DF3E series servo driver

User manual

Wuxi Xinje Electric Co., Ltd.

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Xinje Electric

DF3E series servo driver User manual

Basic explanation

- Thank you for purchasing Xinje DF3E series servo driver products.
- This manual mainly introduces the product information of DF3E series servo driver and MF series servo motor.
- Before using the product, please read this manual carefully and connect the wires on the premise of fully understanding the contents of the manual.
- Please deliver this manual to the end user.

This manual is suitable for the following users

- Designer of servo system
- Installation and wiring workers
- Commissioning and servo debugging workers
- Maintenance and inspection workers

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Declaration of liability

- Although the contents of the manual have been carefully checked, errors are inevitable, and we cannot guarantee complete consistency.
- We will often check the contents of the manual and make corrections in the subsequent versions. We welcome your valuable comments.
- If there is any change to the contents introduced in the manual, please understand without further notice.

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Safety Precautions

Before using this product, please read this part carefully and operate after fully understanding the use, safety and precautions of the product. Please connect the product correctly on the premise of paying great attention to safety.

To ensure safe operation, be sure to comply with the safety labels affixed to the equipment. Do not damage or remove the safety labels. The details are as follows:

 Danger	Never fail to connect Protective Earth(PE) terminal.Readthe manual and follow the safety instructions before use.
 High Temperature	Do not touch the radiator after electrification, risk of scald.
 Indoor Only	Please install it indoors without sun and rain.

Problems that may arise during product use are basically included in the safety precautions. For other unmentioned matters, please comply with the basic electrical operating procedures.

 Attention to Product Confirmation

1. Do not install damaged drives, drives that lack spare parts, or drives whose models do not meet the requirements.

 Installation Notes

1. Before installing wiring, be sure to disconnect the power supply to prevent electric shock.
2. It is forbidden to expose the product to water, corrosive gases, flammable gases and other substances, causing electric shock and fire hazards.
3. Do not touch the conductive part of the product directly, which may cause misoperation and malfunction.

 Cautions for wiring

1. Connect the DC power supply to the dedicated power terminals of the drive correctly (connect to DC+ and DC-). Do not connect the drive's output terminals U, V, W to a single-phase power supply.
2. Connect the ground wire correctly. Poor grounding may cause electric shock. Use a 2mm² wire to ground the drive's grounding terminal. (Except for DF3E-0206, which uses a 0.75mm² wire.)
3. Please lock the fixed screw of the terminal, otherwise it may cause fire.
4. Be sure to disconnect all external power supply before wiring the driver.
5. Wiring, please ensure that the encode line, power line is loose, do not tighten, lest cable damage.

Operation Cautions

1. Do not touch the rotating part of the motor after the driver is running. There is a danger of injury.
2. Please pay attention to the test run of the motor once, do not connect the motor with the machine, there is the possibility of injury.
3. After connecting the machine, please set the appropriate parameters before running, otherwise it may cause the machine out of control or failure.
4. In operation, do not touch the radiator, there is a risk of scald.
5. Under power-on condition, do not change the wiring, there is a risk of injury.
6. Do not switch power frequently. If you need to switch power many times, please control it once in 2 minutes.

Maintenance and inspection

1. Do not touch the inside of servo driver and servo motor, otherwise it may cause electric shock.
2. When the power is started, it is forbidden to remove the driver panel, otherwise it may cause electric shock.
3. Within 10 minutes of power off, the terminal should not be contacted. Otherwise, the residual voltage may cause electric shock.

Wiring attention

1. Do not cross the power line and the control signal line from the same pipeline, nor tie them together. The power line and the control signal line are separated by more than 30 centimeters.
2. For signal line and encoder (PG) feedback line, please use multi-stranded wire and multi-core stranded integral shielding line. For wiring length, the longest signal input line is 3 meters and the longest PG feedback line is 20 meters.

Catalog

Confirmation on product arrival

After the product arrives, please confirm the integrity of the product in the following aspects.

Items	Notes
Does the product on arrival match the specified model?	Please confirm according to the nameplate of servo motor and servo unit.
Does the servomotor shaft rotate smoothly?	The servo motor shaft is normal if it can be turned smoothly by hand. Servo motors with brakes, however, cannot be turned manually.
Is there any damage?	Check the overall appearance, and check for damage or scratches that may have occurred during shipping.
Are there any loose screws?	Check screws for looseness using a screwdrive.
Is the motor code the same with the code in drive?	Check the motor code marked on the nameplates of the servomotor and the parameter **U3-70** on the servo drive.

If any of the above is faulty or incorrect, contact Xinje or an authorized distributor.

1 Selection Of Servo System

1.1 Selection Of Servo Driver

1.1.1 Model Name

DF 3 E – 04 10 Z

Display	Cable type
DF	Servo Drive

Symbol	Product series
3	Series number

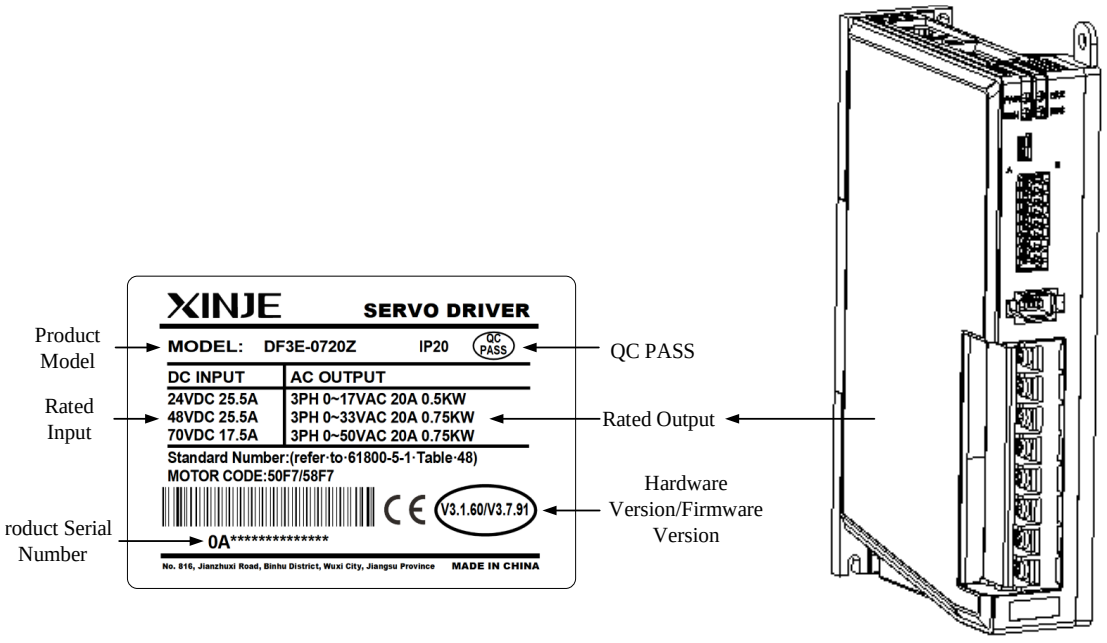
Symbol	Product series
E	Pulse、RS485、CANopen
C	EtherCAT (Not in production)

Symbol	Rated output power
02	200W
04	400W
07	750W
15	1.5KW

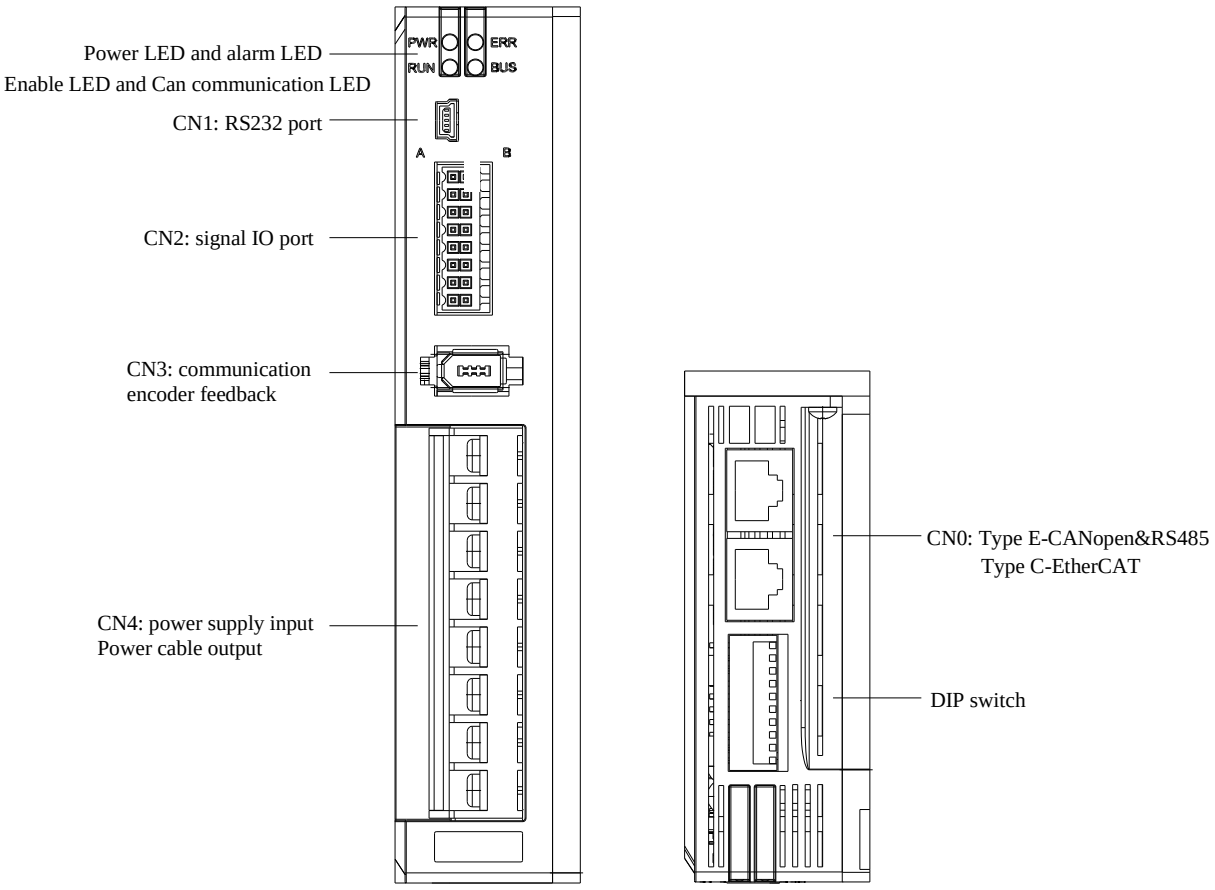
Symbol	Specification
A	Compact drive
Z	Servo can directly drive the brake
空	Cannot directly drive the brake

Symbol	Rated output current
06	6A
10	10A
20	20A
40	40A

1.1.2 Nameplate Description



1.1.3 Description Of Each Part



this driver has no panel, so it can't operate the panel. It needs to connect the cable of Xinje servo DB9 with USB, and use the Xinje servo software.

Description of status indicator light:

Name	Meaning	Light Color	Status Meaning
PWR	Power Indicator	Green	Green on: Drive powered onGreen off: Drive powered off
RUN	Enable Indicator	Green	Green on: Servo enable ONGreen off: Servo enable OFF
ERR	Alarm Indicator	Red	Red steady on: Servo alarmRed flashing: Need to power cycleRed off: No servo alarm
BUS	CAN Communication Indicator	Green	Green steady on: Communication abnormalGreen fast flashing: Communication normalGreen off: No bus communication

1.1.4 Performance specification

Servo unit		DF3E series servo driver
Applicable encoder		Standard: 17-bit communication encoder
Input power supply		DF3E-□□□□: single phase DC48V
Control mode		Three phase full wave rectifying MOSFET controlled sine current drive mode
Using condition	Using temperature	-10~+40℃
	Storage temperature	-20~+60 ℃
	Environment	Below 90％RH (no condensation)

	humidity	
	Vibration resistance	4.9m/s^2
Structure		Vertical or horizontal installation

1.1.5 Electrical specifications

Drive model	Drive power (kW)	Continuous output current (A)	Maximum output current (A)	Power supply input current (A)	Power supply	Cooling method
DF3E-0206	0.2	24	6	6	DC24-60V (48V)	Self-cooling
		48	6			
		60	4.5			
DF3E-0410-A	0.4	24	10	10		Self-cooling
		48	10			
		60	8			
DF3E-0410	0.4	24	13	10	DC24-70V (48V)	Self-cooling
		48	13			
		70	9			
DF3E-0410Z	0.4	24	13	10		Self-cooling
		48	13			
		70	9			
DF3E-0720	0.75	24	25.5	20		Self-cooling
		48	25.5			
		70	17.5			
DF3E-0720Z	0.75	24	25.5	20		Self-cooling
		48	25.5			
		70	17.5			
DF3E-1540	1.5	24	38	40		Self-cooling
		48	38			
		70	26			

The data in the electrical specifications are all currents at 48V power supply!

1.2 Servo Motor Selection

1.2.1 Model Name

MF3S – 60 C S 30 B Z 1 – 5 04

Series	Inertia
MF3S	Low inertia motor
MF3H	High inertia motor
MF5H	High inertia short body

Display	Frame size
60	60 flange
80	80 flange
130	130 flange

Display	Encoder type
C	Magnetic encoder

Display	Encoder accuracy
S	Single-turn 17-bit
M	Multi-turn 17-bit

Display	Rated speed (rpm)
30	3000

Display	Power
02	200W
04	400W
07	750W
15	1.5KW

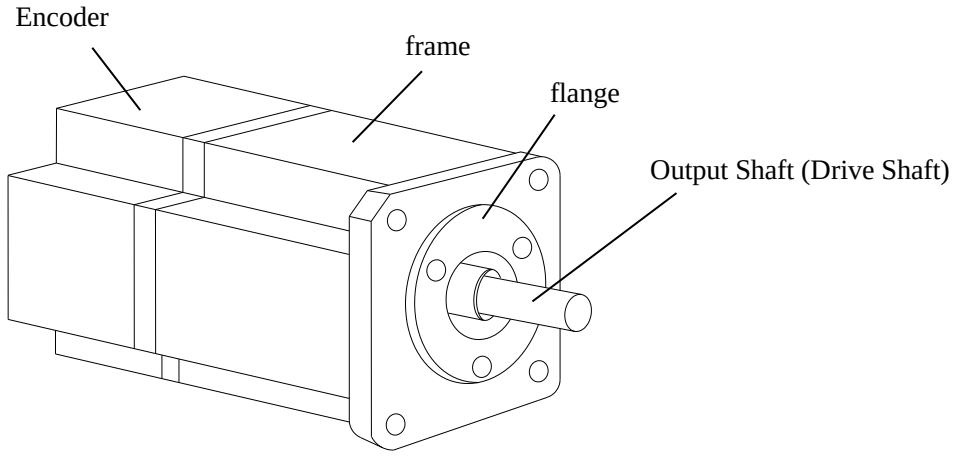
Display	Voltage level
5	48V

Display	Plug type
1	AMP plug
2	Aviation plug

Display	Power-off brake
空	无
Z	有

Display	Keyway, oil seal
B	With keyway, with oil seal

1.2.2 Description of each part



1.3 Cable Selection

1.3.1 Model name

■ **Encoder cable**

CP-SP-M-01

Display	Cable type
CP	Normal
CPT	High flexibility

Display	Plug type
SP	9-core amp plug
SV	7-core waterproof aviation plug
SC	10-core small aviation plug

Display	Plug type
M	No battery box
BM	With battery box

Display	Length (M)
01	1
02	2
03	3
05	5

■ **Power cable**

CM-P 15 - 01

Display	Cable type
CM	Normal
CMT	High flexibility

Display	Plug type
P	4-core amp plug
V	6-core waterproof small aviation plug
L	4-core small aviation plug

Display	Diameter(mm²)
07	0.75
15	1.5
20	2.0

Display	Length (M)
01	1
02	2
03	3
05	5

■ **Brake cable explanation**

- The cable model for motor/brake motor: CB-P03-length (common material) /CBT-P03-length (high flexible material).
- Suitable for 130 flange brake motors, requires optional integrated power and brake cable model: CMB-XL-60-Length.
- The standard wiring length of Xinje cable is 1m, 2m, 3m and 5m.

Cable selection configuration details can be found in Appendix 10 - Selection Configuration Overview Table.

■ **CANopen Communication Cable Model**

J N - CA - 2

Display	Name
J	General Term for Product Matching Cables

Display	Name
N	CAN

Display	Length (m)
0P3	0.3
2	2

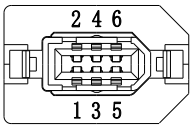
Display	Type
CA	Blue Cat 5e Ethernet Cable

At present, the lengths of the communication cables are 0.3 meters and 2 meters.

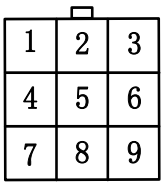
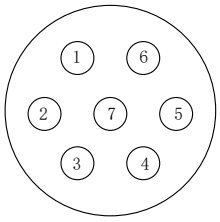
1.3.2 Description of each part

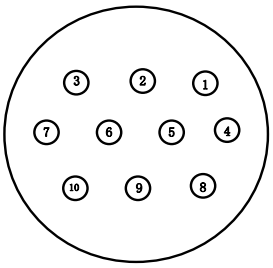
■ **Encoder cable**

(1) Pin definition of encoder on servo driver side

Connector appearance	Pin definition			
	No.	Definition	No.	Definition
	1	5V	4	/
	2	GND	5	485-A
	3	/	6	485-B
	-	-	-	-

(2) Cable connection of encoder on motor side

Motor Model	Connector pins	Pin definition	
		No.	Definition
MF3-60 Frame B1 MotorMF5-60 Frame B1 Motor		1	Battery +
		2	Battery -
		3	Shielded cable
		4	485-A
		5	485-B
		6	/
		7	5V
		8	GND
		9	/
MF3-60, 80 Frame B2 MotorMF5-80 Frame B2 Motor		1	GND
		2	Battery +
		3	Battery -
		4	485-A
		5	485-B
		6	5V
		7	Shielded cable

Motor Model	Connector pins	Pin definition	
		No.	Definition
MF3-130 Frame B2 Motor		1	/
		2	5V
		3	GND
		4	485-A
		5	485-B
		6	Battery +
		7	Battery -
		8	/
		9	/
		10	Shielded cable

Battery box description:

(1) The encoder including the cable definition of battery +, battery- is for the absolute motor, and the non-absolute motor cable has no such pin.

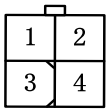
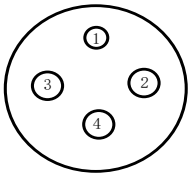
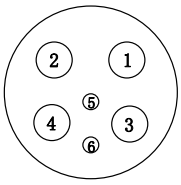
(2) Only the cable of absolute value motor has external battery box, which contains a 3.6V/2.7Ah large capacity battery, and has the function of replacing batteries when power cut. The using life is more than two years. Please refer to chapter 4.6.2 change battery.

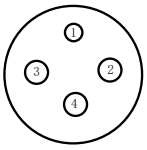
■ Power cable

(1) Pin definition of power cable on servo driver side

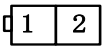
Motor Model	Connector appearance	Pin definition	
		Color	Definition
Non-Small-Size Low-Voltage Servo Driver		Brown	U
		Black	V
		Blue	W
		Yellow-green	PE
Small-Size Low-Voltage Servo Driver		Brown	U
		Black	V
		Blue	W
		Yellow-green	PE

(2) Power cable connection on motor side

Motor Model	Connector pins	Pin definition	
		No.	Definition
MF3-60 Frame B1 MotorMF5-60 Frame B1 Motor		1	U
		2	W
		3	V
		4	PE
MF3-60 Frame B2 MotorMF3-80 Frame B2 MotorMF5-80 Frame B2 Brake MotorMF5-80 Frame B2 Non-Brake Motor		1	U
		2	W
		3	V
		4	PE
MF5-80 Frame B2 Brake Motor		1	U
		2	W
		3	V
		4	PE
		5	BK+
		6	BK-

Motor Model	Connector pins	Pin definition	
		No.	Definition
MF3-130 Frame B2 Motor		1	PE
		2	U
		3	V
		4	W

(3) Brake cable connection

Motor Model	Connector pins	Pin definition	
		No.	Definition
the brake motor		1	BK+
		2	BK-

Brake pins:

The cable including BK pin is used for the brake motor. The cable of the non-brake motor has no BK pin.

1.4 Selection Of Other Accessories

When the servo motor is driven by the generator mode, the power returns to the servo amplifier side, which is called regenerative power. The regenerated power is absorbed by charging the smooth capacitor of the servo amplifier. After exceeding the rechargeable energy, the regenerative resistance is used to consume the regenerative power.

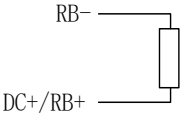
The servo motor driven by regenerative (generator) mode is as follows:

- The deceleration stop period during acceleration and deceleration operation;
- Running vertically and axially;
- When the external load drives the motor to rotate.

■ Associated Parameters

Parameter	Meaning	Factory Setting	Unit	Setting Range	Modify	Take Effect
P0-24	Discharge resistor power protection mode0: Cumulative discharge time1: Average power mode 12: Average power mode 2 (not optimized, not recommended)	0	-	0~2	Servo	Immediate
P0-25	Discharge resistor power value	Set according to model	W	1~65535	Servo	Immediate
P0-26	Discharge resistance value	Set according to model	Ω	1~500	Servo	Immediate

1、Hardware Wiring

Hardware Terminal	Notes	Wiring Diagram
DC+/RB+、RB-	External Resistor	

2、Recommended Specifications for Brake Resistors

Servo Driver Model	Built-in Brake Resistor	External Brake Resistor (Recommended Resistance)	External Brake Resistor (Recommended Power)
DF3E-0206	/	10Ω	Over 100W
DF3E-0410-A		10Ω	Over 100W
DF3E-0410（Z）		10Ω	Over 100W
DF3E-0720（Z）		5Ω	Over 100W
DF3E-1540		3.5Ω	Over 200W

- The smaller the resistance value, the faster the discharge; however, an excessively small value may cause the resistor to break down. Therefore, when selecting a resistor, try to get as close to the lower limit as possible, but do not go below it.
- When wiring, use high-temperature resistant and flame-retardant wires, and ensure that the surface of the brake resistor does not come into contact with the wires.
- For MF series motors, rapid start/stop or frequent forward/reverse operation will cause the motor to feed back charge, leading to an increase in bus voltage. This typically triggers the E-030 alarm. Therefore, it is recommended to connect an external brake resistor in working conditions involving rapid start/stop.

1.5 Peripheral Component Selection

Peripheral Components	Applicable Models	Description
Fuse	All	Used for circuit overcurrent protection: When the current exceeds the rated value for a certain period, the internal metal wire of the fuse melts, cutting off the circuit to prevent equipment damage or fire.
Circuit Breaker	All	Integrates overload and short-circuit protection functions: Automatically trips to open the circuit when abnormal currents (e.g., overcurrent, short circuit) are detected, protecting lines and equipment.
Magnetic Contactor	All	Controls the on/off of the main circuit via an electromagnetic coil; suitable for scenarios such as frequent start/stop of motors and high-power loads.
EMC Filter	All	Suppresses electromagnetic interference (EMI) between the power grid and equipment.
Ferrite Core/Clip	All	Absorbs common-mode noise in cables through high-frequency impedance characteristics, suppressing electromagnetic interference (EMI).

1.5.1 Fuse

Servo Driver Model	Driver Power (kW)	Rated Current (A)	Maximum Current (A)	Recommended Specifications		
				Manufacturer	Model	Rated Current (A)
DF3E-0206	0.2	6	18	Vicfuse	AFT20A60VS	20
DF3E-0410-A	0.4	10	30		AFT20A60VS	20
DF3E-0410	0.4	10	30		AFT20A60VS	20
DF3E-0410Z	0.4	10	30		AFT20A60VS	20
DF3E-0720	0.75	20	60		ANL40A80VDCM8	40
DF3E-0720Z	0.75	20	60		ANL40A80VDCM8	40
DF3E-1540	1.5	40	120		ANL60A80VDCM8	60

1.5.2 Circuit Breaker

Servo Driver Model	Driver Power (kW)	Rated Current (A)	Maximum Current (A)	Recommended Specifications		
				Manufacturer	Model	Rated Current (A)
DF3E-0206	0.2	6	18	Chint Electric	NB1G-63	63
DF3E-0410-A	0.4	10	30			
DF3E-0410	0.4	10	30			
DF3E-0410Z	0.4	10	30			
DF3E-0720	0.75	20	60			
DF3E-0720Z	0.75	20	60			
DF3E-1540	1.5	40	120			

1.5.3 Magnetic Contactor

Servo Driver Model	Driver Power (kW)	Rated Current (A)	Maximum Current (A)	Recommended Specifications		
				Manufacturer	Model	Rated Current (A)
DF3E-0206	0.2	6	18	TENGEN	TGC1-6511	65A
DF3E-0410-A	0.4	10	30			
DF3E-0410	0.4	10	30			
DF3E-0410Z	0.4	10	30			
DF3E-0720	0.75	20	60			
DF3E-0720Z	0.75	20	60			
DF3E-1540	1.5	40	120			

1.5.4 EMC Filter

Servo Driver Model	Driver Power (kW)	Rated Current (A)	Maximum Current (A)	Recommended Specifications		
				Manufacturer	Model	Rated Current (A)
DF3E-0206	0.2	6	18	"Qima Testing (Dongguan) Co., Limited"	QMN10M4-S	10
DF3E-0410-A	0.4	10	30		QMN10M4-S	10
DF3E-0410	0.4	10	30		QMN10M4-S	10
DF3E-0410Z	0.4	10	30		QMN10M4-S	10
DF3E-0720	0.75	20	60		QMN20M4-S	20
DF3E-0720Z	0.75	20	60		QMN20M4-S	20
DF3E-1540	1.5	40	120		QMN40M4-S	40

1.5.5 Ferrite Core and Ferrite Clip

The ferrite core is typically installed near the input or output side of the driver, and it is recommended to mount it as close to the driver body as possible.

When configured on the input side, its core function is to eliminate conductive electromagnetic interference in the power supply lines. When installed on the output side, it can effectively suppress high-frequency radiated interference generated during driver operation and simultaneously reduce parasitic currents in the motor bearings.

For abnormal leakage current phenomena occurring under specific working conditions and electromagnetic interference issues affecting control signal lines, toroidal ferrite cores or ferrite core assemblies with clips can be adopted for targeted treatment. The former is suitable for winding installation, while the latter facilitates quick deployment on cables.

Servo Driver Model	Driver Power (kW)	Rated Current (A)	Maximum Current (A)	Recommended Specifications		
				Manufacturer	Model	Dimensions (Length × Outer Diameter × Inner Diameter) (mm)
DF3E-0206	0.2	6	18	Meifeng Technology Co., Ltd.	DY644020H DY805020H DYR-130-B	64×40×20 80×50×20 32.0×31×13
DF3E-0410-A	0.4	10	30			
DF3E-0410	0.4	10	30			
DF3E-0410Z	0.4	10	30			
DF3E-0720	0.75	20	60			
DF3E-0720Z	0.75	20	60			
DF3E-1540	1.5	40	120			

2 Installation Of Servo System

2.1 Servo Driver Installation

2.1.1 Installation site

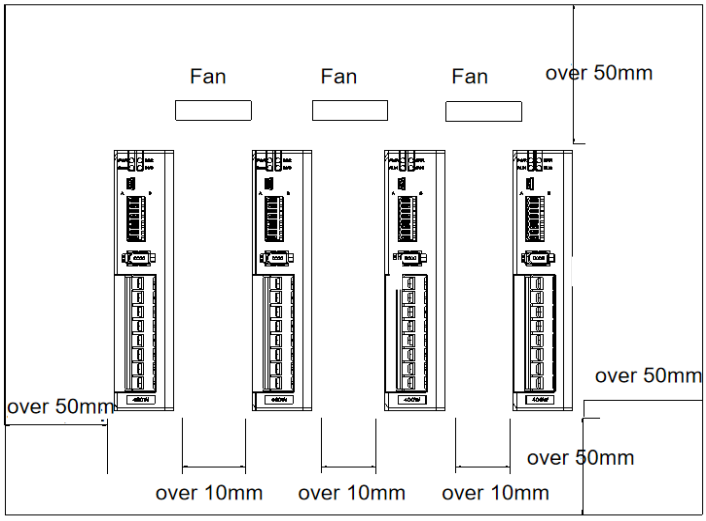
- Please install it in the installation cabinet without sunshine or rain.
- Do not use this product near corrosive and flammable gas environments such as hydrogen sulfide, chlorine, ammonia, sulfur, chlorinated gas, acid, alkali, salt, etc.
- Do not install in high temperature, humidity, dust, metal dust environment;
- No vibration place.

2.1.2 Environment condition

Item	Description
Storage Temperature	-20~60°C
Operating Ambient Temperature	-10~40°C
Storage Humidity	20~90%RH (non-condensing)
Operating Ambient Humidity	20~90%RH (non-condensing)
Vibration Resistance	Not more than 4.9m/s²
Altitude	Not higher than 1000m; derate when exceeding 1000m (1% derating per 100m increase)

2.1.3 Installation standard

Be sure to comply with the installation standard in the control cabinet shown in the figure below. This standard is applicable to the situation where multiple servo drivers are installed side by side in the control cabinet (hereinafter referred to as "when installed side by side").



■ Servo Drive Orientation

Install the servo drive perpendicular to the wall so the front panel containing connectors faces outward.

■ Cooling

As shown in the figure above, allow sufficient space around each servo drive for cooling by cooling fans or natural convection.

■ Side-by-side Installation

When install servo drives side by side as shown in the figure above, make at least 10mm between and at least 50mm above and below each servo drive. Install cooling fans above the servo drives to avoid excessive temperature rise and to maintain even temperature inside the control panel.

■ Environmental Conditions in the Control Panel

- Servo driver working ambient Temperature: -10~40 ℃
- Humidity: 90%RH or less
- Vibration: 4.9m/s^2
- Condensation and Freezing: None

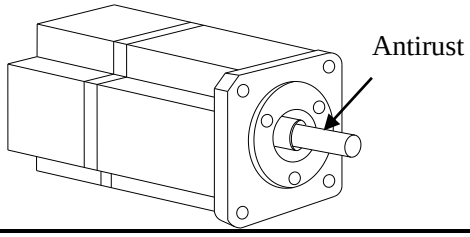
Note: when installing horizontally (mask facing the operator), it needs to use the frame provided by our company (see chapter 2.4 the outline dimensions of servo driver).

2.2 Servo Motor Installation

MF series servomotors can be installed either horizontally or vertically. The service life of the servomotor can be shortened or unexpected problems might occur if it is installed incorrectly or in an inappropriate location. Follow these installation instructions carefully.

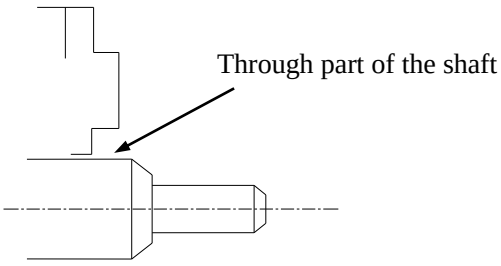
CAUTION

1. The end of the motor shaft is coated with antirust. Before installing, carefully remove all of the paint using a cloth moistened with paint thinner.
2. Avoid getting thinner on other parts of the servo motor.



2.2.1 Environment condition

When used in places with water droplets or oil droplets, the protection effect can be achieved through the treatment of motors. However, in order to seal the through part of the shaft, please specify the motor with oil seal. Connectors should be installed downward.

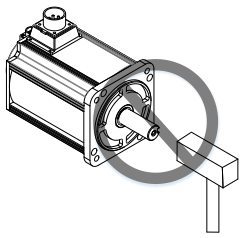
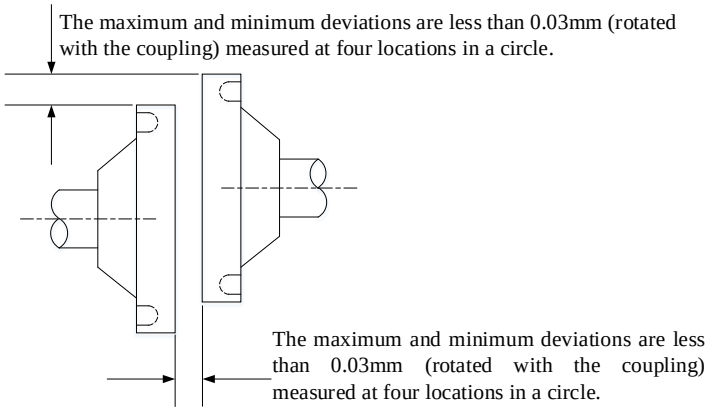
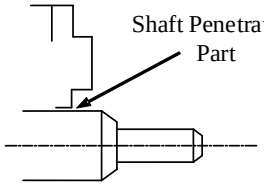


MS series servo motors are for indoor use. Please use them under the following installation conditions:

Item	Description
Use ambient temperature	-20℃~60℃ (relative humidity)
Use ambient humidity	-10℃~40℃ (no freeze)
Storage temperature	20%~90%RH (no condensation)
Storage humidity	20%~90%RH (no condensation)
Protection level	IP66

2.2.2 Installation cautions

Item	Description
Antirust treatment	◆ Before installation, please wipe the "rust-proof agent" of the extension end of the servo motor shaft, and then do the relevant rust-proof treatment.

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td rowspan="2">Encoder cautions</td><td>◆ It is forbidden to impact the extension end of the shaft during installation, otherwise the internal encoder will be broken.
  </td></tr>
<tr><td>◆ When the pulley is installed on the servo motor shaft with keyway, the screw hole is used at the end of the shaft. In order to install the pulley, the double-headed nails are inserted into the screw holes of the shaft, the washer is used on the surface of the coupling end, and the pulley is gradually locked with the nut.
◆ For the servo motor shaft with keyway, use the screw hole at the end of the shaft to install. For shaft without keyway, friction coupling or similar methods are used.
◆ When the pulley is dismantled, the pulley mover is used to prevent the bearing from being strongly impacted by the load.
◆ To ensure safety, protective covers or similar devices, such as pulleys installed on shaft, are installed in the rotating area.</td></tr>
<tr><td>Centering</td><td>◆ When installing the servo motor, make it conform to the centering accuracy requirement shown in the picture below. If the centering is inadequate, vibration will occur, and sometimes the bearing and encoder may be damaged. When installing the coupling, please do not directly impact the motor shaft, otherwise the encoder installed on the opposite side of the load shaft will be damaged.
  </td></tr>
<tr><td>Installation direction</td><td>◆ Servo motor can be installed in horizontal or vertical direction.</td></tr>
<tr><td>Oil and water solutions</td><td>When using in places where water droplets are dropping, please use it on the basis of confirming the protection level of servo motor. (except for the shaft-through part) When oil droplets will drip into the shaft-through part, please specify the servo motor with oil seal.
 
Conditions for use of servo motors with oil seals:
◆ Make sure the oil level is below the lip of the oil seal when using.
◆ Please use the oil seal to keep the splash of oil droplets in good condition.</td></tr>
</table>

Item	Description
	◆ When the servo motor is installed vertically upward, please pay attention not to oil accumulation on the lip of the oil seal.
Stress state of cable	◆ Do not "bend" or apply "tension" to the wire, especially the core of the signal line is 0.2mm or 0.3mm, very thin, so when wiring (using), do not make it too tight.
Processing of Connector Part	For the connector part, please pay attention to the following items: ◆ When connecting the connector, please make sure that there is no foreign matter such as garbage or metal sheets in the connector. ◆ When connecting the connector to the servo motor, it is necessary to connect the connector from the side of the main circuit cable of the servo motor first, and the grounding wire of the main cable must be connected reliably. If one side of the encoder cable is connected first, the encoder may fail due to the potential difference between PE. ◆ When wiring, please make sure that the pins are arranged correctly. ◆ Connectors are made of resin. Do not apply shock to avoid damaging the connector. ◆ When carrying out the operation under the condition that the cable remains connected, it is necessary to grasp the main body of the servo motor. If only the cable is seized for handling, it may damage the connector or pull the cable off. ◆ If bending cable is used, full attention should be paid to the wiring operation and stress should not be applied to the connector part. If the stress is applied to the connector part, the connector may be damaged.

2.2.3 Installation environment

- Do not use this product near corrosive and flammable gas environments such as hydrogen sulfide, chlorine, ammonia, sulfur, chlorinated gas, acid, alkali, salt, etc.
- In places with grinding fluid, oil mist, iron powder, cutting, etc., please choose motor with oil seal.
- A place away from heat sources such as stoves;
- Do not use motor in enclosed environment. Closed environment will lead to high temperature and shorten service life of motor.

2.3 Servo Cable Installation

DF3E series servo motor adopts communication encoder, which may cause uncertain influence due to improper use and environmental factors. When installing power cable and encoder cable, please pay attention to the following instructions.

2.3.1 Cable selection

Our regular cable materials include ordinary cable and high flexible cable. The adapter cable connector for motors with 80 flange or less is divided into aviation plug and amp plug.

The cable selected by the customer needs to define the operating conditions on site.

If the cable is used in general occasions, please select the cable from other manufacturers (2.3.2 specifications of Xinje cable) in strict accordance with the specifications given by Xinje. If the cable is used in unconventional occasions, please select the cable according to the actual working conditions to be superior to the existing specifications of Xinje.

1. In normal situations, the following points should be noted:

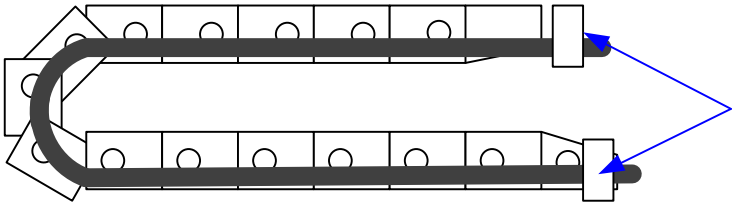
- For pulse command signal cable, please ensure wiring less than 3m.
- The encoder cable shall be within 20 meters. It is recommended to select special cable if it is more than 20 meters. The wire diameter of encoder cable depends on the length of encoder cable used on site. The longer the cable is, the greater the wire resistance is, and the more severe the voltage attenuation or signal distortion is, which is likely to cause pulse loss or no signal can be detected. Therefore, in general, the customized special cable should be selected if it is more than 20 meters.
- The power cable diameter depends on the current condition of the motor. Generally, the wire diameter is 1/10 of the maximum current of the motor. For example, the maximum current of the motor is 60A, and the wire diameter of 6mm² is selected.
- In case of interference, it is necessary to separate strong and weak current. It is recommended to separate power cable from encoder cable and signal cable.
- Ensure the correct grounding of servo driver and servo motor. The grounding resistance is not more than 4Ω, and the grounding depth is more than 2m. It is recommended to use 4*40 angle galvanized steel or 40mm diameter galvanized steel pipe;
- If the customer makes the wire by himself, the cable specification please refer to chapter 2.3.2 Xinje cable specification, the welding reliability shall be ensured when making the wire to avoid false welding, bridge connection, wrong welding, missing welding, etc., and the continuity of both ends of the cable can be tested after the welding is completed.

2. In unconventional occasions, the following items shall be noted:

(1) Occasions of dragging and bending cables

- Do not bend the cable or bear the tension. As the core diameter of signal cable is only 0.2mm or 0.3mm, it is easy to break, please pay attention to it when using.
- When the cable needs to be moved, please use flexible cable. Ordinary cable is easy to be damaged after long-term bending. Small power motor (motor below 80 flange) with its own cable can not be used for cable movement.
- When using cable protection chain, please ensure that:
  ① The bending radius of the cable is more than 10 times of the outer diameter of the cable;
  ② The wiring in the cable protection chain shall not be fixed or bundled, only the two immovable wires end in the cable protection chain shall be bound and fixed;
  ③ Do not twist the cable;
  ④ The duty cycle in the cable protection chain shall be less than 60%;
  ⑤ Do not mix the cables with too big difference in appearance. The thin wire will be broken by the thick wire. If it is necessary to mix the wiring, partition device is arranged in the middle of the

cable.



(2) Greasy and humid occasions

- It is recommended to select cable with aviation plug as connector instead of AMP interface cable.
- It is necessary to make corresponding protection (glass glue/insulating cloth binding, etc.) for the used AMP interface cable on site.
- Use special cable.

(3) Interference, high current / high power occasions (such as welding equipment)

- Use the shortest connection length of command input and encoder wiring and other connection cables.
- Thick wire shall be used for grounding wiring as far as possible (above 2.0mm ^{2})
- Please use noise filter to prevent RF interference. When using in the civil environment or in the environment with strong power interference noise, please install the noise filter on the input side of the power line.
- To prevent the wrong action caused by electromagnetic interference, the following treatment methods can be adopted:
  ① Install the superior device and noise filter near the servo drive as far as possible.
  ② Install surge suppressor on the coil of relay, screw tube and electromagnetic contactor.
  ③ Please separate the strong and weak current cables and keep the interval of more than 30cm when wiring. Do not put in the same pipe or tie together.
  ④ Do not share power with welding machine, discharge processing equipment, etc. When there is a high frequency generator nearby, install noise filter on the input side of the power cable.

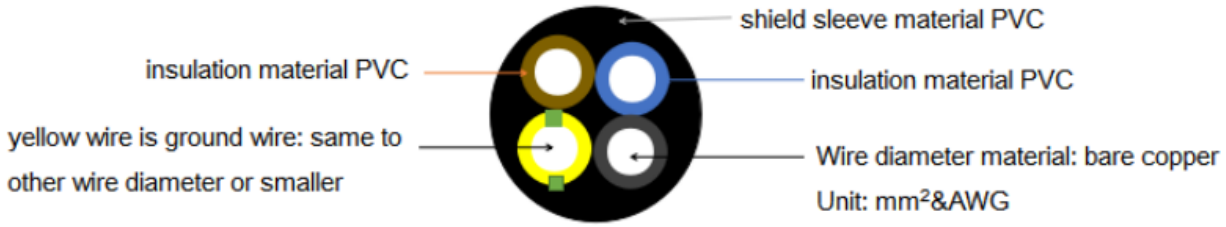
(4) Low / high temperature

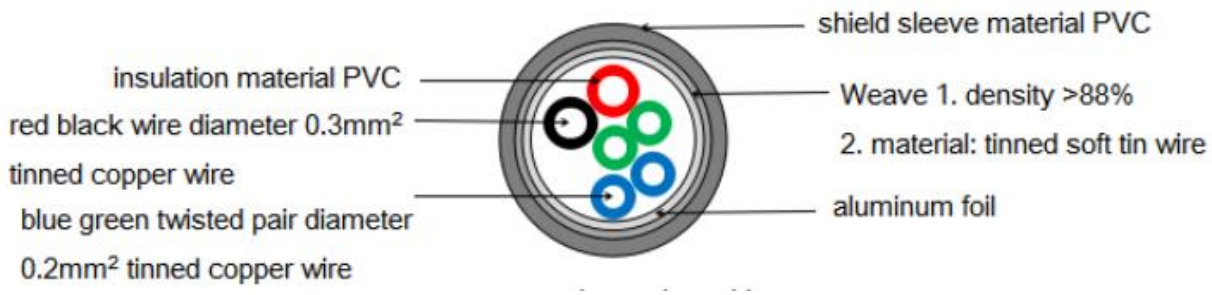
- Select cables (special cables) that meet the use conditions.

2.3.2 Xinje cable specification

1. Material composition of Xinje cable

Cross section of cable (encoder, power cable), corresponding introduction of wire skin material, wire diameter, wire core material shielding material, etc.





2. Cable diameter specification

Power \ Cable type	Encoder cable	Power cable
100W	4*0.2mm²+2*0.3mm²	4*1.5mm²
200W	4*0.2mm²+2*0.3mm²	4*1.5mm²
400W	4*0.2mm²+2*0.3mm²	4*1.5mm²
750W	4*0.2mm²+2*0.3mm²	4*2.0mm²

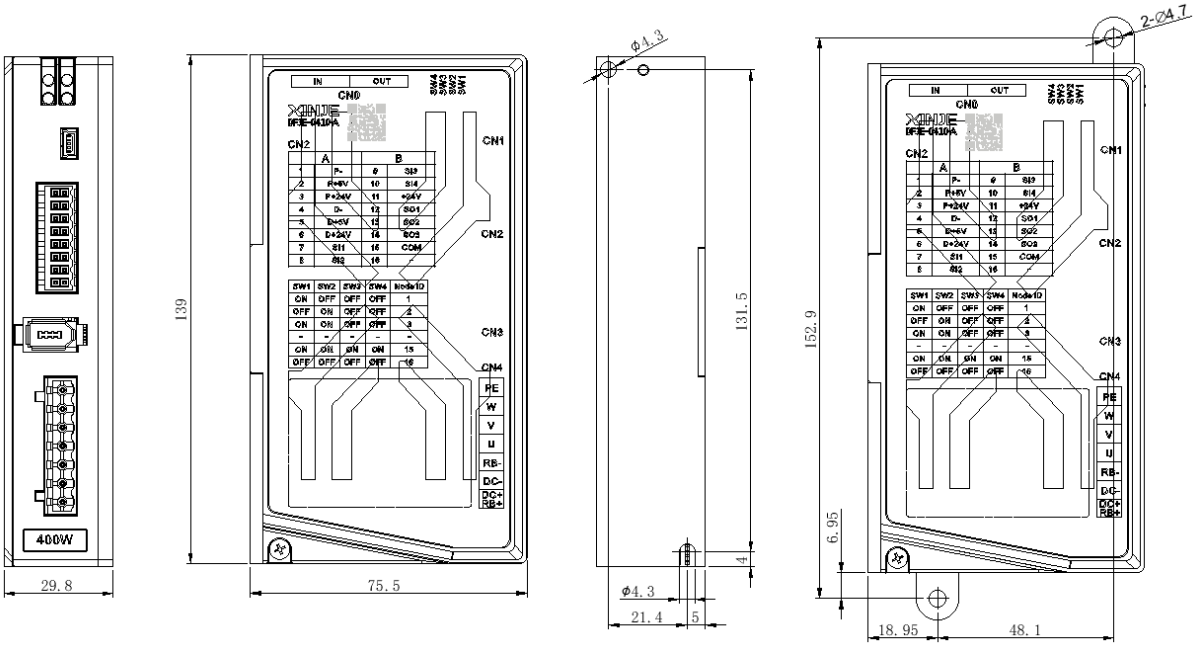
3. Cable performance specification

Cable Type	Cable Performance SpecificationsCable Performance Specifications		Cable Installation Specifications	
	Temperature Resistance	Voltage Resistance	Fixed Installation	Mobile Installation
Standard Cable	-20℃~80℃	2000V/min	≥5*D	/
Highly Flexible Cable	-20℃~80℃	2000V/min		If stroke ≤2m and R≥7.5D, then N≥3 million cycles;If stroke ≤2m and R≥10D, then N≥5 million cycles;

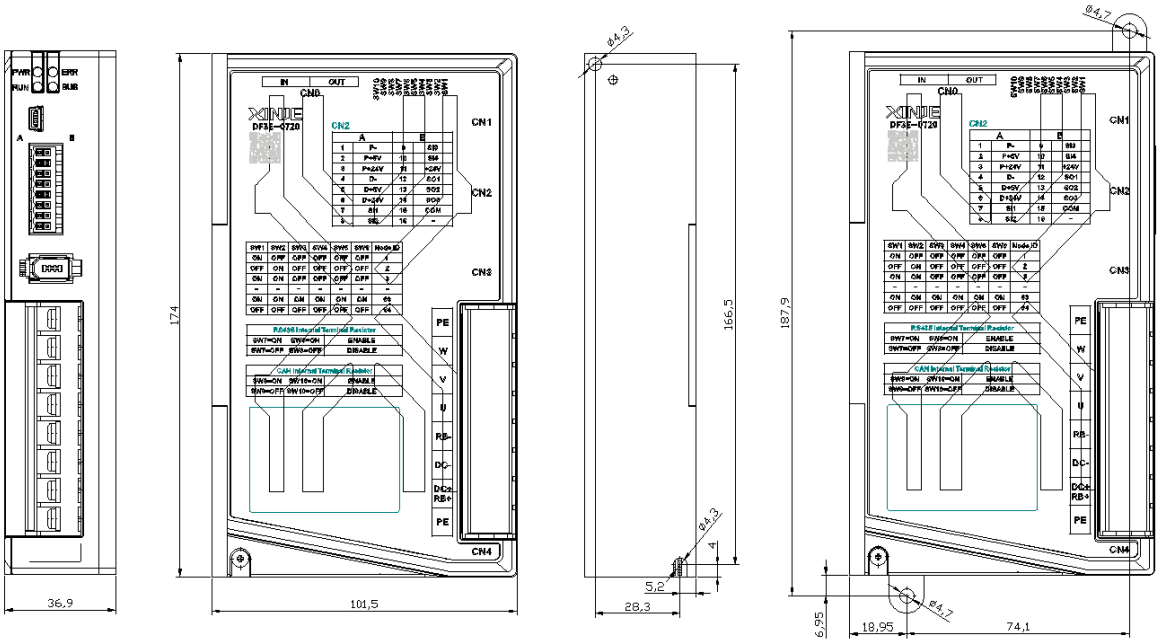
D refers to the finished cable diameter, R refers to the bending radius, and N refers to the bending cycle resistance.

2.4 Servo Driver Dimension

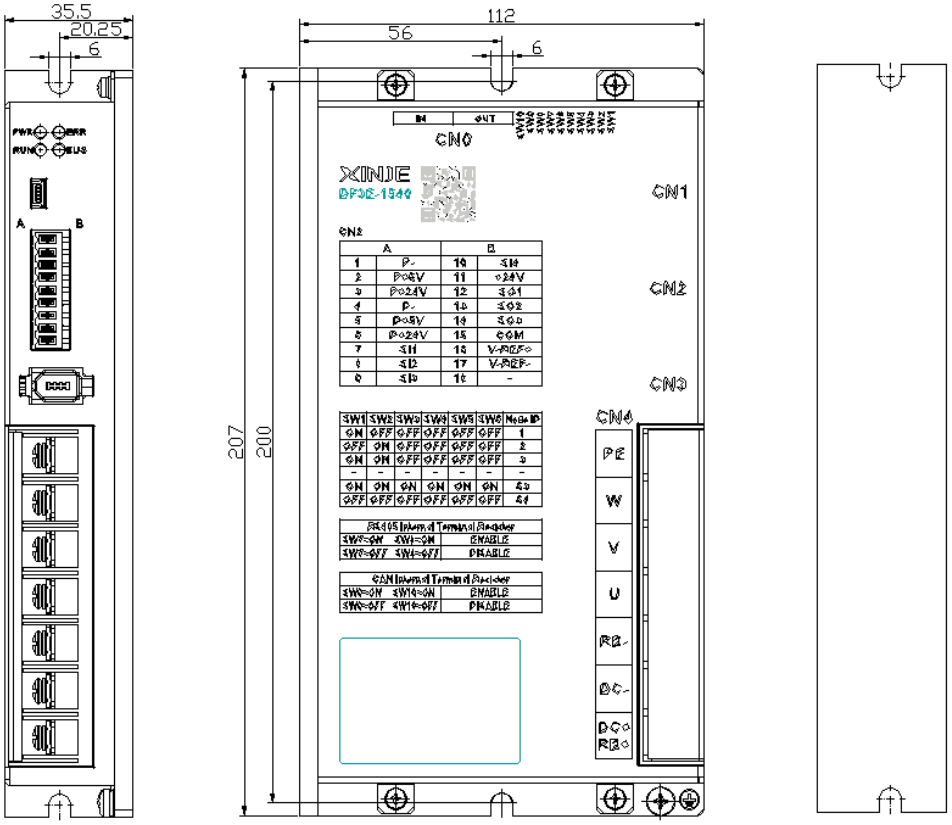
■ **DF3E-0206、DF3E-0410-A** **unit：mm**



■ **DF3E-0410（Z）、DF3E-0720(Z)** **unit：mm**

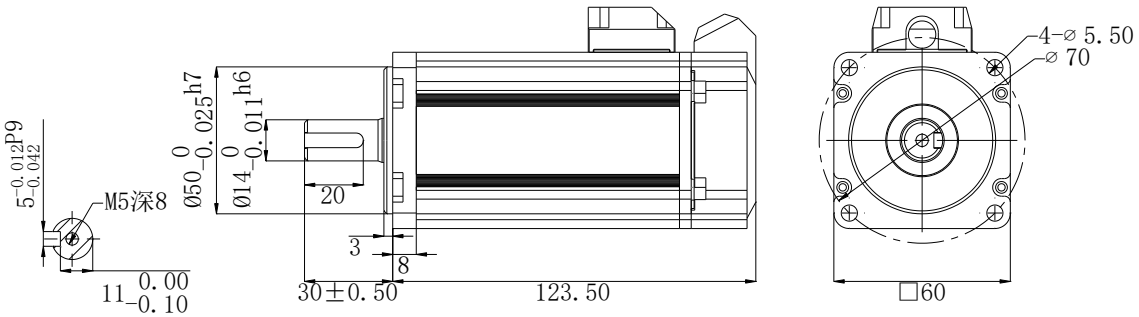


■ **DF3E-1540** **unit：mm**



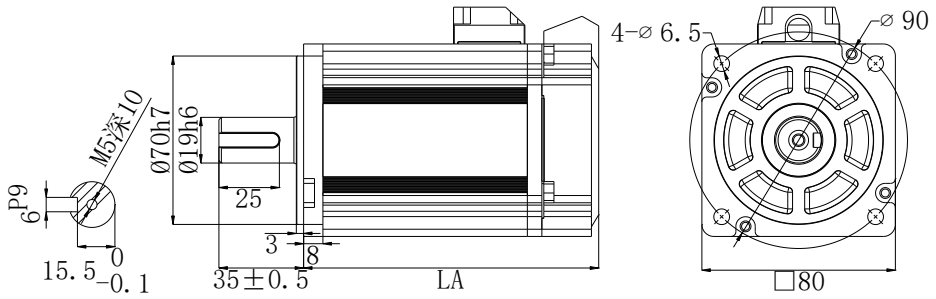
2.5 Servo Motor Dimension

■ **60 series motor without brake installation dimensions** **unit:mm**



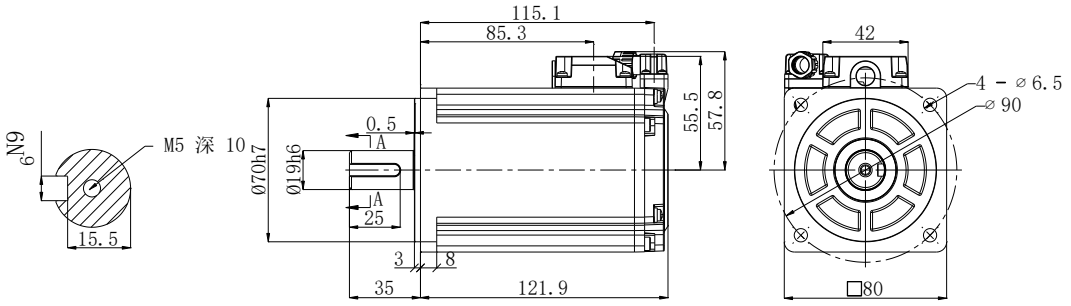
Motor type	Motor model	LA	Inertia	Matched driver
Non-brake type	MF3H-60CS/CM30B1-502	86.2	High inertia	MF3H series
Brake type	MF3H-60CS/CM30BZ1-502	117.2		
Non-brake type	MF5H-60CM30B1-502	66.9	High inertia	MF5H series
Brake type	MF5H-60CM30BZ1-502	93.7		
Non-brake type	MF3S-60CS/CM30B1-504	123.50	Low inertia	MF3S series
Brake type	MF3S-60CS/CM30BZ1-504	155.50		
Non-brake type	MF3H-60CS/CM30B1-504	110	High inertia	MF3H series
Brake type	MF3H-60CS/CM30BZ1-504	141		
Non-brake type	MF5H-60CM30B1-504	82.9	High inertia	MF5H series
Brake type	MF5H-60CM30BZ1-504	109.65		

■ **80 series motor without brake installation dimensions** **unit: mm**



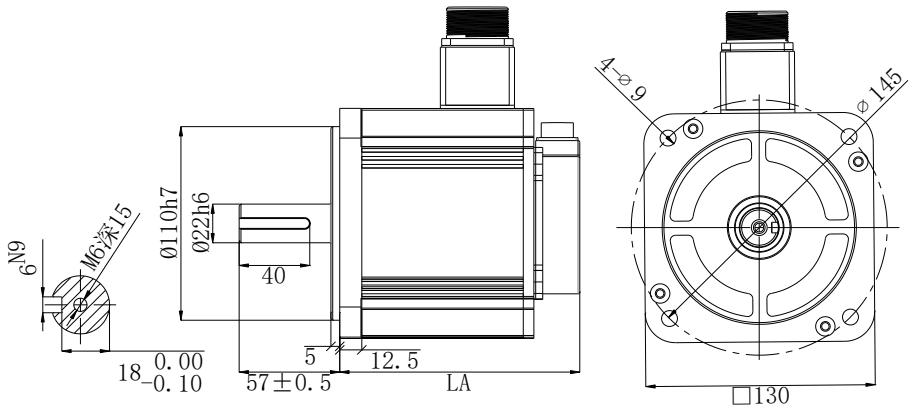
Motor type	Motor model	LA	Inertia	Matched driver
Non-brake type	MF3S-80CS/CM30B2-507	122	Low inertia	MF3S series
Brake type	MF3S-80CS/CM30BZ2-507	155		
Non-brake type	MF5H-80CM30B2-507	85.7	High inertia	MF5H series
Brake type	MF5H-80CM30BZ2-507	117.6		

■ **80 series motor with brake installation dimensions** **unit: mm**



Motor type	Motor model	LA	Inertia	Matched driver
Non-brake type	MF5H-80CM30B2-512	121.9	High inertia	MF5H series
Brake type	MF5H-80CM30BZ2-512	153.8		

■ **130 series motor without brake installation dimensions** **unit：mm**



Motor type	Motor model	LA	Inertia	Matched driver
Non-brake type	MF3S-130CS/CM30B2-515	140	Low inertia	MF3S series
Brake type	MF3S-130CS/CM30BZ2-515	168		

3 Wiring Of Servo System

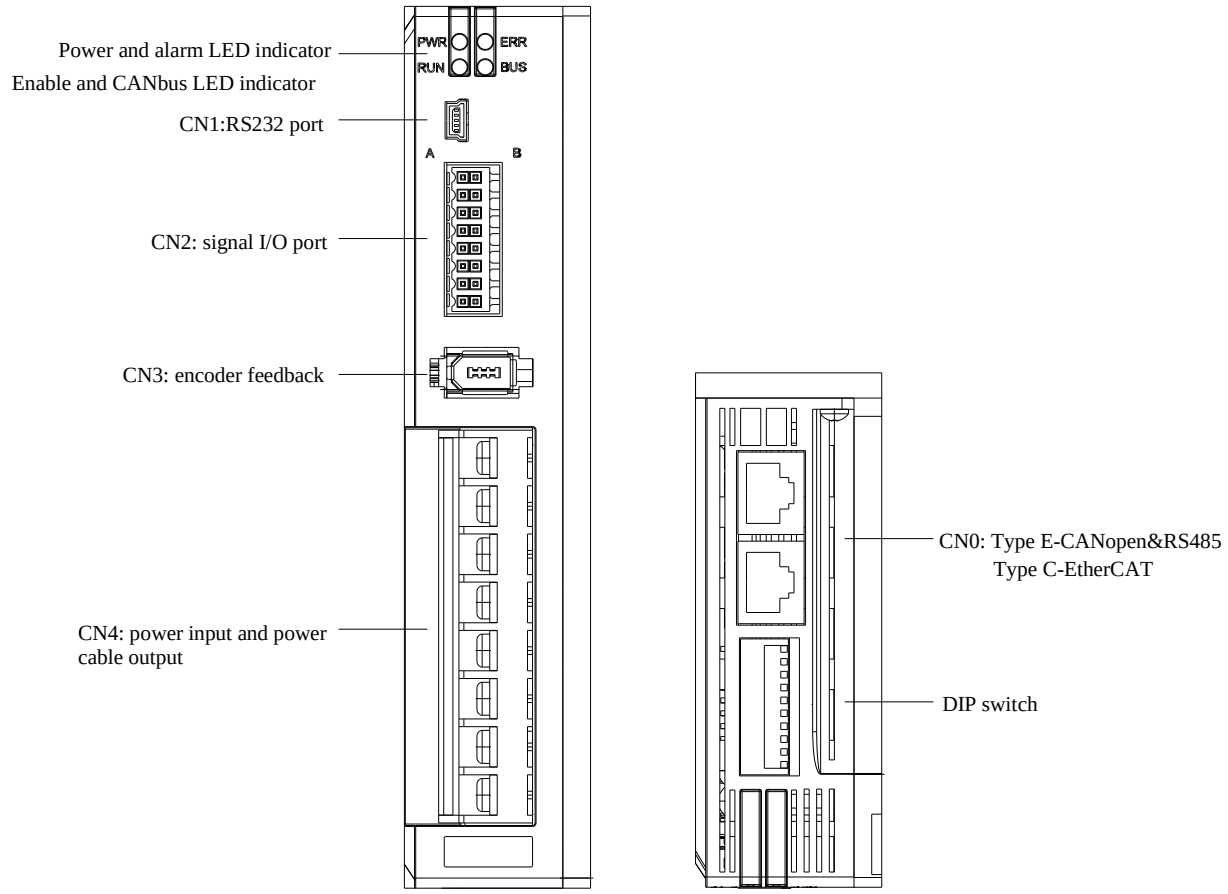
Servo driver interface wiring recommended wire, as shown in the following table:

Servo driver model	Power cable diameter mm²	UVW power cable diameter mm²	Encoder cable diameter mm²	Grould cable ⏚ diameter mm²	Ground Screw Size mm	Recommended Grounding Torque N・m
DF3E-0206	0.75	0.75	0.2（7芯）	0.75	M4	0.54
DF3E-0410	2.0	1.5	0.2（9芯）	2.0	M4	0.54
DF3E-0720	2.0	2.0	0.2（7芯）	2.0	M4	0.54
DF3E-1540	2.0	6.0	0.2（10芯）	2.0	M4、M5	0.54

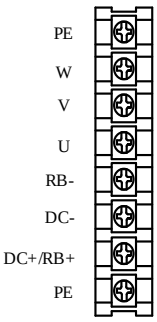
- Please do not cross power wires and signal wires from the same pipeline, nor tie them together. When wiring, please keep the power wire and signal wire more than 30 cm apart
- For the signal wire and the feedback wire of the encoder (PG), please use the multi-stranded wire and the multi-core stranded integral shielding wire.
- For wiring length, the longest instruction input wire is 3m and the longest PG feedback wire is 20m.
- Even if the power supply is off, there may still be a high voltage in the servo unit. Please do not touch the power terminal temporarily (10 minutes).

3.1 Main Circuit Wiring

3.1.1 Servo driver terminal arrangement



3.1.2 CN4 Terminals

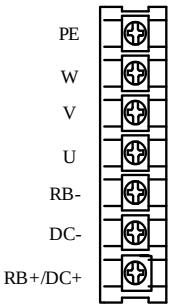


■ **DF3E-0410(Z)/0720(Z)**

According to the order from top to bottom, the main circuit terminal functions are as follows:

Terminal	Function	Explanation
DC+, DC-	Power supply input of main circuit	DC24V-70V
U, V, W, PE	Motor connection terminal	Connect to the motor
RB+, RB-	External regenerative resistor	Connect regenerative resistor between RB+ and RB-, P0-25= power value, P0-26= resistor value

■ DF3E-1540、DF3E-0206、DF3E-0410-A



According to the order from top to bottom, the main circuit terminal functions are as follows:

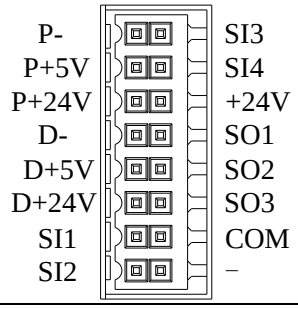
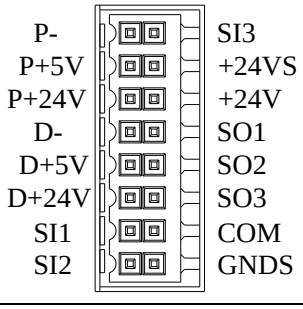
Terminal	Function	Explanation
DC+、DC-	Power supply input of main circuit	DC24V-70V
U、V、W、PE	Motor connection terminal	Connect to the motor
RB+、RB-	External regenerative resistor	Connect regenerative resistor between RB+ and RB-, P0-25= power value, P0-26= resistor value

3.2 Control Terminal Description and Wiring

3.2.1 Description of Control Terminals

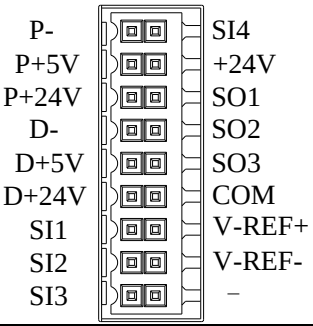
3.2.1.1 Description of CN2 Terminal

■ **DF3E-0410(Z)、DS3E-0720(Z)、DF3E-0410-A、DF3E-0206**

CN2（DF3E-0410/0720/0410-A/0206）	CN2（DF3E-0410Z/0720Z）
	

Name	Description	Name	Description
P-	Pulse-	SI3	Input Terminal
P+5V	Pulse+5V	SI4/+24VS	SI4: Input Terminal (Non-Brake Version)+24VS: Brake Output +24VS (Brake Version)
P+24V	Pulse+24V	+24V	Input +24V
D-	Direction-	SO1	Output Terminal
D+5V	Direction+5V	SO2	Output Terminal
D+24V	Direction+24V	SO3	Output Terminal
SI1	Input Terminal	COM	Output Common Terminal
SI2	Input Terminal	-/GNDS	-: Empty Terminal (Non-Brake Version)GNDS: Brake Output V- (Brake Version)

■ **DF3E-1540**

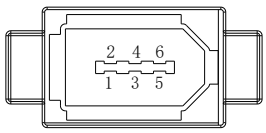
CN2（DF3E-1540）


Name	Description	Name	Description
P-	Pulse-	SI4	Input Terminal (Non-Brake Version)
P+5V	Pulse+5V	+24V	Input +24V
P+24V	Pulse+24V	SO1	Output Terminal
D-	Direction-	SO2	Output Terminal
D+5V	Direction+5V	SO3	Output Terminal
D+24V	Direction+24V	COM	Output Common Terminal

Name	Description	Name	Description
SI1	Input Terminal	V-REF+	External Speed Analog Differential Input +
SI2	Input Terminal	V-REF-	External Speed Analog Differential Input -
SI3	Input Terminal	-	-: Empty Terminal (Non-Brake Version)

3.2.1.2 Description of CN3 Terminal

CN2 Encoder Body Side - The encoder socket terminals are shown in the figure below:



No.	Definition
1	5V
2	GND
3	/
4	/
5	485-A
6	485-B

3.2.1.3 Definition of DIP Switch

The communication station number of the low-voltage servo is adjusted via DIP switches SW1-SW6 (excluding DF3E-0410-A and DF3E-0206):

Station Number	SW1	SW2	SW3	SW4	SW5	SW6
1	ON	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF
...	...	...	...	...	...	...
63	ON	ON	ON	ON	ON	ON
64	OFF	OFF	OFF	OFF	OFF	OFF

The communication station number of the low-voltage servo is adjusted via DIP switches SW1-SW4 (for models DF3E-0410-A and DF3E-0206):

Station Number	SW1	SW2	SW3	SW4
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
...	...	...	...	...
15	ON	ON	ON	ON
16	OFF	OFF	OFF	OFF

SW7 and SW8 control whether the internal RS485 terminal resistor is enabled (not applicable to models DF3E-0410-A and DF3E-0206):

RS485 Internal Terminal Resistor	
SW7=ON SW8=ON	Open
SW7=OFF SW8=OFF	Close

SW9 and SW10 control whether the internal CAN terminal resistor is enabled (not applicable to models DF3E-0410-A and DF3E-0206):

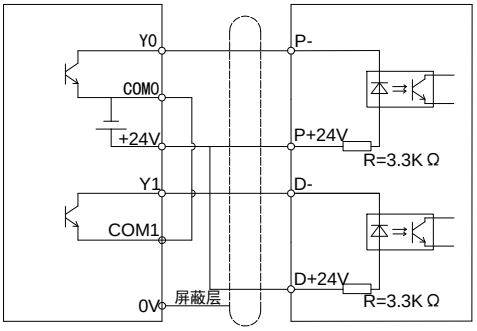
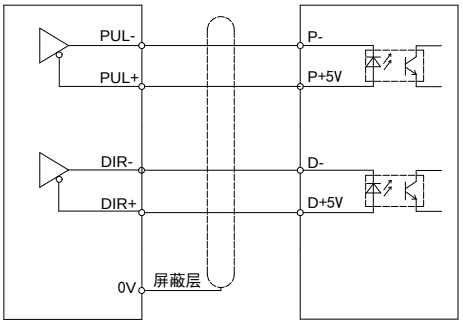
CAN Internal Terminal Resistor	
SW9=ON SW10=ON	Open
SW9=OFF SW10=OFF	Close

Models DF3E-0410-A and DF3E-0206 are not equipped with internal termination resistors. If required, please contact the product's agent, local office, or the sales department of Xinje Corporation in a timely manner to purchase the component.

3.2.2 Wiring of Control Terminals

3.2.2.1 Pulse signal

The interface circuit for open-collector/differential signal pulse input is shown in the wiring diagram below:

Open collector (24V voltage)	Differential mode (5V voltage)
PLC, CNC and SCM servo driver  When the upper-level device adopts open-collector output, this connection method shall be used. Please note that P+5V and D+5V should be left floating.	PLC, CNC and SCM servo driver  When the upper-level device adopts 5V differential signal output, the connection method shown in the diagram shall be used. Please note that P+24V and D+24V should be left floating.

Pulse Input Specifications

Pulse Specifications	Input Type	Maximum Input Frequency
P-, P+5VD-, D+5V	5V Differential Input	500kHz
P-, P+24VD-, D+24V	24V OC Input	200kHz

- To improve anti-interference performance, twisted-shielded cables must be used, and the length of command signal cables is recommended to be within 3m. It is recommended that the shielding layer be connected to the controller's 0V, and the servo should be properly grounded.
- The supply voltage range of P-/P+24V and D-/D+24V is 18V~28V. The supply voltage range of P-/P+5V and D-/D+5V is 3.3V~5V. If the voltage is lower than 18V/3.3V, pulse and direction abnormalities may occur.
- The servo pulse input port has a conducting current of 10mA.
- If the controller is a Xinje PLC (with a rated output current of 50mA for the pulse output port), theoretically, one pulse channel can drive up to 5 servos based on this data. However, it is recommended that the maximum number of connected servos does not exceed 3.
- When using a Xinje PLC and the P+D pulse frequency is higher than 100kHz, a pull-up resistor of 500Ω/2W should be connected in parallel at the PLC pulse output terminal, or a pull-up resistor of 2KΩ/1W should be connected at the servo pulse receiving terminal.

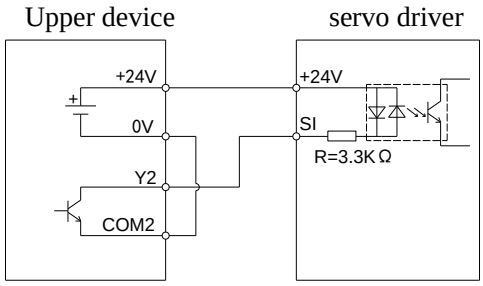
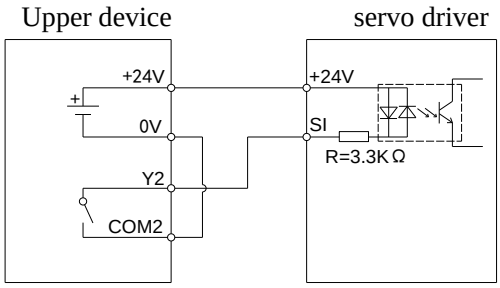
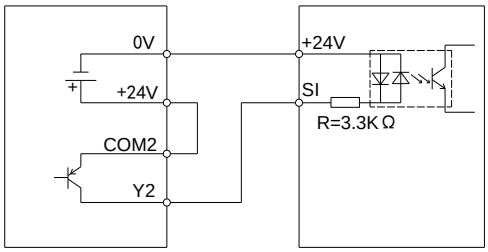
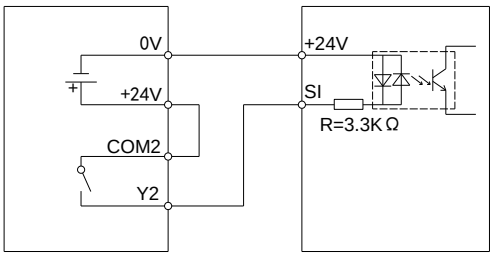
3.2.2.2 SI input signal

Please use a relay or an open collector transistor circuit to connect. When using relay connection, please select the relay for small current. If the relay is not small current, it will cause bad contact.

Category	Input Terminals	Function
Discrete Input	SI1~SI4 (Non-Brake Version)	Multi-Function Input Signal Terminal
Discrete Input	SI1~SI3 (Brake Version)	Multi-Function Input Signal Terminal

Defaulted assignment of input terminals

Terminal	SI1	SI2	SI3	SI4
Function	S-ON/ enable	ALM-RST/alarm reset	P-OT/forward run prohibition	- (Non-Brake Version) +24VS (Brake Version)

Open collector (power supply is 24V, NPN)	Relay type (power supply is 24V, NPN)
	
Open collector (power supply is 24V, PNP)	Relay type (power supply is 24V, PNP)
	

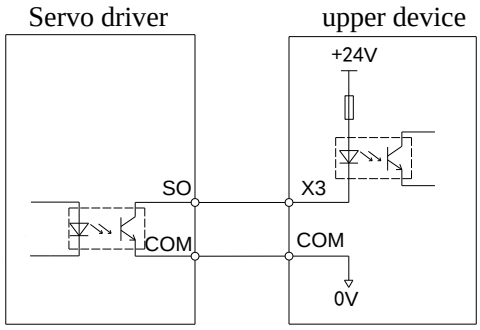
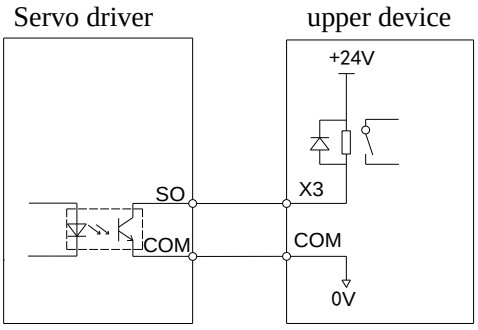
1. The maximum allowable voltage and current ratings of the open-collector output circuit are as follows:
   a) Voltage: DC 30V (max)
   b) Current: DC 50mA (max)
2. The SI terminals support both NPN and PNP wiring; they feature internal low-speed bidirectional optocouplers.
3. There are four low-speed SI inputs, with a response time of ≤ 2ms.

3.2.2.3 SO output signal

Type	Output terminal	Function
Digital output	SO1~SO3	Multifunctional output terminal

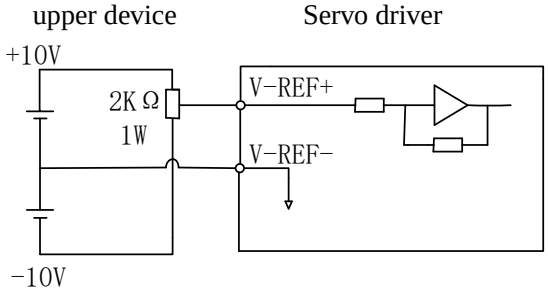
Defaulted assignment of output terminals

Terminal	SO1	SO2	SO3~SO8
Function	COIN/positioning completion	ALM/alarm	Not distribute

Optocoupler type	Relay type
	

- It cannot be directly used as a brake power supply; an external relay is required.
- The maximum allowable voltage and current ratings of the open-collector output circuit are as follows:
  Voltage: DC 30V (max)
  Current: DC 50mA (max)
  All SO terminals have a maximum DC current of 50mA and support 24VDC (with a maximum voltage not exceeding 30VDC). Since the current required by the brake is relatively large, please use an intermediate relay when controlling the brake motor via SO terminals.

3.2.2.4 Analog Input Circuit (only supported by DF3E-1540)

Analog Input


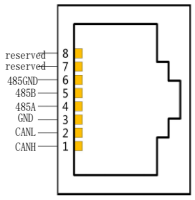
The analog signal serves as the speed command. The input impedance is as follows:

- Speed command input: approx. 13KΩ
- The maximum allowable voltage of the input signal is ±10V. Do not apply a voltage exceeding ±10V.

Analog control is only supported by DF3E-1540, and only one channel of analog speed control is available. Twisted-shielded cables must be used for analog signals, and the shielding layer should be connected to a clean external ground to reduce noise interference.

3.3 Communication Port Description

■ CN0 Port Communication



Pin Number	Pin Definition	Pin Number	Pin Definition
1	CANH	5	485-B
2	CANL	6	485GND
3	GND	Others	Reserved
4	485-A		

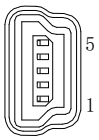
The default communication parameters for CANopen: Baud rate 500kbps.

The station number can be freely assigned, and it is set via P7-00:

Parameter No.	Function	Factory Setting	Setting Range	Modification	Activation
P7-00	Station Number Setting	1	1~100	Servo bb	Immediate

The wiring method for the CN0 port is "bottom-in, top-out" (wires enter through the bottom port and exit through the top port).

■ RS-232 Port Communication



5-Pin Trapezoidal Interface on the Driver Body Side

Pin Number	Name	Description
1	TXD	RS232 Transmit End
2	RXD	RS232 Receive End
3	GND	RS232 Signal Ground

Caution：Please use the dedicated cable provided by Xinje for communication.

The default communication parameters of RS232 are as follows: baud rate 19200bps; 8 data bits; 1 stop bit; even parity.

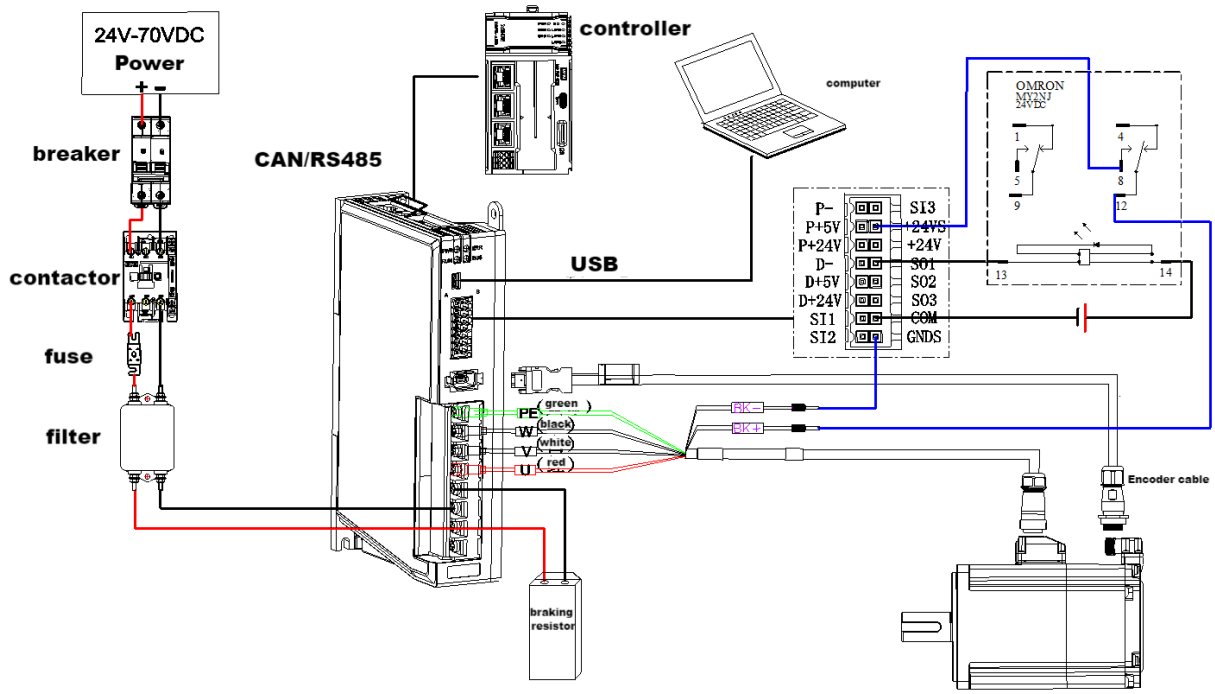
The internal hardware supports a maximum frequency of no more than 250kHz and does not support hot swapping.

The Modbus station number settings are as follows:

Parameter No.	Function	Factory Setting	Setting Range	Modification	Activation
P7-10	Modbus Station Number Setting	1	1~100	Servo bb	Immediate

It supports the standard Modbus RTU protocol and is used as a Modbus RTU slave axis device.

3.4 System wiring diagram



The above diagram uses DF3E-0720Z as an example for introduction; for other models, please refer to the terminal definitions corresponding to their specific model.

4 Operation of servo system

4.1 Control mode selection and switching

4.1.1 Control mode selection

Servo can combine two control modes and switch between them. By switching freely between mode 1 and mode 2 through the / C-SEL signal, more complex control requirements can be satisfied.

User parameter		Control mode	Reference
P0-00 submode	0	Common mode	-
	1 (default)	Fieldbus mode	4.6
P0-01 submode	1 (default)	Torque control (internal setting)	4.5.1
	3	Speed control (internal setting)	4.4.2
	5	Position control (internal position instruction)	4.3.3
	6	Position control (external pulse instruction)	4.3.2
	7	Speed control (Pulse frequency command)	4.4.3
P0-02 submode	1 (default)	Torque control (internal setting)	4.5.1
	3	Speed control (internal setting)	4.4.2
	5	Position control (internal position instruction)	4.3.3
	6	Position control (external pulse instruction)	4.3.2
	7	Speed control (Pulse frequency command)	4.4.3

- **Bus Mode**

The motor operation is controlled via bus commands to meet customer requirements. The master line and slave lines operate with real-time data transmission, and perform data collection and control on the underlying devices under their responsibility.

- **General Mode**

Position control is to input the pulse train command into the servo unit and move it to the target position. The position instruction can be given by the combination of external pulse input, the total number of internal position instructions and speed limit. The position is controlled by the number of input pulses, and the speed is controlled by the frequency of input pulses. It is mainly used in the occasions requiring positioning control, such as manipulator, grinder, engraving machine, CNC machine, etc.

Speed control is to control the speed of machinery by speed command. The servo driver can control the mechanical speed quickly and accurately by the speed command given by digital, analog voltage or communication.

Torque control is to control the output torque of motor by torque command. Torque command can be given by digital, analog voltage or communication. The current of servo motor is linear with torque, so the control of current can realize the control of torque. The torque control mode is mainly used in the devices with strict requirements on the stress of materials, such as some tension control occasions such as winding and unwinding devices. The torque setting value should ensure that the stress of materials is not affected by the change of winding radius.

The bus mode is to control the motor operation through the bus command to meet the needs of customers. The main line and the slave line run real-time, data transmission, and data acquisition and control of the

underlying equipment.

4.1.2 Control mode switching

Control mode switching means that the working mode of servo driver can be switched between mode 1 and mode 2 through external input signal /C-SEL during normal operation of servo.

■ **Related parameter**

Parameter	Name	Default setting	Suitable mode	Meaning	Change	Effective
P5-30	/C-SEL	n.0000	All	To switch the control mode	Anytime	At once
Parameter range n.0000-0014, can be distributed to other input terminal through P5-30. If the control mode needs to be switched through SI2 input signal, P5-30 can be set to n.0002/0012. Refer to section 3.2.2.2 for hardware wiring details.						

Parameter setting	Signal/C-SEL terminal input status	Signal /C-SEL terminal logic	Control mode
P5-30=n.0000	No need external terminal input	Invalid	The control mode set by P0-01 The control modes supported by DF3E are detailed in Chapter 4.1.1
P5-30=n.000□	SI□ terminal no signal input		
P5-30=n.001□	SI□ terminal has low voltage input		
P5-30=n.0010	P5-30 always on	Valid	The control mode set by P0-02 The control modes supported by DF3E are detailed in Chapter 4.1.1
P5-30=n.000□	SI□ terminal has high voltage input		
P5-30=n.001□	SI□ terminal no signal input		

4.2 Basic function setting

4.2.1 Jog operation

Inching operation needs to be completed after the power supply is connected and before the online commissioning operation. Its purpose is to ensure that the servo system can operate normally without abnormal vibration, abnormal sound and other problems. Inching operation can be carried out by panel group F parameters or our upper computer debugging software xinje servo tuner.

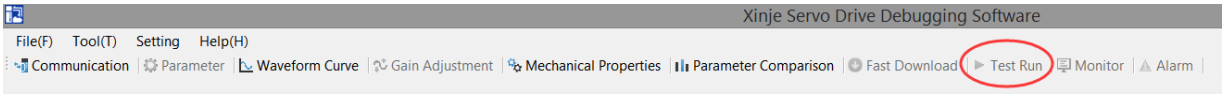
Inching operation can be divided into two modes: inching operation and trial operation. Inching operation is closed-loop control, trial operation is open-loop control, and general steps are trial operation first, and then inching operation. Both operations can take effect only when the servo is not enabled.

■ Related parameter

parameter	Meaning	Default setting	Unit	Range	Modify	Take effect
P3-18	JOG speed	100	1rpm	0～1000	Servo bb	At once

P3-18 is the speed for closed-loop inching operation, which only takes effect in two inching modes, and the rest normal control modes are invalid.

Jog operation through XinjeServo Tuner software:



Click test run button in the menu to show below interface:

The interface is mainly divided into 5 setting modules:
① Jog Speed (P3-18): Determines the operating speed of the motor in the Jog mode.
② Jog Mode: Closed-loop jog operation.
③ Test Run Mode: Open-loop jog operation.
④ Enable: Enables the jog mode.
⑤ Forward/Reverse: Makes the motor run forward or reverse.

The steps of inching through Xinje servo tuner

Open the servo host computer software XinjeServo Tuner, set the jog speed value of P3-18, select the [Test Run]/[Jog] button, click [Enable], and then realize the jog forward and reverse operation function through the forward and reverse buttons on the interface.

4.2.2 Servo enable setting

The servo enable signal effectively represents that the servo motor is powered on. When the servo enable signal is invalid, the motor cannot operate without power. The enabling mode can be controlled by external terminal signal or upper computer communication.

■ **Related parameter**

parameter	Name	Setting	Meaning	Change	Effective
P0-03	Enable mode	0	Not enable	Servo bb	At once
		1	I/O enable /S-ON		
		2	Software enable (F1-05 or enabled by software)		
		3(default)	Bus Enable		

parameter	Name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-20	/S-ON	n.0001	All	servo enable signal	Anytime	At once

1、Forced enabling

When P0-03=2, the forced enabling of F1-05 can take effect, and the forced enabling fails after power on again.
F1-05 can write 1 to hex address 0x2105 through ModbusRTU protocol communication or set to 1 through the panel.

2、Power on enable

Parameter setting P0-03 = 1 (default), P5-20 = n.0010
This setting mode can make the servo system in the enabling state as soon as it is powered on, without external terminal control, and the servo enabling state will remain when it is powered on again.

3、External SI terminal control enable

When P0-03 is set to 1, the external terminal enable control is effective.
Parameter setting P0-03 = 1 (default), P5-20 = n.000□/n.001□.
□ is the SI terminal number, for example, P5-20 is n.0001 (default), that is, SI1 terminal control enable.

Prerequisite	Parameter setting status	signal/S-ON terminal input status	signal/S-ON terminal logic	Servo status
P0-03=1	P5-20=n.000□	SI□ terminal NC signal input	Invalid	Enable LED not light, servo not enable
	P5-20=n.001□	SI□ terminal NO signal input		
	P5-20=n.000□	SI□ terminal NC signal input	Valid	Enable LED light, servo enable
	P5-20=n.001□	SI□ terminal NO signal input		

4、Bus Enable

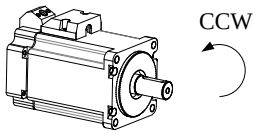
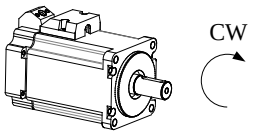
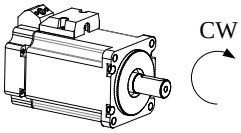
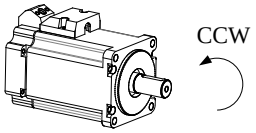
When P0-03 is set to 3, it is applicable to the enable function of the CANopen bus host computer.

4.2.3 Rotation direction switching

■ **Related parameter**

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P0-05	Definition of rotation direction 0- positive mode 1- negative mode	0	-	0~1	Servo bb	Power on again

The user can change the rotation direction of servo motor through parameter P0-05. It is specified that the "forward rotation" of the motor is "counter clockwise rotation" and "reverse rotation" is "clockwise rotation". (all view from the motor axis)

Mode	Forward running	Reverse running	P0-05 setting
Standard setting CCW is forward run			P0-05=0
Reverse mode CW is forward run			P0-05=1

4.2.4 Stop mode

Servo shutdown can be divided into inertia shutdown and deceleration shutdown according to the shutdown mode. The following explains the servo shutdown mode.

Shutdown mode	Inertia stop	Deceleration stop
Stopping principle	The servo driver is not enabled, the servo motor is not powered, and free deceleration to 0. The deceleration time is affected by mechanical inertia, equipment friction, etc.	The servo driver outputs the reverse braking torque, and the motor decelerates rapidly to 0.
Stopping features	Advantages: smooth deceleration, small mechanical impact, small mechanical impact Disadvantage: slow deceleration process	Advantages: short deceleration time Disadvantages: mechanical impact

According to different scenarios of servo shutdown, it can be divided into servo off shutdown, alarm shutdown and over travel shutdown.

1、Servo OFF and alarm shutdown

■ **Related parameter**

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P0-30	Stop timeout	20000	1ms	0～65535	Servo bb	At once
P0-27	Servo OFF stop mode	0	-	0/2	Servo bb	At once
P0-29	Alarm stop mode	2	-	0/2	Servo bb	At once

Parameter	Value	Meaning
P0-27	0	Free run stop, remain in free run state after stopping
	2	Deceleration brake stop, remain in free run state after stopping

P0-29	Enable attribute alarm off	
	0/2	Free run stop, remain in free run state after stopping
	Enable attribute alarm on	
	0	Free run stop, remain in free run state after stopping
	2	Deceleration brake stop, remain in free run state after stopping

Note:

1) Servo Disable Enable Stop Mode (P0-27)

- When P0-27 = 0, if the servo is turned OFF, the motor starts to stop freely without an alarm;
- When P0-27 = 2, if the servo is turned OFF, the motor starts to stop by decelerating until the speed is less than 50 rpm, then switches to free stop. At the same time, the servo will time the deceleration stop phase. If the timing exceeds P0-30 during the deceleration stop process and the motor speed has not dropped below 50 rpm, alarm E-262 will be triggered;

2) Servo Alarm Stop Mode (P0-29)

① Alarm with Disable Attribute

When P0-29 = 0/2, if a servo alarm occurs, the motor starts to stop freely;

② Alarm without Disable Attribute

- When P0-29 = 0, if a servo alarm occurs, the motor starts to stop freely;
- When P0-29 = 2, if a servo alarm occurs, the motor starts to stop by decelerating until the speed is less than 50 rpm, then switches to free stop. At the same time, the servo will time the deceleration stop phase. If the timing exceeds P0-30 during the deceleration process, the servo will directly switch to free stop. At this time, since the servo is in an alarm state, alarm E-262 will not be triggered regardless of the value of P0-29. After stopping, it remains in a free-running state;

3) If the SO terminal of the servo drive is assigned the brake function, the motor will stop in deceleration mode regardless of whether P0-27/P0-29 = 0 or 2.

4) Setting the servo drive to P0-27/29 = 1/3/4/5 is meaningless, and the motor will stop in free stop mode in all cases.

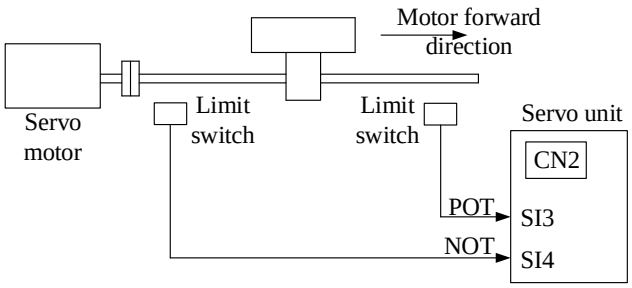
2、Stop mode in case of over travel

The overtravel prevention function of servo unit refers to the safety function that the servo motor is forced to stop by inputting the signal of limit switch when the movable part of the machine exceeds the designed safe moving range.

■ Related parameter

parameter	Meaning	Default setting	Unit	Setting range	Modify	Effective
P0-28	Servo override stop mode	2	-	0~3	Servo bb	At once
P0-30	Stop timeout	20000	1ms	0~65535	Servo bb	At once
P3-32	Braking torque	300	1%	0~1000	Anytime	At once
P5-22	Forward run prohibition /P-OT	n.0003	-	-	Anytime	At once
P5-23	Reverse run prohibition /N-OT	n.0000	-	-	Anytime	At once

Be sure to connect the limit switch as shown in the figure below.



Rotary applications such as round tables and conveyors do not need the function of overrun prevention. At this time, there is no need to connect the overrun prevention with input signals.

Parameter setting	Signal /POT, terminal input status	Overtravel signal (/POT, /NOT) terminal logic
P5-22/P5-23=n.0000	No need to connect external input	invalid
P5-22/P5-23=n.000□	SI□ terminal has no signal input	
P5-22/P5-23=n.001□	SI□ terminal has signal input	
P5-22/P5-23=n.0010	No need to connect external input	valid
P5-22/P5-23=n.000□	SI□ terminal has signal input	
P5-22/P5-23=n.001□	SI□ terminal has no signal input	

1) （P0-00=0）

Parameter settings in forward limit signal /POT and reverse limit signal /NOT can not be set to the same terminal input at the same time.

Direction	Meet the limit	Operation status
Forward run	positive limit is valid	POT, set the servo overrun stop mode as P0-28
	negative limit is valid	Alarm E-261
Reverse run	positive limit is valid	Alarm E-261
	negative limit is valid	NOT, set the servo overrun stop mode as P0-28

Parameter	Value	Meaning
P0-28	0	The deceleration stops 1, the overrun direction moment is 0 after stopping, and receiving instructions.
	1	Inertia stops, after stopping, overrun direction moment is 0, receiving instructions.
	2	The deceleration stops 2, after stopping, the overrun direction does not receive instructions.
	3	Alarm (E-260)

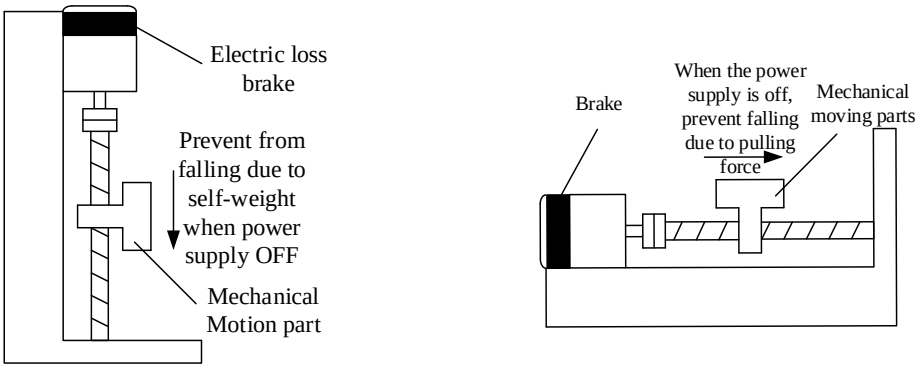
- When P0-28 = 0/2, the motor starts to decelerate and stop after receiving the overtravel stop signal, and the braking torque is P3-32 when decelerating stop, and the stop timeout also plays a role in the overtravel process.
- During position control, when the motor is stopped by over travel signal, there may be position deviation pulse. To clear the position deviation pulse, the clear signal /CLR must be input. If the servo unit still receives pulses, they will accumulate until the servo unit gives an alarm.
- During torque control, the SO terminal of servo drive has the function of holding brake, which can't be distributed through the overtravel signal terminals P5-22 and P5-23.
- Servo driver SO terminal is assigned with holding brake function, P0-28 is automatically set to 2.

2) CAN Bus Mode Parking Method（P0-00=1）

Parameter	Value	Significance
P0-28	0/2/3	Does not detect any servo limit
	1	Alarm (E-260) (effective for version 3791 and later)

4.2.5 Power-off brake

When the servo motor controls the vertical load, the purpose of using the “brake servo motor” is: when the power supply of the system is placed in the "OFF", the movable part will not move under the action of gravity.

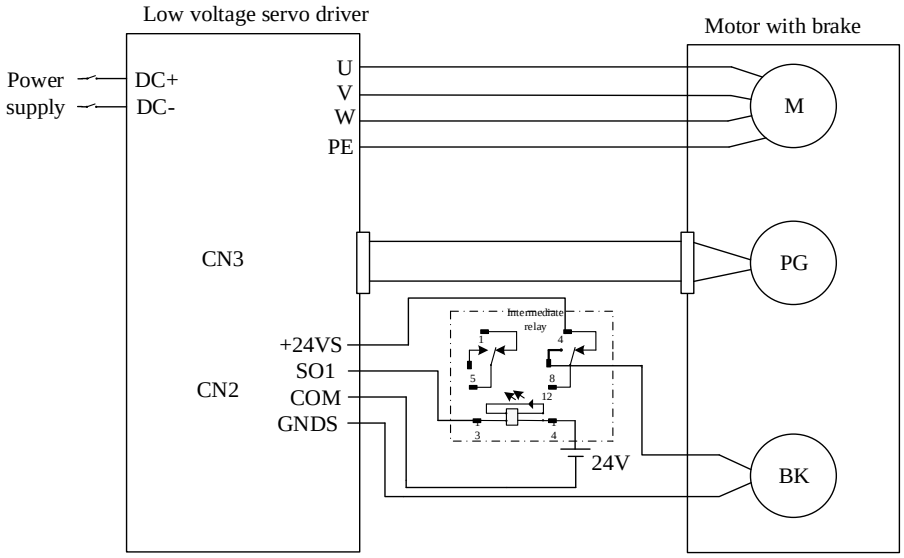


Note: The brake built in the servo motor is a fixed special brake without excitation. It can not be used for dynamic braking. Please use it only when the servo motor is in a stop state.

Parameter	Meaning	Default setting	Unit	Setting range	Modify	Effective
P5-44	Brake interlock/BK	n.0000	-	n.0000~n.0014	Anytime	At once
P5-07	Servo OFF delay time	500	1ms	0~65535	Servo bb	At once
P5-08	Brake command output speed	30	rpm	20~10000	Servo bb	At once
P5-09	Brake command wait time	500	ms	0~65535	Servo bb	At once

(1) Hardware wiring

The ON/OFF circuit of the brake is composed of the sequential output signal of the servo unit "/BK" and "brake power supply". A typical connection example is shown below.



- The excitation voltage of the power-off brake is 24V.
- If the holding brake current is more than 50mA, please transfer it through the relay to prevent terminal burnt out due to excessive current.

(2) Software parameter settings

For the servo motor with holding brake, it is necessary to configure one SO terminal of servo driver as holding brake output /BK function, and determine the effective logic of SO terminal, that is, parameter P5-44 needs to be set.

Parameter setting	Servo status	Signal/BK terminal output logic	Servo motor status
P5-44=n.000□	Servo disable	Invalid	Holding brake power off, motor in position locked state
	Servo enable	Valid	The holding brake power is connected and the motor is in rotatable state
P5-44=n.001□	Servo enable	Invalid	Holding brake power off, motor in position locked state
	Servo disable	Valid	The holding brake power is connected and the motor is in rotatable state

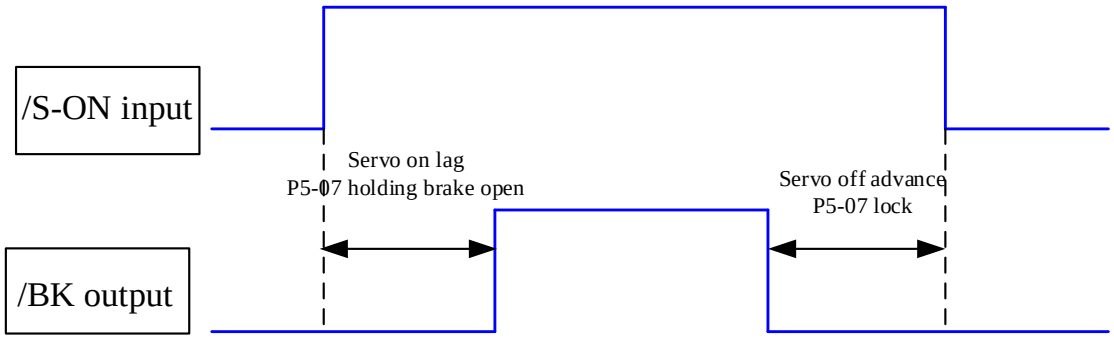
- When SO terminal is used to control holding brake, when servo enable is on, holding brake power is on and motor is in rotatable state;
- If the motor fails to rotate during the debugging of the new machine, please confirm whether the holding brake is open.

(3) Time sequence of holding brake control

① Holding brake sequence in normal state

Due to the action delay time of the brake, the machine moves slightly under the action of gravity. Use P5-07 parameter to adjust the time, so that the holding brake can be opened or closed in advance.

When setting the servo motor with brake, the output signal "/ BK" of control brake and the time of servo SON signal on/off action are shown in the figure below. That is to say, before the /BK signal outputting and brake is opened, the servo motor has entered the power on enabling state; after the / BK not outputting and brake is locked, the servo motor will turn off the power on state.



the setting made here is the time when TGON of rotation detection is invalid when the motor is stopped.

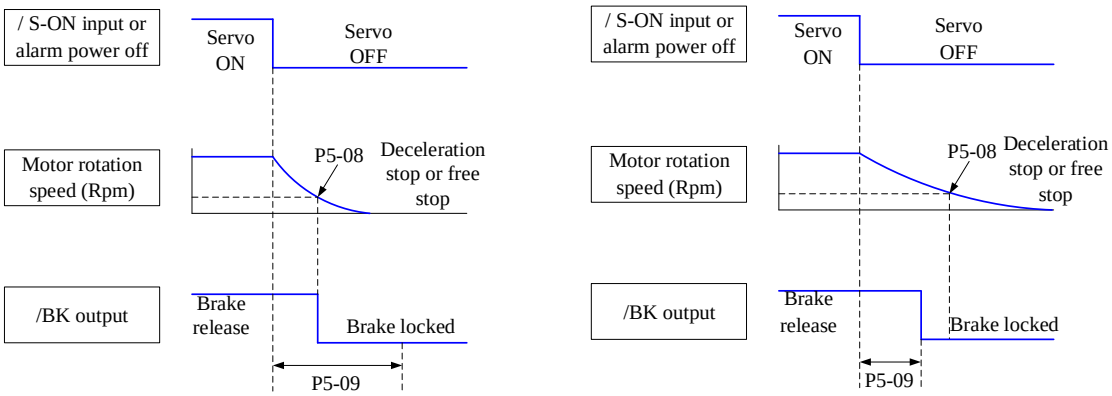
② Abnormal state holding brake timing

When the alarm/power supply interruption occurs, the motor quickly becomes non energized. During the time from gravity or inertia to the brake action, the machine will move. To avoid this,

The conditions for the /BK signal to turn from on to off in the motor rotation are as follows (any of the two conditions will take effect):

1) After the servo is off, the motor speed is below the set value of P5-08;
2) After the servo is off, when the set time of P5-09 is exceeded.

The sequence diagram is as follows:



Since the brake of the servo motor is designed for position holding, it must be enabled at the right time when the motor stops. While observing the action of the machine, adjust the user parameters.

4.3 Position control

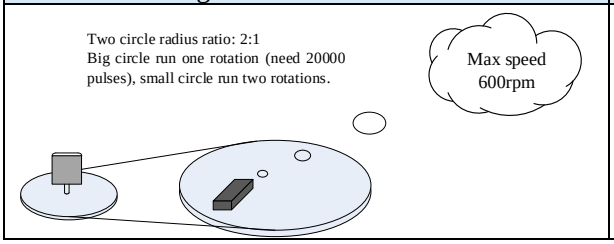
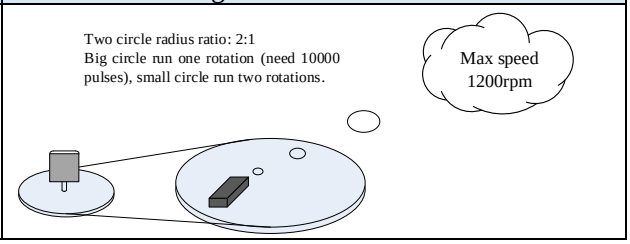
4.3.1 General position control

4.3.1.1 Electronic gear ratio

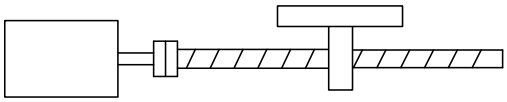
1. Overview

The so-called "electronic gear" function has two main applications:

(1) Determine the number of command pulses needed to rotate the motor for one revolution to ensure that the motor speed can reach the required speed.
As an example of 17-bit encoder motor, the pulse frequency sent by the upper computer PLC is 200kHz:

Pulses per revolution set to 10000 Electronic gear ratio set to 131072:10000	Set pulses per revolution to 5000 Electronic gear ratio set to 131072:5000
	

(2) In the precise positioning, the physical unit length corresponding to 1 command pulse is set for calculation.
For example: the object moves 1um per command pulse. The command pulses of load rotating one circle = 6mm / 1um = 6000. In the case of deceleration ratio is 1:1, set pulse per rotation P0-11=6000, P0-12=0. Then if the PLC outputs 6000 pulses, the object will move 6mm.



Encoder: 131072（17-bit） ball screw pitch: 6mm

Do not change the electronic gear ratio	Change the electronic gear ratio
Without changing the ratio of the electronic gear to the motor, the rotating cycle is 131072 pulses (P 0-11=0, P 0-12=0). If the workpiece is moved 6 mm in one turn, the number of pulses needed is 131072. If the workpiece is moved 10 mm, it will need 10/6*131072=218453.333 pulses. When the decimal number is omitted, the error will occur.	By changing the electronic gear ratio, the motor needs 6000 pulses to rotate one circle. If the workpiece moves 6 mm in one turn, the number of pulses needed is 6 000. If the workpiece is moved 10 mm, it needs 10/6*6000 = 10000 pulses. When the pulse is sent, the decimal number will not be produced and the error will not be produced.

■ **Related parameters**

Parameter	Meaning	Default setting	Unit	Setting range	Modify	Effective
P0-11	Pulse numbers per rotation *1	0	pul	0～9999	Servo bb	At once
P0-12	Pulse numbers per rotation *10000	1	pul	0～9999	Servo bb	At once
P0-13	Electronic gear ratio (numerator)	1	-	0～65535	Servo bb	At once
P0-14	Electronic gear ratio (denominator)	1	-	0～65535	Servo bb	At once
P0-92	Group 2 Electronic gear ratio (numerator) low bit*1	1	-	1～9999	Servo bb	At once
P0-93	Group 2 Electronic gear ratio	0	-	1～65535	Servo bb	At once

Parameter	Meaning	Default setting	Unit	Setting range	Modify	Effective
	(numerator) high bit*10000					
P0-94	Group 2 Electronic gear ratio (denominator) low bit*1	1	-	1～9999	Servo bb	At once
P0-95	Group 2 Electronic gear ratio (denominator) high bit*10000	0	-	1～65535	Servo bb	At once

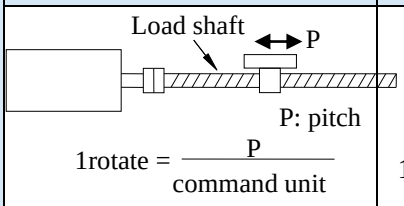
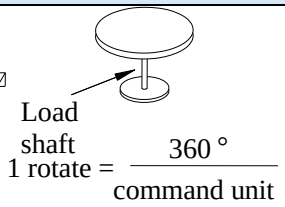
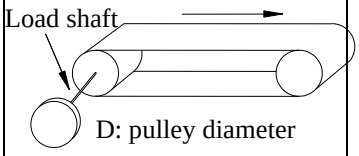
- P0-11~P0-14 is all about the parameters of electronic gear ratio, P0-11, P0-12 is group 1, P0-13, P0-14 is group 2, but the priority of P0-11 and P0-12 is higher than that of P0-13 and P0-14. Only when P0-11 and P0-12 are set to 0, the ratio of electronic gear P0-13 and P0-14 will take effect.
- When P0-11, P0-12, P0-13 and P0-14 are all set to 0, P0-92, P0-93, P0-94 and P0-95 will take effect.
- In BB state, the numerator and denominator of the electronic gear ratio can be modified arbitrarily.In RUN state:
  For versions V3770 and later, the numerator of the electronic gear ratio (P0-13) can only be modified in real time under the pulse position control mode; modification is not allowed in other control modes when the drive is enabled.
  For versions prior to V3770, modification of the electronic gear ratio (P0-13, P0-14) is prohibited in any mode when the drive is enabled.

2. Calculation of Pulse Number per Rotation and Electronic Gear Ratio

Steps	Content	Description	
1	Confirm the machine specification	Confirm the deceleration ratio n:m(servo motor turns m rotations while load turns n rotations), ball screw distance, pulley diameter.	
2	Confirm the encoder pulse	Confirm the servo motor encoder accuracy	
3	Set the command unit	Determine the actual distance or angle corresponding to 1 pulse of the controller	
4	Calculate the command pulses the load shaft rotates 1 circle	Based on the determined command unit, calculate the command quantity n of the load shaft rotating for 1 revolution.	
5	Calculate the pulses per rotation M	Command pulse number of motor shaft rotating for 1 turn M=N/(m/n).	
6	Set the pulses per rotation (P0-11/P0-12) or Electronic gear ratio (P0-13/P0-14)/(P0-92~95)	P0-11=M%10000 P0-12=M/10000	priority ↓
		$\frac{P0-13}{P0-14}=\frac{encoder\ resolution}{M}=\frac{encoder\ resolution\times m}{N\times n}$	

- In step 6, the effective priority of the number of pulses per revolution is higher than the electronic gear ratio, that is, when P0-11 ~ P0-12 are all 0, P0-13 ~ P0-14 will take effect. In special cases, if the number of pulses per revolution is calculated as a decimal, the electronic gear ratio should be considered.
- When P0-13 and P0-14 exceed the setting range, please divide the electronic gear ratio into numerator and denominator. If the ratio still exceeds the parameter setting range, please use the second gear ratio P0-92~P0-95. Only when P0-11~14 = 0, the second gear ratio takes effect.
- The resolution of DS5 series servo motor encoder is 131072 (17 bits) and 8388608 (23 bits).
- The command unit does not represent the machining accuracy. On the basis of the mechanical accuracy, refining the instruction unit quantity can improve the positioning accuracy of the servo system. For example, when using the lead screw, the mechanical accuracy can reach 0.01mm, so the unit equivalent of 0.01mm is more accurate than the unit equivalent of 0.1mm.

3. Example of setting the electronic gear ratio

steps	Name	Ball screw	Round table	Belt + pulley
				
1	Confirm mechanical specifications	Ball screw pitch: 6mm Machine deceleration ratio: 1:1	1-circle rotate angle: 360° Deceleration ratio: 1:3	Pulley diameter: 100mm Deceleration ratio: 1:2
2	Confirm the number of encoder pulses	Encoder resolution 131072	Encoder resolution 131072	Encoder resolution 131072
3	Confirm the command unit	1 command unit: 0.001mm	1 command unit: 0.1°	1 command unit: 0.02mm
4	Calculate the command amount of 1 revolution of load shaft	6mm/0.001mm=6000	360/0.1=3600	314mm/0.02mm=15700
5	Calculate the pulse number m of one revolution of motor shaft	M =6000/(1/1)=6000	M=3600/(3/1)=1200	M=15700/(2/1)=7850
6	Set pulses per rotation P0-11/P0-12	P0-11=6000 P0-12=0	P0-11=1200 P0-12=0	P0-11=7850 P0-12=0
	Set electronic gear ratio (P0-13/P0-14)/(P0-92~95)	P0-13=131072 P0-14=6000 After reduction P0-13=8192 P0-14=375	P0-13=131072 P0-14=1200 After reduction P0-13=8192 P0-14=75	P0-13=131072 P0-14=7850 After reduction P0-13=65536 P0-14=3925 Conver to second gear ratio P0-92=5536 P0-93=6 P0-94=3925 P0-95=0

4.3.1.2 Positioning completion signal (/COIN, /COIN_HD)

In position control, the signal indicating the completion of servo motor positioning is used when the command controller needs to complete positioning confirmation.

■ **Related parameters**

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P5-00	Positioning completion width	11	Command unit	0～65535	Anytime	At once
P5-01	Positioning completion detection	0	-	0～3	Anytime	At once

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
	mode					
P5-02	Positioning completion hold time	0	ms	0～65535	Anytime	At once

Parameter	Signal name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-37	/COIN-HD	n.0000	All	Positioning complete holding	Anytime	At once
P5-38	/COIN	n.0000	All	Positioning complete output	Anytime	At once
Refer to section 3.2.2 for hardware wiring details. If it is necessary to output signal from SO2, P5-37 and P5-38 are set to n.0002/0012. Note that an SO terminal can only be used as a signal function.						

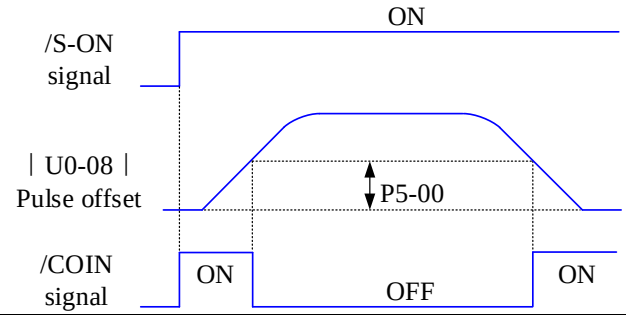
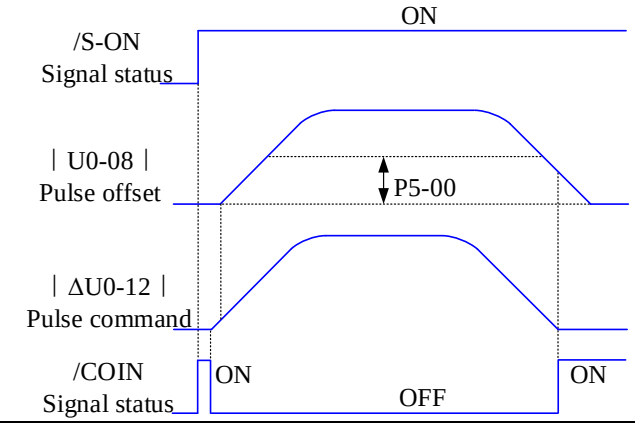
1. Conditions for positioning completion signal output

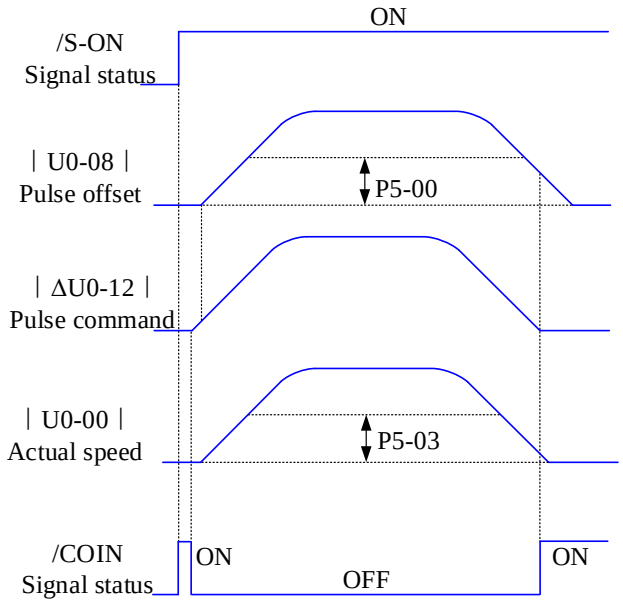
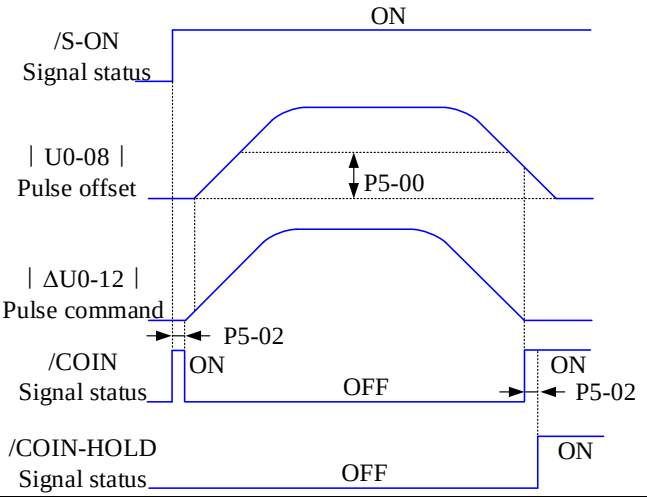
(1) /COIN-HD signal output conditions

When the positioning completion detection mode P5-01 is set to 3, the positioning completion holding /COIN-HD signal can be output. When the /COIN signal holds P5-02 time, the COIN-HD signal can be output.

(2) /COIN signal output conditions

According to the positioning completion detection mode set in P5-01, output positioning completion /COIN signal. The following is the precondition for positioning output and the output diagram.

P5-01 setting	Content	Diagram
0	If the absolute deviation is below P5-00, the COIN signal will be output.	
1	After the instruction is finished, the deviation is below P5-00 and COIN signal is output.	

P5-01 setting	Content	Diagram
2	When the instruction ends and the motor speed is under the rotation detection speed (P5-03) and the absolute deviation is less than P5-00, the COIN signal is output.	
3	At the end of instruction, the absolute deviation value under P5-00, it outputs COIN signal. If COIN maintains P5-02 time, COIN-HOLD signal is output.	

2. Description of positioning completion width

(1) The positioning completion width P5-00 changes proportionally due to the change of electronic gear ratio, and the factory default is 11 command units.

The following table is an example:

Number of command pulses required for one revolution of motor	positioning completion width P5-00
10000 (default)	11 (default)
20000	22
5000	6
3000	4
2000	3

The positioning completion width P5-00 changes proportionally with the number of command pulses required for one revolution of the motor.
The output of the positioning completion signal depends on the positioning completion width. The smaller the width is, the later the positioning completion signal output is, but the signal output does not affect the actual operation state of the motor.

(2) The positioning completion width can also be set separately, and its change will not affect the number of command pulses required for one revolution of the motor.

(3)The values of Positioning Completion Width (P5-00) and Post-Homing Filter Time (Bus) (P7-21) can affect the homing deviation value of the CANopen bus. If the value of 6063h is not 0 after the bus homing is completed, the deviation value of 6063h can be reduced by decreasing P5-00 or increasing P7-21.

4.3.1.3 Positioning near signal (/NEAR)

The servo motor is located near the positioning completion signal, so that the equipment can prepare the next action in advance.

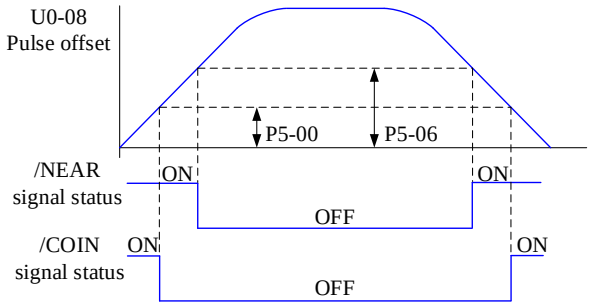
■ **Related parameters**

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P5-06	Near signal output width	50	Command unit	0～65535	Anytime	At once

Parameter	Signal name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-46	/NEAR	n.0000	All	Positioning near	Anytime	At once
Refer to section 3.2.2 for hardware wiring details. If it is necessary to output from the SO2, P5-46 can be set to n.0002/0012.						

1. Positioning approach signal output conditions

When the pulse deviation value U0-08 of the servo driver is lower than the P5-06 setting value, the positioning approach signal (/NEAR) is output.



2. Description of approach signal output

(1) The approach signal output width P5-06 changes proportionally due to the change of the electronic gear ratio. The default setting is 50 command units.
The following table is an example:

Number of command pulses required for one revolution of motor	Near signal output width P5-06
10000 (default)	50 (default)
20000	100
5000	25
3000	15
2000	10

The near signal output width P5-06 changes proportionally with the number of command pulses required for one revolution of the motor.
The output of the positioning completion signal depends on the positioning completion width. The smaller the width is, the later the positioning completion signal output is, but the signal output does not affect the actual operation state of the motor.

(2) The approach signal output width can also be set independently, and its change will not affect the number of command pulses required for one revolution of the motor.

(3) Please set this parameter larger than the positioning completion width.

4.3.1.4 Command pulse prohibition (/INHIBIT)

Position command prohibition, including internal and external position commands. Stop the function of command pulse input during position control. When the /INHIBIT signal is on, the pulse command is no longer counted.

■ **Related parameters**

Parameter	Signal name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-32	/INHIBIT	n.0000	All	Command pulse prohibition	Anytime	At once
Parameter range n.0000-001A, assigned to other input terminals by parameter P5-32. If it is necessary to input from SI2, P5-32 can be set to n.0002/0012. Refer to section 3.2.2 for hardware wiring details.						

1. /INHIBIT terminal effectiveness description

Parameter setting status	Signal/INHIBIT terminal input status	Signal/INHIBIT terminal logic
P5-32=n.0000	No external terminal input	Invalid
P5-32=n.000□	SI□ terminal has no signal input	
P5-32=n.001□	SI□ terminal has signal input	

Parameter setting status	Signal/INHIBIT terminal input status	Signal/INHIBIT terminal logic
P5-32=n.0010	No external terminal input	Valid
P5-32=n.000□	SI□ terminal has signal input	
P5-32=n.001□	SI□ terminal has no signal input	

2. The influence of /INHIBIT terminal signal on the running state of motor

Control mode	Motor operation status	
	/INHIBIT terminal logic valid	/INHIBIT terminal logic invalid
5- internal position control	Pause current segment	/INHIBIT signal is from ON→OFF, continue running from pause point.
6- external pulse position control	Pause pulse command reception	/INHIBIT signal is from ON→OFF, continue running from the pulse command received after OFF.

4.3.1.5 Offset clear（/CLR）

Position offset=(position command – position feedback)(encoder unit)
The position deviation clearing function means that the driver can clear the position deviation when the servo is off or the /CLR signal is received.

■ **Related parameters**

Parameter	Signal name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-34	/CLR	n.0000	All	Pulse deviation clear	Anytime	At once
Parameter range n.0000-001A, assigned to other input terminals by parameter P5-34. If it is necessary to input signal from SI2, P5-34 can be set to n.0002/0012. Refer to section 3.2.2 for hardware wiring details.						

1. /CLR signal effectiveness

parameter setting status	Signal /CLR terminal input status	Signal /CLR terminal logic
P5-34=n.0000	No external terminal input	Invalid
P5-34=n.000□	SI□ terminal has no signal input	
P5-34=n.001□	SI□ terminal has signal input	
P5-34=n.0010	No external terminal input	Valid
P5-34=n.000□	SI□ terminal has signal input	
P5-34=n.001□	SI□ terminal has no signal input	

2. /CLR signal explanation

Send the pulse to the servo, execute the /CLR input signal, the servo will lock the current pulse counts, then update the current position of the encoder to the position feedback in the control, at the same time, clear the intermediate quantity of the position loop, speed loop and current loop.
/CLR signal is triggered by edge.

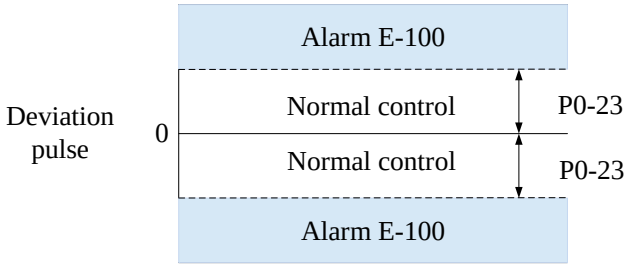
4.3.1.6 Position pulse deviation

Pulse deviation value refers to the difference between command pulse of command controller (such as PLC) and feedback pulse of servo unit in position mode. Its unit is 1 command unit, which is related to the command unit determined by electronic gear ratio.
In position control, when the deviation pulse exceeds a certain limit value, an alarm will occur, and this threshold value is the deviation pulse limit value.

■ **Related parameters**

parameter	Meaning	Default setting	Unit	Range	Change	Effective
P0-23	pulse deviation limit value	2000	0.01 turns	0～65535	Anytime	At once

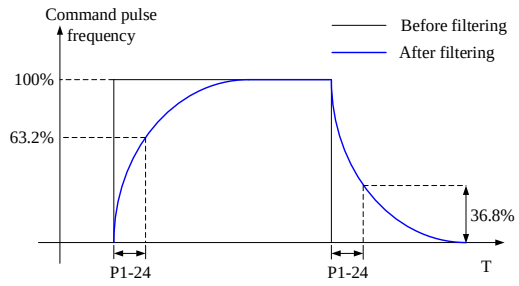
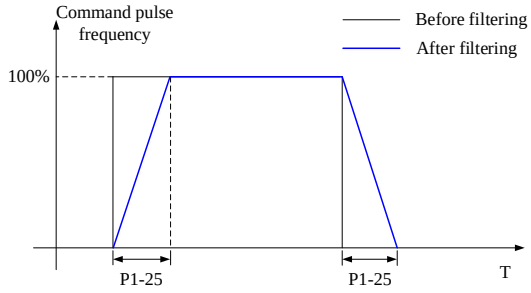
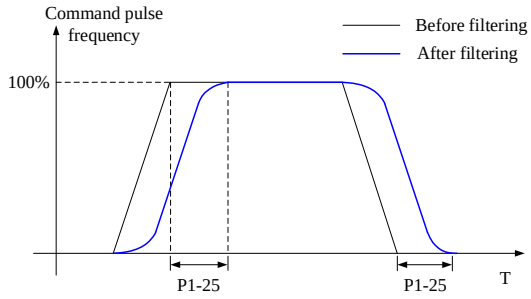
When the deviation pulse limit is 0, the deviation pulse will not be detected.



4.3.1.7 Position command filter

■ **Related parameters**

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P1-24	Position command acceleration and deceleration filtering time	0	0.1ms	0～65535	Servo OFF	At once
P1-25	Position command smoothing filtering time	0	0.1ms	0～65535	Servo OFF	At once

Position command acceleration and deceleration filter	Position command smoothing filter
	
	

4.3.1.8 Reference origin

1. Find the reference origin

To find out the physical origin of working table and make it as the coordinates origin of point position control. Users can select finding reference origin at forward or reverse side.

Function setting:

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P4-00 n.xx□x	Origin function	0	-	0～1	Servo OFF	At once
Note: This function is applicable to position mode 5 and 6; when this parameter is set to 0, the function of Origin-finding is invalid; when it is set to n.001x, the function of Origin-finding can be used.						

Signal setting:

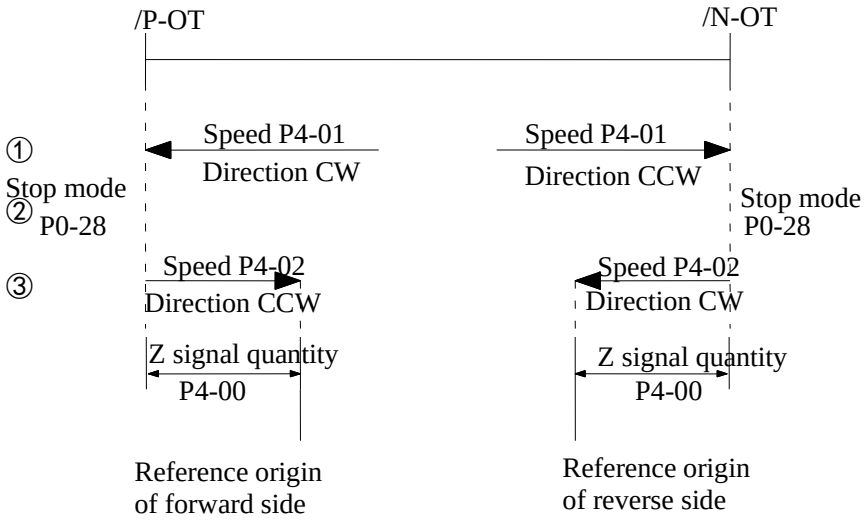
Parameter	Signal	Default	Meaning	Modify
P5-28	/SPD-A	n.0000	Mode 3: internal speed selecting signal Mode 5: find origin point at forward direction	Range: 0000-0014, distributes to input terminal through P5-28. When it set to 0001, it means input signal from SI1.
P5-29	/SPD-B	n.0000	Mode 3: internal speed selecting signal Mode 5: find origin point at reverse direction	Range: 0000-0014, distributes to input terminal through P5-29. When it set to 0001, it means input signal from SI1.

Related parameter setting:

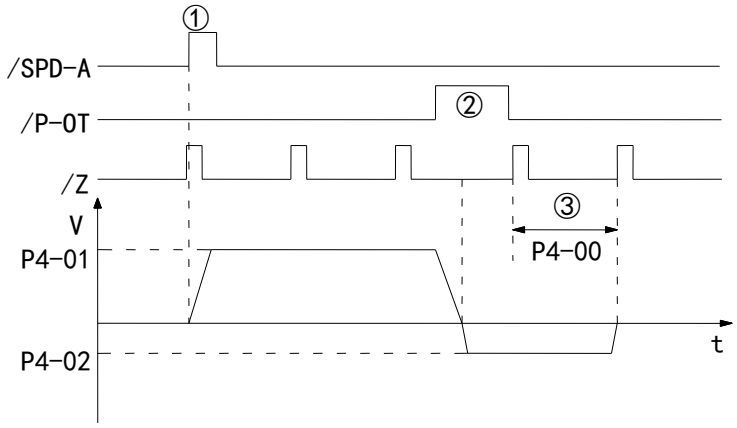
Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P4-00 n.xxx□	Z phase signal numbers	2	-	0～f	Servo OFF	At once
P4-01	The speed hitting the proximity switch	600	rpm	0～65535	Servo OFF	At once
P4-02	The speed leaving	100	rpm	0～65535	Servo OFF	At once

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
	the proximity switch					
Note: the origin searching function is only for single turn absolute motor (the origin searching function can also be supported for multi turn absolute motor P0-79 =1).						

Find reference origin diagram:



Sequential diagram of finding reference origin on forward side:



Steps:

(1) Install limit switch at forward and reverse side. At the rising edge of /SPD-A, motor runs forward at the speed of P4-01 to find the reference origin on forward side.
(2) After the working table hit the limit switch, the motor stop as the mode set by parameter P0-28
(3) Motor leaves the limit switch at the speed of P4-02. After the working table left the limit switch, the motor run at the Z phase signal position of No.n optical encoder. This position is considered as the coordinates origin, n is decided by parameter P4-00.

4.3.1.9 New Homing Function (supported in version 3770 and later)

1、Function Description

The **homing function** refers to the function in the **position control mode** where, when the servo is enabled (ON) and the homing function is triggered, the servo motor will search for the origin and complete positioning. The found origin can be used as the position reference point for subsequent position control. During the homing operation, other position commands (including the homing signal triggered again) are blocked. After the homing is completed, the servo drive can respond to other position commands. Once homing is finished, the servo drive outputs a **homing completion signal**. The upper controller can

confirm that homing has been completed upon receiving this signal.

2、Parameter Settings

Parameter	Name	Setting Range	Meaning	Setting Time	Effective Time	Factory Default
P9-11.0	Number of Z Phases	0~F	P9-11.0=0: Do not search for Z phase P9-11.0=1: Search for 1 Z phase P9-11.0=2: Search for 2 Z phasesAnd so on	Servo OFF	Servo ON	0
P9-11.1	Homing Trigger Mode	0~2	P9-11.1=0: Prohibit triggering homing P9-11.1=1: Trigger homing via SI terminal (P5-28) P9-11.1=2: In this homing mode, homing starts immediately after the first enable upon power-on	Servo OFF	Servo ON	0
P9-11.2	Homing Mode	0~7	P9-11.2=0: Homing Mode 0 P9-11.2=1: Homing Mode 1 P9-11.2=2: Homing Mode 2And so on	Servo OFF	Servo ON	0
P9-11.3	Deceleration Method When Over-Travel Signal is Detected	0, 1	P9-11.3=0: Decelerate according to the acceleration/deceleration time set in P9-14 P9-11.3=1: Decelerate immediately	Servo OFF	Servo ON	

P9-11.0 can be set to a maximum of 15 Z phases. When P9-11.1=0, it means the homing function cannot be used—this parameter can be regarded as the enable bit for the homing function. Homing modes 1, 3, 5, and 7 correspond to the reverse operations of homing modes 0, 2, 4, and 6, respectively.

Parameter	Name	Setting Range	Unit	Meaning	Setting Time	Effective Time	Factory Default
P9-12	Homing High Speed	0~3000	rpm	High homing speed; used to search for the deceleration point and perform mechanical offset.	Servo OFF	Servo ON	200
P9-13	Homing Low Speed	0~1000	rpm	Low homing speed; used to search for the origin. The motor will not stop when decelerating to this speed.	Servo OFF	Servo ON	20

Parameter	Name	Setting Range	Unit	Meaning	Setting Time	Effective Time	Factory Default
P9-14	Homing Acceleration/Deceleration Time	0~1000	ms	Refers to the time required to accelerate from 0 to 1000rpm. If the homing process exceeds the time set by this parameter, an alarm will be triggered. When P9-15=0, the homing timeout alarm is disabled.	Servo OFF	Servo ON	1000
P9-15	Maximum Homing Time	0~12000	10ms	If the homing process exceeds the time set by this parameter, an alarm will be triggered. When P9-15=0, the homing timeout alarm is disabled.	Servo OFF	Servo ON	0
P9-16	Touch-Type Homing Rotation Speed Threshold	0~1000	rpm	This parameter only applies to homing modes 6 and 7.	Servo OFF	Servo ON	2
P9-17	Touch-Type Homing Torque Threshold	0~300%	%	This parameter only applies to homing modes 6 and 7. The percentage is based on the rated torque.	Servo OFF	Servo ON	100%
P9-18	Touch-Type Homing Stop Time Threshold	10~1500	ms	This parameter only applies to homing modes 6 and 7.	Servo OFF	Servo ON	500
P9-19	Fixed-Pulse Count (Low Byte)	-9999~9999	-	Low byte of the fixed-pulse count.	Servo OFF	Servo ON	0
P9-20	Fixed-Pulse Count (High Byte)	-9999~9999	-	High byte of the fixed-pulse count.	Servo OFF	Servo ON	0
P9-21	New/Old Homing Function Selection	0, 1	-	P9-21=0: Old homing functionP9-21=1: New homing function	Servo OFF	Power Cycle	0

Parameter	Name	Setting Range	Unit	Meaning	Setting Time	Effective Time	Factory Default
P9-22	New Homing End Filter Time	50~10000	ms	When homing is about to end, this filter time is required to wait for the motor to stop completely before exiting homing mode. The homing completion signal is output only after this time.	Servo OFF	Servo ON	500

The actual mechanical offset = P9-19 + P9-20 × 10000. P9-19 and P9-20 must have the same sign (both positive or both negative). This mechanical offset is the absolute position of the servo after homing is completed.

Parameter	Name	Setting Range	Meaning	Setting Time	Effective Time	Factory Default
P5-22	Positive Over-Travel Signal (POT)	0000~FFFF	Positive limit signal in homing mode	Runtime Setting	Immediate Effect	0
P5-23	Negative Over-Travel Signal (NOT)	0000~FFFF	Negative limit signal in homing mode	Runtime Setting	Immediate Effect	0
P5-54	Homing Completion Signal	0000~FFFF	Outputs the homing completion signal after all homing actions and states are finished. Even if other operations are performed after homing ends, the homing completion signal will not disappear. When homing is restarted, the homing completion signal will be cleared again.	Runtime Setting	Immediate Effect	0
P5-64	Origin Switch Signal	0000~FFFF	Origin switch signal is required during the homing process	Runtime Setting	Immediate Effect	0
P5-28	SI Terminal Triggers Homing	0000~FFFF	When P9-11.1=1, after P5-28 is assigned to the SI terminal, the terminal can be used to trigger homing.	Runtime Setting	Immediate Effect	0

3. New Homing Mode Selection

To use the new homing function:

First, set **P9-21=1**, then configure the over-travel switches (POT/NOT) and the origin switch. If using the mechanical offset (with P9-19 and P9-20 set), ensure the offset is within the stroke range to prevent mechanical equipment damage during the homing process!

The **number of Z phases (P9-11.0)** and **mechanical offset (P9-19, P9-20)** can take effect simultaneously:

- If both the number of Z phases (P9-11.0) and mechanical offset (P9-19, P9-20) are non-zero: The servo will first search for the set number of Z phases (P9-11.0), then execute the mechanical offset (P9-19, P9-20).

- If the number of Z phases (P9-11.0) is 0 but the mechanical offset (P9-19, P9-20) is non-zero: The servo will skip Z phase searching and directly execute the mechanical offset (P9-19, P9-20).

- If the number of Z phases is non-zero but the mechanical offset is 0: The servo will search for Z phases (P9-11.0) without executing the mechanical offset.

There are a total of 8 homing modes as follows:

1. **Forward homing**: Deceleration point = origin switch; Origin = origin switch or motor Z signal (P9-11.2=0)

2. **Reverse homing**: Deceleration point = origin switch; Origin = origin switch or motor Z signal (P9-11.2=1)

3. **Forward homing**: Deceleration point & Origin = motor Z signal (P9-11.2=2)

4. **Reverse homing**: Deceleration point & Origin = motor Z signal (P9-11.2=3)

5. **Forward homing**: Deceleration point = positive over-travel switch; Origin = positive over-travel switch or motor Z signal (P9-11.2=4)

6. **Reverse homing**: Deceleration point = negative over-travel switch; Origin = negative over-travel switch or motor Z signal (P9-11.2=5)

7. **Forward homing**: Deceleration point = mechanical limit position; Origin = mechanical limit position or motor Z signal (P9-11.2=6)

8. **Reverse homing**: Deceleration point = mechanical limit position; Origin = mechanical limit position or motor Z signal (P9-11.2=7)

Below is a detailed breakdown of each homing mode:

（1）Homing Mode 0 – Forward Homing, Deceleration Point = Origin Switch, Origin = Origin Switch or Motor Z Signal (P9-11.2=0)

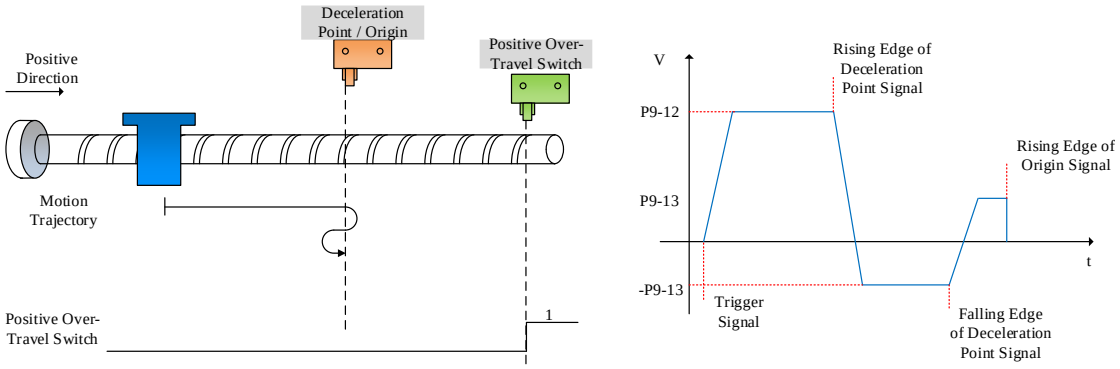
To use this mode, the POT (Positive Over-Travel Switch), NOT (Negative Over-Travel Switch), and origin switch must be connected.

1、The origin switch (deceleration point) signal is invalid (signal terminal assigned by P5-64, 0 = invalid, 1 = valid) when the motor starts to move, and the positive over-travel switch (POT) (P5-22) is not triggered throughout the process.

The servo motor first searches for the deceleration point (origin) signal at high speed in the positive direction according to the value set by P9-12 (homing high-speed velocity). Upon detecting the rising edge of the deceleration point (origin) signal, it gradually decelerates to -P9-13 (homing low-speed velocity) as per the setting of P9-14 (homing acceleration/deceleration time). After that, the servo motor reverses direction and searches for the falling edge of the deceleration point (origin) signal at the low speed specified by -P9-13 (homing low-speed velocity). When the falling edge of the deceleration point (origin) signal is detected, it reverses direction again and continues to search for the rising edge of the deceleration point (origin) signal at the low speed of P9-13 (homing low-speed velocity). The subsequent homing actions are divided into four scenarios:

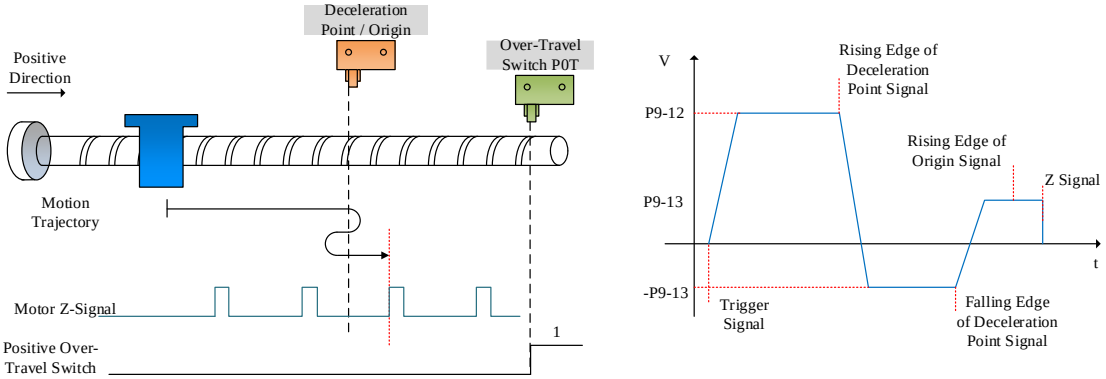
① Number of Z-phases (P9-11.0) = 0 and mechanical offset (P9-19, P9-20) = 0:During the operation of

continuously searching for the rising edge of the deceleration point (origin) signal at P9-13 (homing low-speed velocity), the motor stops immediately upon detecting the rising edge of the deceleration point (origin) signal.



② Number of Z-phases (P9-11.0) = 0 and mechanical offset (P9-19, P9-20) ≠ 0:During the operation of continuously searching for the rising edge of the deceleration point (origin) signal at P9-13 (homing low-speed velocity), the motor stops immediately upon detecting the rising edge of the deceleration point (origin) signal. After the motor comes to a complete stop, it will run a fixed number of pulses (P9-19, P9-20) at the speed set by P9-13 (homing low-speed velocity) according to the set number of mechanical offset pulses and direction (which can be positive or negative), and then the motor stops.

③ Number of Z-phases (P9-11.0) = 1 and mechanical offset (P9-19, P9-20) = 0:During the operation of continuously searching for the rising edge of the deceleration point (origin) signal at P9-13 (homing low-speed velocity), the motor continues to run after detecting the rising edge of the deceleration point (origin) signal, and then stops immediately upon finding the first Z-phase signal.



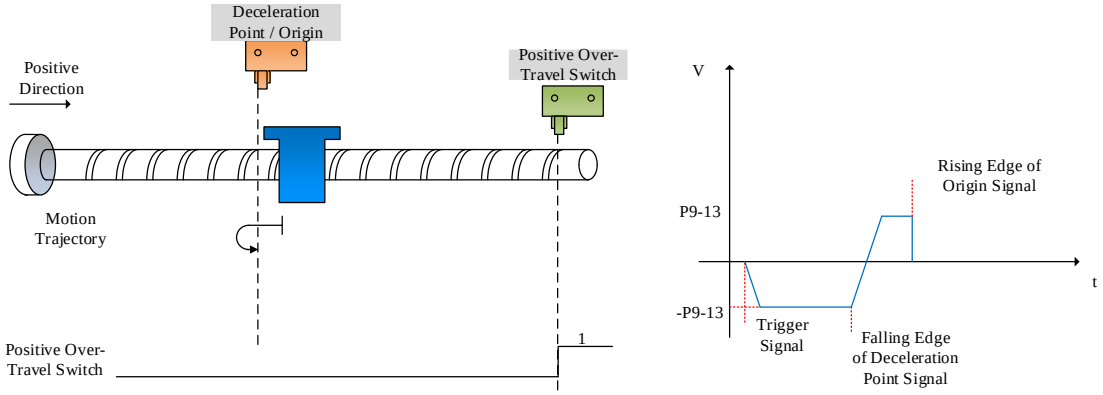
④ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset values (P9-19, P9-20) are non-zero:
During the low-speed operation of searching for the rising edge of the deceleration point (origin) signal at the speed specified by P9-13 (homing low-speed velocity), the motor will continue to run after detecting the rising edge of the deceleration point (origin) signal, and then stop immediately upon finding the first Z-phase signal. After the motor comes to a complete stop, it will further move a fixed number of pulses (set in P9-19 and P9-20) at the velocity defined in P9-13 (homing low-speed velocity) in the specified direction (either positive or negative), and then shut down.

2、When the origin switch (deceleration point) signal is valid at the start of motor movement (signal terminal assigned by P5-64, 0 = invalid, 1 = valid), and the positive overtravel switch (P5-22) is not triggered throughout the process:

The servo motor directly searches for the falling edge of the deceleration point (origin) signal in reverse at the low speed specified by P9-13 (homing low-speed velocity). Upon detecting the falling edge of the deceleration point (origin) signal, it reverses direction (i.e., moves forward), and continues to search for the rising edge of the deceleration point (origin) signal at the low speed set in P9-13 (homing low-speed velocity). The subsequent homing actions are divided into four cases:

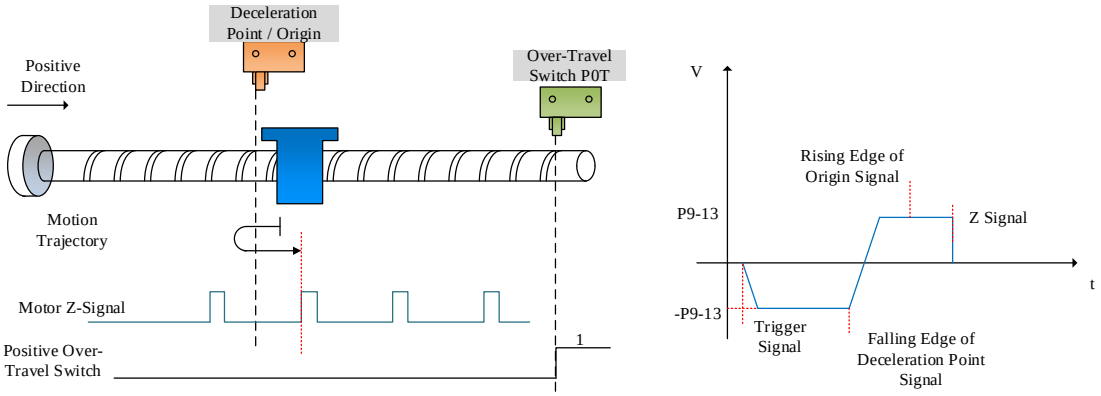
① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset values (P9-19, P9-20) are

0:During forward acceleration or forward uniform-speed operation, the motor will stop immediately upon detecting the rising edge of the deceleration point (origin) signal.



② When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset values (P9-19, P9-20) are non-zero:During forward acceleration or forward uniform-speed operation, the motor will stop immediately upon detecting the rising edge of the origin signal. After the motor comes to a complete stop, it will move a fixed number of pulses (set in P9-19 and P9-20) at the velocity defined in P9-13 (homing low-speed velocity) in the specified direction (either positive or negative), and then shut down.

③ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset values (P9-19, P9-20) are 0:During forward acceleration or forward uniform-speed operation, the motor will continue to run after detecting the rising edge of the origin signal, and then stop immediately upon finding the first Z-phase signal.



④ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset values (P9-19, P9-20) are non-zero:During forward acceleration or forward uniform-speed operation, the motor will continue to run after detecting the rising edge of the origin signal, and then stop immediately upon finding the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (set in P9-19 and P9-20) at the speed specified by P9-13 (homing low-speed velocity) in the preset direction (either positive or negative), and then shut down.

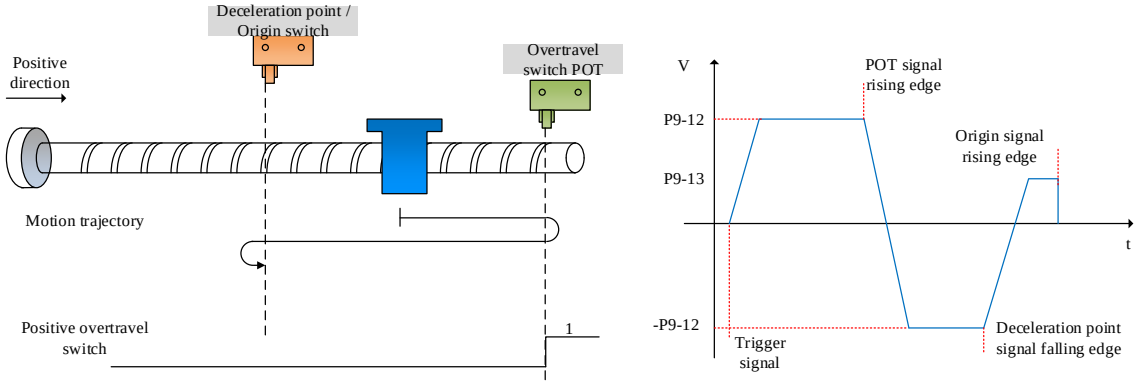
3) When the origin switch (deceleration point) signal is invalid at the start of motor movement (signal terminal assigned by P5-64, 0 = invalid, 1 = valid), and the positive overtravel switch (P5-22) is triggered to be valid during the process:

The servo motor first searches for the deceleration point signal at high speed in the forward direction at the value set by P9-12 (homing high-speed velocity). After triggering the positive overtravel switch (POT) (P5-22), the driver immediately searches for the falling edge of the deceleration point (origin) signal at high speed in the reverse direction at -P9-12 (homing high-speed velocity) according to the value set by P9-14 (homing acceleration/deceleration time). Upon detecting the falling edge of the deceleration point (origin) signal, it decelerates and reverses direction (i.e., resumes forward direction) as per the value set by P9-14 (homing acceleration/deceleration time). The servo motor then searches for the rising edge of the deceleration point (origin) signal at low speed in the forward direction at P9-13 (homing low-speed velocity). The subsequent homing actions are divided into four cases:

① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset values (P9-19, P9-20)

are 0:

During forward acceleration or forward uniform-speed operation, the motor will stop immediately upon detecting the rising edge of the origin signal.

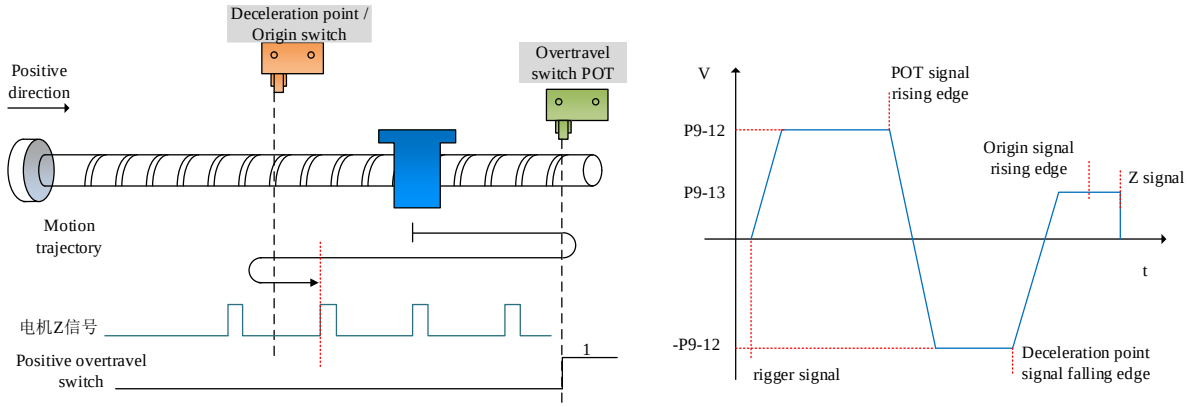


② When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset values (P9-19, P9-20) are non-zero:

During forward acceleration or forward uniform-speed operation, the motor will stop immediately upon detecting the rising edge of the deceleration point (origin) signal. After the motor comes to a complete stop, it will move a fixed number of pulses (set in P9-19 and P9-20) at the speed specified by P9-13 (homing low-speed velocity) in the preset direction (either positive or negative), and then shut down.

③ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset values (P9-19, P9-20) are 0:

During forward acceleration or forward uniform-speed operation, the motor will continue to run after detecting the rising edge of the deceleration point (origin) signal, and then stop immediately upon finding the first Z-phase signal.



④ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is not 0:

During forward acceleration or forward uniform-speed operation, the motor continues to run after detecting the rising edge of the deceleration point (origin) signal. It then stops immediately upon finding the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

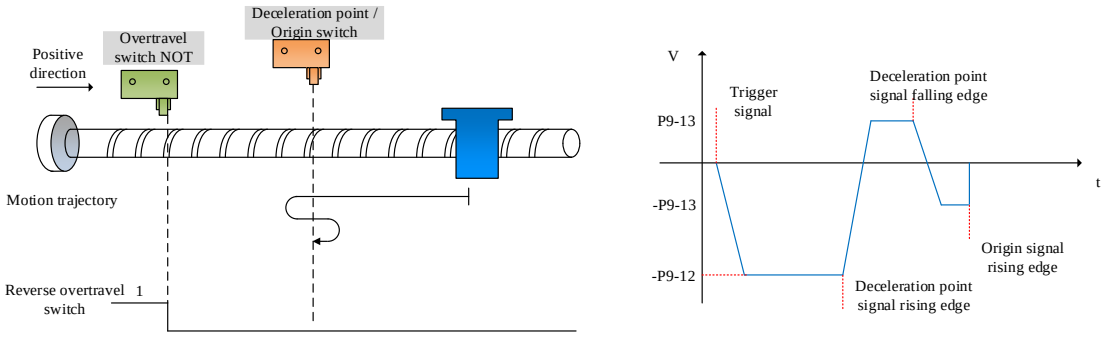
(2)Homing Mode 1 - Reverse Homing, where the deceleration point is the origin switch and the origin is either the origin switch or the motor Z-signal (P9-11.2=1)

To use this mode, it is necessary to connect the POT, NOT, and origin switch.

1) The origin switch (deceleration point) signal is invalid when the motor starts to move, and the reverse overtravel switch (NOT) (P5-23) is not triggered during the entire process.

The servo motor first searches for the deceleration point signal in the reverse direction at high speed according to the value set in **-P9-12 (homing high-speed)**, until the rising edge of the deceleration point signal is detected. It then gradually accelerates (or decelerates, in line with actual motion logic) to the speed set in **P9-13 (homing low-speed)** as per the parameter **P9-14 (homing acceleration/deceleration time)**. After that, the servo motor searches forward at the low speed specified by P9-13 (homing low-speed) for the falling edge of the deceleration point (origin) signal. When the falling edge of the deceleration point (origin) signal is detected, the motor reverses direction (resumes reverse motion) and continues to search at the low speed of -P9-13 (homing low-speed) for the rising edge of the deceleration point (origin) signal. The subsequent homing actions are divided into four scenarios

① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is 0:During the operation of continuously searching for the rising edge of the deceleration point (origin) signal at the low speed of -P9-13 (homing low-speed), the motor stops immediately upon detecting the rising edge of the deceleration point (origin) signal.

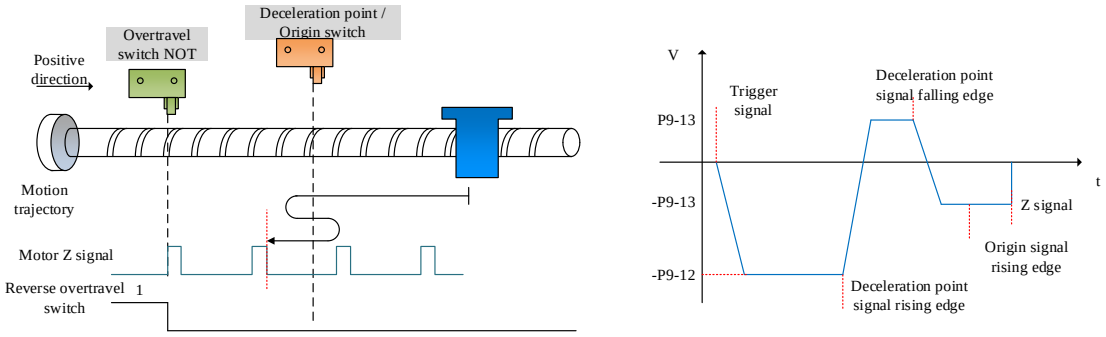


② When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is not 0:

During the operation of continuously searching for the rising edge of the deceleration point (origin) signal at the low speed of **-P9-13 (homing low-speed)**, the motor stops immediately upon detecting the rising edge of the deceleration point (origin) signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

③ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is 0:

During the operation of continuously searching for the rising edge of the deceleration point (origin) signal at the low speed of **-P9-13 (homing low-speed)**, the motor continues to run after detecting the rising edge of the deceleration point (origin) signal, and then stops immediately upon finding the first Z-phase signal.



④ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is not 0:

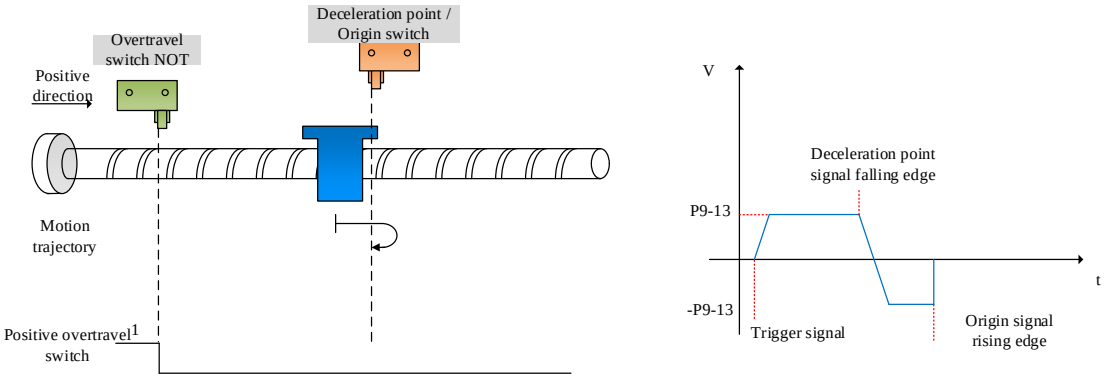
During the operation of continuously searching for the rising edge of the deceleration point (origin) signal at the low speed of -P9-13 (homing low-speed), the motor continues to run after detecting the rising edge of the deceleration point (origin) signal, then stops immediately upon finding the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the

speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

2) The origin switch (deceleration point) signal is valid (for the signal terminal assigned by P5-64; 0 = invalid, 1 = valid) when the motor starts to move, and the reverse overtravel switch (NOT) (P5-23) is not triggered during the entire process.

The servo motor directly searches forward at the low speed specified by P9-13 (homing low-speed) for the falling edge of the deceleration point (origin) signal. When the falling edge of the deceleration point (origin) signal is detected, the motor reverses direction (i.e., moves in the negative direction) and continues to search at the low speed of -P9-13 (homing low-speed) for the rising edge of the deceleration point (origin) signal. The subsequent homing actions are divided into four scenarios:

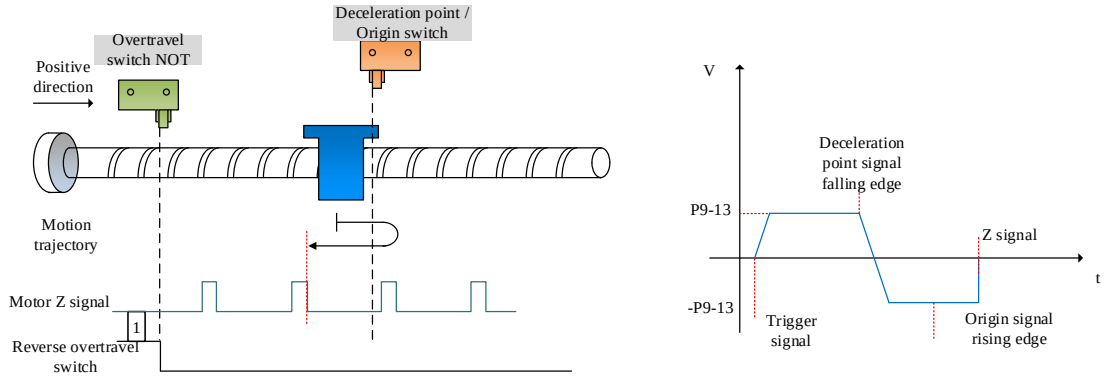
① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is 0:During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge of the origin signal.。



② When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is not 0:

During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge of the origin signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

③ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is 0:During reverse acceleration or reverse uniform-speed operation, the motor continues to run after detecting the rising edge of the deceleration point (origin) signal, and then stops immediately upon finding the first Z-phase signal.



④ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is not 0:

During reverse acceleration or reverse uniform-speed operation, the motor continues to run after detecting

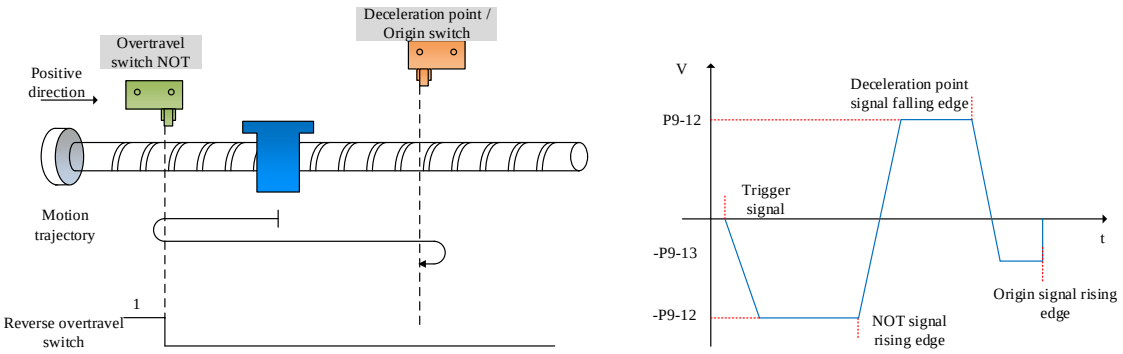
the rising edge of the deceleration point (origin) signal, then stops immediately upon finding the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

3）The origin switch (deceleration point) signal is invalid (for the signal terminal assigned by P5-64; 0 = invalid, 1 = valid) when the motor starts to move, and the reverse overtravel switch (NOT) (P5-23) is triggered and becomes valid during the process.

The servo motor first searches for the deceleration point (origin) signal in the reverse direction at high speed according to the value set in -P9-12 (homing high-speed). When the reverse overtravel switch (NOT) is triggered, the drive decelerates and reverses direction (i.e., moves forward) based on the value set in P9-14 (homing acceleration/deceleration time), and immediately starts searching forward at high speed (per the value of P9-12 (homing high-speed)) for the falling edge of the deceleration point (origin) signal. After detecting the falling edge of the deceleration point (origin) signal, it decelerates and reverses direction again (i.e., moves in reverse) as per the setting of P9-14 (homing acceleration/deceleration time). The servo motor then searches for the rising edge of the deceleration point (origin) signal at low speed in the reverse direction at -P9-13 (homing low-speed). The subsequent homing actions are divided into four scenarios:

① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is 0:

During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge of the origin signal.。

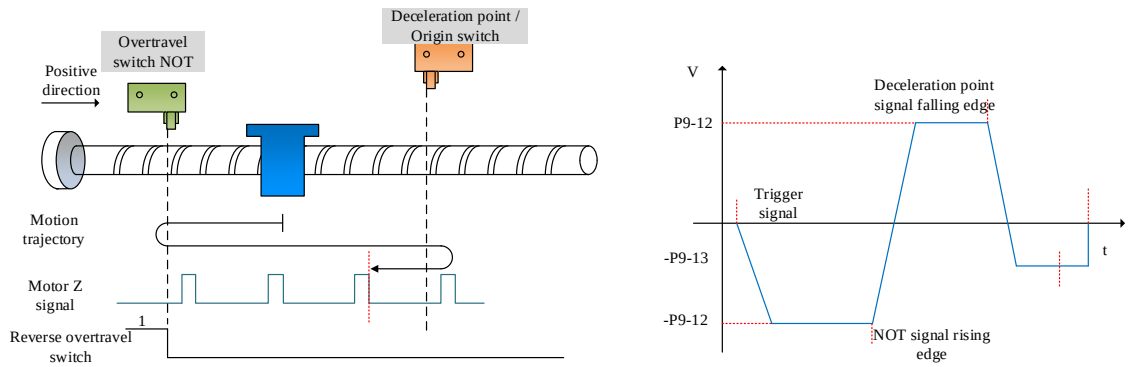


② When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is not 0:

During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge of the deceleration point (origin) signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

③ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is 0:

During reverse acceleration or reverse uniform-speed operation, the motor continues to run after detecting the rising edge of the origin signal, and then stops immediately upon finding the first Z-phase signal.



④ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is not 0:

During reverse acceleration or reverse uniform-speed operation, the motor continues to run after detecting the rising edge of the deceleration point (origin) signal, then stops immediately upon finding the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

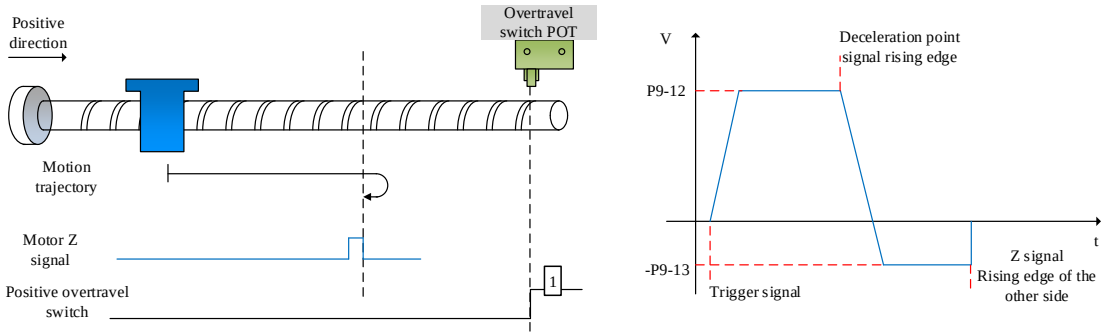
(3)Homing Mode 2 - Forward Homing, where the deceleration point and origin are the motor Z-signal (P9-11.2=2)

In this mode, the number of motor Z-phases is not detected. To use this mode, it is necessary to connect the POT and NOT (switches)

1) When the motor starts to move, the Z-signal is either invalid or valid (for the signal terminal assigned by P5-64; 0 = invalid, 1 = valid), and the forward overtravel switch (POT) is not triggered during the entire process.

The servo motor first searches for the Z-signal forward at high speed according to the value set in P9-12 (homing high-speed). After detecting the rising edge of the Z-signal, it decelerates and reverses direction as per the setting of P9-14 (homing acceleration/deceleration time), then accelerates to -P9-13 (homing low-speed) to search for the Z-signal in reverse at low speed. The subsequent homing actions are divided into two scenarios:

① When the mechanical offset (P9-19, P9-20) is 0:During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge on the other side of the motor Z-signal.



② When the mechanical offset (P9-19, P9-20) is not equal to 0:

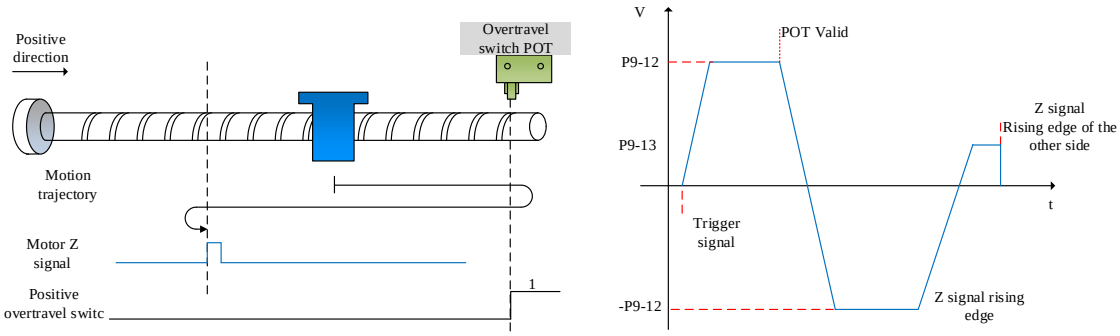
During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge on the other side of the motor Z-signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

2） When the motor starts to move, the Z-signal is either invalid or valid (for the signal terminal assigned by P5-64; 0 = invalid, 1 = valid), and the forward overtravel switch (POT) (P5-22) is triggered during the process.

The servo motor first searches for the Z-signal forward at high speed according to the value set in P9-12 (homing high-speed). After triggering the forward overtravel switch, the drive decelerates and reverses direction based on the setting of P9-14 (homing acceleration/deceleration time), and then searches for the Z-signal in reverse at high speed at -P9-12 (homing high-speed) until the rising edge of the Z-signal is detected. It then gradually decelerates and reverses direction again (i.e., resumes forward motion) as per the value of P9-14 (homing acceleration/deceleration time). The servo motor then searches forward at low speed at P9-13 (homing low-speed) for the rising edge on the other side of the Z-signal. The subsequent homing actions are divided into two scenarios:

①When the mechanical offset (P9-19, P9-20) is 0:During forward acceleration or forward uniform-speed

operation, the motor stops immediately upon detecting the rising edge on the other side of the Z-signal.



② When the mechanical offset (P9-19, P9-20) is not equal to 0:

During forward acceleration or forward uniform-speed operation, the motor stops immediately upon detecting the rising edge on the other side of the motor Z-signal. After the motor comes to a complete stop, it will move a fixed number of pulses at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the set mechanical offset pulse count, and then shut down.

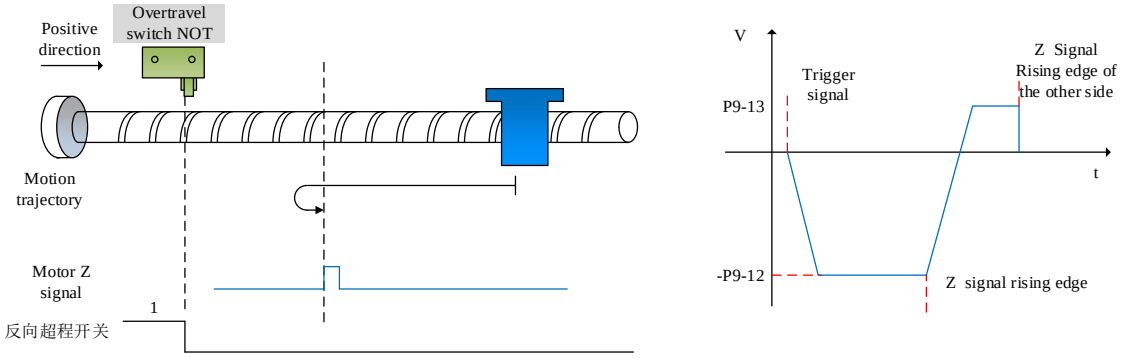
(4) Homing Mode 3 – Reverse Homing, where the deceleration point and origin are the motor Z-signal (P9-11.2=3)

1) In this mode, the number of motor Z-phases is not detected. To use this mode, it is necessary to connect the POT and NOT (switches).

When the motor starts to move, the Z-signal is either invalid or valid (for the signal terminal assigned by P5-64; 0 = invalid, 1 = valid), and the reverse overtravel switch (NOT) is not triggered during the entire process.

The servo motor first searches for the Z-signal in reverse at high speed according to the value set in -P9-12 (homing high-speed). After detecting the rising edge of the Z-signal, it decelerates and reverses direction as per the setting of P9-14 (homing acceleration/deceleration time), then accelerates to P9-13 (homing low-speed) to search for the Z-signal forward at low speed. The subsequent homing actions are divided into two scenarios:

① When the mechanical offset (P9-19, P9-20) is 0:During forward acceleration or forward uniforspeed operation, the motor stops immediately upon detecting the rising edge on the other side of the motor Z-signal.



②When the mechanical offset (P9-19, P9-20) is not equal to 0:

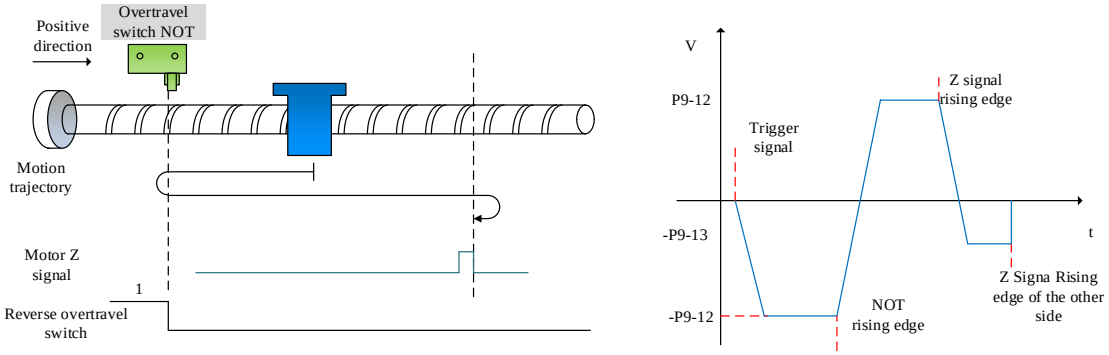
During forward acceleration or forward uniform-speed operation, the motor stops immediately upon detecting the rising edge on the other side of the motor Z-signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in P9-13 (homing low-speed) in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

2)When the motor starts to move, the Z-signal is either invalid or valid (for the signal terminal assigned by **P5-64**; 0 = invalid, 1 = valid), and the reverse overtravel switch (NOT) is triggered during the process.

The servo motor first searches for the Z-signal in reverse at high speed according to the value set in **-P9-12 (homing high-speed)**. After triggering the reverse overtravel switch, the drive decelerates and reverses direction based on the setting of **P9-14**, then searches for the Z-signal forward at high speed at **P9-12 (homing high-speed)** until the rising edge of the Z-signal is detected. It then gradually decelerates and reverses direction again (i.e., resumes reverse motion) as per the value of **P9-14 (homing acceleration/deceleration time)**. The servo motor then searches for the rising edge on the other side of the Z-signal in reverse at low speed at **-P9-13 (homing low-speed)**. The subsequent homing actions are divided into two scenarios:

①When the **mechanical offset (P9-19, P9-20)** is 0:

During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge on the other side of the Z-signal.



② When the **mechanical offset (P9-19, P9-20)** is not equal to 0:

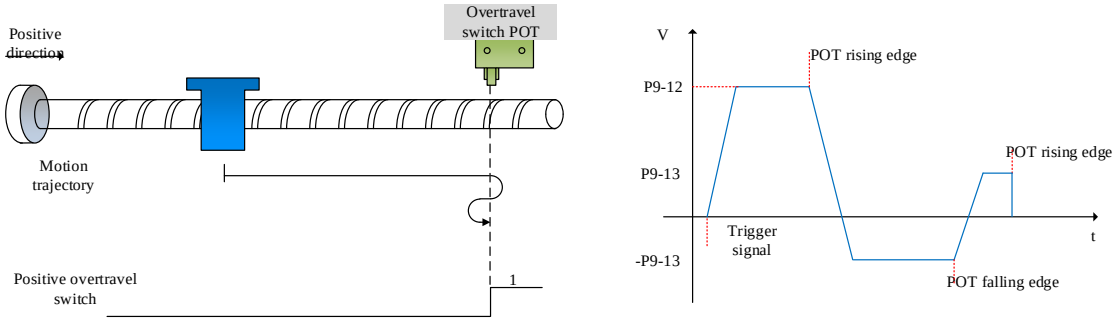
During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge on the other side of the motor Z-signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction (either forward or reverse) defined by the mechanical offset parameters, and then shut down.

(5)Homing Mode 4 - Forward Homing, where the deceleration point and origin are the forward overtravel switch POT (P5-22) (P9-11.2=4)

To use this mode, it is necessary to connect the NOT and POT (switches).

1） When the forward overtravel switch (POT) is invalid when the motor starts to move:The servo motor first searches for the forward overtravel switch forward at high speed according to the value set in P9-12 (homing high-speed). After detecting the rising edge of the forward overtravel switch signal, it gradually decelerates and reverses direction as per the setting of P9-14 (homing acceleration/deceleration time). The servo motor then searches for the falling edge of the forward overtravel switch signal in reverse at low speed as set in -P9-13 (homing low-speed). After detecting the falling edge of the forward overtravel switch signal, the subsequent homing actions are divided into four scenarios:

①When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is 0:The motor decelerates and reverses direction (i.e., resumes forward motion), and searches forward at low speed for the rising edge of the forward overtravel switch signal at the speed set in P9-13 (homing low-speed). During forward acceleration or forward uniform-speed operation, the motor stops immediately upon detecting the rising edge of the forward overtravel switch signal.。

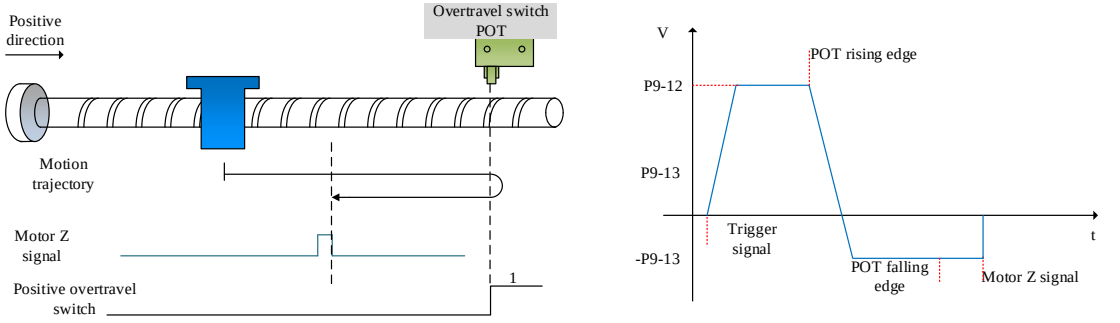


②When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is not 0:

The motor decelerates and reverses direction (i.e., resumes forward motion), and searches forward at low speed for the rising edge of the forward overtravel switch signal at the speed set in P9-13 (homing low-speed). During forward acceleration or forward uniform-speed operation, the motor stops immediately upon detecting the rising edge of the forward overtravel switch signal. After the motor comes to a complete stop, it will move a fixed number of pulses at the speed set in P9-13 (homing low-speed) in the direction defined by the set mechanical offset pulse count (which can only be the reverse direction, i.e., it must move between the origin switch and NOT), and then shut down.

③When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is 0:

The motor continues to run in reverse at low speed as set in -P9-13 (homing low-speed), and then stops immediately upon detecting the rising edge of the first Z-phase signal.



④ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is not 0:

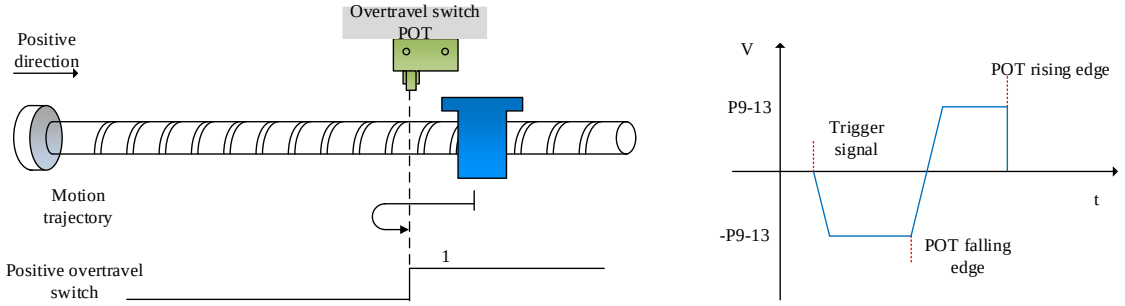
The motor continues to run in reverse at low speed as set in -P9-13 (homing low-speed), and then stops immediately upon detecting the rising edge of the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses at the speed set in P9-13 (homing low-speed) in the direction defined by the set mechanical offset pulse count (which can be either reverse or forward direction, but must move between the origin switch and NOT), and then shut down.

2) When the forward overtravel switch (POT) (**P5-22**) is valid when the motor starts to move:

The servo motor directly searches in reverse at low speed for the falling edge of the forward overtravel switch (POT) signal at the value set in **-P9-13 (homing low-speed)**. After detecting the falling edge of the POT signal, the subsequent homing actions are divided into four scenarios:

① When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is 0:

The motor decelerates and reverses direction (i.e., resumes forward motion), searches forward at low speed for the rising edge of the POT signal at **P9-13 (homing low-speed)**, and stops immediately upon detecting the rising edge of the POT signal during forward acceleration or forward uniform-speed operation.

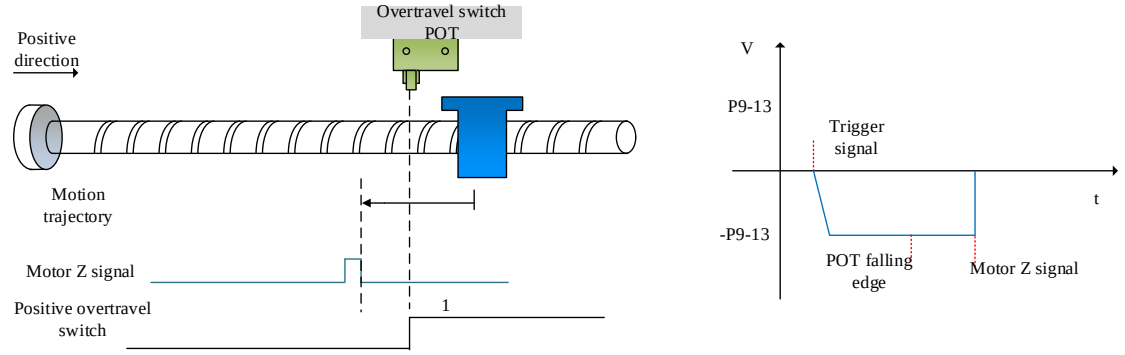


② When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is not 0:

The motor decelerates and reverses direction (i.e., resumes forward motion), searches forward at low speed for the rising edge of the POT signal at **P9-13 (homing low-speed)**. During forward acceleration or forward uniform-speed operation, the motor stops immediately upon detecting the rising edge of the POT signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction defined by the set mechanical offset pulse count (which can only be the reverse direction, i.e., it must move between the origin switch and NOT), and then shut down.

③ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is 0:

The motor continues to run in reverse at low speed as set in **-P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal.



④ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is not 0:

The motor continues to run in reverse at low speed as set in **-P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction defined by the set mechanical offset pulse count (which can be either reverse or forward direction, but must move between the origin switch and NOT), and then shut down.

(6) Homing Mode 5 – Reverse Homing, where the deceleration point and origin are the reverse overtravel switch NOT (P5-23) (P9-11.2=5)

To use this mode, it is necessary to connect the POT and NOT (switches).

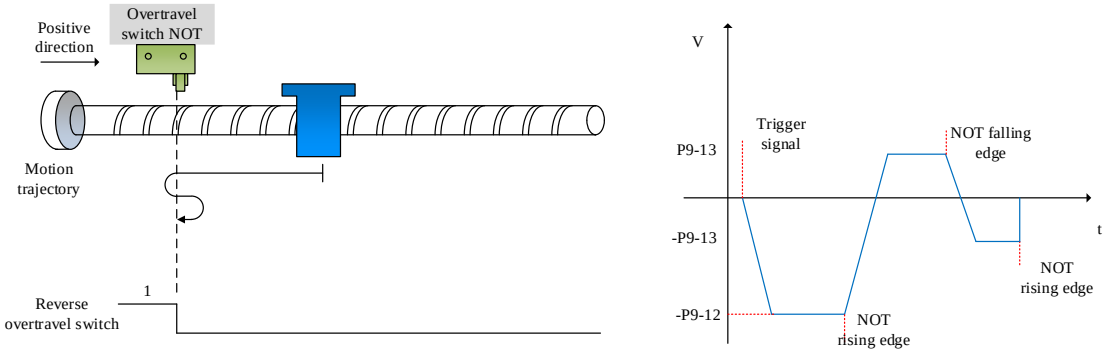
1) When the reverse overtravel switch (NOT) is invalid when the motor starts to move:

The servo motor first searches for the reverse overtravel switch (NOT) in reverse at high speed according to the value set in -P9-12 (homing high-speed). After detecting the rising edge of the NOT signal, it gradually decelerates and reverses direction as per the setting of P9-14 (homing acceleration/deceleration time). The servo motor then searches for the falling edge of the NOT signal forward at low speed as set in P9-13 (homing low-speed). After detecting the falling edge of the NOT signal, the subsequent homing actions are

divided into four scenarios:

① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is 0:

The motor decelerates and reverses direction (i.e., resumes reverse motion), and searches in reverse at low speed for the rising edge of the NOT signal at the speed set in -P9-13 (homing low-speed). During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge of the NOT signal.

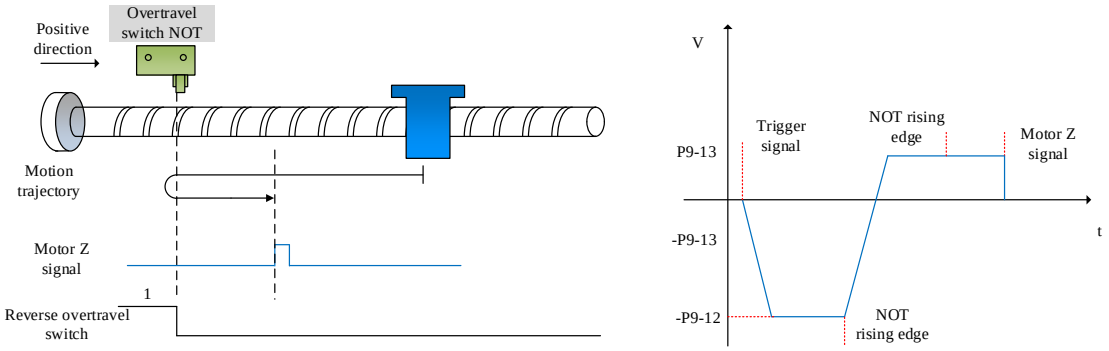


② When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is not 0:

The motor decelerates and reverses direction (i.e., resumes reverse motion), and searches in reverse at low speed for the rising edge of the reverse overtravel switch (NOT) signal at the speed set in **-P9-13 (homing low-speed)**. During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge of the NOT signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction defined by the set mechanical offset pulse count (which can only be the forward direction, i.e., it must move between the origin switch and POT), and then shut down.

③ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is 0:

The motor continues to run forward at low speed as set in **P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal. 。



④ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is not 0:

The motor continues to run forward at low speed as set in **P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction defined by the set mechanical offset pulse count (which can be either forward or reverse direction, but must move between the origin switch and POT), and then shut down.

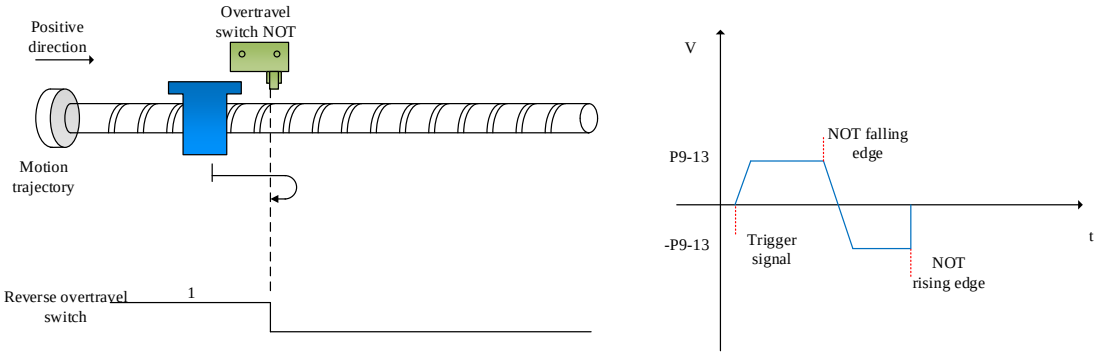
2) When the reverse overtravel switch (NOT) (P5-23) is valid when the motor starts to move:

The servo motor directly searches forward at low speed for the falling edge of the reverse overtravel switch (NOT) signal at the value set in P9-13 (homing low-speed). After detecting the falling edge of the NOT

signal, the subsequent homing actions are divided into four scenarios:

① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is 0:

The motor decelerates and reverses direction (i.e., resumes reverse motion), searches in reverse at low speed for the rising edge of the NOT signal at -P9-13 (homing low-speed), and stops immediately upon detecting the rising edge of the NOT signal during reverse acceleration or reverse uniform-speed operation.

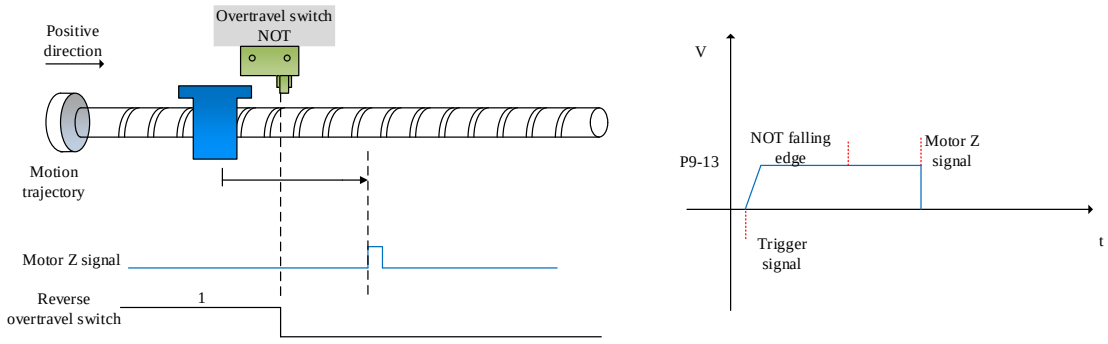


② When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is not 0:

The motor decelerates and reverses direction (i.e., resumes reverse motion), and searches in reverse at low speed for the rising edge of the NOT signal at the speed set in **-P9-13 (homing low-speed)**. During reverse acceleration or reverse uniform-speed operation, the motor stops immediately upon detecting the rising edge of the NOT signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction defined by the set mechanical offset pulse count (which can only be the forward direction, i.e., it must move between the origin switch and POT), and then shut down.

③ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is 0:

The motor continues to run forward at low speed as set in **P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal.



④ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is not 0:

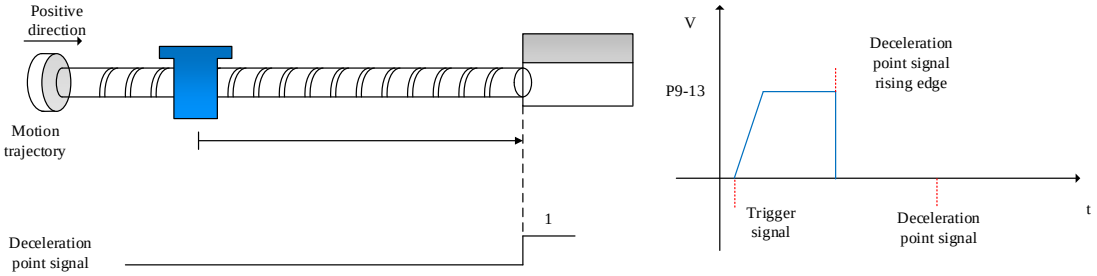
The motor continues to run forward at low speed as set in **P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal. After the motor comes to a complete stop, it will move a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** in the direction defined by the set mechanical offset pulse count (which can be either forward or reverse direction, but must move between the origin switch and POT), and then shut down.

(7)Homing Mode 6 – Forward Homing, where the deceleration point and origin are the forward mechanical limit position (P9-11.2=6)

To use this mode, there is no need to connect the POT, NOT, or origin switch.

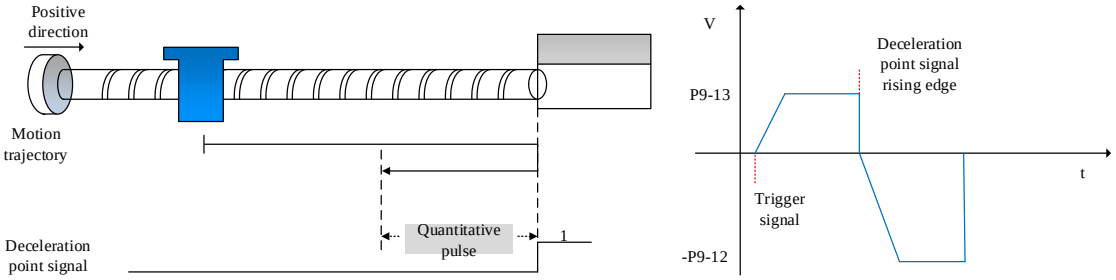
The servo motor first runs forward at low speed according to the value set in **P9-13 (homing low-speed)**. After colliding with the forward mechanical limit position, if the absolute value of the torque reaches the torque upper limit of **P9-17 (contact-stop homing torque threshold)** and the absolute value of the speed is lower than the value set in **P9-16 (contact-stop homing speed threshold)**, and this state is maintained for the time set in **P9-18 (contact-stop homing time threshold)**, it is judged that the mechanical limit position has been reached. The subsequent homing actions are divided into four scenarios:

①When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is 0: The motor stops immediately.



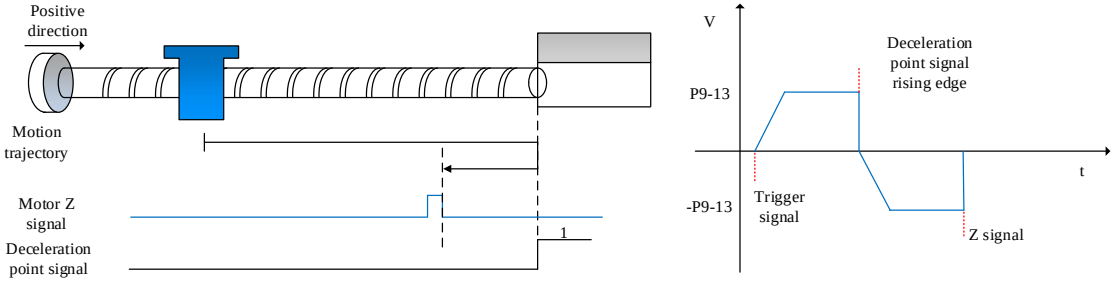
② When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is not 0:

The servo motor stops immediately. After coming to a complete stop, it will move in reverse by a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** according to the set mechanical offset pulse count, and then shut down.



③ When the number of Z-phase pulses (P9-11.0) is set to 1 and the mechanical offset (P9-19, P9-20) is 0:

It runs in reverse at low speed as set in -P9-13 (homing low-speed), and then stops immediately upon detecting the rising edge of the first Z-phase signal.



④ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is not 0:

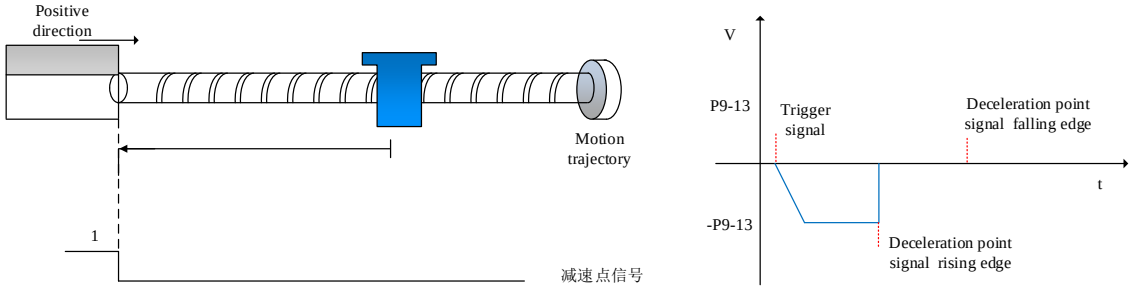
It runs in reverse at low speed as set in **-P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal. After coming to a complete stop, the motor will move a fixed number of pulses at the speed set in **P9-13 (homing low-speed)** according to the set mechanical offset pulse count (it can run in either forward or reverse direction, but must be within the range of the mechanical limit position), and then shut down.

(8) reverse mechanical limit position (P9-11.2=7)

To use this mode, there is no need to connect the POT, NOT, or origin switch.

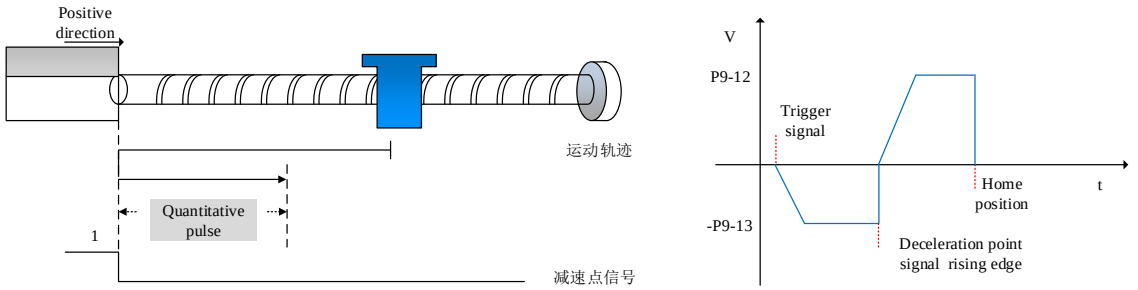
The servo motor first runs in reverse at low speed according to the value set in -P9-13 (homing low-speed). After colliding with the reverse mechanical limit position, if the absolute value of the torque reaches the torque upper limit of P9-17 (contact-stop homing torque threshold) and the absolute value of the speed is lower than the value set in P9-16 (contact-stop homing speed threshold), and this state is maintained for the time set in P9-18 (contact-stop homing time threshold), it is judged that the mechanical limit position has been reached. The subsequent homing actions are divided into four scenarios:

① When the number of Z-phase pulses (P9-11.0) is set to 0 and the mechanical offset (P9-19, P9-20) is 0: The motor stops immediately.



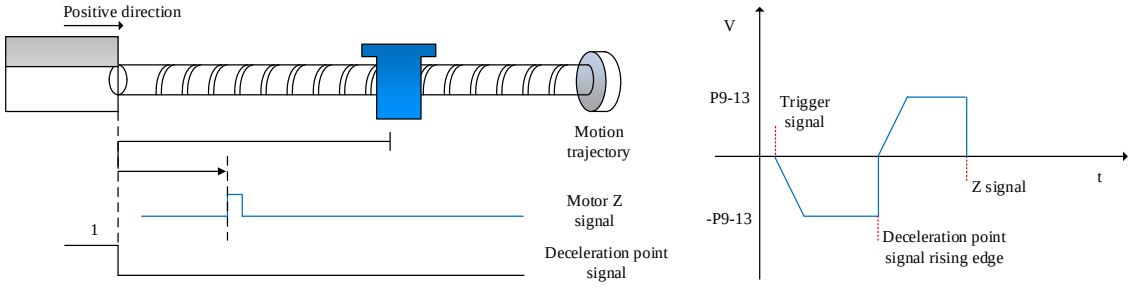
② When the **number of Z-phase pulses (P9-11.0)** is set to 0 and the **mechanical offset (P9-19, P9-20)** is not 0:

The servo motor stops immediately. After coming to a complete stop, it will move forward by a fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** according to the set mechanical offset pulse count, and then shut down.



③ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is 0:

It runs forward at low speed as set in **P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal.



④ When the **number of Z-phase pulses (P9-11.0)** is set to 1 and the **mechanical offset (P9-19, P9-20)** is not 0:

It runs forward at low speed as set in **P9-13 (homing low-speed)**, and then stops immediately upon detecting the rising edge of the first Z-phase signal. After coming to a complete stop, the motor will move a

fixed number of pulses (specified by P9-19 and P9-20) at the speed set in **P9-13 (homing low-speed)** (it can run in either forward or reverse direction, but must be within the range of the mechanical limit position), and then shut down.

Applicable Only to Homing Modes 6 & 7

- For Homing Modes 6 and 7, once either of these two homing modes is triggered, the maximum torque during the homing process will be 1.1 times the value set in P9-17 (contact-stop homing torque threshold). If both the internal forward/reverse torque limits (P3-28 and P3-29) are lower than 1.1 times the value of P9-17, then the torque limits will be the values set in P3-28 and P3-29. Similarly, if the external forward/reverse torque limits (P3-30 and P3-31) are enabled, the actual torque limit will be the minimum value among the internal torque limit, external torque limit, and 1.1 times the value of P9-17.
- The 1.1x multiplier of the P9-17 (contact-stop homing torque threshold) setting only takes effect when these two homing modes are triggered. If homing is merely enabled (with P9-11.2 set to 6 or 7 for homing mode) but the homing process is not initiated, the 1.1x multiplier of the P9-17 setting will not take effect.

4.3.2 Position control (external pulse command)

Parameter	Overview	Reference chapter
P0-01 control mode selection	Set to 6: external pulse mode	4.3.2.1
P0-10 pulse instruction form	Set the pulse form 0-CW/CCW 1-AB 2-P+D	4.3.2.2
P0-11 Motor pulse numbers per rotation*1 P0-12 Motor pulse numbers per rotation*10000 P0-13 Electronic gear ratio (numerator) P0-14 Electronic gear ratio (denominator) P0-92～P0-93 32-bit electronic gear ratio (numerator) P0-94～P0-95 32-bit electronic gear ratio (denominator)	Setting of command pulse number required for one revolution of motor P0-11 and P0-12=0, P0-13/P0-14 are effective P0-11～P0-14 are 0, P0-92~P0-95 are valid 32-bit electronic gear ratio (numerator): P0-92*1 + P0-93 *10000 32-bit electronic gear ratio denominator: P0-94*1 + P0-95 *10000	4.3.2.2
P0-09 Pulse command setting	You can set the command direction and filter time of low-speed pulse respectively	4.3.2.2

4.3.2.1 External pulse position mode

Parameter	Setting value	Meaning	Modify	Effective
P0-01	6	Control the position by external pulse	Servo bb	At once

4.3.2.2 Forward direction of pulse instruction and pulse form

1. set the forward direction of pulse instruction

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P0-09.0 n.xxx□	forward direction of pulse instruction	0	-	0/1	Servo bb	Re-power on
P0-09 will change the counting direction of the internal counter in the servo system. The counting direction determines the rotation direction of the motor. Therefore, this parameter can be adjusted if the actual rotation direction of the motor is different from the expected direction in the position mode.						

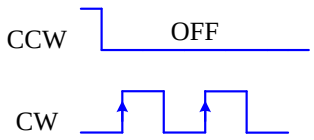
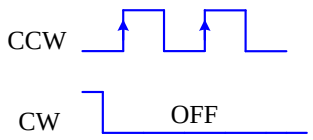
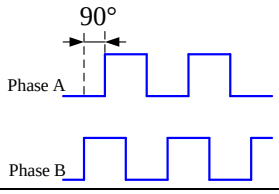
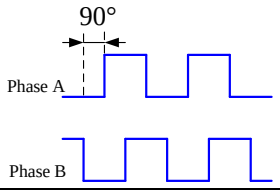
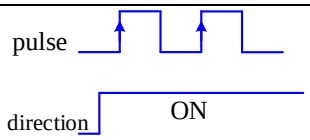
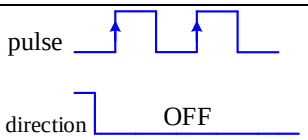
Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P0-09.2 n.x□xx	Low speed pulse command filter time	F	4.167ns	0~F	Servo bb	Re-power on
P0-09.2 is pulse filter time. It can enhance the anti-interference ability of low-speed pulses (less than 200K). When the input is less than 700K, the maximum filtering time F is recommended. When the input pulse frequency exceeds 1M, the filtering time should not be more than 7.						

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P0-09.3 n.□xxx	Predistribution of input pulse command filter	1	-	0~7	Servo bb	Re-power on
P0-09.3 setting value is n (range is 0~7), the received pulse number is 2^-n of normal one. The received frequency is 2^-n of original one. For example, pulse number per rotation is 10000, sending frequency is 10KHz, pulse number is 10000, when P0-09=1000, then U0-12=5000, U0-00 is 2^-n of original one.						

2. set the pulse instruction form

Parameter	Meaning	setting	Meaning	Change	Effective
P0-10 n.xxx□	Pulse command form	0	CW, CCW mode	Servo bb	At once
		1	AB phase		
		2	Pulse + direction (defaulted)		

3. Details of pulse command

P0-10.0	Forward rotation	Reverse rotation
0: CW/CCW		
1: AB		
2: P+D		

4. Pulse specification

Pulse specification		Highest input frequency	Voltage	Forward current
Low speed pulse	Open collector	200KPPs	24V	<25mA
	Differential signal	500KPPs	3.3~5V	<25mA

4.3.3 Position control (Internal command)

Parameter	Overview	Reference chapter
P0-01 control mode selection	Set to 5: internal position mode	4.3.3.1
P4-03 internal position mode P4-04 valid segment number P4-10~P4-254 internal position 1 to 35 parameters	Control mode setting of internal position mode: including step change mode, positioning mode and adjustment time Configuration of pulse displacement, speed, acceleration and deceleration time of each segment	4.3.3.3
P5-35 change step signal/GHGSTP P5-32 pause present segment signal /INHIBIT P5-31 jump present segment signal /Z-CLAMP	Common terminal function assignment	4.3.3.4 4.3.1.4 4.3.3.5
P4-00 number of Z-phase signal after leaving limit switch P4-01 speed of hitting the proximity switch P4-02 speed of leaving proximity switch P5-28 /SPD-A: find reference origin on forward side in position mode P5-29 /SPD-B: find reference origin on reverse side in position mode	Internal position back to origin setting parameters	4.3.1.8
F2-09 35 segments position setting	Set segment no. by communication	4.3.3.6

4.3.3.1 Internal position mode

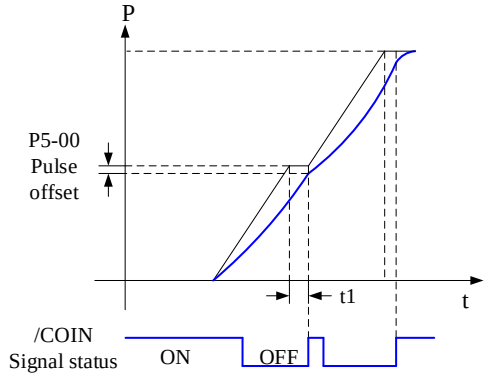
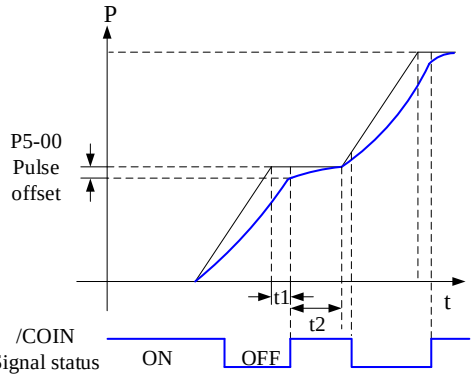
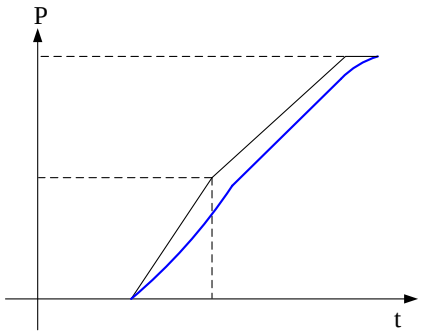
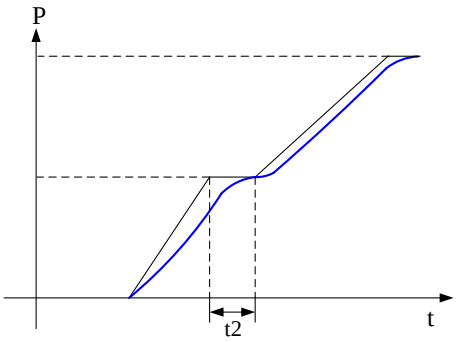
Parameter	Setting value	Meaning	Change	Effective
P0-01	5	Position control by preset values of internal registers in servo units	Servo bb	At once

4.3.3.2 Internal position mode setting

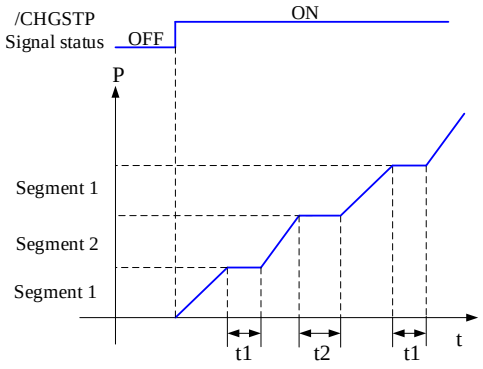
Parameter	Function	Unit	Default setting	Suitable mode	modify	Effective
P4-03	Internal position mode setting	—	n.0000	5	Servo bb	At once
	Parameter setting	Meaning	Default setting	Setting range		
	n.□xxx	No meaning				
	n.x□xx	Waiting mode	0	0～1		
	n.xx□x	Change step mode	0	0～6		
	n.xxx□	Positioning mode	0	0～1		

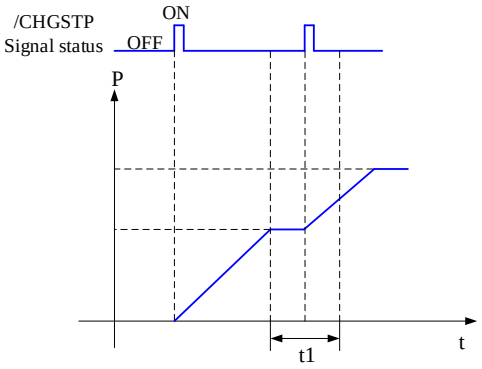
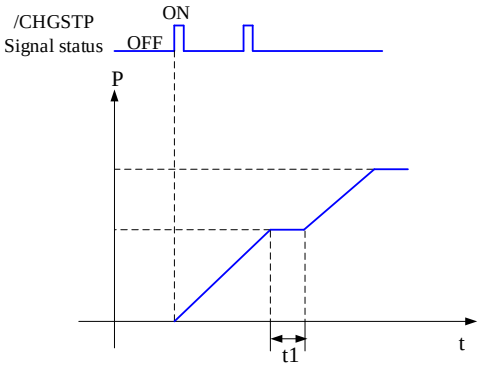
1. waiting mode

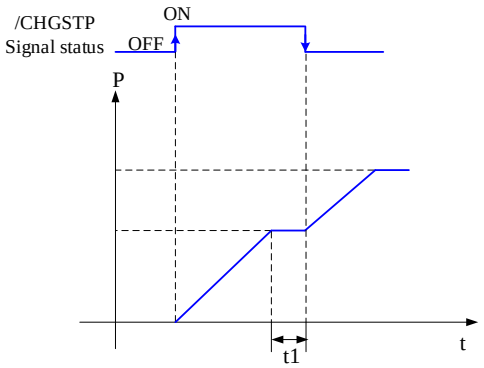
n.x□xx	Meaning
0	Wait for positioning completion
1	Not wait for positioning completion
Note: Waiting mode refers to whether the driver waits for the motor to be positioned after outputing a position instruction in internal position mode. It takes effect in all Step-Changing modes.	

Waiting mode=0, adjust time =0ms	Waiting mode =0, adjust time >0ms
	
After the drive output 1-segment position command, it will wait for the completion of motor positioning, and then start the next position command at once. T1 is positioning time, which means the time from pulse output complete to the output of positioning completion signal.	After the drive output 1-segment position command, it will wait for the completion of motor positioning, and pass the adjust time, then start the next position command. T1 is positioning time, t2 is adjust time. Refer to parameter P4-11.
Wait mode = 1, adjust time = 0ms	**Wait mode = 1, adjust time > 0ms**
	
After the drive output 1-segment position command, it will not wait for the completion of motor positioning, and start the next position command at once.	After the drive output 1-segment position command, it will not wait for the completion of motor positioning, but pass the adjust time, and then start the next position command. T2 is adjust time. Refer to parameter P4-11.

2. change step mode

n.xx□x	Description	
0: Change the step when signal is ON, recycling		t1=P4-16, t2=P4-23. 1. If the /CHGSTP signal is always on, the servo unit will cycle the set position segment all the time. 2. If the /CHGSTP signal is set to off when executing a certain segment, the servo will continue to complete the execution of that segment without the execution of the next segment. 3. In this mode, the step change signal /CHGSTP is triggered at high level. 4. When the servo enable is off during a certain section of operation, the motor stops according to the servo off shutdown mode. After the shutdown,

n.xx□x	Description	
		the positioning is invalid. 5. After each operation completion, positioning completion and positioning approach signal are all effective. 6. In this mode, the adjustment time of each period is valid.
1: Change the step at the rising edge of the signal, single-step execution		Take setting two segments as an example, t1 = p4-16 in the figure. 1. Note that as shown in the figure, in this mode, the set adjustment time actually does not work. As long as the previous position command has been sent out, the next command will be entered immediately when a new step change signal arrives. 2. In this mode, the step change signal /CHGSTP is triggered by rising edge. 3. After each operation completion, positioning completion and positioning approach signal are all effective. 4. When the servo enable is off during a certain section of operation, the motor stops according to the servo off shutdown mode. After the shutdown, the positioning is invalid. 5. The adjustment time is not valid in this mode.
2: Start at the rising edge of the signal, sequential run all, not recycling		Take setting two segments as an example, t1 = p4-16 in the figure. 1. The /CHGSTP signal before the completion of a cycle will not be counted, as shown in the second /CHGSTP signal in the figure. 2. In this mode, the step change signal /CHGSTP is triggered by rising edge. 3. After each operation completion, positioning completion and positioning approach signal are all effective. 4. When the servo enable is off during a certain section of operation, the motor stops according to the servo off shutdown mode. After the shutdown, the positioning is invalid. 5. The adjustment time is valid in this mode.
3: set segment no. through communication	Servo is ON, set parameter P2-09=0, then set the running segment. The motor will run the setting segment. Refer to chapter 4.4.8.	

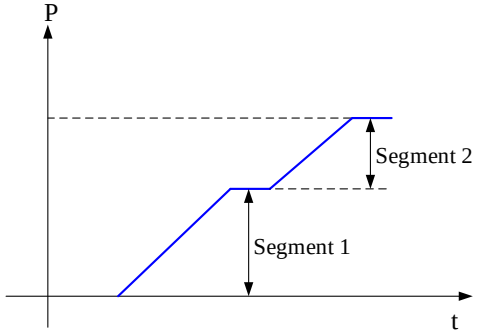
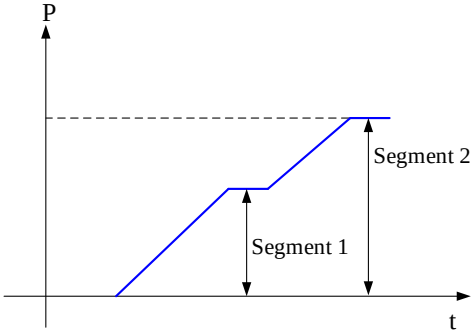
<table>
<tr><th>n.xx□x</th><th colspan="2">Description</th></tr>
<tr><td>4: /CHGSTP double edge triggering</td><td> 
</td><td>t1 = p4-16 in the figure.
1. /CHGSTP rising edge triggers the first segment and falling edge triggers the second segment. Where, if the first segment position is required to operate completely, the /CHGSTP signal remains on until the end of the first segment.
2. Only in this mode, the number of p4-04 valid segments is invalid.
3. After each operation completion, positioning completion and positioning approach signal are all effective.
4. When the servo enable is off during a certain section of operation, the motor stops according to the servo off shutdown mode. After the shutdown, the positioning is invalid.
5. The adjustment time is not valid in this mode.
6. Before using this mode, p5-35 terminals need to be allocated first, but not when using this mode.</td></tr>
<tr><td>5: /PREFA(P5-57) /PREFB(P5-58) /PREFC(P5-59) Choose the segment through terminal, the range is segment 1~3</td><td colspan="2"><table>
<tr><th>/PREFC</th><th>/PREFB</th><th>/PREFA</th><th>Segment no.</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>-</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1 (segment 1 position)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>2 (segment 2 position)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>3 (segment 3 position)</td></tr>
</table>
1. After each operation completion, positioning completion and positioning approach signal are all effective.
2. When the servo enable is off during a certain section of operation, the motor stops according to the servo off shutdown mode. After the shutdown, the positioning is invalid.
3. The adjustment time is valid in this mode.
4. /CHGSTP signal is invalid only in this mode.
5. The segment number selection terminal can not only trigger the step change at the edge, but also keep on state. This mode supports continuous and repeated triggering of a certain segment. If the segment number selection terminal remains on, the motor stops after encountering the overtravel signal, it is necessary to change the segment number selection terminal to off, otherwise, the motor will execute the position segment after the overtravel signal is cancelled.</td></tr>
<tr><td>6: /PREFA(P5-57) /PREFB(P5-58) /PREFC(P5-59) Choose the segment through terminal, the range is segment 1~8.</td><td colspan="2"><table>
<tr><th>/PREFD</th><th>/PREFC</th><th>/PREFB</th><th>/PREFA</th><th>Segment no.</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (segment 1 position)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2 (segment 2 position)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>3 (segment 3 position)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>4 (segment 4 position)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>5 (segment 5 position)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>6 (segment 6 position)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>7 (segment 7 position)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>8 (segment 8 position)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>9 (segment 1 position)</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>n.xx□x</th><th>Description</th></tr>
<tr><td>Note:
① Firmware version 3730 and later supports 1-8 segments of step change mode 6
② Firmware version 3740 and later supports 1-16 segments of step change mode 6</td><td>
<table>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>10 (segment 2 position)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>11 (segment 3 position)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>12 (segment 4 position)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>13 (segment 5 position)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>14 (segment 6 position)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>15 (segment 7 position)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16 (segment 8 position)</td></tr>
</table>
Note: the rising edge of P5-35 step change signal triggers each position (the rising edge is invalid during operation).
1. When the servo enable is off during a certain section of operation, the motor stops according to the servo off shutdown mode. After the shutdown, the positioning is invalid.
2. The adjustment time is not valid in this mode.
3. After each operation completion, positioning completion and positioning approach signal are all effective.
4. After the segment number is selected, the rising edge of P5-35/CHGSTP step change signal is required to trigger to run the position segment, and the step change triggering during segment operation is invalid.
5. Segment number selection terminal logic is voltage level valid. Input high voltage level is valid, input low voltage level is invalid.
</td></tr>
</table>

The following input signal can switch the segment 1 to 3 or 1 to 8:

Parameter	Signal name	Default setting	Suitable mode	Setting range	Modify	Effective
P5-57	/PREFA internal position segment 1	n.0000	5	Range 0000-0014, distribute to input terminal through P5-57	Anytime	At once
P5-58	/PREFB internal position segment 2	n.0000	5	Range 0000-0014, distribute to input terminal through P5-58		
P5-59	/PREFC internal position segment 3	n.0000	5	Range 0000-0014, distribute to input terminal through P5-59		
P5-60	/PREFD internal position segment 3	n.0000	5	Range 0000-0014, distribute to input terminal through P5-60		

3. Positioning mode

<table>
<tr><th>n.xxx□</th><th>Meaning</th></tr>
<tr><td>0</td><td>Relative positioning</td></tr>
<tr><td>1</td><td>Absolute positioning</td></tr>
<tr><td colspan="2">
<table>
<tr><td>0: relative positioning</td><td>1: absolute positioning
(take the reference origin as the absolute positioning origin)</td></tr>
<tr><td> 
</td><td> 
</td></tr>
</table>
</td></tr>
</table>

4.3.3.3 Position segment 1 to 35 parameter settings

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P4-10+（n-1）*7	Pulse number (low bit)	0	1 pulse	-9999～9999	Servo bb	At once
P4-11+（n-1）*7	Pulse number (high bit)	0	10000 pulses	-32767～32767	Servo bb	At once
P4-12+（n-1）*7	Speed	0	0.1rpm	0～65535	Servo bb	At once
P4-13+（n-1）*7	Trapezoid acceleration time	0	ms	0～65535	Servo bb	At once
P4-14+（n-1）*7	Trapezoid deceleration time	0	ms	0～65535	Servo bb	At once
P4-15+（n-1）*7	Reserved	-				
P4-16+（n-1）*7	Adjust time	0	ms	0～65535	Servo bb	At once

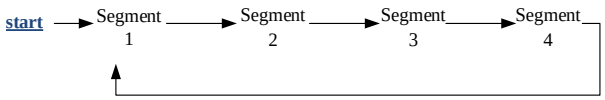
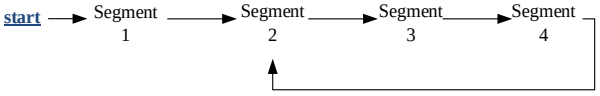
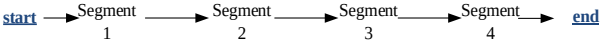
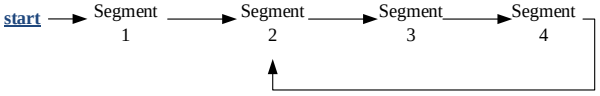
Notes:
1. Set pulse number = pulse number (high bit) ×10000 + pulse number (low bit).
2. In formula P4-10+(n-1)*7, n is the segment no. of internal position; the range is 1~35. Segment 1~12 can be set through the operate panel, segment 13~35 needs to write in parameters through communication (RS232 or RS485).
3. In the relative positioning mode, if the pulse high bit is set to 9999, the pulse low bit is set to 9999, or the pulse high bit is set to - 9999, the pulse low bit is set to - 9999, and P4-03.3 = 1 (do not wait for the positioning to complete), the infinite pulse mode is entered. On the contrary, the number of pulses is limited.
4. If one of the segment speed is zero, servo will skip this segment and run the next segment.
5. In relative positioning mode, if one segment speed is not zero but the pulse number is zero, the motor will not run, but the wait mode is effective. The servo will run the next segment when the adjust time is out.
6. In absolute positioning mode, if one segment speed is not zero but the pulse number is zero, the motor will return to the reference origin with the speed of this segment.
7. In the absolute positioning mode, if the speed settings of two consecutive segments are not zero and the pulse number settings are the same, then the latter segment of the two segments will not run, but the waiting mode determined by the segment is valid.
8. In the absolute positioning mode, the number of motor turns is limited, not unlimited.
9. At present, there are only step velocity and slope velocity in the position section of internal position mode, and there are no other velocity forms. When trapezoidal acceleration time and trapezoidal deceleration time are set to 0, it is in the form of step speed. When trapezoidal acceleration time and trapezoidal deceleration time are greater than 0, it is in the form of slope speed.
10. Trapezoidal acceleration time and trapezoidal deceleration time refer to the time required to change from 0 to rated speed.
11. If the speed of a certain segment is set to 0, the position command of this segment will be ignored in step change mode 0 / 1 / 2. In the step change mode of 4 / 5 / 6, when the step change is triggered at this position, the motor will not rotate.
12. The position commands of pulse high position and pulse low position in the parameters of internal position segment are still affected by the electronic gear ratio. The actual number of turns of the motor should be determined according to the combination of the pulse command and the electronic gear ratio.
13. In the absolute positioning mode, the starting position of each step change is based on the starting position of the first step change. In the relative positioning mode, the starting position of each step change is based on the position at the end of the last step change.
14. In the relative positioning mode, an infinite pulse position segment can be set in the 35 segment position. Only when the motor runs to this position segment, it will continue to run unless it is triggered to skip the present segment.

Parameter	Meaning	Default setting	Range	Change	Effective
P4-04	Effective segment	0	0～35	Servo bb	At once

There are 35 sections in total in the internal position. If 10 sections need to be operated and 5 sections need to be operated switched for use due to process requirements, the effective segment can be set. For example, parameters are set for sections 1-10, and P4-04 is set to 5, that is, the position of section 1-5 is valid; if it is set to 10, the position of section 1-10 is valid.

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P4-08	Internal position mode start segment number	1	-	0～35	Servo bb	At once

P4-08 sets the starting operation section number after the first round, and it is valid when the change mode P4-03.1 is set to 0 and 1. The settings are explained below, and valid values are set for No.1-No.8 sections.

Change step mode	Setting	Parameter	Actions
P4-03.1=0	P4-08=0 or P4-08>P4-04	P4-08=8 P4-04=4	
	1≤P4-08≤P4-04	P4-08=2 P4-04=4	
P4-03.1=1	P4-08=0 or P4-08>P4-04	P4-08=8 P4-04=4	
	1≤P4-08≤P4-04	P4-08=2 P4-04=4	

4.3.3.4 Change step signal (/CHGSTP)

Parameter	Name	Setting	Meaning	Range
P5-35	Change step signal /CHGSTP	n.0000	Defaulted is not distribute to input terminal. Refer to chapter 4.4.3.	Range: 0000-0014. Distribute to input terminal through P5-35. When it set to 0001, it means input from SI1.

4.3.3.5 Skip present segment signal (/ZCLAMP)

Parameter	Signal name	Setting	Meaning	Range
P5-31	Skip the present segment /Z-CLAMP	n.0000	Defaulted is not distribute to input terminal.	Range: 0000-0014. Distribute to input terminal through P5-31. When it set to 0001, it means input from SI1.

In different Step-Changing modes, the function of skipping the current segment will have different effects, as follows:

Change step mode P4-03 n.xx□x	Skip the present segment	Actions
0	/Z-CLAMP	Cancel current segment, execute the next segment at once
1		Cancel current segment, execute the next segment when the change step signal is ON
2		Cancel current segment, execute the next segment at once
3		Cancel current segment, set the F2-09 again
4		The current segment is cancelled and executes the next segment at the falling edge of signal /CHGSTP
5		The current segment is cancelled, and the corresponding segment is executed after other segments are selected
6		When the current segment is cancelled, executes the selected position segment at the rising edge of signal /CHGSTP

When using the skip current segment function, the SI terminal assigned by P5-31 needs to be triggered by the rising edge.

4.3.3.6 Set segment through communication

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
F2-09	Set the segment number through communication	0	-	0～35	Anytime	At once
If this parameter is set to a certain segment number, this segment position will be executed without step change signal. Communication can be used to modify parameters. For example: to execute the second segment position, set F2-09 = 0, and then F2-09 = 02.						

4.3.3.7 Motion start signal (/MRUN)

Parameter	Signal name	Default setting	Meaning	Modify
P5-50	Motion start /MRUN	n.0000	Terminal output is not assigned by default. It is only valid in the internal position mode, similar to the positioning completion signal in the external pulse mode; there is output when the motor is running, and there is no output when the motor stops.	Parameter range 0000-0014, assigned to the output interface through parameter P5-50. When it is set to 0001, the signal is output from SO1 terminal.

4.4 Speed control

4.4.1 Speed mode general control

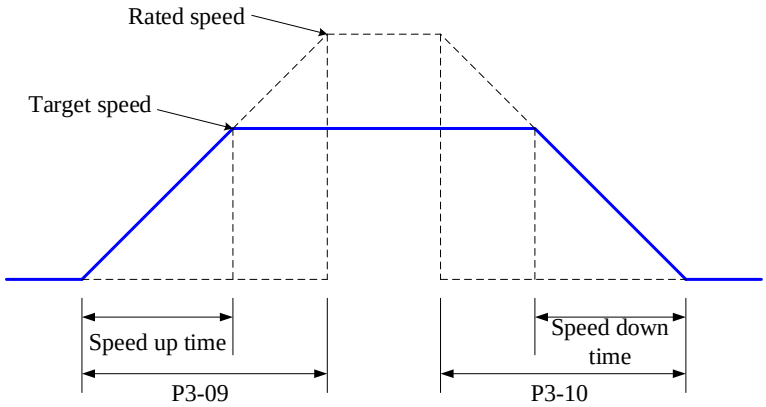
4.4.1.1 Soft start

Parameter	Meaning	Defaulted setting	Unit	Range	Modify	Effective
P3-09	Soft Start Acceleration Time	0	ms	0～65535	Servo bb	At once
P3-10	Soft Start deceleration Time	0	ms	0～65535	Servo bb	At once

Soft start acceleration and deceleration time is suitable for mode 3/4/7. Smooth speed control can be carried out when step speed instruction is input or internal setting speed is selected.

P3-09: Time from stop to rated speed

P3-10: Time from rated speed to stop



4.4.1.2 Zero clamp (/ZCLAMP)

1. Overview

The upper device uses the "speed command" input, and the function is used when there is no "position loop" configured. This function is used when the speed command is not 0, the motor needs to stop and make tbe servo in locking status.

When the "zero clamp" function is set to "on", the position loop is temporarily configured inside, the motor clamps within ±1 pulse at this position. It will return to zero clamp position even the motor rotates with external force.

When zero clamping is used, the current speed must be less than zero clamping speed to make the motor shaft clamped; When the zero clamping function is started, the motor changes from speed mode to position mode. At this time, if the motor shaft is rotated and released again, it will return to its original position. However, when the motor shaft is rotated in speed mode, it will not return to its original position because there is no position feedback.

2. Input signal setting

Parameter	Signal	Setting	Meaning	Range
P5-31	Zero clamp /ZCLAMP	n.0000 (default)	Defaulted is not distribute to input terminal	/Z-CLAMP signal is distributed to input terminal by parameter P5-31, Range: 0000-0014.
		n.0002	Input signal from SI2 terminal	

3. Parameter setting

parameter	Meaning	Default setting	Unit	Range	Change	Effective
P3-13	Zero clamp speed	10	rpm	0～300	Servo bb	At once
P3-12	Zero clamp mode	0	-	0～3	Servo bb	At once

P3-12 setting	Contents
0	ZCLAMP input signal is ON, forced speed command is 0, when the speed below P3-13, switch to position mode and the servo lock in this position.
1	ZCLAMP input signal is ON, forced set the speed command to 0.
2	ZCLAMP input signal is ON, the speed below P3-13, switch to position mode and the servo lock in the position. Note: after entering zero clamp mode, present setting speed is higher than P3-13, motor doesn't run, the ZCLAMP signal must be OFF, then motor will run again.
3	ZCLAMP signal is ON, the setting speed is less than P3-13, switch to position control mode, and servo is locked at this position. At this time, if setting speed is over P3-13, the motor will run again.

4.4.1.3 Speed reach signal (/V-RDY)

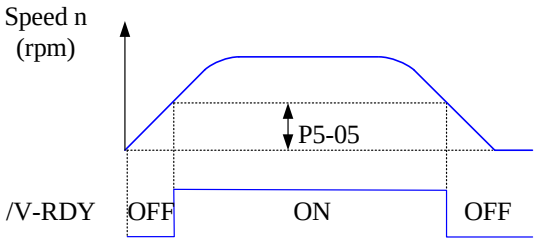
■ **Related parameter**

Parameter	Signal	Default setting	Suitable mode	Meaning	Modify	Effective
P5-51	/V-RDY	n.0000	3, 7	Speed reach signal	Anytime	At once

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P5-05	Reach speed	50	rpm	0～10000	Anytime	At once

Speed arrival signal output condition

When the actual motor speed is greater than P5-05, output speed reach signal (/V-RDY).



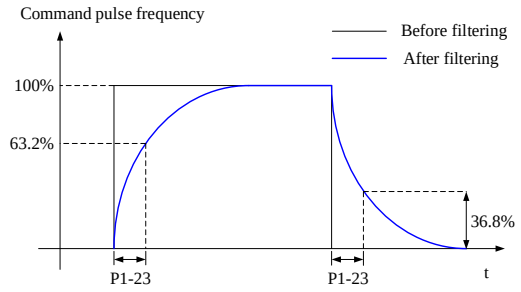
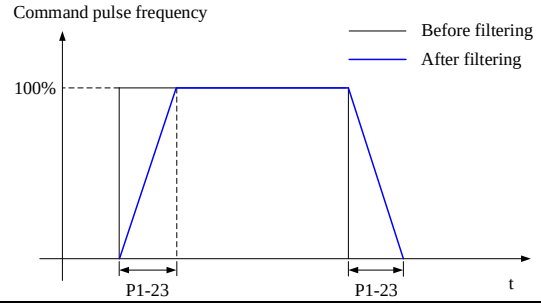
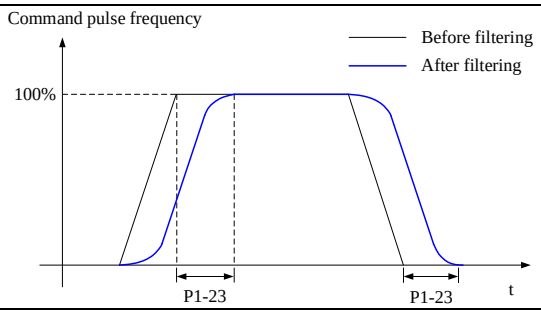
4.4.1.4 Speed command filter

1、Before version 3770

■ **Related parameter**

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P1-22	Speed command filter selection	0	-	0～1	Servo bb	At once
P1-23	Speed command filter time	0	0.1ms	0～65535	Servo bb	At once

P1-22	Contents
0	First-order Inertial Filter
1	Smooth filter

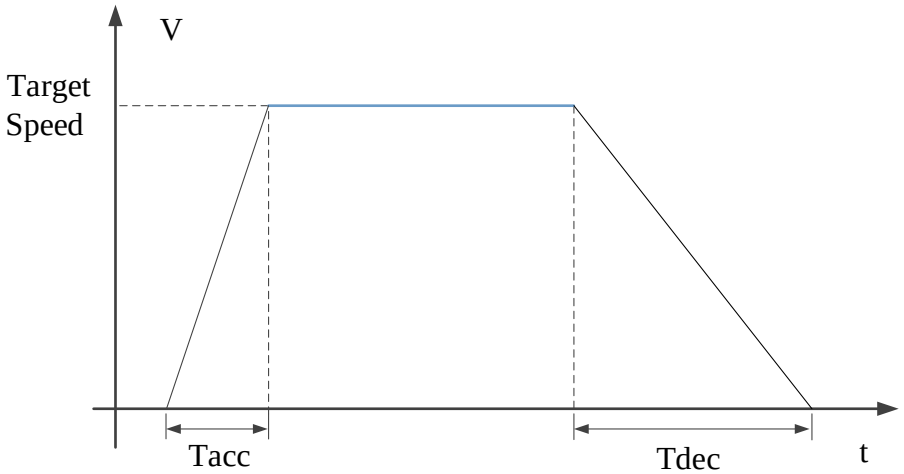
Position command acceleration and deceleration filter	Smooth filter of position instruction
	
	

2、After version 3770

■ Parameters

Parameter	Meaning	Factory Setting	Unit	Setting Range	Modification	Activation
P1-23	Speed command filter time constant	0	0.1ms	0 ~ 65535	Servo bb	Immediate
P3-09	Acceleration time	200	1ms	0 ~ 65535	Servo bb	Immediate
P3-10	Deceleration time	200	1ms	0 ~ 65535	Servo bb	Immediate
P3-11	Sliding average filter time constant	0	0.1ms	0 ~ 65535	Servo bb	Immediate

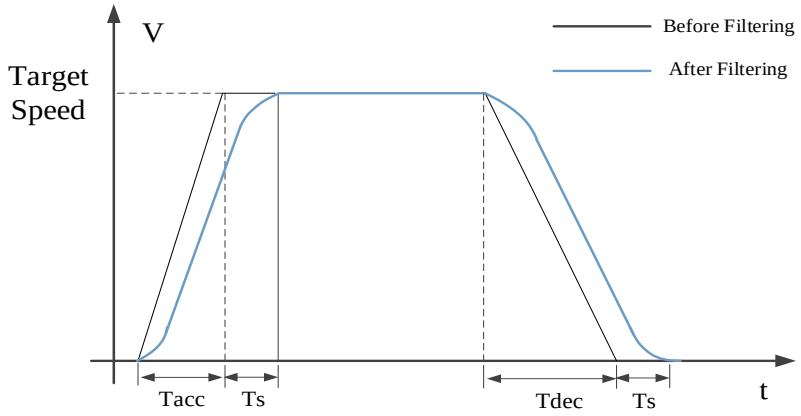
First, set P3-09 and P3-10 to configure the acceleration and deceleration times for the speed command.



Here, the acceleration time Tacc = (Target Speed / Rated Speed) * P3-09 [ms], and the deceleration

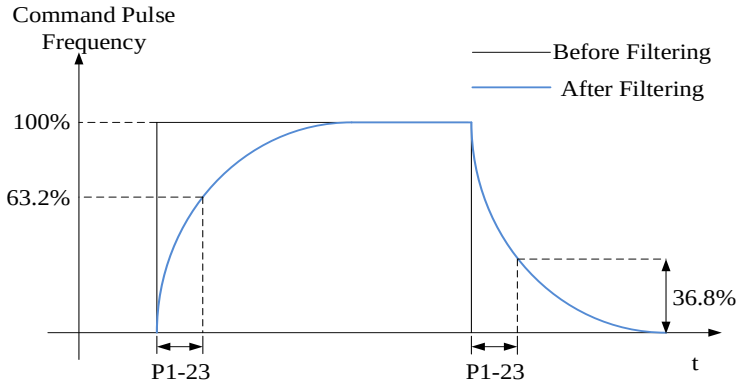
time Tdec = (Target Speed / Rated Speed) * P3-10 [ms].

Set an appropriate sliding average filter time constant P3-11 (S-curve acceleration/deceleration time constant). The calculation is: Ts = P3-11 * 0.1 [ms].



The sliding average filter time constant must be set to meet the requirements: **Ts < 0.5*Tacc** and **Ts < 0.5*Tdec**. Otherwise, an excessively large sliding average filter time will cause the acceleration and deceleration times to increase, which will not match the settings of P3-09 and P3-10.

When P3-09 and P3-10 are set to 0, configuring the sliding average filter time will change the speed command to a trapezoidal acceleration/deceleration speed command. When setting P1-23 (speed command filter time constant) and P1-24 (first-order low-pass filter time constant), the effects are as follows:



If acceleration and deceleration are configured, the first-order low-pass filter will increase the hysteresis of the speed command.

4.4.2 Speed control (internal speed)

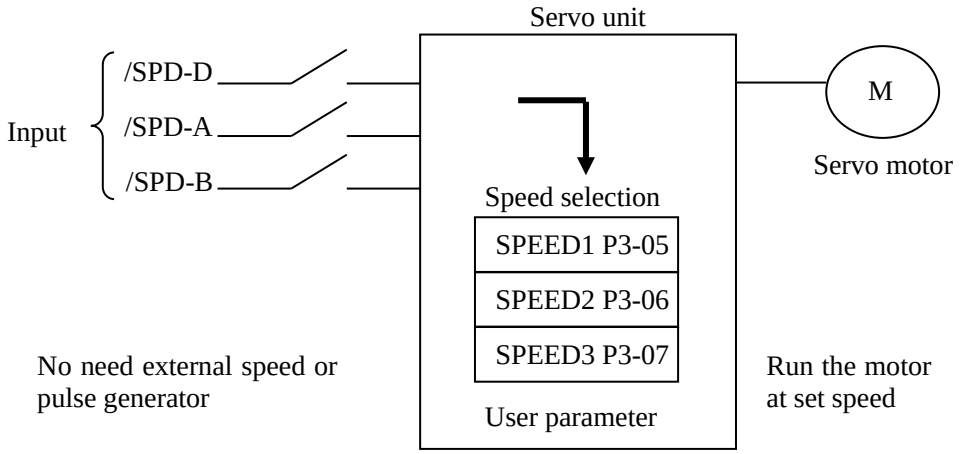
Parameter	Overview	Chapter
P0-01 Control mode selection	Set to 3: internal speed control mode	4.4.2.1
P3-05 Internal speed 1 P3-06 Internal speed 2 P3-07 Internal speed 3	Speed value setting of internal 3-segment speed in rpm	4.4.2.1
P5-28 internal speed selection /SPD-A P5-29 internal speed selection /SPD-B	The combination of terminals determines the speed of corresponding section	4.4.2.1
P5-27 internal speed direction selection /SPD-D	Direction changing, default is n.0000 If the direction changing is given through SI2 terminal, P5-27 can be set to n.0002	4.4.2.1

Parameter	Overview	Chapter
P3-09 soft start acceleration time P3-10 soft start deceleration time	Set acceleration and deceleration time in ms	4.4.1.1

4.4.2.1 Internal speed mode

Parameter	Set value	Meaning	Modify	Effective
P0-01	3	Speed control: internal speed selection	Servo bb	At once

Function: internal speed selection will set 3 motor speeds and select the speed by external signal. It is no need to configure external speed generator or pulse generator.



■ **Related parameter**

Parameter	Meaning	Defaulted setting	Unit	Range	Modify	Effective
P3-05	Internal speed 1	0	rpm	-9999～+9999	Anytime	At once
P3-06	Internal speed 2	0	rpm	-9999～+9999	Anytime	At once
P3-07	Internal speed 3	0	rpm	-9999～+9999	Anytime	At once

Parameter	Signal	Default setting	Range	Modify	Effective
P5-27	Internal direction /SPD-D	n.0000	Range: 0000-0014. Distribute to input terminal through P5-27.	Anytime	At once
P5-28	Internal speed /SPD-A	n.0000	Range: 0000-0014. Distribute to input terminal through P5-28.		
P5-29	Internal speed /SPD-B	n.0000	Range: 0000-0014. Distribute to input terminal through P5-29.		

1. Correlation between running speed and terminal signal

Input signal			Running speed
/SPD-D（P5-27）	/SPD-A（P5-28）	/SPD-B（P5-29）	
0: forward run	0	0	Internal speed is zero
	0	1	P3-05: SPEED1
	1	1	P3-06: SPEED2
	1	0	P3-07: SPEED3
1: reverse run	0	0	Internal speed is zero
	0	1	P3-05: SPEED1
	1	1	P3-06: SPEED2

Input signal			Running speed
/SPD-D（P5-27）	/SPD-A （P5-28）	/SPD-B （P5-29）	
	1	0	P3-07: SPEED3

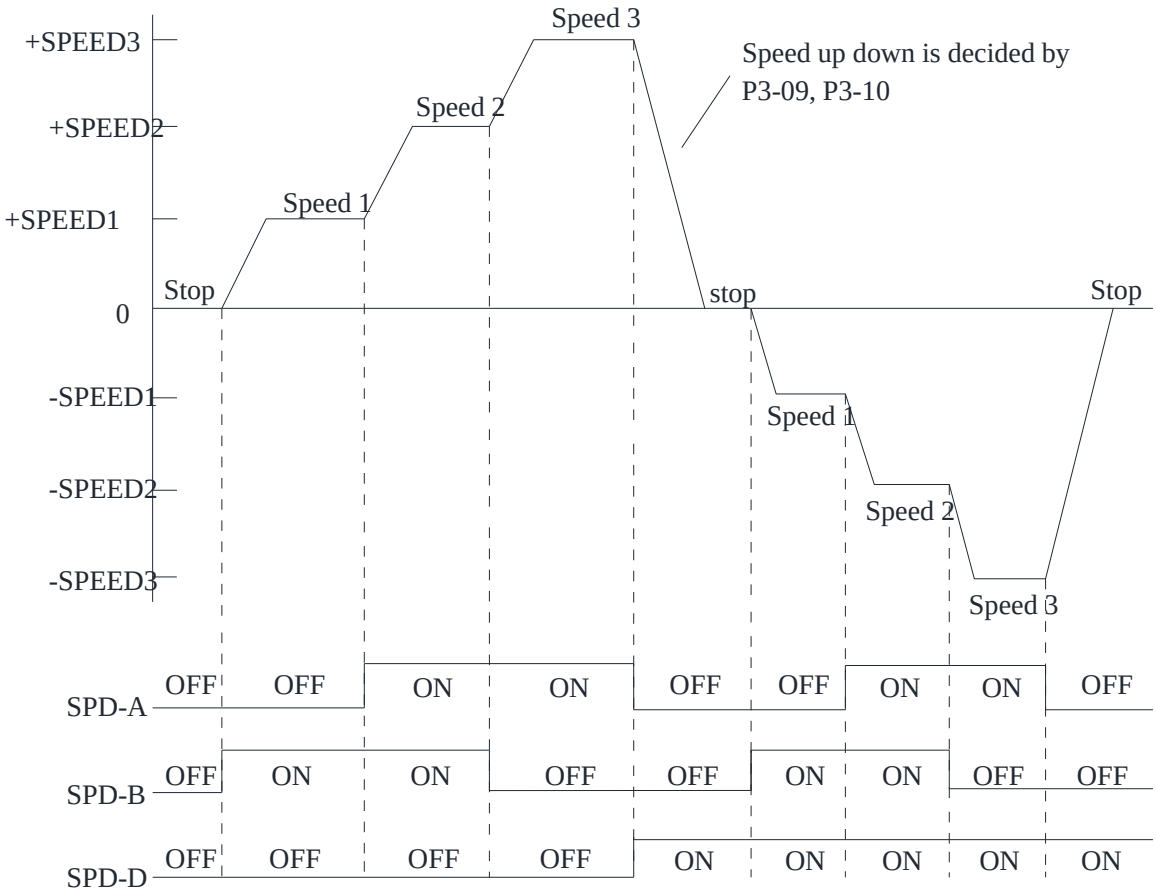
- /SPD-D signal is direction control, input SI terminal can be changed according to P5-27. The validity of the terminal signal determines the direction of the motor.
- The combination of /SPD-A and /SPD-B input terminal effectiveness determines the multi segment speed
- 0/1 of the above table represent the validity of the signal. The 0 is terminal input is invalid. 1 is the terminal input valid.

2. Terminal effectiveness description

The following table takes /SPD-D as an example, /SPD-A, /SPD-B signals are the same.

Parameter setting	Signal/SPD-D terminal input status	Signal/SPD-D terminal logic
P5-27=n.0000	No need external terminal input	Invalid
P5-27=n.000□	SI□ terminal no signal input	
P5-27=n.001□	SI□ terminal has signal input	
P5-27=n.0010	No need external terminal input	Valid
P5-27=n.000□	SI□ terminal has signal input	
P5-27=n.001□	SI□ terminal no signal input	

3. Running example



4.4.3 Speed control (pulse frequency command)

Parameter	Overview	Reference chapter
P0-01 Control mode selection	Set to 7: external pulse speed mode	4.4.3.1
P0-10 Pulse command form	Set pulse form 0-CW/CCW 1-AB 2-P+D	4.3.2.2
P0-15 Command pulse frequency at rated speed	Determine the linear relationship between the command pulse frequency and the speed	4.4.3.3
P0-16 Speed command pulse filter time	When the command pulse frequency is relatively low, setting this parameter properly can reduce the speed fluctuation	4.4.3.4
P5-71 Function selection of direction terminal in pulse speed mode	change the pulse direction	4.4.3.5

4.4.3.1 External pulse speed mode

Parameter	Setting value	Meaning	Modify	Effective
P0-01	7	Speed control: pulse frequency speed command	Servo bb	At once
Function: speed command is decided by external pulse frequency, but not related to pulse quantity. The wiring is the same as position command. Select CW, CCW mode or direction + pulse mode, AB phase pulse mode.				

4.4.3.2 Pulse frequency command

Pulse frequency command is the same as external pulse command position control, refer to chapter 4.3.2.

4.4.3.3 Command pulse frequency at rated speed

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P0-15	command pulse frequency at rated speed	1000	100Hz	0~10000	Servo bb	At once
Note: the unit is 100Hz. Example: P0-15=300, command pulse frequency at rated speed=30kHz; P0-15=1000, command pulse frequency at rated speed= 100kHz.						

4.4.3.4 Speed command pulse filter time

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P0-16	speed command pulse filter time	100	0.01ms	0~10000	Servo bb	At once
When the command pulse frequency is low, setting a suitable value for this parameter can decrease the speed fluctuation.						

4.4.3.5 Speed command pulse direction

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P5-71	Function selection of direction terminal in pulse speed mode	0	-	0～1	Servo bb	At once

The function of **P5-71** is as follows: when set to 1, the direction can be reversed by turning on **P5-27**; when set to 0, this function is inactive.

4.4.4 Speed Control (External Analog Input) (Supported by DF3E-1540)

Parameter	Summary	Reference Section
P0-01	Control mode selection: Set to 4 for external analog speed mode	4.4.4.1 External Analog Speed Mode
P3-00	V-REF function assignment: Runs the servo motor at rated speed based on the set speed command voltage (unit: 0.001V)	4.4.4.2 Analog Quantity Corresponding to Rated Speed
P3-09	Soft-start acceleration time: Set acceleration/deceleration time (unit: ms)	4.4.1.1 Soft Start
P3-10	Soft-start deceleration time	4.4.1.1 Soft Start
P3-02	Analog voltage speed filter (unit: 0.01ms)	4.4.4.3 Analog Voltage Speed Filter
P3-03	Speed command input deadband voltage (unit: 0.001V)	4.4.4.6 Speed Command Input Deadband Voltage

4.4.4.1 External Analog Speed Mode

Parameter	Setting Value	Meaning	Modification	Activation
P0-01	4	Speed control: External analog	Servo bb	Immediate
Function Overview The speed command is given by an external analog quantity. The analog voltage command input from the V-REF terminal is used as the signal for speed control to regulate the rotation speed.				

- Direction switching: Both positive/negative voltage and SPD-D (P5-27) can control the direction.
- For the hardware wiring part, refer to Section 3.2.4 Analog Input Circuit.

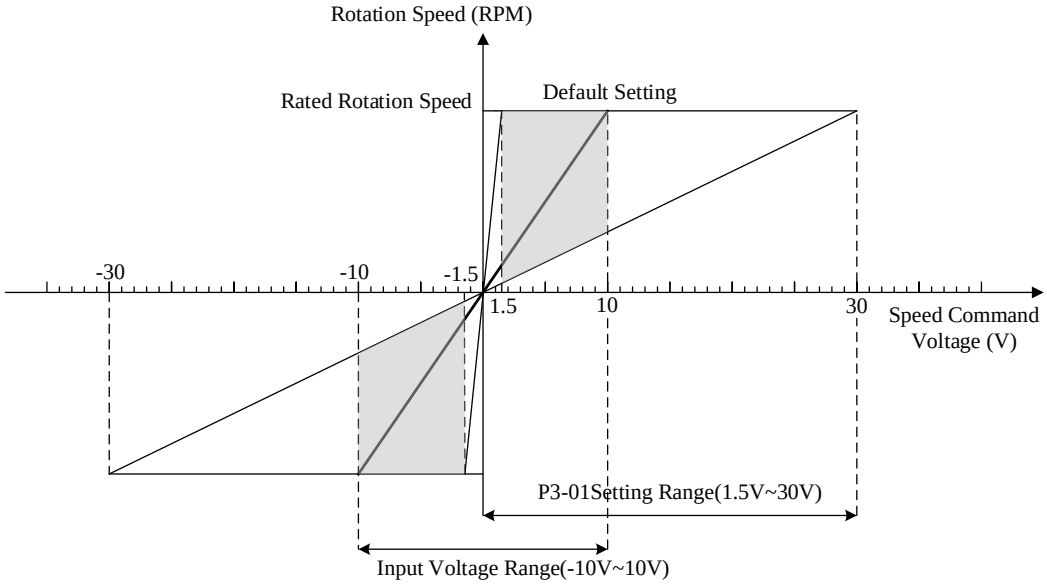
4.4.4.2 Digital Control for Analog Speed Mode (supported in version 3770 and later)

Parameter	Meaning	Factory Setting	Unit	Modification	Activation
P5-65	Digital control for analog speed mode	0	-	Servo bb	Immediate

4.4.4.3 Analog Quantity Corresponding to Rated Speed

Parameter	Meaning	Factory Setting	Unit	Setting Range	Modification	Activation
P3-00	V-REF function assignment	0	-	0~2	Servo bb	Immediate
P3-01	Analog voltage corresponding to rated speed	10000	0.001V	1500~30000	Servo bb	Immediate

Function Description: Set the speed command voltage (V-REF) required for the servo motor to operate at the rated speed.For example:
When P3-01=5000, it means the motor runs at the rated speed when the analog input voltage is 5.00V;
When P3-01=8000, it means the motor runs at the rated speed when the analog input voltage is 8.00V.



- The analog voltage command input for speed limiting has no polarity. The absolute value is taken for both positive and negative voltages, and the speed limit value based on this absolute value applies to both forward and reverse directions.
- The maximum allowable voltage for the analog input signal is ±10V. Do not apply a voltage exceeding ±10V.

4.4.4.4 Analog Voltage Speed Filter

Parameter	Meaning	Factory Setting	Unit	Setting Range	Modification	Activation
P3-02	Analog voltage speed filter	0	0.01ms	0~10000	Anytime	Immediate

4.4.4.5 Analog Speed Direction Switch

There are two ways to realize direction switching in analog speed control:① Positive/negative voltage;② /SPD-D (P5-27) pulse signal.

Parameter	Meaning	Factory Setting	Unit	Setting Range	Modification	Activation
P3-04	Analog speed direction switch	0	-	0~1	Anytime	Immediate

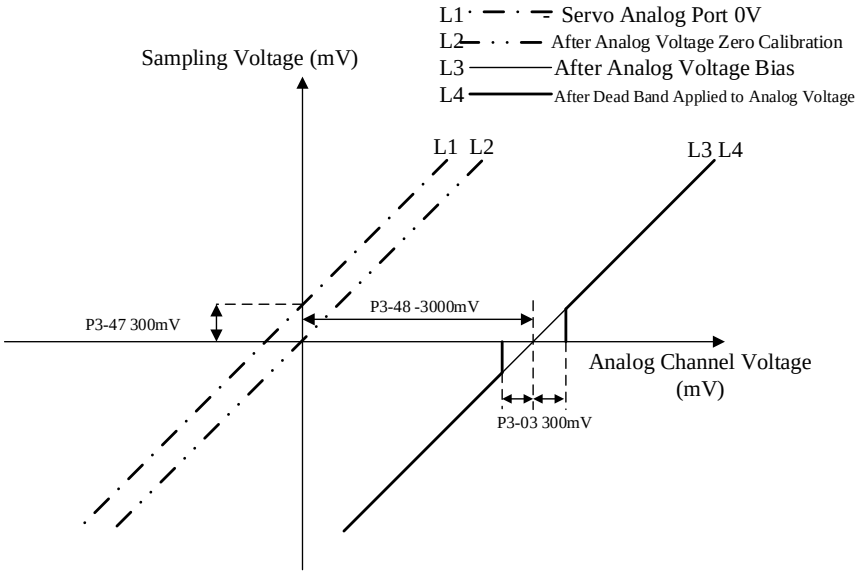
4.4.4.6 Speed Command Input Deadband Voltage

Parameter	Meaning	Factory Setting	Unit	Setting Range	Modification	Activation
P3-03	Speed command input deadband voltage	0	0.001V	0~500	Anytime	I
P3-47	V-REF analog zero drift calibration	0	-	-1000~1000	Anytime	Immediate
P3-48	V-REF analog voltage offset	0	mV	-9999~9999	Anytime	Immediate

Note:

(1) When the input speed command voltage is within the range set by this parameter, the input command is regarded as 0.

(2) If there is still slight movement after the automatic offset adjustment, appropriately increase the deadband voltage.



4.5 Torque control

Parameter	Overview	Reference chapter
P0-01 Control mode selection	Set to 1: internal torque mode	4.5.1.1
P3-33 Internal torque command	The given value is the percentage of rated torque	4.5.1.2
P3-16 Internal forward speed limit of torque control P3-17 Internal reverse speed limit of torque control P3-14 Forward max speed limit (MAX speed) P3-15 Reverse max speed limit (MAX speed)	Speed limit in torque mode	4.4.2.1
P5-27 Speed direction switch /SPD-D	Change the direction, default is n.0000 If it is given through SI2 terminal, P5-27 can be set to n.0002	

4.5.1 Torque control (internal setting)

Parameter	Set value	Function	Modify	Effective
P0-01	5	Torque control: internal setting	Servo bb	At once
Function: Control the torque by internal torque command.				

4.5.1.1 Internal torque command

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P3-33	Internal torque command	0	1% rated torque	-1000~+1000	Anytime	At once
The unit of this parameter is 1% of the rated torque. For example: P3-33=50, motor forward run with 50% of the rated torque; P3-33= -20, motor reverse run with 20% of the rated torque. In addition to using the torque to control the direction of servo operation, it can also use / SPD-D to control the direction.						

4.5.1.2 Internal speed limit of torque control

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P3-16	internal forward speed limit in torque control mode	Motor rated	rpm	5～65535	Anytime	At once
P3-17	internal reverse speed limit in torque control mode	Motor rated	rpm	5～65535	Anytime	At once
Note: Even if the setting speed of this parameter is greater than the speed limit of P3-14, the actual effective speed limit is the lower speed limit. (The maximum speed is the smaller value in P3-14/P3-15 and P3-16/P3-17)						

4.5.1.3 Speed reach signal output (/VLT)

In torque mode, when the absolute value of the actual speed of the servo motor exceeds the speed limit value, it is considered that the actual speed of the servo motor is limited. At this time, the servo driver

can output /VLT signal. Otherwise, if any condition is not met, the speed limit signal is invalid.

Parameter	Signal name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-43	/VLT	n.0000	1, 2	Speed limit detection	Anytime	At once
By default, no terminal is allocated, the parameter range is 0000-0014, and is allocated to the output interface through parameter P5-43. When set to 0002, the signal is output from the SO2 terminal. /VLT signal is only valid in torque mode.						

4.6 Bus control

CANopen is a high level protocol based on CAN (control LAN network) serial bus system and CAL (CAN application layer). CANopen assumes that the hardware of the connected devices has a CAN transceiver and a CAN controller which conform to ISO11898 standard.

CANopen communication protocol CiA DS-301 includes periodic and event driven communication, which can not only reduce the bus load to a minimum level, but also ensure a very short response time. It can achieve higher communication performance at lower baud rate, thus reducing the electromagnetic compatibility problem and reducing the cable cost.

CANopen device protocol defines the mechanism of direct access to servo parameters and time critical process data communication.

4.6.1 Object dictionary region assignment

CANopen communication mainly realizes the control of various parameters of servo motor through several operation modes, and realizes some other auxiliary functions. For more information, please refer to the CAN literature of the automation International Association of users and manufacturers (www.can-cia.de).

CAL provides all network management services and message delivery protocols, but does not define the content of the object or the type of object being communicated (it only defines how, and does not define what), which is the entry point of CANopen.

CANopen is developed on the basis of CAL, which uses a subset of CAL communication and service protocols, and provides a realization scheme of distributed control system. CANopen can ensure the interoperability of network nodes, and allow the function of nodes to be expanded randomly: simple or complex.

All objects of CANopen are configured in the object dictionary of each group through the 16bit Index address represented by 4-bit hexadecimal.

The object dictionary of CoE (CANopen over EtherCAT) specified in CiA402 and the object dictionary of DF3E series servo are as follows:

Object dictionary specified by CiA402		Object dictionary of DF3E series	
Index	Content	Index	Content
0000h～0FFFh	Data type area	0000h～0FFFh	Data type area
1000h～1FFFh	COE communication area	1000h～1FFFh	Data type area
2000h～5FFFh	Factory defined area	2000h～2FFFh	CANopen communication area
		3000h～3FFFh	Servo parameter area (group P)
		4000h～4FFFh	Servo parameter area (group U)
		5000h～5FFFh	Servo parameter area (group F)
6000h～9FFFh	Profile area	6000h～6FFFh	Reserved
		7000h～9FFFh	CiA402 motion control equipment sub-protocol area
A000h～FFFFh	Reserved	A000h～FFFFh	Reserved

4.6.1.1 CANopen communication area object dictionary list (DS301)

Index	Sub index	Object type	Name	Data type	Read/ write	PDO mapping
1000	-	VAR	Device type	UINT32	RO	NO
1001	-	VAR	Error register	UINT8	RO	NO
1003	-	ARRAY	Pre-defined Error Field	-	-	-
	01	VAR	Standard Error Field	UINT32	RO	NO

Index	Sub index	Object type	Name	Data type	Read/ write	PDO mapping
	02	VAR	Standard Error Field	UINT32	RO	NO
	03	VAR	Standard Error Field	UINT32	RO	NO
	04	VAR	Standard Error Field	UINT32	RO	NO
1005	-	VAR	COB-ID SYNC	UINT32	RW	NO
1006	-	VAR	Communication Cycle Period	UINT32	RW	NO
1007	-	VAR	Sync Windows Length	UINT32	RW	NO
1008	-	VAR	Manufacturer Device Name	STRING	-	-
1009	-	VAR	Manufacturer Hardware Version	STRING	-	-
100A	-	VAR	Manufacturer Software Version	STRING	-	-
100B	-	VAR	Device ID	UINT8	RW	NO
100C	-	VAR	Guard Time	UINT16	RW	NO
100D	-	VAR	Life Time Factor	UINT8	RW	NO
1010	-	ARRAY	Store Parameter Field	-	-	-
	01	VAR	Save All Parameters	UINT32	RW	NO
	02	VAR	Save Communication Parameters	UINT32	RW	NO
	03	VAR	Save APPlication Parameters	UINT32	RW	NO
1011	-	ARRAY	Restore Default Parameters	-	-	-
	01	VAR	Restore all Default Parameters	UINT32	RW	NO
	02	VAR	Restore Communication Default Parameters	UINT32	RW	NO
	03	VAR	Restore APPlication Default Parameters	UINT32	RW	NO
1014	-	VAR	COB-ID EMCY	UINT32	RW	NO
1017	-	VAR	Producer Heartbeat Time	UINT16	RW	NO
1018	-	-	Identity Object	-	-	-
	01	VAR	Vendor ID	UINT32	RO	NO
	02	VAR	Product Code	UINT32	RO	NO
	03	VAR	Revision Number	UINT32	RO	NO
	04	VAR	Serial Number	UINT32	RO	NO
1400	-	RECORD	1. receive PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1401	-	RECORD	2. receive PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1402	-	RECORD	3. receive PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1403	-	RECORD	4. receive PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1600	-	RECORD	1. receive PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO

Index	Sub index	Object type	Name	Data type	Read/ write	PDO mapping
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
1601	-	RECORD	2. receive PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
1602	-	RECORD	3. receive PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
1603	-	RECORD	4. receive PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
1800	-	RECORD	1. transmit PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1801	-	RECORD	2. transmit PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1802	-	RECORD	3. transmit PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1803	-	RECORD	4. transmit PDO parameter	-	-	-
	01	VAR	COB-ID used by PDO	UINT32	RW	NO
	02	VAR	transmission type	UINT8	RW	NO
1A00	-	RECORD	1. transmit PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO

Index	Sub index	Object type	Name	Data type	Read/ write	PDO mapping
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
1A01	-	RECORD	2. transmit PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
1A02	-	RECORD	3. transmit PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
1A03	-	RECORD	4. transmit PDO maPPing	-	-	-
	01	VAR	1. maPPed object	UINT32	RW	NO
	02	VAR	2. maPPed object	UINT32	RW	NO
	03	VAR	3. maPPed object	UINT32	RW	NO
	04	VAR	4. maPPed object	UINT32	RW	NO
	05	VAR	5. maPPed object	UINT32	RW	NO
	06	VAR	6. maPPed object	UINT32	RW	NO
	07	VAR	7. maPPed object	UINT32	RW	NO
	08	VAR	8. maPPed object	UINT32	RW	NO
Note: items marked with "-" in the table indicate that there are no related properties in the object dictionary.						

4.6.1.2 User defined area object dictionary list

The object dictionary of the user-defined area is one-to-one corresponding to the panel parameters of the servo driver, and only U group parameters in the object dictionary in this area have PDO mapping attributes, which can be read by PDO. Other object dictionaries can only operate based on SDO. The corresponding rules are as follows:

Object dictionary index	Corresponding panel parameters	
2000	Group P0 parameters	P0-00
2001		P0-01
……		……

Object dictionary index	Corresponding panel parameters	
205F		P0-95
2100	Group P1 parameters	P1-00
2101		P1-01
……		……
2142		P1-66
2200	Group P2 parameters	P2-00
2201		P2-01
……		……
2255		P2-85
2300	Group P3 parameters	P3-00
2301		P3-01
……		……
232D		P3-45
2500	Group P5 parameters	P5-00
2501		P5-01
……		……
2547		P5-71
2700	Group P7 parameters	P7-00
2701		P7-01
……		……
271F		P7-31
2800	Group P8 parameters	P8-00
2801		P8-01
……		……
2817		P8-23
3000	Group U0 parameters	U0-00
3001		U0-01
……		……
3061		U0-97
3100	Group U1 parameters	U1-00
3101		U1-01
4000	Group F0 parameters	F0-00
4105	Group F1 parameters	F1-05
4106		F1-06

4.6.1.3 Motion control device sub-protocol object dictionary list (CiA402)

Index	Sub-Index	Type	Name/Description	DateType	Access	PDO	Op-mode
6040h	00h	VAR	Controlword	U16	rw	YES	All
			Control word. Refer to chapter 4.6.2.2				
6041h	00h	VAR	Statusword	U16	ro	YES	All
			Status word. Refer to chapter 4.6.2.3				
605Ah	00h	VAR	Quickstop Option Code	I16	rw	NO	All
			To select the action when servo system responses urgent stop command. Default value id 2, refer to chapter 4.6.2.5				
605Bh	00h	VAR	Shutdown option code	I16	rw	NO	All
			Set the motor deceleration stop mode when receiving PDS command 「				

Index	Sub-Index	Type	Name/Description	DateType	Access	PDO	Op-mode
			Shutdown」,「Disable voltage」. Default value is 0, refer to chapter 4.6.2.5				
605Ch	00h	VAR	Disable operation option code	I16	rw	NO	All
			Set the motor deceleration stop mode when receiving PDS command 「Disable operation」, default value is 1, refer to chapter 4.6.2.5				
605Dh	00h	VAR	Halt option code	I16	rw	NO	All
			Set the motor deceleration stop mode when receiving command 「Halt」, default value is 1, refer to chapter 2-5				
605Eh	00h	VAR	Fault reaction option code	I16	rw	NO	All
			Set the motor stop mode when alarm occurs. Default value is 2, refer to chapter 4.6.2.5				
6060h	00h	VAR	Modes of Operation	I8	rw	YES	All
			To set the servo driver control mode. Refer to chapter 4.6.2.4				
6061h	00h	VAR	Modes of Operation Display	I8	ro	YES	All
			To show the servo driver present control mode. Refer to chapter 4.6.2.4				
6062h	00h	VAR	Position Demand Value	I32	rw	YES	PP, HM
			The output value of the position track generator.				
6063h	00h	VAR	Position Actual Internal Value	I32	ro	YES	All
			Internal actual position of servo motor feedback, which is the feedback of position loop.				
6064h	00h	VAR	Position Actual Value	I32	ro	YES	All
			Actual position of servo motor feedback.				
606Bh	00h	VAR	Velocity Demand Value	I32	ro	YES	PV
			Output value of speed trajectory generator, which is the input of speed loop.				
606Ch	00h	VAR	Velocity Actual Value	I32	ro	YES	All
			Actual speed of servo motor feedback, which is the feedback of speed loop.				
6071h	00h	VAR	Target Torque	I16	rw	YES	TQ
			When the servo driver is in TQ mode, the user's target torque input, the unit is 0.1% of the rated torque, which is only valid in TQ mode.				
6072h	00h	VAR	Max Torque	U16	rw	YES	All
			The maximum torque that the servo drive system can produce, the unit is 0.1% of the rated torque. The default value is 3000, which is 300% of the rated torque.				
6073h	00h	VAR	Max Current	U16	rw	YES	All
			The maximum current that the servo motor can bear, the unit is 0.1% of the rated current. The default value is 3000, which is 300% of the rated current.				
6074h	00h	VAR	Torque Demand Value	I16	rw	YES	All
			Torque command, input of torque loop, unit is 0.1% of rated torque.				
6075h	00h	VAR	Motor Rated Current	U32	ro	YES	All
			The rated current of the servo motor is set automatically by the system according to the parameters of the servo motor. Generally, it does not need to be set by the user. The unit is 0.1% of the rated current.				
6076h	00h	VAR	Motor Rated Torque	U32	ro	YES	All
			The rated torque of servo motor is set automatically according to the parameters of servo motor, and it is not required to be set by users generally, the unit is 0.1% of rated torque.				
6077h	00h	VAR	Torque Actual Value	I16	ro	YES	All
			The actual torque of the servo motor, that is, the feedback of the torque loop, the unit is 0.1% of the rated torque.				
6078h	00h	VAR	Current Actual Value	I16	ro	YES	All
			Actual quadrature axis current of servo motor, the unit is 0.1% of rated				

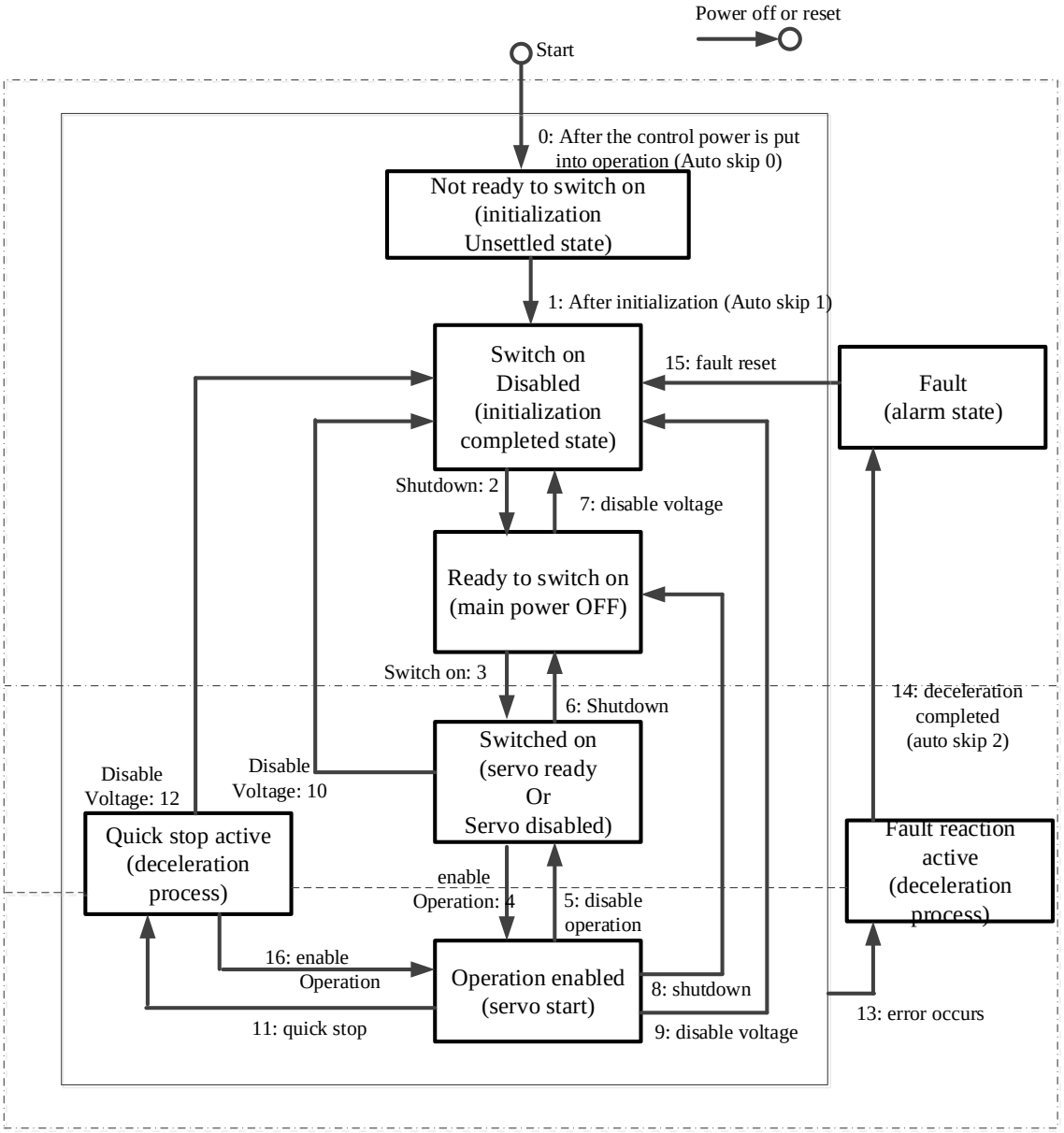
<table>
<tr><th>Index</th><th>Sub-Index</th><th>Type</th><th>Name/Description</th><th>DateType</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td></td><td></td><td></td><td colspan="5">current.</td></tr>
<tr><td rowspan="2">6079h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>DC Link Circuit Voltage</td><td>U32</td><td>ro</td><td>YES</td><td>All</td></tr>
<tr><td colspan="5">DC bus voltage of servo driver, the unit is 0.001V.</td></tr>
<tr><td rowspan="2">607Ah</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Target Position</td><td>I32</td><td>rw</td><td>YES</td><td>PP</td></tr>
<tr><td colspan="5">The user's target position when the servo driver is in PP mode, the unit is the command unit, which is only valid in PP mode.</td></tr>
<tr><td rowspan="2">607Eh</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Polarity</td><td>U8</td><td>rw</td><td>YES</td><td>All</td></tr>
<tr><td colspan="5">User instruction polarity, which has 8 bits, is shown in the following table:
<table>
<tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit0-4</th></tr>
<tr><td>position polarity</td><td>velocity polarity</td><td>torque polarity</td><td>reserved</td></tr>
</table>
When BitX (X = 5, 6, 7) is 0, user instruction is forward.
When BitX (X = 5, 6, 7) is 1, user instruction is reverse.</td></tr>
<tr><td rowspan="2">607Fh</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Max Profile Velocity</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td colspan="5">The maximum speed of the servo motor in the process of operation, the unit is the command unit/s, which is effective in the control mode other than TQ. The default value is 1000000 (0xF4240).</td></tr>
<tr><td rowspan="2">6080h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Max Motor Speed</td><td>U32</td><td>rw</td><td>YES</td><td>ALL</td></tr>
<tr><td colspan="5">The maximum speed of servo motor in operation, unit: r/ min. The default value is 6000 (0x1770).</td></tr>
<tr><td rowspan="2">6081h</td><td rowspan="2">00h</td><td>VAR</td><td>Profile Velocity</td><td>U32</td><td>rw</td><td>YES</td><td>PP</td></tr>
<tr><td></td><td colspan="5">In the process of position trajectory planning, the speed reached when the motor acceleration process is completed the unit is command unit/s, which is only valid in PP mode.</td></tr>
<tr><td rowspan="2">6083h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Profile Acceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV</td></tr>
<tr><td colspan="5">In position trajectory planning or speed trajectory planning, the acceleration speed in the process of motor acceleration. The unit is command unit/s2, which is only valid in PP mode and PV mode. The default value is 5000000.</td></tr>
<tr><td rowspan="2">6084h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Profile Deceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV</td></tr>
<tr><td colspan="5">In position trajectory planning or speed trajectory planning, the deceleration speed in the process of motor deceleration. The unit is command unit/s2, which is only valid in PP mode and PV mode. The default value is 5000000.</td></tr>
<tr><td rowspan="2">6085h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Quick Stop Declaration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td colspan="5">The deceleration speed when the servo drive system responds to the emergency stop command. The unit is command unit/s2, which is effective in control mode other than TQ. The default is 10000000.</td></tr>
<tr><td rowspan="2">6087h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Torque Slope</td><td>U32</td><td>rw</td><td>YES</td><td>TQ</td></tr>
<tr><td colspan="5">The torque change rate used in the servo drive system, the unit is 0.1% of the rated torque, which is only effective in TQ mode.</td></tr>
<tr><td rowspan="2">6098h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Homing Method</td><td>I8</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td colspan="5">It is used to set the zero return mode of servo drive system, which is only valid in HM mode.</td></tr>
<tr><td rowspan="6">6099h</td><td rowspan="2">00h</td><td rowspan="2">RECORD</td><td>Homing Speeds</td><td>-</td><td>-</td><td>-</td><td>HM</td></tr>
<tr><td colspan="5">It has two sub indexes, which are only valid in HM mode.</td></tr>
<tr><td rowspan="2">01h</td><td rowspan="2">VAR</td><td>Speed during Search Switch</td><td>U32</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td colspan="5">The speed of servo motor when looking for switch signal, the unit is command unit/s. The default value is 10000.</td></tr>
<tr><td rowspan="2">02h</td><td rowspan="2">VAR</td><td>Speed during Search Zero</td><td>U32</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td colspan="5">The speed of servo motor when looking for zero signal, the unit is command unit/s. The default value is 5000.</td></tr>
<tr><td rowspan="2">609Ah</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Homing Acceleration</td><td>U32</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td colspan="5">The acceleration and deceleration speed used by servo motor in return to zero motion. The unit is command unit/s2, which is only valid in HM</td></tr>
</table>

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Type</th><th>Name/Description</th><th>DateType</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td></td><td></td><td></td><td colspan="5">mode. The default value is 20000.</td></tr>
<tr><td rowspan="2">60C5h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Max Acceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td colspan="5">The maximum allowable acceleration speed of servo motor during acceleration, the unit is command unit/s2, it is valid in PP, PV and HM modes. The default value is 4294967295.</td></tr>
<tr><td rowspan="2">60C6h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Max Deceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td colspan="5">The maximum allowable deceleration speed of servo motor during deceleration, the unit is command unit/s2, it is valid in PP, PV and HM modes. The default value is 4294967295.</td></tr>
<tr><td rowspan="2">60F4h</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Following Error Actual Value</td><td>I32</td><td>ro</td><td>YES</td><td>PP,HM</td></tr>
<tr><td colspan="5">The position deviation of servo drive system in position control, which is 0x60f4 = 0x6062 – 0x6064, it is effective in PP and HM modes.</td></tr>
<tr><td rowspan="2">60FCh</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Position Demand Internal Value</td><td>I32</td><td>ro</td><td>YES</td><td>PP,HM</td></tr>
<tr><td colspan="5">The motion polarity processing result of object dictionary 0x607E(Polarity) processed 0x6062, it is the input of position loop.</td></tr>
<tr><td rowspan="2">60FDh</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Digital Inputs</td><td>U32</td><td>ro</td><td>YES</td><td>All</td></tr>
<tr><td colspan="5">To represent the input status of POT, NOT, SPD-D through the function signal distributed by panel parameter P5-22 (POT), P5-23 (NOT), P5-27 (SPD-D), it is 32-bit, shown as the following:
<table>
<tr><th>Bit31~Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr>
<tr><td>reserved</td><td>SPD-D</td><td>POT</td><td>NOT</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">60FFh</td><td rowspan="2">00h</td><td rowspan="2">VAR</td><td>Target Velocity</td><td>I32</td><td>rw</td><td>YES</td><td>PV</td></tr>
<tr><td colspan="5">The user's target speed when the servo driver is in PV mode, the unit is instruction unit/s, which is only valid in PV mode.</td></tr>
</table>

4.6.2 CiA402 motion control explanation

4.6.2.1 PDS (Power Drive Systems) specification

The core of CiA402 motion control protocol is PDS (power drive system) state machine, which defines and controls the state of servo drive system and the transformation between different states. The transformation of PDS state machine depends on 0x6040 (control word) drive. The detailed transformation relationship between the eight states is shown in the figure below:



After migration to Operation enabled, please raise to more than 100ms and input action command.
The following table shows the PDS state migration event (migration condition) and the action at migration time.
PDS migration, while getting handshake, the status migration is performed (through 6041h: Statusword confirm that the status has been converted, and send the next migration instruction).

PDS conversion		Event	Action
0	Auto skip 0	After the power supply is put into operation, or after the application layer is reset, it will migrate automatically.	After the power supply is put into operation, or after the application layer is reset, it will migrate automatically.
1	Auto skip 1	Automatic conversion after initialization.	Communication was established.
2	Shutdown	Receiving the shutdown command.	Nothing special.
3	Switch on	When the power supply is on, it receives the switch on command.	Nothing special.
4	Enable operation	Receiving Enable operation command.	The driving function is effective. In addition, all previous set point data are cleared.
5	Disable operation	Receiving Disable operation command.	Driving function is ineffective.
6	Shutdown	When the power supply is on, it receives the shutdown command. Power off is	Nothing special.

PDS conversion		Event	Action
		detected.	
7	Disable voltage	Receiving Disable voltage command. Receiving Quick stop command.	Nothing special.
8	Shutdown	When the power supply is on, it receives the shutdown command.	Driving function is ineffective.
9	Disable voltage	Receiving Disable voltage command.	Driving function is ineffective.
10	Disable voltage	Receiving Disable voltage command. Receiving Quick stop command.	Nothing special.
11	Quick stop	Receiving Quick stop command.	Execute Quick stop function.
12	Disable voltage	Quick stop selection code is 1, 2, 3 and Quick stop action completed. Quick stop selection code is 5, 6, 7 and Quick stop action completed, receive Disable voltage command. Power off is detected.	Driving function is ineffective.
13	Error occurs	Abnormal detection.	Execute Fault reaction function.
14	Auto skip 2	After the completion of abnormal detection and deceleration processing, it will automatically migrate.	Driving function is ineffective.
15	Fault reset	Receiving the fault reset instruction after the fault occurrence factor is removed.	The fault factor does not exist, reset the fault state.
16	Enable operation	Quick stop selection code is 5, 6, 7, receive Enable operation command.	Driving function is effective.

4.6.2.2 Controlword (6040h)

The command to control the slave station (servo driver), PDS status migration is set through 6040h (control word).

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
6040h	00h	Controlword	0~65535	U16	rw	RxPDO	All

Set the control command of servo driver such as PDS state transition.
Bit information

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

r = reserved (No correspondence)
oms = operation mode specific (control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on

Command	bits of the controlword					PDS conversion
	bit7	bit3	bit2	bit1	bit0	
	fault reset	Enable operation	quick stop	Enable voltage	Switch on	
Shutdown	0	-	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3+4
Enable operation	0	1	1	1	1	4, 16
Disable voltage	0	-	-	0	-	7, 9, 10, 12
Quick stop	0	-	0	1	-	7, 10, 11
Disable operation	0	0	1	1	1	5
Fault reset	0->1	-	-	-	-	13

- The bit logic of quick stop command is effective under 0.
- Please note that the other bit logic and the opposite actions are performed.

bit8(halt):

- At 1, the motor deceleration pause is performed through 605Dh (Halt selection code).
- After pause, return to 0 and start the action.
- However, the operation is interrupted through 1 in HM control mode, and even if 0 is returned, it cannot be opened again.

Bit6-4 (operation mode specific):

The following shows the change of inherent OMS bit in OP mode (For details, please refer to the chapter of related objects of each control mode.)

Op-mode	Bit6	Bit5	Bit4
PP	absolute /elative	change set immediately	new set-point
PV	-	-	-
TQ	-	-	-
HM	-	-	start homing

4.6.2.3 Statusword (6041h)

The command to control the slave station (servo driver), PDS status migration is set through 6040h (control word).

Index	Sub-Index	Name/ Description	Range	Date Type	Access	PDO	Op-mode
6041h	00h	Statusword	0~65535	U16	ro	TxPDO	All

Indicates the status of the servo driver.
Bit information

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

r = reserved(No correspondence)
oms = operation mode specific (control mode based on bit)
ila = internal limit active
tr= target reached
rm = remote
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = fault
oe = operation enabled
so = switched on
rtso = ready to switch on

bit6,5,3-0 (switch on disabled/quick stop/fault/operation enabled/switched on/ready to switch on): confirm the PDS status according to this Bit. The status and corresponding bit are shown below.

StatusWord	PDS State	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Initialization incomplete state
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization complete state
xxxx xxxx x01x 0001 b	Ready to switch on	Initialization complete state
xxxx xxxx x01x 0011 b	Switched on	Servo enable OFF/servo ready
xxxx xxxx x01x 0111 b	Operation enabled	Servo enable ON
xxxx xxxx x00x 0111 b	Quick stop active	Stop at once
xxxx xxxx x0xx 1111 b	Fault reaction active	Fault (alarm) judgement
xxxx xxxx x0xx 1000 b	Fault	Fault (alarm) status

The PDS state machine of DF3E series servo can be monitored through U0-99, and the specific meaning can be referred to the following table:

U0-99	Description
0x01	NOT READY TO SWITCH ON
0x02	SWITCH ON DISABLED
0x04	READY TO SWITCH ON
0x08	SWITCHED ON
0x10	OPERATION ENABLED
0x20	QUICK STOP ACTIVE
0x40	FAULT REACTION ACTIVE
0x80	FAULT

bit4 (voltage enabled): at 1, indicates that the power supply voltage is applied to the PDS.
bit5 (quick stop): at 0, indicates PDS receives quick stop requirements. The bit logic of quick stop is effective under 0. Please note that other bit logic and opposite actions are performed.
bit11(internal limit active): it is subject to internal restrictions.
bit13,12(operation mode specific): the following indicates the change of inherent OMS bit in control mode. (For details, please refer to the chapter of related objects of each control mode.)

Op-mode	bit13	bit12
PP	-	set-point acknowledge
PV	-	-
TQ	-	-
HM	homing error	homing attained

4.6.2.4 Control mode setting

1. Modes of operation (6060h)

The control mode is set through 6060h(Modes of operation).

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
6060h	00h	Mode of operation	-128~127	I8	rw	RxPDO	All

Set the control mode of servo driver.
Non corresponding control mode setting is prohibited.

bit	Mode of operation	abbreviation	corresponding
-128~ -1	Reserved	-	-
0	No mode changed/No mode assigned (No control mode change/no control mode assignment)	-	-
1	Profile position mode (Profile position control mode)	PP	YES
3	Profile velocity mode (Profile speed control mode)	PV	YES
4	Torque profile mode (Profile torque control mode)	TQ	YES
6	Homing mode (origin reset position mode)	HM	YES
7~127	Reserved	-	-

As 6060h (Modes of operation) is default = (No mode change/no mode assigned), please set the control mode value after the power is put into use. When the setting value of 6060h and 6061h is 0, if the PDS status is migrated to Operation enabled, E-881 will occur (control mode setting fault protection).
After the initial state 6060h=0 (No mode assigned) converted to supportable control mode (PP, PV, TQ, HM), set 6060h=0 again, this case is seemed as “No mode changed”. Switching of control mode cannot be performed. (keep previous control mode).

2. Modes of operation display (6061h)

The confirmation of servo driver internal control mode is performed as 6061h (Modes of operation display).

After 6060h (Modes of operation) is set, please confirm whether the action of this object is feasible through detecting.

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
6061h	00h	Mode of operationdisplay	-128~127	I8	ro	TxPDO	All

Indicates the present control mode.

bit	Mode of operation	abbreviation	corresponding
-128~ -1	Reserved	-	-
0	No mode changed/No mode assigned (No control mode change/no control mode assignment)	-	-
1	Profile position mode (Profile position control mode)	PP	YES
3	Profile velocity mode (Profile speed control mode)	PV	YES
4	Torque profile mode (Profile torque control mode)	TQ	YES
6	Homing mode (origin reset position mode)	HM	YES
7~127	Reserved	-	-

4.6.2.5 Selection code (deceleration stop time setting)

PDS is a motor deceleration stop method in operation enabled state (servo enable is on) when the main power interruption or alarm occurrence.
The deceleration function (dynamic brake stop, free running stop, instant stop) and deceleration function (selection code) defined by CoE (CiA402) are used together.

■ **PDS selection code list**

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
605Ah	00h	Quick stop option code	0-7	I16	rw	NO	All
605Bh	00h	Shutdown option code	0-1	I16	rw	NO	All
605Ch	00h	Disable operation option code	0-1	I16	rw	NO	All
605Dh	00h	Halt option code	1-3	I16	rw	NO	All
605Eh	00h	Fault reaction option code	0-2	I16	rw	NO	All

■ **Other related objects list**

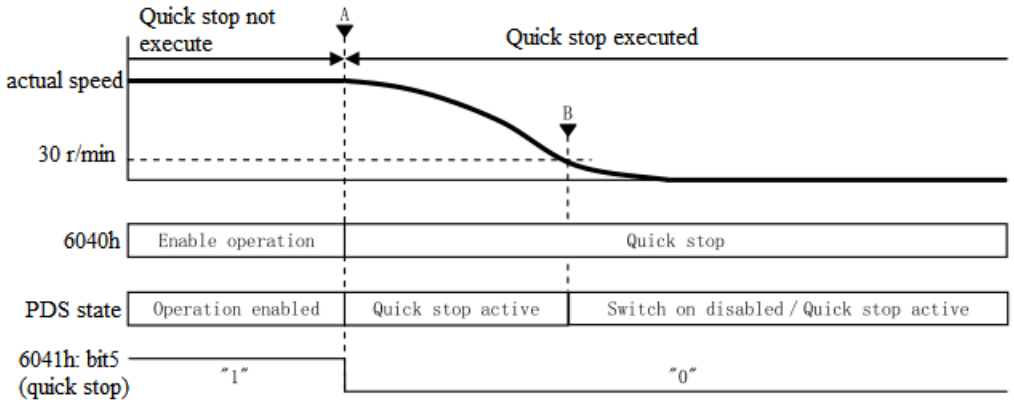
Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
6084h	00h	Profile deceleration	0 – 4294967295	U32	rw	RxPDO	All
6085h	00h	Quick stop deceleration	0 – 4294967295	U32	rw	RxPDO	All
6087h	00h	Torque slope	0 – 4294967295	U32	rw	RxPDO	All
609Ah	00h	Homing acceleration	0 – 4294967295	U32	rw	RxPDO	All
60C6h	00h	Max deceleration	0 – 4294967295	U32	rw	RxPDO	All

1. Quick stop option code (605Ah)

The motor deceleration stop mode when PDS command「Quick Stop」is receiving.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="15">605Ah</td><td rowspan="15">00h</td><td>Quick stop option code</td><td>0-7</td><td>I16</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">Sets the timing of Quick stop. It is different according to the definition of control mode. Set prohibition outside of the following values.
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Stop immediately and migrate the PDS state to Switch on disabled</td></tr>
<tr><td rowspan="3">1</td><td>Control mode is PP, PV: after motor stop through 0x6084 (Profile Deceleration), PDS state migrates to Switch on disabled</td></tr>
<tr><td>Control mode is HM: after motor stop through 0x609A (Homing Acceleration), PDS state migrates to Switch on disabled</td></tr>
<tr><td>Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on disabled</td></tr>
<tr><td rowspan="2">2</td><td>Control mode is PP, PV, HM: after motor stop through 0x6085 (Quick Stop Declaration), PDS state migrates to Switch on disabled</td></tr>
<tr><td>Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on disabled</td></tr>
<tr><td rowspan="2">3</td><td>Control mode is PP, PV, HM: after motor stop through 0x60C6 (Max Deceleration), PDS state migrates to Switch on disabled</td></tr>
<tr><td>Control mode is TQ: after motor stop through torque 0, state migrates to Switch on disabled</td></tr>
<tr><td rowspan="3">5</td><td>Control mode is PP, PV: after motor stop through 0x6084 (Profile Deceleration), PDS state migrates to Quick stop active</td></tr>
<tr><td>Control mode is HM: after motor stop through 0x609A (Homing Acceleration), PDS state migrates to Quick stop active</td></tr>
<tr><td>Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Quick stop active</td></tr>
<tr><td rowspan="2">6</td><td>Control mode is PP, PV, HM: after motor stop through 0x6085 (Quick Stop Declaration), PDS state migrates to Quick stop active</td></tr>
<tr><td>Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Quick stop active</td></tr>
<tr><td rowspan="2">7</td><td>Control mode is PP, PV, HM: after motor stop through 0x60C6 (Max Deceleration), PDS state migrates to Quick stop active</td></tr>
<tr><td>Control mode is TQ: after motor stop through torque 0, PDS state migrates to Quick stop active</td></tr>
</table></td></tr>
</table>

Examples of deceleration stop action according to Quick stop command:
If 6040h: bit2 (Controlword: quick stop) changes from 1 to 0 to slow down and stop.
The PDS status in deceleration changes to Quick stop active.
The PDS status after stop is Switch on disabled or Quick stop active.

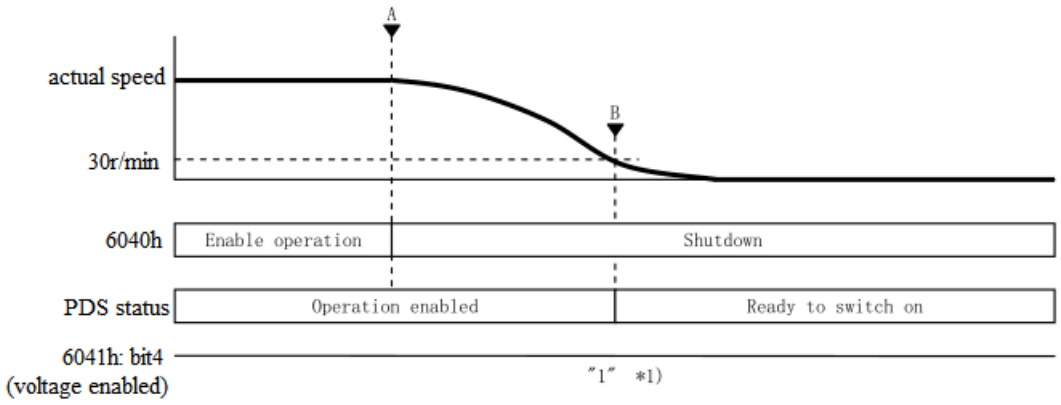


2. Shutdown option code (605Bh)

The motor stop mode when receiving PDS command「Shutdown」,「Disable voltage」.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="4">605Bh</td><td rowspan="4">00h</td><td>Shutdown option code</td><td>0-1</td><td>I16</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">Set the time sequence of「Shutdown」,「Disable voltage」. It is different according to the definition of control mode.
The setting is prohibited except the following values.
(1) PDS command「Shutdown」is receiving
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Stop at once, PDS state migrates to Ready to switch on.</td></tr>
<tr><td rowspan="3">1</td><td>The control mode is PP, PV: motor stop through 0x6084 (Profile deceleration), PDS state migrates to Ready to switch on.</td></tr>
<tr><td>The control mode is HM: motor stop through 0x609Ah (Homing acceleration), PDS state migrates to Ready to switch on.</td></tr>
<tr><td>The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS state migrates to Ready to switch on.</td></tr>
</table>
(2) PDS command「Disable voltage」is receiving.
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Stop at once, PDS state migrates to Switch on disabled.</td></tr>
<tr><td rowspan="3">1</td><td>The control mode is PP, PV: motor stop through 0x6084 (Profile deceleration), PDS state migrates to Switch on disabled.</td></tr>
<tr><td>The control mode is HM: motor stop through 0x609Ah (Homing acceleration), PDS state migrates to Switch on disabled.</td></tr>
<tr><td>The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on disabled.</td></tr>
</table></td></tr>
</table>

Examples of deceleration stop action according to the shutdown command:
If the PDS command "shutdown" is received, it will start to decelerate and stop.
PDS status during deceleration remains Operation enabled.
The PDS status after stop is Ready to switch on.



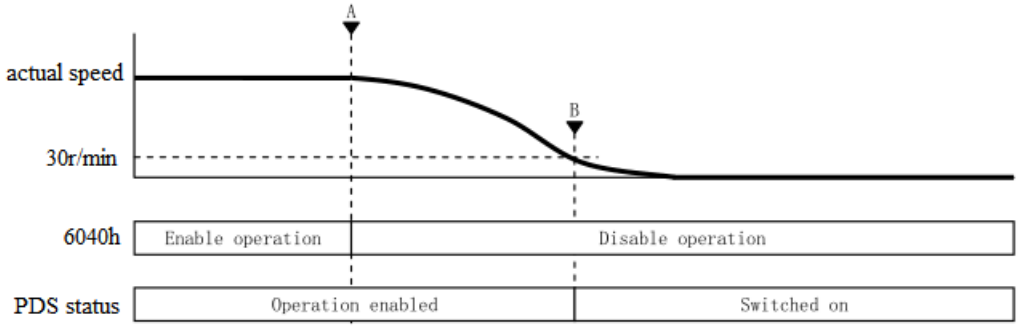
6041h: bit4(Statusword: voltage enabled) is still 1, not changed.

3. Disable operation option code (605Ch)

Set the motor deceleration stop mode when receiving PDS command「Disable operation」.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">605Ch</td><td rowspan="2">00h</td><td>Disable operation option code</td><td>0-1</td><td>I16</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">Set the time sequence of「Disable operation」. It is different according to the definition of control mode.
The setting is prohibited except the following values.
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Stop at once, PDS state migrates to Switch on.</td></tr>
<tr><td rowspan="3">1</td><td>The control mode is PP, PV: motor stop through 0x6084 (Profile deceleration), PDS state migrates to Switch on.</td></tr>
<tr><td>The control mode is HM: motor stop through 0x609Ah (Homing acceleration), PDS state migrates to Switch on.</td></tr>
<tr><td>The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on.</td></tr>
</table></td></tr>
</table>

Examples of deceleration stop action according to the Disable operation command:
If the PDS command「Disable operation」is received, it will start to decelerate and stop.
PDS status during deceleration remains Operation enabled.
The PDS status after stop is Switched on.



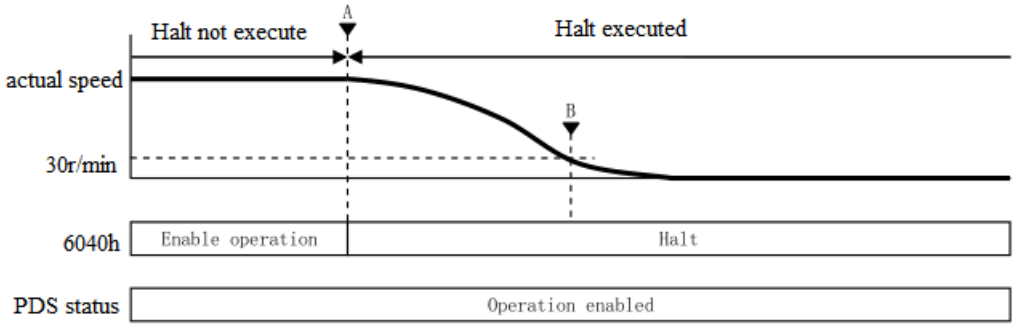
4. Halt option code (605Dh)

Set the motor deceleration stop mode when 6040h (Controlword) bit8 (Halt) is 1.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">605Dh</td><td rowspan="2">00h</td><td>Halt option code</td><td>1-3</td><td>I16</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">Set the time sequence of Halt. It is different according to the definition of control mode.
The setting is prohibited except the following values.
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td rowspan="3">1</td><td>The control mode is PP, PV: motor stop through 0x6084 (Profile Deceleration), PDS status migrates to Operation enabled</td></tr>
<tr><td>The control mode is HM: motor stop through 0x609A (Homing Acceleration), PDS status migrates to Operation enabled</td></tr>
<tr><td>The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS status migrates to Operation enabled</td></tr>
<tr><td rowspan="2">2</td><td>The control mode is PP, PV, HM: motor stop through 0x6085 (Quick Stop Declaration), PDS status migrates to Operation enabled</td></tr>
<tr><td>The control mode is CST, TQ: motor stop through 0x6087 (Torque</td></tr>
</table></td></tr>
</table>

			Slope), PDS status migrates to Operation enabled	
		3	The control mode is PP, PV, HM: motor stop through 0x60C6 (Max Deceleration), PDS status migrates to Operation enabled	
			The control mode is TQ: motor stop through torque 0, status migrates to Operation enabled	

Examples of deceleration stop action according to Halt function:
If 6040h: bit8(Controlword: halt) changes from 0 to 1, it will start to decelerate and stop.
PDS status during deceleration remains Operation enabled.
The PDS status after stop is Operation enabled.



5. Fault reaction option code (605Eh)

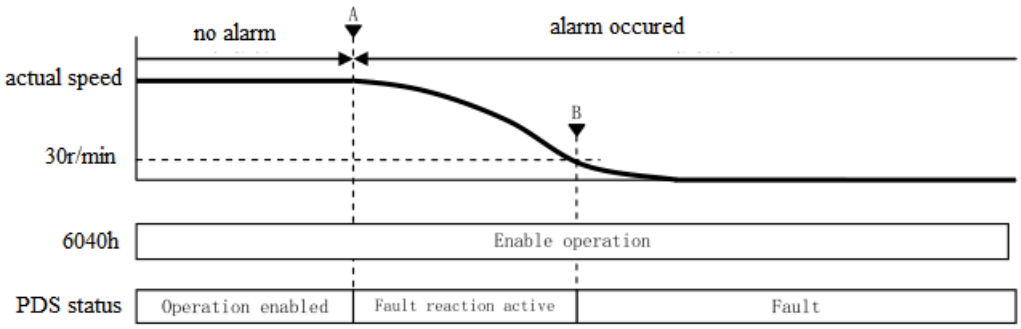
Set the motor stop method when the alarm occurs.

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
605Eh	00h	Fault reaction option code	0-2	I16	rw	NO	All

Set the time sequence when the alarm occurs. It is different according to the definition of control mode.
The setting is prohibited except the following values.

Value	Definition
0	Stop at once, PDS status migrates to Fault.
1	The control mode is PP, PV: motor stop through 0x6084 (Profile deceleration), PDS status migrates to Fault.
	The control mode is HM: motor stop through 0x609Ah (Homing acceleration), PDS status migrates to Fault.
	The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS status migrates to Fault.
2	The control mode is PP, PV, HM: motor stop through 6085h (Quick stop deceleration), PDS status migrates to Fault.
	The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS status migrates to Fault.

Examples of deceleration stop action when alarm occurs:
It will start to decelerate and stop when the alarm occurs.
PDS status during deceleration is Fault reaction active.
The PDS status after stop is Fault.



4.6.3 CIA402 motion control mode

4.6.3.1 PP mode

PP (Profile position control mode) is a position control mode in which the target position, target speed, acceleration and deceleration are specified, and the position command is generated inside the servo driver.

1. Related parameters

PP control mode related objects (command · setting type)

Register	Explanation	Unit
RXPDO[0x6040]	Control word	-
RXPDO[0x6060]	Set to 1	-
RXPDO[0x607A]	Position setting	Command unit
RXPDO[0x6072]	Max torque	0.1%
RXPDO[0x607F]	Max internal speed	Command unit/s
RXPDO[0x6080]	Max motor speed	r/min
RXPDO[0x6081]	Internal speed setting	Command unit/s
RXPDO[0x6083]	Internal acceleration speed	Command unit/s²
RXPDO[0x6084]	Internal deceleration speed	Command unit/s²
RXPDO[0x60C5]	Max acceleration speed	Command unit/s²
RXPDO[0x60C6]	Max deceleration speed	Command unit/s²

- 6081h (Profile velocity) is limited by the smaller one of 607Fh (Max profile velocity) and 6080h (Max motor speed).
- Changing the set value of 607Fh (Max profile velocity) or 6080h (Max motor speed) is not reflected in the action.

PP control mode related object (command · monitor type)

Register	Explanation	Unit
TXPDO[0x6041]	Status word	-
TXPDO[0x6061]	Mode query	
TXPDO[0x6063]	Internal actual position	Command unit
TXPDO[0x6064]	Position feedback (motor actual position)	Command unit
TXPDO[0x606C]	Speed feedback	Command unit /s
TXPDO[0x6077]	Actual torque	0.1%
TXPDO[0x60F4]	Actual following error	Command unit

2. Control word (6040h) <PP control mode function>

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6040h</td><td rowspan="2">00h</td><td>Controlword</td><td>0~65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="6">Set the control command of servo driver such as PDS state conversion.
Bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="7">r</td><td>h</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="2">fr</td><td colspan="3">oms</td><td rowspan="2">eo</td><td rowspan="2">qs</td><td rowspan="2">ev</td><td rowspan="2">so</td></tr>
<tr><td>Abs/rel</td><td>Change set immediately</td><td>New set point</td></tr>
</table>
r = reserved (Not corresponding)
oms = operation mode specific
(control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on</td></tr>
</table>

Bit4-6 (operation mode specific):

Bit	Name	Value	Definition
4	new set-point	0 -> 1	Trigger the positioning action start and setting value update. Get a new position decision task (607Ah (Target position), 6081h (Profile velocity)
5	change set immediately	0	Complete the currently running positioning action.
		1	Interrupt the current positioning action and start the downward positioning action immediately
6	absolute/ relative	0	607Ah (Target position) is processed as absolute position.
		1	607Ah (Target position) is processed as relative position.

Please do not change the acceleration and deceleration (*) during motor operation.
If you change the acceleration and deceleration, please change bit4 (new set point) from 0 - > 1 after the motor stops.
6083h (Profile acceleration)
6084h (Profile deceleration)
60C5h (Max acceleration)
60C6h (Max deceleration)

3. Status word (6041h) <PP control mode function>

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>Statusword</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the servo driver status.
Bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="3" rowspan="2">r</td><td>oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>set- point acknowledge</td><td>Target Reached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (Not corresponding)
oms = operation mode specific
(control mode based on bit)
ila = internal limit active
w = warning
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = fault</td></tr>
</table>

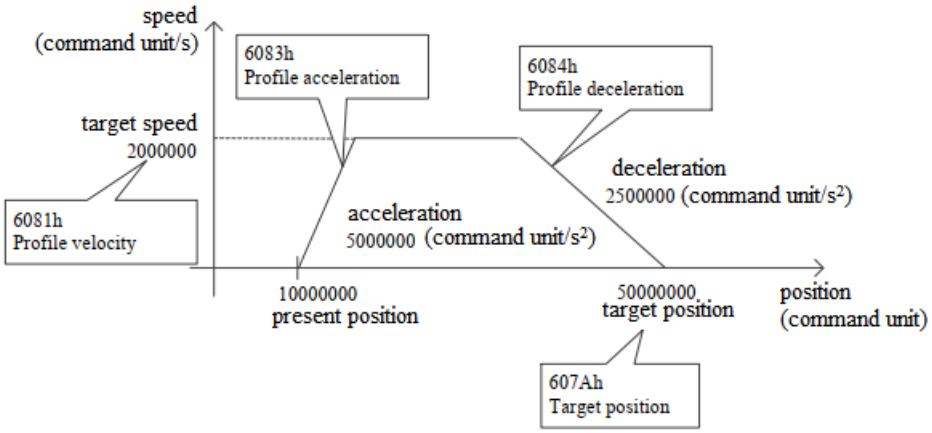
		rm = remote	oe = operation enabled so = switched on rtso = ready to switch on

bit12, 10 (operation mode specific):

Bit	Name	Value	Definition
10	target reached	0	halt=0 (normal): positioning not completed halt=1 (stop as halt): axis is decelerating
		1	halt=0 (normal): positioning completed halt=1 (stop as halt): axis stop (axis speed is 0)
12	set-point acknowledge	0	new-setpoint is 0 and the buffer is empty after executing the action of the current target position
		1	The new location task data is put into the buffer. The buffer is not empty

4. PP control mode action explanation

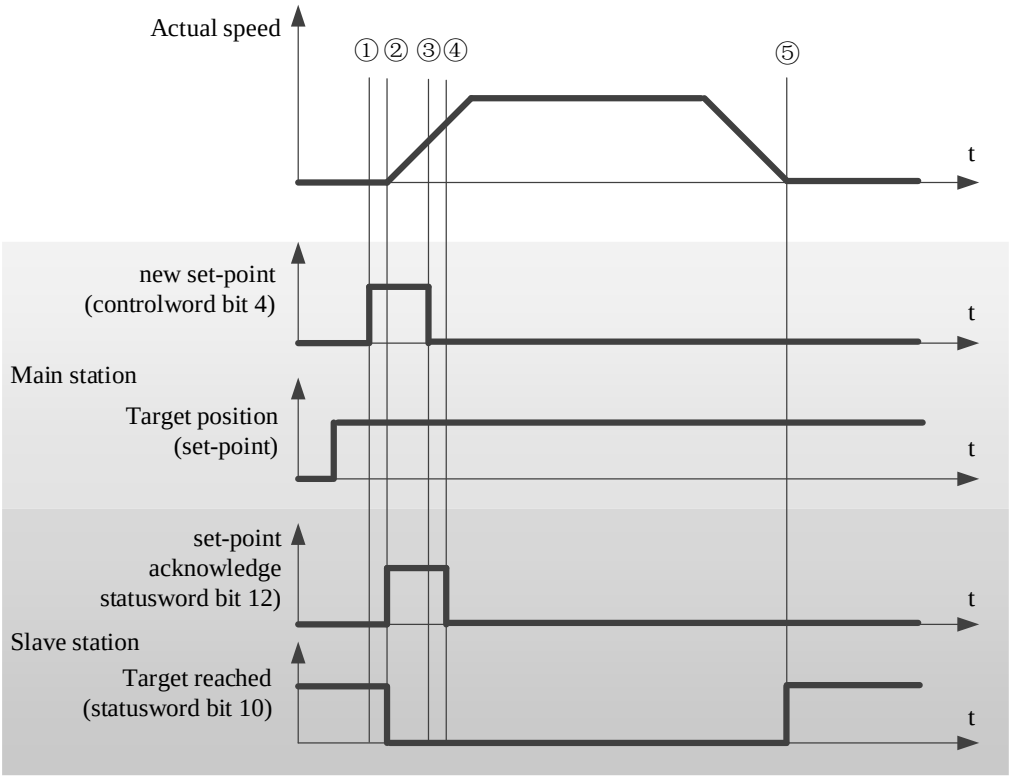
The working principles of object dictionary 0x607a, 0x6081, 0x6083 and 0x6084 are as follows:



The relative mode or absolute mode can be determined by bit6 (absolute / relative) of 6040h (control word).

Action 1: set-point

① Main station: set the value of 607Ah (Target position), change 6040h (Controlword) bit4 (new set-point) from 0 to 1. At this time, please set 6081h (Profile velocity).
② Motor has no action when 6081h (Profile velocity) is 0.
③ Slave station: confirm the rising edge of 6040h (Controlword) bit4 (new set-point) is from 0 to 1, 607Ah (Target position) is considered as target position to start positioning action. At this time, 6041h (status word) bit12 (set-point acknowledge) is from 0 to 1.
④ Main station: confirm 6041h (Statusword) bit12 (set-point acknowledge) is from 0 to 1, 6040h (Controlword) bit4 (new set-point) returns 0.
⑤ Slave station: confirm 6040h (Controlword) bit4 (new set-point) is 0, 6041h (status word) bit12 (set-point acknowledge) becomes to 0.
⑥ When reaching the target position, 6041h (Controlword) bit10 (target reached) changes from 0 to 1.



< Set-point example >

Action 2: Action data change without buffer: single set-point

When 6040h (Controlword) bit5 (change set immediately) is 1, if the positioning action data changed, interrupt the present positioning action, start the next positioning action at once.

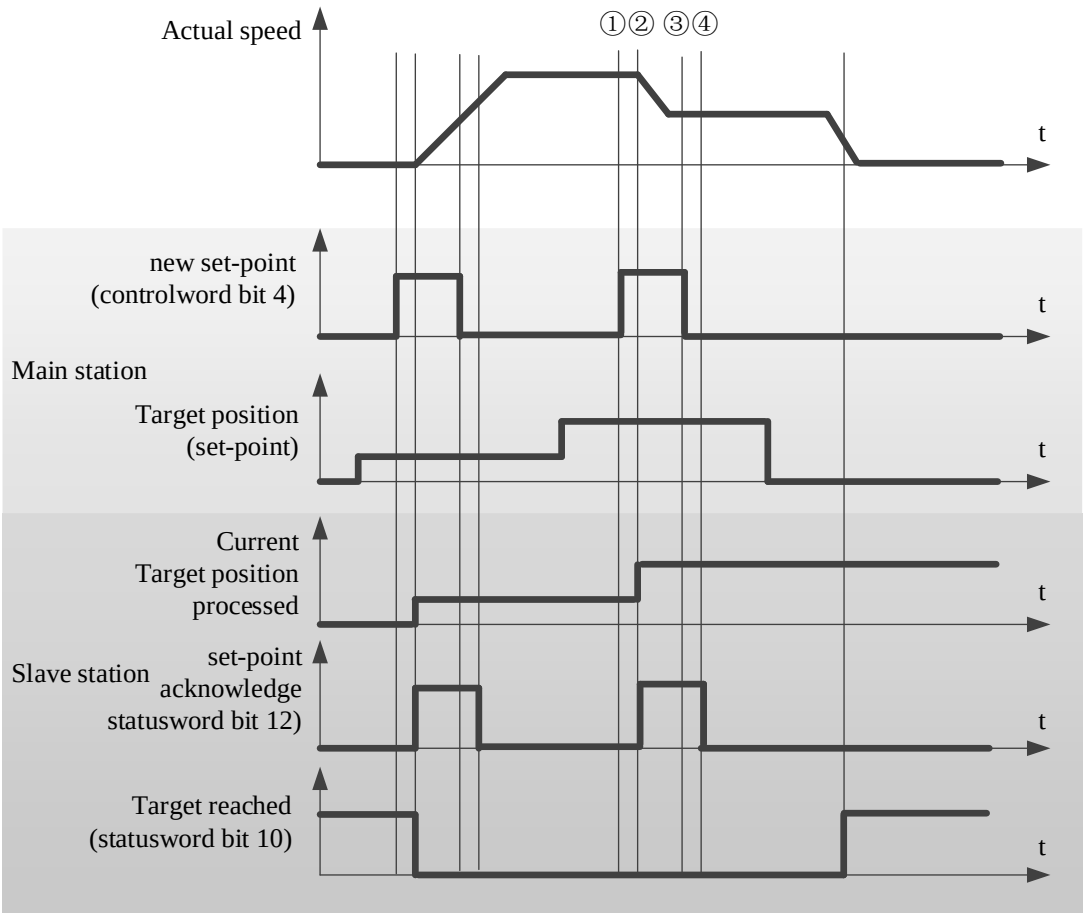
① Main station: confirm 6041h (Statusword) bit12 (set-point acknowledge) is 0, after changing the value of 607Ah (Target position), 6040h (Controlword) bit4 (new set-point) changes from 0 to 1.

do not change acceleration and deceleration at this time.

② Slave station: confirm the rising edge of 6040h (Controlword) bit4 (new set-point) is from 0 to 1. As new target position and new internal execution speed, 607Ah (Target position) and 6081h (Profile velocity) are updated immediately. At this time, 6041h (Statusword) bit12 (set-point acknowledge) changes from 0 to 1.

③ Main station: confirm 6041h (Statusword) bit12 (set-point acknowledge) has changed from 0 to 1, 6040h (Controlword) bit4 (new set-point) returns 0.

④ Slave station: confirm 6040h (Controlword) bit4 (new set-point) is 0, 6041h (Statusword) bit12 (set-point acknowledge) is 0.



< handshaking procedure for the single set-point method >

4.6.3.2 PV mode

PV (Profile speed control mode) is a speed control mode that specifies the target speed, acceleration and deceleration, and generates position command action in the servo driver.

1. Related object

PV control mode related object (command · setting type)

Register	Explanation	Unit
RXPDO[0x6040]	Control word	-
RXPDO[0x6060]	Set to 3	-
RXPDO[0x60FF]	Speed setting	Command unit/s
RXPDO[0x6072]	Max torque	0.1%
RXPDO[0x607F]	Max internal speed	Command unit /s
RXPDO[0x6080]	Max motor speed	r/min
RXPDO[0x6083]	Internal acceleration speed	Command unit /s²
RXPDO[0x6084]	Internal deceleration speed	Command unit /s²
RXPDO[0x60C5]	Max acceleration speed	Command unit /s²
RXPDO[0x60C6]	Max deceleration speed	Command unit /s²

PV control mode related object (command · monitor type)

Register	Explanation	Unit
TXPDO[0x6041]	State word	-
TXPDO[0x6061]	Mode query	-
TXPDO[0x6063]	Internal actual position	Command unit

Register	Explanation	Unit
TXPDO[0x6064]	Position feedback (motor actual position)	Command unit
TXPDO[0x606C]	Speed feedback	Command unit /s
TXPDO[0x6077]	Actual torque	0.1%

2. Control word (6040h) <PV control mode function >

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6040h</td><td rowspan="2">00h</td><td>Controlword</td><td>0~65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
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Bit information
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<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="2">fr</td><td colspan="3">oms</td><td rowspan="2">eo</td><td rowspan="2">qs</td><td rowspan="2">ev</td><td rowspan="2">so</td></tr>
<tr><td>r</td><td>r</td><td>r</td></tr>
</table>
r = reserved (No correspondence)
oms = operation mode specific
(control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on</td></tr>
</table>

PV mode doesn’t use oms bit.

3. Control word (6041h) <PV control mode function>

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>Statusword</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
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<tr><td colspan="2" rowspan="2">r</td><td colspan="2">oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>r</td><td>r</td><td>Targetreached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
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r = reserved (No correspondence)
oms = operation mode specific
(control mode based on bit)
ila = internal limit active
rm = remote
w = warning
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = fault
oe = operation enabled
so = switched on
rtso = ready to switch on</td></tr>
</table>

bit10 (target reached (Velocity reached)):

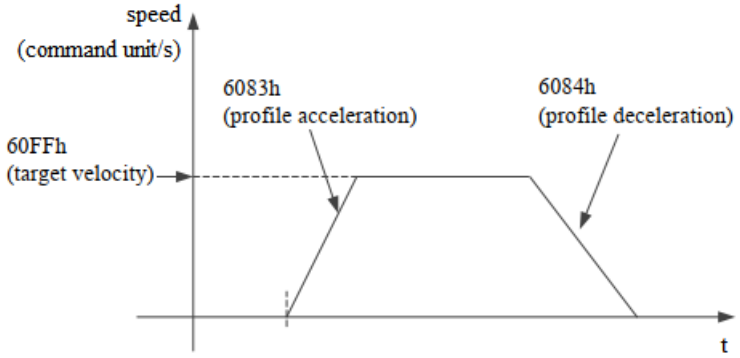
The difference between the total value of 60FFh (target velocity) and 60B1h (velocity offset) and 606Ch (velocity actual value) is within the range set by 606Dh (velocity window). If the time set by 606Eh (velocity window time) passes, bit10 of 6041h (status word) becomes 1.

Bit	Name	Value	Definition
10	Target reached	0	halt=0 (normal): speed control not completed halt=1 (stop as halt): axis is decelerating
		1	halt=0 (normal): speed control completed halt=1 (stop as halt): axis stop (axis speed is 0)

4. PV control mode action explanation

PV control mode generates speed command based on below parameters:

Target Velocity (60FFh)　　Profile acceleration (6083h)
Profile deceleration (6084h)
Turn off motor enable, set object word 6060h to 3, set target speed 60FFh, acceleration and deceleration 6083h and 6084h, speed 6080h and torque limit 6072h. The target speed is 60FFh, the maximum speed is limited by 6080h (max motor speed), and the torque is limited by 6072h (max torque). Turn on the motor enable, the motor should start to move according to the set value.



4.6.3.3 TQ mode

TQ (Profile torque control mode) is a torque control mode in which the target torque, acceleration and deceleration are specified and the position command is generated inside the servo driver.

1. Related parameters

TQ control mode related object (command・setting type)

Register	Explanation	Unit
RXPDO[0x6040]	Control word	-
RXPDO[0x6060]	Set to 4	-
RXPDO[0x6071]	Target torque setting	0.1%
RXPDO[0x6072]	Max torque	0.1%
RXPDO[0x6080]	Max motor speed	r/min
RXPDO[0x6087]	Set the torque slope	0.1%/S

Torque type

Index	Sub-index	Name	Units	Range	Data type	Access	PDO	OP-mode
6087h	00h	Torque slope	0.1 %	0~4294967295	U32	rw	RxPDO	TQ cst
		Set the parameter value to give the torque command. If it is set to 0, the internal processing is operated as 1.						

TQ control mode related object (command・monitor type)

Register	Explanation	Unit
TXPDO[0x6041]	Status word	-
TXPDO[0x6061]	Mode query	-
TXPDO[0x6064]	Position feedback (motor actual position)	Command unit
TXPDO[0x606C]	Speed feedback	Command unit /s
TXPDO[0x6077]	Actual torque	0.1%

2. Control word (6040h) <TQ control mode function >

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
6040h	00h	Controlword	0~65535	U16	rw	RxPDO	All

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode

Set the control command of servo driver such as PDS state transition.
Bit information

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

r = reserved (No correspondence)
oms = operation mode specific (control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on

TQ mode doesn't use oms bit.

3. Status word (6041h) <TQ control mode function >

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
6041h	00h	Statusword	0~65535	U16	ro	TxPDO	All

Indicates the servo driver status.
Bit information

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

r = reserved (No correspondence)
oms = operation mode specific (control mode based on bit)
ila = internal limit active
rm = remote
w = warning
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = fault
oe = operation enabled
so = switched on
rtso = ready to switch on

bit13,12,10 (operation mode specific):

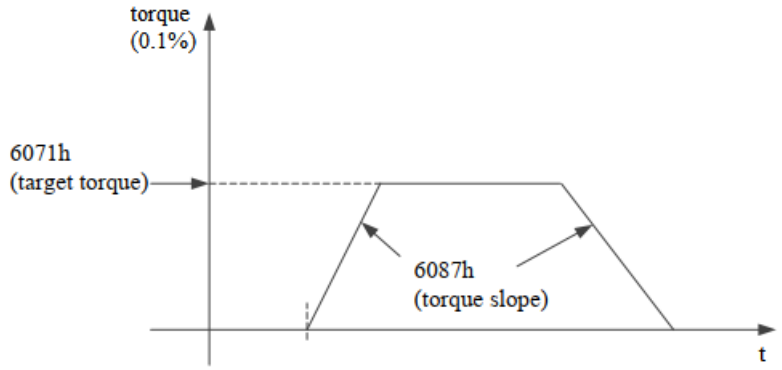
Bit	Name	Value	Definition
10	target reached	0	halt=0 (normal): 6074h (Torque demand) not reach target torque halt=1 (stop as halt): axis is decelerating
		1	halt=0 (normal): 6074h (Torque demand) reach the target torque halt=1 (stop as halt): axis stop (axis speed is 0)
12	reserved	-	Not use
13	reserved	-	Not use

4. TQ control mode action explanation

TQ control mode generates torque command based on the following parameters:
Target torque (6071h)
Torque slope (6087h)
Target torque is 6071h (Target torque), torque slope is 6087h (Torque slope). The max speed is limited through 6080h (Max motor speed), the max torque is limited by the min value among 6072h (Max torque), 2312h (P3-28), 2313h (P3-29).

Operation steps:
(1) Turn off motor enable, set object word 6060 to 4, set target torque 6071h, max motor speed 6080h and max torque 6072h.

(2) Turn on the motor enable, the motor should increase the output torque according to the set torque slope until the set value and the speed does not exceed the set maximum speed.



4.6.3.4 HM mode

HM mode (i.e. return to origin mode) is a position control mode that specifies various action speeds, generates position instructions in the servo driver, and executes return to zero action. In this mode, external signals (POT, NOT, SPD-D) must be used together.

1. Related parameters

HM control mode related object (command · setting type)

Register	Explanation
RXPDO[0x6040]	Control word, modify the control word to turn on the origin return
RXPDO[0x6060]	Set to 6 when the motor is disabled
RXPDO[0x607F]	Max internal speed
RXPDO[0x6080]	Max motor speed
RXPDO[0x60C5]	Max acceleration speed
RXPDO[0x60C6]	Max deceleration speed
RXPDO[0x6098]	Return to origin mode
RXPDO[0x6099]	Return to origin speed
RXPDO[0x609A]	Return to origin acceleration speed

PV control mode related object (command · monitor type)

Register	Explanation
TXPDO[0x6041]	Status word
TXPDO[0x6061]	Mode query
TXPDO[0x6064]	Position feedback (motor actual position)
TXPDO[0x606C]	Speed feedback
TXPDO[0x6077]	Actual torque

2. Control word (6040h) <HM control mode function >

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="6">6040h</td><td rowspan="6">00h</td><td>Controlword</td><td>0~65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="6">Set the control command of servo driver such as PDS state transition.
Bit information</td></tr>
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<tr><td colspan="7">r</td><td>h</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="2">fr</td><td colspan="3">oms</td><td rowspan="2">eo</td><td rowspan="2">qs</td><td rowspan="2">ev</td><td rowspan="2">so</td></tr>
<tr><td>r</td><td>r</td><td>sh</td></tr>
</table></td></tr>
</table>

		r = reserved (No correspondence) oms = operation mode specific (control mode based on bit) h = halt sh = start homing	fr = fault reset eo = enable operation qs = quick stop ev = enable voltage so = switch on

bit6-4 (operation mode specific):

Bit	Name	Value	Definition
4	start homing	0→1	Start back to zero
5	reserved	-	Invalid information
6	reserved	-	Invalid information

3. Status word (6041h) <HM control mode function >

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>Statusword</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
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<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td rowspan="2">r</td><td rowspan="2">r</td><td colspan="2">oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>r</td><td>r</td><td>Targetreached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (No correspondence)
oms = operation mode specific
(control mode based on bit)
ila = internal limit active
rm = remote
w = warning
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = fault
oe = operation enabled
so = switched on
rtso = ready to switch on</td></tr>
</table>

bit10, 12-13 (operation mode specific):

Bit	Name	Value	Definition
10	target reached	0	Zero return in progress
		1	Zero return completed
12	homing attained	0	Zero return not complete
		1	The return to zero action is completed normally
13	homing error	0	No fault occurred in return to zero action
		1	The return to zero action is abnormal

Return to zero action has the following status:

Bit13	Bit12	Bit10	Definition
0	0	0	Zero return is in progress
0	0	1	The return to zero action has not started, or is interrupted
0	1	0	The return to zero action has been completed, but the target position has not been reached
0	1	1	The return to zero action has been completed and the target position has been reached successfully
1	0	0	It is detected that the return to zero action is abnormal and still in action
1	0	1	It is detected that the return to zero action is abnormal and has stop

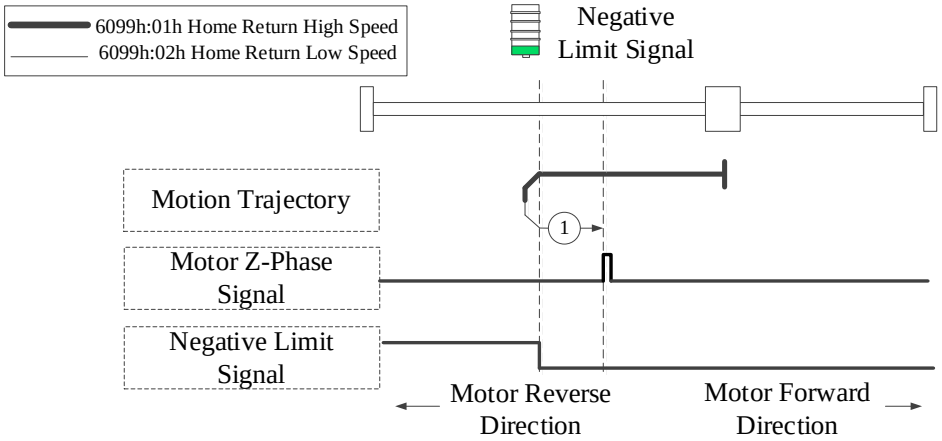
After the CANopen bus homing is completed (in incremental mode and when P0-79=1), the value of the object dictionary 0x6063 will be 0, with possible minor deviations

4. Return to origin mode (6098h)

At present, DF3E series servo supports 1-14, 17-30, 33, 34, 35 and 37 homing modes.

- **Method 1 (6098h=1):**

When using this Homing Method 1, if the reverse limit switch is in a non-triggered state, the initial movement direction will be to the left. The home position is the first Z-phase pulse to the right of the position where the negative limit switch becomes inactive.
Mechanical origin: Motor Z-phase signalDeceleration point: Reverse overtravel switch



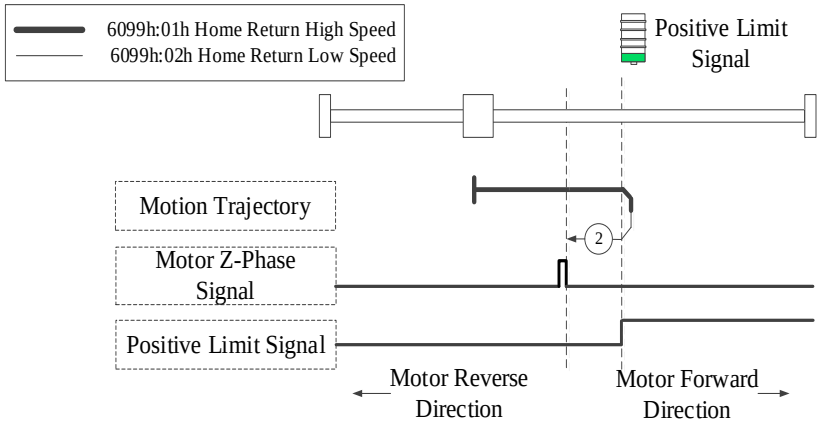
Using a negative limit switch and the Z-axis signal to reset the motor

6098h=1 Action Description:

The reverse limit is invalid: When starting the return, the system initiates reverse zeroing at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), it decelerates and reverses direction, then proceeds at low-speed forward return (6099h:02h). After detecting the falling edge of the reverse limit, it stops at the first motor Z signal.

- **Method 2 (6098h=2):**

When using Method 2, if the forward limit switch remains inactive, the initial movement direction is right. The origin is located at the first Z-phase pulse to the left of the position where the forward limit switch becomes invalid.
Mechanical origin: Motor Z positive signal
Reduction point: forward overtravel switch



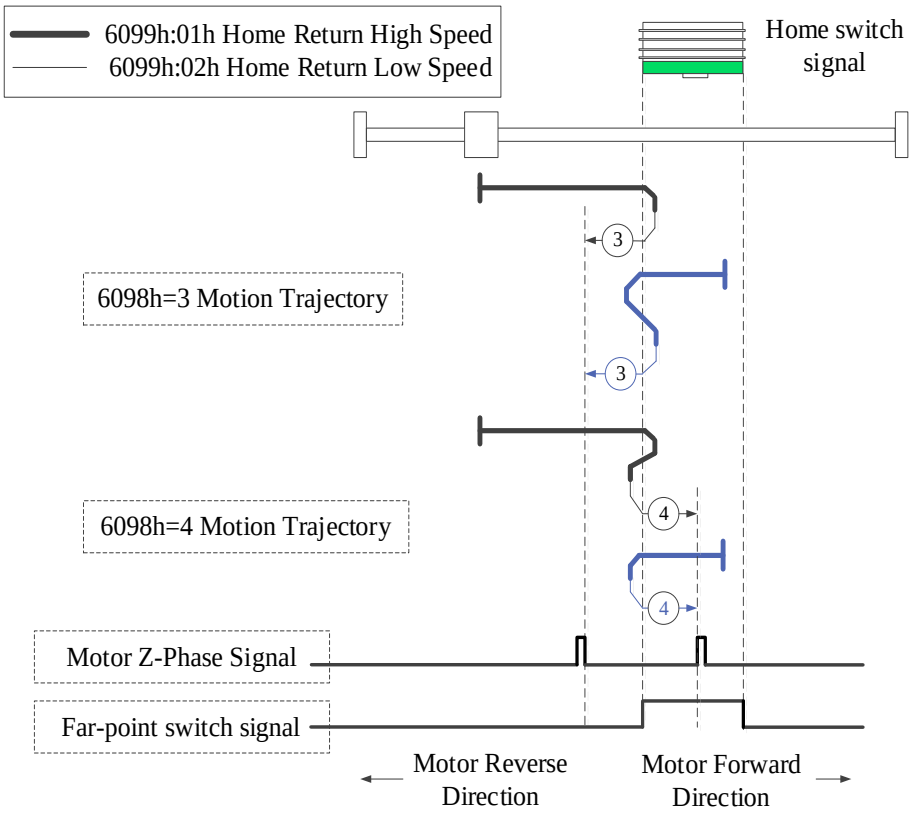
Using a positive limit switch and the Z-axis signal of the motor to return to the original position

6098h=2 Action Description:

The forward limit is invalid: When starting the return, the system initiates the forward reset at high speed (6099h:01h). Upon encountering the rising edge of the forward limit (POT), it decelerates and reverses direction, then operates backward at the low speed of 6099h:02h. After detecting the falling edge of the forward limit, it stops at the first motor Z signal.

■ **Method 3 (6098h=3) and Method 4 (6098h=4):**

The initial direction of the movement is determined by the state of the origin switch. The origin position is either on the reverse side of the origin switch or at the initial detected Z-phase position in the forward direction.
Mechanical origin: Motor Z positive signal
Reduction point: origin switch



Use the origin switch and motor Z signal to return to the origin.

6098h=3 Action Description:

① When the origin switch is invalid, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's rising edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's falling edge.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

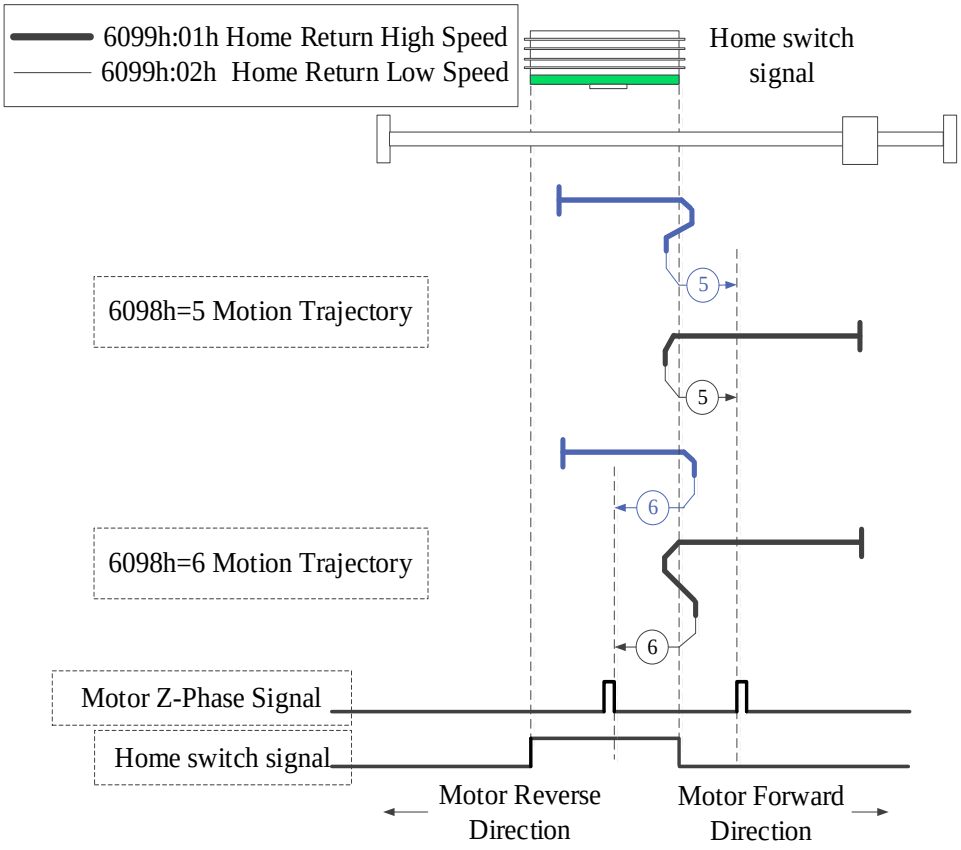
6098h=4 Action Description:

① When the origin switch is inactive, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's rising edge, it reverses direction and waits for the falling edge before decelerating and reversing again. The system then proceeds forward at the original return speed (6099h:02h). When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system stops at the first motor Z signal upon receiving the origin switch's rising edge.

■ **Method 5 (6098h=5) and Method 6 (6098h=6):**

Using method 5 or 6, the initial direction of movement is determined by the state of the origin switch. The origin position is either on the reverse side of the origin switch or at the initial detected Z-phase position in the forward direction.
Mechanical origin: Motor Z positive signal
Reduction point: origin switch



Use the origin switch and motor Z signal to return to the origin.

6098h=5 Action Description:

① When the origin switch is invalid, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. After encountering the origin switch's falling edge, it stops at the first motor Z signal.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

6098h=6 Action Description:

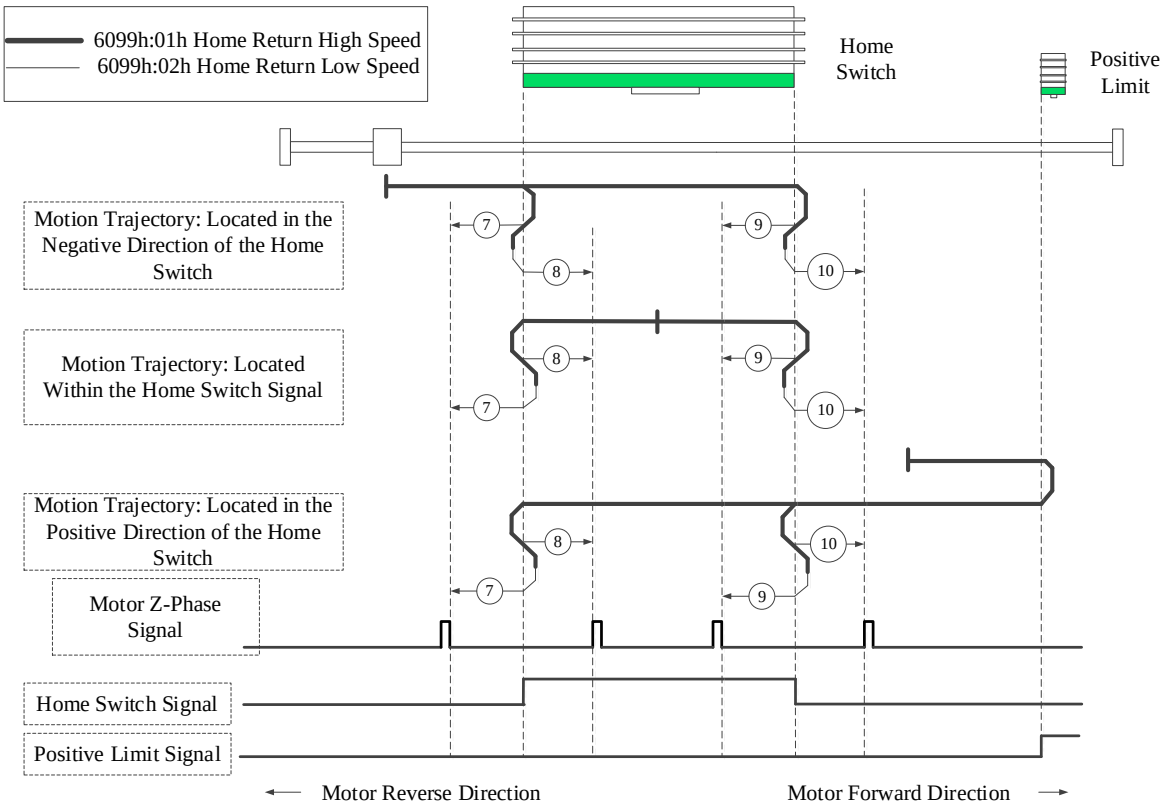
① When the origin switch is inactive, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it reverses direction and searches for the falling edge, then decelerates before reversing again. The system then operates at 6099h:02h speed in reverse mode. When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse

return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

■ **Methods 7-14 (6098h=7-14):**

7-14 all use the origin switch and Z signal;
The initial action direction of mode 7 and 8 is negative if the origin switch is activated at the start of the action.
The initialization action direction of mode 9 and 10 is positive if the origin switch is activated at the start of the action.
The initialization action direction of mode 11 and 12 is positive if the origin switch is activated at the start of the action.
The initialization action direction of mode 13 and 14 is negative if the origin switch is activated at the start of the action.
The final position of the returning to the origin is the Z-phase signal near the rising or falling edge of the origin switch.
Mechanical origin: Motor Z positive signal
Reduction point: origin switch



Use the origin switch, forward limit signal, and motor Z-axis signal to return to the origin.

6098h=7 Action Description:

① When the motor is located at the negative direction of the origin switch, the motor starts to return to the origin at high speed (6099h:01h) in the positive direction. After encountering the rising edge of the origin switch, the motor decelerates and reverses direction, running in the reverse direction at the speed of 6099h:02h. After encountering the falling edge of the origin switch, the motor stops at the first Z signal.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the positive limit, it automatically reverses to

high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, then reverses to locate the next rising edge. The system decelerates and reverses again, executing a reverse return speed of 6099h:02h. Upon detecting the origin switch's falling edge, it stops at the first motor Z signal.

6098h=8 Action Description:

① When the motor is initially in reverse, it first reverses to the zero position at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, it reverses direction and decelerates until it detects the falling edge, then reverses again. The motor then resumes forward operation at 6099h:02h. When the origin switch's rising edge is detected, it stops at the first Z-axis signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system stops at the first motor Z signal upon receiving the origin switch's rising edge.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) forward zero return. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, where deceleration and direction reversal occur. The system then maintains forward operation at the original return speed (6099h:02h). Upon detecting the origin switch's rising edge again, it stops at the first motor Z signal.

6098h=9 Action Description:

① When the origin switch is in the negative position: During initial return, the system initiates a rapid forward reset at 6099h:01h. Upon detecting the origin switch's rising edge, it accelerates until encountering the falling edge, then decelerates and reverses direction, operating backward at 6099h:02h. After detecting the origin switch's rising edge again, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) positive return to zero. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it switches direction and searches for the origin switch's falling edge, decelerates, and reverses again. The system then operates in reverse at the original return speed (6099h:02h). When the origin switch's rising edge is detected, it stops at the first motor Z signal.

6098h=10 Action Description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates positive zeroing at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it advances until encountering the falling edge, then reverses direction. The system then searches for the origin switch's rising edge, decelerates, and reverses again. It subsequently operates forward at the original return speed (6099h:02h), stopping at the first motor Z signal upon detecting the origin switch's falling edge.

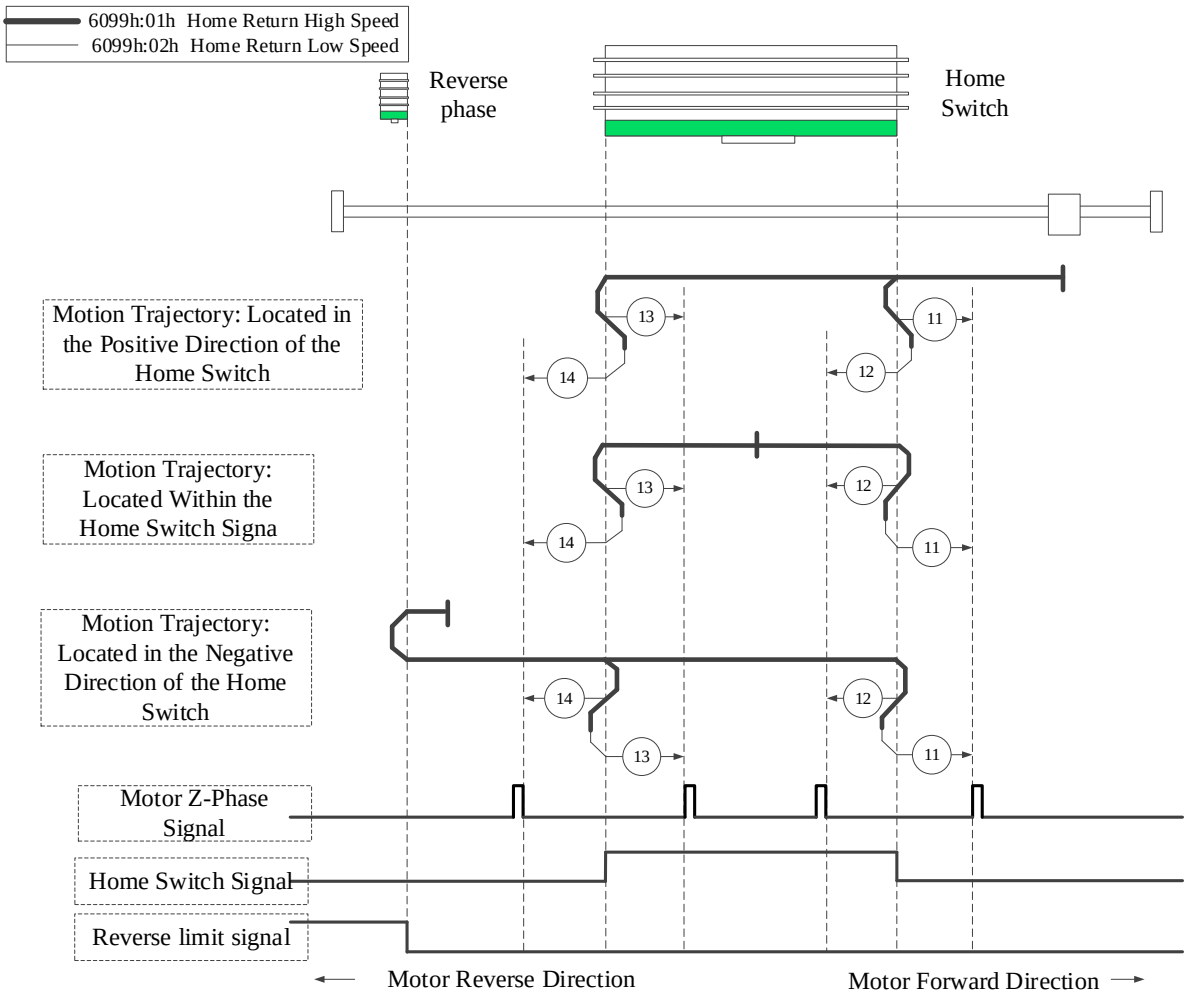
② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the origin switch is in the forward position: During initial return, the system initiates a rapid forward reset (6099h:01h). Upon reaching the forward limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it decelerates and reverses, then proceeds forward at the reset speed (6099h:02h). When the origin switch's falling edge is detected, it stops at the first motor Z signal.

④ When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, then reverses direction. The system then searches for the origin switch's rising edge, decelerates, and reverses again. It proceeds forward at the original return speed (6099h:02h) until detecting the origin switch's falling edge, at which point it stops by seeking the first motor Z signal.

⑤ When the origin switch is active: The system initiates zero return at 6099h:01h speed. Upon detecting the origin switch's falling edge, it reverses direction to locate the rising edge, then decelerates and reverses again. It then resumes forward operation at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

⑥ When the motor starts to return to the origin, it first reverses back to zero at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it decelerates and reverses direction, then runs forward at the original return speed (6099h:02h). After detecting the falling edge of the origin switch, it stops at the first Z-axis signal.



Use the origin switch, reverse limit signal, and motor Z-axis signal to return to the origin.

6098h=11 Action Description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, then reverses to locate the next rising edge. The system decelerates and reverses again, then runs forward at the original return speed (6099h:02h). Upon detecting the origin switch's falling edge, it stops at the first motor Z signal.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the motor starts to return to the origin, it first reverses to zero at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it decelerates and reverses direction, then runs forward at the original return speed (6099h:02h). After detecting the falling edge of the origin switch, it stops at the first Z-axis signal.

6098h=12 Action Description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the origin switch's rising edge, it advances until encountering the origin switch's falling edge, where deceleration and directional reversal occur. The system then operates in reverse at the original return speed (6099h:02h). Upon detecting the origin switch's rising edge again, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

③ When the motor starts returning to the origin, it first reverses to zero at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, it reverses direction and decelerates until finding the falling edge. It then reverses again, returning to the origin at 6099h:02h. After encountering the rising edge of the origin switch, it stops at the first Z-axis signal.

6098h=13 Action description:

① When the origin switch is in the negative position: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and accelerates. After detecting the origin switch's rising edge, it switches direction to locate the falling edge, decelerates, and reverses again. The system then proceeds forward at the original return speed (6099h:02h). When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system stops at the first motor Z signal upon receiving the origin switch's rising edge.

③ When the origin switch is in the forward position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it accelerates forward until encountering the falling edge, then decelerates and reverses direction. The system resumes forward operation at 6099h:02h speed. After detecting the origin switch's rising edge again, it stops at the first motor Z signal.

6098h=14 Action description:

① When the origin switch is in the negative position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and accelerates. After detecting the origin switch's rising edge, it decelerates and reverses, maintaining the original return speed (6099h:02h) until the falling edge. The system then stops at the first motor Z signal.

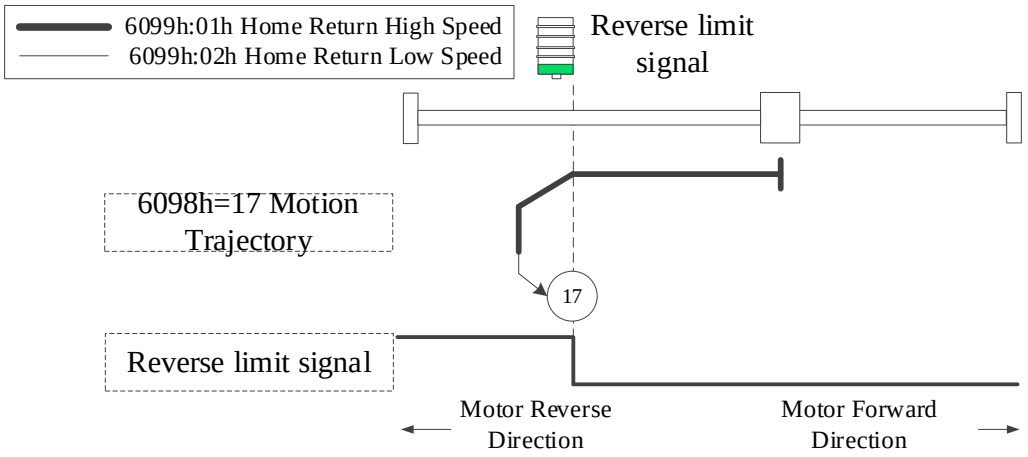
② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When positioned at the origin switch's positive direction: Initiate reverse zero return at high speed

(6099h:01h). Upon detecting the origin switch's rising edge, continue forward until encountering its falling edge, then reverse direction. Seek the origin switch's rising edge, decelerate, and reverse again. Operate in reverse at 6099h:02h speed until reaching the origin switch's falling edge, then halt at the first motor Z signal.

■ **Method (6098h=17):**

This method is similar to method 1.
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position change of the reverse limit switch (see figure below).
Homing error = 1 when the reverse limit (NOT) is not allocated.
Mechanical origin: reverse limit switch
reduction point: reverse limit switch



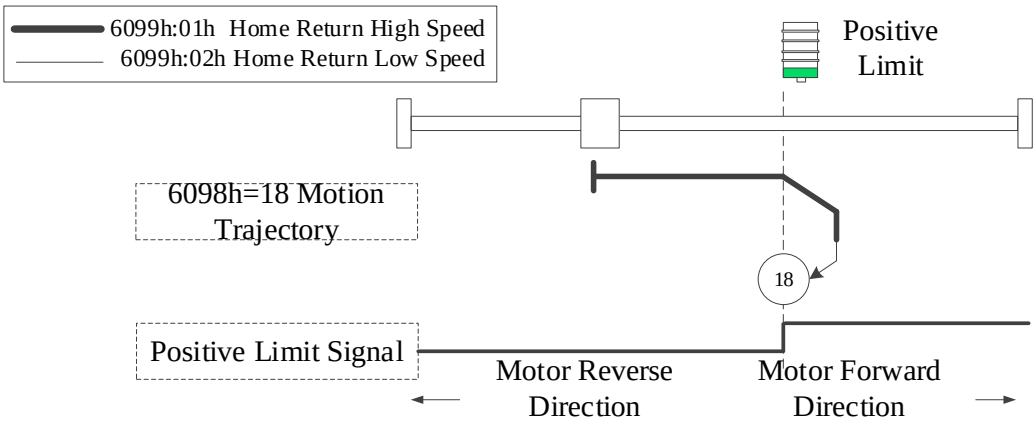
Use the reverse limit signal to return to the original position.

6098h=17 Action description:

The reverse limit is invalid: When starting the return to zero, the system initiates the reverse return at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), it switches direction and decelerates, then proceeds at the low-speed forward return speed of 6099h:02h. The system stops when the falling edge of the reverse limit is detected.

■ **Method (6098h=18):**

This method is similar to Method 2.
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position change of the forward limit switch (see figure below).
Homing error = 1 when the positive limit (POT) is not allocated.
Mechanical origin: forward limit switch
Deceleration point: forward limit switch



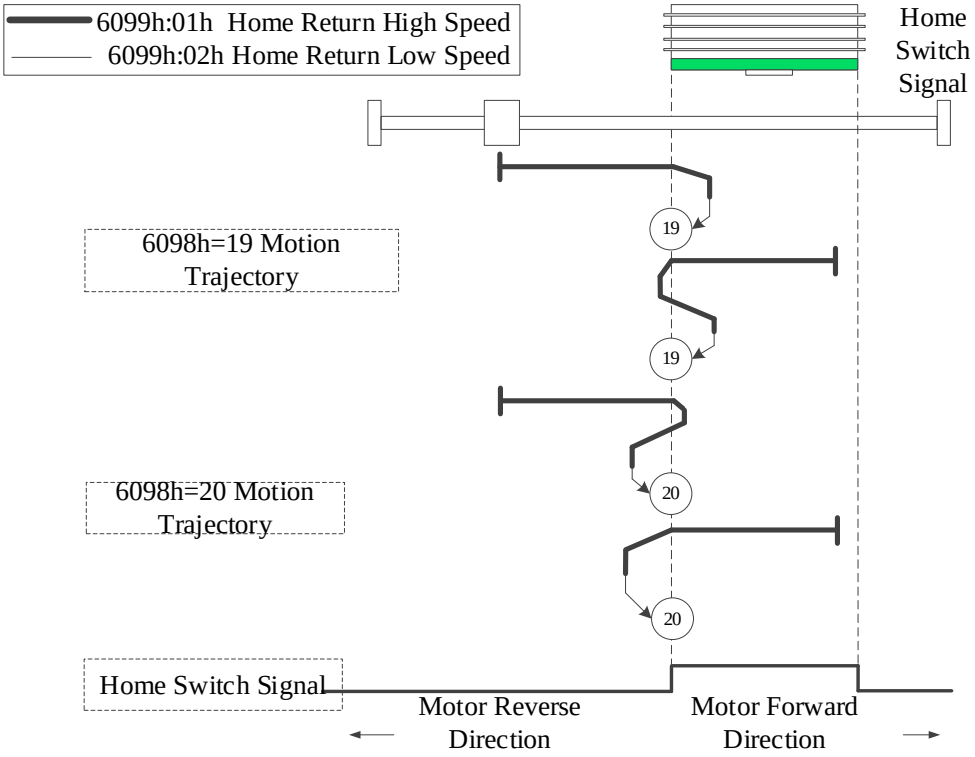
Use the forward limit signal to return to the original position.

6098h=18 Action Description:

The forward limit is invalid: When starting the return to zero, the system initiates the forward return at high speed (6099h:01h). Upon encountering the rising edge of the forward limit (POT), it reverses direction and decelerates, then proceeds to reverse operation at the low speed of 6099h:02h. The system stops upon reaching the falling edge of the forward limit.

■ **Method (6098h=19,6098h=20):**

This method is similar to the original method 3,4.
The difference is that the origin detection position is not the motor's Z-axis signal, but the position where the origin switch changes. (Refer to the figure below)
Homing error = 1 when HOME is not allocated.
Mechanical Origin: Origin Switch
Reduction point: origin switch



Use the origin switch signal to return to the origin.

6098h=19 Action Description:

① The origin switch is invalid: When starting the return, the forward return begins at high speed (6099h:01h). After encountering the rising edge of the origin switch, the direction is reversed and decelerated, then the return proceeds in reverse at 6099h:02h. The machine stops upon receiving the falling edge of the origin switch signal.

② The origin switch is in the active state: When starting the return to the origin, the system begins the reverse return to zero at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, it switches direction and searches for the rising edge of the origin switch, then switches direction again, decelerates, and runs in reverse at the return speed of 6099h:02h. The system stops upon encountering the falling edge of the origin switch.

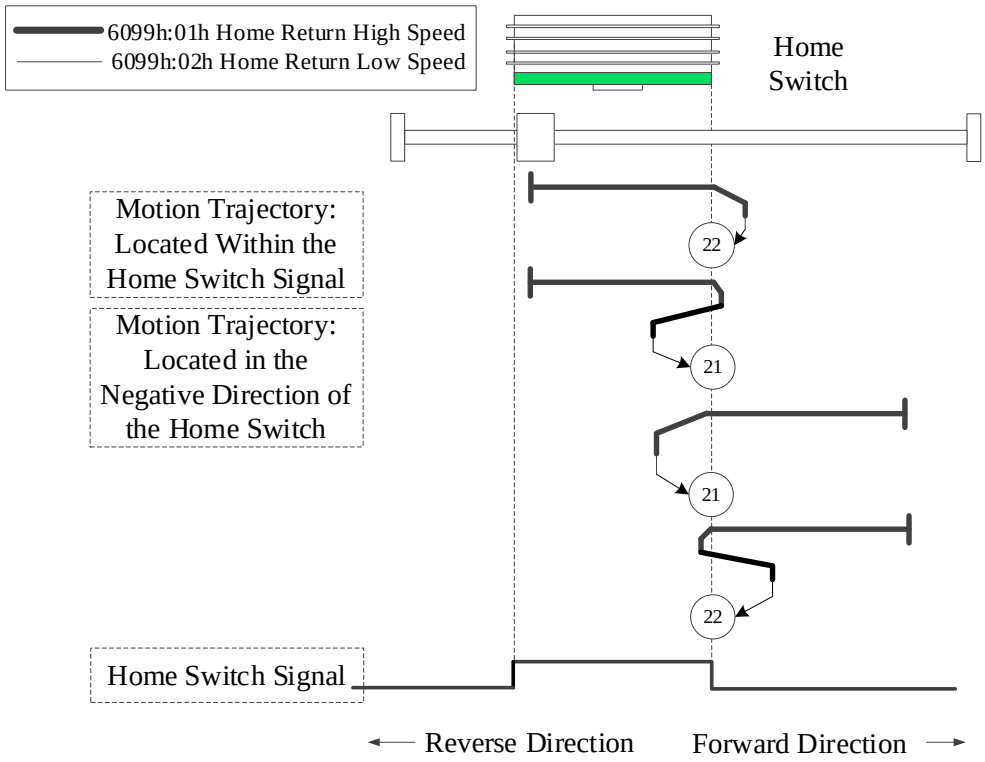
6098h=20 Action Description:

① The origin switch is invalid: When starting the return, the forward return begins at high speed (6099h:01h). After encountering the rising edge of the origin switch, the direction is reversed to find the falling edge of the origin switch, then reversed again. The speed is reduced, and the return proceeds forward at 6099h:02h. Upon encountering the rising edge of the origin switch, the machine stops.

② When the origin switch is active, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and decelerates, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

■ **Method (6098h=21,6098h=22):**

This method is similar to the original method 5,6.
The difference is that the origin detection position is not the motor's Z-axis signal, but the position where the origin switch changes. (Refer to the figure below)
Homing error = 1 when the origin signal is not assigned.
Mechanical Origin: Origin Switch
Reduction point: origin switch



Use the origin switch signal to return to the origin.

6098h=21 Action Description:

① When the origin switch is invalid, the system starts reverse return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it reverses direction and decelerates, then runs forward at 6099h:02h. The system stops when the falling edge of the origin switch is detected.

② When the origin switch is in the active state, the system initiates the return process at high speed (6099h:01h) for a forward return to zero. Upon detecting the falling edge of the origin switch, it reverses direction to locate the rising edge and performs another reverse movement. The system then decelerates and resumes forward operation at the return speed of 6099h:02h, stopping again when the origin switch's falling edge is detected.

6098h=22 Action Description:

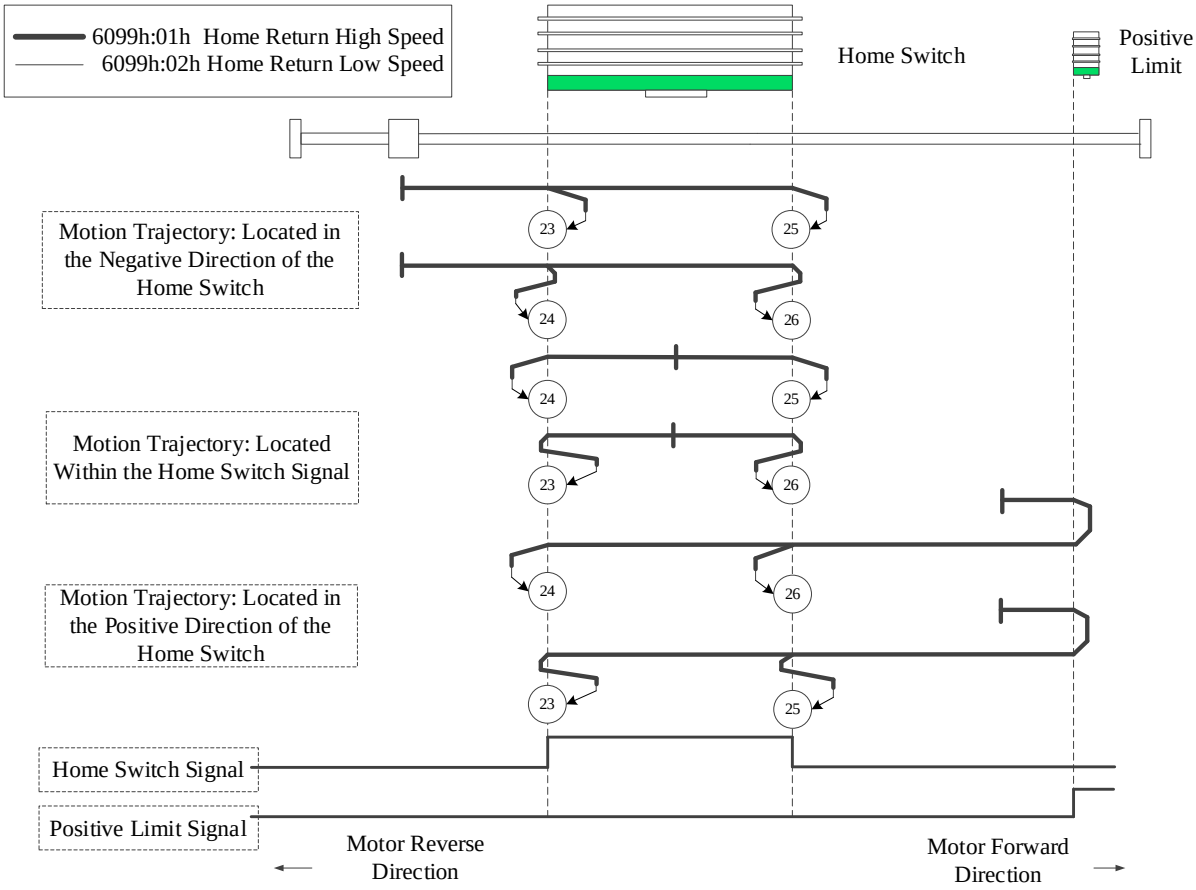
① The origin switch is invalid: When starting the return, reverse the return speed to 6099h:01h. After encountering the rising edge of the origin switch, reverse direction and find the falling edge of the origin switch, reverse direction again, slow down, reverse the return speed to 6099h:02h, stop after encountering the rising edge of the origin switch.

② When the origin switch is in the active state, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it reverses direction and decelerates, then proceeds

backward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

■ **Method (6098h=23,24,25,26):**

This method is similar to the back-to-origin methods 7, 8, 9, 10.
The difference is that the origin detection position is not the motor's Z-axis signal, but the position where the origin switch changes. (Refer to the figure below)
Homing error = 1 if the origin signal and forward limit signal are not assigned.
Mechanical Origin: Origin Switch
Reduction point: origin switch



Use the origin switch signal and forward limit signal to return to the origin.

6098h=23 Action Description:

① The original point switch is located in the negative direction: when starting to return to the origin, it starts with high speed (6099h:01h) to return to zero in the positive direction. After encountering the rising edge of the original point switch, it decelerates and changes direction, running in reverse with the original point switch speed of 6099h:02h. After encountering the falling edge of the original point switch, it stops.

② The origin switch is in the active state: When starting the return to the origin, the reverse return to zero begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return to the origin proceeds at the speed of 6099h:02h, stopping when the falling edge of the origin switch is encountered.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, then reverses to locate the next rising edge. The system decelerates, reverses again, and executes a reverse return at 6099h:02h speed. Upon reaching the origin switch's falling edge, it stops.

6098h=24 Action Description:

① The system is located at the negative direction of the origin switch. When starting to return to the origin, it starts to return to zero in the positive direction at high speed (6099h:01h). After encountering the rising edge of the origin switch, it changes direction, searches for the falling edge of the origin switch, decelerates, changes direction again, and runs in the positive direction at the return speed of 6099h:02h. After encountering the rising edge of the origin switch, it stops.

② When the origin switch is active, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

③ When positioned at the origin switch's positive direction, the system initiates a high-speed (6099h:01h) return to zero. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, where it decelerates and reverses direction. The system then maintains the original return speed (6099h:02h) in the forward direction until stopping at the origin switch's rising edge.

6098h=25 Action Description:

① The original point switch is located in the negative direction: when starting to return to the origin, it begins the positive return at high speed (6099h:01h). After encountering the rising edge of the original point switch, it continues forward until it meets the falling edge, then decelerates and reverses direction, running backward at the original point switch's return speed (6099h:02h). Upon encountering the rising edge of the original point switch again, it stops.

② When the origin switch is in the active state, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then halts when the origin switch's rising edge is detected.

③ When the original point switch is in the forward direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the forward limit, it automatically reverses to high-speed operation. After detecting the rising edge of the original point switch, it switches direction to locate the falling edge, decelerates, and reverses again. The system then returns to the original point at a reduced speed (6099h:02h) and stops upon encountering the rising edge of the original point switch.

6098h=26 Action Description:

① When the system initiates return to origin, it first performs a rapid forward reset (6099h:01h). Upon detecting the rising edge of the origin switch, it accelerates until encountering the falling edge, at which point it reverses direction. The system then searches for the next rising edge, decelerates, and reverses again. It subsequently returns to origin at the 6099h:02h speed before stopping when the falling edge is detected.

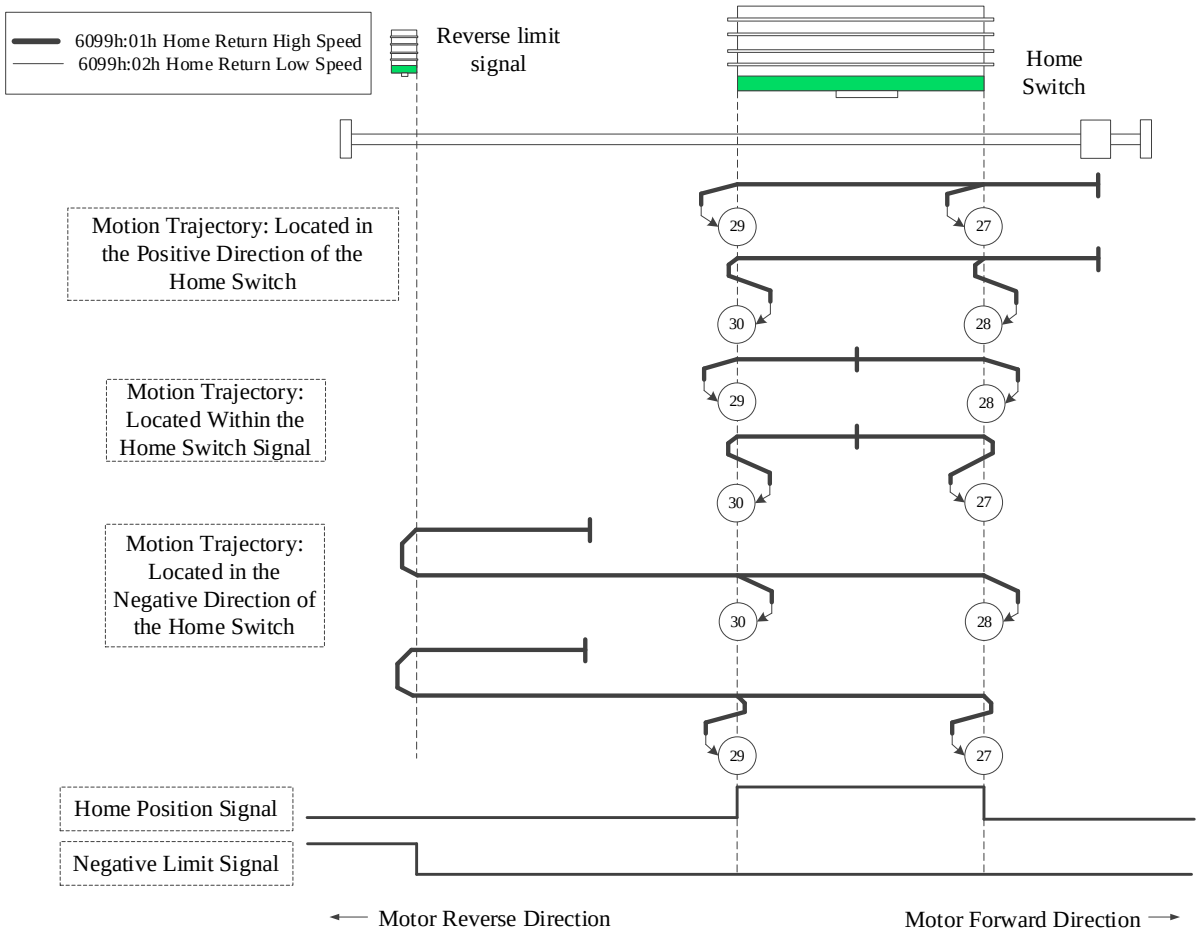
② The origin switch is in the active state: When starting the return to the origin, the forward return begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return proceeds forward at the speed of 6099h:02h until the origin switch's falling edge is encountered, at which point the machine stops.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reaches the positive limit, then automatically reverses direction and runs at high speed. After the original point switch rises, the system decelerates and reverses direction, and runs forward at the original speed (6099h:02h).

■ **Method (6098h=27,28,29,30):**

This method is similar to the original method 11,12,13,14.
The difference is that the origin detection position is not the motor's Z-axis signal, but the position where the origin switch changes. (Refer to the figure below)
Homing error = 1 when the origin switch and negative limit are not allocated.

Mechanical Origin: Origin Switch
Reduction point: origin switch



Use the origin switch signal and reverse limit signal to return to the origin.

6098h=27 Action Description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the rising edge of the origin switch, it continues forward until encountering the falling edge, then reverses direction again. The system then decelerates, searches for the next rising edge, and reverses direction once more. It proceeds forward at the original return speed (6099h:02h) until stopping upon detecting the falling edge of the origin switch.

② The origin switch is in the active state: When starting the return to the origin, the forward return begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return proceeds forward at the speed of 6099h:02h until the origin switch's falling edge is encountered, at which point the machine stops.

③ When the system starts to return to the origin, it first reverses to zero at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it decelerates and switches direction, then runs forward at the original return speed (6099h:02h). The system stops when the falling edge of the origin switch is detected.

6098h=28 Action Description:

① When positioned at the negative direction of the origin switch, the system initiates a high-speed (6099h:01h) reverse return to zero. Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the rising edge of the origin switch, it advances until encountering the falling edge, where it decelerates and reverses direction, executing a reverse return at

6099h:02h. The system then stops upon detecting the rising edge of the origin switch.

② When the origin switch is in the active state, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then halts when the origin switch's rising edge is detected.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reverses to return to zero. After encountering the rising edge of the original point switch, it changes direction, searches for the falling edge of the original point switch, decelerates, and changes direction again. The system then runs in reverse at the original speed of 6099h:02h until it stops upon encountering the rising edge of the original point switch.

6098h=29 Action description:

① When the system initiates return to the origin, it first reverses at high speed (6099h:01h) until encountering the reverse limit. Upon reaching the origin switch's rising edge, it reverses again to seek the falling edge, decelerates, and reverses once more. The system then proceeds forward at the original return speed (6099h:02h) until stopping at the origin switch's rising edge.

② When the origin switch is active, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reverses to return to zero. After encountering the rising edge of the original point switch, it continues forward until it meets the falling edge of the original point switch, then decelerates and changes direction. The system runs forward at the original return speed (6099h:02h) and stops after encountering the rising edge of the original point switch.

6098h=30 Action Description:

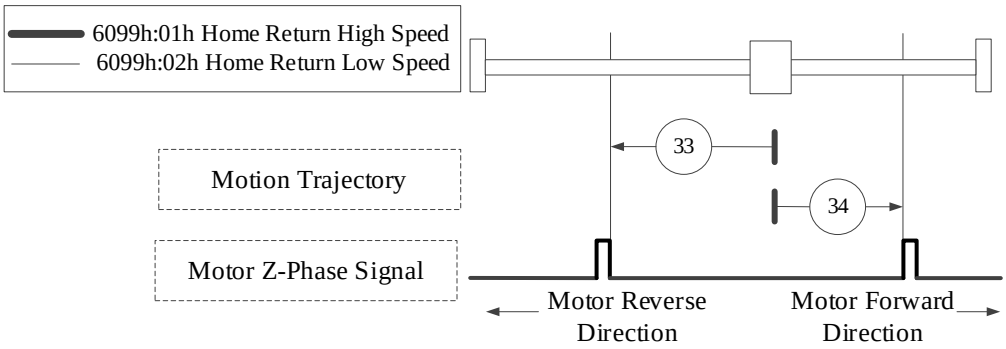
① The system is located at the negative direction of the origin switch. When starting to return to the origin, it starts to reverse to zero at high speed (6099h:01h). After encountering the reverse limit, it automatically changes direction and runs at high speed. After encountering the rising edge of the origin switch, it decelerates and changes direction, and runs in reverse at the speed of 6099h:02h. After encountering the falling edge of the origin switch, it stops.

② The origin switch is in the active state: When starting the return to the origin, the reverse return to zero begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return to the origin proceeds at the speed of 6099h:02h, stopping when the falling edge of the origin switch is encountered.

③ When the original point switch is in the forward direction: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the rising edge of the original point switch, it advances until encountering the falling edge, then reverses direction. The system searches for the next rising edge, decelerates, and reverses again. It then returns to the original point switch at the speed of 6099h:02h, stopping when the falling edge is detected.

- **Method (6098h=33,34):**

Use method 33 or 34, where the direction to the origin is negative or positive, respectively. The original position is near the Z axis in the selected direction.
Mechanical origin: Motor Z positive signal
Deceleration point: None



The origin is on the Z-axis.

6098h=33 Action Description:

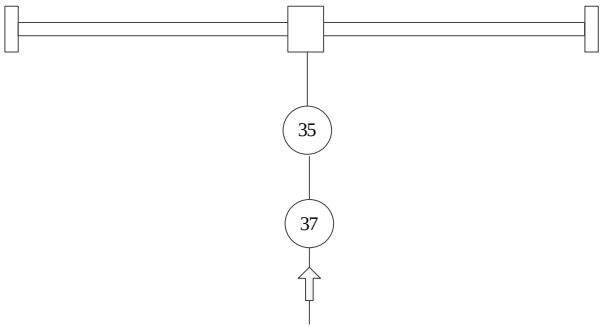
During the initial reset, the system operates in reverse at 6099h:02h speed, stopping at the first motor Z signal.

6098h=34 Action description:

During the initial return phase, the system operated forward at 6099h:02h speed until encountering the first motor Z signal, which triggered a shutdown.

- **Methods 35 (6098h=35) and 37 (6098h=37):**

In the original 35,37 mode, the current position is the origin after triggering the origin reset action.
Mechanical origin: Trigger position



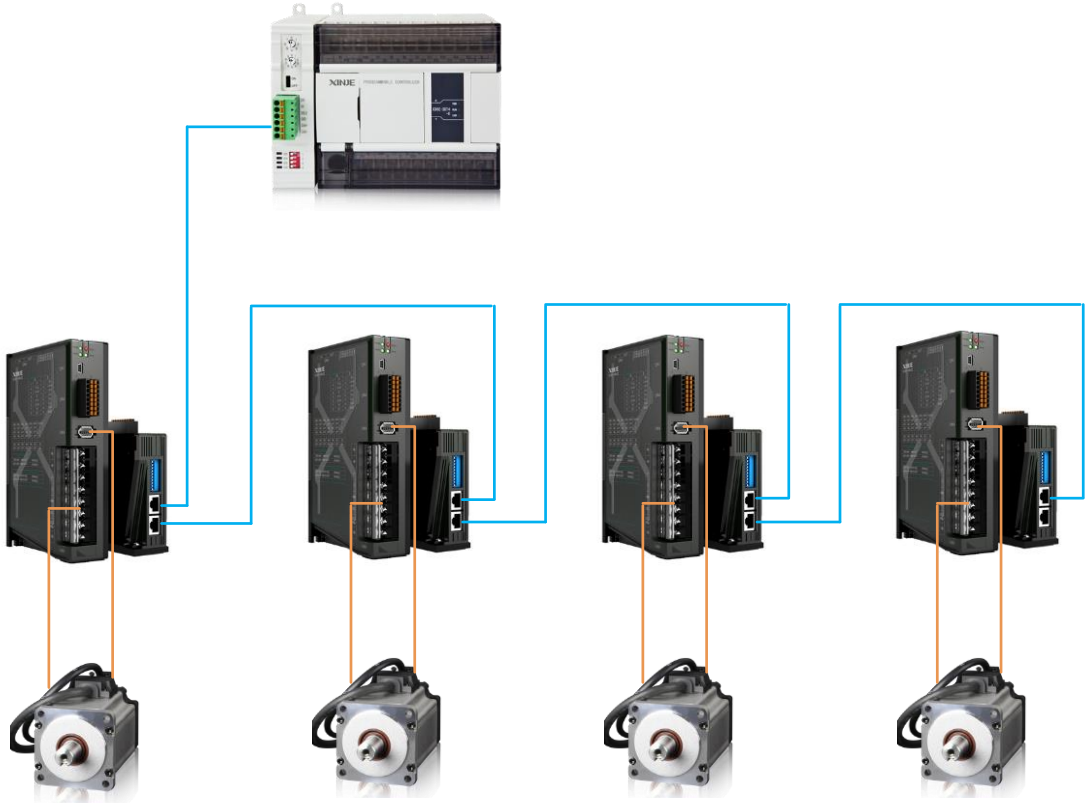
All revert methods require the revert action command to trigger before taking effect.

4.6.4 CANopen Communication Case

4.6.4.1 System Configuration

name	Model/Specification	quantity	remarks
motion control software	Xinjie PLC Programming Tool Software	1	
Configuration Tools	X-NetConfig configuration tool	1	
Xinjie Left Extension Module	XD-COBOX-ED	1	
Xinjie PLC	XD5E-30T4-E	1	
Servo of XJ	DF3E-0720	1	
parvicostellae	JC-CA-3	a surname	Used for connecting XD-COBOX-ED to servos and between servos

4.6.4.2 System Topology



■ **Baud rate setting**

In XD-COBOX-ED, set all three digital switches (1-3) to OFF (1000Kbps baud rate) and switch 4 to ON (COBOX as master station). Configure the servo's P7-31=5 (1000Kbps baud rate) through the servo host software.

■ **Station ID**

For XD-COBOX-ED: 1. Set the first rotary switch to 0. 2. Set the second rotary switch to 1 (assigning station number 1).3. On the DF3E servo driver: Set the second DIP switch to ON and the 1st to 6th DIP switches to OFF (assigning station number 2).

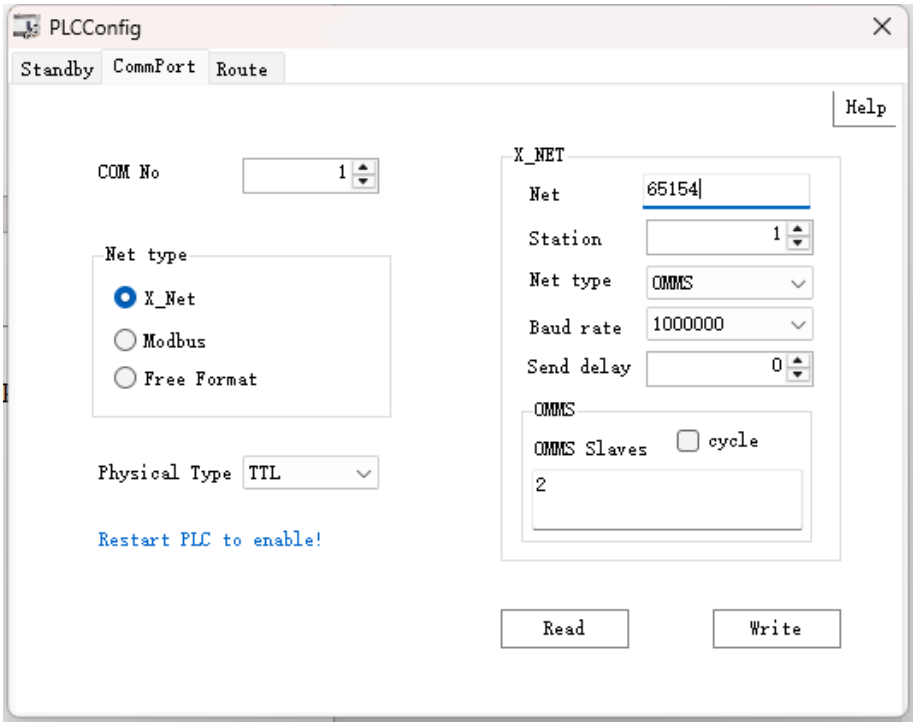
- The baud rates of XD-COBOX-ED and the servo driver must be set to the same value.
- The station numbers of XD-COBOX-ED and the servo driver cannot be set to match.
- The DF3E's CANopen communication port is a network port, whereas the XD-COBOX-ED lacks this feature. To configure it, refer to the pin configuration of the DF3E's CN0 port (see Section 3.3), identify the CANH and CANL pins, and connect them separately to the CAN+ and CAN-terminals on the XD-COBOX-ED module.

4.6.4.3 Debugging Steps

4.6.4.3.1 PLC Communication Configuration with XD-COBOX-ED

1. Configure COM3 serial port parameters

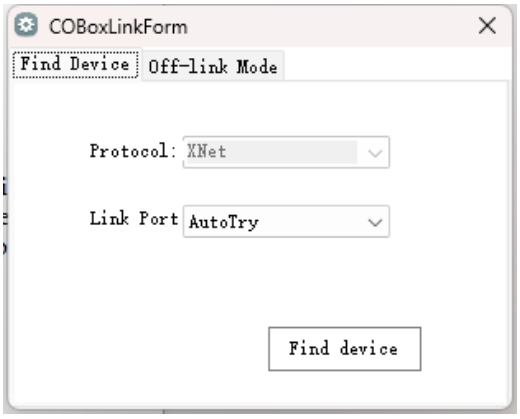
Open the "X-NetConfig Configuration Tool" and select "PLC" to access the device search interface. After locating the PLC, configure the parameters for COM3 (Left Expansion ED). These serial port settings enable communication between XD-COBOX-ED and the PLC via the left expansion port. The specific parameters are illustrated in the diagram below.



After completing the configuration, click 'Write Configuration'. The 'Write Successful' prompt will appear, confirming the configuration is complete and will take effect after a power cycle. When powered on again, the COM indicator light of XD-COBOX-ED will flash, indicating normal communication between XD-COBOX-ED and the PLC.

2. Find XD-COBOX-ED

Click "COBox" to open the device search interface shown below:



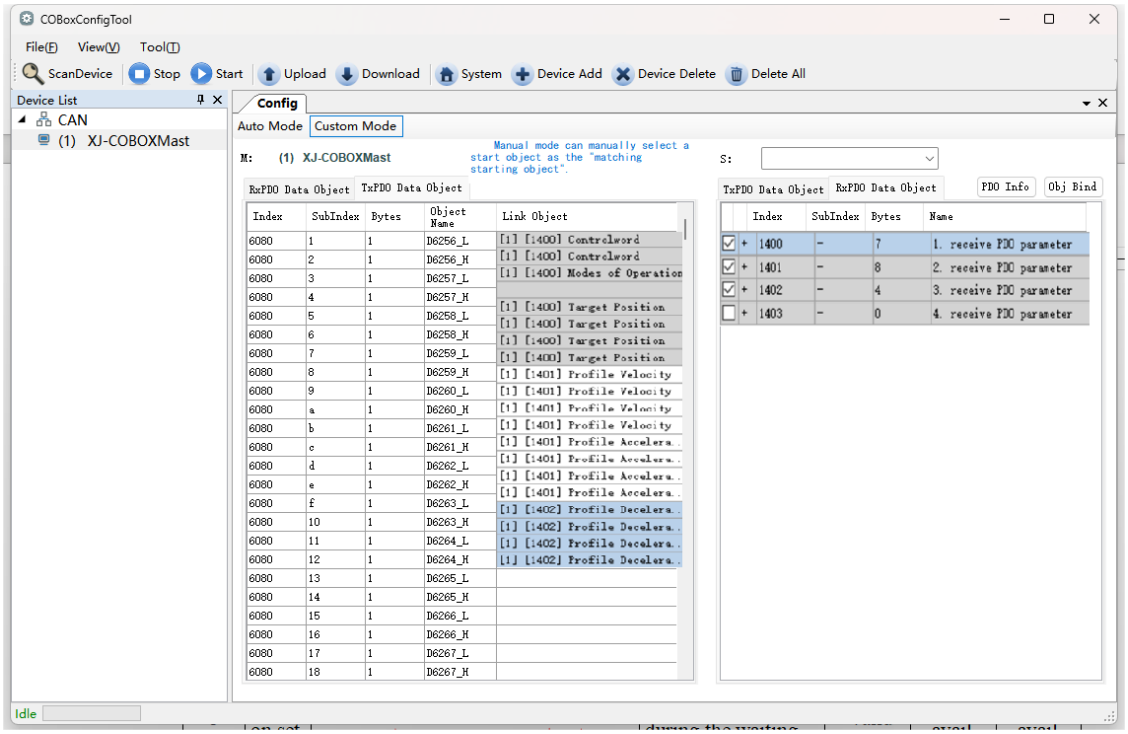
- The connection protocol must be X-NET, and the port selection should be AutoTry (automatic discovery).
- If clicking 'Find Device' displays 'Find timeout' due to communication failure between PLC and XD-COBOX-ED, check the following:

  ① Verify the correct COM3 parameter on PLC;

  ② Confirm proper communication connection between PLC and XD-COBOX-ED;

  ③ Ensure the device being searched is the CANopen master station.

After locating XD-COBOX-ED, you can access the main CANopen configuration interface as shown in the figure below.

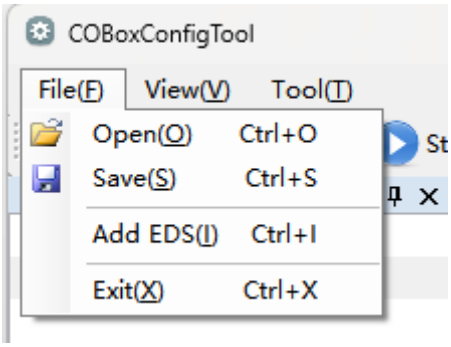


4.6.4.3.2 Add EDS file

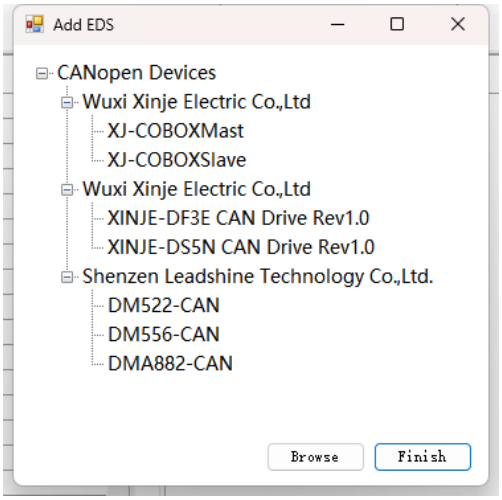
You can add EDS files in two ways.

The first method:

① First click [File], then click [EDS Library].



② A pop-up window appears. Click [Add EDS]:

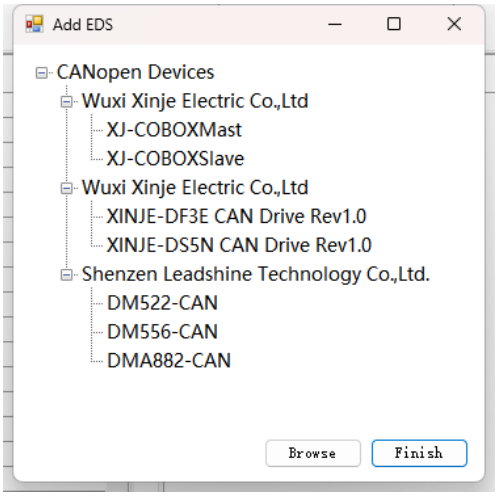


③ Locate the EDS file on your desktop, select it, then click [Open].

The second method:

① Click [Add Site], and 

the following pop-up window will appear. Click the blue [Add EDS]:



② Locate the EDS file on your desktop, select it, then click [Open].

③ After successful addition, the following window will appear. Click [OK] to confirm.

④ Upon re-entering the EDS database, you'll notice an additional "XJ-ServoDriver" in the [CANopen Device List].

4.6.4.3.3 Operational Examples

1. Example of PP mode operation

- PP control mode associated objects (commands,settings)

register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	Set to 1	-
RXPDO[0x607A]	Position given	instruction unit
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	maximum internal velocity	Command unit/s

register	explain	unit
RXPDO[0x6081]	internal speed given	Command unit/s
RXPDO[0x6083]	internal acceleration	instruction units/s²
RXPDO[0x6084]	internal deceleration	instruction units/s²
RXPDO[0x60C5]	maximal acceleration	instruction units/s²
RXPDO[0x60C6]	maximum deceleration	instruction units/s²

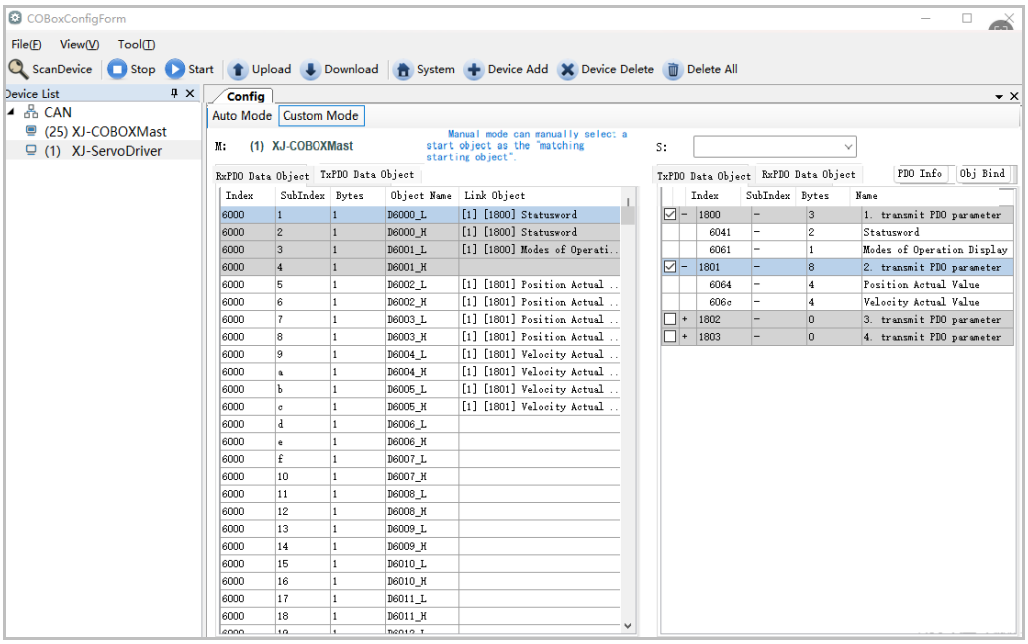
- The 6081h (contour velocity) is limited by the 607Fh (maximum internal velocity).
- When modifying the 607Fh (maximum internal speed) setting in the action, the change will not be reflected in the action.

- PP control mode associated objects (commands and monitoring)

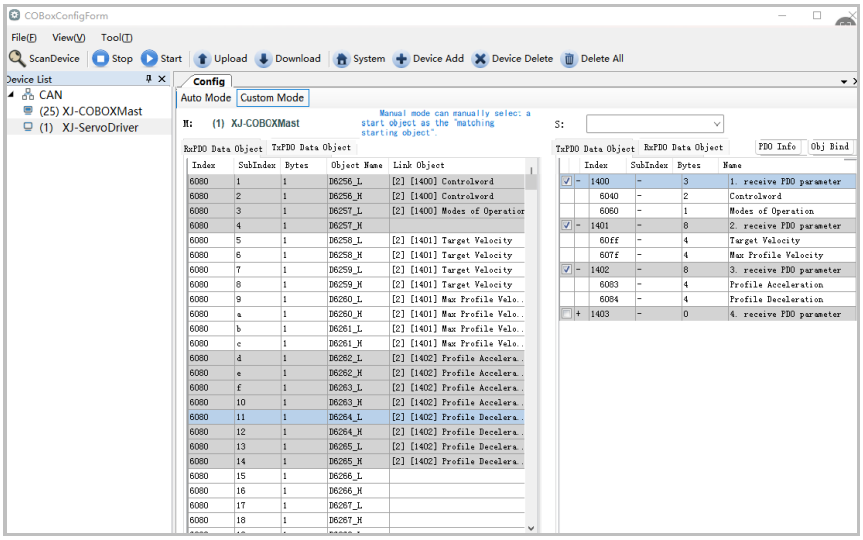
register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6061]	Pattern Query	
TXPDO[0x6063]	Internal actual location	instruction unit
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%
TXPDO[0x60F4]	actual following error	instruction unit

① In the CANopen configuration interface, select [Scan] or [Add Slave] to configure object bindings for TxPDO and RxPDO. This section binds commonly used objects in PP mode. Additional objects can be added as needed, and the configured PDOs should be enabled. The detailed configuration is shown in the figure below.

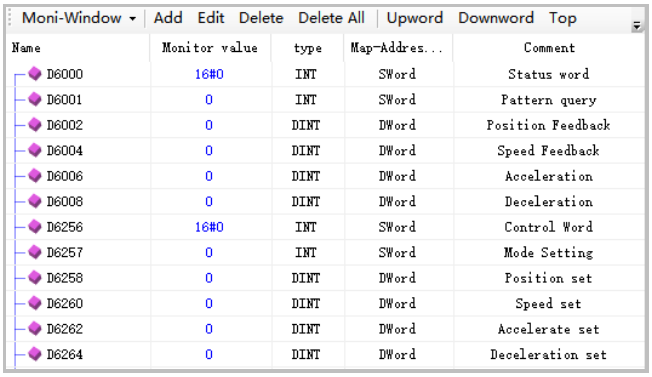
TxPDO (Monitoring Parameter):



RxPDO (Control Parameter):



② After downloading the configuration, the slave state machine automatically transitions from PreOP to OP state, enabling SDO and PDO to transmit and receive signals. XDPPRO allows monitoring or modifying object dictionary mappings. The specific mappings are as follows:



Name	Monitor value	type	Map-Addres...	Comment
D6000	16#0	INT	SWord	Status word
D6001	0	INT	SWord	Pattern query
D6002	0	DINT	DWord	Position Feedback
D6004	0	DINT	DWord	Speed Feedback
D6006	0	DINT	DWord	Acceleration
D6008	0	DINT	DWord	Deceleration
D6256	16#0	INT	SWord	Control Word
D6257	0	INT	SWord	Mode Setting
D6258	0	DINT	DWord	Position set
D6260	0	DINT	DWord	Speed set
D6262	0	DINT	DWord	Accelerate set
D6264	0	DINT	DWord	Deceleration set

③ To activate the CIA402 motion control function, first set P0-00 to 1 (default). Then, configure D6257 (6060h to 1) to PP mode. Modify D6256 (control word 6040h from 0x06 to 0x07 then 0x0F) to enable the slave. After setting parameters like position, speed, and acceleration/deceleration via D6258-D6264, adjust control word 0x4F→0x5F for relative position movement, and 0x0F→0x1F for absolute position movement. Other monitoring parameters are controlled by D6000-D6008.

2. Examples of PV mode operation

- PV control mode associated objects (commands and settings)

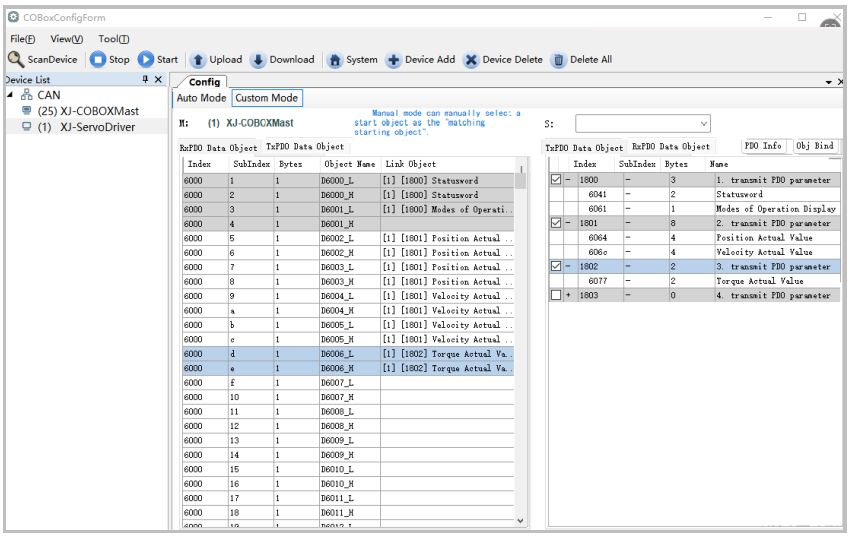
register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	Set to 3	-
RXPDO[0x60FF]	velocity given	Command unit/s
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	maximum internal velocity	Command unit/s
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6083]	internal acceleration	instruction units/s²
RXPDO[0x6084]	internal deceleration	instruction units/s²
RXPDO[0x60C5]	maximal acceleration	instruction units/s²
RXPDO[0x60C6]	maximum deceleration	instruction units/s²

- PV control mode associated objects (commands and monitoring)

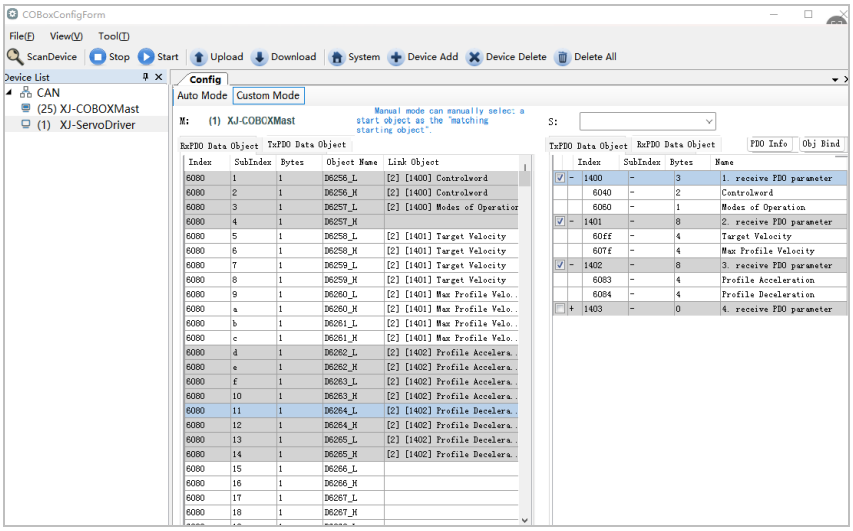
register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6061]	Pattern Query	-
TXPDO[0x6063]	Internal actual location	instruction unit
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%

① In the CANopen configuration interface, select [Scan] or [Add Slave] to configure object bindings for TxPDO and RxPDO. This section binds commonly used objects in PV mode. Additional objects can be added as needed, and the configured PDOs should be enabled. The detailed configuration is shown in the figure below.

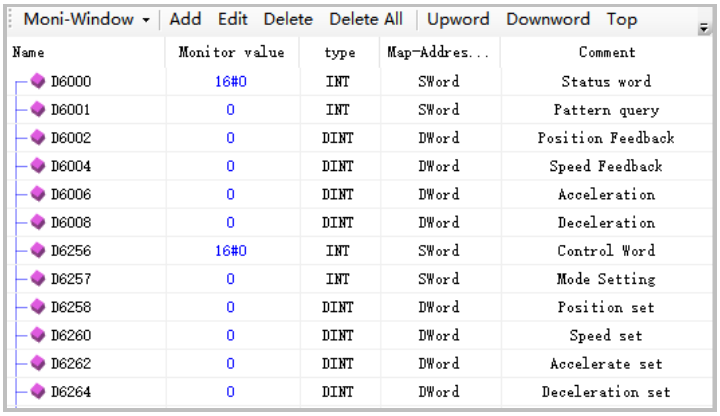
TxPDO (Monitoring Parameter):



RxPDO (Control Parameter):



②After downloading the configuration, the slave state machine automatically transitions from PreOP to OP state, enabling SDO and PDO to transmit and receive signals. XDPPRO allows monitoring or modifying object dictionary mappings, as detailed below.



Name	Monitor value	type	Map-Addres...	Comment
D6000	16#0	INT	SWord	Status word
D6001	0	INT	SWord	Pattern query
D6002	0	DINT	DWord	Position Feedback
D6004	0	DINT	DWord	Speed Feedback
D6006	0	DINT	DWord	Acceleration
D6008	0	DINT	DWord	Deceleration
D6256	16#0	INT	SWord	Control Word
D6257	0	INT	SWord	Mode Setting
D6258	0	DINT	DWord	Position set
D6260	0	DINT	DWord	Speed set
D6262	0	DINT	DWord	Accelerate set
D6264	0	DINT	DWord	Deceleration set

③ To activate the CIA402 motion control function, first set P0-00 to 1 (default). Then, configure D6257 (6060h to 3) to PV mode. After setting speed and acceleration/deceleration parameters via D6258 (60FFh), modify D6256 (control word 6040h from 0x06 to 0x07 then 0x0F) to enable the slave device and initiate speed mode. Other monitoring parameters are controlled by D6000-D6008.

3. Examples of TQ mode operations

- TQ control mode associated objects (commands,settings)

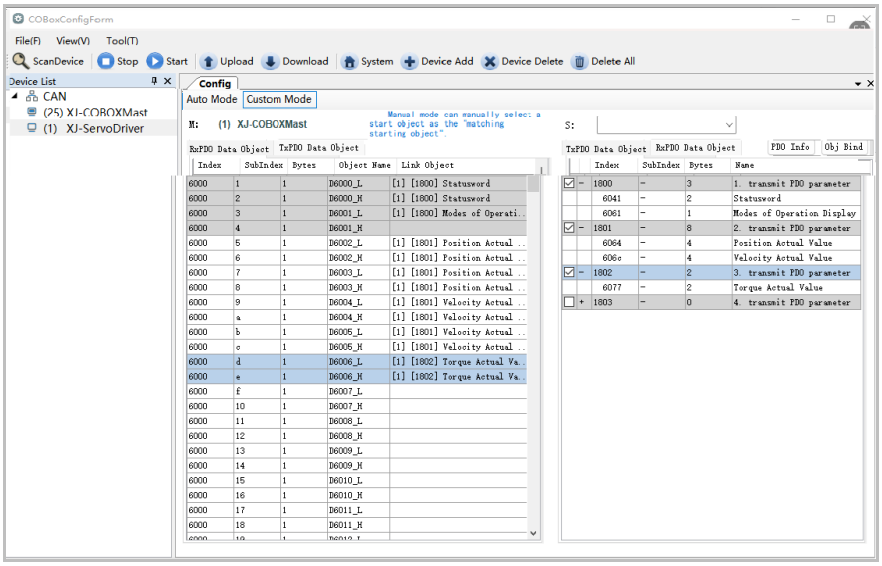
register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	Set to 4	-
RXPDO[0x6071]	target torque given	0.1%
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6087]	Set torque slope	0.1%/s

- TQ control mode associated objects (commands and monitoring)

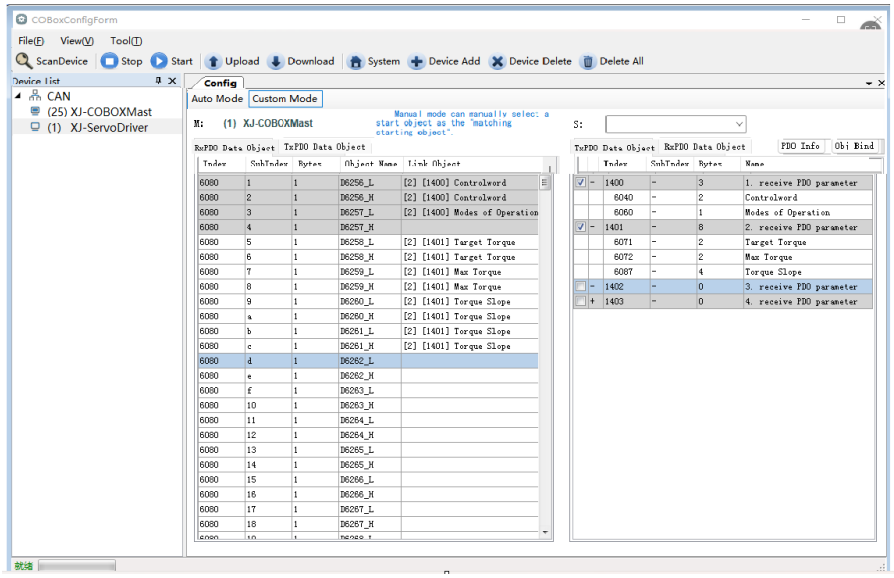
register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6061]	Pattern Query	-
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%

①In the CANopen configuration interface, select [Scan] or [Add Slave] to configure object bindings for TxPDO and RxPDO. This section binds commonly used objects in TQ mode. Additional objects can be added as needed, and the configured PDOs should be enabled. The detailed configuration is shown in the figure below.

TxPDO (Monitoring Parameter):



RxPDO (Control Parameter):



② After downloading the configuration, the slave state machine automatically transitions from PreOP to OP state, enabling SDO and PDO to transmit and receive signals. XDPPRO allows monitoring or modifying object dictionary mappings, as detailed below.

Moni-Window | Add | Edit | Delete | Delete All | Upword | Downword | Top

Name	Monitor value	type	Map-Addres...	Comment
D6000	16#0	INT	SWord	Status word
D6001	0	INT	SWord	Pattern query
D6002	0	DINT	DWord	Position Feedback
D6004	0	DINT	DWord	Speed Feedback
D6006	0	DINT	DWord	Acceleration
D6008	0	DINT	DWord	Deceleration
D6256	16#0	INT	SWord	Control Word
D6257	0	INT	SWord	Mode Setting
D6258	0	DINT	DWord	Position set
D6260	0	DINT	DWord	Speed set
D6262	0	DINT	DWord	Accelerate set
D6264	0	DINT	DWord	Deceleration set

③ First, set P0-00 to 1 (default) to enable the CIA402 motion control function. Then, modify D6257 (6060h to 4) to set it to TQ mode. After setting torque and torque slope parameters via D6258 (6071h), modify D6256 (control word 6040h from 0x06 to 0x07 to 0x0F) to enable the slave and start the speed mode. Other monitoring parameters are monitored by D6000-D6008.

4. Examples of HM Mode Operations

- HM control mode associated objects (commands,settings)

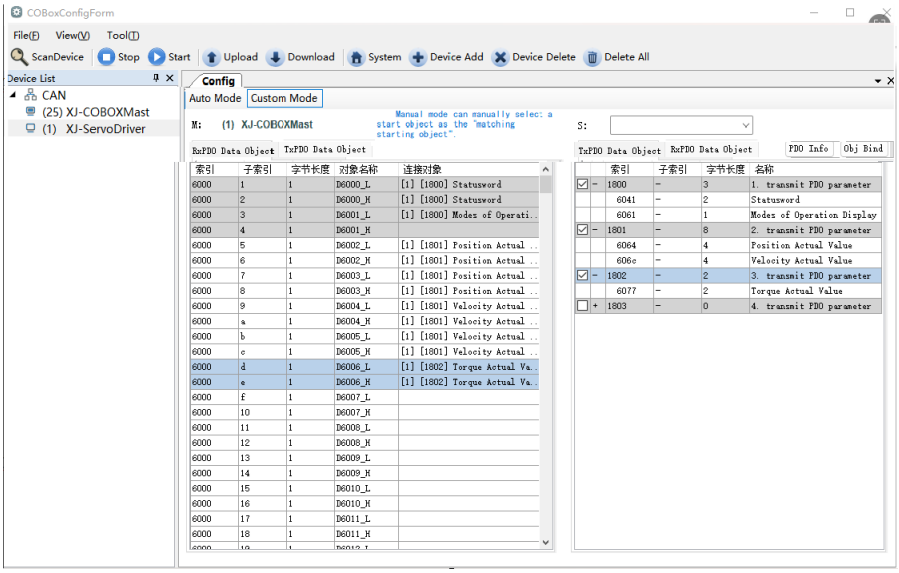
register	explain
RXPDO[0x6040]	Control word, modify control word to return to origin
RXPDO[0x6060]	Set to 6 when the motor is not enabled
RXPDO[0x607F]	maximum internal velocity
RXPDO[0x60C5]	maximal acceleration
RXPDO[0x60C6]	maximum deceleration
RXPDO[0x6098]	return to origin method
RXPDO[0x6099]	return to origin velocity
RXPDO[0x609A]	acceleration to origin

- HM control mode associated objects (commands and monitoring)

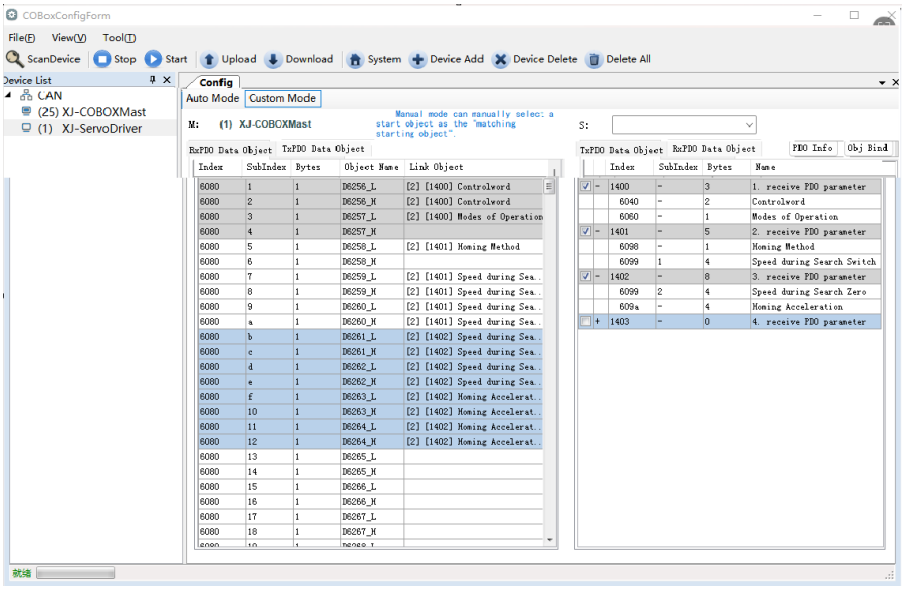
register	explain
TXPDO[0x6041]	status word
TXPDO[0x6061]	Pattern Query
TXPDO[0x6064]	Position feedback (actual motor position)
TXPDO[0x606C]	rate feedback
TXPDO[0x6077]	actual torque

① In the CANopen configuration interface, select [Scan] or [Add Slave] to configure object bindings for TxPDO and RxPDO. This section binds commonly used objects in HM mode. Additional objects can be added as needed, and the configured PDOs should be enabled. The detailed configuration is shown in the figure below.

TxPDO (Monitoring Parameter):



RxPDO (Control Parameter):



② After downloading the configuration, the slave state machine automatically transitions from PreOP to OP state, enabling SDO and PDO to transmit and receive signals. XDPPRO allows monitoring or modifying object dictionary mappings. The specific mappings are as follows:

Moni-Window | Add | Edit | Delete | Delete All | Upword | Downword | Top

Name	Monitor value	type	Map-Addres...	Comment
D6000	16#0	INT	SWord	Status word
D6001	0	INT	SWord	Pattern query
D6002	0	DINT	DWord	Position Feedback
D6004	0	DINT	DWord	Speed Feedback
D6006	0	DINT	DWord	Acceleration
D6008	0	DINT	DWord	Deceleration
D6256	16#0	INT	SWord	Control Word
D6257	0	INT	SWord	Mode Setting
D6258	0	DINT	DWord	Position set
D6260	0	DINT	DWord	Speed set
D6262	0	DINT	DWord	Accelerate set
D6264	0	DINT	DWord	Deceleration set

③ To activate the CIA402 motion control function, first set P0-00 to 1 (default). Modify D6257 (6060h to 6) to HM mode, then set D6258 (6098h) to return-to-origin mode. After configuring the return-to-origin speed via D6259-D6263 (6099h,609Ah), modify D6256 (control word 6040h from 0x06 to 0x07 then 0x0F) to enable the slave. Subsequently, set D6256 (control word 6040h from 0x0F to 0x1F) to initiate the return-to-origin mode. Other monitoring parameters are tracked by D6000-D6011. During the return-to-origin process, if the origin signal is triggered, the system will decelerate and stop according to the corresponding return-to-origin method. To re-initiate the return-to-origin, first reset 6040h to 0x06, then repeat the above steps.

4.7 Absolute value system

4.7.1 Absolute system setting

In order to save the position data of absolute encoder, the battery unit needs to be installed.
Install the battery on the battery unit of the encoder cable with the battery unit.
If you do not use encoder cable with battery unit, please set P-79 to 1, that is, multi-loop absolute value encoder is used as incremental encoder.

Pararmeter	Name	setting	Meaning	Range
P0-79	Absolute encoder battery undervoltage alarm switch	0	Normally use absolute encoder and use battery to memorize position.	0~2
		1(default)	Use multi-loop absolute encoder as incremental encoder and no longer remember position	
		2	Use as absolute encoder, ignore the multi-loop overflow alarm	

4.7.2 Replace the battery

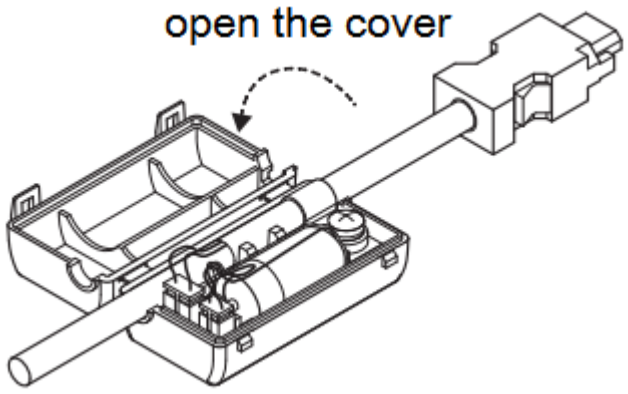
When replacing the battery, please replace the battery while keeping the driver and motor connected well and the control power is connected. If the battery is replaced when the control power between the driver and the motor is closed, the data stored in the encoder will be lost.

Note: Absolute Encoder Battery Model (This Battery Can't Charge)
Battery unit for normal cable:CP-B-BATT
Battery unit for tank chain cable: CPT-B-BATT

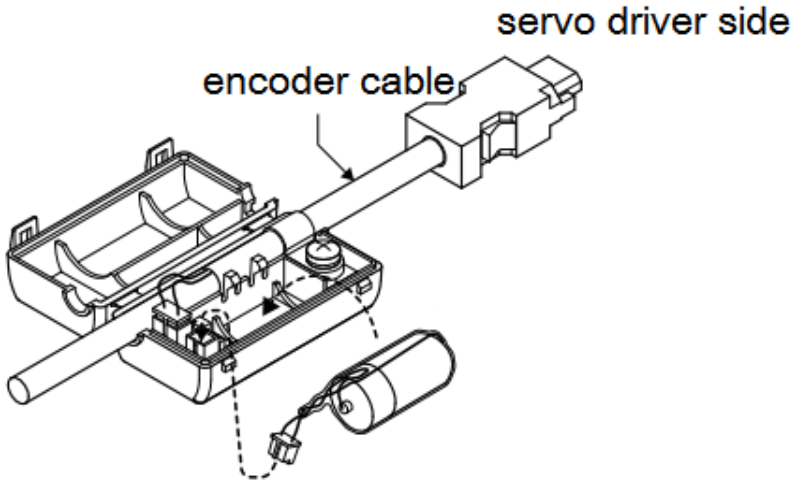
Battery replacement steps

When using encoder cable with battery unit

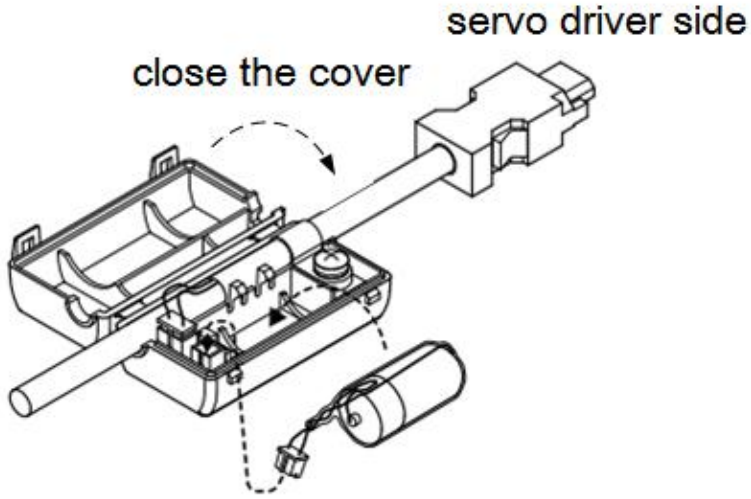
(1) Only the control power of the servo unit is connected;
(2) Open the cover of the battery cell;



(3) Take out the old battery, install the new one.



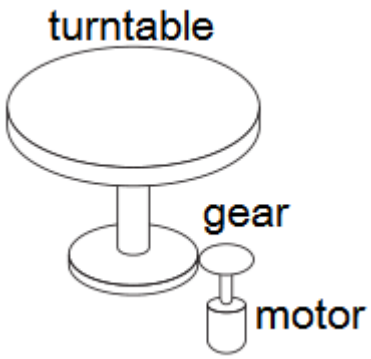
(4) Close the cover of the battery unit



(5) After replacing the battery, in order to remove the "Encoder Battery Alarm (E-222)" display, please do clear alarm twice (F0-00=1).
(6) Connect the power supply of the servo unit again;
(7) Make sure the error display disappears and the servo unit can operate normally.

4.7.3 The upper limit of turns

The upper limit of rotating cycles can be used for position control of gyroscopes such as turntables.
For example, suppose there is a machine whose turntable moves only in one direction, as shown in the figure below.



Because it can only rotate in one direction, after a certain period of time, the number of revolving cycles will always exceed the upper limit of absolute value encoder.

Servo motor series	Resolution (single-circle data)	Rotating Circle Serial Data Output range	Operation of overtime
CM/T	17	-32768~32767	When it is higher than the upper limit value in the forward direction (+32767*2^ 17): Rotation serial data = 32767*2^17 When it is below the lower limit of reversal direction (-32768*2^ 17): Rotation Serial Data=-32767*2^17
TL	23		When it is higher than the upper limit value in the forward direction (+32767*2^23): Rotation serial data = 32767*2^23 When it is below the lower limit of reversal direction (-32768*2^ 23): Rotation Serial Data=-32767*2^23

4.7.4 Read absolute position through communication

Basic parameters		
User parameter	Name	Use
U0-10	encoder feedback value	Absolute value single-turn position, read 0x100A and 0x100B hexadecimal address through Modbus RTU, U0-10+ U0-11*10000 is present encoder single-turn position
U0-11		
U0-91	present turns of multi-turn absolute	Read 0x105F hex address through ModbusRTU, which is the current number of encoder turns;
U0-57	absolute encoder present position feedback low 32-bit	Read 0x1039 hex address through ModbusRTU doubleword, which is the current encoder position, with positive and negative pulses;
U0-58		
U0-59	absolute encoder present position feedback high 32-bit	Read 0x103B hexadecimal address through ModbusRTU doubleword, which is the high bit of current encoder and needs to add the low bit data;
U0-60		

Servo driver transmits position data information of encoder through RS485 port and Modbus RTU protocol.

- **17-bit absolute value encoder has 131072 pulses per cycle.**

First read the U0-60 (0x103C) value
(1) 0 means running in the positive direction. The current position of the encoder is U0-57*1+U0-58*2^16.
(2) -1 means running in the opposite direction. The current encoder value is:
(U0-57-65535)*1+(U0-58-65535)*2^16+(U0- 59-65535)*2^32.

If the position is read by XINJE HMI and the U0-57 (Modbus address is decimal 4153) double-word is read, the high-low byte exchange should be selected. If communicating with Xinje PLC, direct double-word reading is ok.

- **23-bit absolute value encoder, one-cycle pulse number is 8388608.**

First read the U0-60 (0x103C) value
(1) 0 means running in the positive direction. The current encoder value is U0-57*1+U0-58*2^16 +U0-59*2^32.
(2) -1 means running in the opposite direction. The current encoder value is:
[(65536 - U0-57)* 1 + (65535-U0-58)* 2^{16} + (65535 - U0-59)* 2^{32}]*(-1).

4.7.5 Reset absolute position

Parameters	Name
U0-94	Relative encoder feedback value which can be reset
U0-95	
U0-96	
U0-97	

- **Clear the multi-turns**

The encoder turns clearing needs to be completed in the servo bb state, and the encoder turns clearing can be done through ModbusRTU communication. The current number of turns U0-91 of multi-turn absolute value will be set to zero, and the current position feedback U0-57 ~ U0-59 of absolute value encoder will also change accordingly.
Write 1 to the hexadecimal address of 0x2106 through Modbus RTU to clear the number of turns.
The servo bb status takes effect, and after clearing, write address 0x2106 to 0.
The decimal 3 can be written into the Modbus address 0x2106 through Modbus RTU communication, and U0-94 ~ 97 is used to display the absolute position of the motor after calibration.

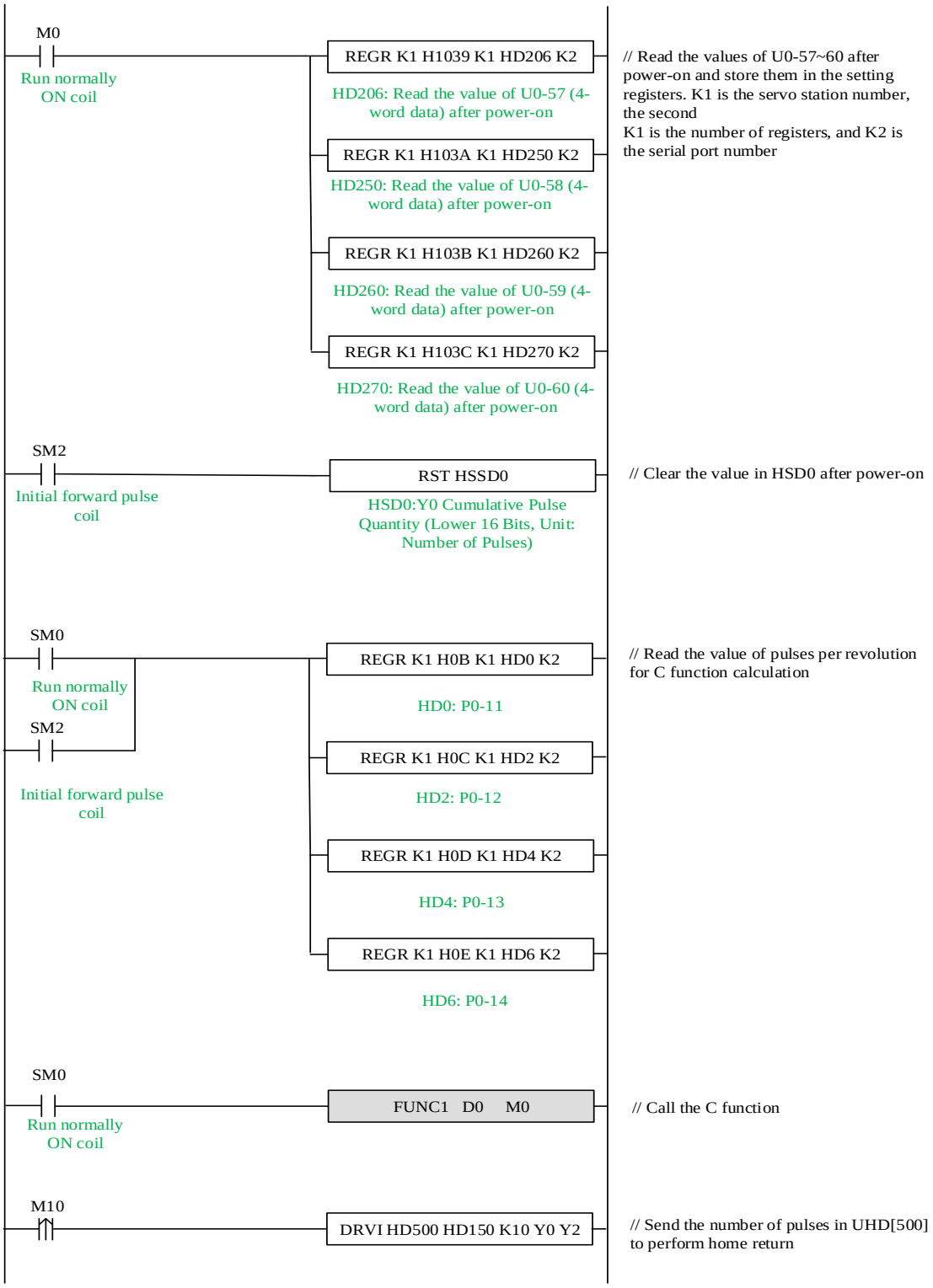
4.7.6 Absolute Encoder Zero Position Calibration

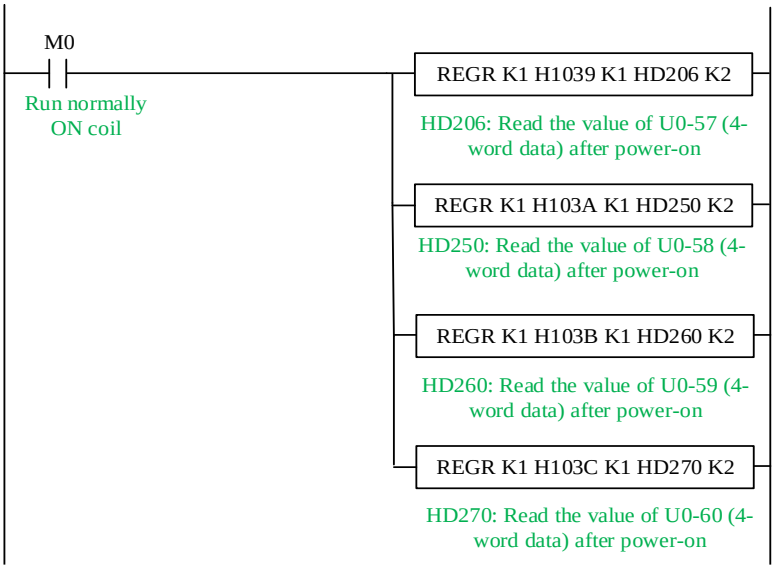
ModbusRTU Communication Clearance
The decimal value 3 can be written into F1-06 (Modbus address 0X2106) via ModbusRTU communication, and U0-94~97 are used to display the calibrated absolute position of the motor.

Only valid for multi-turn absolute value motors; the servo enable function needs to be turned off first.

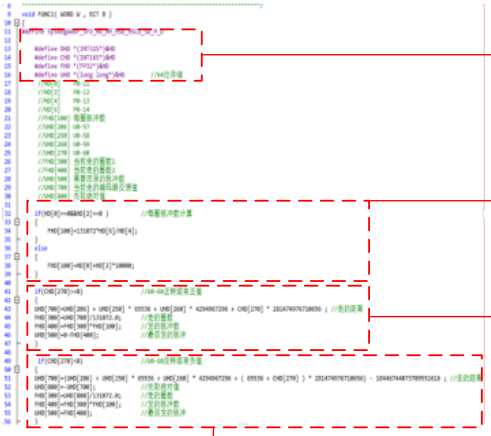
4.7.7 Absolute Value Homing Case

When using Xinje PLC to read the multi-turn absolute position, 4-word reading can be adopted. The following case realizes homing via the feedback of the multi-turn absolute encoder: M1 being closed memorizes the origin position, SM12 memorizes the real-time position, the encoder feedback difference of the traveled position is read through function call, and the DRVI instruction is used to return to the origin.


M0
Run normally ON coil
REGR K1 H1039 K1 HD206 K2
// Read the values of U0-57~60 after power-on and store them in the setting registers. K1 is the servo station number, the second
K1 is the number of registers, and K2 is the serial port number
HD206: Read the value of U0-57 (4-word data) after power-on
REGR K1 H103A K1 HD250 K2
HD250: Read the value of U0-58 (4-word data) after power-on
REGR K1 H103B K1 HD260 K2
HD260: Read the value of U0-59 (4-word data) after power-on
REGR K1 H103C K1 HD270 K2
HD270: Read the value of U0-60 (4-word data) after power-on
SM2
Initial forward pulse coil
RST HSSD0
// Clear the value in HSD0 after power-on
HSD0:Y0 Cumulative Pulse Quantity (Lower 16 Bits, Unit: Number of Pulses)
SM0
Run normally ON coil
REGR K1 H0B K1 HD0 K2
// Read the value of pulses per revolution for C function calculation
HD0: P0-11
SM2
Initial forward pulse coil
REGR K1 H0C K1 HD2 K2
HD2: P0-12
REGR K1 H0D K1 HD4 K2
HD4: P0-13
REGR K1 H0E K1 HD6 K2
HD6: P0-14
SM0
Run normally ON coil
FUNC1 D0 M0
// Call the C function
M10
DRVI HD500 HD150 K10 Y0 Y2
// Send the number of pulses in UHD[500] to perform home return



// Read the values of U0-57~60 after power-on and store them in the setting registers. K1 is the servo station number, the second
K1 is the number of registers, and K2 is the serial port number



Define the byte(s) of register data

First, determine the number of pulses per revolution required for the motor to rotate one revolution based on the pulses per revolution and electronic gear ratio read via communication, and store it in FHD[100]

Calculate the real-time feedback value of the encoder's movement and store it in UHD[700].

For forward operation (U0-60>0), since the encoder feedback resolution is inconsistent with the number of pulses per revolution, first calculate the number of revolutions traveled, then multiply it by the number of pulses per revolution to obtain the number of pulses required for the real-time traveled distance.

As the movement is in the forward direction, negative pulses need to be sent to return to the origin when issuing pulses; take the negative value and store it in UHD[500].

For reverse operation (U0-60<0), first take the absolute value of the encoder feedback value corresponding to the real-time traveled distance.

Since the encoder feedback resolution is inconsistent with the number of pulses per revolution, perform the calculation in Step ② above.

4.8 Auxiliary functions

4.8.1 Anti-blocking protection

Anti-blocking alarm: When the motor speed is lower than P0-75 (unit 1 rpm) and the duration reaches the set value of P0-74 (unit ms), the current output torque U0-02 is greater than the internal positive torque limit of P3-28 and the internal reverse torque limit of P3-29, it will show the alarm E-165 blocking overtime.

■ **Related parameters**

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P0-74	Blocking alarm time	According to models	1ms	0～65535	Anytime	At once
P0-75	Blocking alarm speed	50	rpm	5～9999	Anytime	At once
P3-28	Internal forward torque limit	300	%	0～300	Anytime	At once
P3-29	Internal reverse torque limit	300	%	0～300	Anytime	At once
P3-38	Anti-blocking alarm internal forward torque limit	300	%	0～300	Anytime	At once
P3-39	Anti-blocking alarm internal reverse torque limit	300	%	0～300	Anytime	At once

Note:

(1) When P0-74 or P0-75 is set to 0, this alarm will not be detected;
(2) If this alarm occurs during normal operation of servo, please confirm:
(a) Monitor U0-02 motor torque and check if P3-28 and P3-29 (P3-38/P3-39) torque limits are set properly;
(b) Check the external mechanical structure and installation;

(3) P0-74 the default value of locked rotor alarm time is as follows:

Driver model	P0-74 (/ms) default parameter
DF3E-0410	3000
DF3E-0720	5000

P0-74 is 0, the anti-stall alarm is not opened by default, and users can configure it according to their own needs.

(4)P3-38/P3-39 are only used as the comparison value of anti locked rotor alarm, P3-28/P3-29 are the internal torque limit of motor in actual operation.

4.8.2 Torque limit

1. Internal torque limit

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P3-28	Internal Forward torque limit	300	%	0～300	Anytime	At once
P3-29	Internal reverse torque limit	300	%	0～300	Anytime	At once
1. if this parameter value is less than external torque limit value, the final limit value is this parameter. 2. The unit is percent of the motor rated torque; the default value is 300%. The real max output torque is limited by motor overload times.						

2. External torque limit (via input signal)

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P3-30	Forward external torque limit	300	%	0～300	Anytime	At once
P3-31	Reverse external torque limit	300	%	0～300	Anytime	At once
The unit is the percent of motor rated torque; the default value is 300%.						

Parameter	Signal name	Default setting	Meaning	Range	Modify	Effective
P5-25	/P-CL	n.0000	The necessary condition to use forward external torque limit	Range 0000-0014, can be distributed to other input terminals through P5-25.	Anyti me	At once
P5-26	/N-CL	n.0000	The necessary condition to use reverse external torque limit	Range 0000-0014, can be distributed to other input terminals through P5-26.	Anyti me	At once

3. Relationship

The following are the relationship of internal torque limit, external torque limit, P-CL, /N-CL.

P-CL/N-CL state	Final forward torque	Final reverse torque
0	Decided by P3-28	Decided by P3-29
1	The smaller one of internal forward torque limit and external forward torque limit	The smaller one of internal reverse torque limit and external reverse torque limit

4. Output torque up to limit value signal

Parameter	Signal name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-42	Torque limit /CLT	n.0000	All	Output signal when motor output torque up to P3-28, P3-29.	Anytime	At once
No terminals are assigned by default. The parameter range is 0000-0014, which is assigned to the output interface through parameter P5-42. When set to 0002, the signal is output from the SO2 terminal.						

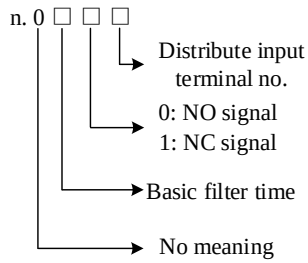
4.8.3 Speed limit

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P3-14	Forward max speed command limit	4000	rpm	0～65535	Servo bb	At once
P3-15	Reverse max speed command limit	4000	rpm	0～65535	Servo bb	At once
Note: P3-14 and P3-15 are effective in all the modes.						

4.8.4 I/O signal distribution

4.8.4.1 Input terminal distribution

1. Input signal distribution

Parameter	Parameter Meaning	Set value	Meaning
P5-20~P5-36		n.0000	Not distribute to terminal input
		n.000x	Input always open signal from SIx
		n.0010	Set the signal to be always valid
		n.001x	Input always close signal from SIx

Note: The basic filtering time refers to input terminal filtering time.

2. default setting of input terminal

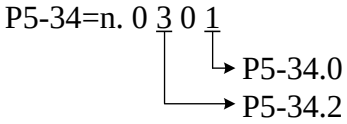
Input terminal	SI1	SI2	SI3	SI4
Signal	/S-ON	/ALM-RST	/P-OT	/N-OT

3. Filtering time of input terminal

■ **Related parameter**

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P5-18	SI filtering time multiple	1	-	0~10000	Anytime	At once

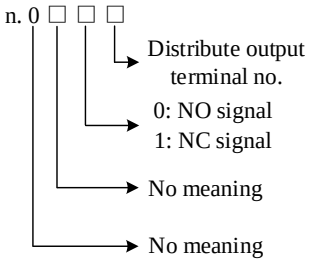
SI input filtering time is determined by IO parameter value and P5-18. Examples are as follows:
Pulse deviation clear set to SI1 terminal, and 30ms Filtering Time
The parameters are set as follows:



P5-34.0=1 input terminal is SI1
P5-34.2=3 basic filtering time is 3ms
P5-18=10 filtering time multiple is 10
So the total filtering time is P5-34.2 * P5-18=3ms*10=30ms

4.8.4.2 Output terminal distribution

1. Output signal distribution

Parameter	Parameter Meaning	Set value	Meaning
P5-37～P5-53		n.0000	Not distribute to terminal input
		n.000x	Output always open signal from SOx
		n.0010	Set the signal to be always valid
		n.001x	output always close signal from SOx

2. Default setting of output terminal

Output terminal	SO1	SO2	SO3
Signal	/COIN	/ALM	/S-RDY

4.8.5 Output terminal function

4.8.5.1 Servo ready output (/S-RDY)

■ **Related parameter**

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P5-70	/S-RDY: output condition selection	1	-	0~1	Anytime	At once

Parameter	Signal name	Default setting	Suitable mode	Meaning	Modify	Effective
P5-41	/S-RDY	n.0003	All	servo ready output	Anytime	At once
Refer to section 3.2.2 for hardware wiring details. P5-41 parameter setting range is n.0000-0014, which is assigned to other output terminals through parameters. If it is necessary to output signal from SO2, P5-41 can be set to n.0002/0012.						

Servo ready signal output conditions

When P5-70 is set to 0: after the driver initialization is completed and the servo has no alarm status /S-RDY is valid;
When P5-70 is set to 1: after enabling, the servo has no alarm status /S-RDY is valid.

4.8.5.2 Rotating detection output (/TGON)

1. Signal setting

Parameter	Signal	Default setting	Suitable mode	Meaning	Modify	effective
P5-40	/TGON	n.0000	All	Rotating detection output	Anytime	At once
It is the output signal indicating that the servo motor is rotating at a speed higher than the set value. 1. No terminal output signal is assigned by default. The parameter range is 0000-0014, which is allocated						

to other output terminals through parameter P5-40. 2. When the speed of the servo motor is higher than the set value of P5-03, the signal that the servo is rotating is considered.

2. Related parameters

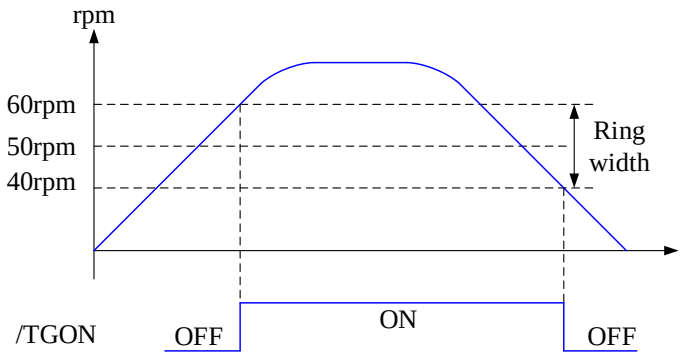
Parameter	Meaning	Default value	Unit	Range	Modify	Effective
P5-03	Rotating detection speed /TGON	50	rpm	0～10000	Anytime	At once
If the speed of the servo motor exceeds the set value of P5-03, it is judged that the servo motor is rotating and the output of the rotation detection (/TGON) signal.						

Note: Rotation detection has a hysteresis of 10 rpm.

3. Hysteresis

Hysteresis is set up to prevent the system from repeatedly acting and oscillating when the parameters fluctuate up and down in a certain value. Once the hysteresis value is set, there will be a fixed ring width. Then only when the parameter must be greater than a certain value can the action be taken. When the parameter is smaller than another value, the action will be released. The ring width determines the interval time of the action. The action of small ring width is sensitive and frequent, and the action of large ring width is slow.

It should be noted that the rotation detection speed (P5-03), the same speed detection speed (P5-04), the arrival detection speed (P5-05), all contain 10 rpm hysteresis. For example, the rotation detection speed P5-03 is set to 50, and the rotation detection/TGON output port is SO3.



4.8.5.3 Same speed detection (/V-CMP)

Parameter	Signal	Default setting	Suitable mode	Meaning	Modify	Effective
P5-39	/V-CMP	n.0000	3, 4, 7	Same speed detection	Anytime	At once
Defaulted is not distribute to the terminals. Range: 0000-0014. Distribute to output terminal through P5-39. When it set to 0002, it means output from SO2.						

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P5-04	Same speed detection signal width	50	rpm	0～10000	Anytime	At once

There is default 10rpm hysteresis loop, please refer to chapter 5-12-3 for hysteresis loop.

4.8.5.4 Warn output (/WARN)

Set the alarm output threshold, when the current speed is higher than the warning speed, output / WARN.

Parameter	Meaning	Default value	Unit	Range	Modify	Effective
P3-19	Forward warning speed	Motor related	rpm	0～65535	Servo bb	At once
P3-20	Reverse warning speed	Motor related	rpm	0～65535	Servo bb	At once

Parameter	Signal	Default setting	Suitable mode	Meaning	Modify	effective
P5-45	/WARN	n.0000	All	Warning output	Anytime	At once
1. No terminal output signal is assigned by default. The parameter range is 0000-0014, which is allocated to other output terminals through parameter P5-45. 2. When a warning occurs, the servo unit only outputs the warning and will not be forced to set OFF.						

4.8.5.5 Alarm output (/ALM)

1. Servo alarm output /ALM

Parameter	Signal name	Setting	Meaning	Range
P5-47	Alarm output /ALM	n.0002 (default)	When the servo alarm, SO2 and COM are connected, and the alarm signal is output.	The parameter range is 0000-0014, which is assigned to the output interface by parameter P5-47. When set to 0001, the signal is output from the SO1 terminal.
		n.0012	When the servo alarm, the SO2 and COM are switched off.	

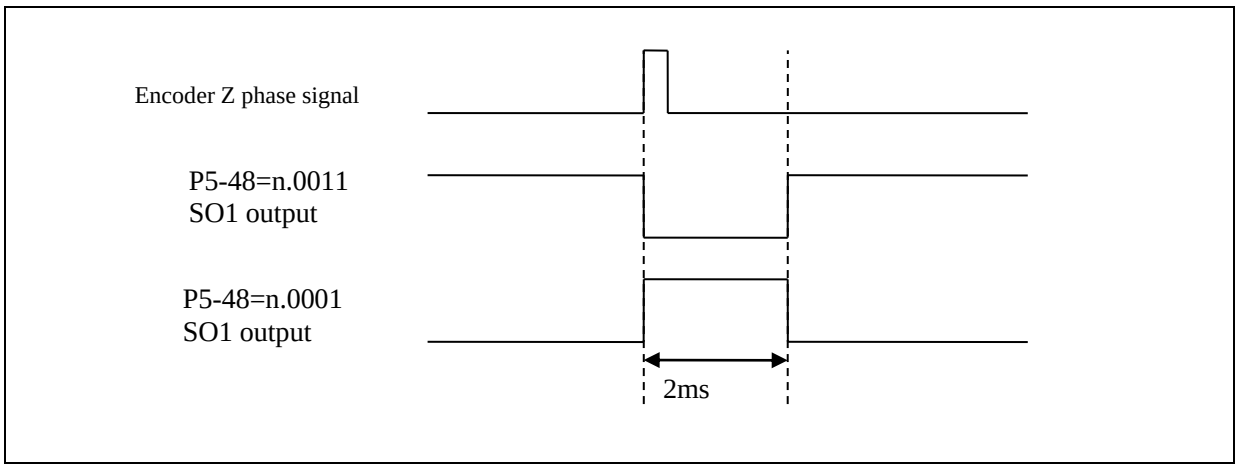
Note:

(1) When an alarm occurs, the servo unit is forced to set OFF, and the motor will move with external forces (including gravity). If you need to keep the motor in position, please select the motor with power loss brake (also known as brake) and use / BK signal. Refer to Section 5.2.5.

(2) The output of the functional parameters can not be repeated.

4.8.5.6 Encoder Z phase output (/Z)

parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P5-48	Z phase output /Z	n.0000	-	0000～0014	Anytime	At once
P5-19	Z phase pulse width	2	ms	2～20	Anytime	At once
1. /Z signal can be distributed to the output terminal through P5-48. 2. Z phase signal is single pulse output mode, the default pusle width is 2ms, it can set through P5-19, it is not related to the motor speed.						



4.8.5.7 User-defined output signal

User can define 2 outputs. The defined method is SOx output when A>B or A<B. A is 9 activating conditions; B is user-defined comparison value.

User-defined output 1:

P5-10	The trigger condition of user-defined output 1					
	Default trigger condition	Trigger condition setting	Unit	Suitable mode	Change	effective
	0	See below table: optional trigger condition	Related to trigger condition	All the modes	Anytime	At once
P5-11	The comparison value for the trigger condition of user-defined output 1					
	Unit	Default setting	Range	Suitable mode	Change	Effective
	Related to trigger condition	0	-32768~ 32767	All the modes	Anytime	At once

P5-12	When P5-10≥P5-11 or P5-10<P5-11, SOx output					
	Setting value	Function	Default value	Suitable mode	Change	Effective
	0	P5-10≥P5-11, SOx output	0	All the modes	Anytime	At once
	1	P5-10＜P5-11, SOx output				
	2	P5-10 absolute value ≥P5-11, SOx output				
	3	P5-10 absolute value ≤P5-11, SOx output				

P5-13	User-defined output 1 hysteresis loop					
	Unit	Default setting	Range	Suitable mode	Change	Effective
	Related to trigger condition	0	0~65535	All the modes	Anytime	At once
P5-52	Output terminal setting of user-defined output 1					
	Signal name	Default setting	Meaning	Change		
	User-defined output 1	n.0000	Default setting is not distribute to the output terminal	Range 0000-0014, distribute to the output terminal through P5-52.		

User-defined output 2:

P5-14	The trigger condition of user-defined output 2					
	Default trigger condition	Trigger condition setting	Unit	Suitable mode	Change	Effective
	0	See below table: optional trigger condition	Related to trigger condition	All the modes	Anytime	At once
P5-15	The comparison value for the trigger condition of user-defined output 2					
	Unit	Default setting	Range	Suitable mode	Change	Effective
	Related to trigger condition	0	-9999~9999	All the modes	Anytime	At once

P5-16	When P5-14≥P5-15 or P5-14<P5-15, SOx output					
	Setting value	Function	Default setting	Suitable mode	Change	Effective
	0	P5-14≥P5-15, SOx output	0	All the modes	Anytime	At once
	1	P5-14＜P5-15, SOx output				
	2	P5-14 absolute value ≥P5-15, SOx output				
	3	P5-14 absolute value ＜ P5-15, SOx output				

P5-17	User-defined output 2 hysteresis loop					
	Unit	Default setting	Range	Suitable mode	Change	Effective
	Related to trigger condition	0	-32768~ 32767	All the modes	Anytime	At once
P5-53	Output terminal setting of user-defined output 2					
	Signal name	Default setting	Meaning	Change		
	User-defined output 2	n.0000	Default setting is not distribute to the output terminal	Range 0000-0014, distribute to the output terminal through P5-53		

Note: please refer to chapter 4.7.5.2 for hysteresis loop.

4.8.5.8 Other SO terminal function

Terminal name	Description	Chapter
/COIN-HD	Positioning completion hold	5.3.1.2
/COIN	Positioning end	5.3.1.2
/CLT	Torque limit detection	5.8.2
/VLT	Speed limit detection	5.5.1.3
/MRUN	Internal position mode motion start	5.3.2.7
/V-RDY	Speed arriving signal	5.4.1.3
/PREFA	Internal position selection signal	5.3.2.1
/PREFB	Internal position selection signal	5.3.2.1
/PREFC	Internal position selection signal	5.3.2.1

4.8.6 Input terminal function

4.8.6.1 Proportion action command (/P-CON)

Parameter	Signal	Type	Default	State	Meaning	Modify	Effective
P5-21	Proportion action /P-CON	Input	n.0000	Valid	Run in P control mode	Anytime	At once
				Invalid	Run in PI control mode		
1. /P-CON is the speed control mode signal selected from PI (proportion integral) and P (proportion). 2. If set to P control mode, the motor rotate and micro-vibration caused by speed command input drift can be decreased. But the servo stiffness will decrease. 3. /P-CON signal can be distributed to input terminal via parameter P5-21.							

4.8.6.2 Alarm reset (/ALM-RST)

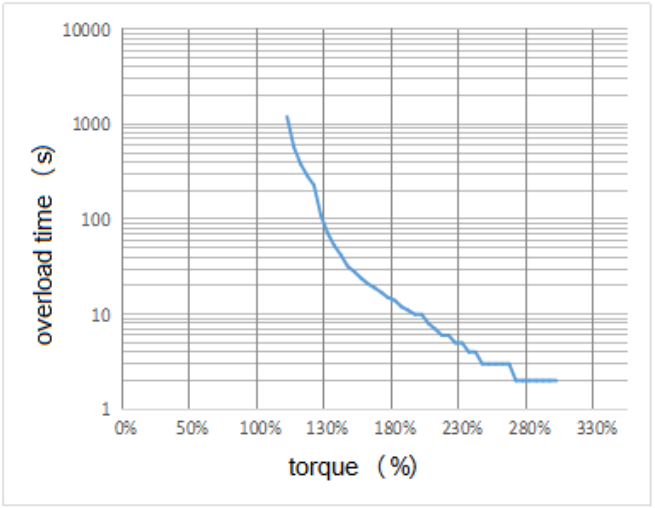
Parameter	Signal	Default setting	Suitable mode	Meaning	Modify	effective
P5-24	/ALM-RST	n.0002	All	Input normally open signal from SI2 terminal	Anytime	At once
1. The parameter range is 0000-0014, which is allocated to other input terminals through parameter P5-24. 2. When an alarm occurs, find out the cause of the alarm and remove it, then clear the alarm by setting the signal to be effective. 3. /ALM-RST signal can be assigned to other terminals through this parameter, because the alarm signal is related to the safe operation of the servo, so the /ALM-RST signal can not be set to be always valid (n.0010).						

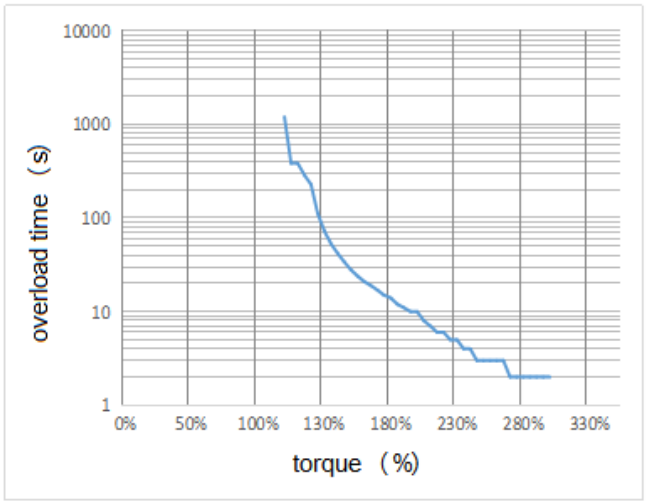
4.8.6.3 Other SI terminal function

Terminal name	Description	Chapter
/S-ON	Servo enable	5.2.2
/P-OT	No forward driving	5.2.4
/N-OT	No reverse driving	5.2.4
/P-CL	Forward side external torque limit	5.8.2
/N-CL	Reverse side external torque limit	5.8.2
/SPD-D	Internal speed direction	5.4.2
/SPD-A	Internal setting speed	5.4.2
	Position mode reference origin triggering	5.3.1.8
/SPD-B	Internal setting speed	5.4.2
	Position mode reference origin triggering	5.3.1.8
/C-SEL	Control mode selection	5.1.2
/ZCLAMP	Zero clamp	5.4.1.2
/INHIBIT	Command pulse inhibit	5.3.3.4

4.8.7 Time limit curve of overload protection

The time limit curve of overload protection is only used for the judgment of alarm output and the protection of overload operation. It is recommended to use it within the continuous operation stage of torque speed curve. For the torque speed curve, please refer to appendix 8.

400W suitable model (motor code)	
50F4 58F4	

750W suitable model (motor code)	
50F7 58F7	

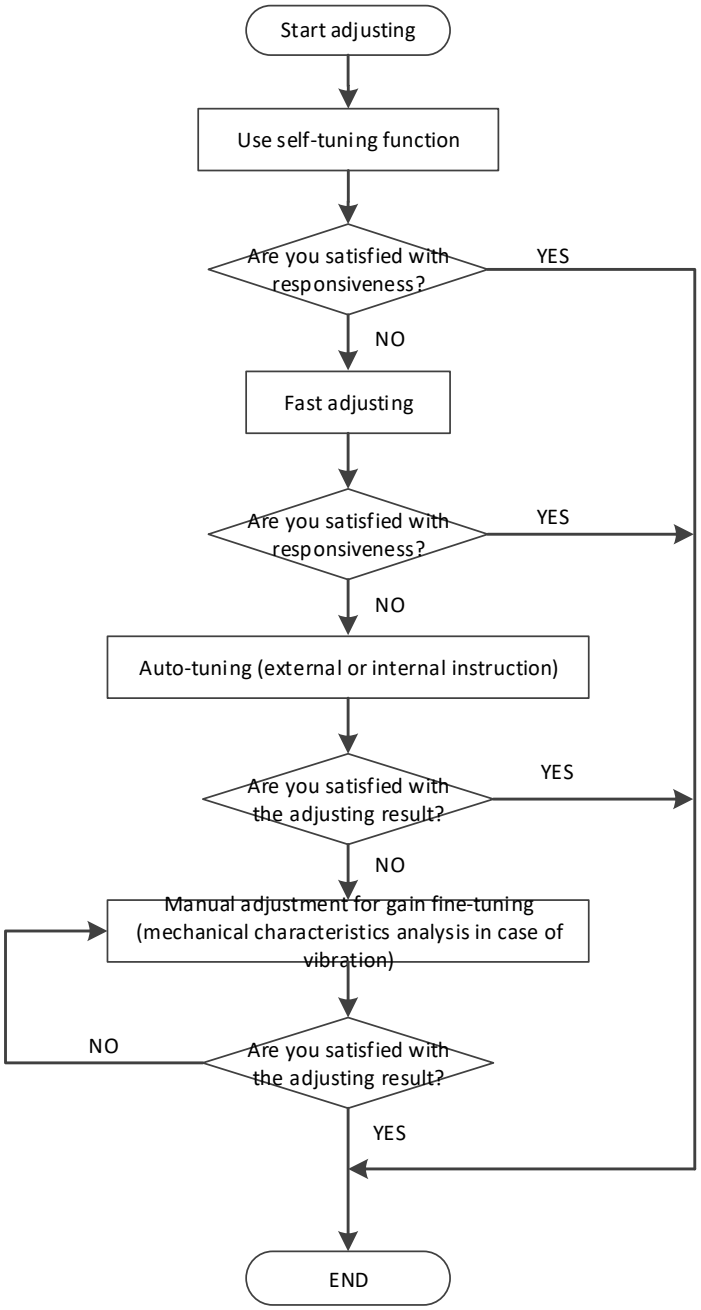
5 Servo gain adjustment

5.1 Overview of servo gain adjustment

5.1.1 Overview and process

The servo driver needs to drive the motor as fast and accurately as possible to track the instructions from the upper computer or internal settings. In order to meet this requirement, the servo gain must be adjusted reasonably.

Servo gain factory value is adaptive mode, but different machines have different requirements for servo responsiveness; the following figure is the basic process of gain adjustment, please adjust according to the current machine status and operation conditions.



5.1.2 The difference of these adjustment modes

Adjustment modes are divided into adaptive and auto-tuning, and their control algorithms and parameters are independent. Among them, the auto-tuning mode is divided into three functions: fast adjustment, automatic adjustment and manual adjustment. The three functions are the same in essence but different in implementation. Refer to the corresponding chapters of each function.

Mode	Type	Parameters	Rigidity	Responsiveness	Related parameters
Adaptive	Automatic adaptation	P2-01.0=1	middle	150ms	P2-05 adaptive speed loop gain P2-10 adaptive speed loop integral P2-11 adaptive position loop gain P2-07 adaptive inertia ratio P2-08 adaptive speed observer gain P2-12 adaptive stable max inertia ratio
Auto-tuning	Fast adjusting	P2-01.0=0	high	10~50ms	P0-07 first inertia ratio P1-00 speed loop gain P1-01 speed loop integral P1-02 position loop gain P2-35 Torque instruction filtering time constant 1 P2-49 Model loop gain
	Automatic adjustment		high	10ms	
	Manual adjusting		high	Determined by parameters	

5.2 Rotary inertia presumption

5.2.1 Overview

Rotational inertia estimation is the function of automatic operation (forward and reverse) in the driver and estimate the load inertia in operation.

Rotational inertia ratio (the ratio of load inertia to motor rotor inertia) is a benchmark parameter for gain adjustment, and it must be set to the correct value as far as possible.

Parameter	Meaning	Default setting	Unit	Setting range	Modification	Effective
P0-07	First inertia ratio	1500	%	0~50000	Anytime	At once

5.2.2 Notes

Occasions where inertia cannot be presumed

- Mechanical systems can only operate in one direction

The occasion where inertia presumption is easy to fail

- Excessive load moment of inertia
- The running range is narrow and the travel is less than 0.5 circles.
- The moment of inertia varies greatly during operation.
- Mechanical rigidity is low and vibration occurs when inertia is presumed.

Notes of Inertia Presumption

- Since both directions are rotatable within the set range of movement, please confirm the range or direction of movement; and ensure that the load runs in a safe journey.
- If the presumed inertia under default parameters runs jitter, indicating that the present load inertia is too large, please switch to large inertia mode (P2-03.3=1) and operate again. It is also possible to set the initial inertia to about twice the current one and execute again under larger loads.
- Driver inertia ratio recognition upper limit is 200 times (parameter upper limit is 20000). If the estimated inertia ratio is exactly 20000, it means that the inertia ratio has reached the upper limit and can not be used, please replace the motor with larger rotor inertia.

Other notes

- At present, the inertia switching function is not supported, and the second inertia ratio is invalid.
- The inertia ratio upper limit changes to 500 times for the driver firmware 3700 and higher version (parameter upper limit value is 50000).

5.2.3 Operation tool

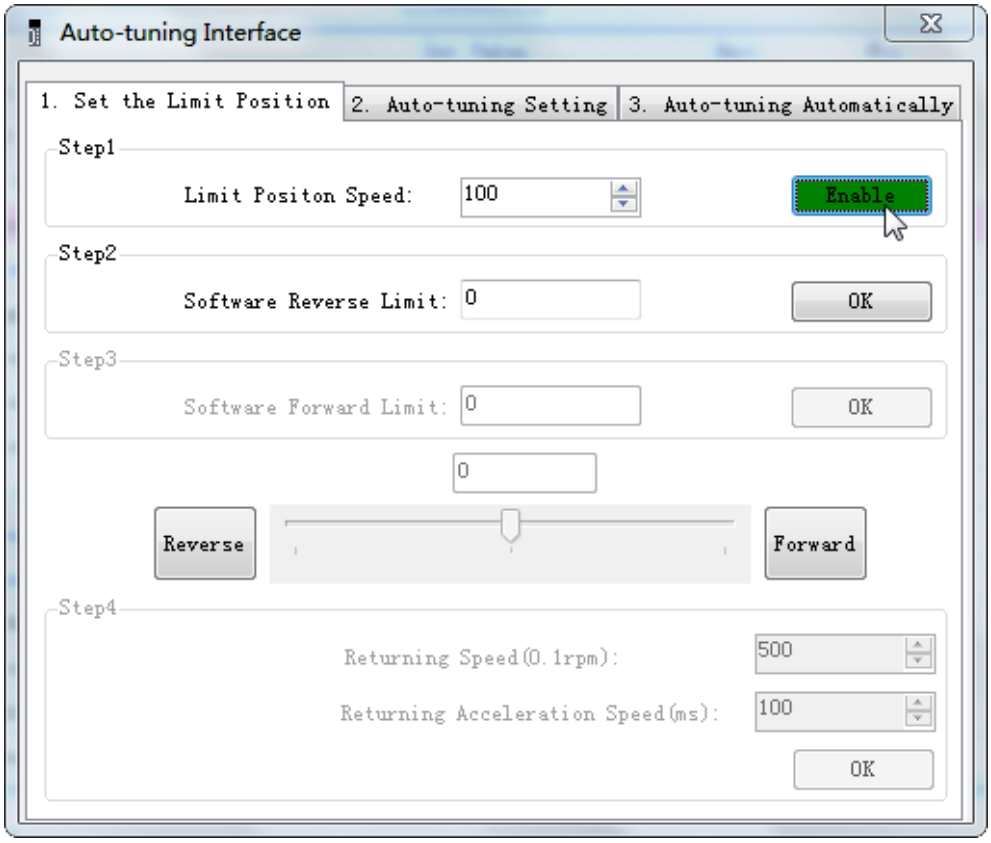
The presumptive tools of load moment of inertia are driver panel and XinjeServo software.

Operation tool	Description
XinjeServo software	All versions of software supported

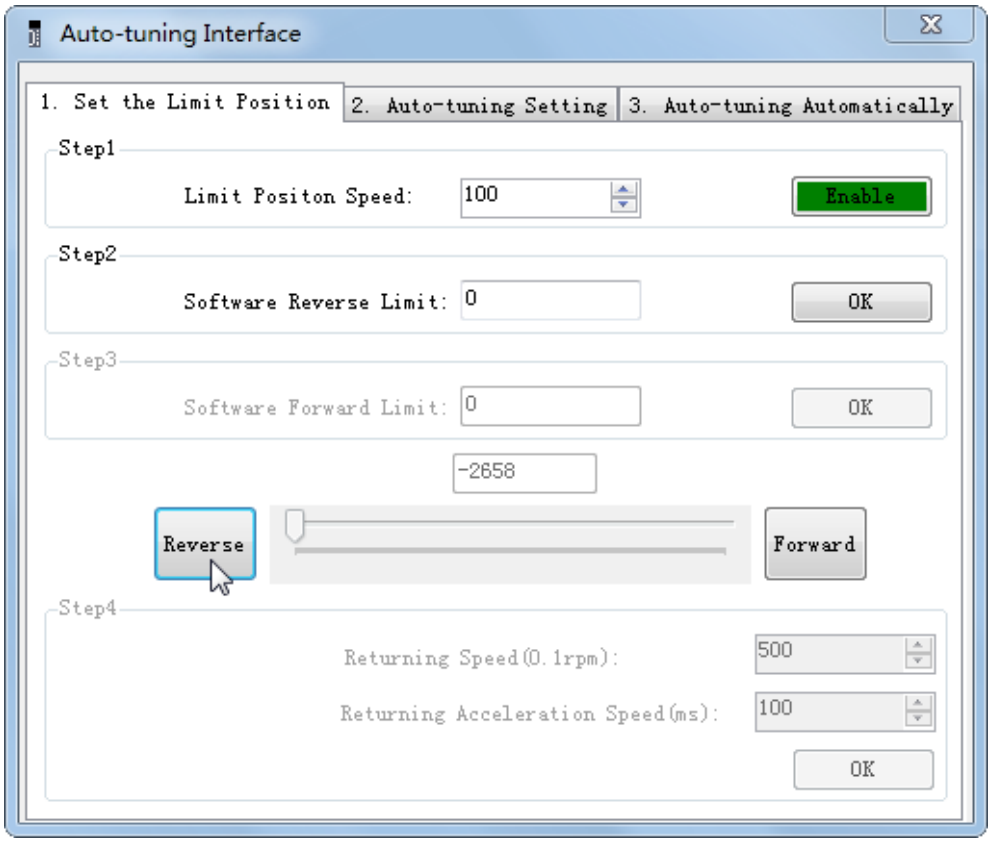
Note: driver firmware version can be checked through U2-07.

5.2.4 Operation steps

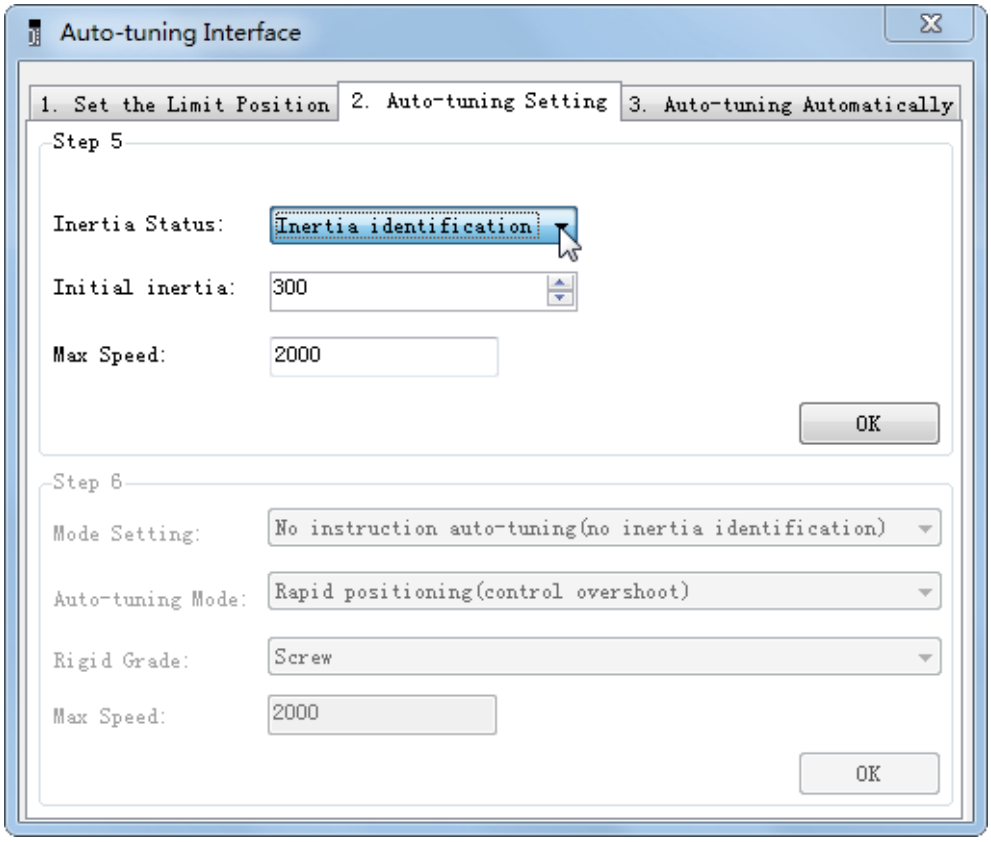
1. Click auto-tuning on the main interface of XinJeServo



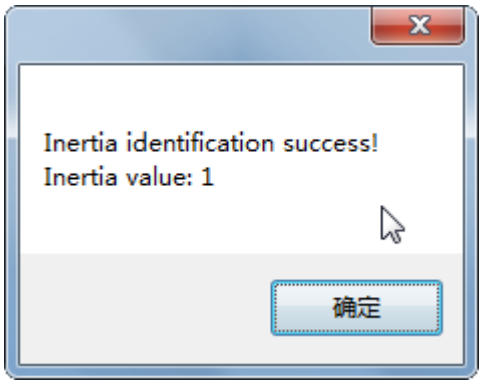
2. select jog setting or manual setting to configure the inertia estimation trip



3. Set the auto-tuning interface



4. Click ok to start inertia identification.



Note:

(1) If the auto-tuning interface is closed directly, the driver only configures inertia ratio parameters.

(2) The detailed steps of XinJeServo's presumptive inertia refer to XinJeServo's help document.

5.3 Fast adjustment

5.3.1 Overview

Fast adjustment needs to set the load inertia first, and then turn off the adaptive function. If the inertia does not match, it will cause oscillation alarm. The gain parameters of fast adjustment belong to self-tuning mode.

5.3.2 Fast adjustment steps

1. estimate the load inertia through servo driver panel or XinJeServo software, refer to chapter 5.2
2. shut down adaptive mode, set P2-01.0 to 0
3. set the rigidity level P0-04

Note: P2-01.0 is the first bit of P2-01

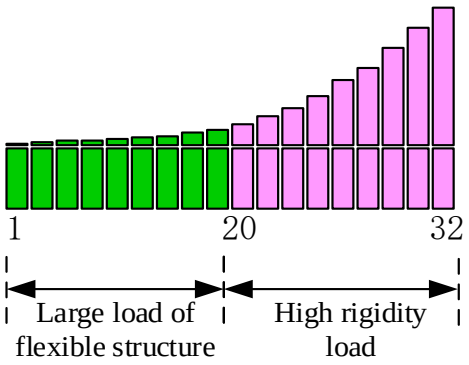
P2-01=n. 0 0 1 0
↳ P2-01.0

5.3.3 Rigidity level corresponding gain parameters

P0-04 Rigidity level	P1-00 Speed loop gain	P1-01 speed loop integral	P1-02 Position loop gain	P2-35 Torque instruction filter	P2-49 Model loop gain
1	20	31831	20	100	50
2	25	25464	25	100	60
3	35	18189	35	100	110
4	50	12732	50	100	150
5	65	9794	65	100	175
6	80	7957	80	100	200
7	95	6701	95	100	230
8	110	5787	110	100	245
9	130	4897	130	100	290
10	150	4244	150	100	340
11	170	3744	170	100	380
12	190	3350	190	100	410
13	210	3031	210	100	450
14	235	2709	235	100	540
15	260	2448	260	100	700
16	270	2357	270	100	800
17	285	2233	285	100	900
18	300	2122	300	100	1000
19	320	1989	320	100	1100
20	340	1872	340	100	1250
21	360	1768	360	100	1400
22	400	1591	380	80	1600
23	460	1383	420	60	1800
24	530	1201	470	40	2100
25	610	1043	540	20	2400
26	700	909	620	10	2700
27	800	795	710	10	3000
28	920	691	820	10	3400
29	1070	594	970	10	3800
30	1220	521	1110	10	4200

P0-04 Rigidity level	P1-00 Speed loop gain	P1-01 speed loop integral	P1-02 Position loop gain	P2-35 Torque instruction filter	P2-49 Model loop gain
31	1370	464	1250	10	4600
32	1600	397	1450	10	5000

The rigidity level should be set according to the actual load. The larger the P-04 value, the greater the servo gain. If there is vibration in the process of increasing the rigidity level, it is not suitable to continue to increase. If vibration suppression is used to eliminate vibration, it can try to continue to increase. The following is the recommended rigidity level of the load, for reference only.



Flexible structure large load: refers to the type of synchronous belt structure, large load inertia equipment.
High rigid load: refers to the mechanism of screw rod or direct connection, and equipment with strong mechanical rigidity.

Driver power	Default parameters	The firmware corresponds to the rigidity level
400w~750w	P1-00=65 P1-01=9794 P1-02=80 P2-35=100 P2-49=175	5

5.3.4 Notes

- The gain parameters corresponding to the rigidity level can be independently fine-tuned in the fast adjustment mode.
- In order to ensure stability, the gain of model loops is small at low rigidity level, which can be added separately when there is high response requirement.
- When vibration occurs in fast adjustment, the torque instruction filter P2-35 can be modified. If it is ineffective, the mechanical characteristic analysis can be used and the relevant notch parameters can be set (refer to chapter 5.7 vibration suppression).
- Fast adjustment mode defaults to set a rigidity level. If the gain does not meet the mechanical requirements, please gradually increase or decrease the settings.
- At present, gain switching function is not supported, that is, the second gain parameters such as P1-05, P1-06, P1-07 are invalid.

5.4 Auto-tuning

5.4.1 Overview

Auto-tuning is divided into internal instruction auto-tuning and external instruction auto-tuning.

Auto-tuning (internal instruction) refers to the function of automatic operation (forward and reverse reciprocating motion) of servo unit without instructions from the upper device and adjusting according to the mechanical characteristics in operation.

Auto-tuning (external instruction) is the function of automatically optimizing the operation according to the instructions from the upper device.

The automatic adjustments are as follows:

- Load moment of inertia
- Gain parameters (speed loop, position loop, model loop gain)
- Filter (notch filter, torque instruction filter)

5.4.2 Notes

Untunable occasions

- Mechanical systems can only operate in one direction.

Setting occasions that are prone to failure

- Excessive load moment of inertia;
- The moment of inertia varies greatly during operation.
- Low mechanical rigidity, vibration during operation and failure of detection positioning;
- The running distance is less than 0.5 circles.

Preparations before auto-tuning

- Use position mode;
- Driver in bb state;
- Driver without alarm;
- The matching of the number of pulses per rotation and the width of positioning completion should be reasonable.

5.4.3 Operation tools

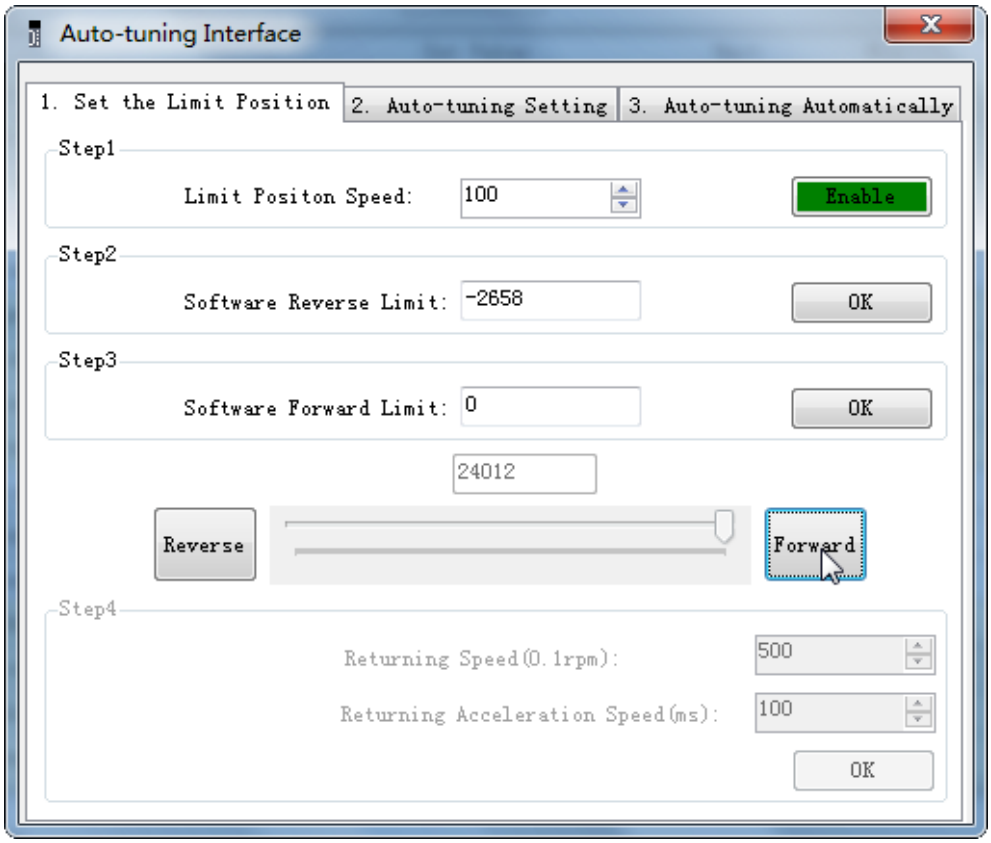
Internal instruction auto-tuning and external instruction auto-tuning can be executed by XinJeServo software.

Auto-tuning mode	Operation tools	Limit item
Internal instruction auto-tuning external instruction auto-tuning	XinJeServo software	All the versions support

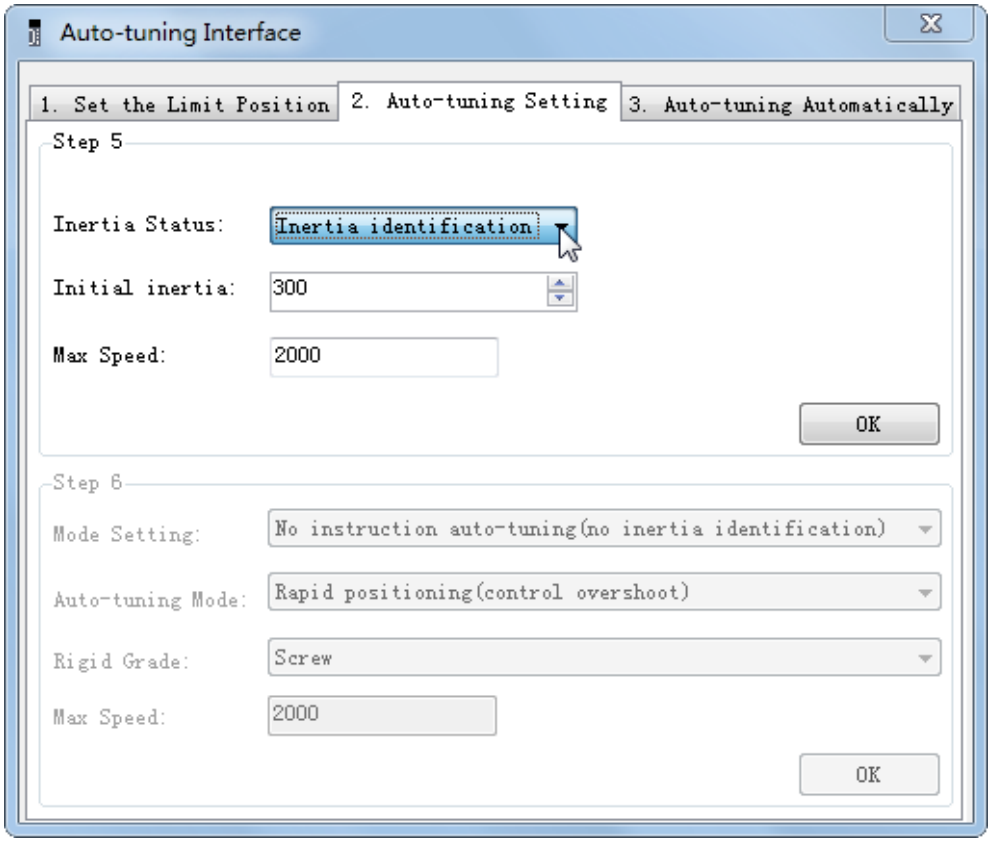
Note: please check the driver firmware version through U2-07.

5.4.4 Internal instruction auto-tuning steps

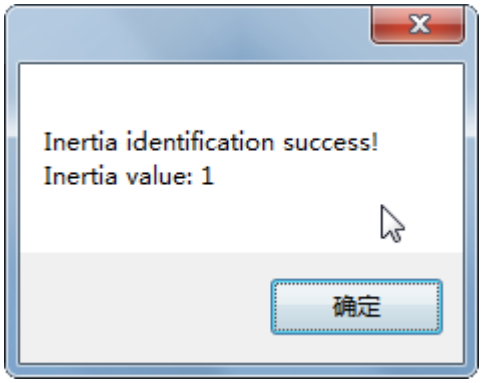
1. click auto-tuning on the XinJeServo software main interface
2. set the auto-tuning trip in jog mode or manually



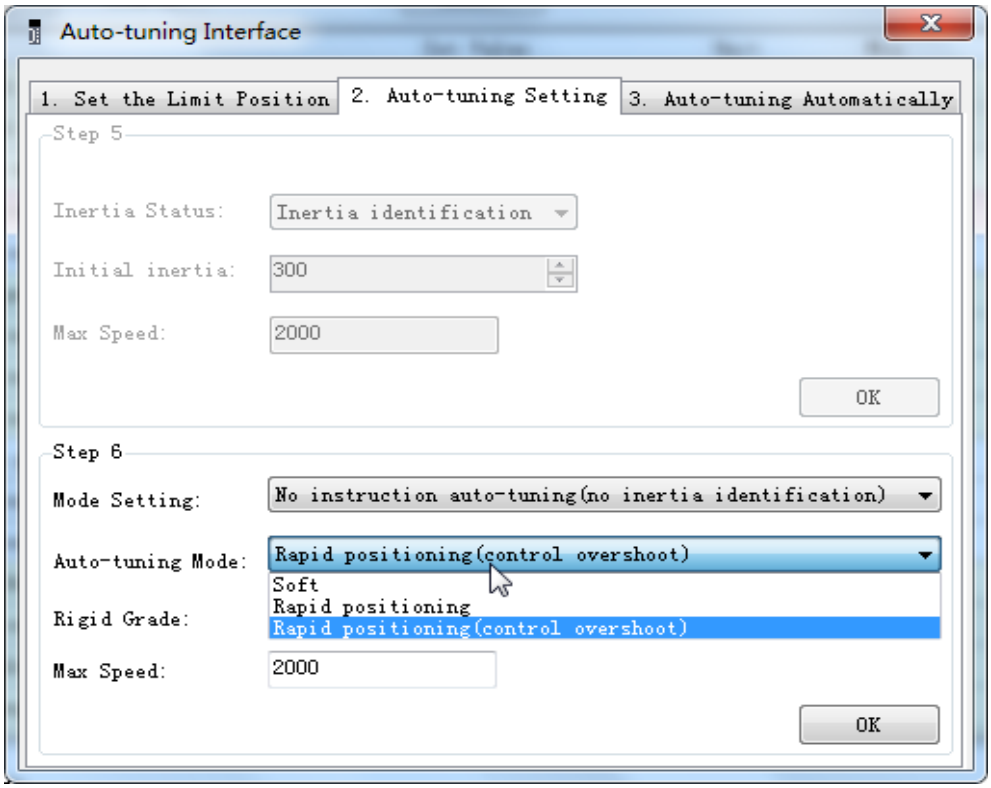
3. set the auto-tuning interface



4. click ok to estimate the inertia.



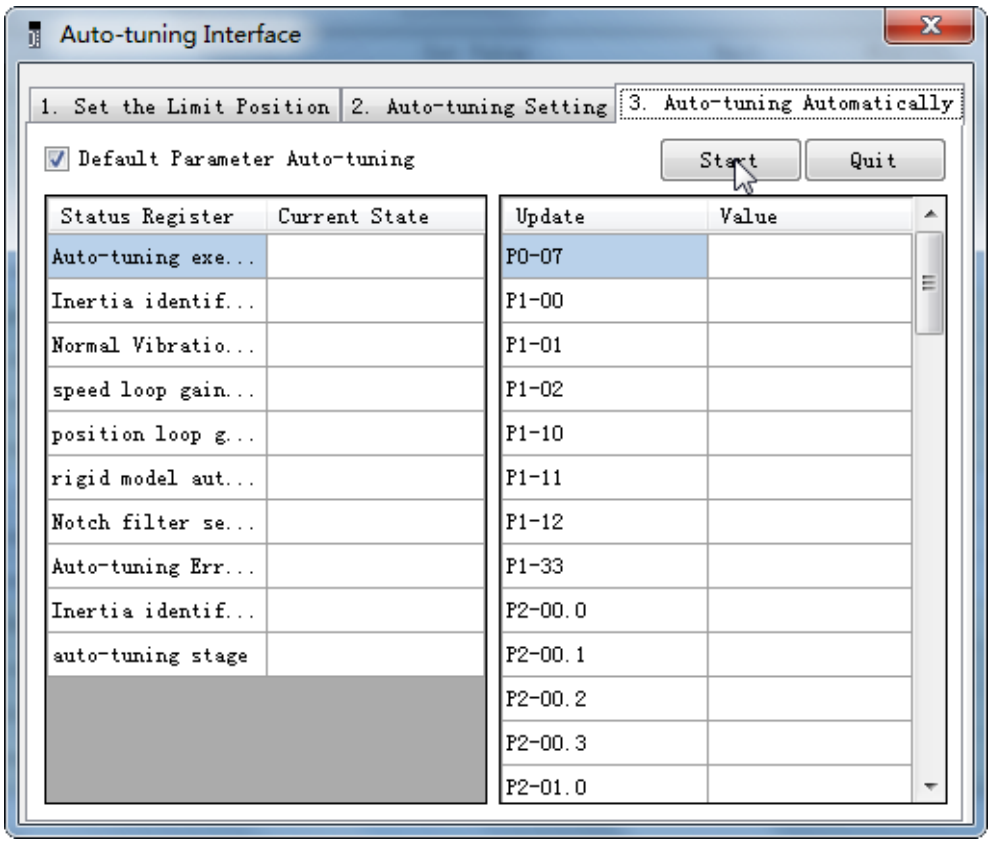
5. set the auto-tuning parameters



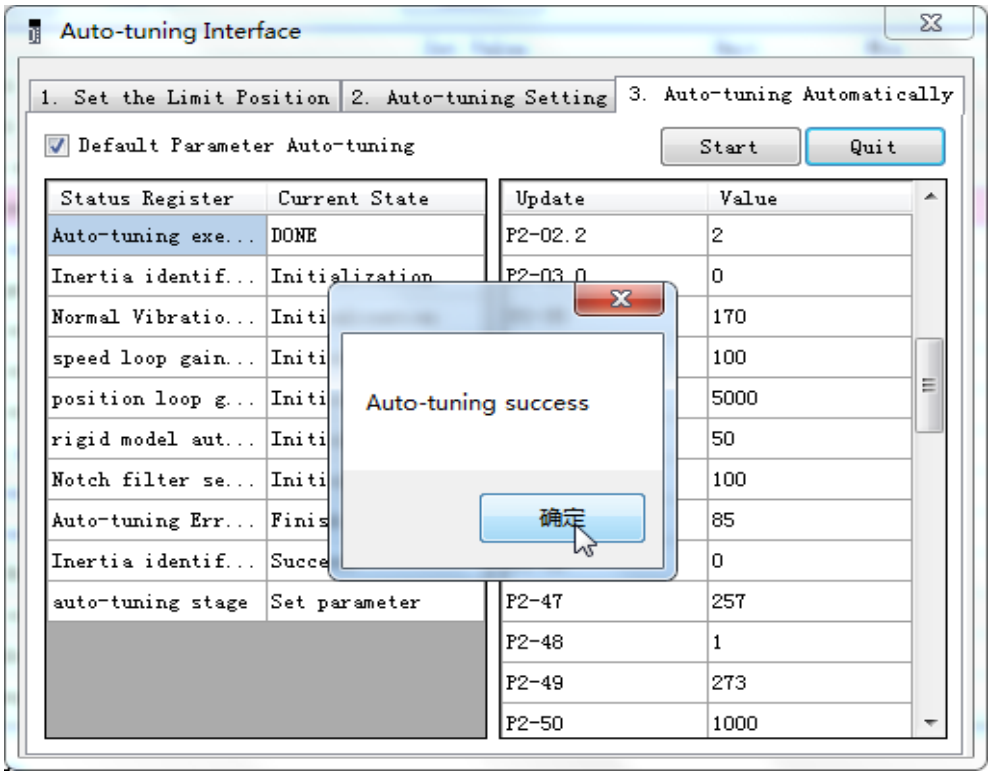
Auto-tuning mode	Description
Soft	Make a soft gain adjustment. Besides gain adjustment, notch filter is automatically adjusted.
Fast positioning	Make special adjustment for positioning purpose. Besides gain adjustment, the model loop gain and notch filter are automatically adjusted.
Fast positioning （control overshoot）	In the use of positioning, we should pay attention to adjusting without overshoot. Besides gain adjustment, the model loop gain and notch filter are automatically adjusted.

Load type	Description
Synchronous belt	Fit for the adjustment of lower rigidity mechanism such as synchronous belt mechanism.
Screw rod	It is suitable for adjustment of higher rigidity mechanism such as ball screw mechanism. If there is no corresponding mechanism, please choose this type.
Rigid connection	It is suitable for the adjustment of rigid body system and other mechanisms with higher rigidity.

6. Start auto-tuning

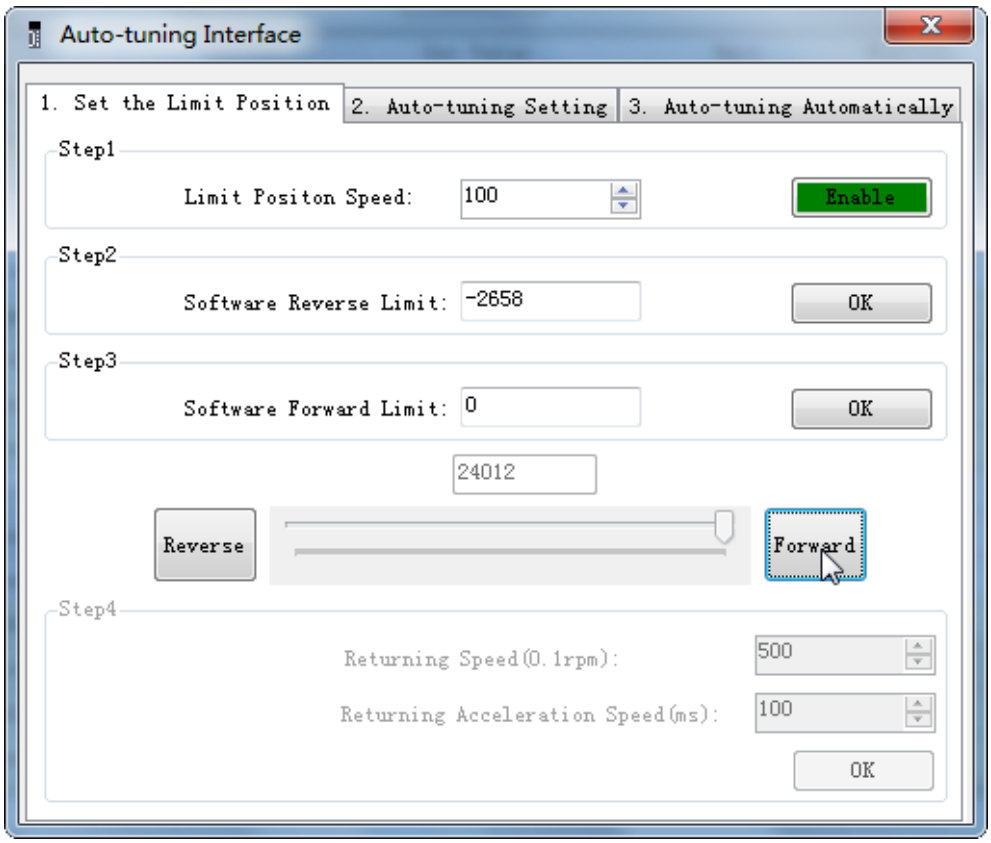


7. Wait for the end of the auto-tuning



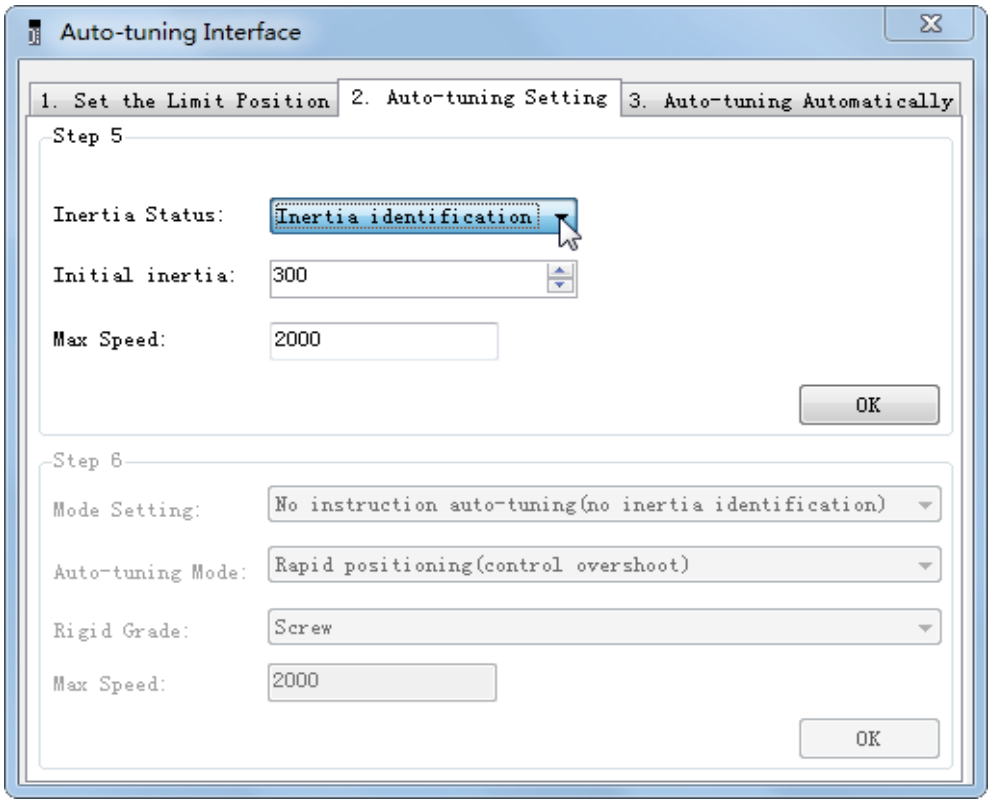
5.4.5 External instruction auto-tuning steps

1. Click auto-tuning on the main interface of XinJeServo software

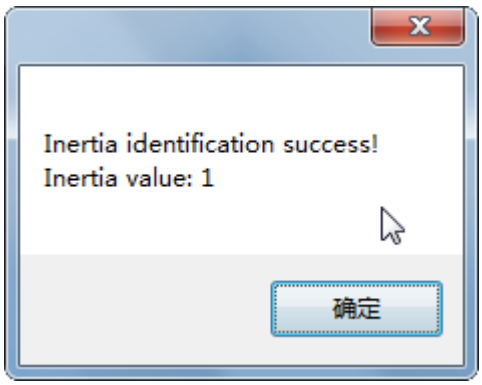


2. Select jog or manual setting to configure the trip of inertia identification.

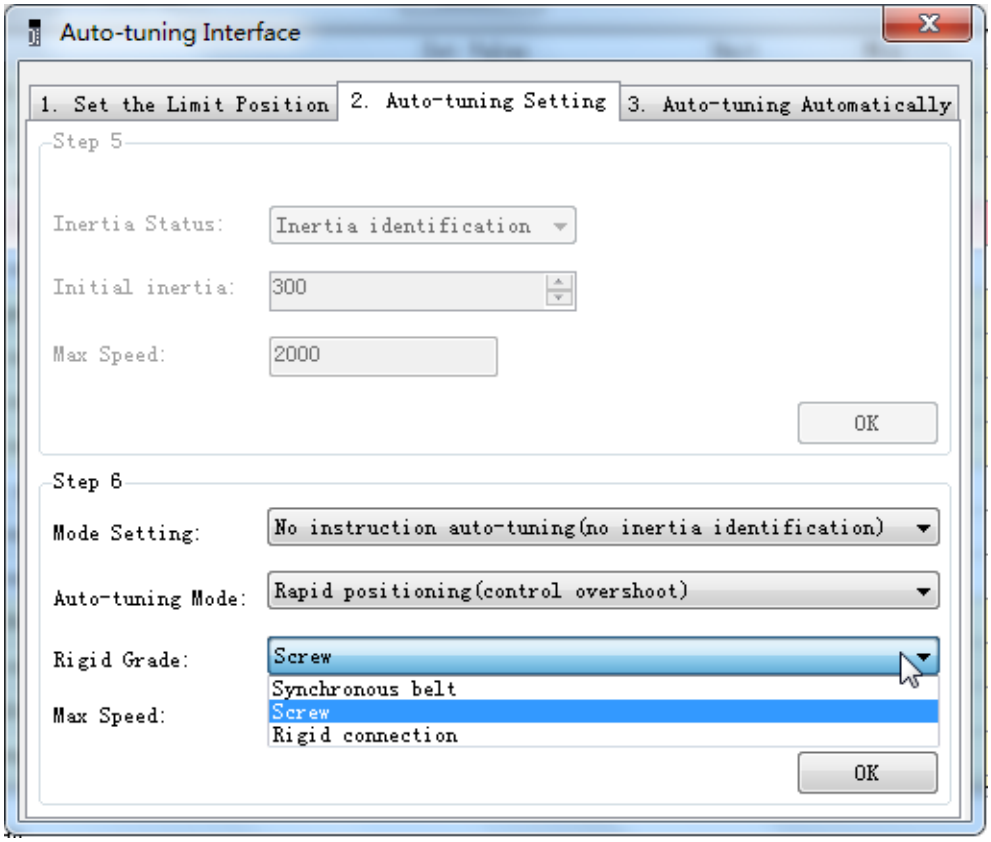
3. Set the auto-tuning interface



4. Click ok to start the inertia identification.



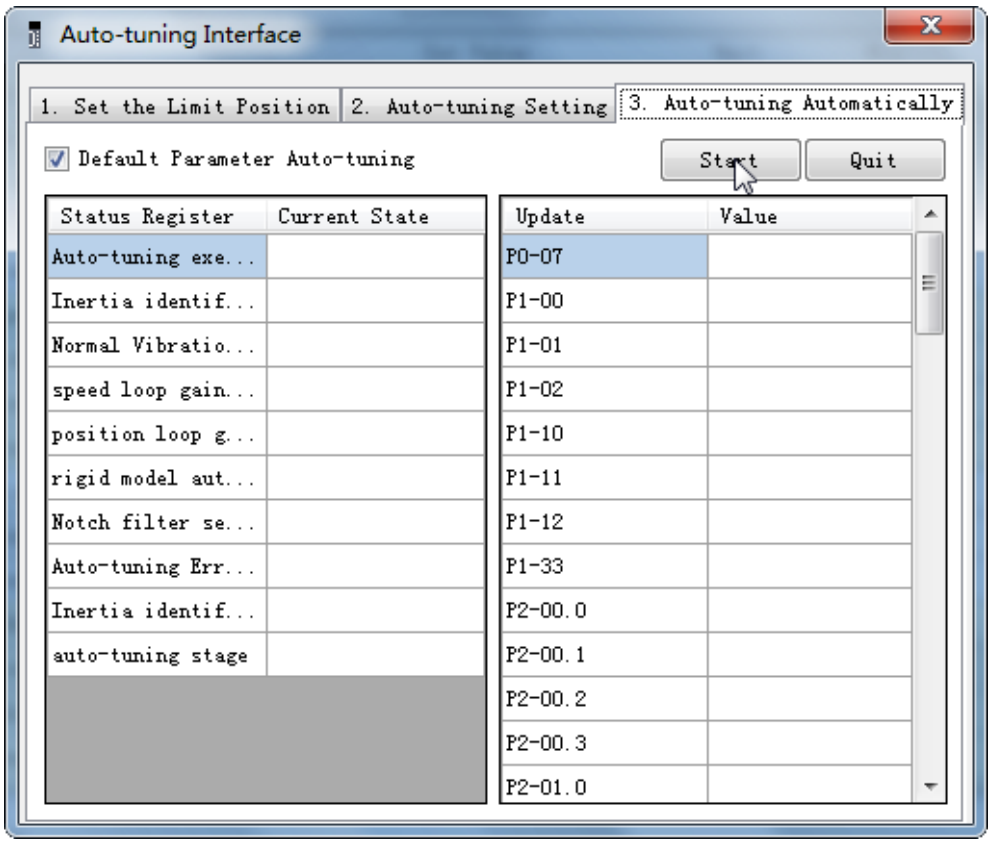
5. Configure the auto-tuning parameters



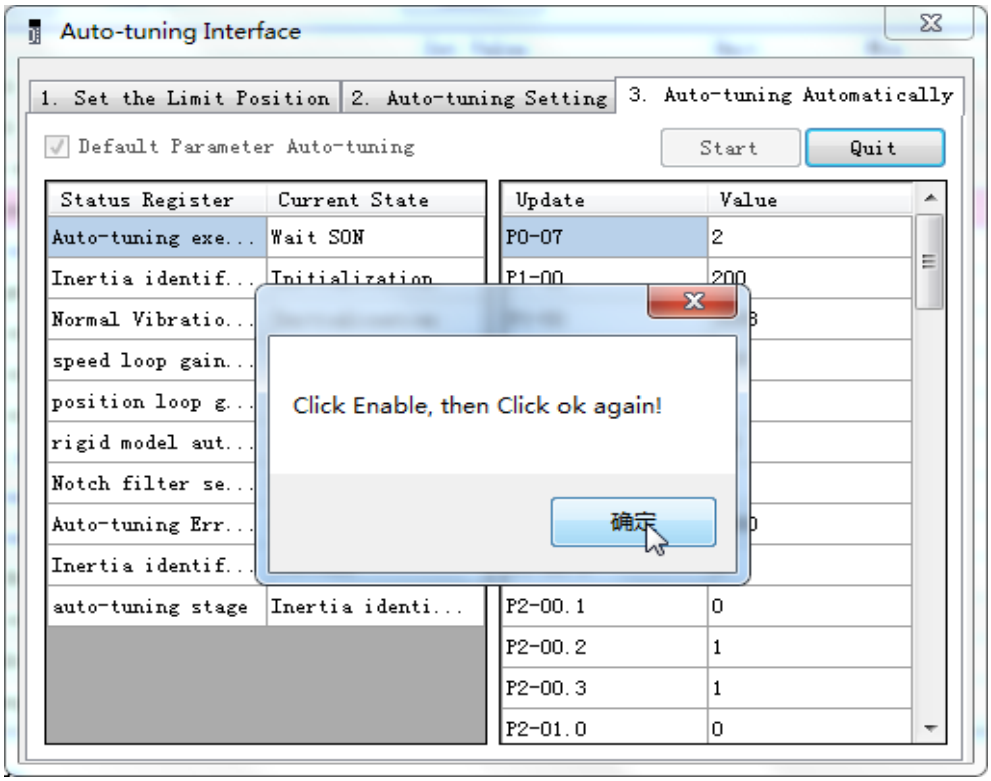
Auto-tuning mode	Description
Soft	Make a soft gain adjustment. Besides gain adjustment, notch filter is automatically adjusted.
Rapid positioning	Make special adjustment for positioning purpose. Besides gain adjustment, the model loop gain and notch filter are automatically adjusted.
Rapid positioning (control overshoot)	In the use of positioning, we should pay attention to adjusting without overshoot. Besides gain adjustment, the model loop gain and notch filter are automatically adjusted.

Load type	Description
Synchronous belt	Adjustment of lower rigidity mechanism such as synchronous belt
Screw	It is suitable for adjusting higher rigidity mechanism such as ball screw mechanism. If there is no corresponding mechanism, please choose this type.
Rigid connection	It is suitable for the adjustment of rigid body system and other mechanisms with higher rigidity.

6. Start auto-tune

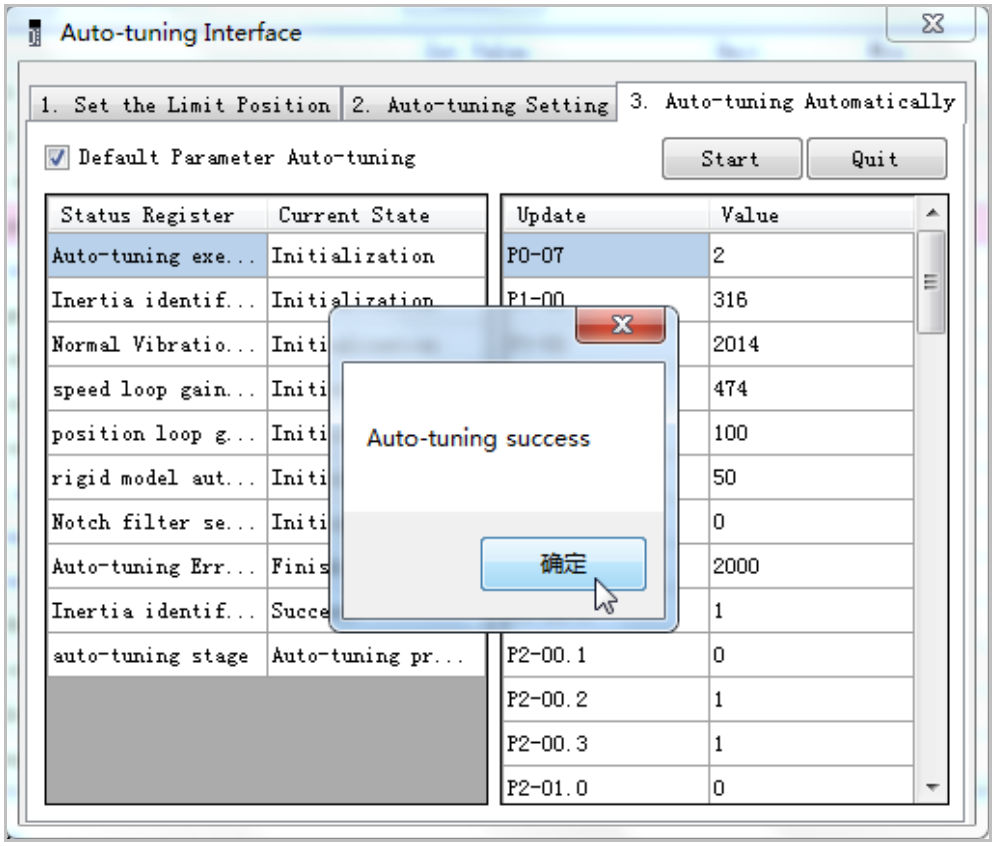


7. Open the servo enable, then click ok.



8. The upper device starts to send pulses, wait the completion of auto-tuning.

9. Auto-tuning is finished, click ok.



5.4.6 Related parameters

The following parameters may be modified during auto-tuning. Do not change them manually during auto-tuning.

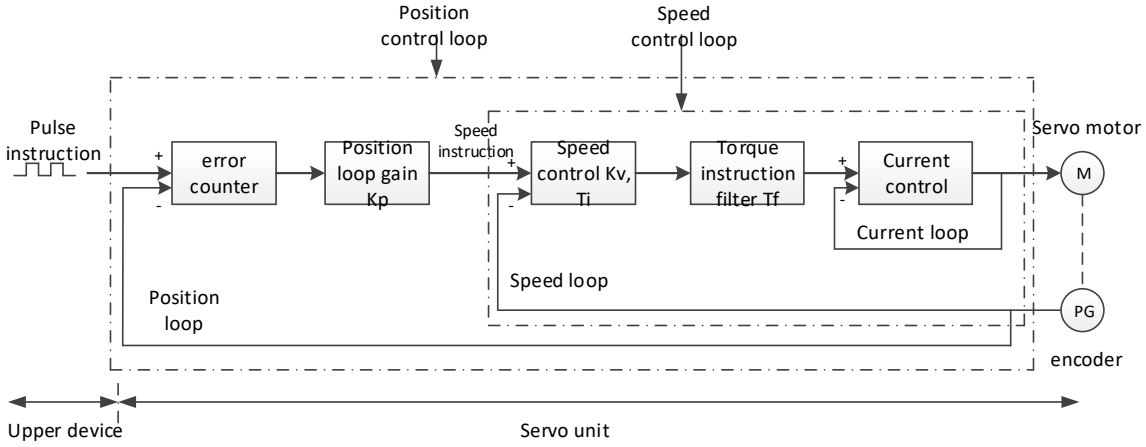
Parameter	Name	Property	The influence of numerical value on gain after auto-tuning
P0-07	First inertia ratio	Gain performance parameters	Yes
P1-00	First speed loop gain		
P1-01	Integral time constant of the first speed loop		
P1-02	First position loop gain		
P2-00.0	Disturbance observer switch		
P2-01.0	Adaptive mode switch		
P2-35	Torque command filter time constant 1		
P2-41	Disturbance observer gain		
P2-47.0	model loop switch		
P2-49	model loop gain		
P2-55	model speed feedforward gain		
P2-60.0	Active vibration suppression switch		
P2-61	Active vibration suppression frequency		
P2-62	Active vibration suppression gain		
P2-63	Active vibration suppression damping		
P2-64	Active vibration suppression filter time 1		
P2-65	Active vibration suppression filter time 2		
P2-66	Second group of active vibration suppression damping		
P2-67	Second group of active vibration suppression frequency		
P2-69.0	First notch switch		
P2-69.1	Second notch switch		

Parameter	Name	Property	The influence of numerical value on gain after auto-tuning
P2-71	First notch frequency		
P2-72	First notch attenuation		
P2-73	First notch band width		
P2-74	Second notch frequency		
P2-75	Second notch attenuation		
P2-76	Second notch band width		
P2-17	Inertia identification and internal instruction auto-tuning max speed	Auto-tuning setting parameters	No
P2-86	auto-tuning jog mode		
P2-87	auto-tuning min limit position		
P2-88	auto-tuning max limit position		
P2-89	auto-tuning max speed		
P2-90	auto-tuning acceleration/deceleration time		

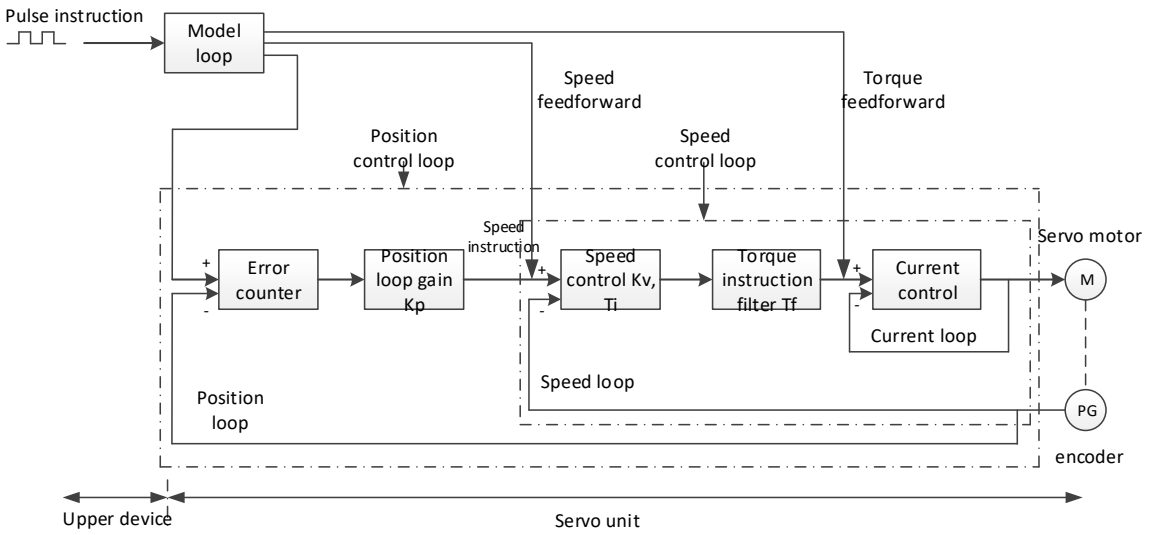
Note: P2-60~P2-67 are automatically modified in auto-tuning process. Users are not allowed to modify them manually. Manual modification may lead to the risk of system runaway.

5.5 Manual adjustment

5.5.1 Overview



Position control loop diagram (shut down the model loop)



Position control loop diagram (turn on the model loop)

Servo unit consists of three feedback loops (current loop, speed loop and position loop) from inside to outside. The more inner loop, the more responsive it is. Failure to comply with this principle will result in poor response or vibration. Among them, the current loop parameters are fixed values to ensure adequate responsiveness, and users do not need to adjust.

Please use manual adjustment in the following occasions:

- When the expected effect can not be achieved by fast adjusting the gain
- When the expected effect is not achieved by automatically adjusting the gain

5.5.2 Adjustment steps

In position mode, if the soft mode (P2-02.0=1) is selected by auto-tuning, the function of model loop will be turned off; in speed mode, the gain of position loop will be invalid.

Increasing response time

1. Reducing the filter time constant of torque instruction (P2-35)
2. Increasing Speed Loop Gain (P1-00)
3. Reducing Integral Time Parameter of Speed Loop (P1-01)
4. Increasing the gain of position loop (P1-02)
5. Improving Model Loop Gain (P2-49)

Reduce response, prevent vibration and overshoot

1. Reducing the Speed Loop Gain (P1-00)
2. Increasing Integral Time Constant of Speed Loop (P1-01)
3. Reducing the gain of position loop (P1-02)
4. Increase the filter time constant of the torque instruction (P2-35)
5. Reducing Model Loop Gain (P2-49)

5.5.3 Gain parameters for adjustment

The gain parameters that need to be adjusted:

P1-00 Speed Loop Gain

P1-01 Integral Time Constant of Speed Loop

P1-02 position loop gain

P2-35 Torque Instruction Filtering Time Constant

P2-49 Model Loop Gain

■ Speed loop gain

Because the response of the speed loop is low, it will become the delay factor of the outer position loop, so overshoot or vibration of the speed command will occur. Therefore, in the range of no vibration of mechanical system, the larger the setting value, the more stable the servo system and the better the responsiveness.

Parameter	Name	Default setting	Unit	Range	Modification	Effective
P1-00	Speed loop gain	65	0.1Hz	10～20000	Anytime	At once

■ Integral time constant of speed loop

In order to respond to small inputs, the speed loop contains integral elements. Because this integral factor is a delay factor for servo system, when the time constant is too large, it will overshoot or prolong the positioning time, which will make the response worse.

The relationship between the gain of the speed loop and the integral time constant of the speed loop is approximately as follows:

P1-00 × P1-01 = 636620

Parameter	Name	Default setting	Unit	Range	Modification	Effective
P1-01	integral time constant of speed loop	9794	0.01ms	15～51200	Anytime	At once

■ Position loop gain

When the model loop is invalid (P2-47.0=0), the responsiveness of the position loop of the servo unit is determined by the gain of the position loop. The higher the position loop gain is, the higher the responsiveness is and the shorter the positioning time is. Generally speaking, the gain of position loop cannot be increased beyond the natural vibration number of mechanical system. Therefore, in order to set the position loop gain to a larger value, it is necessary to improve the rigidity of the machine and increase the number of inherent vibration of the machine.

Parameter	Name	Default setting	Unit	Range	Modify	Effective
P1-02	Position loop gain	65	0.1/s	10～20000	Anytime	At once

■ Filter time constant of torque instruction

When machine vibration may be caused by servo drive, it is possible to eliminate vibration by adjusting the filtering time parameters of the following torque instructions. The smaller the numerical value, the better the response control can be, but it is restricted by the machine conditions. When vibration occurs, the parameter is generally reduced, and the adjustment range is suggested to be 10-150.

Parameter	Name	Default setting	Unit	Range	Modify	Effective
P2-35	Filter time constant of torque instruction 1	100	0.01ms	0～65535	Anytime	At once

■ Model loop gain

When the model loop is valid (P2-47.0=1), the response of the servo system is determined by the gain of the model loop. If the gain of the model loop is increased, the responsiveness is increased and the positioning time is shortened. At this time, the response of the servo system depends on this parameter, not P1-02 (position loop gain). The gain of the model loop is only valid in position mode.

Parameter	Name	Default setting	Unit	Range	Modify	Effective
P2-49	Model loop gain	175	0.1Hz	10～20000	Anytime	At once

5.6 Vibration suppression

5.6.1 Overview

The mechanical system has a certain resonance frequency. When the servo gain is increased, the continuous vibration may occur near the resonance frequency of the mechanical system. Generally in the range of 400Hz to 1000Hz, it caused the gain can not continue to increase. Vibration can be eliminated by automatically detecting or manually setting the vibration frequency. After the vibration is eliminated, if the responsiveness needs to be improved, the gain can be further improved.

Note:

(1) Servo responsiveness will change after vibration suppression operation.
(2) Before performing the vibration suppression operation, please set the inertia ratio and gain parameters correctly, otherwise it can not be controlled properly.

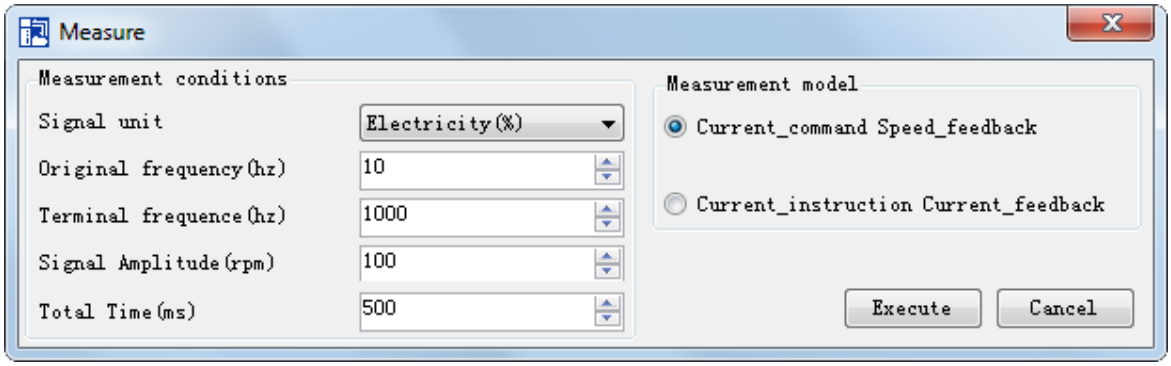
5.6.2 Operation tools

Adjustment mode	Operation tools	Control mode	Operation steps	Limitation
Adaptive mode	XinJeServo Mechanical Characteristic Analysis	Position mode	5.6.4 Vibration Suppression (PC Software)	All versions of PC software support
Auto-tuning mode	XinJeServo Mechanical Characteristic Analysis		5.6.4 Vibration Suppression (PC Software)	All versions of PC software support

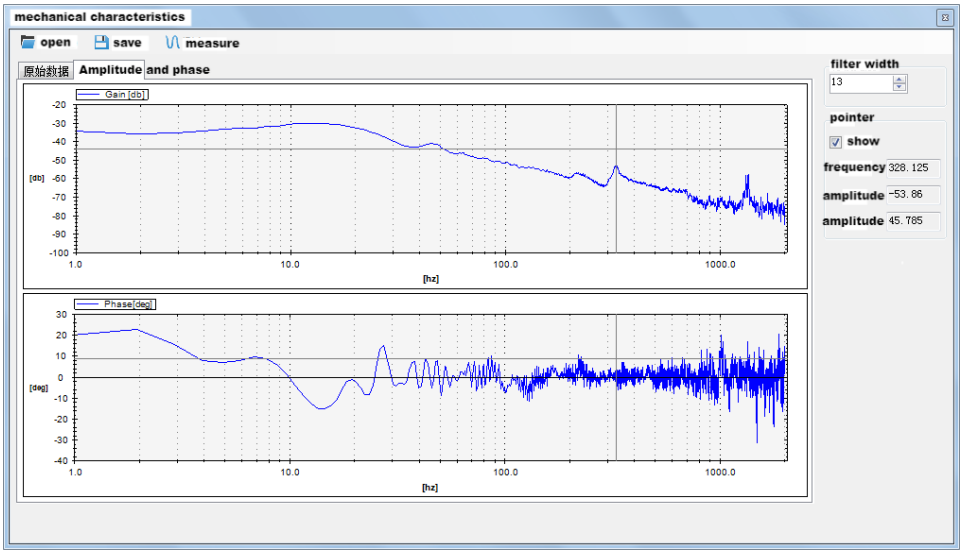
Note: The firmware version of the drive is viewed through U2-07.

5.6.3 Vibration suppression (PC software)

1. open XinJeServo software, click mechanical properties;
2. click measure;



3. set the measure conditions, then click execute;
4. select amplitude and phase;



5. set the filter width (to see resonance frequencies clearly), find the resonance frequency;
6. Notch parameters need to be set manually. Refer to 6.7.7 notch filter for details.

As an example, through the analysis of mechanical characteristics, the resonance frequency is 328 Hz, and the third notch filter can be used. The parameters are as follows:
P2-69 = n.1000 P2-77 = 328

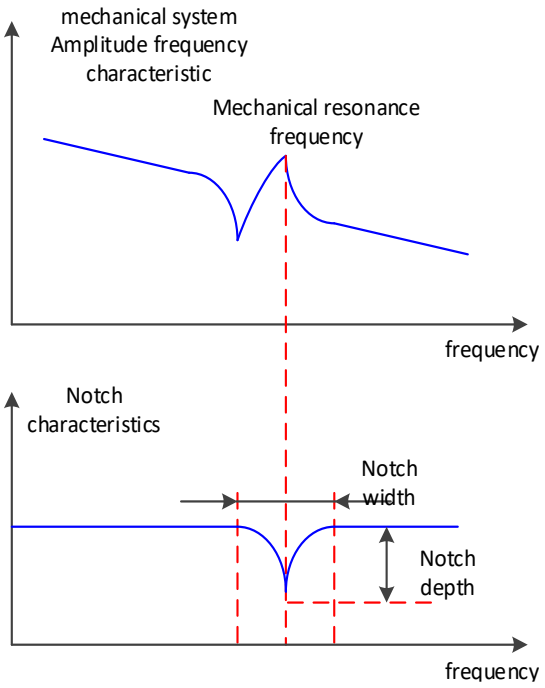
Note: In both adaptive and auto-tuning modes, if mechanical characteristic analysis is used, the notch can be set manually. If there are multiple resonance points, the third to fifth notch can be configured in turn.

5.6.4 Vibration suppression (manual setting)

If the resonance frequency of the mechanical system is known, the vibration can be eliminated by setting the vibration frequency manually. Please configure the third to fifth notches. The related parameters are detailed in 5.6.5 notch filter.

5.6.5 Notch filter

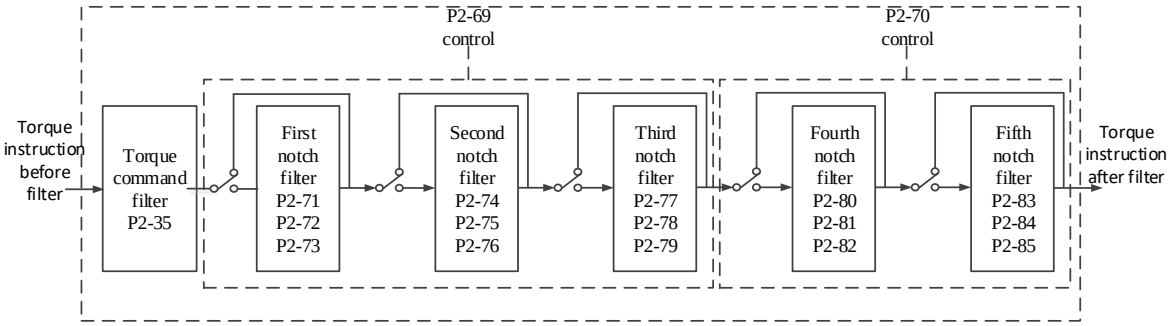
Notch filter can suppress mechanical resonance by reducing the gain at a specific frequency. After the notch filter is set correctly, the vibration can be effectively suppressed and the servo gain can be continuously increased.
The principle diagram of notch filter is as follows:



Principle diagram of notch filter

The servo driver has five sets of notch filters, each with three parameters, notch frequency, notch attenuation and notch bandwidth. The first and second notches are set automatically, and the third, fourth and fifth are set manually.

The torque instruction filter and notch filter are in series in the system. As shown in the figure below, the switch of the notch filter is controlled by P2-69 and P2-70.



Parameter		Meaning	Default setting	Change	Effective
P2-69	n.□□□0	First notch off	n.□□□0	Anytime	At once
	n.□□□1	First notch on			
	n.□□0□	Second notch off	n.□□0□	Anytime	At once
	n.□□1□	Second notch on			
	n.0□□□	Third notch off	n.0□□□	Anytime	At once
	n.1□□□	Third notch on			
P2-70	n.□□□0	Fourth notch off	n.□□□0	Anytime	At once
	n.□□□1	Fourth notch on			
	n.□□0□	Fifth notch off	n.□□0□	Anytime	At once
	n.□□1□	Fifth notch on			

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P2-71	First notch frequency	5000	Hz	50～5000	Anytime	At once
P2-72	First notch attenuation	70	0.1dB	50～1000	Anytime	At once
P2-73	First notch bandwidth	0	Hz	0～1000	Anytime	At once

Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P2-74	Second notch frequency	5000	Hz	50～5000	Anytime	At once
P2-75	Second notch attenuation	70	0.1dB	50～1000	Anytime	At once
P2-76	Second notch bandwidth	0	Hz	0～1000	Anytime	At once
P2-77	Third notch frequency	5000	Hz	50～5000	Anytime	At once
P2-78	Third notch attenuation	70	0.1dB	50～1000	Anytime	At once
P2-79	Third notch bandwidth	0	Hz	0～1000	Anytime	At once
P2-80	Fourth notch frequency	5000	Hz	50～5000	Anytime	At once
P2-81	Fourth notch attenuation	70	0.1dB	50～1000	Anytime	At once
P2-82	Fourth notch bandwidth	0	Hz	0～1000	Anytime	At once
P2-83	Fifth notch frequency	5000	Hz	50～5000	Anytime	At once
P2-84	Fifth notch attenuation	70	0.1dB	50～1000	Anytime	At once
P2-85	Fifth notch bandwidth	0	Hz	0～1000	Anytime	At once

Note:

1. In the adaptive mode, if the vibration is detected, the second notch filter will be automatically configured.
2. In the auto-tuning mode, the second and first notches will be automatically configured if the vibration is detected (the second notches will be preferentially opened when there is only one vibration point).
3. Whether in self-adaptive or auto-tuning mode, if the mechanical characteristic analysis is sued, it belongs to manual setting of notches, please configure the third to fifth notches.

5.7 Gain adjustment

5.7.1 Load shaking

The following causes cause load wobble:

1. The instruction is not smooth enough when the load inertia is too large.

Countermeasure:
(1) Use position instruction smoothing filter P1-25;
(2) Optimizing the instructions of the upper device to reduce the acceleration of the instructions;
(3) Replace the motor with greater inertia.

2. Servo gain is too small, resulting in insufficient rigidity

Countermeasure:
(1) Increase the gain parameters and rigidity to enhance the anti-disturbance ability.

3. Insufficient rigidity of mechanism and equipment sloshing

Countermeasure:
(1) Reducing gain parameters;
(2) Optimize the instructions of the upper device and reduce the acceleration of the instructions.

5.7.2 Vibration

The following causes cause machine vibration:

(1) Vibration due to inappropriate servo gain
Countermeasure: Reduce gain

(2) Mechanical resonance point
Countermeasure: Setting notch parameters manually or through mechanical characteristic analysis

5.7.3 Noise

In adaptive mode:
(1) Inappropriate servo gain
Countermeasure: Reduce the adaptive control bandwidth (P2-19).

In auto-tuning mode:
(1) Inappropriate servo gain
Countermeasure: Under the mode of rapid adjustment, reduce the rigidity level.

Automatic Adjustment Mode: Reducing Model Loop Gain P2-49
(1) Noise due to mechanical resonance
Countermeasure: Refer to 5.7.2 vibration.

5.8 Benefit adjustment application function

5.8.1 Model Ring Control

In self-tuning mode, the system gains include those of the speed loop, position loop, and model loop, with the model loop gain having a significant impact on servo responsiveness. When the model loop is disabled, the position loop gain determines the servo response. When the model loop is enabled, the model loop gain governs the servo response. Functionally, the model loop acts as a feedforward component in the driver control loop.
The model loop function automatically turns off when the auto-tuning mode is set to Soft, and turns on when the auto-tuning mode is set to Fast Positioning or Fast Positioning (Control Overshoot).

self-tuning mode

parameter		meaning	factory setting	revise	come into force
P2-02	n.□□□1	soft	n.□□□3	at any time	immediately
	n.□□□2	quick positioning			
	n.□□□3	Quick positioning (overshoot control)			

Selection of self-tuning mode:

① P2-02.0=1: Softness
The method does not open the model loop gain, and the operation is soft, which is suitable for the occasions that the mechanical rigidity is insufficient and the responsiveness is not high.

② P2-02.0=2: Fast positioning
The response of the parameters is the fastest, but the overshoot is not suppressed.

③ Fast positioning (control overshoot) (P2-02.0=3):
The method has the advantage of fast response and can suppress overshoot.

loadtype	explain
locking-in range on synchronization	The adjustment is suitable for the lower rigidity mechanism such as the synchronous belt mechanism.
lead screw	Adjust for high-rigidity mechanisms such as ball screw mechanisms. Select this type if no corresponding mechanism is available.
fixed joint	The adjustment is suitable for rigid body system and other rigid mechanism.

self-tuning mode	explain
soft	Apply a soft gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.
quick positioning	Adjusts for positioning purposes. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.
quick positioning (overshoot control)	The system performs overshoot-free adjustments during positioning. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.

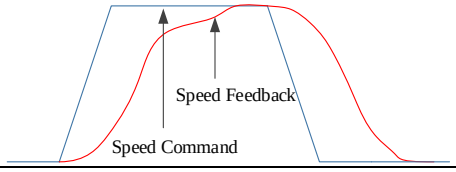
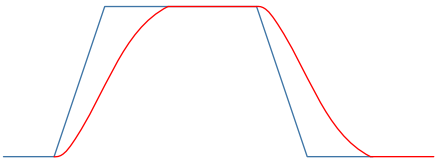
parameter		meaning	factory setting	revise	come into force
P2-02	n.□□□1	soft	n.□□□3	at any time	immediately
	n.□□□2	quick positioning			
	n.□□□3	Quick positioning (overshoot control)			

model loop function switch

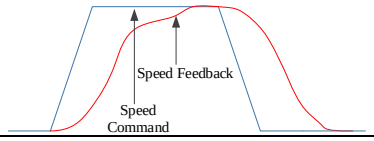
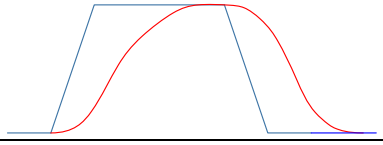
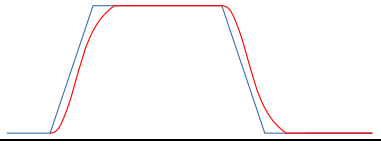
parameter		meaning	factory setting	revise	come into force
P2-47	n.□□□0	Model loop closed	n.□□□1	at any time	immediately
	n.□□□1	Model loop open			

Using the DF3 series servo self-tuning mode as an example, with a 750W servo system operating at five times the load inertia:

■ **Model loop function off (soft mode)**

low rigidity, low response	high rigidity, medium response
	
Load inertia ratio P0-07:500%	
Speed loop gain P1-00:200	Speed loop gain P1-00:800
Speed loop integral P1-01:3300	Speed loop integral P1-01:825
Position loop gain P1-02:200	Position loop gain P1-02:700
Phenomenon: Run jitter and slow response	Phenomenon: Running smoothly and responding quickly

■ **Enable model loop function (Quick Positioning or Quick Positioning (Control Overshoot))**

low rigidity, low response	high rigidity, low response	high rigidity, high response
		
Load inertia ratio P0-07:500%		
Speed loop gain P1-00:200	Speed loop gain P1-00:800	Speed loop gain P1-00:800
Speed loop integral P1-01:3300	Speed loop integral P1-01:825	Speed loop integral P1-01:825
Position loop gain P1-02:200	Position loop gain P1-02:700	Position loop gain P1-02:700
Model loop gain P2-49:300	Model loop gain P2-49:300	Model loop gain P2-49:4000
Phenomenon: Run jitter and slow response	Phenomenon: Running smoothly, but slow response	Phenomenon: Smooth operation and fast response

The above curve diagram only shows the parameter effect and does not represent the actual running curve.

5.8.2 Torque disturbance observation

The disturbance observer detects and estimates the external disturbance torque of the system, and compensates the torque command, which can reduce the influence of external disturbance on the servo and improve the disturbance resistance.

parameter		meaning	factory setting	revise	come into force
P2-00	n.□□□0	disruptive observer shutdown	n.□□□1	servo bb	immediately
	n.□□□1	Enable the disturbance observer			

parameter	meaning	factory setting	unit	Set range	revise	come into force
P2-41	perturbation observer gain	85	%	0 ~ 100	at any time	immediately

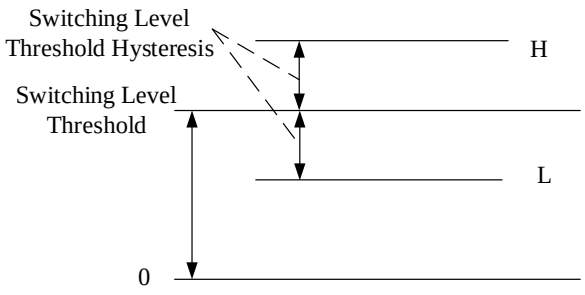
5.8.3 Gain Switching

Version 3770 and later support gain switching.

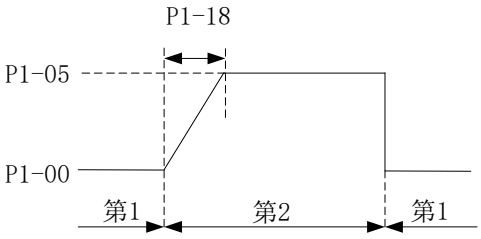
parameter		meaning	factory setting	unit	revise	come into force
P1-14.0	n.□□□X	n.□□□X: Gain switch function 0-SI terminal gain switching is active (gain switching condition parameters are not active) 1: Perform gain switching according to the gain switching conditions 2: Reserve	0	-	servo bb	immediately
P1-14.1	n.□□X□	n.□□X□: Gain switch condition selection 0: First gain fixed 1: Switch using external SI terminals 2: The torque command is large. 3: Speed command is large 4: Speed commands vary significantly 5: [Keep] 6: Large positional deviation 7: Position command 8: Location completed 9: Actual speed is high A: Position command + actual speed				
P1-15		gain switching delay	5	ms	servo bb	immediately
P1-16		gain switching level threshold	50	-	servo bb	immediately
P1-17		Hysteresis Loop of Gain Switching Level Threshold	30	-	servo bb	immediately
P1-18		position loop gain switching time	3	ms	servo bb	immediately

Explain:

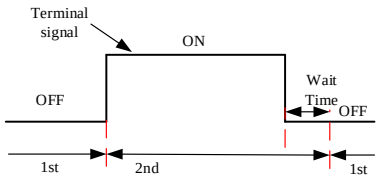
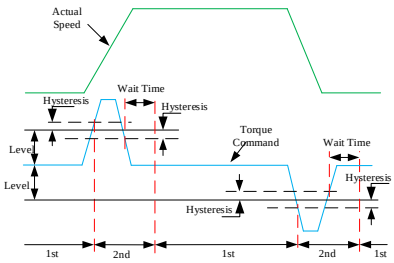
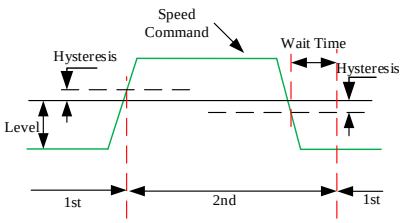
1) Gain switch wait time, which only applies during the process of switching from the second gain to the first gain.
2) The definition of "gain switching level threshold hysteresis" is illustrated in the figure below:

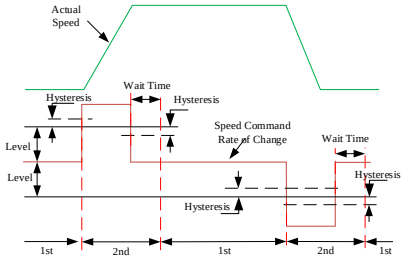
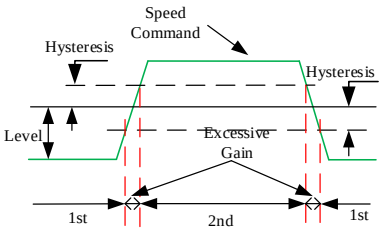


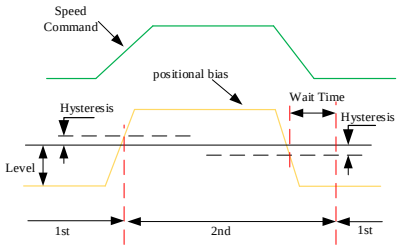
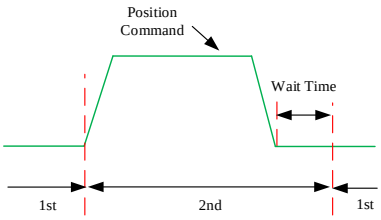
3) "Location gain handover time" description:

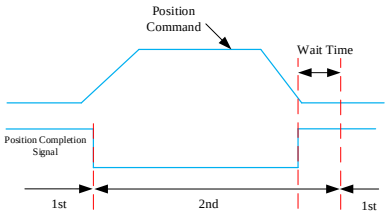
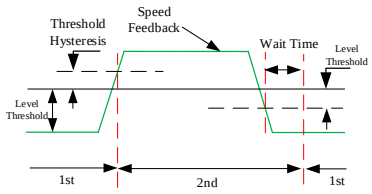
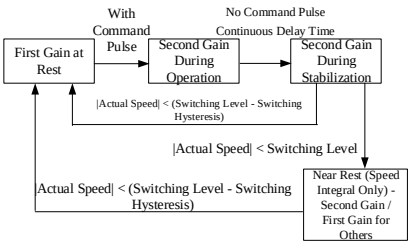


4) Gain Switching Conditions

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
0	first gain fixed	-	-	of no avail	of no avail	of no avail
1	terminal switching		Use G-SEL signals for gain switching: G-SEL signal invalid, gain of group 1 G-SEL signal is valid, gain for the second group	valid	of no avail	of no avail
2	torque command		When the absolute value of the torque command exceeds (level + hysteresis) [%] during the first gain phase, the system switches to the second gain. When the absolute value of the torque command during the last second gain cycle was below the threshold of [level-hysteresis], and the P1-15 sensor maintained this condition, the system reverted to the first gain setting.	valid	valid (%)	valid (%)
3	velocity instruction		When the absolute value of the speed command exceeds (level + hysteresis) [rpm] during the first gain phase, the system switches to the second gain. When the absolute value of the speed command during the last second gain	valid	valid	valid

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
			phase was below (level-hysteresis) [rpm], and P1-15 remained in this state, the system returned to the first gain setting.			
4	rate of change of speed command		When the absolute value of the speed command rate change exceeds (level + hysteresis) [10 rpm/s] during the first gain adjustment, the system switches to the second gain. During the last second gain cycle, when the absolute value of the speed command rate change remained below (level-hysteresis) [10 rpm/s] and P1-15 maintained this condition, the system reverted to the first gain setting.	valid	valid (10rpm/s)	valid (10rpm/s)
5	Speed command high-low threshold [Not supported yet]		When the absolute value of the speed command exceeds (level-hysteresis) [rpm] during the first gain phase, the system switches to the second gain phase. The gain gradually adjusts until the absolute value reaches (level + hysteresis) [rpm], at which point the gain fully transitions to the second level. During the second gain phase, when the absolute value of the speed command falls below (level + hysteresis) [rpm], the system initiates	of no avail	valid (rpm)	valid (rpm)

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
			the first gain phase. The gain value then gradually adjusts until the absolute value reaches (level-hysteresis) [rpm], at which point the gain fully returns to the first setting.			
6	position deviation		Only in location mode (other modes fixed at gain 1) When the absolute value of positional deviation exceeds (level + hysteresis) [encoder units] during the first gain adjustment, switch to the second gain. When the absolute value of positional deviation during the last second gain cycle was below (level-hysteresis) [encoder units], and the P1-15 state remained in this condition, the system reverted to the first gain setting.	valid	valid Encoder unit	valid Encoder unit
7	position instruction		Only in location mode (other modes fixed at gain 1) When the first gain is applied, if the position command is not zero, switch to the second gain. During the second gain phase, if the position command remains at zero for the entire waiting period P1-15, the system will revert to the first gain state.	valid	of no avail	of no avail

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
8	Location set		Only in location mode (other modes fixed at gain 1) If the positioning is not completed during the first gain, switch to the second gain. If the positioning completion status remains unchanged during the waiting period P1-15 during the second gain phase, the system will revert to the first gain phase. [Note] Set the positioning mode for detection completion according to P5-01	valid	of no avail	of no avail
9	actual velocity		Only in location mode (other modes fixed at gain 1): When the absolute value of the actual speed exceeds (level + hysteresis) [rpm] during the first gain adjustment, the system switches to the second gain. During the last second gain cycle, when the absolute value of the relative speed remained below the threshold (level-hysteresis) [rpm] and P1-15 maintained this condition, the system reverted to the first gain setting.	valid	valid (rpm)	valid (rpm)
A	position command + actual speed		Only in location mode (other modes fixed at gain 1): When the first gain is applied, if the position command is not zero, switch to the second gain. During the second gain phase, the	valid	valid (rpm)	valid (rpm)

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
			system maintains the second gain setting when the position command is 0 for the duration of P1-15. When the position command is 0 and the waiting time P1-15 is reached, if the absolute value of the actual speed is below (hysteresis level) [rpm], the speed integral time constant remains fixed at the second speed loop integral time constant (P1-06), while the system returns to the first gain setting. If the actual speed's absolute value falls below (hysteresis level) [rpm], the speed integral also resets to the first speed loop integral time constant (P1-02).			

6 Alarm

6.1 Alarm code list

Historical record: "√" means that historical alarms can be recorded; "○" is not recorded;
The column that can be cleared: "√" represents the alarm that can be cleared; "○" represents the alarm that cannot be cleared.

Alarm code type		Alarm code	Explanation	Property			Servo status when alarming
				Historical records	Can be cleared	Whether power on is needed to clear the alarm	
01	0	E-010	Firmware version not match	○	○	Yes	Servo enable
	3	E-013	FPGA loading error	○	○	Yes	Servo enable
	5	E-015	Program operation error	○	○	Yes	Servo enable
	6	E-016	Hard error	○	○	No	Servo enable
	7	E-017	Processor running timeout	○	○	Yes	Servo enable
	9	E-019	System password error	○	○	Yes	Servo enable
02	0	E-020	Parameter loading error	○	○	Yes	Servo enable
	1	E-021	Parameter range over limit	○	√	No	Servo enable
	2	E-022	Parameter conflict	√	√	No	Servo enable
	3	E-023	Sampling channel setting error	○	○	Yes	Servo enable
	4	E-024	parameter lost	√	√	No	Servo enable
	5	E-025	Erase FLASH error	√	√	No	Servo enable
	6	E-026	Initialization FLASH error	√	√	No	Servo enable
	8	E-028	EEPROM write in error	√	√	No	Servo enable
03	0	E-030	Bus voltage overvoltage	√	√	No	Servo off
04	0	E-040	Bus voltage under voltage ①Low grid voltage	√	√	No	Servo enable
			Bus voltage under voltage ② Bus voltage undervoltage caused by power failure of driver	○	√	No	Servo off
	1	E-041	Driver power down	○	√	No	Servo enable
	3	E-043	Bus Voltage Charging Failure	√	√	No	Servo off

Alarm code type		Alarm code	Explanation	Property			Servo status when alarming
				Historical records	Can be cleared	Whether power on is needed to clear the alarm	
	4	E-044	Three phase voltage input phase loss	√	√	No	Servo off
06	0	E-060	Module temperature too high	√	√	No	Servo enable
	1	E-061	Motor overheating	√	√	Yes	Servo enable
	3	E-063	Thermocouple disconnection alarm	√	√	No	Servo enable
08	0	E-080	Overspeed alarm	√	√	No	Servo off
09	2	E-092	Analog Tref Zero-Calibration Over limit	√	√	No	Servo enable
	3	E-093	Analog Vref Zero-Calibration Over limit	√	√	No	Servo enable
10	0	E-100	Excessive position deviation	√	√	No	Servo enable
11	0	E-110	External UVW Short Circuit Discovered in Self-Inspection	√	√	No	Servo off
13	0	E-150	Power cable disconnection	√	√	No	Servo off
16	1	E-161	Driver thermal power overload	√	√	No	Servo enable
	5	E-165	Anti-blocking alarm	√	√	No	Servo enable
20	0	E-200	Regenerative resistance overload	√	√	No	Servo enable
22	0	E-220	Communication error of absolute servo encoder	√	√	No	Servo off
	1	E-221	Too many CRC errors in encoder communication	√	√	No	Servo off
	2	E-222	Absolute value servo encoder battery low voltage alarm	√	√	No	Servo off
	3	E-223	Absolute value servo encoder data access alarm	√	√	No	Servo off
	7	E-227	Power on encoder multi-turn signal data error	√	√	No	Servo off
	8	E-228	Absolute Servo Encoder Value Overflow	√	√	No	Servo off
24	0	E-240	Timing error in fetching encoder position data	√	√	No	Servo off
	1	E-241	Encoder reponse data is error code	√	√	No	Servo off
26	0	E-260	Over range alarm	√	√	No	Servo enable
	1	E-261	Overrun signal connection error	√	√	No	Servo enable
	2	E-262	Control stop timeout	√	√	No	Servo off
	4	E-264	Excessive vibration	√	√	No	Servo enable
	5	E-265	Motor vibration too large	√	√	No	Servo enable
28	0	E-280	Failed to access motor parameters	√	○	Yes	Servo off
	1	E-281	Error writing data to encoder	√	○	Yes	Servo off

Alarm code type		Alarm code	Explanation	Property			Servo status when alarming
				Historical records	Can be cleared	Whether power on is needed to clear the alarm	
			EEPROM				
31	0	E-310	Motor power mismatch	○	○	Yes	Servo off
	1	E-311	Motor code missing	√	○	Yes	Servo off
	2	E-312	Reading motor parameter is damaged	√	○	Yes	Servo off
	3	E-313	Encoder software version mismatch	√	○	Yes	Servo off
	4	E-314	Encoder software version not supported	√	○	Yes	Servo off
	5	E-315	Unable to read valid motor parameters	√	○	Yes	Servo off
	6	E-316	Reading motor code is inconsistent with setting code	√	○	Yes	Servo off
85	2	E-852	Interruption of data interaction with CANopen master station	√	√	No	Servo off

6.2 Analysis of alarm types

DF3E alarm code format is E-XX□, "XX" means main type, "□" means sub-type.

Main type	Sub type	Code	Description	Reasons	Solutions
01	0	E-010	Firmware version mismatch	Downloaded firmware version error	Please contact the agent or the manufacturer
	3	E-013	FPGA loading error	①program damaged ②device damaged	Please contact the agent or the manufacturer
	4	E-014	FPGA Access error	(1) Program damage (2) Device damage (3) serious external interference	Please contact the agent or the manufacturer
	5	E-015	Program running error	Program damage	Please contact the agent or the manufacturer
	6	E-016	Hardware error	①program damaged ②hardware damaged ③Excessive intensity of external interference	① Check the input voltage, whether the input phase is missing or the supply voltage is too low ② Contact agent or manufacturer
	7	E-017	Processor Running Timeout	Program damage	Please contact the agent or the manufacturer
	9	E-019	System password error	Program damage	Please contact the agent or the manufacturer
02	0	E-020	Parameter loading error	Failure of parameter self-checking	Re-energizing can restore default parameters, if there are repeated problems, please contact the agent or manufacturer.
	1	E-021	Parameter range beyond limit	Setting values are not within the prescribed range	Check parameters and reset them
	2	E-022	Parameter	Conflict of TREF or	P0-01=4, P3-00 set to 1 will alarm

Main type	Sub type	Code	Description	Reasons	Solutions
			conflict	VREF Function Settings	
	3	E-023	Sampling channel setting error	Error setting of custom output trigger channel or data monitoring channel	Check that the settings are correct
	4	E-024	parameter lost	Low voltage of power grid	(1) show E-024 immediately after power failure (2) Resetting parameters
	5	E-025	Erase FLASH error	Abnormal parameter preservation during power failure	please contact the agent or the manufacturer
	6	E-026	Initialization FLASH error	Power supply instability of FLASH chip	please contact the agent or the manufacturer
	8	E-028	EEPROM write in error	Voltage instability or chip abnormality	Please contact the agent or the manufacturer
03	0	E-030	Bus voltage U0-05 is higher than the actual preset threshold, 48V Power Supply Machine (U0-05≥83V)	High voltage of power grid	DF3E rated input power voltage is DC48V. If the voltage fluctuation is large, it is recommended to use the correct voltage source and regulator.
				Excessive load moment of inertia (insufficient regeneration capacity)	(1) connect external regenerative resistor, the resistor details please refer to chapter 1.4.1 (48V: bus voltage U0-05=73 discharge starts, U0-05=60 discharge ends) (2) Increasing Acceleration and Deceleration Time (3) Reducing load inertia (4) Reduce start-stop frequency (5) Replacement of larger power drivers and motors
				Brake resistance damage or excessive resistance value	Check the regenerative resistor and replace the external resistor with the appropriate resistance value. See chapter 1.4.1 for the selection of the external resistor.
				Acceleration and deceleration time is too short	Extending Acceleration and Deceleration Time
04	0	E-040	Bus voltage U0-05 is lower than the actual preset threshold, 48V Power Supply Machine (U0-05≤18V)	low voltage of power grid when normal power on	① Check the power grid fluctuation. If the voltage fluctuation is large, it is recommended to use voltage regulator ② Replacement of transformers with larger capacity
				Instantaneous power failure	Re-energize after voltage stabilization
				Hardware Fault of Driver Internal Sampling Circuit	The value of servo DC + DC - incoming line is measured by DC gear of multimeter, and the normal value is 48V. If the power supply voltage is normal, monitor U0-05 in servo bb state, the voltage measured by multimeter > U0-05, the servo driver is faulty and needs to be sent

Main type	Sub type	Code	Description	Reasons	Solutions
					back for maintenance.
	1	E-041	Driver power down	Driver power off	Check the power supply
	3	E-043	Bus Voltage Charging Failure	low voltage of power grid when normal power on	low voltage of power grid when normal power on
				Hardware damage	When the driver is on, please pay attention to whether there is relay actuation sound
	4	E-044	Three phase voltage input phase loss	Three phase input power supply is lack of phase	Check the power supply
06	0	E-060	Module temperature is too high (Module temperature U-06 ≥ 90℃ alarm, U-06 ≥ 70℃ Warning)	Running under heavy load for a long time	Re-consider the capacity of the motor, monitor the U0-02 torque during operation, whether it is in the value of more than 100 for a long time, if yes, please chose the large-capacity motor or load reduction.
				Excessive ambient temperature	(1) Enhance ventilation measures to reduce ambient temperature; (2) Check whether the fan rotates when the servo is enabled; when the module temperature U-06 ≥45℃, the fan opens.
				Fan damage	Replace the fan
	1	E-061	Motor overheat	Alarm when motor temperature is higher than 95℃	① Check whether the motor fan is abnormal ② Contact the manufacturer for technical support
	3	E-063	Thermocouple disconnection alarm	The motor false opening detection and disconnection alarm	Check the external thermocouple connection; Shield thermocouple disconnection alarm: P0-69.1 = 1
08	0	E-080	Overspeed (actual speed ≥ P3-21/P3-22) The maximum forward speed is P3-21 and the maximum reverse speed is P3-22.	Motor code not match	Check if the driver U3-00 is identical with the motor code of the motor label (the number after MOTOR CODE), if not, please change to the same one, then power on again.
				UVW wiring error	Inspection of motor UVW wiring, need to be connected in phase sequence.
				Motor speed too fast	(1) The maximum speed limit value P3-21/P3-22 was reduced. (2) To confirm whether the external force makes the motor rotate too fast, whether the pulse input frequency is too high, and whether the electronic gear ratio is too large.
08	0	E-080	Overspeed (actual speed ≥ P3-21/P3-22) The maximum forward speed is P3-21 and the	Encoder fault	(1) Check the encoder cable or change a new one (2) Set the servo driver to BB state and the driver to U-10. Rotate the motor shaft slowly by hand to see if the value of U-10

Main type	Sub type	Code	Description	Reasons	Solutions
			maximum reverse speed is P3-22.		changes normally, increasing in one direction and decreasing in one direction (0-9999 cycle display).
				Parameter setting	When the actual speed is larger than P3-21/P3-22, it will alarm.
09	2	E-092	Analog Tref Zero-Calibration Over limit	Analog Zero Calibration Operation Error	Please correct zero without analog voltage
	3	E-093	Analog Vref Zero-Calibration Over limit	Analog Zero Calibration Operation Error	Please correct zero without analog voltage
10	0	E-100	Position offset too large	In position control, the difference between the given position and the actual position exceeds the limit value.	(1) Observe whether the motor is blocked or not. (2) Reducing the given speed of position; (3) Increase the deviation pulse limit P0-23.
11	0	E-110	External UVW Short Circuit Discovered in Self-Inspection	Not match the motor code	Check if the driver U3-00 is identical with the motor code of the motor label (the number after MOTOR CODE), if not, please change to the same one, then power on again.
				UVW wiring error	Inspection of motor UVW wiring, need to be in phase sequence (brown U, black V, blue W)
				Driver UVW Output Short Circuit or Motor Failure	(1) Measure whether the UVW phase resistance of the motor is balanced. If the phase resistance is unbalanced, replace the motor. (2) Measure whether there is short circuit between UVW and PE of the motor. If there is short circuit, replace the motor. (3) Measure the driver side UVW output through multimeter (diode gear), black pen P+, red pen to measure UVW; red pen P-, black pen to measure UVW; if anyone is 0 in 6 groups of value, replace the driver.
				Load part is blocked	It is suggested that the motor should be operated on an empty shaft to eliminate the load problem.
				High-speed start-stop instantaneous alarm	Increasing Acceleration and Deceleration Time
				Encoder problem	(1) Check the encoder cable or change a new one (2) Set the servo driver to BB state and the driver to U-10. Rotate the motor shaft slowly by hand to see if the value of U-10 changes normally, increasing in one direction and decreasing in one direction (0-9999 cycle

Main type	Sub type	Code	Description	Reasons	Solutions
					display).
13	0	E-150	Power cable disconnection	Any phase in UVW of driver, cable or motor broken	Disconnect the power supply of the driver and check the connection of the power cable. It is suggested that the multimeter be used to test the condition. After eliminating the errors, the driver should be re-energized.
16	1	E-161	Driver thermal power overload	Not match the motor code	Check if the driver U3-00 is identical with the motor code of the motor label (the number after MOTOR CODE), if not, please change to the same one, then power on again.
				Overload, the actual operating torque exceeds the rated torque, and continuous operation for a long time. (Monitor U0-02 to check the actual operating torque. If the motor is in normal operation, it will not jam or jitter. If the U0-02 is longer than 100, it will be considered improper selection of the motor.)	Increase the capacity of drivers and motors. Extend the acceleration and deceleration time and reduce the load. Monitor the U-00, whether it is running over speed.
				Mechanisms are impacted, suddenly weighted and distorted.	Eliminate mechanical distortion. Reduce load
				Motor action when motor brake is not opened	Measure the voltage of the brake terminal and decide to open the brake. It is suggested to use servo BK signal to control the brake lock. If it is not servo control, attention must be paid to the timing of brake opening and motor action.
				Wrong wiring of encoder cable, power cable or broken wire or loose pin of connector plug	Check the UVW connection of power cable to see if there is any phase sequence error. The multimeter is used to measure whether all the encoder cable are on. Check whether the plug is loose, for machine vibration, whether the plug has shrinkage pin, virtual welding, damage.
				In multiple mechanical wirings, incorrect connection of motor cable to other shafts leads to incorrect wiring.	Detection of servo wiring, the motor cable, encoder cable are correctly connected to the corresponding shaft.

Main type	Sub type	Code	Description	Reasons	Solutions
				Poor gain adjustment results in motor vibration, back and forth swing and abnormal noise.	Readjustment of gain parameters
				Driver or motor hardware failure;	There are servo cross test or motor empty shaft on site, F1-01 trial operation, F1-00 jog run can not rotate uniformly; Replace the new driver or motor and send the malfunction machine back to the manufacturer for repair.
	5	E-165	Anti-blocking alarm Judging that the current motor output torque is greater than P3-28/P3-29 (internal forward/reverse torque limit), and the time reaches P0-74 (unit ms), and the speed is lower than P0-75 (unit 1 rpm).	(1) Machinery is impacted, suddenly becomes heavier and distorted; (2) When the brake of the motor is not opened, the motor moves; (3) The parameter setting is unreasonable.	(1) Eliminate the factors of mechanical distortion. Reduce load (2) Measure the voltage of the brake terminal and determine the opening of the brake; It is suggested to use servo BK brake signal to control the brake lock. If it is not servo control, attention must be paid to the timing of brake opening and motor action. (3) Monitor the actual output torque range of U0-02 and check whether the setting of P3-28/29 torque limit is reasonable. (After version 3760, the output torque limit setting parameters of anti locked rotor alarm are P3-38 and P3-39）
20	0	E-200	Regenerative resistance overload	High Voltage Fluctuation in Power Grid	Stable the input voltage
				Selection of regenerative resistance is too small	Replacement of higher power regenerative resistors (refer to chapter 1.4.1)
				Acceleration and deceleration time is too short	Extending Acceleration and Deceleration Time
				Hardware damage	The value of servo DC + DC - incoming line is measured by DC gear of multimeter, and the normal value is 48V. If the power supply voltage is normal, monitor U0-05 in servo bb state, the voltage measured by multimeter > U0-05, the servo driver is faulty and needs to be sent back for maintenance.
22	0	E-220	Communication error of absolute servo encoder	Motor matching error	Check if the motor matches correctly
				Unconnected encoder cable or poor contact	Check whether the value of U0-54 increases rapidly. If yes, the encoder circuit is disconnected.Disconnect the power supply of the driver, check

Main type	Sub type	Code	Description	Reasons	Solutions
					the connection of the encoder cable, if there is cable loosening, it is recommended to use the multimeter to test the conduction condition; after eliminating errors, power on again Hot plugging is strictly prohibited, and special cables are required for tank chains.
				Received encoder data errors, and the number of errors exceeds the number of error retries of encoder registers P0-56	Check whether the value of U0-79 and U0-54 increase. If yes, the encoder is interfered. Encoder wire and strong power do not have the same pipeline wiring; install filter on servo driver power input side; encoder wire sleeves magnetic ring; shut down welding machine type of equipment with large interference
	1	E-221	Too many CRC errors in encoder communication	The received encoder data is wrong and the number of errors exceeds the value in encoder error retry number register P0-56	Encoder interfered, isolate interference source
	2	E-222	Absolute value servo encoder battery low voltage alarm (can shield this alarm)	Battery Voltage in Battery Box of Encoder cable is less than 2.75V	Please replace the battery while keeping the power supply ON of the servo driver in order to avoid the error of encoder position information. Battery specification: No.5 battery, 3.6V (model CP-B-BATT, CPT-B-BATT)
				Power on alarm for new machine	(1) When the absolute value motor is powered off, the memory position depends on the battery on the encoder cable. Once the encoder cable and the motor are disconnected, the power supply can not be carried out, which will lead to the loss of the current position of the motor, it will alarm 222. Please set F0-00=1 to clear the alarm, it can be used normally. (2) The alarm can be shielded by using P0-79. When P0-79 is set to 1, it will be used as a single-loop absolute value motor, and the current position will not be remembered when power off.
	3	E-223	Data access alarm of absolute value servo encoder	Encoder cable with battery box is not used for multi-turn absolute motor	① Please use encoder cable with battery box; ② Power off and power on again (the driver panel shall be completely off). If the alarm cannot be removed, please contact the agent or manufacturer
				Generally, it is the problem of the encoder itself, or the power supply of the	

Main type	Sub type	Code	Description	Reasons	Solutions
				encoder is unstable	
				Abnormal power on of main control chip of multi-turn absolute value servo encoder	
				ADC sampling is out of range, some resistance and capacitance devices have problems or the signal consistency of magnetic sensor is poor	
	7	E-227	Power on encoder multi turn signal data error	Generally, it is the problem of the encoder itself, or the power supply of the encoder is unstable	In the case of no battery, unplugging the encoder cable may cause this alarm.
	8	E-228	Absolute value servo encoder value overflow	The motor runs in one direction continuously, the encoder data value is too large, overflow	① Set F1-06 = 1, clear the absolute encoder's multiple turns; ② Set P0-79 = 2, the alarm can be shielded.
24	0	E-240	Timing error in fetching encoder position data	① The number of consecutive errors in encoder data update sequence is greater than the value in P0-68 ② CPU timer fluctuates	① Restart driver ② Check the arrangement of transmission cables to ensure that the strong and weak current are wired separately. ③ High current equipment is supplied separately. ④ The grounding is good.
	1	E-241	Encoder responding data scrambling	The received encoder data is wrong and the number of errors exceeds the value in encoder error retry number register P0-56	① Check the arrangement of transmission cables to ensure that the strong and weak current are wired separately. ② High current equipment is supplied separately. ③ The grounding is good.
26	0	E-260	Over range alarm	Overrun signal was detected and the overrun processing mode was configured to alarm	If you do not want to alarm immediately when the overrun occurs, you can change the overrun signal processing mode.
	1	E-261	Overrun signal connection error	(1) When the motor is in forward rotation, it encounters reverse overrun signal. (2) When the motor is in reverse rotation, it encounters forward overrun signal.	Check over-run signal connection and over-run terminal allocation.
	2	E-262	Control stop timeout	(1) Excessive inertia (2) Stop timeouts too short (3) The setting of braking torque is too small.	(1) Reduce inertia or use brake motor; (2) Increase the stop timeout time P0-30; (3) Increase braking torque P3-32.

Main type	Sub type	Code	Description	Reasons	Solutions
	4	E-264	Excessive vibration	(1) Oscillation caused by external forces (2) Load inertia is large and the setting of load inertia ratio is wrong or the gain is too small, which leads to the oscillation of positioning.	(1) Check the source of external force to see if there are any problems in mechanical installation; (2) Increase the servo gain to improve the anti-disturbance ability; (3) Acquisition speed curve analysis; When the first three peaks are convergenced after pulse instruction completed (0.8* | first peak | > | second peak | and 0.8* | second peak | > | third peak |), the driver should not alarm, which can adjust the relevant threshold. When the first three peaks speed are not less than 300 rpm for three consecutive times after the completion of the pulse instruction, the driver will alarm. (4) Contact manufacturers for technical support
	5	E-265	Excessive motor vibration	Mechanical vibration	Check the motor installation
28	0	E-280	Failed to read motor parameters	Request to read EEPROM failed	On the premise that the driver and motor are matched and can be used together, read the alarm shielding position of motor parameters through P0-53, and set the motor code correctly
	1	E-281	Error writing data to encoder EEPROM	Request to write EEPROM failed	On the premise that the driver and motor are matched and can be used together, read the alarm shielding position of motor parameters through P0-53, and set the motor code correctly
31	0	E-310	Power mismatch between driver and motor	Such as 750W driver with 200W motor	Match the correct motor and driver, and use it after setting the motor code correctly
	1	E-311	When the motor code is read automatically, the motor parameter is 0	Motor code not set	On the premise that the driver and motor are matched and can be used together, read the alarm shielding position of motor parameters through P0-53, and set the motor code correctly
	2	E-312	Reading motor parameter is damaged	Parameter CRC verification failed	On the premise that the driver and motor are matched and can be used together, read the alarm shielding position of motor parameters through P0-53, and set the motor code correctly
	3	E-313	Encoder software version mismatch	Encoder software version mismatch	① Update driver firmware to maximize current motor parameter performance ② Read the alarm shielding position of motor parameters

Main type	Sub type	Code	Description	Reasons	Solutions
					through p0-53, and set the motor code correctly. At this time, the motor parameters are in the driver, which can work normally, but may affect some performance
	4	E-314	Motor code does not match software version	Encoder hardware version is higher than driver firmware version	Contact the manufacturer's technical support to update the driver firmware
	5	E-315	When the motor code is read automatically, the motor parameter is 0	Read the motor code is 0	On the premise that the driver and motor are matched and can be used together, read the alarm shielding position of motor parameters through P0-53, and set the motor code correctly
	6	E-316	Auto-read code error	The auto read motor code is inconsistent with the motor code set in P0-33	Check U3-00 and motor label. ① If the two values are the same, change P0-33 motor code or set P0-33 to 0 to read motor code automatically; ② If the two values are different, contact the manufacturer for technical support
85	2	E-852	Interruption of data interaction with CANopen master station	Communication interruption between master and slave station	①Check whether the CAN network wiring is disconnected or damaged; ② Check whether the CANopen master station is powered down; ③ After ensuring that there is no problem with the wiring, first power off and restart CANopen slave station, and then power off and restart CANopen master station.

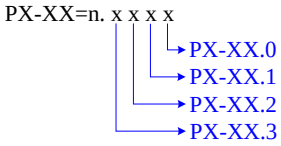
Appendix

Appendix 1. Group P parameters

Modification and effective:
"○" means modifying when servo OFF and take effect at once.
"√" means modifying anytime and take effect at once.
"●" means modifying when servo OFF and take effect when power on again.
"△" means modifying anytime and take effect when the motor doesn't rotate.

For parameters set in hexadecimal system, the prefix "n." is added to the setting value to indicate that the current setting value is hexadecimal number.

Composition of parameters:



P0-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P0-00	**Control mode** 0-General mode 1-Bus mode	-	1	0~1	○	-	-
P0-01	**Control mode 1** 1- Internal Torque Mode 3- Internal speed Model 5- Internal Location Mode 6- External Pulse Position Mode 7- External Pulse speed Mode	-	1	1~7	○	1|3|5|6|7|	4.1.1
P0-02	**Control mode 2** (ditto)	-	1	1~10	○	1|3|5|6|7	4.1.1
P0-03	**Enabling mode** 0-not enabled 1-IO enable 2-Software Enablation	-	3	0~3	○	1|3|5|6|7|	4.2.2
P0-04	Rigidity grade	-	5	0~63	△	1|3|5|6|7|	5.3.3
P0-05	**Definition of rotation direction** 0- positive mode 1- negative mode	-	0	0~1	●	1|3|5|6|7|	4.2.3
P0-07	First inertia ratio	1%	1500	0~50000	√	1|3|5|6|7|	5.2.1
P0-09.0	Forward Direction of Input Pulse Instruction 0-Forward Pulse	-	0	0~1	●	6|7	4.3.2

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	Counting 1-Reverse Pulse Counting						
P0-09.2	Input pulse command filter time	-	F	0~F	●	6|7	4.3.2
P0-09.3	Predistribution of input pulse command filter	-	0	0~7	●	6|7	4.3.2
P0-10.0	0-CW/CCW 1-AB 2-P+D	-	2	0~2	○	6|7	4.3.2
P0-11～ P0-12	Number of instruction pulses per cycle 0: Electronic gear ratio Non-0: Number of command pulses required for motor rotation	1 pul	10000	0~99999999	○	5|6	4.3.1.1
P0-13	Electronic Gear Numerator	-	1	0~65535	○	5|6	4.3.1.1
P0-14	Denominator of Electronic Gear	-	1	0~65535	○	5|6	4.3.1.1
P0-15	Pulse frequency corresponding to rated speed	100Hz	1000	1~10000	○	7	4.4.3.2
P0-16	Speed command pulse filter time	0.01ms	100	0~10000	○	7	4.4.3.3
pulse offset limit	pulse offset limit	0.01 turn	2000	0~65535	√	5|6	4.3.1.6
P0-24	**Type selection of discharge resistance** (version 3640 and before) 0: built in 1: external **Power protection mode of discharge resistance** (version 3700 and later) 0 - cumulative discharge time 1 - average power mode 1 2-average power mode 2	-	0	0~1	○	1|3|5|6|7|	4.2.6
P0-25	Power Value of Discharge Resistance	W	100	1~65535	○	1|3|5|6|7	4.2.6
P0-26	Discharge resistance value	Ω	80	1~500	○	1|3|5|6|7	4.2.6
P0-27	Servo shutdown the enable stop mode 0-Inertial Operation Stop 2-deceleration stop	-	0	0~5	○	1|3|5|6|7|	4.2.4
P0-28	Servo Overrun Stop Mode (P0-28.0) 0-deceleration stop 1 1-Inertial Stop 2-deceleration stop 2 3-Alarm Stop Overtravel alarm shield switch (P0-28.1)	-	2	0~3	○	1|3|5|6|7	4.2.4
			0	0~1			

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	0-not shield the alarm 1-shield the alarm						
P0-29	Servo Alarm Stop Mode 0-Inertial Operation Stop 2-deceleration stop	-	2	0~2	○	1|3|5|6|7|	4.2.4
P0-30	stop timeout time	1ms	20000	0~65535	○	1|3|5|6|7|	4.2.3
P0-31	Deceleration stop time	1ms	25	0~5000	○	1|3|5|6|7	4.2.3
P0-33	Set the motor code	-	0	0~ffff	●	1|3|5|6|7	4.7
P0-53	Read motor parameter alarm shield bit 0-not shield alarm shield alarm	-	0	0~1	●	1|3|5|6|7	-
P0-69	Fan switch (P0-69.0) 0- Turn on the fan when the temperature greater than 45℃ and turn off the fan when less than 42℃ (hysteresis 3℃) 1 - Turn on the fan after enabling, turn off the fan when not enabling Large motor thermocouple break alarm shield switch (P0-69.1) 0-shield thermocouple disconnection alarm 1-thermocouple disconnection	-	1 0	0~1 0~1	√	1|3|5|6|7	-
P0-74	Blocking alarm time	ms	0	0~5000	√	1|3|5|6|7	4.8.1
P0-75	Blocking alarm speed	rpm	50	5~9999	√	1|3|5|6|7|	4.8.1
P0-79	Absolute Encoder Battery Undervoltage Alarm Switch (firmware version 20160304 and later) 0-used as absolute value encoder 1-1-used as incremental encoder 2-used as absolute value encoder, ignoring multi turn overflow alarm	-	1	0~2	●	1|3|5|6|7|	4.7.1
P0-80	Thermal Power Protection of Motor 0-current protection 1-Average Thermal Power Protection 2-Analog Thermal Power Protection	-	2	0~2	●	1|3|5|6|7|	-
P0-92～ P0-93	32-bit electronic gear ratio numerator. take effect when P0-11～P0-14 is 0. P0-92*1 +	-	1	1~9999 1~65535	○	5|6	4.3.1.1

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	P0-93 *10000						
P0-94～ P0-95	32-bit electronic gear ratio denominator. take effect when P0-11～ P0-14 is 0. P0-94*1 + P0-95 *10000	-	1	1~9999 1~65535	○	5|6	4.3.1.1

P1-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P1-00	First speed loop gain	0.1Hz	65	10~20000	√	1|3|5|6|7	5.5.3
P1-01	Integral Time Constant of the First Speed Loop	0.01ms	9794	15~51200	√	1|3|5|6|7	5.5.3
P1-02	First position loop gain	0.1/s	65	10~20000	√	1|3|5|6|7	5.5.3
P1-10	Speed feedforward gain	1%	0	0~300	√	5|6|7	-
P1-11	Speed feedforward filter time	0.01ms	50	0~10000	√	5|6|7	-
P1-22	Speed Instruction Filter Selection 0-first order low pass filter 1-Smooth Average Filter	-	0	0~1	○	3|7	4.4.1.4
P1-23	speed instruction filter time	0.1ms	0	0~65535	○	3|7	4.4.1.4
P1-24	Position command acceleration and deceleration filtering time	0.1ms	0	0~65535	△	5|6	4.3.1.7
P1-25	position instruction smooth filter time	0.1ms	0	0~65535	△	5|6	4.3.1.7

P2-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P2-00.0	Disturbance observer switch 0- OFF 1- ON	-	1	0~1	○	1|3|5|6|7	5.1.4
P2-01.0	Adaptive mode switch 0-OFF 1-ON	-	0	0~1	●	1|3|5|6|7	-
P2-01.1	Adaptive level 0-high response 1-low noise	-	1	0~1	●	1|3|4|6|7	-
P2-02.0	Auto-tuning mode 1-soft 2-fast positioning 3-fast positioning, control the overshoot	-	3	1~3	√	1|3|5|6|7	5.1.3
P2-02.2	Load type (valid only	-	2	1~3	√	1|3|5|6|7	5.1.3

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	during auto-tuning) 1- synchronous belt 2- screw rod 3-Rigid Connection						
P2-03.3	Adaptive load type 0-Small Inertia Mode 1-Large Inertia Mode	-	0	0~1	●	1|3|5|6|7	-
P2-05	Adaptive mode speed loop gain (standard)	0.1Hz	400	1~65535	○	1|3|5|6|7	-
P2-07	Adaptive mode inertia ratio (standard)	%	0	0~10000	○	1|3|5|6|7	-
P2-08	Gain of adaptive mode speed observer (standard)	Hz	60	10~1000	○	1|3|5|6|7	-
P2-12	Maximum Inertia Ratio of Adaptive Mode (Standard)	-	30	1~10000	○	1|3|5|6|7	-
P2-15	Inertia Identification and Internal Instruction Auto-tuning Maximum Travel	0.01r	100	1~3000	√	1|3|5|6|7	5.2.4
P2-16	Motor rotor inertia coefficient of adaptive mode	-	100	10~1000	○	1|3|5|6|7	5.2.4
P2-17	Maximum Speed of Inertia Identification and Internal Instruction Auto-tuning	rpm	0	0~65535	√	1|3|5|6|7	5.2.4
P2-18	Initial inertia ratio of inertia identification	%	500	1~20000	√	1|3|5|6|7	5.2.4
P2-19	Adaptive mode bandwidth	%	50	1~100	○	1|3|5|6|7	5.2.4
P2-35	Torque Instruction Filtering Time Constant 1	0.01ms	100	0~65535	√	1|3|5|6|7	5.5.3
P2-41	Disturbance Torque Compensation Coefficient (Non-adaptive Mode Effective)	%	85	0~100	√	1|3|5|6|7	5.1.4
P2-47.0	Model Loop Switch 0-OFF 1-ON	-	1	0~f	√	1|3|5|6|7	5.1.3
P2-49	Model loop gain	0.1Hz	175	10~20000	√	3|5|6|7	5.5.3
P2-60.0	Active Vibration Suppression Switch 0-OFF 1-ON	-	0	0~1	√	3|5|6|7	5.4.6
P2-60.1	Active Suppression Auto-tuning Switch 0-Active Vibration Suppression is not Configured in auto-tuning 1- configure the Active Vibration Suppression when auto-tuning	-	1	0~1	√	3|5|6|7	5.4.6
P2-61	Active Vibration Suppression frequency	0.1Hz	1000	10~20000	√	1|3|5|6|7	5.5
P2-62	Active Vibration	%	100	1~1000	√	1|3|5|6|7	5.4.6

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	Suppression gain						
P2-63	Active Vibration Suppression damping	%	100	0~300	√	1|3|5|6|7	5.4.6
P2-64	Filtering time of active vibration suppression 1	-	0	-5000~5000	√	1|3|5|6|7	5.4.6
P2-65	Filtering time of active vibration suppression 2	-	0	-5000~5000	√	1|3|5|6|7	5.4.6
P2-66	The second group of active vibration damping	-	0	0~1000	√	1|3|5|6|7	5.4.6
P2-67	Second group active vibration suppression frequency	Hz	20000	10~50000	√	1|3|5|6|7	5.4.6
P2-69.0	Notch filter 1 switch	-	0	0~1	√	1|3|5|6|7	5.4.6
P2-69.1	Notch filter 2 switch	-	0	0~1	√	1|3|5|6|7	5.4.6
P2-69.3	Notch filter 3 switch	-	0	0~1	√	1|3|5|6|7	-
P2-70.0	Notch filter 4 switch	-	0	0~1	√	1|3|5|6|7	-
P2-70.1	Notch filter 5 switch	-	0	0~1	√	1|3|5|6|7	-
P2-71	First notch frequency	Hz	5000	50~5000	√	1|3|5|6|7	5.7.7
P2-72	First notch attenuation	0.1dB	70	50~1000	√	1|3|5|6|7	5.7.7
P2-73	First notch band width	Hz	0	0~1000	√	1|3|5|6|7	5.7.7
P2-74	Second notch frequency	Hz	5000	50~5000	√	1|3|5|6|7	5.7.7
P2-75	Second notch attenuation	0.1dB	70	50~1000	√	1|3|5|6|7	5.7.7
P2-76	Second notch band width	Hz	0	0~1000	√	1|3|5|6|7	5.7.7
P2-77	Third notch frequency	Hz	5000	50~5000	√	1|3|5|6|7	5.7.7
P2-78	Third notch attenuation	0.1dB	70	50~1000	√	1|3|5|6|7	5.7.7
P2-79	Third notch band width	Hz	0	0~1000	√	1|3|5|6|7	5.7.7
P2-80	Fourth notch frequency	Hz	5000	50~5000	√	1|3|5|6|7	5.7.7
P2-81	Fourth notch attenuation	0.1dB	70	50~1000	√	1|3|5|6|7	5.7.7
P2-82	Fourth notch band width	Hz	0	0~1000	√	1|3|5|6|7	5.7.7
P2-83	Fifth notch frequency	Hz	5000	50~5000	√	1|3|5|6|7	5.7.7
P2-84	Fifth notch attenuation	0.1dB	70	50~1000	√	1|3|5|6|7	5.7.7
P2-85	Fifth notch band width	Hz	0	0~1000	√	1|3|5|6|7	5.7.7

P3-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P3-00	V-REF Function Allocation 0-V-REF as Speed Instruction Input 1-V-REF will be used as input reference value of external speed limit. The actual speed limit depends on the speed limit of external analog quantity. 2-Speed Feedforward	-	0	0~2	○	1	4.5

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P3-01	Analog voltage corresponding to rated speed	0.001 V	10000	1500~30000	○	1	4.5
P3-02	Analog voltage speed filter	0.01m s	0	0~10000	√	1	4.5
P3-03	Speed instruction input dead zone voltage	0.001v	0	0~500	√	1	4.5
P3-04	V-REF analog speed direction	-	0	0~1	√	1	4.5
P3-05	Preset speed 1	rpm	0	-9999~9999	√	3	4.4.2
P3-06	Preset speed 2	rpm	0	-9999~9999	√	3	4.4.2
P3-07	Preset speed 3	rpm	0	-9999~9999	√	3	4.4.2
P3-09	Acceleration time	ms	200	0~65535	○	3|7	4.4.1.1
P3-10	Deceleration time	ms	200	0~65535	○	3|7	4.4.1.1
P3-12	Zero-speed clamping mode	-	0	0~3	○	3|7	4.4.1.2
P3-13	Zero-speed clamping speed	rpm	10	0~300	○	3|7	4.4.1.2
P3-14	Forward Maximum Speed Instruction Limit	rpm	4000	0~10000	○	1|3|5|6|7	4.8.3
P3-15	Reverse Maximum Speed Instruction Limit	rpm	4000	0~10000	○	1|3|5|6|7	4.8.3
P3-16	Internal Forward Speed Limitation in Torque Control	rpm	2000	5~10000	√	1	4.5.1.2
P3-17	Internal Reverse Speed Limitation in Torque Control	rpm	2000	5~10000	√	1	4.5.1.2
P3-18	Jogging speed	rpm	100	0~1000	○	1|3|5|6|7	3.4.2
P3-19	forward warning speed	rpm	3000	0~10000	○	1|3|5|6|7	4.8.5.4
P3-20	reverse warning speed	rpm	3000	0~10000	○	1|3|5|6|7	4.8.5.4
P3-21	forward alarming speed	rpm	4000	0~10000	○	1|3|5|6|7	-
P3-22	reverse alarming speed	rpm	4000	0~10000	○	1|3|5|6|7	-
P3-23	T-REF Function Allocation 0 - Input as Torque Instruction 1 - As a necessary condition for limiting input of external torque, the minimum value is valid compared with P3-28/P3-29. 2-Torque Feedforward	-	0	0~2	○	3|5|6|7	-
P3-24	analog value	0.001	10000	1500~30000	○	3|5|6|7	-

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	corresponding to rated torque	V					
P3-25	Analog Voltage Torque Filtering Time	0.01ms	0	0~10000	√	3|5|6|7	-
P3-26	Torque instruction input dead-zone voltage	0.001V	0	0~500	√	3|5|6|7	-
P3-27	Analog Torque Forward Direction 0-forward 1-reverse	-	0	0~1	○	3|5|6|7	-
P3-28	Internal forward torque limit	%	300	0~1000	√	1|3|5|6|7	4.8.2
P3-29	Internal reverse torque limit	%	300	0~1000	√	1|3|5|6|7	4.8.2
P3-30	external forward torque limit	%	300	0~1000	√	1|3|5|6|7	4.8.2
P3-31	external reverse torque limit	%	300	0~1000	√	1|3|5|6|7	4.8.2
P3-32	Brake torque	1%	300	0~1000	√	1|3|5|6|7	4.2.4
P3-33	Preset torque	%	0	-1000~1000	√	1	4.5.1.1
P3-38	Anti blocking forward torque limit	%	300	0~1000	√	1|3|5|6|7	4.8.1
P3-39	Anti blocking reverse torque limit	%	300	0~1000	√	1|3|5|6|7	4.8.1
P3-45	Torque mode switching delay	ms	40	0~9999	√	1	-

P4-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P4-00.0	Z phase signal numbers The Z phase signal numbers after leaving the limit switch (note: stop when N+1 Z phase signal reached)	pcs	2	0~f	○	5|6	4.3.1.8
P4-00.1	Search the origin function 0-OFF 1-ON	-	0	0~1	○	5|6	4.3.1.8
P4-00.2	return to zero overrun prohibition 0-not prohibit 1-prohibit	-	0	0~1	○	5|6	4.3.1.8
P4-01	Speed of hitting the proximity switch	rpm	600	0~65535	○	5|6	4.3.1.8
P4-02	Speed of leaving proximity switch	rpm	100	0~65535	○	5|6	4.3.1.8
P4-03.0	Internal Location Given Mode Sets Location Mode 0-relative positioning 1-Absolute positioning	-	0	0~1	○	5	4.3.3.1
P4-03.1	Internal Position-Given Mode Sets Step Change Mode 0-step-changing when signal is	-	0	0~6	○	6	4.3.3.1

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	ON, recyclable 1-change step at signal rising edge, single step execution 2-starting at Signal rising edge, sequential execution of all, no cycle 3-set segment no. through communication 4-/CHSTP dual edge triggerring 5-terminal/PREFA(P5-57), /PREFB(P5-58), /PREFC(P5-59) select the segment no., range 1~3 6-terminal/PREFA (P5-57), /PREFB(P5-58), /PREFC(P5-59) select segment no., range 1~8						
P4-03.2	Internal position mode sets waiting mode 0-wait positioning completion 1-not wait positioning completion	-	0	0~1	○	5	4.3.3.1
P4-04	Valid segment number	-	0	0~35	○	5	4.3.3.2
P4-08	Internal position mode start segment No	-	1	0~35	○	5	4.3.3.3
P4-10～P4-11	First segment pulse	1pul	0	-327689999 ~327679999	√	5	4.4.3
P4-12	First segment speed	0.1rpm	0	0~65535	√	5	4.4.3
P4-13	First segment acceleration time	1ms	0	0~65535	√	5	4.4.3
P4-14	First segment deceleration time	1ms	0	0~65535	√	5	4.4.3
P4-16	Adjusting time	1ms	0	0~65535	√	5	4.4.3
P4-10+（n-1）*7 ~P4-16+（n-1）*7	segment 1 to 35 pulse parameters (n is segment number)	-	-	-	√	5	4.4.3

P5-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P5-00	Positioning completion width/COIN	Command unit	11	1~65535	√	5|6|10	4.3.1.2
P5-01	Location Completion Detection Mode	-	0	0~3	√	5|6|10	4.3.1.2
P5-02	Location completion retention time	ms	0	0~65535	√	5|6|10	4.3.1.2
P5-03	Rotation Detection Speed	rpm	50	0~10000	√	1|3|5|6|7	4.8.5.2
P5-04	Same speed detection speed	rpm	50	0~10000	√	1|3|5|6|7	4.8.5.3
P5-05	Reached detection speed	rpm	1000	0~10000	√	1|3|5|6|7	4.4.1.3
P5-06	Positioning near output width	Command unit	50	1~65535	√	5|6	4.3.1.3
P5-07	Servo OFF delay time	ms	500	-500~9999	○	1|3|5|6|7	4.2.5
P5-08	Brake instruction output speed	rpm	30	20~10000	○	1|3|5|6|7	4.2.5
P5-09	Brake instruction waiting	ms	500	0~65535	○	1|3|5|6|7	4.2.5

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	time						
P5-10	user-defined output 1 trigger condition	-	0	0~ffff	√	1|3|5|6|7	4.8.5.7
P5-11	Set a value that compares with the trigger condition of custom output 1	Relating to trigger condition	0	-9999~9999	√	1|3|5|6|7	4.8.5.7
P5-12	Select custom output 1 mode	-	0	0~3	√	1|3|5|6|7	4.8.5.7
P5-13	Setting custom output 1 hysteresis	Relating to trigger condition	0	0~65535	√	1|3|5|6|7	4.8.5.7
P5-14	Custom Output 2 Trigger Condition	-	0	0~ffff	√	1|3|5|6|7	4.8.5.7
P5-15	Set a value that compares with the trigger condition of custom output 2	Relating to trigger condition	0	-9999~9999	√	1|3|5|6|7	4.8.5.7
P5-16	Select custom output 2 mode	-	0	0~3	√	1|3|5|6|7	4.8.5.7
P5-17	Setting custom output 2 hysteresis	Relating to trigger condition	0	0~65535	√	1|3|5|6|7	4.8.5.7
P5-18	SI filter time multiple	-	1	0~10000	√	1|3|5|6|7	4.8.4.1
P5-19	Z phase output maintain time	ms	2	1~65535	√	1|3|5|6|7	4.8.5.6
P5-20.0~1	/S-ON: servo signal 00: Set the signal to be invalid all the time. 01: Input positive signal from SI1 terminal. 02: Input positive signal from SI2 terminal. 03: Input positive signal from SI3 terminal. 04: Input positive signal from SI4 terminal. 10: Set the signal to always be "valid". 11: Inverse signal is input from SI1 terminal. 12: Inverse signal is input from SI2 terminal. 13: Inverse signal is input from SI3 terminal. 14: Inverse signal is input from SI4 terminal.	-	01	0~ff	√	1|3|5|6|7	4.2.2
P5-20.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-21.0~1	/P-CON proportion action instruction	-	00	0~ff	√	1|3|5|6|7	4.8.6.1
P5-21.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-22.0~1	/P-OT: Forbidden forward driving	-	03	0~ff	√	1|3|5|6|7	4.2.4
P5-22.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-23.0~1	/N-OT: forbidden reverse driving	-	04	0~ff	√	1|3|5|6|7	4.2.4
P5-23.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-24.0~1	/ALM-RST: alarm clear	-	02	0~ff	√	1|3|5|6|7	4.8.6.2
P5-24.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P5-25.0~1	/P-CL：External Torque Limitation at Forward Rotation Side	-	00	0~ff	√	1|3|5|6|7	4.8.2
P5-25.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-26.0~1	/N-CL：External Torque Limitation at Reverse Rotation Side	-	00	0~ff	√	1|3|5|6|7	4.8.2
P5-26.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-27.0~1	/SPD-D: Internal Speed Direction Selection	-	00	0~ff	√	1|3|7	4.4.2
P5-27.2	SI terminal filtering time	ms	0	0~f	√	1|3|7	4.8.4.1
P5-28.0~1	/SPD-A: Internal Setting Speed Selection	-	00	0~ff	√	3|5	4.4.2
P5-28.2	SI terminal filtering time	ms	0	0~f	√	3|5	4.8.4.1
P5-29.0~1	/SPD-B: Internal Setting Speed Selection	-	00	0~ff	√	3|5	4.4.2
P5-29.2	SI terminal filtering time	ms	0	0~f	√	3|5	4.8.4.1
P5-30.0~1	/C-SEL: control mode selection	-	00	0~ff	√	1|3|5|6|7	4.1.2
P5-30.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-31.0~1	/ZCLAMP: zero position clamping	-	00	0~ff	√	3|7	4.4.1.2
P5-31.2	SI terminal filtering time	ms	0	0~f	√	3|7	4.8.4.1
P5-32.0~1	/INHIBIT: Instruction pulse prohibition	-	00	0~ff	√	5|6|7	4.3.1.4
P5-32.2	SI terminal filtering time	ms	0	0~f	√	5|6|7	4.8.4.1
P5-34.0~1	/CLR: pulse offset clear	-	00	0~ff	√	5|6	4.3.1.5
P5-34.2	SI terminal filtering time	ms	0	0~f	√	5|6	4.8.4.1
P5-35.0~1	/CHGSTP: internal position mode change step signal	-	00	0~ff	√	5	4.3.3
P5-35.2	SI terminal filtering time	ms	0	0~f	√	5	4.8.4.1
P5-36.0~1	/I-SEL: inertia ratio switching	-	00	0~ff	√	1|3|5|6|7	5.6.7
P5-36.2	SI terminal filtering time	ms	0	0~f	√	1|3|5|6|7	4.8.4.1
P5-37	/COIN_HD: Location Completion Maintenance 00: No output to terminal 01: Output positive signal from SO1 terminal 02: Output positive signal from SO2 terminal 03: Output positive signal from SO3 terminal 11: Output reverse signal from SO1 terminal 12: Output reverse signal from SO2 terminal. 13: Output reverse Signal from SO3 terminal	-	0000	0~ffff	√	5|6	4.3.1.2
P5-38	/COIN: positioning completion	-	0001	0~ffff	√	5|6	4.3.1.2
P5-39	/V-CMP: same speed detection	-	0000	0~ffff	√	3|7	4.8.5.3
P5-40	/TGON: rotation detection	-	0000	0~ffff	√	1|3|5|6|7	4.8.5.2

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P5-41	/S-RDY: ready	-	0000	0~ffff	√	1|3|5|6|7	4.8.5.1
P5-42	/CLT: torque limit	-	0000	0~ffff	√	1|3|5|6|7	4.8.2
P5-43	/VLT: speed limit detection	-	0000	0~ffff	√	1	4.5.1.3
P5-44	/BK: brake locking	-	0000	0~ffff	○	1|3|5|6|7	4.2.5
P5-45	/WARN: warning	-	0000	0~ffff	√	1|3|5|6|7	4.12.2
P5-46	/NEAR: near	-	0000	0~ffff	√	5|6	4.3.7
P5-47	/ALM: alarm	-	0002	0~ffff	√	1|3|5|6|7	4.2.6
P5-48	/Z: encoder Z phase signal output	-	0000	0~ffff	√	1|3|5|6|7	4.12.5
P5-50	/MRUN: internal position mode motion starting signal	-	0000	0~ffff	√	5	4.3.3.6
P5-51	/V-RDY: speed reached	-	0000	0~ffff	√	3|7	4.4.1.3
P5-52	/USER1: user-defined output 1	-	0000	0~ffff	√	1|3|5|6|7	4.8.5.7
P5-53	/USER2: user-defined output 2	-	0000	0~ffff	√	1|3|5|6|7	4.8.5.7
P5-57.0~1	/PREFA: intenral position selection signal A	-	00	0~ff	√	5	4.3.3.1
P5-57.2	SI terminal filtering time	ms	0	0~f	√	5	4.8.4.1
P5-58.0~1	/PREFB: intenral position selection signal B	-	00	0~ff	√	5	4.3.3.1
P5-58.2	SI terminal filtering time	ms	0	0~f	√	5	4.8.4.1
P5-59.0~1	/PREFC: internal position selection signal C	-	00	0~ff	√	5	4.3.3.1
P5-59.2	SI terminal filtering time	ms	0	f~f	√	5	4.8.4.1
P5-61.0~1	/TRAJ-START: Motion start trigger signal	-	00	0~ff	√	5	
P5-61.2	SI terminal filtering time	ms	0	0~f	√	5	
P5-70	/SRDY: Output Conditions Selection 0: This terminal is turned on after initialization of the driver is completed 1: This terminal will not turn on until enabled.	-	0	0~1	√	1|3|5|6|7	4.8.5.1
P5-71	Function Selection of Directional Terminal of Pulse Speed Mode	-	0	0~1	○	7	4.4.3.4

P6-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P6-05	Adaptive Mode Speed Loop Gain (Large Inertia)	0.1Hz	200	1~65535	○	1|3|5|6|7	5.2.4
P6-07	Adaptive mode inertia ratio (Large inertia)	%	50	0~10000	○	1|3|5|6|7	5.2.4
P6-08	Gain of adaptive mode speed observer (large inertia)	Hz	40	10~1000	○	1|3|5|6|7	5.2.4
P6-12	Maximum Inertia Ratio of Adaptive Mode (Large Inertia)	-	50	1~10000	○	1|3|5|6|7	5.2.4

P7-XX:

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P7-00	RS485 station no.	-	1	0~100	○	1|3|5|6|7	7.2
P7-01.0~1	RS485 baud rate 00：300 01：600 02：1200 03：2400 04：4800 05：9600 06：19200 07：38400 08：57600 09：115200 0A：192000 0B：256000 0C：288000 0D：384000 0E：512000 0F：576000 10：768000 11：1M 12：2M 13：3M 14：4M 15：5M 16：6M	baud rate	06	0~16	○	1|3|5|6|7	7.2
P7-01.2	RS485 stop bit 0：2 bits 2：1 bit	Stop bit	2	0~2	○	1|3|5|6|7	7.2
P7-01.3	RS485 parity bit 0-no parity 1-odd parity 2-even parity	Parity bit	2	0~2	○	1|3|5|6|7	7.2
P7-02	RS485 communication protocol 1-Modbus Rtu protocol 2-Xnet bus protocol 3-read Xnet bus torque	-	1	1~3	○	1|3|5|6|7	7.2
P7-03	Xnet Synchronized sampling time	1ms	9	1~500	○	1|3|5|6|7	7.2
P7-04	Xnet slave station data	-	15	1~500	○	1|3|5|6|7	7.2
P7-05	Xnet slave station numbers	-	10	1~256	○	1|3|5|6|7	7.2
P7-06	Number of communication overtime retries	times	10	1~500	○	1|3|5|6|7	7.2
P7-07	Bus instruction refresh cycle	1us	3000	1~65535	○	1|3|5|6|7	7.2

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
P7-08	Compensation Threshold of Position Deviation	-	0	0	○	1|3|5|6|7	7.2
P7-09	Compensation times for Position Deviation	-	0	0	○	1|3|5|6|7	7.2
P7-10	RS232 station no.	-	1	0~100	○	1|3|5|6|7	7.2
P7-11.0~1	**RS232 baud rate** 00：300 01：600 02：1200 03：2400 04：4800 05：9600 06：19200 07：38400 08：57600 09：115200 0A：192000 0B：256000 0C：288000 0D：384000 0E：512000 0F：576000 10：768000 11：1M 12：2M 13：3M 14：4M 15：5M 16：6M	Baud rate	6	0~16	○	1|3|5|6|7	7.2
P7-11.2	RS232 stop bit 0：2-bit 2：1 bit	Stop bit	2	0~2	○	1|3|5|6|7	7.2
P7-11.3	RS232 parity bit 0-no parity 1-odd parity 2-even parity	Parity bit	2	0~2	○	1|3|5|6|7	7.2
P7-20	Return to zero direction (bus)	-	1	-9999~9999	○	1|3|5|6|7	7.2
P7-21	Filtering time after return to zero(bus)	ScanA Cycle	400	1~65525	○	1|3|5|6|7	7.2
P7-31	**CANbus baud rate** 00:100000 01:125000 02:250000 03:500000 04:800000 05:1000000	Baud rate	3	0~5	○	1|3|5|6|7	7.2

P9-XX (supported in version 3770 and later)

Parameter	Function Description	Unit	Factory Default	Value Range	Effective Timing	Applicable Range	Reference Section
P9-11.0	Number of Z phases for homing	-	0	0-F	○	5/6	4.3.1.9
P9-11.1	Homing trigger mode:0: Trigger homing via stop contact1: Trigger homing via S1 terminal2: In this mode, homing starts immediately after power-on (only for the first startup after power-on)	-	0	0~2	○	5/6	4.3.1.9
P9-11.2	New homing mode:0: Homing mode 01: Homing mode 12: Homing mode 23: Homing mode 34: Homing mode 45: Homing mode 56: Homing mode 67: Homing mode 7	-	0	0~7	○	5/6	4.3.1.9
P9-11.3	Deceleration mode when homing signal is received	-	0	0~1	○	5/6	4.3.1.9
P9-12	Homing high-speed velocity	-	200	0~3000	○	5/6	4.3.1.9
P9-13	Homing low-speed velocity	-	20	0~1000	○	5/6	4.3.1.9
P9-14	Homing acceleration/deceleration time	-	1000	0~5000	○	5/6	4.3.1.9
P9-15	Homing timeout time	-	0	0~12000	○	5/6	4.3.1.9
P9-16	Speed threshold for contact homing	-	2	0~1000	○	5/6	4.3.1.9
P9-17	Torque threshold for contact homing	-	100	0~300	○	5/6	4.3.1.9
P9-18	Time threshold for contact stop homing	-	500	10~1500	○	5/6	4.3.1.9
P9-19	Low byte of fixed pulse count(Unit: Command pulse)	-	0	-9999~9999	○	5/6	4.3.1.9
P9-20	High byte of fixed pulse count(Unit: Command pulse)	-	0	-9999~9999	○	5/6	4.3.1.9
P9-21	Homing selection	-	0	0~1	●	5/6	4.3.1.9
P9-22	Filter time after homing completion	-	500	50~10000	○	5/6	4.3.1.9

Appendix 2. UX-XX monitoring parameters

U0-XX:

Code	Contents		Unit
U0-00	servo motor speed		Rpm
U0-01	Input speed instruction		Rpm
U0-02	Torque instruction		% rated
U0-03	Mechanical angle		1°
U0-04	Electric angle		1°
U0-05	Bus voltage		V
U0-06	IPM temperature		0.1℃
U0-07	Torque feedback		% rated
U0-08	pulse offset	（0000～9999）*1	Instruction pulse
U0-09		（0000～9999）*10000	
U0-10	Encoder feedback	（0000～9999）*1	Encoder pulse
U0-11	Encoder feedback	（0000～65535）*10000	Encoder pulse
U0-12	input instruction pulse numbers	（0000～9999）*1	Instruction pulse
U0-13		（0000～9999）*10000	
U0-14	position feedback	（0000～9999）*1	Instruction pulse
U0-15		（0000～9999）*10000	
U0-16	encoder accumulated position	（0000～9999）*1	Encoder pulse
U0-17		（0000～9999）*10000	
U0-18	Torque current		0.01A
U0-19	Analog input V-REF value		0.01V
U0-20	Analog input T-REF value		0.01V
U0-21	Input signal status 1		
U0-22	Input signal status 2		
U0-23	output signal status 1		
U0-24	ouput signal status 2		
U0-25	Input pulse frequency	（0000～9999）*1	Hz
U0-26		（0000～9999）*10000	
U0-41	Instantaneous output power		1W
U0-42	Average output power		1W
U0-43	Instantaneous thermal power		1W
U0-44	average thermal power		1W
U0-49	position feedforward		1 command unit
U0-50	speed feedforward		rpm
U0-51	torque feedforward		% rated
U0-52	Instantaneous Bus Capacitor Power		1W
U0-53	Average Bus Capacitor Power		1W
U0-54	Discharge power of instantaneous regenerative braking		-
U0-55	Average regenerative brake discharge power		1W
U0-56	Instantaneous output power		1W
U0-57	Absolute encoder present position feedback low 32-bit		Encoder position
U0-58			
U0-59	Absolute encoder present position feedback high 32-bit		Encoder position
U0-60			
U0-62	Xnet Communication Waiting Synchronization Frame State Interference		-
U0-63	Xnet Communication Waiting for Synchronization Frame State Receiving Data Frame		-
U0-64	Xnet Communication Waiting Data Frame State Interference		-
U0-65	Xnet Communication Waiting for Data Frame Status Receive Synchronized Frame		-

Code	Contents		Unit
U0-66	Xnet communication CRC parity error		-
U0-67	Xnet communication UART error		-
U0-68	Xnet communication timeout counting		-
U0-69	Communication encoder timeout counting		-
U0-79	Encoder CRC error counting		-
U0-80	Internal position mode error segment number		-
U0-81	Internal position mode present segment number		-
U0-82	Analog input V-REF initial value		-
U0-83	Analog input T-REF initial value		-
U0-88	Motor code reading status		-
U0-89	Real-time speed feedback (displaying range -99.99~99.99rpm)		0.01rpm
U0-90	Maximum position deviation when enabling in static status		-
U0-91	Multi-turn absolute motor circles		
U0-94	Encoder feedback position after calibration	（0000～65536）*1	Encoder pulses
U0-95		（0000～65536）*2^16	
U0-96		（0000～65536）*2^32	
U0-97		（0000～65536）	
U0-98	High power motor temperature	℃	
U0-99	Current State of PDS State Machine in CiA402 Operating Mode		-

U1-XX:

Code	Contents	Unit
U1-00	present alarm code	
U1-01	present warning code	
U1-02	U phase current when alarming	0.01A
U1-03	V phase current when alarming	0.01A
U1-04	bus voltage when alarming	V
U1-05	IGBT temperature when alarming	0.1℃
U1-06	torque current when alarming	0.1A
U1-07	excitation current when alarming	A
U1-08	position offset when alarming	Instruction pulse
U1-09	speed when alarming	rpm
U1-10	Seconds(low 16-bit) when alarming, cumulated seconds from the first time power-on	s
U1-11	Seconds(high 16-bit) when alarming, cumulated seconds from the first time power-on	s
U1-12	this time running error numbers, counting after power on this time	
U1-13	this time operation warning numbers, counting after power on this time	
U1-14	historical alarm amounts	
U1-15	historical warning amounts	
U1-16	Recent 2nd alarm code	
U1-17	Recent 3rd alarm code	
U1-18	Recent 4th alarm code	
U1-19	Recent 5th alarm code	
U1-20	Recent 6th alarm code	
U1-21	Recent 7th warning code	
U1-22	Recent 8th warning code	
U1-23	Recent 9th warning code	
U1-24	Recent 10th warning code	
U1-25	Recent 11th warning code	
U1-26	Recent 12th warning code	
U1-21	Most recent 2nd alarm code	-
U1-27	Most recent 13th alarm code	
U1-28	Most recent 14th alarm code	

Code	Contents	Unit
U1-29	Most recent 15th alarm code	
U1-30	Most recent 16th alarm code	
U1-31	Most recent 17th alarm code	
U1-32~U1-47	Most recent 2nd to 17th warning codes	

U2-XX:

Code	Contents		Unit
U2-00	Power on times		
U2-01	series		
U2-02	Model (low 16-bit)		
U2-03	Model (high 16-bit)		
U2-04	out of factory date: year		
U2-05	out of factory date: month		
U2-06	out of factory date: day		
U2-07	Firmware version		
U2-08	Hardware version		
U2-09	Total running time (from the first time power on)		hour
U2-10	Total running time (from the first time power on)		minute
U2-11	Total running time (from the first time power on)		second
U2-12	This time running time (from this time power on)		hour
U2-13	This time running time (from this time power on)		minute
U2-14	This time running time (from this time power on)		second
U2-15	Average output power (from the first time enabled, average power in the process of enabling)		1W
U2-16	Average thermal power (from the first time enabled, average power in the process of enabling)		1W
U2-17	Average bus capacitor filter power (from the first time power on, average power in the process of power on)		1W
U2-18	Motor accumulated turn	（0000～9999）*1	Turn
U2-19		（0000～9999）*10000	Turn
U2-20	Device serial no.: low 16-bit		-
U2-21	Device serial no.: high 16-bit		-
U2-22	Firmware generation date: year		-
U2-23	Firmware generation date:month/day		-
U2-24	Firmware generation date: hour/minute		-

U3-XX:

Code	Contents	Unit
U3-00	Motor code (including thermal power parameters) read automatically by driver	-
U3-01	Motor version	-
U3-02	Encoder version	-
U3-70	Automatically read the motor code of the encoder in the motor parameters (only related to the motor code)	-

U4-XX:

Code	Contents	Unit
U4-10	Resonance frequency detected by fast FFT	Hz
U4-16	Thermal Power Protection Continuous Overload Operation Accumulated Value (supported from version 3770 onwards)	-
U4-17	Thermal Power Protection Instantaneous Overload Operation Accumulated Value (supported from version 3770 onwards)	-

Appendix 3. Contents of FX-XX Auxiliary Functions

Function Code	Description	Effective Timing	Reference Section
F0-00	Clear Alarm	Servo OFF	-
F0-01	Restore Factory Settings	Servo OFF	-
F0-02	Clear Position Deviation	Servo OFF	-
F1-05	Software Enable	Servo OFF	-
F1-06	Absolute Encoder Position Clear	Servo OFF	4.7.6

Appendix 4. Modbus address list

1. Address correspondence rules

According to the description of servo MODBUS address allocation rules, the parameter addresses not involved in the follow-up refer to this address allocation rule.

Parameter groups	Modbus address	Explanation
P0-00~P0-xx	0x0000~0x0063	Modbus address is added 1 in turn from 0x0000, for example, Modbus address of P0-23 is 0x0017
P1-00~P1-xx	0x0100~0x0163	Modbus address is added 1 in turn from 0x0100, for example, Modbus address of P1-10 is 0x010A
P2-15~P2-xx	0x020F~0x0263	Modbus address is added 1 in turn from 0x020F, for example, Modbus address of P2-16 is 0x0210
P3-00~P3-xx	0x0300~0x0363	Modbus address is added 1 in turn from 0x0300, for example, Modbus address of P3-13 is 0x030D
P4-00~P4-xx	0x0400~0x0463	Modbus address is added 1 in turn from 0x0400, for example, Modbus address of P4-25 is 0x0419
P5-00~P5-xx	0x0500~0x0563	Modbus address is added 1 in turn from 0x0500, for example, Modbus address of P5-20 is 0x0514
P6-00~P6-xx	0x0600~0x0663	Modbus address is added 1 in turn from 0x0600, for example, Modbus address of P6-05 is 0x0605
P7-00~P7-xx	0x0700~0x0763	Modbus address is added 1 in turn from 0x0700, for example, Modbus address of P7-11 is 0x070B
U0-00~U0-xx	0x1000~0x1063	Modbus address is added 1 in turn from 0x1000, for example, Modbus address of U0-05 is 0x1005
U1-00~U1-xx	0x1100~0x1163	Modbus address is added 1 in turn from 0x1100, for example, Modbus address of U1-14 is 0x110E
U2-00~U2-xx	0x1200~0x1263	Modbus address is added 1 in turn from 0x1200, for example, Modbus address of U2-08 is 0x1208
F0-00~F0-xx	0x2000~0x2063	Modbus address is added 1 in turn from 0x2000, for example, Modbus address of F0-01 is 0x2001
F1-00~F1-xx	0x2100~0x2163	Modbus address is added 1 in turn from 0x2100, for example, Modbus address of F1-03 is 0x2103
F0-00~F0-xx	0x2000~0x2063	Modbus addresses start from 0x2000 and increment by 1 sequentially; for example, the Modbus address corresponding to F0-01 is 0x2001
F1-00~F1-xx	0x2100~0x2163	Modbus addresses start from 0x2100 and increment by 1 sequentially; for example, the Modbus address corresponding to F1-03 is 0x2103

2. Address examples

- **Group P parameter address**

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P0-00	0x0000	0	P0-17	0x0011	17
P0-01	0x0001	1	P0-18	0x0012	18
P0-02	0x0002	2	P0-19	0x0013	19
P0-03	0x0003	3	P0-20	0x0014	20
P0-04	0x0004	4	P0-21	0x0015	21
P0-05	0x0005	5	P0-22	0x0016	22
P0-06	0x0006	6	P0-23	0x0017	23
P0-07	0x0007	7	P0-24	0x0018	24

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P0-08	0x0008	8	P0-25	0x0019	25
P0-09	0x0009	9	P0-26	0x001A	26
P0-10	0x000A	10	P0-27	0x001B	27
P0-11	0x000B	11	P0-28	0x001C	28
P0-12	0x000C	12	P0-29	0x001D	29
P0-13	0x000D	13	P0-30	0x001E	30
P0-14	0x000E	14	P0-31	0x001F	31
P0-15	0x000F	15	P0-32	0x0020	32
P0-16	0x0010	16	P0-33	0x0021	33

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P1-00	0x0100	256	P1-15	0x010F	271
P1-01	0x0101	257	P1-16	0x0110	272
P1-02	0x0102	258	P1-17	0x0111	273
P1-03	0x0103	259	P1-18	0x0112	274
P1-04	0x0104	260	P1-19	0x0113	275
P1-05	0x0105	261	P1-20	0x0114	276
P1-06	0x0106	262	P1-21	0x0115	277
P1-07	0x0107	263	P1-22	0x0116	278
P1-08	0x0108	264	P1-23	0x0117	279
P1-09	0x0109	265	P1-24	0x0118	280
P1-10	0x010A	266	P1-25	0x0119	281
P1-11	0x010B	267	P1-26	0x011A	282
P1-12	0x010C	268	P1-27	0x011B	283
P1-13	0x010D	269	P1-28	0x011C	284
P1-14	0x010E	270			

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P2-00	0x0200	512	P2-15	0x20F	527
P2-01	0x0201	513	P2-16	0x210	528

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P3-00	0x0300	768	P3-19	0x0313	787
P3-01	0x0301	769	P3-20	0x0314	788
P3-02	0x0302	770	P3-21	0x0315	789
P3-03	0x0303	771	P3-22	0x0316	790
P3-04	0x0304	772	P3-23	0x0317	791
P3-05	0x0305	773	P3-24	0x0318	792
P3-06	0x0306	774	P3-25	0x0319	793
P3-07	0x0307	775	P3-26	0x031A	794
P3-08	0x0308	776	P3-27	0x031B	795
P3-09	0x0309	777	P3-28	0x031C	796
P3-10	0x030A	778	P3-29	0x031D	797
P3-11	0x030B	779	P3-30	0x031E	798

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P3-12	0x030C	780	P3-31	0x031F	799
P3-13	0x030D	781	P3-32	0x0320	800
P3-14	0x030E	782	P3-33	0x0321	801
P3-15	0x030F	783	P3-34	0x0322	802
P3-16	0x0310	784	P3-35	0x0323	803
P3-17	0x0311	785	P3-36	0x0324	804
P3-18	0x0312	786			

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P4-00	0x0400	1024	P4-15	0x040F	1039
P4-01	0x0401	1025	P4-16	0x0410	1040

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P5-00	0x0500	1280	P5-27	0x051B	1307
P5-01	0x0501	1281	P5-28	0x051C	1308
P5-02	0x0502	1282	P5-29	0x051D	1309
P5-03	0x0503	1283	P5-30	0x051E	1310
P5-04	0x0504	1284	P5-31	0x051F	1311
P5-05	0x0505	1285	P5-32	0x0520	1312
P5-06	0x0506	1286	P5-33	0x0521	1313
P5-07	0x0507	1287	P5-34	0x0522	1314
P5-08	0x0508	1288	P5-35	0x0523	1315
P5-09	0x0509	1289	P5-36	0x0524	1316
P5-10	0x050A	1290	P5-37	0x0525	1317
P5-11	0x050B	1291	P5-38	0x0526	1318
P5-12	0x050C	1292	P5-39	0x0527	1319
P5-13	0x050D	1293	P5-40	0x0528	1320
P5-14	0x050E	1294	P5-41	0x0529	1321
P5-15	0x050F	1295	P5-42	0x052A	1322
P5-16	0x0510	1296	P5-43	0x052B	1323
P5-17	0x0511	1297	P5-44	0x052C	1324
P5-18	0x0512	1298	P5-45	0x052D	1325
P5-19	0x0513	1299	P5-46	0x052E	1326
P5-20	0x0514	1300	P5-47	0x052F	1327
P5-21	0x0515	1301	P5-48	0x0530	1328
P5-22	0x0516	1302	P5-49	0x0531	1329
P5-23	0x0517	1303	P5-50	0x0532	1330
P5-24	0x0518	1304	P5-51	0x0533	1331
P5-25	0x0519	1305	P5-52	0x0534	1332
P5-26	0x051A	1306	P5-53	0x0535	1333

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P6-00	0x0600	1536	P6-10	0x060A	1546
P6-01	0x0601	1537	P6-11	0x060B	1547

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P7-00	0x0700	1792	P7-10	0x070A	1802
P7-01	0x0701	1793			
P8-25	0x0819	2073			
P9-11	0x090B	2315	P9-17	0x0911	2321
P9-12	0x090C	2316	P9-18	0x0912	2322
P9-13	0x090D	2317	P9-19	0x0913	2323
P9-14	0x090E	2318	P9-20	0x0914	2324
P9-15	0x090F	2319	P9-21	0x0915	2325
P9-16	0x0910	2320	P9-22	0x0916	2326

■ **Group U parameter address**

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
U0-00	0x1000	4096	U0-28	0x101C	4124
U0-01	0x1001	4097	U0-29	0x101D	4125
U0-02	0x1002	4098	U0-30	0x101E	4126
U0-03	0x1003	4099	U0-31	0x101F	4127
U0-04	0x1004	4100	U0-32	0x1020	4128
U0-05	0x1005	4101	U0-33	0x1021	4129
U0-06	0x1006	4102	U0-34	0x1022	4130
U0-07	0x1007	4103	U0-35	0x1023	4131
U0-08	0x1008	4104	U0-36	0x1024	4132
U0-09	0x1009	4105	U0-37	0x1025	4133
U0-10	0x100A	4106	U0-38	0x1026	4134
U0-11	0x100B	4107	U0-39	0x1027	4135
U0-12	0x100C	4108	U0-40	0x1028	4136
U0-13	0x100D	4109	U0-41	0x1029	4137
U0-14	0x100E	4110	U0-42	0x102A	4138
U0-15	0x100F	4111	U0-43	0x102B	4139
U0-16	0x1010	4112	U0-44	0x102C	4140
U0-17	0x1011	4113	U0-45	0x102D	4141
U0-18	0x1012	4114	U0-46	0x102E	4142
U0-19	0x1013	4115	U0-47	0x102F	4143
U0-20	0x1014	4116	U0-48	0x1030	4144
U0-21	0x1015	4117	U0-49	0x1031	4145
U0-22	0x1016	4118	U0-50	0x1032	4146
U0-23	0x1017	4119	U0-51	0x1033	4147
U0-24	0x1018	4120	U0-52	0x1034	4148
U0-25	0x1019	4121	U0-53	0x1035	4149
U0-26	0x101A	4122	U0-57	0x1039	4153
U0-27	0x101B	4123	U0-58	0x103A	4154
U0-28	0x101C	4124	U0-95	0x105F	4191

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
U0-29	0x101D	4125	U0-96	0x1060	4192
U0-30	0x101E	4126	U0-97	0x1061	4193
U0-31	0x101F	4127			

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
U1-00	0x1100	4352	U2-00	0x1200	4608
U1-01	0x1101	4353	U2-01	0x1201	4609
U1-02	0x1102	4354	U2-02	0x1202	4610
U1-03	0x1103	4355	U2-03	0x1203	4611
U1-04	0x1104	4356	U2-04	0x1204	4612
U1-05	0x1105	4357	U2-05	0x1205	4613
U1-06	0x1106	4358	U2-06	0x1206	4614
U1-07	0x1107	4359	U2-07	0x1207	4615
U1-08	0x1108	4360	U2-08	0x1208	4616
U1-09	0x1109	4361	U2-09	0x1209	4617
U1-10	0x110A	4362	U2-10	0x120A	4618
U1-11	0x110B	4363	U2-11	0x120B	4619
U1-12	0x110C	4364	U2-12	0x120C	4620
U1-13	0x110D	4365	U2-13	0x120D	4621
U1-14	0x110E	4366	U2-14	0x120E	4622
U1-15	0x110F	4367	U2-15	0x120F	4623
U1-16	0x1110	4368	U2-16	0x1210	4624
U1-17	0x1111	4369	U2-17	0x1211	4625
U1-18	0x1112	4370	U2-20	0x1214	4628
U1-19	0x1113	4371			
U1-20	0x1114	4372			
U1-21	0x1115	4373			
U1-22	0x1116	4374			
U1-23	0x1117	4375			
U1-24	0x1118	4376			
U1-25	0x1119	4377			

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
F0-00	0x2000	8192	F1-00	0x2100	8448
F0-01	0x2001	8193	F1-01	0x2101	8449
F0-02	0x2002	8194	F1-02	0x2102	8450
F2-09	0x2209	8713	F1-03	0x2103	8451
			F1-04	0x2104	8452
			F1-05	0x2105	8453
			F1-06	0x2106	8454

Appendix 5. Q&A

Q1: What is BB and run?

1. BB standby state, without enabling, the motor is in the state of power failure.
2. Run running state, with enabling, the motor is in the power on state.

Q2: How to check and set the parameters?

Refer to chapter 4.6

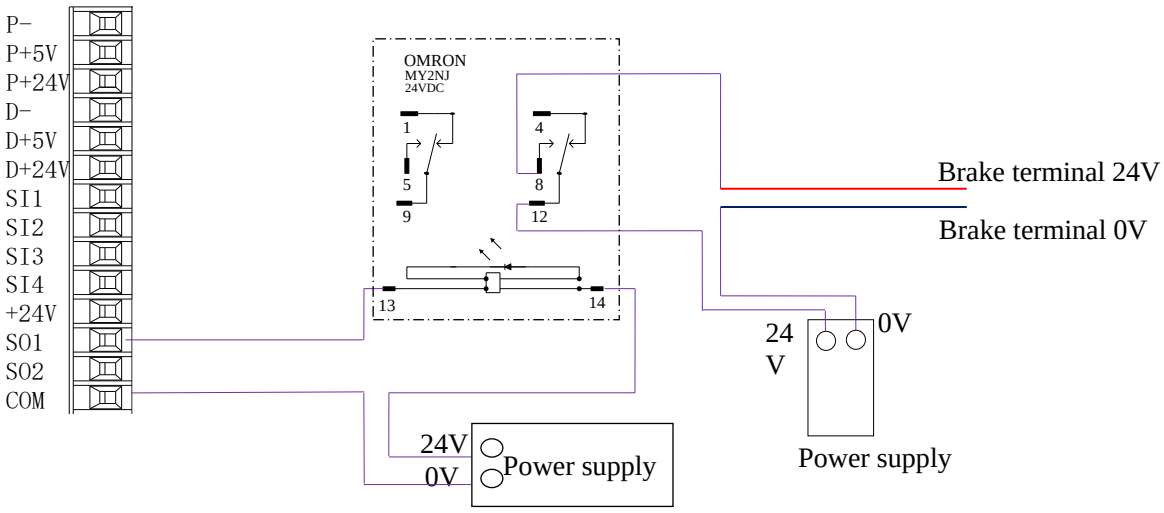
Q3: How to change the parameters in enabled status?

P5-20=0000, enabling is invalid, P5-20=0010, enabling when power on, no need to power on again.
The default value is 0001, which means input signal from SI1, SI1 connects to low voltage, +24V connects to high voltage (refer to chapter 5.2.2)

Q4: How to restore out of factory settings?

P5-20=0000 enabling is invalid, F0-01=1.

Q5: How to wiring for brake motor? How to modify parameters for slight slip of brake motor after power failure?



1. P5-44 defines the terminal of the brake output signal. As shown in the figure above, the SO1 controls brake, that is, P5-44 = 0001.
2. Extend the delay time of servo OFF P5-07 (default 500ms), and the waiting time of braking instruction P5-09 is set to 0, which can be responded.

Q6: The initial direction is not what I want. How can I change it through a servo driver?

Change the initial direction by modifying P0-05, set the value to 0 or 1, and take effect after re-energizing. (For mode 2, 4, 6, 7 only). If the internal speed mode (mode 3) is used, the positive and negative values of the speed setting can be changed.

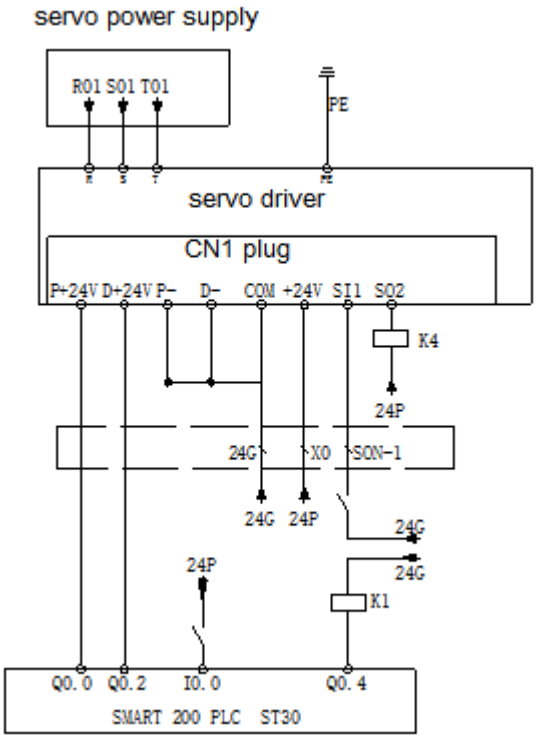
Q7: How do the two modes switch to each other?

Both P0-01 main mode and P0-02 sub-mode set the required mode. P5-30=0002 and SI2 are defined as mode switching terminals. When the SI2 terminal has no signal, it runs according to the set mode in the main mode P0-01. When the SI2 terminal has signal input, it runs according to the set mode in the sub-mode P0-02.

SI2 terminal signal can be switched only if it is a constant ON signal.

Q8: What is the connection mode between PLC and servo?

- NPN low-level output PLC: Y0 pulse connects P-, Y1 direction connects D-, +24V connects P+24, D+24. (Xinje PLC as an example)
- PNP high-level output PLC: Q0.0 pulse connects P+24, Q0.2 direction connects D+24, 0V connects P-, D-. (Siemens PLC as an example) as follows:



Q9: The service life of tank chain?

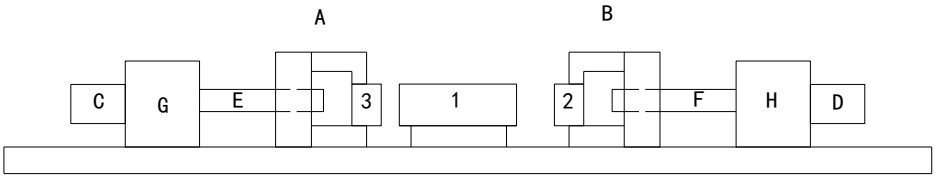
The bending resistance is 5 million times and the bending radius is 50 mm.

Appendix 6. General debugging steps

1. Before power on, carry out preliminary inspection according to the product inspection manual to confirm that there is no obvious damage to the equipment.
2. In the case of no obvious damage, connect the servo driver and the servo motor, and connect the power supply. Pay attention to the power supply. The U, V, W connectors of the power cable must be connected with the U, V, W terminals on the servo driver one by one, without crossing, otherwise the servo motor will block or fly.
3. Turn on the power and the servo power light is always on;
4. Read the parameter U3-00 through the upper computer and check the motor code value on the motor label. If U3-00 ≠ motor code on the motor nameplate, please write the motor code on the motor nameplate into P0-33 through the upper computer. If necessary, contact the manufacturer for technical support.
5. Check the running state of the motor during trial operation. If the motor can run smoothly, the wiring is normal. If the motor does not run, it is abnormal;
6. After inching operation to ensure no error, install the motor to the mechanical equipment;
7. Before starting the equipment, set the parameters of the servo driver according to the actual application, and adjust them according to the actual application.

Appendix7. Application example

Mode 6: Pulse instruction position mode



Equipment introduction:

This is a welder. Workpiece 1, 2, 3 are the object to be operated. 2 and 3 is fixed on B and A individually. A and B can whole move and be pushed by ball screw E and F. The screw pitch is 5mm. C and D is servo motor. G and H is reducer. The deceleration ratio is 40.
It needs to adjust the machine with standard dimension workpiece and find the origin of A and B.
Workpiece 1 lies on the worktable and moves left and right. Its dimension is positive tolerance, cannot shorter than standard workpiece. The process to put the workpiece is random. It requires that the left and right soldering is symmetrical.
A and B move toward 1 with 3 and 2 at the same speed. Whatever the position of 1, 2 or 3 will touch 1 at first and push 1 to another side until 2 and 3 all touch 1. The result is the motor torque will increase. At this time, 1 will at the symmetrical position.
A and B will return to the origin position after soldering is finished.

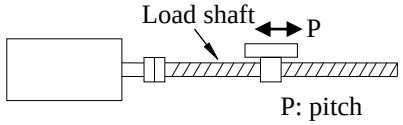
Analysis

1. Make sure the work mode: 6
2. It needs to judge whether 2 and 3 touch 1 when finding the symmetrical point first time. The sign is servo output torque will increase. It needs to use torque limit (P3-28, P3-29) and torque limit output signal /CLT.
3. As the dimension of workpiece 1 is larger than standard, offset pulse will remain in servo when the symmetrical point is found. /CLR signal can clear the pulse. The servo motor running distance is different from PLC pulse number. If it needs to know the actual distance, servo encoder feedback /A+, /A-, /B+, /B- and AB phase count are needed.
4. The machine motion direction of A and B.

Signal and terminal

/COIN positioning finished signal: SO1
/CLT torque up to upper limit output: SO2
/CLR pulse offset clear input: SI1
Encoder feedback signal /A+, /A-, /B+, /B-

Calculate the electronic gear ratio

Step	Explanation	Ball screw
	 $1\ \text{rotation} = \frac{P}{\text{Command unit}}$	
1	Confirm the mechanical specification	Ball screw pitch: 5mm Reduction ratio: 40/1
2	Confirm the encoder pulse number	131072
3	Decide the command unit	1 command unit: 0.001mm
4	Calculate the motion value of load shaft rotate 1 circle	5mm/0.001mm=5000

Step	Explanation	Ball screw
5	Calculate the electronic gear ratio	$\frac{B}{A}=\frac{2^{17}}{5000}=\frac{16384}{625}$
6	Set the user parameters	P0-13=16384 P0-14=625

Parameter setting

Operation Mode	P0-01=6
Pulse Command Form	P0-10=2
Electronic Gear Ratio	P0-11=0 P0-12=0 P0-13=32768 P0-14=125
Forward Torque Limit	P3-28=150
Reverse Torque Limit	P3-29=150
Positioning Completion Width	P5-00=7
/S-ON Signal Setting	P5-20=0010
/CLR Signal Setting	P5-34=0001
/COIN Signal Setting	P5-38=0001
/CLT Signal Setting	P5-42=0002

Appendix 8. Servo general mode parameters

Appendix 8.1 Basic parameters

Basic parameters	
Parameter	Overview
P0-03 enable mode P5-20 servo ON signal /S-ON	Enable mode selection, generally P0-03 is default, P5-20 sets n.0010 as enable on after power on
P0-04 Rigidity grade	Adjust servo gain in auto-tuning fast adjustment mode
P0-05 Definition of rotation direction	Determine the motor direction, generally 0/1 by default
P0-25 Power value of discharge resistance P0-26 Discharge resistance value	Set the specification parameters of external regeneration resistance to ensure that they are the same as the actual ones
P3-28 internal forward torque limit P3-29 internal reverse torque limit P3-30 external forward torque limit P3-31 external reverse torque limit	Set servo torque limit source and limit value. The unit of default value is the percentage of servo torque
P5-44 power loss brake / BK P5-07 servo off delay time P5-08 brake command output speed P5-09 brake command waiting time	The motor with holding brake adopts servo SO terminal to control the setting parameters of holding brake
P5-47 alarm output /ALM	output alarm function setting through the SO terminal, SO2 terminal default output is dynamic closing signal.
P7-00 RS485 Station No P7-01 communication configuration P7-02 RS485 communication protocol	Communication setting related parameters

Appendix 8.2 External pulse position mode general parameters

External pulse position mode general parameters	
Parameter	Overview
P0-01 control mode selection	Set to 6: external pulse mode
P0-10 pulse instruction format	Set pulse format 0-CW/CCW 1-AB 2-P+D
P0-11 set motor pulses per revolution * 1 P0-12 set motor pulses per revolution * 10000 P0-13 electronic gear ratio (numerator) P0-14 electronic gear ratio (denominator) P0-92~P0-93 32-bit electronic gear ratio numerator P0-94~P0-95 32-bit electronic gear ratio denominator	Setting of command pulse number required for one revolution of motor When P0-11 / P0-12 are all zero, P0-13 / P0-14 takes effect When P0-11-P0-14 is zero, P0-92~P0-95 is effective 32-bit gear ratio numerator: P0-92 * 1 + P0-93 * 10000 32-bit gear ratio denominator: P0-94 * 1 + P0-95 * 10000
P0-09 pulse instruction setting	Each bit can set the command direction and filter time of low-speed pulse respectively

Appendix 8.3 Internal position mode general parameters

Internal position mode general parameters	
Parameter	Overview
P0-01 control mode selection	Set to 5: internal position mode
P4-03 internal position setting mode P4-04 number of effective segments P4-10 ~ P4-254 internal section 1 to section 35 position parameter setting	Control mode setting of internal position mode: including step change mode, positioning mode and adjustment time Configuration of pulse displacement, speed, acceleration and deceleration time of each section
P5-35 step change signal /GHGSTP P5-32 suspend the current signal /Inhibit P5-31 skip current segment No. /Z-Clamp	Common terminal function assignment
P4-00 Number of Z-phase signals after leaving limit switch P4-01 speed of collision with proximity switch P4-02 speed of leaving proximity switch P5-28 find reference origin in forward side under position mode /SPD-A P5-29 find reference origin in forward side under position mode /SPD-B	Internal position back to origin setting parameters
F2-09 35 Any setting of segment position	Set the segment no. through communication

Appendix 8.4 Internal torque control general parameters

Internal torque control	
Parameter	Overview
P0-01 control mode selection	Set to 1: internal torque mode
P3-33 Internal torque command given	The given value is the percentage of rated torque
P3-16 internal forward speed limit for torque control P3-17 internal reverse speed limit for torque control P3-14 forward maximum speed limit (max speed) P3-15 reverse maximum speed limit (max speed)	Speed limit in torque mode
P5-27 speed direction switch /SPD-D	Change direction, default is n.0000. If the direction changing is given through SI2 terminal, p5-27 can be set to n.0002.

Appendix 8.5 Internal speed control general parameters

Internal speed control	
Parameter	Overview
P0-01 control mode selection	Set to 3: internal speed control mode
P3-05 internal set speed 1 P3-06 internal set speed 2 P3-07 internal set speed 3	Speed value setting of internal 3-segment speed in rpm
P5-28 internal speed selection /SPD-A P5-29 internal speed selection /SPD-B	The combination of terminals determines the speed of corresponding section
P5-27 internal speed direction selection /SPD-D	Change direction, default is n.0000. If the direction changing is given through SI2 terminal, p5-27 can be set to n.0002.
P3-09 soft start acceleration time P3-10 soft start deceleration time	Set acceleration and deceleration time in ms

Appendix 8.6 External pulse speed control general parameters

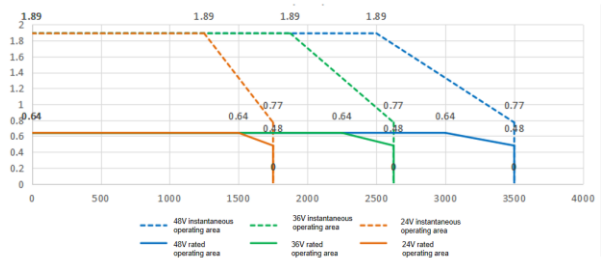
External pulse speed control	
Parameter	Overview
P0-01 control mode selection	Set to 7: external pulse speed mode
P0-10 pulse command format	Set the pulse format 0-CW/CCW 1-AB 2-P+D
P0-15 Command pulse frequency at rated speed	Determine the linear relationship between the command pulse frequency and the speed
P0-16 Speed command pulse filtering time	When the command pulse frequency is relatively low, setting this parameter properly can reduce the speed fluctuation

Appendix 8.7 Common Parameters for External Analog Speed Control

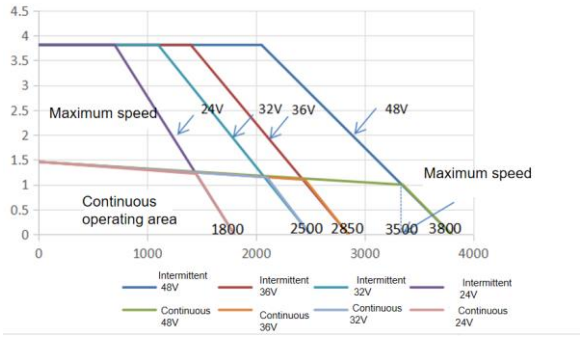
External Analog Speed Control	
Parameter	Summary
P0-01 Control Mode Selection	Set to 4: External Analog Speed Control Mode
P3-00 V-REF Assignment	Default setting 0 is for analog speed command input
P3-01 Analog Voltage Corresponding to Rated Speed	Determine the linear relationship between analog speed command and speed
P3-14 Forward Maximum Speed Command Limit	Maximum speed restriction
P3-15 Reverse Maximum Speed Command Limit	Maximum speed restriction

Appendix 9. Torque-speed characteristic curve

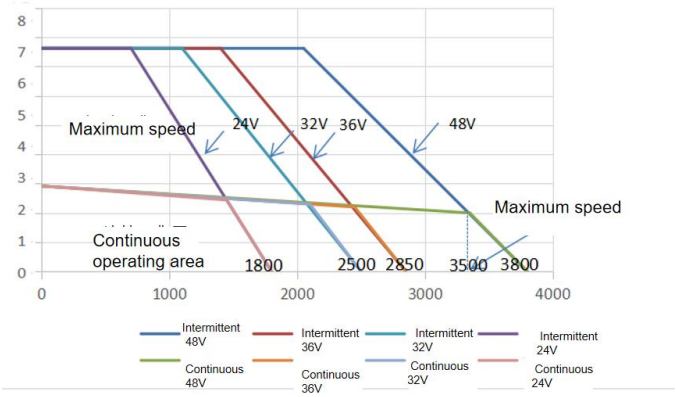
MF3H-60CS（CM）30B1-502



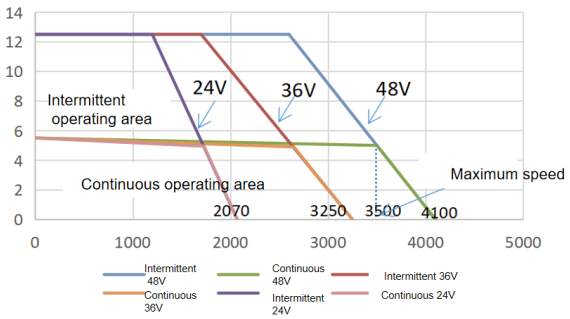
MF3S-60CS30B1-504



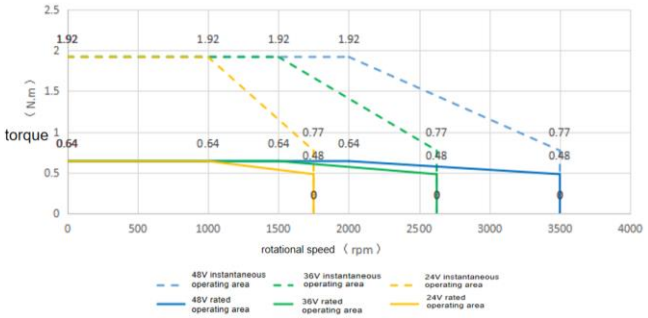
MF3S-80CS30B2-507



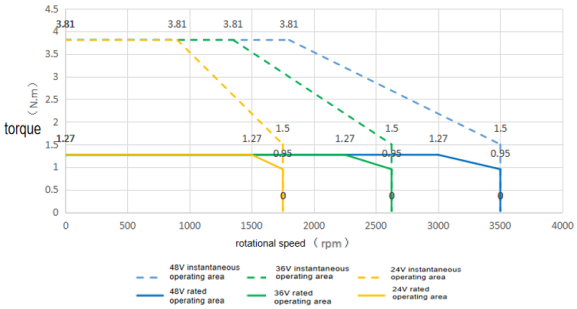
MF3S-130CS30B2-515



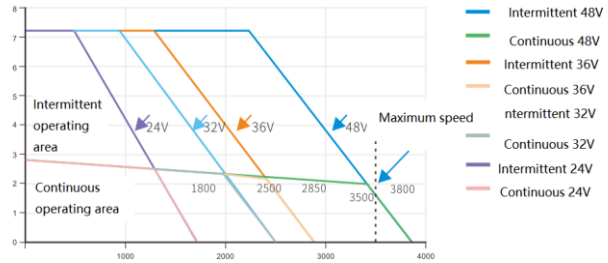
MF5H-60CM30B（Z）1-502



MF3H-60CS（CM）30B（Z）1-504
MF5H-60CM30B（Z）1-504



MF5H-80CM30B（Z）2-507



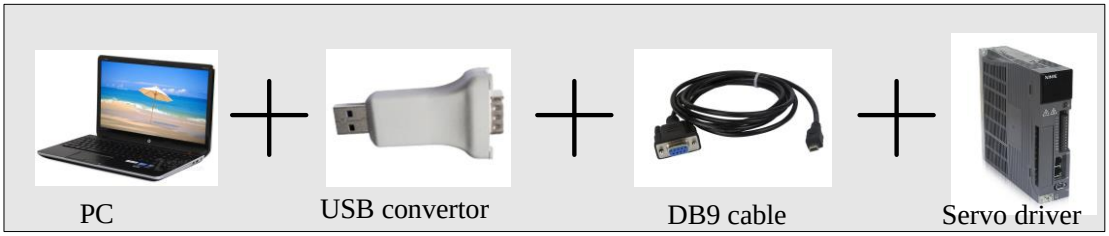
Appendix 10. List of model selection and configuration

Motor model	Matched driver	Encoder cable	Power cable	Brake cable
MF3H-60CS30B1-502	DF3E-0206	CP-SP-M-length	CM-P07A-length	-
MF3H-60CM30B1-502		CP-SP-BM-length		
MF3S-60CS30B1-504	DF3E-0410-A	CP-SP-M-length	CM-P15-length	-
MF3S-60CM30B1-504		CP-SP-BM-length		
MF3S-60CS30B1-504	DF3E-0410(Z)	CP-SP-M-length	CM-P15-length	-
MF3S-60CM30B1-504		CP-SP-BM-length		
MF3S-60CS30BZ1-504		CP-SP-M-length	CM-P15-length	CB-P03-length
MF3S-60CM30BZ1-504		CP-SP-BM-length		
MF3S-80CS30B2-507	DF3E-0720(Z)	CP-SV-M-length	CM-V20-length	-
MF3S-80CM30B2-507		CP-SV-BM-length		
MF3S-80CS30BZ2-507		CP-SV-M-length	CM-V20-length	CB-P03-length
MF3S-80CM30BZ2-507		CP-SV-BM-length		
MF3S-130CS30B2-515	DF3E-1540	CP-SC-M-length	CM-XL60-length	-
MF3S-130CM30B2-515		CP-SC-B-length		
MF5H-60CM30B1-502	DF3E-0206 DF3E-0410-A	CP-SP-M-length	CM-P07A-M-length	-
MF5H-60CM30BZ1-502		CP-SP-BM-length		CB-P03-length
MF5H-60CM30B1-504	DF3E-0410-A	CP-SP-BM-length	CM-P07A-M-length	-
MF5H-60CM30BZ1-504				CB-P03-length
MF5H-60CM30B1-504	DF3E-0410(Z)	CP-SP-BM-length	CM-P15-length	-
MF5H-60CM30BZ1-504				CB-P03-length
MF5H-80CM30B2-507	DF3E-0720(Z)	CP-SV-BM-length	CM-V20-length	-
MF5H-80CM30BZ2-507		CP-SV-BM-length		CB-P03-length

Appendix 11. Servo software

Appendix 11.1 Communication between servo software and servo driver

The communication mode between the upper computer software and the servo driver is wired communication. The DB9 cable is connected to the computer (the laptop needs to add a USB convertor), and the other end is connected to the servo driver. The connection mode is as follows.



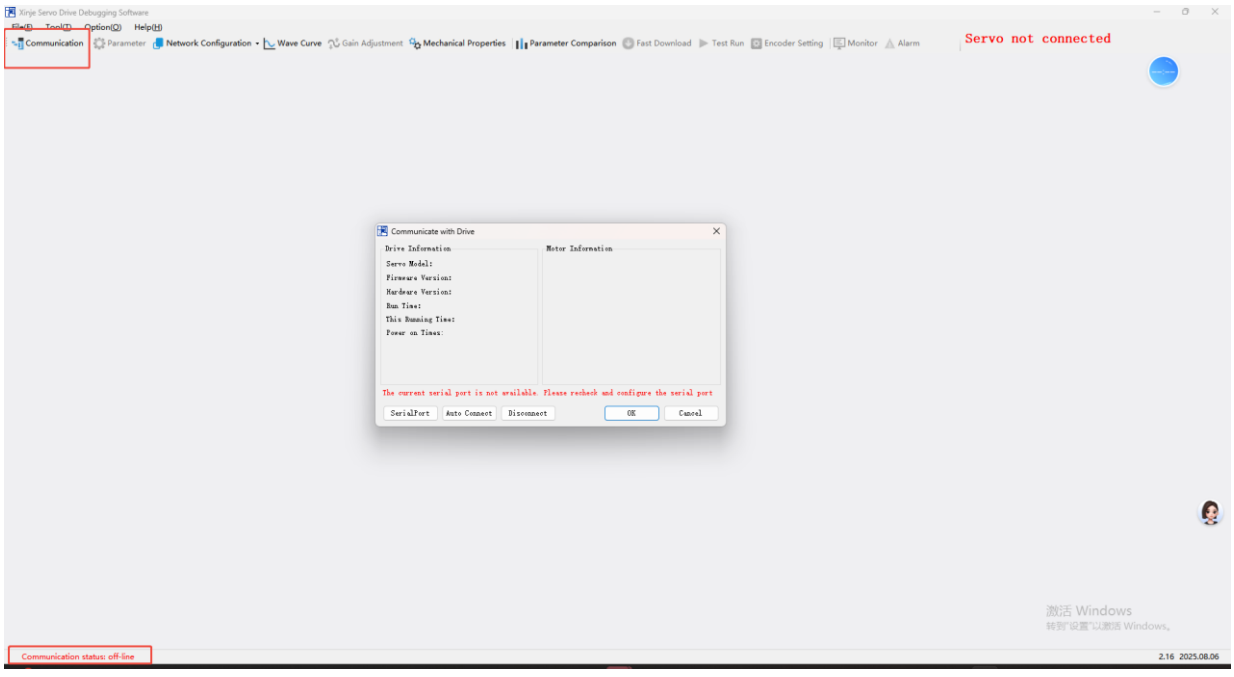
Appendix 11.2 start [driver communication]

There are two ways to open the communication window.

First, click [communication] on the main interface toolbar to open the communication with driver window.

Second, double click [communication status: offline] in the main interface to open the communication with drive window.

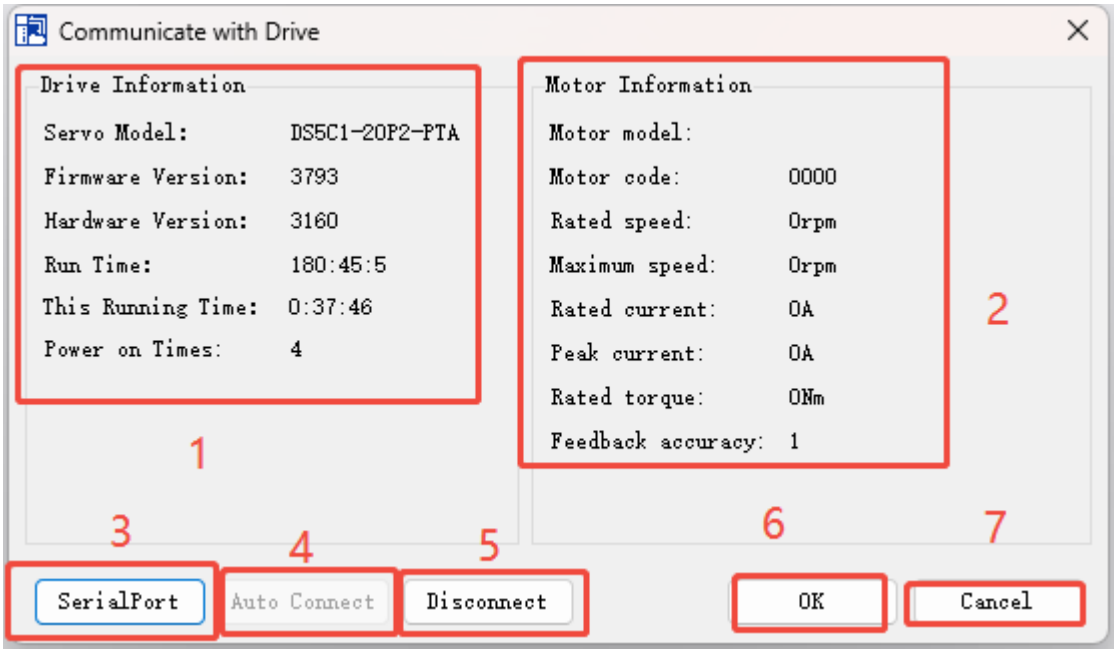
If the [communication status] is online, double-click it to change to offline status.



Appendix 11.3 Close [driver communication]

Click  of【communicate with drive】window to close the window.

Appendix 11.4 [Driver communication] interface

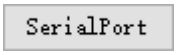


Area 1: drive information

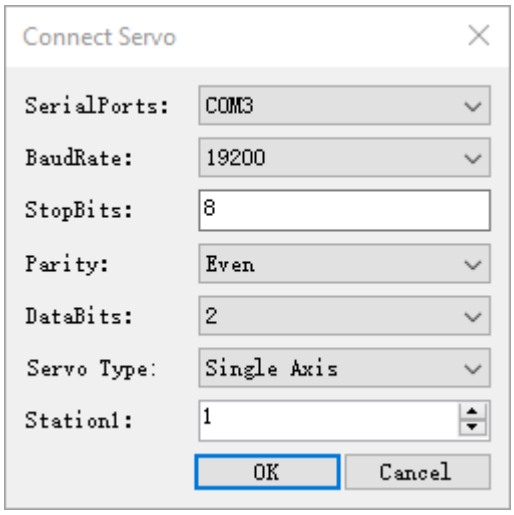
Area 2: motor information

if the servo motor is not connected, the information displayed in area 2 will be incomplete, and the motor model and motor code will not be displayed.

Area 3: serial port configuration



Click [serial port], pop up [connect servo] window, click drop down box to set the serial port number, baud rate, data bit and so on. Please check P7-10 to know the RS232 parameters.



if the serial port configuration is correct, the information will be displayed in area 1 and area 2. If the configuration is wrong or the serial port is occupied, the [communicate with drive] window will display [current serial port is not available, please check and configure the serial port again].

Area 4: auto connect

Auto Connect

The automatic connection is only valid when the station number is 1. Automatic connection can automatically find the serial port that can communicate with the servo and read the information of the driver and motor.

Area 5: disconnect

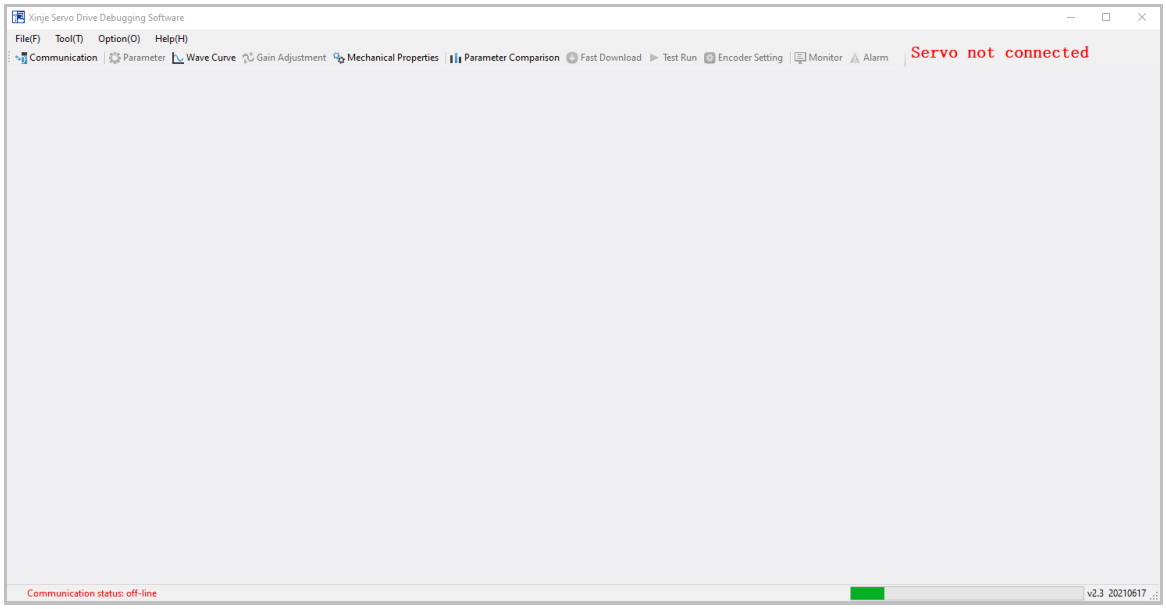
Disconnect

Click 【disconnect】to disconnect the connection between software and drive.

Area 6: ok

OK

Area 1 and area 2 display the correct information, and there is no prompt [no servo connection or servo not powered up], click OK to exit [communicate with drive], starts reading data at the same time. As shown in the following figure, the progress bar (data reading progress) is displayed in the lower right corner of the interface during data reading.



Area 7: cancel

Cancel

Close 【communicate with servo】window.

Manual Update Log

The information regarding the revision of the document, along with the document number, is recorded in the bottom right corner of the cover of this document.

No.	Document No.	Update Content
1	SF3 01 20200722 1.0	1. Add 1.5kW servo instructions; 2. Correct content errors in the previous version
2	SF3 01 20210607 1.1	1. Add servo instructions for DF3E-0410-A, DF3E-0206; 2. Add high-inertia motor instructions for the P5H series; 3. Correct content errors in the previous version
3	SF3 01 20230130 1.2	Modify 4-2-5, Appendix 5 configuration diagrams
4	SF3 01 20230130 1.2.1	1. Add high-inertia motor instructions for the P5H series; 2. Correct other errors and content
5	SF3 01 20231011 1.2.2	1. Add CANopen communication cable model naming; 2. Modify 4-2-3, 3-2-12 terminal descriptions, 3-2-2-2, 3-2-2-4, 4-2-2, 1-4-2, 4-6-3, 1-4-6 diagrams, 6-1 tables; 3. Add Modbus addresses in Appendix 4; 4. Add servo brake voltage setting
6	SF3 01 20231221 1.2.3	1. Modify 4.2.4 to the previous version; 2. Correct other errors and content
7	SF3 01 20240407 1.2.4	1. Modify content in 1.1.3, 1.4.1, 2.1.2, 3.2.2.2, 4.2.4, 4.3.3.2 sections; 2. Modify parameter descriptions for P0-02-P0-07, P0-24-P0-31, P0-92, P0-93, P5-28-P3-31, P5-29-01, P3-39, P4-031, P5-44-P5-11, P5-28-0-1, P5-28-3, P5-38, P5-40-P5-42, P5-200-00-1, P5-47-P5-48, P5-52-P5-53, P5-60-0-2, P5-70, P6; 3. Add content in 1.1.4 section
8	SF3 01 20240707 1.2.5	1. Modify 1.3.1, 2.2.1, 5.3.1.3, 5.4.3.1, 5.6.5, 5.3.2, 5.6.7 sections; 2. Modify parameter descriptions for P5-31; P0-10, P5-42, U1-16-U1-47; 3. Correct other errors and content
9	SF3 01 20241231 1.2.6	1. Modify content in 1.3.1, 2.2.3, 2.3.1 sections; 2. Modify parameter, U2 parameter, alarm instructions; 3. Correct other errors and content
10	SF3 01 20250731 1.2.7	1. New driver knob, external component selection, system wiring diagram, driver ground, wiring specifications; 2. Optimize safety precautions, driver performance specifications; 3. Update driver external dimensions; 4. Modify driver power supply voltage, power supply range; 5. Correct other errors and content

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