	RW	Default	-3
Function	Set the interpolation period unit. A value of -3 indicates that the unit of the interpolation cycle is milliseconds (ms). A value of -4 indicates that the unit of the interpolation cycle is 0.1 milliseconds (0.1 ms). And a value of -2 indicates that the unit of the interpolation cycle is 0.1 milliseconds (10 ms).				

60C5h	-				PP	PV	PT	HM	IP
Index	60C5h	-							
Name	Max Profile Acceleration								
Object Structure	VAR	Data Type	Uint32	Data Range	$0\sim(2^{32}-1)$				
Mapping	Y	W/R	RW	Default	2147483647				
Function	Set the maximum profile acceleration (unit: reference unit/s^2).								

60C6h	-				PP	PV	PT	HM	IP
Index	60C6h	-							
Name	Max Profile DEC								
Object Structure	VAR	Data Type	Uint32	Data Range	$0\sim(2^{32}-1)$				
Mapping	Y	W/R	RW	Default	2147483647				
Function	Set the maximum profile deceleration (unit: reference unit/s^2).								

60E0h	-				PP	PV	PT	HM	IP
Index	60E0h	-							
Name	Positive torque limit								
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16				
Mapping	Y	W/R	RW	Default	3000				
Function	Set the limit to the positive torque (unit: 0.1%).								

60E1h	-				PP	PV	PT	HM	IP
Index	60E1h	-							
Name	Negative Torque Limit								
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16				
Mapping	Y	W/R	RW	Default	3000				
Function	Set the limit to the negative torque (unit: 0.1%).								

60F4h	-				PP	HM	IP
Index	60F4h	-					
Name	Position Deviation Feedback						
Object Structure	VAR	Data Type	Int32	Data Range	$-2^{31}\sim(2^{31}-1)$		
Mapping	Y	W/R	RO	Default	0		
Function	It indicates the real time position deviation in reference unit.						

60FCh	-		PP	HM	IP
Index	60FCh	-			

Name	Motor Position Reference*				
Object Structure	VAR	Data Type	Int32	Data Range	-2^{31}~$(2^{31}-1)$
Mapping	Y	W/R	RO	Default	0
Function	It indicates the actual motor position feedback value in encoder unit. Motor Position Reference*(60FCh)= User Position Reference (6062h) × Gear Ratio (6091h).				

60FDh	-	PP	PV	PT	HM	IP
Index	60FDh	-				
Name	Digital Input					
Object Structure	VAR	Data Type	Uint32	Data Range	0~$(2^{32}-1)$	
Mapping	Y	W/R	RO	Default	0	
Function	It indicates the current digital output terminal logic of the drive, 0 indicating invalid and 1 indicating valid. The DI signals on each bit are as follows:					

MSB					LSB
31 16	15 4	3	2	1	0
Manufacturer-defined	NA	Undefined	Undefined	Positive limit switch	Negative limit switch

60FEh	-	PP	PV	PT	HM	IP
Index	60FEh	-				
Name	Digital Output					
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32	
Mapping	Y	W/R	RO	Default	0	

Subindex	00h	-			
Name	Number of Entries				
Object Structure	VAR	Data Type	Uint8	Data Range	1
Mapping	N	W/R	RO	Default	1

Subindex	01h	-			
Name	Physical Output				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RO	Default	0

<table>
<tr><td>Function</td><td>It indicates the current digital output terminal logic of the drive, with 0 indicating invalid and 1 indicating valid.
<table>
<tr><td colspan="2">MSB</td><td>LSB</td></tr>
<tr><td>31 16</td><td>15 1</td><td>0</td></tr>
<tr><td>Manufacturer-defined</td><td>NA</td><td>Brake engage signal</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>60FFh</td><td colspan="4">-</td><td>PV</td></tr>
<tr><td>Index</td><td>60FFh</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">Target Velocity</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Int32</td><td>Data Range</td><td>Int32</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td>0</td></tr>
<tr><td>Function</td><td colspan="5">Set the speed reference (unit: reference unit/s) in profile velocity mode (PV).</td></tr>
</table>

<table>
<tr><td colspan="6">6502h: Operation Mode</td></tr>
<tr><td>Index</td><td>6502h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">Drive Mode</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td>Uint16</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td>Default</td><td>6Dh</td></tr>
<tr><td>Function</td><td colspan="5">0 in the table means the operation modes are not available yet while 1 means available now.
<table>
<tr><th>Bit</th><th>Description</th><th>Value</th></tr>
<tr><td>0</td><td>Profile position mode (PP)</td><td>1</td></tr>
<tr><td>1</td><td>NA</td><td>0</td></tr>
<tr><td>2</td><td>Profile velocity mode (PV)</td><td>1</td></tr>
<tr><td>3</td><td>Profile torque mode (PT)</td><td>1</td></tr>
<tr><td>4</td><td>NA</td><td></td></tr>
<tr><td>5</td><td>Home mode (HM)</td><td>1</td></tr>
<tr><td>6</td><td>Interpolation mode(IP)</td><td>1</td></tr>
<tr><td>7~15</td><td>NA</td><td>0</td></tr>
</table>
</td></tr>
</table>

9.2.11 CANopen Debugging Example

For the SD100-CA model, users can debug the SD100 drive using CANopen communication. This section provides an operational example of profile position mode control, using our company's VC5-3232MAT-32 PLC as the control master and an SD100-400G-CA as the slave.

There are two main methods to configure the servo controller using CANopen communication, namely SDO or PDO.

9.2.11.1 Environment Setup and PDO Read/Write

Step 1: Open the PLC programming software AutoStudio, and create a new temporary project with PLC type set to VC5, as shown in the figure below.

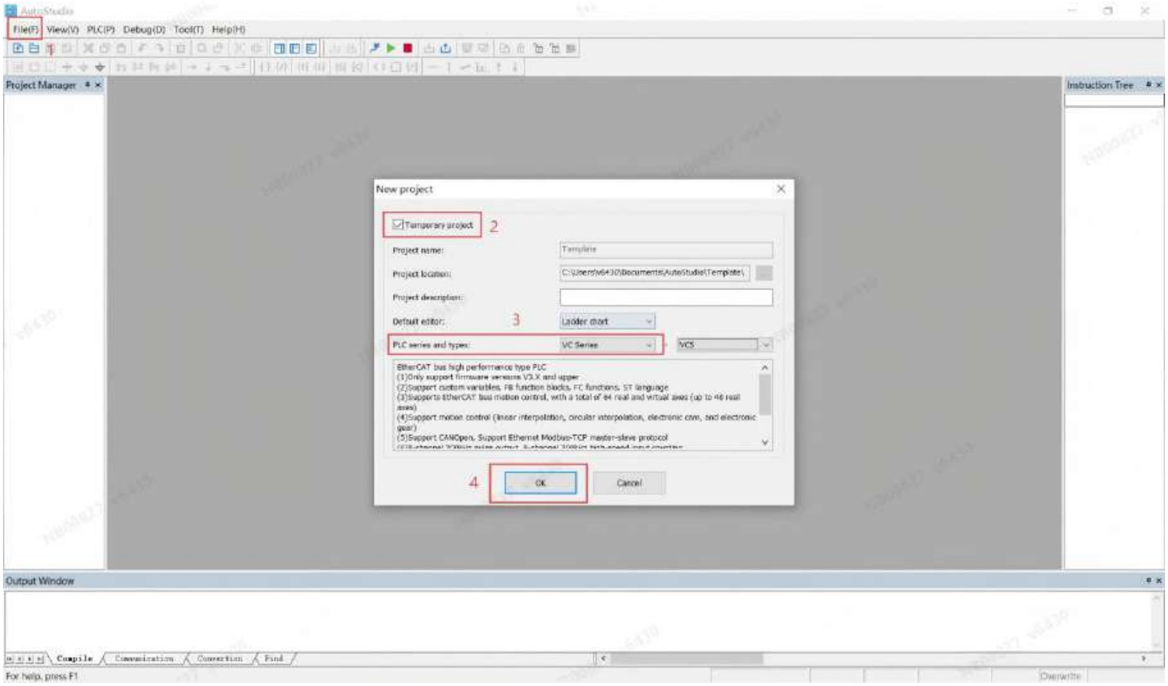


Figure 9-23 VC5 New Project

Step 2: In the Project Manager, go to Communication Configuration, double-click CAN, set protocol as Master, configure baud rate and node ID, then click OK, as shown below.

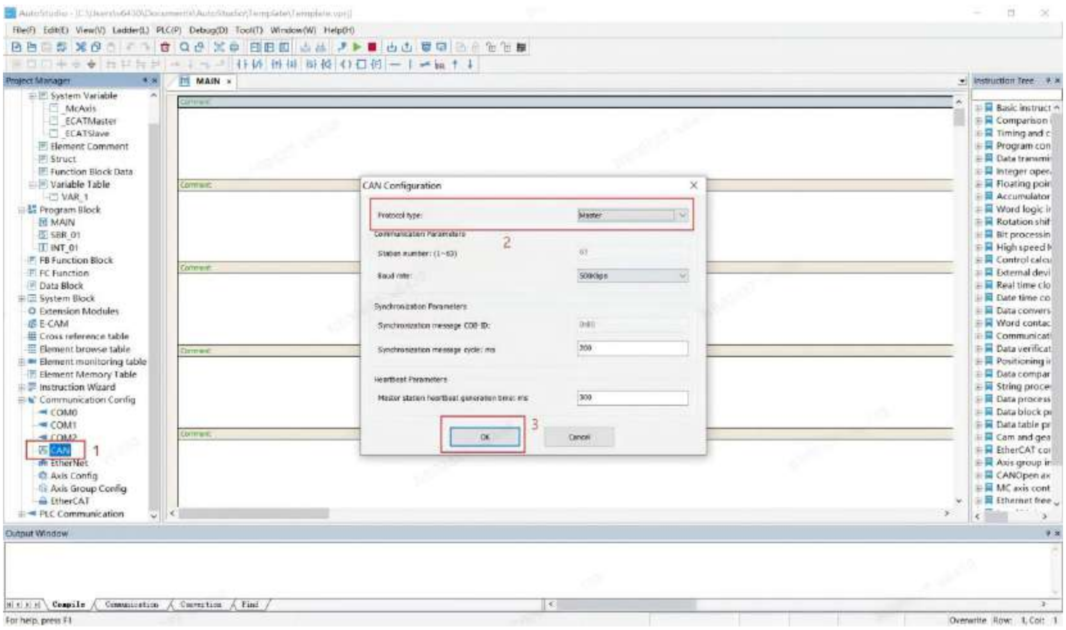


Figure 9-24 CAN Configuration

Step 3: Right-click on the CAN option added in the previous step and select Add Configuration, as shown below.

Figure 9-25 Add CAN Configuration

Step 4: Double-click the added CANopen Configuration to open the CANopen setup interface, as shown below.

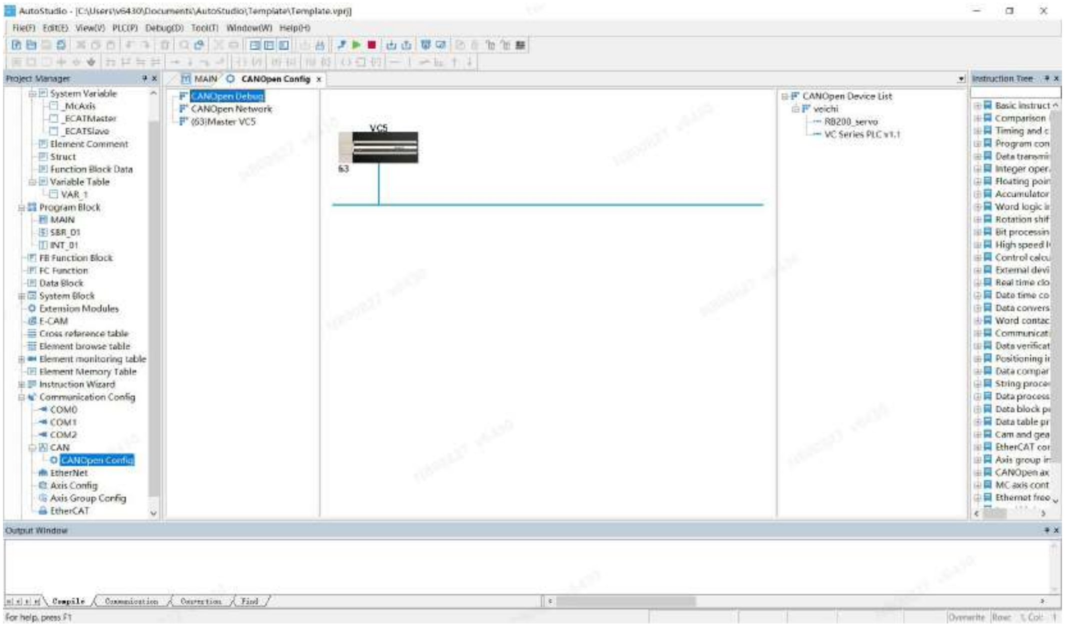


Figure 9-26 CANopen Configuration Interface

Step 5: Right-click on the CANopen Device List in the configuration interface and select Import EDS. The purpose of this step is to import an EDS-type configuration file compatible with the servo controller, as shown below.

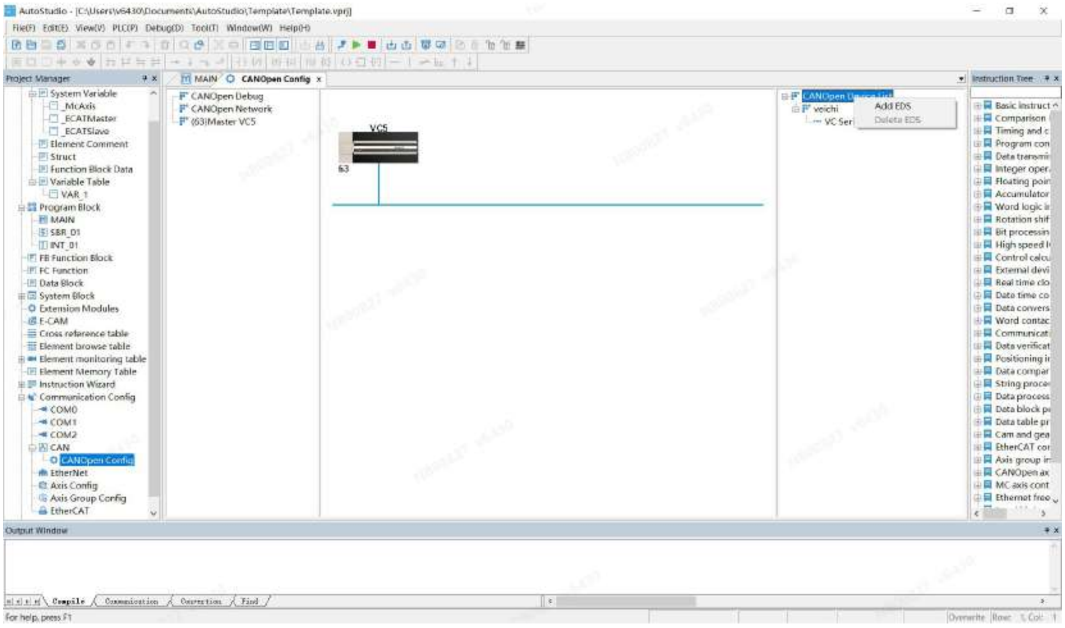


Figure 9-27 Importing an EDS File

Step 6: After importing the EDS file, a device option with the same name as the controller will appear in the list on the right. Double-click it to configure the controller onto the bus deployment on the left, as shown in the figure below.

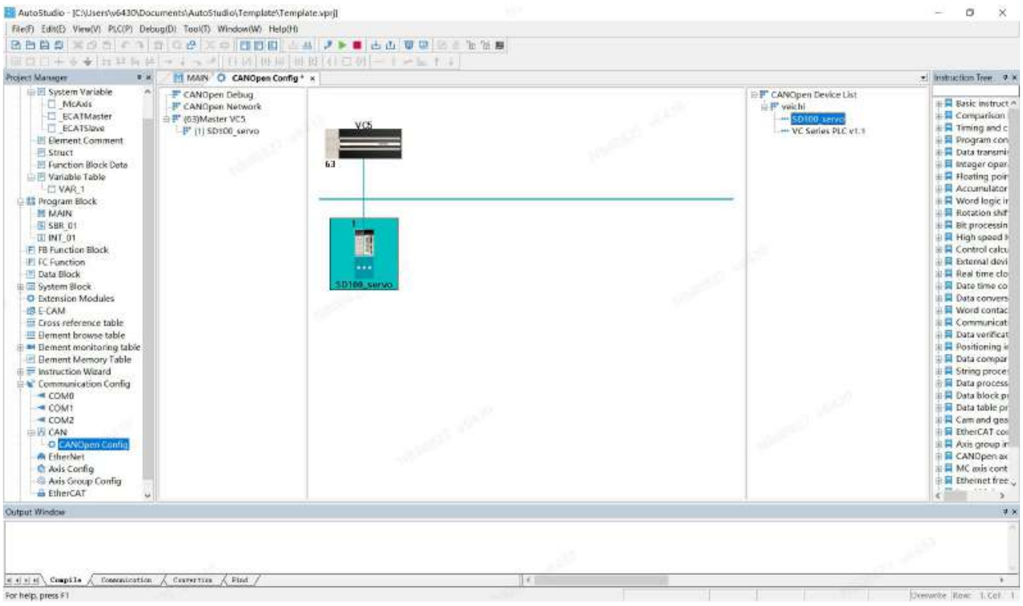


Figure 9-28 Adding Device to Bus

Step 7: Double-click the slave controller icon added to the bus to enter the related configuration interface for the slave station, as shown in the figure below.

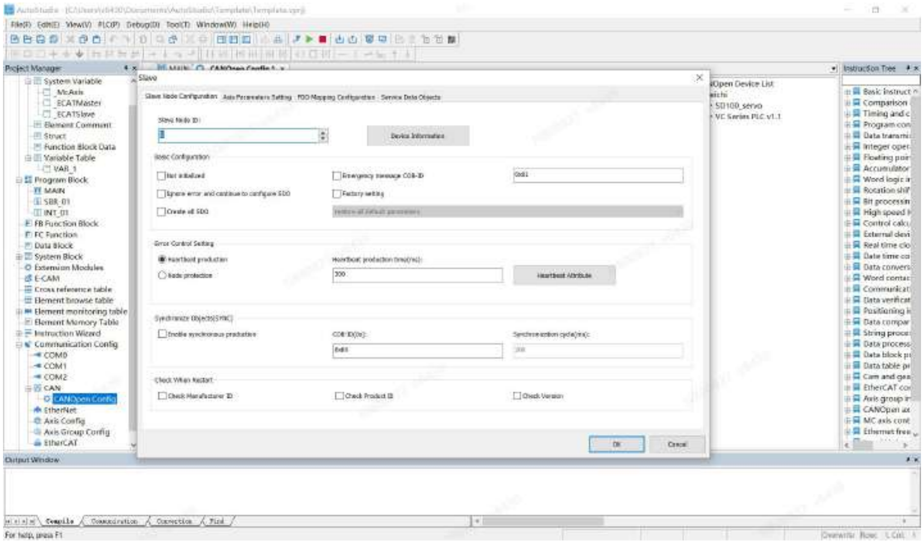


Figure 9-29 Slave Configuration Interface

Step 8: When the slave node ID matches the controlled slave station, click the PDO Mapping and Configuration tab to enter the PDO mapping setup. Taking RPDO2 mapping to 6060 (Control Mode) as an example, select PDO2 in the RPDO list, click Add, bring up the object dictionary Index, locate Index 6060, select it, and click Add. This will add the PDO mapping in the corresponding position, as shown in the figure below. To enable communication for this PDO, check the box in front of it.

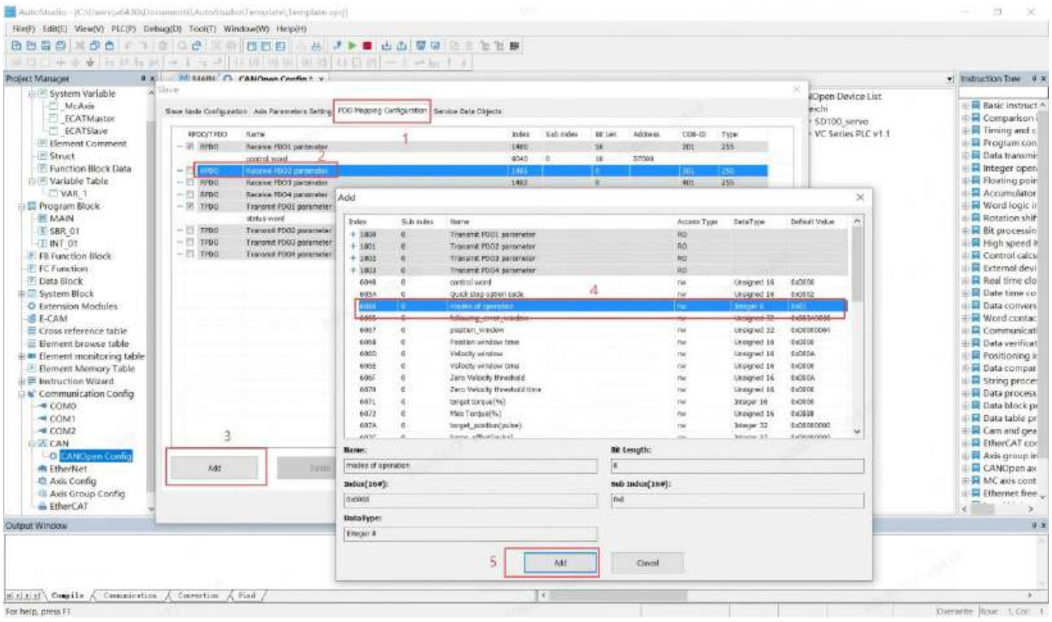


Figure 9-30 PDO Mapping Configuration

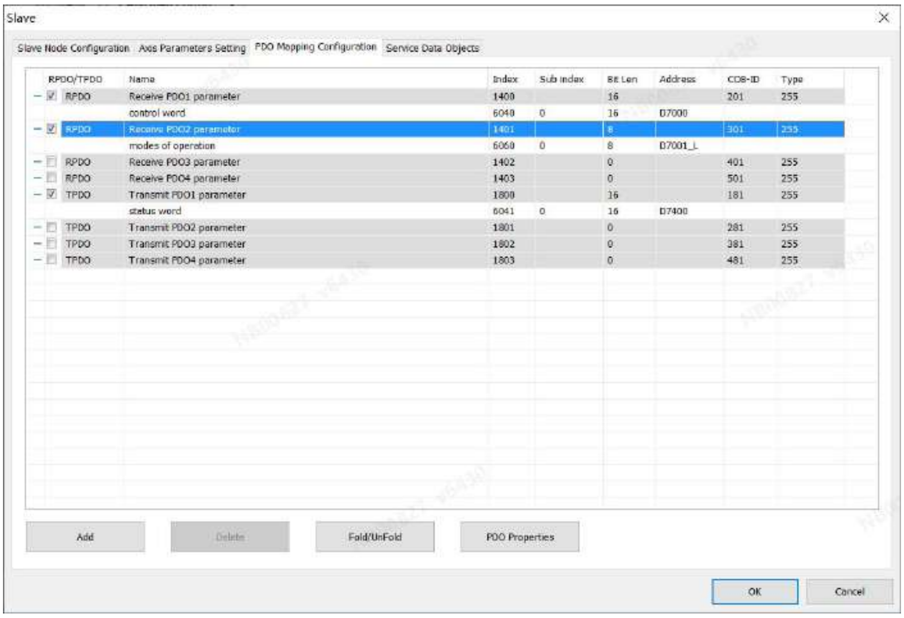


Figure 9-31 Checking the PDOs to be Enabled

Step 9: After adding the basic Indexes required for profile velocity mode access to the PDO mapping as described in the previous steps, record the corresponding address variables, as marked by the red box in the figure below. Then click OK to exit the configuration interface.

Note:

Each time the PLC file is modified, the program must be re-downloaded to the PLC, and the PLC must be set to run mode.

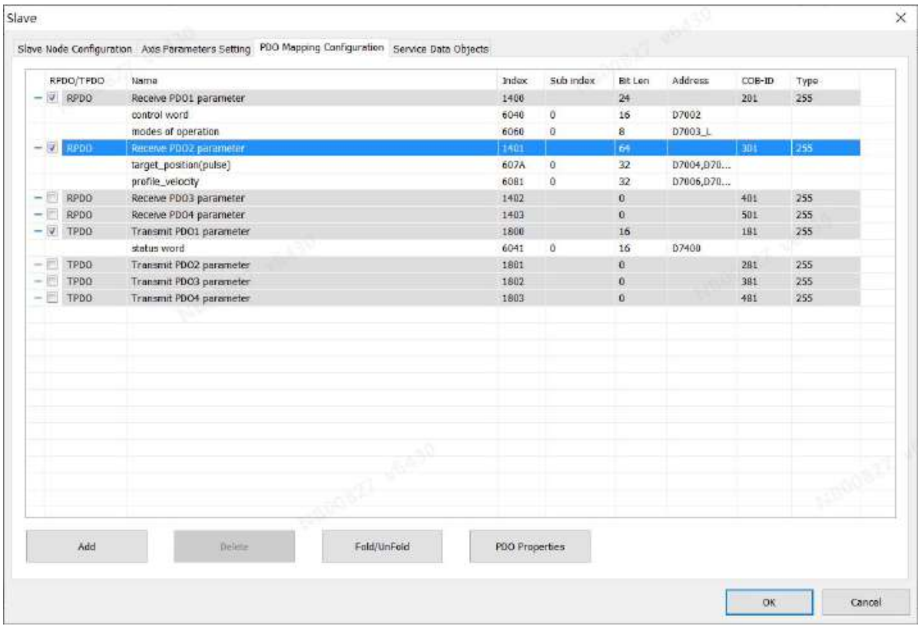


Figure 9-32 PDO Mapping for Profile Velocity Mode

Step 10: Write the CANopen control program and set the parameters as listed in the table below:

Table 9-31 Parameter Table

Item	Step	Input
Profile Position Parameter Assignment	0	607Ah = 100000
	1	6081h = 10000
Control Mode Switching	4	6060h = 0x01
Servo Enable	5	6040h = 0x06
	6	6040h = 0x07
	7	6040h = 0x0F
	8	6040h = 0x1F

After enabling the servo drive, the motor can be controlled to move at a speed of 60rpm to a position where the user position feedback (6064h) is 100,000. Open the oscilloscope to observe the waveforms of the written objects and the feedback speed, as shown in the figure below.

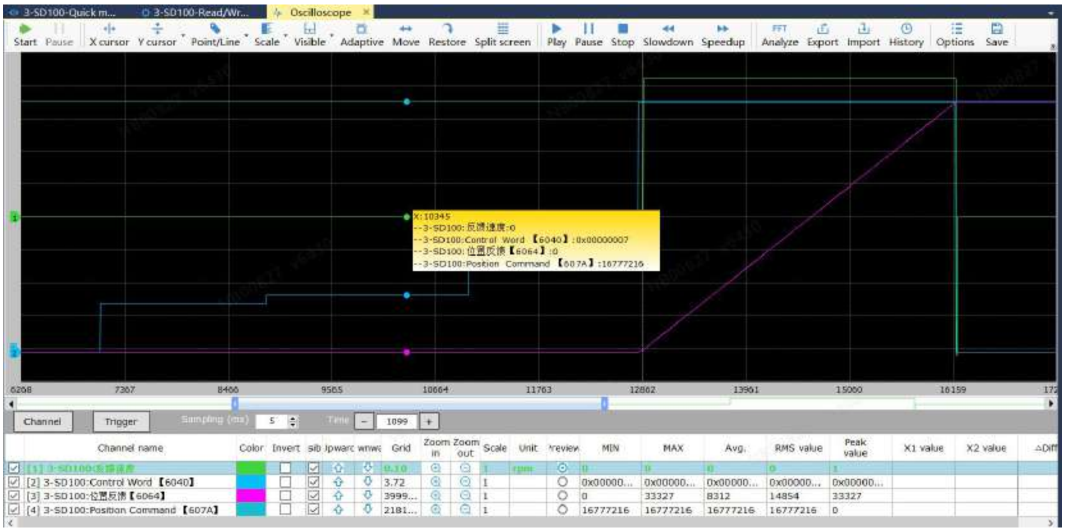


Figure 9-33 Waveforms on Oscilloscope

9.2.11.2 SDO Read/Write

In actual CANopen communication, the mapping of PDOs is implemented via SDO. That is, SDO can also be used for data communication, but with lower read/write efficiency compared to PDO. The following demonstrates the process of configuring using SDO in the profile position mode described above.

Step 1: In the CANopen configuration interface, click the CANopen Debug option to enter the CANopen debugging interface, and then start monitoring, as shown in the figure below.

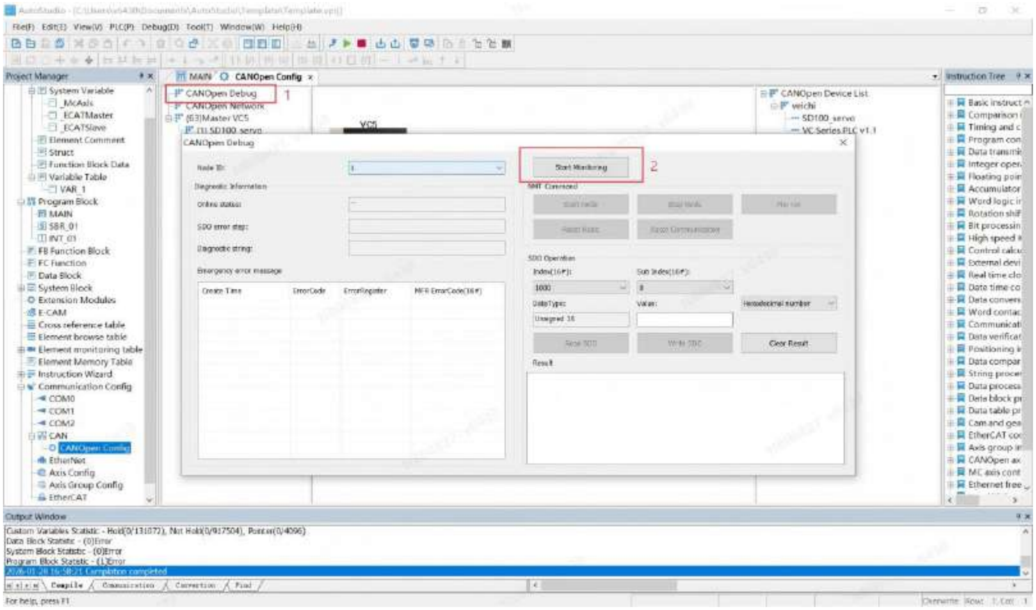


Figure 9-34 CANOPENDebug Monitoring

Step 2: In the SDO read/write section, locate the Indexes 607A, 6081, 6060, and 6040 as shown in the figure below. Enter the values corresponding to each Index from Table 9-31 in the Data field (Note: The data type selected in the dropdown menu should match the Data value entered).

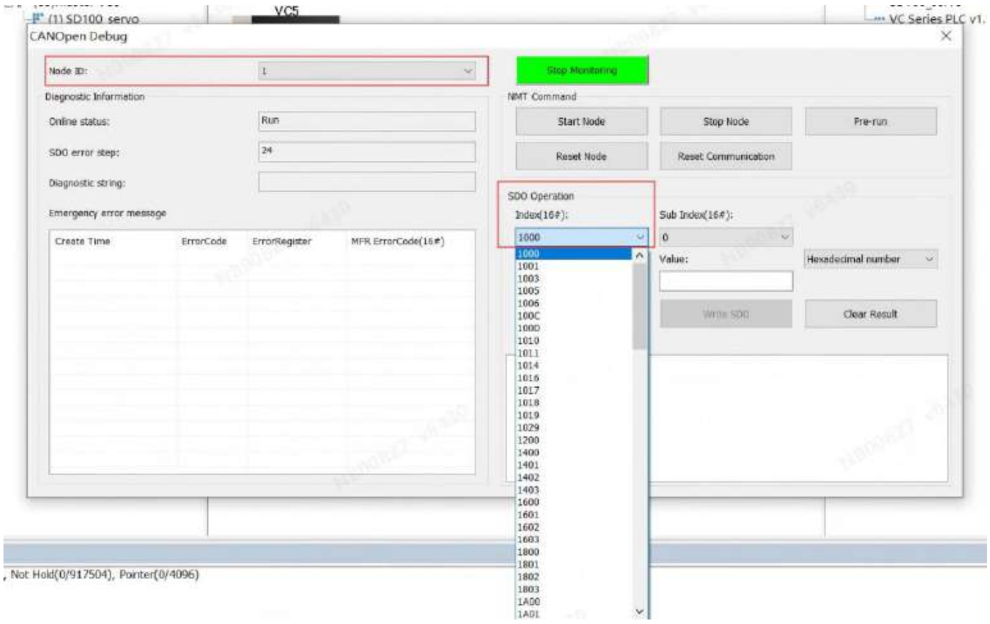


Figure 9-35 SDORead/Write Object Dictionary

Step 3: The corresponding Indexes can be accessed via Write SDO and Read SDO, as shown in the figure below. After writing the parameters, control the motor to operate in profile position mode.

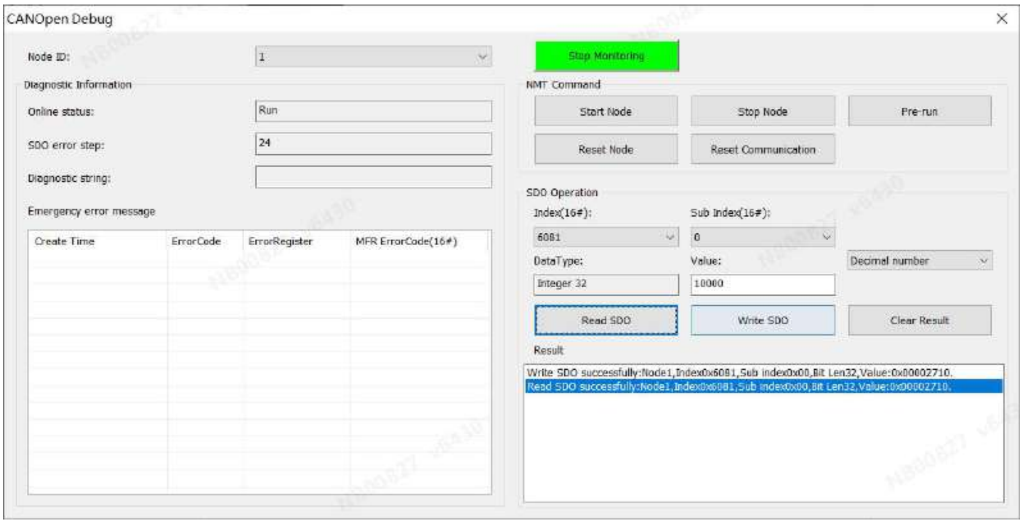


Figure 9-36 SDO Read/Write Results

For the object dictionary parameters required for other control modes, please refer to the relevant descriptions of motion modes in the communication chaptER.

9.2.12 CANopen Abort Codes

Abort Code	Description
0x05040001	Control command invalid (SD0 only supports 0x40, 0x2F, 0x2B, and 0x23)
0x06010002	Attempt to write a read-only object
0x06020000	Object does not exist in the object dictionary
0x06040041	Object cannot be mapped to the PDO
0x06040042	Qty and length of mapped objects above PDO length
0x06070010	Data length mismatch (Length defined in object dictionary does not match write data length)
0x06070012	Data type mismatch, service parameter length mismatch
0x06090011	Sub-index does not exist
0x06090031	High value written
0x06090032	Low value written

9.3 EtherCAT Communication

9.3.1 EtherCAT Communication Specification

Table 9-32 Communication Description

Name		Description
EtherCAT Communication Functions	Physical layer	100BASE-TX
	Communication port	2×RJ45
	Sync method	Distributed clock
	Physical layer	100Mbit/(100Base-TX)

	Duplex mode	Full duplex(100Mbps)
	Topology	Ring, and line
	SyncManager	SM0: MailBox output SM1: MailBox input SM2: Cyclic data output SM3: Cyclic data input
	FMMU (Bus memory management unit)	FMMU0: Cyclic data input area FMMU1: Cyclic data output area FMMU2: MailBox status area
	Application layer protocol	COE: CANOpen Over EtherCAT
	Sync mode	DC (SYNC0)
	Communication object	SDO: Service data object (acyclic data) PDO: Process data object (cyclic data) EMCY: Emergency
	Application layer specification	IEC61800-7 CIA402 Driver Profile
CIA402 operating modes		Profile position mode (PP) Profile velocity mode (PV) Profile torque mode (PT) Cyclic synchronous position mode (CSP) Cyclic synchronous velocity mode (CSV) Cyclic synchronous torque mode (CST) Home mode (HM)

9.3.2 EMC Standards

SD500-EtherCAT Spindle Servo Drive accords to the IEC/EN61800-3:2004(Adjustable speed electrical power drive systems-part3:EMC requirements and specific test methods) and GB/t12668.3. TThe EtherCAT communication interface definition for the SD100 servo drive is specified in “ 3.4.1CAN/RS485/EtherCAT Communication Terminal ”.

9.3.3 EtherCAT Communication Settings

Steps for EtherCAT communication configuration are as follows:

1. Import XML file. (Determine the import method according to the master at the field)
2. Set the EtherCAT mode parameters (refer to 9.3.5 EtherCAT Mode Setting).
3. Configure EtherCAT communication parameters(refer to 9.3.7 EtherCAT Communication Basis).
4. Map PDOs (Refer to 9.3.7.4 Process Data Object (PDO)).
5. Start the remote node (Refer to 9.3.6EtherCAT Status Monitor).

9.3.4 EtherCAT Protocol Brief

EtherCAT is a high-performance, cost-effective, and easy-to-use industrial Ethernet technology with flexible topology, which is designed for ultra-fast I/O networks in industrial field-level applications. It features standard Ethernet physical layers and transmission media such as twisted-pair cables or fiber optics.

An EtherCAT system consists of a master and slaves. The master requires only a standard network PCB, while slaves require dedicated controller chips.

EtherCAT enables end-to-end communication with protocol all the way to I/O layer:

1. No sub-bus systems required

2. No gateway delays

3. A single system supports all devices: I/Os, sensors, actuators, drives, etc.

4. Transmission rate: 2 × 100 Mbit/s (High-speed Ethernet, full-duplex mode)

5. Synchronization: With 300 nodes and 120 meters of cable, synchronization jitter <1µs

6. Refresh time:

   1) 1256 digital I/Os: 11µs

   2) 1000 distributed digital I/Os across 100 nodes: 30µs (0.03 ms)

   3) 200 analog I/Os (16-bit): 50µs (20kHz sampling rate)

   4) 100 servo axes (each with 8-byte IN+OUT): 100µs (0.1 ms)

   5) 12000 digital I/Os: 350µs

To support more device types and broader application layers, EtherCAT implements the following application-layer protocols:

1. CoE (CANopen over EtherCAT)

2. SoE (Servo Drive Profile compliant with IEC 61800-7-204)

3. EoE (Ethernet over EtherCAT)

4. FoE (File Access over EtherCAT)

Slave devices only need to support the most suitable for their application rather than all of the protocols.

9.3.5 EtherCAT Mode Setting

To integrate the servo drive into the EtherCAT fieldbus network, please configure the relevant function codes of the servo drive.

<table>
<tr><td>Pn000</td><td colspan="3">Basic Switch 0</td><td>Address: 0x0000</td></tr>
<tr><td>Default: 0000</td><td colspan="2">Range: 0000~001B</td><td>Unit: N/A</td><td>Control Mode: P S T</td></tr>
<tr><td rowspan="6">Parameter setting</td><td rowspan="6">0-th bit
X</td><td colspan="3">Control mode</td></tr>
<tr><td>0</td><td colspan="2">Position mode</td></tr>
<tr><td>1</td><td colspan="2">Velocity mode</td></tr>
<tr><td>2</td><td colspan="2">Torque mode</td></tr>
<tr><td>3</td><td colspan="2">Position-velocity mode</td></tr>
<tr><td>4</td><td colspan="2">Position-torque mode</td></tr>
</table>

		5	Velocity-torque mode
	1-st bit Y	Reserved	
	2-nd bit Z	Drive type	
		0	Standard pulse
		1	CANopen
		2	EtherCAT
	3-rd bit W	Motor type	
		0	Rotary motor
		1	Liner motor
		2	Virtual motor

NOTE
• When set to EtherCAT-type model, the control mode parameter is invalid and it is decided by the mastER. • After power-up, the drive model will be automatically detected.

9.3.6 EtherCAT Status Monitor

Un032	EtherCAT Status	Unit: N/A	Address: 0xE022
Parameter setting	0-th bit X	EtherCAT control mode	
		0	Reserved
		1	Profile position mode (PP)
		3	Profile velocity mode (PV)
		4	Profile torque mode (PT)
		6	Home mode (HM)
		8	Cyclic synchronous position mode (CSP)
		9	Cyclic synchronous velocity mode (CSV)
		A	Cyclic synchronous torque mode (CST)
	1-st bit Y	EtherCAT state machine	
		1	Initial status
		2	Pre-operation
		4	Safe operation
		8	Operation status
	2-nd bit Z	EtherCAT port connection	
		0	Port 1 and Port 2 not connected
		1	Port 1 connected
		2	Port 2 connected

		3	Port 1 and Port 2 connected
	3-rd bit W	EtherCAT port communication	
		0	Port 1 and Port 2 not ready for communication
		1	Port 1 ready for communication
		2	Port 2 ready for communication
		3	Port 1 and Port 2 ready for communication

9.3.7 EtherCAT Communication Basis

9.3.7.1 EtherCAT Communication Standard

Item		Specification
Communication protocol		IEC61158 Type12, IEC61800-7 CiA 402 Drive Profile
Application layer	SDO	SDO Request, SDO Response
	PDO	Dynamic PDO mapping
	CiA402	Profile position mode (PP) Profile velocity mode (PV) Profile torque mode (PT) Homing mode (HM) Cyclic synchronous position mode (CSP) Cyclic synchronous velocity mode (CSV) Cyclic synchronous torque mode (CST)
Physical layer	Protocol	100BASE-TX (IEEE802.3)
	Max. distance	100m
	Port	2 × RJ45(1×IN,1× OUT)

9.3.7.2 Communication Structure

There are several application layer protocols for EtherCAT communication, but the servo drives described in this manual use the IEC 61800-7 (CiA402)-CANopen Motion Control sub-protocol. The following figure shows the communication structure of an EtherCAT-based application.

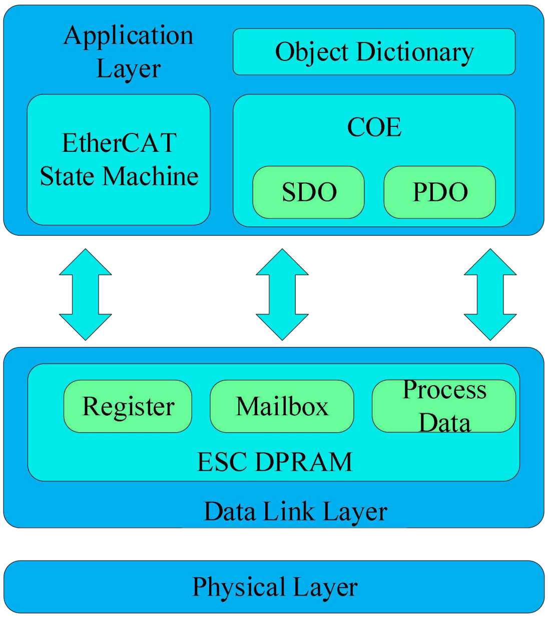


Figure 9-37 EtherCAT Communication Structure

In the structural diagram, the application layer object dictionary includes communication parameters, Service Data Objects (SDO), and Process Data Objects (PDO), among others. The PDO contains real-time data during servo operation, enabling read and write operations cyclically. In contrast, SDO mailbox communication operates acyclically, allowing configuration, access, and modification of communication parameter objects.

9.3.7.3 EtherCAT State Machine

The following is a block diagram of the EtherCAT state transition:

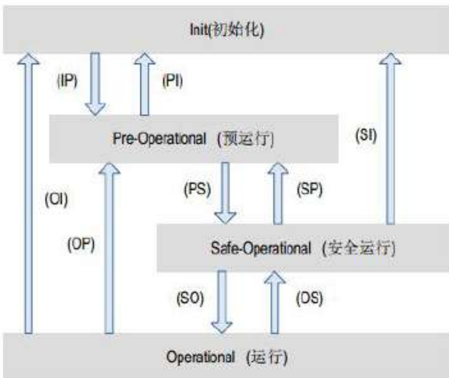


Figure 9-38 EtherCAT State Transition

The SD100-EtherCAT servo drive supports four state transitions between the master and slave from initialization to operational status.

Init (I): Initialization

P: Pre-operational

S: Safe-Operational

O: Operational

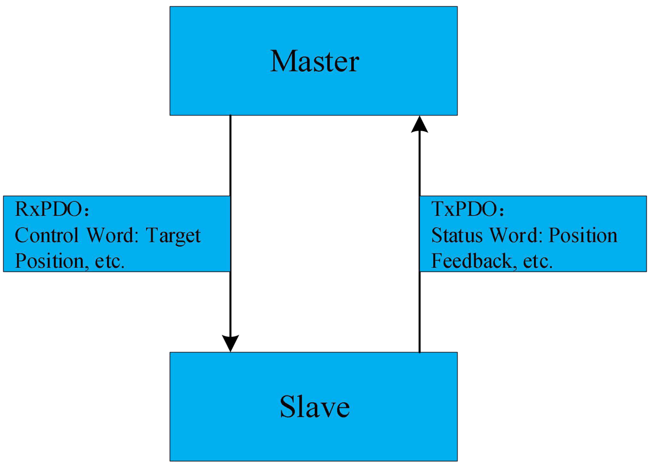
The transition from initialization to operational state

Init→Pre-Operational→Safe-Operational→Operational The table below describes the internal operations performed during the transition from initialization to operational state.

State or State Transition	Related Operations
Initialization (I)	No communication from application side, master only reads and writes ESC registers
Initialization to Pre-operation Init to Pre-Op (IP)	Master configures slave registers Configure mailbox channel parameters Configure distributed clock (DC) related registers Master writes the state control register to request Pre-Operational state
Pre-operation (P)	Communicate for SDO on application layer
Pre-operation to safe-operation (PS) Pre-Op to Safe-Op (PS)	Master initializes process data mapping via mailbox Master configures SM channel for PDO Master configures FMMU Master writes state control registers to request safe-operation state
Safe-operation (S)	Support SDO on application layer Read the PDO input only rather than sending output signal
Safe-operation to operation (SO) Safe-Op to Op (SO)	Master sends valid output data Master writes state control registers to request operation state
Operation (O)	Output and input both valid SDO still available

9.3.7.4 Process Data Object (PDO)

Process data object (PDO) follows the producer-consumer model. And it can be divided into RPDO (Receive PDO) and TPDO (Transmit PDO). The slaves receive master commands by RPDO and send their states to the master by TPDO.



(1) PDO Mapping Parameters

PDO mapping is used to establish the mapping relationship between object dictionary and PDO. As to the SD100-EtherCAT servo drive, 1600h~1603h are RPDO and 1A00h~1A03h are TPDO. The following table shows the information about PDO mapping and mapping objects of this product, and the mapping objects can be changed as needed.

PDO	Index	Max. Mapping Count	Longest Mapping Byte	Default Mapping Entries
RPDO	1600h	15	32	6040h (Control Word) 607Ah (Target Position) 60FFh (Target Velocity) 6071h (Target Torque) 6060h (Control Mode)
	1601h	15	32	6040h (Control Word) 607Ah (Target Position)
	1602h	15	32	6040h (Control Word) 60FFh (Target Velocity)
	1603h	15	32	6040h (Control Word) 6071h (Target Torque)
TPDO	1A00h	15	32	6041h (Status Word) 6064h (Position Actual Value) 606Ch (Velocity Actual Value) 6077h (Torque Actual Value)
	1A01h	15	32	6041h (Status Word) 6064h (Position Feedback)
	1A02h	15	32	6041h (Status Word) 6064h (Position Feedback) 606Ch (Velocity Feedback)
	1A03h	15	32	6041h (Status Word) 6064h (Position Feedback) 6077h (Torque Feedback)

(2) PDO Sync Manager Assignment Settings

In cyclic data communication, process data can include multiple PDO mapping objects. The CoE protocol uses data objects 0x1C10 to 0x1C2F to define the PDO mapping object lists for the corresponding synchronous management channels. Multiple PDOs can be mapped into different sub-indexes within the range mentioned. In the SD100-EtherCAT servo drive, only one RPDO and one TPDO allocation are supported, as shown in the table below:

Index	Subindex	Mapping Assignment	Default Mapping Assignment
0x1C12	01h	Select one between 1600h~1603h for RPDO	1600h
0x1C13	01h	Select one between 1A00h~1A03h for TPDO	1A00h

(3) PDO Configuration

The PDO mapping parameters (e.g., 0x1600) contain pointers to the process data that the PDO needs to send or receive. This includes the index, sub-index, and length of the mapped objects. Among them, the mapping parameter subindex 0 records the number N of mapping objects specific to this PDO (e.g., the maximum value(N)of SD100-EtherCAT servo drive is 8), which can map one or more objects at the same time. and subindexes 1~8 are the mapping contents (mapping objects). The mapping parameter content is defined as follows:

Bit	31	…	16	15	…	8	7	…	0
Definition	Index			Subindex			Object Length		

The index and subindex together determine the object's position in the object dictionary, and the object length specifies the bit length.

Object Length	Bit Length
08h	8-bit
10h	16-bit
20h	32-bit

For example, the mapping parameter for 6040h-00 is 60400010h.

The configuration flow is as follows:

1. Cancel PDO. Write 0 to the 00h of 1C12h (or 1C13h).
2. Clear the original mapping contents. Write 0 to the subindex 00h of the mapping parameter (e.g., 1600h-00) to clear the original mapping contents.
3. Write PDO mapping contents. Write subindexes 1~N (N is up to 8) of the mapping parameters as defined above.
4. Write the total mapping object number of that PDO. Write the number of mapping objects N in step 3 to subindex 0 of the parameter (e.g. 1600h-00 is written to N).
5. Enable PDO Write 1 to the 00h subindex of 1C12h (or 1C13h)

9.3.7.5 Service Data Object (SDO)

SDO is used to transfer non-periodic data such as communication parameters, or servo drive operating parameters configuration etc. While SD100-EtherCAT servo drive supports RPDO and SDO so far.

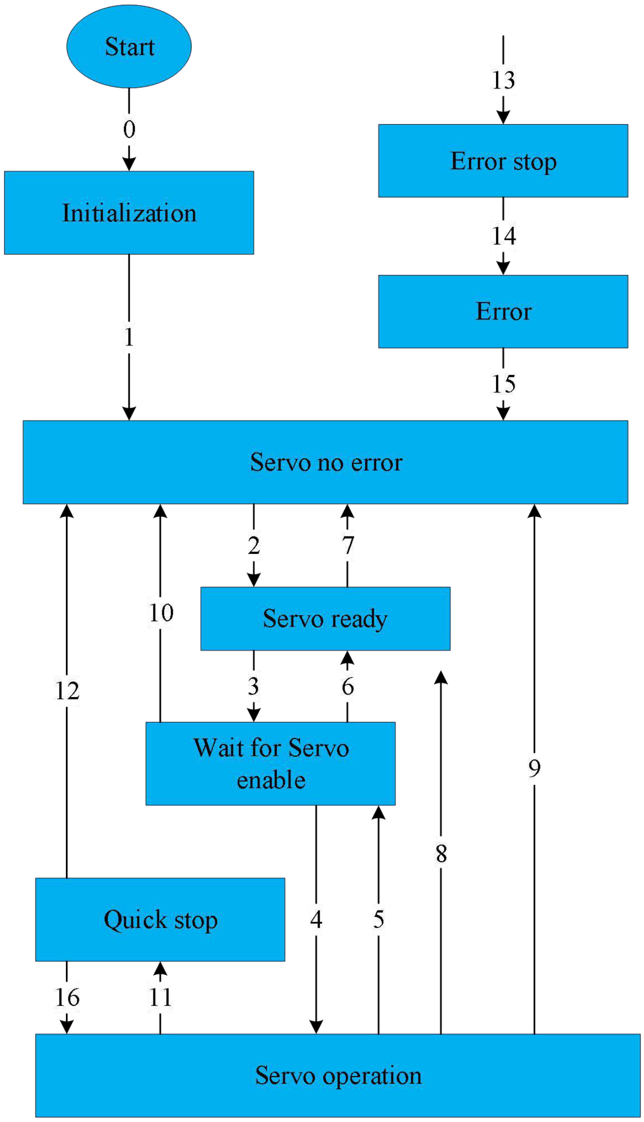
9.3.7.6 Distributed Clock

Distributed clocks enable different servo devices to use the same system clock, ensuring that different servo drives receive references and execute them at the same moment for absolute synchronization. And slave devices can generate synchronization signals based on the synchronous system time. This servo drive only supports DC synchronization mode, and the synchronization period is controlled by SYNC0, and which is an integer multiple of 125μs or 250μs.

9.3.8 Servo Motor Status

9.3.8.1 Servo State Machine

The SD100 EtherCAT drive is controlled in compliance with the standard CiA 402 protocol. The overall operational state diagram is as follows.



please see the status details below:

CiA Status and Descriptions

CiA State	Description
Initialization	The drive is initializing and internal self-test is in progress. Drive parameters cannot be set for now and the drive is not for operation.
Servo no error	The drive is fault-free and drive parameters can be configured.
Servo ready	The drive is ready. Drive parameters are configurable.
Wait for servo enable	The drive is waiting for the Servo Enable signal to be activated. Drive parameters are configurable.
Enable servo operation	The drive is operating normally. An operation mode is enabled and the motor is powered. Drive parameters are modifiable based on the specific active mode.
Quick stop	The Quick Stop function is valid and the drive is executing this function. Drive parameters are modifiable based on the specific active mode.

CiA State	Description
Error stop	A drive error has occurred and the drive is executing this function. Drive parameters are modifiable based on the specific active mode.
Error	The error stop procedure is complete. All drive functions are disabled, and only relevant drive parameters can be changed at this time to troubleshoot and clear the errors Example: For resettable faults, reset them by setting control word 6040h=0x80.

The control commands and corresponding state transitions are shown in the table below:

CiA402 Status Transition		6040h (Control Word)	6041H (Status Word) bit0~bit9[1]
0	Power-on→Initialization	Natural transition with no control command required.	0x0000
1	Initialization→Servo no error	Natural transition with no control command required. If an error occurs during initialization, it transitions directly to step 13 (Error).	0x0250
2	Servo no error→Servo ready	0x06	0x0231
3	Servo ready→Wait for servo enable	0x07	0x0233
4	Wait for servo enable→Enable servo operation	0x0F	0x0237
5	Enable servo operation→Wait for servo enable	0x07	0x0233
6	Wait for servo enable→Servo ready	0x06	0x0231
7	Servo ready→Servo no error	0x00	0x0250
8	Enable servo operation→Servo no error	0x06	0x0231
9	Wait for servo enable→Servo no error	0x00	0x0250
10	Wait for servo enable→Servo no error	0x00	0x0250
11	Enable servo operation→Quick stop	0x02	0x0217
12	Quick stop→Servo no error	Natural transition after quick stop completes; no control command needed.	0x0250
13	Any state→Error stop	Automatic transition upon error detection; no control command needed.	0x021F

14	Error stop→Error	Automatic transition after error stop procedure completes; no control command needed.	0x0218
15	Error→Servo no error	0x80: Error reset	0x0250
16	Quick stop→Enable servo operation	Send 0x0F after stop completes.	0x0237

Note:

Since bits 10 and 15 of the Status Word (6041h) are related to the operational state of various servo modes, they are represented as "0" in this context.

9.3.8.2 Control Word 6040h and Status Word 6041h

<table>
<tr><th>6040h</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6040h</td><td colspan="9">-</td></tr>
<tr><td>Name</td><td colspan="10">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="3">Data Range</td><td colspan="4">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td colspan="3">Default</td><td colspan="4">0</td></tr>
<tr><td>Function</td><td colspan="10">Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4~6</td><td>Operation mode</td><td>Operation mode-related</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table>
Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

6041h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6041h	-						

Name	Status Word				
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535
Mapping	Y	W/R	RO	Default	0
Function	Status word bit definitions are as follows:				

Bit	Content	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Operation error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: OFF 1:ON
10	Target reached	0: OFF 1: ON
11	Internal position limit	0: No error 1: Error
12~13	Operation mode-related	Operation mode-related
14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

9.3.8.3 Stop Modes

SD100-CANopen supports the following stop methods:

(1) Servo Enable OFF Stop

The servo stops running when the Servo Enable signal is turned OFF.

(2) Servo Error Stop

The servo automatically enters a stop state when an error occurs.

(3) Quick Stop

Set Control Word 6040h.bit2=0 to enable quick stop when there is no error. The stop method is selected via 605Ah.

605Ah	-		PP	PV	PT	HM	CSP	CSV	CST
Index	605Ah	-							
Name	Quick Stop Mode								

<table>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td><td>Data Range</td><td>0~2</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>2</td></tr>
<tr><td>Function</td><td colspan="5">
<table>
<tr><th>Display</th><th>Control Mode</th></tr>
<tr><td>0</td><td>Coast to stop and motor shaft not locked</td></tr>
<tr><td>1</td><td>Stop by 0x6084 (0x609A during home) setting and motor shaft not locked</td></tr>
<tr><td>2</td><td>Stop by 0x6085h setting and motor shaft not locked</td></tr>
<tr><td>5</td><td>Stop by 0x6084 (0x609A during home) setting and motor shaft locked</td></tr>
<tr><td>6</td><td>Stop by 0x6085h setting and motor shaft locked</td></tr>
</table>
</td></tr>
</table>

(4) Halt Stop

Set Control Word(6040h.bit8)=0 to enable halt stop when there is no error. The stop method is selected via 605Dh.

<table>
<tr><th>605Dh</th><th colspan="2">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>605Dh</td><td colspan="8">-</td></tr>
<tr><td>Name</td><td colspan="9">Halt Stop Mode</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td colspan="2">Int16</td><td colspan="2">Data Range</td><td colspan="3">1~3</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td colspan="2">RW</td><td colspan="2">Default</td><td colspan="3">1</td></tr>
<tr><td>Function</td><td colspan="9">
<table>
<tr><th>Display</th><th>Control Mode</th></tr>
<tr><td>1</td><td>Stop by 6084h (0x609A during home) setting and motor shaft locked</td></tr>
<tr><td>3</td><td>Stop as emergency stop and motor shaft locked</td></tr>
</table>
</td></tr>
</table>

9.3.8.4 Servo Drive Operation Modes

The SD100 EtherCAT drive supports seven servo operation modes,

which can be set via object dictionary 6060h. The current servo operation mode can be read via 6061h.

(1) 6060h Operation Mode

<table>
<tr><th>6060h</th><th colspan="2">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6060h</td><td colspan="8">-</td></tr>
<tr><td>Content</td><td colspan="9">Operation Mode</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td colspan="2">Int8</td><td colspan="2">Data Range</td><td colspan="3">0~10</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td colspan="2">RW</td><td colspan="2">Default</td><td colspan="3">8</td></tr>
</table>

Function	Set the servo drive operation mode.

Setting	Description
0	NA
1	Profile position mode (PP)
3	Profile velocity mode (PV)
4	Profile torque mode (PT)
6	Home mode (HM)
8	Cyclic synchronous position mode (CSP)
9	Cyclic synchronous velocity mode (CSV)
10	Cyclic synchronous torque mode (CST)

(2) 6061h Operation Mode Display

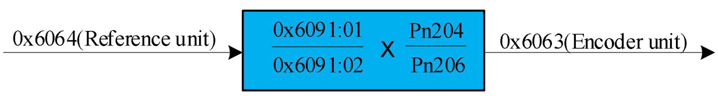
6061h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6061h	-						
Content	Operation Mode Display							
Object Structure	VAR	Data Type	Int8	Data Range	0~10			
Mapping	Y	W/R	RO	Default	0			
Function	Display the current operation mode on the servo drive:							

Setting	Description
0	NA
1	Profile position mode (PP)
3	Profile velocity mode (PV)
4	Profile torque mode (PT)
6	Home mode (HM)
8	Cyclic synchronous position mode (CSP)
9	Cyclic synchronous velocity mode (CSV)
10	Cyclic synchronous torque mode (CST)

9.3.8.5 Conversion Factor

Encoder Unit: The direct user of the drive is the motor, and the motor's position feedback is in pulses, therefore, the encoder unit is the pulse unit.

Reference Unit: The reference unit and the encoder unit are converted using the gear ratios $\frac{\text{Pn204}}{\text{Pn206}}$ and $\frac{\text{0x6091:01}}{\text{0x6091:02}}$.



If the encoder unit and reference unit are inconsistent, it will cause wrong motor operation. Therefore, before operating the servo drive, users need to set the conversion factor correctly. This factor establishes the proportional relationship between the two units, as shown below:

$$0x6063=0x6064\times\left(\frac{6091:01h}{6091:02h}\right)\times\left(\frac{Pn204}{Pn206}\right)$$

Example: $\frac{Pn204}{Pn206}=\frac{8388608}{10000}$, $\frac{6091:01h}{6091:02h}=\frac{2}{1}$.

When 6064h = 10000 (reference unit), 6063h=6064h$\times\left(\frac{6091:01h}{6091:02h}\right)\times\left(\frac{Pn204}{Pn206}\right)$=16777216(encoder unit).

6091h	-			PP	PV	PT	HM	CSP	CSV	CST
Index	6091h									
Content	Gear Ratio									
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32					
Mapping	Y	W/R	RW	Default	-					
Function	Set a proportional relationship between load position and motor turns: $\text{Motor Displacement}\text{Motor Unit} = \text{Load Displacement}\text{User Unit} \times \text{Position Factor}$ The position factor is related to the mechanical reduction ratio, mechanical dimension parameters, and motor resolution. The calculation method is as follows: $\text{Position Factor} = \frac{\text{Motor Resolution} \times \text{Gear Ratio}}{\text{Load Feed}}$									

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	Y	W/R	RO	Default	2

Subindex	01h	-			
Name	Motor Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

Subindex	02h	-			
Name	Shaft Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

9.3.9 Operation Mode

9.3.9.1 Profile Position Mode (PP)

In Profile Position Mode, the master station sends relevant object dictionary entries—such as the target position (absolute or relative), the velocity for the position profile, acceleration, and deceleration—to the servo drive. The servo drive then generates the target trajectory reference based on the received data and commands.

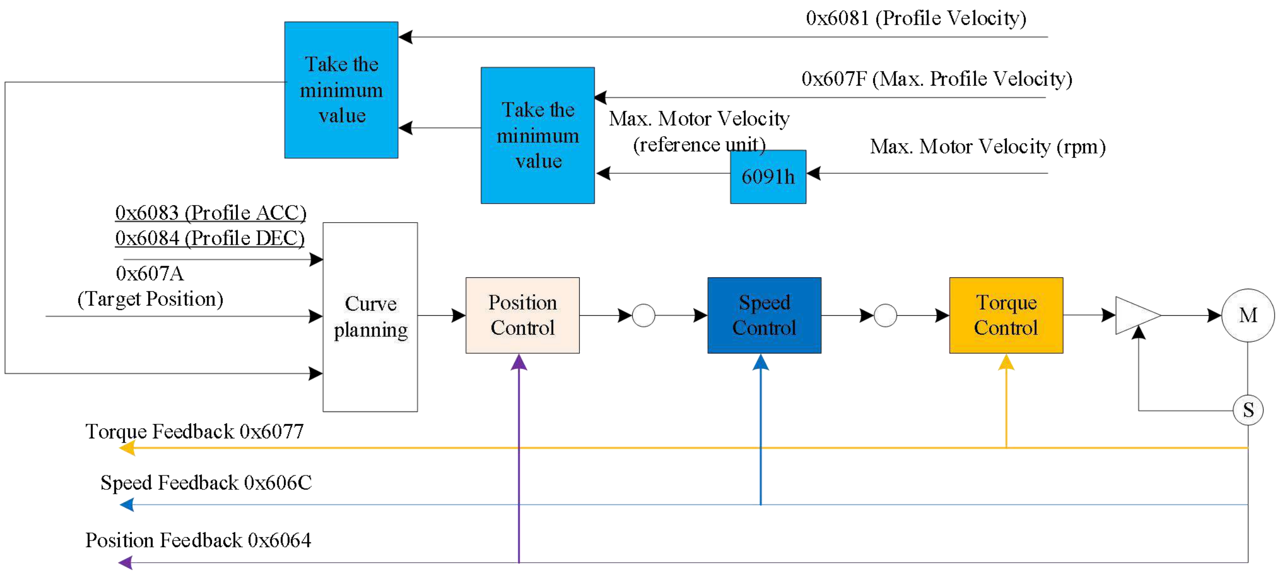


Figure 9-39 Position Position Control

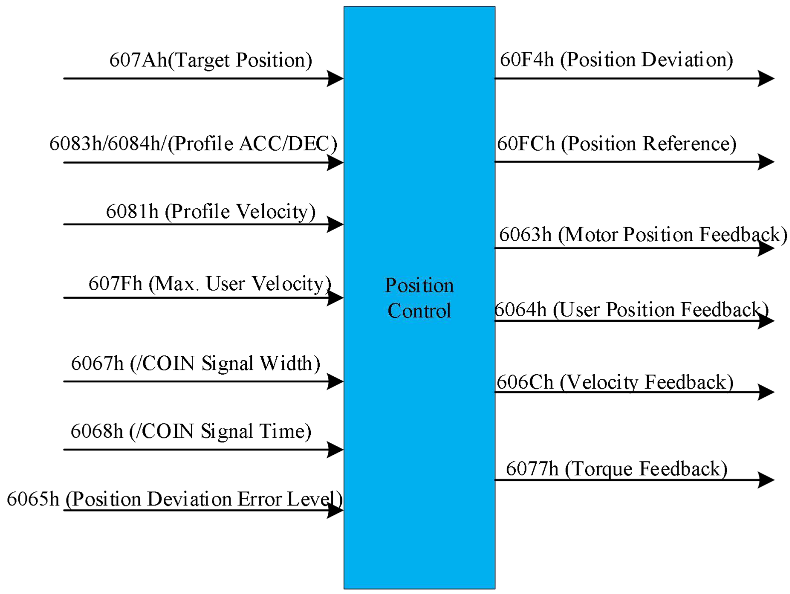
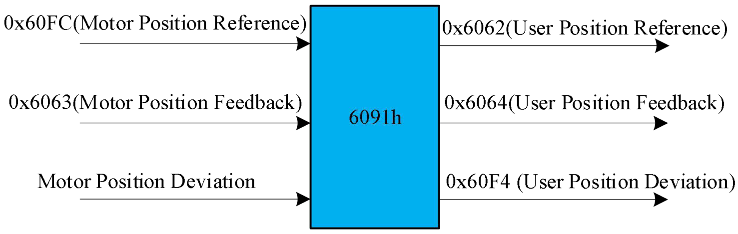


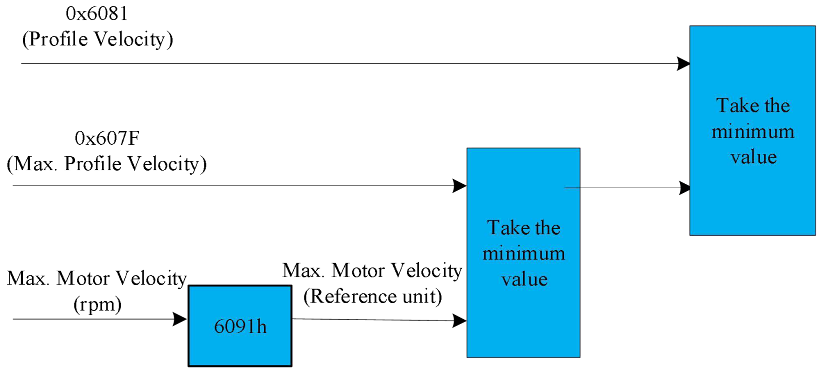
Figure 9-40 Profile Position Input and Output

The conversion diagram for user unit and encoder unit in Profile Position Mode via 0x6091 is as follows:



0x6091(Gear Ratio) $= \frac{0x6091:01}{0x6091:02}$. The relationship between Motor Position Feedback (0x6063) and User Position Feedback (0x6064):0x6063(Encoder unit)=0x6064(Reference unit) $\times \frac{0x6091:01}{0x6091:02}$.

The following relationship exist between Profile Velocity (0x6081), Max Profile Velocity (0x607F), and the corresponding motor maximum speed after conversion:



Relationship between motor speed (rpm) and load shaft speed (reference unit/s):

$$\text{Rated speed(rpm)}=\frac{\text{Load Axis Speed}\times\frac{0\times 6091:01}{0\times 6091:02}}{\text{Encoder Resolution}}\times 60$$

Example: Gear ratio = 1:1, 23-bit encodER.

Motor speed=500rpm(0× 6081（Load Axis Speed）)=500× $\frac{8388608}{60}$=69905066(reference unit/s)

Example: Gear ratio = 1:1, 23-bit encodER.

Motor speed=500rpm/s(0× 609A(Load axis ACC/DEC))=500500× $\frac{8388608}{60}$=69905066(reference unit/s).

Relevant object directories:

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x603F	00	Error Code	RO	UINT16	-	0~65535
0x6040	00	Control Word	RW	UINT16	-	0~65535
0x6041	00	Status Word	RO	UINT16	-	0~65535
0x6060	00	Operation Mode	RW	INT8	-	0~10
0x6061	00	Operation Mode Display	RO	INT8	-	0~10
0x6062	00	Position Reference	RO	DINT32	Reference unit	-2^{31}~$(2^{31}-1)$

0x6063	00	Motor Position Feedback	RO	INT32	Encoder unit	-2^{31}~(2^{31}-1)
0x606C	00	Velocity Feedback	RO	INT32	Reference unit/s	-2^{31}~(2^{3}1-1)
0x607A	00	Target Position	RW	INT32	Reference unit	-2^{31} ~(2^{31}-1)
0x6081	00	Profile Velocity	RW	UINT32	Reference unit/s	0~(2^{32}-1)
0x6083	00	Acceleration	RW	UINT32	Reference unit/s^2	0~(2^{32}-1)
0x6084	00	Deceleration	RW	UINT32	Reference unit/s^2	0~(2^{32}-1)

The steps for setting the profile position mode are shown in the table below:

Item	No.	Parameter Input	Status Word (6041h)
Profile position parameter values	0	607Ah=10000	0x0250
	1	6081h=1000	0x0250
	2	6083h=200	0x0250
	3	6084h=200	0x0250
Control mode	4	6060h=0x01	0x0250
Enable servo drive	5	6040h=0x06	0x0231
	6	6040h=0x07	0x0233
	7	6040h=0x0F	0x0637
Absolute/relative position	8	6040h: Bit6 to 1(relative position)	0x0637
Position reference trigger	9	6040h: Bit4 to 1 (rising edge)	0x1237
Position coincidence	10	6041h: Bit10 to 1	0x0637
Trigger bit cleared for next use	11	6040H: Bit4 cleared	0x0637

Control word 6040h and status word 6041h in profile position mode are as follows:

6040h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6040h							
Name	Control Word							
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535			
Mapping	Y	W/R	RW	Default	0			

Function

Control word bit definitions are as follows:

Bit	Content	Setting
0	Servo ready	0: OFF 1: ON
1	Enable main power circuit	0: OFF 1: ON
2	Quick stop	0: ON 1: OFF
3	Enable servo operation	0: OFF 1: ON
4	Enable new position reference	0→1: When a new position reference needs to be updated, whether it is valid is determined by the servo drive status. 1→0: Set 6041h:bit12 from 1→0. Whether it is valid is determined by the servo drive status.
5	Position reference update mode	0: Non-immediate update 1: Immediate update
6	Position reference type	0: Absolute position reference 1: Relative position reference
7	Error reset	bit7 rising edge valid bit7 set to 1, and other control references invalid
8	Halt	0: OFF 1: ON
9~10	NA	-
11~15	Manufacturer-defined	-

Note: Each bit in the control word must be combined with other bits to form a control reference.

6041h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6041h	-						
Name	Status Word							
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535			
Mapping	Y	W/R	RO	Default	0			

Function	Status word bit definitions are as follows: <table><tr><th>Bit</th><th>Content</th><th>Setting</th></tr><tr><td>0</td><td>Servo ready</td><td>0: OFF 1:ON</td></tr><tr><td>1</td><td>Wait for servo enable</td><td>0: OFF 1:ON</td></tr><tr><td>2</td><td>Enable servo operation</td><td>0: OFF 1:ON</td></tr><tr><td>3</td><td>Error</td><td>0: No error 1: Error</td></tr><tr><td>4</td><td>Enable main power circuit</td><td>0: OFF 1:ON</td></tr><tr><td>5</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr><tr><td>6</td><td>Enable power-on operation</td><td>0: OFF 1:ON</td></tr><tr><td>7</td><td>Alarm</td><td>0: OFF 1:ON</td></tr><tr><td>8</td><td>Manufacturer-defined</td><td>-</td></tr><tr><td>9</td><td>Remote control</td><td>0: OFF 1:ON</td></tr><tr><td>10</td><td>Target reached</td><td>0: Not reached 1: Reached</td></tr><tr><td>11</td><td>Internal position limit</td><td>0: OFF 1:ON</td></tr><tr><td>12</td><td>Position command update signal</td><td>0: Allow receiving new position 1: Do not allow receiving new position</td></tr><tr><td>13</td><td>Position deviation status</td><td>0: Position deviation within 6065h 1: Position deviation exceeds 6065h</td></tr><tr><td>14</td><td>NA</td><td>-</td></tr><tr><td>15</td><td>Home completed</td><td>0: Not performed or not completed 1: Completed and reference point established</td></tr></table>

Non-Immediate Update Mode of Profiling

1. The master station sends relevant information of the position reference to the slave station as needed (acceleration 6083h, deceleration 6084h, profile velocity 6081h, target displacement 607Ah).
2. The master station sets bit 4 of 6040h to 1. Upon detecting the rising edge signal of 6040h-bit 4, the slave processes the newly received displacement reference.

   First, the slave tells whether bit5 of 6040h is 0. If it is not, the relevant reference information is not processed.

   Second, if the slave tells that bit 5 of 6040h is 0 and bit 12 of 6041h is 0, it sets bit 12 of 6041h to 1 and executes the relevant reference information from step ①. At this time, the slave is not available for new position references.
3. After the master detects that bit 12 of the status word 6041h is set to 1, it can release the relevant data of the displacement reference and set bit 4 of the control word 6040h from 1 to 0.
4. When the slave detects that bit 4 of the control word 6040h is 0, it sets bit 12 of 6041h to 0 after the current segment positioning is completed, indicating that the slave can receive new displacement references.

In the non-immediate update mode, the servo drive does not process any new position references while the current stage is running only when the current positioning is completed.

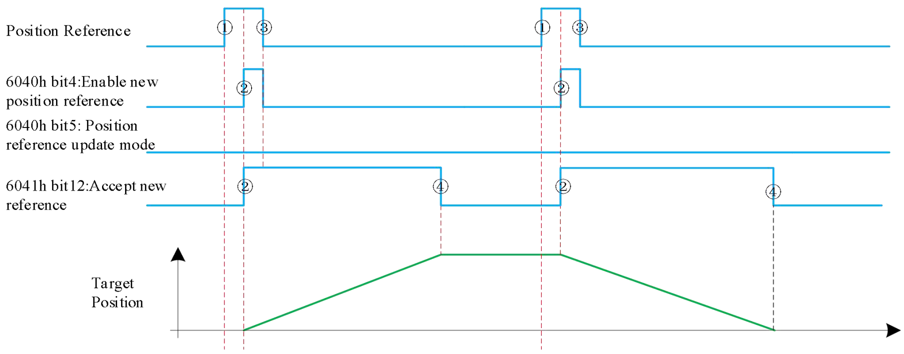


Figure 9-41 Non-immediate Update Mode Sequence

When bit 6 of the control word 6040h is 0, it represents absolute position, and if it is 1, it represents relative position.

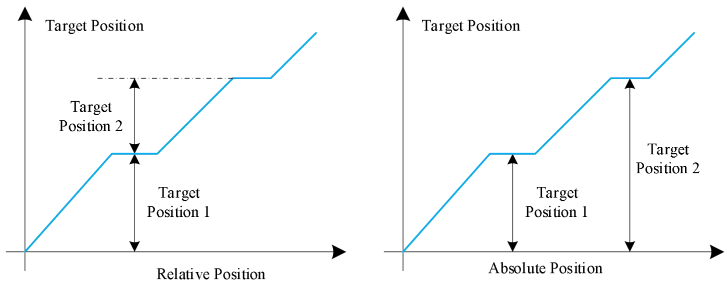


Figure 9-42 Difference between Absolute Position and Relative Position

Immediate Update Mode of Profiling

1. The master station sends relevant information of the position reference to the slave station as needed (acceleration 6083h, deceleration 6084h, profile velocity 6081h, target displacement 607Ah).
2. The master sets bit 4 of 6040h to 1. Upon detecting the rising edge signal of 6040h-bit 4, the slave processes the newly received displacement reference.

   First, the slave tells whether bit5 of 6040h is 1. If it is not 1, the relevant command information is not processed.

   Second, if the slave tells that bit 5 of 6040h is 0 and bit 12 of 6041h is 0, it sets bit 12 of 6041h to 1 and executes the relevant reference information from step ①. At this time, the slave is not available for new position references.
3. After the master detects that bit 12 of the status word 6041h is set to 1, it can release the relevant data of the displacement reference and set bit 4 of the control word 6040h from 1 to 0.
4. When the slave detects that bit4 of 6040h is set from 1 to 0, it sets bit12 of 6041h to 0, indicating that it is available for new displacement commands.

In the immediate update mode, the slave detects the rising edge of bit4 of control word 6040h is 0 and sets bit12 of 6041h to 0 after the current positioning is complete, indicating that the slave can receive new displacement references.

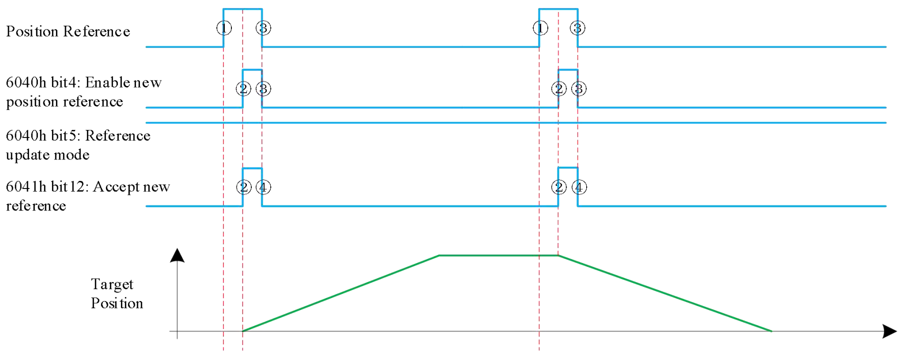


Figure 9-43 Immediate Update Mode Sequence

In Profile Torque (PP) mode, the recommended basic configuration is as follows:

RPDO	TPDO	Comment
6040h: Control Word	6041h: Status Word	Necessary
607A: Target Position	6064h: User Position Feedback	Necessary
6081h: Profile Velocity	-	Necessary
6083h: Profile Acceleration	-	Optional
6084h: Profile Deceleration	-	Optional
6060h: Operation Mode	6061h: Operation Mode Display	Optional

9.3.9.2 Profile Velocity Mode (PV)

When in the profile velocity mode, the master transmits the demanded target velocity, acceleration time, and deceleration time to the servo drive, which performs velocity and torque regulation.

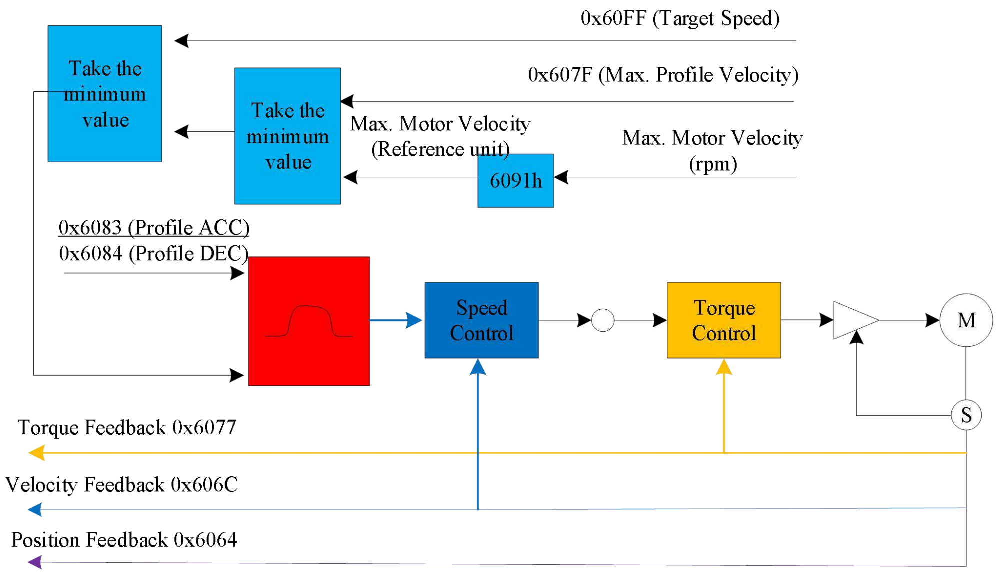


Figure 9-44 Position Velocity Control

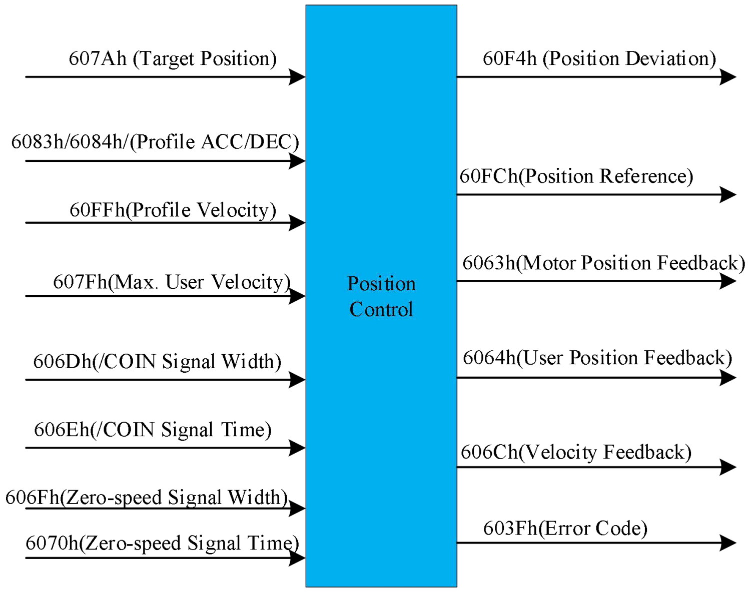
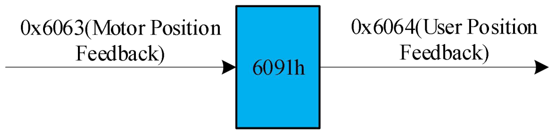


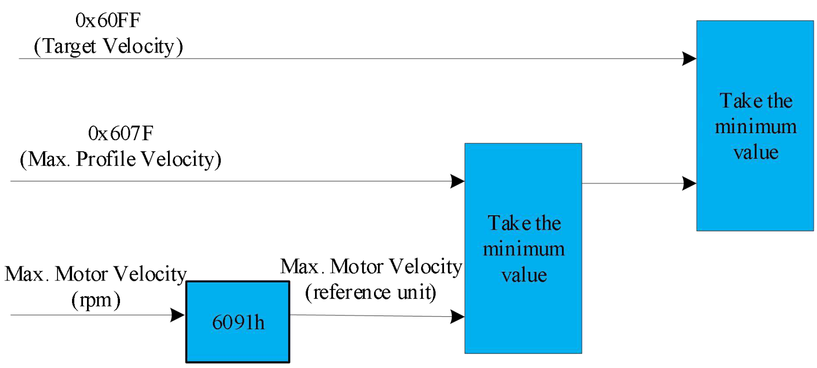
Figure 9-45 Profile Torque Input and Output

The conversion diagram for user unit and encoder unit in Profile Velocity Mode via 0x6091 is as follows:



$0x6091(\text{Gear Ratio}) = \frac{0x6091:01}{0x6091:02}$. The relationship between Motor Position Feedback (0x6063) and User Position Feedback (0x6064):$0x6063(\text{Encoder unit})=0x6064(\text{Reference unit})\frac{0x6091:01}{0x6091:02}$.

The following relationships exist between Velocity Reference (0x60FF), Max Profile Velocity (0x607F), and the corresponding motor maximum speed after conversion:



Relationship between motor speed (rpm) and load shaft speed (reference unit/s):

$$\text{Motor Velocity(rpm)} = \frac{\text{Load Axis Velocity} \times \frac{0x6091:01}{0x6091:02}}{\text{Encoder Resolution}} \times 60$$

Example: Gear ratio = 1:1, 23-bit encodER.

$$\text{Motor Velocity} = 500\text{rpm}\big(0\text{x}6099(\text{Load Axis Velocity})\big) =$$

$$500 \times \frac{8388608}{60} = 69905066(\text{ Reference unit/s}).$$

Example: Gear ratio = 1:1, 23-bit encodER.

$$\text{Motor ACC/DEC} = 500\text{rpm/s}\big(0\text{x}609\text{A}(\text{Load Axis Velocity})\big) = 500 \times \frac{8388608}{60}$$

$$= 69905066(\text{ Reference unit/s}^2)$$

Relevant object directories:

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x603F	00	Error Code	RO	UINT16	-	0~65535
0x6040	00	Control Word	RW	UINT16	-	0~65535
0x6041	00	Status Word	RO	UINT16	-	0~65535
0x6060	00	Operation Mode	RW	INT8	-	0~10
0x6061	00	Operation Mode Display	RO	INT8	-	0~10
0x606C	00	Velocity Feedback	RO	INT32	Reference unit/s	-
0x607F	00	Max. Profile Velocity	RW	UINT32	Reference unit/s	0~(2^{32}-1)
0x6083	00	Profile ACC	RW	UINT32	Reference unit/s^2	0~(2^{32}-1)
0x6084	00	Profile DEC	RW	UINT32	Reference unit/s^2	0~(2^{32}-1)
0x60FF	00	Target Velocity	RW	INT32	Reference unit/s	-2^{31}~(2^{31}-1)

Control word 6040h and status word 6041h in profile velocity mode are as follows:

<table>
<tr><th>Object 6040h</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6040h</td><td colspan="9">-</td></tr>
<tr><td>Name</td><td colspan="10">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="3">Data Range</td><td colspan="4">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td colspan="3">Default</td><td colspan="4">0</td></tr>
</table>

<table>
<tr><td rowspan="2">Function</td><td>Control word bit definitions are as follows:

Bit	Content	Setting
0	Servo ready	0: OFF 1: ON
1	Enable main power circuit	0: OFF 1: ON
2	Quick stop	0: ON 1: OFF
3	Enable servo operation	0: OFF 1: ON
4~6	NA	-
7	Error reset	bit7 rising edge valid bit7 set to 1, and other control references invalid
8	Halt	0: OFF 1: ON
9~10	NA	-
11~15	Manufacturer-defined	-
</td></tr>
<tr><td>Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

<table>
<tr><td>6041h</td><td colspan="3">-</td><td>PP</td><td>PV</td><td>PT</td><td>HM</td><td>CSP</td><td>CSV</td><td>CST</td></tr>
<tr><td>Index</td><td>6041h</td><td colspan="9">-</td></tr>
<tr><td>Content</td><td colspan="10">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="2">Data Range</td><td colspan="5">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td colspan="2">Default</td><td colspan="5">0</td></tr>
</table>

Function	Status word bit definitions are as follows: <table><tr><th>Bit</th><th>Content</th><th>Setting</th></tr><tr><td>0</td><td>Servo ready</td><td>0: OFF 1:ON</td></tr><tr><td>1</td><td>Wait for servo enable</td><td>0: OFF 1:ON</td></tr><tr><td>2</td><td>Enable servo operation</td><td>0: OFF 1:ON</td></tr><tr><td>3</td><td>Error</td><td>0: No error 1: Error</td></tr><tr><td>4</td><td>Enable main power circuit</td><td>0: OFF 1:ON</td></tr><tr><td>5</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr><tr><td>6</td><td>Enable power-on operation</td><td>0: OFF 1:ON</td></tr><tr><td>7</td><td>Alarm</td><td>0: OFF 1:ON</td></tr><tr><td>8</td><td>Manufacturer-defined</td><td>-</td></tr><tr><td>9</td><td>Remote control</td><td>0: OFF 1:ON</td></tr><tr><td>10</td><td>Target reached</td><td>0: Not reached 1: Reached</td></tr><tr><td>11</td><td>Internal position limit</td><td>0: No error 1: Error</td></tr><tr><td>12</td><td>Zero-speed</td><td>0: Speed not be 0 1: Speed be 0</td></tr><tr><td>13~14</td><td>NA</td><td>-</td></tr><tr><td>15</td><td>Home completed</td><td>0: Not performed or not completed 1: Completed and reference point established</td></tr></table>

In Profile Velocity (PV) mode, the recommended basic configuration is as follows:

RPDO	TPDO	Comment
6040h: Control Word	6041h: Status Word	Necessary
60Ffh: Target Profile Velocity	-	Necessary
-	6064h: User Position Feedback	Optional
-	606Ch: Speed Feedback	Optional
6083h: Profile Acceleration	-	Optional
6084h: Profile Deceleration	-	Optional
6060h: Operation Mode	6061h: Operation Mode Display	Optional

9.3.9.3 Profile Torque Mode (PT)

In Profile Torque Mode, the master sends Target Torque Reference (6071h) and Torque ACC (6087h) to the servo drive, which will execute torque regulation internally. When the speed reaches the maximum limit, it will enter the speed regulation phase. When the speed reaches the limit value 607Fh, it will enter the speed regulation stage.

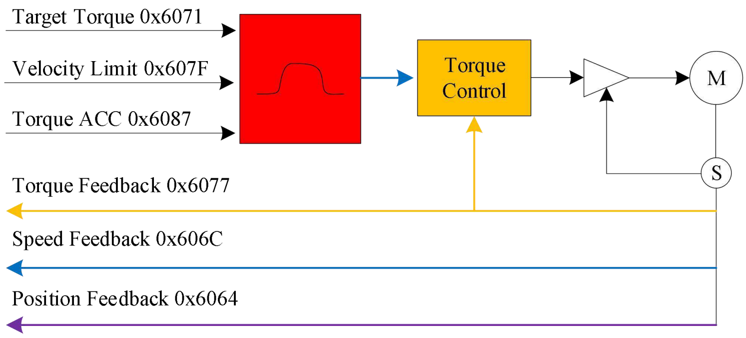


Figure 9-46 Profile Torque Control

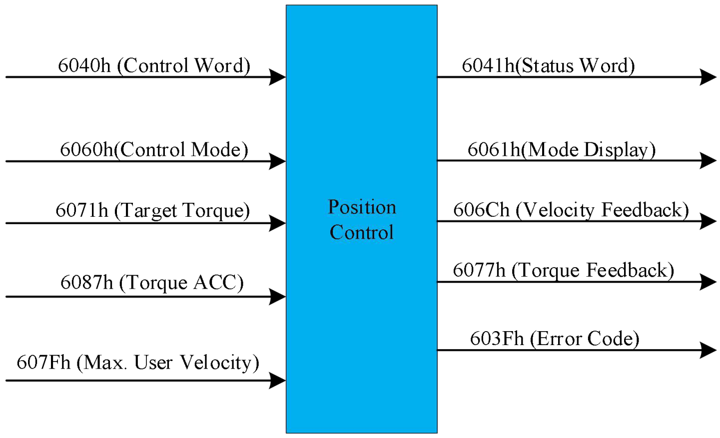


Figure 9-47 Profile Torque Input and Output

Relevant object directories:

Index	Subindex	Content	R/W	Data Type	Unit	Range
0x603F	0x00	Error Code	RO	UINT16	-	0~65535
0x6040	0x00	Control Word	RW	UINT16	-	0~65535
0x6041	0x00	Status Word	RO	UINT16	-	0~65535
0x6060	0x00	Operation mode	RW	INT8	-	0~10
0x6061	0x00	Operation Mode Display	RO	INT8	-	0~10
0x606C	0x00	Velocity Feedback	RO	INT32	Reference unit/s	-
0x6071	0x00	Target Torque	RW	INT16	0.1%	-3000~3000
0x6072	0x00	Max. Profile Torque	RW	UINT16	0.1%	0~3000
0x6074	0x00	Torque Reference	RO	INT16	0.1%	-
0x6077	0x00	Torque Feedback	RO	UINT16	1%	-
0x607F	0x00	Max. Profile Velocity	RW	UINT32	Reference unit/s	$0\sim(2^{32}-1)$
0x6087	0x00	Torque ACC	RW	UINT32	ms	$0\sim(2^{32}-1)$

Control word 6040h and status word 6041h in profile torque mode are as follows:

6040h	-		PP	PV	PT	HM	CSP	CSV	CST
Index	6040h								
Content	Control Word								

<table>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td>0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td>0</td></tr>
<tr><td>Function</td><td colspan="5">Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4~6</td><td>NA</td><td>-</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table>Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="2">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="8">-</td></tr>
<tr><td>Content</td><td colspan="9">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td colspan="5">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td>Default</td><td colspan="5">0</td></tr>
</table>

Function	Status word bit definitions are as follows: <table><tr><th>Bit</th><th>Content</th><th>Setting</th></tr><tr><td>0</td><td>Servo ready</td><td>0: OFF 1:ON</td></tr><tr><td>1</td><td>Wait for servo enable</td><td>0: OFF 1:ON</td></tr><tr><td>2</td><td>Enable servo operation</td><td>0: OFF 1:ON</td></tr><tr><td>3</td><td>Error</td><td>0: No error 1: Error</td></tr><tr><td>4</td><td>Enable main power circuit</td><td>0: OFF 1:ON</td></tr><tr><td>5</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr><tr><td>6</td><td>Enable power-on operation</td><td>0: OFF 1:ON</td></tr><tr><td>7</td><td>Alarm</td><td>0: OFF 1:ON</td></tr><tr><td>8</td><td>Manufacturer-defined</td><td>-</td></tr><tr><td>9</td><td>Remote control</td><td>0: OFF 1:ON</td></tr><tr><td>10</td><td>Target reached</td><td>0: Not reached 1: Reached</td></tr><tr><td>11</td><td>Internal position limit</td><td>0: No error 1: Error</td></tr><tr><td>12~14</td><td>NA</td><td>-</td></tr><tr><td>15</td><td>Home completed</td><td>0: Not performed or not completed 1: Completed and reference point established</td></tr></table>

In Profile Torque (PT) mode, the recommended basic configuration is as follows:

RPDO	TPDO	Comment
6040h: Control Word	6041h: Status Word	Necessary
6071h: Target Torque	-	Necessary
6087h: Torque ACC	-	Optional
-	6064h: User Position Feedback	Optional
-	606Ch: Velocity Feedback	Optional
-	6077h: Torque Feedback	Optional
6060h: Operation Mode	6061h: Operation Mode Display	Optional

9.3.9.4 Cyclic Synchronous Position Mode (CSP)

In the cyclic synchronous position mode, the master sends the Target Position (607Ah) to the servo drive in cyclic synchronous mode, so that it can internally perform position, speed and torque control.

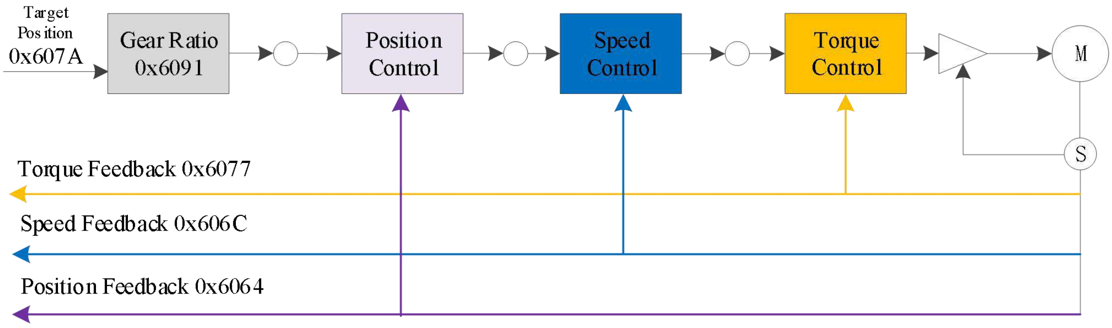


Figure 9-48 Cyclic Synchronous Position Mode Control

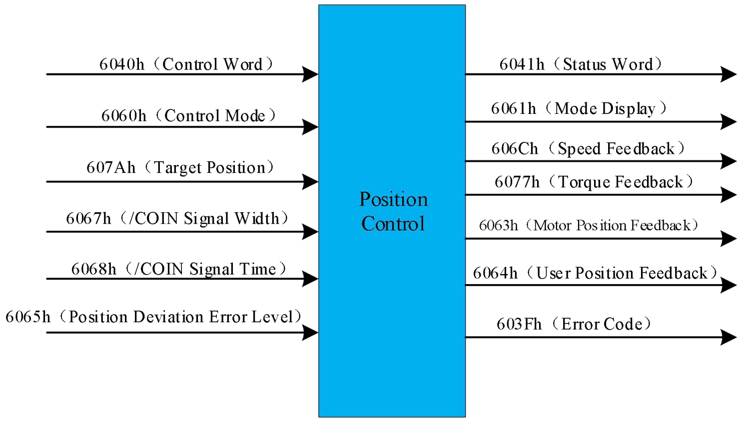


Figure 9-49 Cyclic Synchronous Position Input and Output

Relevant object directories:

Index	Subindex	Content	R/W	Data Type	Unit	Range
0x603F	00	Error Code	RO	UINT16	-	0~65535
0x6040	00	Control Word	RW	UINT16	-	0~65535
0x6041	00	Status Word	RO	UINT16	-	0~65535
0x6060	00	Operation Mode	RW	INT8	-	0~10
0x6061	00	Operation Mode Display	RO	INT8	-	0~10
0x6063	00	Motor Position Feedback	RO	INT32	Encoder unit	-
0x6064	00	User Position Feedback	RO	INT32	Reference unit	-
0x6065	00	Position Deviation Error Level	RW	UINT32	Reference unit	0~(2^{32}-1)
0x6067	00	/COIN Signal Width	RW	UINT32	Encoder unit	0~65535
0x6068	00	/COIN Signal Time	RW	UINT16	ms	0~65535
0x606C	00	Velocity Feedback	RO	INT32	Reference unit/s	-

0x607A	00	Target Position	RW	INT32	Reference unit	$-2^{31}\sim(2^{31}-1)$
0x6091	01	Motor Resolution	RW	UINT32	-	$0\sim(2^{32}-1)$
	02	Axis Resolution	RW	UINT32	-	$1\sim(2^{32}-1)$
0x60B0	00	Position Offset	RW	INT32	Reference unit	$-2^{31}\sim(2^{31}-1)$

Control word 6040h and status word 6041h in synchronous cyclic position mode are as follows:

6040h	-		PP	PV	PT	HM	CSP	CSV	CST
Index	6040h	-							
Content	Control Word								
Object Structure	VAR	Data Type	Uint16	Data Range		0~65535			
Mapping	Y	W/R	RW	Default		0			
Function	Control word bit definitions are as follows: (see table below)								

Control word bit definitions are as follows:

Bit	Content	Setting
0	Servo ready	0: OFF 1: ON
1	Enable main power circuit	0: OFF 1: ON
2	Quick stop	0: ON 1: OFF
3	Enable servo operation	0: OFF 1: ON
4	Enable new position reference	0→1: When a new position reference needs to be updated, whether it is valid is determined by the servo drive status. 1→0: Set 6041h:bit12 from 1→0. Whether it is valid is determined by the servo drive status.
5	Position reference update mode	0: Non-immediate update 1: Immediate update
6	Position reference type	0: Absolute position reference 1: Relative position reference
7	Error reset	bit7 rising edge valid bit7 set to 1, and other control references invalid
8	Halt	0: OFF 1: ON
9~10	NA	-
11~15	Manufacturer-defined	-

Note: Each bit in the control word must be combined with other bits to form a control reference.

6041h	-			PP	PV	PT	HM	CSP	CSV	CST
Index	6041h	-								
Name	Status Word									
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535					
Mapping	Y	W/R	RO	Default	0					
Function	Status word bit definitions are as follows:									

Bit	Content	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: OFF 1:ON
10	Target reached	0: Not reached 1: Reached
11	Internal position limit	0: No error 1: Error
12	Slave following	0: The slave station did not follow the instructions 1: The slave station followed the instructions
13	Position deviation status	0: :Position deviation within 6065h 1: Position deviation exceeds 6065h
14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

In Cycle Synchronization Positioning (CSP) mode, the recommended basic configuration is as follows:

RPDO	TPDO	Comment
6040h: Control Word	6041h: Status Word	Necessary
607Ah: Target Position	6064h: User Position Feedback	Necessary
6060h: Operation Mode	6061h: Operation Mode Display	Optional

9.3.9.5 Cyclic Synchronous Velocity Mode (CSV)

Master sends the calculated target speed (60FFh) to the servo drive in a cyclic synchronous manner so that the drive can perform the speed and torque regulations internally.

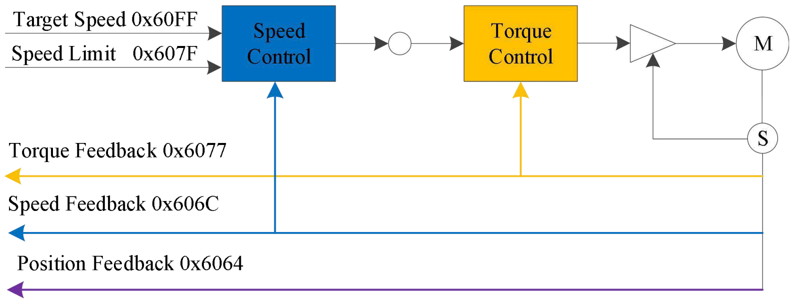


Figure 9-50 Cyclic Synchronous Velocity Mode Control

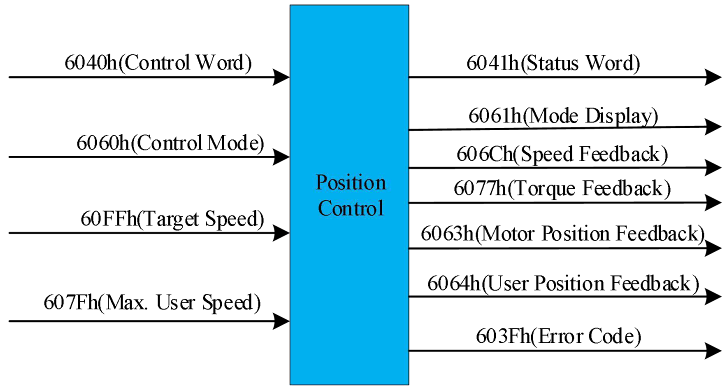


Figure 9-51 Cyclic Synchronous Velocity Input and Output

Relevant object directories:

Index	Subindex	Content	R/W	Data Type	Unit	Range
0x603F	00	Error Code	RO	UINT16	-	0~65535
0x6040	00	Control Word	RW	UINT16	-	0~65535
0x6041	00	Status Word	RO	UINT16	-	0~65535
0x6060	00	Operation Mode	RW	INT8	-	0~10
0x6061	00	Operation Mode Display	RO	INT8	-	0~10
0x6063	00	Motor Position Feedback	RO	INT32	Encoder unit	-
0x6064	00	User Position Feedback	RO	INT32	Reference unit	
0x606C	00	Velocity Feedback	RO	INT32	Reference unit/s	-
0x6077	00	Torque Feedback	RO	INT16	1%	-
0x607F	00	Max. Profile Velocity	RW	UINT32	Reference unit/s	0~50000
0x6083	00	Profile Acceleration	RW	UINT32	Reference unit/s^2	$0\sim(2^{32}-1)$
0x6084	00	Profile Deceleration	RW	UINT32	Reference unit/s^2	$0\sim(2^{32}-1)$
0x6091	01	Motor Resolution	RW	UINT32	-	$0\sim(2^{32}-1)$
	02	Axis Resolution	RW	UINT32	-	$1\sim(2^{32}-1)$
0x60FF	00	Target Velocity	RW	INT32	Reference unit/s	$-2^{31}\sim(2^{31}-1)$

Control word 6040h and status word 6041h in cyclic synchronous velocity mode are as follows:

6040h	-		PP	PV	PT	HM	CSP	CSV	CST
Index	6040h	-							

<table>
<tr><td>Content</td><td colspan="5">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td>0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td>0</td></tr>
<tr><td>Function</td><td colspan="5">Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4~6</td><td>NA</td><td>-</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table>
Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

6041h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6041h	-						
Content	Status Word							
Object Structure	VAR	Data Type	Uint16	Data Range	0~65535			
Mapping	Y	W/R	RO	Default	0			

Function

Status word bit definitions are as follows:

Bit	Content	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: OFF 1:ON
10	Target reached	0: Not reached 1: Reached
11	NA	-
12	Slave following	0: The slave station did not follow the instructions 1: The slave station followed the instructions
13~14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

In Cyclic Synchronous Velocity (CSV) mode , the recommended basic configuration is as follows:

RPDO	TPDO	Comment
6040h: Control Word	6041h: Status Word	Necessary
60Ffh: Target Velocity	-	Necessary
-	6064h: User Position Feedback	Optional
-	606Ch: Velocity Feedback	Optional
6060h: Operation Mode	6061h: Operation Mode Display	Optional

NOTE	
⚠	● The speed limit value is determined by the smaller value between 0x607F and the maximum motor speed.

9.3.9.6 Cyclic Synchronous Torque Mode (CST)

In the cyclic synchronous torque mode, the master sends the target torque 6071h to the servo drive in cyclic synchronous mode to perform torque regulation internally. When the speed reaches the limit, it will enter the speed regulation stage.

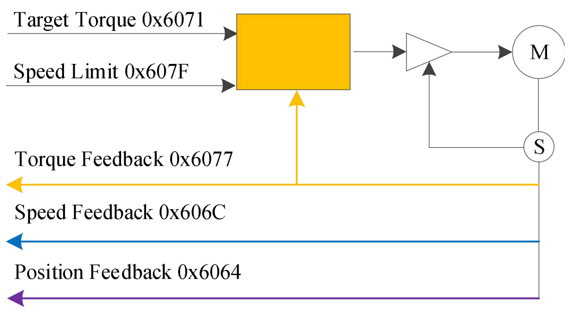


Figure 9-52 Cyclic Synchronous Torque Mode

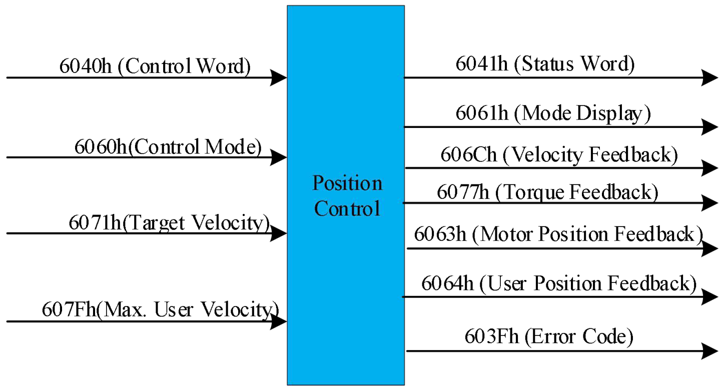


Figure 9-53 Cyclic Synchronous Torque Input and Output

Relevant object directories:

Index	Subindex	Content	R/W	Data Type	Unit	Range
0x603F	00	Error Code	RO	UINT16	-	0~65535
0x6040	00	Control Word	RW	UINT16	-	0~65535
0x6041	00	Status Word	RO	UINT16	-	0~65535
0x6060	00	Operation Mode	RW	INT8	-	0~10
0x6061	00	Operation Mode Display	RO	INT8	-	0~10
0x6063	00	Motor Position Feedback	RO	INT32	Encoder unit	-
0x6064	00	User Position Feedback	RO	INT32	Reference unit	-
0x606C	00	Velocity Feedback	RO	INT32	Reference unit/s	-
0x6071	00	Target Torque	RW	INT16	0.1%	-3000~3000
0x6072	00	Max. Profile Torque	RW	UINT16	0.1%	0~3000
0x6077	00	Torque Feedback	RO	INT16	1%	-
0x607F	00	Max. Velocity	RW	UINT32	Reference unit/s	0~(2^{32}-1)

Control word 6040h and status word 6041h in cyclic synchronous torque mode are as follows:

<table>
<tr><th>6040h</th><th colspan="4">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6040h</td><td colspan="10">-</td></tr>
<tr><td>Name</td><td colspan="11">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td colspan="7">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td colspan="7">0</td></tr>
<tr><td>Function</td><td colspan="11">Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4~6</td><td>NA</td><td>-</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table>
Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="4">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="10">-</td></tr>
<tr><td>Content</td><td colspan="11">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td colspan="7">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td>Default</td><td colspan="7">0</td></tr>
</table>

<table>
<tr><td rowspan="2">Function</td><td>Status word bit definitions are as follows:</td></tr>
<tr><td>

Bit	Content	Setting
0	Servo ready	0: OFF 1:ON
1	Wait for servo enable	0: OFF 1:ON
2	Enable servo operation	0: OFF 1:ON
3	Error	0: No error 1: Error
4	Enable main power circuit	0: OFF 1:ON
5	Quick stop	0: ON 1: OFF
6	Enable power-on operation	0: OFF 1:ON
7	Alarm	0: OFF 1:ON
8	Manufacturer-defined	-
9	Remote control	0: OFF 1: ON
10	Target reached	0: Not reached 1: Reached
11	NA	-
12	Slave following	0: The slave station did not follow the instructions 1: The slave station followed the instructions
13~14	NA	-
15	Home completed	0: Not performed or not completed 1: Completed and reference point established

</td></tr>
</table>

In Cyclic Synchronous Torque (CST) mode , the recommended basic configuration is as follows:

RPDO	TPDO	Comment
6040h: Control Word	6041h: Status Word	Necessary
6071h: Target Torque	-	Necessary
-	6064h: User Position Feedback	Optional
-	606Ch: Velocity Feedback	Optional
-	6077h: Torque Feedback	Optional
6060h: Operation Mode	6061h: Operation Mode Display	Optional

NOTE	
⚠	The speed limit value is determined by the smaller value between 0x607F and the maximum motor speed.

9.3.9.7 Home Mode (HM)

The home mode is used to find the mechanical home point and determine the positional relationship between the mechanical home point and the mechanical zero point.

Mechanical Home: A fixed mechanical position that corresponds to a certain home signal switch.

Mechanical Home: Mechanical Zero+Home Bias (607C).

Mechanical Zero: Absolute 0 position.

The motor stops at the mechanical home position after the drive performs this command. The positional relationship between the mechanical home position and the mechanical zero point is adjusted by setting the value of the object dictionary 0x607C.

Home Control:

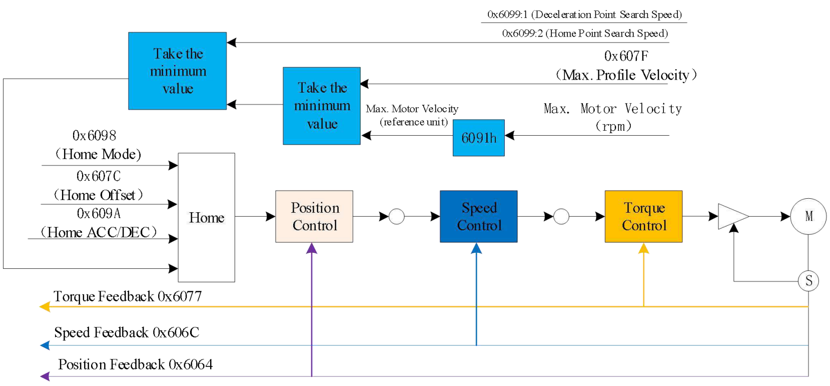


Figure 9-54 Home Mode Control

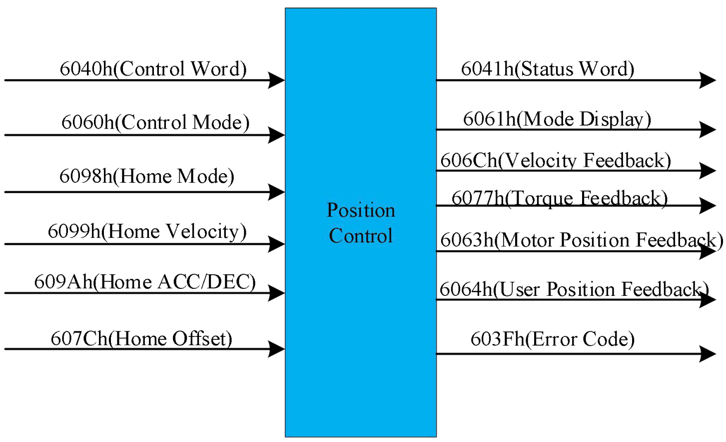
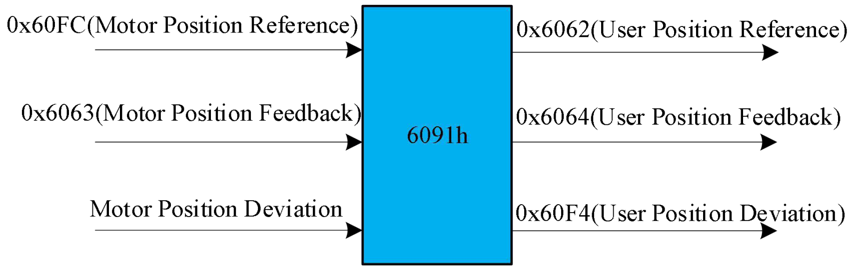


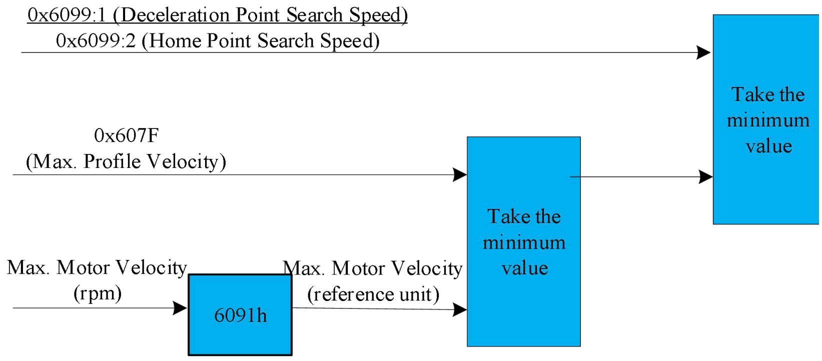
Figure 9-55 Profile Torque Input and Output

The conversion diagram for user unit and encoder unit in Home Mode via 0x6091 is as follows:



0x6091(Gear Ratio) $= \frac{0x6091{:}01}{0x6091{:}02}$. The relationship between Motor Position Feedback (0x6063) and User Position Feedback (0x6064):0x6063(Encoder unit)=0x6064(Reference unit) $\times \frac{0x6091{:}01}{0x6091{:}02}$.

Relationship between Deceleration Point Search Velocity (0x6099-01), Home Point Search Velocity (0x6099-02), and the converted maximum motor speed is as follows:



Relationship between motor speed (rpm) and load shaft speed (reference unit/s):

$$\text{Motor Velocity(rpm)} = \frac{\text{Load Axis Velocity} \times \frac{0x6091{:}01}{0x6091{:}02}}{\text{Encoder Resolution}} \times 60$$

Example: Gear ratio = 1:1, 23-bit encodER.

$$\text{Motor Velocity} = 500\text{rpm}(0x6099(\text{Load Axis Velocity})) = 500 \times \frac{8388608}{60} = 69905066(\text{ Reference unit/s})$$

Example: Gear ratio = 1:1, 23-bit encodER.

$$\text{Motor ACC/DEC} = 500\text{rpm/s}(0x609A(\text{Load Axis ACC/DEC})) = 500 \times \frac{8388608}{60} = 69905066(\text{ Reference unit/s}^2)$$

Relevant object directories:

Index	Subindex	Content	R/W	Data Type	Unit	Range
0x603F	00	Error Code	RO	UINT16	-	0~65535
0x6040	00	Control Word	RW	UINT16	-	0~65535
0x6041	00	Status Word	RO	UINT16	-	0~65535
0x6060	00	Operation Mode	RW	INT8	-	0~10
0x6061	00	Operation Mode Display	RO	INT8	-	0~10
0x6063	00	Motor Position Feedback	RO	INT32	Encoder unit	-
0x6064	00	User Position Feedback	RO	INT32	Reference unit	-

Index	Subindex	Content	R/W	Data Type	Unit	Range
0x606C	00	Velocity Feedback	RO	INT32	Reference unit/s	-
0x6067	00	Position Window	RO	UINT32	User unit	-
0x6068	00	Position Window	RW	UINT16	1ms	-
0x6077	00	Torque Feedback	RO	INT16	1%	-
0x6098	00	Home Mode	RW	INT8	-	1~35
0x6099	01	Deceleration Point Search Velocity	RW	UINT32	Reference unit/s	0~(2^{32}-1)
	02	Home Point Search Velocity	RW	UINT32	Reference unit/s	1~(2^{32}-1)
0x609A	00	Home Acceleration/Deceleration	RW	UINT32	Reference unit/s	0~(2^{32}-1)

Control word 6040h and status word 6041h in home mode are as follows:

<table>
<tr><th>6040h</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6040h</td><td colspan="9">-</td></tr>
<tr><td>Name</td><td colspan="10">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="2">Data Range</td><td colspan="5">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td colspan="2">Default</td><td colspan="5">0</td></tr>
</table>

<table>
<tr><td rowspan="2">Function</td><td>Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4</td><td>Home</td><td>0: OFF
0→1: ON
1: Homing
1→0: Cancel</td></tr>
<tr><td>5~6</td><td>NA</td><td>-</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>0: OFF 1: ON</td></tr>
<tr><td>9~10</td><td>NA</td><td>-</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>-</td></tr>
</table></td></tr>
<tr><td>Note: Each bit in the control word must be combined with other bits to form a control reference.</td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="3">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="9">-</td></tr>
<tr><td>Name</td><td colspan="10">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="3">Data Range</td><td colspan="4">0~65535</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td colspan="3">Default</td><td colspan="4">0</td></tr>
</table>

<table>
<tr><td rowspan="17">Function</td><td colspan="3">Status word bit definitions are as follows:</td></tr>
<tr><th>Bit</th><th>Content</th><th>Setting</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1:ON</td></tr>
<tr><td>1</td><td>Wait for servo enable</td><td>0: OFF 1:ON</td></tr>
<tr><td>2</td><td>Enable servo operation</td><td>0: OFF 1:ON</td></tr>
<tr><td>3</td><td>Error</td><td>0: No error 1: Error</td></tr>
<tr><td>4</td><td>Enable main power circuit</td><td>0: OFF 1:ON</td></tr>
<tr><td>5</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>6</td><td>Enable power-on operation</td><td>0: OFF 1:ON</td></tr>
<tr><td>7</td><td>Alarm</td><td>0: OFF 1:ON</td></tr>
<tr><td>8</td><td>Manufacturer-defined</td><td>-</td></tr>
<tr><td>9</td><td>Remote control</td><td>0: OFF 1:ON</td></tr>
<tr><td>10</td><td>Target reached</td><td>0: Not reached
1: Reached</td></tr>
<tr><td>11</td><td>Internal position limit</td><td>0: No error 1: Error</td></tr>
<tr><td>12</td><td>Home completed</td><td>0: Not completed
1: Completed</td></tr>
<tr><td>13</td><td>Home error</td><td>0: No error
1: Error</td></tr>
<tr><td>14</td><td>NA</td><td>-</td></tr>
<tr><td></td><td>15</td><td>Home completed</td><td>0: Not performed or not completed
1: Completed and reference point established</td></tr>
</table>

In Profile Torque (HM) mode, the recommended basic configuration is as follows:

RPDO	TPDO	Comment
6040h: Control Word	6041h: Status Word	Necessary
6098h: Home Mode	-	Optional
6099-01H: Deceleration Point Search Velocity	-	Optional
6099-01H: Home Point Search Velocity	-	Optional
609Ah: Home ACC	-	Optional
-	6064h: User Position Feedback	Optional
6060h: Operation Mode	6061h: Operation Mode Display	Optional

9.3.9.8 Probe Function

The probe function refers to latching the position information (in user units) at the exact moment when an external input signal X changes.

This product supports the simultaneous use of two probes, allowing the recording of position information corresponding to both the rising and falling edges of each probe signal.

The external input terminal X3 signal can be used as the probe signal for probe 1, while X4 for probe 2.

(1) Relevant Object Directories

Index	Subindex	Name	R/W	Data Type	Unit	Range
0x60B8	00	Probe Function	RW	UINT16	-	0~65535
0x60B9	00	Probe Status	RO	UINT16	-	-
0x60BA	00	Probe 1 Rising Edge Latch Position	RO	INT32	Reference unit	-
0x60BB	00	Probe 1 Falling Edge Latch Position	RO	INT32	Reference unit	-
0x60BC	00	Probe 2 Rising Edge Latch Position	RO	INT32	Reference unit	-
0x60BD	00	Probe 2 Falling Edge Latch Position	RO	INT32	Reference unit	-

(2) Steps

This product supports X3 and X4 as external trigger signals for the probe function, and they are forced internally in the software. To prevent the mis-operation of the programmable functions assigned to the X5 and X6, please set the relevant pins to the probe function before use.

When signal filtering is required for the probe inputs, the filter time for Probe 1 and Probe 2 can be configured separately through function codes Pn632 and Pn633.

(3) Probe Function

The relevant bit definitions in 0x60B8 are as follows:

Bit	Description	Bit	Description
0	Probe 1 enable 0: OFF 1: ON	8	Probe 2 enable 0: OFF 1: ON
1	Probe 1 trigger mode 0: Single trigger 1: Continuous trigger	9	Probe 2 trigger mode 0: Single trigger 1: Continuous trigger
2	Probe 1 home signal 0: DI3 signal 1: Z signal	10	Probe 2 home signal 0: DI4 signal 1: Z signal
3	NA	11	NA
4	Probe 1 rising edge latch 0: OFF 1: ON	12	Probe 2 rising edge latch 0: OFF 1: ON
5	Probe 1 falling edge latch 0: OFF 1: ON	13	Probe 2 falling edge enable 0: OFF 1: ON

6~7	NA	14~15	NA

Note:

- Once the enable bit of Probe 1 (rising edge of 60B8h bit0) is valid, its function settings (Trigger mode, edge latch) cannot be changed, and 60B8h bit0 must remain valid during the Probe 1 operation.
- So as the Probe 2.

(4) Probe Status Reading(0x60B9)

The relevant bit definitions in 0x60B9 are as follows:

Bit	Description	Bit	Description
0	Probe 1 enable status 0: OFF 1: ON	8	Probe 2 enable status 0: OFF 1: ON
1	Probe 1 rising edge latch 0: Not completed 1: Completed	9	Probe 2 rising edge latch 0: Not completed 1: Completed
2	Probe 1 falling edge latch 0: Not completed 1: Completed	10	Probe 2 falling edge latch 0: Not completed 1: Completed
3~6	Probe 1 execution count	11~14	Probe 2 execution count
7	Probe 1 monitoring 0: DIBit3 low level 1: DIBit3 high level	15	Probe 2 monitoring 0: DIBit4 low level 1: DIBit4 high level

For example, when Probe 1 takes X3 position for latch trigger, users can check the Bit 1 or Bit 2 of 0x60B9 to see if the rising edge or falling edge is latched. At the same time, users can read Bit3~Bit7 to check the performed single cycle count. And the host controller will do the cumulative counting based on these values.

(5) Probe 1 Latch Position

The latched position information for Probe 1 and Probe 2 is stored in object dictionaries 0x60BA, 0x60BB, 0x60BC, and 0x60BD, respectively. Users can read the corresponding position values based on actual requirements.

Example: Probe 1 rising edge, continuous trigger

① Configure Probe 1 to continuous trigger with Bit1 of 60B8h set to 1.

② Configure Probe 1 to rising edge latch, with Bit4 of 60B8h set to 1.

③ Enable Probe 1 latch, with Bit0 of 60B8h set to 1.

After enabling Probe 1, the drive detects a valid probe edge and saves the position information value of it.

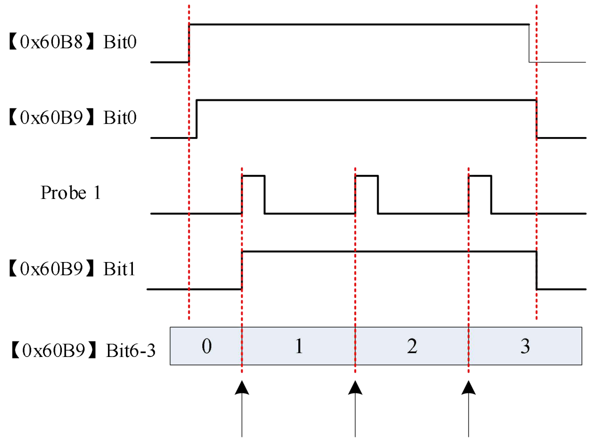


Figure 9-56 Probe Function Description

9.3.10 Object Dictionary

9.3.10.1 Object Property

Term explanation

“Index”: specifies the position of each object in the object dictionary, expressed in hexadecimal (h).

“Data Type”: see the table below for details.

Table 9-33 Data Type

Data Type	Data Range	Data Length	DS301 Value
Int8	-128~127	1 byte	2
Uint8	0~255	1 byte	5
Int16	-32768~+32767	2 bytes	3
Uint16	0~65535	2 bytes	6
Int32	-2147483648~+2147483647	4 bytes	4
Uint32	0~4294967295	4 bytes	7
String	ASCII	-	9

“R/W Type”: see the table below for details.

Table 9-34 R/W Type

R/W	Description
RW	Read and write
WO	Write only
RO	Read only
CONST	Constant, read only

“Object Structure”: see the table below for details.

Table 9-35 Object Structure Description

Object Structure	Description	DS301 Value
VAR	Clean values containing the data types in Table 9-33	7

ARR	Data blocks of the same type	8
REC	Data blocks of different types	9

9.3.10.2 1000h Object List

Index	Subindex	Name	Type	R/W	Data Type	Mapping
1000h	-	Device Type	VAR	RO	Uint32	N
1001h	-	Error Register	VAR	RO	Uint8	Y
1008h	-	Device Name	STRING	RO	Uint8	N
1009h	-	Hardware Version	STRING	RO	Uint8	N
100Ah	-	Software Version	STRING	RO	Uint8	N
1018h	-	ID Object	REC	RO	Uint16	N
	00h	Entry Number	-	RO	Uint8	N
	01h	Manufacturer Identity	-	RO	Uint32	N
	02h	Device Code	-	RO	Uint32	N
	03h	Device Revision	-	RO	Uint32	N
1600h	-	RPDO1 Mapping	REC	RW	-	N
	00h	RPDO1 Mapping Entry Number	-	RW	Uint8	N
	1h~15h	RPDO Mapping	-	RW	Uint32	N
1601h	-	RPDO2 Mapping	REC	RW	-	N
	00h	RPDO2 Mapping Entry Number	-	RW	Uint8	N
	1h~15h	RPDO Mapping Object	-	RW	Uint32	N
1602h	-	RPDO3 Mapping	REC	RW	-	N
	00h	RPDO3 Mapping Entry Number	-	RW	Uint8	N
	1h~15h	RPDO Mapping Object	-	RW	Uint32	N
1603h	-	RPDO4 Mapping	REC	RW	-	N
	00h	RPDO4 Mapping Entry Number	-	RW	Uint8	N
	1h~15h	RPDO Mapping	-	RW	Uint32	N
1A00h	-	TPDO1 Mapping	REC	RW	-	N
	00h	RPDO4 Mapping Entry Number	-	RW	Uint8	N
	1h~15h	RPDO Mapping Object	-	RW	Uint32	N
1A01h	-	TPDO2 Mapping	REC	RW	-	N
	00h	RPDO4 Mapping Entry Number	-	RW	Uint8	N
	1h~15h	RPDO Mapping Object	-	RW	Uint32	N

1A02h	-	TPDO3 Mapping	REC	RW	-	N
1A02h	00h	RPDO4 Mapping Entry Number	-	RW	Uint8	N
1A02h	1h~15h	RPDO Mapping Object	-	RW	Uint32	N
1A03h	-	TPDO4 Mapping	REC	RW	-	N
1A03h	00h	RPDO4 Mapping Entry Number	-	RW	Uint8	N
1A03h	1h~15h	RPDO Mapping Object	-	RW	Uint32	N
1C00h	-	Sync Manager Type	REC	RO	48	N
1C12h	-	SM1 RPDO Assignment	ARR	RW	Uint8	N
1C12h	00h	SM1 RPDO Assignment Entry Number	-	RW	Uint16	N
1C12h	01h	SM1 RPDO Assignment Entry Index	-	RW	Uint16	N
1C13h	-	SM2 RPDO Assignment	ARR	RW	Uint8	N
1C13h	00h	SM2 RPDO Assignment Entry Number	-	RW	Uint16	N
1C13h	01h	SM2 RPDO Assignment Entry Index	-	RW	Uint16	N
1C32h	-	SM2 Output Parameters	REC	RO	-	N
1C32h	00h	SM2 Output Entry Number	-	RO	Uint8	N
1C32h	01h	Sync Type	-	RO	Uint16	N
1C32h	02h	Cycle Time	-	RO	Uint32	N
1C32h	04h	Supported Sync Type	-	RO	Uint16	N
1C32h	05h	Min. Cycle Time	-	RO	Uint32	N
1C32h	06h	Calculation and Copy Time	-	RO	Uint32	N
1C32h	08h	Cycle Time Access	-	RO	Uint16	N
1C32h	09h	Delay Time	-	RO	Uint32	N
1C32h	0Ah	SYNC0 Cycle Time	-	RO	Uint32	N
1C32h	0Bh	Sync Event Loss	-	RO	Uint16	N
1C32h	0Ch	Cycle Overrun Count	-	RO	Uint16	N
1C32h	20h	Sync Error	-	RO	BOOL	N
1C33h	-	SM2 Input Parameters	REC	RO	-	N
1C33h	00h	SM2 Input Entry Number	-	RO	Uint8	N
1C33h	01h	Sync Type	-	RO	Uint16	N
1C33h	02h	Cycle Time	-	RO	Uint32	N
1C33h	04h	Supported Sync Type	-	RO	Uint16	N
1C33h	05h	Min. Cycle Time	-	RO	Uint32	N

	06h	Calculation and Copy Time	-	RO	Uint32	N
	08h	Cycle Time Access	-	RO	Uint16	N
	09h	Delay Time	-	RO	Uint32	N
	0Ah	SYNC0 Cycle Time	-	RO	Uint32	N
	0Bh	Sync Event Loss	-	RO	Uint16	N
	0Ch	Cycle Overrun Count	-	RO	Uint16	N
	20h	Sync Error	-	RO	BOOL	N

9.3.10.3 2000h Object List

The Group 2000h object dictionary provides a mapping to the drive's internal parameters, among which, 2000h~2006h correspond to parameter groups Pn0xx to Pn6xx, respectively, and 2010h~2018h correspond to the monitoring parameters Un0xx to Un8xx. The specific function codes of the drive correspond to the subindexes within the Group 2000h object dictionary.

The correspondence rule is as follows: the corresponding object dictionary subindex is calculated by adding 1 to the last two digits of the function code, see "7.3 Pn Parameter Overview" and "7.4 Un Parameter Overview" for details.

Index	Subindex	Description	Data Type	R/W Type	Mapping
2000h	-	Pn0xx Basic: Basic Parameters	-	-	-
	00h	Entry Number	Uint8	RO	N
	01h	Pn000: Basic Switch 0	Uint16	RW	N
	02h	Pn001: Basic Switch 1	Uint16	RW	N
	03h	Pn002: Motor Direction	Uint16	RW	N
	...	...	...	RW	N
	82h	Pn081: Local Communication Format	Uint16	RW	N
	83h	Pn082: EtherCAT Station Alias	Uint16	RW	N
2001h	-	Pn1xx Gain Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn100: Moment of Inertia (MOI) Ratio	Uint16	RW	N
	02h	Pn101: ASR Gain	Uint16	RW	N
	...	...	...	RW	N
	94h	Pn193: Max. Advanced Tuning Gain	Uint16	RW	N
2002h	-	Pn2xx Position Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn200: Position Reference Source	Uint16	RW	N
	02h	Pn201: Pulse Input Pattern	Uint16	RW	N
	03h	Pn202: Pulse Reference Logic	Uint16	RW	N
	04h	Pn203: Pulse Reference Multiplier	Uint16	RW	N
	...	...	...	RW	N

	98h	Pn297: Absolute Zero Single-turn Value	Uint16	RW	N
	9Ah	Pn299: Home Timeout	Uint16	RW	N
2003h	-	Pn3xx Velocity Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn300: Velocity Reference Source	Int16	RW	N
	02h	Pn301: Velocity Reference Direction	Int16	RW	N
	...	...	...	RW	N
	21h	Pn320: /V-CMP Signal Width	Uint16	RW	N
2004h	-	Pn4xx Velocity Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn400: Torque Control 1	Uint16	RW	N
	02h	Pn401: Torque Reference Filter Cutoff Frequency	Uint16	RW	N
	...	...	...	RW	N
	31h	Pn430: Torque Control 2	Uint16	RW	N
2005h	-	Pn5xx Auxiliary Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn500: Jog Velocity	Uint16	RW	N
	02h	Pn502: Programmed Jog Mode	Uint16	RW	N
	...	...	...	RW	N
	09h	Pn508: Programmed Jog Velocity	Uint16	RW	N
2006h	-	Pn6xx Terminal Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Pn600: X Terminal Filter Time	Uint16	RW	N
	02h	Pn601: X1 Terminal Configuration	Uint16	RW	N
	...	...	...	RW	N
	31h	Pn630: Internal Setting on X Terminal	Uint16	RW	N
2010h	-	Un0xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Un000: Motor Feedback Velocity	Int16	RO	N
	02h	Un001: Reference Velocity	Int16	RO	N
	...	...	...	RO	N
	39h	Un038: CANopen Version (Sub-version)	Uint16	RO	N
	3Ah	Un039: EtherCAT Version (Sub-version)	Uint16	RO	N
2011h	-	Un1xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	05h	Un104: Serial Encoder Communication Error Counter	Uint16	RO	N

	06h	Un105: Position Tuning Time	Uint16	RO	N
	...	...	...	RO	N
	54h	Un153: Analog 2 Voltage (Offset, Gain, Zero Corrected)	Uint16	RO	N
2012h	-	Un2xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	04h	Un203: Error Parameter Funcode (ER.040)	Uint16	RO	N
	13h	Un212: System Time Monitor A (Avg)	Uint16	RO	N
	...	...	...	RO	N
	1Ah	Un219: System Time Monitor R (Max)	Uint16	RO	N
2015h	-	Un5xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	13h	Un512: U-phase Zero Crossing	Uint16	RO	N
	14h	Un513: V-phase Zero Crossing	Uint16	RO	N
2016h	-	Un6xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	04h	Un603: Absolute Encoder Pulse [Low 32 bits]	Uint32	RO	N
	06h	Un605: Absolute Encoder Pulse [High 32 bits]	Uint32	RO	N
2018h	-	Un8xx Monitoring Parameters	-	-	N
	00h	Entry Number	Uint8	RO	N
	01h	Un800: Current Error or Alarm Code	Uint16	RO	N
	02h	Un801: Error-Code	Uint16	RO	N
	...	...	...	RO	N
	43h	Un842: Alarm History 9 Time	Uint16	RO	N

NOTE

- The last two digits of the function code correspond to the sub-index. Both the function code and sub-index are hexadecimal values.

Example: When reading from or writing to Pn299, the corresponding object dictionary entry is 2002h:2002_9Ah.

9.3.10.4 6000h Object List

Index	Subindex	Name	R/W	Mapping	Data Type	Unit
603Fh	00h	Error Code	RO	Y	Uint16	-
6040h	00h	Control Word	RW	Y	Uint16	-
6041h	00h	Status Word	RO	T	Uint16	-

605Ah	00h	Quick Stop	RO	Y	Int16	-
605Dh	00h	Halt Stop	RO	Y	Int16	-
6060h	00h	Operation Mode	RW	Y	Int8	-
6061h	00h	Operation Mode Display	RO	Y	Int8	-
6062h	00h	User Position Reference	RO	Y	Int32	Reference unit
6063h	00h	Motor Position Feedback	RO	Y	Int32	Encoder unit
6064h	00h	User Position Feedback	RO	Y	Int32	Reference unit
6065h	00h	Position Deviation Error Level	RW	Y	Uint32	Reference unit
6067h	00h	/COIN Signal Width	RW	Y	Uint32	Reference unit
6068h	00h	/COIN Signal Time	RW	Y	Uint16	ms
606Bh	00h	Velocity Reference	RW	Y	Int32	0.1rpm
606Ch	00h	Velocity Feedback	RO	Y	Int32	Reference unit/s
606Dh	00h	/V-CMP Signal Width	RW	Y	Uint16	0.1rpm
606Eh	00h	/V-CMP Signal Time	RW	Y	Uint16	2ms
606Fh	00h	Zero-speed Reach Level	RW	Y	Uint16	0.1rpm
6070h	00h	Zero-speed Reach Time	RW	Y	Uint16	ms
6071h	00h	Target Torque	RW	Y	Int16	0.1%
6072h	00h	Max. Profile Torque	RW	Y	Uint16	0.1%
6074h	00h	Torque Reference	RO	Y	Uint32	0.1%
6075h	00h	Motor Rated Current	RO	Y	Uint32	mA
6076h	00h	Motor Rated Torque	RO	Y	Uint32	mNm
6077h	00h	Motor Feedback Velocity	RO	Y	Uint16	0.1%
607Ah	00h	Target Position	RW	Y	Int32	Reference unit
607Ch	00h	Home Offset	RW	Y	Int32	Reference unit

607Dh	01h	Min. Internal Position Limit	RW	Y	Int32	Reference unit
	02h	Max. Internal Position Limit	RW	Y	Int32	Reference unit
607Eh	00h	Command Polarity	RW	Y	Uint8	-
607Fh	00h	Max. Profile Velocity	RW	Y	Uint32	Reference unit/s
6080h	00h	Max. Motor Velocity	RW	Y	Uint32	rpm
6081h	00h	Profile Velocity	RW	Y	Uint32	Reference unit/s
6083h	00h	Profile ACC	RW	Y	Uint32	Reference unit/s^2
6084h	00h	Profile DEC	RW	Y	Uint32	Reference unit/s^2
6086h	00h	Motion Profile	RW	Y	Int16	-
6087h	00h	Torque ACC	RW	Y	Uint32	ms
6091h	01h	Gear Ratio Numerator	RW	Y	Uint32	-
	02h	Gear Ratio Denominator	RW	Y	Uint32	-
6098h	00h	Home Mode	RW	Y	Int8	-
6099h	01h	Home Point Search Speed	RW	Y	Uint32	Reference unit/s
	02h	Home Velocity (Low)	RW	Y	Uint32	Reference unit/s
609Ah	00h	Home ACC/DEC	RW	Y	Uint32	Reference unit/s^2
60B0h	00h	Position Offset	RW	Y	Int32	Reference unit
60B1h	00h	Velocity Offset	RW	Y		Reference unit/s
60B2h	00h	Torque Offset	RW	Y	Int16	0.1%
60B8h	00h	Probe Enable	RW	Y	Uint16	-
60B9h	00h	Probe Status	RO	Y	Uint16	-
60BAh	00h	Probe 1 Rising Edge Position Feedback	RO	Y	Int32	Reference unit
60BBh	00h	Probe 1 Falling Edge Position Feedback	RO	Y	Int32	Reference unit

60BCh	00h	Probe 2 Rising Edge Position Feedback	RO	Y	Int32	Reference unit
60BDh	00h	Probe 2 Falling Edge Position Feedback	RO	Y	Int32	Reference unit
60E0h	00h	Positive Torque Limit	RW	Y	Uint16	0.1%
60E1h	00h	Negative Torque Limit	RW	Y	Uint16	0.1%
60F4h	00h	User Position Deviation	RO	Y	Int32	Reference unit
60FCh	00h	Motor Position Reference	RO	Y	Int32	Encoder unit
60FDh	00h	DI Status	RO	Y	Uint32	-
60FEh	00h	DO Qty	RO	N	Uint8	-
	01h	DO Status	RO	Y	Uint16	-
60FFh	00h	Target Velocity	RW	Y	Uint32	Reference unit/s
6502h	00h	Servo Drive Mode	RO	Y	Uint32	-

9.3.10.5 1000h Object Details

1000h					
Index	1000h	-			
Name	Device Type				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	NO	W/R	RO	Default	0x20192
Function	It indicates the device subprotocol or application specification employed.				

Bit	Name	Description
0~15	Device Sub-protocol	402(0x192): Device sub-protocol
16~23	Type	02: Servo drive
25~31	Mode	Manufacturer-defined

1001h					
Index	1001h	-			
Name	Error Register				
Object Structure	VAR	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RO	Default	0x0

<table>
<tr><td rowspan="2">Function</td><td>It indicates the error information by bit as below:

Bit	Content	Bit	Content
0	General	4	Communication
1	Current	5	Sub-protocol
2	Voltage	6	Reserved
3	Temperature	7	Manufacturer-defined
</td></tr>
<tr><td>When an error occurs, the corresponding bit is set to “1”, and whenever an error is present, bit0 must be “1”.</td></tr>
</table>

1008h					
Index	1008h	-			
Name	Manufacturer Device Name				
Object Structure	REC	Data Type	Uint8	Data Range	Uint8
Mapping	NO	W/R	RO	Default	Servo Device

100Ah					
Index	100Ah	-			
Name	Software Version				
Object Structure	REC	Data Type	Uint8	Data Range	-
Mapping	NO	W/R	RO	Default	Up to model

1018h					
Index	1018h	-			
Name	ID Object				
Object Structure	REC	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	

Subindex	00h	-			
Name	Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	4
Mapping	NO	W/R	RO	Default	4

Subindex	01h	-			
Name	Manufacturer ID				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	0x850104

Function	It indicates a unique number assigned uniformly by the ETG.

<table>
<tr><td>Subindex</td><td>02h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">Product Code</td></tr>
<tr><td>Object Structure</td><td>-</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>-</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RO</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">The device code corresponds to the product series and product model on the electronic label, and the correspondence is as follows:
<table>
<tr><td>MSB</td><td>LSB</td></tr>
<tr><td>31 16</td><td>15 0</td></tr>
<tr><td>Product Series</td><td>Product Model</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>Subindex</td><td>03h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">Revision Number</td></tr>
<tr><td>Object Structure</td><td>-</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>-</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RO</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">The specific meanings corresponding to the software version number 100Ah are as follows:
<table>
<tr><td>MSB</td><td>LSB</td></tr>
<tr><td>31 16</td><td>15 0</td></tr>
<tr><td>Primary revision number</td><td>Secondary revision number</td></tr>
</table></td></tr>
</table>

<table>
<tr><td colspan="6">1600h: RPDO1 Mapping
1601h: RPDO2 Mapping
1602h: RPDO3 Mapping
1603h: RPDO4 Mapping</td></tr>
<tr><td>Index</td><td colspan="2">1600h~1603h</td><td colspan="3">-</td></tr>
<tr><td>Name</td><td colspan="5">RPDO Mapping</td></tr>
<tr><td>Object Structure</td><td>REC</td><td>Data Type</td><td>-</td><td>Data Range</td><td>-</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">This object can be modified only when PDO is invalid. The total bit length of the mapped object must not exceed 32 bits, and only byte-level mapping is supported, no bit-level mapping.</td></tr>
</table>

Subindex	00h	-
Name	PDO Mapping Entry Number	

Object Structure	-	Data Type	Uint8	Data Range	0~4
Mapping	NO	W/R	RW	Default	-
Function	When it is written 0, the other sub-index mapping entries are invalid.				

<table>
<tr><td>Subindex</td><td>1h~15h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">PDO Mapping Object</td></tr>
<tr><td>Object Structure</td><td>-</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>Uint32</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">The mapping object index and subindex must exist in the object dictionary list, be writable, and be mappable. Write the corresponding mapping object in the following format:
<table>
<tr><td colspan="2">MSB</td><td>LSB</td></tr>
<tr><td>31 16</td><td>15 8</td><td>7 0</td></tr>
<tr><td>Index</td><td>Subindex</td><td>Object Length</td></tr>
</table></td></tr>
</table>

RPDO default mapping contents are:

(1) RPDO1(1600h)

Subindex	Value	Setting
0	1	Map one entry
1	0x60400010	Control Word

(2) RPDO2(1601h)

Subindex	Value	Setting
0	2	Map two entries
1	0x60410010	Control word
2	0x60600008	Operation Mode

(3) RPDO3 (1602h)

Subindex	Value	Setting
0	2	Map two entries
1	0x60410010	Control word
2	0x607A0020	Target Position (Position Reference)

(4) RPDO4 (1603h)

Subindex	Value	Setting
0	2	Map two entries
1	0x60410010	Control word
2	0x60FF0020	Target Velocity (Velocity Reference)

1A00h: TPDO1 Mapping Parameter 1A01h: TPDO2 Mapping Parameter 1A02h: TPDO3 Mapping Parameter 1A03h: TPDO4 Mapping Parameter					
Index	1A00h~1A03h	-			
Name	TPDO Mapping				
Object Structure	REC	Data Type	-	Data Range	-
Mapping	NO	W/R	RW	Default	-
Function	This object can be modified only when PDO is invalid. The total bit length of the mapped object must not exceed 64 bits, and only byte-level mapping is supported, no bit-level mapping.				

Subindex	00h	-			
Name	PDO Mapping Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	0~4
Mapping	NO	W/R	RW	Default	-
Function	When it is written 0, the other sub-index mapping entries are invalid.				

<table>
<tr><th>Subindex</th><th>1h~8h</th><th colspan="4">-</th></tr>
<tr><td>Name</td><td colspan="5">TPDO Mapping Object</td></tr>
<tr><td>Object Structure</td><td>-</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td>Uint32</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td>Default</td><td>-</td></tr>
<tr><td>Function</td><td colspan="5">The mapping object index and subindex must exist in the object dictionary list, be writable,
and be mappable.
Write the corresponding mapping object in the following format:
<table>
<tr><td colspan="3">MSB
LSB</td></tr>
<tr><td>31 16</td><td>15 8</td><td>7 0</td></tr>
<tr><td>Index</td><td>Subindex</td><td>Object Length</td></tr>
</table></td></tr>
</table>

TPDO default mapping contents are:

(1) TPDO1 (1A00h)

Index	Value	Setting
0	1	Map one entry
1	0x60410010	Status Word

(2) TPDO2 (1A01h)

Index	Value	Setting
0	2	Map two entries

1	0x60410010	Status Word
2	0x60610008	Current operation mode

(3) TPDO3 (1A02h)

Index	Value	Setting
0	2	Map two entries
1	0x60410010	Status Word
2	0x60640020	Current position

(4) TPDO4 (1A03h)

Index	Value	Setting
0	2	Map two entries
1	0x60410010	Status Word
2	0x606C0020	Current velocity

1C12h: SM2 RPDO Assignment					
Index	1C12h	-			
Name	SM2 RPDO Assignment				
Object Structure	ARR	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RW	Default	1

Subindex	00h	-			
Name	SM2 RPDO Assignment Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	0~1
Mapping	NO	W/R	RW	Default	1

Subindex	01h	-			
Name	SM2 RPDO Assignment Entry Index				
Object Structure	-	Data Type	Uint16	Data Range	0~65535
Mapping	YES	W/R	RW	Default	0x1601
Function	Set the index number assigned by RPDO: 1. Configure the indexes under pre-operation state. 2. Select the RPDO assignment with the TwinCAT software directly , otherwise: a. Write 1C12-00h to 0. b. Write the index of the pre-defined RPDO (e.g., 0x1600) to object 0x1C12, sub-index 0x01. c. Write 1C12-00h to 1.				

1C13h: SM2 TPDO Assignment					
Index	1C13h	-			
Name	SM2 TPDO Assignment				
Object Structure	ARR	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RW	Default	1

Subindex	00h	-			
Name	SM2 Max. TPDO Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	0~1
Mapping	NO	W/R	RW	Default	1

Subindex	01h	-			
Name	TPDO Assignment Entry Index				
Object Structure	-	Data Type	Uint16	Data Range	0~65535
Mapping	YES	W/R	RW	Default	0x1A01
Function	Set the index number assigned by TPDO: 1. Configure the indexes under pre-operation state. 2. Select the TPDO assignment with the TwinCAT software directly , otherwise: a. Write 1C13-00h to 0. b. Write the preconfigured TPDOx (1A00h~1A03h) to 1C13-01h to configure the RPDOx mapping object (for example, 1A00h). c. Write 1C13-00h to 1.				

1C32h: SM2 Output Parameter					
Index	1C32h	-			
Name	SM2 Output Parameters				
Object Structure	REC	Data Type	-	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	00h	-			
Name	SM2 Output Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	-
Mapping	NO	W/R	RO	Default	32

Subindex	01h	-
Name	Sync Type	

Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	32
Function	0x0002 indicates that the synchronization type of SM2 is Distributed Clock 0.				

Subindex	02h	-			
Name	Cycle Time				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	0
Function	It indicates the cycle of SYNC0.				

Subindex	04h	-			
Name	Sync Type				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	4
Function	It indicates the type of the distributed clock. 0x0004 indicates that the synchronization type of SM2 is Distributed Clock 0.				

Subindex	05h	-			
Name	Min. Cycle				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	125000
Function	It indicates the minimum synchronization period supported by the slave (ns).				

Subindex	06h	-			
Name	Calculation and Copy Time				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	08h	-			
Name	Cycle Time Access				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RW	Default	-

Subindex	09h	-			
Name	Delay Time				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	0Ah	-			
Name	SYNC0 Cycle Time				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RW	Default	-
Function	Set the ESC register 09A0h by this parameter under DC mode.				

Subindex	0Bh	-			
Name	Sync Event Loss				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	0Ch	-			
Name	Cycle Overrun Count				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	-
Function	It indicates a too low cycle time setting.				

Subindex	20h	-			
Name	Sync Error				
Object Structure	-	Data Type	BOOL	Data Range	-
Mapping	NO	W/R	RO	Default	-
Function	TURE: Synchronization is valid without any errors. FALSE: Synchronization is not valid or there are errors.				

1C32h: SM2 Input Parameter					
Index	1C33h	-			
Name	SM2 Input Parameters				
Object Structure	REC	Data Type	-	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	00h	-			
Name	SM2 Input Entry Number				
Object Structure	-	Data Type	Uint8	Data Range	-
Mapping	NO	W/R	RO	Default	32

Subindex	01h	-			
Name	Sync Type				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	32
Function	0x0002 indicates that the synchronization type of SM2 is Distributed Clock 0.				

Subindex	02h	-			
Name	Cycle Time				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	0
Function	It indicates the cycle of SYNC0.				

Subindex	04h	-			
Name	Supported Sync Type				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	4
Function	It indicates the type of the distributed clock. 0x0004 indicates that the synchronization type of SM2 is Distributed Clock 0.				

Subindex	05h	-			
Name	Min. Cycle				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	125000
Function	It indicates the minimum synchronization period supported by the slave (ns).				

Subindex	06h	-			
Name	Calculation and Copy Time				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	08h	-			
Name	Cycle Time Access				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RW	Default	-

Subindex	09h	-
Name	Delay Time	

Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	0Ah	-			
Name	SYNC0 Cycle Time				
Object Structure	-	Data Type	Uint32	Data Range	-
Mapping	NO	W/R	RW	Default	-
Function	Set it to the same value as 1C32-0Ah.				

Subindex	0Bh	-			
Name	Sync Event Loss				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	0Ch	-			
Name	Cycle Overrun Count				
Object Structure	-	Data Type	Uint16	Data Range	-
Mapping	NO	W/R	RO	Default	-

Subindex	20h	-			
Name	Sync Error				
Object Structure	-	Data Type	BOOL	Data Range	-
Mapping	NO	W/R	RO	Default	-
Function	● TURE: Synchronization is valid without any errors. ● FALSE: Synchronization is not valid or there are errors.				

9.3.10.6 6000h Object Details

Description

Mark	Description
HM	Home mode (HM)
CSP	Cyclic synchronous position mode(CSP)
PP	Profile position mode (PP)
CSV	Cyclic synchronous velocity mode(CSV)
PV	Profile velocity mode (PV)
CST	Cycle profile torque mode (CST)
PT	Profile torque mode (PT)

<table>
<tr><th>603Fh</th><th colspan="2">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>603Fh</td><td colspan="8">-</td></tr>
<tr><td>Name</td><td colspan="9">Error Code</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td colspan="2">Uint16</td><td colspan="2">Data Range</td><td colspan="3">Uint16</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td colspan="2">RO</td><td colspan="2">Default</td><td colspan="3">-</td></tr>
<tr><td>Function</td><td colspan="9">It indicates the last error that occurred in the drive. See " 9.4 Error Diagnosis " for details.</td></tr>
</table>

<table>
<tr><th>6040h</th><th colspan="2">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6040h</td><td colspan="8">-</td></tr>
<tr><td>Name</td><td colspan="9">Control Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td colspan="2">Data Range</td><td colspan="4">Uint16</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td colspan="2">Default</td><td colspan="4">0</td></tr>
<tr><td>Function</td><td colspan="9">Control word bit definitions are as follows:
<table>
<tr><th>Bit</th><th>Definition</th><th>Description</th></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1: ON</td></tr>
<tr><td>1</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>2</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>3</td><td>Enable servo operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>4~6</td><td>Mode-related</td><td>Operation mode-related</td></tr>
<tr><td>7</td><td>Error reset</td><td>bit7 rising edge valid
bit7 set to 1, and other control references invalid</td></tr>
<tr><td>8</td><td>Halt</td><td>None</td></tr>
<tr><td>9~10</td><td>NA</td><td>Reserved</td></tr>
<tr><td>11~15</td><td>Manufacturer-defined</td><td>Reserved</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>6041h</th><th colspan="2">-</th><th>PP</th><th>PV</th><th>PT</th><th>HM</th><th>CSP</th><th>CSV</th><th>CST</th></tr>
<tr><td>Index</td><td>6041h</td><td colspan="8">-</td></tr>
<tr><td>Name</td><td colspan="9">Status Word</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td colspan="2">Uint16</td><td colspan="2">Data Range</td><td colspan="3">Uint16</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td colspan="2">RO</td><td colspan="2">Default</td><td colspan="3">0</td></tr>
</table>

<table>
<tr><td rowspan="17">Function</td><td colspan="3">Status word bit definitions are as follows:</td></tr>
<tr><td>Bit</td><td>Content</td><td>Setting</td></tr>
<tr><td>0</td><td>Servo ready</td><td>0: OFF 1:ON</td></tr>
<tr><td>1</td><td>Wait for servo enable</td><td>0: OFF 1:ON</td></tr>
<tr><td>2</td><td>Enable servo operation</td><td>0: OFF 1:ON</td></tr>
<tr><td>3</td><td>Error</td><td>0: No error 1: Error</td></tr>
<tr><td>4</td><td>Enable main power circuit</td><td>0: OFF 1: ON</td></tr>
<tr><td>5</td><td>Quick stop</td><td>0: ON 1: OFF</td></tr>
<tr><td>6</td><td>Enable power-on operation</td><td>0: OFF 1: ON</td></tr>
<tr><td>7</td><td>Alarm</td><td>Reserved</td></tr>
<tr><td>8</td><td>Manufacturer-defined</td><td>-</td></tr>
<tr><td>9</td><td>Remote control</td><td>0: Non-EtherCAT 1: EtherCAT</td></tr>
<tr><td>10</td><td>Target reached</td><td>0: OFF 1: ON</td></tr>
<tr><td>11</td><td>Internal position limit</td><td>0: No error 1: Error</td></tr>
<tr><td>12~13</td><td>Mode-related</td><td>Operation mode-related</td></tr>
<tr><td>14</td><td>NA</td><td>Reserved</td></tr>
<tr><td>15</td><td>Home completed</td><td>0: Not performed or not completed
1: Completed and reference point established</td></tr>
</table>

<table>
<tr><td>605Ah</td><td colspan="3">-</td><td>PP</td><td>PV</td><td>PT</td><td>HM</td><td>CSP</td><td>CSV</td><td>CST</td></tr>
<tr><td>Index</td><td>605Ah</td><td colspan="9">-</td></tr>
<tr><td>Name</td><td colspan="10">Quick Stop Mode</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Int16</td><td colspan="2">Data Range</td><td colspan="5">Int16</td></tr>
<tr><td>Mapping</td><td>NO</td><td>W/R</td><td>RW</td><td colspan="2">Default</td><td colspan="5">2</td></tr>
<tr><td rowspan="5">Function</td><td colspan="10">Set the servo drive operation mode.</td></tr>
<tr><td>Display</td><td colspan="9">Control Mode</td></tr>
<tr><td>0</td><td colspan="9">Coast to stop and motor shaft not locked</td></tr>
<tr><td>1</td><td colspan="9">Stop by 0x6084 (0x609A during home) setting and motor shaft locked
Coast to stop and motor shaft not locked</td></tr>
<tr><td>2</td><td colspan="9">Stop by 0x6085h setting and motor shaft not locked</td></tr>
</table>

<table>
<tr><td>605Dh</td><td colspan="2">-</td><td>PP</td><td>PV</td><td>PT</td><td>HM</td><td>CSP</td><td>CSV</td><td>CST</td></tr>
<tr><td>Index</td><td>605Dh</td><td colspan="8">-</td></tr>
<tr><td>Name</td><td colspan="9">Halt Stop Mode</td></tr>
</table>

Object Structure	VAR	Data Type	Int16	Data Range	Int16
Mapping	NO	W/R	RW	Default	1
Function	Set the servo drive operation mode.				

Display	Control Mode
1	Stop by 6084h (0x609A during home) setting and motor shaft locked
2	Stop by 6085h setting and motor shaft locked
3	Stop as emergency stop and motor shaft locked

6060h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6060h	-						
Name	Operation Mode							
Object Structure	VAR	Data Type	Int8	Data Range	Int8			
Mapping	Y	W/R	RW	Default	8			
Function	Set the servo drive operation mode.							

Setting	Description
0	Reserved
1	Profile position mode (PP)
3	Profile velocity mode (PV)
4	Profile torque mode (PT)
6	Home mode (HM)
8	Cyclic synchronous position mode (CSP)
9	Cyclic synchronous velocity mode (CSV)
10	Cyclic synchronous torque mode (CST)

6061h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6061h	-						
Name	Operation Mode Display							
Object Structure	VAR	Data Type	Int8	Data Range	Int8			
Mapping	Y	W/R	RO	Default	0			
Function	It displays the actual servo drive operation mode, the format and content are identical to object 6060h.							

6062h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6062h	-						
Name	User Position Reference							

Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RO	Default	0
Function	It indicates the required value in reference unit.				

6063h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6063h	-						
Name	Motor Position Feedback							
Object Structure	VAR	Data Type	Int32	Data Range	Int32			
Mapping	Y	W/R	RO	Default	0			
Function	It indicates the actual position feedback value in encoder unit.							

6064h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6064h	-						
Name	User Position Feedback							
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32			
Mapping	Y	W/R	RW	Default	3840000			
Function	Set the real-time motor absolute position feedback (unit: reference unit). User Position Feedback (6064h) × gear ratio (6091h) = motor position feedback (6063h).							

6065h	-	PP	HM	CSP
Index	6065h	-		
Name	Position Deviation Error Window			
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	3840000
Function	Set the position deviation error level (in user unit). When the difference between user position reference 6062h and user position feedback 6064h exceeds ±6065h, ER.d00 occurs. When 6065h is set to 4294967295, the servo drive does not perform position deviation monitoring.			

6067h	-	PP	HM	CSP	
Index	6067h	-			
Name	/COIN Signal Width				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	100

Function	Set the position arrival level in reference unit. When the difference between the user position reference (6062h) and the actual user position feedback (6064h) is within ±6067h, and the duration reaches 6068h, the position is considered to be reached. In profile position mode, bit10 of the status word (6041h) is set to 1.

6068h	-			PP	HM	CSP
Index	6068h	-				
Name	/COIN Signal Time					
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16	
Mapping	Y	W/R	RW	Default	2	
Function	Set the time range to judge if the position target is reached (unit: 1ms). When the difference between the user position reference (6062h) and the actual user position feedback (6064h) is within ±6067h, and the duration reaches 6068h, the position is considered to be reached. In profile position mode, bit10 of the status word (6041h) is set to 1.					

606Bh	-	PP	PV	PT	HM	CSP	CSV	CST
Index	606Bh	-						
Name	Velocity Reference							
Object Structure	VAR	Data Type	Int32	Data Range	Int32			
Mapping	Y	W/R	RO	Default	-			
Function	It indicates the actual position feedback value (unit: 0.1rpm). ● In position mode, it reflects the speed reference corresponding to the output of the position regulator, ● while it indicates the input reference of the speed regulator in velocity mode.							

606Ch	-	PP	PV	PT	HM	CSP	CSV	CST
Index	606Ch	-						
Name	Velocity Feedback							
Object Structure	VAR	Data Type	Int32	Data Range	-2^{31}~$(2^{31}-1)$			
Mapping	Y	W/R	RO	Default	-			
Function	It indicates the actual position feedback value(unit: user unit/s).							

606Dh	-		PV	CSV
Index	606Dh	-		

Name	V-CMP Signal Width				
Object Structure	VAR	Data Type	Uint16	Data Range	0~3000
Mapping	Y	W/R	RW	Default	10
Function	Set the speed window threshold (unit : 1rpm). If the difference between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches 606Eh, the target speed is considered to have been reached, and bit10 of status word 6041h is set to 1 in profile speed mode, otherwise, bit10 is 0.				

606Eh	-				PV	CSV
Index	606Eh	-				
Name	/V-CMP Signal Time					
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16	
Mapping	Y	W/R	RW	Default	2	
Function	Set the time window to judge if the position target is reached. If the difference between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches 606Eh, the target speed is considered to have been reached, and bit10 of status word 6041h is set to 1 in profile speed mode, otherwise, it is 0.					

606Fh	-				PV	CSV
Index	606Fh	-				
Name	Zero-speed Reach Level					
Object Structure	VAR	Data Type	Uint16	Data Range	0~2000	
Mapping	Y	W/R	RW	Default	10	
Function	Set the speed threshold to tell if the speed is 0 by 1rpm. When the user velocity feedback (606Ch) remains within the range of ±606Fh and this condition persists for the time specified in 6070h, the user velocity is considered 0, and at this time, the status word 6041h-bit12 is set to 1. If either of the conditions is not met, the user velocity is considered non-zero and 6041h-bit12 is 0.					

6070h	-			PV	PT	CSV	CST
Index	6070h	-					
Name	Zero-speed Reach Time						
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16		
Mapping	Y	W/R	RW	Default	2		

Function	Set the speed threshold time to tell if the speed is 0 (unit: 2ms). When the user velocity feedback (606Ch) remains within the range of ±606Fh and this condition persists for the time specified in 6070h, the user velocity is considered 0, and at this time, the status word 6041h-bit12 is set to 1. If either of the conditions is not met, the user velocity is considered non-zero and 6041h-bit12 is 0.

6071h	-				CST	PT
Index	6071h	-				
Name	Target Torque					
Object Structure	VAR	Data Type	Int16	Data Range	-5000~5000	
Mapping	Y	W/R	RW	Default	0	
Function	set the target reference value in profile torque mode and cyclic synchronous torque mode(unit: 0.1%).					

6072h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6072h	-						
Name	Max. Torque Limit							
Object Structure	VAR	Data Type	Uint16	Data Range	-5000~5000			
Mapping	Y	W/R	RW	Default	3000			
Function	Set the maximum output torque value for the servo drive (unit: 0.1%).							

6074h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6074h	-						
Name	Torque Reference							
Object Structure	VAR	Data Type	Uint16	Data Range	-5000~5000			
Mapping	Y	W/R	RO	Default	-			
Function	It indicates the current torque command value (unit: 0.1%).							

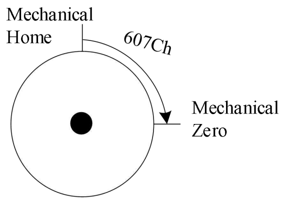
6075h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6075h	-						
Name	Rated Motor Current							
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32			
Mapping	Y	W/R	RO	Default	2800			
Function	It indicates the motor rated current on the nameplate(unit: mA). All current-related parameter values are tied to this parametER.							

6076h	-		PP	PV	PT	HM	CSP	CSV	CST
Index	6076h	-							
Name	Rated Motor Torque								
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32				
Mapping	Y	W/R	RO	Default	0				
Function	It indicates the motor rated torque on the nameplate (unit: mNm). All torque-related parameter values are tied to this parametER.								

6077h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	6077h	-						
Name	Motor Torque Feedback							
Object Structure	VAR	Data Type	Int16	Data Range	Int16			
Mapping	Y	W/R	RO	Default	0			
Function	It indicates the instantaneous torque output value of the servo motor (unit: 0.1%).							

607Ah	-				PP	CSP
Index	607Ah	-				
Name	Target Position					
Object Structure	VAR	Data Type	Int32	Data Range	Int32	
Mapping	Y	W/R	RW	Default	0	
Function	Set the servo target position in reference unit under the profile position mode. When Control Word (6040h-bit6) is 0, 607Ah is the absolute position of the current stage. When Control Word (6040h-bit6) is 1, 607Ah is the incremental position of the current stage.					

607Ch	-				HM
Index	607Ch	-			
Name	Home Offset				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	0

Function	Set the physical position by which the mechanical zero point deviates from the motor home position in encoder unit under the position mode.  Mechanical home=Mechanical Zero+ 607Ch (Home offset). When it is set to 0, then home point has no offset at all.

607Dh	-			PP	PV	PT	HM	CSP	CSV	CST
Index	607Dh	-								
Name	Internal Absolute Position Limit									
Object Structure	VAR	Data Type	Int32	Data Range		-				
Mapping	Y	W/R	RW	Default		0				
Function	Set the minimum and maximum value of the absolute position limit in the software. ● The min. absolute position limit is set on 607D-01h. ● The max. absolute position limit is set on 607D-02h. The software position limit will ● When both 607Dh:01h and 607Dh:02h are set to their default values, the software position limits are disabled. ● If the minimum absolute position limit (607Dh:01h) is greater than the maximum absolute position limit (607Dh:02h), the system will automatically adjust these values. ● When the position reference or position feedback reaches the software limit value: In position mode, the servo drive will treat the position limit as the target position, move to the limit point, stop, and trigger an overtravel alarm. A reverse reference can be issued to move the motor out of the overtravel state. ● The absolute position limits are defined relative to the motor feedback position 6064h (in user unit).									

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	Y	W/R	RO	Default	2

Subindex	01h	-
Name	Min. Internal Absolute Position Limit	

Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	-2^{31}

Subindex	02h	-			
Name	Max. Internal Absolute Position Limit				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	$2^{31}-1$

<table>
<tr><td>607Eh</td><td colspan="4">-</td><td>CSP</td><td>PP</td><td>CSV</td><td>PV</td><td>CST</td><td>PT</td></tr>
<tr><td>Index</td><td>607Eh</td><td colspan="9">-</td></tr>
<tr><td>Name</td><td colspan="10">Reference Polarity</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint8</td><td>Data Range</td><td colspan="6">Int8</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td colspan="6">0</td></tr>
<tr><td>Function</td><td colspan="10">Set the polarity of position, speed and torque references.
<table>
<tr><td colspan="3">MSB</td><td>LSB</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4 0</td></tr>
<tr><td>Position reference polarity</td><td>Speed reference polarity</td><td>Torque reference polarity</td><td>NA</td></tr>
</table>
● Bit7=1: Indicates standard position mode. Multiply the position reference by (-1) to reverse the motor rotation direction. In profile position mode and cyclic synchronous position mode, both the position reference and target position are inverted.
● Bit6=1: Indicates velocity mode. Multiply the velocity reference by (-1) to reverse the motor rotation direction.
● Bit5=1: Indicates torque mode. Multiply the torque reference by (-1) to reverse the motor rotation direction.</td></tr>
</table>

<table>
<tr><td>607Fh</td><td colspan="4">-</td><td>PP</td><td>PV</td><td>PT</td><td>HM</td><td>CSP</td><td>CSV</td><td>CST</td></tr>
<tr><td>Index</td><td>607Fh</td><td colspan="10">-</td></tr>
<tr><td>Name</td><td colspan="11">Max. Profile Velocity</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint32</td><td>Data Range</td><td colspan="7">Uint32</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RW</td><td>Default</td><td colspan="7">13107200</td></tr>
</table>

Function	Set the user maximum operating speed (unit: user units/s). This value takes effect when the slave's speed reference changes. $$\text{Max. Profile Velocity(rpm)} = \frac{607\text{Fh} \times \frac{6091\text{h}-01}{6091\text{h}-02}}{\text{Encoder Resolution}} \times 60$$ Note: In all operating modes, the maximum operating speed is limited not only by 607Fh but also by Pn318. The smaller value between these two values works actually.

6080h	-		PP	PV	PT	HM	CSP	CSV	CST
Index	6080h	-							
Name	Max. Motor Velocity								
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32				
Mapping	Y	W/R	RO	Default	167772160				
Function	It indicates the maximum permissible operating speed of the motor that can be obtained from the manual of the servomotor (unit: rpm).								

6081h	-				PP
Index	6081h	-			
Name	Profile Velocity				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	167772160
Function	Set the running speed of the constant stage after completing the acceleration in the profile position mode (unit: reference unit/s). $$\text{Motor Velocity(rpm)} = \frac{6081\text{h} \times \frac{6091\text{h}-01}{6091\text{h}-02}}{\text{Encoder Resolution}} \times 60$$				

6083h	-			PP	PV
Index	6083h	-			
Name	Profile ACC				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	16777216

Function	● Set the acceleration for profile position mode and profile velocity mode (unit: reference unit/s²). ● In profile position mode: Acceleration changes take effect before the next segment reference is triggered. If modified during the execution of this segment, the new value will apply after the current segment completes. ● In profile velocity mode, the acceleration changes take effect immediately. ● If this is set to 0, the software internally forces it to 1.

6084h	-			PP	PV
Index	6084h	-			
Name	Profile DEC				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	16777216
Function	● Set the deceleration for profile position mode and profile velocity mode (unit: reference unit/s²). ● In profile position mode: Acceleration changes take effect before the next segment reference is triggered. If modified during the execution of this segment, the new value will apply after the current segment completes. ● In profile velocity mode, the acceleration changes take effect immediately. ● If this is set to 0, the software internally forces it to 1.				

6086h					
Index	6086h	-			
Name	Motor Operation Curve				
Object Structure	VAR	Data Type	Int16	Data Range	Int16
Mapping	Y	W/R	RW	Default	-
Function	It indicates the profile type of the position, speed or torque reference. 0: Linear				

6087h	-			PT	CST
Index	6087h	-			
Name	Torque ACC				
Object Structure	VAR	Data Type	Uint32	Data Range	0~65535
Mapping	Y	W/R	RW	Default	1000

Function	● Set the torque acceleration in profile torque mode, representing the torque reference increment per second (0.1%/s). ● If this is set to 0, the software internally forces it to 1.

6091h	-			PP	PV	PT	HM	CSP	CSV	CST
Index	6091h	-								
Name	Gear Ratio									
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32					
Mapping	Y	W/R	RW	Default	-					
Function	Set a proportional relationship between the user-defined load displacement and the motor displacement: Motor displacement (encoder unit) = Load displacement (user unit) × position factor The setting of the position factor is related to parameters such as the mechanical reduction ratio, mechanical dimensions, and motor resolution. The calculation method is as follows: $\text{Position Factor} = \frac{\text{Motor Resolution} \times \text{Gear Ratio}}{\text{Load Feed}}$									

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2
Mapping	Y	W/R	RO	Default	2

Subindex	01h	-			
Name	Motor Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

Subindex	02h	-			
Name	Shaft Resolution				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	1

6098h	-				HM
Index	6098h	-			
Name	Home Mode				
Object Structure	VAR	Data Type	Int8	Data Range	0~35
Mapping	Y	W/R	RW	Default	0
Function	Select the home mode here.				

Value	Description
1	Starts at the negative limit switch and Z-pulse
2	Starts at the positive limit switch and Z-pulse
3, 4	Starts at the positive home switch and Z-pulse
5, 6	Starts at the negative home switch and Z-pulse
7~14	Starts at the home switch and Z-pulse
15~16	Reserved
17~30	Home without reference to Z-pulse
31~32	Reserved
33~34	Home without reference to Z-pulse
35	Reset the current position

NOTE	
⚠	● ER.E03 will occur when data other than the above is set.

6099h					HM
Index	6099h	-			
Name	Home Velocity				
Object Structure	ARR	Data Type	Uint8	Data Range	Uint32
Mapping	Y	W/R	RW	Default	-
Function	There are two speed settings under the home mode, ● 6099-1h: Deceleration Point Search Velocity ● 6099-2h: Home Point Search Velocity				

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	2

Mapping	Y	W/R	RO	Default	2

Subindex	01h	-			
Name	Deceleration Point Search Velocity				
Object Structure	VAR	Data Type	Uint32	Data Range	$0\sim(2^{32}-1)$
Mapping	Y	W/R	RW	Default	27962027
Function	Set the search speed for the deceleration point signal. Set it to a higher value to prevent excessive homing time and homing errors.				

Subindex	02h	-			
Name	Home Point Search Velocity				
Object Structure	VAR	Data Type	Uint32	Data Range	1~500
Mapping	Y	W/R	RW	Default	5592405

NOTE	
	● During homing, the slave device will decelerate after detecting the deceleration point signal. ● During deceleration, the slave device ignores changes in the home signal. To avoid finding the home signal during deceleration, please set the deceleration point switch signal appropriately. For example, ensure sufficient deceleration distance or increase the homing acceleration rate.

609Ah	-				HM
Index	609Ah	-			
Name	Home ACC/DEC				
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	100
Function	Set the acceleration and deceleration for home mode. That is, the position reference increment per second. If the parameter is set to 0, it will be automatically forced to 1.				

60B0h	-				CSP
Index	60B0h	-			
Name	Position Offset				
Object Structure	VAR	Data Type	Int32	Data Range	Int32

Mapping	Y	W/R	RW	Default	0
Function	Set the position reference offset in Cyclic Synchronous Position (CSP) mode (unit: reference unit). Target position of the servo drive = 607Ah (Position offset) + 60B0h (Target position)				

60B1h	-			CSP	CSV
Index	60B1h	-			
Name	Velocity Offset				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	0
Function	Set the speed reference offset in Cyclic Synchronous Position (CSP) mode (unit: reference unit/s). Target speed of the servo drive = 60FFh + 60B1h				

60B2h	-		CSP	CSV	CST
Index	60B2h	-			
Name	Torque Offset				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	0
Function	Set the servo drive torque reference offset value in Cyclic Synchronous Torque (CST) mode (unit: 0.1%). Target torque = 6071h+60B2h				

60B8h	-				
Index	60B8h	-			
Name	Probe Enable				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	0

<table>
<tr>
<td>Function Description</td>
<td>Set to capture the position information when an external DI signal or the motor Z-signal changes, also known as position latch.
This servo drive supports two independent probe functions (Probe 1 and Probe 2), allowing up to 4 position values to be latched. Probe 1: Use input X3 as the trigger signal.
Probe 2: Use input X4 as the trigger signal.
Probe 1 or Probe 2 description:
<table>
<tr><th>Bit</th><th>Setting</th><th>Range</th></tr>
<tr><td>0</td><td>Probe 1 enable</td><td>0: OFF
1: ON</td></tr>
<tr><td>1</td><td>Probe 1 trigger mode</td><td>0: Single trigger
1: Continuous trigger</td></tr>
<tr><td>2</td><td>Probe 1 trigger signal</td><td>0: DI3 signal
1: Z signal</td></tr>
<tr><td>3</td><td>NA</td><td>-</td></tr>
<tr><td>4</td><td>Probe 1 rising edge latch</td><td>0: OFF
1: ON</td></tr>
<tr><td>5</td><td>Probe 1 falling edge latch</td><td>0: OFF
1: ON</td></tr>
<tr><td>6-7</td><td>NA</td><td>-</td></tr>
<tr><td>8</td><td>Probe 2 enable</td><td>0: OFF
1: ON</td></tr>
<tr><td>9</td><td>Probe 2 trigger mode</td><td>0: Single trigger
1: Continuous trigger</td></tr>
<tr><td>10</td><td>Probe 2 trigger signal</td><td>0: DI4 signal
1: Z signal</td></tr>
<tr><td>11</td><td>NA</td><td>-</td></tr>
<tr><td>12</td><td>Probe 2 rising edge latch</td><td>0: OFF
1: ON</td></tr>
<tr><td>13</td><td>Probe 2 falling edge latch</td><td>0: OFF
1: ON</td></tr>
<tr><td>14-15</td><td>NA</td><td>-</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr><th>60B9h</th><th colspan="5">-</th></tr>
<tr><td>Index</td><td>60B9h</td><td colspan="4">-</td></tr>
<tr><td>Name</td><td colspan="5">Probe Status</td></tr>
<tr><td>Object Structure</td><td>VAR</td><td>Data Type</td><td>Uint16</td><td>Data Range</td><td>Uint16</td></tr>
<tr><td>Mapping</td><td>Y</td><td>W/R</td><td>RO</td><td>Default</td><td>0</td></tr>
</table>

Function	It indicates the Probe 1 and Probe 2 status.

Bit	Setting
0	0: Probe 1 disabled 1: Probe 1 enabled
1	Probe 1 rising edge latch not performed Probe 1 rising edge latch performed
2	Probe 1 falling edge latch not performed Probe 1 falling edge latch performed
3~6	Probe 1 execution count
7	0: DI3 low level 1: DI3 high level
8	0: Probe 2 disabled 1: Probe 2 enabled
9	Probe 2 rising edge latch not performed Probe 2 rising edge latch performed
10	Probe 2 falling edge latch not performed Probe 1 falling edge latch performed
11~14	Probe 2 execution count
15	0: DI4 low level 1: DI4 high level

60BAh	-				
Index	60BAh	-			
Name	Probe 1 Rising Edge Position Feedback				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RO	Default	0
Function	Set to display the position at the moment of the rising edge of the Probe 1 (reference unit).				

60BBh	-				
Index	60BBh	-			
Name	Probe 1 Falling Edge Position Feedback				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RO	Default	0
Function	Set to display the position at the moment of the falling edge of the Probe 1 (reference unit).				

60BCh	-	
Index	60BCh	-

Name	Probe 2 Rising Edge Position Feedback				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RO	Default	0
Function	Set to display the position at the moment of the rising edge of the Probe 2 (reference unit).				

60BDh	-				
Index	60BDh	-			
Name	Probe 2 Falling Edge Position Feedback				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RO	Default	0
Function	Set to display the position at the moment of the falling edge of the Probe 2 (reference unit).				

60E0h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	60E0h	-						
Name	Positive Torque Limit							
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16			
Mapping	Y	W/R	RW	Default	3000			
Function	Set the limit to the positive torque (unit: 0.1%).							

60E1h	-	PP	PV	PT	HM	CSP	CSV	CST
Index	60E1h	-						
Name	Negative Torque Limit							
Object Structure	VAR	Data Type	Uint16	Data Range	Uint16			
Mapping	Y	W/R	RW	Default	3000			
Function	Set the limit to the negative torque (unit: 0.1%).							

60F4h		PP	HM	CSP	
Index	60F4h	-			
Name	Position Deviation Feedback				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RO	Default	0
Function	It indicates the real time position deviation in reference unit.				

60FCh		PP	HM	CSP
Index	60FCh	-		

Name	Motor Position Reference*				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RO	Default	0
Function	It indicates the motor's real-time position reference (unit before electronic gear: increments). User Position Reference (6062h) × Position Factor (6091h) = Motor Position Reference (60FCh)				

60FDh	-	HM	CSP	PP	CSV	PV	CST	PT
Index	60FDh	-						
Name	Digital Input							
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32			
Mapping	Y	W/R	RO	Default	0			
Function	It indicates the current digital output terminal logic of the drive, 0 indicating invalid and 1 indicating valid. The DI signals on each bit are as follows:							

MSB					LSB
31~16	15~4	3	2	1	0
Manufacturer-defined	Reserved	Undefined	Home signal	Positive limit switch	Negative limit switch

60FEh	-	PP	PV	PT	HM	CSP	CSV	CST
Index	60FEh	-						
Name	Digital Output							
Object Structure	ARR	Data Type	Uint32	Data Range	Uint32			
Mapping	Y	W/R	RO	Default	0			

Subindex	00h	-			
Name	Entry Number				
Object Structure	VAR	Data Type	Uint8	Data Range	1
Mapping	N	W/R	RO	Default	1

Subindex	01h	-			
Name	Physical Output				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32

Mapping	Y	W/R	RO	Default	0
Function	It indicates the current digital output terminal logic of the drive, 0 indicating invalid and 1 indicating valid. The DO signals on each bit are as follows: MSB LSB 31~16: Manufacturer-defined; 15~1: Reserved; 0: Brake engage signal				

MSB		LSB
31~16	15~1	0
Manufacturer-defined	Reserved	Brake engage signal

Subindex	02h	-			
Name	Physical Output				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	Y	W/R	RW	Default	0
Function	It indicates the current digital output terminal logic of the drive, 0 indicating invalid and 1 indicating valid. The DO signals on each bit are as follows:				

MSB		LSB	
31~18	17	16	15~0
NA	Force 2	Force 1	NA

60FFh	-			PV	CSV
Index	60FFh	-			
Name	Target Velocity				
Object Structure	VAR	Data Type	Int32	Data Range	Int32
Mapping	Y	W/R	RW	Default	0
Function	It indicates the user speed reference (unit: user speed/s).				

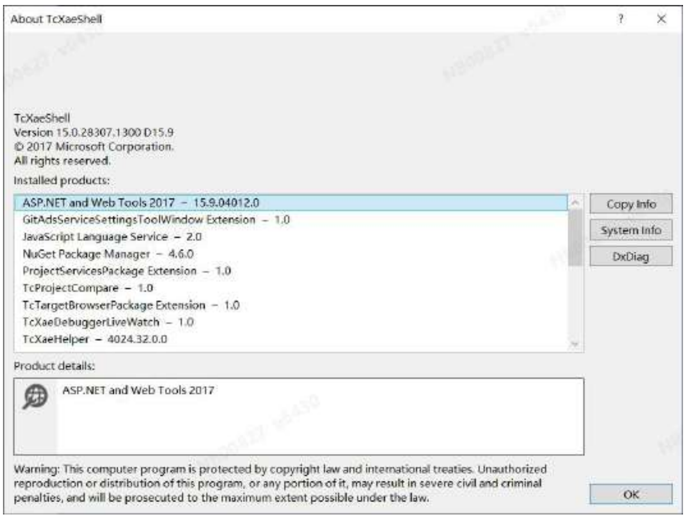
6502h	-				
Index	6502h	-			
Name	6502h: Operation Mode				
Object Structure	VAR	Data Type	Uint32	Data Range	Uint32
Mapping	N	W/R	RO	Default	3EDh

Function	0 in the table means the operation modes are not available yet while 1 means available now.		
	Bit	Setting	Value
	0	Profile position mode (PP)	1
	1	NA	0
	2	Profile velocity mode (PV)	1
	3	Profile torque mode (PT)	1
	4	NA	0
	5	Home mode (HM)	1
	6	Interpolation position mode	0
	7	Cyclic synchronous position mode (CSP)	1
	8	Cyclic synchronous velocity mode (CSV)	1
	9	Cyclic synchronous torque mode (CST)	1
	10~31	Manufacturer-defined	Reserved

9.3.11 TWINCAT3 Example

TwinCAT3, developed by Beckhoff of Germany, is a PC-based real-time automation control platform widely used in industrial control, robotics, servo motor drives, and other fields. This section will demonstrate how to control an SD100-EA machine in EtherCAT Profile Position Mode using the TwinCAT3 platform, accompanied by a simple step-by-step example.

The TwinCAT version used in this example is shown below:

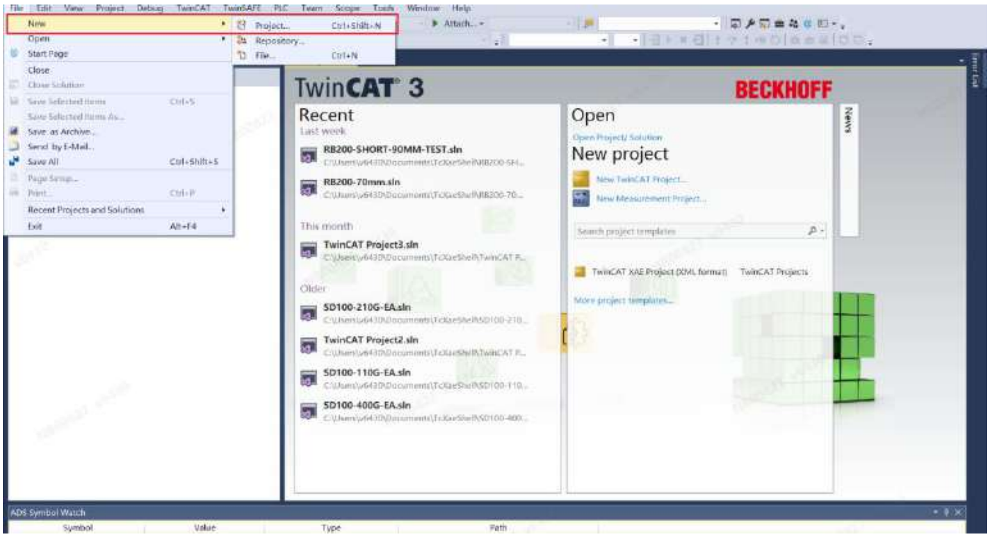


Preparation:

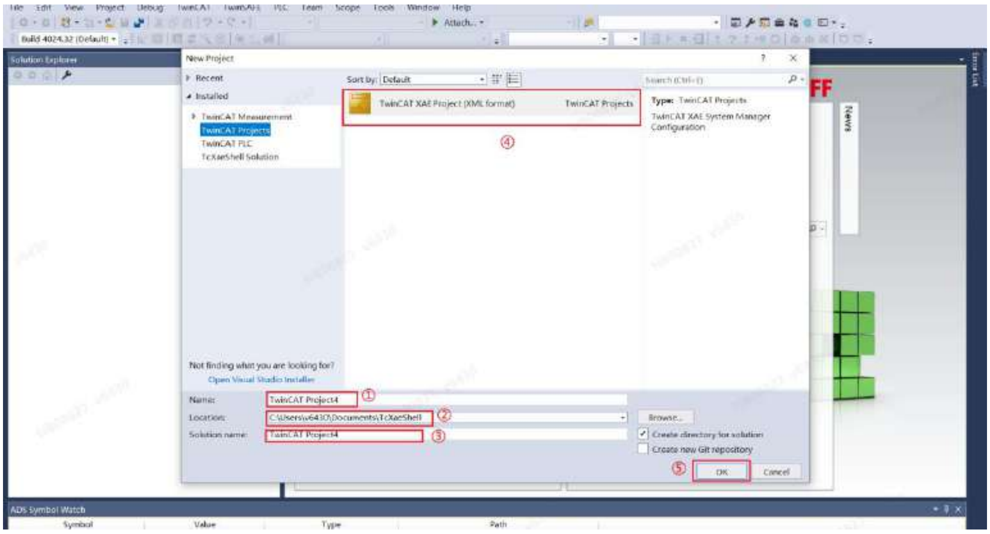
Save the ESI file (in .xml format) provided by the supplier to the following TWINCAT3 installation directory: ...\TwinCAT\3.1\Config\Io\EtherCAT\.

Procedure:

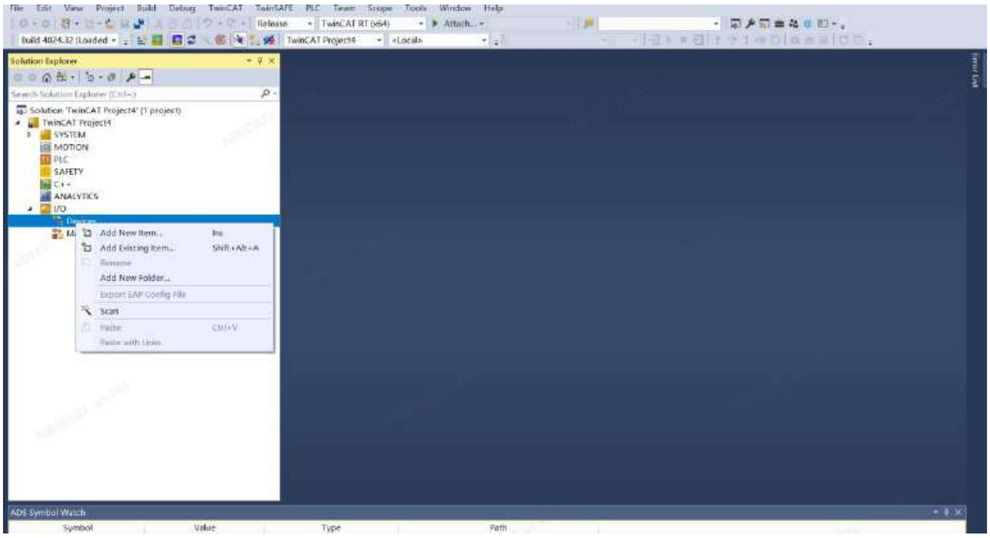
Step 1: Create a new project.



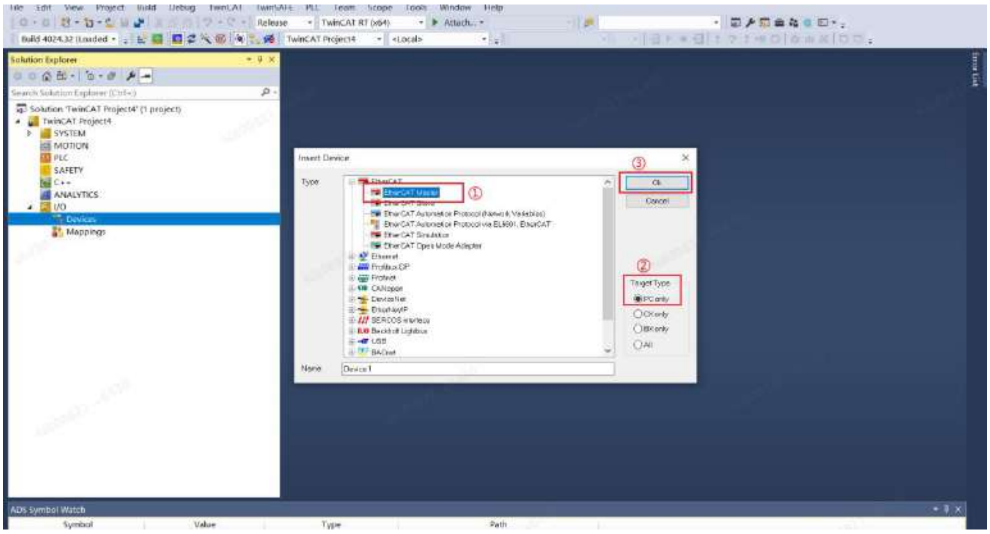
Step 2: Select a project template and fill in the project information.



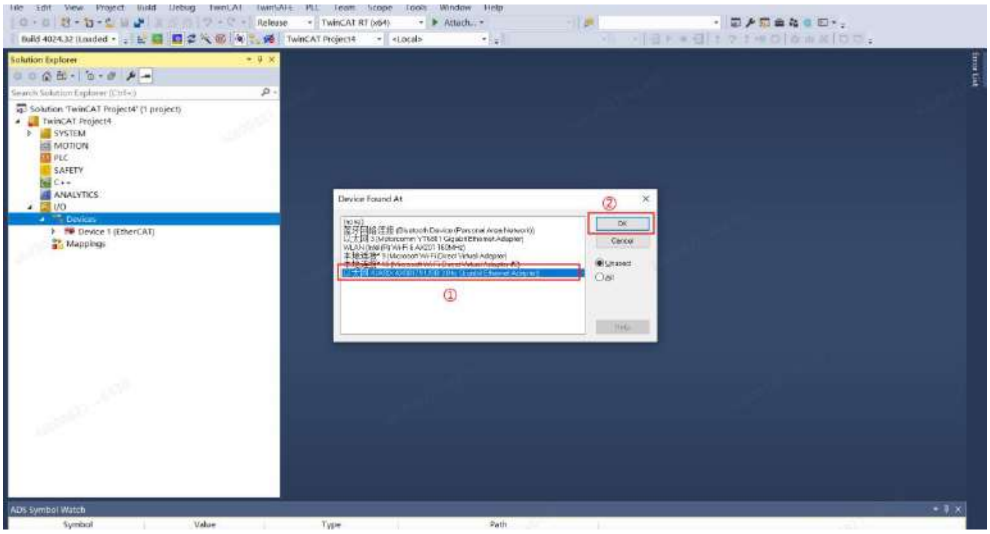
Step 3: Add a new item in the Devices section.



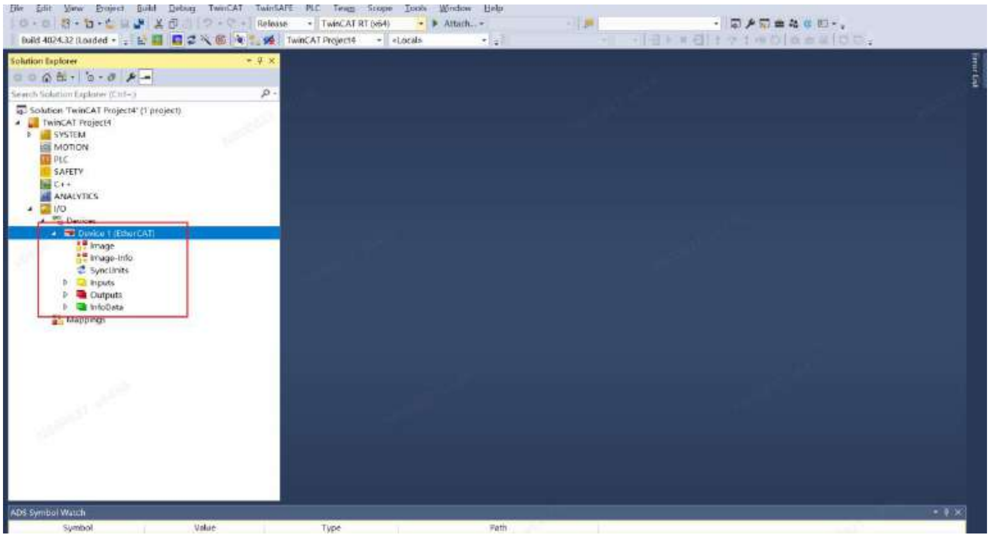
Step 4: Add the EtherCAT Master as the mastER.



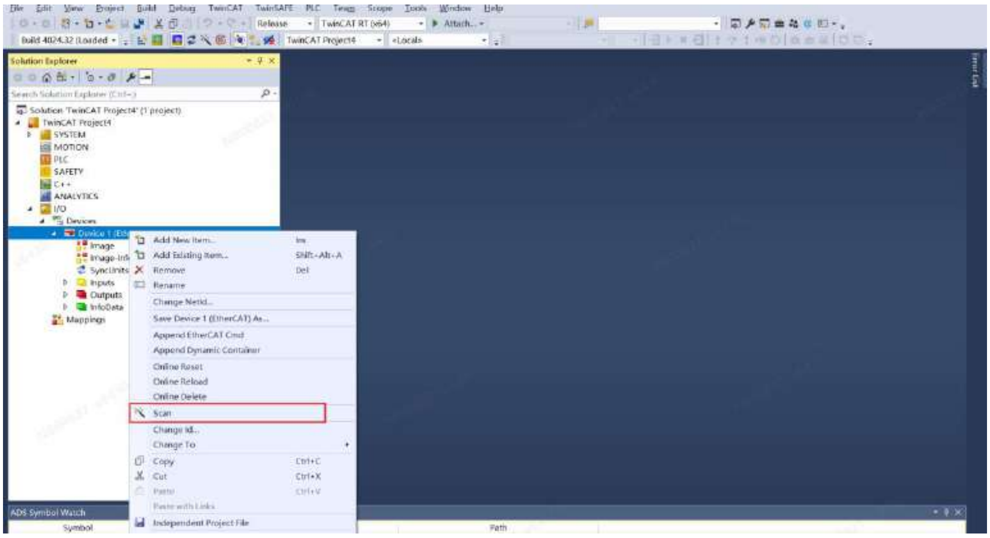
Step 5: Select the computer's network port. If the physical network port where the Ethernet cable is connected cannot be found at this step, please refer to Issue 7 in Section 9.3.12 to install the network port driver for the current computER.



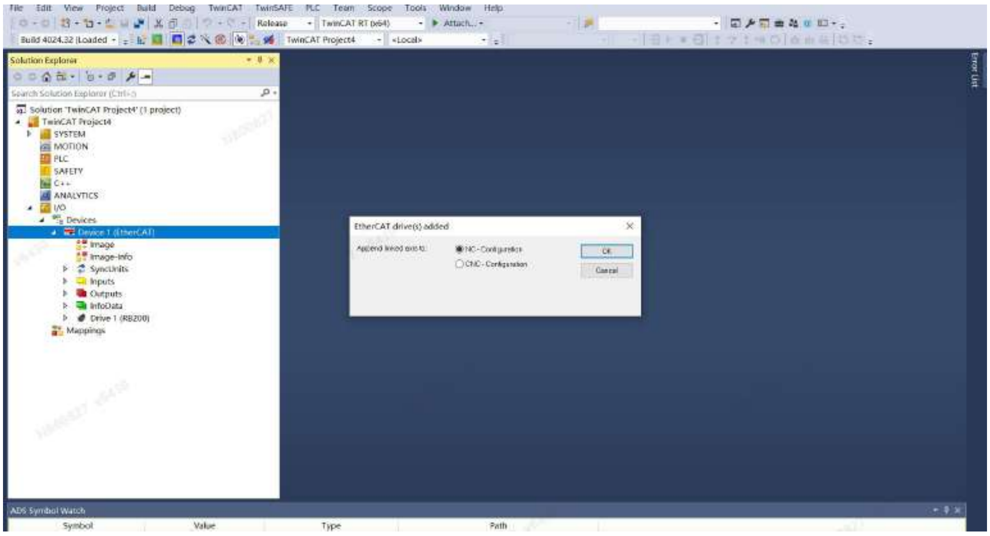
After the addition is completed, you can view the EtherCAT master station information in the Devices section of the project management.



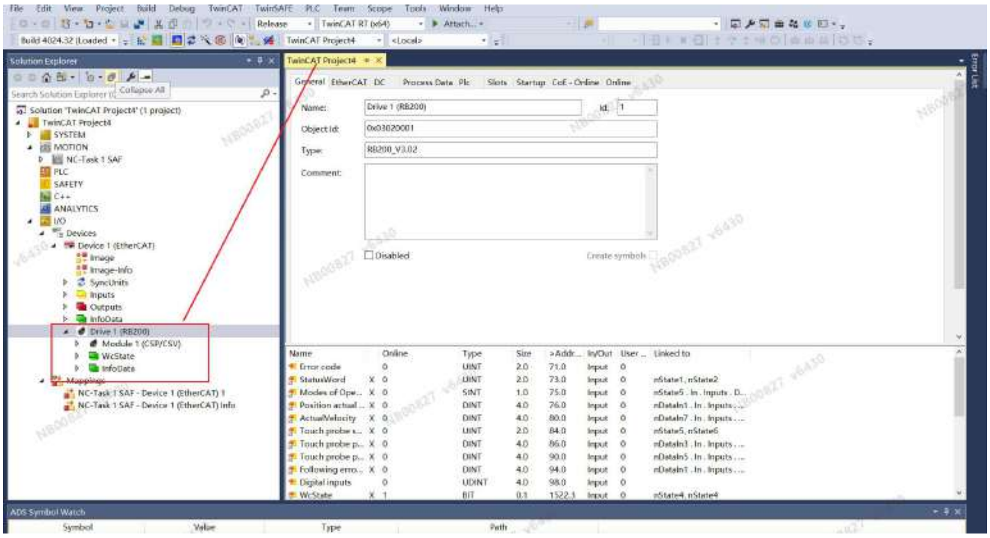
Step 6: Add a slave station under the EtherCAT master station.



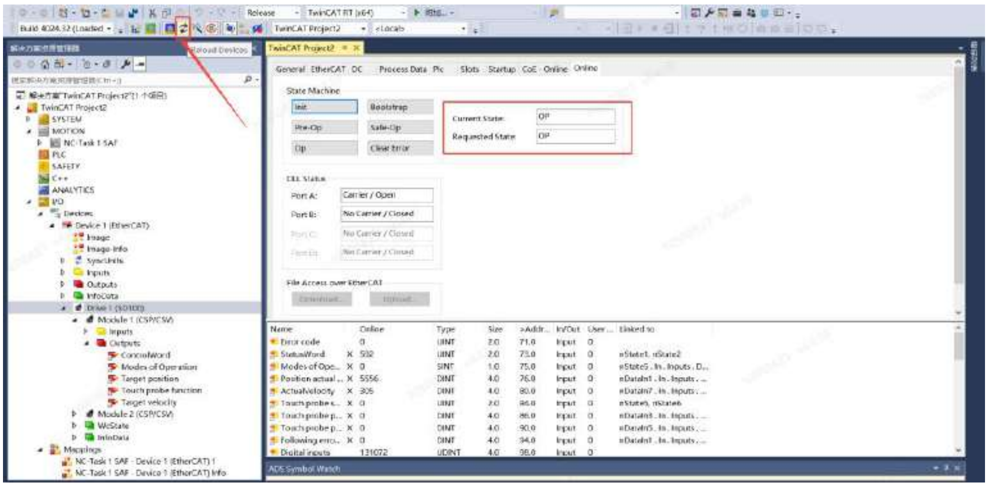
Step 7: Select the NC axis configuration.



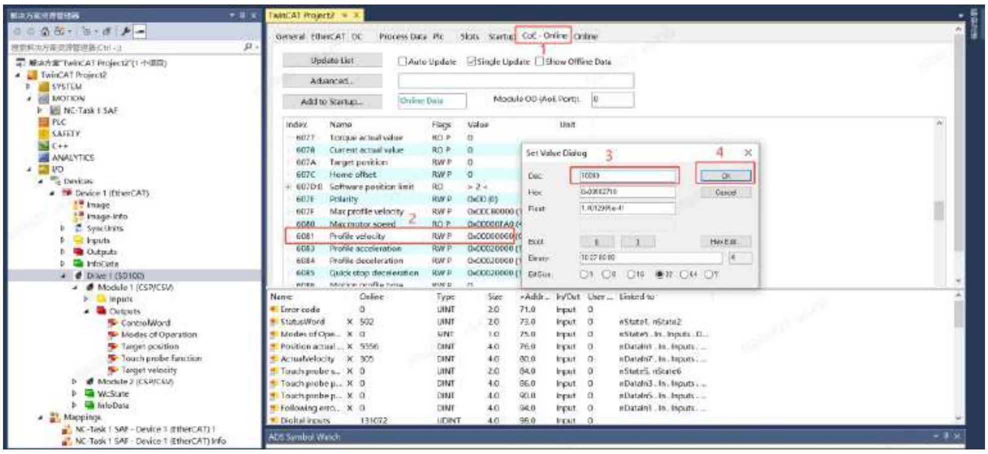
After adding the slave station, you can see that the SD100 slave station has been added under the EtherCAT master station in the Project Manager on the right. Double-click the SD100 slave station name to open its configuration interface.



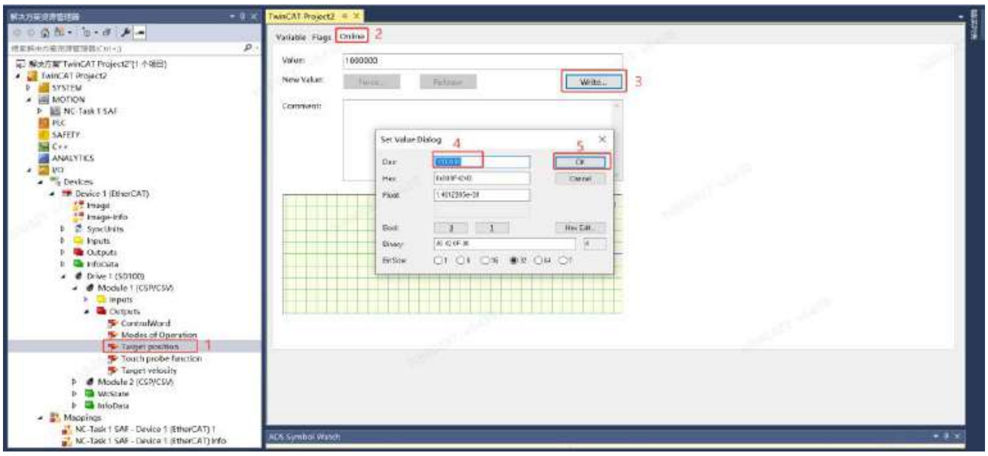
Step 8: Click the Reload Devices button to reset the state machine to the OP (Operation) state.



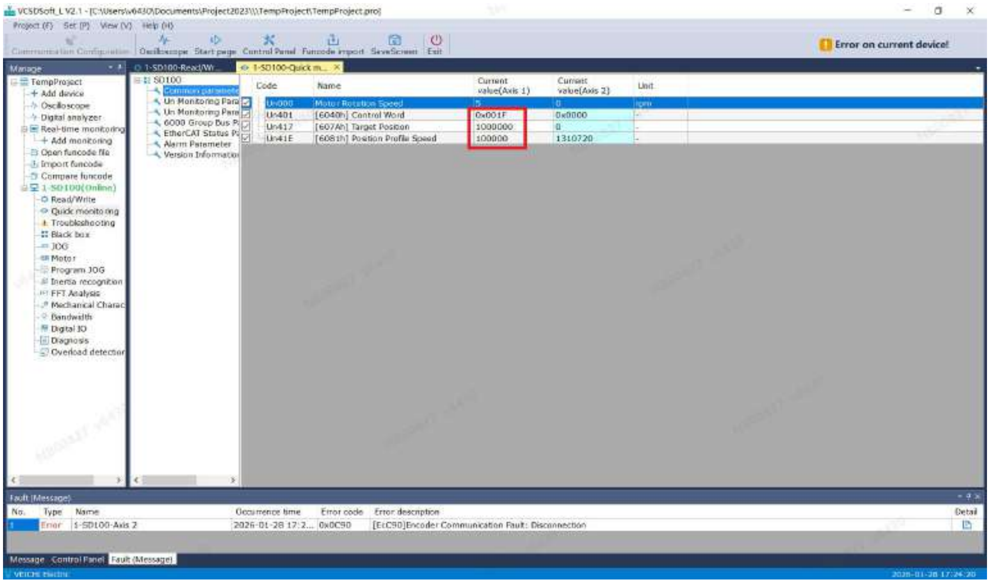
Step 9: In the CoE-Online tab, you can view the object dictionary information recorded by the imported ESI file. Locate object [6081] and write the decimal value 10000.



Step 10: The default RPDO mapping is configured under the Outputs under Drive1 (SD100) on the left. This mapping includes the control word [6040], mode selection [6060], and target position [607A], which are required for this example. These objects can be written via the PDO method. The following example demonstrates writing [607A] = 1000000.



Step 11: After writing the control word [6040] = 6 → 7 → F → 1F, the motor starts rotating. The host computer monitoring parameters are shown in the figure below (electronic gear ratio is 131072:10000).



9.3.12 EtherCAT Troubleshooting

1. Issue:

TwinCAT is unable to detect EtherCAT devices from the installed network adapter (NIC), and only displays RT-Ethernet devices.

Troubleshooting:

(1) Refer to the TwinCAT configuration procedure and ensure the network adapter (NIC) is correctly installed.

(2) Verify that the wiring is properly connected and the EtherCAT network status is normal (check error code Un032).

(3) Confirm that the function code Pn000.Z is set to "EtherCAT Model" (Pn000.Z = 2).

2. Issue:

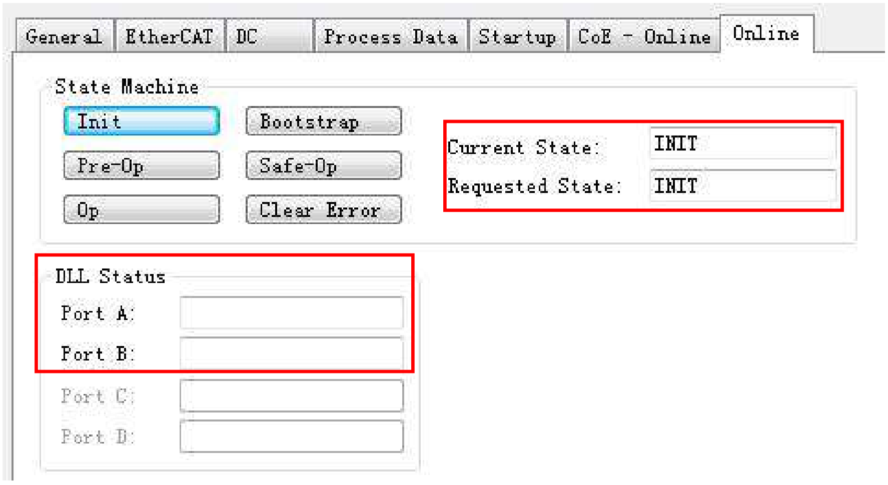
When scanning devices with TwinCAT, the dialog box shows "New device type found," as illustrated in the figure below:

Troubleshooting:

Copy the SD100 XML file to the TwinCAT software folder (typically located at C:\TwinCAT\IO\EtherCAT), and restart the TwinCAT system.

3. Issue:

TwinCAT displays "INIT" in the "Current State" field and a blank "DLL Status" field for EtherCAT status in Config Mode, as shown in the figure below:



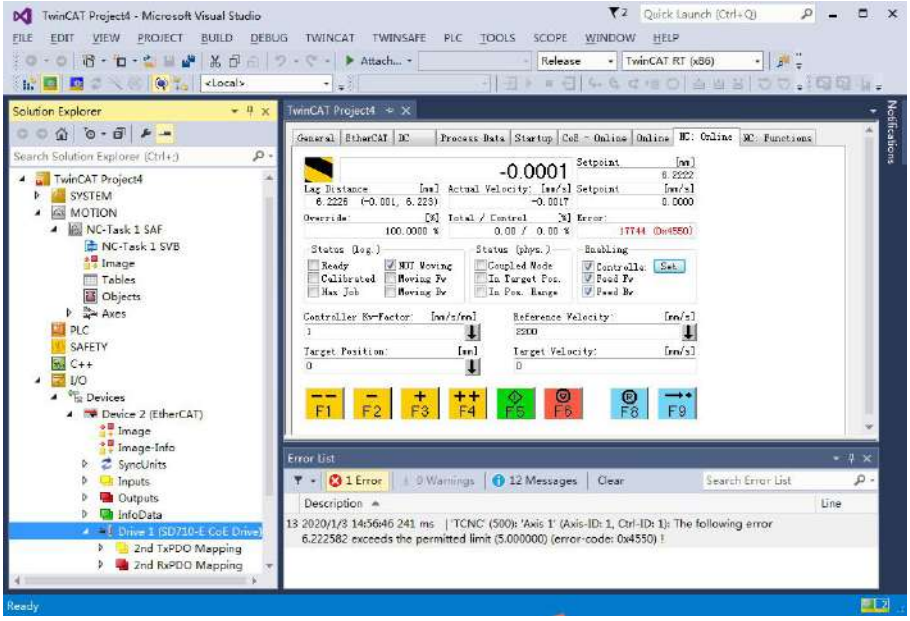
Troubleshooting:

(1) Set function code Pn000.Z to 2 (EtherCAT model).

(2) Check the wiring status of the EtherCAT communication ports between the host controller and the drive via function code Un032.

4. Issue:

TwinCAT displays "Following Error" (Error-code: 0x4550).



Troubleshooting:

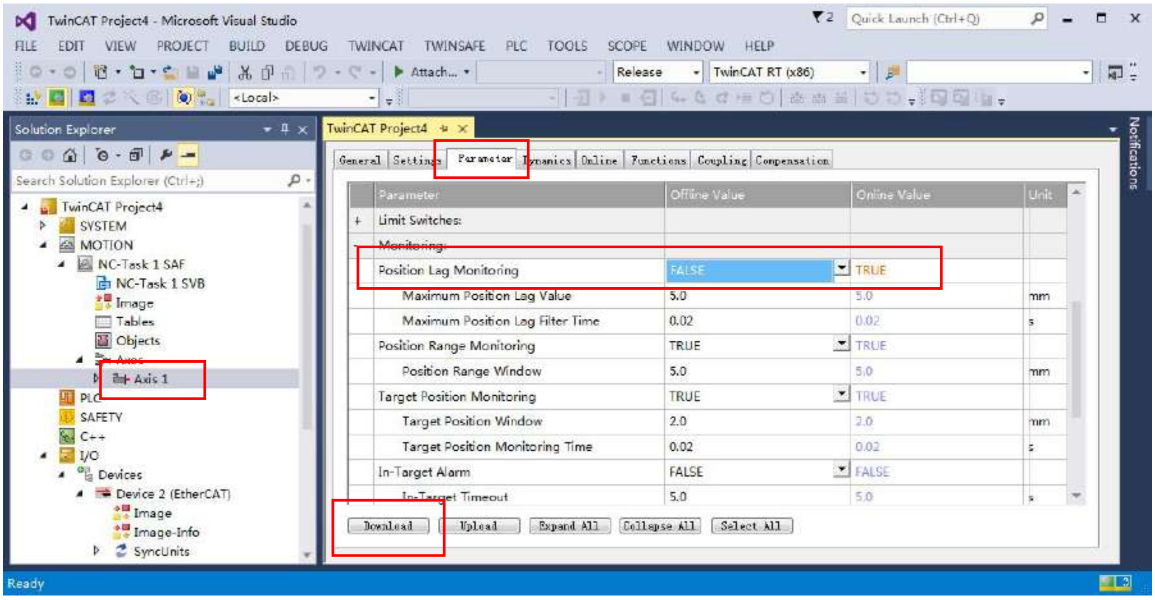
Check if the drive has any erros or alarms, and resolve them if present.

Set the "Following Error Calculation" to "Extern":

Step 1: Select "Axis 1" in the left window.

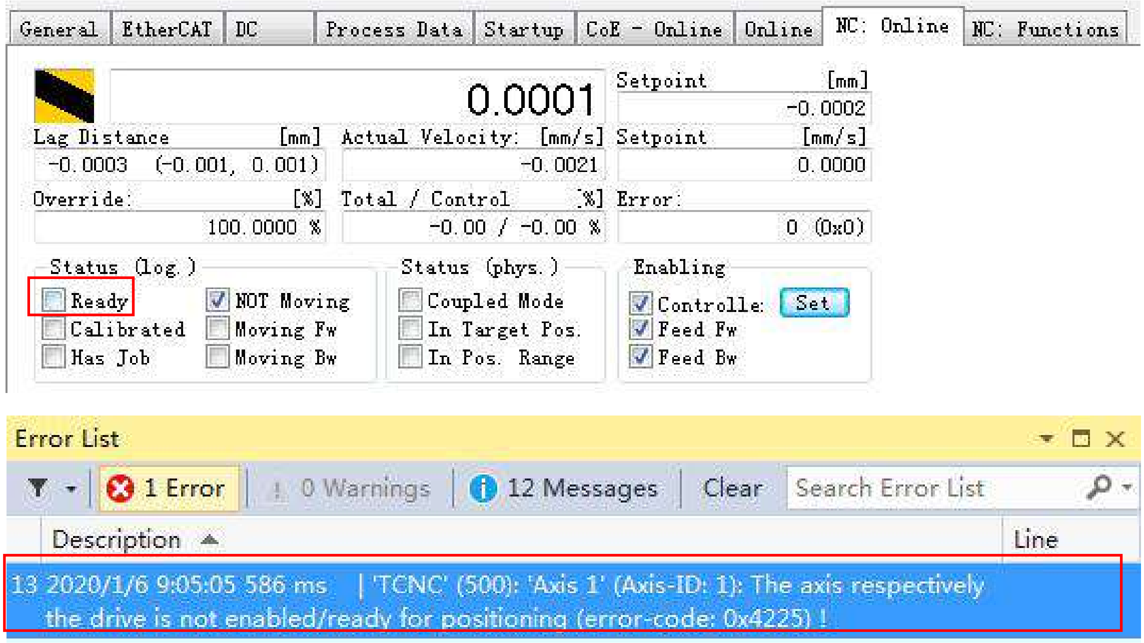
Step 2: Under the "Parameter" tab, set "Position Lag Monitoring" to "False".

Step 3: Click "Download" and select "OK" in the pop-up dialog.



5. Issue:

In NC mode, after enabling the drive, the "Ready" status remains inactive. When attempting "Forward" or "Reverse" jogging, fault code 0x4225 appears.



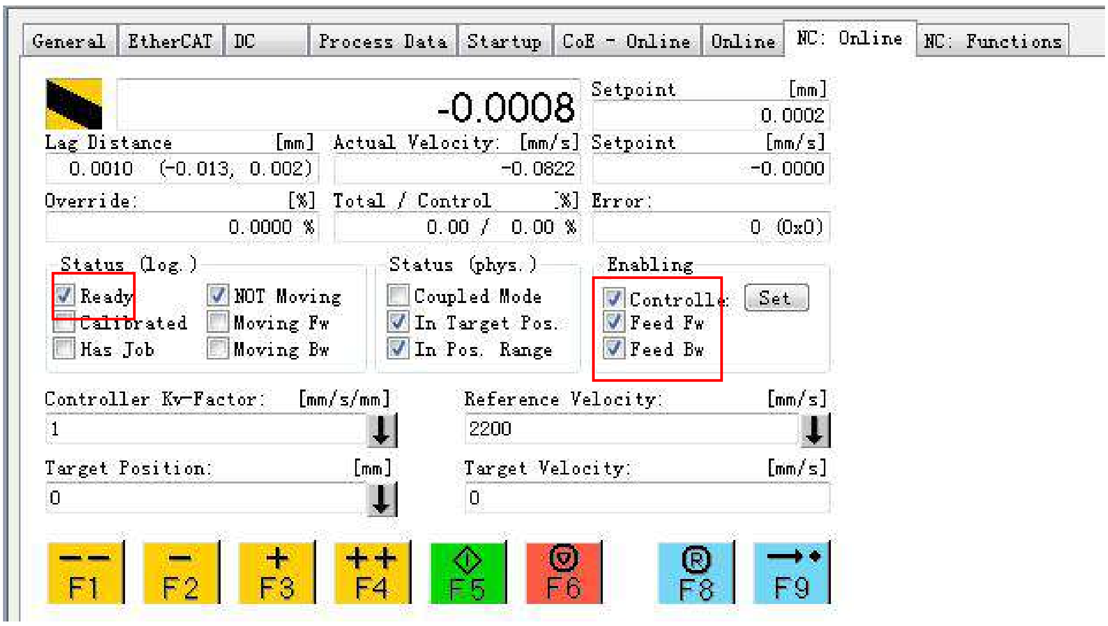
Troubleshooting:

(1) Check if the drive currently has any faults.

(2) Verify whether the main power supply is connected to the drive.

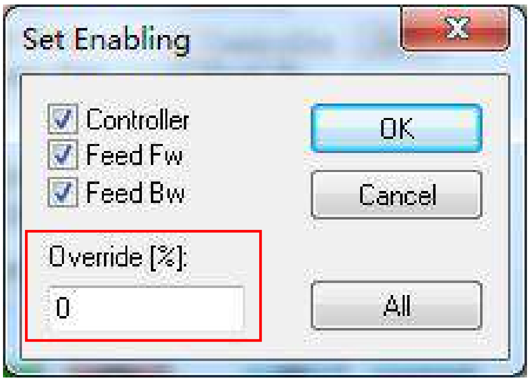
6. Issue:

In NC mode, after enabling the drive, the "Ready" status becomes active, and "Forward" or "Reverse" jogging is allowed. However, the motor does not rotate during jogging.



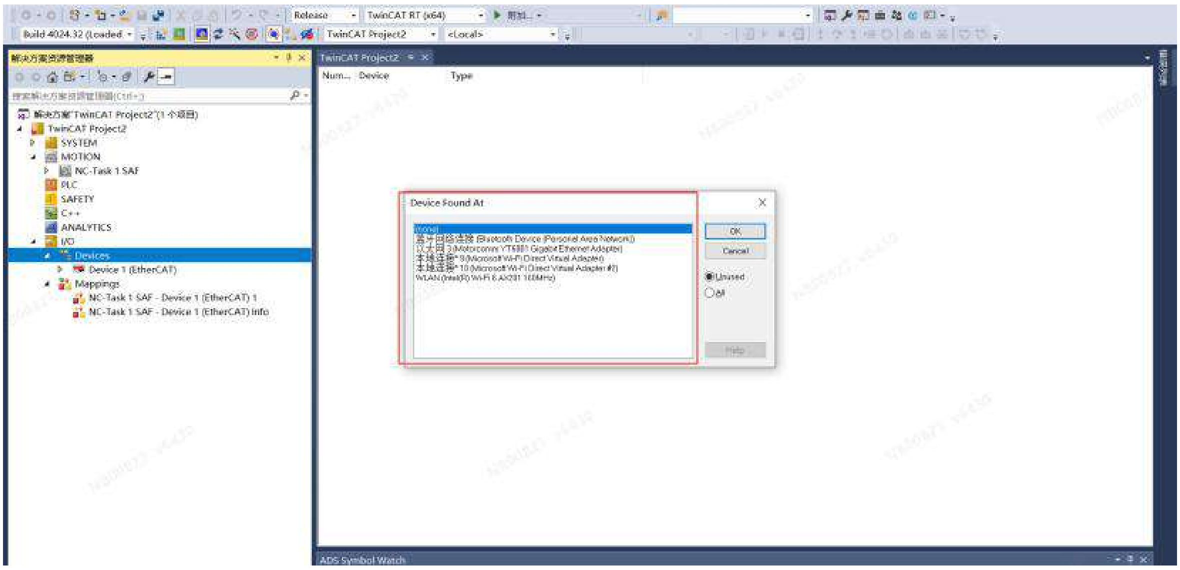
Troubleshooting:

After pressing the "Set" button, check if the "Override(%)" value is 0. If so, change it to a non-zero value.



7. Issue

When adding the EtherCAT Master, the network port selection dialog for device scanning does not display the physical network port currently in use on the PC, as shown in the figure below.



Troubleshooting:

This issue occurs because the EtherCAT driver is not installed for the device. To resolve it:

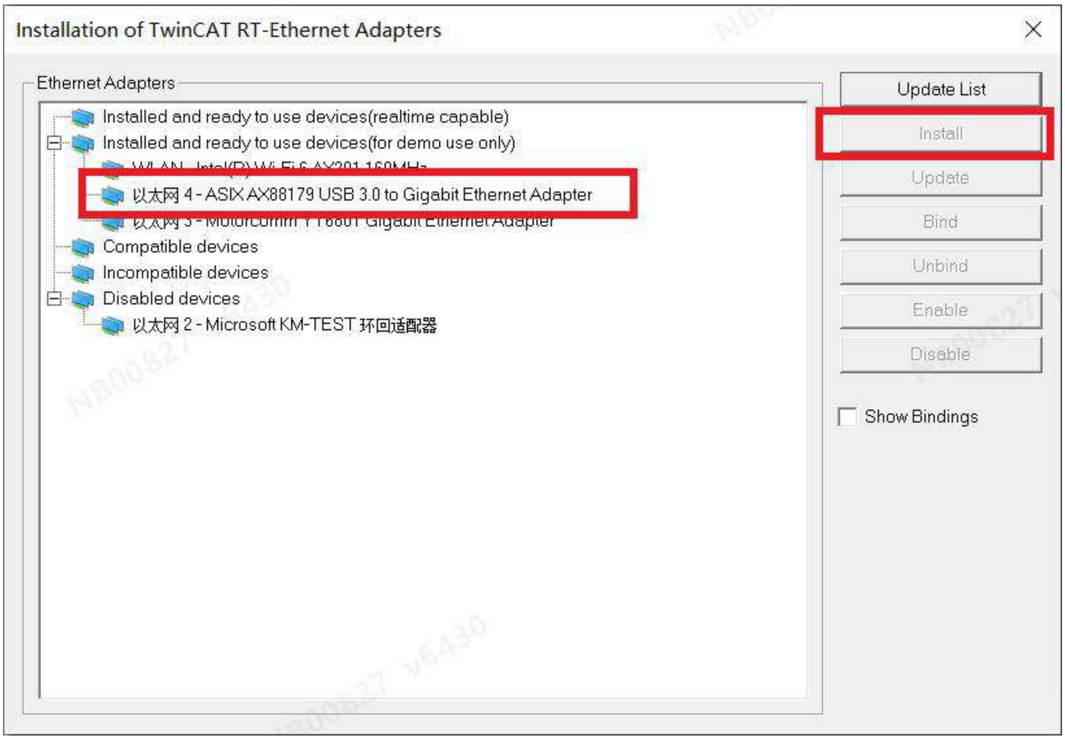
1. Navigate to the TwinCAT installation directory: C:\TwinCAT\3.1\System.

2. Locate and run the executable file TcRteInstall.exe as an administrator.

3. Select the network adapter that requires the driver installation.

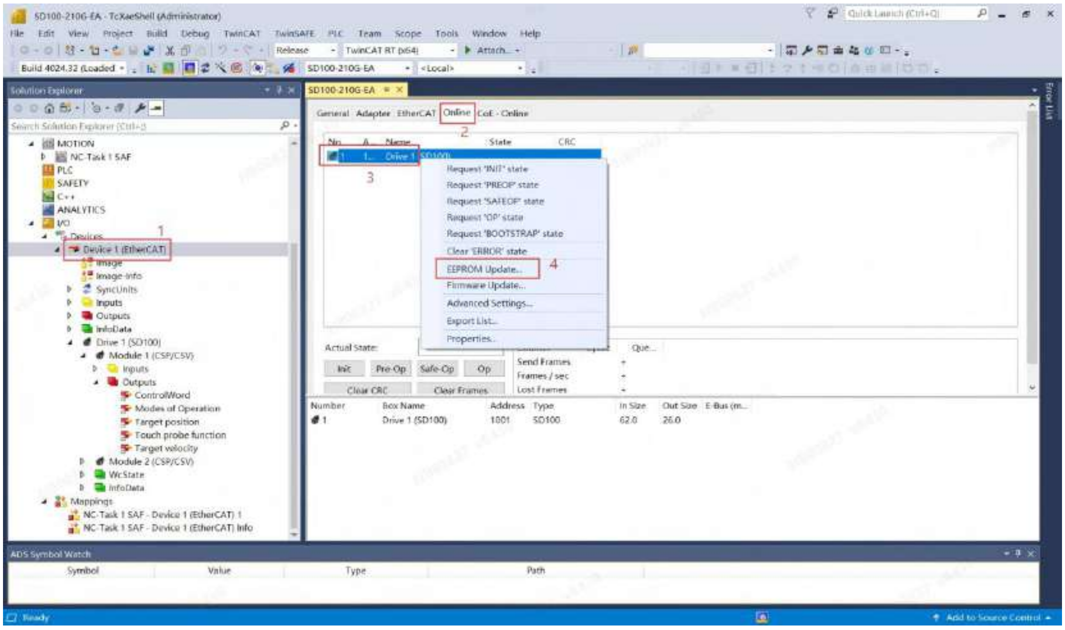
4. Click Install.

After successful installation, the network port will appear under the "Installed and ready to use devices" level, as shown in the figure below.



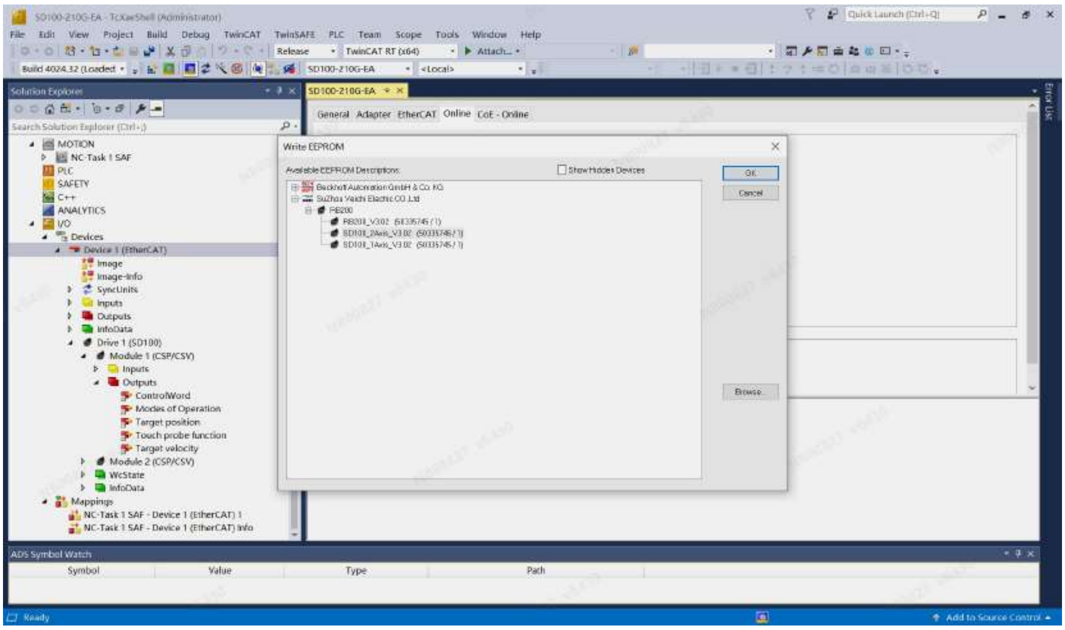
8. Issue

When it is necessary to update the ESI file (with the .xml extension) for the drive currently in use, users can independently update the ESC chip's EEPROM via TwinCAT 3, provided they have the corresponding version of the ESI file.



Troubleshooting:

Select the file that matches the actual product specifications, then click "OK" to proceed with the EEPROM update.



9.4 Error Diagnosis

Display	Name	Error Code	Auxiliary Code
ER.020	User parameter and parity error	0x6000	0x00000020
ER.021	Function code parameter formatting error	0x6001	0x00000021
ER.02	Parameter and parity error	0x6002	0x00000022
ER.023	MCU and FPGA communication error	0x6003	0x00000023
ER.030	FPGA running back code error	0x6004	0x00000030
ER.040	Parameter setting out of range error	0x6005	0x00000040
ER.042	Parameter combination error	0x6007	0x00000042
ER.050	Motor-drive capacity mismatch error	0x6009	0x00000050
ER.0B0	Invalid servo-ON reference error	0x600C	0x000000B0
ER.100	Drive software overcurrent error	0x600D	0x00000100
ER.101	Drive hardware overcurrent error	0x600E	0x00000101
ER.320	Regenerative overload error	0x6010	0x00000320
ER.400	Overvoltage error	0x6012	0x00000400
ER.410	Undervoltage error	0x6013	0x00000410
ER.42A	KTY temp. sensor overheat error	0x6014	0x0000042A
ER.450	DI terminal assignment conflict error	0x6015	0x00000450
ER.451	DO terminal assignment conflict error	0x6016	0x00000451
ER.452	Torque mode AI assignment error	0x6017	0x00000452
ER.520	Vibration error	0x6018	0x00000520
ER.521	No-tuning vibration error	0x6019	0x00000521
ER.710	Instantaneous drive overload error	0x601A	0x00000710
ER.711	Instantaneous motor overload error	0x601B	0x00000711

ER.720	Continuous drive overload error	0x601C	0x00000720
ER.721	Continuous motor overload error	0x601D	0x00000721
ER.730	Dynamic brake overload alarm	0x601E	0x00000730
ER.7A0	Drive overheat error	0x6020	0x000007A0
ER.810	Abs encoder multi-turn data error	0x6023	0x00000810
ER.820	Abs encoder data parity error	0x6024	0x00000820
ER.830	Abs encoder battery low error	0x6025	0x00000830
ER.840	Multi-turn upper limit direction error	0x6026	0x00000830
ER.860	Absolute encoder overheat error	0x6028	0x00000860
ER.890	Invalid motor ID error	0x6029	0x00000890
ER.8A1	Home timeout error	0x602C	0x000008A1
ER.B31	U-phase circuit error	0x6034	0x00000B31
ER.B32	V-phase circuit error	0x6035	0x00000B32
ER.B33	W-phase circuit error	0x6036	0x00000B33
ER.BF0	System operation error SCANB	0x6039	0x00000BF0
ER.BF2	MCU-FPGA data transfer error	0x603B	0x00000BF2
ER.BF3	Pulse reference source error	0x603C	0x00000BF3
ER.C10	Overspeed error	0x603E	0x00000C10
ER.C21	Abs encoder multi-turn overflow error	0x6040	0x00000C21
ER.C80	Incremental encoder division setting error	0x6047	0x00000C80
ER.C90	Encoder disconnection error	0x6048	0x00000C90
ER.C91	Encoder acceleration error	0x6049	0x00000C91
ER.C92	Incremental encoder z signal loss error	0x604A	0x00000C92
ER.C95	Encoder UVW signal error	0x604B	0x00000C95
ER.D00	Excessive position deviation error	0x6050	0x00000D00
ER.D01	Servo-ON excessive position deviation error	0x6051	0x00000D01
ER.D02	Servo-ON excessive position deviation error due to speed limit	0x6052	0x00000D02
ER.D03	Excessive hybrid deviation (motor feedback position & optical encoder feedback)	0x6053	0x00000D03
ER.D04	Electronic gear ratio setting over range error	0x6054	0x00000D04
ER.E00	EtherCAT chip error	0x6055	0x00000E00
ER.E01	EtherCAT EEPROM load error	0x6056	0x00000E01
ER.E02	EtherCATSM0/SM1 mailbox data length error	0x6057	0x00000E02
ER.E03	Home mode error	0x6058	0x00000E03
ER.E05	Operation mode not supported by the drive	0x605A	0x00000E05
ER.E20	CANopen master disconnection (life factor)	0x6064	0x00000E20
ER.E21	CANopen master disconnection (consumer time)	0x6065	0x00000E21

9.5 Home Mode Description

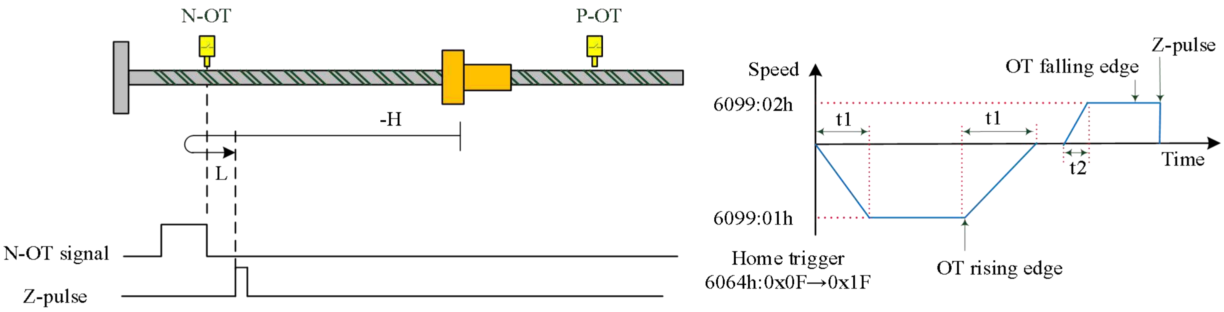
9.5.1 Home Mode 1 (6098h=1)

Home signal: Z signal

Deceleration point signal: /N-OT

(1) Deceleration Point Signal OFF during Homing

Trajectory: /N-OT=0, home mode starts in reverse direction at high speed until /N-OT rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after the falling edge of /N-OT.

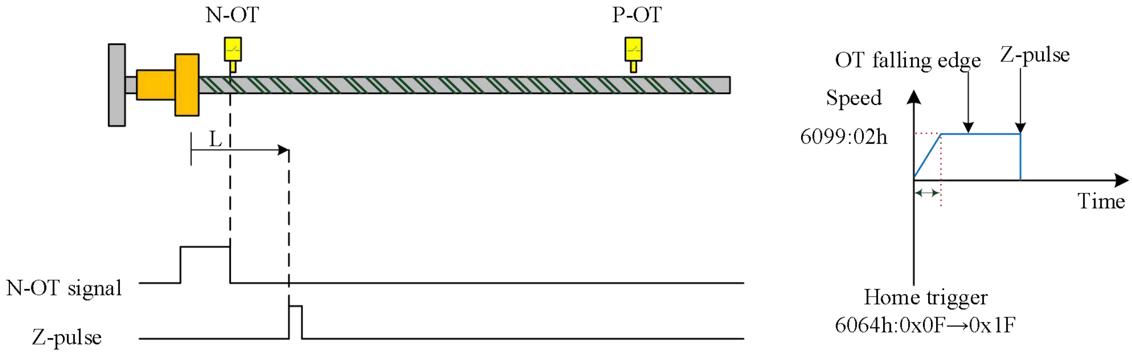


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

A.6098h=1, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /N-OT=1, home mode starts in forward direction at low speed, and stops at the first Z-phase signal after the falling edge of /N-OT.



$$t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

b.6098h=1, initial deceleration point signal = ON

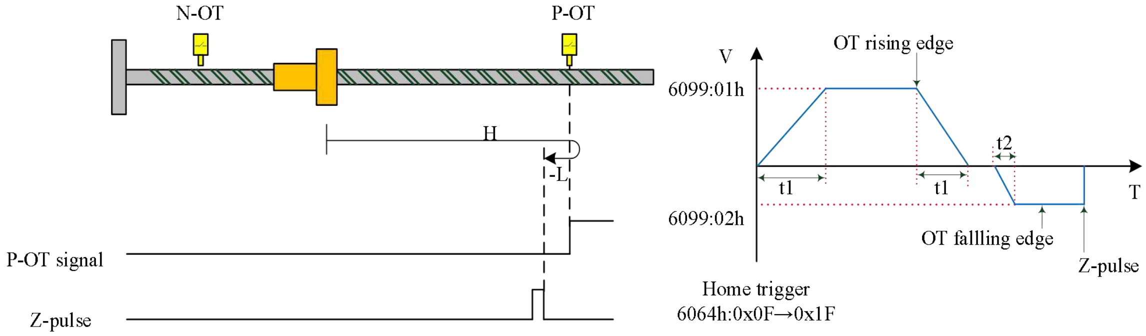
9.5.2 Home Mode 2 (6098h=2)

Home signal: Z signal

Deceleration point signal: /P-OT(positive overtravel)

(1) Deceleration Point Signal OFF during Homing

Trajectory: /P-OT=0, home mode starts in forward direction at high speed until /P-OT rising edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after the falling edge of /P-OT.

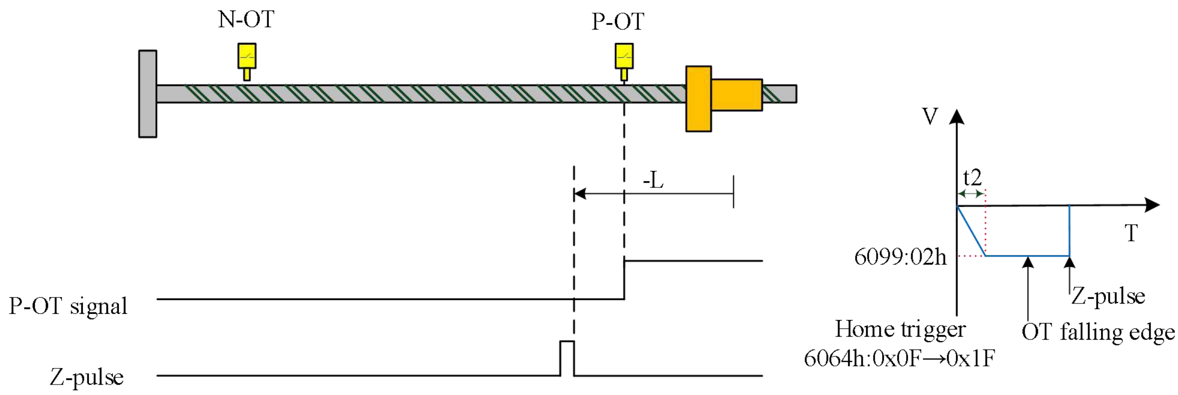


$$t_1 = \frac{6099:01h}{609Ah}(s),\ t_2 = \frac{6099:02h}{609Ah}(s)$$

A.6098h=2, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /P-OT=1, home mode starts in reserve direction at low speed, and stops at the first Z-phase signal after the falling edge of /P-OT.



$$t_2 = \frac{6099:02h}{609Ah}(s)$$

b.6098h=2, initial deceleration point signal = ON

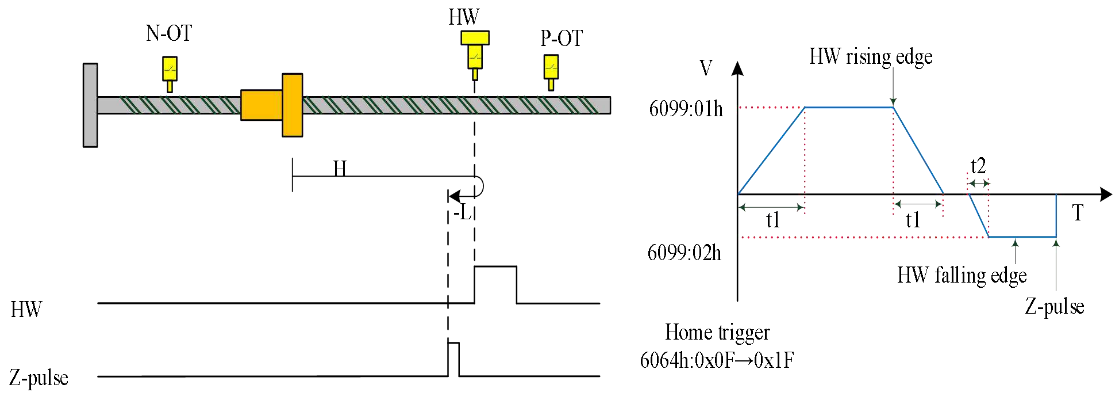
9.5.3 Home Mode 3 (6098h=3)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in forward direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW falling edge.

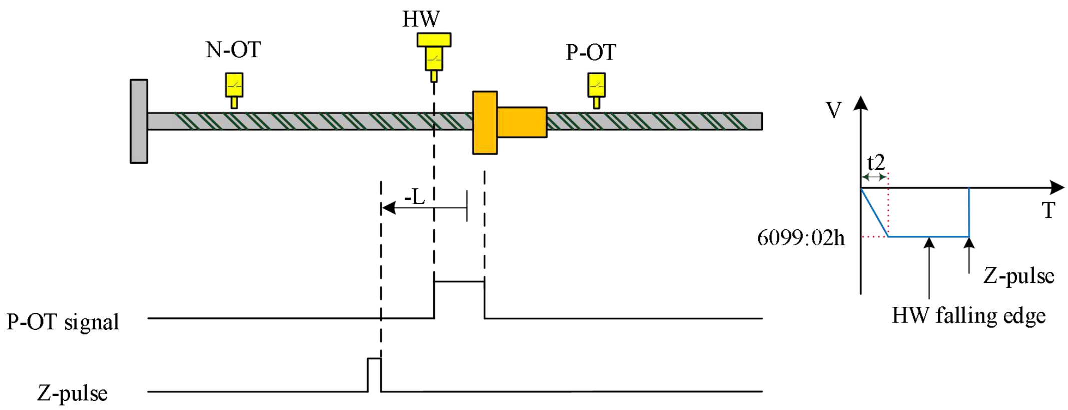


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ t_2 = \frac{6099{:}02h}{609Ah}(s)$$

A.6098h=3, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in reserve direction at low speed, and stops at the first Z-phase signal after /HW falling edge.



$$t_2 = \frac{6099{:}02h}{609Ah}(s)$$

b.6098h=3, initial deceleration point signal = ON

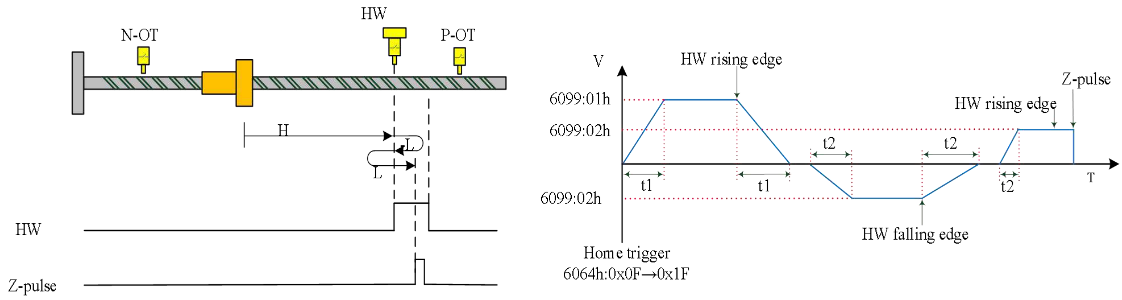
9.5.4 Home Mode 4 (6098h=4)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in forward direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction until /HW falling edge, and stops at the first Z-phase signal after /HW rising edge.

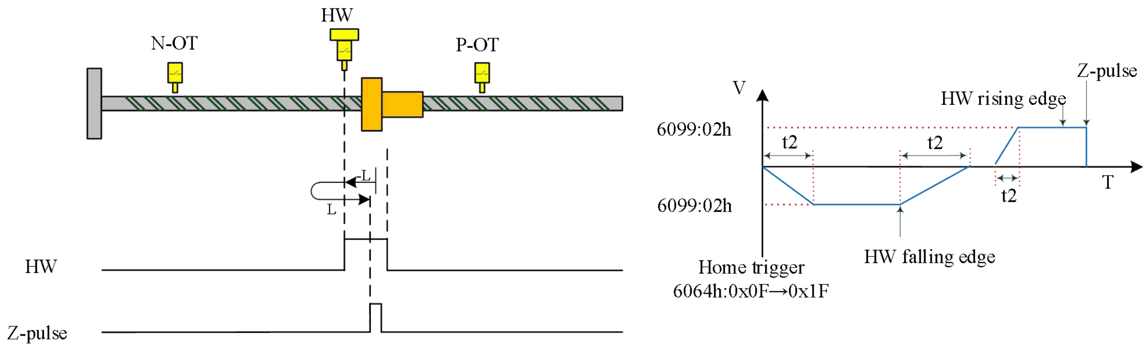


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\ \ t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

A.6098h=4, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in reverse direction at low speed until /HW falling edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=4, initial deceleration point signal = ON

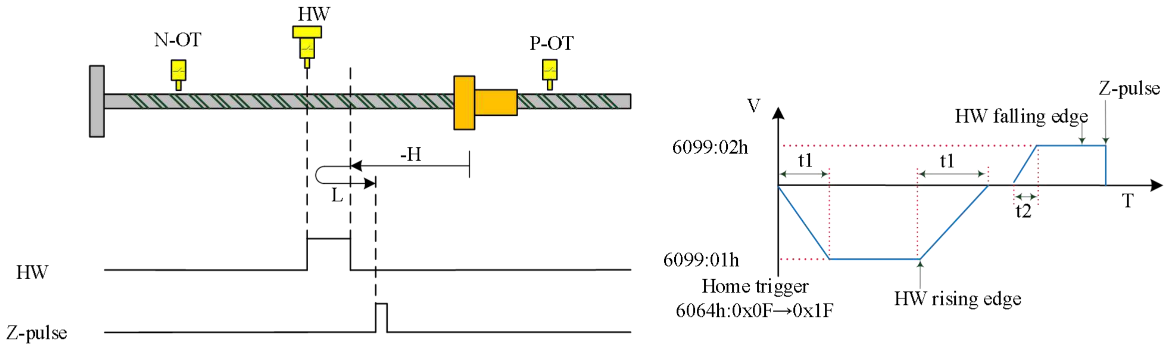
9.5.5 Home Mode 5 (6098h=5)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW falling edge.

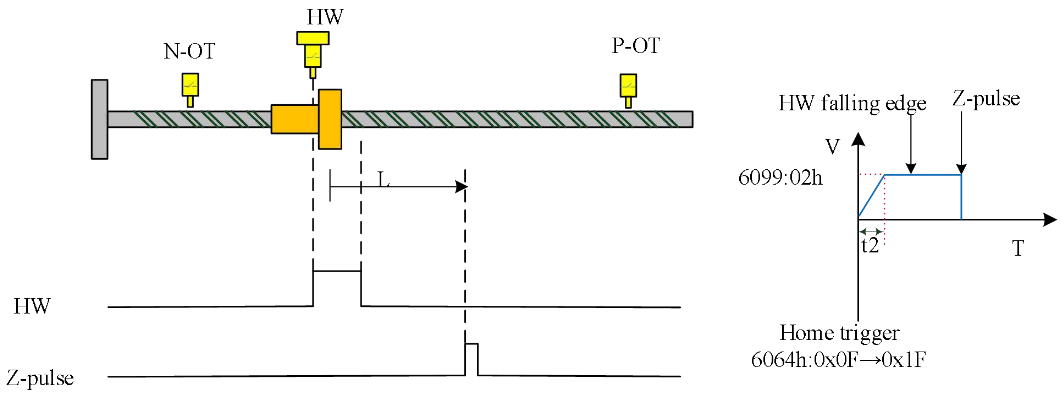


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\ t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

A.6098h=5, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in forward direction at low speed, and stops at the first Z-phase signal after /HW falling edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=5, initial deceleration point signal = ON

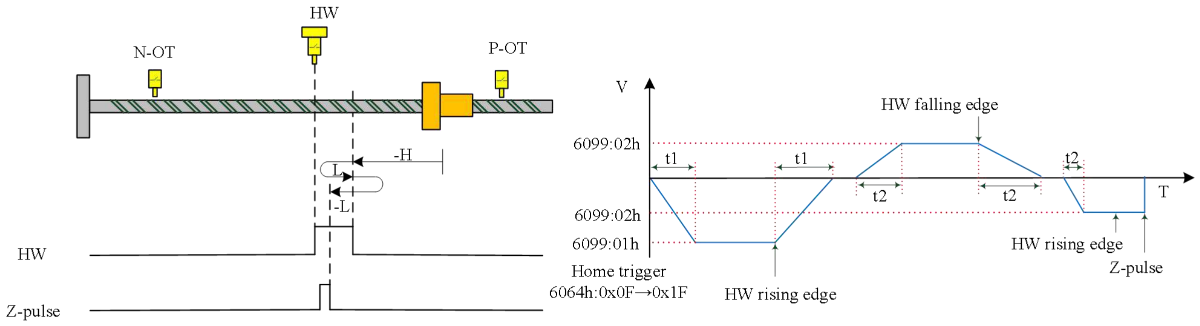
9.5.6 Home Mode 6 (6098h=6)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.

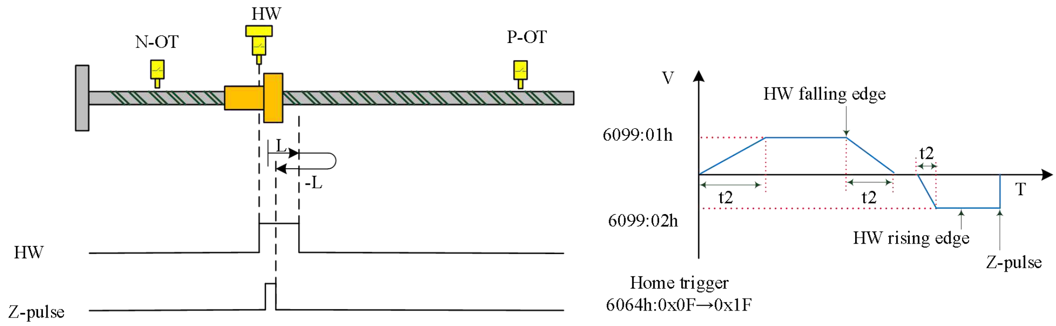


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ t_2 = \frac{6099{:}02h}{609Ah}(s)$$

A.6098h=6, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in forward direction at low speed until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.



$$t_2 = \frac{6099{:}02h}{609Ah}(s)$$

b.6098h=6, initial deceleration point signal = ON

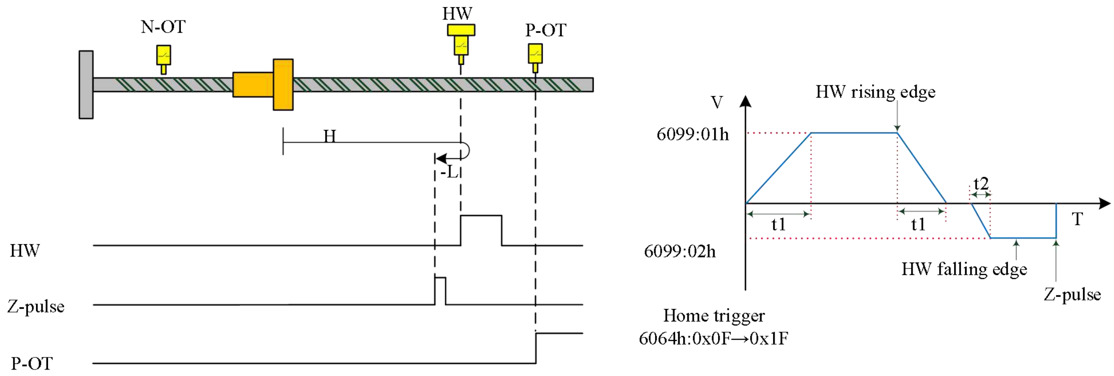
9.5.7 Home Mode 7 (6098h=7)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with no /P-OT until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW falling edge.

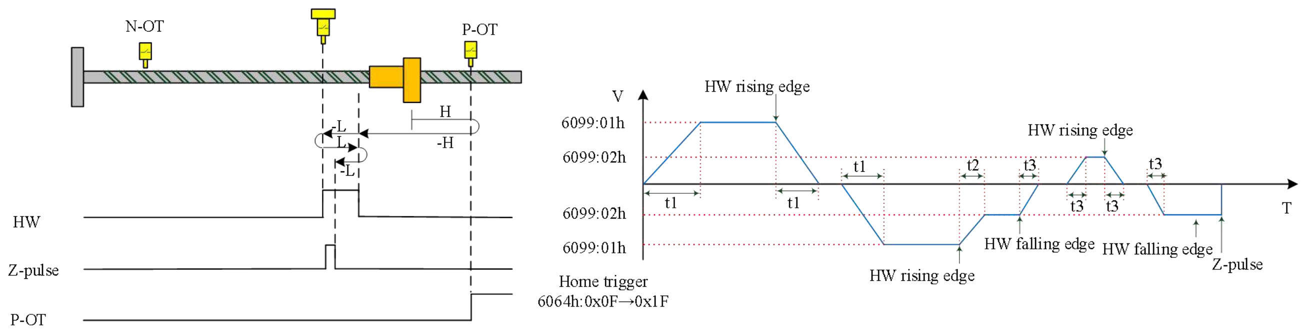


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

a.6098h=7, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /P-OT, reverses direction→runs at high speed in reverse direction until /HW rising edge, decelerates→runs at low speed in reverse direction until /HW falling edge, decelerates→ reverses direction→runs at low speed in forward direction until /HW rising edge, decelerates→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW falling edge.

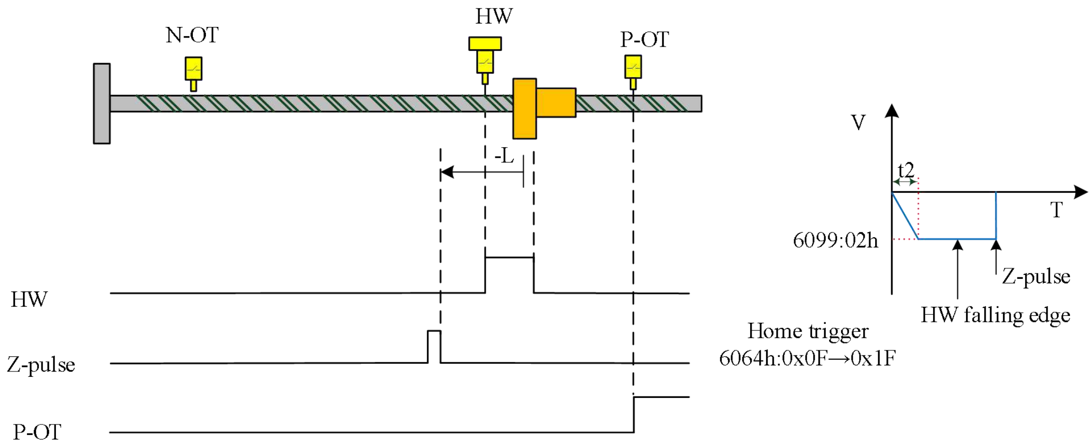


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\quad t_2 = \frac{\text{(6099:01h)}-\text{(6099:02h)}}{\text{609Ah}}(s),\quad t_3 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

b.6098h=7, initial deceleration point signal = OFF, with no /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in reserve direction at low speed, and stops at the first Z-phase signal after /HW falling edge.



$$t_2 = \frac{6099{:}02h}{609Ah}(s)$$

c.6098h=7, initial deceleration point signal = ON, with no /P-OT

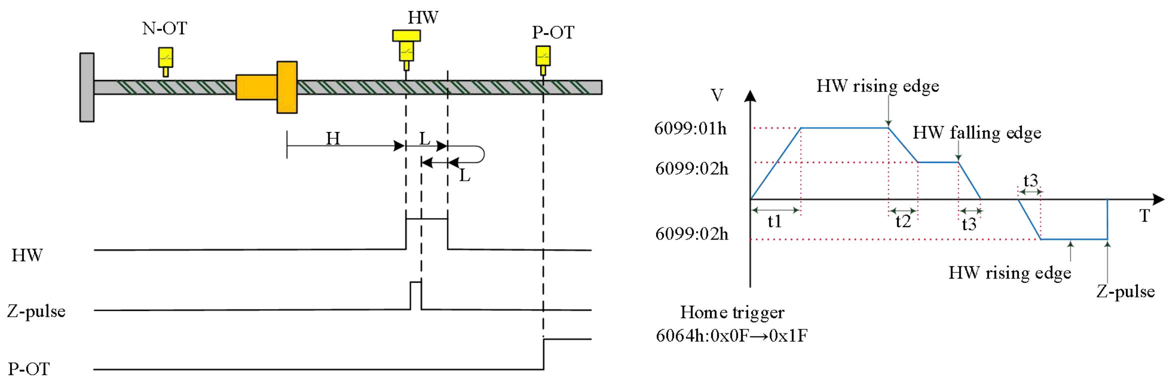
9.5.8 Home Mode 9 (6098h=9)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with no /P-OT until /HW rising edge, decelerates→runs at low speed in forward direction until /HW falling edge, reverses directions→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.

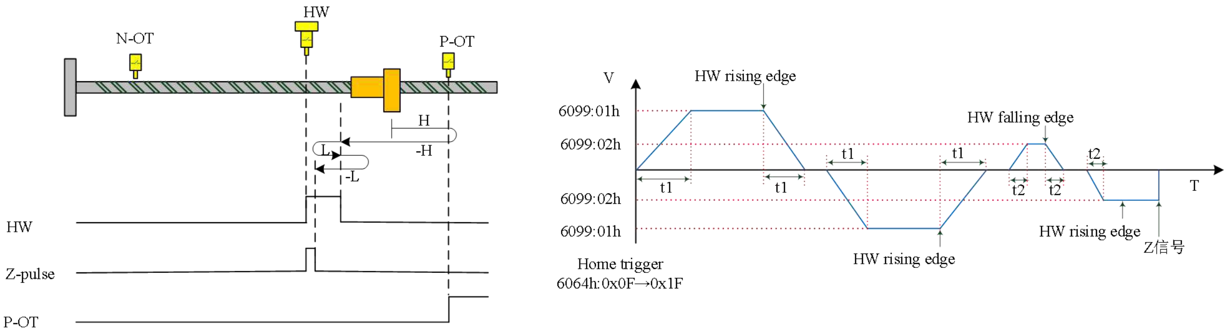


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\quad t_2 = \frac{(6099{:}01h)-(6099{:}02h)}{609Ah}(s),\quad t_3 = \frac{6099{:}02h}{609Ah}(s)$$

a.6098h=9, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /P-OT, reverses directions→runs at high speed in reverse direction until /HW rising edge, decelerates→runs at low speed in forward direction until the /HW falling edge, reverses directions→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.

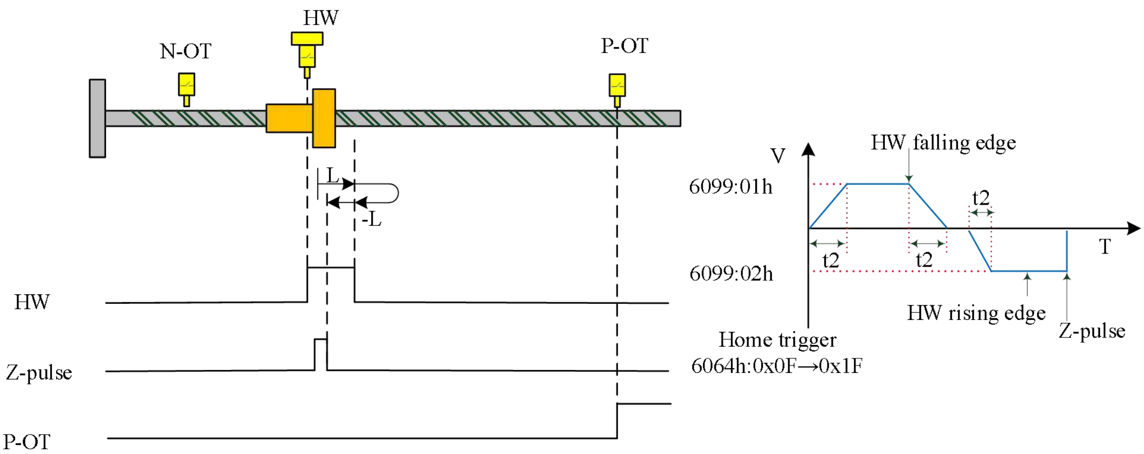


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\ t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=9, initial deceleration point signal = OFF, with /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in forward direction at high speed until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=9, initial deceleration point signal = ON, with no /P-OT

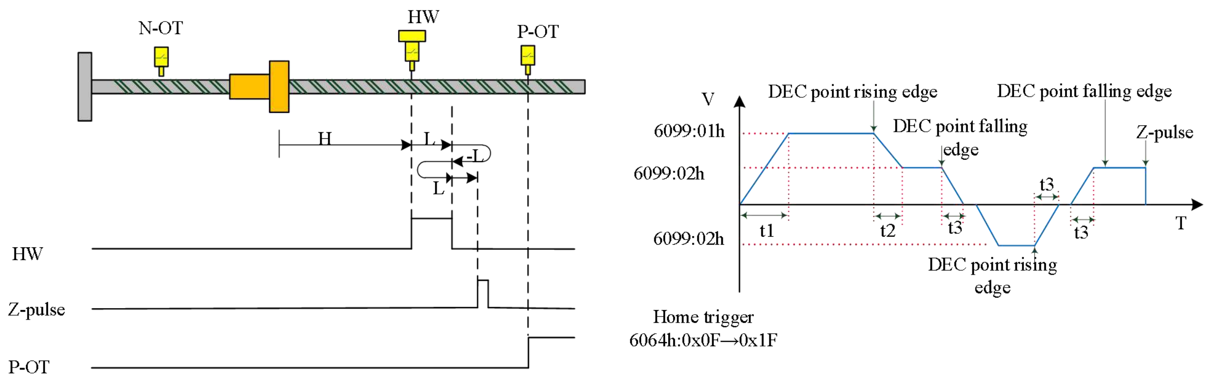
9.5.9 Home Mode 10 (6098h=10)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /HW rising edge, decelerates→runs at low speed in forward direction until /HW falling edge, decelerates→runs at low speed in reverse direction until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW falling edge.

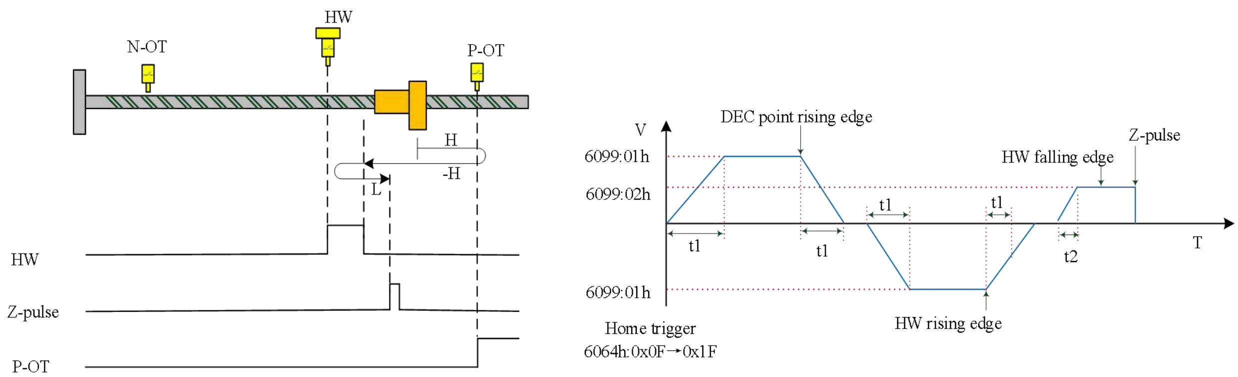


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ \ t_2 = \frac{(\text{6099:01h})-(\text{6099:02h})}{\text{609Ah}}(s),\ \ t_3 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

a.6098h=10, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /P-OT, reverses directions→runs at high speed in reverse direction until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.

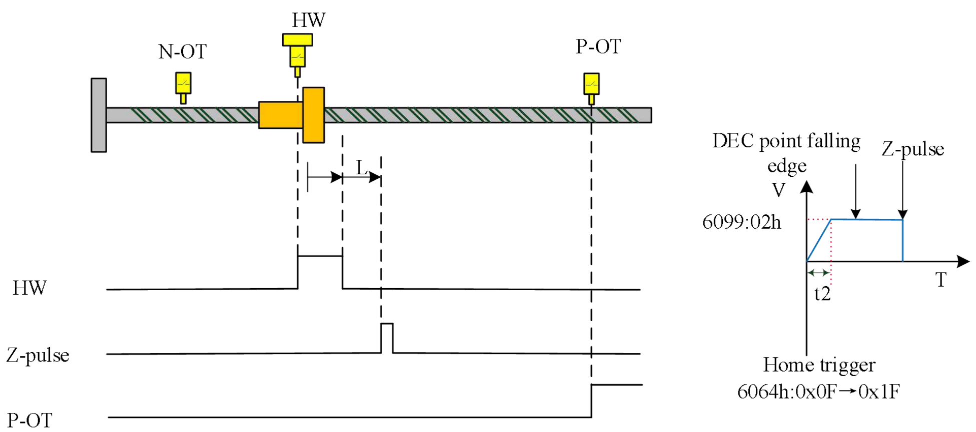


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ \ t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

b.6098h=10, initial deceleration point signal = OFF, with /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in forward direction at low speed, and stops at the first Z-phase signal after /HW falling edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=10, initial deceleration point signal = ON, with no /P-OT

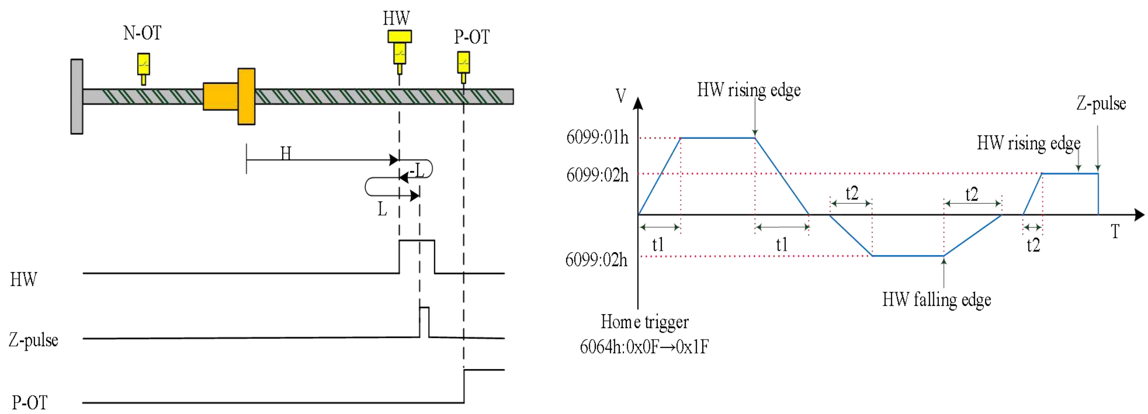
9.5.10 Home Mode 8 (6098h=8)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with no /P-OT until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction until /HW falling edge, reverses directions→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.



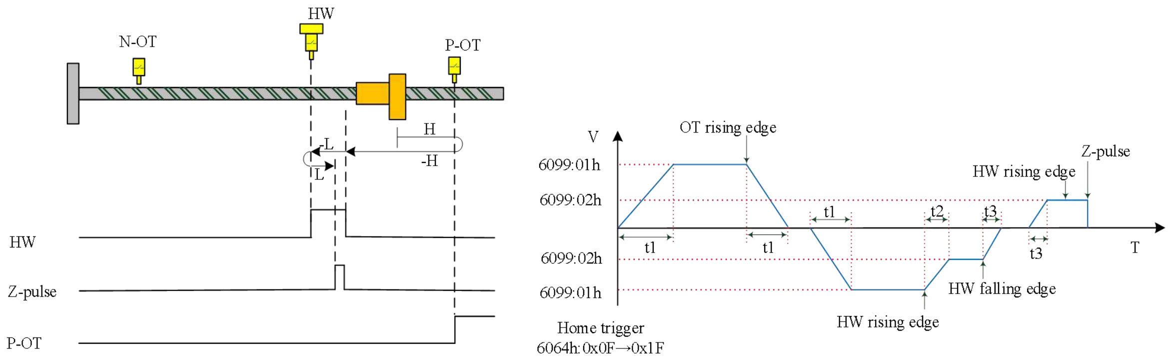
$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\ t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=8, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with until /P-OT, reverses direction→runs at high speed in reverse direction

until /HW rising edge, decelerates→runs at low speed in reverse direction until /HW falling edge, reverses directions→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.

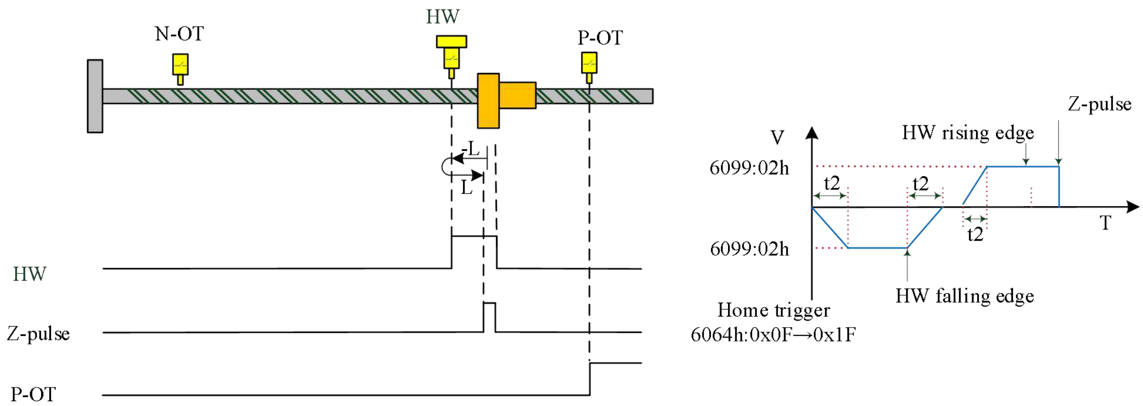


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s),\quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=8, initial deceleration point signal = OFF, with /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in reverse direction at low speed until /HW falling edge, reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=8, initial deceleration point signal = ON, with no /P-OT

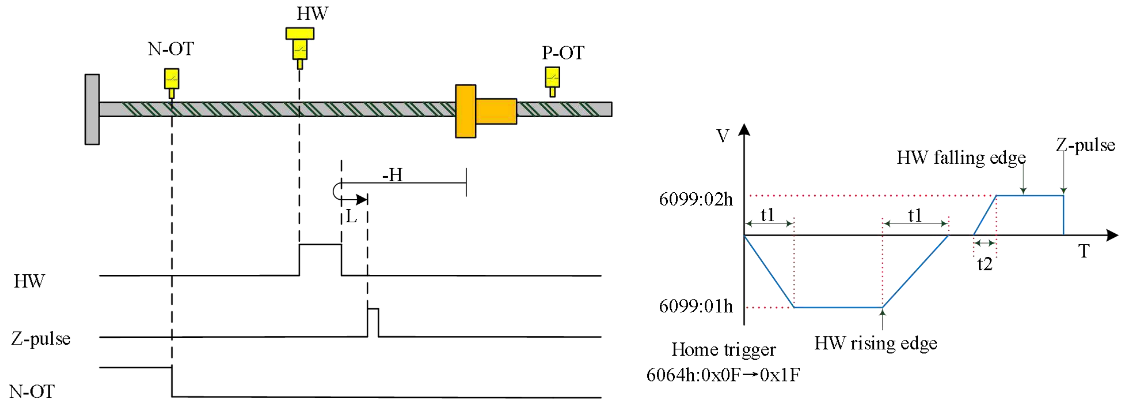
9.5.11 Home Mode 11 (6098h=11)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed with no /N-OT until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW falling edge.

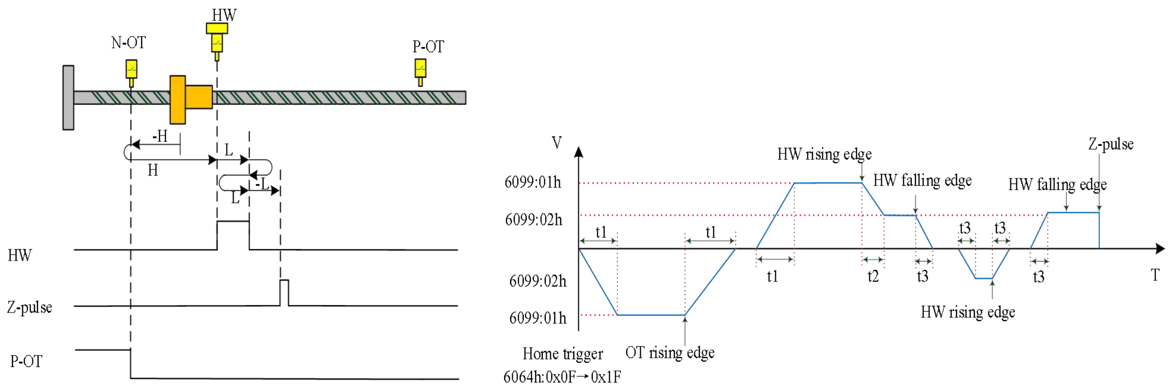


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

a.6098h=11, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, reverses direction→runs at high speed in forward direction until /HW rising edge, decelerates→runs at low speed in forward direction until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW falling edge.

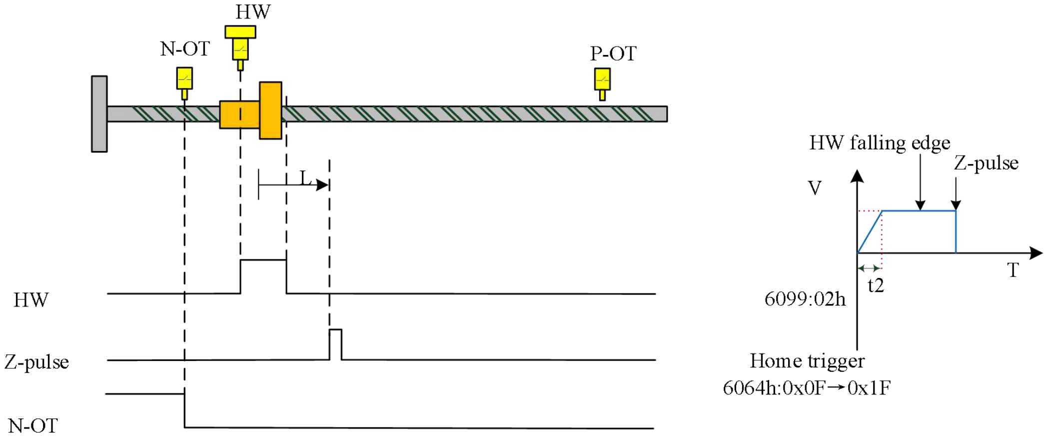


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ t_2 = \frac{(\text{6099:01h})-(\text{6099:02h})}{\text{609Ah}}(s),\ t_3 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

b.6098h=11, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in forward direction at low speed, and stops at the first Z-phase signal after /HW falling edge.



$$t_2 = \frac{6099\text{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=11, initial deceleration point signal = ON, with no /N-OT

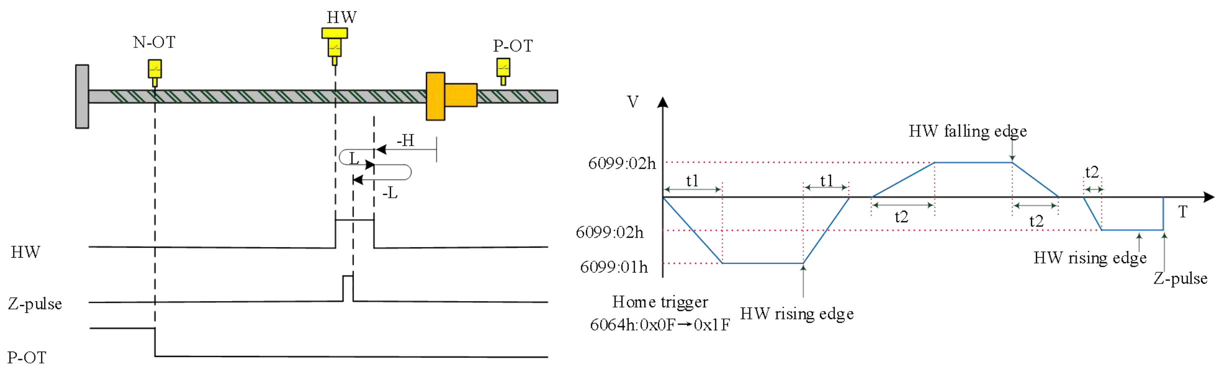
9.5.12 Home Mode 12 (6098h=12)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed with no /N-OT until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction until /HW falling edge, reverses directions→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.

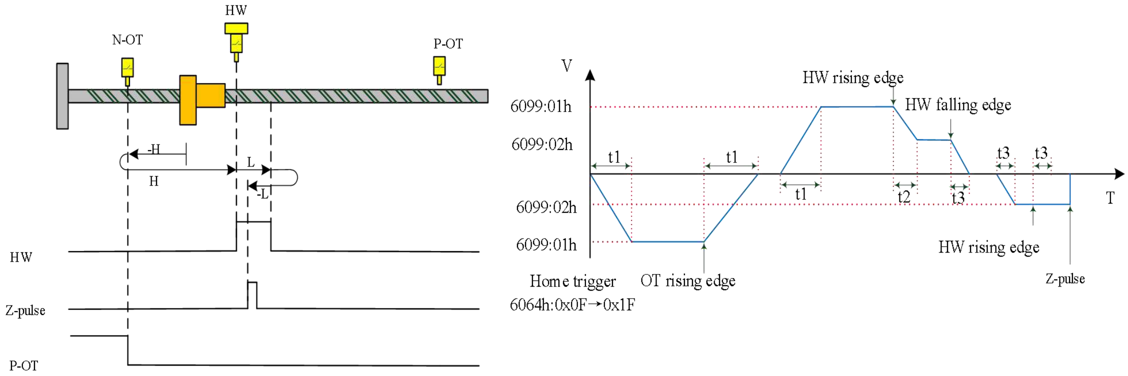


$$t_1 = \frac{6099\text{:}01\text{h}}{609\text{Ah}}(s),\ t_2 = \frac{6099\text{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=12, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, reverses directions→runs at high speed in forward direction until /HW rising edge, decelerates→runs at low speed in forward direction until the /HW falling edge, reverses directions→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.

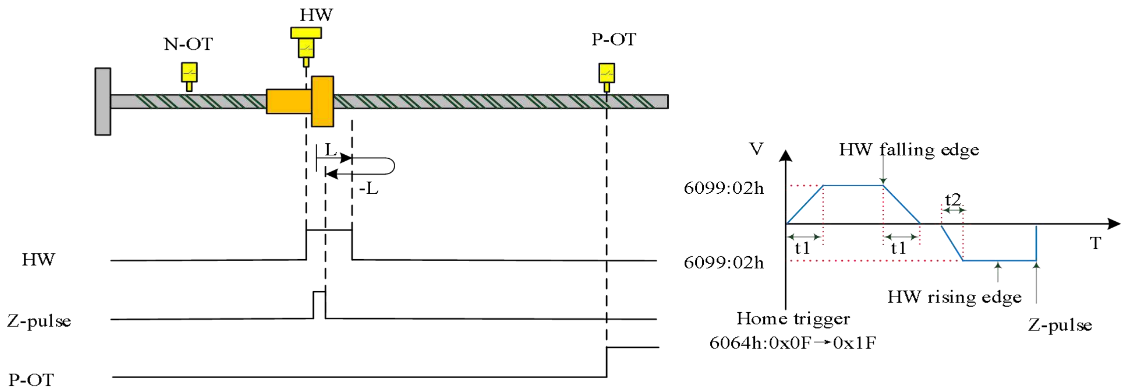


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s),\quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=12, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in forward direction at low speed until /HW falling edge, reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=12, initial deceleration point signal = ON, with no /N-OT

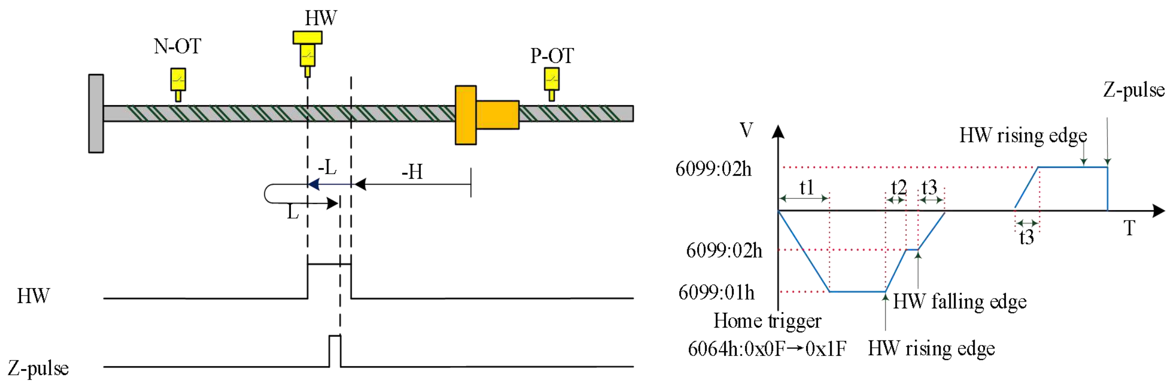
9.5.13 Home Mode 13 (6098h=13)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed with no /N-OT until /HW rising edge, decelerates→runs at low speed in reverse direction until /HW falling edge, reverses directions→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.

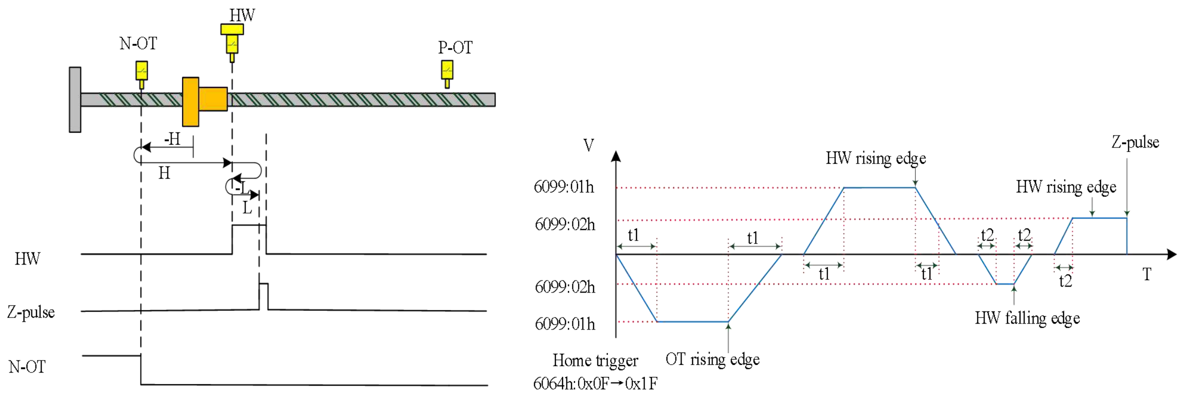


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\quad t_2 = \frac{(\text{6099:01h})-(\text{6099:02h})}{\text{609Ah}}(s),\quad t_3 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

a.6098h=13, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, reverses directions→runs at high speed in forward direction until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction until the /HW falling edge, reverses directions→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.

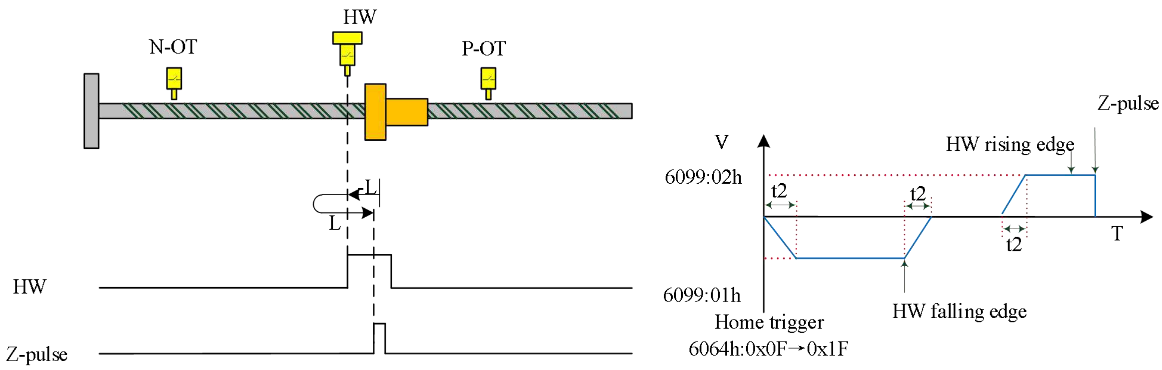


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\quad t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

b.6098h=13, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in reverse direction at low speed until /HW falling edge, reverses direction→runs at low speed in forward direction, and stops at the first Z-phase signal after /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=13, initial deceleration point signal = ON, with no /N-OT

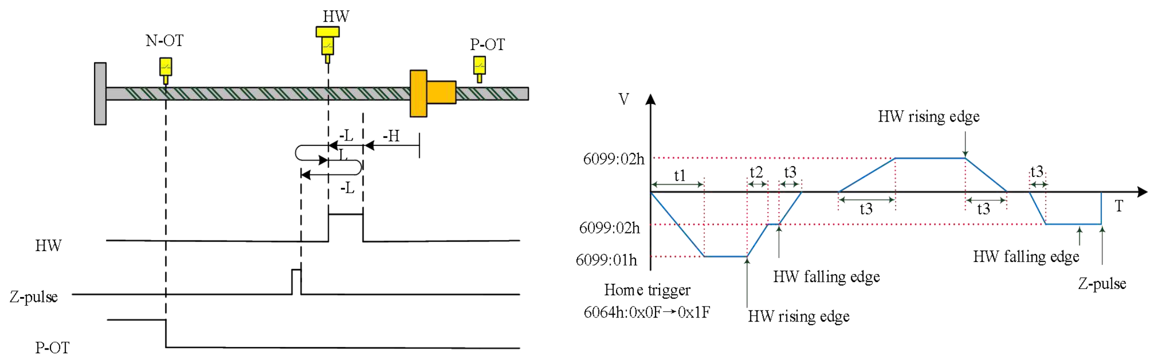
9.5.14 Home Mode 14 (6098h=14)

Home signal: Z signal

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /HW rising edge, decelerates→runs at low speed in reverse direction until /HW falling edge, decelerates→ reverses direction→runs at low speed in forward direction until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW falling edge.

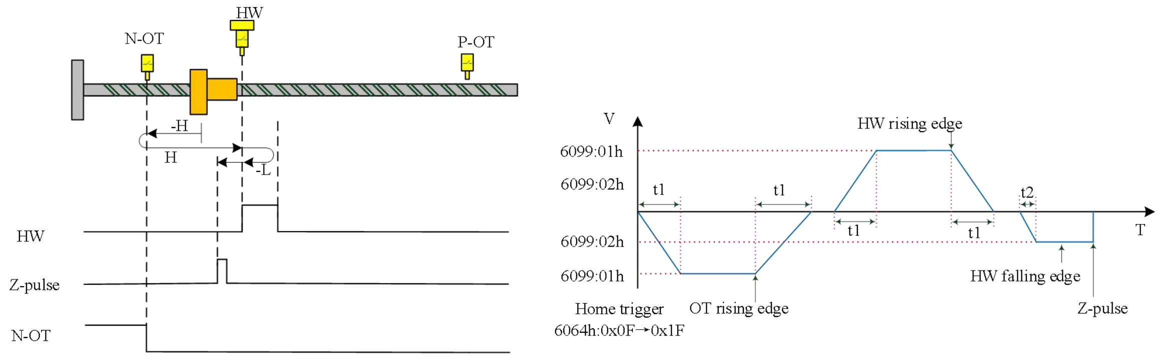


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s), \quad t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s), \quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=14, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, reverses directions→ runs at high speed in forward direction until /HW rising edge, decelerates→ reverses direction→ runs at low speed in reverse direction, and stops at the first Z-phase signal after /HW rising edge.

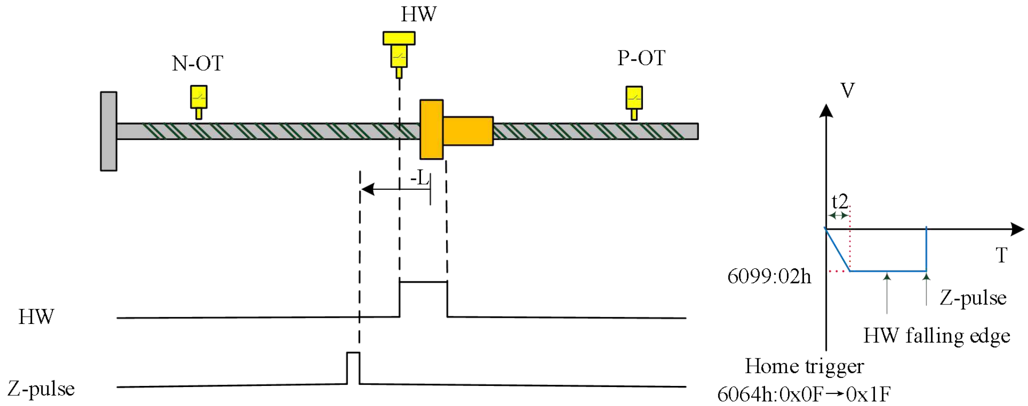


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

b.6098h=14, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in reserve direction at low speed, and stops at the first Z-phase signal after /HW falling edge.



$$t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

c.6098h=14, initial deceleration point signal = ON, with no /N-OT

9.5.15 Home Mode 15 (6098h=15) and Home Mode 16 (6098h=16)

The standard 402 protocol does not define these two homing modes.

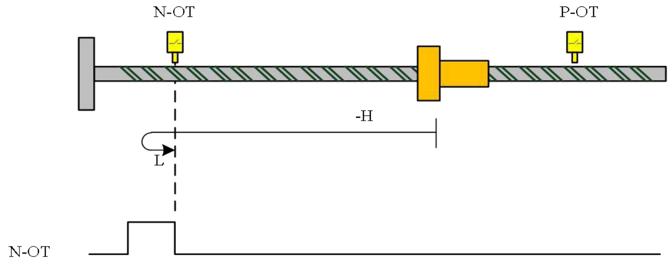
9.5.16 Home Mode 17 (6098h=17)

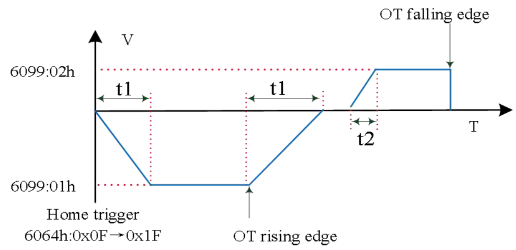
Home signal: /N-OT falling edge

Deceleration point signal: /N-OT

(1) Deceleration Point Signal OFF during Homing

Trajectory: /N-OT=0, home mode starts in reverse direction at high speed until /N-OT rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at the /N-OT falling edge.



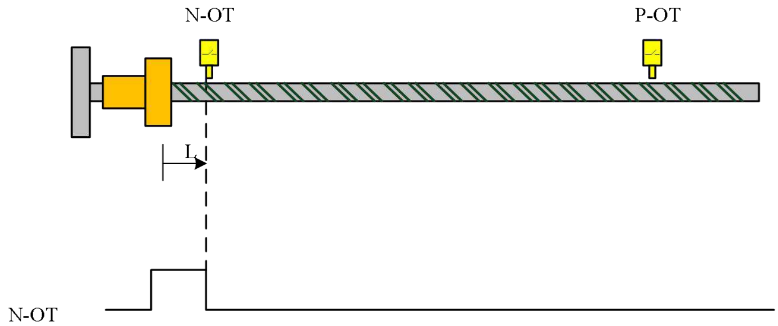


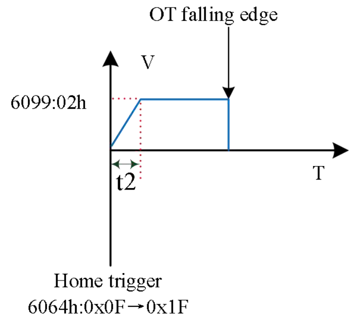
$$t_1 = \frac{6099:01h}{609Ah}(s),\ t_2 = \frac{6099:02h}{609Ah}(s)$$

a.6098h=17, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /N-OT=1, home mode starts in forward direction at low speed, and stops at the /N-OT falling edge.





$$t_2 = \frac{6099:02h}{609Ah}(s)$$

b.6098h=17, initial deceleration point signal = ON

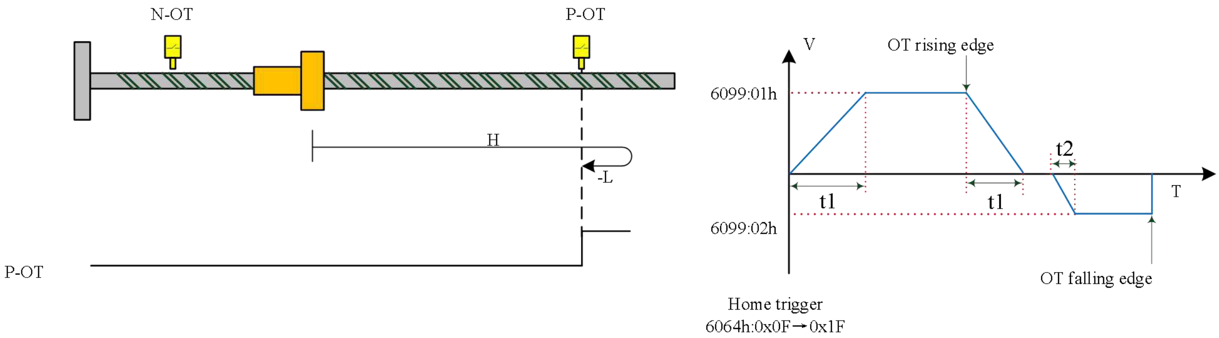
9.5.17 Home Mode 18 (6098h=18)

Home signal: /P-OT falling edge

Deceleration point signal: /P-OT signal

(1) Deceleration Point Signal OFF during Homing

Trajectory: /P-OT=0, home mode starts in forward direction at high speed until /P-OT rising edge, decelerates→reverses direction→runs at low speed in reverse direction, stops at /P-OT falling edge.

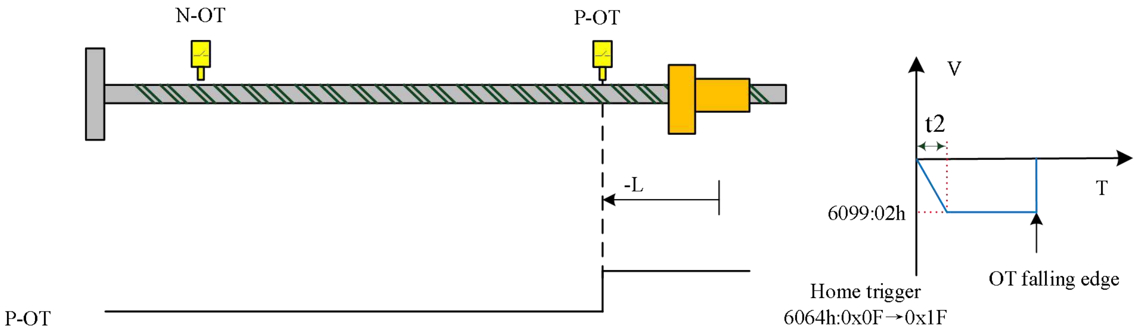


$$t_1 = \frac{6099\text{:}01\text{h}}{609\text{Ah}}(s),\ t_2 = \frac{6099\text{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=18, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /N-OT=1, home mode starts in reverse direction at low speed, and stops at the /N-OT falling edge.



$$t_2 = \frac{6099\text{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=18, initial deceleration point signal = ON

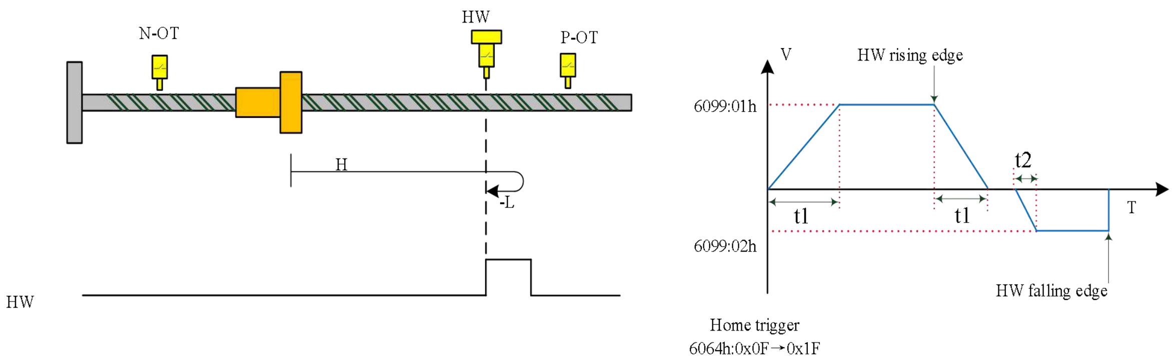
9.5.18 Home Mode 19 (6098h=19)

Home signal: /HW (home switch) falling edge

Deceleration point signal: /HW (home switch)

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in forward direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at /HW falling edge.

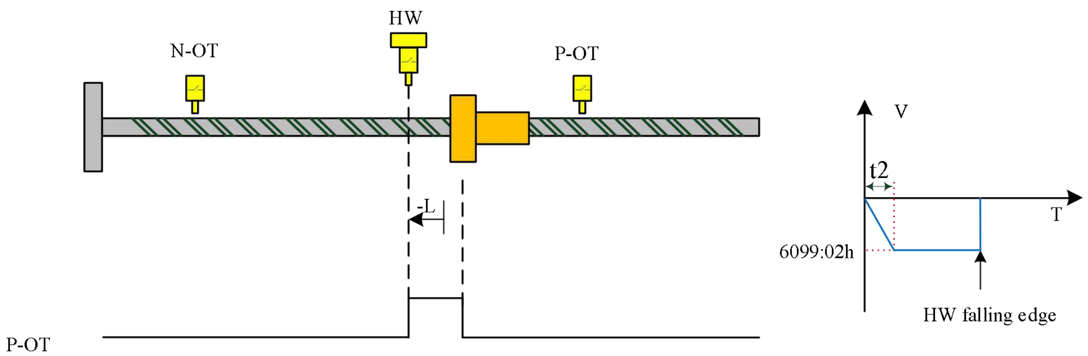


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

a.6098h=19, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in reserve direction at low speed, and stops at /HW falling edge.



$$t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

b.6098h=19, initial deceleration point signal = ON

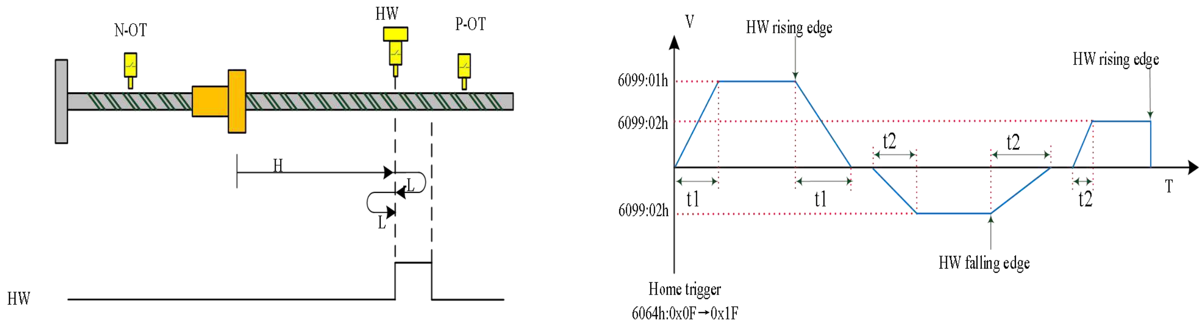
9.5.19 Home Mode 20 (6098h=20)

Home signal: /HW(Home switch) rising edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in forward direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction until /HW falling edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at /HW rising edge.

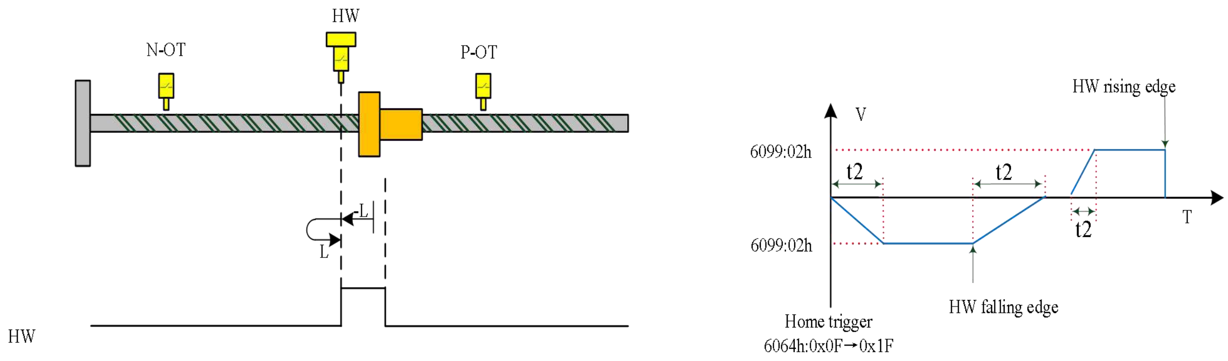


$$t_1 = \frac{\text{6099:01h}}{\text{609Ah}}(s),\ t_2 = \frac{\text{6099:02h}}{\text{609Ah}}(s)$$

a.6098h=20, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in reverse direction at low speed until /HW falling edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at /HW rising edge.



$$t_2 = \frac{6099:02h}{609Ah}(s)$$

b.6098h=20, initial deceleration point signal = ON

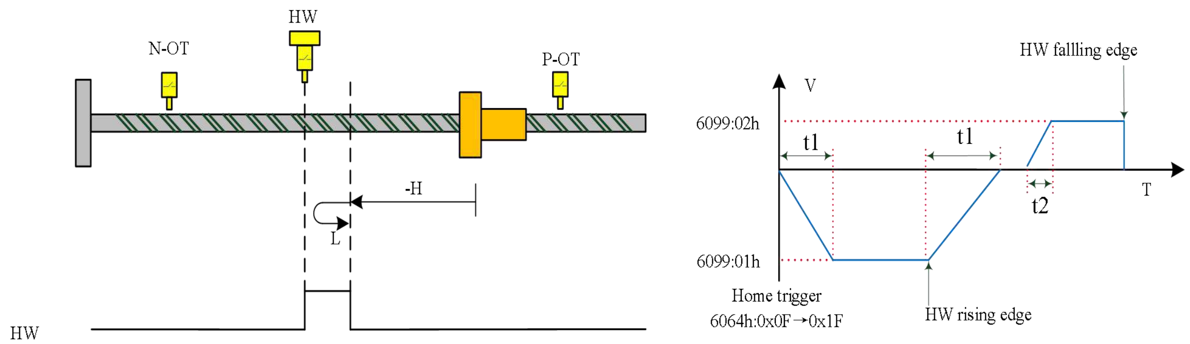
9.5.20 Home Mode 21 (6098h=21)

Home signal: /HW (home switch) falling edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at /HW falling edge.

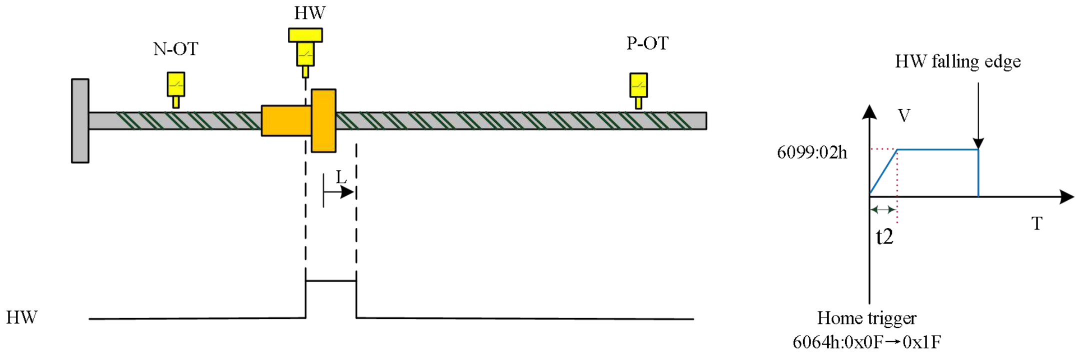


$$t_1 = \frac{6099:01h}{609Ah}(s),\ t_2 = \frac{6099:02h}{609Ah}(s)$$

a.6098h=21, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in forward direction at low speed, and stops at /HW falling edge.



$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\ t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=21, initial deceleration point signal = ON

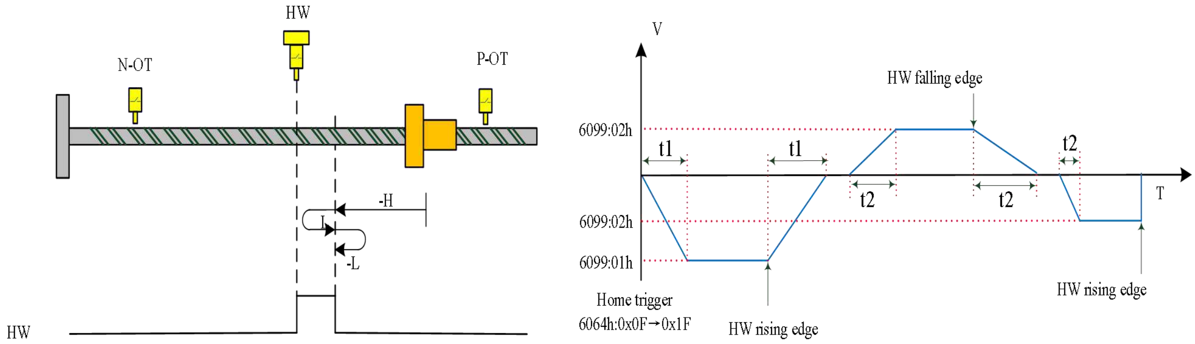
9.5.21 Home Mode 22 (6098h=22)

Home signal: /HW(Home switch) rising edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at /HW rising edge.

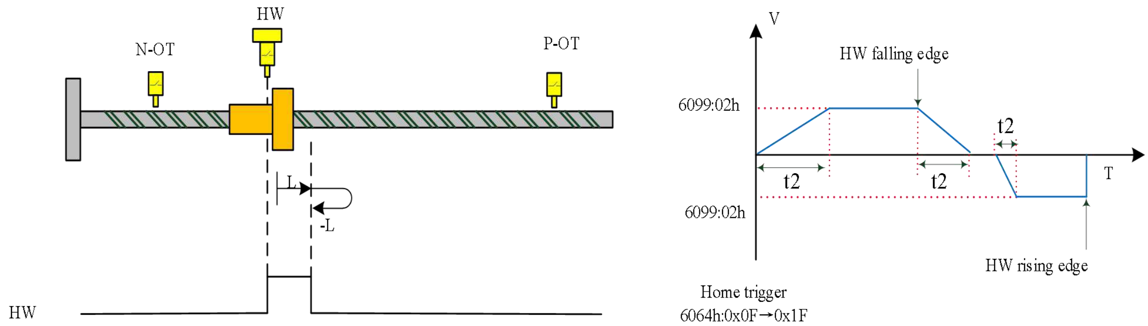


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\ t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=22, initial deceleration point signal = OFF

(2) Deceleration Point Signal ON during Homing

Trajectory: /HW=1, home mode starts in positive direction at low speed until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at /HW rising edge.



$$t_2 = \frac{6099{:}02h}{609Ah}(s)$$

b.6098h=22, initial deceleration point signal = ON

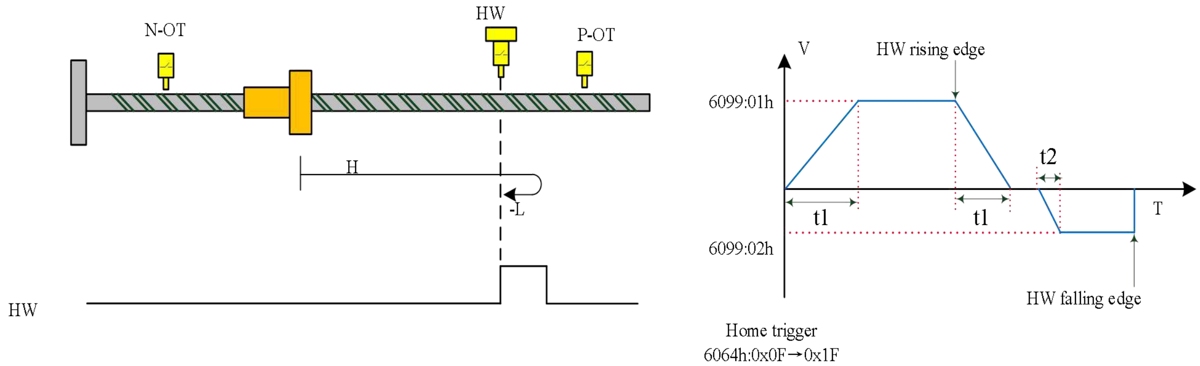
9.5.22 Home Mode 23 (6098h=23)

Home signal: /HW (home switch) falling edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with no /P-OT until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction, stops at /HW falling edge.

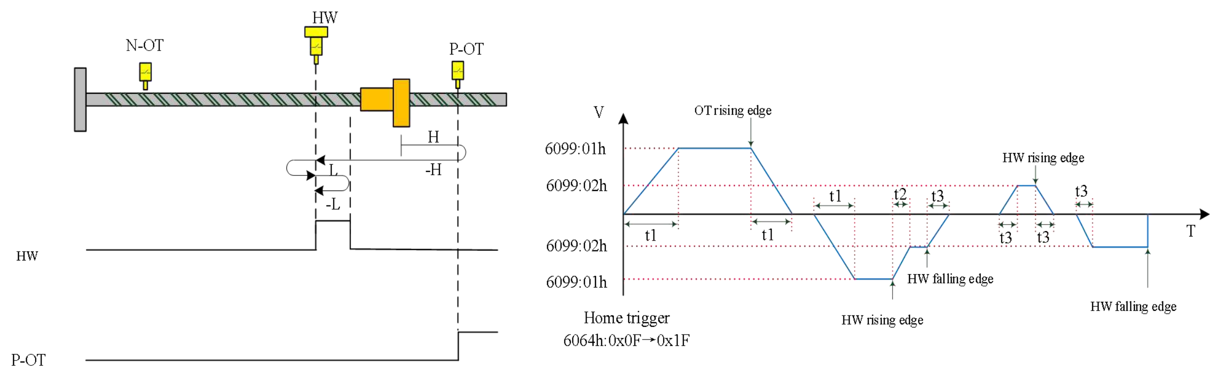


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ t_2 = \frac{6099{:}02h}{609Ah}(s)$$

a.6098h=23, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /P-OT, decelerates→reverses direction→runs at high speed in reverse direction until /HW rising edge, decelerates→ runs at low speed in reverse direction until /HW falling edge, decelerates→ reverses direction→runs at low speed in forward direction until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction, stops at /HW falling edge.

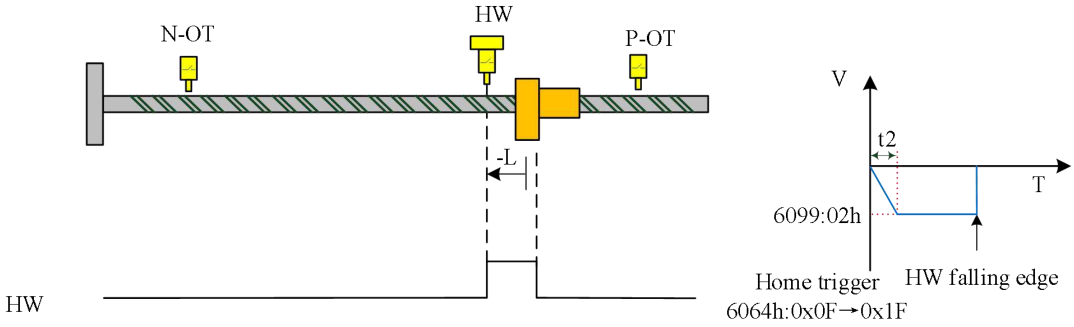


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ \ t_2 = \frac{(6099{:}01h)-(6099{:}02h)}{609Ah}(s),\ \ t_3 = \frac{6099{:}02h}{609Ah}(s)$$

b.6098h=23, initial deceleration point signal = OFF, with no /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in reserve direction at low speed, and stops at /HW falling edge.



$$t_2 = \frac{6099{:}02h}{609Ah}(s)$$

c.6098h=23, initial deceleration point signal = ON, with no /P-OT

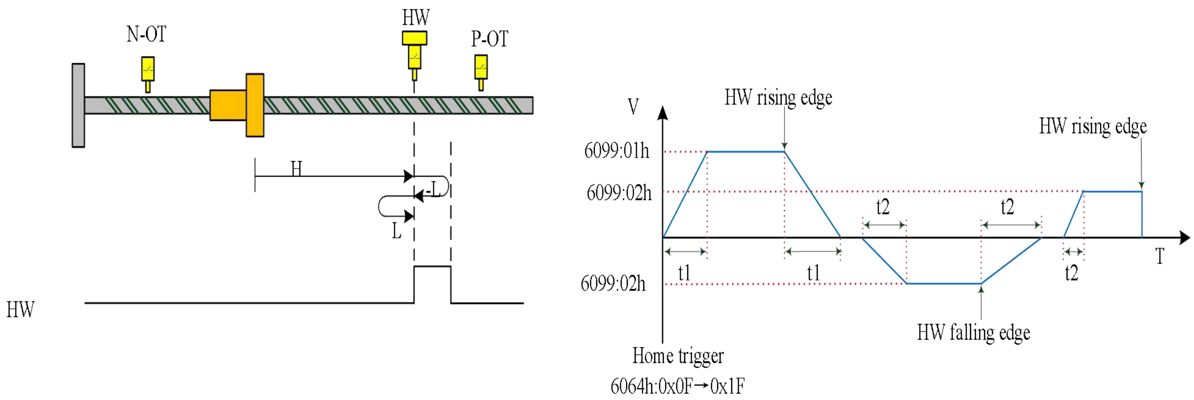
9.5.23 Home Mode 24 (6098h=24)

Home signal: /HW(Home switch) rising edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with no /P-OT until /HW rising edge, decelerates→ reverses direction → runs at low speed in reverse direction until /HW falling edge, reverses directions→ runs at low speed in forward direction, and stops at /HW rising edge.

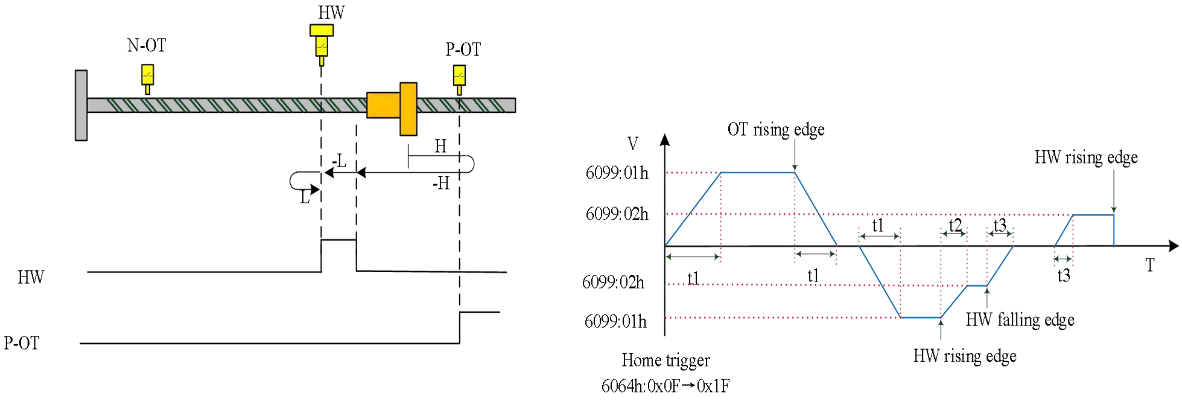


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ t_2 = \frac{6099{:}02h}{609Ah}(s)$$

a.6098h=24, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with until /P-OT, decelerates→reverses direction→runs at high speed in reverse direction until /HW rising edge, decelerates→runs at low speed in reverse direction until /HW falling edge, reverses directions→runs at low speed in forward direction, and stops at /HW rising edge.

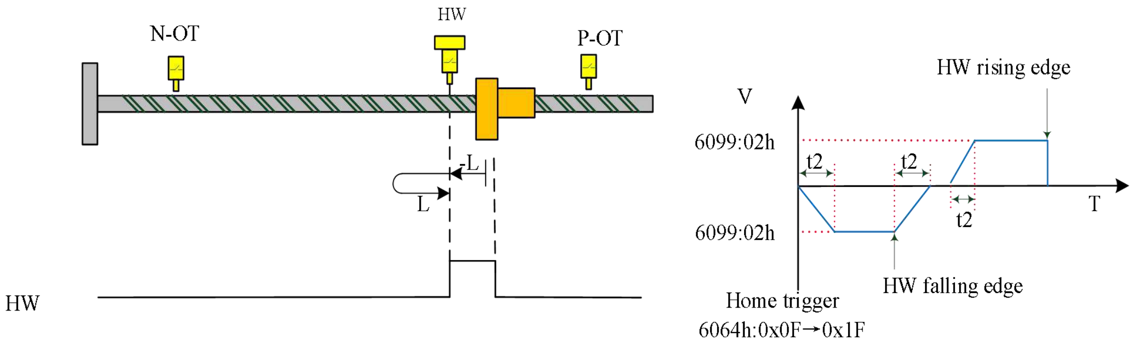


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{(6099{:}01\text{h}) - (6099{:}02\text{h})}{609\text{Ah}}(s),\quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=24, initial deceleration point signal = OFF, with /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in reverse direction at low speed until /HW falling edge, reverses direction→runs at low speed in forward direction, and stops at /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=24, initial deceleration point signal = ON, with no /P-OT

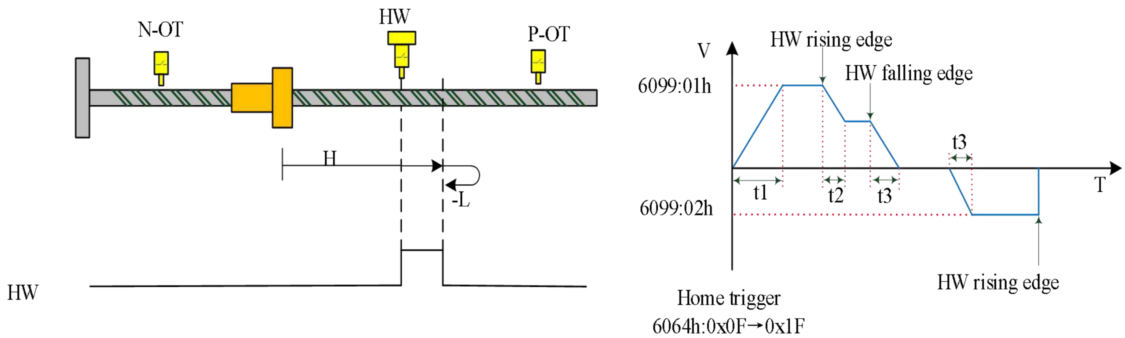
9.5.24 Home Mode 25 (6098h=25)

Home signal: /HW(Home switch) rising edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed with no /P-OT until /HW rising edge, decelerates→runs at low speed in forward direction until /HW falling edge, reverses directions→ runs at low speed in reverse direction, and stops at /HW rising edge.

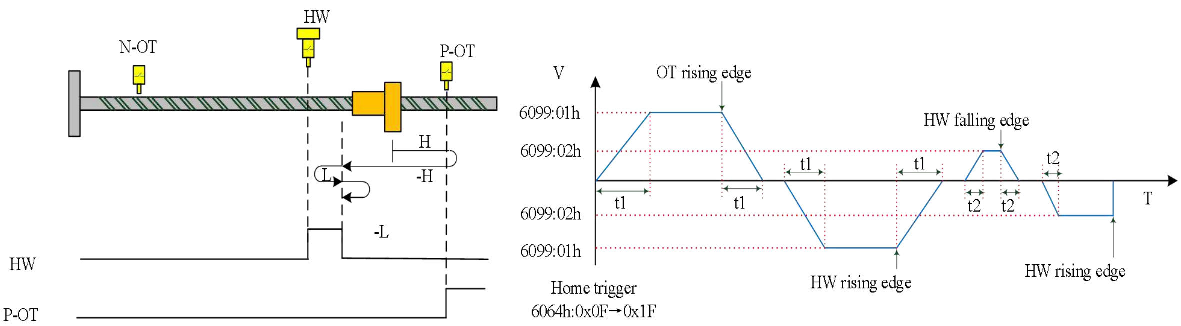


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s),\quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=25, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /P-OT, reverses directions→ runs at high speed in reverse direction until /HW rising edge, decelerates→ runs at low speed in forward direction until the /HW falling edge, reverses directions→ runs at low speed in reverse direction, and stops at /HW rising edge.

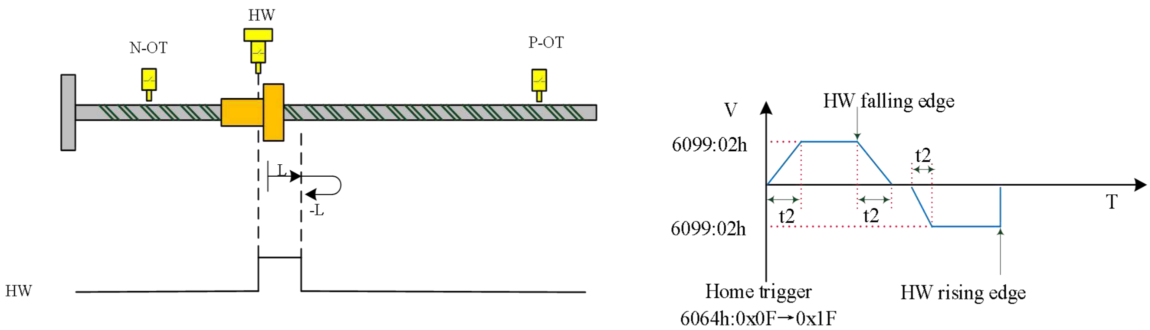


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=25, initial deceleration point signal = OFF, with /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in forward direction at high speed until /HW falling edge, decelerates→reverses direction→ runs at low speed in reverse direction, and stops at /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=25, initial deceleration point signal = ON, with no /P-OT

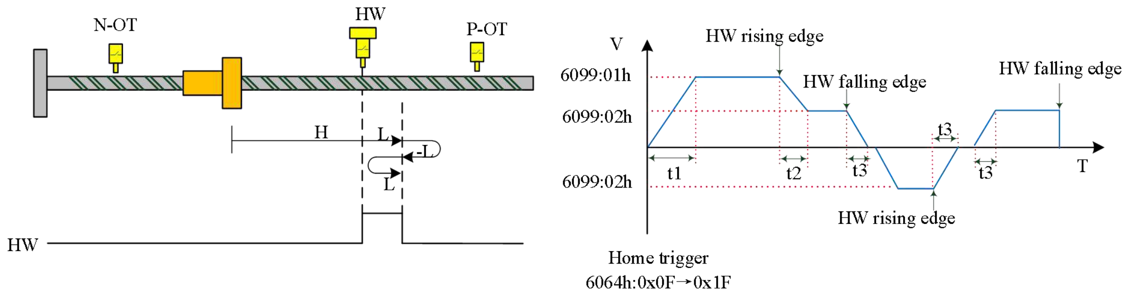
9.5.25 Home Mode 26 (6098h=26)

Home signal: Z signal

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /HW rising edge, decelerates→runs at low speed in forward direction until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at /HW falling edge.

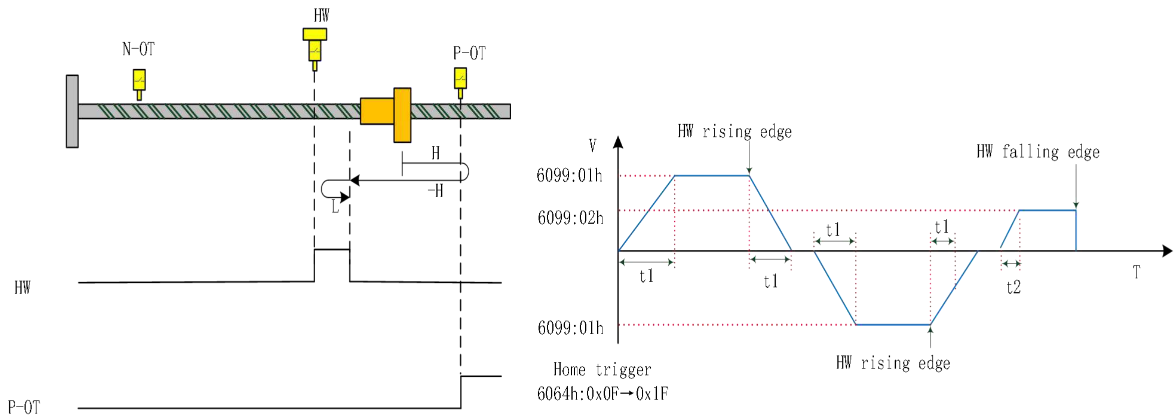


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s),\quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=26, initial deceleration point signal = OFF, with no /P-OT

(2) Deceleration Point Signal OFF during Homing with /P-OT

Trajectory: /HW=0, home mode starts in forward direction at high speed until /P-OT, reverses directions→ runs at high speed in reverse direction until /HW rising edge, decelerates→reverses direction →runs at low speed in forward direction, and stops at /HW rising edge.

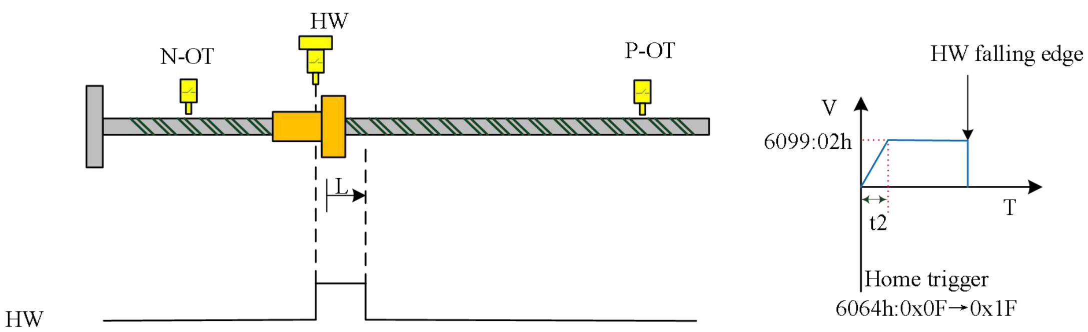


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=26, initial deceleration point signal = OFF, with /P-OT

(3) Deceleration Point Signal ON during Homing without /P-OT

Trajectory: /HW=1, home mode starts in forward direction at low speed, and stops at /HW falling edge.



$$t_2 = \frac{6099{:}02h}{609Ah}(s)$$

c.6098h=26, initial deceleration point signal = ON, with no /P-OT

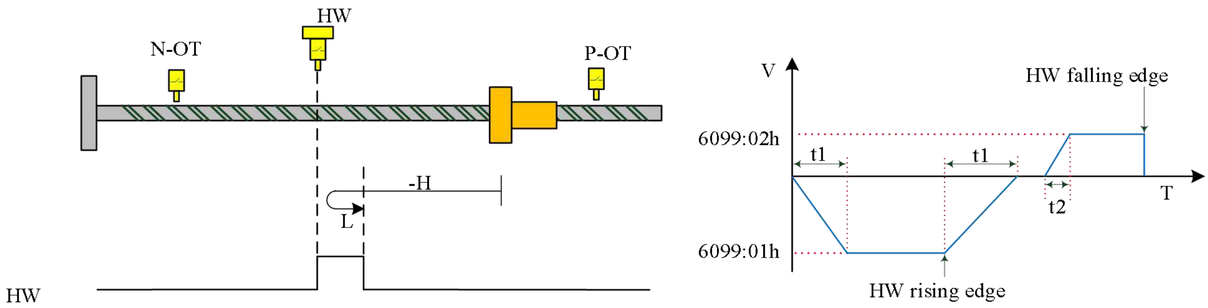
9.5.26 Home Mode 27 (6098h=27)

Home signal: /HW falling edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed with no /P-OT until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, stops at /HW falling edge.

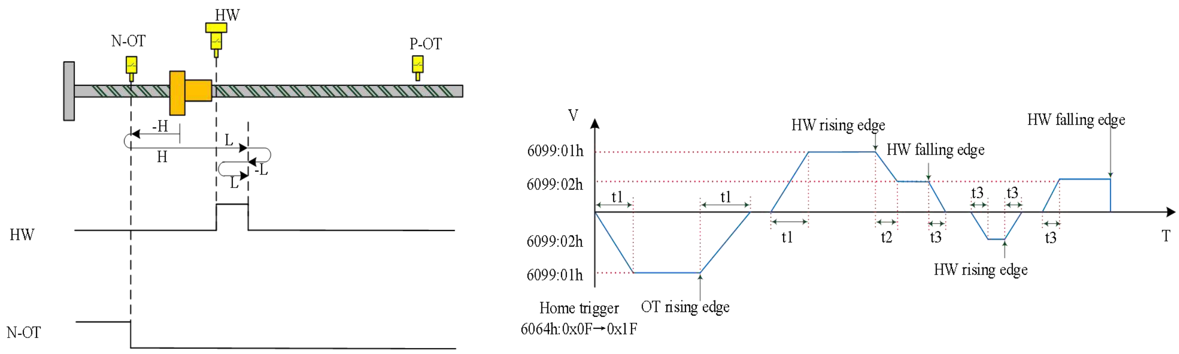


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ t_2 = \frac{6099{:}02h}{609Ah}(s)$$

a.6098h=27, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, decelerates→reverses direction→runs at high speed in forward direction until /HW rising edge, decelerates→ runs at low speed in forward direction until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction, and stops at /HW falling edge.

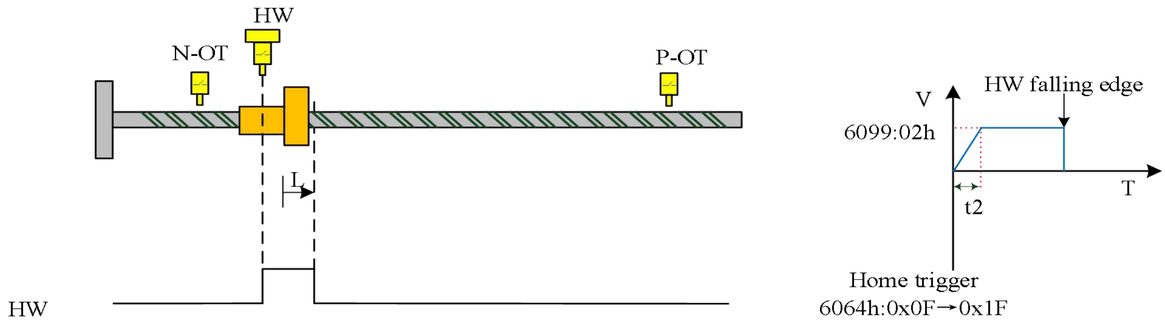


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ t_2 = \frac{(6099{:}01h)-(6099{:}02h)}{609Ah}(s),\ t_3 = \frac{6099{:}02h}{609Ah}(s)$$

b.6098h=27, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in forward direction at low speed, and stops at /HW falling edge.



$$t_2 = \frac{6099{:}02h}{609Ah}(s)$$

c.6098h=27, initial deceleration point signal = ON, with no /N-OT

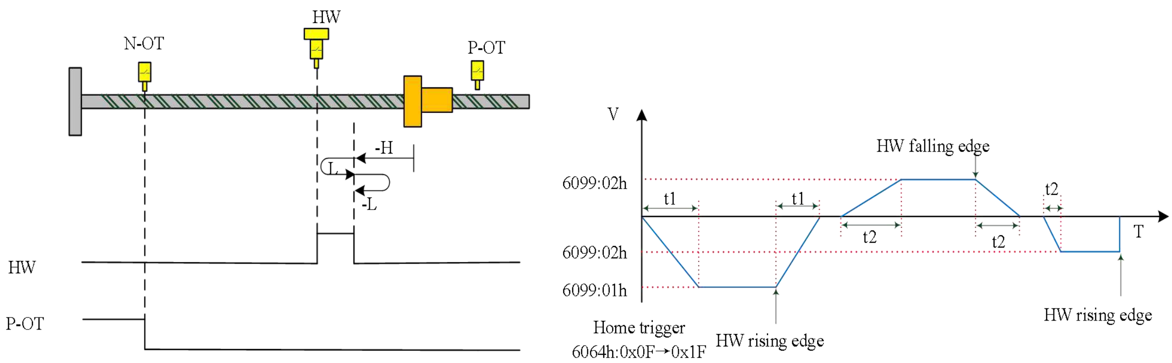
9.5.27 Home Mode 28 (6098h=28)

Home signal: /HW falling edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed with no /N-OT until /HW rising edge, decelerates→reverses direction→runs at low speed in forward direction until /HW falling edge, reverses directions→runs at low speed in reverse direction, and stops at /HW rising edge.

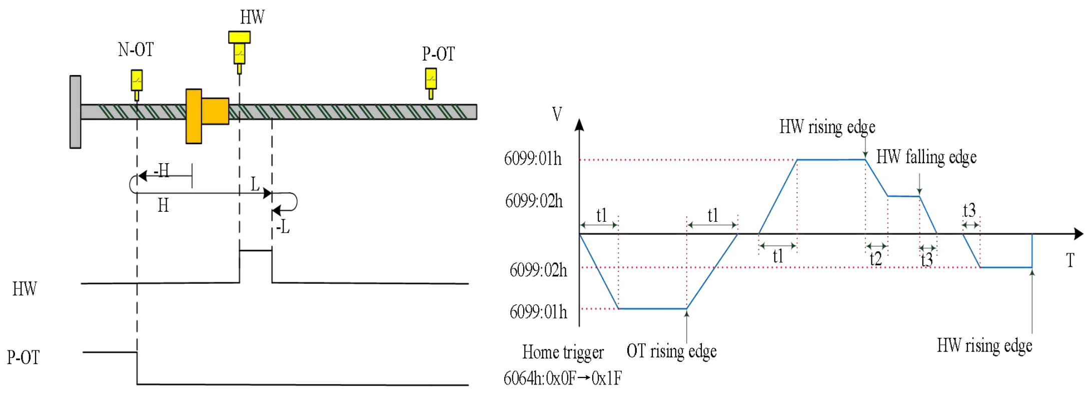


$$t_1 = \frac{6099{:}01h}{609Ah}(s),\ t_2 = \frac{6099{:}02h}{609Ah}(s)$$

a.6098h=28, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, reverses directions→runs at high speed in forward direction until /HW rising edge, decelerates→runs at low-speed in forward direction until the /HW falling edge, reverses directions→runs at low-speed in reverse direction, and stops at /HW rising edge.

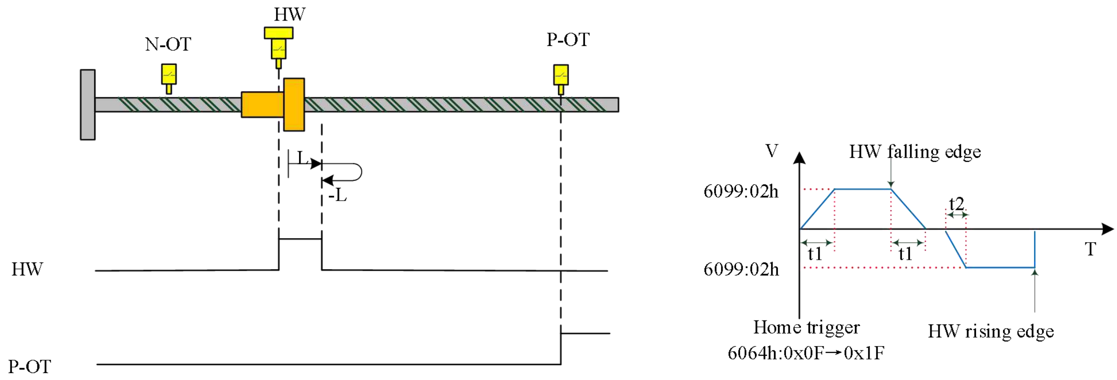


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\ \ t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s),\ \ t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=28, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in forward direction at low speed until /HW falling edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=28, initial deceleration point signal = ON, with no /N-OT

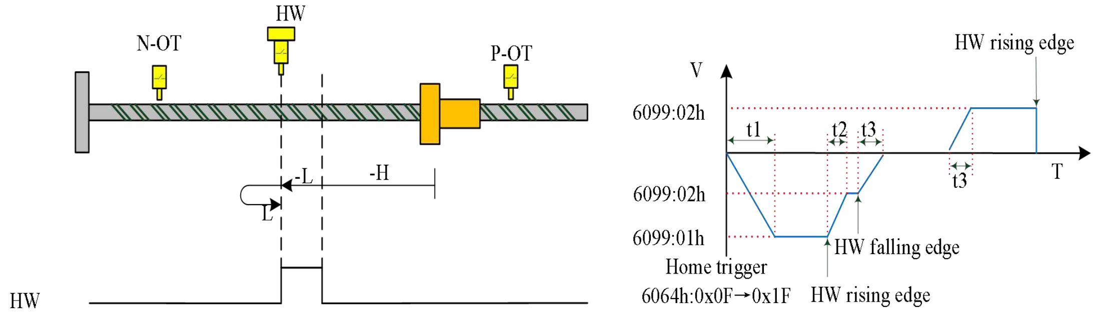
9.5.28 Home Mode 29 (6098h=29)

Home signal: /HW(Home switch) rising edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed with no N-OT until /HW falling edge, decelerates→reverses direction→runs at low speed in forward direction, stops at /HW falling edge.

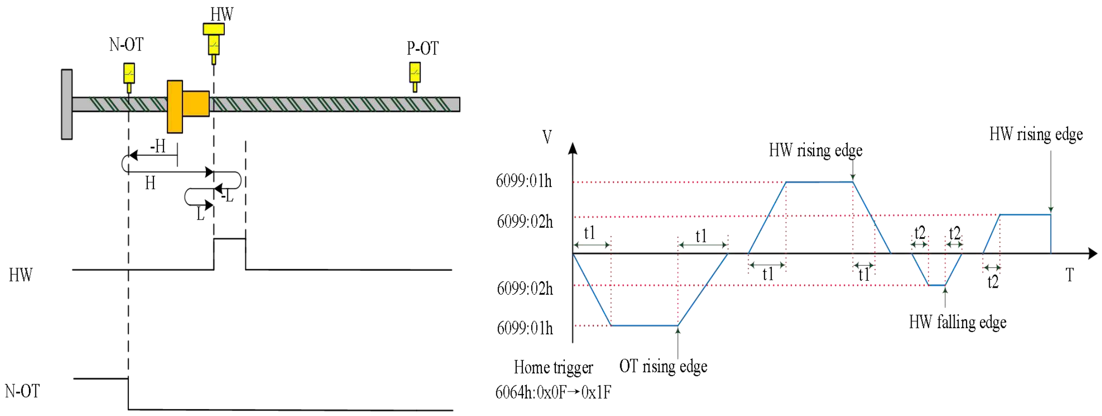


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s),\quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=29, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, decelerates→reverses directions→runs at high speed in forward direction until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction until the /HW falling edge, reverses directions→runs at low speed in forward direction, and stops /HW rising edge.

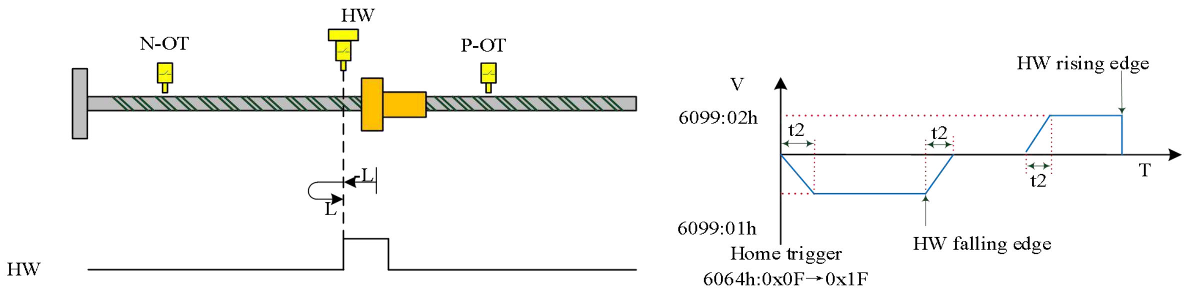


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=29, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in reverse direction at low speed until /HW falling edge, reverses direction→runs at low speed in forward direction, and stops at /HW rising edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=29, initial deceleration point signal = ON, with no /N-OT

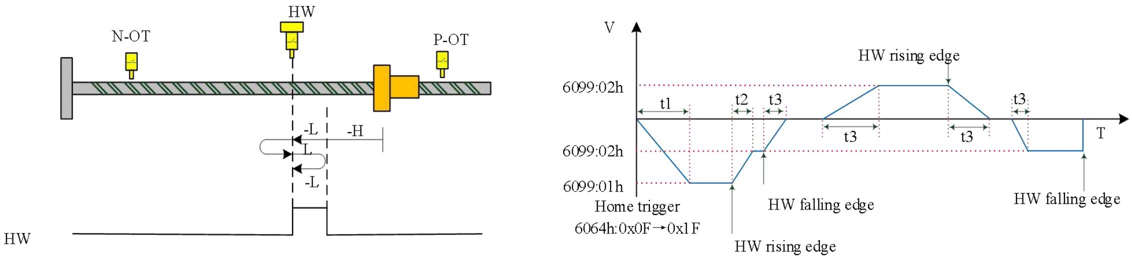
9.5.29 Home Mode 30 (6098h=30)

Home signal: /HW falling edge

Deceleration point signal: /HW signal

(1) Deceleration Point Signal OFF during Homing without /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /HW rising edge, decelerates→runs at low speed in reverse direction until /HW falling edge, decelerates→reverses direction→runs at low speed in forward direction until /HW rising edge, decelerates→reverses direction→runs at low speed in reverse direction, and stops at /HW falling edge.

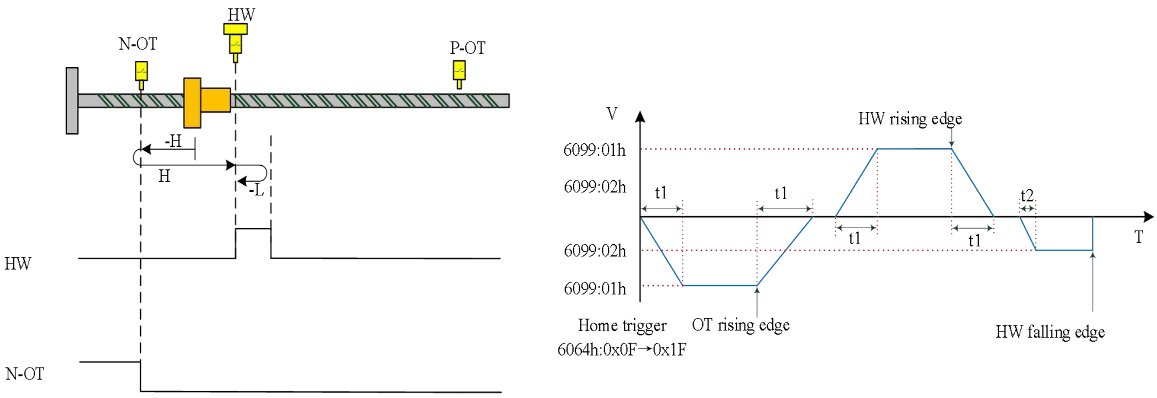


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{(6099{:}01\text{h})-(6099{:}02\text{h})}{609\text{Ah}}(s),\quad t_3 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

a.6098h=30, initial deceleration point signal = OFF, with /N-OT

(2) Deceleration Point Signal OFF during Homing with /N-OT

Trajectory: /HW=0, home mode starts in reverse direction at high speed until /N-OT, decelerates→reverses directions→runs at high speed in forward direction until /HW rising edge, decelerates→reverses direction→ runs at low speed in reverse direction, and stops at /HW rising edge.

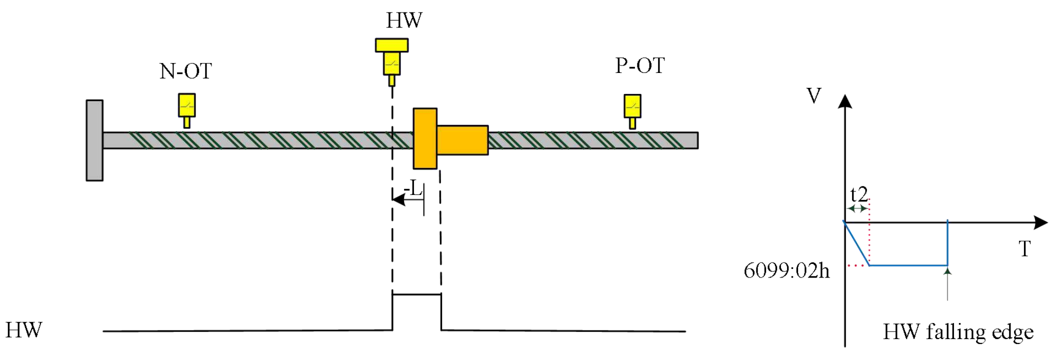


$$t_1 = \frac{6099{:}01\text{h}}{609\text{Ah}}(s),\quad t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

b.6098h=30, initial deceleration point signal = OFF, with /N-OT

(3) Deceleration Point Signal ON during Homing without /N-OT

Trajectory: /HW=1, home mode starts in reserve direction at low speed, and stops at /HW falling edge.



$$t_2 = \frac{6099{:}02\text{h}}{609\text{Ah}}(s)$$

c.6098h=30, initial deceleration point signal = ON, with no /N-OT

9.5.30 Home Mode 31 (6098h=31) and Home Mode 32 (6098h=32)

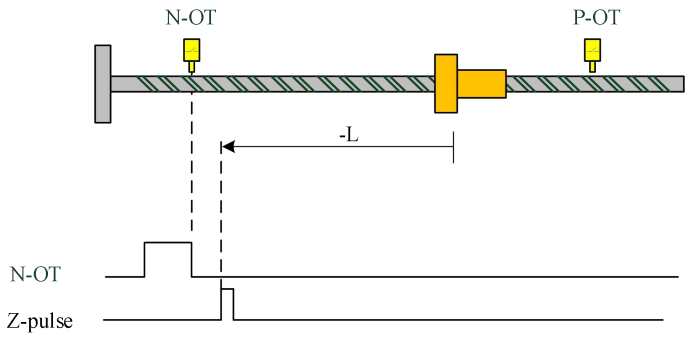
The standard 402 protocol does not define these two homing modes.

9.5.31 Home Mode 33 (6098h=33)

Home signal: Z signal

Deceleration point signal: none

Trajectory: Home mode starts in reserve direction at low speed, and stops at the first Z signal.

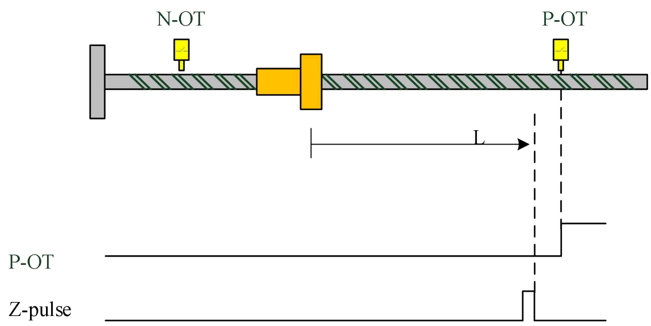


9.5.32 Home Mode 34 (6098h=34)

Home signal: Z signal

Deceleration point signal: none

Trajectory: Home mode starts in forward direction at low speed, and stops at the first Z signal.



9.5.33 Home Mode 35 (6098h=35)

Taking the current position as the mechanical home, after triggering the homing operation, the user position (6064h) = home offset (607Ch).

10 Motion Control

10.1 Home

10.1.1 Overview

Home Position (Mechanical Origin): Defined by limit switches or motor Z-signal (configured via Pa290.Y).

Zero Position (Target Point): Home position + Pn294 [Home Position Offset], when Pn294=0, zero position coincides with home position.

The drive controls the motor in position mode to locate either the home or zero position based on the configured method, which is the home process.

Users can send home signal by limit switches, mechanical home signals and Z-pulse (encoder index). And this home signal, indicated by a level signal with defined pulse width, needs to be selected with the positive or the negative rising edge together to locate the home position accurately, as shown in Fig. 10.1.

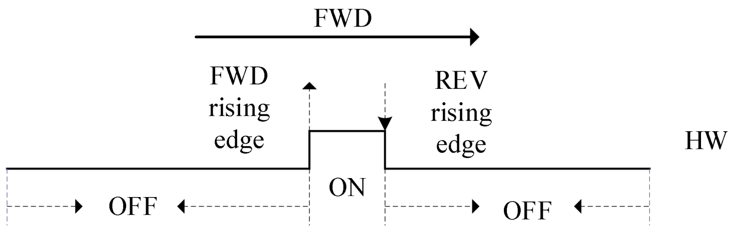


Figure 10-1 Home signal direction selection

Give a large speed value when home starts to ensure the searching speed for home. The first encountered home signal is defined as the deceleration point. After reaching the deceleration point, the homing speed switches to a low velocity for precise home point positioning. During the whole process, the accuracy of the home position is affected by the low-speed home finding speed; the higher the speed is, the larger the pulse deviation of the signal edge.

Input Signals:

Setting	Name	Function	Description	Trigger	Mode
0x02	P-OT	Positive limit	Positive direction limit at high level	Level	P
0x03	N-OT	Negative limit	Negative direction limit at high level	Level	P
0x27	ORGEN	Home enable	Trigger home in position control mode	Level Edge	P
0x28	ORGS	Mechanical origin	As a home signal sent to the drive	Level Edge	P

Output Signals:

Setting	Name	Function	Description	Trigger	Mode
0x15	ORGC	Home completion	Home not performed or interrupted When home fails: OFF When home succeeds: ON	Level	P

Home-related Funcodes:

Funcode	Name	Range	Default
Pn000.X	Control Mode	0: Position mode 1: Velocity mode 2: Torque mode 3: Velocity-Position mode 4: Torque-Position mode 5: Velocity-Torque mode	0
Pn290.X	Home enable control	0: Home disabled 1:Trigger home via DI terminal 2:Home immediately after power-up and servo enabled. 3: Home immediately 4:Take the current point as the home position	0
Pn290.Y	Home mode	0~10(See Table 10-1)	0
Pn290.Z	Home trigger method	0:Run at low level, stop at high level (falling edge triggering) 1:Rising edge triggering 2:Falling edge triggering 3:Run at high level, stop at low level (rising edge triggering)	1
Pn290.W	Home timeout unit	0: 1ms 1: 10ms 2: 100ms	0
Pn291	Home Velocity (High)	0rpm~3000rpm	100
Pn292	Home Velocity (Low)	0rpm~1000rpm	10
Pn293	Home ACC/DEC Time	0.000ms~3000ms	3000
Pn294	Home Position Offset	-2147483648~21474883647	0
Pn296	Absolute Zero Multi-turn Value	-32768~32767	0
Pn297	Absolute zero single-turn value setting	0~21474883647	0
Pn299	Home Timeout	0.000ms~65535ms	10000

10.1.2 General Overview of Home Modes

The home modes can be categorized according to the home signal source, home direction, deceleration point type, and whether or not the Z-pulse is used for processing, as shown in the table below.

Table 10-1 Classification of SD100 Home Modes

Home Mode	Start Direction	Deceleration Position	Home Position
0	Positive	Home switch	Home switch
1	Negative	Home switch	Home switch
2	Positive	Home switch	Z signal
3	Negative	Home switch	Z signal
4	Positive	Positive limit	Positive limit
5	Negative	Negative limit	Negative limit
6	Positive	Positive limit	Z signal
7	Negative	Negative limit	Z signal
8	Positive	Z signal	Z signal
9	Negative	Z signal	Z signal
10	Absolute homing: move to the specified position. (This absolute position is set by Pn296[Absolute Zero Multi-turn Value] and Pn297[Absolute Zero Single-turn Value])		

10.1.2.1 Home Mode 0

Home signal:HW(Home switch) rising edge signal

Deceleration point signal: /HW signal

(1) Home mode 0 trajectory 1

Home mode 0 running trajectory 1 starts at high speed in the forward direction until the positive home signal rising edge, decelerates→reverses→runs at low speed in the reverse direction until the positive home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the deceleration point, which is the home signal. See Figure 10-2.

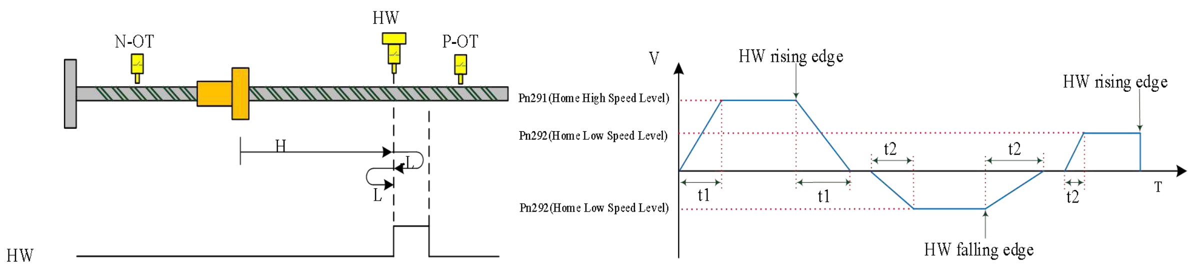


Figure 10-2 Home Mode 0 Trajectory 1

(2) Home mode 0 trajectory 2

Home mode 0 running trajectory 2 starts at high speed in the forward direction until the positive home signal rising edge, decelerates→reverses→runs at low speed in the reverse direction until the negative home signal rising edge, decelerates→runs at low speed in the reverse direction until the positive home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the deceleration point, which is the home signal. See the figure below.

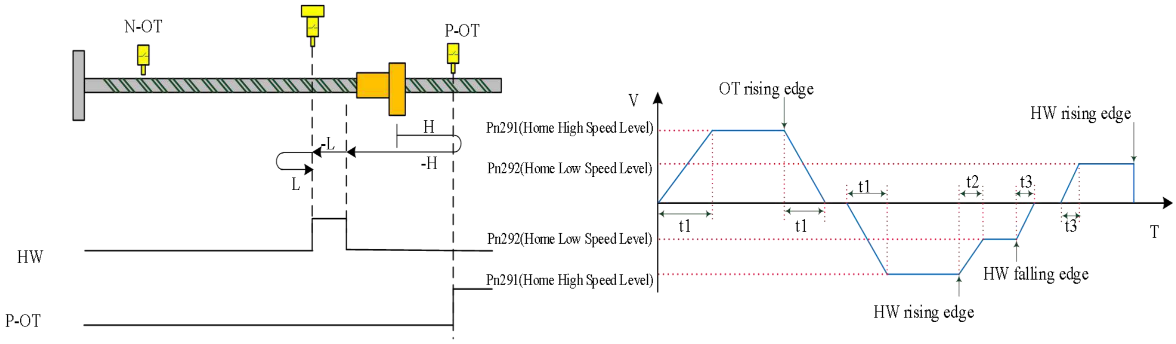


Figure 10-3 Home Mode 0 Trajectory 2

(3) Home mode 0 trajectory 3

Home mode 0 running trajectory 3 starts when home signal is high level, means it is at the deceleration point already, so it directly runs at low speed in the reverse direction until negative home signal falling edge, decelerates→ reverses→runs at low speed in the forward direction until the deceleration point, which is the home signal. See the figure below.

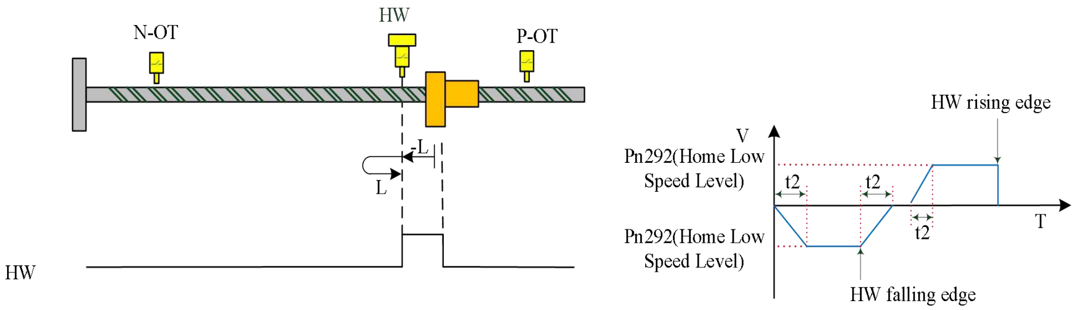


Figure 10-4 Home Mode 0 Trajectory 3

10.1.2.2 Home Mode 1

Home signal: /HW rising edge

Deceleration point signal: /HW signal

(1) Home mode 1 trajectory 1

Home mode 1 running trajectory 1 starts at high speed in the reverse direction until the negative home signal rising edge, decelerates→reverses→runs at low speed in the forward direction until the negative home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the deceleration point, which is the home signal. See the figure below.

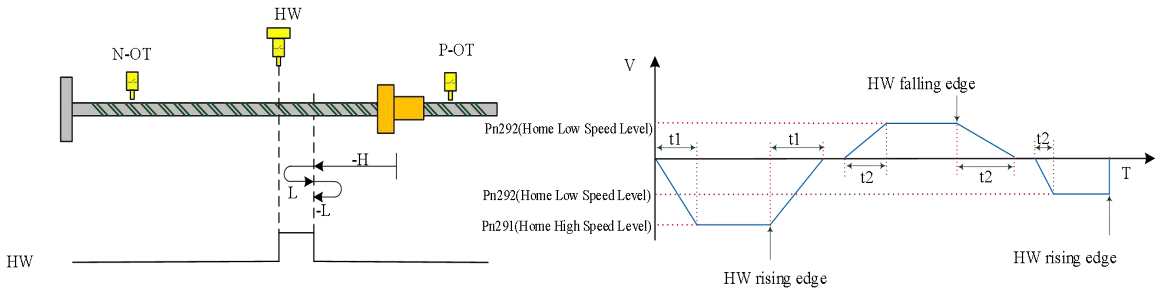


Figure 10-5 Home Mode 1 Trajectory 1

(2) Home mode 1 trajectory 2

Home mode 1 running trajectory 2 starts at high speed in the reverse direction until the negative home signal rising edge, decelerates→reverses→runs at high speed in the forward direction until the positive home signal rising edge, decelerates→reverses→runs at low speed in the reverse direction until the deceleration point, which is the home signal. See the figure below.

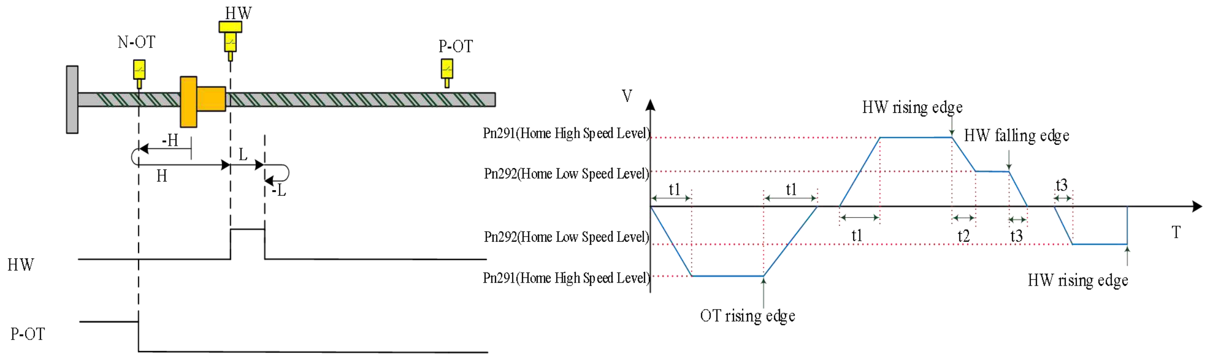


Figure 10-6 Home Mode 1 Trajectory 2

(3) Home mode 1 trajectory 3

Home mode 1 running trajectory 3 starts when home signal is high level, means it is at the deceleration point already, so it directly runs at low speed in the forward direction until negative home signal falling edge, decelerates→reverses→runs at low speed in the reverse direction until the deceleration point, which is the home signal. See the figure below.

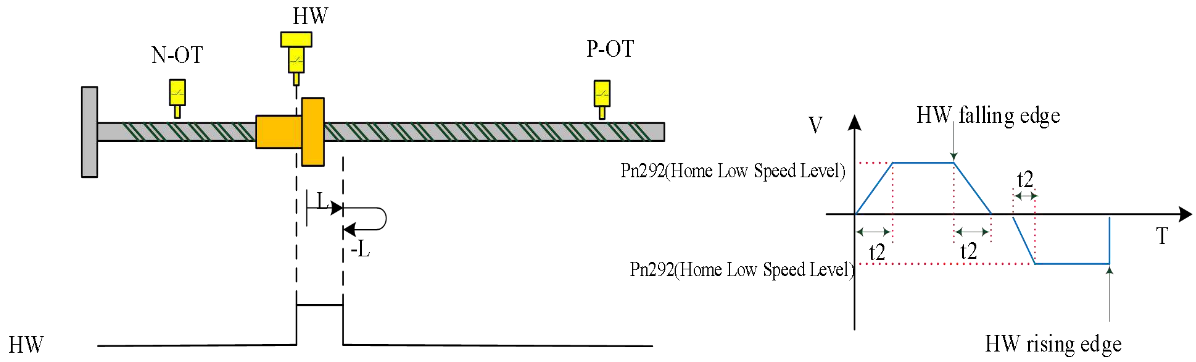


Figure 10-7 Home Mode 1 Trajectory 3

10.1.2.3 Home Mode 2

Home signal: Z signal

Deceleration point signal: /HW signal

(1) Home mode 2 trajectory 1

Home mode 2 running trajectory 1 starts at high speed in the forward direction until the positive home signal rising edge, decelerates→reverses→runs at low speed in the reverse direction until the positive home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the positive home signal rising edge until the first positive Z signal, which is the home signal. See the figure below.

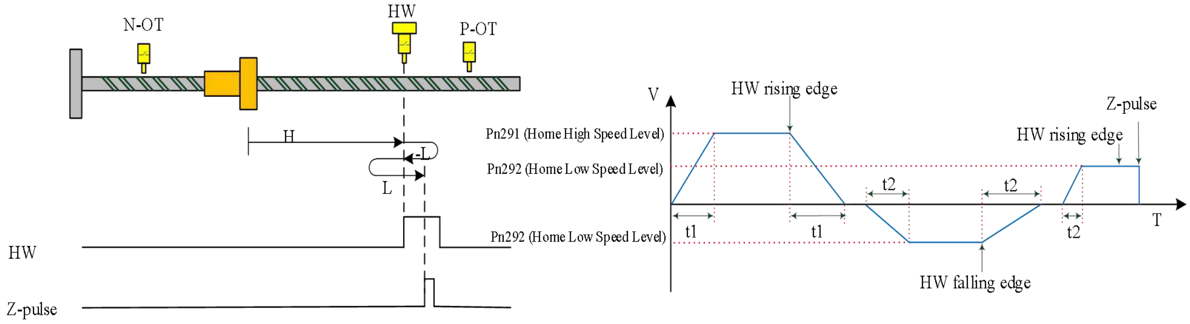


Figure 10-8 Home Mode 2 Trajectory 1

(2) Home mode 2 trajectory 2

Home mode 2 running trajectory 2 starts at high speed in the forward direction until /P-OT signal rising edge, decelerates→reverses→runs at high speed in the reverse direction until the negative home signal rising edge, decelerates→runs at low speed in the reverse direction until the positive home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the positive home signal rising edge until the first positive Z signal, which is the home signal, See the figure below.

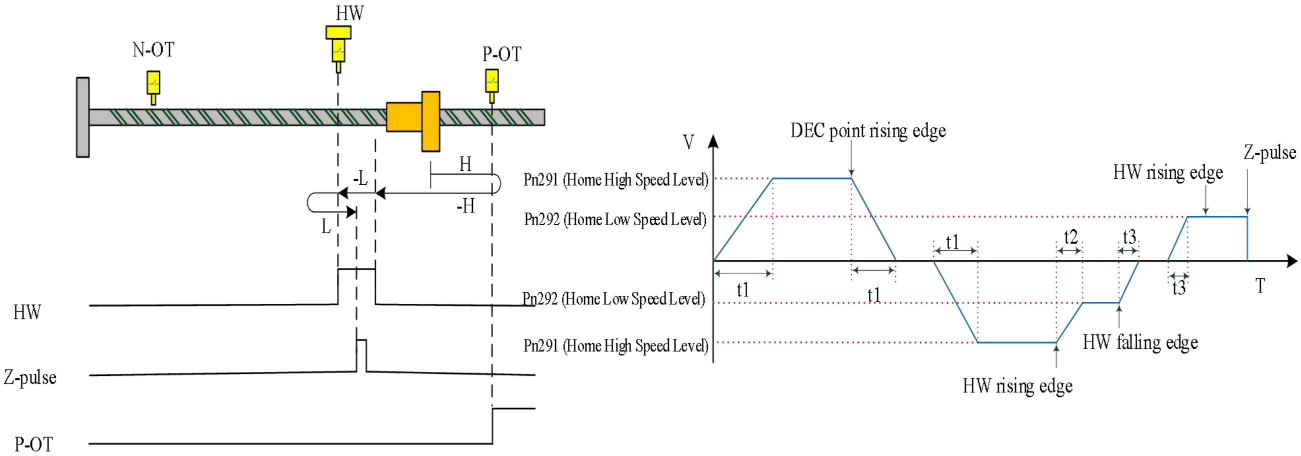


Figure 10-9 Home Mode 2 Trajectory 2

(3) Home mode 2 trajectory 3

Home mode 2 running trajectory 3 starts at low speed in the reverse direction until the positive home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the positive home signal rising edge until the first positive Z signal, which is the home signal. See the figure below.

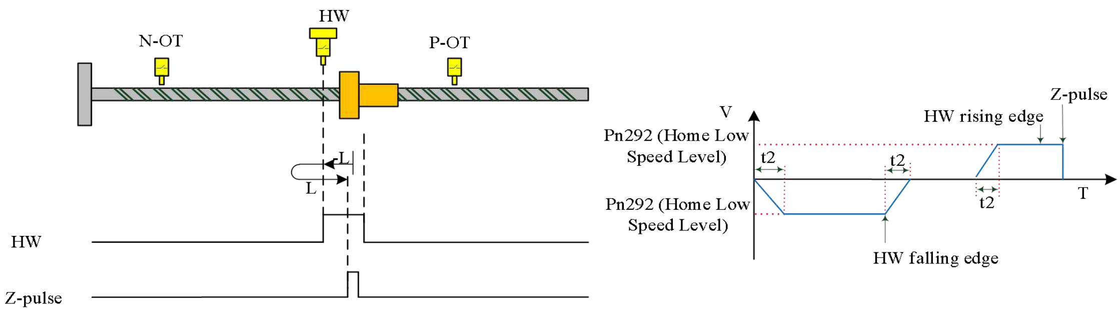


Figure 10-10 Home Mode 2 Trajectory 3

10.1.2.4 Home Mode 3

Home signal: Z signal

Deceleration point signal: /HW signal

(1) Home mode 3 trajectory 1

Home mode 3 running trajectory 1 starts at high speed in the reverse direction until the negative home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the negative home signal rising edge, decelerates→reverses→runs at low speed in the reverse direction until the negative home signal rising edge until the first negative Z signal, which is the home signal. See the figure below.

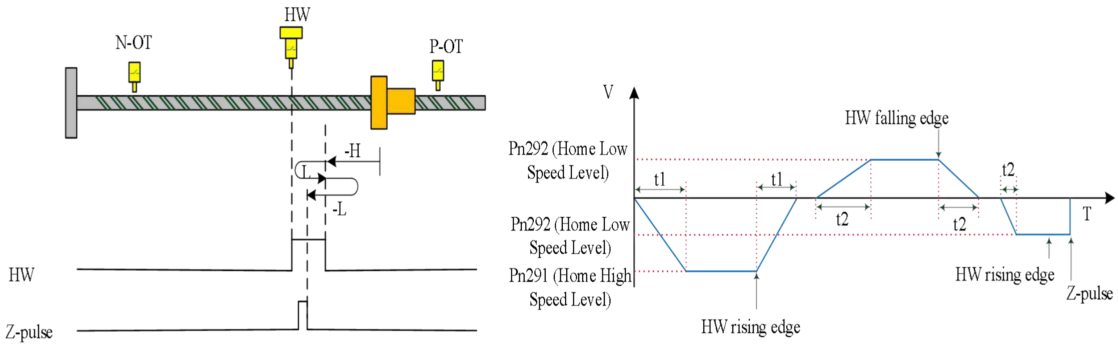


Figure 10-11 Home Mode 3 Trajectory 1

(2) Home mode 3 trajectory 2

Home mode 3 running trajectory 2 starts at high speed in the reverse direction until /N-OT signal rising edge, decelerates→reverses→runs at high speed in the forward direction until the positive home signal rising edge, decelerates→runs at low speed in the forward direction until the negative home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the negative home signal rising edge until the first negative Z signal, which is the home signal, See Figure 10.12.

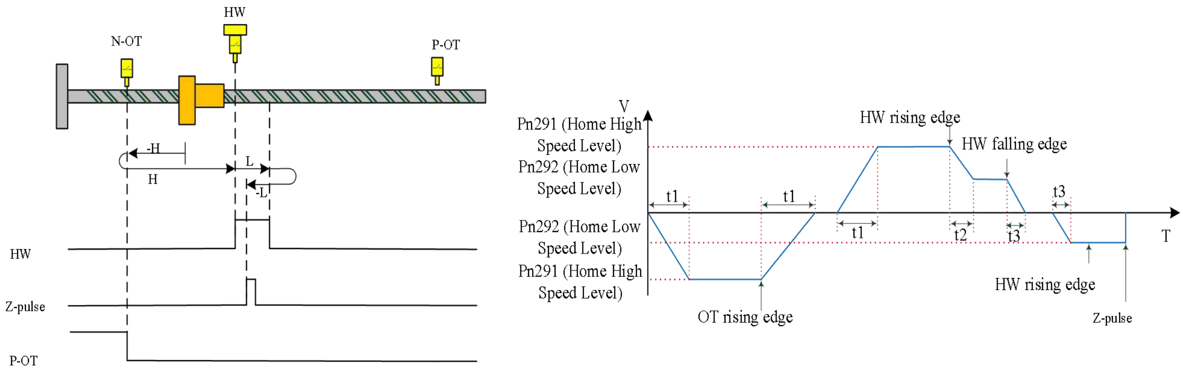


Figure 10-12 Home Mode 3 Trajectory 2

(3) Home mode 3 trajectory 3

Home mode 3 running trajectory 3 starts at low speed in the reverse direction until the positive home signal falling edge, decelerates→reverses→runs at low speed in the forward direction until the positive home signal rising edge until the first negative Z signal, which is the home signal. See the figure below.

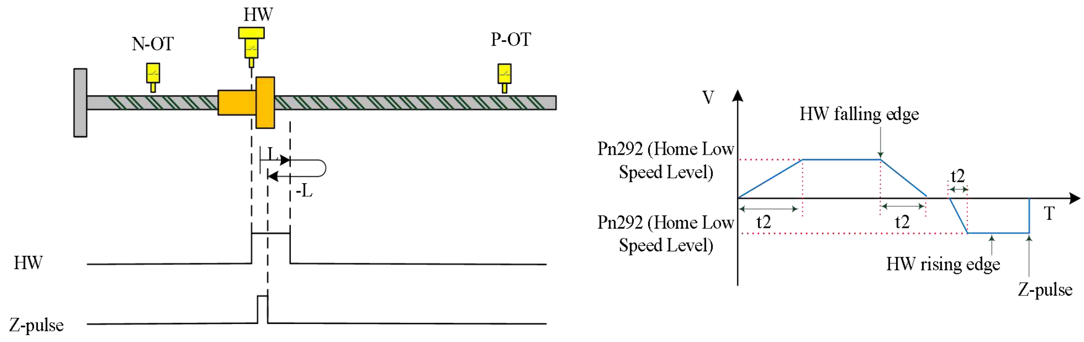


Figure 10-13 Home Mode 3 Trajectory 3

10.1.2.5 Home Mode 4

Home signal: N-OT falling edge

Deceleration point signal: N-OT signal

(1) Home mode 4 trajectory 1

Home mode 4 running trajectory 1 starts at high speed in the forward direction until /P-OT rising edge, decelerates →reverses→runs at low speed in the reverse direction until the/P-OT falling edge, which is the home signal. See Figure 10-14.

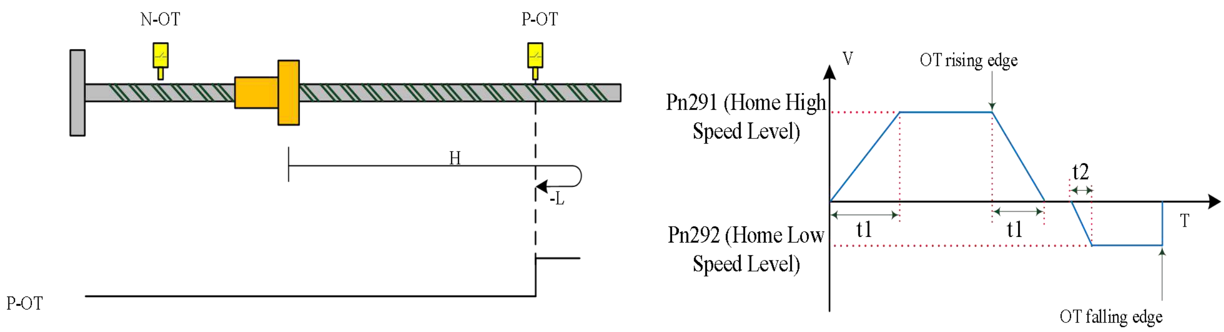


Figure 10-14 Home mode4 trajectory 1

(2) Home mode 4 trajectory 2

Home mode 4 running trajectory 2 starts at low speed in the reverse direction until /P-OT falling edge, which is the home signal. See the figure below.

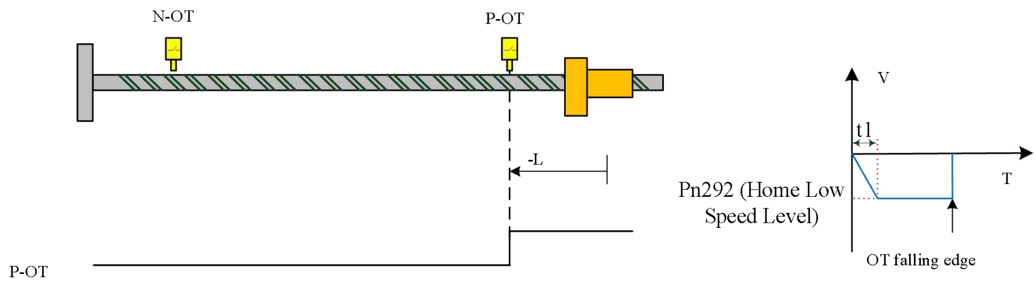


Figure 10-15 Home Mode 4 Trajectory 2

10.1.2.6 Home Mode 5

Home signal: /N-OT falling edge

Deceleration point signal: /N-OT signal

(1) Home mode 5 trajectory 1

Home mode 5 running trajectory 1 starts at high speed in the reverse direction until /N-OT rising edge, decelerates→reverses→runs at low speed in the forward direction until /N-OT falling edge, which is the home signal. See the figure below.

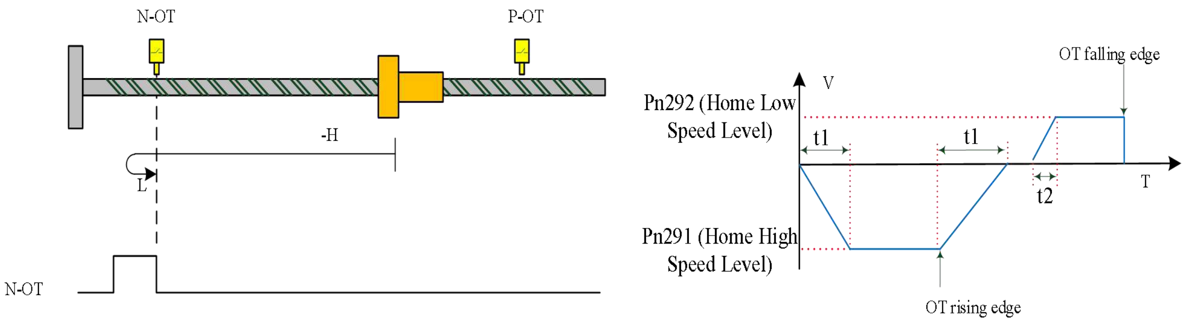


Figure 10-16 Home Mode 5 Trajectory 1

(2) Home mode 5 trajectory 2

Home mode 5 running trajectory 2 starts at low speed in the positive direction until /N-OT falling edge, which is the home signal. See the figure below.

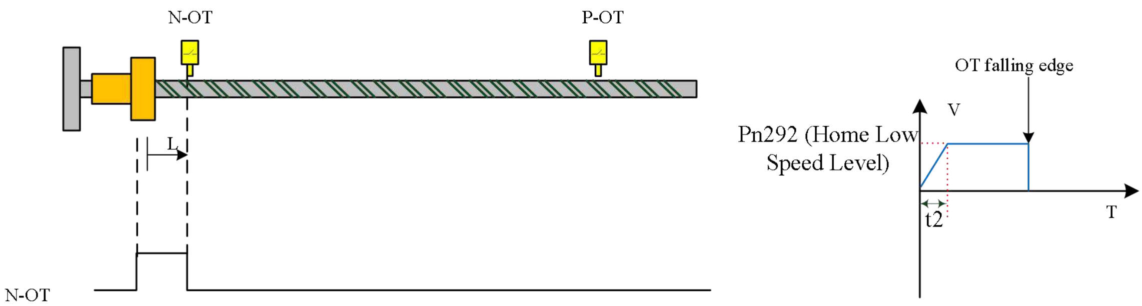


Figure 10-17 Home Mode 5 Trajectory 2

10.1.2.7 Home Mode 6

Home signal: Z signal

Deceleration point signal: P-OT(positive overtravel) signal

(1) Home mode 6 trajectory 1

Home mode 6 running trajectory 1 starts at high speed in the forward direction until /P-OT rising edge, decelerates→reverses→runs at low speed in the reverse direction until the first Z signal after /P-OT falling edge, which is the home signal. See the figure below.

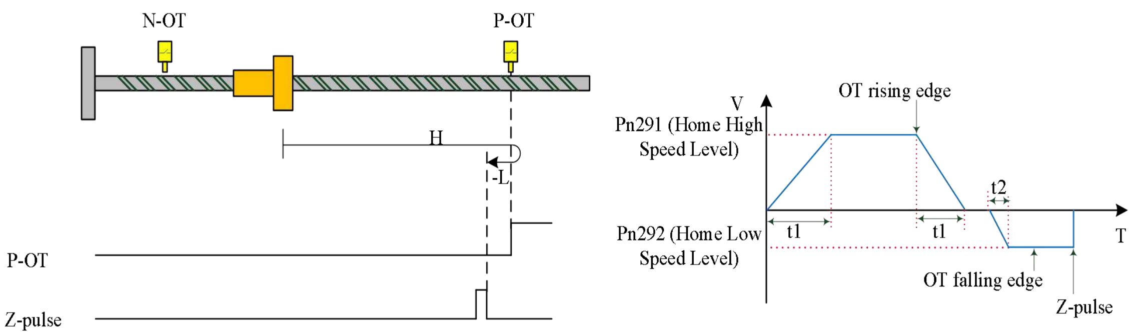


Figure 10-18 Home mode6 trajectory 1

(2) Home mode 6 trajectory 2

Home mode 6 running trajectory 2 starts at low speed in the reverse direction until the first Z signal after /P-OT falling edge, which is the home signal. See the figure below.

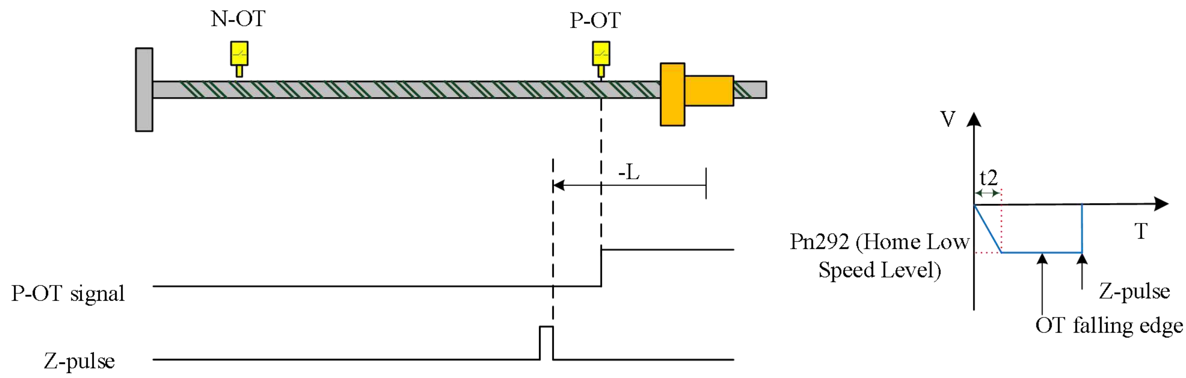


Figure 10-19 Home Mode 6 Trajectory 2

10.1.2.8 Home Mode 7

Home signal: Z signal

Deceleration point signal: /N-OT signal

(1) Home mode 7 trajectory 1

Home mode 7 running trajectory 1 starts at high speed in the reverse direction until /N-OT rising edge, decelerates→reverses→runs at low speed in the forward direction until the first Z signal after /N-OT falling edge, which is the home signal. See the figure below.

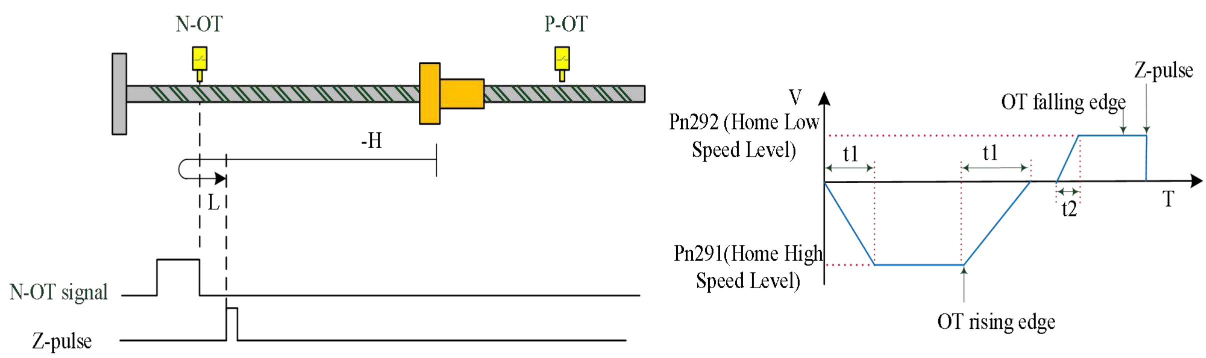


Figure 10-20 Home Mode 7 Trajectory 1

(2) Home mode 7 trajectory 2

Home mode 7 running trajectory 2 starts at low speed in the forward direction until the first Z signal after /N-OT falling edge, which is the home signal. See the figure below.

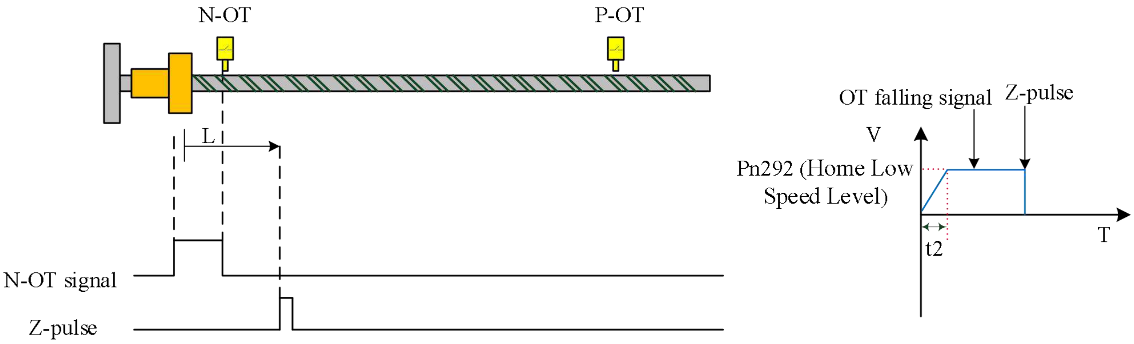


Figure 10-21 Home Mode 7 Trajectory 2

10.1.2.9 Home Mode 8

Home signal: Z signal

Deceleration point signal: none

Home mode 8 starts in forward direction until the first positive Z signal and decelerates to 0 and stops. Its process of searching for the home signal is shown in the figure below.

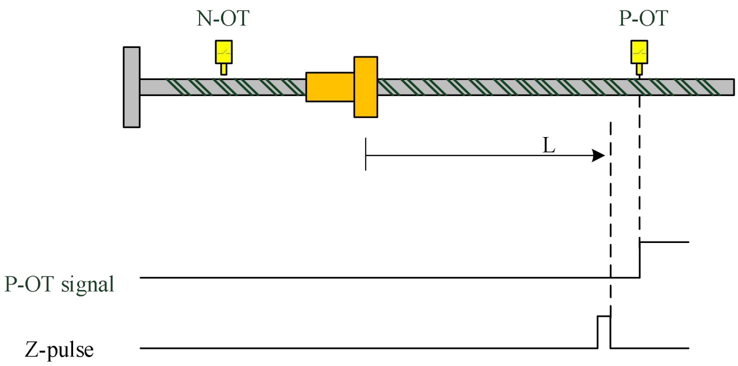


Figure 10-22 Home Mode 8

10.1.2.10 Home Mode 9

Home signal: Z signal

Deceleration point signal: None

Home mode 9 starts in reverse direction until the first negative Z signal and decelerates to 0 and stops. Its process of searching for the home signal is shown in the figure below.

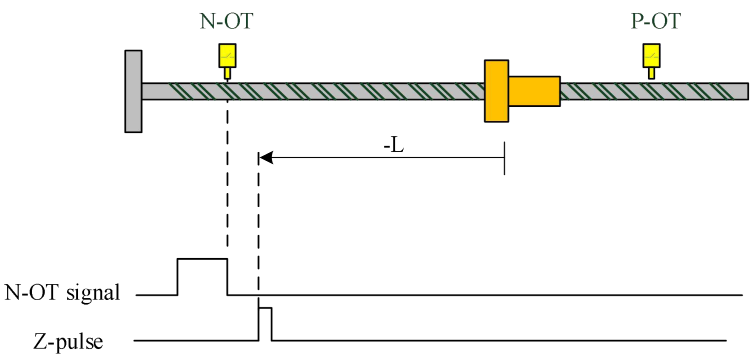


Figure 10-23 Home Mode 9

10.1.2.11 Home Mode 10

Home mode 10 is an absolute position homing mode.

Set the absolute zero point value via Pn296 and Pn297. Under this mode, the motor moves directly from its current position to the preset position at the high speed, so it requires the use of a multi-turn absolute encodER.

Example: If the motor's current absolute encoder position is 5 turns and 0 pulses, and the preset multi-turn value for absolute home mode is 10 (with the single-turn value set to 0), the motor will directly run 5 turns at the high speed.

10.2 Internal Pr Reference

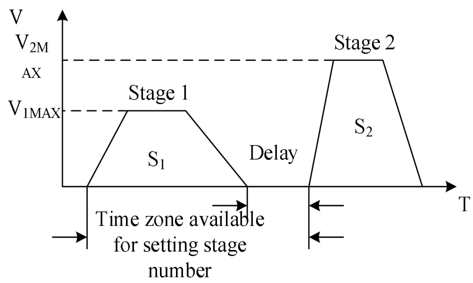
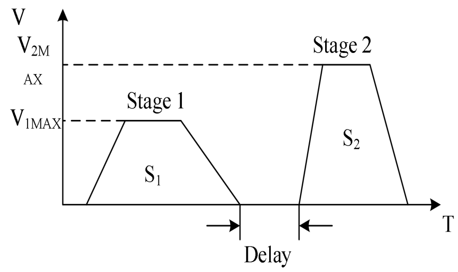
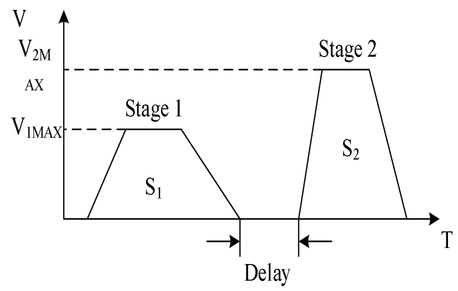
10.2.1 Basic Settings for Internal Pr References

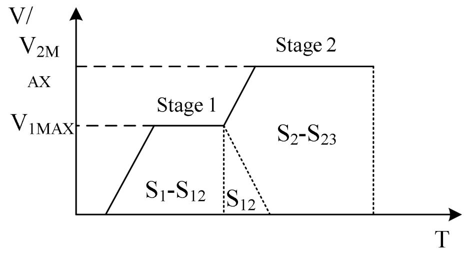
Funcode	Name	Range	Setting
Pn000.X	Control Mode	0: Position mode 1: Velocity mode 2: Torque mode 3: Velocity-Position mode 4: Torque-Position mode 5: Velocity-Torque mode	0
Pn202.X	Position Mode Reference Source	0: External low-speed pulse train 1: External high-speed pulse train 2: NA 3: Internal position 4: CANopen	2
Pn204	Electronic Gear Ratio Numerator (B)	0~1073741824	1
Pn206	Electronic Gear Ratio Denominator (A)	1~1073741824	1

Precautions	
	● When the numerator of the electronic gear ratio is 0, the denominator setting is the number of reference pulses of one revolution of the motor. ● If the setting range exceeds 0.001 ≤ electronic gear ratio (B/A) ≤ 64000, a "Parameter error (ER.d04)" occurs.

10.2.2 Internal Pr Reference Mode

Table 10-2 Internal Pr Reference Mode

Pn802.X Setting	Operation Mode	Comment	Waveform
0	Single segment position	The segment number is set by Pn806 or the DI terminal (CTRG and POS0 to POS3). When running the current segment, the next segment number are available for setting, and the motor stops after the current segment is completed. Rising edge of CTRG triggers operation.	 Vxmax and Vymax are max working speed(target speed)of the X-seg and Y-seg respectively, while Sx and Sy are displacement of the No. X and No.Y segment respectively.
1	Single Pr reference	Auto incremental switching of the segments with delay time set between each two, stop after 1 round; Valid at CTRG high level and stop at CTRG low level.	 V1max and V2max are max working speed (target speed)of the first and second segment respectively, while S_1 and S_2 are displacement of the first and second segment respectively.
2	Cyclic Pr reference	Auto incremental switching of the segments with delay time set between each two, cyclic operation starting with Pr1; Valid at high level of CTRG, stop at low level.	

3	Sequential Pr reference	Auto incremental switching of the segments with no delay time set between each two; Cyclic operation or only 1 round operation optional (only 1 round when Pn804=0 or Pn804＞Pn803). The 1st round takes Pr1 as the start; the starting segment number after the 1st round is Pn804. Valid at CTRG high level and stop at CTRG low level.	 S_{12} is the deceleration phase displacement of S_1. It is directly skipped, and this segment position is executed during the operation of S_2.

NOTE	
⚠	● When Pr reference (Pn802.X=1, 2, 3), setting Pn806=1 (communication, keypad) will trigger the operation, too. ● When Pn806=1000, all position modes (home and internal Pr reference) can be forced to stop.

Related function codes:

Funcode	Name	Range	Default
Pn802.X	Internal position mode	0:Single segment 1:Single continuous operation 2:Cyclic continuous operation 3: Sequential operation	0
Pn802.Y	Pr reference margin processing mode	0: Continue to run the unfinished path (start from the next segment of the pause) 1: Restart from Pr1	0
Pn802.Z	Single-segment position new reference processing	0: Non-immediate update When there is a new reference, it will wait until the current one is finished (delay time valid) 1: Immediate update (delay time invalid)	0
Pn802.W	Absolute position start	0: Start from motor position at initial power-up or after homing 1: Absolute zero point set by Pn296 and Pn297	0
Pn803	Pr Reference End Path	1~15	1

Pn804	Sequential Pr Reference Start Path	0~15	1
Pn806	Single Pr Reference Communication	0~65535	10000
Pn810.X	Pr reference type	0: Position control 1: Speed control	0
Pn810.Y	Position control type	0: Incremental position 1: Absolute position 2: Relative position	0
Pn810.Z	Speed control unit	0: 0.1rpm 1: PPS	0
Pn811.X	ACC Time	0~7: for Pn890~Pn897	0
Pn811.Y	DEC Time	0~7: for Pn890~Pn897	0
Pn811.Z	Position control target selocity	0~7: for Pn8A0~Pn8A7	0
Pn811.W	Delay time	0~7: for Pn898~Pn89F	0
Pn812	Pr1 Path Information	-2^{31}~$(2^{31}-1)$	0
...	...	...	...
Pn890~Pn897	Pr ACC/DEC 0~7	0~60000	-
Pn898~Pn89F	Pr Delay Time 0~7	0~60000	-
Pn8A0~Pn8A7	Pr Target Velocity 0~7	0~60000	-

Notes

- The first round of sequential operation starts from Pr1 and runs to the path pointed by Pn803;
- If Pn804 = 0 or Pn804 > Pn803 during sequential operation, it stops after 1 round.
- If Pn804≤Pn803 during sequential operation, the cycle runs after the 1st round and the starting segment number is Pn804.

10.2.3 Internal Pr Reference Operation

The positioning function plans the corresponding position trajectory based on the set speed, acceleration/deceleration time, delay time, and target position value. Here we take the operation parameters of the first segment Pr reference as an example.

(1) Position reference

In position mode, the number of position reference pulses for point-to-point control is decided by Pn804 + POSNUM * 4. And its unit is user-defined. The number of pulses per revolution for the position reference is configured through the electronic gear ratio parameters Pn204 and Pn206.

And in position mode, the target position value can be set as incremental, relative, or absolute.

1. The reference point for incremental positions is the current target value of the position reference. As shown in the figure below, the first segment position reference is set to PosCmd0. After executing Pos0 pulses, the motion completes, leaving PosRem0 pulses unexecuted. If a second incremental position reference PosCmd1 is inserted at this point, then the total number of pulses executed for the second reference will be PosCmd1 + PosRem0, and the final position will be PosCmd0 + PosCmd1.

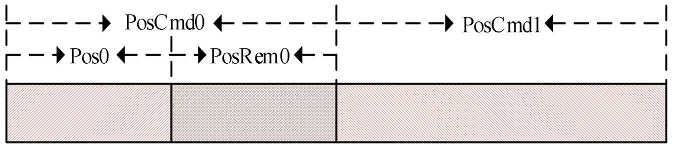


Figure 10-24 Incremental Position Reference Operation

2. The reference point for relative positions is the actual position value. The target position value for each subsequent segment is calculated based on the actual position at the time of execution. As shown in the figure below, the first position reference is set to PosCmd0. After executing Pos0 pulses, a second relative position reference PosCmd1 is inserted. The total number of pulses executed for the second reference is PosCmd1, and the final position is Pos0 + PosCmd1.

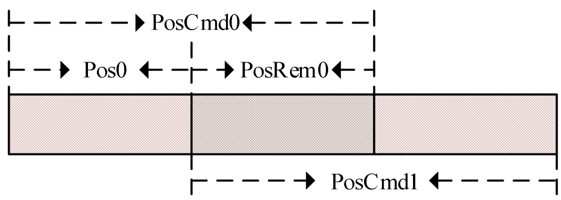


Figure 10-25 Relative Position Reference Operation

3. The reference point for absolute positions is the position value relative to the absolute zero point (Pn296 and Pn297). As shown in the figure below, the first position reference is set to PosCmd0. After executing Pos0 pulses, a second absolute position reference PosCmd1 is inserted. The total number of pulses executed for the second reference is PosCmd1 - Pos0, and the final position is PosCmd1.

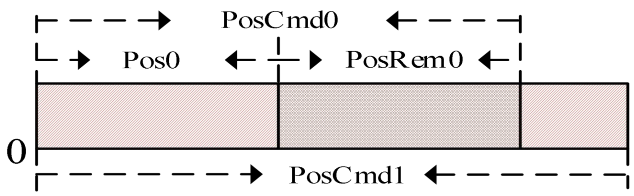


Figure 10-26 Absolute Position Reference Operation

(2) Acceleration and deceleration time

The acceleration and deceleration time of motor operation under position control are calculated with a 3000rpm basis. For example, if the acceleration time is set to 300ms and the target speed is 1000rpm, this means: the time required to accelerate from 0rpm to 3000rpm is set to 300ms and the time required to accelerate from 0rpm to the target speed of 1000rpm is 100ms.

(3) Speed control

The internal Pr reference speed setting varies under position control and speed control.

1. During position control, the desired operating speed is determined by high bits 8~11 of the Pr reference control word.
   For example, if the control word for Pr1 is configured via Pn810 and Pn811, the speed is set by Pn811.Z.

The set speed value must be positive and the actual direction is determined by the sign (positive/negative) of the target position value.

2. During speed control, the target speed value is defined through the corresponding Pr parametER. For example, if Pr1 is under speed control, the unit of target speed (0.1rpm or PPS) is set by Pn810.Z, and Pr1 target speed is set by Pn812; If the motor direction needs reversion, set Pn812 to a negative value.

(4) Delay time

1. The delay time function is valid in single Pr reference, acyclic Pr reference, and cyclic Pr reference. If the delay time for Pr1 is set to T(ms), after the completion of the Pr1 reference, a delay of T (ms) will be performed before the next Pr reference. If the delay time is set to 0, the deceleration phase of the current Pr reference or the acceleration phase of the next Pr reference will be skipped. For example, if the target speed of Pr1 is 1000rpm and the target speed of Pr2 is 800rpm, when switching from Pr1 to Pr2, and the delay time is 0, it will directly accelerate from 800rpm to 1000rpm.
2. For sequential Pr reference, the delay time is not effective. Between segments, the deceleration or acceleration process is skipped, and the system directly transitions from the deceleration point of the previous segment to the target speed of the next. For example, if the target speed of Pr1 is 1000rpm and the target speed of Pr2 is 800rpm, when switching from Pr1 to Pr2, it will directly decelerate from 1000rpm to 800rpm.

10.2.4 Single Pr Reference Operation

For the single segment among a Pr reference (Pn802.X = 0), users can modify and trigger the Pr reference segment through external DI terminals or Pn806. When selecting the Pr segment via external terminals, the relationship between the terminals and the Pr segment is shown in Table 12-3. When triggering via communication function codes:
If Pn806 = 0, the homing operation is executed.
If Pn806 = 1~15, the corresponding Pr segment is executed. During operation:
Pn806 = 10000 + Num (where Num is the Pr segment No, e.g., *Num = 1* for Pr1 execution).
After operation completes:
Pn806 = 20000 + Num.

Table 10-3 Terminals and Pr Segments during Single Pr Reference Operation

POS3	POS2	POS1	POS0	CTRG↑ Function	CTRG↓ RUN command
0	0	0	0	Home	Immediately stop
0	0	0	1	Pr1	
0	0	1	0	Pr2	
0	0	1	1	Pr3	
0	1	0	0	Pr4	
0	1	0	1	Pr5	
0	1	1	0	Pr6	
0	1	1	1	Pr7	
1	0	0	0	Pr8	
1	0	0	1	Pr9	
1	0	1	0	Pr10	

1	0	1	1	Pr11	
1	1	0	0	Pr12	
1	1	0	1	Pr13	
1	1	1	0	Pr14	
1	1	1	1	Pr15	

Table 10-4 Example of Single Pr Reference Operation

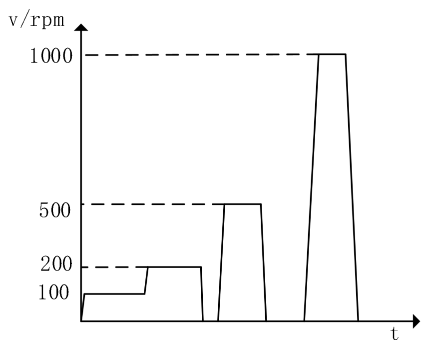
No.	Item	Description
1	Operation Mode	Pn000.X=0 (control mode is position control); Pn200.X=3 (give by internal position) Pn802.X=0 (selection of single-segment operation mode) Pn204=0, Pn206=20000 (23-bit encoder motor with electronic gear ratio 8388608:20000)
2	Terminal assignment	Pn601.YX=0x01 (assigns terminal X1 as servo enable terminal S-ON); Pn604.YX=0x20 (assigns terminal X4 as internal position trigger terminal CTRG); Pn605.YX=0x21 (assigns terminal X5 as internal position selection POS0);
3	Acceleration/deceleration time setting	Pn890=600 (Acceleration and deceleration time for segment 0 is 600, acceleration from 0rpm to 3000rpm or deceleration from 3000rpm to 0 is 600ms).
4	Pr1 reference control word setting	Pn810.X=0, Pn810.Y=0 (i.e., selected as incremental position mode). Pn811=0x0000 (target speed is Pn8A0, i.e. 100rpm; acceleration/deceleration time is Pn890, i.e. 600ms; delay time is Pn898, i.e. 0ms, no delay).
5	Terminal triggering operation Pr1	Servo enable, POS0=1, Pr1 path is selected; Pn812=100000, Pr1information is 100000 pulses; Change CTRG from 0 to 1, then run Pr1 to run 100000 pulses at 100rpm. Un013 has increased by 100000 from the value after the operation.
6	Communication triggering operation Pr1	Make Pn812=200000, Pn806=1, then the servo drive excutes the internal position Pr1 by 200000 pulses; make Pn806=1000 during running then the servo drive stops immediately.

10.2.5 Single Continuous Pr Reference Operation

Single continuous Pr reference (Pn802.X=1) is oen of the internal Pr reference operation mode, which runs from Pr1 and only runs once per triggER. Its end segment is controlled by Pn803, for example, Pn803=3, and the drive runs from from Pr1 to Pr3.

Table 10-5 Single Continuous Pr Reference Operation

No.	Item	Description
1	Operation Mode	Pn000.X=0 (control mode to position control); Pn200.X=3 (internal position); Pn802.X=1 (selection of single-segment operation mode) Pn204=0, Pn206=20000 (23-bit encoder with electronic gear ratio 8388608:20000)
2	Terminal assignment	Pn601.YX=0x01 (terminal X1 to enable drive); Pn604.YX=0x20 (terminal X4 to internal trigger CTRG).
3	Pr reference setting	Pn803=4, internal Pr reference end path set to Pr4 Pr1: Pn810=0x0000, Pn811=0x0000, Pn812=100000; Pr2: Pn814=0x0000, Pn815=0x1111, Pn816=200000; Pr3: Pn818=0x0000, Pn819=0x2222, Pn81A=300000; Pr4: Pn81C=0x0000, Pn81D=0x3333, Pn81E=400000; ACC/DEC time 0~3, target speed 0~3, and delay time 0~3 are default values.

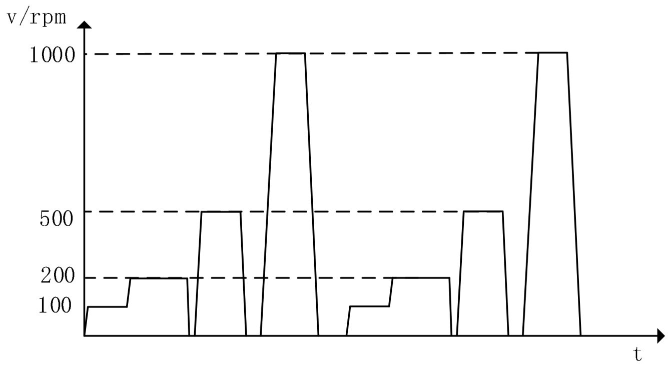
No.	Item	Description
4	Terminal triggering single Pr reference	Enable servo. Toggle CTRG from 0 to 1 to trigger a single Pr reference The running speed waveform is shown below, and the encoder position feedback pulse increment is 100000PUU. 

10.2.6 Cyclic Continuous Operation

Cyclic continuous operation (Pn802.X=2) is the second operation mode for internal Pr references, running from Pr1, the end segment is controlled by Pn803. For example, Pn803=3, the cyclic Pr reference triggers to run from Pr1 to Pr3, and the cycle repeats.

Table 10-6 Cyclic Pr Reference Example

No.	Item	Description
1	Operation Mode	Pn000.X=0 (control mode to position control); Pn200.X=3 (internal position); Pn802.X=2 (cyclic continuous operation mode); Pn204=0, Pn206=20000 (23-bit encoder with electronic gear ratio 8388608:20000)

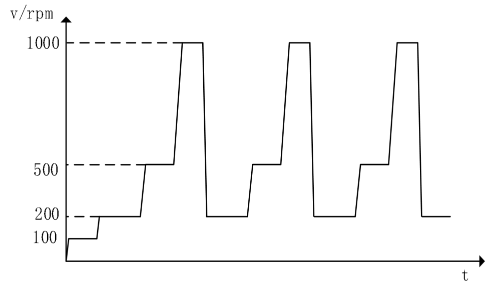
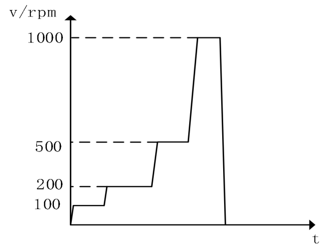
2	Terminal assignment	Pn601.YX=0x01 (assigns terminal X1 to /S-ON); Pn604.YX=0x20 (assigns terminal X4 to /CTRG)
3	Pr reference setting	Pn803=4, internal Pr reference end path set to Pr4 Pr1: Pn810=0x0000，Pn811=0x0000，Pn812=100000; Pr2: Pn814=0x0000，Pn815=0x1111，Pn816=200000; Pr3: Pn818=0x0000，Pn819=0x2222，Pn81A=300000; Pr4: Pn81C=0x0000，Pn81D=0x3333，Pn81E=400000; ACC/DEC time 0~3, target speed 0~3, and delay time 0~3 are default values.
4	Terminal triggering cyclic Pr reference	Enable servo: Toggle CTRG from 0 to 1 to trigger a single Pr reference The running speed waveform is shown below, run Pr1to Pr4, and then Pr1 again. Repeat the cycle. 

10.2.7 Sequential Pr Reference

Cyclic continuous operation (Pn802.X=3) is the third operation mode of internal Pr, running from Pr1, the end segment is decided by Pn803. For example, Pn803=4, the cyclic Pr reference triggers to run from Pr1 to Pr4. After the first cycle, the starting point is controlled by Pn804. If Pn804=0 or Pn804>Pn803, the operation will end after the first cycle. If 0 < Pn804 ≤ Pn803, the starting point will change to the path indicated by Pn804 after the first cycle. There is no delay time between the segments in this mode.

Table 10-7 Sequential Pr Reference Operation

No.	Item	Description
1	Operation Mode	Pn000.X=0 (control mode to position control); Pn200.X=3 (internal position); Pn802.X=3 (sequential operation). Pn204=0, Pn206=20000 (23-bit encoder with electronic gear ratio 8388608:20000)
2	Terminal assignment	Pn601.YX=0x01 (terminal X1 to enable drive); Pn604.YX=0x20 (terminal X4 to internal trigger CTRG).

3	Pr reference setting	Pn803=4, Internal Pr reference end path set to Pr4 Pr1: Pn810=0x0000, Pn811=0x0000, Pn812=100000; Pr2: Pn814=0x0000, Pn815=0x1111, Pn816=200000; Pr3: Pn818=0x0000, Pn819=0x2222, Pn81A=300000; Pr4: Pn81C=0x0000, Pn81D=0x3333, Pn81E=400000; ACC/DEC time 0~3, target speed 0~3, and delay time 0~3 are default values.
4	Terminal triggering sequential single Pr reference	Enable the servo, make Pn804=2 (0<Pn804<Pn 803), and then toggle CTRG from 0 to 1, then the single Pr reference is triggered. The running speed waveform is shown as follows. 
5	Modify Pn804 to run again	Toggle CTRG from 1 to 0 to stop sequential multi-stage positional operation. Make Pn804=5 (Pn804>Pn803 or Pn804=0) Trigger the single multi-stage operation command again, and the running speed waveform is shown as follows. 

11 Appendix

11.1 Attachment 1 Input Terminal Definitions

Setting: 0x01			
Mark	Enable servo drive	Trigger	Control Mode
S-ON	This signal is used to activate the servo drive. Invalid: Servo motor is not enabled (Servo-OFF). Valid: Servo motor is enabled (Servo On).	High/low level	$\boxed{P}\boxed{S}\boxed{T}$

Setting: 0x02			
Mark	Positive overtravel	Trigger	Control Mode
P-OT	This signal is used to limit the motor from forward operation when a forward reference is sent externally. Invalid: motor continues to run forward. Valid: motor stays.	High/low level	$\boxed{P}\boxed{S}\boxed{T}$

Setting: 0x03			
Mark	Negative overtravel	Trigger	Control Mode
N-OT	This signal is used to limit the motor from reverse operation when a reverse command is sent externally. Invalid: motor continues to run reversely. Valid: motor stays.	High/low level	$\boxed{P}\boxed{S}\boxed{T}$

Setting: 0x04			
Mark	Error reset	Trigger	Control Mode
ALM-RST	This signal is used to clear an error prompt that has occurred in the drive. Invalid: Error clear inhibit Valid: Error reset available	High/low level	$\boxed{P}\boxed{S}\boxed{T}$

Setting: 0x05			
Mark	PI/P shift	Trigger	Control Mode
P-CON	This signal is used to switch the PI (Proportional/Integral) and P (Proportional) regulators of the drive's speed loop. Invalid: PI control (proportional/integral). Valid: P control (proportional).	High/low level	$\boxed{P}\boxed{S}\boxed{T}$

<table>
<tr><th colspan="4">Setting: 0x06</th></tr>
<tr><td>Mark</td><td>Torque limit shift</td><td>Trigger</td><td>Control Mode</td></tr>
<tr><td>TL-SEL</td><td>This signal is used to limit the forward and reverse torque of the drive.
Position mode or speed mode:
Invalid: limit forward and reverse torque by Pn053.
Valid: limit forward and reverse torque by Pn054.
Torque mode:
Invalid: limit forward and reverse torque by Pn051.
Valid: limit forward and reverse torque by Pn052.</td><td>High/low level</td><td>P S T</td></tr>
</table>

<table>
<tr><th colspan="4">Setting: 0x08</th></tr>
<tr><td>Mark</td><td>Speed reference direction</td><td>Trigger</td><td>Control Mode</td></tr>
<tr><td>SPD-D</td><td>This signal is used to adjust the direction of the speed reference in speed mode.
Invalid: the same as the speed reference
Valid: opposite to the speed reference</td><td>High/low level</td><td>S</td></tr>
</table>

<table>
<tr><th colspan="4">Setting: 0x09, 0x0A</th></tr>
<tr><td>Mark</td><td>Internal register speed reference buffer</td><td>Trigger</td><td>Control Mode</td></tr>
<tr><td>SPD-A
SPD-B</td><td>SPD-A: internal register speed reference buffer 1
SPD-B: internal register speed reference buffer 2<table><tr><th>SPDB</th><th>SPDA</th><th>Reference source</th></tr><tr><td>0</td><td>0</td><td>Pn304 setting</td></tr><tr><td>0</td><td>1</td><td>Pn305 setting</td></tr><tr><td>1</td><td>0</td><td>Pn306 setting</td></tr><tr><td>1</td><td>1</td><td>Pn307 setting</td></tr></table></td><td>High/low level</td><td>S</td></tr>
</table>

<table>
<tr><th colspan="4">Setting: 0x0B</th></tr>
<tr><td>Mark</td><td>Control mode shift</td><td>Trigger</td><td>Control Mode</td></tr>
</table>

<table>
<tr><td>C-SEL</td><td>This signal is used to shift the control mode.
<table>
<tr><td rowspan="2">P000.X Setting</td><td colspan="2">Control Mode Shift Signal (/C-SEL)</td></tr>
<tr><td>High level (H)</td><td>Low level (L)</td></tr>
<tr><td>3</td><td>Velocity mode</td><td>Position mode</td></tr>
<tr><td>4</td><td>Torque mode</td><td>Position mode</td></tr>
<tr><td>5</td><td>Velocity mode</td><td>Torque mode</td></tr>
</table></td><td>High/low level</td><td>$\boxed{P}\boxed{S}\boxed{T}$</td></tr>
</table>

Setting: 0x0C			
Mark	Zero clamp	Trigger	Control Mode
ZCALMP	This signal is used to send zero clamp signal to the drive. Invalid: zero clamp function is off Valid: zero clamp function is on	High/low level	$\boxed{S}$

Setting: 0x0D			
Mark	Reference pulse inhibit	Trigger	Control Mode
INHIBIT	This signal is used to control reference pulses sending to the drive. Invalid: drive stops receiving reference pulses and counting Valid: drive receives reference pulses and counts	High/low level	$\boxed{P}$

Setting: 0x0E			
Mark	Gain shift	Trigger	Control Mode
G-SEL	This signal is used to select between the two gains in speed and position mode. Invalid: Switch to 1st gain. Valid: Switch to 2nd gain.	High/low level	$\boxed{P}\boxed{S}\boxed{T}$

Setting: 0x0F			
Mark	Torque reference direction shift	Trigger	Control Mode
TPR-D	This signal is used to adjust the output direction of the torque reference via this terminal in the torque mode: Invalid: same as the torque reference Valid: opposite to the torque reference	High/low level	$\boxed{T}$

<table>
<tr><th colspan="4">Setting: 0x10</th></tr>
<tr><td>Mark</td><td>Pulse reference multiplier shift</td><td>Trigger</td><td>Control Mode</td></tr>
<tr><td>P-GAIN</td><td>This signal is used to set the frequency multiplier of the reference pulse input under position mode.
Invalid: same as input
Valid: use multipliER.</td><td>High/low level</td><td>$\boxed{P}$</td></tr>
</table>

<table>
<tr><th colspan="4">Setting: 0x11</th></tr>
<tr><td>Mark</td><td>Pulse deviation clear</td><td>Trigger</td><td>Control Mode</td></tr>
<tr><td>CCLR</td><td>This signal is used to clear the pulse count buffer, which is decided by Pn200.Y.
When this signal is valid, the position pulse deviation accumulated by the servo drive is cleared to zero.</td><td>Edge
High/low level</td><td>$\boxed{P}$</td></tr>
</table>

<table>
<tr><th colspan="4">Setting: 0x12, 0x13</th></tr>
<tr><td>Mark</td><td>Internal register torque reference buffer</td><td>Trigger</td><td>Control Mode</td></tr>
<tr><td>TOR-A
TOR-B</td><td>TOR-A: internal register torque reference buffer 1
TOR-B: internal register torque reference buffer 2
<table>
<tr><th>TOR-B</th><th>TOR-A</th><th>Reference source</th></tr>
<tr><td>0</td><td>0</td><td>Pn410 setting</td></tr>
<tr><td>0</td><td>1</td><td>Pn411 setting</td></tr>
<tr><td>1</td><td>0</td><td>Pn412 setting</td></tr>
<tr><td>1</td><td>1</td><td>Pn413 setting</td></tr>
</table>
</td><td>High/low level</td><td>$\boxed{T}$</td></tr>
</table>

<table>
<tr><th colspan="4">Setting: 0x15</th></tr>
<tr><td>Mark</td><td>Torque mode speed limit source</td><td>Trigger</td><td>Control Mode</td></tr>
<tr><td>T-SLMT</td><td>This signal is used to select the desired speed limit source in torque control.
Invalid: limit by Pn415.
Valid: limit by Pn416.</td><td>High/low level
Edge</td><td>$\boxed{T}$</td></tr>
</table>

Setting: 0x17			
Mark	Positive jog	Trigger	Control Mode
JOGP	This terminal is used to input a positive jog speed reference to the drive. Invalid: positive jog speed reference input OFF. Valid: positive jog speed reference input ON.	High/low level	🄿🅂🅃

Setting: 0x18			
Mark	Reverse jog	Trigger	Control Mode
JOGN	This terminal is used to input a negative jog speed reference to the drive. Invalid: negative jog speed reference input OFF. Valid: negative jog speed reference input ON.	High/low level	🄿🅂🅃

Setting: 0x19			
Mark	Emergency stop	Trigger	Control Mode
EMSTOP	This terminal is used to input an emergency stop command to the drive. Invalid: servo drive maintains the current operating status. Valid: Coasting stop and motor shaft locked	High/low level	🄿🅂🅃

Setting: 0x1A			
Mark	Control mode shift 2	Trigger	Control Mode
C-SEL2	This signal is used to shift control mode when Pn000.X=6.	High/low level	🄿🅂🅃

Setting: 0x1B			
Mark	Control mode confirm	Trigger	Control Mode

<table>
<tr>
<td>C-Trig</td>
<td>This terminal is used to confirm the selected control mode when Pn000.X=6.
<table>
<tr><th rowspan="2">Pn000.X Setting</th><th colspan="2">Control Mode Shift Signal</th><th rowspan="2">C-Trig</th><th rowspan="2">Control Mode</th></tr>
<tr><th>C-SEL</th><th>CSEL2</th></tr>
<tr><td rowspan="3">6</td><td>0</td><td>0</td><td rowspan="3">↑</td><td>Velocity mode</td></tr>
<tr><td>0</td><td>1</td><td>Position mode</td></tr>
<tr><td>1</td><td>0</td><td>Torque mode</td></tr>
</table>
</td>
<td>Edge</td>
<td>🄿🅂🅃</td>
</tr>
</table>

Setting: 0x1F			
Mark	Brake Input	Trigger	Control Mode
BKSel	This signal is used to control the brake via external terminals. When the brake is controlled externally, it disables the brake enable logic.	High/low level	🄿🅂🅃

Setting: 0x1F			
Mark	Brake Input	Trigger	Control Mode
BKSel	This signal is used to control the brake via external terminals. When the brake is controlled externally, it disables the brake enable logic.	High/low level	🄿🅂🅃

Setting: 0x20			
Mark	Internal position reference	Trigger	Control Mode
CTRG	In the PR mode, the position references selected from POS0 to POS5 are read into the controller at the moment of CTRG conduction (rising edge).	High/low level	🄿

Setting: 0x27			
Mark	Home enable	Trigger	Control Mode

ORGEN	In position mode, when the terminal triggers home return, the home command is read into the controller.	High/low level Edge	Ⓟ

Setting: 0x28			
Mark	Mechanical home signal	Trigger	Control Mode
ORGS	This signal is used as a home signal source during home mode. Invalid: home signal not met Valid: home signal met	Rising edge	Ⓟ

11.2 Attachment 2 Output Terminal Definitions

Setting: 0x01			
Mark	Servo ready	Trigger	Control Mode
RDY	If the servo drive is ready and there is no fault at present, the output of this signal is ON. If the servo is ready or currently faulty, this signal output is OFF.	High/low level	ⓅⓈⓉ

Setting: 0x02			
Mark	Position coincidence	Trigger	Control Mode
COIN	When the current position deviation is within Pn262 [/COIN Signal Width], this signal output is ON. When the current position deviation is not within Pn262 [/COIN Signal Width], this signal output is OFF.	High/low level	Ⓟ

Setting: 0x03			
Mark	Velocity clamp	Trigger	Control Mode
V-CMP	When the deviation between the motor feedback speed and the target is within Pn320 [/V-CMP Signal Width], this signal output is ON. When the deviation between the motor feedback speed and the target is not within Pn320 [/V-CMP Signal Width], this signal output is OFF.	High/low level	ⓅⓈⓉ

Setting: 0x04			
Mark	Motor rotation signal	Trigger	Control Mode
TGON	When the motor running speed is lower than the motor rotation detection threshold (Pn317), this signal is OFF. When the motor running speed is greater than the motor rotation detection threshold (Pn317), this signal is ON.	High/low level	P S T

Setting: 0x05			
Mark	Torque limit in effect	Trigger	Control Mode
TLT	When the output torque of the motor is within the set range, this signal is ON. When the output torque of the motor is not within the set range, this signal is OFF.	High/low level	P S T

Setting: 0x06			
Mark	Velocity limit	Trigger	Control Mode
VLT	In torque mode: When the motor speed is not within the set speed limit, this signal is ON. When the motor speed is within the set speed limit, this signal is OFF.	High/low level	T

Setting: 0x07			
Mark	Brake output signal	Trigger	Control Mode
BK	When this signal is invalid, the brake power supply disconnects, the brake engages, and the motor position is locked. When this signal is valid, the brake power supply connects, the brake opens, and the motor will be able to rotate.	High/low level	P S T

Setting: 0x08			
Mark	Alarm output	Trigger	Control Mode

/WARN	When alarm occurs on the current drive, this signal is ON. When no alarm occurs on the current drive, this signal is OFF.	High/low level	P S T

Setting: 0x09			
Mark	Position near signal	Trigger	Control Mode
NEAR	When the current position deviation is within Pn260 [/Near Signal Width], this signal is ON. When the current position deviation is not within Pn260 [/Near Signal Width], this signal is OFF.	High/low level	P S T

Setting: 0x0A			
Mark	Reference pulse input multiplier	Trigger	Control Mode
PSELA	When the pulse input multiplier is used, this signal is ON. When the pulse input multiplier is not used, this signal is OFF.	High/low level	P S T

Setting: 0x0B			
Mark	Error output	Trigger	Control Mode
Alarm	When an error occurs on the drive, this signal is ON. When no error occurs on the drive, this signal is OFF.	High/low level	P S T

Setting: 0x0C			
Mark	Target torque reach	Trigger	Control Mode
TorqR	Set the corresponding timing using function codes Pn420 and Pn421.	High/low level	P S T

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