Simphoenix

CD300 Series
EtherCAT Servo Drive
User Manual

www.simphoenix.com

Preface

Thank you for choosing the CD300 series EtherCAT servo drive.

The CD300 series EtherCAT servo drive is a general-purpose, high-performance AC servo drive developed by Simphoenix.It supports the EtherCAT communication protocol, by utilizing the corresponding Ethernet communication interface and coordinating with the host controlor, multi-axis servo networking operation can be achieved.

This series features the latest model-based tracking control and gain adjustment-free functionality, enabling active identification and correction of deviations in input commands for more responsive equipment performance and greater motion precision. Through real-time command reconstruction and dynamic compensation, it effectively eliminates jitter and jerk during movement, ensuring smooth operation across the entire speed range from low to high, and significantly improving machining and control accuracy of the equipment. In addition, functions such as single-parameter auto-tuning, 1-second inertia identification, online load measurement, online resonance suppression, end vibration suppression, and pulse/bus communication make servo control convenient and easy to use. Paired with the CM10 series high-response servo motors, the system delivers reliable and stable performance, making it suitable for automation equipment in typical industries including packaging, food production, CNC cutting, textiles, machine tools, and wood carving. With a high-performance solution, it enables fast and precise position control, speed control, and torque control.

This manual is the product user manual for the CD300E series servo drive, providing content and precautions covering product selection, installation, wiring, basic debugging, function descriptions, parameter descriptions, and troubleshooting. For first-time users, please read this manual carefully. For further information regarding product usage, please contact our technical staff for more detailed and professional support! Thanks for your use!

The content of this manual is subject to change without prior notice as Simphoenix continuously optimizes product functionality and performance. For the latest updates, please refer to our official website: www.simphoenix.com.cn.

If you identify any discrepancies in this manual or encounter issues with the product, please contact our 24/7 customer service team:

- **Hotline:** 400-8819-800
- **Email:** marketing@simphoenix.com

We highly value your feedback and appreciate your trust in Simphoenix. Thank you for your support!

Version: V1.1

Revision Date: September 2026

Contents

Chapter 1 Safety Precautions

1.1 Safety Statement

- This chapter explains the safety precautions that must be observed for the correct use of this product. **Read and understand all safety instructions thoroughly before use.** Failure to comply with the matters stipulated in the safety precautions may result in serious injury and even death, or equipment damage.
- The "DANGER", "WARNING", and "CAUTION" notices in this manual do not represent all safety matters that should be observed; they serve only as a supplement to all safety precautions.
- This product should be used in an environment that meets the design specifications. Otherwise, it may cause malfunctions. Functional abnormalities or component damage caused by non-compliance with relevant regulations are not covered by the product quality warranty.
- Our company will not assume any legal responsibility for personal safety accidents, property damage, etc., caused by non-compliance with the contents of this manual or by operating the product in violation of regulations.

Safety Level Definitions

Danger **Indicate that failure to follow instructions will result in serious physical injury or even death.**

Warning **Indicate that failure to follow instructions may result in serious physical injury or even death.**

CAUTION **Indicate that failure to follow instructions may result in minor physical injury or equipment damage.**

Safety Precautions

- In this manual, product illustrations may sometimes show the product with its cover or safety guard removed to display detailed parts.
- When using this product, always ensure that the cover or guard is properly installed and operate according to the instructions in the manual.
- Product diagrams in this manual are for illustration purposes only and may differ slightly from the product you ordered. Please refer to the actual product ordered.
- Operators must take mechanical protective measures to ensure personal safety. Please wear and use necessary protective equipment, such as safety shoes, safety clothing, safety glasses, protective gloves, and arm sleeves.

Unboxing Inspection

Warning

- Unpacking and acceptance: If the product or its accessories are found to be damaged, rusted, or show signs of prior use during unpacking, do not install!
- If water ingress, missing components, or damaged components are found inside the product during unpacking, do not install!
- Please carefully check the packing list. If the packing list does not match the product name, do not install!

CAUTION

- Before unpacking, please check if the external packaging of the equipment is intact, free from damage, wetting, dampness, or deformation.
- Please open the packaging in sequential order, and strictly prohibit violent striking!
- When unpacking, please check the surface of the equipment and accessories for any residual damage, rust, or impact marks.
- After unpacking, please carefully compare with the packing list to verify the quantity of equipment and accessories, and whether all documents are complete.

Storage and Transportation

Warning

- Always use professional lifting equipment and have large or heavy products moved by qualified professionals with operating licenses. Otherwise, there is a risk of injury or product damage!
- Before vertically lifting the product, confirm that the front cover, terminal block, and other components of the product are securely fastened with screws. Otherwise, there is a risk of components falling off, leading to personal injury or product damage!
- No personnel are allowed to stand or remain under the product when it is being lifted by lifting equipment.
- When lifting the product with steel wire ropes, lift it smoothly and at a constant speed. Do not subject the product to vibration or impact, do not turn the product over, and do not keep the product suspended for extended periods. Otherwise, there is a risk of personal injury or product damage!

CAUTION

- Always lift and place the product gently when moving it, and always be aware of objects underfoot to prevent tripping or falling. Otherwise, there is a risk of injury or product damage!
- When carrying the product by hand, always grasp the product casing firmly to prevent components from falling off. Otherwise, there is a risk of injury!
- Please strictly follow the product's required storage and transportation conditions for storage and transportation. Otherwise, there is a risk of product damage.
- Avoid storing and transporting in locations exposed to water splashes or rain, direct sunlight, strong electric fields, strong magnetic fields, or severe vibrations.
- Avoid storing the product for more than 3 months. If stored for an extended period, more stringent protection and necessary inspections should be performed.
- Please package the product strictly before vehicle transportation. For long-distance transportation, enclosed containers must be used.
- It is strictly prohibited to transport this product mixed with equipment or items that may affect or damage this product.

During installation

Danger

- Only professional personnel who have received training related to electrical equipment and possess electrical knowledge are allowed to operate. Non-professional personnel are strictly prohibited from operating!

Warning

- Before installation, be sure to carefully read the product user manual and safety precautions!
- Do not install this product in locations with strong electric fields or strong electromagnetic wave interference!
- Before performing installation work, ensure that the mechanical strength of the installation location is sufficient to support the weight of the equipment, otherwise, it may lead to mechanical hazards.
- When performing installation work, do not wear loose clothing or jewelry, otherwise, there may be a risk of electric shock!
- When installing the product in an enclosed environment (such as inside a cabinet or chassis), ensure adequate cooling with cooling devices (such as cooling fans or air conditioners) to meet installation environment requirements. Otherwise, it may lead to product overheating or fire.
- It is strictly prohibited to modify this product!
- It is strictly prohibited to tighten or loosen the fixing bolts and red-marked bolts of product parts and components!
- When this product is installed in a cabinet or terminal equipment, the cabinet or terminal equipment needs to provide corresponding protective devices such as fire-resistant enclosures, electrical protective enclosures, and mechanical protective enclosures. The protection level should comply with relevant IEC standards and local legal and regulatory requirements.
- When installing equipment that generates strong electromagnetic interference, such as transformers, please install shielding protection devices to prevent this product from malfunctioning!
- Please install the product on flame-retardant materials such as metal. Do not allow flammable materials to come into contact with the product or attach flammable materials to the product, otherwise, there is a risk of fire.

CAUTION

- When performing installation work, cover the top of the product with cloth or paper to prevent metal chips, oil stains, water, and other foreign matter from entering the product during drilling, which could lead to product failure. After the work is completed, remove the cover to prevent it from blocking the ventilation holes, which could affect the drive's heat dissipation and lead to abnormal product heating.
- Resonance may occur when a machine operating at a constant speed is switched to variable speed operation. In this case, installing anti-vibration rubber under the motor frame or using the vibration suppression function can Validationly reduce resonance.

Wiring

Danger

- Non-professional personnel are strictly prohibited from performing equipment installation, wiring, maintenance, inspection, or component replacement!
- Before wiring, disconnect the power to all equipment. After power is disconnected, residual voltage may remain in the internal capacitors of the equipment. Please wait at least the time specified on the product's warning label before performing wiring or other operations. Measure the DC voltage of the main circuit and confirm it is below a safe voltage, otherwise there is a risk of electric shock.
- Perform un-wiring, removal of product covers, or touching of circuit boards only when power is disconnected, otherwise there is a risk of electric shock.
- Always ensure proper grounding of the equipment and product, otherwise there is a risk of electric shock.

Safety Precautions

- It is strictly prohibited to connect the input power to the output terminals of the equipment or product, otherwise it will cause equipment damage and even fire.
- When connecting the drive equipment to the motor, always ensure that the phase sequence of the product and motor terminals are accurate and consistent to avoid reverse rotation of the motor.
- When connecting the drive equipment to the motor, always ensure that the phase sequence of the product and motor terminals are accurate and consistent to avoid reverse rotation of the motor.
- Please tighten terminal screws according to the specified tightening torque in the manual. Insufficient or excessive tightening torque may lead to overheating, damage to the connections, and a risk of fire.
- After wiring is complete, ensure that all cables are correctly wired and that there are no loose screws, washers, or exposed cables inside the product, otherwise there may be a risk of electric shock or product damage.

CAUTION

- Please follow the steps specified by electrostatic discharge (ESD) prevention measures and wear an anti-static wrist strap when performing wiring or other operations to avoid damaging the equipment or internal circuitry of the product.
- When wiring the control circuit, use a shielded twisted pair cable and connect the shield to the product's grounding terminal for grounding, otherwise the product may malfunction.

Powering up

Warning

- After wiring and parameter settings are complete, perform a test run to confirm that the machine can operate safely, otherwise it may result in personal injury or equipment damage.
- Before powering on, ensure that the rated voltage of the product matches the power supply voltage. Incorrect power supply voltage carries a risk of fire.
- Before powering on, ensure that no personnel are around the product, motor, or machinery, otherwise it may result in personal injury or death.

During running

Danger

- Non-professional personnel are strictly prohibited from operating the product, otherwise there is a risk of personal injury or death!
- It is strictly prohibited to touch any wiring terminals, or dismantle any devices or components of the equipment and product while they are operating, otherwise there is a risk of electric shock!

Warning

- It is strictly prohibited to touch the equipment casing, fan, or resistors to test temperature, otherwise it may cause burns!
- During operation, prevent other items or metal objects from falling into the equipment, otherwise it may cause fire or product damage!

Maintenance

Danger

- Non-professional personnel are strictly prohibited from performing equipment installation, wiring, maintenance, inspection, or component replacement!
- It is strictly prohibited to perform equipment maintenance while power is on, otherwise there is a risk of electric shock!
- After disconnecting power to all equipment, please wait at least the time specified on the product's warning label before performing equipment maintenance or other operations.
- When using a PM motor, even if the product's power is off, induced voltage will be generated at the motor terminals during motor rotation. Do not touch the motor terminals, otherwise there may be a risk of electric shock.

Warning

- Please perform daily and periodic inspections and maintenance on the equipment and product according to the equipment maintenance and care requirements, and keep maintenance records.

Repair

Danger

- Non-professional personnel are strictly prohibited from performing equipment installation, wiring, maintenance, inspection, or component replacement!
- It is strictly prohibited to perform equipment repair while power is on, otherwise there is a risk of electric shock!
- After disconnecting power to all equipment, please wait at least the time specified on the product's warning label before performing equipment inspection, repair, or other operations.

Warning

- Please report equipment repairs according to the product warranty agreement.
- When a fuse blows, circuit breaker trips, or earth leakage circuit breaker (ELCB) trips, please wait at least the time specified on the product's warning label before restoring power or operating the machine, otherwise it may result in personal injury or death and equipment damage.
- If the equipment malfunctions or is damaged, it is imperative to have professional personnel troubleshoot and repair the equipment and product according to the repair guidelines, and keep repair records.
- Do not continue to use a damaged machine, otherwise it may cause personal injury or further damage to the product.
- After replacing equipment, be sure to re-check the equipment wiring and reset parameters.

Scrapping

Warning

- Please scrap equipment and products according to relevant national regulations and standards to avoid property damage or casualties!
- Please dispose of and recycle scrapped equipment and products in accordance with industrial waste treatment standards to

prevent environmental pollution.

1.2 Other Precautions

Precautions for Drives Equipped with Dynamic Braking Function

- Dynamic braking is only for emergency stops in case of malfunction or sudden power failure. Do not frequently trigger malfunctions or power failures.
- At high speeds, ensure an operation interval of at least 5 minutes for the dynamic braking function, otherwise it may damage the internal dynamic braking circuit.
- Commonly seen in rotating mechanical structures, when dynamic braking stops the motor, the motor has already stopped rotating, but it continues to rotate due to the load on the shaft. In this state, the motor is driven by an external load and is in a power generation state, and short-circuit current flows through the dynamic brake. If continuously driven externally, the drive may smoke or catch fire, and the motor itself may also burn out.

Safety Signs

To ensure safe operation, always comply with the safety labels affixed to the equipment. Do not damage or remove safety labels. Safety label descriptions are as follows:

Safety Signs	Description of Safety Label Content
	• To prevent electric shock, always connect the grounding terminal properly. Please operate strictly according to the instructions in the user manual. • Never fail to connect Protective Earth(PE) terminal. Read the manual and follow the safety Instructions Before use. • Do not touch terminal parts within 15 minutes after power is disconnected, otherwise it may cause electric shock. • Do not touch terminals within 15 minutes after Disconnect the power, Risk of electric shock. • Do not touch the heat sink after powering on, otherwise it may cause burns. • Do not touch heatsink when power is ON, Risk of burn.

Chapter 2 Product Information

2.1 Servo Drive and Motor Model Description

2.1.1 Drive Model

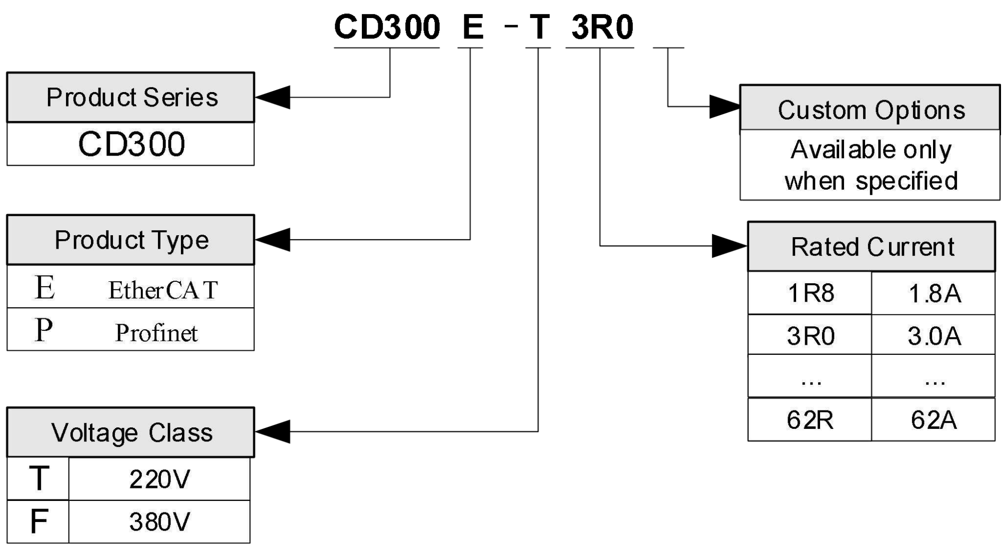


Figure 2-1 Servo Drive Model Naming Rule

Rated Voltage	Drive Model	Rated Current (A)	Maximum Compatible Motor Power (kW)
Single-phase AC220V	CD300E-T1R8	1.8	0.2
	CD300E-T3R0	3.0	0.75
	CD300E-T4R0	4.5	1.0
Single-phase/three-phase AC220V	CD300E-T4R5	4.5	1.0
	CD300E-T5R5	5.5	1.3
	CD300E-T7R5	7.5	2.0
	CD300E-T10R	10	2.1
	CD300E-T13R	13	2.3
Three-phase AC380V	CD300E-F4R0	4.0	1.5
	CD300E-F6R5	6.5	2.3
	CD300E-F8R5	8.5	3.0
	CD300E-F12R	12	4.5
	CD300E-F17R	17	4.4
	CD300E-F22R	22	5.5
	CD300E-F27R	27	7.5
	CD300E-F38R	38	15
	CD300E-F52R	52	22
	CD300E-F62R	62	30

2.1.2 Motor Model

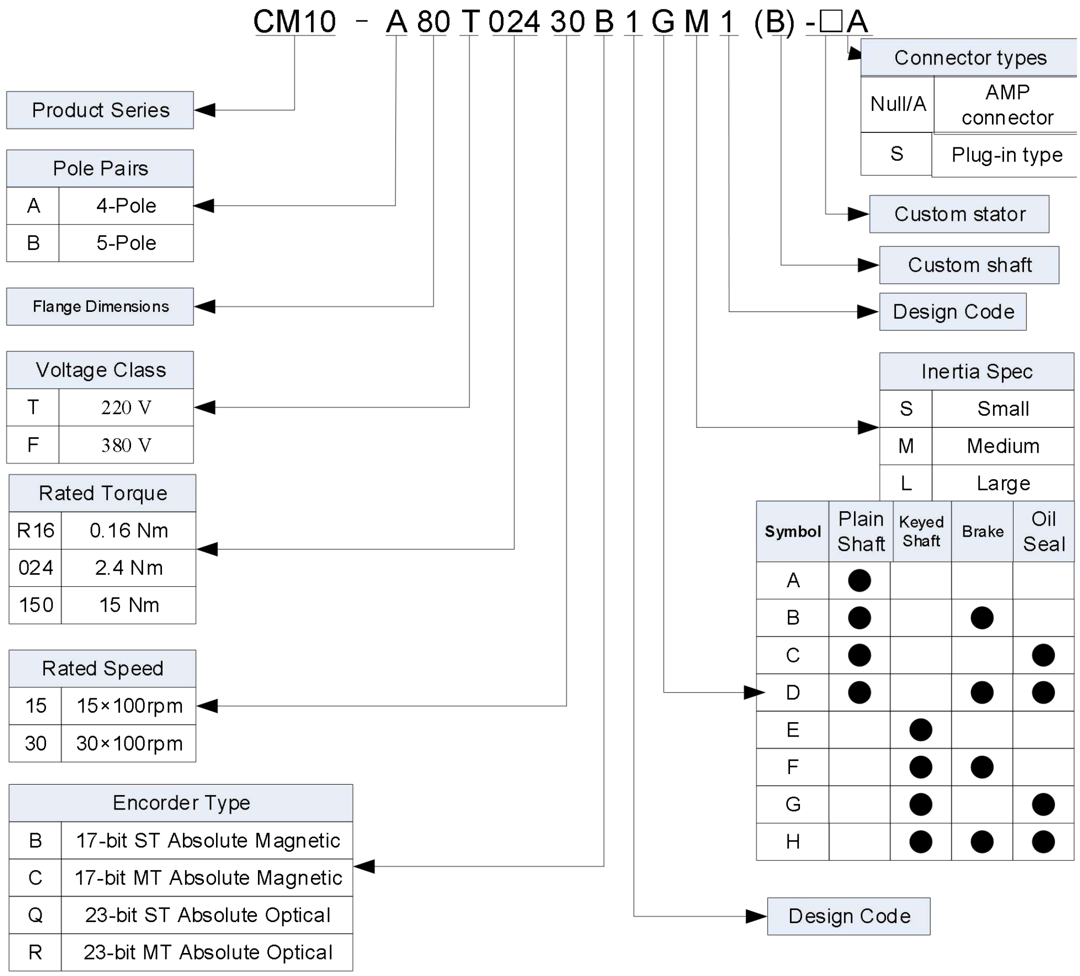


Figure 2-2 Servo Motor Model Naming Rule

Motor Model	CM10-			
	B60TR6430B	B60T01330B	B80T02430B-3A	B80T03230B-4A
Voltage (V)	AC220			
Frame Size	60	60	80	80
Rated Output Power (kW)	0.2	0.4	0.75	1.0
Rated Current (A)	1.4	2.6	3.0	4.5
Rated Torque (N·m)	0.64	1.27	2.4	3.2
Maximum Torque (N·m)	1.92	3.81	7.2	9.6
Rated Speed (r/min)	3000	3000	3000	3000
Maximum Speed (r/min)	6000	6000	3500	3500
Rotor Inertia (Kg·m^2×10^{-4})	0.29	0.52	1.48	1.93
Torque Constant (N·m/A)	0.46	0.49	0.8	0.71
Back EMF (V/1000r/min)	31.7	31	53	50
Line Resistance (Ω)	8	4.3	3.4	1.85
Line Inductance (mH)	15	6.7	11.2	19.9
Number of Pole Pairs	5	5	5	5
Insulation Level	F	F	F	F
Protection Level	IP65	IP65	IP65	IP65
Body Length L (mm)	78 (110)	94 (126)	105 (142)	114 (152)

Note: For body length, the value in parentheses is the length with the holding brake function.

Motor Model	CM10-			
	A130T05025	A130T060025	A130T07725	CM10-A130T10015
Voltage (V)	AC220			
Frame Size	130	130	130	130
Rated Output Power (kW)	1.3	1.5	2.0	1.5
Rated Current (A)	5.0	6.0	7.5	6
Rated Torque (N·m)	5.0	6.0	7.7	10
Maximum Torque (N·m)	12.5	15.0	18.7	25
Rated Speed (r/min)	2500	2500	2500	1500
Maximum Speed (r/min)	3000	3000	3000	2000
Rotor Inertia ($Kg\cdot m^2\times 10^{-4}$)	10.7	12.9	14.1	18.8
Torque Constant (N·m/A)	1.0	1.0	1.03	1.67
Back EMF (V/1000r/min)	65	65	68	108
Line Resistance (Ω)	1.6	1.3	1.2	1.85
Line Inductance (mH)	8.0	6.2	5.8	9.9
Number of Pole Pairs	4	4	4	4
Insulation Level	F	F	F	F
Protection Level	IP65	IP65	IP65	IP65
Body Length L (mm)	171 (224)	179 (224)	192 (229)	209 (265)

Note: For body length, the value in parentheses is the length with the holding brake function.

Motor Model	CM10-			
	A130F06025	A130F15015	A180F19015	A180F21520
Voltage (V)	380			
Frame Size	130	130	180	180
Rated Output Power (kW)	1.5	2.3	3	4.5
Rated Current (A)	4	5	7.5	9.5
Rated Torque (N·m)	6	15	19	21.5
Maximum Torque (N·m)	15	30	57	64.5
Rated Speed (r/min)	2500	1500	1500	2000
Maximum Speed (r/min)	3000	2000	1800	2150
Rotor Inertia ($Kg\cdot m^2\times 10^{-4}$)	12.9	25.5	63.5	72.7
Torque Constant (N·m/A)	1.5	3	2.53	2.26
Back EMF (V/1000r/min)	108	180	166	140
Line Resistance (Ω)	3.1	3.2	1.33	0.84
Line Inductance (mH)	17.1	19	14.2	8.4
Number of Pole Pairs	4	4	4	4
Insulation Level	F	F	F	F
Protection Level	IP65	IP65	IP65	IP65
Body Length L (mm)	179(224)	231(282)	205(252)	215(262)

Motor Model	CM10-			
	B180F28415	A180F35015	A180F48015	A200F70015
Voltage (V)	380			
Frame Size	180	180	180	200
Rated Output Power (kW)	4.4	5.5	7.5	11
Rated Current (A)	16.5	12	20	21
Rated Torque (N·m)	28.4	35	48	70
Maximum Torque (N·m)	85.2	105	120	175
Rated Speed (r/min)	1500	1500	1500	1500
Maximum Speed (r/min)	3000	1750	1750	1800
Rotor Inertia (Kg·m^2×10^{-4})	88.5	114	137.3	97.7
Torque Constant (N·m/A)	1.72	2.92	2.4	3.33
Back EMF (V/1000r/min)	104	181	171	220
Line Resistance (Ω)	0.31	0.78	0.56	0.95
Line Inductance (mH)	3.7	8	6.1	10.3
Number of Pole Pairs	5	4	4	4
Insulation Level	F	F	F	F
Protection Level	IP65	IP65	IP65	IP65
Body Length L (mm)	232(279)	260(307)	305(352)	438(538)

Note: For body length, the value in parentheses is the length with the holding brake function.

2.2 Technical Specifications of Drive

Item			Description
Basic Specifications	Main Power Supply		Single-phase 220-240VAC, -1 5% to +10% (50/60Hz) Three-phase 380-415VAC, -15% to +10% (50/60Hz)
	Control Method		FOC+SVPWM
	Encoder Feedback		Serial Communication Encoder: 17bit-26bit optional
	Protection		Overcurrent, abnormal voltage, overload, input/output phase loss, motor stall, overspeed, Drive overheating, encoder abnormality, EtherCAT communication abnormality, etc.
	Digital Input		6 DI (supporting NPN and PNP)
	Digital Output		3 DO (load capacity 50mA, voltage range 5V-28V)
	Operating Conditions	Temperature	Operating temperature: 0℃-+45℃; Ambient temperature: +45℃-50℃; Please derate usage, current derates 2% for every 1℃ increase; Storage temperature: -20℃-+60℃
		Humidity	Relative humidity: below 90%RH (non-condensing)
		Vibration	0.5g (4.9m/S^2)
		Protection	IP20
		Altitude	Below 1000m (>1000m, please derate usage)
		Others	1: No electrostatic interference, strong electric fields, strong magnetic fields, radiation, etc. 2: No corrosive gases, flammable gases, no water, oil, or chemical splashes. 3: In an environment with little dust, dirt, or salt, and no metal powder.
EtherCAT	Applicable		IEC 61800-7 CiA402 Drive Profile, IEC 61158 Type12

Communication	standards	
	Transmission Protocol	100BASE-TX (IEEE802.3)
	Interfaces	RJ45×2 (IN, OUT)
	Synchronization mode	DC - Distributed Clock (DC synchronization period: 125μs-10ms Free Run (asynchronous)
	Topology	Ring, Line
	Number of Slave Stations	Maximum number of slaves 65535, actual use less than 100
	Transmission Medium	Shielded Cat5e or Cat6 and higher Ethernet cables with electrical performance specifications
	Transmission Distance	Less than 100M between two nodes (good environment, excellent cable)
	EtherCAT Frame Length	44 bytes - 1498 bytes
	FMMU Unit	FMMU0: Mapped to Process Data Slave RxPDO area FMMU1: Mapped to Process Data Slave TxPDO area FMMU2: Mapped to Mailbox State
	Sync Manager	Sync Manager 0: Allocated to Mailbox Out Sync Manager 1: Allocated to Mailbox In Sync Manager 2: Allocated to Process Data Out Sync Manager 3: Allocated to Process Data In
	PDO Data	Dynamic PDO mapping
	MailBox (CoE)	SDO request, SDO response, emergency events
	Control Mode	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)
	Probe	2 channels rising edge/falling edge
Internal Function	Model-based tracking control	Actively identifies and corrects deviations in input commands, enabling more responsive equipment performance and greater motion precision. Through real-time command reconstruction and dynamic compensation, it effectively eliminates jitter and jerk during movement, ensuring smooth operation across the entire speed range from low to high, and significantly improving the machining and control accuracy of the equipment.
	Adjustment- free function	Automatically identifies load characteristics, optimizes parameters with a single click, and eliminates the need for complex manual tuning.
	Vibration Inhibiting	Two vibration suppression notch filters: Settable vibration suppression frequency and intensity Two notch filters: Settable notch frequency, width, and depth
	Overtravel Prevention	Positive limit, negative limit, and software limit
	Virtual Braking	In some applications, the motor can be used for virtual regenerative braking, replacing the braking resistor
	LED Display	Main power CHARGE, 6-digit LED display
	Others	Gain adjustment, inertia identification, mechanical frequency analysis, alarm recording, JOG operation, etc.

2.3 Names of Servo Drive Components

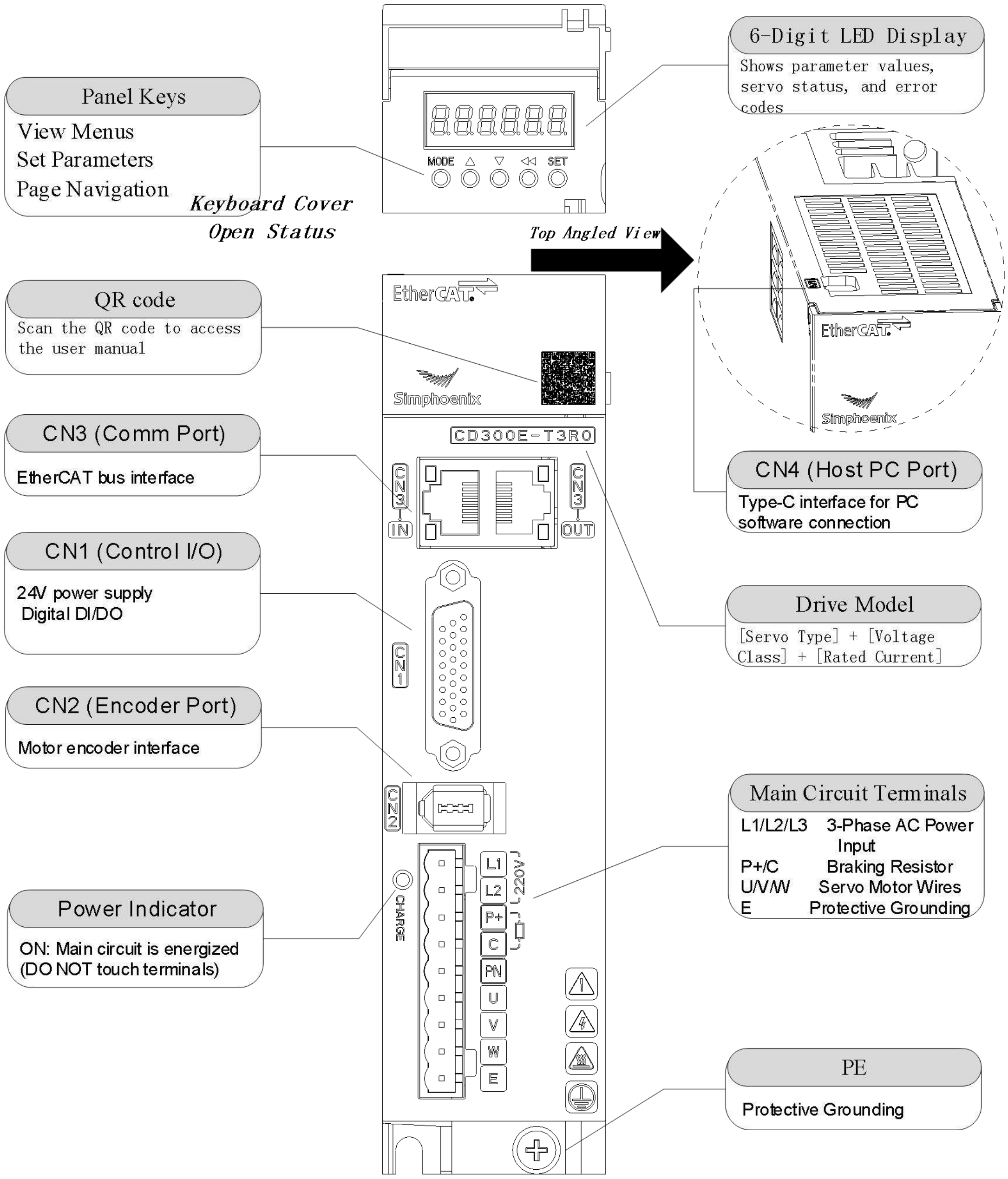


Figure 2-3 Names of CD300E Drive Components

2.4 Servo Drive Terminal Layout

2.4.1 CN1 Control Signal Interface

The control signal terminals provide the necessary signals for connection with the host controller. A DB26 connector is used, and the pin distribution and wiring diagram are as follows:

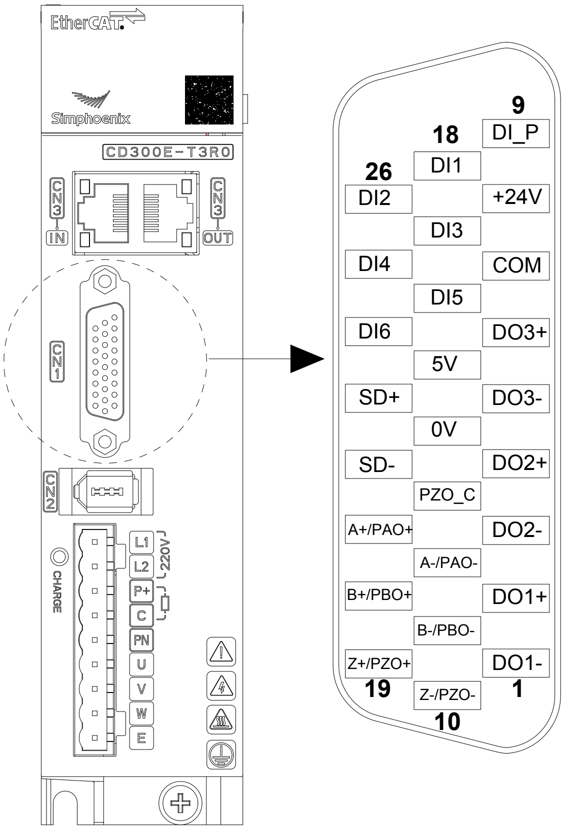


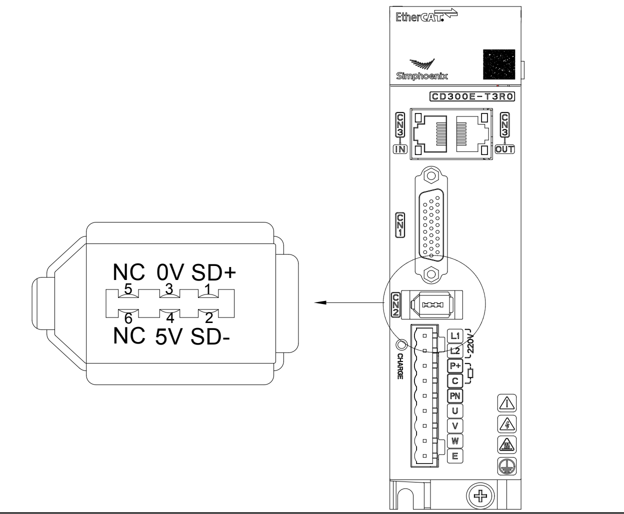
Figure 2-4 CD300E Servo Drive CN1 Terminal Pin Distribution Diagram

● **CN1 Control Signal Terminal Plug Pin Distribution and Function Description**

Signal Name		Pin No.	Function Description
Power Supply	+24V	8	Internal 24V power supply, voltage range +20V ～ 28V, maximum output current 100mA
	COM	7	Internal 24V power ground
	5V	15	Secondary encoder 5V power supply, maximum output current 150mA
	0V	14	Secondary encoder 5V power ground
Digital Input	DI1	18	Digital input, default function: Servo enable
	DI2	26	Digital input, default function: Fault reset
	DI3	17	Digital input, default function: Positive limit
	DI4	25	Digital input, default function: Negative limit
	DI5	16	Digital input, default function: Origin signal
	DI6	24	Digital input, default function: Start origin search
	DI_P	9	Digital Input Common Terminal
Digital Output	DO1-	1	Digital output, default function: Brake control
	DO1+	2	
	DO2-	3	Digital output, default function: Error output
	DO2+	4	
	DO3-	5	Digital output, default function: Target position (speed) reached
	DO3+	6	

Signal Name		Pin No.	Function Description	
Frequency Division Output	SD+	23	Secondary encoder communication input	Expandable communication type full-closed loop function
	SD-	22		
	A+/PAO+	21	A, Secondary encoder pulse A input PAO, Frequency division output	Expandable frequency division output function
	A-/PAO-	12		
	B+/PBO+	20	B, Secondary encoder pulse B input PBO, Frequency division output	
	B-/PBO-	11		
	Z+/PZO+	19	Z, Secondary encoder pulse Z input PZO, Frequency division output	
	Z-/PZO-	10		
	PZO_C	13	Z pulse open collector output	

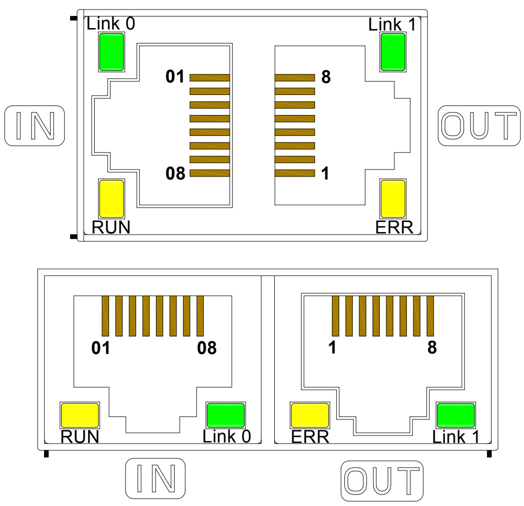
2.4.2 CN2 Encoder Signal Interface



Pin	Signal	Description
1	SD+	Data transmit +
2	SD-	Data transmit -
3	0V	Encoder 5V power
4	5V	
5	NC	-
6	NC	-

2.4.3 CN3 Communication (EtherCAT) Interface

Terminal Position Number CN3



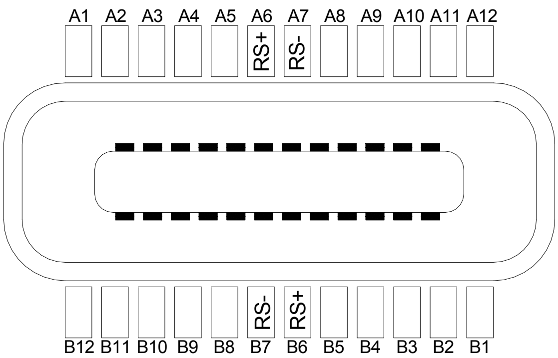
Pin	Signal	Description
01	TD+	Data transmit +
02	TD-	Data transmit -
03	RD+	Data Receive +
04/05	-	-
06	RD-	Data Receive -
07/08	-	-
1	TD+	Data transmit +
2	TD-	Data transmit -
3	RD+	Data Receive +
4/5	-	-
6	RD-	Data Receive -
7/8	-	-

It is recommended to use shielded Cat-5e or higher Ethernet cables for EtherCAT cables;
The maximum distance between two drives in a daisy-chain network is ≤30m.

EtherCAT Interface LED Indicator Status Display Description:

LED		Display	Status	Meaning
Link 0	Green	Off	Unconnected	No connection with the previous EtherCAT device
		Always on	Connected	Already connected to the previous EtherCAT device
		Flash	Communicating	Connected and communicating with the previous EtherCAT device
Link 1	Green	Off	Unconnected	No connection with the next EtherCAT device
		Always on	Connected	Already connected to the next EtherCAT device
		Flash	Communicating	Connected and communicating with the next EtherCAT device
RUN	Yellow	Off	INIT	Interface is in "INIT" state
		Flashing (slow)	PRE_OPERATIONAL	Mailbox communication possible Process data communication not possible
		Flashing (fast)	SAFE_OPERATIONAL	Mailbox and process data communication possible Safety output signals are not output
		Always on	OPERATIONAL	Mailbox and process data communication possible
ERR	Yellow	Off	No fault	The interface is in working state
		Flash	Fault occurred	Communication Disconnection

2.4.4 CN4 Communication (Host Computer) Interface

Terminal Position Number CN4	Pin	Signal	Description
	A1-A5	-	-
	B1-B5	-	-
	A6/B6	RS+	RS485+
	A7/B7	RS-	RS485-
	A8-A12	-	-
	B8-B12	-	-

- One end of the connecting cable is Type-C, the other end is USB. Shielded cables with ferrite cores are recommended.
- Cable length ≤ 3m.

2.5 Servo Cables

2.5.1 Motor Cables

(1) Servo Cable Naming Rule

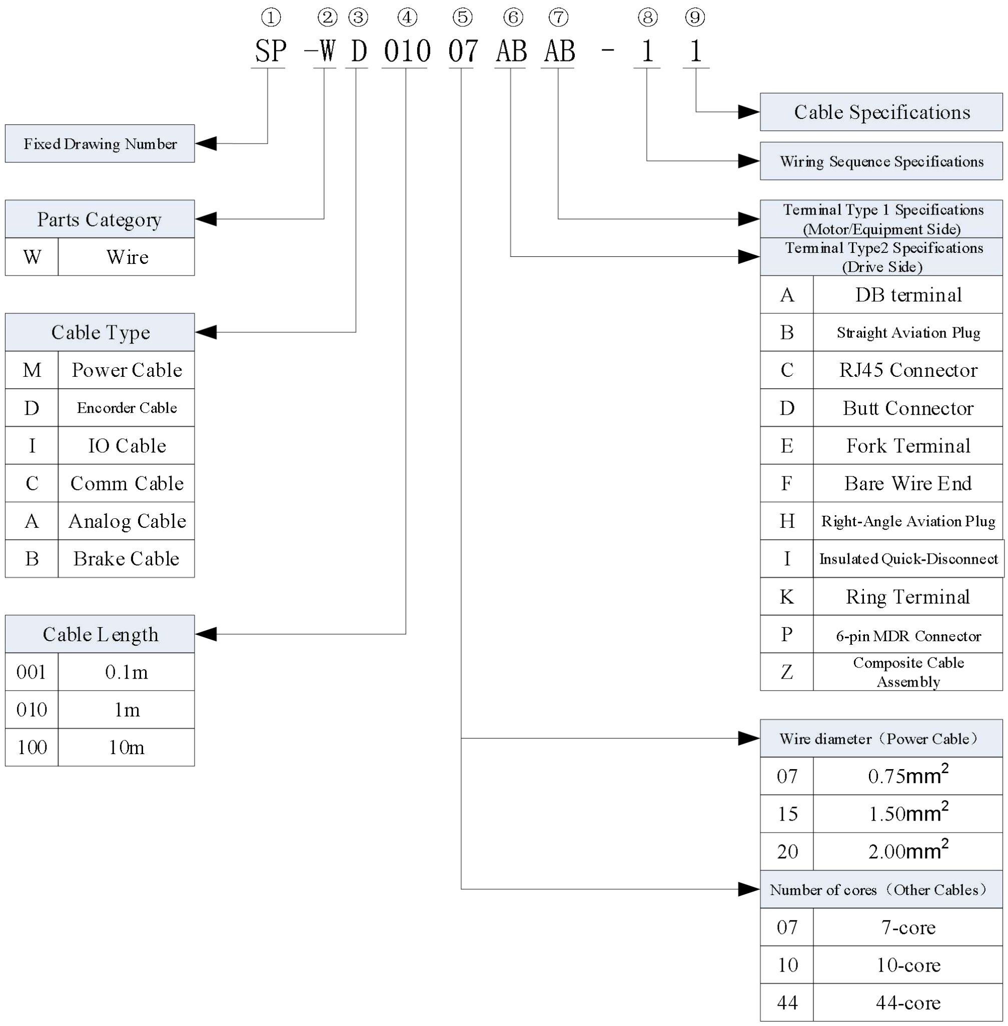


Figure 2-5 Servo Motor Cable Naming Rule

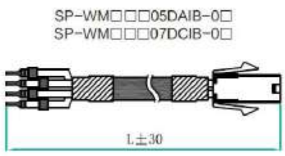
Note:

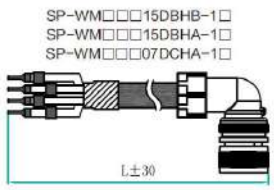
⑧ Wire sequence specifications: To distinguish the wire sequence of motor power cables, for the CD300E series compatible with a 110 flange (using an aviation plug), the power cable fixed selection is 1

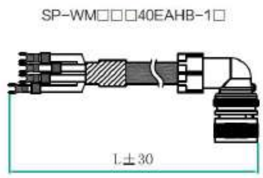
⑨ Cable material specifications: 1 = Ordinary cable, 2 = High-Flex Cable

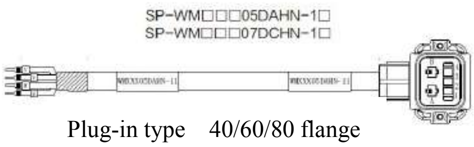
Power	Motor Model	Power Cables	Encoder Cable
T1R8	CM10-B40TR3230	SP-WMXXX05DAIB-01（AMP connector） SP-WMXXX05DAHN-01（Plug-in type）	SP-WDXXX05PAID-01（AMP connector） SP-WDXXX05PAHO-01（Plug-in type）
	CM10-B60TR6430		
T3R0	CM10-B60T01330		
	CM10-B80T02430		
T4R0	CM10-B80T03230	SP-WMXXX07DCIB-01(AMP connector) SP-WMXXX07DCHN-01(Plug-in type)	SP-WDXXX05PAID-01(AMP connector) SP-WDXXX05PAHO-01(Plug-in type)
T4R5	CM10-B80T03230		
T5R5	CM10-B130T05430	SP-WMXXX07DCHA-11	SP-WDXXX05PAHC-01
T7R5	CM10-A130T07725		
T10R	CM10-B130T08415	SP-WMXXX15DBHA-11	SP-WDXXX05PAHC-01
T13R	CM10-B130T11515	SP-WMXXX15DBHA-11	SP-WDXXX05PAHC-01
F4R0	CM10-A130F10015	SP-WMXXX15DBHA-11	SP-WDXXX05PAHC-01
F6R5	CM10-B130F08415		
F8R5	CM10-B130F11515	SP-WMXXX15DBHB-11	SP-WDXXX05PAHC-01
F12R	CM10-B180F18615		
	CM10-A180F21520		
F17R	CM10-B180F28415	SP-WMXXX40EAHB-11	SP-WDXXX05PAHC-01
F22R	CM10-A180F35015	SP-WMXXX15DBHB-11	SP-WDXXX05PAHC-01
F27R	CM10-A180F48015	SP-WMXXX40EAHB-11	SP-WDXXX05PAHC-01

2.5.1 Power Cables

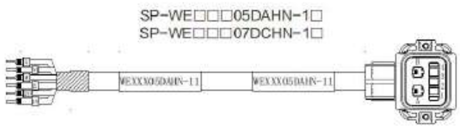




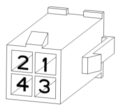
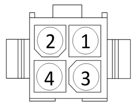
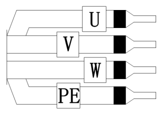
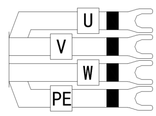
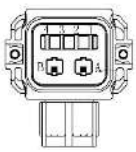
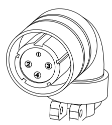
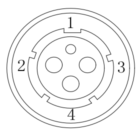




Plug-in type 40/60/80 flange

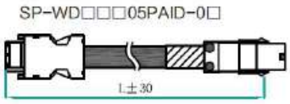


Plug-in type with brake

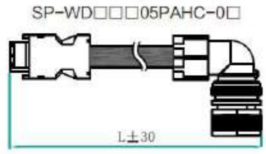
<table>
<tr><th colspan="5">Motor Terminal Wire Sequence</th><th>Drive Side</th></tr>
<tr><td>Motor Flange Type</td><td>Terminal View</td><td>Terminal Number</td><td>Pin</td><td>Definition</td><td>Terminal Number</td></tr>
<tr><td rowspan="4">40/60/80
Using AMP plug</td><td rowspan="4"></td><td rowspan="4"></td><td>1</td><td>PE</td><td rowspan="15"></td></tr>
<tr><td>2</td><td>U</td></tr>
<tr><td>3</td><td>V</td></tr>
<tr><td>4</td><td>W</td></tr>
<tr><td colspan="5">The 80-flange using a small aviation plug to replace the AMP plug is mainly for motor applications involving reciprocating motion and harsh conditions like high temperature and high humidity.</td></tr>
<tr><td rowspan="6">40/60/80
Using Plug-in connector</td><td rowspan="6"></td><td rowspan="6"></td><td>1</td><td>U</td></tr>
<tr><td>2</td><td>V</td></tr>
<tr><td>3</td><td>W</td></tr>
<tr><td>4</td><td>PE</td></tr>
<tr><td>A</td><td>24V</td></tr>
<tr><td>B</td><td>0V</td></tr>
<tr><td rowspan="4">80 (using small aviation plug)
130/180
Using aviation plug</td><td rowspan="4"></td><td rowspan="4"></td><td>1</td><td>PE</td></tr>
<tr><td>2</td><td>U</td></tr>
<tr><td>3</td><td>V</td></tr>
<tr><td>4</td><td>W</td></tr>
</table>

2.5.2 Encoder Cables

AMP connector
40/60/80 flanges



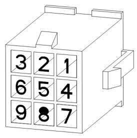
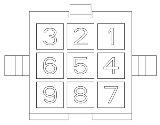
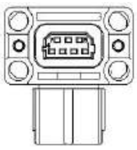
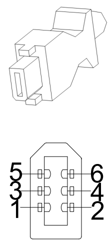
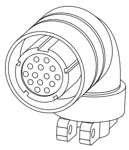
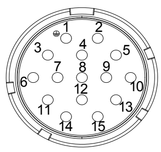
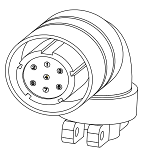
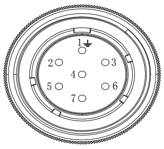
Aviation connector
130 mm flange and above



Plug-in connector
40/60/80 flanges

Plug-in connector
With battery

(1) Encoder Cable Terminal Definition

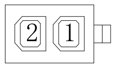
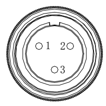
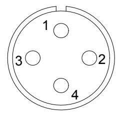
Motor Side					Drive Side	
Motor Flange Type	Terminal Shape	Terminal Number	Pin	Definition	Pin	Terminal Number
40/60/80 Using AMP plug			1	PE	PE	
			2	5V	4	
			3	0V	3	
			4	SD+	1	
			5	SD-	2	
			6	E+	NC	
			7	E-	NC	
			8	NC	NC	
			9	NC	NC	
The 80-flange using a small aviation plug to replace the AMP plug is mainly for motor applications involving reciprocating motion and harsh conditions like high temperature and high humidity.						
40/60/80 Using Plug-in connector			1	PE	PE	
			2	E-	NC	
			3	E+	NC	
			4	SD-	2	
			5	0V	3	
			6	SD+	1	
			7	5V	4	
			8	NC	NC	
			9	NC	NC	
80 (using small aviation plug)			1	PE	NC	
			2	E-	NC	
			3	E+	NC	
			4	SD-	2	
			5	0V	3	
			6	SD+	1	
			7	5V	4	
130/180 Using aviation plug			1	PE	NC	
			2	E-	NC	
			3	E+	NC	
			4	SD-	2	
			5	0V	3	
			6	SD+	1	
			7	5V	4	

Encoder Wiring Precautions: Please reliably ground the encoder shielding mesh on both the drive and motor sides, otherwise it may cause false alarms from the drive.

(2) Encoder Cable Battery Selection

Battery Model	Battery Parameters	Rated Value	Remarks
EVE Energy EVE ER14505 AA (Recommended)	Battery Output Voltage (V)	3.6	-
	Battery Capacity (mAh)	2700	-
	Battery Low Voltage Warning Value (V)	3.1	Alarm Code AL.0001
	Battery Operating Ambient Temperature (°C)	-20～+85	-
	Battery Storage Ambient Temperature (°C)	⩽30	-

2.5.3 Brake Terminal Definition

Motor Type	Brake Terminal Model	Motor Side Terminal	Pin	Definition
40/60	172233-1		1	24V
			2	0V
80/130	XS12K3P		1	24V
			2	0V
			3	NC
180	XS16K4TM		1	24V
			2	0V
			3	NC
			4	NC

2.6 Regenerative Braking Resistor Selection

When the motor's output torque is opposite to its operating speed direction, the motor will be in a power generation state. This regenerative energy will cause the bus voltage to rise, and its magnitude depends on the inertia of the motor rotor and the load. If the system inertia is small, the internal bus capacitors of the drive can absorb the regenerative energy. However, if the system inertia is large, the bus capacitors are insufficient to absorb the regenerative energy, and it must be dissipated through a braking resistor. Otherwise, excessive bus voltage rise will cause the drive to report an overvoltage shutdown or even damage.

Formula for calculating regenerative energy from rotor inertia:

$$E_r = J \times V^2/182, \text{unit J}$$

Where J *is rotor inertia, unit* kg·m^2×10^{-4} and V is motor rated speed, unit rpm.

Formula for calculating braking resistor capacity:

$$P_r = 2 \times (nE_r - E_C)/T, \text{unit W}$$

Where nE_r is the total load inertia, E_c is the maximum braking energy that the bus capacitor can absorb, and T is the action cycle.

Drive Model		Built-in Regenerative Braking Resistor Specifications		Minimum allowable external resistance (Ω)	Maximum Braking Energy Ec that Capacitor can Absorb (J)
		Resistance value (Ω)	Capacity (W)		
Single-phase AC220V	CD300E-T1R8	N/A	N/A	50	11
	CD300E -T3R0	N/A	N/A	50	16
	CD300E -T4R0	50	50	50	16
Single-phase/ Three-phase AC220V	CD300E -T4R5	50 (optional)	40	50	19
	CD300E -T5R5	50 (optional)	40	25	29
	CD300E -T7R5	25 (optional)	100	25	34
	CD300E -T10R	25 (optional)	100	15	48
	CD300E -T13R	25 (optional)	100	15	60
Three-phase AC380V	CD300E -F4R0	100 (optional)	100	80	33
	CD300E -F6R5	100 (optional)	100	60	33

	CD300E -F8R5	50 (optional)	100	40	33
	CD300E -F12R	50 (optional)	100	40	48
	CD300E -F17R	40 (optional)	150	40	60
	CD300E -F22R	30 (optional)	150	20	80
	CD300E -F27R	30 (optional)	150	20	96
	CD300E -F38R	N/A	N/A	10	144
	CD300E -F52R	N/A	N/A	10	192
	CD300E -F62R	N/A	N/A	10	240

When using an external braking resistor, connect the resistor to the P+ and C terminals, and ensure that P+ and D are open-circuited;The external braking resistor must be greater than the resistance values listed in the table, otherwise it may cause damage to the drive;

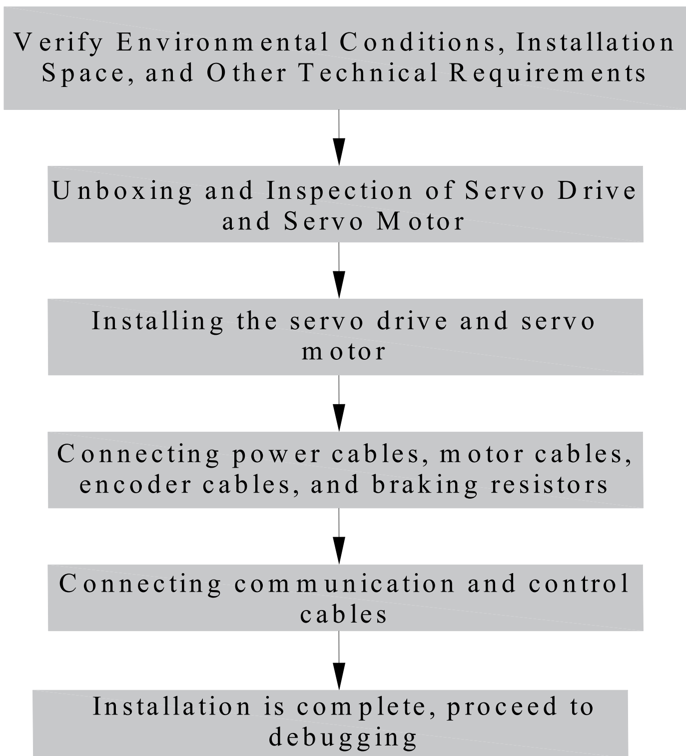
Chapter 3 Installation

3.1 Installation Notes

Users should pay special attention to the following:

- Always comply with the installation direction requirements in this manual, otherwise it may lead to product malfunction or damage.
- It is strictly prohibited to install or operate equipment that is damaged or has missing components, otherwise it will cause personal injury.
- It is strictly prohibited to install this product in locations where water may splash or in corrosive environments, otherwise it will lead to product malfunction.
- It is strictly prohibited to install this product near flammable gases or combustible materials, otherwise it will lead to fire or electric shock.
- Please install this product in an installation cabinet that provides fire and electrical protection, otherwise it may lead to fire.
- Please ensure the specified clearance between the servo drive and the inner surface of the control cabinet, as well as other machinery, otherwise it may lead to fire or product malfunction.
- It is strictly prohibited to place heavy objects on the product, otherwise it may cause personal injury or product damage.
- It is strictly prohibited to apply excessive impact force to the equipment, otherwise it may cause product damage.
- It is strictly prohibited to block the intake and exhaust ports of the drive, and do not allow foreign objects to enter the product's interior, otherwise it may lead to fire or product malfunction.
- Servo motors can be installed horizontally and vertically. When connecting to machinery, use an elastic coupling if possible, and ensure the axis of the servo motor is aligned with the axis of the mechanical load. If the concentricity deviation is too large, it will cause mechanical vibration and damage to the servo motor bearings.
- Axial striking is strictly prohibited during installation, otherwise it is highly likely to damage the servo motor's encoder.
- If the connection between the drive and motor exceeds 20 meters, please use thicker U/V/W connection cables and encoder connection cables.

3.2 Installation Flowchart



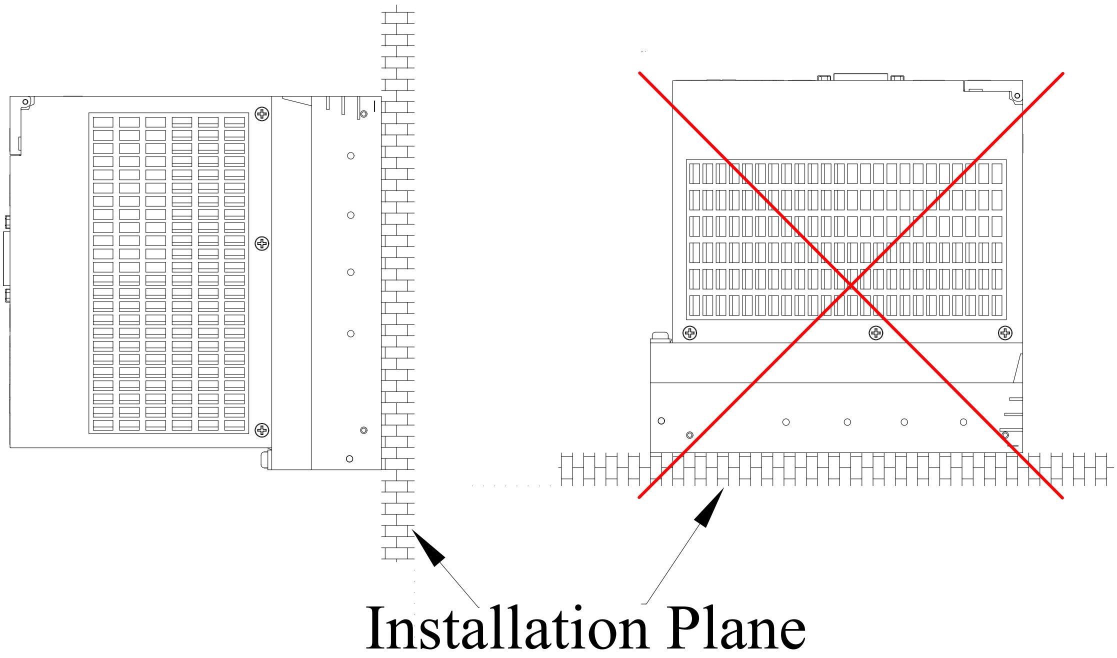
3.3 Installation Requirements

3.3.1 Installation Environment Requirements

Item	Requirements
Mounting Place	Indoor
Grid Overvoltage	Overvoltage Category III (OVCIII)
Altitude	Maximum altitude up to 1000m • Above 1000m, derate by 10% for every 1000m increase • For altitudes exceeding 2000m, please contact the manufacturer
Temperature	• Installation/Operation temperature: 0℃-+50℃. No derating needed for 0℃-+45℃. For temperatures above 45℃, derate usage by 2% for every 1℃ increase • Storage/Transportation temperature: -40℃-+70℃ • To improve the machine reliability, please use this product in locations where temperature does not change drastically • When used in enclosed spaces such as control cabinets, use cooling fans or air conditioning to keep the equipment's intake air temperature below 45℃. Otherwise, it may lead to overheating or fire • Install the product on the surface of flame-retardant material, with sufficient space around it for heat dissipation. • Please prevent the product from freezing
Ambient Humidity	Below 90% RH, non-condensing
Storage Humidity	Below 90% RH, non-condensing
Vibration Resistance Strength	During transportation: Conform to IEC60721-3-2:1997 Class 2M3 During operation: Conform to IEC60721-3-3:2019 Class 3M2
Protection Level	IP20
Environment	Pollution Degree 2 or below Please install the product in the following locations: • Locations not exposed to direct sunlight, free from dust, corrosive gases, flammable and explosive gases, oil mist, water vapor, dripping water, or salt • Please install in a place where vibration is unlikely (especially away from equipment like punching machines) • No metal powder, oil, water, or other foreign matter should enter the interior of the product • Locations free from radioactive substances, flammable materials, harmful gases and liquids, and with low salt corrosion • Do not install the product on flammable materials such as wood • Do not use in a vacuum environment

3.3.2 Installation Space Requirements

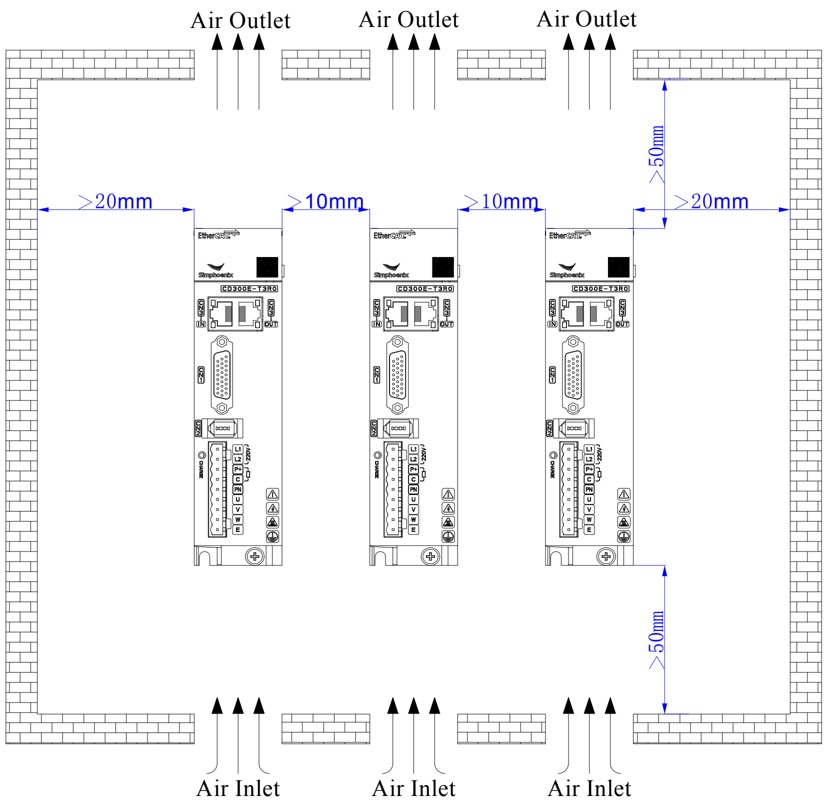
(1) Installation Direction



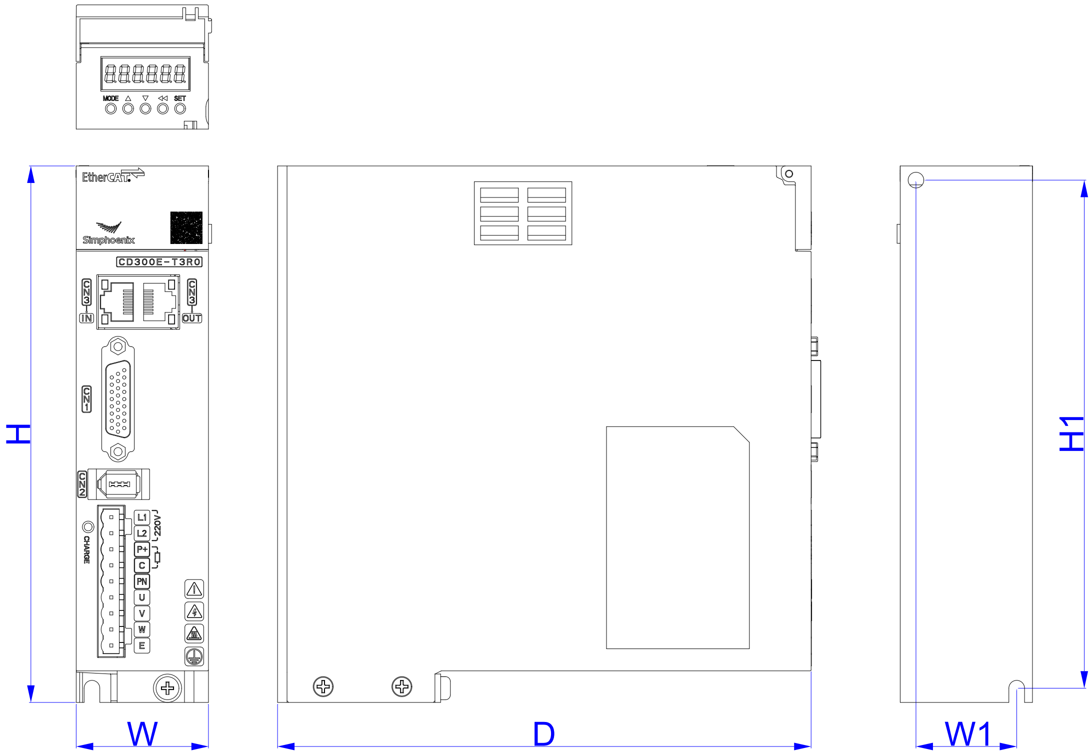
The drive only supports vertical installation. Incorrect installation direction may lead to overheating or damage to the drive.

(2) Installation Clearance

To ensure good cooling circulation, when installing the AC servo drive, there must be sufficient space above, below, left, and right from adjacent items and baffles (walls), otherwise it may cause malfunction. Its intake and exhaust holes must not be blocked, nor should it be placed on its side, otherwise it may cause malfunction. When multiple servo drives are installed side by side in a control cabinet, users should observe the installation clearances shown in the following diagram:



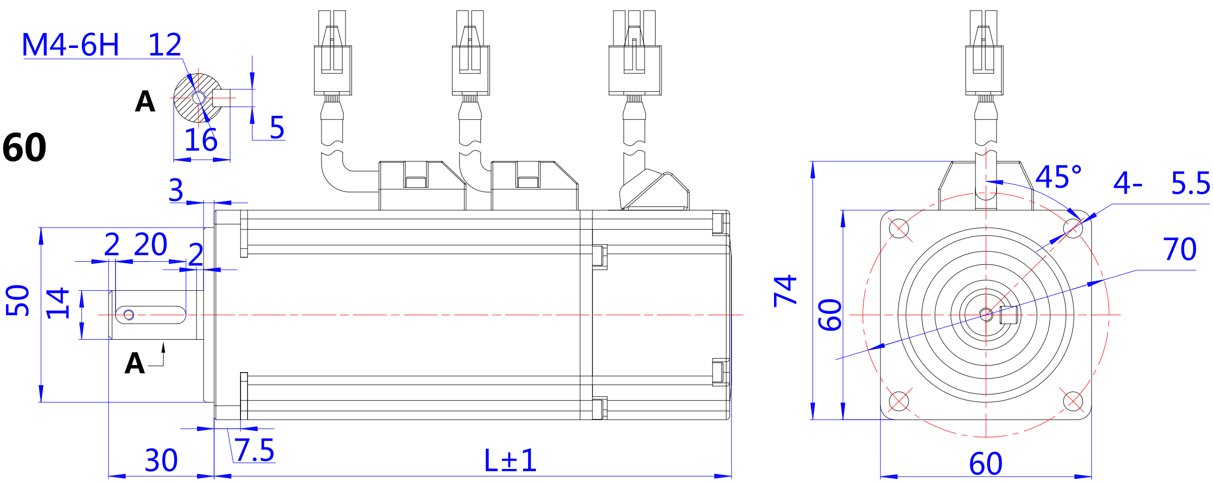
(3) Drive Dimensions



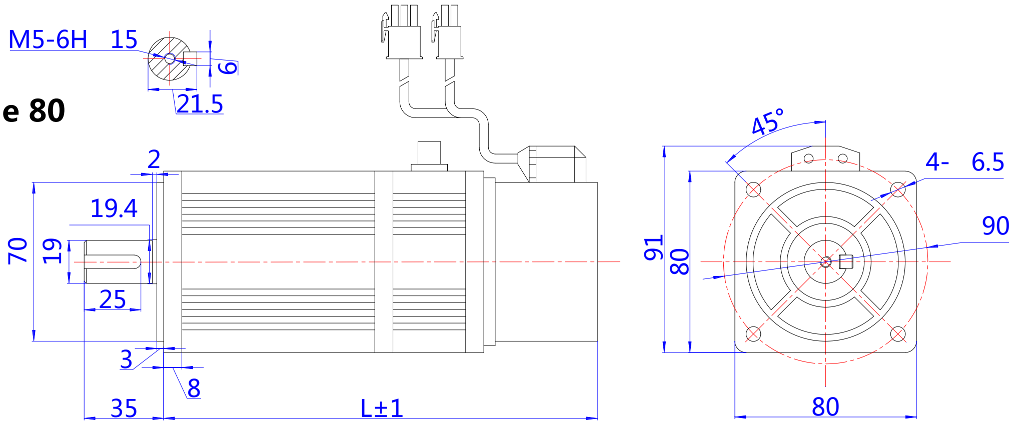
Drive Model	W1 (mm)	W (mm)	H1 (mm)	H (mm)	D (mm)	Screw Specifications	Weight (KG)
T1R8/T3R0/T4R0	32	42	161	170	170	M4	1
T4R5/T5R5/T7R5	40	50	161	170	170	M4	1.3
T10R/T13R	64	80	186	195	182	M4	2.1
F4R0/ F6R5/ F8R5/ F12R	64	80	186	195	182	M4	2.1
F17R/F22R/F27R	70	95	263	276	227	M4	4.9
F38R/F52R/F62R	100	150	410	426	250	M6	12.7

(4) Motor Dimensions

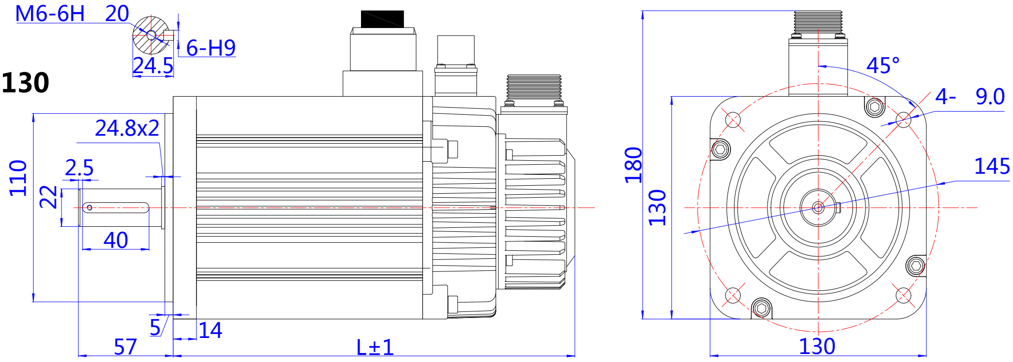
Flange 60



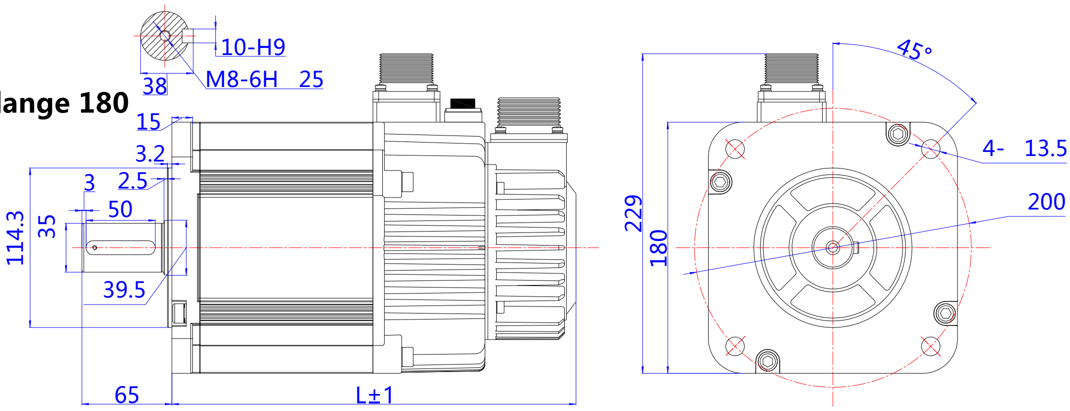
Flange 80



Flange 130



Flange 180



3.4 Inspection after Installation

S/N	Content	Confirm
1	Check if power input terminals (L1, L2, L3) are connected correctly	☐
2	Check if P+, D, C, and PN are connected correctly	☐
3	Check if the phase sequence of the servo drive output terminals (U, V, W) is consistent with that of servo motor cable (U, V, W)	☐
4	Confirm that servo drive power input terminals (L1, L2, L3) and main circuit output terminals (U, V, W) are not short-circuited	☐
5	Ensure that the encoder is correctly wired and operating	☐
6	Ensure no oil, water, or foreign contaminants inside the motor socket or at the motor installation location, otherwise it may cause short circuits	☐

7	Ensure that motor casing is grounded, and the ground wire is always connected to earth	□

Chapter 4 Electrical Design Guidelines

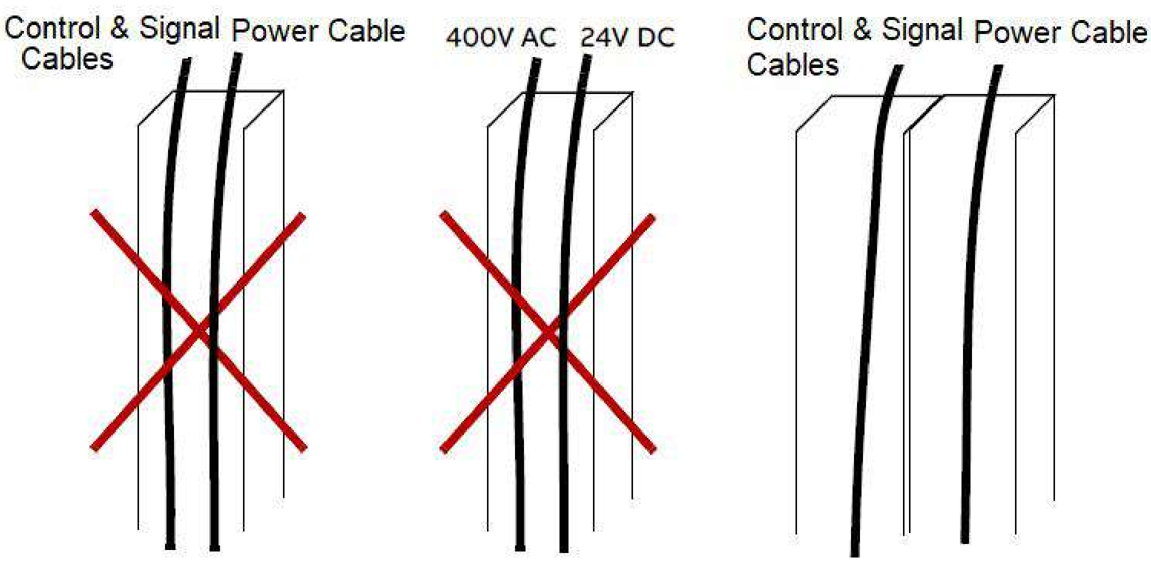
4.1 Wiring Precautions

Danger

- After the power is turned off, high voltage may still remain inside the servo drive. Do not touch the power terminals. Inspection operations can only be performed after confirming that the CHARGE indicator light has extinguished.
- Confirm that the phase sequence wiring of the U, V, W terminals of the servo motor is correct. Incorrect wiring may cause the motor to not rotate or to run away.
- Do not connect the input power cable to the output terminals U, V, W, otherwise it will damage the servo drive.
- Ensure reliable grounding of the servo drive and motor, otherwise there is a risk of electric shock.

Attention

- When an external braking resistor is used, it should be connected to the P+ and C terminals (at this time, P+ and D terminals must be open-circuited). If the internal braking resistor is used, P+ and D terminals should be short-circuited (at this time, P+ and C terminals must be open-circuited).
- Neither run power cables and signal lines through the same conduit, nor bundle them together. When wiring, power cables and signal lines should be separated by at least 30cm, otherwise it may lead to malfunctions.
- Do not frequently turn the power ON/OFF. If repeated continuous ON/OFF of power is necessary, limit it to less than once per minute. Because the power section of the servo drive contains large capacitors, a large charging current will flow when power is turned ON (the charging time is several hundred milliseconds). Therefore, frequently turning ON/OFF of power will cause performance degradation of the main circuit components inside the servo drive.
- The maximum wiring length for input/output signal cables is 3m, and the maximum length for main circuit cables and encoder cables is 30m. Please use twisted-pair and shielded signal lines with isolated grounding.
- Please use thick wire for grounding cables (2.0mm² or larger) whenever possible.
- If the servo motor and mechanical system are insulated from each other, please ground the servo motor directly.



4.2 Main Circuit Terminals and Wiring

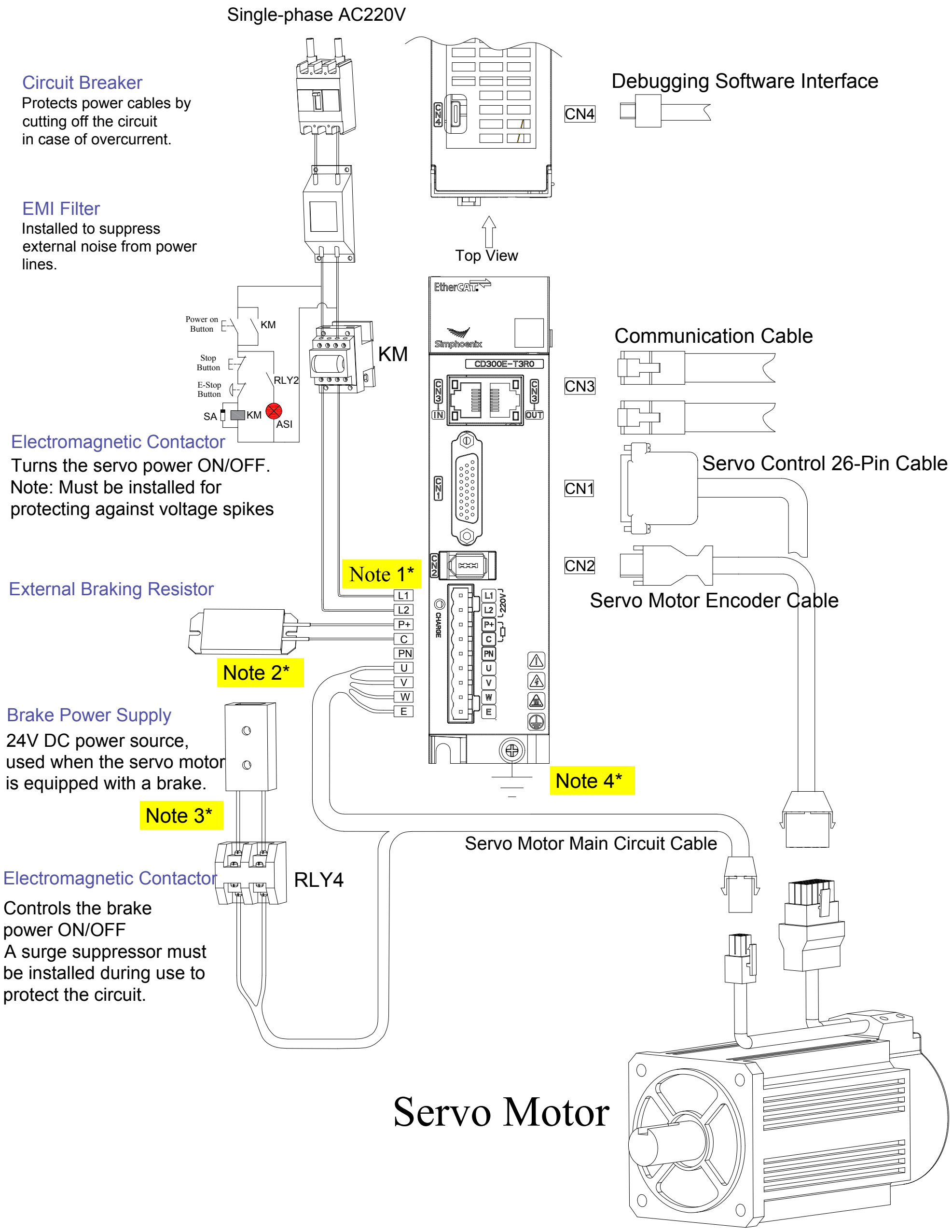
4.2.1 Main Circuit Terminals

<table>
<tr><th>Symbol</th><th>Name</th><th>Drive Model</th><th>Function and Connection</th></tr>
<tr><td rowspan="3">L1
L2
(L3)</td><td rowspan="3">Main Circuit Power Input Terminal</td><td>T1R8/T3R0/T4R0</td><td>Single-phase AC220V power input (no L3 terminal)</td></tr>
<tr><td>T5R5~T13R</td><td>Single-phase/three-phase AC220V power input</td></tr>
<tr><td>F4R0-F62R</td><td>Three-phase AC 380V Power Input</td></tr>
<tr><td rowspan="4">P+
D
C</td><td rowspan="4">External Braking Resistor Connection Terminals</td><td>T1R8/T3R0</td><td>Internal braking: None
External braking: Braking resistor between P+ and C</td></tr>
<tr><td>T4R0</td><td>Internal braking: 50Ω,50W
External braking: Braking resistor between P+ and C</td></tr>
<tr><td>T5R5~T13R
F4R0-F27R</td><td>Internal braking: Optional
Short-circuit between P+ and D
External braking: Connect braking resistor between P+ and C, and open circuit between P+ and D</td></tr>
<tr><td>F38R-F62R</td><td>Internal braking: None
External braking: Connect braking resistor between P+ and C, and open circuit between P+ and D</td></tr>
<tr><td>U
V
W</td><td>Motor Connection Terminals</td><td colspan="2">Power cable connection terminals of the servo drive, connected to the U/V/W phases of the motor, respectively</td></tr>
<tr><td>P+
PN</td><td>Common DC Bus Terminals</td><td colspan="2">Common DC bus terminals of the servo drive, used for common bus when multiple drives are connected in parallel</td></tr>
<tr><td>N1
N2</td><td>External Reactor Terminals</td><td colspan="2">By default, N1 and N2 are short-circuited. When high-order harmonics of the power supply need to be suppressed, remove the short-circuit between N1 and N2 and connect an external DC reactor</td></tr>
<tr><td>PE</td><td>Ground Terminal</td><td colspan="2">Connect to the ground terminal of the power supply and the ground terminal of the motor</td></tr>
</table>

4.2.2 Main Circuit Cable Diameter Specifications

Drive Model	Power Input Cable	Motor Connection Cable	Braking Resistor Connection Cable	Protective Earth Wire
	L1/L2/L3	U/V/W	P+/D/C	PE
CD300E-T1R8	0.50 mm^2	0.50 mm^2	0.50 mm^2	0.50 mm^2
CD300E -T3R0	0.50 mm^2	0.50 mm^2	0.50 mm^2	0.50 mm^2
CD300E -T4R0/T4R5	0.75 mm^2	0.75 mm^2	0.75 mm^2	0.75 mm^2
CD300E -T5R5/T7R5	0.75 mm^2	0.75 mm^2	0.75 mm^2	0.75 mm^2
CD300E -T10R/T13R	1.5 mm^2	1.5 mm^2	1.5 mm^2	1.5 mm^2
CD300E -F4R0	1.5 mm^2	1.5 mm^2	1.5 mm^2	1.5 mm^2
CD300E -F6R5	1.5 mm^2	1.5 mm^2	1.5 mm^2	1.5 mm^2
CD300E -F8R5	1.5 mm^2	1.5 mm^2	1.5 mm^2	1.5 mm^2
CD300E -F12R	1.5 mm^2	1.5 mm^2	1.5 mm^2	1.5 mm^2
CD300E -F17R	4.0mm^2	4.0mm^2	4.0mm^2	4.0mm^2
CD300E -F22R	4.0mm^2	4.0mm^2	4.0mm^2	4.0mm^2
CD300E -F27R	4.0mm^2	4.0mm^2	4.0mm^2	4.0mm^2
CD300E -F38R	6.0mm2	6.0mm2	6.0mm2	6.0mm2
CD300E -F52R	10.0mm2	10.0mm2	10.0mm2	10.0mm2
CD300E -F62R	16.0mm2	16.0mm2	16.0mm2	16.0mm2

4.2.3 Single-Phase 220V Wiring（T1R8/T3R0/T4R0）



- **KM**: Electromagnetic Contactor **D**: Freewheeling Diode **SA**: Surge Suppressor **RLY2/RLY4**: Relays **ASI**: Alarm Status Indicator

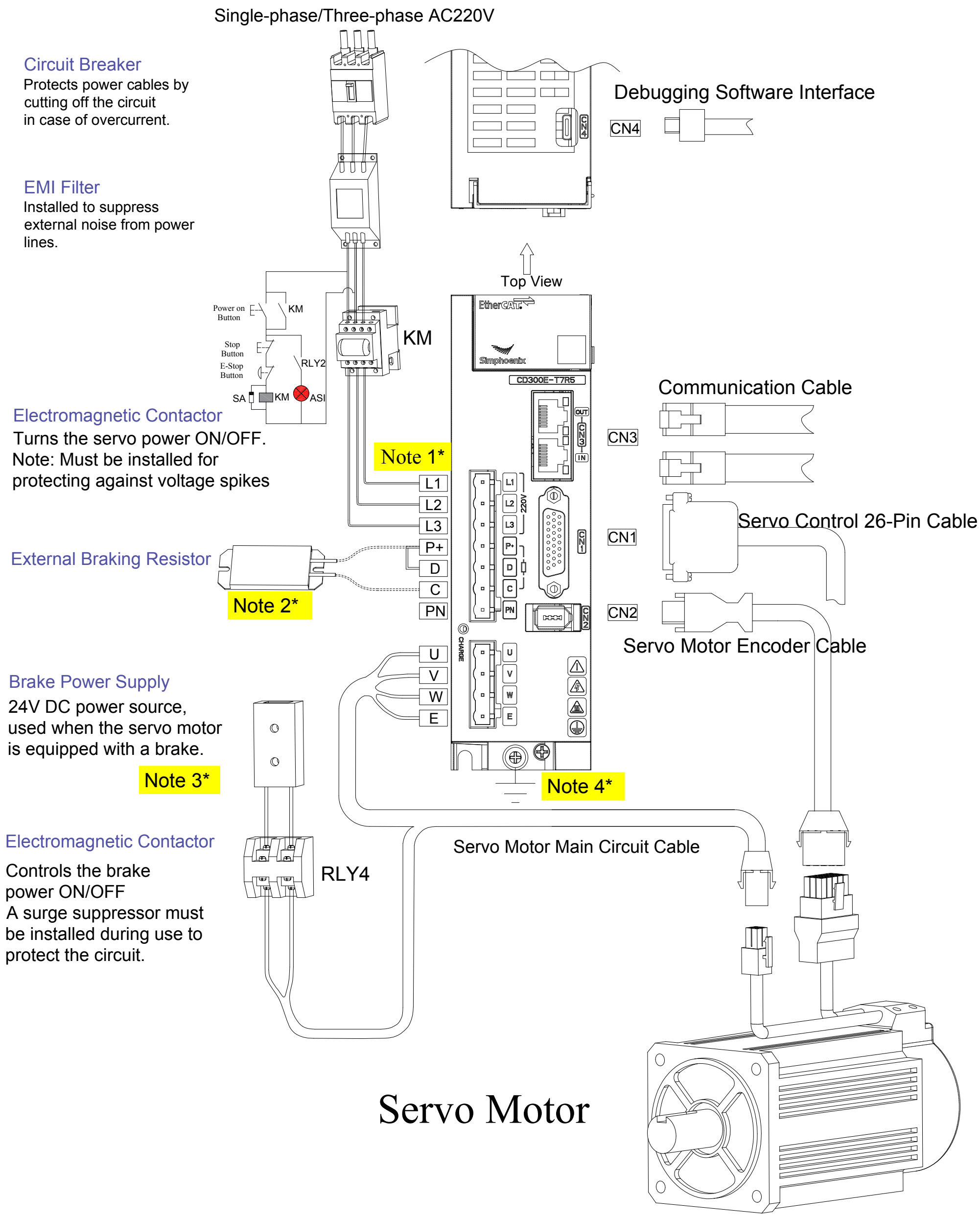
Note 1* : **T1R8/T3R0/T4R0** accepts single-phase AC 220V power input.

Note 2* : **T1R8/T3R0** has no internal braking resistor. Connect an external braking resistor between **P+** and **C** terminals.

Note 3* : The **24V DC brake power supply** must be user-provided.**Galvanically isolated** from the control signal power (12–24V).

Note 4* : Motor cable shield must terminate at the product’ s **PE output terminal**.
Main circuit **PE input terminal** must connect to the control cabinet’ s **grounding busbar** via a protective earth conductor.

4.2.4 Single-Phase/Three-Phase 220V Wiring（T4R5/T5R5/T7R5）



- **KM**: Electromagnetic Contactor **D**: Freewheeling Diode **SA**: Surge Suppressor
  RLY2/RLY4: Relays **ASI**: Alarm Status Indicator

Note 1*： **T4R5/T5R5/T7R5** accepts either three-phase AC 220V or single-phase AC 220V power supply

Note 2*： When using external braking resistor:Connect between P+ and C terminals, Meanwhile keep P+ and D terminals open-circuit;

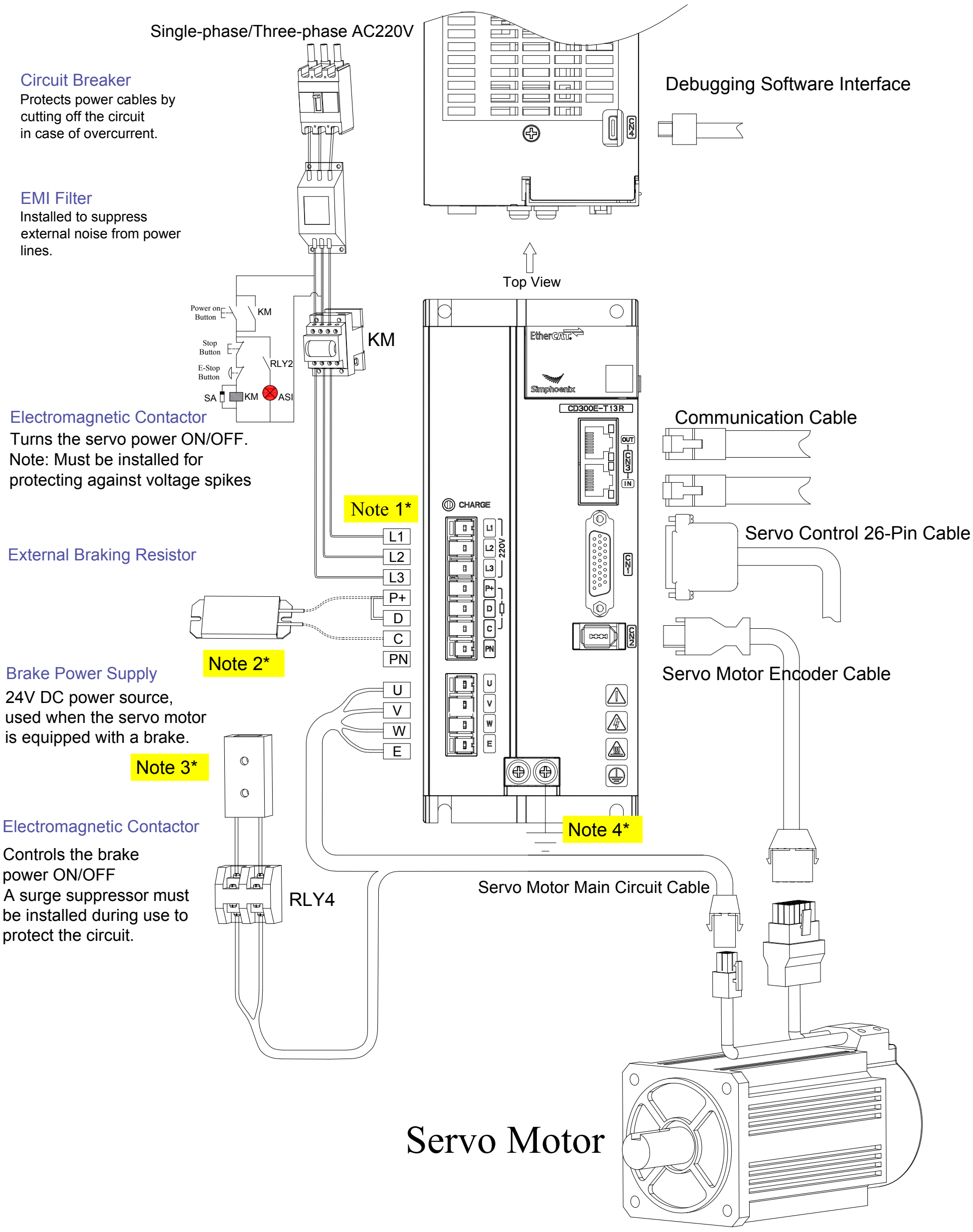
When no external braking resistor is used: Must short-circuit P+ and D terminals

Note 3*： The **24V DC brake power supply** must be user-provided. **Galvanically isolated** from the control signal power (12–24V).

Note 4*： Motor cable shield must terminate at the product’s **PE output terminal**.

Main circuit **PE input terminal** must connect to the control cabinet’s **grounding busbar** via a protective earth conductor.

4.2.5 Single-Phase/Three-Phase 220V Wiring（T10R/T13R）



- **KM**: Electromagnetic Contactor **D**: Freewheeling Diode **SA**: Surge Suppressor
  RLY2/RLY4: Relays **ASI**: Alarm Status Indicator

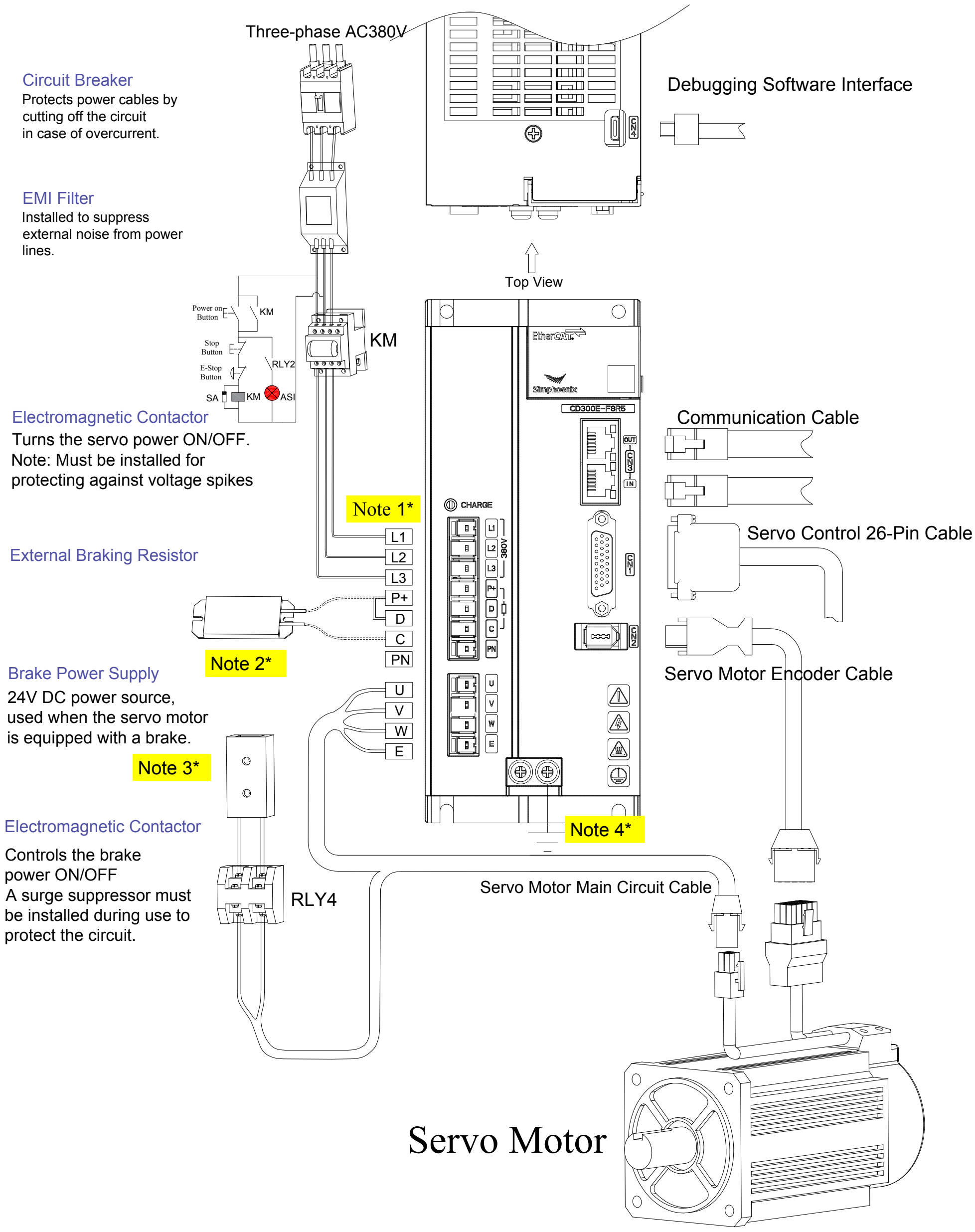
Note 1*： **T10R~T13R** accepts three-phase AC 380V power supply

Note 2*： When using external braking resistor:
Connect between P+ and C terminals, Meanwhile keep P+ and D terminals open-circuit;
When no external braking resistor is used: Must short-circuit P+ and D terminals

Note 3*： The **24V DC brake power supply** must be user-provided. **Galvanically isolated** from the control signal power (12–24V).

Note 4*： Motor cable shield must terminate at the product's **PE output terminal**.
Main circuit **PE input terminal** must connect to the control cabinet's **grounding busbar** via a protective earth conductor.

4.2.6 Three-Phase 380V Wiring（F4R0～F12R）



- **KM**: Electromagnetic Contactor **D**: Freewheeling Diode **SA**: Surge Suppressor

  RLY2/RLY4: Relays **ASI**: Alarm Status Indicator

Note 1*： **F4R0~F12R** accepts three-phase AC 380V power supply

Note 2*： When using external braking resistor:

Connect between P+ and C terminals, Meanwhile keep P+ and D terminals open-circuit;

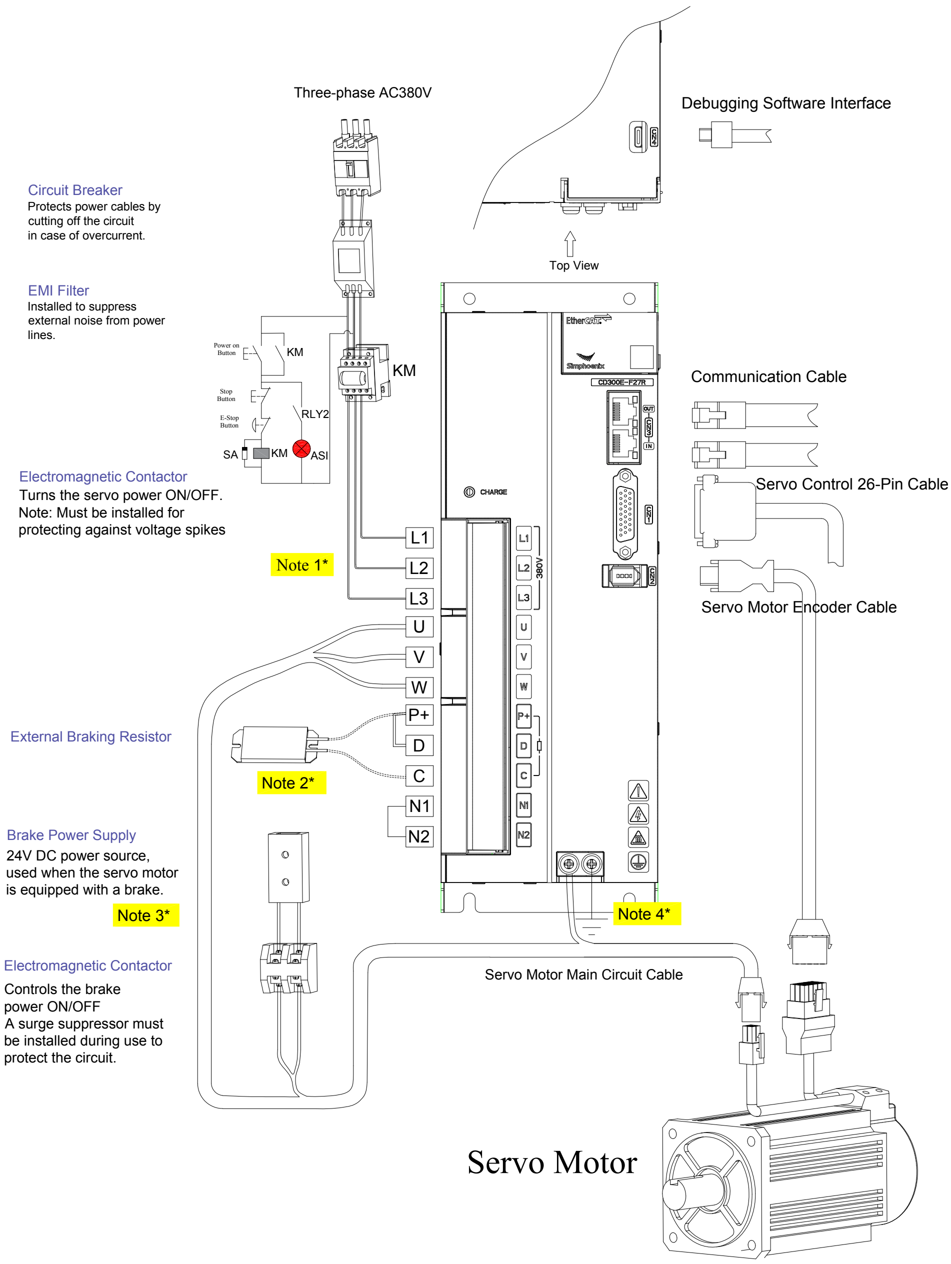
When no external braking resistor is used: Must short-circuit P+ and D terminals

Note 3*： The **24V DC brake power supply** must be user-provided. **Galvanically isolated** from the control signal power (12–24V).

Note 4*： Motor cable shield must terminate at the product’s **PE output terminal**.

Main circuit **PE input terminal** must connect to the control cabinet’s **grounding busbar** via a protective earth conductor.

4.2.7 Three-Phase 380V Wiring（F17R～F27R）



KM: Electromagnetic Contactor **D**: Freewheeling Diode **SA**: Surge Suppressor

RLY2/RLY4: Relays **ASI**: Alarm Status Indicator

Note 1*： **F17R0~F27R** accepts three-phase AC 380V power supply

Note 2*： When using external braking resistor:

Connect between P+ and C terminals, Meanwhile keep P+ and D terminals open-circuit;

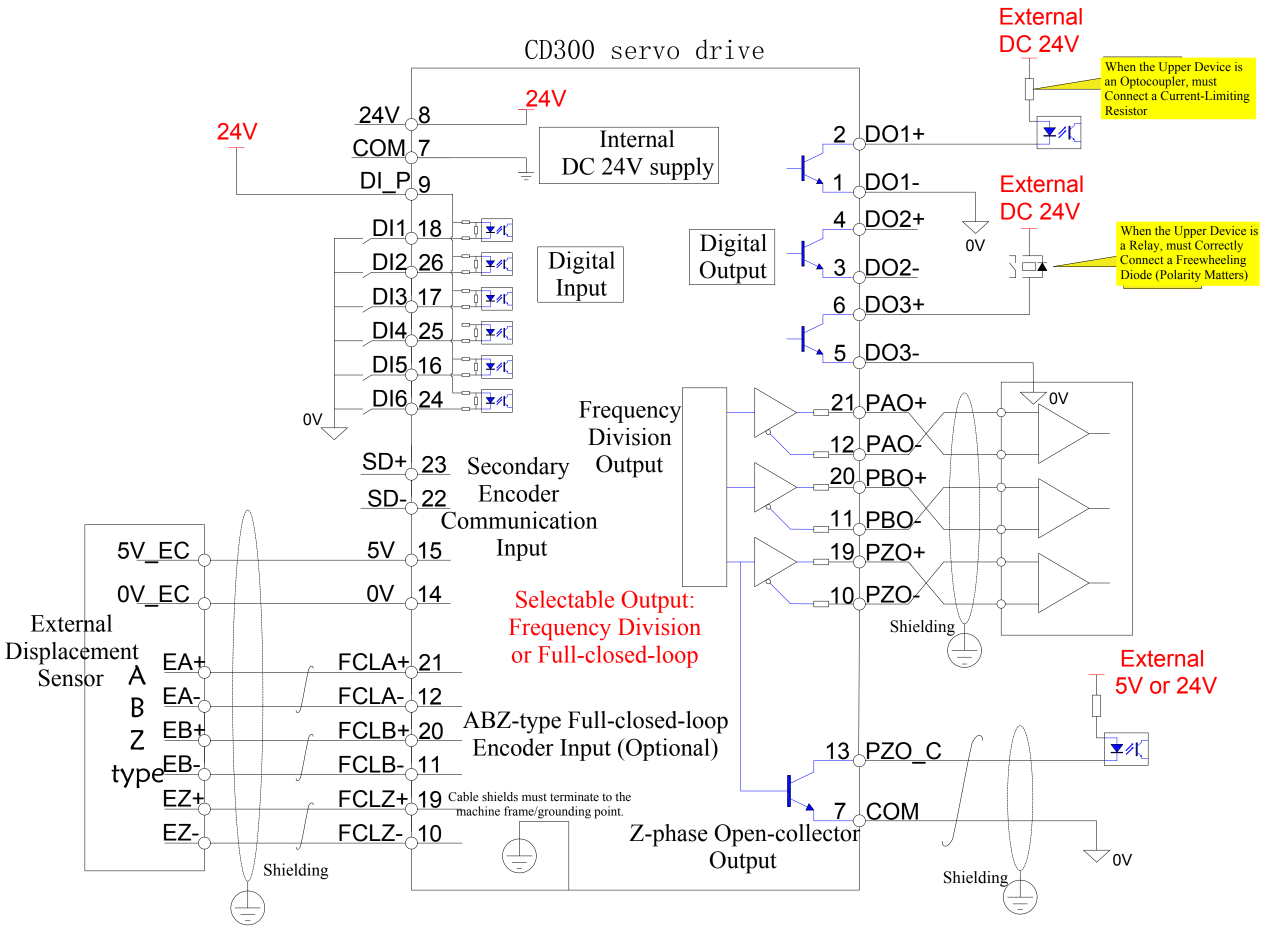
When no external braking resistor is used: Must short-circuit P+ and D terminals

Note 3*： The **24V DC brake power supply** must be user-provided. **Galvanically isolated** from the control signal power (12–24V).

Note 4*： Motor cable shield must terminate at the product’s **PE output terminal**.

Main circuit **PE input terminal** must connect to the control cabinet’s **grounding busbar** via a protective earth conductor.

4.3 Control Circuit Wiring



Note：

[1] **Internal 24V Power Supply Specifications:**

Voltage Range: 20V~28V DC,

Maximum Current: 100mA

[2] **Pulse Signal Wiring Requirements:**

Cable Type: Twisted-pair shielded cable

Shielding: Shield layer **must be connected to PE at both ends**

DGND must be reliably connected to the host controller's signal ground

[3] **DO (Digital Output) Power Supply:**

User-provided power supply range: 5V~24V DC

DO Port Limits: **Max Voltage:** 30V DC,

Max Current: 50mA.

[4] **Frequency Division Output Wiring Requirements:**

Cable Type: Twisted-pair shielded cable

Shielding: Shield layer **must be connected to PE at both ends**

DGND must be reliably connected to the host controller's signal ground

4.3.1 Digital Input (DI)

(1) DI Terminal Pin Definition

The digital input interface of the servo drive adopts a bidirectional optocoupler design, allowing users to connect via relays or open collector transistors. When connecting with relays, please select relays for small currents, otherwise it may result in poor contact or failure of the circuit to conduct.

Note:

1. When using an external power supply, disconnect 24V from the DI_P terminal

2. Mixing PNP and NPN inputs between multiple DI terminals is not supported

3. Do not reuse functions for different DI terminals

Signal Name		Pin Number	Default Function
Digital Input	DI1	18	Servo Enable
	DI2	26	Fault Reset
	DI3	17	Positive Limit
	DI4	25	Negative Limit
	DI5	16	Origin Signal
	DI6	24	Start Origin Search
	DI_P	9	Digital Input Common Terminal
Power Supply	+24V	8	Internal 24V Power Supply
	COM	7	

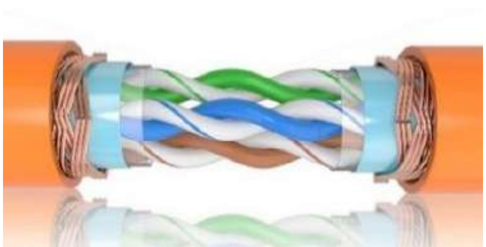
(2) Digital Input (DI) Function Definition Table

S/N	Function	Function Description	Remarks
0	No Function		
1	Servo Enable	Control the servo to enter the running or standby status	Only when there is no fault can it be enabled
2	Fault Reset	Control the servo to switch back to the ready status from fault status	Before resetting, please ensure that the fault has been cleared
3	Position Table Index 0	In PP mode, for position table mode task index selection, the index value composed of the states of "Position Table Index 0-4" selects the starting sequence number for position table execution tasks	Position table mode requires at least one input terminal function configured as "Position Table Index". "Index 31" is a special function configuration
4	Position Table Index 1		
5	Position Table Index 2		
6	Position Table Index 3		
7	Position Table Index 4		
8	Operating Mode Index 0	The index value composed of the states of "Operating Mode Index 0/1" selects the servo operating mode	The corresponding operating mode for DI terminal input can be set via "DIN Operating Mode 0-4"
9	Operating Mode Index 1		
10	Gain Index 0	The index value composed of the states of "Gain Index 0/1" selects the internal gain group	Each gain group parameter includes: position loop bandwidth, speed loop proportional gain, speed loop integral gain, speed loop integral limit, and speed loop PDFF coefficient
11	Gain Index 1		
12	Integral Clear	Clear "Speed Loop Integral Output" to zero.	
13	Positive Limit	Positive limit switch input, "----PL" is displayed after triggering	To prevent accidents caused by abnormal signal triggering or broken wires, use "normally closed contacts" for limit switches. Positive and negative limit functions are invalid in torque mode
14	Negative Limit	Reverse limit switch input, "nL----" is displayed after triggering	

S/N	Function	Function Description	Remarks
15	Origin Signal	Origin mode home switch signal	Home switch input
16	Start Origin Search	Origin finding action trigger signal in origin mode	
17	Command Reversal	Reverse the command target	Control loop command and feedback in reverse direction
18	Emergency Stop	Execute emergency stop action according to the set method	The emergency stop method can be set via "Emergency Stop Option" With some emergency stop options, motion will resume after the emergency stop signal disappears.
19	Trigger 0	Trigger oscilloscope data acquisition	Click "re-read data" to display data acquired at the trigger point
21	Condition 0	Judgment condition for the next index in position table mode. Setting control register bit 9 and bit 10 to 1 enables condition 0 and condition 1 inputs, respectively. When both are active, bit 11 can select the execution logic as condition 0 | condition 1 (bit 12 set to 0), or condition 0 & condition 1 (bit 12 set to 1)	If both condition 0 and condition 1 are inactive, the execution condition remains 1; If condition 0 is active and condition 1 is inactive, the execution condition is condition 0; If condition 0 is inactive and condition 1 is active, the execution condition is condition 1.
22	Condition 1		
23	Pause	Pause command execution in PV and PP modes	Set "Control Word 6040" bit 8 to 1. After release, incomplete commands will continue to execute
25	Activate Position Table	Run the position table task	
26	Interrupt Position Table	Interrupt the position table running	After running the current index, the entire position table running ends. The position table will rerun from the beginning after the next activation
27	Pause Position Table	Pause the position table running	After running the current index, the next index will pause, and resume running until the pause signal is cleared
28	Probe 1	The probe function can record the position and time information of the rising and falling edges of the probe signal when triggered, and can also record the number of triggers	Probe enable and trigger methods are configured via "Probe Settings"
29	Probe 2		
30	Full/Half Closed-loop Switching	Enables full closed- loop control	
31	Pulse input disable	Ignores all received pulse commands when active	

(3) DI Terminal Wiring Usage

It is recommended to use shielded cables for control cables, and the shield layer should be reliably connected to the drive enclosure

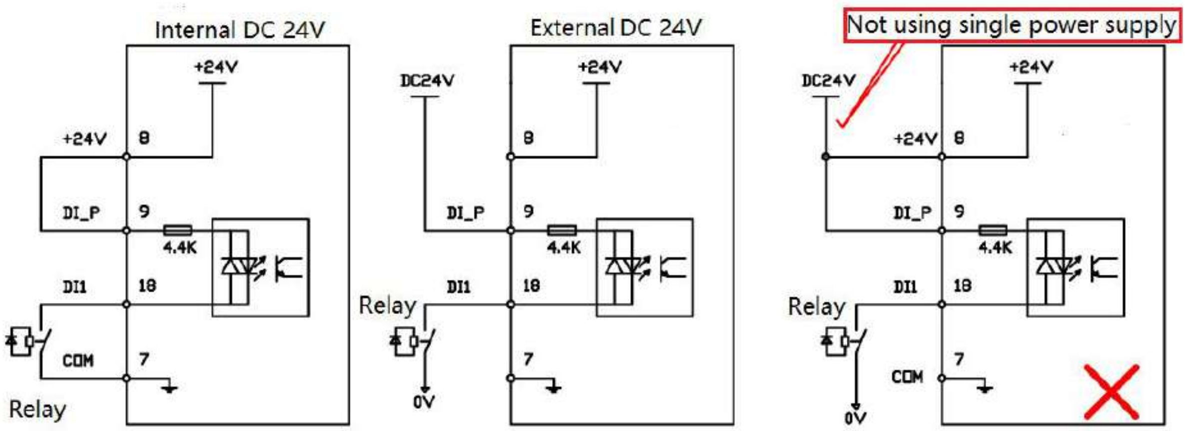


Simphoenix

(E) using a 360° circumferential connection for better EMC anti-interference performance.

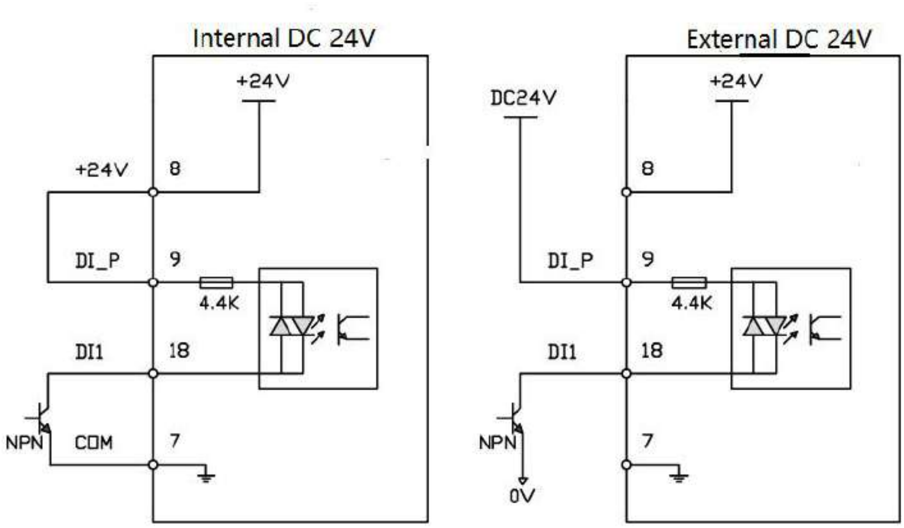
Connection Guide for Relay Output from Host Controller

Taking DI1 as an example, various wiring methods are as follows. The interface circuits for DI1 to DI6 are identical.



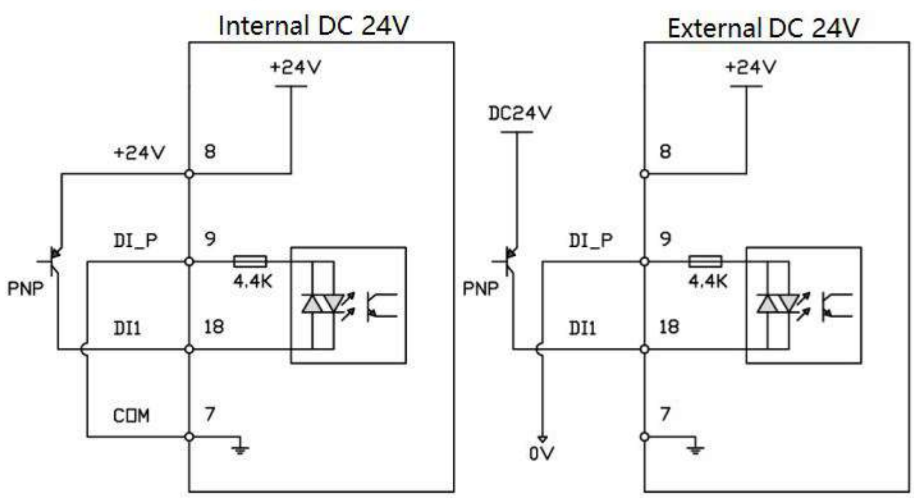
Digital input wiring diagram when the host device is a relay output

- **Host device is NPN open collector output:**



Digital input wiring diagram when the host device is an open collector (NPN) output

- **Host device is PNP open collector output:**



Digital input wiring diagram when the upper device is an open collector (PNP) output

4.3.3 Digital Output DO

The digital output interface of the CD300E servo drive adopts a differential output design.

Note:

1. The maximum allowed voltage for the output transistor of the servo drive is DC28V.

2. The maximum allowed current for the digital output transistor of the servo drive is DC50mA.

(1) DO Terminal Pin Definition

Signal Name		Pin Number	Function
Digital Output	DO1-	1	Brake control
	DO1+	2	
	DO2-	3	Servo Fault
	DO2+	4	
	DO3-	5	Target position (speed) reached
	DO3+	6	
	COM	7	Internal 24V Power Supply
	+24V	8	

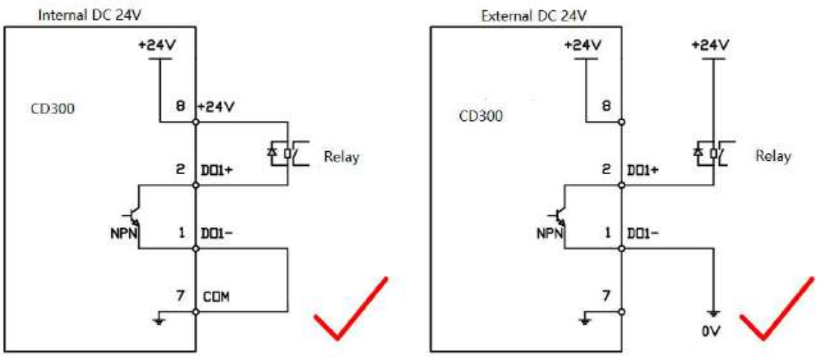
(2) Digital Output (DO) Function Definition Table

S/N	Function	Function Description	Remarks
0	No Function	No Function	
1	Ready	Servo ready, no fault	
2	Fault	Servo fault alarm output	
3	Target Reached	Reached the set target position or target speed	Output after the servo is enabled
4	Speed Saturation	Speed reaches or exceeds "Maximum Speed Command"	The position mode is active
5	Current Saturation	Current reaches or exceeds "Current Command Limit Value"	
6	Motor Zero Speed	The motor speed is zero	Independent of servo enable status
7	Brake Control	Brake control output after servo enable	
8	Dynamic Braking	Bus voltage exceeds "Braking Point"	The braking resistor is working
9	Z Signal	Motor encoder Z signal output	
10	Motor Overspeed	The motor speed exceeds "Maximum Speed Setting" in torque mode	
11	Enabling	The servo is in enable status	
12	In Limit	The servo is in the positive/negative limit status of software/hardware	
13	Origin Found	Origin finding completed in origin mode	Origin mode active
14	Origin Search	Origin finding action in progress in origin mode	Origin mode active
18	Current Reached	The current is greater than "Current Comparison Value"	

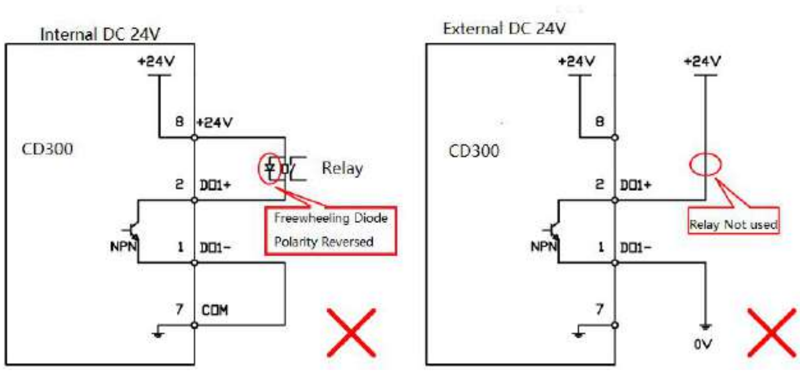
(3) DO Terminal Wiring Usage

Taking DO1 as an example, various wiring methods are as follows. The interface circuits for DO1 to DO3 are identical.

● **Host device is relay input:**

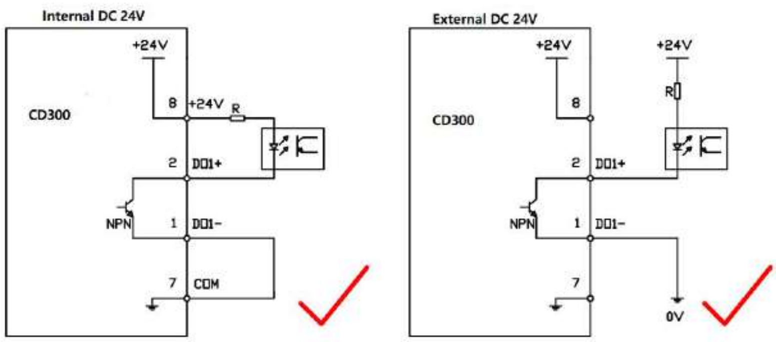


Correct wiring when digital output terminal connects to a relay

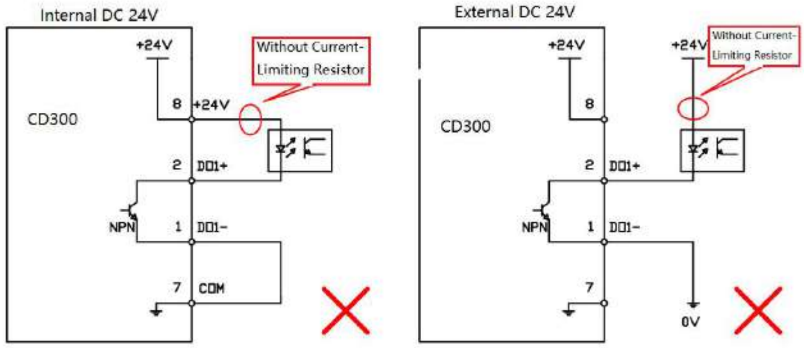


Incorrect wiring when digital output terminal connects to a relay

● **Host device is optocoupler input:**



Correct wiring when digital output terminal connects to an optocoupler



Incorrect wiring when digital output terminal connects to an optocoupler

4.3.4 Full-closed loop/Frequency Division Output (Expandable)

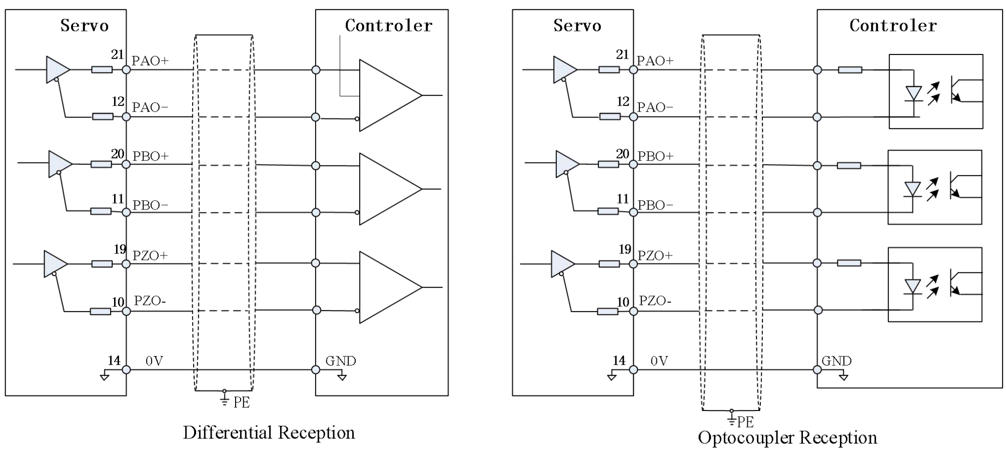
The encoder frequency division output signal of the drive is a differential signal, typically used as a position feedback signal when the host device performs position control. On the host device side, please use a differential receiving circuit.

Note:

1. The maximum allowed voltage for the internal output circuit of the servo drive is DC28V.

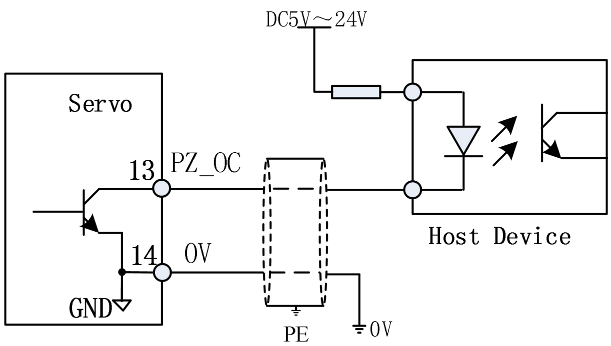
2. The maximum allowed current for the internal output circuit of the servo drive is DC20mA.

Signal Name		Pin Number	Function	
Full-closed loop /Frequency division output	SD+	23	Secondary encoder communication input	Expandable communication type full-closed loop function
	SD-	22		
	5V	15	Secondary encoder 5V power supply	Maximum output current 150mA
	0V	14		
	A+/PAO+	21	A, Secondary encoder pulse A input PAO, A-phase frequency division output signal	Expandable ABZ type full-closed loop function Expandable frequency division output function But only one of the two can be selected
	A-/PAO-	12		
	B+/PBO+	20	B, Secondary encoder pulse B input PBO, B-phase frequency division output signal	
	B-/PBO-	11		
	Z+/PZO+	19	Z, Secondary encoder pulse Z input PZO, Z-phase frequency division output signal	
	Z-/PZO-	10		
	PZ_OC	13	Z-phase frequency division open collector output	
	PE	Casing	Shielding layer	



Encoder frequency division output wired to host device

Additionally, the Z-phase of the encoder frequency division output signal provides an open collector output signal, which can serve as a feedback signal when the servo drive and the higher-level device form a position control system. On the higher-level device side, please use an optocoupler circuit, relay circuit, or bus receiver circuit to receive it.

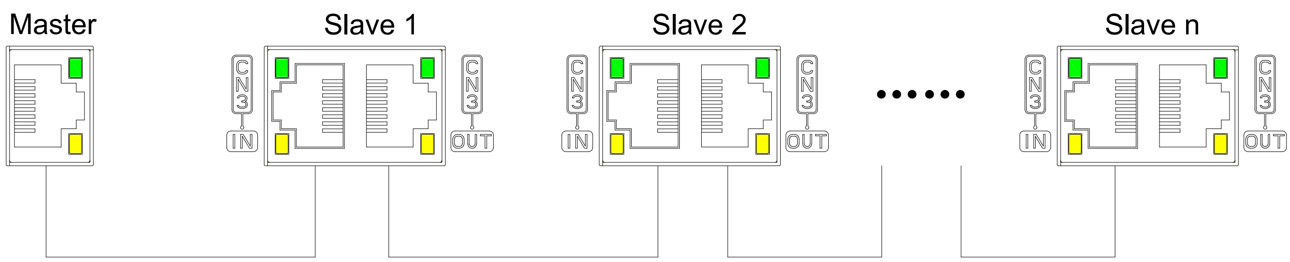


Encoder (open collector output) wired to host device

4.3.5 Communication Interface Wiring

(1) EtherCAT communication connection

EtherCAT bus communication supports cascading. CN3-IN connects to the output of the PLC/controller or the CN3-OUT of the previous drive; CN3-OUT connects to the CN3-IN of the next drive.

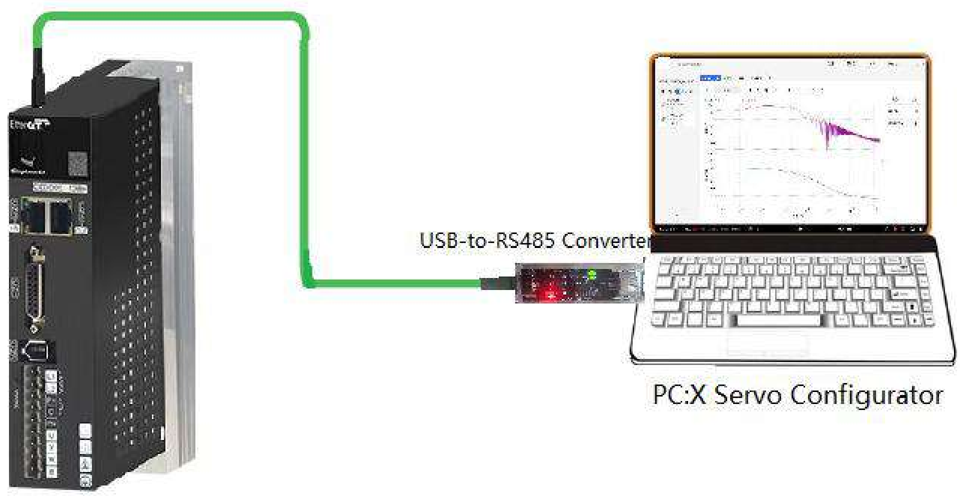


Communication Cable Description:

- Please use Cat5e shielded (100BASE- TX) network cables or high-strength shielded network cables. Connectors with metal shielding layer are recommended to prevent signal interference.
- The maximum distance between two drives in a daisy-chain network is ≤30m.

(2) Communication Interface with Host Computer

As shown in the figure below, the communication interface **CN4** on the top of the servo drive allows connecting the drive to the dedicated debugging tool X Servo Configurator for operations such as parameter setting & monitoring, gain adjustment, troubleshooting, and firmware upgrades.



4.4 Anti-Interference Measures

As a key component of motion control systems, servo drives have high requirements for anti-interference. Variations in peripheral wiring and grounding methods for servo drives may lead to noise affecting the normal operation of the system. Therefore, correct grounding methods and wiring procedures must be adopted.

Grounding Procedures

To prevent potential electromagnetic interference problems, please ground according to the following methods:

- Always use a single-point grounding method, ensuring that the protective earth (PE) conductor has sufficient conductivity and complies with local regulatory requirements.
- When multiple units are connected in parallel, connect the PE cable from the input power supply to the grounding copper bar of the control cabinet, and connect the grounding terminal of the drive to the copper bar inside the control cabinet via a protective earth conductor. The grounding copper bar of the control cabinet should then be connected to the metal enclosure of the control cabinet.
- When the servo motor is grounded mechanically, switching interference currents may flow from the main circuit of the servo unit through the parasitic capacitance of the servo motor. To prevent this phenomenon, ensure that the E terminal of the main circuit cable connected to the servo motor is connected to the E grounding terminal of the servo unit. Additionally, the grounding terminal must be grounded.
- The shield wire of the encoder cable connected to the servo motor must be connected to the plug housing (casing).
- If input/output signal cables are susceptible to noise interference, use a 360° grounding method for the shield at the cable entry point to reduce electromagnetic radiation and interference.
- If the main circuit cable of the servo motor is encased in a metal conduit, ensure single-point grounding for both the metal conduit and the grounding box.
- When installing inside the control cabinet, the cabinet should be divided into multiple EMC areas or separated into multiple control cabinets based on the strength of interference sources:
- ● When using multiple control cabinets, they should be connected with grounding wires of at least 16mm² cross-sectional area to achieve equipotential bonding between cabinets
- Within a single control cabinet, equipment should be partitioned based on signal strength, and devices in different areas of the control cabinet should be equipotentially bonded
- All communication and signal cables routed out of the control cabinet must be properly shielded

Chapter 5 Display and Operation

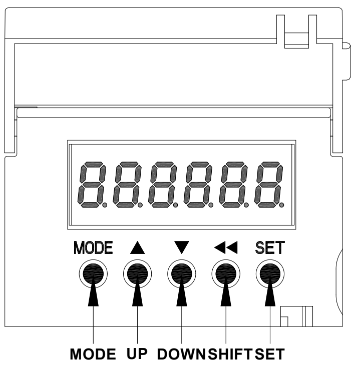
The CD300E can perform operations such as viewing and setting drive parameters, checking alarm information, monitoring operating parameters, and adjusting servo parameters through the following two methods:

- Operation panel of the drive
- Host computer software X Servo Configurator (recommended)

5.1 Operation Panel

5.1.1 Front Panel Composition

The CD300E servo drive panel consists of a display (6-digit, 8-segment LED digital tube) and 5 buttons.

Front Panel Appearance	Symbol	Name	Function
	**MODE**	**Mode Switch Button**	**Menu/Setting Toggle** **Exit current parameter/function operation, and return to previous menu**
	▲	**Up Button**	**Submenu toggle, increase value** **High/low digit display toggle**
	▼	**Down Button**	**Submenu toggle, decrease value** **High/low digit display toggle**
	◀◀	**Shift Button**	**Input digit (flashing) shift** **Enter parameter monitoring menu**
	SET	**OK Button**	**Enter next menu** **Confirm input** **Long press for fault reset**

5.1.2 Panel Operation Process

The operation panel allows switching between basic modes, as well as status monitoring, parameter setting, and fault display, etc.

(1) Main Menu

When the drive is powered on, the display LEDs will light up fully for about two seconds. Then, if the drive has no abnormal alarms, it will enter the main menu; otherwise, it will display the corresponding abnormal alarm code. This menu has 4 states.

1. Normal State

The factory default display is the current speed. The content displayed in this state is defined in the F007 group. You can also enter the Jog and constant display interface using the "▲+SET" shortcut key, then scroll up to Pr7.01 to set the constant display content.

2. Drive Fault Display State. Highest priority

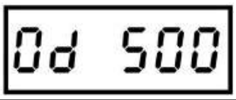
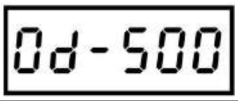
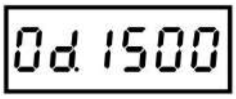
Once the drive experiences a fatal fault, when the drive transitions from a non-fault state to a fault state, it will directly jump to the fault display state, regardless of the current display state. **Faults are displayed in the format 'Er.XXXX' accompanied by 650ms flashing.** After troubleshooting the fault, long-press "SET" for about 3 seconds in the fault state to perform a control word "0x86" operation, i.e., attempt a fault reset.

3. Warning Display State

The warning state is superimposed on the normal state, displaying "AL.00XX" and flashing. It flashes once every 350ms, for a total of three flashes, then displays the normal screen for about 10 seconds. In the warning state, press "SET" to enter the warning clear interface, displaying "CLrUU". At this point, pressing "SET" will attempt to clear the warning. Warnings caused by low battery power of encoder will cause the digital tube to alternately flash 3 times with a 200ms interval. Other warnings will clear automatically.

4. Status Monitoring

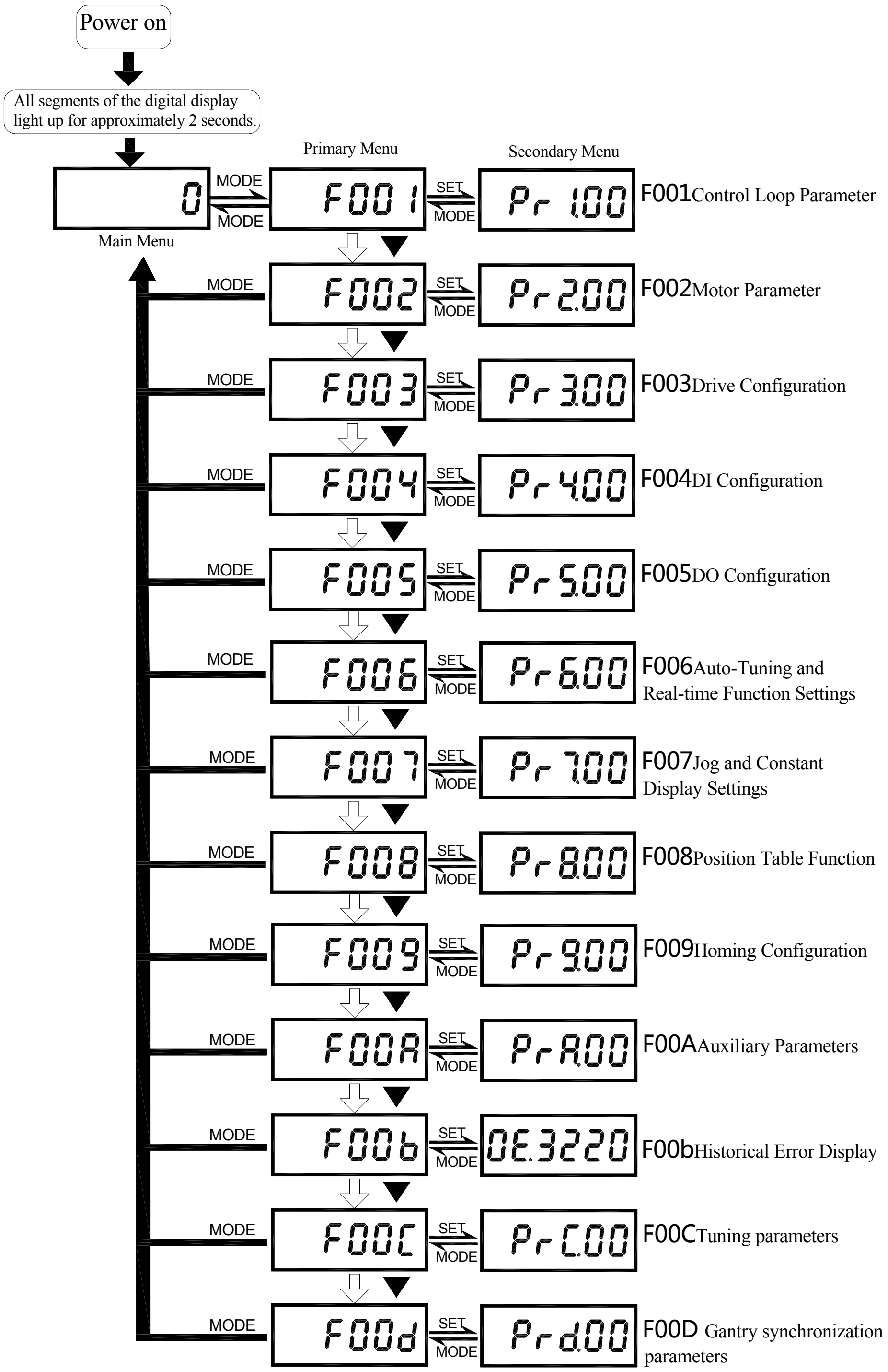
From the main menu, press the "◀◀" key to enter the status monitoring menu bar. The displayed parameters can be used to monitor the operating status of the servo drive. Specific explanations for monitoring display are as follows:

Display	Description		Remarks
	Speed 500 r/m	The leftmost digital tube displays a number corresponding to different monitoring values, which corresponds to the constantly displayed parameter monitoring setting The second digital tube from the left displays "d", indicating that the parameter is displayed in decimal; displaying "H" indicates that the parameter is displayed in hexadecimal If the displayed value is negative, a "dot" lights up directly next to the highest digit, or in the lower right corner of the second digital tube from the left if the value exceeds four digits	Monitored parameter corresponding value 0: Speed 1: Bus voltage 2: Drive temperature 3: Input terminal status 4: Output terminal status 5: Drive load rate 6: Motor load rate Other monitoring parameters can be extended
	Speed -500 r/m		
	Speed -1500 r/m		
	Bus voltage 320.8V		
	DI1, DI2 with input		

(2) Primary Menu

From the main menu, press the "MODE" key to enter the primary submenu. Use "▲" or "▼" to cycle through the primary submenu. After switching to the desired primary submenu, press "SET" to enter the secondary submenu. Press "MODE" in the primary menu to return to the main menu.

- Use the "▲+SET" key to directly switch to the "Jog and Constant Display Setting Parameter Group". Note that pressing the "▲" key in the Jog interface can switch to the corresponding Jog speed settings.
- Use the "▼+SET" key to directly switch to the "Auto-tuning Parameter Group", Pr6.05 is displayed, allowing quick access to offline inertia measurement The operation process is as follows:



(3) Secondary Menu

The secondary submenu corresponds to the parameter list of the primary menu, displayed as "PrX.xx". Where, "X" represents the group, "xx" represents the parameter number in the current parameter group, and "." indicates the editable parameter.

When entering the secondary menu, the rightmost digital tube will flash. The flashing cursor can be moved using the "◄◄" key. If the cursor is on the units digit, pressing "▲" or "▼" keys will cycle through all members of the current group. If the cursor is on the tens digit, pressing "▲" or "▼" keys will limit the display content to the valid range of the current group and will not cycle.

5.1.3 Parameter Display Description

Display	Description	Remarks
H 103F	The leftmost digital tube displays "H", indicating that the parameter is displayed in hexadecimal	**Hexadecimal Data Display** When displaying 32-bit data, by default, the lower 16 bits are displayed first, by switching with "▲" or "▼" keys
HH0000	The two leftmost digital tubes display "HH", indicating that the higher 16 bits of a 32-bit data are displayed	
HL0000	The two leftmost digital tubes display "HL", indicating that the lower 16 bits of a 32-bit data are displayed	
‾ -1	32-bit data will be split into higher 5 bits and lower 5 bits The topmost segment of the leftmost digital tube for the higher 5 bits lights up	**Decimal Data Display** If there is a negative sign, it is next to the most significant digit. Switch between higher and lower 5 bits with "▲" or "▼" keys
_00000	The bottommost segment of the leftmost digital tube for the lower 5 bits lights up	
StF-13	The rigidity level parameter is displayed as "5tF-xx", where "xx" is the rigidity level value. It needs to be directly modified using the "▲" or "▼" keys, and will take effect immediately.	**Rigidity Level Adjustment** The range is from 0-31, and the rigidity level must be adjusted step by step to prevent control issues.
PPPP1	PPPP1 indicates that a position operation is about to be performed. After pressing SET to enter, PP1.01 will be displayed. The first "1" indicates that the current edited item is a position, and the "01" after it indicates that the first position is being edited, and so on	In position table editing status, PPPPx will be displayed, where "x" represents the group. For details, please refer to 9.1.8 F008 Parameter Group Settings
Er.7510	Once the drive experiences a fatal fault, it will directly jump to the fault display state, regardless of the current display state. The fault display format is "Er.XXXX", where "XXXX" is the alarm code	Flash with a 650ms cycle
AL.0001	The warning state is superimposed on the normal state, displaying "AL.00XX" and flashing	Flash once every 350ms, for a total of three times, then display the normal screen for about 10 seconds

Note:

● Enable state: The dot on the rightmost digital tube continuously flashes

● When not in the main menu, a timeout counter starts. If no keyboard operation occurs within 30 seconds, it automatically returns to the main menu

5.1.4 Parameter Setting Description

When entering the parameter editing state, it always starts from the lowest digit, and the edited position will flash rapidly

Display	Description	Remarks	
-001	Signed data, occupying the right 4 digital tubes, and the leftmost one is the sign bit	**8-bit Data Editing** When editing the sign bit, pressing "▲" or "▼" will toggle the sign between "-" and "0"	**Decimal Display**
001	Unsigned data, occupying the right 3 digital tubes when entering editing state		
-00001	Signed data, fully occupying 6 digital tubes when entering editing state, and the leftmost one is the sign bit	**16-bit Data Editing** When editing the sign bit, pressing "▲" or "▼" will toggle the sign between "-" and "0"	
00001	Unsigned data, occupying 5 digital tubes when entering editing state		
=00001	Signed data, occupying two screens when entering editing state, and splitting into lower 5 bits and higher 5 bits. The higher 5 bits will carry the sign bit on the leftmost digital tube. When editing the lower 5 bits, the leftmost digital tube will not enter the editing flashing state. When editing the higher 5 bits, the leftmost digital tube is the sign bit and also represents the higher 5 bits, and will enter the editing state.	**32-bit Data Editing** Long press "◄◄" key to toggle between lower five bits and higher five bits When editing the sign bit, pressing "▲" or "▼" will toggle the sign between "-" and "=" If the entire data is 0, editing the sign bit is invalid	
_00001			
‾00001	Unsigned data, occupying two screens when entering editing state, and splitting into lower 5 bits and higher 5 bits, without a sign bit. Therefore, the cursor will not move to the leftmost digital tube; the leftmost digital tube only displays a horizontal line indicating higher or lower 5 bits		
_00001			
H 103F	16-bit data, when entering editing state, the leftmost digital tube displays "H". Parameter settings occupy the right 4 digital tubes, and each digit is toggled between 0 and F by "▲" or "▼"	**16-bit Data Editing**	**Hexadecimal Display**
HH0000	32-bit data, occupying two screens when entering editing state, and splitting into lower 16 bits and higher 16 bits, without a sign bit. Each digit is toggled between 0 and F by "▲" or "▼"	**32-bit Data Editing** Long press "◄◄" key to toggle between lower 16 bits and higher 16 bits	
HL0000			

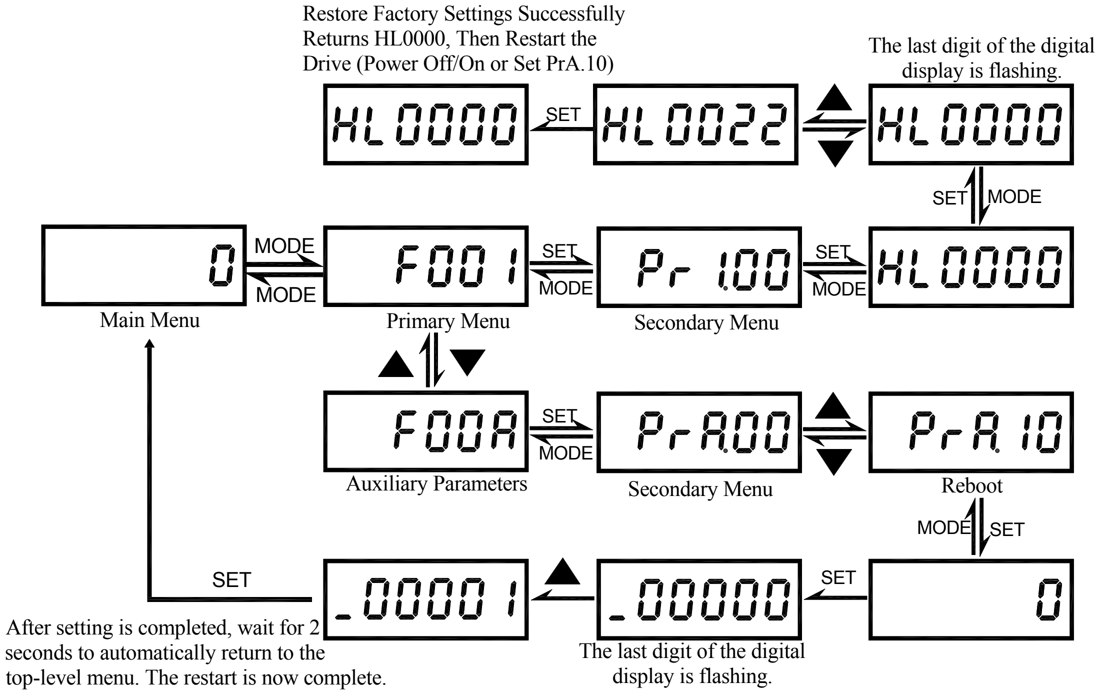
Note:

● After editing, press the "SET" key to modify the data. At this time, the data validity will be checked. If incorrect data is entered, such as data exceeding the range, it will enter the abnormal parameter operation state, and after flashing "d Err" twice, it will return to the parameter display state.

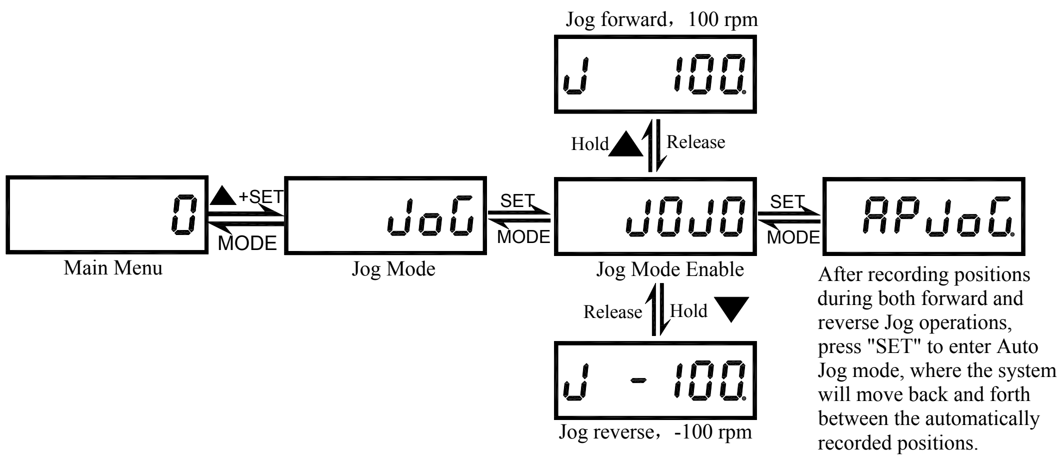
● If correct data is entered, it will directly revert to the parameter display state. If the parameter is not editable, "ro" will be displayed and flash twice, then it will revert to the parameter display state.

5.1.5 Parameter Setting Examples

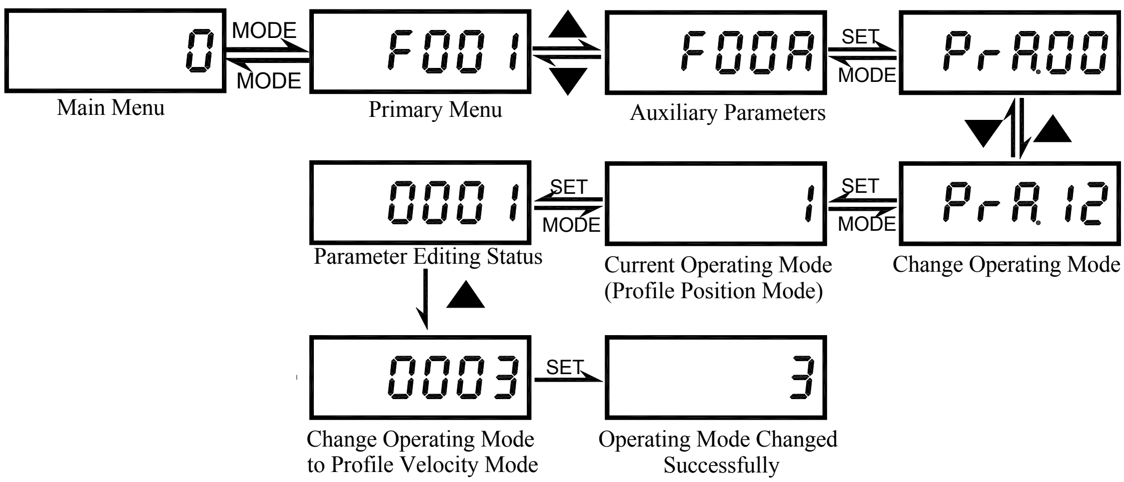
(1) Restore Factory Settings



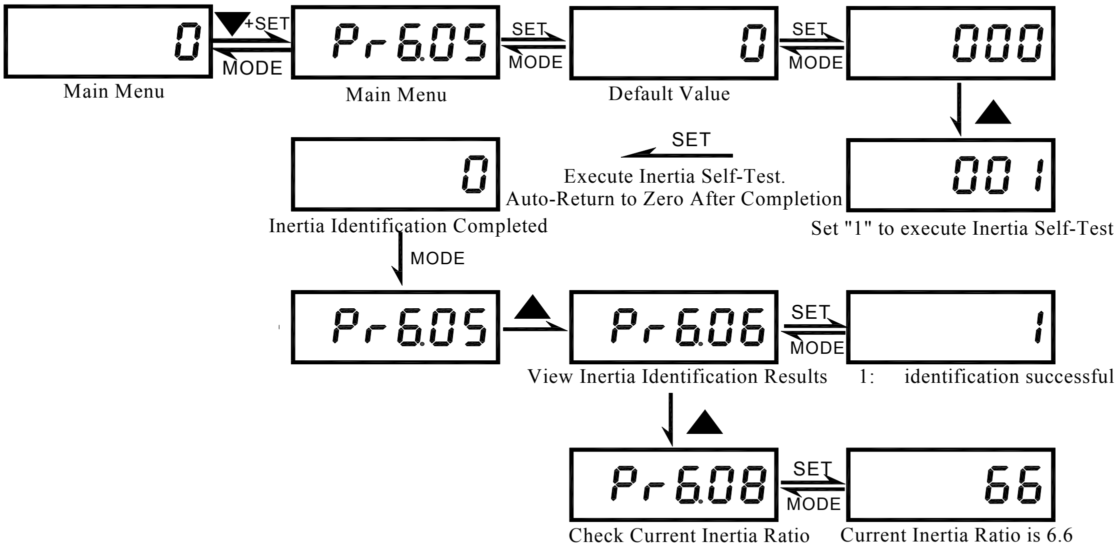
(2) Jog Mode Setting



(3) Change Operating Mode

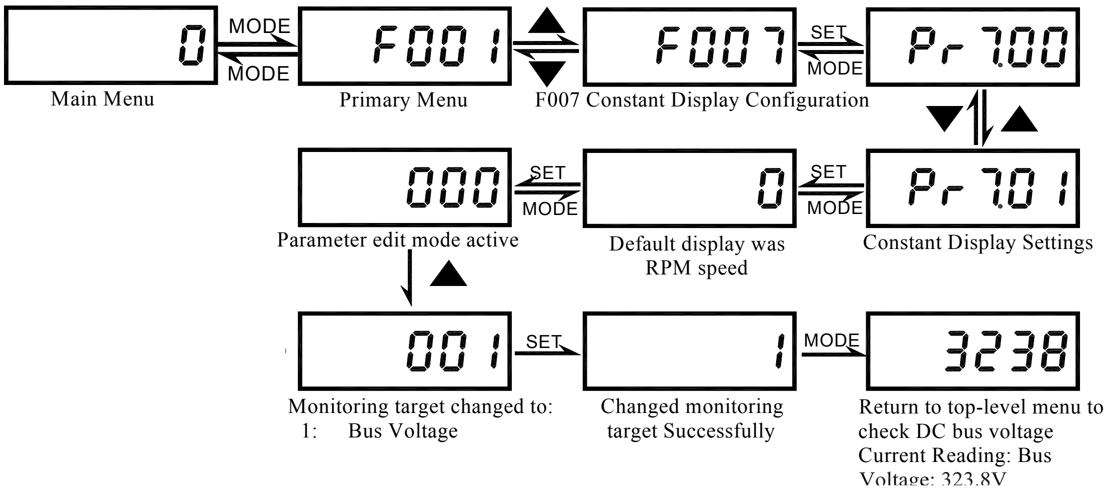


(4) Motor Parameter Auto-tuning



(5) Constant Monitoring Setting

Constant monitoring display can be set by modifying Pr7.01. For example, to change the constant display from RPM speed to bus voltage, follow these steps:



No.	Index H	Parameter Name	Setting/Help Information	Default Value	Type	Validation
Pr7.01	310024	Constant Monitoring Object	0: Display RPM speed 1: Display bus voltage 2: Display temperature 3: DIN final input signal 4: DOUT final output status 5: Drive load rate 6: Motor load rate **7:** Encoder single-turn position (H) **8:** Current display Other monitoring parameters are expandable.	0	U8	Immediate

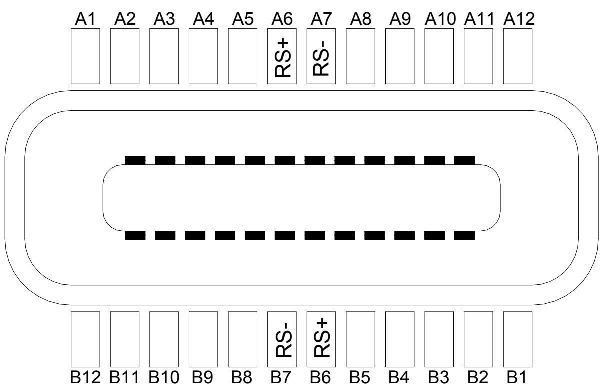
5.2 Software Overview

Communication Guide for CD200 Series Servo Drives with PC:

Please use the **factory-provided USB/RS485 isolated converter** for connection.

USB/RS485 isolated converter

The drive-side interface is **Type-C port** with **RS485 communication** support.

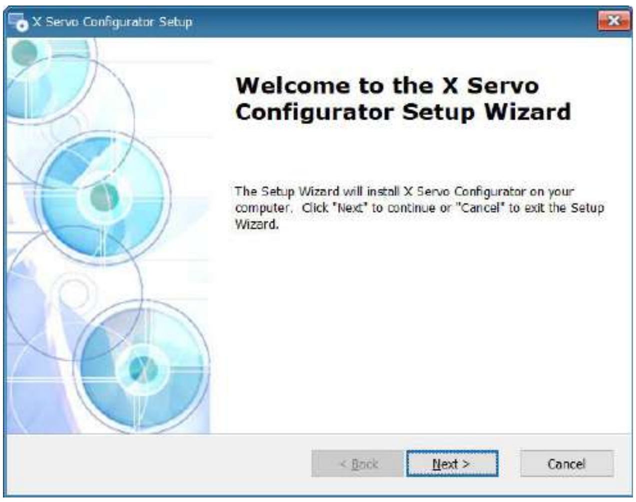
CN4	Pinout	Signal	Description
	A1-A5	-	-
	B1-B5	-	-
	A6/B6	RS+	RS485+
	A7/B7	RS-	RS485-
	A8-A12	-	-
	B8-B12	-	-

5.2.1 Software Installation

(1) X Servo Configurator Installation

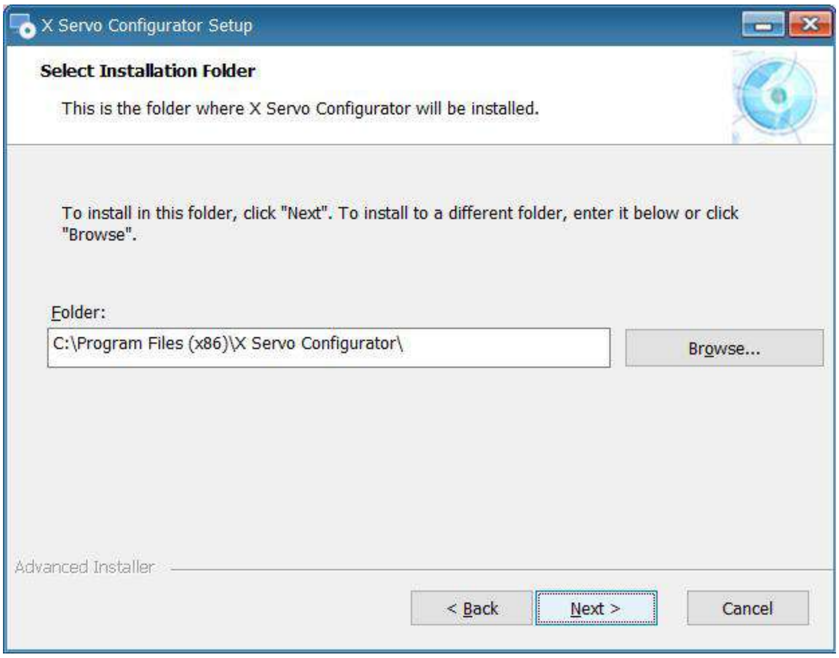
1. Run the Installer

Locate the installation file X Servo Configurator Setup.exe.Double-click the file to launch the setup wizard. Then click "Next".

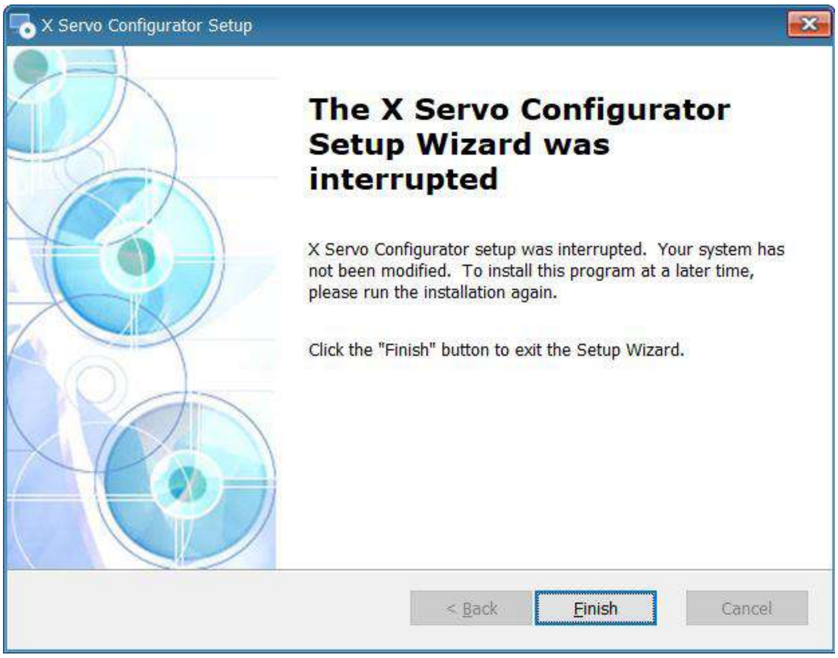


2.Installation Path Selection

Recommendation:Use the default installation path (C:\Program Files (x86)\X Servo Configurator\) for optimal compatibility and stability.



After the installation is complete, click "Finish."

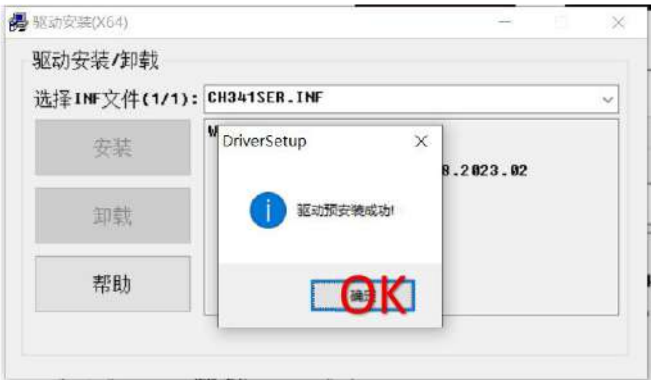


A shortcut will be created on the desktop automatically.

(2) Installation of USB/485 Converter Driver

Double-click the "CH341SER.exe" file to start the installation, then click "Install".

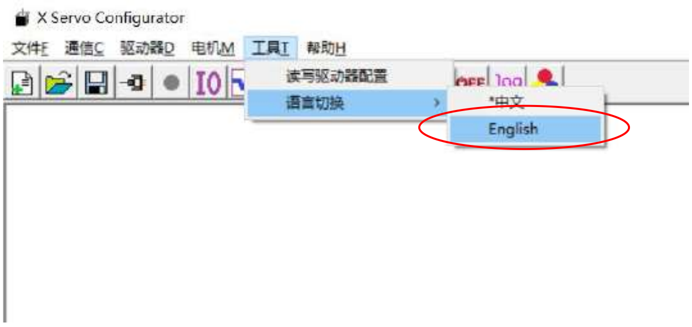
The driver installation is complete. Click "OK" to confirm.



5.2.2 Connection established.

Launch X Servo Configurator.

First of all, select the language: Navigate to the 'Tools' menu, then choose 'English' from the language dropdown options."

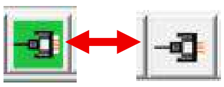


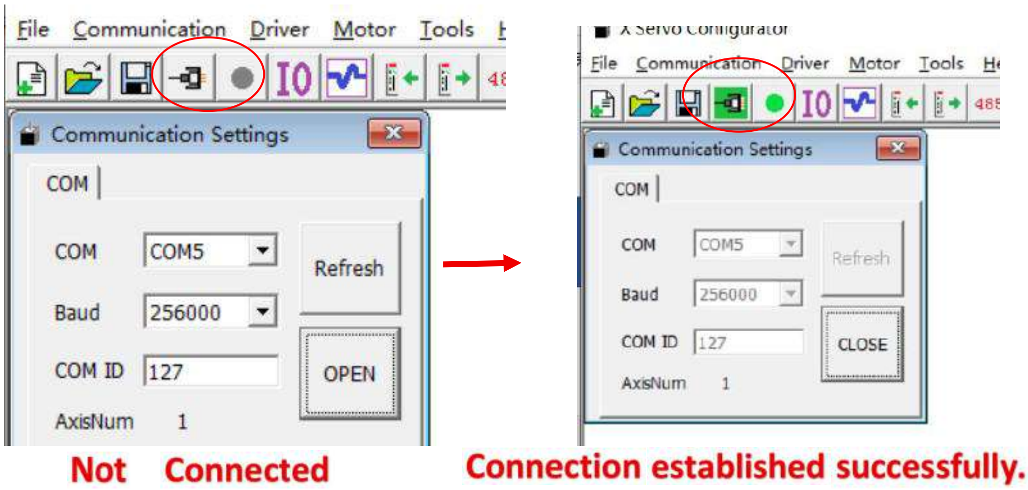
Locate the **"Communication"** option in the menu bar and click **"Communication Settings"** to establish the connection.

In the **"COM"** dropdown, select **"USB Serial Port"** or click **"Refresh"** to auto-detect available ports.

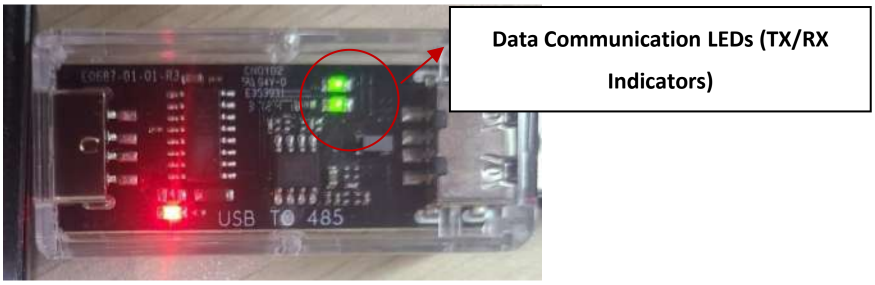
Set the appropriate **Baud Rate** (default: *256000*) and **Communication ID** (default: *127*).

Click **"Open"** to initiate the connection.

When the connection is established, the **'Communication Settings'** button will turn **green** (as shown below). After the servo drive successfully communicates with the host PC, click the button  to **toggle** (disable/enable) the connection."



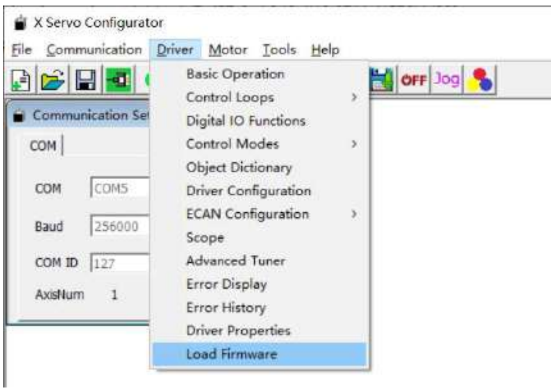
When the connection is normal, the TX/RX indicators on the USB/485 converter will illuminate.

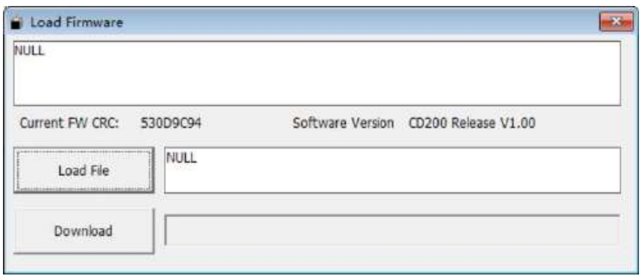


5.2.3 Software Function Overview

(1) Firmware Update(Drive Software Version Update)

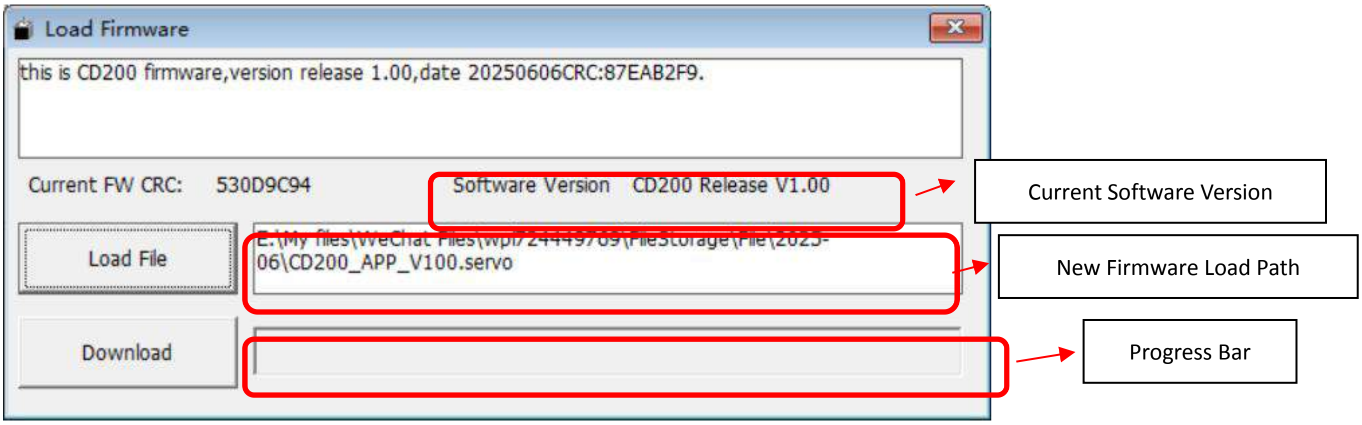
Click **Driver** in the menu bar →**Load Firmware** to open the firmware update toolbar.

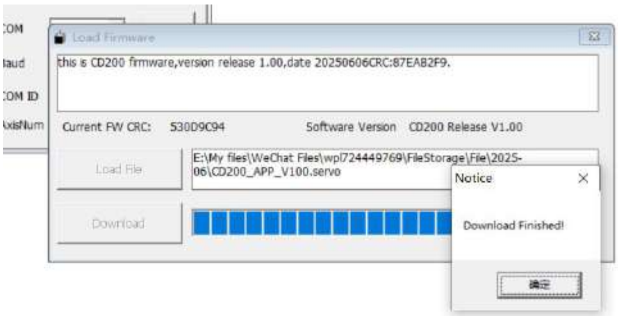




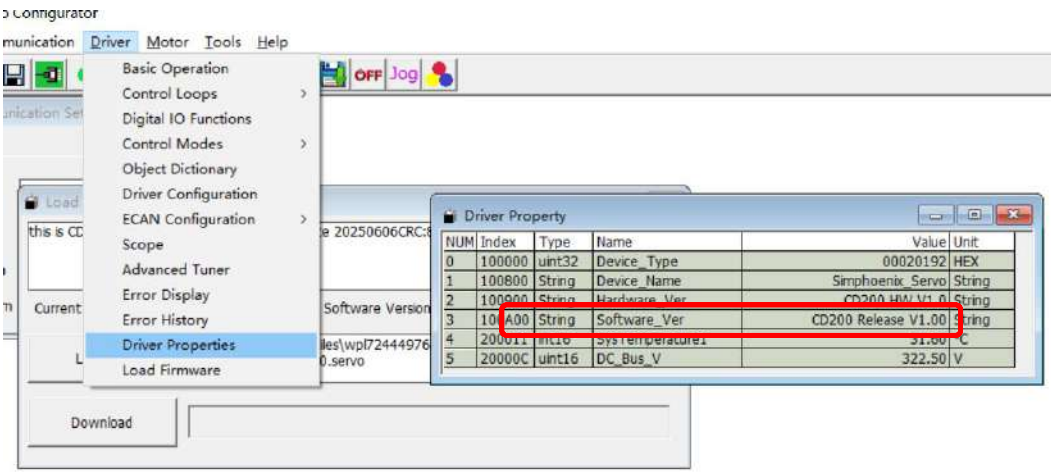
Click **"Load File"** to select the new firmware file, then click **"Download"** and wait for the process to complete.

(Before performing the firmware update, please back up the parameters. Refer to the ***Batch Parameter Read/Write*** *operation for details.)*





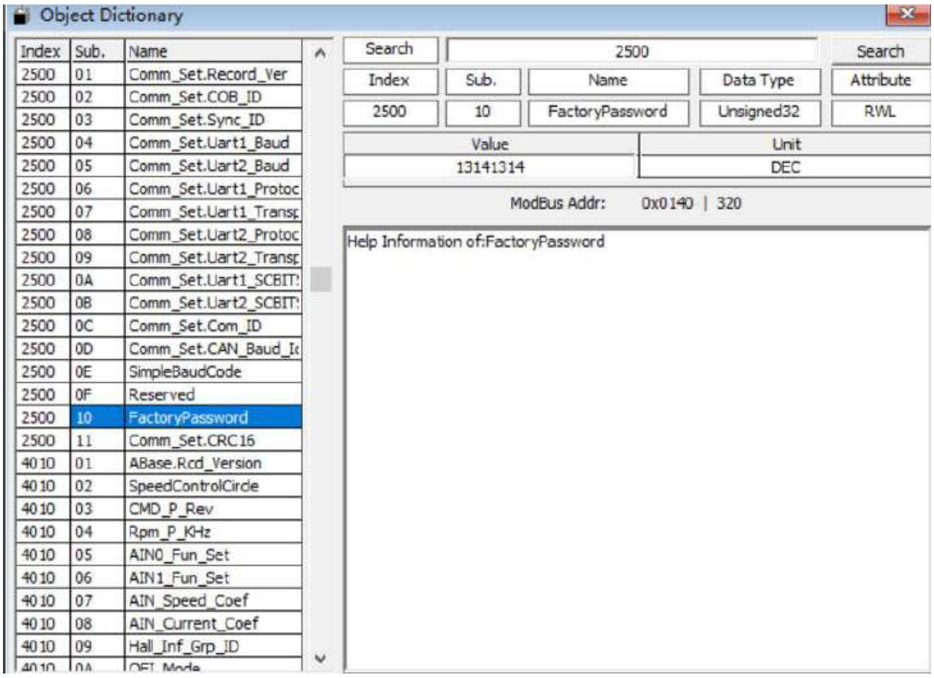
When the "Download Successful" window appears, go to the menu and select **Driver** → **Drive Properties** to verify whether the current version has been successfully updated.



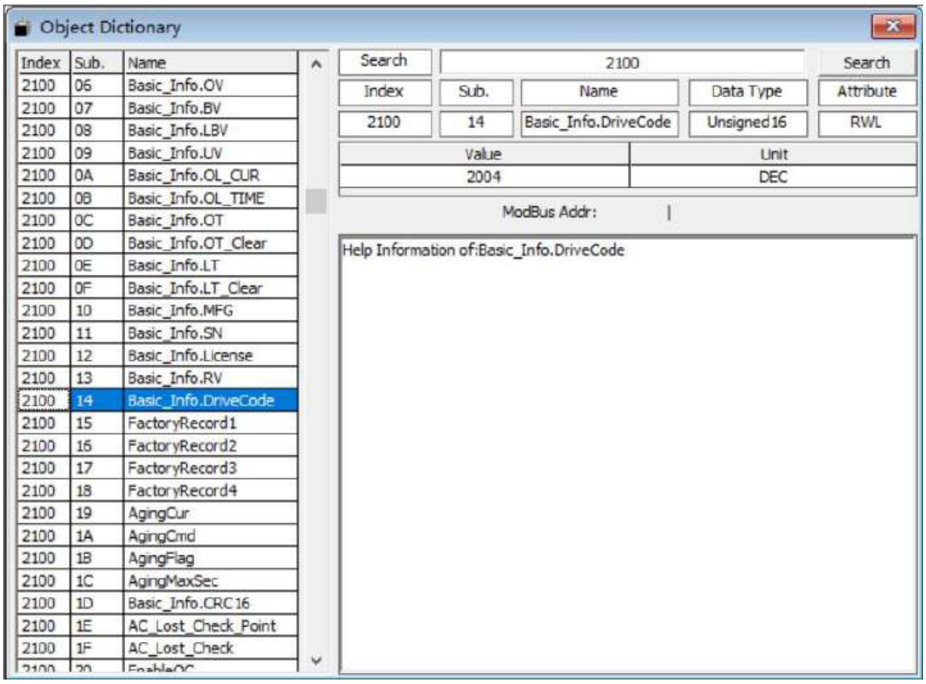
After updating the software version, an Er.6301 alarm (Memory Fault) may occur. Click 'Restart'  in the menu bar to resolve.

If the following status occurs after the update, a drive reset operation is required.

Search the object dictionary at address 2500h-10h for the manufacturer password, input the default code 13141314



Then, set the corresponding drive code 2100h-14h (e.g., CD200-T3R0 = 2004). Reboot the drive after configuration.



(2) Parameter configuration

1. Basic Parameter Settings

Access Parameter List:

Navigate to **Driver** → **Basic Operation** to open the list of commonly used configuration parameters.

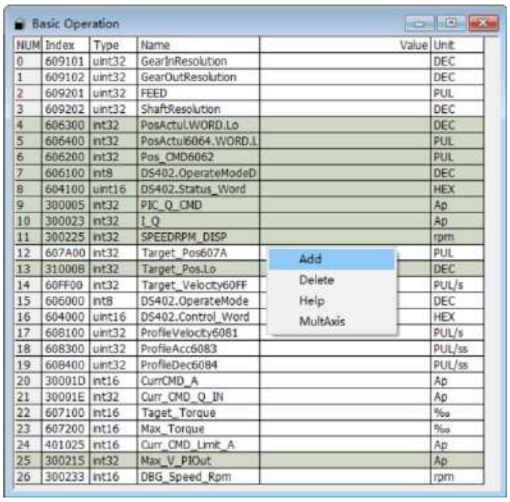
Add Parameters:

Right-click anywhere in the table → Select "Add" to open the Object Dictionary.

Choose the desired parameters and double-click to add them to the Basic Operation table.

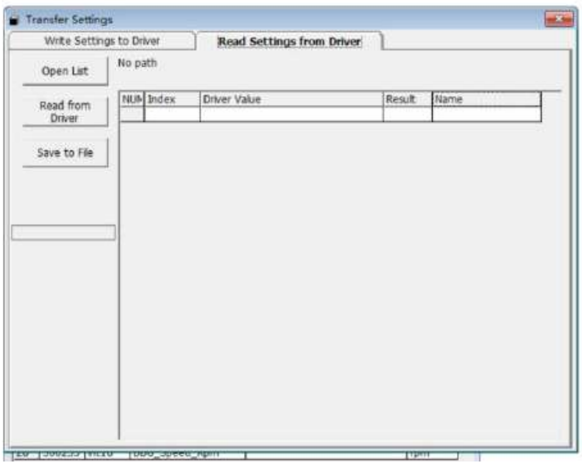
View Parameter Help:

Right-click on a parameter → Select "Help" to see detailed configuration instructions.



Batch Parameter Read/Write Function

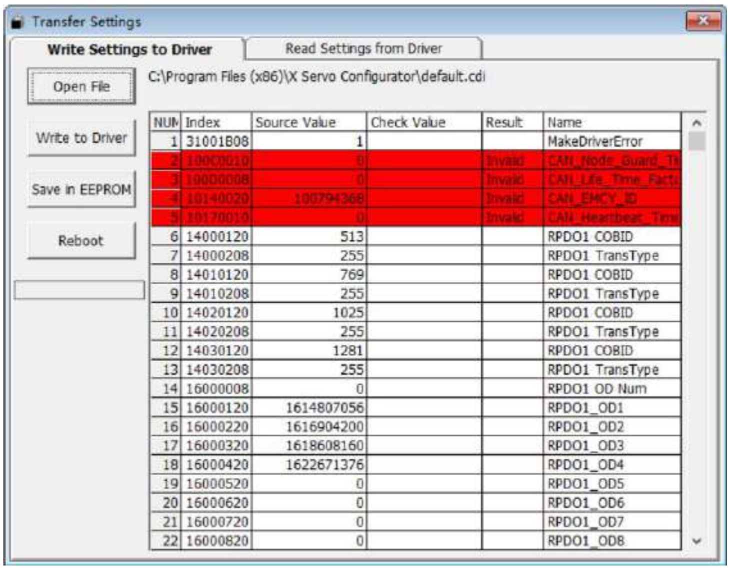
Click **Tools** → **Read/Write Drive Configuration**,or use the toolbar icons (**Read Parameters** / **Write Parameters**)



Click open list, select the "存储列表.cdo" file (C:\Program Files (x86)\X Servo Configurator)to load the drive parameter configuration list, then click "Read Data" to obtain the drive configuration parameters.

Click **Save File** to generate a **".cdi" file**. When you need to configure the same parameters to other drives, select **Write Drive Configuration**, open the saved file, and click **Write to Drive**. After successful writing, click **"Save Data to EEPROM"**, then click **Reboot** once to complete the data writing to the drive.

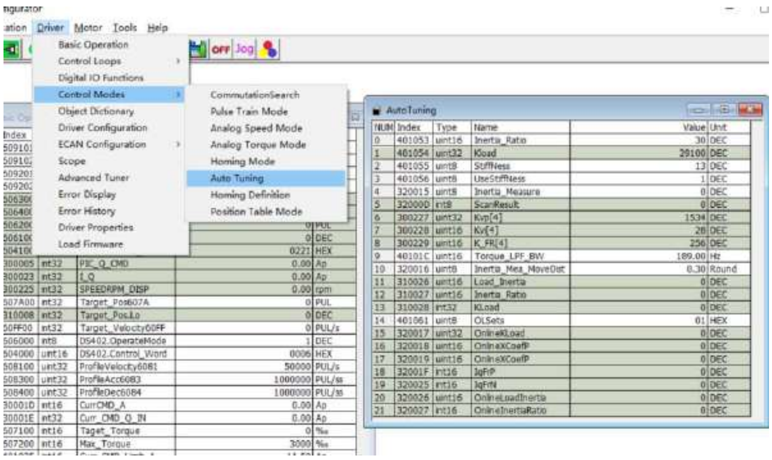
(Note: Parameters Marked in red are currently not supported by the drive and can be ignored.)



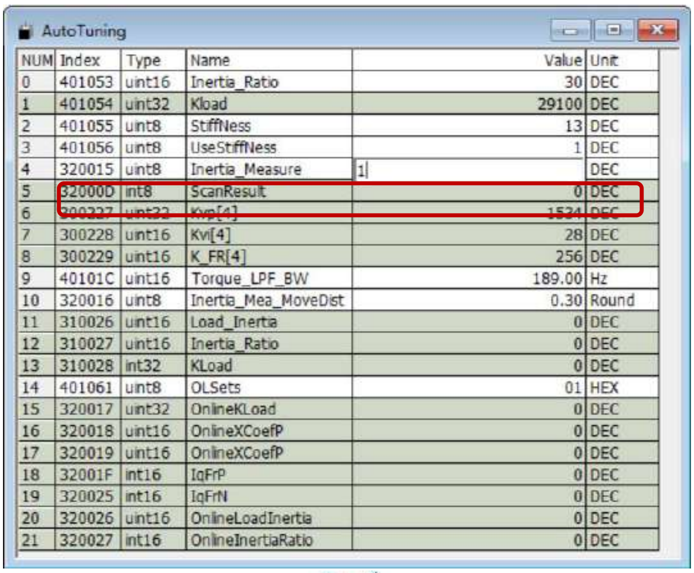
NUM	Index	Source Value	Check Value	Result	Name
1	31001B08	1			MakeDriverError
2	100C0010	0		Invalid	CAN_Node_Guard_Ti
3	100D0008	0		Invalid	CAN_Life_Time_Factr
4	10140020	100794368		Invalid	CAN_EMCY_ID
5	10170010	0		Invalid	CAN_Heartbeat_Time
6	14000120	513			RPDO1 COBID
7	14000208	255			RPDO1 TransType
8	14010120	769			RPDO1 COBID
9	14010208	255			RPDO1 TransType
10	14020120	1025			RPDO1 COBID
11	14020208	255			RPDO1 TransType
12	14030120	1281			RPDO1 COBID
13	14030208	255			RPDO1 TransType
14	16000008	0			RPDO1 OD Num
15	16000120	1614807056			RPDO1_OD1
16	16000220	1616904200			RPDO1_OD2
17	16000320	1618608160			RPDO1_OD3
18	16000420	1622671376			RPDO1_OD4
19	16000520	0			RPDO1_OD5
20	16000620	0			RPDO1_OD6
21	16000720	0			RPDO1_OD7
22	16000820	0			RPDO1_OD8

(3) Inertia Measurement

Click **Driver → Control Modes → Auto-Tuning** to open the motor parameter auto-tuning interface.

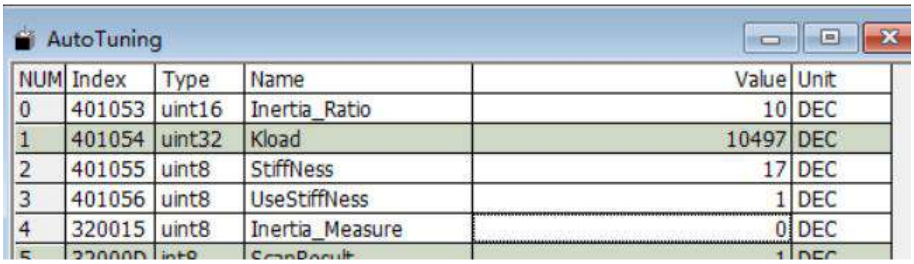


By default, the rigidity level is used. Enter '1' in the inertia_measure field and press Enter to start motor inertia identification."



NUM	Index	Type	Name	Value	Unit
0	401053	uint16	Inertia_Ratio	30	DEC
1	401054	uint32	Kload	29100	DEC
2	401055	uint8	StiffNess	13	DEC
3	401056	uint8	UseStiffNess	1	DEC
4	320015	uint8	Inertia_Measure	1	DEC
5	32000D	int8	ScanResult	0	DEC
6	300227	uint32	Kvp[4]	1534	DEC
7	300228	uint16	Kvi[4]	28	DEC
8	300229	uint16	K_FR[4]	256	DEC
9	40101C	uint16	Torque_LPF_BW	189.00	Hz
10	320016	uint8	Inertia_Mea_MoveDist	0.30	Round
11	310026	uint16	Load_Inertia	0	DEC
12	310027	uint16	Inertia_Ratio	0	DEC
13	310028	int32	KLoad	0	DEC
14	401061	uint8	OLSets	01	HEX
15	320017	uint32	OnlineKLoad	0	DEC
16	320018	uint16	OnlineXCoefP	0	DEC
17	320019	uint16	OnlineXCoefP	0	DEC
18	32001F	int16	IqFrP	0	DEC
19	320025	int16	IqFrN	0	DEC
20	320026	uint16	OnlineLoadInertia	0	DEC
21	320027	int16	OnlineInertiaRatio	0	DEC

After the measurement is completed, you may view parameters such as the current inertia ratio, torque inertia coefficient, and rigidity level.



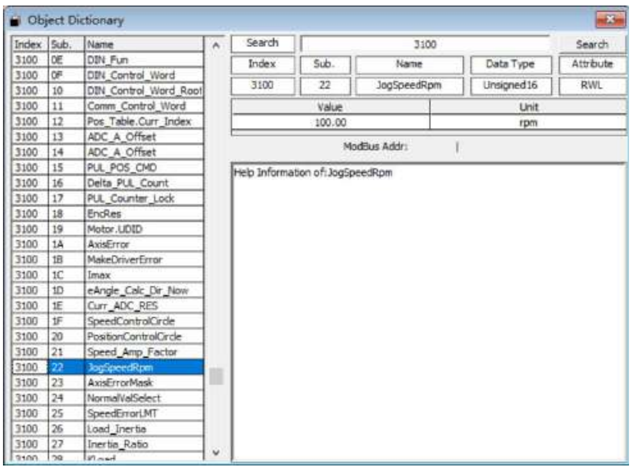
The measurement results are displayed in **Object 3200h-0Dh**.

No.	Index	Parameter Name	Set/Display Value
Pr6.06	*3200h-0Dh*	**Inertia Measurement Results**	***0:* Test not started or in progress** ***1:* Success (updates rigidity list)** ***-1:* Speed amplitude too small** ***-2:* Current amplitude too small** ***-3:* Inertia ratio exceeds 25:1** ***-4:* Inertia ratio exceeds 40:1**

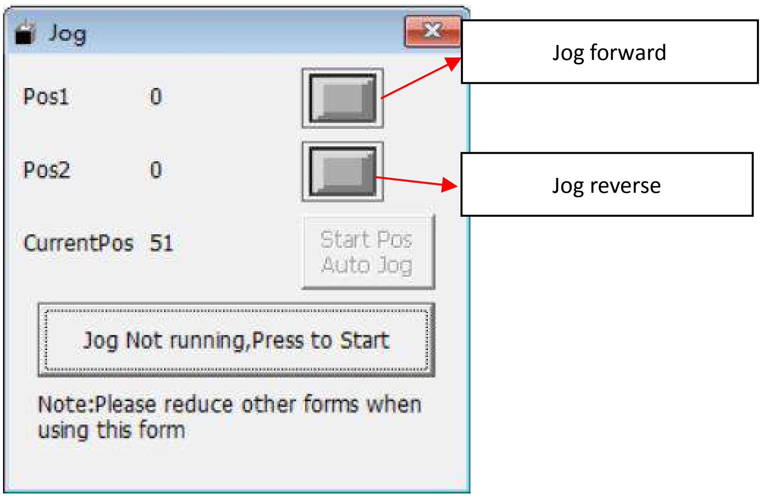
(4) Test Run in Jog Mode

Click the menu bar button  to open the Jog mode debugging interface.

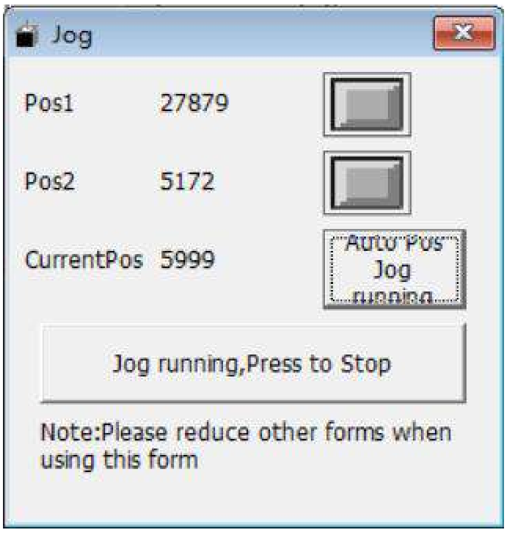
The default speed for Jog mode is set to 100 rpm. The Jog mode speed can be adjusted by modifying Object 3100h-22h.



Click "Jog not running, press to start" to enable Jog mode. Then, press the forward/reverse jog buttons to perform jog operation.



After both Position 1 and Position 2 data have been recorded, click the "Start Auto Jog" function to activate automatic reciprocating movement of the motor between the preset Position 1 and Position 2 range.



(5) Digital I/O Configuration

Click on **Driver** → **Digital IO functions** or click the shortcut toolbar button  to open the Digital IO Settings interface.

T Mode: This mode determines the form in which the input signal triggers. Options include **Low** (low-level trigger), **High** (high-level trigger), **Rise** (rising-edge trigger), and **Fall** (falling-edge trigger).

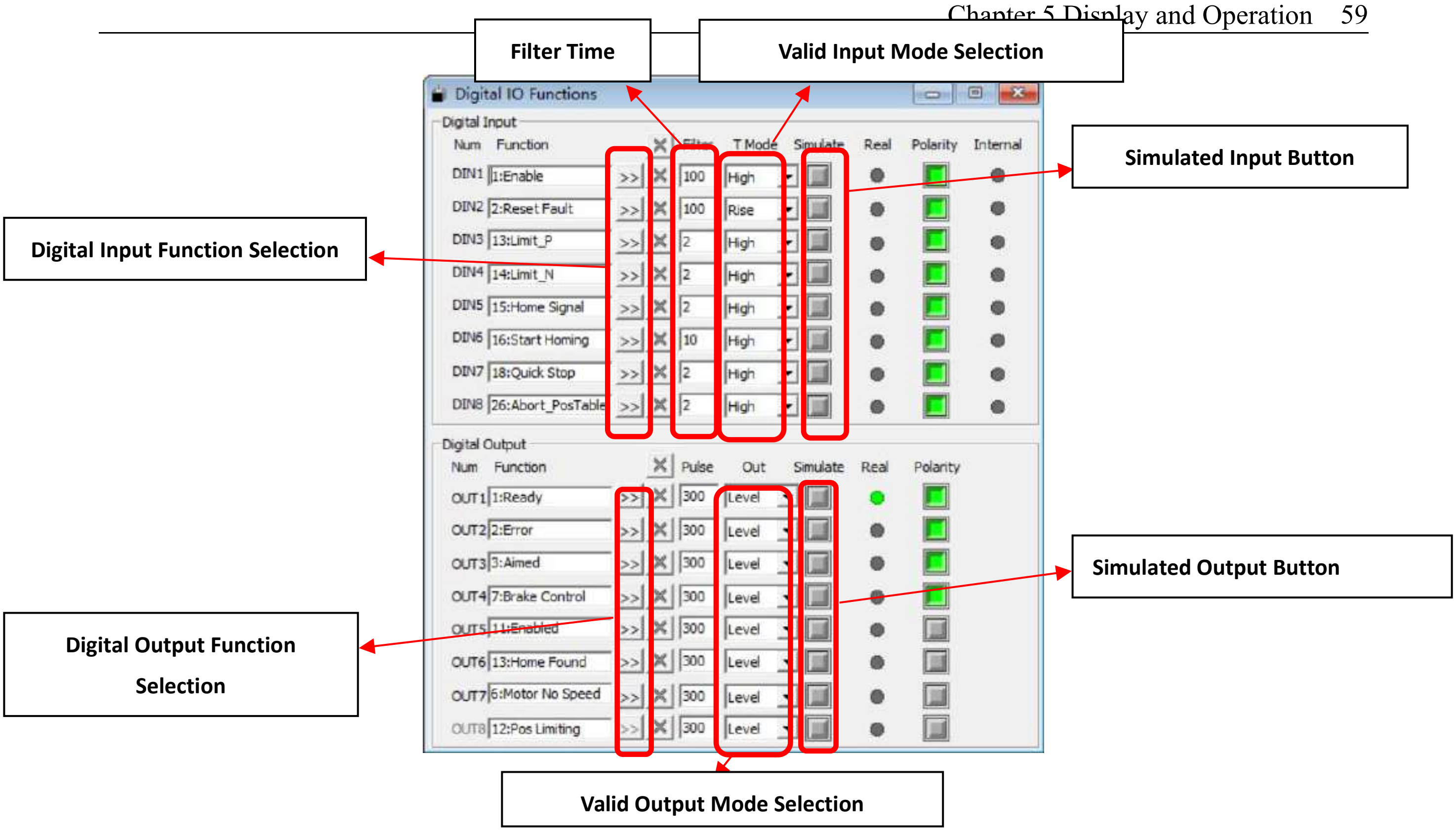
Actual Input: Displays the real-time input status.

Level: Controls the switching of active-level logic.

Valid Input: The result of the combined action of simulation, actual input, and polarity.

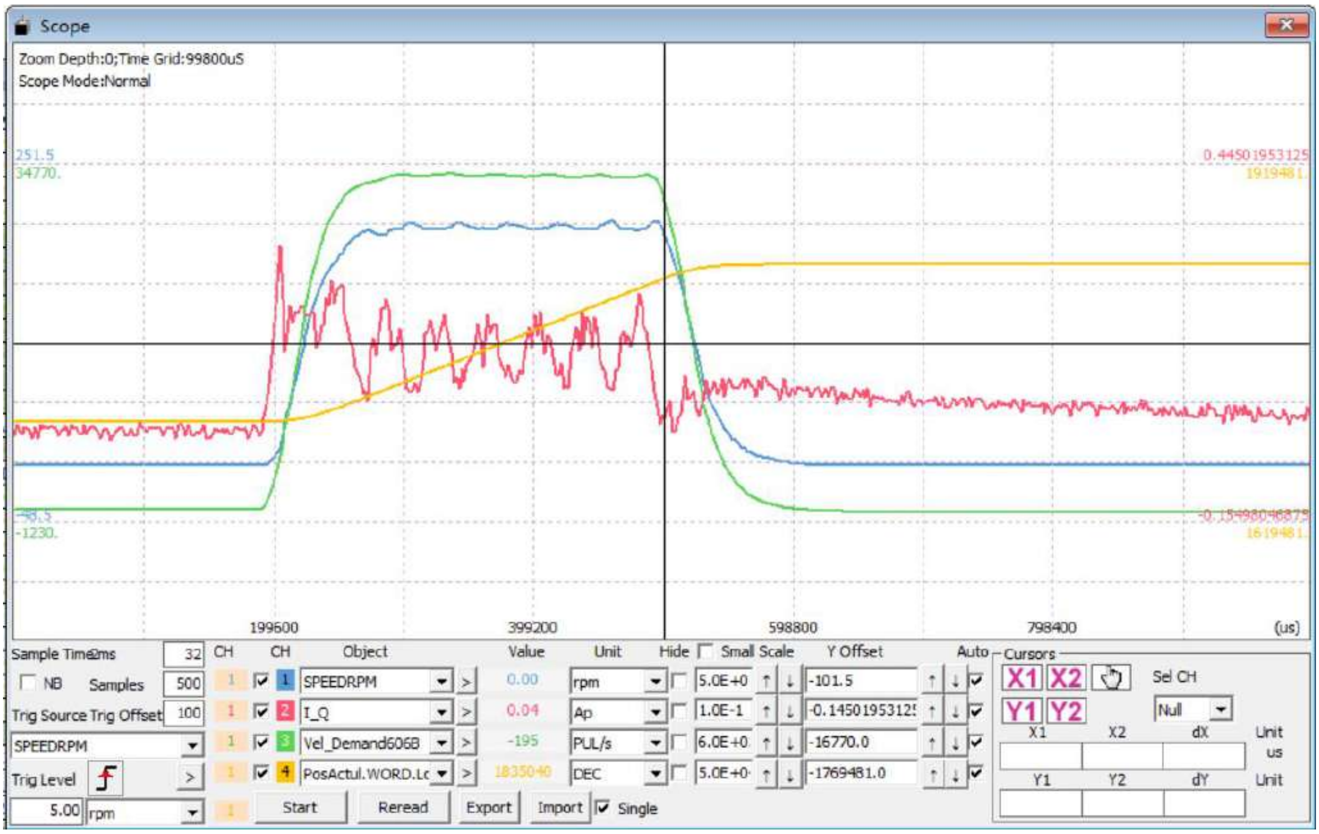
Indicates that the current state is **inactive** (logical state **0**).

Indicates that the current state is **active** (logical state **1**).



(6) Oscilloscope Function

Click Driver → Scope or click the **shortcut toolbar button**  to open the oscilloscope interface.



Sampling Configuration

Parameter	**Description**	**Example Value**
Sampling Period	Minimum sampling interval: 62.5μs (configurable in integer multiples)	62.5μs × 4 = 250μs
Sample Count	Total data points captured per trigger event	1024 points
Trigger Position	Number of pre-trigger samples collected before trigger activation	300 points

Trigger Configuration

Trigger Source: You can select common trigger sources from the dropdown menu, or click the ">" button to choose from the object dictionary.Like RPM Speed

Trigger Level: **Trigger Comparison Value Setting,like** 200 RPM

Trigger Edge:

 Rising Edge (Trigger when value exceeding 200 RPM)

 Falling Edge (Trigger when value **falls below** 200 RPM)

Note: Data acquisition initiates when trigger conditions are satisfied.

Multi-Channel Setup

- **Maximum Channels**: 4 simultaneous inputs
- **The total combined data width of all acquired signals must not exceed 64 bits, with a maximum of 32-bit data type per individual channel.**

You can select common trigger sources from the dropdown menu, or click the ">" button to choose from the object dictionary.

Acquisition Modes

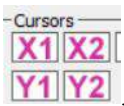
Mode	**Functionality**
	One-time capture per trigger
	Repeated capture while conditions persist

Display Controls

Zoom Functions:

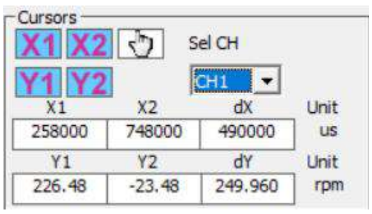
Zoom Out: Right-click + drag upper-left

Zoom In: Right-click + drag lower-right

Cursor: Select the desired cursor by clicking 

.

Move the cursor： Move the mouse close to the cursor—when it turns red, hold down the left mouse button to drag it. The cursor measurement data is displayed as follows.



Waveform Movement

Click and drag  to horizontally scroll the zoomed-in waveform.

Export/Import

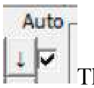
Export: Save sampled data as a **.scope** file.

Import: Load a **.scope** file to display its waveform.

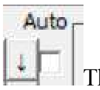
Reload Data

Read the most recently collected data from the drive and regenerate the waveform for display.

Auto Mode



The oscilloscope automatically adjusts the scale and offset for optimal waveform display.

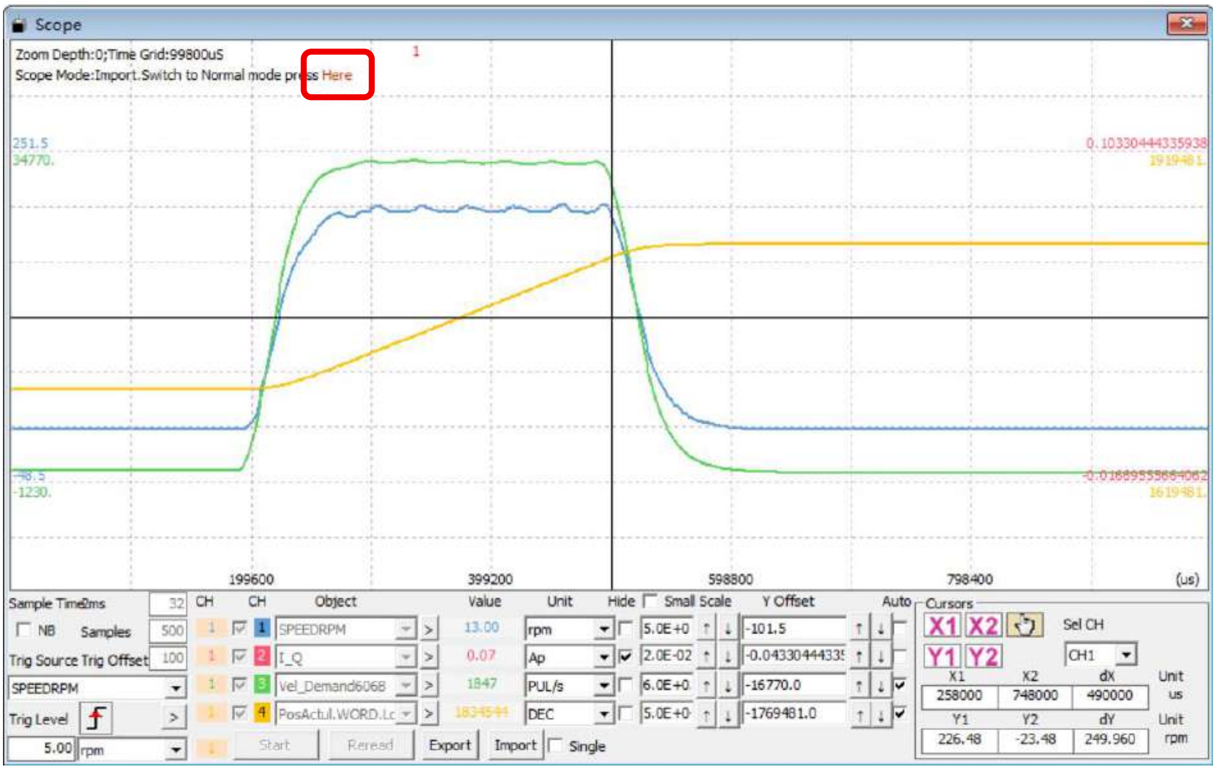


The waveform is displayed with fine scaling and follows the manually set Y-axis offset range.

Oscilloscope Mode

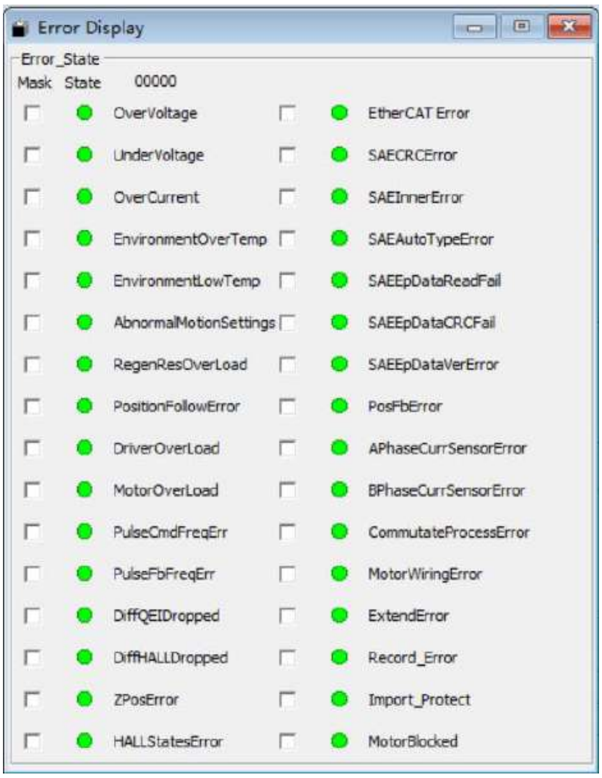
Import Mode (left diagram):

The oscilloscope is in read-only mode (displaying an imported waveform).Functional buttons are disabled.Click **"Here"** to return to **Normal Mode**.

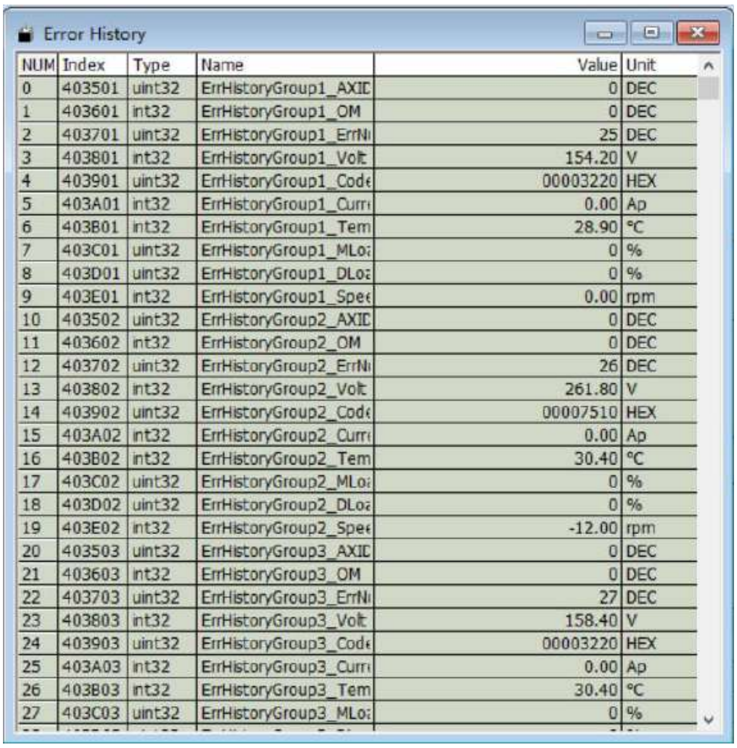


(7) Fault Display

Click **Driver → Error Display**, or select the Error Display button on the Quick Access Toolbar to open the Error Display interface (as shown below). The displayed error messages can be used to diagnose and resolve faults.



Click **Driver→ Error history** to view the most recent 8 fault records. A higher recorded fault count value indicates a more recent occurrence time.

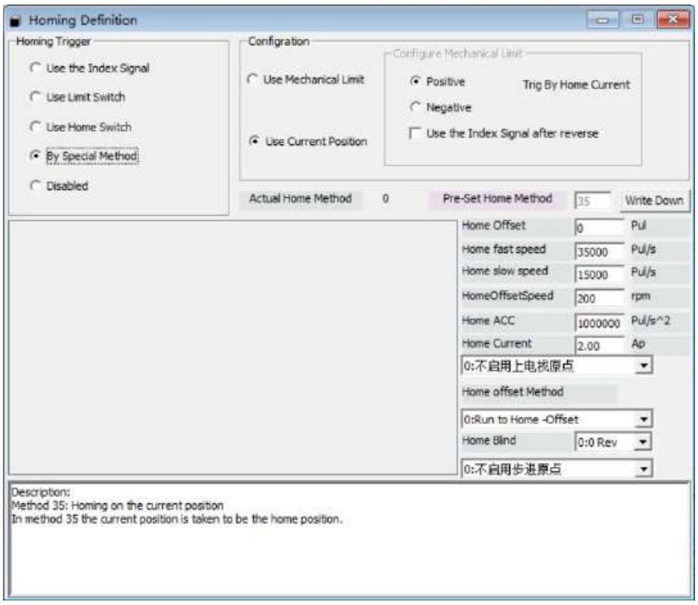

Error History

NUM	Index	Type	Name	Value	Unit
0	403501	uint32	ErrHistoryGroup1_AXID	0	DEC
1	403601	int32	ErrHistoryGroup1_OM	0	DEC
2	403701	uint32	ErrHistoryGroup1_ErrNı	25	DEC
3	403801	int32	ErrHistoryGroup1_Volt	154.20	V
4	403901	uint32	ErrHistoryGroup1_Code	00003220	HEX
5	403A01	int32	ErrHistoryGroup1_Curr	0.00	Ap
6	403B01	int32	ErrHistoryGroup1_Tem	28.90	℃
7	403C01	uint32	ErrHistoryGroup1_MLoa	0	%
8	403D01	uint32	ErrHistoryGroup1_DLoa	0	%
9	403E01	int32	ErrHistoryGroup1_Spee	0.00	rpm
10	403502	uint32	ErrHistoryGroup2_AXID	0	DEC
11	403602	int32	ErrHistoryGroup2_OM	0	DEC
12	403702	uint32	ErrHistoryGroup2_ErrNı	26	DEC
13	403802	int32	ErrHistoryGroup2_Volt	261.80	V
14	403902	uint32	ErrHistoryGroup2_Code	00007510	HEX
15	403A02	int32	ErrHistoryGroup2_Curr	0.00	Ap
16	403B02	int32	ErrHistoryGroup2_Tem	30.40	℃
17	403C02	uint32	ErrHistoryGroup2_MLoa	0	%
18	403D02	uint32	ErrHistoryGroup2_DLoa	0	%
19	403E02	int32	ErrHistoryGroup2_Spee	-12.00	rpm
20	403503	uint32	ErrHistoryGroup3_AXID	0	DEC
21	403603	int32	ErrHistoryGroup3_OM	0	DEC
22	403703	uint32	ErrHistoryGroup3_ErrNı	27	DEC
23	403803	int32	ErrHistoryGroup3_Volt	158.40	V
24	403903	uint32	ErrHistoryGroup3_Code	00003220	HEX
25	403A03	int32	ErrHistoryGroup3_Curr	0.00	Ap
26	403B03	int32	ErrHistoryGroup3_Tem	30.40	℃
27	403C03	uint32	ErrHistoryGroup3_MLoa	0	%

(8) Homing Mode Configuration

Click Driver → Control Modes → Homing Definition, configure encoder index signals, home switches, and limit switches as needed for homing triggers and reference signals.

For detailed application methods, see **Section 8.3.7: Home Mode (HM)** in the manual.



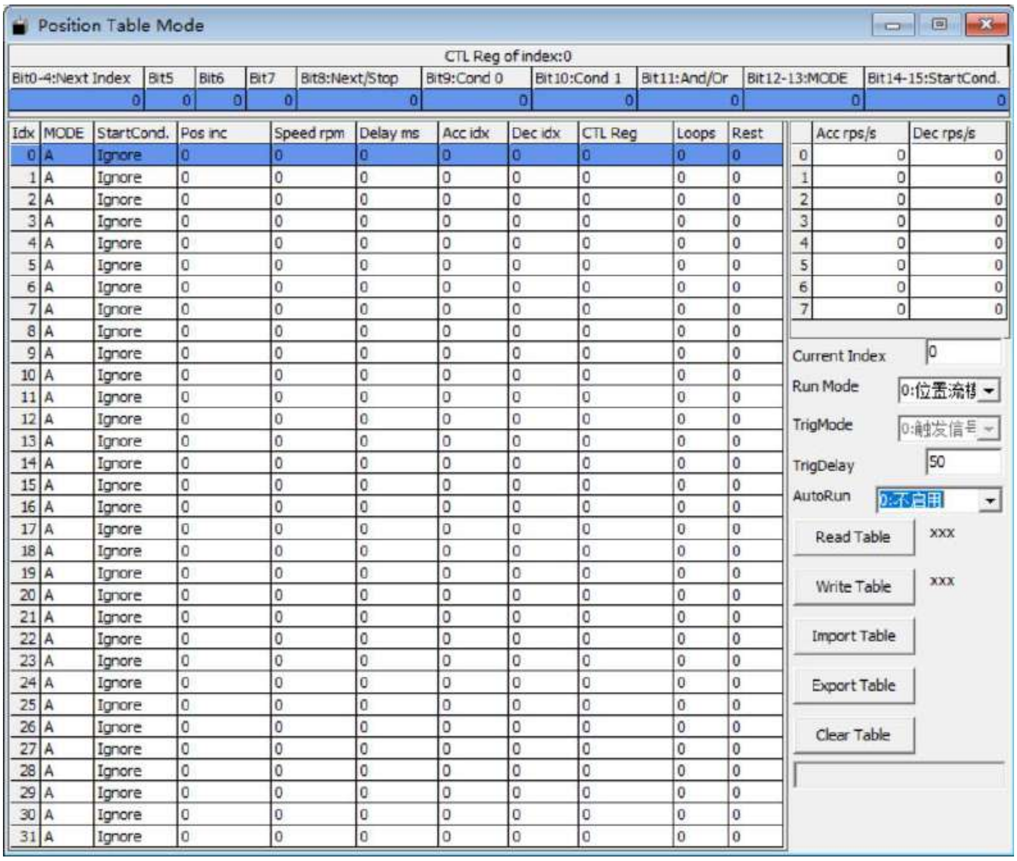
Related Parameters:

No.	Index	Parameter Name	Set/Display Value	Unit	*Type*	Validation
Pr9.01	**607C00**	**Homing offset**	**This parameter allows the alignment of the final origin position with the physical signal trigger point by applying a programmable displacement value**	**PUL**	**S32**	**Immediate**
Pr9.03	**609901**	**Homing *Retract Speed***	**A high-speed motion phase during homing operations, used for coarse origin search.**	**PUL/s**	**U32**	**Immediate**
Pr9.04	**609902**	**Homing Approach Speed**	**A low-speed motion phase for precise origin positioning**	**PUL/s**	**U32**	**Immediate**
Pr9.05	**609903**	**Automatic Homing**	***0:* Disabled** ***1:* On Power-Up** ***2:* On Origin Loss**		**U8**	**Reboot**
Pr9.06	**609A00**	**Homing Acceleration**	**The acceleration/deceleration rate applied during homing search motions**	**rpss**	**U32**	**Immediate**
Pr9.07	**609904**	**Homing Current Limit**	**The maximum motor current allowed during mechanical limit-based origin searches**	**0.1A**	**U16**	**Immediate**
Pr9.08	**609905**	**Homing Offset Mode**	***0*：Move to the offset position, then zero the position** ***1*：Do not move; directly set the current position as negative offset**		**U8**	**Immediate**
Pr9.10	***609907***	**Homing Offset Positioning Speed**	**The controlled velocity used when moving to the origin offset position during homing**	**rpm**	**U16**	**Immediate**

(9) Position Table Mode

click **Driver → Control Modes → Position Table Mode** to open the Position Table Mode interface.

(Note: Position Stream Mode and I/O Position Mode require Profile Position Mode as the base, while I/O Velocity Mode requires Profile Velocity Mode.)



Position Table Mode is a function designed for position control, allowing the execution of up to 32 independent tasks in this mode.

Each task contains multiple key parameter settings, such as target position, operating speed, acceleration, and deceleration. Additionally, tasks include configurations such as whether to proceed to the next task upon completion, the index value of the next task, the trigger condition for executing the next task, and the maximum number of task cycles.

To use this function, users must first configure the "Enable Position Table" signal and the index signal at the input ports to ensure the Position Table Mode can start and execute properly. Beyond this, other position table-related functions in the system can be flexibly defined based on specific application requirements to meet different control and task demands.

This highly configurable approach ensures tasks are executed efficiently according to predefined parameters and conditions, while also providing extensive customization capabilities for complex motion control applications.

Control Register Settings

Bits 0-4: **Next Task** – Defines which task will execute after the current task completes.

Bits 5-7: **Reserved**, undefined.

Bit 8: **Continue/Stop**

1: Proceed to the next task (if **Bits 9-11** are all **1** and the cycle count is not reached).

0: Stop after the current task completes.

Bit 9: **Condition 0 Control**

1: Condition 0 is active.

0: Condition 0 is inactive.

Bit 10: **Condition 1 Control**

1: Condition 1 is active.

0: Condition 1 is inactive.

Bit 11: **Condition 0 & 1 Logic**

1: The next task index proceeds **only if both Condition 0 and Condition 1 are met**.

0: The next task index proceeds **if either Condition 0 or Condition 1 is met**.

Special Cases:

If **either Condition 0 or 1 is inactive**, Bit 11 is ignored.

If **both are inactive**, the position table runs **without condition restrictions**.

If **only Condition 0 is active**, the task loops while Condition 0 (I/O trigger) remains active.

If **only Condition 1 is active**, the task runs **only once** when Condition 1 is met.

Bits 12-13: **Positioning Mode**

0:(Mode A): **Absolute Position** – The set value is the target absolute position.

1:(ModeRN): **Relative to Target** – The set value is the offset from the current **target** position.

2:(ModeRA): **Relative to Actual** – The set value is the offset from the current **actual** position.

Bits 14-15: **Task Trigger Behavior**

When the **"Enable Position Table"** signal is triggered:

If no task is running: Bits 14-15 are ignored.

If a task is running:

0: **Ignore new task**, continue current task.

1: **Execute new task immediately after current task completes**.

2: **Interrupt current task and execute new task immediately**.

Position Table Parameters

Index (Idx): Task index range (**0–31**).

Position (inc): Target position (incremental/absolute based on mode).

Speed (rpm): Velocity to reach the target position.

Delay (ms): Time delay before jumping to the next task (controls task transition timing).

Acc Index & Dec Index: Acceleration/deceleration profile indices (supports 8 predefined profiles, configurable in the interface).

	Acc rps/s	Dec rps/s
0	10	10
1	20	20
2	30	30
3	40	40
4	50	50
5	60	60
6	70	70
7	80	80

Loop: The loop function defines cycle limits for tasks.

0：indicates infinite looping.

1： ≥1 means the position table will stop when either the current task's cycle count or the next index's cycle count reaches the set value.

Remaining Cycles:

When the loop is set to **0**, the remaining execution count is invalid.

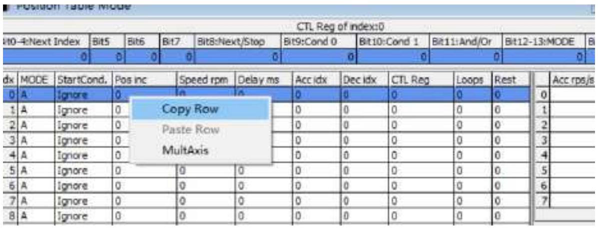
When the position table starts, it loads the preset cycle count. Each task execution decrements the remaining count by 1. Execution stops when the count reaches **0**.

Copy/Paste:

Position table task information can be copied to another row.

Right-click the source task row and select **"Copy Row"**.

Select the target row, then click **"Paste Row"**.



Current Index: Indicates the currently executing indexed task.

RUN Mode:

0：**Position Stream Mode**: Operates according to the conditions and parameters set in the position table mode.

1：**I/O Position Mode**:

Only relates to Position (inc), Speed (rpm), Delay (ms), and acceleration/deceleration.

Position (inc) determines the movement direction.

Speed (rpm) sets the operating speed.

Delay (ms) controls the duration of operation.

Note: I/O Position Mode only takes effect when the operating mode is set to 1（PP）.

2:I/O Speed Mode:

Only relates to Speed (rpm), Delay (ms), and acceleration/deceleration.

Speed (rpm) determines both the operating speed and direction.

Delay (ms) sets the duration of operation.

Note: I/O Speed Mode only functions when the operating mode is 3.(PV)

Trigger Mode:

(Note: Trigger mode can only be modified when the operation mode is set to 1：I/O Position or 2： I/O Speed)

0:Signal Trigger: The position table operation is triggered by I/O input signals

1:Time Trigger: The operation is triggered after a specified delay

(Note: When using time trigger, set "Delay (ms)" to 0)

Trigger Delay:Only Validation when trigger mode is set to Time Trigger

Auto Run:

0: Auto run disabled

1: Automatically execute position table on power-up

2: Automatically execute position table after fault clearance

3: Automatically execute homing then run position table after power-up

Configuration Operations:

Read Table: Load position table data from drive to the configuration window

Write Table: Save position table data from window to the drive

Import Table: Import existing .pft file to the position table window

Export Table: Export current position table data as .pft file

Clear Table: Erase all data in the position table window

5.3 Quick Start for CD300E Servo Drive

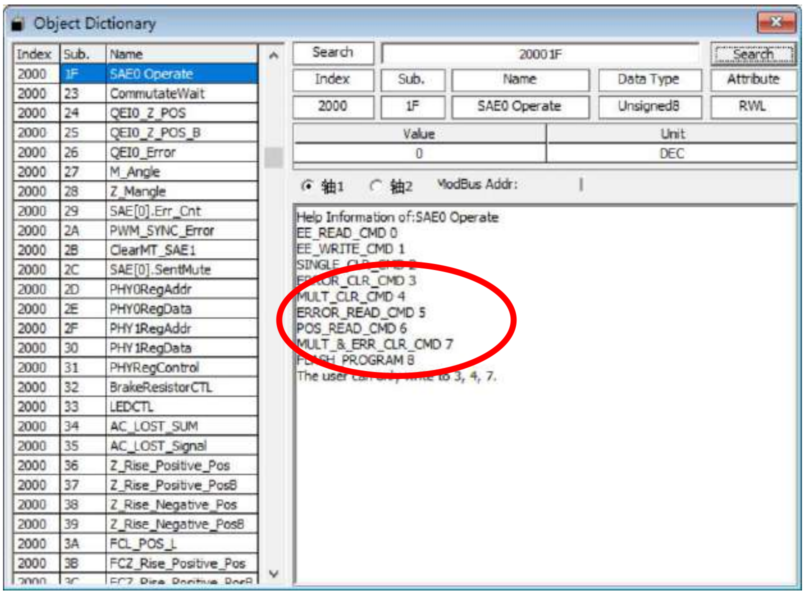
5.3.1 Drive Initialization Operation

If error "Er.FF02: multi-turn encoder data anomaly" appears after connection, you need to perform an encoder reset operation.

Reset method:

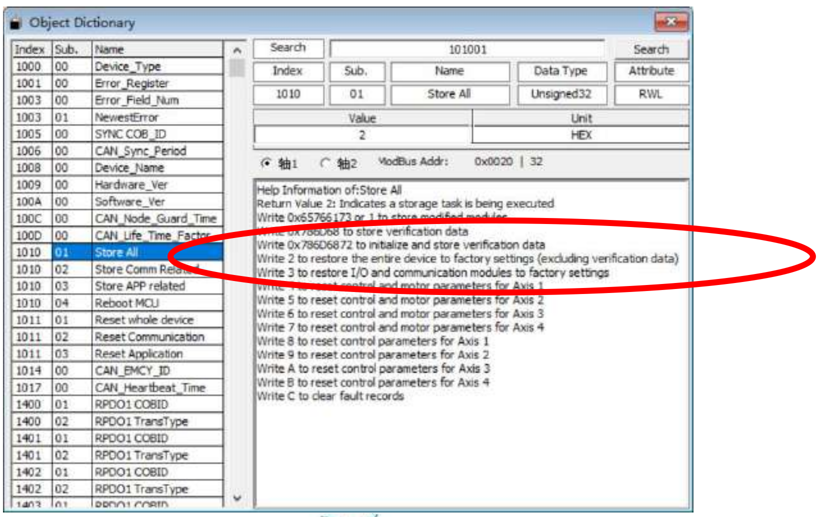
Open the object dictionary, search for SAE0 operation or 2000 1F, then enter the corresponding value in the "Value" field and press Enter to confirm.

Eg. Write 3 can clear the encoder error.



Then reboot the drive.

If other alarms occur, try writing "2" to parameter 1010 01 to restore factory settings and clear the alarms.



5.3.2 Set the Basic Parameters

(1) Electronic Gear Ratio (Feed Rate) Setting

For CD300/CD200 Servo System, the feed rate (electronic gear ratio) defines the command pulses per motor revolution.

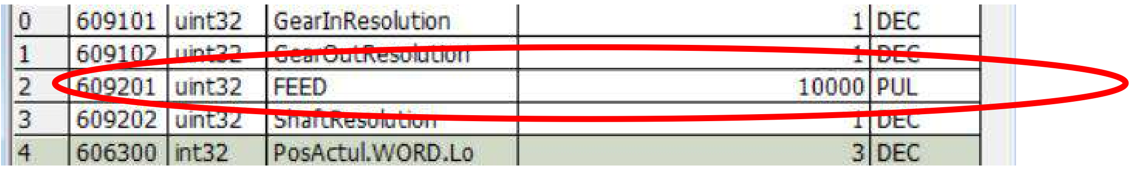
The **feed (6092-01h)** must match the **pulses/rev sent by the controller.**

Configuration Rules:

If the controller sends:

131,072 pulses/rev (17-bit: **2^17**) → Write **131072** to **6092-01h**.

8,388,608 pulses/rev (23-bit: **2^23**) → Write **8388608** to **6092-01h**.



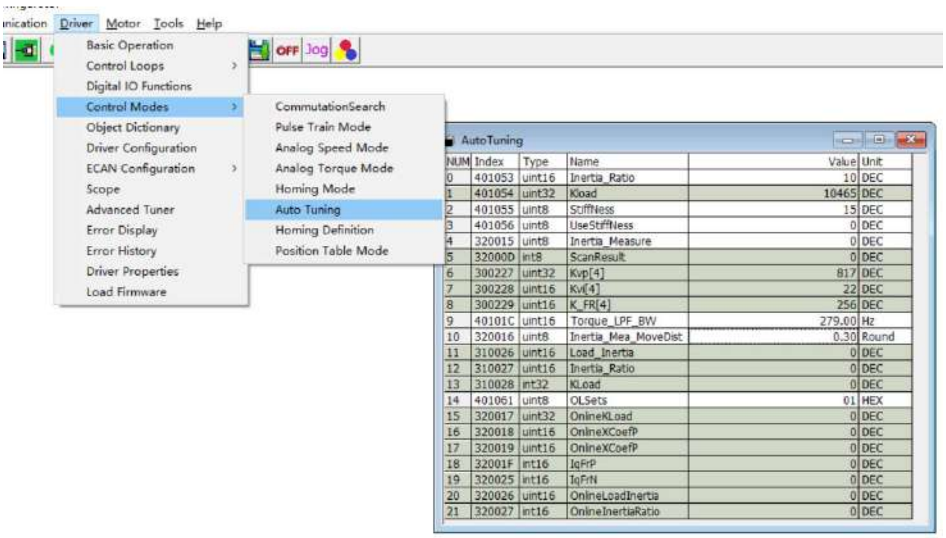
0	609101	uint32	GearInResolution	1	DEC
1	609102	uint32	GearOutResolution	1	DEC
2	609201	uint32	FEED	10000	PUL
3	609202	uint32	ShaftResolution	1	DEC
4	606300	int32	PosActul.WORD.Lo	3	DEC

The value "10000" in the figure above means the drive receives 10,000 command units per revolution of the motor shaft.

(2) Inertia Identification

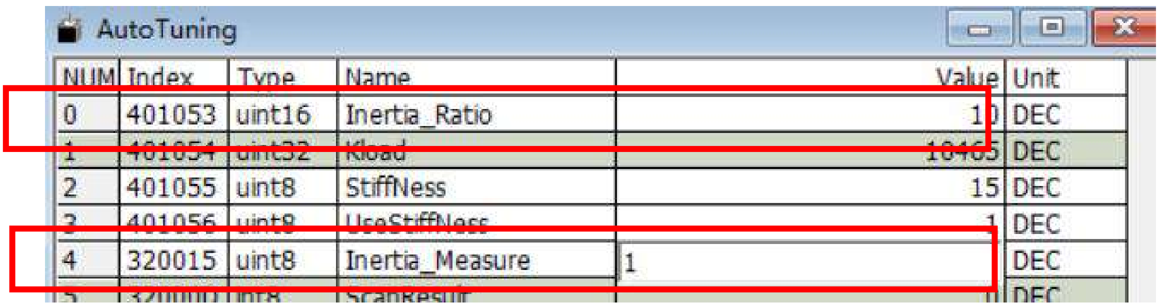
After setting the feed rate (electronic gear ratio), perform auto-tuning for inertia identification:

Click **Driver→ Control Modes→ Auto-Tuning**



NUM	Index	Type	Name	Value	Unit
0	401053	uint16	Inertia_Ratio	10	DEC
1	401054	uint32	Kload	10465	DEC
2	401055	uint8	StiffNess	15	DEC
3	401056	uint8	UseStiffNess	0	DEC
4	320015	uint8	Inertia_Measure	0	DEC
5	32000D	int8	ScanResult	0	DEC
6	300227	uint32	Kvp[4]	817	DEC
7	300228	uint16	Kvi[4]	22	DEC
8	300229	uint16	K_FR[4]	256	DEC
9	40101C	uint16	Torque_LPF_BW	279.00	Hz
10	320016	uint8	Inertia_Mea_MoveDist	0.30	Round
11	310026	uint16	Load_Inertia	0	DEC
12	310027	uint16	Inertia_Ratio	0	DEC
13	310028	int32	KLoad	0	DEC
14	401061	uint8	OLSets	01	HEX
15	320017	uint32	OnlineKLoad	0	DEC
16	320018	uint16	OnlineXCoefP	0	DEC
17	320019	uint16	OnlineXCoefP	0	DEC
18	32001F	int16	IqFrP	0	DEC
19	320025	int16	IqFrN	0	DEC
20	320026	uint16	OnlineLoadInertia	0	DEC
21	320027	int16	OnlineInertiaRatio	0	DEC

Auto-tuning primarily involves setting two parameters: **Stiffness Level** and **Inertia Identification**. By default, the Stiffness Level is used. When initiating Inertia Identification, the corresponding Stiffness Level will be automatically matched—for most applications, this auto-matched value is usually suitable.



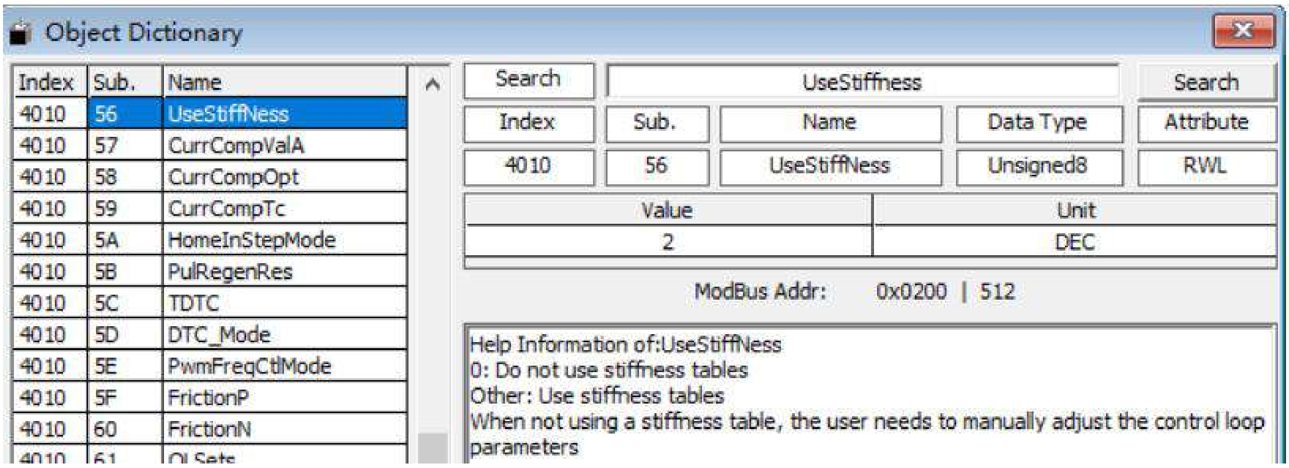
NUM	Index	Type	Name	Value	Unit
0	401053	uint16	Inertia_Ratio	10	DEC
1	401054	uint32	Kload	10465	DEC
2	401055	uint8	StiffNess	15	DEC
3	401056	uint8	UseStiffNess	1	DEC
4	320015	uint8	Inertia_Measure	1	DEC
5	32000D	int8	ScanResult	0	DEC

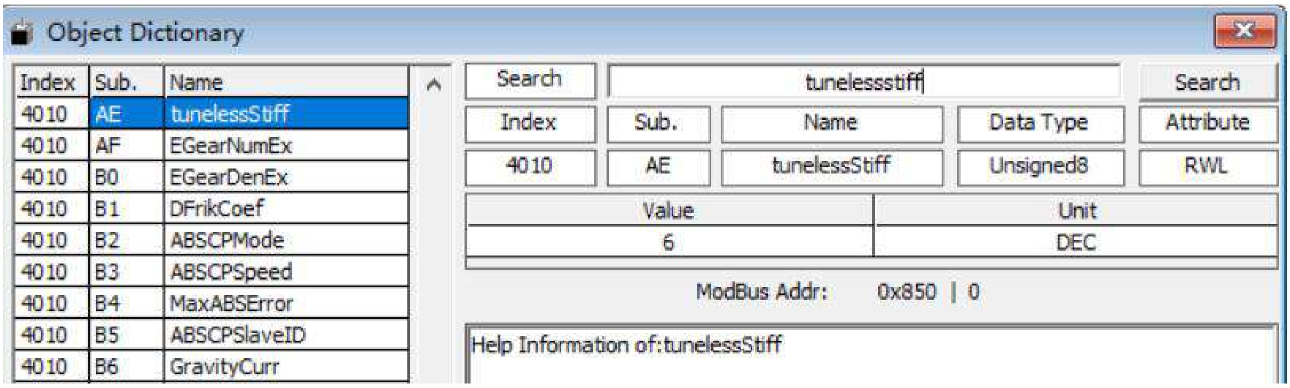
The Stiffness Level is a set of control loop parameters based on empirical values. After the Stiffness Level is matched, you must **manually re-enter the value and press Enter** to confirm and activate it. Once the identification is complete, check that the **Inertia Ratio** value has changed accordingly.

For general applications, after the auto-matching of stiffness level is completed, you may incrementally increase the stiffness level step by step (the motor will begin to vibrate when exceeding optimal stiffness, at which point you should reduce the level). If satisfactory performance is achieved after a few increments, no further manual adjustment of control loop parameters is required.

(3) Adjustment-free function

Through real-time command reconstruction and dynamic compensation, it effectively eliminates jitter and jerk during motion, ensuring smooth operation across the entire speed range from low to high, and significantly improving the machining and control accuracy of the equipment. When the adjustment-free function is enabled, it automatically identifies load characteristics, and parameter optimization can be completed with simple settings using just two parameters – rigidity level and adjustment-free level – eliminating complex manual tuning. It also actively identifies and suppresses mechanical resonance, reduces operational vibration, and greatly enhances system stability. Even when the load inertia is 30 times greater than that of the motor, it can be easily adapted, making commissioning simple and efficient.



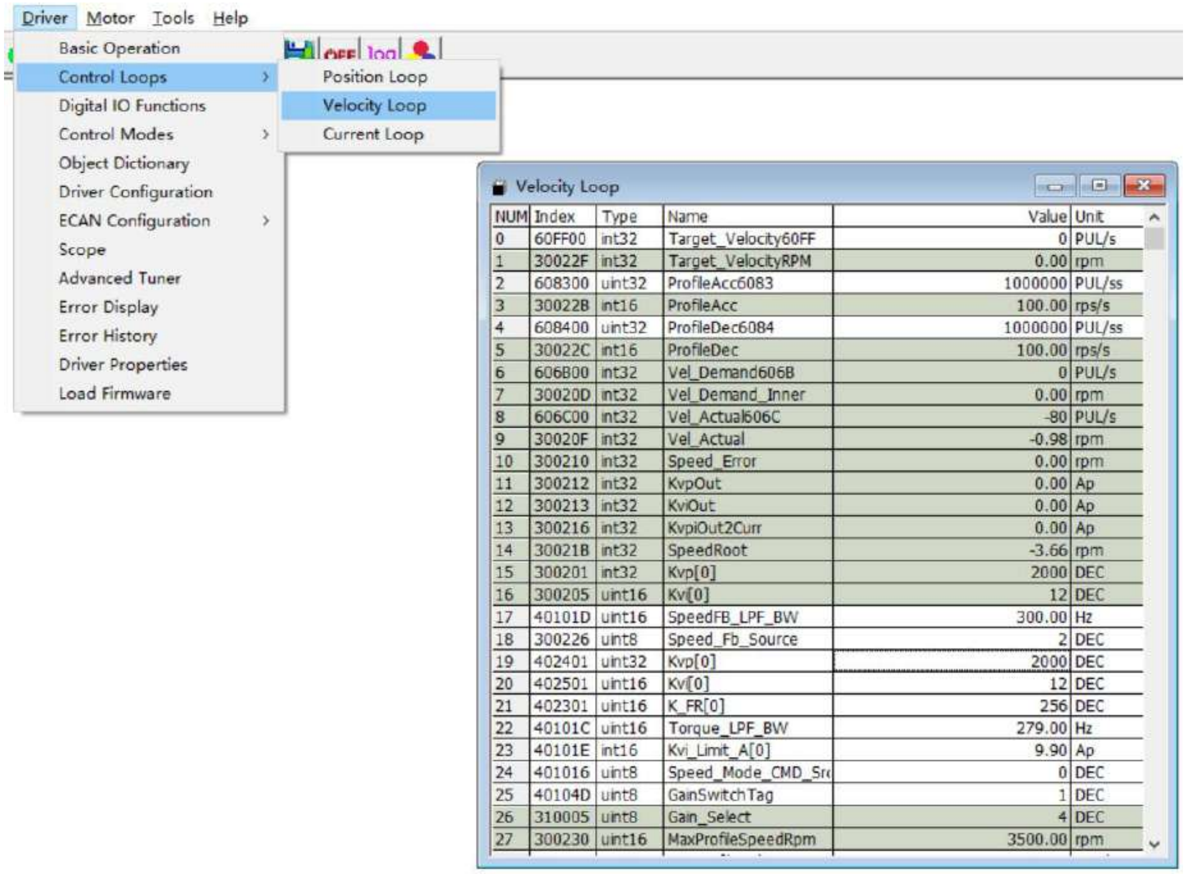


Using rigidity level settings 2, 3, or 4 to enable the adjustment-free function, the system can automatically accommodate complex mechanical systems with varying rigidity and inertia. The settings 2, 3, and 4 correspond to relatively high, high, and very high adjustment-free response levels, respectively. It is necessary to comprehensively consider factors such as inertia matching, mechanical rigidity, and external disturbances when selecting the appropriate adjustment-free mode and adjustment-free level. The adjustment-free level can be set from 1 to 12, corresponding to position loop response from low to high.

(4**) Manual Gain Tuning Procedure**

However, if the automatically matched stiffness level fails to meet control requirements, manual adjustment of the control loop parameters becomes necessary. When manually configuring these parameters, you must first set the UseStiffLevel parameter (401056)to 0 (to disable automatic stiffness control).

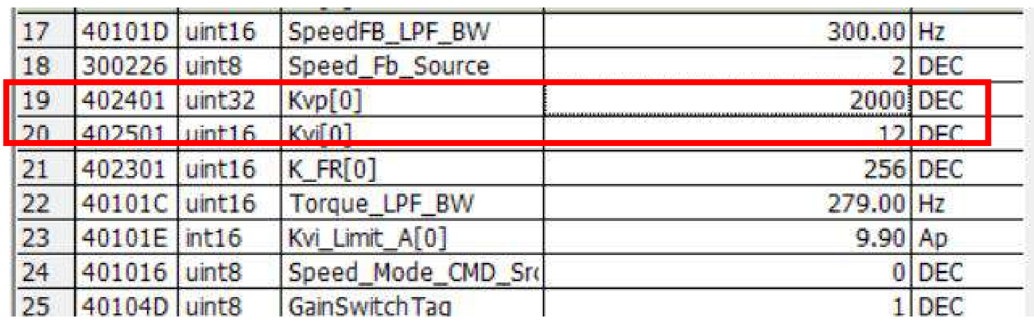
First, attempt to configure the speed loop parameters to enhance speed loop response.



NUM	Index	Type	Name	Value	Unit
0	60FF00	int32	Target_Velocity60FF	0	PUL/s
1	30022F	int32	Target_VelocityRPM	0.00	rpm
2	608300	uint32	ProfileAcc6083	1000000	PUL/ss
3	30022B	int16	ProfileAcc	100.00	rps/s
4	608400	uint32	ProfileDec6084	1000000	PUL/ss
5	30022C	int16	ProfileDec	100.00	rps/s
6	606B00	int32	Vel_Demand606B	0	PUL/s
7	30020D	int32	Vel_Demand_Inner	0.00	rpm
8	606C00	int32	Vel_Actual606C	-80	PUL/s
9	30020F	int32	Vel_Actual	-0.98	rpm
10	300210	int32	Speed_Error	0.00	rpm
11	300212	int32	KvpOut	0.00	Ap
12	300213	int32	KviOut	0.00	Ap
13	300216	int32	KvpiOut2Curr	0.00	Ap
14	30021B	int32	SpeedRoot	-3.66	rpm
15	300201	int32	Kvp[0]	2000	DEC
16	300205	uint16	Kvi[0]	12	DEC
17	40101D	uint16	SpeedFB_LPF_BW	300.00	Hz
18	300226	uint8	Speed_Fb_Source	2	DEC
19	402401	uint32	Kvp[0]	2000	DEC
20	402501	uint16	Kvi[0]	12	DEC
21	402301	uint16	K_FR[0]	256	DEC
22	40101C	uint16	Torque_LPF_BW	279.00	Hz
23	40101E	int16	Kvi_Limit_A[0]	9.90	Ap
24	401016	uint8	Speed_Mode_CMD_Sr	0	DEC
25	40104D	uint8	GainSwitchTag	1	DEC
26	310005	uint8	Gain_Select	4	DEC
27	300230	uint16	MaxProfileSpeedRpm	3500.00	rpm

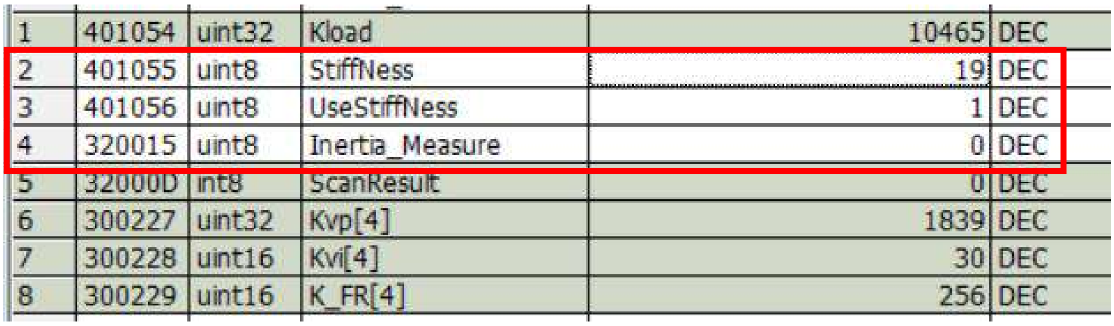
Initially set the speed loop integral gain (Ki,402501) to a relatively small value, such as 2. Then gradually increase the speed loop proportional gain (Kp,402401) until either:

1. The system response meets requirements, OR
2. Mechanical vibration occurs (at which point slightly reduce the gain)"



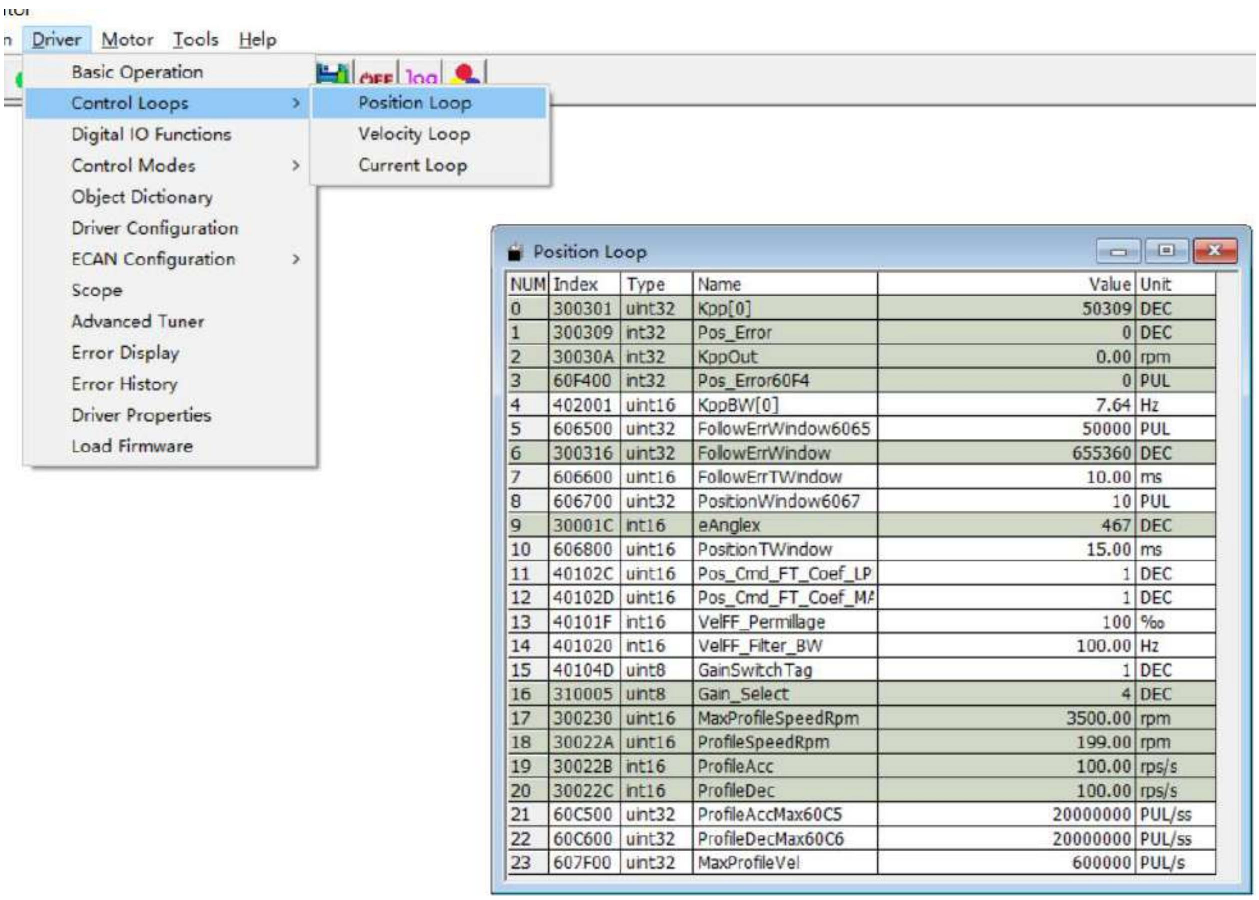
17	40101D	uint16	SpeedFB_LPF_BW	300.00	Hz
18	300226	uint8	Speed_Fb_Source	2	DEC
19	402401	uint32	Kvp[0]	2000	DEC
20	402501	uint16	Kvi[0]	12	DEC
21	402301	uint16	K_FR[0]	256	DEC
22	40101C	uint16	Torque_LPF_BW	279.00	Hz
23	40101E	int16	Kvi_Limit_A[0]	9.90	Ap
24	401016	uint8	Speed_Mode_CMD_Sr	0	DEC
25	40104D	uint8	GainSwitchTag	1	DEC

There is a useful method to find a property **Optimal Speed Loop Gains.**You can manually set the stiffness level to examine the control loop parameters under different inertia conditions at various stiffness levels, thereby identifying the appropriate speed loop gain. As shown in the figure below, **Stiffness Level 19** corresponds to a **speed loop proportional gain (Kp) of 1839**. You can begin testing by setting the speed loop gain to **1800** as an initial value to verify its suitability.



1	401054	uint32	Kload	10465	DEC
2	401055	uint8	StiffNess	19	DEC
3	401056	uint8	UseStiffNess	1	DEC
4	320015	uint8	Inertia_Measure	0	DEC
5	32000D	int8	ScanResult	0	DEC
6	300227	uint32	Kvp[4]	1839	DEC
7	300228	uint16	Kvi[4]	30	DEC
8	300229	uint16	K_FR[4]	256	DEC

Once the **speed loop gains (Kp/Ki)** are properly tuned, proceed to configure the **position loop parameters** for optimal motion control performance.



NUM	Index	Type	Name	Value	Unit
0	300301	uint32	Kpp[0]	50309	DEC
1	300309	int32	Pos_Error	0	DEC
2	30030A	int32	KppOut	0.00	rpm
3	60F400	int32	Pos_Error60F4	0	PUL
4	402001	uint16	KppBW[0]	7.64	Hz
5	606500	uint32	FollowErrWindow6065	50000	PUL
6	300316	uint32	FollowErrWindow	655360	DEC
7	606600	uint16	FollowErrTWindow	10.00	ms
8	606700	uint32	PositionWindow6067	10	PUL
9	30001C	int16	eAnglex	467	DEC
10	606800	uint16	PositionTWindow	15.00	ms
11	40102C	uint16	Pos_Cmd_FT_Coef_LP	1	DEC
12	40102D	uint16	Pos_Cmd_FT_Coef_MA	1	DEC
13	40101F	int16	VelFF_Permillage	100	‰
14	401020	int16	VelFF_Filter_BW	100.00	Hz
15	40104D	uint8	GainSwitchTag	1	DEC
16	310005	uint8	Gain_Select	4	DEC
17	300230	uint16	MaxProfileSpeedRpm	3500.00	rpm
18	30022A	uint16	ProfileSpeedRpm	199.00	rpm
19	30022B	int16	ProfileAcc	100.00	rps/s
20	30022C	int16	ProfileDec	100.00	rps/s
21	60C500	uint32	ProfileAccMax60C5	20000000	PUL/ss
22	60C600	uint32	ProfileDecMax60C6	20000000	PUL/ss
23	607F00	uint32	MaxProfileVel	600000	PUL/s

402001 KppBW[0]: position loop bandwidth

The larger the position loop bandwidth, the faster the position loop response.

However, due to the limitation of the speed loop bandwidth, if the speed loop response cannot keep up, simply increasing the position loop bandwidth will lead to control loop instability.

40102D Pos_Cmd_FT_Coef_MAF

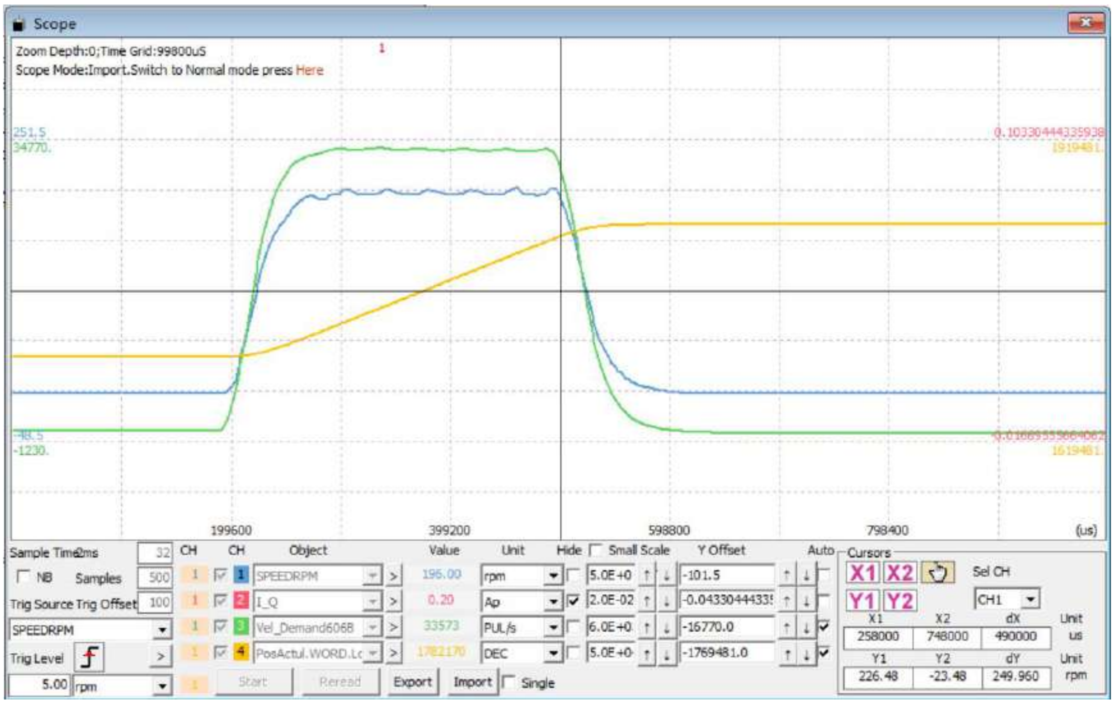
Position command sliding filtering (similar to position smoothing filter time) can eliminate disturbances caused by commands, resulting in smoother operation. However, it may affect Motion Path details. The setting values are 1, 2, 4, 8, 16, 32, 64... (integer multiples of 2).

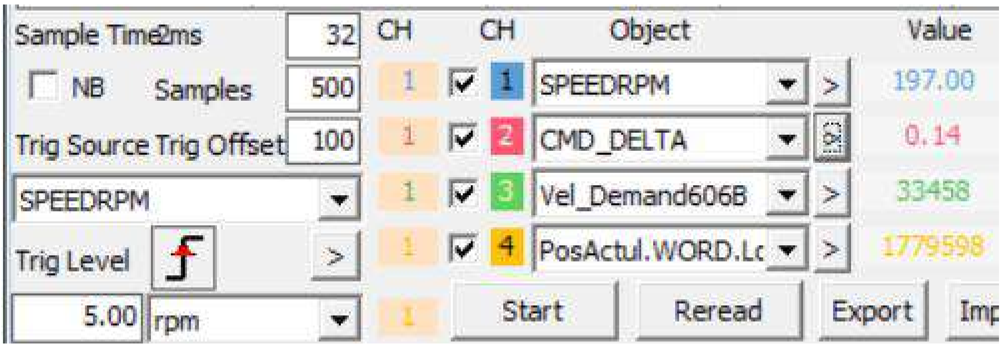
40101F VelFF_Permillage

Speed feedforward (in per mille) can improve speed tracking capability, enhance speed response, and eliminate steady-state following errors.

5.3.3 Operation Monitoring

While adjusting the control loop parameters, observe the operational performance using the scope.





Sampling Period Configuration:

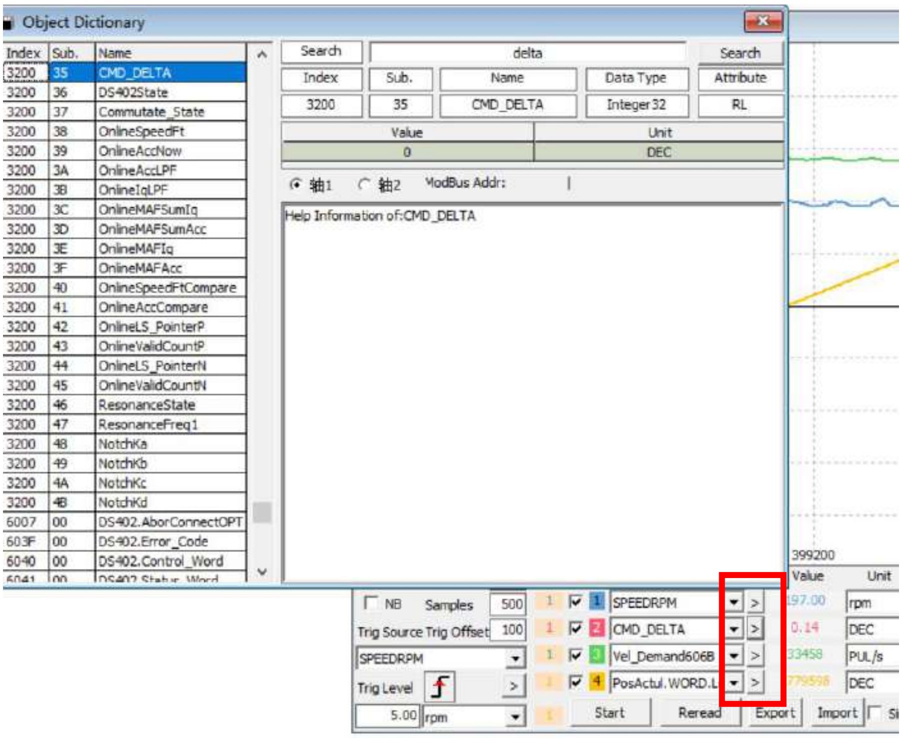
Set the sampling period to 1, 2, 4, 8, 16, 32, 64... (integer multiples of milliseconds) for convenient observation.

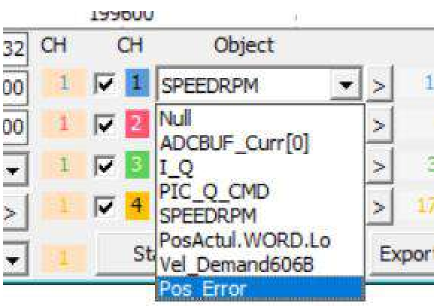
Trigger Condition:

Data acquisition can be configured to start once the operating speed reaches a specified value. As shown in the figure above, recording begins 100 sample points before the trigger point when the speed reaches 5 RPM (pre-trigger capture).

Selectable Sampling Channel Object:

You can choose like CMD_DELTA (command delta) as the sampling object. This parameter represents the speed variation value in motion Motion Path planning, allowing you to verify whether the command planning is functioning correctly.



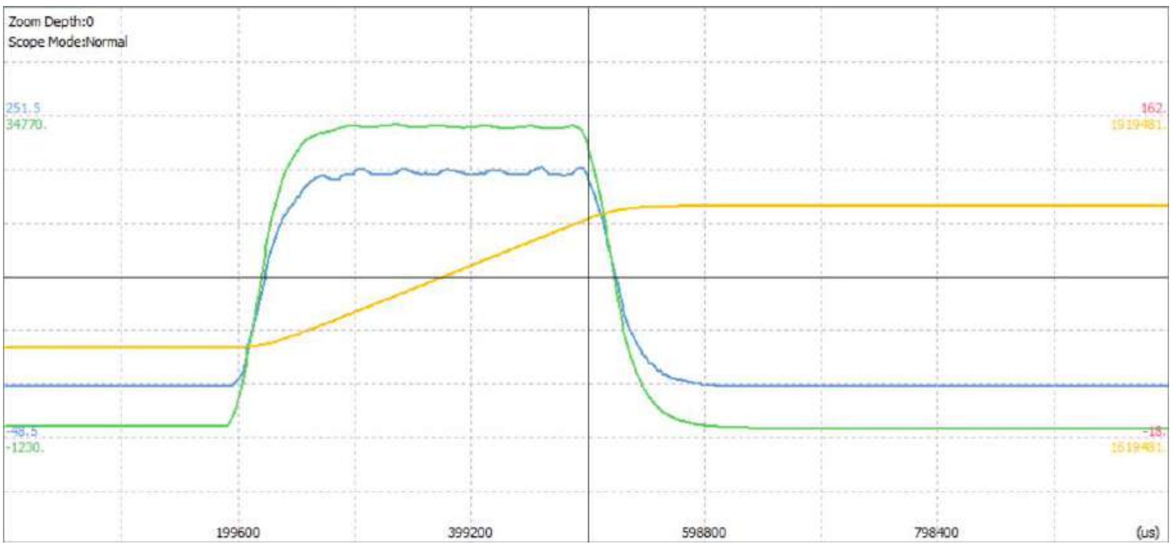


Pos_error is the difference between the commanded position (planned value) and the actual position, reflecting the system's tracking performance. Ideally, this value should remain small and stable (minimal fluctuation).

Unit: Encoder units

Example: 10,000 units = 10,000/8,388,608 ≈ **0.0012 revolutions** (assuming a 23-bit encoder resolution).

Note: Additional parameters can be monitored as needed based on specific application requirements.



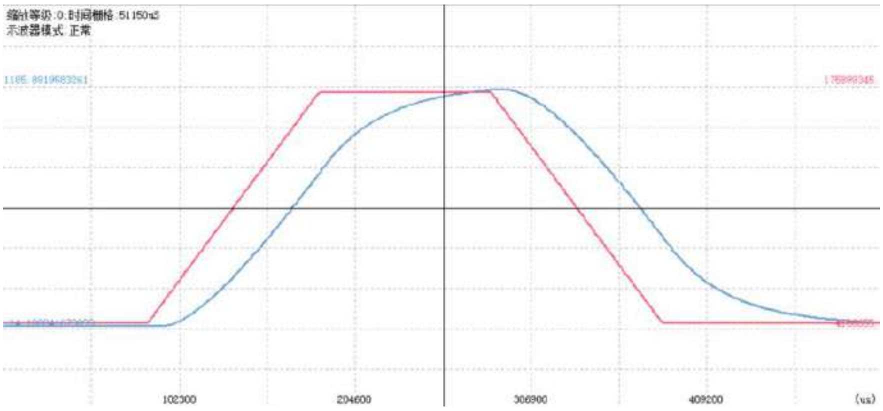
Chapter 6 Adjustment

6.1. Overview

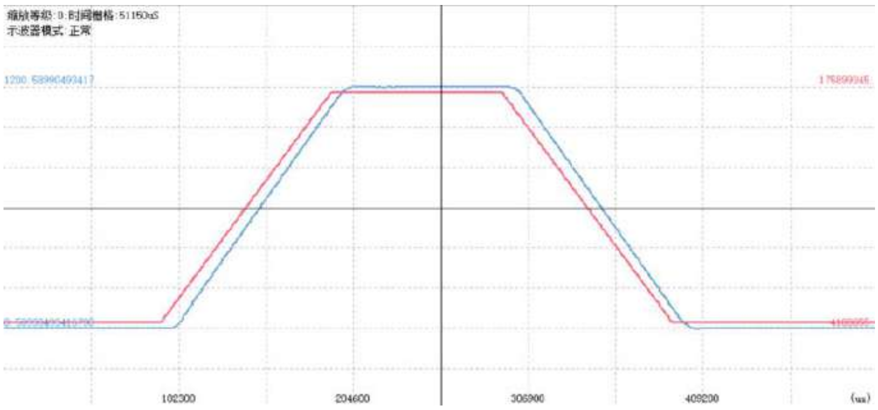
To adapt to user commands and actual mechanical conditions, it is necessary to adjust the internal gain, filtering, feedforward, and other parameters of the servo drive to achieve ideal operating results.

Below are waveform comparisons for different parameter settings.

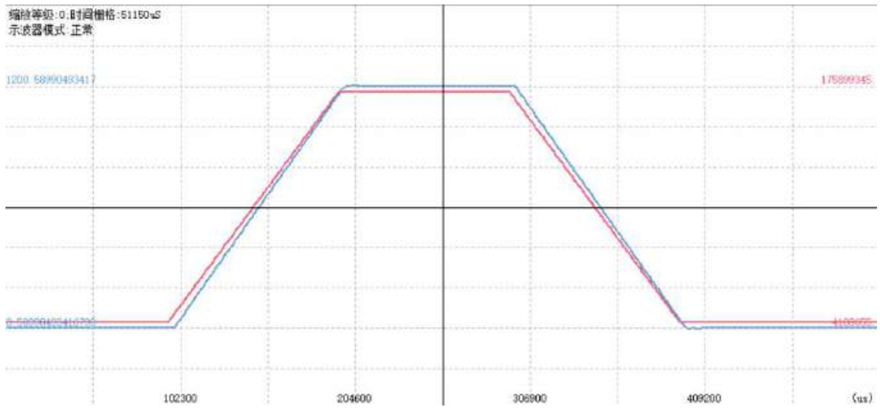
Kpp: Position Loop Bandwidth	Kvp: Speed Loop Proportional Gain	Kvi: Speed Loop Integral Gain
Vff: Velocity Feedforward	Tff: Torque Feedforward	VBW:ActualVelocityLoopBandwidth
VFBF:VelocityFeedbackFilter Bandwidth	TCMDF: Torque Command Filter Bandwidth	



Kpp=4Hz	Kvp=43	Kvi=1
Vff=0	Tff=0	TCMDF=500Hz
VFBF=500Hz	VBW=79Hz	Inertia Ratio=1.03



Kpp=20Hz	Kvp=43	Kvi=1
Vff=0	Tff=0	TCMDF=500Hz
VFBF=500Hz	VBW=79Hz	Inertia Ratio=1.03



Kpp=30Hz	Kvp=43	Kvi=1
Vff=0	Tff=0	TCMDF=500Hz
VFBF=500Hz	VBW=79Hz	Inertia Ratio=1.03

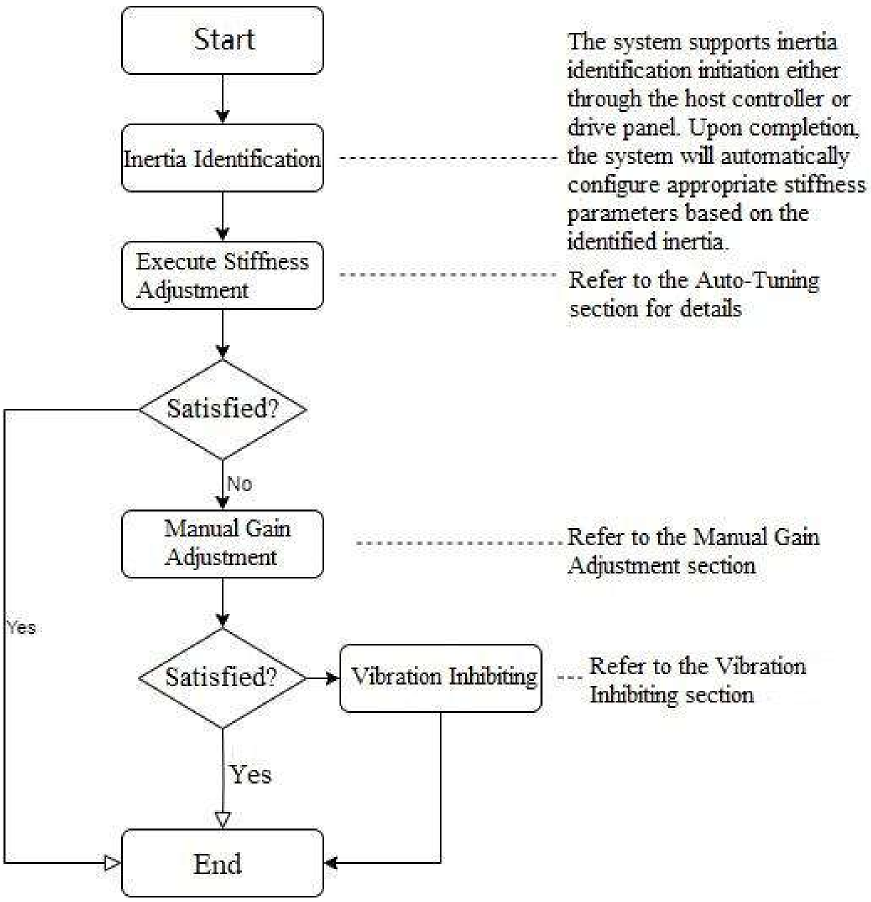
From the above comparison, it can be seen that different motion effects can be achieved through different parameter combinations

※ Note:

- Before adjusting the drive, it is recommended to first run in Jog mode to ensure that the drive and motor can operate normally.

Servo gain is set by combining multiple parameters (speed loop, position loop gain, inertia ratio, filters, etc.), which influence each other. Therefore, setting servo gain must consider the balance between the set values of various parameters.

The gain adjustment process is as follows:



Gain Adjustment Process Description:

Gain Adjustment Process			Function Description	Corresponding Chapter
1	Inertia Identification	Offline	Execute built-in specific actions to obtain inertia	6.2 Inertia Identification
		Online	Real-time monitoring of motion status to obtain inertia	
2	Rigidity Adjustment		Adjust control loop based on inertia and rigidity table	
3	Manual Gain Adjustment (Disabling the rigidity level function is required)	Control Loop Gain	First speed loop, then position loop, finding the balance point between response and stability	6.3 Manual Gain Adjustment
		Loop Filter	Improve vibration, noise, and smoothness of motion	
		Feedforward and Filtering	Optimize tracking capability	
		PDFF	Change speed loop structure, improve positioning capability	
		Motion Compensation	Optimizes start/stop performance	
4	Vibration Inhibiting	Mechanical Resonance	Suppress resonance through notch filters	6.4 Vibration Suppression Function
		End Vibration	Suppress end vibration through shaping filters	

6.2 Inertia Identification

Inertia identification refers to the process where the drive infers the motor load inertia by using information related to current, displacement, and the motor body.

After executing the inertia identification function with a matched motor, the total inertia of the motor and load, the ratio of total inertia to motor rotor inertia, and the torque inertia coefficient can be obtained. The definition of inertia ratio is as follows:

$$\text{Inertia Ratio} = \frac{\text{Motor Inertia}+\text{Load Inertia}}{\text{Motor Inertia}} \quad \text{Inertia Ratio} \geq 1$$

Inertia ratio is a key parameter of the servo system, whose role spans the entire process from mechanical design to servo motor selection to performance tuning.

CD300E drives offer two inertia identification methods:

I. 1-second Inertia Identification

1-second offline inertia identification can be started via the operation panel or host computer. During identification, the motor will move a certain distance, with a default maximum movement range of 0.3 turns, ending after 1 second.

II. Online Inertia Identification

The drive defaults to real-time online inertia identification. As long as the motor performs a movement that meets the conditions, real-time online inertia calculation can be triggered. Therefore, executing 1-second inertia identification will also trigger online inertia calculation. Results can be compared.

※ Note:

Online inertia identification requires the following conditions to be met for normal triggering:

- Motor speed higher than 150rpm
- Motor acceleration/deceleration higher than 1200rpm/s
- Load inertia and load torque do not change drastically
- If the drive's speed loop gain and load inertia ratio do not match, the motor's acceleration/deceleration may not meet requirements, thus preventing online inertia calculation from triggering. In this case, the speed loop proportional gain needs to be increased.
- If position closed-loop control is used during inertia identification, oscillation may occur due to loop mismatch. Immediate disablement, modification of gain parameters, or switching to speed closed-loop should be performed.
- Identification may be invalid in situations with excessive backlash, friction, or gravity.
- Inertia identification results can be used with rigidity levels for quick adjustment.

6.2.1 1-second Offline Inertia Identification

Inertia Identification Parameter Setting:

Start 1-second inertia identification by setting Pr6.05 in panel F006 group to 1, or by setting "Inertia Measurement (3200h-15h)" to 1 in the host computer [Drive]-[Control Mode]-[Auto-tuning]. The motor will perform about 1 second of oscillation.

Inertia Ratio Setting and Viewing:

The execution result can be viewed via Pr6.06 or host computer 3200h-0Dh. If the result is 1, it means inertia measurement was successful, and the inertia ratio can be further viewed via Pr6.03 or host computer 3100h-27h.

After offline inertia is identified successfully, the drive will automatically select an appropriate rigidity level (Pr6.02 or 4010h-56h) based on the inertia ratio value. The automatically set rigidity range is 3-17, corresponding to the inertia ratio range of 200-20. A larger inertia ratio results in lower rigidity.

※ Note: The unit of inertia ratio is 0.1

When using the panel, you can directly access Pr6.05 from the main menu using the "▼+SET" shortcut key

If the 1-second offline inertia identification result is negative, and the result is -1 or -2, you can try increasing the oscillation distance (Pr6.07 or 3200h-16h) and re-execute the measurement. If it is -3 or -4, it indicates that the load inertia ratio is too large and requires manual confirmation. This function is associated with parameters

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	Access	Validation
Pr6.05	3200h-15h	Inertia Measurement	0→1 Start	0		RW	Immediate
Pr6.06	3200h-0Dh	Inertia Measurement Result	0: Not started 1: Successful -1: Speed amplitude too small -2: Current amplitude too small -3: Inertia ratio exceeding 25 times -4: Inertia ratio exceeding 40 times	0		RO	
Pr6.03	4010h-53h	Inertia Ratio	10-300	30	0.1	RW	Immediate
Pr6.01	4010h-55h	Rigidity Grade	0-31	13		RW	Immediate
Pr6.07	3200h-16h	Inertia Measurement Distance	10-50	30	0.01 Turn	RW	Immediate
Pr6.04	3100h-26h	Current Load Inertia		0	0.01Kg·cm²	RO	
Pr6.08	3100h-27h	Current Inertia Ratio	10-250	0	0.1	RO	
Pr6.09	3100h-28h	Current KLoad		0		RO	
Pr6.02	4010h-56h	Use Rigidity Level	0: Do not use 1: Use	0		RW	Immediate
Pr6.10	3002h-27h	Speed Loop Proportion 4	0-65535			RO	
Pr6.11	3002h-28h	Speed Loop Integral 4	0-65535			RO	
Pr6.12	3002h-29h	Speed Loop KFR4	0-256			RO	

6.2.2 Online Inertia Identification

Online inertia identification is enabled by default. As long as the load meets the calculation trigger conditions, the online inertia identification function will update the results. Enable online inertia identification by setting Bit0 of Real-time Function Settings (Pr6.17 or 4010h-61h) to 1 (default is 1). Enable online gain adjustment by setting Bit3 to 1, which adjusts the control loop gain based on the user-set rigidity and the currently detected inertia ratio parameter.

Online inertia identification and online gain adjustment are not suitable for situations with drastic inertia changes or excessive backlash

This function is associated with parameters

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	Access	Validation
Pr6.17	4010h-61h	Real-time Function Settings	Bit0: Enable inertia identification Bit1: Enable friction compensation Bit2: Friction compensation source 0: User set 1: Online detection result Bit3: Enable online gain adjustment	1		RW	Immediate
Pr6.18	3200h-1Fh	Forward Load Current		0		RO	
Pr6.19	3200h-25h	Reverse Load Current		0		RO	
Pr6.20	3200h-26h	Online Inertia		0	0.01kg·cm²	RO	
Pr6.21	3200h-27h	Online Inertia Ratio		0	0.1	RO	
Pr6.10	3002h-27h	Speed Loop Proportion 4	0-65535			RO	
Pr6.11	3002h-28h	Speed Loop Integral 4	0-65535			RO	

Pr6.12	3002h-29h	Speed Loop KFR4	0-256			RO	

6.2.3 Rigidity Adjustment

Servo rigidity refers to the servo drive's ability to eliminate error disturbances. Higher rigidity means faster drive response and stronger tracking capability.

Rigidity essentially corresponds to the gain of the control loop. Here, rigidity adjustment is based on the built-in empirical loop gain parameter table. It involves selecting a suitable combination of loop parameters by setting the index of the parameter table, and then combining it with the user-set or identified inertia ratio to adjust the final internal gain parameters, for the purpose of jointly adjusting position and speed loop parameters by adjusting a single parameter (rigidity index).

Executing 1-second offline inertia identification will automatically set the rigidity index. The rigidity table is as follows:

Rigidity Grade	Position Loop Gain 0.1/s	Speed Loop Proportion 0.1Hz	Speed Loop Integral 0.1ms	Torque Filtering Time 0.01ms
0	20	15	3700	1500
1	25	20	2800	1100
2	30	25	2200	900
3	40	30	1900	800
4	45	35	1600	600
5	55	45	1200	500
6	75	60	900	400
7	95	75	700	300
8	115	90	600	300
9	140	110	500	200
10	175	140	400	200
11	320	180	310	126
12	390	220	250	103
13	480	270	210	84
14	630	350	160	65
15	720	400	140	57
16	900	500	120	45
17	1080	600	110	38
18	1350	750	90	30
19	1620	900	80	25
20	2060	1150	70	20
21	2510	1400	60	16
22	3050	1700	50	13
23	3770	2100	40	11
24	4490	2500	40	9
25	5000	2800	35	8
26	5600	3100	30	7
27	6100	3400	30	7
28	6600	3700	25	6
29	7200	4000	25	6
30	8100	4500	20	5
31	9000	5000	20	5

Associated parameters are

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	Access	Validation
Pr6.01	4010h-55h	Rigidity Grade	0-31	13		RW	Immediate
Pr6.02	4010h-56h	Use Rigidity Level	0: Do not use 1: Use	1		RW	Immediate

6.3 Manual Gain Adjustment

※ Note:

Before performing manual gain adjustment, the "Use Rigidity Level" function must be disabled (Pr6.02 set to 0 or 4010h-56h=0)

6.3.1 Control Loop Gain Adjustment

(1) Speed Loop Gain Adjustment

I. Speed Loop Bandwidth

Speed loop bandwidth refers to the drive's maximum response capability to speed commands, based on the current speed loop gain parameter settings and load characteristics. It is defined as the frequency value where the actual response amplitude / command amplitude = -3dB.

For rigid body loads, the calculation relationship between speed loop bandwidth and gain is:

$$kvpx := \frac{8192\, J_{driver}\, \mathrm{pi}^2\, Fbw\, ADCRES \sqrt{2}}{I\_Max\, kt_{driver}\, Encoder}$$, where kvpx is the internal speed loop gain

From this relationship, it can be seen that for the same speed loop bandwidth, the speed loop gain is directly proportional to the load inertia and inversely proportional to the motor torque constant and encoder resolution. That is, when the speed loop bandwidth is constant:

Larger load inertia, larger gain

Larger motor torque constant, smaller gain

Higher motor encoder resolution, smaller gain

However, the speed loop gain cannot be set arbitrarily; the following three aspects need to be considered:

1. Larger gain will also amplify noise, so a balance between noise and gain needs to be achieved during actual setting;
2. The above formula is based on rigid body loads. Actual load frequency characteristics are much more complex, possibly having multiple resonance points. Therefore, suppression of resonance also needs to be considered during setting;
3. When setting, consider the host computer command requirements or actual motion effects, and leave sufficient margin.

Method 1: Using Speed Command Step Response

Step 1: Set Speed Loop Integral Gain 0 (4025h-01h) to 0. Set the drive's operating mode (6060h-00h) to -3. Set "Speed Command rpm (3002h-1Fh)" to a small speed, such as 100 rpm - depending on encoder resolution and whether the load will cause current saturation. If the encoder with 23-bit resolution is set to 200 rpm, the encoder with 17-bit resolution can be set to around 400 rpm.

Step 2: Set the oscilloscope trigger condition to "Speed Loop Command (3002h-0Dh)". Select "Speed Loop Command (3002h-0Dh)" for acquisition channel 1, and "Speed Feedback 1st Order Low-Pass Output (3002h-17h)" for acquisition channel 2.

Step 3: Click the start button of the oscilloscope. Enable the drive via the host computer (it is recommended to use the simulation function in the digital I/O settings), then disable it after about 1 second.

Step 4: Observe the oscilloscope waveform. If overshoot or oscillation is observed in the step response waveform, decrease Speed Loop Proportional Gain 0 (4024h-01h) and repeat Step 3. When Speed Loop Proportional Gain 0 just causes slight overshoot, this setting value is considered acceptable after being slightly reduced.

Step 5: Gradually increase Speed Loop Integral Gain 0 (4025h-01h). Using a method similar to Steps 3 and 4, observe the step response. When slight overshoot appears, the integral gain is considered acceptable.

Method 2: Empirical Judgment Method

Set the servo drive to speed mode, with target speed and "Speed Loop Integral Gain 0" both set to 0, and then enable the drive. Modify "Speed Loop Proportional Gain 0", and touch with your hand or listen with your ear to select a value that results in less vibration or noise. Then, gradually increase "Speed Loop Integral Gain 0" starting from 1, execute the "motion-pause-motion" cyclic curve for the drive, and observe whether there is obvious jitter when the motor pauses. If there is, decrease "Speed Loop Integral Gain 0".

- "Speed Loop Integral Gain 0" should be set to a minimum of 1

II. Speed Loop Integral Limit

The speed loop integral limit restricts the output current of the speed loop's integral term to a reasonable range (e.g., just above friction torque). Its purpose is to prevent excessive speed overshoot or oscillation caused by continuous integration due to unreasonable acceleration/deceleration commands or loads leading to sustained inability of speed to follow.

Allow the motor to operate in constant velocity mode, then observe the "Current Loop Command q (3000h-05h)" at this time, and set the integral limit to approximately twice the current. Usually, keeping the default value is sufficient. If speed overshoot or oscillation occurs, combine with the software oscilloscope to observe "Speed Loop Integral Output 3002h-13h" and the speed waveform to determine if integral limiting is needed.

- For gravity loads, it is recommended to keep the default value or increase it.

III. Speed Loop Related Filtering

Speed Feedback Filtering (Pr1.09, 4010h-1Dh):

Filters out noise from the speed feedback signal. The default bandwidth is 300Hz. For general applications, the default value is usually sufficient. If the application requires a speed loop bandwidth exceeding 150Hz, this parameter should be increased as needed.

A smaller speed feedback filter setting results in stronger suppression of speed signal noise, but also introduces greater phase lag, leading to instability in the speed control loop.

A larger speed feedback filter setting results in weaker suppression of speed signal noise, but introduces less phase lag, allowing for a higher control loop bandwidth.

The maximum setting for Speed Feedback Filtering (4010h-1Dh) is 2000Hz. By setting "Speed Feedback Channel (Pr1.11, 3002h-26h)" to 0, speed feedback filtering is canceled. Setting it to 1 selects 1st order low-pass data, and setting it to 2 selects 2nd order low-pass data.

Torque Filtering (Pr1.10, 4010h-1Ch):

Filter out noise from the output signal of the speed PI controller. Its function is to eliminate control noise and suppress resonance frequencies.

From a loop stability perspective, torque filtering should be set at more than 2 times the speed loop bandwidth. During actual debugging, adjust from a larger to smaller value based on actual operating noise and vibration.

The maximum value for torque filtering (4010h-1Ch) is 1000Hz. If it is actually higher than 994Hz, the filtering function becomes inValidation.

The order can be selected via "Torque Filter Selection (Pr1.12, 4010h-24h)". A first-order filter attenuates noise less than a second-order filter but has less impact on control loop stability.

Notch Filter:

The drive has two built-in notch filters to suppress resonance, thereby extending the speed loop bandwidth. For more details, please refer to the Vibration Suppression section.

(2) Position Loop Gain Adjustment

Based on reasonably set speed loop parameters, proceed with position loop gain adjustment.

For general applications, if the load inertia ratio is known, the theoretical speed loop bandwidth can be calculated from the speed loop gain parameters. Then, 1/4 to 1/3 of this bandwidth can be set as the position loop bandwidth. When setting the position loop bandwidth, the drive automatically calculates the internal position loop gain. If the load inertia ratio is unknown, the position loop bandwidth needs to be set from small to large based on specific repetitive position loop commands, until satisfactory.

Position Loop Bandwidth 0 (Pr1.01, 4020h-01h)

6.3.2 Input Shaping

The input position command can be shaped using "Position Command Low-Pass Filter Coefficient (Pr1.07, 4010h-2Ch)" or "Position Command Smoothing Filter Coefficient (Pr1.08, 4010h-2Dh)" to make it smoother and acceleration/deceleration more reasonable. If the position command sent to the servo is already sufficiently fine, both parameters can be set to 1 to disable the related smoothing functions.

6.3.3 Enhance Position Tracking Capability

When the speed loop bandwidth cannot be further increased, considering the stability of the position loop, its host limit for position loop bandwidth is fixed. It is no longer possible to improve position tracking capability by increasing the position loop proportional gain. Velocity feedforward and torque feedforward functions can be used to further enhance dynamic tracking capability.

(1) Velocity Feedforward Function

This function separates velocity information from the position command and directly uses a portion (Velocity Feedforward Permille Pr1.17, 4010h-1Fh) as the speed loop's reference command. Since the velocity feedforward command consumes some of the speed loop's response capability, the position loop bandwidth needs to be appropriately reduced after using feedforward to avoid oscillation or overshoot.

(2) Torque Feedforward Function

This function separates acceleration information from the position command. The drive combines this with the set inertia ratio to convert it into torque information, then directly uses a portion (Torque Feedforward Permille) as the current loop's reference command. Torque feedforward further enhances tracking capability, but since it consumes some current loop response capability, the speed loop gain may need to be appropriately reduced when used.

※ **Note:**

● The torque feedforward function is limited by the stability of load characteristics and should be used with caution.

(3) Startup Compensation Function

The startup compensation function can accelerate the motor's transition from stop to start. Its principle is to output a gradually changing current over a certain period to speed up the motor's action. This function does not affect the overall tracking performance.

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	ACCESS	Validation
Pr1.44	4010h-76h	Startup Compensation Current	0-1500	0	Internal Unit	RW	Immediate
Pr1.45	4010h-77h	Startup Compensation Time		15	ms	RW	Immediate

Startup compensation current is an internal unit, and its conversion to amperes is:

Amperes Current = Startup Compensation Current * [3100h-1Ch] / 8192

(4) Friction Compensation Function

The friction compensation function can improve the speed loop's low-frequency tracking capability during startup. Independent settings are required for forward and reverse compensation circuits.

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	ACCESS	Validation
Pr1.46	4010h-5Fh	Forward Friction Current	0-100	0	0.1A	RW	Restart
Pr1.47	4010h-60h	Reverse Friction Current	0-100	0	0.1A	RW	Restart
Pr1.48	4010h-61h	Real-time Function Settings	Bit1: Enable friction compensation Bit2: Friction compensation source 0: User set 1: Online detection result	1		RW	Immediate
Pr1.49	4010h-62h	Forward Maximum Friction Limit		10	0.1A	RW	Immediate
Pr1.50	4010h-63h	Reverse Maximum Friction Limit		10	0.1A	RW	Immediate

Forward/Reverse Friction Current are user-set friction compensation values, corresponding to bit2=0 of the real-time function settings

Forward/Reverse Maximum Friction Limit restricts the online detected friction, corresponding to bit2=1 of the real-time function settings

(5) Speed-up Positioning

To achieve better positioning performance, it is necessary to increase the bandwidth of all control loops as much as possible. The methods previously used to improve tracking capability cannot Validationly speed-up positioning; reducing the position loop bandwidth will weaken positioning capability. By using the gain switching function, higher position loop and speed loop proportional parameters can be used during positioning, and a stronger integral gain can accelerate the positioning process.

Using the PDFF function to strengthen the speed loop integral capability can also enhance positioning capability

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	Access	Validation
Pr1.19	4010h-4Ch	Gain Switching Mode	0: No switching 1: Switch when speed is 0 2: Switch when position command is constant and position error is less than object 4010h-75h	0		RW	Immediate
Pr1.20	4010h-4Dh	Gain Switching Target	0-3	0		RW	Immediate
Pr1.51	4010h-75h	Gain Switching Positioning Error Comparison Value		2000	Encoder Unit	RW	Immediate

6.4 Vibration Suppression Function

6.4.1 Mechanical Characteristic Analysis

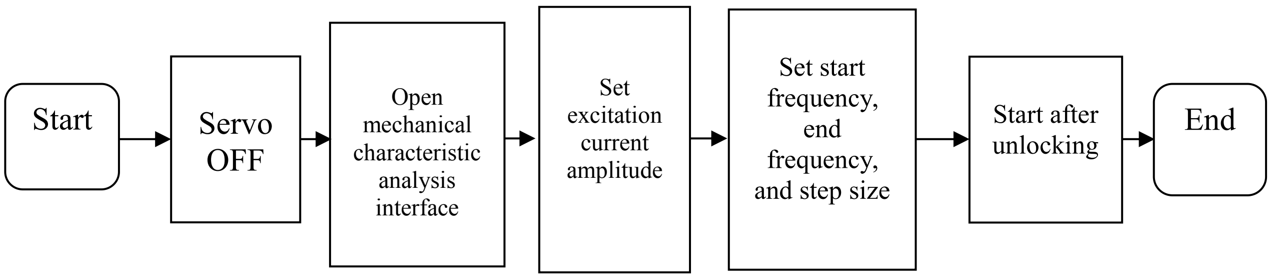
Mechanical characteristic analysis is used to determine mechanical resonance points and system bandwidth, supporting up to 1kHz response characteristic analysis.

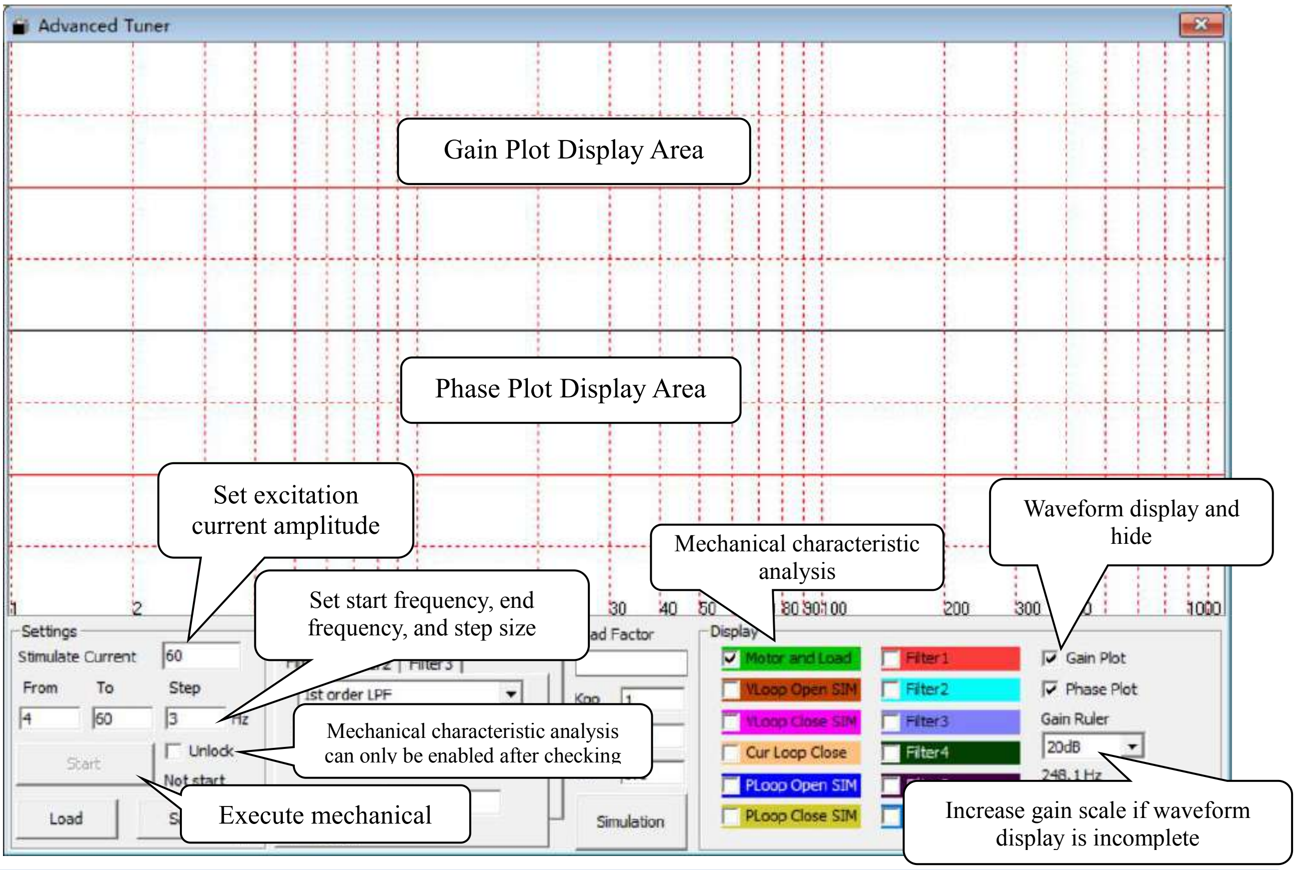
Reasonably setting notch filters based on the resonance points identified by mechanical characteristic analysis can Validationly improve mechanical resonance, making the equipment run more smoothly.

The mechanical characteristic analysis interface is accessed via 'Drive D' → 'Tuner/Expert Mode' in the debugging software menu bar.

The waveform display in the mechanical characteristic analysis interface is divided into a gain plot and a phase plot, with the gain plot displayed above and the phase plot below.

The general operation procedure for mechanical characteristic analysis is as follows:





※ Note:

● **To avoid excessive vibration during testing, the excitation current amplitude should not be set too high during the first implementation, generally within the range of 300-600;**

● **If the current excitation is too small, the analyzed waveform will have some distortion;**

Safety Instructions:

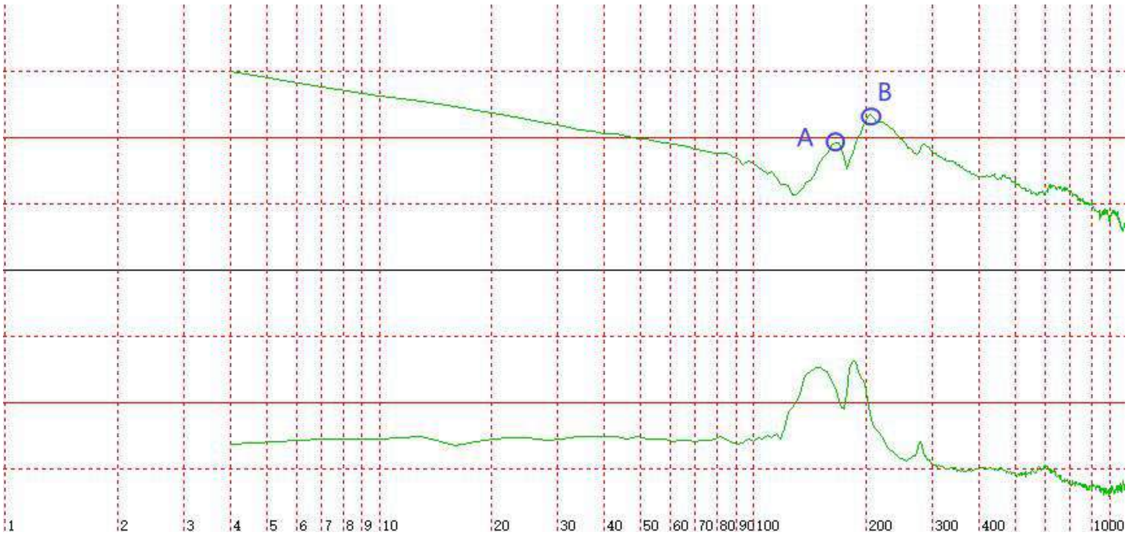
● **During mechanical characteristic analysis, the motor automatically runs for a certain time and distance without external signal control. Please perform this operation only under safe conditions to avoid casualties and equipment damage!**

6.4.2 Mechanical Resonance Suppression

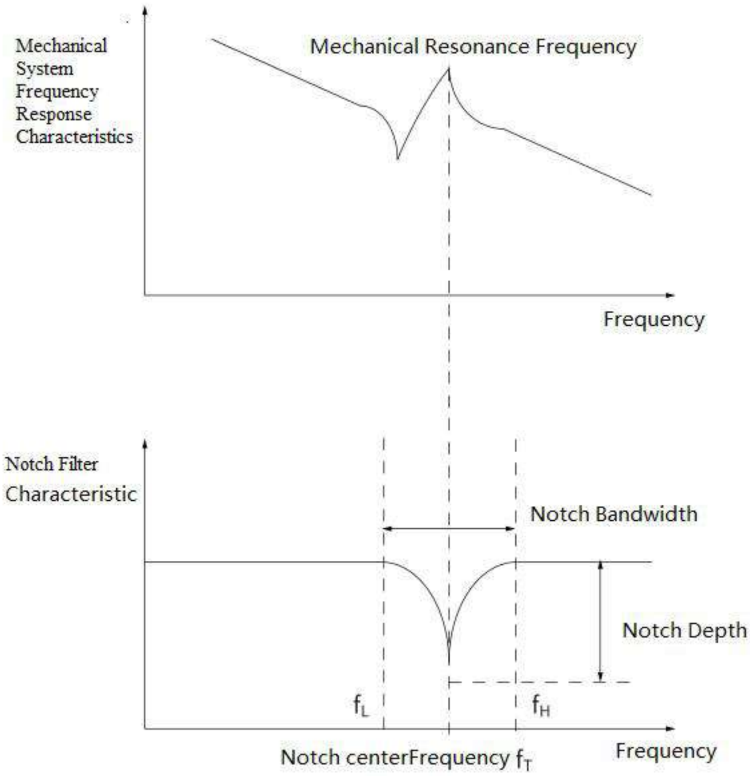
Mechanical resonance between the motor shaft and load typically occurs in elastic transmission mechanisms.

Near resonance frequencies, the speed closed-loop gain can become extremely high, leading to positive feedback and system instability, thus requiring resonance characteristics to be suppressed.

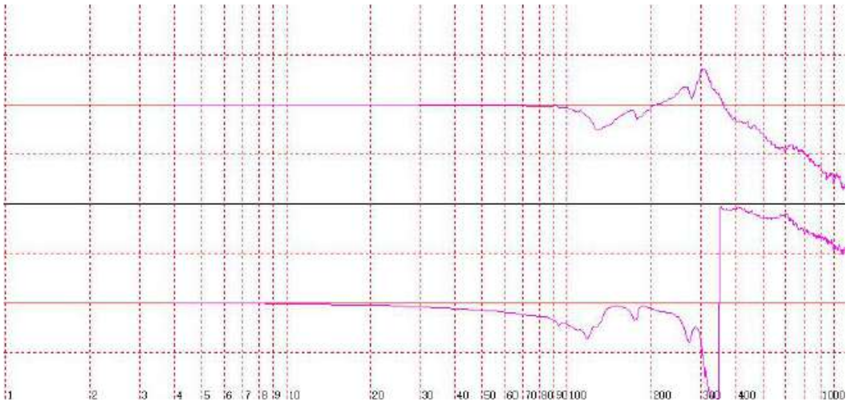
Load resonance frequency can be measured using the mechanical frequency characteristic analysis tool in the host computer. As shown in the figure below



In the figure, two resonance frequency points (A and B) can be found. Resonance can be suppressed by using torque filters or notch filters. The working principle of a notch filter is shown below:

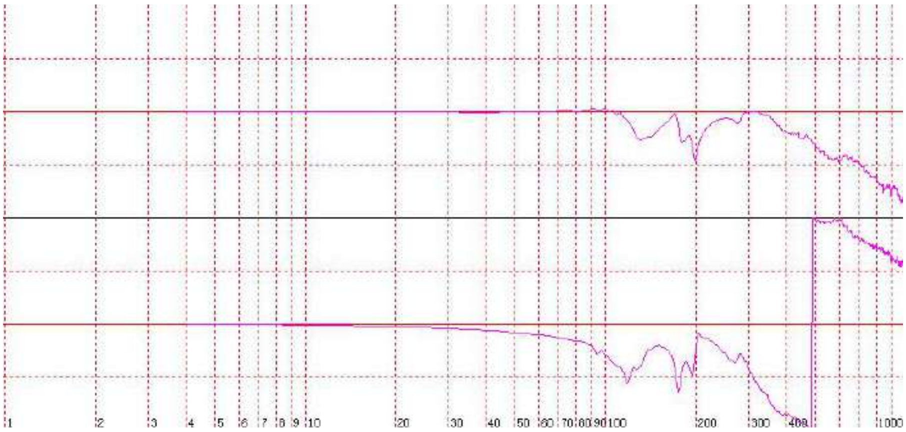


When resonance suppression is not used, the speed closed-loop frequency characteristic is as follows:



As seen from the figure, the system is close to positive feedback and is uncontrollable.

If a notch filter is used:



As seen from the figure, the frequency peak and positive feedback characteristics have been suppressed.

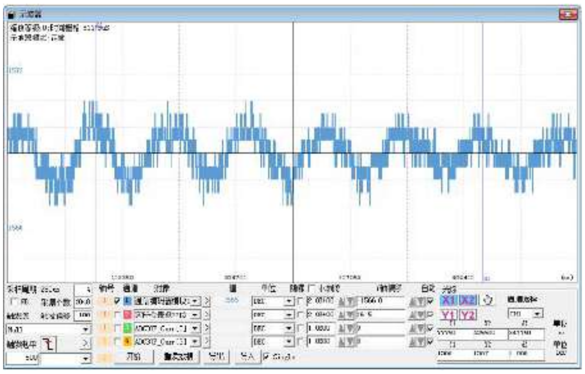
CD300E drives have two built-in notch filters, A and B.

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	ACCESS	Validation
Pr6.23	4010h-6Fh	Notch Filter A Width	0-60	45	Hz	RW	Immediate
Pr6.24	4010h-70h	Notch Filter A Depth	0-100	50	dB	RW	Immediate
Pr6.25	4010h-71h	Notch Filter A Frequency	100-8000	8000	Hz	RW	Immediate
Pr6.26	4010h-72h	Notch Filter B Width	0-60	45	Hz	RW	Immediate
Pr6.27	4010h-73h	Notch Filter B Depth	0-100	50	dB	RW	Immediate
Pr6.28	4010h-74h	Notch Filter B Frequency	100-8000	8000	Hz	RW	Immediate

6.4.3 End Vibration Suppression

End vibration typically occurs in transmission mechanisms where the end has a certain weight and elasticity, but not enough to cause mechanical resonance.

In some scenarios, you can use a software oscilloscope to give the end a sudden disturbance with the motor shaft loose, then observe the frequency of position or speed fluctuations. Set the servo to the OFF state, open the oscilloscope function in the debugging software, set the acquisition channel data to "Actual Position (6063h)", manually push the load end in the direction of vibration, and then observe the frequency of the vibration waveform via the oscilloscope function. As shown in the figure on the lower right, the waveform frequency is approximately 14.4Hz.



$$\text{End Vibration Frequency} = \frac{1}{\text{Waveform Period Average}}, \text{Waveform Period Average} = \frac{\text{Time}}{\text{Period Count}}$$

Waveform Period Average = 347750 ÷ 5 ÷ 1000000 = 0.06955 seconds (※ Note: microseconds need to be converted to seconds, so divide by 1000000)

End Vibration Frequency = 1 ÷ 0.06955 ≈ 14.4Hz

In scenarios where it cannot be observed with the software oscilloscope, users need to use other means such as cameras or accelerometers to measure the vibration frequency. The trial and error method can also be used to gradually test the actual suppression effect of various frequencies.

Input Shaping to Suppress End Vibration

By setting the input shaping related filters, end vibration can be suppressed. Input shaping filters can suppress relevant frequencies in the command signal, but their Validationness varies greatly on different equipment. Please refer to Section 6.3.2 Input Shaping for details

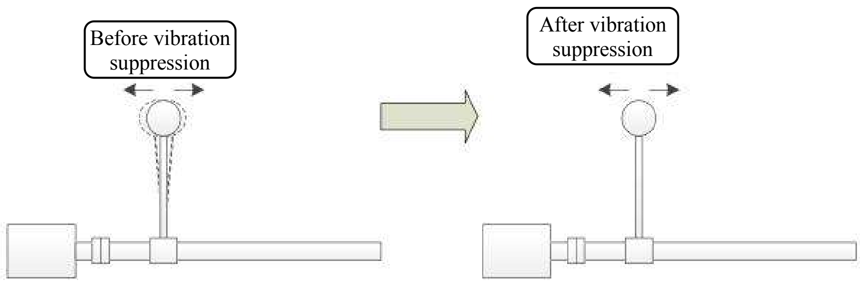
End Vibration Suppression Filter

The drive has two built-in end vibration suppression filters. When using them, the suppression frequency and suppression intensity need to be entered and fine-tuned based on the execution effect.

No.	Index	Parameter Name	Setting/Display Value	Default Value	Unit	ACCESS	Validation
Pr1.38	4010h-64h	Vibration Suppression Function Setting	0: Not enabled 1: Enable Filter A 2: Enable Filter B 3: Enable Filter AB	0		RW	Immediate
Pr1.39	4010h-65h	Vibration Suppression Frequency A	≤100	100	Hz	RW	Immediate
Pr1.40	4010h-66h	Vibration Suppression Intensity A	1-30	10		RW	Immediate
Pr1.41	4010h-67h	Vibration Suppression Frequency B	≤100	100	Hz	RW	Immediate
Pr1.42	4010h-68h	Vibration Suppression Intensity B	1-30	10		RW	Immediate

※ Caution

- **End vibration suppression function parameters can be set via the panel or debugging software.**
- **"Vibration Suppression Frequency" is the vibration frequency at the load end when vibration occurs, and the measured end vibration frequency (in 0.1Hz units) is directly written to this parameter**
- **"Vibration Suppression Intensity" determines the attenuation capability of the "Vibration Suppression Frequency" component in the command, and both must be used together. Excessive settings can cause command distortion.**



Chapter 7 EtherCAT Communication

7.1 EtherCAT Overview

EtherCAT is a high-performance, low-cost, easy-to-use, and topologically flexible industrial Ethernet technology developed by Beckhoff Germany, which can be used as an ultra-high-speed I/O network at the industrial field level, utilizing standard Ethernet physical layers with twisted-pair or fiber optic transmission media. Its basic communication method is single-master multi-slave communication. Compared with other communication methods, EtherCAT has the following characteristics:

EtherCAT extends to the very bottom, with protocol processing directly reaching the I/O layer:

- ● No need for any lower-level sub-buses
- ● No gateway delays
- ● A single system can cover all devices: inputs/outputs, sensors, actuators, drives, displays, etc.
- ● Transmission rate: 2 × 100 Mbit/s (High-speed Ethernet, full-duplex mode)
- ● Synchronicity: Two devices 300 nodes apart, cable length 120 meters, synchronization jitter less than 1µs

Refresh time:

- ● 30µs to process 1000 digital I/O
- ● 100 µs to process 100 servo axes

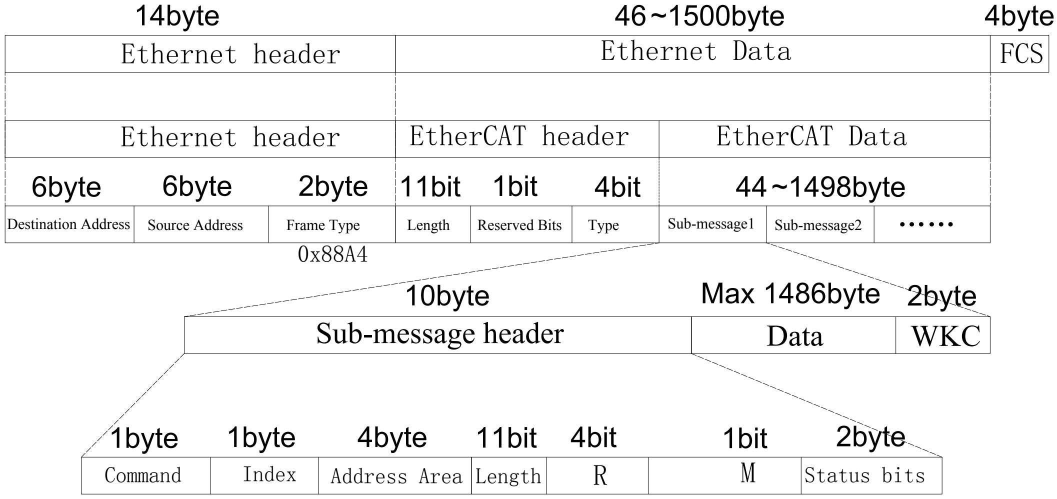
7.1.1 EtherCAT Specifications

Item	Specifications
Applicable standards	IEC 61800-7 CiA402 Drive Profile, IEC 61158 Type12
Transmission Protocol	100BASE-TX (IEEE802.3)
Interfaces	RJ45×2 (IN, OUT)
Synchronization mode	DC - Distributed Clock (DC synchronization period: 125µs-8ms) Free Run (asynchronous)
Topology	Ring, Line
Transmission Medium	Shielded Cat5e or Cat6 and higher Ethernet cables with electrical performance specifications
Transmission Distance	Less than 100M between two nodes (good environment, excellent cable)
EtherCAT Frame Length	44 bytes - 1498 bytes
FMMU Unit	FMMU0: Mapped to Process Data Slave RxPDO area FMMU1: Mapped to Process Data Slave TxPDO area FMMU2: Mapped to Mailbox State
Sync Manager	Sync Manager 0: Allocated to Mailbox Out Sync Manager 1: Allocated to Mailbox In Sync Manager 2: Allocated to Process Data Out Sync Manager 3: Allocated to Process Data In
PDO Data	Dynamic PDO mapping
MailBox (CoE)	SDO request, SDO response, emergency events

7.1.2 EtherCAT Frame Structure

Since the EtherType of the Ethernet Header is "88A4h", the subsequent Ethernet Data is processed as an EtherCAT frame.

An EtherCAT frame consists of an EtherCAT frame header and one or more EtherCAT datagrams, as shown below:



The meaning of EtherCAT frame is shown in the table below:

Name	Description
Destination Address	Receiver MAC Address
Source Address	Sender MAC Address
Frame Type	0x88A4
EtherCAT Header: Length	Length of the EtherCAT data area, i.e., the sum of all datagram lengths
EtherCAT Header: Type	0x0001: EtherCAT DLPDU 0x0004: Network Variable 0x0005: Mailbox
FCS	Frame Check Sequence

The structure of EtherCAT datagram is shown in the table below:

Name	Description
Command	Addressing Mode and Read/Write Mode
Index	Frame Encoding
Address Area	Slave Station Address
Length	Datagram Data Area Length
R	Reserved Bit
M	Subsequent Datagram Flag
Status Bit	Interrupt Arrived Flag
Data Area	Datagram Data Structure, user-defined
WKC	Working Counter

7.1.3 EtherCAT Device Addressing Methods

EtherCAT communication is achieved by the master sending EtherCAT data frames to the slaves to perform read/write operations on the internal storage area of the slave device. EtherCAT messages have multiple addressing operation methods for the ESC internal storage area, thus enabling various communication services. Within an EtherCAT segment, there are two addressing methods: device addressing and logical addressing.

(1) Device Addressing

Device addressing refers to reading and writing to a single slave. It can be further divided into **sequential addressing and configured addressing:**

Sequential Addressing:

This refers to the slave number counted from the master in the order of network connection, addressing the corresponding slave by decreasing negative numbers. For example, 0 is the first slave, -1 is the second slave, and so on.

Configured Addressing:

This involves assigning a "slave address" to each slave device. The slave for communication is identified by finding its corresponding slave address, which is also a common form in traditional master-slave networks. The slave address can be pre-set in the EEPROM externally attached to the ESC, or it can be modified during communication.

Sequential addressing is only used during the network initialization phase to read and write the slave address of each slave device, while subsequent communication typically uses configured addressing.

(2) Logical Addressing

Logical addressing maps the master's 32-bit, 4G-sized "data logical address" to the slave ESC's "physical space". This mapping function is performed by the FMMU within the slave's ESC chip.

FMMU (Fieldbus Memory Management Units)

FMMU, also known as the Fieldbus Memory Management Unit, resides in the slave chip ESC and is responsible for translating and establishing mapping relationships between the slave's physical address and the master's logical address. The master configures the FMMU during bus startup, which includes:

● Start address of logical address
● Data length (calculated by number of bytes spanned)
● Start bit of logical address
● End bit of logical address
● Start address of slave physical address
● Start bit of slave physical address
● Operation type (read-only, write-only, read/write)
● Enable

Logical addressing has the following characteristics:

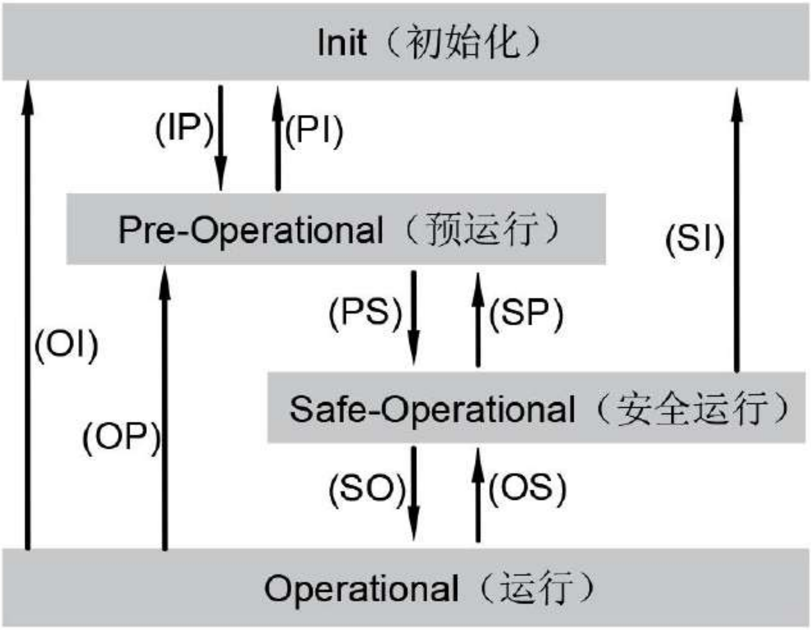
● Logical addressing completely disregards the slave's address; it only cares whether the FMMU-configured slave maps the currently accessed logical address
● Multiple slaves can configure FMMU to map to the same logical address space on the master. In this case, a single operation by the master on one logical address can simultaneously operate on multiple mapped slaves

7.1.4 EtherCAT State Machine

To coordinate the state relationship between master and slave applications during initialization and operation, EtherCAT slave devices must implement the following four basic states:

·**Init(I):** Initialization state
·**Pre-Operational(P): Pre-**operational state
·**Safe-Operational(S): Safe-**operational state
·**Operational(O):** Operational state

When EtherCAT communication starts and runs, the communication state transitions (EtherCAT State Machine) between master and slave applications are shown below:



When transitioning from the Init state to the Operational state, it must follow the sequence of "Init → Pre-Operational → Safe-Operational → Operational"; skipping levels is not allowed. When returning from the Operational state, skipping levels is allowed. States and state transition operations are shown in the table below:

Status	Description
Init(I)	• Mailbox not communicable state • Process data not communicable state
Init to Pre-Op (IP)	• The master sets link layer address and Sync Manager channels for mailbox communication • The master initializes DC clock synchronization • The master requests transition to Pre-Op state • The master sets AL Control Register • The slave checks if mailbox initialization is correct
Pre-Operational(P)	• Mailbox communicable state • Process data not communicable state
Pre-Op to Safe-Op (PS)	• The master sets Sync Manager channels and FMMU channels for process data • The master configures PDO mapping and Sync Manager PDO assignment parameters via SDO • The master requests transition to Safe-Op state • The slave checks Sync Manager channels for process data communication, and checks Distributed Clocks settings as needed
Safe-Operational(S)	• Mailbox communicable state • Process data communication is enabled, but only input data is valid; output data remains invalid
Safe-Op to Op (SO)	• The master sends valid output data • The master requests Operational state
Operational(O)	• Mailbox communicable state • Process data communicable state

7.2 CANopen over EtherCAT (CoE)

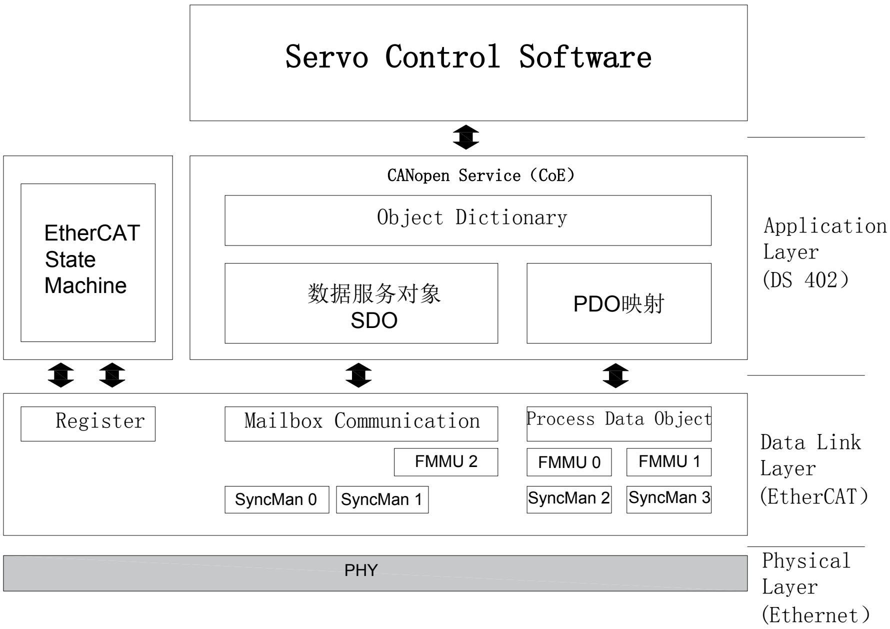
To support a wider variety of devices and broader application layers, EtherCAT has established the following application protocols:

- CoE (CANopen application protocol based on EtherCAT)
- SoE (Servo Drive Profile compliant with IEC 61800-7-204 standard)
- EoE (Ethernet over EtherCAT)
- FoE (File over EtherCAT)

CoE (CiA 402 CANopen protocol) is a communication protocol based on IEC 61800-7-1, IEC 61800-7-201, and IEC 61800-7-301 standards, and designed to achieve international standardization of drive control and motion control. Currently, the CD300E drive supports the CoE protocol.

7.2.1 OSI Reference Model of CoE

The servo unit consists of three layers of the OSI reference model: Application Layer (CANopen), Data Link Layer (EtherCAT), and Physical Layer (Ethernet). The other 4 layers, besides the Application Layer, Data Link Layer, and Physical Layer, are not used. The Data Link Layer implements EtherCAT communication, and the Application Layer implements the CANopen motion control protocol (DS402).



7.2.2 EtherCAT Communication Structure

The application layer object dictionary includes: communication parameters, application data, and PDO mapping data, etc.

PDO (Process Data Objects) contain real-time data during servo drive operation and are accessed periodically for reading and writing.

SDO (Service Data Objects) mailbox communication performs non-periodic access and modification of some communication parameter objects and PDO process data objects

(1) SDO Implemented in CoE

Non-periodic data communication in the EtherCAT protocol is called mailbox data communication, which can be bidirectional - master to slave and slave to master. It supports full duplex, independent communication in both directions, and multi-user protocols. The mailbox data header includes an address field, allowing the master to resend mailbox data. Mailbox data communication is the standard method for parameter exchange. If PDO configuration or other non-periodic services are required, mailbox data communication needs to be used, typically implemented by encapsulating the CiA301 protocol (object dictionary, CoE) within the mailbox. The following describes master-slave mailbox communication.

● Master to slave communication, write mailbox command

The master sends a write data area command to send mailbox data to the slave. The master needs to check the working counter (WKC) in the slave's mailbox command response message. If the working counter is 1, it indicates that the write command was successful. Conversely, if the working counter has not increased, typically because the slave has not finished reading the previous command, or has not responded within the limited time, the master must re-send the write mailbox data command.

● Slave to master communication, read mailbox command

When a slave has data to send to the master, it must first write the data to the input mailbox buffer area, and then the master reads it. When the master discovers data waiting to be sent in the slave ESC input mailbox data area, it will send appropriate read commands as soon as possible to read the slave's data. The master has two methods to determine if the slave has filled the mailbox data into the data area. One is to periodically read a flag bit using FMMU. Using logical addressing can simultaneously read flag bits from multiple slaves, but its disadvantage is that each slave requires an FMMU unit. The other method is simply to poll the data area of the ESC input mailbox. A working counter increment of 1 for a read command indicates that the slave has filled new data into the input data area.

In CoE, the concept of CAN ID is transformed into a "Type" parameter, and the entire 8-byte content of CAN's data segment is placed into the "Data Area" of the EtherCAT datagram format and sent as "Mailbox Data".

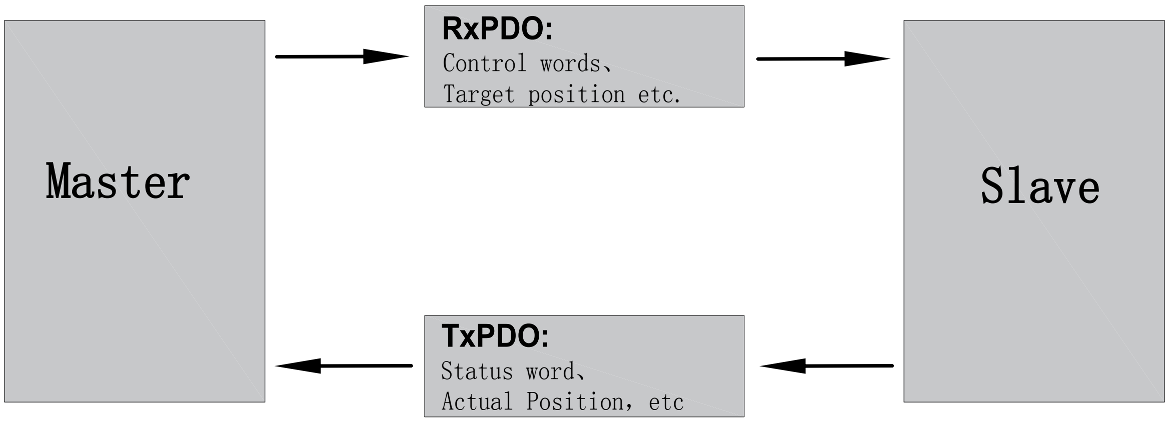
The meaning of each field in the mailbox data is shown in the table below:

Data Area	Name	Description
Mailbox Header	Length	Length of the following mailbox service data
	Address	When communicating from master to slave, this is the data source slave address When communicating from slave to master, this is the data destination slave address
	Channel	Reserved
	Priority	Reserved
	Type =3 (CoE)	Mailbox Type, protocol type of the following data: 0: Mailbox communication error 2: EoE (Ethernet over EtherCAT) 3: CoE (CANopen application protocol based on EtherCAT) 4: FoE (File over EtherCAT) 5: SoE (Servo drive profile compliant with IEC 61800-7-204 standard)
	Counter	Sequence number used for repetition detection, increments by 1 for each new mailbox service
Command	PDO No.	PDO sequence number when sending PDO
	Type	CoE Service Type: 1: Emergency event information 2: SDO request 3: SDO response 4: TxPDO 5: RxPDO 6: Remote TxPDO send request 7: Remote RxPDO send request 8: SDO information Note: In CD300E series drives, only SDO request and SDO response are currently supported

The SM0 and SM1 synchronous managers of CD300E are used for mailbox communication. When there is mailbox data, an SM0 or SM1 signal will be triggered to process the mailbox data (SM0=mailbox output, SM1=mailbox input).

(2) PDO Implemented in CoE

EtherCAT real-time data transmission is achieved through Process Data Objects (PDO). According to the data transmission direction, PDOs can be divided into RPDO (Reception PDO) and TPDO (Transmission PDO). RPDO transmits master data to the slave, and TPDO sends slave data back to the master.

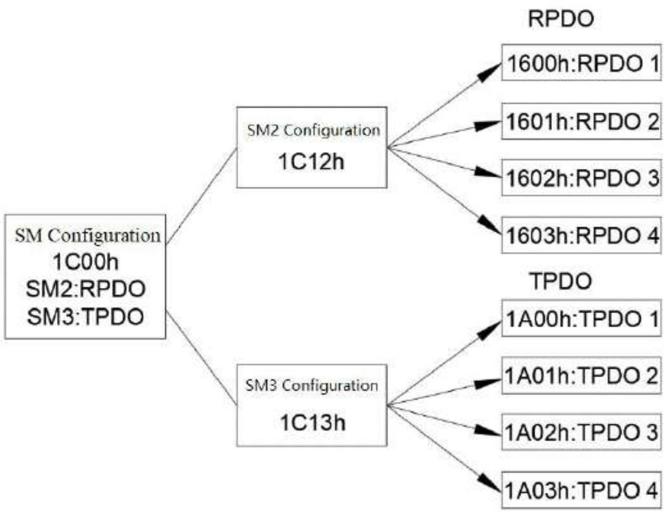


PDO usage requires PDO assignment and PDO mapping.

1. **PDO Assignment**

PDO assignment is used to establish the link between PDO mapping and the Sync Manager (SM). CD300E drives support four groups of PDO assignments. Each Sync Manager (SM2 and SM3) can be assigned up to 4 groups of PDO mappings.

Assignment-related objects are shown in the figure below:



※ Note:

PDO configuration can only be set when the EtherCAT Communication State Machine is in Pre-Operational state, otherwise an error will occur.

PDO configuration parameters cannot be stored in EEPROM. Therefore, after each power-up, it is essential to reconfigure the mapped objects, otherwise, the mapped objects will revert to the drive's default parameters.

Steps to modify PDO assignment, taking 1C12h as an example:

I. ESM state machine switches to Pre-Operational (Pre-Op) state (Init→Pre-Op)

II. Write 0 to sub-index 00h of 1C12h

III. Write new values to sub-indexes 01h-04h of 1C12h (default 01h:1600h)

IV. Write the new number of sub-indexes to sub-index 00h of 1C12h (the default is 1)

V. SM state machine switches to Safe-Operational (Safe-Op) state, re-assignment is complete

2. **PDO Mapping**

PDO mapping is the correspondence between application objects (real-time process data) from the object dictionary to PDOs. CD300E drives support variable PDO mapping. There are 4 groups of RPDO mappings and 4 groups of TPDO mappings in the object dictionary. Each PDO mapping group can be assigned up to 8 sub-index objects. Users can flexibly configure as needed, taking care of data length limitations.

The index numbers for the 4 RPDO mapping groups are 1600h - 1603h, and for the 4 TPDO mapping groups are 1A00h - 1A03h. The sub-index length is 32 bits, containing the index, sub-index, and length information of the mapped application object, as shown in the table below:

Bit	31-16	15-8	7-1
Description	Mapped application object index	Sub-index of application object	Object length 08h: 8-bit 10h: 16-bit 20h: 32-bit
Example	6040h	00h	10h

The mapped application object must be in the drive's object dictionary and support PDO mapping. The access attribute of mapped application objects in RPDO mapping is read/write (RW), and in TPDO mapping, it is read-only (RO). The CiA 402 protocol imposes the following constraints on the object dictionary:

Index	Description
0000h-0FFFh	Data type description
1000h-1FFFh	CoE communication object
2000h-5FFFh	Manufacturer-defined object
6000h-9FFFh	Profile-defined object
A000h-FFFFh	Reserved

The access attributes of objects 1600h - 1603h and 1A00h - 1A03h are read/write (RW), but writing is only allowed under specific conditions. Only in the Pre-Operational (Pre-Op) state can the value of sub-index 00h be modified. Only when sub-index 00h equals 0 can the values of sub-indexes 01h-08h be modified.

The steps to modify PDO mapping are as follows, taking 1600h as an example:

I. ESM state switches to Pre-Operational (Pre-Op) state (Init → Pre-Op)

II. Write 0 to sub-index 00h of 1600h

III. Write new values to sub-indexes 01h - 08h of 1600h

IV. Write the new number of indexes to sub-index 00h of 1600h

V. ESM state switches to Operational (OP) state (Pre-Op→Safe-Op→Op), new RPDO mapping can be used

3. PDO Default Configuration

Default configuration for the 1st PDO mapping group, generally used for Cyclic Synchronous Position (CSP) mode and probe function.

Index	Sub-index	Default Value	Description
1600h	00h	0004h	4 mapped objects
	01h	60400010h	Control word (6040h), 16-bit length
	02h	60600008h	Operating mode (6060h), 8-bit length
	03h	607A0020h	Target position (607Ah), 32-bit length
	04h	60B80010h	Probe settings (60B8h), 16-bit length
1A00h	00h	0007h	7 mapped objects
	01h	603F0010h	Error code (603Fh), 16-bit length
	02h	60410010h	Status word (6041h), 16-bit length
	03h	60610008h	Current mode (6061h), 8-bit length
	04h	60640020h	Actual position (6064h), 32-bit length
	05h	60B90010h	Probe status (60B9h), 16-bit length
	06h	60BA0020h	Probe 1 rising edge position (60BAh), 32-bit length
	07h	60F40020h	Position following error (60F4h), 32-bit length

7.3 Synchronization Mode and Communication Cycle

7.3.1 Synchronization Mode

CD300E drives support two synchronization modes: FreeRun mode and DC Synchronous mode.

(1) Free Run Mode

In FreeRun mode, the drive uses its local clock to process communication data and is not synchronized with the EtherCAT communication cycle. This mode is asynchronous and suitable for applications with low real-time requirements.

(2) DC Synchronous Mode

In DC (Distributed Clocks) Synchronous mode, the drive and master use the same system clock (SYNC0 event) to achieve synchronized execution of EtherCAT communication. This mode allows all devices to use the same reference time, thus achieving synchronization between devices, and is suitable for applications where multiple drives need to coordinate motion.

7.3.2 Communication Cycle

CD300E drives support communication cycles of 125μs, 250μs, 500μs, 1ms, 2ms, 4ms, 8ms. A smaller communication cycle means faster response. In DC Synchronous mode, the drive acts as a slave and needs to synchronize with the controller's communication cycle. When the drive is connected to a controller, it will automatically match the controller's communication cycle. If matching fails, a communication failure with the controller will be indicated.

Related objects:

Index	Sub-index	Name	Description
1C32 (SM 2)	01h	Synchronization Mode	0: Free Run mode 2: DC Synchronous mode
	02h	Communication Cycle	125μs, 250μs, 500μs, 1ms, 2ms, 4ms, 8ms
	05h	Minimum Communication Cycle	125μs
1C33 (SM 3)	01h	Synchronization Mode	0: Free Run mode 2: DC Synchronous mode
	02h	Communication Cycle	125μs, 250μs, 500μs, 1ms, 2ms, 4ms, 8ms
	05h	Minimum Communication Cycle	125μs

7.4 Communication Configuration Examples

7.4.1 CD300E with Beckhoff Controller Operation Case

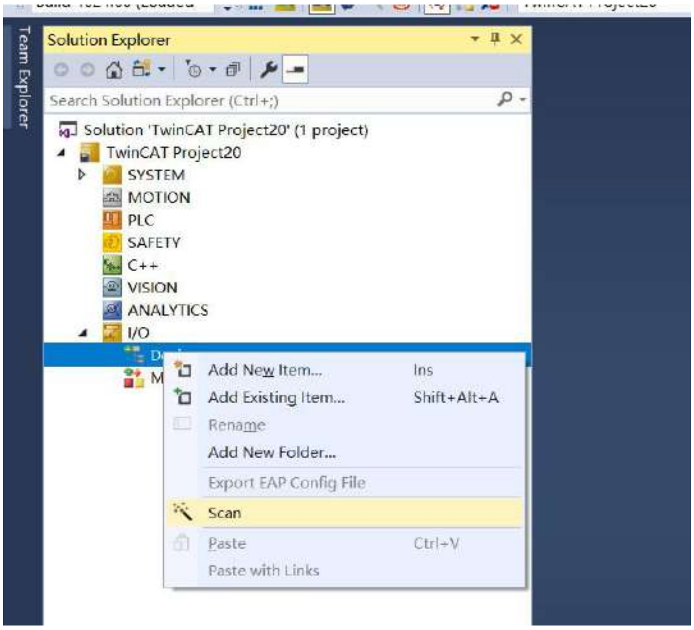
(1) Hardware Scan and Parameter Configuration

I. XML Description File Loading

Go to the official website of Simphoenix Electric www.simphoenix.com.cn to download the EtherCAT slave description file for the CD300E series servo drive. After downloading, copy the XML file to the C:\TwinCAT\3.1\Config\Io\EtherCAT directory.

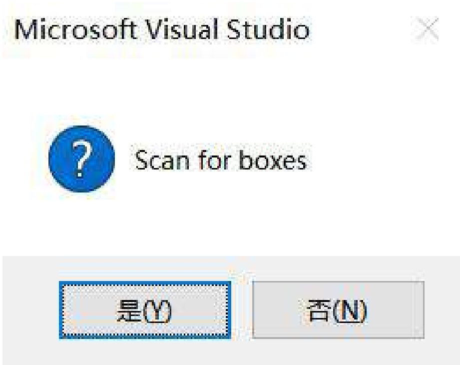
II. Hardware Scan

Create a new TwinCAT Project, and then set the connected controller as the target controller; right-click the icon in the bottom right corner and switch TwinCAT to the configuration mode; expand the I/O tab, right-click Devices, and click Scan.

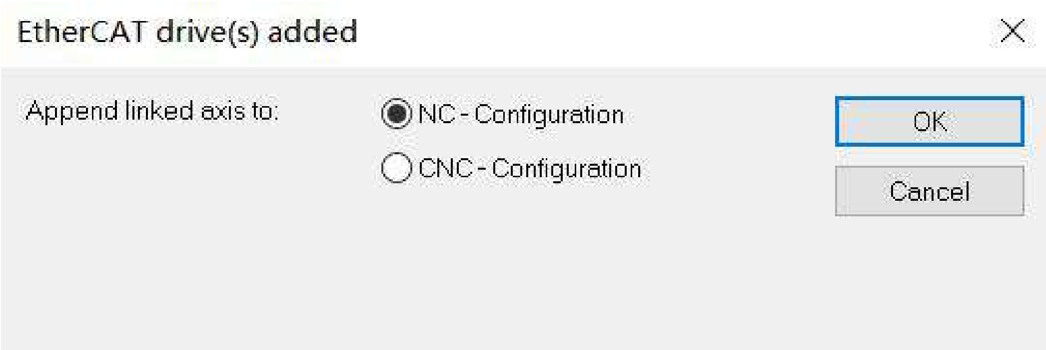


At this point, a prompt "Not all devices can be scanned automatically" will appear. We have already added the XML file, and click OK.

In the pop-up dialog box, check the I/O device with the (EtherCAT) suffix and click OK to confirm. When asked if you want to scan devices, select Yes;



Next, it asks if you want to automatically add axis configuration templates in MOTION. Here, select NC and click OK to auto-add;



Finally, it asks if you want to enter Free Run mode, select No;

At this point, the hardware scan is complete.

III. Parameter Configuration

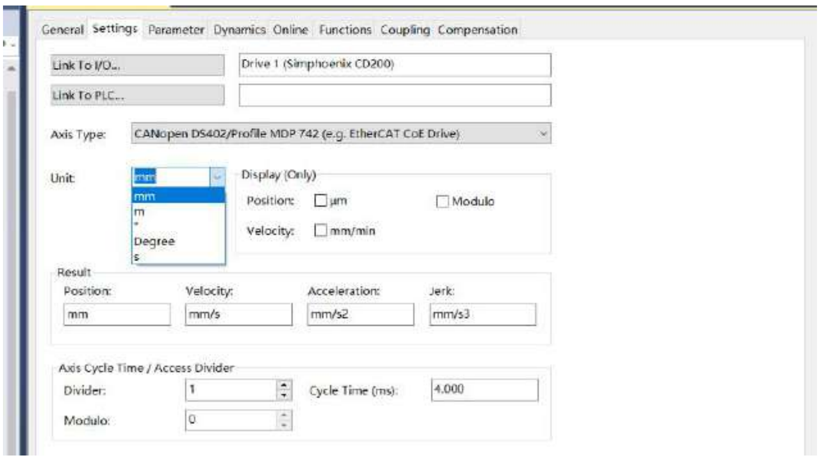
1. DC Mode Setting

In the left Solution Explorer, expand the newly added Device1 (EtherCAT), click Drive 1 (Simphoenix CD300), go to the DC tab on the right, and change the Operation Mode to DC-Synchron. If it's already DC, no modification is needed.

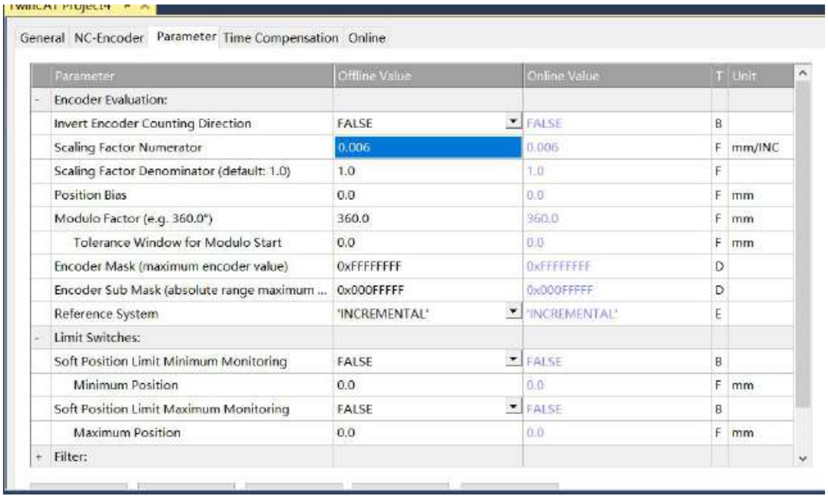
2. NC Axis Parameter Setting

a. Pulse Equivalent Scaling Factor Setting

Expand MOTION → NC Task 1 SAF → Axes1, select Settings in the right tab; choose an appropriate unit as needed (options include mm/°/radian, etc., and we takes mm as an example)



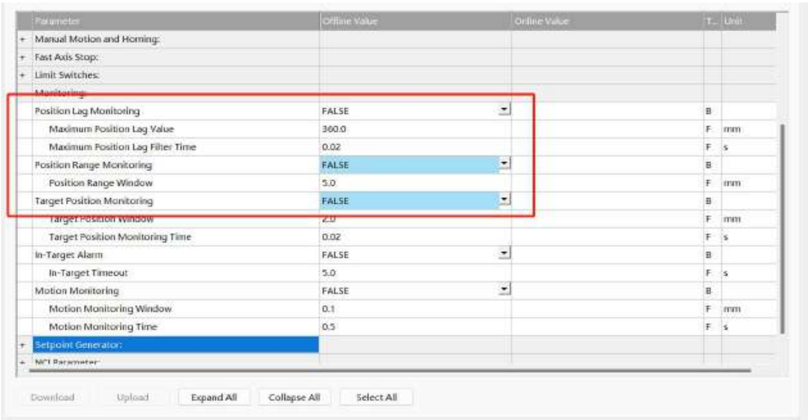
Then, in the left Solution Explorer, click Enc to modify encoder parameters



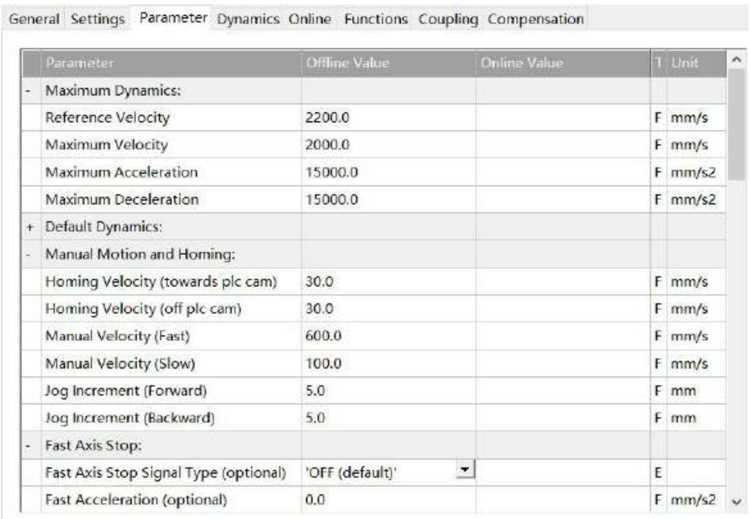
$$ScalingFactor = \frac{ScalingFactor\ Numerator}{ScalingFactor\ Denominator} = \frac{Displacement\ per\ Revolution}{\text{Feed（6092h} - \text{01h）}}$$

The CD300E drive's feed amount (6092h-01h) is set to 10000 by default, i.e., 10000 pulses from the controller correspond to one revolution of the motor. Depending on the selected displacement unit, the value of the Scaling Factor numerator needs to be modified. For example, if the displacement unit is "mm", it's generally set that one revolution of the motor corresponds to 60mm of the movement. In this case, 1mm/s corresponds to 1r/min, because the motor's rated speed unit is r/min, which is more intuitive during debugging.

b. For initial debugging, it is recommended to disable following error monitoring, position range monitoring, and target position monitoring. Otherwise, not only will following error report an alarm, but the NC axis will also report an alarm. These can be set as needed later.



c. Related Speed Setting



	Parameter	Offline Value	Online Value	T	Unit
-	Maximum Dynamics:				
	Reference Velocity	2200.0		F	mm/s
	Maximum Velocity	2000.0		F	mm/s
	Maximum Acceleration	15000.0		F	mm/s2
	Maximum Deceleration	15000.0		F	mm/s2
+	Default Dynamics:				
-	Manual Motion and Homing:				
	Homing Velocity (towards plc cam)	30.0		F	mm/s
	Homing Velocity (off plc cam)	30.0		F	mm/s
	Manual Velocity (Fast)	600.0		F	mm/s
	Manual Velocity (Slow)	100.0		F	mm/s
	Jog Increment (Forward)	5.0		F	mm
	Jog Increment (Backward)	5.0		F	mm
-	Fast Axis Stop:				
	Fast Axis Stop Signal Type (optional)	'OFF (default)'		E	
	Fast Acceleration (optional)	0.0		F	mm/s2

- Reference Velocity: Set to the speed at which the load moves when the motor is at its rated speed;
- Maximum Velocity: During debugging or PLC axis control, the target speed must not exceed this value. It should be slightly less than the reference velocity, typically set to about 95% of the reference velocity;
- Manual Velocity (Fast/Slow): Speed for jogging (manual jogging), standard fast mode, and standard slow mode;
- Jog Increment (Forward/Backward): Displacement step for forward and reverse jogging.

In this test, one revolution of the motor is **60mm, and the motor's rated speed of the drive is 3000** rpm. Thus,

Reference Velocity **= 60mm * 3000/60 = 3000mm/s**

Maximum Velocity = 0.95 * **3000mm/60 = 2850mm/s**

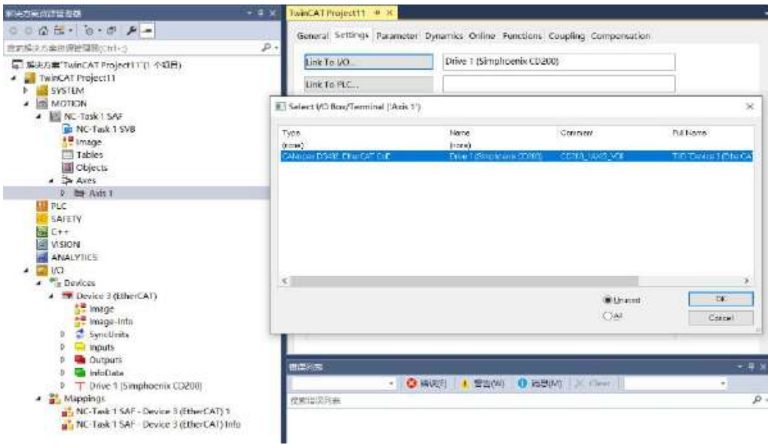
Other speed parameters are set according to the specific application.

After setting the parameters, click the "Download" button below to update parameters or directly activate the configuration to download all parameters. (Some parameters may not be directly downloadable and will prompt a message box; configuration activation is required. Please operate according to the actual prompt).

(2) Drive Function Debugging

I. Relationship between NC Axis and Physical Axis

You can select the physical axis associated with the NC axis via Axis1 → Settings → Link to. This link is automatically added during hardware scanning, or you can manually right-click Axes, click Append axis to add an axis, and manually link the NC axis to the physical axis. This window shows the correspondence between NC axis and physical axis.

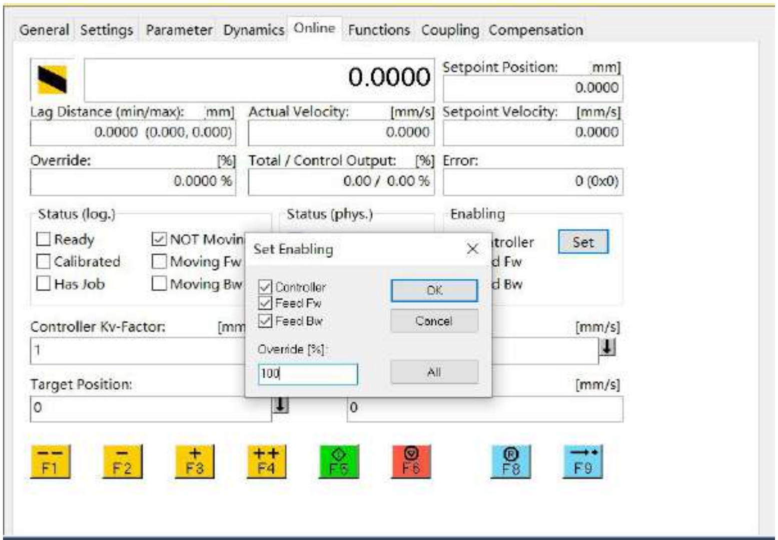


Expanding the variables in I/O Devices, you can see that the variables under the drive are already linked. Right-click one of the variables and click Go to Link Variable to see the link between this variable and the variable in the NC axis. The NC axis and physical axis exchange data through these variables. Drive data is read into the NC every cycle, and after processing, the NC sends control commands to the drive.

(3) NC Interface Debugging

After parameter configuration is complete and the configuration is activated into run mode, click "motion" → "Axes" → "Axis1" → "Online" as shown in the figure, to perform debugging.

I. Click SET, manually check Controller, Feed Fw, Feed Bw, and set Override (speed ratio), then click OK. Alternatively, directly click ALL to enable the axis, which automatically sets the speed ratio to 100%.

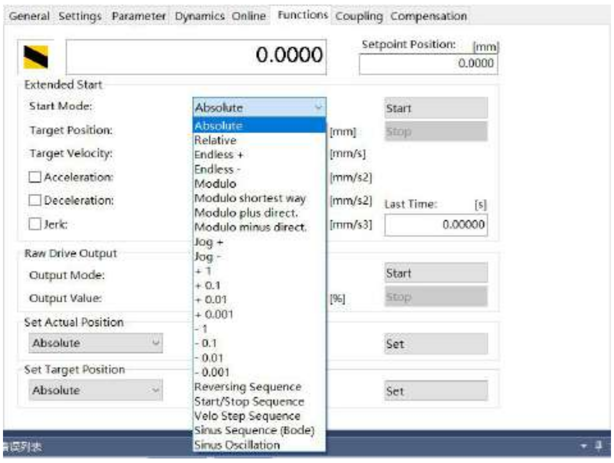


II. After enabling, you can see that the Ready status is checked, meaning that the motor is enabled. Controller, Feed Fw, Feed Bw statuses will also be checked. Then, pressing F1 to F4 allows jogging the motor. Pressing F1 jogs, releasing F1 stops the motor. Jog speed is set in Manual Velocity under the Parameter tab, with default speeds of 100mm/s and 600mm/s, corresponding to slow jog and fast jog, respectively.

III. After setting Target Position and Target Velocity, press F5 to achieve the position control, and the motor will move to the target position at the set target speed. For example, if the current position is 0 and the target position is 10000, then after triggering F5, the motor will move from position 0 to 10000, which is absolute position positioning, and F6 can be used to stop during positioning.

IV. When the NC reports an error, there will be an error code in Error. You need to reset the error with F8, otherwise the axis cannot continue to move. F9 is the origin finding button. After pressing F9, the axis position will become 99999... and move slowly. However, the origin finding process requires an external hardware signal as the home position signal, which cannot be captured in the Online window. Therefore, F9 button is generally not used for homing; instead, the origin finding function is implemented through programming.

V. Through Set Actual Position in Functions, you can modify the current position of the axis. If the current position is set to 0, then the current position is the origin. This position will be lost after TwinCAT restarts. If it's an absolute encoder type feedback, then after restarting, the actual feedback position of the encoder will be the current position. In the Functions → Start Mode menu, there are many debugging methods for single axes, commonly including Absolute (absolute position movement), Relative (relative position movement), Endless+- (infinite forward/reverse), Modulo (modulo movement), Reversing Sequence (reversing sequence), Start/Stop Sequence (start/stop sequence), Velo Step Sequence (velocity step sequence).



7.4.2 CD300E with Trio Controller Operation Case

Below, taking Trio MC4N-ECAT (P900) master as an example, we will describe the simple configuration and usage process of the CD300E servo drive.

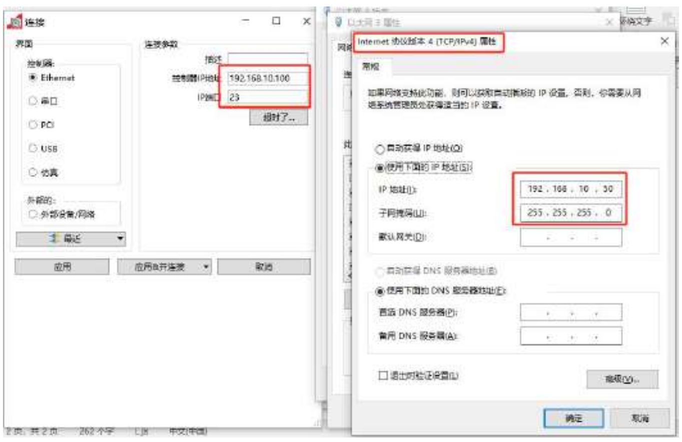
(1) Hardware Scan and Parameter Configuration

I. **Install Software**

Install Motion Perfect software. V5.4 or higher is recommended.

II. **Set Network Connection Properties**

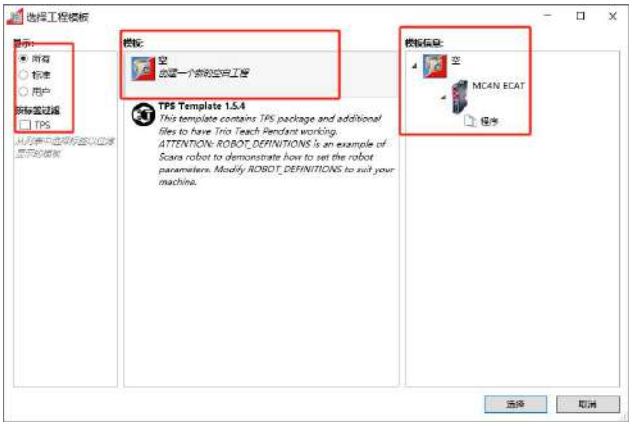
Connect the computer and controller directly via Ethernet, and set the computer's TCP/IP properties as shown below:



Manually set the IP address for the computer's IPv4 protocol, ensuring that the computer's IP address and the drive are on the same network segment. The controller should select IP port 23. After ensuring consistency, click Apply and Connect to complete controller-computer communication.

III. Create New Project

Click Project → New (after the programming software connects to the controller, creating a new project will automatically identify the controller model) → Select (select project template, save location, and name) → Confirm to complete new project creation. as shown in the figure below:



Then add the program, steps as follows: click File/Program → New (or directly double-click the project on the left)

You can choose Trio BASIC programming language or IEC61131-3 programming language. Below, we will use Trio BASIC program as an example. First, you need to load the network configuration file **"EC_EXTEND"** and the controller configuration file "**MC_CONFIG",** as shown below:

After creating a new network configuration file, you need to add the CD300E's XML file. Only after adding it will the EtherCAT network be scannable. The steps are as follows:

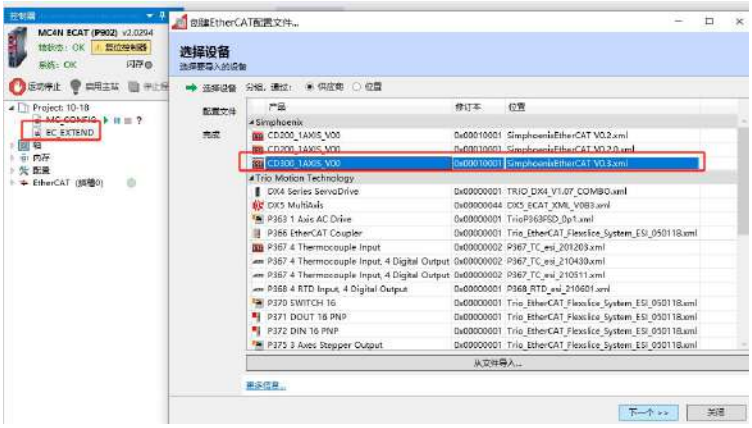
EC_EXTEND Program Configuration:

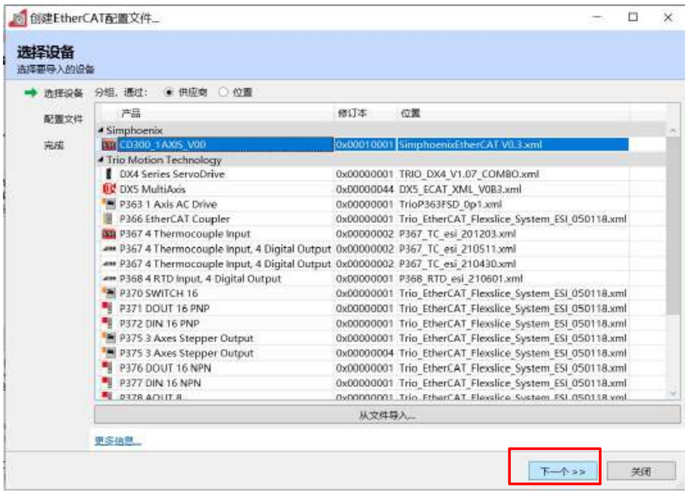
Right-click EC_EXTEND project → Import ESI file → CD300-1AXIS_V00 → Select CD300 from the selected device dropdown → Choose Control Mode for Axis Type (default Position: CSP) → Merge to complete the drive XML file configuration.

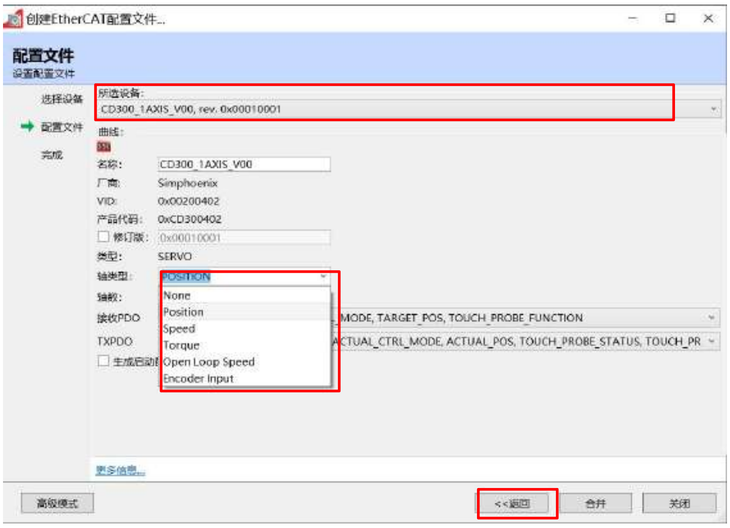
MC_CONFIG Program Configuration:

Double-click MC_CONFIG → click Edit → EtherCAT → Network Cycle Time Selection (MC4N supports 500us at minimum, and 2000us is recommended) to complete the new project configuration. Click Reset Controller to complete slave configuration.

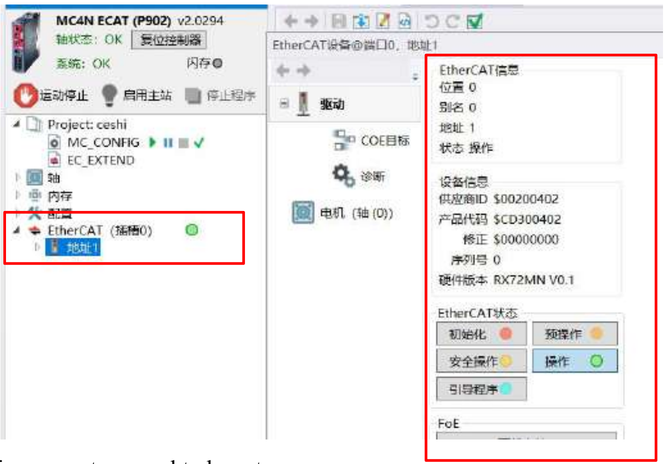
The new process is shown below:



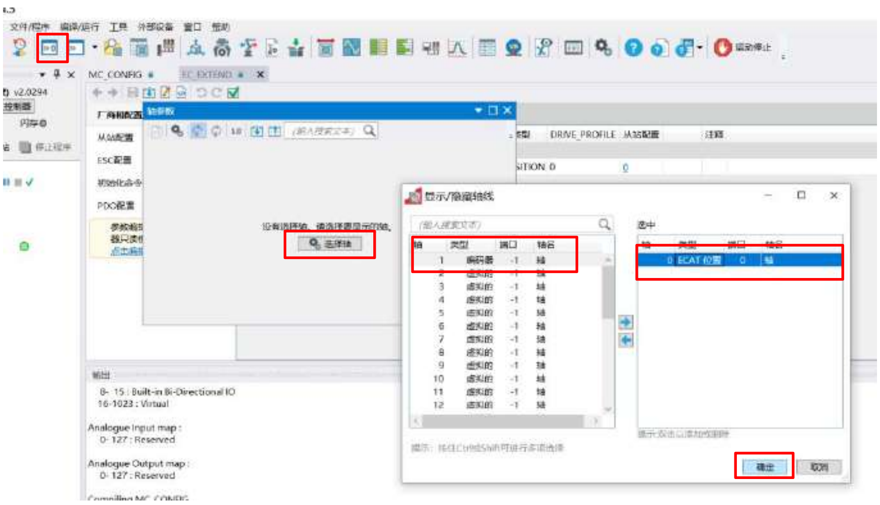


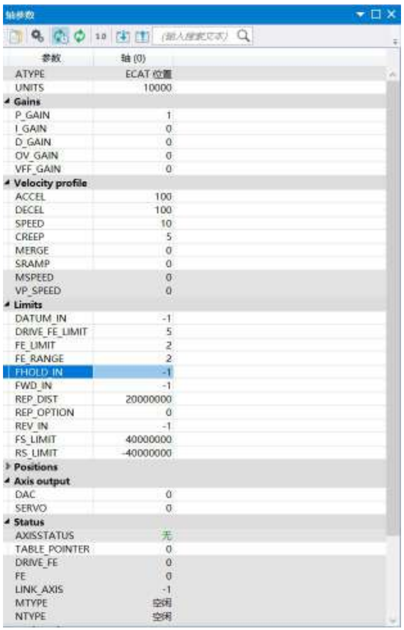


At this point, you can view the slave status via the navigation bar EtherCAT:



After configuration is complete, axis parameters need to be set:





Including:

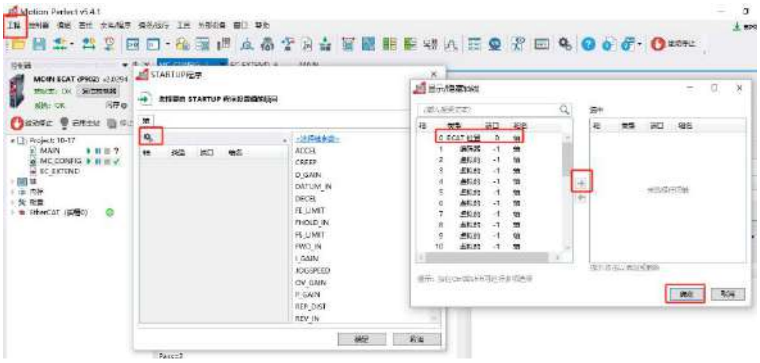
UNITS is the servo motor pulse equivalent (pulses per revolution, CD300E is set to 10000)

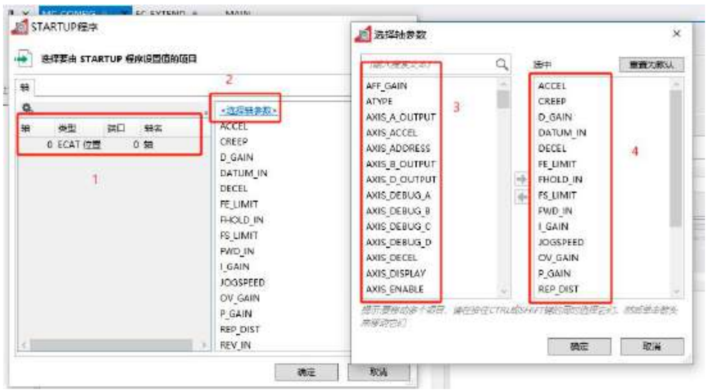
SPEED is the motor speed, corresponding to (set value * UNITS)/second

SERVO is the open/closed-loop control selection, 1 for closed-loop control. Before closed-loop control, ensure that the analog output direction and encoder direction are the same. You can first set SERVO=OFF, output a positive voltage using the DAC command, and observe if the encoder value increases. If they are opposite, you can change the encoder direction using encoderratio=(-1,1). If you start with closed-loop control immediately and the analog output direction and encoder direction are opposite, it will create positive feedback, leading to run away.

Gains (gain parameter group), Velocity Profile (speed, acceleration/deceleration settings), Limits (soft limit, position tracking error setting, etc.) can be set as needed. After configuring axis parameters, create a new program to initialize axis parameters, as follows:

Click Project → Modify STARTUP → Axis → Select connected axis → Select the axis parameters to be initialized as needed → OK





Right-click on the STARTUP program and set the auto-run option to set STARTUP process to 0 (run once at power-up initialization)

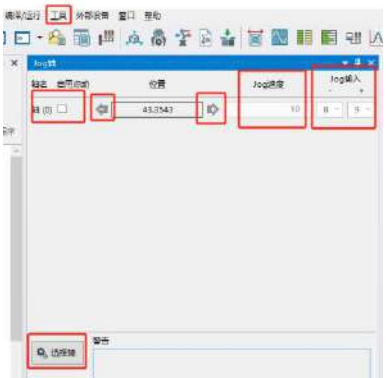
The above completes the parameter configuration

(2) Drive Function Debugging

Ⅰ. JOG **(Jogging) Demonstration:**

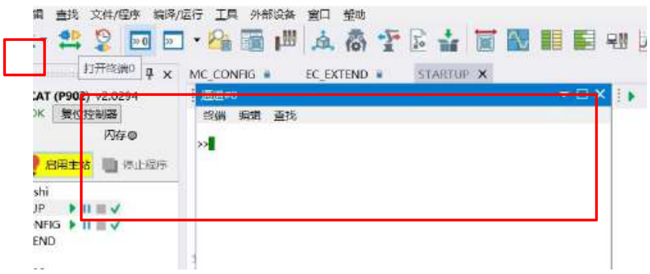
Jogging control axis mode operation:

After enabling the jogging control axis, click Tools → JOG Axis → Select Axis → JOG Input (i.e., mapped to forward/reverse input terminals) → Set JOG Speed → Use +/- to achieve forward/reverse rotation of the servo axis, the motor speed will be the JOG speed.



II. BASIC Instruction Run

Select to open the instruction editing interface from the menu bar



WDOG: Instruction to enable servo drive

FORWARD is the axis forward command

REVERSE is the axis reverse command

CANCEL is the command to cancel axis movement (CANCEL(1) cancels the current running command, CANCEL(2) cancels all axis movement commands)

MOVE() instruction moves relative to the current position

MOVEABS() instruction moves the servo to an absolute position

DATUM() is the origin finding instruction, with 6 modes available to position the axis to an absolute location Set CREEP speed in axis parameters to change the creeping speed to the zero signal point. The set speed can be configured via SPEED in the axis parameter table

Chapter 8 Servo Basic Functions

8.1 Electronic Gear

8.1.1 Electronic Gear Ratio

Electronic gear is a function that converts the displacement set by the "command unit" input from the host computer into the number of pulses required for actual movement.

The "command unit" refers to the minimum displacement of the load. The command unit does not convert displacement into pulses but into units of physical quantities that are easy to understand, such as distance (e.g., μm or °).

Through the electronic gear function, each pulse input to the servo unit corresponds to one command unit of workpiece movement. With the use of this function, the motor rotation and movement amount per command unit can be arbitrarily set.

Set the electronic gear ratio according to objects 608Fh (Position encoder resolution), 6091h (Gear ratio), and 6092h (Feed) as specified by CoE (CiA402).

The relationship between user-defined command units and internal units (pul) is calculated according to the following equation:

$$\text{Electronic Gear Ratio} = \frac{Positionencoder\ resolution \times Gear\ ratio}{Feedconstant}$$

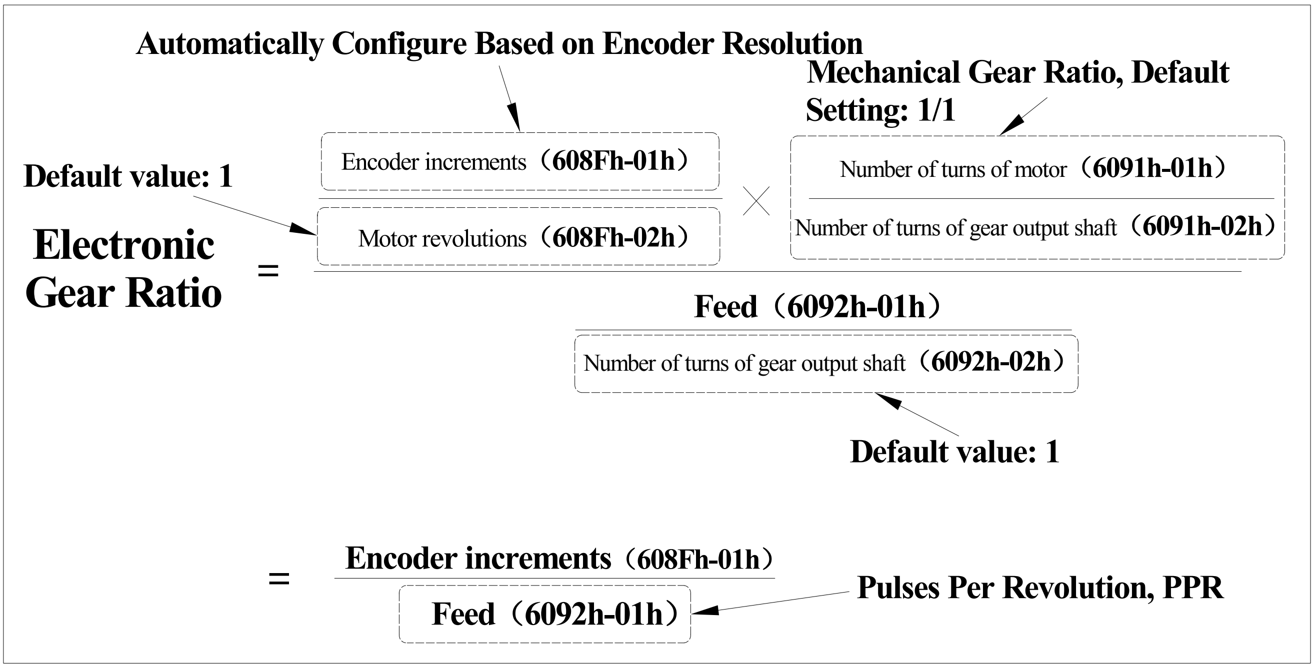
$$\text{Position demand value} \times \text{Electronic Gear Ratio} = \text{Position demand internalvalue}$$

Note:

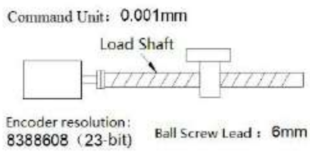
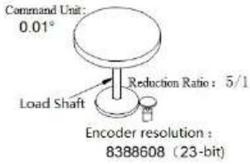
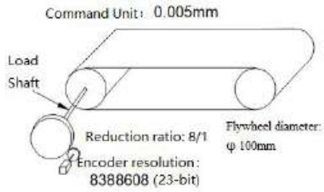
- **The electronic gear ratio is Validation in the range of 8000 times to 1/1000 times.**
  If the set electronic gear ratio is outside this range and enabling is attempted, Er.FF09 (Abnormal Action Setting) will be triggered.
- **608Fh-01h (Encoder increments) is automatically set according to the encoder's resolution.**
- **608Fh-02h (Motor revolutions) is fixed at 1.**
- **When modifying the electronic gear ratio, please disable first.**

8.1.2 Common Electronic Gear Setting Methods

(1) Set the number of command pulses for one turn. The drive's default is this setting.



Examples of settings for three common mechanical systems are as follows:

Content	Mechanical System Configuration		
	Ball Screw	Round Table	Belt + Flywheel
			
Mechanical Specification	Ball screw lead: 6mm Reduction Ratio: 1/1	1 turn angle: 360° Reduction Ratio: 5/1	Flywheel diameter: 100mm (circumference 314mm) Reduction ratio: 8/1
Encoder Resolution	8388608 (23-bit)	8388608 (23-bit)	8388608 (23-bit)
Command Unit	0.001mm (1μm)	0.01°	0.005mm (5μm)
Load Shaft Rotation 1 Turn Displacement	6mm/0.001mm=6000	360°/0.01°=36000	314mm/0.005mm=62800
Electronic Gear Ratio	$\frac{8388608}{6000} \times \frac{1}{1}$	$\frac{8388608}{36000} \times \frac{5}{1}$	$\frac{8388608}{62800} \times \frac{8}{1}$

(2) Set the electronic gear ratio numerator and denominator.

Automatically Configure Based on Encoder Resolution

Default value: 1

$$\text{Electronic Gear Ratio} = \frac{\dfrac{\text{Encoder increments (608Fh-01h)}}{\text{Motor revolutions (608Fh-02h)}} \times \dfrac{\text{Number of turns of motor (6091h-01h)}}{\text{Number of turns of gear output shaft (6091h-02h)}}}{\dfrac{\text{Feed (6092h-01h)}}{\text{Number of turns of gear output shaft (6092h-02h)}}}$$

Setting the Same Value as 608Fh-01h

Default value: 1

$$= \frac{\text{Number of turns of motor (6091h-01h)}}{\text{Number of turns of gear output shaft (6091h-02h)}}$$

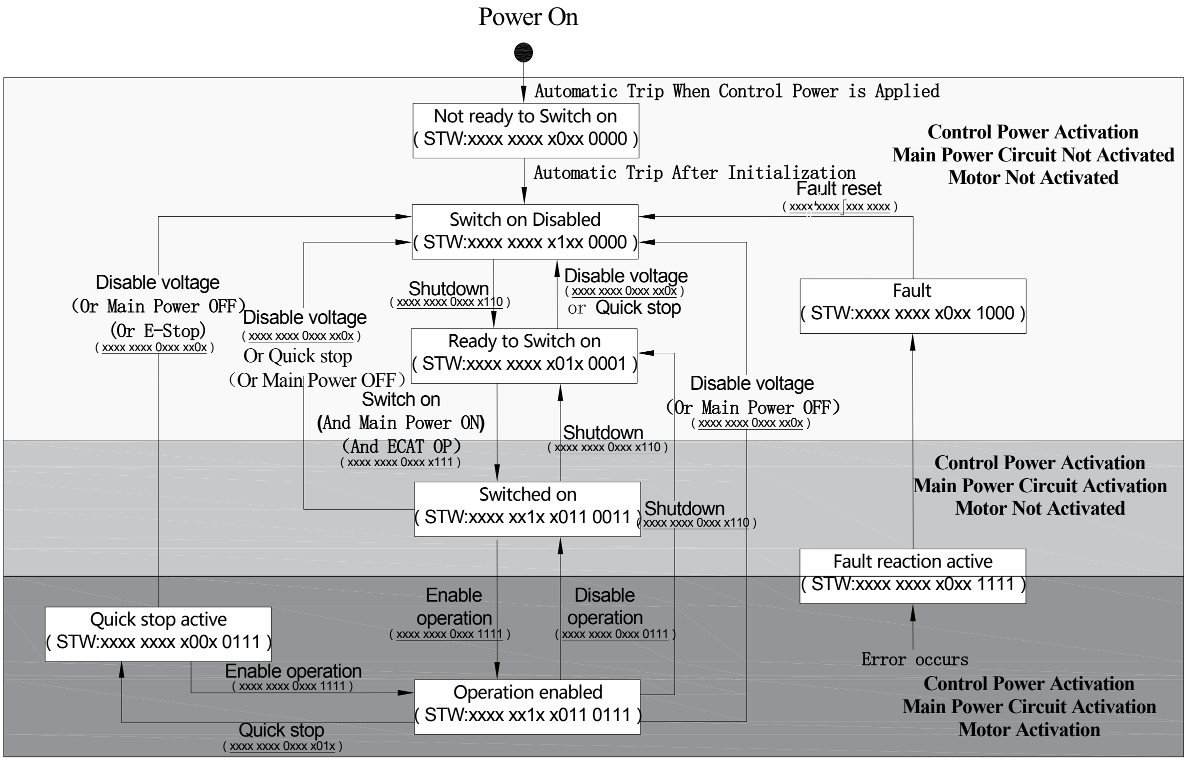
Electronic Gear Ratio Numerator

Electronic Gear Ratio Denominator

8.2 Device Control

8.2.1 Power Drive Systems (PDS)

The power drive system (PDS) state transition for CD300 series EtherCAT bus servo drives, as specified by the CiA402 protocol, is shown below. The state transitions are controlled via Controlword (6040h), and the servo drive's device state is monitored using Statusword (6041h).



(Note) • ☐ indicates a state.

• STW refers to Statusword (6041h).

• ___ (underscore) is the control command for Controlword (6040h).

Each state is described in the table below:

PDS Status		Description
Not ready to Switch on	Initialization (incomplete state)	The device power is on, the drive is in initialization process and performing internal self-check, and the brake is activated. Drive parameters cannot be set, and drive functions cannot be executed.
Switch on Disabled	Initialization (complete state)	The servo drive is fault-free, or the error has been cleared. Drive parameters can be set using SDO communication service.
Ready to Switch on	Main circuit power OFF state	The servo drive is ready, and the motor is not energized. Drive parameters can be set.
Switched on	Servo Enable Off / Servo Ready	The drive motor is in ready state, the main circuit power will be finally connected in this state, but drive functions cannot be executed. Drive parameters can be set.
Operation enabled	Servo Enable On	The drive is operating normally, a servo operating mode has been enabled, and the motor is energized. When the speed command is not 0, the motor rotates. Drive parameters with "Runtime Change" attribute can be set, others cannot.
Quick stop active	Quick Stop	The quick stop function is activated, and the drive is executing quick stop function. Drive parameters with "Runtime Change" attribute can be set, others cannot.
Fault reaction active	Fault (Alarm) Active	Drive has faulted, stopping according to set method. Motor is still enabled. Drive parameters with "Runtime Change" attribute can be set, others cannot.
Fault	Fault status	Fault Stop complete, all drive functions are inhibited, and drive parameters can be changed to troubleshoot the fault.

Commands controlling the servo drive PDS state transition are set via 6040h (Control Word)

Index	Sub-index	Name/Description	Access	Data Type	Ranges
6040h	00h	Controlword	RW	U16	0-65535

Details of each bit of Controlword are as follows:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Manufacture specific							h	fr	oms			eo	qs	ev	so

Where: so = switch on fr = fault reset

ev= enable voltage h = halt

qs= quick stop oms = operation mode specific

eo= enable operation

PDS state transition is triggered by control commands formed by combining bits 7, 3-0 of Controlword

Command	Controlword (6040h) bits				
	bit7	bit3	bit2	bit1	bit0
Shutdown	0	X	1	1	0
Switch on	0	0	1	1	1
Switch on + Enable operation	0	1	1	1	1
Disable voltage	0	X	X	0	X
Quick stop	0	X	0	1	X
Disable operation	0	0	1	1	1
Enable operation	0	1	1	1	1
Fault reset	0→1	X	X	X	X

Note: X in the table means the bit can be ignored

Servo drive status confirmation is done via Statusword (6041h)

Index	Sub-index	Name/Description	Access	Data Type	Ranges
6041h	00h	Statusword	RO	U16	0-65535

Details of each bit of Statusword are as follows:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r		oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	so	rtso

Including:

r = reserved w = warning

oms = operation mode specific qs = quick stop

ila = internal limit active ve = voltage enabled

oe = operation enabled rm = remote

sod = switch on disabled so = switched on

rtso = ready to switch on f = fault

8.2.2 Stop Methods

The servo system's stop method can be set via the following objects:

▪605Ah (Quick Stop Option Code)

▪605Bh (Shutdown Option Code)

▪605Ch (Disable Operation Option Code)

Index	Sub-index	Name/Description	Access	Data Type	Ranges	Default Value
605Ah	00h	Quick stop Option Code	RW	INT16	0-15	0

When the servo state machine executes the Quick stop command from the "Operation enabled" state, the drive will perform the stop operation according to the stop method defined by 605Ah.

Value	Description
0	Turn off motor excitation signal, motor stops by inertia
1	Stop with deceleration according to object 6084h, then remain in "Switch on Disabled" state
2	Stop with deceleration according to object 6085h, then remain in "Switch on Disabled" state
3/4	The motor stops with maximum current limit and remains in Switch on Disabled state
5/9	Stop with deceleration according to object 6084h, then remain in "Quick stop active" state
6/10	Stop with deceleration according to object 6085h, then remain in "Quick stop active" state
7/8	The motor stops immediately and remains in Quick stop active state
11/13	The motor stops with maximum current limit and remains in Quick stop active state
12	The motor stops with maximum current limit, reset integrator, and remains in Quick stop active state
14	Stop with deceleration according to object 6084h, then remain in "Switched on" state
15	Stop with deceleration according to object 6085h, then remain in "Ready to Switch on" state

Index	Sub-index	Name/Description	Access	Data Type	Ranges	Default Value
605Bh	00h	Shutdown Option Code	RW	INT16	0-1	0

When the servo state machine executes the Shutdown command from the "Operation enabled" state, the servo will perform the stop operation according to the stop method defined by 605Bh.

Value	Description
0	Turn off motor excitation signal, motor stops by inertia
1	Stop with deceleration according to object 6084h, then remain in "Ready to Switched on" state

Index	Sub-index	Name/Description	Access	Data Type	Ranges	Default Value
605Ch	00h	Disable Operation Option Code	RW	INT16	0-1	0

When the servo executes the Disable operation command, the servo will perform the stop operation according to the stop method defined by 605Ch.

Value	Description
0	Turn off motor excitation signal, motor stops by inertia
1	Stop with deceleration according to object 6084h, then remain in "Switched on" state

8.3 Control Mode Setting

CD300E can determine supported control modes via object 6502h. Servo pre-operational control modes can be set via object 6060h, and the current servo operating mode can be viewed via object 6061h.

Index	Sub-index	Name/Description	Access	Data Type	Ranges	Default Value
6502h	00h	Supported Drive Modes	RO	U32	0-4294967295	0x000003AD

Each bit definition is as follows:

bit	Modes of Operation	Supported or not
0	Profile Position Mode (PP)	Yes
1	Velocity Mode (VL)	No
2	Profile Velocity Mode (PV)	Yes
3	Profile Torque Mode (PT)	Yes
4	Reserved	
5	Homing Mode (HM)	Yes
6	Interpolated Position Mode (IP)	No
7	Cyclic Synchronous Position Mode (CSP)	Yes
8	Cyclic Synchronous Velocity Mode (CSV)	Yes
9	Cyclic Synchronous Torque Mode (CST)	Yes
10-31	Reserved	

<table>
<tr><td rowspan="3">6060h</td><td rowspan="3">00h</td><td>Modes of Operation</td><td>RW</td><td>INT8</td><td>-128-127</td><td>1</td></tr>
<tr><td colspan="5">Set the servo's control mode; unsupported control modes are prohibited from setting.</td></tr>
<tr><td colspan="5"><table>
<tr><th>Value</th><th>Modes of Operation</th></tr>
<tr><td>0</td><td>No mode change/no mode assigned</td></tr>
<tr><td>1</td><td>Profile Position Mode (PP)</td></tr>
<tr><td>3</td><td>Profile Velocity Mode (PV)</td></tr>
<tr><td>4</td><td>Profile Torque Mode (PT)</td></tr>
<tr><td>6</td><td>Homing Mode (HM)</td></tr>
<tr><td>8</td><td>Cyclic Synchronous Position Mode (CSP)</td></tr>
<tr><td>9</td><td>Cyclic Synchronous Velocity Mode (CSV)</td></tr>
<tr><td>10</td><td>Cyclic Synchronous Torque Mode (CST)</td></tr>
</table></td></tr>
<tr><td rowspan="3">6061h</td><td rowspan="3">00h</td><td>Modes of Operation Display</td><td>RO</td><td>INT8</td><td>-128-127</td><td>0</td></tr>
<tr><td colspan="5">Current Operating Mode Display</td></tr>
<tr><td colspan="5"><table>
<tr><th>Value</th><th>Modes of Operation Display</th></tr>
<tr><td>0</td><td>No mode change/no mode assigned</td></tr>
<tr><td>1</td><td>Profile Position Mode (PP)</td></tr>
<tr><td>3</td><td>Profile Velocity Mode (PV)</td></tr>
<tr><td>4</td><td>Profile Torque Mode (PT)</td></tr>
<tr><td>6</td><td>Homing Mode (HM)</td></tr>
<tr><td>8</td><td>Cyclic Synchronous Position Mode (CSP)</td></tr>
<tr><td>9</td><td>Cyclic Synchronous Velocity Mode (CSV)</td></tr>
<tr><td>10</td><td>Cyclic Synchronous Torque Mode (CST)</td></tr>
</table></td></tr>
</table>

The operating mode can be switched via Modes of Operation (6060h). To prevent abrupt motor actions, change the operating mode when the motor speed is 0. When changing modes while the motor is running, the master must simultaneously update the selected operating mode and all operation mode specific process data objects. When the master selects a new operating mode, the servo unit will immediately switch to the new mode. The action when changing operating mode is shown below.

Operation Mode before Change	**Action when Changing Operation Mode**
Profile Position Mode	Controlword bit 4 = 0: Stop the motor in position control mode. Controlword bit 4 = 1: Immediately start new positioning.
Homing mode (Homing mode)	Controlword bit 4 = 0: Stop the motor in position control mode. Controlword bit 4 = 1: Immediately start origin return.
Profile Torque Mode	The new operating mode will take effect immediately.
Profile Velocity Mode	The new operating mode will take effect immediately.
Cyclic Synchronous Position Mode	The new operating mode will take effect immediately.
Cyclic Synchronous Velocity Mode	The new operating mode will take effect immediately.
Cyclic Synchronous Torque Mode	The new operating mode will take effect immediately.

8.3.1 Cyclic Synchronous Position Mode (CSP)

In Cyclic Synchronous Position mode, the host computer controller completes position command planning and then periodically sends the planned target position 607Ah to the servo drive. Position, velocity, and torque control are completed internally by the servo drive. To enable Cyclic Synchronous Position mode, set object 6060h to 8.

(1) Control Description

Controlword 6040h and Statusword 6041h in CSP mode are described as follows:

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6040h	00h	Controlword	RW	RxPDO	U16	0-65535

Bit	Name	Description
0	Switch on	Must be set to 1 when enabling the servo
1	Enable voltage	Must be set to 1 when enabling the servo
2	Quick stop	Must be set to 1 to enable the servo. Setting to 0 results in quick stop
3	Operation enable	Must be set to 1 when enabling the servo
7	Fault Reset	Execute a fault reset when changing from 0→1. Other commands are invalid when set to 1

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6041h	00h	Statusword	RO	TxPDO	U16	0-65535

Bit	Name	Description
0	Ready to switch on	0: Invalid, 1: Valid. When valid, servo can be enabled
1	Switched on	0: Invalid, 1: Valid. When valid, servo can be enabled
2	Operation enabled	0: Invalid, 1: Valid. When valid, indicates servo is enabled
3	Servo Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Invalid, 1: Valid. When valid, servo can be enabled
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Invalid, 1: Valid. When valid, servo can be enabled
7	Warning	0: No warning, 1: With warning
9	Remote Control	0: Invalid, 1: Valid. When active, it indicates the Controlword has taken effect
10	Target Reached	0: Position not reached, 1: Position reached
11	Internal soft limit status	0: Soft limit not triggered, 1: Soft limit triggered
12	Slave Following Command	0: Target position not followed, 1: Target position followed already
13	Following Position Error Alarm	0: No position deviation alarm, 1: Position deviation alarm
15	Homing completed	0: Homing not completed, 1: Homing completed

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
603Fh	00h	Error Code	RO	Not changeable	UINT16
6040h	00h	Control Word	RW	Real-time change	UINT16
6041h	00h	State Word	RO	Not changeable	UINT16
605Ah	00h	Quick stop option	RW	Real-time change	UINT 16
6060h	00h	Control Mode	RW	Real-time change	INT 8
6061h	00h	Current operating mode	RO	Not changeable	INT 8
6064h	00h	Actual Position	RO	Not changeable	INT 32
6065h	00h	Position following error window	RW	Real-time change	UINT 32
606Ch	00h	Velocity loop feedback	RO	Not changeable	INT 32
6077h	00h	Actual torque	RO	Not changeable	INT 16
607Ah	00h	Target Position	RW	Real-time change	INT 32
607Dh	01h	Soft limit position 1	RW	Real-time change	INT 32
	02h	Soft limit position 2	RW	Real-time change	INT 32
607Eh	00h	Command polarity	RW	Real-time change	UINT 8
6080h	00h	Maximum motor velocity	RW	Real-time change	UINT 32
6085h	00h	Emergency Stop Deceleration	RW	Real-time change	UINT 32
60B0h	00h	Position Offset	RW	Real-time change	INT 32
60B1h	00h	Velocity Offset	RW	Real-time change	INT 32
60B2h	00h	Torque Offset	RW	Real-time change	INT 16
60F4h	00h	Position following error	RO	Not changeable	INT 32

(3) Recommended Configuration

RPDO	TPDO	Description
6040h: Control word	**6041h:** Status word	Required
607Ah: Target position	**6064h:** Position actual value	Required
6060h: Modes of operation	**6061h:** Modes of operation display	Optional

8.3.2 Cyclic Synchronous Velocity Mode (CSV)

In Cyclic Synchronous Velocity mode, the host computer controller periodically and synchronously sends the calculated target velocity 60FFh to the servo drive. Velocity and torque regulation are performed internally by the servo. To enable Cyclic Synchronous Velocity mode, set object 6060h to 9.

(1) Control Description

Controlword 6040h and Statusword 6041h in CSV mode are described as follows:

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6040h	00h	Controlword	RW	RxPDO	U16	0-65535

Bit	Name	Description
0	Switch on	Must be set to 1 when enabling the servo
1	Enable voltage	Must be set to 1 when enabling the servo
2	Quick stop	Must be set to 1 to enable the servo. Setting to 0 results in quick stop
3	Operation enable	Must be set to 1 when enabling the servo
7	Fault Reset	Execute a fault reset when changing from 0→1. Other commands are invalid when set to 1

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6041h	00h	Statusword	RO	TxPDO	U16	0-65535

Bit	Name	Description
0	Ready to switch on	0: Invalid, 1: Valid. When valid, servo can be enabled
1	Switched on	0: Invalid, 1: Valid. When valid, servo can be enabled
2	Operation enabled	0: Invalid, 1: Valid. When valid, indicates servo is enabled
3	Servo Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Invalid, 1: Valid. When valid, servo can be enabled
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Invalid, 1: Valid. When valid, servo can be enabled
7	Warning	0: No warning, 1: With warning
9	Remote Control	0: Invalid, 1: Valid. When active, it indicates the Controlword has taken effect
11	Internal soft limit status	0: Soft limit not triggered, 1: Soft limit triggered
12	Slave Following Command	0: Target velocity not followed, 1: Target velocity followed already

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
603Fh	00h	Error Code	RO	Not changeable	UINT16
6040h	00h	Control Word	RW	Real-time change	UINT16
6041h	00h	State Word	RO	Not changeable	UINT16
605Ah	00h	Quick stop option	RW	Real-time change	UINT 16
6060h	00h	Control Mode	RW	Real-time change	INT 8
6061h	00h	Current operating mode	RO	Not changeable	INT 8
6064h	00h	Actual Position	RO	Not changeable	INT 32
606Bh	00h	Speed Loop Command	RO	Not changeable	INT 32
606Ch	00h	Velocity loop feedback	RO	Not changeable	INT 32
606Dh	00h	Velocity Reached Threshold	RW	Real-time change	INT 16
606Eh	00h	Velocity Reached Time	RW	Real-time change	INT 16
6077h	00h	Actual torque	RO	Not changeable	INT 16
607Eh	00h	Command polarity	RW	Real-time change	UINT 8
6080h	00h	Maximum motor velocity	RW	Real-time change	UINT 32
6085h	00h	Emergency Stop Deceleration	RW	Real-time change	UINT 32

60B1h	00h	Velocity Offset	RW	Real-time change	INT 32
60B2h	00h	Torque Offset	RW	Real-time change	INT 16
60E0h	00h	Positive torque limit	RW	Real-time change	UINT 16
60E1h	00h	Negative torque limit	RW	Real-time change	UINT 16
60FFh	00h	Target Speed	RW	Real-time change	INT 32

(3) Recommended Configuration

RPDO	TPDO	Description
6040h: Control word	**6041h:** Status word	Required
60FFh: Target velocity		Required
6060h: Modes of operation	**6061h:** Modes of operation display	Optional
	6064h: Position actual value	Optional
	606Ch: Velocity actual value	Optional

8.3.3 Cyclic Synchronous Torque Mode (CST)

In Cyclic Synchronous Torque mode, the host computer controller periodically and synchronously sends the calculated target torque 6071h to the servo drive. Torque regulation is performed internally by the servo. To enable Cyclic Synchronous Torque mode, set object 6060h to 10.

(1) Control Description

Controlword 6040h and Statusword 6041h in CST mode are described as follows:

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6040h	00h	Controlword	RW	RxPDO	U16	0-65535

Bit	Name	Description
0	Switch on	Must be set to 1 when enabling the servo
1	Enable voltage	Must be set to 1 when enabling the servo
2	Quick stop	Must be set to 1 to enable the servo. Setting to 0 results in quick stop
3	Operation enable	Must be set to 1 when enabling the servo
7	Fault Reset	Execute a fault reset when changing from 0→1. Other commands are invalid when set to 1

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6041h	00h	Statusword	RO	TxPDO	U16	0-65535

Bit	Name	Description
0	Ready to switch on	0: Invalid, 1: Valid. When valid, servo can be enabled
1	Switched on	0: Invalid, 1: Valid. When valid, servo can be enabled
2	Operation enabled	0: Invalid, 1: Valid. When valid, indicates servo is enabled
3	Servo Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Invalid, 1: Valid. When valid, servo can be enabled
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Invalid, 1: Valid. When valid, servo can be enabled
7	Warning	0: No warning, 1: With warning
9	Remote Control	0: Invalid, 1: Valid. When active, it indicates the Controlword has taken effect
12	Slave Following Command	0: Target torque not followed, 1: Target torque followed already

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
4010h	6A	Torque mode speed limit	RW	Real-time change	UINT 32
603Fh	00h	Error Code	RO	Not changeable	UINT16
6040h	00h	Control Word	RW	Real-time change	UINT16
6041h	00h	State Word	RO	Not changeable	UINT16
605Ah	00h	Quick stop option	RW	Real-time change	UINT 16
6060h	00h	Control Mode	RW	Real-time change	INT 8
6061h	00h	Current operating mode	RO	Not changeable	INT 8
606Ch	00h	Velocity actual value	RO	Not changeable	INT 32
6071h	00h	Target Torque	RW	Real-time change	INT 16
6072h	00h	Maximum Torque	RW	Real-time change	INT 16
6074h	00h	Torque command	RO	Not changeable	INT 16
6077h	00h	Actual torque	RO	Not changeable	INT 16
607Eh	00h	Command polarity	RW	Real-time change	UINT 8
6085h	00h	Emergency Stop Deceleration	RW	Real-time change	UINT 32
60E0h	00h	Positive torque limit	RW	Real-time change	UINT 16
60E1h	00h	Negative torque limit	RW	Real-time change	UINT 16

(3) Recommended Configuration

RPDO	TPDO	Description
6040h: Control word	**6041h:** Status word	Required
6071h: Target torque		Required
6060h: Modes of operation	**6061h:** Modes of operation display	Optional
	6064h: Position actual value	Optional
	606Ch: Velocity actual value	Optional
	6077h: Torque actual value	Optional

8.3.4 Profile Position Mode (PP)

Profile position mode is mainly used for point-to-point positioning applications. In this mode, the host computer sets the target position, operating speed, and acceleration/deceleration. The servo's internal position Motion Path generator will generate position curve commands based on the settings, and the drive will complete position control, speed control, and torque control internally. To enable Profile Position Mode, set object 6060h to 1.

(1) Control Description

Controlword 6040h and Statusword 6041h in PP mode are described as follows:

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6040h	00h	Controlword	RW	RxPDO	U16	0-65535

Bit	Name	Description
0	Switch on	Must be set to 1 when enabling the servo
1	Enable voltage	Must be set to 1 when enabling the servo
2	Quick stop	Must be set to 1 to enable the servo. Setting to 0 results in quick stop
3	Operation enable	Must be set to 1 when enabling the servo
4	New target position	0→1: Trigger a new target position. 1→0: Clear bit12 of the status word
5	Immediate update	0: Wait for the current position command to complete before executing the new command 1: Abort the currently executing command and execute the latest position command
6	Position command type	0: Absolute position command, 1: Relative position command
7	Fault Reset	Execute a fault reset when changing from 0→1. Other commands are invalid when set to 1

Note: Bits 4, 5, 9:

Bit9		Bit5	Bit4	**Description**
0		0	0→1	After the current positioning is completed, start the next positioning
X		1	0→1	Immediately start the next positioning
1		0	0→1	Position to the current target position with the current profile velocity, then start the next positioning

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6041h	00h	Statusword	RO	TxPDO	U16	0-65535

Bit	Name	Description
0	Ready to switch on	0: Invalid, 1: Valid. When valid, servo can be enabled
1	Switched on	0: Invalid, 1: Valid. When valid, servo can be enabled
2	Operation enabled	0: Invalid, 1: Valid. When valid, indicates servo is enabled
3	Servo Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Invalid, 1: Valid. When valid, servo can be enabled
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Invalid, 1: Valid. When valid, servo can be enabled
7	Warning	0: No warning, 1: With warning
9	Remote Control	0: Invalid, 1: Valid. When active, it indicates the Controlword has taken effect
10	Target Reached	0: Position not reached, 1: Position reached
11	Internal soft limit status	0: Soft limit not triggered, 1: Soft limit triggered
12	New position command reception status	0: Previous setpoint operation completed, the target position can be updated 1: Previous setpoint operation is in progress, the target position cannot be updated
13	Position following error	0: No position deviation alarm, 1: Position deviation alarm
15	Homing completed	0: Homing not completed, 1: Homing completed

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
603Fh	00h	Error Code	RO	Not changeable	UINT16
6040h	00h	Control Word	RW	Real-time change	UINT16
6041h	00h	State Word	RO	Not changeable	UINT16
6060h	00h	Control Mode	RW	Real-time change	INT 8
6061h	00h	Current operating mode	RO	Not changeable	INT 8
6064h	00h	Actual Position	RO	Not changeable	INT 32
6065h	00h	Position following error window	RW	Real-time change	UINT 32
6066h	00h	Position following error time window	RW	Real-time change	UINT 32
6067h	00h	In-position window	RW	Real-time change	UINT 32
6068h	00h	In-position time window	RW	Real-time change	UINT 32
606Ch	00h	Velocity loop feedback	RO	Not changeable	INT 32
6077h	00h	Actual torque	RO	Not changeable	INT 16
607Ah	00h	Target Position	RW	Real-time change	INT 32
607Dh	01h	Soft limit position 1	RW	Real-time change	INT 32
	02h	Soft limit position 2	RW	Real-time change	INT 32
607Eh	00h	Command polarity	RW	Real-time change	UINT 8
6081h	00h	Profile velocity	RW	Real-time change	UINT 32
6083h	00h	Profile acceleration	RW	Real-time change	UINT 32
6084h	00h	Profile deceleration	RW	Real-time change	UINT 32
60F4h	00h	Position following error	RO	Not changeable	INT 32

8.3.5 Profile Velocity Mode (PV)

In Profile Velocity mode, the host controller sends the target velocity, acceleration, and deceleration to the drive. Velocity and torque regulation are executed internally by the drive. When enabling Profile Velocity mode, set object 6060h to 3.

(1) Control Description

Controlword 6040h and Statusword 6041h in PV mode are described as follows:

<table>
<tr><th>Index</th><th>Sub-index</th><th>Name/Description</th><th>Access</th><th>PDO Mapping</th><th>Data Type</th><th>Ranges</th></tr>
<tr><td rowspan="2">6040h</td><td rowspan="2">00h</td><td>Controlword</td><td>RW</td><td>RxPDO</td><td>U16</td><td>0-65535</td></tr>
<tr><td colspan="5">
<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Switch on</td><td>Must be set to 1 when enabling the servo</td></tr>
<tr><td>1</td><td>Enable voltage</td><td>Must be set to 1 when enabling the servo</td></tr>
<tr><td>2</td><td>Quick stop</td><td>Must be set to 1 to enable the servo. Setting to 0 results in quick stop</td></tr>
<tr><td>3</td><td>Operation enable</td><td>Must be set to 1 when enabling the servo</td></tr>
<tr><td>7</td><td>Fault Reset</td><td>Execute a fault reset when changing from 0→1.
Other commands are invalid when set to 1</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>Statusword</td><td>RO</td><td>TxPDO</td><td>U16</td><td>0-65535</td></tr>
<tr><td colspan="5">
<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Ready to switch on</td><td>0: Invalid, 1: Valid. When valid, servo can be enabled</td></tr>
<tr><td>1</td><td>Switched on</td><td>0: Invalid, 1: Valid. When valid, servo can be enabled</td></tr>
<tr><td>2</td><td>Operation enabled</td><td>0: Invalid, 1: Valid. When valid, indicates servo is enabled</td></tr>
<tr><td>3</td><td>Servo Fault</td><td>0: No fault, 1: Fault</td></tr>
<tr><td>4</td><td>Voltage enabled</td><td>0: Invalid, 1: Valid. When valid, servo can be enabled</td></tr>
<tr><td>5</td><td>Quick stop</td><td>0: Quick stop enabled, 1: Quick stop disabled</td></tr>
<tr><td>6</td><td>Switch on disabled</td><td>0: Invalid, 1: Valid. When valid, servo can be enabled</td></tr>
<tr><td>7</td><td>Warning</td><td>0: No warning, 1: With warning</td></tr>
<tr><td>9</td><td>Remote Control</td><td>0: Invalid, 1: Valid. When active, it indicates the Controlword has taken effect</td></tr>
<tr><td>10</td><td>Target Reached</td><td>0: Velocity not reached, 1: Velocity reached</td></tr>
<tr><td>11</td><td>Internal soft limit status</td><td>0: Soft limit not triggered, 1: Soft limit triggered</td></tr>
<tr><td>12</td><td>Velocity information</td><td>0: Velocity is not 0, 1: Velocity is 0</td></tr>
</table>
</td></tr>
</table>

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
603Fh	00h	Error Code	RO	Not changeable	UINT16
6040h	00h	Control Word	RW	Real-time change	UINT16
6041h	00h	State Word	RO	Not changeable	UINT16
6060h	00h	Control Mode	RW	Real-time change	INT 8
6061h	00h	Current operating mode	RO	Not changeable	INT 8
6064h	00h	Actual Position	RO	Not changeable	INT 32
606Ch	00h	Velocity loop feedback	RO	Not changeable	INT 32
606Dh	00h	Velocity window	RW	Real-time change	INT 16
606Eh	00h	Velocity stable time window	RW	Real-time change	INT 16
607Dh	01h	Soft limit position 1	RW	Real-time change	INT 32
	02h	Soft limit position 2	RW	Real-time change	INT 32
607Eh	00h	Command polarity	RW	Real-time change	UINT 8
607Fh	00h	Maximum profile velocity	RW	Real-time change	UINT 32
6080h	00h	Maximum motor velocity	RW	Real-time change	UINT 32
6081h	00h	Profile velocity	RW	Real-time change	UINT 32
6083h	00h	Profile acceleration	RW	Real-time change	UINT 32
6084h	00h	Profile deceleration	RW	Real-time change	UINT 32
60FFh	00h	Target Speed	RW	Real-time change	INT 32

8.3.6 Profile Torque Mode (PT)

In Profile Torque mode, the host controller sends the target torque 6071h to the servo drive. The servo drive itself plans the torque command curve, and torque regulation is executed internally by the servo. When enabling Profile Torque mode, set object 6060h to 4.

(1) Control Description

Controlword 6040h and Statusword 6041h in PT mode are described as follows:

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6040h	00h	Controlword	RW	RxPDO	U16	0-65535

Bit	Name	Description
0	Switch on	Must be set to 1 when enabling the servo
1	Enable voltage	Must be set to 1 when enabling the servo
2	Quick stop	Must be set to 1 to enable the servo. Setting to 0 results in quick stop
3	Operation enable	Must be set to 1 when enabling the servo
7	Fault Reset	Execute a fault reset when changing from 0→1. Other commands are invalid when set to 1

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6041h	00h	Statusword	RO	TxPDO	U16	0-65535

Bit	Name	Description
0	Ready to switch on	0: Invalid, 1: Valid. When valid, servo can be enabled
1	Switched on	0: Invalid, 1: Valid. When valid, servo can be enabled
2	Operation enabled	0: Invalid, 1: Valid. When valid, indicates servo is enabled
3	Servo Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Invalid, 1: Valid. When valid, servo can be enabled
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Invalid, 1: Valid. When valid, servo can be enabled
7	Warning	0: No warning, 1: With warning
9	Remote Control	0: Invalid, 1: Valid. When active, it indicates the Controlword has taken effect

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
4010h	6A	Torque mode speed limit	RW	Real-time change	UINT 32
603Fh	00h	Error Code	RO	Not changeable	UINT16
6040h	00h	Control Word	RW	Real-time change	UINT16
6041h	00h	State Word	RO	Not changeable	UINT16
6060h	00h	Control Mode	RW	Real-time change	INT 8
6061h	00h	Current operating mode	RO	Not changeable	INT 8
606Ch	00h	Velocity loop feedback	RO	Not changeable	INT 32
6071h	00h	Target Torque	RW	Real-time change	INT 16
6072h	00h	Maximum Torque	RW	Real-time change	INT 16
6074h	00h	Torque command	RO	Not changeable	INT 16
6077h	00h	Actual torque	RO	Not changeable	INT 16
607Eh	00h	Command polarity	RW	Real-time change	UINT 8
6083h	00h	Profile acceleration	RW	Real-time change	UINT 32
6084h	00h	Profile deceleration	RW	Real-time change	UINT 32
60E0h	00h	Positive torque limit	RW	Real-time change	UINT 16
60E1h	00h	Negative torque limit	RW	Real-time change	UINT 16

8.3.7 Homing Mode (HM)

Homing mode is used to find the mechanical origin and establish the positional relationship between the mechanical origin and the mechanical zero point.

▪ **Mechanical Origin**: A fixed position on the machine, which can correspond to a specific home switch, or the motor Z-pulse signal.

▪ **Mechanical Zero Point**: The absolute 0 position on the machine.

After successful homing, the motor stop position is the mechanical origin. By setting 607Ch (Home Offset), the relationship between the mechanical origin and the mechanical zero point can be defined:

Mechanical Origin = Mechanical Zero Point + 607Ch (Home Offset)

When 607Ch = 0, it means the mechanical origin and the mechanical zero point coincide.

When enabling this mode, set object 6060h to 6.

(1) Control Description

Controlword 6040h and Statusword 6041h in HM mode are described as follows:

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6040h	00h	Controlword	RW	RxPDO	U16	0-65535

Bit	Name	Description
0	Switch on	Must be set to 1 when enabling the servo
1	Enable voltage	Must be set to 1 when enabling the servo
2	Quick stop	Must be set to 1 to enable the servo. Setting to 0 results in quick stop
3	Operation enable	Must be set to 1 when enabling the servo
4	Homing enable	0: Inactive, 1: Active. When active, start the homing process; it must remain active throughout the homing process; switching to inactive stops the homing process.
7	Fault Reset	Execute a fault reset when changing from 0→1. Other commands are invalid when set to 1

Index	Sub-index	Name/Description	Access	PDO Mapping	Data Type	Ranges
6041h	00h	Statusword	RO	TxPDO	U16	0-65535

Bit	Name	Description
0	Ready to switch on	0: Invalid, 1: Valid. When valid, servo can be enabled
1	Switched on	0: Invalid, 1: Valid. When valid, servo can be enabled
2	Operation enabled	0: Invalid, 1: Valid. When valid, indicates servo is enabled
3	Servo Fault	0: No fault, 1: Fault
4	Voltage enabled	0: Invalid, 1: Valid. When valid, servo can be enabled
5	Quick stop	0: Quick stop enabled, 1: Quick stop disabled
6	Switch on disabled	0: Invalid, 1: Valid. When valid, servo can be enabled
7	Warning	0: No warning, 1: With warning
9	Remote Control	0: Invalid, 1: Valid. When active, it indicates the Controlword has taken effect
10	Target Reached	0: Homing in progress, 1: Positioned at origin or homing interrupted
12	Home found	0: Home signal not found, 1:Home signal found
13	Homing error	0: No error occurred during homing, 1: An error occurred during homing
15	Homing Complete	0: Homing not completed, 1: Homing completed

Note: Bits 10, 12, 13:

Bit13	Bit12	Bit10	**Description**
0	0	0	Home return action in progress
0	0	1	Home return action interrupted or not yet started
0	1	0	Home setting completed, action continues
0	1	1	Home return action completed normally
1	0	0	Home return error occurred, non-zero speed
1	0	1	Home return error occurred, zero speed

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
603Fh	00h	Error Code	RO	Not changeable	UINT16
6040h	00h	Control Word	RW	Real-time change	UINT16
6041h	00h	State Word	RO	Not changeable	UINT16
605Ah	00h	Quick stop option	RW	Real-time change	UINT 16
6060h	00h	Control Mode	RW	Real-time change	INT 8
6061h	00h	Current operating mode	RO	Not changeable	INT 8
6065h	00h	Position following error window	RW	Real-time change	UINT 32
6066h	00h	Position following error time window	RW	Real-time change	UINT 32
6067h	00h	In-position window	RW	Real-time change	UINT 32
6068h	00h	In-position time window	RW	Real-time change	UINT 32
606Ch	00h	Velocity loop feedback	RO	Not changeable	INT 32
607Ch	00h	Home Offset	RW	Real-time change	INT 32
607Dh	01h	Soft limit position 1	RW	Real-time change	INT 32
	02h	Soft limit position 2	RW	Real-time change	INT 32
6098h	00h	Homing mode	RW	Real-time change	INT 32
6099h	01h	Home Locate speed	RW	Real-time change	UINT 32
	02h	Home Creep Speed	RW	Real-time change	UINT 32
609Ah	00h	Home Acceleration	RW	Real-time change	UINT 32

(3) Homing Mode Introduction (6098h)

Based on encoder index signals, home switch signals, and limit switch signals, CD300E supports the following homing methods:

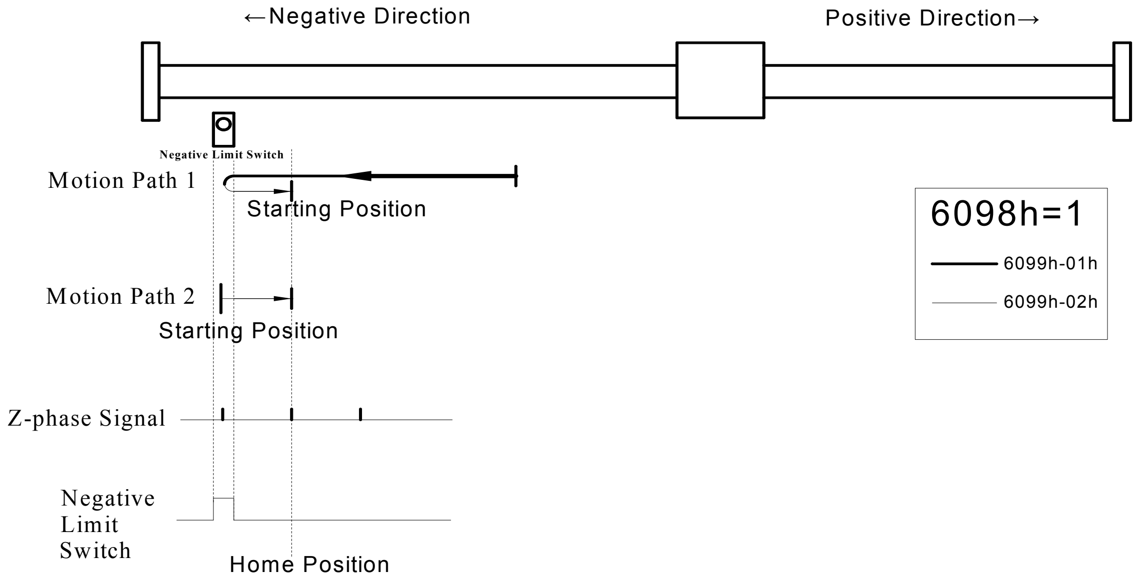
6098h=1

Mechanical origin: Motor Z signal

Deceleration point: Negative limit switch

If the deceleration point signal is inactive at startup, move at home locate speed in the negative direction. After encountering the OFF→ON state of the negative limit switch, decelerate and stop, then change to home creep speed and move in the positive direction. After encountering the ON→OFF state of the negative limit switch while running at home creep speed in the positive direction, continue in the positive direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 1.

If the deceleration point signal is active at startup, move at home creep speed in the positive direction. After encountering the ON→OFF state of the negative limit switch while running in the positive direction, continue in the positive direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 2.



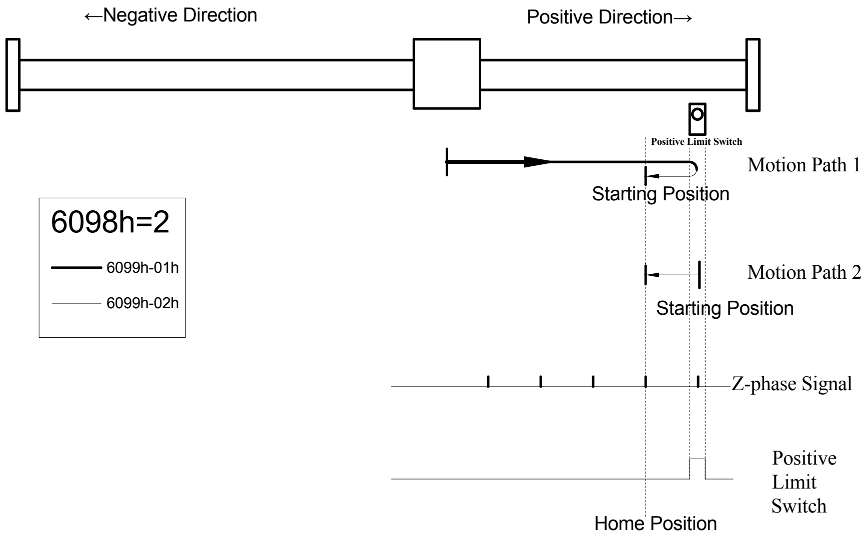
6098h=2

Mechanical : Motor Z signal

Deceleration point: Positive limit switch

If the deceleration point signal is inactive at startup, move at home locate speed in the positive direction. After encountering the OFF→ON state of the positive limit switch, decelerate and stop, then change to home creep speed and move in the negative direction. After encountering the ON→OFF state of the positive limit switch while running at home creep speed in the negative direction, continue in the negative direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 1.

If the deceleration point signal is active at startup, move at home creep speed in the negative direction. After encountering the ON→OFF state of the positive limit switch while running in the negative direction, continue in the negative direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 2.



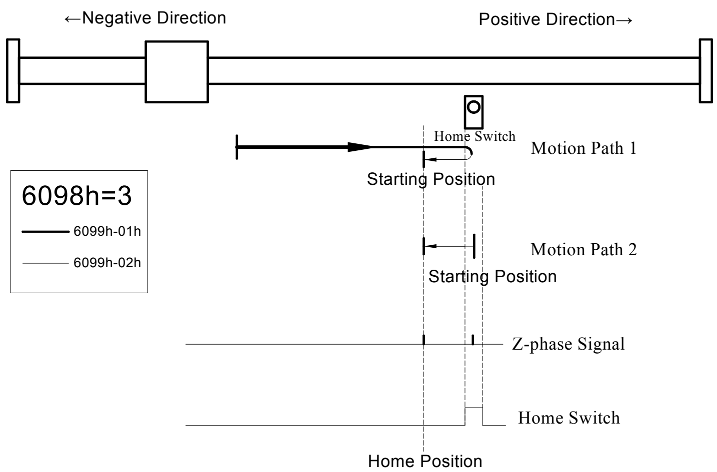
6098h=3

Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup, move at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, decelerate and stop, then change to home creep speed and move in the negative direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the negative direction, continue in the negative direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 1.

If the home switch is active at startup, run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running in the negative direction, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 2.



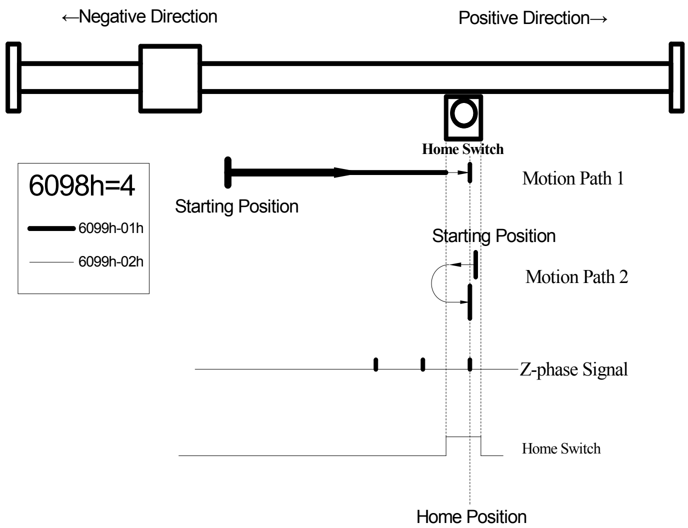
6098h=4

Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup, run at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it continues searching at home creep speed in the positive direction for the nearest Z-phase signal as the home position, as shown in Motion Path 1.

If the home switch is active at startup, run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running in the negative direction, decelerate and stop, then run at home creep speed in the positive direction. After encountering the OFF→ON state of the home switch while running at home creep speed in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 2.



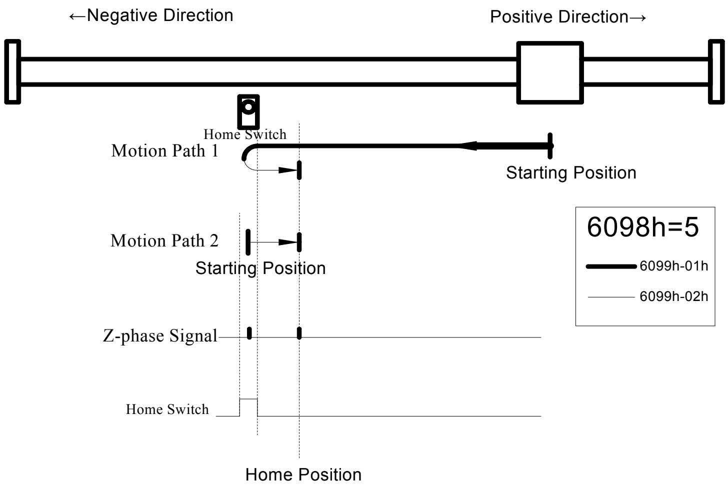
6098h=5

Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup, run at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate and stop, then switch to home creep speed and run in the positive direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 1.

If the home switch is active at startup, run at home creep speed in the positive direction. After encountering the ON→OFF state of the home switch while running in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 2.



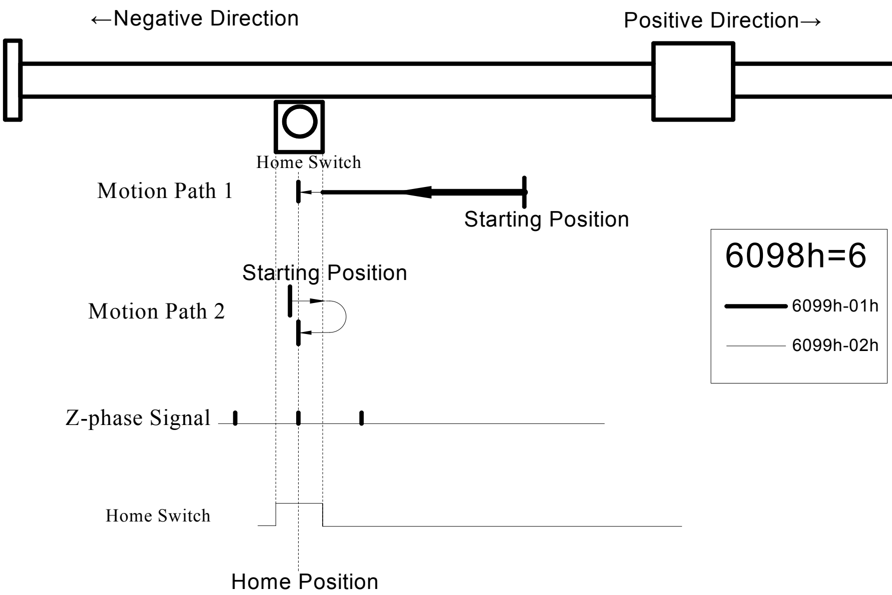
6098h=6

Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup, run at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, switch to home creep speed and it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 1.

If the home switch is active at startup, then run at home creep speed in the positive direction. After encountering the ON→OFF state of the home switch while running in the positive direction, decelerate and stop, then run at home creep speed in the negative direction. After encountering the OFF→ON state of the home switch while running at home creep speed in the negative direction, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 2.



6098h=7

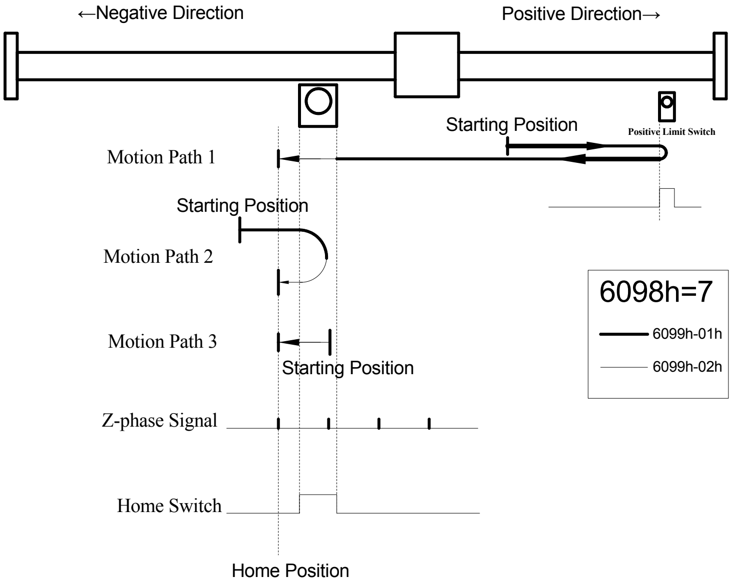
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. If encountering the positive limit switch, decelerate and stop, then reverse direction and continue running at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate, then run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the negative direction, continue in the negative direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, decelerate and stop, then switch to home creep speed and run in the negative direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the negative direction, continue in the negative direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running in the negative direction, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 3.



6098h=8

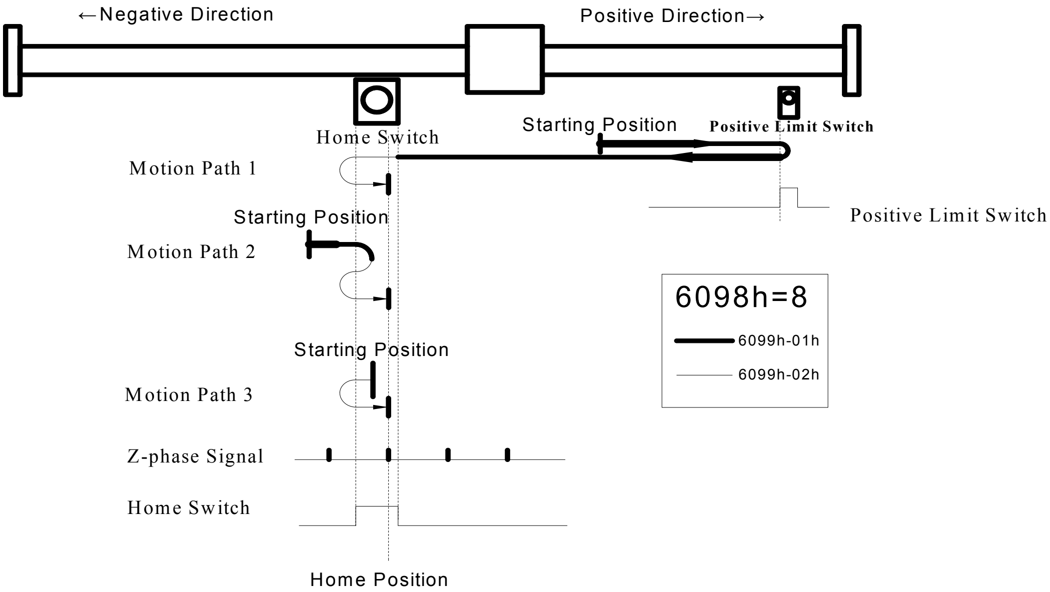
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the positive limit switch, decelerate and stop, then run at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate, then run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the negative direction, decelerate and stop, then switch to home creep speed and run in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, decelerate and stop, then switch to home creep speed and run in the negative direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the negative direction, decelerate and stop, then switch to home creep speed and run in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running in the negative direction, decelerate and stop, then run at home creep speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 3.



6098h=9

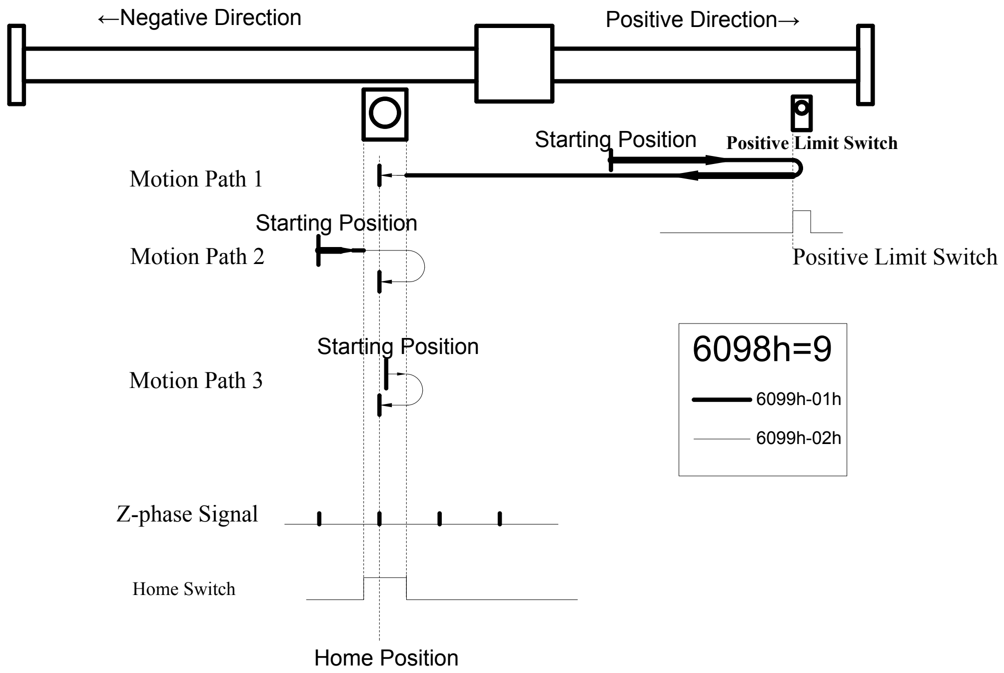
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the positive limit switch, decelerate and stop, then run at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate, and search for the nearest Z-phase signal at home creep speed as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it switches to home creep speed and runs in the positive direction. When running at home creep speed in the positive direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. After encountering the OFF→ON state of the home switch while running at home creep speed in the negative direction, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path3.



6098h=10

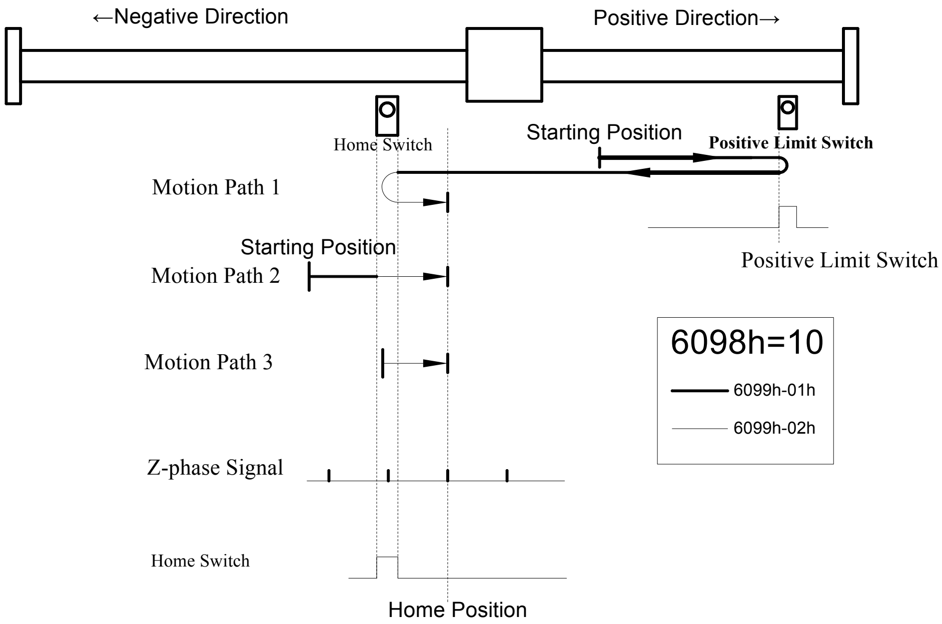
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the positive limit switch while running in the positive direction, it decelerates and stops, then runs at home locate speed in the negative direction. While running in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the positive direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it switches to home creep speed and runs in the positive direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. After encountering the ON→OFF state of the home switch while running in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 3.



6098h=11

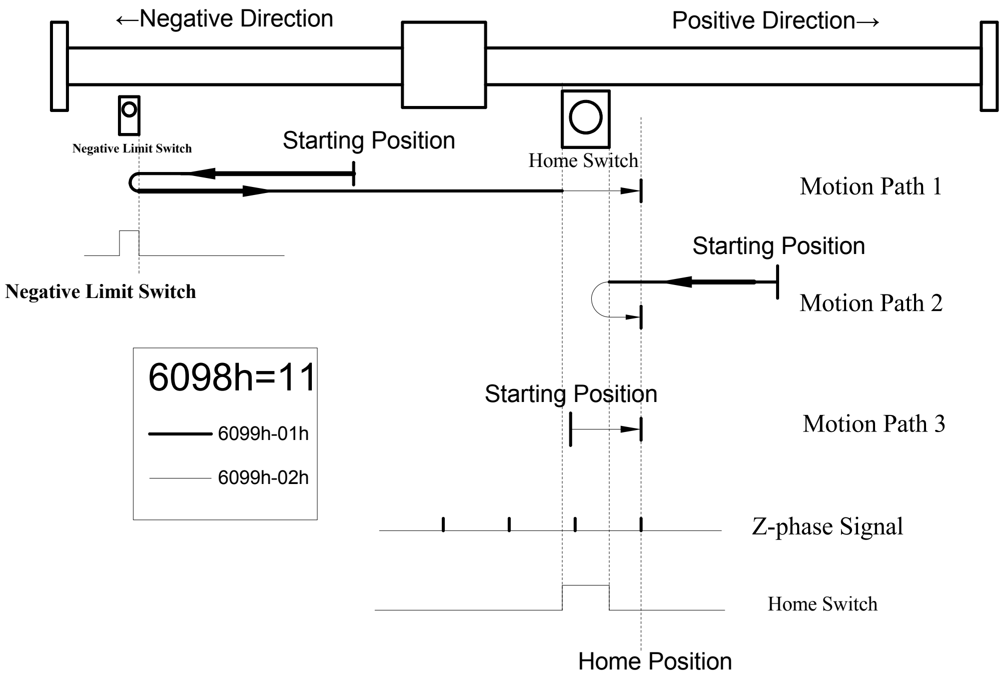
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch, it switches to home creep speed and runs in the positive direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, it decelerates and stops, then switches to home creep speed and runs in the positive direction. After encountering the ON→OFF state of the home switch while running at home creep speed in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. After encountering the ON→OFF state of the home switch while running in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 3.



6098h=12

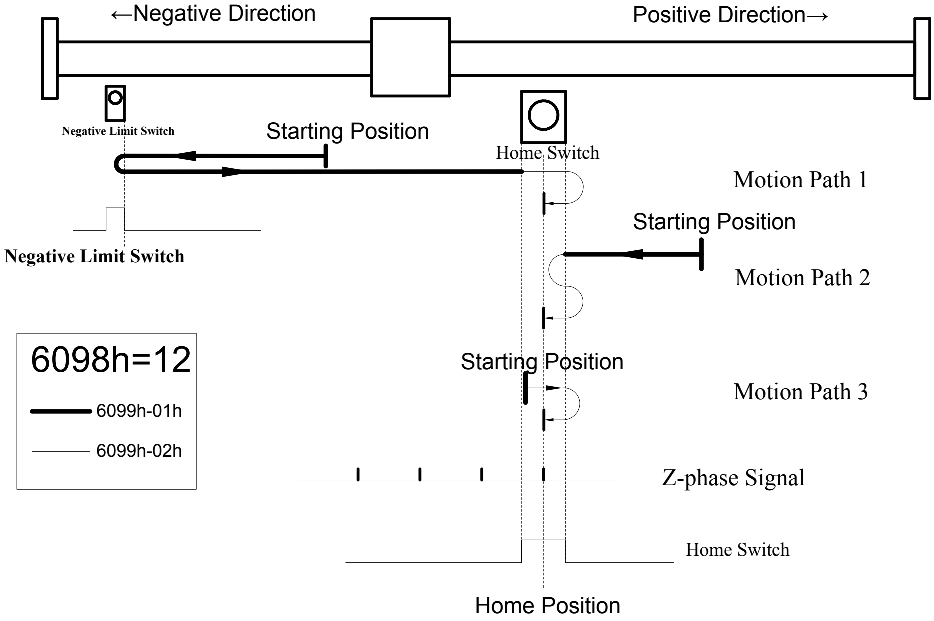
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. When running in the positive direction, after encountering the OFF→ON state of the home switch, it switches to home creep speed and continues running in the positive direction. When running at home creep speed in the positive direction, after encountering the ON→OFF state of the home switch, it stops, then switches to home creep speed and runs in the negative direction. After encountering the OFF→ON state of the home switch while running at home creep speed in the negative direction, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running at home creep speed in the negative direction, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. After encountering the ON→OFF state of the home switch while running in the positive direction, it stops, then runs at home creep speed in the negative direction. When running at home creep speed in the negative direction, after encountering the OFF→ON state of the home switch, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 3.



6098h=13

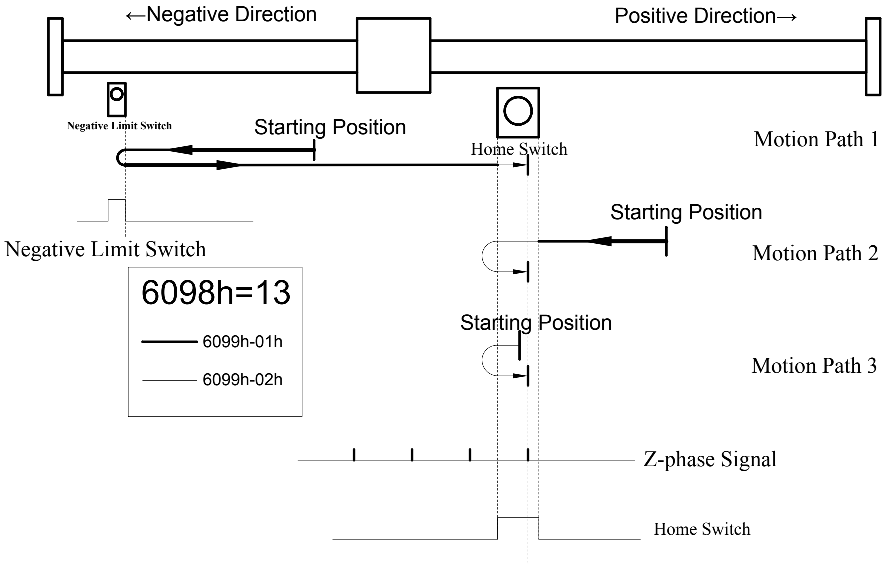
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it decelerates, then switches to home creep speed and runs in the positive direction to find the nearest Z-phase signal as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, it switches to home creep speed and continues running in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it stops, then switches to home creep speed and runs in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running in the negative direction, it stops, then switches to home creep speed and runs in the positive direction. After encountering the OFF→ON state of the home switch while running at home creep speed in the positive direction, it continues searching for the nearest Z-phase signal in the positive direction as the home position, as shown in Motion Path 3.



6098h=14

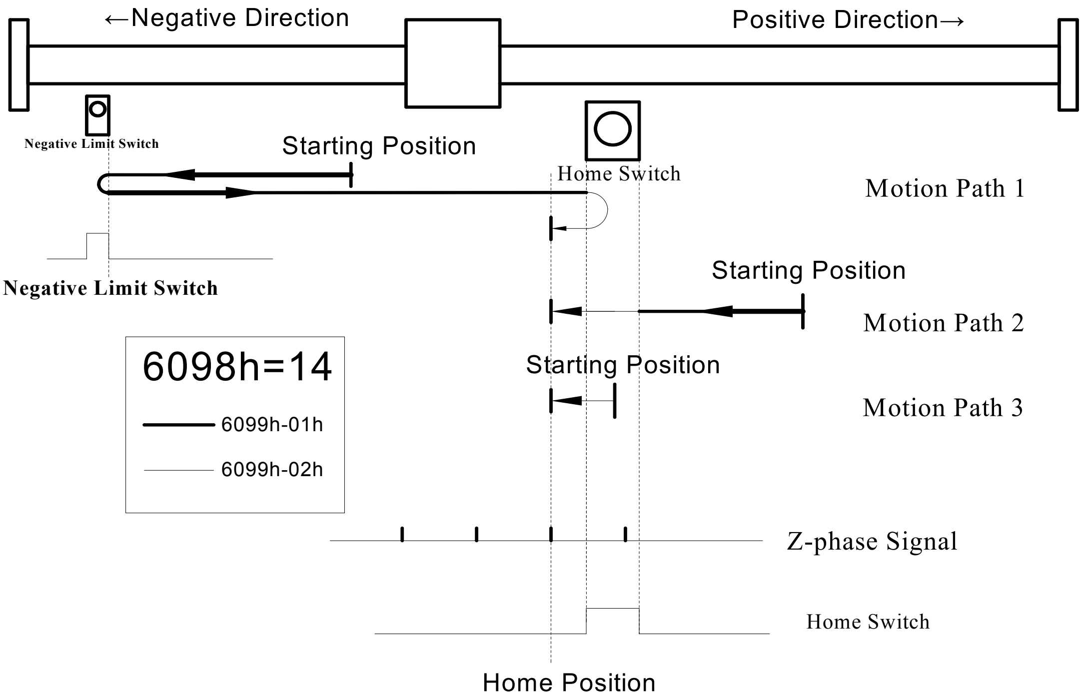
Mechanical origin: Motor Z signal

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, it stops, then switches to home creep speed and runs in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, it switches to home creep speed and runs in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. After encountering the ON→OFF state of the home switch while running in the negative direction, it continues searching for the nearest Z-phase signal in the negative direction as the home position, as shown in Motion Path 3.



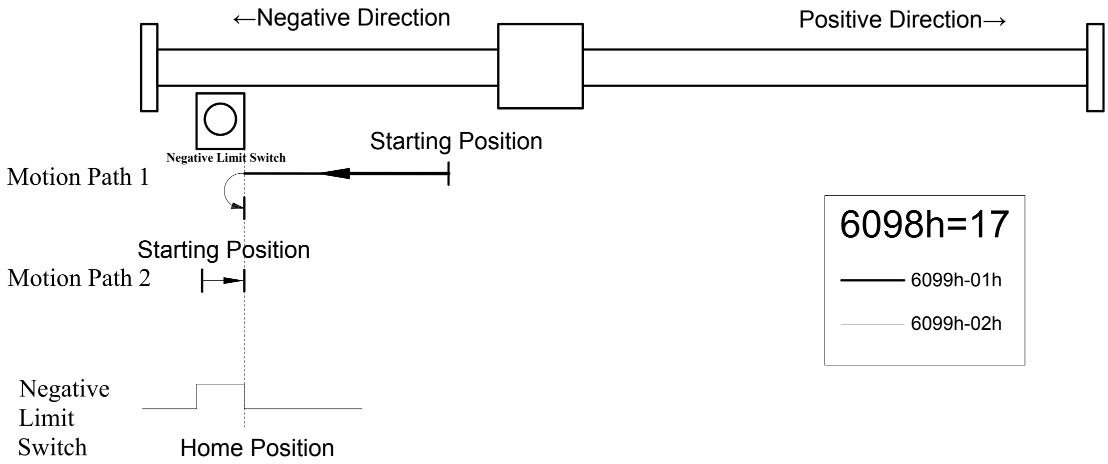
6098h=17

Mechanical origin: Negative limit switch

Deceleration point: Negative limit switch

If the negative limit switch is inactive at startup, it runs at home locate speed in the negative direction. After encountering the OFF→ON state of the negative limit switch, it decelerates and stops, then switches to home creep speed and runs in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the negative limit switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the negative limit switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, upon encountering the ON→OFF state of the negative limit switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.



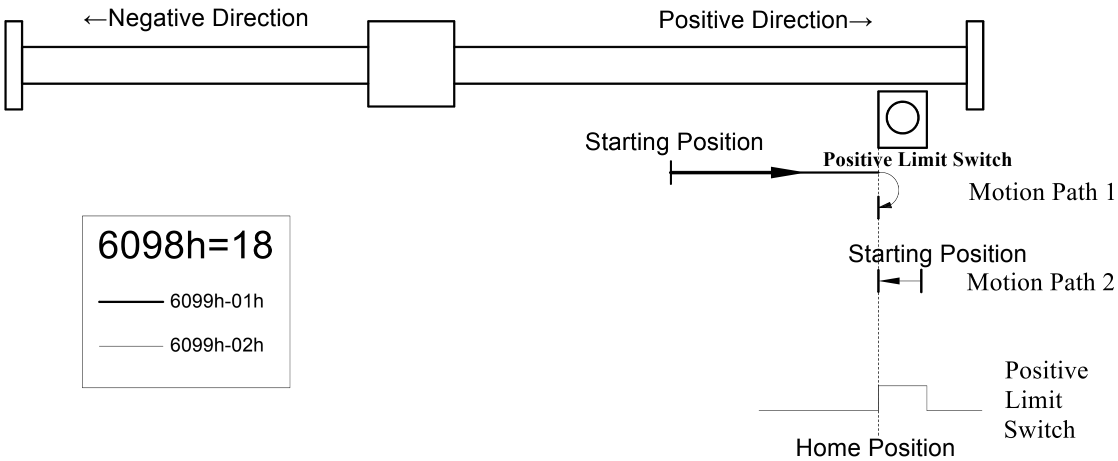
6098h=18

Mechanical origin: Positive limit switch

Deceleration point: Positive limit switch

If the positive limit switch is inactive at startup, it runs at home locate speed in the positive direction. After encountering the OFF→ON state of the positive limit switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running at home creep speed in the negative direction, upon encountering the ON→OFF state of the positive limit switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the positive limit switch is active at startup, it runs at home creep speed in the negative direction. When running at home creep speed in the negative direction, upon encountering the ON→OFF state of the positive limit switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.



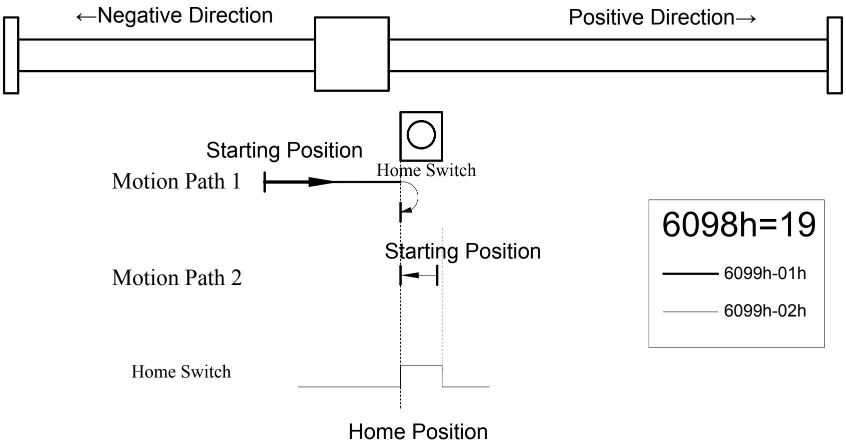
6098h=19

Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup, move at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, decelerate and stop, then change to home creep speed and move in the negative direction. When running at home creep speed in the negative direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is active at startup, it runs at home creep speed in the negative direction. When running in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.



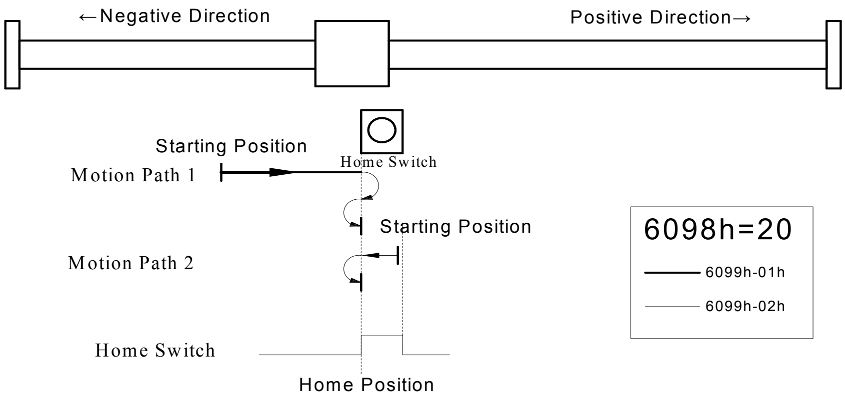
6098h=20

Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup, move at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, decelerate and stop, then change to home creep speed and move in the negative direction. When running at home creep speed in the negative direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is active at startup, it runs at home creep speed in the negative direction. When running in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.



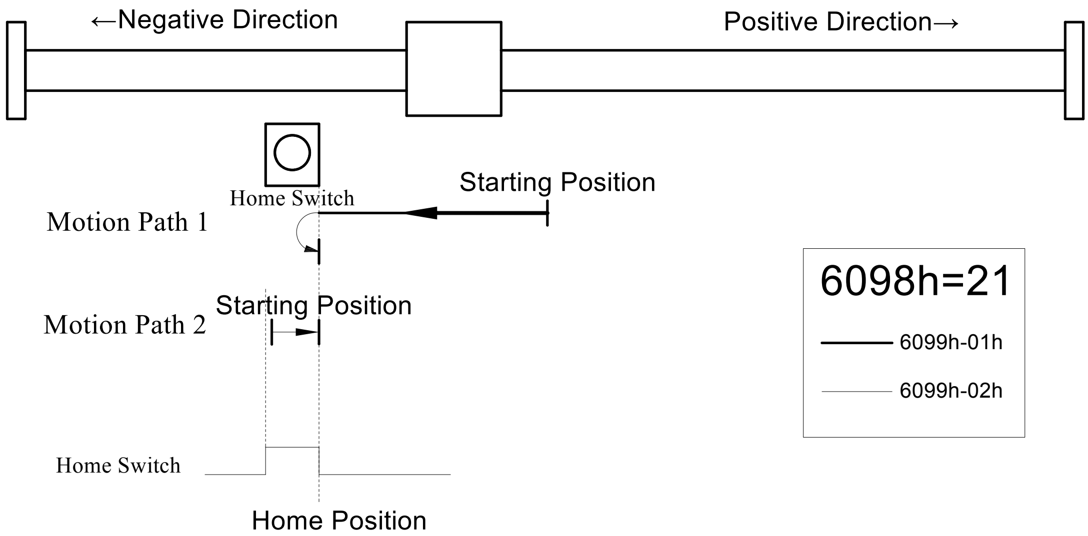
6098h=21

Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup, run at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate and stop, then switch to home creep speed and run in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.



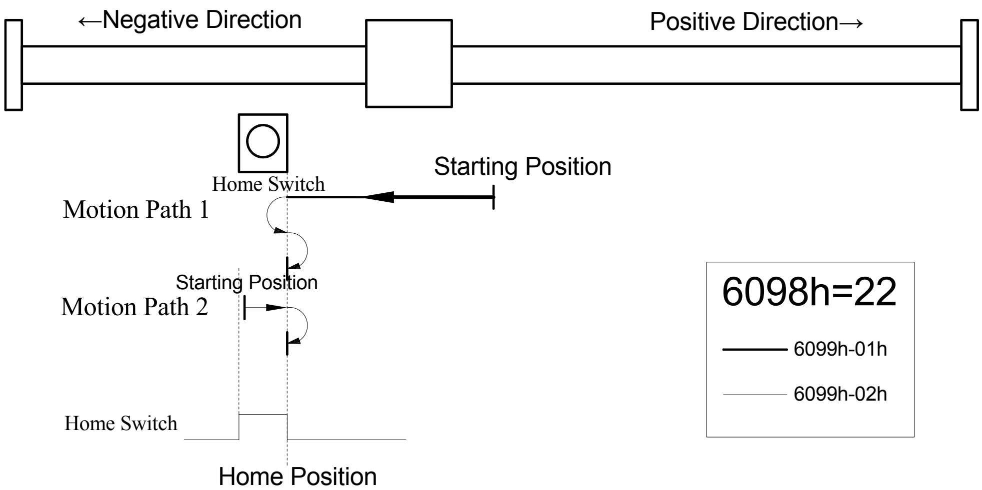
6098h=22

Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup, run at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate and stop, then switch to home creep speed and run in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running at home creep speed in the negative direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running at home creep speed in the negative direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.



6098h=23

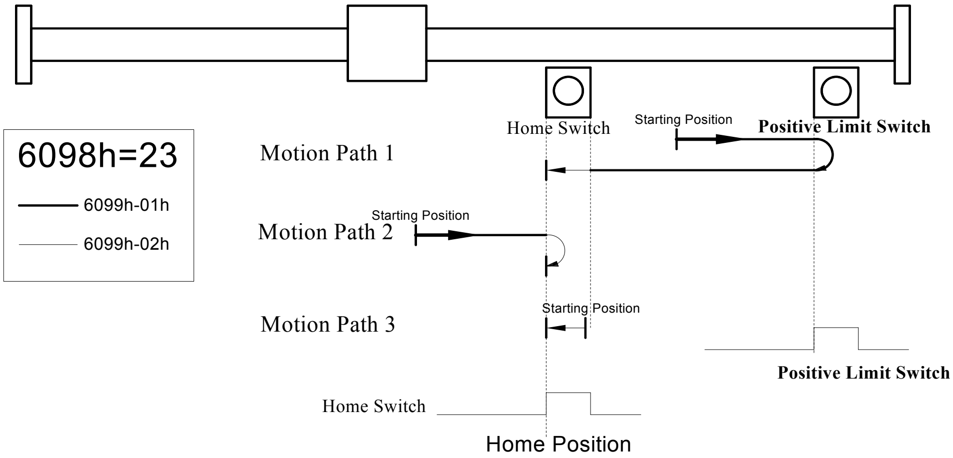
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive and the positive limit switch is inactive at startup, it runs at home locate speed in the positive direction. After encountering the positive limit switch while running in the positive direction, it decelerates and stops, then runs at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate, then run at home creep speed in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive and the positive limit switch is inactive at startup, it runs at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, decelerate and stop, then switch to home creep speed and run in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. When running in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.



6098h=24

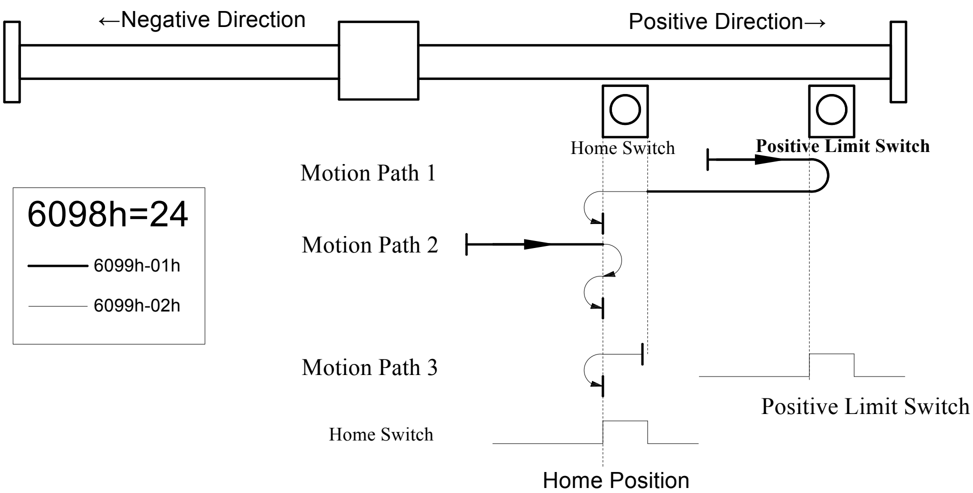
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive and the positive limit switch is inactive at startup, it runs at home locate speed in the positive direction. After encountering the positive limit switch while running in the positive direction, it decelerates and stops, then runs at home locate speed in the negative direction. After encountering the OFF→ON state of the home switch while running in the negative direction, decelerate, then run at home creep speed in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive and the positive limit switch is inactive at startup, it runs at home locate speed in the positive direction. After encountering the OFF→ON state of the home switch while running in the positive direction, decelerate and stop, then switch to home creep speed and run in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. When running in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.



6098h=25

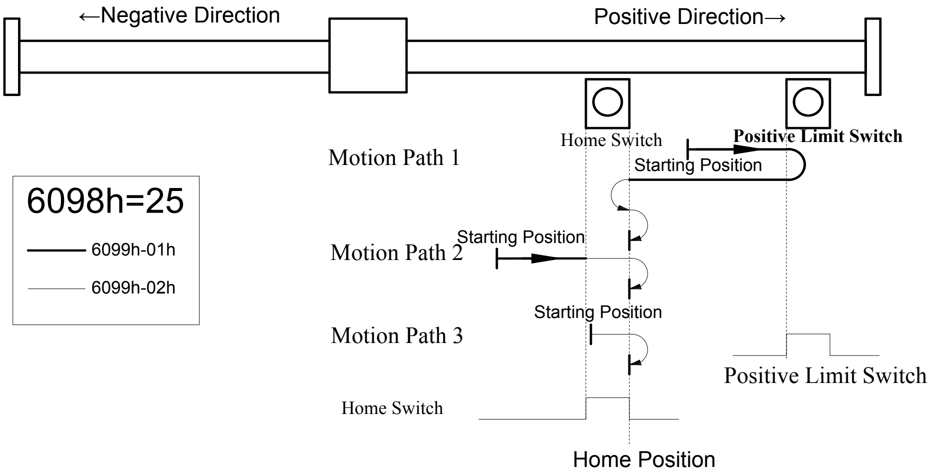
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the positive limit switch while running in the positive direction, it decelerates and stops, then runs at home locate speed in the negative direction. When running in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running in the negative direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. When running in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates, then switches to home creep speed and continues running in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running in the negative direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running in the negative direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.



6098h=26

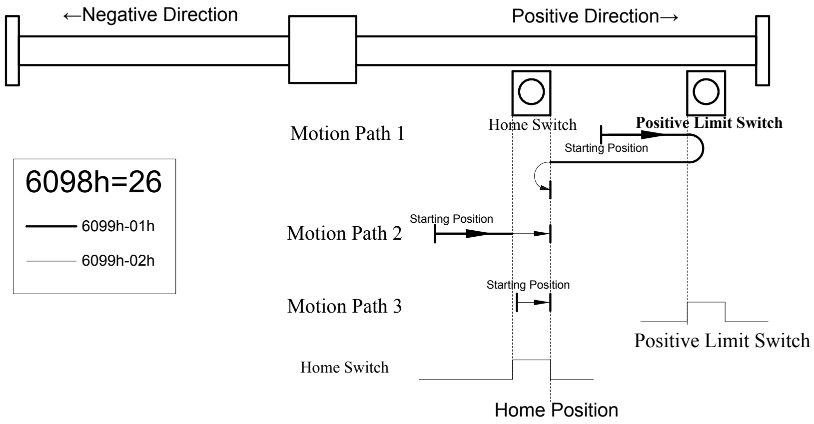
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. After encountering the positive limit switch while running in the positive direction, it decelerates and stops, then runs at home locate speed in the negative direction. When running in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the positive limit switch is inactive, then run at home locate speed in the positive direction. When running in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates, then switches to home creep speed and continues running in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.



6098h=27

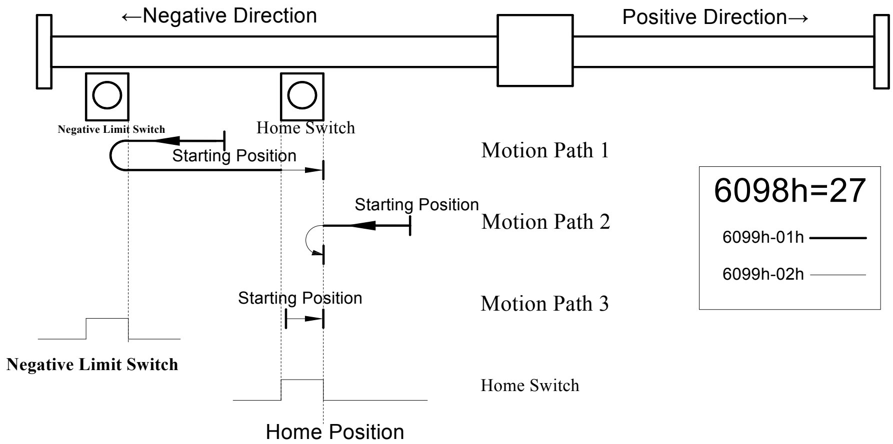
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. When running in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates, then runs at home creep speed and continues running in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. When running in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.



6098h=28

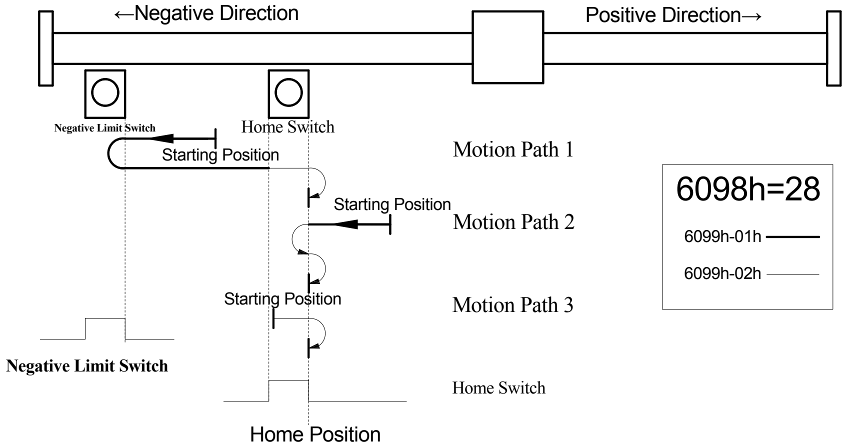
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. When running in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates, then runs at home creep speed and continues running in the positive direction. When running at home creep speed in the positive direction, upon encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the negative direction. When running at home creep speed in the negative direction, upon encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. When running in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the positive direction. When running at home creep speed in the positive direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the negative direction. When running at home creep speed in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, it runs at home creep speed in the positive direction. When running in the positive direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the negative direction. When running at home creep speed in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.



6098h=29

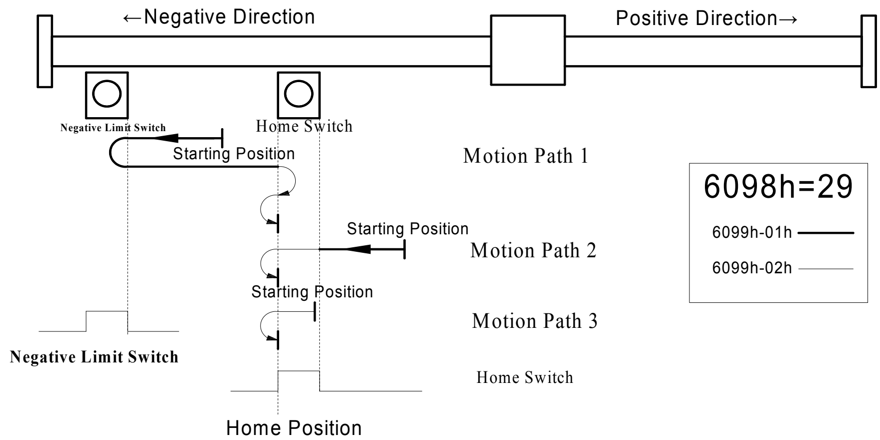
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. When running in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. When running in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates, then switches to home creep speed and continues running in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. When running in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, then runs at home creep speed in the positive direction. When running at home creep speed in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.



6098h=30

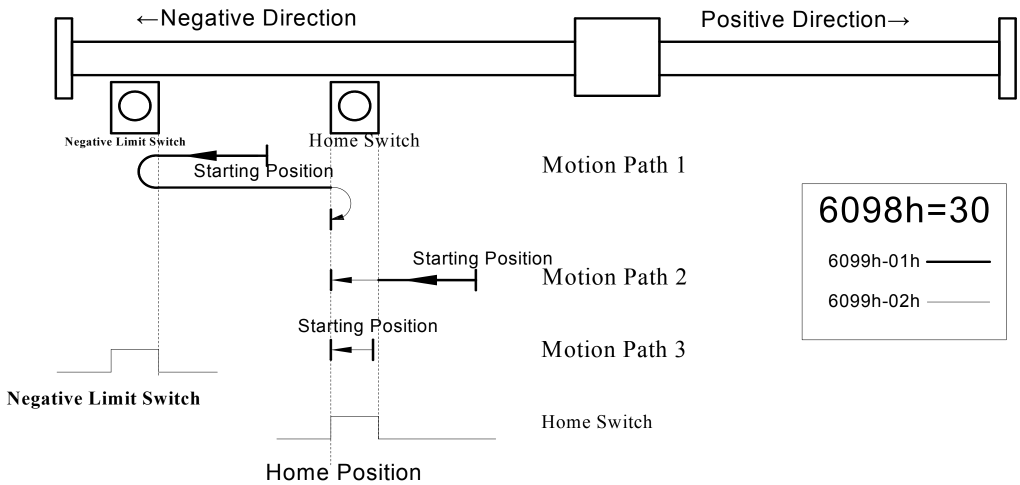
Mechanical origin: Home switch

Deceleration point: Home switch

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. After encountering the negative limit switch while running in the negative direction, it decelerates and stops, then runs at home locate speed in the positive direction. When running in the positive direction, after encountering the OFF→ON state of the home switch, it decelerates and stops, then switches to home creep speed and runs in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 1.

If the home switch is inactive at startup and the negative limit switch is inactive, it runs at home locate speed in the negative direction. When running in the negative direction, after encountering the OFF→ON state of the home switch, it decelerates, then switches to home creep speed and continues running in the negative direction. When running at home creep speed in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 2.

If the home switch is active at startup, then run at home creep speed in the negative direction. When running in the negative direction, after encountering the ON→OFF state of the home switch, it decelerates and stops, using the stopping position as the home position, as shown in Motion Path 3.

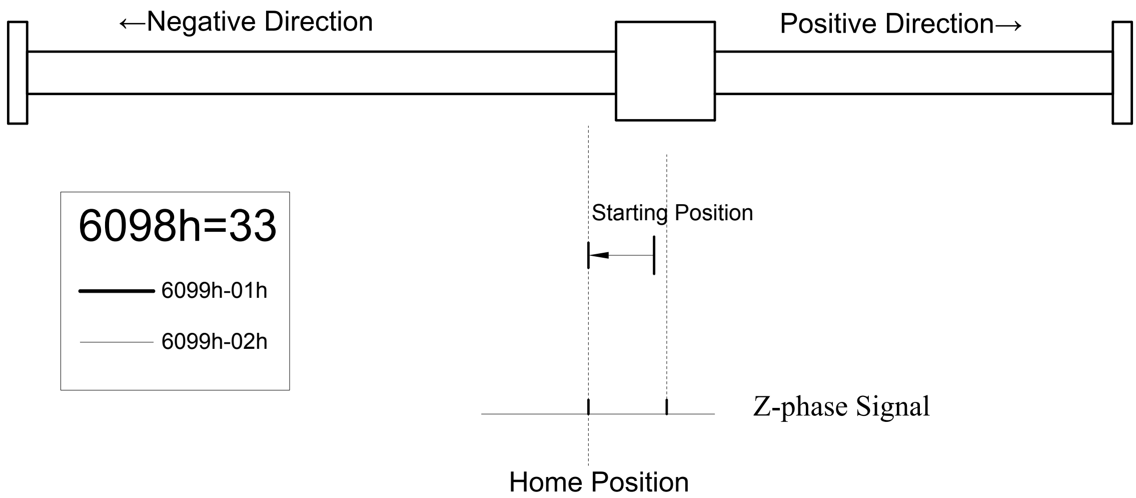


6098h=33

Mechanical origin: Motor Z signal

Deceleration point: None

At startup, it searches for the nearest Z-phase signal as the home position, running at home creep speed (6099h-02h) in the negative direction.

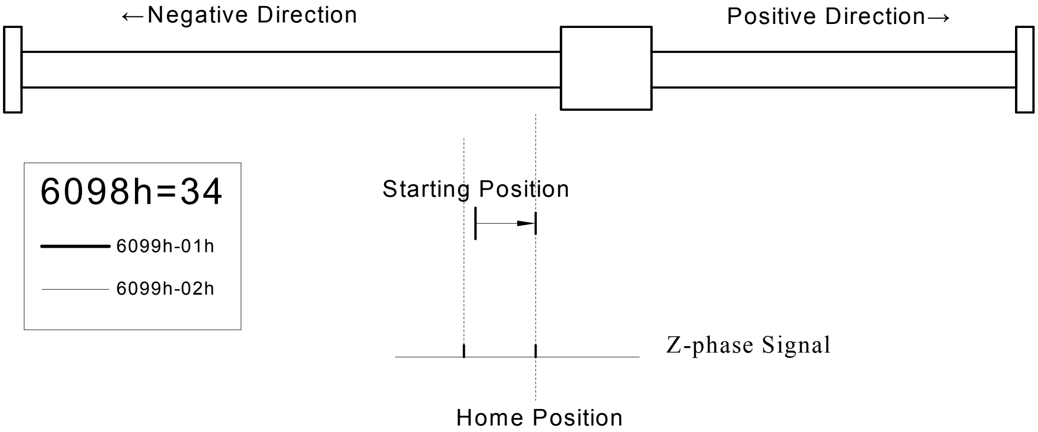


6098h=34

Mechanical origin: Motor Z signal

Deceleration point: None

At startup, it searches for the nearest Z-phase signal as the home position, running at home creep speed (6099h-02h) in the positive direction.

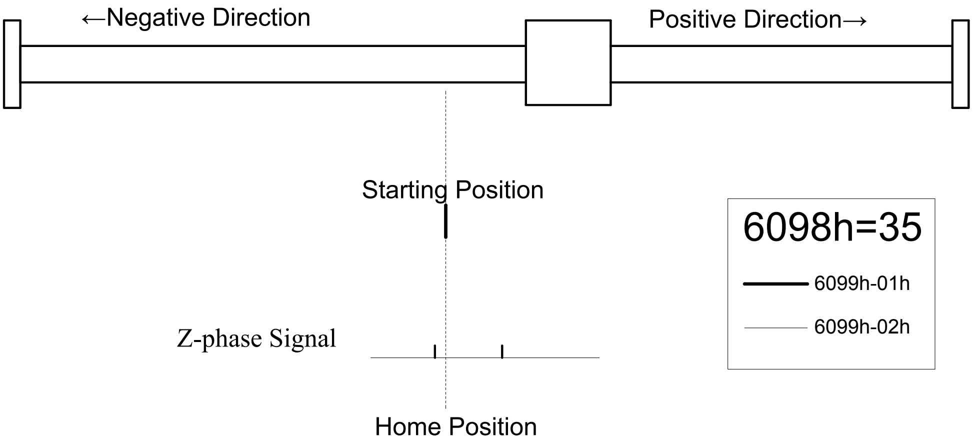


6098h=35

Mechanical origin: Current position

Deceleration point: None

After triggering homing, the current position is set as the home position.

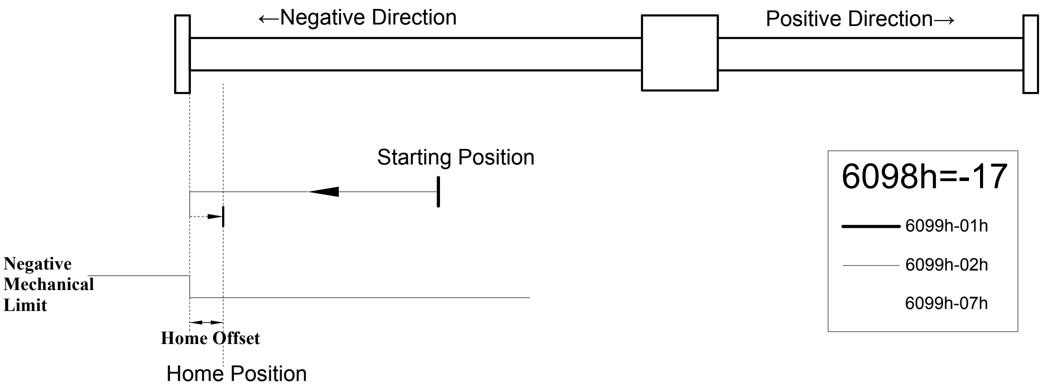


6098h= -17

Mechanical origin: Negative mechanical limit

Deceleration point: None

After triggering homing, it runs at home creep speed (6099h-02h) in the negative direction. After hitting the negative mechanical limit, when the motor speed is 0 and the current is greater than "Origin Finding Current (6099h-04h)", it moves in the positive direction by the set origin offset distance at the offset positioning speed (6099h-07h), using this position as the home position reference point.

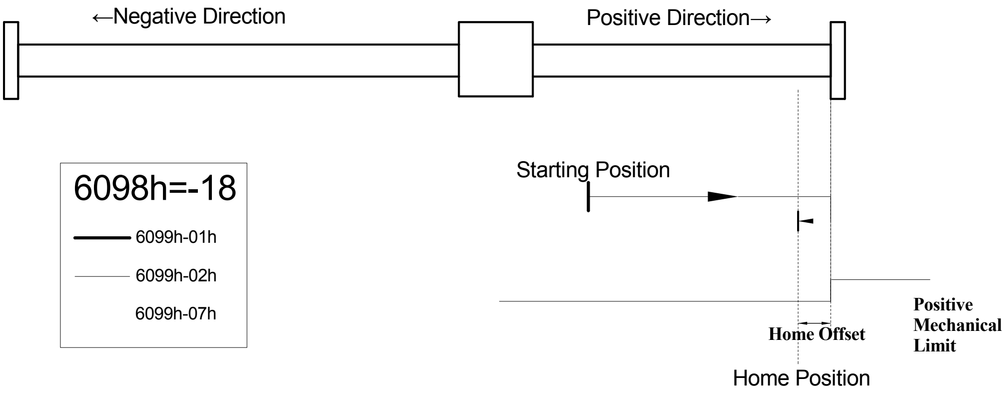


6098h= -18

Mechanical origin: Positive mechanical limit

Deceleration point: None

After triggering homing, it runs at home creep speed (6099h-02h) in the positive direction. After hitting the positive mechanical limit, when the motor speed is 0 and the current is greater than "Origin Finding Current (6099h-04h)", it moves in the negative direction by the set origin offset distance at the offset positioning speed (6099h-07h), using this position as the home position reference point.

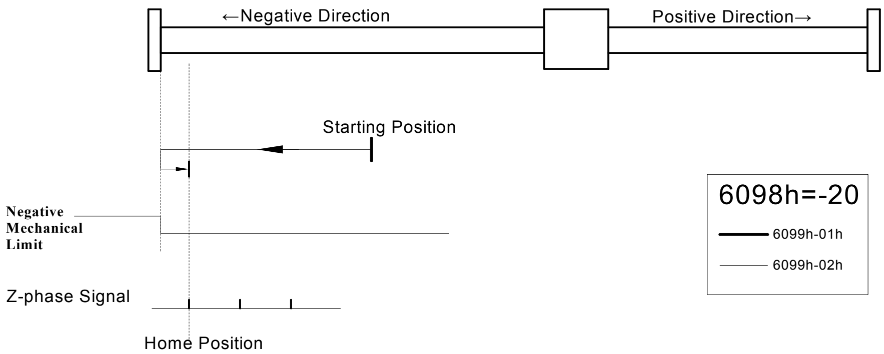


6098h= -20

Mechanical origin: Motor Z signal

Deceleration point: None

After triggering homing, it runs at home creep speed (6099h-02h) in the negative direction. After hitting the negative mechanical limit, when the motor speed is 0 and the current is greater than "Origin Finding Current (6099h-04h)", it switches to the positive direction and runs at the offset positioning speed (6099h-07h), searching for the nearest Z-phase signal as the home position.

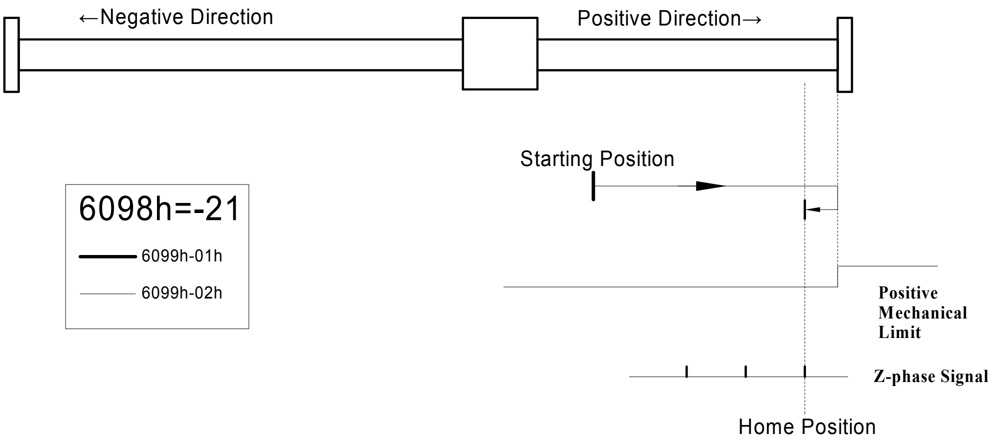


6098h= -21

Mechanical origin: Motor Z signal

Deceleration point: None

After triggering homing, it runs at home creep speed (6099h-02h) in the positive direction. After hitting the positive mechanical limit, when the motor speed is 0 and the current is greater than "Origin Finding Current (6099h-04h)", it switches to the negative direction and runs at the offset positioning speed (6099h-07h), searching for the nearest Z-phase signal as the home position.



8.4 Application Functions

8.4.1 Probe Function

The probe function, also known as position latching, is a feature where the servo drive records the position information at the moment an externally specified DI signal or motor Z signal changes, and stores it in designated registers. The CD300E supports 2 probe functions.

(1) Control Description

Related settings for the probe function are done via object (60B8h). The meaning of each bit is shown in the table below:

<table>
<tr><th>Bit</th><th>Description</th><th>Remarks</th></tr>
<tr><td>0</td><td>Probe 1 Enable:
0: Probe 1 not enabled
1: Probe 1 enabled</td><td rowspan="7">bit0-bit5: Probe 1 related settings
• When using DI as the probe trigger signal, the DI source cannot be changed after the probe is enabled.
• For absolute encoders, the Z signal refers to the zero point of the motor's single-turn position feedback.
• When bit0/bit8 transitions from "0→1", position information is latched according to the setting of (bit1-bit5)/(bit9-bit13) and stored in objects 60BAh (Probe 1 rising edge position), 60BBh (Probe 1 falling edge position), 60BCh (Probe 2 rising edge position), and 60BDh (Probe 2 falling edge position)
• If the probe function setting is changed, please return bit0/bit8 to 0, then change it from "0→1" again for the change to take effect</td></tr>
<tr><td>1</td><td>Probe 1 Trigger Mode:
0: Single trigger, only when the trigger signal is active for the first time
1: Continuous trigger</td></tr>
<tr><td>2</td><td>Probe 1 Trigger Signal Selection:
0: DI input signal
1: Motor encoder Z signal</td></tr>
<tr><td>3</td><td>Reserved</td></tr>
<tr><td>4</td><td>Probe 1 Rising Edge Enable:
0: Do not use Probe 1 rising edge latch
1: Use Probe 1 rising edge latch</td></tr>
<tr><td>5</td><td>Probe 1 Falling Edge Enable:
0: Do not use Probe 1 falling edge latch
1: Use Probe 1 falling edge latch</td></tr>
<tr><td>6-7</td><td>Reserved</td></tr>
<tr><td>8</td><td>Probe 2 Enable:
0: Probe 2 not enabled
1: Probe 2 enabled</td><td rowspan="7">Bit8-bit13: Probe 2 related settings</td></tr>
<tr><td>9</td><td>Probe 2 Trigger Mode:
0: Single trigger, only when the trigger signal is active for the first time
1: Continuous trigger</td></tr>
<tr><td>10</td><td>Probe 2 Trigger Signal Selection:
0: DI input signal
1: Motor encoder Z signal</td></tr>
<tr><td>11</td><td>Reserved</td></tr>
<tr><td>12</td><td>Probe 2 Rising Edge Enable:
0: Do not use Probe 1 rising edge latch
1: Use Probe 1 rising edge latch</td></tr>
<tr><td>13</td><td>Probe 2 Falling Edge Enable:
0: Do not use Probe 1 falling edge latch
1: Use Probe 1 falling edge latch</td></tr>
<tr><td>14-15</td><td>Reserved</td></tr>
</table>

Object (60B9h) allows viewing probe running status. The meaning of each bit is shown in the table below:

<table>
<tr><th>Bit</th><th>Description</th><th>Remarks</th></tr>
<tr><td>0</td><td>Probe 1 Enable:
0: Probe 1 not enabled
1: Probe 1 enabled.</td><td rowspan="4">bit0-bit2: Probe 1 Running Status</td></tr>
<tr><td>1</td><td>Probe 1 Rising Edge Trigger Data Valid:
0: Rising edge trigger data invalid
1: Rising edge trigger data valid</td></tr>
<tr><td>2</td><td>Probe 1 Falling Edge Trigger Data Valid:
0: Falling edge trigger data invalid
1: Falling edge trigger data valid</td></tr>
<tr><td>3-7</td><td>Reserved</td></tr>
<tr><td>8</td><td>Probe 2 Enable:
0: Probe 2 not enabled
1: Probe 2 enabled</td><td rowspan="4">Bit8-bit10: Probe 2 Running Status</td></tr>
<tr><td>9</td><td>Probe 2 Rising Edge Trigger Data Valid:
0: Rising edge trigger data invalid
1: Rising edge trigger data valid</td></tr>
<tr><td>10</td><td>Probe 2 Falling Edge Trigger Data Valid:
0: Falling edge trigger data invalid
1: Falling edge trigger data valid</td></tr>
<tr><td>11-15</td><td>Reserved</td></tr>
</table>

(2) Related Objects

Index	Sub-index	Name	Access Type	Validation	Data Type
60B8h	00h	Probe Settings	RW	Real-time change	UINT16
60B9h	00h	Probe Status	RO	Not changeable	UINT16
60BAh	00h	Probe 1 Rising Edge Position	RO	Not changeable	INT 32
60BBh	00h	Probe 1 Falling Edge Position	RO	Not changeable	INT 32
60BCh	00h	Probe 2 Rising Edge Position	RO	Not changeable	INT 32
60BDh	00h	Probe 2 Falling Edge Position	RO	Not changeable	INT 32
60D1h	00h	Probe 1 Rising Edge Time	RO	Not changeable	UINT 32
60D2h	00h	Probe 1 Falling Edge Time	RO	Not changeable	UINT 32
60D3h	00h	Probe 2 Rising Edge Time	RO	Not changeable	UINT 32
60D4h	00h	Probe 2 Falling Edge Time	RO	Not changeable	UINT 32
60D5h	00h	Probe 1 Rising Edge Count	RO	Not changeable	UINT 16
60D6h	00h	Probe 1 Falling Edge Count	RO	Not changeable	UINT 16
60D7h	01h	Probe 2 Rising Edge Count	RO	Not changeable	UINT 16
60D8h	00h	Probe 2 Falling Edge Count	RO	Not changeable	UINT 16

8.4.2 Position Limit Function

CD300E supports traditional hardware limit functions: the extreme position is given by an external DI signal, connecting the external limit switch signal to the servo drive's CN1 interface (default DI3 for positive limit, DI4 for negative limit). It also supports the use of software limit functions, defining soft limits relative to the mechanical origin using object 607Dh as an absolute position. However, it must be noted that hardware limits and software limits cannot be used simultaneously; software limits are inValidation when hardware limits are used.

(1) Control Description

For software limit function to work properly, the following conditions must be met:

• In control modes (PP, PV, CSP, CSV)

·607Dh-01h＜607Dh-02h

(2) Related Objects

Set the software limit function using parameters Pr.3.34(4010h-4A), Pr3.35(607Dh-01h), Pr3.36(607Dh-02h):

No.	Index	Sub-index	Name/Description	Description
Pr3.34	4010h	4Ah	Software Limit Enable	0: Disabled, 1: Enabled
Pr3.35	607Dh	01h	Soft limit position 1	Set the minimum position value for the soft limit function, restricting the motor's reverse movement range
Pr3.36	607Dh	02h	Soft limit position 2	Set the maximum position value for the soft limit function, restricting the motor's forward movement range

8.4.3 Forced DO Output

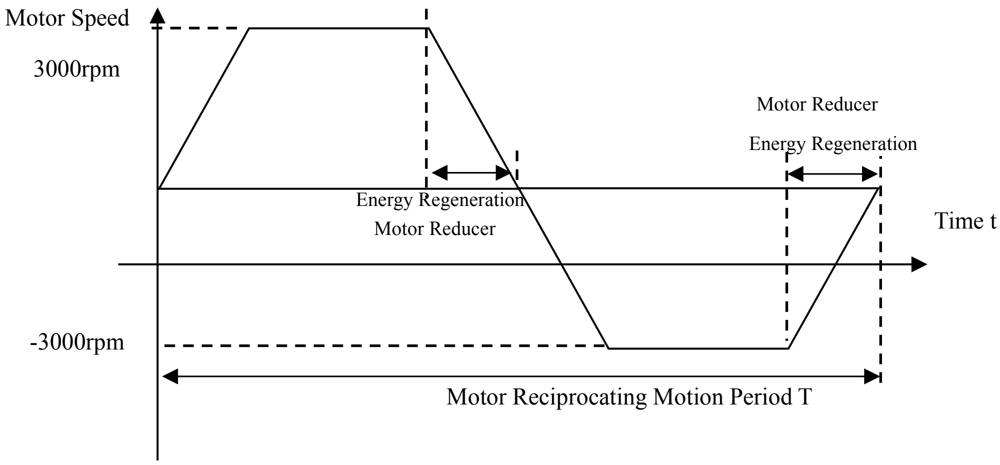
(1) Control Description

When ESM switches to OP, forced DO output is determined jointly by 60FEh-01h/60FEh-02h. DOs can be selected bitwise for forced DO output. CD300E can set 1 brake output and 3 forced DO outputs.

<table>
<tr><th>Index</th><th>Sub-index</th><th>Name/Description</th><th>Access</th><th>PDO Mapping</th><th>Data Type</th></tr>
<tr><td rowspan="2">60FEh</td><td rowspan="2">01h</td><td>Physical Outputs</td><td>RW</td><td>RxPDO</td><td>U32</td></tr>
<tr><td colspan="4"><table>
<tr><td>Bit</td><td>Name</td><td>Description</td></tr>
<tr><td>0</td><td>Brake Enable</td><td>0: Brake not active
1: Forced control of brake enable</td></tr>
<tr><td>16</td><td>DO1</td><td rowspan="3">0: DO no output
1: Forced DO output</td></tr>
<tr><td>17</td><td>DO2</td></tr>
<tr><td>18</td><td>DO3</td></tr>
</table></td></tr>
<tr><td rowspan="2">60FEh</td><td rowspan="2">02h</td><td>Bit Mask</td><td>RW</td><td>RxPDO</td><td>U32</td></tr>
<tr><td colspan="4">When the corresponding position in 60FEh-01h is set to 1, the setting in 60FEh-01h becomes Validation</td></tr>
</table>

8.4.4 Virtual Braking Function

When the motor's torque and speed directions are opposite, energy is fed back from the motor to the drive, causing the bus voltage to rise. When it rises to the braking point, energy needs to be dissipated through a braking resistor or the virtual braking function to prevent further bus voltage increase, otherwise it may trigger an overvoltage alarm or even damage the servo drive. Taking the motor running from 3000rpm to standstill at no load as an example, the motor speed curve is as follows:



For drives experiencing overvoltage alarms, if the load is not heavy, virtual braking function can be considered first. The braking current should be gradually increased until the overvoltage alarm disappears. Using the virtual braking function eliminates the need for an external braking resistor, saving costs.

※ Note:

· **A larger value for virtual braking current (2421h-07h) results in stronger braking capability (more regenerative energy can be consumed), but it also means the motor's operating temperature may be higher. Therefore, users should test and select an appropriate virtual braking current value based on actual working conditions, ensuring that the motor's operating temperature does not reach its maximum allowed value under corresponding conditions and has a certain temperature rise margin.**

· **Motor noise may increase when virtual braking is active.**

Related Object

Index	Parameter Name	Set Value	Default Value	Unit	ACCESS	Validation
2421h-06h	Virtual Braking Function	0: Not enabled Not 0: Enabled	0		RW	Immediate
2421h-07h	Virtual Braking Current	≤100	10	0.1A	RW	Immediate

Chapter 9 Parameters

9.1 Panel Parameters

ReMarks:

- ✧ The first parameter Prx.00 of all panel parameter groups corresponds to the storage function
- ✧ Indices are all represented in hexadecimal
- ✧ The "Mark" column RW indicates Read/Write, RO indicates Read-Only, and RWS indicates Read/Write and Save
- ✧ The second row of the "Mark" column indicates the parameter type. The letter 'U' indicates unsigned, the letter 'I' indicates signed, and the number indicates the bit width
- ✧ Objects that are operated in hexadecimal will be specially Marked in the "Type" attribute

9.1.1 F001 Group (Control Loop Parameter Group) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr1.00	101001	Storage	Return value 2: indicates storage task is being executed Write 1: Store changed modules Write 0x786D68: Store checksum data Write 0x786D6872: Initialize and store checksum data Write 22: Restore entire machine to factory settings Write 3: Restore I/O and communication modules to factory settings Write 4: Reset axis 1 control and motor parameters Write 8: Reset axis 1 motor parameters Write 12: Clear fault records	0		U32 HEX	RW	Immediate
Pr1.01	402001	Position Loop Bandwidth 0	Correspond to position loop response capability Please refer to the "Adjustment" section for setting method	764	0.01Hz	U16	RW	Immediate
Pr1.02	402401	Speed Loop Proportional Gain 0	Correspond to speed loop response capability Please refer to the "Adjustment" section for setting method	Determined by motor parameters		U32	RWS	Immediate
Pr1.03	402501	Speed Loop Integral Gain 0	Correspond to speed loop steady-state following capability Please refer to the "Adjustment" section for setting method	Determined by motor parameters		U16	RWS	Immediate
Pr1.04	401028	Current Loop Proportional Gain	Correspond to current loop response capability This parameter is automatically calculated based on motor parameters by default It can be manually adjusted when using custom motors For manual adjustment, Pr1.06 needs to be enabled	Determined by motor parameters		U16	RWS	Immediate
Pr1.05	401027	Current Loop Integral Gain	Correspond to current loop steady-state following capability This parameter is automatically calculated based on motor parameters by default It can be manually adjusted when using custom motors For manual adjustment, Pr1.06 needs to be enabled	Determined by motor parameters		U16	RWS	Immediate
Pr1.06	401026	Current Loop PI Auto Calculation	0: Automatically calculate current loop PI parameters after each power-up 1: Use manually set current loop PI parameters	0		U8	RWS	Restart
Pr1.07	40102C	Position Command Low-Pass Filter	Correspond to position command low-pass filter coefficient Larger setting value means stronger filtering, greater lag Setting value -1 is the actual filtering coefficient 1-20000	1	62.5us	U16	RWS	Immediate
Pr1.08	40102D	Position Command Smoothing Filter	Correspond to position command moving average filter coefficient Larger setting value means stronger filtering, greater lag Setting value -1 is the actual filtering coefficient 1-2048	1	62.5us	U16	RWS	Immediate
Pr1.09	40101D	Speed Feedback Filter Bandwidth	Set the bandwidth of the speed feedback filter Larger setting value means weaker filtering, smaller lag Reasonable setting can reduce noise Too small a setting may affect loop stability 10-2000	300	Hz	U16	RWS	Immediate
Pr1.10	40101C	Torque Filter Bandwidth	Set the bandwidth of the current command filter Larger setting value means weaker filtering, smaller lag Reasonable setting can eliminate noise and resonance Too small a setting may affect loop stability	418	Hz	U16	RWS	Immediate
Pr1.11	300226	Speed Feedback Channel	0: Original speed information 1: Information after 1st order low-pass filtering 2: Information after 2nd order low-pass filtering Note: If encoder resolution exceeds 65536, setting to 2 has the same effect as setting to 1	2		U8	RWS	Immediate

Pr1.12	401024	Torque Filter Order	0: First-order low-pass 1: Second-order low-pass	1		U8	RWS	Immediate
Pr1.13	606500	Position following error window	One of the detection conditions for position following alarm, used with 606600 Trigger position following alarm detection when position error exceeds this setting	50000	PUL	U32	RWS	Immediate
Pr1.14	606600	Position Following Error Time Window	One of the detection conditions for position following alarm Used with 606500 Trigger alarm when position error exceeds the setting value of 6065 and persists for this time window	10	ms	U16	RWS	Immediate
Pr1.15	606700	In-position Window	One of the detection conditions for in-position detection Used with 606800	10	PUL	U32	RWS	Immediate
Pr1.16	606800	In-position time window	One of the detection conditions for in-position detection Used with 606700	15	ms	U16	RWS	Immediate
Pr1.17	40101F	Velocity Feedforward Permille	Setting velocity feedforward can improve dynamic tracking performance Note: Setting value / 1024 corresponds to true permille	0	‰	U16	RWS	Immediate
Pr1.18	401020	Velocity Feedforward Filter Bandwidth	Filters velocity information in the position command 6-2000	100	Hz	U16	RWS	Immediate
Pr1.19	40104C	Gain Switching Mode	0: Do not use automatic gain switching If "Gain Select" is configured for the input function, the gain group corresponding to the "Gain Select" function is used. Otherwise, if rigidity level is used, the rigidity gain group is selected; otherwise, gain group 0 is selected 1: Switch gain to the group corresponding to 40104D when speed is 0 2: In position mode, when position error is less than the value corresponding to 401075, and the position command is unchanged, switch gain to the group corresponding to 40104D. For non-position modes, use gain group 0 or the rigidity gain group	0		U8	RWS	Immediate
Pr1.20	40104D	Gain Switching Target	Set the gain group number selected when automatic gain switching is enabled 0-3			U8	RWS	Immediate
Pr1.21	310005	Current Gain Selection	Display the number of the currently used gain group	0		U8	RO	
Pr1.22	402002	Position Loop Bandwidth 1	Reference Position Loop Bandwidth 0					
Pr1.23	402003	Position Loop Bandwidth 2	Reference Position Loop Bandwidth 0					
Pr1.24	402004	Position Loop Bandwidth 3	Reference Position Loop Bandwidth 0					
Pr1.25	402402	Speed Loop Proportional Gain 1	Reference Speed Loop Proportional Gain 0					
Pr1.26	402403	Speed Loop Proportional Gain 2	Reference Speed Loop Proportional Gain 0					
Pr1.27	402404	Speed Loop Proportional Gain 3	Reference Speed Loop Proportional Gain 0					
Pr1.28	402502	Speed Loop Integral Gain 1	Reference Speed Loop Integral Gain 0					
Pr1.29	402503	Speed Loop Integral Gain 2	Reference Speed Loop Integral Gain 0					
Pr1.30	402504	Speed Loop Integral Gain 3	Reference Speed Loop Integral Gain 0					
Pr1.31	402702	Integral Limit 1	Set the speed loop integral output current limit Should not exceed the current command limit when set	Drive limited	0.1A	U16	RWS	Immediate
Pr1.32	402703	Integral Limit 2	Reference "Integral Limit 1"					
Pr1.33	402704	Integral Limit 3	Reference "Integral Limit 1"					
Pr1.34	401025	Current Command Limit	Limit the drive's maximum output current	Drive limited	0.1A	U16	RWS	Immediate
Pr1.35	401021	Torque Feedforward Permille	Setting torque feedforward can improve dynamic tracking performance Torque feedforward setting assumes correct inertia ratio Note: Setting value / 1024 corresponds to true permille	0	‰	U16	RWS	Immediate
Pr1.36	401022	Torque Feedforward Filter Bandwidth	Filter acceleration in the position command 6-2000	100	Hz	U16	RWS	Immediate
Pr1.37	401016	Speed Mode Command Source	0: Speed command originates from the profile generator (operating mode 3) or immediate speed command source (operating mode -3) 1: Speed command originates from analog input 2: Speed command originates from pulse frequency 4: Speed command originates from Pr1.55(40109B)	0		U8	RWS	Immediate

Pr1.38	401064	Vibration Suppression Setting	Bit0-1: 0 does not enable vibration suppression function 1 Enable vibration filter A 2 Enable vibration filter B 3 Enable vibration filter A+B	0		U16 HEX	RWS	Immediate
Pr1.39	401065	Vibration Suppression Frequency A	Set frequency of vibration filter A 10-1000	100	0.1Hz	U16	RWS	Immediate
Pr1.40	401066	Vibration Suppression Intensity A	Set intensity of vibration filter A 1-30	10		U16	RWS	Immediate
Pr1.41	401067	Vibration Suppression Frequency B	Reference Group A	100	0.1Hz	U16	RWS	Immediate
Pr1.42	401068	Vibration Suppression Intensity B	Reference Group A	10		U16	RWS	Immediate
Pr1.43	40101E	Integral Limit 0	Reference Integral Limit 1					
Pr1.44	401076	Startup Compensation Current	Accelerate motor from 0 speed Validation in position mode	0	Internal Unit	U16	RWS	Immediate
Pr1.45	401077	Startup Compensation Time	Constant time for startup compensation current, which will gradually decay to 0 later	15	ms	U8	RWS	Immediate
Pr1.46	40105F	Forward Friction Current	This compensation current can be set to accelerate motor startup	0	0.1A	U8	RWS	Restart
Pr1.47	401060	Reverse Friction Current	This compensation current can be set to accelerate motor startup	0	0.1A	U8	RWS	Restart
Pr1.48	401061	Real-time Function Settings	Bit0: Enable online load detection Bit1: Enable friction compensation Bit2: Friction compensation source, 0 from 40105F and 401060, 1 from online detected value Bit3: Enable online gain adjustment, and adjust gain based on online measured inertia and user-selected rigidity level	1		U8 HEX	RWS	Immediate
Pr1.49	401062	Forward Maximum Friction Current	Limit the maximum forward friction current detected online	10	0.1A	U8	RWS	Restart
Pr1.50	401063	Reverse Maximum Friction Current	Limit the maximum reverse friction current detected online	10	0.1A	U8	RWS	Restart
Pr1.51	401075	Gain Switching Positioning Error Comparison Value	Used when gain switching mode is 2 Need to be adjusted according to actual conditions	2000	inc	U16	RWS	Immediate
Pr1.52	242213	Pulse command hardware filtering	Setting format is hexadecimal 0xAB. B represents the filter value, settable from 0 to F. A represents the division value, settable from 0 to 3. With the same filter value, a larger division value results in stronger filtering	00		U8 HEX	RWS	Immediate
Pr1.53	401099	Multi- turn cycle function	Set the usage method of the absolute encoder. **0:** Used in absolute system (absolute mode). **2:** Used in absolute system (absolute mode), but allows arbitrary setting of the multi- turn count upper limit and ignores multi- turn count overflow (infinite rotation absolute mode).	0		U8	RWS	Restart
Pr1.54	40109A	Multi- turn cycle maximum value	Set the upper limit of absolute multi- turn data in infinite rotation absolute mode. If the multi- turn data exceeds this set value, it will reset to zero; conversely, when reversing at 0, it will become the set value of this parameter.	50	round	U16	RWS	Restart
Pr1.55	40109B	Speed command in velocity mode	When the operating mode is 3 (speed mode) and the Pr1.37=4 , this is the speed command set value.	0	rpm	I16	RWS	Immediate
Pr1.57	401044	Pulse overclocking	Input pulse frequency comparison point; if exceeded, an alarm will be triggered.	1000	KHz	U16	RWS	Immediate
Pr1.58	40109E	CAN disable	0: Enable CAN; other values: disable CAN	255		U8	RWS	Immediate
Pr1.59	401097	Pulse speed command filter coefficient	The larger the value, the lower the filter bandwidth	10		U16	RWS	Immediate
Pr1.60	401069	Enable torque speed limiting		1		U8	RWS	Immediate
Pr1.61	40106A	Speed limit in torque mode		3000	rpm	U16	RWS	Immediate
Pr1.62	40106B	Torque mode compensation current limit				U16	RWS	Immediate
Pr1.63	40106C	Torque speed proportional gain		100		U16	RWS	Immediate
Pr1.64	40106D	Torque speed integral gain		1		U16	RWS	Immediate

Pr1.65	401098	Gravity integral compensation current	Used to counteract vertical axis gravity	0	Ap	I8	RWS	Immediate
Pr1.66	4010AF	Gear expansion coefficient numerator	Used for gear ratio switching.	1		U16	RWS	Immediate
Pr1.67	4010B0	Gear expansion coefficient denominator	Used for gear ratio switching.	1		U16	RWS	Immediate

9.1.2 F002 Group (Motor Parameter Group) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr2.00	101001	Storage	Refer to Pr1.00					
Pr2.01	310019	Current Motor Model	Display the currently connected motor model			U16	RO	
Pr2.02	47FE01	Motor Model Setting	Display or sets the motor model 0 means custom motor			U16	RWS	Restart
Pr2.03	47FE02	Motor Body ID	Correspond to motor body code			U16	RWS	Restart
Pr2.04	47FE03	Motor Encoder ID	Correspond to encoder code			U16	RWS	Restart
Pr2.05	47FE04	Motor Bandwidth	It can be fixedly set to 2000Hz	2000	Hz	U16	RWS	Restart
Pr2.06	47FE05	Rotor Inertia	Motor rotor inertia		kg·mm²	U16	RWS	Restart
Pr2.07	47FE06	Back EMF Coefficient	Describe the relationship between motor speed and back EMF		0.1V/krpm	U16	RWS	Restart
Pr2.08	47FE07	Torque Coefficient	Describe the relationship between current (RMS) and torque		0.01Nm/A	U16	RWS	Restart
Pr2.09	47FE08	Motor Inductance	Line-to-line inductance		0.1mH	U16	RWS	Restart
Pr2.10	47FE09	Motor Overload Time	Motor's continuous operating time slightly above rated current		s	U16	RWS	Restart
Pr2.11	47FE0A	Motor Pole Pair Number	Number of magnetic pole pairs in the motor rotor			U16	RWS	Restart
Pr2.12	47FE0B	Rated Current of Motor	Current during motor continuous operation		0.1Arms	U16	RWS	Restart
Pr2.13	47FE0C	Rated Power of Motor	Rated Power of Motor		W	U16	RWS	Restart
Pr2.14	47FE0D	Motor Resistance	Line-to-line resistance		0.1Ω	U16	RWS	Restart
Pr2.15	47FE0E	Baud Rate Index	Describe the baud rate used by the encoder communication protocol	0		U8	RWS	Restart
Pr2.16	47FE0F	Motor Maximum Speed	Describe the maximum allowable motor speed		rpm	U16	RWS	Restart
Pr2.17	47FE10	Multi-turn Resolution	Use when the encoder is a multi-turn absolute encoder Otherwise, set to 0		round	U32	RWS	Restart
Pr2.18	47FE11	Single-turn Resolution	Encoder position resolution within one revolution		inc	U32	RWS	Restart
Pr2.19	47FE12	Encoder Type	Currently only support type 1	1		U8	RWS	Restart
Pr2.20	47FE13	Excitation Mode	0: Dither excitation 1: Use default excitation information	1		U16	RWS	Restart
Pr2.21	47FE14	Brake ID	Motor brake code Set to 0 if no brake	0		U16	RWS	Restart
Pr2.22	47FE15	Temperature Sensor ID	Motor built-in temperature sensor code Set to 0 if no temperature sensor	0		U16	RWS	Restart
Pr2.23	300102	Brake Delay	Set the brake release delay When Brake ID is not 0, the drive will attempt to control the brake drive signal to release the brake when enabled	100	ms	U16	RWS	Immediate
Pr2.24	40102A	Motor Model Auto-Recognition	0: Do not auto-recognize motor 1: Auto-recognize motor. The drive identifies the current encoder, then automatically reads data from inside the encoder.	1		U8	RWS	Immediate

9.1.3 F003 Group (Drive Configuration Parameter Group) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr3.00	101001	Storage	Refer to Pr1.00					
Pr3.01	609101	Gear Input Turns	Motor shaft (gear input shaft) rotation turns Refer to "Motion Equivalent Setting"	1	r	U32	RWS	Immediate
Pr3.02	609102	Gear Output Turns	Gear output shaft rotation turns Refer to "Motion Equivalent Setting"	1	r	U32	RWS	Immediate
Pr3.03	609201	Feed	Number of commands issued by the controller Refer to "Motion Equivalent Setting"	10000	PUL	U32	RWS	Immediate
Pr3.04	609202	Rotations of Shaft	"Fee" corresponds to the number of rotations of the gear output shaft Refer to "Motion Equivalent Setting"	1	r	U32	RWS	Immediate
Pr3.05	607E00	Rotation Direction	0: Command positive polarity	0		U8	RWS	Restart

			1: Command negative polarity					
Pr3.06	25000C	Communication ID	Drive communication ID. Used for 485, CAN, or 232 cascaded buses. The host computer can set the ID to 127 to connect to drives with unknown communication IDs from 1 to 126	1		U8	RWS	Immediate
Pr3.07	401031	Operating Mode at Power-up	Set the drive's default operating mode at power-up	1		S8	RWS	Restart
Pr3.08	250004	Serial Port 1 Baud Rate	Serial port 1 is the drive's debug port, use a 485 interface. Baud rate cannot be changed arbitrarily Support 128000, 256000, 512000	256000		U32	RWS	Restart
Pr3.09	25000E	Temporary Baud Rate	When decide to use a non-default baud rate, first set the temporary baud rate code, if communication is normal then execute Serial Port 1 baud rate modification	1		U8	RW	Immediate
Pr3.10	250005	Serial Port 2 Baud Rate	Serial Port 2 is an RS485 bus interface	57600		U32	RWS	Restart
Pr3.11	250008	Serial Port 2 Protocol	0: Proprietary protocol 1: Modbus RTU	1		U8	RWS	Restart
Pr3.12	25000D	CAN Baud Rate	CAN bus baud rate setting			U8	RWS	Restart
Pr3.13	250010	Manufacturer Password	For drive factory configuration use			U32	WO	Immediate
Pr3.14	242105	User Password	Protect application data. When user password protection is not released, application data cannot read or write, user password returns 9527, otherwise returns 0	0		U16	RWS	Immediate
Pr3.15	300103	Relay Control Delay	Manufacturer Parameters	120	ms	U16	RWS	Immediate
Pr3.16	401012	Encoder Multi-turn Disable	Validation when the encoder is a multi-turn absolute encoder 0: Position feedback is multi-turn absolute 1: Disable multi-turn data, position feedback is single-turn	0		U8	RWS	Restart
Pr3.17	401013	Auto Enable	0: Do not auto-enable 1: Auto-enable at power-up 2: Automatically execute enable after each fault reset	0		U8	RWS	Restart
Pr3.18	401014	Auto Fault Reset	0: Do not auto-reset fault 1: Automatically clear after a certain time after fault occurs	0		U8	RWS	Immediate
Pr3.19	401015	Fault Reset Time	Validation when auto fault reset is enabled	5000	ms	U16	RWS	Immediate
Pr3.20	40102B	Auto Run Position Table	0: Do not auto-run position table >=1: Auto-run position table at power-up 2: Auto-run position table after fault reset 3: Automatically execute position table after re-homing	0		U8	RWS	Immediate
Pr3.21	609903	Auto Origin Finding	0: Do not auto-homing >=1: Auto-homing at power-up 2: Auto-homing after being enabled when origin is lost 3: Always auto-homing when fault is cleared	0		U8	RWS	Immediate
Pr3.22	242101	Use internal braking resistor	0: Not used 1: Use Used by default if an internal braking resistor is present	0/1		U8	RWS	Immediate
Pr3.23	242102	Braking Resistor Resistance	External braking resistor resistance	20	Ω	U8	RWS	Immediate
Pr3.24	242103	Braking Resistor Overload Time	External braking resistor overload time 1-255	15	s	U8	RWS	Immediate
Pr3.25	242104	Braking Resistor Rated Power	External braking resistor power	100	w	U16	RWS	Immediate
Pr3.26	210007	Braking Voltage	Trigger voltage to open the braking circuit Manufacturer Parameters		0.1V	U16	RWS	Immediate
Pr3.27	210008	Braking Release Voltage	Trigger voltage to close the braking circuit Manufacturer Parameters		0.1V	U16	RWS	Immediate
Pr3.28	401057	Current Comparison Value A	When this object is 0, the current comparison function is inactive	0	0.1A	S16	RWS	Restart
Pr3.29	401058	Current Comparison Rule	0: Compare actual current value 1: Compare absolute current value	0		U8	RWS	Immediate
Pr3.30	401059	Current Comparison Time	Time window required for current comparison output result	50	ms	U16	RWS	Immediate
Pr3.31	401034	Stop in step	0: Not enabled 1: When the drive stops moving, automatically switch to current lock state to prevent closed-loop jitter	0		U8	RWS	Restart
Pr3.32	40103A	Step Stop Start Current	Current when entering step stop mode	30	0.1A	U16	RWS	Immediate
Pr3.33	401045	Step Stop End Current	Holding current in step stop mode	10	0.1A	U16	RWS	Immediate
Pr3.34	40104A	Software Limit Enable	0: Do not enable 1: Enable	0		U8	RWS	Immediate
Pr3.35	607D01	Soft limit position 1	Correspond to the soft limit negative position	0	PUL	S32	RWS	Immediate
Pr3.36	607D02	Soft limit position 2	Correspond to the soft limit positive position	0	PUL	S32	RWS	Immediate
Pr3.37	401078	Locked Rotor Current	Stall Detection Threshold	Hardware limited	0.1A	U16	RWS	Restart
Pr3.38	40105B	Pulse Regeneration	Quantity of quadrature pulse regeneration per revolution	10000	edge	U32	RWS	Restart

		Quantity							
Pr3.39	401079	Regeneration Index Width	Width of the pulse regeneration index signal	50	edge	U16	RWS	Restart
Pr3.40	242108	Dynamic Braking Mode	0: Continuously enable relay after enabling 1: Relay controlled by enable state 2: Automatically enable relay after power-up	0		U8	RWS	Immediate
Pr3.41	40100B	Pulse mode	0:Pulse + direction 1:CW + CCW 2:AB phase quadrature pulse 3:Two- channel unidirectional pulse bus 4:Four- channel bidirectional pulse bus 5:Two- channel bidirectional pulse bus with analog	0	-	U8	RWS	Immediate
Pr3.42	401085	High-speed pulse axis number	One- Drive- Multi- Axis Control Axis Number Setting 0:Corresponds to the 1st pulse input of the conversion card 1:Corresponds to the 2nd pulse input of the conversion card 2:Corresponds to the 3rd pulse input of the conversion card 3:Corresponds to the 4th pulse input of the conversion card	0	-	U8	RWS	Immediate
Pr3.43	25000B	Serial port 2 data Transmission format	0: Stop bit 1, no parity 1: Stop bit 1, odd parity 2: Stop bit 1, even parity 3: Stop bit 2, no parity 4: Stop bit 2, odd parity 5: Stop bit 2, even parity	0	-	U8	RWS	Restart
Pr3.44	401088	Enable pulse bus DIN	0: Disable 1: Enable	0	-	U8	RWS	Restart
Pr3.45	250006	port 1 communication protocol	Serial Port 1 Communication Protocol Manufacturer protocol	0		U8	RWS	Restart
Pr3.46	401004	Speed pulse frequency coefficient	Speed Pulse Frequency Coefficient rpm/kHz	100	rpm/kHz	I16	RWS	Immediate
Pr3.47	242106	Virtual braking function	0: Virtual braking function disabled Non- zero: Virtual braking function enabled Note: This function can be enabled when a slight braking capability is required.	0		U8	RWS	Restart
Pr3.48	242107	Virtual braking current		0	0.1A	U8	RWS	Restart
Pr3.49	605A00	Emergency stop option	Emergency Stop Options 0: Drive disable (free stop) 1: Decelerate using RAMP0 (6084), then disable 2: Decelerate using RAMP1 (6085), then disable 3, 4: Decelerate with maximum current limit, then disable 5, 9: Decelerate using RAMP0 (6084) and maintain emergency stop 6, 10: Decelerate using RAMP1 (6085) and maintain emergency stop 7, 8: Decelerate with maximum current limit and maintain emergency stop 11, 13: Decelerate with maximum current limit and maintain emergency stop 12: Decelerate with maximum current limit, clear integral, and maintain emergency stop 14: Decelerate using RAMP0 (6084) and remain in SWITCHED_ON state 15: Decelerate using RAMP0 (6084) and remain in READY_TO_SWITCH_ON state	0		I16	RWS	Immediate
Pr3.50	605B00	Shutdown option	0: Free stop 1: Decelerate to 0 and remain in READY_TO_SWITCH_ON (ready2on)	0		I16	RWS	Immediate
Pr3.51	605C00	Disable option	0: Free stop 1: Decelerate to 0 and remain in SWITCHED_ON	0		I16	RWS	Immediate
Pr3.52	608300	Profile acceleration		1000000	PUL/ss	U32	RWS	Immediate
Pr3.53	608400	Profile deceleration		1000000	PUL/ss	U32	RWS	Immediate
Pr3.54	608500	Emergency stop deceleration		20000000	PUL/ss	U32	RWS	Immediate
Pr3.55	607F00	Maximum profile velocity		600000	PUL/s	U32	RWS	Immediate
Pr3.56	608000	Maximum speed command (rpm)		3500	rpm	U32	RWS	Immediate

Pr3.57	608100	Profile velocity		50000	PUL/s	U32	RWS	Immediate
Pr3.58	607A00	Target position		0	PUL	I32	RWS	Immediate
Pr3.59	607100	Target torque		0	‰	I16	RWS	Immediate
Pr3.60	607200	Maximum torque		3000	‰	I16	RWS	Immediate
Pr3.61	40109D	Home switch position	Setting is referenced to position 6064h.	0	PUL	I32	RWS	Immediate
Pr3.62	40107A	PWM frequency Switch enableode	0:Cannot switch (PWM frequency control mode disabled) 1: Can switch PWM frequency control mode (enabled)	1		U8	RWS	Restart

9.1.4 F004 Group (Input Pin Configuration) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr4.00	101001	Storage	Refer to Pr1.00					
Pr4.01	240001	DIN1 Action Mode	0: Low level 1: High level 2: Rising edge 3: Falling edge	1		U8	RWS	Immediate
Pr4.02	240002	DIN2 Action Mode	Same as above	2		U8	RWS	Immediate
Pr4.03	240003	DIN3 Action Mode	Same as above	1				
Pr4.04	240004	DIN4 Action Mode	Same as above	1		U8	RWS	Immediate
Pr4.05	240005	DIN5 Action Mode	Same as above	1				
Pr4.06	240006	DIN6 Action Mode	Same as above	1		U8	RWS	Immediate
Pr4.07	240007	DIN7 Action Mode	Same as above	1				
Pr4.08	240008	DIN8 Action Mode	Same as above	1		U8	RWS	Immediate
Pr4.09	240101	DIN1 Filter Coefficient	Apply a low-pass filter to the DIN pins	100	ms	U16	RWS	Immediate
Pr4.10	240102	DIN2 Filter Coefficient	Apply a low-pass filter to the DIN pins	100	ms	U16	RWS	Immediate
Pr4.11	240103	DIN3 Filter Coefficient	Apply a low-pass filter to the DIN pins	2	ms	U16	RWS	Immediate
Pr4.12	240104	DIN4 Filter Coefficient	Apply a low-pass filter to the DIN pins	2	ms	U16	RWS	Immediate
Pr4.13	240105	DIN5 Filter Coefficient	Apply a low-pass filter to the DIN pins	2	ms	U16	RWS	Immediate
Pr4.14	240106	DIN6 Filter Coefficient	Apply a low-pass filter to the DIN pins	10	ms	U16	RWS	Immediate
Pr4.15	240107	DIN7 Filter Coefficient	Apply a low-pass filter to the DIN pins	2	ms	U16	RWS	Immediate
Pr4.16	240108	DIN8 Filter Coefficient	Apply a low-pass filter to the DIN pins	2	ms	U16	RWS	Immediate
Pr4.17	240201	DIN1 Function Index	0: No function 1:Enable 2:Reset 3: Index 0 4: Index 1 5: Index 2 6: Index 3 7: Index 4 8: Mode Index 0 9: Mode Index 1 10: Gain Index 0 11: Gain Index 1 12: Integral Clear 13: Positive Limit Switch 14: Negative Limit Switch 15: Origin Signal 16: Start Origin Finding 17: Command Reversal 18: Emergency Stop 19: Trigger 0 20: Trigger 1 21: Condition 0 22: Condition 1 23:Pause 24: Pulse gear 25: Activate Position Table 26: Interrupt Position Table 27: Pause Position Table 28: Probe 1 29: Probe 2 30: Full/half closed-loop switching 31: Pulse input inhibit	1		U8	RWS	Immediate
Pr4.18	240202	DIN2 Function Index	Same as above	2		U8	RWS	Immediate
Pr4.19	240203	DIN3 Function Index	Same as above	3		U8	RWS	Immediate
Pr4.20	240204	DIN4 Function Index	Same as above	4		U8	RWS	Immediate
Pr4.21	240205	DIN5 Function Index	Same as above	5		U8	RWS	Immediate
Pr4.22	240206	DIN6 Function Index	Same as above	16		U8	RWS	Immediate
Pr4.23	240207	DIN7 Function Index	Same as above	15		U8	RWS	Immediate
Pr4.24	240208	DIN8 Function Index	Same as above	18		U8	RWS	Immediate
Pr4.25	240301	DIN1 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.26	240302	DIN2 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.27	240303	DIN3 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.28	240304	DIN4 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.29	240305	DIN5 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.30	240306	DIN6 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.31	240307	DIN7 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.32	240308	DIN8 Polarity	0: Negative polarity 1: Positive polarity	1		U8	RWS	Immediate
Pr4.33	40107D	Hybrid deviation clear setting	Set internal encoder multi- turn count	0		U16	RWS	Immediate
Pr4.34	401018	Full closed- loop encoder baud rate	Full closed- loop encoder baud rate	0		U8	RWS	Immediate

Pr4.35	401081	External division numerator	Default is 0, which equals the encoder resolution automatically identified by the current drive (17-bit = 131072, 23-bit = 8388608)	0		U32	RWS	Immediate
Pr4.36	401082	External division denominator	Number of external encoder pulses per revolution of the servo motor; takes effect after saving and restarting.	10000		U32	RWS	Immediate
Pr4.37	401080	Maximum hybrid deviation		16000	PUL	U32	RWS	Immediate
Pr4.38	40107F	Hybrid filter coefficient		1		U16	RWS	Immediate
Pr4.39	40107E	Hybrid gain offset	Correction for hybrid gai	0		I16	RWS	Immediate
Pr4.40	40107B	Full closed-loop index signal mode	0: Do not use Z signal 1: Use periodic Z signal, mostly low level 2: Use periodic Z signal, mostly high level	1		U8	RWS	Immediate
Pr4.41	40107C	Full closed-loop counting direction	0: Forward; 1: Reverse	0		U8	RWS	Immediate
Pr4.42	401019	Full closed-loop encoder resolution	Full closed-loop encoder resolution	10000		U32	RWS	Immediate
Pr4.43	20003B	Full closed-loop Z forward rising edge position low				I32	RO	
Pr4.44	20003D	Full closed-loop Z reverse rising edge position low				I32	RO	
Pr4.45	20003A	Full closed-loop position low 32 bits				I32	RO	
Pr4.46	401017	Full closed-loop encoder model	0:Disable full closed-loop function; 1:Enable full closed-loop function. Takes effect after saving and restarting.			U8	RWS	Immediate
Pr4.47	200040	Full closed-loop quadrature fault				U8	RO	
Pr4.48	300239	Initiate homing via keypad				U8	RWS	Immediate
Pr4.49	310031	Absolute clear / Absolute zero reset	For multi-turn absolute encoder motors, perform fault and position clear when the drive is not enabled.			U8	RWS	Restart
Pr4.50	4010B2	Gantry correction mode	The correction function must be used with two pulse servo drives and in pulse control scenarios, and the motors must be equipped with multi-turn absolute encoders. Before enabling this function, ensure that the absolute positions of the two axes meet the user's required settings.	0		U8	RWS	Restart
Pr4.51	4010B3	Gantry correction speed				U8	RWS	Restart
Pr4.52	4010B4	Gantry correction maximum deviation				I32	RWS	Restart
Pr4.53	4010B5	Gantry correction slave address				U8	RWS	Restart

9.1.5 F005 Group (Output Pin Configuration) Parameter List

No.	Index H	Parameter Name	Setting/Help Information		Default Value	Unit	Type	Access	Validation
Pr5.00	101001	Storage	Refer to Pr1.00						
Pr5.01	240701	DOUT1 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.02	240702	DOUT2 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.03	240703	DOUT3 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.04	240704	DOUT4 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.05	240705	DOUT5 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.06	240706	DOUT6 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.07	240707	DOUT7 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.08	240708	DOUT8 Polarity	0: Negative polarity	1: Positive polarity	1		U8	RWS	Immediate
Pr5.09	240801	DOUT1 Function Index	0: No Function	1: Ready	1		U8	RWS	Immediate
			2: Fault	3: Target Reached					
			4: Speed Saturated	5: Current Saturated					
			6: Motor 0 Speed	7: Brake Control					
			8: Regenerative Braking	9: Z Signal Output					
			10: Torque Mode Speed Limit	11: Motor Enable					
			12: In Limit	13: Origin Found					
			14: Homing	15: Output Index 0					
			16: Output Index 1	17: Output Index 2					
			18: Current Reached						
Pr5.10	240802	DOUT2 Function Index	Same as above		2		U8	RWS	Immediate
Pr5.11	240803	DOUT3 Function Index	Same as above		3		U8	RWS	Immediate
Pr5.12	240804	DOUT4 Function Index	Same as above		7		U8	RWS	Immediate
Pr5.13	240805	DOUT5 Function Index	Same as above		11		U8	RWS	Immediate
Pr5.14	240806	DOUT6 Function Index	Same as above		13		U8	RWS	Immediate

Pr5.15	240807	DOUT7 Function Index	Same as above	6		U8	RWS	Immediate
Pr5.16	240808	DOUT8 Function Index	Same as above	12		U8	RWS	Immediate

9.1.6 F006 Group (Auto-Tuning and Real-time Function Settings) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr6.00	101001	Storage	Refer to Pr1.00					
Pr6.01	401055	Rigidity Grade	0-31 Refer to "Rigidity Gain Table"	17		U8	RWS	Immediate
Pr6.02	401056	Use Rigidity Level	0: Not used 1: Use	0		U8	RWS	Immediate
Pr6.03	401053	Inertia Ratio	Define the content about inertia ratio in "Adjustment" Users can manually set inertia ratio	30	0.1	U16	RWS	Immediate
Pr6.04	310026	Current Load Inertia	Total load inertia deduced from inertia ratio	3*motor	Kg*mm^2	U16	RO	
Pr6.05	320015	Start Inertia Measurement	0: Not started. Automatically reset to 0 after execution 1: Start	0		U8	RWS	Immediate
Pr6.06	32000D	Measuring Results	1: Measurement successful 0: Measurement not started or in progress -1: Speed or current response amplitude too small -2: Measured torque inertia coefficient abnormal -3: Inertia ratio too large, exceeding 25 times -4: Inertia ratio exceeding 40 times	0		S8	RO	
Pr6.07	320016	Movement distance during inertia measurement	10-50	30	0.01 Turn	U8	RWS	Immediate
Pr6.08	310027	Current Inertia Ratio	Measurement result of current inertia ratio	30	0.1	U16	RO	
Pr6.09	310028	Current KLoad	Current torque inertia coefficient			U32	RO	
Pr6.10	300227	Speed Loop Proportion 4	Validation when "Use Rigidity Level" is 1			U32	RO	
Pr6.11	300228	Speed Loop Integral 4	Validation when "Use Rigidity Level" is 1			U16	RO	
Pr6.12	300229	Speed Loop KFR4	Validation when "Use Rigidity Level" is 1	256		U16	RO	
Pr6.13	401061	Real-time Function Settings	Refer to Pr1.48	1		U8	RWS	Immediate
Pr6.14	32001F	Positive Damping Current	Online detected positive damping current	0	ADC/4	S16	RO	
Pr6.15	320025	Negative Damping Current	Online detected negative damping current	0	ADC/4	S16	RO	
Pr6.16	320026	Online Inertia	Total load inertia deduced from online inertia ratio	0	Kg*mm^2	U16	RO	
Pr6.17	320027	Online Inertia Ratio	Online real-time detected inertia ratio	0		U16	RO	
Pr6.19	40106F	Notch Filter A Width	Set the frequency range of the notch filter	45	Hz	U8	RWS	Immediate
Pr6.20	401070	Notch Filter A Depth	Set the filter strength of the notch filter	50	dB	U8	RWS	Immediate
Pr6.21	401071	Notch Filter A Frequency	100-8000. 8000 indicates function disabled	8000	Hz	U16	RWS	Immediate
Pr6.22	401072	Notch Filter B Width	Set the frequency range of the notch filter	45	Hz	U8	RWS	Immediate
Pr6.23	401073	Notch Filter B Depth	Set the filter strength of the notch filter	50	dB	U8	RWS	Immediate
Pr6.24	401074	Notch Filter B Frequency	100-8000. 8000 indicates function disabled	8000	Hz	U16	RWS	Immediate
Pr6.25	401093	Stiffness compensation bandwidth	**0–15:** Stiffness compensation disabled **>15:** Stiffness compensation enabled	0		U8	RWS	Immediate
Pr6.26	401094	Stiffness compensation gain	Enhance system rigidity, actively increase the motor's resistance stiffness, and improve dynamic response.	4000		U16	RWS	Immediate
Pr6.27	40109F	Model switch	**0:**Model tracking control disabled **1:**First-order rigid body model tracking control enabled **2:**Inertia model tracking control enabled	0		U16	RWS	Immediate
Pr6.28	4010A0	Model bandwidth	Determines the system response speed. The higher the bandwidth, the faster the system response, but it may also amplify mechanical vibration. **Range:**1–500 Hz	20	Hz	U16	RWS	Immediate
Pr6.29	4010A1	Model damping	Used to suppress overshoot and oscillation of the system in response to commands, enabling smooth positioning to the target position.	1000		U16	RWS	Immediate
Pr6.30	4010A2	Model anti-resonance frequency	The frequency point corresponding to the "resonance frequency" at which the system's vibration response is minimal.	50	Hz	U16	RWS	Immediate

			Active when inertia model is enabled					
Pr6.31	4010A3	Model resonance frequency	The frequency at which the mechanical system resonates, i.e., the point where vibration is greatly amplified due to energy concentration. The servo system needs to suppress it via a filter Active when inertia model is enabled	70	Hz	U16	RWS	Immediate
Pr6.32	4010A4	Model speed compensation	Speed feedforward compensation. It applies a feedforward command directly to the speed loop, enabling the motor to respond faster to speed changes and thus shorten positioning time	1024	‰	U16	RWS	Immediate
Pr6.33	4010A5	Model forward compensation	Acceleration feedforward compensation	1024	‰	U16	RWS	Immediate
Pr6.34	4010A6	Model reverse compensation	Deceleration feedforward compensation	1024	‰	U16	RWS	Immediate
Pr6.35	4010A7	Vibration suppression frequency	Used to set the mechanical vibration frequency to be suppressed. It can be determined by observing waveforms using the servo software.	100	Hz	U16	RWS	Immediate
Pr6.36	4010A8	Vibration suppression gain	Adjusts the intensity of vibration suppression. The larger the gain, the stronger the suppression effect, but excessive gain may cause system instability.	100		U16	RWS	Immediate
Pr6.37	4010A9	Vibration suppression damping	Adjusts the speed of vibration decay, affecting the smoothness of vibration suppression. Range:0–384	0		U16	RWS	Immediate
Pr6.38	4010AA	Vibration suppression offset 1		0		U16	RWS	Immediate
Pr6.39	4010AB	Vibration suppression offset 2		0		U16	RWS	Immediate
Pr6.40	4010AC	Vibration suppression frequency 1	Used to set a second set of vibration suppression frequencies to handle multiple different vibration frequency points	100	Hz	U16	RWS	Immediate
Pr6.41	4010AD	Vibration suppression damping 1		0		U16	RWS	Immediate

9.1.7 F007 Group (Jog and Constant Display Settings) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr7.00	101001	Storage	Refer to Pr1.00					
Pr7.01	310024	Always Display Object	0: Display RPM speed 1: Display bus voltage 2: Display temperature 3: DIN final input signal 4: DOUT final output status 5: Drive load rate 6: Motor load rate Other monitoring objects can be extended	0		U8	RW	Immediate
Pr7.02	310022	Jog Speed	Set the speed for jog movement	100	rpm	U16	RW	Immediate
Jog		Jog mode entry	Press SET to enter Jog mode Refer to "Jog Mode" for details					
Softn	100A00	Software version	Software version (x.xx format)				RO	
Pr7.03	20003F	Customer code	Customized code				RO	
Pr7.04	606300	Actual position				I32	RO	
Pr7.05	300306	Position loop command				I32	RO	
Pr7.06	20001B	Pulse input 0 counter				I32	RO	
Pr7.07	300039	1 ms pulse count	Pulse input count per ms			I16	RO	
Pr7.08	30003A	Disable control	1: Disable drive	0		U8	RW	Immediate
Pr7.09	300032	I_Q_LFT			Arms	I32	RO	
Pr7.10	20000D	Firmware CRC checksum				U32	RO	
Pr7.11	101803	XML version				U32	RO	
Pr7.12	606400	Position feedback	Actual position feedback (command units)		PUL	I32	RO	

9.1.8 F008 Group (Position Table Function) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr8.00	101001	Storage	Refer to Pr1.00					
Pr8.01	31000B	Position Table Run Mode	0: Position Table 1: I/O Position 2: I/O Speed	0		U8	RWS	Immediate
Pr8.02	31000C	Position Table Trigger Mode	0: Trigger Signal 1: Time Trigger	0		U8	RWS	Immediate
Pr8.03	31000D	Position Table Trigger Delay	Delay when triggering by time	100	ms	U16	RWS	Immediate
Pr8.04	40102B	Position Table Auto Run	0: Do not auto-run 1: Execute auto-run once at power-up 2: After fault cleared 3: After auto-origin finding	0		U8	RWS	Immediate
PPPP1		Position Setting Entry	Setting range PP1.01-PP1.30	0	inc	S32	RWS	Immediate
PPPP2		Speed Setting Entry	Setting range PP2.01-PP2.30	0	rpm	S16	RWS	Immediate
PPPP3		Delay Register Entry	Setting range PP3.01-PP3.30	0	ms	U32	RWS	Immediate
PPPP4		Acceleration/Deceleration Index Entry	Setting range PP4.01-PP4.30	0		U8	RWS	Immediate
PPPP5		Control Register Entry	Setting range PP5.01-PP5.30	0		U16	RWS	Immediate
PPPP6		Cycle Count Entry	Setting range PP6.01-PP6.30	0		U16	RWS	Immediate
PPPP7		Acceleration Setting Entry	Setting range PP7.01-PP7.30	0	rps/s	U16	RWS	Immediate
PPPP8		Deceleration Setting Entry	Setting range PP8.01-PP8.30	0	rps/s	U16	RWS	Immediate
PPPP9		Cycle Count Entry	Setting range PP9.01-PP9.30	0		U16	RO	

9.1.9 F009 Group (Origin Function Settings) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
Pr9.00	101001	Storage	Refer to Pr1.00					
Pr9.01	607C00	Origin Offset	Through this object, the final origin is offset from the physical signal generation point		PUL	S32	RWS	Immediate
Pr9.02	609800	Origin mode	Refer to "Origin Mode Section"	0		S8	RWS	Immediate
Pr9.03	609901	Origin Rough Positioning Speed	A faster speed used for rough origin search	35000	PUL/s	U32	RWS	Immediate
Pr9.04	609902	Origin Fine Positioning Speed	A slower speed used for precise origin positioning	15000	PUL/s	U32	RWS	Immediate
Pr9.05	609903	Auto Origin Finding	0: Disabled 1: When power-up 2: Origin lost	0		U8	RWS	Restart
Pr9.06	609A00	Origin Acceleration	This object is used for acceleration and deceleration during the origin finding process	1000000	rpss	U32	RWS	Immediate
Pr9.07	609904	Origin Finding Current	Validation when using mechanical limits for origin finding	20	0.1A	U16	RWS	Immediate
Pr9.08	609905	Origin Offset Mode	0: Move to the origin offset position, then clear the position 1: Do not move, directly set the current position as negative origin offset	0		U8	RWS	Immediate
Pr9.09	609906		For manufacturer use					
Pr9.10	609907	Origin Offset Positioning Speed	The speed when moving to the origin offset position	200	rpm	U16	RWS	Immediate
Pr9.11	40105A		For manufacturer use					

9.1.A F00A Group (Auxiliary Parameter Settings) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
PrA.00	101001	Storage	Refer to Pr1.00					
PrA.01	20002B	Encoder Reset	Write non-0 data to execute multi-turn data clear and encoder fault clear actions	0		U8	W	Immediate
PrA.02	20000F	Encoder Multi-turn Data	Display encoder multi-turn data	0		U32	RO	
PrA.03	200004	Encoder Single-turn Data	Display encoder single-turn data	0		U32	RO	
PrA.04	200017	Encoder Internal Fault	Display encoder internal fault word	0		U16	RO	

PrA.05	20001F	SAE Operation	User can only write 3, 4, 7 3: Clear encoder fault 4: Clear multi-turn data 7: Clear both fault and multi-turn data Some faults require repeated power-up	0		U32	RW	Immediate
PrA.06	30001D	Current Command A	N/A					
PrA.07	310001	Execute excitation information search	N/A					
PrA.08	310002	Apply excitation search results	N/A					
PrA.09	310004	Hall Status Access	Not applicable. Complete when it is 3F and changes 12 times					
PrA.10	101004	Restart Processor	Write 1 to perform hot restart	0		U32	RW	
PrA.11	310010	DIN Control Word Source	Corresponding control word when DIN pin is enabled	103F		U16 HEX	RWS	Immediate
PrA.12	606000	Working Mode	Drive Target Operating Mode Refer to Operating Mode section			S8	RWS	Immediate
PrA.13	606100	Current Operating Mode	The operating mode currently in use by the drive			S8	RO	Immediate
PrA.14	210019	Aging Current	This parameter is internally limited when written Manufacturer Parameters	Drive Rated	0.1A	U8	RWS	Immediate
PrA.15	21001A	Aging Command	Write 1, enter aging mode after next restart Manufacturer Parameters	0		U8	RWS	Restart
PrA.16	21001B	Aging State	0: Not aged 1: Aging complete 2: Aging failed	0		U8	RO	

9.1.B F00b Group (Historical Error Display Group)

No.	Example	Help Information
xE.yyyy		x represents the x-th historical error, 0 is the latest E is the abbreviation for Error yyyy is the error code, specifically check error code description For detailed historical error information, please use the debugging software's fault display

9.1.C F00C Group (Tuning Parameters) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
PrC.00	101001	Storage	Refer to Pr1.00					
PrC.01	609201	Feed	Number of commands issued by the controller Refer to "Motion Equivalent Setting"	10000	PUL	U32	RWS	Immediate
PrC.02	402001	Position loop bandwidth 0	Correspond to position loop response capability Please refer to the "Adjustment" section for setting method	764	0.01Hz	U16	RW	Immediate
PrC.03	40101F	Speed feedforward ratio (per mille)	Setting velocity feedforward can improve dynamic tracking performance Note: Setting value / 1024 corresponds to true permille	0	‰	U16	RWS	Immediate
PrC.04	401021	Torque feedforward ratio (per mille)	Setting torque feedforward can improve dynamic tracking performance Torque feedforward setting assumes correct inertia ratio Note: Setting value / 1024 corresponds to true permille	0	‰	U16	RWS	Immediate
PrC.05	40101D	Speed feedback filter bandwidth	Set the bandwidth of the speed feedback filter Larger setting value means weaker filtering, smaller lag Reasonable setting can reduce noise Too small a setting may affect loop	300	Hz	U16	RWS	Immediate

			stability 10-2000					
PrC.06	40101C	Torque filter bandwidth	Set the bandwidth of the current command filter Larger setting value means weaker filtering, smaller lag Reasonable setting can eliminate noise and resonance Too small a setting may affect loop stability	418	Hz	U16	RWS	Immediate
PrC.07	402401	Speed loop proportional gain 0	Correspond to speed loop response capability Please refer to the "Adjustment" section for setting method	Determined by motor parameters		U32	RWS	Immediate
PrC.08	402501	Speed loop integral gain 0	Correspond to speed loop steady-state following capability Please refer to the "Adjustment" section for setting method	Determined by motor parameters		U16	RWS	Immediate
PrC.09	40105E	PWM frequency control mode	PWM switch frequency setting 0:16K single, 1:8K double, 2:16K double, 3:8K double to 16K single automatic switching, 4:8K double to 16K double automatic switching					Immediate
PrC.10	401055	Stiffness level	0-31 Refer to "Rigidity Gain Table"	17		U8	RWS	Immediate
PrC.11	401056	Use rigidity level	**0:**Manual gain parameter setting – refer to Section 6.3 "Manual Gain Setting". **1:**Use the "Rigidity Gain Table". **2/3/4:**Enable the adjustment- free function, which can automatically accommodate complex mechanical systems with different rigidity and inertia. The settings 2, 3, and 4 correspond to relatively high, high, and very high adjustment- free response levels, respectively. It is necessary to comprehensively consider factors such as inertia matching, mechanical rigidity, and external disturbances when selecting the appropriate adjustment- free mode and adjustment- free level.	0		U8	RWS	Immediate
PrC.12	401053	Inertia ratio	Define the content about inertia ratio in "Adjustment" Users can manually set inertia ratio	30	0.1	U16	RWS	Immediate
PrC.13	47FE14	Brake ID	Motor brake code Set to 0 if no brake	0		U16	RWS	Restart
PrC.14	21000E	Low temperature protection temperature		-20		I16	RWS	Restart
PrC.15	4010AE	Adjustment- free rigidity level	The adjustment- free level can be set from 1 to 12, corresponding to position loop response from low to high.	6		U8	RWS	Immediate
PrC.16	401094	Stiffness compensation gain	Enhance system rigidity, actively increase the motor's resistance stiffness, and improve dynamic response.	4000		U16	RWS	Immediate

9.1.D F00d Group (Gantry synchronization parameters) Parameter List

No.	Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
PrD.00	101001	Storage	Refer to Pr1.00					
PrD.01	401091	Enable gantry	**0:**Disable **1:**Set as gantry master axis **2:**Set as gantry slave axis **3:**Set as gantry slave axis (consistent with master axis command)	0		U8	RWS	Immediate
PrD.02	401089	Gantry parameter synchronization	**0:**Synchronized **1:**Unsynchronized	0		U8	RW	Immediate
PrD.03	40108A	Gantry slave axis synchronization	**0:**Slave not reversed **1:**Slave reversed	0		U8	RWS	Immediate

		direction						
PrD.04	40108B	Gantry synchronization type	**0:**Rigid gantry **1:**Flexible gantry	0		U8	RWS	Immediate
PrD.05	40108C	Gantry synchronization filter coefficient	Range**:**1–255	1		U8	RWS	Immediate
PrD.06	40108D	Maximum synchronization deviation		100	PUL	U32	RWS	Immediate
PrD.07	40108E	Gantry position bandwidth		15	Hz	U16	RWS	Immediate
PrD.08	40108F	Gantry integral gain		0		U8	RWS	Immediate
PrD.09	401090	Gantry data channel	**0:**Use RS485 channel (Ethernet port) **1:**Use auxiliary communication encoder interface (CN1)	0		U8	RWS	Restart
PrD.10	401092	Gantry compensation gain		1		I8	RWS	Immediate
PrD.11	300323	Gantry synchronization deviation				I32	RO	

9.2 Object Dictionary

Index H	Parameter Name	Setting/Help Information	Default Value	Unit	Type	Access	Validation
300210	Speed Error	Speed loop command - speed feedback		Internal	S32	RO	
300222	Speed Mode Profile Velocity	Speed profile generated by the internal speed profile generator		Internal	S32	RO	
30020D	Speed Loop Command_Internal	Speed loop's command input		Internal	S32	RO	
300217	Speed Feedback 1st Order Low-Pass	Feedback speed after first-order low-pass filtering		Internal	S32	RO	
300305	Position Loop Command	Position Loop's Command Input		inc	S64	RO	
300306	Position Loop Command Low 32 bits	Lower 32 bits of 64-bit position loop command		inc	S32	RO	
30001D	Current Command A	Manufacturer Parameters		0.1A	S16	RWS	Immediate
300321	Actual Position Low 32 bits	Lower 32 bits of 64-bit position data	0	inc	S32	RO	
300322	Actual Position High 32 bits	Higher 32 bits of 64-bit position data	0	inc	S32	RO	
300307	Actual Position	64-bit Position Data	0	inc	S64	RO	
300309	Position Error	Position loop command - actual position	0	inc	S32	RO	
300318	VPG Position Planning Output	Position profile generated by the internal position profile generator	0	inc	S32	RO	
300319	VPG Speed Planning	Speed profile during the VPG planning position curve process	0	inc	S32	RO	
30031A	VPG Target Position	Planning target of the internal profile generator	0	inc	S32	RO	
30031B	Velocity Feedforward Command	Velocity feedforward command generated by velocity feedforward calculation	0	Internal	S32	RO	
30031D	Electronic Gear Numerator	Derived from 402 gear ratio related objects			U32	RO	
30031E	Electronic Gear Denominator	Derived from 402 gear ratio related objects			U32	RO	
603F00	Error Code	Current servo error code	0		U16	RO	
604000	Control Word	402 state machine control word			U16	RW	Immediate
604100	State Word	402 state machine status word			U16	RW	Immediate
605A00	Quick stop option	Emergency stop command action selection	0		U16	RWS	Immediate
605B00	Shutdown Option	Shutdown command action selection	0		U16	RWS	Immediate
605C00	Disable Option	Disable operation command action selection	0		U16	RWS	Immediate
606000	Working Mode	Select drive operating mode	1		I8	RWS	Immediate
606100	Current Operating Mode	Current operating mode display			I8	RO	
606300	Actual Position	Real-time motor absolute position feedback (encoder units)		DEC	I32	RO	
606400	Position Feedback	Actual position feedback (command units)		PUL	I32	RO	
606500	Position following error window	Position following error alarm threshold	50000	PUL	U32	RWS	Immediate
606600	Position following error time window	Position following error alarm window time	10	ms	U16	RWS	Immediate

606700	Position reached window	Position reached detection threshold	10	PUL	U32	RWS	Immediate
606800	Position reached time window	Position reached window time	15	ms	U16	RWS	Immediate
606B00	Speed Loop Command	Generate internal command velocity value with velocity command Motion Path		PUL/s	I32	RO	
606C00	Velocity loop feedback	Encoder actual feedback velocity value		PUL/s	I32	RO	
607100	Target Torque	CST mode command input, limited by 607200.		‰	S16	RWS	Immediate
607200	Maximum Torque	0~3000. Limit the range for 607100.		‰	U16	RWS	Immediate
607400	Torque command	Display target torque value, 1000 corresponds to 1x rated torque		‰	I16	RO	
607700	Actual torque	Servo internal actual torque feedback		‰	I16	RO	
607A00	Target Position	Command interface for position control modes (PPM, CSP).		PUL	S32	RWS	Immediate
607D01	Soft limit position 1	Soft limit minimum position limit		PUL	I32	RWS	Immediate
607D02	Soft limit position 2	Soft limit maximum position limit		PUL	I32	RWS	Immediate
607E00	Control loop command and feedback in reverse direction	Control loop command value and feedback value reversed	0	DEC	U8	RWS	Restart
608000	Maximum Speed Command	Limit the speed of the controller		rpm	U32	RWS	Immediate
608100	Profile velocity	Profile speed used in "Position Profile Mode"		PUL/s	U32	RWS	Immediate
608300	Profile acceleration	Profile acceleration used in "Position Profile Mode"		PUL/s²	U32	RWS	Immediate
608400	Profile deceleration	Profile deceleration used in "Position Profile Mode"		PUL/s²	U32	RWS	Immediate
608500	Emergency Stop Deceleration	Deceleration when emergency stop command is set to decelerate to stop		PUL/s²	U32	RWS	Immediate
609200	Feed Amount	Number of feed commands per revolution issued by the controller	10000	PUL	U32	RWS	Immediate
609800	Origin mode	Set the homing method		DEC	I8	RWS	Immediate
60B800	Probe Settings	Set probe function, see Probe Function for details		HEX	U16	RWS	Immediate
60B900	Probe Status	Probe running status, see Probe Function for details		HEX	U16	RO	
60E000	Positive torque limit	Positive maximum torque limit value		‰	U16	RWS	Immediate
60E100	Negative torque limit	Reverse maximum torque limit value		‰	U16	RWS	Immediate
60F400	Position following error	Position following error real-time value		PUL	I32	RO	
60FD00	External signal input status	Feedback limit, origin, enable, and other signal states		HEX	U32	RO	
60FE01	DO Forced Output	Forced control DO output state		HEX	U32	RWS	Immediate
60FE02	DO Forced Output Mask	Mask 60FEh-01h, control is active when corresponding bit is 1		HEX	U32	RWS	Immediate
60FF00	Target Speed	Command interface for speed control modes (PVM, CSV)		PUL/s	S32	RW	Immediate
650200	Supported Operating Modes	Operating modes supported by the drive		HEX	U32	RO	

Chapter 10 Troubleshooting

10.1 Warning Codes

10.1.1 Warning Code List

When a servo drive issues a warning, display the warning code with an AL. prefix. This indicates that the drive detects an abnormality. Inspect and eliminate the cause of the warning, otherwise it will affect the continuous normal use of the servo system.

Warning Code	Name
AL.0001	Battery Warning
AL.0002	Drive Overload Warning
AL.0003	Motor Overload Warning

10.1.2 Warning Handling

➢ **AL.0001**: **Battery Warning**

Fault mechanism: Multi-turn absolute encoder battery voltage is below 3.0V

Confirmation method: Measure battery voltage (EVE ER14505 AA rated voltage 3.6V)

Solution: Power on the drive, replace the battery in a non-operating state. The warning will clear automatically after battery replacement

Note:

If replace the battery while powered off, the drive will alarm Er.FF02 (Encoder Internal Fault) upon power-up. In this case, first set PrA.05=3 (2000h-1Fh) to reset the encoder fault, then re-perform the homing function operation

➢ **AL.0002**: **Drive Overload Warning**

Fault mechanism: Drive average load rate exceeds overload warning threshold

Fault Cause	Inspection Method	Solution
1. The load the drive needs to operate exceeds its capacity	Confirm the overload characteristics of the motor or servo drive Check if the servo drive's average load rate (3000h-25h) is continuously greater than 95.0%	Reduce load weight or reduce load inertia to ensure that the load is within the drive's rated capacity; Replace with a larger capacity servo drive and matched motor
2. The output capability of drive does not match actual load operation	Check mechanical inertia ratio or perform inertia identification, check inertia ratio Pr6.03(4100h-53h) Confirm single operating cycle time during servo motor cyclic operation	Reasonably arrange equipment operating cycles, avoid prolonged continuous operation, and ensure the drive has sufficient cooling time
3. Motor stalls due to mechanical factors, causing excessive load during operation	Use X Servo Configurator to check operating commands and motor speed (3002h-25h) ·Operating command in position mode: 6062h ·Operating command in speed mode: 606Bh ·Operating command in torque mode: 6074h Confirm if, in the corresponding mode, the operating command is not 0 or very large, while the motor speed is 0	Eliminate mechanical factors
4. Servo drive failure	Check if the drive cooling fan is working properly and if the drive's operating environment is normal; Power up again after a period of power-off	Eliminate other fault factors, if fault reports after power up again, please contact Simphoenix Electric technical support to replace the servo drive

➤ AL.0003: Motor Overload Warning

Fault mechanism: Motor average load rate exceeds overload warning threshold

Fault Cause	Inspection Method	Solution
1. Motor wiring or encoder wiring errors or poor connections	Compare with the correct wiring diagram, check wiring between motor, drive, and encoder	Connect cables according to the correct wiring diagram; Prioritize using Simphoenix Electric's standard cables; When using self-made cables, please follow the hardware wiring guide to produce and connect
2. Load is too heavy, motor output Validation torque exceeds rated torque, continuous operation for a long time	Confirm the overload characteristics of the motor or servo drive; Check if the servo drive's average load rate (3000h-25h) is continuously greater than 95.0%	Replace with a larger capacity servo drive and matched motor; or reduce the load, increase acceleration and deceleration time.
3. Too frequent acceleration/deceleration or excessive load inertia	Check mechanical inertia ratio or perform inertia identification, check inertia ratio Pr6.03(4100h-53h) Confirm single operating cycle time during servo motor cyclic operation	Extend acceleration/deceleration time
4. Improper gain adjustment or excessive rigidity	Observe if the motor vibrates or makes abnormal sounds during operation	Re-adjust gain
5. Motor stalls due to mechanical factors, causing excessive load during operation	Use X Servo Configurator to check operating commands and motor speed (3002h-25h) ·Operating command in position mode: 6062h ·Operating command in speed mode: 606Bh ·Operating command in torque mode: 6074h Confirm if, in the corresponding mode, the operating command is not 0 or very large, while the motor speed is 0	Eliminate mechanical factors
6. Servo drive failure	Power up again after a period of power-off	If fault reports after power-up again, please contact Simphoenix Electric technical support to replace the servo drive

10.2 Error Codes

When the servo drive issues a fault alarm, a fault code with an Er. prefix is displayed. At this time, the motor will stop operating

10.2.1 Error Code List

Fault Code	Name
Er.2250	Bus current overcurrent
Er.2320	Motor phase current overcurrent
Er.2350	Drive Overload
Er.3130	Input Phase Loss
Er.3210	Main circuit overvoltage
Er.3220	Main circuit undervoltage
Er.4310	Drive Overheating
Er.4320	Drive low temperature
Er.5210	Current detection circuit fault
Er.6310	Storage module fault
Er.7110	Braking resistor protection
Er.7121	Motor Stalling
Er.7122	Excitation error
Er.7305	Pulse encoder anomaly
Er.7306	Input pulse frequency anomaly
Er.7307	Full-closed loop Z signal anomaly
Er.7510	Encoder communication loss
Er.7511	Encoder communication interference
Er.8611	Position tracking error
Er.8700	Bus Communication Fault
Er.FF00	Drive configuration error
Er.FF01	Motor Overload
Er.FF02	Encoder Internal Fault
Er.FF03	Encoder model identification fault
Er.FF04	Encoder data read anomaly
Er.FF05	Encoder data checksum error
Er.FF06	Encoder data version error
Er.FF08	Data import protection
Er.FF09	Configuration parameter setting error
Er.FF0A	Output Phase Loss
Er.FF0B	Motor setting error
Er.FF0C	Full-closed loop setting error
Er.FF0D	Excessive mixed control deviation
Er.FF0E	Full-Closed Loop Quadrature Signal Loss

10.2.2 Troubleshooting

➤ Er.2250: Bus Current Overcurrent

Fault mechanism: Bus current detection feedback value exceeds protection threshold

Fault Cause	Inspection Method	Solution
1. Gain setting is not reasonable, and motor is oscillating	Check if there is vibration or sharp noise during motor startup and operation; also use X Servo Configurator to monitor parameters like "Current Feedback"	1. Motor parameter setting error, check motor parameter settings; 2. Current loop parameters anomaly, readjust current loop parameters; 3. Speed loop parameters anomaly, oscillation generated from servo; 4. Servo drive anomaly, replacement of servo drive is required.
2. Encoder wiring anomaly	Check encoder cable for aging, corrosion, or loose connectors; turn off servo enable signal, manually rotate motor shaft, and check if drive display speed changes with motor shaft rotation	Re-solder, firmly plug in, or replace encoder cable
3. Servo drive failure	1. Disconnect the motor cable and power up again, but the fault still reports; 2. Check the external braking resistor configuration for a resistance value that is too low or a short circuit in the wiring (at the main circuit input terminals P+ and C).	Replace the servo drive Re-select braking resistor resistance and model Rewire

➤ Er.2320: Motor Phase Current Overcurrent

Fault mechanism: Phase current detection feedback value exceeds protection threshold

Fault Cause	Inspection Method	Solution
1. Motor cable damaged, grounded, or Poor contact	1. Check if the servo drive's UVW output and motor side connections are loose; 2. After ensuring that the drive's power cables and motor cables are securely connected, measure the insulation resistance between the servo drive's UVW terminals and the ground wire (PE) to confirm that it is in the megaohm (MΩ) range	Tighten loose or disconnected wiring Replace problematic motor or motor cable if insulation is poor
2. The motor is burned out	Disconnect the motor cable, measure if the motor UVW phase resistance is balanced, and check if there is a short circuit between motor UVW phases	Correctly connect motor cables If the motor is faulty, please replace the motor
3. Drive power module fault	Disconnect the motor cable and power up again, but the fault still reports;	Please contact Simphoenix Electric technical support to replace the servo drive

➤ Er.2350: Drive Overload

Fault mechanism: Drive average load rate exceeds overload warning threshold

Fault Cause	Inspection Method	Solution
1. The load the drive needs to operate exceeds its capacity	Confirm the overload characteristics of the motor or servo drive Check if the servo drive's average load rate (3000h-25h) is continuously greater than 100.0%	Reduce load weight or reduce load inertia to ensure that the load is within the drive's rated capacity; Replace with a larger capacity servo drive and matched motor
2. The output capability of drive does not match actual load operation	Check mechanical inertia ratio or perform inertia identification, check inertia ratio Pr6.03(4100h-53h) Confirm single operating cycle time during servo motor cyclic operation	Reasonably arrange equipment operating cycles, avoid prolonged continuous operation, and ensure the drive has sufficient cooling time
3. Motor stalls due to mechanical factors, causing excessive load during operation	Use X Servo Configurator to check operating commands and motor speed (3002h-25h) ·Operating command in position mode: 6062h ·Operating command in speed mode: 606Bh ·Operating command in torque mode: 6074h Confirm if, in the corresponding mode, the operating command	Eliminate mechanical factors

Fault Cause	Inspection Method	Solution
	is not 0 or very large, while the motor speed is 0	
4. Servo drive failure	Check if the drive cooling fan is working properly and if the drive's operating environment is normal; Power up again after a period of power-off	Eliminate other fault factors, if fault reports after power up again, please contact Simphoenix Electric technical support to replace the servo drive

➢ Er.3130: Input Phase Loss

Fault mechanism: Abnormal three-phase input to the drive (applicable to 380V servo drives)

Fault Cause	Inspection Method	Solution
1. Poor connection of the three-phase input wiring	Check if the servo drive's main circuit input terminals (R S T) and the upstream input cables are good and securely connected	Replace cables and correctly connect main circuit power lines
2. 380V servo drive running on single-phase power	Check the servo drive's input power specifications, check actual input voltage specifications, and measure if the main circuit input voltage complies with the following specifications: 380V servo drive: RMS value: 380V-440V AC All three phases need to be measured	According to power specifications, replace or adjust power

➢ Er.3210: Main Circuit Overvoltage (DC Bus Voltage)

Fault mechanism: Detected DC bus voltage exceeds alarm threshold:

220V servo drive: Overvoltage point 405V

380V servo drive: Overvoltage point 805V

Fault Cause	Inspection Method	Solution
1. Main circuit input voltage too high	Check servo drive input power specifications, and measure if the main circuit cable servo drive (R S T) input voltage complies with the following specifications: 220V servo drive: RMS value: 220V-240V AC 380V servo drive: RMS value: 380V-440V AC	According to power specifications, replace or adjust power
2. Power supply is unstable or affected by lightning strike	Troubleshoot if the drive input power supply has been affected by lightning, measure if the input power supply is stable, and if it meets the above specifications	Access a surge suppressor, then power on again. If the fault still occurs, replace the servo drive
3. Braking resistor selection inappropriate or failed	If built-in braking resistor is used (Pr3.22=1/2421h-01h=1), confirm if P+ and D are reliably connected with a wire. If yes, then measure the resistance between C and D; If external braking resistor is used (Pr3.22=0/2421h-01h=0), measure the resistance of the external braking resistor between P+ and C, and compare it with the recommended value; For braking resistor specifications, please refer to 2.6 Regenerative Braking Resistor Selection	1. If the resistance is "∞" (infinity), the internal wire of the braking resistor is broken, replace with a new braking resistor; 2. If built-in braking resistor is used, adjust to use external braking resistor, and remove the short-circuit wire between P+ and D. The resistance value can be chosen to be consistent with the built-in braking resistor, and the power needs to be not less than the built-in braking resistor; 3. If external braking resistor is used, replace with an external braking resistor of appropriate specifications and reconnect between P+ and C; 4. Be sure to set Pr3.23 (External Braking Resistor Resistance) and Pr3.25 (External Braking Resistor Power) to match the parameters of the actual

Fault Cause	Inspection Method	Solution
		external braking resistor used.
4. The motor is running in rapid acceleration/deceleration state, and the maximum braking energy exceeds absorbable value	Confirm the acceleration/deceleration time during operation, measure the DC bus voltage, and confirm if the voltage exceeds fault value during deceleration phase	First, ensure that the main circuit input voltage is within the specification, secondly, and adjust the acceleration/deceleration time if allowed
5. Large deviation in bus voltage sampling value	Measure if the DC bus voltage value is normal, compare with the drive's monitored bus voltage value	Please contact Simphoenix Electric technical support
6. Servo drive failure	Repeatedly power off and reconnect main circuit power, but the fault still reports	Replace the servo drive

➢ Er.3220: Main Circuit Undervoltage (DC Bus Voltage)

Fault mechanism: Detected DC bus voltage is below alarm threshold

220V servo drive: Undervoltage point 180V

380V servo drive: Undervoltage point 380V

Fault Cause	Inspection Method	Solution
1. Main circuit power supply unstable or power loss	Check servo drive input power specifications, and measure if the main circuit cable power side and servo drive side (RST) input voltage comply with the following specifications: 220V servo drive: RMS value: 220V-240V AC 380V servo drive: RMS value: 380V-440V AC	According to power specifications, replace or adjust power
2. Power supply voltage drops during operation	Monitor servo drive input power voltage, and check if the same main circuit power supply has too many other settings enabled, causing insufficient power capacity and voltage drop	Increase power capacity
3. Phase loss, servo drive that should operate on 3-phase power actually operate on single-phase power	Check if the main circuit wiring is correct and reliable	Replace cables and correctly connect main circuit power lines
4. Servo drive failure	Measure if the DC bus voltage value is normal, and compare with the drive's monitored bus voltage value; Repeatedly power off and reconnect main circuit power, but the fault still reports	Please contact Simphoenix Electric technical support to replace the servo drive

➢ Er.4310: Drive Overheat

Fault mechanism: Servo drive power module temperature is higher than overtemperature protection value (88℃)

Fault Cause	Inspection Method	Solution
1. The ambient temperature is too high	Measure ambient temperature	Improve servo drive cooling conditions, and reduce ambient temperature
2. After overload, reset overload fault by turning off power, and repeat multiple times	Check fault records for overload faults or warnings	Change fault reset method, wait 30s after overload before resetting. Increase servo drive and motor capacity, extend acceleration/deceleration time, and reduce load.
3. Fan operation anomaly	Check if the fan is operating during run	Please contact Simphoenix Electric technical support to replace the servo drive
4. Unreasonable installation space for servo drive	Compare with 3.3.2 Installation Space Requirements, confirm if servo drive installation is reasonable	Install according to servo drive installation standards

Fault Cause	Inspection Method	Solution
5. Servo drive failure	Still reports fault after 5 minutes of power off and restart	Please contact Simphoenix Electric technical support to replace the servo drive

➢ Er.4320: Drive Low Temperature

Fault mechanism: Servo drive power module temperature is below low temperature protection value (-10℃)

Fault Cause	Inspection Method	Solution
1. Ambient temperature too low	Measure ambient temperature	Improve servo drive operating conditions, increase ambient temperature Power on and preheat for a period of time, start operation after the alarm clears
2. Servo drive failure	Still reports fault after 5 minutes of power off and restart	Please contact Simphoenix Electric technical support to replace the servo drive

➢ Er.5210: Current Detection Circuit Fault

Fault mechanism: Phase current sensor sampling value anomaly

Fault Cause	Inspection Method	Solution
1. Short circuit or other problems occurred on encoder or I/O interface power pins	Troubleshoot if there is any anomaly in encoder and I/O interface wiring	Re-process encoder and I/O interface wiring
2. Servo drive failure	Attempt power cycling several times, but the fault still reports	Please contact Simphoenix Electric technical support to replace the servo drive

➢ Er.6301: Storage Module Fault

Fault mechanism: Internal logic power supply issue occurred during data storage execution

Fault Cause	Inspection Method	Solution
1. Short circuit or other problems occurred on encoder or I/O interface power pins	Troubleshoot if there is any anomaly in encoder and I/O interface wiring	Re-process encoder and I/O interface wiring
2. Perform firmware upgrade	Alarm occurs after firmware upgrade is completed	Perform the initialization operation
3. Servo drive failure	Attempt power cycling several times, but the fault still reports	Please contact Simphoenix Electric technical support to replace the servo drive

➢ Er.7110: Braking Resistor Protection

Fault mechanism: Braking resistor actual power exceeds rated power

Fault Cause	Inspection Method	Solution
1. Regenerative energy exceeds dissipation limit	Whether the motor speed is too fast; whether the load inertia is too large; monitor actual bus voltage value during braking	Reduce load weight or reduce load inertia to ensure that the load is within the drive's rated capacity; Replace with a larger capacity servo drive and matched motor
2. Braking resistor wiring error	Check wiring against 2.4.1 Braking Resistor Wiring	Correctly connect braking resistor
3. Braking resistor selection or parameter setting is unreasonable	Refer to 2.6 Regenerative Braking Resistor Selection to confirm braking resistor specifications, and verify parameter values for Pr3.23 (External Braking Resistor Resistance) and Pr3.25 (External Braking Resistor Power)	Select appropriate braking resistor and correctly set parameters

➢ Er.7121: Motor Stall

Fault mechanism: Actual speed of motor is zero, but the operating current reaches the limit, and persists for a certain time

Fault Cause	Inspection Method	Solution
1. Servo drive U V W output phase sequence wired incorrectly	Verify if the motor phase sequence is correct	Rewire according to correct wiring
2. Motor stall due to mechanical factors	Use X Servo Configurator to monitor if the operating command and motor speed match, and monitor current feedback waveform	Troubleshoot mechanical factors causing jamming, occasional sticking, eccentricity, etc. For motors with brakes, check if the brake is working properly

➢ Er.7122: Motor Excitation Error

Fault mechanism: Execute special excitation function failed

Cause: During motor excitation, motor phase loss or motor parameter error is detected (motor pole pairs, encoder resolution, etc.)

Solution: Troubleshoot encoder and motor information input; check motor wiring

➢ Er.7305: Pulse Encoder Anomaly

Fault mechanism: Pulse encoder internal parameter anomaly

<table>
<tr><th>Fault Cause</th><th>Inspection Method</th><th>Solution</th></tr>
<tr><td>1. Pulse encoder wiring error or loose cable</td><td>1. Check encoder wiring
2. Check if field vibration is too large, causing encoder cable to loosen, or even vibrate and damage the encoder.
3. Replace with a working encoder cable. If the fault no longer occurs after replacement, it indicates that the original encoder cable was damaged</td><td rowspan="2">1. Rewire according to the correct wiring diagram, and ensure that encoder terminal connections are tight. Prioritize using Simphoenix Electric's standard cables; if non-standard cables are used, check if they meet specifications, e.g., use shielded twisted pair. When routing cables, try to separate strong and weak currents. Do not bundle motor cables and encoder cables. Ensure good ground contact for motor and servo drive.
2. Check if the plugs at both ends of the encoder have good contact, if any pins are recessed.
3. Replace with a working encoder cable. If not, the encoder itself has a significant problem, and replace the servo motor.</td></tr>
<tr><td>2. Encoder Z signal interference</td><td>Check field wiring: Are there large devices nearby that produce interference, or are there multiple power/frequency conversion devices and other interference sources in the cabinet?</td></tr>
</table>

➢ Er.7306: Input Pulse Frequency Anomaly

Fault mechanism: Input pulse frequency exceeds the limit

Solution: Troubleshoot controller pulse parameter configuration, and system interference

➢ Er.7307: Full-closed loop Z Signal Anomaly

Fault mechanism: When using periodic full-closed loop Z signal, signal detection is abnormal due to disconnection, etc.

Solution: Troubleshoot full-closed loop encoder wiring, and system interference

➢ Er.7510: Encoder Communication Loss

Fault mechanism: No encoder signal detected

Fault Cause	Inspection Method	Solution
1. Encoder wiring error or loose cable	1. Check encoder wiring 2. Check if field vibration is too large, causing encoder cable to loosen, or even vibrate and damage the encoder. 3. Replace with a working encoder cable. If the fault no longer occurs after replacement, it indicates that the original encoder cable was damaged	1. Rewire according to the correct wiring diagram, and ensure that encoder terminal connections are tight. Prioritize using Simphoenix Electric's standard cables; if non-standard cables are used, check if they meet specifications, e.g., use shielded twisted pair. When routing cables, try to separate strong and weak currents. Do not bundle motor cables and encoder cables. Ensure good ground contact for motor and servo drive. 2. Check if the plugs at both ends of the encoder have good contact, if any pins are recessed. 3. Replace with a working encoder cable. If not, the encoder itself has a significant problem, and replace the servo motor.
2. Encoder damaged	Power up after 30S power off. If the fault still occurs, the motor encoder may be damaged	
3. Drive failure	Power up after 30S power off. If the fault still occurs, the drive may be faulty	

➢ Er.7511: Encoder Communication Interference

Fault mechanism: Encoder communication data anomaly

Fault Cause	Inspection Method	Solution
1. Encoder signal interfered	Check field wiring: Are there large devices nearby that produce interference, or are there multiple power/frequency conversion devices and other interference sources in the cabinet?	Rewire according to the correct wiring diagram, and ensure encoder terminal connections are tight. Prioritize using Simphoenix Electric's standard cables; if non-standard cables are used, check if they meet specifications, e.g., use **shielded twisted pair**. When routing cables**, try to separate strong** and weak currents. Do not bundle motor cables and encoder cables. Ensure good ground contact for motor and servo drive.
2. Encoder damaged	If the fault reoccurs, the motor encoder may be damaged	Please contact Simphoenix Electric technical support

➢ Er.8611: Position Tracking Error

Fault mechanism: Position response cannot follow command

Fault Cause	Inspection Method	Solution
1. Motor stall due to mechanical factors	Use X Servo Configurator to monitor if the operating command and motor speed match, and monitor current feedback waveform	Troubleshoot mechanical factors
2. Servo drive parameter settings are unreasonable	Check servo drive ·Position loop gain: ·Speed loop gain: Pr1.02 (4024h-01h) ·Profile speed: 6081h ·Position deviation threshold: Pr1.13(6065h) ·Profile acceleration/deceleration: 6083h/6084h ·Positive/negative torque limit: 60E0h/60E1h	1. Re-perform servo gain adjustment 2. Set appropriate position deviation threshold Pr1.13 (6065h) according to operating conditions 3. Adjust parameters such as command acceleration/deceleration time, torque limits

Fault Cause	Inspection Method	Solution
	Whether the set values are reasonable	
3. Host computer position command inappropriate	Position Control Mode: ·CSP mode: Check gear ratio 6091h-01h/6091h-02h to determine the increment value of position command corresponding to a single synchronous cycle, and convert to velocity information; ·PP mode: Check gear ratio 6091h-01h/6091h-02h to determine 6081h (profile run speed); ·HM mode: Check gear ratio 6091h-01h/6091h-02h to determine 6099.01h and 6099.02h.	·CSP: Reduce the position command increment corresponding to a single synchronous cycle. When planning commands in the host computer, increase the position ramp. ·PP: Reduce 6081h, or increase acceleration/deceleration (6083h, 6084h). ·HM: Reduce 6099h-01h and 6099h-02h, or increase origin acceleration/deceleration (609Ah). ·Adjust gear ratio according to actual conditions.
4. Servo drive/motor fault	Monitor operating waveforms using X Servo Configurator's oscilloscope function: position command, position feedback, speed command, torque command, etc.	If position command is non-zero but position feedback is always zero, please replace servo drive/motor

➢ Er.8700: BUS Communication Fault

Fault mechanism: EtherCAT communication loss

Fault Cause	Inspection Method	Solution
1. Unstable physical connection of data link, or loss of process data due to unplugging network cable	Check if servo drive network cable connection is reliable and firm, if there is severe vibration on site; confirm if unplug or plug network cable; confirm if it is the specified network cable specification	Replace with a more reliable network cable
2. Data loss due to EMC interference, poor network cable quality, or poor connection	Check host computer network status; Detect if servo drive is reliably grounded	Ensure reliable grounding of servo drive, rectify EMC

➢ Er.FF01: Motor Overload

Fault mechanism: The average load rate of motor exceeds overload alarm threshold

Fault Cause	Inspection Method	Solution
1. Motor wiring or encoder wiring errors or poor connections	Compare with the correct wiring diagram, check wiring between motor, drive, and encoder	Connect cables according to the correct wiring diagram; Prioritize using Simphoenix Electric's standard cables; When using self-made cables, please follow the hardware wiring guide to produce and connect
2. Load is too heavy, motor output Validation torque exceeds rated torque, continuous operation for a long time	Confirm the overload characteristics of the motor or servo drive; Check if the servo drive's average load rate (3000h-25h) is continuously greater than 100.0%	Replace with a larger capacity servo drive and matched motor; or reduce the load, increase acceleration and deceleration time.
3. Too frequent acceleration/deceleration or excessive load inertia	Check mechanical inertia ratio or perform inertia identification, check inertia ratio Pr6.03(4100h-53h) Confirm single operating cycle time during servo motor cyclic operation	Extend acceleration/deceleration time
4. Improper gain adjustment or excessive rigidity	Observe if the motor vibrates or makes abnormal sounds during operation	Re-adjust gain
5. Motor stalls due to mechanical factors, causing excessive load during operation	Use X Servo Configurator to check operating commands and motor speed (3002h-25h) ·Operating command in position mode: 6062h ·Operating command in speed mode: 606Bh ·Operating command in torque mode: 6074h Confirm if, in the corresponding mode, the operating command is not 0 or very large, while the motor speed is 0	Eliminate mechanical factors
6. Servo drive failure	If fault reports after powering off for a period and	Please contact Simphoenix Electric technical support to

Fault Cause	Inspection Method	Solution
	then power up again	replace the servo drive

Fault	Fault Cause	Solution
Er.FF00: Drive Configuration Error	The drive did not execute full factory procedure or configuration data lost	Please contact Simphoenix Electric technical support
Er.FF02: Encoder Internal Fault	A fault of the encoder is detected	Please contact Simphoenix Electric technical support to replace the motor
Er.FF03: Encoder Model Identification Fault	Failed to correctly identify its type upon power-up or re-connection of encoder	Please contact Simphoenix Electric technical support to re-perform motor excitation operation
Er.FF04: Encoder Data Read Anomaly	Error reading internal encoder data	Please contact Simphoenix Electric technical support
Er.FF05: Encoder Data Checksum Error	Motor encoder not initialized by manufacturer or information modified	Please contact Simphoenix Electric technical support
Er.FF06: Encoder Data Version Error	The drive does not support encoder internal data version	Update drive firmware, please refer to 5.2.4 Firmware Download
Er.FF08: Data Import Protection	Actively generate this error when performing batch data import	Execute save and restart after data import, and set ***PrA.10 to 1 or operate 1010h-04h=1***
Er.FF09: Configuration Parameter Setting Error	Set unreasonable motion equivalent and enable it	Re-set reasonable motion equivalent data, refer to Section 8.1 Electronic Gear for settings
Er.FF0A: Output Phase Loss	One or more phases of the motor power lines (U/V/W) have abnormal connections	Confirm if power lines have breaks or poor contact, and reconnect; Contact Simphoenix Electric technical support to replace the servo motor
Er.FF0B: Motor Setting Error	Occur when motor encoder type is set to incremental encoder but drive hardware do not support it	Correctly set motor parameters, then restart the drive
Er.FF0C: Full-closed loop Z Signal Anomaly	Apply full-closed loop settings to a drive without a full-closed loop hardware circuit	Correctly set drive parameters, then restart
Er.FF0E:Full-Closed Loop Quadrature Signal Loss	Abnormal detection of quadrature input signals occurs during power-on due to issues such as wire breaks.	Check connections of the full-closed loop encoder, rectify EMC

- **Er.FF0D: Excessive Mixed Control Deviation**

Fault mechanism: Caused by excessive position error during full-closed loop mixed control

Fault Cause	Inspection Method	Solution
1. Motor stall due to mechanical factors	Use X Servo Configurator to monitor if the operating command and motor speed match, and monitor current feedback waveform	Troubleshoot mechanical factors
2. Servo drive parameter settings are unreasonable	Check servo drive ·Position loop gain: 4020h-01h ·Speed loop gain: Pr1.02 (4024h-01h) ·Profile speed: 6081h ·Position deviation threshold: 4010h-80h ·Profile acceleration/deceleration: 6083h/6084h ·Positive/negative torque limit: 60E0h/60E1h Whether the set values are reasonable	1. Re-perform servo gain adjustment 2. Set appropriate maximum mixed control position deviation threshold (4010h-80h) according to operating conditions 3. Adjust parameters such as command acceleration/deceleration time, torque limits
3. Host computer position command inappropriate	Position Control Mode: ·CSP mode: Check gear ratio 6091h-01h/6091h-02h to determine the increment value of position command corresponding to a single synchronous cycle, and convert to velocity information; ·PP mode: Check gear ratio 6091h-01h/6091h-02h to determine 6081h (profile run speed); ·HM mode: Check gear ratio 6091h-01h/6091h-02h to determine 6099.01h and 6099.02h.	**·CSP: Reduce the position command increment corresponding to a single synchronous cycle. When planning commands in the host computer, increase the position ramp.** **·PP: Reduce 6081h, or increase acceleration/deceleration (6083h, 6084h).** **·HM: Reduce 6099h-01h and 6099h-02h, or increase origin acceleration/deceleration (609Ah).** **·Adjust gear ratio according to actual conditions.**

Fault Cause	Inspection Method	Solution
4. Servo drive/motor fault	Monitor operating waveforms using X Servo Configurator's oscilloscope function: position command, position feedback, speed command, torque command, etc.	If position command is non-zero but position feedback is always zero, please replace servo drive/motor

Maintenance

Due to the influence of various factors such as ambient temperature, humidity, dust, vibration, and aging or wear of internal components of the servo drive, the servo drive may have potential faults. To ensure long-term, stable operation of the servo drive, regular maintenance and upkeep must be performed during storage and use.

If the servo drive has undergone long-distance transportation, check if components are intact and screws are tightened before use. During normal use, regularly clean dust inside the servo drive and check for loose screws, etc.

High voltage is present during servo drive operation, and incorrect operations may lead to serious personal injury. Maintenance operations can only be performed by cutting off the servo drive power supply and waiting until the servo drive panel's digital display extinguishes (after ten minutes).

- Inspections must be performed by professional technical personnel, and the servo drive's power supply must be cut off.
- For servo drives stored for more than half a year, when powering on, the voltage should be slowly increased via a voltage regulator, otherwise there is a risk of electric shock and explosion (of internal electrolytic capacitors).

Daily Maintenance and Upkeep

Through daily inspections and maintenance, various abnormal situations can be discovered promptly, their causes identified in time, and potential faults eliminated early, ensuring normal equipment operation and extending the service life of the servo drive. Please refer to the table below for daily inspections and maintenance.

Inspection and Maintenance Checklist

Inspection Subject	Inspection Cycle		Inspection Items	Judgment Criteria
	Any time	Regular		
Operating Environment	√		1. Temperature, humidity 2. Dust, moisture 3. Gas	1. When temperature > 45℃, the servo drive cover should be opened, humidity < 95%, no frost 2. No abnormal odor, no flammable or explosive gases
Cooling System		√	1. Installation environment 2. Fan of servo drive	1. Good ventilation in the installation environment, no obstruction in the air duct 2. Body fan operates normally, no abnormal noise
Servo Drive	√		1. Vibration, temperature rise 2. Noise 3. Wires, terminals	1. Stable vibration, normal air outlet temperature 2. No abnormal noise, no abnormal odor 3. Tightened screws are not loose
Motor	√		1. Vibration, temperature rise 2. Noise	1. Stable operation, normal temperature 2. No abnormal, uneven noise
Input or Output Parameters	√		1. Input voltage 2. Output current	1. Input voltage within specified range 2. Output current below rated value

- The servo drive has undergone electrical insulation tests before leaving the factory, and users do not need to perform additional withstand voltage tests. Otherwise, internal components may be damaged.
- If insulation testing of the servo drive is necessary, all input and output terminals must be reliably short-circuited. Insulation testing on individual terminals is strictly prohibited. Use a 500V megohmmeter for testing.
- Do not use a megohmmeter to measure the control circuit. The servo drive contains electrostatic-sensitive components—direct contact is prohibited.
- When performing insulation testing on the motor, the connection between the motor and the servo drive must be disconnected.

Inspection and Replacement of Vulnerable Parts

Some components inside the servo drive may wear out or degrade in performance during use. To ensure stable and reliable operation of the servo drive, preventive maintenance should be performed, and components replaced when necessary.

Filter Capacitor

Possible causes of damage: High ambient temperature, large pulsating current, electrolyte aging.

Judgment criteria: Does the servo drive frequently experience faults like overcurrent or overvoltage during loaded operation? Is there any liquid leakage? Is the safety valve protruding? Are the measurements of static capacitance and insulation resistance abnormal?

- The pulsating current in the main circuit will affect the performance of aluminum electrolytic filter capacitors. The extent of the effect is related to ambient temperature and usage conditions. Servo drives used under normal conditions should have their electrolytic capacitors replaced every 3 to 4 years.
- When the electrolytic capacitor's electrolyte leaks, the safety valve protrudes, or the capacitor body expands, it should be replaced immediately.

Cooling Fan

Possible causes of damage: Bearing wear, blade aging, etc.

Judgment criteria: When the servo drive is powered off, check for cracks or other abnormalities in the fan blades and other parts; when the servo drive is powered on, check if the fan operation is normal, and if there is abnormal vibration, noise, etc.

- The service life of all cooling fans inside the servo drive is approximately 15,000 hours (i.e., approximately two years of continuous use of the servo drive). If the fan produces abnormal sound or vibration, it should be replaced immediately.

Storage

If the servo drive is purchased but not used immediately or stored for a long time, the following precautions should be observed:

Storage environment should comply with the table below:

Environmental Characteristics	Requirements	Remarks
Ambient Temperature	-10°C-45°C	Long-term storage temperature should not exceed 45℃ to prevent capacitor characteristics from deteriorating. Environments where condensation or freezing may occur due to sudden temperature changes should be avoided.
Relative Humidity	5-95%	Measures such as sealing with plastic film and desiccants can be adopted.
Storage Environment	Do not expose to direct sunlight, free from dust, corrosive or flammable gases, oil, steam, gas, dripping water, vibration, and low in salt.	

If the servo drive is not used for a long time, it should be powered on every six months to restore the characteristics of the filter capacitors, and at the same time, check the other functions of the servo drive. When powering on, the voltage should be gradually increased via an autotransformer, and the power-on time should be more than half an hour.

- The performance of the internal filter capacitors in the servo drive may degrade if it remains unused for an extended period.

Warranty

The manufacturer will provide warranty service for the servo drive body under the following conditions:

Free repair is provided for failures or damages occurring under normal use within the warranty period (18 months from the date of purchase). After 18 months, a reasonable repair fee will be charged.

Even within the warranty period, a certain repair fee will be charged for faults caused by the following reasons:

- ❋ **Faults caused by not following the operation manual or exceeding standard specifications;**
- ❋ **Faults caused by unauthorized self-repair or modification;**
- ❋ **Faults caused by improper storage;**
- ❋ **Faults caused by using the servo drive for abnormal functions;**
- ❋ **Machine damage caused by fire, salt corrosion, gas corrosion, earthquake, storm, flood, lightning, abnormal voltage, or other force majeure.**

Even beyond the warranty period, the manufacturer also provides lifelong paid repair services.

More

For more product information, please follow the product center and our official WeChat account (scan QR code).

Shenzhen Simphoenix Electric Technology Co., Ltd.

Address: Factory Building A, Huichao Industrial Zone, Gushu Second Road, Xixiang, Bao'an District Shenzhen

Tel: (86) 0755-26919258

Fax: (86) 0755-26919882

Website: www.simphoenix.com.cn

Wanwei Electric (Huizhou) Co., Ltd.

Address: **No. 23 Songbailing Avenue, Start-up Area, China-Korea Huizhou Industrial Park, Zhongkai High-tech Zone, Huizhou City, Guangdong Province, China.**

Tel: (86) 0752-2600100

Release Date: September 2026

Version: V1.1